Jeffrey M. Harper

Mastering Autodesk®
3ds Max® 2013

Mastering

Autodesk® 3ds Max® 2013

Jeffrey M. Harper

WILEY

John Wiley & Sons, Inc.

Dear Reader,

Thank you for choosing *Mastering Autodesk 3ds Max 2013*. This book is part of a family of premium-quality Sybex books, all of which are written by outstanding authors who combine practical experience with a gift for teaching.

Sybex was founded in 1976. More than 30 years later, we're still committed to producing consistently exceptional books. With each of our titles, we're working hard to set a new standard for the industry. From the paper we print on, to the authors we work with, our goal is to bring you the best books available.

I hope you see all that reflected in these pages. I'd be very interested to hear your comments and get your feedback on how we're doing. Feel free to let me know what you think about this or any other Sybex book by sending me an email at `nedde@wiley.com`. If you think you've found a technical error in this book, please visit `http://sybex.custhelp.com`. Customer feedback is critical to our efforts at Sybex.

Best regards,

Neil Edde
Vice President and Publisher
Sybex, an Imprint of Wiley

This book is dedicated to my family and friends for always encouraging me in my endeavors, for providing their emotional support, and for their understanding when I missed events or disappeared from the face of the earth to finish projects such as attempting to complete this book on schedule.

Acknowledgments

About the Author

Jeffrey M. Harper started using Autodesk products (initially AutoCAD® 9 software) in his architectural drafting classes when he was in high school. Jeff was very excited to see AutoCAD add 3D modeling to its toolset, and he merged this with his love of photography and started thinking cinematographically, creating renderings of his AutoCAD files with AutoShade. Soon he began using 3D Studio R3 (for DOS) to help visualize his projects while he studied architecture at the University of Colorado at Boulder. He quickly upgraded to R4 for DOS when it came out. Jeff immediately upgraded to 3D Studio Max 1.0 for Windows when it was released, and he has used every version of 3ds Max since. He has also used Lightscape 3.2 and a few versions of Autodesk VIZ. Jeff also regularly uses Lightwave 3D, Vue, and many of the Adobe Master Collection products including Photoshop Extended, Adobe Illustrator, Premiere Pro, After Effects, Audition, and Encore.

Jeff has used 3ds Max to create architectural and civil engineering visualizations from a combination of aerial and terrestrial LiDAR, USGS NED data, high-resolution digital orthophotography, stereo-compiled mapping data, and CAD files from different packages and disciplines. He has also used 3ds Max to create models, stills, animations, and interactive components used in computer-based training programs for aircraft maintenance. Jeff has even used 3ds Max to design and create a stereo-lithography (STL) file used to build a rapid-prototyped form from which he hand-pressed ceramic tiles that were glazed and fired and then used in the backsplash of a kitchen remodeling project. Jeff also uses 3ds Max to create visual effects elements for a variety of media. His work on the short film *Random Natural Occurrence* won the Brad Carvey Award for Best Visual Effects at the 2010 Duke City Shootout film festival.

As a CADD manager and data manager for a large multistate, multidiscipline engineering firm, Jeff wrote a number of workflow/training documents to assist users with CAD and GIS functions, and he assisted users with AutoCAD, Revit® Structure, Civil 3D®, MicroStation, InRoads, Adobe Photoshop, ArcGIS, and GeoMedia.

Jeff is also an avid photographer and graphic/multimedia designer and editor. He recently helped rebrand one of the best talent agencies in the southwest and is managing the social media presence for Tim's Place (`www.facebook.com/timsplaceabq`), a local Albuquerque restaurant.

Contents at a Glance

Contents

Introduction

A significant portion of your work as a 3D artist will involve sketching and drawing throughout the design process. Not only will these visual explorations help convey your ideas to others, but they will help you see problems within a design and help you refine your ideas. 3D computer modeling and animation take design visualization beyond hand-drawn sketches and foam-core models by allowing you to create a complete replica of your design and study it from any point of view in any lighting condition.

With Autodesk® 3ds Max® 2013, you can apply color, texture, lighting, and other effects to see how variations of these elements affect your design. You can get a realistic look at your design to help you make better decisions as you progress through the design process.

Mastering Autodesk 3ds Max 2013 is intended to help an extremely broad audience ranging from those interested in creating content for films, television, and games to architects, designers, and visualization artists to present their designs through 3D models, rendered still images, and animations. This book focuses on the use of 3ds Max 2013 as a modeling and presentation tool. Because *Mastering Autodesk 3ds Max 2013* is focused on such varied issues, you will not find comprehensive information about character animation or advanced special effects. You also will not find descriptions of every single tool or function available in 3ds Max 2013, since the software is extremely robust and the length of this book, after all, is limited.

In this book you will find step-by-step tutorials covering the primary functions of the software that you will use in the process of modeling, texturing, lighting, and animating projects. These tutorials are based on years of experience using 3ds Max on real projects with real requirements and deadlines. By completing the tutorials, you will learn how to construct complex geometric forms and how to apply realistic textures and lighting to study a design. You will also learn how to create effects to help emphasize parts of your projects for presentations.

Mastering Autodesk 3ds Max 2013 is also an Official Training Guide for Autodesk's 3ds Max 2013 certification exam. See Appendix B for more information about certification.

How to Use This Book

The goal of this book is to give you the appropriate skills to produce professional-level presentations of your ideas, from conceptual designs to finished renderings and animations. Once you have mastered those fundamental skills, you will be equipped to confidently explore 3ds Max 2013 and its robust set of tools and options on your own.

To get the most value from this book, you should read the chapters sequentially from front to back, doing all the exercises as you go, including the "Master It" problems at the end of each

chapter. Each chapter builds on skills you learned in previous chapters, so you can think of this book as your personal, self-paced course on 3ds Max 2013. As you are doing the exercises, don't be afraid to try things not in the tutorials. 3ds Max is too robust and complicated to be taught completely in one volume.

The first two chapters of this book will help you become familiar with how 3ds Max 2013 works and how it is organized. If you are already familiar with 3ds Max, 3ds Max Design, or Autodesk VIZ, you will still want to study these chapters to become accustomed to the new user interface and to be introduced to some of the new features of 3ds Max 2013. Chapters 3 through 6 will show you how to build fairly complex geometry using a variety of tools. These chapters introduce you to the more common methods of constructing and modifying objects in 3ds Max 2013. Chapters 7 through 9 show you how to use lights, materials, and cameras. Chapter 10 covers scene management to help you work with large complex scenes and external files. Chapters 11 through 13 introduce and then expand on animation topics. Chapter 14 discusses advanced rendering techniques with the mental ray renderer. Chapter 15 covers using more mental ray effects, rendering those effects to high dynamic range files, and then compositing elements from your renderings and tweaking those materials in 3ds Max Composite in order to enhance your projects.

There is a set of appendices online (`www.sybex.com/go/mastering3dsmax2013`) that offers general reference information on some of the most common tools used in 3ds Max 2013. Once you have completed the first few chapters of the book, you can use the appendices as an aid in your own exploration of 3ds Max. You can then refer to the appendices as you continue to work through the rest of the book. If you are interested in certification for 3ds Max 2013, Appendix B will help you find the information in this book, the 3ds Max Help System, or in other resources that will help you prepare to take the test.

The Tutorial Files on the Website

It's very important that before you start going through the tutorials in this book, you visit this book's page on the Sybex website (`www.sybex.com/go/mastering3dsmax2013`) and download the compressed files with the content that will be used in the throughout this book. The website includes archive files of the `*.max` variety and support files necessary to complete the exercises in this book. You must extract the chapter archive files to a folder on your computer that you will use to complete the tutorials in the book. You should not try to open the `.max` files directly from the website.

CONNECTING 3DS MAX TO THE CHAPTER FILES

It is important that you configure 3ds Max 2013 to recognize the location of the tutorial files from the Sybex website (`www.sybex.com/go/mastering3dsmax2013`). Make sure that you perform the instructions given in the section titled "Adding a Map Path to Help 3ds Max Find Bitmaps" in Chapter 8. If you like, you can set up 3ds Max as described in that section right after you have extracted the files.

What You'll Find

To give you a better idea of what you'll find in this book, here is a summary of the chapters and their contents:

Chapter 1: Getting to Know Autodesk® 3ds Max® 2013 In Chapter 1, you will get an introduction to 3ds Max 2013 and the user interface, and you'll get a first look at 3ds Max objects and how they are created and animated. Toward the end of Chapter 1, you will be introduced to the different ways you can view your projects in 3ds Max 2013.

Chapter 2: Introducing Objects Chapter 2 delves deeper into the workings of 3ds Max objects. You'll learn about the different types of objects available in 3ds Max 2013 and how you can use them to create the shapes you want. You will learn how to manipulate the core set of shapes in 3ds Max, called *primitives*, and turn them into more complex shapes. You will also learn about the different methods you can use to duplicate shapes and how these methods can help you quickly complete your design.

Chapter 3: Creating Shapes with Splines In Chapter 3, you will look at how you can create complex forms from simple lines. Here you will learn how to manipulate a basic type of object, called a *spline shape*, and turn it into a wineglass. You will look at creating walls and 3D text objects as well.

Chapter 4: Editing Meshes and Creating Complex Objects Chapter 4 introduces you to object creation and editing methods that are common to architectural projects. You will start modeling a well-known building using a hand-drawn sketch as a template. You will also focus on drawing objects that have unusual shapes.

Chapter 5: Working with External Design Data Chapter 5 introduces you to concepts and workflows that will be helpful with importing data from other programs into 3ds Max 2013 and using that data to enhance your models and scenes.

Chapter 6: Organizing and Editing Objects In Chapter 6, you will continue working on the main scene from Chapter 5 by exploring ways to organize the components of the scene. You will learn how to use object names and layers to help identify parts in the design. You will also continue your exploration of modeling complex forms by creating additional objects and modifying existing objects to add detail and depth to the scene.

Chapter 7: Light and Shadow Chapter 7 continues to use the well-known building started in Chapter 5 to introduce you to the concepts of lighting and rendering your digital models. You will also learn about the different types of lighting and shadows and how to use them together. In addition, you will learn how you can create more realistic renderings by the careful placement of additional lights in strategic locations.

Chapter 8: Enhancing Models with Materials In Chapter 8, you will continue to build on what you learned in Chapter 7 by exploring materials. You will experiment with the many properties of materials and maps in 3ds Max, such as diffuse color, bump map textures, and reflections. You will learn how to align a texture to a surface, and you will be introduced to methods for adding 2D entourage, such as trees and people, to scenes.

Chapter 9: Using the Camera Chapter 9 discusses placing cameras in your model and creating environments to surround your models. You will learn how to control the background

to affect the mood of your renderings. You will also experiment with rendering only selected portions of your scene to save time.

Chapter 10: Organizing Objects and Scene Management   Chapter 10 shows you different ways to use 3ds Max files. You will learn how to combine different files efficiently to allow you to work collaboratively with other members of a design team. You will discover ways to share data between project files. You will also see how you can use models found on the Internet.

Chapter 11: Understanding Animation   Chapter 11 offers you an introduction to animation in an architectural context. You will learn to create and control the animation of a camera to create a flyover of one of the buildings you worked on in earlier chapters. You will also learn how to edit an animated object's motion, create previews of your animation, and control lights over time.

Chapter 12: Creating Animations, Particles, and Dynamics   Chapter 12 continues your look at animation by exploring the options for outputting your animations to files, creating time-lapse shadow studies, adding other animated elements to add to the realism of your visualizations, and creating effective animations of your projects. You will also learn about other animation topics, such as creating and animating particle systems, as well as animating using rigid body physics in dynamic simulation systems.

Chapter 13: Rigging for Animation   Chapter 13 expands on the animation topic by introducing concepts necessary for linking objects for creating mechanical animation, using Inverse and Forward Kinematics (IK/FK), creating a simple morph animation, and understanding the concept of bones, biped, and rigging objects for animation.

Chapter 14: Advanced Rendering Using mental ray   In Chapter 14, you will learn how to take advantage of the advanced features of the rendering engine in 3ds Max 2013 to optimize rendering your stills and animations with global illumination and caustics.

Chapter 15: Finishing It Off: Atmosphere, Effects, and Compositing   Chapter 15 shows you how to take your 3ds Max 2013 renderings to the next level, adding depth and mood to your renderings, using effects available with mental ray, adding effects to your final renderings with 3ds Max Composite, adjusting how your final renderings look, and compositing anaglyph stereo renderings.

In addition to the main chapters in this book, there are four appendices:

Appendix A: The Bottom Line   Appendix A has the solutions to the "Master It" exercises found at the end of each chapter.

Appendix B: Autodesk® 3ds Max® Certification   Appendix B is a reference for finding information that will help you prepare for taking the Autodesk certification exams related to 3ds Max 2013.

The following appendices are available online from this book's web page:

Bonus Appendix 1: Modifiers, Maps, and Materials   Bonus Appendix 1 is a reference for the modifiers and materials in 3ds Max 2013.

Bonus Appendix 2: MAXScript   Bonus Appendix 2 is a reference for finding information on using MAXScript.

System Requirements

This book assumes that you already have Autodesk 3ds Max 2013 and a computer that can properly run the software. Additionally, you should perform a complete installation of 3ds Max 2013, including the optional tutorials and plug-ins. Many of the extra and demonstration plug-ins are not covered in this book; however, you should experiment with them on your own. The following list shows you the minimum system requirements necessary to run 3ds Max 2013; you should exceed these values whenever possible for better system performance and stability:

◆ Intel Pentium4 1.4GHz or AMD-based equivalent processor with SSE2 technology

◆ 2GB of RAM (4GB recommended)

◆ 2GB of swap space (4GB recommended)

◆ 3GB of free disk space after 3ds Max 2013 software installation

◆ Microsoft Internet Explorer 9.0 or newer

◆ Direct3D 10, Direct3D 9, or OpenGL-capable graphics card supporting 1024 768, 32-bit color display; 512MB video memory (1GB or higher recommended)

◆ DVD-ROM drive for installing from physical media.

◆ A three-button mouse with the appropriate driver software

◆ Microsoft Windows XP Professional (Service Pack 3 or higher) or Microsoft Windows 7, 32-bit or 64-bit

◆ Internet connection for web downloads and Autodesk Subscription access

Autodesk does not support running 3ds Max 2013 on Windows Me, NT 4.0, 98, or prior versions.

You can find the complete system requirements for 3ds Max 2013 on the Autodesk website, including system requirements for running 3ds Max on Apple Macintosh systems using Boot Camp or Mac virtualization on the Parallels Desktop (`www.autodesk.com/3dsmax`).

The 3GB of free disk space includes space for the sample files and general workspace for your projects. For later chapters, you may want to install AutoCAD 2010 or newer and Adobe Photoshop CS4 or newer. You can obtain a trial version of Photoshop from the Adobe website. You can also download a 30-day trial version of AutoCAD 2013 from the Autodesk website. These additional software applications are not crucial, but you may find them to be useful companions to 3ds Max 2013.

About the Cover

The cover of this book is created from a scene very similar to one of the scenes you will use in Chapter 15. I will admit right off the bat that yes, the driveway is in front of the wrong side of the Villa Savoye. The driveway really backs up to the flat, non-cantilevered side of the house. This view was chosen because it created a much more interesting image for the book. For the architectural purists, I deeply apologize. Some additional work was done on the building object to apply additional mental ray materials. The vehicle model on the driveway is the Dodge

Charger model from the XYZ vehicles collection that is included with the Autodesk 3ds Max 2013 Sample Files Subscription download. The trees and shrubs in the scene include some of the foliage objects included with the AEC Extended objects in 3ds Max, as well as a number of the Xfrog Inc objects that are available for free at seek.autodesk.com.

The scene is rendered with NVIDIA mental ray using the Glare and Depth of Field/Bokeh effect covered in Chapter 15, but with much higher settings than those used in the book. The final resolution of the cover rendering was 2160 pixels wide by 2780 pixels tall. The entire file took an excessive amount of time to render on a quad-core workstation with 8 gigabytes of RAM.

Getting to Know Autodesk® 3ds Max® 2013

Welcome to *Mastering Autodesk 3ds Max 2013*. Autodesk 3ds Max is the premier software package for 3D modeling, texturing, and animation, and it has many features specifically designed to assist artists, architects, engineers, and designers in various disciplines in the realization of their projects. It includes a Software Development Kit (SDK), which is used to develop plug-ins that give the program additional functionality. 3ds Max Design is a different installation and, in addition to having all the features of 3ds Max (except for the SDK), 3ds Max Design offers two exclusive tools. The Lighting Analysis tool is used to help meet the Leadership in Energy and Environmental Design (LEED) 8.1 certification standards. The Civil Visualization Extension is a customized version of the Dynamite VSP plug-in for importing design data from AutoCAD Civil 3D or the Bentley MX design tools. In this book, we simply refer to the program as 3ds Max.

Autodesk 3ds Max 2013 provides users with cutting-edge rendering technology, easy-to-use materials, improved interoperability with other related design and CAD software, enhancements to modeling and animation tools, and better viewport interactivity than ever before.

This chapter introduces some of the special features of 3ds Max 2013, and then it gets you started working with the 3ds Max interface.

In this chapter, you will learn to

◆ Navigate and configure the viewports

◆ Dock and float toolbars

◆ Copy objects and use the transform tools

◆ Create a named selection set

Introducing the New 3ds Max 2013 Features

3ds Max 2013 is a notable release that extends the comprehensive features and functionality with new, exciting capabilities, and it also updates many existing features. This is an important release with a long list of improvements and additions that will greatly impact your projects, whether you have been using 3ds Max for a number of years or are new to the world of 3D.

Each new version of 3ds Max incorporates fresh and exciting tools to enhance your capabilities and workflow while also increasing the performance of the program on your computer system. Utilizing these new features is a key to improving your skills and decreasing the time

it takes to complete your projects. When you start the program, you are presented with the Welcome To 3ds Max dialog box (see Figure 1.1), which includes links to Essential Skills Movies, which teach many of the basic skills for using 3ds Max. It also includes a link to the "What's New" section of the Help documents, which explain the new features and links to the 3ds Max Learning Channel on YouTube. Autodesk has done a tremendous job of regularly adding new content to that channel. The Welcome To 3ds Max dialog box also provides you quick access to start a new empty scene, the Open File dialog box, and a list of the last 10 files you have opened. Note that if you don't see this dialog box, you can go to the Help menu and click Essential Skills Movies from there.

FIGURE 1.1
The Welcome To
3ds Max dialog box
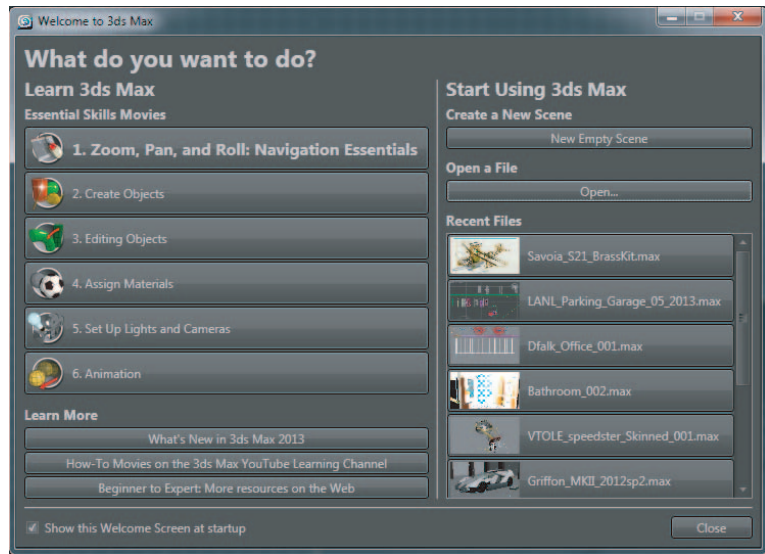
Here, in no particular order, are some of the high points of 3ds Max 2013:

Modeless Array Dialog Box   The Array dialog box is now modeless, meaning that you can interact with the 3ds Max 2013 viewports while the dialog box is open, so that you can adjust your views and see the preview of the array before you commit to it. This is a great ease-of-use update for 3ds Max.

Egg Spline   A new default shape called *Egg* has been added to 3ds Max. This allows you to create a closed spline that resembles an egg. The spline shape includes a built-in Outline parameter. This feature is in both 3ds Max 2013 and 3ds Max Design 2013, and it is primarily used for support of the Autodesk Civil View Pipe Network tools that work only with 3ds Max Design 2013.

Hair And Fur   Hair And Fur has seen some updates for 3ds Max 2013.

MassFX   The MassFX dynamics tools from NVIDIA have been updated and now include cloth simulation, an updated Ragdoll (formerly Skeleton) system, and a Multi-Object Editor to modify selections of objects more easily. Dynamics simulations can now take advantage of and interact with standard 3ds Max Force space warps.

gPoly   gPoly is a new mesh format designed and optimized for the internal mesh format of 3ds Max, which eliminates the conversions needed from editable mesh and poly formats. The result is faster animation when playing back high-resolution deforming objects.

Retime Tool   The new Retime Tool works in the Curve Editor to help you adjust the animation of your scenes.

Track View   The Track View menus have been updated to more closely resemble the animation editor found in Autodesk® Maya® software.

Autodesk Animation Store   The Autodesk Animation Store appears at the bottom of the Animation menu, and it opens in the Utilities tab. You can browse a selection of readymade animation clips, purchase the animation clips directly from the site, and apply them to your Biped-based characters.

Skin Modifier   The Skin Modifier has been updated to sort bones automatically in ascending or descending order and provide better content filtering of bone names based on user-entered criteria.

Workspaces   3ds Max 2013 users can now store multiple workspaces directly in a 3ds Max 2013 session. The workspaces are accessed from the Quick Access toolbar at the top of the 3ds Max interface.

State Sets   Found on the Rendering menu, state sets provide you with a way to keep and interact with different states of scenes you are editing. State sets also directly integrate with Adobe After Effects CS4 (32-bit) and CS5.x (64-bit only) so that you can send your 3ds Max 2013 scene to After Effects, make modifications, and then have those updates applied back to 3ds Max.

Viewport Layouts   The Viewport Layouts toolbar appears on the 3ds Max 2013 interface vertically along the left edge, and it allows you to store and quickly access different viewport configurations set up in the scene.

Skylights   Skylights in 3ds Max 2013 have been updated with Sky Color Maps that can use HDR images, which can then be used to render illumination in all renderers and also cast light and shadows in the Nitrous viewports.

Viewport Gradient Background   The Nitrous viewports now use a default gradient as the background of Perspective viewports. You will see this in the screen captures throughout this book. The gradient colors can be changed in the Customize User Interface dialog box.

Nitrous Viewports   The Nitrous viewports have been improved. The Perspective viewport now has a gradient background that you can customize; performance on large scenes has been improved; support for image-based lighting using the Skylight enhancements, viewport depth of field, and new Facets and Clay shading modes have been added.

Slate Material Editor   The interface for the Slate Material Editor has been improved. The nodes that are displayed in the Parameter Editor now have a dotted line surrounding them in the View windows; context menus work with multiple items selected. You can now get the materials from a selected object brought to the active View window, using the Get From Selected feature of the Material menu. There are new options that make working with material libraries much easier.

Render Setup Dialog   The Render Setup dialog has been improved with a drop-down menu that allows you to quickly select among Production, Iterative, ActiveShade, and Network Rendering.

iray Renderer   The NVIDIA iray renderer for 3ds Max 2013 has been upgraded to iray 2.1.

mental ray Renderer   The NVIDIA mental ray rendering engine has been updated to mental ray 3.10.

FBX File Link Enhancements   The File Link Manager is now capable of directly linking Revit Architecture (RVT) files, and new Link options can be found by going to Application menu ➢ Import.

Improved Geometry Support   3ds Max 2013 takes advantage of Autodesk DirectConnect to support importing many different data formats into 3ds Max 2013 as Body objects, including STEP files, SolidWorks, Pro/E, CATIA (v4 and v5), and IGES files (which no longer come in as NURBS objects).

Send To Menu   The new Send To feature on the Application menu allows you to send files directly to Maya, Autodesk® Softimage®, Autodesk® MotionBuilder®, Autodesk® Mudbox®, and Autodesk® Infrastructure Modeler software if you are running one of the Autodesk suites.

Maya Interaction Mode   For 3ds Max 2013 users who are accustomed to using Autodesk Maya, the new Maya Interaction mode adjusts 3ds Max 2013 to work with viewport controls and keyboard shortcuts from Maya.

Lightscape Compatibility Removed   If you are a previous user of 3ds Max, 3ds Max Design, or 3ds VIZ and Lightscape, be aware that all Lightscape compatibility, utility, and material features have been removed from 3ds Max 2013.

Product Updates   3ds Max 2013 also ushers in a new update scheme. Instead of having confusingly numbered Hot Fixes and service packs that you have to make sure to install in the correct order for 3ds Max to function properly, fixes for 3ds Max will now come out as sequentially numbered Product Updates. These Product Updates are easy to install in the right order and will ensure that 3ds Max is working properly. Make sure that your installation of 3ds Max 2013 has all available Product Updates installed before proceeding with the exercises in this book.

For more information about the new features and improvements in 3ds Max, go to the "What's New in Autodesk 3ds Max 2013" section of the Help system. You can also find information on the Autodesk website or the Autodesk media and entertainment forums called the Area (`area.autodesk.com`).

Getting Started with Autodesk 3ds Max

Although many of 3ds Max's components are typical for a Windows program, quite a few are unique to 3ds Max; therefore, a solid understanding of them is essential to using the program effectively. To begin exploring the 3ds Max 2013 interface, start the program by doing one of the following:

◆   Double-click the 3ds Max 2013 icon on the Desktop.

◆ Choose Start ➢ All Programs ➢ Autodesk ➢ Autodesk 3ds Max 2013 ➢ Autodesk 3ds Max 2013.

If you are on a 64-bit Windows system, you will see the 64-bit suffix on the folder and icon names.

You'll see a variety of components in the 3ds Max 2013 window (see Figure 1.2). Some may be familiar to you while others may not.

FIGURE 1.2
The standard 3ds
Max 2013 window
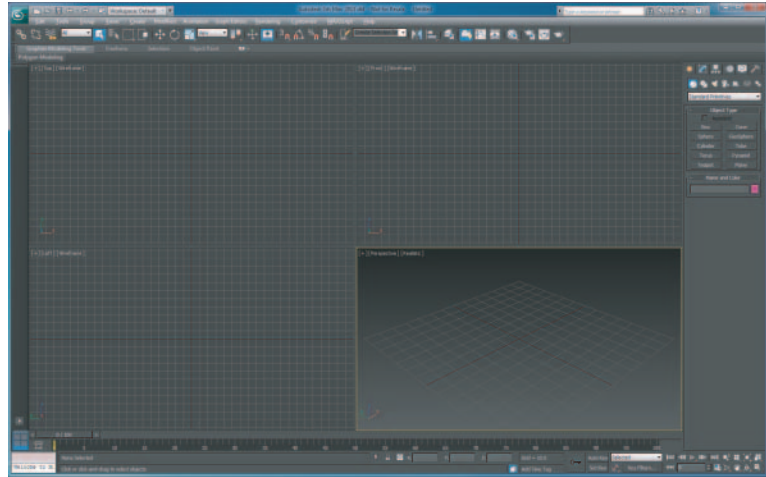
THE LARGE ICONS OPTION

The images in this book use the default Large Icons option to display the toolbar buttons better. To deactivate this option and use the smaller icons, thereby gaining some much-needed viewport workspace, choose Customize ➢ Preferences to open the Preference Settings dialog box. In the UI Display group of the General tab, deselect the Use Large Toolbar Buttons option, and then shut down and restart 3ds Max for this setting to take effect.

At the top, you see a typical Windows menu bar and the 3ds Max Main Toolbar. Depending on your default settings, you may also see up to nine more floating or docked toolbars containing additional 3ds Max tools. Beneath the Main Toolbar is the Graphite Modeling Tools toolbar. In the center, you see the viewport area, which currently shows the Top, Front, Left, and Perspective viewports. At the lower-right corner of the screen, you find the viewport navigation tools for adjusting your views in the current viewport. Also included are the time controls for creating and playing animations, the prompt line and status bar, and the MAXScript Mini Listener (for creating macros). On the left side of the window above the MAXScript area is the new Viewport Layout Tabs toolbar. On the right side of the user interface is the Command panel, which contains nearly all the tools you'll use to create and edit objects in 3ds Max. Let's take a closer look at each of these components. 3ds Max often provides several methods, including toolbars, Command panels, menus, and shortcuts, for accomplishing the same task.

Touring the Interface

3ds Max offers a wealth of tools, and their sheer number can be overwhelming. To get a basic understanding of the 3ds Max window, we'll present each of the window components individually, starting with the Menu Bar.

The Menu Bar

At the top of the screen is the Menu Bar. Here you'll find the typical Windows commands for file maintenance, as well as commands specific to 3ds Max.

Standard to 3ds Max 2013 is the Application button (see Figure 1.3), which replaced the traditional File menu in the 2010 release. The Application button is a graphical representation of the tools from the traditional File menu, including opening and saving files, importing, exporting, and referencing files. The Application button is also where you can set a project folder, access the Asset Tracking tool, and check statistics about the current file. If you are more comfortable using the traditional File menu, you can restore it to the 3ds Max interface using the dialog box that appears when you select Customize ➤ Customize User Interface.

FIGURE 1.3
The Application button

The options in the Menu Bar are organized the same way as they are in most Windows applications. Clicking an option issues a command, and you're expected to take some action. An option that's followed by three periods, called an *ellipsis*, opens a dialog box, usually to allow you to make changes to settings related to the option. An option with a right-pointing arrow displays more options in what is called a *cascading menu*, as shown in Figure 1.4. Depending on your version of Windows, user settings, and if you have a pen tablet attached to you system, your menus may cascade to the left or to the right.

FIGURE 1.4
A typical cascading menu
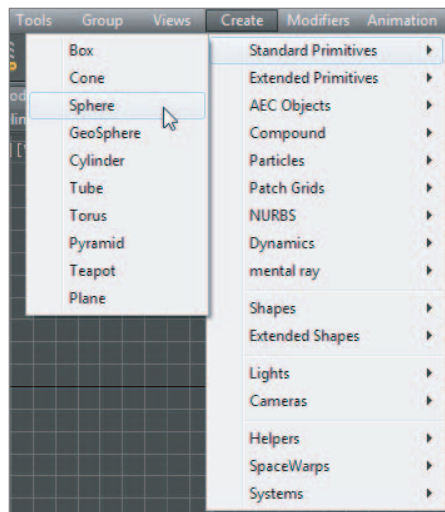
Try out the Menu Bar by taking a look at the Units Setup dialog box:

1. Choose Customize ➢ Units Setup. The Units Setup dialog box displays.

2. Select the US Standard radio button, and make sure that Feet w/Decimal Inches is selected below it and that the Inches radio button is selected for Default Units, as shown in Figure 1.5.

FIGURE 1.5
Defining the units
in the Units Setup
dialog box
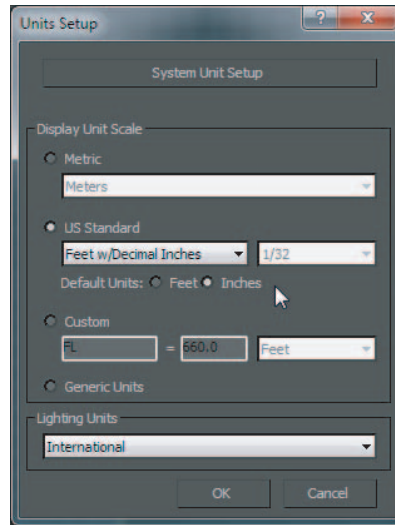
3. Click the System Unit Setup button at the top of the dialog box, and you will see the System Unit Setup dialog box shown in Figure 1.6. Make sure 1 Unit is set to 1.0 Inches. Do not change anything else in the System Unit Setup dialog box, and click OK twice to close both dialog boxes.

FIGURE 1.6
The System Unit
Setup dialog box

By setting the System Unit Setup options, you ensure that you'll be working with the same units that are discussed in this book.

REVERTING TO THE STARTUP LAYOUT

3ds Max 2013 is something of a chameleon. It can change its appearance depending on the focus of your modeling needs. Users of 3ds Max 2013 will see tools designed more for the game and entertainment industries, while users of 3ds Max Design 2013 will see an interface and defaults geared more toward architectural and design visualization. If your 3ds Max 2013 window doesn't look the way it does in the figures in this book, choose Customize ➢ Revert To Startup Layout. You'll see a warning message telling you that any user interface (UI) changes you have made will be lost. Click Yes to set up your 3ds Max windows to match the interface you see in this book. You can also reload Custom UI schemes to reset the interface or use the Custom UI and Defaults Switcher to accomplish the same thing, plus more. See the "Working with the Custom UI And Defaults Switcher" section later in this chapter for more information on this topic.

The Quick Access Toolbar

Just to the right of the Application button is the Quick Access Toolbar, shown in Figure 1.7, another standard feature in 3ds Max 2013. As its name implies, it provides quick access to a number of useful commands, including New Scene, Open File, Save File, Undo and Redo Scene Operation, the Select Project Folder Browser, and the Workspaces tool.

FIGURE 1.7
The Quick Access
Toolbar

Click the Undo Scene Operation button to undo your last actions, up to 20 by default, or the Redo Scene Operation button to redo any undone actions. Clicking the drop-down button next to either the Undo or Redo Scene Operation button opens a list of actions from which you can select.

You can customize the Quick Access Toolbar by clicking the down-arrow icon at the far right of the toolbar.

The Information Center Toolbar

All the way across the screen at the upper-right corner of the interface, near the traditional Windows Minimize, Maximize, and Close buttons, is the Information Center Toolbar, as shown in Figure 1.8. The Information Center Toolbar provides a search function for 3ds Max topics in the online Help files and on the Autodesk website; the Subscription Center (if you have Subscription Center access); the Communication Center, where you'll receive notices of program updates and other relevant announcements; a Favorites panel, where you can store links to commonly-accessed websites; and pages and elements from the 3ds Max Help menu. You can use the right-facing arrow button at the left end of the Information Center Toolbar to minimize the Search field if you wish.

FIGURE 1.8
The upper-right
corner of the 3ds
Max 2013 interface

The Main Toolbar

Just below the Menu Bar is the Main Toolbar. The tools on this toolbar offer tooltips, which are exposed when your cursor pauses over them, to help you identify their purpose.

The first set of tools, shown in Figure 1.9, is for linking and selecting objects. The two linking tools, one for linking and the other for unlinking, cause one object to move, rotate, or scale based on commands applied to another object. The third linking tool, the Bind To Space Warp tool, can be used to attach objects and space warps to each other. The selection filter allows you to limit what can be selected with the cursor. The selection tools let you select objects by clicking them or by selecting them by name. You can also specify the method for selecting objects by using a *selection window*, which lets you indicate a selection by placing a rectangle, circle, or other border around the objects.

FIGURE 1.9

The Linking and Selecting tools on the 3ds Max 2013 Main Toolbar
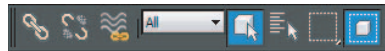
To the right of the selection tools are the transform tools, shown in Figure 1.10. This set of tools lets you select and move, rotate, and scale objects. You can also choose the reference coordinate system; set the center of the transform using the pivot point options; toggle the ability to manipulate certain objects, modifiers, and controllers by clicking and dragging visible manipulators in the viewports; toggle the keyboard shortcut overrides; use different snap options; work with named selection sets; and use tools to mirror and align objects.

FIGURE 1.10

The 3ds Max transform tools
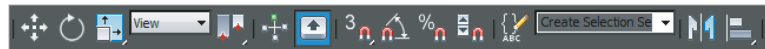
The next group of tools to the right, shown in Figure 1.11, includes access to the Layer Manager, the Graphite Modeling Tools display toggle, the Track View Curve Editor, the Schematic View tools, and the Material Editors and rendering tools. The Layer Manager gives you control over all of the settings for layers in your scene and the objects contained in those layers. The Graphite Modeling Tools are a complete set of more than 100 tools to improve creating and editing poly objects within 3ds Max. (Note that the Graphite Modeling Tools are the first 3ds Max tools available on a customizable ribbon interface. You will explore the Graphite Modeling Tools interface in Chapter 4, "Editing Meshes and Creating Complex Objects.") The Track View - Curve Editor displays your scene information as curves on a graph that indicates the position, rotation, and scale of objects in your scenes over time. Dope Sheet mode displays a graph of the keys of your animation over time. The Schematic View tools provide a visual graph and control how all the elements of your scene are linked. The Materials tools give you control over the appearance of objects by defining and applying their surface properties. With these tools, you can create color, texture, opacity, and other material characteristics and then apply these characteristics to objects in your model. You can also open the Render Setup dialog box, select the render type, view the last rendered frame, and quickly access the production renderer or the ActiveShade renderer.

FIGURE 1.11
The Layer Manager,
Graphite Modeling
Tools Toggle, Curve
Editors, Schematic
View, Material
Editors, and
Rendering tools

The rendering tools give you control over the image output of your 3ds Max scene. Unlike output from most applications, output from 3ds Max 2013 is most likely to be image or animation files or models and resources for exporting to real-time game engines. The rendering tools let you set the type and size of output, from single, large-format stills to video-ready animations.

WORKING ON A LOWER-RESOLUTION SYSTEM

If you're working with a screen resolution less than 1280 × 1024, you will not be able to see all the tools on the Main Toolbar. Some of the tools are off the screen to the far right. To access these tools, place the cursor on the toolbar so that a hand icon appears, and then click and drag the toolbar to the left. If you have trouble with this, move your cursor under one of the drop-down lists on the Main Toolbar to access the pan ("hand") tool. The hidden tools will emerge. You can also click the Rendering menu item to access all the rendering tools. The smallest supported screen resolution for the UI in 3ds Max 2013 is 1024 × 768, but the recommended resolution is 1280 × 1024 or higher. All the screenshots presented in this book use a 1680 × 1050 resolution.

Docked and Floating Toolbars

In addition to the Main Toolbar, you may see several floating toolbars sitting on top of the viewport. These toolbars may be hidden by default. You can open hidden toolbars by right-clicking a blank part of any open toolbar. A context menu will appear listing the available toolbars. Let's take a quick look at the floating toolbars.

1. Right-click a blank area of the Main Toolbar, and click any of the toolbar items that do not have a check mark next to them, as shown in Figure 1.12.

FIGURE 1.12
Right-click and
select a toolbar.
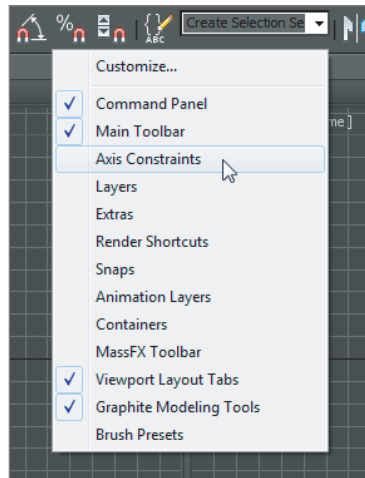
2. Repeat the process until all the floating toolbars are exposed.

All the toolbars float over the viewports and have titles such as Layers, Render Shortcuts, Snaps, Axis Constraints, and Extras. As with most toolbars, you can dock these floating toolbars to the side or hide them altogether to gain better access to objects in the viewports. The toolbars can be resized by clicking and dragging any of their edges.

CONSIDER A DUAL-SCREEN SYSTEM

In 3ds Max and many other graphics programs, screen space is always at a premium. You can use a two-monitor (or even three-monitor) system to help unclutter your primary screen workspace. Simply move items such as floating toolbars, the Material Editor, Curve Editor, Rendered Frame Window, and so forth to the second monitor, freeing up as much screen real estate as possible.

Layers are like overlays that help you organize the objects in your model. If you are an AutoCAD or Adobe Photoshop user, you already have an idea of how layers work. You'll learn more about layers in Chapter 10, "Organizing Objects and Scene Management." The Layers toolbar is shown in Figure 1.13.

FIGURE 1.13
The Layers toolbar
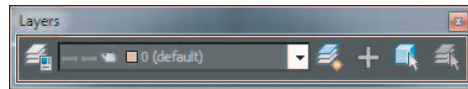
Render shortcuts contain predefined render settings, such as resolution and output file type, that are used to create content from your 3ds Max scenes. The Render Shortcuts toolbar, shown in Figure 1.14, is where you will find the tools for saving and storing your preset values. You'll learn about rendering in Chapters 9 through 15.

FIGURE 1.14
The Render
Shortcuts toolbar
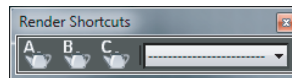
Snaps are features that control where the cursor jumps to, adding a degree of precision to your scene, when the cursor is near a characteristic in the scene. Using snaps, you can easily move the corner of one object to the midpoint of another or nearly any other characteristic combination. The Snaps toolbar is shown in Figure 1.15.

FIGURE 1.15
The Snaps toolbar

Objects are frequently transformed (moved, rotated, or scaled) along a particular axis, or direction, relative to the object or the scene. This functionality is usually utilized through the transform gizmos, onscreen tools used to facilitate the transforms. The Axis Constraints toolbar, shown in Figure 1.16, allows you to control which axis constraints are used in transformations and if constraints are considered when Snaps are enabled.

FIGURE 1.16
The Axis
Constraints toolbar
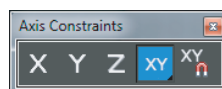
The Extras toolbar (Figure 1.17) contains tools that don't fit cleanly into other categories. With the AutoGrid button, you can turn on a creation grid relative to the surface of any object in the scene. You can also create an *array* (numerous, precisely placed clones) of objects in matrices, along a path or at equal intervals.

FIGURE 1.17
The Extras toolbar
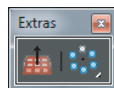
Several tools found within 3ds Max utilize a paint brush analogy in their implementation. The location and intensity of the effects are determined by how the *brush cursor* is dragged over an object's surface. The Brush Presets toolbar, shown in Figure 1.18, gives you access to the standard brushes and the Brush Preset Manager so that you can modify and save a brush's parameters. This toolbar is grayed out unless a tool that utilizes it is active.

FIGURE 1.18
The Brush Presets
toolbar
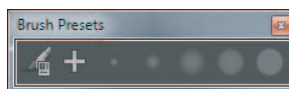
The Animation Layers toolbar (Figure 1.19) lets you access tools that control the layering of objects' animated parameters. *Layering* allows you to designate which animated features are enabled and which are not, allowing for many possible combinations.

FIGURE 1.19
The Animation
Layers toolbar

Large scenes and projects can become very complicated quickly. Containers help you organize assets by combining them into groups. They can be loaded and unloaded at will to reduce the size of files and how much information is active at one time. By refreshing the link to a container, you can help coordinate data and project changes among project teams. By limiting write access to data files, you can protect project scene files. Use container proxies to reduce the size of the file while still seeing the container contents. The Containers toolbar is shown in Figure 1.20.

FIGURE 1.20
The Containers
toolbar

Interactions between objects (for example, rigid object collisions, cloth surfaces, ragdolls, and jointed constraints) can be difficult to animate manually. Using MassFX, a dynamics simulation toolset, you can quickly create simulations that account for properties such as gravity, friction, and wind. The MassFX Toolbar is shown in Figure 1.21.

FIGURE 1.21
The MassFX toolbar

The Graphite Modeling Tools, shown in Figure 1.22, are typically docked right under the Main Toolbar, and they provide context-sensitive access to a number of tools and features that enhance the poly-modeling capabilities of 3ds Max.

FIGURE 1.22
The Graphite
Modeling Tools
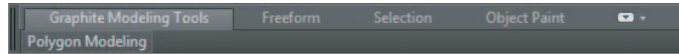
The Viewport Layouts tabs bar, shown in Figure 1.23, is docked by default to the left edge of the 3ds Max 2013 interface, and it provides access to the standard viewport layouts and allows you to save different viewport layouts in your 3ds Max files to enhance your workflows.

FIGURE 1.23
The Viewport
Layouts tabs bar
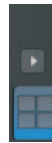
You can dock the floating toolbars or float the docked toolbars. Try the following exercise to see how to change the location of toolbars:

1. Click and drag the title bar of the Layers toolbar so that the toolbar is below the Main Toolbar. The Layers toolbar appears ghosted as a horizontal outline just before you release the mouse button.

2. When the outline is in the position shown in Figure 1.24, release the mouse button. The Layers toolbar is now in a docked position.

FIGURE 1.24
Docking the Layers
toolbar under the
Main Toolbar
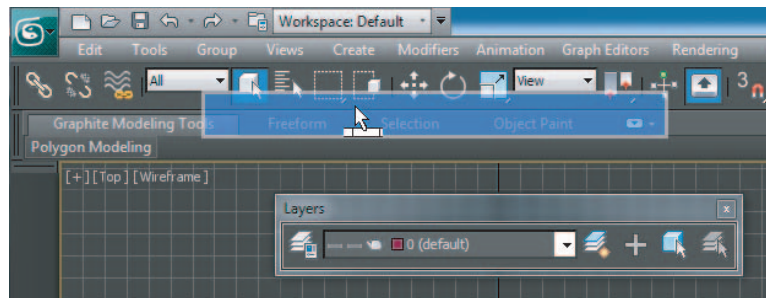
3. Click and drag the Extras toolbar, and dock it just to the right of the Layers toolbar (also just under the Main Toolbar), as shown in Figure 1.25.

FIGURE 1.25
Docking the Extras
toolbar
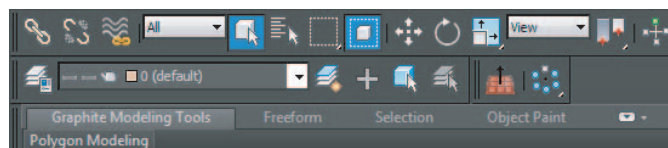
4. Right-click the two vertical lines (called the *toolbar handle*) on the left side of the Extras toolbar to open the context menu shown in Figure 1.26.
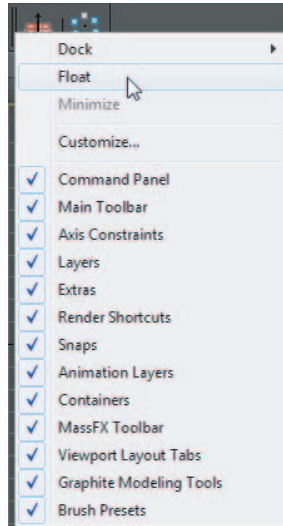
5. Select Float from the context menu. The Extras toolbar returns to its floating position. Other ways to float a toolbar include dragging the toolbar by its handle down into the viewport or double-clicking the handle.

6. Toolbars can be docked on any side of the viewports. However, you should avoid docking toolbars to the left and right sides of the interface if the toolbars have drop-down lists; otherwise, the lists will not appear. Select the Axis Constraints toolbar, and dock it to the left side of the user interface (Figure 1.27).
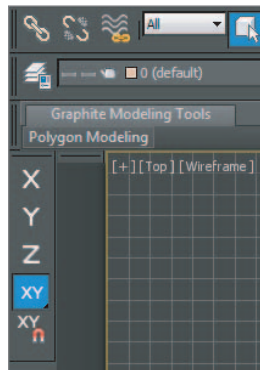
7. Select the remaining floating toolbars, and dock them on the top, right, or left edge of the viewport.

In this brief exercise, you learned how to dock and float toolbars and how to access the context menu where you can toggle the toolbars on and off. Most of the toolbars aren't required in the early chapters of this book, and they occupy a portion of available screen space. You can hide or float the toolbars however you like.

Toolbar Flyouts

You may have noticed that some of the tools in the Main Toolbar show a small triangle in the lower-right corner of the tool's icon (see Figure 1.28).

FIGURE 1.28
Flyout arrow

That arrow indicates that the tool is one of several offered in a flyout. A *flyout* is like a graphical version of options in a menu bar. If you click and hold a tool that's part of a flyout, you see a set of additional, similar tools appear. For example, if you click and hold the Select And Uniform Scale tool, two additional tools appear, as shown in Figure 1.29.

FIGURE 1.29
The Select And Uniform Scale flyout menu
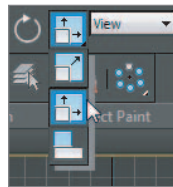
Once you select an option from a flyout, it becomes the default button that you see in the toolbar.

The Viewports

At the center of the window are the *viewports* (see Figure 1.30). You'll be doing most of your modeling work in a viewport. In a blank file, the viewports show a grid that you can use as a reference for orientation and size.

FIGURE 1.30
A typical viewport configuration
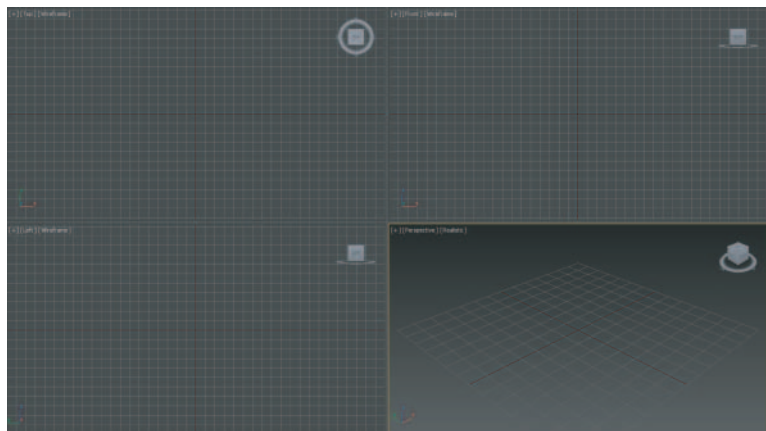
If you look in the lower-left corner of the viewport, you will see the World Axis Tripod that indicates the orientation of the X-, Y-, and Z-axis. The World Axis Tripod helps you get your bearings when you are looking at camera and perspective views.

Currently, there are four viewports named Top, Left, Front, and Perspective, as indicated by the labels in the upper-left corner of each viewport. You can also tell that the Perspective viewport is different from the others by the way the grid squares get smaller and converge in the distance, and it has a gradient background. As you'll see toward the end of this chapter, you can configure and view your model in a variety of ways, depending on your needs.

Tools for Working with the Viewports

At the bottom of the window are several other options that are grouped into six sections the status bar, the prompt line, the time controls, the time slider, the track bar, and the viewport navigation tools (see Figure 1.31). Most of these tools affect the viewport, either by modifying the display of the viewport directly or by affecting the way you interact with objects within the viewport.

FIGURE 1.31
The bottom sections of the 3ds Max 2013 window

Mini Curve Editor
Time slider
Track bar
MAXScript Mini Listener
Prompt line
Status bar
Animation Keying Controls
Animation Playback Controls
Viewport navigation tools
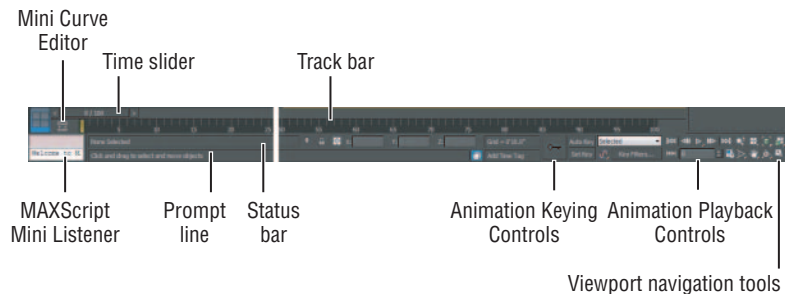
The viewport navigation tools give you control over the main graphic display in the center of the window. With these tools, you can zoom and pan over the display as well as alter the viewpoint of your model. You can also switch between multiple views and a single view. Try the following:

1. Right-click in the Perspective viewport to make it the active viewport, and note that it is now surrounded with a gold border; then click the Maximize Viewport toggle in the far lower-right corner of the window. This is a tool you'll be using often. You can also press Alt+W on the keyboard.

   The graphic display changes to display a single viewport showing only the viewport that had the gold border, the Perspective viewport in this case.

2. Click the Maximize Viewport toggle to divide the viewport area into four individual viewports again.

3. Click the upper-right viewport, labeled Front. Notice that the border of the Front viewport becomes highlighted in yellow.

4. Click the Maximize Viewport toggle again. Now the Front viewport fills the graphic area. Notice how you can quickly expand the view of a viewport to see more detail.

5. Click the Maximize Viewport toggle again to return to a four-viewport layout.

6. Place your cursor at the intersection of the four viewports until it changes to a crossed-arrows cursor. Click and drag to resize all viewports simultaneously, as shown in Figure 1.32. You can also place the cursor between just two viewports to resize the viewports in only one direction.

FIGURE 1.32
Resize the viewports by dragging their intersection.
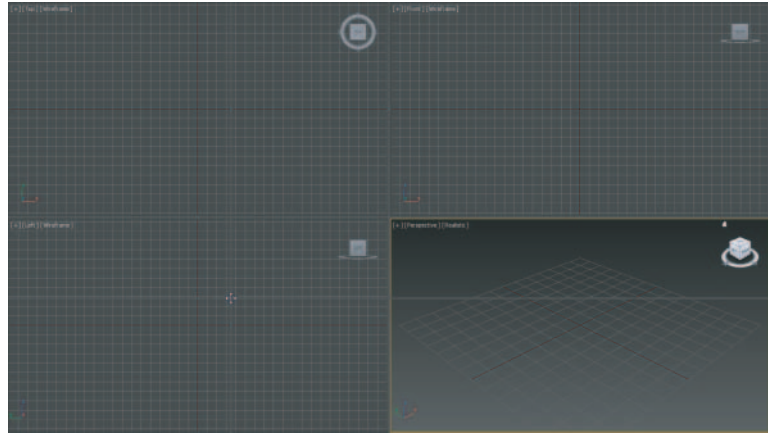
7. Right-click the border between two viewports, and choose Reset Layout from the context menu to return to the default layout, as shown in Figure 1.33.

FIGURE 1.33
Reset Layout option
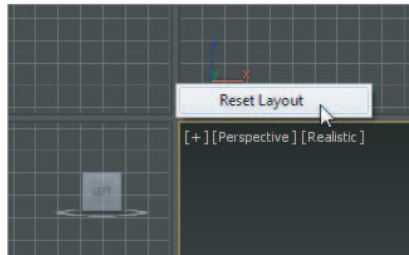
You've just seen how you can display a single viewport or expand the graphic area into multiple viewports showing the Top, Front, Left, and Perspective viewports. Several other views and viewport arrangements are available, as you'll see later in this chapter.

USING SHORTCUT KEYS TO SWITCH VIEWPORTS

You can set the current, active viewport to display a top, front, or left side view by pressing the **T**, **F**, or **L** key. You can also press **B** for the bottom view. Pressing **P** will display the perspective view, and pressing **U** will display an orthographic user-defined view. If you have added a camera, you can press **C** to select from a list of camera views. The hotkeys of **R** for right view and **K** for back have been changed from the defaults in previous versions of 3ds Max and now are used for cycling Scale options and Set Keys respectively. You can easily assign your own hotkeys to commands.

To the left of the viewport navigation tools are time controls. These tools give you control over the animation functions of 3ds Max. Here you can set your creations in motion by selecting the length of time for your animation as well as set the precise location of objects within that time frame.

Near the bottom center of the interface is a large button with the symbol of a key on it and two smaller buttons to the right that are used to create animation keyframes, called *keys*, as shown in Figure 1.34.

FIGURE 1.34
The animation and time controls
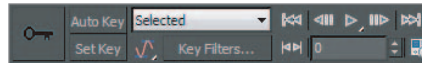
The long horizontal elements across the bottom of the viewport are the time slider and track bar, which are used for animation. You can hide the track bar to save space on the screen. Choose Customize ➤ Show UI ➤ Show Track Bar to toggle this part of the interface off until you're ready to make animations. For the exercises in this book, leave the track bar visible.

Just to the left of the animation controls are the transform type-ins, shown in Figure 1.35. This area displays the location of your cursor in X, Y, and Z coordinates. It also displays other types of data, depending on your current activity. For example, if you're rotating an object, the coordinate readout displays the rotation angle of the object being rotated. If you're scaling the data, these text boxes will show percentages.

FIGURE 1.35
The transform type-in
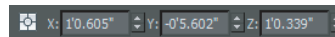
In addition to the transform type-ins, there is a Grid panel, shown in Figure 1.36, which may be hidden to the right if your display is set to low resolution. To find it, if necessary, place the cursor on the vertical bar just to the left of the prompt line until you see a double-pointed arrow.

FIGURE 1.36
The Grid panel
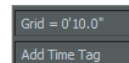
When you see the arrow, click and drag to the left. The Grid panel will be revealed to the right of the transform type-ins.

The Grid panel displays the default setting for the grid size in the current scene. You can hide or display a grid in the active viewport by pressing the **G** shortcut key. Right-click the Snaps toggle, Angle Snap toggle, or Percent Snap toggle in the Main Toolbar, and then click the Home Grid tab of the Grid And Snap Settings dialog box to set the grid spacing and other grid parameters, as shown in Figure 1.37.

FIGURE 1.37
Grid and Snap Settings
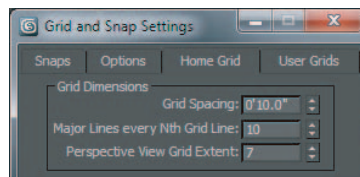
Finally, to the far left at the bottom of the 3ds Max window is the MAXScript Mini Listener, as shown in Figure 1.38. MAXScript is a programming language that allows you to create custom applications or *macros* in 3ds Max. A *macro* contains a prerecorded series of instructions. The MAXScript Mini Listener serves two functions the pink area displays your activity when the MAXScript MacroRecord function is turned on, and the white area provides a space where you can enter commands using the keyboard.

FIGURE 1.38

The MAXScript Mini Listener
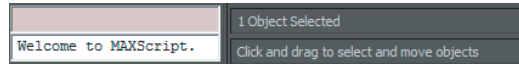
Getting to Know the Command Panel

You'll be using the Command panel for most of your work in 3ds Max. If you're an experienced AutoCAD user, you might think of the Command panel as the equivalent of the AutoCAD command line; it's a single entry point for most of the program's functions. The Command panel offers nearly all the tools for creating and editing in 3ds Max.

Across the top of the Command panel, you'll see a set of six tabs, each displaying an icon, as shown in Figure 1.39.

FIGURE 1.39

The tabs at the top of the Command panel

From left to right, the tabs are Create, Modify, Hierarchy, Motion, Display, and Utilities. If you place your cursor on a tab, you'll see a tooltip displaying the name of the tab. When you click a tab, the functions relating to the tab appear in the rest of the Command panel. Here's a brief rundown of what each tab offers:

Create   This tab allows you to create two- and three-dimensional objects. You can also create light sources, cameras, and helper objects that are used to determine distance and relationships between objects. Light sources, cameras, and helpers are objects that don't appear when your view is rendered.

Modify   This tab gives you control over the dimension, shape, and parameters of your objects. On it, you'll find tools to extrude, twist, and bend your objects. You can also control methods for applying material definitions to objects (called *mapping coordinates*) on this tab.

Hierarchy   This tab offers a set of tools aimed primarily at animation. The options on this tab let you build relationships between objects to simulate joint movement or to constrain the motion of one object in relation to another. It also offers a way to control the location of an object's pivot point.

Motion   This tab also gives you control over animation. Here you can control the actual motion or parameter change of objects over time and view the objects' trajectories.

Display   This tab lets you turn the visibility of objects on or off in your model. There may be times when you don't want a particular object visible while you render your model or while

you're editing a complex model full of objects. Display lets you temporarily hide objects from view or lock them out from being selected. Objects can be hidden individually or by category.

Utilities This is a kind of catchall tab that provides access to special features and plug-ins. Here you find the Camera Match utility, which lets you match your model view to a photograph. You can also get access to the MAXScript customization features on this tab.

FLOATING AND HIDING THE COMMAND PANEL

You can move the Command panel just like any other toolbar, or you can close the panel entirely by clicking the Close button (the one with the X, in the upper-right corner of the window) when the panel is floating. To bring the Command panel back, right-click the blank area of any toolbar and then select Command Panel from the context menu. You can also right-click the Command panel's title bar to dock the panel on the left or right side of the screen or minimize the Command panel to autohide it when it's not in use.

Understanding the 3ds Max Tools

A few ways of working in 3ds Max are a bit unusual for a Windows program. In this section, you'll explore the Create tab of the Command panel as a way to understand some of the quirks of 3ds Max. There aren't many, but understanding them now will make it easier for you to learn how to use the program.

GETTING TO KNOW SCROLLING PANELS AND ROLLOUTS

3ds Max 2013 has a rich set of creation and editing tools — so many, in fact, that 3ds Max's programmers had to come up with a way to get to them easily without making the program too arcane. Two of these tools help you navigate its interface: the scrolling panel and the rollout. A *scrolling panel* is an area that can be scrolled up or down using a pan cursor. A *rollout* is a set of tools that can be opened or closed, much like a drawer in a dresser. Let's start by looking at how a scrolling panel works:

1. Click the Create tab of the Command panel. Notice the row of icons just below the title of the tab, as shown in Figure 1.40. These icons are buttons, or tools, that offer different categories of objects.

FIGURE 1.40
The categories
under the Create
tab

2. Place the cursor over the tool that looks like a movie camera. Notice that a tooltip displays, offering the name of the tool.

3. Click the Cameras tool. You see the options change below the tools, as shown in Figure 1.41.

FIGURE 1.41
Click the Cameras
tool
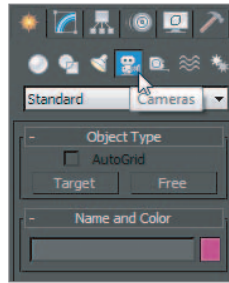
4. Click the Target button. A set of additional options appears. Although it may not be obvious, these options extend beyond the bottom of the Command panel.

5. Move your cursor down to a blank spot in the Command panel. The cursor changes to a hand.

6. Click and drag upward with your mouse. Notice that the options in the Command panel scroll up, following the motion of your mouse. This is an example of a scrolling panel. This scrolling action exposes the rest of the options in the lower portion of the Command panel. Release the mouse button at any time once you've seen how this scrolling action works.

7. Place your cursor on a blank area again so that the pan cursor displays. Then click and drag down to view the Target and Free buttons under the Object Type bar.

8. You can also scroll the Command panel by dragging the dark-gray slender vertical scroll bar on the right side of the Command panel, as shown in Figure 1.42. Try both of these methods.

FIGURE 1.42
Scroll the contents
of the Command
panel
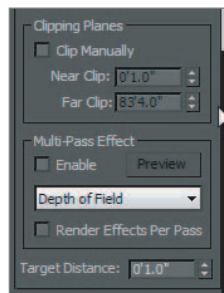
9. Another way to see more of the Command panel is to increase its width by dragging the vertical border between the Command panel and the viewport. Position your cursor along this edge, drag to the left, and expand the Command panel to two and then three columns.

10. The advantage to having a two- or three-column Command panel is obvious — you can see all the controls within the Command panel at once. The disadvantage is equally

apparent — the viewport area becomes much smaller. Drag the Command panel back to one vertical column to give yourself the maximum amount of screen space. In a one-monitor system, it's better to scroll within the Command panel than to sacrifice valuable viewport space.

11. Hover the mouse near the top of the Command panel, and you will see the cursor change. Then right-click and choose Minimize. The Command panel is reduced to a single, narrow border tab. Move your cursor over it to reveal it; move it off it to autohide. This works really well if you have a two- or three-column format.

In this exercise, you learned that you can change the entire set of options by clicking a single tool. You can also see that the set of tools can extend beyond the bottom of the Command panel. You can scroll the options up or down within the panel in several ways. This allows 3ds Max to offer a wide variety of options within the limited space of your display.

The Main Toolbar also acts like a scrolling panel whenever a portion of the toolbar extends beyond the screen area. For example, if your screen resolution is 1024 × 768, a portion of the Main Toolbar isn't visible to the right of the screen. If you place the cursor on a blank area of the Main Toolbar, it turns into the pan cursor. You can then click and drag to the left to display the additional tools.

When you clicked the Target button in step 4 of the preceding exercise, a set of options appeared under a bar labeled Parameters. There are three other bars, labeled Depth Of Field Parameters, Object Type, and Name And Color. Notice the minus (–) sign to the far left of these bars. These bars display the titles of the *rollouts*. They let you open and close a set of options to get them out of the way or to roll them out for use. Try the following:

1. Click the rollout labeled Parameters. The options below the Parameters rollout disappear. Also notice that the minus (–) sign to the left of the rollout changes to a plus (+) sign. This indicates that the rollout is in its closed state. The plus tells you that there is more information inside, waiting to be rolled out.

2. Click the rollout labeled Name And Color. It also closes and displays a plus (+) sign to the left. Click the rollout to open it again. Right-click a blank part of the interface within any one of the rollouts, and you'll see a context menu (Figure 1.43). Select Close All.

FIGURE 1.43
Select Close All to close open rollouts in a panel
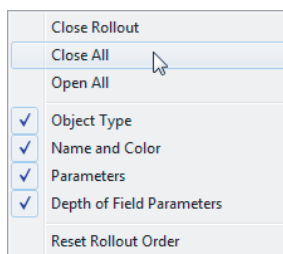
3. Notice that the Parameters and Depth Of Field Parameters rollouts closed but Object Type and Name And Color remained open. This is because all objects on the Create Panel have Object Type and Name And Color rollouts, and these always remain open by default. Any additional rollouts belong to the object you have chosen to create and can be controlled with this context menu. Try dragging the Depth Of Field Parameters rollout above the Parameters rollout, as shown in Figure 1.44.

FIGURE 1.44
Drag the Depth Of
Field Parameters
rollout above the
Parameters rollout
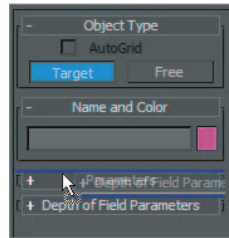
4. You will see a horizontal blue bar appear with an image of the rollout you are dragging ghosted. When you release the mouse, the rollout you are dragging gets docked where the blue bar used to be. Now the Depth Of Field Parameters rollout should appear above the Parameters rollout, as shown in Figure 1.45.

FIGURE 1.45
The new position of
the Depth Of Field
Parameters rollout
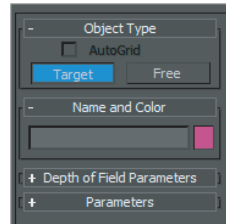
5. Click the Parameters and Depth Of Field Parameters rollouts again to display the options.

Now you can see how easy it is to control and customize the Command panel interface. In this and later chapters, you'll explore the rollouts that appear in the Command panel.

CREATING OBJECTS AND SETTING THEIR PARAMETERS

By now, you've seen most of the 3ds Max interface and how it functions. However, you should know about a few more tools and methods before you delve into using 3ds Max. In the following exercises, you'll get a chance to create a simple object and, in the process, you'll be introduced to a few new tools.

**CERT
OBJECTIVE**

1. On the Create tab of the Command panel, click the Geometry tool at the top of the panel, as shown in Figure 1.46. Make sure that Standard Primitives appears in the drop-down menu, and you will see the Object Type rollout with a set of object types.

FIGURE 1.46
Click the Geometry
tool, and the avail-
able Standard
Primitives object
types will appear.
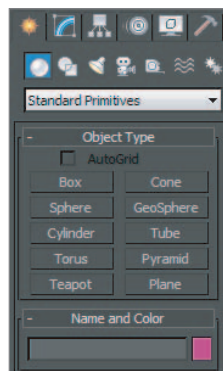
2. Click the Box button. Additional rollouts appear in the Command panel. They include Creation Method, Keyboard Entry, and Parameters. Notice that a message in the prompt line at the bottom of the screen says, "Click and drag to begin creation process." Also, the cursor in the graphic area displays as a cross, telling you that you're in Object Creation mode.

3. In the Perspective viewport, place the cursor at the center of the graphic area at coordinates 0,0, where the two darker grid lines intersect, and click and drag diagonally to the upper-right corner of the screen — don't release the mouse button just yet. As you move the mouse, a rectangle follows your cursor. Notice that the values in the Length and Width input boxes in the Parameters rollout change as you move the mouse.

4. Place the cursor so that the rectangle looks similar to the one shown in Figure 1.47, and then release the mouse button. (You don't need to match the rectangle in the figure exactly.) Now, as you move the cursor, the rectangle changes in height. Notice that the Height value in the Parameters rollout also follows the change in height.

5. Adjust the height so that the Height parameter shows about 3′ 0″, and left-click your mouse. The box is now fixed at the height you selected. It should look similar to Figure 1.48.

FIGURE 1.47
The box object so far
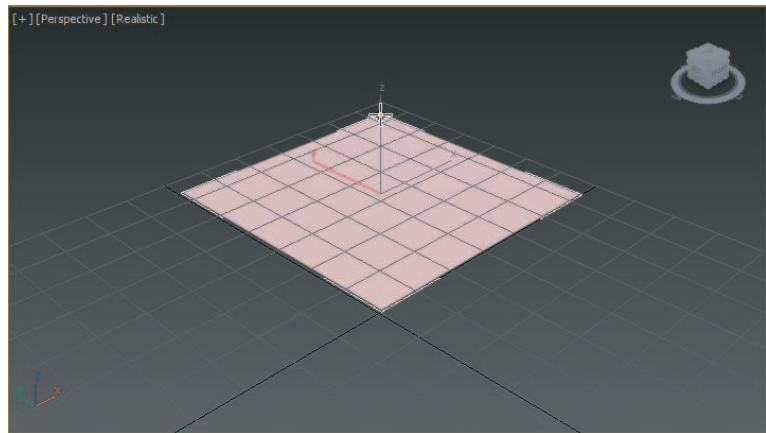
CREATE A NEW BOX IF NECESSARY

The following steps work as directed only if you have not deselected the box. If you have, click the Undo Scene Operation button in the Quick Access Toolbar until the box disappears, create a new box, and then proceed with the following steps.

You've just created your first object in 3ds Max and, in the process, you've seen how the dimensions of an object are reflected in the Parameters rollout. Once you've created an object, you can continue to modify its parameters, as the following exercise demonstrates.

FIGURE 1.48
The finished box
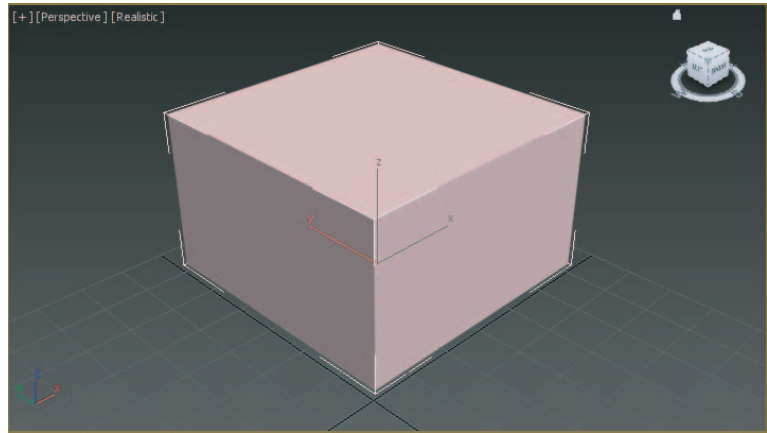
1. In the Parameters rollout, locate the Width input box and click the up arrow to the right of the box several times. Arrows like this one are called *spinners*, and they allow you to adjust graphically the value of the associated input box. Notice that the box in the Perspective viewport begins to widen as the value in the Width input box increases, as shown in Figure 1.49.

FIGURE 1.49
Adjust the Width of the box
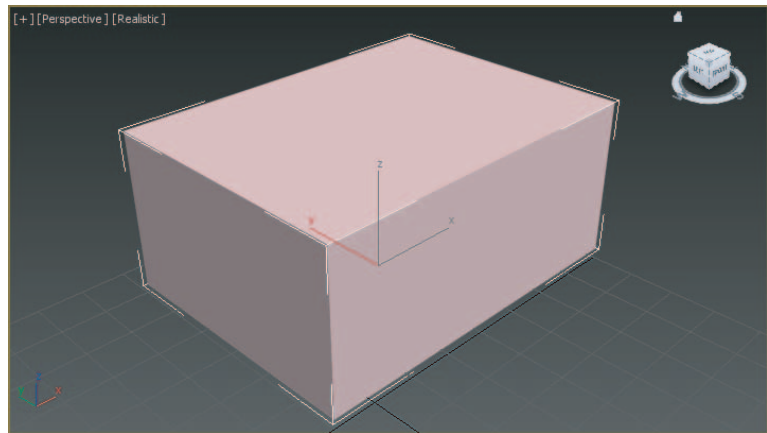
2. Click and hold down the left mouse button while pointing to the up arrow of the Width spinner. Notice that the box continues to grow in width as you hold down the mouse button. When you hold down the mouse button and move the mouse forward or backward, the rate of change on the values accelerates.

3. Right-click the spinner arrow. The box shrinks in width to 0′0.0″. Right-clicking any spinner changes the spinner value to its lowest possible non-negative value, which is 0′0.0″ in this case.

4. Click the Width spinner, and drag the mouse up. The box grows wider. Click and drag down, and the width decreases.

5. Click and drag the Width spinner up until your cursor reaches the top of the screen. Then continue moving the mouse up the screen, and notice that the cursor reappears at the bottom of the screen and continues moving up the screen. This *circular* action of the spinner lets you scroll continuously without being limited by the screen area.

UNDOING SPINNER CHANGES

While adjusting a spinner, you can immediately undo any changes you make by right-clicking the mouse while still holding the left mouse button. This allows you to experiment with spinner settings quickly while you work.

You've just seen how you can change the parameters of an object by using the spinner. Now let's take a look at the absolute way of entering values into input boxes:

1. Double-click the Length input box in the Parameters rollout and type **60** ↵. Notice how the box's length changes and the Length value changes to 5′0.0″, the feet and inches equivalent of 60″.

Notice that it's not necessary to enter the inch (″) symbol to indicate a measurement in inches. You are, however, required to enter the foot (′) symbol when entering a measurement in feet. This is because you selected the Inches option as the default units in the Units Setup dialog box earlier in the chapter.

2. Press the Tab key. Notice that the Width value is now highlighted, as shown in Figure 1.50.

FIGURE 1.50
Press the Tab key to jump to the next value
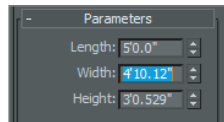
3. Type **60**↵ for the width, and press Tab again. The Height value is highlighted.

4. This time enter **5′** ↵ . The box is now a cube 60″ square.

USING THE CUBE CREATION METHOD

You can also create a cube directly by selecting the Cube radio button in the Creation Method rollout.

USING THE TAB KEY

If there is a series of related input boxes — such as the Length, Width, and Height boxes in the previous exercise — the Tab key lets you advance from one field to the next. You'll find that numeric input boxes and spinners are quite common throughout 3ds Max.

SETTING THE SPINNER RATE OF CHANGE

If you hold down the Ctrl key while you move a spinner, the rate of change in the spinner value increases. The Alt key has the opposite effect, decreasing the rate of change. The higher the numeric value in the spinner, the faster the rate of change and vice versa.

Working with Objects

Now that you've seen the main elements of the 3ds Max interface, we'll cover how you interact with objects in the viewport. You'll start by looking at a way to move the box you've just created. Then you'll learn how you can view your box from different angles.

Selecting and Moving Objects

The basic editing tools of 3ds Max are simple and straightforward, although it may take a little explaining for you to grasp the finer points. As with most graphics programs, you use a selection tool to select objects. The Select tool is typically shown on the toolbar as an up arrow that looks like the standard Windows cursor floating over a cube.

1. Click the Select Object tool in the Main Toolbar.

2. Click a blank area of the viewport. This clears any selections that may currently be active.

3. Move the cursor over the box. Notice that the cursor turns into a plus (+) sign. This tells you that the cursor has found a selectable object.

4. Click the box to select it. A graphic displays, showing the X, Y, and Z orientation of the box in relation to the viewport (see Figure 1.51). Also notice that in the Perspective view, marks like 3D *corner marks* appear at the corners of the box. These are called *selection brackets*, and they graphically indicate the objects that are selected.

FIGURE 1.51
The selected box
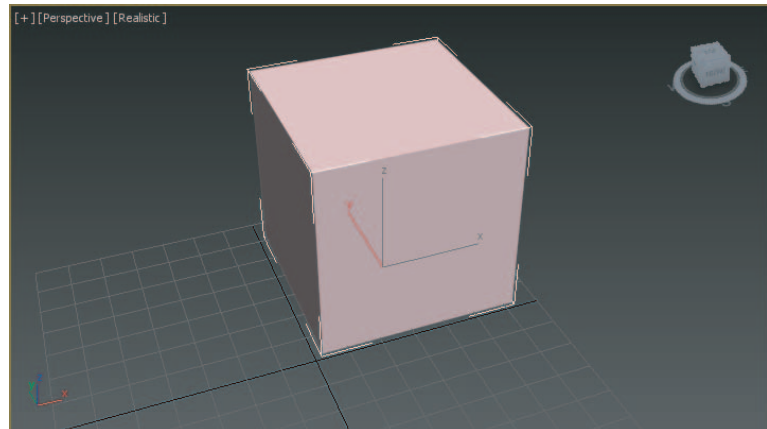
With the box selected, you can go to the Modify tab of the Command panel and edit its properties, or you can use any number of other editing tools to affect the box.

Let's continue by looking at one of the more basic editing tools you'll use — the Select And Move tool.

1. Click the Select And Move tool in the Main Toolbar. Notice that the graphics indicating the box selection change and new ones appear.

2. Place the cursor on the box. It changes into the Select And Move icon.

3. Click the box if it isn't still selected. A manipulator known as the Move transform gizmo appears, showing the X, Y, and Z orientation of the box in relation to the viewport. Selection brackets also appear at the corners of the box.

4. Place the cursor on the blue Z-axis handle of the Move transform gizmo; the blue arrow represents the Z-axis. Notice that the Z-axis and axis label highlight in yellow and the X-axis and axis label turn back to red. When you move the cursor away from the Z-axis, the X-axis is highlighted again and the Z-axis returns to blue.

   The yellow highlighting shows you which axis is currently active. The X-axis is the default constraint direction. If the Axis Constraints toolbar is still open, you'll see that the X-axis button is selected. As you've seen in this step, you can select an axis to constrain just by placing your cursor on the axis coordinate arrow.

5. Place the cursor on the XY-plane handle, the square that joins the X and Y handles of the Move gizmo. Notice that the XY-plane handle highlights in yellow (see Figure 1.52). Click and drag the box on the grid. The box now moves in the XY-plane. When you click and drag the X arrow, movement is constrained along the X-axis only.

FIGURE 1.52
Moving the box in
the XY-plane
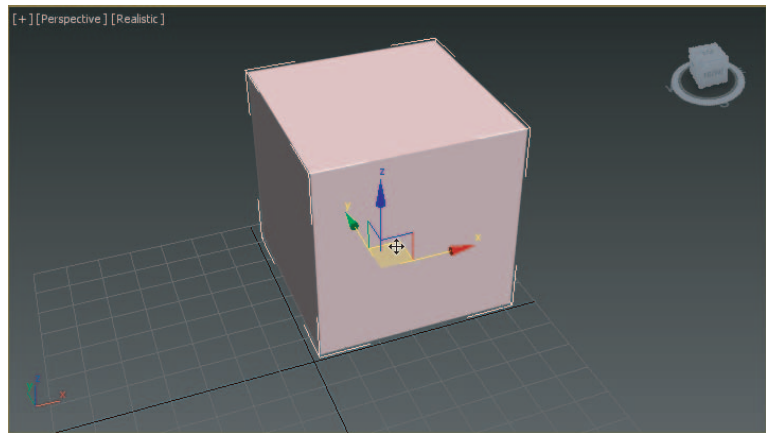
6. Click and drag the blue Z-axis handle upward. Now movement is constrained in the Z-axis, away from and toward the grid. As you may guess, clicking and dragging the green Y-axis handle constrains movement along the Y-axis.

THE LAST AXIS TRANSFORMED IS HIGHLIGHTED IN YELLOW

The axis that is highlighted in yellow is the last axis constraint that was used. For example, if you transform an object in the Y direction, the next time you start to transform an object, the Y-axis will be highlighted.

If you click an object in a location other than the coordinate arrows, you can freely move the object in the current axis or plane restriction. Notice that the coordinate location of the object is displayed in the status line.

CONSTRAINING MOTION

The tools in the Axis Constraints toolbar constrain the motion of an object in the X-, Y-, or Z-axis. For example, to constrain motion in the X-axis, click the Select And Move tool, and then click the X in the Constraints toolbar. The selected object's motion is constrained to the X-axis. In early versions of 3ds Max, this was the only method available to constrain motion.

Another important function that the Axis Constraints toolbar offers is the selection of the default *free motion* plane. In step 5 of the preceding exercise, you were able to move the box freely in the XY-plane, but you were constrained to that plane. The Axis Constraints toolbar lets you select the default plane to which you are constrained. The Restrict To XY-Plane tool is a flyout offering three options: XY, YZ, and ZX. You can select the plane in which you want to constrain motion by selecting one of these three options. The XY option is fine for nearly all of your work; every now and then, though, you'll want to use one of the other options, so it's good to be aware of this tool. You can also access these constraint planes simply by dragging the appropriate parts of the transform gizmo — it's very intuitive.

If you prefer to use shortcut keys instead of a toolbar, the F5, F6, and F7 keys toggle the Y-, Y-, and Z-axis constraints, respectively. Pressing the F8 key repeatedly cycles through the XY-, YZ-, and XZ-plane constraints.

Finally, a tool that is related to the transform tools is the Selection Lock Toggle tool.
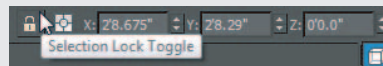
Any objects that are selected when this tool is clicked will remain selected as long as the Selection Lock Toggle is toggled to the On position. This tool helps prevent the accidental loss of a selection due to a mouse click. It also allows you to use the transform tools without actually placing the cursor on the selected objects. You can also toggle this tool on and off by clicking it or by pressing the spacebar while in a selection mode.

As you see, moving an object in 3ds Max is fairly straightforward. But what if you want to move an object a specific distance or to a known position? The following exercise demonstrates how this is done:

1. With the box still selected and the Select And Move tool still active, click the Absolute Mode Transform Type-In button at the bottom of the 3ds Max window, as shown in Figure 1.53. The tool changes to show that the Offset mode is active.

FIGURE 1.53
Absolute Mode
Transform Type-In
(top); Offset mode
(bottom)
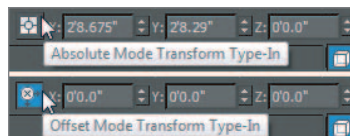
When the Absolute/Offset Mode Transform Type-In button is in the Absolute mode (up), you can enter the specific coordinates of the point where you want to move your object. When it's in the Offset mode (down), you can enter a relative distance from the object's current location.

2. Click in the X input box in the coordinate readout and type **10** ↵. The box moves 10 inches in the positive X direction.

3. Click and drag the Z-coordinate readout spinner upward. The box moves vertically.

4. Click the Absolute/Offset Mode Transform Type-In button to switch to Absolute mode. Then click in the Z-coordinate readout input box and enter **1′** ↵. The box moves so that its base is exactly at 1′ for the Z-coordinate.

5. Right-click the X-coordinate readout spinner. Remember that right-clicking a spinner converts the value associated with the spinner to its lowest value, which is 0′0.0″ in this case. Notice that the box moves to 0 for the X-coordinate.

6. Right-click the spinners for the Y- and Z-coordinates in the coordinate readout. The box moves to the center of the screen at the origin (coordinates 0,0,0), as shown in Figure 1.54.

FIGURE 1.54
Moving the box to
the origin
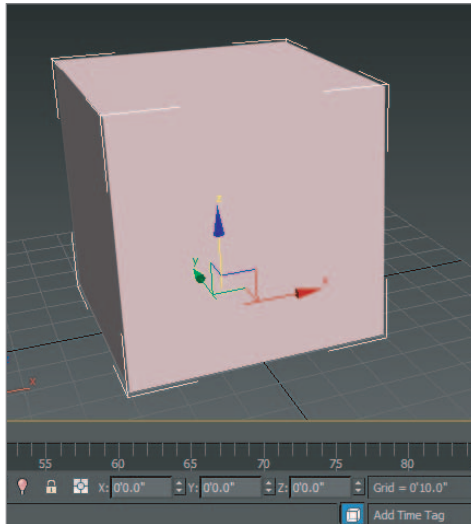
Just as with the spinners in the Command panel, the Coordinate Display spinners let you set values by clicking and dragging. You can also return to the default values of zero by right-clicking the spinners. When in Offset mode, the spinners automatically reset to zero because the values represent numerical values away from the current, baseline location. The spinners in the coordinate readout appear when you turn on the Select And Move, Select And Rotate, or Select And Scale tool from the Main Toolbar.

ACCESSING THE TRANSFORM TYPE-IN DIALOG BOXES

If you are accustomed to earlier versions of 3ds Max, you can still use the floating Transform Type-In dialog boxes that appear when you right-click the Select And Move, Select And Rotate, and Select And Scale tools. Most recently, this functionality has been added to the quad menu; by clicking the Settings button to the right of Move, Rotate, or Scale, you are taken to the appropriate Transform Type-In dialog box automatically. You can also access the Transform Type-In dialog box by using the F12 key.

Rotating and Scaling Objects

Besides the Move tool, the transform tools also include the Rotate and Scale tools. Try the following set of exercises to see how these tools work.

1. With the box selected, click the Select And Rotate tool in the Main Toolbar. The Rotate transform gizmo, a kind of virtual trackball, appears with rings representing the rotation about the X-, Y-, and Z-axes.

2. Place your cursor on the red ring that circumscribes the X-axis. Notice that the ring is highlighted in yellow. Click and drag the X-axis ring upward. The box rotates about the X-axis, as shown in Figure 1.55. A tangent indicator arrow will appear, indicating the direction of rotation. A transparent red slice along with a text tooltip also appears, displaying the amount of rotation. Release the mouse button to set the rotation angle.

FIGURE 1.55
Rotating the box about the X-axis
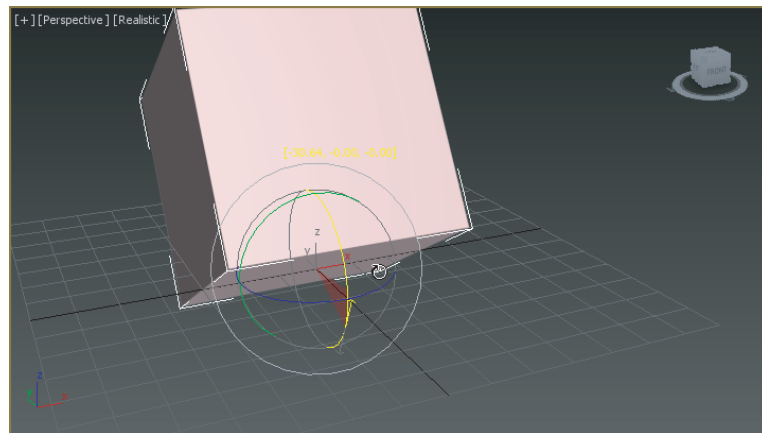
Make sure that the Absolute/Offset Mode Transform Type-In button is in the Absolute mode and look at the coordinate readout. Notice that the X value is not zero, because you rotated it in step 2. It now shows a number of degrees.

3. Right-click the X spinner in the coordinate readout to set the X value rotation back to zero. Notice that the box snaps back to its original orientation.

The Select And Rotate tool's methods are the same as the Select And Move tool's methods. You can rotate an object graphically by clicking and dragging the object or, with an object selected, you can enter an exact rotation value in the coordinate readout. When the Absolute/Offset Mode Transform Type-In button is in the Absolute mode, you can control the orientation in relation to the object's original orientation when it was created. In the Offset mode, you can control the orientation relative to the object's current orientation.

Now try the Select And Uniform Scale tool:

1. With the box selected, click the Select And Uniform Scale tool in the Main Toolbar. The Scale transform gizmo appears, showing the X, Y, and Z orientation of the box in relation to the viewport.

2. Click in the center of the Scale gizmo that appears, or on the box itself, and drag upward. The box grows uniformly in size.

3. Click and hold the Select And Uniform Scale tool. Then, from the flyout, select the middle tool, which is the Select And Non-uniform Scale tool, as shown in Figure 1.56. This step is not absolutely required; it is presented here to clarify the concept. The axis handles alone can be used to scale an object non-uniformly.

FIGURE 1.56
The Select And
Scale flyout
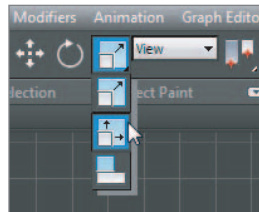
4. Drag the XY-plane handle of the Scale gizmo (highlighted in yellow onscreen) to scale the box non-uniformly in the XY-plane in this case, but not along the Z-axis. Similarly, the axis handles can be dragged individually to constrain the scaling of an object to one axis (Figure 1.57).

FIGURE 1.57
Using the
Non-uniform Scale
transform on the
box
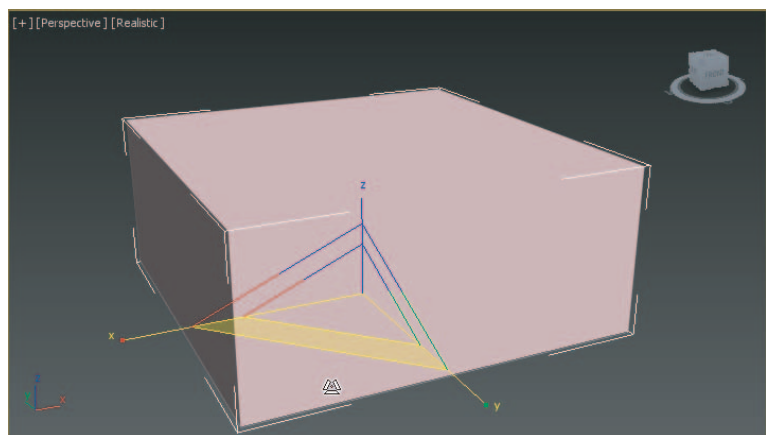
Now take a look at the coordinate readout. The values you see are percentages of scale. When the Absolute/Offset Mode Transform Type-In button is in the Absolute position (up), the values are percentages of the original size of the object. When it's in the Offset position (down), the values are the scale in relation to the current size and are immediately reset to 100 percent when you release the mouse button.

1. With the Absolute/Offset Mode Transform Type-In tool in the Absolute position, click and drag the Z spinner up. Notice that the box grows in the Z-axis.

2. Right-click the Y-axis spinner. The box distorts to a 0 value in the Y-axis.

3. Click in the X-value input box, and enter **100** ↵. The box's X value is restored to its original size.

> **HOW 3DS MAX SEES THE SCALE TRANSFORM**
>
> Look at the box's Length, Width, and Height values in the Parameters rollout in the Command panel. If the Parameters rollout for Box001 does not display, you have to click the Modify tab. The values all read 5´0.0˝ even though the box has been scaled. This is an important indicator as to how 3ds Max handles object data. For example, if you have a box that is 1 unit long on each side and then you scale it to twice its size, 3ds Max does not now see this as a box that is 2 units on each side; it sees it as a 1-unit box with a 200 percent scale factor applied.

4. Press the Tab key to move to the Y-value input box and enter **100** ↵.

5. Press Tab again to move to the Z-value box and enter **75** ↵. The box is now slightly shorter than it is wide and long.

The Select And Scale tool works in a slightly different way from the other two transform tools. For one thing, a zero value in the coordinate readout doesn't return the selected object to its original shape. This is because the values in the coordinate readout represent percentages, where 100 percent is the object's original size.

The Scale gizmo allows you both to uniformly and non-uniformly scale an object by automatically switching between scale modes. Which operation you perform depends on which part of the Scale gizmo you drag.

1. Try dragging the center of the Scale gizmo. You will see the object get uniformly bigger or smaller when you drag upward or downward.

2. This time, put your cursor over one of the edges of the Scale gizmo. When you drag over one of the plane handles, you are performing a non-uniform scale in two directions at once. Look closely at the gizmo, and you can see that the two axes of the plane are highlighted. Try non-uniformly scaling the box in the YZ plane (see Figure 1.58a).

3. The last operation you can perform using the Scale transform gizmo is a non-uniform scale in one direction. To accomplish this, put your mouse directly over the axis handle at the tip of an axis. For example, put your mouse over the end of the Y-axis and drag to scale in that direction only, as shown in Figure 1.58b.

Once you master the mechanics of the transform gizmos, you will find that you have much finer and more intuitive control over your objects in 3ds Max.

FIGURE 1.58
Using the Uniform
Scale transform
gizmo, in two axes
on the box (a), and
along one axis, on
the box (b)

(a)   (b)
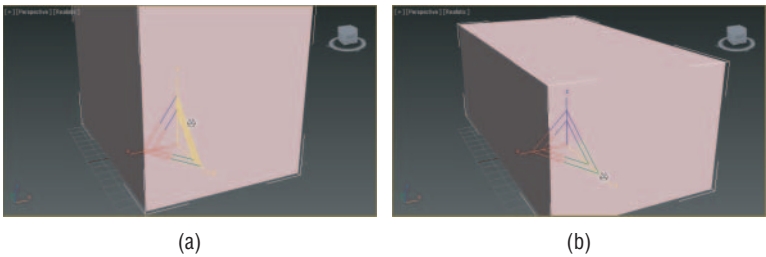
Copying an Object

We've covered just about all the ways of moving, rotating, and scaling an object in the
Perspective viewport. If you want to copy an object, use the same methods you would to move,
rotate, or scale objects — with the addition of holding down the Shift key. Try the following
steps to see how copying, or *cloning*, as it's called in 3ds Max, works. (Copying is one of the
forms of a more general function called cloning.)

1. From the Application menu, choose Open and click No in the dialog box that opens ask-
   ing whether you want to save the changes in your current file. The Open File dialog box
   appears. Navigate to the Chapter 1 files you downloaded from the book's accompanying
   web page, www.sybex.com/go/mastering3dsmax2013. Select the Chair.max file, and then
   click the Open button.

2. Click the Select Object button in the Main toolbar, and then select the chair.

3. Click the Select And Move button.

4. While holding down the Shift key, move the cursor over the XY-plane of the transform
   gizmo, and then drag the chair to the left. A second chair appears.

5. Release the mouse button. The Clone Options dialog box displays (see Figure 1.59). This
   dialog box lets you control the quantity and type of copies you're making as well as the
   name of the new objects.

FIGURE 1.59
The Clone Options
dialog box
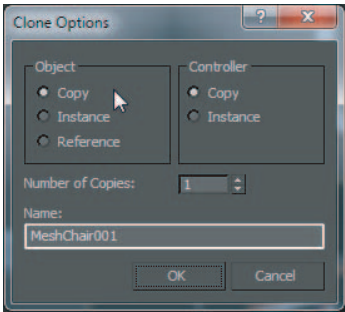
6. In the Object group of the Clone Options dialog box, select Copy.

7. Click OK. The new chair is added to your model, as shown in Figure 1.60.

CREATE A COPY IN THE SAME LOCATION AS THE ORIGINAL

You may want to make a copy of an object in exactly the same location as the original object. To accomplish this, first select the object you want to copy and then select Edit ➢ Clone from the Menu Bar or press Ctrl+V on the keyboard. You will see a Clone Options dialog box similar to the one that you saw in the preceding exercise. Set your options and click OK. Note that the new copy doesn't appear at first because it occupies the same space as the original. (You can accomplish the same thing by Shift+clicking an object with the Select And Move tool or by selecting Clone from the Transform quad menu, which can be accessed by right-clicking the object.)

FIGURE 1.60
The original and cloned chairs
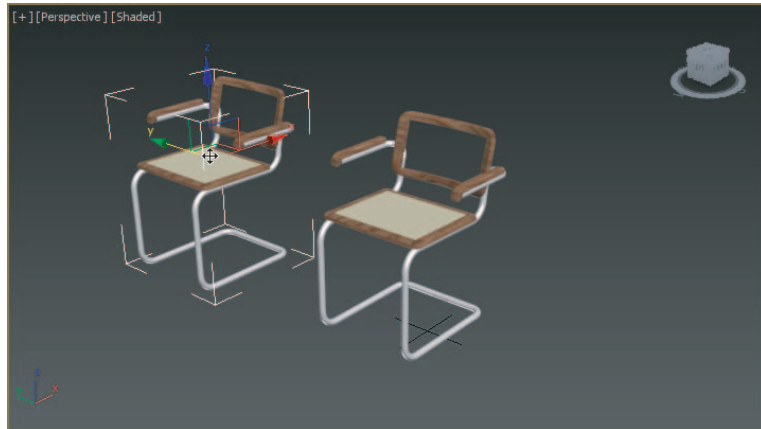
In step 6, you selected the Copy option in the Clone Options dialog box. This option creates a distinct copy of the original object. The other two options, Instance and Reference, create clones that are related to the original in such a way that changes in one object affect the other. You'll learn more about these options in Chapter 2, "Introducing Objects."

PARKING CURBS AND BOLLARDS

Jon McFarland, one of the authors of this book's 2010 edition and the technical editor on this edition, says that every project has features in it that vary from interesting and cool to mundane and repetitive. Although we all like to work on the exciting projects, we all do our share of the latter. When those less-than-exciting projects pop up, it's best to crank them out quickly and accurately and then move on to the next portfolio-quality project down the line.

While the main effort of McFarland's company was focused on the creation of a mall, complete with an entertainment center and several freestanding buildings for restaurants and other shops, someone had to work on the parking lot. He was hired to place several thousand parking curbs and bollards (vertical posts used to restrict vehicular traffic) accurately throughout the parking lot and around the entrances to the structure. Parking curbs are usually identical and placed equidistant from each other (usually 9′ 0″ apart), so the layout wasn't difficult. After modeling the simple curb, he placed one at the end of each parallel run of parking spaces. He selected the first curb on each run, held down the Shift key, and moved it 9′ in the proper direction. In the Clone Options dialog box, he set Number Of Copies to the number of curbs in the longest run and then deleted any superfluous curbs.

This process was repeated several times for the remaining curbs, and then a similar process was used to place the bollards. Upon receiving the completed work, the company assigned McFarland the task of creating the traffic islands and the screen walls around the service areas. He says, "I'm sure one of these days they'll give me a fun job to do."

Selecting Multiple Objects

You've now learned how to select, move, and copy a single object, but what do you do if you want to move or copy several objects at once? You can select multiple objects, or create *selection sets*, as they are called in 3ds Max, using two methods. The first is one that is also employed in other graphics programs.

1. Click the Select Object tool on the Main Toolbar.

2. Click a blank area of the viewport to clear any selections you may already have, or press Ctrl+D on the keyboard.

3. Click and hold your cursor at a point below and to the left of the chair copy. Then drag upward to the right. Notice that a dotted rectangle follows your cursor, as shown in Figure 1.61.

FIGURE 1.61
Placing the selection rectangle around the chairs

...to here.

Click and drag from here...
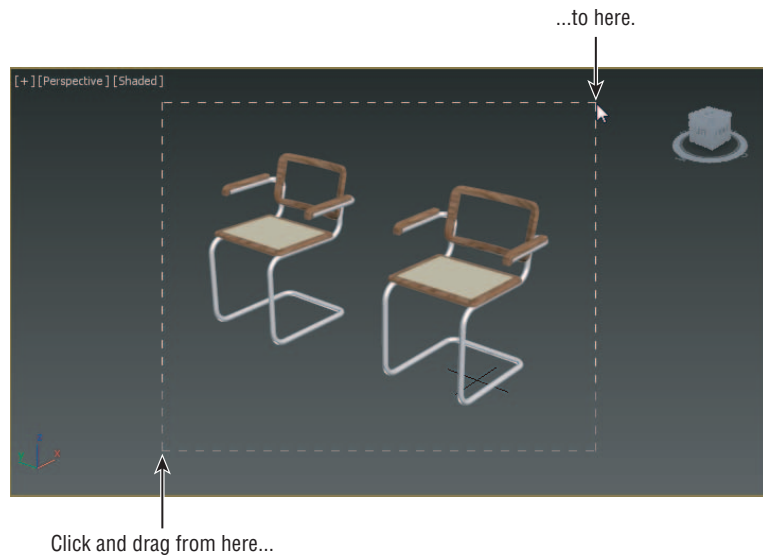
4. Continue to drag the cursor upward and to the right until it encloses both chairs. Then release the mouse button. Both chairs are selected.

Notice that selection brackets (or bounding boxes) appear at the corners of both chairs, and a gizmo appears between them, indicating that the two objects are selected. You can select objects in a couple of other ways, which you'll learn about in a moment, but first, let's use the current selection to make a few more copies of the box.

1. Click the Select And Move tool in the Main Toolbar.

2. Hold down the Shift key, and drag back the X-axis arrow of the Move transform gizmo so that copies of the two chairs appear in the location shown in Figure 1.62. (You don't need to be exact about the placement of the copies.)

3. When the copies are in place, release the mouse button.

4. In the Clone Options dialog box, make sure that Copy is selected in the Object group and click OK.

FIGURE 1.62
Place the copies just beyond your first two objects.
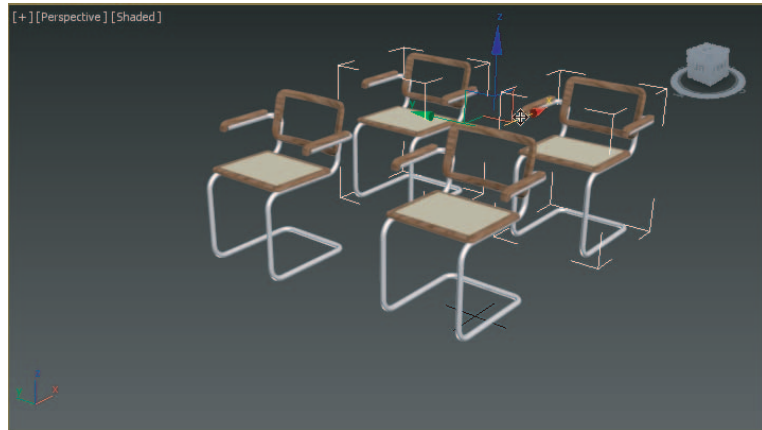
The four chairs will help to demonstrate some of the other selection methods available to you. First, let's look at another property of the selection window:

1. Click the Select Object tool, or right-click and choose Select from the quad menu.

2. Click a blank spot in the viewport to clear your selection set.

3. Click and drag the cursor from the point indicated in Figure 1.63.

FIGURE 1.63
Selecting points for a crossing window
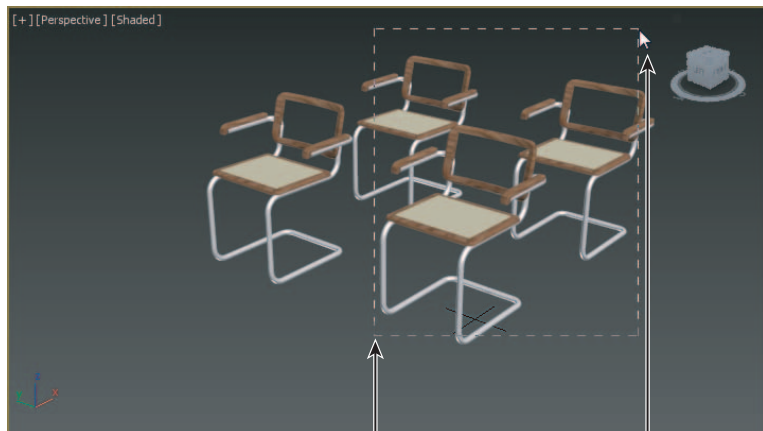
Click and drag from here...   ...to here.

4. Drag the rectangle up and to the right so that it completely encompasses one chair but just a portion of two other chairs, as shown in Figure 1.63. Then release the mouse button. Three of the four chairs are selected.

Notice that you didn't need to enclose the chairs completely to select them. In the current selection mode, you only need to have the selection window cross over the desired objects. This is known as a *crossing window*. If you're an AutoCAD user, this type of window should be familiar to you.

CERT OBJECTIVE

You can change the way the selection window works by using the Window/Crossing Selection tool. The following exercise demonstrates this:

1. Click a blank area in the drawing in order to clear your selection set.

2. Click the Window/Crossing tool in the Main Toolbar.

Notice that the icon highlights in blue and changes to one showing a cube that's completely within a dotted rectangle. This tells you that you are now in Window Selection mode.

3. Click a point above and to the left of the front left chair in the foreground, as shown in Figure 1.64.

FIGURE 1.64
Placing a Window Selection window

Click and drag from here...

...to here.
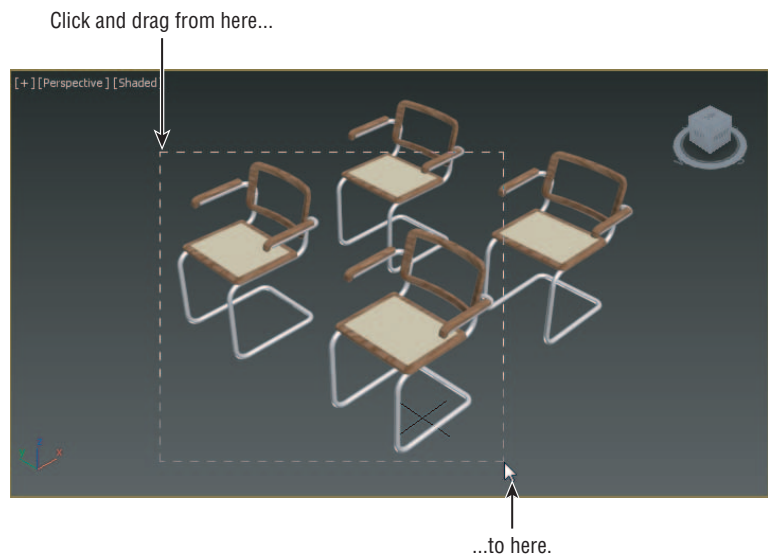
4. Drag the rectangle downward and to the right until it completely encompasses the two chairs in the front, as shown in Figure 1.64. Then release the mouse button. Notice that the only objects selected are the two chairs on the left.

When you use Window Selection mode, only objects that are completely within the selection window are supposed to be selected. Unlike with the Crossing Selection window, objects that are partially inside the selected window are supposed to be omitted from the selection. There is an issue with 3ds Max 2013 with the updated Nitrous viewports that cause some objects to be

selected if their pivot point is within the Window Selection window, even if the entire object is not enclosed in the selection.

You can use the Ctrl key in conjunction with any selection method to continue to add more objects to your selection set. You can also remove objects from your selection set by using the Alt key. This was a new behavior introduced in 3ds Max 2011. Previously the Ctrl key would both add to and subtract from selection sets. Now the Ctrl key is only for addition and the Alt key only for subtraction. The following activity demonstrates how adding and subtracting from selections works:

1. Switch back to the Crossing Selection method, and then Ctrl+click and hold a point below and to the right of the chair near the bottom of the viewport. Notice the small plus (+) sign next to the cursor indicating that selected objects are to be added to the current selection set, as shown in Figure 1.65.

FIGURE 1.65
Adding objects to your selection set using the Ctrl key
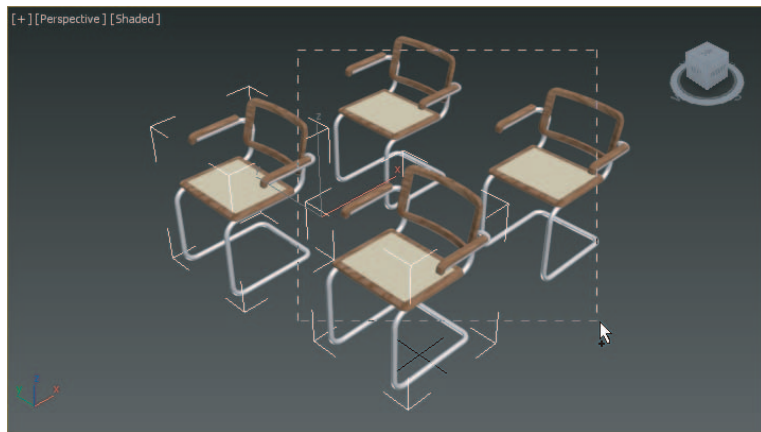
2. Drag the window upward and to the left so that it encloses a portion of the two chairs on the right. Then release the mouse button. Now all four chairs are selected.

3. Hold down the Alt key and then click (Alt+click) the chair in the upper right of the screen, as shown in Figure 1.66. Now all chairs except the upper-right one are selected.

FIGURE 1.66
Removing an object from your selection using the Alt key
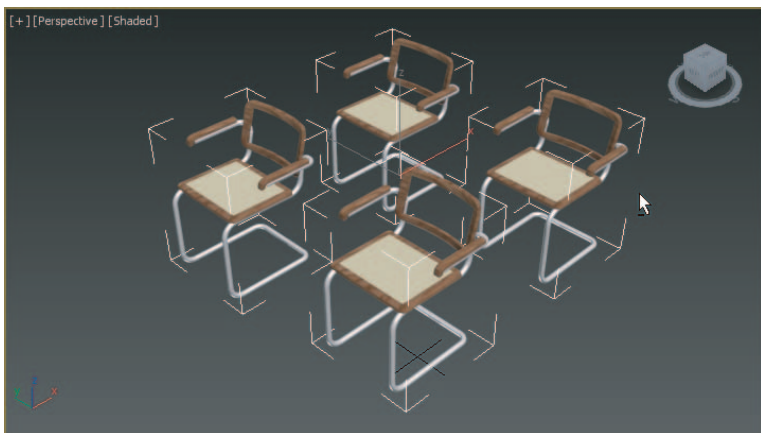
You can change the shape of your selection window to help select objects. There are Rectangular, Circular, Fence, Lasso, and Paint Selection Region options. The next exercise explores the lasso selection region, which allows freeform sketching for a selection.

1. Click and hold to open the Selection Window flyout, and click the Lasso Selection Region button.

2. Switch back to the Window Selection option.

3. Sketch a lasso selection region by dragging the mouse in a freeform manner around two of the chairs to select them, as shown in Figure 1.67. Because the Ctrl button was not held down during the selection process, only the two chairs fully encompassed by the lasso are selected while the rear-left chair, which was previously selected, is now unselected.

FIGURE 1.67
Selecting objects using a lasso selection region
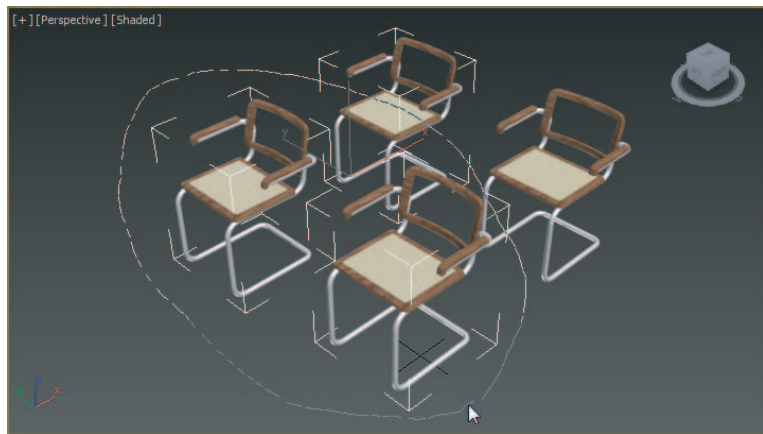
Right now, you have only a few objects in your model, but as your models and scenes develop, you'll find that selecting objects in a crowded model becomes more of a challenge. Knowing about the different selection modes will go a long way toward making your work easier.

One more selection method will be an invaluable tool as your model becomes more complex. You can select objects by their names, using the Select From Scene dialog box. The following is a quick exercise that will introduce you to this important tool.

1. Click the Select By Name tool in the Main Toolbar or press **H** on the keyboard.

   The Select From Scene dialog box displays. It contains a list showing the names of the objects in your drawing with the currently selected objects highlighted (see Figure 1.68). Groups of objects are preceded by an icon consisting of an overlapping circle and square contained within brackets. Right now, the list shows the default names given to the objects by 3ds Max. You can always change the name of an object in the Command panel. (You can rename an object on every tab except Utilities.)

2. Click the Select None button on the second row of icons on the dialog box. This clears the selection.

3. Click MeshChair001 and then Ctrl+click MeshChair003 in the list of object names. This list lets you select multiple names as you would in a typical Windows list box. You can

Shift+click to select a group of adjacent names or Ctrl+click to select a group of individual names. Figure 1.69 shows the Select From Scene dialog box with the new selection.

FIGURE 1.68
Selected objects appear highlighted in the Select From Scene dialog box.
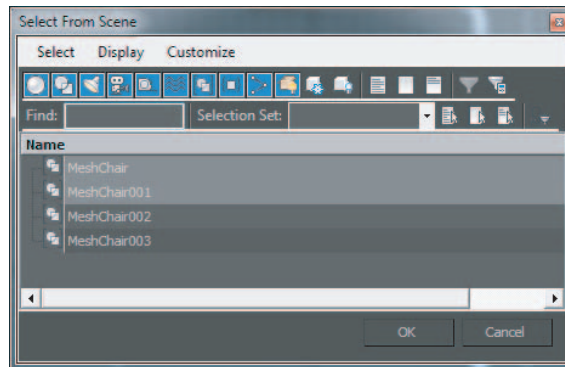
FIGURE 1.69
The Select From Scene dialog box with the new selection set
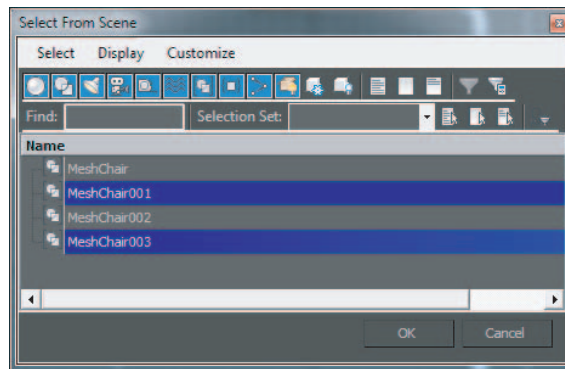
4. Click the OK button. The two chairs are selected.

The preceding exercise showed you how to select objects based on their names, but it also indirectly showed you the importance of the names of objects. Giving objects meaningful names helps you locate and select them more easily, especially in a crowded model.

EACH OBJECT HAS ITS OWN NAME AND PARAMETERS

3ds Max is a parametric, object-oriented program, and every object has its own name. Each object has its own parameters that can be accessed from the Modify tab.

Whenever you create an object in 3ds Max 2013, you have the opportunity to give the new object a name. If you don't indicate a new name, 3ds Max provides a name for you. If the new object is a copy of an existing one, the new name that 3ds Max provides is the name of the original object, with a number appended to its name. If you don't give an object a meaningful name when you create it, it's easy enough to change the name later. Just select the object, and then

enter a new name in the Object Name input box at the top of the Modify tab or in the Name And Color rollout of the Create tab.

Naming Selection Sets

Suppose you've gone through a lot of effort selecting a set of objects, and you know you will want to select the same set of objects again at a later time. 3ds Max offers the Named Selection Sets tool, which lets you name a selection set for later recall. Here's how it works:

1. Make sure two of the chairs are selected. It doesn't matter which two, because you're just practicing using the Named Selection Sets tool.

2. Click inside the Named Selection Set input box that's just to the left of the Mirror tool in the Main Toolbar.

3. Type the name **Sample** ↵, as shown in Figure 1.70. You've just given the current selection set a name. (You can enter a selection set name up to 15 characters long.)

FIGURE 1.70
Enter Sample in the Named Selection Sets field
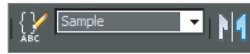
4. Click in a blank area of the viewport to clear the current selection set.

5. In the Main Toolbar, click the down arrow to the right of the Named Selection Sets input box. Select Sample. The two chairs you selected earlier are now the current selection set.

In these early stages of learning 3ds Max, the concept of named selection sets may seem unnecessary, but you'll likely use named selections quite a bit as you expand your skills.

OTHER METHODS FOR SELECTING OBJECTS

The Edit option in the Menu Bar offers some additional selection commands, such as Select All, Select None, and Select Invert. You can also use the Edit ➢ Select By cascading menu to select objects by color, name, or layer.

Editing Named Selection Sets

Named selection sets are not set in stone. You can add to or subtract from them, or you can delete them entirely through the Named Selection Sets dialog box.

1. Open the Named Selection Sets dialog box by choosing Edit ➢ Manage Selection Sets or by clicking the Edit Named Selection Sets button just to the left of the Named Selection Sets input box you used before (Figure 1.71). The Named Selection Sets dialog box appears with a list of all of the selection sets that have been created.

FIGURE 1.71
Edit Named Selection Sets
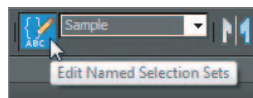
2. Click the plus (+) symbol next to your Sample named selection set to see which objects are contained within this set, as shown in Figure 1.72.

FIGURE 1.72

The Named Selection Sets dialog box showing the contents of the Sample selection set
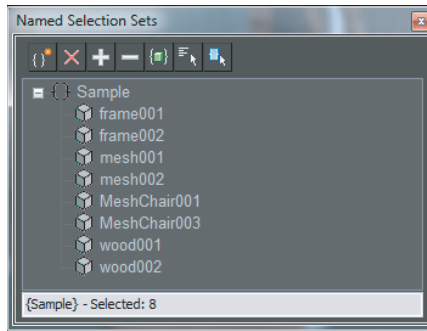
3. Click Sample in the list. Then click the Select Objects By Name button in the Named Selection Sets toolbar (Figure 1.73).

FIGURE 1.73

Select Objects By Name
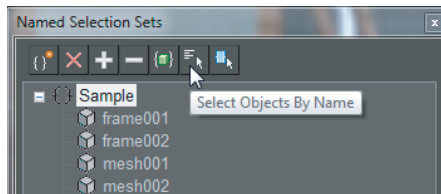
4. The Select Objects dialog box displays — this is identical to the Select From Scene dialog box that you used in the previous exercise. Select one of the names in the list that doesn't already appear in the Named Selection Sets dialog box, as shown in Figure 1.74, and then click the Select button. This selects the listed objects in the scene but doesn't add them to the named selection set.

FIGURE 1.74

Selecting an object with the Select Objects dialog box
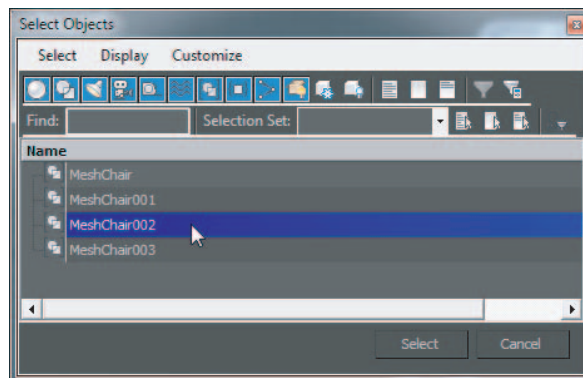
SEVERAL OBJECTS ACTING AS ONE

It may appear that objects in the Select Objects or Select From Scene dialog box are different from the objects listed in the Named Selection Sets dialog box. This is only partially correct. The chairs used in these exercises are *groups*, collections of objects that react as if they were a single object. The Select Objects and Select From Scene dialog boxes display the names of the groups, but the Named Selection Sets dialog box displays the names of the component objects that make up the groups. Groups are covered in more detail in the "Working with Groups" section in Chapter 2.

---

5. Click the Add Selected Objects button in the Named Selection Sets dialog box (Figure 1.75).

FIGURE 1.75
Add Selected
Objects
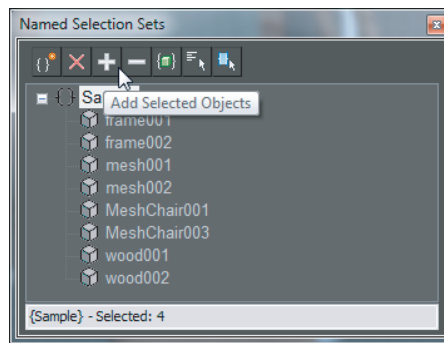
The names of the objects you selected now appear in the list of objects contained in the selection set, as shown in Figure 1.76.

6. Close the dialog box, and deselect all by clicking off to the side in the viewport.

7. Select Sample from the Named Selection Sets drop-down list. Now you see that three of the chairs are selected.

8. Click a blank area of the viewport to clear the selection set again.

FIGURE 1.76
The expanded list
of objects in the
Named Selection
Sets dialog box
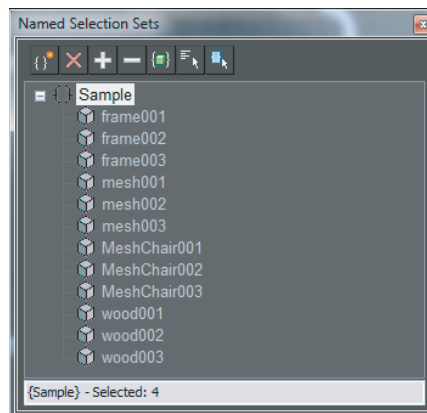
There are several other tools in the Named Selection Sets dialog box. These tools let you select objects from a set, highlight selected objects, delete objects from a set, or remove a set altogether. You can also create new named selection sets using the Create New Set tool at the far left of the toolbar on the Named Selection Sets dialog box.

You've now seen most of the selection tools you'll need to get started with 3ds Max. You'll learn about a few other selection tools as you work with 3ds Max, and you'll also get a chance to apply the tools you've already learned as you start to build and edit 3D models in later chapters.

In the next section, you'll learn about the tools that enable you to view your model from different angles and how these different views can aid you in creating and editing your model.

Named selection sets can also contain selections of sub-objects, such as vertices, edges, or polygons, the components that make up an object. When a sub-object named selection set is created, it is available only when that object is selected and the sub-object level is accessed. You will learn about sub-objects in Chapter 4.

Getting the View You Want

So far in this chapter, you've done all of your work without making any modifications to the *point of view* of your model. Now let's take a look at ways you can control your view. Understanding the viewport controls is essential for manipulating objects in your model, so take some time to become familiar with all the tools discussed in this section.

Understanding the Perspective Viewing Tools

If you look at the viewport navigation controls in the lower-right corner of the 3ds Max window, you'll see some tools that are common among most graphics programs. They include the magnifying glass and the hand. Other tools in this area may be a bit more mysterious. In this section, you'll learn how these tools let you get around in your model.

Panning and Zooming Your View

Let's begin by looking at the tool with the hand icon, known as the Pan View tool. Like similar tools in other programs, the Pan View tool displaces your view up, down, left, or right. But in the 3ds Max Perspective viewport, it also changes your point of view. Do the following to see what this means:

1. Click the Pan View tool.

2. Click and drag the cursor to the left and upward until the chairs are roughly centered in the viewport.

3. In the viewport, click and drag the cursor in a circular fashion. Notice that your view of the model appears to change as if you were moving sideways while looking at the chairs.

Next try the Zoom tool:

1. Click the Zoom tool.

2. Click and drag the cursor up from the center of the viewport. Notice how you appear to get closer to the chairs.

3. Click and drag the cursor down in the viewport. Now you appear to be moving away from the chairs.

4. Continue to click and drag downward until your view looks similar to the one shown in Figure 1.77.
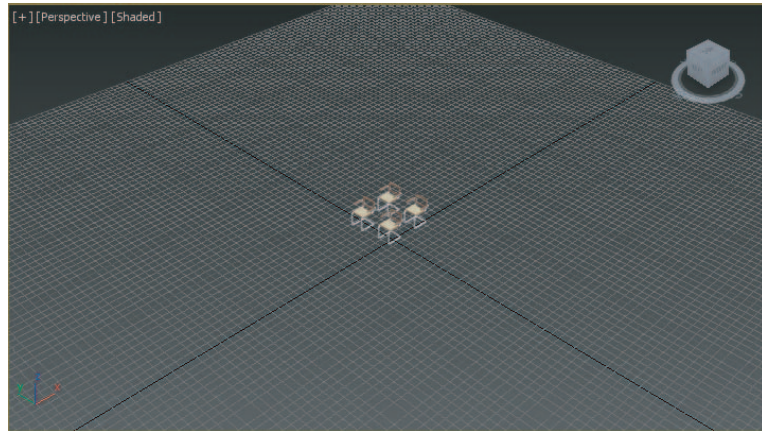
Depending on your settings, as you moved farther away, the grid may have become denser. Then, at a certain point, the grid changed to a wider interval. 3ds Max does this so that the grid doesn't overwhelm the view when it becomes too dense.

If the grid does not increase in size to fill the viewport, right-click the Snaps toggle in the Main Toolbar. Click the Home Grid tab in the Grid And Snap Settings dialog box, and uncheck the Inhibit Perspective View Grid Resize option.

Again, as with other graphics programs, the Zoom tool enlarges or reduces your view. In addition to the Zoom tool, you can use the wheel of the mouse to zoom in and out within a viewport. In the 3ds Max Perspective viewport, zooming has the effect of moving you closer to or farther away from the objects in your model.

Now suppose you don't like the last view change you made and you want to go back to the previous view. Try the following steps to return to the previous view:

1. Choose Views ➢ Undo View Change. You return to the previous view. (Alternatively, press Shift+Z.)

2. Choose Views ➢ Undo View Change or press Shift+Z again. Your view returns to the view prior to the last view.

3. Choose Views ➢ Undo View Change a third time. You return to the view you had before you panned your view.

The Views ➢ Undo View Change command lets you step back to a previous view in case the last view change you made is one you don't like. Views ➢ Undo View Change undoes any view change, regardless of which viewport tool you used last.

Undo View Is Different from Undo

Don't confuse Views ➢ Undo View Change with the Edit ➢ Undo command. Edit ➢ Undo undoes creation and editing operations but not view changes.

SAVING A VIEW YOU LIKE

If you happen to get a view that you know you want to go back to later, you can save the view with the Views ➢ Save Active View command from the Menu Bar. Use it in the next exercise to save a view that you'll return to later in this chapter. As you'll see in Chapter 7, "Light and Shadow," you can also create a Camera object and align it to an existing view.

1. Click the Zoom Extents tool to set up your view for the next exercise. Zoom Extents causes the viewport to display the entire model.

2. Save this view by choosing Views ➢ Save Active Perspective View.

The Zoom Extents tool repositions your view so that the entire model just fits within the viewport, filling the viewport as much as possible. If you're an AutoCAD user, you're familiar with this tool, because its counterpart in AutoCAD performs the same function.

RESETTING THE PERSPECTIVE VIEWPORT

You can also restore the Perspective viewport (the one you see in the lower-right corner when you open a new file) in a blank file by clicking the Zoom Extents tool.

CHANGING YOUR VIEWING ANGLE

Three other tools are specifically designed for viewing 3D objects: Field-Of-View, Orbit Selected, and the ViewCube® tool. The Field-Of-View tool changes your field of view, the Orbit Selected tool lets you rotate your view around a selected object, and the ViewCube contains several tools for modifying your viewpoint.

The Field-Of-View tool appears to do the same thing as the Zoom tool but, as you'll see in the following exercise, there is a significant difference between the Zoom and Field-Of-View tools.

1. Save the current view by choosing Views ➢ Save Active Perspective View. This lets you return to the current view later.

2. Click the Field-Of-View tool.

3. Place the cursor in the viewport, and click and drag downward until your view looks similar to Figure 1.78.

FIGURE 1.78
The Perspective viewport after increasing the field of view
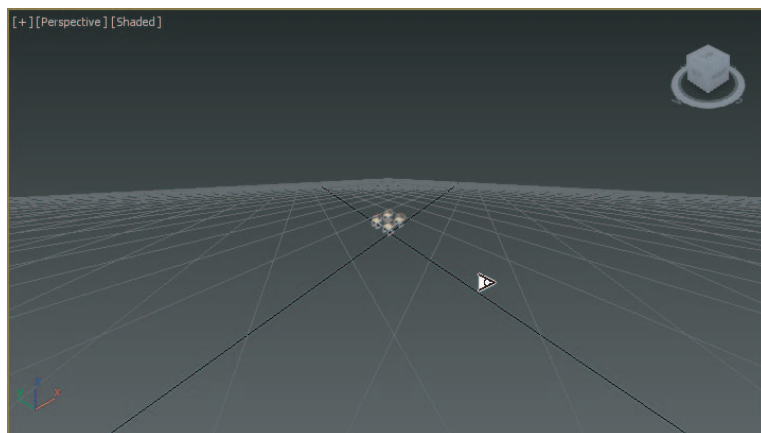
In one sense, it appears as though you've zoomed out from the chairs, but if you compare this view to the zoomed-out view in the previous exercise, you'll notice a difference. When you use the Zoom tool in the Perspective viewport, your view changes as though you were physically moving closer to or farther away from the chairs. As the name implies, the Field-Of-View tool widens or narrows your field of view in the same manner as a zoom lens on a camera. You're not actually changing the distance from the object; instead, you're changing the area that your viewport displays. The Field-Of-View tool has the potential to distort your view, just as a super-wide-angle fish-eye lens or a super-telephoto lens tends to distort a photograph. Until you are in a situation where you really need to change the field of view, you may want to refrain from using the Field-Of-View tool.

Now let's take a look at the Orbit Selected tool:

1. Return to the view you had before you used the Field-Of-View tool by choosing Views ➢ Restore Active Perspective View.

2. Click the Select Object tool, and then click a blank space in the viewport to clear any selections that may be active. In the next exercise, you'll see why this is significant.

3. Click the Orbit Selected tool (this may be hidden on the Orbit flyout menu).

   You see a yellow circle with squares at each of the four cardinal points on the circle. If you place your cursor inside the circle, the cursor looks like two overlapping ellipses, as shown in Figure 1.79.

4. Place your cursor on the square at the far left of the circle. Notice that the cursor changes shape to what looks like a horizontal ellipse.

FIGURE 1.79
The Orbit Selected tool used in the Perspective viewport
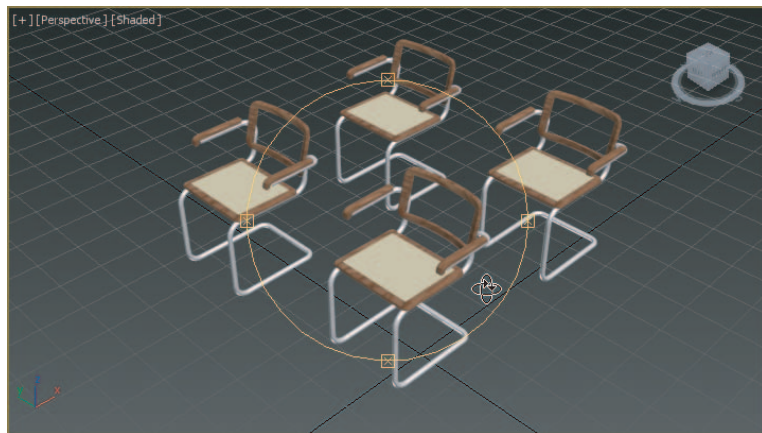
5. With your cursor on the square, slowly click and drag the cursor to the right. Notice how the view rotates.

6. Place your cursor on the square at the top of the circle. Now the cursor changes to a vertically oriented ellipse.

7. With your cursor on the square, click and drag the cursor down. The view now rotates in that direction.

The squares on the yellow circle are like handles that you can grab and turn to change your view orientation. The left and right squares constrain the rotation to the horizontal plane, and the top and bottom squares constrain the rotation to the vertical plane. If you prefer, you can adjust the view freely without constraint in the vertical or horizontal direction by clicking and dragging the cursor anywhere within the circle. You can also rotate the view by clicking and dragging anywhere outside the circle. The following exercise demonstrates these features. Pay attention to the shape of the cursor in each step.

1. Place your cursor anywhere within the circle. Then slowly click and drag in a small, circular motion. Notice how the view changes as if your point of view were rotating around the group of chairs.

2. Place your cursor anywhere outside the circle. Then slowly click and drag in an up-and-down motion. Now the view rotates around the circle as if you were tilting your head from side to side.

You may have noticed that the cursor changes, depending on whether you're inside or outside the circle. This gives you further cues regarding the way the Orbit Selected tool affects your view.

You've been introduced to nearly all of the viewport tools. However, there's one more feature of the Orbit Selected tool that you'll want to know about before you continue. The Orbit Selected tool uses the center of the viewport as the center about which it rotates when no object is selected. But the Orbit Selected tool works in a slightly different way when objects are selected. Try the following exercise to see how this variation works:

1. Choose Views ➢ Restore Active Perspective View to restore the view you saved earlier.

2. Click the Select Object tool from the Main Toolbar.

3. Click the chair on the left side in the back row, as shown in Figure 1.80.

FIGURE 1.80
Selecting a chair in the back row
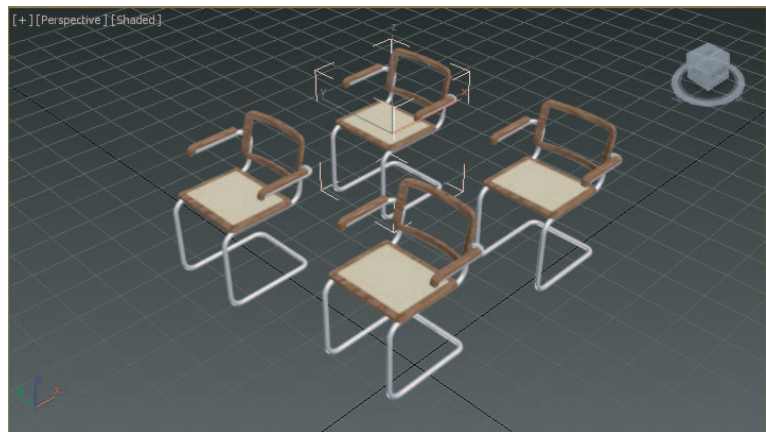
4. Click the Orbit Selected tool again.

5. Slowly click and drag the cursor within the circle. Notice how the view appears to be fixed at the center of the selected chair.

6. Slowly click and drag the cursor in a vertical motion outside the circle. The view appears to rotate around the selected chair.

7. Return to the saved view by choosing Views ➢ Restore Active Perspective View.

If you click and hold the Orbit Selected tool, you'll see two other Orbit tools in the Orbit flyout. The tool at the top, called simply the Orbit tool, rotates the view about the view center, regardless of whether an object is selected. You've already seen how the second tool, the Orbit Selected tool, works. The tool at the bottom of the Orbit flyout is the Orbit SubObject tool. This tool rotates a view about a sub-object-level selection. You'll learn about sub-object-level editing in Chapter 4.

ORBIT ON THE FLY

You can orbit on the fly, without leaving the current command, by holding down the Alt key on the keyboard and holding down the wheel button while you move the mouse. This is a huge time-saver because you'll find that you don't have to spend time clicking the Orbit button when you want to rotate your viewing angle.

USING THE VIEWCUBE

Changing the viewpoint to view your scenes is especially important in a 3D environment because you are more likely to encounter a situation where foreground objects obscure background objects. The ViewCube, the tool in the upper-right corner of the viewport, is used to access common views quickly, return to a saved view, or navigate freely in the drawing area.

CERT OBJECTIVE

The ViewCube consists of a center cube with each face labeled, identifying the standard orthographic view that it represents. Clicking any of these labeled faces changes the viewpoint in the drawing area to display the objects from that point of view. For example, clicking the ViewCube face labeled TOP changes the drawing area to display the scene from the top, with the X-axis pointing to the right and the Y-axis pointing to the top of your screen (see Figure 1.81).

FIGURE 1.81
The functions of the ViewCube

Click to switch to the Home view.

Click a face to switch to that view.

Click a corner to switch to an isometric view.

Click an edge to switch to a view rotated 45° from the adjacent orthographic view.

Click and drag to set a non-standard view.

Click a letter to switch to an elevation view from that direction.
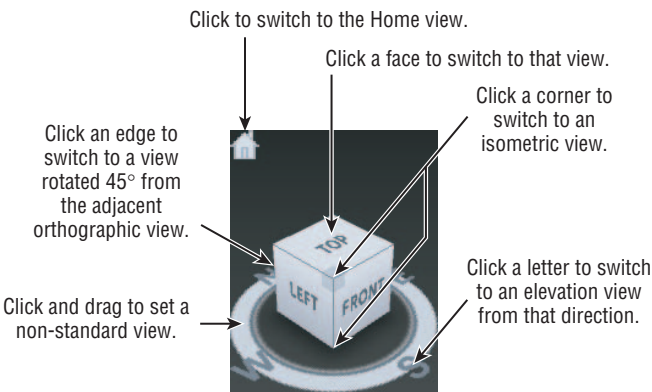
The face views are not the only viewpoints that you can access from the ViewCube. Clicking any corner changes the drawing area to display the objects from an isometric vantage point that is a combination of the three labeled faces. Clicking the corner at the intersection of the TOP, FRONT, and LEFT faces (see Figure 1.82a) produces a southwest isometric view.

FIGURE 1.82
Clicking a corner of the ViewCube creates an isometric view (a), and clicking an edge of the ViewCube creates a view adjacent to a face view (b).

(a)   (b)
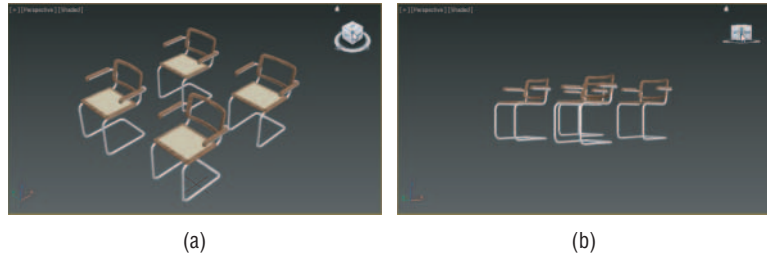
Clicking any of the edges (see Figure 1.82b) changes the drawing area to display the objects rotated 45 degrees from one of the adjacent face views. You'll usually perform a Zoom after using the ViewCube.

Surrounding the ViewCube is a ring with the compass directions indicated. Clicking any of the letters switches the view in the drawing area to a view from that direction. For example, clicking the letter E on the ring displays the elevation from the east.

Switching to a predesignated view is quick and can often provide the vantage point that you need, but you may have to view your objects from a specific, nonstandard location. Clicking and dragging the ViewCube changes the viewpoint freely without any constraints to the predesignated views.

Another tool, called the SteeringWheels® tool, lets you zoom, pan, and orbit in the viewport similarly to these other methods. Because this tool is off by default, we're not going to cover it in this book. The SteeringWheels tool is available in other Autodesk programs; if you are familiar with it and want to use it, you can turn it on by choosing Views ➢ SteeringWheels ➢ Toggle SteeringWheels.

By being able to select an object or set of objects as the center of rotation for your view, you are better able to set up your views for rendering or editing. The combination of the Zoom, Pan, and Orbit tools allows you to obtain just about any view you may need as you work within the 3ds Max Perspective viewport. But you aren't limited to a perspective view of your model. In fact, there are many situations where the perspective view is not ideal, especially when editing your model. In the next section, you'll look at other viewport types that give you greater flexibility in creating and editing objects in your model.

Using Multiple Viewports

So far, you've done all your work in the Perspective viewport, but this isn't the only view you have available. You currently have four equal viewports, each representing a different view. Let's explore some 3ds Max display tools in the other viewports, starting with the way that the Field-Of-View tool changes when your active viewport changes.

1. If necessary, click the Maximize Viewport toggle in the set of viewport navigation controls to display a four-viewport configuration.

2. Click anywhere in the viewport labeled Top in the upper-left corner of the display. Notice that the Field-Of-View tool changes to a magnifying glass with a rectangle. This is the Zoom Region tool.

Also notice that the Top viewport now shows a gold border around it, indicating that it is the active viewport.

3. Click the Zoom Region tool.

4. Click and drag the cursor on a point above and to the left of the chairs, as shown in Figure 1.83. As you drag the cursor, you see a rectangle appear. Don't release the cursor yet.

FIGURE 1.83
Selecting a view to enlarge with the Zoom Region tool
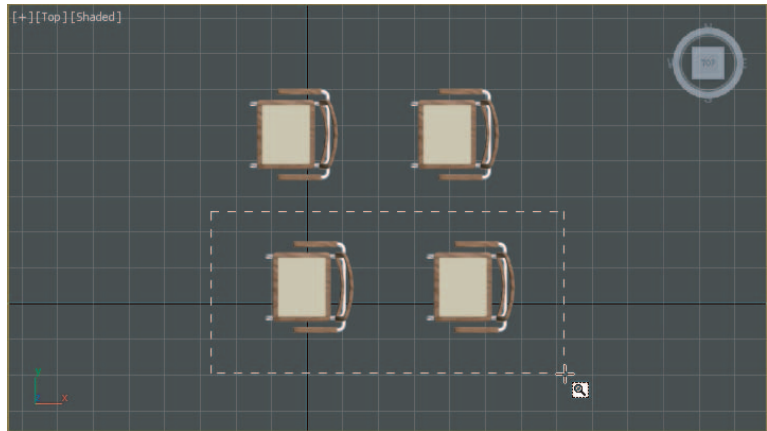
5. Position the rectangle below and to the right of the bottom row of chairs, as shown in Figure 1.83, and then release the mouse button. The view enlarges to the region you just indicated with the Zoom Region tool.

The Zoom Region tool acts like the magnifying tools in many other graphics programs. Also, the Zoom and Pan View tools perform the same functions in orthogonal views in 3ds Max as they do in other programs, allowing you to zoom in and pan over the view. The Zoom Region tool is available in Perspective viewports. It is in the flyout under the Field-Of-View tool.

You may have noticed two other tools in the viewport navigation controls that haven't been discussed yet: the Zoom All and Zoom Extents All tools. Now that you have multiple viewports displayed, you can try these two tools:

1. Click the Zoom All tool.

2. In any viewport, click and drag the cursor up and down. Notice that the view in all of the viewports is enlarged or reduced as the cursor moves.

3. Click and drag the cursor down, and the views expand to show more of the model area.

4. Click the Zoom Extents All tool.

All of the viewports change to display enlarged views of the chairs, as shown in Figure 1.84.

FIGURE 1.84
The four viewports
after using the
Zoom Extents All
tool
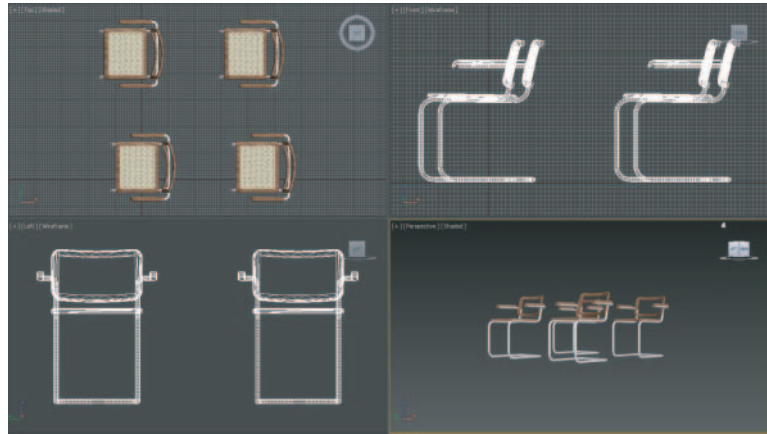
Although not as frequently used as the other viewport navigation tools, the Zoom All tool and the Zoom Extents All tool can be helpful when you need to adjust the overall view of your model in multiple viewports.

You should be aware that the Orbit Selected tool you used in the Perspective viewport also works in the other viewports. Try it out on the Top viewport in this exercise:

1. Click the Orbit Selected tool.

2. Select one chair, and then click and drag the cursor from the center of the Top viewport upward and to the right, so that it shows a view similar to Figure 1.85.

FIGURE 1.85
The Top viewport
after using Orbit
Selected
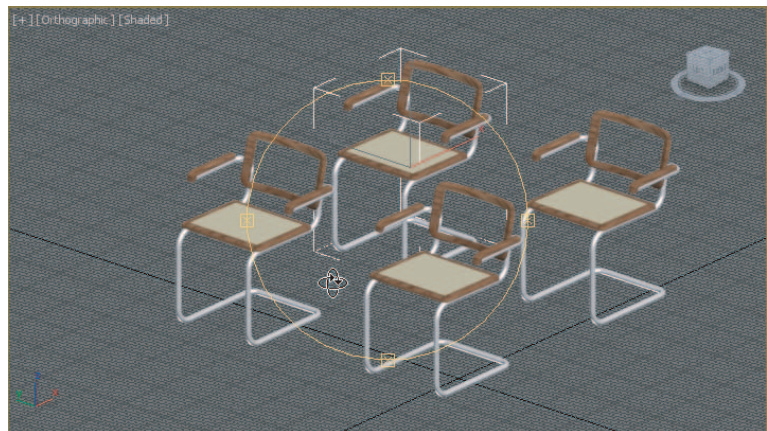
The view changes to a type of 3D view known as an *orthographic projection*. Also notice that the label in the upper-left corner of the viewport now reads Orthographic. This indicates that the view is a custom view based on your changes.

3. Click the Zoom Extents tool to center the view in the viewport.

The 3D view in the upper-left corner of the display differs in many ways from the perspective view. But, as you'll see in the next section, it's different only because a few of the settings for that viewport are different from those of the Perspective viewport.

Changing the Viewport Display and Configuration

If you compare the Orthographic viewport with the Perspective viewport, you'll notice one thing that is different. As mentioned in the previous exercise, the Orthographic viewport shows a 3D orthographic projection. Parallel lines do not converge as the distance from the viewpoint increases as they do in the Perspective viewport. You'll notice that the Orthographic viewport is set to the Shaded display mode. The chairs appear solid, they have color and texture, and the metal appears shiny. These display characteristics can be modified for each viewport.

Look at the upper-left corner of the viewport, and you will see the Viewport Label menus (Figure 1.86). These three menus provide access to control the characteristics of the selected view.

FIGURE 1.86
The Viewport Label menus
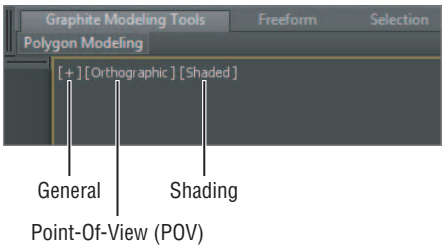
In the following exercise, you'll see how you can alter viewport settings to obtain specific view characteristics such as shading and perspective:

1. Move the cursor and hover over the Shading Viewport Label menu, which is the rightmost set of brackets in the upper-left corner of the viewport. The label inside the brackets turns yellow. Now click the label. A context menu appears, as shown in Figure 1.87.

FIGURE 1.87
Shading Viewport label menu
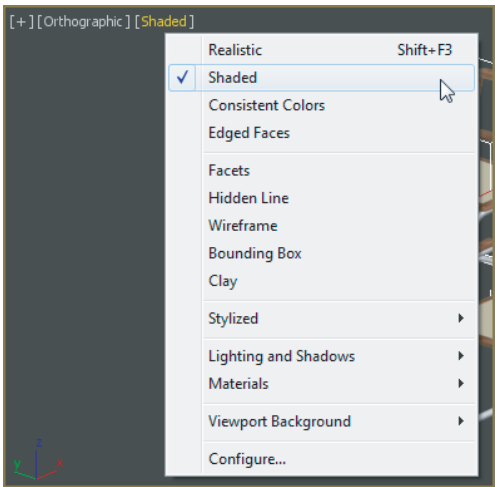
2. Select Wireframe from the menu. The chairs now appear as wireframes (see Figure 1.88), just as they do in two of the other viewports.

3. Click the Orthographic viewport Shading label again, and then select Hidden Line from the context menu. The Orthographic viewport changes to reflect the contents in the Hidden Line rendering mode.

4. Zoom into the chairs to get a better look at the Hidden Line rendering mode. Your view should be shaded similarly to Figure 1.89.

FIGURE 1.88
The Orthographic viewport in Wireframe mode

[+] [Orthographic] [Wireframe]
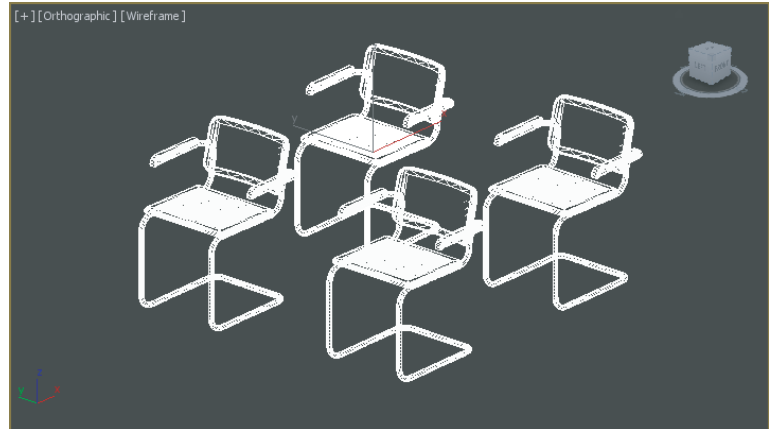
FIGURE 1.89
A single chair in Hidden Line rendering mode

[+] [Orthographic] [Hidden Line]
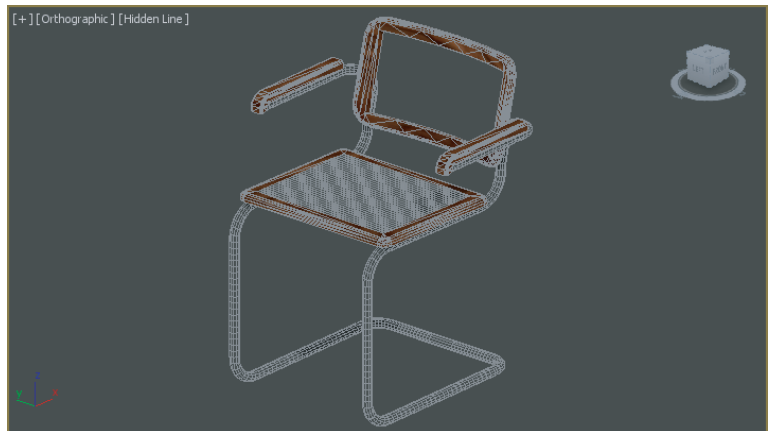
The context menu is the same for both the Orthographic and Perspective viewports. This menu gives you control over the display characteristics of the viewport. Try a few of the other options in the Viewport Label menus:

1. Click the Point-Of-View (POV) label, select Perspective, and then click the Zoom Extents button. The Orthographic viewport changes to a Perspective viewport. Notice that the label changes to read Perspective, so that you now have two Perspective viewports, as shown in Figure 1.90.
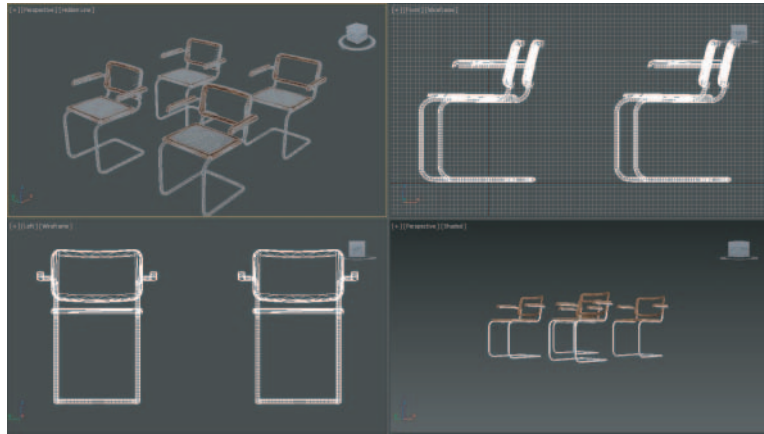
2. Click the POV label of the upper-left viewport, select Top, and then click Zoom Extents. The view changes back to the original top view. Notice that the chairs are still in Hidden Line mode.

3. Click the Shading label of the Top viewport, and then select Wireframe.

Three of the viewports show wireframe views of the chairs. Wireframe views are best for many types of editing operations. Wireframes also redraw faster when your model is very large and full of complex geometry. Another type of view, called a *bounding box*, is even faster than a wireframe view, but bounding-box views reduce the representation of objects to rectangular boxes. The Edged Faces mode, available when the viewport is in any of the available Shaded modes, displays both the Shaded mode and the edges of the visible objects.

Besides changing the way the viewport displays your model, wireframe view also gives you control over the layout of the viewports themselves. The following exercise shows you the variety of layouts you can create in 3ds Max:

1. Choose Views ➢ Viewport Configuration. The Viewport Configuration dialog box appears, as shown in Figure 1.91.

2. Click the Layout tab. You see the current viewport layout at the bottom of the tab. Above it is a set of 14 predefined layouts, as shown in Figure 1.92.

3. Click the layout that looks like three small rectangles stacked on the left side with one large rectangle on the right.

4. Click OK. The viewports change to the selected layout.

5. Click the Zoom Extents All button to zoom all the viewports to show the contents of the scene. Your viewports should look similar to the viewports in Figure 1.93.
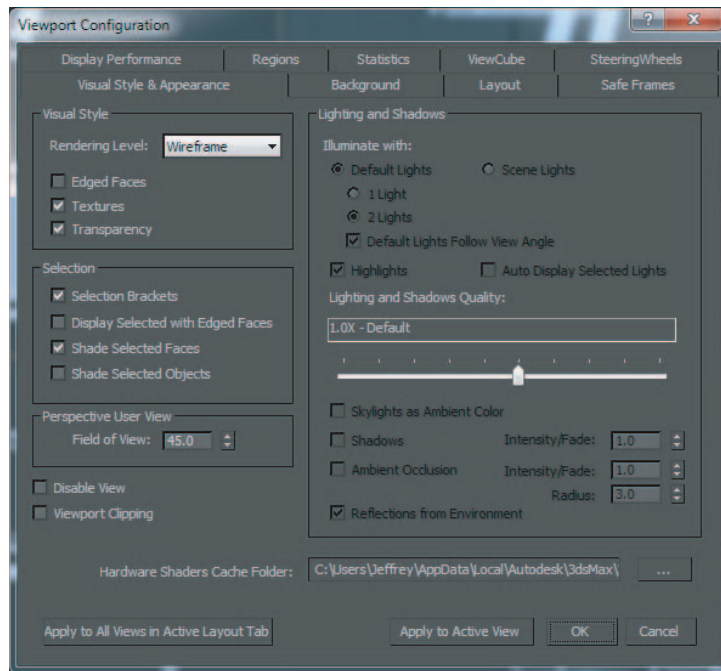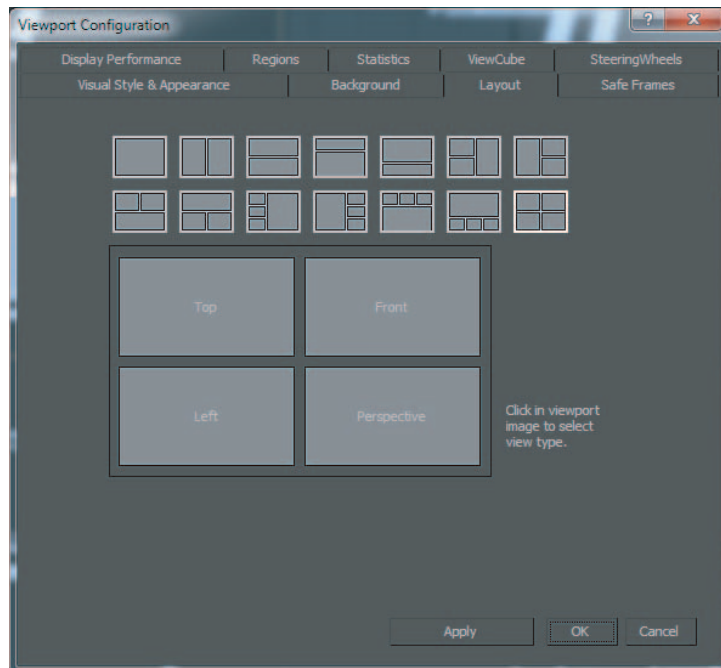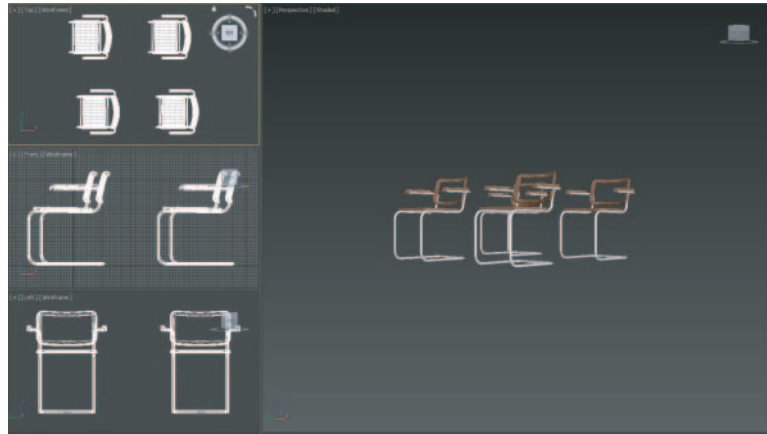
You aren't limited to the canned layouts either. You may decide that you want the layout to reflect a more traditional mechanical drawing layout, with top, front, and right-side views. Here's how you can set up such a viewport arrangement:

1. Choose Views ➢ Viewport Configuration.

2. With the Layout tab selected, click the layout showing four equal viewports, which is the rightmost layout in the bottom row of layout options.

3. Click the sample viewport labeled Front in the upper-right corner of the large sample layout, and select Perspective in the pop-up menu, as shown in Figure 1.94.

4. Click the sample Perspective viewport in the lower-right corner, and select Right from the pop-up menu.

5. Click the sample Left viewport in the lower-left corner, and select Front from the pop-up menu.

6. Click OK. Now you have a layout that shows the Top, Front, and Right viewports, plus a Perspective viewport arranged in a more traditional manner. Change the Right viewport to Wireframe mode and the Perspective viewport to Shaded. Perform a Zoom Extents All, and your viewports should look like Figure 1.95.

As you can see from what you've learned so far, 3ds Max 2013 provides a wide array of display options, but most of the time you'll stick with one viewport layout that you find comfortable. For the purposes of this book, you'll use the default layout that shows the four equal-size viewports.

Before you conclude your tour of the 3ds Max interface, take a look at how the Move tool acts in the non-Perspective viewports. The following exercise will give you a feel for the ways that you can use multiple viewports.

FIGURE 1.94
Changing a specific
viewport's view
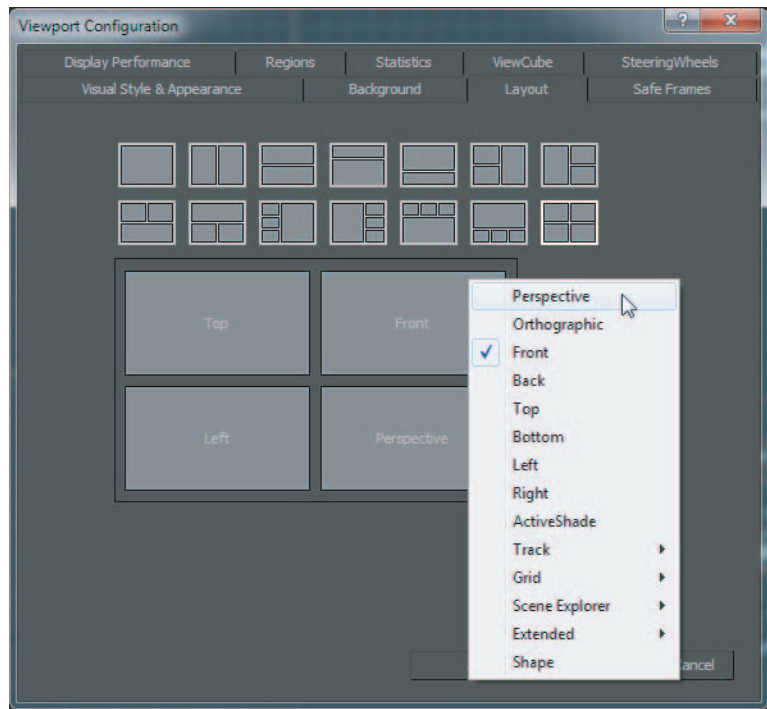
FIGURE 1.95
The four-viewport
layout with
modifications
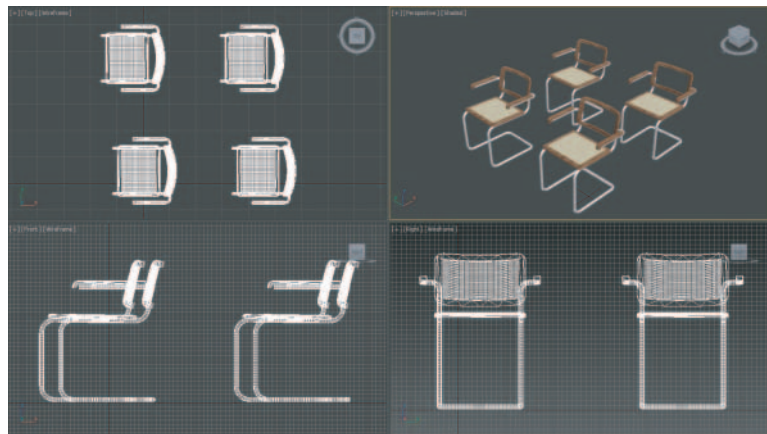
1. Click the Select And Move tool.

2. Click and hold to open the Selection Region flyout, and select Rectangular Selection
   Region.

3. In the Top viewport, click and drag the cursor from a point above and to the left of the bottom row of chairs.

4. Drag the selection region below and to the right of the two chairs in the lower row, as shown in Figure 1.96, so that they are enclosed in the rectangle. The two chairs are selected.

FIGURE 1.96
Drag a selection region around the lower chairs.
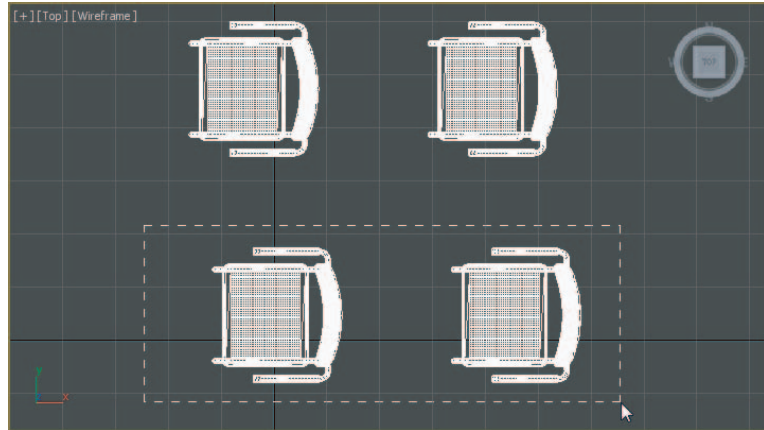
5. Right-click in the Right viewport.

RIGHT-CLICKING RETAINS THE SELECTION SET

By right-clicking in a viewport, you can make it active without disrupting any selections that may be active at the time. It is a good habit to just right-click to switch active viewports.

6. In the Right viewport, click and drag the green Y-arrow upward. Notice how the chairs move in the Front and Perspective viewports as you do this.

7. Position the chairs so that they are higher by about one-half the height of a chair.

8. Click and drag the red X-axis of the chairs to the right of the screen so that they merge with the chair to the right, as shown in Figure 1.97.

9. You can save or discard this file. You won't need it anymore.

In this exercise, you saw a number of methods in action. First, you saw how to use the Select And Move tool to select objects as well as move them. This can help you move objects quickly by reducing the number of clicks you need to make. Be careful, though; you might select and move the wrong object when you are in a hurry. Next, you saw how you can right-click in a viewport to make it active. Had you simply clicked in the Right viewport in step 4, you would have lost the selection set you created in step 3.

FIGURE 1.97
Move the selected
chairs along the
X-axis.
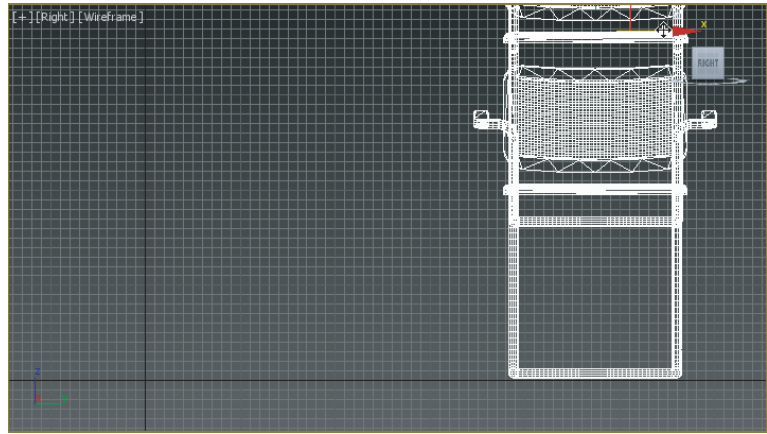
Finally, you saw how objects in 3ds Max don't conform to one of the basic rules of physics. In 3ds Max, more than one object *can* occupy the same space at the same time. This characteristic can be extremely useful in a number of ways as you build models in 3ds Max 2013.

Working with the Custom UI And Defaults Switcher

The Custom UI And Defaults Switcher provides an easy and unified method for managing all the myriad preference settings within 3ds Max. Let's explore what the Custom UI And Defaults Switcher has to offer.

1. Choose Customize ➢ Custom UI And Defaults Switcher, as shown in Figure 1.98

FIGURE 1.98
The Customize
menu
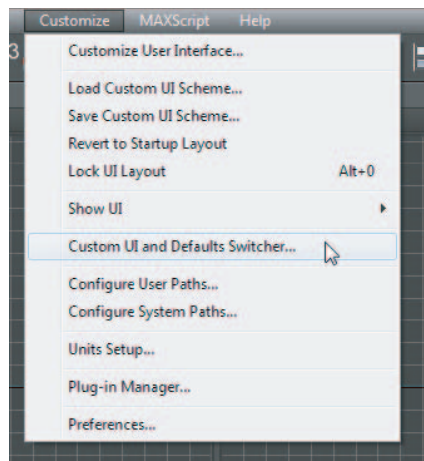
2. Click the DesignVIZ item in the Initial Settings For Tool Options group in the upper-left corner of the dialog box to see the settings listed in Figure 1.99.
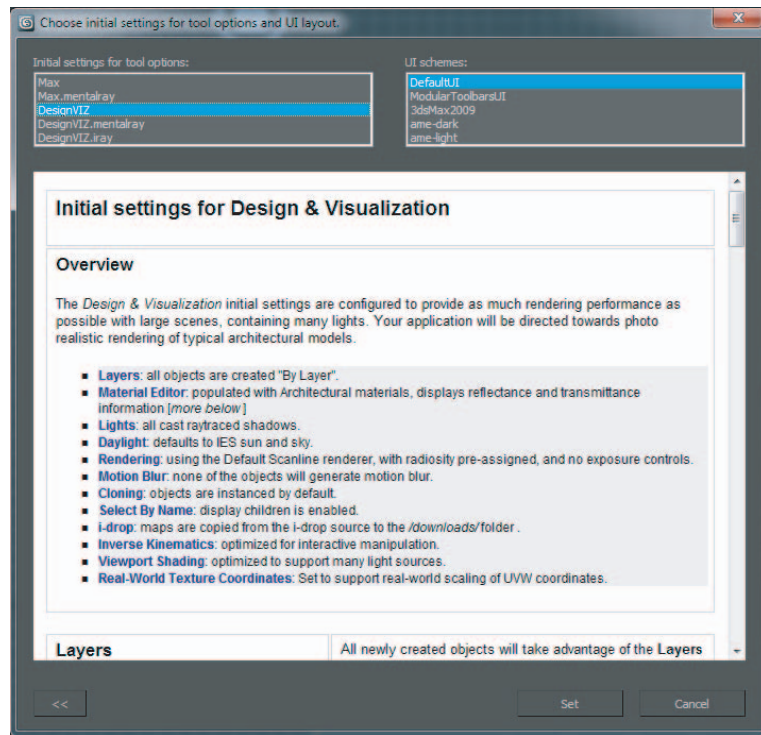
3. Scroll down in the dialog box, and read through the changes that the DesignVIZ settings represent in the HTML file that is part of the dialog box. There are five possible settings for tool options: Max, Max.mentalray, DesignVIZ, DesignVIZ.mentalray, and DesignVIZ.iray.

The DesignVIZ settings are configured to provide the 3ds Max user with good rendering performance in large scenes with many lights; this assumes that you'll be using the Default Scanline Renderer with the Radiosity Advanced Lighting plug-in and photometric lights.

The DesignVIZ.mentalray initial settings are meant to be used in conjunction with the NVIDIA mental ray renderer. Each of these settings automatically configures multiple preferences in Layers, the Material Editor, Lights, Daylight System, Rendering, Motion Blur, Cloning, Select by Name, Inverse Kinematics, Viewport Shading, and Real-World Texture Coordinates. The Max and Max.mentalray initial settings are designed for use when utilizing 3ds Max for game, film, and video production.

On the right side of the Custom UI And Defaults Switcher dialog box, you'll see a default list of UI schemes. Here you can conveniently select which UI scheme you'd like to use. UI schemes hold all the customizations you can make to the keyboard hotkeys, toolbar, quad menus, standard menus, and color schemes in one place. To make changes to an existing UI scheme, you'll use the Customize User Interface dialog box.

1. Click Cancel since you will be using the default 3ds Max settings for the majority of the exercises in this book.

2. Choose Customize ➢ Customize User Interface to display the dialog box shown in Figure 1.100.
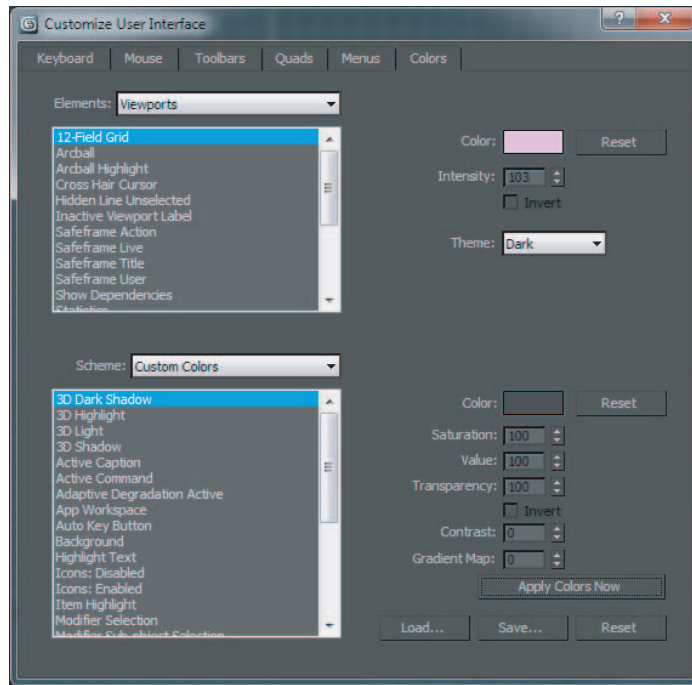
3. Click each of the tabs at the top of this dialog box to become familiar with all the ways that you can customize your user interface. Changes can be made to the keyboard short-cuts, mouse buttons, toolbars and buttons, quad menus, all pull-down menus, and inter-face colors. If you do decide to make any changes, simply click the Save button on the tab in this dialog box to record your specific changes to disk, as shown in Figure 1.101. Each tab saves as a different file type that controls different aspects of the user interface.

4. Choose Customize ➢ Save Custom UI Scheme. Open the Save As Type drop-down list, shown in Figure 1.102. You will notice five different file formats that can be saved (and loaded) through Save (and Load) Custom UI Scheme from the Customize menu. Each one of the lower four formats — UI File (`*.cui`), Menu File (`*.mnu`), Color File (`*.clr`), and Shortcut File (`*.kbd`) — corresponds to each of the tabs in the Customize User Interface dialog box — Toolbars and Quads, Menus, Colors, and Keyboard, respectively. Note that the mouse customizations are not listed and that these are all the legacy customization file formats. If you want to save your customizations with the current formats, you must use the Save buttons on the six tabs of the Customize User Interface dialog box.

FIGURE 1.101

Saving the customization
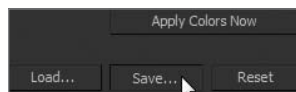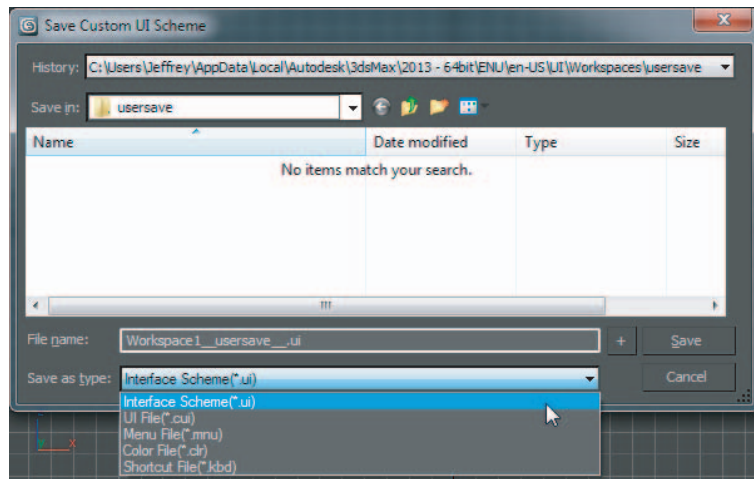
When you choose to save the first format in the Save Custom UI Scheme dialog box (Interface Scheme format), you are saving a composite file that contains all the customizations present in all the other formats combined. It is this Interface Scheme format (`*.ui`) that is displayed in the UI Schemes portion of the new Custom UI And Defaults Switcher.

Close the Save Custom UI Scheme dialog box without saving any files.

WARNING   You will need to reset your 3ds Max 2013 configuration back to the defaults at the conclusion of the following exercises in order for the exercises in the rest of the book to work as written.

The Bottom Line

Navigate and configure the viewports.   The 3ds Max viewports can be configured in several ways, including setting the quantity and configuration of the viewports.

Master It   Configure the viewports so that there are three small viewports stacked on the left side and one larger viewport on the right. From top to bottom, set the three stacked viewports to Top, Front, and Right, respectively; then set the large viewport to a Perspective viewport.

Dock and float toolbars.   The 3ds Max user interface has several customizable features, including the ability to hide or expose and dock or float the program's toolbars.

Master It   Detach the Command panel from the right side of the 3ds Max window, and release it so that it floats in the middle of the 3ds Max window. Select the Command panel again, and attach it to the left side. Expose a hidden toolbar, and dock it to the left of the Command panel.

Copy objects and use the transform tools.   The transform tools (Move, Rotate, and Scale) are the most commonly used tools in 3ds Max. With them, you can position, orient, and scale

your objects as required in the scene. You can quickly create a copy in 3ds Max, a process called *cloning*, by holding down the Shift key while using any of the transform tools.

Master It   Make a box that is 3´ long, 10´ wide, and 8" high. Make five instance clones of the box, and rotate each clone 20 degrees more than the previous clone. Stack the boxes like a spiral staircase, with an increasing amount of swing with each stair and leaving no vertical or horizontal gaps in the stairs.

Create a named selection set.   Whenever any objects are selected in 3ds Max, the selected objects are referred to as a *selection set*. Often, you may need to select the same objects repeatedly for different operations. By creating named selection sets, you can quickly select objects by selecting the selection set name from a drop-down list.

Master It   Continuing from the previous "Master It" exercise, rename the boxes to **Step1**, **Step2**, **Step3**, and so on, starting with the bottom step. Make and test two named selection sets — one containing the lower three steps and another containing the even-numbered steps.

Introducing Objects

If you've never used a 3D modeling program, you may find the behavior of Autodesk® 3ds Max® objects to be rather unusual. Objects in 3ds Max are dynamic and malleable. They can be basic or extremely complex. In this chapter, you'll be introduced to some of the ways that you can create and form objects. In the process, you'll see that you can create just about any shape from just a handful of basic object types and modifiers.

Most 3D modeling programs offer basic building blocks called primitives. *Primitives* are rudimentary shapes upon which you can build to form your model. 3ds Max offers three types of primitives that you can use to build forms: standard primitives, extended primitives, and splines. This chapter covers standard primitives and extended primitives. (We'll get to splines in Chapter 3, "Creating Shapes with Splines.")

In this chapter, you will learn to

◆ Create and modify standard primitives

◆ Apply a modifier

◆ Make a clone of a 3ds Max object

◆ Manipulate a group

Understanding Standard Primitives

In Chapter 1, "Getting to Know Autodesk® 3ds Max® 2013," you used the Create tab of the Command panel to create a box. Let's take another look at the Command panel to see what else it has to offer.

1. Start 3ds Max 2013.

2. Click the Create tab in the Command panel.

3. Click the Geometry button just below the Create tab label.

You'll see the Object Type rollout that contains the 10 standard primitives. You already created the Box primitive in Chapter 1. The drop-down box below the Geometry button provides access to 12 other sets of default objects that you can create in 3ds Max 2013. If you install other object plug-ins, additional sets of objects will be listed there as well.

CREATING OTHER TYPES OF GEOMETRY

The list box just below the Create tools displays the Standard Primitives option. You can create other types of geometry objects by selecting them from this list box. For now, concentrate on the standard primitives.

Besides the Box primitive, there are nine other object types of standard primitives, as shown in Figure 2.1. To create any of these primitives, you use a method that's similar to the one you used to create the box in Chapter 1.

FIGURE 2.1
A perspective viewport showing all the standard primitives
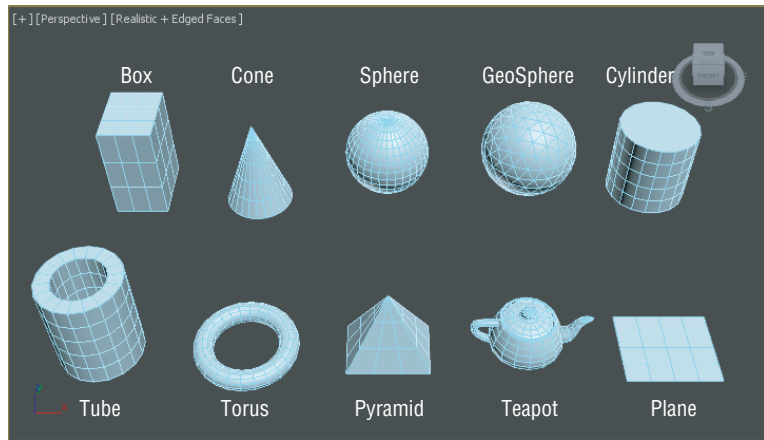
To create a box, click and drag to determine the base dimensions, and then click again to establish the height. To create a sphere, click and hold to set the center point of the sphere and then drag and release to set the radius. Try it out in the following exercise:

1. In the Object Type rollout, click the Sphere button.

2. Click and hold in the Perspective viewport near the origin, where the two darker lines cross.

3. Drag the mouse slowly away from the center point. The sphere grows as you do this. Also notice that the Radius input box in the Parameters rollout displays the radius of the sphere as you move your mouse.

4. Release the mouse to complete the sphere.

You may recall that you were able to adjust the parameters of the box after you created it. You can do the same with the sphere.

SETTING THE UNITS TO FEET AND INCHES

If the Parameters rollout doesn't display dimensions in feet and inches, choose Customize ➢ Units Setup to open the Units Setup dialog box. Select the US Standard radio button and Feet w/Decimal Inches from the list box, and then click OK.

5. Double-click the Radius input box in the Parameters rollout to select the entire current value.

6. Type **6**↵. The sphere now has a 6-foot radius.

7. Click and drag the Radius spinner, the double arrows to the right of the input field, upward. The sphere grows in size.

> **3DS MAX INPUT IS IN FEET BY DEFAULT**
>
> When using Feet w/Decimal Inches as the units, you don't specify feet or inches with the apostrophe (') or quote (") characters. 3ds Max uses feet as the default unit. If you prefer to input inches rather than feet, choose Customize ➢ Units Setup to open the Units Setup dialog box and then, in the Default Units field under US Standard, select the Inches radio button.

By default, 3ds Max places the sphere's center on the plane defined by the grid. The grid shows the World Coordinate System, which is the main coordinate system for your model. As you'll see later, you can also use other coordinate systems.

Adjusting an Object's Parameters

You can see from the sphere (and from the box example in Chapter 1) that the form of a standard primitive is not fixed. You can change its size and other properties by using the tools in the Command panel. This ability to adjust the parameters of an object is referred to as *parametric modeling*. This means that you don't need to be precise in your initial placement and creation of a primitive object because you can refine its form later by entering values in the Parameters rollout.

To see the variety of forms you can generate from just one type of object, try modifying the sphere's other parameters:

1. In the Parameters rollout, double-click the Radius input box to highlight the contents and then enter **2**↵. This changes the radius of the sphere to 2′ 0.0″.

Please note that changes to an object's parameters can occur only when the object is selected. If you change the numbers in any of the parameter input boxes and nothing happens, most likely you clicked one extra time in the viewport and deselected your sphere. If that has happened, you have to go to the Modify panel to adjust the object's parameters.

2. Scroll down the rollout until you see the Hemisphere input box, as shown in Figure 2.2.

FIGURE 2.2
The Hemisphere parameter
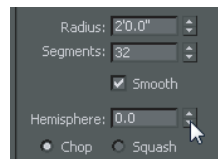
3. Click and drag the Hemisphere spinner up and watch the sphere. It starts to collapse into a closed dome from the bottom up. The Chop option deletes any segmentation that existed below the area that the Hemisphere setting eliminated. The Squash option retains

all segmentation but condenses it to the area unaffected by the Hemisphere setting. You can use the F4 key to toggle on or off the Edged Faces viewport-rendering mode, which displays an object's edges as well as its faces.

4. Highlight the entire value in the Hemisphere input box, and then enter **0.5**↵. This gives you an exact hemisphere, as shown in Figure 2.3.

FIGURE 2.3
The sphere is now a hemisphere.

[+] [Perspective] [Shaded + Edged Faces]
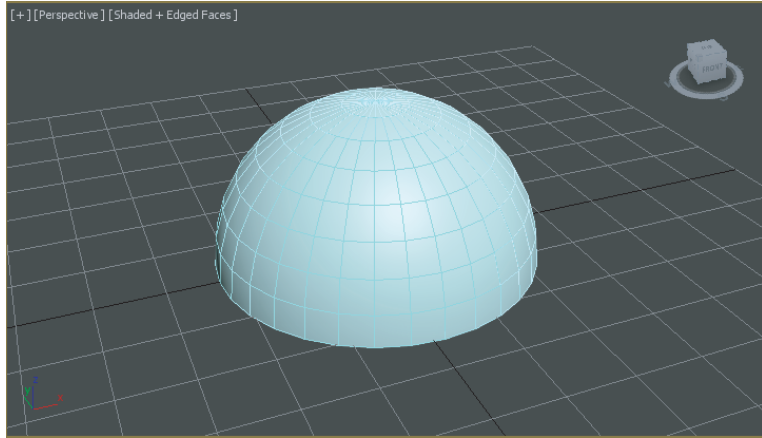
COORDINATES IN 3DS MAX

One feature that stands out in the viewports is the grid. The grid offers some orientation in an otherwise empty space, and it also shows the coordinates of the space. You may remember from high school geometry that the X- and Y-axes form the basis of a standard two-dimensional grid, with the X-axis defining the horizontal (or width) dimension and the Y-axis forming the vertical (or length) dimension. Here, you also have the additional Z-axis, which forms the height dimension.

The grid you see in a new file shows the World Coordinate System, which is the basis of your model's coordinates. In a new file, you can see the *origin* of the World Coordinate System at the center of the grid. The World Coordinate System is also called the home grid in 3ds Max. The origin is where the X-, Y-, and Z-axis zero coordinates intersect. The origin is frequently used as a reference point for your model. It is also used as a common reference point among separate model files that need to be combined later. If you are an Autodesk® AutoCAD® user, you'll know how the World Coordinate System's origin can be used to keep external reference drawings aligned. In 3ds Max, you can use the origin to align different models in a similar way.

The World Coordinate System is fixed and cannot be moved. You can, however, adjust the grid spacing and the type of units you want to use. Later you will learn about user grids, which allow you to create local coordinate systems that can be placed anywhere.

3ds Max also uses another coordinate system based on what is called Object Space. *Object Space* is the coordinate system of individual objects. When an object is moved or rotated, its Object Space, or *Local Coordinate System*, is moved or rotated with it. You see evidence of this object space in the form of a graphic showing the X, Y, and Z orientation of an object when it is first created or when it is selected. This graphic, along with the transform gizmos (the Move gizmo, the Scale gizmo, and

the Rotate gizmo), represents both the position of the object in World Space and the origin point of the object in its own space—the Object Space. There are two classifications of modifiers—tools to change an object's appearance or features—in 3ds Max: the World-Space Modifiers (WSMs) and the Object-Space Modifiers (OSMs). World-Space Modifiers affect objects relative to the home grid, and Object-Space Modifiers affect objects relative to their local coordinates.

A LEADING ZERO IS NOT REQUIRED FOR INPUT

For the sake of clarity on the printed page, you will see a leading zero before a decimal measurement. However, you don't need to type this zero when you are entering values.

You can further adjust the shape of the sphere by removing a section. The Slice From and Slice To input boxes allow you to do this.

1. Locate the Slice options below the Hemisphere input box. Click the Slice On check box, and then click and drag the Slice From spinner up until it reads 135 (see Figure 2.4). This value is the angle in degrees from the Y-axis to the beginning of the slice.

FIGURE 2.4
Changing the Slice From option
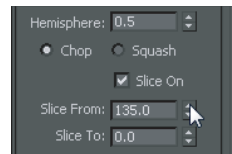
2. Click and drag the Slice To spinner down until it reads -135 (negative 135). Your hemisphere now looks like a segment was removed, as shown in Figure 2.5.

FIGURE 2.5
The hemisphere after removing a segment with the Slice tool
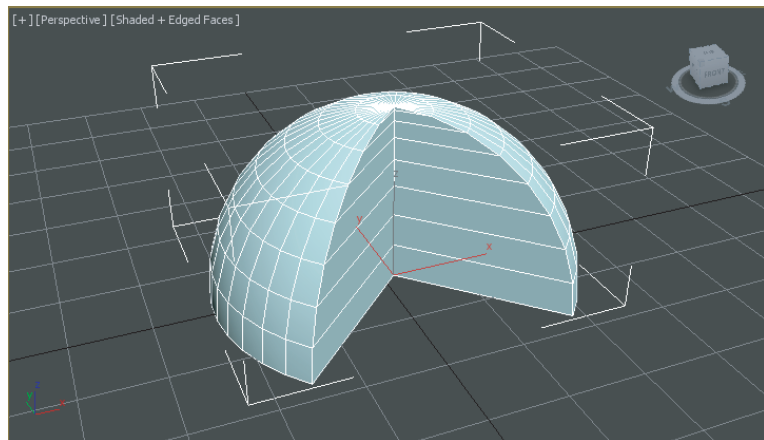
As you can see, you can use a variety of parameters to modify the shape of an object, and each object has a different set of parameters that are appropriate to that object. For example,

most of the round primitive objects have the Slice From and Slice To parameters to let you create a segment in a manner similar to the sphere example (see Figure 2.6), while the Cylinder and Tube primitives have the Height and Radius parameters to define their shapes further.

FIGURE 2.6
Other standard primitives that can use the Slice tools
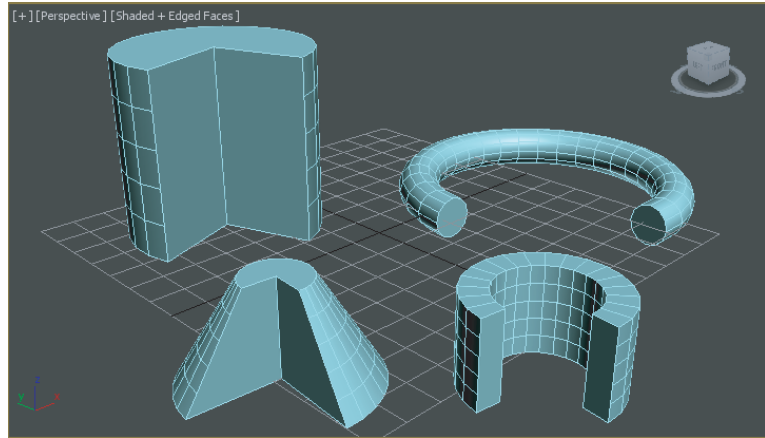
In the Parameters rollout for the sphere are a couple of other parameters. The Smooth parameter is a check box that turns smoothing on and off. *Smoothing* is a feature of 3ds Max that is found in most 3D modeling programs. It removes the hard edges between the facets that make up the object. Let's see how smoothing works with the hemisphere you created.

1. Make sure the sphere is selected.

2. Click the Slice On check box to remove the check mark from this setting. The hemisphere returns to its full shape.

3. Click the Smooth check box to remove the check mark. (The Smooth check box is just below the Segments input box in the Parameters rollout.) Notice that the sphere now looks faceted. (The Edged Faces display was turned off for clarity.) You're seeing the polygons that make up the sphere.

With smoothing turned off, the sphere looks as if it has a rough surface. In fact, all objects are faceted, even if they appear to be smooth; the Smooth parameter merely blends the appearance between adjacent faces to achieve a smooth look. The Smooth parameter is available for all of the curved primitives—the Cone, Sphere, GeoSphere, Cylinder, Tube, Teapot, and Torus.

4. To see the construction of the sphere more clearly, click the Shaded viewport label in the upper-left corner of the viewport and select Wireframe from the context menu. Only the edges show, as seen in Figure 2.7.

Now let's look at another parameter that is somewhat related to the Smooth parameter. The Segments parameter gives you control over the number of facets that make up an object. Try the following to see how the Segments parameter affects the sphere:

1. Click and drag the Segments spinner down until the Segments value is 12 (see Figure 2.8).
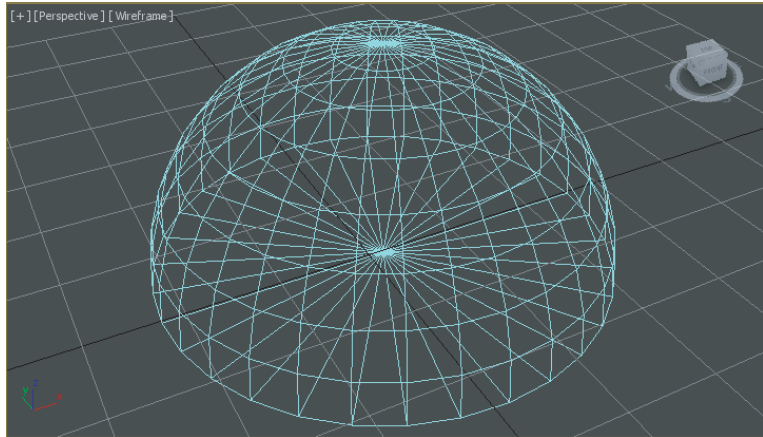
Notice in Figure 2.9 that the sphere appears to have fewer surface segments.

FIGURE 2.8
Adjusting the Segments parameter
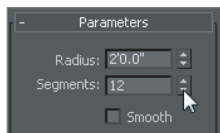
FIGURE 2.9
The sphere with fewer segments
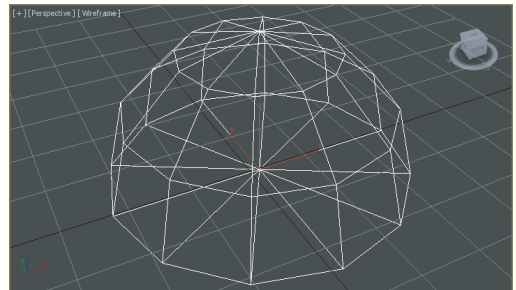
2. Click the [Wireframe] label in the upper-left corner of the viewport and select Shaded from the context menu. Figure 2.10 clearly shows the faceting because a sphere's Smooth parameter overrides the viewport's rendering mode.

3. Click the sphere's Smooth check box to turn on smoothing. In Figure 2.11, the sphere's surface appears smoother, although you can detect the faceting, especially around the perimeter of the object.

FIGURE 2.10
The sphere after changing the viewport rendering mode
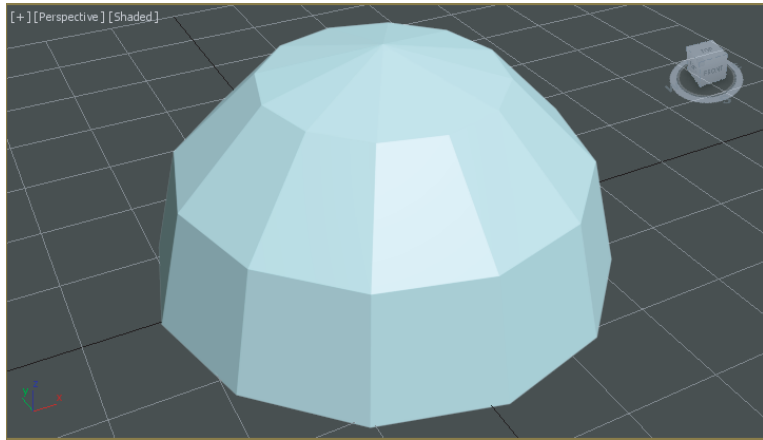
FIGURE 2.11
The sphere after smoothing is turned back on
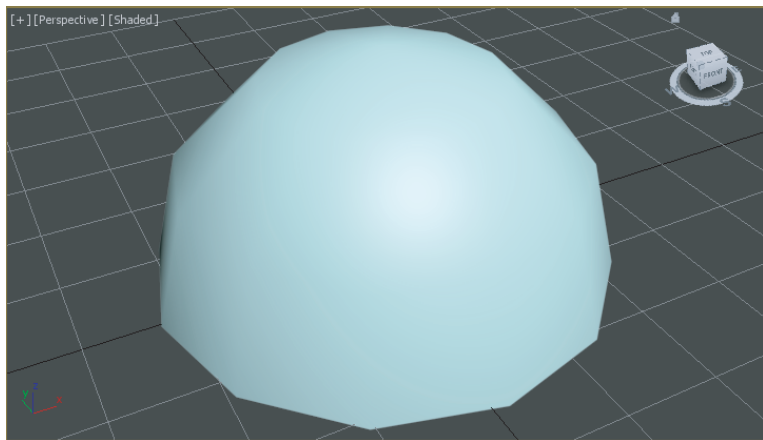
4. Click and drag the Segments spinner down so that the Segments value reads 4, the lowest possible value for a sphere. Figure 2.12 shows that the sphere becomes a pyramid shape with the edges smoothed.

5. Click the Smooth check box again to turn off smoothing. The sphere now looks like a pyramid with flat surfaces (see Figure 2.13).

FIGURE 2.12
The smoothed
sphere after the
number of seg-
ments is lowered
to four
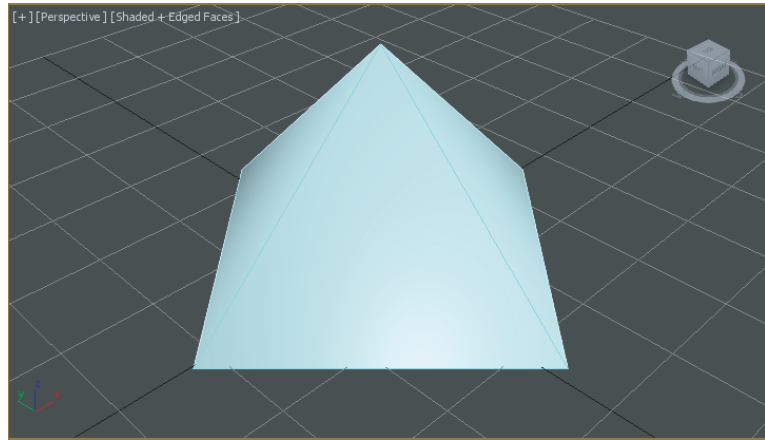
FIGURE 2.13
The sphere after
Smoothing is
turned off
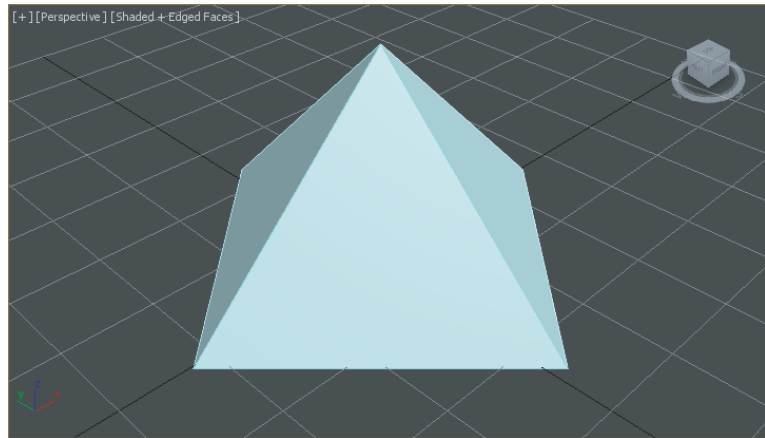
Smoothing provides the illusion of a gradual curve, hiding the polygons that are required to construct objects. In the extreme case where a sphere is reduced to four sides, smoothing still provides the illusion of a smooth edge, but it does not hide the sharp corners along the profile of the sphere's geometry.

In situations where you need to show a smooth, curved surface, the Smooth parameter is essential. You can apply smoothing to all objects, even if they do not have a Smooth parameter by default. You'll learn more about applying smoothing to objects in later chapters.

Accessing Parameters

Immediately after you create an object, you can set its parameters on the Create tab of the Command panel. However, if you create several objects and then decide you want to modify the parameters of an object you created earlier, you'll need to use the Modify tab of the Command panel.

1. Click the Select Object tool, and then click a blank area of the viewport to clear your current selection set. (When you create an object, it is automatically the current selection, so you need to click to clear the previous selection of the sphere, or you can press Ctrl+D on the keyboard to deselect any currently selected objects.)

2. Select the sphere, which at this point looks like a pyramid with flat surfaces. Notice that the sphere's parameters do not appear in the Create tab of the Command panel.

3. Click the Modify tab of the Command panel. You see the parameters for the sphere, as shown in Figure 2.14. You can now make adjustments to the sphere from the Parameters rollout.

The Modify tab displays the parameters of any single object you select. If, however, your selection consists of multiple objects, the individual objects' parameters will not be available. The Modify tab is the doorway to editing all objects in your model, as you'll see a little later in this chapter.

Introducing the Standard Primitive Objects

As you've seen, there are 10 standard primitive object types. So far, you've used the Box and Sphere tools to create objects. Now let's take a quick look at how each of the standard primitives works. Although you won't be trying every standard primitive in this chapter, the method of creation for all of these objects is quite similar to the procedure for creating Box and Sphere objects, so you shouldn't have any trouble if you want to experiment with them.

The Plane primitive is perhaps the simplest of all. Click and hold to establish one corner of the plane, and then drag to locate the other corner. Once you are satisfied with the size of the plane, release the mouse. Figure 2.15 illustrates the procedure for creating a plane.

The Box, Cylinder, and Pyramid tools all work in a similar way. First click and hold to set one corner of the box or pyramid or, for a cylinder, the center point. Drag to locate the other corner of the box or pyramid or the radius of the cylinder. Release the mouse when you are satisfied with the size of the base. Next, move the mouse forward or backward to establish a height. Click when you want to fix the height. Figure 2.16 shows how to create these objects.

FIGURE 2.14
The sphere's param-
eters shown in the
Modify tab
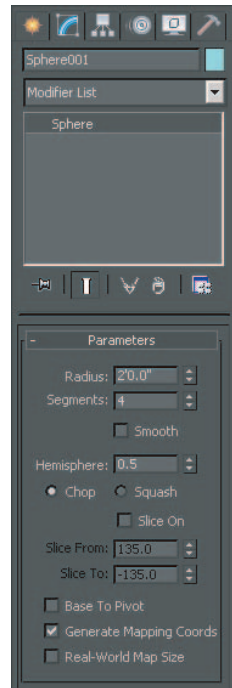
FIGURE 2.15
Drawing a plane

Drag to the opposite corner.

Click to place a corner.
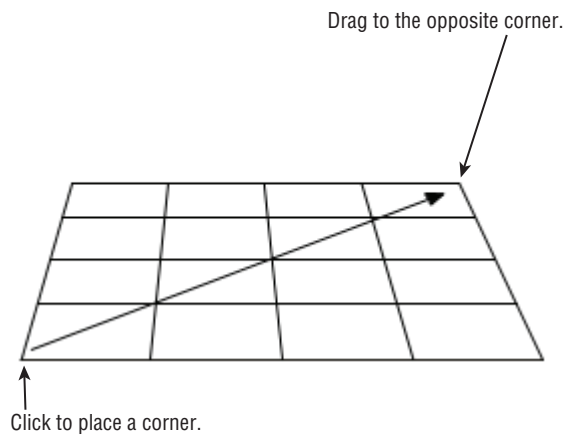
FIGURE 2.16
Drawing a box, cyl-
inder, and pyramid

Click to
set height.

Click to
set height.

Click to
set height.

Click and drag
from corner to
corner.

Click and drag
from center to
define radius.

Click and drag
from corner to
corner.
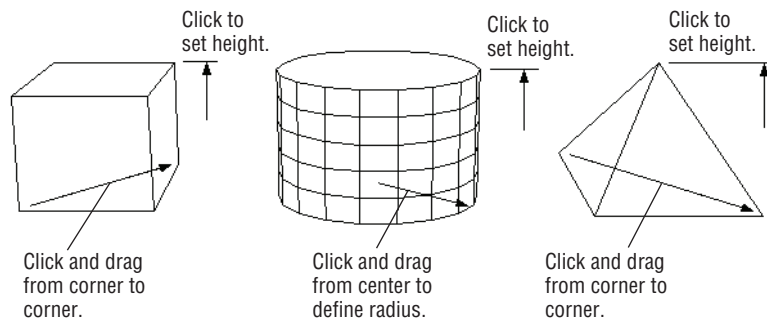
The Sphere and GeoSphere primitives are created in the same way. Click and hold to estab-
lish the center point, and then drag to locate the radius. When you're satisfied with the radius,
release the mouse button. Figure 2.17 illustrates the process.

FIGURE 2.17
Drawing a sphere
and geosphere

Click and drag from center to radius.
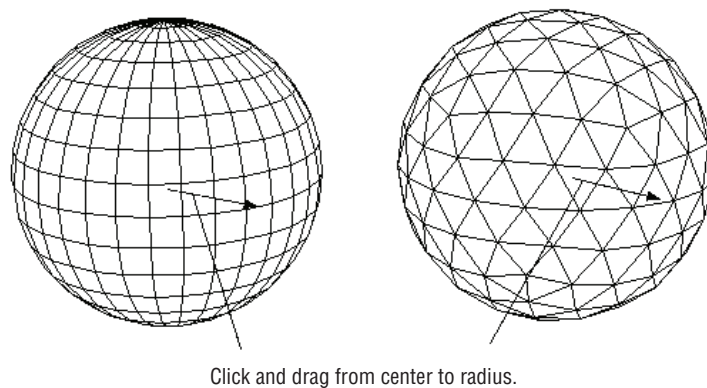
WHAT'S THE DIFFERENCE BETWEEN SPHERE AND GEOSPHERE?

You may notice that both the Sphere and GeoSphere tools create the same thing—a sphere. But if
you look at the wireframe view of each of these objects, you'll see that there's a structural difference.
The sphere is created with horizontal and vertical segments, much like the longitude and latitude
lines on a globe. The geosphere is constructed like a geodesic dome, with triangles.

The sphere's construction lets you convert it into a dome of varying configurations, but the geo-
sphere can only be cut to an exact hemisphere. The advantage of the geosphere is its modeling
plasticity. Because its shape is derived from a less-regular construction, it can be molded more easily
into other shapes. Also, it requires fewer facets to simulate a smooth surface, which is important
when you're creating a complex model that contains many faces.

The Cone, Torus, and Tube primitives are a bit more complicated to construct, requiring a few
more steps than the other types.

Just like the Cylinder, the Cone starts with a click and drag to establish its center and base.
And, as with the Cylinder, the next step is to establish the height by positioning the mouse and

then clicking to set the height. But unlike the Cylinder, the Cone requires an additional step to establish the radius of the opposite end of the Cone, as shown in Figure 2.18.

FIGURE 2.18
Drawing a cone

Click to define the second radius.

Click to set height.

Click and drag from center to define the first radius.
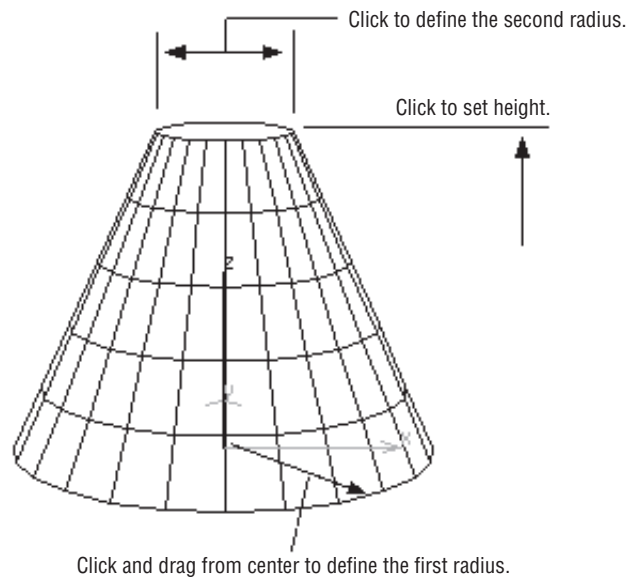
The Torus object may be the most unusual of the standard primitives in its construction method. First, click and hold to establish the center point of the torus, and then drag to locate the radius of its tubular cross section. Release the mouse button when you're satisfied with the radius. Next, move the mouse forward or backward to establish the radius of the torus body. Click the mouse when you're satisfied with the radius. Figure 2.19 shows how to draw a torus.

FIGURE 2.19
Drawing a torus

Click to set torus body radius.

Click and drag from center to the radius of the tubular cross section.
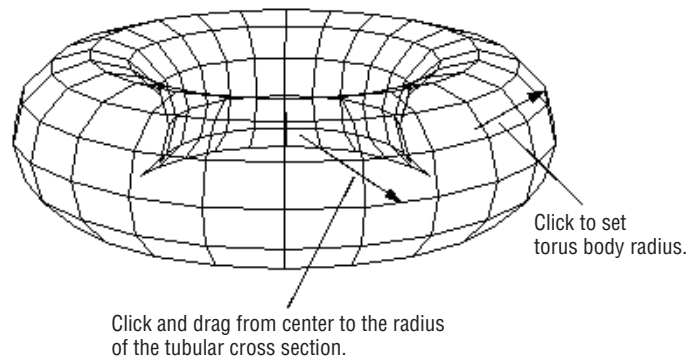
UNDERSTANDING THE CONE PRIMITIVE

The Cone primitive is not restricted to a shape with a large base and a smaller top. The second radius defined can just as easily be larger than the first and, with a negative Height value, it can be below the initial radius.

The method for creating a Tube primitive is similar to the method for creating a Cylinder primitive but with a slight twist. Click and hold to select the center of the tube, and then drag to establish the first radius. Release the mouse to fix the first radius. Move it again, and then click the mouse to establish the second radius. The Radius1 and Radius2 parameters reflect the order that the radii are determined and not which radius defines the inside or outside surfaces of the tube. Finally, move and click the mouse to establish the height. Figure 2.20 illustrates this process.

FIGURE 2.20
Drawing a tube

Click to set height.

Click for second radius.

Click and drag for center and radius.
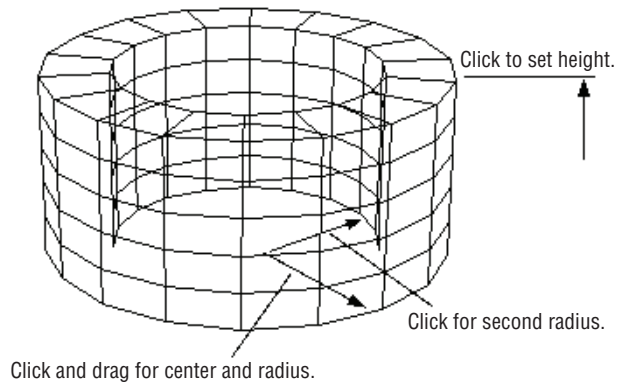
Remember that you can make adjustments to the dimensions of the primitives after their creation. In fact, you may find it easier just to place a primitive in your model quickly, without giving much care to determining its size, and then adjust the dimensions of the primitive in the Parameters rollout to fine-tune its shape.

The method for drawing a Teapot (see Figure 2.21) is similar to creating a sphere. Click and hold to select the center of the base of the teapot, and then drag to establish the overall teapot size. There are options in the Parameters rollout to toggle the visibility of the body, handle, spout, and lid elements. As with many of the other primitives, there is a Smooth check box and a Segments parameter to control the density.

THE HISTORY OF THE TEAPOT PRIMITIVE

The teapot is a sort of mascot of computer graphics. People have been using teapots, with their intersecting and curved surfaces, as test and benchmark objects in renderings ever since Martin Newell modeled the teapot form at the University of Utah in 1975 to test shading algorithms. There are websites dedicated to the history of the Utah Teapot that you can read yourself.

Modeling Standard Primitives with Modifiers

You've seen how standard primitives have basic parameters that can be modified any time after the creation of the primitive. Tools called *modifiers* can further act on a primitive to change its form. You might think of modifiers as invisible attachments that add functions to a primitive, in much the same way that a software plug-in adds functions to your Internet browser or other programs.
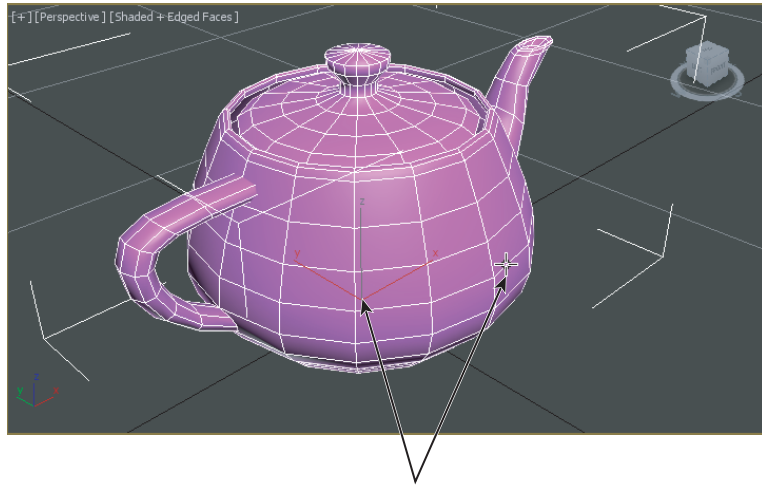
Click and drag for center and radius.

Adding a Modifier

In this section, you'll explore a few of the most commonly used modifiers offered on the Modify tab of the Command panel. Think of this section as a general introduction to modifiers. You'll explore the use of other modifiers in later chapters.

You'll start your exploration of modifiers by creating a box. You'll use the box to try the modifiers. If you have created a bunch of primitives in the previous exercise, you can save your file before proceeding with the next exercise.

1. Expand the Application menu, and then choose New ➢ New All to start a new scene while retaining the settings from the previous scene.

2. Click the Zoom Extents All tool to display the default view for a new file if necessary.

3. Click the Create tab in the Command panel, and then click the Box button.

4. Create a box in the Perspective viewport and then, in the Parameters rollout, set the Length and Width to 3′ 0.0″ and the Height to 6′ 0.0″. Your Parameters rollout should look like Figure 2.22.

FIGURE 2.22
Setting the box's parameters
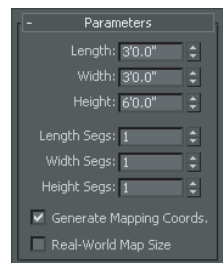
5. If the box you created is not shaded, click the viewport shading label in the upper-left corner of the viewport and select Shaded. Click the label again, and select Edged Faces, or press the F4 key on your keyboard to highlight the edges in your model. You won't see the effect very much on the box now, but the benefits of Edged Faces will be apparent shortly and the effects of changes that you make to the box's parameters will be evident. You should have a view that looks similar to Figure 2.23. Click the Zoom Extents button if you don't.

FIGURE 2.23
The box in the
viewport
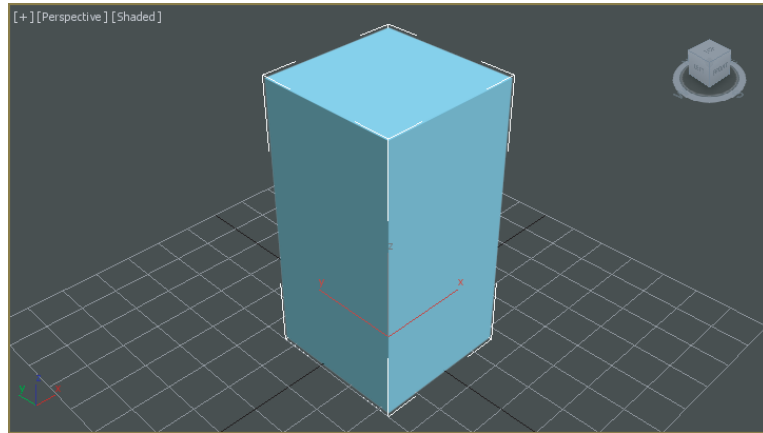
Now let's add a modifier to change the shape of the box into a curved box:

1. Make sure the Box001 object is selected. Click the Modify tab in the Command panel.

Notice the list box, shown in Figure 2.24, with only Box listed. This is the *modifier stack*. You'll use it in the following exercises. Also notice the options in the Parameters rollout. You'll see the standard Length, Width, and Height options as well as the Length Segs, Width Segs, and Height Segs options shown here.

In the next section, you'll see what these Segs options do.

2. Click the Modifier List drop-down arrow near the top of the Command panel. This expands to show a scrollable list of modifiers, as shown in Figure 2.25. Notice that the list is divided into three categories.

3. Click the Bend modifier, which is under Object-Space Modifiers in the list. Notice that Bend now appears in the modifier stack just below the Modifier List drop-down. You'll also see an orange outline appear, superimposed on the box. This orange box is another gizmo, like the Move, Rotate, and Scale gizmos introduced in Chapter 1, and it shows the general effect of the modifier. Figure 2.26 shows that the Parameters rollout changes to show the options for the Bend modifier rather than the parametric options for the box.

4. In the Bend group of the Parameters rollout, click and drag the Angle spinner up and watch what happens to the box: it cants to the right, but it does not bend, as you can see in Figure 2.27. You can see the orange Bend gizmo showing the optimum result of the modifier, which is achieved only when the object is pliable enough to match it.

FIGURE 2.24
Only the Box
entry shows in the
Modifier stack.
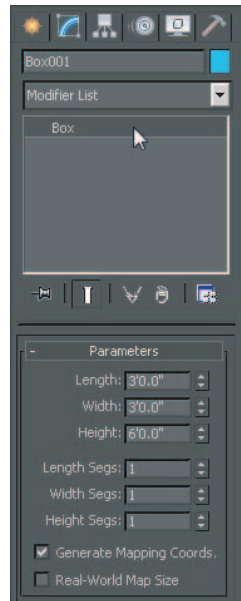
FIGURE 2.25
The Modifier List
drop-down
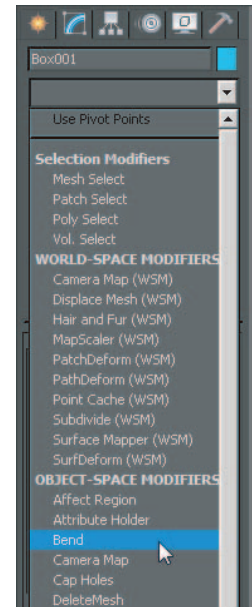
FIGURE 2.26
The Bend modifier's
parameters
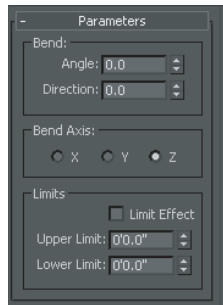
FIGURE 2.27
The canted box
showing the curved
Bend gizmo
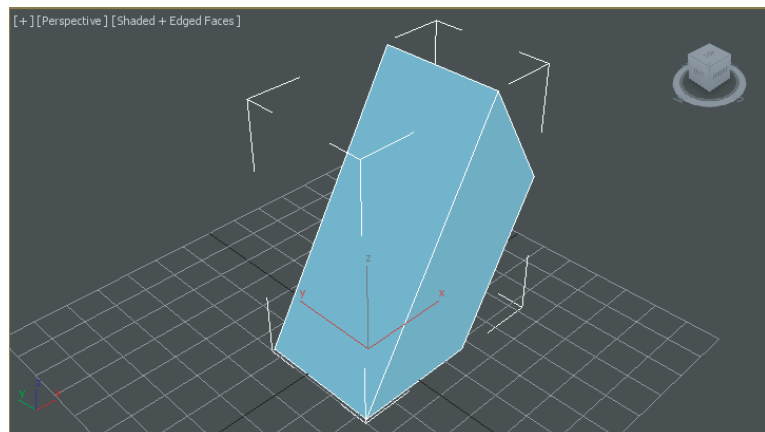
5. Adjust the Angle spinner so that its value reads 60. Alternatively, you can highlight the Angle value, and then enter **60**↵.

The Bend modifier has its own set of parameters that can alter the shape of an object. This is typical for any modifier you might use on an object. However, adding a modifier doesn't mean that you cannot return to the original parameters of the object to make changes there.

Accessing Modifier Parameters

You've just applied the Bend modifier to the box, but the result may not be exactly what you expected. The box now looks like a trapezoid. To get the box to appear curved, you need to adjust the Segs parameters you saw earlier as part of the box's parameters.

Currently, the object's modifier stack contains Bend, the modifier you just added, and Box, which is the current object type.

1. Click Box in the modifier stack (beneath the Modifier List drop-down). Notice that the original box parameters appear in the Parameters rollout.

2. Click the up arrow of the Height Segs spinner repeatedly, and notice what happens to the box.

Horizontal lines appear, dividing the box horizontally. The value in the Height Segs input box shows the number of segments. Also notice that the box now appears to be curved, as shown in Figure 2.28.

FIGURE 2.28
The increased Height Segs value allows for a smoother bend.
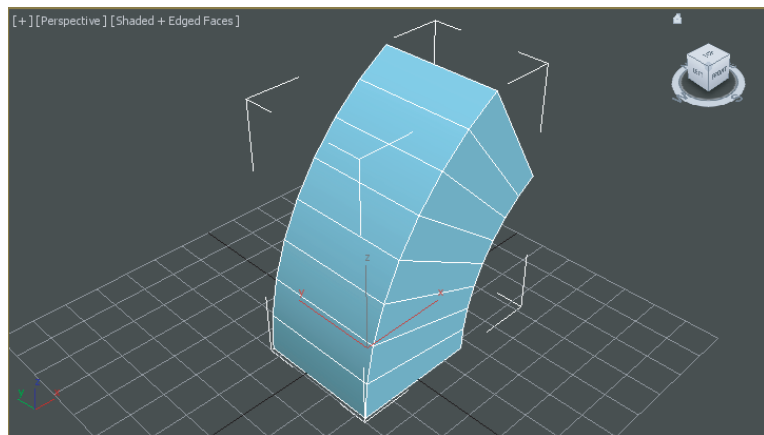
3. Set the Height Segs value to 8.

In this exercise, you saw how you can increase the number of segments in the box, allowing the Bend modifier to give the box a curved appearance. You also saw how the modifier stack offers access to the box's original parameters. The modifier stack plays a key role in your ability to edit objects in 3ds Max, as you'll see as you work through the examples in this book.

Now let's try making another adjustment to the Bend modifier's parameters:

1. Click Bend in the modifier stack. The Bend modifier's parameters reappear.

2. Click the Direction spinner in the Parameters rollout and drag it up. Notice how the top of the box rolls around as you change the Bend Direction parameter, while the base remains fixed.

3. Adjust the Direction value to 180. This causes the Bend modifier to point in a direction that is at an angle of 180 degrees from its original direction. You can see the result in Figure 2.29.

FIGURE 2.29
Changing the Direction parameter alters the bend direction.
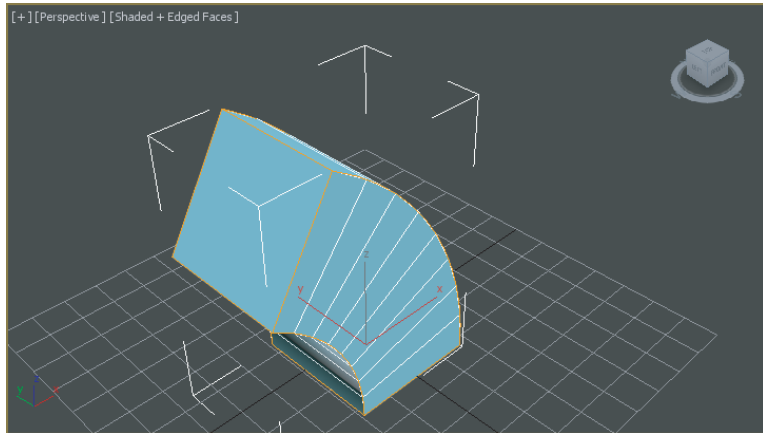
Once again, you moved from one set of parameters to another. This time, you switched from the box's basic parameters to the Bend modifier's parameters. When you adjusted the Direction spinner in step 2, you saw how the box appeared to roll around as it changed the direction of the bend.

You may have noticed the plus (+) sign to the left of the Bend item in the modifier stack. If you click the plus sign, the modifier expands to show additional parameters, also called *sub-objects*, available for the modifier, as shown in Figure 2.30. For the Bend modifier, Gizmo and Center are two additional options.

FIGURE 2.30
The Bend modifier's sub-objects
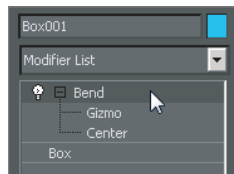
As noted earlier, the Gizmo option refers to the orange shape superimposed over the box. It lets you see how the modifier is being applied to the object. The Center option refers to the origin of the modifier object, which is usually the first point you click when you create the object. Both the Gizmo and Center options can be edited, as you will learn in later chapters.

Now let's try another modifier. The Taper modifier does just what you might guess: it tapers an object.

1. Start by changing the view to one that will show the box from a lower angle. Click and drag the ViewCube slightly up and to the right.

2. Click the Zoom Extents tool in the viewport navigation controls.

3. Click the Modifier List drop-down arrow, and select Taper from the list. (It's in alphabetical order under Object-Space Modifiers in the list.) Now the Parameters rollout shows a different set of options (see Figure 2.31) specific to the Taper modifier.

FIGURE 2.31
The Taper modifier's parameters
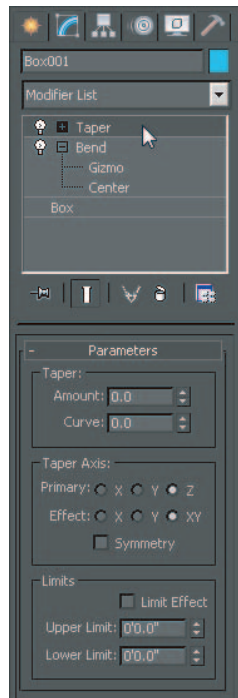
QUICKLY NAVIGATING THE MODIFIER LIST

The modifier list shows all modifiers that can be applied to the selected objects. This list can be long and extend beyond the display area. To navigate to a modifier quickly, press the key that corresponds with the first letter of the modifier's name to highlight that modifier in the list. When multiple modifiers exist with the same first letter (for example, Taper, Tesselate, TurboSmooth, and so on), press the key repeatedly to continue moving down the modifier list. Press ↵ when the desired modifier is highlighted to add it to the stack.

1. In the Parameters rollout, click and drag the Amount spinner down. The box tapers vertically. You also see the orange gizmo change shape as you adjust the Amount spinner.

2. Click and drag the Curve spinner upward, and watch how the box bulges, as shown in Figure 2.32.

3. Set the Curve spinner back to zero for now.

FIGURE 2.32
As the Amount
and Curve settings
change, the box
changes shape.
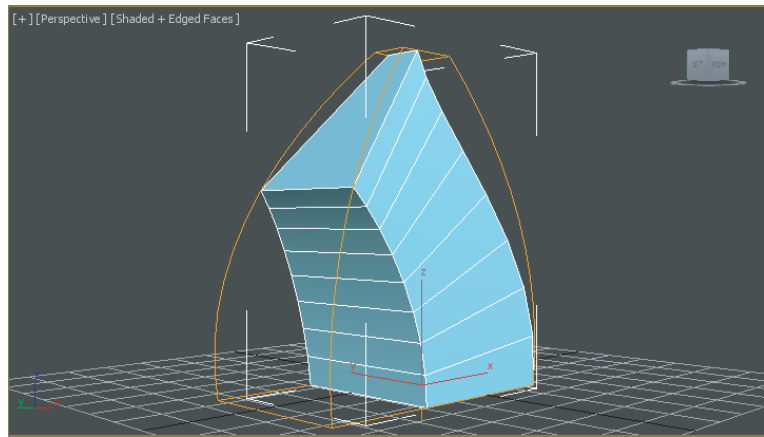
Although this is an interesting form, you may have expected the box to taper along its curved length instead of straight up. You can change the effect of the Taper modifier by changing its position in the modifier stack, as explained in the next section.

Placing Modifiers Where You Want Them

The modifier stack is a collection of modifiers, each one stacked on another one. It is important to understand that each modifier in the stack is applied to the result of the modifier, or the original object, located directly below it. An object that is twisted and then bent yields a much different result than an object that is first bent and then twisted. Currently, Taper is at the top of the modifier stack because it is the last modifier you added to the box. Below Taper is Bend, and below Bend is the Box object itself. You can change the order of the modifiers in the stack to obtain a slightly different effect on the box. Try the following to see how this works:

1. If the Taper entry in the modifier stack is not highlighted in gray, click to select it. If it highlights in blue or the Box object now has a yellow gizmo instead of orange, this is an indication that one of the sub-objects in the collapsed list is selected—click it again to return to the modifier itself.

Take care not to click the plus sign or the lightbulb icon in the list. (Clicking the plus sign shows additional levels of the modifier, as you saw earlier, and clicking the lightbulb toggles the modifier off and on, as you'll learn in the next section.)

2. Right-click, and select Cut from the context menu to remove the Taper modifier from the stack and place it temporarily into the computer's memory.

3. Click the Box entry in the stack to select it.

4. Right-click, and select Paste from the context menu. The Taper modifier is pasted just above Box in the list, changing the order of the modifiers. Notice the change in the shape of the box. It now tapers along the length of the bend, as shown in Figure 2.33.

This exercise demonstrated a couple of things. First, you saw how to change the order of modifiers in the modifier stack. You also saw how a change in the order affects the way multiple

modifiers work on the box. When the Taper modifier is below the Bend modifier, the box is tapered *before* it is bent, giving the modified box a completely different shape. Therefore, you can see how 3ds Max evaluates the stack from the bottom up in sequential order. Remember that the order of the modifiers in the stack affects the way the modifiers work.

FIGURE 2.33
Changing the location of the Taper modifier in the stack changes the appearance of the box.
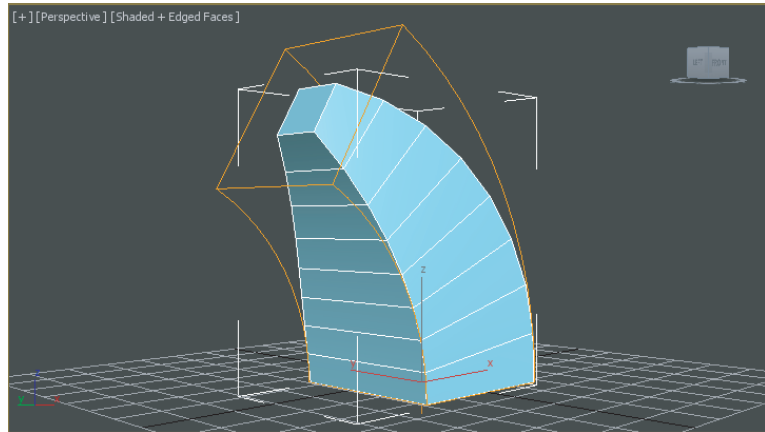
WHAT CAN YOU DO WITH PRIMITIVES AND MODIFIERS?

Some examples of objects built with the help of modifiers are the binoculars and drawer pulls shown here:
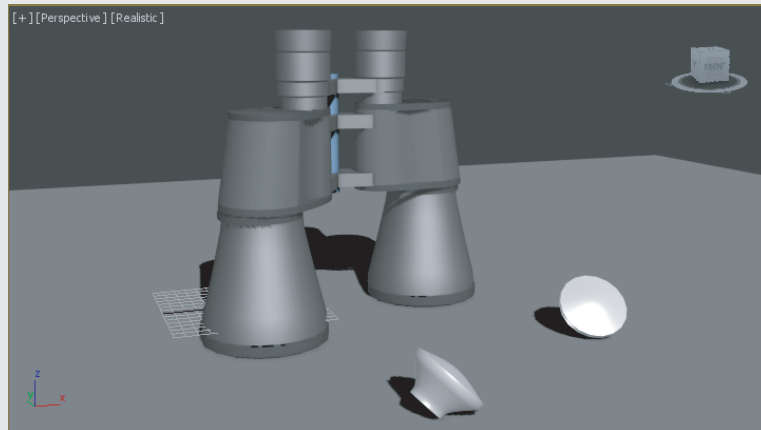
Several objects were used for the binoculars, including cylinders and a few splines. A Taper modifier was used to taper the large end of the binoculars, and a combination of Taper and Skew modifiers was used in the main body. The drawer pulls are just cylinders with a Squeeze modifier applied. The Squeeze modifier gives the cylinder a slight bulge at the top while tapering the sides down.

DRAGGING TO RELOCATE MODIFIERS IN THE STACK

Instead of cutting and pasting to move a modifier in the modifier stack, you can simply click and drag a modifier into a different location in the list. The blue bar previews where you will paste the modifier in the stack before you release the mouse button. You can also highlight the modifier stack entry below where you want a new modifier inserted, before selecting the modifier from the list. New modifiers are inserted above the currently highlighted entry or at the top of the stack if no entry is selected.

You also saw how the context menu lets you manipulate the modifiers. You can cut, paste, and even delete modifiers using the context menu that appears when you right-click a modifier label.

Using the Modifier Stack Tools

You've seen how you can make changes to the modifier stack to fine-tune the shape of an object. Some additional tools offer ways to manage the modifier stack. The following set of exercises will let you see what these tools do:

1. Choose Edit ➢ Hold from the Menu Bar or select Ctrl+H. This command acts as a place marker to which you can return, using Edit ➢ Fetch, if you want to experiment.

SAVING YOUR SCENES USING HOLD AND FETCH

The Edit ➢ Hold command performs the same function as the AutoCAD Mark option under the Undo command. You can save your drawing in its current condition in case you want to return to this condition later. It lets you try various what-if scenarios without the risk of losing your work up to a certain point. Hold writes the `maxhold.mx` file to the AutoBackup folder specified in the Configure User Paths dialog box, and you do not have to be in the same 3ds Max session to use the Fetch command. Be aware that there is only one `maxhold.mx` file. Each time Hold is used, it is overwritten and the previous file is saved as `maxhold.bak`. The Fetch command is not undoable.

---

2. Roll up the Bend modifier by clicking the minus (–) sign to the left of its entry in the stack.

3. Click the lightbulb icon to the left of the Bend modifier.

Clicking the lightbulb icon turns off the modifier. Notice that the box changes to a shape with a taper but without the Bend modifier.

4. Click the Bend lightbulb again to turn Bend back on.

5. Click the lightbulb next to the Taper modifier. Notice how the box reverts to the shape it had before Taper was added.

6. Choose Edit ➢ Fetch or select Alt+Ctrl+F. You see a message box asking if it's OK to restore. Click Yes. Your box returns to its original state (as it was before step 1), but the object is no longer selected.

The lightbulb icon lets you turn on or off a modifier so that you can quickly view the effects of removing a modifier from the stack without actually deleting it. A somewhat similar means is to use the Show End Result tool. When the modifier is turned off, the Show End Result tool simply shows you the shape of the object at the currently selected modifier stack level. The following example demonstrates this:

1. Select the object in the viewport, and then select Taper in the modifier stack.

2. Click the Show End Result tool in the toolbar just below the modifier stack.

The viewport shows the box in its form before the Bend modifier is applied. Also notice that the Show End Result icon changes into a half gray and half white bar. This helps you remember whether the Show End Result tool is on or off.

3. Click the Select Object tool in the Main Toolbar, and then click a blank area of the model to clear the selection. The box returns to its original form, with all of the modifiers active.

4. Click the box to select it again, and then choose Taper from the modifier stack. The box again returns to the form it had before the Bend modifier was applied. This shows that the Show End Result tool doesn't actually affect the end result of the box's modifiers, just how the box is displayed in the viewport when it is selected.

5. Click the Show End Result tool to turn it on again. The viewport displays the box in its final form.

Now suppose you want simply to delete a modifier from the stack. This is easy to do with the context menu.

1. Right-click the Taper modifier in the stack, and select Delete from the context menu. Now the Taper modifier is removed from the modifier stack. The box reverts to the form it had before you added the Taper modifier.

2. Choose Edit ➢ Fetch to restore the box with the Taper modifier intact.

> **REMOVING MODIFIERS FROM THE STACK**
>
> Another way to remove a modifier from the modifier stack is to select it and then click the garbage can icon in the toolbar below the modifier stack. This is the Remove Modifier from the Stack tool. Do not press the Delete key on the keyboard; this deletes the selected object rather than the modifier.

The Delete context-menu option is a quick way to remove a modifier. You can accomplish the same thing by selecting the Cut option from the context menu. Another modifier stack tool (available on the toolbar beneath the modifier stack) is Make Unique. This tool works with special types of clones, which you'll learn about in the "Making Clones That Share Properties" section, coming up shortly.

How 3ds Max Sees Objects

Let's take a break from the tutorial for a moment to understand how 3ds Max 2013 sees objects. When you create and edit an object in 3ds Max, you are creating data that 3ds Max evaluates to display your model. The order in which that data is evaluated is known as the *object data flow*. 3ds Max sees objects as a stream, or flow, of data in a particular order. The order in which this data is evaluated affects the outcome of the data; in other words, the order affects the behavior and appearance of the object in your model.

When you rearranged the modifiers in the modifier stack, you saw an example of object data flow. You saw that the order in which modifiers appear in the stack affects the shape of a box. 3ds Max also applies this data flow to the overall object by evaluating all modifications made to an object in a specific order.

The first piece of data 3ds Max looks at is the *master object*. This is the object as you first create it, including a set of parameters, its position, and its orientation.

The next item is the modifier or set of modifiers you apply to an object. Modifiers are evaluated in their order in the modifier stack, as you've already seen. Of course, if there are no modifiers, 3ds Max skips to the next piece of data.

The third item in the data flow consists of the transformations applied to the object. *Transformations* refer to the movement, cloning, scaling, or rotation of an object. For example, even though you may have moved the object *before* you applied modifiers, 3ds Max will evaluate the object's Move transformation after it evaluates its modifiers. The one exception to this occurs when you use the XForm (transform) modifier, which places transform operations within the bounds of the modifier stack.

3ds Max evaluates the properties of an object last. *Properties* include the object's name, color, layer assignment, display, rendering, shadow casting and receiving, motion blur, and so on. For example, even though an object acquires a default color and name as soon as it's created, 3ds Max evaluates the name and color last.

To summarize object data flow, 3ds Max looks at object data in the following order:

1. Master object
2. Modifiers
3. Transforms
4. Properties

The ramifications of object data flow are not obvious at first, but keep the concept in the back of your mind as you work with 3ds Max. It will help you understand the behavior of the program and ultimately give you better control over your models.

Making Clones That Share Properties

The modifier stack plays a major role in allowing you to mold objects to a desired form, but you can go a step further and have modifiers act across several objects instead of just one. In Chapter 1, when you learned about copying objects, you may have noticed three clone options in the Clone Options dialog box: Copy, Instance, and Reference.

Instances and references are more than just clones of objects; they share modifiers, so the changes you make to one clone affect all the other clones. This can be a great editing aid when you have multiple copies of the same object, such as columns in a building, lighting fixtures, or a horde of alien invaders. By making instance clones, for example, you can place the objects in your model before you've finalized the particular parameters of the objects. Instances and references also reduce file size by defining a single object or modifier that is repeated in multiple locations, rather than defining the parameters of each identical object.

Creating an Instance Clone

The instance and reference clones are quite similar but with a subtle yet powerful difference. You'll start by examining the simpler of the two types of clones—the *instance clone*.

1. Open the `Clone_Window.max` file, which you'll find in the `Chapter 2` archive of this book's accompanying web page, `www.sybex.com/go/mastering3dsmax2013`. This file consists of a Fixed Window object with a Taper modifier applied.

   If you see a File Load: Units Mismatch dialog box when you open the file, this indicates that the file's System Units setting is different than the current scene's System Units setting. Select the Adopt The File's Unit Scale option, and then click OK.

2. In the Perspective viewport, select the Window object and then click the Select And Move tool.

3. Hold the Shift key down, and drag the red X-coordinate arrow to the right; then move the copy of the window along the X-axis toward the upper-right corner of the viewport until it is beyond the extents of the original window.

4. Release the mouse button. The Clone Options dialog box displays, as shown in Figure 2.34.

FIGURE 2.34
The Clone Options
dialog box
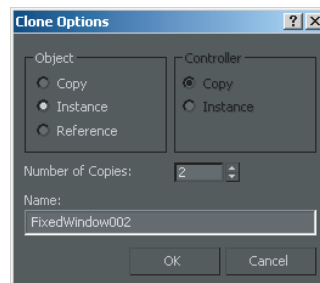
5. If it is not already selected, click the Instance radio button in the Object group, increase Number of Copies to **2**, and then click OK. You now have two instance clones of the original window arranged similarly to the windows in Figure 2.35.

FIGURE 2.35
The original window and two instanced clones
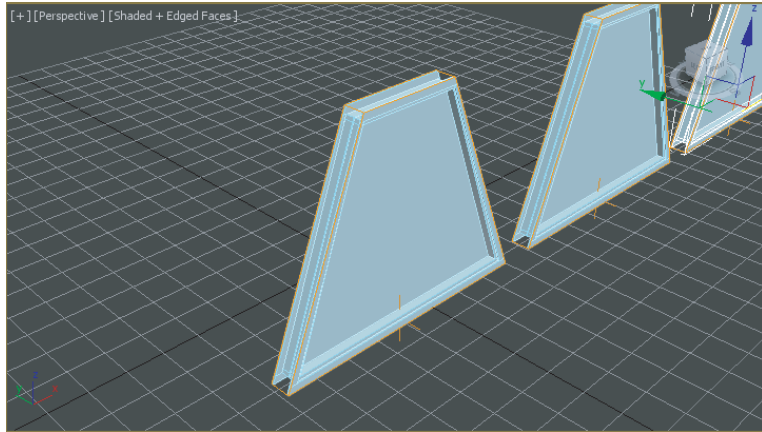
Pan and zoom as required to get a better view of the scene. You now have three identical windows. The similarities of the three boxes go beyond appearances, as the following steps demonstrate:

6. With the Window object to the far right selected (FixedWindow003), click the Modify tab in the Command panel.

7. Make sure the Taper modifier is selected in the modifier stack.

8. In the Parameters rollout, click and drag the Amount spinner down until its value reads −0.9 and the windows have a more tapered appearance.

9. Click the FixedWindow entry in the modifier stack. In the Rails And Panels section of the window's Parameters rollout, change # Panels Horiz to **3** and # Panels Vert to **2**.

10. Notice that all three windows change their shapes and parameters simultaneously, as shown in Figure 2.36.

FIGURE 2.36
Altering the parameters of one instance changes the parameters of all three.
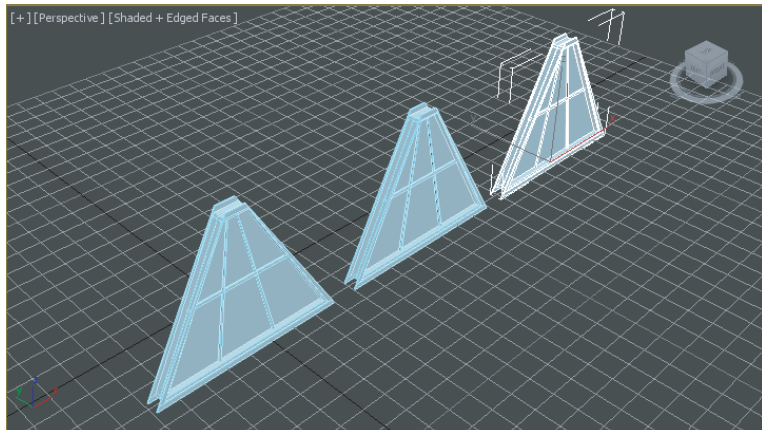
Any parameter change you make to any of the windows will be reflected in all of the instanced clones. Furthermore, if you add additional modifiers to any of the clones, each will have the modifier applied to the same position in its modifier stack. This is true because instance clones share modifiers in their respective modifier stacks. This sharing of its modifiers is what distinguishes an instance clone from an ordinary copy. 3ds Max identifies clones by displaying their entries in the modifier stack in a bold font.

INSTANCES SAVED MANY HOURS OF WORK

The decision was made to replace the windows in a downtown Cleveland, Ohio, office building to improve both its appearance and energy efficiency. The company requested a 3D model to show the city officials what the building would look like with the renovation in place. The final model had more than 2,400 3ds Max Window objects placed over 52 floors. When the model was presented the first time, it was determined that the new window style, a sliding window with two horizontal panels, needed to look like the existing, historical windows consisting of a single horizontal panel. Because all the windows were instance clones, changing one window modified all the remaining windows instantly. The company wanted to show a few windows partially opened to their 6-inch maximum, so specific windows were selected, and then the Make Unique option at the bottom of the modifier stack was used to break the instanced connection to the other windows, thereby allowing them to open individually.

By using the Instanced option when cloning the original window, many hours of work were saved when the window design was changed.

Creating a Reference Clone

Like an instance clone, a *reference clone* shares modifiers in its modifier stack, but in addition it allows you to include modifiers that are not shared. The following example shows how this works:

1. Select the middle window.

2. With the Select And Move tool, Shift+click and drag the Move gizmo's XY-plane to the foreground. Relocate the window to a location similar to the one shown in Figure 2.37.

FIGURE 2.37
The location of the reference clone
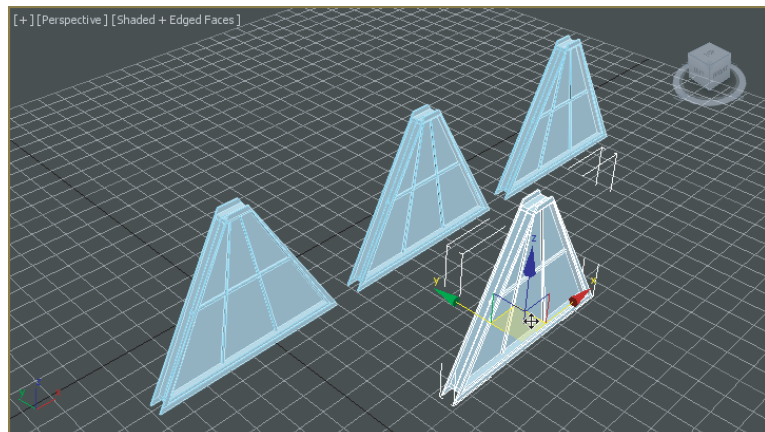
3. In the Clone Options dialog box, click the Reference radio button and then click OK.

4. Click the clone farthest to the right (FixedWindow003) to select it.

5. Change the Taper modifier's Amount parameter to -0.5. Now all four of the clones change shape.

6. Click the newest clone to select it. Look carefully at the modifier stack, and you'll see a gray bar at the very top of the stack (see Figure 2.38). This line divides the shared modifiers from potentially unshared modifiers.

FIGURE 2.38
The reference clone's modifier stack
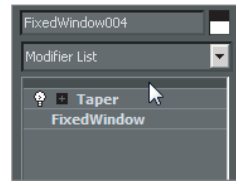
The shared modifiers of all the clones are still accessible through the reference clone.

1. With the reference clone selected, select Taper from the modifier stack.

2. In the Parameters rollout, adjust the Amount spinner down to read -0.8. All of the clones change shape, as shown in Figure 2.39.

3. With the reference clone selected, click the blank, gray line at the top of the modifier stack.

4. Open the Modifier List drop-down list, and select Skew. (It's in alphabetical order under Object-Space Modifiers in the list.) The Skew modifier is now added to the top of the modifier stack of the selected window.

FIGURE 2.39
Changing the reference clone's Taper Amount spinner affects all four windows.
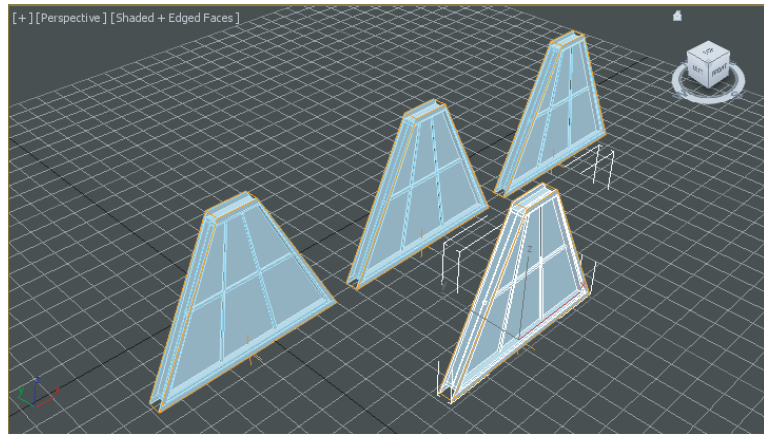
5. In the Parameters rollout, set the Skew Axis to Y and then set the Amount spinner to approximately –2′ 7″ until the left edge of the window is vertical. Notice that the reference window changes shape independently of the other windows, as shown in Figure 2.40.

FIGURE 2.40
Changing the reference clone's Skew Amount spinner affects only the reference clone.
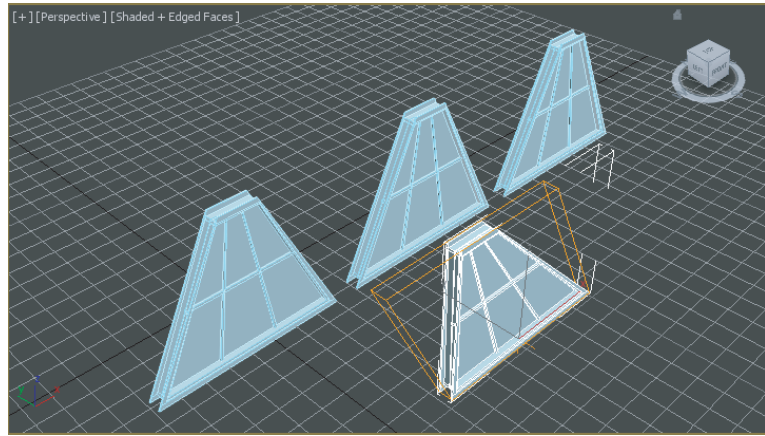
Here you see that the blank line in the modifier stack delineates the modifiers that are shared between the clones from those that are specific to the selected object. Try testing this by moving the Skew modifier below the line.

1. In the modifier stack, select Skew and then drag it below the gray line (see Figure 2.41).

FIGURE 2.41
Moving the Skew modifier
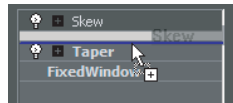
Now all four windows share the Skew modifier, as shown in Figure 2.42.

FIGURE 2.42
After the Skew modifier is relocated in the modifier stack, all clones become affected.
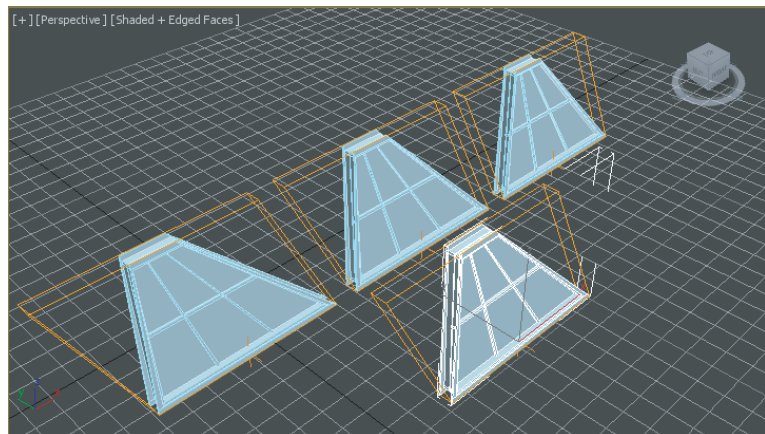
2. Select the Skew modifier, right-click, and select Delete to remove it.

As you see, you can manipulate the reference clone's modifier stack in quite a number of ways to achieve an effect across multiple objects. Next you'll see another way that the stack can be used in conjunction with a modifier to apply the Transform tools to multiple objects.

3DS MAX INSTANCES ARE SIMILAR TO AUTOCAD BLOCKS

If you're an AutoCAD user, you might think of instance and reference clones as being similar to blocks in AutoCAD. But as you can see from these exercises, they are far more flexible in 3ds Max. Reference clones can share some parameters and also include parameters that are independent of other instances.

Scaling and Rotating Objects with Transform Tools

CERT OBJECTIVE

Now that you have a set of objects in your scene, let's take a break from our look at modifiers to examine the Transform tools. In Chapter 1, you learned how you can scale and rotate a single object using the Transform tools in the Main Toolbar. You can also scale and rotate a collection of objects by selecting the set of objects and applying the Scale or Rotate tools. When you do this, by default 3ds Max affects all the selected objects uniformly. For example, if you rotate a collection of objects, they all rotate about a common axis, as illustrated in the top of Figure 2.43. If you scale a collection of objects, they all change their scale, including the distance between objects in the collection, as illustrated at the bottom of Figure 2.43.

3ds Max offers a few options that alter the way objects are affected by the Transform tools. In this section, you'll learn how the Transform Center options give you a higher degree of control over the transform tools.

First, try rotating one of the clones by itself:

1. Click the Select And Rotate tool on the Main Toolbar.

2. Select the window in the middle of the viewport.

3. Click and drag the red X-coordinate axis up. The window rotates independently of the clones.

4. Click the Undo Scene Operations button in the Quick Access toolbar to return the window to its original orientation.

FIGURE 2.43
Rotating objects in a selection set (left) and scaling objects in a selection set (right)
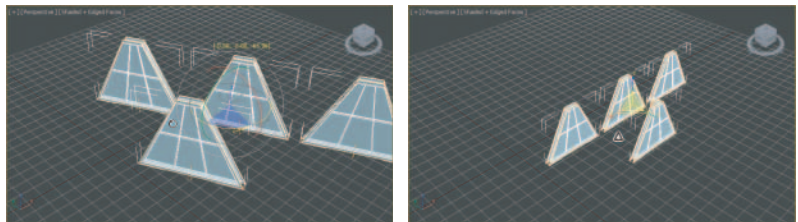
CLONES AND THE TRANSFORM TOOLS

Although this exercise involves a set of cloned objects, the Transform tools in the Main Toolbar do not consider whether the selected objects are clones of one another or a set of dissimilar objects.

Here you see that the Rotate tool affects only the currently selected clone. You also see that you can use the Rotate gizmo's rings to control the orientation of the rotation.

Now let's take a look at how the Rotate tool affects a group of objects:

1. Click the Select Object tool, and then select all four objects. You can either click and drag a region enclosing all of the objects or Ctrl+click each object.

2. Click the Select And Rotate tool on the Main Toolbar.

3. Click the Use Pivot Point Center tool on the Main Toolbar. If you don't see it, click and hold the tool just to the right of the Reference Coordinate System drop-down list in the middle of the Main Toolbar (see Figure 2.44), which should be set to View, and then select the Use Pivot Point Center tool from the flyout.

FIGURE 2.44
Selecting the Use Pivot Point Center option
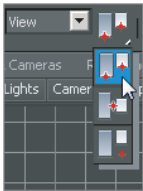
4. Click and drag the red X-axis ring. Now all of the cloned windows rotate in unison with the original window, each on its own axis, as shown in Figure 2.45.

FIGURE 2.45
All the selected windows rotate in unison.
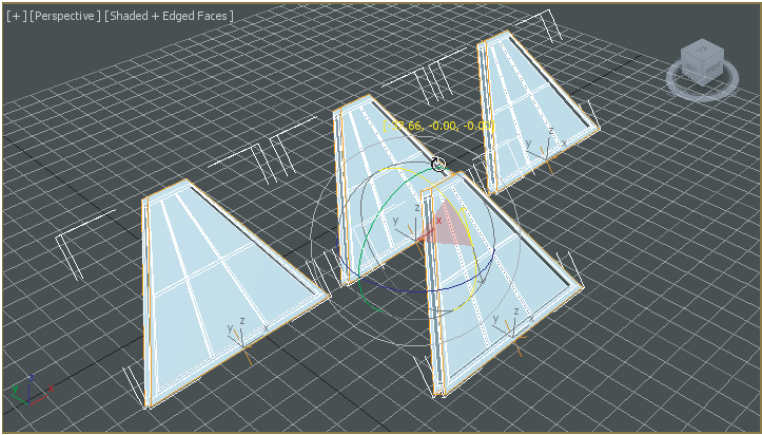
THE TRANSFORM COORDINATE CENTERS ARE TRANSFORM SPECIFIC

It is important to understand that the Transform Center options are specific to the current transform and are not global across all the transforms. For example, if the Use Pivot Point Center option is current for all transforms and then, with the Rotate Transform active, you make the Use Selection Center option active, it is active for only the Rotate Transform. For this reason, the transform must be selected before the Transform Center option is changed. You can change this default parameter by clicking Customize ➢ Preferences on the Menu Bar and then checking the Constant option in the Ref. Coord. System area under the General tab of the Preference Settings dialog box.

Next try the Select And Uniform Scale tool:

1. Click the Undo Scene Operations button to return the windows to their original orientation.

2. Click the Select And Uniform Scale tool from the flyout on the Main Toolbar.

3. Click the Use Pivot Point Center tool on the Main toolbar, and then click and drag the center of the Scale gizmo. Each of the windows now scales in unison with the others, each about its own pivot point, as shown in Figure 2.46.

FIGURE 2.46
The windows scale about their own pivot points.
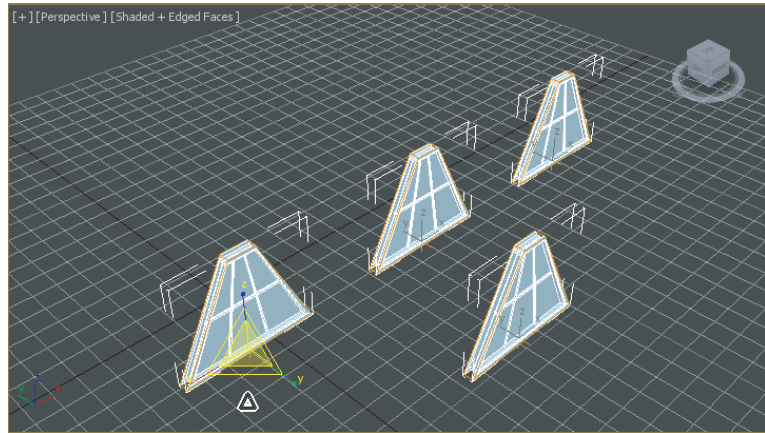
4. Click the Undo Scene Operations button to return the windows to their original size.

You've seen how the Use Pivot Point Center tool affects the Rotate and Scale Transform tools. Next, try the Use Transform Coordinate Center tool to see its effect on the Scale tool:

1. Click and hold the Use Pivot Point Center tool, and then select the Use Transform Coordinate Center tool from the flyout.

Notice that the Transform gizmo now appears at the origin of the World Coordinate System on the home grid, as shown in Figure 2.47 (shown in Wireframe mode for clarity).

2. Click and drag the Scale gizmo or any of the windows. Notice that they all change in scale about the origin of the scene.

3. Click the Undo Scene Operations button to return all the clones to their original scale.

SETTING THE NUMBER OF UNDO LEVELS

You can use the Undo Scene Operations tool to undo as many as 20 steps back by default. You can also set the number of steps 3ds Max will allow for Undo. To set the number of steps, click Customize on the Menu Bar, choose Preferences, and then, on the General tab of the Preference Settings dialog box, set the Scene Undo Levels option to the value you want. Understand that holding onto more Undo steps consumes more system memory.
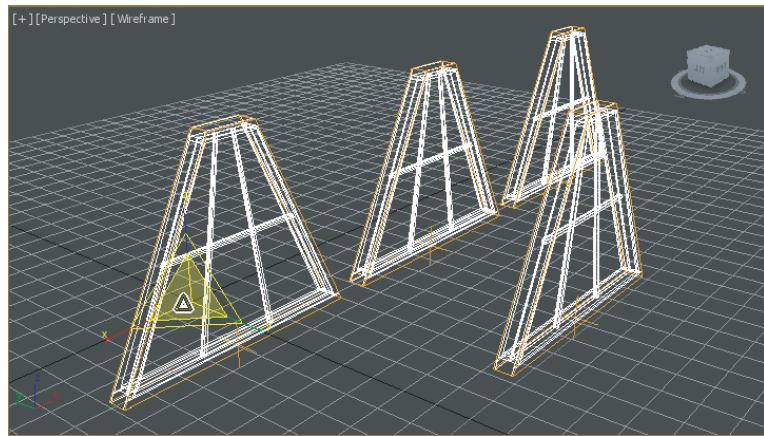
As you can see from the previous exercise, the Transform Center options allow you to select the center location of the currently active grid and provide a simple set of options that enhance your ability to control the result of the Transform tools. You haven't had a chance to try all the options with all the Transform tools, so here's a summary of the Transform Center tool functions:

Use Pivot Point Center   This tool places the center of the transformation at the pivot point of the selected object. If multiple objects are selected, each object is transformed about its own Object Space.

Use Selection Center   This tool places the center of the transformation at the center of the set of selected objects. This differs from Use Pivot Point Center in that all objects move, scale, or rotate about a common, single point, rather than about their individual pivot points.

Use Transform Coordinate Center   This tool places the center of transformation at the origin of the World Coordinate System. Or, if you're using a user grid, the center of transformation will be at the origin of the user grid. This option, in conjunction with a user grid, is useful for moving, scaling, or rotating an object or set of objects in relation to a specific point in a model.

ADDING TRANSFORMS TO THE MODIFIER STACK

The XForm modifier lets you scale and rotate objects from the modifier stack. This has the advantage of allowing you to apply Transform tools to cloned objects without needing to select the objects individually. It also has the effect of applying the Transform tools to a specific position in the object data flow. Normally, transforms are evaluated after the modifiers, but you can insert transforms within the modifier stack using the XForm modifier.

Making a Clone Unique

At some point, you may decide that you want to turn a clone into a unique object so that it no longer reacts in unison with other clones. You can do this easily with the Make Unique button in the modifier stack toolbar.

1. Click the Select Object tool, and then select the instanced clone to the far left.

2. Make sure that the Modify tab is selected in the Command panel and that the Taper modifier is highlighted in the modifier stack.

3. Click the Make Unique button on the toolbar below the modifier stack. The selected window is now an independent object that is no longer connected to the other two clones.

Notice that the entries in the modifier stack are no longer bold, indicating that the object is independent of all others and no longer an instance.

Cloning a Modifier

You've learned the many ways in which you can clone an object and edit those clones together. You've also seen most of the major methods used to create objects from primitives. However, there is one more feature related to clones and modifiers that you'll want to understand. At times, you may want to clone just one modifier instead of an entire object. This allows you to have an object maintain a degree of uniqueness and still have at least one modifier cloned so that it acts on a set of objects. The following exercise will demonstrate the principle.

First, make a copy of one of the clones:

1. With the Window object still selected, click the Select And Move tool, and then Shift+click and drag the green Transform gizmo handle for the instanced window clone in the center of the scene.

2. Drag the copy to a location behind the initial row of clones, so the set of windows forms a rough X shape.

3. In the Clone Options dialog box, click the Copy radio button and then click OK.

4. Using the Modifier List drop-down, add a Lattice modifier to the window copy. The struts and joints unique to that modifier appear on the selected window only.

Now let's add a cloned Lattice modifier to the instanced clones. You can do this by copying the modifier to the Clipboard and then pasting it back into the modifier stack.

1. With the newest window selected, click the Lattice modifier in the modifier stack, right-click, and select Copy.

2. Select the window at the center of the scene.

3. In the modifier stack, right-click Taper and then select Paste Instanced from the context menu to place the new Lattice modifier above the Taper modifier. Notice that the new instanced Lattice modifier is italicized to indicate that it is an instanced modifier.

You've just created an instance clone of the Lattice modifier that affects all the windows in the scene except the window that was made unique in a previous exercise. Now let's see the results:

1. Click the instanced window nearest to the top-right corner of the viewport.

2. Click Taper in the modifier stack.

3. Try adjusting the Amount spinner in the Parameters rollout. The instance and reference clones change in unison, but the newest copy and the unique window do not, as shown in Figure 2.48.

FIGURE 2.48
The cloned Lattice
modifier affects
three of the five
windows.
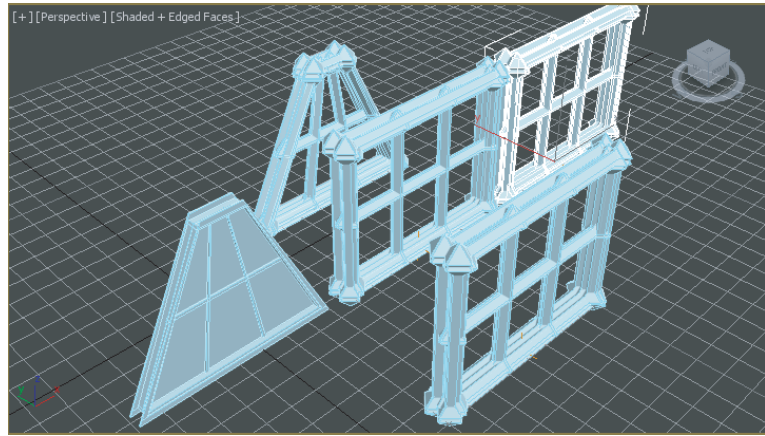
4. Click the instanced Lattice modifier in the stack.

5. Change the Radius value in the Joints area to **0′ 9.5″.** Four of the objects change their shape, as shown in Figure 2.49.

By placing an instance copy of a modifier in an object's modifier stack, you can apply a cloned modifier to an object, so a unique object can share a few characteristics with other similar objects. An example of this might be a set of windows across the facade of a building, as shown in Figure 2.50.

FIGURE 2.49
Adjustments to the
Joints Radius value
affect four of the
windows.
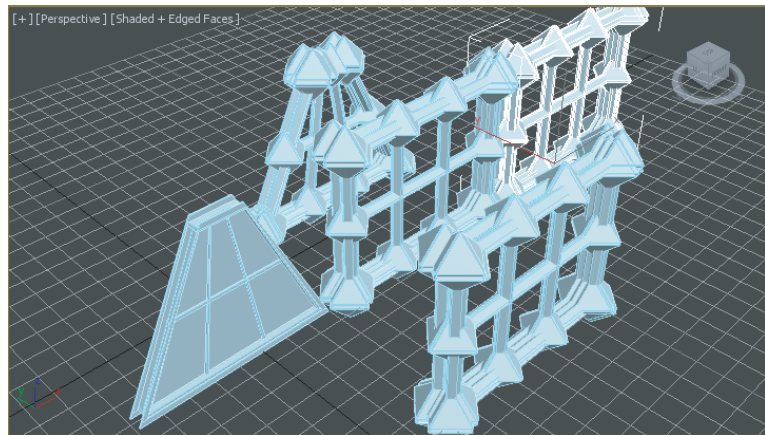
Most of the windows are identical. The window design can be modified for one window, and all the windows will be affected. Some of the windows may need to share only a few (but not all) of the parameters of the rest of the windows. It saves memory to make instances of objects that are identical.

FIGURE 2.50
A facade of a build-
ing using cloned
references for
windows
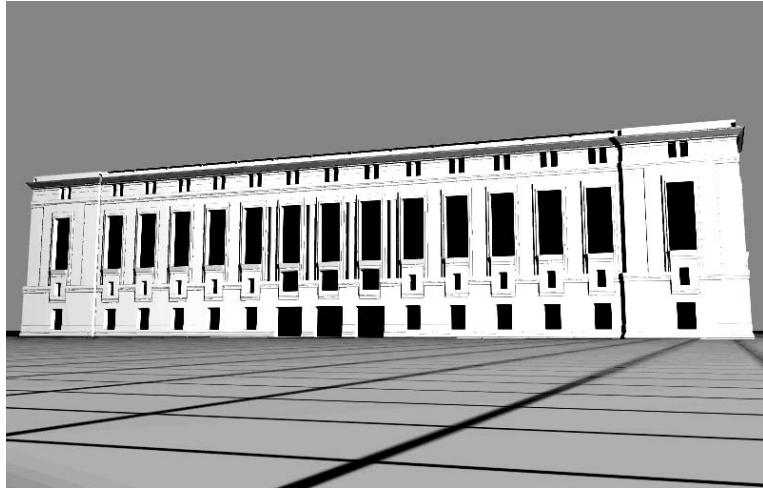
Introducing Extended Primitives

Before moving on to the next chapter, you should be aware of the *extended primitives*. They are a set of primitives that offer a few more parameters than the standard primitives. In most cases, the extended primitives offer shapes with adjustable smoothing along their edges. Some of the other extended primitives are complex shapes, such as the Hedra and Gengon objects. Figure 2.51 shows the extended primitives in their default configurations.

FIGURE 2.51
Examples of
extended primitives
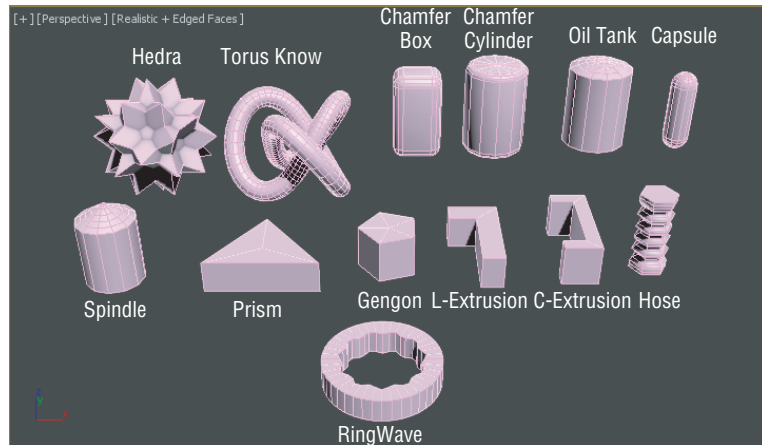
You can get to the extended primitives by clicking the Geometry tool on the Create tab of the Command panel and then selecting Extended Primitives from the drop-down list that appears just below the Create tools.

For several of the extended primitives, you'll see a Fillet parameter. This controls the radius of the edges. For example, the Chamfer Cylinder (ChamferCyl) primitive has a Fillet parameter that works in conjunction with a Fillet Segments parameter to control the rounding of its top and bottom edges. The Oil Tank and Spindle primitives use a Blend parameter to round their corners.

Modeling a Couch

Up until now, you've been creating random forms using the primitives. In this section's exercises, you'll get a chance to create a small couch by trying some of the tools you've learned so far.

Start by setting up a new file:

1. Save your scene as **MySample.max** if you like.

2. Open the Application menu, and then choose New ➢ New All.

3. Set the units to Feet w/Fractional Inches.

You'll start your model by creating the base. For this, you'll use one of the extended primitives:

1. Click the Create tab of the Command panel.

2. Click the Geometry category button, and select Extended Primitives from the drop-down list, as shown in Figure 2.52.

3. Click the ChamferBox tool, and then expand the Keyboard Entry rollout, as shown in Figure 2.53.

4. In the Keyboard Entry rollout, double-click the inches value in the Length input box and enter **20"**↵. Press Tab to accept the value and advance to the Width input box, where you will enter **44"**↵.

FIGURE 2.52
Selecting Extended Primitives from the drop-down list
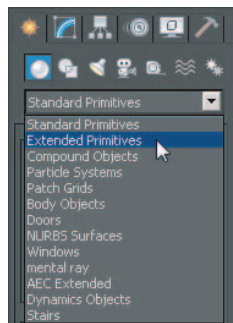
FIGURE 2.53
Expand the Keyboard Entry rollout.
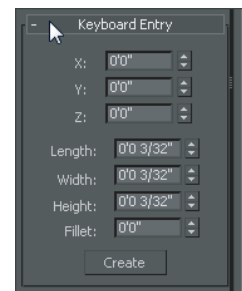
5. Press Tab again to advance to the Height input box and enter **9"**↵.

6. Press Tab, and enter **1"**↵ for the Fillet value.

7. Scroll down to the Parameters rollout, and change the Fillet Segs value to **1**.

8. Now in the Keyboard Entry rollout, click Create. Figure 2.54 shows the new base that is created. (The view is rotated from what you might have in your viewports for clarity.)

FIGURE 2.54
The base of the couch
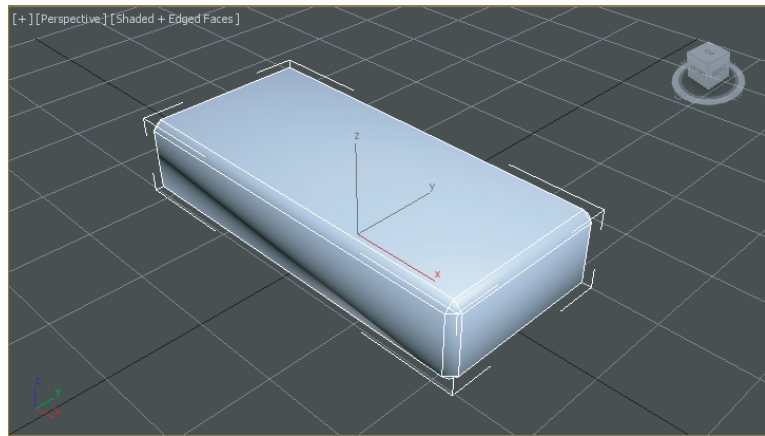
9. Display all four viewports if necessary, then click Zoom Extents All to get an enlarged view of the base in all the viewports.

In this exercise, you created the base strictly by using the Keyboard Entry rollout. Now create the back of the couch:

1. Double-click the Length input box of the Keyboard Entry rollout to select the entire value, and then enter **8"↵**.

2. Press Tab twice to go to the Height input box, leaving the Width input box unchanged. Then enter **26"↵**.

3. Press Tab again, and then enter **2"↵**.

4. Click the Create button. The seat back is created in the middle of the base.

5. Click the Select And Move tool in the Main Toolbar, and then right-click the Top viewport to make it active.

6. Click and drag the green Y-axis arrow of the seat back up to move the seat back to the back side of the base, as shown in Figure 2.55. Click the Zoom Extents All tool to get a better view.

FIGURE 2.55
Move the seat back into position. The Shaded rendering mode is used for clarity.
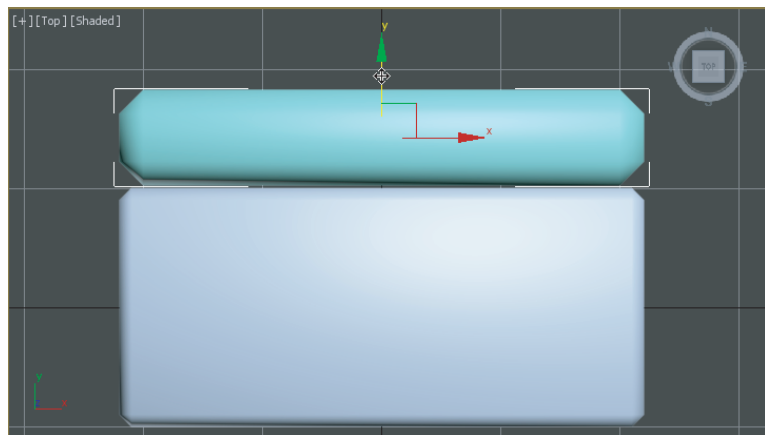
Let's also rotate the seat back so that it is angled slightly backward:

1. Click the Select And Rotate tool in the Main Toolbar. Then right-click in the Perspective viewport to make it active.

2. Click and drag the red X-axis ring upward, and watch the coordinate readout on the Transform gizmo. When the readout shows approximately -8 (negative 8) degrees, as shown in Figure 2.56, release the mouse button.

USE THE TAB KEY TO HIGHLIGHT INPUT FIELDS

Rather than pressing ↵ and then highlighting the next input field with your cursor, consider using the Tab key. Tab accepts the value in the current field and then highlights the next available field. Pressing Tab repeatedly highlights the subsequent fields in an object's Create or Modify panel.

FIGURE 2.56
Rotating the back of the couch
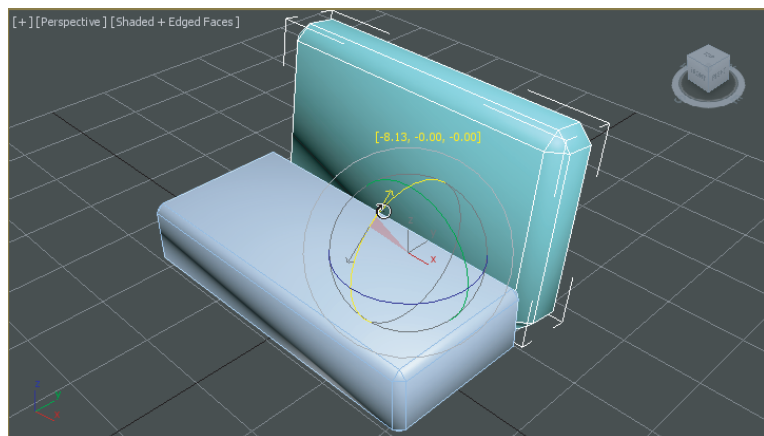
To add an arch to its shape, apply a Squeeze modifier to the back:

1. Click the Select Object button to exit the Rotate transform, and then click the Modify tab in the Command panel.

2. Open the Modifier List drop-down, and select Squeeze.

3. Go to the Axial Bulge group in the Parameters rollout, and click and drag the Amount spinner up until its value reads 0.15.

4. Press Tab twice, and set the Curve value to **3**. Notice that the seat back shows a gizmo bending up, but the back itself does not bend. This is because the back is made up of only a single segment in the horizontal direction.

To allow the Squeeze option to take effect, you need to increase the number of horizontal segments in the seat back.

5. Select ChamferBox in the modifier stack, and locate the Width Segs input box in the Parameters rollout.

6. Click the Width Segs input box and enter **20**↵. The back divides into 20 segments, and a curve appears at the top of the back, as shown in Figure 2.57.

FIGURE 2.57
The back of the couch with additional Width segments
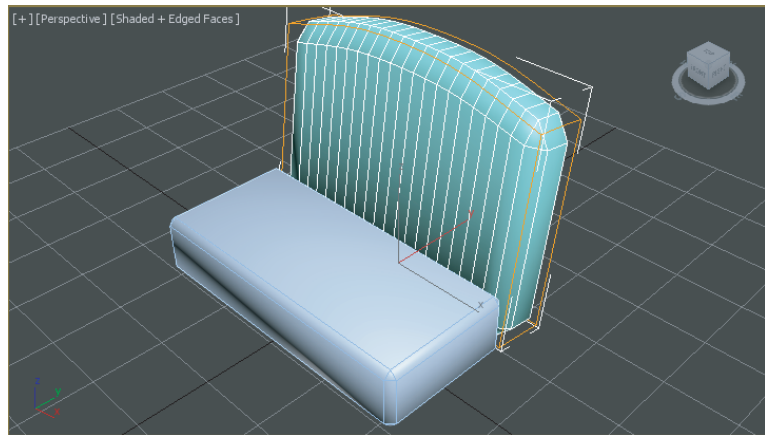
Now let's add arms to the couch. Once again, you'll use the ChamferBox extended primitive, but this time you'll use a different modifier to adjust its shape:

1. Click the Create tab in the Command panel, and then click ChamferBox again.

2. Click the Keyboard Entry rollout to open it. Enter **28"**↵ for the length, **7"**↵ for the width, **22"**↵ for the height, and **2"**↵ for the Fillet value.

3. Click the Create button. The arm appears in the center of the base, as shown in Figure 2.58.

FIGURE 2.58
The first couch arm object created
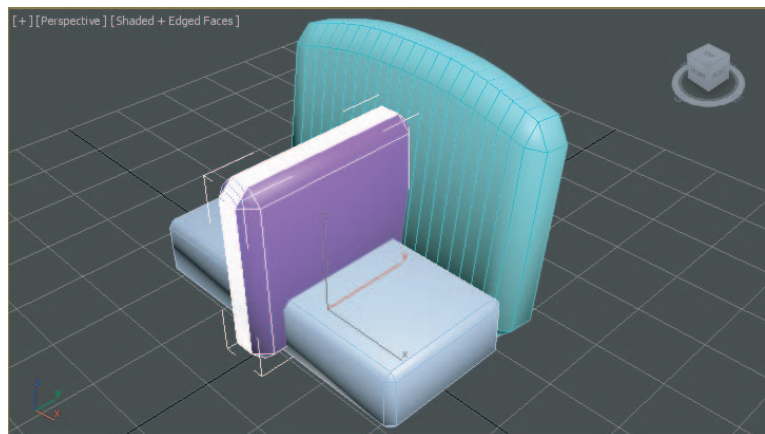
4. Click the Select And Move tool. Right-click the Top viewport to make it active, and then click and drag the arm into the position shown in Figure 2.59.

FIGURE 2.59
Moving the arm
into position

Move the arm to this position.
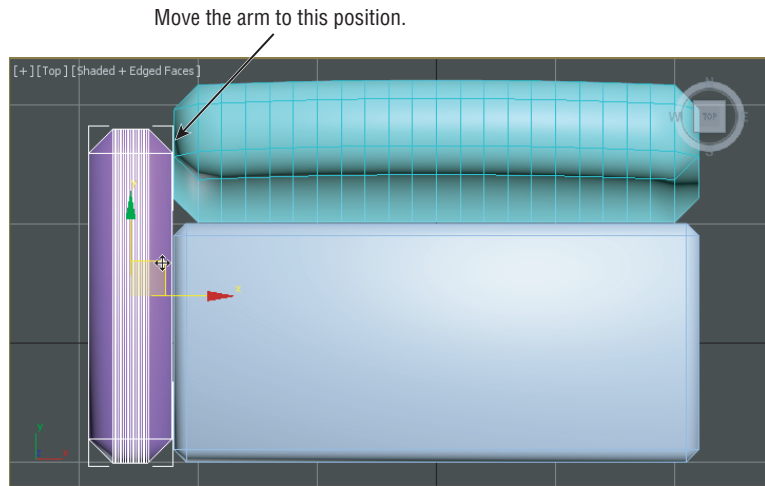
> **USING THE TRANSFORM PLANE HANDLES RATHER THAN THE AXIS HANDLES**
>
> If you place the Select And Move cursor on the rectangular plane handle at the intersection of the
> Move Transform gizmo, you can move the arm freely in the XY-plane.

5. Shift+click and drag the red X-axis arrow of the arm to the right until you see a copy of
the arm in the position shown in Figure 2.60.

FIGURE 2.60
Creating a copy of
the arm
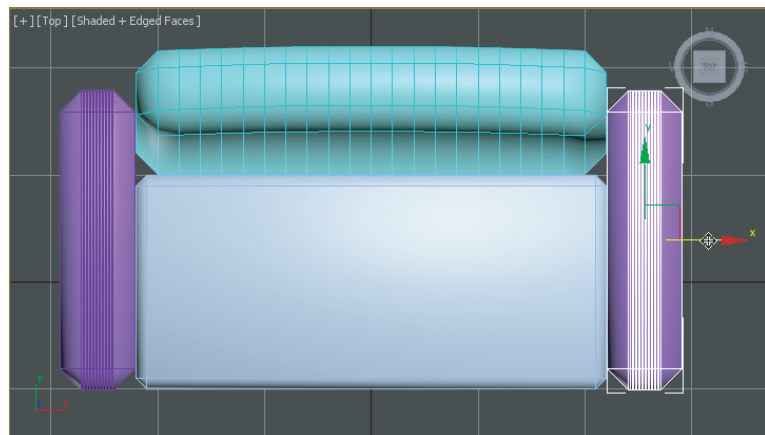
6. In the Clone Options dialog box, click the Instance radio button and then click OK. (You
make an instance clone because you want to modify both arms simultaneously.)

7. Click the Modify tab of the Command panel.

8. Open the Modifier List drop-down, and select Taper.

9. In the Parameters rollout, click and drag the Amount spinner until its value reads 0.2. Both arms taper, widening at their tops in both the X- and Y-axes.

10. Click the ChamferBox object in the Modifier stack, and change the Width Segs value back to **1**. Notice that both couch arms change because they are instanced objects.

The 3ds Max primitives remember the parameters of the last object of that type you created. Thus when you increased the number of segments for the couch back ChamferBox, that setting carried forward when you created the first arm of the couch.

You're nearly finished with the couch. The final part consists of the seat cushions. For that, you'll use a copy of the base:

1. Click the Select And Move tool in the Main Toolbar.

2. Right-click in the Left viewport to make it active. This viewport offers the clearest view of the seat base.

3. Click the seat base to select it, and then Shift+click and drag the green Y-axis arrow upward until you have a copy of the seat base, as shown in Figure 2.61.

4. In the Clone Options dialog box, click the Copy radio button and then click OK. You don't want this clone to be instanced to the base.

You need to change a few parameters for the cushion. It's a bit too thick, and you want two cushions to fit in the seat, so you need to reduce the width of the cushion.

5. In the Parameters rollout, change the Length and Width values in the Parameters rollout to **22"**, and change the Height value to **7"**.

FIGURE 2.61
The copy of the seat base
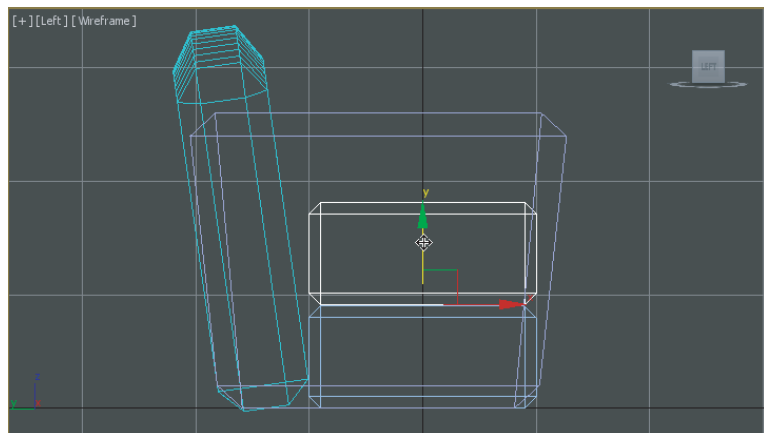
6. With the Select And Move tool selected, right-click the Top viewport. Then click and drag the red X-axis arrow of the cushion to the left to place the cushion, as shown in Figure 2.62.
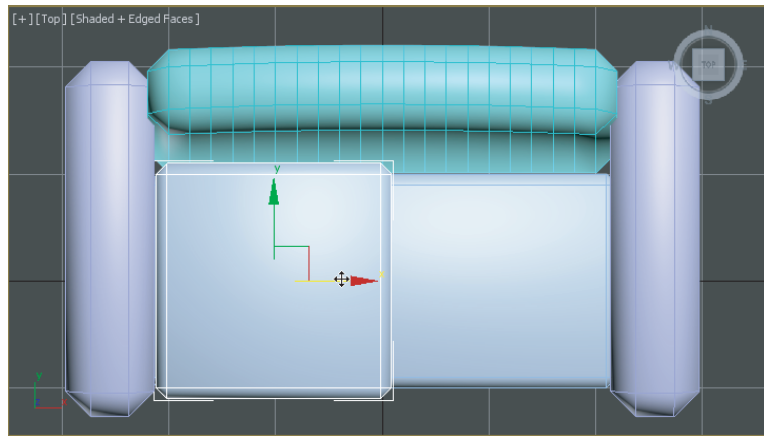
7. Shift+click and drag the red X-axis arrow to the right to make a copy of the cushion on the right side of the couch.

8. In the Clone Options dialog box, click Instance and then click OK.

The couch is complete. Let's get a better view of it:

1. Right-click in the Perspective viewport to make it active.

2. Click and drag the ViewCube to get a view that better shows the couch.

3. Click the Zoom Extents All tool.

You will notice that the fillets on the couch have only one segment and look very sharp because you changed the Fillet Segs parameter on the first ChamferBox created. You will now select the primitives of the couch and increase the number of fillet segments on each object to round the edges of the couch.

4. Select one of the arms of the couch and then, in the modifier stack, click the ChamferBox entry and change the Fillet Segs value to **3**. Both ends of the couch are now much rounder than before.

5. Starting with the back of the couch, select the remaining objects of the couch and, one by one, increase the number of fillet segments to three. Because you made the second seat cushion of the couch as an instance, you will only have to modify one of the seat cushions.

6. Right-click the viewport rendering label, and turn off Edged Faces.

7. Click the Maximize Viewport Toggle. Your view should look like Figure 2.63.

8. Save the file as **MyCouch.max**.

FIGURE 2.63
The completed
couch

Working with Groups

Now that you modeled a couch in the previous section with extended primitives, it is important
to organize the primitive objects that compose this piece of furniture into a group. That way,
you'll be able to select and transform this piece of furniture easily within your modeled envi-
ronments as a single object.

Grouping the Components of the Couch

The couch consists of six ChamferBox extended primitive objects. For convenience, you'll want
this set of objects to act like one object when it is selected. To do this, you can use the Group
feature of 3ds Max. You'll create a group containing only a few objects; then you'll add other
objects to that group.

1. Select the seat cushions and base of the couch.

2. Choose Group ➢ Group from the Menu Bar. The Group dialog box displays, as shown in
   Figure 2.64.

FIGURE 2.64
The Group dialog
box
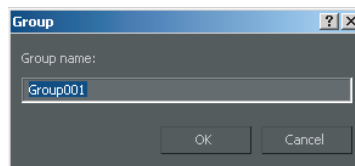
3. Replace the default Group001 name with **Couch001** and then click OK.

4. Click a blank area of the viewport to clear the selection set, and then select and move
   any of the objects that you just added to the group. All the objects react as if they are a
   single object.

NAMING A SERIES OF OBJECTS

It is always a good idea to name the first object in a series with a 001 suffix. If you ever instance this group, the clones will be automatically numbered in sequence by 3ds Max, with the number of the last object's suffix being the total number of clones. 3ds Max 2013 by default now uses three digits to identify objects, and it will start numbering any copies/clones of objects after the highest currently existing number of that named object in the file. 3ds Max will not fill in missing values in numbering sequences.

---

5. Click Undo Scene Operations to return the group to its original location.

6. Select the couch back and both arms, and then choose Group ➢ Attach.

7. Notice that the Prompt line on the Status Bar says, "Click on Group to attach selection." Place the cursor over a couch cushion, and notice that a selection cursor displays, as shown in Figure 2.65. This selection cursor, showing the name of the group and the individual object, will display whenever the cursor passes over a group. Click the seat cushion, which is now part of the Couch001 group. Now all the components of this piece of furniture are contained in the Couch001 group.

8. Click the Select By Name tool on the Main Toolbar to open the Select From Scene dialog box. You'll see the name Couch001 preceded by a circle overlapping a box icon in square brackets, indicating that Couch001 is a group. Click Cancel when you've finished looking at the list.

FIGURE 2.65
The selection cursor appears as you pass the cursor over the couch cushion.
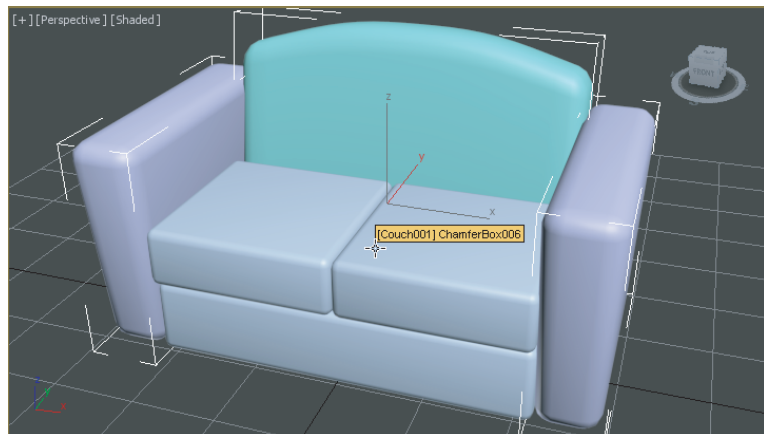
Even though you could have created the Couch001 group all at once by selecting all the components of the couch in step 1, this exercise gave you the opportunity to see how you can add objects to a group that has already been created.

The couch will now act as a single object for selection and transform operations. It will be much easier to locate this piece of furniture in a complex scene because it shows up in the Select From Scene dialog box as Couch001, rather than six rather anonymous-sounding chamfer boxes.

Working within Groups

After you've contained objects within a group, you can always open the group to work on the objects inside. When you've finished making changes, remember to close the group to stay organized.

1. Select the Couch001 group you made previously.

2. Choose Group ➢ Open. All open groups will display pink selection brackets, as shown in Figure 2.66.

FIGURE 2.66
Open groups display pink selection brackets.

Pink bounding box indicates an open group.
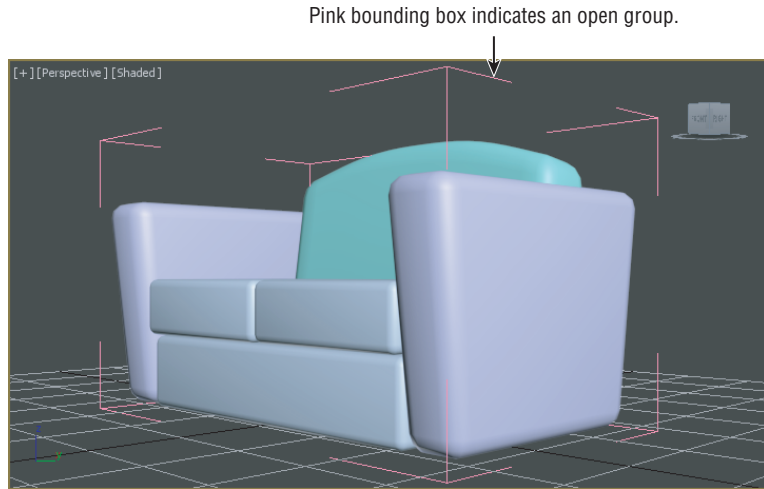
3. In the Left viewport, select the couch back.

4. Click the Angle Snap Toggle icon on the Main Toolbar to turn on the Angle Snap feature.

5. Right-click the Angle Snap Toggle icon to open the Options tab of the Grid And Snaps Settings dialog box, as shown in Figure 2.67.

FIGURE 2.67
The Grid And Snaps Settings dialog box
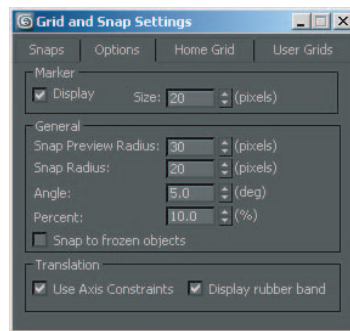
Notice that the Angle snap option is set to 5 degrees; you'll keep this option to restrict the rotation of the back of the couch to 5-degree increments. After you have reviewed the settings on the Options tab, you can dismiss the dialog box by clicking the red X icon.

6. With the back of the couch still selected, click the Select And Rotate button and, in the left viewport, rotate it back 5 degrees more to have a more relaxed seating position, as shown in Figure 2.68.

7. Move the couch back forward to eliminate any gap that may have opened up between the back and seat, as shown in Figure 2.69.

FIGURE 2.68
Rotate the couch-back cushion counterclockwise.
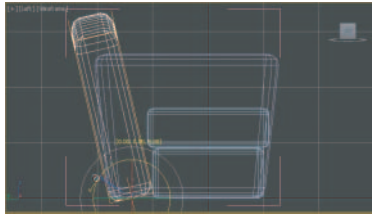
FIGURE 2.69
Move the couch-back cushion to eliminate any gaps.
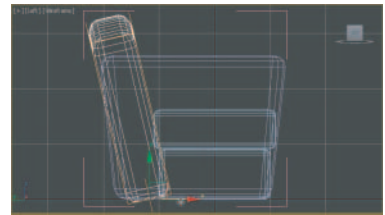
8. Open the Select From Scene dialog box by pressing **H** on the keyboard, and observe how the objects within the group are displayed while the group is open. Notice how the objects belonging to the group are indented to let you know they belong to the Couch001 group, as shown in Figure 2.70. If the group members are not indented, choose Display ➢ Display Children in the Select From Scene dialog box.

FIGURE 2.70
The Select From Scene dialog box showing the open group
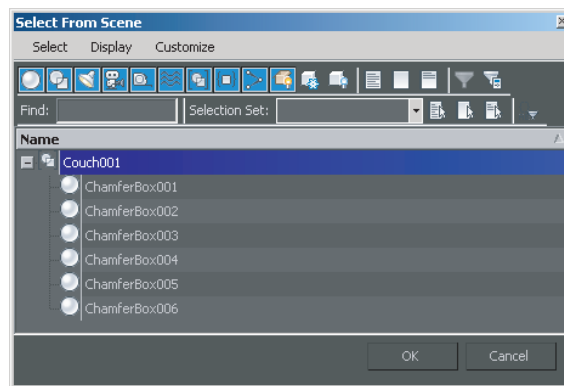
9. Click Cancel to close the Select From Scene dialog box.

10. Now that you have finished editing the objects contained within the group, it is time to close the group. Make sure that at least one group member is selected, and then choose Group ➢ Close.

CLOSING ALL OPEN GROUPS IN A SCENE

If several groups, including nested groups, are open in your scene, you can quickly close all of them by selecting all the objects in the scene (using Edit ➢ Select All or Ctrl+A) and then choosing Group ➢ Close.

11. Open the Select From Scene dialog box again. Note that the edited-and-then-closed group looks just like the group did right after you created it.

12. Save your file.

Disassembling Groups

Groups are convenient for making multiple components react as a single object, but the relationship does not have to be permanent. As easily as groups are created, they can be disbanded.

1. Select the Couch001 group you made previously.

2. Choose Group ➢ Open.

3. Select the two arms of the couch.

4. Choose Group ➢ Detach. Notice that the pink bounding box of the group shrinks just to the four objects currently in the group.

5. Open the Select From Scene dialog box. As you can see in Figure 2.71, the two chamfer boxes that represented the arms are no longer part of the group and are no longer listed under Couch001. Close the dialog box when you have finished.

FIGURE 2.71
The Select From Scene dialog box after the arms are detached
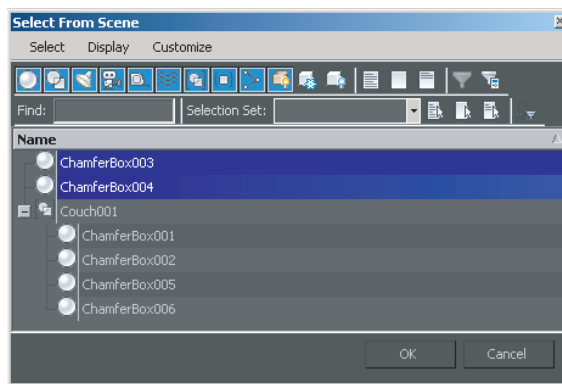
6. Select a remaining member of the Couch001 group, and then choose Group ➢ Close.

7. Choose Group ➢ Ungroup to disband the Couch001 group permanently and remove any relationship between the objects.

8. Close your file without saving it.

You have seen how easy it is to work with groups. If you're familiar with blocks in AutoCAD, you will recognize the similarity to groups in 3ds Max. They are both structures that contain objects and yield higher levels of organization for your data. They differ in that 3ds Max does not automatically instance the objects contained within groups, whereas in AutoCAD, blocks are always made as instances. Grouping in 3ds Max is independent of cloning; the choice of whether to instance, reference, or copy is yours to make separately from any organizational structures of convenience you choose to make with groups.

Groups can contain not only individual objects but other groups as well. This is called *nesting groups*. To manipulate members of a nested group, open the parent group, select the nested

group, and then open that as well. Similar to the Ungroup option, Group ➢ Explode disbands all selected groups as well as any nested groups contained within them.

Similar to groups are Containers. *Containers* are like groups in that they take a number of objects and put them into one single unit that can be transformed easily and can be used to condense long lists of objects in a list view, such as the Select From Scene dialog. Containers have the added attraction that they can be stored in external files and can be "unloaded" from the scene in which you are working to relieve memory problems and unclutter the viewport, thereby increasing performance.

The Bottom Line

Create and modify standard primitives.   3ds Max provides users with a number of standard primitives that can be used to start creating more complex objects. Understanding the shapes of the standard primitives, you can see how more complex objects can be created by the arrangement of simpler standard primitives.

Master It   True or False:
Once you have created a standard primitive in 3ds Max you cannot modify it.

Apply a modifier.   Modifiers provide many ways to manipulate an object that may not be possible by manually transforming the object's sub-objects. The order in which the modifiers appear in the modifier stack determines the final result.

Master It   Create a Teapot primitive, and apply the Slice modifier to it. Raise the Slice plane sub-object until it passes through the middle of the object. Choose the Remove Top option from the Slice Parameters rollout to delete everything above the Slice Plane. Add a Cap Holes modifier to the top of the stack.

Make a clone of a 3ds Max object.   The type of clones you make determines whether modifiers and parameter changes affect the clones as well as the original. Copies are distinct objects, instances maintain the changes between all clones, and references maintain all changes below the reference bar.

Master It   Select the teapot from the previous exercise, and make two clones: one instance and one reference. Turn off the Slice modifier for the instance, and then apply a Twist modifier and increase the amount of twist reflected in the objects. Select the reference clone, and apply a Spherify modifier to the top of the stack.

Manipulate a group.   Groups provide a method for associating separate objects so that they act as if they are a single object. Groups can be opened, allowing individual member objects to be selected or exploded, or the members associated with it to be changed.

Master It   Make one clone each of the teapots from the previous exercise. Select the three original objects, and make them into a group. Remove the spherified teapot from the group, and then add the remaining two non-spherified teapots to the group.

Creating Shapes with Splines

In the previous chapter, you learned about the Autodesk® 3ds® Max 3D primitives and how they can be shaped by parameters and modifiers into an infinite variety of forms. In this chapter, you'll continue your introduction to primitives with an exploration of splines. *Splines* are a type of primitive, and they are classified as shapes in 3ds Max. In a way, shapes are even more primitive than the geometry primitives you looked at in Chapter 2, "Introducing Objects." You can create more varied forms with splines than you can with the geometry primitives, but they require a bit more work to use.

In general, you can think of splines as objects composed of straight-line or curved-line segments. Splines can be two- or three-dimensional; however, unlike solid geometry, splines do not define surface areas or volumes. Splines are defined only along their edge segments. Strictly speaking, a spline is a line or curve whose shape is controlled by its *vertices*, which are the points along the spline. *Bezier* splines are a type of spline that includes features, called *handles*, for controlling the curvature of the spline as it enters or exits each vertex. Splines are initially created as two-dimensional objects (with the exception of the Helix spline primitive, which is a line that curves in 3D space like a spring or a DNA strand).

Like the standard primitives in 3ds Max, most splines are parametric; that is, they can be modified using parameters such as the Width and Length parameters of the Box standard primitive. All the splines can be made three-dimensional by editing their vertices and handles.

A benefit of splines is that you can use them to create an outline of virtually any two-dimensional shape and then *extrude* (project into the third dimension to define a volume) the outline into the third dimension. You can use splines as paths for a variety of purposes, such as camera motion for animated sequences or the path for a *loft*, which is a type of extruded form along a path. Splines can be *lathed* (revolved around an axis), making a surface or volume. You can also create a complex 3D armature with splines over which a surface can be draped.

A *shell* defines a volume that can be extruded out of a three-dimensional surface, which itself may be generated from splines. Suffice it to say that splines are used almost everywhere in 3ds Max and are definitely worth learning to use well.

In this chapter, you'll learn how to use splines to create complex extruded and lathed forms. You'll see how you can apply modifiers to enhance splines, just as you did with geometry primitives. You'll also begin to explore methods for editing objects on what are called *levels*, similar to the modifiers that we discussed in Chapter 2. These are levels of editing at which you can manipulate the components that make up an object.

In this chapter, you will learn to

◆ Draw shapes with splines

◆ Outline and extrude splines

◆ Modify closed splines with Boolean tools

Drawing with Splines

As you'll see in this and later chapters, the ability to edit the location and characteristics of an object's vertices is an essential part of creating and editing objects in 3ds Max. In this chapter, you'll begin working with splines and their associated vertices to gain a better understanding of how you can manipulate objects in general. You'll start with the most primitive of the shape objects: the line. With the Line tool, you can draw line segments, curves, squares, circles, or just about any shape you want. Such shapes can then be extruded, in a manner similar to the way the box and cylinder standard primitives are created, as you saw in the previous chapter.

THE NONPARAMETRIC SHAPES

We mentioned that most 3ds Max shapes are *parametric*, which means they offer a set of parameters that let you modify the shape at will. The Line spline is an exception. Once you've created a Line spline, you cannot use parameters to modify its shape. Lines behave more like the common splines used in other computer design and drafting programs. The Section shape, which is created by following the intersection of a 3D object's edges and a slice plane, is another nonparametric shape. All shapes that are converted to editable splines lose their parametric capabilities.

Let's get started by drawing a simple rectangle using a Line spline:

1. Start 3ds Max 2013, or choose Reset from the Application menu.

2. If necessary, click the Maximize Viewport toggle to display all four viewports, and then right-click in the Top viewport.

3. If required, choose Customize ⊳ Units Setup, then click US Standard and set the units to Feet w/Decimal Inches, set Inches as the default units, and then click OK.

4. If it isn't selected already, click the Create tab in the Command panel.

5. Click the Shapes category. Notice that the drop-down list shows Splines; if it doesn't, expand the drop-down list and select it, as shown in Figure 3.1.

FIGURE 3.1
Selecting Splines as the shapes to create
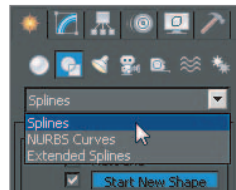
6. Click the Line button in the Object Type rollout.

Notice that a set of new rollouts appears in the bottom half of the Command panel. The Line options that appear offer a variety of ways to construct a spline from line segments.

Drawing Straight-Line Segments

Now you're ready to draw a spline made of line segments. Use the unfinished rectangle in Figure 3.5 as a guide to help you select points as you draw the spline in this exercise. You don't need to be too exact, because you're just practicing.

1. Maximize the Top viewport, and then click a point near coordinate 0'0.0", 10'0.0", 0'0.0" just above the 0,0 origin in the viewport. You can use the coordinate readout at the bottom of the 3ds Max window to locate the point. Now, as you move the cursor, a rubber-banding line follows from the point you just clicked, as shown in Figure 3.2.

FIGURE 3.2
Drawing a line with the Line tool
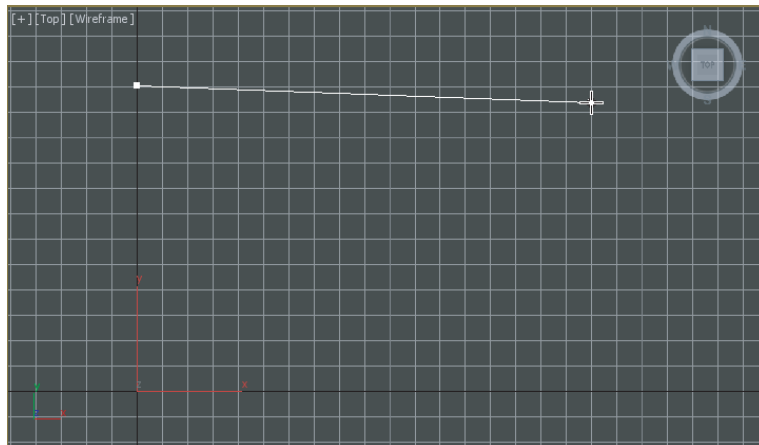
2. Place the cursor near the 15' X-coordinate, directly to the right of the first point, and click. You may need to pan or zoom to avoid clicking the ViewCube®, if you have not hidden it.

ZOOMING WITH THE SCROLL WHEEL

You can zoom toward or away from your scene on the fly by gently rolling the mouse's scroll wheel. Be careful not to click it, because doing so will exit the current command.

3. You can use the coordinate readout again to locate a relative coordinate near 15′0.0″, 0′0.0″, 0′0.0″. Click to create the second line segment fixed between the last two points you selected, as shown in Figure 3.3. (Don't worry if your line segment is not exactly straight.)

FIGURE 3.3
Drawing the second line segment
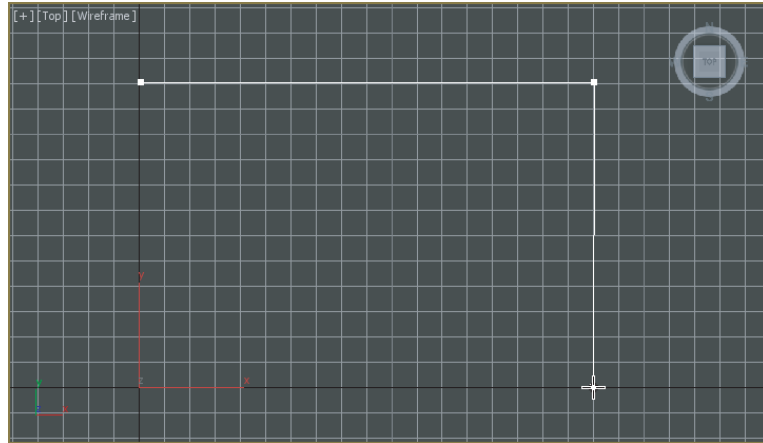
4. Place the cursor over a point near the origin of the grid, and then click again.

5. Click the beginning of the line segment near where you started drawing the line. You'll see a dialog box asking you whether you want to close the spline (see Figure 3.4).

FIGURE 3.4
Closing the spline
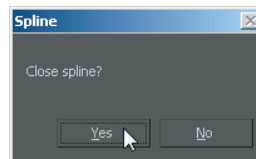
6. Click Yes. The rectangle is complete, and 3ds Max awaits your next point selection to draw another spline. Figure 3.5 shows the entire rectangle procedure.

CREATING AN OPEN SPLINE

You can right-click to stop drawing and create an open spline with an ending vertex that isn't connected to its starting vertex.

You've just drawn a rectangle. It's not necessarily straight, but now you know that you can draw a rectangle by clicking points in the drawing area. You also saw that you can close the set of line segments by clicking the beginning point. The Spline dialog box appears, offering you the option of either closing the set of line segments or leaving it open. When you select Yes, the beginning and ending points of the spline are connected exactly end to end.

FIGURE 3.5

Drawing a rectangle with the Line tool

Start your line here.
Return to the beginning in the X direction.

Second 15-foot vertex

[+][Top][Wireframe]

Fourth vertex near origin

Third 10-foot vertex in the negative Y direction
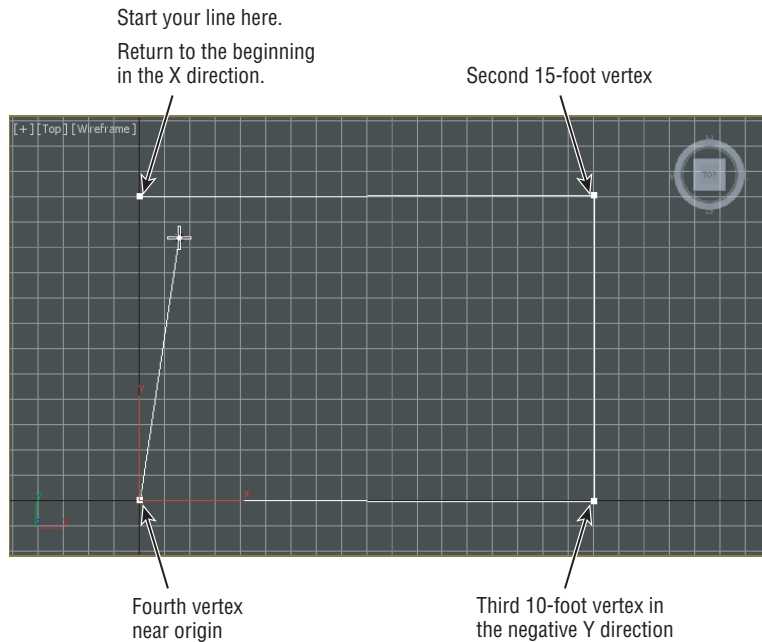
Constraining Lines Vertically and Horizontally

Some of the lines you drew in the previous exercise may not be perfectly horizontal or vertical. 3ds Max offers some tools that constrain your lines to ones that are perfectly horizontal and vertical, much as a T-square and triangle constrain your lines when you draft on a drafting board.

One way to constrain lines vertically or horizontally is to use the Shift key. Let's try drawing another rectangle using this technique:

1. Make sure the Line button in the Object Type rollout is still active; it should be highlighted and appear to be in a down position.

2. Click a point about 10″ directly below the 0,0 coordinate. Once again, you see a rubber-banding line as you move your cursor around the screen.

3. Hold down the Shift key as you move the cursor. The rubber-banding line is constrained in a vertical or horizontal direction.

4. Point the cursor down, and click a point 5′ below the last point. A vertical line is drawn.

5. Right-click to stop drawing the current line, and then press the Delete key to delete the line you just drew.

6. Choose the Select tool from the Main tool bar, or press Esc on the keyboard to exit the Line tool. Then select and delete the original rectangle as well.

SELECTING OBJECTS WITH THE QUAD MENU

You can also access the Select Object tool by right-clicking and choosing Select from the quad menu's Transform quadrant.

Drawing Curves

The Spline tool also allows you to draw curves, as the following exercise demonstrates:

1. Set the Top viewport so that the origin is near the upper-left corner of the viewport.

2. With the Line button selected, change the Drag Type to Bezier in the Creation Method rollout.

3. Click and drag the mouse while still holding down the left mouse button from a point near the origin to the right.

4. Continue to drag the mouse approximately 10′ to the right, and then release the left mouse button. You can use the coordinate readout to estimate your distance. Now, as you move the mouse, the line becomes a curve emerging from the starting point in the general direction indicated by the first two points you selected or indicated (see Figure 3.6).

5. Click a point about 10′ to the right and 10′ down, as shown in Figure 3.7. The spline's curved shape is now fixed, and a straight rubber-banding line appears from the last point you picked.

FIGURE 3.6
Placing the second point of a curved-line segment

Click and drag the line
from here to the right.

[+][Top][Wireframe]

And then here.
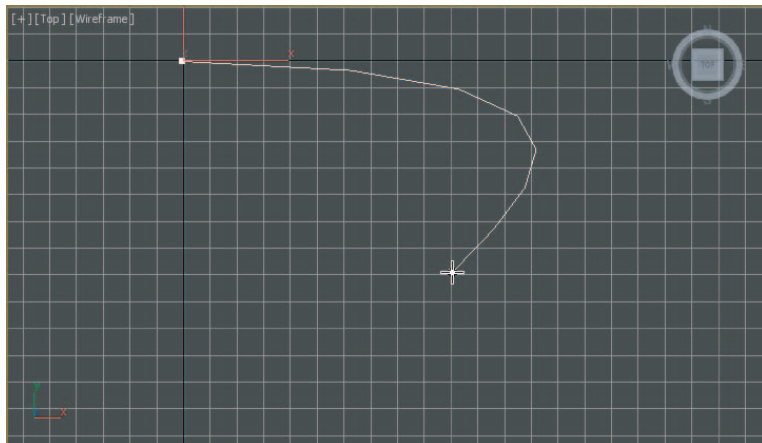
Click here.
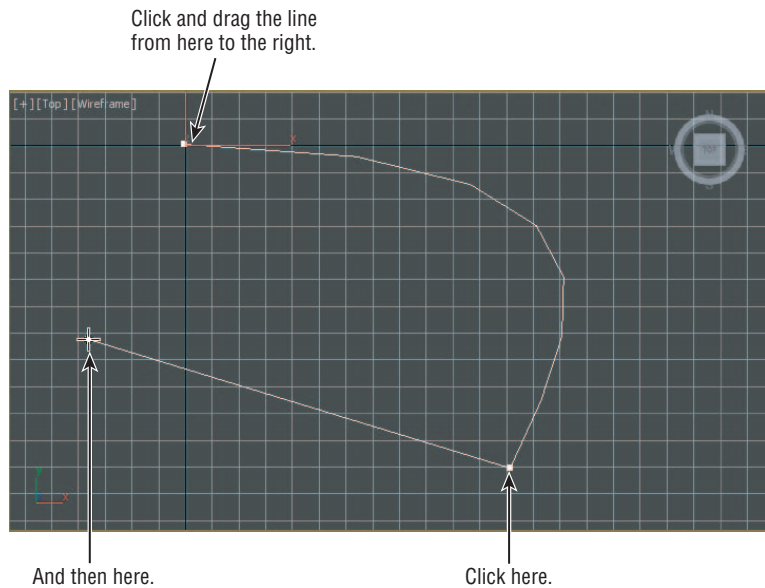
6. Click another point below and to the left of the origin of the drawing at coordinate
   –3′,–6′. A straight-line segment is added.

7. Right-click to end your line input. (See Figure 3.7.)

8. Press the Delete key to erase the lines. You won't need them anymore.

CREATING CURVED OR STRAIGHT SPLINE SEGMENTS

It is fairly easy, especially when you're in a hurry, to click and drag a point accidentally, in which
case you'll get a curve in your line segment. If you just want a straight-line segment, take care not
to drag your mouse inadvertently while clicking. You can also set the Drag Type option to Corner
in the Creation Method rollout of the Line object to ensure that you'll get a straight line even if you
drag. This is the default behavior in 3ds Max 2013.

You have seen that by clicking and dragging a point, you can add a curve to the spline. A
single click gives you a straight *corner point*. Once you've drawn a spline, you can later edit a
curve in the spline, add more vertices, remove existing ones, or even convert a corner vertex into
a curved one for rounded corners.

You can add accurate lines to a 3ds Max scene in several ways. Two other common methods
are setting up an appropriately sized grid and snapping to the grid points, or importing 2D

linework from Autodesk's AutoCAD® family of products or Adobe Illustrator. Snaps are covered later in this chapter, and utilizing AutoCAD files is covered in Chapter 5, "Working with External Design Data."

Lathing a Spline

Next, you'll create a wineglass using a spline. This will give you a chance to see how you can edit a spline to achieve a desired effect. A wineglass provides a fine example of the versatility of the Line tool, and you can use the Lathe modifier to create any type of revolved object, from a bowling pin to a banister post, using a spline. You will create a model of the wineglass shown in Figure 3.8.

FIGURE 3.8
The wineglass you
will model

When creating 3D objects, whether it is for use in television, films, or games or for visualization, it is important that the models you build are at the correct real-world size. This is important for many reasons, including how 3ds Max and mental ray treat light and material properties, which you will learn about later in this book. Another crucial reason for modeling to real-world dimensions is that, when you bring many different models together to create more complex and compelling scenes, if the models you use are not built to real-world dimensions, an object like this wine glass could be significantly larger than the table it is to be placed on, and then you will have to spend time scaling all the objects in the scene to fit together appropriately.

1. To view all the viewports if necessary, click the Maximize Viewport toggle in the viewport navigation controls. Then right-click in the Front viewport to activate it.

2. Click the Rectangle button in the Object Type rollout of the Create tab.

3. Expand the Keyboard Entry rollout, enter **7.125**″ for the Length value and **3.125**″ for the Width, and click the Create button.

4. Click the Zoom Extents All button to make the rectangle fill the Front viewport.

5. Click the Line button in the Object Type rollout of the Command panel's Create tab.

6. Draw the initial profile of the wineglass, starting at the lip and working down to the base. You can use the grid and Figure 3.9 to locate the points indicated in the figure. If the grid doesn't already appear, press the **G** key to turn it on.

FIGURE 3.9
Drawing the initial wineglass profile
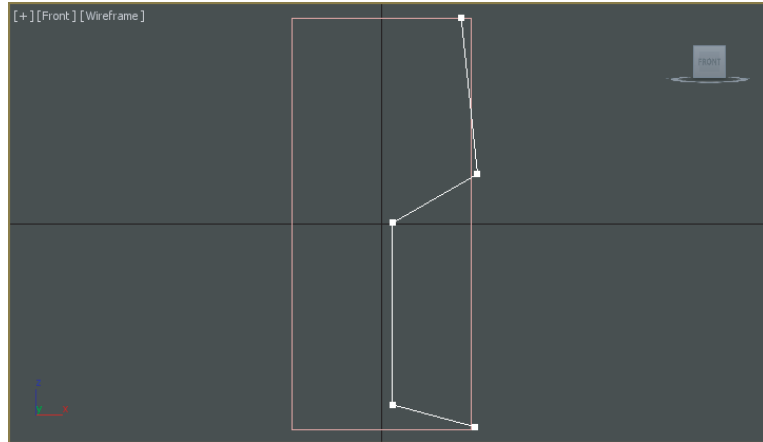
VIEWPORT GRID SUBDIVISION

The default setting, Inhibit Grid Subdivision Below Grid Spacing, prevents 3ds Max from generating smaller grids when viewports are zoomed in closer than the value specified in the Grid Spacing parameter on the Home Grid tab of the Grid And Snap Settings dialog box. To see finer-resolution grids in your scenes, you need to turn off this setting.
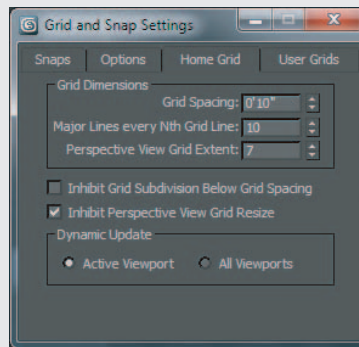
Don't click and drag any of the points, and don't worry if your placement isn't exact. You just need to create the general outline. Later, you'll learn how to apply a curve to a spline. It is easier to start with straight-line segments and later curve them to your liking than it is to start directly with imperfect curved segments.

7. Right-click to terminate the command when you have finished.

DELETING A VERTEX WITHOUT TERMINATING THE LINE TOOL

Don't try to click the Undo Scene Operations button when you're using the Line tool; this will place a vertex in the scene at a location behind the button. If you click a point accidentally, you can go back to the previous vertex by pressing the Backspace key.

The next step is to turn the profile you have drawn into a 3D wineglass.

8. With the spline profile selected, click the Modify tab in the Command panel.

9. Open the Modifier List drop-down. Find and then click the Lathe modifier.

A somewhat cylindrical shape is created by revolving the profile of the spline, as you can see in Figure 3.10.

The shape isn't quite what you would expect. The Lathe tool wrapped the spline profile about the profile's center, which is not necessarily where you want the action to occur. You can make some simple adjustments to a spline on a sub-object level to get the exact shape you want, as described in the next section.

FIGURE 3.10
The result of applying the Lathe modifier to the spline
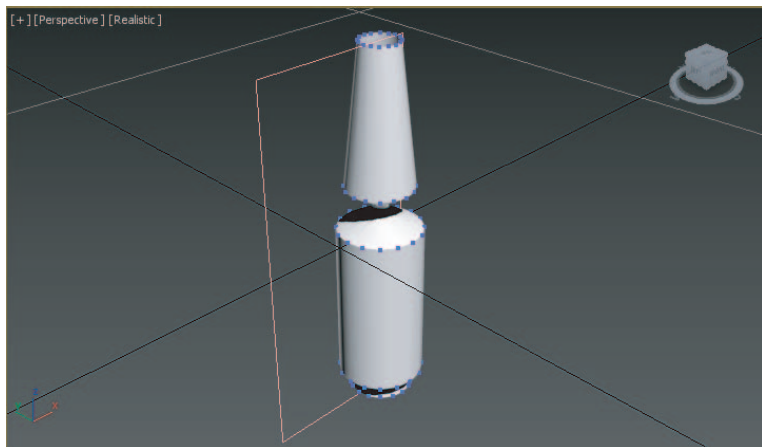
USING THE LATHE MODIFIER'S MIN OPTION

You could also click the Min button in the Align section of the Lathe modifier's Parameters rollout without resorting to entering a sub-object level, but you would still need to make some fine adjustments to make sure the stem had some volume.

Modifying a Shape Using Sub-object Levels

Objects in 3ds Max are fairly complex entities that offer built-in parameters for controlling their shape. As you saw in Chapter 2, you can add even more control by using modifiers. However, parameters and modifiers are limiting when it comes to some of the more minute

and detailed changes you might want to make to objects. For example, parameters allow you to adjust the overall height and width of a box, and modifiers allow you to taper the overall shape — but what do you do when you want to add a bulge to one surface or remove one side of a box? To make these types of changes, you need to access objects on a more fundamental level than parameters and modifiers provide. 3ds Max offers that access through sub-object modeling.

There are four basic methods for gaining access to an object's sub-object levels:

◆ One method, not available to all objects or modifiers, is to use the red buttons in the Selection rollout on the Modify tab of the Command panel.

◆ Another method is to click the plus (+) sign next to the name of an object in the modifier stack and then select the sub-object level from the expanded list.

◆ You can also use the 1 through 6 keys, at the top of the keyboard (but not in the numeric keypad), to act as shortcut keys. The 1 through 5 keys access the different sub-object levels when available, and the 6 key returns 3ds Max to the object or modifier top level. The 6 key does not work with editable splines.

◆ Still another way to access an object's sub-object levels is to use the quad menus that appear when you right-click in a viewport. The tools 1 quad menu contains a listing of each of the available sub-object levels as well as the Top level.

Sub-objects in a spline are the lines or curve segments of the spline and the vertices at each line-segment intersection. When you enter the sub-object level of an object, you gain access to these sub-objects. You can alter the characteristics of each sub-object to fine-tune the overall object's shape.

There are three sub-object levels in a spline: Vertex, Segment, and Spline. Vertices are points in space that define both the endpoints of each segment and the curvature of the segments as they enter or exit the vertex. Segments are the visible portions of the spline that display in the viewports. Segments consist of one or more straight steps that further define the curvature of the segment. The number of steps between each vertex is set in the spline's Interpolation rollout. Every segment is terminated at each end by one vertex, but a single vertex can terminate many segments. This may be a bit confusing, but splines can also consist of several noncontiguous spline sub-objects. A *spline sub-object* consists of all contiguous segments that were created at the same time. The Donut spline primitive and text objects consist of more than one spline sub-object that can be selected and edited independently of the others.

You can also edit modifiers on a sub-object level, although you are usually more limited in the number of levels to choose from within modifiers. Still, using these levels, you can make adjustments to the way modifiers affect the object. You'll start your exploration of sub-object editing by adjusting the Lathe modifier's Axis level.

Adjusting the Lathe Axis

The wineglass profile you created in the previous exercise isn't quite where it should be in relation to the center of the Lathe axis. You can move the center axis of the Lathe modifier to the location you want by moving the modifier's axis of rotation. Let's try that now:

1. Click the plus sign to the left of the Lathe listing in the modifier stack. Axis appears as an option under the Lathe modifier.

2. Click the Axis option, and it will be highlighted in yellow to indicate that you can now edit on this level. Also notice that the Select And Move tool in the Main Toolbar is

automatically selected and that the Move Transform gizmo appears at the center of the Lathe object.

3. In the Front viewport, click and drag in the X-axis handle of the Transform gizmo to the left until it looks like Figure 3.11. Now the lathed spline looks more like a wineglass.

4. Click the Zoom Extents All tool to get a better view. Your Perspective viewport should look similar to Figure 3.12.

FIGURE 3.11
Moving the Lathe axis

Click and drag the X-axis handle, with the red arrow, to the left.
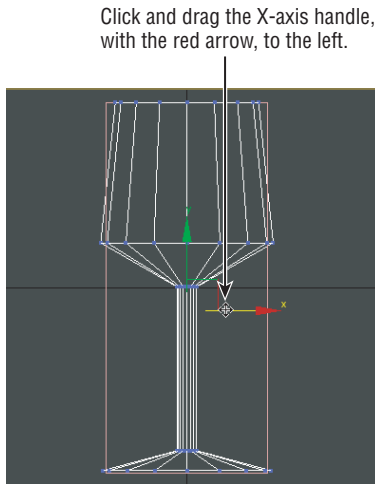
FIGURE 3.12
The wineglass so far
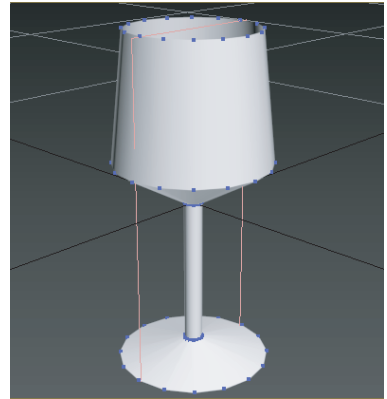
LOOK OUT FOR YELLOW

Yellow is a warning color in 3ds Max, and it is meant to grab your attention. Whenever a sub-object level is selected, you can select and manipulate only sub-objects of the currently selected object, and you are prohibited from selecting anything else in your scene.

The sub-object button is highlighted whenever a sub-object level is accessed.

The Selection Lock toggle — the icon that looks like a padlock to the left of the transform type-ins at the bottom of the user interface — becomes highlighted in yellow to indicate that the user has locked the current selection to ensure that the selection set remains selected even if a blank area of a viewport is clicked. The shortcut key for the Selection Lock toggle is the spacebar. If you find that you cannot select an object, ensure that a sub-object level is not accessed and that the Selection Lock toggle is not active.

TRANSFORMING THE AXIS GIZMO

As a shortcut to steps 1 and 2 of this exercise, you can click the plus sign next to Lathe in the modifier stack so that it is expanded. You can first use the Min button in the Align group of the Parameters rollout to get a shape closer to the one you want and then fine-tune the shape by entering the Axis level and transforming the gizmo if necessary.

Here you see how the Transform gizmo can be moved to alter the way the Lathe axis affects the resulting three-dimensional object. The Lathe axis offers control over the way modifiers act on an object.

Flipping Surface Normals

At this point, you might notice that your perspective view of the wineglass looks a bit odd. Some of the parts may seem to be missing. As you model other objects in 3ds Max 2013, you may find that sometimes surfaces seem to disappear. This can also be a problem when files are imported from some CAD programs. You know that the surfaces are there, because you can see them in wireframe view. Where do these surfaces go? This problem happens less as video card hardware and drivers increase in quality and speed, so it may not occur on your system. If the wineglass displays correctly on your system, as shown in the earlier Figure 3.12, you can skip to the "Smoothing Spline Corners" section.

To understand why surfaces disappear, you need to know one basic fact about 3D computer models: A surface has only one visible side. The other side of a surface is invisible. Like a one-way mirror, an object appears solid from one direction and transparent from the other.

CERT OBJECTIVE

Surfaces are visible or invisible, depending on the direction of their normals. A *normal* is a mathematical concept indicating a vector pointing perpendicularly away from a plane (as defined by at least three points); the direction of the normal is determined by the order and direction in which these points are created. Figure 3.13 shows an example of a typical object face and its normal.

FIGURE 3.13

A typical 3D surface and its components and normal
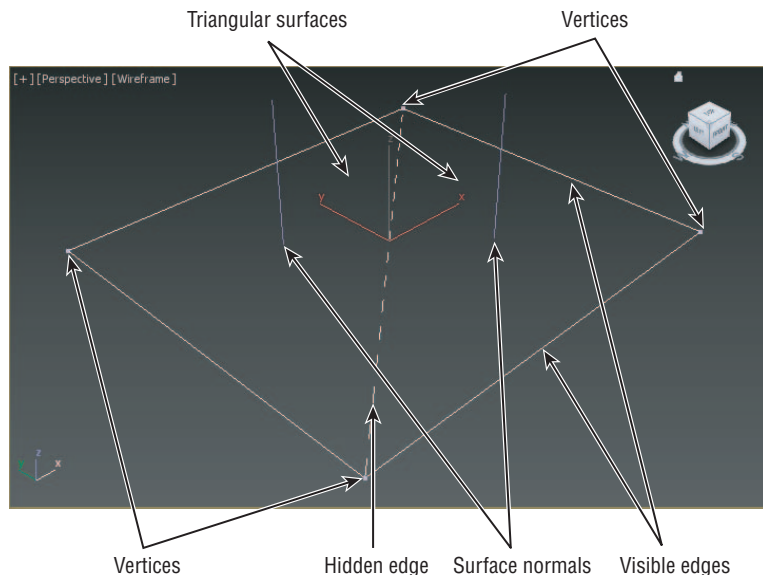
You will now flip the normals of the wineglass so that the surface faces the opposite direction:

1. Select the top level of the Lathe modifier by clicking Lathe in the modifier stack.

2. Check the Flip Normals option in the Parameters rollout.

To verify that the normals of the wineglass are now facing the exterior of the glass, you will place an Edit Mesh modifier on the object.

3. From the Modifier drop-down list, select the Edit Mesh modifier.

4. Select the Polygon sub-object mode, and then press Ctrl+A or choose Edit ➢ Select All to select all the polygons in the Wineglass object.

You may have to check the Show Normals option in the Selection rollout and lower the scale to 1.0. Now you can see the blue lines of the polygon normals radiating away from the Wineglass object (see Figure 3.14).

FIGURE 3.14
Flipped normals on the wineglass
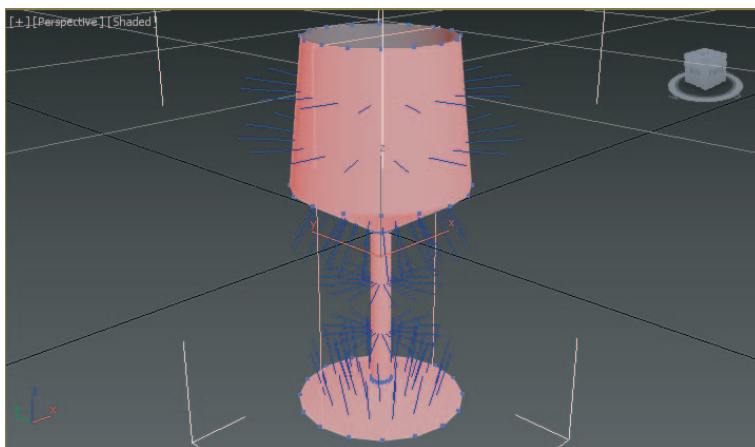
5. Click the trash bin icon to remove the Edit Mesh modifier from the stack.

In most situations, you'll create objects in 3ds Max that have volume rather than objects with flat, two-dimensional faces. When you create a volume such as a box or the lathed outline of a wineglass, 3ds Max will automatically align the normals of the surfaces so that they all point outward, away from the interior of the volume. You'll see this happen later, when you use the Outline option on the spline for the wineglass, effectively creating a double-walled surface to represent the glass. Instead of creating a surface using a single layer of surfaces, the Outline option creates a closed volume with a distinct interior and exterior.

In general, 3ds Max takes care of the normals in objects, but if you import objects from some CAD packages, sometimes surfaces disappear. You can use a number of methods to fix these disappearing surfaces. One method to fix the normals on a mesh that works most of the time is to use the Shell modifier with values of zero. The Shell modifier works similarly to the Outline option on a spline, by offsetting new faces on the geometry. You'll learn about the other methods as you begin to work with materials later in this book.

Smoothing Spline Corners

You now have a wineglass that looks a bit crude. Next you'll smooth some of the rough spots out by returning to the Spline primitive and editing it.

1. Select Line from the modifier stack. Your view of the wineglass returns to the flat spline you drew earlier. Notice that the options below the modifier stack change to a set of options related to the spline.

2. Click the Vertex option in the Selection rollout so that it is highlighted.

3. Click the second vertex of the spline to select it.

4. Right-click in the viewport to open the quad menu, and then click the Bezier option, as shown in Figure 3.15.

FIGURE 3.15
Converting the
second vertex to a
Bezier vertex
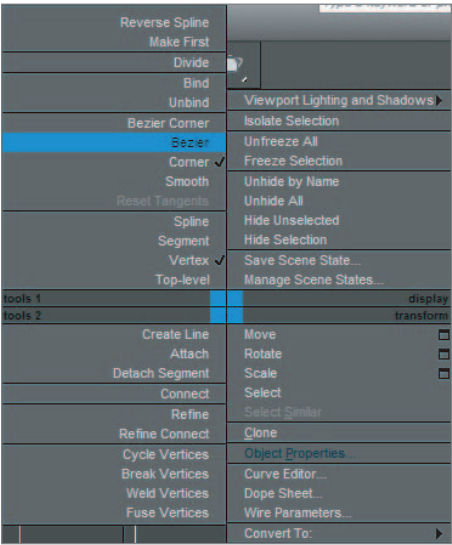
The line changes to a curve, and two handles appear emerging from the vertex, as shown in Figure 3.16.

FIGURE 3.16
The second vertex
converted to a
Bezier vertex
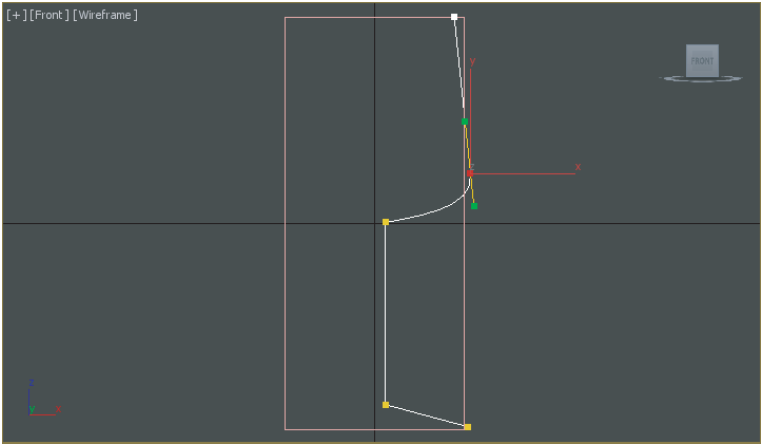
The Bezier option turns a vertex into a control point for a Bezier curve passing through that vertex. You can manipulate the Bezier curves by adjusting the tangent handles that appear:

1. With the Select And Move tool active, click and drag the upper Bezier tangent handle (the green end of the yellow lines protruding from the vertex) to deform the spline to the shape shown in Figure 3.17. If the Move tool is restricted to an axis, press the F8 key repeatedly until the Transform gizmo's XY-plane handle highlights, indicating that it is free to move in both axes. You may also want to drag the vertex itself to a new position by clicking and dragging the axis and plane handles of the Transform gizmo.

FIGURE 3.17
Click and drag the
vertex and its tan-
gent handles.

Use the Move tool to drag the
selected vertices to a new position.
Also drag the green handles to
adjust the curvature of the spline.
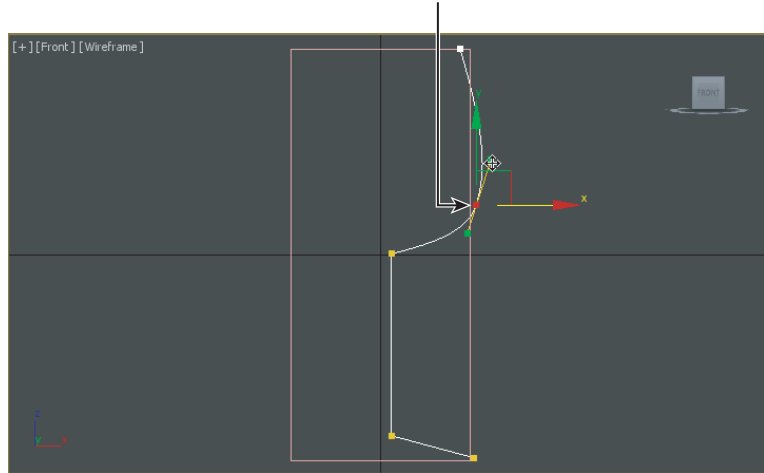
2. Click the next vertex toward the stem of the wineglass, as shown in Figure 3.18. Right-
   click in the viewport after you select the vertex, and then select Bezier Corner from the
   quad menu. Now you see two handles from this vertex, but this time the handles are not
   opposite each other. Instead, they point in different directions.

FIGURE 3.18
Convert the next
vertex to a Bezier
Corner vertex.

Select this vertex.
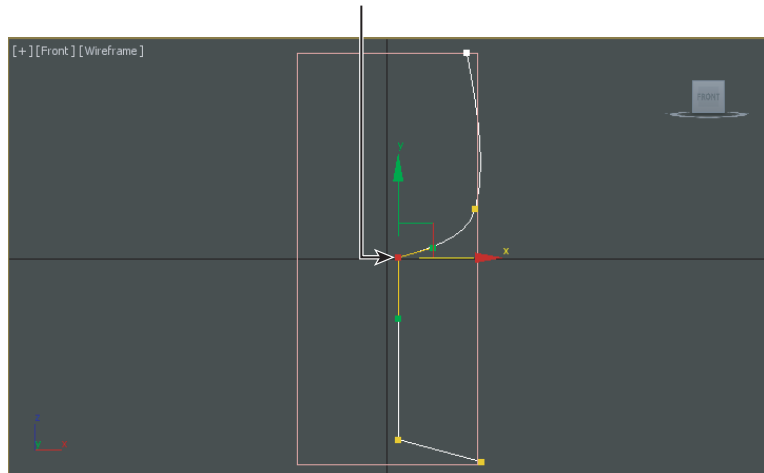
3. Click and drag each of the Bezier handles into position, as shown in Figure 3.19.
   Notice that the Bezier Corner option lets you control the curve from the vertex in both
   directions.

Move the handles as shown to
adjust the curvature at the stem.
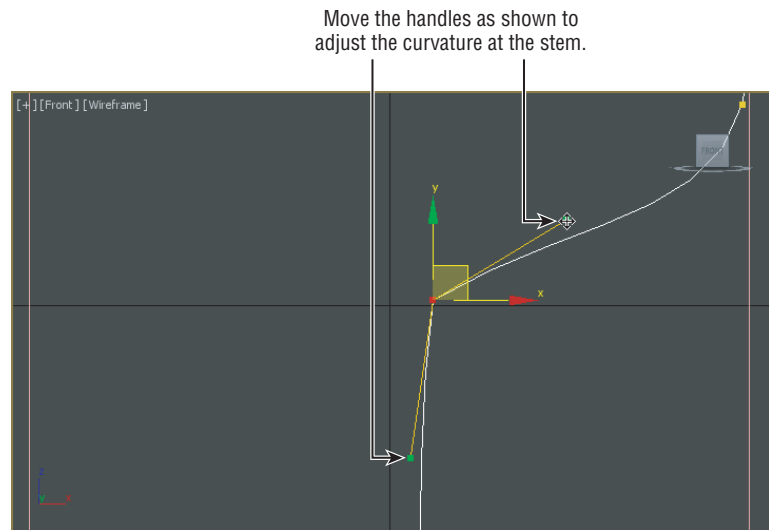
4. Click Line in the modifier stack to exit the Vertex sub-object level, and then click Lathe in the modifier stack. You now see how your changes to the spline translate to the form of the wineglass, as shown in Figure 3.20.

FIGURE 3.20
The view of the
wineglass so far
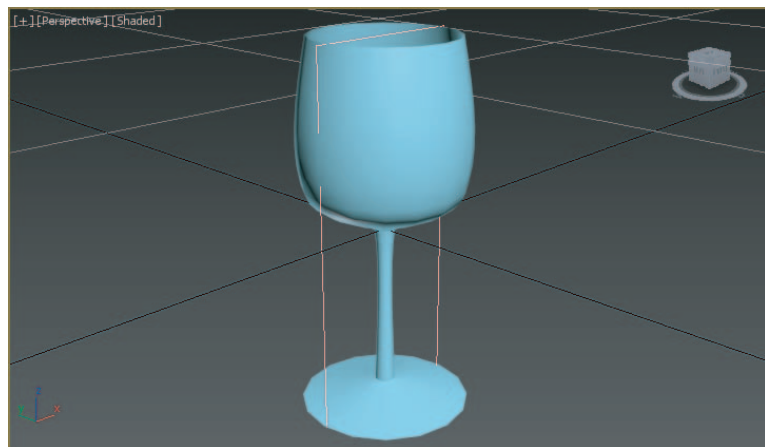
In this exercise, you have begun to see that splines are really made up of components, or sub-objects. You used the Transform gizmo to reposition the axis used by the Lathe modifier. You also changed the characteristics of a vertex by editing at the Vertex level. For example, the quad menu options allow you to change the shape of a spline just by changing the type of vertex being used. Four of the options on the Vertex shortcut menu relate to the way the vertex affects corners:

Smooth This option turns a sharp corner into a rounded one. This has an effect similar to that of the Bezier option without offering the Bezier handles.

Corner   This option turns a Bezier or smooth corner into a sharp corner with no curve entering or exiting the vertex.

Bezier   This option converts a corner into a Bezier curve with symmetrical handles that allow you to adjust the pull and direction of the curve.

Bezier Corner   This option converts a corner to a Bezier curve with handles that allow you to adjust the pull and direction of the curve. Unlike the regular Bezier option, Bezier Corner allows you to control the handles independently in both directions from the vertex.

Remember that to use these corner options, you need to be editing on the Vertex sub-object level.

USING QUAD SHORTCUT MENUS

In the wineglass exercise, you used a context menu that appeared when you right-clicked the vertex of a selected spline. You may have been a bit surprised by the appearance of this particular shortcut menu — it's really several menus arranged in a quad fashion. In fact, 3ds Max calls this a *quad menu*. The options on the quads vary depending on the context.

Many of the options in the quad menu are actually duplicates of options in the Modify tab of the Command panel and on the Main Toolbar. These options provide a quick way to get to options that relate specifically to the object you're editing. By using the quad menu, you don't need to sort through a set of buttons in the Command panel, many of which may be grayed out.

Be aware that the options in the quad menu are often abbreviated versions of those found in the Command panel, and they frequently don't offer keyboard input. If you want to edit an object visually, the context menu options work just fine. However, if you need to enter exact dimensions, you'll want to go to the Modify tab of the Command panel and use the tools and options there.

Adjusting Tangent Handles

3ds Max has several controls for the way you can work with spline vertices and their tangent handles. Let's explore these features.

1. Above your wineglass, draw a spline in the Top viewport, alternating straight and curved segments similar to Figure 3.21. Do this by alternately clicking and clicking/dragging the mouse while using the Line tool. Right-click to finish drawing the spline.

2. Switch to the Modify panel, and right-click in the viewport to bring up the quad menu. Select Vertex from the tools 1 quad to enter the Vertex sub-object level for editing.

3. Select a few vertices of your choosing either by dragging a selection window or by Ctrl+clicking individual vertices.

4. Right-click, and change the tangent type for the entire selection to Bezier Corner from the tools 1 quad.

Being able to change the tangent type of multiple vertices in a selection set is an excellent feature in 3ds Max. This is much better than it was in early versions of 3ds Max, where you had to change each vertex one at a time by right-clicking directly on top of the vertex on which you

wanted to work. Another valuable feature is the way you can copy and paste tangent handle orientations between handles:

FIGURE 3.21
Draw a curved spline in the viewport.
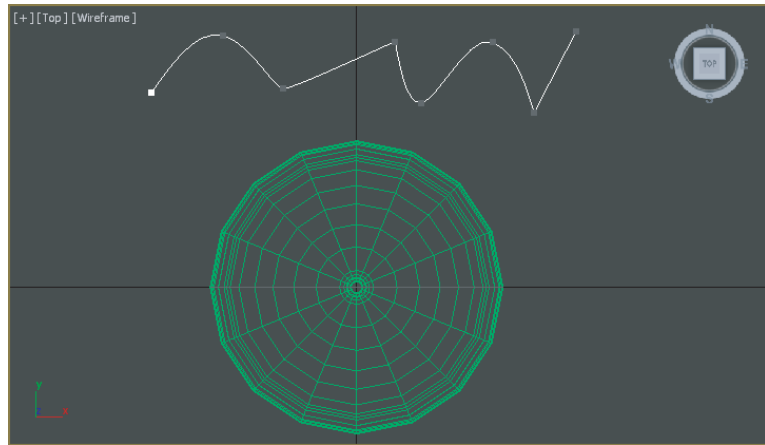
1. While you are still in the Vertex sub-object level for editing, in the Modify panel, scroll down in the Geometry rollout and locate the Tangent group. Click the Copy button.

2. When the Copy button is active, you are in a mode where you can select a tangent handle to copy its orientation to the Clipboard. Click one of the handles of either a Bezier or Bezier Corner vertex, as shown in Figure 3.22. You will automatically exit Copy mode when you click.

FIGURE 3.22
Copying the tangent handle's orientation to the Clipboard
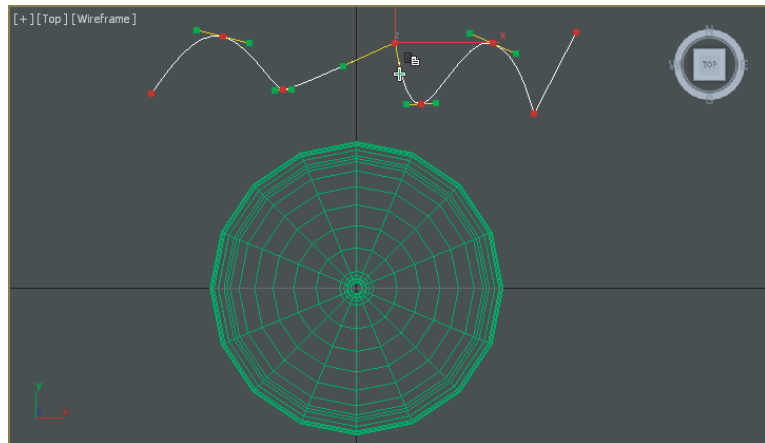
3. Click the Paste button in the Tangent group.

4. Click the handle of another Bezier vertex. This matches the tangent handle orientation stored on the Clipboard to the vertex where you choose to paste it. Notice that your cursor changes to a Clipboard Paste icon while over a green tangent handle, as shown in Figure 3.23.

FIGURE 3.23
Pasting one tangent handle's orientation to another
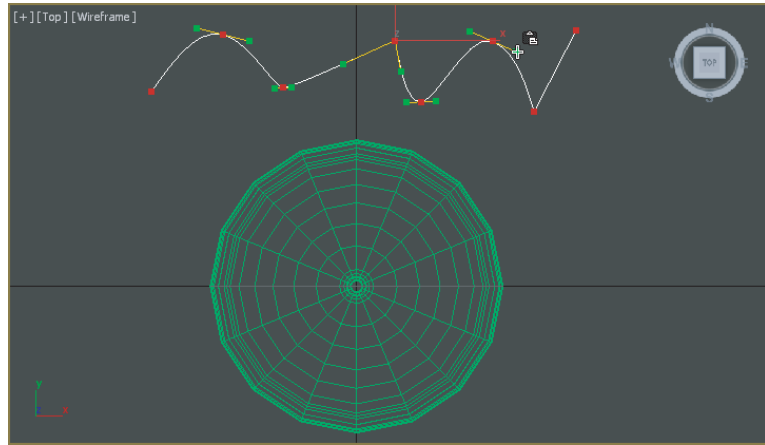
As you copy and paste handle orientations between vertices, you are making these handles parallel to each other (see Figure 3.24). This can be convenient when you're shaping splines in your 3ds Max scene.

FIGURE 3.24
Once you paste the orientation, the handles from different vertices are parallel.
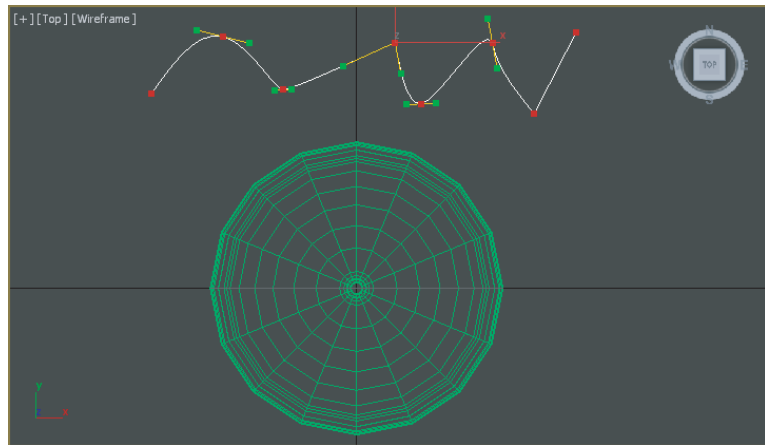
Another feature that is useful when editing splines is the Reset Tangents option in the tools 1 quad menu. Use this option when you want the orientations of the tangent handles you already copied and pasted to revert to their original orientations. You can think of it as a specialized undo tool for tangent handles. Exit the Vertex sub-object level, and then delete the selected line.

Creating Thickness with a Spline

The wineglass is currently an object with surfaces but no thickness. To make this glass appear more realistic, you can give it some thickness. Here's how it's done:

1. Select the wineglass, and then click Line in the modifier stack.

2. Select the Spline level in the Selection rollout.

3. Click the spline. Notice that now the entire spline turns red, indicating that it's selected.

4. Scroll down the Modify panel until you see the Outline button in the Geometry rollout.

5. Click the input box to the right of the Outline button, and then change its value from 0'0.0″ to **0'0.125″** and press ↵. The spline is outlined and now represented by a double wall.

6. Go back up to the modifier stack and select Lathe. You now see the entire glass, including those portions of the glass that may not have appeared previously because of the orientation of the normals (see Figure 3.25).

7. Zoom in close to the top of the object; you will see that the wineglass appears chunky, or faceted, as shown in Figure 3.26.

8. Try increasing the number of segments in the Lathe modifier Parameters rollout to 36 or so to make the edges of the wineglass appear more rounded.

9. Your wineglass appears smoother and less faceted in the Perspective viewport, as shown in Figure 3.27.

FIGURE 3.25
The wineglass after outlining the spline

FIGURE 3.26
The rim of the wineglass
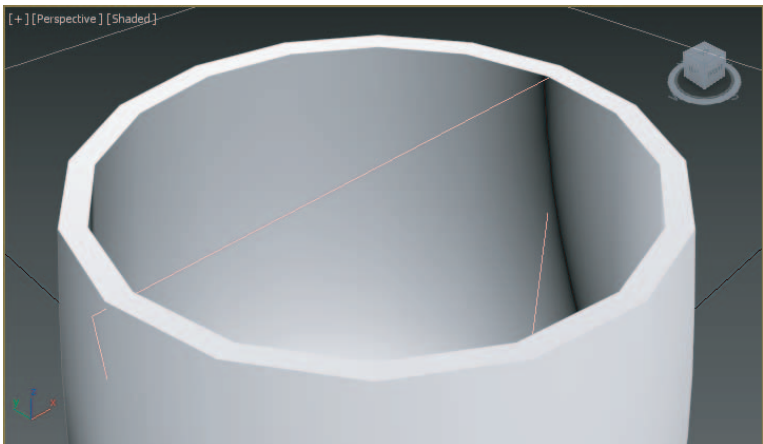
FIGURE 3.27
The smooth
wineglass
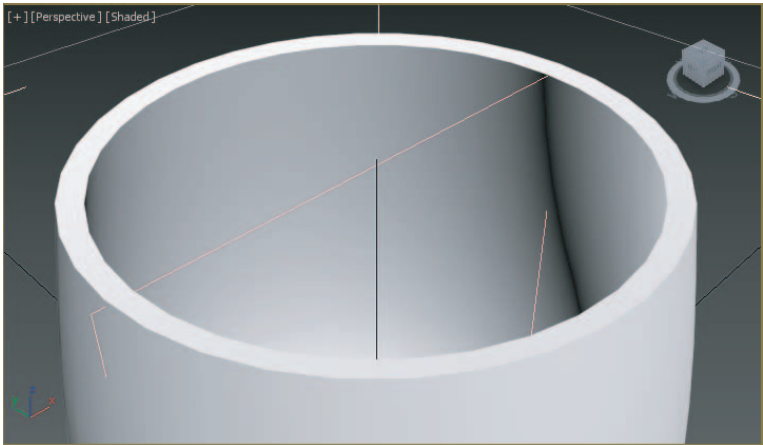
10. Choose File ➢ Save, and then name and save your wineglass model in your Chapter 3 project directory as **My_Wineglass.max**.

In step 5, when you entered a value for the outline, 3ds Max changed the single-line spline into an outline using the spline, thereby creating a double-lined spline. In this context, entering an Outline value has the effect of creating a cross section with thickness.

The Outline option generates an outline using the existing spline as one side of the outline. To determine the side on which the outline appears, check the direction in which the original spline was created. For example, if a spline is drawn from left to right, the outline will appear on the top side, as shown in Figure 3.28.

FIGURE 3.28
Determining the
side of the outline

Direction of vertex creation

Direction of outline
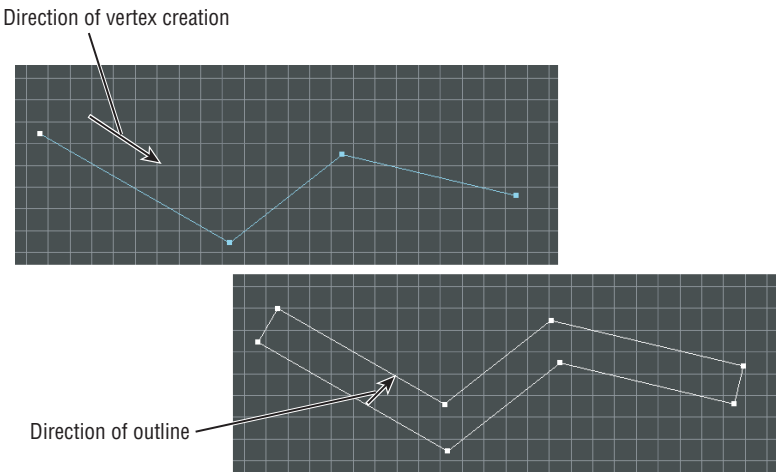
THE OUTLINE TOOL'S CENTER OPTION

The Center check box just below the Outline input box causes the outline to be centered on the original spline instead of on either side of the spline.

If you're not sure of the order in which a spline was drawn, select the Line object, select Vertex, and then click the Show Vertex Numbers check box in the Selection rollout of the Modify tab (see Figure 3.29).

FIGURE 3.29
Turning on Show
Vertex Numbers
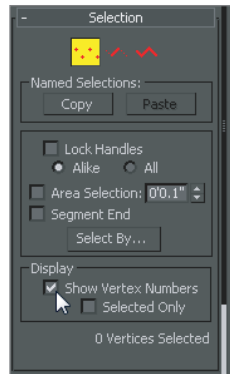
With the Show Vertex Numbers check box selected, you'll see each vertex labeled with a small black number, indicating the order in which the vertices were created (Figure 3.30).

FIGURE 3.30
The vertex
numbers shown in
the viewport
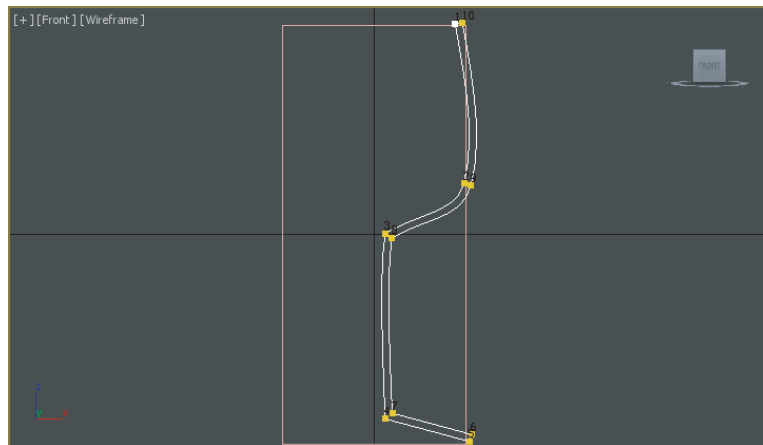
If you want the outline to appear on the opposite side, you can either enter a negative value for the Outline distance, or you can reverse the order of the vertices using the Reverse button in the Geometry rollout of the Modify tab. The Reverse button is active only when you select Spline from the Selection rollout or the modifier stack. You must also have a spline sub-object selected.

So far, you've used the sub-object options and parameters to adjust the spline curve to a shape that gives the impression of a wineglass. The steps you took while editing the spline are similar to those you would take for other types of objects. As you've seen in some of the rollouts, there is a bewildering array of options you can apply to a sub-object, but you've covered the main points regarding sub-object editing. Throughout this book, you'll continue to work on a sub-object level to edit items such as segments and vertices.

Detailing the Wineglass Base

The wineglass doesn't yet look exactly like the picture you saw at the beginning of these exercises, so let's finish it up quickly so that you have an object you can use again later in this book for applying materials and then rendering with some advanced features of mental ray.

1. Click the Line entry in the modifier stack, and then select the Segment sub-object level.

2. Select the spline segment that would represent the inside of the stem of the glass, as shown in Figure 3.31, and delete it.

3. Switch to the Vertex sub-object of the spline, and select the top vertex of the open spline, as shown in Figure 3.32.

4. Right-click in the viewport to bring up the quad menu, and click the Transform type-in button next to Move on the Transform panel, as shown in Figure 3.33.

FIGURE 3.31
Select the inner segment of the wineglass stem.
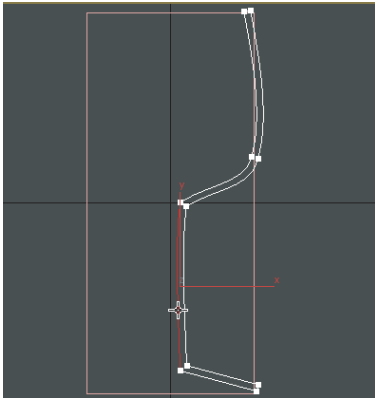
FIGURE 3.32
Select the top vertex of the open spline.
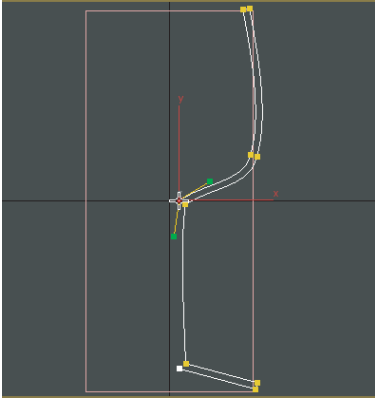
FIGURE 3.33
Activate the Move Transform type-in dialog box.
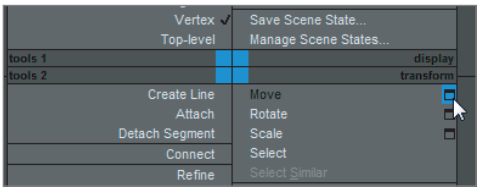
5. On the Move Transform type-in dialog box, enter **0** for the Absolute:World X coordinate.

6. Select the lower vertex of the open spline and, using the Move Transform type-in dialog box in the Absolute:World group, set its X-coordinate to **0** and its Y-coordinate to **-0'3.4"**. Then close the Move Transform type-in dialog.

7. Zoom in on the outer vertices of the base of the wineglass, select the two vertices, and move them in about a .25" and down so that the lower vertex rests at the bottom of the rectangle drawn at the very beginning of the wineglass project.

8. Deselect the top vertex by Alt+clicking it, move the lower vertex directly under the top vertex of the base, and then, using the Bezier Corner handle, make the bottom of the glass somewhat flat near the outer edge of the base, as shown in Figure 3.34.

FIGURE 3.34
Fixing the base of
the wineglass.
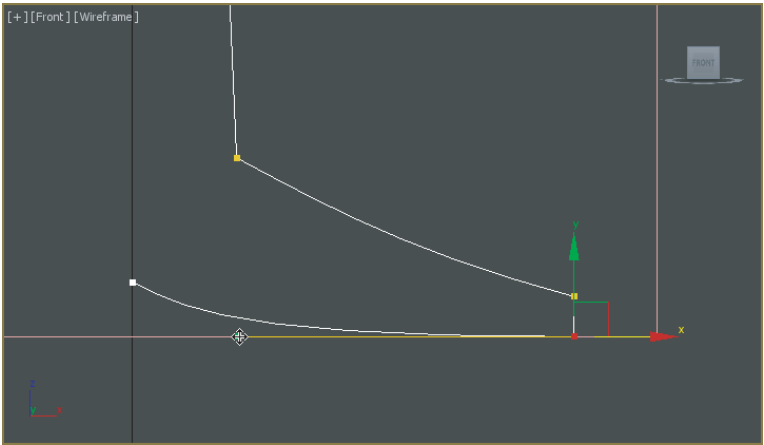
Now you need to add some more detail to the top of the base of the wineglass.

9. Change to the Segment sub-object mode, and then select the top segment of the wineglass's base and click the Divide button near the bottom of the Geometry rollout (see Figure 3.35).

FIGURE 3.35
Click the Divide
button to split
the selected
segment.
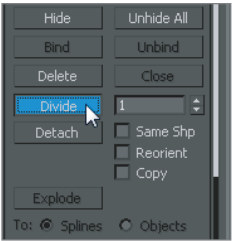
FIGURE 3.36
Click the Fillet
button.
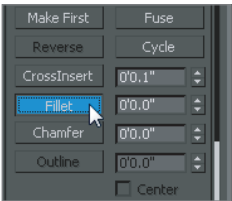
10. Switch to the Vertex sub-object mode, select the vertex where the base and stem of the wineglass meet, and click the Fillet button in the Geometry rollout, as shown in Figure 3.36.

11. Click the selected vertex — notice that the mouse pointer changes — and drag the mouse. You will see the vertex fillet interactively; continue dragging the mouse until you set the radius to about 0.35″, as shown in Figure 3.37.

FIGURE 3.37
Interactively fillet
the vertex.
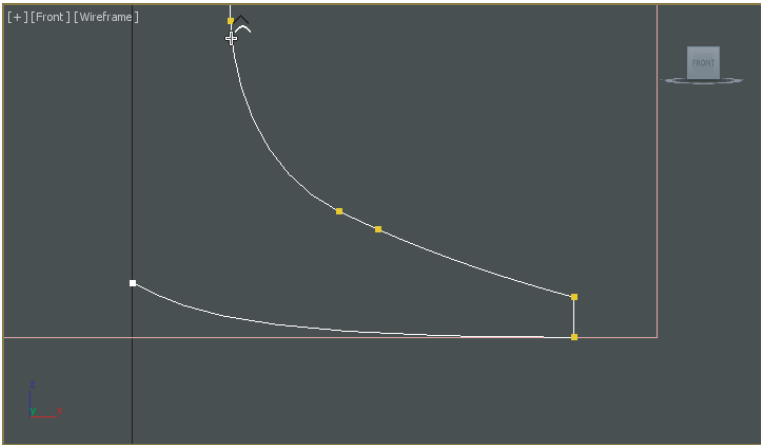
12. Select the middle vertex on the top of the wineglass base, and move it as shown in Figure 3.38.
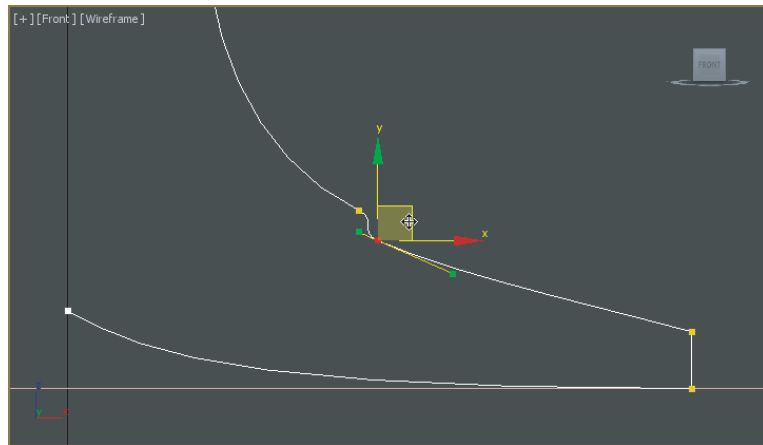
13. Select the vertex on the top corner of the base and, using the Bezier handle, add some curvature to the segment, as shown in Figure 3.39.

You have now finished the base of the wineglass, giving it a good surface on which to rest on a tabletop and adding some fine detail to the model. Now you will fix the inside and upper lip of the glass:

1. Using the Select And Move tool, select the vertex on the bottom of the inside of the glass and move it up slightly, as shown in Figure 3.40.
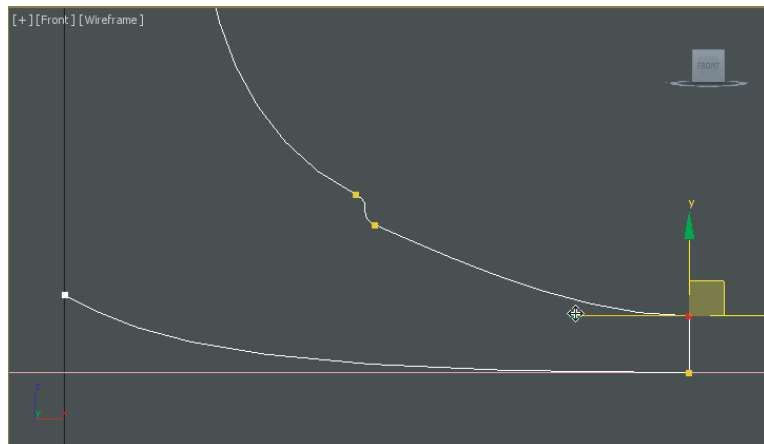
FIGURE 3.40
Moving the inside
of the glass up
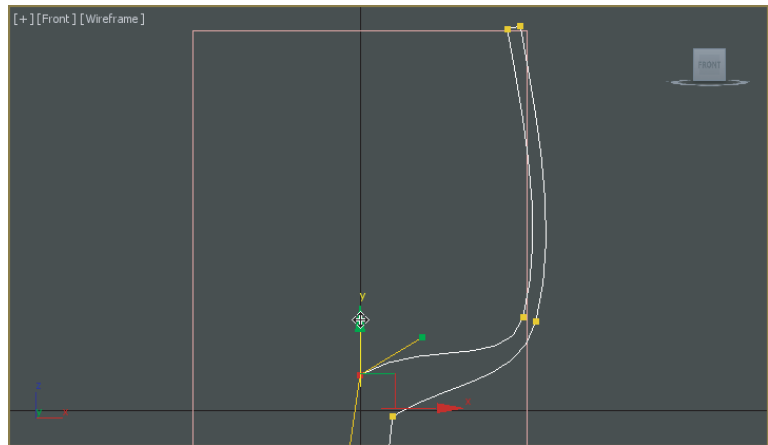
2. Select the Bezier handle, and move it down to flatten the inside curve of the glass, as
shown in Figure 3.41.

FIGURE 3.41
Flatten the inside of
the glass.
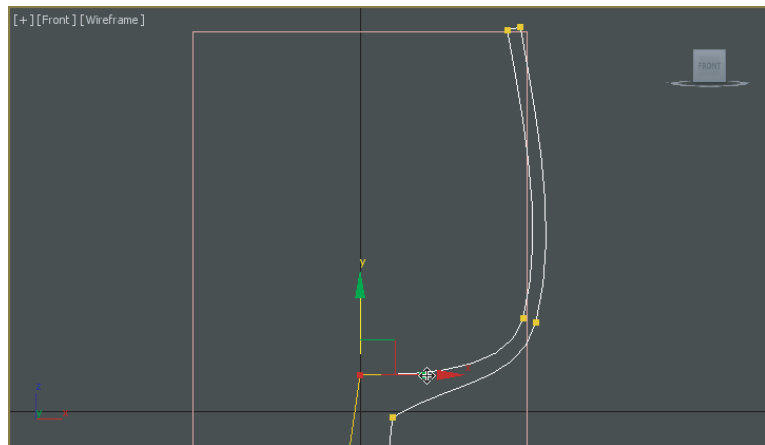
3. Select the vertices that make up the top of the glass, and move them so that they are
inside the rectangle, as shown in Figure 3.42.
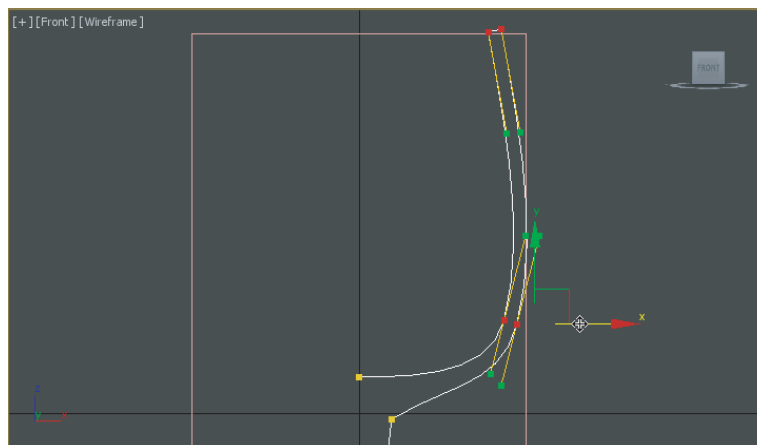
4. Using the Select And Move tool, select the vertex on the inner lip of the glass and move it close to the outer vertex to make the upper lip of the glass very thin (like the glass in Figure 3.8), as shown in Figure 3.43.

You are almost finished detailing the wineglass so that it is like the one in Figure 3.8. There is one detail left to add: the curves at the top of the stem. You'll add those now:

1. Pan the viewport so that you can see the top of the glass's stem.

2. Click the Refine button in the Geometry rollout, as shown in Figure 3.44.

FIGURE 3.43
Move the vertex at
the lip of the glass.
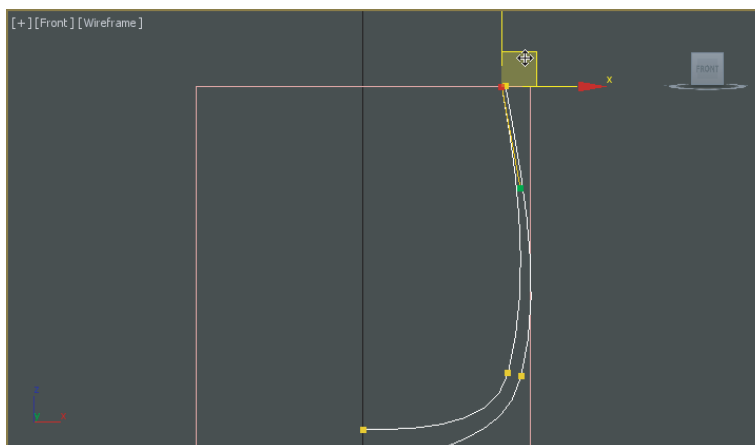
FIGURE 3.44
Click the Refine
button.

3. Move the mouse pointer over the spline in the Front viewport; notice that it changes to
show two black line segments, one with a white vertex in the middle. Using the Refine
tool will allow you to add new vertices to the spline without changing its shape. Click
and add a vertex about half an inch down from where the stem joins the top of the glass,
as shown in Figure 3.45.

FIGURE 3.45
Add a new vertex to
the spline.
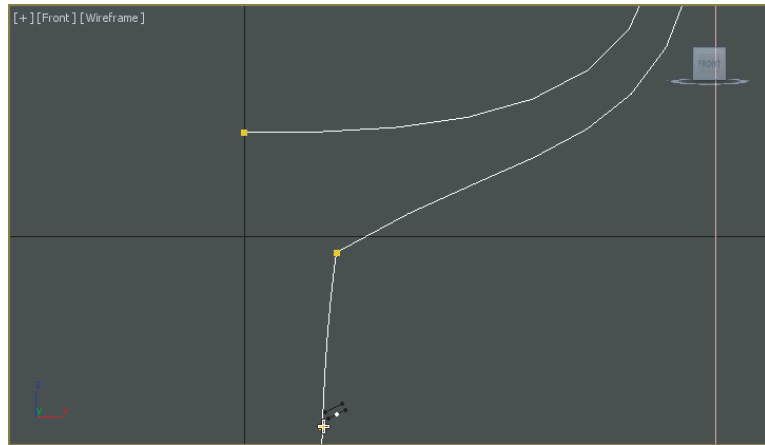
4. Click the Refine button again to turn off the Refine tool.

5. Click the Insert button in the Geometry rollout, and then set the New Vertex Type option
to Bezier, as shown in Figure 3.46.

FIGURE 3.46
Set the New Vertex
Type to Bezier.
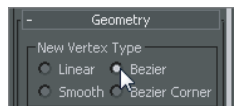
6. Move the mouse pointer over the middle of the short line segment at the top of the glass
stem, and notice that the pointer changes to show a black line segment and a white line
segment that has additional curves. Click once to put a new vertex on the segment, move
the mouse to the right, and click and drag to place the new vertex with a Bezier curve, as
shown in Figure 3.47. Right-click to stop adding new points to the line segment.

FIGURE 3.47
Add and shape the new curve on the spline.
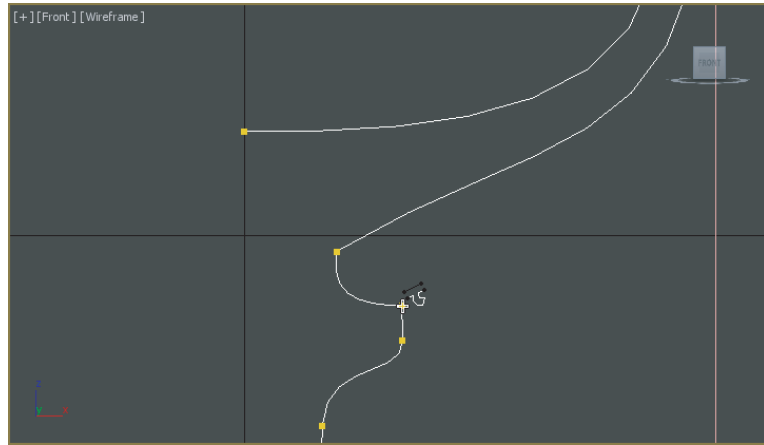
7. Click the Insert button again to turn it off.

8. Select the vertices around the bulge you just created, and move them by adjusting the Bezier handles to make the spline look like Figure 3.48, or you can make the spline look any way you want, also known as "season to taste."

FIGURE 3.48
Adjust the Bezier handles to create the curves you desire.
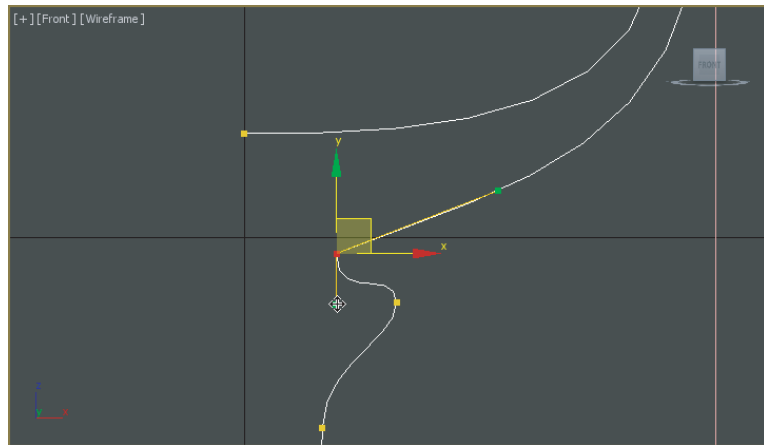
Finishing the Wineglass

You are almost finished making the wineglass; only a few steps remain to make it an object that you can reuse many times in your visualization career.

1. Deactivate the sub-object mode, and click the Lathe modifier.

2. Click the Axis sub-object of the Lathe modifier. Earlier you placed the Axis sub-object by hand to create the revolved shape of the wineglass.

3. Press the F12 button on your keyboard to open the Move Transform type-in dialog box, enter **0** for the Absolute:World: X coordinate, and press Enter on your keyboard to commit that value.

4. Click the Lathe modifier again to turn off the sub-object mode, and then click the Weld Core box on the Parameters rollout. This will make the wineglass a watertight model. You also need to uncheck the Flip Normals option.

You have now finished modeling your wineglass (see Figure 3.49).

FIGURE 3.49
Your finished wineglass

5. Save your model as My_Wineglass.max, overwriting the previous file.

Outlining and Extruding Splines

You've just seen how you can create a complex wineglass using a spline, the Lathe modifier, and sub-object editing. Now let's look at drawing a type of object that is simpler in many ways but that requires quite a different approach to using splines. Walls are usually drawn with straight-line segments and they require a fairly high degree of accuracy. In the following exercise, you'll learn how to draw a spline using exact coordinates.

OTHER METHODS FOR CREATING WALLS IN 3DS MAX

This example is intended primarily to demonstrate a technique of working with splines, not necessarily a method you'll use in the real world to draw walls. 3ds Max provides a set of architecture, engineering, and construction (AEC) tools, which includes a Wall tool. The AEC tools offer specialized functions geared toward the creation of building components such as walls and stairs, which can help you quickly model content for films, television, games, or visualization. The 3ds Max AEC Wall tool works in a way that is slightly different from the splines described here, and it offers some timesaving features for inserting doors and windows. You can also link AutoCAD and AutoCAD Architecture drawings to your scene and manipulate the walls created in AutoCAD using the 3ds Max toolset.

Drawing Accurate Splines

You'll start by setting up a top view in a new file that will include the area in which you'll draw the walls. The walls will cover a 20'-square area, so you'll want to include an area that covers about 20' square.

1. Expand the Application menu, and choose New.

2. Choose Customize ➤ Units Setup. In the Units Setup dialog box, make sure that US Standard and Feet w/Decimal Inches are selected, and click the Inches radio button for the Default Units setting, as shown in Figure 3.50. Then click OK.

FIGURE 3.50
Setting the units
in the Units Setup
dialog box
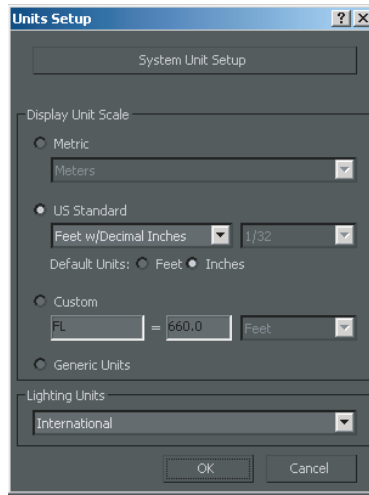
3. Click the Maximize Viewport toggle to display all four viewports if necessary.

4. Click the Zoom Extents All tool to restore the views to their default zoom factors.

5. Click in the Top viewport, and then click the Maximize Viewport toggle to enlarge it to fit the entire viewport area.

6. Click the Zoom tool, and zoom out until you can see both –12'0″ and 12'0″ in the X direction by alternately zooming and placing the cursor along the edges of the viewport, causing the coordinates to display at the bottom of the user interface.

7. Click the Pan View tool, or hold down the mouse's scroll wheel and pan the view down and to the left so that the 0,0 origin of the grid is in the lower-left corner of the viewport.

Now you're ready to start drawing. You'll draw an L-shaped room that is 20' by 20' overall, with each leg 10' long.

1. If it isn't already selected, click the Create tab of the Command panel.

2. Make sure that the Shapes category and Splines are selected. Then click the Line button.

3. Locate the Keyboard Entry rollout at the bottom of the panel, and then click to expand it if necessary.

You'll see three coordinate input boxes and three buttons labeled Add Point, Close, and Finish. These are the tools you'll use to place the walls accurately.

1. Click the Add Point button. This starts the wall by inserting the start point at the coordinates shown in the coordinate-input boxes. Because the input boxes show the coordinates 0'0.0", 0'0.0", 0'0.0" for the X-, Y-, and Z-coordinates, the line starts at the origin of the World Coordinate System.

2. Click the X-coordinate input box and enter **20'↵**.

3. Click the Add Point button again. You should see a line appear along the X-axis. You've just created a line segment from the point at coordinates 0'0.0", 0'0.0", 0'0.0" to 20'0.0", 0'0.0", 0'0.0".

4. Double-click the Y-coordinate input box, enter **10'↵**, and click the Add Point button. Another line segment is added.

5. Double-click the X-coordinate input box, enter **10'↵**, and click the Add Point button.

6. Double-click the Y-coordinate input box, enter **20'↵**, and click Add Point.

7. Double-click the X-coordinate input box, enter **0'0.0"**, and click Add Point.

8. Click the Close button to create the final segment, and close the shape.

   You've just drawn the basis for the walls.

9. Click the Zoom Extents tool to get an overall view of your walls. You scene should look like Figure 3.51.

FIGURE 3.51
The walls drawn using the Keyboard Entry rollout
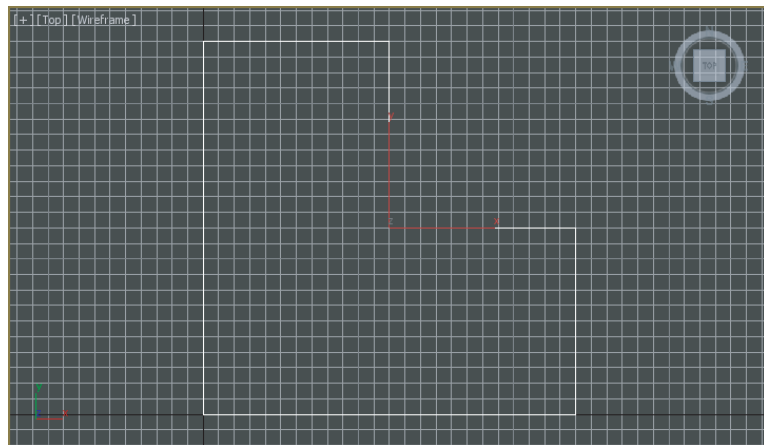
As you can see from this exercise, you can enter coordinate values to place the corners of the walls accurately. Because you started at the World Coordinate System origin 0,0,0, it's fairly easy to determine the coordinate location of your walls.

Giving Walls Thickness

Right now, you have only a single-line representation. To give the walls thickness, you can use the Outline tool, which you used earlier in the wineglass exercise.

1. Click the Modify tab of the Command panel. Because you just created the wall outline, that shape is still selected and you can see the options for the spline in the Modify tab.

2. Click the Spline button in the Selection rollout, and then select the spline.

3. Scroll down the Modify panel to the Geometry rollout so that you can see the Outline button.

4. Double-click the input box next to the Outline button and enter **5″↵**. Notice that a new spline outline appears inside the original outline. This is the inside face of the wall.

5. Exit the Spline sub-object level by clicking Line in the modifier stack.

When you used the Outline option in the wineglass example, 3ds Max turned the single, open line into a single, continuous outline of the wineglass section. In this wall example, you actually have two splines, with one closed spline inside the other. Even though there are two splines, 3ds Max considers this to be one object. This is so because the new spline was created while you were in the sub-object spline level of the line. As you'll see in the next exercise, concentric closed splines behave in an unusual manner.

1. Click the Maximize Viewport toggle to view the other viewports.

2. Click the Zoom Extents All tool to see the entire outline in all the viewports.

3. Expand the Modifier List drop-down, and click Extrude, which is in the Object-Space Modifiers category.

4. In the Parameters rollout, click the Amount input box and enter **8′↵**.

5. Make sure the Segments input box shows a value of 1. Walls are usually vertical planes, so you don't need the extra segments in the wall's vertical plane. You now have a wall that is 8′ tall, as shown in Figure 3.52.

IMPORTING AUTOCAD FILES

AutoCAD users will find it easier to import 2D floor plans into 3ds Max and then extrude the walls of the floor plan in 3ds Max. You'll learn how to import AutoCAD 2D plans in Chapter 5.

If you're an AutoCAD user, you may find drawing walls with accurate dimensions a bit more difficult in 3ds Max. It can be done but, as you've just seen, you need to translate the wall dimensions into coordinates. You can use a tool called the *user grid* as an aid for drawing accurately.

FIGURE 3.52
The walls after
extruding them 8'
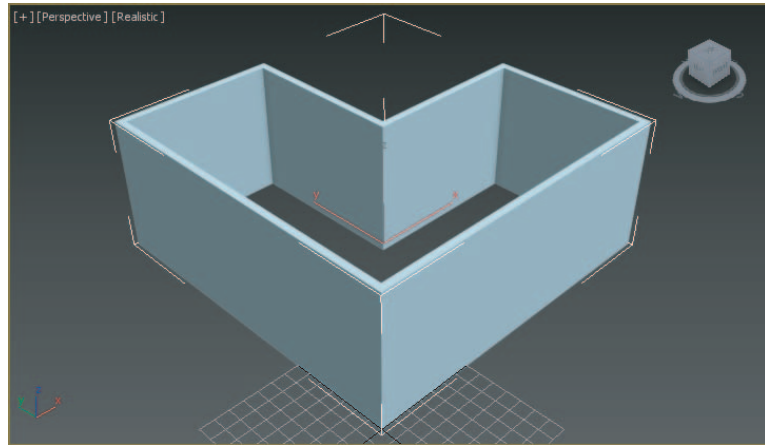
Using Grids and Snaps to Align Objects Accurately

You've seen how you can enter coordinate data for splines using the Keyboard Entry rollout in a simple example. As you can imagine, entering coordinates can become quite cumbersome and tedious for any wall configuration that is even slightly more complex than the simple example you are modeling here. There are a couple of tools that can help make drawing walls easier: user grids and snaps.

User Grids   These are nonrenderable reference objects that you can align to any orientation or object geometry you want. You can use them to set up a *local coordinate system* in which to add other objects.

Snaps   This is a set of options that lets you accurately select specific geometry on existing objects, such as endpoints of line segments, midpoints of lines, and intersections. Snaps also let you select grid points.

In the next exercise, you'll use grid objects and snaps to add some walls to the existing set of walls. Start by setting up a view that will allow you to see your work:

1. Make the Top viewport active, and then maximize it.

2. Click and drag the ViewCube to the left and upward to view the model from the other side. The view should be somewhat opposite of the Perspective viewport that you have been working in, or, if you can, with the Select Object tool activated (so you have the narrow pointer making it easier to see), click the opposite corner on the top of the ViewCube and the viewport will rotate to the view you need.

3. If it is not already selected, choose the Shaded viewport display by clicking the Shading Viewport Label menu and selecting Shaded from the menu.

4. Click the Zoom Extents tool or use the Zoom tool to fit the model in the view. Your viewport should look similar to Figure 3.53.

FIGURE 3.53
The view of the building
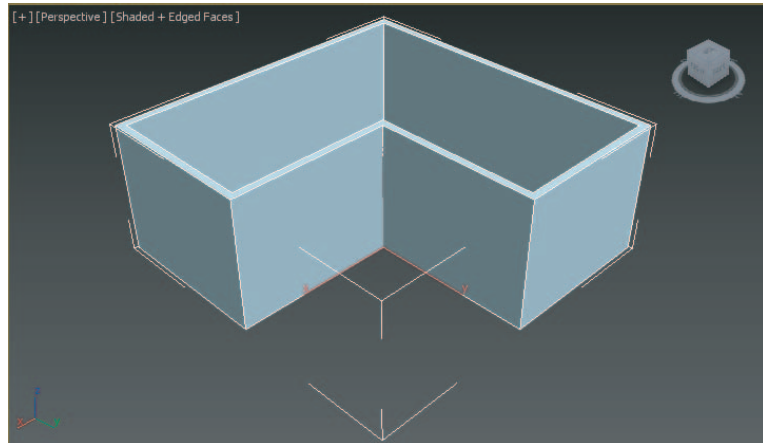
Now you're ready to add a user grid. First, you'll place it somewhere in the drawing; then you'll move it into a position that makes it easier to add a new wall.

1. Click the Create tab of the Command panel.

2. Click the Helpers category.

3. Click the Grid button in the Object Type rollout.

4. Click and drag down from a point near the upper center of the view, as shown in Figure 3.54. Just approximate the location — it doesn't need to be exact.

FIGURE 3.54
Adding a user grid

First, click here to start the grid placement.

Then click here.
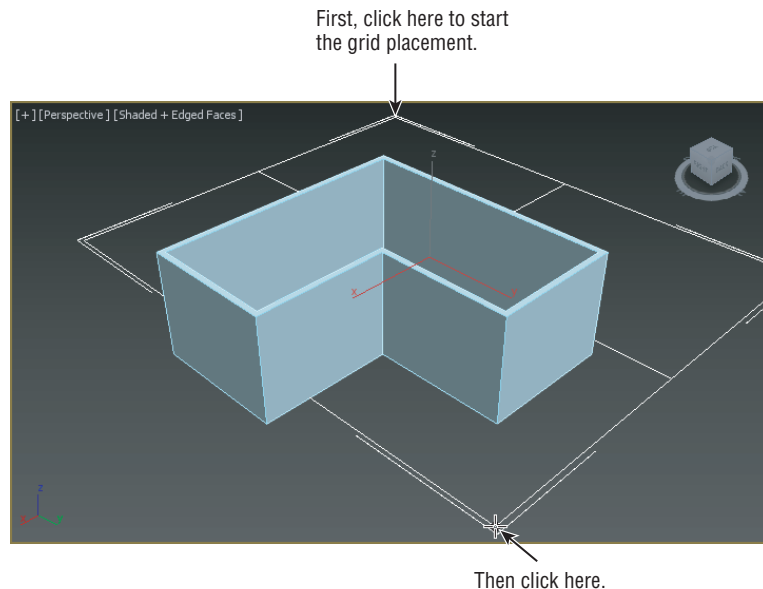
You don't need to be too accurate about the shape and size of the grid. As with all other 3ds Max objects, you can fine-tune its parameters in the Command panel after it is created. You can set the width and length, as well as the grid spacing. In this set of exercises, you're just using the grid to create a local coordinate system, from which you can draw additional walls.

Next, you'll move your user grid into a position that will allow you to enter coordinates relative to an existing feature of the walls you've drawn so far. To place the grid accurately, you'll use snaps. First, set up the snaps to connect to the geometry with which you plan to work. In this case, you'll want to snap to grid points and endpoints of objects.

1. Right-click the Snaps toggle in the Main Toolbar at the top of the 3ds Max window.

   The Grid And Snap Settings dialog box displays, as shown in Figure 3.55.

FIGURE 3.55
The Grid And Snap
Settings dialog box
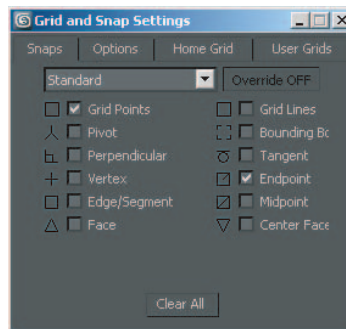
2. Click the Grid Points and Endpoint check boxes. Clear any other check boxes, and then close the Grid And Snap Settings dialog box.

3. Click the Snaps toggle to make it active, or press **S** on the keyboard. (You'll know it's active if the button is highlighted.)

4. Right-click, and choose Activate Grid from the tools 1 quad menu. Grids must be activated for 3ds Max to assume their coordinate system as the active coordinate system.

Now you're ready to move the grid using the snap settings to guide your movements:

5. Click the Select And Move tool in the Main Toolbar. Now, as you move the cursor over the viewport, you'll see a snap marker appear on the grid.

   The cursor jumps to grid points on the user grid. You may also notice that it jumps to the endpoints of the walls you've drawn so far.

6. Place the cursor so that it is on the 0,0 origin of the user grid (see Figure 3.56). You can spot the origin by the new origin target on the Transform gizmo, which appears as a circle and will highlight when you are snapped to the origin.

7. Click and hold the origin, and then drag the grid to the corner of the wall, as shown in Figure 3.57.

8. Make sure that the cursor shows the endpoint marker graphic before you release the mouse button.

FIGURE 3.56
Start the Move
command at the
origin of the user
grid.
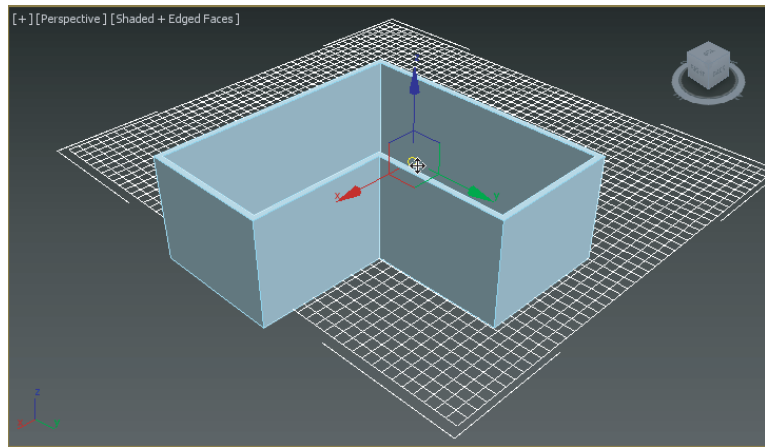
FIGURE 3.57
Dragging the grid
to the corner of the
wall.
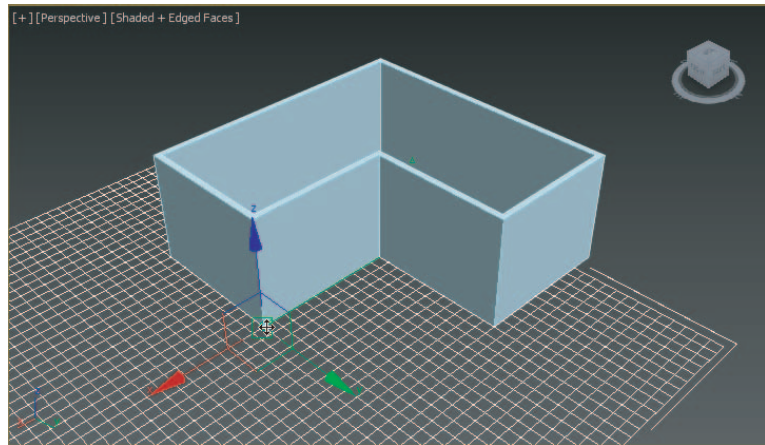
Now you're ready to start drawing the wall addition:

1. Click the Shapes category in the Create tab of the Command panel.

2. Click the Line button in the Object Type rollout.

3. Open the Keyboard Entry rollout.

4. Set the X, Y, and Z values to **0'0.0''** in the Keyboard Entry rollout, and click the Add Point button. This starts the new line at the 0'', 0'', 0'' coordinate of the user grid (on the corner of the existing wall).

5. Double-click the X value, enter **12'**↵, and click the Add Point button.

6. Double-click the Y value, enter **10'**↵, and click the Add Point button.

7. Double-click the X value again, enter **–10'**↵, and click the Add Point button.

8. Click the Finish button to stop the current line. Then press Esc to exit the Line tool.

MOVING AND ROTATING GRIDS

Grids are helper objects, and they can be moved or rotated as the need arises. For example, the grid's Z value can be increased to create the walls, equipment, or other objects at an upper floor's height.

By using the user grid, you were able to draw the additional wall lines using coordinates relative to the corner of the existing wall. This is far easier than trying to translate world coordinates into the coordinates relative to the existing walls. You can place as many user grids as you need in a model, and they can be oriented in any direction you choose. You can also align them to the surfaces of objects if you so choose. You'll learn how to do this in later chapters.

3DS MAX GRIDS ARE SIMILAR TO AUTOCAD UCSS

If you're an AutoCAD user, you can think of the user grid as a User Coordinate System (UCS), as it is known in AutoCAD. The methods for using the user grid may differ from those for using the UCS, but its purpose is the same. In addition, 3ds Max offers an *autogrid*, which is a quick, temporary grid that works on the fly.

Now let's finish the additional wall by giving it some thickness and height:

1. With the new wall selected, click the Modify tab. (Because the wall has just been created, it should already selected.)

2. Click the Spline sub-object level in the Modifier stack.

3. Select the spline. Scroll down the Command panel until you see the Outline button, and enter **5"**↵ in the input box next to the Outline button. Once you press ↵, the wall will be given a thickness of 5", as shown in Figure 3.58. Exit the Spline level.

FIGURE 3.58
Offsetting the new walls.
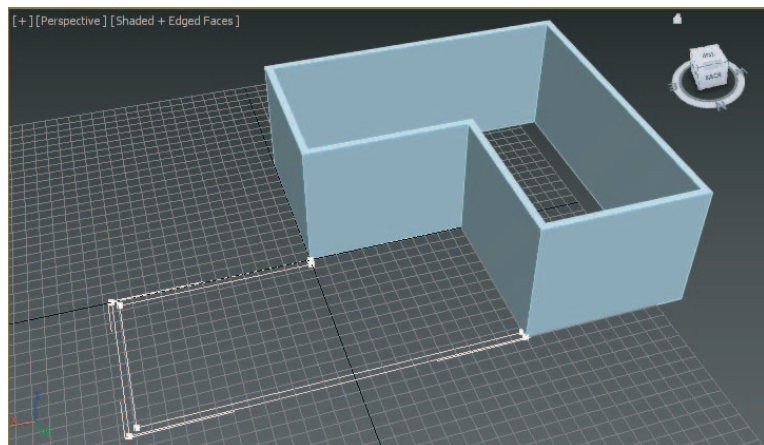
4. Apply an Extrude modifier to the new wall shape. Make sure that the Amount value in the Parameters rollout is set to 8'. Your additional wall now appears in place.

5. Click the Zoom Extents tool to get an overall view of your model so far. Your scene should look like Figure 3.59.

FIGURE 3.59
The new walls after extruding them 8'
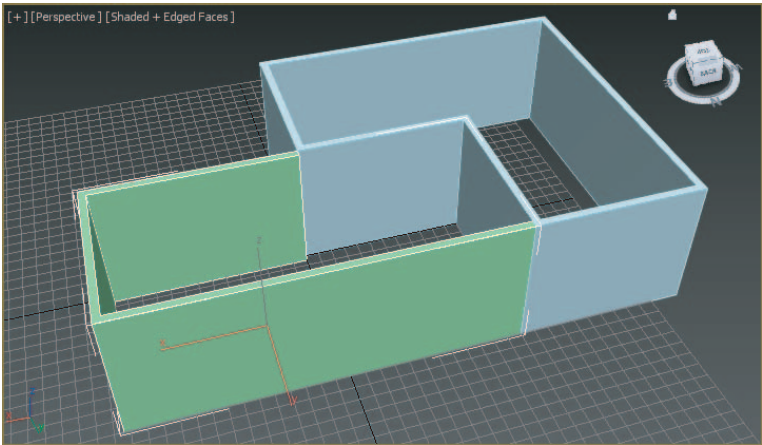
Once again, you used the Outline option to convert a single-line spline into an outline, giving the wall a thickness. Unlike other parameters, an outline cannot be changed by simply changing a parameter once it's in place. This is true for most Spline functions. You can make changes at sub-object levels, such as changes to the vertices or line segments.

While you were working to add the new wall, you got a glimpse of the Grid And Snap Settings dialog box. That dialog box contains quite a few snap options (on the Snaps tab), of which you used only two. Table 3.1 describes the Standard snap options. (You won't use all of these options in this book.)

TABLE 3.1: Grid And Snap Settings options

SETTING	DESCRIPTION
Standard/Body Snaps/ NURBS	Drop-down list revealing different sets of snaps for Standard Max objects, SAT Body objects, and NURBS objects. (Body Snaps and NURBS aren't listed in this table.)
Grid Points	Snap to intersection of grid lines.
Pivot	Snap to an object's pivot point as represented by the Transform gizmo.
Perpendicular	Snap to perpendicular line segments and edges.
Vertex	Snap to vertices.
Edge/Segment	Snap to the cursor location over an edge or segment.
Face	Snap to the cursor location over a face.
Grid Lines	Snap to any point on the grid lines.

TABLE 3.1:   Grid And Snap Settings options   *(CONTINUED)*

Bounding Box	Snap to bounding box corner.
Tangent	Snap to tangent of curves and circles.
Endpoint	Snap to endpoints.
Midpoint	Snap to midpoints of line segments and edges.
Center Face	Snap to center of face.
Clear All	Clear all snap settings.

SNAP TO GRID POINTS TO CREATE STRAIGHT LINE SEGMENTS

Another way to draw line segments is to set the snap setting to Grid Points (on the Snaps tab of the Grid And Snap Settings dialog box) and then set the grid spacing to the smallest value with which you need to work (on the Home Grid tab). Then, as you select points for the line, you can check the coordinates readout at the bottom of the 3ds Max window. You'll see that the coordinates show your current position relative to the last point you selected in the X-, Y-, and Z-coordinate format.

You may have noticed a graphic next to each of the options on the Snaps tab of the Grid And Snap Settings dialog box. When a snap setting is selected, the cursor will display the graphic associated with the snap setting whenever the cursor approaches a geometry that matches the snap setting. For example, if you select the Endpoint snap setting, when Snap is turned on and the cursor approaches and touches an endpoint, the cursor will display the graphic associated with the endpoint snap.

SNAP OPTIONS ARE ON THE SNAPS TOOLBAR

Most of the common snap options are available on the Snaps toolbar, which is closed by default in most scenes. If the Snaps toolbar isn't visible, open it by right-clicking an open area of any toolbar and choosing Snaps from the context menu. Like other toolbars, the Snaps toolbar can remain floating or you can dock it to the edge of the user interface.

Adjusting a Wall Location

The wall you just added isn't quite aligned properly with the first set of walls. If you look at a top view of the walls, you'll see that one of the 10' sections of the new wall is offset by the width of the wall where the new wall meets one of the corners of the old wall.

To move the new wall section into place, you need to work with the vertices of the wall. Once again, this means working with the wall on a sub-object level. The following exercise will give you some hands-on experience with some simple vertex transformations. Start by returning to the top view of the walls.

1. Press **T** to switch to a Top viewport. If it is not already selected, choose Wireframe from the Viewport Label context menu.

2. Click the Select Object tool, click the user grid, and then press the Delete key. You don't need the user grid anymore.

3. Click the Zoom Extents tool to get an overall view of the model, and press the **G** key to turn off the grid. Your view will look similar to Figure 3.60.

FIGURE 3.60
Top view showing the new wall offset

The wall is offset at this corner.
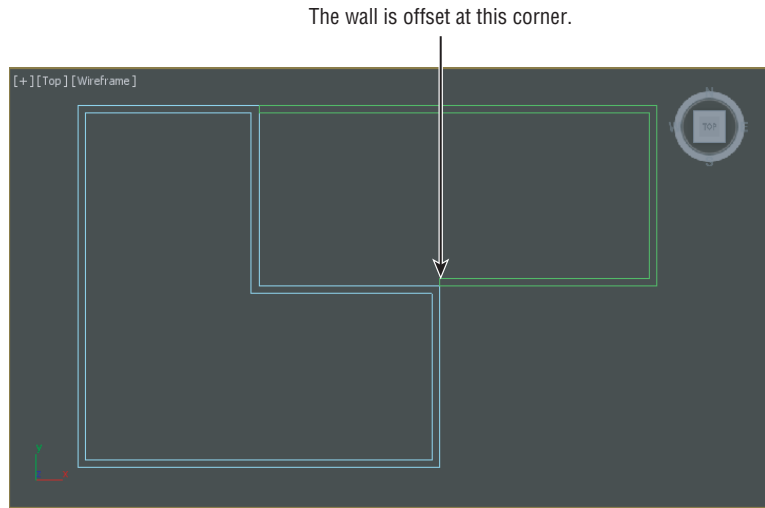
Now you can see the offset more clearly. Let's go on to the work of moving the wall into alignment with the existing wall. First, set up the snap for endpoints. You don't want to snap to a grid point accidentally.

1. Right-click the Snaps toggle at the top of the 3ds Max window.

2. In the Grid And Snap Settings dialog box, uncheck Grid Points, make sure that Endpoint is still checked, and then close the dialog box. Make sure that the Snaps toggle is enabled.

   Next, you'll move the wall section:

3. Click the Select Object tool, and then click the new wall.

4. Click the Modify tab of the Command panel, and select Line in the modifier stack.

5. Expand Line in the stack, and click the Vertex sub-object level.

6. With the Select Object tool active, place a window around the four vertices on the 10' section that you want to move. Do this by clicking and dragging a window. You'll see the selected vertices turn red, as shown in Figure 3.61.

FIGURE 3.61
The four vertices
are selected.
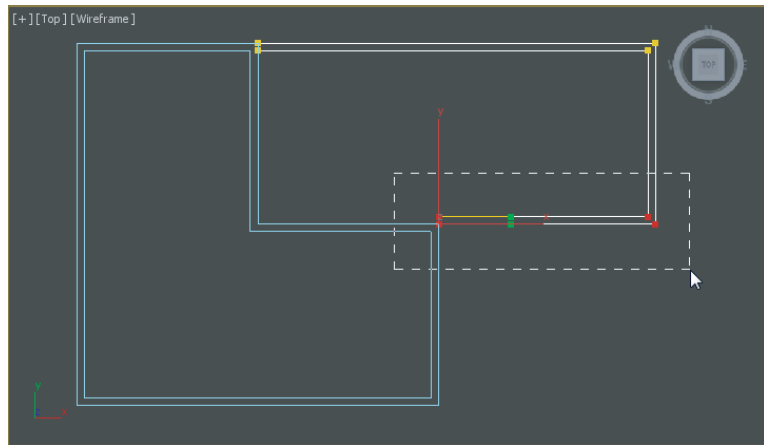
7. If you look carefully, you will see that some of the selected vertices are Bezier Corners; this isn't optimal for straight wall segments. Right+click in the viewport, and change the selected vertices mode to Corner.

8. Click the Select And Move tool in the Main Toolbar.

9. Place the cursor on the wall vertex, as shown in Figure 3.62, click and move the vertex to the corner of the previously created walls. Only one vertex explicitly needs to be moved; all of the selected vertices will move relative to it.

FIGURE 3.62
The four vertices
selected to move.

With the endpoint marker on
this point, click and drag down.
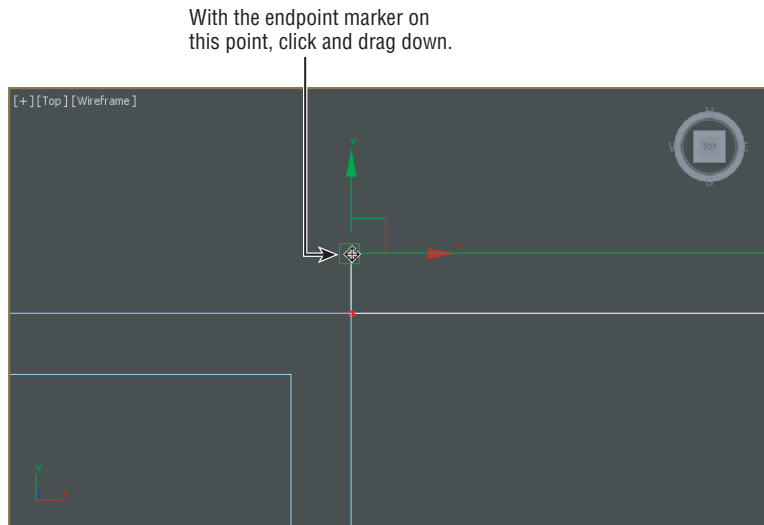
10. Use the ViewCube tool until you can see the walls in three dimensions. This changes the current viewport into an Orthographic viewport.

You w ill see that the vertices you moved are no longer at the bottom level of the walls but are snapped to the top of the first set of walls you created. This is because you completed the move operation with the 3D Snap toggle on. You can fix this either by moving the vertices down verti-cally with the 3D Snap mode on, or you can undo moving the vertices, constrain the snaps to 2D mode, and then move the walls again. Let's try the first method now.

11. When you see the Endpoint Snap marker, click and drag the vertex down to the location of the vertex just below it, as shown in Figure 3.63.

FIGURE 3.63
Selecting the new location of the vertex.

When the cursor snaps to the endpoint, release the mouse button.
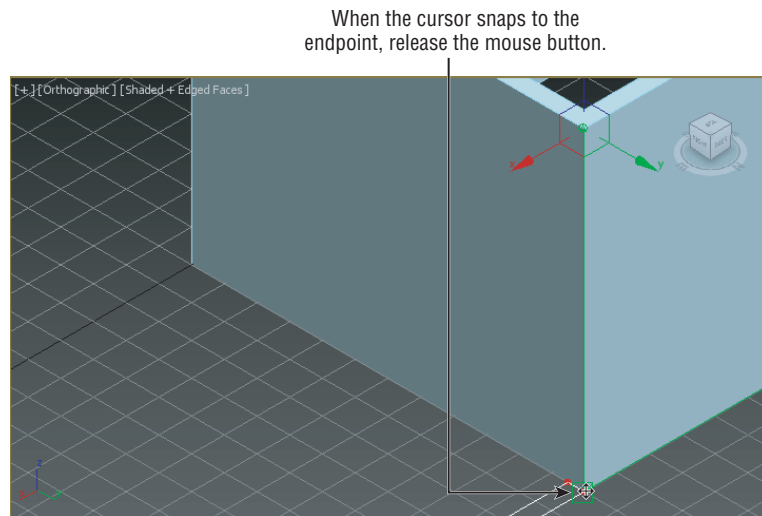
You've moved the selected vertices into place. Now let's take a look at the results:

1. Click the Maximize Viewport toggle to view all the viewports.

2. Click the Zoom Extents All tool to show the entire model in the viewport. Notice that the new walls no longer appear as walls. Because you are editing at the Line level in the modifier stack, 3ds Max displays the wall as a spline.

3. In the modifier stack, select Extrude. The wall reappears at its full height.

You've just moved a set of vertices, thereby stretching a wall into a new location. As you can see, you need to enter the sub-object level of editing before you can make changes to vertices. Once you do, however, you have a good deal of freedom to edit parts of an object. As you've seen through these exercises, you can easily get to the sub-object level by selecting the level, such as Vertex, from the Selection rollout or from the modifier stack.

If you're working with mechanical or architectural models, you'll use this operation fre-quently to fine-tune parts of a model. You'll get a chance to edit the vertices of objects in a num-ber of ways as you work through the exercises in this book.

EXTRUDE DOES NOT FOLLOW THE STANDARD MODIFIER CONVENTION

Normally, when you're editing at the sub-object level and a sub-object is active below a modifier in the stack, only those selected sub-objects are passed up to the modifier. The Extrude modifier is one of the few exceptions to this rule. Regardless of the sub-object level active below the Extrude modifier, the entire spline is passed up to it.

Combining and Extruding Primitive Splines

You've learned how you can create walls with simple lines. Lines are perhaps the most basic type of object with which you can draw, and you'll use them often when creating your models. However, for walls of a floor plan, you can use another object type that can simplify your work.

3ds Max offers a number of 2D shapes that can help make quick work of your modeling efforts, as long as you know how to apply them. In this section, you'll use the Rectangle spline to add a room to your current plan.

1. Change the Orthographic viewport into a Top viewport, and then click the Maximize Viewport toggle to enlarge it if necessary.

2. Click the Zoom tool, and then click and drag down on the Top viewport so that you get a view of a larger area.

3. Click the Create tab of the Command panel, and click the Rectangle button in the Object Type rollout.

4. Right-click the Snaps toggle to open the Grid And Snap Settings dialog box, and then click the Grid Points option. You'll use the Grid Points snap to help you create the next set of walls. Make sure Endpoint is turned off as well.

5. Click the Home Grid tab of the Grid And Snap Settings dialog box, set the Grid Spacing to **0′6.0″**, and then press ↵.

6. Close the dialog box, and turn the grid back on.

7. Make sure that the Snaps toggle is turned on. Then click and drag from coordinate 26′, 14′, 0 to coordinate 41′, -1′, 0 to draw a rectangle that is 15′ wide by 15′ deep. You can use the coordinate readout at the bottom of the screen to read the dimensions of your rectangle as you move the mouse. Use the scroll wheel on your mouse to zoom in and pan if necessary. The Snap functions do not work if the grid points are not displayed in the viewport.

In the exercise in the previous section, you started out with a single-line representation of the wall. In this case, it's a rectangle that is 15′ × 15′. You were able to use the grid and snap together in this exercise to place the rectangle and determine its size.

The next step in adding the wall is to combine it with the existing walls. The rectangle needs to have a portion of its upper-left corner removed. To make the plan a little more interesting, you'll also add a curve to the lower-right corner.

USING EDITABLE SPLINES FOR MODELING

A while back, one of the original authors of this book was given a project that entailed creating a model of a large, complex sign that was to be placed at a major downtown intersection. Most of the sign's components were structural steel members consisting of tubular, channel, and I-shaped posts and beams. The purpose of the model was to investigate the visual appeal of the sign from angles that were not provided with the designer's two-dimensional renderings and construction drawings.

Using the information provided by the designer, the author found it easy to use the objects under the Shapes ➢ Extended Splines category that matched the sign's components. When he could not make the available extended primitives match the members' profiles by adjusting their parameters, he converted the shapes to editable splines and then edited them manually by adjusting their vertices and using the Spline Boolean tools.

Once the shapes were created, they were moved to their proper locations and oriented accordingly. Great care was taken to use instance clones whenever possible to maintain consistency when duplicate parts were used in the sign's design. Then each shape was extruded to the proper length and examined for accuracy. He then modeled the remaining parts of the model, including light fixtures and informational panels, and added them to the project. The total project time was less than a day, and the model that resulted helped gain approval for the sign's design and placement.

Combining Splines

You've learned that Spline objects can be composed of multiple splines, accessible on the Spline sub-object level. In this section, you'll see how to combine two Spline objects into one and edit the new object to form new shapes.

1. Turn the grid off if you like, then click the Select Object tool in the Main Toolbar, and click the 10′ × 20′ wall that intersects the rectangle you just drew, as shown in Figure 3.64.

FIGURE 3.64
Select the wall you created in a prior exercise.
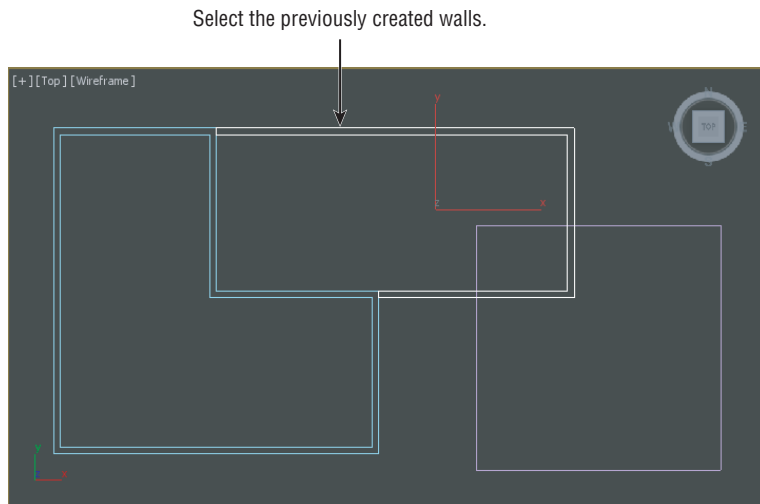
Select the previously created walls.

2. Click the Modify tab in the Command panel, and select Line in the modifier stack.

3. Scroll down the Command panel to the Geometry rollout, and click the Attach button.

4. Move the cursor on top of the rectangle you added in the previous exercise. You'll see the Attach cursor appear (see Figure 3.65) when the cursor finds an available object to attach.

FIGURE 3.65
Attach the new rectangle to the existing wall.
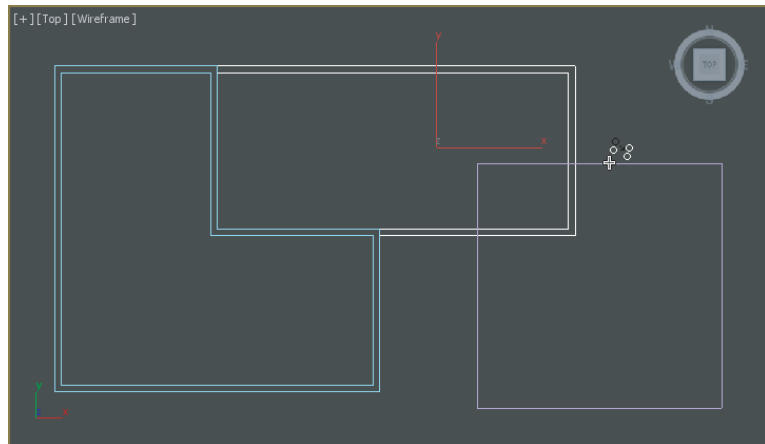
5. Click the rectangle. Notice that it turns white as it becomes part of the selected object.

6. Click the Attach button again to deactivate it.

You've just attached the rectangle to the wall you selected at the beginning of this exercise. Earlier, you saw how the Outline option created two concentric rectangles to form a rectangular wall. That was a clue that objects can contain multiple splines. The outer and inner walls of that rectangular wall are separate splines contained within the same object. In this exercise, you added the rectangle you just created to the wall of the previous exercise.

Next, you'll see how you can trim the parts of the rectangle that you don't need:

1. Click the Zoom Region tool.

2. Place a Zoom window around the intersection of the walls and the rectangle. Your drawing area should look like Figure 3.66.

FIGURE 3.66
Zoom into this area.
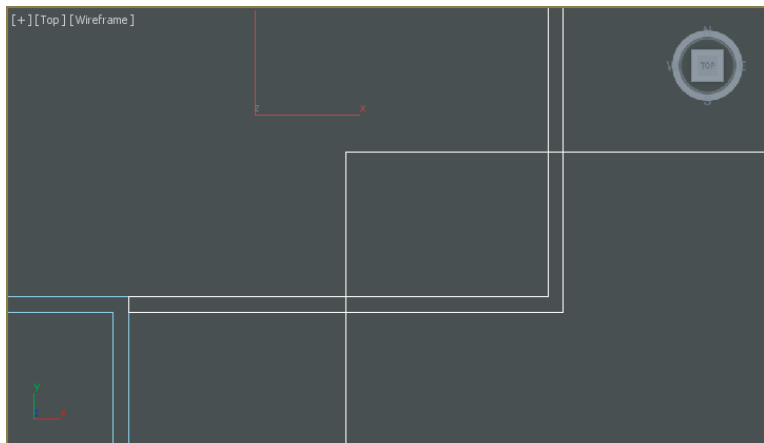
3. With the wall selected, click the Spline button in the Selection rollout.

4. Locate the Trim button in the Geometry rollout (you may need to scroll down the rollout), and click it.

5. After you click the Trim button, place the cursor on the upper-left corner of the rectangle. Notice how the cursor changes to a graphic that indicates the Trim operation.

6. Click the rectangle in the location shown in Figure 3.67. The corner of the rectangle is trimmed back to the wall.

7. Click the Trim button to deactivate it.

8. Click the Zoom Extents tool to get an overall view of the walls.

The Trim tool will trim a spline to the nearest spline that is a part of the same object. Trim ignores any splines that are not included in the current object. This is why you needed to attach the rectangle before you used the Trim tool.

You can continue to trim a spline by clicking the side you want to trim. The spline will then trim back to the nearest spline that is part of the currently selected object. Figure 3.68 shows an example of what the rectangle would look like if you continued to click the remaining endpoints of the rectangle with Trim activated.

FIGURE 3.67
Select the portion of the rectangle to be trimmed.
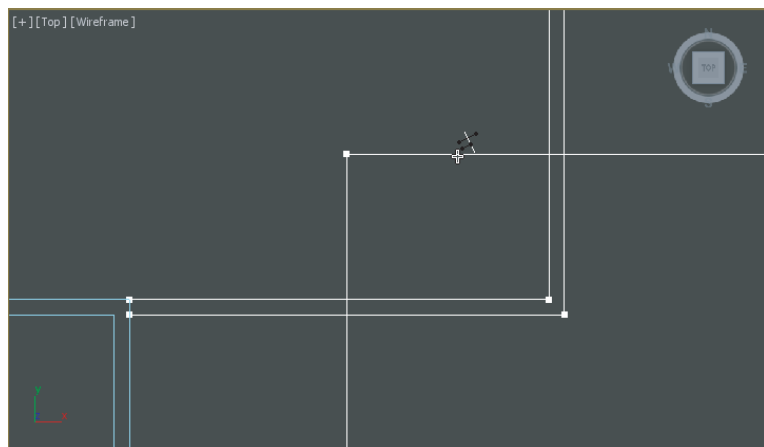
FIGURE 3.68
Click the endpoints of the rectangle to trim it back to the outside of the wall.
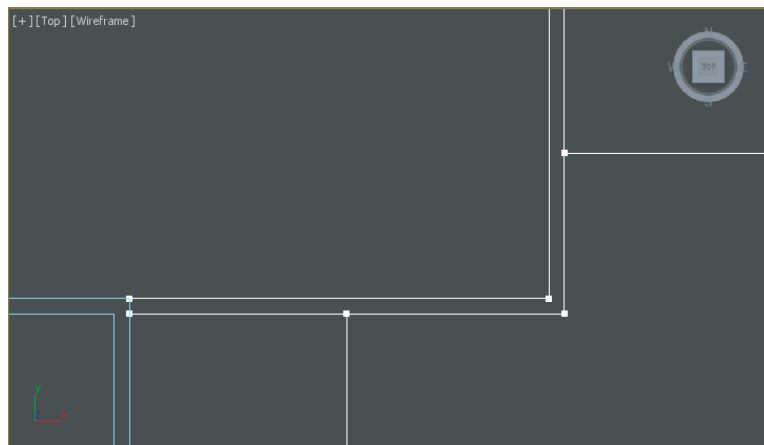
You won't be trimming the rectangle any farther than you have in step 6. Instead, in a later exercise in this chapter, you'll use the rectangle in its current configuration to learn how you can merge two sets of lines using the Boolean tools.

Now let's see how you go about adding a rounded corner to a spline using the Fillet tool:

1. Scroll to the Selection rollout, and click the Vertex option.

2. Click the Select Object tool, and click the lower-right corner of the rectangle. You'll see the axis tripod appear at the corner along with the Bezier handles, as shown in Figure 3.69.

3. Scroll down the Command panel until you see the Fillet button in the Geometry rollout.

4. Click/drag the Fillet input box spinner up. Notice what happens to the corner as you move the spinner — the corner turns into a radius. Don't release the mouse button just yet.

FIGURE 3.69
Select the lower-right vertex of the trimmed rectangle.
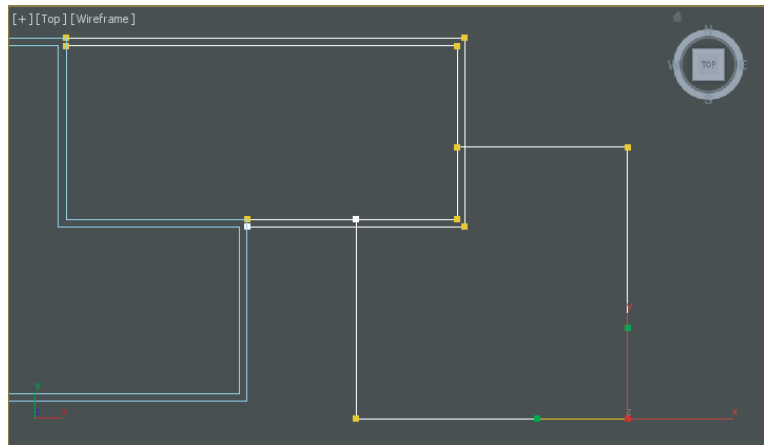
5. Adjust the spinner until the Fillet value reads 5'0.0", and then release the mouse button. (If you release the mouse button before you get to 5'0", click the Undo Scene Operations button and try again.) You could also just type **5'↵** in the Fillet text box. Your completed fillet should look like Figure 3.70.

FIGURE 3.70
Filleting the corner
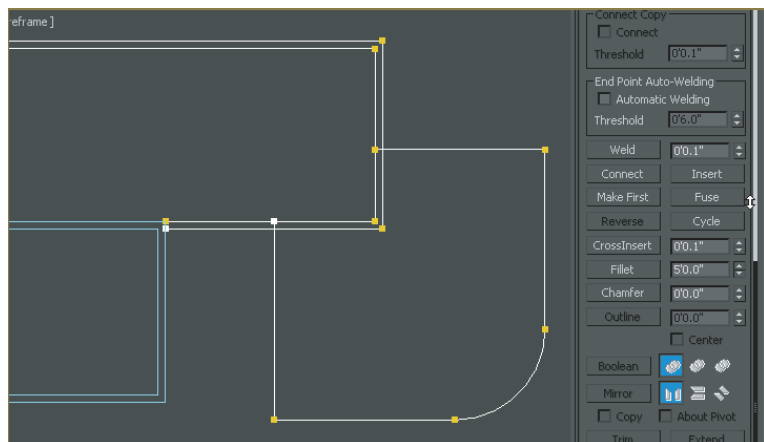
The Fillet tool is an option of the Vertex sub-object level, so you need to be in the Vertex sub-object editing mode before you can use it.

Now, to finish off the new wall, use the Outline tool once again:

1. Access the Spline sub-object level.

2. If it isn't already selected, click the Select Object tool and then click the filleted rectangle. It turns red when it's selected.

3. Scroll down the Command panel to get to the Outline tool on the Geometry rollout.

4. Enter **5"⏎** in the Outline tool's input box. The rectangle is outlined.

5. Click the Maximize Viewport toggle to view all of the viewports.

6. Click in the viewport — away from any objects — to deselect the spline.

7. Scroll up the Command panel, exit the sub-object mode, and then click Extrude in the Modifier stack.

8. Save the walls you've drawn as a file named **My_Walls.max**.

Because the rectangle is attached to the Wall spline you created earlier, it's also affected by the Extrude modifier. Look at your model from the Perspective viewport to see this effect. Figure 3.71 shows your model up to this point, from an angle that shows all the components.

FIGURE 3.71
The perspective view of the walls
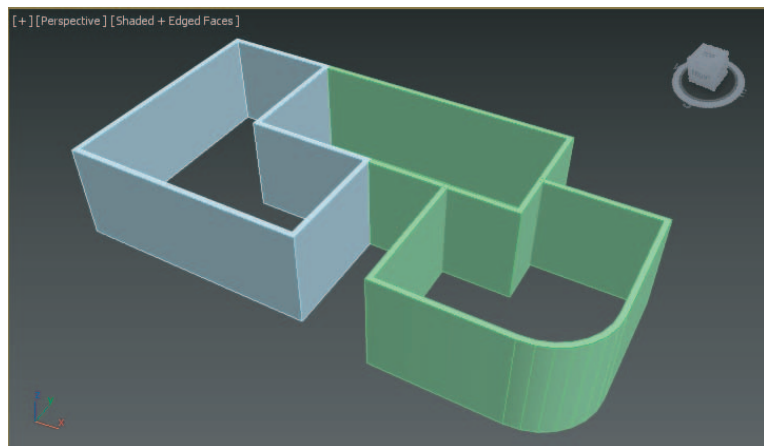
As you work with splines, you'll see that the type of tool options you can use to edit a spline depends on the sub-object type you select in the Selection rollout or the modifier stack. Fillets and Bezier curves can be edited when the Vertex sub-object level is selected. Trim is available when you select the Spline sub-object level. The Attach option is available in object mode as well as in all sub-object levels.

Joining Closed Splines with Boolean Tools

In the previous exercise, you combined the rectangle with a wall to form a wall object that is made up of two splines. The added rectangle protrudes into the wall with which it is joined, as shown in an enlarged view of the walls in Figure 3.72.

FIGURE 3.72
The walls joined at
a corner

These wall intersections are
actually overlapping splines.

Although these wall intersections do not adversely affect your ability to work with the model in many situations, you may eventually want to merge the wall intersections into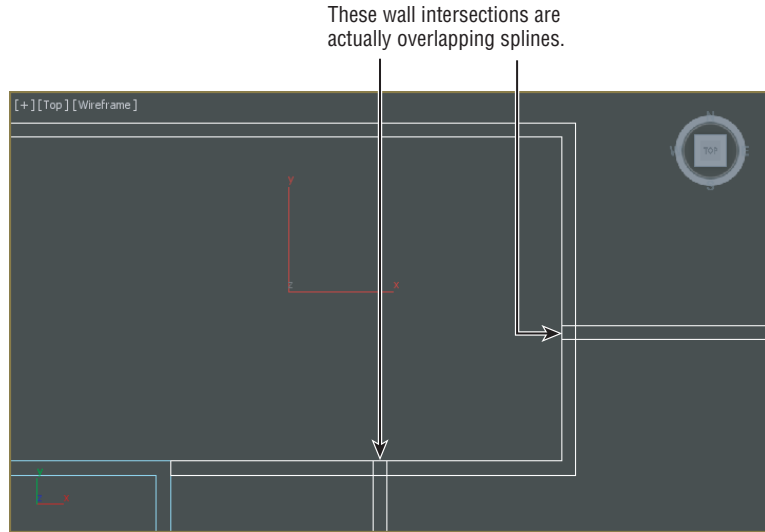 a clean joint. This is important when working with several of the advanced lighting or rendering tools. You can clean up these intersections by using spline Boolean operations. Boolean operations combine two spline sub-objects using one of three distinct operations. The Union Boolean operation combines two overlapping splines to form a single spline by creating vertices where the segments cross and by deleting any segments that are within the shared area of the new shape. The Subtract operation deletes one spline and any area shared by the two splines. Finally, the Intersection operation deletes all areas that are not shared by both splines. Spline Boolean operations work only when both splines are closed.

1. Make sure the Top viewport is active, and then click the Maximize Viewport toggle to display only the Top viewport.

2. Select Line from the modifier stack.

3. Access the Spline sub-object level, select the filleted wall, and then scroll down the Command panel to the Geometry rollout until you see the Boolean button.

4. Next to the Boolean button, click the Union button and then click the Boolean button. In the Top viewport, move your cursor to the other wall that is connected with the currently selected wall, as shown in Figure 3.73.

FIGURE 3.73
Selecting the wall for the Boolean operation
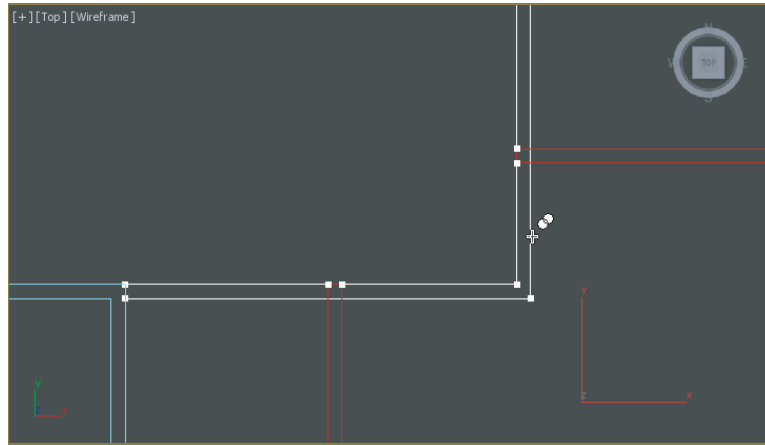
Notice that the cursor shows a graphic indicating that it has found a candidate for the Boolean operation.

5. Click the wall. The wall intersections form a neat connection.

6. Scroll up the Command panel, and click Line in the modifier stack to exit the sub-object level. You can now see the corners more clearly, as shown in Figure 3.74.

FIGURE 3.74
The wall intersections after using the Boolean tool
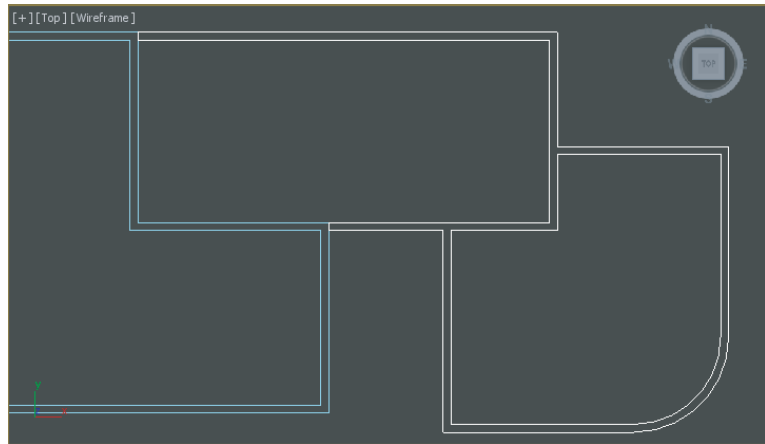
7. Select Extrude from the modifier stack to restore the wall height.

You can use the Boolean tool to join any closed splines, such as those that form the two walls from the previous exercise. Figure 3.75 shows some examples of other splines that are joined using this tool. Besides joining spline outlines, you can subtract outlines or obtain the intersection of two outlines.

FIGURE 3.75
Examples of
Boolean operations
on closed splines

Union rectangle and circle

Subtract NGon from circle

Intersection of two ellipses
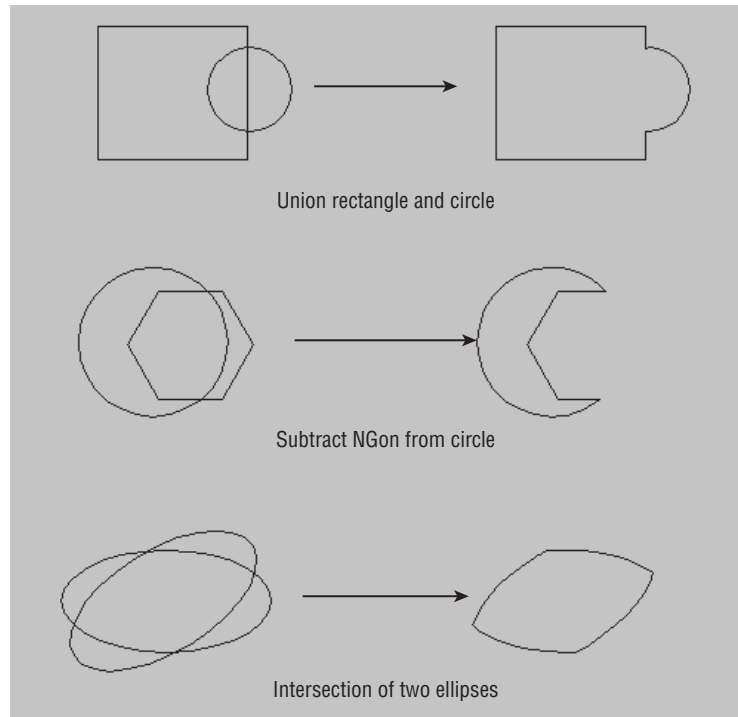
SPLINE BOOLEANS DIFFER FROM BOOLEAN COMPOUND OBJECTS

In Chapter 4, "Editing Meshes and Creating Complex Objects," you'll learn about the ProBoolean compound objects, which create new objects by combining existing ones through Boolean operations. Boolean operations with compound objects are different from those created through the Boolean options in the object's Spline sub-object level.

To perform these other types of Boolean operations, follow the same steps you used to join the wall intersections in the previous exercise; however, before you select the object to be joined, click the appropriate Boolean option (the buttons to the right of the Boolean tool button).

Creating a Solid Form with Splines

You've been using splines to create outline shapes such as the profile of the wineglass and the walls of a floor plan. You can also create solid forms like those of the primitive objects you saw in the previous chapter. Splines let you go beyond the primitive forms of circles, rectangles, and squares to make just about any shape you need.

In the following exercise, you'll use a spline to create a ceiling for the walls that you've created so far. This involves creating an outline of the walls and then using the Extrude modifier to give the outline some thickness.

Start by setting up a view that will make it easier to add the ceiling:

1. Adjust the view of the Perspective viewport so that you can see the entire top edge of the walls.

2. Next, set up the snaps to place the spline at the perimeter of the walls accurately. Right-click the Snaps toggle.

3. In the Grid And Snap Settings dialog box, click Clear All and then click the Endpoint check box.

4. Close the Grid And Snap Settings dialog box.

5. Make sure the Snaps toggle option is on.

Now you're ready to add the spline that will become the ceiling:

1. Click the Create tab of the Command panel, and then click the Shapes category if it isn't already selected.

2. Click the Line tool.

3. Click the outside corners of the walls, as shown in Figure 3.76. When you get to the rounded corner, click the point indicated in the figure. You'll move and reshape that corner later.

FIGURE 3.76
Drawing the Roof spline

Select the new endpoint at the top of the wall on the outside for the rounded corner.

Start the line at this corner.

Continue to select the top outside endpoints.
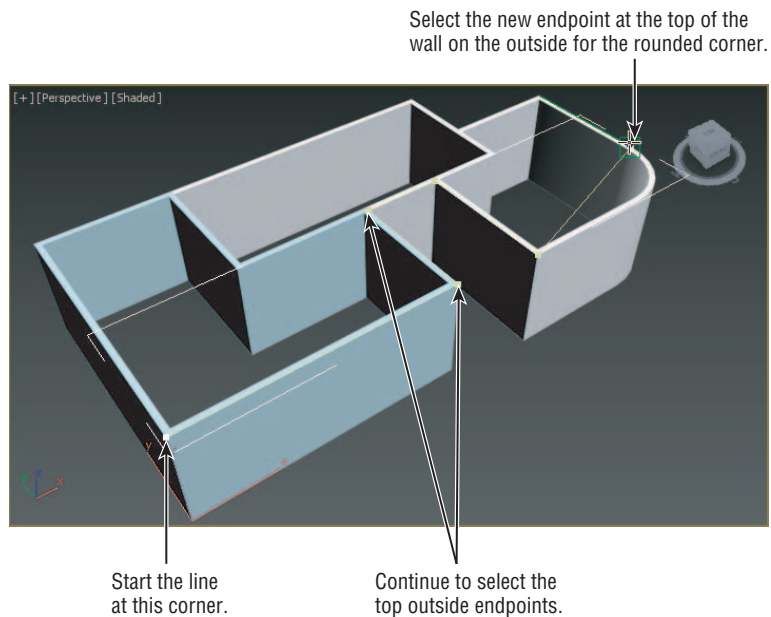
4. When you return to the starting corner, click it. In the Spline dialog box, click Yes to close the spline.

Now you have the Roof plane outlined with a spline. Next, you need to make an adjustment to the corner where the walls are rounded:

1. With the Ceiling spline selected, click the Modify tab in the Command panel.

2. Turn off the Snaps toggle, and access the Vertex level; then click the Select And Move tool in the Main Toolbar.

3. Click the vertex at the corner where the wall is rounded, as shown in Figure 3.77.

FIGURE 3.77
Moving the vertex
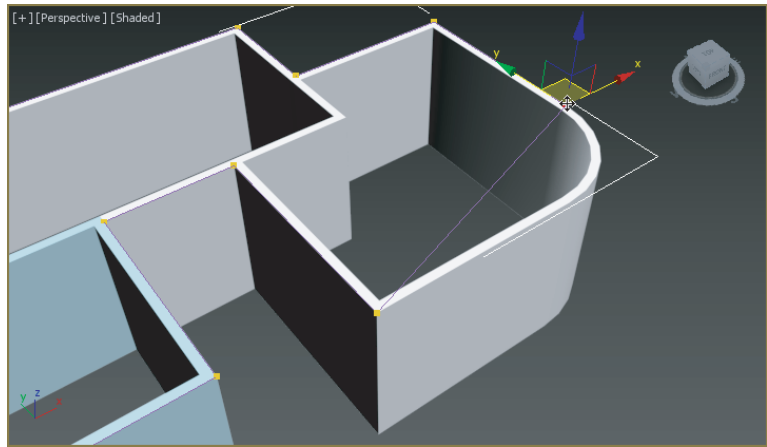
4. Click the Absolute Mode Coordinate Display button at the bottom of the 3ds Max window to switch to Offset mode. While in Offset mode, you don't enter the actual destination coordinates, just the distance from the current location that you want the feature to move.

5. Enter **–5′** in the Y input field, as shown in Figure 3.78, and then press ↵. The lines are now aligned with the original wall.

FIGURE 3.78
Moving the
vertex using the
Coordinate Display
fields
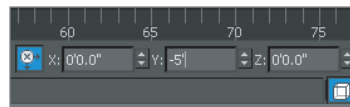
6. Scroll down to the Geometry rollout in the Modify tab of the Command panel until you see the Fillet tool.

7. Double-click the Fillet input box so that the entire value is highlighted, and then enter **5′**↵. The corner is filleted to match the wall, as shown in Figure 3.79.

FIGURE 3.79
The spline after
filleting
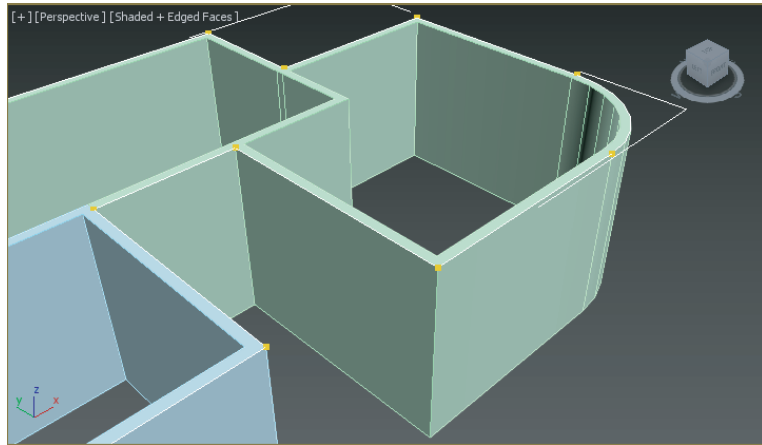
8. Click the Offset Mode Transform type-in button to switch back to Absolute mode.

For the final operation, you need to give the new spline volume with thickness. Typically, you would make a ceiling around 10″ to 12″ thick between floors of a building. Use the Extrude modifier to extrude the spline to a thickness of 12″.

1. Click the Line level in the modifier stack so that you're not on any sub-object level. Scroll up to the top of the Command panel, and click the Modifier List drop-down arrow.

2. Click the Extrude modifier.

3. Go to the Parameters rollout, click the Amount input box, and enter **12″**↵. The spline extrudes into a thick, slab-like object in the shape of the wall outline, as shown in Figure 3.80.

FIGURE 3.80
The finished ceiling
on top of the walls
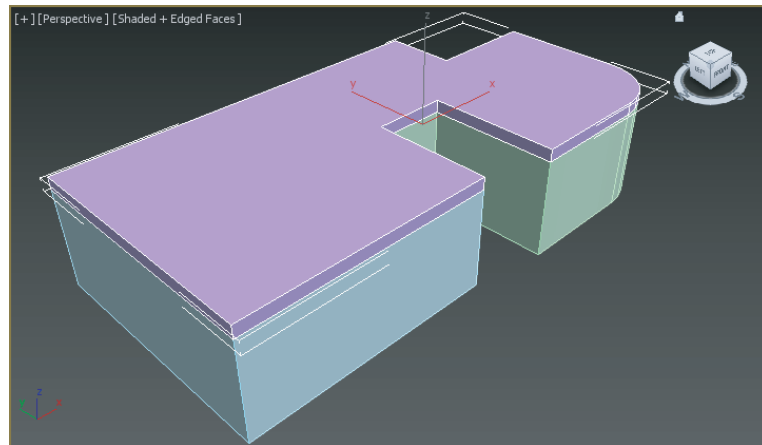
4. Click the Maximize Viewport toggle to see the walls in all the viewports.

5. If any of the ceiling's corners appear rounded instead of sharp, select Line in the modifier stack and then access the Vertex sub-object level.

6. Select any offending vertices, right-click, and choose Corner from the quad menu.

7. Save your scene as `My_WallsRoof.max`.

You extruded the ceiling outline only 12″, but it could easily have been extruded several feet. You can also copy the spline vertically and use the Outline tool to form the exterior walls of a second floor.

You've seen a few examples of using splines to create walls and a ceiling. There are many ways to create walls, as you'll learn in later chapters. For now, let's move on to the other spline types.

Introducing the Other Spline Types

You've already used the Line and Rectangle splines, and you've gotten some practice in editing them. Before you continue, you'll want to know a little about the other spline types. Table 3.2 shows the various spline options, how they are created, and some of the editing characteristics of each object.

TABLE 3.2: Creation methods for splines

SPLINE NAME AND FUNCTION	CREATION METHOD	CREATION OPTIONS*	PARAMETERS*
Line — Draws splines	Click points to place line segments. Click and drag adds smoothing when Smooth is selected for Initial Type or Drag Type groups	*Initial Type*: Corner/Smooth *Drag Type*: Corner/Smooth/Bezier	Lines are not parametric objects
Circle — Draws circles	Click center and drag radius [Center]. Or click two points to locate points on circumference edge [Edge]	Edge/Center	Radius
Arc — Draws arcs	Click to place first endpoint and drag to place second endpoint; then adjust and click for radius [End-End-Middle]. Alternatively, click center, drag to radius and first endpoint, and click second endpoint [Center-End-End]	End-End-Middle/Center-End-End	Radius, From, To, Pie Slice (creates pie-slice shape with line segments from the center to each endpoint), Reverse

TABLE 3.2: Creation methods for splines *(CONTINUED)*

SPLINE NAME AND FUNCTION	CREATION METHOD	CREATION OPTIONS*	PARAMETERS*
NGon — Draws regular polygons	Click center, and then drag to place radius [Center]. Or click to place one edge, and then drag for other edge [Edge]	Edge/Center	Radius, Inscribed/Circumscribed, [number of] Sides, Corner Radius, Circular
Text — Draws text	Click to place text	Input box for entering text	Font, Size, Kerning, Justification, Italic, Underline, Leading, Text, Manual Update
Rectangle — Draws rectangles with or without curved corners	Click first corner and drag for other corner [Edge]. Or click center and drag for corner [Center]	Edge/Center	Length, Width, Corner Radius
Ellipse — Draws ellipses	Click first tangent edge, and drag for other edge [Edge]. Or click center and drag for edge [Center]	Edge/Center	Length, Width, Outline, Thickness
Donut — Draws donut shape — two concentric circles	Click first point on circumference, and drag for second point on circumference; click for second radius [Edge]. Or click center, and drag for first radius; click for second radius [Center]	Edge/Center	Radius 1, Radius 2
Star — Draws star shapes	Click center, and drag for first radius; click again for second radius		Radius 1, Radius 2, [number of] Points [of star], Distortion [twist], Fillet Radius 1, Fillet Radius 2
Helix — Draws a 3D helix (spiral)	Click first circumference point, drag second circumference point, click height, click second radius [Edge]. Or click center, drag first radius, click height, and click second radius [Center]	Edge/Center	Radius 1, Radius 2, Height, Turns, Bias, CW [clockwise]/CCW [counterclockwise]

Items separated by a slash (/) denote radio button options. Italics denote button group names.

You may want to experiment by creating some different splines in a separate file. Remember that you can extrude most of them into the third dimension by using the Extrude or Bevel modifiers and the Loft compound object, which extrudes a shape along a spline path (you'll learn about lofting in Chapter 6, "Organizing and Editing Objects").

Common parameters among all of the shape primitives are found in the Rendering and Interpolation rollouts. In the Rendering rollout, you can force 3ds Max to render a two-dimensional spline as if it were a three-dimensional object complete with surfaces. The Interpolation rollout contains controls for adjusting the number of steps, or straight segments, between each vertex. The more steps a shape has, the smoother the curves are, but this results in a more complex object when the shape is lofted or extruded.

In addition to the Splines group of objects that are created in the Shapes category, there are also NURBS curves and a small library of other shapes called *Extended Splines* consisting of common structural steel cross sections. The NURBS Curves and Extended Splines options are accessed from the drop-down list above the Object Type rollout when the Shapes button is active. Table 3.3 explains the Extended Spline types and options.

TABLE 3.3:   Creation methods for extended splines

SPLINE NAME AND FUNCTION	CREATION METHOD	CREATION OPTIONS*	PARAMETERS*
WRectangle — Draws offset rectangular splines with or without corner radii	Click first corner, and drag for other corner; then click for inner offset [Edge]. Or click center, drag for corner, and then click for inner offset [Center]	Edge/Center	Length, Width, Thickness, Sync Corner Fillets, Corner Radius 1, Corner Radius 2
Angle — Draws an "L" shape	Click first corner, and drag for other corner; then click for inner offset [Edge]. Or click center, drag for corner, and then click for inner offset [Center]	Edge/Center	Length, Width, Thickness, Sync Corner Fillets, Corner Radius 1, Corner Radius 2, Edge Radii
Wide Flange — Draws an "I-beam" shape	Click first corner, and drag for other corner; then click for inner offset [Edge]. Or click center, and drag for corner; then click for inner offset [Center]	Edge/Center	Length, Width, Thickness, Corner Radius
Channel — Draws a "C" shape	Click first corner, and drag for other corner; then click for inner offset [Edge]. Or click center, drag for corner, and then click for inner offset [Center]	Edge/Center	Length, Width, Thickness, Sync Corner Fillets, Corner Radius 1, Corner Radius 2

TABLE 3.3: Creation methods for extended splines *(CONTINUED)*

SPLINE NAME AND FUNCTION	CREATION METHOD	CREATION OPTIONS*	PARAMETERS*
Tee — Draws a "T" shape	Click first corner, and drag for other corner; then click for inner offset [Edge]. Or click center, and drag for corner; then click for inner offset [Center]	Edge/Center	Length, Width, Thickness, Corner Radius

*Items separated by a slash (/) denote radio button options.*

Editing Splines

You've seen how you can edit the rectangle and line shapes through the Modify tab of the Command panel. In most cases, you need to select the Edit Spline modifier from the Modifier List drop-down to gain access to the sub-object levels of a spline where parametric controls are usually shown.

The exception to this is the Line spline, which will display its sub-object level options as soon as you select the Modify tab.

Once you've selected Edit Spline, you can make changes to the vertices, segments, or splines by entering the corresponding sub-object level of the Edit Spline modifier. You can even attach or detach components of a spline to create new forms, as you'll see in the next chapter.

Another way to access a spline's sub-object level is to convert it into an editable spline. This is accomplished by right-clicking the object name in the modifier stack and selecting Convert To: Editable Spline from the context menu, as shown in Figure 3.81.
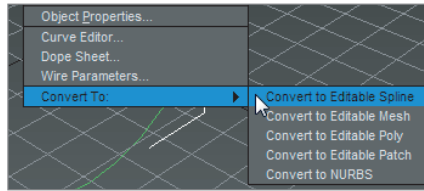
FIGURE 3.81
Convert a Shape to an Editable Spline using the Modifier Stack.
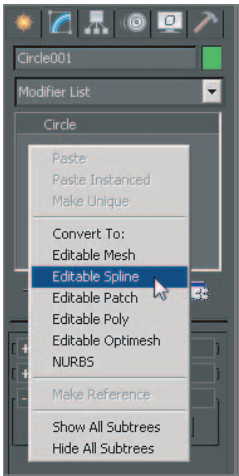
You can also right-click the object in the viewport, and choose Convert To ➢ Convert To Editable Spline from the quad menu, as shown in Figure 3.82.

FIGURE 3.82
Convert a Shape to
an Editable Spline
with the Right-click
quad menu.

This exposes the sub-object level of the selected spline in a way similar to the Edit Spline modifier, but it does so by permanently converting the spline into an editable spline. The spline then loses its parametric functions.

After modifying a spline's sub-objects using the Edit Spline modifier, especially if vertices are added or removed, editing the spline at its top level may yield unpredictable results. For this reason, converting a parametric shape into an editable spline is often preferred to using the Edit Spline modifier. If you want to experiment with the spline's sub-objects but are not sure if the end result will be adequate, use the Edit Spline modifier first. If the desired shape is created, convert the object into an editable spline. If not, simply delete the modifier to return the shape to its unaltered configuration.

In this chapter, you have learned how to draw splines with the traditional tools in 3ds Max 2013. The Graphite Modeling tools provide some alternative ways to sketch splines that can be used for many purposes. For example, you can use the Poly:Freeform PolyDraw panel to sketch splines on grids or on the topology of other Edit Poly objects that can automatically create polygons when you create quadrilaterals with the splines you draw.

Collapsing to an Editable Spline Reduces Memory Usage

Collapsing a spline with modifiers to an editable spline helps reduce the memory usage of your scene. 3ds Max must use additional memory from your system in order to maintain the parameters of objects as well as the modifiers in the stack. If you convert a spline to an editable spline, 3ds Max no longer needs to draw on that additional memory for the spline. As your scene becomes larger, these memory issues become more important. On the other hand, using the Edit Spline modifier consumes more memory than converting a primitive spline shape to an editable spline, but you have the best of both worlds — parametric and explicit control.

Placing and Beveling Text

3ds Max treats text as a parametric spline with parameters that control many features found in word processing software. Text can be justified, bolded, and italicized; the space between letters can be adjusted (kerned); the space between lines can be adjusted (leaded); and the 3ds Max text object can use most Windows fonts. 3ds Max is far from a robust text editor, but within it you will find most of the tools necessary to add text-based geometry to your scenes, including cutting and pasting text from TXT files into the Text tool's Text field.

CERT
OBJECTIVE

You've noticed that, when you create objects, they are created on and oriented to either the home grid or a user grid. 3ds Max also has the ability to create grids on the fly using the surfaces of scene geometry as the basis for the grid's location and orientation. This feature is

accessed by checking the AutoGrid check box in the Object Type rollout. AutoGrid is available whenever you create any type of geometry or shape primitive and remains active until the box is unchecked.

The following exercises explain the use of Text, AutoGrid, and the Bevel modifier:

1. Choose File ➢ Open, and open the `Signage.max` file from the book's companion web page, `www/sybex.com/go/mastering3dsmax2013`. The file consists of a rectangular sign with a curved border. The sign has been rotated off the home grid.

2. Click Create ➢ Shapes ➢ Splines in the Command panel.

3. Click the Text button in the Object Type rollout, and then select the AutoGrid check box at the top of the Object Type rollout.

4. Drag your cursor over the sign in the viewport, and notice that the axis tripod orients its axes to whichever face the cursor is over at any given time, as shown in Figure 3.83.

FIGURE 3.83
With the AutoGrid feature active, the axis tripod orients itself to the face over which the cursor is placed.
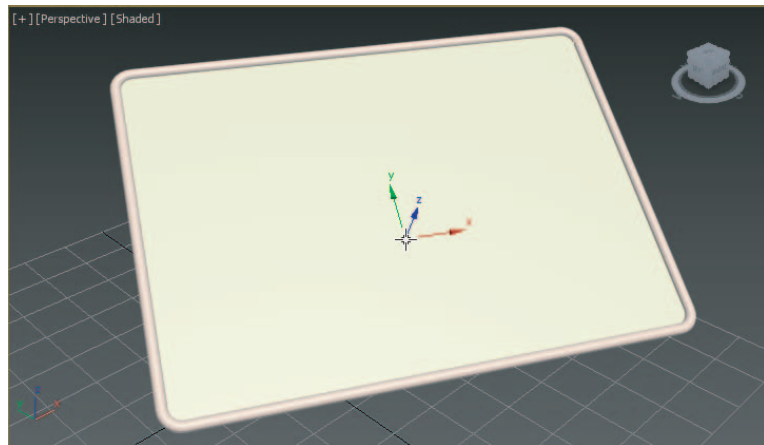
5. With the cursor over the central part of the sign, click the mouse to place the default "MAX Text" text on the sign in the scene. The text is created, but it is too large for the sign (see Figure 3.84). Uncheck AutoGrid.

FIGURE 3.84
Placing new text on the board with AutoGrid turned on
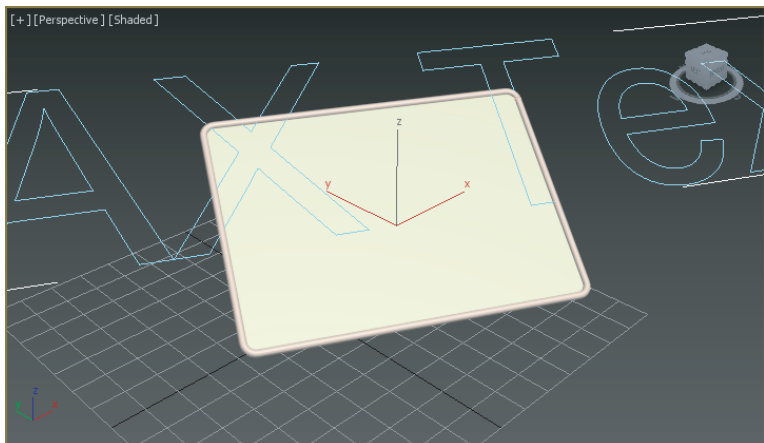
THE START NEW SHAPE OPTION

You may have noticed the Start New Shape option near the top of the Splines Object Type rollout. When this option is unchecked, each shape created becomes a spline sub-object of a greater spline object, rather than individual, parametric spline objects. This option is checked by default.

---

6. In the Parameters rollout, select a font from the drop-down list and then adjust the Size value to change the text to a more appropriate size. Select the text in the Text field, and replace it with the words that you want to appear on your sign. The included figures use the text "Today's Specials."

Different fonts can yield different results when modifiers are applied to them. This is usually the result of using a font with tight corners or thin areas, and then beveling the text in such a manner that it is forced to cross over itself. In other cases, the fonts are designed poorly and don't work well when extruded or beveled. This exercise uses the Book Antiqua Bold font with a Size parameter set to 2'3" and the Center text-alignment setting. You should try a variety of the fonts that are available on your system.


CYCLING THROUGH THE FONT OPTIONS

With the font highlighted in the Parameters rollout, use the up and down arrow keys to cycle through the fonts and observe how each looks in the viewports. If you use the arrows in the numeric keypad, make sure Num Lock is not turned on.

The text assumes the characteristics that you assigned, but its location on the sign is too low. To move it properly, you must use the Local Reference Coordinate System, which uses the X-, Y-, and Z-orientation of the selected object rather than using the World Coordinate System.

1. Click the Select And Move button on the Main Toolbar.

2. To the right of the transform tools, expand the Reference Coordinate System drop-down list, and select Local, as shown in Figure 3.85.

FIGURE 3.85
Choose the Local
coordinate system
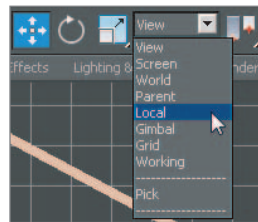
3. Select the text, and notice that the Move Transform gizmo is oriented to the text. Place the cursor over the XY-plane handle, and move the text into place, as shown in Figure 3.86.

Most real-world objects that you will find outside of a machine shop do not have perpendicular faces that join at sharp angles. They usually have a curved (filleted) or straight (chamfered) transition between the surfaces. Although it may not be obvious visually, this transition between the edges of objects in your scenes will appear more realistic to viewers by creating a condition that they are used to seeing. With proper lighting, the transition surfaces can generate a specular

highlight, subtly calling attention to the edges. The Extrude modifier does not provide for a fillet or chamfer, but these features can be found in the Bevel modifier's option, as explained in the following steps. Although this example uses text, the Bevel modifier can be used with any spline.

FIGURE 3.86
Moving the text
into place
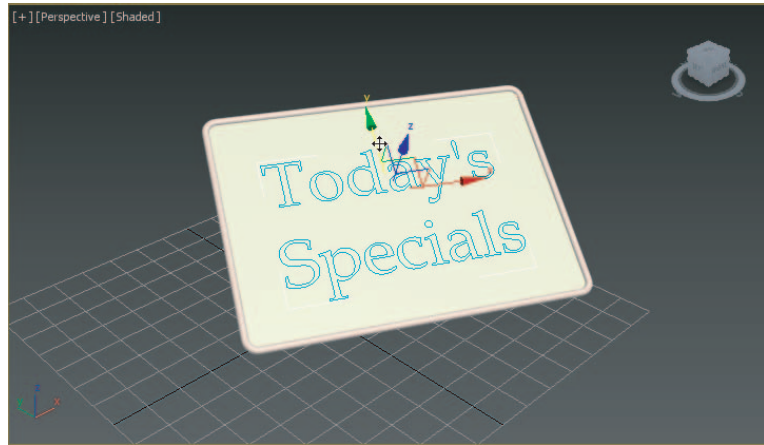
The Bevel modifier's Bevel Values group has controls for setting the height and outline amount at three different locations perpendicular to the spline's current location. The Outline value is an offset size that the shape assumes, at the specified Height value, relative to its original size.

Add the Bevel modifier to your text using the following steps:

1. Select the text, if you have deselected it, click the Modify tab, and then choose Bevel from the Modifier List drop-down.

2. In the Bevel Values rollout, make sure the Start Outline value is 0′0″, then set the Level 1 Height parameter to **3**″, and leave Outline set to 0.0″. This will generate an initial straight segment for the letters.

3. Check the Level 2 check box. Set the Level 2 Height to **0.25**″ and the Outline to **−0.25**″.

4. Zoom into the letters to see the chamfered effect of the Bevel modifier, as shown in Figure 3.87.

5. In the Parameters rollout, select Curved Sides in the Surface group, set Segments to **4**, and select the Smooth Across Levels check box. These settings will generally soften the transition between levels and, when a small Outline value is present, can create a ridge around the perimeter of the splines, as shown in Figure 3.88.

6. Save your scene as **My_Signage.max**.

FIGURE 3.87
The chamfered effect of the Bevel modifier

FIGURE 3.88
Smoothing the transition between surfaces

The Bottom Line

Draw shapes with splines. Two-dimensional splines can be used as the building blocks for more complex, three-dimensional objects. You can draw splines from scratch using the Line tool or start with a parametric shape and then collapse it to an editable spline.

Master It Create a rainbow-shaped set of splines — in other words, a series of concentric arcs.

Outline and extrude splines. Outlining splines provides a way to create a new spline sub-object that parallels the original. This is faster and more accurate than creating the second

spline manually and then attaching it to the original. Extruding splines is the most common method for creating 3D objects from 2D splines.

Master It   A column surround is a shell that covers a structural column to give it a more appealing appearance. Create a 16′-tall, 2″-thick, semicircular column surround with a 16″ outside radius.

Modify closed splines with Boolean tools.   Nearly any shape can be formed using the standard Editable Spline tools. Rather than adding, deleting, and adjusting vertices, it is often faster and easier to create two or more simple shapes and combine them for a more complex shape.

Master It   Using the spline Boolean tools, create the cross-sectional shape of a fluted column, similar to the shape shown here.
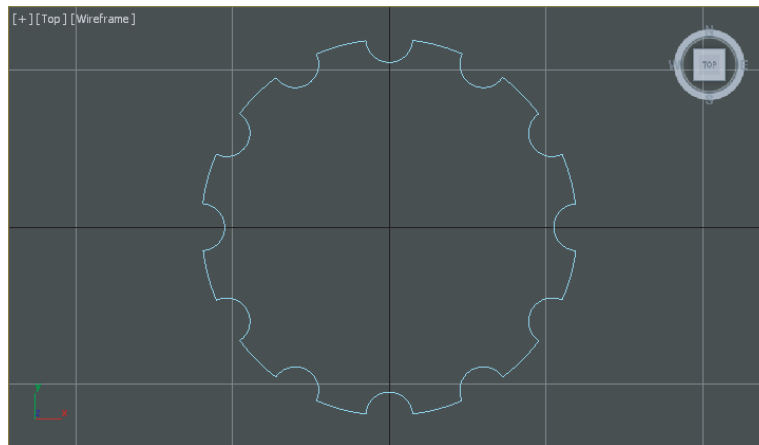
Editing Meshes and Creating Complex Objects

In the three previous chapters, you spent some time becoming familiar with the Autodesk® 3ds Max® platform. In this chapter, you'll continue exploring the modeling features of 3ds Max while exercising your newfound skills. You'll start by learning how to add openings to the walls you created in Chapter 3, "Creating Shapes with Splines." Then you'll learn how you can import scanned images that you can use to trace. In the process of tracing a building's floor plan, you'll further explore methods for creating and editing forms using splines. You'll also be introduced to ways you can edit the extruded shapes that you have created, as well as edit any other mesh object.

In this chapter, you will learn to

◆   Create openings with ProBoolean operations

◆   Designate a modeling template image

◆   Create and modify objects using box modeling

◆   Attach objects to a mesh

◆   Create clones with Array and Snapshot

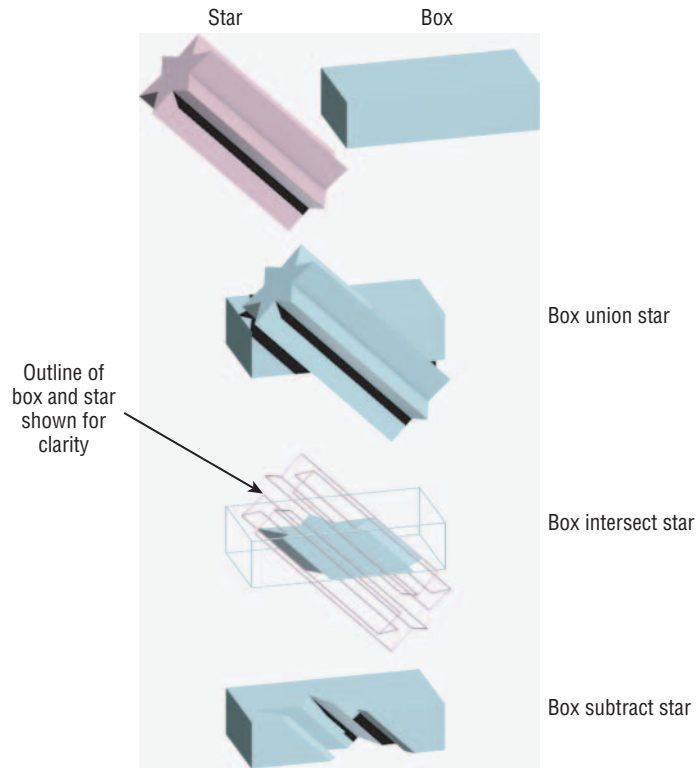## Creating Openings in a Wall with Boolean Operations

In Chapter 3, you created a set of walls that completely enclosed a space. Now you need to add wall openings between the enclosed spaces of your model. To do this, you'll use *Boolean* operations to remove portions of a wall.

A BRIEF HISTORY OF BOOLEANS

Boolean operations are named after George Boole, who developed a mathematical branch of symbolic logic. Boolean logic includes AND, OR, and NOT operators, which correspond to geometric union, intersection, and subtraction.

Boolean operations are methods you can use to join two objects, subtract the shape of one object from another, or obtain a shape that is the intersection of two objects. Figure 4.1 illustrates the effect of Boolean operations on some sample shapes.

Star   Box

Box union star

Outline of
box and star
shown for
clarity

Box intersect star

Box subtract star

3ds Max allows you to use two existing objects to form one new object using Boolean operations. The original objects are referred to as the *operands* of the Boolean operations, and they are not deleted when the operation is performed; they become sub-objects of the resultant Boolean object. In the following exercise, you'll use a simple box to define the opening in your walls. The existing wall is one operand, and the box that forms the opening is the other operand.

In addition to the legacy Boolean tool, 3ds Max has the ProBoolean and ProCutter compound objects. The ProBoolean compound object has the classic three Boolean operations and adds Merge, Attach, and Insert. You can also use the Imprint and Cookie options to enhance your operations further. The ProBoolean tools keep the history of operations; you can modify the operators or change the ordering of operators anytime you want. You can even change an operation's type (for example, change a subtracted operand to a union operand). The ProBoolean operations create better geometry than the original Boolean tools in 3ds Max. They provide you enormous flexibility in creating objects for your projects.

Hiding Shapes That Get in the Way

Start by setting up your wall model and creating an object you'll use to subtract from the walls.

1. Open the My_Walls.max model you created in the previous chapter, or open MyWalls_ C04.max that you downloaded from www.sybex.com/go/mastering3dsmax2013.

2. If your 3ds Max window shows only a single viewport, click the Maximize Viewport toggle to view the four viewports.

You'll need to hide the ceiling of your model in order to work on the model more easily. Here's a quick way to hide objects temporarily if they're in your way.

3. Right-click in the viewport, choose Select from the quad menu, and then click to select the ceiling object.

4. Click in the Name input box in the Name And Color rollout in the Command panel, and change the name to **Ceiling**, as shown in Figure 4.2. This will help you find the ceiling later.
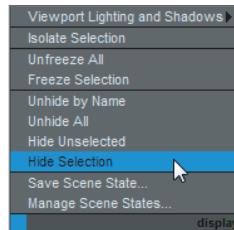
FIGURE 4.2
Rename an object in the Command panel.
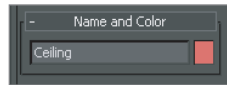
5. Right-click in the viewport, and choose Hide Selection from the quad menu (see Figure 4.3). The ceiling disappears.

FIGURE 4.3
Using the quad menu, hide the selected object.

6. The ceiling hasn't really gone anywhere—you've just hidden it. Just so you know where to look when you do need to reveal the object, right-click in the viewport again and choose Unhide By Name from the quad menu, which can be seen three spaces above Hide Selection, as shown in Figure 4.3.

The Unhide Objects dialog box appears, as shown in Figure 4.4.

FIGURE 4.4
The Unhide Objects dialog box
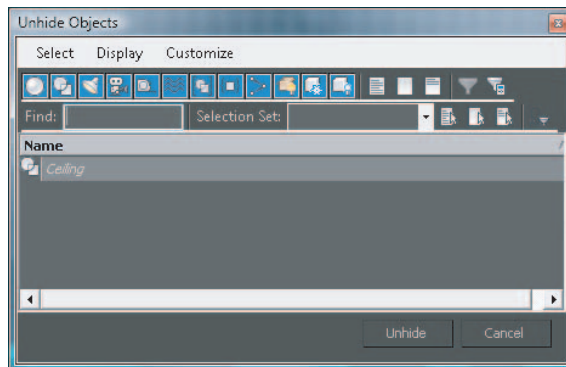
7. You can see that Ceiling is listed in the dialog box. To display the object in the viewport, you would click the name in the list and then click Unhide. You want to keep it hidden for now, so click Cancel.

The display functions shown in this section are also available from the Display tab of the Command panel and by selecting Tools ➢ Display Floater, which is shown in Figure 4.5.

FIGURE 4.5
The Display Floater
dialog box
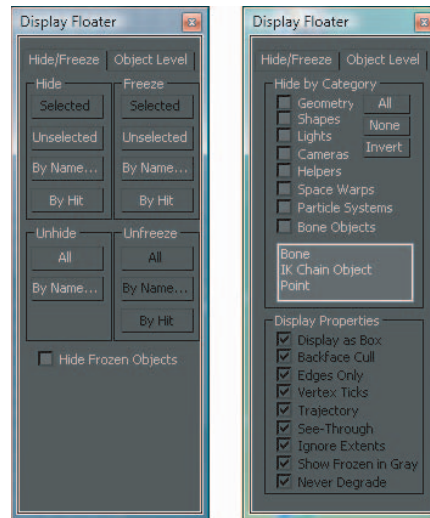
The Display Floater is a non-modal dialog box that you can keep open while you work, and it can help speed up your workflows by allowing you to adjust which objects are hidden or frozen quickly, including at the object levels, without needing to change the current tab of the command panel interrupting your current task. Figure 4.5 shows the Display Floater dialog box with the Hide/Freeze tab on the left and the Object Level tab on the right.

Creating the Shape of the Opening

Now you're ready to get to work on the walls. Your first step is to create the shape of the opening. You can think of this shape as the negative space of the opening or as the shape that is to be removed from the wall.

1. Click in the Top viewport to make it active.

2. Click the Zoom Extents tool so that you can see the entire plan in the viewport.

3. Click the Geometry tool in the Create tab of the Command panel, and make sure that Standard Primitives is selected in the drop-down list.

4. Click the Box button in the Object Type rollout. Then, in the Top viewport, click and drag a rectangle that is roughly 3′ × 3′ square at the location shown in Figure 4.6. You don't need to draw the box precisely because you'll enter the exact dimensions in the Parameters rollout.

5. Make the height of the box roughly 7′.

6. Go to the Parameters rollout of the Create tab, and set the Length and Width values to **3′** and Height to **6′ 8″**.

You now have a box that will be used to create an opening. The next steps are to place the box in the locations for the openings.

[+] [Top] [Wireframe]
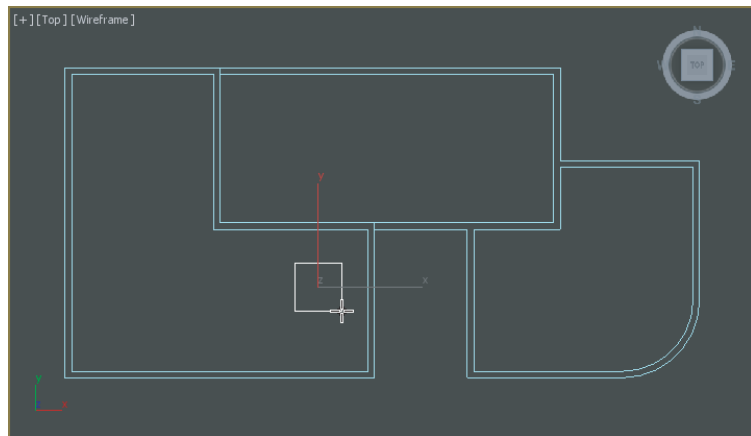
7. Click the Select And Move tool in the Main Toolbar and move the box to the location on the left, as shown in Figure 4.7. Remember that you need to place the cursor on the selected object. Then, when you see the Move cursor, click and drag the object into position.

[+] [Top] [Wireframe]
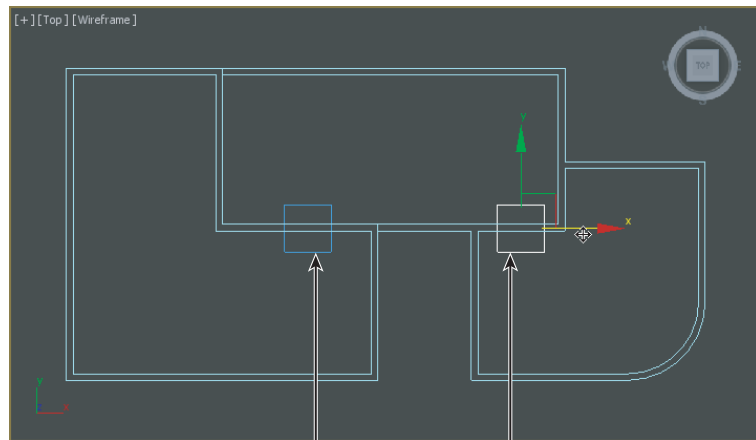
Move the box here.   Make a copy here.

8. Shift+click and drag the box to make a copy of the box in the location to the right, as shown in Figure 4.7.

**9.** In the Clone Options dialog box, click Copy and then click OK.

Subtracting the Opening from the Wall

CERT OBJECTIVE

Now that you have the object ready, you can use the ProBoolean tool to subtract it from the wall. First you'll select the object from which you want to subtract the opening—this is referred to as *Operand 0*. Afterward, you'll select the object to subtract, called *Operand 1*.

1. Click the Select Object tool, and click the first wall you created, as shown in Figure 4.8.

FIGURE 4.8
Selecting the wall for the Boolean operation


Select this object first. Operand
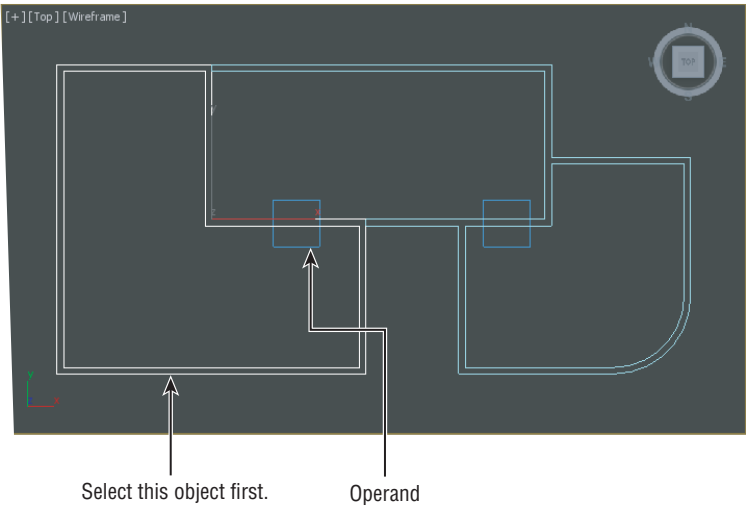
2. Click the drop-down list under the row of tools near the top of the Command panel, and then select Compound Objects, as shown in Figure 4.9.

FIGURE 4.9
Starting the creation process for compound objects
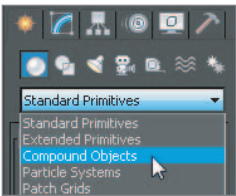
3. Click the ProBoolean button in the Object Type rollout. The ProBoolean options appear in the Command panel.

4. Scroll down the Command panel to the Parameters rollout, and make sure that the Subtraction radio button is selected (see Figure 4.10).
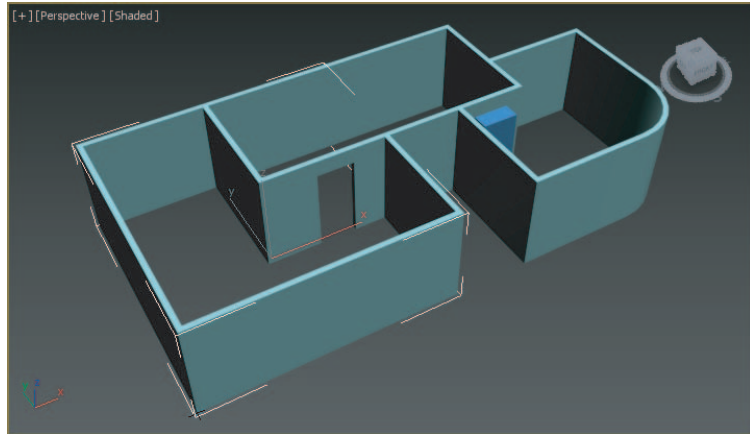
FIGURE 4.10
Choose the Boolean operation to be performed.
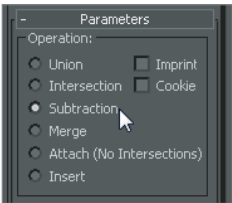
5. Click the Start Picking button in the Pick Boolean rollout.

6. Click the box that intersects the wall, as shown in Figure 4.8.

If you look in the Perspective viewport, you'll see that an opening appears in the wall where you had previously placed the box, as shown in Figure 4.11.

FIGURE 4.11
The opening in the wall

PROBOOLEANS ARE MORE POWERFUL THAN BOOLEANS

You may have noticed the Boolean option under the Object Type rollout. This is the older Boolean tool developed with 3ds Max. This tool is at least 17 years old; it was part of the first release of 3ds Max in 1995. ProBoolean was a more powerful plug-in available for 3ds Max that has been incorporated into the program.


Now repeat the operation for the other wall:

1. Click the Select Object button to exit the ProBoolean tool, and then click the second wall.

This becomes the first operand for the next Boolean operation.

2. Click the ProBoolean button in the Object Type rollout of the Command panel.

3. Click the Start Picking button, and then select the box. The second opening appears, as shown in Figure 4.12. You may need to Orbit your viewport a little to get a better view of the new opening.

In this example, you created a simple rectangular opening in the wall. The shape of the opening can be anything you want it to be. You just need to create the geometry using primitives or extruded splines. In addition, the object that you're subtracting from doesn't need to be thin like the wall in this example. It can be any geometry you want, and the subtracted shape will leave its impression. Figure 4.13 shows some examples of other Boolean subtractions to give you an idea of other possibilities.
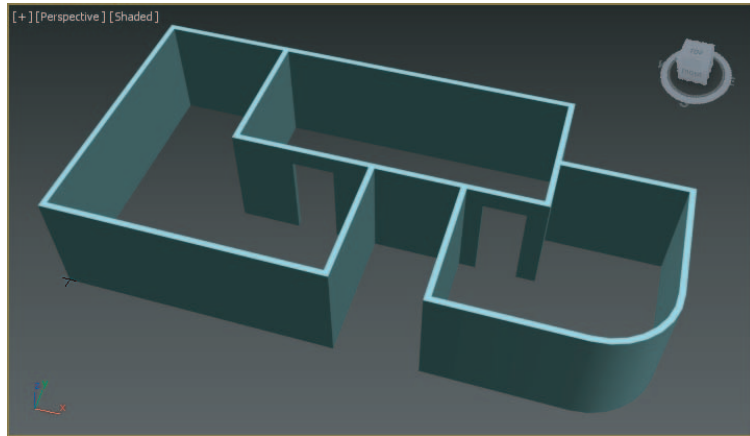
Creating Multiple Openings in a Single Wall

You can perform multiple ProBoolean operations on any 3D object, such as creating several openings in one wall. To do this, you only need to continue selecting objects while the Start Picking button is selected. All of the objects selected become operands of the Boolean operation.

   If you've deselected a ProBoolean object, simply reselect it, click the Modify tab, click the Start Picking button, and then continue picking operands. If you have a number of objects to subtract from another, after you have clicked the Start Picking button, you can press the **H** key on the keyboard to bring up the Pick Object dialog box and select all of the objects for your operation. All of the objects will appear in the Operands display; they can still be reordered and modified as if you had selected them individually.

   If you collapse a ProBoolean object to an Editable Mesh or Editable Poly, you lose the operands history. This means that you cannot edit the openings by going back and changing the size of the boxes. You can, however, edit openings in the object at sub-object levels.

FIGURE 4.13
Some samples
of Boolean
subtractions
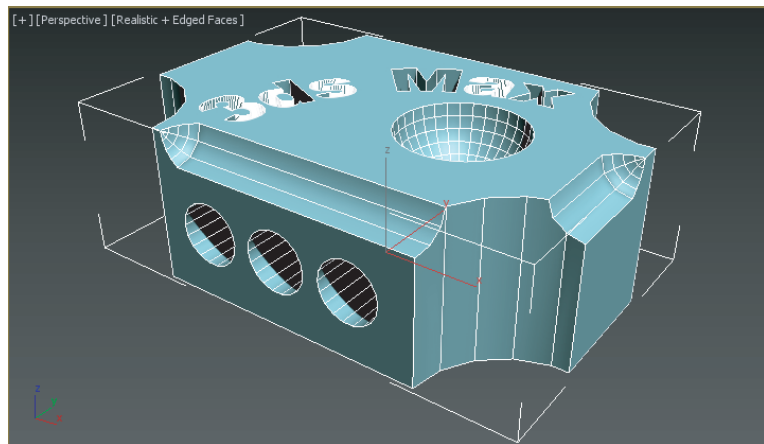
Making Changes to the Opening

Suppose that you decide to increase the size of one of the openings. You can go back and modify the box used as the Boolean operand so that it's wider. This, in turn, will increase the opening size.

1. Click the Select Object tool in the Main Toolbar, and click the first wall, as shown in Figure 4.14.

FIGURE 4.14

Moving the oper-and to change the location of the wall opening

Select this wall.

Resize operand and move to this location.
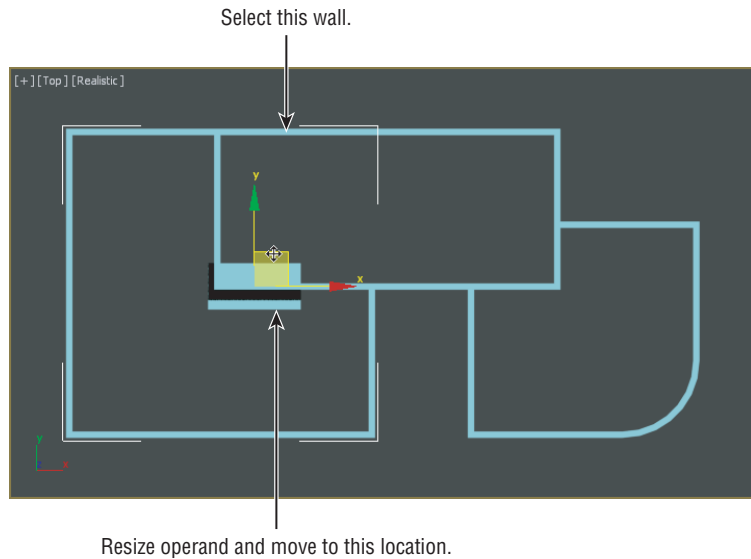
2. Click the Modify tab in the Command panel. Scroll down to the Display section of the Parameters rollout, and click the Operands radio button. The box reappears in the viewports.

3. Scroll down to the bottom of the Parameters rollout, and then click the 1: Subtr – Box001 item in the selection field. See Figure 4.15.
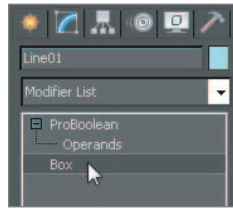
FIGURE 4.15

Selecting the sub-traction operation
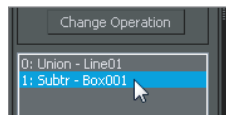
4. Notice that Box is now listed in the modifier stack at the top of the Command panel. Click the Box item. See Figure 4.16.

FIGURE 4.16
Selecting Box in the
stack

The Command panel options change to show the parameters for the box.

5. In the Parameters rollout, change the Width value to **6**′. Notice how the box changes in the viewports as you edit the Width parameter.

6. Go back to the top of the modifier stack and select ProBoolean.

7. Scroll down to the Parameters rollout, and click the Result radio button, shown in Figure 4.17.

**FIGURE 4.17**
Display the result.

Now you can see the result of your edit in the Perspective viewport. The opening is now 6′ wide instead of 3′ wide.

Besides altering the shape of the box, you can also reposition it to change the location of the opening in the wall. Here's how it's done:

1. Click the Operands radio button in the Parameters rollout again to view the box.

2. Scroll up the Command panel to the modifier stack, click the plus (+) sign next to the ProBoolean option, and then click the Operands entry. It highlights to indicate that it is selected. See Figure 4.18.

3. Click the Select And Move tool in the Main Toolbar. Then click and drag the box to the left, in the -X direction, so that it passes through the corner of the wall, as shown earlier in Figure 4.14.

FIGURE 4.18
Selecting the
Operands
sub-object
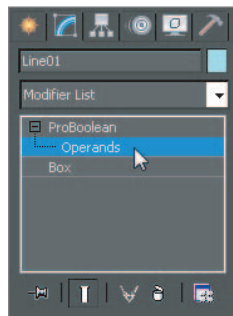
4. Click Operands again in the modifier stack, or click the top ProBoolean entry to exit the sub-object level (the highlight color disappears).

5. Scroll down the Parameters rollout, and click the Result radio button. The new wall opening configuration appears in the Perspective viewport, as shown in Figure 4.19.

FIGURE 4.19
The result of moving the Box operand
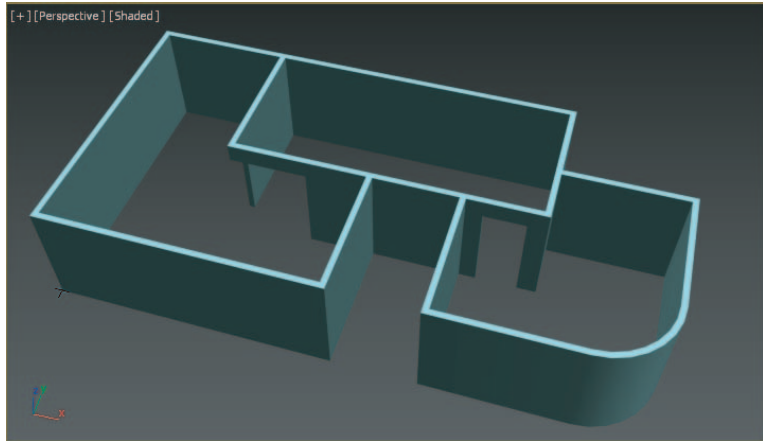
6. Save the `MyWalls_C04.max` file incrementally by choosing Application button ➢ Save As and clicking the plus (+) button in the Save File As dialog box. The file will be named `My_WallsRoof01.max` if you continued from the previous chapter or `MyWalls_C05.max` if you used the file provided.

The tricky part of moving the opening in this exercise is making sure that the sub-object level is active and that the proper operand is selected at the bottom of the Parameters rollout.

These exercises demonstrate that you can alter the shape of the opening by modifying the parameters of the object you used to create the opening. The trick here is to know how to get to the box operand in order to edit its parameters. It's a good idea to first make the subtracted operand visible. It's not absolutely necessary, but it helps to see the operand as you make changes. Use the modifier stack to gain access to the operand. Once there, you can access the operand's parameters and make changes to its geometry or change its location. To change the location of either of the operands within a compound object, go to the Operands sub-object level and select the operand. The operands are considered sub-objects of the ProBoolean compound object. Like almost everything else in 3ds Max, this can be animated. You can use ProBoolean animations to make quick animations of objects appearing or disappearing.

Tracing a Sketch

You cannot always predict when or where you'll have a brilliant design idea. Frequently, ideas arise when you're sitting at a table during a brainstorming session or perhaps even while you are out eating lunch. The basic tools of pencil and paper offer the spontaneity needed to express your ideas freely, as do many smartphones and tablets that allow you to run applications such as Autodesk® SketchBook® and Autodesk®AutoCAD® WS software.

Once you've created an inspired sketch, 3ds Max offers a way to transfer your inspiration quickly into a 3D model. Among its view options, 3ds Max can display bitmap images in the viewports for a variety of purposes, including the tracing of scanned design sketches.

In this section, you'll continue your exploration of splines by importing a sketch and tracing it. You'll use a sketch that roughly approximates the floor plan of Notre Dame du Haut, more commonly known as the Chapel at Ronchamp, which was designed by Le Corbusier in 1950. Figure 4.20 shows a photograph of one view of the famous building. If you use Google to search for images of the Ronchamp Chapel you'll find hundreds of photos that give views of all sides of this masterpiece of modern architecture. A good way to practice your skills is by re-creating recognizable objects or buildings, because there is a lot of information with which you may compare your reconstruction.

FIGURE 4.20
Notre Dame du
Haut in Ronchamp

By modeling this building, you will have the opportunity to examine how you might use splines to create shapes other than simple straight walls like those you created in the previous chapter. You'll also be introduced to other methods for modeling forms by combining splines and primitives.

Using a Bitmap Image

Using a bitmap image as a modeling template is fairly simple, but you need to watch out for a few settings. In the following exercise, you'll import an image that is a sketch of the Ronchamp Chapel floor plan. The sketch shows a grid that is spaced at approximately 4.5 meters, as shown in Figure 4.21.

Figure 4.21
The bitmap image of the Notre Dame du Haut floor plan
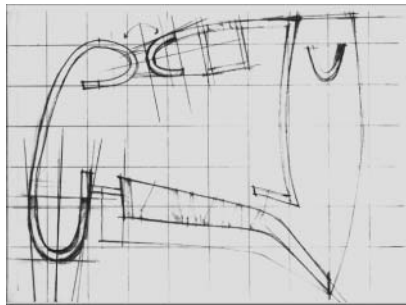
Accessing the Background Image

To access the background image, you'll need a file from this book's website (`www.sybex.com/go/ mastering3dsmax2013`), so make sure you've installed the sample files before you start.

1. Choose Application button ➢ Reset, and click Yes at the reset query message.

2. Choose Customize ➢ Units Setup, and select US Standard, Feet w/Decimal Inches, and Inches as the Default Units.

3. Click the Create tab of the Command panel, and click the Plane button.

4. Activate the Top viewport. Now draw a plane that is about 20′ × 20′, as shown in Figure 4.22.

5. With the Plane001 object selected, right-click the Select And Move icon on the Main Toolbar to open the Move Transform Type-In box.

FIGURE 4.22
Creating the image
plane
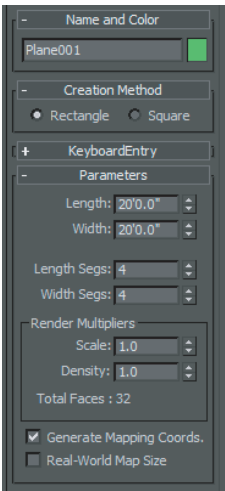
6. Enter **0** for both the X and Y locations, and press Enter to center the plane on the world origin, as shown in Figure 4.23. Close the Move Transform Type-In box when you have finished.

FIGURE 4.23
Centering the plane
on the world origin
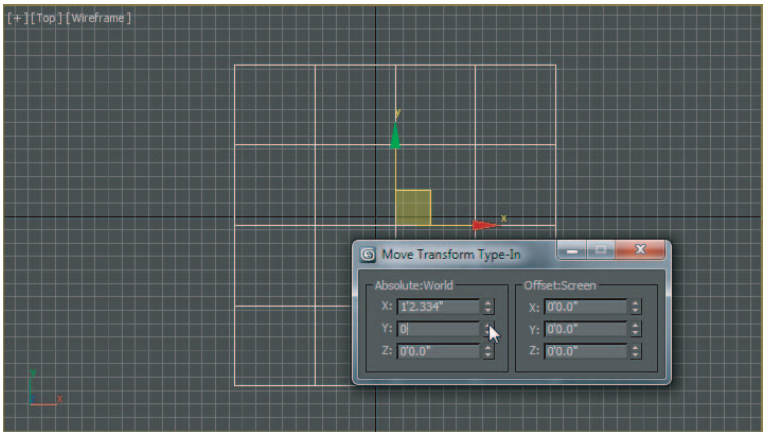
Now you're ready to set up your scanned floor plan.

7. Click the Compact Material Editor icon on the Main Toolbar to open the Compact Material Editor, as shown in Figure 4.24. Note there are now two different Material Editors in 3ds Max; here we're using the Compact Material Editor. The icon on the Main Toolbar is a flyout now, so make sure that you've chosen the correct one. The icon should look like the one in the margin here.

The Material Editor uses the renderer to display the sample spheres. Since you are working with a default 3ds Max 2013 scene, this file is set up to use the Default Scanline Renderer.
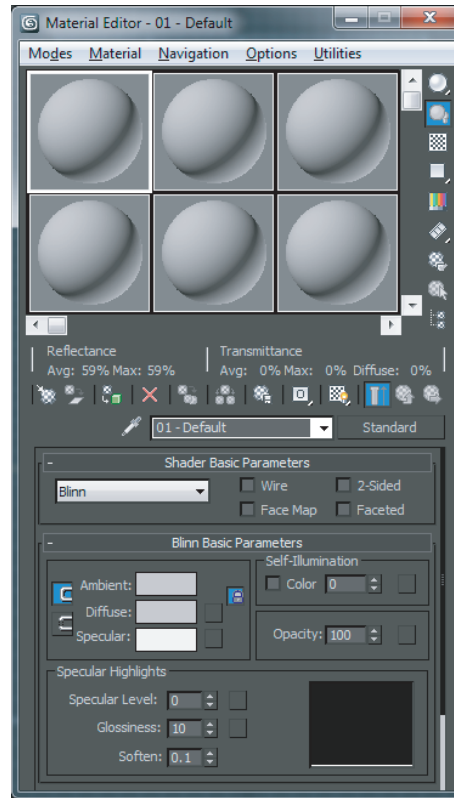
You will be using the Material Editor here to set up your sketch to use as a modeling template. The Material Editor will be covered in more detail in Chapter 8, "Enhancing Models with Materials."

8. Pick the second sphere in the upper row of the material samples. The thick, white border around the sample will indicate that it is selected.

9. Click in the Material Name box, and rename 02 – Default to **RonchampPlan** so that you will know where you will use the material. Click the button to the right of the material name currently labeled Standard to change the material type. In the Material/Map Browser's Materials rollout, click the Standard rollout, then click Architectural, and then click OK at the bottom of the Material/Map Browser. This changes the material type to Architectural for the new material you are making. Note that changing the material type changes the available parameters and rollouts for the new material.

10. In the Physical Qualities rollout, click the button currently labeled None to the right of the Diffuse Map item. This will again bring up the Material/Map Browser.

11. To open the Select Bitmap Image File dialog, open Standard in the Maps rollout and double-click the Bitmap entry at the top of the listing of available maps.

12. Navigate to where you downloaded the `ronchampscan.gif` file, select the file, and click the Open button.

13. Notice that the Tiling value for both U and V mapping coordinates is set to 1. Deselect the Tiling option for both U and V; this prevents 3ds Max from trying to blend the edge pixels of the map as if it were to be tiled. Click the Go To Parent button to go to the top level of the material you just created. Leave the Material Editor open.

14. Select the Plane001 object you created at the beginning of these exercises and, in the Name And Color field, rename the plane to **RonchampPlanTemplate** so that you will be able to identify the object in the scene in the future.

15. With the RonchampPlanTemplate object selected, on the Compact Material Editor, click the Assign Material To Selection button.

16. Click the Show Shaded Material In Viewport button. The scanned image appears on the plane object in the Perspective viewport, as shown in Figure 4.25.

FIGURE 4.25
The Ronchamp image plane in the Perspective viewport
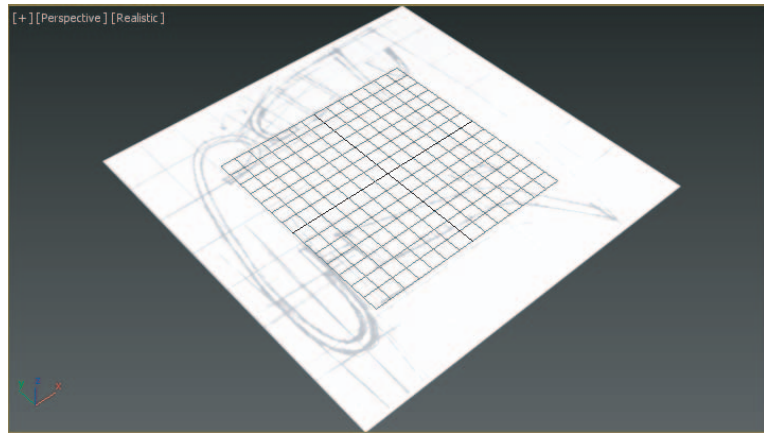
How Resetting 3ds Max Differs from Starting a New File

The difference between choosing Application button ➤ Reset and choosing Application button ➤ New is subtle, but there is an important distinction. When you reset the scene, you are starting over completely and everything defaults to the way that it was when you first launched 3ds Max. When you create a new scene, it merely erases all the objects, leaving your scene seemingly empty; however, the new scene still has all the materials, units, and other settings as they were set before you chose Application button ➤ New.

Scaling the Image Plane to the Model's Size

The image appears stretched across the 20' × 20' plane that you created at the beginning of the exercise. You'll want to size the image plane so that it's to scale—that is, so that the distances represented by the image are the same as those in the 3ds Max model. You can

approximate the correct scale, although you won't be able to get it exactly the same. Here's how it's done:

Start by setting up the units with which you'll be working.

1. Choose Customize ➢ Units Setup. The Units Setup dialog box displays.

2. Click the Metric radio button, and make sure Meters is displayed in the Metric drop-down list. Then click OK.

   You'll use meters in this example because this is a European building project. Now let's scale the image plane to the proper size.

3. Type **G** to toggle off the grid display.

   If you look at the scanned image carefully, you'll see a grid whose spacing is about 4.5 meters.

You see 10 reference grid spaces in the horizontal direction. By inspecting the image in an image-editing application such as Adobe Photoshop, you can determine that the grid lines are about 63 pixels apart and that the image is 640 × 470 pixels. You can use these numbers and the grid spacing interval estimate of 4.5 meters to determine that the entire image is 45.85 meters × 33.57 meters.

Now you will adjust the size of the image plane to accommodate the measurements of the sketch.

1. Select the RonchampPlanTemplate object, and then click the Modify tab of the Command panel (see Figure 4.26).

   The Length and Width values are now shown in meters.

2. Set the Length value to **33.57** and the Width value to **45.85**, based on the image-scaling calculations, as shown in Figure 4.27.

FIGURE 4.26
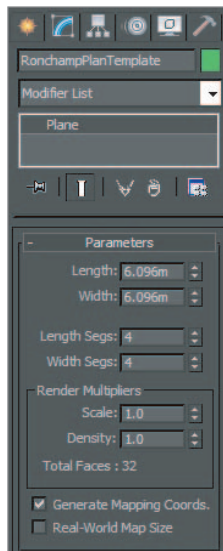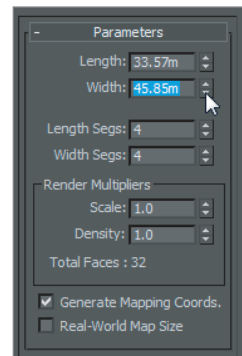The Parameters rollout for the RonchampPlanTemplate object

FIGURE 4.27
Sizing the Image Plane object

3. Press the **G** key to turn on the grid.

4. Click the Zoom Extents All button.

5. Click the Shading menu on the Top viewport, and select Realistic.

6. Save your scene as **MyRonchamp01.max**.

You will see your modeling template displayed in the Perspective viewport, as shown in Figure 4.28.

The RonchampPlanTemplate image plane that you have created may not be exactly the same size as the real chapel but, based on the estimate of the grid size of the hand-drawn sketch, it is probably as close as you can make it. If you had accurate dimensions from the actual structure that related to parts of the sketch, and if you knew the sketch was very accurate, you could get a much closer approximation of the size of the structure.

FIGURE 4.28
The ronchamp-scan.gif image applied to your plane object in the Perspective viewport
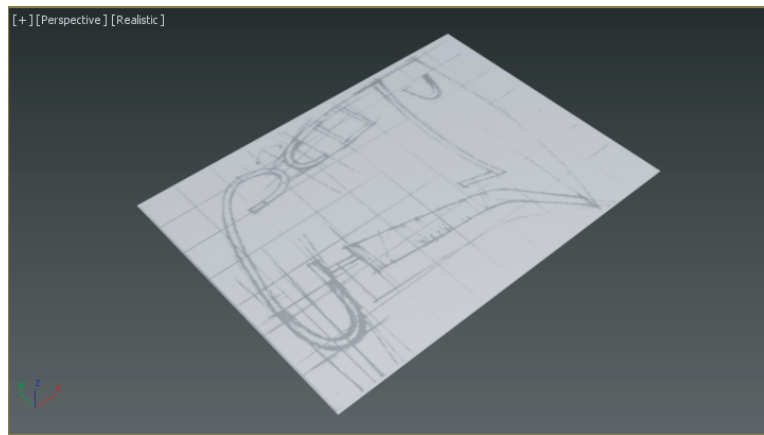
When creating 3D objects for any project, it is crucial that you build all of your objects at their real-world size. Doing so will help you significantly as you build a collection of objects and buildings that you can merge together to create more visually interesting scenes. If your objects are not built to real-world size, the objects will not relate to each other, and you will have to scale manually and guess at the sizes of objects to make them fit together correctly.

There are other reasons for building your objects at their real-world size. The mental ray materials that you will learn about in Chapter 8 and Chapter 14, "Advanced Rendering Using mental ray," are designed to work in real-world units. If you use those materials on objects that are not real-world size, the results can be unpredictable. The photometric lights are also intended to be used in models that are real-world size, and you will get the best results if your models are built to the correct real-world size.

BLUEPRINT RESOURCES

There are many websites for finding blueprints (or reference images) of almost every conceivable object, including cars, airplanes, buildings, trains, tanks, all manner of weapons, animal and human anatomy, and more. A few good websites for finding blueprints online are www.smcars.net, www.the-blueprints.com, and www.greatbuildings.com. I have also found that imported

model kits from most Japanese manufactures often have very good orthographic drawings of the completed models that are perfect for scanning and using as your modeling blueprints.

There will undoubtedly be times when you can't find a blueprint of something, but you might have access to the object you wish to model. To create your own photo-reference blueprints, it is best to use the longest (telephoto) lens you have, get back as far away from the object as possible while getting the object as large in the frame as possible. Be careful to level the camera and center the object in the viewfinder so that you will have as little distortion as possible in your images. It is also good to put some kind of measurement reference in the photographs as well that you can use in an image-editing program to measure the number of pixels so that you can set up your photo reference to scale in 3ds Max.

CERT OBJECTIVE

AVOID DISTORTION BY USING BITMAP FIT

There is another way to make sure that the image to which you apply the plane doesn't get distorted. Applying a UVW Map modifier to the plane and choosing Bitmap Fit will lock the proportions of the UVW coordinates to the original bitmap, avoiding distortion.

Now that you have set the image plane to a size that makes some sense scale-wise, you are ready to get on with the real work of building the model.

Tracing the Image

To trace the bitmap, you'll use the Line tool you were introduced to in the previous chapter. You won't trace all of the walls at first.

Start by tracing the small, U-shaped wall on the exterior of the chapel:

1. Continue with the previous exercise, or open Ronchamp_01.max. If you use the provided file, you may need to retarget the ronchampscan.gif image in the Material Editor.

2. In the Top viewport, use the Zoom Region tool to zoom into the U-shaped wall area so that your view looks similar to Figure 4.29. Don't select too small an area.

FIGURE 4.29
Tracing the wall
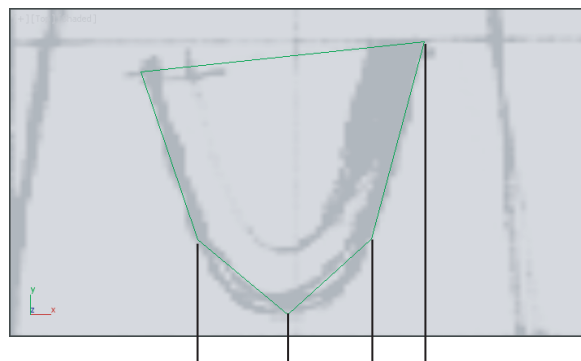
Continue creating points in a counter-clockwise fashion.

3. Click the Create tab of the Command panel, and then click Shapes.

4. Click the Line button in the Object Type rollout of the Command panel.

5. Open the Creation rollout, and set the Initial type to Corner and Drag type to Bezier, if these are not already selected.

6. Trace the outside of the wall using single clicks in a counterclockwise fashion to select the points shown in Figure 4.29.

   Another alternative is to change the color of the line you are drawing by using the color swatch in the Name And Color rollout.

USE THE COLORCORRECTION MAP TO CHANGE BRIGHTNESS

You may have trouble seeing the line against the texture map. You can easily change the brightness of the sketch by going to the Material Editor and navigating to the Coordinates rollout. Click the button marked Bitmap just above the Coordinates rollout to launch the Material/Map Browser. In the Maps ➢ Standard rollout, choose ColorCorrection and click OK. In the Replace Map dialog, choose Keep Old Map As Sub-Map. The map will disappear in the viewport. To see the map again, click the Show Shaded Material In Viewport button. Scroll down until you see the Lightness rollout, where you can adjust the brightness and contrast of the sketch. For the screen images shown in this book, the brightness was dropped to -50 so that you could see the white first vertex markers and the selection brackets against the grayer background of the template image.

---

7. For the last point, click the beginning of the spline. In the Spline dialog box, click Yes to close the spline.

   If the line disappears and is not visible when you finish drawing it, try selecting and moving the plane down slightly on the Z-axis to make sure that it is just below the home grid. You can do this by selecting and then right-clicking the plane and then choosing the Move Settings button on the right side of the quad menu. Use the Transform Type-In spinners to move the plane down in the negative Z direction.

The line needs to be curved, so you will use the Bezier Vertex option to adjust the curvature of the wall:

1. Click the Modify tab of the Command panel, and then right-click in the viewport to open the quad menu.

2. Click the Vertex option in the tools 1 quad menu (see Figure 4.30) to access the Vertex sub-object level for the spline. You can also click the plus (+) sign next to Line in the modifier stack and then click Vertex in the expanded list, or click the Vertex button in the Selection rollout of the Modify tab.

3. With the Select Object tool, click the middle vertex of the wall.

4. Right-click to open the quad menu, and select Bezier from the list of Vertex options.

5. Click the Select And Move tool in the Main Toolbar, and the Transform gizmo appears. Drag the XY gizmo (the yellow box), and then drag the tangent handles to a position similar to the one shown in Figure 4.31. Note that the tangent handles honor the last-used

Transform gizmo setting, so if you have it set to X only, you'll be able to move only the handles in X. This is not obvious, but once you understand this, you'll be a happier 3ds Max user.
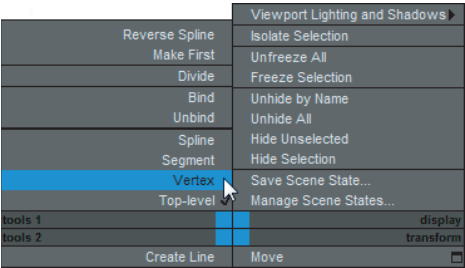
FIGURE 4.30
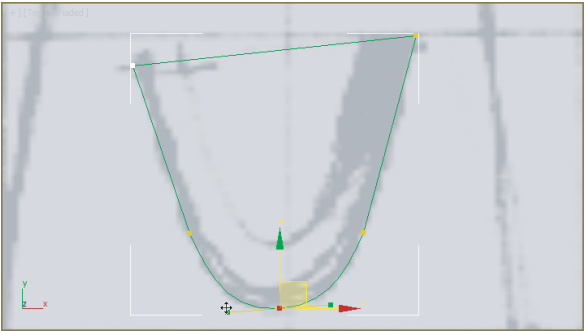Accessing the Vertex sub-object level

FIGURE 4.31
Editing the middle vertex

You'll want to smooth the bottom curve to match the bitmap image.

6. Right-click the vertex to the left of the one you just edited, and select Bezier from the quad menu. Adjust the tangent handles until the curve of the line matches the sketch, as shown in Figure 4.32.

FIGURE 4.32
Editing the second vertex to the left of the middle vertex
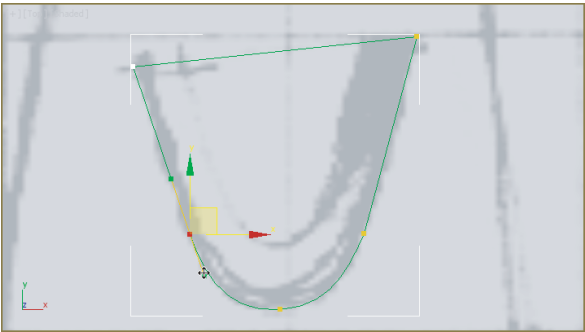
7. Right-click the vertex to the right of the first vertex that you edited, select Bezier from the quad menu, and adjust the Bezier handles so that the wall looks fairly symmetrical, as shown in Figure 4.33.

SETTING THE AXIS LOCKS

If the handles still will not move in the direction that you want, the axis locks may be active. Use the F5 through F8 keys to set the proper lock axis. These cycle through the Axis Constraints. F5 locks the X-axis, F6 locks the Y-axis, and F7 locks the Z-axis. F8 cycles through the XY, XZ, and YZ planes.

If you don't have the Axis Constraints toolbar docked to the top of your user interface, as shown in Chapter 1, "Getting to Know Autodesk® 3ds Max® 2013," it may be a good idea to display the toolbar and dock it to the UI.

FIGURE 4.33
Editing the third vertex to the right of the middle vertex
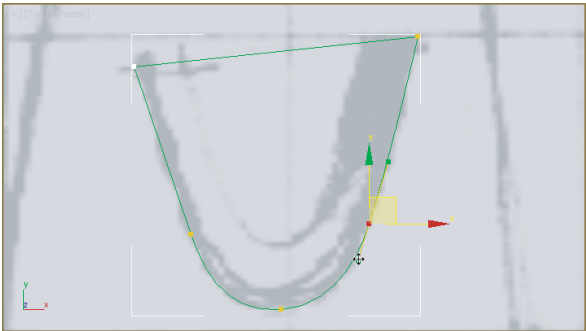
Now you have the basic outline of the wall. You could extrude the spline now to get the general shape of the wall, but the design calls for a bit more elaboration.

Building Objects from Traced Lines

The shape of the wall starts at its base as a solid form and, as you move up the height of the wall, it becomes partially open. In the transition area, you have a sloped roof that covers the enclosed portion of this piece of the chapel, as you can see in Figure 4.34.

FIGURE 4.34
Looking at the form of the U-shaped wall

Sloped roof
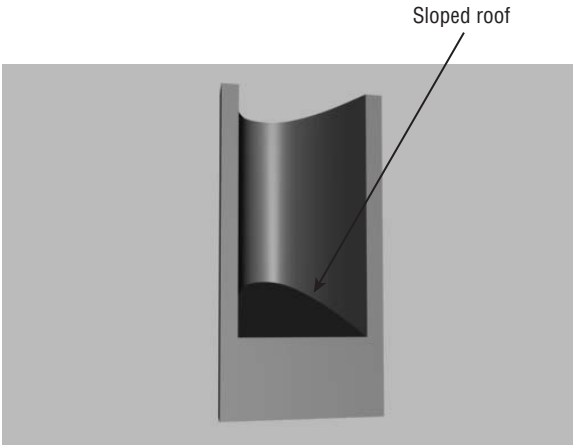
To obtain this shape, you'll make a copy of the wall outline you've just drawn and then form it to create an object matching the void of the upper part of the piece. Once you have the void object, you can subtract it from the main outer part of the wall using the Boolean operation you learned about earlier in this chapter.

CREATING THE VOID OUTLINE

While you're creating the void object, you'll get a chance to explore some spline-editing tools. First, you'll make a copy of the existing wall outline, and then you'll edit the copy to get the outline of the void object.

1. Click Line in the modifier stack to deactivate the Vertex sub-object level.

2. With the Select And Move tool selected, Shift+click and drag the wall you just created to the right so that you have a copy, as shown in Figure 4.35.

FIGURE 4.35
Copy the wall as shown here.
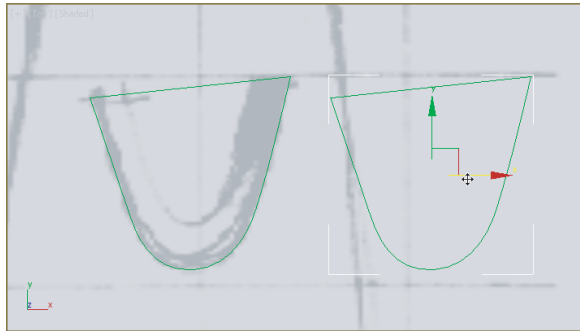
3. In the Clone Options dialog box, click Copy and then click OK. You don't need an instance or reference copy for this part because the new object is destined to be different from the original.

Next, you'll work on the copy to form the void outline:

1. With the copy of the line selected, right-click in the viewport and choose Spline from the quad menu. (You can also click the Spline button in the Selection rollout or the modifier stack.)

2. Click the spline to select the shape at the Spline level, scroll down the Command panel to the Outline input box in the Geometry rollout, double-click the input box, and enter **0.4**↵. This creates an outline that is 0.4 meters thick.

3. Right-click and choose Segment in the quad menu to access the Segment sub-object level of the spline (see Figure 4.36).

4. Click the straight-line segment at the top of the interior wall outline, as shown in Figure 4.37, and then press the Delete key to delete the segment.
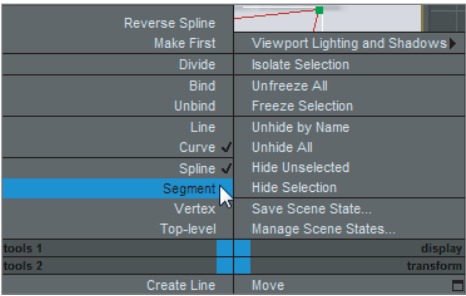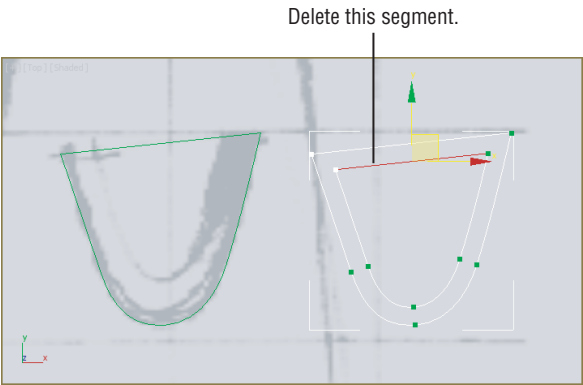
FIGURE 4.36
Accessing the
Segment sub-object
level

FIGURE 4.37
Delete the straight-
line segment.

Delete this segment.

With the straight-line segment deleted, you can extend the remaining portion of the line to
the outside edge of the wall.

1. Enter the Spline sub-object level again, and then click the remaining portion of the inte-
   rior wall outline so that it turns red.

2. Scroll down the Command panel, and click the Extend button in the Geometry rollout.

3. Place the cursor on the left endpoint of the inside wall so that the Extend cursor displays,
   as shown in Figure 4.38, and click the line. It extends to the outside line.

FIGURE 4.38
Extending the
inside wall to the
straight-line
segment of the
outside wall outline
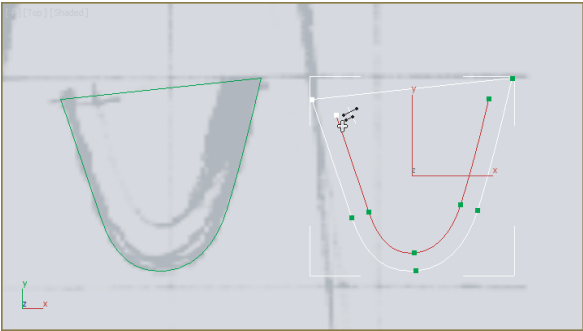
4. Click the other end of the inside wall so that it too extends to the straight-line segment of the outside line, and then click the Extend button in the Command panel to deactivate the tool.

5. Click the Close button in the Command panel. This generates a new straight-line segment across the top.

6. Click the Select Object tool, click the outside spline, as shown in Figure 4.39, and then press the Delete key to delete it.

FIGURE 4.39
Select the outside wall, and then press the Delete key.
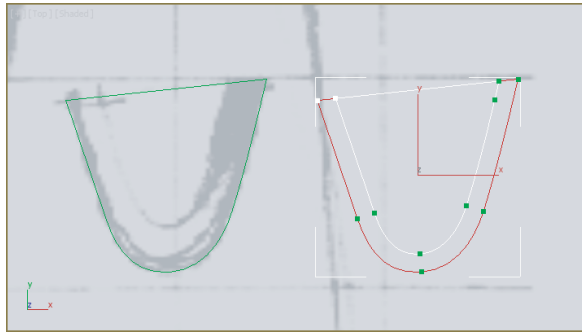
7. Right-click and choose Top-Level from the quad menu to exit the sub-object level.

You have the outline of the shape you want to subtract from the wall. Now move it into position.

1. Right-click the Snaps toggle in the Main Toolbar.

2. In the Grid And Snap Settings dialog box, click the Clear All button and then click Midpoint. Close the Grid And Snap Settings dialog box by clicking the X button in the upper-right corner.

3. If it isn't already active, click the Snaps toggle to make it active.

4. With the Select And Move tool selected, place the cursor on the midpoint of the straight-line segment of the wall copy.

5. When you see the Midpoint cursor appear on the line, click and drag the wall outline to the straight segment of the original wall, as shown in Figure 4.40. You may have to select the new spline and use the Selection Lock Toggle to keep from moving the modeling template.

6. Save the file as **MyRonchamp02.max**.

Forming the Wall Void

Now you're ready to extrude both the wall and the wall void. First, move the void object to the elevation where the void begins. If you don't want to continue with your file, you can open Ronchamp_02.max and continue from there.

1. Click the Maximize Viewport toggle to see all four viewports if necessary.

FIGURE 4.40
Selecting and moving the wall copy using the Midpoint snap
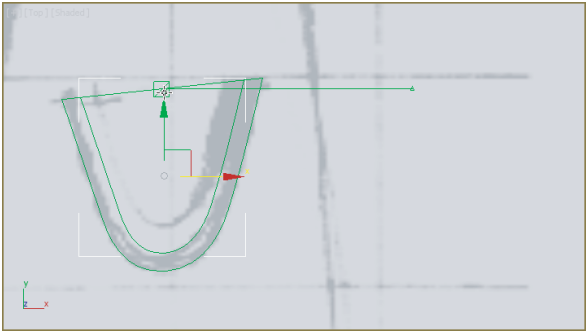
2. Right-click the Perspective viewport, and then click the Zoom Extents tool.

3. With the inside wall line selected, right-click to open the quad menu and click the Move Settings button, the small square symbol next to Move (see Figure 4.41), to open the Move Transform Type-In dialog box.

FIGURE 4.41
Click the Settings button next to the Move option in the quad menu.
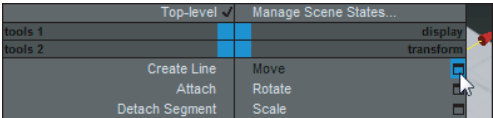
USING THE TRANSFORM TYPE-IN FIELDS IN THE UI

You can also use the transform type-ins that are integrated into the bottom of the user interface. Opening the Transform Type-In dialog box from the quad menu is just a way of focusing your attention on entering coordinate values. The dialog box has the advantage that you can see both absolute and offset (relative) values simultaneously.

---

4. Double-click the Z input box of the Absolute:World group to highlight the current value, and then enter **3.0**↵, for 3 meters. Close the Move Transform Type-In dialog box.

5. Click Zoom Extents again to see both wall outlines. The inside wall outline now appears above the outside wall outline.

Now it's time to extrude the two outlines. This piece of the chapel is about 7.5 meters high, so you can extrude both pieces to this height. The height of the void is somewhat arbitrary, because it's to be subtracted from the main, outside form of the wall.

1. Click the Snaps Toggle or press **S** on the keyboard to turn it off. It may be a distraction during the next few operations.

2. Click the inside wall line to select it.

3. In the Modify tab, select Extrude from the Modifier List drop-down.

4. In the Parameters rollout, click the Amount input box and enter **7.5**↵, for 7.5 meters. The inside wall appears at its full height.

Now extrude the exterior shape.

5. In the Top viewport, click the outer wall line, as shown in Figure 4.42.

FIGURE 4.42
Select the form of the exterior wall line.

Select the larger outer line.
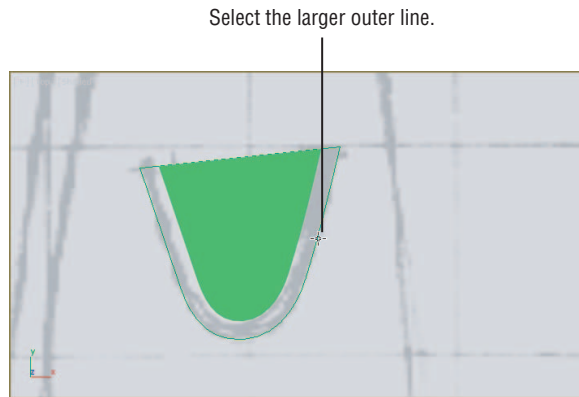
6. Select Extrude from the Modifier List drop-down again. The object extrudes to the same height as the other wall. 3ds Max applies to the current extrusion the last value you entered for the first extrusion.

7. Right-click in the Perspective viewport, and then click the Zoom Extents tool to get a better look at the two extrusions. Because one extrusion is inside the other, you won't see both extrusions completely.

ADDING A SKEW TO THE VOID OBJECT

You're almost ready to subtract the interior void object from the outer wall object. You need to apply the Skew modifier to the void object to get the sloping roof (shown earlier in Figure 4.34).

1. With the Perspective viewport selected, click the Maximize Viewport toggle to enlarge the view if you so desire.

2. Click the Orbit Selected tool, the middle tool in the Orbit flyout menu, in the viewport navigation controls. The yellow Orbit circle appears in the viewport.

3. Click and drag the left square on the circle's perimeter to the right so that you get a view similar to Figure 4.43. You might want to use the Zoom tool as well as Orbit Selected to get the view of the object you want.

4. With the interior void object selected, right-click and select Isolate Selection from the display quad menu. The viewport changes to show only the interior wall object. In previous releases of 3ds Max, the Warning: Isolated Selection dialog box would display with a button called Exit Isolation Mode.
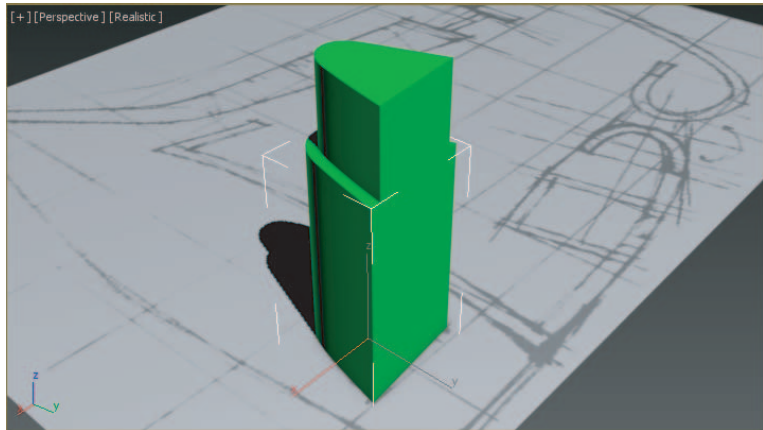
By using the Isolate Selection tool, you can more easily view and edit objects that may be partially obscured by other objects in your scene. Now you can apply the Skew modifier to the selected object and see its effects more clearly.

1. Select Skew from the Modifier List drop-down.

FIGURE 4.43
Using the Orbit
Selected tool,
match this view.

2. In the Parameters rollout, click the Y radio button in the Skew Axis group. This causes the taper to occur in the Y-axis.

3. In the Parameters rollout, set the Amount input box to **-0.76** m to specify the amount of the skew, and change the Direction to **90.0**. The top of the extrusion now slopes down toward the flat surface, as shown in Figure 4.44.

FIGURE 4.44
The result of using
the Skew modifier
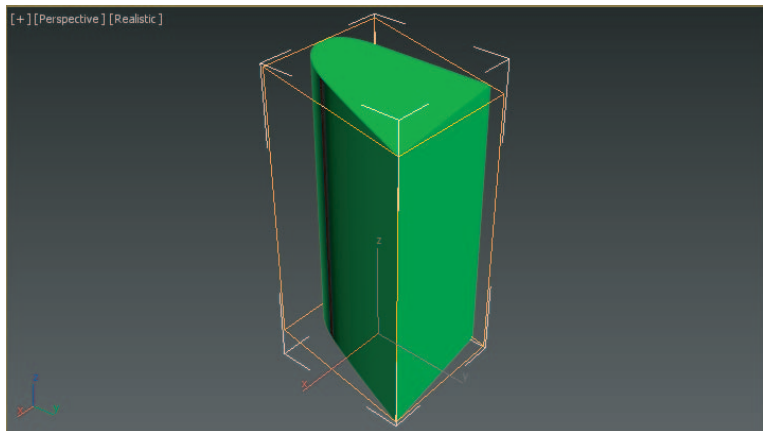
4. Press Alt+Q on the keyboard to restore all the scene objects to the viewports.

You're just about ready to subtract the inside wall shape from the outside shape, but there are a couple of little details you'll want to handle. You now need to align the skew to the extrusion.

ALIGNING THE SKEW MODIFIER TO THE OBJECT

The Skew modifier acts on the shape in a direction that is aligned with the World Coordinate System. You really want the Skew modifier to be aligned with the void object, which is slightly rotated in relation to the World Coordinate System. You may recall from earlier chapters that you can adjust the orientation of a modifier by adjusting its gizmo. In the next exercise, you'll rotate the Skew gizmo to align it with the inside wall shape.

1. With the Skew modifier still active, click the plus (+) sign next to Skew in the modifier stack. You should see Gizmo and Center in the expanded list.

2. Click Gizmo, and then click the Select And Rotate tool in the Main Toolbar.

3. In the Top viewport, carefully click and drag the blue Z-axis ring of the Transform gizmo down until the rectangular Skew gizmo is aligned with the top edge of the wall, as shown in Figure 4.45.

FIGURE 4.45
Click and drag the Z-axis to rotate the Skew gizmo.

Align the Skew gizmo's edge with top edge of the object.

Drag the blue Z-axis ring down to align the Skew gizmo with the object.
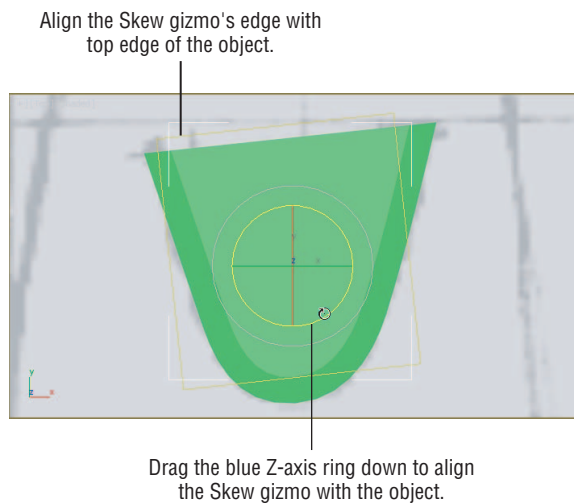
4. Click the Skew level in the stack again to return to modifier-level editing.

   The skew is now aligned with the extrusion.
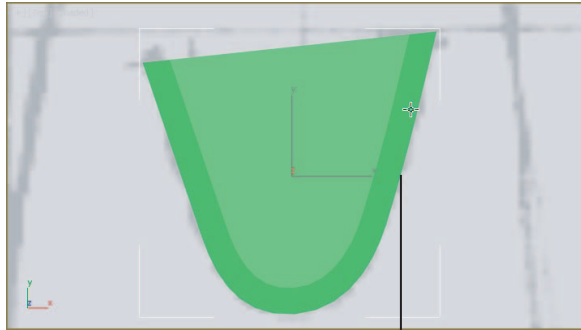

FIRST, SELECT THE OPERAND TO REMAIN

The rule of thumb with Boolean subtractions is always to select the object that is to remain before you select any other objects.

You're now ready to subtract the void object from the outer wall object.

1. Click the Select Object tool in the Main Toolbar. In the Top viewport, select the outer wall object, as shown in Figure 4.46.

Select the larger outer object.

2. Click the Create tab in the Command panel, and then click the Geometry icon.

3. Click the drop-down list just below the Create buttons, and select Compound Objects.

4. Click the ProBoolean button, and then click the Start Picking button in the Pick Boolean rollout. Make sure Subtraction is selected in the Operation group in the Parameters rollout.

5. Click the void shape. It is subtracted from the outer wall object to form the final shape of the wall. You can see the result in the Perspective viewport, as shown in Figure 4.47.
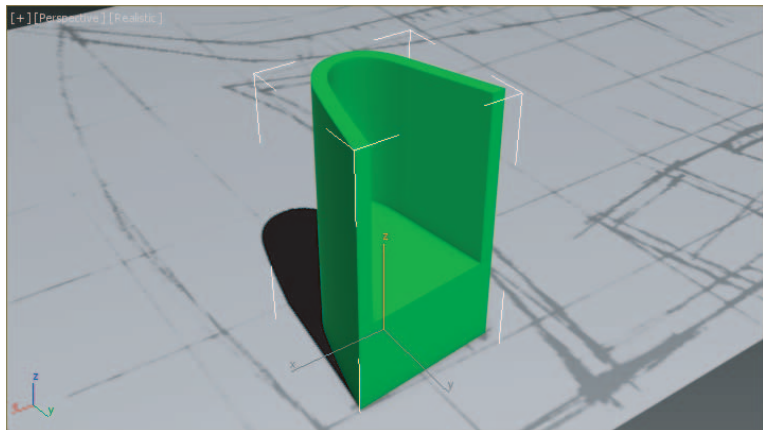
You've just created part of the Chapel at Ronchamp. The method shown here is just one of a number of ways you could have created the wall. By using this method, you were able to try

some spline-editing tools, and you also got a chance to practice using some other modeling methods you learned in previous chapters.

LOCKING OBJECT TRANSFORMS

When you are modeling using an image applied to a plane, it can be troublesome if you accidentally click the plane object and move it, misaligning it with the rest of your objects. To prevent this, you can turn off the ability to move, rotate, or scale the plane.

1. Save your work from the previous section as **MyRonchamp03.max**. You can continue with your scene, or if you would like, you can open `Ronchamp_03.max`.

2. Select the RonchampPlanTemplate object.

3. Click the Hierarchy tab of the Command panel, and click the Link Info button.

4. In the Locks rollout, click in all nine check boxes, as shown in Figure 4.48, to prevent accidentally changing one of the transforms on your modeling template.

FIGURE 4.48
Enable all the locks.
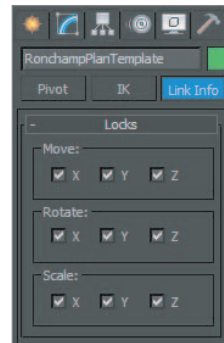
Now even if you accidentally select the RonchampPlanTemplate, you will not be able to move, rotate, or scale it.

A good trick to accomplish the same thing is to freeze the selection, which can be done through the Object Properties dialog box, which you can access from the quad menu. If you deselect Show Frozen In Gray in the Object Properties dialog box, you can freeze objects and still see their textures in the viewport.

USING SEE-THROUGH MODE

Another technique that can help you when you are modeling with image planes is to set your objects to See-Through mode.

1. Select the object you just created in the previous exercise.

2. Right-click to bring up the quad menu, and select Object Properties.

3. On the General tab of the Object Properties dialog box, click the See-Through check box, then click OK to close the dialog box.

4. Now you can see through the object to the sketch applied to the image plane. This technique can help you when you are building objects such as buildings and cars or packaging designs from sketches. You can go back to the Object Properties dialog box and the change the tower's properties back so that you can see it more clearly in the viewports, as shown in the figures in the rest of this chapter.

Now let's move on to another part of the building to examine another way of editing objects.

Editing Meshes

You've been introduced to 3ds Max objects in the form of the standard primitives, splines, and compound objects. It also helps to think about 3ds Max objects in terms of parametric and non-parametric objects. This can be a bit confusing because virtually all objects in 3ds Max start out as parametric objects. But, as you'll see, a lot of your work with objects will depart from the parametric level of editing as soon as you begin editing objects in earnest. In fact, you've already seen this with the spline examples in this and the previous chapter.

The term *mesh* is somewhat generic and refers to a nonparametric geometry object composed of vertices, edges, and surfaces. 3ds Max can convert geometry into two types of working meshes: Editable Mesh and Editable Poly. Both object types consist of comprehensive toolsets, located in the rollouts under the Modify tab, for editing geometry. The Editable Poly is newer and has a more robust toolset, including the new Graphite Modeling toolbar. Many of the Graphite Modeling tools have both dialog and visual input methods, and they will be the tools used in these exercises. The tools available for the Editable Mesh and Editable Poly objects are also available with the Edit Mesh and Edit Poly modifiers.

In your introduction to 3ds Max objects, you created simple forms and adjusted them using the object's parameters. Parameters are great for establishing the initial dimensions and characteristics of an object. They can also serve as a convenient way to make adjustments to objects as you progress through the design process. However, you'll eventually begin to make changes on a deeper level, bypassing the parameters altogether. At this point, you'll be editing 3D objects as *editable polys*. Editing 3D objects as editable polys is similar to the sub-object level editing you've already performed on splines. The main difference is that you have some additional sub-object levels with which to work in the form of edges, borders, and polygons.

In this section, you'll begin to explore editable polys by creating the south wall of the chapel. You'll learn how you can convert an extruded spline into an editable poly, and then you'll proceed to modify the mesh on a sub-object level.

Creating a Tapered Wall

The part of the chapel you just created was unusual because it was a curved wall. Ronchamp contains many curved walls, but they shouldn't pose a problem to you because you've had some experience drawing such shapes and extruding them. One wall of the chapel is quite unusual, however. The south wall tapers in two directions, plus it has a curve in it. In the following set of exercises, you'll look at a way to create such a wall in 3ds Max and, in the process, you'll be introduced to some additional methods for editing sub-objects.

You'll start, as usual, by outlining the plan of the wall. Once again, you'll trace the imported bitmap sketch using a line. First set up your view to prepare for tracing:

1. Right-click the Top viewport to make it active, and then click the Maximize Viewport toggle to enlarge the view.

2. Click Zoom Extents to view the entire RonchampPlanTemplate object.

3. Click the Pan View tool, and pan the view so that the south wall is centered in the view. Then use the Zoom Region tool to enlarge the south wall to fill as much of the viewport as possible, similar to Figure 4.49.

**FIGURE 4.49**
Zoom to the outside wall shape.
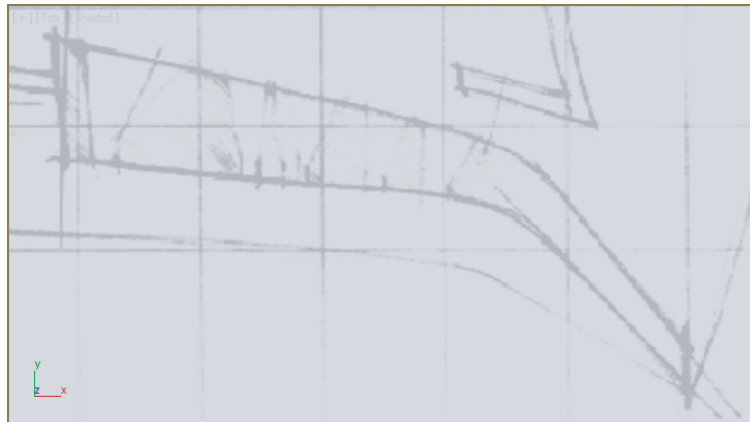
Now you're ready to trace the wall:

1. Click the Create tab of the Command panel, and click the Shapes tool.

2. Click Line, and draw the line as shown in Figure 4.50. Pay special attention to the vertices at the curved portion of the wall. You'll want to place three vertices around the curve so that you can change them into Bezier vertices later.
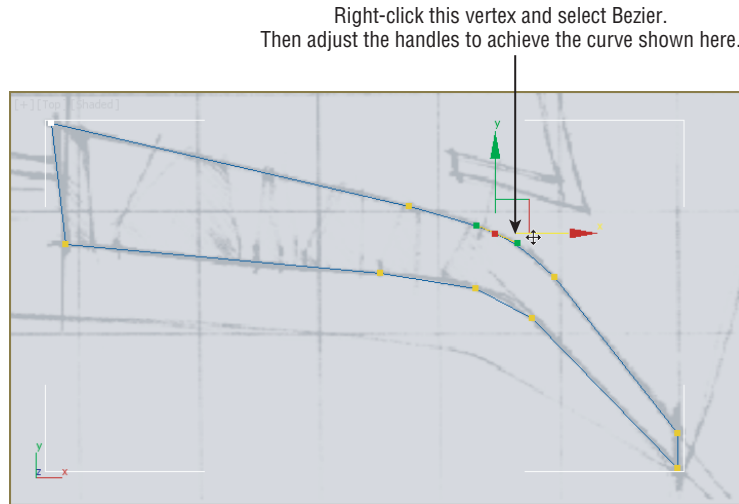
FIGURE 4.50
Trace the south wall as shown here. The vertices are shown for clarity.

Trace the starting line here. Then select points in a clockwise direction.
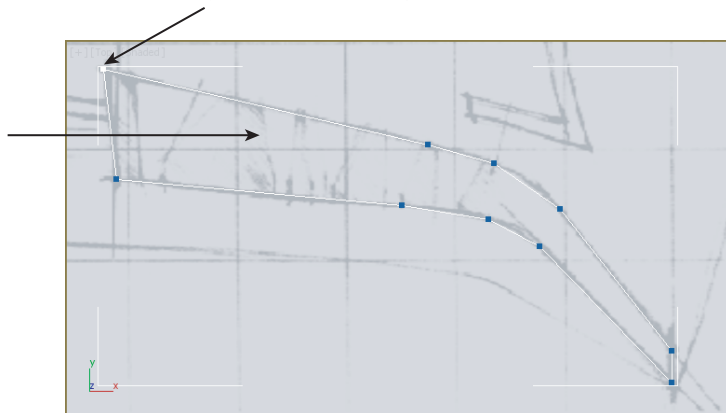
3. At the last point, click the beginning of the line and close the spline.

4. Click the Modify tab of the Command panel, and then enter the Vertex sub-object level of the spline.

5. Click the Select And Move tool in the Main Toolbar, right-click the vertex as shown in Figure 4.51, and select Bezier from the quad menu.

FIGURE 4.51
Selecting and editing the vertex on the top of the wall

Right-click this vertex and select Bezier.
Then adjust the handles to achieve the curve shown here.

6. Using the tangent handles, adjust the curve of the wall so that it looks similar to Figure 4.51. You'll want the curve of the wall to join the straight portions of the wall in a tangent.

7. Right-click the vertex across the wall from the one you just edited and select Bezier.

8. Adjust the curve of this vertex so that it looks similar to Figure 4.52. Exit the Vertex sub-object mode when you're finished.

FIGURE 4.52
Selecting and editing the vertex on the bottom of the wall
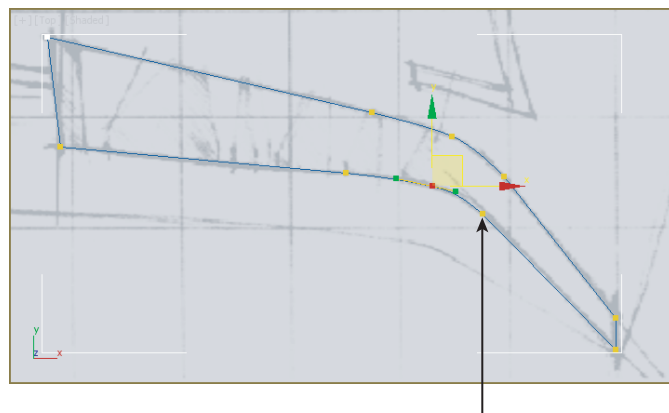
Right-click this vertex and select Bezier.
Then adjust the curve to match the one shown here.

Now it's time to extrude the wall. The wall forms a peak at its easternmost end, and that peak is approximately 14 meters high. You'll want the wall to be at least 14 meters high so that you have enough material with which to work.

1. You're already in the Modify tab of the Command panel, so open the Modifier List drop-down and select Extrude. If you're continuing from the previous section, the wall will extrude to the last height you entered.

2. In the Parameter rollout, change the value in the Amount input box to **14**. Also make sure that the Segments value is set to 1.

3. Click the Maximize Viewport toggle if you need to reveal all four viewports, right-click the Perspective viewport, and then click the Zoom Extents Selected tool on the Zoom Extents flyout to get a better look at the south wall so far.

4. Click the Shading Viewport menu, and select Edged Faces so that you can see the geometry that makes up the wall more easily.

5. Click the Orbit Selected tool, and then click and drag the rightmost square of the navigation circle to the left until your view looks similar to Figure 4.53. Alternatively, you can drag the ViewCube ring (if you haven't turned it off) to the left to achieve the same result.

FIGURE 4.53
The Perspective viewport after rotating with the Orbit Selected tool or the ViewCube
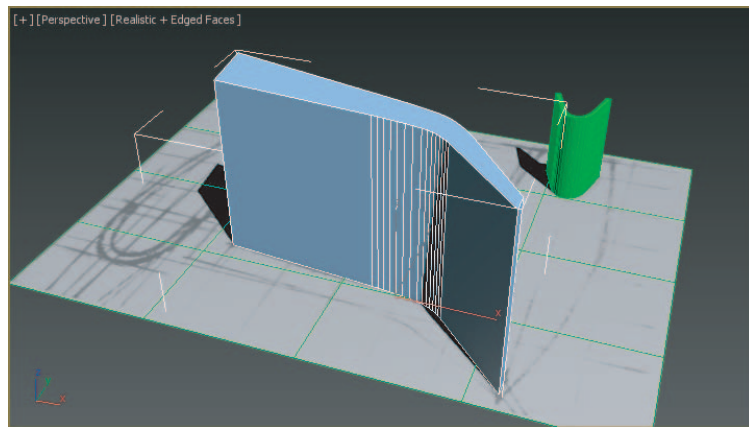
6. Click the Maximize Viewport toggle to enlarge the Perspective viewport so that you can see your work more easily.

You now have the basic form of the wall, but the actual wall tapers vertically. Not only that, but the taper is not uniform across the entire wall. It tapers more at its west end, and it doesn't taper at all at its east end. You won't be able to use the Taper modifier to accomplish this nonuniform taper. Instead, you'll edit the mesh directly by rotating some of the edges.

Converting the Spline to a Mesh

To edit the south wall, you need to convert the extruded spline to an editable poly to take advantage of the special features of the editable poly tools. You can then make the appropriate

changes at the sub-object level of the mesh to get the volume you want. Start by setting up the view to aid in your editing:

1. Right-click the Shading viewport label in the upper-left corner of the Perspective viewport, and select Wireframe.

2. Use the Orbit Selected tool or ViewCube to adjust your view until it looks similar to Figure 4.54. You want to get a good view of the top of the wall.

FIGURE 4.54
Rotate the view to see the top of the wall.
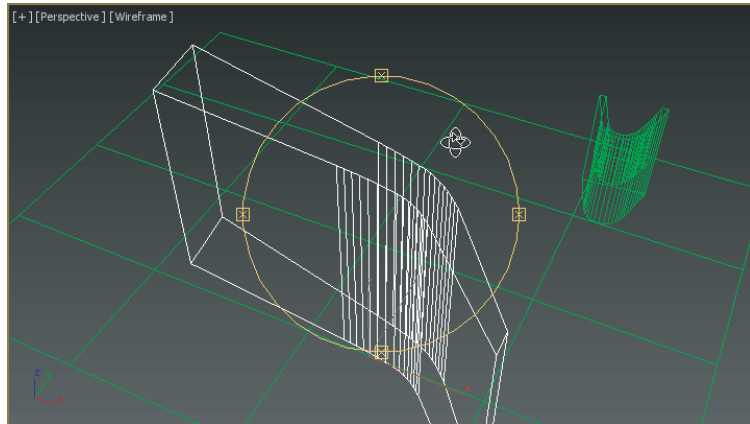
3. Click the Zoom tool, and then click and drag up in the viewport to enlarge the view of the wall.

EDITING THE EDGE OF A MESH

Now you're ready to start editing the wall. You'll convert the object to an editable poly to access the sub-object tools, and then you'll learn how to use the Lasso Selection Region tool to select an edge of the wall for editing.

1. Make sure that the south wall is selected.

2. Right-click in the viewport, and choose Convert To ➢ Convert To Editable Poly from the quad menu, as shown in Figure 4.55.

You've just converted your extruded spline into an editable poly. The editable poly tools appear in the Modify panel.

The quad menu options you will see when you right-click an item in the modifier stack depend on the item that is currently selected. Usually, this menu will include the Editable Mesh and Editable Poly options. Now let's proceed with editing the wall:

1. Expand the Polygon Modeling item on the Graphite Modeling toolbar and click Edge, as shown in Figure 4.56.

FIGURE 4.55
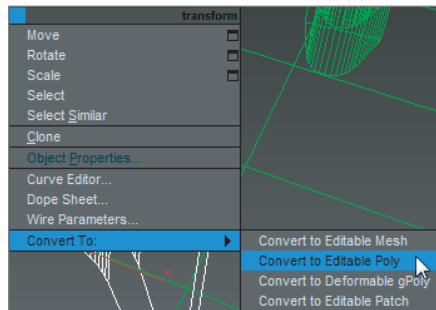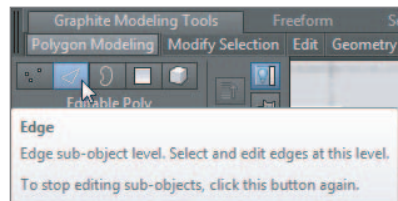Converting the
selected object to
an editable poly

FIGURE 4.56
Selecting the Edge
sub-object mode

THE GRAPHITE MODELING TOOLBAR

The Graphite Modeling toolbar is a feature that provides more than 100 modeling tools for working on Editable Poly objects. If you do not see the Graphite Modeling toolbar, you can click the Graphite Modeling Tools icon on the Main Toolbar.
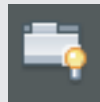
When it is docked to the top of your 3ds Max interface, the Graphite Modeling toolbar has three modes. You can access these modes with the drop-down icon to the right of the Selection tab of the Graphite Modeling tools. They include showing the full ribbon interface using tabs and minimizing to show just panel titles or panel buttons. This functionality provides you with a great number of options for working with the Graphite Modeling tools and conserving screen real estate.

The Graphite Modeling toolbar, like many user-interface (UI) features, can be turned into a floating toolbar or docked to another side of the 3ds Max UI. You can also customize the ribbon, making your own collection of tools. You can assign a shortcut to the floating ribbon to make it appear and disappear at your command.

---

2. In the Main Toolbar, click and hold the Rectangular Selection Region tool until its flyout displays, and then drag the mouse down to the near-bottom option, the Lasso Selection Region tool (see Figure 4.57).

You're going to select the top edge of the wall that is closest to you, so you'll need a selection tool that lets you select a freeform area.

3. Click the Crossing Selection tool in the Main Toolbar so that it changes to the Window Selection tool (the icon changes to a dotted square enclosing a sphere). This causes 3ds Max to select only objects that fall completely within the selection window.

FIGURE 4.57
Selecting the Lasso
Selection Region
tool
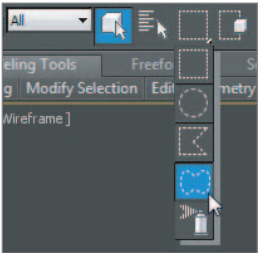
4. Click the Select Object tool, and then start dragging a selection lasso around the wall, as shown in Figure 4.58.

FIGURE 4.58
Drawing the lasso
selection

Drag a lasso around the top edge
to make a freehand selection.
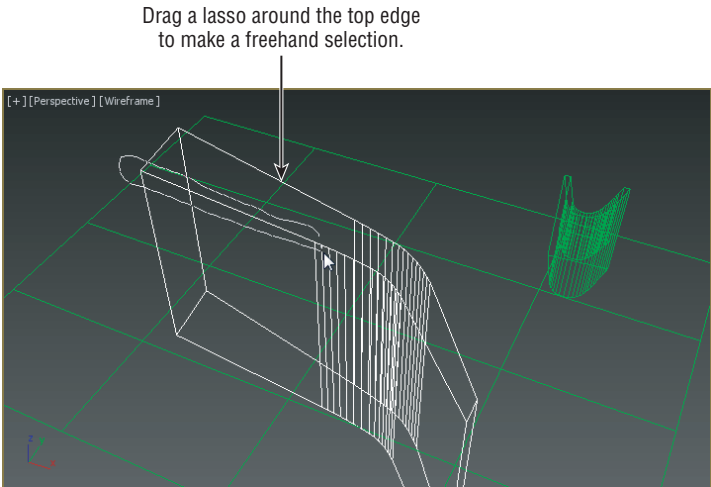
5. Continue to drag the lasso so that the front, top edge of the wall is completely enclosed by the selection. Release the mouse button, and your selection should turn red and appear as shown in Figure 4.59.

Now that you have the edge selected, you want to rotate it. The best view for this operation is the top view, so the first thing to do is to go to the Top viewport.

1. Press Alt+W to show all four viewports, right-click in the Top viewport to make it active, and press Alt+W again to give you a maximized Top viewport. If the geometry disappears, do a Zoom Extents by pressing Alt+Ctrl+Z.

2. Change the Top viewport to Wireframe mode if necessary.

3. Click the Select And Rotate tool in the Main Toolbar.

4. Place the cursor on the inner ring of the Rotate gizmo, and then click and drag clockwise until the selected edge is rotated in such a way that it appears to be parallel to the opposite edge of the wall. You can look at the coordinate readout and set the angle to

approximately -7 (negative seven) degrees or, better yet, just type **-7** in the Z field of the transform type-ins at the bottom of the user interface.
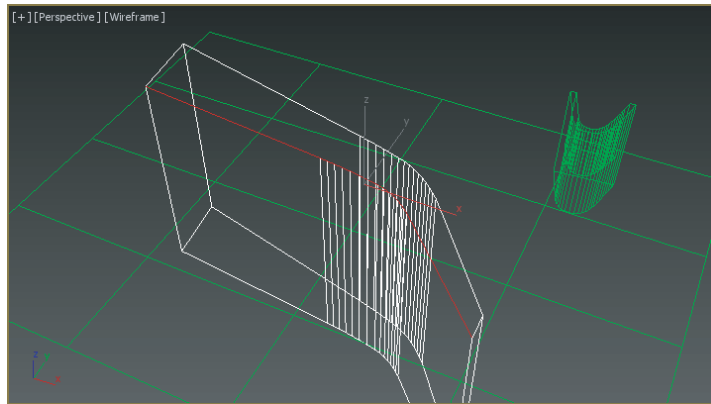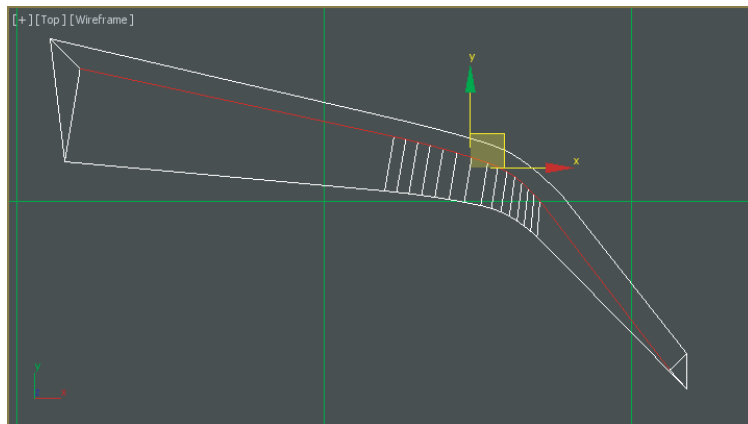
5. Click the Select And Move tool, and then click and drag the edge up so that the top edges are closer together, as shown in Figure 4.60.

6. Exit the Edge sub-object level, and return to the top level.

Moving a Single Mesh Vertex

You've managed to taper the south wall. The right end of the wall is a vertical surface that does not taper, so you need to realign the upper corner to its original location. You can do this by moving the vertex and using the endpoint snaps.
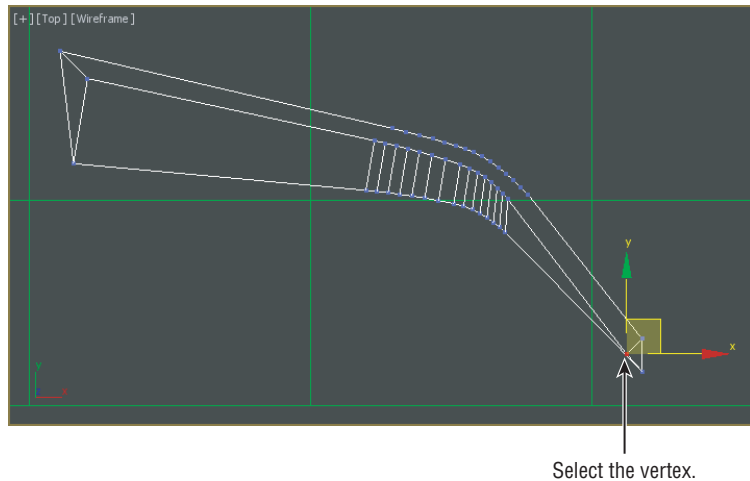
1. Enter the Vertex sub-object level.

2. Click the vertex at the corner of the top of the wall to select it, as shown in Figure 4.61.

Before you move the vertex, activate the endpoint snaps so that you can get a perfect alignment.

**3.** Right-click the Snaps Toggle button in the Main Toolbar.

FIGURE 4.61
Select the corner of the top of the wall.

Select the vertex.

4. In the Grid And Snap Settings dialog box, click the Midpoint check box to deactivate it (no snaps should be active now), and then click Endpoint. Close the Grid And Snap Settings dialog box.

5. Click and hold the Snaps Toggle to expose its flyout. Select the 2.5D Snaps Toggle tool. The 2.5D Snaps Toggle tool snaps to a point projected from the location selected to the active grid beyond or in front of it. This allows you to visually snap from one vertex to another located away from and below it, but to move only the selected vertex in the XY-plane.

6. Click the Select And Move tool. Then place the cursor on the selected vertex so that the Endpoint Snap cursor displays, as shown in Figure 4.62.
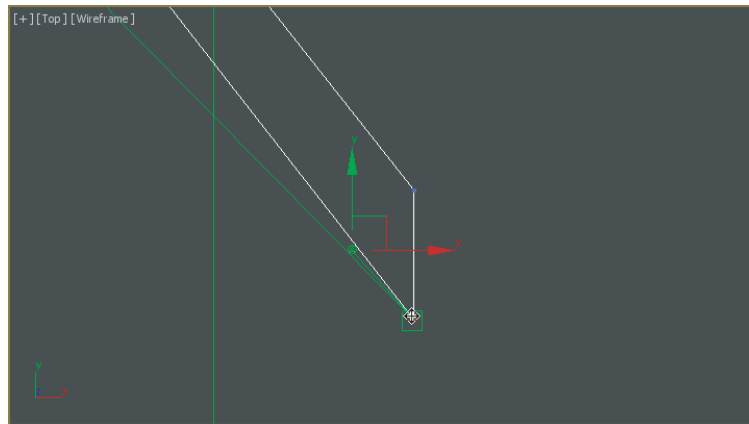
FIGURE 4.62
Place the cursor on the selected vertex to display the Endpoint Snap cursor.
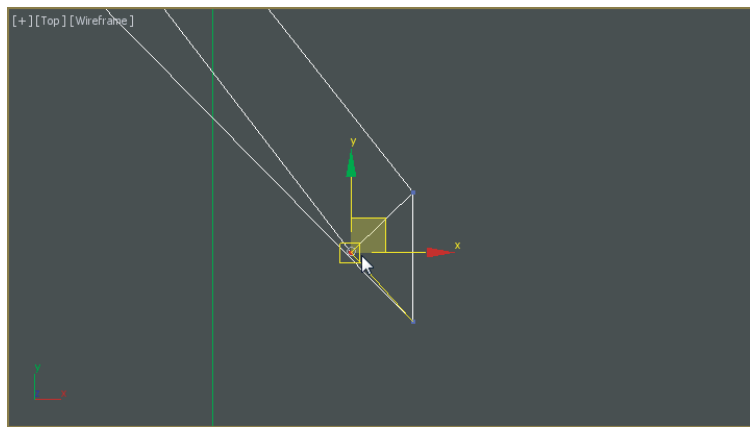
7. Click and drag the cursor to the vertex shown in Figure 4.63. When the Endpoint Snap cursor displays, release the mouse button.

FIGURE 4.63
Moving the vertex

8. Click the Maximize Viewport toggle to view the results in the Perspective viewport, and then exit the sub-object level.

9. Turn off the Snaps toggle.

Now that you have the east end of the wall back to its original configuration, you can move on to editing the interior side of the wall.

USING THE SNAPS TOGGLE OPTIONS

In the previous exercise, you were able to move a vertex to a point exactly above another vertex by using endpoint snaps in conjunction with the 2.5D Snaps Toggle tool. You might have thought the two vertices would merge into one point; in fact, that is what would have happened if you used the 3D Snaps Toggle tool. Instead, the vertex you moved was constrained to its Z-axis location, and it remained above the vertex to which you snapped.

The 2.5D Snaps Toggle tool automatically constrains the relative movement of objects to the location projected from the viewpoint of the viewport to the plane of the current grid. It's called 2.5D Snaps because you can select any vertex in 3D space while restricting the motion to a 2D plane. In the previous exercise, you were moving the vertex in the Top viewport, so the vertex's movement was restrained to the plane of the home grid. Had you been in the Left or Front viewport, the movement of the vertex would have been restrained in the plane defined by those views.

You also saw the 2D Snaps Toggle option in the Snaps Toggle flyout. This option not only restrains motion to the view plane but also restricts your selection of vertices to those on the currently active working grid, which is usually the world grid, unless you have created and activated a user grid.

FLATTENING A SURFACE

The interior side of the wall also tapers in toward the top, but that taper occurs only along the straight portion of the wall, starting from the curve and progressing to the left. In this situation, you need to move only the vertex at the end of the wall corner.

1. In the Left viewport, click the Zoom Extents tool. You'll use this view to help adjust the taper of the wall.

2. Right-click in the Perspective viewport, and then use the Select Object tool to select the wall, if it's not still selected. Go to the Vertex sub-object level, and then select the two vertices on the top-left corner of the wall. You can use the Rectangular Selection Region setting from the Main Toolbar to select the vertices with a rectangular window, as shown in Figure 4.64.

FIGURE 4.64
Selecting the corner vertices

Select these two vertices with a rectangular region.
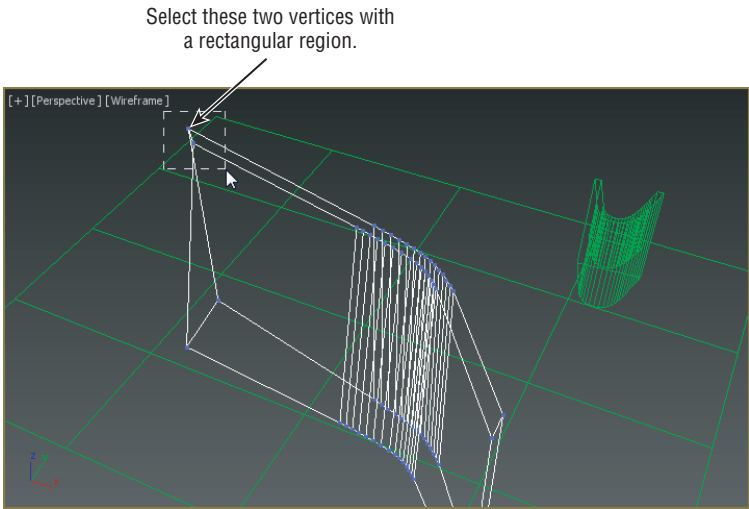
Verify that only two vertices are selected by reading the display at the bottom of the Selection rollout, as shown in Figure 4.65.

FIGURE 4.65
The Selection rollout shows the number of vertices selected.
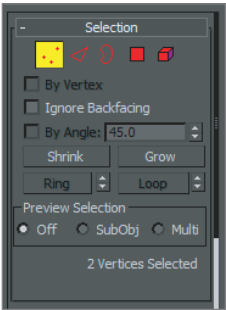
3. Right-click the Left viewport, and then turn off the Snaps Toggle if it is still on.

4. With the Select And Move tool selected, click and drag the red X-axis to the right. Adjust the wall so that it looks similar to Figure 4.66.

FIGURE 4.66
In the Left view-
port, move the
vertices so that the
wall looks like this.
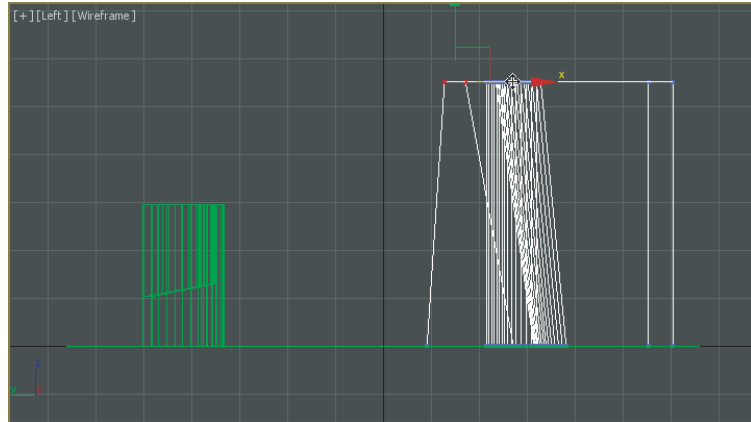
Now you have both sides of the wall tapering in. But there's one problem with the wall: the west end to the left of the wall is twisted and not flat because of all of the changes you've made to the vertices. You can quickly flatten that end of the wall using the View Align tool.

1. Click the Select Object tool. In the Top viewport, change the viewport to Wireframe mode, and click and drag a selection region so that all of the vertices of the left end of the wall are selected, as shown in Figure 4.67.

FIGURE 4.67
Selecting the verti-
ces of the left side of
the wall

Select all of the vertices at this end of the wall.
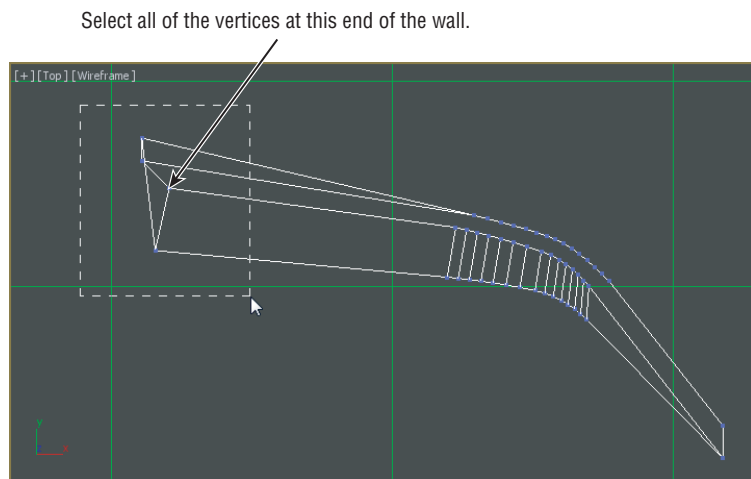
**2.** Right-click in the Left viewport to make it active.

3. Scroll down the Command panel until you see the View Align button toward the bottom of the Edit Geometry rollout, and then click it.

The selected vertices are aligned to the Left viewport, forming a flat plane (see Figure 4.68). The View Align tool flattened the left side of the wall so that it became a plane parallel to the active viewport (the Left viewport in this case).

FIGURE 4.68
Aligning the vertices of the left side of the wall
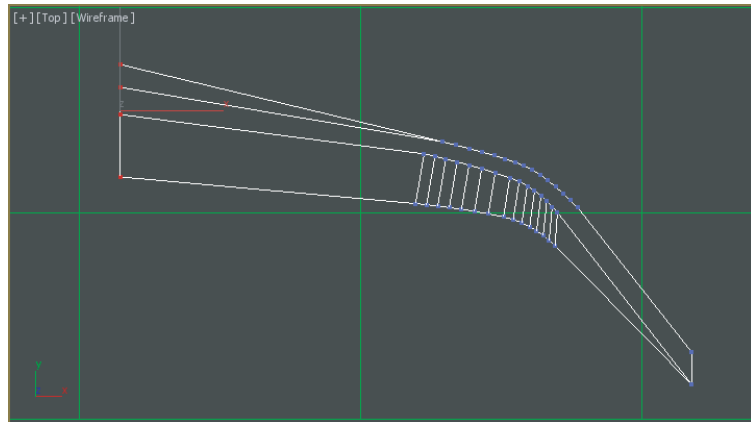
4. If your Top viewport is still in wireframe mode, change to Shaded so that you can see the sketch plane. With the four points at the left end of the wall selected, click the Select And Rotate tool from the Main Toolbar and rotate the points so that they are aligned with the sketch, as shown in Figure 4.69.

FIGURE 4.69
Rotating the vertices of the left side of the wall
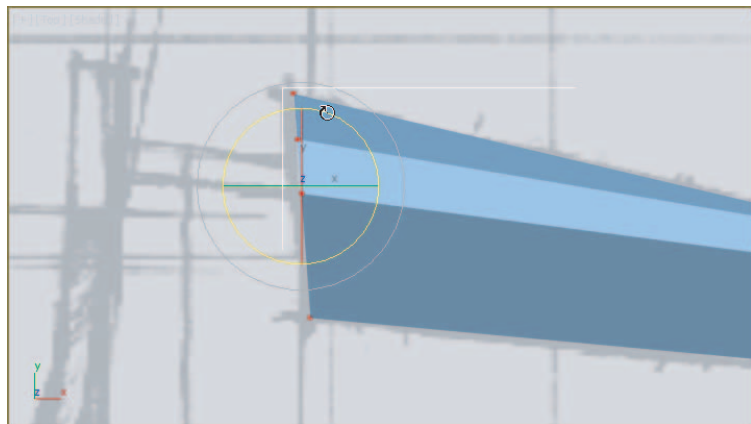
5. Using the Select And Move tool, finish moving the points so that they line up with the sketch.

> **OTHER ALIGNMENT TOOLS**
>
> You might have noticed a few other buttons in the group with the View Align button. Grid Align aligns the points to the current active user grid or to the nearest grid line in the home grid. Make Planar causes all of the selected points to be coplanar, taking the average location of all of the points to determine the plane. Collapse, near the top of the Edit Geometry rollout, causes all of the selected points to converge into a single point.

Tapering the Top of the Wall

To finish the wall, you need to slope the top of the wall down from right to left. This will be a uniform slope, so you can use the Taper modifier for the operation.

1. Right-click the Front viewport, and then click the Zoom Extents tool to get a better view of the wall.

2. Exit the sub-object level.

3. Open the Modifier List drop-down and select Taper. (You may need to scroll to the bottom of the list to find it.)

4. In the Parameters rollout, set the value in the Amount input box to **0.35**.

5. In the Taper Axis group of the Parameters rollout, click the X Primary and Z Effect radio buttons. This causes the taper to occur only on the X-axis.

The Taper occurs from roughly the midpoint of the wall, which causes the left side to drop and the right side to rise, as with a balance scale. However, you want to maintain the height of the wall at its highest point instead of having it rise. You can adjust the taper by moving the Center sub-object with the Transform gizmo.

1. Expand Taper in the modifier stack, and select the Center option.

2. Make sure that the Select And Move tool is selected. Then, in the Front viewport, click and drag the red X-axis arrow to the right until the Y-axis arrow is aligned with the right edge of the wall, as shown in Figure 4.70.
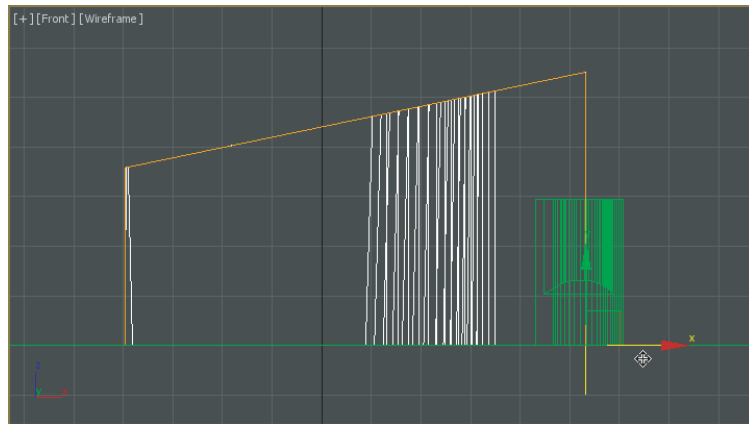
3. Exit the Center sub-object level.

Notice that the wall drops in height. If you adjust the Amount parameter spinner, you'll see that the top of the wall now changes its taper angle in relation to the right end of the wall. Make sure that you set the Amount value back to 0.35 when you've finished experimenting.

The wall is also tapered to the north, so you want to apply the Taper modifier again.

1. Select Taper from the Modifier List drop-down.

2. In the Parameters rollout, set the Taper Amount input box value to **-0.1**. This is equivalent to roughly 10 degrees.

3. In the Taper Axis group of the Parameters rollout, click the Y Primary and Z Effect radio buttons. This causes the taper to occur only on the Y-axis.

4. Save your work as **MyRonchamp_TaperedWalls.max**.

USING THE EDIT POLY MODIFIER

In the beginning of this section, you converted an extruded spline into an editable poly. You could have used the Edit Poly modifier to gain access to the same mesh sub-object level you used to edit the south wall. The advantage to using the modifier is that you can return to the Spline level in the modifier stack to make changes at that level. The disadvantage is that your model uses more memory to store the Edit Poly modifier's parameters. The Edit Poly modifier also inserts more complexity into the object data flow, which can cause unpredictable results if you make changes to the geometry or modifiers below it in the modifier stack.

The Edit Poly modifier is a great option while you're in the process of creating an object, and you aren't quite sure that you want to commit to a particular set of changes. It allows you to return to other levels of the modifier stack and experiment. It also helps to maintain the parametric characteristics of objects so that you have more flexibility in shaping an object, and you can always delete the modifier if the edits don't work out as expected. But once you've created an object with which you're satisfied, it's a good idea to convert objects to editable polys for the sake of data, flow simplicity, and efficient memory use.

You now have an editable poly to which you've applied two Taper modifiers. You could right-click the object's modifier stack and select Collapse To or Collapse All to convert the wall to an editable poly again, thereby combining the effects of the Taper modifiers into a single editable poly object, but don't make any changes to the object at this point.

Now you've completed the main shape of the south wall. Next to the roof, the south wall is the most complex part of the building, so it took quite a bit of effort to construct. In the next set of exercises, you'll create the towers of the chapel. These towers are somewhat easier to build, but they're also a bit tricky.

CREATING SPLINES FROM MESHES

It is possible to create a flat 2D spline from a 3D mesh object. You can create a spline where a section plane intersects the 3D form. This can be useful when you are trying to create section drawings of complex forms, as in the following example.

1. Continue from the previous exercises, or open Ronchamp_TaperedWalls.max that you downloaded from the book's web page.

2. With the curved wall on which you have been working selected, right-click and pick Isolate Selection from the quad menu, or press Alt+Q.

3. Click the Create tab, and click the Shapes button. Make sure that Splines is shown in the drop-down list, and then click the Section button.
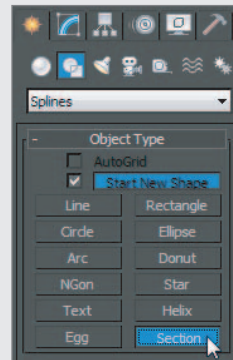

4. Drag out a section plane on the home grid at the base of the curved wall. It doesn't matter how large you make this plane, because it is only a placeholder representing the section cut you are making through the curved wall. The actual cutting plane extends infinitely in two directions.

5. Change the Perspective viewport to Wireframe mode.

6. Move the section plane up in the Z direction.

    As you move the section plane, a yellow highlight shows where the section plane cuts through the mesh. Observe how the yellow highlighting changes shape as the section plane moves because the curved wall's cross-section changes height.
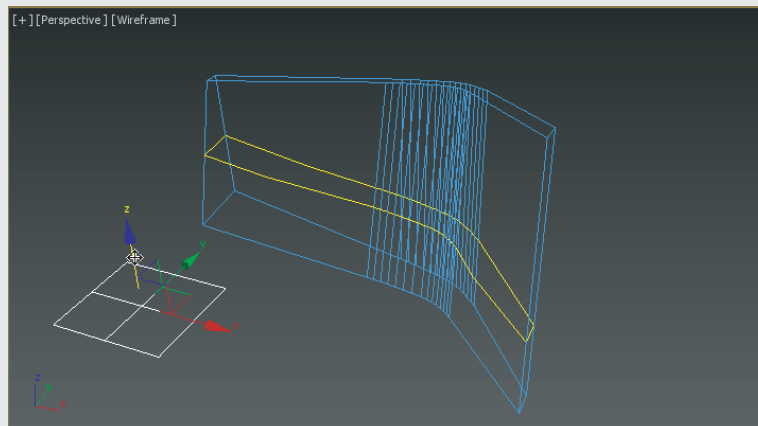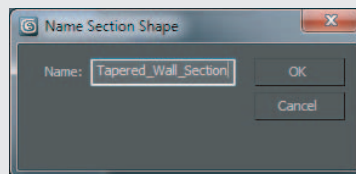
7. Try rotating the section plane. See how the highlighting always represents the intersection of the section plane with the mesh object.
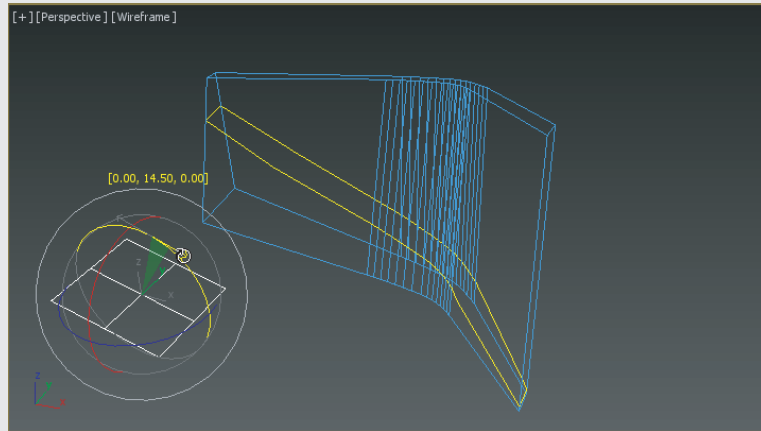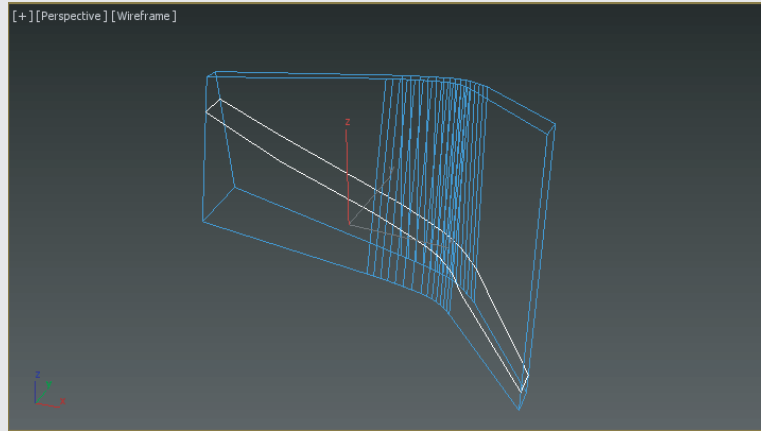

8. With the section plane still selected, switch to the Modify tab of the Command panel. Click the Create Shape button.
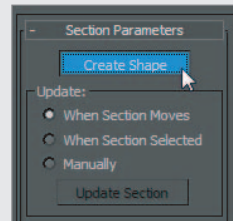
9. Assign a name to the new spline you are creating in the Name Section Shape dialog box, and then click OK.

10. Delete the section plane. Notice that something is still intersecting the mesh—this is the new spline you created from the mesh.

11. Select the object that is intersecting the mesh. It is an editable spline, as shown in the Modify panel. Finally, delete this spline and exit Isolation mode.

You have seen how you can use the Section tool to highlight the relationship between your 3D mesh object and a plane. After positioning and orienting the section plane, you created a spline, crystallizing this intersecting relationship. This procedure can be useful when you go to generate any number of splines from a mesh.

Using Instanced Clones to Create Symmetrical Forms

The towers of Ronchamp enclose smaller mini-altars apart from the main altar at the east end of the building. The towers' forms reflect the shape of a nun's hat. To create the towers, you'll create half of the tower plan and then mirror that half to complete the rest of the plan. This will ensure that the walls are symmetrical, and it will also give you the parts you need to construct the top of the tower.

Adding a User Grid to Aid Tracing

First, set up the Top viewport to trace the plan of the tower. The tower is slightly skewed from the axis of the main floor, so adding a user grid will help you create it.

1. Right-click the Top viewport to make the viewport active, and then click the Maximize Viewport toggle to enlarge the view of the Top viewport.

2. Use the Pan View and Zoom tools to adjust the view so that the template plan is centered in the viewport, as shown in Figure 4.71.

3. Click the Zoom Region tool, and place the zoom region around the tower plan, as shown in Figure 4.71.

4. Click the Create tab in the Command panel, and then click the Helpers button.

FIGURE 4.71
Centering the tower
plan, and selecting
the zoom region
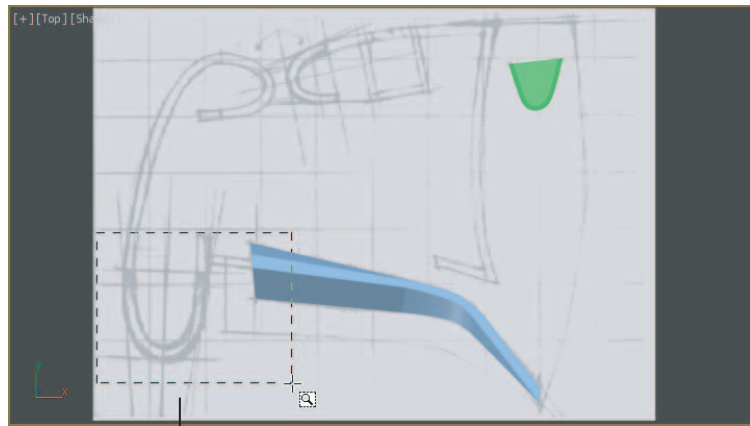
Select this area with the Zoom Region tool.

5. Click Grid, and then click and drag a grid across the viewport, starting in the lower-left corner of the viewport, as shown in Figure 4.72. As you're aligning the grid, place its vertical centerline at the center of the plan, as indicated in the figure.

FIGURE 4.72
Adding a grid to the
viewport

Place the grid so that it is centered on this point.
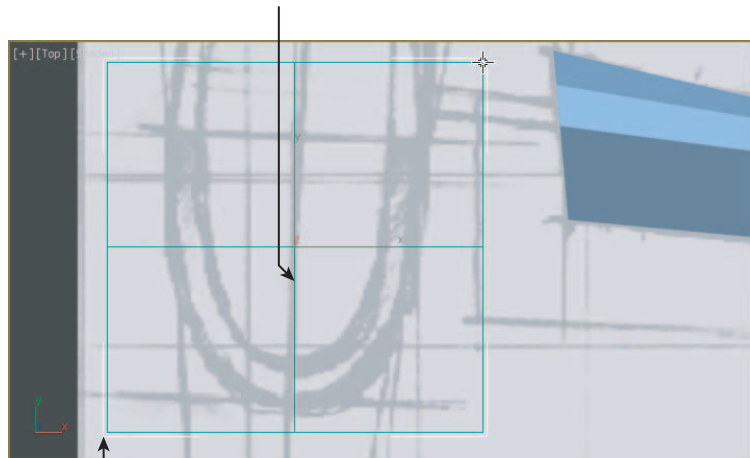
Drag the grid helper starting from here.

6. Press **G** on the keyboard to display the grid. The grid is a bit too dense. To adjust its spacing, go to the Spacing group in the Parameters rollout and change the Grid value to **2**, for 2 meters.

7. To align the grid with the tower, click the Select And Rotate tool in the Main Toolbar and then carefully click and drag the Z-axis ring clockwise so that it is aligned with the lines

indicating the top edge of the tower, as shown in Figure 4.73. The angle is very small, around -1.5, so you need to rotate the grid only slightly.

ACTIVATING A USER GRID

As soon as a user grid is created, it can become the currently active grid. If your system does not react this way, choose Tools ➢ Grids And Snaps ➢ Grid And Snap Settings ➢ User Grids and check the Activate Grids When Created check box. When multiple user grids exist in a scene, to activate the selected grid, right-click and then choose Activate Grid from the quad menu. Since your system wasn't set up to activate the user grid automatically, you need to select the Grid001 object if it is not currently selected; then right-click and pick Activate Grid from the tools 1 quad menu.

FIGURE 4.73
The grid aligned
with the tower plan

Rotate the grid so that it is aligned
with this line from the sketch.
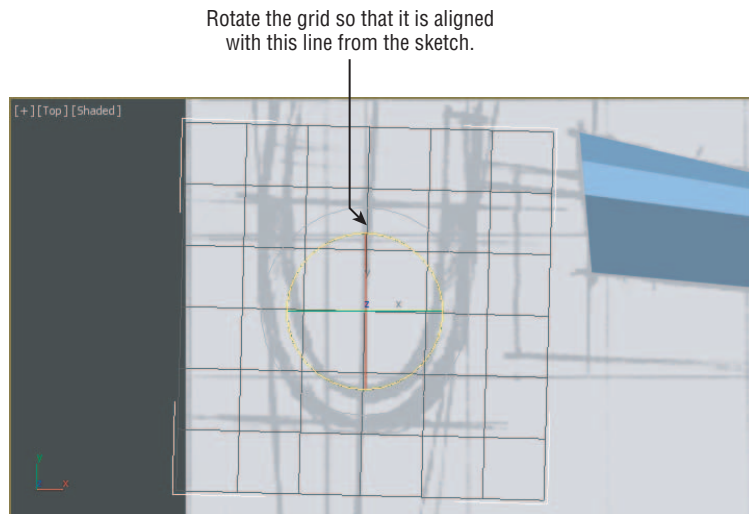
Building the Tower Walls

Now you're ready to lay out the tower. Start by tracing the left side of the tower plan.

1. Click the Shapes button in the Create tab of the Command panel, and then click the Line tool in the Object Type rollout.

2. Draw the lines shown in Figure 4.74, starting from the upper-left corner of the plan. Finish the lines at the centerline of the grid. Right-click when you've finished drawing the lines.

3. Click the Modify tab in the Command panel, and then click the Vertex tool in the Selection rollout (or select Vertex from the quad menu).

4. Right-click the last vertex in the lower half of the viewport, and select Bezier from the quad menu.

5. Click the Select And Move tool, and adjust the Bezier handle of the selected vertex to shape the spline as shown in Figure 4.75.

FIGURE 4.74
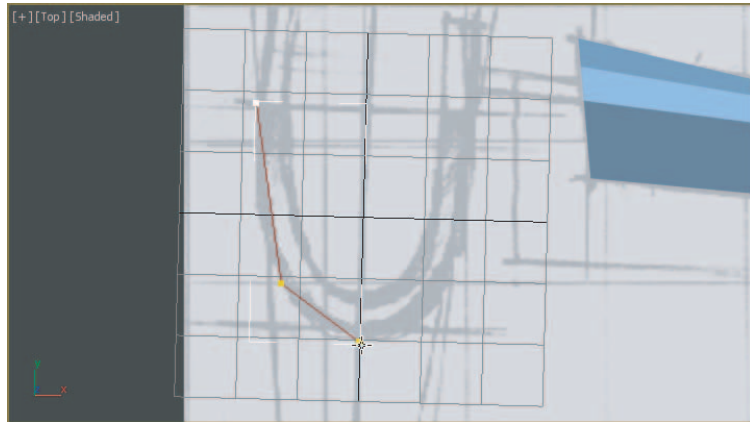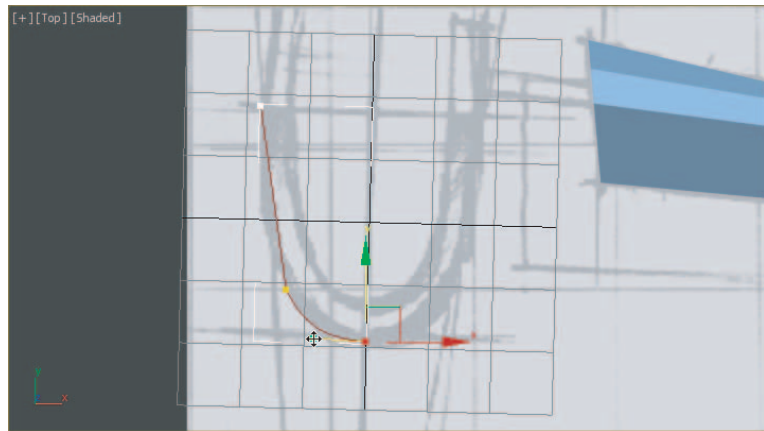Drawing the left half of the tower plan

FIGURE 4.75
Moving the vertex handle of the end of the line

6. Right-click the middle vertex, choose Bezier from the shortcut menu, and adjust the handles so that the line looks similar to Figure 4.76.

7. To add thickness to the wall, enter the Spline sub-object level, select the spline, and then scroll down the Command panel to find the Outline option.

8. Double-click the Outline input box and enter **0.5**↵. The line becomes a wall with a thickness of 0.5 meter.

The next step is to mirror the wall you just created. You want to use the X-axis of the user grid you set up earlier as the mirror axis.

CERT
OBJECTIVE

1. Click Line in the modifier stack to exit the sub-object level.

2. In the Main Toolbar, click the Reference Coordinate System drop-down list (see Figure 4.77) to view its options.

FIGURE 4.76
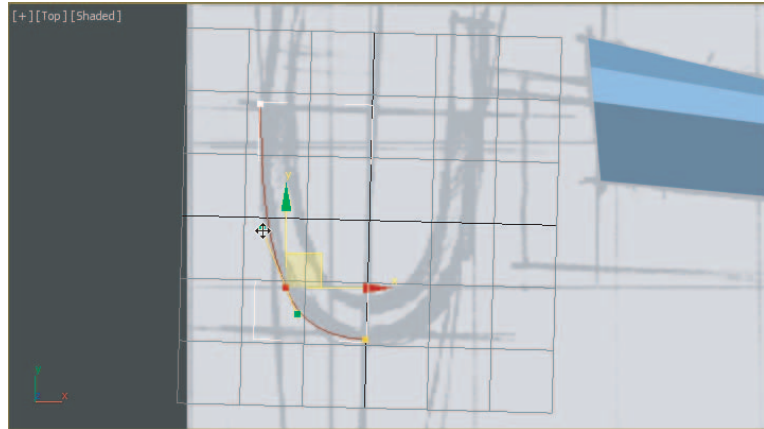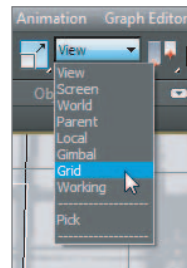Adjusting the middle vertex

FIGURE 4.77
The Reference Coordinate System drop-down

3. Select Grid. Notice that the Transform gizmo rotates slightly to match the user-grid orientation, and the reference coordinate system is displayed as Grid on the Main Toolbar.

4. Click the Mirror tool in the Main Toolbar.

5. In the Mirror: Grid Coordinates dialog box, make sure that the X radio button in the Mirror Axis group is selected, as shown in Figure 4.78.

6. Click the Reference radio button in the Clone Selection group. You see a mirrored copy of the wall you just drew. Adjust the Offset using the spinners so that the corners of the mirror segments are close to touching each other. Click and drag up and down on the spinner to see the effect, gently move the copy into the correct location, and then click OK.

7. Zoom into where the two clones are close. Click the Select And Move tool, and click the Snaps Toggle button to turn on Snaps. Right-click the Snaps toggle, choose Clear All, and then check Vertex.

8. Using the vertex snaps, click and drag the bottom vertex of the wall spline half you just created to the bottom vertex of the original wall so that they meet end to end, as shown in Figure 4.79.
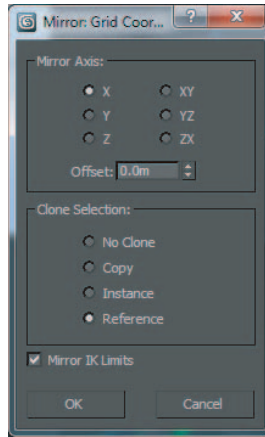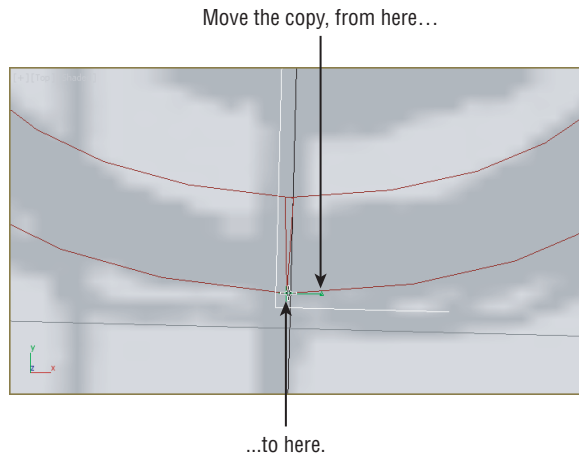
FIGURE 4.78
The Mirror: Grid Coordinates dialog box

FIGURE 4.79
Snap the bottom vertex of the reference clone to the original spline.

Move the copy, from here…

…to here.

The plan of the tower is a bit too wide at the opening. You can adjust one side of the plan and, because the two halves are references, adjustments you make to one side will affect the other side.

1. Exit the sub-object mode, and turn off the Snaps toggle. Then select the left half of the tower plan.

2. Go to the Vertex sub-object level, and then use the Rectangular Selection Region setting to select the two wall corner vertices at the top of the wall, as shown in Figure 4.80.

3. Click the Select And Move tool. Make sure Grid is selected from the Reference Coordinate System drop-down list.

4. Click and drag the red X-axis handle of the Transform gizmo to the right a slight amount so that the walls look similar to Figure 4.81.
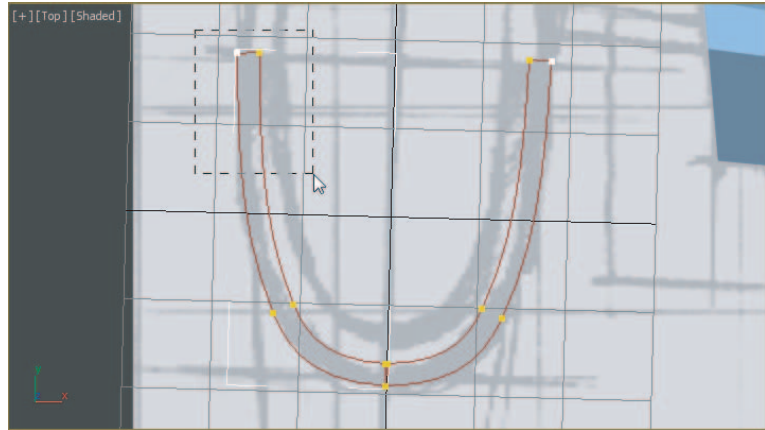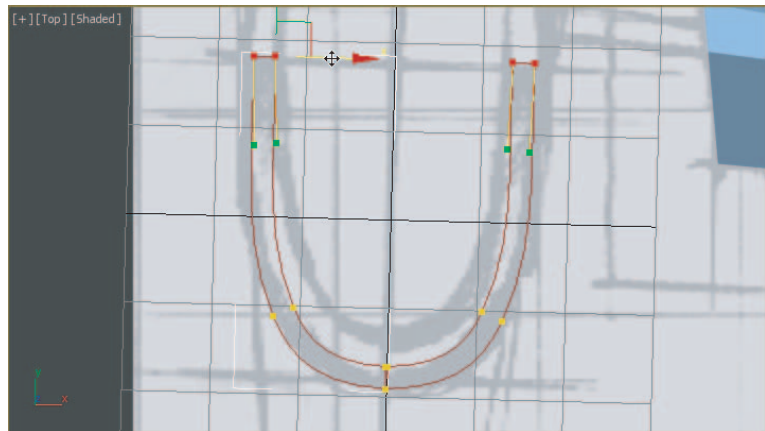
Because they are reference clones, both ends of the wall move in unison toward the centerline of the tower plan.

5. Save your work as **MyRonchamp_MirroredWalls.max**.

Adding the Vaulted Ceiling

You need another copy of the wall half to use later to cap the tower. This copy will be extruded using the Lathe modifier to form the vaulted ceiling of the tower.

1. Exit the Vertex sub-object level and then, using the Select And Move tool, Shift+click and drag the right half of the tower plan to the left.

2. In the Clone Options dialog box, click Copy. Then enter the name **Vault** in the Name input box and click OK.

Now you're ready to extrude the plan into a tower. The overall height of the tower is 22 meters. Subtract 2 meters for the vaulted ceiling, for a height of 20 meters for the straight portion of the tower.

1. Click the Select Object tool, and click the left half of the tower plan.

2. In the Command panel, select Extrude from the Modifier List drop-down.

3. In the Parameters rollout, change the value in the Amount input box to **20m**.

4. Right-click the Perspective viewport, and click the Zoom Extents tool to get a better view of your model.

To finish the basic shape of the tower, you need the vaulted ceiling.

1. In the Top viewport, select the leftmost copy of the tower plan outline that you named Vault.

2. Click the Shading viewport label, and click Edged Faces. This will help you see the geometry better.

3. In the Command panel, select Lathe from the Modifier List drop-down.

4. In the Parameters rollout, change the Degrees value to **180**. The ceiling won't look quite right, but in the next step you'll fix things.

5. Click the plus (+) sign next to Lathe in the modifier stack and select Axis.

6. Use the Select And Move tool to click and drag the red X-axis arrow to the left until the shape of the vault appears to be about the same width as the extruded tower plan, as shown in Figure 4.82. Zoom in on the apex of the lathed roof to ensure that the axis is moved accurately.

FIGURE 4.82
Using the Lathe modifier to form the ceiling


Drag the Lathe axis to the left.
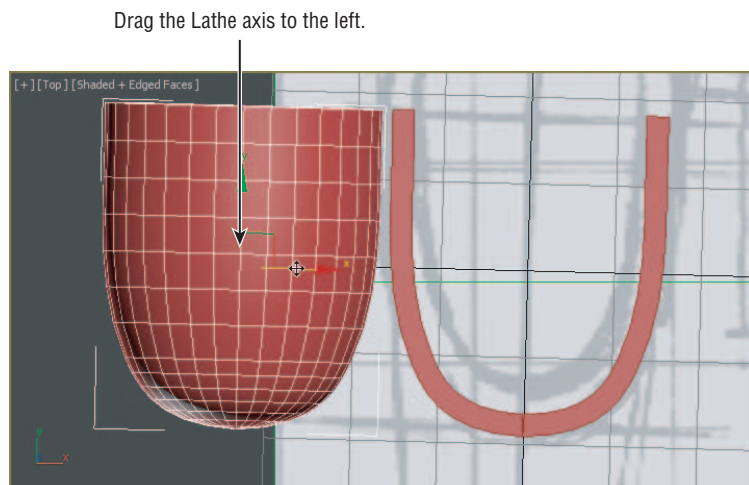
7. Exit Axis mode.

You need to prepare the tower and ceiling to be combined into a single object, but first save a copy of them to use in case you want to use a different approach to create the towers in a later exercise.

1. Select both the extruded tower wall and vaulted ceiling objects.

2. Click the Select And Move tool, hold down the Shift key, and move the objects off to the left, as shown in Figure 4.83.

FIGURE 4.83
Shift+move the
selected objects
to the left to copy
them.
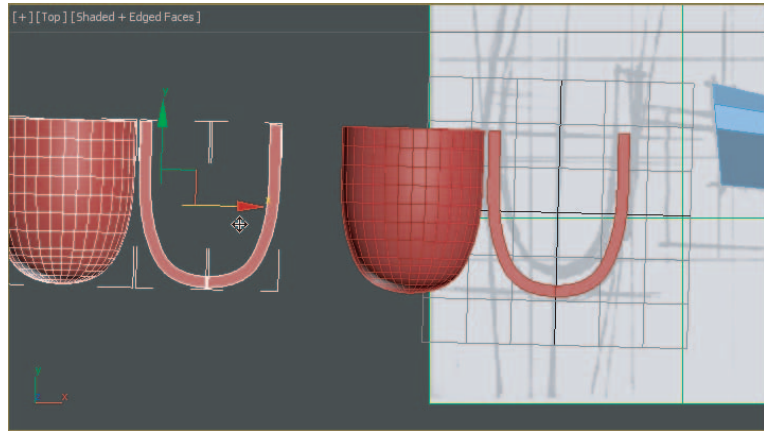
3. In the Clone Options dialog box, choose Copy and then click OK.

4. Right-click and choose Hide Selection from the quad menu to remove these objects from the display.

To join the walls and ceiling, you start by attaching the two wall objects, and then you complete the task by bridging the gap between the objects.

1. Click the Perspective viewport Shading label, and choose Shaded from the menu.

2. Click the label again, and select the Edged Faces option. This will display both the surfaces as well as the edges in the viewport.

3. Select the left wall object.

4. Right-click and choose Convert To ➤ Convert To Editable Poly to convert it to an editable poly object.

5. Click the Modify tab, scroll down to the Edit Geometry rollout, click the Attach button, and then click the right wall object. The two walls are now part of one object. Click Attach again to turn off the feature.

6. Switch to the Top viewport, and zoom into the area where the two walls touch.

7. Go to the Polygon Modeling panel of the Graphite Modeling tools, and turn on the Polygon sub-object mode. Polygons are contiguous, coplanar surfaces bound by visible edges.

8. Click the Select Object tool from the Main Toolbar, and then change the selection mode to Window.

9. Make a selection window just around the edge between the two halves of the wall, as shown in Figure 4.84. You can confirm that only two polygons are selected on the Selection rollout.

FIGURE 4.84
Make a selection around the edge of the two wall halves.
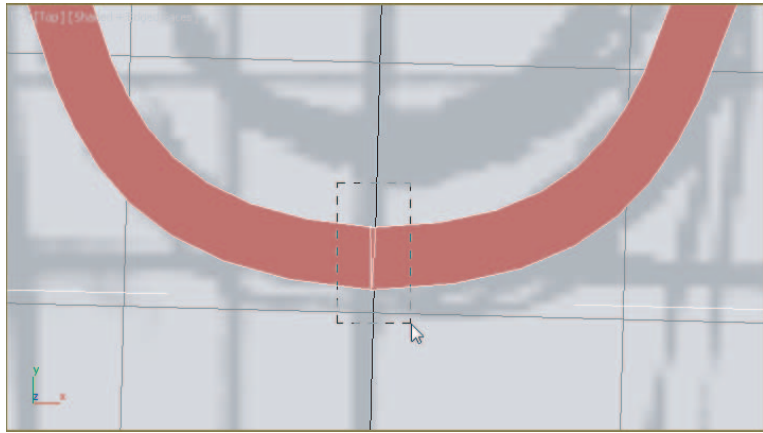
10. Press the Delete key on the keyboard to delete the two interior faces.

11. Switch the sub-object mode to Vertex, and make a selection the same size as the one you made in step 9.

12. You should have eight vertices selected. Click the Zoom Extents Selected button to get a close-up view of the selection.

13. Click the Settings box next to the Weld button on the Edit Vertices rollout.

14. The Weld Vertices caddy appears. Move it to the right so that you can see the vertices. Adjust the Weld Threshold value until it reads about .048 meters. This should cause the Number Of Vertices feedback to display 120 vertices before the weld and 116 after the weld, as shown in Figure 4.85. Click the green check mark to approve this change.

15. Deselect the four vertices.

This closes the mesh so that there will be no more modeling issues with this section of the building—or any more problems if you render the scene with radiosity or mental ray.

Now you need to remove the faces at the top of the wall to prepare to move the vault and attach the faces to the tower object.

1. Right-click in the Front viewport to make it active.

2. Change the sub-object mode to Polygon, and make a selection around the top of the joined walls. You should have two polygons selected.

3. Press the Delete key on the keyboard to delete the selection.

The polygons are deleted (see Figure 4.86). Portions of the vertical side walls may appear to be missing; however, this is just a function of the direction of the face normals. When the normal of a face is directed toward you, the face is visible. If the normal is pointed away from you, it will not display in the viewport.

4. Exit the sub-object mode.

A similar procedure must be completed for the bottom of the vaulted ceiling object. Here's how:

1. Select the vaulted ceiling object, and then isolate the selection.

2. Use Orbit Selected or the ViewCube to adjust the view so that you can see the bottom surfaces of the ceiling.

3. Right-click and choose Convert To ➢ Convert to Editable Poly to convert the lathed spline to an editable poly object.

4. Enter the Polygon sub-object level.

5. In the Front viewport, use a rectangular selection region to select all the polygons on the bottom surface of the ceiling, as shown in Figure 4.87. Be careful not to select any polygons above the bottom surface.

6. Press Delete to remove the selected polygons. Your model should look similar to Figure 4.88.
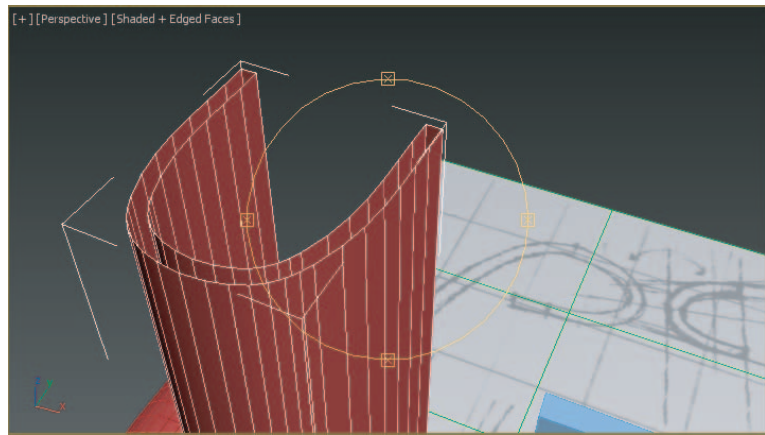
FIGURE 4.86
The top polygons
have been deleted.

FIGURE 4.87
Select the bottom
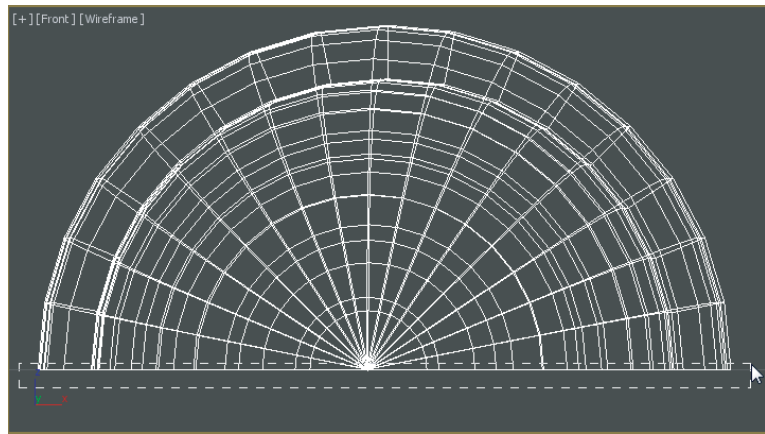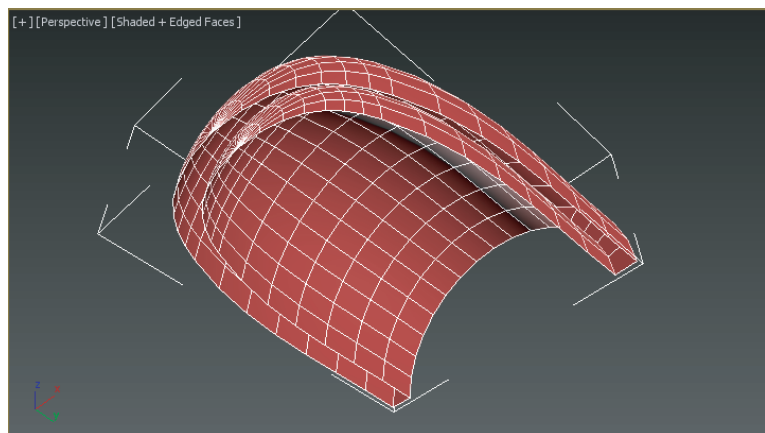surface using a
selection region.

FIGURE 4.88
The vault model
with the bottom
polygons deleted

7. Exit the Polygon sub-object level.

8. Exit Isolation mode.

Next, you'll move the vaulted ceiling into position and adjust its width to fit exactly over the vertical walls of the tower.

1. With the Vault object still selected, click the Select And Move tool.

2. In the transform type-ins at the bottom of the user interface, change the Z input box to **20.5** to raise the vault to 20.5 meters.

The vaulted ceiling is near its proper Z-axis location. Now you need to place the ceiling exactly over the vertical wall.

1. Right-click the Perspective viewport, and click the Maximize Viewport Toggle to enlarge the viewport. This will help you move the ceiling more accurately.

2. Use the ViewCube or Orbit Selected tool to make your viewport look like Figure 4.89.

3. Click the Snaps toggle to activate the 3D Snap mode, and then place the cursor on the lower-left corner of the vaulted ceiling, as shown in Figure 4.89. (The Vault object has been duplicated in the image for clarity.)

4. When you see the Snap cursor, click and drag the mouse to the upper-left corner of the wall, as shown in Figure 4.89.

5. Turn off the Snaps toggle.

6. If the width of the vault is different from the width of the walls, you'll need to take the following steps. First, center the vault over the walls by pressing Alt+A and then clicking the extruded wall object. Choose Center for both the current and target objects, and align only the X and Y positions. Click OK. Next, go to the Hierarchy panel, click the Pivot button, click Affect Pivot Only, and then click Center To Object. Turn off Affect Pivot Only. This forces the pivot point into the center of the object. Now adjust the width of the object by right-clicking and selecting Scale on the quad menu. Drag the red handle to scale in the X direction only.

7. Go to the Modify tab, and click the Attach button in the Edit Geometry rollout, and then click the wall object to join the two objects as one editable poly. Click the Attach button again to turn it off; you don't need to attach any additional objects.

8. Click the Maximize Viewport toggle to view the other viewports.

9. Right-click in the viewport, and select the Vertex sub-object level from the quad menu.

10. In the Front viewport, drag a selection box around the vertices where the vault and the walls meet, as shown in Figure 4.90.

11. Click the Settings button next to the Weld button in the Edit Vertices rollout.

12. Weld Threshold spinner until it looks like all areas with multiple vertices have been welded together; a value such as 0.2 meters should work, but depending on your modeling, the values may be different. Orbit around the model and adjust the Weld Threshold, watching the result. See where it is too much, back away from that value a little, and then

orbit some more to confirm that the setting is what you need. Click the green check mark to approve this change.

FIGURE 4.89
Moving the vaulted
ceiling into place
above the vertical
wall

Move the vault from this corner…

…to this corner of the extruded walls.
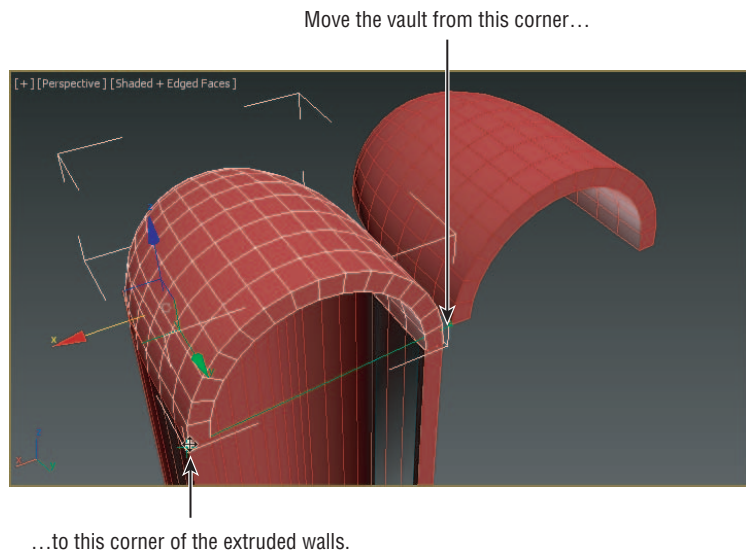
13. Deselect the vertices, exit the sub-object level, and then delete the user grid you created earlier. You won't need it anymore.

14. Save your work as **MyRonchamp_AttachedVault.max**.

FIGURE 4.90
Select the vertices
where the objects
meet.
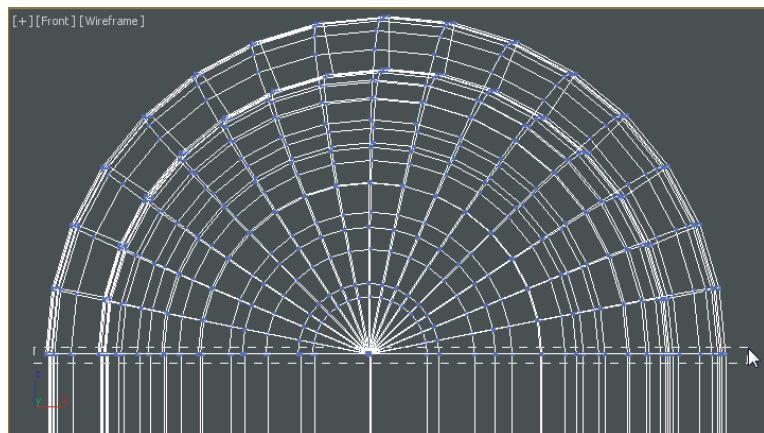
Creating the Smaller Towers

You have completed one tower. There are two smaller towers of a similar configuration. You can make a copy of the large tower you just created, and then edit the copy to create the smaller

tower. First, copy the tower, and move the copy into its new location at the north side of the building.

1. Continue from the previous exercise, or load `Ronchamp_AttachedVault.max`. Click the Top viewport, and click the Maximize Viewport toggle to enlarge the viewport.

2. Click the Zoom Extents tool to get an overall view of the plan so far.

3. Click the Select Object tool, and select the existing tower.

4. Click the Select And Move tool, and then Shift+click and drag the tower to the location of the smaller tower. (See Figure 4.91.)

5. In the Clone Options dialog box, click Copy and click OK.

The copy is a bit too large, and it's oriented in the wrong direction. You need to rotate the tower copy and then scale it down.

1. Pan the view so that the tower copy is centered in the viewport, and use the Zoom Region tool to enlarge the view of the tower, as shown in Figure 4.91.

FIGURE 4.91
Centering the tower copy in the viewport, and selecting a region to enlarge

Use the Zoom Region tool to enlarge this area.
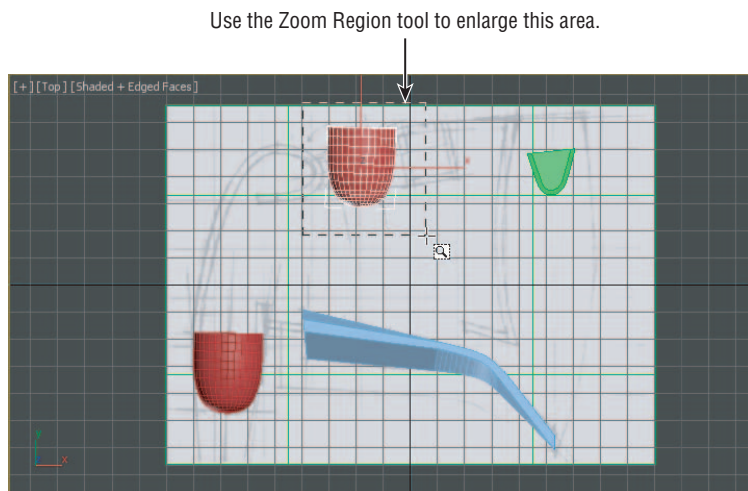
2. Click the Select And Rotate tool, and then click and drag the blue Z-axis ring clockwise until the tower is aligned with the image of the smaller tower in the imported bitmap sketch. You can use the centerline in the sketch to help you align the tower. Note that Alt+X is the shortcut for See-Through mode, which will help to check the size against the sketch when you're in the Top viewport.

3. Use the Select And Move tool to center the tower over the sketch.

4. Click the Select And Uniform Scale tool, and click and drag the Scale Transform gizmo's triangular handle down until the tower is about the same width as the sketch of the smaller tower, as shown in Figure 4.92.

5. Re-center the tower using the Select And Move tool.

6. Click the Select And Non-Uniform Scale tool, and then set the Transform Coordinate System to Local. Now click and drag the gizmo axis handles to refine the size of the tower until you are happy with its position relative to the sketch.

7. Press Alt+X again to turn off See-Through mode.

You may also need to experiment with the rotation of the tower to get it in the correct orientation. You don't need to be too fussy about the tower, however. Just use this as an opportunity to get accustomed to the 3ds Max Move, Scale, and Rotate tools.

When you scaled the copy of the tower, 3ds Max scaled it down in all directions. This caused the tower copy to appear to be floating in space because its pivot point was not at the base of the object. It now needs to be brought back down to the ground level.
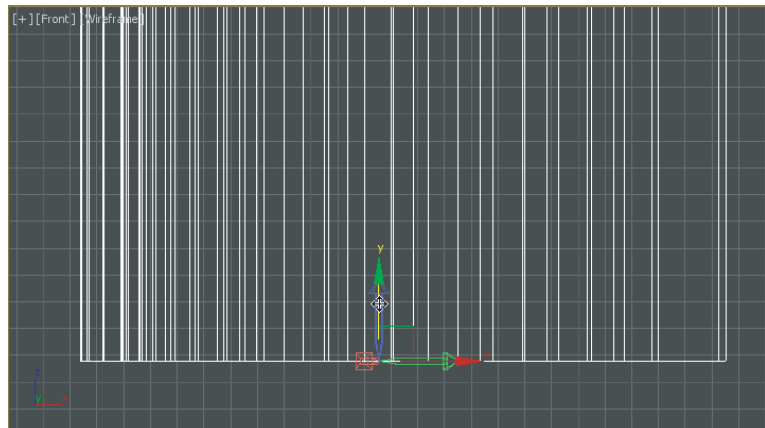
FIGURE 4.92
Fine-tune the size and location of the tower over the sketch so that it looks similar to this figure.
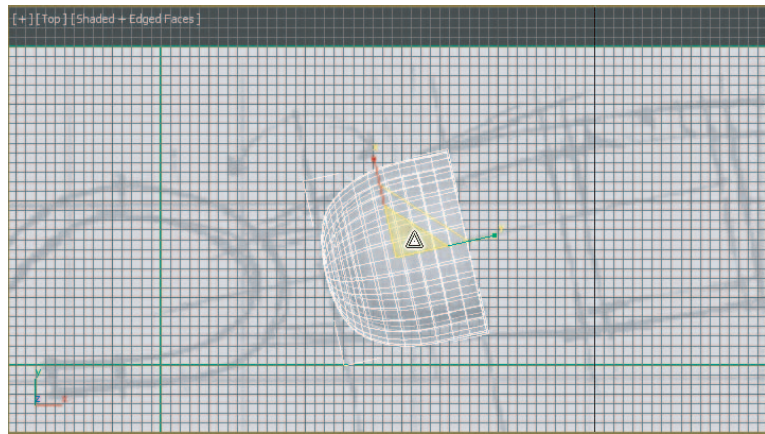
1. Click the Maximize Viewport toggle, and then right-click in the Front viewport.

2. On the Hierarchy panel's Pivot tab, under the Adjust Pivot rollout, click Affect Pivot Only and then, in the Alignment group, select Center To Object.

3. In the Front viewport, move the pivot down in the Z-axis until it is at the base of the tower, as shown in Figure 4.93. Zoom in to get it accurate.

FIGURE 4.93
Moving the pivot to the base of the small tower

4. Turn off Affect Pivot Only.

5. Lower the small tower to the ground, as shown in Figure 4.94, by right-clicking the Z Transform Type-In spinner at the bottom of the interface.

You have the tower in the location and orientation you like. Now you need to copy and rotate it to represent the other small tower.

1. Use the Select Object tool to select the tower you just created.

2. In the Main Toolbar, expand the Reference Coordinate System and choose View as the new coordinate system.

FIGURE 4.94
The smaller tower on the ground
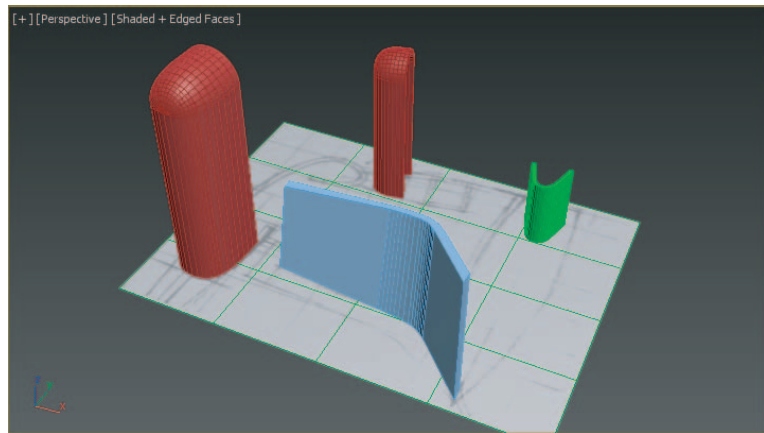
3. Click the Mirror tool in the Main Toolbar.

4. In the Mirror: Screen Coordinates dialog box, make sure that the X radio button is selected in the Mirror Axis group and the Instance option is selected in the Clone Selection group. Then click OK.

5. Click the Select And Move tool, and then move the tower instance left to the location of the first smaller tower. (See Figure 5.95.)

6. Use the Select And Rotate tool to rotate the new tower so that it is oriented in a way similar to that shown in Figure 4.95.

Move it again, if necessary, to center it on the sketch.

7. To see your results so far, click the Maximize Viewport toggle.

The smaller towers could use a little more work to refine their forms, but for now you have the general form of the towers in place.

Drawing the Remaining Walls

A few other walls still need to be added to the model. As a review of some of the skills you learned earlier, go ahead and add the other walls, starting with the west wall on the left side of the floor plan.
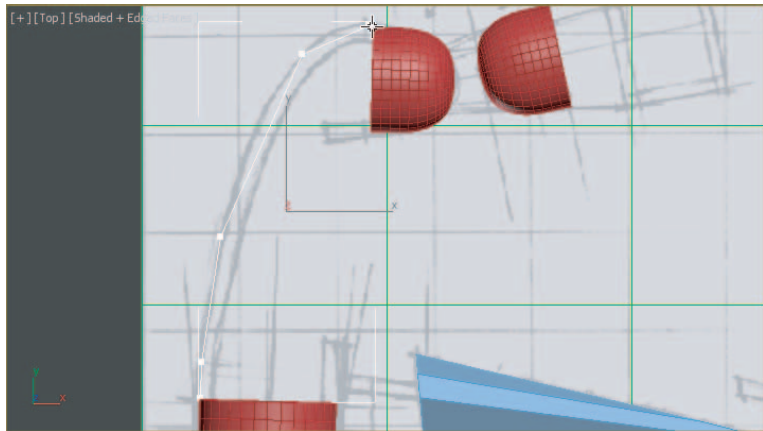
FIGURE 4.95
The final location and orientation of the second, smaller tower
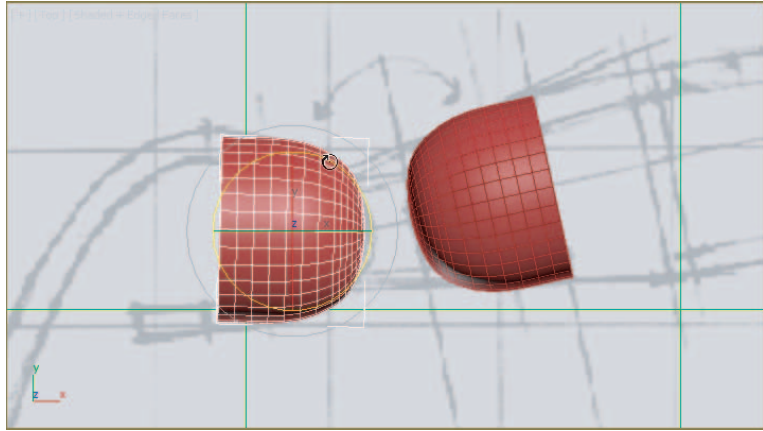
1. Click the Maximize Viewport toggle to enlarge the Top viewport again. Then click the Zoom Extents tool to view the entire top view.

2. Use the Zoom Region tool to zoom into the area shown in Figure 4.96.

FIGURE 4.96
Draw the west wall as shown here. The vertices are marked for clarity.

3. In the Create tab of the Command panel, click the Shapes button if it isn't already selected, and then draw a line on the left side of the wall, as shown in Figure 4.96, starting at the top.

4. Click the Modify tab of the Command panel, and then click the Vertex button in the Selection rollout.

5. Select all the vertices, and then right-click to open the quad menu. Convert all of the points on the line to Bezier curves. Adjust the tangent handles to match as closely as possible the curve shown in Figure 4.97.

FIGURE 4.97
Match the curve
shown here.
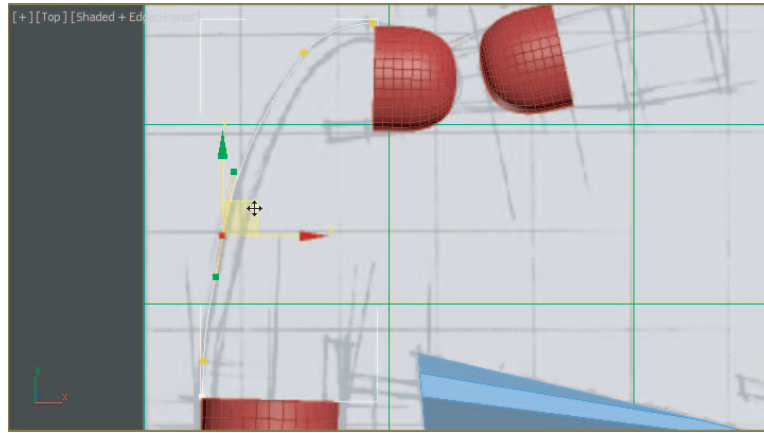
6. In the Modify tab, click the Spline tool in the Selection rollout. Then scroll down the panel to the Outline input box and enter **0.5**↵. The west wall will convert to a thick wall.

7. Scroll up to the top of the Command panel, and select Extrude from the Modifier List drop-down.


EXTRUDE ACTS ON THE ENTIRE OBJECT

When a sub-object selection is active, most modifiers pass that selection only to the modifiers in the stack. The Extrude modifier is one exception where the entire shape is extruded, not just the selected vertices, edges, or splines. In the case where a sub-object selection has been passed to a modifier and you want to start passing the entire object up the stack again, apply a Poly Select modifier to the top of the stack. Without a sub-object selection at the Mesh Select modifier, all subsequent modifiers are applied to the entire object.

---

8. In the Amount input box of the Parameters rollout, enter **9.5**↵.

The west wall will need some editing later. For now, continue with the addition of the north wall.

1. Choose Views ➢ Undo View Change, and then zoom into the area shown in Figure 4.98.

2. Draw the line shown in Figure 4.98, and convert the vertex indicated in the figure to Bezier. Adjust the Bezier handles so that the line follows the curve of the sketch. By now, this should be a familiar process.

3. Access the Spline sub-object level, and then, in the Modify panel, scroll down to the Outline input box to set the wall outline to **0.5** meters. If your wall outline appears on the wrong side of the line, click the Undo tool, click the Reverse button, and reenter the **0.5** Outline value.

FIGURE 4.98
Drawing the north
wall

Convert the middle vertex to a Bezier type.
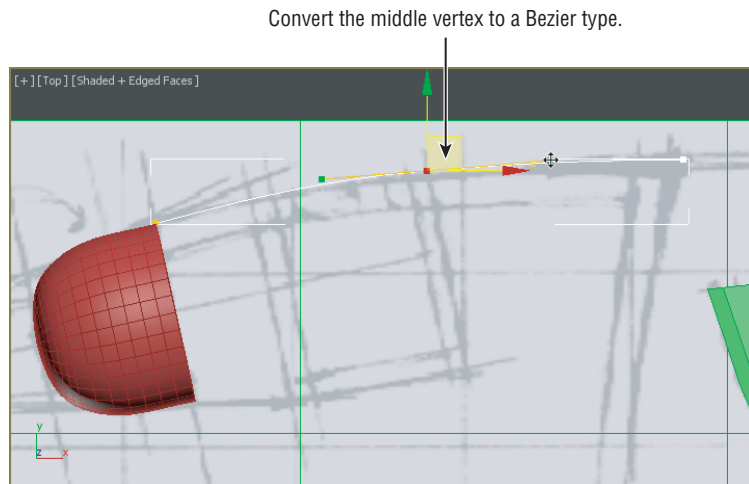
4. Scroll up to the top of the Command panel, and select Extrude from the modifier stack list. 3ds Max uses the last value you entered for the Extrude amount, so the wall automatically extrudes to 9.5 meters.

5. Save your work.

OBJECT DATA FLOW, SCALED PARAMETRIC OBJECTS, AND EDITABLE POLYS

When you scale an object, the object's apparent size is affected, but the parameters of the object are not. For example, if you create two spheres, the first with a radius of 2 and the second with a radius of 1, the first appears twice as large as the second, just as it should. When you then scale the first sphere to 50 percent of its size, it appears equal in dimensions to the second sphere. Select each sphere in turn, and verify its Radius value in the Modify panel. Although they appear to be the same size, the Radius of the first sphere is 2 and the second is 1. This can cause a good deal of confusion.

The reason for this seemingly odd behavior becomes clearer when you consider the object data flow in 3ds Max. You may recall that 3ds Max evaluates the data associated with an object in a particular order before the object is displayed. The order of that data evaluation is master object, modifiers, transforms, and then properties. The object's parameters fall under master object, which is the first item in the object data flow. Transforms are third in the evaluation order. Transforms affect the way the master object is displayed, but they have no effect on the master object's internal parameters or other data at its sub-object level. The net result of this is that when parametric objects are scaled up or down in size, their parameters remain at their original values before being scaled, even though the object itself appears larger or smaller than its original size.

Another way of saying all of this is that the object really exists in its own space, called Object Space (*Object Space* means a 3D Cartesian coordinate system with an origin and a grid). Objects are defined, sculpted, and modified in Object Space. Objects can be transformed in Object Space using the XForm modifier. Moving, rotating, and scaling (in other words, transforming) an object actually occurs in World Space, and it is applied later in the object data flow. (Objects can be transformed in World Space to align with Object Space by using the Local Reference Coordinate System.)

An alternative way to look at it is to consider the master object as having internal data, which includes its own unit of measure and coordinate system, called Object Space. This internal data is unaffected by modifiers, transforms, and properties. The modifiers, transforms, and properties you apply to an object affect only the object's appearance in the 3ds Max viewport.

This all changes when you convert an object to an editable poly. In terms of 3ds Max data, an editable poly is a more fundamental way of representing the object on a mathematical level, even though its appearance is identical to that of the original object from which it was derived. Once you convert an object to an editable poly, the editable poly becomes the master object in the data flow. This new master object then inherits the properties and structure of the original object, while the modifiers are collapsed into the original master object. You can then apply more modifiers and transforms to this new master object, and the process goes on.

Finally, add the east wall to the model.

1. Choose View ➤ Undo View Change, or press Shift+Z to return to the overall view of the plan. Then zoom into the area shown in Figure 4.99.

FIGURE 4.99
Drawing the east wall
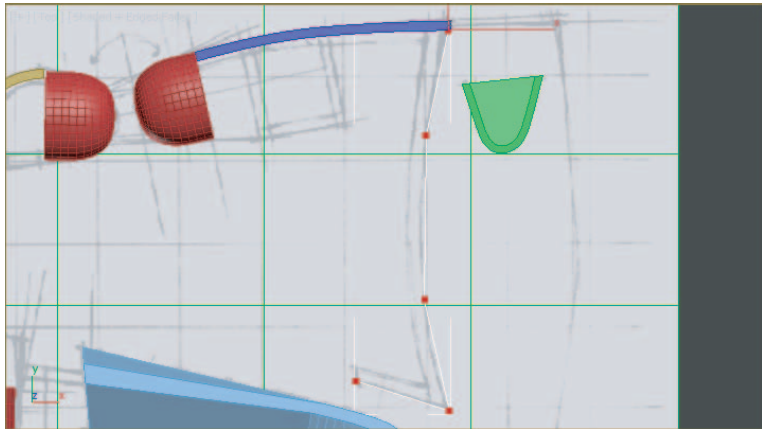
2. Draw the line shown in Figure 4.99.

3. Convert the vertices shown in Figure 4.100 to Bezier, and adjust the tangent handles to match the curve of the sketch.


ADDING VERTICES TO A SPLINE

To add a vertex to an existing spline, click the Refine button in the Geometry rollout at either the Vertex or Segment sub-object level. To delete an unnecessary vertex, simply select it and press the Delete key. 3ds Max spans the gap created with a segment to maintain the spline's integrity.

---

4. Use the Outline option to create an outline that is 0.5 meters wide.

5. Extrude the east wall to a height of 11 meters.

FIGURE 4.100
Convert these verti-
ces to curves.

Convert these two vertices to Bezier.
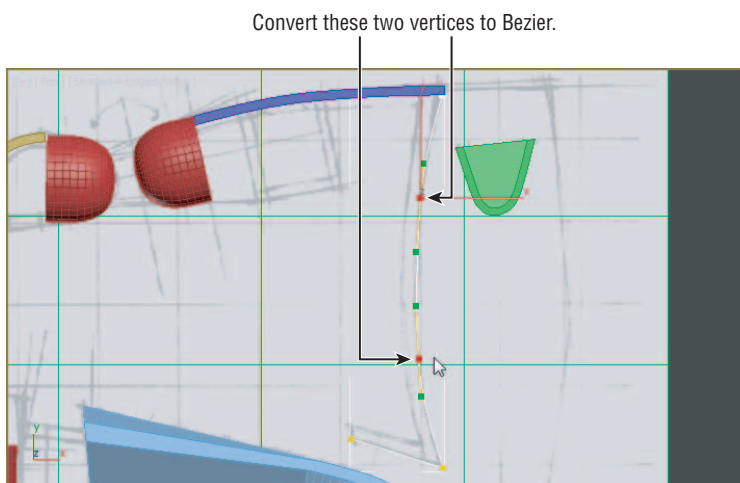
6. Click the Maximize Viewport Toggle to view all of the viewports.

7. Save your work as **My_Ronchamp_04.max**.

You've created most of the major structure of the chapel. If you're familiar with the Chapel at Ronchamp, you'll see that there are a few areas where the model doesn't quite match the real building but, in general, you get the overall flavor of the design. Refining the details will come later. For a view of the chapel so far, see Figure 4.101.

**FIGURE 4.101**
A view of the chapel
so far
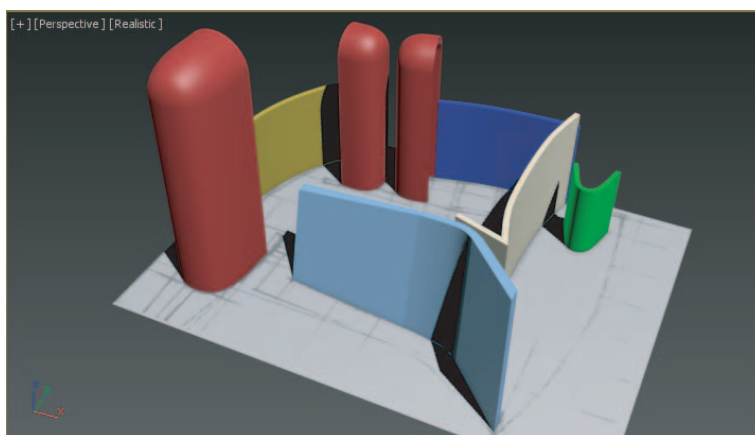
Attaching Objects to a Mesh

As you have been modeling the Chapel at Ronchamp, you have been creating a series of objects. Sometimes, and particularly in more complicated projects where you anticipate creating hundreds of objects, it can be helpful to attach multiple objects to a mesh. By aggregating objects by attachment, you reduce the total number of objects in the scene. It often makes sense to attach the objects that logically belong together to a mesh object for simplified organization of your scene, but it is not strictly necessary. You will learn how to attach objects to a mesh next.

1. Adjust the Perspective viewport and then select the north wall, which is the second-to-last object you made. (See Figure 4.102.)

2. In order to attach other objects to this one, you'll first either have to convert this object to an editable poly or use the Edit Poly modifier. Apply the Edit Poly modifier to this wall.

3. Click the Attach button in the Edit Geometry rollout.

4. Click the adjacent tower to attach it to the north wall, as shown in Figure 4.102. You could also click the small Attach List button to the right of the Attach button to select the objects to attach from a list.

FIGURE 4.102
Attaching the adjacent tower to the north wall

Attach the adjacent tower to the north wall.
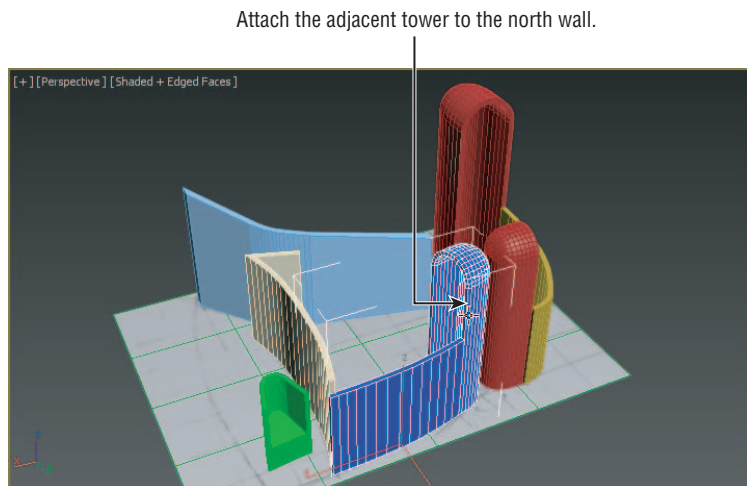
5. Click the Attach button again to turn it off.

6. Click the Select By Name tool to open the Select From Scene dialog box. Notice that the object you attached no longer appears in the list because it has become part of the north wall. Close the Select From Scene dialog box.

7. Now that you have seen how attachment works, try the opposite—detaching. Enter the Element sub-object level of the north wall's Edit Poly modifier.

8. Select the element that was formerly the independent tower within the east wall object, as shown in Figure 4.103.

FIGURE 4.103
Selecting elements within a mesh
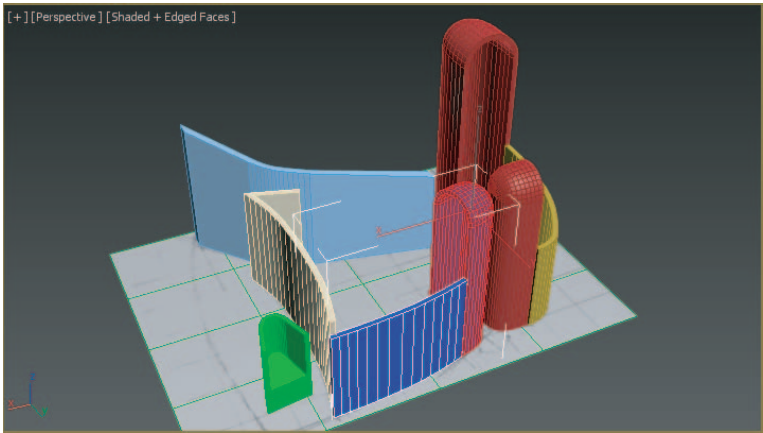
9. Click the Settings button next to the Detach button in the Edit Geometry rollout, as shown in Figure 4.104.

FIGURE 4.104
Selecting the Settings button for the Detach option
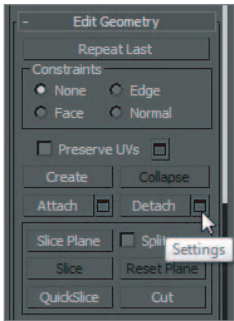
**DETACHING AN OBJECT CREATES AN EDITABLE POLY**

Once you detach an object from a poly, it too becomes an editable poly. The modifiers you may have used before the attachment occurred are lost. Because of this, it is important not to attach objects to a poly until you have finished editing their modifier stacks.

---

10. The Detach dialog box appears to prompt you for the name of this new object. Type **Vault02** in the Detach As field and then click OK.

11. Exit the Element sub-object level. Observe how the tower is no longer part of the bounding box of the east wall object, as shown in Figure 4.105. It has become its own object once again.

You have seen how you can organize a complex scene by attaching multiple objects to a single poly object. You have also learned how to detach elements from a poly, returning them to their former object status. Utilizing the two opposites of attaching to and detaching from meshes is an optional way to organize your scenes.

FIGURE 4.105
The scene after you've detached an element from the mesh
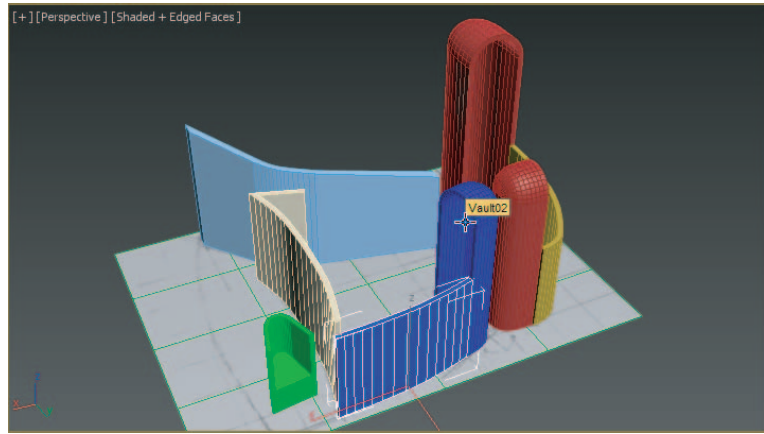
CHOOSING MESHES OVER GROUPS

You may choose to organize your scene using Attach as an alternative to using groups. Objects that are attached to a mesh lose the modifiers in their stacks and often require the use of more complicated Multi/Sub-Object materials. However, mesh elements require much less memory than grouped objects.

Smoothing Meshes

You learned in Chapter 2, "Introducing Objects," that many of the 3ds Max primitive objects have a Smooth parameter. *Smoothing* is an inherent quality of mesh objects.

All meshes are composed of vertices that are themselves connected by straight lines called *edges*. Sets of edges define surfaces called *faces* or *polygons* (depending on whether they are three-sided or multisided). Multiple polygons form *elements*, as you previously learned.

The relatively simple surfaces set up by the sub-objects literally define a faceted overall surface. Smoothing is an illusion created by blending the appearance of adjacent surfaces to give the appearance of a continuously curved surface over a discrete set of vertices, edges, faces, and so on. The left image in Figure 4.106 shows the actual surfaces of a sphere, while the right image shows the same sphere with smoothing turned on.

Each mesh object stores smoothing information that can be edited. You will learn two different ways to adjust smoothing—within a mesh and by using the Smooth modifier.

Smoothing within a Mesh

You can adjust smoothing at the sub-object level within a mesh object. The smoothing data is part of the mesh itself. Next, you will learn how to convert an object into an editable mesh and adjust its smoothing.

1. Select the tapered wall of the Ronchamp model, which you modeled earlier in this chapter.
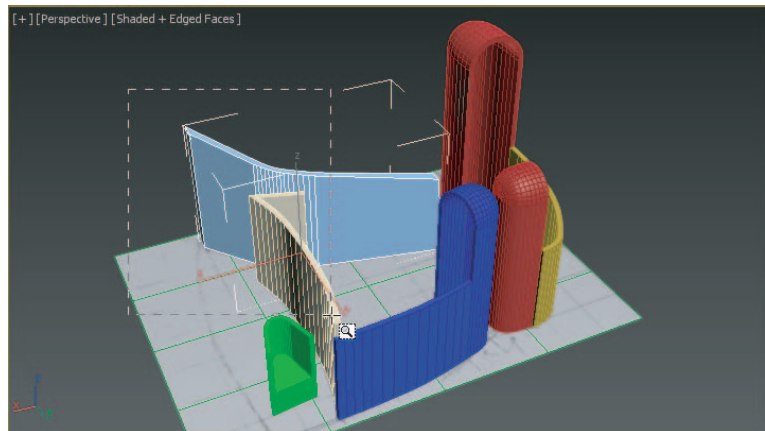
FIGURE 4.106
Compare a fac-
eted sphere and a
smooth sphere.
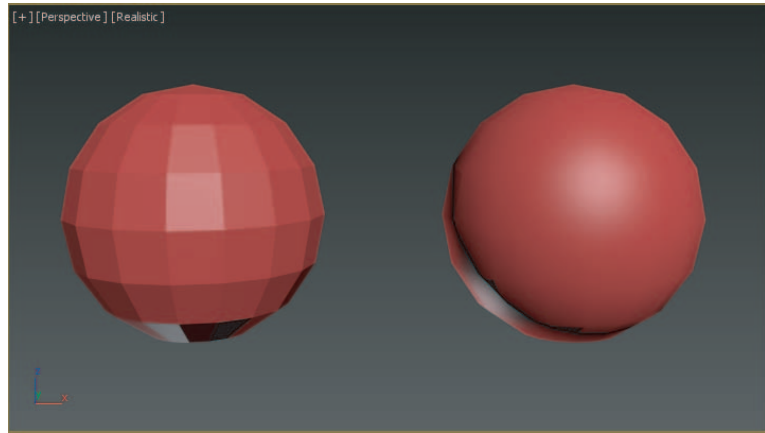
2. Right-click in the viewport, and choose Convert To ➤ Convert To Editable Poly, and the object becomes an editable poly.

3. Zoom into the area indicated in Figure 4.107.

FIGURE 4.107
Zoom into the
curved area on the
back side of the
tapered wall.

ZOOM REGION WITH PERSPECTIVE VIEWPORTS

The Field-Of-View navigation tool in a Perspective viewport is actually the top button in a flyout. Hold down the button to extend the flyout and expose the Zoom Region tool underneath.

---

4. Observe that there is a smoothing discontinuity, or *seam*, that shows up along the back side of the tapered wall, as shown in Figure 4.108. This is typical of many modified mesh forms. Turn off Edged Faces in the viewport's shading menu to see this seam.

FIGURE 4.108
Smoothing discontinuity, or "seam"

5. Add an Edit Poly modifier to the top of the stack, and then go to the Polygon sub-object level.

6. Select all polygons within this object by pressing Ctrl+A on the keyboard.

7. Scroll way down in the Modify panel, and locate the Polygon Smoothing Groups rollout. Click the Clear All button (see Figure 4.109).
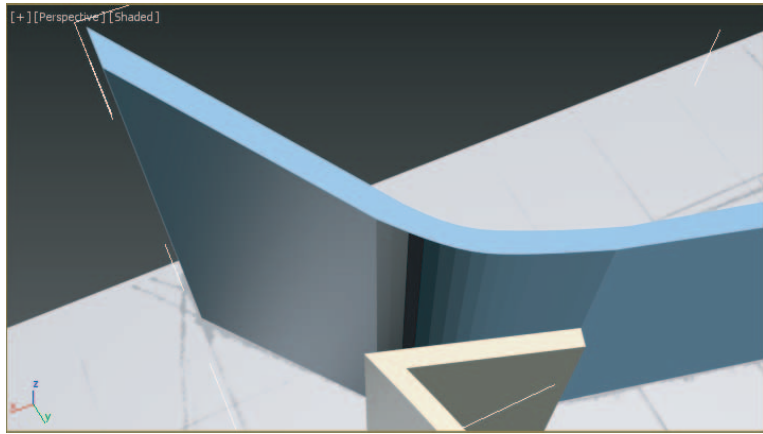
FIGURE 4.109
Clearing the smoothing groups
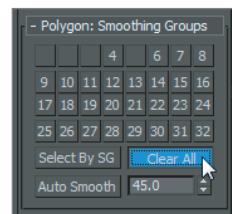
8. Deselect all polygons by clicking off to the side in the viewport. Notice that all the smoothing information that was previously stored in the editable poly has been cleared out, as shown in Figure 4.110. Each surface appears faceted and is easily discernible from the adjacent surfaces.

9. Select all polygon sub-objects again by pressing Ctrl+A.

10. Click the Auto Smooth button near the Clear All button.

11. Deselect all polygon sub-objects, and exit Polygon mode. The seam that was present in Figure 4.108 has been smoothed out now that you've smoothed the mesh (see Figure 4.111). Look carefully, because the effect is subtle.

FIGURE 4.110
The editable poly
has been cleared of
all smoothing.

FIGURE 4.111
The resmoothed
mesh
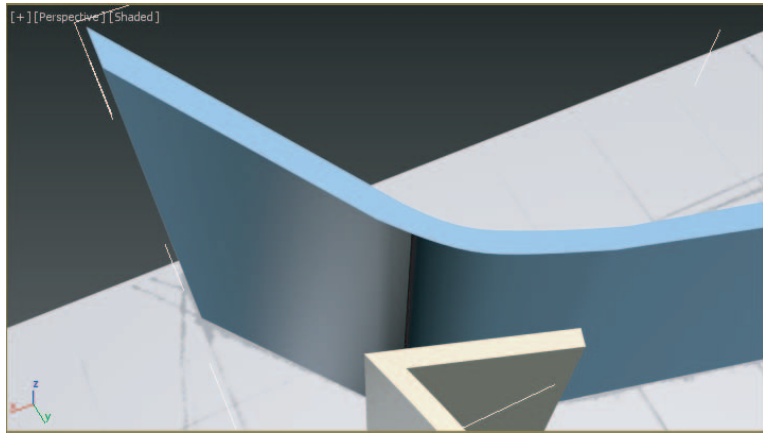
UNDERSTANDING SMOOTHING GROUPS

Smoothing groups are the numbers in the 8 × 4 grid in the Polygon Smoothing Groups rollout. Each polygon sub-object can have a smoothing group number assigned. Just select a polygon, and click the number button to assign a smoothing group. When adjacent polygons have the same smoothing group number, their surface appearance is smoothed together. When the angle between adjacent faces exceeds the threshold value in the input box next to the Auto Smooth button, the faces are not smoothed together. You can manually edit the smoothing groups for maximum control over the illusion.

The Smooth Modifier

Another way of applying smoothing to any object—whether it is a mesh or a parametric object—is to use the Smooth modifier.

1. Select the tapered wall again.

2. Apply the Smooth modifier.

3. Check Auto Smooth in the Parameters rollout.

4. Adjust the Threshold value to **0.0** degrees. This effectively removes smoothing from the object.

5. Drag the Threshold spinner up. As you do, observe how more and more of the object gets smoothed. Set the threshold to **30** degrees. Figure 4.112 shows the object properly smoothed.

6. Set the Threshold at **90** degrees, and observe how the illusion of smoothing extends now across the top edge. This is an example of incorrect smoothing. Figure 4.113 shows a case where the threshold value was set too high so that the crisp edges that you want to remain are smoothed.

FIGURE 4.112
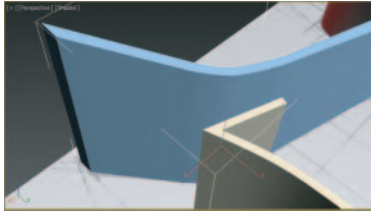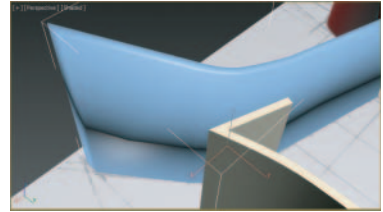Smoothing Threshold set at 30 degrees

FIGURE 4.113
Smoothing Threshold too high

7. Delete the Smooth modifier after you have finished experimenting by clicking Remove Modifier from the Stack tool below the modifier stack.

8. Save your file as **MyRonchamp_Smoothed.max**.

Creating and Modifying Objects Using Box Modeling

The toolsets included with the 3ds Max editable poly and editable mesh objects are extensive, giving you an immense amount of control over the objects in your scene. Using either mesh type, you can manipulate, delete from, or add to the sub-objects to create nearly any object imaginable. This modeling technique, often called *box modeling* because the initial mesh begins as a box primitive, is very powerful and often used to create objects in 3ds Max scenes where primitives, extrusions, and modifiers are not flexible enough to complete a project or feature.

Preparing a Box for Box Modeling

Figure 4.114 shows a 3D model of the type of pew found in the Ronchamp chapel. This is an example where you could use box modeling. The pews consist of poured concrete supports and carved wooden planks that can quickly be modeled using a combination of polygon editing tools.

In the next exercise, you'll model a pew similar to those shown in Figure 4.114:
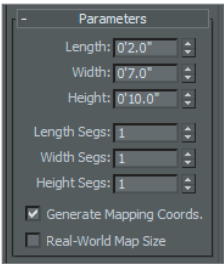
1. Click the Application button, and select Reset to prepare for working on a new scene.

2. Set the units to Feet w/Decimal Inches, and set the Default Units to Inches.
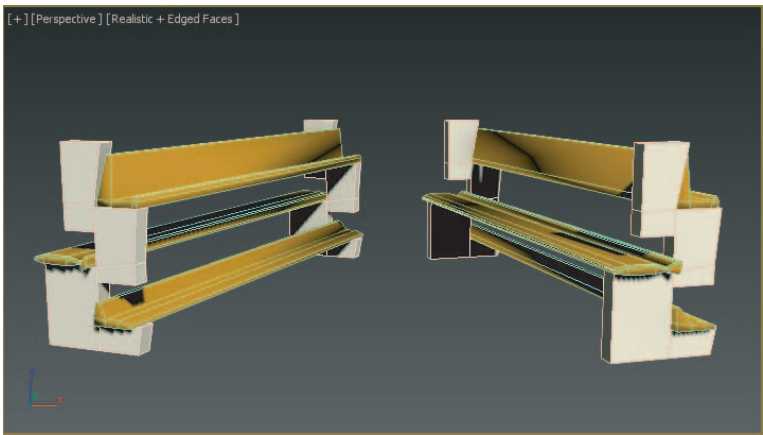
3. In the Perspective viewport, make a box primitive near the origin, set its Length to **0′ 2″** and Width to **0′ 7″**, and set its Height to **0′ 10″**. Your Parameters rollout should look like Figure 4.115.

4. Click the viewport shading label, and choose Edged Faces to display the object's edges. Orbit the viewport so that your Perspective viewport looks similar to Figure 4.116.

5. Right-click in the viewport, and convert the box into an editable poly.

CONNECTING THE EDGES

Starting on the back side, the next step is to connect the edges to divide the one polygon into three polys, which you can then extrude.

1. Click the Polygon Modeling tab of the Graphite Modeling toolbar, and then access the Edge sub-object level.

2. Click to select the two vertical edges on the right side of the box as it appears in the viewport.

3. Right-click to access the quad menu. In the lower-left quad (tools 2), click the Connect Settings button, as shown in Figure 4.117.

FIGURE 4.116
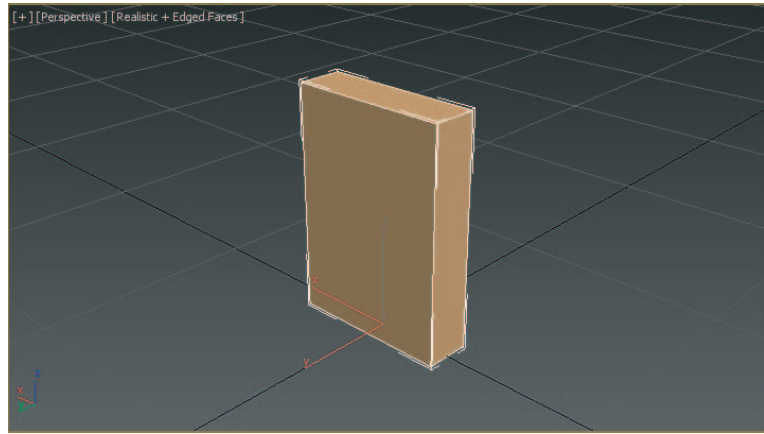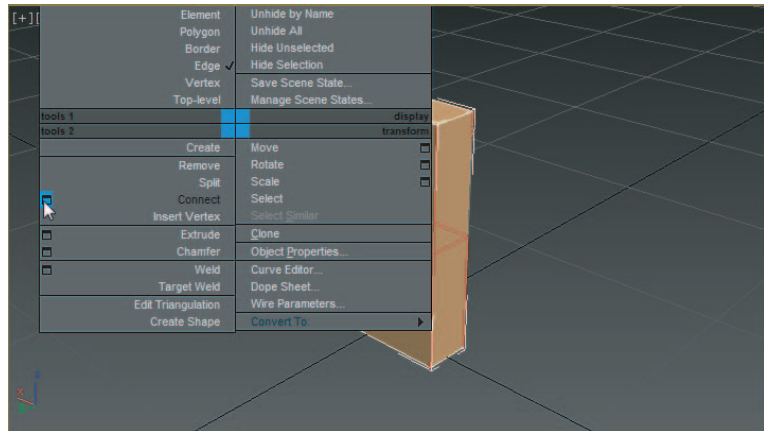The Perspective viewport after activating Edged Faces


FIGURE 4.117
Accessing the Connect Settings

4. The Connect Edges caddy appears, as shown in Figure 4.118. Move it to the side, and mouse over the caddy. Notice that the caddy label changes as you move your cursor over each field. Click in the first field, and then change the number of segments to **2**, the Pinch setting to **24**, and the Slide setting to **10**. Also notice the new edge positions on the box as you adjust the values.

5. Click the green check mark to approve the changes. Next, you'll start extruding polygons to build the pew support.

EXTRUDING POLYS

The Extrude modifier projects a 2D object into 3D space by building vertical faces and capping the top and bottom surfaces. The Extrude tool in the editable poly toolset projects a selected set of faces away from their existing locations by building new perpendicular faces. Here you'll extrude the faces at the top and bottom of the box to model the supports for the kneepad and the prayer book rest.

FIGURE 4.118
The Connect Edges
settings
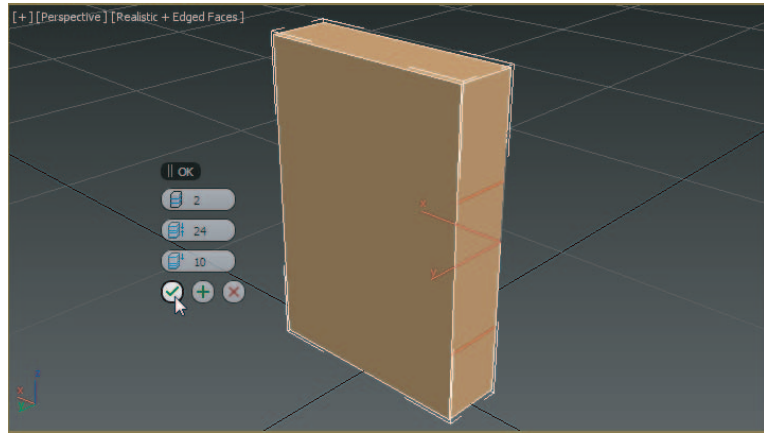
1. In the Main Toolbar, set the Crossing/Window option to Crossing.

2. Click the Polygon Modeling tab of the Graphite Modeling toolbar, and select the Polygon sub-object mode, or press **4** on the keyboard to go to that mode.

3. Ctrl+click the polys to get the top and bottom vertical polygons, as shown in Figure 4.119.

4. In the Perspective viewport, zoom into the base of the support. In the Polygons tab of the Graphite Modeling toolbar, click the drop-down arrow below the Extrude icon and then click the Extrude Settings button to open the Extrude Polygons caddy.

5. Set the Extrusion Type to Local Normal so that each polygon extrudes perpendicular to the angle of its surface and so that the intersection between adjacent selected polys is maintained. Set the Extrusion Height to **5″**, as shown in Figure 4.120.

6. Click the green check mark to approve the changes. The extrusions are executed and the caddy closes.

7. Select the polygon on the top right of the model, and then choose the Extrude settings from the quad menu. Using the quad menu is the fastest method to get to the basic tools; accessing the more advanced tools requires that you use the full Graphite Modeling toolbar.

8. Set the Extrusion Height to **6″** and click OK.

   Repeat the process now on the two front vertical edges of the newly extruded polygon. Select the two edges, and use Connect Edges to divide them into two polys, as shown in Figure 4.121.

9. Select the upper poly, and extrude it **4″**. Repeat the process once more, selecting the new top poly, and extrude it **7″**. Your model should resemble Figure 4.122.

10. You can add a slant to the back support by selecting two vertices and moving them to angle the vertical faces on the back side of the support. Select two vertices, and move them to the right in the X-axis only. You can do this on each set of vertices, as shown in Figure 4.123. For the seat, select the pair of vertices and move them downward slightly.

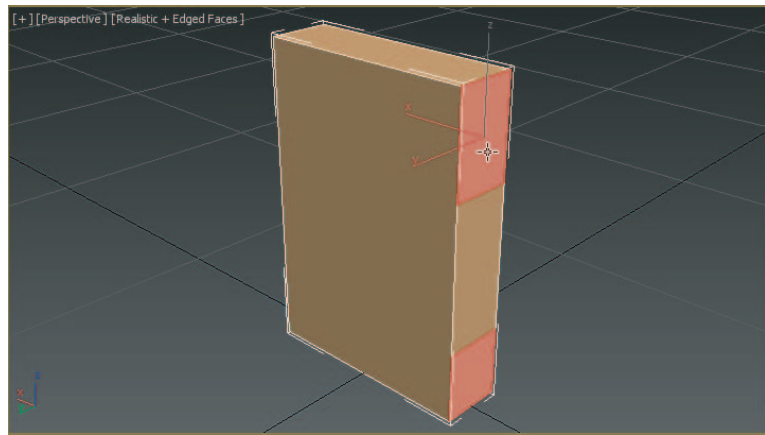**FIGURE 4.119**
Selecting the top and bottom polygons
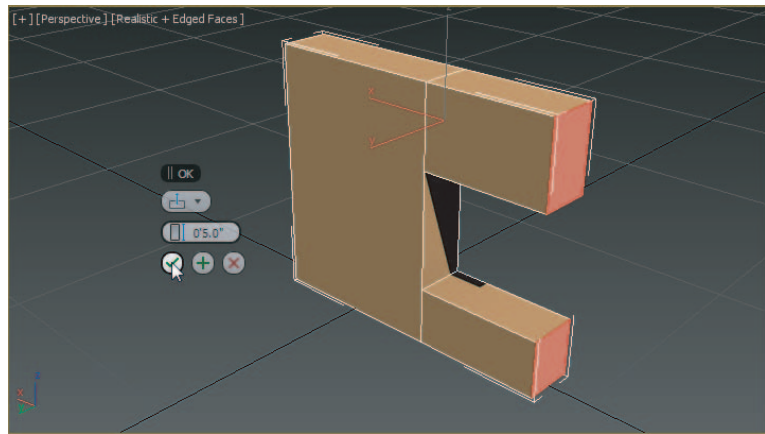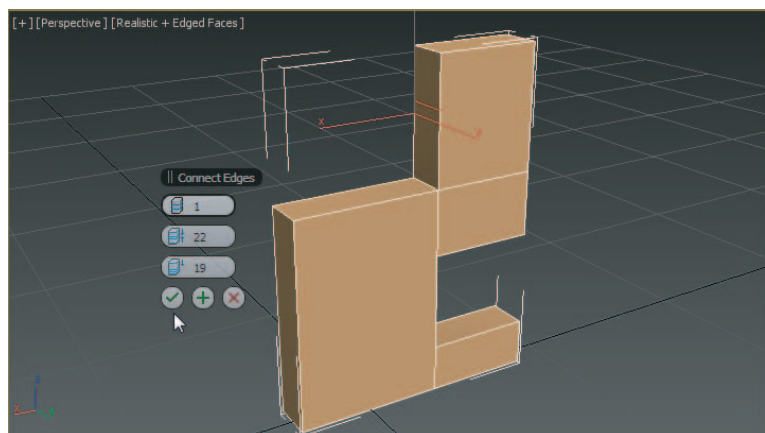

FIGURE 4.120
Extruding the polys

FIGURE 4.121
Connect the newly created edges.

Next, you'll add the horizontal pieces for the prayer book rest, knee rest, and the bench for seating. You'll use the Bevel tool and the Chamfer Edge function to shape and round the crosspieces.
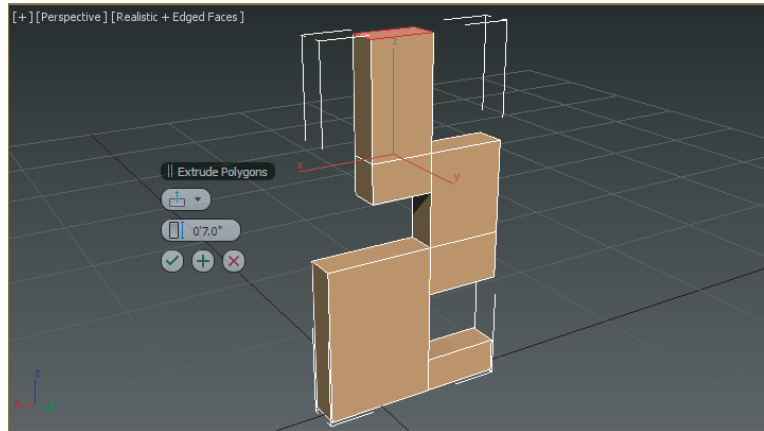
FIGURE 4.122
The pew support

FIGURE 4.123
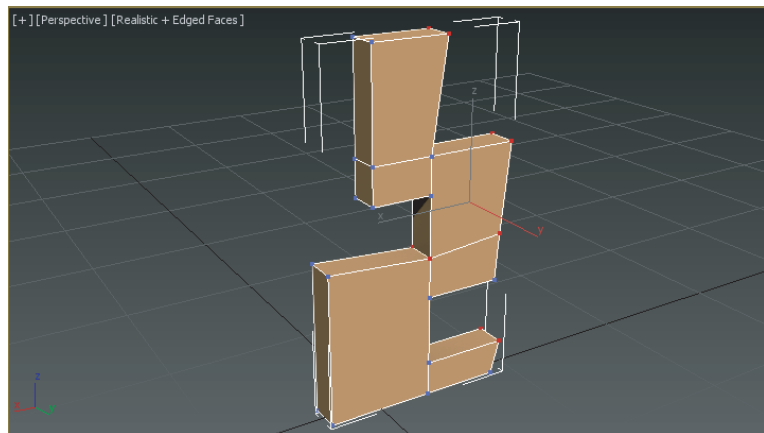Adjust the support's vertices.

BEVELING POLYS

So far you've used Connect to create new polygons and Extrude to build additional geometry. You can use the Bevel tool and the Chamfer Edge function to make rounded sections of your model.

1. In the Perspective viewport, zoom out so that you can see the entire editable poly, and then click the top of the stack so that you're out of the sub-object level.

2. On the Edit menu, choose Clone. Create an instance of the support by clicking OK.

3. Move the clone 5′ away from the original object in the Y-axis by using the Move tool and watching the transform type-in.

4. Create a box for the bench by going to the Create panel, clicking Box and AutoGrid, and then dragging out a box starting on the slanting surface on the support, as shown in Figure 4.124. Since the surface is angled and AutoGrid is on, the box should lay flat on the angled surface. Name the object **Bench**.

FIGURE 4.124
Creating the bench
with AutoGrid

CERT OBJECTIVE
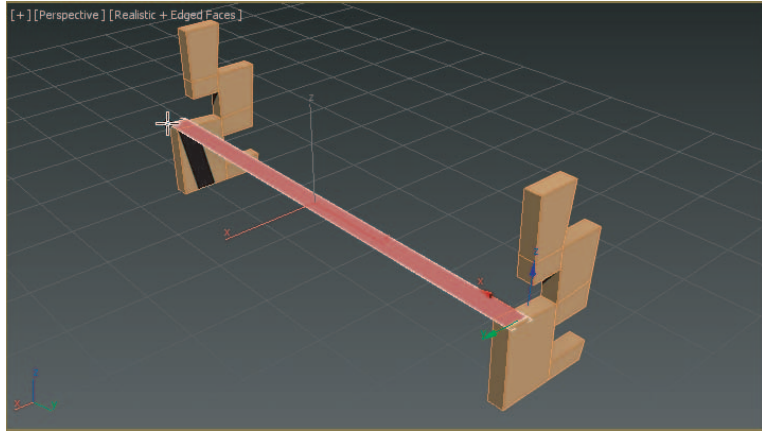
CREATING USER GRIDS WITH AUTOGRID

If AutoGrid is on and you hold down the Alt key, the newly created grid will be displayed and remain active in the viewport. The grid object will remain in the file unless you delete it, so you can always activate it and reuse it to create additional objects.

5. Adjust the height, width, and length to taste. You can use Length = **6**′, Width = **3**″, and Height = **1**″.

6. Add an Edit Poly modifier to the bench.

7. Select the front polygon, and choose the Bevel Settings button from the quad menu. Set the Bevel Height to around **2**″ and the Outline to **-0.3**″, as shown in Figure 4.125. Click OK to commit the changes.

8. Repeat the process to create the rest of the bench. Bevel as before; then add a second bevel where you make the outline larger. Move the last polygon up so that it fits in the cutout area.

9. You can round individual edges by using the Chamfer tool. In the Edit Edges rollout, choose Chamfer Settings and then select the edge, adjust the Chamfer Amount and Segments values, and click the green check mark to approve and commit (see Figure 4.126).

10. For practice, create the knee rest and the prayer book rest to finish the pew assembly. The finished pew should look something like Figure 4.127.

FIGURE 4.125
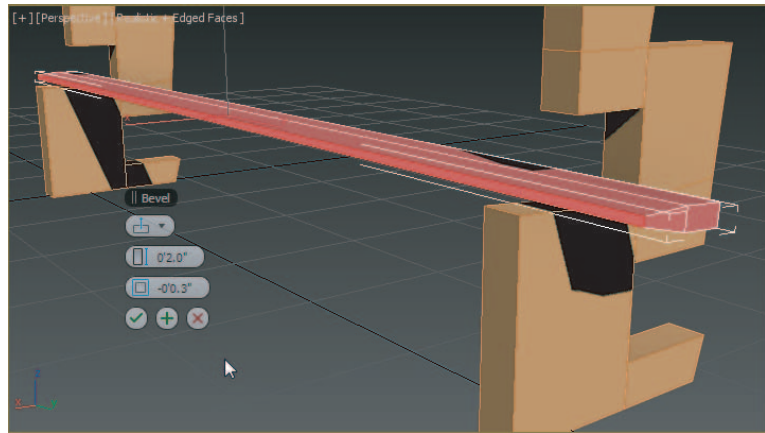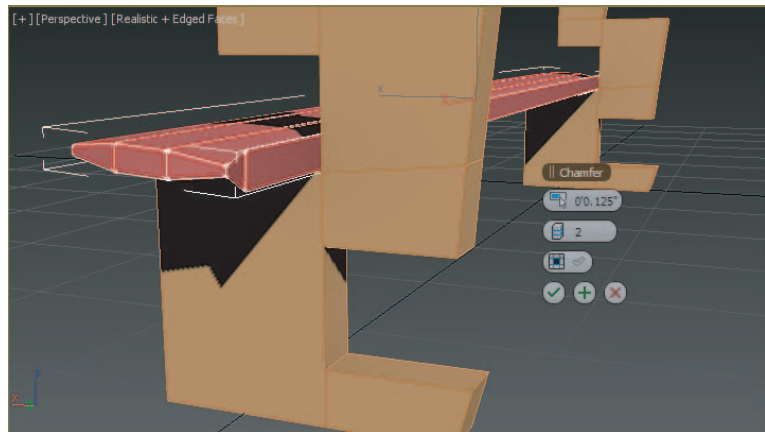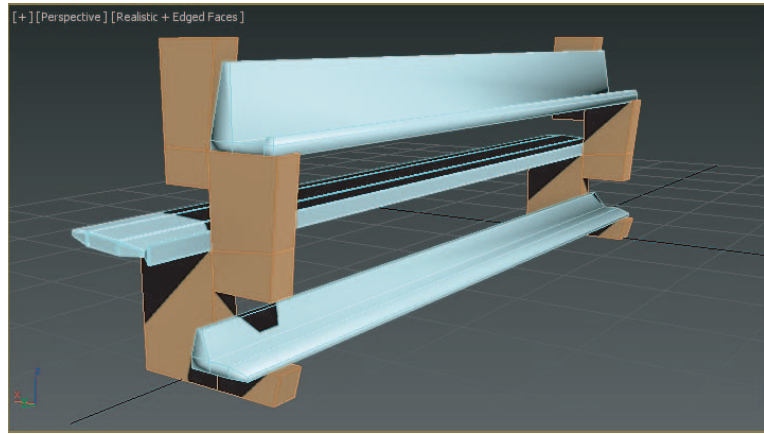Beveling the bench polygons

FIGURE 4.126
Chamfering the edges

11. Save your work as **MyPew_Boxmodel.max**.

Now that you've been introduced to box modeling techniques, let's use soft selection methods to adjust the Ronchamp chapel model.

FIGURE 4.127
The finished pew

SHAPING THE WALLS WITH SOFT SELECTION

Soft selection allows you to select sub-objects in a graduated set. When a soft selection is applied to a sub-object selection, transforms and modifiers affect the selection with a falloff. This allows you to build gentle, graceful curves with ease.

1. Open Ronchamp_shapeWall.max from this chapter's downloads.

2. Select and navigate to the Line006 West Wall object, the wall between the tallest tower and the shorter two towers.

3. Add an Edit Poly modifier to the object.

4. Select a pair of vertices in the top center of the wall.

5. In the Soft Selection rollout, turn on Use Soft Selection. Adjust the value for the Falloff, and watch as a rainbow-colored display appears over the vertices (see Figure 4.128). You can download the color file at www.sybex.com/go/mastering3dsmax2013).

6. Make sure Pinch and Bubble are set to zero, and then use the Select And Move tool to move the selected vertices down in the Z-axis. The Move transform is applied in a graduated effect over the soft selection, and the wall is given a gentle, graceful undulation, as shown in Figure 4.129.

7. Try the same thing on the opposite wall for practice. Select the vertices at the end of the wall, near the outdoor altar, rather than adding a curve in the middle. Your wall should look something like Figure 4.130. If the bottom of the wall is affected, move those vertices back into place by turning *off* the soft selection, and use the Transform gizmo on vertices one at a time or in small groups. You can right-click the Z Transform type-in to zero out (flatten) the vertices.

8. Save your work as **MyRonchamp_curvedWalls.max**.
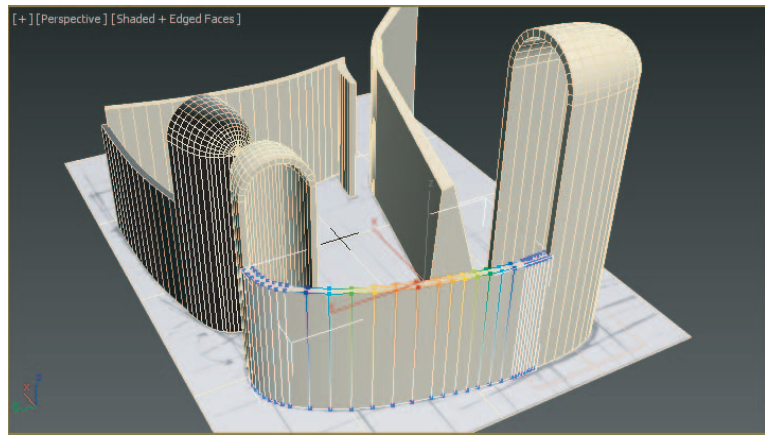
FIGURE 4.128
Soft selection of the
wall vertices

FIGURE 4.129
Curved wall created
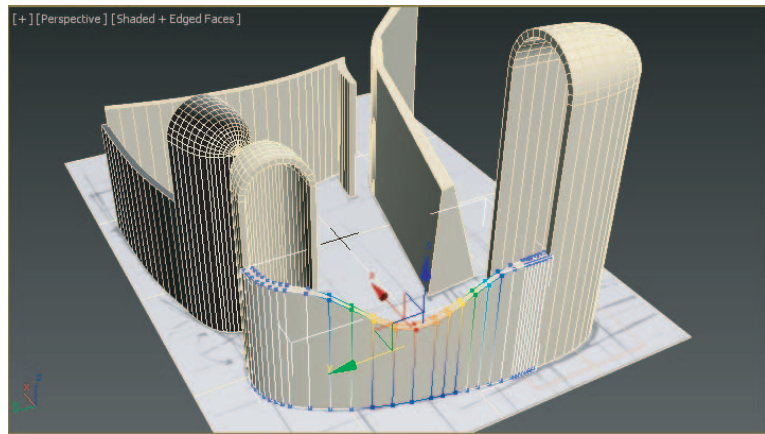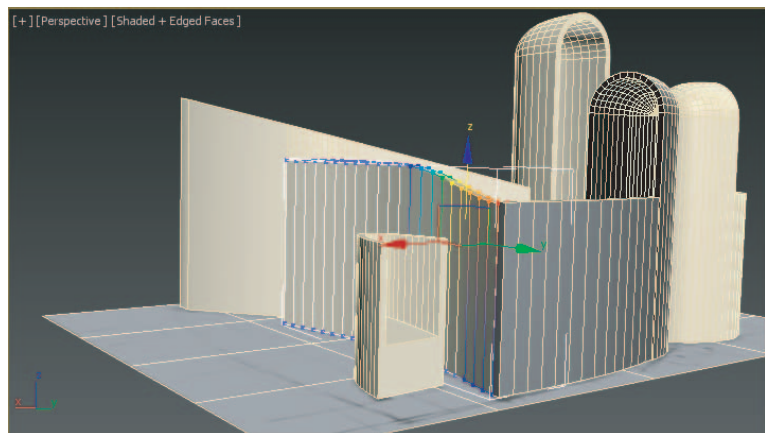with soft selection

FIGURE 4.130
Curving the east
wall

Using the Transform Toolbox

Another tool that can be helpful in your daily use of Editable Poly objects in 3ds Max 2013 is the Transform Toolbox. Choose Edit ➢ Transform Toolbox to display the floating toolbox, as shown in Figure 4.131. The toolbox allows you easily to rotate, scale, adjust the pivot points and move/clone objects in your scene. The toolbox is divided into four sections: the Rotate tools, Size tools, the Align Pivot tools, and the Object tools. The Transform Toolbox is dockable to any side of the 3ds Max user interface.

FIGURE 4.131

The floating
Transform Toolbox
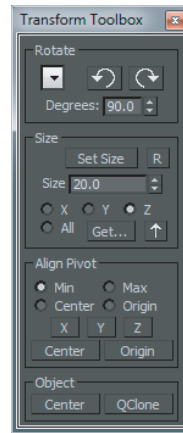
The Rotate group of tools will rotate a selected object or sub-object clockwise or counterclockwise based on the current view. You can select the amount of rotation in degrees by using the presets in the provided drop-down or by entering a value in the Degrees field. You can type in a value or use the spinners.

1. Open the Ronchamp_pew.max file.

   If you haven't already opened the Transform Toolbox, choose Edit ➢ Transform Toolbox to display the dialog box.

2. Select the Pew Support object you created in an earlier series of exercises. Isolate this object by pressing Alt+Q.

3. Click the drop-down in the Rotate group of the toolbox, and select the 30 Degrees preset.

4. With the Top viewport active, click the counterclockwise-curving arrow in the toolbox. See how your pew support has changed its rotation, as shown in Figure 4.132.

5. Press Ctrl+Z, or click the Undo Scene Operation button on the Quick Access toolbar, to return the pew support to its original rotation.

When using this tool with Perspective, Orthographic, or Camera viewports, you have to watch out for which axis the object is rotated around.

The Size group of the toolbox does not directly resize the object as if you were adjusting parameters in the Modify tab; it acts like the Scale command that you were introduced to in Chapter 1. The tool can calculate the current size of an object in a given dimension, and based

on the new measurement you enter, the tool will figure out the correct scaling factor to apply to the object to make it the desired size. If you look at the parameters of a primitive object that you have resized, you will see that the sizes are the original values. This can be a very helpful tool in adjusting your models, but you need to be aware of the impact of using this tool on your objects.

FIGURE 4.132
The rotated pew
support
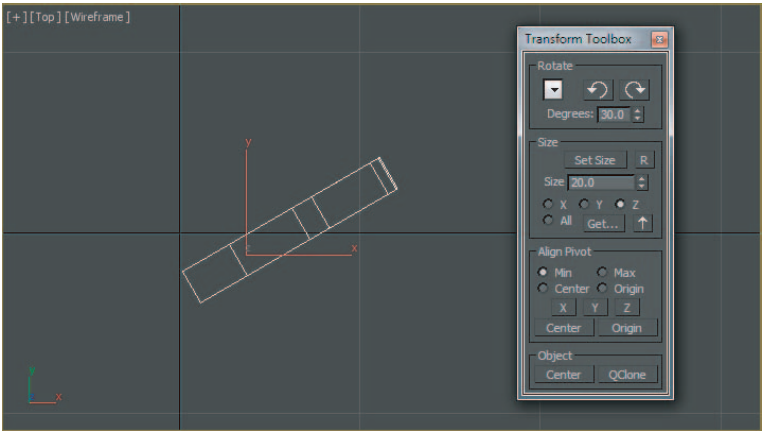
1. Select the pew support again, and click the Get button in the Size group of the Transform Toolbox.

   The Get button queries the selected object and returns the bounding box dimensions of the object in a new Size dialog box, as shown in Figure 4.133.

FIGURE 4.133
The Size dialog box
is returned when
you click the Get
button.
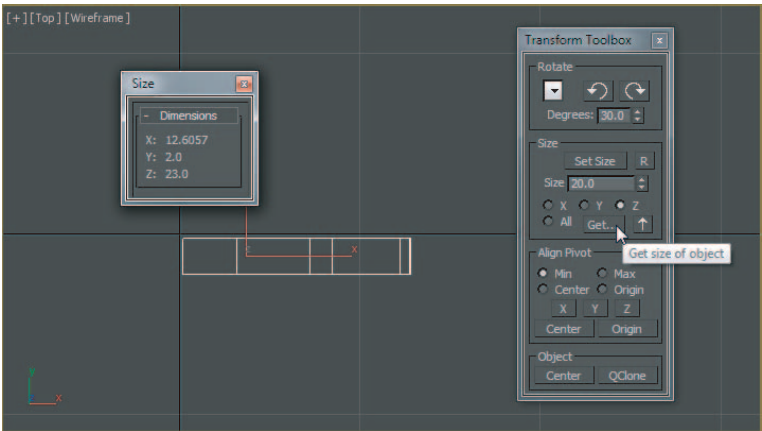
2. The Size field in the Transform Toolbox says 20, which is a default value. With the Z radio button selected, click the button with an up arrow on it. This button puts the current value of the dimension selected into the Size field.

3. The pew is 23 inches tall, which seems too short. In the Transform Toolbox's Size field, enter **26** and make sure that the Z radio button is still selected.

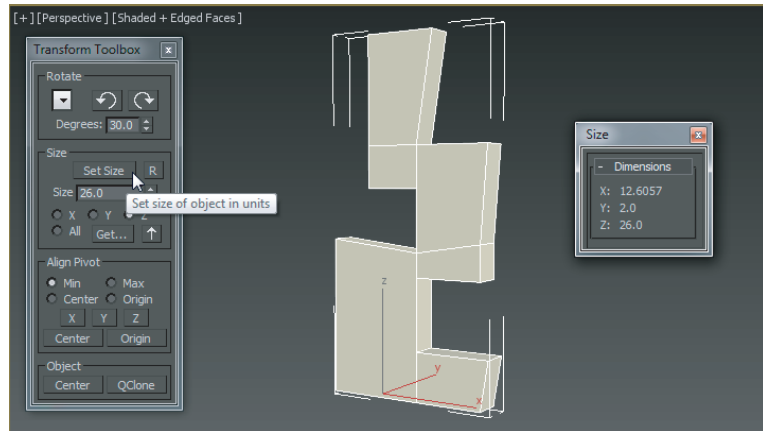4. Click the Set Size button. This will scale your pew to be 26″ in height. Look at the pew in the Perspective viewport, as shown in Figure 4.134.

FIGURE 4.134
The pew support now scaled to 26 inches tall

5. Close the Transform Toolbox and Size dialog box.

The Align Pivot tools allow you to modify an object's pivot point easily to help with modeling and scene-building operations, applying modifiers to shapes or objects, or animating the objects in your scenes. You can quickly move the object's pivot point to the minimum, maximum, or center of the object in any given dimension, or you can set the pivot point right on the scene's World Origin regardless of the object's current position, which can be helpful for creating radial arrays. You will learn to use radial arrays later in this chapter. Changes to the object's pivot take effect immediately; there is no Apply button, so be careful.

The Object Tools section has two buttons: Center and QClone.

The Center Tool This moves the currently selected object so that its pivot point is on the scene origin (0,0,0). This can be helpful for when you need to reset an object that isn't near the origin, or if you want to use the Save Selected option to extract an object from a scene.

The QClone (Quick Clone) Button This creates a copy of an object directly to the right (offset by the object's width) in the current viewport. Three keyboard modifiers enhance the way the QClone tool works. If you hold down the Shift key and click QClone, you will make an instanced copy of the selected object. If you hold down the Alt key, QClone will make two copies of the object. If you hold down Shift+Alt, you will create two instances of the original object.

Creating Clones with Array and Snapshot

As you saw earlier, clones, particularly instanced clones, are great time-savers in 3ds Max. Using the Shift key in conjunction with any of the transform tools (Move, Rotate, or Scale), you

can quickly create multiple copies by entering a value in the Number Of Copies input box. Each subsequent clone will be created at the same interval as the initial from the original object clone. This is adequate when only one transform is required for a clone operation.

The Array and Snapshot tools both create organized patterns of clones with much more creative control than the Shift+Transform clone methods. The Array tool creates patterns in three magnitudes of complexity: 1D, 2D, and 3D. A 1D array moves, rotates, and scales an object's clones in an axis or combination of axes to create a row of cloned objects. The 2D and 3D array options are used to create fields (2D) of the first array or stacks (3D) of the 2D array.

The Snapshot tool creates clones of animated objects at any time interval you choose. An instanced clone retains a parameter link to all other instances, while the Copy option creates an object that holds the animated object's shape only at the time that it was cloned.

Creating a Pew Grid with Array

The pew must be repeated over a grid pattern to lay out the seating for the congregation inside the main space of the chapel. This makes the pew layout a fine example for explaining the Array tool.

1. Open the file `Array_Pew.max` without saving the changes you made to the `Ronchamp_Pew.max` file from the previous exercise. Select the PewSupport Left object, and then right-click in the Top viewport to activate it.

2. Right-click a blank area of any toolbar, and select Extras from the context menu to open the Extras toolbar if it isn't already open.

3. In the Extras toolbar, click the Array tool.

The Array dialog box that opens (see Figure 4.135) may appear formidable at first, but it is broken down into a few logical groups. At the top of the dialog box is the Array Transformation section. Input information into the left (Incremental) side to specify the distance, degrees, or percentage difference between each clone, and 3ds Max will transform each clone per the input values. Input information into the right side (Totals) of the Array Transformation section to specify the distance, degrees, or percentage difference between the original object and the last clone created. 3ds Max divides the total value by the number of clones to determine the incremental value. Both halves are arranged in columns and rows, with the columns determining the axes in which each transform is affected. Enter data in the top row to set the distance between clones, the middle row to set the angular displacement, and the bottom row to set the percentage change between each clone.

INCREMENTAL VALUES

When working with incremental values, it's important to understand that each increment is applied to the clones in relation to the state of the previous clone. For example, a 15-degree Z-rotation increment rotates each clone 15 degrees more than the previous clone's rotation. This is especially important when working with the Scale transform in the Array dialog. If a tubular column is 10′ 0″ tall, the Incremental X Move value in the Array dialog box is set to 10′, and the Incremental Z Scale value is set to 90 percent, how many columns are created before the Z height becomes zero? The answer is that the height will never be zero because each 90-percent Z-scale reduction is applied to the total height of the current column. The first clone will be 9′ 0″ (108″) tall, the next will be 8′ 1.2″ (90 percent of 9′ 0″), then 7′ 3.48″, and so on.

FIGURE 4.135

The Array dialog box contains controls for creating arrays of clones.
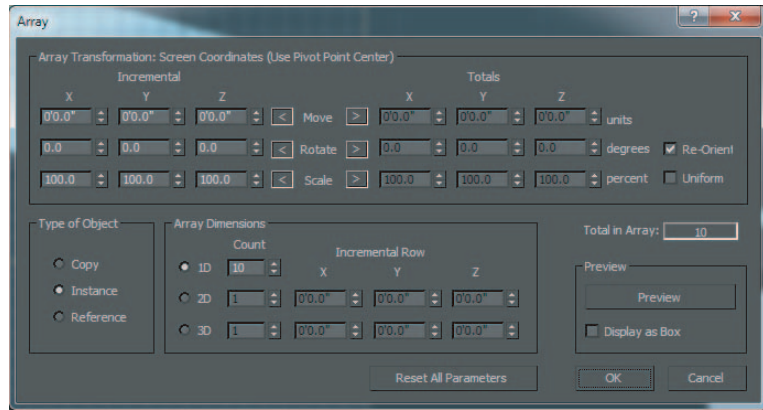
The Type Of Object section at the bottom of the Array dialog box contains controls for specifying the type of clones to create. The Array Dimensions section contains controls for the type of array and the offset distance between 2D and 3D arrays. The Preview button generates a preview in the viewports for your review before the array operation is committed. In the following exercise, you create a 3D array of pews using the Array dialog box:

1. Turn on the Preview button. On the Move row, enter **-2′ 9″** in the X Incremental input box and **10″** in the Y field, make sure the Instance radio button is checked in the Type Of Object section, enter **7** in the 1D Count input box (see Figure 4.136), and then click the OK button.

2. The viewport displays a series of seven supports at 2′ 9″ increments, as shown in Figure 4.137. The last object created is the currently selected object.

3. Click the Undo Scene Operation button on the Quick Access Toolbar, or press Ctrl+Z to undo the array.

FIGURE 4.136
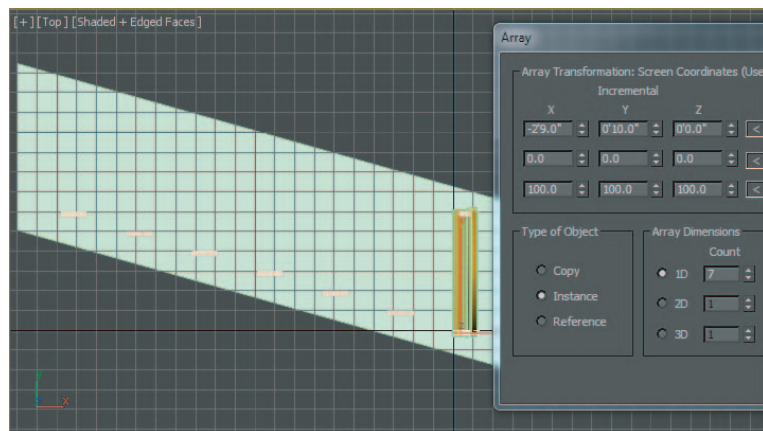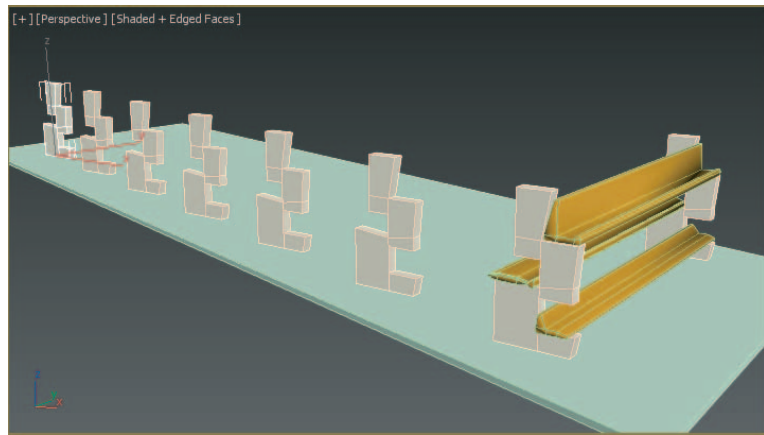
The settings in the Array dialog box

FIGURE 4.137
The six new supports created using the Array dialog box

**ARRAY DIALOG BOX IS NOW MODELESS**

The Array Preview tool can be useful when you're creating a complex array. Prior to 3ds Max 2013, when in Preview mode, you could not zoom or pan in a viewport to inspect a sprawling array. That limitation has gone away, and it will make creating arrays much more productive.

---

4. Click the Array tool again, and notice that the previous settings remain in the Array dialog box.

5. In the Array Dimensions area, click the 2D radio button and enter **2** in the 2D Count input box. Click the Preview button. It appears as if nothing happened because the six copies of the array are collocated over the original array. There was no offset specified in the Array dialog box.

6. In the Array Dimensions area, enter **5′ 0.0″** in the Y Incremental Row input box for the 2D array to create clones of the pew supports to fill the trapezoidal base evenly. The dialog box should look like Figure 4.138.

7. Click OK; this time all the supports appear in the viewport.

8. There's an extra pew support object you can delete, and then select the bench object and array it. Repeat the process for the knee rest and prayer book rest objects. Your finished array should look like Figure 4.139. Save your file as **MyRonchamp_PewArray.max**.
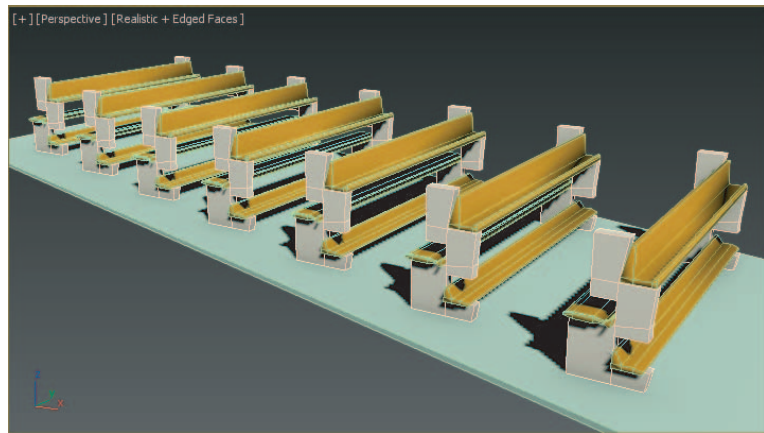
As you can see, the Array tool can quickly and accurately construct many clones in a structured pattern. The tool can also be used to form clones with multiple transforms applied simultaneously, as you will see in the next exercise.

FIGURE 4.138
The Array
Dimensions section
of the Array dialog
box should now look
like this.
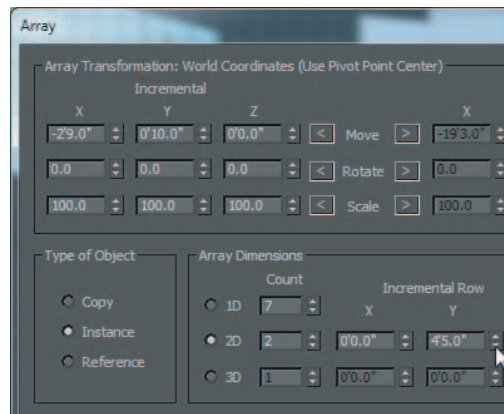
FIGURE 4.139
The finished pew
array



Creating a Multitransform Polar Array

A *polar array* is an array with an angular translation controlling the spacing between objects, rather than a lateral increment. In 3ds Max, when you rotate an object, it is rotated about its pivot. To create a polar array effectively, you first need to move the pivot point away from the geometry of the object.

1. Open the Array_Polar.max file. This consists of a single, short tubular column. Select the column.

2. Click the Hierarchy category in the Command panel to access the Hierarchy and Pivot tools.

3. Make sure that the Pivot option is selected at the top of the Hierarchy panel, and then click the Affect Pivot Only button in the Adjust Pivot rollout. (The other options are Affect Object Only and Affect Hierarchy Only.) The button turns blue, and the axis tripod changes shape in the viewports.

4. Click the Select And Move tool and then, in the Top viewport, move the pivot point to the left, near the origin. Be sure to click and drag on the red X-axis to restrict the movement to a single direction. Only the pivot point moves while the geometry stays in a fixed location, as shown in Figure 4.140.

FIGURE 4.140
Moving the pivot point
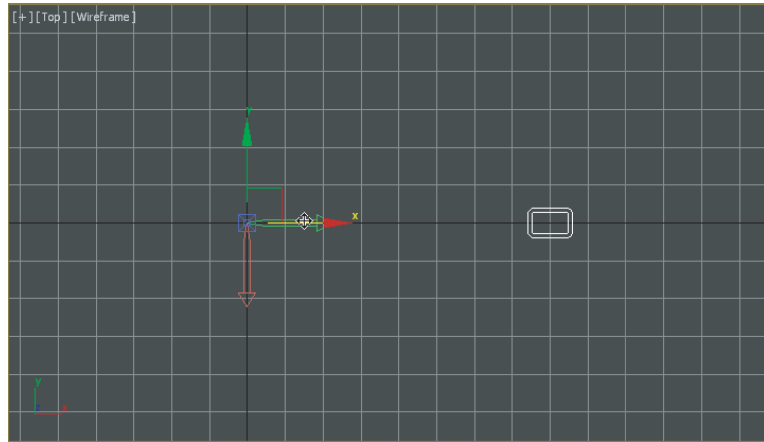
5. Click the Affect Pivot Only button to turn it off.

6. Open the Array dialog box, and then click the Reset All Parameters button at the bottom of the dialog box to clear any settings from the previous exercise.

7. In the Incremental Z Rotate input box, enter **30** to create a 30-degree rotation in the Z-axis between each column.

8. Click the right-facing arrow next to the Scale label to activate the Scale Totals input boxes.

9. Enter **900** in the Totals Z Scale input box. This will cause the last column in the array to be 900 percent larger than the first.

10. In the 1D Count input box, enter **7**. This is a setup to create a semicircular array of columns with ascending heights. Your Array dialog box should look like Figure 4.141.

11. Click the Preview button. The array is displayed properly in the viewports, as shown in Figure 4.142.

12. Make any adjustments you want in the Array dialog box, and then click OK to create the array.

13. Save your scene as `My_Array_Polar.max`.

FIGURE 4.141
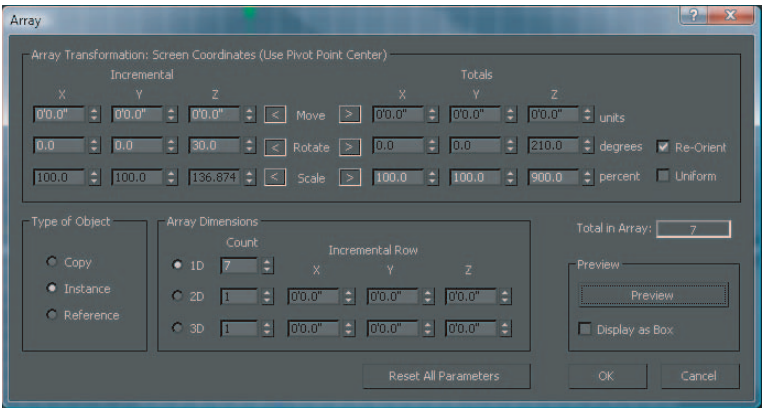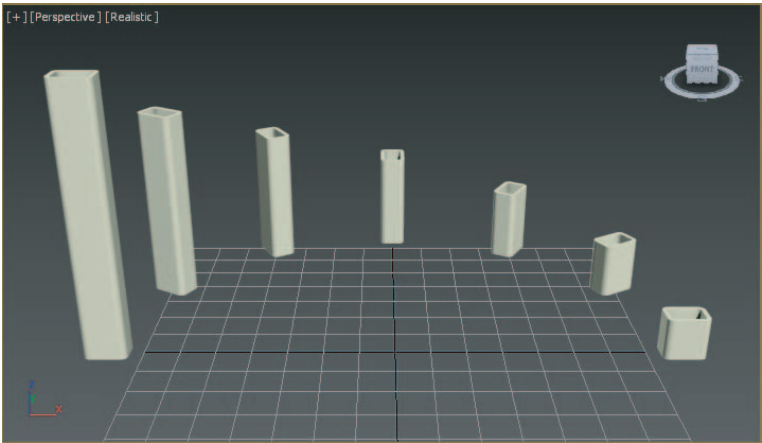The Array dialog
box prepared for a
polar array

FIGURE 4.142
The polar array in
the Perspective
viewport

The Array tool's capability to create a vast number of clones is significant and deserves additional experimentation. Consider using Array to generate all of the windows in a high-rise or fields of cars or light posts.


USING THE ARRAY TOOL TO CREATE WINDOWS

Modern office buildings are often designed with large, redundant surfaces covered with windows or glass panes. The windows are usually of the same size and design and equally distributed throughout large portions of a building's vertical surfaces. A common practice is to use the Array command to reproduce the windows in an accurate and orderly fashion. As long as the on-center distance between windows is known and consistent both vertically and horizontally, the Array tool can be a great time-saver.

Creating Multiple Clones Using Snapshot

When an object is animated, it may have a change in its transforms (Move, Rotate, and Scale), parameters, modifier settings, and so on. The Snapshot tool, located on the Array flyout, captures the state of the selected object at the specified time interval. You can create copy, instance, or reference clones as well as mesh clones (that is, clones collapsed to editable meshes). The Snapshot tool requires an animated object; animation is covered thoroughly in Chapter 11, "Understanding Animation," and Chapter 12, "Creating Animations, Particles, and Dynamics."

1. Open the Snapshot.max file. This scene consists of a single wrought-iron fence post and three rails forming a 50' × 50' square (see Figure 4.143). The post's vertical scale reciprocates between approximately 7' 0" and 6' 0" every 20 frames and travels along the 200' 0" perimeter over 400 frames.

FIGURE 4.143
A fence with rails and a single post
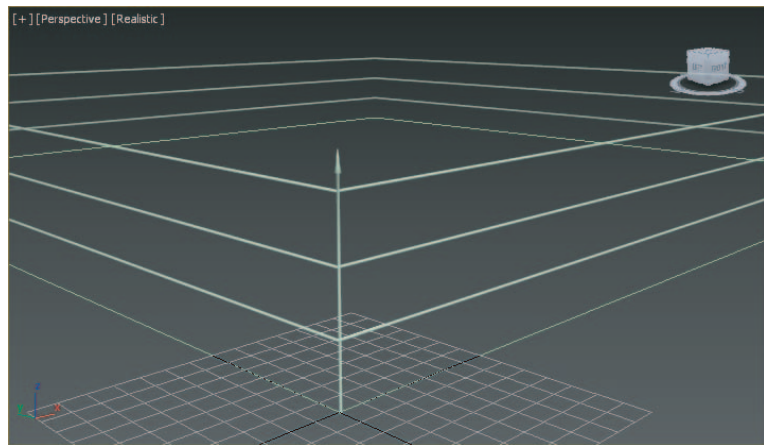
A FRAME IS A POINT IN TIME

A *frame* is a point on a timeline that corresponds to one displayed image and is measured in frames per second (fps). This scene is set up to create and play back animation at 30 fps.

---

2. In the Perspective viewport, select the fence post.

3. In the Extras toolbar, click and hold the Array tool and select the Snapshot tool.

4. The Snapshot dialog box opens, as shown in Figure 4.144. Click the Range radio button to instruct 3ds Max to create copies over a specified period of time.

5. In the Snapshot area, set the From input box to **0**, the To input box to **400**, and the Copies input box to **200**. The 200 clones will be generated during the entire 400-frame animation, or one clone every 1/15 of a second.

6. In the Clone Method section, choose Instance and then click the OK button.

7. The posts, reciprocating heights and all, are created as shown in Figure 4.145.
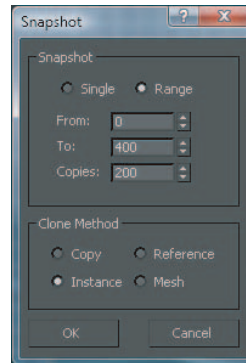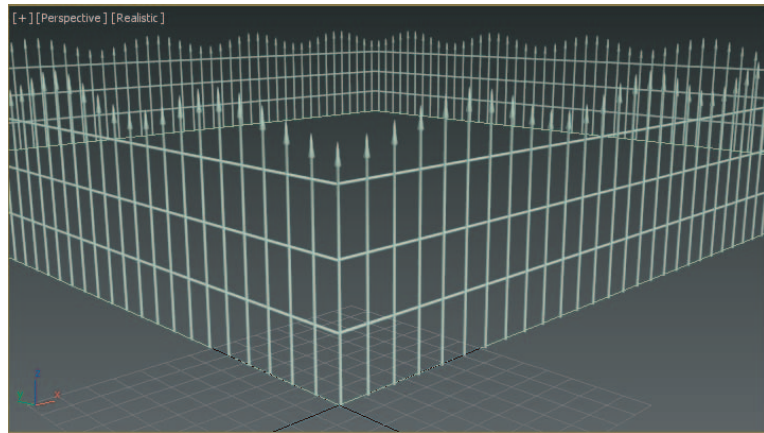
FIGURE 4.144
The Snapshot dialog
box

FIGURE 4.145
The Snapshot tool
created 200 evenly
spaced instanced
post clones.

The only slight problem in the scene is that there are three posts in the corner where the original post started. These are the original post and the posts created at frames 0 and 400 with the Snapshot tool. Only one is necessary, so we will re-create all of the posts with slightly different parameters:

1. Click the Undo Scene Operation button, or press Ctrl+Z to undo the Snapshot operation.

2. Click the Snapshot tool again to open the Snapshot dialog box.

3. Set the From value to **2** and the To value to **398**. Reduce the number of copies to **198**, and then click the OK button.

4. Save your scene as `MySnapshot.max`, so that you can use this fenced area later.

The posts are created again, this time without the additional objects at the starting point. Because all of the posts are instances, changes to any single object will be instantly reflected in all of the others. When the posts are required to be closer together, set the number of copies higher to increase the clone count generated in the same amount of time. A similar tool on the same flyout as the Array and Snapshot tools is the Spacing tool. Use Spacing instead of Snapshot when there is no animation involved or when the precise distance between objects is pertinent, rather than the

count. Another useful feature on the Array flyout is the Clone And Align tool, which can be used to place a clone of a Source object at the positions of selected Destination objects.

The Bottom Line

Create openings with ProBoolean operations.   Using the ProBoolean tools, you can join meshes (union), delete one object and any volume it shares with another object (subtraction), or delete two objects while retaining the volume that the objects share (intersection).

Master It   Using the ProBoolean tools, cut an archway into a box primitive representing a wall. The archway is to be 3′ wide and 8′ high at the top of the arch.

Designate a modeling template image.   Using a template image applied to geometry, such as a plane or a box, can be very helpful in the modeling process. These image planes can be used to display reference information, such as plans, sections, or elevations that are needed to aid the modeling process.

Master It   So that you can use it to model the building's elevation, add an image plane that uses the `House.jpg` file provided with 3ds Max to your Front viewport.

Create and modify objects using box modeling.   Virtually any real-world object can be created using box modeling methodology. Instead of combining primitive objects, you can take a plane or a box and extrude/bevel, inset, and otherwise build up new polys to model anything you wish.

Master It   Create any object you want using box-modeling techniques.

Attach objects to a mesh.   The Attach option of an Editable Poly object causes objects to become Element sub-objects of an existing Editable Poly. This creates a single object from multiple objects and reduces the memory requirements of the object.

Master It   Create a short tube primitive to act as a simple, round picture frame. Taper the tube. Create a short cylinder to represent the picture backing. Use the Attach option to attach the backing to the frame.

Create clones with Array and Snapshot.   The Array and Snapshot tools both provide a method of creating many clones of scene objects. The Array tool creates them in patterns of rows and columns, and the Snapshot tool creates clones by capturing their appearance at any point in time.

Master It   Create a window that's 4′ wide by 6′ tall. In the Front viewport, create an array of windows that are spread out 8′ on center horizontally and 12′ on center vertically.

Working with External Design Data

Autodesk® 3ds Max® is a complete and powerful product, but it can't do everything you might need to do in your career on its own—you will need other resources. 3ds Max 2013 is extremely robust, and it can take advantage of data created in many of the other design and drafting programs from Autodesk. Other products that are useful when working with 3ds Max are AutoCAD®-based applications, including AutoCAD®, AutoCAD LT®, AutoCAD® Mechanical®, AutoCAD® Architecture®, AutoCAD® Civil 3D®, Autodesk® Inventor® and Autodesk Inventor LT™, and the Autodesk® Revit® family of products. With the FBX file format, you can also easily bring in content from Autodesk® Maya® and Autodesk® Mudbox®.

In this chapter, you'll look at ways that you can use AutoCAD-based applications more directly with 3ds Max in your design and visualization workflow. You'll explore the common practices of importing 2D AutoCAD line drawings as a starting point in the creation of 3ds Max geometry and the direct linking of the AutoCAD drawings. The latter procedure incorporates the entire DWG file into the 3ds Max scene with a one-way pipeline; that is, any changes to the AutoCAD file are reflected in the 3ds Max scene. You will also learn how to import 2D linework from a graphics package into 3ds Max so that you can easily create logo animations or other motion graphics content. Many mechanical components in the cars, trains, airplanes, and other objects you use in daily life are designed in packages such as Autodesk Inventor; you will see how to bring those assemblies into 3ds Max 2013. Finally, you'll look at the procedure for incorporating Revit files into 3ds Max.

In this chapter, you will learn to

- ◆ Create topography with splines
- ◆ Import AutoCAD plans into 3ds Max
- ◆ Import Adobe Illustrator files into 3ds Max
- ◆ Import Autodesk Inventor files into 3ds Max
- ◆ Use the Substitute modifier
- ◆ Link Revit files into 3ds Max
- ◆ Link FBX files into 3ds Max

Creating Topography with Splines

In 3ds Max, there are many ways to add detail to an object created with splines, as you saw with the wineglass in Chapter 3, "Creating Shapes with Splines," and modeling the walls of the Ronchamp Chapel in Chapter 4, "Editing Meshes and Creating Complex Objects." In Chapter 8, "Enhancing Models with Materials," you will learn to create geometry using a displacement map. A *displacement map*, which is similar to a bump map, creates a deformed surface based on the light and dark areas of a bitmap image. A *bump map*, on the other hand, simply applies shadows to your rendered objects, giving the illusion of texture. You can create terrain in a 3ds Max scene by painting light and dark areas in an image and then importing that image and using it as a displacement map, as shown in Figure 5.1.

FIGURE 5.1
A bitmap image (left) and the terrain created by using the image as a displacement map (right)
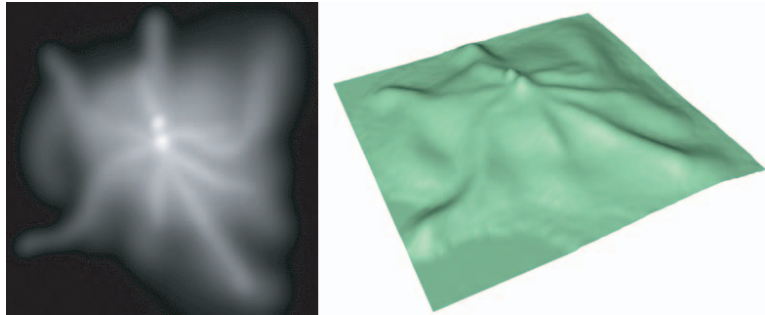
INTEGRATING AUTODESK PRODUCTS INTO YOUR WORKFLOW

The tight integration between all of Autodesk's AutoCAD-based products and 3ds Max 2013 allows you to maximize the strengths of each program in your workflow. By using AutoCAD and 3ds Max together, you can maintain a single design database that carries throughout your entire workflow. 3ds Max will never overwrite an AutoCAD DWG or DXF file that you import or link into your scene, so you can be sure of the integrity of your design database.

Depending on your particular needs and skill level with each program, you will want to consider several strategies for planning the tasks to perform in each software package.

Although it is possible to create your entire project in 3ds Max alone, if you have access to and proficiency with AutoCAD, we don't recommend that you do so. The real strengths of 3ds Max are in modeling complex forms, assigning materials, lighting, composing scenes, rendering, and animating. 3ds Max is not as proficient at managing the complex 2D linework needed in drafting—this is the traditional strength of AutoCAD and AutoCAD LT. Therefore, if you have both programs, it is more efficient to utilize AutoCAD for what it is best at doing and use 3ds Max for its particular strengths.

AutoCAD and AutoCAD LT are excellent tools for creating 2D geometry. If you are in the architectural or engineering field, much of your work as a designer will require accurate renditions of your designs in the traditional plan and elevation views. Frequently, designs begin as 2D plans anyway, so having the ability to import or link to a DWG or DXF file is a natural extension of 3ds Max. In the most common strategy, the 2D linework is handled by CAD, and the rest of the workflow is handled by 3ds Max.

Another strategy to consider is to bring a well-developed 3D model into 3ds Max from AutoCAD, AutoCAD Architecture, or AutoCAD Mechanical. Some veteran AutoCAD users (or those very new to 3ds Max) may prefer to do basic 3D modeling in AutoCAD and use 3ds Max later in their workflow to add materials and create animation.

Although the 3D aspects of AutoCAD have been addressed in the most recent releases, the AutoCAD 3D modeling tools can seem quite primitive in comparison with the 3ds Max modeling tools. 3ds Max is much better for modeling curving, organic forms, such as those found in furniture, ornamentation, and luminaries.

AutoCAD Architecture is designed to build a 3D model as you work, so it makes sense to link an AutoCAD Architecture model into 3ds Max and use 3ds Max for the visualization aspects of the workflow.

There is a strong push in the architecture, engineering, and construction (AEC) industry to incorporate the Revit family of building information modeling (BIM) products into the construction pipeline. Using Revit, for example, wall objects are more than simple lines or flat structures. They are data-rich elements that define every aspect of the wall, such as construction type, coatings, surface properties, or surface area. Changing a wall type from stud with a brick facade to 8″ block not only changes the appearance of the structure but also cascades data throughout the file. Incorporating Revit files into a 3ds Max scene is discussed near the end of this chapter.

AutoCAD, AutoCAD Architecture, and Revit 2013 include mental ray as their core renderer—the same mental ray that is incorporated into 3ds Max.

Using the lights, cameras, and materials included with the program, you can render your scenes in AutoCAD, AutoCAD Architecture, or Revit, but the 3ds Max rendering toolset is more robust.

Importing AutoCAD Files the Old Way

You can still access the legacy DWG importer if you want importing files to work the same way as it did in Autodesk® VIZ 2008. Click the Application menu and select Import. Then click the Files of Type drop-down list, and select Legacy AutoCAD (*.DWG) to access the old importer.

This type of terrain modeling is fine for creating freeform shapes. Displacement maps for terrain can also be created from Geographic Information System (GIS) and mapping programs so that you will have a good approximation of a project site to create large areas of land for visualization projects quickly or for film, television, and games. If you want to have a very accurate model of terrain based on survey data, you need to use other tools to create your terrain model, such as AutoCAD® Map 3D or AutoCAD® Civil 3D®, or contour lines created in AutoCAD. In this section, you'll learn how you can quickly create a terrain model from contour lines generated in AutoCAD. You'll also get a look at ways of linking files from AutoCAD to allow you to maintain one data source for both AutoCAD and 3ds Max. The importer for DWG and DXF files has been refined in 3ds Max 2013 to support files from the latest versions of the software; however, support for much older DWG and DXF files has been removed. Thus, if you come across those files, you will need to open them in a recent release of AutoCAD and save them in the current format. Both DWG and DXF files are imported through the same dialog box.

1. Start 3ds Max and using Customize ➢ Units Setup, set Display Unit Scale to US Standard Feet w/Decimal Inches and click OK. Click the Application menu, and choose References ➢ Manage Links.


ACCESSING THE MANAGE LINKS DIALOG BOX FROM THE COMMAND PANEL

You can also access the Manage Links dialog box from the Utilities tab of the Command panel; choose More ➢ File Link Manager.

---

2. In the Manage Links dialog box, make sure the Attach tab is selected; then click the File button.

3. In the Open dialog box, locate and open the `contour.dwg` file that you downloaded from the book's website. The contour lines are AutoCAD splines, as shown in Figure 5.2.

FIGURE 5.2
The `contour.dwg` file in the AutoCAD viewport
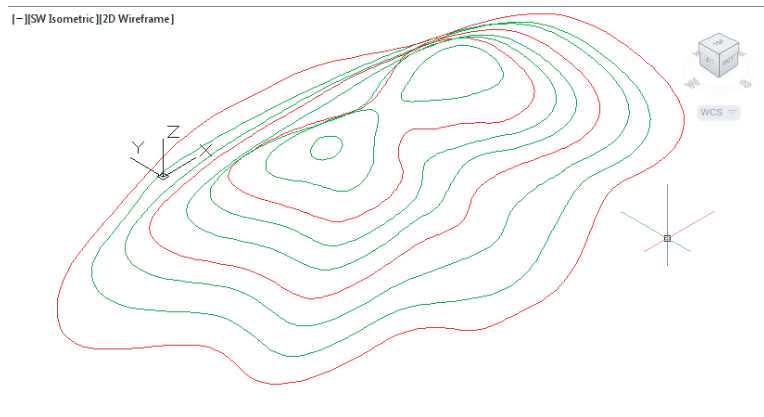
4. Back in the Manage Links dialog box, you want to make sure that the Preset drop-down menu is set to DWG File Saved From AutoCAD. Click the Attach This File button. The contours appear in the 3ds Max Perspective viewport, as shown in Figure 5.3.

FIGURE 5.3
The imported contour lines in the Perspective viewport
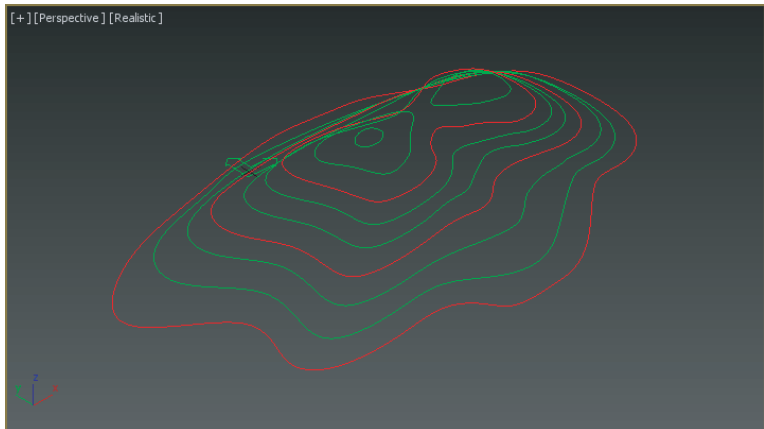
5. Close the Manage Links dialog box.

TURN OFF THE GRID IF NECESSARY

You may want to toggle the grid off if it makes the scene appear too cluttered.


By linking an AutoCAD file, you keep the imported geometry associated with the original AutoCAD file. As you'll see a bit later, this link will enable you to update the 3ds Max scene whenever changes occur to the AutoCAD file.

You should notice the axis arrows that appear at the origin of the scene. This is a link helper that identifies the coordinate system origin point of the linked file. You can select and hide this helper if you want to reduce clutter in your scenes.

Now let's see how the contours can be turned into a surface model:

1. Click the Select by Name button to open the Select From Scene dialog box.

2. In the Select From Scene dialog, click Display ➢ Display Children and then click `contour.dwg`, as shown in Figure 5.4.

FIGURE 5.4
The Select From
Scene dialog
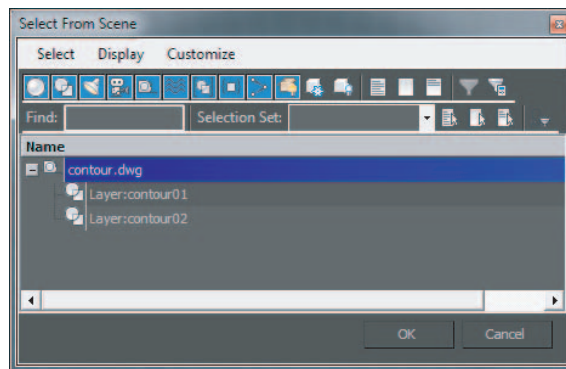
3. Click OK to close the Select From Scene dialog box, and click the Modify tab of the Command Panel. Notice that the AutoCAD contour layers are linked to the `contour.dwg` LinkOriginPtHelper that is named for the file that you linked, as shown in Figure 5.5.

FIGURE 5.5
The Modifier
Tab showing the
LinkOriginPtHelper
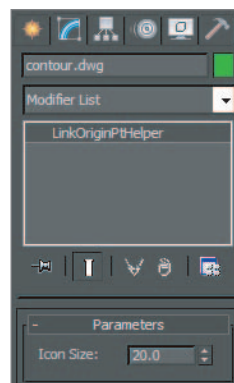
4. Click the Select From Scene button again, click the plus (+) sign in front of `contour.dwg`, and select both Layer objects in the list; then click OK.

5. Make sure that the Geometry button is selected in the Create tab of the Command panel; then choose Compound Objects on the Create drop-down list.

6. Click Terrain on the Object Type rollout.

Figure 5.6 shows the surface that appears over the contour lines.

FIGURE 5.6
The surface created using the Terrain compound object
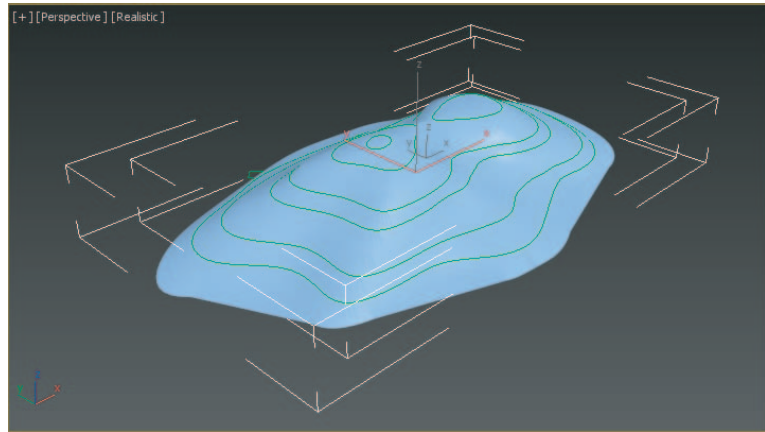
3ds Max creates a Terrain object based on the contour lines. You can improve the visibility of the terrain's shape by using the Color By Elevation option:

1. In the Command panel, scroll down to the Color By Elevation rollout and open it.

2. Click the Create Defaults button in the Zones By Base Elevation group.

The Terrain object changes to show a series of colored bands, as shown in Figure 5.7. (Note: The Terrain object was deselected when creating the figure for clarity.)

FIGURE 5.7
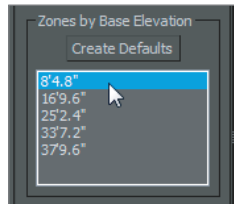The contour line surfaces shown as a series of colored bands
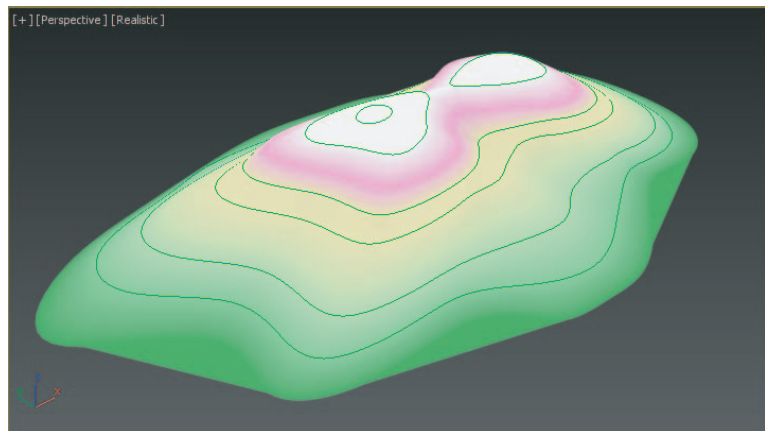
The values in the Zones By Base Elevation list box tell you the base elevation for each of the colors. You can change the color and the base elevation:

1. Select the first elevation value in the list box of the Zones By Base Elevation group, shown in Figure 5.8.

FIGURE 5.8
Select the first zone.

2. In the Color Zone group, click the Base Color swatch.

3. In the Color Selector dialog box, click a cyan color in the Hue/Blackness field and then click OK.

4. Click the Modify Zone button in the Color Zone group. The base of the Terrain object changes to the cyan color you selected.

You can also change the vertical location for a color by changing the Base Elev value in the Color Zone group. This doesn't have any effect on the shape of the Terrain object; it only changes the location of the color.

Updating Changes from an AutoCAD File

You brought the AutoCAD contour map into 3ds Max by clicking the Application menu and choosing the References ➢ Manage Links option. By using this option, you link your 3ds Max scene to the contour.dwg file in a way that's similar to using External References (XRefs) files in AutoCAD. Just as with changes made to an XRef, changes in the contour.dwg file will affect any 3ds Max file to which it's linked.

Let's suppose that you have some corrections to make to the AutoCAD contour drawing that will affect the Terrain object you've just created. You can change the AutoCAD drawing file and then update the 3ds Max scene to reflect those changes:

1. If you have AutoCAD 2004 or later or download a free trial of AutoCAD 2013, open the contour.dwg file in AutoCAD and make the changes shown in Figure 5.9. Save the file when you have finished, overwriting the original.

2. If you don't have AutoCAD, use Windows Explorer to rename the contour.dwg file to **contour_old.dwg**; then make a copy of the contour_Modified.dwg file, and rename it **contour.dwg** to replace the file you deleted. The contour_Modified.dwg file contains the changes shown in Figure 5.9. (If you do this, you will lose the Terrain Compound object, and you will have to reselect the two layers and re-create the Terrain Compound object.)

3. In 3ds Max, click the Application menu and choose References ➢ Manage Links.

FIGURE 5.9
Stretch these points
outward.
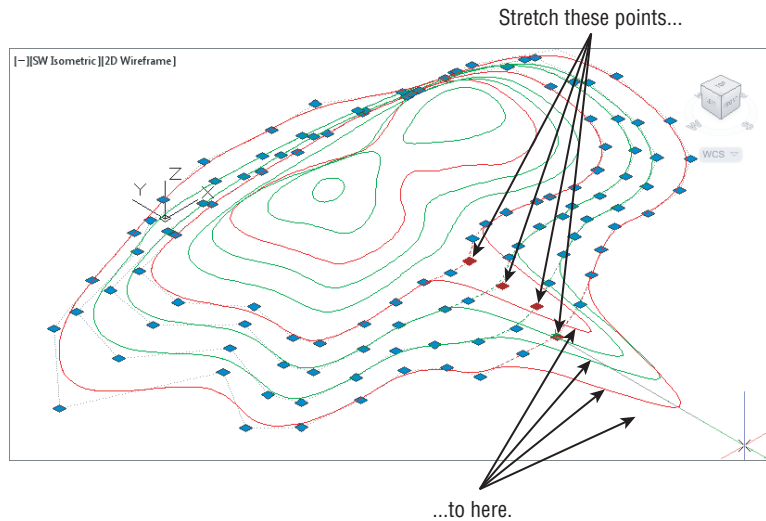
4. In the Manage Links dialog box, select the Files tab; then click the `contour.dwg` listing in the Linked Files list box at the top of the dialog box.

5. Click the Reload button. The File Link Settings: DWG Files dialog box displays.

6. In the File Link Settings: DWG Files dialog box, click OK. The file is reloaded, and the changes are applied in the current 3ds Max scene.

7. Close the Manage Links dialog box. The changes to the drawing are reflected in the 3ds Max scene. See Figure 5.10.

FIGURE 5.10
The modified DWG
file after reloading
it into the 3ds Max
scene
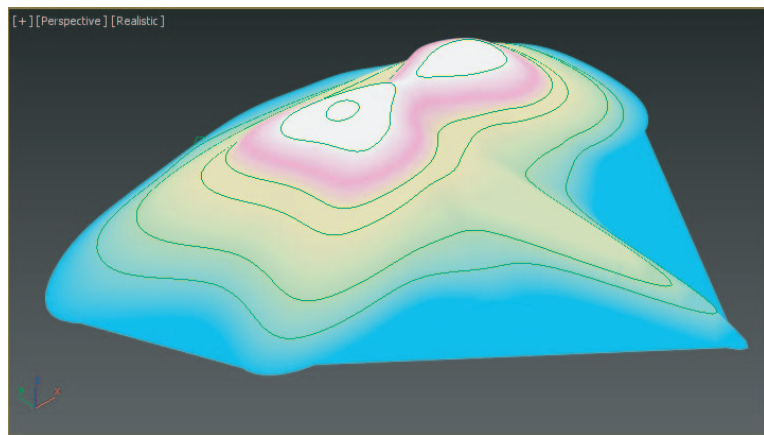
8. Save your terrain as **MyContours.max**.

Like XRef files, 3ds Max scenes that are linked to AutoCAD files can be updated to reflect changes that are made to the source AutoCAD file. You'll get a chance to take a closer look at this feature later in this chapter.

Exploring Terrain Options

The Terrain object has quite a few parameters that allow you to make adjustments to the terrain. For example, if you prefer, you can have the terrain appear as a terraced form instead of a smooth one, as shown in Figure 5.11.

FIGURE 5.11
The Terrain object with the Layered Solid option (The scene is shown rendered for clarity.)
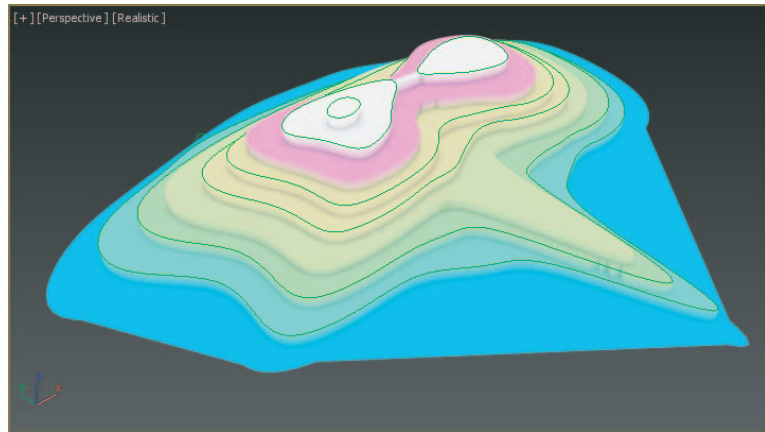
THE LAYERED SOLID OPTION IS SIMILAR TO A TRADITIONAL MODEL

The Layered Solid option of the Terrain object creates a surface that resembles a traditional site-plan physical model made of plywood, foamcore, or a similar material.

You've already seen how a few of the Color by Elevation rollout options work. Here's a rundown of the rest of the Terrain object parameters. These options allow you to add additional splines to, or delete splines from, an existing Terrain object.

THE PICK OPERAND ROLLOUT

The Pick Operand rollout allows you to add other splines to an existing Terrain object. The splines used for the Terrain object are referred to as the *operands* of the Terrain object. When a Terrain object is created, a Reference clone of the selected splines is added as part of the Terrain object. This is the default option in the Pick Operand rollout. When adding additional splines, you can choose the type of clone you want to use instead of the Reference clone. The Override option lets you replace one operand with another.

THE PARAMETERS ROLLOUT

The Parameters rollout, shown in Figure 5.12, offers settings that control the overall form of the Terrain object. The Operands group lets you selectively delete operands from the terrain. (Note: The UI header for the Parameters rollout is broken in the shipping release of the software and it may appear that the contents are a continuation of the Pick Operand rollout, but they belong in the Parameters rollout.)

FIGURE 5.12
The Parameters rollout
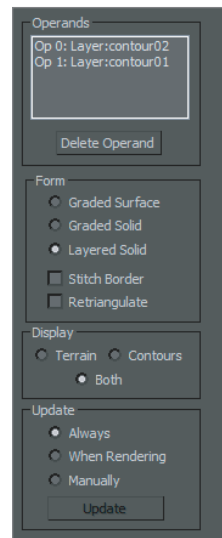
The Form group gives you control over the way the contour data is shaped into the terrain. Graded Surface creates the type of terrain you've seen in previous exercises. Graded Solid creates a solid form that encloses the entire terrain, including the underside. Layered Solid creates a terraced form. The Stitch Border option improves the formation of terrain where open splines are used in the contour. Retriangulate helps to generate a terrain that follows the contours more closely, especially when they are close together.

The Display group allows you to view the terrain as a surface terrain only, as contour lines only, or as both. The default is to show only the terrain.

At the bottom of the rollout, the Update group lets you control the way that the Terrain object is revised when the operands are edited. The Always option updates the Terrain object as soon as a contour is modified. The When Rendering option updates when you render the scene. You can also use the Update button with the Manually option to update the terrain selectively.

THE SIMPLIFICATION ROLLOUT

3ds Max uses the vertices of the original contour polylines to generate the Terrain object. The Simplification rollout options give you control over the number of vertices used to generate the

terrain. You can choose Use 1/2 Of Points or Use 1/4 Of Points both horizontally and vertically; or horizontally you can Interpolate Points * 2 or Interpolate Points * 4.

In the Horizontal group, both the Use 1/2 Of Points option and the Use 1/4 Of Points option reduce the number of points used from the contour line. These procedures reduce the accuracy of the terrain, but they also reduce the complexity of the geometry, thereby making the terrain's memory requirements smaller and rendering time shorter. The Interpolate Points options increase the number of points used. Interpolate Points * 2, for example, doubles the number of vertices used by interpolating new points between the existing points in the contour.

The Vertical group determines whether all of the selected contour lines are used. You can reduce the terrain's complexity by using either the Use 1/2 of Lines option or the Use 1/4 of Lines option.

THE COLOR BY ELEVATION ROLLOUT

3ds Max lets you color the Terrain object by elevation, using the rollout shown in Figure 5.13. This enables you to visualize the terrain more clearly and helps you identify elevations by color-coding them.

FIGURE 5.13
The Color by
Elevation rollout
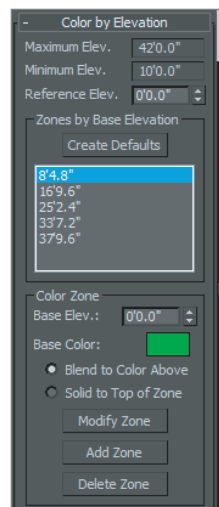
The Maximum Elev. and Minimum Elev. options display the maximum and minimum extents of the terrain based on the contour data. The Reference Elev. option lets you establish a reference elevation that is used for assigning colors to the terrain. If this value is equal to or less than the lowest contour, 3ds Max generates five color zones for the terrain, as you saw in an earlier exercise. If the Reference Elev. is greater than the lowest contour, 3ds Max treats the lower elevations as water, using the Reference Elev. value as the water level. Water is given a blue color by default.

The Zones By Base Elevation group gives you control over the individual colors for each color zone. As you've seen from the exercise, the Create Defaults button applies the colors to the

Terrain object based on the current settings of the rollout. You can also change the color of each zone by selecting the zone elevation from the list box and using the Base Color swatch to select a color.

The Blend To Color Above and Solid To Top Of Zone options let you choose to blend colors between zones or to have each zone one solid color. By default, colors are blended. You can change from blended to solid by selecting the zone elevation from the Zones By Base Elevation list, selecting Solid To Top Of Zone, and then clicking the Modify Zone button. The Add Zone and Delete Zone options add and delete zones.

Setting Up an AutoCAD Plan for 3ds Max

If you're an experienced AutoCAD, Revit, AutoCAD Architecture, or AutoCAD Mechanical user, you may find it easier to create at least part of your 3D model in your CAD program and then import the model into 3ds Max to refine it. If this is the case, simply import or link the CAD model into 3ds Max and then resume your design visualization workflow at the point of assigning material or adding lights and cameras. Then you can animate and render the scene.

On the other hand, you can also import 2D plans and elevations and build your 3D model entirely in 3ds Max. In this section, you'll explore the ways you can set up an AutoCAD or AutoCAD LT 2D drawing to take advantage of 3ds Max's superior modeling tools.

One of the drawbacks of importing fully developed 3D models from AutoCAD is that, frequently, the surface normals of the AutoCAD model are not all oriented in the proper direction. You can use 3ds Max to adjust the normals to point in the correct direction, but that takes time. In this situation, it's sometimes more efficient to apply two-sided materials to the offending objects and leave it at that. Using two-sided materials increases rendering time; however, this disadvantage is often offset by the amount of time it would have taken to identify and adjust misaligned normals. You can also use the Normal modifier or apply the Edit Poly modifier to selected objects and adjust individual sub-objects in order to correct problems with surface normals.

This is less of a problem when the 3D geometry is created in Revit and then linked into 3ds Max using the original RVT file format. The geometry almost always comes in correctly using this method. You can also link Filmbox (FBX) files exported out of Revit or any application that supports the FBX format into 3ds Max. Be sure to update to the latest FBX version by using the Web Update button in the FBX Import dialog. The FBX importer has been updated since the release of 3ds Max 2013. FBX also imports materials and lights from Revit. Its only real drawback is that it has a huge file size, so you often have to import pieces of your Revit project and assemble them inside 3ds Max.

You can avoid the normals problem altogether by importing a specially prepared 2D drawing from AutoCAD into 3ds Max.

In the next set of exercises, you'll use AutoCAD to prepare a plan for export to 3ds Max. If you don't have AutoCAD, you can skip to the section "Importing AutoCAD Plans into 3ds Max."

1. Open AutoCAD 2004 or later; then open the `savoye-ground.dwg` file, which you'll find in the Chapter 5 archive at this book's accompanying web page, `www.sybex.com/go/mastering3dsmax2013`. This is the ground floor plan of the Villa Savoye. This is an early twentieth-century residential design built at Poissy, outside of Paris, France, by the world-famous architect Le Corbusier (see Figure 5.14).

FIGURE 5.14
The Villa Savoye
drawing
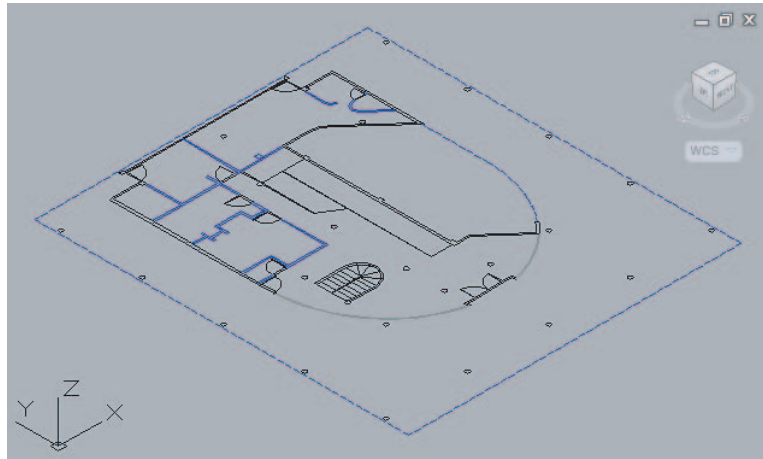
> **USING A LEGACY VERSION OF AUTOCAD**
>
> All the files provided with this book are saved in the AutoCAD 2004 file format. If you have a version of AutoCAD previous to 2004, you will not be able to open the provided files. You can download the Autodesk DWG TrueView application from www.autodesk.com and install it on your system to open and save the files to a previous version of AutoCAD's file format so that you can open the files and work along with these exercises.

2. Select WALL-3ds-EXT from the Layer drop-down list on the Layer Properties panel of the ribbon.

3. Use the Zoom Window tool to enlarge your view so that it looks similar to Figure 5.15.

FIGURE 5.15
Selecting points
inside the exterior
walls

Click the interior of these objects.
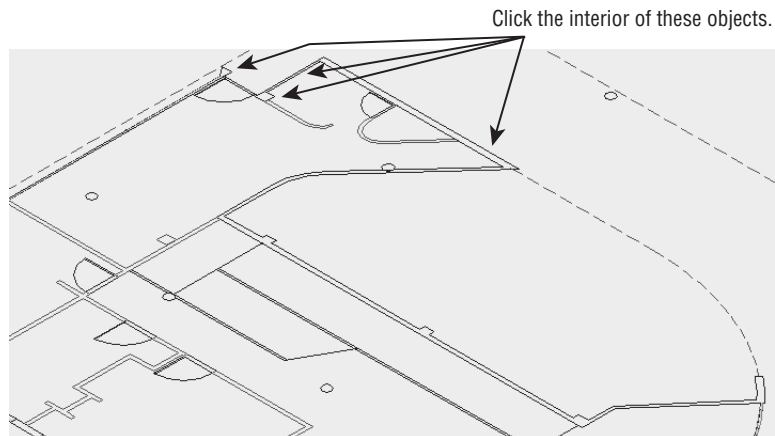
4. From the Home tab, choose the Draw panel and then click the drop-down menu on the Hatch button to select Boundary. The Boundary Creation dialog box displays.

5. In the Boundary Creation dialog box, click Pick Points. The dialog box temporarily disappears to allow you to select points.

At times, you might encounter an error message while selecting areas with the Boundary Creation dialog box. This is usually caused by one of two reasons: either the area you select isn't completely closed, or a single line intrudes into the space you're trying to outline. In these cases, you will have to trim away intruding lines manually or join lines that do not meet.

6. Click the points shown in Figure 5.15. Press Enter when you've finished. A magenta outline of the wall appears, outlining the areas you selected. Your closed polylines might appear below the existing CAD linework; if you mouse over the areas that you selected, you should see the boundary lines highlight.

The magenta outlines are continuous, closed polylines, which will become closed splines in 3ds Max. Closed splines are preferable entities because they extrude without any problems with surface normals in 3ds Max. Because the WALL-3ds-EXT layer is current, the outline is placed on this layer. The layer's color is magenta, so the wall acquires the layer's color.

YOU MAY HAVE TO SEE THE ENTIRE BOUNDARY

Depending on your version of AutoCAD, particularly for versions prior to 2011, you may be required to see the entire boundary on the screen before picking a point to create a boundary object. The Boundary Creation tool may fail unless the boundary is visible because the older algorithm analyzes what is visible on the screen only. Try zooming out a bit and choosing Draw ➤ Boundary again if you get the message "Boundary Definition Error: Valid hatch boundary not found." Boundary creation will also fail if you click outside the lines or if the point you click is directly on an object.

Next, continue to add the outlines of the exterior walls using the Boundary Creation dialog box:

**1.** Use the Pan tool to adjust your view to look similar to Figure 5.16.

FIGURE 5.16
Selecting other points for the exterior wall

Select these locations.
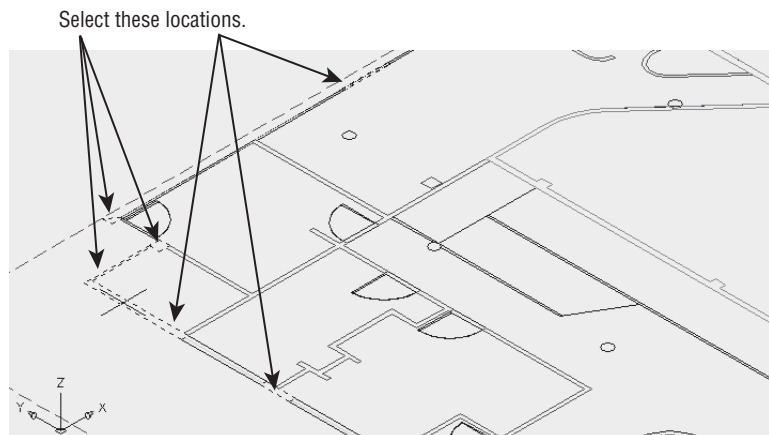
2. Open the Boundary Creation dialog box again, and then click the Pick Points button.

3. Select the points indicated in Figure 5.16.

4. Press Enter when you've selected all the points.

5. Adjust your view so that it looks like Figure 5.17.

FIGURE 5.17
Select points inside the walls near the curved glass.

Select inside the walls at these locations.
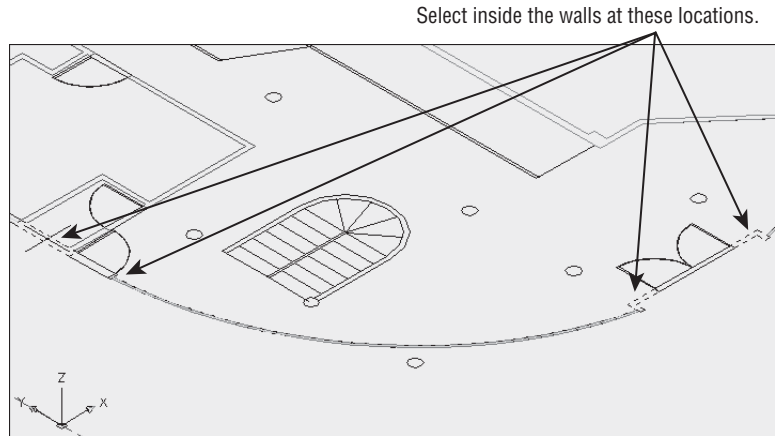
6. Use the Boundary Creation dialog box again to select the areas indicated in Figure 5.17. Press Enter when you've finished.

7. Select WALL-3ds-INT from the Layer drop-down list on the Layer Properties panel of the ribbon.

8. Use the Boundary Creation dialog box to create outlines of the interior walls. When you've finished, the interior walls should all appear in the cyan color, which is the color for the WALL-3ds-INT layer.

You want the interior walls to be on a different layer from the exterior walls so that when the drawing is imported into 3ds Max, you can apply separate materials to the interior and exterior wall objects. By default, 3ds Max converts AutoCAD objects into 3ds Max objects based on their layers, although you can have 3ds Max use other criteria for converting objects if you so choose.

Go ahead and use the Boundary Creation dialog box to outline the other portions of the drawing:

1. Choose the WALL-3ds-EXT-HDR layer; then use the Boundary Creation dialog box to outline the door headers over the exterior doors.

2. Turn off the Glass layer; then make the WALL-3ds-SILL layer current.

3. Use the Boundary Creation dialog box to outline the areas where the windows are indicated in the plan, as shown in Figure 5.18.

4. Finally, turn off the MULLION-VERT layer, set the current layer to MULLION-3ds-HORIZ, and outline the areas indicated in Figure 5.19.
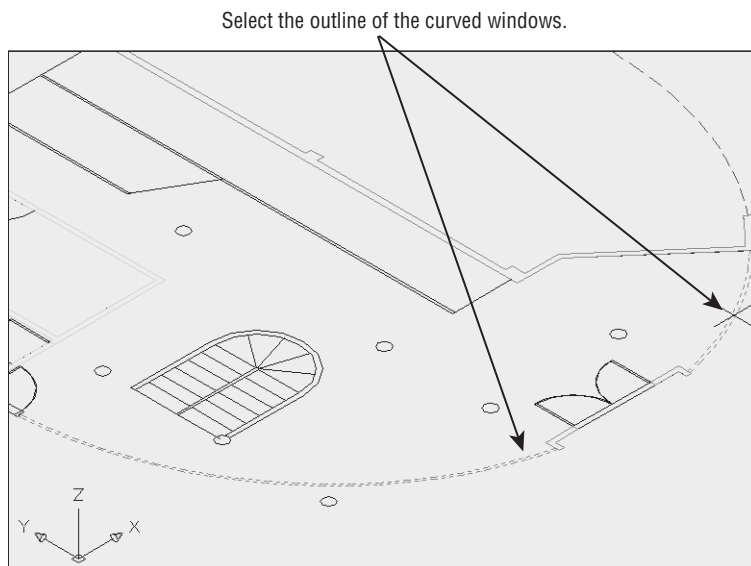
FIGURE 5.18
Outline the window
areas.

Select the window sill areas.
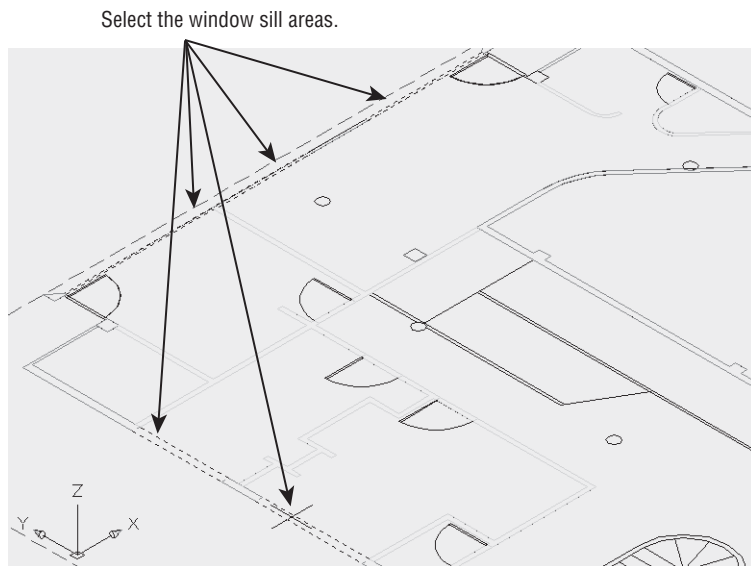
FIGURE 5.19
Outline the areas
that are the
horizontal
mullions.

Select the outline of the curved windows.

5. Make sure that all the layers are turned back on; then choose File (the Application menu in AutoCAD 2009 and newer), choose Save As, and save the file as **MySavoye-ground-max.dwg**.

The main point of these exercises is that you want to segregate the different parts of the drawing so that later, in 3ds Max, you can control the extruded heights of the separate layers

individually. You ensure that you can do this by using layers in AutoCAD to organize the closed polylines that are to be extruded in 3ds Max.

You used the Boundary Creation dialog box to ensure that the polyline outlines are continuous and closed. Alternatively, you can just use the Polyline tool on the Draw panel to trace over the wall outlines if you prefer. The Boundary Creation dialog box makes the work a lot easier because it relieves you from having to click every point in each boundary.

Importing AutoCAD Plans into 3ds Max

Now that you have the plan set up, you can import it into 3ds Max and make fairly quick work of the conversion to 3D. You've done all of the organizing in AutoCAD, so all that is left is to extrude the building parts to their appropriate heights:

1. Open 3ds Max, or click the Application menu and choose Reset if it is already open. You should have saved your changes from the terrain exercise, so click No at the "Do you want to save your changes?" warning and click Yes at the "Do you really want to reset?" warning.

2. Since this is an architectural project, go to Customize ➢ Units Setup and select US Standard: Feet w/Decimal Inches and Inches as the Default Unit and click OK.

3. Click the Application menu and choose Import. The Select File To Import dialog box displays.

4. In the Select File To Import dialog box, select AutoCAD Drawing (*.DWG, *.DXF) from the Files Of Type drop-down list; then locate and open the `MySavoye-ground-max.dwg` file. If you haven't done the preceding AutoCAD exercises, you can open the `savoye-ground-max.dwg` file.

5. In the AutoCAD DWG/DXF Import Options dialog box, make sure that the settings are the same as those shown in Figure 5.20.

6. Make sure that the Orient Normals Of Adjacent Faces Consistently check box is selected. This is an important setting because it tells 3ds Max to align all the normals so that they are pointing outward.

WHEN TO TURN OFF ORIENT NORMALS OF ADJACENT FACES CONSISTENTLY

This option should be turned off when you are working with 3D objects created in AutoCAD Architecture or Revit.

---

7. Click OK to import the AutoCAD file. The plan appears in the viewport.

FIGURE 5.20
The AutoCAD DWG/DXF Import Options dialog box showing the settings needed for this exercise
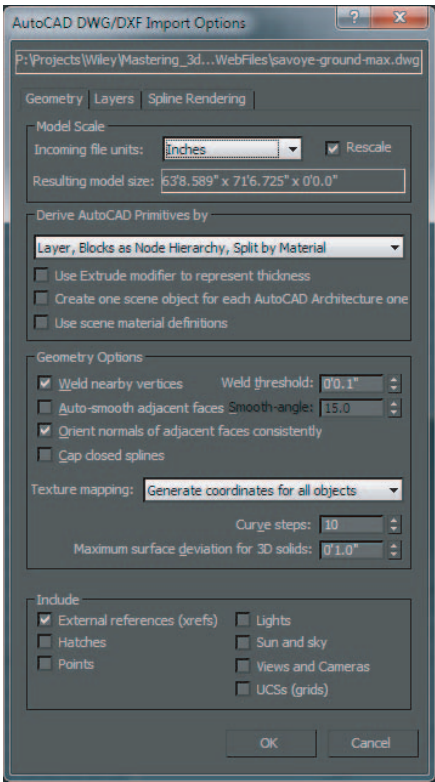
The next step is to set up a comfortable view of the model so that you can easily maneuver within it:

1. Click the POV label in the upper-left corner of the viewport, and then select Orthographic or press U. Your view changes to an orthographic projection instead of a perspective view.

2. Click the Shading viewport label, and set the mode to Shaded.

TURN ON THE MATERIAL COLOR OPTION

When AutoCAD files are imported, they often appear uniformly as a dull gray or black color. In rendered viewports, that may be similar to the viewport background color. A common solution to this situation is to open the Display tab in the Command panel and select the Material Color radio button in the Shaded area of the Display Color rollout. If the objects' material colors don't have a good contrast with the background color, try the Object Color option instead.

---

3. Orbit so that your point of view is above and at a 45-degree angle to the plan. Alternatively, you can click the corner of the ViewCube where the Front, Left, and Top faces intersect.

4. Press the **G** key to hide the grid for a clearer view.

5. Click the Zoom Extents tool to view the plan so that it looks similar to Figure 5.21.

FIGURE 5.21
The view so far
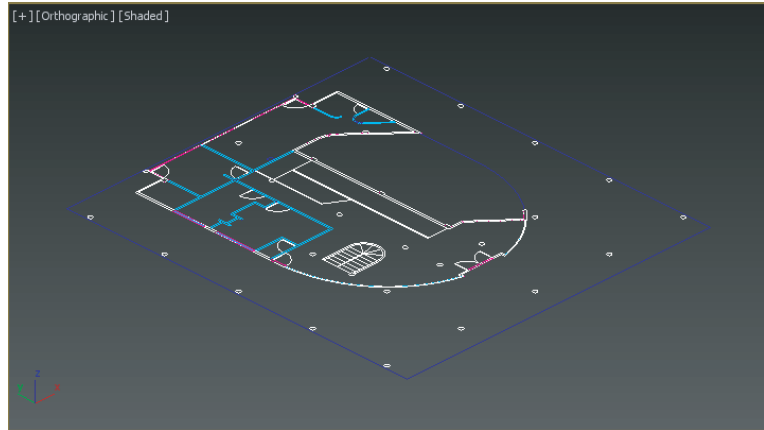
Extruding the Walls

The next step is to start extruding the walls. The polyline outlines that you created in AutoCAD are converted to closed splines in 3ds Max, so you need only to select the splines and apply the Extrude modifier:

1. Right-click in the viewport, and choose Unhide All from the quad menu to unhide the Layer:MULLION-VERT and Layer:GLASS objects. Layers that are turned off in AutoCAD are imported as objects that are hidden in 3ds Max.

2. In the Unhide All dialog box that opens, click Yes to unhide the layers on which these objects are located.

3. Click the Select By Name tool on the Main Toolbar to open the Select From Scene dialog box.

4. Select Layer:Wall-3ds-INT, Layer:Wall-3ds-EXT, and Layer:MULLION-VERT from the list, and then click OK. Remember that you can select multiple, nonconsecutive items from a list by holding down the Ctrl key while you click.

COMBINING OBJECTS BY LAYER

Objects that were combined by layer in the conversion from AutoCAD to 3ds Max have "Layer:" preceding their AutoCAD layer name.

---

5. Select the Modify tab in the Command panel, and then select Extrude from the Modifier List drop-down.

6. In the Parameters rollout, set the Amount input box to **9′6″**. The walls and mullions display in the viewport, as shown in Figure 5.22.

FIGURE 5.22
The building after
extruding the
selected objects
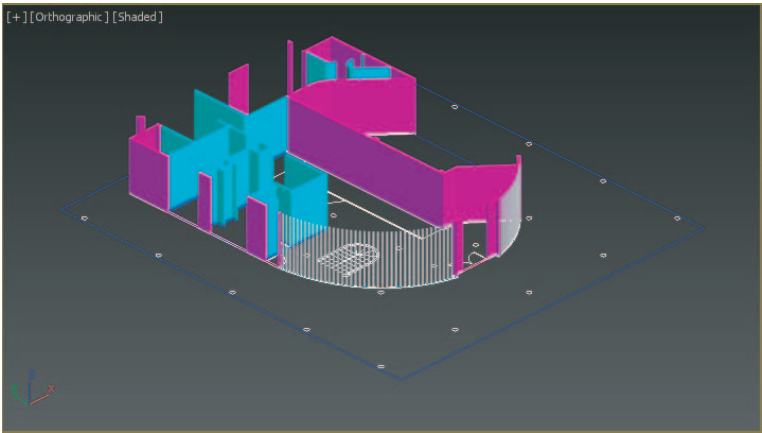
In this exercise, you applied the same modifier to three objects: Layer:Wall-3ds-INT, Layer:Wall-3ds-EXT, and Layer:MULLION-VERT. Whenever you change the Extrude Amount parameter for one object, it changes for the others because the Extrude modifier is instanced across the objects you selected in step 4, applied to in step 5. The two sets of walls and the vertical mullions were segregated in AutoCAD so that you could apply a different material to each of them in 3ds Max, but because all of these items are the same height, you applied a single modifier to all three of them.

If you decide that you need to give each set of walls its own Extrude modifier, you can do so by clicking one of the walls, selecting the italicized Extrude modifier in the stack, and then clicking the Make Unique button in the modifier stack, as shown in Figure 5.23.

FIGURE 5.23
Make the instanced
modifier unique.
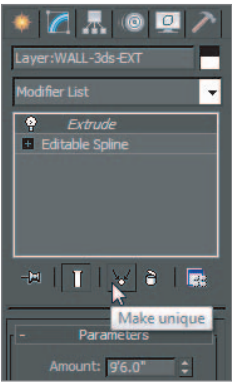
ITALIC AND BOLD MODIFIERS

Modifiers that appear in italics in the stack are instanced. Modifiers that appear in bold in the stack are modifiers applied to instanced objects.

Extruding Exterior Wall Headers

Now let's continue with the exterior door headers and the walls around the windows:

1. Open the Select From Scene dialog box again. Then select Layer:WALL-3ds-EXT-HDR and Layer:Wall-3ds-SILL.

2. Select Extrude again from the modifier list; then change the Amount value in the Parameters rollout to **1′6″**.

3. Click the Select And Move tool; then click the Absolute/Offset Mode Transform Type-In tool next to the coordinate readout so that you are in the Offset mode. You'll see values appear in the coordinate readout.

4. In the coordinate readout, change the Z value to **8′0″**. Figure 5.24 shows the door headers all moved to their positions above the doors.

FIGURE 5.24
The headers moved to an elevation of 8′0″
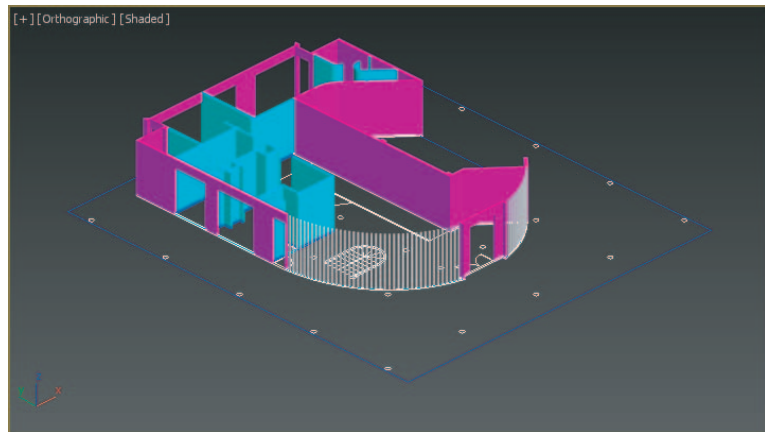
You may have noticed that in step 3, the coordinate readout showed values only when you selected the Offset mode from the Absolute/Offset Mode Transform Type-In tool. This is because you have more than one object selected. The Absolute mode has no significance for multiple selections because several objects can have different locations in the scene.

Also, just as with the walls, you used a single instanced Extrude modifier to effect changes to multiple objects.

Now take a closer look at the windows. You have the window headers in place, but you also need a portion of wall to fill in below the windows. You'll need to copy the window headers and change their Extrude amount:

1. Select the Layer:WALL-3ds-SILL object. You can use the Select From Scene dialog box to do this, or you can simply click one of the window headers toward the back of the building.

2. With the Select And Move tool selected, Shift+click the blue Z-axis arrow of the Transform gizmo and drag the selected header down to make a clone of the window header object, roughly placing the copy at ground level.

3. In the Clone Options dialog box, click the Copy radio button to enable it. You can keep the Layer:WALL-3ds-SILL001 name. Click OK to accept the clone settings.

4. Click the Absolute/Offset Mode Transform Type-In tool to change to the Absolute mode; then right-click the Z spinner arrows to change the Z value in the coordinate readout to 0′0.0″.

5. Change the Amount value in the Parameters rollout of the Modify tab to **2′8″**.

Extruding the Mullions

You now have the walls in place. Because you did some prep work in AutoCAD, the work in 3ds Max went fairly quickly. Even so, you still need to take care of a few items. The horizontal mullions for the curved window need to be created:

1. Use the Zoom Region tool to enlarge your view of the plan near the entrance to the right, as shown in Figure 5.25.

FIGURE 5.25
A close-up view of the entrance and curved window
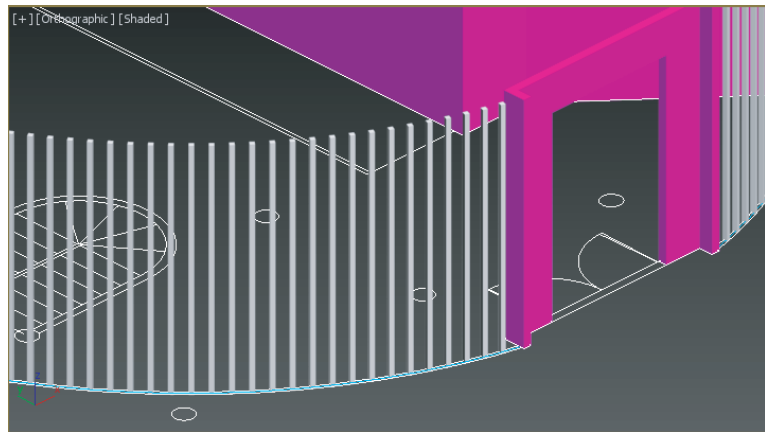
2. Select the horizontal mullion outline named Layer:MULLION-3ds-HORIZ.

3. Select the Extrude modifier in the Modifier List drop-down; then change the Amount parameter to **2″**.

4. Choose Edit ➢ Clone; then, in the Clone Options dialog box, click Instance and then click OK. The clone is now the selected object.

5. Click the Select And Move tool; then change the absolute Z value in the coordinate readout to **32″** or **2′8″**.

6. Choose Edit ➢ Clone again; then click OK in the Clone Options dialog box.

7. With the Select And Move tool still selected, change the Z value in the coordinate readout to **9′4″**. The horizontal mullions for the curved window are now in place.

Creating Interior Wall Headers

You used the Extrude modifier to create the headers for the exterior walls of the Villa. You are going to use a different method to create the headers for the interior walls.

1. Select Layer:WALL-3ds-INT object.

2. On the Modify tab, select the Extrude modifier and then select the Make Unique button that was mentioned earlier in the chapter.

3. In the Parameters group of the Extrude modifier, change the number of segments to **2**.

4. Right-click the Shading viewport label and select Edged Faces. Pan the viewport to the right, and you should see the extra segment on your interior walls, as shown in Figure 5.26.

FIGURE 5.26
Extra segments on the interior walls
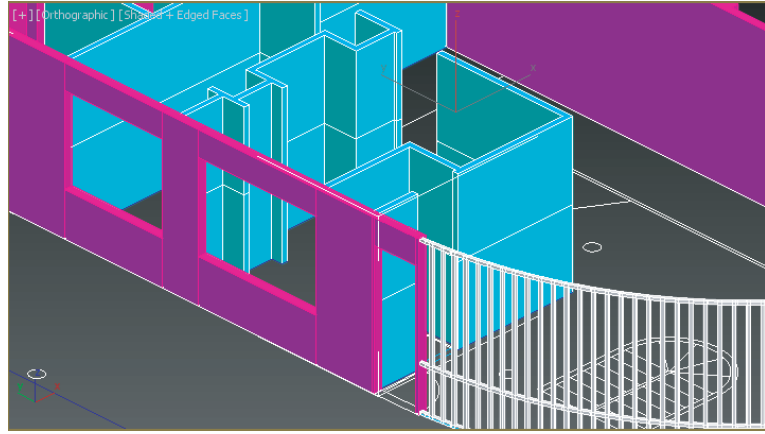
5. With the Layer:WALL-3ds-INT object selected, add an Edit Poly modifier to the stack.

6. Expand the Edit Poly modifier, and select the Vertex sub-object mode.

7. Right-click in the Left viewport to make it active, and make a selection window through the middle of the first floor, as shown in Figure 5.27, to select the newly added vertices.

FIGURE 5.27
Select the center vertices with a crossing window.
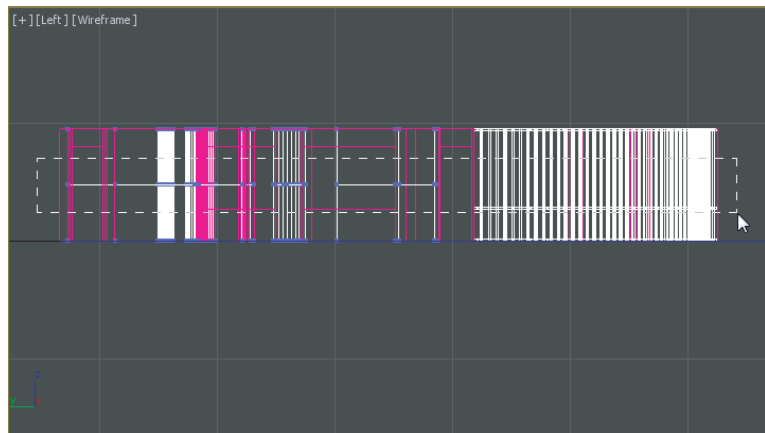
8. In the Transform Type-In, change the Z value to **8'**.

9. Deselect the vertices you just moved.

10. Change the sub-object mode to Polygon, and select the polygon, as shown in Figure 5.28.

FIGURE 5.28
Select the polygon
at the top of the
wall.
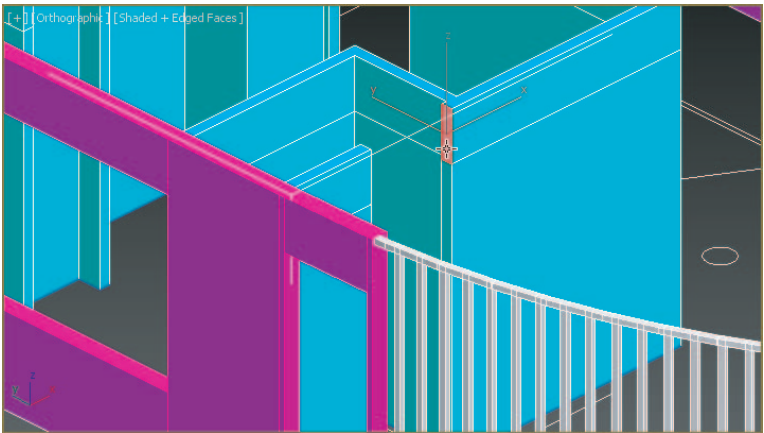
11. Using Orbit SubObject, arrange the view so that you can see the opposite side of the closet opening.

12. Ctrl+click and select the polygon opposite the currently selected polygon.

13. On the Graphite Modeling toolbar, go the Polygons panel and select the Bridge command, as shown in Figure 5.29.

FIGURE 5.29
Select the Bridge
command to close
the gap between the
selected polygons.
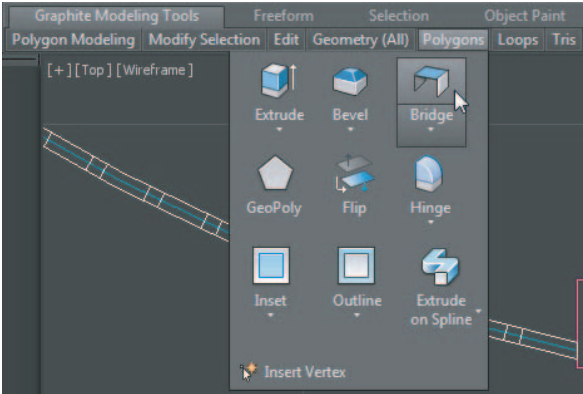
The Bridge tool connects the selected polygons, removing any interior polygons and welding the polygons of those faces. See Figure 5.30 to view the bridged polygons.

FIGURE 5.30
The bridged polygons form the header over the closet opening.
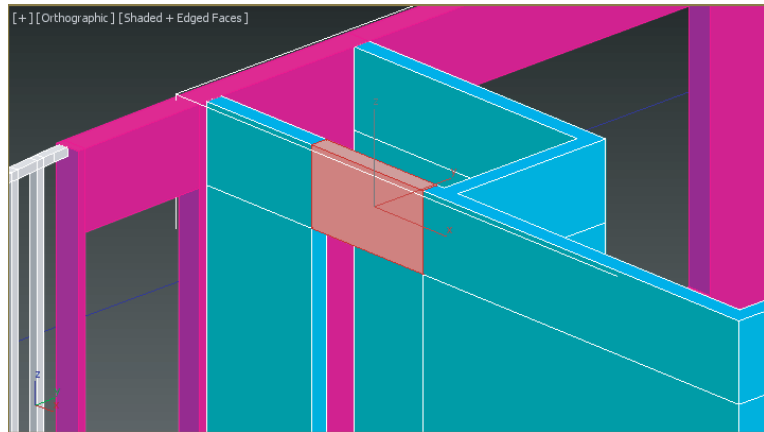
Using this technique, you need to create the headers over the remaining four interior door openings on the ground floor of the villa. Once you have finished creating the remaining interior headers, deselect all of the polygons and close the sub-object mode of the Edit Poly modifier.

Using the Edit Poly modifier and the Bridge tool allows you to create a model that is well suited for radiosity or mental ray rendering, or even for sending out for rapid prototyping.

Adding Glass

Let's continue to model the ground floor of the villa. Next, you need to add the glass:

1. Open the Select From Scene dialog box and select Layer:GLASS.

2. Select Extrude from the Modifier List drop-down; then change the Amount parameter to **9′6″**, and make sure that the Segments value is set to 1.

If you are using the Direct3D viewports instead of the Nitrous viewports, the glass appears in only one or two areas. This is because the Glass object is a single spline and not an outline. You may recall from Chapter 3 that the normals of a surface will render the surface visible in only one direction. To compensate for this limitation, you can turn the Layer:GLASS spline into an outline:

1. In the Command panel, select Editable Spline from the modifier stack. The glass disappears in the viewport because you are below the Extrude level in the stack.

2. Right-click in the viewport, and then click the Spline option in the quad menu to enter that sub-object level for editing.

3. Click the Zoom Extents Selected tool to view the entire Layer:GLASS object.

4. Press Ctrl+A to select all the spline sub-objects of the Layer:GLASS object.

5. Scroll down to the Outline button and input field in the Geometry rollout. Enter **0.2″**↵ for the Outline value. You won't see any changes at this viewing distance, but the glass is now a closed outline instead of a single line. Deselect the spline by pressing Ctrl+D.

6. Select Editable Spline in the modifier stack to exit the sub-object level.

7. Click Extrude in the modifier stack. The glass appears in all of the appropriate places and will render correctly (see Figure 5.31) because it now has two surfaces that both have normals that face outward.

FIGURE 5.31
The Villa Savoye model after outlining the glass splines
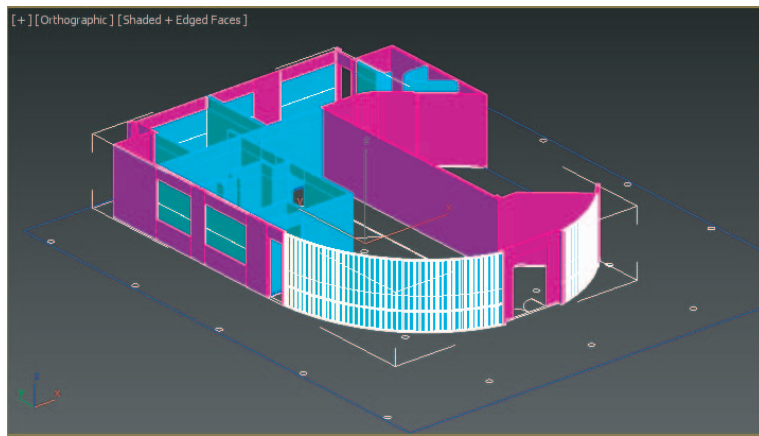
8. Save this file as `Mysavoye-ground-max.max`.

You could have left the glass as a single line. That would make the glass difficult to see in a shaded viewport, but you could apply a two-sided material to the glass so that it would appear in a finished rendering. Although a two-sided glass material takes a bit longer to render, the single-line glass material is a less-complex geometry. This makes the file a bit smaller. For this reason, if your model contains lots of curved glass, it may make sense to leave the glass as a single line. Otherwise, you may want to convert all of the glass in your model to outlines. As you've seen here, that's fairly easy to do in 3ds Max. It takes a bit more work to accomplish the same results in AutoCAD using the Boundary tool.

Also, in the previous exercise, you may have noticed that you gave the glass a full height of 9′6″, even though in many cases, the glass only filled a height of 64″ or less. You can do this because 3ds Max takes care of the small details of object intersections. In those places where the glass occurs within a wall, 3ds Max hides most of the glass, and it is displayed only where it appears in an opening, as shown in Figure 5.32. 3ds Max also takes care of the intersection of the vertical and horizontal mullions.

FIGURE 5.32
The window
showing the glass
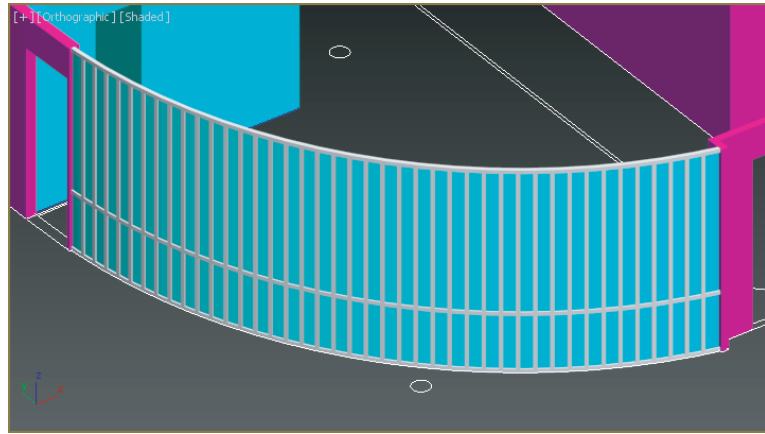
RADIOSITY REQUIRES BETTER MODELING

The creation methods used in these exercises are fine when using the 3ds Max Standard lights and Scanline Renderer. If you intend to render your project using radiosity, the modeling must be cleaner, with no overlapping of faces, for the renderer to create an accurate radiosity solution. Good, clean geometry and models are said to be watertight, meaning the geometry is completely enclosed. If you're using mental ray, it's also a good idea for the geometry to be non-overlapping.

Creating a Floor with Openings

You've seen how the ground floor of the villa can be set up in AutoCAD to make quick work of the extrusions in 3ds Max. The second floor and rooftop can be done in the same way, but the floors between the different levels require a slightly different approach.

Both the second floor and the roof surface have openings that need some special attention when you are setting up to export to 3ds Max:

1. Go back to AutoCAD and open the savoye-second.dwg file. If you don't have AutoCAD, skip ahead to the "Importing the Second Floor" section later in this chapter.

2. Click the Layer Properties icon and, in the Layer Properties Manager dialog box, click the New Layer button. Create a layer named **FLOOR-2ND-3ds**. Right-click the new layer, and select Set Current from the context menu to make it the current layer.

3. Use the Rectangle or Polyline tool to outline the second floor, as shown in Figure 5.33.

Place a rectangle or closed polyline around the perimeter of the second floor plan.

FIGURE 5.33
Outline the second
floor.
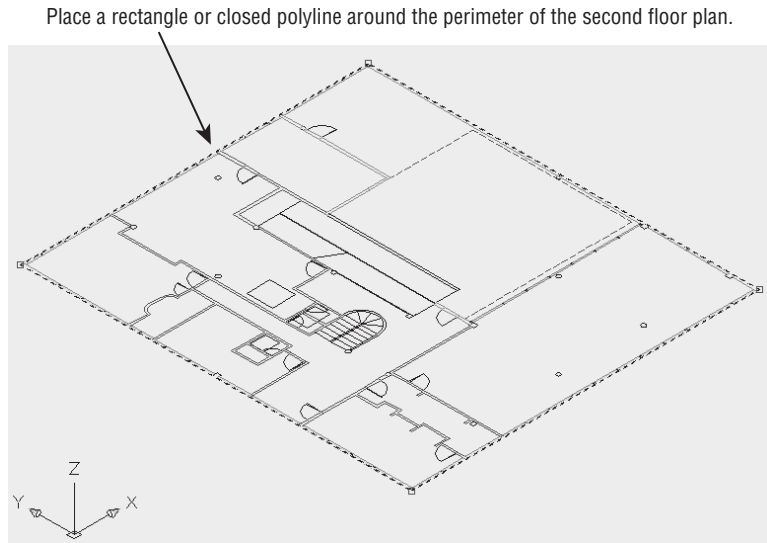
4. Turn off all the layers except FLOOR-2ND-3ds, STAIR, and RAMP; then zoom into the stair, as shown in Figure 5.34.

Outline the stair with a closed polyline.

FIGURE 5.34
Outline the stair.
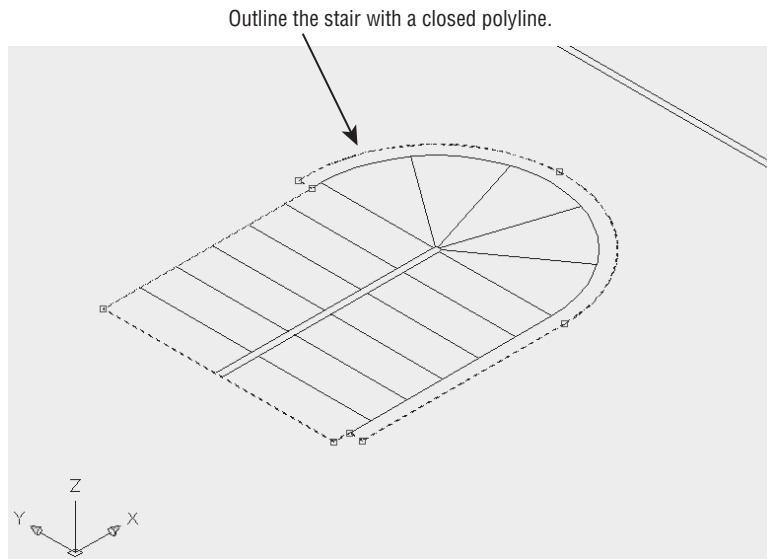
5. Outline the stair with a closed polyline, as shown in Figure 5.34. (In this operation, you're drawing the outline of the stair opening in the floor. You will have to toggle between Arc and Line modes while drawing with the Polyline tool in AutoCAD to complete the outline shown in the figure.)

6. Pan over to the ramp. Then draw an outline of the ramp with a closed polyline (you can use the Rectangle tool), as shown in Figure 5.35.

Figure 5.35
The outline of the
ramp floor opening

Outline the ramp with a closed polyline or rectangle.
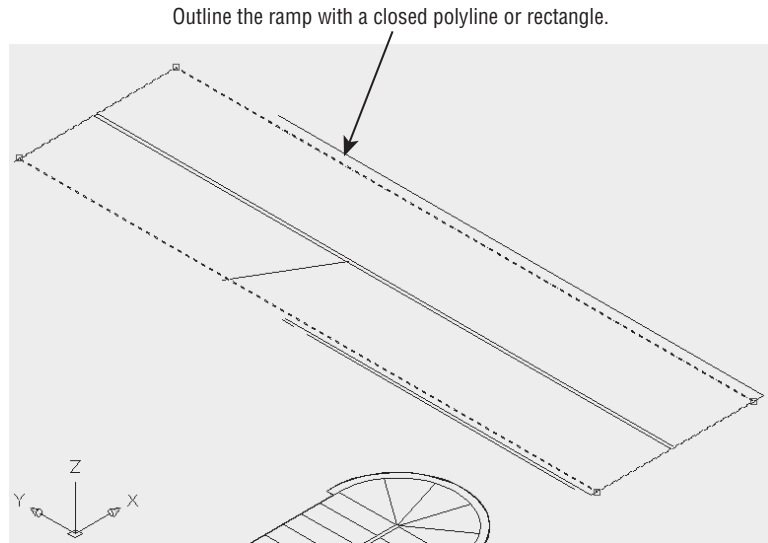
You have all of the additional linework you need to export the floor of the second story to 3ds Max, but you still need to take a few more steps to complete the setup for 3ds Max:

1. Freeze all of the layers except the FLOOR-2ND-3ds layer.

Importing Frozen Layers

Frozen layers are automatically excluded from importing into 3ds Max. However, it is possible to manually select which layers will be included upon import, regardless of their layer state in AutoCAD (but the workflow is less efficient).

---

2. Use the Zoom Extents tool to view your work so far (see Figure 5.36). You now have the outline of the second floor and the two openings through the floor.

Figure 5.36
The outline of the
second floor
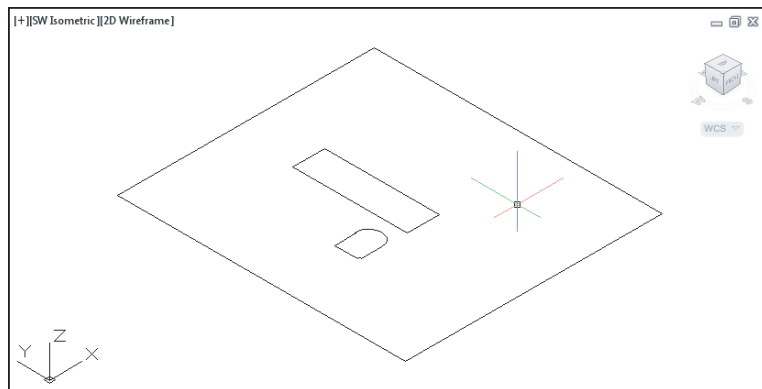
3. Choose File (the Application menu in AutoCAD 2009 and newer), and choose Save As to save your changes to a file named **Mysavoye-second-max.dwg**.

Basically, you've outlined the second floor and its openings with closed polylines. In addition, you've frozen all the layers except the floor outline and openings. This last step lets you automatically limit the objects that 3ds Max imports to only those items you added to the AutoCAD file.

IMPORTING THE SECOND FLOOR

The next step is to import your work into 3ds Max:

1. Go back to 3ds Max, click the Application menu, and choose Reset. You can go ahead and reset the scene because you've already saved your work.

2. Click the Application menu and choose Import. Then, in the Select File To Import dialog box, locate and open the `Mysavoye-second-max.dwg` file you just saved from AutoCAD. If you don't have AutoCAD, open the `savoye-second-max.dwg` file.

3. In the AutoCAD DWG/DXF Import Options dialog box, adjust the settings to match those shown in Figure 5.37.

FIGURE 5.37
The AutoCAD
DWG/DXF Import
Options dialog box
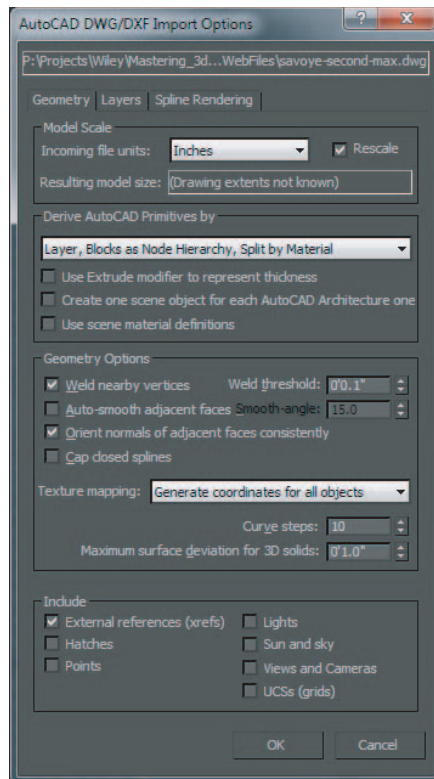
4. Click the Layers tab in the AutoCAD DWG/DXF Import Options dialog box. Note that the Skip All Frozen Layers radio button is selected by default. This setting lets you automatically skip importing the layers you froze in AutoCAD.

When you click the Select From List radio button on the Layers tab of the AutoCAD DWG/DXF Import Options dialog box, you are able to check manually which layers are imported by toggling the large check mark along the left edge of the list. The layer states shown in the list (on/off, freeze/thaw, lock/unlock) represent the current state of the DWG or DXF file and are not functional; they are for your information only.

5. Click OK to import the drawing, and close the AutoCAD DWG/DXF Import Options dialog box.

You now see the outline of the second floor that you created in AutoCAD.

The final step is fairly easy. You only need to extrude the spline, and the openings will appear automatically:

1. Click the Select Object tool; then click the floor outline.

2. Select the Modify tab in the Command panel; then select Extrude from the Modifier List drop-down.

3. Set the Amount parameter to **18"**. You now have the floor of the second story, complete with openings, as shown in Figure 5.38.

FIGURE 5.38
The extruded second floor
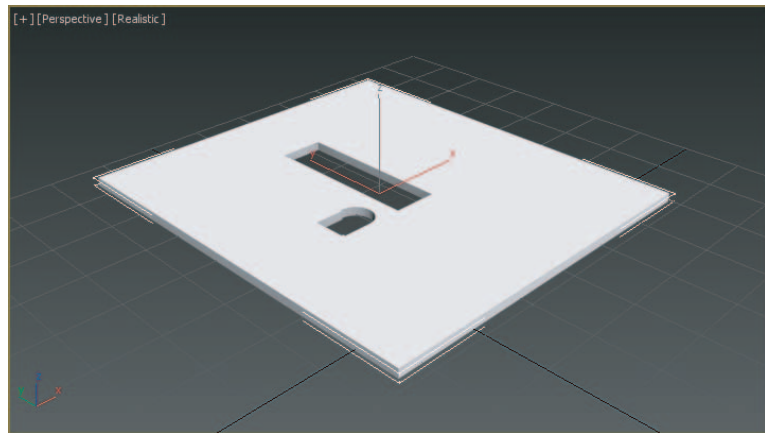
4. If you'd like, save this file as `Mysavoye-secondfloor.max` for future reference.

When creating an extrusion, 3ds Max automatically subtracts the nested splines, closed subsplines that are enclosed by other subsplines, of the same spline object. On the second floor, ramp and stair openings are automatically subtracted from the second floor perimeter.

You were asked to freeze all the layers in AutoCAD except the FLOOR-2ND-3ds layer. This allowed you to automatically limit the objects that were imported from AutoCAD into 3ds Max. You can go back to the AutoCAD file; thaw the wall, header, and other layers; and then freeze the Max-floor layer. Once you've done that, you can import the other second-story elements into a 3ds Max file and then merge the floor and the walls. On the other hand, you can choose exactly which layers will be imported on the Layers tab of the updated AutoCAD DWG/DXF

Import Options dialog box. Of course, you can also thaw all the layers and import the entire AutoCAD drawing at once. But importing parts of an AutoCAD file can help simplify your work and keep it manageable.

USING BUILDING ELEVATIONS AND WALL PROFILES FROM AUTOCAD

In the preceding section, you learned how to convert outlines of a building plan into a floor with openings. You can employ the same procedures for converting building elevations from AutoCAD to 3ds Max scenes. For example, in AutoCAD you can outline an elevation of the Villa using concentric rectangles for the second floor outline and the windows. You can then import the outlines to 3ds Max and extrude them, just as you did with the floor. That will give you the exterior walls of the building that you can rotate into a vertical position. This 3ds Max technique is similar to real-world tilt-up wall-framing construction.

Using this method, you can even include other details such as the window mullions. Once you've done this for all four exterior walls, you can join the walls to form the second floor exterior walls, complete with window openings and even window detail.

Another great tool for forming building exteriors and interiors is the Loft tool. Sometimes a simple vertical extrusion won't be enough for walls. You may be working with a design that uses strong horizontal elements, such as a wide cornice or exaggerated rustication. You can make quick work of such detail by using the 3ds Max Loft tool. Draw the profile of the wall and the building footprint in AutoCAD. Be sure each of these items is on a separate layer and is made of polylines. You can then import the AutoCAD file into 3ds Max and use the Loft compound object or the Sweep modifier to loft the wall profile along the building footprint in a way similar to the exercises in Chapter 6, "Organizing and Editing Objects." This is especially helpful if the building footprint contains lots of curves and corners that would otherwise be difficult to model.

As an alternative, in AutoCAD, you can convert the closed splines of the stair, ramp, and floor into regions and then subtract the stair and ramp regions from the floor outline. AutoCAD regions are converted into 3ds Max mesh surfaces. You then have to extrude the floor with the tools within the polygon level of the Editable Poly, rather than with the Extrude modifier.

Exploring the Manage Links Dialog Box

Earlier in this chapter, you were introduced to the Manage Links tool when you imported topographic contour lines from AutoCAD. In that example, the Manage Links tool allowed you to update the 3ds Max terrain model when a change was made to the AutoCAD DWG file. You can also use the Manage Links tool with floor plans to help maintain design continuity between AutoCAD and 3ds Max.

Try using the Manage Links tool with the second floor of the villa in the following exercises:

1. To reset 3ds Max, click the Application menu, choose Reset, and click Yes in the dialog box that appears.

2. Click the Application menu, and choose Import ➢ Link AutoCAD.

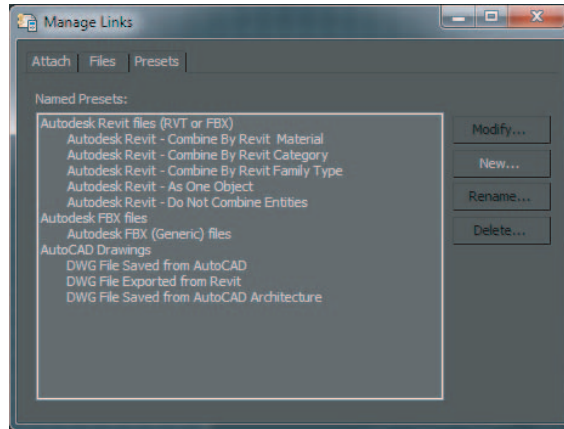3. In the Open dialog box, locate and open `savoye-second-link.dwg`.

4. The Manage Links dialog box opens with the `savoye-second-link.dwg` in the File box of the Attach tab.

Now let's take a closer look at some of the options in the Manage Links dialog box:

1. In the Manage Links dialog box, click the Presets tab (see Figure 5.39).

**FIGURE 5.39**
The Presets tab of the Manage Links dialog box

The Autodesk Revit files (RVT or FBX) presets contain the settings most commonly used when linking to native RVT files or FBX files saved from Autodesk's Revit family of BIM programs. The Autodesk FBX files work best for bringing in FBX files from Autodesk applications such as Maya, Softimage, Mudbox, or other programs that support the FBX format. The AutoCAD Drawings presets provide defaults for linking DWG files from various Autodesk applications. We will create a new preset based on one of the AutoCAD profiles.

2. Select the DWG File Saved From AutoCAD preset and notice that the New button (visible when no presets are selected) changes to Copy. Click the Copy button to bring up the New Settings Preset dialog box.

3. In the New Name field, enter **My_DWG_from_AutoCAD** and click OK to close the dialog box.

4. Select the preset you just created and click the Modify button. The File Link Settings: DWG Files dialog box appears and defaults to the Basic tab.

5. On the Basic tab, check Orient Normals Of Adjacent Faces Consistently.

6. Select the Advanced tab, as shown in Figure 5.40.

7. In the Derive AutoCAD Primitives By drop-down list, notice that the Layer, Blocks As Node Hierarchy, Split By Material option is selected and the Create Helper At Drawing Origin option is checked.

8. Click Save. Then, in the Manage Links dialog box, select the Attach tab and select My_DWG_from_AutoCAD from the Preset drop-down menu.

FIGURE 5.40
The Advanced tab
of the File Link
Settings: DWG Files
dialog box
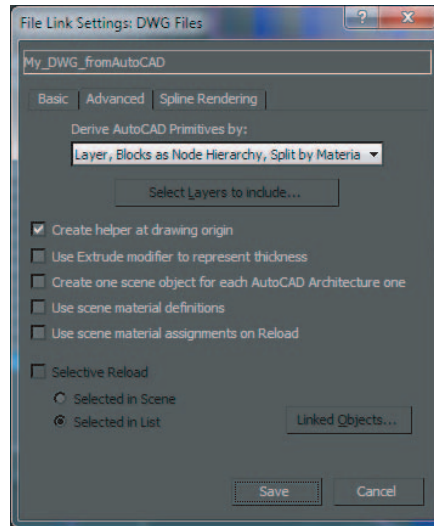
9. Click the Rescale option, and set the Incoming file units to Inches.

10. Click the Attach This File button. The plan displays in the viewports.

   A good tip to know is that, by double-clicking the Helper object, you will select all the objects linked from the source file.

11. Close the Manage Links dialog box.

12. Click the Manage Layers tool in the Main Toolbar. The AutoCAD layers are re-created in 3ds Max in the Layer dialog box.

With the File Link settings, you can control layers as you would in AutoCAD, using the AutoCAD layer names preserved in 3ds Max. You can also create your own settings for special conditions by using the Manage Links Presets tab and adjusting your custom presets as you need them.

To confirm that you have full control over the linked drawing, try the following steps:

1. Open the Select From Scene dialog box; click the + symbol to expand the hierarchy, and then select the Layer:Wall-3ds-int and Layer:Wall-3ds-ext objects.

2. Click the Modify tab in the Command panel; then choose Extrude from the Modifier List drop-down.

3. Set the Amount parameter to **9′6″** or **114″**. The interior and exterior walls are extruded in the scene.

As you can see, the method for extruding the walls in the linked file is exactly the same for the imported AutoCAD file. You can now select and extrude objects as you did for the savoye-ground.dwg file that you imported earlier. The difference with the linked file is that changes made in the AutoCAD file can be reloaded in 3ds Max, much like the way XRefs work in both AutoCAD and 3ds Max.

Editing Linked AutoCAD Files

Now let's take a look at one of the key advantages of using the Manage Links dialog box instead of the simpler DWG file import.

CONTINUING THE EXERCISE WITHOUT AUTOCAD

If you don't have AutoCAD, rename the existing `savoye-second-link.dwg` file to **savoye-second-link-bak.dwg** and then use Windows Explorer to save a copy of the `savoye-second-link-mod.dwg` file as **savoye-second-link.dwg** to replace the existing file. The `savoye-second-max-mod.dwg` file contains the modifications described in the preceding steps; however, linking to a different drawing will cause the Extrude modifiers to be deleted from the scene.

---

1. In AutoCAD, open the `savoye-second-link.dwg` file.

2. Turn on and thaw all the layers, and use the Stretch command to stretch the walls as shown in Figure 5.41.

FIGURE 5.41
Stretch these walls as shown here.
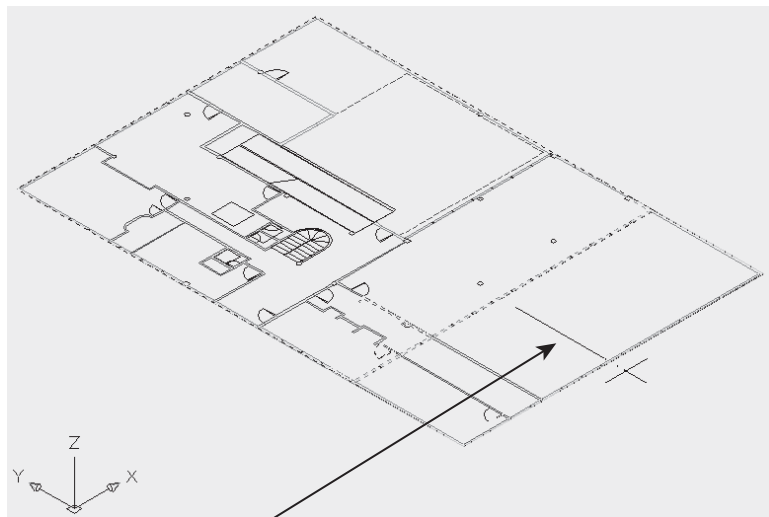
Stretch these walls outward.

3. Choose File ➢ Save to save the changes.

4. In 3ds Max, click the Application menu and choose References ➢ Manage Links.

5. In the Manage Links dialog box, click the Files tab and then select `savoye-second-link.dwg` in the Linked Files list box.

6. Click the Reload button. The File Link Settings dialog box displays.

7. In the File Link Settings: DWG Files dialog box, click OK. Then close the Manage Links dialog box.

The 3ds Max scene is updated according to the changes made in the AutoCAD file.

You've seen how you can update 3ds Max scenes when changes occur in a linked AutoCAD object. If you add objects in AutoCAD, those objects are also added to the 3ds Max scene. If the new object is added to a layer that already exists, and the objects associated with that layer are attached to a modifier, the new object is also controlled by the modifier. For example, if you add a rectangle to the AutoCAD drawing on the WALL-3ds-EXT layer, the new rectangle will be extruded to the 114″ height, just like all the other objects on the WALL-3ds-EXT layer. New objects on that layer that have a thickness or that are extruded within AutoCAD will be ignored by 3ds Max unless they are placed on a newly created layer.

Understanding the Block Node Hierarchy

> **ENCOUNTERING MAXBLOCKS**
>
> Prior to 3ds Max 6, AutoCAD blocks translated into *Maxblocks*, which were collections of entities treated as a single object (which worked like a compound object). You can still encounter Maxblocks in 3ds Max 2013 if you choose to derive AutoCAD primitives by Layer, Entity, Color, or One Object only.

Beginning with 3ds Max 8, blocks are linked in a *node hierarchy* when you choose to derive AutoCAD primitives by Layer, Blocks As Node Hierarchy Or Entity, or Blocks As Node Hierarchy. To understand how this works, let's do a short exercise:

1. Click the Application menu, choose Reset, and do not save the changes you made to the scene earlier.

2. Click the Application menu, choose References ➢ Manage Links, and click the Attach tab.

3. Click the File button, and select the `Blocks.dwg` file; then click Open.

4. Click the Presets tab and, without selecting any named preset, click New. Give the new preset the name **Entity Blocks**, select AutoCAD Drawings from the Format drop-down, and click OK.

5. Select Entity Blocks in the Named Presets list, and click Modify.

6. Click the Advanced tab in the File Link Settings: DWG Files dialog box. Click the Derive AutoCAD Primitive By drop-down list and select Entity, Blocks As Node Hierarchy. In this example, it also makes sense to combine by entity (rather than layer) because there are only a few simple objects.

7. Click Save to close the File Link Settings: DWG Files dialog box.

8. Click the Attach tab of the Manage Links dialog box, and select Entity Blocks from the Preset drop-down list if it is not already selected.

9. Check the Rescale option, and select Inches for Incoming file units.

10. Finally, click Attach This File and close the dialog box. The drawing appears in the viewport as shown in Figure 5.42.

FIGURE 5.42
The block node
hierarchy
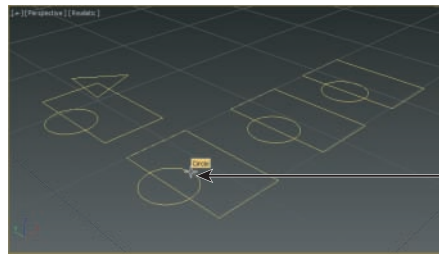
Click here to select a child node
of this instance of BlockA.

The Blocks.dwg file contains two simple blocks called BlockA and BlockB. BlockA contains a circle and a rectangular polyline. There are three instances of BlockA in the scene. BlockB has only one instance and contains a triangular polyline and BlockA nested within it.

11. Click the Select And Move tool, and select the circle of BlockA, as shown in Figure 5.43.

FIGURE 5.43
Moving one portion
of the BlockA object
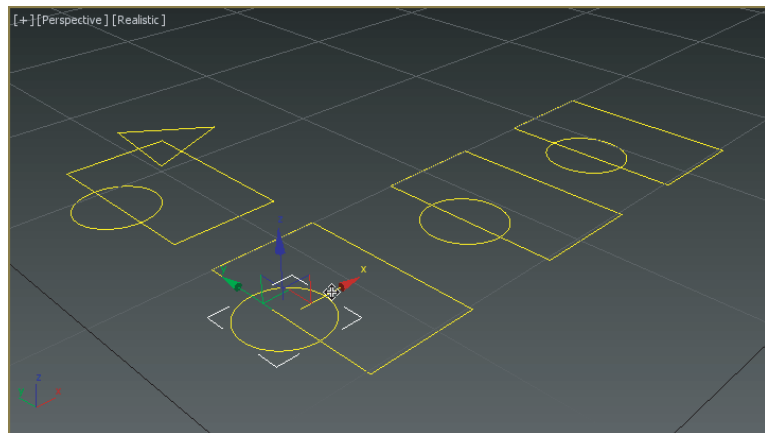
12. Move the circle you selected a short distance in the XY-plane.

Notice that all the child circle nodes move relative to their block headers (like the insertion point of AutoCAD blocks). In AutoCAD lingo, entities in the block definition are moving relative to the insertion points in their block instances.

13. Press Ctrl+Z to undo the transform you did in step 12.

14. Open the Select From Scene dialog box, and notice which node is selected—the circle in the second instance of Block:BlockA (see Figure 5.44). Select Block:BlockA above the

selected Circle, which is the block header node. The block header node contains all of the nested objects but doesn't represent an object itself.

FIGURE 5.44
Selecting an object with the Select From Scene dialog box
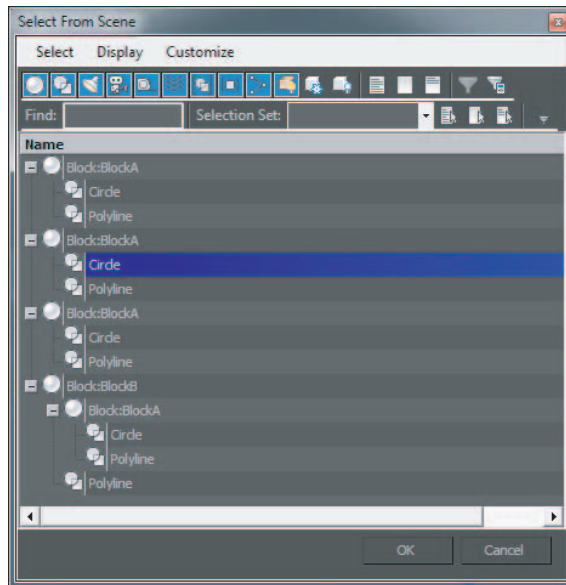
15. Using the Select And Move tool, drag the selected block header a short distance in the XY-plane. Notice that this time the entire block moves, and only the second instance of BlockA moves.

16. Click the Modify tab of the Command panel. Notice that the block header shows up as Block/Style Parent in the stack. Click the Reset Position button in the Linked Geometry rollout to return the block instance to the original position it had in the linked DWG file.

17. Save your work as **MyBlocks.max**.

As you can see from this exercise, selecting a block node on the screen selects a child in the block hierarchy. Transforming a child node actually transforms all instances of that child relative to their block headers.

On the other hand, when you select the top node in the hierarchy, called the *block header*, moving the block header allows you to transform a unique block instance independently of all other block instances. When you transform a parent node, the relative positions of its children do not change. AutoCAD blocks are now handled essentially as kinematic chains in 3ds Max.

BLOCKS IN 3DS MAX DIFFER FROM BLOCKS IN AUTOCAD

The block node hierarchy works much as it does in AutoCAD, with the exception that you do not have to redefine a block explicitly each time you make a change to the constituent geometry of the block definition. In 3ds Max, it is easy to change the relationship between what is inside a block definition (by moving the child nodes) and the block instance (by moving the block header). No block redefinition is required in 3ds Max because it all happens automatically, depending on which node you select in the block hierarchy. The entire block node hierarchy brings block behavior much more in line with how AutoCAD handles blocks as compared with the more limited functionality of Maxblocks.

Understanding the Manage Links Options

In the preceding exercises, you were able to try out a few of the Manage Links options. The Manage Links dialog, like so many other 3ds Max features, offers numerous options to tailor your workflow to the particular needs of your project. Given the limited space of this book, an example of every option available won't be shown, but you can get started with this feature after reviewing the exercises. Here's a summary of the Manage Links dialog box options, organized by tabs.

The Attach Tab

As you've already seen, this tab lets you locate a file using the File button. The File drop-down list shows a history of previously attached files from which you can select. The Preset drop-down list lets you select from a collection of presets that you've saved earlier.

The Select Layers To Include button opens the Select Layers dialog box, which allows you to select or deselect specific layers that you may want to include or exclude from the link.

The Attach This File button lets you attach an AutoCAD DWG, DXF, Autodesk FBX, Revit RVT, or Revit FBX file to the current 3ds Max scene. Files can be attached from versions 12 through 2013 of AutoCAD and other releases of AutoCAD Architecture, AutoCAD Mechanical, and the Revit family of products. If you're using a CAD program other than AutoCAD, you can use the DXF file format instead of the DWG format, although many CAD programs today support the DWG file format directly.

Using Object Enablers

Many Autodesk products, including AutoCAD Architecture, AutoCAD Mechanical, and AutoCAD Civil 3D require that Object Enablers be installed to import certain objects properly. To find the proper Object Enabler to install, go to `www.autodesk.com` and search for "Object Enabler." An absent Object Enabler results in the appearance of a Proxy Object Detected dialog box when you attempt to import or link to the offending DWG files. You can still use the drawings without the enablers present; however, the associated geometry may not properly come into 3ds Max.

The Files Tab

The Files tab allows you to control how a file is linked to the current 3ds Max file.

As you've seen in previous exercises, the Reload option lets you manually reload a linked file. The File Link Settings dialog box displays when you click this button if you have the Show Reload Options check box selected.

Detach removes a linked file from the current 3ds Max scene. Use this option with caution, because it deletes all of the linked objects in the scene even if they have been modified in 3ds Max.

The Bind option removes any links to the source AutoCAD file while maintaining the objects in the current 3ds Max scene. The 3ds Max scene then becomes an independent scene file, and it can no longer be affected by the source AutoCAD file.

Binding Linked Files Eliminates Interoperability

Binding a link will increase your file size as the data is migrated from CAD into 3ds Max when the link between them is broken. Do this with caution because changes made in the CAD file will no longer affect the 3ds Max scene.

Finally, the Files tab displays a list of DWG, DXF, RVT, or FBX files that are currently linked to the 3ds Max scene file. An icon next to the filename indicates the status of the linked file:

◆ A paper clip indicates that the source file has not changed and that there are no errors in the link.

◆ A question mark indicates that the file cannot be found.

◆ A red flag indicates that the file has changed since import and that it must be reloaded using the Reload button.

◆ A grayed-out page indicates that a different file has been selected through another path.

◆ A curved arrow indicates that the Dynamic Reload option has been turned on for the file.

The Presets Tab

You saw in an earlier exercise how you can create a preset, which determines the settings when files are linked. The Presets tab also lets you modify an existing preset through the Modify button or rename or delete an existing preset. When you create a preset, it appears as an option in the Attach tab's Preset drop-down list. You'll learn more about the actual preset settings in the next section.

Understanding File Link Settings

When you import a linked AutoCAD file, you have the option of controlling the way that file is imported through the File Link Settings dialog box. This dialog box appears by default when you've selected a file for linking, but you can set 3ds Max to avoid this dialog box by deselecting the Show Reload Options check box in the Files tab of the File Link Manager dialog box.

As you saw in previous exercises, the options selected in the File Link Settings dialog box can make a huge difference in the way the resulting 3ds Max file is organized. Because AutoCAD and 3ds Max use entirely different ways of organizing data, this dialog box is necessary to make some sense of the way that AutoCAD DWG files are converted to 3ds Max files. To help in the translation process, 3ds Max uses a type of node called *Linked Geometry*. All linked AutoCAD objects are converted to Linked Geometry or 3ds Max blocks, which occurs only when you choose to derive AutoCAD primitives by Layer, Entity, Color, or One Object.

For example, objects in an AutoCAD file that reside on layer 0 are collected into a single 3ds Max block. The name of the 3ds Max block will depend on the settings you choose in the File Link Settings dialog box. In an earlier exercise, you chose the Layer option in the File Link Settings dialog box's Derive AutoCAD Primitives By drop-down list. You can further refine the way 3ds Max combines objects through a combination of layer, thickness, and color, or you can have 3ds Max import each AutoCAD object as a single object in 3ds Max.

Most of the time, you will probably choose to derive your AutoCAD primitives using one of the Blocks As Node Hierarchy options in the File Link Settings dialog box because of the improved way that you can work with blocks using these options. Therefore, the objects that appear in 3ds Max will most often be Linked Geometry nodes.

Linked Geometry nodes have only one parameter on the Modify tab of the Command panel: the Reset Position button. Click Reset Position when you want to restore the node to the location it has in the linked DWG or DXF file. Any transforms that you apply to Linked Geometry nodes are stored in 3ds Max alone, and there is no chance that 3ds Max will ever overwrite your AutoCAD files.

AVOIDING SYSTEM INSTABILITY

You'll want to avoid several things when working with Linked Geometry because of its connection to a foreign file format. System instability may occur if you include Linked Geometry in groups or assemblies, attach them to an Editable Mesh or Editable Poly, change animation controllers, create hierarchical links, or make instance clones of Linked Geometry. However, you can confidently make copy clones and apply transforms, modifiers, and materials to Linked Geometry without any problems.

THE BASIC TAB

The options in the Basic tab, shown in Figure 5.45, give you control over the way imported objects are converted into 3ds Max objects. These options are similar to those found in the Geometry Options group of the AutoCAD DWG/DXF Import Options dialog box that you see when you import a DWG or DXF file using the Application menu's Import option.

FIGURE 5.45
The Basic tab of the
File Link Settings
dialog box
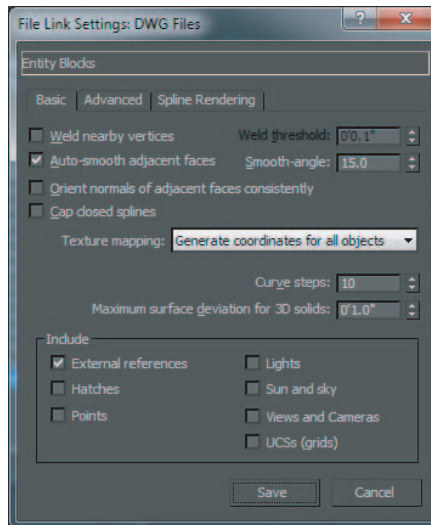
Weld Nearby Vertices   This option determines whether coincident vertices of imported objects are joined, or *welded*, together to form a contiguous object. When Weld is turned on, the Weld Threshold setting is used to determine how close together objects need to be before they are welded.

Auto-Smooth Adjacent Faces   This option determines whether to apply smoothing to contiguous surfaces in imported objects. When Auto-Smooth is turned on, the Smooth-angle setting is used to determine the minimum angle to which smoothing should be applied.

Orient Normals Of Adjacent Faces Consistently   This option attempts to align all the normals of an object so that they point outward from the center of the object.

Cap Closed Splines   This option causes 3ds Max to apply an Extrude modifier to closed objects such as closed polylines or rectangles.

Texture Mapping   The options in this drop-down list determine whether 3ds Max generates mapping coordinates for imported mesh objects. The Generate Coordinates For All Objects option creates mapping coordinates for all mesh objects, which may take a while with a complex 3D AutoCAD file. This option should always be used when importing AutoCAD Architecture files that already have mapping coordinates assigned to their objects. The Generate Coordinates On-Demand option causes 3ds Max to assign mapping coordinates automatically to Linked Geometry when a mapped material is assigned to it.

Curve Steps   This option gives you control over the way curves are converted. A low Curve Steps value causes curves to appear as straight segments, and higher values generate a more accurate curve.

Maximum Surface Deviation For 3D Solids   This option controls tessellation in 3ds Max on objects that are converted from AutoCAD 3DSOLID entities. Small numbers produce accurate surfaces with a greater number of faces, whereas larger numbers use less memory but produce less-accurate surfaces with fewer faces.

Include   This group of options has a number of check boxes that can be toggled to indicate which categories of objects you want to link into 3ds Max. The choices include External References (these are XRefs from AutoCAD, not 3ds Max), Hatches, Points, Lights from AutoCAD, Sun and Sky objects, Views and Cameras, and UCSs (Grids) (UCS stands for User Coordinate System).

LINKED HATCHES INCREASE FILE SIZE

It is generally not a good idea to include Hatch patterns in a file link. 3ds Max cannot store the entities making up the pattern in as efficient a way as AutoCAD, and the result usually consumes far too much memory, results in too large a file size, and requires too much translation time.

THE ADVANCED TAB

The options on the Advanced tab give you control over the way AutoCAD primitives are derived, as well as several important settings and the possibility of selectively reloading only a portion of the linked file.

Derive AutoCAD Primitives By   The Derive AutoCAD Primitives By drop-down option is available only when modifying a preset.

This option lets you determine how entities from AutoCAD are treated in 3ds Max. Perhaps the simplest choice from this drop-down list is Layer, Blocks As Node Hierarchy, which converts AutoCAD layers to Linked Geometry and blocks into a node hierarchy. The similar Layer, Blocks As Node Hierarchy, Split By Material option converts AutoCAD layers to Linked Geometry and then further subdivides the AutoCAD objects on each layer by the materials assigned to them. Blocks using this option are assigned a node hierarchy. The next

option is Entity, Blocks As Node Hierarchy, which converts AutoCAD entities to Linked Geometry and blocks into a node hierarchy.

You may also choose Layer, Entity, Color, or Color and Material, which groups AutoCAD objects by their layer, entities, color, or color and material and then converts them to Maxblocks. The Entity option creates an object for each entity in the AutoCAD file. The One Object option turns the entire AutoCAD drawing into a single Maxblock.

Select Layers To Include   Click this button to open the Select Layers dialog box, where you can choose the option Skip All Frozen Layers (default) or Select From List. The Select Layers To Include button is grayed out unless you are reloading a linked file. Layers that are checked are linked, regardless of their layer state in AutoCAD. Note that the layer state data shown in the dialog box is for your information only—it is not functional and does not update in AutoCAD. This button is also available on the Attach tab.

Create Helper At Drawing Origin   This option will include an Origin Point helper object with the linked file that appears as LinkOriginPtHelper in the modifier stack if you select the helper. This helper is placed at the origin of the linked file to help identify its origin and to facilitate alignment of other files.

Use Extrude Modifier To Represent Thickness   When checked, this setting will apply an Extrude modifier matching the height of any entities that have a thickness value. Note that thickness is a very old concept (prior to AutoCAD release 12) from the early days of 3D modeling in AutoCAD, and that it is not in wide use today. Most contemporary 3D modeling is done with surfaces or solids in AutoCAD.

Create One Scene Object For Each AutoCAD Architecture One   When this option is checked, AutoCAD Architecture–specific objects, such as doors and windows, are imported as single objects rather than each component being imported separately.

Use Scene Material Definitions   This option matches material names coming from an AutoCAD file with material names in 3ds Max. When there is a match, the material names in 3ds Max are used when checked. When unchecked, the material names are always taken from the DWG file. Note that DXF files do not support materials.

Use Scene Material Assignments On Reload   This important option allows you to maintain the materials you have assigned in 3ds Max after you reload a DWG file. When unchecked, the materials from AutoCAD will overwrite materials made in 3ds Max when the linked file is reloaded.

Selective Reload   Check Selective Reload when you want to reload only a subset of all the objects in the linked file. You may want to do this if you do not want subsequent changes made in the CAD file to be linked into 3ds Max. Selective Reload can also be used in complex scenes to minimize the time spent loading the entire linked database.

When Selective Reload is on, either you can select the objects to reload in the scene manually, or you can select them from the Select Linked Objects dialog box by clicking the Linked Objects button. This option is available only when reloading a linked file.

AUTODESK PRODUCTS THROUGHOUT THE PRODUCTION PIPELINE

A major jewelry store chain was redesigning its freestanding stores complete with a customer lounge, jewelry design rooms, and a childcare area. A Cleveland-based architectural firm was tasked with defining the store design and creating the construction documents (CDs) for the new store template. Part of the design process included creating renderings for approval by the client. The firm's pipeline for larger projects used Autodesk products at each phase.

Revit (see "Linking Revit Files into 3ds Max" later in this chapter) was first used to design the building and create the construction documents. Walls, doors, windows, partitions, and so on were all modeled in Revit. AutoCAD or AutoCAD Architecture was then used to model the interior components such as the display cases, point-of-sale features, fixtures, and signage. The AutoCAD drawings were imported into Revit, and then elevations, sections, views, and notes were all defined and assembled into a complete set of drawing sheets.

To create the renderings, the structural components from Revit and the interior components from AutoCAD were then linked to a 3ds Max scene. Materials, lighting, and animation were completed in 3ds Max and sent electronically to the client for review. Required changes were made in Revit or AutoCAD, and were reflected in the 3ds Max scene or in 3ds Max itself, and then revised renderings or animations were made.

Through the interoperability of several Autodesk products, the architectural firm was able to increase productivity and quickly address the client's needs.

THE SPLINE RENDERING TAB

The options in the Spline Rendering tab, shown in Figure 5.46, give you control over the way AutoCAD splines and polylines are imported into 3ds Max. Renderability, appearance, smoothing, and mapping coordinates are controlled through this tab.

FIGURE 5.46
The Spline
Rendering tab of the
File Link Settings
dialog box
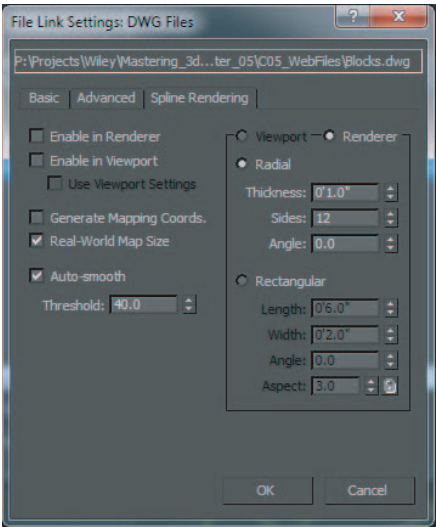
Enable In Renderer   When this option is checked, imported shapes are rendered as 3D geometry using the settings in the Viewport/Renderer section. See the Viewport/Renderer description later in this list for a description of these settings.

Enable In Viewport   This option determines whether the shape is displayed in the viewports using the Viewport/Renderer settings. When Enable In Viewport is on, the Use Viewport Settings option becomes available. Use Viewport Settings toggles on the Viewport option in the Viewport/Rendering group.

Generate Mapping Coords.   When this option is checked, mapping coordinates are applied to the shapes, thereby allowing control over the appearance of mapped materials. The default U mapping direction consists of a single loop around the shape, and the V mapping direction follows the length of the shape.

Real-World Map Size   This option determines whether a map's scaling is controlled by the material's Use Real-World Scale settings.

Auto-smooth   This option controls the smoothing of the splines based on the Threshold parameter. When this option is checked, adjacent segments are smoothed when their angular difference is less than the Threshold value.

Viewport/Renderer   Turn on these options to set the rendering appearance of splines in the viewports and in rendered scenes. The Radial option creates a rounded cross section while the Rectangular option consists of straight sides. It is common to have different Viewport and Renderer settings with less-dense geometry created in the viewports and more-dense geometry in rendered views. The Viewport option is available only when Enable In Viewport is checked.

Linking files into 3ds Max allows you to maintain a single design database that begins in AutoCAD and continues seamlessly into 3ds Max. File linking makes a good alternative to simply importing an AutoCAD file directly by clicking the Application menu and choosing the Import option because of the connection that carries into the future between the AutoCAD and 3ds Max databases. You can always use the Bind option to sever the link and make the imported data a stand-alone 3ds Max file, but be aware that you lose the benefits that accrue to those who use both AutoCAD and 3ds Max together in a continuing relationship throughout the design workflow.

Importing Adobe Illustrator Files into 3ds Max

If you are doing television commercial work, animation graphics for use on monitor screens in television or film, or other motion graphic work, you will most likely get Adobe Illustrator files from the graphic artist, Production Design departments, or your clients directly. These files could be computer interface designs, logos, and so on. Sometimes you might even get prop designs or set floor plan and elevation designs in Illustrator format. Adobe Illustrator is an amazing product for creating vector graphics.

When working with Adobe Illustrator files in 3ds Max, there are some important things to understand about importing the AI files. Unlike AutoCAD, Illustrator is designed primarily for creating graphics and drawings, and it has tools far superior for that purpose that 3ds Max doesn't understand. In addition, Illustrator only deals with units as large as inches (points, picas, centimeters, and millimeters), so when you do import an AI file, the files will not come in very large. Sometimes you might want to create an extremely large art board in Illustrator

and scale up the vector artwork considerably before saving the file to bring into 3ds Max. As with AutoCAD files, Adobe Illustrator files have to be properly prepared before importing them into 3ds Max to get the best results. If you don't have access to Adobe Illustrator, you will have to have someone in the Art department use the Illustrator File ➢ Save As command and, in the Illustrator Options dialog box that opens, change the Version to Illustrator 8. This is the best Illustrator file format for bringing graphics into 3ds Max. This will cause Illustrator to convert content that's capable only in its newest versions to something compatible to the earlier format. Saving down to Illustrator version 8 works well for me, but many users say that saving all the way back to Illustrator 3 is the only method that works reliably for them to import into 3ds Max.

It might work best, depending on the complexity of the artwork, to convert all text to outlines, especially if the art was created on a different system that the one you are using and has fonts that 3ds Max cannot access, and simplify the art as much as possible. 3ds Max also does not respond well to Illustrator files that are small. It is recommended to scale up the art in Illustrator greatly before saving to import into 3ds Max.

1. Reset 3ds Max.

2. Choose the Application menu, and click Import. If the submenu opens, you can select Import from there as well.

3. In the Select File To Import dialog box, change the Files Of Type drop-down menu to All Formats; then browse to where you have saved this chapter's files, which you downloaded from the Sybex website. Then select the `Special_Report_AI8.ai` file and click Open.

   This file represents the Japanese Kanji for Special Report (or Special Bulletin) and the Kanji has been converted to outlines from the TrueType font that was used to create it. The file was created in Adobe Illustrator CS5, but it has been saved with a suffix of AI8 to identify it easily to the creator and the 3ds Max user who will import it. It is always a good idea when exporting or "saving down" a file to a previous version to name the file appropriately. This also helps prevent overwriting the original file with one that has been prepared for a special purpose.

4. You are presented with the AI Import dialog box.

   If you are bringing a logo or element into an existing scene, you should select Merge Objects With Current Scene; if you want the art isolated from everything else, you should use the Completely Replace Current Scene option.

5. Leave the Merge objects with current scene option selected and click OK.

6. Next, you see the Shape Import dialog box.

   The Shape Import dialog gives you the option to import the artwork as one object or as multiple objects. The decision will depend on the artwork itself and what you plan to do with it once it's imported into 3ds Max. However, very few choices in 3ds Max are completely permanent, so for now, since you haven't seen a sample of the artwork yet (something that happens more often than not in production) and don't know what to expect, you will bring the art in as one object.

7. Leave the Single Object option selected and click OK.

   In a flash, the artwork appears in your 3ds Max viewport, as shown in Figure 5.47.

FIGURE 5.47
The Illustrator artwork in the 3ds Max viewports
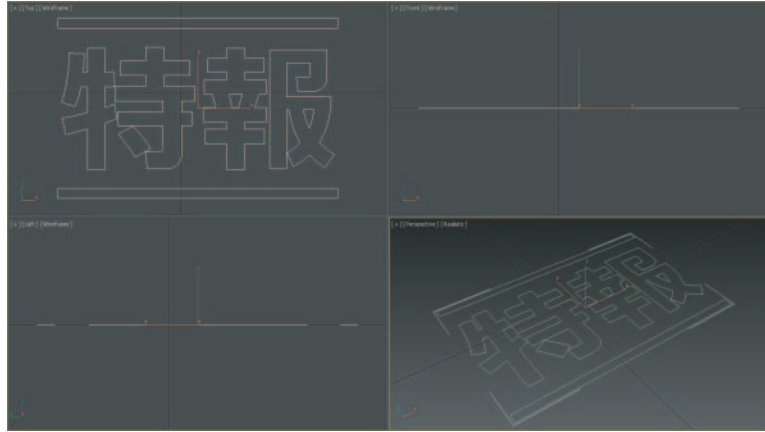
Now that you can see the artwork that you were provided, you realize that it would be an interesting animation to have the different components of the graphic fly in from different places in space and then form the completed art. However, you imported the art as one object. Not to worry—you can easily fix that.

1. With the artwork still selected, go to the Command panel and, in the Name and Color rollout, change the name to **SpecialReportLogo**.

2. Click the Modify tab of the Command panel.

Look at the modifier stack, and see that the artwork is an Editable Spline object.

3. Click the Spline Sub-object Level button.

4. Select the bottom horizontal bar of the artwork.

5. Scroll to near the bottom of the Geometry rollout, and click the Detach button, as shown in Figure 5.48.

FIGURE 5.48
Click Detach.
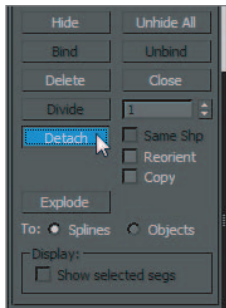
6. In the Detach dialog box that appears, enter **SpecialReport_LowerBar** and click OK.

7. The SpecialReportLogo shape is still selected. Select the top horizontal bar, detach it, and name it **SpecialReport_TopBar**.

8. Select the first character on the left. It consists of only one shape. Detach it, and name it **SpecialReport_C1**.

9. The next character is made up of two separate shapes. However, you want to treat them as one, so select both shapes using Ctrl+click, detach them, and name the shape **SpecialReport_C2**.

10. The next character has a void in the middle, just like the second floor of the Villa you worked on previously. For the character to extrude properly, both the outer and inner splines have to be part of the same shape, so using Ctrl+click, or by using the Crossing window, select both parts of the character.

11. Detach the selected splines, and name them **SpecialReport_C3**.

12. The last character is now the only spline left from the original artwork, so click Editable Spline to get out of sub-object mode, and then rename the character **SpecialReport_C4**.

You have now created six splines that make up the logo. Now you need to make them 3D so that they will look good on TV or in any project for which they might be used.

1. Press Ctrl+A on the keyboard to select all the splines.

2. Just as you did when extruding the walls previously, go to the Modifier List and click the down arrow to open the menu. This time, instead of using Extrude, select Bevel.

3. In the Bevel Values rollout, set the Starting outline to **-.25″**.

4. Set the Level 1 Height and Outline values to **.25″**.

5. Check the empty box in front of Level 2, and set the Height to **8.25″**.

6. Check the empty box in front of Level 3, and set the Height to **.5″** and the Outline to **-.5″**. Your perspective viewport should look like Figure 5.49.

FIGURE 5.49
The finished Special
Report logo
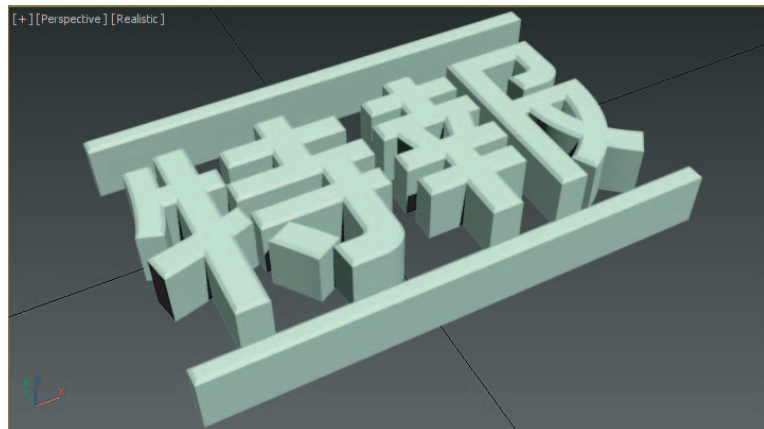
7. Save your scene as **MySpecial_Report.max**.

As with the wall shapes you extruded earlier, the Bevel modifier is instanced on all six shapes. Thus, if you select one of the shapes and make a change to any of the Bevel values, all

the shapes will change accordingly, which can be very helpful if you have someone over your shoulder requesting changes.

You can use many of the tools and mesh-editing techniques that you learned in Chapter 3 and Chapter 4 to detail this text further for use as content for a motion graphics–style animation, sometimes called *bumpers*, that might represent the beginning or ending of an urgent news bulletin on a major news network.

Importing Autodesk Inventor Files into 3ds Max

Another application from which you will probably get source files for your projects is Autodesk Inventor. This is a 3D mechanical design solids-modeling program that is used to create accurate 3D digital prototypes of mechanical components that can be validated against a number of criteria and have various simulations performed on them. Inventor can also be used to create the proper 2D or 3D documentation for manufacturing and further visualization. You can find out more about Autodesk Inventor at the Autodesk products website by clicking the Inventor Products link.

The files for the following exercises are provided by Curtis Waguespack. They are taken from the exercises his book, *Mastering Autodesk Inventor 2013 and Autodesk Inventor LT 2013* (Sybex, 2012).

1. Reset or restart 3ds Max 2013, and make sure your units are set to US Standard Feet w/Decimal Inches and that the Default Units are set to Inches.

2. Click the Application menu, and select Import.

3. In the Select File To Import dialog box, click the Look In drop-down menu and navigate to the location on your hard drive where you saved this chapter's files.

4. In the Files Of Type drop-down menu, select the Autodesk Inventor (`*.IPT,*.IAM`) entry.

5. Select the `01_Simple Engine.iam` file and click Open.

6. 3ds Max will process for a moment, and then the Autodesk Inventor File Import dialog box will open, as shown in Figure 5.50.

   The Autodesk Inventor File Import dialog box provides you with a number of options that control how 3ds Max imports the data. The Import As group has two available options: Body Objects and Meshes. Body Objects are an object class that natively supports the ACIS solid models imported from Autodesk Inventor and represent a technology that is licensed from NPower Software. For more information about Body Objects, you can read about this topic in the 3ds Max 2013 Help system.

   In the Assembly Options group you can choose Reference Duplicate Parts to save file size and system resources. You can also select Create Layers By Material, and if you want have the object's name added to the material name, you can do this by checking the Add Object Name To Material box.

   The Merge/Replace Options group is similar to the options in many of the other Import dialog boxes. You can merge the new data with the currently open scene, or you can replace all the existing content in the scene with the Inventor file.

The Material Options group allows you to bring or not bring across the Autodesk Inventor materials, and it also allows you to assign Material IDs to the data. Mesh Resolution is a horizontal slider that you can use to set the amount of detail with which imported mesh will be tessellated. A value of 0 brings the mesh in at the same resolution of the Inventor model, while lower values will have less detail and higher values will come in with more faces.

The Inventor File Vertical Direction option allows you to determine which axis in the Inventor file is set to the X-axis in 3ds Max.

FIGURE 5.50
The Autodesk Inventor File Import dialog box
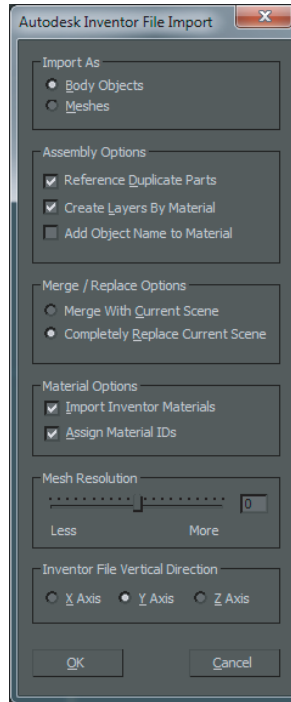
1. Accept all the default values in the Autodesk Inventor File Import dialog box, but change the Inventor File Vertical Direction setting to Z Axis and click OK.

2. 3ds Max will process the data for a moment, and you will see the model in your viewports, as shown in Figure 5.51.

If you wish, click Zoom Extents All to see the whole Simple Engine object.

1. Click the Modify tab of the Command panel. Notice that only the name of the object appears and nothing appears in the Modifier List, as shown in Figure 5.52. This is because the Inventor file has been imported as a group.

2. On the Main Menu Bar, select Group ➢ Open.

3. Click the Select By Name button on the Main Toolbar, and click the plus (+) symbol in the Select From Scene dialog box to expand the group, as shown in Figure 5.53.

FIGURE 5.51

The Simple Engine Autodesk Inventor file in the Perspective viewport
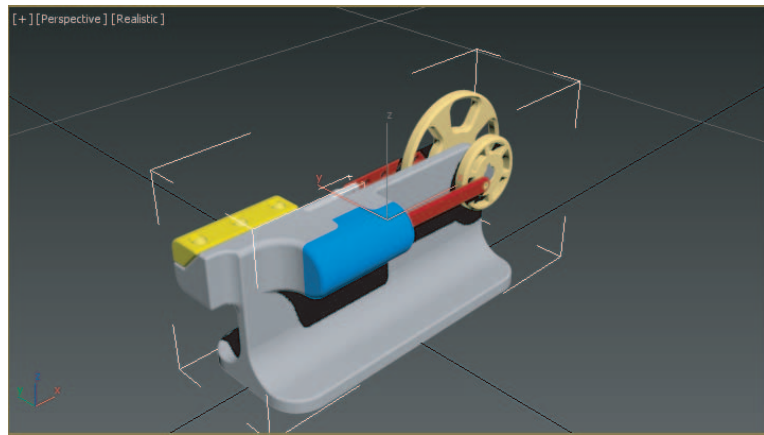
FIGURE 5.52

The imported Inventor file selected and displayed in the Modifier List
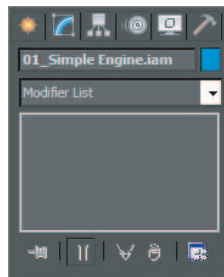
FIGURE 5.53

The Select From Scene dialog box showing the components of the `01_Simple Engine.iam` group.
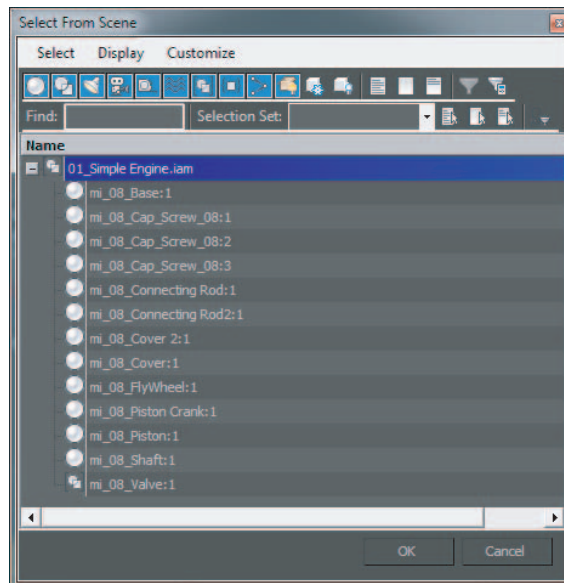
4. Click OK to dismiss the Select From Scene dialog box.

5. Open the Compact Material Editor. Although you will work with materials primarily in Chapter 8, this will show you briefly how the materials came across into 3ds Max from Autodesk Inventor.

6. Click the Get Material button to open the Material/Map Browser dialog box.

7. Close the Materials and Maps rollouts by clicking the plus (+) symbol to bring the Scene Materials group up to near the top of the dialog box, as shown in Figure 5.54.

FIGURE 5.54
The Scene Materials rollout showing the imported materials
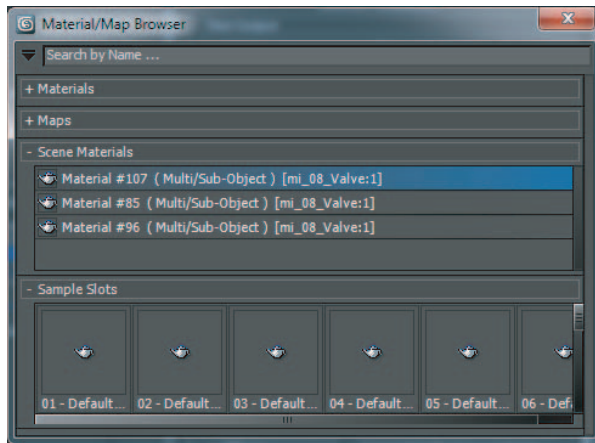
The Inventor model came over with three Multi/Sub-Object materials.

8. Close the Material/Map Browser and the Compact Material Editor.

9. Save the scene as **My_Imported_InventorModel_01.max**.

You have now learned how to import an Autodesk Inventor solid model into 3ds Max. After you have finished working through Chapter 8, you should return to this file, explore the imported materials, and see how you can modify the materials or create and apply new materials to the objects for when you want to render this file.

Using the Substitute Modifier with Linked Geometry

You can substitute a complex piece of furniture modeled in 3ds Max for a simple outline drawn in AutoCAD. Designers often do space planning in AutoCAD with simple 2D blocks that are drawn to scale. You can link a space-planning drawing into 3ds Max and then proceed to substitute a complex 3D version of a piece of furniture for a simple 2D block. After seeing the more realistic depiction of the scene in 3ds Max, a designer may want to revise the space plan in AutoCAD. The AutoCAD DWG file can then be reloaded in 3ds Max, and the changes automatically affect the complex 3D models in the scene. Let's try out this idea:

1. Open the MyBlocks.max file you saved earlier, or open Blocks.max.

2. Select the rectangular polyline in the foreground. Note that it appears as Linked Geometry in the modifier stack.

3. Apply the Substitute modifier to the object.

4. Click the Select XRef Object button in the Parameters rollout, as shown in Figure 5.55. Note that you also have the option to pick an object that is already in the scene for the substitution.

FIGURE 5.55
The Substitute modifier's Parameters rollout
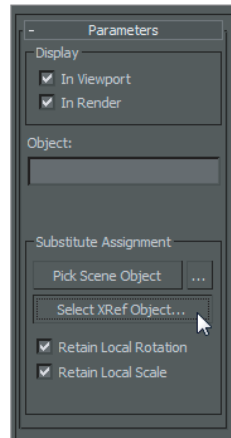
5. Select the `Worktop.max` file and click Open. This is a free 3D model of a desk worktop from ScottOnstott.com.

6. The XRef Merge dialog box appears, listing the objects that are in `Worktop.max`. Select Worktop01 and click OK.

7. Answer Yes to the Substitution Question dialog box that asks, "Do you want to assign the substitute object's material to this object?" The 3D model appears in the viewport, substituting for the rectangular polylines that were there previously (see Figure 5.56).

FIGURE 5.56
The substituted geometry in the viewport
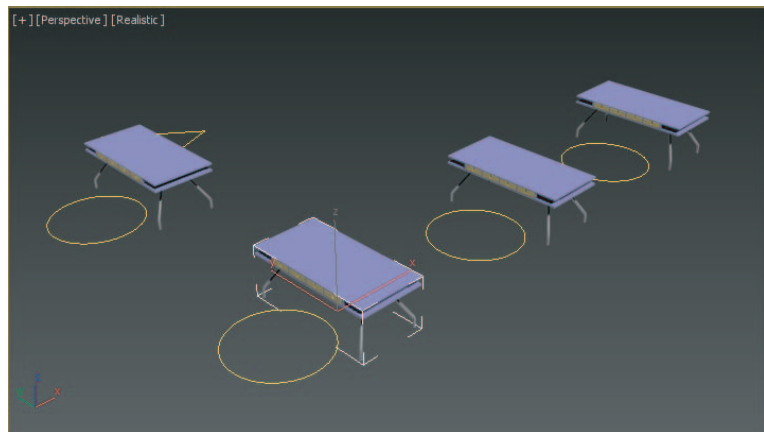
8. Select the circle in the foreground, and apply the Substitute modifier to this Linked Geometry.

9. Click the Select XRef Object button again, and select the `Chair.max` file. (This is part of the collection of free designer furniture models at the same website.) Click Open.

10. Select the object Chair01 from the XRef Merge dialog box and click OK.

11. Answer Yes again at the Substitution Question dialog box that appears.

12. Rotate the chair and observe that it behaves exactly as the circle did within the linked block node hierarchy. All the block instances of the chair rotate accordingly, as shown in Figure 5.57.

13. Save your file as **MyBlocks_Sub.max**.

FIGURE 5.57
The substituted geometry behaves like the linked geometry.
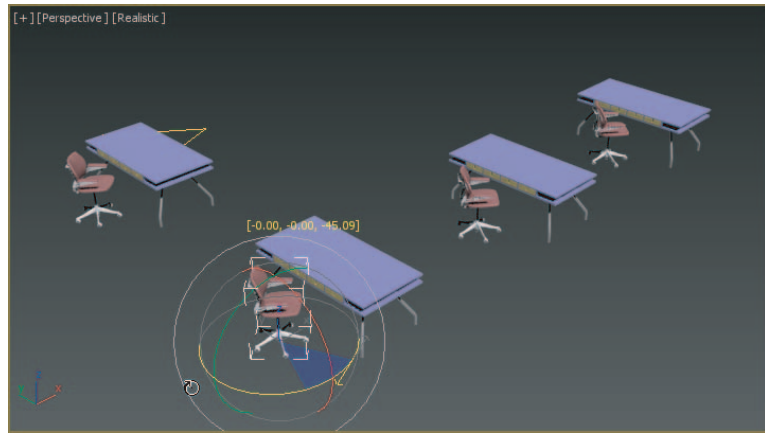
RENDERING LINKED SPLINES

You can make linked splines render by applying the Renderable Spline modifier.

You have now seen how easy it is to link a 2D space plan drawn in AutoCAD into 3ds Max and then to substitute more complex geometry in 3ds Max for the simple blocks from CAD. The benefits of such an approach are that you are using each application for what it does best: AutoCAD for drafting and 3ds Max for visualizing 3D models. Not only are you focusing on the strengths of the applications you use in your workflow, but there is a dynamic link between the programs so that there can be a design dialogue, and changes can be incorporated using the best tools for the job.

Importing a Truss

Frequently, you may be called on to include a truss in your projects. If it's a flat truss, you can draw a side view of the truss in AutoCAD using closed polylines (or in Adobe Illustrator using Shapes) and then import the drawing to 3ds Max and extrude it in a way similar to the floor of

the earlier `savoye-second.dwg` example. If you import the truss line drawing as a single object, 3ds Max will automatically subtract the truss web from the outline of the truss, as shown in Figure 5.58.

FIGURE 5.58
An AutoCAD drawing of a truss at the top and the extruded 3ds Max object
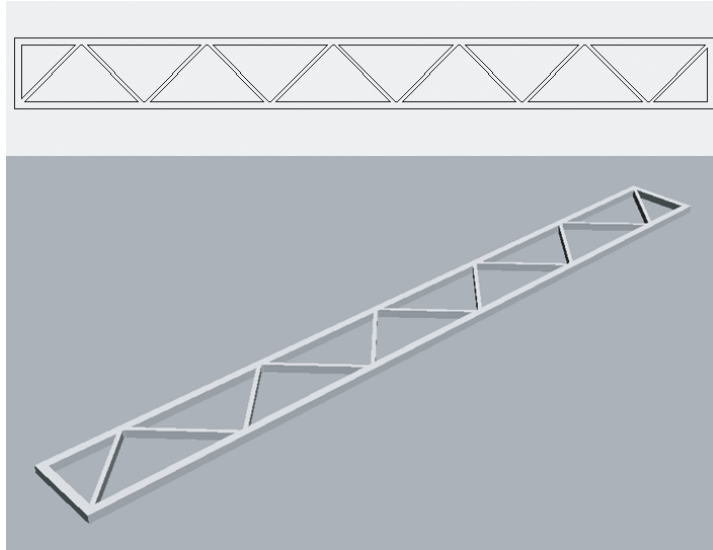
Tubular trusses can be created easily from engineering 3D line diagrams. Figure 5.59 shows an AutoCAD diagram of a truss whose components are to be made of tubular steel. The different diameters are represented by different layers in this model.

FIGURE 5.59
A 3D line diagram of a truss in AutoCAD
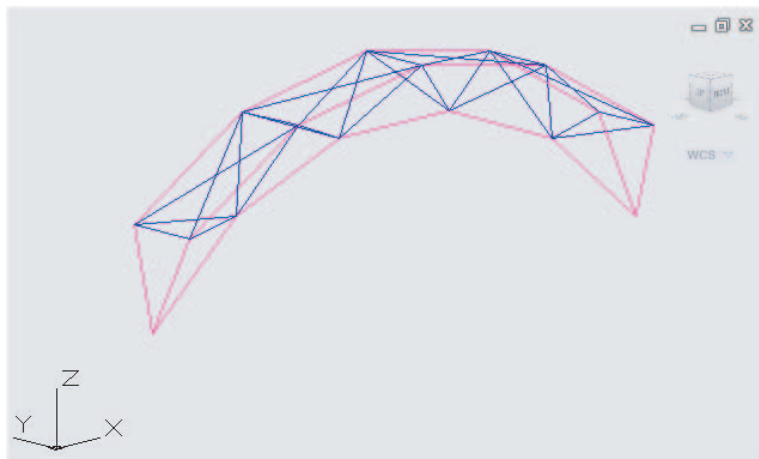
The following exercise will show you how the model can be turned into a renderable truss in 3ds Max:

1. Click the Application menu, choose Reset, and then click Yes to reset 3ds Max.

2. Click the Application menu, choose Import, and then select and open the `truss.dwg` file.

3. The AutoCAD DWG/DXF Import Options dialog box displays.

4. Make sure that the settings in the AutoCAD DWG/DXF Import Options dialog box are the same as those shown in Figure 5.60. Click OK.

FIGURE 5.60
The AutoCAD DWG/DXF Import Options settings
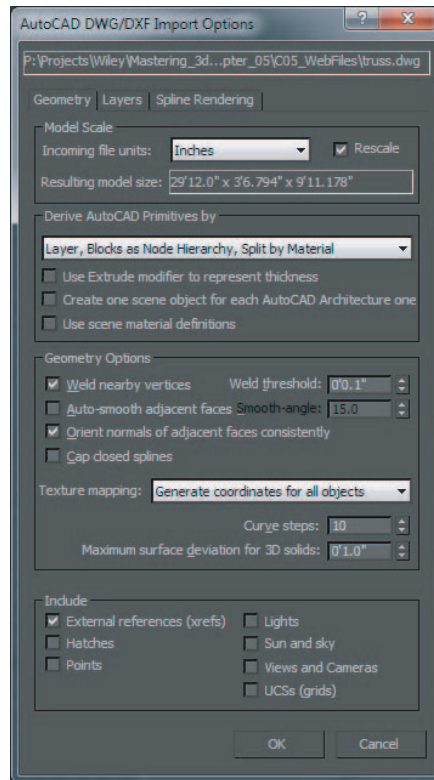
The truss displays in the 3ds Max viewport.

With the truss imported into 3ds Max, you only need to change a parameter to alter the way the lines are rendered:

1. Select one of the truss's struts. Layer:brace appears in the name field at the top of the Command panel. You can also use the Select From Scene dialog box to select the Layer:brace object.

2. Click the Modify tab of the Command panel.

3. Open the Rendering rollout, check both the Enable In Renderer and Enable In Viewport options, and change the Thickness to **4″**.

4. Select the Layer:main object, the main frame around the truss.

5. In the Command panel, check both the Enable In Renderer and Enable In Viewport check boxes and change the Thickness value to **6"**.

6. Deselect the truss object.

7. Click the Display tab of the Command panel.

8. In the Display Color rollout, click Object Color for the Shaded display color. The viewports now display the AutoCAD linework as tubes, as shown in Figure 5.61.

9. Save your scene as **My_Truss.max**.

FIGURE 5.61
The tubular truss
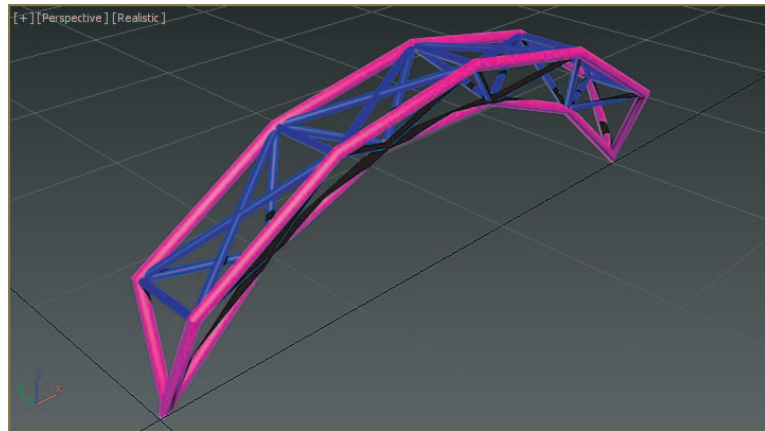
METHODS FOR RENDERING SPLINES

You can use the Manage Links dialog to import linked AutoCAD drawings and still use the Spline Rendering tab parameters to create the truss shown in the preceding exercise. You can also use the Renderable Spline modifier if you prefer. To create actual geometry around the splines, consider using the Sweep modifier.

You saw this earlier in Chapter 4, where you were quickly introduced to the Rendering rollout of the Editable Spline object. Here you see a practical use for this set of options. Without much effort in 3ds Max, you can create a reasonable-looking truss. You just need to remember to place the different-diameter truss members on different layers in AutoCAD before you import the file to 3ds Max.

You can also make quick work of window mullions using this method. Typically, mullions are square, but if they are to be viewed from a distance, you can use single lines for mullions and set up the Rendering rollout to have them render as rectangular section tubes.

Linking Revit Files into 3ds Max

The Revit family of software products appears to be the next step in BIM. Using AutoCAD Architecture or a similar CAD program, you can draw a 3D Wall object that has the form and volume of a wall but is still a simple 3D mesh. These objects tend to be flat-sided, and there

is little or no true information associated with the objects. Anybody viewing the drawing, as either a hard copy or within the CAD package, can deduce the composition of the wall only by reading a note or associated attribute.

Even the parametric Wall objects in 3ds Max are little more than mesh objects with a few parameters to control and adjust their appearance.

Revit handles walls and most other aspects of drawing a building differently. Walls, for example, are first created in families that define their construction. A 16″ on-center 2 × 4 stud wall with 5⁄8″ drywall and a 2-hour fire rating is different than an 8″ CMU (concrete masonry unit) wall with a brick fascia on one side and furring strips and drywall on the other. When either wall family is used in Revit, each component of the wall is created in the file. An estimator can query the file to determine the amount of each component necessary for the structure's construction. It's a snap to select one wall type and switch its family to determine how the project is affected.

Revit had a small but loyal following through its acquisition by Autodesk in 2002. Since then, its capabilities, stability, and integration with the other Autodesk products have led to a significant increase in the size of the Revit user base. As its integration into the workflow of many companies increases, the chances that you may work with a Revit file increase as well. Revit 2009 and newer let you export to 3ds Max via the Filmbox (FBX) file format. This works really well and carries lights and materials across platforms without hassle. The only drawback to FBX is that the file size is gigantic when compared to the alternatives. A 10 MB Revit file can become a 70 MB FBX file. For this reason, you often have to import your model in pieces to work with manageable file sizes.

Fortunately, you don't have to export to FBX anymore. In 3ds Max 2013, you can directly link the Revit RVT files into 3ds Max.

One of the benefits of using Revit with 3ds Max 2013 is the inclusion of the Autodesk Materials and the Autodesk Material Library, a set of more than 1,200 preset textures and materials that are common across all of Autodesk's 2013 products that use the mental ray renderer. We will discuss materials in Chapter 8, but you will be introduced to the Autodesk Materials here as we link an RVT file from Revit 2011 into 3ds Max 2013.

Revit Files Are Forward Compatible Only

Revit files are not backward compatible, and there is no method for saving a file to be compatible with a previous version of Revit. When a file from an older version of Revit is opened in a newer version of the software, the file is automatically upgraded to the newer version's file format. Included in the upgrade process with Revit 2013 is the immediate conversion of all materials in the older Revit file to the new Autodesk Materials. If you have older Revit projects with materials that you are very happy with, you may not want to open those projects in Revit 2013 or newer, because you will lose those materials.

Linking the Revit File in 3ds Max

It is important that you have your System Units configured to feet for elements such as lights and cameras to come in properly. Let's link in the RVT file you downloaded with this chapter's materials:

1. Open or reset 3ds Max.

2. Choose Customize ➢ Units Setup, and then click the System Unit Setup button.

3. On the System Unit Setup dialog box, use the drop-down menu to select Feet as the unit.

4. Click OK to close the System Unit Setup dialog box, and click OK again to close the Unit Setup dialog box.

5. Click the Application menu, and choose Import ➤ Link Revit.

6. On the Open dialog, navigate to the location where you saved this chapter's files, find the Revit file Shop_r2011.rvt, select it, and click Open. The Link Revit View dialog box appears and 3ds Max processes the file. Depending on your system, this process might take a while.

7. When 3ds Max has finished processing the RVT file, you are shown the Select Revit View dialog so that you can choose which 3D view to look at. Select Sun Study View, as shown in Figure 5.62, and click OK.

FIGURE 5.62
Select Sun Study View.
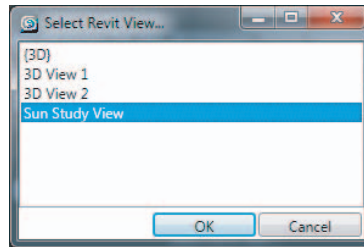
8. On the Manage Links dialog box, select the Presets tab, pick the Autodesk Revit – Do Not Combine Entities preset, and then click the Copy button.

9. In the New Settings Preset dialog box, rename the preset **My_RVT_Link** and click OK.

10. Select My_RVT_Link in the Named Presets window, and then click Modify.

11. In the File Link Settings dialog box that opens, make sure that the Keep 3ds Max Scene Material Parameters On Reload and Keep 3ds Max Scene Material Assignments On Reload options are selected; then click Save.

12. Click the Attach tab of the Manage Links dialog box; then click the Attach This File button. The system processes the file again; then the shop appears in the viewport.

13. Close the Manage Links dialog box.

You can see that the Perspective viewport is overexposed, the Revit file was set up to use the mental ray render, and 3ds Max is configured to use the Default Scanline Renderer. You will change the renderer and settings to get a better view of the model and materials, but materials are covered in Chapter 8 and mental ray is addressed in Chapter 14, "Advanced Rendering Using mental ray."

1. Click Render Setup from the Main Toolbar.

2. Scroll down to the very bottom on the Render Setup dialog box, and expand the Assign Renderer rollout, as shown in Figure 5.63.
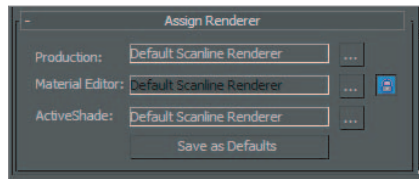
3. Click the ellipsis button at the end of the Production: line and, from the Choose Renderer dialog box, select NVIDIA mental ray and click OK.

4. Close the Render Setup dialog box.

5. Press **8** on the keyboard to access the Environment and Effects dialog box.

6. In the Exposure Control rollout, click the drop-down menu and select mr Photographic Exposure Control, as shown in Figure 5.64.

FIGURE 5.64
Select mr
Photographic
Exposure Control.
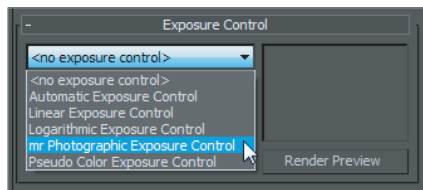
7. Click the Process Background And Environment Maps box, and close the Environment And Effects dialog box.

8. Now your Perspective viewport looks much better. Click the POV label in the Perspective viewport, select Cameras, and then select 3D View: Sun Study View. Your viewport should look like Figure 5.65.

FIGURE 5.65
The linked building

Next, you will see how the materials assigned in Revit are imported into 3ds Max:

1. To see the materials assigned to the shop building, on the Menu Bar choose Rendering ➢ Material/Map Browser.

   The use of the Material/Map Browser will be covered in greater detail in Chapter 8.

2. In the Material/Map Browser, use the scroll bar next to the right edge of the dialog box to find the Scene Materials rollout and, if it is closed, expand it by clicking the group heading. It might help to close the Autodesk Material Library rollout. The Scene Materials rollout expands to display the Autodesk Materials that are applied to the shop building (see Figure 5.66). If the Scene Materials rollout appears short, you can increase the size of its window by clicking and dragging the lower divider bar of the group to extend it.

3. Save your scene as `My_Shop.max`.

After you have finished working through Chapter 9, "Using the Camera," you should return to this scene and experiment with the camera and render settings to see what you can come up with.

Using the Scene Explorer

Now that you have linked the shop file into 3ds Max from Revit and seen how the Autodesk Materials transport, let's look at some of the geometry of the model using the Scene Explorer. The Scene Explorer is a modeless dialog box that you can use to accomplish many logistical tasks in 3ds Max, including viewing, sorting, selecting, renaming, hiding, and freezing objects in the scene; creating or modifying object hierarchy trees; and editing groups of objects at the same time. You can also use the Scene Explorer to see how many faces are on a particular object.

1. On the Menu Bar, choose Tools ➢ New Scene Explorer to create the first Scene Explorer in the scene.

FIGURE 5.66
The Material/Map Browser showing the linked Revit materials
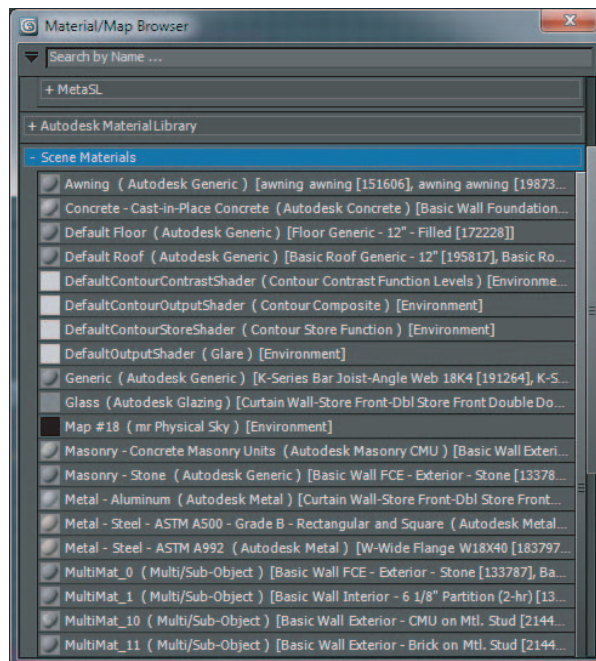
2. The Scene Explorer dialog box opens and the title bar of the dialog box says Scene Explorer – Scene Explorer 1, as shown in Figure 5.67. Click the plus (+) symbol to expand the scene node, Shop_r2011.rvt. You can create and save as many uniquely configured Scene Explorers as you need to maximize your workflows.

FIGURE 5.67
The Scene Explorer
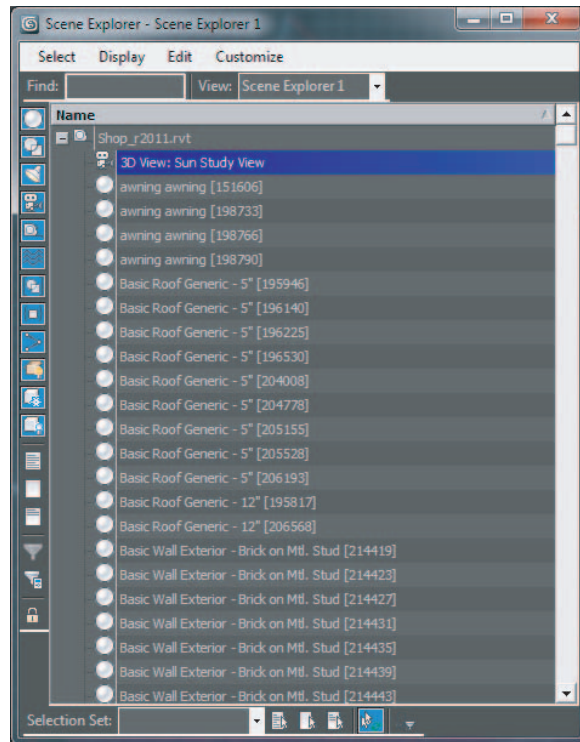
The Scene Explorer is showing you the contents of the Revit file that was linked using the Do Not Combine Entities preset, so every item in Revit is a unique item in 3ds Max. If you used the Combine By Revit Material preset, you would see the just the Revit Material names. However, because of the way the items are combined, you would lose access to additional information about the individual objects that can be displayed in the Scene Explorer.

3. On the Scene Explorer dialog box, choose Customize ⯈ Configure Columns to open the Configure Columns floater, as shown in Figure 5.68.

The Configure Columns floater is a dynamic list of columns that are available to add to the Scene Explorer dialog box, or you can move columns currently in the Scene Explorer back to the Configure Columns floater if you don't want them to display.

FIGURE 5.68
Some of the
additional columns
available on the
Configure Columns
floater
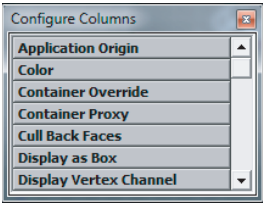
4. In the Configure Columns floater, drag the Faces button to the Screen Explorer dialog box
and drop it on the end of the Name column.

Now you can see how many faces each object has in the scene, as shown in Figure 5.69.
You will have to adjust the columns to see them.

FIGURE 5.69
The Scene Explorer
now showing how
many faces each
object has in the
scene
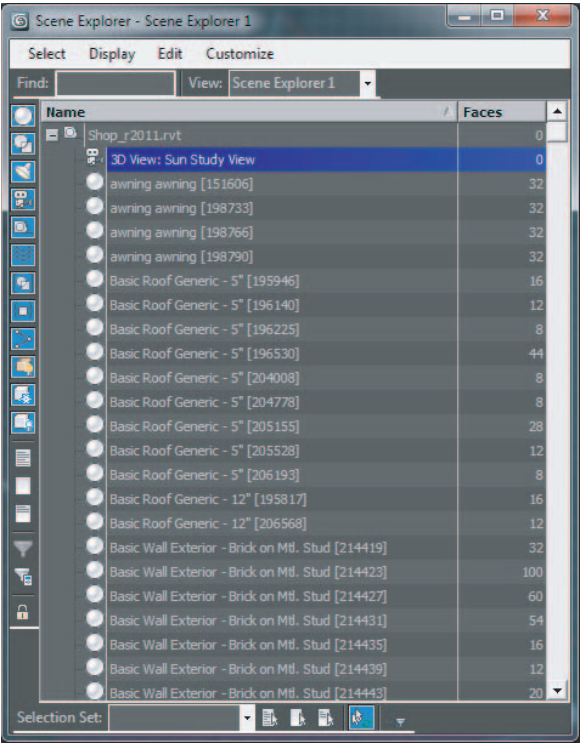
Now that you have the faces column in the Scene Explorer, you can sort the objects in the
scene to see which objects have the most faces.

5. Click the Faces column header in the Scene Explorer dialog box. Notice the up-pointing
triangle after the heading Faces and that the objects in the scene are sorted in ascending
order of number of faces per object.

6. Click the Faces column header again to see the list sorted in descending order of number of faces, as shown in Figure 5.70.
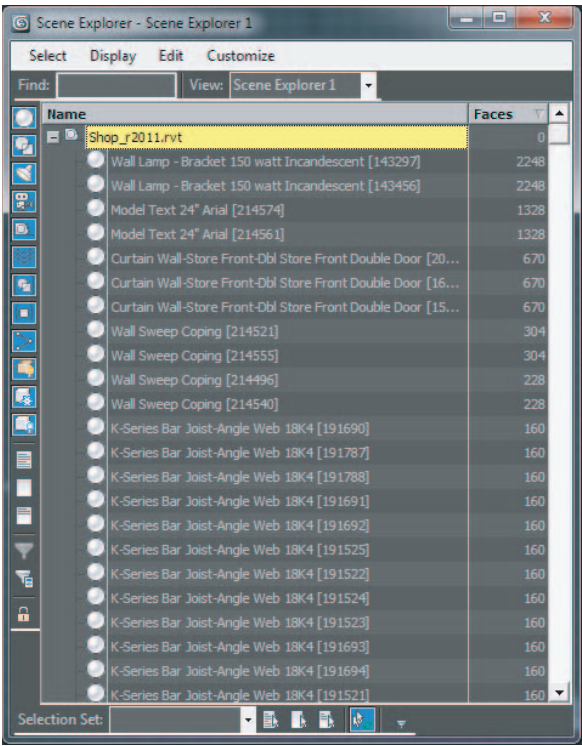
7. Close the Scene Explorer dialog box. Closing the Scene Explorer dialog will close the Configure Columns dialog box at the same time.

8. Resave your scene as `My_Shop.max`.

As you've seen in these exercises, Revit files are incorporated in 3ds Max scenes by linking the files right into 3ds Max. You have also seen how the new Autodesk Materials help improve workflow across the Autodesk 2011 and newer product lines. The benefit of linking directly to the RVT file is that any changes in the Revit file will be reflected in 3ds Max when the linked file is reloaded.

Importing FBX Files into 3ds Max

When working on projects, you might often need to get files, oftentimes called *assets*, from other sources, including other 3D artists who might be using a different 3D modeling application. As you saw earlier when you used the Select File To Import dialog box, 3ds Max can bring in a number of different file formats. One of the most common nowadays is the Filmbox (FBX)

format, and many applications can import and export this file type. In the next exercise, you will import a small FBX file.

1. Reset 3ds Max, and change the System Units back to Inches.

2. Select the Application menu ➢ Import.

3. On the Select File To Import dialog box, browse to where you downloaded this chapter's files.

4. Click the Files Of Type drop-down list, and look at all the file types that 3ds Max 2013 can import, as shown in Figure 5.71.

FIGURE 5.71
The file types that 3ds Max 2013 can import
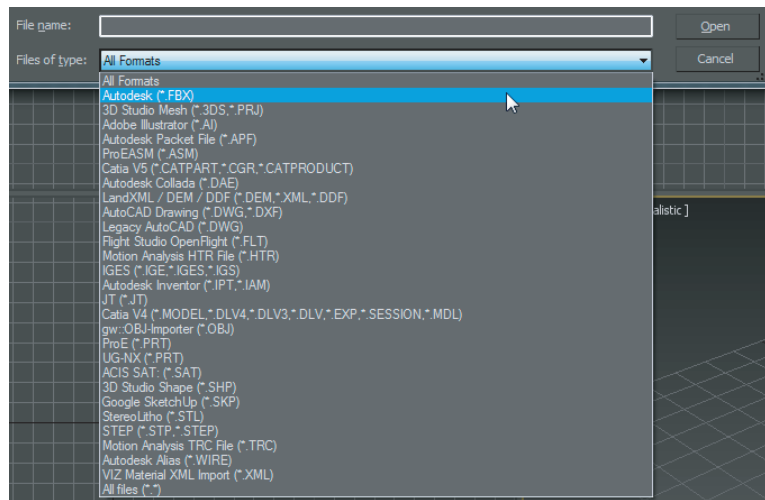
5. Select the Autodesk (*.FBX) format.

6. Select the Ship.fbx file and click Open.

7. The FBX Import (Version 2013.x) dialog box opens with all the information about the FBX file you selected, as shown in Figure 5.72.

8. In the Presets group, click the Current Preset drop-down menu. There are two choices: Autodesk Media & Entertainment and Autodesk Architectural (Revit). Select the Media & Entertainment preset.

9. At the bottom of the dialog box, click OK.

10. The model appears in the viewports, as shown in Figure 5.73, and the FBX importer has scaled the units and adjusted the Up value for you. It does this because the file was created in an application that uses the Y-axis as the "up" direction and 3ds Max uses the Z-axis as up.

FIGURE 5.72
The FBX Import
dialog
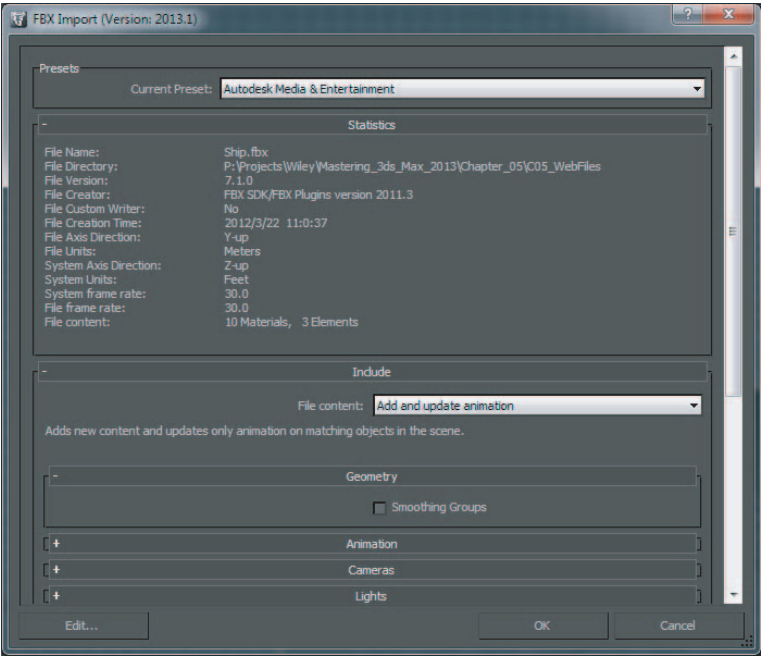
FIGURE 5.73
The imported Ship
model
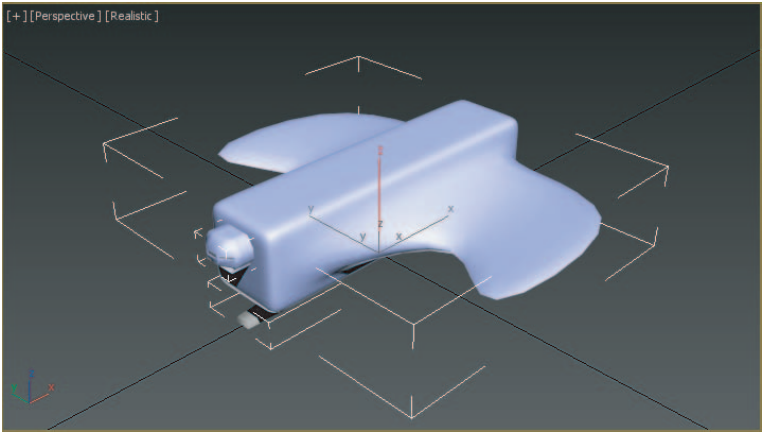
11. Open the Slate Material Editor (the button is found under the Compact Material Editor on the Main Toolbar), and scroll down in the Material/Map Browser to the Scene Materials rollout, as shown in Figure 5.74. The materials from the original file, as simple as they are, came across as Standard materials. However after you finish Chapter 8, you will know how to modify and improve those materials.

FIGURE 5.74
The materials from
the FBX file
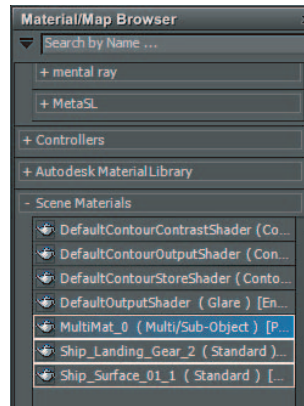
12. Save your scene as `MyShip.max`.

RESOURCES FOR FINDING ADDITIONAL FILES FOR USE IN 3DS MAX

There are many times when you will need to use resources that you didn't create in 3ds Max yourself, and there are a number of resources for getting good assets. TurboSquid (`www.turbosquid.com`) is an online marketplace for finding models, textures, and plug-ins. Many are free and some are very expensive. Another great resource for materials for your projects is Seek by Autodesk (`www.seek.autodesk.com`), which has over 100 free 3D trees from xfrog that are excellent for use as entourage. Seek also has 3ds, Maya, AutoCAD, and Revit files of all sorts of household, building, and construction items that you can use for free. Many are just 2D shapes, but you now know how to take 2D shapes and easily make professional 3D objects from them.

The Bottom Line

Create topography with splines.   Using the Terrain compound object, you can create flowing or layered surfaces defined by the height, shape, and location of the included splines.

Master It   Create a Terrain object in a shape that represents a valley that extends between two peaks. The summit of the peaks should be approximately 1,000' above the ground plane, and the valley should extend approximately 200' below it. Contour lines should be present for every 100' of elevation change.

Import AutoCAD plans into 3ds Max.   The Manage Links dialog box allows you to incorporate AutoCAD drawings into a 3ds Max scene while maintaining a link between the two files. Changes made to the DWG file are reflected in the 3ds Max scene whenever the drawing is reloaded.

Master It   Create a File-Link preset so that you can repetitively use the same settings when you file-link a drawing file into the 3ds Max scene.

Import Adobe Illustrator files into 3ds Max. When working on 3D projects, it is very likely that you will frequently get files that were originally created in Adobe Illustrator. When working with Illustrator files, you need to make sure that they are prepared properly before attempting to import them into 3ds Max, which involves simplifying the art as much as possible, converting text to outlines, and saving the file down to the Adobe Illustrator 8 format.

Master It Using the Import workflow, bring a properly prepared Adobe Illustrator file into 3ds Max and add a simple Bevel modifier to the imported data.

Import Autodesk Inventor files into 3ds Max. Autodesk Inventor is a software program that is often used to design complex mechanical components, test the models in virtual situations, and then prepare documentation for manufacturing or files for 3D artists to render and even animate.

Master It Use the Import dialog to bring an Autodesk Inventor file into 3ds Max.

Use the Substitute modifier. It is best to use your CAD application and 3ds Max to each of their strengths: drafting 2D plans with blocks for laying out space arrangements and then linking that plan into 3ds Max, extruding walls, and then using the Substitute modifier to replace 2D CAD blocks with the appropriate 3D models for rendering your views and presenting to the designers or clients.

Master It Using the Manage Links dialog box, attach `Classroom01.dwg` into a new 3ds Max scene. Using the Substitute modifier, replace the circles of the StudentDesk blocks with the `Chair.max` file and the rectangles with the `Worktop.max` file.

Link Revit files into 3ds Max. Revit is Autodesk's premier building information modeling (BIM) software. Using Revit, every element of a building's construction is modeled as a 3D component. The lights, materials, and views from Revit can all be incorporated into a 3ds Max scene.

Master It What is one method of bringing the components of a Revit file into 3ds Max?

A. Use the Link Revit command to link the native Revit RVT file into the 3ds Max scene.

B. Save the Revit file in Revit 2009 or earlier, and then use the Manage Links dialog box to link the Revit file to the 3ds Max scene.

C. Save the Revit file in Revit 2009 or earlier, and then click the Application menu and choose References ➢ Import to import the Revit file to the 3ds Max scene.

D. Use the Layer Manager to define the Revit layers to import, and then drag the file from Windows Explorer to a 3ds Max viewport.

Link FBX files into 3ds Max. When you are working on projects with other 3D artists who don't use 3ds Max, or you are getting resource files from sites on the Internet, you will very likely get files in the Filmbox (`.FBX`) format and then have to bring those files into 3ds Max.

Master It Use the Link FBX workflow to bring the `Singing_Tear.fbx` character object model into 3ds Max.

Organizing and Editing Objects

In this chapter, you'll work on a condominium model. You'll be introduced to the Loft compound object and the Sweep modifier, which allow you to extrude a shape along a path to create more complex forms. To be able to see your work clearly and continue working on the building, you'll need to employ some organizational tools. You'll learn more ways to create and edit extruded spline shapes. Along the way, you'll learn how to organize your work using object names and layers and aligning one object's location based on the location of another.

In this chapter, you will learn to

- ◆ (Re)name objects
- ◆ Loft a shape
- ◆ Organize objects with layers
- ◆ Deform an object with the Noise modifier
- ◆ Model with the Symmetry modifier
- ◆ Extrude with the Sweep modifier
- ◆ Align objects

(Re)Naming Objects

Perhaps one of the simplest and most important things you can do to help keep your models and scenes organized is to give the objects in your model meaningful names. You were introduced to this concept in Chapter 2, "Introducing Objects." Let's go ahead and name some of the parts of a condominium project, to prepare for creating more objects in the scene:

1. Open the C06_CondoA.max file. This is the condominium project you'll start to work with.

2. If the file opens with a single viewport displayed, press Alt+W, or click the Maximize Viewport toggle.

3. Click the Zoom Extents All tool to get a view of all the parts of your model.

4. In the Top viewport, zoom in and use the Select Object tool to select the wall, as shown in Figure 6.1.

5. In the Name And Color rollout of the Create tab of the Command panel, change the existing name to **Wall_Den**. If you're in the Modify tab, change the name that appears just below the Modify label at the top of the tab. (In fact, you can change the name of an object in any tab except the Utilities tab.)

FIGURE 6.1
Selecting the wall in
the Top viewport
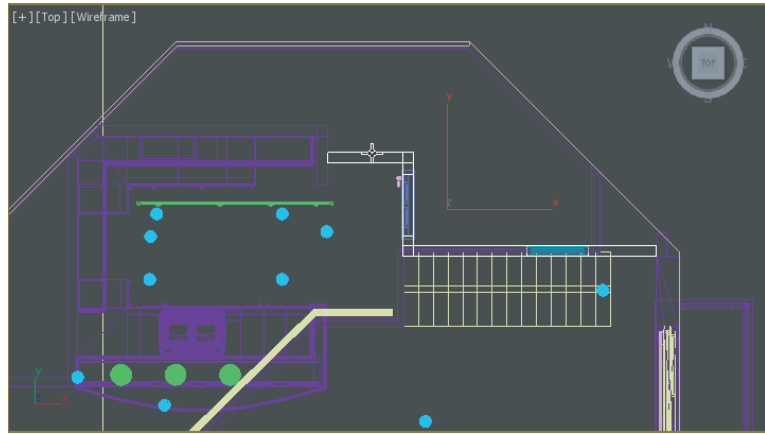
6. Select the pivot door in the middle section of the Wall_Den object, change its name
   to **Door_Den**, and then rename the sliding window in the long section of the wall to
   Window_Den.

7. Repeat this process for the three sliding doors, renaming them from top to bottom in the
   Top viewport to **Door_Patio_East**, **Door_Patio_Middle**, and **Door_Patio_South**. It will
   be much easier to accomplish this if you switch to the Perspective viewport and, using
   the viewport navigation tool, set your viewport as shown in Figure 6.2.

FIGURE 6.2
Renaming the slid-
ing doors and fixed
windows
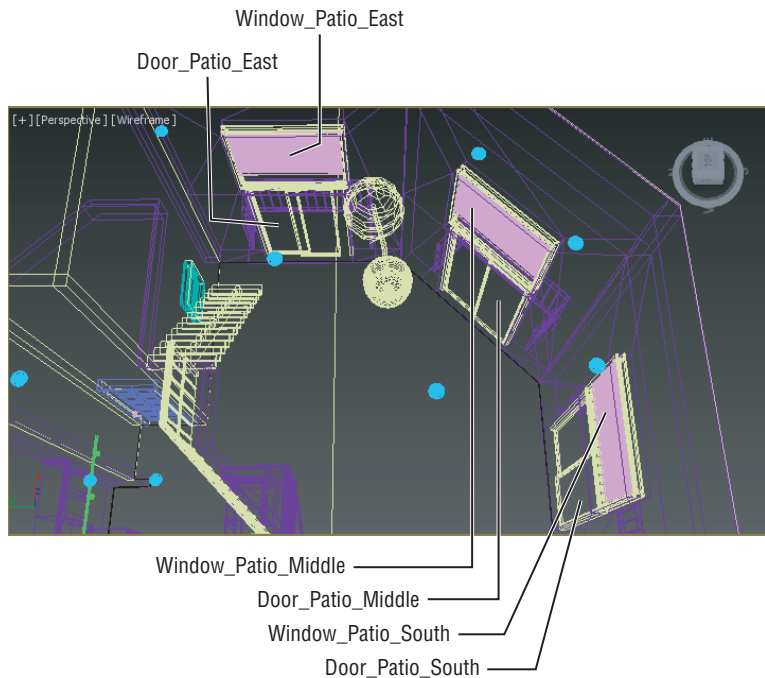
8. Next rename the fixed windows over the sliding doors to **Window_Patio_East**, **Window_Patio_Middle**, and **Window_Patio_South**, as shown in Figure 6.2.

Now that you've renamed the wall, windows, and doors, the next step is to rename the deck for each patio. Right now, it's difficult to access the decks because the railings are in the way in the plan view, and their arrangement in the other views is overlapping. The easiest way to get to the decks is to turn off the visibility of the rails temporarily. Let's do that in the next exercise:

1. Click the Select By Name tool on the Main Toolbar, or type **H** on the keyboard.

The Select From Scene dialog box appears (see Figure 6.3.)

FIGURE 6.3
The Select From Scene dialog box
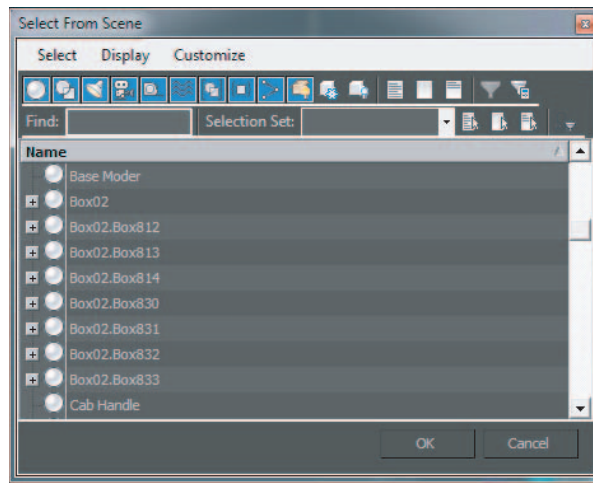
2. Click the Name column label to organize the objects alphabetically by name if necessary, and then Ctrl+click all of the objects with names that start with "Railing." Alternatively, you can select the first Railing object in the list and then Shift+click the last one to highlight all of them.

3. Click OK. The dialog box closes, and the objects are selected in the viewports.

4. Right-click in the viewport, and choose Hide Selection from the quad menu.

5. Using Figure 6.4 as your guide, rename the patio deck objects as you did the wall, window, and door objects. Use the Select Object tool to select a deck, and then use the Name And Color rollout to enter the new name.

Although you can use the Modify tab to change the name of an object, using the Create tab is faster for changing the names of multiple objects, because you don't need to wait for the object's parameters to load each time you make a selection.

6. To finish the process, redisplay the hidden railings. Right-click in the viewport, and choose Unhide By Name in the quad menu.

The Unhide Objects dialog box displays, as shown in Figure 6.5.

This is basically the same dialog box as the Select From Scene dialog box, but instead of listing all objects that are on, it shows only the objects that have been hidden.

Patio_East

Patio_Middle

Patio_South
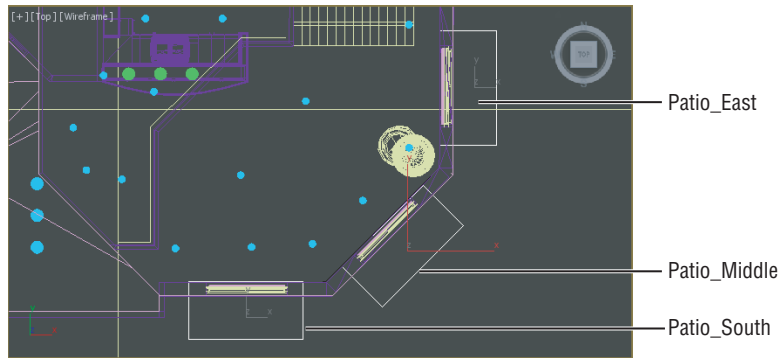
FIGURE 6.5
The Unhide Objects
dialog box
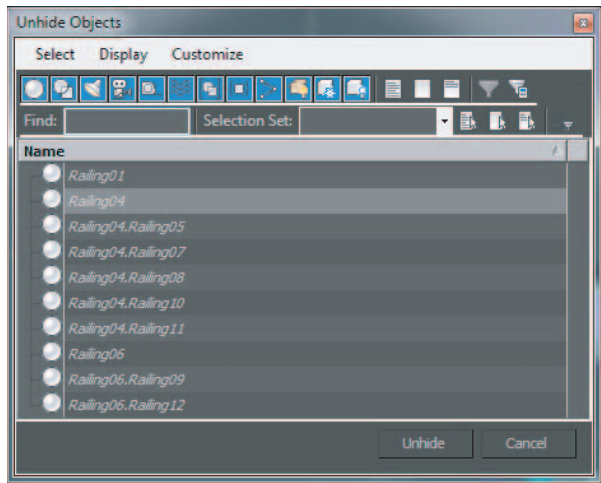
7. Click the Select All button on the toolbar on the right side of the dialog box, and then
click Unhide. The railings reappear.

If you simply want to unhide all the objects that were hidden, you can click the Unhide All
option in the quad menu. In this exercise, you used the Unhide Objects dialog box just so that
you'll know how to unhide objects by name selectively if necessary. This demonstrates the use-
fulness of meaningful names for objects. If the object names are not descriptive, you'll have a
difficult time determining which object in the list is the one you want to turn on.

Another point to consider when naming objects is their alphabetical listing. In the Sort
group of the Select From Scene and Unhide Objects dialog boxes, you have the option to sort the
objects in a variety of ways. By default, names are sorted alphabetically. To help you keep track
of an object, you might consider how its name will appear in the alphabetical listing. For exam-
ple, you named the patio door and window objects in a way that keeps them grouped together
in the listing. The name Door or Window appears first, then the location (Patio), and then the
direction that the object faces, such as East or South. This hierarchical naming scheme helps

keep objects grouped together in a listing. When you have several objects to sort through in the list, this can be an extremely handy practice to maintain.

USING THE RENAME OBJECTS TOOL

Renaming a large number of objects can be a tedious and time-consuming procedure. When several objects need to be renamed, try to use the Rename Objects tool (Tools ➤ Rename Objects) whenever possible. The Rename Objects tool completely changes the names of all selected objects, or you can use it to add or remove a prefix or suffix from the objects' names.

In a recent project, several objects had names such as 3DRCab223, 3DRCab224, 3DRCab225, and so on. These names made sense to the consultant who designed the kitchen, but the objects needed more descriptive names that adhered to the company's standard naming convention. We quickly renamed these objects to Cabinet Kitchen 3 Drawer01, Cabinet Kitchen 3 Drawer02, Cabinet Kitchen 3 Drawer03, and so on, using the Rename Objects tool. The Rename Objects tool can also rename objects when they currently have identical names, a condition that Autodesk® 3ds Max® allows.

To use this feature, select the objects to be renamed.

1. In the Base Name input box, enter a new name for the objects, such as **Cabinet** or **Chair** or an even more descriptive name.

2. If you leave this input box blank and deselect the corresponding check box, it will retain the existing name while modifying it using the following options.

3. Add a prefix or suffix by selecting those options' check boxes and entering the text in the matching input box. Start or end the line with a space if you want to have a gap between the existing or base name and the new prefix or suffix.

4. You can use the Remove First or Remove Last Digits option to delete the leading or trailing characters of the current names, or you can set the numbering procedure using the Numbered options.

5. Click the Rename button at the bottom of the dialog box to execute the process.

The objects will be renamed, and the Rename Objects dialog box will remain on the screen. It will not indicate that the objects were successfully renamed, but you can verify that the names changed in the Select From Scene dialog box. Alternatively, you can choose the Pick option at the top of the Rename Objects dialog box rather than the Selected option. Pick opens the Pick Objects To Rename dialog box, which works similarly to the Select From Scene dialog box, where you selected the objects to be renamed.

Renaming the Ceiling Fixtures

Several pairs of objects that represent the glass cover and support ring for the recessed ceiling lamps are spread across the ceilings of the condo. They all have nondescriptive names such as 3Ring20 and D3Glass22. In this exercise, you'll use the Rename Objects tool to rename all of these objects in the scene quickly.

1. Continue with your existing scene, or open the `c06_CondoB.max` file that you can download from `www.sybex.com/go/mastering3dsmax2013`.

2. Click the Select By Name button, select all the objects with names that start with "3Ring" (see Figure 6.6), and then click OK.
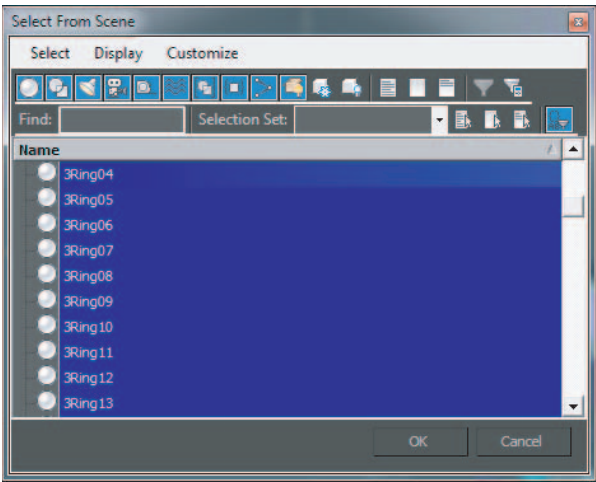
3. Choose Tools ➢ Rename Objects to open the Rename Objects dialog box.

4. Make sure the Selected radio button and Base Name check box are selected, and then type **Fixture_Ceiling_Ring** in the Base Name field.

5. Select the Numbered option, and then make sure Base Number is set to 0 and Step is set to 1, as shown in Figure 6.7. With these settings, all the fixture rings will be renamed to Fixture_Ceiling_Ring00, Fixture_Ceiling_Ring01, Fixture_Ceiling_Ring02, and so on.

FIGURE 6.7
Renaming the
selected "3Ring"
objects
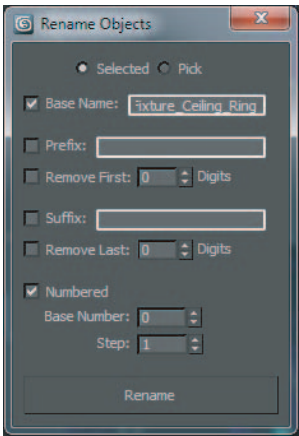
6. Click Rename, and then verify the success of the operation in the Select From Scene dialog box (see Figure 6.8).

7. Repeat the process, and rename the fixtures' glass objects as follows:

   A. Select all of the D3Glass objects.

   B. Open the Rename Objects dialog box if necessary.

The Selected, Base Name, and Numbered options should still be active.

C.   Type **Fixture_Ceiling_Glass** in the Base Name field.

D.   Click Rename.

E.   Verify the success of the operation.

F.   Close the Rename Objects dialog box.

FIGURE 6.8
The objects are
renamed.
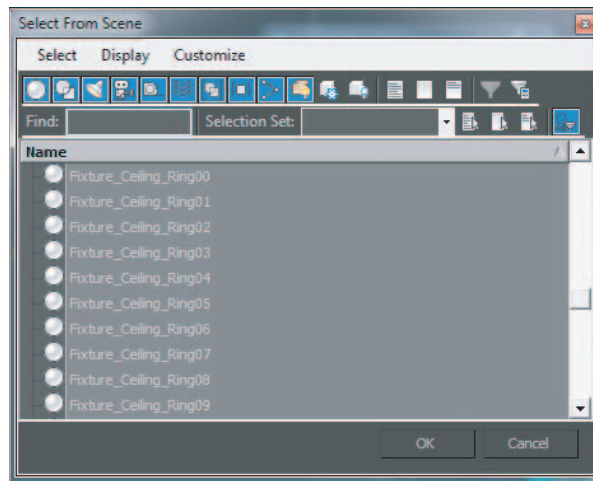
As you can see, you can use the Rename Objects dialog box to rename objects in a scene quickly. In the previous exercise, you renamed 46 objects in a matter of minutes.

Organizing Objects by Layers

Another way to keep your model organized is through layers. The idea of layers comes from traditional drafting, where different disciplines literally drew their parts of a design on different sheets (layers) of media. For example, in an architectural drawing, the mechanical engineer would draw ductwork and piping on a separate sheet, which was overlaid on the floor plan of the drawing. The different overlays were eventually combined into one sheet through reprographic techniques.

In *computer-aided drafting (CAD)*, layers are used to help keep drawings organized and easy to manage. This concept is taken a step further by organizing types of graphics into walls, doors, reflected ceiling information, and so on. In addition, notes and dimensions are usually separated into their own layers.

In 3ds Max, you can use layers in a similar way by organizing parts of your model by the type of material you'll be applying to each object. For example, the walls that will be stucco might be placed in a layer called Walls_Stucco. In the condo scene, if the bulkhead for the mezzanine is to be given the same appearance as the walls, you might combine it into the Walls_Stucco layer as well. Roof and floor components will be given their own layers, too. You might even go further and create layers for window glass, mullions, wood detail, and so on, if these components are not parts of a single-piece object. As you've learned in Chapter 5, "Working with External Design Data," another way of working with layers is to link or import your CAD data into 3ds Max.

In this section, you'll begin to explore layers by using them to organize objects in the condo model by their material assignments. You'll use these different layer/material assignments in later chapters to apply materials to objects.

Setting Up Layers

Start by setting up a few layers that you'll use for objects in your condo scene:

1. Click an empty area in the viewport, or press Ctrl+D on the keyboard to clear the current selection, and then click the Manage Layers button on the Main Toolbar. This button is also available in the Layers toolbar, which you can access by right-clicking a blank area of any toolbar and choosing Layers from the context menu.

The Layer dialog box displays (see Figure 6.9).

FIGURE 6.9
The Layer dialog box
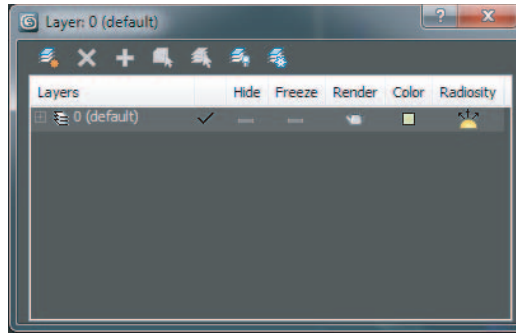
2. Click the Create New Layer (Containing Selected Objects) button. Layer001 appears in the list box. If any objects were selected at this time, they would be assigned to the new layer. In this case, the layer is empty.

3. Click Layer001 to highlight the name for editing, and type the name **Windows**↵. It appears in place of the Layer001 name.

4. Click the Create New Layer (Containing Selected Objects) button again, select the layer, and type **Doors**↵.

5. Click the Create New Layer (Containing Selected Objects) button again, and name the new layer **Walls**↵.

6. Click the Create New Layer (Containing Selected Objects) button again, and name this final layer **Patios**↵.

If you're an Autodesk® AutoCAD® user, you'll notice that most of the 3ds Max methods for creating and using layers are identical to those for AutoCAD.

You might have noticed that one layer already exists. Layer 0 is always present, and it is the default layer on which all objects in a new file are created. All of the objects that already existed when you started the project and all the objects you've created in the condo scene reside on layer 0.

You may even notice that the Color column in the Layer dialog box shows a particular color for layer 0. This is the same color that you see on objects when you look at the shaded view in the Perspective viewport, unless the object's color is manually changed.

The color that you see on newly created objects is not the color of layer 0 by default. This is because the new nodes that are created default to a setting of By Object, meaning an object's color is controlled by the order in which it was created. If you are using Autodesk 3ds Max Design®, the default creation mode for new objects is By Layer, and the object color will be controlled by the layer it is on. Most of the objects in this scene are currently set to By Layer because this scene was originally created in 3ds Max Design, but that is easily changed if you so desire.

In 3ds Max, layer 0's color is randomly chosen when you start a new scene. If you don't like the particular color that was chosen, you can easily change the color in the Layer Manager. See the section "Assigning Color to Layers" later in this chapter for information about changing layer colors.

Assigning Objects to Layers

Now that you have some new layers, go ahead and assign some of the objects to the proper layers. This is fairly easy to do: you select the object and then use the Layer drop-down list on the Layers toolbar to select a layer for the object:

1. Click the Select By Name tool on the Main Toolbar. The Select From Scene dialog box appears with a list of all of the objects in the file.

2. Highlight the three Window_Patio objects and the Window_Den object. Click OK. The Window_Den object is a sub-object of the Wall_Den object you worked with earlier and won't be found alphabetically with the other Window objects.

3. If necessary, open the Layer dialog box.

4. Select the Windows layer in the Layer dialog box to highlight it, and then click the Add Selected Objects To Highlighted Layer button, as shown in Figure 6.10.

FIGURE 6.10
Add the objects selected in the viewport to the layer.
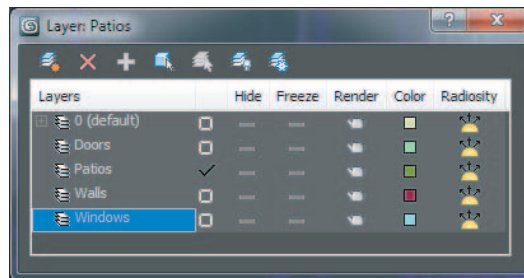
5. The selected objects are now on the Windows layer. Click the plus (+) sign next to the Windows entry in the Layer dialog box, as shown in Figure 6.11, and you'll see a listing of all the objects on that layer.

FIGURE 6.11
Objects on the
Window layer
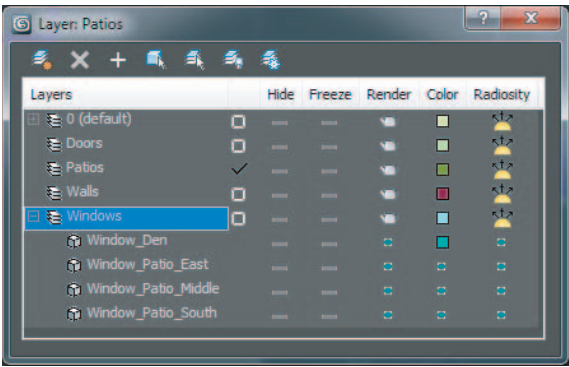
6. Using the Select From Scene dialog box, select the four Door objects that you renamed earlier and add them to the Doors layer. The Door_Den object is found indented under the Wall_Den object.

7. In the Top viewport, use the Ctrl key and a crossing selection window to select the patio decks and railings, as shown in Figure 6.12, and add them to the Patios layer.

FIGURE 6.12
Selecting the patio
components
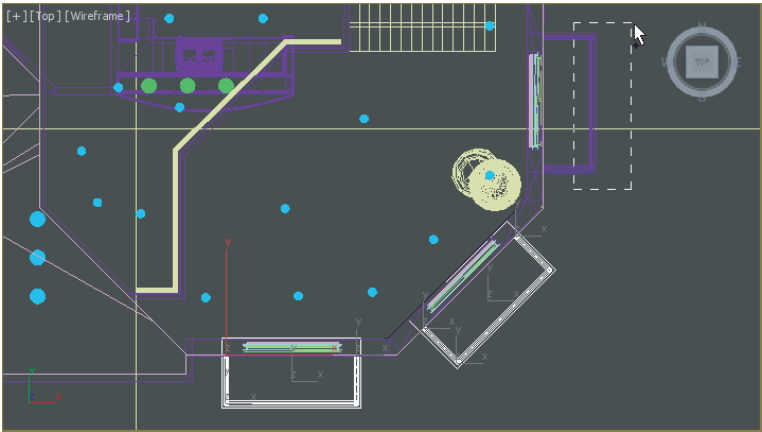
8. Finally, select the three Wall objects and move them to the Walls layer.

Another way to add objects to a layer is to create the layer with the objects preselected:

1. Select all the objects with names that start with the word "Lamp." These are the objects that combine to represent the six suspended lights in the kitchen and dining area.

2. Click the Create New Layer (Containing Selected Objects) button on the Layer dialog box's toolbar.

3. The objects are moved to the new layer automatically as the layer is made. Give the new layer the name **Lamp Suspended** (see Figure 6.13).

FIGURE 6.13
The Lamp
Suspended layer
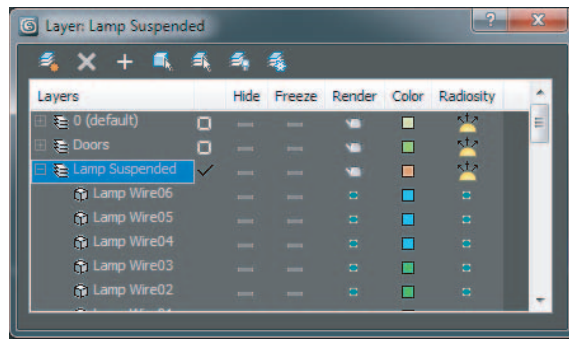
Now try a little experiment to see how you can control the visibility of objects based on their assigned layers.

1. Click the Hide column next to the Patios entry in the Layer dialog box. A lightbulb icon appears in place of the horizontal line, and all the objects on the Patios layer disappear, as shown in Figure 6.14.

FIGURE 6.14
Hiding the objects
assigned to the
Patios layer
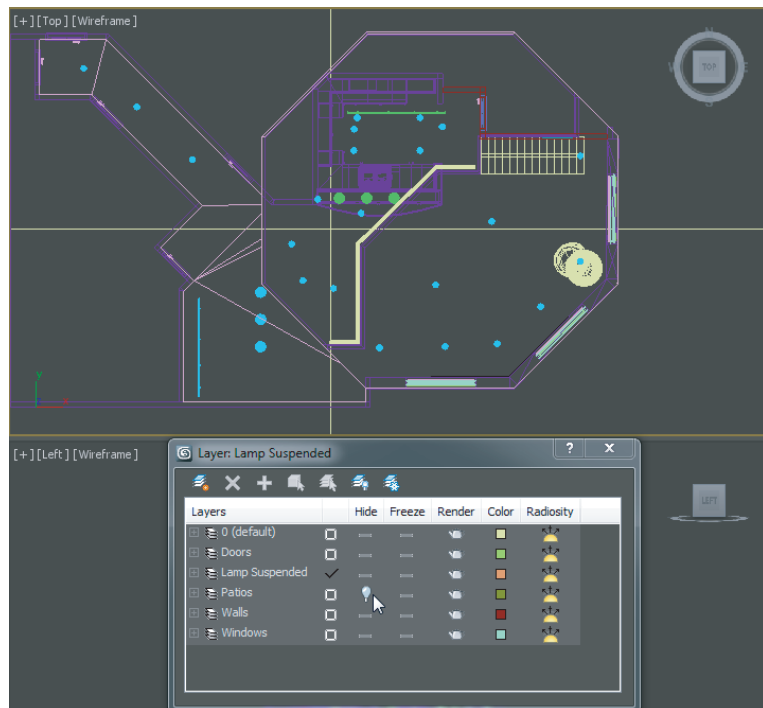
HIDDEN OBJECTS AND HIDDEN LAYERS

In 3ds Max, you cannot show an object that is on a hidden layer. However, you can hide an object that is on a visible layer.

---

2. Click the Freeze column next to the Windows entry. The windows turn gray, and a snow-flake icon appears in the Freeze column (see Figure 6.15). You can freeze selections of objects in your scene by right-clicking in a viewport and then choosing Freeze Selection from the quad menu.

FIGURE 6.15
Freezing the objects on the Windows layer
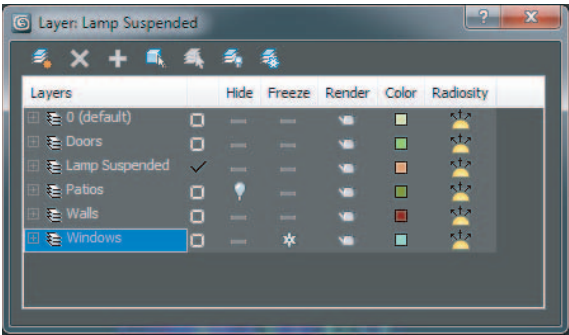
Try to select one of the windows, and you'll find it to be impossible. When an object or object's layer is frozen, those objects are visible in the viewports but cannot be selected and, therefore, cannot be changed.

3. Click the Patios lightbulb symbol to unhide the Patios layer. The patio components reappear in the viewports.

4. Click the snowflake icon next to Windows to unfreeze the Windows layer.

Earlier, you used the quad menu to hide individual objects. You can see from this exercise that you can also hide an object through its layer assignment by hiding a layer. In this exercise, you used the Hide and Freeze columns in the Layer dialog list to hide and unhide the Patios layer and to freeze and unfreeze the Windows layer.

When a layer is frozen, choosing Unfreeze All from the quad menu opens a dialog box that asks whether you want layers unfrozen as well as the objects that were frozen using the Freeze Selection quad menu option.

Assigning Color to Layers

Another way to help you keep track of objects and their layers is to assign a unique color to layers, assuming that you changed the properties of all scene objects to be By Layer. This helps you visually keep track of layer assignments and can help in your everyday editing tasks by toning

down the appearance of objects that you are not currently editing. Layer colors also give you a visual reference for object organization.

1. In the Layer dialog box, click the color swatch associated with the Windows layer to display the Layer Color dialog box.

   You can toggle to the AutoCAD (ACI) palette in the Layer Color dialog box if you are more familiar with the arrangement of palette colors in AutoCAD, but keep the current 3ds Max palette to finish the exercises in this book.

2. Click the medium-green color swatch in the bottom row, as shown in Figure 6.16.

FIGURE 6.16
Selecting the color for the Windows layer
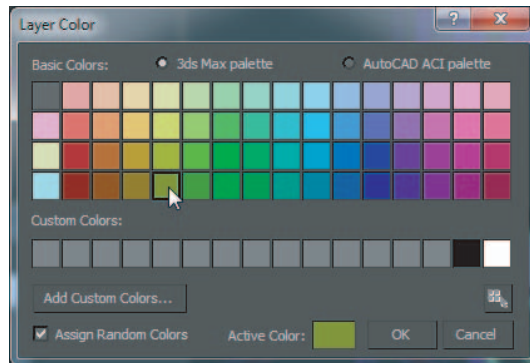
3. Click OK. The objects assigned to the Windows layer now appear in this color because their Object Display Properties are set to By Layer.

4. Set the colors for the rest of the new layers. Use Figure 6.17 as a guide.

FIGURE 6.17
Use this view of the Layer Color dialog box to set the colors for the rest of the layers.

Walls   Layer 0

Lamp Suspended   Doors   Patios
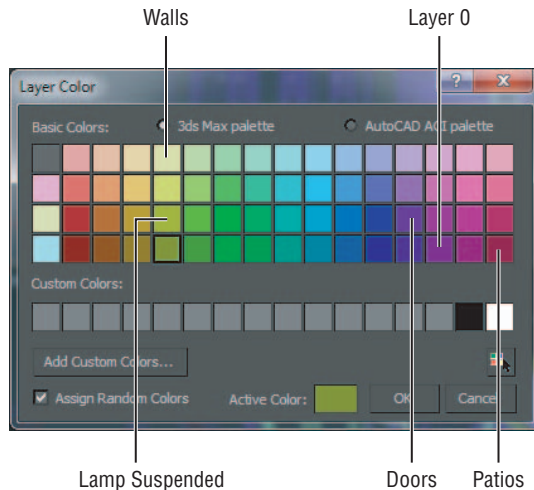
WHAT IF AN OBJECT DOESN'T CHANGE TO ITS LAYER COLOR?

Color can be confusing if you don't understand the distinction between setting color By Layer or By Object, especially when you open up a legacy scene made in an older version of 3ds Max. You may find that some older scenes don't use layers at all, although you still have the option of taking them or leaving them in 3ds Max 2013. It's important to note that layers are best used to organize complex scenes and are especially appropriate to use if you import data from any CAD-based application into 3ds Max.

If each object that you create has a different color, then your scene is set to assign color By Object, meaning that each object created is assigned a random color. If the scene is set to By Layer, the objects assume the color of the layer on which they reside.

A preference setting in 3ds Max lets you set the default creation method for new nodes to either By Layer or By Object. Choose Customize ➤ Preferences. Then select the General tab and, in the Layer Defaults group, select the Default To By Layer For New Nodes check box if you plan on using layers in your own projects. But for this book, we are using the 3ds Max default of By Object for creating new objects.
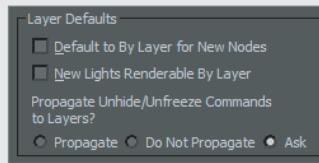
No matter which way you decide to set the preferences, each individual object can have its color assigned By Layer or By Object. One quick way to tell whether an object's color is assigned By Object or By Layer is to look at the color swatch next to the object's name in the Modify panel.
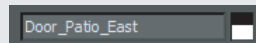
If the color swatch shows stacked black and white swatches, its color assignment is By Layer. If it shows a single color, its color assignment is By Object.

You can change an object's property setting from By Object to By Layer. This change will cause the object to inherit its display properties from its assigned layer. To make this change, use the Select Object tool to select an object and then right-click the object and select Object Properties from the quad menu. The Object Properties dialog box displays.

Click the By Layer button in the Display Properties group. This will cause the Display Properties check boxes to be enabled. The check boxes are properties that are available for each object if you enable the By Object mode
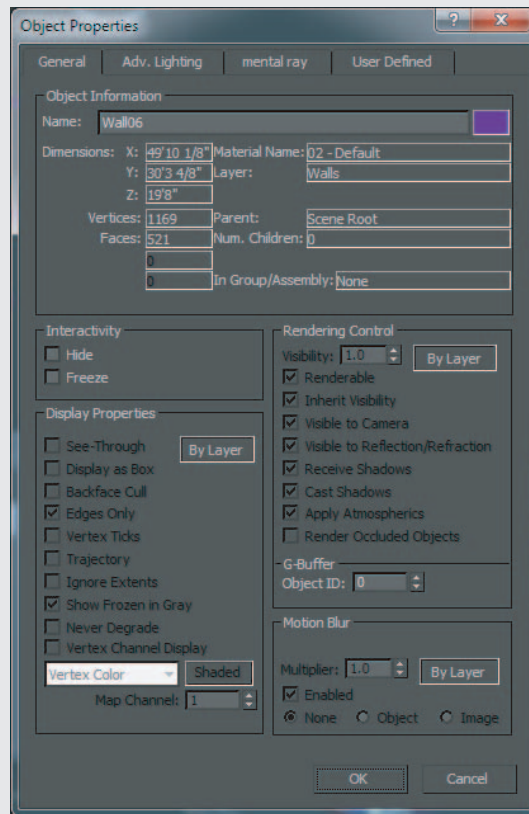
You'll also see that the By Layer button is available for the Rendering Control and Motion Blur groups of the Object Properties dialog box. Just as with Display Properties, the By Layer button lets you determine whether the Rendering Control and Motion Blur properties are controlled by the individual object or by the layer to which the object is assigned. You'll learn more about Rendering properties in Chapter 12, "Creating Animations, Particles, and Dynamics."

Notice that there are also tabs in the Object Properties dialog box for Advanced Lighting (Radiosity Renderer) and mental ray. These tabs control specific properties for these renderers that you will be learning about in Chapter 14, "Advanced Rendering Using mental ray." There is also a User Defined tab, which allows you to enter properties or text descriptions for the objects. 3ds Max does not take these properties into account, but they can be very useful for your own project and data management requirements.

Clicking the color swatch at the top of the Object Properties dialog box (also available next to the object name in the Command panel) opens the Object Color dialog box, where the object color can be changed from By Object to By Layer.

Not all of the objects, including the original walls and the patio components, respect the assigned layer color. This is because the colors of these objects are assigned on a per-object basis rather than per layer color. This problem can be fixed globally using the Object Color dialog box.

1. Choose Edit ➢ Select All, or press the Ctrl+A shortcut key combination. All the nonhidden and nonfrozen objects in the scene turn white to indicate that they are selected.

2. Click the color swatch in the Command panel to open the Object Color dialog box.

3. Click the Mixed button once or twice until it changes to read By Layer and the Current Color field changes to stacked black and white swatches. Mixed indicates that the objects selected include objects with colors assigned By Layer and By Color.
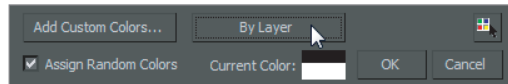
4. Click OK to accept the new object properties and close the dialog box.

5. Choose Edit ➢ Select None, or press the Ctrl+D shortcut key combination, to clear the selection.

6. All the objects in the current scene now respect the color designated to their assigned layers.

7. Save your scene as **My_C06_CondoC.max**.

Once your layers are set up, you can use a layer as a selection criterion.

1. In the Layer dialog box, make the Doors layer current by double-clicking the layer name or clicking the square icon to the right of the layer's name. It changes to a check mark to indicate that Doors is the current layer.

2. Click the Select Highlighted Objects And Layers button on the Layer dialog box's toolbar. The objects on that layer are selected.

You can also set the current layer by first selecting an object. This technique can be useful if you want to model additional objects on the same layer as something you see on the screen.

1. Select a window object.

2. Click the Highlight Selected Objects' Layers button in the Layer dialog box. The Windows layer is highlighted.

3. Click the Select Highlighted Objects And Layers button. The objects on the Windows layer are selected.

One nice thing about this method is that you don't even have to know the name of the layer to which you are changing because you are getting that information by picking the object.

The layer color or object color property with which you've been working so far defines the color of the objects only as you work with them in wireframe views. These colors also appear in shaded views until you assign materials to the objects. At that point, the shaded views of objects

will show a facsimile of the materials assigned to objects rather than the object's Color property. The Color property is only there to help you differentiate between objects, and it is not meant to represent the surface qualities of the material. You will learn more about materials in Chapter 8, "Enhancing Models with Materials."

Understanding the Icons in the Layer Dialog Box

In a previous exercise, you used the Layer dialog box to hide and unhide and freeze and unfreeze objects. The Layer dialog box provides layer-based controls for several 3ds Max features. Here is an overview of some of the control options:

1. Open the Layer dialog box, if it isn't already open.

2. Click the plus (+) sign next to the Doors layer. The list expands to show the objects that are assigned to the Doors layer.
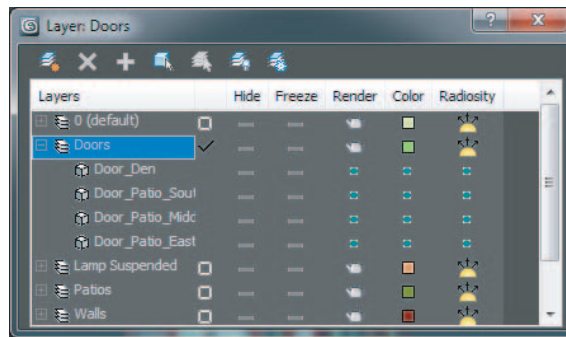
Dots appear next to the object names in the Render, Color, and Radiosity columns. This indicates that those properties are controlled by the layer to which the objects are assigned. Dashes in the Hide and Freeze columns indicate that nothing object-specific has been set.

RENDERING AND RADIOSITY

Rendering is the process that 3ds Max uses when the effect of lighting on materials and geometry is calculated and output to an image file. *Radiosity* is a lighting system that calculates indirect illumination — that is, bounced lighting — to determine the coloration of the pixels in a rendering. The Radiosity Renderer is an Advanced Lighting plug-in for the Default Scanline Renderer global illumination system; other systems that work similarly include mental ray, iray, V-Ray, and the Brazil renderer. V-Ray and Brazil are third-party plug-in rendering engines that you have to purchase separately from 3ds Max.

---

3. Next to the Door_Patio_South entry, click the dot in the Render column repeatedly. The icon cycles through a dot-teapot-dash sequence.

The icons define whether the object's rendering capabilities are defined by the layer's settings (dot) or, if the object is not rendered, regardless of the layer's rendering setting (dash). The teapot icon indicates that the object will render, even when the layer is set not to render.

Similarly, you can control whether an object or layer is considered when calculating a radiosity solution. Omitting objects from the radiosity calculations can speed up the rendering process but will also lower the accuracy of the rendered image.

You can also control the color of individual objects by clicking the icon in the Color column. In fact, if you click the Color option for an object in the Layer dialog box, you'll see the Object Color dialog box you saw earlier.

The By Layer/By Object option allows you to toggle the method of assigning color to the object. If you select an object that currently has its color assigned By Layer, as soon as you select a color for the individual object, the By Layer button changes to By Object to indicate the new state. If the object doesn't change to the color of its layer, you can choose By Layer to force the object to observe the layer's color. You can also choose a color from the color palette to give the object a different color from its layer color to make it easier to identify on screen.

Lofting an Object

Now that your model is a bit more organized, you're ready to model a few new components. In this section, you'll look at how you can use splines to create unique forms — in this case, a pedestal for showcasing a statuette or plant.

Lofting is a process whereby a cross-sectional shape is extruded along a path. The result of this procedure is called a *loft object*. Loft objects are a bit like Boolean objects in that they are the compound result of the combination of multiple objects, namely cross-sectional shapes and the path. The term *lofting* comes from shipbuilding, and it refers to the method of laying out the contours of a ship's hull. Like a ship's hull, the cross-sectional shape of a loft can vary along the path. As you'll see later, you can adjust the shape of the loft along the path by adjusting the profile at various points along the path.

Setting Up the Shapes to Form the Pedestal

The pedestal that you'll create has a fairly common shape: a square base and cap with a round body. The goal is to make a form similar to the one shown in Figure 6.18. This shape may pose a challenge to most modeling programs, but 3ds Max can easily create this unique shape.

FIGURE 6.18
A pedestal created using the Loft tools
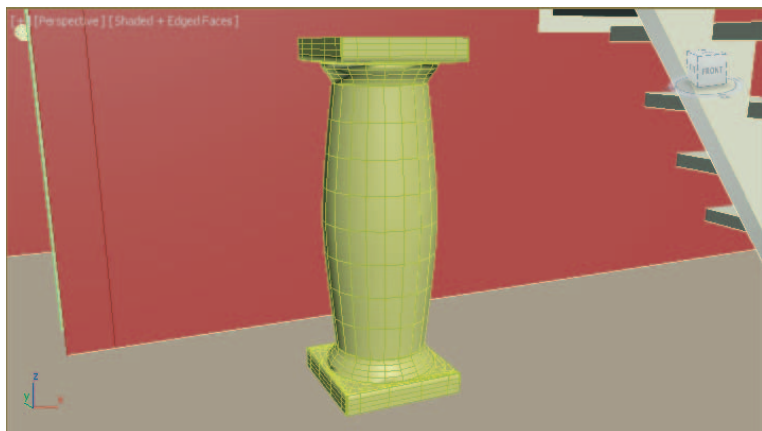
To begin the process, you'll draw two splines. One spline will represent the cross-sectional shape of the base, and the other spline will define the length and direction the form follows. The cross-sectional shape is projected, similar to the behavior of the Extrude modifier, along the path shape, to form the new 3D loft object.

Let's start the lofting process by hiding most of the model so that you can see your work more clearly. You'll leave the den wall and floor visible.

1. Make a new, empty layer named **Pedestal**, and make it the current layer.

2. Use the Select Object tool to select the Wall_Den and Floor407 objects. If you prefer, you can practice using the Select From Scene dialog box to do this.

3. Right-click in the viewport, and then click Hide Unselected in the quad menu.

All of the objects disappear except for the den wall and the lower-level floor. Now draw the cross section for the pedestal base:

1. Use the Zoom Region tool to zoom into the portion of the Top viewport near the den window, as shown in Figure 6.19.

FIGURE 6.19
Use the Zoom Region tool to enlarge this portion of the Top viewport.
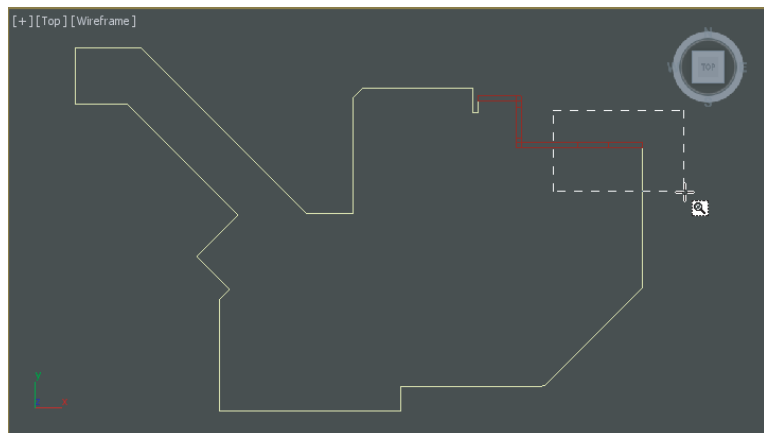
2. Click the Create tab of the Command panel. Then click the Shapes button and click Rectangle.

3. Select the AutoGrid option and then, in the Top viewport, click and drag a rectangle just below the den wall. You don't need to be exact about the placement or size of the rectangle. The AutoGrid option ensures that the rectangle is drawn at the same elevation as the top of the floor.

4. In the Parameters rollout of the Command panel, change the Length and Width values to **12**″ and the Corner Radius value to **1/8**″.

You now have the profile ready, so it's time to create the path over which the profile will be lofted. This time, you'll create a shape in the Front viewport.

1. Right-click in the Front viewport, and zoom into the area near the rectangle.

2. In the coordinate readout area at the bottom of the user interface, turn on Offset mode.

3. Click the Create tab in the Command panel. Click the Shapes button, if it isn't already active. Click the Line button, and then deselect AutoGrid.

4. Start from the top of the floor, click to start drawing the line shown in Figure 6.20, and then click and hold down the Shift key to force the creation of a straight line.

FIGURE 6.20
Draw this line, starting at the square shown at the bottom of the line.
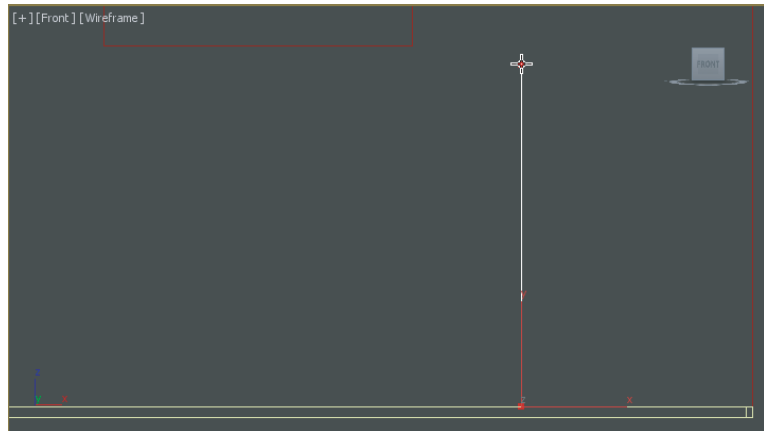
5. When the Z Transform type-in field shows approximately 2' 11", click the left mouse button to create the second vertex of the line and then right-click to terminate the Line tool.

6. Click the Modify tab. Then click the Vertex button in the Selection rollout (or open the quad menu, and select Vertex).

7. Select both vertices and, if necessary, convert them to Corner vertices.

8. Select only the bottom vertex, right-click the Select And Move tool to open the Move Transform type-in, and set the Absolute: World Z value to **1**".

9. Select only the top vertex, and set its Absolute: World Z value to **2' 11**".

10. Click the red X in the upper-right corner of the Move Transform Type-In dialog box to close it.

11. Deselect the top vertex, and exit the Vertex sub-object mode.

You now have the path you need to create the loft object.

OBJECT CREATION AND THE CURRENT VIEWPORT

If you zoom out in the Top viewport and turn on the grid, you'll notice that 3ds Max placed the path line on the X-axis as you see it in the Top viewport. By default, 3ds Max places objects on the planes defined by the X-, Y-, and Z-axes of World Space. When you draw objects in the Top or Perspective

viewport, they are placed on the plane defined by the X- and Y-axes of the World Coordinate System. For the Front and Back viewports, objects are placed on the plane defined by the X- and Z-axes, and for the Left and Right viewports, objects are placed on the plane defined by the Y- and Z-axes.

For this exercise, it's not imperative that the path be near the cross-section shape, but you can move it closer if you prefer.

Lofting a Shape along a Path

Now you're ready to loft the shape you created earlier. You'll use the Loft compound object in the Create tab to perform this maneuver.

1. Click the profile rectangle shape you created earlier to select it.

2. Click the Create tab in the Command panel. Then click the Geometry button.

3. In the Create drop-down list, select Compound Objects.

4. Click the Loft button in the Object Type rollout. Note that the Loft button will be grayed out if you do not first select a spline to act as either the loft path or shape.

5. Click the Get Path button in the Creation Method rollout, and make sure that the Instance radio button is selected, as shown in Figure 6.21.

6. Move the cursor over the line you created in the previous exercise. The cursor shows an ellipse marker, indicating that the cursor has found an object that can be used as a path for the loft. Click the line. The profile extrudes along the shape of the path, as shown in Figure 6.22.

FIGURE 6.21
The Creation Method options for Loft compound objects
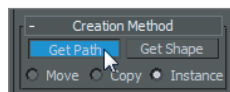
FIGURE 6.22
The lofted shape
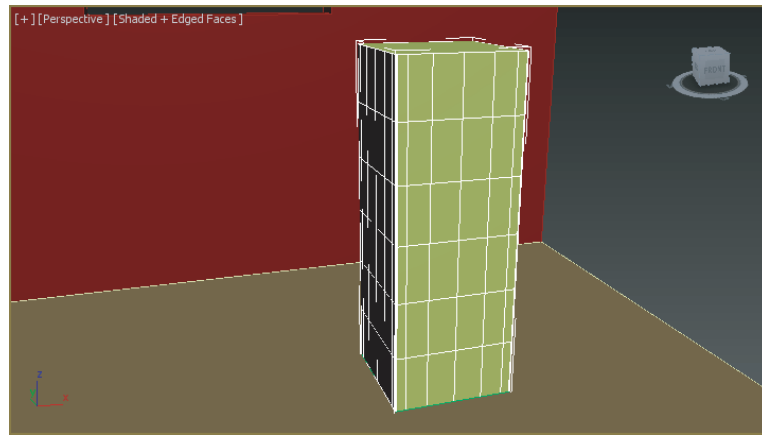
UNDERSTANDING WHAT A LOFT DOES

A loft is constructed by creating a cross section (the shape object) at each vertex of the path object, starting at the path object's first vertex. If the resultant loft appears backward, select the path object, access the Spline sub-object level, and then click the Reverse button in the Geometry rollout. With an open spline, the vertex at the opposite end of the spline will become the designated first vertex. With a closed spline, the same vertex will remain the first vertex; however, the direction to the subsequent vertices will be reversed.

When you create a loft, you are given the option of having the loft make an instance or reference copy of the shape to place at the beginning of the path. The default is to create an instance copy. This allows you to modify the original profile object, which will modify the cross-sectional shape of the loft. When you create the loft, a clone of the original shape is placed at the starting point of the path. The clone is placed in the same location as the original shape, so it isn't obvious that a clone has been created. Also, the clone of the original shape becomes a sub-object of the loft (as you'll see in a later exercise).

When you select a spline, initiate the Loft tool and then choose the Get Shape option; the current object becomes the path object, and the shape object, or a clone of it, is moved to the first vertex of the path. When you choose the Get Path option, the current object becomes the shape object, and the path object, or a clone of it, is moved to the shape. The loft emerges from the shape object as if the path were perpendicular to the face of the profile shape. You can later adjust the location of the loft using the transform tools. Any shape object can be the shape component of a loft object, but only shapes with a single, contiguous spline can be the path object. For example, text can be a shape but it cannot be a path. When you need to extrude a shape along a complex, noncontiguous spline, consider using the Sweep modifier discussed later in this chapter.

Using Different Shapes along the Loft Path

The loft object you just created is basically a uniform shape along its length. But suppose you want the form of the loft to change along the path. You can do this by introducing additional

shapes along the path. Here you'll begin to see some of the powerful capabilities of the Loft tool in 3ds Max.

The goal here is to have a 2"-thick square base and cap with each of these transitioning to an 11"-diameter circular cross section and then a 9" cross section. Try the following exercise to see how to switch the shape object in a loft:

1. Choose Create ➢ Shapes, click the Circle button, and then activate the AutoGrid option.

2. In the Top viewport, create one circle with a radius of 5.5" and one with a radius of 4.5".

3. Click the Select Object tool to exit the Circle tool, and then select the Loft compound object.

4. Click the Modify tab. You should see the name Loft001 at the top of the Command panel.

5. Scroll down the Command panel to the Path Parameters rollout and, if necessary, click the plus symbol to open it. Path Parameters lets you select a location along the path where you can place a new shape (see Figure 6.23).

FIGURE 6.23
The Path
Parameters rollout
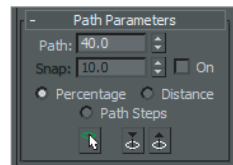
6. Click and drag the Path spinner up to about 40 percent. As you do this, you see a small, yellow X, called the *path marker*, move along the loft path, as shown in Figure 6.24.

FIGURE 6.24
The path marker
appears as an X.
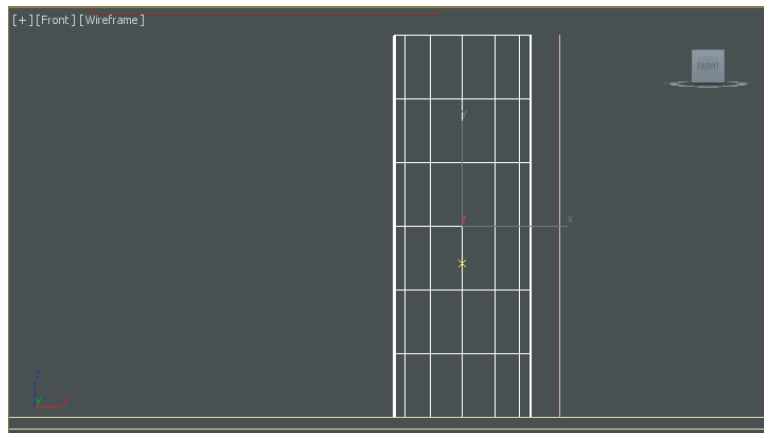
Often, the loft object obscures your view of its component objects. You can toggle off the visibility of the loft object in the Display group of the Skin Parameters rollout, as shown in Figure 6.25. The Skin option sets the display of the loft in Wireframe viewports, and the Skin In Shaded option affects Shaded viewports. The loft objects appear in renderings regardless of the Display settings.

FIGURE 6.25
The Skin
Parameters rollout
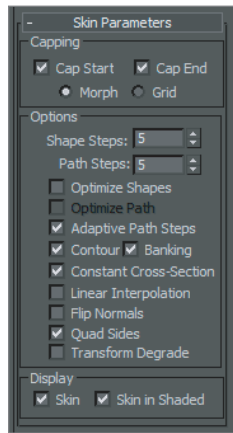
7. Click the Distance radio button, and then enter **2.125"↵** in the Path field. This places the yellow X marker at a point that is 2 ~1/8" from the first vertex of the path object. The Distance option causes the Path value to reflect an actual measurement, rather than a percentage of the path length.

8. Scroll up the Command panel to the Creation Method rollout, and click Get Shape.

9. Place your cursor on the larger of the two circles and click it. The loft object changes to include a transition of the cross section from the original shape to the new shape, as shown in Figure 6.26.

FIGURE 6.26
The new loft shape
with the modified
profile in place
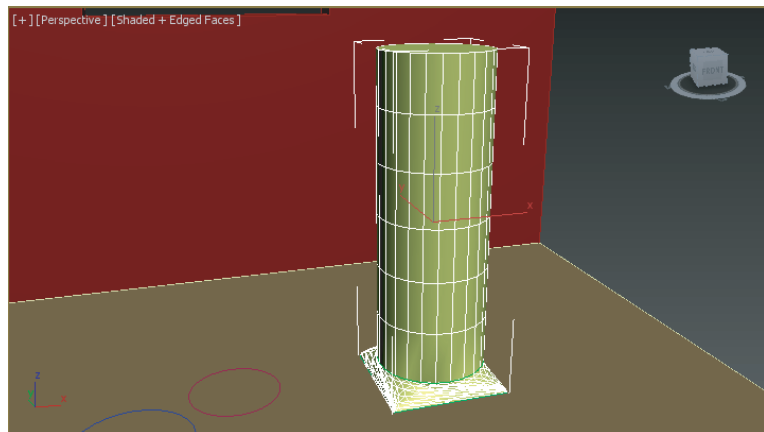
HOLDING ONE CROSS SECTION

The result of the new loft isn't quite right. You want the square base to be maintained for the first two inches and then instantly switch to a circular cross section. In this case, the transition begins immediately. A multi-cross-sectional loft object will always transition from one shape to

the next without holding a shape for any length of the path. To maintain the rectangular shape for any portion of the path, you must bracket both ends of that portion with the same shape.

1. In the Path Parameter rollout, highlight the Path value and enter **2**"↵.

2. Make sure the Get Shape button is still active, and then place the cursor over the rectangle shape at the base of the pedestal and click on the rectangle to select it.

    It's important to understand what you accomplished here. The rectangle shape isn't actually maintained from the beginning of the path; for a length of 2", the loft transitions from one rectangle to another, identical rectangle over that distance. The cross section quickly transitions to a circle over the next 0.125" (see Figure 6.27).

FIGURE 6.27
Transition from one shape to another.
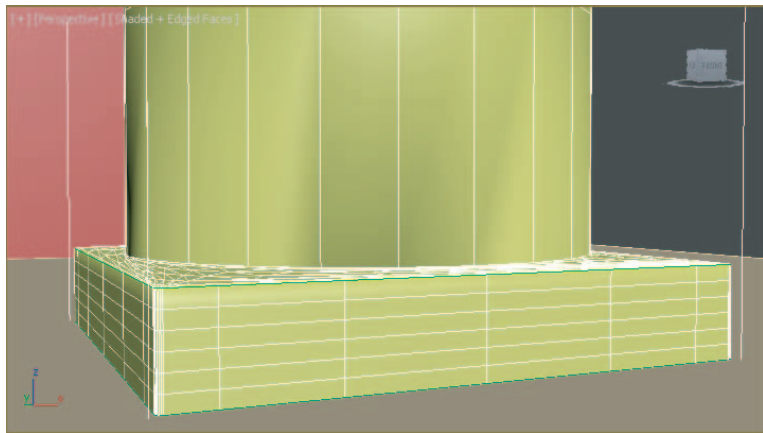
COMPLETING THE LOFT CROSS SECTIONS

The last steps required to finish the basic shape of the pedestal are to place the remaining cross sections at the proper distances from the first vertex in the path.

1. To place the first smaller, circular shape, change the Path value to **4**", click the Get Shape button, and then select the smaller circle. The base of the pedestal's circular area shrinks.

    The top of the pedestal is a reciprocal of the base. You'll need to add the same shapes but in the reverse order.

2. Change the Path value to **2' 6**", make sure Get Shape is still active, and then click the small circle. This causes the 4 1/2" radius to be held for most of the pedestal's height.

3. Set the Path value to **2' 7.875**", (the Path value should read 2' 7 ~7/8", but it will probably change to 2' 7 ~6/8" because of accuracy issues within 3ds Max), and then select the large circle as the shape.

4. Finally, enter **2' 8**" in the Path field, and then select the rectangle at the base of the pedestal, as you did in step 2 of the prior exercise. You don't need to place the rectangular cross section at the top of the pedestal; when there is no shape at the end of the path, the last shape given is continued to the end. Your pedestal should look like the one shown in Figure 6.28.
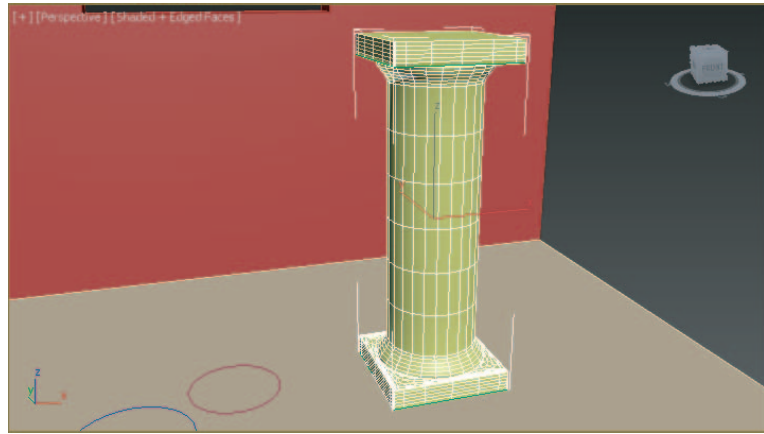
5. Save your file as `My_C06_Loft.max`.

The basic form of the pedestal is complete. In the next section, you'll learn some techniques for fine-tuning the loft.

Fine-Tuning a Loft Object

You now have a pretty good piece of furniture for your condo, but let's suppose you want to refine the shape. For example, you might want to make some slight adjustment in the diameter of the main shaft so that it bows outward slightly. Although you could accomplish this with additional path shapes, this technique might cause a noticeable change between shapes and would require calculating and creating additional shapes. Instead, you'll use Loft Deformations to change the overall shape of the loft object.

USING LOFT DEFORMATIONS

Loft Deformations are a set of tools that alter the shape of the loft object as a whole, rather than changing the shape of path sub-objects. Deformations use a graph to adjust the parameters of each deformation type: Scale, Twist, Teeter, Bevel, and Fit. The deformations are available only from the Modify tab of the Command panel.

1. Continue with the previous exercise or open `C06_Loft.max`, which you downloaded from this book's website.

2. With the pedestal selected, click the Modify tab in the Command panel.

3. Expand the Deformations rollout, and then click Scale. Scale changes the size, in the X or Y direction, of the loft object. The Z direction always points along the path; the X- and Y-axes are always perpendicular to the path.

This opens the Scale Deformation(X) dialog box shown in Figure 6.29. The red line, currently at a value of 100, indicates that the scale of the loft is consistently at 100 percent of its designed size. In other words, all the cross sections appear at the same size as their instanced counterparts. The black boxes at the end of the red line represent the corner points where the scale is defined. To change the scale, you would move a corner point upward to increase it or downward to decrease it.

FIGURE 6.29
The Scale Deformation(X) dialog box for the pedestal loft object
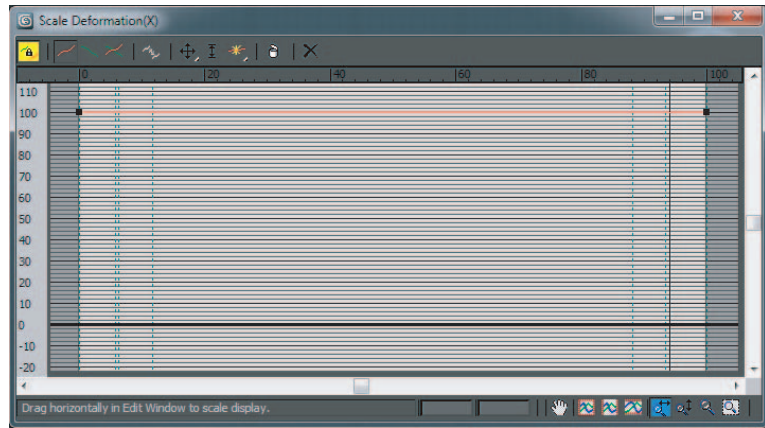
4. Make sure the Make Symmetrical button in the Scale Deformation box's toolbar is active. In this exercise, only the scale of the X-axis is changed, but the Make Symmetrical button forces the Y-axis to match the X-axis.

5. You want to change the scale at the middle of the object but not at the ends, so you'll need to add a new corner point at the midpoint of the path. Click the Insert Corner Point button.

6. Click on the red line, about halfway along its length. A white box appears showing the location of the new corner point. Like most objects in 3ds Max, selected corner points are white. The unselected corner points are black.

   There are two fields at the bottom of the dialog box. The left field is the location, as a percentage of the path, of the selected corner point. The right field is the value, as a percentage of scale, of the loft at that corner point.

7. In the left field, enter **50**↵. In the right field, enter **125**↵ (see Figure 6.30). You may have to use the Zoom and Pan tools in the lower-right corner of the Scale Deformation dialog to get the new vertex to show.

FIGURE 6.30
Moving the mid-point vertex
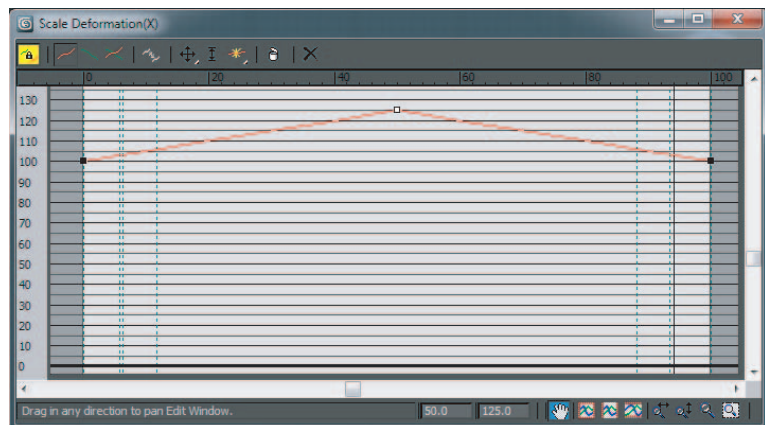
The pedestal shaft bows outward at the 50 percent mark along the path (see Figure 6.31).

The main, tubular shaft isn't the only part of the pedestal with an increased scale. The entire length is in a constant state of increased or decreased scale. Here, you'll restrict the scale deformation to the shaft section only.

The vertical dashed lines indicate the points along the path where shapes are placed. The solid line indicates the location specified in the Path field of the Path Parameters rollout.

1. Select Insert Corner Point, and then click on the red line at approximately 12 percent, where the 4 ~1/2" radius circular cross sections begins, and then click again, at about 88 percent, where it ends (see Figure 6.32).

2. To find the exact percentage value for the smaller circular cross sections, click the Percentage radio button in the Path Parameters rollout on the Modify tab, and then use the Previous Shape and Next Shape buttons at the bottom of the group to jump to the smaller circular shapes in the loft object, as shown in Figure 6.33. You will see the X marker jump from shape to shape along the path in the viewports and the percentage displayed in the Path Parameters rollout change, but you won't see any changes to the Scale Deformation dialog.

FIGURE 6.31
The pedestal after increasing the scale to 125 percent at the midpoint
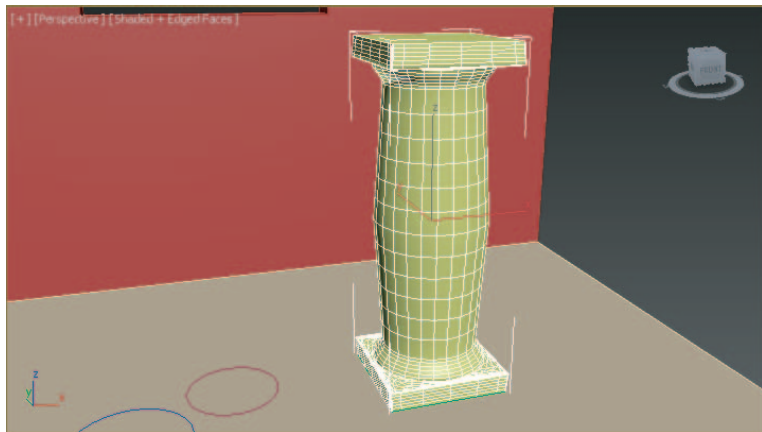
FIGURE 6.32
The Scale Deformation points are inserted.
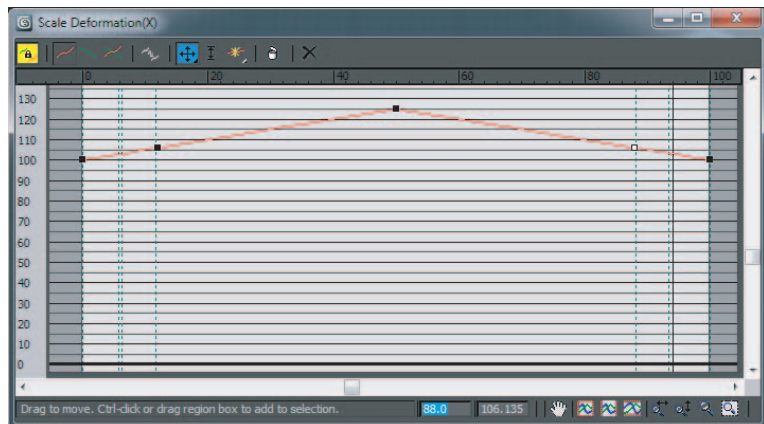
FIGURE 6.33

The Previous Shape and Next Shape buttons

Pick Shape

Previous Shape

Next Shape
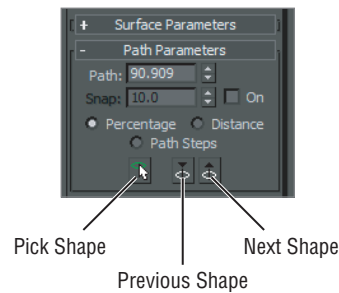
3. Select a corner point in the Scale Deformation(X) dialog box that corresponds to the current cross section in the Path Parameters rollout, and then enter the Path value into the left input field and **100.↵** into the right. Your path scale should begin and end with flat sections, indicating no change in scale, and have a peak in the middle when the increase in scale occurs (see Figure 6.34).

FIGURE 6.34

Flat sections and peaks
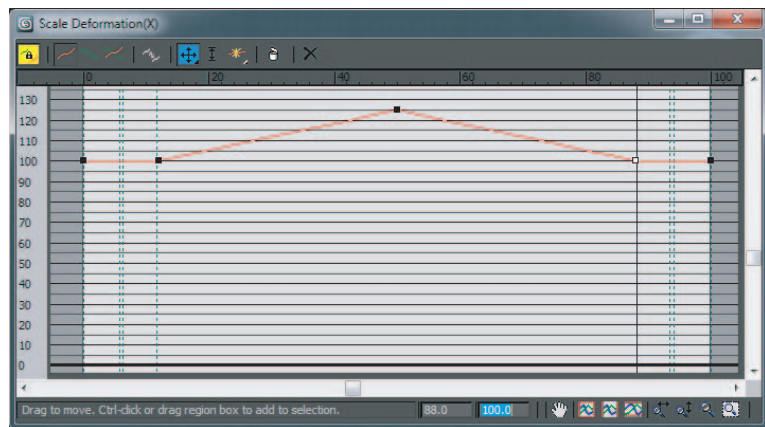
The last item to adjust is the sharpness of the corner point at the middle of the loft. Like the vertices of a spline, the corner points can be either sharp or smooth.

1. Select the corner point at the middle of the path, right-click, and choose Bezier-Corner from the context menu. (Other options are Corner and Bezier-Smooth.)

2. Two handles appear, projecting from the selected corner point, as shown in Figure 6.35. Move each handle upward to soften the transition into the corner point. Be sure not to move the handles higher than the corner point, or the shaft diameter will become larger on one side of the corner point and then recede back to 125 percent at the corner point.

When you've finished, the pedestal should look like Figure 6.36.

3. Close the Scale Deformation(X) dialog box.

4. Save your file.

FIGURE 6.35
The Bezier handles
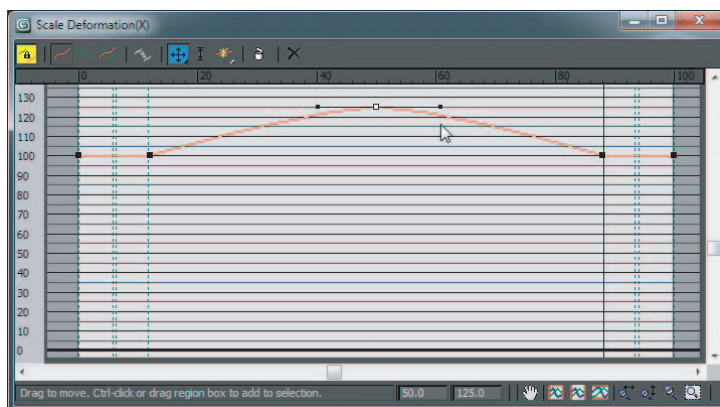
FIGURE 6.36
The pedestal after
adjusting the mid-
dle corner point
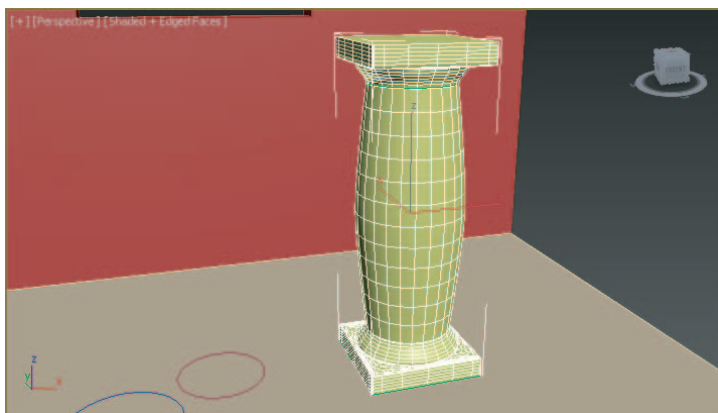
TURNING DEFORMATIONS ON AND OFF

Each of the deformation types has a lightbulb icon next to it in the Deformations rollout. Turning any of these off preserves the settings while preventing the deformation from affecting the loft object. This is similar to clicking the lightbulb icon in the Modifier Stack to turn off a modifier.

Feel free to experiment with the other deformation options. Each has a unique function, as listed here:

Twist   Like the Twist modifier, the Twist deformation turns a loft object around the path. Using the deformation, you can change the twist direction and vary the rate of change over the length.

Teeter   By default, the cross-section shape is perpendicular to the path. Using the Teeter deformation, you can adjust the shape's pivot along the path.

Bevel   Usually used at the ends of a loft, Bevel reduces the size of a cross section to give a tapered appearance.

Fit   Fit doesn't work like the other deformation curves; it doesn't affect the loft along the path. Rather, you define the shapes in the X- and Y-axes, and the lofted shape conforms to those shapes, along their related axes, as it is lofted.

ADJUSTING THE DENSITY OF THE LOFT

Look in a Wireframe viewport or activate the Edged Faces option, which is accessed from the Viewport Shading Label menu, and you'll see that the pedestal is broken into several vertical segments along the path and several along the perimeter of each shape. Each series of segments adds to the total number of faces in the object and, in turn, the file size and rendering time. Just as with many other objects in 3ds Max, you can set the number of segments used to create a loft.

The Shape Steps setting determines how many subdivisions occur between each vertex of the loft object's cross section. The Path Steps setting determines the number of segments between each cross-section shape, or between each deformation corner point, when they exist. Neither of these values affects the original shape and path objects used to create the loft. To get a less-dense loft, decrease the number of segments along the path and shape. Here's how it's done:

1. Select the loft object.

2. In the Modify panel, scroll down to the Skin Parameters rollout label and expand it (see Figure 6.37).

FIGURE 6.37
The Skin
Parameters rollout
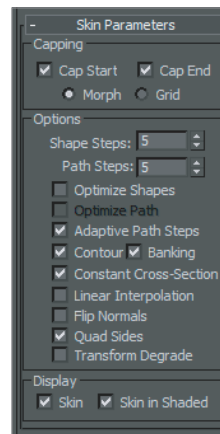
3. Change the Shape Steps value to 4 and the Path Steps value to 3. This reduces the number of faces in the loft from about 4,000 to approximately 2,000. Your pedestal should look like Figure 6.38.

Using the Instance Clones to Edit the Loft

In an earlier exercise, you drew the original loft path so that it was close to the rectangle shape. You did this so that you could have a clear view of the path in order to select it. In the next exercise, you'll make changes to the loft by editing the original line you used to define its path and the cross-section shapes.

Start by adjusting the line that defines the loft path of the pedestal:

1. To save the model temporarily in its current state, choose Edit ➢ Hold.

2. In the Front viewport, select the line you created to define the path of the loft, as shown in Figure 6.39, and then click Vertex in the modifier stack.

FIGURE 6.38
The pedestal after
reducing the num-
ber of path and
shape steps
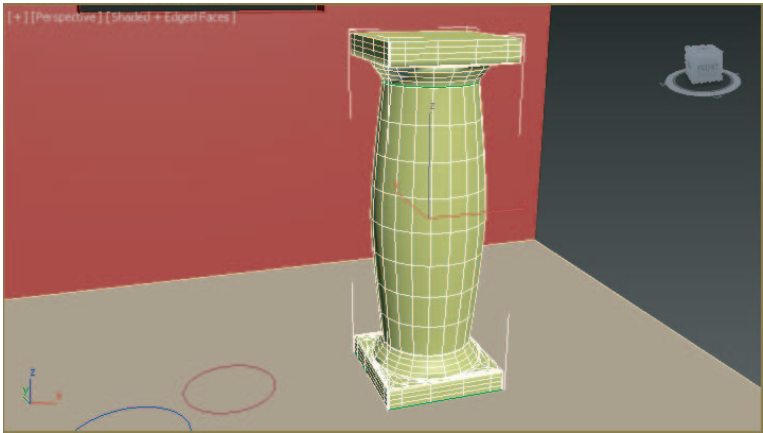
FIGURE 6.39
The path selected
with the Vertex
sub-object mode
active
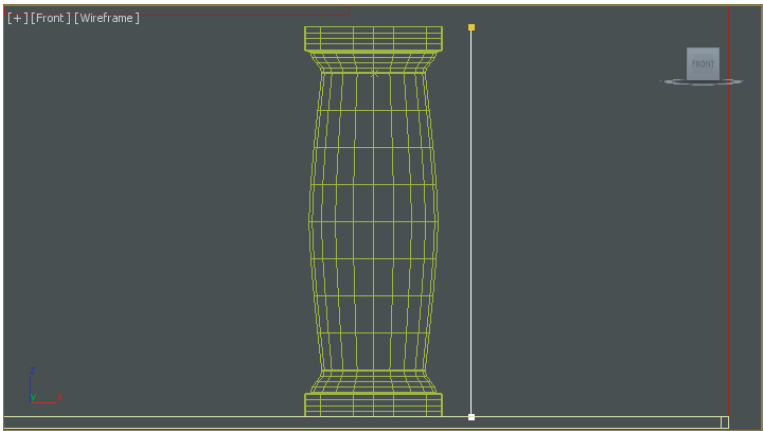
3. In the Geometry rollout, click the Refine button (see Figure 6.40). Refine is one tool that can be used to add segments to a spline.

FIGURE 6.40
The Refine button
on the Geometry
rollout
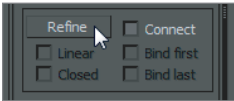
4. Click in two locations along the path to add two new vertices, as shown in Figure 6.41. The segmentation of the loft object increases to accommodate the new vertices.

FIGURE 6.41
Adding new verti-
ces to the path
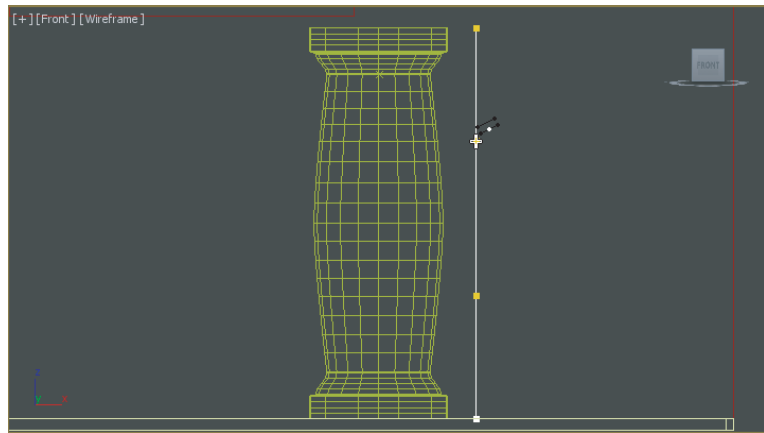
5. Use the Select And Move tool to move the new vertices. Observe how the loft reacts to the changes, as shown in Figure 6.42.

FIGURE 6.42
Moving the vertices
in the path
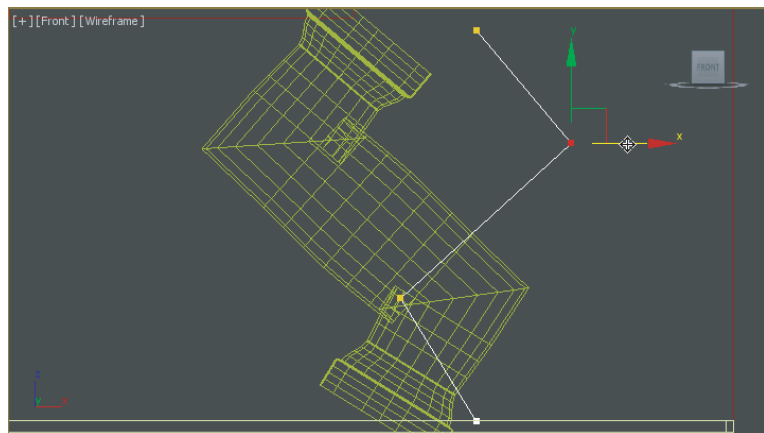
6. Undo the changes made in step 5.

The transforms (Move, Rotate, and Scale) placed on a shape are disregarded when they are considered to be components of a loft object. For example, a shape object's position or rotation does not matter when the loft is created. Understanding this is very important when the Scale transform has been used on a shape. A 4"-diameter circle scaled to 50 percent so that it appears to be 2" in diameter will still loft with a 4" diameter. This is due to the method that 3ds Max uses to evaluate data. If a shape to be used in a loft has been scaled, use the Reset

XForm utility (Command Panel ➢ Utilities tab ➢ Reset XForm) to set the current transforms to be the object's default.

Here's an example where the transforms do not affect a loft:

1. Exit the Vertex sub-object level, and then select the smaller circular shape near the loft object.

2. Click the Select And Uniform Scale button; then click and drag upward on the Scale gizmo. As you can see in Figure 6.43, the scaling of the shape instance has no effect on the loft.

FIGURE 6.43
Using the Scale transform has no effect on the loft object.
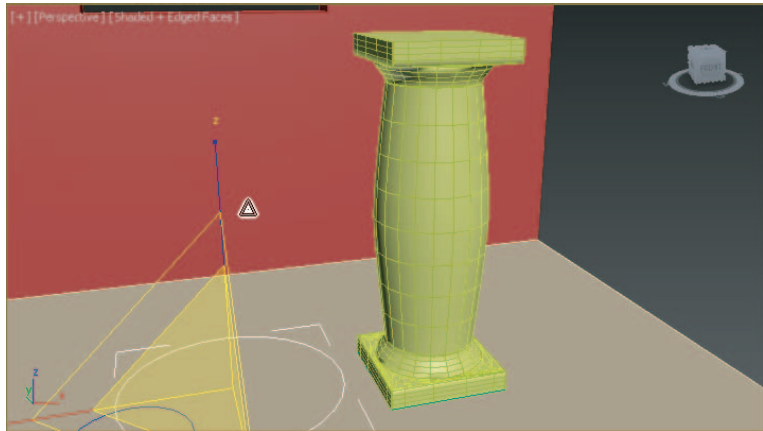
3. Undo the Scale operation.

4. In the Parameters rollout, change the Radius parameter to 6". Figure 6.44 illustrates how changing the Radius value is reflected in the loft.

FIGURE 6.44
Changing the radius of the instanced shape is reflected in the loft.
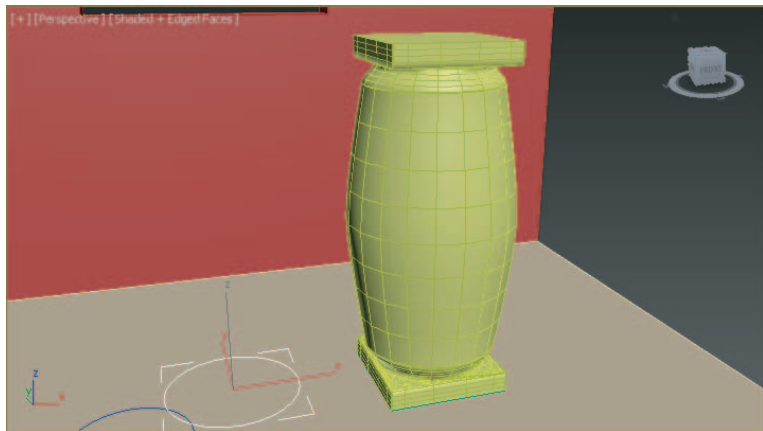
5. Choose Edit ➢ Fetch, and then click Yes in the About To Fetch. OK? dialog box. Your scene is restored to the state it was in when you chose Edit ➢ Hold at the beginning of the previous exercise.

6. Save your scene as `My_c06_Loft_Complete.max`.

EXPLORING THE DIFFERENT MODELING TECHNIQUES

You should experiment on your own with the many different modeling techniques available in 3ds Max. There are usually several ways to achieve the same three-dimensional form.

Using the Noise Modifier

Straight lines, flush surfaces, and perfect spheres are easy to accomplish in computer-generated (CG) graphics, but they are often the downfall of CG images. Randomness and imperfections, although sometimes subtle, are normal in the real world and their absence is very noticeable. Noise, in CG, is the addition of apparent randomness as a feature to an object and, when properly used, can add a sense of realism in a scene. In this exercise, you'll add the Noise modifier to a primitive to move the object's vertices, adding some randomness.

1. Continue from the previous exercise, or open C06_Noise.max, which you downloaded from the book's website.

2. Right-click in a viewport, and choose Unhide All from the quad menu.

3. If necessary, move the pedestal so that it is located under the stairs.

4. In the Top viewport, zoom in on the large planter.

5. Make sure AutoGrid is off, and then create a Cylinder primitive with a Radius value of approximately 13" and a height of 2". The perimeter of the cylinder should overlap the inside edges of the planter.

6. Move the cylinder in the Z-axis so that its top is below the upper rim of the planter, as shown in Figure 6.45.

FIGURE 6.45
The Cylinder primitive inside the planter
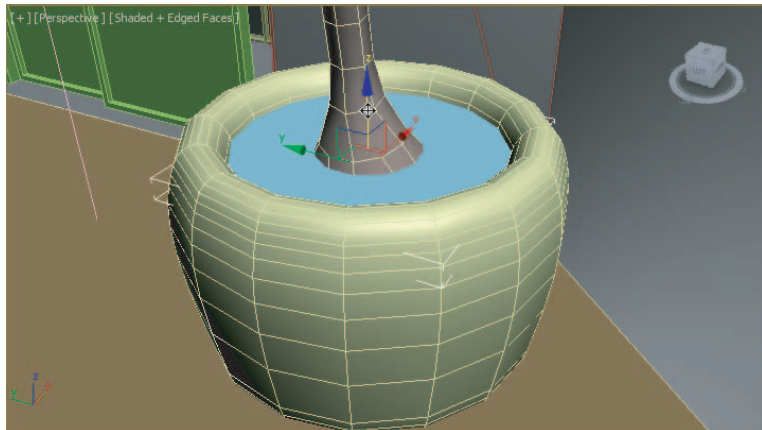
7. Expand the Modifier List drop-down, and click the Noise modifier.

8. In the Strength area, increase the Z value to 3". In this case, we want the noise to affect only the cylinder in the Z-axis and not the X- or Y-axis. A small amount of change has occurred on the surface of the cylinder but not enough to be easily noticeable.

The Scale parameter sets the size of the noise effect but not the strength in a particular direction. Smaller Scale values produce rougher noise patterns.

9. Reduce the Scale value to 5. The noise becomes more apparent.

The Noise modifier accomplishes its task of moving vertices as well as it can, given the assets it has. By default, a cylinder has only a single cap segment at each end. This isn't enough segmentation to create a rough surface.

10. To increase the amount of segmentation and provide the Noise modifier with additional vertices with which to work, click the Cylinder entry in the modifier stack to access the cylinder's parameters.

11. Set the Cap Segments to 5. The surface change is now smoother, as shown in Figure 6.46.

FIGURE 6.46
Smoothing the surface
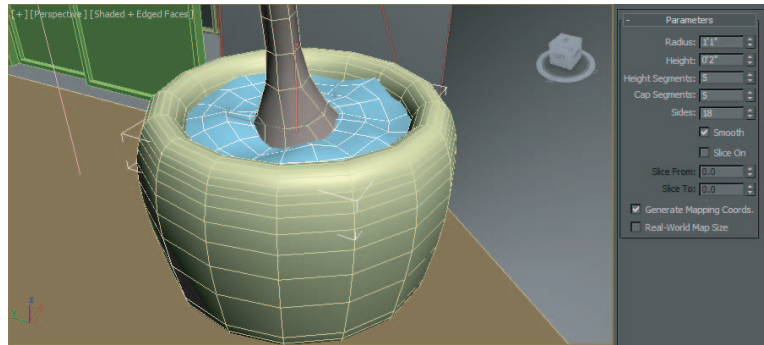
12. Select Noise in the modifier stack.

As you can see, the Noise modifier can add randomness that would be difficult and time consuming to achieve by moving the vertices manually.

13. Save your file as `My_C06_Noise.max`.

Modeling with Soft Selection

Soft selection gives you a way to deform an object gently by transforming the vertices. When soft selection is used, unselected sub-objects have the same transforms or modifiers applied to them as the sub-objects that are explicitly selected — but to a lesser degree. You can partially select multiple vertices and apply your transform gently across the entire selection set. You'll use soft selection here to pull out the sides of the planter to form spout type ends.

1. Select the planter, right-click, and then choose Isolate Selection in the display quad menu so that only the planter remains in the viewports.

2. Expand the Modifier List drop-down, and click the Edit Poly modifier, as shown in Figure 6.47.

FIGURE 6.47
The Edit Poly modifier
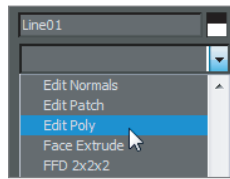
3. Select the Polygon Modeling tab on the Graphite Modeling Tools ribbon, and activate the Vertex sub-object level, as demonstrated in Figure 6.48.

FIGURE 6.48
The Vertex sub-object level on the Graphite Modeling Tools ribbon
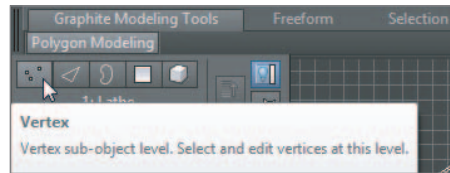
4. Drag a window selection region in the Front viewport, similar to the one shown in Figure 6.49. Notice that the selected vertices turn red while the unselected vertices remain blue.

5. Click the Select And Move tool, make sure that the Reference Coordinate System is set to World, and then move the vertices in the X direction. The vertices move and the edges between the selected vertices and the unselected vertices remain straight, as shown in Figure 6.50.

6. Undo step 5.

7. Expand the Soft Selection rollout on the Edit Poly modifier, and then select the Use Soft Selection option.

As you can see in Figure 6.51, the vertices now change colors from red to orange, yellow, green, and then blue. The red vertices are fully affected by the transform, and the blue vertices are unaffected; however, the remaining colored vertices are affected based on their distance from the selected vertices.

FIGURE 6.49
Drag a selection window in the Front viewport.
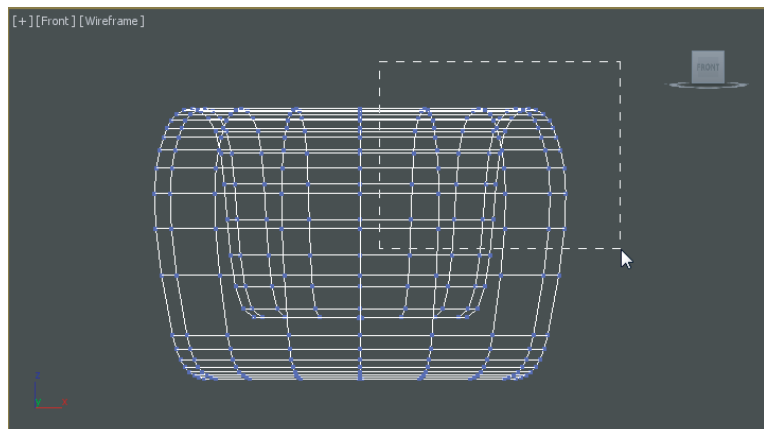
FIGURE 6.50
Moving the vertices
in the X direction
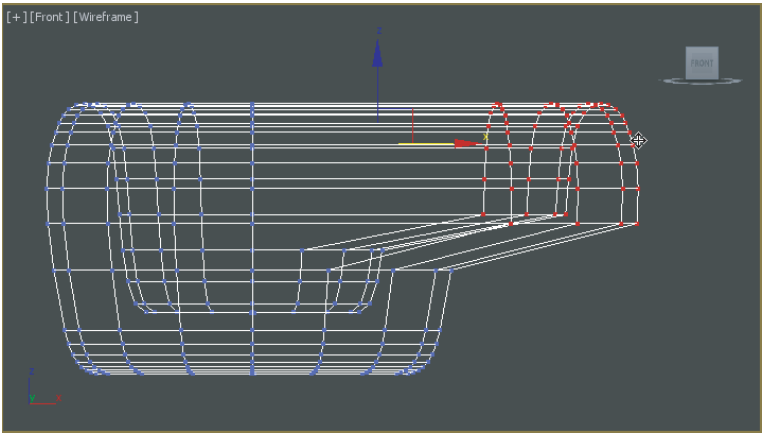
FIGURE 6.51
The colors of the
soft-selected ver-
tices indicate the
amount they will
be affected by a
transform.
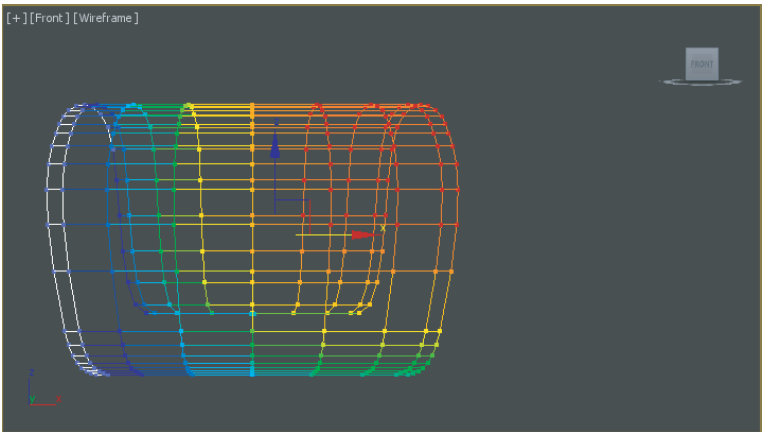
8. Too much of the planter is affected by the soft selection. Adjust the Falloff value to about 7" to affect a smaller region around the selected vertices (see Figure 6.52).

FIGURE 6.52
Soft Selection roll-
out with the Falloff
setting
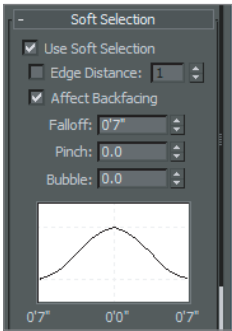
> **DEFINING THE SOFT SELECTION METHOD**
>
> You can adjust the way the Soft Selection options affect the vertices by making changes to the Pinch and Bubble settings just below the Falloff setting. Pinch causes the selection to create a spiked form when a selection of vertices is transformed. Bubble causes the selection to create a more wavelike form. The graphic below these settings displays a visual sample of their effects.

9. Move the selected vertices along the X-axis. Watch as the softly selected vertices get pulled along according to the degree to which they were selected (Figure 6.53).

FIGURE 6.53
Moving the planter vertices with soft selection
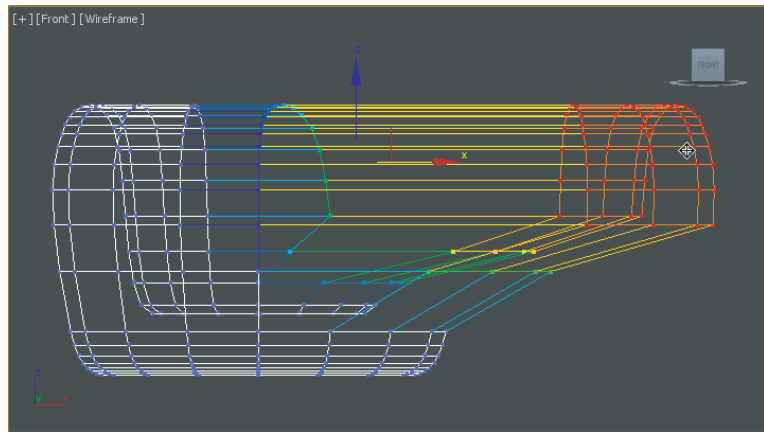
10. Right-click in the Top viewport, and then click the Select And Uniform Scale button. Click and drag downward on the Y-axis handle to narrow the spout a bit, as shown in Figure 6.54.

As you can see, the Soft Selection tool can effectively create objects with soft, flowing curves.

FIGURE 6.54
Forming a gradual spout
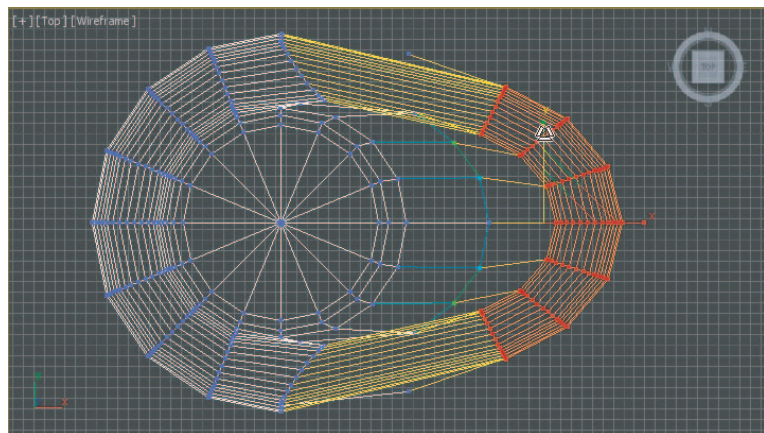
11. Exit the Vertex sub-object level.

EDITING BELOW THE EDIT POLY MODIFIER

It's important to understand how 3ds Max manipulates objects and the restrictions that are in place. When you moved the selected vertices, you moved a set of distinct, numbered vertices. Making changes to an object or modifier below the Edit Poly modifier might renumber the vertices — an act that is lost on the Transform modifier that remembers the vertex numbers but not their specific locations. As an example, if you were to click the Lathe modifier in the stack, you would see a Warning dialog box noting that the Edit Poly modifier is dependent on the selected modifier. It's highly recommended that you select No to cancel the attempt to access the lower modifier or Hold/ Yes to save the file in its current state if you need to fetch it later.
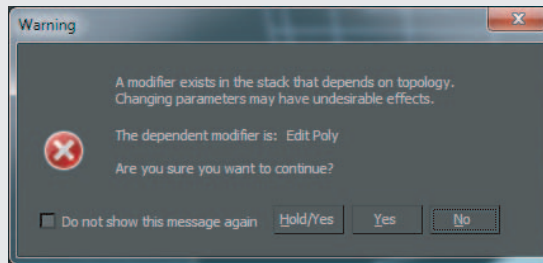
When you access the Lathe level in the modifier and make changes that affect the vertex count, such as increasing the number of segments, there can be unexpected results.
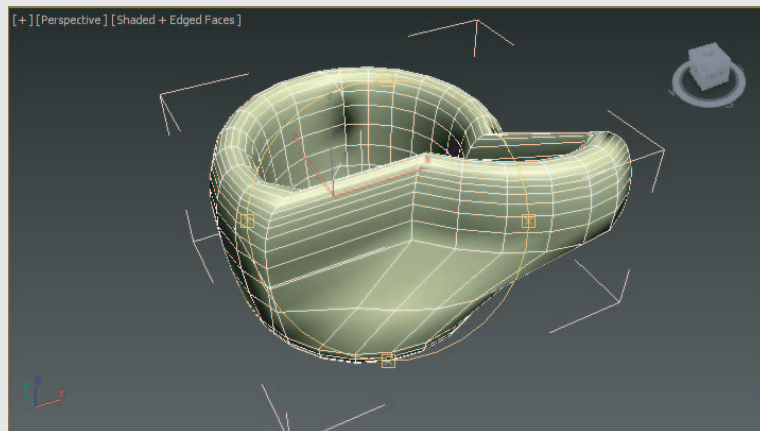
If you work beyond the number of available Undos, you can use the Fetch command to return to the previous state only if you selected Hold/Yes in the Warning dialog box.

COMPLETING THE PLANTER WITH THE SYMMETRY MODIFIER

To complete the planter, you need to make the right side look like the left side. One option is to perform the same steps that you did in the prior section on the opposite side of the object. This

would be the ideal procedure when the goal is to make both sides similar but not identical. In this exercise, you'll use the Symmetry modifier to make the left side of the planter a reciprocal of the right side.

1. Make sure that the planter is selected, expand the Modifier List drop-down, and then select the Symmetry modifier. (Other options are Substitute, SurfDeform, Taper, and Tesselate.)

   Figure 6.55 shows that the initial result is not the intended result. The Symmetry modifier is acting along the wrong axis.

2. In the Mirror Axis area of the Parameters rollout, click the Y radio button and then the Z radio button, as shown in Figure 6.56. Neither option results in the proper symmetry of the planter's geometry.

3. The problem is that when using Z as the mirror axis, the left side of the planter is mirrored over to the right side of the planter. In the Mirror Axis area, select the Flip option. This results in the right side mirroring over to the left, as shown in Figure 6.57.

FIGURE 6.55
The initial, unintended result after applying the Symmetry modifier
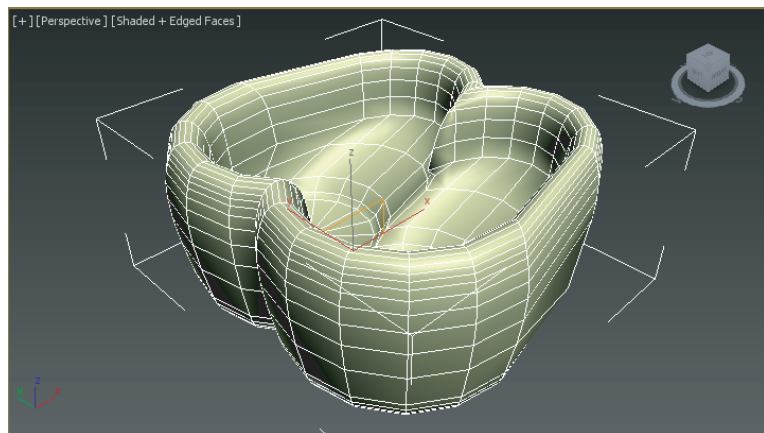
FIGURE 6.56
The results after changing the mirror axis
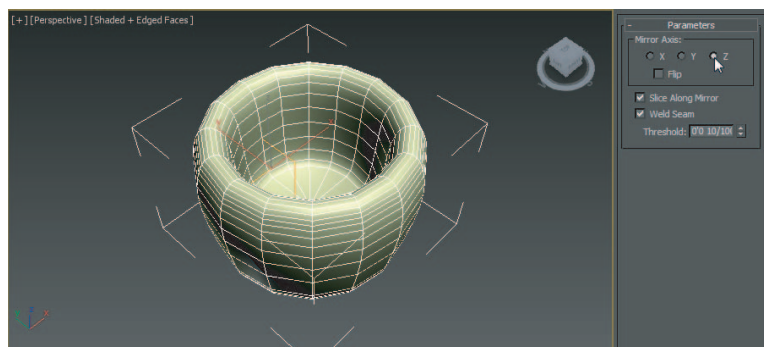
FIGURE 6.57
The planter after
you've chosen the
Z-axis and flipped
the result
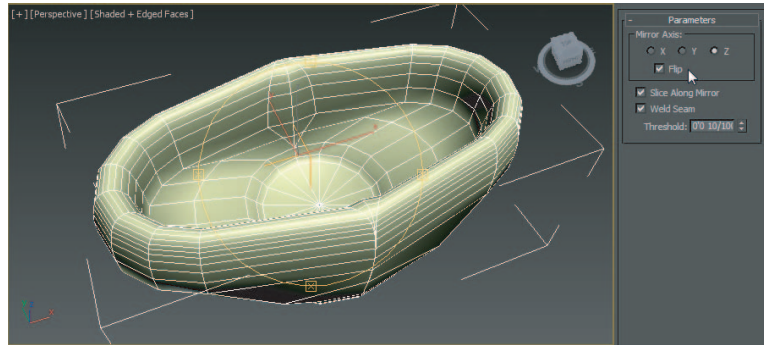
4. From the Main menu select Tools ➢ Isolate Selection, or press Alt+Q on the keyboard to bring the other scene objects back into view.

5. Select the cylinder object, apply the Edit Poly modifier, and use soft selection and the Symmetry modifier to fit it to the newly shaped planter.

6. If necessary, rotate the planter and cylinder so that they do not intersect the wall.

7. Now it is time to do a little scene housekeeping. Select the cylinder, rename it **Planter_Dirt**, and assign a brown color to it. Select and rename the planter to **Planter** and the tree to **Planter_Yucca**. Leave their colors set to By Layer.

8. Finally, select the planter, dirt, and tree, and place them on a new layer named **Planter**.

9. Set the current layer to layer 0.

10. Save your file as **My_C06_Condo_Done.max**.

ACTIVATING USER GRIDS

A user grid is still active even when hidden. If a user grid does not become the active grid immediately after you create it, select the Activate Grids When Created box in the User Grids tab of the Grid And Snap Settings dialog box. When you have multiple user grids in a scene and need to change the active grid, select it, right-click, and choose Activate Grid from the quad menu. Choose Activate Home Grid from the quad menu to switch back to the home grid.

Extruding with the Sweep Modifier

The Loft compound object is an excellent tool for creating complex extruded shapes with multiple cross sections and smooth transitions between them. For quick and simple extrusions of shapes along a path, nothing beats the Sweep modifier. Sweep projects a cross-sectional shape along a path regardless of the number of noncontiguous spline sub-objects that it contains. The Sweep modifier comes with a library of premade shapes to use as the cross section, or you can

use a shape that you make yourself. The following exercise demonstrates the application of the Sweep modifier:

1. Open the C06_Sweep.max file that you downloaded from www.sybex.com/go/mastering3dsmax2013.

2. Select the text object, and apply the Sweep modifier. The default Angle cross section is applied to all splines in the shape, as shown in Figure 6.58.

3. Expand the drop-down list in the Built-In Section area of the Section Type rollout, and choose Pipe (see Figure 6.59).

   The cross section changes to a tube shape throughout the object, as shown in Figure 6.60.

THE SWEEP MODIFIER AND STRUCTURAL STEEL COMPONENTS

Using the Sweep modifier, you can quickly create the structural steel used in a construction project or create the look of a technological/industrial complex for a video game or movie location. Many of the shapes found in the Built-In Section drop-down list correspond with common structural steel components.

FIGURE 6.58
The text shape with the default Angle cross-section shape

FIGURE 6.59
The Pipe Built-In Section shape
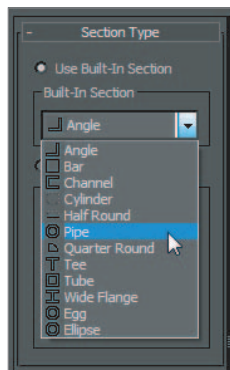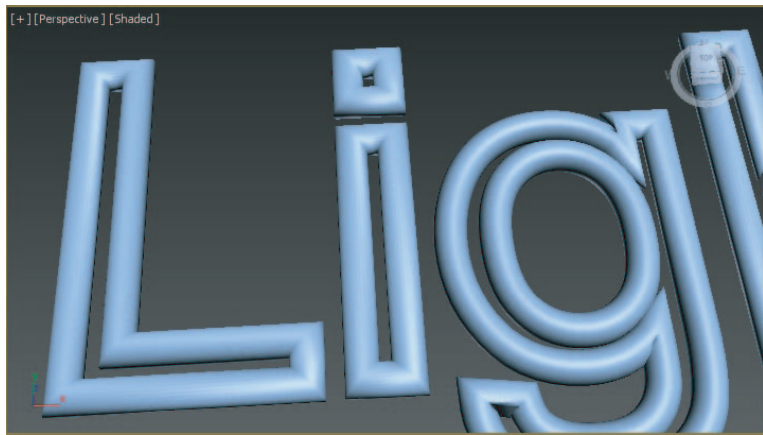
4. In the Parameters rollout, reduce the Radius value to 2.0. The Thickness parameter will not apply unless a transparent material is used or the ends of an open spline are visible.

5. Create a small 2D shape object in the scene. This example uses a five-pointed star with radii of 2.5 and 1 (see Figure 6.61).

FIGURE 6.61
The text with the
custom cross sec-
tion selected
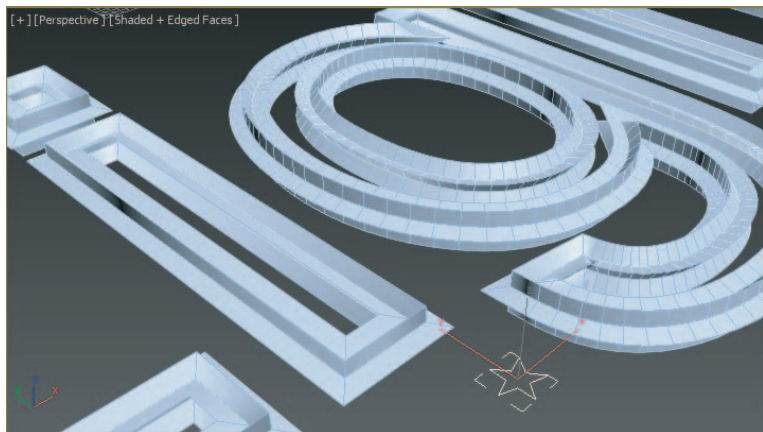
6. Select the text object, and then click the Modify tab.

7. In the Section Type rollout, select the Use Custom Section radio button and then click the Pick button, as shown in Figure 6.62, in the Custom Section Types area. Make sure that

the Instance option is selected near the bottom of the rollout. In a complex scene, you can click the Pick Shape button in the same section to select the cross-section shape from a list.

FIGURE 6.62
Select the Pick button on the Section Type rollout.
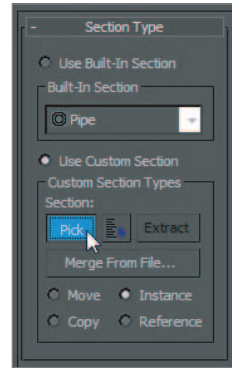
8. Click the shape that you created in step 2. The text object's cross section assumes the same configuration as the shape object, as shown in Figure 6.61. Because the Instance option was selected, any changes made to the shape are instantly transferred to the text object.

9. Save the scene as **My_Sweep.max**.

THE SWEEP PARAMETERS ROLLOUT

The Sweep modifier contains several controls, located in the Sweep Parameters rollout, for adjusting the cross section's shapes as well as its alignment with the paths that it follows. By default, the pivot point of a shape is located at its geometric center, and this point is used as the center of the cross section for the Sweep modifier. This may not be the optimum location for a project, but this can be fixed within the Sweep modifier's Sweep Parameters rollout. For example, if you draw a line that follows the intersection of the walls and ceiling in a room to use as the path that the crown molding will follow, then the default location of the pivot, at the center of the crown molding's shape, will force half of the molding to be behind the wall or above the ceiling. By choosing the Pivot Alignment button (out of a grid of nine buttons) that corresponds with the molding cross section's corner, the molding will be properly aligned with the path.
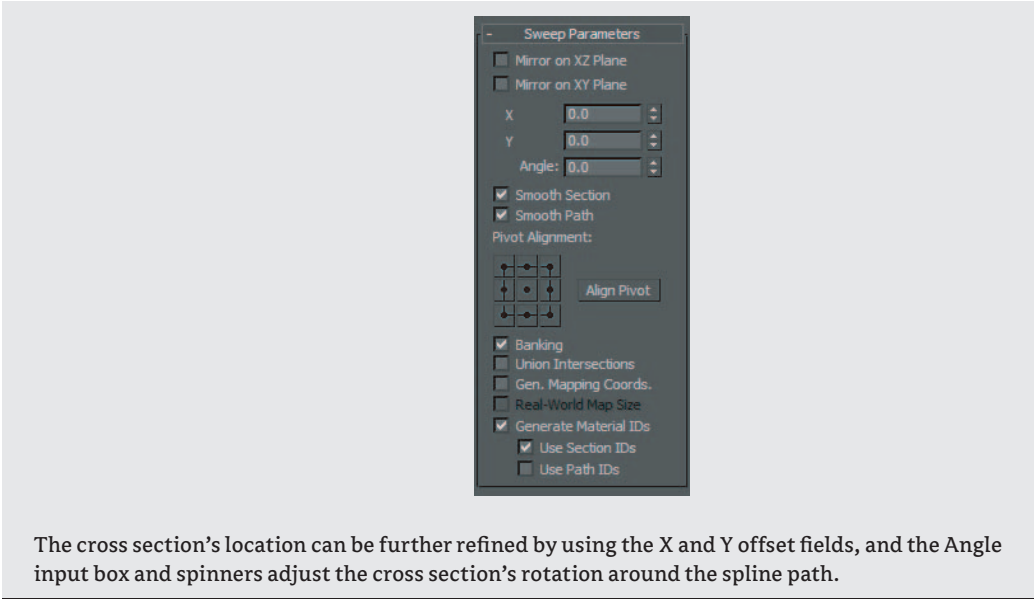
The cross section's location can be further refined by using the X and Y offset fields, and the Angle input box and spinners adjust the cross section's rotation around the spline path.

Aligning Objects

If you want your scenes to look professional and accurate, your 3ds Max objects must be aligned with one another in your scenes so that their intersecting surfaces are touching rather than overlapping or in a condition where one object inexplicably hovers over another. The Align tool, found on the Main Toolbar, is used to align one object's bounding box with the bounding box of another. A *bounding box* is an implicit box defined by the boundaries of an object or the smallest possible box that completely surrounds it. To begin this exercise, open the C06_Align.max file. In this exercise, you will align an end plate and an angle beam to an I-beam. Align can just as easily be used to place objects on a shelf or table or to locate windows on a wall.

1. Select the Plate object, the box near the end of the beam. The object selected when the Align command is initiated becomes the *current object* and is the object that is moved. The second object selected becomes the *target object*; the current object is moved in relation to it.

2. In the Main Toolbar, click the Align button. The cursor changes to the Align cursor, similar in appearance to the Align button, with the addition of a cross whenever the cursor is over an applicable target object. Instructions to pick the target object appear in the status bar, as shown in Figure 6.63.

FIGURE 6.63
Pick Align Target
Object
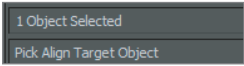
3. Click the Wide Flange object to designate it as the target. The Align Selection dialog box opens, as shown in Figure 6.64, and the plate relocates to the default location, aligning the centers of both objects.

FIGURE 6.64
The Align Selection
dialog box
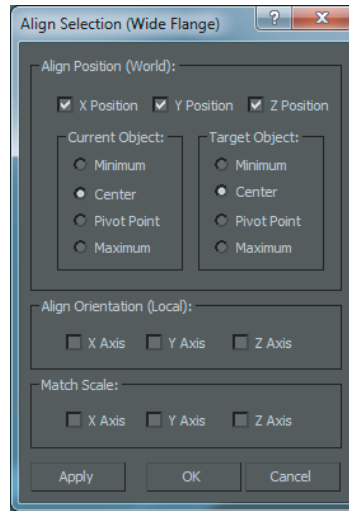
The X, Y, and Z Position check boxes refer to the current viewport's coordinate system. Aligning an object's Y position in the Front viewport is the same as aligning its Z position in the Top or Perspective viewport.

The plate must be moved to the end of the beam and centered. The Align Position section contains four options for each object: Minimum, Center, Pivot Point, and Maximum. The Minimum and Maximum options refer to the extreme locations of the objects' bounding boxes in the directions identified with the Position check boxes at the top of the dialog box. The Center option refers to the center of the bounding box, again only in the directions identified by the Position check boxes. The Pivot Point applies to each object's pivot point.

4. Deselect the X and Z Position check boxes if they are selected. Align allows you to address the concerns for each axis independently. Select the Y Position check box if necessary, as shown in Figure 6.65.

5. The positive Y-axis points to the far end of the beam, as indicated by the axis tripod in the lower-left corner of the Perspective viewport. Therefore, the near end of the beam's bounding box would be its lowest, or minimum, Y value. In the Target Object area, select the Minimum radio button.

FIGURE 6.65
Align Position
(World)
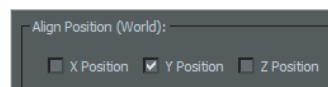
6. Similarly, the highest Y value for the plate is the surface facing away from the viewport, and the lowest Y value is facing the viewport. Because you want the back of the plate to touch the front of the beam, click the Maximum radio button in the Current Object section. With each option selected, the current object changes location.

7. Your Align Selection dialog box should look like Figure 6.66. Click the Apply button on the left side of the dialog box. Apply executes the Align command, moving the current

object into position, and then clears the Position check boxes and awaits further position modifications.
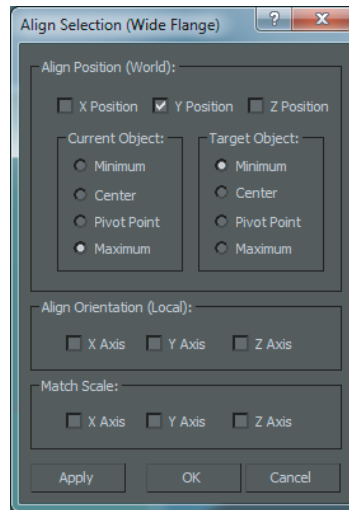
8. The plate must be centered on the beam to complete the repositioning shown in Figure 6.67. In the Align Selection dialog box, select both the X and Z Position check boxes and click both Center radio buttons. Then click OK to execute the Align command, and close the dialog box.

FIGURE 6.67
The plate is aligned
with the I-beam.
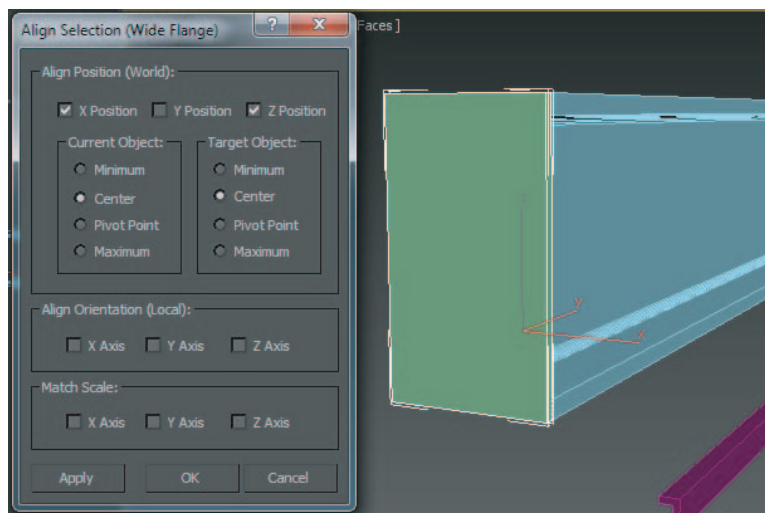
9. Complete the exercise by aligning the Angle object to the bottom-right edge of the Wide Flange object. Each position must be aligned independently. Here is a summary of the steps:

   A. Select the Angle beam, click the Align button, and then click the Wide Flange beam.

   B. Click the X Position option only, choose Maximum for both objects, and then click Apply.

   C. Click the Y Position check box only, choose Minimum for both objects, and then click Apply.

   D. Click the Z Position check box only, choose Maximum for the current object, choose Minimum for the target object, and then click OK. Figure 6.68 shows the completed exercise.

FIGURE 6.68
The angle is aligned with the I-beam.
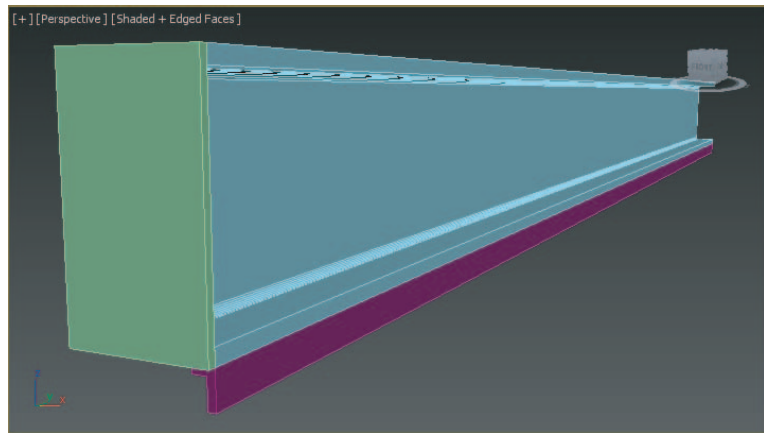
10. Save the scene as **My_Align.max**.

USING THE QUICK ALIGN TOOL

To align the pivot points of two objects quickly, use the Quick Align tool. With one object selected, choose Tools ➢ Align ➢ Quick Align, or press Shift+A and then select another object. The first object is moved so that its pivot point is also located at the second object's pivot point.

Using the Align tool, you can quickly and accurately position objects in your scene. You are not restricted to using a single current object. To place several objects on a table, you can select all of the objects, click the Align button, and then select the table. Choosing Minimum for the object's Z Position and Maximum for the table's Z Position will align the base of all the objects simultaneously with the table's top. The objects can then be moved manually on the X- and Y-axes.

The Bottom Line

Loft a shape.   Lofting is the practice of extruding a two-dimensional shape along the length of another two-dimensional shape. There are few restrictions on the shape component of the loft object, but the path component must consist of a single spline.

> **Master It**   Use the Loft tool to create a table leg that is 32" tall. The table leg is to start as a 1"-diameter circle and end as a square that is 1 ~1/2" on a side.

Organize objects with layers.   By assigning the objects in your scenes to layers, you can define which layers are hidden, frozen, rendered, and subject to a radiosity calculation. New objects are always created in the current layer using the current layer's color.

> **Master It**   Make three instance clones of the table leg from the previous Master It exercise. Also, make two teapot primitives and a 32"-long, 32"-wide, 2"-tall box. Place the two-dimensional shapes in one layer and hide the layer. Place the legs in one layer, the box in one layer, and the two teapots in one layer. Assign each layer a unique name and layer color.

Deform an object with the Noise modifier.   Applying the Noise modifier to any object adds apparent randomness to the object's surfaces. This can often add a sense of realism to a scene by eliminating the perfect roundness and flatness of many objects created in 3ds Max.

> **Master It**   Select the potted tree in the last condo scene you saved, add the Noise modifier to it, and then adjust the Noise parameters so that the trunk of the tree is slightly more jagged than it is at present.

Model with the Symmetry modifier.   In many cases, objects are symmetrical across one or more axes. Rather than attempting to model both sides of an object, you can model one side and then, using the Symmetry modifier, adjust the other side automatically to appear as its reciprocal.

> **Master It**   Being able to modify objects you have already built quickly to create new objects is an important skill. Open the last condo scene in which you modified the pedestal. Create a clone of the first pedestal you built, modify one side of the pedestal, and then make the new pedestal model symmetrical.

Extrude with the Sweep modifier.   Similar to the Loft compound object, the Sweep modifier extrudes one 2D object along the length of another. While the Loft tool is more powerful, with more controls and features, the Sweep modifier is faster, can be applied to multiple objects, and comes with a library of 2D shapes.

> **Master It**   The goal of this exercise is to make a round bumper to fit around the TableTop that you made in the second Master It exercise. The large, flat surfaces of the box should transition seamlessly into the bumper. Use the Sweep modifier to extrude a half-round shape that fits precisely around the box.

Align objects.   3D modeling or layout specialists frequently must move one object so that it sits directly on, or butts precisely against, another object — with no gaps or overlaps. The Align tool is often the best choice when you need to align the minimum or maximum axis values of different objects.

> **Master It**   Continuing from the previous exercise, you need to align the table legs with the box so that the top of each leg is aligned to the bottom of the table and two of the rectangular edges at the top of each leg are aligned with the outside edges of the box. Move

the teapots so that they lie within the perimeter of the box, and then align the bottom of the teapots with the top of the box. Align the bumper so that it is centered on the box.

Rename objects.   A good naming convention is invaluable when a scene becomes complicated, with many objects to control and select. The Rename Objects tool is invaluable for quickly renaming several objects to a standard naming convention.

> **Master It**   Again continuing from the previous exercise, use the Rename Objects tool to rename the four table leg clones to objects named Table_Leg_01, Table_Leg_02, Table_ Leg_03, and Table_Leg_04.

Light and Shadow

Up until now, you've been concentrating on methods of constructing models and scenes in Autodesk® 3ds Max®. In this chapter, you'll learn some of the ways you can control the appearance of the objects you build by manipulating light and shadow.

After your model is built, three main elements affect the look of your models: materials, cameras, and lighting. This chapter will introduce you to the influence of lighting.

Lighting is one of the most interesting features of 3ds Max. You can use lighting to create effects, emphasize parts of your model, or simply set up a daytime scene. Through lighting, you can control shadows, manipulate reflective color, calculate the bending of light passing through a transparent material, and simulate lighting fixtures based on specifications from a lighting manufacturer. It's best to think of lighting in 3ds Max as a kind of paint tool to add emphasis, color, or a sense of realism to your model.

In this chapter, you'll learn to

◆ Create and adjust the different light types

◆ Render a scene

◆ Define shadow effects

◆ Save and restore scene states

Lighting Your Model

When you are creating 3D graphics, lighting is one of the most important tools at your disposal. Whether you are able to render your model successfully depends largely on your ability to control and manipulate the lighting on your model. A poor lighting setup can ruin an outstanding modeling effort, while proper lighting can emphasize the best parts of a scene. There's a lot to cover in this topic, so let's start with an overview of the different types of lights available in 3ds Max.

Understanding the Types of Lights

So far, you've been depending on the default lighting in 3ds Max. In a Perspective viewport with Realistic turned on, one light source is above the origin and shifted in the negative X direction, while the other is below the origin and shifted in the positive X direction.

3ds Max 2013 offers a bewildering array of light types. There are five standard light types, two mental ray lights, the Skylight, two lighting systems (Daylight and Sunlight), and three photometric lights. The reason there are so many light types in 3ds Max 2013 is historical and has to do with the various ways that you can render your model, using the standard scanline rendering system, the Radiosity advanced renderer, or mental ray.

ADDING THE DEFAULT LIGHTING TO A SCENE

3ds Max has the ability to display the effects of lighting interactively in your viewport. In 3ds Max 2013, you will see the following behavior. When you place your first light in the scene, the hidden default lights that illuminated the scene previously are automatically disabled in Realistic mode viewports and when the scene is rendered, but they remain as the only lighting visible in Shaded viewports. If you have the 3ds Max Design version, the default lights are not automatically disabled when lights are added in the viewport, and you won't see the lighting in the viewport right away.

To display the default lighting in the Realistic viewport and disable the effect of the lights you add, click the General viewport label and then click Configure Viewports to open the Viewport Configuration dialog box. Select the Visual Styles & Appearance tab, and locate the Lighting And Shadows group. In this section, select the Default Lights option by clicking the radio button.

You can convert the default lights into actual, editable scene light objects by choosing Create ➤ Lights ➤ Standard Lights ➤ Add Default Lights To Scene. This command is available only when Default Lighting is enabled and the 2 Lights option is selected in the Visual Style & Appearance tab of the Viewport Configuration dialog box (Views ➤ Viewport Configuration).

As mentioned, there are three photometric lights. With the settings available in those lights, however, they can act as many more different types of lights.

This book focuses on using the default configuration of 3ds Max 2013 and uses the Default Scanline Renderer and photometric lighting systems. If you are using 3ds Max Design 2013 with this book, you will need to change your 3ds Max Design 2013 defaults using the Custom IU and Defaults switcher, as discussed in the "Working with the Custom UI and Defaults Switcher" section of Chapter 1, "Getting to Know Autodesk® 3ds Max® 2013." You'll also need to make sure to set your system to the 3ds Max preferences. Also, since this book is focused on 3ds Max 2013, you will not have access to the Light Analysis features of 3ds Max Design 2013, and they won't be covered in this book.

Along with the improvements in the hardware and software available to designers and visualization artists, there has been a convergence in the styles and techniques used to create compelling visualizations. More and more visualizations are crafted in the same way that Hollywood blockbuster feature films or television series are created, and they use many of the same lighting, camera, compositing, and special-effects techniques, as you will learn about in Chapter 10, "Organizing Objects and Scene Management," Chapter 14, "Advanced Rendering Using mental ray," and Chapter 15, "Finishing It Off: Atmosphere, Effects, and Compositing."

The standard lights are Target Spot, Target Direct, Free Spot, Free Direct, and Omni. As you might guess from their names, the spot and directed lights come in two versions.

The lights that have "Target" in their name use a target point helper that is linked to the light source but that can be moved independently from it. A light source always points at its own target, so you change the light's orientation by moving the target.

Lights that have "Free" in their name are light sources that don't require the placement of a target point. You can freely rotate and move Free lights without having to transform a target location. The drawback to Free lights is that they're a bit more difficult to aim because you must rotate the sources to orient these lights. Their advantage is that they're a bit easier to move in animated scenes because you do not have to move their targets too.

For better control over the rotation, always use the Local Reference Coordinate System when you are rotating Free lights.

Here's a brief rundown of these various types of standard lights:

Target Spot   Like a spotlight in a theater or headlights on a car, a Target Spot projects a focused beam of light from a single point source that can be aimed in a specific direction. The light rays emitted from a spotlight diverge as they get farther from the source. The Target Spot is perhaps one of the most versatile light sources offered in 3ds Max.

Target Direct   Otherwise known as *directional lighting*, a Target Direct is a source whose light rays remain parallel, rather than diverging with distance from the source. A Target Direct is like a single, very distant light source, such as our sun, with rays that are nearly parallel when they reach Earth.

Free Spot   The Free Spot is similar to the Target Spot, except that it has no target point helper. With a Target Spot, you must move the target location to rotate the light. A Free Spot can be freely rotated in any direction using the Transform tools.

Free Direct   A Free Direct light is the same as the Target Direct light, except that it doesn't use a target point helper. Like the Free Spot, the Free Direct can be rotated freely without involving a target point.

Omni   The Omni light acts similarly to an incandescent lightbulb, radiating light in all directions. Like the Target Spot, Omni is a versatile light source that you'll use frequently. Because an Omni light has no particular direction, it doesn't have a target version.

Don't Mix 3ds Max Light Types

If you are using the mental ray renderer, it is not recommended to mix using standard and photometric lights. You will get the best results using only photometric lights with mental ray.

A feature that is extremely helpful in using lights in 3ds Max is the ability to take a targeted light and toggle off and back on the target helper so that you can have complete freedom for positioning and rotating the lights in your scene. You cannot toggle the targets on and off on the Create tab, but you can do so on the Modify tab.

CERT
OBJECTIVE

When working with the lights in 3ds Max, an important piece of information of which you should be aware is the *angle of incidence*. The angle of incidence is calculated using a vector from the light object and the face normal of the geometry that the light is affecting. If the angle of incidence is zero degrees, indicating that the light rays are perpendicular to the geometric surface, the geometry will be lit by the full intensity of the light. When the value of the angle of incidence rises above zero degrees, the surface will be affected less and less by the light.

Another lighting feature you'll grow to understand and use is *ambient lighting* (also called *global lighting*). Ambient lighting can best be described as the secondary, indirect light that doesn't come directly from a particular source. You can think of ambient light as the light you get on an overcast day, when the light seems to be coming from all directions. You can use ambient lighting to bring out hidden detail or, conversely, to suppress detail. Proper usage of ambient light contributes a great deal toward photorealism. In Chapter 14, you will use the advanced features of the mental ray renderer, a Daylight system, and photometric lights to calculate global illumination as a way to calculate indirect (ambient) lighting in a scene accurately.

It is best to increase the ambient light in a scene with great care. In actuality, no additional illumination is included in a scene, but the surface colors of the scene's objects are brightened,

which may cause a loss of surface texture or appearance. In this chapter, you will begin your ambient-light journey by learning how to make quick approximations of indirect light. But first, you'll learn about the obvious light in the scene — the light that comes directly from illumination sources.

In traditional photography or filmmaking, setting up your lighting to create the desired impact of a scene is an important aspect of making your images (or *shots*, as they are commonly called) engaging for the viewer or to set a specific tone or mood for the image or sequence.

CERT OBJECTIVE

One of the simplest and most overused lighting setups is the *three-point lighting method*. The benefit of the three-point setup is that the photographer/cinematographer can control the amount and direction of illumination on the subject, including the appearance of shadows.

Figure 7.1 shows what you might commonly see arranged on a tabletop in a beginning drawing, painting, or photography class: recognizable objects set about to allow the students to see how light falls across the shapes as the directionality of the lighting changes.

FIGURE 7.1
A collection of objects on a tabletop
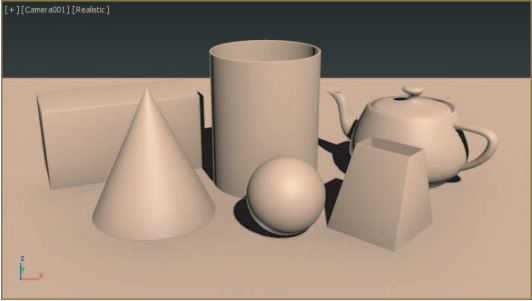
It is good lighting practice to set up your initial lighting with all objects using a neutral diffuse gray material. This is because the human eye is more perceptive to changes in brightness than it is to changes in color. Therefore, it is easier and more informative to make decisions about lighting and layout in gray tones. Your eye can get fooled if you add color and complex materials too early in the process of setting up lighting in your scenes.

The three-point lighting setup has a key light, a fill light, and a back light. Figure 7.2 presents a top view of the mock tabletop scene and indicates the three-point lighting that is used in the scene.

FIGURE 7.2
Three-point lights identified in the scene

Back light

Fill light
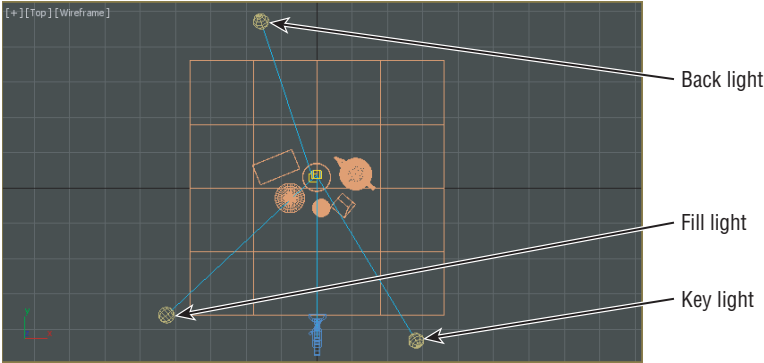
Key light

The primary key light provides the majority of the light on the subjects and casts the most discernible shadows. Figure 7.3 shows the scene illuminated by just the key light.

FIGURE 7.3
The scene using just the key light
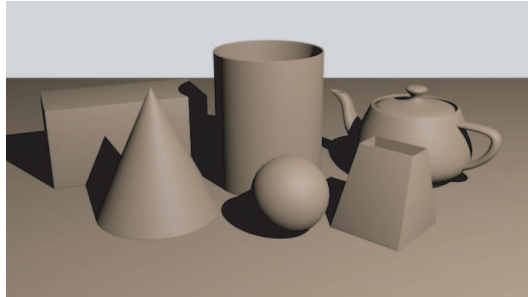
Typically fill lights are placed with a lower angle to the subject to add light in shadow areas and are typically set at about 50 percent the intensity of the key light, as shown in Figure 7.4.

FIGURE 7.4
The scene using just the fill light
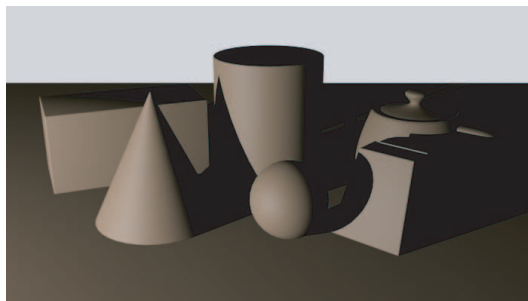
The back light, the effect of which is shown in Figure 7.5, is used to help separate the subject from the background and give a little kick of light around the perimeter of the objects in the scene. It is often seen as the highlight or halo in the top/back of an actress's hair in photographs or recorded interviews.

FIGURE 7.5
The scene using just the back light
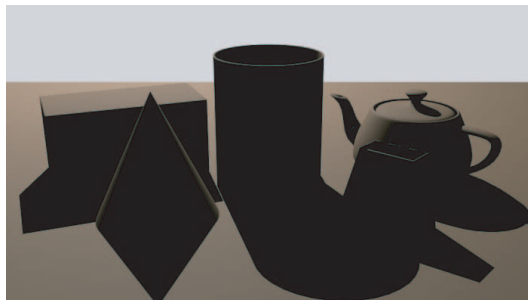
Figure 7.6 shows a render of the scene with all the lights on.

FIGURE 7.6
A rendering of
the scene with all
lights on
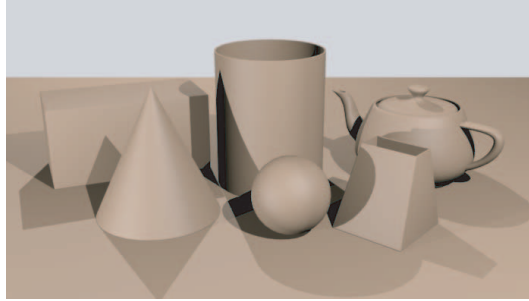
In the last few images, you have seen how lighting in the 3D scene accumulates to form the three-point lighting technique. The three-point lighting technique is one of many basic techniques used to light objects or actors for photography or film recording; however, it is not used very much in architectural renderings.

Suggested Additional Reading

Mastering Autodesk 3ds Max 2013 is designed to give you a fundamental understanding of how to use 3ds Max 2013 to create your projects, from modeling through final rendering, quickly and efficiently; therefore, it cannot cover all the fundamentals of basic photographic, studio, or stage/set/location lighting. Some information about traditional lighting techniques is discussed in this book, but for a much greater appreciation of the history of set and production lighting, you should consider reading these books:

◆ *Painting with Light* by John Alton (University of California Press, 1995)

◆ *The Art of 3D Computer Animation and Effects* by Isaac Kerlow (Wiley, 2009)

◆ *Digital Lighting & Rendering* by Jeremy Birn (New Riders Press, 2006)

Adding a Spotlight to Simulate the Sun

3ds Max offers a way to simulate the sun accurately, including the correct sun angle, depending on the time of day and the location of the illuminated object on the earth. You'll see how you can accurately place the sun in your scene in the sidebar "Creating an Accurate Daylight Environment with the Daylight and Sunlight Systems." (You can find a complete tutorial on placing the sun in your scene in Chapter 14.) First, to get a feel for how lighting works in general, you'll use a spotlight to simulate the sun.

Understanding Spotlights

Although a spotlight may not be the best type of light to simulate the sun, it's a type of light that you'll use often, so it makes a good introduction to lighting.

3ds Max lets you control the intensity as well as the *spread* of the spotlight. You can focus the light down to a narrow beam like the headlights of a car, or you can spread the light out in a wide angle like the light from a desk lamp. To simulate the sun with a spotlight, you can place a standard Target Spot in your scene at a relatively large distance from the objects. The Target Spot light requires the placement of both the light source and the target of the light. In the following steps, you will add a Target Spot to the scene.

ADDING OMNI OR FREE LIGHTS

The process for creating all lights is the same. The steps to add an Omni or Free light are nearly identical to those for adding a spotlight. The main difference is that an Omni or Free light doesn't require a target point.

---

1. Open the `C07_Savoye_01.max` file, which you'll find at this book's accompanying web page, `www.sybex.com/go/mastering3dsmax2013`. This file displays a residential building, the Villa Savoye, of which you modeled parts in Chapter 5, "Working with External Design Data." If the File Load: Units Mismatch dialog box opens, make sure the Adopt The File's Unit Scale radio button is selected, as shown in Figure 7.7, and then click the OK button.

FIGURE 7.7
The File Load: Units Mismatch dialog box
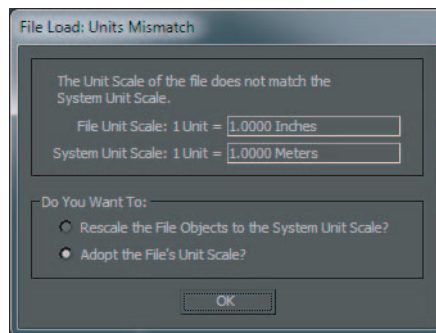
2. Right-click the Top viewport; then use the Zoom tool to zoom out (make your top view look similar to the one shown later in Figure 7.9).

3. Click the Create tab of the Command panel; then click the Lights category button.

4. Change the Light Type drop-down list to Standard, and click the Target Spot button in the Object Type rollout to activate it, as shown in Figure 7.8.

5. Click and hold at a point in the lower-left corner of the top viewport, as shown in Figure 7.9.

   As you move the cursor, the light appears at the point where you clicked and the spotlight target follows your cursor.

6. Move the cursor to a point in the center of the model plan (shown in Figure 7.9). Then release the mouse button.

FIGURE 7.8
Activating the
Target Spot tool

FIGURE 7.9
Placing the
Target Spot
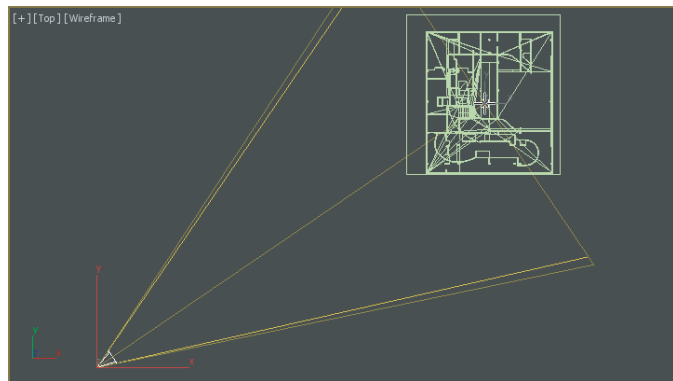
Once the Target Spot is placed, it takes over as the light source in the model. To get the Perspective viewport to change to show the light you placed in the scene, right-click the Shading viewport label and change the viewport shading mode to Realistic. Then click the Shading viewport label again, and then choose Lighting And Shadows ➢ Illuminate With Scene Lights.

7. Type **SUN001** in the Name And Color rollout's input box so that you can identify this new light source.

As you can see from the options in the Command panel, quite a few alternatives are available for controlling the characteristics of a spotlight. You can always go back and make changes to a spotlight. For now, accept the default settings created with the spotlight.

Moving a Light

Notice that in the Front viewport, the spotlight is oriented horizontally. 3ds Max places the light and target objects flat along the XY-plane when the light is created in the Top viewport. You must then move the light into position to simulate the sun high in the sky. Let's move the light to a point higher in the Z direction.

1. Right-click the Front viewport to make it active.

2. Use the Zoom and Pan tools to adjust the Front viewport so that it looks similar to Figure 7.10.

FIGURE 7.10
Moving the
spotlight and
spotlight target
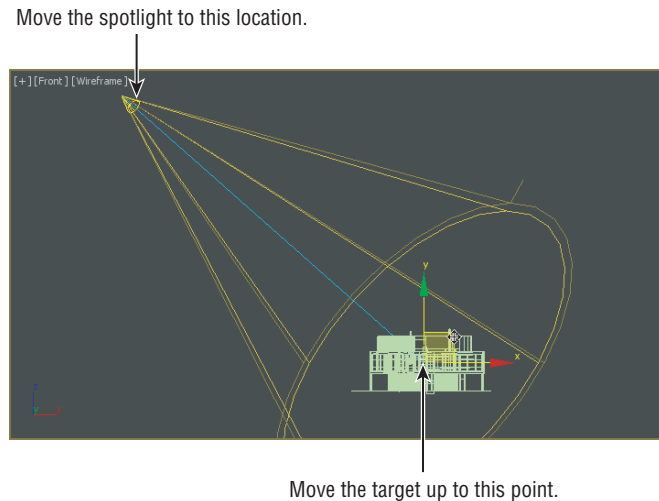
Move the spotlight to this location.

Move the target up to this point.

3. Click the Select And Move tool on the Main Toolbar. Then click and drag the Y-axis handle of the Transform gizmo of the SUN001 spotlight into the position shown in Figure 7.10. Once you've moved the light source, you'll see a change in the lighting of the Perspective viewport.

4. Click the Select By Name tool on the Main Toolbar. Then click SUN001.Target in the list, and click OK. Alternatively, with a light selected, you can right-click and choose Select Light Target from the tools 1 quad menu to select the target.

5. With the Select And Move tool active, click and drag the spotlight target's location up, as shown in Figure 7.10. You can use the SUN001 light cone in the Perspective viewport to help match the target position.

The light source and its target move independently, yet they are linked to each other. If you need to move both objects simultaneously, you can select and move the light-blue line that connects them. You also see that viewports using the Realistic rendering mode give you immediate feedback regarding the light's effect on your model.

CREATING AN ACCURATE DAYLIGHT ENVIRONMENT WITH THE DAYLIGHT AND SUNLIGHT SYSTEMS

The Daylight system can be useful for shadow studies and for creating an accurate daylight representation of your design. It simulates the color, intensity, and surface reflections of a scene, and it takes into account the "sky glow" or general diffuse lighting from the sky. When the DesignVIZ User Interface and Defaults settings are chosen in 3ds Max 2013, the Daylight system places a special light source called an Illuminating Engineering Society (IES) Sun that more accurately simulates the position and intensity of sunlight according to geographic location, time of year, and time of day. The Daylight system is intended for use in conjunction with Radiosity. Another lighting system, called Sunlight, works very much like the Daylight system. The Sunlight system is meant to be used with the Default Scanline Renderer because it uses a direct light source instead of an IES Sun.

To get the most from the Daylight and Sunlight systems, you need to set a North Direction parameter to orient your model accurately in the north-south direction. You also need to know the location of your building or site and the date and time you want to use for the sun's position. Once you've established these criteria, you can set up your system of choice fairly easily. You'll learn more about this feature in Chapter 14.

When 3ds Max is set to use the DesignViz.mentalray settings, the Daylight system defaults to creating an mr Sun And mr Sky for producing accurate shadow studies and sunlight simulation. It is designed to work with mental ray as the renderer, and it is also required when doing lighting analysis using the Light Meter objects in 3ds Max Design. The process of creating a Daylight system is similar whether you are creating one for the Default Scanline Renderer, Radiosity, or mental ray.

Editing a Spotlight

Many settings are available for your new spotlight. You can set the intensity, the color, and even the shape of the light, just to mention a few. But the two settings you'll be using the most adjust the light intensity and the light cone. The light intensity is set in the Intensity/Color/Attenuation rollout, and the light cone is set in the Spotlight Parameters rollout.

Let's start by looking at the Hotspot and Falloff settings:

1. Use the Select Object tool to select the SUN001 Spotlight object (not its target).

2. Click the Modify tab in the Command panel; then scroll down and click to open the General Parameters rollout.

   Notice in the Perspective viewport that you don't see any shadows from the Sun001 light. By default, lights in 3ds Max aren't set to cast shadows. You will adjust that right now.

   In the Shadows group of the General Parameters rollout, click the box in front of On to enable the light to cast shadows.

   Now you should see proper shadows cast from the light on the building.

3. Scroll down to the Spotlight Parameters rollout and expand it to see the available settings. Click and drag the Falloff/Field spinner down until its value reaches 12 degrees (Figure 7.11). Notice that the cone of the light is reduced in size, shining on only a small part of the scene. Also notice that when you reduce the Falloff/Field value, the Hotspot/Beam value also drops. The Hotspot/Beam will always be at least two degrees smaller than the Falloff/Field value.

   FIGURE 7.11
   Reduce the Falloff/
   Field value.
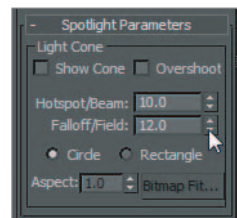
4. Click and drag the Hotspot/Beam spinner up until it reaches a value of about 50. The light spreads out to cover a larger area. Notice that the Falloff/Field value also increases, staying slightly larger in value.

5. Now click and drag the Hotspot/Beam spinner down to about 20. This time the Falloff/Field value remains where it was last set while the hotspot got smaller.

6. Set the Hotspot/Beam value to about 34 and the Falloff/Field value to about 36.

The Hotspot/Beam and Falloff/Field spinners control the *spread* of the Target Spot. The Hotspot/Beam value controls the area covered by the most intense portion of the light; everything within the Hotspot cone will receive the full intensity of the light. The Falloff/Field value controls where the light intensity is reduced to zero; nothing beyond the Falloff cone receives any illumination from the light. There is a continuous gradient between the maximum intensity of the light within the hotspot and the zero intensity at the edge of the Falloff cone. The greater the difference between the Hotspot and the Falloff, the smoother the transition will be from bright to dark at the edge of the light pool. This is difficult to see in the Perspective viewport, but it will be more obvious in a rendered view. You'll see this better when you learn to make a quick rendering later in this chapter. Directional lights have identical Hotspot and Falloff controls; however, their cones are cylindrical or box shaped.

Now try setting the light intensity. This is done through the Multiplier input box.

1. On the Modify tab of the Command panel, expand the Intensity/Color/Attenuation rollout; then click and drag the Multiplier spinner down.

As you reduce the Multiplier value, the view in the Perspective viewport dims. Remember, this is because the SUN001 Target Spot is now the only light illuminating the scene. If you set this light's multiplier to zero, there will be no light at all.

2. Click the Undo Scene Operations tool on the Quick Access Toolbar to return the Multiplier value to 1.0.

CREATING NEW LIGHTS AFTER ADJUSTING EXISTING LIGHTS

When you create a new light after adjusting an existing light's Multiplier value, the new light's default Multiplier will match the previous light's modified value.

The Multiplier spinner controls the overall intensity of the light source. Technically, this parameter is multiplied by the color value to result in the total output intensity. You can change the color of the light source using RGB (Red, Green, and Blue) or HSV (Hue, Saturation, and Value) values. You select a color using the Color Selector shown in Figure 7.12.

To open the Color Selector dialog box, click the color swatch next to the Multiplier spinner in the Intensity/Color/Attenuation rollout.

The Color Selector dialog box lets you see your chosen color as a sample in the lower-right corner of the dialog box. Adjacent to this on the left is the original color that was in the swatch when you opened the Color Selector. This feature can be helpful when you want to compare the new with the old. If the light color that you chose is not appropriate and you have not exited the Color Selector, use the Reset button to return the light to its color prior to making any modifications.
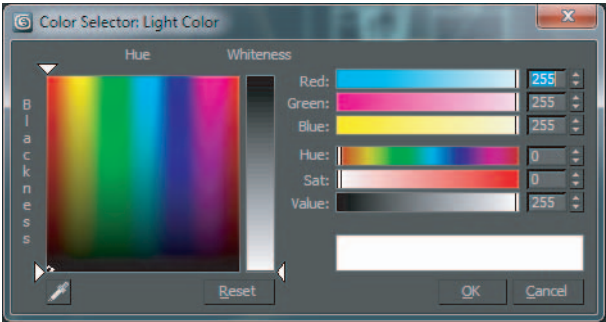
Finally, if you decide that the light you selected originally isn't appropriate for the task at hand, you can use the Light Type drop-down list in the General Parameters rollout to change the type of light used, as shown in Figure 7.13. You can switch the light type only within the same category of lights (standard, photometric, or mental ray) but not between the different categories.

FIGURE 7.13
Changing the type
of light
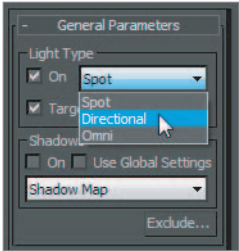
This tool, along with the Targeted option in the same group, offers a convenient way to change a light type without having to delete the light and create a new one.

Changing the Light Type

As mentioned in the preceding section, once you've placed a light in your model, you aren't stuck with your choice of light type. You can change it in the Modify tab of the Command panel.

You were asked to create a sunlight source using a Target Spot. There is nothing wrong with using such a light for the sun, but the Target Direct is a more appropriate standard light source for the sun.

TREAT THE SUN AS A DIRECT LIGHT

The light rays from a 3ds Max Target Direct or Free Direct light are parallel, just as the rays from our sun are basically parallel in relation to the earth. The rays from the sun are almost parallel because of the relative sizes of the sun and the Earth and the vast distance between them. Even though the sun is effectively an Omni light source, it is about 93 million miles from Earth; so from our perspective, the rays of light from the sun striking Earth are essentially parallel.

Here's how you can change a light from Target Spot to Target Direct:

1. Click the Light Type drop-down list in the General Parameters rollout, and select Directional (see Figure 7.14). Also make sure that the Targeted option is checked. The light pool produced by a directional light that has been created from a spotlight can be very small compared to the original expanse of the spotlight.

FIGURE 7.14
The Directional light and Targeted settings selected
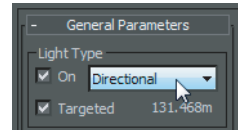
Notice that the light changes its icon in the viewports to indicate a Target Direct light object. You might also notice that, instead of showing a cone, the light shows a narrow cylinder to indicate the direction and parallel spread of the light rays. You can see this cylinder more clearly in the Left viewport after you click the Zoom Extents button.

2. Scroll down the Modify panel, and open the Directional Parameters rollout (Figure 7.15).

FIGURE 7.15
The Directional Parameters rollout
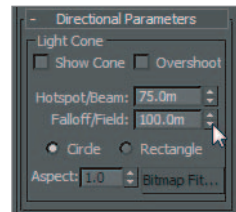
3. Click and drag the Hotspot/Beam spinner up until its value reads around 45m. Click and drag the Falloff/Field spinner until its value reads 50m. You see the light enlarge to form a large cylinder, as shown in Figure 7.16.

FIGURE 7.16
The light with the Hotspot and Falloff increased
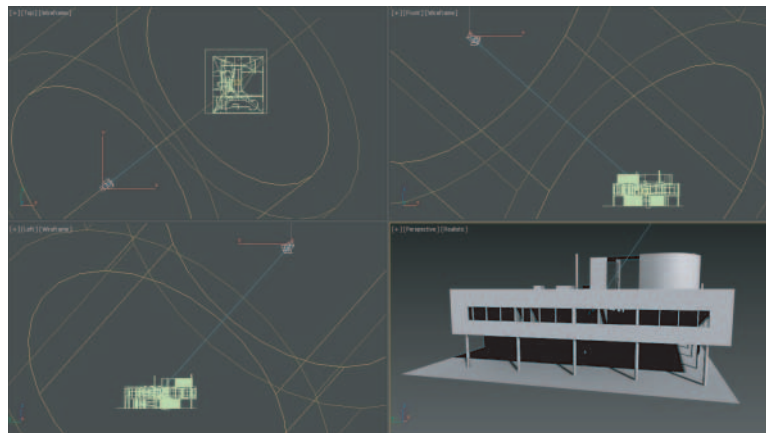
As described earlier, the Target Direct light source produces a light whose rays are parallel, so the light appears as a cylinder. The light rays from a Target Spot diverge, so the light forms a cone. Both light sources offer a Falloff option to soften the edge of the light.

Many other parameters are associated with the light objects, and you'll get to use a few more in later chapters. For now, let's see how lighting and camera locations affect your rendering.

Rendering a View

One of the main reasons for using 3ds Max is to get an idea of how your project will look before it is built. Although you can get a fairly decent idea of how it looks in the Perspective viewport, you need to render your model to get a finished image.

The rendering facilities that 3ds Max offers let you create a wide range of images, from quick-study renderings to photorealistic images. You can also generate animated walkthroughs or virtual-reality environments.

All of these types of output are produced through the Render Setup dialog box. Clicking the Render Setup button on the Main Toolbar opens this dialog box, and the Render Production button executes the rendering, using the Render Setup parameters without opening the dialog box. In this section, you'll get a look at some of the ways you can control your rendered output through Render Production. The Render Setup dialog box will be covered in Chapter 9, "Using the Camera," and Chapter 14. This chapter was written, and its accompanying files were created, with the Default Scanline Renderer in mind.

Try the following exercise to get a good look at the rendering options you have available:

1. Make sure the Perspective viewport is active, use Orbit to get a better view of the Villa Savoye model if desired, and then click Render Production on the Main Toolbar (see Figure 7.17).

FIGURE 7.17
The Render
Production button

The Rendered Frame Window appears, as shown in Figure 7.18, and the view is rendered with the Scanline Renderer.

Rendering is the process of calculating image pixels from mathematical vectors or, in other words, generating a picture based on the objects, lights, and materials in a scene. A *frame* is a single still image on the timeline (animations are composed of numerous frames). Notice that the lighting in the Rendered Frame Window looks quite close when compared with the perspective viewport, and it includes shadows.

2. In the upper-left corner of the Rendered Frame Window, click the Save Image button.

3. The Save Image dialog box appears, as shown in Figure 7.19. Click the Save As Type drop-down list. A wide variety of output formats is available. Scroll through the drop-down list to get an idea of the choices.

FIGURE 7.18
The Rendered
Frame Window
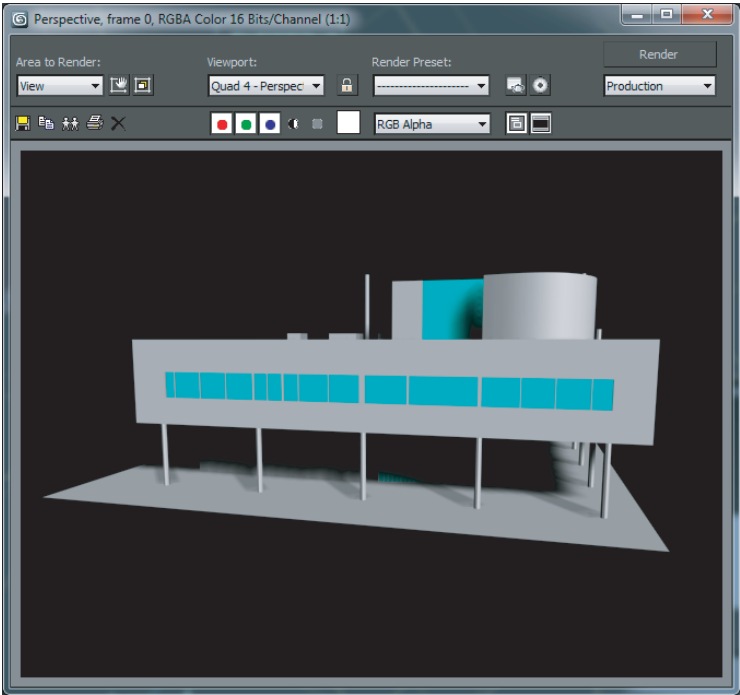
FIGURE 7.19
The Save Image
dialog box
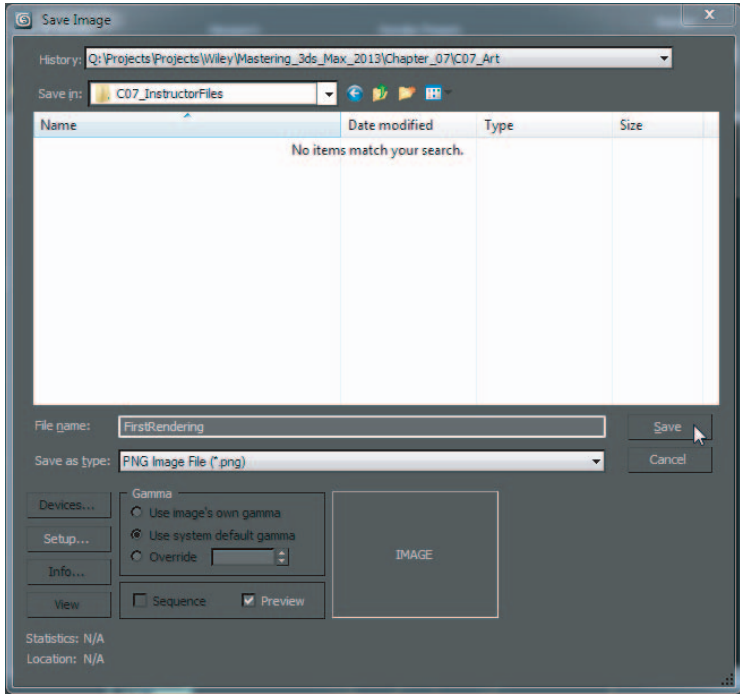
4. Select PNG Image File (*.png) from the drop-down menu. Type in the filename **MyFirstRendering**, and click the Save button. The .png file extension is automatically appended to the output file. The default location for the file is the same folder as the current project.

5. The PNG Configuration dialog box appears, as shown in Figure 7.20. Click OK to accept the defaults, and the file is saved to your hard drive. Each one of the output formats will have its own configuration dialog box with information that must be selected that is specific to each format. You will learn more about image and video formats in later chapters.

FIGURE 7.20
The PNG Configuration dialog box
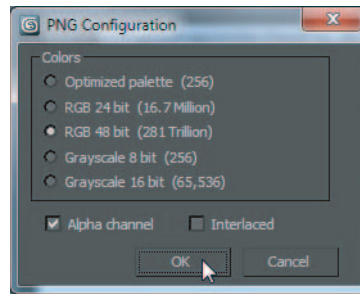
6. Close the Rendered Frame Window.

7. Click the Rendered Frame Window button from the Main Toolbar to view the last rendering you made in your scene. The next time you make a rendering, the contents of the Rendered Frame Window will be overwritten.

Because you haven't added materials to the model yet, the rendering displays with the default colors assigned to all surfaces. Your rendering has the appearance of a cardboard model painted gray. Although it definitely is not the greatest rendering, it does offer a fairly accurate representation of the design. This is really just a start. The process of creating a finished rendering or animation involves a repeated cycle of rendering, adjusting (lights, materials, and camera settings), and rendering again (and again) until you've reached a look that pleases you or, more important, your client or employer.

One of the many initiatives for 3ds Max has been the improvements in the viewport system. The Nitrous viewports in 3ds Max 2013 should allow you to get a much better preview of how your finished rendering will turn out, thereby saving you many hours of rendering different iterations of your scenes as you adjust lights, materials, and camera positions. Rendering is representative of the magic of computer graphics — seeing your beautiful renderings appear can be quite fulfilling to you as a designer and to your clients. As you progress through the chapters in this part of the book, you'll learn these processes firsthand. In the next chapter, you'll learn the method for adding materials and for further enhancing the rendered image. For now, however, let's continue with more on light and shadow.

WHEN OBJECTS APPEAR TO BE MISSING

If you're familiar with the Villa Savoye design, you may notice that some parts of the building are missing or suffer from overlapping surfaces called display *artifacts*. All of the parts are there but because their normals aren't aligned properly — a common occurrence when using CAD-generated models — they disappear when the model is rendered. You can use the 2-Sided option in the Shader Basic Parameters rollout of the Standard Material or on the Physical Qualities rollout of the Architectural Material to force 3ds Max to render both sides of a surface, regardless of the direction of the normals.

Ambient Light

The rendering shows a picture with lots of contrast. The lit areas are bright enough so that you can clearly see the building features; however, you cannot see any detail in the shadows. This is because there is no ambient light in the model. In the real world, there is usually some ambient light that bounces off the surrounding objects. Indoor ambient light comes from light that is bounced off walls, floors, and ceilings; outdoor ambient light comes from clouds and the general glow from the sky overhead.

   If you add ambient light to your scene, you'll begin to see more of the objects in the shadows, and you'll give your rendering a little friendlier appearance. As mentioned earlier, ambient light can be calculated in many ways. The most realistic methods for calculating ambient light (Radiosity or Light Tracer with the Default Scanline Renderer and using Global Illumination and Final Gather in mental ray) generally take much longer to process. Although it is often better to fake bounced light (see the "Faking Radiosity" section), here's how you can quickly increase the ambient light while using the Scanline Renderer:

   1. Close the Rendered Frame Window to make more room on the screen.

   2. Choose Rendering ➢ Environment from the menu bar or press **8** on the keyboard. The Environment And Effects dialog box opens to the Environment tab (see Figure 7.21).

FIGURE 7.21
The Environment tab
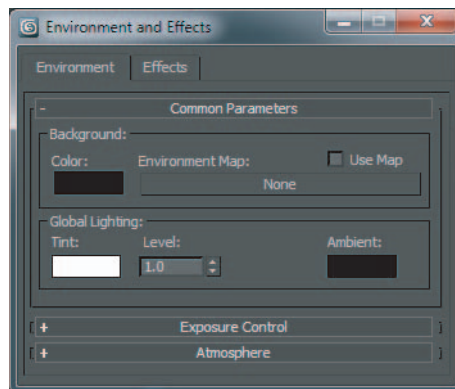
3. For now, you will just be dealing with the Common Parameters rollout on the Environment tab. Click the Ambient color swatch in the Global Lighting group.

The Color Selector displays (see Figure 7.22).

FIGURE 7.22
Adjusting the
Whiteness value

Drag the Whiteness slider downward.
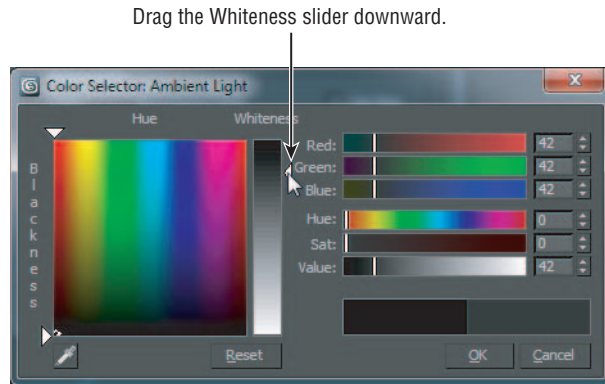
4. Click and drag the triangular slider in the Whiteness column downward, as shown in Figure 7.22. This adjusts the general brightness of the ambient light.

5. As you move the triangular slider, notice that the Value spinner changes. Adjust the Value setting approximately to 80 and then click OK.

6. Click the Color swatch in the Background group. In the Color Selector, adjust the Whiteness slider so that the Value setting shows 150. This will make the background lighter.

7. Click OK in the Color Selector; then close the Environment And Effects dialog box.

You've increased the ambient light so that objects in shadow will be more visible. To see the results, you'll have to render the model.

8. Make sure the Perspective viewport is selected, and then click the Render Production button in the Main Toolbar. The Default Scanline Renderer quickly calculates the new rendering, as shown in Figure 7.23.

9. Save your scene as **MyVilla01.max**.

In this exercise, you only increased the amount of ambient light in your model and changed the brightness of the background. This is clearly the simplest approach to ambient lighting — that of approximating all the indirect light with a single color. As you can see in the Color Selector dialog box, you can also tint the ambient light with hue and saturation if you so choose. This can be useful for interior views of rooms that have a predominant color or for sunset exterior views.

Because artificial lighting (incandescent) usually has a slight orange cast, as a general rule adding an orange cast to interior scenes helps give them a more natural appearance. Likewise, outdoor scenes can be improved by adding a bit of blue to the light source to simulate the ambient light in the sky. Keep the color saturation levels very low to avoid strange results. You can

imagine that if you increased the ambient color value to 255, or pure white, all the darker areas in the rendering would disappear as the contrast was eliminated. Using a particularly bright ambient color washes out the rendering and makes lighting irrelevant, because all surfaces seem to emit their own brightness. Therefore, avoid using an overly bright ambient color, or there will be no point to making a rendering at all.

FIGURE 7.23
The model with ambient lighting and background color increased
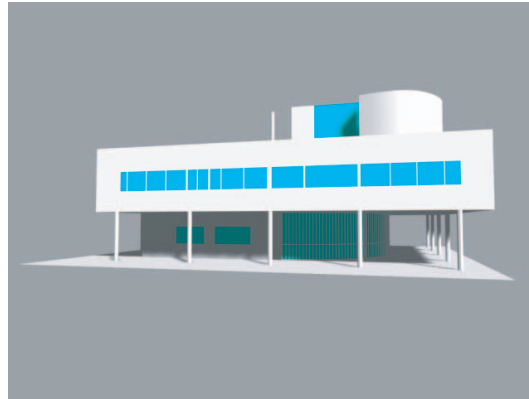
Faking Radiosity

As you will learn in Chapter 14, Global Illumination is a more sophisticated way of calculating ambient light than the method you have seen so far. Using Radiosity can help you generate photorealistic renderings. The downside to using Radiosity is the greatly increased render time.

To save time, you might find it useful to learn to fake the look of Radiosity ("fakiosity") using standard lights and the Default Scanline Renderer. The downside of using this method is that it isn't nearly as realistic or convincing as Radiosity or Global Illumination in mental ray for simulating ambient light. Even though mental ray is provided as an additional renderer for 3ds Max, there are many situations where it is faster and easier to use standard materials and the Scanline Renderer.

SIMULATING AMBIENT LIGHTING

It is relatively easy to simulate "direct light" — that is, light striking surfaces on a beeline from the light source. What is somewhat more difficult in computer graphics is efficiently simulating ambient light — all the light striking the surfaces in a space. Ambient light is influenced by light bouncing everywhere in a space from every angle, and it represents a huge number of calculations.

---

1. Open C07_Savoye02.max, another version of the Villa Savoye model with which you've been working. Choose Adopt The File's Unit Scale, and then click OK if you see the File Load: Units Mismatch dialog box.

2. Right-click in the Perspective viewport. Click Render Production. A view of the interior courtyard appears in the Rendered Frame Window, as shown in Figure 7.24.
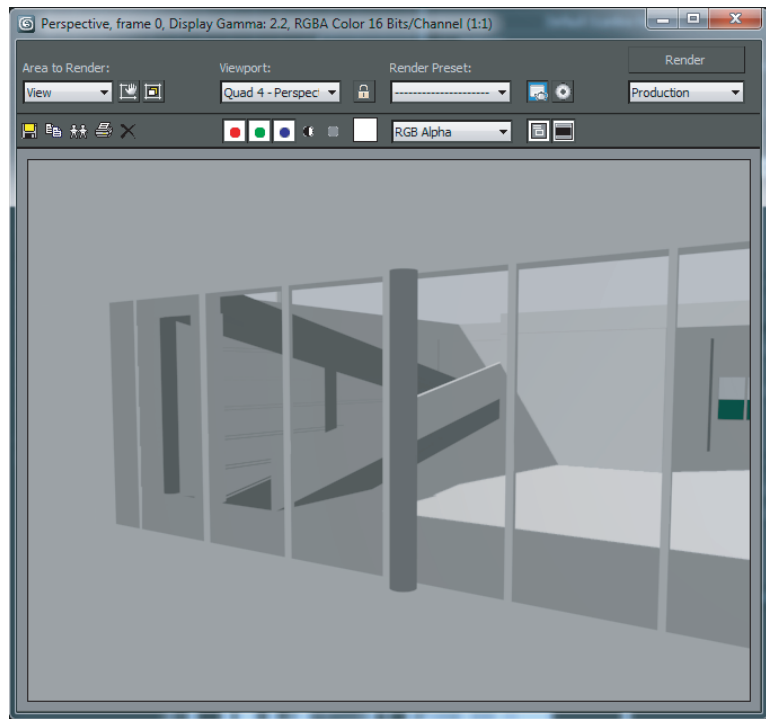
Because the entire scene is lit only with the SUN001 direct light, the courtyard looks flat and cartoon-like. In real life, the light reflected from the floor would bounce up and illuminate the courtyard walls. Although the Default Scanline Renderer doesn't simulate light this way, you can add some lighting of your own to help simulate ambient light.

Although it is fast, the Default Scanline Renderer is historically the oldest and least realistic rendering algorithm in 3ds Max. In Chapters 14 and 15, you will learn how to use the mental ray renderer for increased realism.

In the next exercise, you'll add some Omni lights and adjust their color settings to fake your own "bounced light" from the courtyard floor:

1. Close or minimize the Rendered Frame Window.

2. Right-click the Top viewport to make it active, and then zoom out until your viewport looks like Figure 7.25.

3. Click the Maximize Viewport toggle to enlarge the Top viewport.

4. Click the Create tab in the Command panel; then click the Lights category button.

5. Choose the Standard option, click the Omni button, and then click the location shown in Figure 7.25 to place an Omni light in the courtyard.

6. Give this new Omni light the name **Omni-court** in the Name And Color rollout input box.

FIGURE 7.25
Placing an Omni
light in the
courtyard

Place the Omni light here.

[+] [Top] [Wireframe]
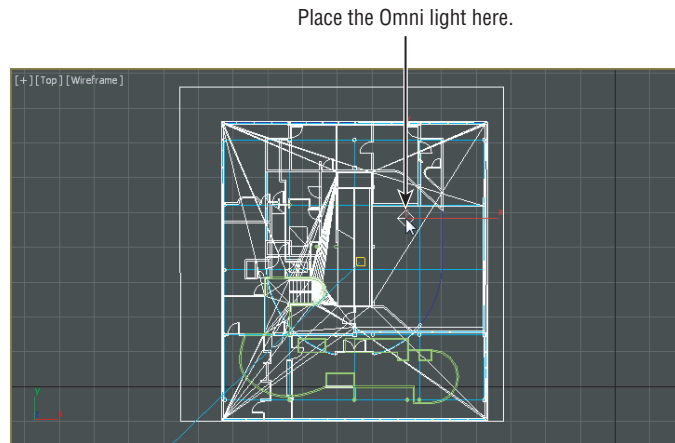
The Omni light is at 0 elevation. You'll want to raise it to a location that's just above the second-floor surface in order to simulate the light bouncing off that surface:

1. With the Omni courtyard light selected, click the Select And Move tool on the Main Toolbar.

2. In the Transform Type-In area at the bottom of the user interface, make sure that the Absolute/Offset Mode Transform type-in tool is set to Absolute; then change the Z value to 3.81 meters. This will raise the Omni light from the ground level to a level just above the floor of the courtyard.

Because the light bouncing off the courtyard floor represents a broad area, it would throw off a very diffuse light in the real world. The Omni light, on the other hand, is a point source. You'll want to spread the bounced light source around a bit to create a more diffuse appearance. To do this, make a few clones of the Omni light:

1. With the Select And Move tool still active, Shift-drag the X-axis of the Omni light's Transform gizmo and make a clone just to the right of the current Omni light's position (see Figure 7.26).

FIGURE 7.26
Cloning the Omni
light

[+] [Top] [Wireframe]

Drag an instance to the right.
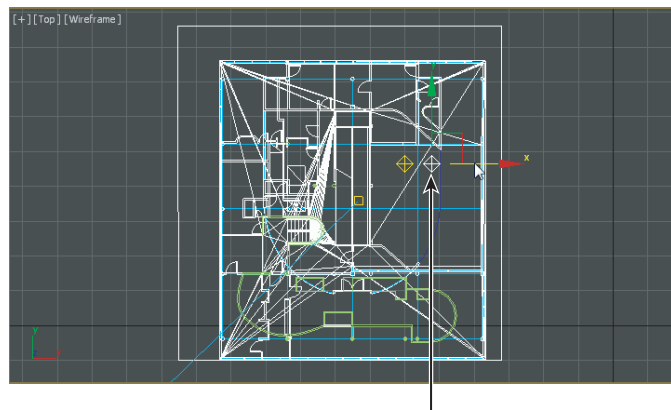
2. In the Clone Options dialog box, click Instance. You'll see the importance of making the clone an instance in the next few exercises.

3. Click OK to close the Clone Options dialog box.

4. Make two more Instance clones, as shown in Figure 7.27.

FIGURE 7.27
Adding more Omni light instances
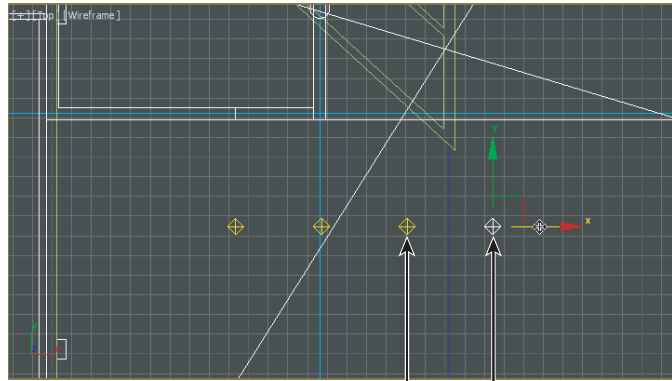
Make two or more Omni light instances.

With the lights in place, you can make a few adjustments to them to simulate the bounced light from the floor. First, you'll want to reduce the intensity of the light. Right now, the Omni lights are at full intensity. You can adjust the intensity of all four of the lights simultaneously by adjusting any one of the clones. This is because you created Instance clones rather than Copy clones. Just as with primitive objects, lights can be instanced so that the edits made to one clone are propagated to all the other clones:

1. With the last clone created still selected, click the Modify tab in the Command panel.

2. Set the Shadows parameter to Shadow Map on the General Parameters rollout, and click the On check box to have the light cast shadows in the scene.

3. Go to the Intensity/Color/Attenuation rollout; then set the Multiplier spinner to 0.14.

4. Click the color swatch next to Multiplier to open the Color Selector: Light Color dialog box.

5. Set Hue to 20 and Saturation to 60; then click OK. This will give the light a slight orange cast, as if it were picking up the color of the floor.

   Do not use highly saturated lights or you will overly influence the materials used. For example, if you shine a saturated red light on a blue surface, it will appear red (drowning out the blue material) because of the strong influence of the light.

6. Click the Maximize Viewport toggle; then right-click the Perspective viewport to make it active.

7. Click the Render Production tool to get a view of your model so far. Your view will be similar to Figure 7.28.

FIGURE 7.28

A rendered view of the courtyard after adding the simulated bounced light
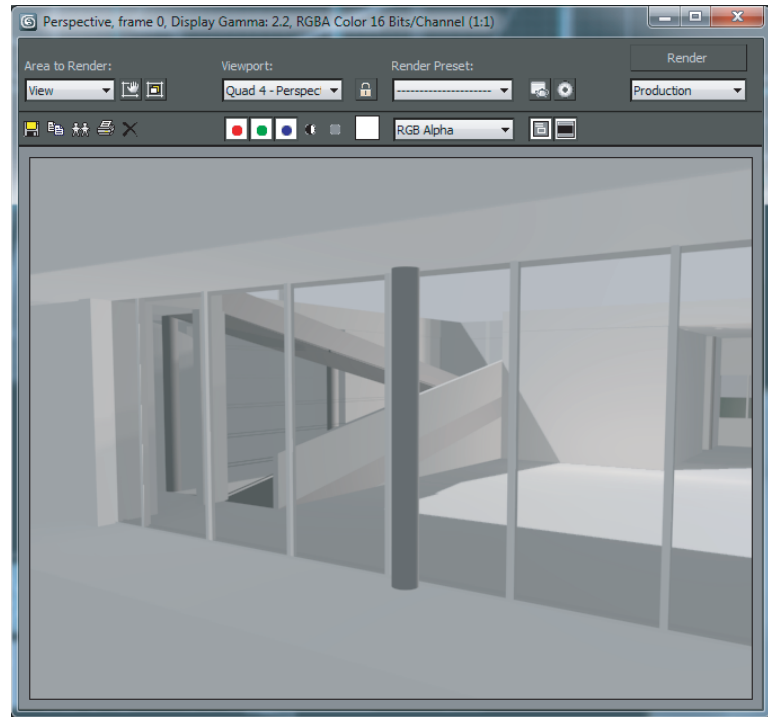
Now you begin to see more detail in the courtyard. The area around the ramps is better defined, and the alcove to the right shows more depth. You see the ceiling of the room in the foreground beginning to appear. Using colored lights can be an effective way to simulate color bleeding off large surfaces, such as the courtyard or the ceiling. It is a little like color painting with light.

When faking ambient light, don't be afraid to place lights in physically impossible places, like under the floor, behind a solid wall, or above the ceiling. As you'll learn later in this chapter, lights that do not cast shadows penetrate through surfaces and illuminate what lies beyond. The best "fakiosity" results come from using multiple strategically placed, low-intensity lights to simulate the light bounced off large surfaces.

Adding a Highlight with an Omni Light

Next, you'll learn how to add a highlight to the glass. By adding a highlight, you will be able to see that there is indeed glass in the windows, and doing so adds a bit of interest to the rendering. You'll also get a chance to see some of the advanced features of an Omni light.

1. Select the Create tab in the Command panel, and click the Lights button. Then click the Omni button in the Object Type rollout.

2. In the Perspective viewport, click to place an Omni light anywhere. You don't need to be exact about the location, because the Place Highlight tool that you'll use later will place

the light accurately for you. You might notice that the shaded Perspective viewport lightens thanks to the addition of a new light source.

3. With the Omni light selected, choose Tools ➤ Align ➤ Place Highlight, or hold down the Align tool on the Main toolbar to reveal the flyout menu and release the mouse over the Place Highlight button. The cursor changes to the Place Highlight icon.

4. Go to the Perspective viewport, move the mouse about the screen, and see the cursor appear as a cross above and to the left of a small representation of the Place Highlight button. Click and hold the location shown in Figure 7.29; notice the cursor changes to an arrow that indicates the direction the moved light will moved toward.

FIGURE 7.29
Click here to place the highlight on the column.
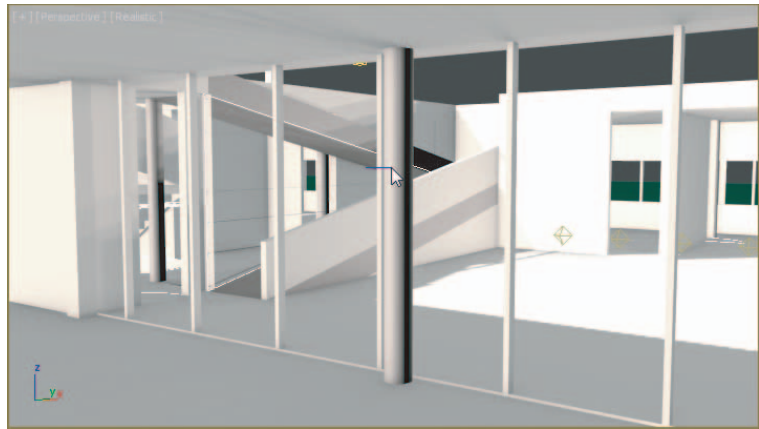
You should notice that the mouse cursor changes from a sphere with an arrow pointing at it to crosshairs when the mouse is over an object to which the tool can align the highlight. When the mouse is over the column, press and hold the left mouse button and a blue normal arrow will appear at your cursor position. Move the mouse, and you can see the effect of the light's position in the perspective viewport. Release the mouse button when you see the normal arrow pointing near the middle of the column.

The blue normal arrow represents a direction vector that is perpendicular to the surface over which the Place Highlight tool is positioned. The Place Highlight tool's job is to relocate the selected light somewhere along the normal vector. In other words, you will find the new Omni light some distance in a straight line away from the normal vector. This is helpful because it provides you with a quick way of orienting a light source in relation to a surface.

You may notice that the Omni light was moved, but now it lies outside the room.

5. Set the light's Multiplier to 0.8.

6. Click the Render Production button on the Main Toolbar, and observe the highlight that appears on the glass, as shown in Figure 7.30.

The Place Highlight tool places the currently selected light in a location that produces a high-light reflection at the location you selected in step 4 of the previous exercise. But the Omni light also shines on the rest of the building, washing out some detail. Fortunately, you can set lights in 3ds Max to affect only selected objects instead of the entire model:

1. With the Omni light selected, click the Modify tab of the Command panel.

2. In the General Parameters rollout, click the Exclude button.

3. In the Exclude/Include dialog box, click the Include radio button in the upper-right corner.

4. In the Scene Objects list, click [GLASS.03] to select it; then click the transfer button that points right, as shown in Figure 7.31. [GLASS.03] moves from the list on the left to the list on the right.

FIGURE 7.31
The Exclude/
Include dialog box
set to include only
the glass in the
Omni light's list of
objects

Select the [GLASS.03] group, and then
click the right-arrow transfer button.
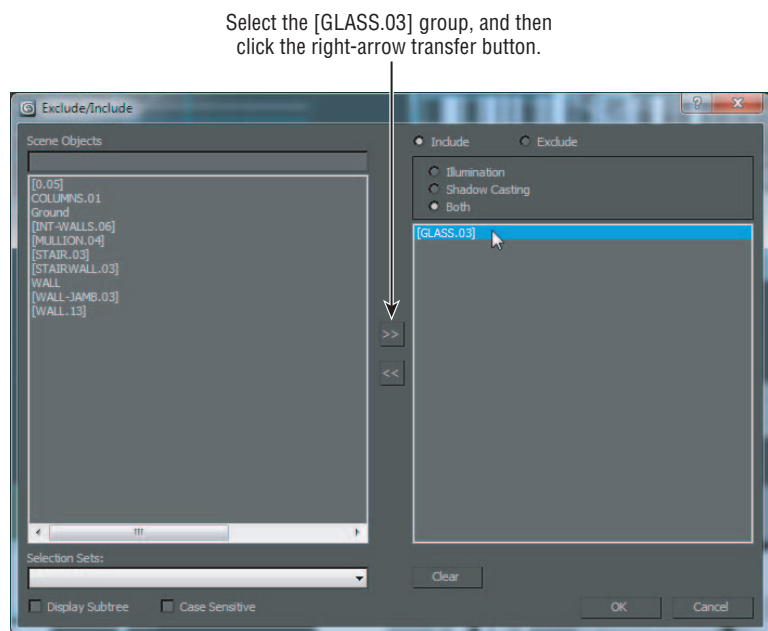
You could have excluded all the objects except [GLASS.03] to create the same effect; however, that would mean all objects subsequently added to the scene would have to be added to the Exclude list for this light.

5. Click OK to close the Exclude/Include dialog box; then click the Render Production button. Now the highlight is limited to the glass, as shown in Figure 7.32.

FIGURE 7.32
The villa rendered with a highlight on the glass

6. Save the file as **MyVilla02.max**.

At times, you may need to stretch reality a bit when you produce renderings. The highlighted glass adds some interest to the rendering, even though it isn't necessarily a realistic portrayal of the lighting in the model. The highlight effect is not exclusive to the Omni light. The same effect can be achieved using virtually any type of light you choose.

The ability to select the objects that individual lights affect, although not possible in the real world, gives you some freedom to play with a scene, adding emphasis to some areas while downplaying others.

Looking at Omni Light Options

CERT OBJECTIVE

Because you're working with Omni lights, let's take a look at some of the other Omni light parameters. You've seen how you can choose which objects are affected by Omni lights. The Exclude/Include dialog box is a feature common to all lights. Just as with all other lights, you can include or exclude shadows in the manner described in the previous exercise. You can also control the Attenuation settings of the Omni light. These settings let you control the distance of the light's reach.

> **CONTROLLING LIGHTS WITH ATTENUATION**
>
> *Attenuation* adds another bit of control over 3ds Max lighting that you do not have over real-world lights. Think of it as the ability to control how much illumination a light contributes to a scene as a function of how far the light travels from its source.

By default, Attenuation is turned off. Try the following exercise to see how you can control the attenuation of an Omni light:

1. Open the `C07_Omni.max` file from this book's companion web page. This is the file shown in Figure 7.33.
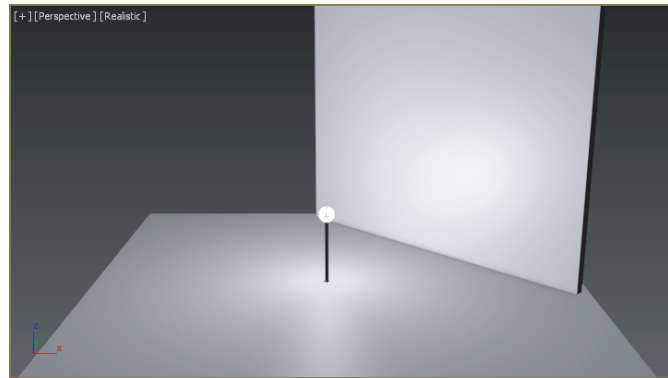
The `C07_Omni.max` model is a simple scene of a light pole, a ground plane, and a wall. The light pole has an Omni light at the center of its globe. The globe itself has been excluded from the effects of the Omni light so that the light is obstructed beyond the globe, with the exception of the pole beneath it. The Omni light in this rendering has been inserted into the scene with its default settings unchanged.

ATTENUATION VS. DECAY

In addition to the Attenuation parameters of lights, which are a contrived way to adjust the brightness of a light over distance, standard lights have a Decay group in the Intensity/Color/Attenuation group. This feature allows you to select from None, Inverse decay, and Inverse Square decay. Real-world lights decay at the Inverse Square rate.

You can set an attenuation range with photometric lights as well, but this attenuation does not affect how the light falls off over distance (all photometric lights use an inverse square rate of decay). Rather, it sets a limit for how far the light can affect objects in the scene. Limiting how far a photometric light can proceed through a scene can reduce the calculation time necessary to render a scene with the mental ray renderer.

You can adjust the attenuation, however, to limit the range of the light. Try the following exercise to get a feel for the Attenuation settings:

2. Click the Select By Name button. In the Select From Scene dialog box, choose Omni001 from the list and click OK.

3. Click the Modify tab of the Command panel, scroll down the panel to the Intensity/ Color/Attenuation rollout, and open the rollout if it is closed.

4. Click the Use check box in the Far Attenuation group, as shown in Figure 7.34.

CERT
OBJECTIVE

FIGURE 7.34
Click the Use
check box
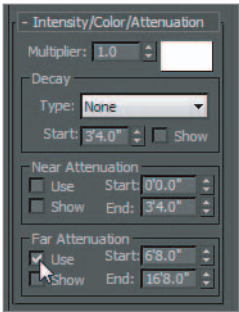
A pair of Sphere gizmos appear around the Omni light, as shown in Figure 7.35.

FIGURE 7.35
The Perspective
viewport showing
the Far Attenuation
gizmos
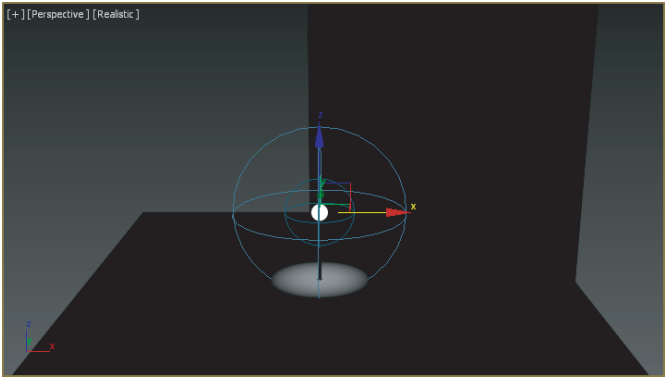
5. Click and drag the Far Attenuation End spinner upward so that its value reads 37′.

6. Click and drag the Far Attenuation Start spinner upward so that its value reads 10′.

7. Click the check box to turn on shadows in the General Parameters rollout.

THE FAR ATTENUATION'S SHOW PARAMETER

The Show check box causes 3ds Max to display the Attenuation gizmos even when the light is not selected. The gizmos will always show when the light is selected, regardless of the Show setting. This is similar to the Show Cone option for spot and direct lights.

---

8. Click the Render Production button. You now see the light limited to a distance of 37′. It casts a dim light against the wall (see Figure 7.36).

The End distance setting controls the farthest reach of the light. You can also set the distance of maximum brightness using Far Attenuation's Start setting:

1. Click and drag the Far Attenuation Start spinner up so that its value reads 28′. At this distance, the lighter center gizmo just touches the wall and passes through the floor.

FIGURE 7.36
The rendering with
Far Attenuation
turned on and
the End distance
set to 37′
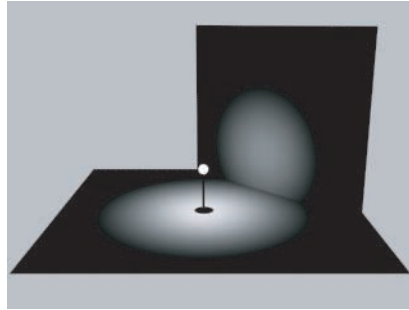
2. Click the Render Production button. Now the light on the wall and floor is much brighter (see Figure 7.37).

FIGURE 7.37
The rendering with
the Far Attenuation
Start setting at 28'
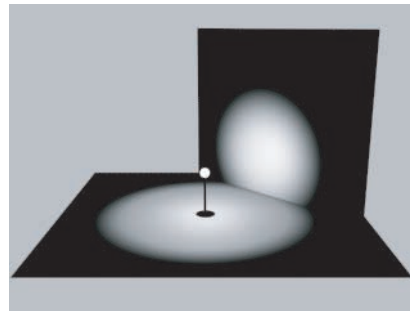
The Start and Far Attenuation settings act a bit like the Hotspot and Falloff settings in direct lights and spotlights, except that they act according to the distance away from the source rather than the angular spread of the light. All areas from the light source to the Far Attenuation Start gizmo receive the full intensity of the light, and all areas beyond the Far Attenuation End gizmo receive no illumination from the light.

You've probably noticed that Attenuation parameters also offer a Near Attenuation group. The settings in this group give you control of where the Omni light begins to take effect, as demonstrated in the following exercise:

1. Click the Use check box in the Near Attenuation group. Blue Attenuation gizmos display in the viewport.

2. Set the Near Attenuation Start value to 15′ and the Near Attenuation End value to 17′.

3. Click the Render Production button. Notice that the shadow of the pole appears to expand and soften, as shown in Figure 7.38.

4. Save your scene as `MyOmniLight01.max`.

This time, the Near Attenuation settings are limiting the near distance that the light begins to affect. In this scene, we created the effect of a larger, softer shadow being cast by the pole, even though the dark area is actually the result of the Near Attenuation setting limiting the near range of the light cast by the Omni light.

FIGURE 7.38
The scene rendered using the Near Attenuation parameters
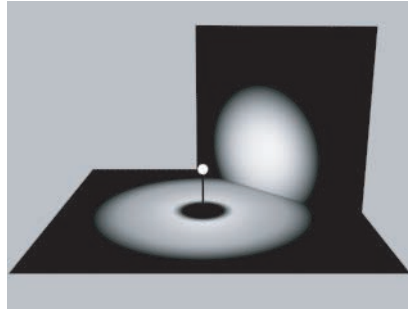
Adding Shadow Effects

You've seen how a single direct light can be used to simulate the sun. You can also use lighting to add emphasis or to provide a sense of drama. Shadows can be controlled to provide a seemingly sharp, strong light source or a softer, more diffuse interior light. In this section, you'll look at some of the more commonly used lighting options, starting with shadows.

By default, the Shadow option for lights is turned off so that when you render your model, you will not see shadows cast. However, the shadows have been turned on in the provided file.

1. Open the file C07_Savoye_03.max.

2. Right-click in the Perspective viewport, and then click Render Production on the Main Toolbar. The front of the Villa Savoye is rendered with shadows, as shown in Figure 7.39.

FIGURE 7.39
With the current shadow settings, the shadows are not completely correct.
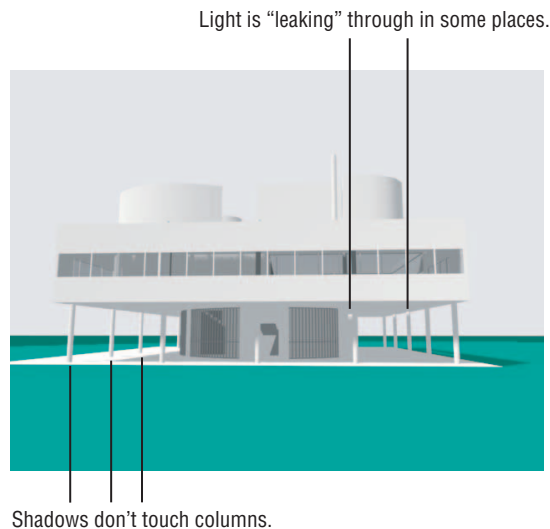
Light is "leaking" through in some places.

Shadows don't touch columns.

If you look carefully at your last rendering, you'll see that there are indeed shadows from the columns and the rest of the building. The shadows are not exactly right, however. Parts of the model show light *leaking* through the shadows, as shown in Figure 7.39. You might also notice that the shadows from the columns don't quite start at the column bases.

There are a few options that you can use to correct these problems. Let's start with the Shadow Map parameters of the Target Direct light object you're using to simulate the sun:

1. Select the Target Direct light object named SUN001. This is the light in the lower-left corner of the building in the Top viewport.

2. Click the Modify tab in the Command panel to view the parameters for SUN001.

3. Scroll down the panel to the Shadow Map Params rollout, and click it to open, as shown in Figure 7.40. You see the Bias, Size, and Sample Range settings.

FIGURE 7.40
The Shadow Map
Params rollout
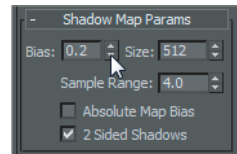
4. Click the Bias setting, and enter **0.2** ↵ to change its value from 1 to 0.2. By reducing this number, you bring the shadow closer to the object that is casting the shadow.

5. Open the Rendered Frame Window, and then click the Render button in the upper-right corner to render the scene. This time the shadows are rendered more accurately, filling in those portions missed in the previous rendering (see Figure 7.41).

FIGURE 7.41
The new rendering
with the filled-in
shadows
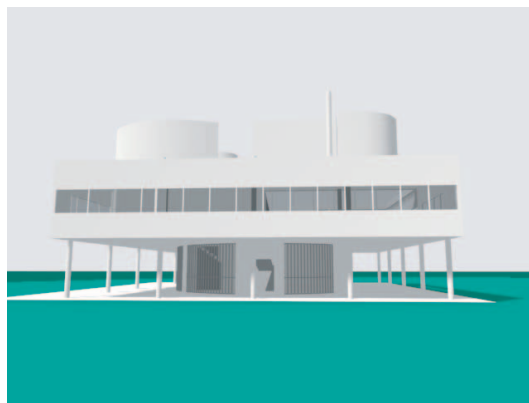
Softening Shadow Edges

Another option that lets you control the softness of the shadow edge is Sample Range. In some situations, you may want the edge of the shadow softer for partially cloudy outdoor scenes or for interior views with combined diffuse and direct lighting. The following exercise shows the effect of Sample Range:

1. Set Sample Range for the SUN001 direct light to 10.

2. Click the Render Production button to see the effects of the new Sample Range setting, as shown in Figure 7.42.

FIGURE 7.42
The shadow edges are softened with a larger Sample Range setting.

Softened shadow edges
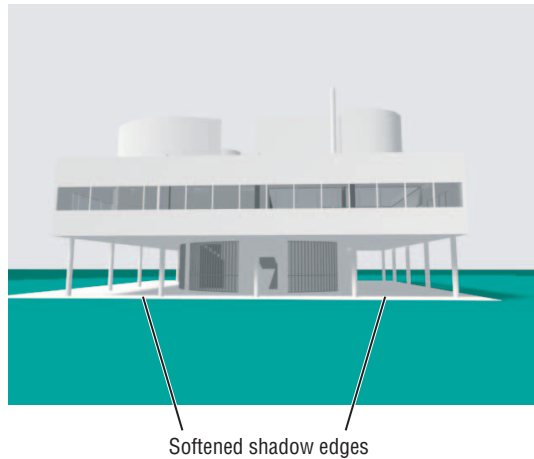
You can see the subtle effects of a softer shadow by looking at the shadows of the columns. Also notice that the shadows of the columns disappear on the ground below the building. The Sample Range setting is high enough to obliterate the thin column shadows.

A soft shadow edge lends realism to objects in indoor settings and in close-up views of outdoor objects; however, in some situations, a sharp, crisp shadow edge is more desirable. There are two ways to achieve a sharp shadow edge. You can manipulate shadow settings in 3ds Max to obtain a high degree of accuracy in the shadow representation, or you can go with an entirely different shadow rendering method offered by 3ds Max, called *ray tracing*. This method models the actual path of light to generate shadows. Ray-traced shadows are more accurate, but they can add a lot of time to the rendering process. They also produce a sharp shadow edge, so in situations where a soft shadow is desired, you will have to use the default shadow-mapped type of shadow or some combination of both ray-traced and shadow map shadows.

In the next section, you'll look at how you can set up a shadow map to create a sharper shadow edge.

Understanding Shadow Maps

So far, you've been using the default *shadow mapping* method for casting shadows. A shadow map is a temporary *bitmap* image (made of pixels) of the shadows cast by objects in the model. You never actually see this bitmap. 3ds Max determines the shape and location of the shadow

by determining where the light is obscured and placing the shadow map on all surfaces beyond that point. Because the shadow map is really a bitmap image, a shadow's sharpness depends on the resolution of the shadow map. If the shadow map has a small Size setting, it creates a shadow that is rough around the edges, like a low-resolution rendering. Figure 7.43 shows a sample model with a very low-resolution shadow map that clearly displays the shadow map pixels around the shadow edge. The chair used in these examples is the Reaction Work Chair model from Herman Miller, which is available as a free 3ds DOS file from their website (`www.hermanmiller.com`) along with a great selection of seating and office furniture models.

FIGURE 7.43
This image shows a shadow with a low Shadow Map Size setting coupled with a low Sample Range setting of 0.1
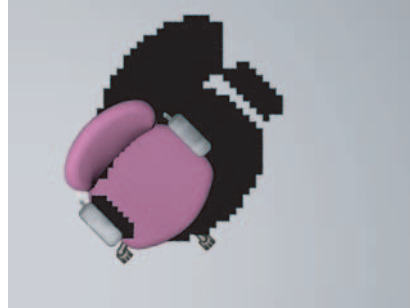
You can increase the Shadow Map Size setting to reduce the stair-stepping effect of the shadow edge. This stair-stepping comes directly from the pixels that make up the shadow map. Figure 7.44 shows the sample image again with the Size setting doubled from the previous figure.

FIGURE 7.44
Increase the Shadow Map Size setting to reduce the stair-step effect.

A larger shadow map makes for a more even shadow edge. If the shadow map size is too great, however, it will consume greater amounts of memory and increase rendering time.

Another setting that is directly related to shadow map size is the spread of the light source. The shadow map is directly related to the area that is lit by the light source casting the shadow. If the area or spread of the light is decreased, the shadow map must also include a smaller area. If the shadow map size is reduced relative to the object casting the shadow, more of the shadow map area can be devoted to the shadow outline. This has the effect of reducing the jagged edge of the shadow. Figure 7.45 shows the same model and light source as shown in Figure 7.44, but the hotspot and falloff have been reduced in size so the light is focused on a smaller area. Notice

that the edges of the shadow appear less jagged because the shadow map isn't as stretched as it was in Figure 7.44.
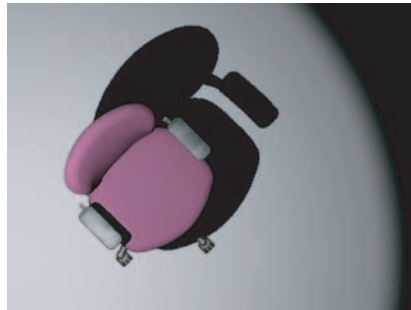
You can control the jagged edge of the shadow to some degree by using the Sample Range setting. In the previous exercise, you saw how the Sample Range setting controls the softness of the edge of the shadow. A smaller Map Sample value makes for a sharper shadow but also reveals more of the shadow map's bitmap edge. If the Sample Range setting is too low, you begin to see the stair-step edges of the pixels of the shadow map, as shown in Figure 7.43.

The Sample Range value is actually the number of pixels in the rendered image that are blended to soften the edge of the shadow. This has the effect of hiding the pixelated shadow edges, as shown in Figure 7.46. Here you see the same image as shown in Figure 7.45 but with an increased Sample Range value.
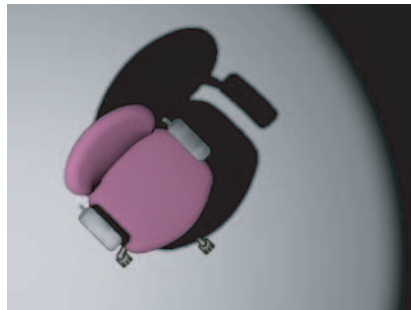
If you look carefully at the shadow that runs vertically up the right edge of the image, you can still detect the stair-step edge of the pixelated shadow map (it appears as a slightly wavy edge). If you aren't looking for it, you may not notice it. You can also further increase the softness of the shadow edge by increasing the difference between the Hotspot and Falloff settings. As the Sample Range setting decreases, however, the hotspot/falloff difference has less effect.

Taking all of this into account, you need to increase the shadow map size and reduce the Sample Range setting to sharpen the shadow edge. You also need to keep the lit area as narrow as possible while still keeping all of the objects in your scene adequately lit. Therefore, to get the sharpest shadow with a shadow map, you need to find a balance between the map size, sample range, light spread, and, to some degree, the hotspot/falloff difference. Figure 7.47 shows the

sample scene and light with a Sample Range value of 1, a Shadow Map Size setting of 2048, and a Falloff setting as close to the hotspot setting as possible.

FIGURE 7.47
A fairly sharp shadow achieved with a high Size setting and a low Sample Range
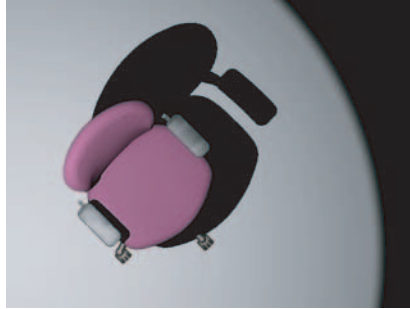
To see firsthand the effects of these settings, try sharpening the shadows on the villa model:

1. In the Shadow Map Params rollout for the SUN001 light source, change the Size value to 2048.

2. Change Sample Range to 1.

3. Make sure that the Perspective viewport is selected, and then click the Render Production button. Notice how the shadow appears to be sharper. You may also notice that the shadow is more jagged around the edges in some locations (see Figure 7.48).

4. Save the villa model as **MyVilla03.max**.

FIGURE 7.48
The villa rendered with a sharper shadow map
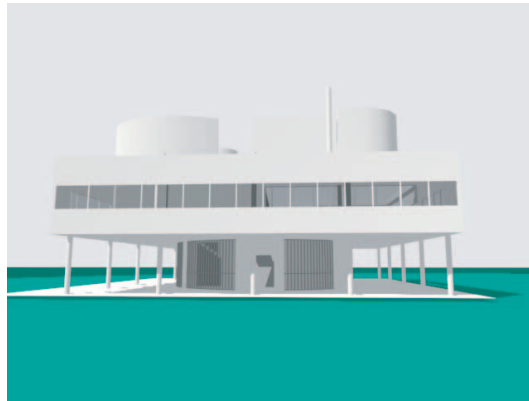
Using Ray-Traced Shadows

You may feel that using the shadow map settings in the previous exercise requires too many compromises to achieve the sharpest shadows. If you want the sharpest, most accurate shadows possible, you'll want to use ray tracing.

Ray-traced shadows derive the shadow boundary by modeling the path of light from the light source to the shadow surface. The benefit is a very accurate shadow with no stair-step edges, because ray tracing is not based on a projected bitmap. You do pay a penalty in increased rendering time but, in many cases, the time is well worth it. Figure 7.49 shows two images of a fairly complex model that contains transparent elements as well as some detailed structural elements. The top image is the model rendered with a shadow map, whereas the second is rendered using ray-traced shadows. The ray-traced shadows show much more detail.

FIGURE 7.49
An image using shadow map shadows (top) and the same image using ray-traced shadows (bottom)
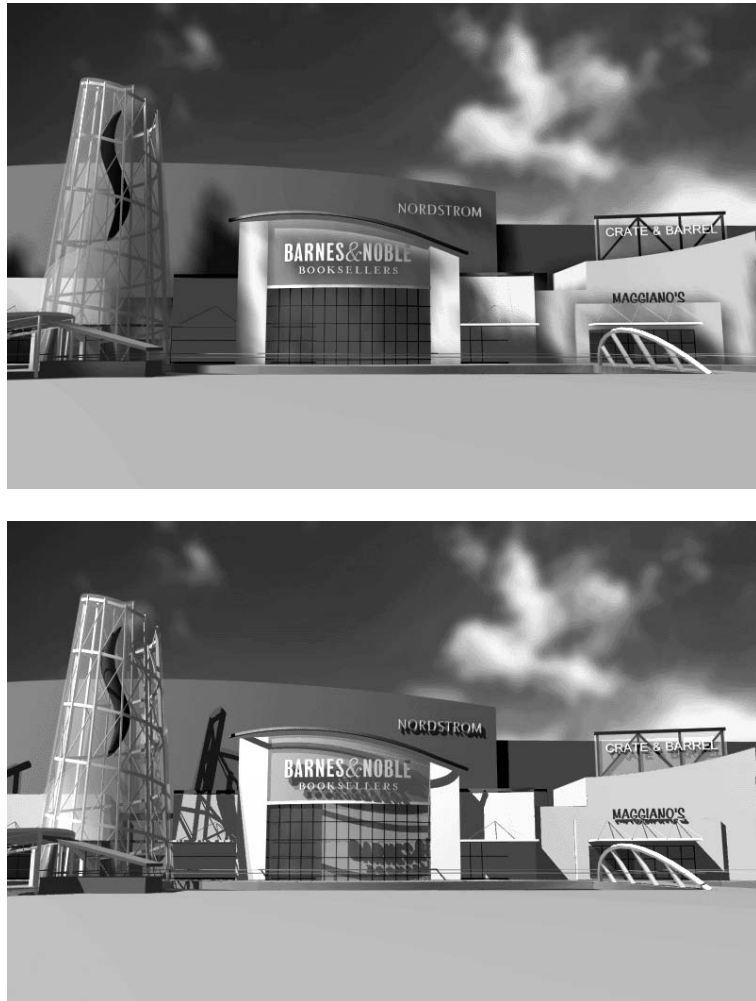
RAY-TRACED SHADOWS AND TRANSPARENCY

Only shadows created using the Ray Traced Shadows (and Advanced Ray Traced) options consider the transparency of the objects they encounter. Shadow map shadows are consistent regardless of an object's transparency.

With ray-traced shadows, you don't have to be concerned with map sizes and sample ranges. Try the following exercise to see how ray-traced shadows affect the villa model:

1. In the Modify tab of the Command panel, scroll up to the General Parameters rollout.

2. Click the Shadow Map drop-down menu in the Shadows group, and select Ray Traced Shadows (see Figure 7.50).

Figure 7.50
Select Ray Traced Shadows.
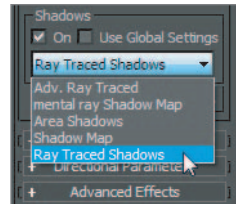
3. Click the Render Production button on the Main Toolbar. The villa is rendered with smoother-looking shadows, as shown in Figure 7.51.

Figure 7.51
The villa rendered using the Ray Traced Shadows option
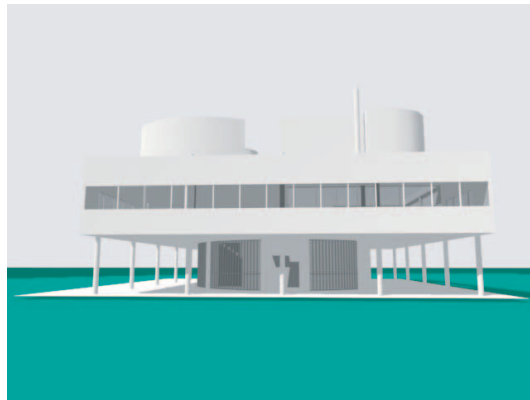
Although the differences are not as dramatic as those shown in Figure 7.49, the ray-traced-shadows rendering of the villa does show smoother shadows, particularly on the lower-right side of the image. You can also see more detail in the shadow behind the window at the right side of the image. You can increase the spread of the light source now without affecting the sharpness of the shadows.

Using Advanced Ray Traced and Area Shadows

Both the Advanced Ray Traced and Area Shadows options create ray-traced shadows, but they offer a few additional properties that the standard ray-traced shadows don't offer.

Blurring Shadow Edges

CERT OBJECTIVE

The Advanced Ray Traced option allows you to add a softer edge, or *penumbra*, to shadows (see Figure 7.52), which is a feature absent in a standard ray-traced shadow.

FIGURE 7.52
The features of an
area shadow
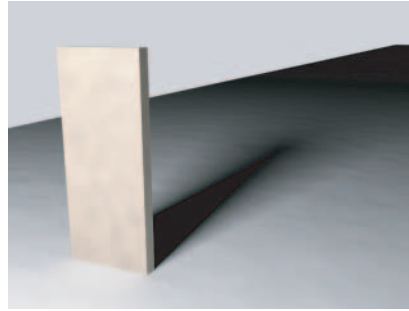
The area shadow consists of two primary parts, the *umbra* and the *penumbra*. The umbra is the darkest part of the shadow, represented by the dark triangular area behind the monolith in Figure 7.52. The penumbra is area that blends between the darkest parts of the shadow and the unshadowed ground around the monolith.

To use the Advanced Ray Traced option, you can select Adv. Ray Traced from the Shadows group of the General Parameters rollout of any light.
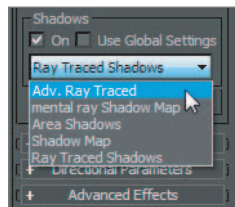
This selection displays the Adv. Ray Traced Params rollout, where you can control the quality with the Basic Options drop-down list. Select 2-Pass Antialias for maximum quality.
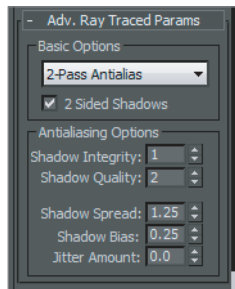
The Shadow Bias option works like the Bias option for map shadows. If the shadow appears to "bleed" around the edge of the object casting the shadow, forming a dark edge, you can increase the Shadow Bias setting to remove the dark edge. If the shadow appears to begin too far from the object, you can decrease the Shadow Bias setting.

The Jitter Amount setting smoothes out the effect of the blurred shadow edge. If you look carefully at a blurred shadow, you will see that it is made up of several gradations of values,

each with its own distinct edge. The Jitter Amount setting will blend the gradations together to soften the shadow edge further.

CONTROLLING SHADOW SHARPNESS OVER DISTANCE

If you look at the shadow of a tree on a bright, sunlit day, you'll notice that parts of the tree closer to the ground cast sharper shadows than those farther away. This is caused by the combined effect of direct sunlight and the general ambient glow given off by the sky. You can simulate this effect using the Area Shadows shadow type. Area shadows will vary the width of shadow edge blurring, or penumbra, depending on the distance between the object casting the shadow and the surface upon which the shadow falls. Figure 7.53 shows this effect.

FIGURE 7.53
The shadows from the top of the post are softer than those from the bottom.
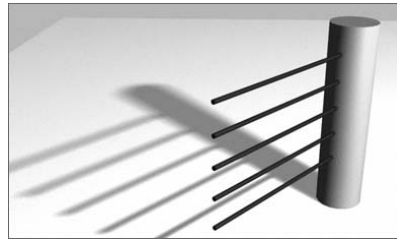
To use the Area Shadows shadow type, select it from the Shadows group of the General Parameters rollout of any light. Once you've selected it, you can add the shadow penumbra effect to the shadow edge by increasing the Shadow Quality value under the Area Shadows rollout in the Antialiasing Options group (see Figure 7.54).

FIGURE 7.54
The Area Shadows rollout
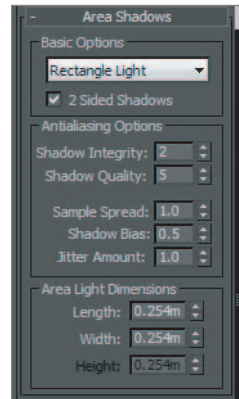
As with the Adv. Ray Traced settings, Shadow Bias controls how close or far away the shadow starts from its object, and Jitter Amount smoothes the effect of the blurred shadow edge.

A couple of other options in the Area Shadows rollout are important in controlling shadows. The first is the Basic Options drop-down list (see Figure 7.55).
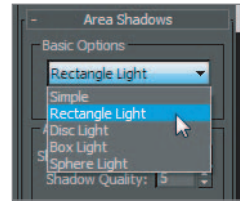
These options — Simple, Rectangle Light, Disc Light, Box Light, and Sphere Light — affect the shape and quality of the shadow being cast. For example, Rectangle Light casts a shadow in the manner of a flat ceiling light fixture. Sphere Light casts a shadow like a globe. The light itself does not take on any of these shapes, but you can think of these Area Shadows modes as the "virtual" shape of the light fixture.

In conjunction with the Basic Options settings are the Area Light Dimensions settings at the bottom of the Area Shadows rollout. These options control the size of the "virtual" shape of the light as set by the Mode setting. A larger Area Light Dimension tends to increase the spread of the shadow edge blur, just as a larger light fixture would tend to spread shadow edges in the real world.

You won't use these shadow options in any of the exercises of this book, so you should experiment with them on your own by creating a simple scene with a box, a plane for a ground surface, and a single standard light source.

The mental ray shadow map type will be covered in Chapter 14.

Playing in the Shadows

You've seen how you can bring out the depth of a space by adding lights to simulate reflected light. In the villa example you looked at earlier, you had a combination of direct light simulating the sun and a set of Omni lights to simulate ambient light. In this section, you'll learn how to play with shadows by using a combination of lights and objects.

In the previous section, you learned that if you use a bitmap shadow, you can soften the edge of your shadows. You were also shown that ray-traced shadows can bring out detail in your model. Obtaining both effects in the same rendering can be a little tricky, but you may find that you need to do just that in some situations. The following series of exercises will show you how you can mix these two types of shadows to control the composition and appearance of a rendering.

Using Two Suns

You'll use a model that was created for the Avery Aquatic Center on the Stanford campus in Palo Alto, California. You'll be working on a view of the entrance to the center. The entrance consists of a tree-lined, paved walkway with a sign and a set of monuments. Let's take a look at the file and a first rendering:

1. Open the C07_Aquatic.max file from this book's companion web page.

2. Make sure that the Perspective viewport is selected; then click the Render Production button. The rendering appears as shown in Figure 7.56.

Figure 7.56
The Avery Aquatic
Center rendered

Notice the large, square shadow in the foreground. This is a shadow of the tree in the foreground. You can see a small part of this tree in the upper-left corner of the rendering. All the trees in this scene project rectangular shadows, although this is less obvious in the trees toward the back. Also notice the odd shadows of the Avery Aquatic Center sign. The saw-tooth pattern on the shadow is the result of the low resolution of the shadow map used by the direct light that simulates the sun. To give you a better idea of what the sign is supposed to look like, Figure 7.57 shows a better view of the sign's design.

Figure 7.57
The design of the
Avery Aquatic
Center sign
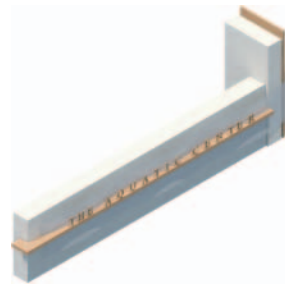
This sign poses an unusual problem in lighting because it contains a wavy, perforated screen. At a distance, this screen looks like a translucent material, so it is given a material that is partially transparent. Even so, a shadow map shadow doesn't work with this design, nor does it work well with the trees.

You can improve the look of the sign by using a ray-traced shadow for the sun, but the complexity of the model combined with a ray-traced shadow will substantially increase the rendering time. You want to minimize the rendering time if you can, especially if you are working under a deadline. Figure 7.58 shows the same rendering with the sun's shadow type changed to a ray-traced shadow. Compared to the rendering with shadow maps, which took 2 seconds to render on a quad-core system with 8 GB of RAM, the ray-traced shadows took 11 seconds to render. That might not sound like a lot, but on a complex project, an increase in rendering time of 550 percent is very significant.

FIGURE 7.58
A second render-
ing, with the Ray
Traced Shadow set-
ting and with the
sun's shadow type
changed

With a ray-traced shadow, the sign looks fine, but the tree shadow looks a bit odd because the trees in the scene are really just flat, vertical planes with materials applied. In reality, the tree would cast a larger shadow. The tree shadow in the foreground would also have a softer edge.

To obtain a fast rendering speed and still maintain a crisp shadow on the sign, you can use two different light sources for the sun. One light will project a ray-traced shadow specifically for the sign and trees, while the other will project a shadow map shadow for the rest of the model.

Adding a Second Sun

You saw in previous examples that you can select objects for illumination and shadow casting for each light in your model. In the following exercise, you'll remove the sign and trees from the effects of the current sunlight; then you'll create a second sun that will affect only the trees and the sign. This second sun will be set to create ray-traced shadows.

1. Close the Rendered Frame Window; then select the target directional light in the Front viewport. This is the light used to simulate the Sun.

2. In the Modify tab of the Command panel, click the Exclude button in the General Parameters rollout. The Exclude/Include dialog box is displayed.

3. Scroll down the Scene Objects list box to the left, and select each object with a name that begins with "SIGN": SIGNbody, SIGNmetal, SIGNmetal2, SIGNscreen, SIGNText01, and SIGNtower.

SELECTING AND MOVING SIMILARLY NAMED OBJECTS

You can select similarly named objects in the Exclude/Include dialog box by typing the first few letters of their names in the input box in the upper-left corner. For example, typing **SI** ↵ selects all objects that begin with the letters *SI*. Pressing ↵ again moves the selected objects from the left window to the right window only when the items were selected using the input box.

4. Click the right-pointing double-arrow button to move the selected items to the list box to the right.

5. Scroll further down the list on the left and select each item whose name begins with "Tree" except Treeshadow. These are Tree01 through Tree04 and the three Treecamphor items.

6. Click the right-pointing arrow button again to include these trees in the list box on the right.

7. Make sure the Exclude and Both radio buttons are selected near the top center of the dialog box. This has the effect of excluding these objects from both illumination and shadow casting.

8. Click OK to exit the dialog box.

9. Right-click the Perspective viewport to activate it, and click the Render Production button. Now you see the rendering with the trees and sign appearing rather dark and failing to cast shadows, as shown in Figure 7.59.

FIGURE 7.59
The rendering with the trees and sign excluded from the sunlight object

You need to illuminate the sign and trees with a light. To do this, make a copy of the existing sun and change its shadow type to Ray Traced Shadows:

1. If it isn't selected already, select the SUN direct light in the Orthographic viewport.

2. Choose Edit ➢ Clone.

3. In the Clone Options dialog box, choose the Copy radio button and enter **SUNraytraced** for the name. Click OK to close the dialog box. The new light remains selected.

4. In the Modify tab, click the Exclude button in the General Parameters rollout. The Exclude/Include dialog box displays. Notice that the list on the right includes the same items that you excluded from the original SUN light object.

5. Click the Include radio button in the top right of the dialog box. This causes the new light to include only the items listed in the list box to the right, instead of excluding those items.

6. Click OK to close the dialog box.

You've created a second sun that illuminates only the sign and the trees. The original SUN directed light illuminates everything else. Now you have one more important step to take: you need to set the new sun to cast ray-traced shadows.

LIGHTS AND THE VIEWPORTS

You may notice that the Perspective viewport has become very bright. The Shaded viewport rendering mode does not consider the inclusion or exclusion of any object's illumination while displaying the scene. The viewport is bright because of the two direct lights illuminating the scene.

---

1. Scroll in the Command panel to the General Parameters rollout, and open it if it isn't already open.

2. Click the Shadows drop-down list, and select Ray Traced Shadows.

3. Make sure the Perspective viewport is selected; then click the Render Production button. The rendering will take a bit more time when it gets to the sign. Once it's done, you'll see a view similar to Figure 7.60.

FIGURE 7.60
The design rendered with the Shadow Map and Ray Traced Shadow light sources

Although the view took longer to render, it still rendered considerably faster than if you had used a ray-traced shadow for the entire scene. But there is something missing: the sign and trees

don't cast shadows. This is because the ground plane isn't included in the set of objects affected by the SUNraytraced sun object. You could include the ground in the SUNraytraced light, but you'd greatly increase the rendering time and you'd have the same effect as you would if you had simply changed the original sun to project a ray-traced shadow.

To get around this problem, you can add some additional props that will cast shadows from the original SUN directed light that is casting a shadow map shadow.

Using Unseen Objects to Cast Shadows

The trees in this model produce a good deal of shade — considerably more than even the shadows created by the Ray Traced Shadow version of the rendered Perspective viewport you saw earlier. To simulate the shade from the trees, you can employ 2D shapes in the form of a tree shadow. These shapes can be used to cast shadows from the SUN directed light that uses a shadow map shadow. This combination will produce a softer shadow, which offers a somewhat more pleasing effect, especially for shadows in the foreground.

To save some time, these shadow shapes have already been added to the Avery Aquatic model. In the next exercise, you'll turn these shadow objects on and render the view to see how they work:

1. Right-click in a viewport to open the quad menu.

2. Click Unhide All in the display quad. The 2D shadow objects will appear in the model, as shown in Figure 7.61. They may be difficult to see in the Perspective viewport.

FIGURE 7.61
The 2D shadow objects appear in the model.

The 2D tree shadow objects
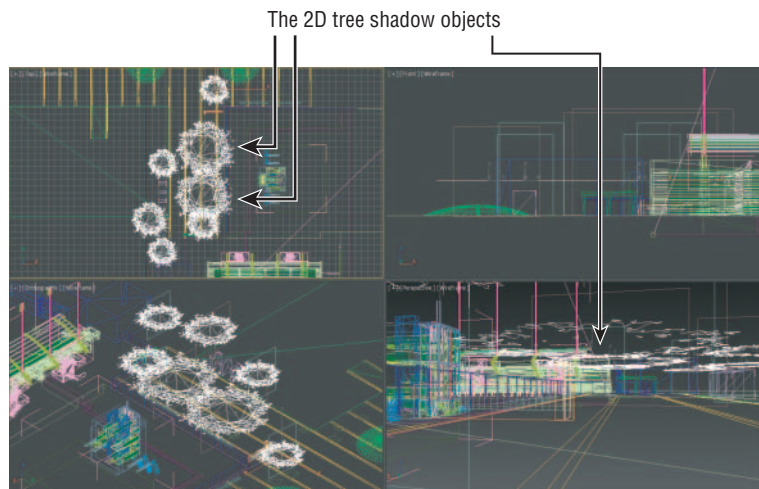
3. Click the Render Production tool. The view is rendered with the additional shadows being cast by the 2D shadow objects, as shown in Figure 7.62.

The character of the rendering changes dramatically with the addition of shadows. The walkway has a more inviting appearance instead of the somewhat harsh, sunlit open space. Also, the shadow in the foreground helps soften the composition by introducing a change in the ground plane.

Because you were spared the work of actually building and placing the shadow objects, you'll want to know some of the details of their construction. The shadow objects, named Treeshadow in the model, are 2D surfaces formed into the shape of a tree shadow. If you look in the Perspective viewport, in Wireframe mode, you'll see that they are placed at about the height of the bottom of the tree canopy (see Figure 7.63). This location offers a more accurate placement for the shadow on the ground plane.

FIGURE 7.63
The Perspective
viewport with the
Treeshadow objects
at the level of the
bottom of the tree
canopy

2D tree shadow objects   Tree objects
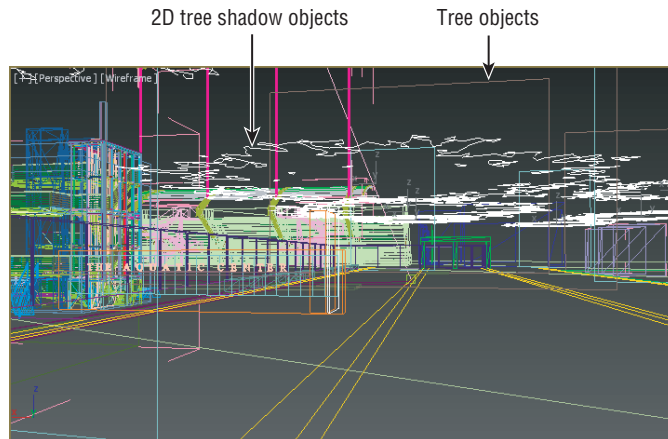
If you look carefully at the Top viewport, you'll see that the Treeshadow objects aren't centered on the trees for which they cast shadows. Instead, they are offset to the left and downward

in the direction away from the light source. This simulates the way a tree shadow might be cast, given the relationship it has to the sun angle in the design.

Something else is quite unusual about the Treeshadow objects. Although they cast shadows in the rendering and are plainly visible in the Perspective viewport, they don't appear in the rendered view. You may recall that when you created a wineglass in Chapter 3, "Creating Shapes with Splines," parts of the glass disappeared when it was rendered. This was due to the alignment of the normals on a single surface. Remember that a surface has only one visible side. The Treeshadow object takes advantage of this fact by orienting its normals toward the sky and away from our point of view. The end result is that 3ds Max doesn't render the Treeshadow object, but the trees still cast shadows.

You can create a Treeshadow object by starting with a plane or a star spline shape, editing its vertices to form a shape like the shadow of a tree. You can also form one random shape and then make multiple copies and join the copies into one object.

Another technique for creating shadows is to use a *gobo light*. In this technique, you assign a projector map (a bitmap usually) to a light, and the light will cast a shadow in the shape of the bitmap. A projector map can be added to a light through the Projector Map group of its Advanced Effects rollout. Projector maps can also be animated to simulate the shadows of trees being blown by the wind or a movie being projected on the big screen.

Using a Clone to Cast Shadows

The Avery Aquatic Center rendering is just about finished. Unfortunately, the sign itself looks as if it were floating in the rendering — as though it were pasted in. It appears to be dislocated because it doesn't cast a shadow on the ground.

You want the sign to cast a shadow using the original SUN directed light that uses a shadow map shadow. To do this, you'll make a copy of the main sign components that cast shadows. Those copies will be included in the set of objects that cast shadows from the original SUN directed light.

1. Click the Select By Name tool on the Main Toolbar.

2. In the Select From Scene dialog box, select the SIGNbody and SIGNtower objects from the list; then click OK. These are the two main components of the sign.

3. Choose Edit ➢ Clone; then in the Clone Options dialog box, make sure that Copy is selected and click OK. 3ds Max creates copies of the objects you've selected, appending the number 001 to the name of each object.

You don't want these new objects to affect the rendered scene in any way other than to cast a shadow from the SUN directed light. To avoid any interference with other objects, you can reduce the size of these new objects so that they are smaller than the objects from which they were cloned.

1. Click the Select by Name tool again; then, in the Select From Scene dialog box, select SIGNbody001 and click OK.

2. Click the Select And Uniform Scale tool on the Main Toolbar.

3. In the Transform Pivot Point flyout, next to the Reference Coordinate System drop-down in the Main Toolbar, select Use Pivot Point Center. This will cause the SIGNbody001 object to remain centered within the original SIGNbody object as it is scaled down,

thereby keeping the SIGNbody001 object completely nested within the SIGNbody object (see Figure 7.64).

FIGURE 7.64
The SIGNbody001
object is nested
within the
SIGNbody object.

The white outline shows the SIGNbody001 clone.
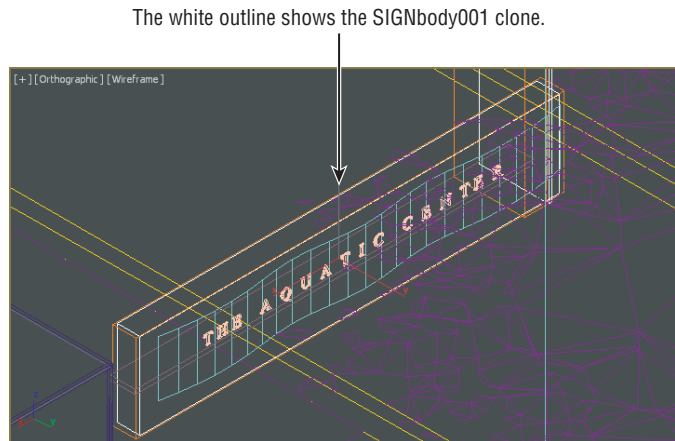
4. In the Transform Type-In area at the bottom of the user interface, change the X spinner value to 98.

You've made the SIGNbody001 object slightly smaller than the original object from which it was cloned. Repeat the process for the SIGNtower001 object:

1. Click the Select By Name tool again; then, in the Select From Scene dialog box, select SIGNtower001.

2. In the Transform Type-In area, change the coordinate readout's X spinner value to 98. 3ds Max maintains the Use Pivot Point Transform option.

3. Click the Select By Name tool once again, and select SIGNbody001 and SIGNtower001.

4. Choose Group ➢ Group.

5. In the Group dialog box, enter **Signshadow** and then click OK. By grouping the newly created objects, you can keep them together and manage them more easily. From now on, you'll see the pair of objects listed as a single entity called Signshadow in the Select From Scene dialog box, and it will have an icon that looks like an overlapping circle and square surrounded by square brackets.

The new objects are automatically included to cast shadows from the original light source and, because you haven't explicitly included them with the objects lit by the SUNraytraced directed light, they aren't affected by that light.

It is possible to use lights that have negative multipliers. This has the amazing effect of removing light from the scene — something that is clearly not possible in the real world. Try using negative lights to soak up light from washed-out areas in scenes that use the Default Scanline Renderer. Negative lights will not be effective in physically based lighting simulations with Radiosity or the mental ray renderer.

Using the Light Lister

In more complex scenes, you will find that you need to have dozens or perhaps even hundreds of lights. Managing these lights can become a huge problem if you have to edit the parameters for each light source — one at a time.

As you do test renderings, you will undoubtedly see problems in the levels of illumination, light color, shadow casting, and so on that require you to edit many light parameters. Fortunately, there is a special tool called the Light Lister that is designed to help you with light management.

Be sure to instance lights that are meant to be wired together in the real world. For example, you'll save quite a bit of time by making instance clones of downlights in the same room. That way, changes that you make to one instance are immediately updated in all of its siblings.

1. Create two Omni lights located as shown in Figure 7.65. Create the right one first.

FIGURE 7.65
Add two Omni
lights to the scene.

New Omni lights
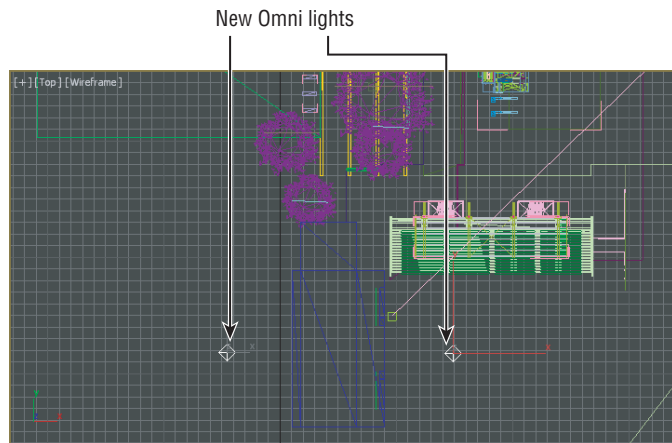
2. In the Front or Top viewport, move the new lights to a height of approximately 60′.

3. Choose Tools ➢ Light Lister.

   The Light Lister is shown in Figure 7.66. It lists each of the light sources in your scene, and it allows you to change almost all of the relevant parameters in one convenient dialog box.

   Using the columns shown from left to right in Figure 7.66, you can select a light object; turn each light on or off; change the name, the multiplier, or the color; toggle shadows on or off; change the shadow type; and alter many of the relevant shadow parameters. This is obviously much faster than individually selecting each light and changing its parameters in the Modify panel. Furthermore, any object selected when you open the Light Lister remains selected throughout any modifications that you make to the lights in your scene.

FIGURE 7.66
The Light Lister
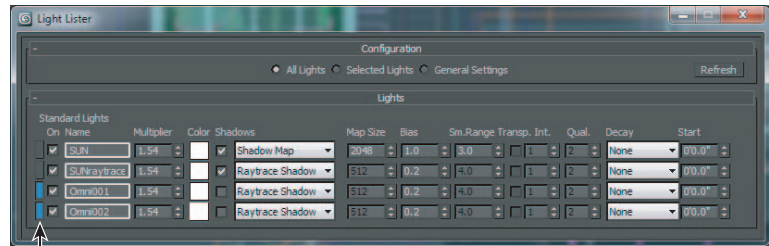
This vertical bar indicates the selected lights.

4. By using the General Settings feature, you can make changes to selections of lights all at the same time. Click the General Settings radio button in the Configuration rollout (Figure 7.67).

FIGURE 7.67
The General Settings rollout in the Light Lister
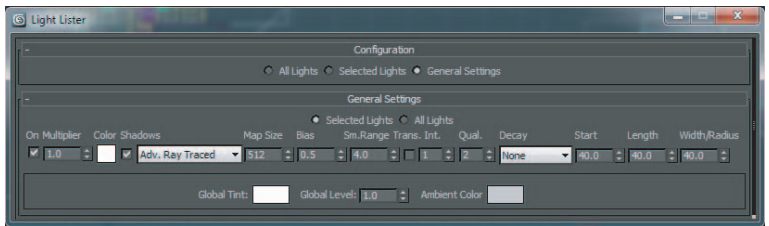
5. In the General Settings rollout, click the All Lights radio button. Any changes you make here will now affect all the lights in the scene.

6. Select the All Lights radio button in the Configuration rollout to display the options for all the lights in the scene.

You can make changes to a series of lights (but not to all the lights in the scene) by first selecting those light objects you want to change and then using the Selected Lights radio button in the General Settings rollout. The Selected Lights radio button in the Configuration rollout displays only the lights selected in the scene in the Lights rollout, rather than all the lights that are displayed when All Lights is selected.

7. Turn on the shadows for the first Omni light, and then change the shadow type to Shadow Map for the second Omni light.

8. Turn off both the Omni lights, as shown in Figure 7.68.

FIGURE 7.68
Adjusting lights in the Light Lister
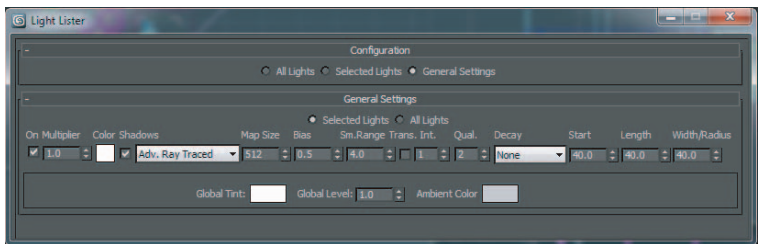
9. Save your scene as **MyAquaticCenter01.max**.

As you can see, the Light Lister provides quick access to the most common properties of all the lights in a scene. In the next exercise, you will learn how to save and retrieve the status of your lights to re-create a lighting scheme instantly.

Using Scene States

Throughout the course of a project, you will experiment with lighting setups, materials, and layer schemes, trying to make your scenes as appealing, accurate, and streamlined as possible. In the event that the lighting does not work out or a material's appearance needs to be re-created, there are several methods to retrieve your work. You can undo the most recent steps, use the Edit ➢ Hold and Edit ➢ Fetch tools, or simply reopen your scene without saving any changes. The problem with all of these methods is that they are destructive and all steps, even those that you want to retain, are lost. The Scene States tool solves this issue by saving only certain features to be restored by you.

1. Open C07_Scene State.max from this book's web page.

2. Choose Tools ➢ Manage Scene States from the Main Menu. The Manage Scene States dialog box opens.

3. Click the Save button.

4. In the Save Scene State dialog box (see Figure 7.69), hold down the Ctrl key; highlight the Light Properties, Light Transforms, and Environment items, and then deselect any others. Enter **Aquatic Day** in the Enter A Scene State Name input box, and then click the Save button. The current parameters and transforms for the lights and all the environment information are saved as a scene state.

FIGURE 7.69
The Save Scene
State dialog box
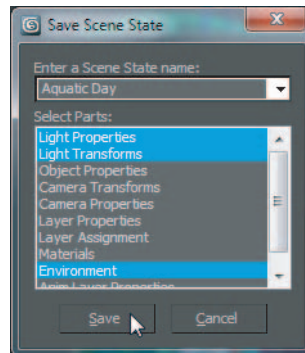
5. Choose Rendering ➢ Environment to open the Environment tab of the Environment And Effects dialog box.

6. Click the Ambient color swatch, and then choose a very dark gray in the Color Selector dialog box that opens. Close the Environment And Effects dialog box when you have finished.

7. Open the Light Lister.

8. Turn off the SUN and SUNraytraced lights. Turn on the Omni001 and Omni002 lights.

9. Set the Omni001 light's Multiplier to 1.0 and Omni002 to 0.5.

SCENE STATES

Clients can often be demanding regarding the amount of information they require. This can be especially true when renderings are produced on a computer and the clients believe that a few mouse clicks can generate a large amount of changes to the output.

A residential project on which one of the authors of *Mastering Autodesk VIZ 2008* (Sybex, 2007) worked quickly blossomed into a time-killer when the owner started requesting images of the home under various lighting conditions. The owner wanted to see what the home looked like during the day in each season, at night with the interior lights on but the exterior lights off, at night with the interior lights off but the exterior lights on, and under a few more conditions. With dozens of lights in the project, each situation required many parameter (intensity, attenuation, position, orientation, color, and so on) changes.

By saving the lighting schemes as scene states, the author was quickly able to return to any state that was saved to make client-requested changes and to return to the feature images that he was originally commissioned to produce.

---

10. Click the color swatch of one of the Omni lights, and assign it a pale orange color. Drag the color swatch that you just modified over the other Omni's color swatch to clone the colors. In the Copy Or Swap Colors dialog box, choose Copy.

    The left half of the Light Lister should look like Figure 7.70.

FIGURE 7.70
The Light Lister after modifying the lights
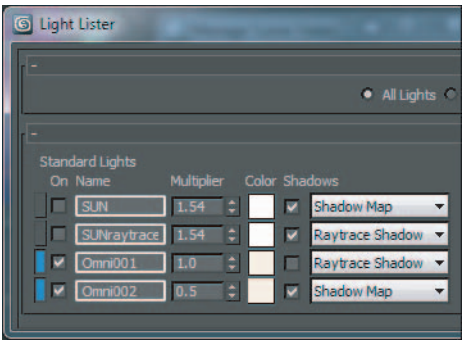
11. Make sure the Perspective viewport is active, and then click the Render Production button. The scene renders with a darker appearance, indicating that evening is quickly approaching, as shown in Figure 7.71.

12. Open the Manage Scene States dialog box if it isn't already open, and click the Save button.

FIGURE 7.71
The darker scene after adjusting the lights
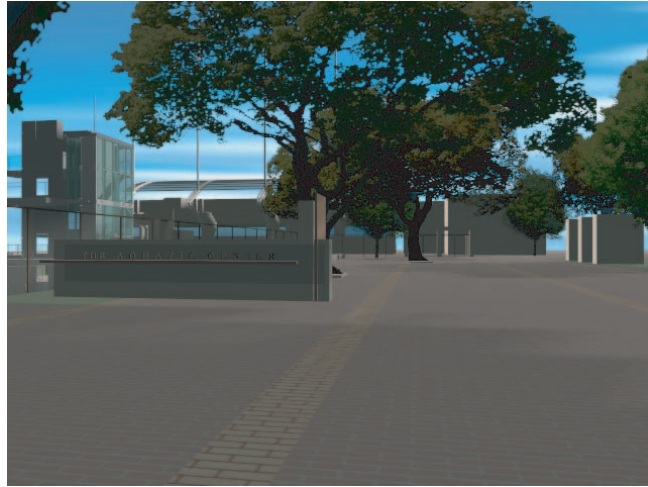
13. Highlight the Light Properties, Light Transforms, and Environment options again. Enter **Aquatic Evening** as the state name, and then click the Save button, as shown in Figure 7.72. The new scene state is saved.

FIGURE 7.72
Save the new scene state.
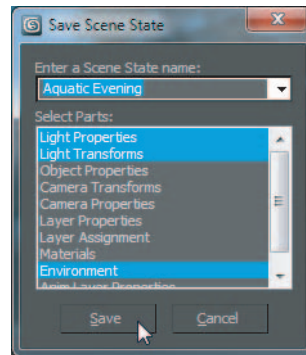
THE LIGHT LISTER AND SCENE STATES

If the Light Lister is open when a scene state is restored, it does not refresh to indicate the restored light parameter values. The Light Lister must be closed and then reopened to display the updated values.

---

14. Select Aquatic Day in the Manage Scene States dialog box, and then click Restore. In the Restore Scene State dialog box, highlight all three options and then click Restore, as shown in Figure 7.73.
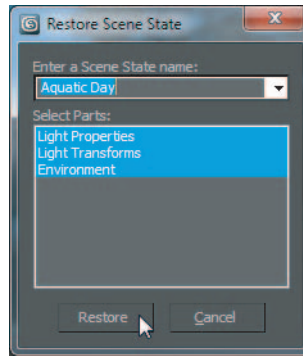
15. Save your scene as **MyScene State.max**.

The light and environment parameters are returned to their settings from the beginning of the exercise. You can repeat the process, selecting Aquatic Evening to restore the evening lighting scene state.

The Bottom Line

Create and adjust the different light types.   Lighting is an important component of any 3ds Max scene, and proper lighting schemes add to its quality. The various types project light into the scene in different ways.

Master It   What is the difference between a spotlight's falloff and its far attenuation?

Render a scene.   3ds Max scenes are generally output to image files or animated files for viewing. Choosing the proper output file type is important to manage the file size and quality.

Master It   Render a camera view, and save the file as a JPEG file with a Quality value of 100. Render it three more times with Quality values of 90, 50, and 30. Compare the four files for both quality and file size.

Define shadow effects.   Shadows are an important feature of any 3ds Max scene. They convey information regarding the intensity and type of illumination. Shadows also define where in the scene an object resides by tying it to the surrounding objects.

Master It   What is the procedure for causing an object not to cast shadows from a specific light?

Save and restore scene states.   Scene states let you save and restore the parameters of the lights in a scene. They can save a great amount of time by eliminating the need to note each light's parameters, on/off status, and other parameters to accommodate different lighting conditions.

Master It   Open the file you saved in the "Using Scene States" section in this chapter. Save the light parameters as a lighting scheme, change the parameters, and then restore the new scheme.

Enhancing Models with Materials

The material and mapping features of the Autodesk® 3ds Max 2013® platform let you simulate surface qualities such as color, texture, transparency, reflectance, roughness, and bumpiness. The Material Editor in 3ds Max lets you create and modify materials that you can then apply to objects to achieve realistic effects.

This chapter will introduce you to both forms of the Material Editor (the Compact Material Editor and the Slate Material Editor) and show how to design, edit, and use materials. You'll see how you can use materials to add color, texture, and realism to your models.

In this chapter, you will learn to

◆ Create and edit materials

◆ Select shaders

◆ Use bump maps

◆ Create a material with sub-materials

◆ Add entourage

◆ Use the Autodesk Materials

◆ Use the Displace modifier

Understanding Bitmap Texture Maps

To simulate a surface material, 3ds Max offers a number of preset material libraries. These are libraries of simulated materials that you can assign to objects. Each material contains properties such as color, reflectance, transparency, and roughness. Many materials also use images, or *bitmaps*, to simulate the look of complex surfaces such as marble, wood, or brick. Other materials use *procedural maps*, which are mathematical simulations of actual (or fictitious) materials.

A *bitmap* is an image file composed of an array of pixels that represent a graphic sample of the material. One common bitmap image is marble; another is brick. You might think of a material that uses bitmaps as a kind of decal or sticker that is placed on a surface. You can use bitmaps in the properties of a material in several ways: texture maps, bump maps, opacity maps, specular maps, shininess maps, self-illumination maps, and reflection maps to name a few. Diffuse color maps are the most common use of bitmaps and are the easiest to understand.

Procedural maps use mathematical formulas instead of bitmap images to simulate a texture. Unlike bitmaps, procedural maps often have parameters that can be set to control their visual appearance; they also have a more uniform appearance when applied to objects that have

unusual shapes or that are sliced or cut open in some way. For example, you can apply the Wood procedural map to create the look of an elaborately carved wood sculpture. The wood grain is mathematically defined three-dimensionally, so that you can see the grain running throughout the carved regions. Phenomena such as smoke, which might normally be difficult to simulate, can also be simulated effectively using a procedural map.

CERT OBJECTIVE

3ds Max 2013 has many types of materials available, including (but not limited to) the following:

◆ Standard material

◆ Architectural material

◆ Ink 'n Paint

◆ DirectX Shader

◆ Arch & Design (mi)

◆ Car Paint Material (mi)

◆ Autodesk Materials (mi)

Arch & Design (mi), Car Paint Material (mi), and the Autodesk Materials (mi) are used with the mental ray renderer, which will be covered in Chapter 14, "Advanced Rendering Using mental ray." Many of the principles regarding the construction of materials span most material types. Not all bitmap channels are available with all materials, and the following sections do not include every possible bitmap option. In this introduction to materials, you'll focus on bitmap texture maps.

To follow along with the descriptions of map types, open the Compact Material Editor and click a Standard material to expose its properties.

Diffuse Color Maps

The Diffuse channel of a material represents the color the material reflects in direct light. The diffuse component is the most basic element used in creating the appearance of a real-world material. Some of the many predefined materials that 3ds Max offers are Brick materials. Brick is an example of the use of bitmaps to define the appearance of a material. Whenever you assign the Brick material to an object, 3ds Max *pastes* a bitmap image of a brick wall onto the object when it is rendered so that the object looks like a brick surface. Figure 8.1 uses a modified version of the `Brick_Uniform_12Inch_Running_Burgundy.png` image that ships with 3ds Max 2013.

DIFFUSE MAPS

3ds Max calls texture maps, such as the brick example in Figure 8.1, *diffuse color maps* because the bitmap is reflected in diffused light. To get a better idea of the different types of light an object reflects, look at Figure 8.2. It shows a sphere that indicates the different ways light is reflected off an object.

When the ambient light in a scene is increased, you begin to see the dim portions of an object or those parts that are in shadow. The ambient map appears in these areas where indirect light strikes the surface. The diffuse color map appears in the brighter portions of a model, which are lit by light directly emanating from light sources in the scene. The ambient and diffuse color maps blend together so that as the ambient light increases, the ambient maps seamlessly merge with the diffuse maps.

FIGURE 8.1
A bitmap image (left) used as a texture map to simulate a brick wall (right)
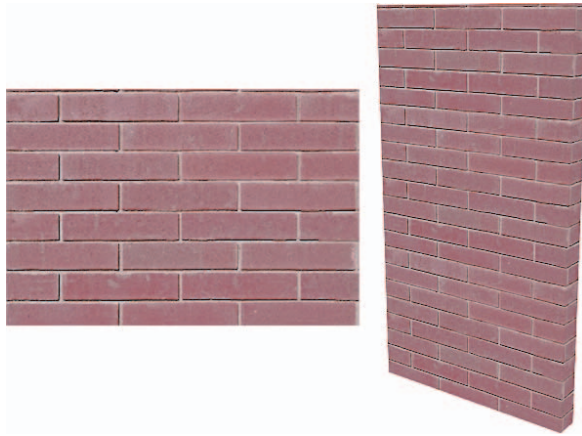
FIGURE 8.2
A sample sphere showing different types of reflected light
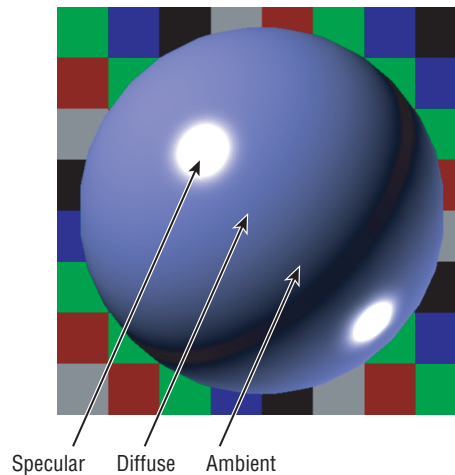
Specular   Diffuse   Ambient

When the ambient light in a scene is increased, you begin to see the dim portions of an object or those parts that are in shadow. The ambient map appears in these areas where indirect light strikes the surface. The diffuse color map appears in the brighter portions of a model, which are lit by light directly emanating from light sources in the scene. The ambient and diffuse color maps blend together so that as the ambient light increases, the ambient maps seamlessly merge with the diffuse maps.

SPECULAR COLOR MAPS

Specular color maps that are full-color image bitmaps appear only in specular highlights of a surface. On a shiny object, the specular portion of the object would normally appear white, as shown in Figure 8.2. You can have the specular region of an object display a surface feature by using specular color maps, as shown in Figure 8.3.

FIGURE 8.3
A sphere with a
specular color map
displaying a shiny
pattern
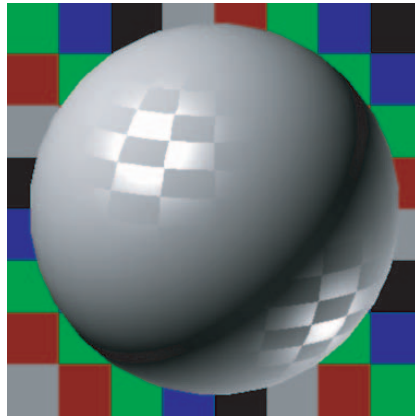
> **SHADERS DEFINE THE APPEARANCE OF A MATERIAL'S COMPONENTS**
>
> *Shaders* control how the ambient, diffuse, and specular components of a material blend together. You will learn more about shaders later in this chapter.

SPECULAR LEVEL MAPS

The Specular Level setting of a material determines the intensity of the specular highlight of a material, also called its *specular bloom*. The specular level maps determine where on the object the specular highlight appears.

GLOSSINESS/SHININESS MAPS

A glossiness map of the Standard material also affects the specular region of a shiny object, but instead of displaying a colored texture, a glossiness map controls the level of glossiness on a surface. You would use a glossiness map on an object whose surface is not uniformly glossy but instead is alternately rough and shiny, like a troweled stucco wall where the flat areas appear to be glossy and the depressions matte. The glossiness map applied to a material is usually identical to the specular level map that is used. The shininess map of the Architectural material is the same as the glossiness map, but it works in conjunction with the *Index Of Refraction (IOR)* setting to create specular reflections.

SELF-ILLUMINATION/LUMINANCE MAPS

Using the self-illumination feature, you can create materials that appear to glow or emit their own light. A self-illumination map is a grayscale bitmap or procedural map that determines the *brightness* of a surface based on the map's grayscale intensity. White is the brightest part of the texture, whereas black areas have no self-illumination at all. The self-illuminated areas of a material do not actually emit light or add illumination to a scene; they are merely areas with

brighter colors and less surface definition to give the appearance of illuminated objects such as fluorescent bulbs or lampshades.

You will learn other more advanced ways to make objects emit light when using the mental ray renderer in Chapter 14.

FILTER COLOR MAPS

Filter color maps control the color of light as it passes through transparent or translucent materials. For example, a filter color map of a stained-glass window would cause the light passing through that window to pick up the window's color and cast it on the floor. Lights must use ray-traced shadows to pick up the colors from a filter color map.

OPACITY/TRANSPARENCY MAPS

Opacity maps use grayscale bitmap images to control opacity and transparency. For example, you can turn a solid surface into an intricate filigree using an opacity map, as shown in Figure 8.4. The transparency map of the Architectural material provides the same capabilities.

FIGURE 8.4
A single, blank surface can be made to appear quite intricate by using opacity/transparency maps. The bitmap image on the left was used to turn a simple rectangular object into the intricate screen on the right.
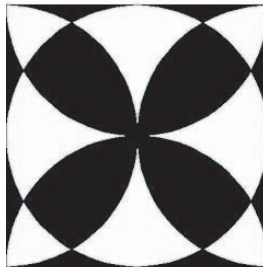
BUMP MAPS

You can also simulate a bumpy surface texture using grayscale bitmap images. Figure 8.5 shows a 2D bitmap image and an object rendered with a material that uses the bitmap to simulate a bumpy surface. 3ds Max converts the different intensities of light and dark tones of the grayscale bitmap into high and low points on the bumpy surface. The bump effect is an illusion created when 3ds Max applies a bitmap to the surface of the objects. The bitmap defines the shadows that would appear on the surface of the objects, based on the locations of the lights in the scene if there were actual surface deviations. Bump maps are often variations of the same image map used as the diffuse color map.

FIGURE 8.5
A bumpy surface can be simulated using a grayscale bitmap (left). The light portions of the bitmap translate to high points in the bumpy surface, while the darker portions of the bitmap translate to low points (right).
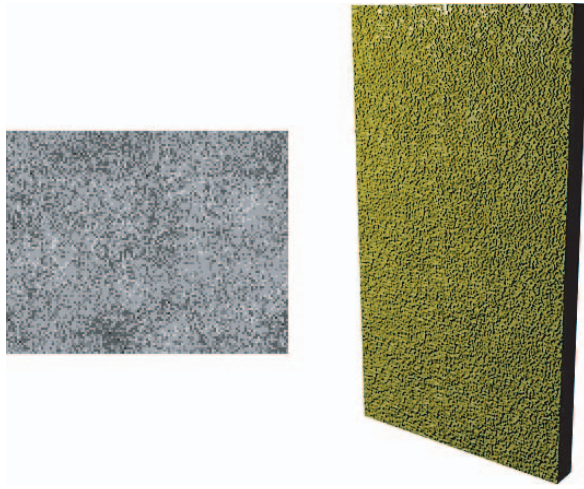
Maps accept both grayscale and color images as input. However, most maps only use the grayscale information of an image to affect a material. The exceptions where color information is actually used by the maps are the diffuse color, ambient, filter color, and reflection maps.

REFLECTION MAPS

A *reflection map* is a special type of bitmap assignment. It is used where you want a material that appears to be reflective, such as the glass in an office building or a lake or pond. In an animated scene, the reflection map you use can move (if you select an animated image format or file sequence), just as reflections move when you pass by a reflective surface. Use caution with reflection maps because reflections that appear to be too intense can ruin the illusion, as shown in Figure 8.6.

FIGURE 8.6
Reflection maps give the impression of a reflective surface, such as the glass and tile floor in this rendering of the Villa Savoye.

REFRACTION MAPS

A *refraction map* is similar to a reflection map; however, instead of giving the appearance of a reflection, such as a chrome ball, it gives the appearance of a refracted image, such as a crystal ball. A refraction map simulates the properties of glass, water, or other transparent materials that bend light.

DISPLACEMENT MAPS

A bump map simulates a bumpy surface, but it doesn't actually change the geometry of the model. Displacement maps are similar to bump maps in that they seem to alter the shape of a surface, but displacement maps go one step further and actually modify the geometry of the object to which they are applied. You can, for example, turn a flat surface into a dome by using a displacement map. You need to be cautious when you use a displacement map because it can generate a large number of faces on an object, thereby increasing the file size and rendering time. You can think of displacement maps as a modeling technique based on materials. 3ds Max now supports Vector Displacement maps from Autodesk® Mudbox® software.

Surface Properties

There are some materials that rely solely on the properties of color, specularity, and opacity and don't use maps of any kind. Instead, they use color and specular levels to simulate the appearance of an object (see Figure 8.7).

FIGURE 8.7
Surface materials
that don't require
bitmaps

Most materials are mixtures of diffuse color, bump, and opacity maps as well as reflection color, specularity, and transparency. Maps and material properties are combined to simulate detail that you would otherwise find impossible to re-create through surface or solid modeling alone (see Figure 8.8).

FIGURE 8.8
A simple Sphere
object with a single
material that uses
many of the differ-
ent types of maps
and properties
available in 3ds Max

The Architectural Material's Physical Qualities Rollout

The Architectural material's Physical Qualities rollout contains the most important and most obvious aspects of the Architectural material. On the Compact Material Editor, click the second material sample, click the button labeled Standard and, from the Material/Map Browser dialog box, select the Architectural material and then click OK to change the type of material in the sample slot. You will use the Physical Qualities rollout to simulate the character of the material accurately with the following controls:

Diffuse Color   Use this swatch to open the Color Selector so that you can assign the diffuse color, often the most important aspect of a material. The ambient color is managed automatically, so you don't have to think about it.

Diffuse Map   Click the None button in this channel to open the Material/Map Browser to assign a map. The Amount spinner varies as a percentage from 0 to 100 and controls what percentage of the map is used in the Diffuse channel. Whatever percentage remains (out of 100) is blended with the diffuse color.

Next to the Amount spinner is a check box that allows you to toggle the map on and off quickly. This helps when you are doing test renders and want to accelerate a rendering by temporarily leaving out certain maps (especially the time-consuming ray-trace map).

To the right of the diffuse color swatch and directly above the diffuse map is the Set Color To Texture Average button. This tool is enabled whenever you assign a diffuse map to an Architectural material. Clicking this arrow calculates the average pixel color of the diffuse map, whether it is a bitmap or a procedural map, and copies it into the diffuse color swatch. This is especially helpful in radiosity renderings, since the diffuse color controls what color surfaces will emit in the form of bounced light.

Shininess   This parameter controls both the specular level and glossiness parameters that you may have used before in the Standard material. You may also notice that you do not have to select any shaders with the Architectural material. The shaders used are automatically applied based on the template that you choose from the drop-down menu in the Templates rollout.

The percentage used in the Shininess amount is entered automatically by the template, so you don't have to alter it unless you want to customize your material further.

Instance the diffuse map in the Shininess channel when you want the bright areas of the diffuse map to represent the shiny areas of the material as well.

Transparency   Transparency is the opposite of opacity (from the Standard material). *Transparency* is the amount of light that passes through the material without illuminating it (as with most kinds of architectural glass).

You won't be able to see any diffuse color on objects that are 100 percent transparent, but you will still be able to see the shiny areas.

Translucency   Use this channel when you are simulating objects that allow some light through them but scatter it within the object. Art glass or frosted privacy glass are some examples of translucent materials.

Index of Refraction   The *Index of Refraction (IOR)* is the measurement of a physical property that all objects naturally have, but it is most apparent in translucent and transparent materials. Light reflects and/or refracts at the interface between two materials with different IORs.

The template will set this value for you. There are no units with this spinner, but be aware that it is not a percentage. Table 8.1 lists the IOR values for some basic materials. You can find more complete IOR tables online so that you can apply the proper values to the materials you create to help improve the realism of your photometric renderings.

TABLE 8.1:   IOR values for some basic materials

MATERIAL	IOR
Vacuum	1.0000
Air	1.0003
Water	1.3330
Glass	1.50 to 1.70
Diamond	2.41
Gold	0.47
Vodka	1.363

Luminance cd/m^2   Set this value if you want the material to glow with its own light. The units are in candelas per square meter. You can think of one candela as roughly the light emitted from one wax candle.

Set Luminance from Light   If you are using the Radiosity lighting plug-in found on the Advanced Lighting tab of the Render Setup: Default Scanline Renderer dialog box, chances are that you are using photometric lights that simulate real-world intensities. Click the spot-light icon near the bottom of the Physical Qualities rollout, and then click a photometric light to copy its intensity into the Luminance Amount spinner. This is a quick way to make your material emit the light intensity of a known luminaire without having to remember the numerical intensity values.

Check Boxes   The 2-Sided check box is useful when you are rendering imported surfaces that have their normals facing in the wrong direction. Be aware that your rendering will take longer (especially if you are ray tracing).

The Raw Diffuse Texture check box is used only in radiosity rendering. It excludes the surface from illumination and exposure control, so that your whites stay pure white. This is helpful when you are simulating the surface of a luminaire and want it to read as pure white but don't want the surface itself to emit light.

The Special Effects Rollout

The Special Effects rollout for Architectural materials contains four channels that simulate advanced features. Earlier in this chapter you saw how to use a bump map, and this channel is the same as the Bump channel found in the Maps rollout of the Standard material.

Bump   Bump simulates low relief by manipulating surface normals (similar to how smoothing works). Any type of map will work in this channel. Noise is often used to make a rough, uneven surface. On the other hand, you can instance the diffuse map into this channel, and only the grayscale equivalent of a color image will be used to lift, or bump, the surface upward.

Displacement   Displacement differs from Bump in that this channel actually alters the geometry to which it is applied at render time. Displacement can be used to simulate surfaces that are difficult to model with other techniques. Typically bitmaps are used in this channel, although most map types are supported.

Intensity   This channel simulates the brightness or *intensity* of a material. It can be used for positive effect to simulate roughness, which you can think of as variable brightness across a surface.

Try using a noise map in the Intensity channel to make your material more realistic and to avoid that flat look that is so common in computer graphics.

Cutout   This is similar to the Opacity channel in the Standard material but better. When you place a bitmap in the Cutout channel, not only are the black areas of the bitmap transparent, but the *cutout* area will not have any reflections, refractions, or shininess. In other words, the black areas of a map in this channel are completely and utterly cut out. This is perfect for creating entourage, covered later in this chapter.

Other Rollouts   The Advanced Lighting Override rollout is used only for tweaking radiosity solutions and works the same as the Advanced Lighting Override material.

The SuperSampling rollout allows you to apply antialiasing at the material level. You can opt to control supersampling at the global or local levels. In other words, you can enable supersampling within one material if you want its settings to differ from the global supersampling options.

The mental ray Connection rollout is to be used only with the mental ray renderer (see Chapter 14).

Ink 'n Paint Material

The Ink 'n Paint material allows you to create the look of traditional animated cartoons, often called cel (or toon) animation. You can render both the ink and the paint, or you can select to have the material represent either just the ink or just the paint.

Basic Material Extensions   The Basic Material Extensions rollout provides check boxes for forcing the material to be rendered two-sided and faceted, with any bitmaps applied individually to every face of the material.

Paint Controls   The Paint Controls rollout allows you to set three colors for the body areas of the material, the Lighted areas, the Shaded areas, and the Highlight areas. You can turn off the Lighted and Shaded areas if you only want to render the ink lines. The Paint Levels spinner allows you to control how many bands of color are interpolated between the Lighted and Shaded areas.

Ink Controls   These controls allow you to control the quality, color, thickness, and other properties of the linework that will be rendered at the perimeter, over and underlaps of the material.

DirectX Shader

The DirectX Shader is designed to provide the ability to apply Direct3D shaders to objects in your viewports. Being able to see Direct3D shaders in the 3ds Max viewports can be incredibly helpful in designing materials for computer games and getting a good visual match for how the objects will look when exported to the game engine.

The DirectX Shader uses these types of shaders: FX, CGFX, and XMSL files. XMSL files are in the MetaSL format, and they can be exported as phenomena from the mental mill shader writing software.

Adding Materials to Objects

For our tutorial, you'll start by selecting a few materials from a list and then apply them to the model. Then, after checking the appearance of the materials with a test rendering, you'll look at ways to adjust the materials to better suit your model.

Before you dive in, it is important to let 3ds Max know where the dependent files are that you plan to use in your project.

Adding a Map Path to Help 3ds Max Find Bitmaps

Maps and other support files are not contained within the 3ds Max files. This would make the files enormous and hinder the ability to update and share those files. Instead, the filenames and paths are referenced in 3ds Max and accessed whenever the files are opened or rendered. 3ds Max needs to know where different types of files are located for its use. 3ds Max stores some of its standard bitmap images in subfolders under the `\maps` folder within the main 3ds Max 2013 application folder. Bitmaps and procedural files for the Autodesk Common materials are stored in subfolders found in the `C:\Program Files (x86)\Common Files\Autodesk Shared\Materials\Textures` folder. When you start to create your own materials, it is a good idea to keep your own bitmap files in folders that are separate from the standard `C:\Program Files\Autodesk\3ds Max 2013\maps` folder. For example, you might create a folder under the 3ds Max 2013 folder called `Custom Maps` to store your own bitmap files, or you might make a series of subfolders on your server so that the same set of maps can be shared within your office. Keeping your personal and project bitmaps separate from the maps that ship with 3ds Max will also make it easier when it is time to upgrade 3ds Max or migrate to a new computer. 3ds Max first searches the folder where the current Max file is located and then searches through a list of paths specified by the user.

You can also define a folder to be the project folder. This provides a common root location to store a scene's assets, including nonstandard map and rendering output. 3ds Max places the project folder, and the subfolders that are automatically created, in the same location where 3ds Max was initially installed. You can set a new project folder by clicking the Application menu, choosing Manage ➢ Set Project Folder (or using the Project Folder button on the Quick Access

toolbar), and then navigating to the preferred location with the Browse For Folder dialog box. When you are working on a team project, maintaining a consistent project folder location and naming scheme is crucial; not using one can significantly impact the collaboration process.

In the exercises in this chapter, you'll use bitmap files from the website. You first need to let 3ds Max know where to look for the files:

1. Choose Customize ➤ Configure User Paths. The Configure User Paths dialog box appears.

2. Click the External Files tab. You see a list showing the current path where 3ds Max searches for bitmap and photometric files among others (see Figure 8.9).

FIGURE 8.9
The External
Files tab of the
Configure User
Paths dialog box
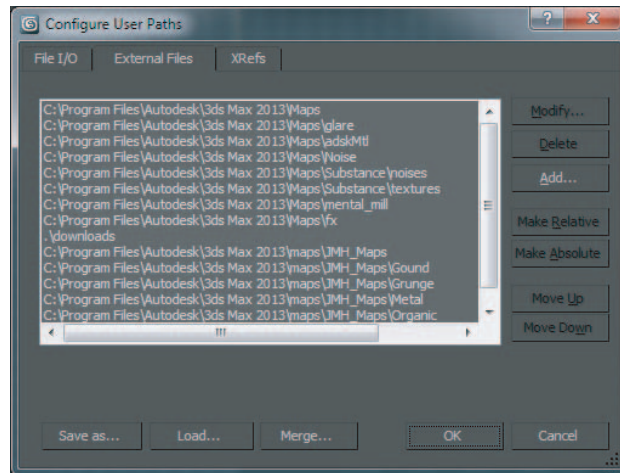
YOUR PATHS MAY BE DIFFERENT

The paths shown might differ from those on your system.

---

3. Click the Add button to the far right. The Choose New External Files Path dialog box appears. This is a typical file dialog box that lets you search for and select a folder.

4. Locate and select the folder that contains all the downloaded and unzipped files from the book's website; select Add Subpaths to add all the folders under the selected path. Then click Use Path to add the new folders to the search path, and close the Choose New External Files Path dialog box.

5. Click OK to close the Configure User Paths dialog box.

RELATIVE USER PATHS

Sharing a project among team members, especially those in different physical locations, has always been difficult, especially when support files are used in a project. In early versions of 3ds Max, the paths to support files and maps were absolute, meaning the programs would look in a specific drive and folder for the files. For example, if your 3ds Max scene file is located in the `P:/Projects/RNO_VFX` folder and search paths for the maps used in the scene are in the `P:/Projects/RNO_VFX/Maps` folder, then 3ds Max, as expected, would search in that folder for the referenced files. Problems would start to occur when you gave the `RNO_VFX` project folder and its subfolders to a colleague, client, or contractor and then they placed it in a different drive or folder. 3ds Max would still search the `P:/Projects/RNO_VFX/Maps` path for the required files, but the path would be invalid.

3ds Max 2010 and beyond have the ability to set the paths for a scene's support files and maps to be relative to the project location, rather than in an absolute folder location. By selecting a path in the Configure User Paths dialog box and then clicking the Make Relative button, the path becomes relative to the current project and is no longer an absolute location. Now when you send the files to someone else, 3ds Max is more likely to locate the referenced files as long as the files are in the same location relative to each other. You can switch relative paths back to absolute paths by clicking the Make Absolute button.

Now you're ready to start using the bitmap files from the book's website (`www.sybex.com/go/mastering3dsmax2013`). You may have noticed other tabs in the Configure User Paths dialog box. As you might guess, these other tabs let you indicate additional places to search: File I/O and XRefs, as the names of the tabs indicate. The File I/O tab lets you determine where 3ds Max should look for various components of the program. The XRefs tab lets you indicate where 3ds Max should look when searching for XRef files. XRefs are scenes or objects that have been externally referenced into a file. XRefs do not become part of the file into which they are imported but remain separate files that are merely referenced when needed. In Chapter 10, "Organizing Objects and Scene Management," you'll get a chance to learn more about XRefs.

You have the ability to save, load, and merge user paths. These options, located at the bottom of the Configure User Paths dialog box, allow the easy transfer of the paths, saved as MXP files, from computer to computer or between project team members.

HOW 3DS MAX SEARCHES FOR FILES

After searching in the folder where the current *.max file is located, 3ds Max searches through the search path starting at the top of the Configure User Paths dialog box and working down. Once 3ds Max locates the referenced filename, the search is terminated and the file is used. If multiple files in the search path have the same name, 3ds Max will use the first one that it finds, which may not be the one you want. Thus it is a good idea to make sure that you use unique descriptive filenames for your bitmap textures.

There are several utility programs that help you work with paths, and you'll learn more about them later in this chapter. Now that 3ds Max knows where to find the dependent files, you are ready to begin the tutorial.

In this exercise, you'll render a kitchen model of a condominium project and see that the materials that are assigned to the objects in the scene generally consist of a light beige color and very few other characteristics. There is no difference between the countertop and the cabinet materials. The glass in the model appears transparent but doesn't have any other glass-like qualities. 3ds Max offers a glass material that's both transparent and shiny, and it includes accurate reflections. In the exercise, you'll add this glass material to the model.

1. Open the C08_001.max file from the sample files on the website.

2. Click the Compact Material Editor button on the Main Toolbar, or press **M** on the keyboard. The Compact Material button is found under the Slate Material Editor button. Note the flyout indicator in the lower-right corner of the icon. Pressing **M** will open the previously used Material Editor as shown by the icon on the toolbar.

The Compact Material Editor appears, as shown in Figure 8.10.

FIGURE 8.10
The Compact
Material Editor
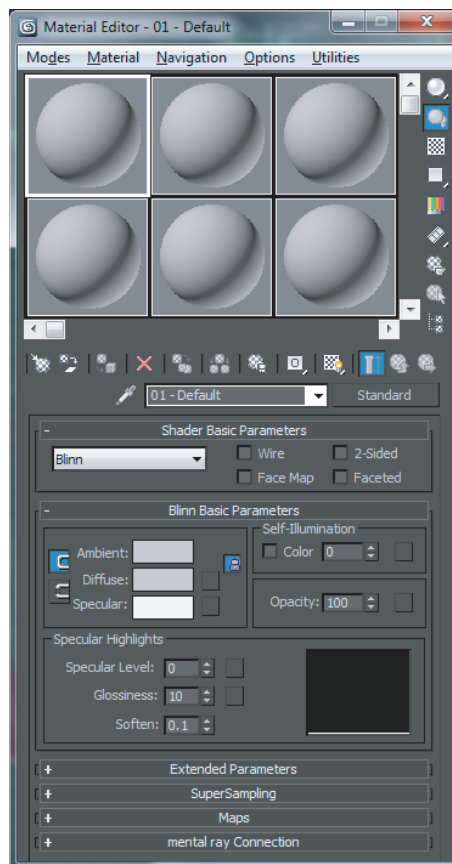
At the top, you see a set of sample slots, which is where you will see preview images of materials. Right now, there are no custom-designed materials in the Material Editor. All the slots show the same blank sphere representing an unaltered Standard material. Also notice that the first material slot in the first row is outlined with a thick, white border. This tells you that it is currently the active slot. Any changes made to the material's parameters affect the material in this slot.

3. Click the Get Material button on the toolbar just below the sample images of spheres. The Material/Map Browser (see Figure 8.11) appears.

FIGURE 8.11
The Material/Map Browser
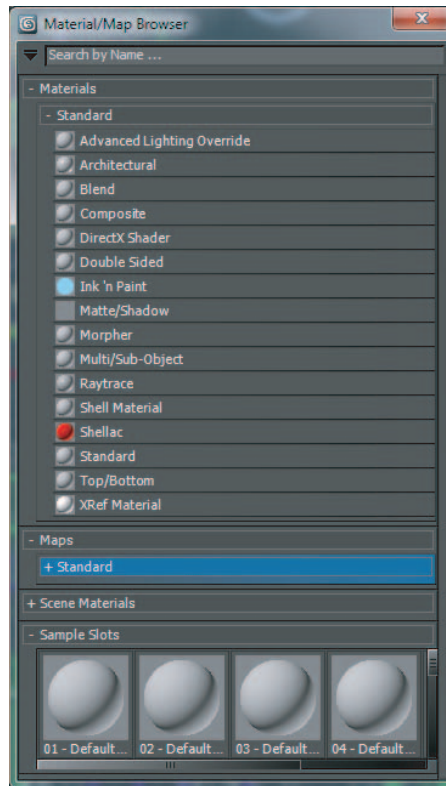
4. Near the top-left corner of the Material/Map Browser, click the Material/Map Browser Options button and then click the Open Material Library button. This lets you load a material library into the Material/Map Browser.

The Import Material Library dialog box displays, listing the material library files that are available, as shown in Figure 8.12.

FIGURE 8.12
The available material library files
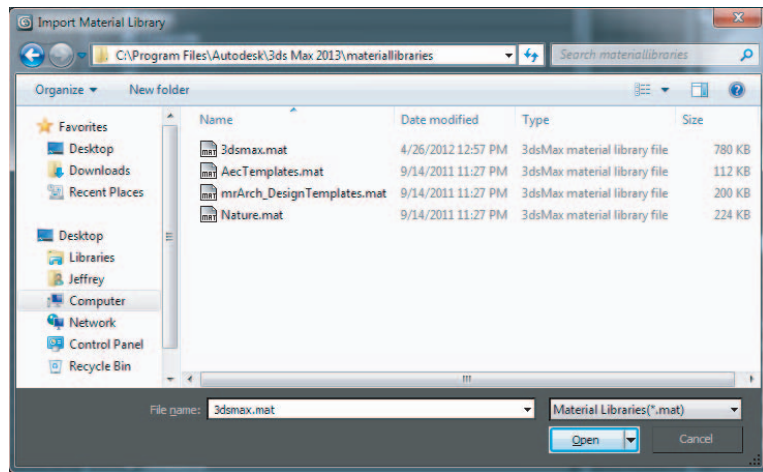
WHERE ARE THE LIBRARIES?

The Import Material Library dialog box may open to the `C:\Users\`*UserName*`\Documents\3dsMax\ materiallibraries` folder or the folder from which the current Max file was loaded, but this is not the location where 3ds Max installs the libraries. Navigate to the `C:\Program Files\ Autodesk\3ds Max 2013\materiallibraries` folder for the default 3ds Max libraries. If you are on Autodesk Subscription for 3ds Max 2013, Samples content for 3ds Max can be found on your Subscription account website on the Product Enhancements page. You should download and extract the Samples content. The 2013 Samples content installs the extra material libraries to the folder

```
C:\Autodesk\Autodesk_3ds_Max_2013_&_Autodesk_3ds_Max_Design_2013_
    English_Win_Samples_Files\Samples\Maps and Materials\MatLibs
```

If you are using the 3ds Max 2013 Trial download, you will not have those additional material libraries; instead, we've provided a `Mastering3dsMax2013.mat` file with the Chapter 8 files that you downloaded from the book's website. Load that material library for these exercises.

There is an additional `3dsmax.mat` material library that you should download from the Autodesk 3ds Max Services and Support Knowledge Base webpage. This file was omitted from the 3ds Max 2012 and 2013 installers. Follow the first two instruction steps provided on the web page, modifying them for the 2013 installation path, to be able to use that material library.

You can create your own library files as you become more familiar with 3ds Max. For now, you'll use a predefined material from the material library that you'll load in the next series of exercises, and you will make a few simple adjustments:

1. Browse to and select the `Mastering3dsMax2013.mat` file you downloaded from the book's website, and then click Open.

   The newly loaded library will appear in the Material/Map Browser as a group listed by its filename, and it will have a gray LIB indicator at the right edge of the group header, as

shown in Figure 8.13. You can see the materials in the library by clicking the + sign on the group's header and expanding the library if it isn't already expanded.

FIGURE 8.13
The loaded material library
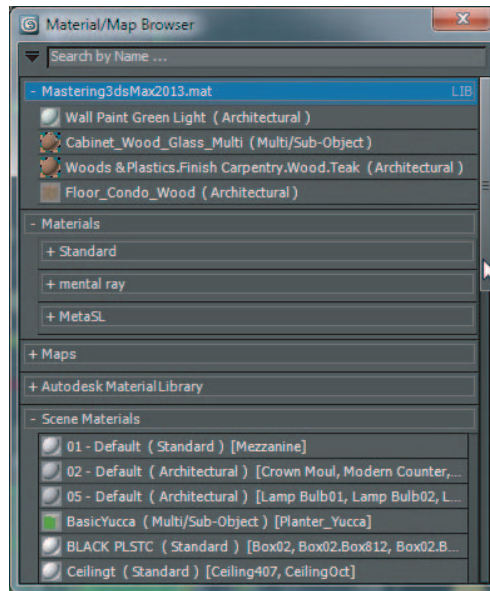
When you have loaded a material library, you can add materials to it, save it with a new name, or remove materials from the library. Be careful removing materials from a library—once you do, if the material isn't saved in any scene file where you can find it to reload it, that material is lost forever.

2. Scroll down the list and find Woods & Plastics.Finish Carpentry.Wood.Teak (Architectural).

3. Double-click the name of the material, and it appears in the Material Editor in the currently selected sample slot. Also notice that the name Woods & Plastics.Finish Carpentry.Wood.Teak (Architectural) appears in the drop-down list just below the horizontal toolbar.

4. Click the Select By Name button. In the Select From Scene dialog box, select all objects with *Draw*, *Cab* (drawers and cabinets), *Crown Moul*, *Microw*, and *Fridge* in the name, but do not select objects that also have *handle* in the object name. Also select the object named Base Moder, and then click OK.

5. In the Material Editor toolbar, click the Assign Material To Selection button. The current material is assigned to the selected objects.

6. In the Main Toolbar, click the Render Production button. The scene is rendered, and the material is displayed, as shown in Figure 8.14. The wood grain appears on all the surfaces, including those behind the cabinet doors in the foreground. The material for those doors will be addressed in a later exercise. This scene may take a moment to render

because it is using the Light Tracer advanced feature of the Default Scanline Renderer to boost the ambient light values in the scene.

FIGURE 8.14
The rendered scene with the wood applied to the cabinets and drawers

As you can see, assigning library materials to scene objects is a fairly quick and easy procedure.

Understanding Material Libraries

You imported the Woods & Plastics.Finish Carpentry.Wood.Teak (Architectural) material from the `Mastering3dsMax2013.mat` material library. You can find other material library files in the `materiallibraries` subfolder of the `3ds Max 2013` folder or with the Samples content. You aren't limited to these material libraries, however. You can use all the files with the `.mat` extension in these folders, you can create your own libraries from materials you create in the Material Editor, or you can even use libraries from third-party producers.

To open a different library, you need to be in the Material/Map Browser. Click the Material/Map Browser Options button, and then select the Open Material Library item to access the Import Material Library dialog box. You can have as many open libraries as you want in the Material/Map Browser.

To create a new library, click the Material/Map Browser Options button and then click New Material Library. You will see the Create New Material Library dialog box. You can then enter a name for your library and click OK. This creates a new empty library that you can populate with the materials you want. The new library is saved in your `Users` folder deep down in the `3dsMax` folder. To save the library to a new location, such as your `3ds Max 2013\material-libraries` folder, right-click the Library group header, highlight the Path/name of the material library, and, from the context menu that opens, choose Save As and navigate to where you want to save the library in the Export Material Library browser and click Save.

To remove a material from a library, in the Material/Map Browser, right-click the material and select Remove From Lib. You can also use the context menu on a material to rename it or copy it to a temporary library or any other library files that are currently open. If you delete a library, you will have to reinstall 3ds Max 2013 to get it back. You should consider making backup copies of all your material libraries prior to making any changes to them.

You can close the Material/Map Browser now if you still have it open. Using the Material Editor and Material/Map Browser at the same time will take up a lot of screen real estate, and you will quickly realize that working on a system with two (or more) monitors will greatly help your work productivity.

Editing Materials

Many 3ds Max materials are ready to use out of the box, but often you'll need to edit the materials to achieve the specific look you want. In this exercise, you'll select materials for the walls and floor and change the parameters to achieve a more pleasant appearance.

1. In the Material Editor, click the unused sample slot next to the Teak material you added in the previous exercises. This is where the next material will be designed.

2. Click the Material Type button, which currently says Standard, as shown in Figure 8.15.

FIGURE 8.15
Click the Material Type button, which says Standard.
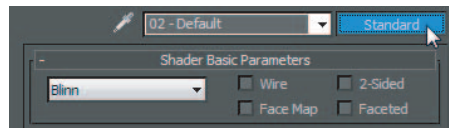
3. In the Material/Map Browser, expand the Materials group, expand the Standard group, and double-click the Architectural material to load it into the selected sample slot in the Compact Material Editor.

4. In the Templates rollout, expand the drop-down list and choose Paint Semi-gloss, as shown in Figure 8.16.

FIGURE 8.16
Choose Paint Semi-gloss.
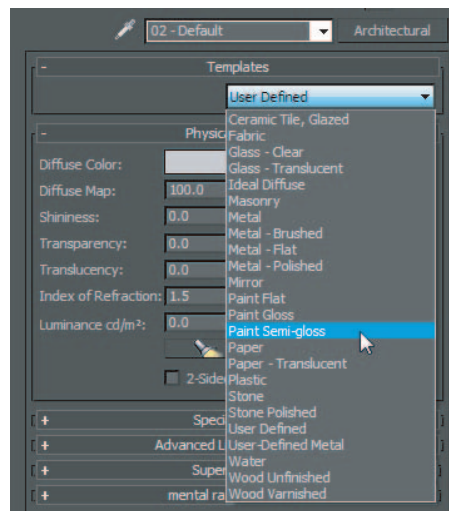
Material templates define many of the properties of a material, including Transparency, Shininess, and Index of Refraction, common to several types of real-world surfaces. Templates also define how bounced light is reflected from or transmitted through the objects. The Reflectance and Transmittance numbers are shown just above the toolbar in the Material Editor, as shown in Figure 8.17. Transmittance values are above 0 (zero) only when the material is not 100 percent opaque. If you do not see the Reflectance and Transmittance values, you may need to go to Customize ➢ Preferences, select the

Radiosity tab, and in the Material Editor group, select the check box in front of Display Reflectance & Transmittance Information. If you have the Compact Material Editor open, you will have to close it and reopen it to see the Reflectance and Transmittance information.
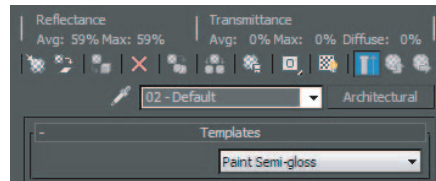
5. In the Physical Qualities rollout, click the Diffuse Color sample swatch to open the Color Selector dialog box.

6. Select a pale green color similar to R = 210, G = 249, B = 213, and then click OK. This will assign a pastel green color to the walls.

7. Assigning descriptive names to your materials is important so that when you access them later or put them in a library, you can quickly understand how they are used in your scene. Click in the Material (Map) Name Field to the left of the Material Type button, and enter **Wall Paint Green Light** as the current material's name, as shown in Figure 8.18.

FIGURE 8.18
Rename the material.
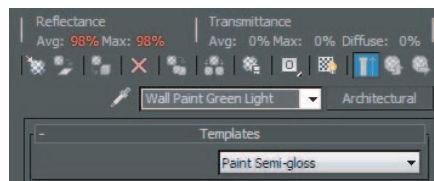
8. Click the Select By Name tool, or press **H** on the keyboard. Using the Select From Scene dialog box, select the three Wall objects but not the sub-objects of Wall_Den. If you do not see the sub-objects of Wall_Den, select the Display menu on the Select From Scene dialog box and select Display Children. You will then have to click the + symbol in front of Wall_Den to display its sub-objects.

9. Click the Assign Material To Selection button to assign the material to the scene's Wall objects.

10. Render the CamWall viewport to see the result of adding the paint to the walls.

11. Save your file as `MyC08_001b.max`.

Using Bump Maps

Earlier in this chapter, you saw a bump map sample (Figure 8.5). It showed how a grayscale image creates the impression of a bumpy surface. Bump maps can also generate other types of surface textures. The paint in the condo, for example, is too flat and could use some texture. To

add that texture, you'll add a map to the Bump Map channel of the current paint material, as shown in these steps:

1. Open the file you saved earlier as `MyC08_001b.max`, or open the `C08_001b.max` file from this book's download files.

2. Click the Material Editor button on the Main Toolbar to open the Compact Material Editor.

3. In the Compact Material Editor, double-click the Wall Paint Green Light sample slot with the triangles in the corner. Double-clicking a material slot in the Compact Material Editor opens the Magnify Window dialog box (also accessible under the Material menu) that contains just the selected material. This dialog box can be resized to provide a better view of the material as you develop it.

   The triangles in the corners of the sample window indicate the status of the material in the scene. White triangles denote a material that is in the scene and applied to the currently selected objects; gray triangles are materials that are applied to objects in the scene that are not currently selected. No triangles around a sample sphere indicates a material that resides in the Material Editor but not in the scene.

4. Scroll down to the Special Effects rollout and open it.

5. Click the Bump Map button that is currently labeled None.

6. In the Material/Map Browser, expand the Maps group and then expand the Standard group.

7. Double-click Noise from the list, as shown in Figure 8.19, to add it to the Bump channel of the Wall Paint Green Light material.

FIGURE 8.19
Select the Noise map.
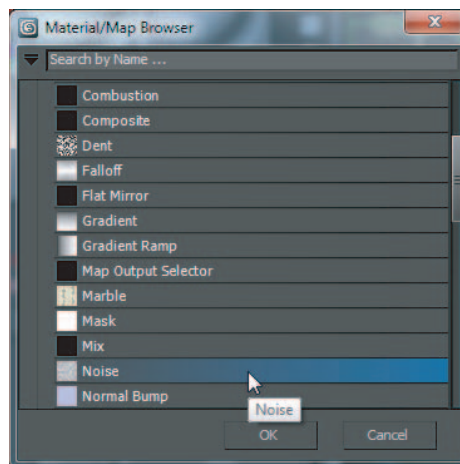
8. With the Noise map added to the material, the parameters for the Noise map appear in the Material Editor, and the effect of the bump map appears in the sample slots, as shown in Figure 8.20.

FIGURE 8.20
The Material Editor
showing the effect
of the bump map
and the Noise
parameters
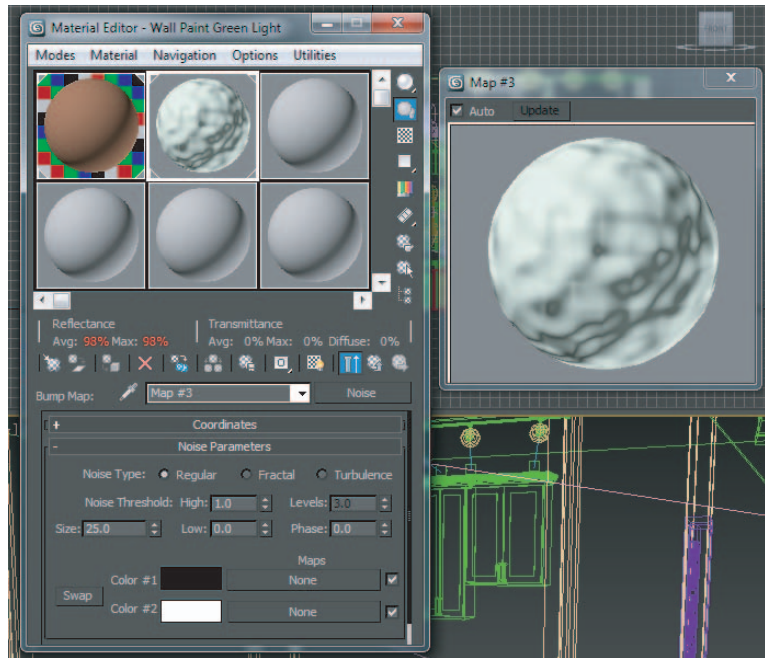
You may recall that a bump map uses varying shades of gray, or the grayscale equivalent when using a color bitmap, to determine the highs and lows of the bumps on a surface. In computer graphics (CG), noise is added to inject randomness into a scene or image, and the Noise map is a procedural map that generates a random pattern of gray tones. As a bump map, the Noise map will produce a random bumpy surface.

With the Noise map added to the material, let's take a look at the walls as they are rendered:

1. Right-click the CamWall viewport, and then click the Render Production button. You see the walls rendered in the Rendered Frame Window, as shown in Figure 8.21.

FIGURE 8.21
The scene after adding the Noise map to the material
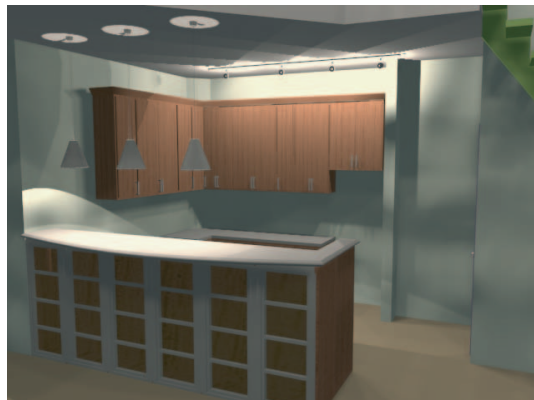
The walls render in a bumpy texture that looks more like a water-damaged, buckling structure than a newly painted wall. This is particularly noticeable on the back wall to the right of the cabinets. You'll want the bumps to be much smaller.

2. In the Noise Parameters rollout, change the Size value from 25.0 to **1.0**. This reduces the distance between each bump. Render the scene again. As shown in Figure 8.22, the bumps are much smaller but still too large; the paint looks more like the surface of an orange than the surface of an interior wall.

FIGURE 8.22
The walls after reducing the Noise map's Size parameter to 1.0
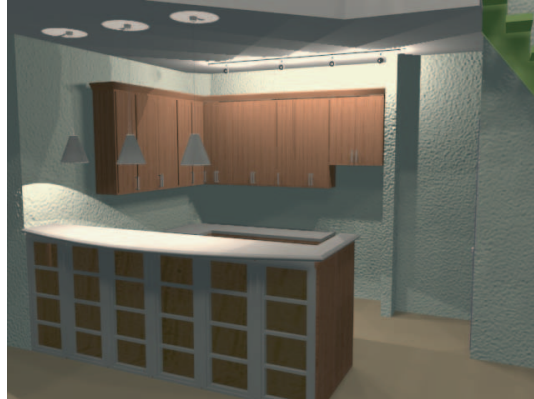
3. In the Noise Parameters rollout, reduce the Size value from 1.0 to **0.1** and then render the scene again. This time, the surface texture is barely noticeable from the current distance to the walls. The size of the bumps is acceptable, but they appear to protrude too far from the wall. You'll fix this by adjusting the intensity of the bump map.

4. In the Material Editor toolbar, click the Go To Parent button.

Think of a material as being constructed of components that are organized into a hierarchy. The bump map is considered a "child" of the material. When you added the bitmap file to the Wall Paint Green Light material, you entered a type of sublevel for the material. The Go To Parent tool brings you back up one level—in this case, to the "main" level of the material's parameters.

5. In the Special Effects rollout, change the value in the Bump input box to **25** and then rerender the scene. This time, the noise pattern appearing on the surface of the walls is slightly more subtle.

Creating a New Material

You've added a wood and a paint material to your model, and you've made a few material modifications. In this section, you'll apply a material to the floor of the condo, but instead of using a preexisting material, you'll create an entirely new one and add a bitmap to define its appearance. The material you create will be fairly simple, but the exercises here will give you a chance to play with some of the settings you haven't tried yet:

1. Open the Material Editor if it is not already open; then click an unused sample slot. You'll use this slot for your new floor material.

2. If necessary, click the Material Type button to the right of the material name, choose Architectural from the Material/Map Browser, and then click OK.

USING THE ARCHITECTURAL MATERIAL

You can use the Architectural material with the Default Scanline Renderer and its Advanced Lighting plug-ins, Light Tracer and Radiosity, and the mental ray renderer. Reflection, Refraction, Radiosity, and Global Illumination parameters are automatically set with this material type.

---

3. In the Material Name drop-down list, change the name to **Floor_Condo_Wood**.

4. In the Physical Qualities rollout, change Shininess to **75** and Index Of Refraction to **1.2**. This causes the material to be shiny and to slightly bend the light that bounces off it.

Notice how the Floor_Condo_Wood sample slot changes. It looks like a sphere with a shiny surface because of the small, tight specular bloom.

5. At the bottom of the Physical Qualities rollout, select the 2-Sided check box to force this material to render on both sides of each face. If some of the surface materials seem to disappear, this setting will force them to appear correctly in the rendering.

SELECTING TWO-SIDED MATERIALS

The 2-Sided option is sometimes needed to correct improper normal orientation in models that have been imported from other 3D programs, particularly CAD programs. This option isn't usually as critical for models built entirely within 3ds Max because the surfaces are usually facing in the correct direction and single-sided materials generally are sufficient.

---

6. Click the None button next to the Diffuse Map label and, in the Material/Map Browser, open the Maps group and then the Standard group. Then double-click Bitmap.

7. In the Select Bitmap Image File browser that opens, navigate to the `C:\Program Files (x86)\Common Files\Autodesk Shared\Materials\Textures\3\Mats` folder. Your actual folder path may vary.

8. Click the `Woods-Plastics.FinishCarpentry.Urethane.jpg` file and make sure the Use System Default Gamma radio button is selected in the Gamma group; then click Open to add it to the Diffuse Map channel of the current material and return to the Material Editor.

9. Right-click the Perspective viewport to make it active if it isn't already, and then click Shading Viewport Label and set the mode to Shaded so that the scene is easier to see for the next step.

10. This time, rather than selecting the destination object and clicking the Assign Material To Selection button, simply click in the material slot and drag it to the floor, as shown in Figure 8.23. A tooltip appears, identifying the object to which the material will be assigned.

FIGURE 8.23
Assigning a material by dragging it into the scene

Click and Drag from here...

...to here.
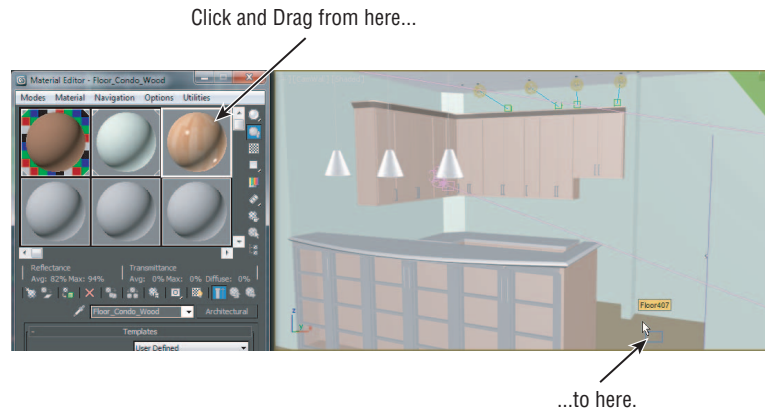
11. You can see in the Shaded viewport that the floor changed from a beige color to gray. This is because the new material you created is still using the default gray color for its Diffuse Color value even though you have a map applied. You will fix that in this next step. On the Compact Material Editor, click the Set Color To Texture Average button that is above the Diffuse Map slot that has the `.jpg` map name in it.

Now the floor of the kitchen appears beige again in the shaded viewport.

12. Render the scene with the floor material added. It's difficult to see any change because the tile pattern is so large it might not be evident.

Try changing the lighting in the scene to see how it affects the materials. Remember that a surface's rendered appearance is the result of the combination of its geometry, lighting, and materials.

Adding Material Mapping Coordinates

If you just want to manipulate the color, transparency, and shininess of an object, you can usually create or use a material that doesn't use bitmaps to simulate a texture. Once you start to add a texture using bitmaps to objects in your scenes, you'll need to specify how that texture is applied to the object. You'll want to tell 3ds Max the size of the texture in relation to the object, as well as its orientation on the object. For example, you wouldn't want the brick pattern to appear with its courses running vertically, as in the example shown in Figure 8.24, nor would you want the brick pattern to be quite so large.

FIGURE 8.24
A brick wall with the brick courses running vertically and at a large scale
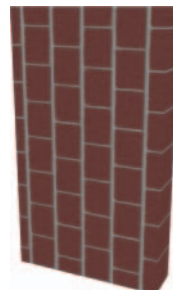
To control how materials are applied to objects, you'll want to know how to use the UVW Map modifier. This modifier lets you control precisely the way a material is placed on an object. In the next exercise, you'll add the modifier to the condo floor to establish the orientation and size of the Floor_Condo_Wood material in relation to the object.

WHAT DOES UVW MEAN?

The *UVW* in the name *UVW map* refers to the coordinates of a material map. They indicate the direction of a map in a way similar to the XYZ Cartesian coordinates with which you're already familiar. The letters *UVW* differentiate map coordinates from the standard XYZ-coordinate designation, and they were chosen simply because they precede XYZ in the alphabet.

UVW map coordinates need to be differentiated from XYZ coordinates because, although they indicate direction similar to XYZ coordinates, they are in relation to the length and width of the image map regardless of the object's orientation in space. UVW coordinates also don't treat measured distances in the same way. In a Cartesian coordinate system, distances are measured at specific intervals of feet, meters, or whatever measurement system you're using. UVW map coordinates, on the other hand, are measured as a percentage of width and height of a surface. Instead of feet or meters, UVW maps use real values from 0 to 1. The value used represents a percentage of the overall width of the surface being mapped, with 1 being equal to 100 percent of the surface width.

Because the coordinate values in a UVW map are based on a percentage, a U value of 0.5 can represent a measured distance that's different from a V value of 0.5. For example, imagine a rectangular surface with a UVW-coordinate system whose origin is the lower-left corner of the rectangle. The upper-right corner of the rectangle would then be the coordinate 1,1, even though the length and width of the rectangle are not equal to each other. This may seem a bit odd at first, but if you consider that material maps are used to match an image to a surface, you begin to see the rationale behind the UVW map system. The relationship between a map and a surface is more important than their actual dimensions. You can think in terms of "What percentage of the surface does the map cover?" rather than "How many square inches does the map cover?"

---

1. Right-click the Top viewport; then use the Zoom Extents tool to zoom out so that your view looks similar to Figure 8.25.

FIGURE 8.25
The condo in the Top viewport
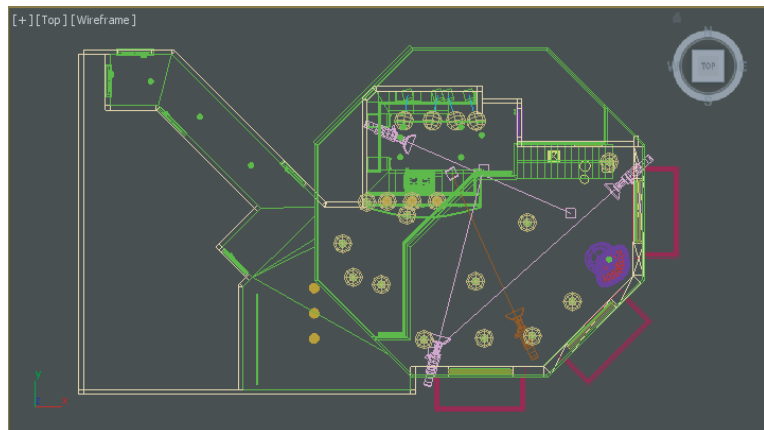
2. Click the Select By Name tool, and use the Select From Scene dialog box to select the Floor407 object.

3. Click the Modify tab of the Command panel, expand the Modifier List drop-down, and then assign the UVW Map modifier to the Floor407 object.

4. In the Parameters rollout, make sure Planar is selected as the mapping type.

5. In the Alignment section, click the Fit button to adjust the gizmo size to match the size of the floor.

Let's take a moment to study the UVW Map gizmo. Click on the plus sign in front of UVW Map in the Modifier Stack to expose its gizmo, and then select Gizmo. When selected, the UVW Map gizmo has one green edge and a small line sticking out on one side. Figure 8.26 gives you a clear picture of what the gizmo looks like. If the map is oriented incorrectly, use the Select And Rotate tool to rotate it properly.

FIGURE 8.26
The UVW Map gizmo assigned to the Floor407 object
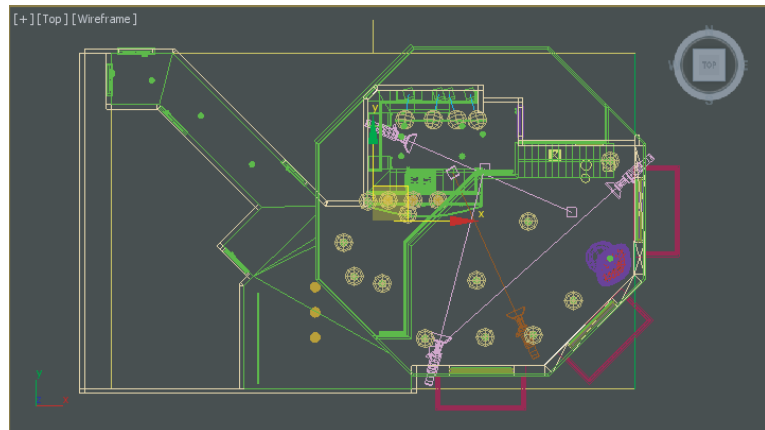
The colored edge and the small line help you orient the UVW Map gizmo to an object by showing you which way is up and which directions are left and right: the short line extending from the frame indicates the top of the image and the green edge denotes the right side. You'll get a more detailed look at the UVW Map gizmo after the current exercise. You can increase the amount of tiling (the number of times a material repeats) two ways: decrease the size of the gizmo or increase the Tile values in the Parameters rollout. Let's continue by adjusting the Tile values to reduce the size of the material on the Floor407 object.

If you were to render the scene now, the `woods&plastics.finishcarpentry.urethane` `.jpg` image would be stretched across the floor a single time and appear pixelated. You'll want to scale the Floor_Condo_Wood material to a size that's more in line with the size of the Floor object by instructing 3ds Max to repeat, or tile, the material several times. Continuing from the previous steps, you will use the UVW Map modifier to improve the appearance of the floor's texture map.

6. In the Mapping section, enter **10** in both the U Tile and V Tile input fields. This causes any material assigned to the Floor object to repeat itself 10 times within the boundary of the UVW Map gizmo.

7. Click the Render Setup button, and on the lower-left corner of the Render Setup dialog box, click the drop-down menu next to View and select Quad 4 – CamWall. Then click the Render button to render the scene. Notice that when you changed the selected view in the Render Setup dialog box, the CamWall viewport became the active viewport. Looking at the completed render in the Rendered Frame Window, the linear pattern of the image map becomes apparent, as shown in Figure 8.27.

   There is one final step that you are going to do to make the floor material pop just a little more. The Architectural materials' Intensity parameter controls the brightness of the material. In the Intensity channel you'll use the same map that you used in the Diffuse color channel.

FIGURE 8.27
Changing the U and V Tile settings causes the diffuse color map to repeat over the surface of the object.
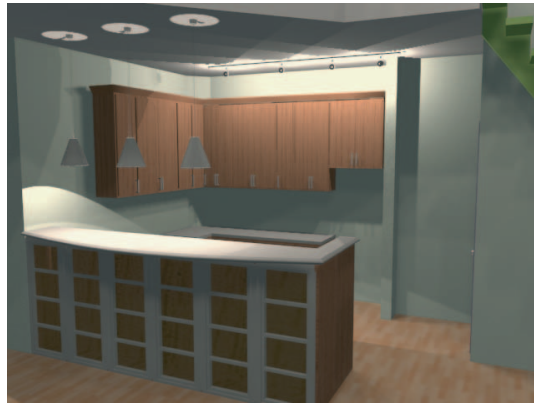
REMOVING BITMAPS FROM MATERIALS

There are several methods for removing a map from a material. While the map's parameters are visible (the Coordinates and Bitmap Parameters rollouts), you can click the Reset Map/Mtl To Default Settings button in the Material Editor toolbar and then click OK in the warning dialog box that opens. You can also click and drag any button labeled None in the Maps rollout and drop it over a button containing a map name to clear the map slot.

---

8. Click the Diffuse Map button, and drag the map to the Intensity button in the Special Effects rollout, as shown in Figure 8.28.

9. In the Instance (Copy) Map dialog box that appears, choose Instance and then click OK. When using the Instance option, changes made to one map are immediately made to the other.

10. Render the scene once more, and you'll see that the wood strips are more defined.

FIGURE 8.28
Dragging a map
from one channel to
another
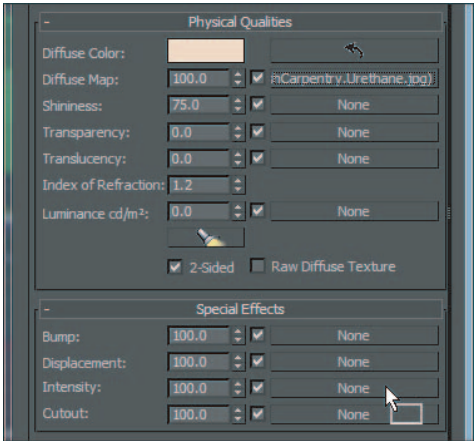
EXPOSING ALL AVAILABLE SAMPLE SLOTS

If your Material Editor displays only 6 or 15 samples, don't worry. You can access the remaining slots by using the vertical and horizontal scroll bars around the slots, or you can expose all of the slots at one time. To expose all of the slots, click the Options button on the Material Editor's vertical toolbar to open the Material Editor Options dialog box.
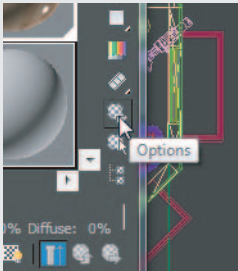
In the Slots area at the bottom of the dialog box, select the 6 × 4 radio button. Click OK to accept the changes; the Material Editor updates to show all 24 sample slots. There is no practical limit to the number of materials in a scene—only the number of materials that can be displayed in the Material Editor is limited.

Understanding Mapping Coordinates

The UVW Map modifier you added in the previous exercise told 3ds Max the size, location, and orientation of the material on the object to which it is assigned. At render time, the image is usually applied to the object in a repeated, or *tiled*, fashion. You can also set a material to apply the bitmap just once. In this section, you'll take a closer look at the UVW Map modifier.

What Happens When You Add the Mapping Coordinates?

The UVW Map gizmo you saw in the previous exercise is a visual representation of the mapping coordinates. Its shape and color are aids in helping you see the bitmap's orientation more clearly. As mentioned earlier, the small line at the top of the icon represents the top of the bitmap, while the green edge shows the right side. These indicators can tell you at a glance whether the bitmap image of the material you are using is upside down or backward in relation to the object to which the coordinates are being applied, as shown in Figure 8.29.

FIGURE 8.29
The UVW Map gizmo in relation to a material bitmap
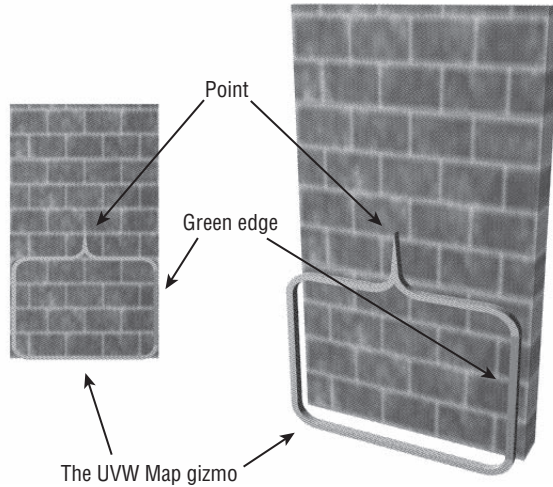
The orientation of the bitmap in the preceding exercise is really not that important, but it can be important for texture maps that do have a specific orientation, such as a brick pattern, or for a single image, such as a wine label or a road sign. The UVW Map gizmo shows the approximate size of the bitmap in relation to the object to which it is being applied. When the model is rendered, multiple copies of the image are applied over the entire surface of the object, like tiles on a kitchen counter.

Figure 8.30 shows another way that the gizmo affects the appearance of a material. You see a brick wall with the gizmo rotated. The bricks are angled and aligned with the UVW Map gizmo.

Adjusting the UVW Map Gizmo

You have a number of options for controlling the size, shape, and orientation of the UVW Map gizmo. These will be crucial to your ability to place materials accurately on an object or an individual face. Here are descriptions of the Alignment group options as they appear in the Command panel:

X Y Z   The X, Y, and Z radio buttons allow you to control along which axis the UVW Map gizmo is projected.

Manipulate   Activates the Select And Manipulate tool. You can also access this tool by clicking the Select And Manipulate icon on the Main Toolbar. The Manipulate option causes the gizmo to turn green and a cursor to appear, like the Select cursor, when it is over the edges of the UVW Map gizmo. Using the Select And Manipulate transform, you can click and drag the edges of the UVW Map gizmo to define the exact size and location for the bitmap.

Region Fit   Lets you fit the UVW Map gizmo to a specific rectangular area. This is useful for situations where you want a texture map to fit exactly over a specific region of an object.

When you choose this option, you can select two points to define the two diagonal corners of the UVW Map gizmo. The process is similar to selecting a zoom region or creating a rectangle. Because this option lets you select any two points, it will stretch and distort the UVW Map gizmo in either the X- or Y-axis. To orient the UVW Map gizmo right side up, pick two points over the region starting with the lower-left corner (see Figure 8.31).

FIGURE 8.30

A sample brick wall with the UVW Map gizmo rotated 30 degrees

The UVW Map gizmo rotated
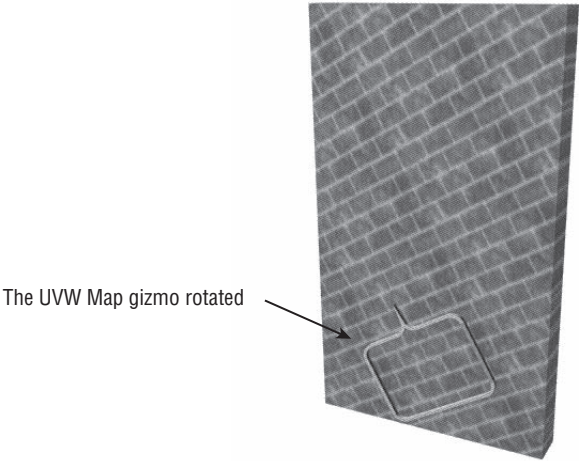
FIGURE 8.31

A Region Fit UVW Map gizmo is placed on a wall in the Front viewport (left). A rendered view is shown with the UVW Map gizmo superimposed on the view (right)

Click here first.   Then click here.

Drag to form a region.

The location of the UVW Map gizmo in relation to the final rendered surface.
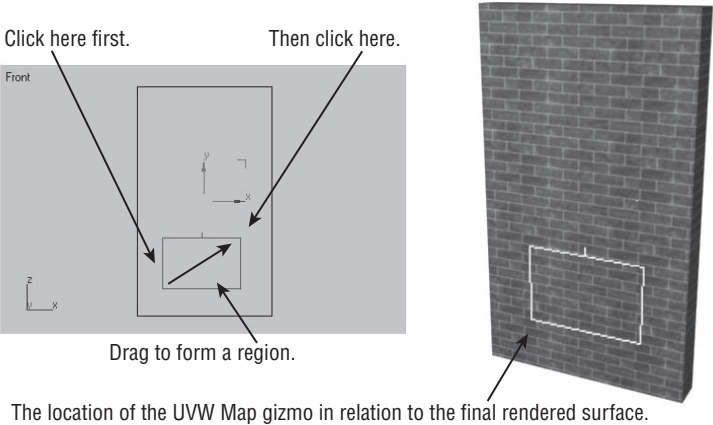
Bitmap Fit   Adjusts the UVW Map gizmo's proportion to fit the shape of a particular bitmap image. This option uses the current UVW map size, and it alters the proportions to fit the bitmap proportions. The option is helpful if you want the bitmap to be displayed accurately in its original form. It also helps if you want a better idea of the bitmap's shape as you assign the mapping coordinates to objects.

View Align   Aligns the UVW Map gizmo to a viewport. This option can help you locate a UVW map or quickly align it to a viewport.

Fit   Stretches the UVW Map gizmo over the surface of an object to make it fit exactly.

Center   Centers the UVW Map gizmo on an object's surface.

Acquire   Sets the UVW Map gizmo to match the mapping coordinates of an object that already has mapping coordinates assigned to it.

Reset   Resets the UVW Map gizmo to the 3ds Max default size and orientation.

Normal Align   Aligns the UVW Map gizmo to the normal of a surface of the object to which the mapping is attached.

CONTROLLING THE TILING EFFECT

When you added the Floor_Condo_Wood material to the Floor object and increased the number for the U and V Tile parameters, the wood striping pattern appeared at a smaller scale and was repeated over the entire surface of the floor in a rectangular array. This repetition of the map is called *tiling*. If you've ever experimented with the Windows Desktop wallpaper, you may already be familiar with the idea of tiling.

Tiling is on by default, but you can turn it off for situations when you want only a single image to appear over the surface. Figure 8.32 portrays the same brick wall shown in Figure 8.31, but this time the Tile option is turned off. The brick pattern appears only in the region defined by the UVW Map gizmo. The rest of the wall surface is rendered based on the Basic Parameters rollout settings of ambient, diffuse, and specular color.

FIGURE 8.32
The brick wall rendered with the Tile option turned off
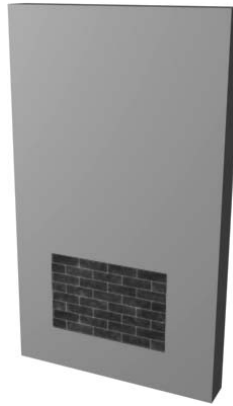
The Tile settings are located in the Material Editor and can be controlled or turned on/off there as well. Here's how to locate the tiling parameters:

1. Open the Material Editor.

2. With the Floor_Condo_Wood material selected, scroll down the list of rollouts and open the Physical Qualities rollout if it isn't already open.

3. Locate the map you want to adjust; then click its button. For example, for the Floor_Condo_Wood material, click the Diffuse Map button labeled `Woods-Plastics.FinishCarpentry.Urethane.jpg` (the button displays as much of the name as it can). The parameters for that particular map display in the Material Editor.

4. Open the Coordinates rollout, and locate the Tile check boxes, as shown in Figure 8.33. You can click the U and V Tile check boxes to turn off tiling. Don't change this setting for your condo model, however—you want to keep the tile setting turned on.
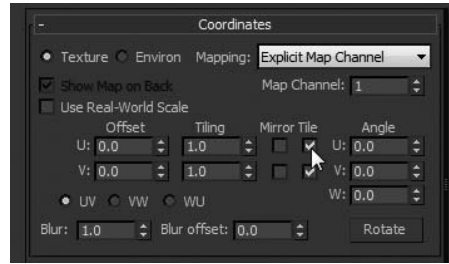
Understanding the Different Types of Mapping

When you first apply the UVW Map modifier to an object, 3ds Max uses its default *planar map type*. As you might guess from its name, this map type maps the bitmap image to a plane, or flat surface, as shown in Figure 8.32. This option projects a flat image onto a surface. The orientation of the UVW Map gizmo in relation to the object affects the appearance of the material. Figure 8.34 shows how the same texture map can be projected onto a box with different effects.

FIGURE 8.34
A box with mapping coordinates oriented in different ways. The texture map is identical in each example.
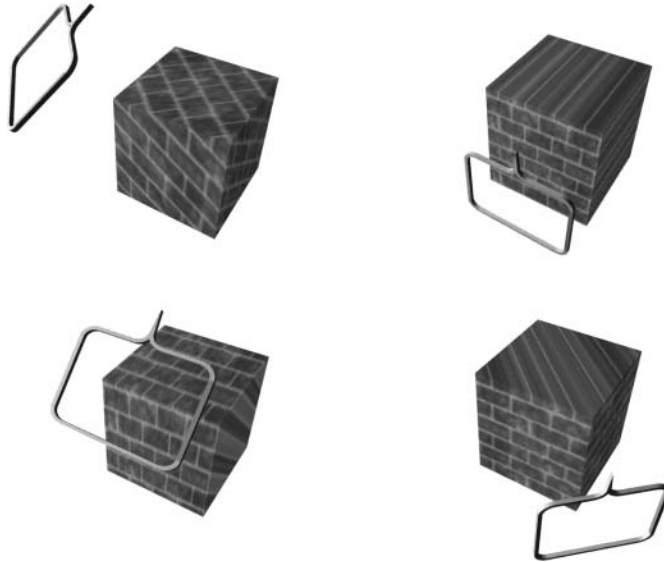
As you can see from Figure 8.34, you aren't limited to using a planar map that's parallel to the surface you are mapping. You can create some interesting effects by reorienting the UVW Map gizmo. The streaking that you see on the boxes is the color of the edge pixels projected across the faces that run perpendicular to the gizmo.

But what do you do if you want to map an image to a cylindrical or spherical object? 3ds Max offers several other mapping types to facilitate mapping to nonplanar surfaces.

If you look at the Parameters rollout for the UVW Map modifier, you see these mapping options: Planar, Cylindrical (with or without Cap), Spherical, Shrink Wrap, Box, Face, and XYZ To UVW.

The *cylindrical map* curves the bitmap into a cylindrical shape, and then it projects the map outward from the center of the cylinder. Naturally, you would use this type of mapping on cylindrical objects. You will want to place such a map in the center of the object. The Cap option places the map on the end caps of the gizmo, similar to the Planar option.

When you choose this map, the UVW Map gizmo changes to a cylindrical one, as shown in Figure 8.35. You would then place this map in the center of a cylindrical object and assign it to the object. You can also distort the map by moving the UVW Map gizmo closer to one side or the other or rotating the map so that it isn't aligned with the object.

FIGURE 8.35
A view of the UVW Map gizmo when using the Cylindrical mapping type, along with a sample of an object that uses this mapping type

Bitmap   Cylindrical UVW Map gizmo   Rendering
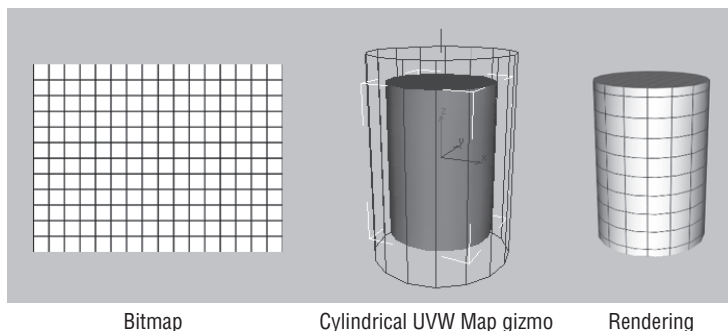
Spherical mapping curves the bitmap into a spherical shape. To understand how it works, imagine taking the rectangular bitmap image and curling it around a spherical shape; then squeeze the top and bottom ends of the bitmap like a candy wrapper (see Figure 8.36). One use of this mapping type is to portray the surface of a planet. You could use the spherical mapping type to place a flat map of the earth on a sphere.

FIGURE 8.36
The Spherical mapping type wraps the bitmap around a sphere.

Bitmap   Spherical UVW Map gizmo   Rendering
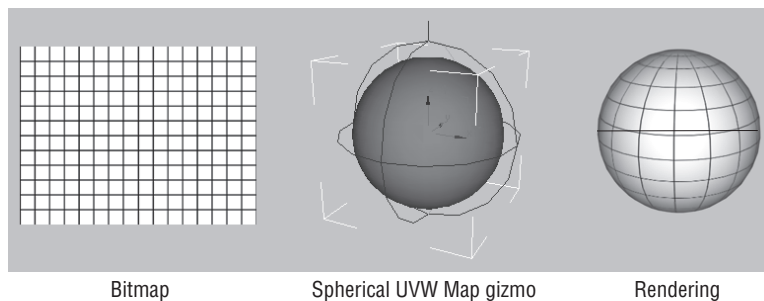
As with the Cylindrical mapping type, the UVW Map gizmo changes to a different shape when the Spherical mapping type is chosen, as shown in Figure 8.36. You would align this gizmo to the center of the spherical shape that requires mapping.

Shrink Wrap is similar to Spherical, but instead of wrapping the image around a sphere, as shown in Figure 8.37, imagine wrapping a sphere in plastic wrap with the bitmap image tied at one end. Figure 8.37 shows a rendering using the same sphere and bitmap texture as in Figure 8.36. The

only difference is that the sphere in Figure 8.37 uses Shrink Wrap mapping instead of the Spherical mapping of Figure 8.36.

FIGURE 8.37
A sample of Shrink
Wrap mapping
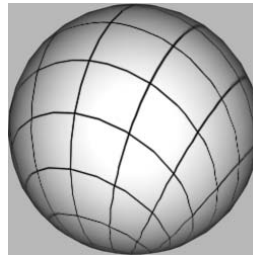
Box mapping is similar to planar mapping, but it projects the image onto six sides, as shown in Figure 8.38, instead of a single plane. You may find that you use box mapping the most, especially if your work involves buildings.

FIGURE 8.38
Box mapping

Box UVW Map gizmo   Rendering with a grid bitmap
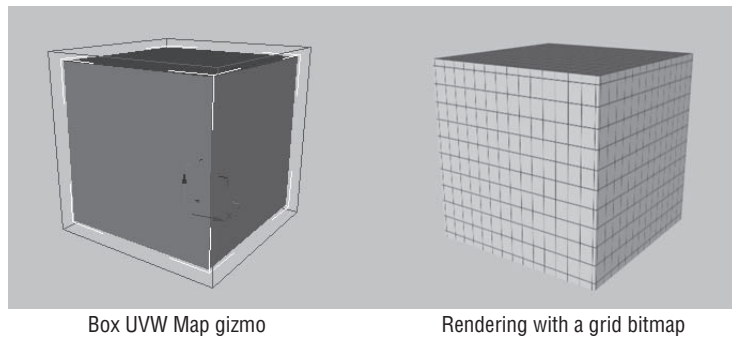
Face mapping is similar to box mapping, but instead of projecting the image from a box-shaped gizmo, face mapping projects the image onto each individual face of an object. This is easiest to see in a faceted object, such as the Sphere primitive set to 12 segments shown in Figure 8.39.

FIGURE 8.39
Using face mapping
on a sphere
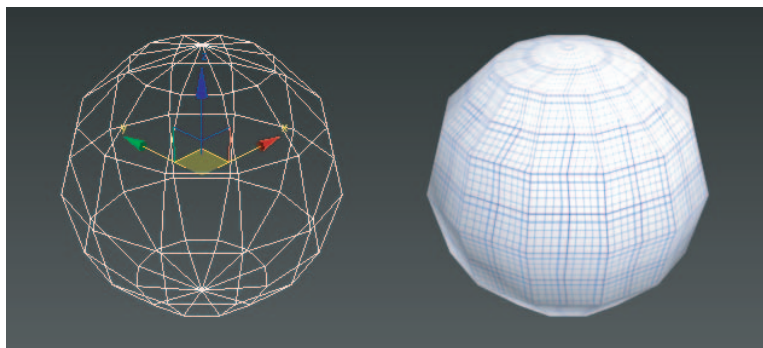
Even if smoothing is used to smooth out the surface of an object, face mapping will project the image onto the individual faces of the object.

XYZ to UVW mapping is mainly used for *procedural maps*. A procedural map is a map that relies on a mathematical formula rather than a bitmap image. The XYZ to UVW map aligns a procedural map to the local coordinates of the object to which it is assigned. This has the effect of *sticking* the map to the object so that, if the object is stretched nonuniformly, the map will stretch with the object as if the map were a rubber sheet stretched over the object.

Although we've suggested that you use each map type with its corresponding object shape, you can achieve some unusual effects by mixing map types with different surfaces. For example, if you use a planar map on a cylinder, the image is stretched as it is projected toward the edge of the cylinder, as shown in Figure 8.40.

FIGURE 8.40
A sample of planar mapping used on a cylindrical surface

Planar UVW Map gizmo   Rendering
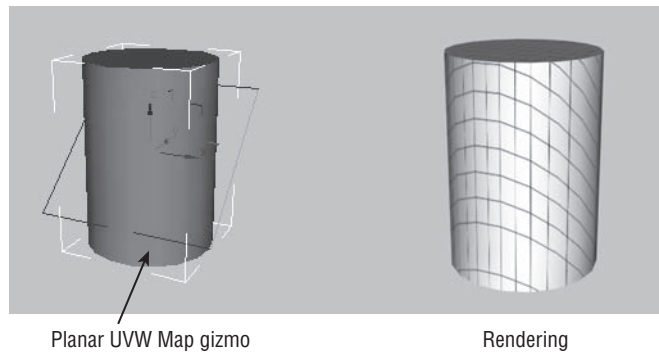
Just below the Mapping radio buttons in the Parameters rollout are the Length, Width, and Height input boxes. As you might guess, these options let you enter numeric values for the length, width, and height of the UVW Map gizmo. Their spinners also let you graphically adjust the size of the gizmo.

Finally, if you want to modify the tiling of the bitmap image within the area defined by the UVW Map gizmo, you can do so using the U Tile, V Tile, and W Tile input boxes at the bottom of the Parameters rollout.

These options are set by default to 1.0, causing a single image to appear within the area of the UVW Map gizmo. You can produce multiple images within the gizmo area by increasing the values in these input boxes. This offers a quick way of increasing the density of the tiled image without having to enter the Material Editor window. Figure 8.41 shows the same brick wall displayed in Figure 8.31, but this time the U and V Tile settings have been changed to 2.

FIGURE 8.41
The brick wall sample shown with the U and V Tile parameters set to 2
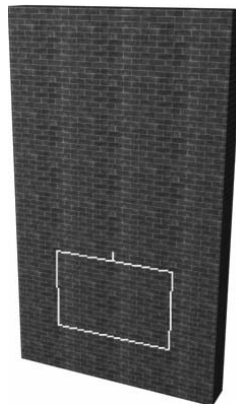
You can also increase the tiling within the Coordinates rollout of the bitmap in the Material Editor. Changes made there affect all objects with the material assigned. In contrast, changes made in the Parameters rollout of the UVW Map modifier affect only the selected object and any instances of that object. The Flip check boxes at the end of each Tile parameter allow you to flip the orientation of the material in each axis.

The Real-World Map Size option is designed to facilitate the implementation of materials where the map relates to a physical scale in the scene. In the Material Editor, when the Use Real-World Scale option in the Coordinates rollout is used, you can specify in scene units how large the map is. For example, a map showing two courses of concrete block may be given the real-world measurement of 16″ × 32″. After assigning the material to an object with the UVW Map modifier applied, use the Real-World Map Size option to scale the gizmo to the map's assigned size.

These mapping coordinate tools give you a high degree of control over the way your material assignments affect your model. As is the case with many 3ds Max tools, your skill in using them will develop over time. As with any craft, practice makes perfect.

THE GENERATE MAPPING COORDINATES OPTION

Many of the 3ds Max objects you encounter will have a Generate Mapping Coords check box active as one of their default parameters. This offers another method for applying mapping coordinates.

The Generate Mapping Coords option applies a sort of custom mapping coordinate to standard primitives. For example, if you create a Box standard primitive and select Generate Mapping Coords in the box's Parameters rollout, materials mapped to the box will behave as if the Box mapping option of the UVW Map modifier were applied to the box. A Sphere primitive with the Generate Mapping Coords option selected will behave as if spherical mapping were applied. As an added benefit, the mapping will conform to any changes applied to the shape of the object. If a box's width is increased, the mapping coordinates will automatically follow the width change (although this may actually be undesirable for some types of material, such as brick or tile).

You have less control over the mapping coordinates with the Generate Mapping Coords option, because objects that use it don't have an adjustable UVW Map gizmo. However, you can still control the UVW tiling to adjust the density of the map over the object. You can do this in the Material Editor's Coordinates rollout for the map with which you are working.

In the case of a lofted object, the Generate Mapping Coords option is the only way to apply a material that will conform to a loft's unusual shape. If you apply a UVW Map modifier, the modifier will take control over the mapping coordinates.

Note that imported objects, such as those found in Autodesk® AutoCAD® files, don't have a Generate Mapping Coords option. They require a UVW Map modifier whenever bitmap materials are applied.

Using the Standard Material

Much of this chapter has centered on the Architectural material. The Architectural material is the default material in 3ds Max 2013 when using the DesignVIZ initial settings in the Custom UI and Defaults Switcher. Each Architectural material can represent one of many real-world materials often found in a residential, office, or retail setting. When using 3ds Max 2013 with the Max standard default initial settings, the Standard material is the default. The Standard material provides many opportunities to create new and exciting materials by setting many different

parameters and accessing several different material-specific map channels that can each hold a unique map to help define a material's appearance. The overall appearance of a Standard material is determined by the shader it uses.

Shaders are a set of methods 3ds Max uses to render materials. When you create a new material, one of the main features you need to determine is which shader to use. Walls are usually matte surfaces, so the wall material should use a shader that's best suited to such a surface. Baseboard and trim might have a semigloss paint, in which case you should select a different shader to simulate the shiny surface.

As you work with the Material Editor, you'll notice that you have a set of options under the Shader Basic Parameters rollout. You can think of shaders as different rendering methods applied to objects when they are rendered. Each shader provides a different way that the primary components of a material (the ambient, diffuse, and specular colors, for example) are blended together, as shown in Figure 8.42.

FIGURE 8.42
The basic areas defined by the Ambient, Diffuse, and Specular settings

Specular   Diffuse   Ambient
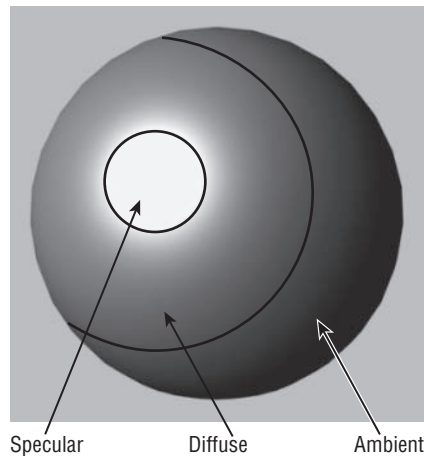
When the material type is set to Standard, the primary shader options are found in the Shader Basic Parameters drop-down list. This list offers eight shaders: Anisotropic, Blinn, Metal, Multi-Layer, Oren-Nayar-Blinn, Phong, Strauss, and Translucent Shader.

Don't let these strange-sounding names scare you off. They are just different methods that 3ds Max uses to render specular highlights and diffuse and ambient lighting on objects. You choose a shader depending on the type of material to which you are assigning the highlights or lighting. Here's a rundown of the shaders and their specialties:

Anisotropic   Measures the difference of shininess from different angles and renders highlights accordingly. The highlight can be oblong rather than round, and you have control over the highlight's shape and orientation. This shader is best used for shiny objects.

Blinn   Offers a softer highlight than Phong, particularly for objects with which you want to show highlights from lights bouncing off at low angles.

Metal   A shader designed for metallic objects. It is specifically designed to simulate the characteristics of light bouncing off a metallic surface. There is no specular swatch to

modify; materials using the Metal shader use the same color for specular highlights that they use as the diffuse color.

Multi-Layer Similar to Anisotropic, but it offers more control, including a second specular highlight. It's especially useful in controlling highlight effects, which makes it highly appropriate for shiny objects.

Oren-Nayar-Blinn Offers a high degree of control over the effects of diffuse lighting on an object. It's especially useful for matte, soft, or rough objects.

Phong Offers a general shader for smooth, uniform surfaces, and it can be used as an all-purpose shader.

Strauss Similar to the Metal shader but with fewer, simpler controls.

Translucent Shader Similar to the Blinn shader but with the additional option of translucency. You can use this shader to simulate frosted glass or any situation where a projected light should pass through a material.

When you select one of these shaders from the Shader Basic Parameters drop-down list, the Basic Parameters rollout will change to offer options specifically geared toward that shader. You may want to stick with one or two of these shaders to start out and then experiment with others as you become more familiar with 3ds Max. By offering these shaders, 3ds Max gives you more control over the way objects look and also makes its own rendering faster.

There are four more options in the Shader Basic Parameters rollout that you can add to your material to control its final appearance:

Wire Renders an object as a wireframe with the object's edges appearing as lines. You can control the thickness of the wires in the Extended Parameters rollout.

2-Sided Forces a material to render on both sides of each face so that the appearance of a surface is not dependent on its normal.

Face Map Causes the assigned bitmap to appear on each face of an object in a way similar to the Face Map parameter found in the UVW Map Modifier's Parameters rollout.

Faceted Discards any smoothing between adjacent faces, which causes objects to be rendered as faceted.

Map Scalar Modifiers

You have seen how you can map materials to objects by generating mapping coordinates (in the case of primitives, this is built in) and by applying the UVW Map modifier. You have also seen how to fine-tune the tiling of a bitmap in the Coordinates rollout in the Material Editor. However, there is another way to approach the issue of mapping materials—using one of the Map Scalar modifiers.

In most cases, map scalars can be used to simplify the issue of mapping. Use the other options if you want greater control, but try Map Scalar first, because it usually works great.

The *Map Scalar Object Space modifier (OSM)* provides a simplified way to map materials that will scale with the object. The older *Map Scalar World-Space Modifier (WSM)* is also available for those occasions when you want the map size to be bound to absolute world scale.

1. Save your Condo scene as **MyCondoMaterials.max**, and open the sample file
   C08_Mapping.max (see Figure 8.43).

FIGURE 8.43
Mapping sample
cubes
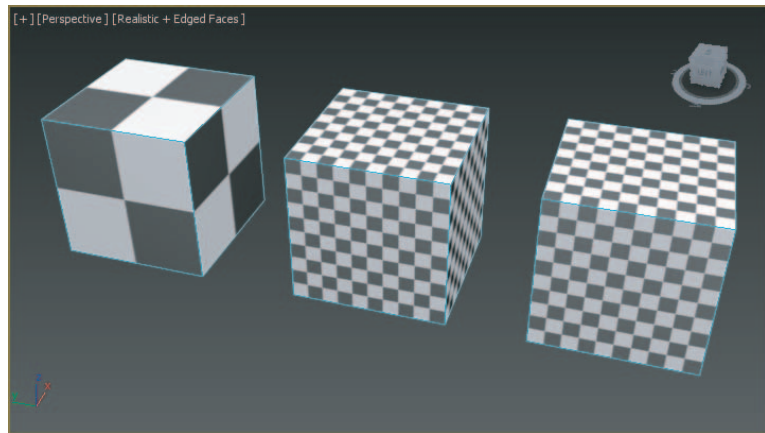
The sample file contains three 5′ cubes that all share the same material. The applied mate-
rial is using a Checker map in the Diffuse Map slot that is set to tile once in each texture
direction, U and V. The pattern that is mapped consists of four squares, alternating white
and black, which makes a larger square, as shown in Figure 8.44.

FIGURE 8.44
The mapped
pattern
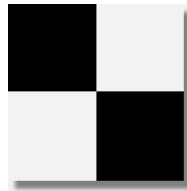
2. Select the first cube on the left, and switch to the Modify panel. Note that the modifier
   stack shows that this Box object has a UVW Map modifier applied with the Box mapping
   type selected.

3. The pattern shown in Figure 8.44 appears on each of the six faces of the cube because Box
   mapping was selected in the UVW Map modifier. In the Parameters rollout, change the V
   Tile parameter to **3**. The checker pattern now repeats three times in one direction on each
   face of the cube.

4. Select the middle cube. Observe how its modifier stack shows a Box object with the
   Map Scalar Binding (WSM) modifier applied. In this case, WSM stands for World-Space
   Modifier, meaning that the effects of the map scalar are bound to the absolute size of the
   system units. Both Map Scalar modifiers apply box mapping automatically, so you see the
   pattern tiling on each of the six faces of the cubes.

5. Change the Scale parameter of the Map Scalar Binding (WSM) to **2′ 6″**.

Observe how the pattern from Figure 8.44 is tiled exactly twice on each surface of the middle cube, as shown in Figure 8.45. This occurs because the cube's edges measure 5' and the pattern is bound to precisely half that size in World Space of 2' 6".

FIGURE 8.45
Map Scalar tiles the map to a specific size.
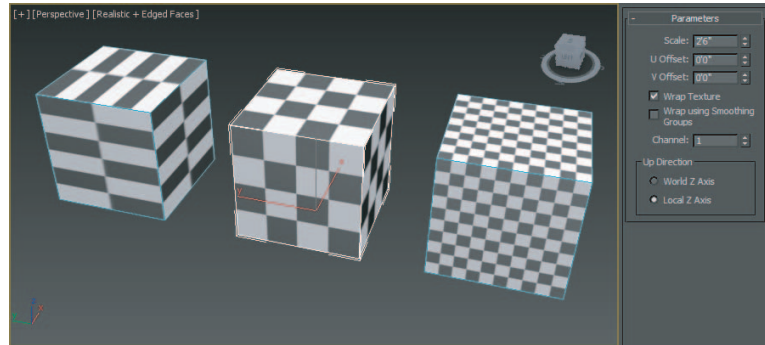
Use one of the Map Scalar modifiers when you want to bind your mapping to a specific size.

6. Select the cube on the right. Observe how its stack shows a box with the *Map Scalar (OSM)* modifier applied. OSM is an object-space modifier, meaning that its scale is based on the object's transform scale.

7. Change the Scale parameter of the Map Scalar OSM to **2' 6"**. The pattern tiles twice, just as the WSM version did earlier.

8. Select all three cubes, and scale them down to 50 percent of their current size.

Figure 8.46 shows the result. The left cube's pattern gets smaller with the object, but it maintains the same nonuniform tiling. The middle cube's pattern remains the same size as the object gets smaller because its Map Scalar is bound to World Space. The right cube's pattern gets smaller as the object is scaled because its Map Scalar works in Object Space, and it is subject to the same transforms as the object itself.

FIGURE 8.46
Scaling the objects reveals the difference between WSM and OSM modifiers.

UVW Mapping maintains nonuniform tiling when it is scaled.

Map Scalar (OSM)'s pattern scales with the object.

Map Scalar Binding (WSM) maintains the size of the pattern when it is scaled.
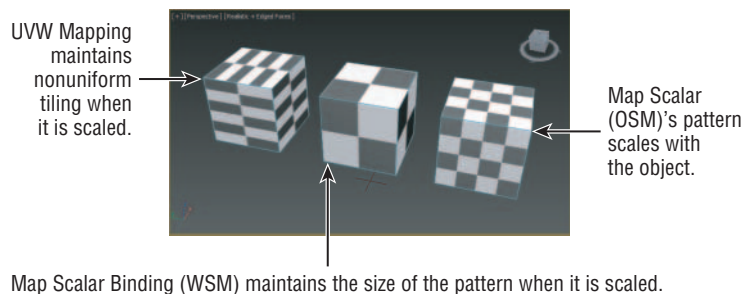
9. Save your scene as **MyMapping.max**.

Spline Mapping

The Spline Mapping tool is used for applying UVW mapping coordinates to irregularly shaped spline-like objects—such as piping or wiring and flat surfaces that have curvature, like paths or architectural archways.

In the next exercise, you will use the Spline Mapping tool to apply a brick paving material to a walkway around the Notre Dame du Haut Ronchamp Chapel:

1. Open the C08_SplineMapping.max file that you downloaded from the book's website.

2. Activate the Top viewport, if it isn't already active.

3. Press F3 to change the viewport to Wireframe display mode.

4. Hold down the Ctrl key, and click the Path object and the Path Spline.

5. Press Alt+Q to isolate the two objects you have selected.

6. In Isolation mode, press F3 again so that you can see the texture. Notice that the brick texture is not following the contours of the path, as shown in Figure 8.47. (The image is zoomed into the end of the path for clarity.)

FIGURE 8.47
The brick texture not flowing with the curved pathway
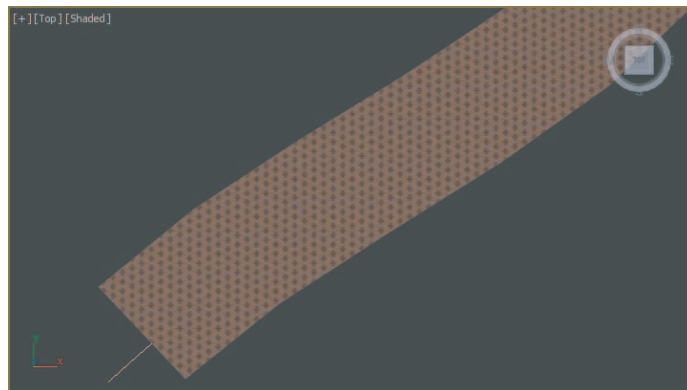
To make it easier to understand what is happening, you'll switch the brick to a checker pattern while applying the spline mapping.

7. On the Rendering menu, choose Material Editor ➢ Compact Material Editor.

8. In the Material Editor, choose the Checker Test material; it's the second material from the left on the top row.

9. In the viewport, select only the Path object and then apply the Checker Test material to the Path object. Your viewport should look similar to Figure 8.48. You will have to zoom in really close on the path to see the checker pattern.

10. On the Modify panel, add an Unwrap UVW modifier to the Path object. Expand the Unwrap UVW modifier, and choose the Face level.

11. Press Ctrl+A to select all the faces in the path, and click Zoom Extents Selected. Your viewport should look like Figure 8.49.

12. Scroll down to the Wrap rollout, and click Spline Mapping.

FIGURE 8.48
The Checker Test material not flowing with the curved pathway
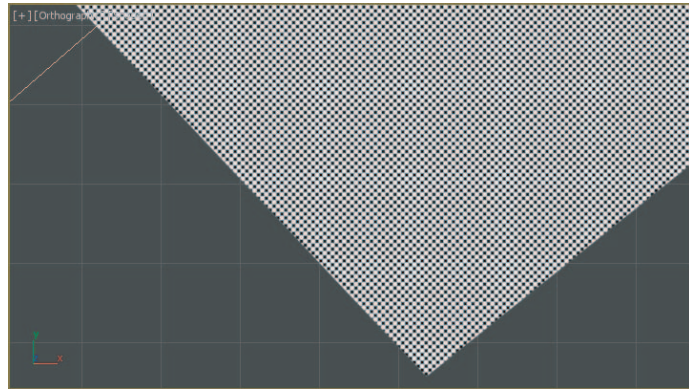
FIGURE 8.49
Select all the faces of the Path object in the Unwrap UVW modifier.
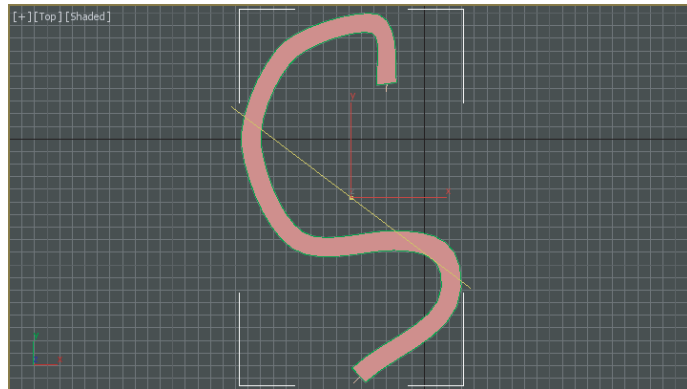
13. In the Spline Map Parameters floater, choose Pick Spline and then select the Path Spline object, which is sticking out of the end of the Path object. Change the Mapping type to Planar in the Spline group, as shown in Figure 8.50.

FIGURE 8.50
Set the Spline Map Parameters options.
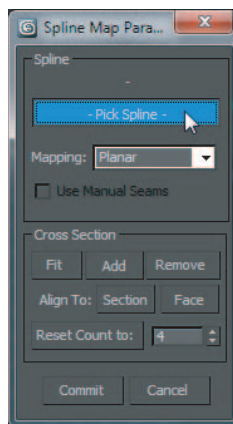
The checker pattern on the spline should dramatically change.

14. Press F2 to toggle the red selected faces display off. Also, in the modifier stack, click Unwrap UVW to move out of sub-object level (Figure 8.51).

FIGURE 8.51
The Checker Test material spline mapped on the Path object
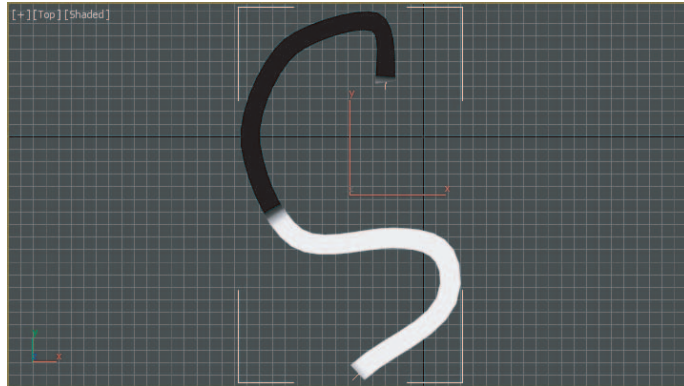
15. On the Compact Material Editor, click the Diffuse Color map to navigate to the Coordinates rollout of the checker texture. Turn off Use Real-World Scale, and adjust the U and V Tiling while observing the effect. Changing the U Tiling value to 2 and the V Tiling value to 12 clearly shows the checker following the path contours now, as shown in Figure 8.52.

FIGURE 8.52
The result of adjusting the U and V Tiling on the Checker Test material
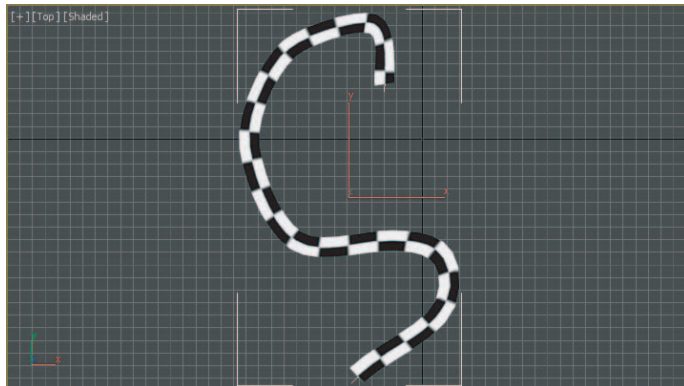
16. To exchange the checker pattern with a bitmap, click the Material Type button to open the Material/Map Browser and then double-click Bitmap. In the Select Bitmap Image File dialog box, navigate to C:\Program Files (x86)\Common Files\Autodesk Shared\ Materials\Textures\3\Mats, and choose Masonry.Unit Masonry.Brick.Modular. Herringbone.jpg. Make sure that Use System Default Gamma is selected, and click Open.

17. Turn on Show Shaded Material In Viewport.

18. Adjust the U and V Tiling to your taste. Zoom in if necessary so that you can see a better view of the mapping, as shown in Figure 8.53.

FIGURE 8.53
Adjust the U and V parameters of the brick material.
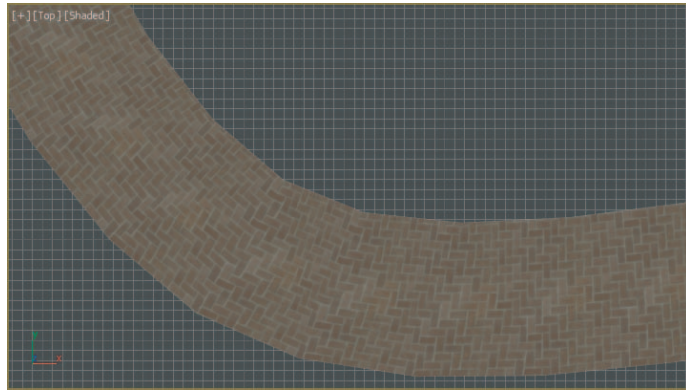
19. Save your file as `MySplineMapping_Completed.max`. Click the Exit Isolation button, change the view to Perspective view, or add a camera to the scene and render it to see the results.

As you saw in the previous exercise, the Spline Mapping feature of the Unwrap UVW map modifier makes mapping paved paths, striped roadways, piping structures, snake-like creatures, or other spline-like objects easier to map.

Adding Entourage

Entourage is a term taken from traditional architectural rendering. It refers to photographic "extras" that are added to a rendering to make it appear more realistic. You can think of entourage as cutouts or props that are added to the scene to make it more lifelike and help define the scale of the scene. Examples of entourage are people, trees and plants, cars, street furniture, and signs. Entourage is not composed necessarily of 3D models, however. As 2D photographic elements, they can be handled mainly through materials.

The key to designing an entourage material is to use an opacity map to hide unwanted portions of the surface to which the texture is mapped. Generally, entourage materials are applied to Plane or Box primitives that act like flat billboards, displaying their contents for the world to see. Once you apply an opacity-mapped material to an object, it is also important to adjust the object to fit the bitmap's aspect ratio or undesirable stretching will occur.

Hiding Unwanted Surfaces with Opacity Maps

An opacity map is a grayscale bitmap image that tells 3ds Max which part of the surface is opaque and which part is transparent. The black portions of an opacity map become completely transparent, whereas white is completely opaque. Shades of gray create varying degrees of opacity.

To see how this works, look at Figure 8.54. To the left you see an opacity map. The middle figure shows a simple box in 3ds Max without a material assigned to it. The figure to the far right

shows the same box that is assigned a material using the opacity map (or a cutout map) at the left. Notice that the portions of the opacity map that are black appear invisible in the box.

FIGURE 8.54
An opacity (cut-out) map and an object to which it is assigned

Opacity map   Object   Object with Opacity
                                               map material applied
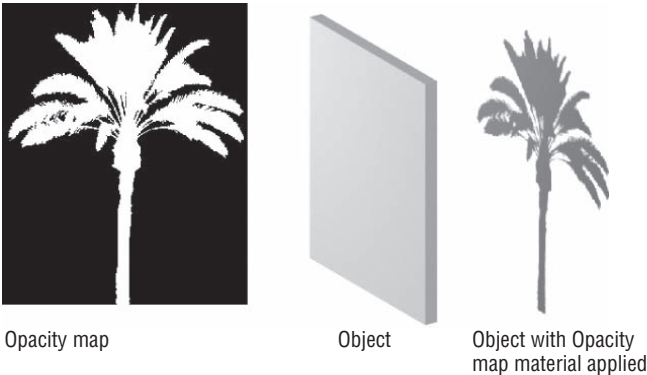
You can also use shades of gray to simulate a semitransparent material or to change the transparency of a surface gradually. Color images can be used for opacity maps as well, although the color information is not used—only the pixel grayscale value is considered.

Now that you understand what opacity maps are, let's design a tree material that you can apply to Plane objects to use as entourage. While doing this, you'll also have a chance to explore the workflow for using the Slate Material Editor.

1. Exit and restart 3ds Max. To open the Slate Material Editor, select the Rendering menu and choose Material Editor ➢ Slate Material Editor. Alternatively, on the Main Toolbar there's a flyout that lets you choose between the Compact and Slate Material Editors if you'd rather use an icon.

2. Right-click in the View1 window of the Slate Material Editor, and choose Materials ➢ Standard ➢ Architectural.

3. Right-click the top bar of the material, as shown in Figure 8.55, and rename this material **Magnolia**. Then click OK.

FIGURE 8.55
Rename the new material Magnolia.
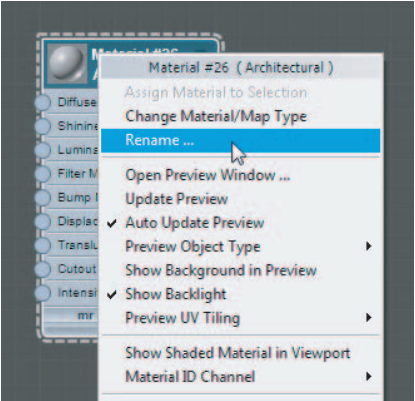
4. Right-click in an empty area of the View1 window of the Slate Material Editor, and choose Maps ➤ Standard ➤ Bitmap to open the Select Bitmap Image File dialog box.

5. In the Select Bitmap Image File dialog box that opens, navigate to and select the `magnoliaIM.jpg` file that you downloaded from the book's website as your diffuse color image, and click Open.

6. Click and drag from the gray circle on the edge of the Bitmap node, called the output socket, in the View1 window to the gray circle next to Diffuse Map, called an input socket, on the Magnolia material, as shown in Figure 8.56. You may have to click and drag the Bitmap node to be able to access both sockets.

FIGURE 8.56
Connect the Bitmap node to the Diffuse Map channel.
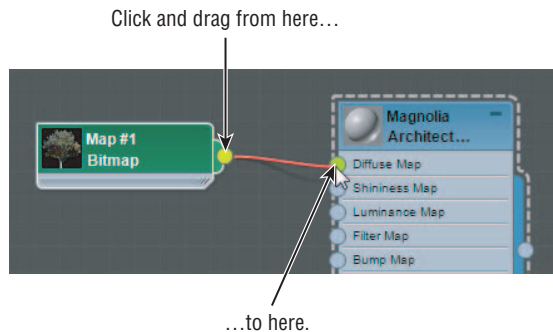
You have just wired the `MagnoliaIM.jpg` bitmap to the Diffuse Map channel of the entourage material.

7. Double-click the Bitmap node to display its properties in the Parameter Editor section of the Slate Material Editor.

8. Deselect the U and V Tile boxes.

9. Dial the Blur value down to as low as it will go, 0.01. This will make the texture look as sharp and detailed as possible in your renderings.

10. Change the Preview Object Type to a box by right-clicking the Magnolia material node and choosing Preview Object Type ➤ Box, as shown in Figure 8.57.

FIGURE 8.57
Changing the material Preview Object Type
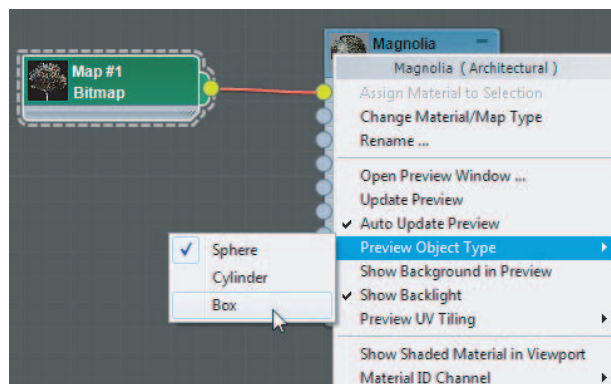
11. Right-click the Material node, and click Open Preview Window to see a larger version of the material sample. This opens a small dialog box, similar to the Magnify window of the Compact Material Editor, which can be resized and which updates with any parameter changes made to the material, as shown in Figure 8.58.

FIGURE 8.58
The Slate Material
Editor preview
window
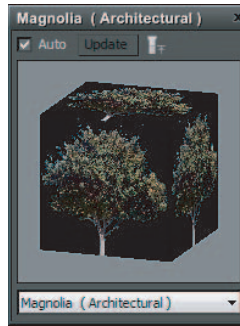
What is really useful about the Slate Material Editor preview window is that you have one preview window that can show the currently selected material/map, a specific material in the Active View window, or any maps in the active view using the drop-down at the bottom of the dialog box, as opposed to the Magnify window of the Compact Material Editor, which displays only the material you selected.

12. Right-click in the Active View window, choose Maps ➢ Standard ➢ Bitmap to open the Select Bitmap Image File dialog box, and select the `magnoliaOP.jpg` file, as shown in Figure 8.59. You see the sample image of the `magnoliaOP.jpg` file in the lower-right corner of the dialog box.

This file is similar to the `magnoliaIM.jpg` file, but it has been reduced to black and white and shows only the silhouette of the tree. The tree is white, and everything else is black. You can also use the alpha channel of some image formats to store the grayscale opacity data.

13. Click Open, and the new Bitmap node is added to the View1 window.

14. Click and drag from the gray circle on the new Bitmap node's output socket, and wire it to the input socket next to Cutout Map, as shown in Figure 8.60.

15. Double-click the Bitmap node wired to the cutout map to open it in the Parameter Editor section of the Slate Material Editor.

16. Select the Coordinates rollout, and deselect the Tile boxes for U and V. Notice what happens to the preview window. Now you see the tree without the black background. The change in the sample can sometimes be subtle.

17. Right-click the Magnolia material node, and select Show Background In Preview. This might make the cutout material easier to see in the preview window.

18. On the Slate Material Editor toolbar, click the Hide Unused Nodeslots icon, as shown in Figure 8.61. This will reduce the size of the material tree in the Active View window (see Figure 8.62).

FIGURE 8.59
Selecting the opacity map
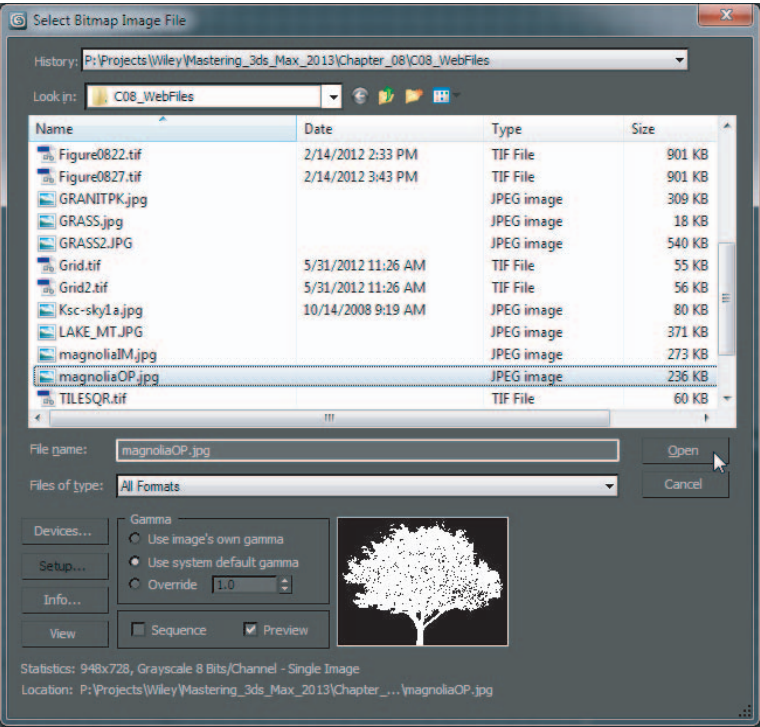
FIGURE 8.60
Wire the cutout map.
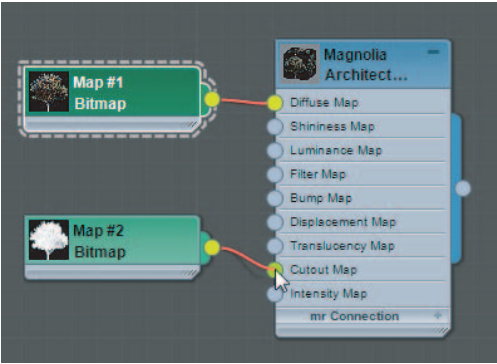
FIGURE 8.61
Hide the unused nodeslots.
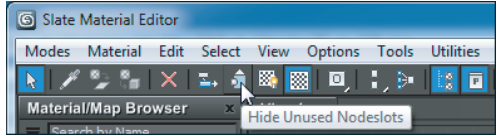
FIGURE 8.62
The finished
Magnolia entourage
node tree
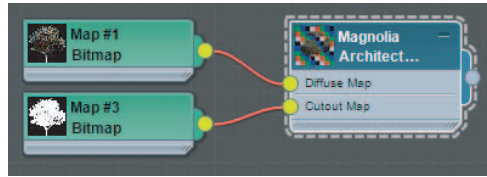
Now let's add geometry for the tree to the empty scene. First you'll need to create an object to which you will apply the Magnolia material. This will essentially be a simple, flat, vertical plane.

1. Minimize the Slate Material Editor to get a clear view of your viewports.

2. Click the Maximize Viewport toggle if necessary to display all four viewports.

3. Click the Create tab in the Command panel; then click the Geometry button if it isn't already highlighted.

4. Click Plane, and then, in the Perspective viewport, create the plane. Use the Length and Width parameter options to set the length to **24′** and the width to **24′**.

5. Give the plane the name **Tree001**. You can also use Box primitives (with 0 depth) for entourage elements, but be aware that boxes are visible from both sides, which can have an unwanted impact on your entourage material. Keep the Tree001 object selected.

Don't worry about the placement of the Tree001 object for now. You will first apply the material that you designed earlier to the plane, and then you will rotate the plane into a vertical position.

1. Restore the Slate Material Editor.

2. With the Magnolia material selected (double-click the Magnolia node if you need to), click the Assign Material To Selection button. The Magnolia material is now assigned to the plane you just created. If you don't have the Magnolia node selected, the Assign Material To Selection button will be grayed out.

3. Click the Show Shaded Material In Viewport button on the Slate Material Editor toolbar.

4. Use the Select And Rotate tool to rotate the plane so that it is vertical. You may want to turn on the Angle Snap toggle so that it is easier to make the tree perpendicular to the XY plane.

5. Zoom and pan in the Perspective viewport until the tree fills the view, as shown in Figure 8.63.

6. Save the scene as **MyMagnoliaTree.max**.

The scene still looks quite bare, but you can easily make several instanced copies of the tree and add some environment to give the impression that the scene is filled with a grove of trees, with very little impact to your scene's size or rendering time.

You've just created a material that, when applied to an object, will appear as a tree. Now let's look at a few of the tools that can help you work with and understand all types of materials.

FIGURE 8.63
The viewport show-
ing the plane with
the tree material
added
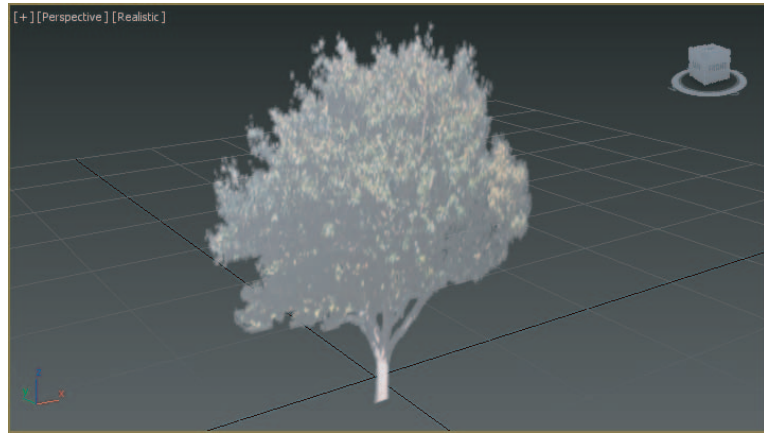
Click the Material/Map Browser button on the Slate Material Editor's top toolbar. This toggles the display of the Material/Map Browser on the left side of the Slate Material Editor. Click the Material/Map Browser button again to open the Material/Map Browser, as shown in Figure 8.64.

FIGURE 8.64
The Material/Map
Browser in the Slate
Material Editor
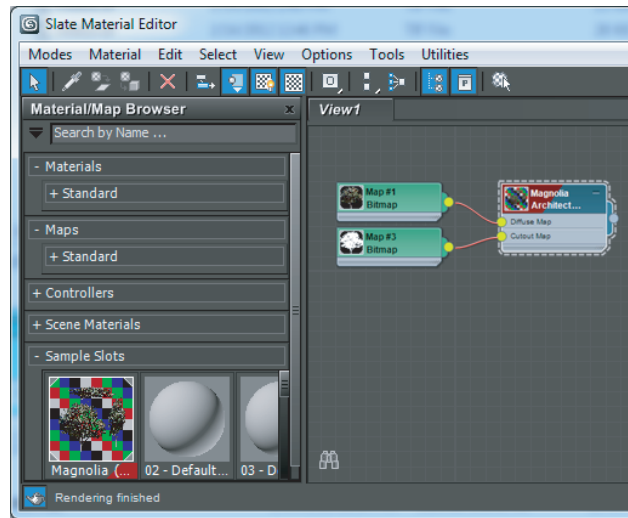
1. On the Slate Material Editor, click the Modes menu, and select Compact Material Editor.

2. Select an unused material sample slot, pick the Pick Material From Object eyedropper, and click the Tree001 object to access the Magnolia material. The materials in the Slate Material Editor are not automatically displayed in the Compact Material Editor.

TIP If you are getting Missing Map errors in a file and the Bitmap/Photometric Paths utility can't help you find the object that is referencing the missing map, and you can't find it in the current mode of the Material Editor you are using, switch to the other Material Editor mode and look there. You will probably find an unused material referencing that map either in the sample slots of the Compact Material Editor, in the Sample Slots area, or in one of the views of the Slate Material Editor.

3. On the Compact Material Editor, click the Material/Map Navigator button. This opens the Material/Map Navigator dialog box shown in Figure 8.65.

FIGURE 8.65
The Material/Map Navigator
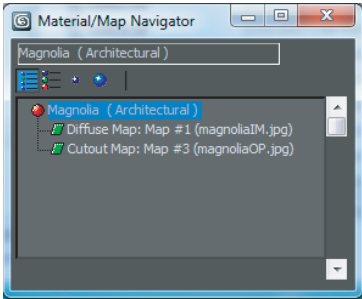
This dialog box gives you a clear picture of the way your material is organized. You see the name at the top with two branches under it. Each branch is a child map that you've added to your material.

4. Click the Diffuse Map listing in the Material/Map Navigator. The parameters in the Material Editor change to those of the selected map.

5. Click the View List + Icons button in the Material/Map Navigator.

Now you see the actual images used for the maps, plus the resulting material at the top of the list, as shown in Figure 8.66. The arrangement of images shows you the material hierarchy. You can click and drag the edges of the Material/Map Navigator to resize it.

FIGURE 8.66
The Material/Map Navigator showing samples of the maps used
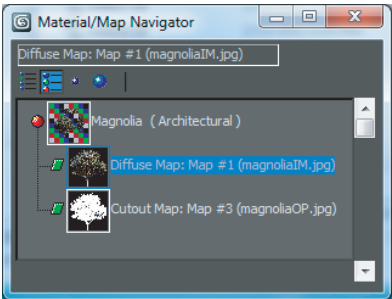
6. Click the Go Forward To Sibling button in the Material Editor. This moves you to the next material or map at the same level in the material hierarchy.

The parameters in the Compact Material Editor dialog box change to the Cutout Map parameters, and the Cutout Map listing in the Material/Map Navigator is highlighted. The Go Forward To Sibling button lets you advance through the different maps at the same child level.

1. Click the Show End Result toggle on the Material Editor toolbar to turn it off.

   The Cutout map appears in the sample slot for the Magnolia material, as shown in Figure 8.67. This tool lets you see the result of any change you make to the child parameters.

FIGURE 8.67
The result of turning off the Show End Result toggle
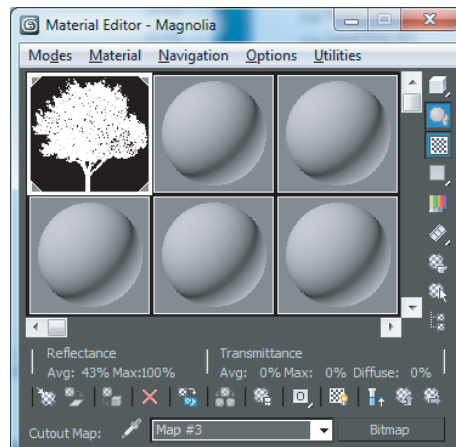
2. Close the Material/Map Navigator, and click the Go To Parent button on the Compact Material Editor toolbar to move to the main parameter level.

3. Save your scene.

The method we've shown you here for creating and adding opacity-mapped trees also works for adding people to you scenes. You can also use this method to add text or signage to a model quickly for which the proper fonts are not available in 3ds Max. Adobe Photoshop or another similar program can aid you in creating the texture and opacity maps for people. If you don't

want to create your own, you can use one of the many third-party sources for texture maps and models. Here is a short list of companies that provide texture maps and models for 3ds Max:

Marlin Studios `www.marlinstudios.com`

ScottOnstott.com `www.scottonstott.com`

TurboSquid `www.turbosquid.com`

Evermotion `www.evermotion.org`

Got3D `www.got3d.com`

In addition to texture maps, some of these companies offer prebuilt 3D objects such as furniture, cars, appliances, cabinetry, people, and animals. If you are in a hurry to build scenes quickly, check out the library of objects offered by these and other companies.

3D AND 2D FOLIAGE HAVE THEIR PLACES

Be aware that 3D foliage can consume large amounts of memory and dramatically increase render times because each leaf is modeled as geometry. Opacity-mapped entourage is much more efficient but remains flat. In animations where the camera is moving, 3D foliage can be more convincing, or you can use multiple 2D trees created in star-shaped patterns to add some depth to the simple entourage.

Adjusting an Object to a Bitmap Shape

Sometimes you may find it necessary to match the object's shape to a bitmap's shape. For example, you may create a material that uses bitmap images of people standing. To avoid distorting the shape of the people, you would want to match the object as closely as possible to the aspect ratio of the bitmap image (see Figure 8.68).

FIGURE 8.68
Two renderings with people used as bitmaps. The image to the left has distorted the people.

To do this, choose the Bitmap Fit Alignment option under the Parameters rollout of the UVW Map modifier, as shown in Figure 8.69.

FIGURE 8.69
Use the Bitmap Fit
option to adjust the
aspect ratio of the
image.
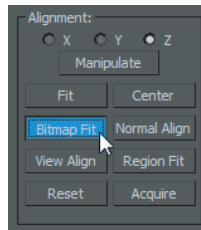
Use the Select Image browser to locate the bitmap file associated with the material. Once the file has been selected, return to the 3ds Max scene, and the Map gizmo will be adjusted to fit the aspect ratio of the selected bitmap.

Once you have the new Map gizmo, you can adjust your object to fit as closely as possible to the Map gizmo proportions. You may not be able to get an absolutely accurate match, but you can get close. Then, once you've gotten the object to the right proportions, use the UVW Map option described earlier in this chapter to align the map exactly to the object.

In the beginning of this chapter, you worked with the condo scene. Let's go back and explore the option of placing more than one material on an object.

Assigning Materials to Parts of an Object

As you work with imported files or complex models in 3ds Max, you'll almost certainly find yourself faced with the situation where you want to add a material to only a single surface, or group of polygons, of an object. This is the situation with the front kitchen cabinet doors in the condo scene, where you could enter the sub-object level of those objects and then detach them into separate objects for the purpose of assigning materials.

To maintain the connection of the cabinet door surfaces with the rest of the cabinet structure and to add a separate material to their surfaces, you'll need to use another method of applying materials. In this section, we'll discuss a type of material called a *multi/sub-object material,* which allows you to apply multiple materials to a single object. In the condo example, you can use a multi/sub-object material to apply the wood material to the front, sides, and mullions of the cabinet and a glass material to the panes.

Creating a Multi/Sub-object Material

A multi/sub-object material is like a group of materials collected under one material definition. Each material in this group is assigned a number to identify it within the collection of materials. It's easiest to understand when you've worked with it firsthand, so let's get started:

1. Open the last condo scene that you worked on or C08_Multisubobject.max from this book's accompanying web page.

2. Click the Material Editor button on the Main Toolbar to open the Compact Material Editor.

3. Click the slot containing the Woods & Plastics.Finish Carpentry.Wood.Teak material, and then drag it to another, unused slot to copy the material.

4. With the new material active in the Material Editor, click the Material Type button, currently labeled Architectural, to open the Material/Map Browser.

5. Expand the Materials group and then the Standard group, select the Multi/Sub-Object material, and then click OK. In the Replace Material dialog box that opens, choose Keep Old Material as Sub-Material and then click OK. This option retains the Woods & Plastics.Finish Carpentry.Wood.Teak material as a sub-material of the current material.

The new material's parameters now appear in the Material Editor. This is the material you assigned to the cabinets and drawers of the condo earlier in the book as a sub-material of the new multi/sub-material. There are nine additional, undefined sub-material slots available in this material.

The next step is to define the rest of the sub-material slots and then assign the material to the cabinet doors:

1. Enter the name **Cabinet_Wood_Glass_Multi** in the Material Name input box. This assigns a new name to the material in the active slot.

   As you can see from the Material Editor, the Multi/Sub-Object Material offers several listings for additional materials. Each material is a sub-material of the main, parent material. In this exercise, you need only six sub-materials, so go ahead and reduce the number of available listings to six.

2. Click the Set Number button in the Multi/Sub-Object Basic Parameters rollout.

3. In the Set Number Of Materials dialog box, enter **6** and then click OK. Your Material Editor should look like Figure 8.70.

FIGURE 8.70

The Cabinet_Wood_Glass_Multi material in the Compact Material Editor
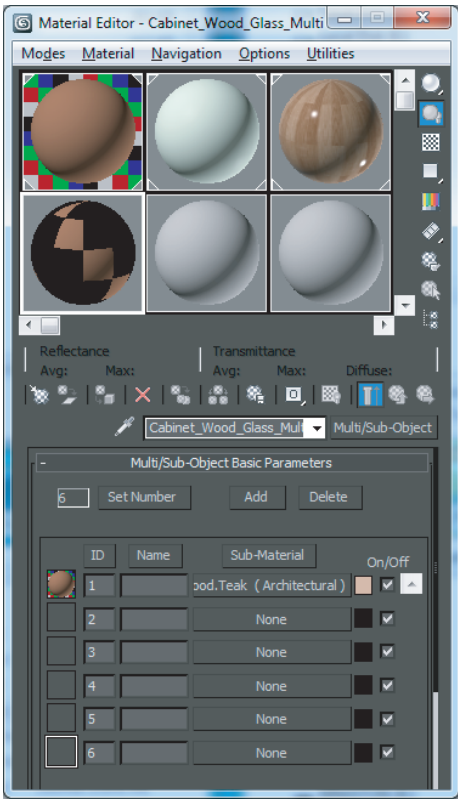
Notice how, at the top level of the Multi/Sub-Object Material, the object in the sample slot has the sub-materials applied to different portions of its surface. Now let's copy the current sub-material to additional slots and add the material that will become the glass panes:

1. Click the material button that's in the number 1 position in the Multi/Sub-Object Basic Parameters rollout, and drag it to the Sub-Material buttons for sub-material numbers 2, 3, 4, and 6 to copy the sub-material to those slots.

2. Each time the Instance (Copy) Material dialog box opens, choose the Instance option and then click OK.

3. Click the Sub-Material button for sub-material number 5, which is labeled None. When the Material/Map Browser opens, select the Architectural material and click OK.

   You'll use a glass material for the glass panes, so you'll want to open the appropriate template from the Architectural material.

4. Expand the drop-down list in the Architectural material's Templates rollout, and then choose Glass-Clear.

VIEWING TRANSPARENT MATERIALS IN THE MATERIAL EDITOR

Glass is almost never completely transparent. It must have some very slight opacity, or you wouldn't be able to see it (not counting reflections or refractions). You can use the Background button (the checkerboard button in the Material Editor's vertical toolbar) to change the current sample slot's background color from black to a multicolor checkered pattern. This helps discern the actual transparency of non-opaque objects.
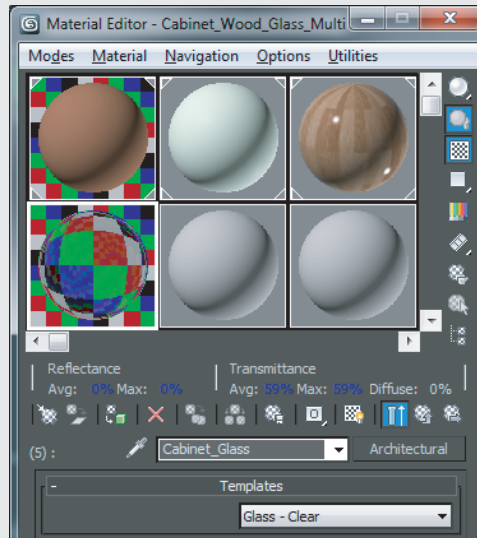
5. Click the Background button in the Material Editor's vertical toolbar to see the new glass material better.

6. Rename the sub-material **Cabinet_Glass**, and then click the Go To Parent button on the toolbar.

Applying a Sub-material to an Object's Surface

The cabinet doors of the condo, named Fixed Winx, were created as AEC Fixed Window objects in 3ds Max and then converted to editable meshes. Most AEC objects are created with different material ID numbers assigned to different parts of the object. In the case of Window objects, material ID number 1 is assigned to the front rail surfaces, number 2 to the back rail surfaces, number 3 to the glazing, and numbers 4 and 5 to the front and back frame surfaces, respectively. The Cabinet objects have been edited to have material ID numbers 1 through 4 assigned to the frames and railings and number 5 to the glass panes. To apply a sub-material to the polygons of an editable mesh, you'll need to identify the Material ID numbers of the polygons to which the sub-materials are to be applied, as shown in these steps:

1. Select one of the cabinet doors below the counter, and then click the Modify tab on the Command panel.

2. Expand Editable Mesh in the stack, and then click the Polygon sub-object level.

3. Scroll down the Modify tab to the Surface Properties rollout.

4. In the Material group, change the Select ID value to **2** and then click the Select ID button, as shown in Figure 8.71. Alternatively, you can use the drop-down box to pick from the material IDs assigned to the selected object.

FIGURE 8.71
The front perimeter surfaces are selected when material ID number 2 is selected.
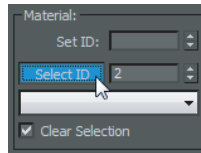
The front surfaces of the cabinet door turn red (see Figure 8.72) to show that they are selected. Remember that the Woods & Plastics.Finish Carpentry.Wood.Teak sub-material is the number 2 material in the Multi/Sub-Object Basic Parameters rollout. The selected surfaces are assigned the material ID number 2 and, therefore, receive the multi/sub-object material number 2. If you were to change the material ID number of the selected surfaces, they would receive the sub-material assigned to that number.

5. Cycle the Select ID value through the numbers 1–6 to see which surfaces bear which material ID numbers. You'll notice that no surfaces currently are assigned to material ID number 6.

ASSIGNING A SUB-MATERIAL WITH A MODIFIER

An alternative method for assigning a sub-material to an object is to use the Material modifier. This modifier offers a single parameter—the Material ID number.

FIGURE 8.72
The selected front panels of the cabinet doors

These polygons are selected as well as the ones tucked under the overhang.
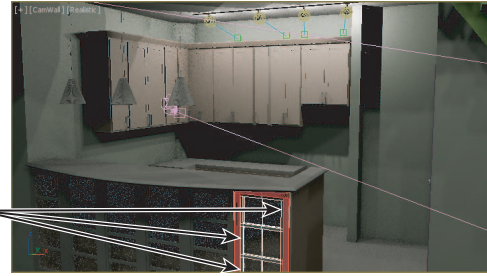
The material is ready, so next you need to assign it to the cabinet door objects:

1. Scroll up to the top of the Command panel; then click the Polygon level to return to the Object level. Alternatively, you can right-click in the viewport and choose Top-level from the tools 1 quad menu.

2. Select all six cabinet doors.

3. Open the Material Editor if necessary, click the Go To Parent button, and then drag the Cabinet_Wood_Glass_Multi sample slot onto one of the selected doors.

4. In the Assign Material dialog box that opens, choose Assign To Selection and then click OK. This option assigns the selected material to all selected objects and not just to the object to which it was dragged.

5. Make sure the CamWall viewport is active, and click the Render Production button in the Main Toolbar. The scene renders, with the new Cabinet_Wood_Glass_Multi material assigned to each of the doors, as shown in Figure 8.73.

FIGURE 8.73
The rendered scene with the new multi/sub-object material assigned to the cabinet doors

6. Save your work as `My_Multisubobject.max`.

USING MULTIPLE UVW MAPS ON A SINGLE OBJECT

If you're able to apply multiple materials to a single object, you may be wondering whether you can apply multiple UVW maps to an object as well. After all, different surfaces may require different UVW Mapping settings. You can indeed apply multiple UVW Map modifiers to a single object. You can then correlate the different UVW Map modifiers to individual sub-materials through *map channels*. You can think of a map channel as a number that links a sub-material to a UVW Map modifier. The concept is simple, but the execution is a bit obscure. Here are the steps that you take to link a sub-material to a UVW map. (These steps aren't part of the main exercise of this book; they are provided only to explain the process for linking multiple UVW maps to multiple material maps.)

1. Open the `C08_Multi_UVW.max` file from the book's website.

2. Open the Compact Material Editor, and then select the multi/sub-object material on which you want to work. In this case, select the Patio_Wood_Bench material.

3. Click the Hardwood Flooring American Cherry sub-material, which is Material ID 2.

4. Click the `american_cherry.png` map, and change the Map Channel to **2**.

5. Select the Patio_Benches object, and add another UVW Map modifier.

6. Change the Mapping setting to Box, click the Real-World Map Size check box to enable it, and set Map Channel to **2**.

7. Render the Perspective viewport, and see how the cherry paneling is now box mapped on the seating areas of the benches.

8. Save your scene as **My_Multi_UVW.max**.

Exploring the Autodesk Materials

So far you've seen convincing surfaces in your renderings using the Architectural materials. This is because the materials you have made account for light reflecting off surfaces or passing through translucent surfaces (refraction). The Autodesk Materials, a set of approximately 1,200 materials shared with all Autodesk 2013 products, were originally added to 3ds Max 2011. These materials help users bring in objects from other Autodesk products to take advantage of the animation and rendering capabilities of 3ds Max while keeping the same materials and look that could be rendered in the original application. The Autodesk Materials are high-quality materials designed for use with the mental ray renderer, and they are based on both manufacturer-supplied data and professional high-quality images. You will use a technique called *ray tracing* to simulate phenomena such as reflectivity and refraction accurately, while using these materials in a new version of the condo scene. You cannot see ray-traced effects in the viewports—they must be rendered.

USING RAY TRACING AT THE MAP LEVEL ONLY

Alternatively, you can use the Raytrace Standard material instead of a mental ray material if you are using the Default Scanline Renderer. We'll start by building a couple of quick models on the countertop.

1. Open the `C08_Condo_mentalray.max` file from this book's companion web page. This file is similar to the previous condo model file you have been using but is set up to use mental ray and mental ray materials.

2. Maximize the CamCounter viewport if necessary.

3. Choose Create ➢ Geometry, select Standard Primitives or Extended Primitives, and then click one of the primitive object buttons.

4. Click the AutoGrid option, and then create an object on the countertop.

5. Repeat steps 3 and 4, and create another object on the countertop. Figure 8.74 shows a teapot and a spindle on the countertop.

FIGURE 8.74
The viewport after creating two primitive objects
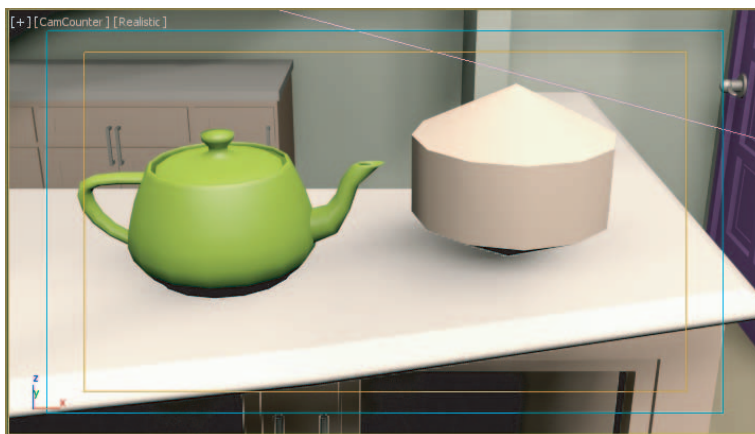
6. Open the Compact Material Editor.

7. Click in an unused sample slot.

8. Click the Get Material button. In the Material/Map Browser that opens, expand the Autodesk Material Library group.

9. Scroll down in the Autodesk Material Library group, and open the Metal group.

10. In the Metal group, scroll down and double-click the Copper - Polished material to copy it to the Compact Material Editor; then drag it from the sample slot to one of the primitives that you created.

11. Repeat steps 7 through 10, but choose the Clear material from the Glass group of the Autodesk Material Library and drag it to the other object you created.

12. Click on an unused sample slot, add the Gray Speckled material from the Stone ➢ Granite group of the Autodesk Material Library to the Material Editor, and then drag it to the countertop.

13. Render your scene. It should look similar to Figure 8.75. This rendering may take some time to complete.

FIGURE 8.75
The rendered scene
after adding the
Autodesk Materials
to the new objects

Adjusting the Autodesk Material Parameters

The cabinets, doors, and even the teapot (in this example) look good, but the glass and granite materials need some work. To improve the appearance of these materials, you should follow these steps:

1. In the Material Editor, select the Stone/Granite Gray Speckled material slot and then click the Map button next to Image in the Stone group. This takes you one level lower in the material to the Autodesk Bitmap options.

2. In the Scale group, make the width and height both **1′ 0″**.

3. Click the Go To Parent button to return to the top level of the material, and click the Show Shaded Material In Viewport button in the Material Editor's horizontal toolbar so that you can see the tiling of the map in the viewport.

4. Add a UVW Map modifier to the countertop, set the mapping type to Box, and select the Real-World Map Size option.

5. In the Compact Material Editor, select the Metal Copper – Polished material, set the Patina value in the Metal rollout to **.25**, and then scroll down to the Ambient Occlusion rollout and click the check boxes next to Enable and Use Color From Other Materials.

6. In the Material Editor, select the Glass Clear material; then, in the Solid Glass rollout, click the Custom Color swatch, which is under the Use Color menu option.

7. Set the colors to a mild blue by setting the RGB values to **0.4**, **0.4**, **0.8**, and then click OK to close the Color Selector dialog box.

8. Select the Stone/Granite Gray Speckled material again and change the Finish to Matte. Then click the Image button again, set Brightness to **25**, and click the Go To Parent button to get back to the top of the material.

9. Scroll down to the Ambient Occlusion rollout, click Enable, and also click the check box to enable Use Color From Other Materials; then close the Compact Material Editor.

10. Render your scene and, with the modified materials, it should look similar to Figure 8.76. The copper material makes the teapot look like it has been used for a number of years. The spindle has a different color, and the countertop tiles are the right size.

FIGURE 8.76
The rendered scene
after adjusting the
Autodesk Materials

11. Save your file as `My_C08_Condo_mentalray.max`.

   In the next section, you'll take a look at some of the utilities available for working with materials and maps in 3ds Max.

Using the Material Explorer

When you start working on scenes with numerous objects and materials, keeping track of which materials are applied to which objects can become quite a headache. This is where the Material Explorer can be helpful by allowing you to organize all the materials currently applied to objects in your scene. The Material Explorer can be launched by choosing Rendering ➢ Material Explorer. The Material Explorer consists of two main windows, as shown in Figure 8.77.

FIGURE 8.77
The Material
Explorer opened in
the last condo scene
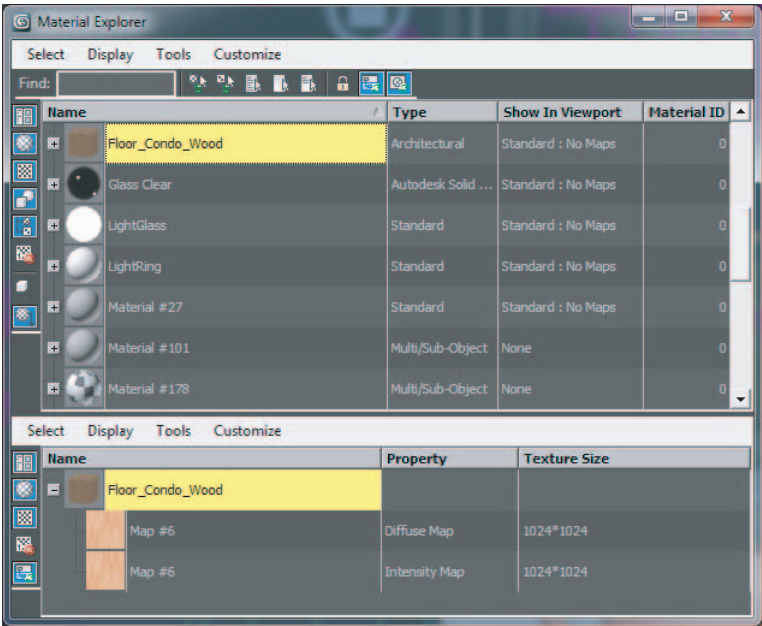
The upper Scene panel displays all the materials in the scene in a tabular fashion. You can navigate through all the materials in the scene, see the material's type, see whether the material is set to display in the viewport, and see the material's ID. You can also click any of the column headings to sort the list of materials by that column and also display the list by the materials or by the objects. The lower Material panel displays properties of a single selected material.

You can drag materials from the Material Explorer onto objects in the viewports the same way you can from the Material Editor. You can also use the Material Explorer to rename materials and maps and change some of the materials' properties.

You still need to apply the Stone/Granite Gray Speckled material you applied to the Modern Kit object to the Modern Counter object in the back corner of the kitchen, which you will do in the following exercise:

1. In the Scene panel, find the Stone/Granite Gray Speckled material and click the plus sign in front of the material sample to expand it, as shown in Figure 8.78.

FIGURE 8.78
The Material Explorer with the Stone/Granite Gray Speckled material selected
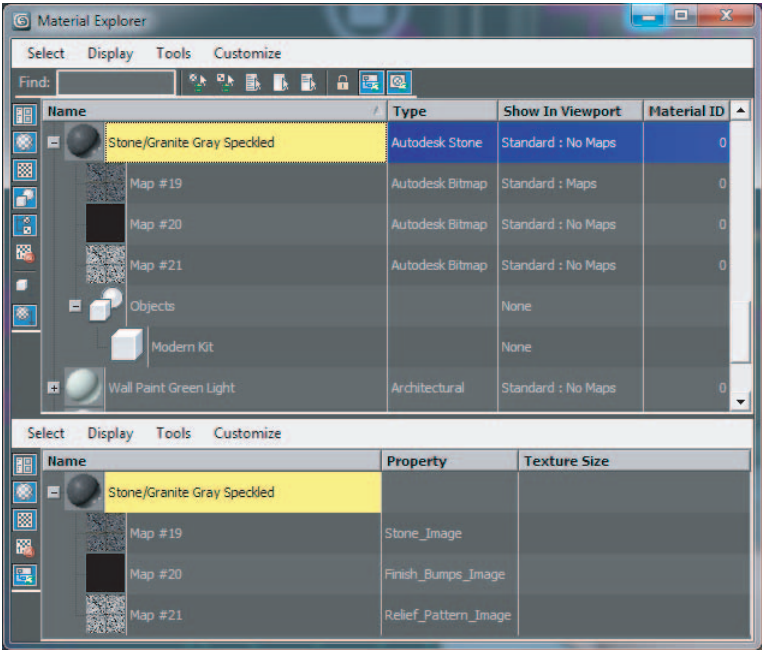
In the Scene panel, you can see that three maps are applied to the material, that one of them is set to display in the viewport, and that the material is applied to the Modern Kit object. The Material panel details the name of the map in the material and the property of the material to which the map is applied, and it is supposed to display the resolution of the bitmap texture.

From Figure 8.78, you can tell that the map for which you adjusted the Brightness value is darker than the other map sample.

2. Select the Map #19 sample, and then click in the Show In Viewport column, which provides a drop-down list. Choose the Standard: Maps option. This allows you to see the map on the front counter in the Perspective viewport.

3. Move the Material Explorer window so that you can see it and the back countertop in the Perspective viewport.

4. Click the Stone/Granite Gray Speckled material sample from the Material panel, and drag it onto the back counter.

In the Scene panel, you will see the Modern Counter object listed with the Modern Kit object under the material. The material has been applied to the object in the viewport.

5. In the Material panel, select Map #19, which is applied to the Stone image property of the Stone/Granite Gray Speckled material.

6. Now click Map #19; you can rename this map by adding *Diffuse* at the end of the name. If you go back to the Granite Gray Speckled material in the Material Editor and click the Image button, you will see that the name of that map has been updated. You may have to click the Go Forward To Sibling button twice to see it. This functionality is a great way to update material/map names in the Material Editor so that they are more descriptive and easier to find in your scenes. This feature does not rename the actual bitmap textures that you are using.

7. Save your scene.

The Material Utilities

Utilities are like separate programs that run inside 3ds Max, and there are many utilities that help with materials. Each of the utilities was designed to do a specific job, and they extend the functionality of 3ds Max. Here is how you can access the relevant utilities that help when you are designing, editing, and managing materials:

1. Click the Utilities tab of the Command panel.

A list of utilities is shown as buttons in the Utilities rollout. You can run each of these utility programs by clicking the appropriate button. There are many more utilities that are not shown as buttons by default.

2. Click the More button in the Utilities rollout. The Utilities dialog box (see Figure 8.79) appears, showing any utilities that are not already shown as buttons in the Command panel.

FIGURE 8.79
The Utilities
dialog box
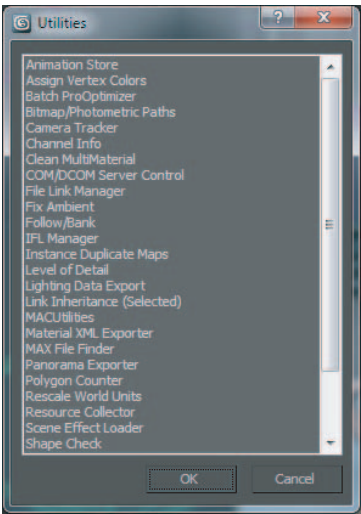
Each of the utilities was designed to do a specific job and to extend the functionality of 3ds Max. The relevant utilities that help when you are designing, editing, and managing materials are as follows:

Bitmap/Photometric Paths   Use this utility, shown in Figure 8.80, to change the hard-coded paths that are referenced by your bitmaps. To access the dialog box, select the utility and click OK. Then from the Path Editor rollout on the Command panel, click the Edit Resources button. Often incredibly helpful when you open a 3ds Max file made by a person in a different organization or department, this utility lets you repath all the missing bitmaps in one interface. This can be a time-saver when compared to searching each material in the scene for its missing bitmaps.

FIGURE 8.80
The Bitmap /
Photometric Path
Editor
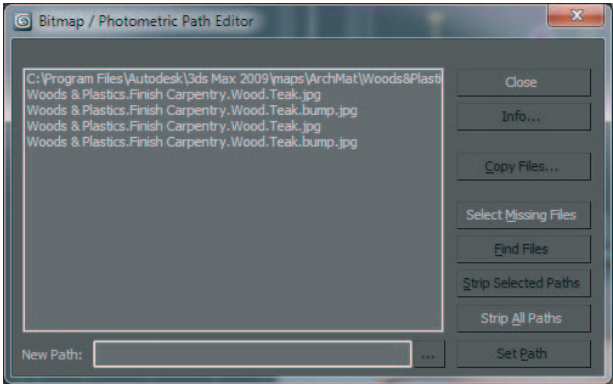
Clean MultiMaterial   This utility fixes a common problem ("extra" sub-materials that aren't referenced anywhere in the scene) with the multi/sub-object material. Use the utility to remove unused sub-materials without affecting material IDs or sub-materials that are in use.

Color Clipboard   Use the Color Clipboard to hold color information in four convenient swatches. Drag a color swatch from anywhere in the Material Editor onto any one of the four swatches in the Color Clipboard rollout, and the color will be stored there during your session.

You can also click the New Floater button to open a separate floating dialog box that has additional color swatches. Click one of the Save buttons to store your 12 favorite colors in a CCB file for later reuse.

Fix Ambient   Use this simple program to change any standard materials that have different colors in the ambient and diffuse color channels. The utility copies the settings for the diffuse color to the ambient color for all materials that you select.

Instance Duplicate Maps   Figure 8.81 shows the Instance Duplicate Maps dialog box. Use this utility in your projects when you want to convert multiple loaded copies of an identical image used as maps in various materials into instanced maps. This is more efficient than loading each occurrence of the map separately, and it may save some memory in addition to giving you more coordinated control over the shared parameters in the instanced maps.

FIGURE 8.81
The Instance
Duplicate Maps
utility
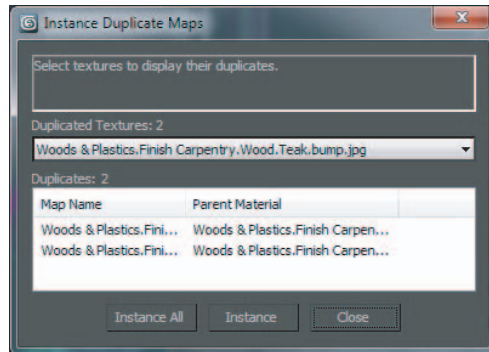
Material XML Exporter   The Material XML utility can be used to export the materials in your scene to an XML file that can be used in AutoCAD Architecture 2004 and newer.

You can drag and drop these XML files from a web page into 3ds Max or AutoCAD Architecture. Use this as an alternative to material libraries within 3ds Max and as a way to communicate with AutoCAD Architecture users.

Resource Collector   Use the Resource Collector to copy and optionally compress all your scene's bitmaps (and photometric files) into a single folder. This makes it much easier to send scenes to other organizations because all the associated bitmaps and other support files will be included. The Compress Files option saves all the files into a single, compressed Zip file.

UVW Remove   The UVW Remove utility deletes the UVW mapping information, the assigned material, or both from the selected objects. The Set Gray option changes the objects' color to a neutral gray.

AUTOCAD'S SIMILAR TOOL

The Resource Collector is very similar to AutoCAD's Pack 'n Go or eTransmit tool, depending on which version of the software you are using.

Modeling with Displacement Maps

You've seen how you can use a bump map to simulate a textured surface such as the cabinets in the previous exercises. Another map option, called a *displacement map*, performs a function similar to that of bump maps, but instead of applying a texture, it actually deforms geometry into new shapes. The effect is akin to a vacuum mold in which a flat surface is stretched over a form to create an object. In this case, the form is a bitmap where dark areas represent lower levels of a surface and light areas represent higher levels, in a similar way to bump maps. Figure 8.82 shows how a displacement map alters the geometry to which it is applied.

FIGURE 8.82
A sample displacement map and resulting mesh
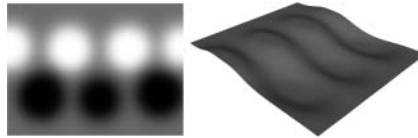
The image on the left, named `disp_dot.jpg`, was created in Photoshop by using the Airbrush tool to create the dots. The background was first filled in with a gray tone; then the black and white dots were sprayed in. As you compare the image with the mesh, you can see that the black dots correspond to the dips in the mesh and the white dots correspond to the bumps. Because the dots are airbrushed with soft edges, they create a smooth transition from high to low in the resulting mesh.

There are two ways that you can create mesh forms with displacement maps:

◆   You can go through the Material Editor and create a material containing a displacement map.

◆   You can use the Displace modifier to apply a bitmap directly to an object to deform it into a new shape.

Effectively displacing objects using either method requires a dense mesh pattern to accommodate the displacement smoothly.

Using the Displace Modifier

Using the Displace modifier is probably the easiest way to utilize a bitmap to deform a surface. In the following exercise, you'll use the modifier to get a feel for how the process works. These exercises use the Default Scanline Renderer, so make sure you have 3ds Max set properly. You'll create the object in Figure 8.82 by using the `disp_dot.jpg` image file:

1. Choose File ➢ Reset. At the warning message, click Yes if you need to save the changes to the condo scene or No if you don't. Then, at the second warning, click Yes to continue with the reset.

2. On the Main menu, select Customize ➢ Units Setup and set the scene's default units to US Standard, Feet w/Fractional Inches, 1/32, and Feet as the default Units.

3. In the Create tab of the Command panel, click Plane; then click and drag a plane that is roughly 12′×10′. Then use the Orbit, ViewCube®, and Pan tools to get a perspective view from the front, as shown in Figure 8.83.

FIGURE 8.83
Draw the plane
shown here.
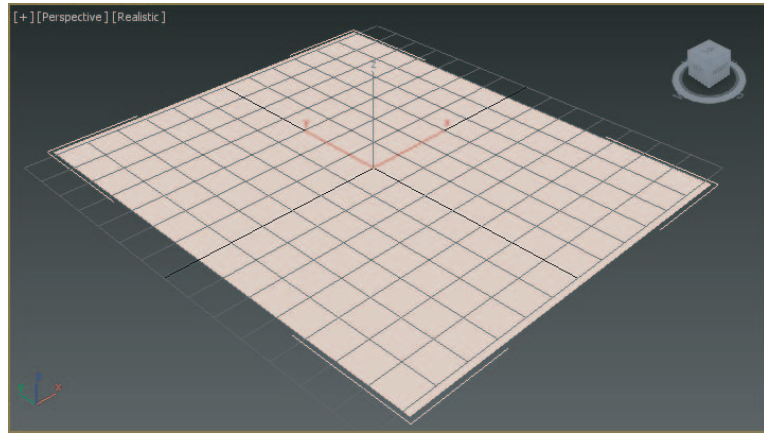
4. Adjust the Length parameter to **12′** and the Width parameter to **10′**. For now, leave the Length Segs and Width Segs at the default value of 4. You'll adjust these settings later.

5. Open the Compact Material Editor, and assign a Standard material in an unused slot to the Plane object. This allows you to see the surface features of the plane a bit more clearly.

The plane is perhaps the best type of geometry to use to demonstrate the effects of the Displace modifier, although you can use the Displace modifier on any NURBS surface, patch, editable poly, or editable mesh.

ADDITIONAL NURBS INFORMATION

NURBS stands for Non-Uniform Rational Basis Spline. It is a type of object that is especially suited to creating smooth curves.

Now let's apply the bitmap:

1. Click the Modify tab; then select Displace from the Modifier List drop-down. You'll find it under the Object-Space Modifiers heading. Do not apply the Displace Mesh modifier under the World-Space Modifiers heading.

2. In the Image group of the Parameters rollout, click the Bitmap button labeled None.

3. Locate and open the file named `disp_dot.jpg`.

4. Locate the Displacement group, and change the Strength setting to **1′**. You'll notice that the plane starts to distort, although it doesn't look anything like the one in Figure 8.82.

You've applied the `disp_dot.jpg` bitmap but haven't gotten the results you might have expected. The reason is that the mesh contains only a 4×4 array of segments. You'll need to increase the number of segments in the plane before you begin to see the form of the bitmap.

1. To get a better idea of what's going on with the mesh, right-click the Perspective label in the upper-left corner of the viewport and select Wireframe.

2. Select Plane from the modifier stack.

3. In the Parameters rollout, change the Length and Width Segs values to **40**. Now you can see the form more clearly.

4. Click the Render Production button to see the mesh as a rendered surface, as shown in Figure 8.84. Note that the background has been changed to white.

FIGURE 8.84
The rendered displaced plane
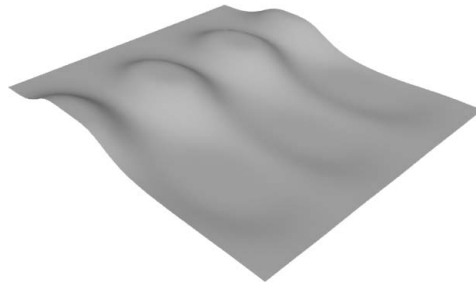
Now you can see that you can use a bitmap image to deform a surface. You don't have a lot of control over the details of the form, but you can create some interesting geometry using this method. For example, you can use a bitmap to create freeform terrain, fairly accurate terrains using specially prepared elevation maps from GIS software, or a relief element for an antique jewelry piece.

THE DISPLACE MODIFIER'S MAP AND BITMAP OPTIONS

You may have noticed that the Image group of the Displace modifier parameters offered two sets of options: Bitmap and Map. Although you used the Bitmap option, you could also have used the Map option to apply a bitmap. The Map option lets you use other types of maps, such as the procedural maps offered in the Material/Map Browser. You can use both Bitmap and Map options to combine maps to displace a mesh.

Now let's go back to the Displace Modifier parameters and see what some of the other options do:

1. In the modifier stack, select Displace.

2. In the Displacement group of the parameters, click and drag the Strength spinner up to 2′ 6″ or 30″. The Strength value indicates the distance from the black portions of the bitmap to the white portions.

3. Click the Luminance Center check box, and make sure the Center value is set to 0.5 if it's not already. The mesh drops down. The Luminance Center lets you control which shades of gray in the bitmap shift the mesh's vertices above or below the Displace gizmo. The gizmo is located on the construction grid.

4. Scroll down to the Map group, and change the Length value to **11′** and the Width value to **9′**. Now the surface really looks like a vacuum-formed plastic object with a flange.

5. Use the U Tile spinner to increase the U Tile value, and then do the same for the V Tile value. As you increase these values, the number of bumps across the width of the plane increases. Figure 8.85 shows the rendered plane after adjusting the Displace parameters.

6. Save your scene as `My_Displace001.max`.

FIGURE 8.85
The rendered displaced plane after adjusting the Displace parameters
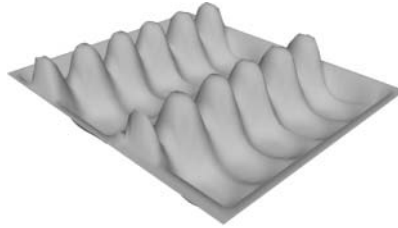
Notice that in the Map group, the Planar radio button is selected. This is the default Map gizmo setting. In fact, because the Displace modifier works with maps, the Map group mimics the map settings for the UVW Map modifier.

Once you've finished working with the object, you can collapse its stack using the quad menu or the context menu in the modifier stack. By doing so, you will help conserve memory and help improve the performance of 3ds Max. You can then start to edit the mesh by going to the sub-object level.

Using the Material Editor to Create Displaced Geometry

If you want to apply a displacement map to an object other than a NURBS surface, patch, editable poly, or editable mesh, you can use the displacement map in the Material Editor. This option works in conjunction with the Displacement Approximation modifier to perform the same function as the Displace modifier but on a wider range of objects. For example, you can form a decorative feature on a building or create signage using the combination of displace, opacity, and diffuse maps in the Material Editor and then apply the resulting material to a cylinder or other geometry.

In this section, you'll create a fictitious concrete landscaping bench using an image file to create the details of the geometry (see Figure 8.86).

FIGURE 8.86
A concrete bench

The image file you will be using was created entirely in Photoshop using the Pen tool for the top and bottom bars and the Horizontal Type tool for the word *Brilliant*. This could really be anything from a scanned photograph to an imported AutoCAD line drawing. The point is that it's a bitmap image in which the dark areas represent low surfaces and the light areas represent high surfaces.

Let's get started with the bench by creating the basic geometry:

1. Choose Application menu ➤ Open and select the `C08_DisplacementStart.max` file. This sets the units and the rendering engine to mental ray.

2. Make sure the Geometry button is selected in the Create tab of the Command panel; then click Cylinder.

3. Click and drag from the origin of the Perspective viewport, and give the cylinder a radius of **30"**. Make the height **24"**.

4. Click the Modify tab in the Command panel, and then select the UVW Map modifier from the Modifier List drop-down.

5. Scroll down the Parameters rollout, and click the Cylindrical radio button.

6. Later, if you alter the cylinder and the Map gizmo doesn't conform to the new shape, click the Fit button in the Alignment group.

With the UVW Map modifier added and set to Cylindrical, any material maps applied to the cylinder will appear around the perimeter. The next step is to create a material that uses a displacement map:

1. Open the Material Editor.

2. Select an unused material slot, and change it to an Architectural material; rename the material **BenchDisplace**.

3. Expand the Special Effects rollout, and then click the Displacement button labeled None.

4. In the Material/Map Browser, scroll to the Maps group, expand the Standard group, and double-click Bitmap.

5. In the Select Bitmap Image File browser, locate and open the file named `Bench_d.jpg`.

6. Make sure that Use Real-World Scale is unchecked and that both the U and V Tiling are set to 1.

7. Click the Assign Material To Selection button, or drag and drop from the sample slot to the object, to assign the material to the cylinder.

8. Use the Orbit, ViewCube, and Pan tools to get a good perspective view of the cylinder. Change the environment background to white by choosing Rendering ➤ Environment, clicking the Background Color swatch, and dragging the Whiteness slider to 0. Do a quick rendering to see the results. Your scene should look similar to Figure 8.87.

FIGURE 8.87
Your first attempt to create a concrete bench
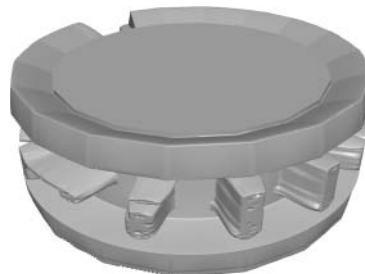
Your rendering doesn't really look much like the `Bench_d.jpg` image shown in Figure 8.86. There are still a few changes that need to be made, however. The amount of displacement is too great, and a single version of the map stretches around the cylinder. You want to reduce the strength of the displacement and have the map repeat four times around the perimeter so that it's readable.

The following steps will increase the number of times the displacement map displays around the cylinder:

1. On the modifier stack, scroll down to the UVW Map parameters.

2. Change the U Tile setting to **4**. Remember that the U setting is similar to the X coordinate. By setting U Tile to 4, you cause the map to repeat four times around the perimeter of the cylinder.

3. Render the scene again using the Render Production tool. Figure 8.88 shows that the rendering is getting a little closer to the target.

FIGURE 8.88
The object after changing the U Tile parameter
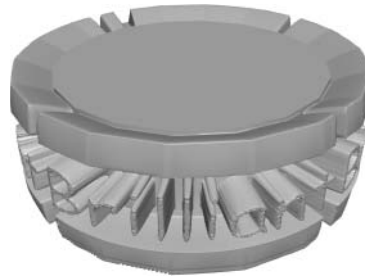
By increasing the number of times the map is repeated over the surface, you have increased the complexity of the displacement map. In relation to the cylinder surface, however, it is still very complex. You may recall that, in an earlier exercise for the Displace modifier, you needed to increase the number of segments in the mesh surface in order to have the displacement map take effect. You need to do the same in this situation. You need to increase the number of segments on the cylinder wall to give the displacement map enough segments to work with.

You can go back to the Cylinder object level to increase the number of segments for the side of the cylinder:

1. Right-click the Perspective label in the upper-left corner of the viewport, and select Wireframe. This will allow you to see the cylinder segments more clearly.

2. In the modifier stack, choose Cylinder.

3. In the Parameters rollout, change the Height Segments value to **12** and the Sides value to **72**. The sides of the cylinder will show polygons that are close to being square.

4. Click the Render Production button again. Now you can see the map clearly.

The depth of the displacement map shows you that it isn't just a bump map. When the cylinder is rendered, 3ds Max converts the flat cylinder wall into a displaced mesh that will cast shadows and stand up to close-up views, even though the cylinder remains a plain cylinder in the viewports.

Now let's see how to reduce the depth of the displacement to something a bit more reasonable. You'll also add some noise to the Bump Map setting to give the object a sandblasted concrete look:

1. Open the Compact Material Editor; then go up one level to the Special Effects rollout.

2. Change the value for the displacement map to **33**.

3. Click the bump map button labeled None.

4. In the Material/Map Browser, scroll to the Maps group, expand the Standard group, and select Noise; then click OK.

5. Back in the Compact Material Editor, change the Size parameter in the Noise Parameters rollout to **0.25** and change the Blur setting in the Coordinates rollout to **0.01**.

6. Click the Go To Parent button on the Compact Material Editor toolbar; then adjust the Bump setting to **90**.

7. Create another rendering of the object. Figure 8.89 shows the completed bench.

FIGURE 8.89
The bench after adjusting the displacement amount and adding a Noise texture

8. Save your scene as **MyBenchDisplacement.max**.

You now have a pretty convincing model of a fairly complex form, and you created it without having to do a lot of editing. The displacement map does take a toll on rendering time, but in some situations it can save you time in building your model.

Converting a Displacement Map into an Editable Mesh

You may find yourself in a situation where you need to edit an object that you've created using a displacement map, like the one in the preceding section. Unfortunately, displacement maps take effect only when you render the image. Meanwhile, the object to which the displacement map is applied remains in its basic form in the viewports. In your exercise example, the cylinder remains a cylinder and doesn't become a displaced mesh.

You can apply two tools to gain access to the mesh that is created using a displacement map. The first is a global modifier that displays the mesh in the viewports so that you don't have to wait until the scene is rendered to see the result of the displacement map.

1. Click the Viewport Shading label, and select Shaded + Edged Faces.

2. To see the effects of the displacement map, make sure the cylinder is selected, and then select Displace Mesh (WSM) from the Modifier List drop-down.

3. Click the box in front of Custom Settings, and then click the Medium button in the Subdivision Presets group.

You'll have to wait a moment while 3ds Max converts the viewport display of the cylinder to show the actual mesh of the displacement map. When 3ds Max is done, you'll see the cylinder with the displacement map in mesh form (see Figure 8.90).

FIGURE 8.90
A close-up view of the cylinder with the Displace Mesh (WSM) modifier active
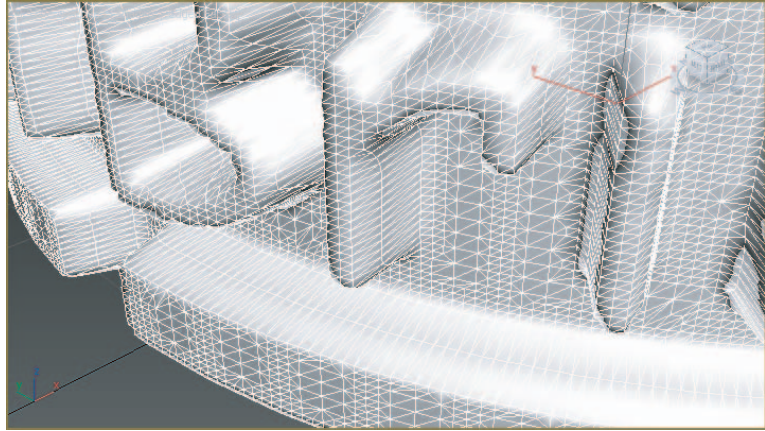
You can now see why the last rendering took a bit more time. With the displacement map added, the mesh is quite dense and complex. You can reduce the complexity of the mesh by reducing the number of segments in the cylinder.

4. You can also experiment with the Subdivision Presets in the Displacement Approx. rollout—try the Low option first (see Figure 8.91).

FIGURE 8.91
The Subdivision Presets in the Displacement Approx. rollout
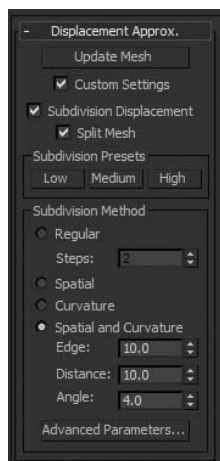
Using the Low setting will reduce the smoothness of the mesh and give it a rough appearance, so you may want to use the Low setting for meshes that will only be viewed from a distance.

THE MULTIRES MODIFIER

Try using the MultiRes modifier to reduce the complexity of objects. MultiRes reduces topology more in flat areas and leaves detail where you need it in curved surfaces.

TEXT IN 3DS MAX

In this example, a raster image of some text was used to show off the capabilities of the displacement map feature. In most cases, however, you'll want to create text using the Text object found in the set of Spline Shape options of the Create tab. A text shape acts just like any other shape in that it can be extruded to form 3D objects. You can also apply modifiers to text shapes. One modifier that is especially useful with text shapes is the Bevel modifier, which was introduced in Chapter 3, "Creating Shapes with Splines," and used again in Chapter 5, "Working with External Design Data." (Also see the "Bevel" section in Bonus Appendix 1.)

3ds Max can use almost any font that is available in the Windows font library to create text shapes. It is important to be aware that some fonts are built in such a way that using them may create problems with Bevel and other modifiers. Text can also be edited and its parameters changed, as long as it isn't collapsed into editable meshes, editable polys, or editable splines. For example, you can create a text shape that spells out *Brilliant*, extrude it, apply a material to it, and then later change the text to *absolutely brilliant*. Through the Text Shape object's parameters, you also have control over fonts, justification, size, kerning, leading, underlining, and italics.

Creating an Editable Mesh from a Displacement Map

The *Displace Mesh (WSM) modifier* allows you to see the displacement map so that you can use the transform tools to adjust the size and orientation of the object within the design. It doesn't let you edit the object's surface, however. If you need to make changes on a sub-object level, you can create a special type of clone of the object that's a full-mesh representation of the object with the displacement map. You can then use the clone to make further changes and hide or delete the original object.

To create this copy, use the Snapshot dialog box as demonstrated in the following exercise:

1. Choose Tools ➢ Snapshot.

THE SNAPSHOT TOOL AS A BUTTON

Snapshot can also be found on the Extras toolbar on the Array button flyout.

---

2. In the Snapshot dialog box, make sure the Single radio button is selected in the Snapshot group and that the Mesh radio button in the Clone Method area is selected; then click OK.

ADDITIONAL MAPPING AND MATERIAL FEATURES

3. Use the Select And Move tool to move the Cylinder001 object to the left so that you can get a clear view of the new mesh. You may experience some lag between the time you move the cylinder and the time the cylinder actually moves on the screen due to the polygon count.

4. Remove the Displace Mesh (WSM) modifier from the Cylinder001 object's modifier stack by selecting Displace Mesh Binding (WSM) from the modifier stack and then clicking the Remove Modifier From The Stack button below the Modifier List. The Displace Mesh (WSM) modifier slows 3ds Max's reaction to your input, so deleting it will help save some time. When the Displace Mesh (WSM) modifier is removed, you see the original cylinder revert to its former shape.

5. Render the scene with the cloned cylinder. You see that it is an exact copy of the original cylinder but that the copy is an editable mesh rather than a cylinder with several modifiers attached.

6. Save your scene.

> **USE SNAPSHOT TO CREATE COLLAPSED COPIES**
>
> You can think of the Snapshot dialog box as a tool to collapse nearly any modified object into an editable mesh.

As you've seen in these exercises, the Displace modifier requires the surface to have at least enough segments to accommodate the form. This means that with complex forms you'll have to create a mesh with lots of segments, which also means that you can quickly expand your file size using the Displace modifier. For this reason, you may want to restrict the use of this modifier to those types of geometry that can best take advantage of its features.

> **CLONING WITH SNAPSHOT**
>
> The Snapshot dialog box is mainly intended to clone an animated object at a particular point in time, such as the fence created at the end of Chapter 4, "Editing Meshes and Creating Complex Objects." For example, suppose you have an animation of an object deforming over time and you want to create a clone of the object at specific points in the deformation. Snapshot is designed to perform this function. As its name indicates, Snapshot takes a snapshot of an object at a particular moment in time. The clone created by Snapshot doesn't inherit the animated motion or deformation of the source object.

Additional Mapping and Material Features

3ds Max 2013 has a great number of material and mapping tools that you can use to create interesting and highly realistic surfaces for the objects you use in your scenes. This book can't possibly go into every feature and use possible in such a robust application. In the following exercise, you will use some additional features of 3ds Max 2013 to create a complex material for a model

that represents a stylized architectural feature similar to something you might encounter in your career:

1. Open the C08_ColumnSurround.max file that you downloaded from the book's website.

   This model could represent a stylized column or some other architectural design feature used in a film, game, or design visualization, as shown in Figure 8.92. This is an Editable Poly object that was modeled from a 3ds Max Box primitive.

FIGURE 8.92
The ColumnSurround001 object
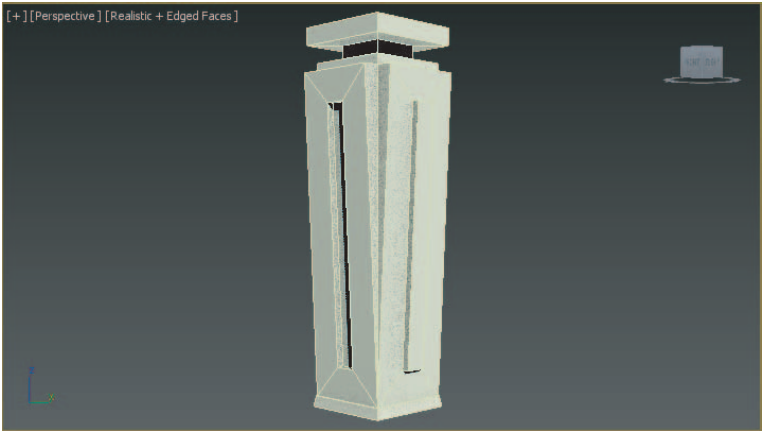
2. Select the ColumnSurround001 object.

3. Open the Slate Material Editor.

4. In the Autodesk Material Library, open the Wood group and find the Goncalo material. Double-click it to add it to the active View1 window, as shown in Figure 8.93.

FIGURE 8.93
The Autodesk Material in the Slate Material Editor
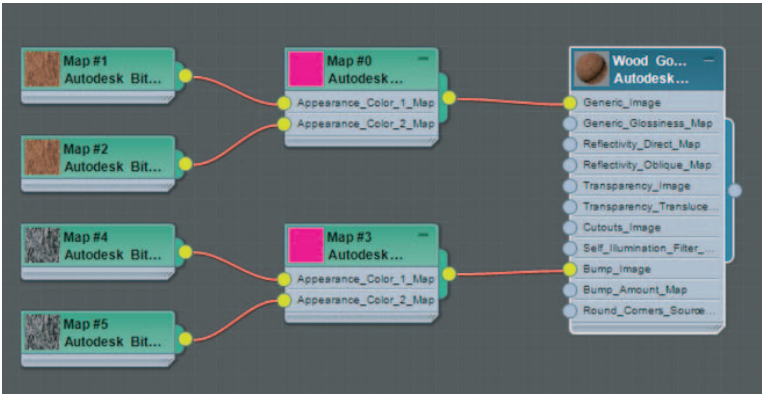
If you look at the maps used in the Wood Goncalo material, you will see that the two Map nodes wired to the Generic_Image channel of the material are using the exact same bitmap with the exact same parameters. This is a bit inefficient, so what you can do using

the Slate Material Editor is use the same bitmap node in multiple inputs on the material, thereby saving unnecessary loading of duplicate texture images and saving system RAM.

5. Right-click the Wood Goncalo node, and select Open Preview Window.

6. Click Assign Material To Selection to apply the material to the ColumnSurround001 object.

7. Select the lower of the two nodes wired to the Generic_Image channel in the active View1 window, and delete it by using Edit ➢ Delete Selected from the Slate menu or pressing the Delete key on your keyboard. Notice the changes in the preview window.

8. Click and drag from the output socket of the Map node, and wire it to the input socket of the Appearance_Color_2_Map on the Autodesk Noise Map node, as shown in Figure 8.94. Watch the preview window return to looking as it did before.

FIGURE 8.94
Wire the Map node to the Noise node.
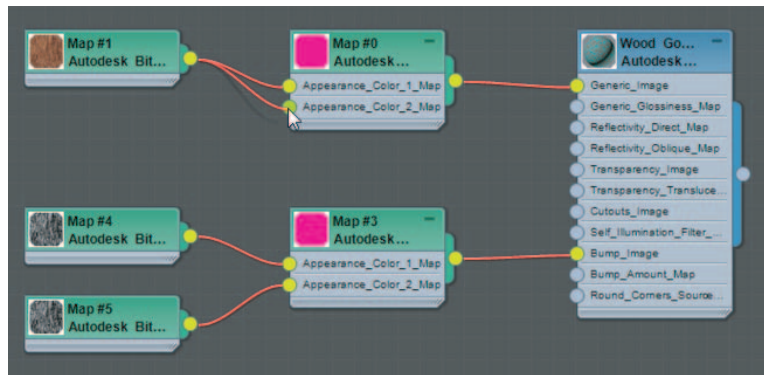
9. Delete the duplicate map wired to the Bump_Image channel of the Wood Goncalo material, and then wire the remaining map to the other socket in the Autodesk Noise Map node.

You have just made the material a little more efficient.

10. Now click the Render Production button.

3ds Max presents you with the Missing Map Coordinates dialog box, indicating that ColumnSurround001 requires map coordinates and may not render correctly.

11. Click Cancel on the Missing Map Coordinates dialog box to stop the render so that you can UVW map the ColumnSurround001 object.

You will now create UVW coordinates for the ColumnSurround001 object so that you can apply materials that require mapping coordinates to it:

1. Close the Slate Material Editor for the moment.

2. On the Modify tab of the Command panel, add an Unwrap UVW modifier.

3. Expand the Unwrap UVW modifier, and select the Face sub-object level; then choose Edit ➢ Select All, or press Ctrl+A on the keyboard, to select all the faces of the object.

4. In the Projection rollout of the Unwrap UVW modifier, select Box Map for the mapping type.

5. In the Edit UVs rollout, click the Open UV Editor button to open the Edit UVWs dialog box, as shown in Figure 8.95.

FIGURE 8.95

The ColumnSurround001 object's faces in the Edit UVWs dialog box
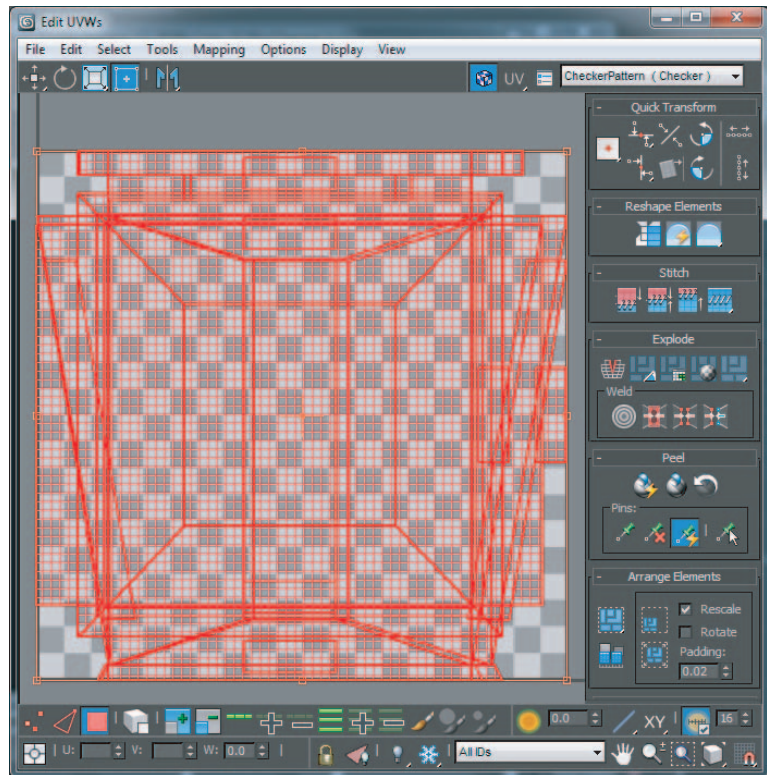
Right now all the polygons of the ColumnSurround001 object are overlapping on the Edit UVWs dialog box, which won't make for a particularly good UVW map.

6. In the Edit UVWs dialog box, choose Mapping ➢ Flatten Mapping. In the Flatten Mapping dialog box, accept the defaults and click OK.

This lays out all the polygons of the ColumnSurround001 object flat in the UV space, as shown in Figure 8.96. It is not the most efficient UVW map for the object, but it will work for what you are going to create.

7. Close the Edit UVWs dialog box.

8. On the Modify panel, right-click the Unwrap UVW modifier and select Collapse To. On the Warning: Collapse To dialog box, click Yes.

9. On the Menu Bar, choose Rendering ➢ Render Surface Map. This opens the Render Surface Map dialog box, as shown in Figure 8.97.

FIGURE 8.96
The ColumnSurround001 object unwrapped in the Edit UVWs dialog box
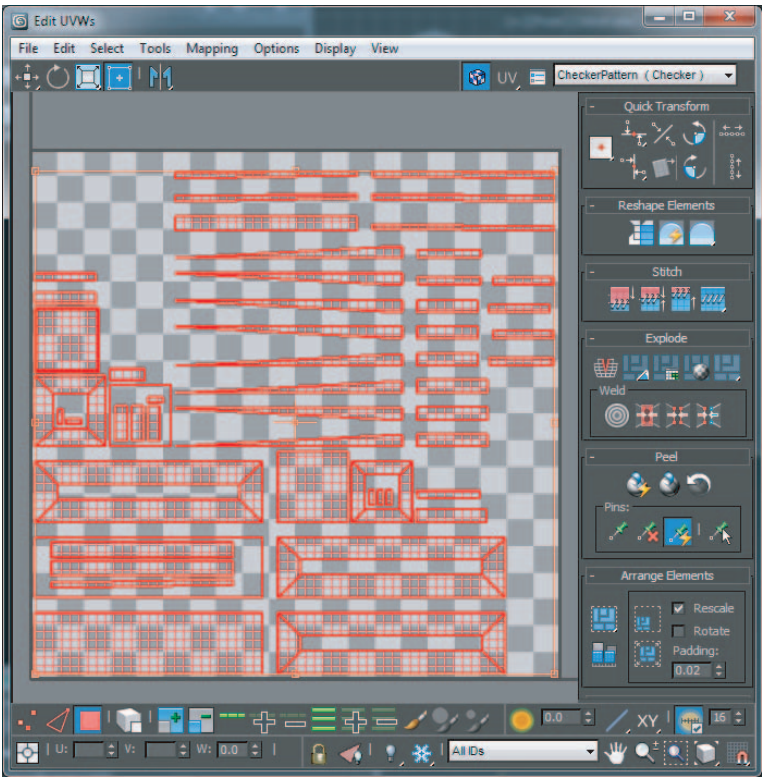
FIGURE 8.97
The Render Surface Map dialog box
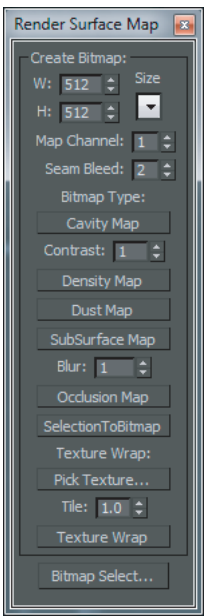
The Render Surface Map dialog box allows you to render a number of special maps with user-selected resolutions and options, based on the UVW mapping of the selected object that you can use to enhance the materials you create for your objects.

10. Click the Cavity Map button in the Render Surface Map dialog box. After your machine processes the rendering, you will see the result in the Cavity Map dialog box, as shown in Figure 8.98.

FIGURE 8.98
The rendered Cavity Map dialog box
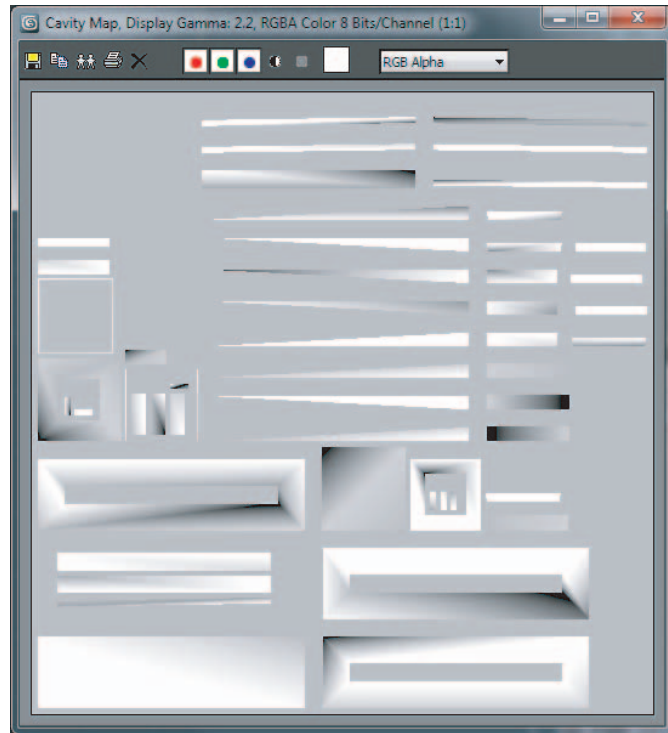
11. In the Cavity Map dialog box, click Save Image. In the Save Image dialog box, navigate to where you are working with the files for this chapter and name the file **ColumnSurround001_MyCavityMap.tif**. Click Save and, in the TIF Image Control dialog box, select 8-bit Grayscale and then click OK.

12. Close the Cavity Map dialog box and the Render Surface Map dialog box.

By rendering out the Cavity map to a file, you created a texture layer that you can use to create more complex and interesting materials for your objects and scenes. Take some time and render out and save the other maps that the Render Surface Map tool allows you to create—Density, Dust, SubSurface, and Occlusion. You will now create a new material for the object, which takes advantage of the Composite Map feature of 3ds Max:

1. Open the Slate Material Editor, right-click the active view, and choose Materials ➢ mental ray ➢ Arch & Design. A new Arch & Design material node is created in the active view. Name the material **ColumnSurround**.

2. Right-click again in the active view, and choose Maps ➢ Standard ➢ Composite to create a new Composite Map node.

3. Wire the output socket of the Composite map to the Diffuse Color Map input socket of the Arch & Design material.

4. Double-click the Composite Map node to display its settings in the Parameter Editor panel, as shown in Figure 8.99.

FIGURE 8.99
The parameters of the Composite map
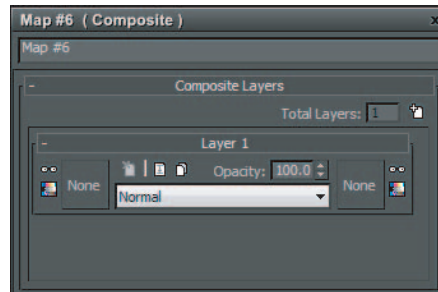
If you are familiar with programs such as Adobe Photoshop or Autodesk Composite, you should have an understanding of the concept of layer-blending modes and masks. The Composite map allows you to build texture components out of different layers that you build up with blending modes, opacity settings, and masks. Right now, the Composite map has only one layer in it. Next, you will start to work with the features of the Composite map.

5. In the Layer 1 rollout, click the Texture button, the button labeled None on the left side of the rollout, to open the Material/Map Browser. Select Maps ➢ mental ray, and double-click the Metal map to add it to Layer 1 of the Composite map.

6. Double-click the Metal map that is now wired into the Layer 1 input of the Composite map, and then change its Surface Material color to **.25, .26, .09** and change the Reflectivity to **.33**.

7. Double-click the Composite map to view its parameters, and click the Add A New Layer button at the top right of the Composite Layers rollout.

8. Click the Texture button of the layer you just created, and in the Material/Map Browser, select Maps ➢ Standard ➢ Bitmap. Then browse to the folder where you have this chapter's files and select the GRANITPK.jpg file.

In the View1 panel of the Slate Material Editor, you will see that the ColumnSurround material now looks like granite marble and that the Composite map shows two layers.

However the granite texture is on top of the base metal, thus hiding it. Now you need to add a mask to the granite layer to reveal the metal layer below it.

9. Double-click the Composite map node to bring it to the Parameters panel if it isn't there already, and click the None button to the right of the Layer 2 group. This is the Mask button, and it will bring up the Material/Map Browser. Choose Maps ➢ Standard ➢ Bitmap. In the Select Bitmap Image File dialog box, navigate to where you saved `ColumnSurround001_MyCavityMap.tif`, select it, and click Open.

You will see the material sample change slightly, and some of the color from the Metal map is now showing through. Let's apply this material to the ColumnSurround001 object and change the viewport settings so that you can see the changes happen while you continue to build the material.

1. Make sure the ColumnSurround001 object is still selected and that the ColumnSurround material is selected in the Slate Material Editor, and click the Assign Material To Selection button.

2. Click the Shading Viewport Label on the Perspective viewport, and change the mode to Realistic.

3. With the material still selected in the Slate Material Editor, click the Show Shaded Material In Viewport button. You should see the material applied to the ColumnSurround001 object, as shown in Figure 8.100.

FIGURE 8.100
The work in progress of the Composite map on the ColumnSurround001 object

4. Double-click the Composite map node to bring it to the Parameters panel, and look at the Layer 2 group. Many features are available at each level, as shown in Figure 8.101.

The Blending Mode drop-down of the Composite map provides you 25 different ways to adjust how the top layer affects the layer below it. This capability, combined with the ability to use masks and color correct each layer and mask individually, gives you tremendous power in creating complex materials for all your projects. Try changing the Blending mode of Layer 2, and check or render the Perspective viewport with each different blending mode to see how the blending mode changes how the material looks. You

should also add some more layers and use different image files or 3ds Max procedural maps for mask layers. When you have finished experimenting on your own, save your file and continue with the following exercise.

You will now use the Mix map to blend different maps together to create a bump channel for the ColumnSurround material.
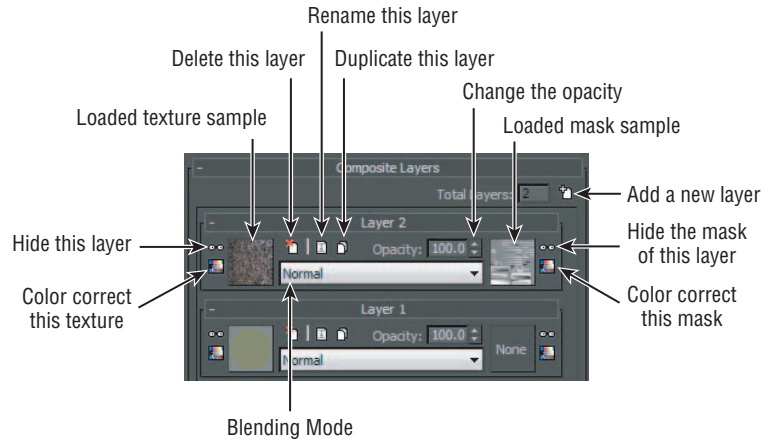
5. In the Slate Material Editor, double-click the ColumnSurround material to view it in the Parameters panel. Then scroll down to the Special Purpose Maps rollout, and click the None button next to Bump. This will bring up the Material/Map Browser. Select Maps ➢ Standard ➢ Mix, and click OK to add the Mix map to the material.

6. Double-click the Mix map node to view its parameters, as shown in Figure 8.102.
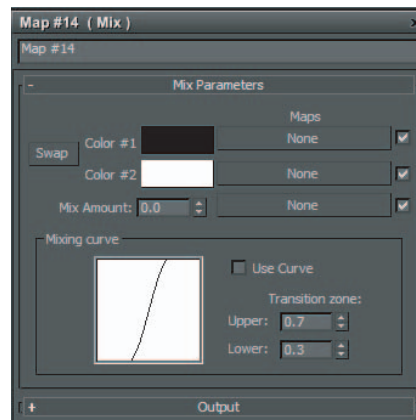
The Mix map allows you to combine two different maps together using a third map or curves settings to control how the first two maps are mixed together. You can even nest multiple Mix maps to create extremely varied materials.

7. Click the None button for Color #1 in the Mix map to access the Material/Map Browser, and select Maps ➢ Standard ➢ Tiles to add it to the Mix map. Double-click the Tiles map to view its parameters.

   There are four rollouts to the Tiles map—Coordinates, Noise, Standard Controls Group, and Advanced Controls. Look at the Standard Controls rollout and the Pattern Setup group. The Preset Type drop-down menu provides you with seven typical masonry placement options and the ability to use a Custom Tiles arrangement. Open the Advanced Controls rollout, which provides you with the ability to apply materials to the face of the tiles and the grout, and adjust the many parameters for the tile and grout. Since you are creating a bump map, change the texture color to white and the grout color to black.

8. Right-click the View1 panel, select Maps ➢ Standard ➢ Perlin Marble, and wire it to the Color #2 input on the Mix map.

9. Right-click in the View1 window again, select Maps ➢ Standard ➢ Noise, and wire it to the Mix Amount input of the Mix map. You should see the ColumnSurround material change.

10. Double-click the ColumnSuround material, scroll to the Special Effects rollout, and expand it if necessary. Click the Ambient Occlusion check box and the Round Corners check box. Change the Fillet Radius to **.25**″.

    The Round Corners feature is great for creating the effect of an edge on objects that often catch glints of light, helping create a sense that the objects are real. This feature works very well on objects with straight edges such as the column on which you have been working. Extremely complex objects or those with curves, however, could cause mental ray to crash while rendering.

    The Ambient Occlusion feature of mental ray materials evaluates the model and determines which areas won't receive direct light, or are occluded, and it darkens those areas. This can also be used to enhance detail or improve the contact shadows between objects.

11. Close the Slate Material Editor, and save your scene incrementally to prepare to move onto the next exercise.

In the previous exercises, you used the Render Surface Map tool to create image files that could be used to create or modify how textures appear on your objects. Now you will experiment with painting texture directly on an object in the 3ds Max viewports.

1. Open the `C08_ColumnSurround ViewportPaint.max` file from this book's website. This is the same model you have been working on but with a fresh Arch & Design material applied to it.

2. On the Menu Bar, choose Tools ➢ Viewport Canvas to open the Viewport Canvas dialog box, as shown in Figure 8.103.

   The Viewport Canvas tools have been in 3ds Max since the 2010 version. The Viewport Canvas tools allow you to paint textures directly onto your UVW-mapped 3D models right in the viewport.

FIGURE 8.103
The Viewport
Canvas dialog box
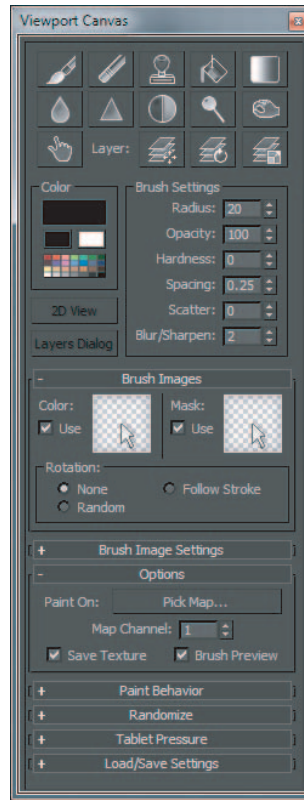
3. In the Viewport Canvas dialog box, click the Paint tool in the upper-left corner, and select Diffuse Color Map from the menu. Since there is no texture map currently applied to the Diffuse Color map, the Create Texture: Diffuse Color Map dialog box appears. You can select a resolution for the new map, a base color, and the name and path to save the file.

   When working on objects with existing texture materials, if you select any of the bitmaps already applied to the object, you will be painting on and overwriting those images, which could ruin the texture files in your maps folders.

4. In the Create Texture: Diffuse Color Map dialog box that comes up, in the Preset Sizes area select 512, unless you have a state-of-the-art workstation with plenty of RAM and unused hard drive space. If so, you can use a higher resolution. Click the ellipsis button in the Save New Texture To group, and in the Save Texture To dialog box, browse to where you are keeping the files for this chapter. Name the new texture **MyColumnSurround001_ Diffuse_Color.tif**, and click the Save button. Make sure to set Image Type to 8-Bit Color and click OK. Then click OK again in the Create Texture dialog box.

   Viewport Canvas works like many layer-based painting applications, such as Adobe Photoshop, and it has an incredible number of features and tools that you can use to create new bitmaps for you models.

5. On the Layers floater, which should have opened after you saved the Diffuse map in the previous step, click the Layer menu and select New Layer, which creates Layer 1, as shown in Figure 8.104.

FIGURE 8.104
The Layers floater
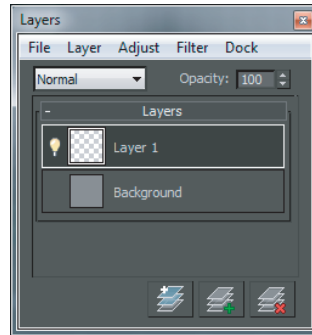
6. Click Layer 1 to make sure it is the current layer.

7. In the Viewport Canvas dialog box, click the color swatch and pick a color you like.

Now you can start painting on the column in the viewport. You can use your mouse, or your pen tablet if you have one, to orbit the viewport and see how your paint strokes are applied to the model.

Experiment with the Brush Settings, such as Radius, Hardness, Spacing, and Scatter. These are very similar to the types of brush controls that you find in other digital painting programs.

Take the time to explore the Viewport Canvas tools. Try using a Brush Image to paint with another bitmap on the model. The Cavity map that you rendered earlier and used as a material mask can also be used as a mask to limit where you can paint on the model. Paint with different colors on different layers, and then try seeing how the layer blending modes change the appearance of the final map. You can also switch to working on a traditional 2D view of your new texture maps if you are more comfortable painting that way.

8. Once you have finished painting, right-click in the viewport to access the Save Texture Layers dialog box, where you can save your map as a layered Adobe Photoshop PSD file or flatten it to save it as a TIF, PNG, or JPEG file.

9. Save your scene as **MyViewportCanvas.max**.

If you open one of the modes of the Material Editor and go to the Material/Map Browser, you should notice that the `Mastering3dsMax2013.mat` Material Library you used earlier in the chapter is still loaded. Material Libraries are persistent and stay loaded within 3ds Max, even across sessions, until you close them.

1. To close the `Mastering3dsMax2013.mat` Material Library, open the Compact Material Editor.

2. Click the Get Material button to open the Material/Map Browser.

3. Scroll to the top of the Material/Map Browser so that you can see the `Mastering3dsMax2013.mat` LIB header.

4. Right-click the `Mastering3dsMax2013.mat` LIB header to open the Options menu for the Material Library.

5. Click Close Material Library at the bottom of the menu.

You have now detached the Material Library from 3ds Max.

In this chapter, you experienced the many facets of using textures and mapping in 3ds Max 2013—creating materials, working with texture maps, applying mapping coordinates to your objects, building complex materials, and even painting textures directly on geometry in the 3ds Max viewports. However, this chapter only scratched the surface of what can be accomplished in 3ds Max; there is only so much that can be covered in the limited number of pages available in this book (and I have gone way over my allotment as it is!). It is up to you to experiment further with what you have learned, explore the Material Libraries and maps that ship with 3ds Max and its sample files, and use the provided Help system to learn more.

The Bottom Line

Create and edit materials. Quality materials can add significantly to the quality of a scene. Materials are constructed by choosing a shader, setting its parameters, and then adding and adjusting maps.

> **Master It** Using the `Masonry.Unit.Masonry.Brick.Modular.Running.Grey.jpg` file in the `3ds Max 2013/maps` folder installed with 3ds Max as the diffuse color map, create a Standard material and assign it to an object.

Select shaders. The shader that you select determines how a material appears when a scene is rendered. The most obvious difference between the different shaders is the appearance of the specular highlight.

> **Master It** Using the material from the previous "Master It" exercise, examine the result of assigning the different shaders to the material. Which shader results in a stretched-out specular highlight? Which shader has the most diffused highlight?

Use bump maps. Image maps assigned to the diffuse color channel of a material tend to look flat, like decals or wallpaper. Adding a bump map can add apparent detail without increasing the complexity of the models.

> **Master It** Continuing from the previous "Master It" exercise, add a noise map to the material's Bump channel to roughen the surface. Copy and rename the material in the Material Editor, and then replace the Noise bump map with the same map used as the diffuse color map. Apply the new material to a copy of the sphere in the scene. Compare the differences in the viewport.

Create a material with sub-materials. Often, a model that is constructed as a single object may represent a structure composed of several objects, each with its own material. The multi/sub-object material is used to assign several distinct materials to a single object.

> **Master It** What is one procedure for creating a multi/sub-object material?

Add entourage. Adding entourage to your scenes can make them seem like they are inhabited and help create a sense of scale to which viewers can relate.

Master It Using the `Tree01AM.tif` and `Tree01op.tif` files you downloaded with this chapter's materials, create a new entourage material with the Compact Material Editor and apply it to a plane so that you can render it.

Use the Autodesk Materials. The Autodesk Materials provide high-quality materials that can help you better simulate real-world materials to enhance the accuracy and realism of your renderings.

Master It Using the `My_C08_Condo_mentalray.max` file that you worked on in this chapter, change the Standard Metal_Chrome_Han material into the Chrome – Polished Brushed Autodesk Material, and render the scene.

Use the Displace modifier. Applying the Displace modifier or applying materials using displacement maps to simple objects can be a powerful way to create highly detailed or irregular forms without taking the time to build the complex geometry.

Master It Create a 50′ × 50′ plane, with 100 Length and Width segments. Apply a Displace modifier that uses the `Bench_d.jpg` image, which tiles six times across the surface.

Using the Camera

If you've ever taken a drawing class, you've probably been shown the importance of carefully observing your subject. It's important to be aware of the details of a scene or landscape that might otherwise go unnoticed. By recording these details in your sketches and preliminary drawings and then addressing them in your models and scenes, you can create a sense of depth and realism.

When you create an Autodesk® 3ds Max® 2013 scene, it helps to recall those lessons in observation, even though you may not be creating a scene from real life. If you're creating a rendering of a building with lots of glass, it helps to take a look at buildings and carefully study how glass reflects the surrounding landscape. If you're doing an interior rendering, you may find it helpful to find a room that's similar in size and composition to the one you are rendering and to examine carefully how the light from various sources is reflected throughout the room. By understanding the behavior of materials and light in the real world, you are better equipped to create realistic scenes in 3ds Max.

In this chapter, you'll take a look at the process of setting up your scene for a virtual photo shoot. This process includes placing a camera and setting up the relationship between the subject being shot and its surrounding environment.

In this chapter, you will learn to

◆ Understand the 3ds Max camera

◆ Set up an interior view

◆ Create an environment

◆ Render elements for compositing

◆ Use the Camera Match utility

Understanding the 3ds Max Camera

So far, you have been working with the standard views, including the Top, Left, Front, Orthographic, and Perspective viewports. By constantly changing the standard views by zooming, panning, and rotating, you have learned to view objects from all angles as you modeled them. When you place a 3ds Max camera, that camera holds a particular point of view that you can use to frame a particular composition such as a helicopter (or crane) view of a large project site or an interior space for a rendering.

3ds Max cameras follow the Single Lens Reflex (SLR) camera metaphor, where you can make adjustments such as changing the focal length of the lens from telephoto to wide angle or

changing the focal depth, which is akin to changing the f-stop on the lens to capture depth-of-field effects. Once you carefully place your camera in the scene, you can switch into this composed point of view and render the scene from within the camera.

Adding a Camera

In this exercise, you'll add a new camera in 3ds Max. You'll add a camera that shows an interior view of the courtyard on the second floor of the Villa Savoye model.

1. Open the C09_Camera_Start.max file from the Sybex website (www.sybex.com/go /mastering3dsmax2013).

2. Right-click the Top viewport to make it active, maximize it, and then use the Zoom Region tool to enlarge the view so that it looks similar to Figure 9.1. Make sure the Top viewport is displaying in the Wireframe rendering mode. If it needs to be changed, you can do so by clicking the Viewport Shading label and selecting Wireframe.

FIGURE 9.1
Click and drag these points to place the camera.

Click and start dragging from here.

Click here to set the camera target location.
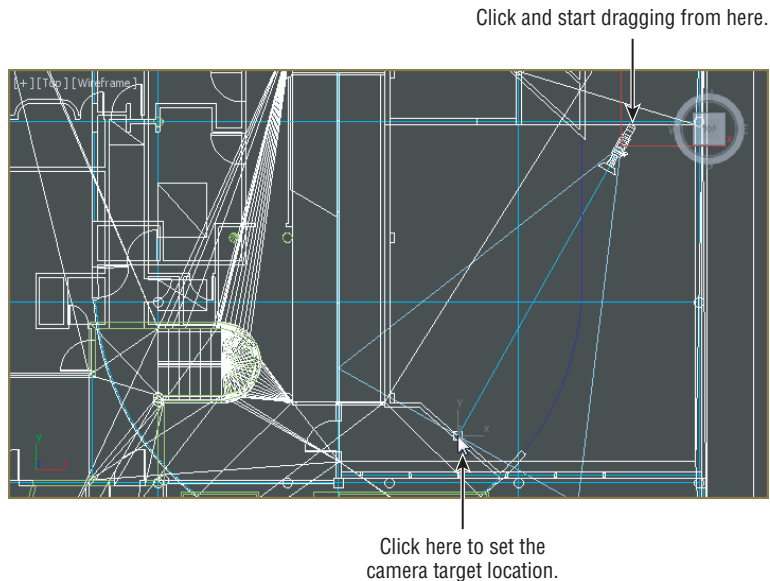
3. Click the Cameras icon in the Create tab of the Command panel (see Figure 9.2).

FIGURE 9.2
The Cameras icon found on the Create tab
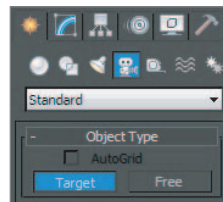
4. Click the Target button in the Object Type rollout.

5. In the Top viewport, click and drag the point shown in Figure 9.1.

6. Move the cursor toward the lower left of the viewport. As you do, you see a rubber-banding line from the point you selected in step 5. Click the point shown in Figure 9.1.

7. You've just created a target camera. Click the Maximize Viewport Toggle to display all four viewports. Now give your new camera a name. In the Name And Color rollout in the Command panel, change the name from Camera001 to **MyCamera**.

8. Click the Select By Name tool and, in the Select From Scene dialog box, Ctrl+click to select both the `MyCamera001` and `MyCamera001.Target` objects and click OK.

9. Click Zoom Extents All Selected. This zooms all the viewports to the selected camera, as shown in Figure 9.3.

FIGURE 9.3
The new camera in
the viewports
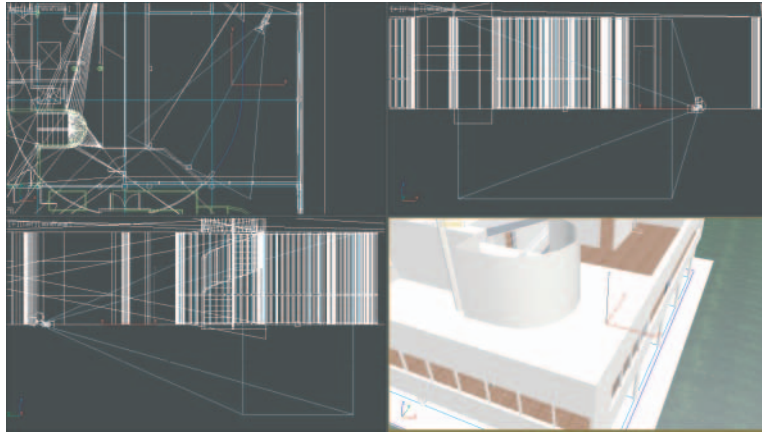
RENAMING CAMERAS

3ds Max automatically assigns the name Camera001 to the first camera created in a scene. Subsequent cameras are named Camera002, Camera003, and so on. To help associate a camera with a view, you might consider assigning your cameras meaningful view names, just as you would name geometry in your model.

CERT
OBJECTIVE

10. Right-click the Perspective viewport; then type **C**. The viewport changes to show the view from your new camera, and the viewport label changes to match the name of the camera.

11. Right-click the Shading Viewport Label, and set the mode to Realistic. Your camera viewport should look like Figure 9.4.

FIGURE 9.4
The view from the
new camera
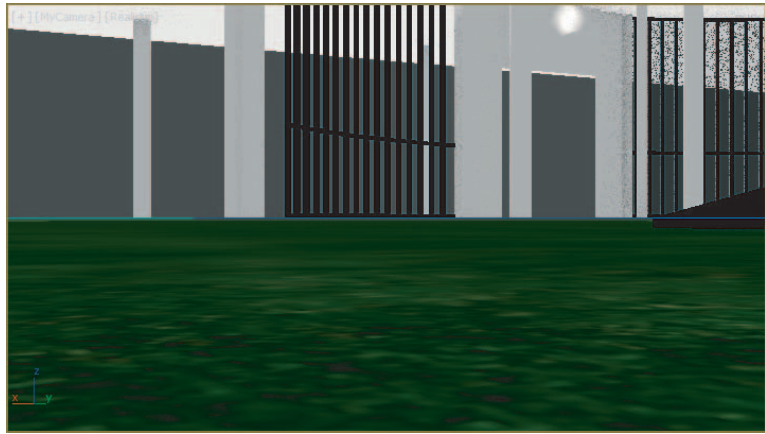
The sections of the ground plane nearest to the camera may appear to be missing. This is a phenomenon called clipping. *Clipping* is a feature in which the viewport or camera hides certain faces in the scene based on the distance from the camera. The clipping distance can be adjusted so that more or less of the scene is clipped from view. You will experiment with the Camera Clipping values later in this chapter.

If you are working in a scene with extremely small or large units, the Perspective viewport's default clipping values may hide portions of the scene. To remedy this, you would use the POV viewport menu and select Viewport Clipping. This displays the Viewport Clipping sliders near the right edge of the viewport, as shown in Figure 9.5.

FIGURE 9.5
The Viewport
Clipping sliders
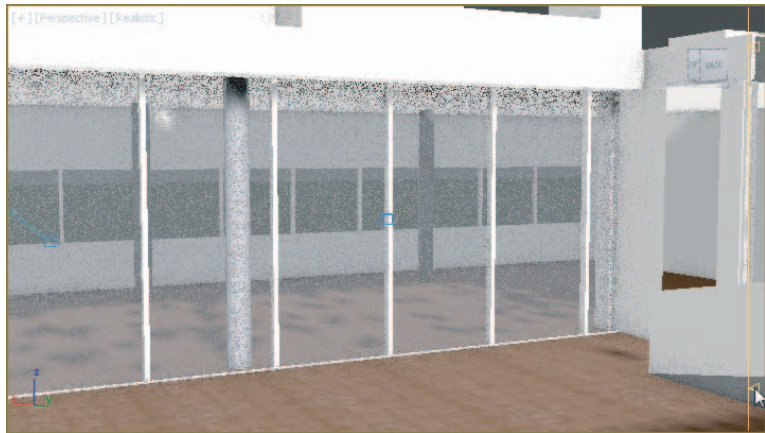
If elements of the viewport closest to you are cut off, you could drag the Near Clip slider (the lower triangle) down to move the clipping plane closer to you. Conversely, if elements farther away in the viewport are clipped, you can click and drag the Far Clip slider to move it up and push the viewport Far Clipping plane farther away.

THE C SHORTCUT KEY

The C shortcut key produces different results depending on the number and status of the cameras in the scene. When there is a single camera in the scene, pressing the C key switches the current viewport to the Camera viewport. When multiple cameras exist and none, or more than one, are selected, the C shortcut key opens the Select Camera dialog box, where you can select a camera from which to view the scene. When a single camera is selected, regardless of the number in the scene, the C key uses that camera as the source for the viewport. If no cameras exist in the scene, pressing the C key opens a dialog box stating "No cameras in scene."

Your new camera displays as a simplified camera shape, and the camera target simply displays as a small-cube helper object. The camera's field of view is also shown, when the camera is selected, as a cyan pyramid. Notice that the camera was created on the ground plane defined by the XY-coordinates. As with all newly created objects, the camera and target originate by default on the XY-plane of world space. The camera's current location won't give you a view of the courtyard, which is on the second floor. You can move the camera into position to get a courtyard view after taking a moment to study some of the camera parameters in the Command panel.
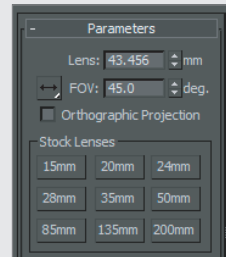
You have the option to define a variety of camera settings. At the top of the Parameters rollout, you see the Lens setting, which adjusts the camera's focal length. A camera's focal length determines its field of view. In fact, just below the Lens setting is the FOV setting (which stands for "field of view"). If you prefer, you can enter the field of view in degrees instead of entering the focal length. When you change one setting, the other setting also changes in an inverse relationship. 3ds Max offers a default focal length of approximately 43 millimeters, or an FOV of 45 degrees, which is close to the typical focal length found in most cameras. (A setting of 43 simulates the human eye.) Below the Lens and FOV settings, you can select from a set of stock lenses with predefined focal lengths.

Using different lens focal lengths allows you to control the view of your scenes that will be rendered, much like a cinematographer determines which lens to use to frame a shot in a film. Your choice of focal length can be based on many criteria from practical to emotional. This book can't provide you a course on cinematography, but there is a list of suggested reading on the subject at the end of this chapter.

You might also notice the Orthographic Projection check box. This check box changes the view from a perspective to an orthographic projection. With this setting selected, your camera view will appear as a flat projection (like the top or right views) instead of a perspective view. The Orthographic Projection check box is handy for creating rendered elevations of building or other linear models.

ADJUSTING THE CAMERA LOCATION

CERT
OBJECTIVE

As with any other 3ds Max object, cameras and targets can be moved or rotated using the transform tools, although the Rotate transform is somewhat limited. The Uniform Scale option has no effect on a camera; however, the Non-Uniform Scale and Squash options change the shape of a camera's field-of-view cone. Cameras come in two different styles that determine how the camera's orientation is managed: free and target. A *target camera* is made up of both the camera and a Target helper object. The camera remains oriented toward the target regardless of which object is moved or where. The Rotate transform affects only the camera's local Z-axis, the axis that points toward the target; it can add a roll to the camera but cannot change the camera's orientation. Rotating the target has no effect on the view that the camera generates. If you look closely, you will notice a line connecting the camera and target. Selecting this line selects both the camera and the target for tandem Move or Rotate operations.

Free cameras do not have targets and can be moved by selecting the camera body only. Rotating the camera rotates the view that it generates. In most cases, the Local Reference Coordinate System should be used to rotate a free camera to better control the direction that the camera is facing.

Choosing which type of camera to create isn't difficult and, like most of 3ds Max's features, isn't permanent. A good rule of thumb is to use a target camera when the camera is stationary but must follow animation in the scene, and use a free camera when the camera's position is animated. The Type drop-down list in the Parameters rollout contains the options to switch the selected camera's type. In this exercise, you'll see how moving your camera affects its view.

1. Right-click the Left viewport. Then use the Zoom Region tool to enlarge the view of the camera and its view cone.

2. Click the Select By Name tool on the Main Toolbar. Then, in the Select From Scene dialog box, Ctrl+click the `MyCamera.Target` listing (MyCamera should already be selected in the list) and click OK. By doing this, you include both the `MyCamera` camera and `MyCamera.Target` in the selection.

RENAMING CAMERAS AND TARGETS

Renaming a camera automatically renames the target to match it with a `.Target` suffix. Renaming a target, however, does not change its associated camera's name.

---

3. Click the Select And Move tool; then, in the Left viewport, click and drag the Y-axis handle of the transform gizmo. Watch the MyCamera viewport. The view looks as though you are riding an elevator up to the second floor.

4. Set the vertical camera location so that the MyCamera object is approximately 18′ above ground level. As you move the objects, watch the Y Transform Type-In field at the bottom of the 3ds Max window.

While you are moving the camera location, you get immediate visual feedback by watching the MyCamera viewport. In this exercise, you moved both the camera and the target together to adjust the view. Next, you'll fine-tune the camera view by moving only the target.

If you want to match a camera to an existing Perspective viewport, you can do so by choosing Views ➢ Create Camera From View or by pressing Ctrl+C. If a camera is selected in the scene, it is modified to match the viewport. If no camera is selected, a new camera is created.

ADJUSTING THE TARGET

The MyCamera camera is at an elevation that roughly approximates the height of a person standing on the second floor. Both the camera and the target are at the same elevation. You'll want to drop the target location down a bit to center the view of the courtyard.

1. Click the Select By Name tool on the Main Toolbar again, or type **H**.

2. In the Select From Scene dialog box, locate and click `MyCamera.Target`. This will deselect any previously selected objects. Then click OK. You can also try to select the target using the Select Object tool. If you don't select the camera target on the first try, keep clicking without moving the mouse; this will cycle the selection through the nearby objects. Another method for selecting a target is to select the camera, right-click, and then choose Select Camera Target from the tools 1 quad menu.

3. In the Left viewport, click and drag the Y-coordinate arrow down about 2′ until the MyCamera viewport looks similar to Figure 9.6.

FIGURE 9.6
Adjust the camera target location until your view looks like this one.
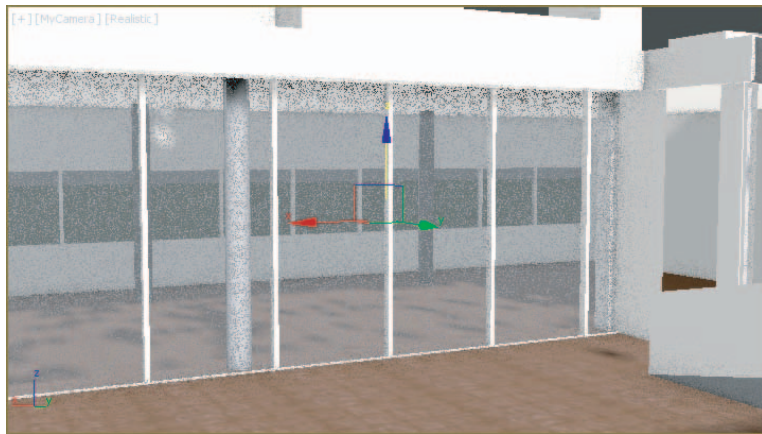
3ds Max Viewport Improvements

If you are upgrading from 3ds Max 2009 or earlier, you will see that many improvements have been made to the viewports in 3ds Max:

3ds Max 2013 uses Nitrous drivers instead of Direct3D as the default viewports. The Nitrous Accelerated Graphics Core was a new feature introduced in 3ds Max 2012 and designed to take advantage of the power of modern GPUs (the Graphical Processing Unit on your video card).

◆ Revised viewport menus, which in 2009 and earlier required you to right-click the viewport label to launch a menu to determine shading mode, show backgrounds and safe frames and configure the viewport layout in addition to other tools. In releases since 3ds Max 2010, these features are divided into three viewport menus: General, Point Of View, and Shading.

◆ Some viewport modes can show soft shadows.

◆ Some viewport modes can show ambient occlusion.

◆ The tools for seeing scene lighting and shadows in the viewport are found on the Viewport Shading menu. Click the viewport label to access the Shading menu, and then choose Lighting And Shadows to gain access to these options.

◆ A tool called xView is available from the General viewport menu. xView lets you diagnose problems in your geometry, such as overlapping faces, unwelded vertices, and face normal orientation.

Note that you need to be running the Nitrous or Direct3D drivers in order to take advantage of these new features. Also, your graphics card has to support SM3 (Shading Model 3). Older graphics cards may not be able to display some of these features, such as viewport shadows. If you are an experienced 3ds Max user, take the time to explore these menus and submenus to familiarize yourself with the new location of the tools because they have been cleverly scattered among the General, Point Of View, and Shading menus. The goal of the Nitrous viewports is to allow you work faster by increasing overall viewport performance and by providing you a much better representation of how your scene will look when rendered. This should allow you to save time by reducing the need to do test renders (hopefully) altogether. There are, however, some features that do not work (yet) with the Nitrous viewports. Depending on your workflows and the material shaders you use, it may be better for you to change the viewport driver and work with the Direct3D driver mode. Changing the viewport driver is covered in Chapter 1, "Getting to Know Autodesk® 3ds Max® 2013." More detailed information about the Nitrous viewports appears on the Autodesk 3ds Max website.

Editing the Camera Location with the Viewport Tools

In the previous chapters, you used the viewport navigation tools in the lower-right corner of the 3ds Max window to control your Perspective and Orthographic viewports. You learned that, in a Perspective viewport, the tools offered on the viewport controls change to tools more appropriate to the perspective view. Similarly, when you have a camera assigned to a viewport, the viewport controls offer a set of tools uniquely suited to cameras. These Camera viewport tools serve not only to alter the view in the Camera viewport but also to edit the camera's location and orientation as well.

Using the Dolly Camera and Field-Of-View Tools

To get a close-up view of a particular portion of your model, you typically use the Zoom Region tool or the Zoom tool in the Orthographic viewports. In a Camera viewport, there really isn't an equivalent to the Zoom Region tool. You do have two tools that have the same effect as the Zoom and Field-Of-View tools for the Perspective viewport.

The Dolly Camera tool acts similar to the Zoom tool in a Perspective viewport by moving the camera toward or away from the target in a straight line. You have the added advantage of being able to see the effect of the Dolly Camera tool on the camera location. Try the following exercise to see firsthand what Dolly Camera does.

CERT OBJECTIVE

1. Select the MyCamera camera, and then right-click in the MyCamera viewport to make it active.

2. Click the Dolly Camera tool in the top-left corner of the viewport controls area.

3. Click and drag upward in the MyCamera viewport, and notice what happens in the other three viewports. The MyCamera viewport enlarges, and you can see the camera move closer to the target in the other viewports. Notice that only the camera moves; the target remains stationary.

4. Release the mouse button, and then click the Undo Scene Operations button, or press Ctrl+Z, to return the camera to its previous location (where it was before you used the Dolly Camera tool).

UNDO VIEW CHANGE

Choosing Views ➢ Undo View Change has no effect on changes to Camera viewports. As with any other parameter modification, you can undo Camera viewport changes by pressing Ctrl+Z or clicking the Undo Scene Operations button on the Quick Access toolbar.

---

5. Click the Field-Of-View tool; then click and drag up in the MyCamera viewport.

Notice what happens to the camera in the other three viewports; the camera's field-of-view cone decreases in size.

6. Click the Modify tab, and watch the camera parameters as you adjust the Field-Of-View settings. Notice that the Lens and FOV settings change with the adjustments of the Field-Of-View tool.

7. Adjust the view so that the Lens parameter shows around 35 mm.

The Field-Of-View tool alters the camera field of view just as it does for the Perspective viewport. The only difference is that now you can see its effect by watching the camera. Field-Of-View is very useful when doing interior shots; it lets you see more of an interior without the camera moving back through a wall. As you click and drag the Field-Of-View tool, you see the cyan-colored field-of-view cone change in the Top, Left, and Front viewports (see Figure 9.7).

FIGURE 9.7
The field of view of a camera changes when you click and drag the Field-Of-View tool.

Using Field-Of-View changes the size of the camera view cone.
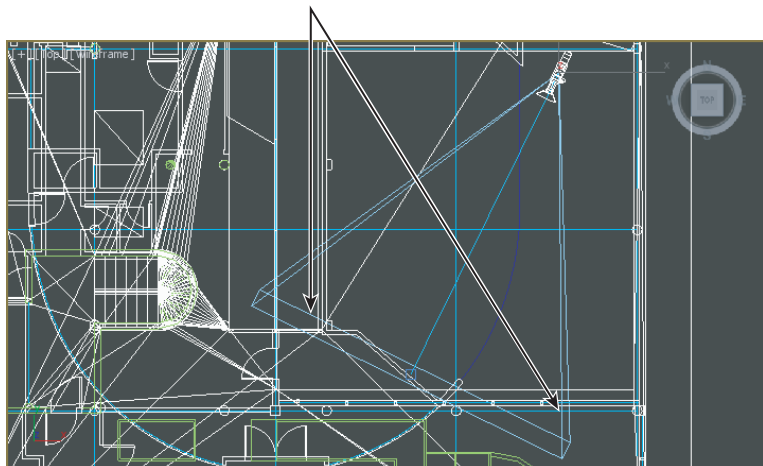
Hold down the Dolly Camera button to access two additional tools from the Dolly Camera flyout. The second tool down, Dolly Target, functions similarly to the Dolly Camera tool except that it moves the target rather than the camera. The bottom option, Dolly Camera + Target, moves both the camera and target along the vector that joins them.

A tool that performs a function similar to that of the Field-Of-View tool is the camera's Perspective tool.

The Perspective tool also changes the camera's field of view, but it simultaneously moves the camera closer to or farther away from the target. This has the effect of keeping the size of the objects near the target a consistent size in the Camera viewport while the field of view changes and the objects in the camera's periphery distort. Animating this feature creates the vertigo effect made famous in the Alfred Hitchcock movie of the same name.

If you set up a camera for a wide field of view, the perspective view may begin to exaggerate the vertical taper of tall objects. You can compensate for this exaggeration by using the Camera Correction modifier, which creates the illusion of a two-point perspective. See Bonus Appendix 1, "Modifiers, Maps, and Materials" (from the Sybex website `www.sybex.com/go /mastering3dsmax2013`), for more information.

CAMERAS DON'T COST A THING

When we teach 3ds Max classes, it seems that, inevitably, some students are hesitant to create very many cameras. As they guide people through their projects, they'll tend to move a single camera through the scene, changing its position and orientation to focus on the different features they've created. Not only is this a slow procedure, but it also eliminates the ability to re-create the exact framing of the scene efficiently from one moment to the next. Don't be frugal with your 3ds Max cameras; place them liberally throughout the scene and be sure to give them descriptive names so that you will know their intended purpose.

One question that is often asked in class is when to use a free camera rather than a targeted camera. The answer depends on whether the camera's position will be animated. It's almost always preferable to animate a free camera over a targeted camera. With a free camera, there is no need to accommodate the transforms of the camera's target objects. If the orientation of the camera is animated but not the camera's position, it's usually easier to animate the position of the target object, which controls the camera's orientation. When you first create a camera, start with a target camera; it's easier to orient than a free camera, and you can always change it to a free camera if you prefer.

TRUCKING YOUR CAMERA VIEW

Like the Dolly Camera and Field-Of-View tools, the Truck Camera tool moves the camera as it alters the camera view. You can see exactly how the Truck Camera tool works by the way that it moves the camera and target.

1. Click the Truck Camera tool in the viewport controls.

2. In the MyCamera viewport, the cursor changes to a black hand. Click and drag in the MyCamera viewport, and watch what the camera does in the Top, Left, and Front viewports.

   The camera and target move together in a path perpendicular to the direction that the camera is pointing. This is similar to using the Pan tool in noncamera viewports.

3. Click the Undo Scene Operations tool to return the camera and target to their previous locations.

WALKING THROUGH YOUR SCENE

Similar to the Truck Camera tool, the Walk Through tool provides tools for moving a camera through your scene. The controls for navigating the camera consist of both mouse movements and keyboard sequences, similar to many PC-based video games. The Walk Through tool is located on the Truck Camera flyout.

1. Choose Edit ➢ Hold to save your scene's current state temporarily.

2. Click and hold the Truck Camera tool in the viewport controls, and then release the mouse over the Walk Through tool, as shown in Figure 9.8.

FIGURE 9.8
Accessing the Walk
Through tool

3. Click and drag in the MyCamera viewport. The cursor changes into a circle with a dot in the middle and the scene appears to be rotating in front of the camera, as shown in Figure 9.9. Depending on the quality and settings of your video card, the viewport may degrade to the Wireframe display mode.

FIGURE 9.9
Navigating the
scene with the Walk
Through tool
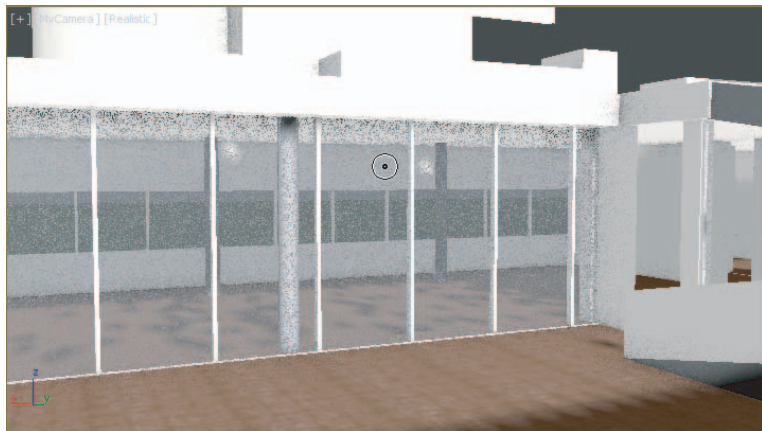
4. Press and hold the **W** key and observe the viewports. In the Top viewport, the camera appears to be moving forward in the same manner as the Dolly Camera + Target tool, but this is not the case. Look closely in the Left viewport, and you will see that the camera's and target's elevations are not changing (they are not moving in a vector shared by their displacement); they are moving forward as a person would in the scene.

5. Press the **Q** key, and then press and hold the **S** key. The camera moves backward but faster than it moved forward. The Q and Z keys control the speed of the camera's movements.

6. Simultaneously hold down the **A** key while dragging the mouse up and to the right. The camera trucks to the left while it rotates up and to the right.

7. Choose Edit ➢ Fetch to restore your scene to the state it was in prior to step 1. Click Yes in the dialog box that opens.

With a little practice, you will be able to traverse your scene easily while keeping the perspective of a person walking through it. Table 9.1 describes the keyboard controls available to the Walk Through tool.

Num Lock must be turned off when you are using the arrow keys in the numeric keypad.

TABLE 9.1:   Default Walk Through tool keyboard controls

SHORTCUT	DESCRIPTION
W, up arrow	Moves the camera forward
S, down arrow	Moves the camera backward
A, left arrow	Trucks the camera to the left
D, right arrow	Trucks the camera to the right
C, Shift+down arrow	Moves the camera and target down
E, Shift+up arrow	Moves the camera and target up
[	Decreases the space between each movement (step size) when a key is pressed
]	Increases the space between each movement (step size) when a key is pressed
Alt+[	Resets the step size to the default value
Q	Increases the speed of the movements
Z	Decreases the speed of the movements
Shift+spacebar	Orients the camera horizontally and eliminates any tilt or roll
Spacebar	Prevents the camera from tilting up or down

ROTATING THE CAMERA

You've used the Orbit tool to move your point of view in the Perspective viewport. When you're working with a Camera viewport, the functionality of the Orbit tool is divided into two tools: the Orbit Camera tool and the Roll Camera tool .

The Orbit Camera tool performs the same function as clicking in the center of the green circle of the Orbit tool. Your camera location orbits about the camera target location as you drag, while remaining at a fixed distance from the target. If you are using a free camera, the camera rotates around an implied target located at the center of the end plane of the field-of-view cone. This is the same location where a target is located with a target camera. You won't see the green circle that you see with the Orbit tool. If you want to limit the camera motion to horizontal or vertical, you can hold down the Shift key as you click and drag the mouse.

The Roll Camera tool performs the same function as clicking and dragging the outside of the green circle of the Orbit tool. The camera view rotates around its local Z-axis, remaining at a fixed location.

There is also a flyout option under the Orbit Camera tool. You can click and hold the Orbit Camera tool to reveal the Pan Camera tool, as shown in Figure 9.10.

FIGURE 9.10
Accessing the Pan
Camera tool

The Pan Camera tool lets you change the direction in which the camera is pointing as if it were on a fixed tripod, without changing the camera's position. This is the exact opposite of the function that the Orbit Camera tool performs. Holding down the Shift key while using the Pan Camera tool constrains the motion to either a vertical or horizontal plane while moving the camera.

Setting Up an Interior View

Now let's focus our attention on the interior space. You may notice that it is difficult to see into an interior space when you are using the Perspective viewport. Placing a camera into an interior is a great way to see inside. You will switch back to a Perspective viewport to continue modeling after you have placed an interior camera. First, set up the camera to view more of the interior and less of the courtyard:

1. Right-click the Top viewport, and click the Maximize Viewport toggle to enlarge the viewport.

2. If you need to, adjust the view so that you can get a good look at the room toward the bottom of the viewport, as shown in Figure 9.11.

3. Click the Select And Move tool; then click the MyCamera camera that you made previously.

4. Hit the spacebar or click the Selection Lock toggle to turn on Selection Lock.

LOCKING THE SELECTION

You may find it easier to move objects with Selection Lock on because you can't inadvertently select anything else in this mode. Just be sure to unlock the selection after you're finished, or you won't be able to select anything else the next time you want to.

5. Shift+click and drag the camera in the XY-plane to the location shown in Figure 9.11.

FIGURE 9.11
Copying the
MyCamera camera

Copy MyCamera from here.

Drag the copy to here.
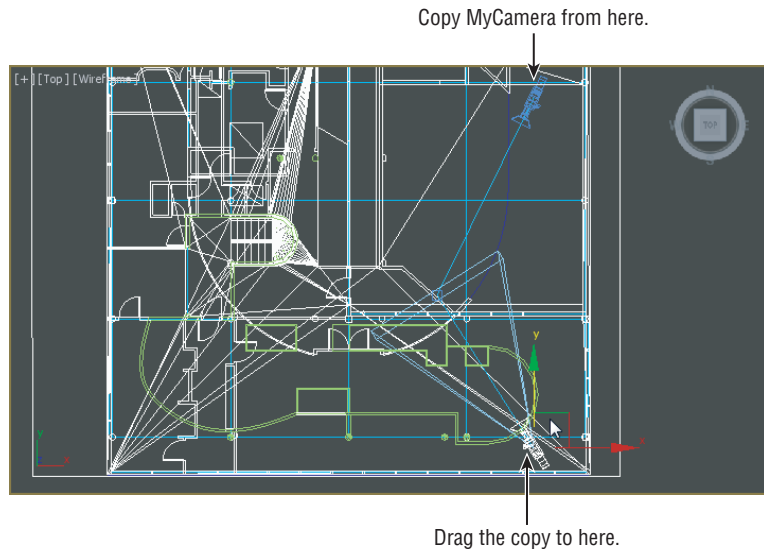
6. In the Clone Options dialog box, make sure the Copy radio button is selected; then click OK. Note that the name of the new camera is MyCamera001.

You now have a new camera for your interior view. Next, rotate the camera so that you are looking down the length of the room instead of out the window:

1. Click the Maximize Viewport Toggle to return to a view of all four viewports.

2. Right-click the MyCamera viewport to make it active; then right-click the POV viewport label and choose Cameras ➤ MyCamera001.

3. Click and hold the Orbit Camera tool in the viewport controls, and then select Pan Camera from the flyout.

4. Start dragging the cursor horizontally from left to right in the MyCamera001 viewport, and then hold down the Shift key to adjust the view so that it looks like Figure 9.12.

FIGURE 9.12
The new
MyCamera001
viewport
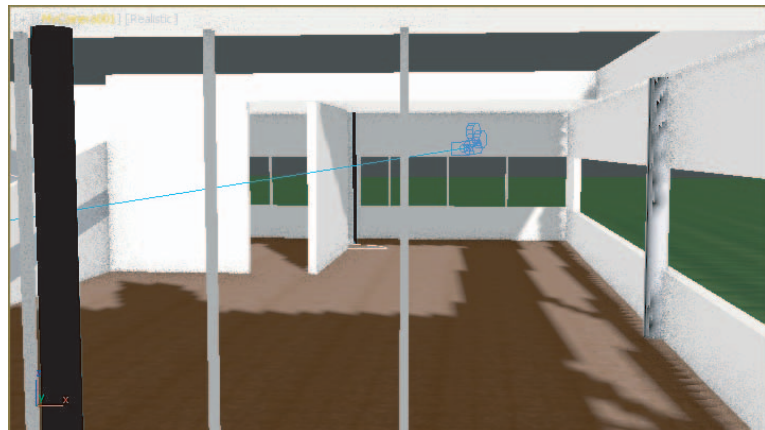
5. Click the Render Production tool to get a look at the room. Your view should look similar to Figure 9.13. Notice that there is a light source that illuminates the courtyard. This file is set up to use the Default Scanline Renderer.

FIGURE 9.13
A rendered view of the interior

You may notice that the rendering doesn't exactly match the shape of your viewport, depending on the resolution/aspect ratio of your monitor and whether you are running 3ds Max in full screen or Windowed mode. For example, the screen shots in this book are from 3ds Max 2013 running at 1680×1050 on a 1920×1200 monitor, to keep the widescreen aspect ratio. The default camera rendering resolution, and the resolution that this scene is using, is 640×480. A discussion of rendering resolutions and formats will be covered later in this book.

6. To see a representation of exactly which pixels will render in your viewport, you can click the POV viewport menu and select Show Safe Frames (or press Shift+F on the keyboard), as shown in Figure 9.14.

Your viewport should now look like Figure 9.15. You will notice that the viewport now has three concentric rectangles. These Safe Frame markers are a holdover from the days of standard definition televisions that had bezels that would obscure the edges of the TV screen. The bezels of different makes of TVs would cover different amounts of the screen, hiding those areas from the viewer. These Safe Areas were a way of ensuring that what was rendered would be visible in the final presentation of the image on almost any TV screen. The outermost rectangle is the limit of what will be rendered, and it matches the 640×480 aspect ratio set in the Output rollout of the Render Setup dialog box. The next inner rectangle is the Action Safe frame, meaning that action within this rectangle would

be visible to the viewer. The innermost rectangle is the Title Safe frame, indicating that you would want to make sure that any titles, credits, or other text elements that need to be read by the viewer would be within this rectangle. You can use the Safe Frames tab of the Viewport Configuration dialog box to determine which Safe areas to include the viewport, the percentages of the area of the viewport, and even enable a 12-field grid to help you with composing the content of your view.

FIGURE 9.14
Enabling Show Safe Frames in the MyCamera001 viewport
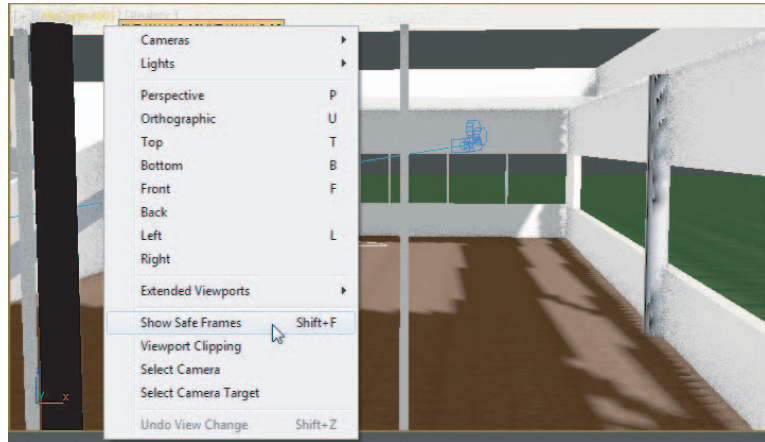
FIGURE 9.15
The MyCamera001 viewport with Show Safe Frames enabled
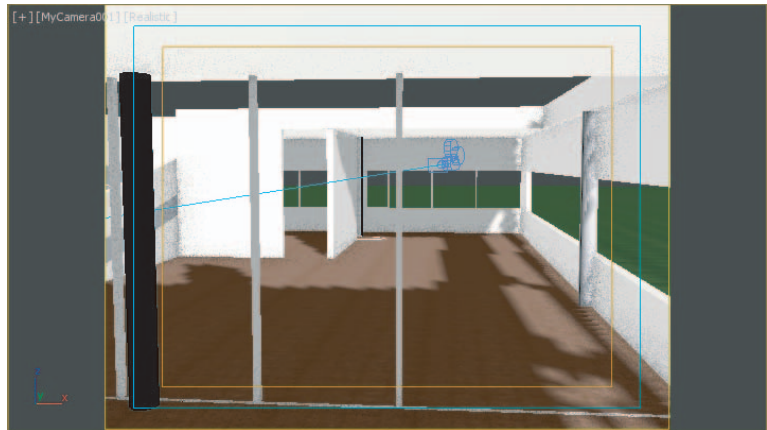
7. Disable the Show Safe Frames feature.

Creating an Environment

In the entertainment industry, artists are employed to produce background images (called *mattes* or *matte paintings*) to simulate special environments, such as mountainous terrain, a canyon, or

the interior of a space station. If you would like to learn more about creating matte paintings and their history and use in filmmaking, you should read *The Digital Matte Painting Handbook* by David B. Mattingly (Sybex, 2011). You can employ a similar technique using 3ds Max's environment background options. The *environment* in 3ds Max is everything surrounding the objects in your scene.

The following exercise will show you how to add a sky quickly to the villa model by adding a bitmap image for a background:

1. Continue with the previous exercise, or open `C09_Environment_Start.max` from the Sybex website (`www.sybex.com/go/mastering3dsmax2013`).

2. Choose Rendering ➢ Environment, or press **8** on the keyboard. The Environment tab of the Environment And Effects dialog box displays, as shown in Figure 9.16.

FIGURE 9.16
The Environment
And Effects
dialog box
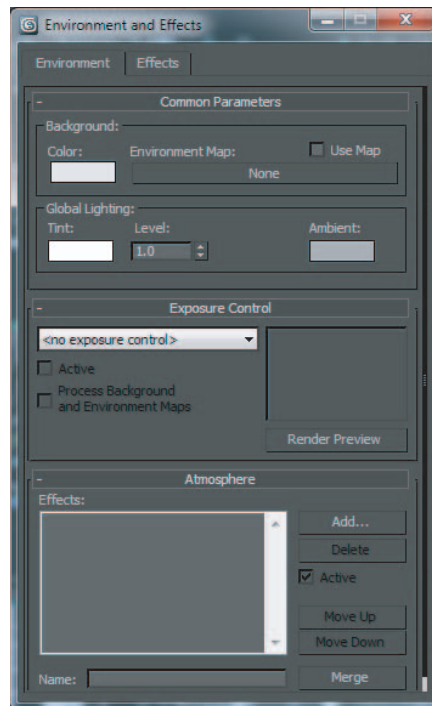
3. Click the Environment Map button labeled None just below the Use Map check box. The Material/Map Browser appears. Locate the Maps rollout, and you will see a list of map types in the Standard rollout. You may have to expand the Standard rollout to see all the map types.

4. Click the Bitmap option (Figure 9.17) in the list of map types, and then click OK.

FIGURE 9.17
Select Bitmap in
the Material/Map
Browser.
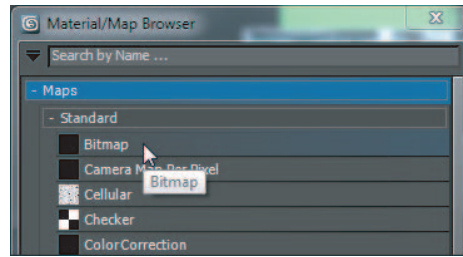
5. The Select Bitmap Image File dialog opens. Navigate to where you saved this chapter's resource files, and select the SUNSET90.jpg file. You'll see a preview of the selected file in the lower-right center of the dialog box. At the bottom right of the dialog box, you'll see statistics about the file.

   If you have an Autodesk Subscription for 3ds Max 2013, go to your Subscription Center and download and extract the Autodesk 3ds Max 2012 & Autodesk 3ds Max Design 2012 English Win Samples Files content. Once extracted, you can find a number of useful texture maps, including background maps at C:\Autodesk\Autodesk_3ds_Max_2012_&_Autodesk_3ds_Max_Design_2012_English_Win_Samples_Files\Maps and Materials.

6. Click Open. Note that the filename now appears on the Environment Map button.

7. Close the Environment And Effects dialog box. Make sure that the MyCamera001 viewport is currently active, and then click the Render Production button to see the result of your background addition. The model is rendered with a sky in the background, as shown in Figure 9.18.

FIGURE 9.18
The sky environment in the rendering

Figure 9.18 highlights a mismatch that often occurs between the lighting in the scene and the environment. Because light sources are independent of environment bitmaps, it is easy to set up lighting in your scene that doesn't necessarily go with the implied lighting in an environment image. In Figure 9.18, the environment shows a sunset while the lighting in the scene suggests midday sun. Clearly, one or the other of these two variables should be adjusted for a more realistic image. Keep this potential mismatch in mind when you design environments.

TURNING OFF THE VIEWPORT BACKGROUND

The environment background automatically displays in the viewport. To turn this off, choose Views ➢ Viewport Background, and then select either Gradient Color or Solid Color. You can use the Configure Viewport Background selection to access the Background tab of the Viewport Configuration dialog box, which provides additional options for the 3ds Max viewports.

Making Adjustments to the Background

In many cases, the background image will need to be adjusted to fit the scene. The background image may not fit the rendering correctly, or it may be too dark or light. You might notice that the sunset background is a bit below the horizon and is a bit dark overall. In this section, you'll use the Compact Material Editor to make adjustments to the background.

1. Click the Compact Material Editor button in the Main Toolbar.

2. In the Material Editor dialog box, click the sample slot on the right of the bottom row. Then click the Get Material button.

3. In the Material/Map Browser dialog box, open the Scene Materials rollout if it is not already visible.

4. Select the listing that shows SUNSET90.jpg in its title. You see a sample of the material to the left of the material label.

5. Double-click the SUNSET90.jpg listing. The sunset image appears in the selected sample in the Compact Material Editor. Parameters for modifying the background bitmap also display in the lower half of the Material Editor. Close the Material/Map Browser.

This may be the first time you have seen a map appear by itself in the Compact Material Editor. Remember that you can't apply maps by themselves to objects — maps are usually children of materials. You can, however, apply maps directly as backgrounds.

Once you have the background image in the Compact Material Editor, you have access to parameters that control its appearance. Next, you'll use the Coordinates rollout to offset the environment background in the viewport.

1. Go to the Coordinates rollout (see Figure 9.19), and try dragging the U and V Offset spinners.

FIGURE 9.19
The Coordinates
rollout lets you
adjust the offset.
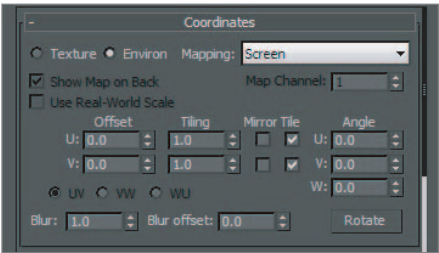
The environment background image moves in relation to the stationary geometry in the MyCamera001 viewport and in the Material Editor.

2. Click the label of the MyCamera001 viewport, and choose Cameras ➤ MyCamera from the context menu.

3. Using the Pan Camera tool, drag up in the viewport to aim the camera upward.

   You now have a better view of the sky above the courtyard. If you've turned off the display of the environment map in the viewport, turn it back on now.

4. Click the Mapping drop-down list in the Coordinates rollout. Change the mapping type to Spherical Environment.

UNDERSTANDING ENVIRONMENTAL MAPPING

Cylindrical and spherical mapping wraps the environment bitmap around the inside of these two corresponding shapes. Shrink-wrap mapping conforms the map to a complex concave surface. Screen wrapping is probably the most frequently used choice because it simply pastes the bitmap flat on the background screen like a matte painting.

Notice that the image distorts as it stretches around the inside of a large sphere that surrounds the model, as shown in Figure 9.20. You can see the clouds curving slightly as they wrap around the sphere.

FIGURE 9.20
Spherical environment mapping

Fisheye camera lenses have spherical distortion appropriate to a spherical environment mapping. In order to use spherical, cylindrical, or shrink-wrap environment mapping effectively, the bitmap used must be distorted in the same way. Otherwise, a "normal" bitmap would appear stretched if used in this way.

Because you will be using the SUNSET90.jpg bitmap, you should use screen mapping to paste the image directly into the environment without distortion:

1. Change the mapping type back to Screen.

2. In the Coordinates rollout, set the Offset amounts back to **0**. The bitmap will now be pasted directly into the background, as shown in Figure 9.21.

FIGURE 9.21
Screen environment mapping
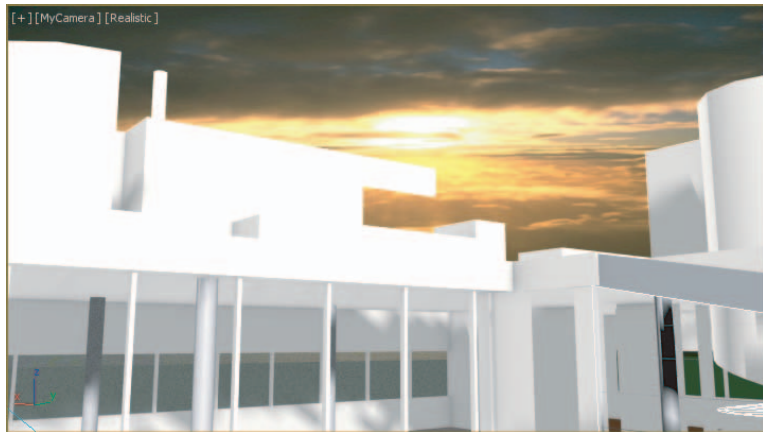
Right-clicking any spinner button sets the value to its lowest non-negative value possible.

You can adjust the Offset and Size spinners as desired to move and stretch the setting sun in the background until it is in an aesthetically pleasing location in relation to the building. Now let's see how to adjust the brightness of the background image:

1. In the Compact Material Editor, scroll down to the Output rollout and click to expand it. You'll see a graph and a set of check boxes and spinners, as shown in Figure 9.22.

2. Click the Enable Color Map check box in the Output rollout. The graph is highlighted so that you are able to adjust its settings.

If you're an Adobe Photoshop user, the Color Map graph should be somewhat familiar because it is similar to the Curves function in Photoshop. The color map lets you adjust the tonal range of an image by manipulating the line in the graph. Right now, the line goes straight from 0,0 in the lower-left corner to 1,1 in the upper right. You can adjust the brightness, contrast, and tonal range of an image by adding control points to the line and then moving the control points. The next exercise will show you some of the Color Map functions:

1. Scroll the Output rollout up or resize the Material Editor so that you can see the entire Color Map group; then click the Add Point tool on the toolbar.

2. Click the Color Map graph line at its midpoint, as shown in Figure 9.23. A square handle appears on the line.

FIGURE 9.22
The Material
Editor's Output
rollout
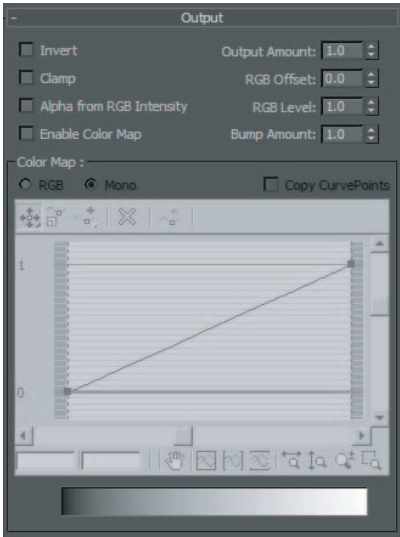
FIGURE 9.23
Click the midpoint
of the line.

Add a point here.
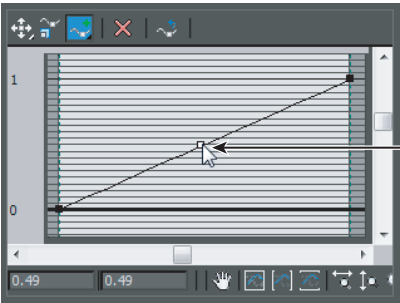
3. Click the Move tool on the Color Map toolbar. This button looks very similar to the Select And Move tool in the Main Toolbar.

4. Click the point you just created and drag it up and then release. Notice what happens to the sample slot image in the Material Editor. It gets brighter.

Changes to the output curves do not appear in the viewports, but they do appear in the Compact Material Editor and in rendered views. By adjusting the line upward at its midpoint, you've increased the amount of the midtones in the image. Let's see what other options you have to edit the curve. You can get direct feedback on the effect of your changes by viewing the sample bar at the bottom of the Output rollout.

1. Scroll the Material Editor panel upward so that you have a good view of the sample gradient bar, as shown in Figure 9.24.

2. Right-click the point you added and moved in the previous exercise, and then select Bezier-Smooth from the context menu.

FIGURE 9.24
Scroll the Output rollout of the Material Editor panel so that you can see a view similar to this one.

Sample gradient bar
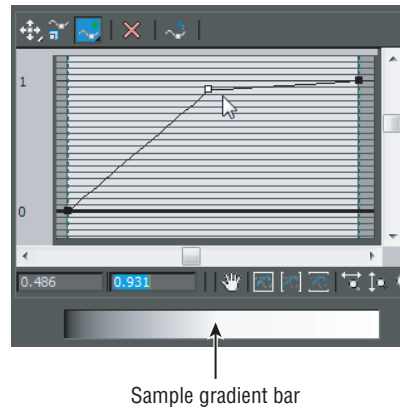
3. Move the point back to its midpoint position; then adjust the Bezier handles so that they look like those in Figure 9.25. The sample image fades in contrast, and the gray area of the sample tonal range below the graph widens.

FIGURE 9.25
The Bezier handles in a new orientation

The gray tones widen.
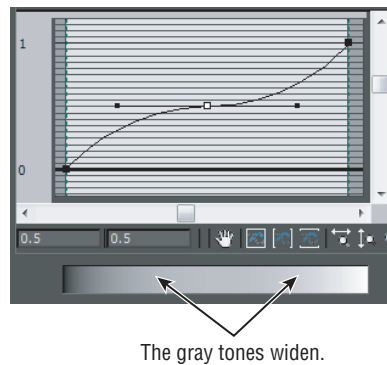
4. Now adjust the handles to look like Figure 9.26. The sample image increases in contrast.

FIGURE 9.26
The Bezier handles set to increase contrast
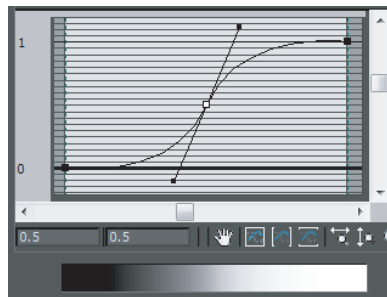
5. Finally, reposition the point to the left to brighten the image so that it looks like Figure 9.27.

FIGURE 9.27
To brighten the
image, move the
point to the left.
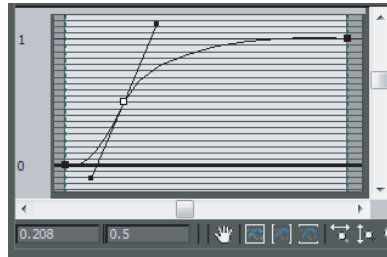
6. To see the changes applied to the environment material, make sure that the MyCamera viewport is active and click the Render Production button.

Besides the overall tone of the image, you can also manipulate the curves for each of the red, green, and blue color components. For example, suppose you want to increase the blue and downplay the red in the background. You can use the R, G, and B tools to isolate each color:

1. In the Output rollout, click the Copy CurvePoints check box and then click the RGB radio button at the top of the Color Map group. Copy CurvePoints forces the RGB settings to use the current curve settings.

2. Click the R and G toggles (see Figure 9.28) on the Output toolbar to deactivate them.

FIGURE 9.28
The Color Map RGB
tools

The tool buttons should look as if they are in an up position. The curve is now blue to indicate that only the blue component of the curve is active.

3. Now move the curve point up and to the left. The sample image becomes bluer.

4. Click the R button to activate the red component. Now you see two curves — one red and one blue.

5. Click the B button to deactivate the blue component. Then click and drag the handle on the red curve (see Figure 9.29) to the right just a little to reduce its strength.

Now the sky is bluer and a little less ominous looking, and you've seen that you have a lot of control over the background image.

You can use the Output options on any material that uses a bitmap. You can even apply an output map as a parent to those map types that do not already have a built-in Output rollout. Use the Output rollout in 3ds Max as a quick alternative to doing color correction on textures in Adobe Photoshop or a similar image-editing program. You can also use a color-correction map to achieve similar results. Just click the selector to the right of the material name (marked Bitmap), and choose Color Correction from the map type list. Keep the existing map as a sub-map, and then you can instantly adjust the hue, saturation, brightness, or contrast using the Color Correction parameters.
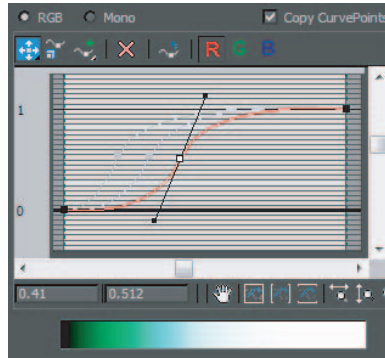
You can also edit the Ground-Grass Diffuse Color bitmap for the ground using the same tools you just used on the background. To gain access to the Output rollout for Maps, go to the Maps rollout and click the button for the map you want to edit. For example, you can click the GRASS2.jpg diffuse color map for the Ground-Grass material. You'll find the Output rollout at the bottom of the map parameters that appear in the Material Editor.

Using Immersive Environments for Animation

One of the limitations of using a matte painting is that the illusion breaks down if the camera moves more than just a little. You can perceive the flatness of the background especially if the camera turns, because the environment bitmap does not turn with the rest of the scene.

In animations where the camera moves, you must devise immersive environments where the background remains believable. One way to accomplish this is to use an abstract background that looks the same no matter where the camera turns. Another, more complex method is actually to model the environment with a large skydome object that envelops the entirety of the scene. You will learn how to create immersive environments that can be used in animated scenes here, but you won't dive into the subject of animation until Chapter 12, "Creating Animations, Particles, and Dynamics."

Creating a Believable Background

In animations where you are showing an outdoor flyby of a building or city, the background can be a simple gradient from bottom to top. Such a background will not appear to be static, because no objects in the background define a point of reference as the camera moves.

1. Continue with the previous exercise, or open C09_Skydome_Start.max.

2. Choose Rendering ➢ Environment. The Environment tab of the Environment And Effects dialog box appears.

3. Click the Environment Map button to open the Material/Map Browser.

4. On the Maps rollout, select Gradient from the Standard list and notice the sample next to the Gradient label. It shows a grayscale gradient from black at the top to white at the bottom.

5. Click OK to select the gradient map.

You've switched to a gradient map for the background, but you will want to add some colors to the gradient:

1. Click the Material Editor button on the Main Toolbar to open the Compact Material Editor if it's not already open.

2. If your Compact Material Editor displays only six sample slots, use the slide bar on the right to view the third row of sample slots just below the ones visible in the dialog box. Alternatively, you could click the Options button on the Material Editor's vertical toolbar and increase the number of visible material slots in the Slots area of the Material Editor Options dialog box that appears. Then close the Material Editor Options dialog box.

3. Click an unused material slot to select it; then click the Get Material button.

4. In the Material/Map Browser, expand the Scene Materials rollout, double-click the map listing that shows Map #24 (Gradient) [Environment] in the name. Your actual map number may be different. The material sample now shows the gradient.

Once you have the gradient in the sample slot, you can begin to adjust its parameters:

1. Close the Material/Map Browser.

2. In the Compact Material Editor, scroll down to the Gradient Parameters rollout and click the color swatch labeled Color #1.

3. In the Color Selector dialog box, set the Hue setting to **155**, the Saturation (Sat) setting to **219**, and the Value setting to **100**. This defines a dark blue color for the top of the gradient. Click OK to accept the color setting.

4. In the Gradient Parameters rollout, click the color swatch for Color #2.

5. At the Color selector, set the Hue setting to **155**, the Saturation to **125**, and the Value to **255** to define a lighter blue shade for the middle of the gradient.

6. Click OK when you've finished, and then close all the dialog boxes. Now you see a color gradient background in the MyCamera viewport, as shown in Figure 9.30. There may be some banding in the viewport background, but this will not appear in any rendered views.

FIGURE 9.30
Your scene with the gradient background

The new background looks like a typical clear sky with a gray horizon. It won't matter that the background remains the same throughout an animation, because the gradient colors won't give away the fact that they are not moving with the camera. Of course, you can use the gradient background for still images as well.

You can create an animated background by using an animated movie file or an animated file sequence for your scene's background. Likewise, you can create an animated texture by using an AVI or MOV file for a texture map. You can also animate a still background by animating the offset value of the map over time.

Using a Texture Map and Hemisphere for the Sky

The gradient background offers the illusion of a crystal-clear sky, but what if you want to add some clouds? You can simulate a cloudy sky by adding a flattened skydome over your model and then assigning to the dome a texture map that uses a bitmap of a cloudy sky. Here's how it's done.

First, you'll add the hemisphere object:

1. Click the Maximize Viewport toggle, if necessary, to display all four viewports.

2. Right-click the Top viewport, and then click the Zoom Extents tool in the lower-right corner of the 3ds Max window.

3. In the Create tab of the Command panel, click the Geometry button and select Sphere.

4. In the Top viewport, click and drag a sphere from the center of the building, as shown in Figure 9.31. Make the sphere extend to the corner of the ground plane with a radius of about 1,060 feet. On the Parameters rollout, set Segments to **18**.

FIGURE 9.31
Create a sphere with a radius of 1,060 feet.
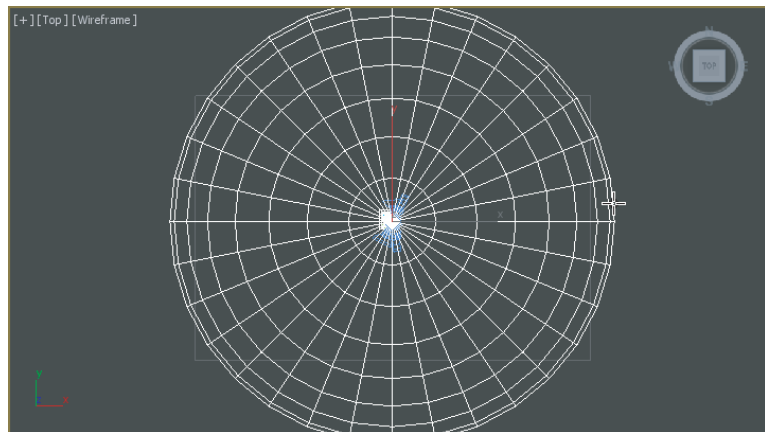
5. Right-click the Front viewport, and click the Zoom Extents button.

6. In the Command panel, change the Hemisphere parameter for the sphere to **0.7** and the mode to Squash. Most of the sphere will disappear, leaving the topmost portion. Change the name of the sphere from Sphere001 to **Skydome** so that you can keep track of its function.

7. Move the Hemisphere so that its base is just below the ground plane, as shown in Figure 9.32.

FIGURE 9.32
Move the hemi-
sphere down in the
viewport's Y-axis so
that its base is just
below the ground
plane.
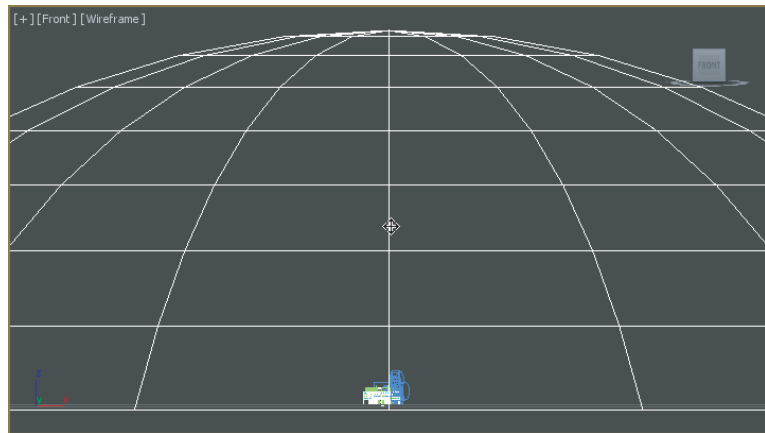
When you adjust the Hemisphere parameter, 3ds Max flattens the bottom of the sphere and places a surface on the flattened area. You need to place the bottom of the hemisphere below the ground plane so that the hemisphere's bottom surface doesn't appear in your camera view. Another option would be to convert the object to an Editable Poly and then delete the faces that form the bottom of the sphere.

Now you have a dome over your model, which will become the sky. Spheres are normally intended to be viewed from the outside, so when 3ds Max creates a sphere, the normals are pointing outward. In this situation, you want your sphere to be viewable from the inside, so you need to invert the direction of the skydome's normals:

1. With the Skydome hemisphere selected, click the Modify tab.

2. Right-click Sphere in the modifier stack, and then select Convert To: Editable Poly from the context menu. You won't need to make changes to the skydome's parameters, so this operation will help conserve memory and simplify the object.

3. Click the Element button in the Selection rollout to enter the Element sub-object level.

4. Click the skydome to select it at the Element sub-object level. The entire dome turns red to indicate that it is composed of a single element.

5. Scroll down to the Edit Elements rollout, and click the Flip button to invert the direction in which the sphere's normals are pointing. You'll notice that the Camera viewport changes so that you no longer see the inside of the hemisphere, and the scene in the viewport becomes extremely dark if not black. This is because the new Nitrous viewports show both sides of all objects, and it is actually the backside of a polygon that casts shadows and the normal side of the polygons that receive the shadows.

6. Back in the modifier stack, click Editable Poly to return to the object level.

7. In the viewport, right-click the skydome and select Object Properties from the transform quad menu.

8. On Object Properties dialog box, find the Rendering Control group and click to uncheck Receive Shadows and Cast Shadows. Then click OK to close the dialog box.

Your viewport should look much better now.

The skydome is just about ready. You need to create a material to apply to the skydome to simulate the clouds. The material will also require a UVW Map modifier applied to the skydome.

1. Open the Compact Material Editor, and click an unused slot.

2. Rename the selected slot's material as **Skydome**. Make sure Material Type is set to Standard and, in the Shader Basic Parameters rollout, set Shader to Blinn. Then open the Maps rollout near the bottom of the dialog box.

3. Click the Diffuse Color Map button. Then, in the Material/Map Browser, double-click Bitmap.

4. In the Select Bitmap Image File dialog box, open the folder where you saved this chapter's files, and then locate and select CLOUD2.jpg. This is a fairly generic sky with a few clouds.

USING THE 3DS MAX SKY MAPS

The maps found in the Skies folder of the Subscription Sample Files download are very common, and their use in a production scene can often be spotted and recognized. Consider expanding your library of sky images by purchasing additional image files or by creating your own. You will need to increase the output of these non-high-dynamic range sky maps when using mental ray for your renderer.

---

5. In the Gamma group, make sure Use System Default Gamma is selected, then click Open. In the Material Editor, you see the sky bitmap in the sample slot.

6. Set both the U and V Tiling settings to **1.0** if necessary, and uncheck the U and V Tile check boxes.

7. With the Skydome object selected, click the Assign Material To Selection button on the Material Editor toolbar.

8. Click the Show Shaded Material In Viewport button in the Material Editor.

The sky in the MyCamera viewport will change color and you will see the cloud map, but it is not displaying the sky bitmap properly. This is because the Skydome object was created with Spherical mapping, and you might want the material to be planar mapped to the skydome.

You've just about finished creating the sky. The last things you need to address are the changing UVW mapping coordinates. For this situation, the best map will be the planar map. You want as much of the material map as possible to fit on the skydome. You'll get the most natural-looking sky by mapping the Skydome material as a flat plane against the Skydome object.

1. In the Modify tab, click the Modifier List drop-down and select the UVW Map modifier. Ensure that the Planar mapping type is selected.

3ds Max automatically aligns the map to the Skydome object and adjusts the UVW map to fit the skydome. If the gizmo doesn't fit the skydome, or you have adjusted the

gizmo's size parameters and want to return to the default size, click the Fit button in the Alignment area.

2. Right-click the Top viewport, and click the Zoom Extents tool to get a better view of the UVW Map gizmo.

3. Right-click in the MyCamera viewport, and then switch it to the MyCamera001 viewport.

4. Click the Render Production tool to see the results. The sky appears out the window, but it is too dark (see Figure 9.33).

FIGURE 9.33
The rendered MyCamera001 viewport with the sky too dark to see
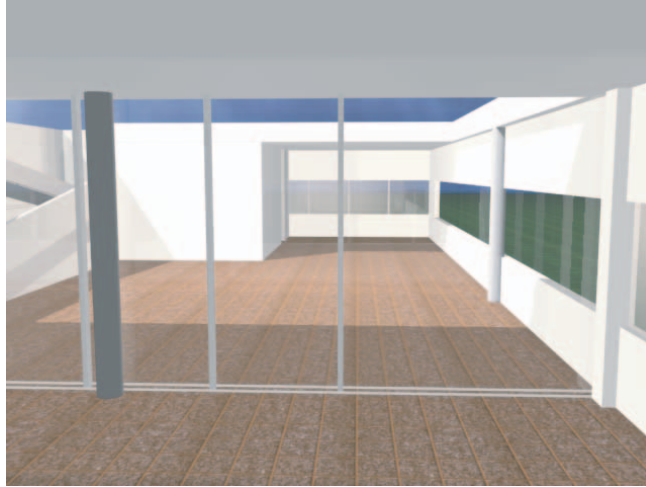
You can simulate clouds blowing in the wind by very slowly rotating the skydome in an animation. You will read more about animation in Chapter 12.

If no lights are directed toward the skydome, it may appear as a dark background. You can change this by turning on Self-Illumination in the material, or you can take the following steps to add an Omni light that includes only the skydome:

1. Right-click the Top viewport.

2. Go to the Create tab in the Command panel, select the Lights button, and change from Photometric to Standard lights. Then click the Omni button under the Standard category.

3. In the Top viewport, click the center of the dome to place an Omni light there.

4. In the Command panel, change the name of the new Omni light to **Skydomelight**.

5. Open the Intensity/Color/Attenuation rollout, and set the Multiplier value to **2**.

Now you have a light for the skydome. You'll want to make sure that it illuminates only the sky:

1. In the General Parameters rollout, click the Exclude button.

2. In the Exclude/Include dialog box, click the Include radio button near the top of the dialog box.

3. Select Skydome from the Scene Objects list box to the left; then click the right-pointing arrow button to move the selection to the list box on the right.

4. Click OK to close the dialog box.

5. In the Rendered Frame Window, click the Clone Rendered Frame Window button. This makes a copy of the existing rendering so that you can compare it to the next one.

6. Right-click the MyCamera001 viewport to make it active, and click the Render Production tool again. This time the sky appears brighter, as shown in Figure 9.34.

FIGURE 9.34
The scene after illuminating the skydome
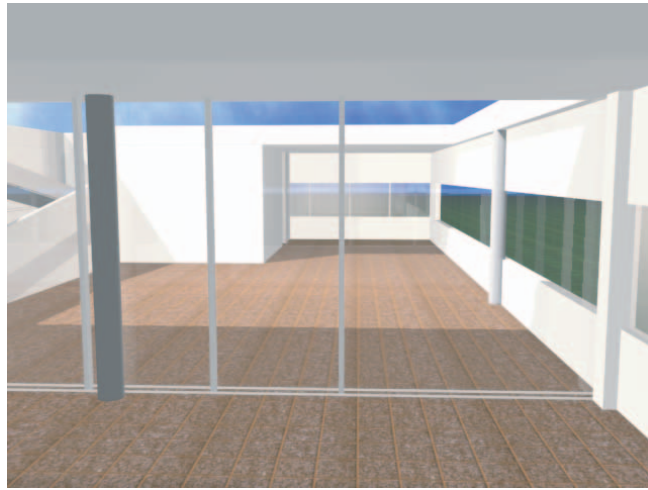
EXCLUDED OBJECTS AND THE VIEWPORT DISPLAY

Objects that are excluded from illumination render correctly but may still appear illuminated in the viewport. Some driver modes of the 3ds Max viewports don't handle this aspect of illumination as well as actually rendering the image, but the viewports do display in real time.

Now you have a sky that will be correct and somewhat convincing as the animation moves through the scene. Because the sky bitmap is now assigned to an object in the model, it will remain fixed in relation to the rest of the model, creating parallax, which gives the animation a sense of greater realism. The net effect will be that the sky will appropriately follow the rest of the objects in the scene as the camera moves along its path.

You can also create an interesting effect by combining the gradient background with the sky-dome sky. If you adjust the Opacity setting for the Skydome material to a value of less than 70, the gradient background will begin to show through the Skydome object.

Using Render Types

Rendering in 3ds Max is often an iterative process of rendering, adjusting, and then rendering again. By rendering just a portion of your scene instead of the whole image, you can save time by reducing the time you spend in these revision cycles. Try re-rendering your scene with changes to the diffuse color, but this time render only the ground object.

1. With the MyCamera001 viewport active, type **P** to switch it to a Perspective viewport.

2. Click the Zoom Extents button to get a view of the whole model, and then use the Zoom, Pan View, and Orbit tools so that you are inside the skydome and can see the exterior of the building.

3. Render the scene. It should look similar to Figure 9.35.

FIGURE 9.35
The scene so far

4. In the Perspective viewport, select the ground object.

5. Click the Area To Render drop-down list in the upper-left corner of the Rendered Frame Window; then choose Selected from the list.

6. Click the Render button in the upper-right corner of the Rendered Frame Window. Your Perspective viewport is rendered much faster with just the ground object re-rendered.

7. Set the Area To Render option back to View.

The F9 key is the shortcut to issue the Render Last command. Render Last renders the same viewport and other rendering parameters to the same specifications as the previous rendering, but it does not save the rendered file even if that setting is On in the Render Setup dialog box. This command does not bring up a dialog box and disregards which viewport is currently active. F9 does not always work, however, when input fields in certain dialog boxes, such as the Material Editor, are selected for input.

The Rendered Frame Window is overwritten with the new pixels from the selected object. In this instance, the rendering process was much faster. By rendering a selected object or set of

objects, you can save some time if you're rendering just to see the results of some changes you've made to your model. There are other options in the Area To Render drop-down list with which you'll want to be familiar. Here's a rundown of those options and what they do:

View   Renders the current viewport in its entirety. This is the option you've used for most of the exercises so far.

Selected   Renders just the objects selected.

Region   Renders a selected region of the viewport. When you choose this option, you are asked to select a region in the currently active viewport, or you can select a region in the Rendered Frame Window. An adjustable marquee displays, which allows you to select a rectangular area (see Figure 9.36). Once you select an area and click the Render button in the upper-right corner of the Rendered Frame Window dialog box, 3ds Max renders only the selected portion and nothing else. If you've previously rendered the full viewport, the region you select will be overlaid onto the last rendered view in the Rendered Frame Window. This can save a lot of time if you need to re-render only a part of a view.

FIGURE 9.36
Selecting a region for the Region, Crop, and Blowup options
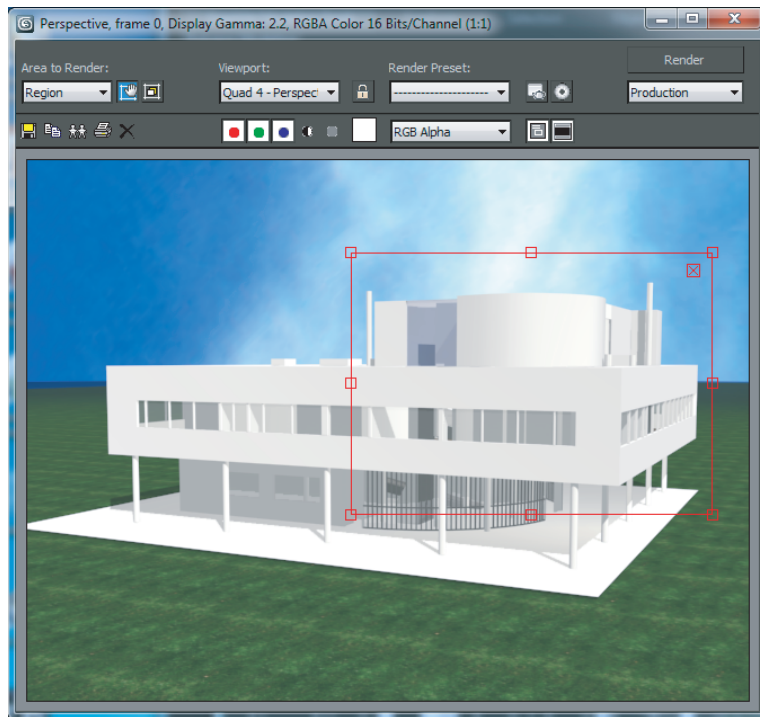
Crop   Lets you crop an area for rendering. It works just like the Region option, but instead of leaving any previous rendering in the Rendered Frame Window, it crops the rendering to the area you selected. To re-render a cropped view, you may use the Crop Selected option.

Blowup   Works like the Region and Crop options, but instead of keeping the view size the same as the overall viewport, Blowup enlarges the selected region to fill the Rendered Frame Window.

Of all the options listed, View, Selected, and Region are the ones you'll use the most. Region, in particular, can be especially useful if you want to change part of a rendering that takes a lot of time to process.

If you decide you don't want to continue with a rendering, you can press the Esc key to cancel at any time.

Using Render Elements for Compositing

Another way of rendering just a portion of your scene is to use render elements. These elements are quite different from render types in what they render. Rather than rendering selected objects or parts of the whole image, *render elements* split the image into its visual components, which can be used later in compositing programs such as Adobe Photoshop (primarily for still images but recent releases can process animated sequences) or 3ds Max Composite, Autodesk® Combustion™ software, or Adobe After Effects for animations.

Elements that can be rendered separately include the alpha, atmosphere, background, reflection, refraction, self-illumination, shadow, specular, Z depth, and many others. To get a sense of how this works, let's try an example:

1. Click the Render Setup button on the right side of the Main Toolbar. The Render Setup dialog box appears.

2. Click the Render Elements tab at the top of this dialog box. The Render Elements dialog box appears, as shown in Figure 9.37.

FIGURE 9.37
The Render Elements tab of the Render Setup dialog box, and the Render Elements dialog box
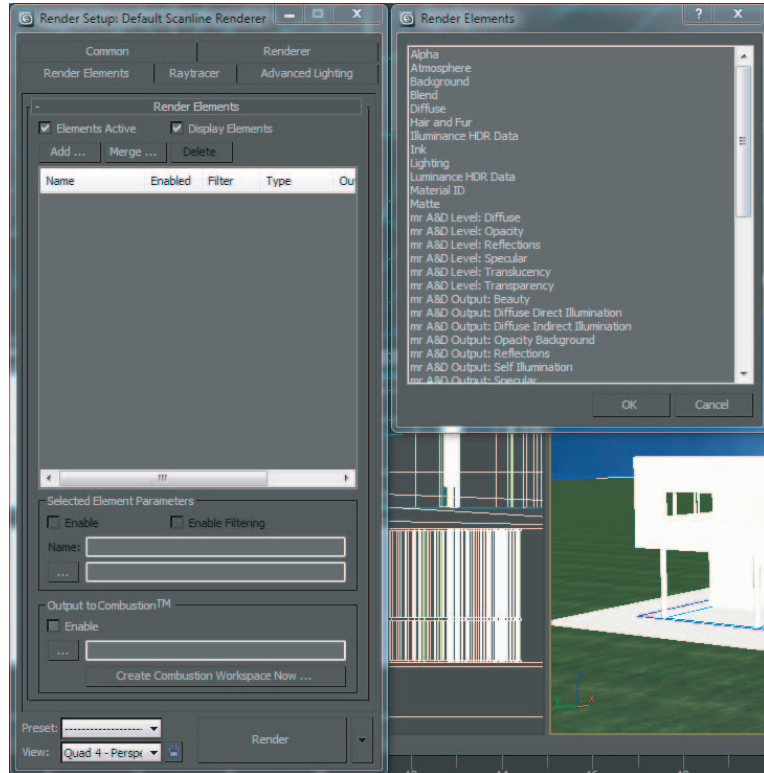
3. Open the Render Elements rollout, and click the Add button.

4. In the Render Elements dialog that appears, scroll down and select Z Depth and click OK.

THE Z DEPTH RENDER ELEMENT

The Z Depth element renders as a grayscale image representing the distance the pixels are away from the picture plane (known in compositing as the camera's Z direction). The darker the value of a pixel, the farther away from the camera it is positioned.

If you wanted to save this render element as an image file, you would enter the filename and folder in the Selected Element Parameters group (see Figure 9.38). Rendered elements are often saved as RLA or RPF images; check your compositing software's documentation to determine the best file type to save. You should set the path to the location where you are working with this chapter's files, and for now change the image type to JPG.

FIGURE 9.38
Naming the render element in the Selected Element Parameters group
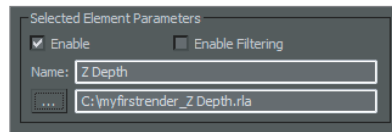
If you wanted to output your render elements to Autodesk Combustion compositing software, you would enable that link and save the file, as shown in Figure 9.39.

FIGURE 9.39
Naming the Combustion workspace render element
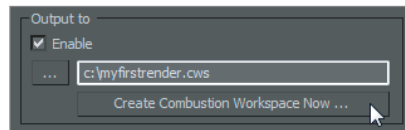
3ds Max Composite, a high-end compositing package, is included with a full license of 3ds Max 2013. Choose the Open EXR (.exr) file format to save render elements and G Buffer channels for use in Composite. You'll learn more about 3ds Max Composite in Chapter 15, "Finishing It Off: Atmosphere, Effects, and Compositing."

Each element's parameters will appear in specialized rollouts at the bottom of the dialog box, like the Z Depth Element Parameters rollout in this example.

1. In the Z Depth Element Parameters rollout, set the Z Max value to **800** (see Figure 9.40).

FIGURE 9.40
Z Depth Element Max and Min values
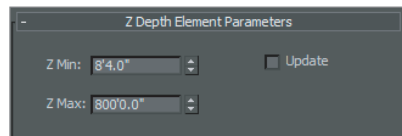
2. Click the Render button at the bottom right of the dialog box. Two separate Rendered Frame Windows will appear. The first one shows the regular rendering, while the second contains the chosen render element, as shown in Figure 9.41.

3. Save your scene file as **MyC09_Camera_Zdepth.max**.

The render element images can be brought into a compositing program where special effects can be applied based on the visual information that has been separated out as elements.

If you want to save the setup for the render elements, you can use the render-preset feature. At the bottom of the Render Elements dialog box there is a Preset field, as shown in Figure 9.42. Click the drop-down arrow there to save your own preset. When you save a custom preset, you can select what categories you want in the preset. Anything found in the Common, Effects, Environment, and Render Elements tabs of the Render Setup dialog box can be saved as part of the preset. Additional categories are available that are renderer specific, so if the mental ray renderer is being used, the Processing and Indirect Illumination settings are available to be saved as part of the preset. If the Scanline Renderer is used, the Radiosity and Advanced Lighting settings are options.

CERT
OBJECTIVE

FIGURE 9.42
Render Preset menu
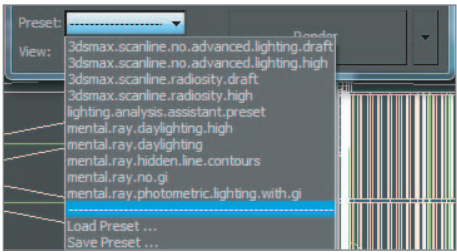
Matching Your Scene to a Background Image

One of the most interesting uses of 3ds Max is to combine a photograph with a design model to create a view of a building as it will appear in its intended location. This can also be used to

create set extensions for film and television effects. This is called *camera matching*, and it is an excellent way to help your client understand the look and scale of a design. It can also play a crucial role in the planning phase of a project, where this type of image may be required as part of a design review submission.

There are two basic ways to do a camera match. You can strictly match the camera with a photo visually, or you can use a precise automatic method. The precise method requires that at least five points be visible in the photograph for which you have corresponding measurements in your design model. You will use this method in the following exercise.

MAKE NOTE OF THE CAMERA SETTINGS IF POSSIBLE

In this section, you'll use 3ds Max's Camera Match tools to place a model of an apartment building in a background photograph of the apartment's intended site. The apartment is located in San Francisco, California, so the model has a Sunlight system light source set up for San Francisco at 1:30 p.m. on July 4, 2013 (see Figure 9.43). It's a good idea to make note of all the camera settings that were used to take the background photograph. Information such as the focal length of the camera lens and the position and height of the camera can help you determine whether you are on the right track when aligning a model to the background. You will also want to keep track of the date, the time of day, and the direction of true north. This information will help you accurately match the sun in your design to the location of the sun in the background.

If you don't take a digital photo yourself, try checking the properties of the digital file; it frequently will tell you the lens focal length, f-stop, and time of day the photograph was taken, if the camera's date and time feature was set properly.

Setting Up the Model and the Image

Before you can align a design with a background image, you need to find at least five locations in the image that you can correlate with locations in the design. The five locations must not all be coplanar or an adequate solution will not be found. In the design, you can create an object, such as a rectangular base, that can be easily located in the photograph. The photographic image for the apartment site already has an outline of the base of the apartment building drawn in for you (see Figure 9.43).

This base is 5′8″ high and matches the building's footprint. The height of 5′8″ was used because it is a known height in the image. The sides of the base were established by locating the building's corner in the image. Although it wasn't done for this photograph, frequently poles of known heights (*storypoles*) are placed at the future corner points of the building before the photograph is taken so that known points can be established more easily.

The vanishing points of the photograph were located so that the outline of the box could be established. Autodesk® AutoCAD® software was used to help locate the vanishing points. The photograph was brought into AutoCAD using the Image command. Then the vanishing points were established by drawing lines over the photograph.

The locations of the vanishing-point lines were carefully noted and then drawn in over the image in Photoshop. Photoshop could also have been used to find the vanishing points, but because AutoCAD offers some specialized tools for drawing vector graphics, it was much easier to find the vanishing points in AutoCAD.

FIGURE 9.43
The background
image of the site
for the apartment
building and a
sample rendering
of the apartment
building

A box was added to the 3ds Max design of the apartment that corresponds to the 5′8″ tall base that was drawn over the photograph. The box will be used to align the model to the image, as you'll see in the following exercise.

Adding the Background Image

You now know that you'll need to do a little background preparation before you can match a design to a photograph. The next step is to do the actual matching in 3ds Max (see Figure 9.44).

FIGURE 9.44
The background
image in AutoCAD
with vanishing
points drawn

Start by assigning the background image to the 3ds Max scene file:

1. Open the file called C09_Noriega.max. This file contains the 3D model of the apartment building.

2. Make sure the Perspective viewport is active, and then add the background image to the viewport by choosing Views ➢ Viewport Background ➢ Configure Viewport Background.

3. On the Viewport Configuration dialog box, click the radio button in front of Use Files and then click the Files button found near the bottom of the Setup group.

4. In the Select Background Image dialog box, locate and open the `noriegaview.tif` image file. This is the image file that contains the additional outline of the apartment base.

5. Back in the Viewport Configuration dialog box, select the Match Bitmap radio button in the Aspect Ratio group.

6. Be sure to deselect the Lock Zoom/Pan check box, and then click OK. After a moment, the image will appear in the viewport as shown in Figure 9.45.

FIGURE 9.45
The Perspective viewport after assigning the background image

---

ADDING A CONDOMINIUM TO SEVERAL IMAGES

Redeveloping downtown areas from industrial and warehouse facilities to mixed-use residential, entertainment, and commercial complexes is a common project in many metropolitan areas. Many cities are attempting to reduce the flow of citizens to the suburbs by offering safe and convenient downtown living spaces.

A friend of mine was working on a project that consisted of an entire block of warehouses being demolished and replaced with one- and two-bedroom luxury condominiums. For project approval, the city's Design Review Board required renderings from several locations. Because of the downtown location, there were ample reference objects available for placing and locating the CamPoint helper objects, so this project was perfect for the Camera Match utility.

A thorough survey yielded drawings of the area and dozens of digital photographs that could be matched to the 3ds Max cameras. In many cases, the physical distances and angular relationships between objects were written and drawn directly on prints of the photographs. A total of eight camera-matched renderings were created showing the proposed structure from five different locations near the job site. If my friend hadn't used Camera Match, the renderings would have been less accurate and more difficult to produce.

You now have the image in the viewport, but you also need to tell 3ds Max that you want an image to be included as the background for renderings:

1. Choose Rendering ➢ Environment.

2. In the Environment tab of the Environment And Effects dialog box, click the Environment Map button, which is currently labeled None.

3. In the Material/Map Browser, click Bitmap; then click OK.

4. In the Select Bitmap Image File dialog box, locate and open the `noriegaview_back-ground.tif` file. This is a duplicate of the `noriegaview.tif` file but without the outline of the base. You can also select `noriegaview.tif`, but if you do, your final rendering will contain a few stray layout lines.

5. Close the Environment And Effects dialog box.

Now you're ready to start using the Camera Match tools.

DRAG AND DROP BACKGROUND IMAGES

You can also add background images — Viewport, Rendering, or both — by dragging the file from Windows Explorer and dropping it in a viewport. When you use this technique, a dialog box appears asking to which type of background image the file is to be applied. This method is quick, but you should use it with extreme caution because it is not undoable.

Adding the Camera Match Points

The Camera Match tools are in two sets. The first set lets you place helper objects in the model. These helper objects, called *CamPoints*, will then be used with the second set of tools to match locations in the design with locations in the background image.

The scene contains a box named Alignobject whose sole purpose is to facilitate the alignment of the design with the background photograph. You'll use the Alignobject box to place the CamPoints accurately in the design at their appropriate locations.

Start by setting up 3ds Max to select endpoint snaps and by hiding all of the geometry except the Alignobject box.

1. Right-click the Snaps toggle.

2. In the Grid And Snap Settings dialog box, select the Endpoint option and clear all others; then close the dialog box.

    On the Main Toolbar, click the Snaps toggle to turn it on.

3. Use the Select By Name tool to select the green base object named Alignobject.

4. Right-click to open the quad menu, and then click the Hide Unselected option in the display quad.

Now only the Alignobject box is showing. This will make it easier to place the CamPoint helpers, as shown in Figure 9.46.

FIGURE 9.46
With the endpoint snap active, place the CamPoints at the corners of the Alignobject box.

Left Top   Right Top

Left Bottom   Front Bottom   Front Top
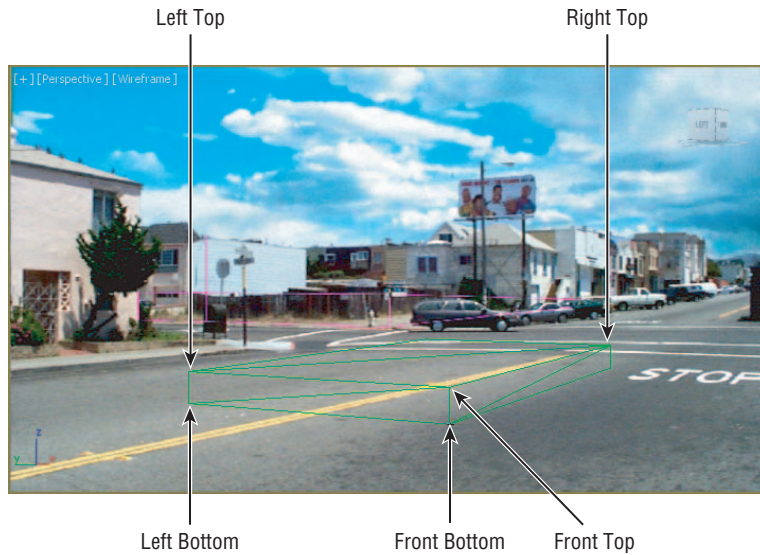
The next step is to place the CamPoint helpers in the model:

1. Click the Create tab in the Command panel; then click the Helpers button.

2. Select Camera Match from the Helpers drop-down list, as shown in Figure 9.47.

FIGURE 9.47
Select Camera Match.
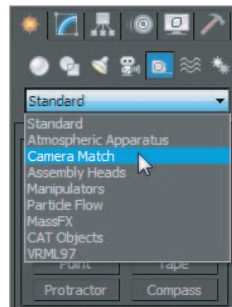
3. In the Object Type rollout, click the CamPoint button.

4. Make sure that the Snaps toggle is active; then click the bottom-front corner of the Alignobject box, as shown in Figure 9.46. You've just added a CamPoint to the scene.

5. Back in the Command panel, change the CamPoint001 name in the Name And Color rollout to **Front Bottom**. This will make it easier to identify the CamPoint you just created.

6. Next, click the top-front corner of the Alignobject box, as shown in Figure 9.46.

7. Change the name in the Name and Color rollout to **Front Top**.

8. Place the rest of the CamPoints — Left Top, Left Bottom, and Right Top — shown in Figure 9.46, as you did for the Front Top CamPoint. Click the location in the design; then change the newly added CamPoint's name to reflect its location.

MAINTAINING A STANDARD NAMING CONVENTION

Always make sure that you have a logical naming convention for the objects in your scenes. A common practice is to prefix all similar objects similarly. For example, prefix all lights with "Light" or all CamPoints with "CamPoint." Using this method will ensure that all objects of the same type will be located near each other in the Select From Scene dialog box.

You now have five CamPoints in place. That is the minimum number that 3ds Max needs to align a scene with a background image. The more camera match points that you can accurately place, the more precise the camera match will be. You've seen how the Alignobject box helps make quick work of placing the CamPoints in the design. You can also place the CamPoints in your design by entering their coordinates using the Camera Match Keyboard Entry rollout. But using geometry like the Alignobject box is a bit more straightforward.

HIDE THE ALIGNOBJECT BOX WHEN RENDERING

The Alignobject box was created specifically for this Camera Match operation and isn't really part of the building, so remember to hide it when you are rendering the model.

Aligning the Camera Match Points to the Background Image

The following steps will require some care. You will locate the places in the background image that correspond to the CamPoints you've just created.

1. Click the Utilities tab in the upper-right corner of the Command panel.

2. Click the Camera Match button. You'll see the CamPoint Info rollout appear with a list of the CamPoints you just created.

3. Click the Front Bottom entry in the list box at the top of the CamPoint Info rollout; then click the Assign Position button at the bottom.

4. Click the location (shown in the background image) that corresponds to the Front Bottom CamPoint in the scene (see Figure 9.48). A small cross appears at the point you click. Try to be as precise as you can in placing the cross. If you don't like the location, you can continue to click points until you have the cross placed in a location that satisfies you.

5. Because this is the first point you are aligning, you'll see a Camera Match warning message. Click Yes.

6. Select Front Top from the list in the CamPoint Info rollout; then click the Front Top corner location in the background image, as shown in Figure 9.48.

7. Repeat step 6 for each of the remaining three CamPoints.

3ds Max now has enough information to create a camera that matches the design geometry to the background image:

1. Scroll down the Command panel so that you can see the Camera Match rollout clearly.

2. Click the Create Camera button.

   You will see a camera appear in the viewports, and a value appears in the Current Camera Error message in the Camera Match rollout. When you click the Create Camera button, 3ds Max creates a camera that matches the view of the design with the background image.

AN ALLOWABLE CURRENT CAMERA ERROR

A good value for the Current Camera Error is any value from 0 to 1.5.

---

3. To see how the camera matching worked, click the Perspective viewport label in the upper-left corner of the viewport and choose Cameras ➢ Camera001. This is the camera that the Create Camera button created. The box will move into position over the image.

4. Unhide the hidden components of the building. The rest of the building appears in the viewport, as shown in Figure 9.49.

5. Hide the Alignobject box; you don't want it to appear in the rendered view.

6. Click the Render Production button on the Main Toolbar. The apartment is rendered on top of the background, as shown in Figure 9.50.

FIGURE 9.49
The apartment
building in position

FIGURE 9.50
The rendered apart-
ment building with
the background

ADJUSTING THE CAMERA

To adjust the camera, reassign the CamPoint positions and then, with the camera selected, click
the Modify Camera button in the Camera Match rollout. You can also adjust the camera manually,
changing the position, rotation, FOV, and so forth to improve the camera match.

Once you have a rendering matched to a background, your work isn't completely finished. As
you see in Figure 9.50, the building obscures some of the objects that are in the foreground (note

the fire hydrant, mail box, cars, and the street sign). You can use an image-editing program, such as Adobe Photoshop, to bring those parts of the image back into the foreground.

Fine-Tuning a Camera-Matched View

Not all of your camera-matching projects will go as smoothly as the previous example. Due to site restrictions or other limitations, you may be able to get only three or four points to match instead of the required five points. In these situations, you have to rely more on your knowledge of the site conditions, camera locations, and camera settings. Perhaps the most important item to record is the position of the camera in relation to the site, both in plan and elevation. If you can accurately place a camera in your scene, you can usually reconstruct a camera-matched view by fine-tuning your view using the Dolly, Field-Of-View, and Roll Camera tools in the Camera Controls section of the user interface. It helps to have topographical information and, if possible, aerial photographs or satellite imagery, although good site plans will work as well.

Matching the Design Image Quality to the Background

You may find that a building doesn't quite match up with the background image in ways other than orientation and size. For example, the contrast in the building may be too low compared with the contrast in the background, or there may be a grain or noise pattern in the background plate that isn't present in the rendered building. These differences can cause the design to stand out from the background, making it obvious that it is a computer rendering superimposed onto a photograph.

You can make adjustments to the lighting and materials in the scene to compensate for contrast and lighting differences, but noise in the background image has to be handled differently. You can deal with both noise and contrast by taking an alternative approach to the final rendering of the design.

Now that you have the design aligned with the background image, you can go ahead and render the image without the background. You can then use Photoshop or another image-editing program to merge the rendered design into the background image. By doing this, you have control over the rendered image of the building apart from the background. You can add noise or adjust the contrast and color tint of the rendered design in Photoshop to match the background before the two images are merged. Figure 9.51 shows the rendering redone using this method. Compare it with the rendering in Figure 9.50, where the background and building were combined and rendered into a single image in 3ds Max.

You can also apply the Film Grain rendering effect through the Add button in the Effects tab of the Environment And Effects dialog box. Be sure to click the Ignore Background option so that only the 3ds Max objects and not the background image receive the grain, as shown in Figure 9.52.

RENDERING WITHOUT THE BACKGROUND IMAGE

To set up 3ds Max to render a view without the background, choose Rendering ➢ Environment and turn off the Use Map option in the Background group. You can always turn the background back on by reversing this procedure.

FIGURE 9.51
The rendered
apartment com-
posited with the
background in
Photoshop

FIGURE 9.52
Adding a Film Grain
effect to the image
as it is rendered
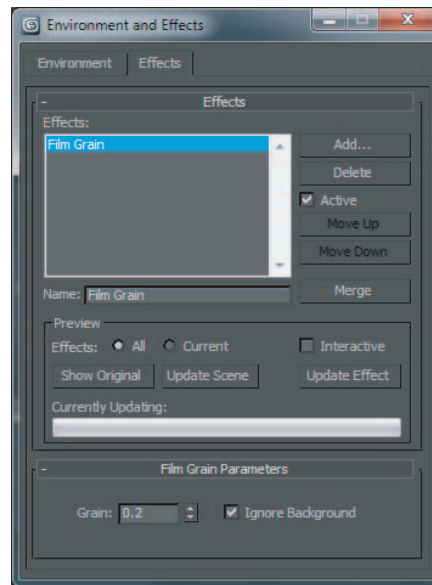
Standard Cinematic Terminology

As a 3D animator, layout artist, or design visualizer, you need to learn the standard language
used to describe camera shots in the filmmaking world. These shot names are usually abbrevi-
ated, and the shortcut names are often used on storyboards and script treatments. The shots that
describe the framing of the scene include the following:

Wide Shot/Extreme Long Shot   A shot from a distance. Humans are very small. This is frequently used as an "establishing shot" that sets the location of the film.

Aerial Shot   Also called a *crane shot* or *overhead shot*, this is often from a plane or helicopter.

Long Shot   The characters/humans are seen from head to toe.

Mid Shot   The characters are seen from head to waist.

Medium Close-Up Shot   The framing of the actors is from head to chest.

Close-Up (CU) Shot   This shows head and shoulders only.

Extreme Close-Up (ECU) Shot   Only part of the character's face is shown.

Other shot terminology describes the relationship of characters in the scene:

Two Shot   A shot with only two characters

Point-Of-View (POV) Shot   A shot from the viewpoint of one character

Over-The-Shoulder (OTS) Shot   A shot of two characters, from the point of view of over the shoulder of one, looking at the other

There are many good sources for more information on cinematic terminology and usage. One excellent book is called *Setting Up Your Shots* by Jeremy Vineyard (Michael Wiese Productions, 2008). This book will teach you everything you need to know to be knowledgeable about traditional camera shots and moves. Another excellent reference is *Digital Cinematography* & *Directing* by Dan Ablan (New Riders Press, 2002).

The Bottom Line

Understand the camera.   The virtual cameras in 3ds Max follow the analogy of real-world SLR cameras. You can set the focal length, set the field of view, and adjust several other parameters. Targeted cameras are oriented by moving a target object, and free cameras are oriented using the Rotate transform.

> **Master It**   Create a new camera that focuses on the lower-level main entranceway, flanked by the tall, thin windows. Switch between a target and a free camera to familiarize yourself with manipulating each type.

Set up an interior view.   Interior cameras are more difficult to place properly than exterior cameras. The scene must be framed properly while maintaining an acceptable field of view and working within the space limitations frequently found indoors.

> **Master It**   Make two clones of the camera that focus on the outside of the entranceway. Move the new cameras and, if necessary, the targets inside the structure. Manipulate each camera so that each displays one side of the entranceway. Show as much of the windows as possible without excessive distortion.

Create an environment.   Most image formats can be used as the background for a rendered scene. Once an image map is selected, it can be positioned and manipulated through the parameters found in the Material Editor.

> **Master It**   Select another sky image map, and replace the map used in this chapter. Choose another map provided with 3ds Max 2013, or create your own with a digital

camera. Use the controls located in the Output rollout to change a darkened sky to a brighter one, or vice versa.

Render elements for compositing. 3D still images and animations must often go through a postproduction compositing process to achieve a higher level of quality or realism. Using the Render Elements feature, you can automatically create many of the required element types at the same time the images are being rendered. Advanced image-processing software, such as Autodesk Composite, can manipulate and composite the different images and create the final output.

Master It Open the most recent Savoye scene, and create two more render elements: one for the shadows and one for the reflections.

Use the Camera Match utility. When a building's model must be incorporated into a background image, you must match the 3ds Max virtual camera to the camera that took the background picture. This is accomplished by placing CamPoint helper objects in the scene and using the Camera Match utility.

Master It What is the difference between adding a CamPoint helper in the scene and assigning the position of a CamPoint helper in the scene?

A. Nothing. The terms are interchangeable.

B. *Adding* the CamPoint helper consists of locating the object accurately in the scene, while *assigning the position* of the CamPoint helper refers to selecting its proper location relative to the background image.

C. *Assigning the position* of the CamPoint helper consists of locating the object accurately in the scene, while *adding* the CamPoint helper refers to selecting its proper location relative to the background image.

D. None of the above.

Organizing Objects and Scene Management

The term *scene* in Autodesk® 3ds Max® software refers to all of your models, materials, effects, and externally referenced files contained within a single `.max` file. In this chapter, you'll look at ways you can access and utilize your scenes while developing your renderings and animations. 3ds Max offers a variety of ways that can help you improve your workflow. You can divide a file into smaller pieces and recombine them while keeping those pieces unique. This can help you manage large scenes that require the work of several artists. Other tools let you quickly update objects in your scene or perform what-if scenarios to try different options.

In this chapter, you'll experiment with various ways of bringing in some additional furniture from the Sybex website. In the process, you'll learn how you can combine and access your scenes.

In this chapter, you will learn to

◆ Use external references

◆ Use the Rendered Frame Window options

◆ Use the Asset Browser

◆ Create a panorama

◆ Publish a scene to the DWF format

Gaining Access to Materials and Objects from Other Files

In this section, you'll be working with groups as you did in Chapter 2, "Introducing Objects." You'll also use a feature called an external reference, or *XRef*, to transfer the modified fabric material from the `Mybigchair.max` file to the `Mycouch.max` file.

XRefs are a way to include other 3ds Max files in your scenes without having to combine file data into a single file. For example, you may want to create a file that contains the furniture arrangement for an office, but you may want to keep that furniture data separate from the office design file. You can XRef the furniture file into your office scene so that you can accurately locate the furniture. Because the furniture data is stored as another file, changes made to the furniture file will be updated automatically in the office file when you reload the XRef. Then, when you've finished, you can remove the XRef of the office design in a single step. The furniture file then

maintains its independence from the office design file. This approach avoids duplication of data and reduces your disk storage space requirements. You can then XRef the furniture file into the office design file whenever you need to show furniture.

XRefs can be used as organizational tools to help reduce the complexity of large models by segregating similar types of objects into separate files. XRefs are also useful for dividing work between members of a design team. In an interior design project, for example, one designer can work on a floor layout while another designer works on floor patterns or lighting.

3ds Max offers two ways to use XRefs. The XRef Scenes dialog box lets you combine whole scene files into a single file. It also allows you to divide portions of a scene into separate files so that they can be edited by several individuals.

COLLABORATING ON A PROJECT

Only one individual may read and write any 3ds Max file on a local area network (LAN) at any given time. External references are a way of combining the files from several people into a master scene.

If you think you might need to edit objects brought in as XRefs, you can use the XRef Objects dialog box. You can apply transforms and modifiers to individual objects that have been imported using this dialog box, although such changes won't affect the source file.

As an introduction to XRefs, you'll use the XRef Objects dialog box in the following exercise to import a material into the MyCouch.max file. XRefs aren't necessarily the only way to import materials, but you'll use the XRef Objects dialog box in this way to see firsthand how this dialog box works.

3DS MAX AND AUTOCAD SIMILARITIES

The 3ds Max XRef tools perform the same functions as the Autodesk® AutoCAD® XRef tools, although 3ds Max uses a different set of dialog boxes.

---

1. Open the MyCouch.max file from the Chapter 10 files from this book's accompanying web page, www.sybex.com/go/mastering3dsmax2013. It should look similar to Figure 10.1.

FIGURE 10.1
The MyCouch scene

2. Press the **H** key.

In the Select From Scene dialog box, the icon to the left of Couch001 is surrounded by square brackets indicating that it is a group (see Figure 10.2).

FIGURE 10.2
The Select From
Scene dialog box
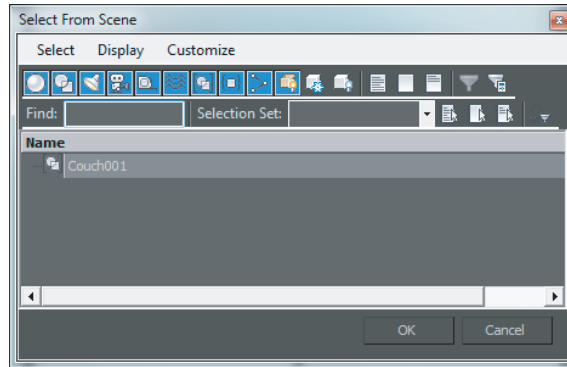
3. Click Cancel to close the Select From Scene dialog box.

This will make it easy to apply a material to the entire piece of furniture because all the objects that compose the group are managed as a single object. The next job is to add the material. You used the Fabric-Blue Nap 2 material from the 3ds Max material library, but it has been modified in the Mybigchair.max file. You could reconstruct the modifications made to the material in this file, but that would be time consuming. Instead, try using the XRef Objects command to import the material and the changes that were made to it from the Mybigchair.max file.

4. Open the Application menu, and then choose References ➢ Ref Objects. The XRef Objects dialog box displays.

The top window in the XRef Objects dialog box lists the records or files that are referenced into the current scene. The bottom window lists the objects, materials, and manipulators within the selected record.

5. In the XRef Objects dialog box, make sure that Merge Materials is unchecked, and then click the Create XRef Record From File button in the upper-left corner.

6. In the Open File dialog box that appears, locate and open the Mybigchair.max file. The XRef Merge dialog box displays, as shown in Figure 10.3. Select the [Bigchair01] entry and click OK. Now the chair appears in the viewports.

7. The XRef Objects dialog box now shows the Mybigchair.max file in the upper window and, after you select the entry, a listing of objects from the file appears in the lower window (see Figure 10.4).

FIGURE 10.3
Select the
Bigchair01 group
in the XRef Merge
dialog box.
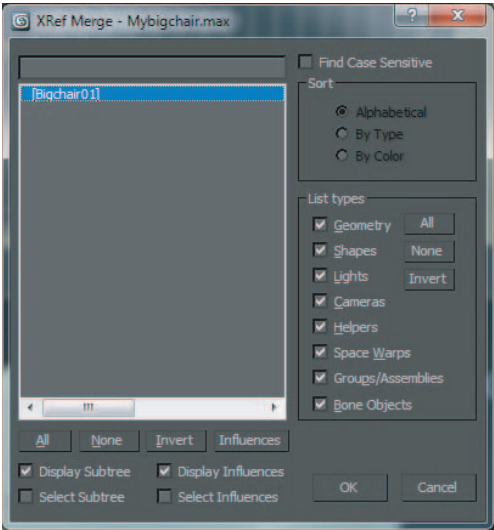
FIGURE 10.4
The selected object
appears in the XRef
Objects dialog box.
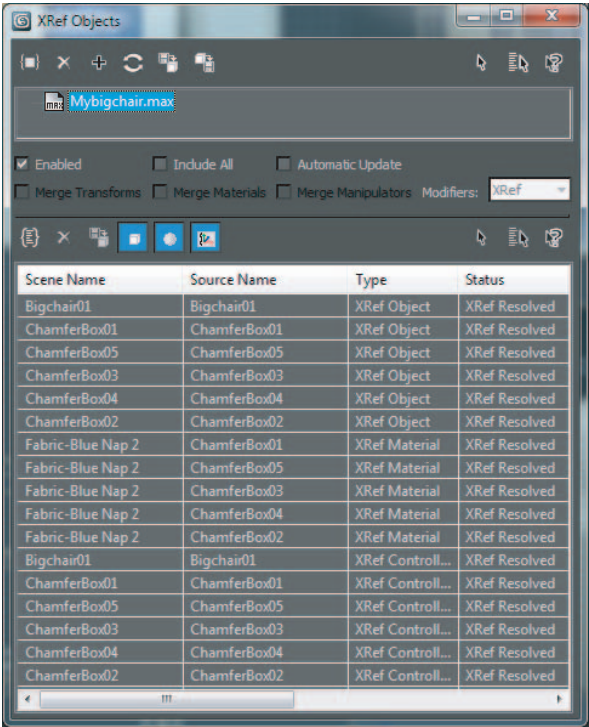
The chair is displayed in the current scene, but the chair hasn't really become a complete part of the scene. You might think of an XRef as a kind of *guest* that is visiting but doesn't maintain permanent roots in the file. Still, you can use the transform tools and modifiers on the "guest" XRef or acquire materials and objects from the XRef.

1. Click the Compact Material Editor tool in the Main Toolbar.

2. In the Material Editor dialog box, make sure an unused Material Sample is selected and then click the Get Material button.

3. In the Material/Map Browser, open the Scene Materials rollout; then double-click the first Fabric-Blue Nap 2 listing to place the material into the current slot in the Material Editor.

4. Close the Material/Map Browser.

   You've just imported a material from the `Mybigchair.max` file into the Material Editor for your current project. You don't need the chair in your couch file, so let's remove it.

5. In the XRef Objects dialog box, select `Mybigchair.max` in the upper window.

6. Click the Remove XRef Record button at the top of the dialog box. You see a warning message asking whether you really want to remove the selected XRefs from the scene.

7. Click OK, and then close the XRef Objects dialog box.

   The chair disappears, leaving your couch file as it was before you imported the chair. Now you can apply the newly acquired material to the couch.

DISABLING THE XREF LINK

To retain the XRef link to the file without actually bringing the objects into the scene, select the XRef file in the XRef Objects dialog box and then deselect the Enabled check box below the upper window.

---

8. Select the Couch001 group.

9. Make sure that the Fabric-Blue Nap 2 material is selected in the Material Editor window.

10. Click the Assign Material To Selection tool.

11. Close the Material Editor.

    For the final step, you'll need to make sure the couch has the same mapping coordinate scale as the other chair.

12. Click the Modify tab; then select UVW Map from the Modifier List drop-down.

13. In the Mapping group of the Parameters rollout, select the Box radio button, and then change the U, V, and W Tile values to **0.7**.

14. Save your file as **MyCouch01.max**.

15. Do a quick rendering of the couch. Your rendering should look like the couch in Figure 10.5.

FIGURE 10.5
The rendered couch

OPTIONS FOR IMPORTING MATERIALS

You have several other options for importing materials from another file. First, you can go to the Mybigchair.max file and save the fabric to the standard material library under a new name. To do this, click the Put To Library tool in the Material Editor window. You can also set up a new material library and place the fabric there. Here are the steps for creating a new material library:

1. Click the Get Material button in the Material Editor.

2. In the Material/Map Browser, click the drop-down arrow to the left of the Search By Name field. Choose New Material Library from the drop-down menu.

3. Enter a name for your new material library file in the Create New Material Library dialog box, and then click Save.

4. Drag the materials you want into that library to add them.

You can then retrieve the fabric from the new library using the Material/Map Browser. This method is helpful when you are working on a team that needs to have access to a common set of materials.

A third option is to use a 3ds Max scene file as if it were a material library. Here are the steps to do this:

1. Click the Material Editor tool on the Main Toolbar.

2. In the Material Editor window, click the Get Material tool.

3. In the Material/Map Browser, click the drop-down arrow to the left of the Search By Name field. Choose Open Material Library.

4. In the Import Material Library dialog box, select 3ds Max File (*.max) from the File Type drop-down list.

5. Locate and open the Mybigchair.max file.

6. In the Material/Map Browser, double-click Fabric-Blue Nap 2 in the list box. The imported material appears in the Material Editor window's sample slot.

7. Right-click the Mybigchair.max group that has LIB at the far right of the header, go to the bottom of the context menu, and click Close Material Library.

As if you didn't have enough options already, you can also use an XRef material type. In the Material Editor, click the Standard button and change the type from Standard to XRef material by choosing from the list of material types. The XRef material type will let you select a file and an object in the file, as well as the material from that object. If you have several large teams working across several locations, this is a good technique because you can have a single "master file" for all your materials and can change them for many different scenes quickly and easily. In fact, when you added the blue chair as an XRef, the material on the chair was converted to an XRef material type. When the XRef record was removed, the material reverted to the Standard material type.

This is the fastest method for obtaining a material from another file.

You are able to import a material from another file using the XRef Objects dialog box. As you might guess, materials aren't the only things you can import. For example, if you want to import the seat back from `Mybigchair.max`, you can do so by selecting the object from the bottom list of the XRef Objects dialog box and selecting Merge. Once an object is merged, it becomes part of the current file's database (no longer an XRef). Here is a list of the options available in the XRef Record toolbar at the top of the XRef Objects dialog box that control the files that are referenced:

Create XRef Record From File   This option opens a File dialog box, allowing you to select a file containing objects to XRef.

Remove XRef Record   This option removes the selected XRef'd files from the current scene.

Combine XRef Records   This option combines the selected records into a single record as a housekeeping task to consolidate identical records.

Update   This option compares the XRef'd file with its source file and updates the XRef if any changes have occurred.

Merge In Scene   This option adds all of the objects in the selected record to the current scene and then deletes the record.

Convert Selected Object(s) To XRefs   This option creates a new `.max` file containing the selected objects and then XRefs the new file, along with the objects, into the current scene.

Select   This option selects the objects in the scene that originate from the highlighted record.

Select By Name   This option opens a Select From Scene dialog box. All objects in the selected XRef record appear highlighted in the dialog box.

Highlight Selected Objects' XRef Records   This option highlights the XRef records in the XRef Objects dialog box that contain the XRef'd objects that are currently selected in the scene.

Here is a list of the options available in the XRef Entities toolbar in the middle of the XRef Objects dialog box. These control the objects contained in the selected record:

Add Objects   This option opens a dialog box listing objects from the selected record that are currently not XRef'd into the scene. Use this dialog box to add these files from the record into the scene as XRefs.

Delete XRef Entity   This option removes highlighted XRef'd objects from the scene.

Merge In Scene   Similar to the Merge In Scene button in the XRef Record toolbar, this button adds the selected entities to the scene as Scene objects and removes them as XRefs.

List Objects   This option controls the display of XRef'd objects contained in the selected record.

List Materials   This option controls the display of XRef'd materials contained in the selected record.

List Controllers   This option adds the ability to display the controllers assigned to the selected XRef objects.

Many of the toolbar functions are also located on the context menu available when a record or entity is selected. Additional XRef options are located below the records list, including the following:

Enabled   When this option is unchecked, XRef objects do not display on the scene and are not loaded into memory with the scene.

Include All   When this option is checked, all objects in an XRef'd record are automatically merged into the scene without user input.

Automatic Update   When this option is checked, XRef objects are updated whenever the source file is saved.

Merge Transforms   This option combines the Transform controllers from the source objects into the current scene. The Merge Transforms option must be selected prior to externally referencing an object into the scene.

Merge Materials   This option combines the materials from the XRef'd records into the current file.

Merge Manipulators   This option allows you to determine whether you have local control over manipulators. When this option is checked, any manipulator applied to the XRef'd object is merged into the scene. The manipulators coming from the XRef cannot be altered when this is unchecked.

Modifiers   This option controls the handling of modifiers from XRef files. When it is set to XRef, the modifiers are contained within the XRef file and cannot be changed. *Merge* means the modifiers assigned to the XRef objects can be changed but are not reflected back into the XRef file. *Ignore* means the modifiers from the XRef file are disregarded.

Once you've imported an XRef object, you can use the transform tools to edit it. You can also modify an XRef object using the Modify tab in the Command panel. With an XRef object selected, the Modify tab gives you control over the way XRef proxy objects behave and are displayed. The options found in the Modify tab correspond to the XRef Objects entities list in the XRef Objects dialog box.

Arranging Furniture with XRefs and the Asset Browser

Using XRefs, you can begin to create a setting for the interior of the villa model. In this section, you'll use the chair — plus some other furniture from this book's accompanying web page — to create the interior setting.

During the process of arranging the furniture, you'll get a chance to explore another way of using XRefs. This time you'll use the XRef Scenes option to combine the villa model temporarily with a new furniture file to help lay out the furniture. You'll also look at how you can import geometry from one 3ds Max file to another through the Merge command and the Asset Browser. The *Asset Browser* is a tool that helps you manage your projects by giving you a seamless way to access data from your own computer, your network, and the Web.

Let's start by taking a look at how the Merge command can be used to import 3ds Max file data:

1. Before you save your current scene, you should strip the bitmap paths so that, if you distribute project files, you don't have 3ds Max looking for maps in locations that might not exist. Go to the Utilities panel, click the More button, and then select Bitmap/ Photometric Paths.

2. In the Path Editor rollout, select Include Material Library and then choose Edit Resources.

3. In the Bitmap/Photometric Path Editor dialog box, you'll see a list of any bitmaps that may have absolute map paths to a particular folder name. Click Strip All Paths, and click OK in the dialog box to continue. Then close the dialog box using the Close button.

4. Save the current scene as **MyVillaCouch.max** in the same folder as the other Chapter 10 files. This will allow 3ds Max to find the associated material maps without adding the external files search path.

5. Choose Reset from the Application menu to create a new file, and reset the new file to 3ds Max's default settings. The Reset Warning message displays. Click Yes.

6. From the Application menu, choose Import ➢ Merge. The Merge File dialog box displays. This is a typical Windows File dialog box.

7. Locate and open the MyVillaCouch.max file you just created. The Merge dialog box appears (see Figure 10.6).

FIGURE 10.6
The Merge dialog box
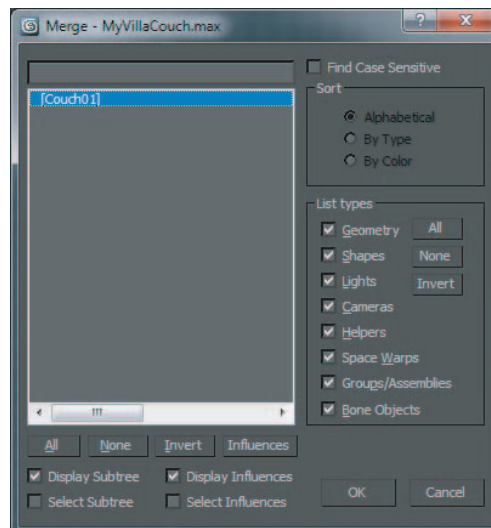
The Merge dialog box shows a listing of objects from the file you selected. Because the `MyVillaCouch.max` file contains only a single group, you see the group name in the list. Had you not grouped the objects in the `Couch01.max` file you saved earlier in this chapter, you would see the individual object names listed.

8. Select [Couch001] from the list; then click OK. The couch displays at the origin of the model, as shown in Figure 10.7.

FIGURE 10.7
The merged couch at the scene origin
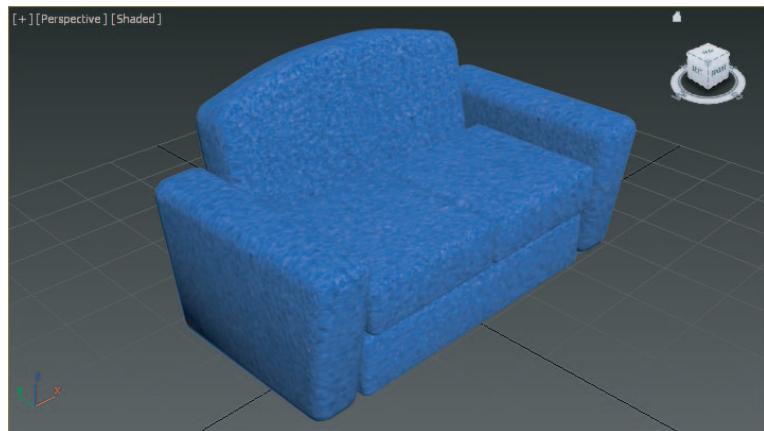
If the couch comes in but doesn't display the material, you may have a path issue in your file. The scene has to be able to find the bitmap file in order to display it in the viewport. This is why you stripped the paths at the beginning of this section — to ensure that the bitmaps would be found.

As you saw in steps 7 and 8, Merge gives you the opportunity to select specific objects to import from other 3ds Max files, although in the case of the couch, you had only one object to choose. You can also use Merge to import cameras or geometry from other models. Unlike XRef objects, the objects you import using Merge become a part of the database of the current file and have no link to the source file.

Let's try the Merge command again by adding the chair you created earlier:

1. Move the couch 5'2" in the X direction so that it's at the far-right side of the viewport.

RESETTING THE UNITS

You may have to change your units to US Standard Feet w/Decimal Inches after resetting the scene earlier.

---

2. From the Application menu, choose Import ➢ Merge.

3. In the Merge File dialog box, locate and select `Mybigchair.max` and then click Open.

4. In the Merge dialog box, click [Bigchair01] and then click OK. This time you see a dialog box warning you that a duplicate material name exists in the current scene.

You have four options at this point:

◆ You can rename the merged duplicate material by entering a new name in the input box near the top of the dialog box and then clicking the Rename Merged Material button. This will maintain both the merged material and the material in the current scene as unique materials.

◆ You can click Use Merged Material to replace the material in the current file with the material of the merged file.

◆ You can click Use Scene Material to maintain the current material and discard the duplicate in the merged file.

◆ You can click Auto-Rename Merged Material to have 3ds Max rename the merged material to maintain it as a unique material.

5. Click Use Scene Material. The chair displays at the origin of the file.

Choosing this option causes 3ds Max to use the Fabric-Blue Nap 2 material currently in the file for both the chair and the couch.

6. Click the Select And Move tool from the Main Toolbar; then Shift+click and drag the chair in the negative X direction approximately 5′2″.

7. In the Clone Options dialog box, make sure the Instance option is selected; then click OK.

Replacing Objects with Objects from an External File

You've just seen how you can use the Merge command to import parts of a scene into the current scene. Another command, called Replace, is similar to Merge, but it lets you replace objects in the current scene with identically named objects from external files. This can be useful in updating scene design elements. You can also use Replace to replace complex geometry temporarily with simple *stand-in geometry* for quick-study renderings. The following exercise will demonstrate how Replace works:

1. Save your file as `MyVillaFurniture.max`.

2. Open the `Mybigchair.max` file.

3. Select the chair; then choose Group ➢ Open. This gives you access to the individual objects that make up the chair's group.

4. Click the ChamferBox02 object (the chair back) to select it; then click the Modify tab of the Command panel.

5. Select ChamferBox from the modifier stack.

6. Change the Width parameter to **2′6″** and the Height to **2′6″**. If your chair values are already similar to those, choose something a few inches bigger or smaller. Basically, you just want to see the difference in the file.

7. Choose Group ➢ Close to close the group; then save the file incrementally.

You've made a slight modification to the chair. Now you can use Replace to see how you can update the chair in the `MyVillaFurniture.max` file to the new chair design.

Before you perform the Replace operation, you need to change the name of the object that forms the back of the couch. Remember that you created the `Bigchair01` file from the `Couch01` file, so the couch and chair share objects of the same name, even though they may not all be the same shape. The Replace command works by replacing objects in one file with objects of the same name from another file. Because you don't want to replace the back of the couch, you'll have to change the couch back object's name first.

1. Open the `MyVillaFurniture.max` file.

2. Select Couch01 on the right side of the Perspective viewport; then choose Group ➢ Open.

3. Click the couch back object named ChamferBox02. Press **H** on the keyboard, and select it by name if necessary.

4. In the Modify tab of the Command panel, change the name of the object, ChamferBox02, to **Couchback01**.

5. Choose Group ➢ Close.

Now you're ready to replace the back of the chair with the one you modified earlier:

1. From the Application menu, choose Import ➢ Replace.

2. In the Replace File dialog box, locate and select `Mybigchair01.max` and then click Open. The Replace dialog box opens, as shown in Figure 10.8.

FIGURE 10.8
The Replace dialog box
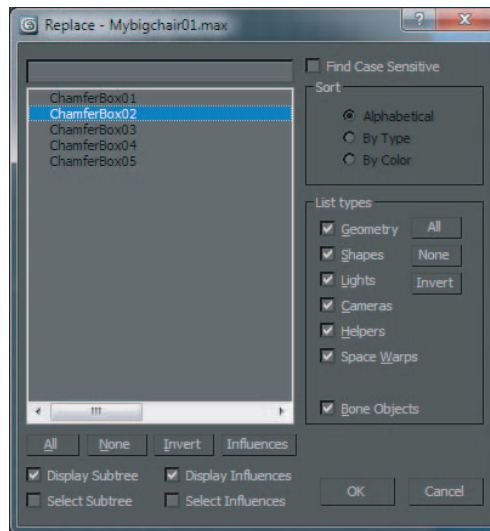
3. Select ChamferBox02; then click OK. You'll see a warning message asking if you want to replace the materials as well as the objects.

4. Click Yes. The chair back will be replaced with the new chair back you edited in the `Mybigchair01.max` file, as shown in Figure 10.9.

FIGURE 10.9
The new chair back
inserted using the
Replace tool
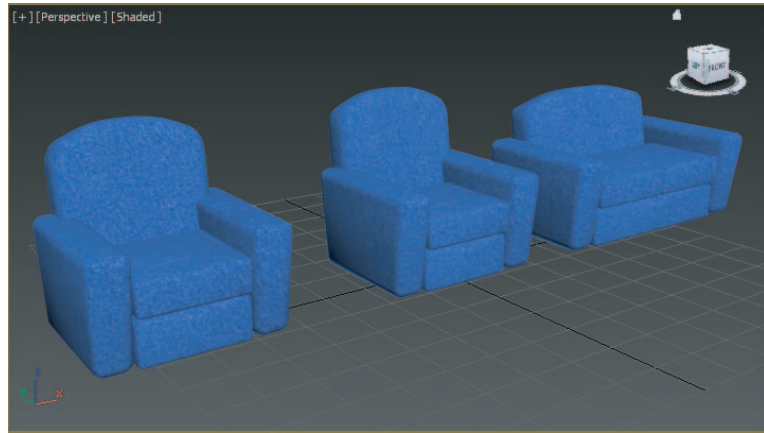
5. Save the MyVillaFurniture.max file.

Notice that the back was replaced in both the original chair and in the instance clone of the chair. Had you made a copy instead of an instance clone, only the original chair back would have been replaced. This demonstrates that instance clones are replaced along with the original objects.

MATERIALS DISPLAYING INCORRECTLY IN THE VIEWPORTS

When you're using XRefs and the Replace option, materials do not always display correctly in the Shaded rendered viewports. To force 3ds Max to reevaluate the materials, select them in the Material Editor, turn off Show Map In Viewport, and then turn it on again. The materials should display correctly.

Substituting Objects for Faster Viewport Performance

Maintaining and optimizing viewport performance is a constant struggle throughout the course of a project. As the number and quality of objects increases in a scene, the speed of pans and zooms and other video-intensive operations (such as playing or rendering animations) often decreases and can detrimentally affect a project's timeline. The Substitute modifier replaces the selected object in the scene with an object from another file. You can use this functionality to help sustain or improve viewport performance by swapping a high-resolution variation of a scene object with a low-resolution version from another file. Unlike the Replace command, the Substitute modifier can affect the object in the viewports, the rendered scene, or both, allowing the viewports to display a low-resolution version and the renderings to display the actual scene object. This next exercise covers the implementation of the Substitute modifier.

1. Open the VillaFurniture2.max file from this book's accompanying web page. This scene is similar to the MyVillaFurniture.max file that you recently saved, with one of the chairs converted to an Editable Poly and its components attached as a single object.

USING THE SUBSTITUTE MODIFIER WITH GROUPS

Because Substitute is a modifier, it works at the object level and you cannot substitute one group for another.

2. Select the chair on the far left.

3. In the Modify panel, expand the Modifier List drop-down and select the Substitute modifier.

4. In the Parameters rollout, uncheck the In Render check box. This causes the original geometry and not the substituted geometry to appear in any future renderings.

5. Click the Select XRef Object button.

6. In the Open File dialog box that appears, locate and select the `BigChair Optimized.max` file and click Open. This is a version of the chair in the current file that has had its face count extremely reduced, with only about 7 percent of the faces of the original.

7. In the XRef Merge dialog box, select the ChairLight object — the only object in the scene — and click OK.

8. Both scenes contain a material with the same name, which causes a Duplicate Material Name dialog box to appear. You don't want to replace the material that exists in the current scene, so click the Use Scene Material button.

9. The Substitute Question dialog box that opens next asks if the substituted material should be applied to the selected object. Click No.

The lower-resolution chair from the referenced scene replaces the higher-resolution chair in the current scene. Press the F4 shortcut key to turn on Edged Faces mode to see the effect more clearly. Your Perspective viewport should look like Figure 10.10.

FIGURE 10.10
The Perspective viewport after substituting the geometry
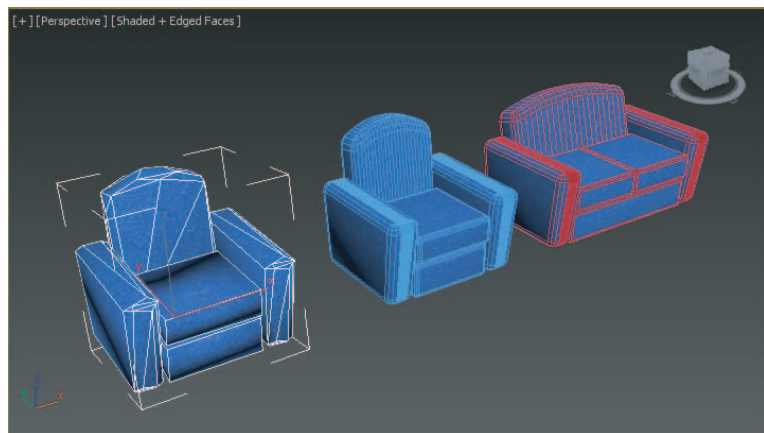
10. Click the Render Production button in the Main Toolbar. The original, nonoptimized chair appears in the rendered scene, as shown in Figure 10.11.

FIGURE 10.11
The rendered scene showing the original geometry
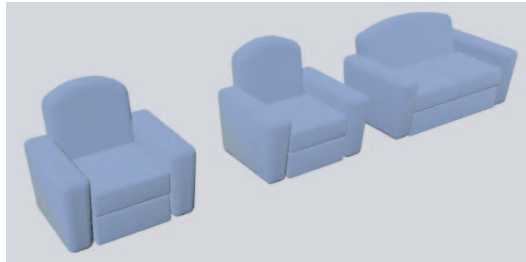
Importing Files with the Asset Browser

Like the Merge command, the Asset Browser lets you import a file into the current file. It doesn't let you pick which parts of a file are imported, but it does perform other functions, such as opening 3ds Max files in a second 3ds Max session or browsing the Web for materials and geometry.

As an introduction to the Asset Browser, try the following exercise. You'll use the Asset Browser to import another copy of the chair.

1. Move the middle chair to the back of the viewport.

2. In the Command panel, select the Utilities tab and then click the Asset Browser button.

You see a dialog box noting that downloaded content may have use restrictions or require licensing.

3. Click OK. The Asset Browser opens. If the window is empty, you may need to navigate to `C:\Program Files\Autodesk\3ds Max 2013`, as shown in Figure 10.12.

FIGURE 10.12
The 3ds Max 2013 Asset Browser
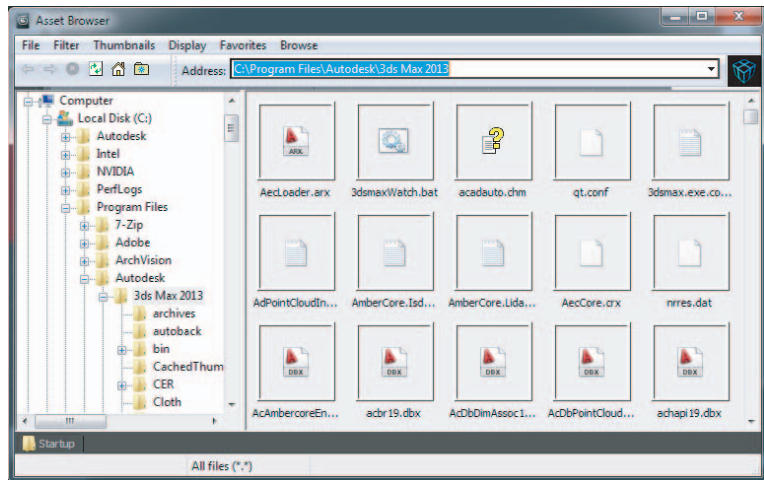
You can browse the contents of your computer and view thumbnail images of 3ds Max files and image files. You can then drag and drop files into 3ds Max, just as you would from Windows Explorer. One special feature of the Asset Browser is its ability to let you drag and drop 3ds Max components from websites that contain what is referred to as *i-drop content*, just as you can from any browser. In fact, the Asset Browser is an Internet browser that is built into 3ds Max.

Before you look at the Asset Browser's Internet capabilities, continue with the chair exercise to see how it works on your own computer. The Asset Browser should default to display all possible files, Filter ➤ All Files (*.*) from the Asset Browser's menu bar, instead of filtering geometry, images, and so forth. At the time of this writing, trying to change the Filter method crashes 3ds Max 2013 to the desktop.

1. On the explorer bar on the left side of the Asset Browser, locate the \3ds Max 2013\maps folder, and click it. The window to the right displays the image files contained in that folder, as shown in Figure 10.13.

FIGURE 10.13
Displaying the contents of a folder with the Asset Browser
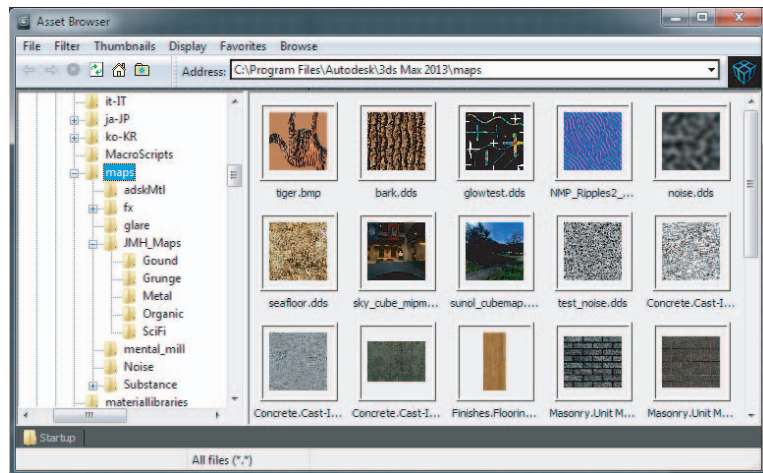
2. Choose Thumbnails ➤ Small (50 × 50) from the Asset Browser menu. The images become smaller, allowing you to see more of them.

3. Browse to C:\Program Files (x86)\Common Files\Autodesk Shared\Materials\ Textures\3\Mats. Again, you see a set of thumbnail views of the files. Note that the Asset Browser shows you the content of image files as well as .max files.

TURNING ON THUMBNAIL VIEWS AND REFRESH

If all you see is a set of blank boxes, you can turn on the thumbnail views by choosing Thumbnails ➤ Create Thumbnails.

If you add content to a folder that the Asset Browser is currently displaying, you will need to use Browse ➤ Refresh to see the new content.

You can drag and drop image files from the Asset Browser into a 3ds Max file. If you drag and drop an image into a viewport, it becomes a background. You'll get a message asking whether you want the image to be used as the viewport background, environment background, or both. If you drag and drop an image onto an object, the image will be mapped to the Diffuse Color or Diffuse Map channel of the object's material, depending on the type of material assigned to the object.

You can also drag and drop image files into map slots or fields in the Maps, Physical Qualities, or Special Effects rollouts of the Material Editor as an alternative way of importing image maps for materials. And, as mentioned earlier, you can import 3ds Max (`.max`) files through the Asset Browser. Try importing a chair into the current scene using the Asset Browser:

1. In the Asset Browser, use the list box to the left to locate the folder containing the Chapter 10 files.

2. Locate the `Mybigchair.max` file and select it.

3. Move the Asset Browser so that you have a clear view of the 3ds Max viewports. Then click and drag the `Mybigchair.max` file from the Asset Browser into the 3ds Max Perspective viewport. A context menu appears offering the Open, Merge, XRef, and Cancel options.

4. Select Merge File. Once again, you see the Duplicate Material Name dialog box.

5. Click Use Scene Material. The chair displays in the viewport. As you move the cursor, the chair follows.

6. Place the chair roughly in the center of the view, and click to set the new chair location.

USING CTRL WITH THE ASSET BROWSER

If you hold the Ctrl key down when dragging geometry from the Asset Browser, the objects are placed in the new scene at the same location they reside in their original scene.

If you have the four standard viewports open in 3ds Max, the orientation of the imported object will depend on the viewport into which the object is dragged. If you drag the imported object into the Top or Perspective viewport, the object will be oriented in the normal orientation. If you drag the object into the Left or Front viewport, the object will be oriented sideways, with its Z-axis pointing toward you from the viewport.

Let's insert a few more items using the Asset Browser. This time, try inserting a lamp into the Top viewport in 3ds Max:

1. Right-click the Top viewport, click the Maximize Viewport Toggle to enlarge it, and then click the Zoom Extents button.

2. Go to the Asset Browser, and locate the file called `torch1.max`.

3. Click and drag the `torch1.max` file into the 3ds Max Top viewport; then select Merge File from the context menu.

4. Adjust the location of the Torch1 lamp so that it displays on the left side of the viewport, as shown in Figure 10.14.

FIGURE 10.14
Objects inserted from the Asset Browser
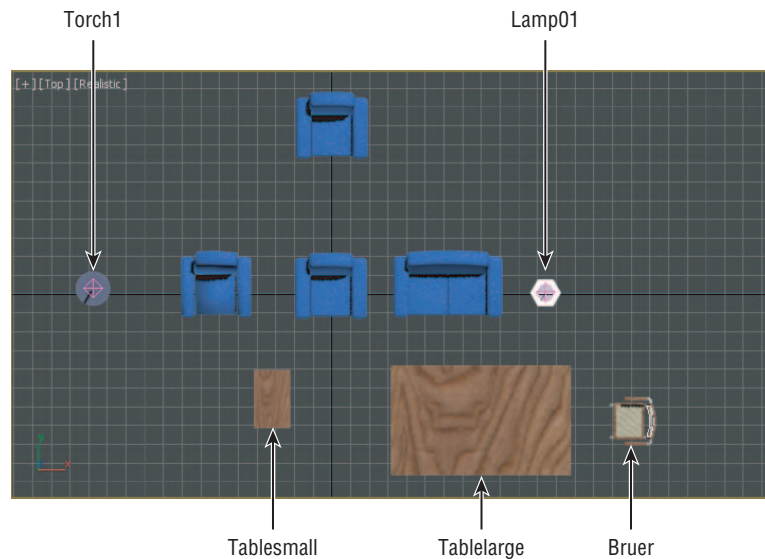
5. Repeat steps 1 through 4 to insert the files named `lamp01.max`, `tablelarge.max`, `tables-mall.max`, and `bruer.max`. Use Figure 10.14 as a reference to position the inserted objects.

OPENING A SECOND 3DS MAX SESSION

You can use the Asset Browser to open a 3ds Max file in a second session of 3ds Max 2013 by double-clicking the file's thumbnail. You may want to refrain from doing this if your system has less than an optimal amount of memory.

As a rule, you can click and drag objects easily from the Asset Browser to 3ds Max using the Windows taskbar, as long as you insert the objects into a non-Perspective viewport. If you must insert an object into a Perspective viewport, you can do so under two conditions. You can click and drag into the 3ds Max button of the Windows taskbar if the Perspective viewport is expanded to fill the entire 3ds Max window. If several viewports are displayed, you must click and drag directly from the Asset Browser to the Perspective viewport, bypassing the Windows taskbar. This requires that the Perspective viewport be at least partially visible, with the Asset Browser window overlapping 3ds Max. If you hold down the Ctrl key when you drag the object into the new scene, it is imported to the same location where it resides in the original file. You must follow this same procedure to click and drag bitmaps into the 3ds Max Material Editor.

Arranging Furniture with XRef Scenes

Now that you have some furniture to work with, the next step is to lay out that furniture. Start by putting together a basic arrangement:

1. In the Top viewport, copy and arrange the furniture in a way similar to that shown in Figure 10.15.

FIGURE 10.15
The furniture
arrangement
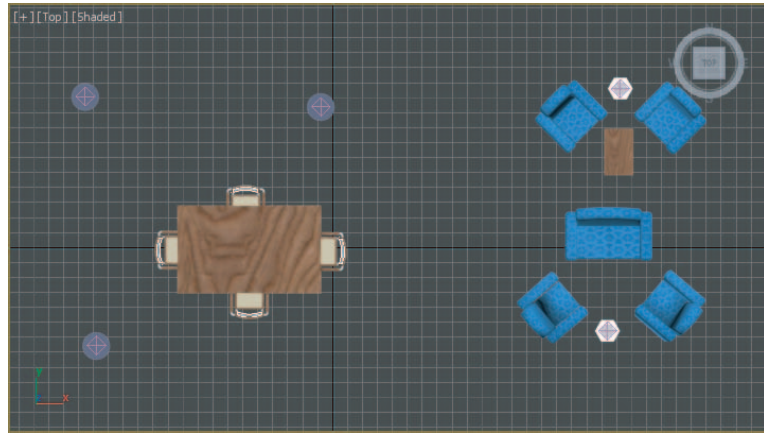
2. Next, attach the villa model as an XRef. This will give you a point of reference for the actual location of the furniture. From the Application menu, choose References ➢ XRef Scene. The XRef Scenes dialog box displays.

3. Click the Add button. The Open File dialog box displays. Locate and select the VillaSavoye_forXRefScene.max file; then click Open. The filename and path display in the XRef Scenes dialog box, and the geometry displays in the current scene.

4. Click Close. You now see the villa in the furniture layout.

5. Change to a wireframe view; then zoom out and adjust your view so that it looks similar to Figure 10.16.

FIGURE 10.16
Move the furniture
into the living room
in the Top viewport.

Move the furniture to the interior of the villa.
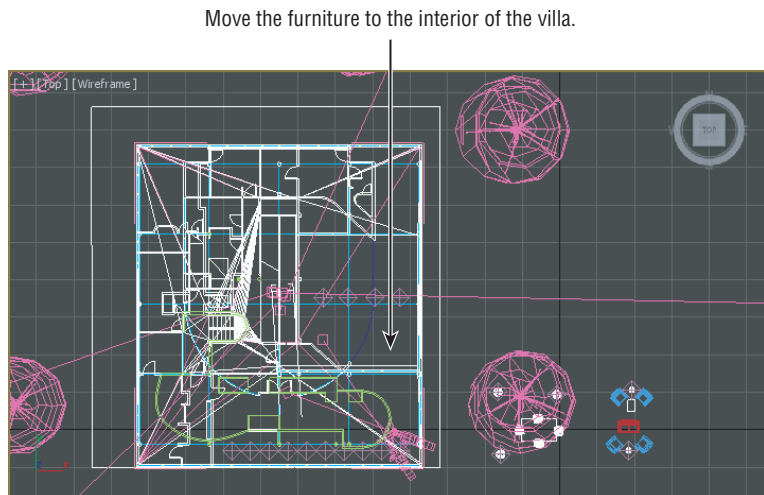
You see that the furniture is on the lower level of the building in the Top viewport. You want to move the furniture into the living room of the XRef villa scene:

1. Click the Select Object tool in the Main Toolbar; then place a selection region around all the furniture in the Top viewport. You may notice that 3ds Max ignores the XRef scene in the selection.

2. In the Top viewport, use the Select And Move tool to move the furniture into the living room area, as shown in Figure 10.16.

3. Switch to the Front viewport, click the Maximize Viewport toggle, and adjust the Front viewport so that you can see the furniture and the second floor of the villa, as shown in Figure 10.17.

FIGURE 10.17
The Front viewport showing the furniture and the villa's second floor
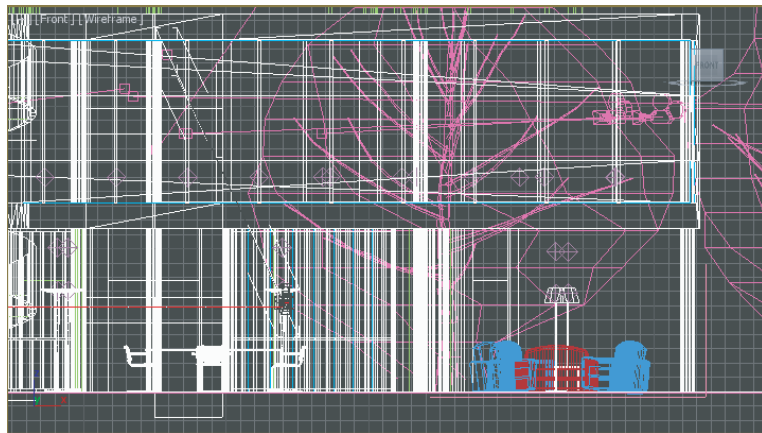
4. Move the furniture to the second floor. Do a rough placement in the Front viewport; then zoom in and make a finer adjustment to the vertical location of the furniture.

5. Go to the Top viewport and fine-tune the furniture arrangement to fit the room, as shown in Figure 10.18.

You might notice that the XRef objects are inaccessible. They are visible and will render, complete with lighting, but you cannot manipulate any of the objects in the XRef scene.

The important thing to note here is that the coordinate system of the XRef file is aligned with the coordinate system of the current scene. Therefore, when you move the furniture to fit the XRef scene, you are placing the furniture in the appropriate location relative to the XRef scene's coordinate system.

Next, you'll switch the relationship of the two files with which you are working. You'll close the furniture file, open the villa file, and import the furniture file as an XRef. You'll start by removing the XRef of the villa file:

1. From the Application menu, choose References ➢ XRef Scene.

2. In the XRef Scenes dialog box, select the villa file in the list box and then click Remove.

3. Click Close to exit the XRef Scenes dialog box.

4. Save the current file as **MyVillaFurniture2.max**.

FIGURE 10.18
Making final adjust-
ments to the furni-
ture placement
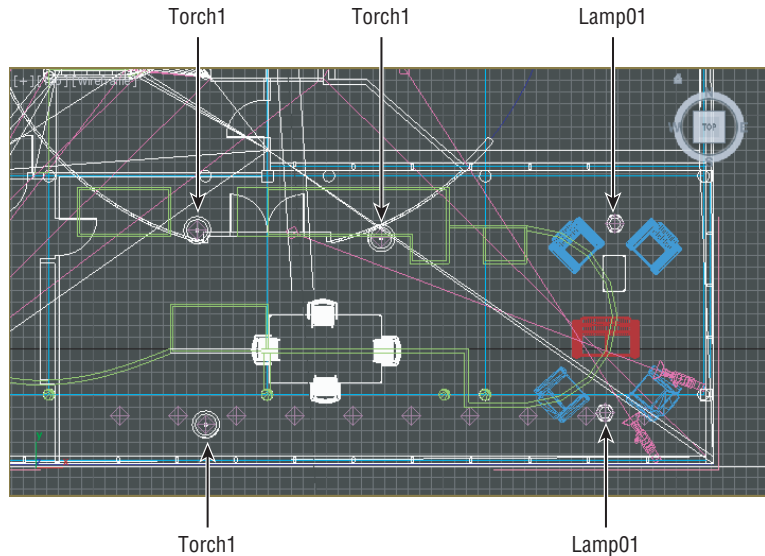
Now you're ready to place the furniture in your villa file:

1. Open the Mysavoye10.max file.

2. Open the XRef Scenes dialog box.

3. Click the Add button.

4. Locate and select the MyVillaFurniture2.max file; then click Open.

5. Close the XRef Scenes dialog box.

6. Right-click the Mycamera01 viewport.

   If you render the scene right now, it will be too bright. It's a good practice to use exposure control on the Render Preview window to get the right brightness and contrast.

7. On the Rendering menu, choose Exposure Control. The Environment And Effects dialog box opens to the Environment tab. In the Exposure Control rollout, click the drop-down arrow; then choose the Logarithmic Exposure Control and click Render Preview. The Raytrace Messages dialog box will briefly appear as the render progresses.

8. Make adjustments to the Logarithmic Exposure Control Parameters while watching the changes in the Render Preview window. Try increasing the Physical Scale setting, increasing the Contrast setting, lowering the Brightness setting, and then sliding the Mid Tones setting until you like the results.

9. Finally, render using the scanline renderer. Your rendering should look similar to Figure 10.19.

FIGURE 10.19
A rendered view of the villa's living room with furniture
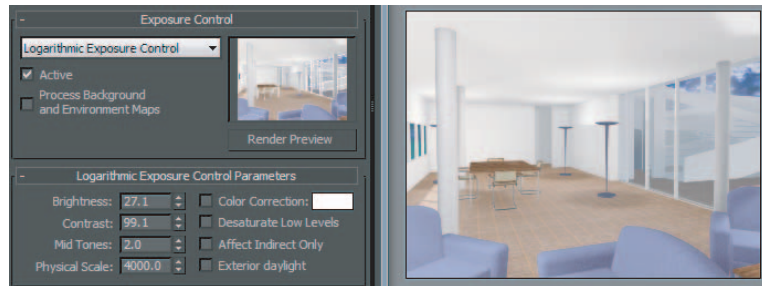
10. Save your file as **MyVillawithfurniture.max**.

XRefs are useful, especially when your models become complex. You can divide a model into several files and XRef them together, for example, to help keep objects organized. This can also aid in situations where you must divide design tasks between several people. You can also nest XRef files where an XRef contains other XRefs. The XRef Scenes dialog box offers other settings as well:

Add   This option lets you locate and select an XRef scene.

Convert Selected   This option lets you convert objects in your current scene into XRef scenes. The selected objects are saved as .max files, and they are removed from the current scene. They are then imported as XRef scenes back into the current scene.

Remove   This option completely removes a selected XRef scene from the current scene.

XRef File   This option gives you control over the way XRef scenes are linked to the current scene:

◆ Enabled lets you turn a selected XRef scene on or off. This is useful if you want to remove an XRef scene temporarily from the current scene without completely removing the link to the XRef scene. This option also removes the XRef scene from memory, making more memory available for other operations.

◆ Overlay prevents circular dependencies, which happen when a nested XRef is referenced back into itself by loading the XRef only into the scenes that reference it. See the "XRef Scene" page in the 3ds Max 2013 Help documentation for a complete explanation and examples of XRef overlays.

◆ Merge merges an XRef scene into the current scene, thereby ending the XRef relationship.

Update File   This option controls how XRef scenes are updated:

◆ Automatic updates XRef objects whenever the source file is edited and saved.

◆ Update Now lets you update XRef objects manually from the current state of the source file.

Display Options These options control the visibility of XRef scenes in the viewports. They have no effect on how XRef scenes are rendered:

◆ Visible turns the display of XRef scenes on or off.

◆ Box converts the display of XRefs into bounding boxes.

Ignore This option lets you control the inclusion of specific types of objects from an XRef scene. Items that are turned off will not be imported into the current scene if Merge is used.

Parent This option gives you control over the position and animation of an XRef scene by associating, or *binding*, an XRef scene to an object in the current scene:

◆ Bind is the mechanism by which you make the association. First click Bind; then select the object to which you want the selected XRef scene to be bound. The XRef scene's origin will be aligned with the selected object's pivot point. You can use a dummy object as a Bind parent object. You can then animate the bound object to animate the XRef scene.

◆ Unbind will unbind the selected XRef scene from the object to which it is bound. The Name field box at the top of the Parent group displays the name of the object to which a selected XRef scene is bound.

Using the Rendered Frame Window

While we're on the subject of file usage, you'll want to know how you can save, compare, and print rendered views using the toolbar at the top of the Rendered Frame Window (RFW). If you decide that you want to save the result from the RFW to a file, you can do so by clicking the Save Image tool on the Rendered Frame Window's toolbar.

This tool opens the Save Image dialog box.

In this dialog box, you can enter a filename and then select a file type for the image. You can choose from a fairly extensive list of bitmap image file types, as listed in Table 10.1.

TABLE 10.1: BITMAP IMAGE FILE TYPES AVAILABLE

FILE TYPE	EXTENSION
Audio-Video Interleaved	`.avi`
Windows Bitmap	`.bmp`
Kodak Cineon	`.cin`
Encapsulated PostScript	`.eps, .ps`
Radiance Image File (HDRI)	`.hdr, .pic`
Joint Photographic Experts Group	`.jpg, .jpe, .jpeg`
OpenEXR	`.exr, .fxr`

TABLE 10.1: **BITMAP IMAGE FILE TYPES AVAILABLE** *(CONTINUED)*

FILE TYPE	EXTENSION
Portable Network Graphics	`.png`
QuickTime	`.mov` (requires Apple QuickTime)
SGI's Image File Format	`.rgb, .rgba, .sgi, .int, .inta, .bw`
RLA	`.rla`
Rich Pixel Format	`.rpf`
Truevision Targa	`.tga, .vda, .icb, .vst`
DirectDraw Surface Image File	`.dds`

The OpenEXR file format is similar to high dynamic range (HDR) image files. HDR image formats support a wide exposure range that stores far more information than normal images. This file format originated within Industrial Light & Magic (ILM), the visual effects company founded by George Lucas in 1975. The OpenEXR file format can hold G-Buffer and Render Element passes, all within a single file.

The Save Image dialog box also lets you set some of the parameters for the chosen image file by using the Setup button. For example, if you select TIF Image File as the Save As Type file option, the Setup button will open a dialog box that lets you choose between 8-bit, 16-bit, or 32-bit color and monochrome TIFF files with or without compression.

ACCESSING ADDITIONAL IMAGE CHANNELS

The RPF file format offers support for arbitrary image channels beyond the standard RGB and alpha channels. These additional channels can be used during postproduction compositing of animations for the inclusion of special effects. When you select the RPF file format at rendering time, 3ds Max will open the RPF Image File Format dialog box, which allows you to select from a set of Optional Channels options. The RPF format is similar to the RLA format that's popular with SGI computers. The EXR file format provides the same functionality for use with the new 3ds Max Composite application, a compositing program that lets you make changes to your animations without re-rendering, because it takes advantage of output channels such as shadow, Z-depth, pixel velocity, and so forth.

Copying the Rendered Image

You can use the Copy Image button to copy the contents of the Rendered Frame Window to the Windows Clipboard, which you can then paste into a word processing document, an email, Photoshop, or other graphics application.

Printing Images

In addition to letting you view and save files, the Rendered Frame Window lets you print your renderings. You can print directly from the window by clicking the Print Image tool on the toolbar. This will send the print job to the default printer you have set up on your computer.

If you want to print an existing image file that you've saved, you can do so from the Save Image dialog box. Click the Save Image tool in the RFW; then, in the Save Image dialog box, locate and select an image file. If the Preview check box is selected, you'll see a thumbnail version of the file in the lower-right corner of the dialog box. You can then click the View button in the lower-left corner. 3ds Max opens another, similar RFW displaying the selected image. From this new window, you can click the Print Image tool to print the image.

> **Viewing Images from inside 3ds Max**
>
> You can open an image that you have already rendered by choosing Rendering ➢ View Image File, and then use the View File dialog box to browse to the file you want to view and click Open. The image will open in its own Rendered Frame Window that you can use to print it. You can also open your rendered images in Adobe Photoshop or a similar image-editing program for greater control over cropping, print size, resolution, and so on.

Opening Multiple RFWs for Comparisons

The View button in the Save Image dialog box can be a handy tool if you want to compare a current rendering with a rendering that you have saved as a file. You can also open multiple RFWs to view several versions of your scene at once while you're rendering it. To do this, use the Clone Rendered Frame Window tool.

This tool will open a copy of the current window contents. You can then modify your scene and render again. The cloned RFW will retain the original rendering, whereas the main RFW will display the revised scene. You can make several clones — one for each scene variation you want to try. You can minimize the windows while you are working and then maximize them later to view their contents.

Zooming, Panning, and Controlling Channels in the RFW

The Rendered Frame Window also provides a set of functions that lets you control various aspects of the window display. For example, you can enlarge an area of the window to get a closer look at a detail in your rendering. To do this, hold down the Ctrl key while you click the mouse. When you press the Ctrl key, the cursor changes to a magnifying glass. Clicking the mouse zooms in on the view. Once it is zoomed in, you can pan by holding down the Shift key and clicking and dragging the mouse. Right-clicking while holding the Ctrl key zooms the view back out. The scroll wheel on your mouse can also be used to zoom and pan in the RFW. Roll the wheel forward to zoom in and backward to zoom out. Click and hold down the scroll wheel, and then move the mouse to pan the image in the RFW.

If you want to view the red, green, blue, or alpha channel of the RFW, you can use the Enable Channel buttons on the window's toolbar, as shown in Figure 10.20. Typically, all three of the channel buttons are on. To view a single color, click the two channel buttons you do *not* want displayed. This turns them off. The Channel Display drop-down list is for RPF images. This list lets you display additional channels rendered when using the RPF file type, which offers the special effects channels.

You can also view a grayscale version of the rendering by using the Monochrome button. Finally, you can clear the contents of the RFW by clicking the Clear button.

Included at the top of the RFW are additional tools for rendering your scene without accessing the Render Setup dialog box. At the far left, the Area To Render drop-down list is where you

select what portion of the current view is to be rendered. When you don't need to render the entire view, you can use the Edit Region button to define the rectangular portion of the view you need. The Auto Region Selected button automatically creates a region that encompasses all the selected objects in the view.

FIGURE 10.20
The Rendered Frame Window tools

The Red, Green, and Blue Channel buttons

The Alpha Channel button

The Clear button

The Monochrome button

Channel Display list

The Color Sampler swatch
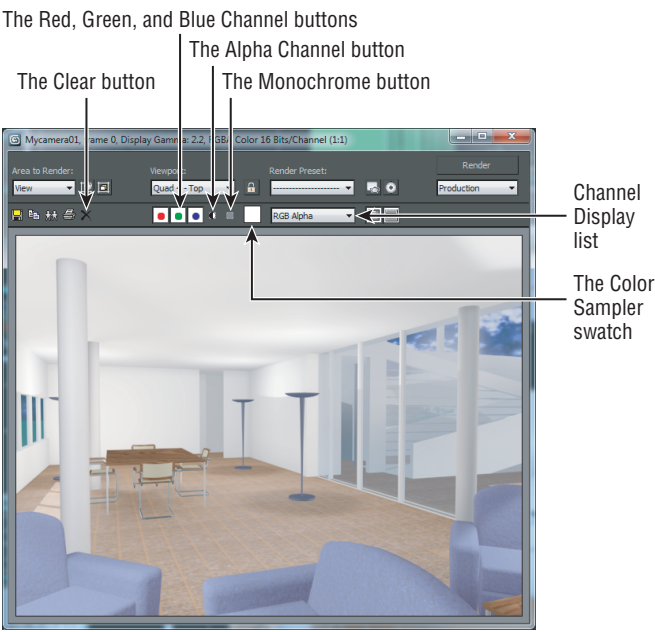
By default, the Viewport drop-down list displays the active viewport, which is the viewport that is rendered when the Render button is clicked. When the Lock To Viewport button is clicked, the listed viewport is rendered regardless of which viewport is active in the 3ds Max window. You can also select a render preset from a drop-down list. There are two buttons to open the Render Setup dialog box and the Environment and Effects dialogs. And, of course, you can render the scene in the RFW. When mental ray is the assigned renderer, many of the common mental ray tools and settings are available at the bottom of the RFW, as shown in Figure 10.21.

Obtaining Colors from External Bitmap Files

Perhaps one of the most interesting features of the RFW is the seemingly innocuous color swatch, located at the center of the lower toolbar (see Figure 10.20). If you right-click in the RFW, 3ds Max will record the color at the location of your cursor in the color swatch. If you right-click and drag the cursor over the contents of the RFW, you'll see a readout of the color over which the cursor passes, as shown in Figure 10.22. The readout contains additional image information you may find helpful.

Once a color is selected and placed in the color swatch, you can click and drag this color swatch to any other color swatch in 3ds Max.

This feature of the Rendered Frame Window color swatch is significant because with it you can import colors from a saved bitmap image file. You may, for example, be asked to match a specific color from a color chip. You can scan the color chip and save it as a bitmap file. Then, using the RFW, you can open the scanned color chip file, right-click the color, and click and drag the color from the Rendered Frame Window color swatch to the Material Editor. You can then apply the material with the imported color to an object such as an interior wall.

CALIBRATING YOUR DEVICES

If you intend to use a scanner to match colors, make sure that your scanner and printer or other output devices have been calibrated for accurate color reproduction.

Tracking and Locating a Scene's Assets

Scenes in 3ds Max can contain many objects that are externally referenced from different files, as well as image maps from several local and network drives. This can create problems when files are renamed or relocated during the course of a project. For example, when you open a scene and the program is unable to locate an XRef at its assigned location, the geometry within the source scene is not available to the current scene. One solution is to keep all files in the same folder on your system. This is often not practical when assets must be shared between artists, and it creates a bloated drive when common image maps are redundantly saved in different folders.

As you learned in Chapter 8, "Enhancing Models with Materials," you have the option to assign relative paths rather than absolute paths for image maps. This allows for greater modularity of the projects and less of a chance that paths to image maps and other support files will be "broken."

It is best to maintain all of your asset files in a logical folder structure with access available to all users on the system. Regardless of how strict a procedure may be, assets get renamed or relocated, especially during software and hardware upgrades. The Asset Tracking dialog box is designed to help you locate and retarget files used in your 3ds Max scenes. This next exercise works through some of the functionality of the Asset Tracking dialog box.

1. Reset 3ds Max.

2. Locate the `MyVillaFurniture3.max` file that is currently XRef'd into `mysavoyeVil-lawithfurniture3.max` and move it into another folder on your system. This will cause an error when `mysavoyVillawithfurniture.max` is opened and the XRef is not located.

3. Open the `mysavoyeVillawithfurniture3.max` file. The Missing XRefs dialog box appears, indicating the name and expected location of the missing XRef file.

4. Click the OK button to close the dialog box.

5. From the Application menu, choose References ➢ Asset Tracking or press Shift+T. The Asset Tracking dialog box opens, displaying the name, location, and status of the files used in the current 3ds Max scene, as shown in Figure 10.23.

FIGURE 10.23
Assets can be located using the Asset Tracking dialog box.
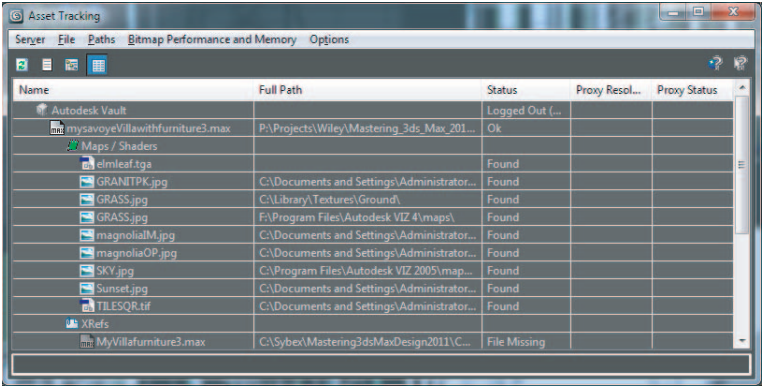
6. If the dialog box has a tree-style view instead of a table-style view, click the Table View button in the Asset Tracking dialog box's toolbar.

As you can see, the File Missing entry in the Status column indicates that the `MyVillafurniture3.max` file in the XRefs section cannot be located at its expected

location. If you are running 3ds Max with Asset Tracking enabled, you may see files with their status listed as Unknown Status, Found. Those are files that are not at their designated location but have been located elsewhere in the 3ds Max search path.

It is not necessary to remove and then add the XRef or to relocate it to its original location. You can use the Asset Tracking dialog box to retarget the XRef dependency to the new file location.

7. Highlight the offending file, and then choose Paths ➢ Set Path from the Asset Tracking menu bar to open the Specify Asset Path dialog box.

CONFIGURING USER PATHS

If a missing file is located in any folder listed in the External Files tab of the Configure User Paths dialog box, you can use the File ➢ Reveal In Explorer option to display the location of the file in a Windows Explorer dialog box. See Chapter 8 for more information regarding the Configure User Paths dialog box.

---

8. Click the Browse button with the ellipses on it to open the Choose A New Asset Path dialog box, and then navigate to the new location of the `MyVillafurniture3.max` file.

9. Select the file, and then click the Use Path button.

10. Click OK back in the Specify Asset Path dialog box to accept the new path. The status of the XRef changes from File Missing to Ok, and the furniture appears in the scene.

Retargeting a scene asset is only one of the functions available in the Asset Tracking dialog box. You can also strip paths from image files to force the system to access these files only from the designated user paths, view image files, or even set up custom file dependencies. 3ds Max 2013 is fully compatible with the Autodesk Vault asset-tracking system, and using the Asset Tracking dialog box, you can check in or out assets for editing, control revision history, and display information on a scene's editing history.

The Asset Tracking dialog box Bitmap Performance And Memory menu provides access to settings that you can use to optimize how 3ds Max behaves when it is rendering, as shown in Figure 10.24. The menu lets you easily enable or disable the Proxy System and Bitmap Paging, access the Global Settings And Defaults For Bitmap Proxies dialog box, and set proxy values if proxies are enabled.

FIGURE 10.24
The Bitmap Performance And Memory menu
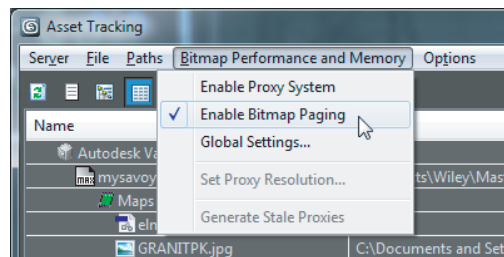
Bitmap Paging saves RAM and render time by saving copies of large texture maps to a folder in your `User` directory (unless you specify an alternate location in the Global Settings And

Defaults For Bitmap Proxies dialog box) instead of keeping them loaded in RAM. If you are using Allegorithmic Substance textures, note that they will not render in the NVIDIA mental ray renderer if you have Bitmap Paging enabled, which is the default in 3ds Max 2013.

Bitmap Proxies work by creating lower-resolution copies of used texture maps and storing those copies in your User directory. You can specify the ratio of how much to reduce the resolution of texture maps and set a maximum pixel limit that will control them when proxies are created. The Global Settings And Defaults For Bitmap Proxies dialog box is shown in Figure 10.25.

FIGURE 10.25
The Global Settings
And Defaults For
Bitmap Proxies
dialog box
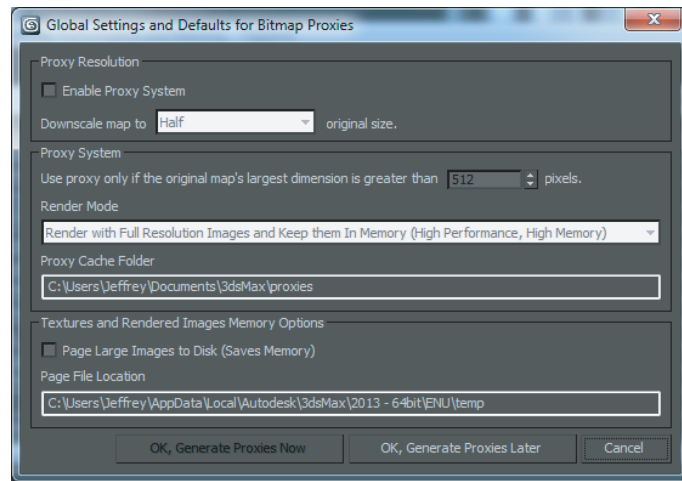
Creating Panoramas

If you've ever shopped for a car or looked at real estate online, you've probably come across a type of "virtual tour" or "wraparound panorama" that offers a 360-degree view of an environment. Spawned by Apple's QuickTimeVR, many software packages are available that make panoramas from a series of images. Panoramas can be made from photographs of real places or from your virtual architecture in 3ds Max.

All panorama software uses an image-distortion technique to create the seamless wraparound illusion. Because the panorama effect is image based, it is essentially a pixel phenomenon and can be efficiently transmitted on the Web. 3ds Max can export 360-degree cylindrical and spherically distorted images that you can use in a wide array of panorama-creating software. In addition, 3ds Max can export panoramas directly to Apple's popular QuickTime format, although you must have QuickTime 7.7.2 installed on your system. 3ds Max 2013 extends this functionality to 64-bit systems. Let's use the Villa Savoye model one last time to export an interior panorama.

1. Open mysavoyeVillawithfurniture.max from this book's accompanying Web page.

2. Right-click the Left viewport to activate it; then zoom into the upper floor area where you placed the furniture.

   3ds Max's Panorama utility requires a camera to be placed at eye level, looking straight ahead in an interior space.

3. On the Create tab of the Command panel, click the Cameras button and click the Free button in the Object Type rollout.

4. Click a point in the middle of the second floor to place a free camera looking straight ahead, as shown in Figure 10.26.
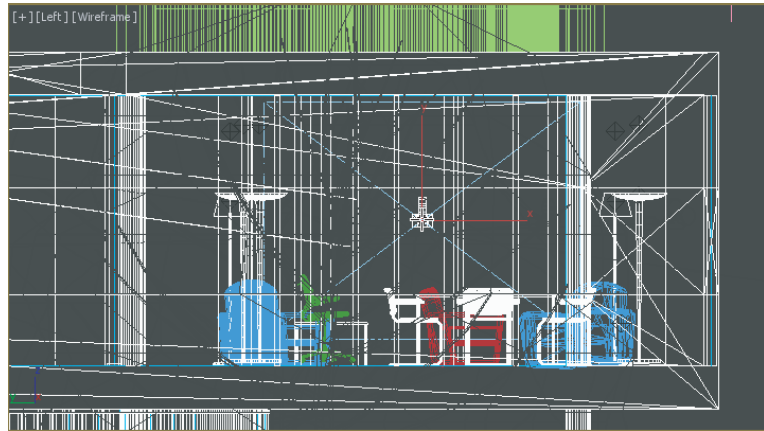
5. Right-click the Top viewport, and zoom out until you can see the new camera; then move the camera to the center of the room containing the furniture (see Figure 10.27).
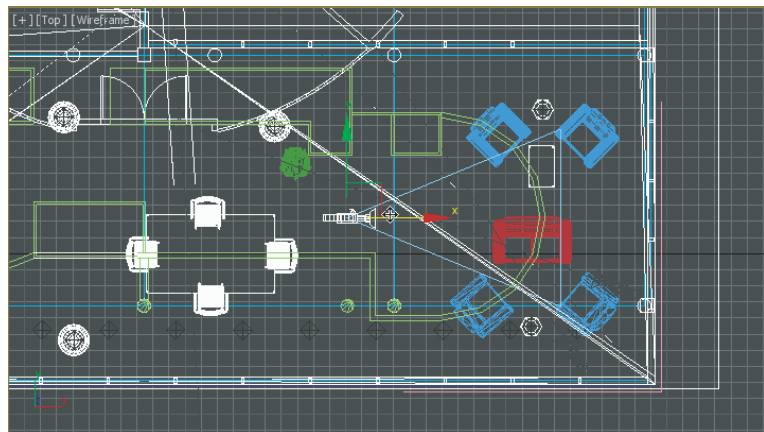
It doesn't matter which way the camera is oriented for a panorama as long as it is facing straight ahead at eye level. The Panorama utility will automatically rotate the camera as needed to generate the panoramic image, as you will see shortly.

6. Using the Select And Move tool, move the camera to a height of 15' in the Z direction to approximate eye level on the second floor.

7. With Camera001 still selected, on the Command panel, switch to the Modify tab and change the name to **MyPanoramaCamera**.

8. Now right-click in the MyCamera01 viewport; then press **C** to look through the currently selected free camera in the viewport.

   Do not worry that the composition through this camera leaves something to be desired. The Panorama utility will utilize this camera and automatically adjust it to generate the panorama.

9. Click the Utilities tab of the Command panel, and then click the More button in the Utilities rollout to open the Utilities dialog box.

10. Click the Panorama Exporter option, and then click OK. The Panorama Exporter rollout appears at the bottom of the Utilities panel.

11. Click the Render button in the Utilities panel. In the Render Setup Dialog dialog box (see Figure 10.28), click the 3072 × 1536 button in the Interactive Panorama Exporter Common Parameters rollout. This sets a large pixel size for the entire panorama, and it yields higher-quality output than the default setting.

12. Scroll down in the Render Setup Dialog dialog box to the Antialiasing group in the Default Scanline Renderer rollout, and from the Filter drop-down menu, select Sharp Quadratic.

FIGURE 10.28
The Render Setup
Dialog dialog box
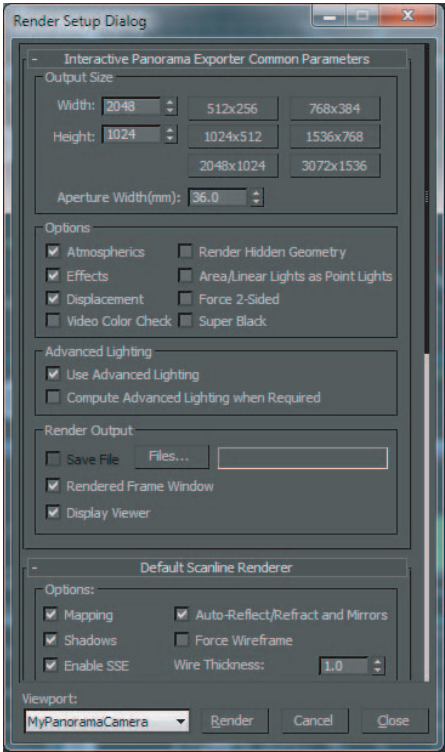
13. Make sure that `MyPanoramaCamera` is selected in the Viewport drop-down list at the bottom of the Render Setup Dialog dialog box, and click the Render button just to the right of it.

A series of six still images corresponding to the six sides of a cube are rendered and appear sequentially in the Rendered Frame Window. At the end of the automatically scripted sequence, the Panorama Exporter Viewer appears, as shown in Figure 10.29.

FIGURE 10.29

The Panorama
Exporter Viewer
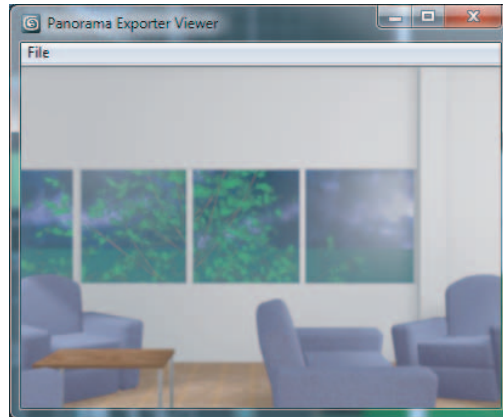
The image that appears in the Panorama Exporter Viewer window looks blurry because of the distortion filter that was applied to create the wraparound illusion.

1. You can make the image look crisper by dragging the corners of the Panorama Exporter Viewer to make it smaller. On the other hand, you could have rendered more pixels in step 11 to make the panorama less blurry, but this takes significant additional render time. The Output Size resolution setting that you choose is for the entire panoramic image and not for each individual side.

IMPROVING THE PANORAMA QUALITY

Try rendering the panorama at a much higher resolution to decrease the inherent blurriness. The trade-off for a sharper image is a larger file size and consequently a longer download time when the panorama is posted on a website.

2. Place your cursor directly in the center of the Panorama Exporter Viewer window, as shown in Figure 10.30.

3. Carefully drag the cursor about 1⁄8″ in any direction, and watch as the image dynamically wraps around as if you are turning your head in the interior space.

You can look from side to side, up and down, and all around. Click to stop moving. For increased control or to turn small amounts, try right-clicking and dragging in the viewer window.

FIGURE 10.30
Place your cursor in
the center and drag.
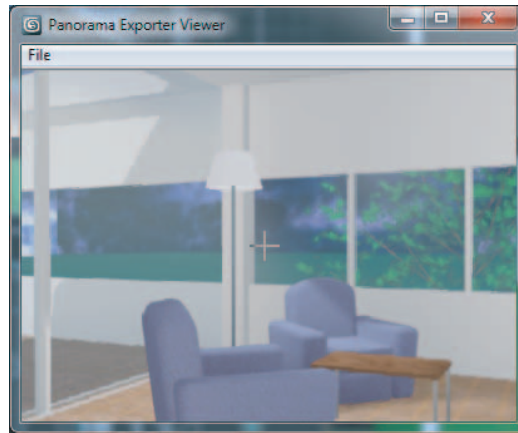
4. Place the cursor in the center again, and hold down the middle button or wheel button on your mouse and drag down. You will zoom out of the panorama, as shown in Figure 10.31. Drag up to zoom in.

FIGURE 10.31
A zoomed-out view
in the Panorama
Exporter Viewer

AVOID EXTREME ZOOMS

Be careful not to zoom in or zoom out too much in a panorama. Because it is a 2D image, you are actually changing the field of view of the effect, and the extremes exhibit wild distortion.

---

5. In the Panorama Exporter Viewer window, choose File ➢ Export ➢ Export QuickTimeVR.

6. In the QuickTimeVR Output File dialog box, browse to where you are working with this chapter's files.

7. Name it **MyPanorama.mov** and click Save.

   At the time of this writing the QuickTime files were not saving properly on 64-bit systems. Saving the file as a Cylinder or Sphere does work.

OTHER QUICKTIME VR EXPORT OPTIONS

You can also export your panorama as regular raster image files with cylindrical or spherical distortion for use in third-party panorama-generating software.

---

8. You can also export your panorama with cylindrical or spherical distortion for use in third-party panorama-generating software. Close the Panorama Exporter Viewer window and the Render Setup Dialog box.

9. Resave your scene as **MyPanorama.max**.

10. To view your new QuickTime VR file, if you have QuickTime installed on your system, double-click the file where you saved it in the filesystem. QuickTime will launch and display the panorama in a similar fashion to 3ds Max's built-in Panorama Exporter Viewer. Drag in the center to spin the panorama.

The advantage of having your panorama in QuickTime format is that you can post it on a website, and anyone who has the free QuickTime plug-in will be able to enjoy your interactive artwork — no other software is required. You must have the current version of Apple's QuickTime player installed on your system to view QuickTimeVR files. You can download it for free from www.apple.com. However, QuickTime doesn't work with all Windows 64-bit operating systems at the time of this writing.

Publishing a DWF File

Still images and animations can be excellent sources of information regarding a scene. What they do not provide is the ability to view a scene interactively from user-defined views. You can't expect every client to have 3ds Max to view the scene through, and there is no viewing application available for .max files. You can, however, publish your 3ds Max scenes as Drawing Web Format (.dwf) files that can be viewed through the Autodesk Design Review software. This free viewer is available from www.autodesk.com and is installed with several Autodesk products, including 3ds Max 2013. You will need to make sure that you have Autodesk Design Review 2013 installed to complete the following exercise.

1. Open the export_to_DWF.max file. This is a simple test scene used for expediency.

2. Right-click in the Top viewport to make it active.

3. From the Application menu, choose Export ➢ Export To DWF.

4. In the Select DWF File dialog box that opens, name the file, select the file's location, and then click Save.

5. In the DWF Publish Options dialog box, check the Show DWF In Viewer option. This will cause the new DWF file to open in the Autodesk Design Review software after it has been created. Make sure that the other options are set the same as those shown in Figure 10.32.

FIGURE 10.32
The DWF Publish
Options dialog box
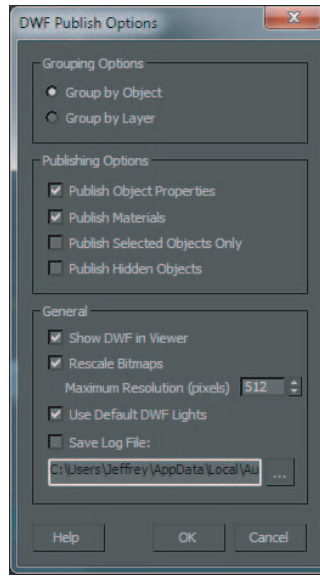
6. Click OK. The system pauses briefly as the DWF file is created. When it is completed, the new DWF file opens in the Autodesk Design Review software.

DWF RESTRICTIONS

There are several restrictions to the items that 3ds Max can create when publishing a DWF file. For example, environment backgrounds are represented as background colors, and environmental effects, such as fog and volumetric lights, are not included. Reflections are not shown, and mental ray materials are displayed with the object's diffuse color. Take a look at the 3ds Max Help for a list of the objects that are supported or unsupported.

7. Click and drag in the Design Review viewport to change your viewpoint; it works similarly to using the Orbit tool in 3ds Max. Roll the mouse wheel to control the zoom factor,

and drag it to pan the view. You can also use the ViewCube® tool to modify the view. Adjust the view until it looks similar to Figure 10.33.

FIGURE 10.33
The DWF file shown in Autodesk Design Review 2013
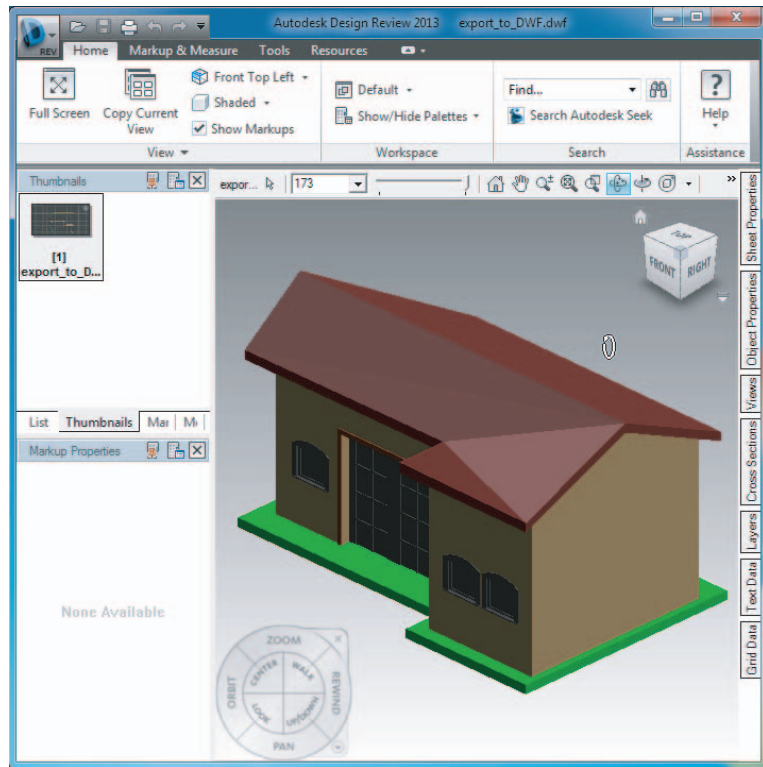
8. Many features are available in the Design Review product. If you expand the Model tab on the left side, you can see the object organization of your file. Selecting any of the objects in the model will display the Node and Object properties of the objects. On the Tools menu on the ribbon, you can move and rotate individual objects or create a section. Let's try it.

9. Click the Tools tab on the ribbon, and then choose Section XZ, as shown in Figure 10.34.
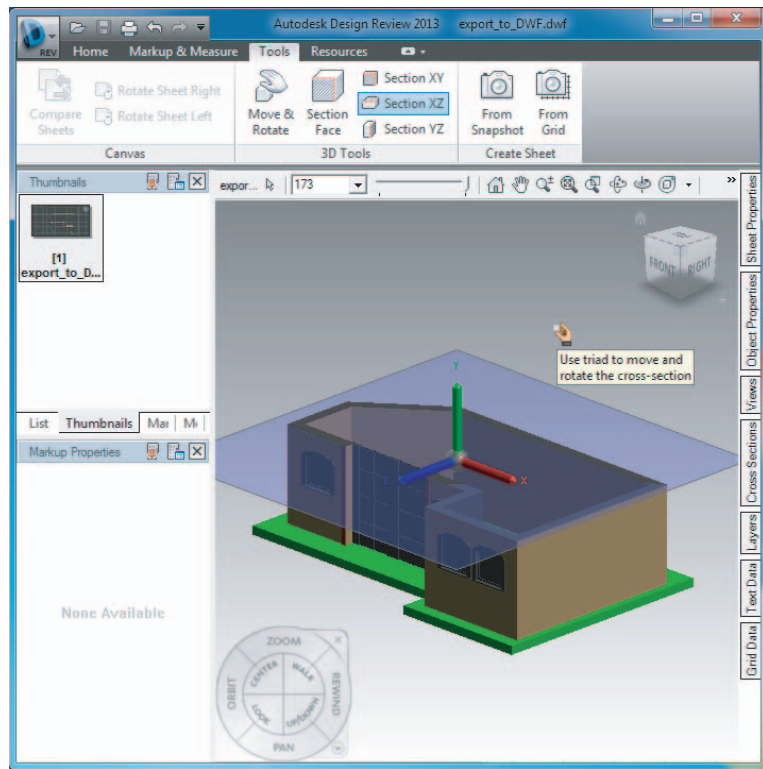
10. The top of the building and its contents are deleted above the Slice plane. Click and drag the green Y-axis handle of the tripod to change the vertical position of the Slice plane. You can move or rotate by selecting different areas of the tripod. Activating the end of the tripod allows you to rotate, as shown in Figure 10.35.

Take an opportunity to experiment with the many tools available in the Autodesk Design Review software, including the ability to slice along any plane. Autodesk has expended a lot of effort to make DWF the format of choice, and you will probably use it extensively to output your projects.

FIGURE 10.35
Rotate the Slice plane to control the display in the viewport.
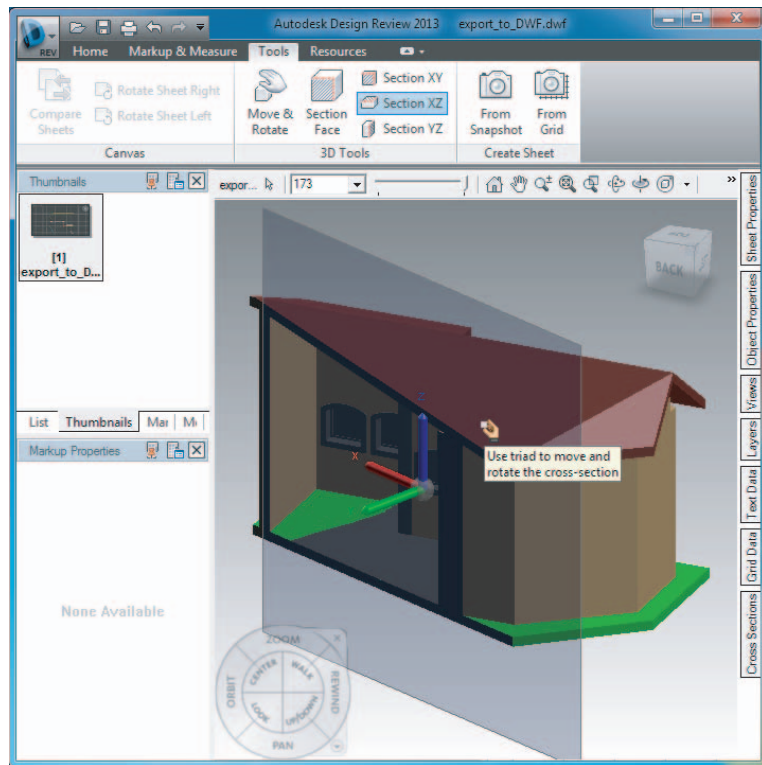
The Bottom Line

Use external references.   Using XRefs can increase productivity by breaking a project into smaller parts that individual artists can work on, and it allows you to disassociate parts of the project as system performance decreases.

Master It   Extract the trees in the `mysavoye10.max` file as a new 3ds Max file. Change the number and arrangement of the trees in this new scene, save the configuration, and then

reopen `mysavoye10.max`, delete the existing foliage, save the scene as a new file, and then XRef the new tree file you made.

Use the Rendered Frame Window options. Using the Rendered Frame Window, you can save, print, and compare the result of your 3ds Max renderings.

Master It Render the MyCamera01 viewport in the `MySavoye10_Trees.max` file. Make changes to the lighting, render the viewport again, and then compare the two renderings using the RFW.

Use the Asset Browser. With the Asset Browser, you can insert one 3ds Max scene into another using the dialog box to see the names of and thumbnails for the assets in any folder locally, on a network, or on the Internet.

Master It Create several 3ds Max scenes consisting of a single, unique tree each. Use the Asset Browser to bring one or more of each of the trees into the `MySavoye10_Trees` scene.

Create a panorama. By creating a panorama, you can allow anybody to view the rendered result of a 3ds Max scene through the free Apple QuickTime viewer. Users can zoom and pan within the viewer to view the scene from different orientations from the original camera's location.

Master It Open the `Condo.max` file from this chapter's downloads. Add a free camera centered in the main room, 6′0″ above the floor, and create a panorama and export it to a QuickTimeVR file.

Publish a scene to the DWF format. DWF files are gaining popularity as a means to distribute interactive access to 3ds Max scene files, so users who don't have 3ds Max can review the objects.

Master It Open the `Condo.max` file from this chapter's downloads. Export the condo scene as a DWF file. Open the resulting DWF in Autodesk Design Review and, using the ribbon, add a Cross Section XY Slice plane to cut away a wall and see into the condo from top to bottom.

Understanding Animation

Perhaps the most interesting and fun part of using the Autodesk® 3ds Max® platform is creating an animated presentation of your design. Animation can bring your designs to life by adding motion or change over time.

Time is the key ingredient to animation. This may sound a bit simplistic, but it will become clear as you work through the tutorials in this chapter—you need to pay close attention to the interaction of objects in your model through time. As you gain more experience animating your work, you'll start to develop an almost intuitive sense of what we call the *spacetime* of your model—the timed period of each animated segment you create. You'll become intimately familiar with this concept as you move and adjust the elements of your model. As you work through this chapter, be aware of how time is always the key component of animation.

Each camera move, light intensity change, and object movement must be carefully choreographed to create a natural flow of your vision through time. We'll show you the basic tools needed to accomplish this. You will be working primarily by keyframing within 3ds Max. This fundamental animation concept means designating critical points in the sequence (keyframes) where you want specific camera positions or lighting conditions and letting the program animate the change between those points.

In this chapter, you'll learn to

◆ Create a quick-study animation

◆ Change the number of frames in an animation

◆ Add and edit keyframes

◆ Preview the animation

◆ Control lights over time

Understanding the World of Video Time

You may recall from childhood a special type of book called a *flipbook* that showed a hand-drawn animation of a cartoon character. Flipbooks are nothing more than a series of still pictures that, when flipped through, give the impression of motion. Today, you can purchase software that will create flipbooks for you. You could probably even create a flipbook of your 3ds Max animation.

Flipbooks demonstrate, in a physical way, how television and film work. To give the impression of motion, your television is actually flashing a series of pictures on the screen. These still images appear so fast that your mind doesn't perceive them individually but as a smooth stream of motion, just like the flipbooks. This process is called *flicker fusion* or *persistence of vision*, where the sequential images fuse in your perception to create the illusion of continuity through time.

Flipbooks are an example of traditional *straight-ahead animation*. They are drawn one picture at a time, in order, from the beginning to the end of the sequence. After being drawn, they are shot a frame at a time with a stationary camera. In traditional cartoon animation, frames (or *cels*) were shot "on twos," with 12 drawings yielding 24 frames or 1 second of film animation.

This process of shooting a frame at a time can be applied not just to drawings but to actual models. When shot with a still camera, this technique is called *stop-motion animation,* and it is often how Claymation, such as the movie *The Adventures of Mark Twain* (1986) and other films, shorts, and commercials created at Will Vinton Studios, is filmed. The *Wallace* & *Gromit* episodes and movies, the *Chicken Run* (2000) movie by Aardman Animations, and movies such as *Coraline* (2009) or *The Nightmare Before Christmas* (1993) are good examples of stop-motion animation, as are the star and other creatures of the classic film *King Kong* (1933) animated by Willis O'Brien. The techniques were also used in *The Seventh Voyage of Sinbad* (1958) and *Clash of the Titans* (1981) by O'Brien's protégé, Ray Harryhausen.

Traditional animators came up with a more-efficient technique called *pose-to-pose animation*. In this technique, the most talented traditional animator, called the *key animator* or *key artist*, draws only the important poses, or *keyframes*, for a character to tell the story. The junior artists or interns do the tedious work to fill in all the pictures in between the poses, called *in-betweens* or simply *tweens*, to produce a smooth stream of motion. Each picture is known as a *frame*.

Technological filmmaking standards vary by geography. North America, most of Central and South America, and Japan use what is called the National Television System Committee (NTSC) standard for standard-definition television broadcasts and VHS and DVD recordings. This standard determines, among other factors, the number of times per second these still images appear on your TV. The rate of images per second, or *frame rate* as it is more commonly called, is 29.97 frames per second (fps). This means that your TV displays one whole picture or frame each 1/29.97 of a second. Therefore, for 10 seconds you will see 299.7 frames, or approximately 1,800 frames every minute. This is also called *dropframe frame rate*, because it drops about one frame an hour. Standard Definition NTSC-compliant television sets display an image at a resolution of 720×486 pixels, although each TV may crop the images around all four sides a little differently. The European standards, called Phase Alternate Line (PAL) and Séquentiel Couleur à Mémoire (SECAM), use 25 fps and 24 fps, respectively. HDTV standards are based on a resolutions of 1920×1080 pixels of interlaced or progressive image streams and 1280×720 pixels of progressive image streams at 29.97 frames per second or at dozens of different frame rates. This book isn't designed for a detailed discussion of broadcasting specifications. If you are interested in this topic, you should look into the Society for Motion Picture and Television Engineers (SMPTE) and their publications.

As you work in 3ds Max, you can think of each of these frames as the unit of time they occupy. For the sake of our discussion, we'll round this unit of time to 1/30 of a second; therefore, 30 frames are displayed every second. This will become more apparent as you work through the tutorials.

Like traditional animators, you will be responsible for establishing the keyframes, known as *keys* in your sequence. 3ds Max will fill in all the in-between frames automatically, and you'll be able to fine-tune the way 3ds Max interpolates between your keys to control the nuances of motion.

For a comprehensive introduction to digital filmmaking, check out Dan Ablan's *Digital Cinematography & Directing* (New Riders Press, 2002). Also, Joseph V. Mascelli's *The 5 C's of Cinematography*: *Motion Picture Filming Techniques* (Silman-James Press, 1998) is a classic.

Creating a Quick-Study Animation

A single image, such as a rendering, can show a lot of detail. However, an animated view of a design can offer a better sense of form and space. If an animated view is properly done, you can also get a better sense of the scale of a design or environment for film and games.

When you create an animation, you are rendering several hundred still images that are later combined to form the frames of an animated movie. Because you are generating so many renderings, animations can take quite a bit longer to produce than do still images. You can use different renderers to generate different quality results, and there is an art to finding a happy balance between render time and render quality. Each renderer has its own tricks and techniques to achieve this.

Animation in 3ds Max begins by getting into a keyframing mode. There are two keyframing modes to choose from: Auto Key and Set Key.

AUTO KEY AND SET KEY MODES

Set Key is a keyframing mode originally designed for character animators. This mode allows you to try a pose before you commit to it by saving specific keys manually. Auto Key mode, on the other hand, records the final state of all changed parameters for each keyframe, without explicit key-setting by hand.

Auto Key mode is often easier to understand and use, and it will be the focus of this chapter. You get into this mode by simply clicking the Auto Key button at the bottom of the user interface.

1. Open the C11_CameraAnimation_Start.max file.

2. Choose Customize ➢ Show UI ➢ Show Track Bar if it is not already selected. The track bar represents time as it flows from left to right. Keys you create will appear on the track bar when an object containing the keys is selected.

3. Click the Auto Key button at the bottom of the user interface.

   The button turns red to let you know that you are in Auto Key mode. The background behind the Time slider and the edge of the active viewport also turn red.

4. Click and drag the Time slider, which currently reads 0/100, to the far right. The Time slider sits just below the viewports and just above the track bar, as shown in Figure 11.1.
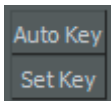
FIGURE 11.1
The Time Slider when Auto Key mode is enabled.
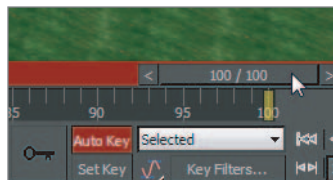
When you start to animate your model, you can think of your animation as a self-contained slice of time. That time is divided into 30 divisions per second. Each of those divisions is called a frame, and each frame when rendered will appear as a single, still image.

The Time slider shows two numbers. The first number is the current frame, and the second number is the total number of frames in your slice of time, called a *segment*. The default active time segment that 3ds Max offers is 101 frames long (frame 0 through frame 100), or a little over 3 seconds of animation at 30 fps. This time segment can be extended to longer sequences using the Time configuration tools. When you move the Time slider to the far right, you change your position in your active time segment to the last frame, or frame 100. This may seem a bit confusing right now, but the next exercise will give you a firsthand example of how time works in 3ds Max.

Longer animations may be made of multiple segments, called *shots*. Typically, video-editing software is used to composite rendered sequences from 3ds Max together into shots and provide transitions and special effects. There are many popular video-editing packages, such as Adobe Premiere Pro, Apple Final Cut Pro, and Avid Media Composer. You can also use compositing software such as Adobe After Effects, The Foundry's NUKE, or Autodesk 3ds Max Composite (now bundled with 3ds Max).

Adding Camera Motion

3ds Max starts out by giving you an active time segment of 101 frames numbered 0 to 100. The Time slider you just used lets you move through the frames quickly. To get a better understanding of how this works, let's add some motion to the scene:

1. Right-click the Perspective viewport to make it active, right-click the POV viewport label, and then choose Cameras ➢ Camera.View.3DFRONT. You'll use this view in the animation example.

2. Right-click in the Top viewport to make it active.

3. Click the Select And Move tool; then click the Camera.View.3DFRONT camera object. When you select the camera, look in the Name field in the Command panel to verify that you have the correct camera selected. This is the camera at the very bottom of the Top viewport.

4. Make sure the Time slider is at frame 100. Move the Camera.View.3DFRONT camera to the location shown in Figure 11.2.

5. Now, right-click the Camera.View.3DFRONT viewport to activate it. Click and drag the Time slider slowly from its position at the far right to the far left and back again.

   The view changes dynamically as you move the bar. Also notice that the camera moves in the other viewports, showing you its location at each frame.

You have just created a camera motion by simply selecting a frame using the Time slider and then positioning the camera in the new location for that frame. Moving objects while in Auto Key mode changes their location in time as well as within the space of the model. Had you moved the camera with Auto Key mode turned off, you would have simply moved the camera with no resulting change in the relative motion over time.

FIGURE 11.2
Selecting and moving the Camera.
View.3DFRONT camera

Move the camera to this location.

Click this camera.
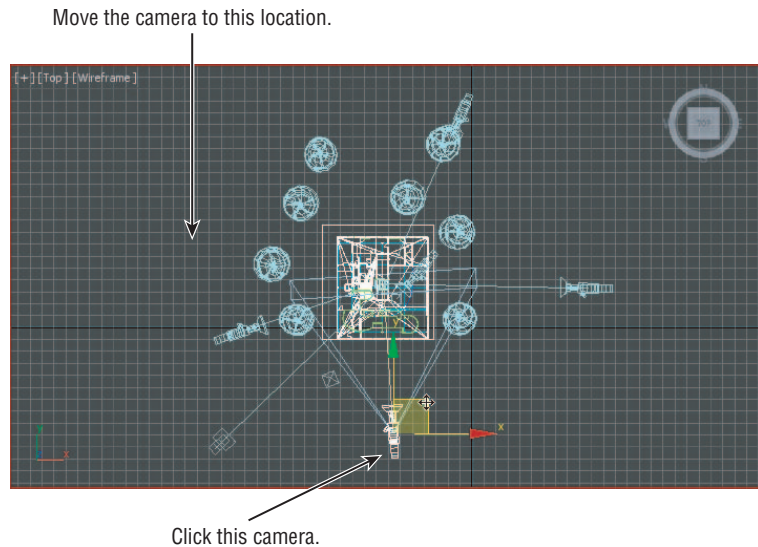
When you create a new keyframe, the parameters are *interpolated* from the previous keyframe to the new keyframe. If there is no previous keyframe for the parameters being adjusted, the parameters prior to modification are added to a new key automatically created at frame 1. Take a look at the track bar below the Time slider, and you will notice two red boxes, representing the keyframes, at frames 0 and 100. By default, 3ds Max 2013 places keyframes at Frame 0 when using Auto Key. You can change this behavior by modifying the Auto Key Default Frame setting found under Customize ➢ Preferences and going to the bottom of the Animation tab.

KEY COLOR CODING

Keys indicating transforms are color-coded: position keys are red, rotation keys are green, and scale keys are blue. Most other keys are gray.

Adjusting the Camera Path

If you study the animation in the Camera viewport as you move the Time slider back and forth, you may notice that you alternately move closer to the building and then farther away from it. This is because the motion path of the camera is a straight line between the beginning camera location and the end location, as shown in Figure 11.3. As the camera moves through its path, or *trajectory* as it is called in 3ds Max, it also moves farther from the building.

The camera's trajectory.
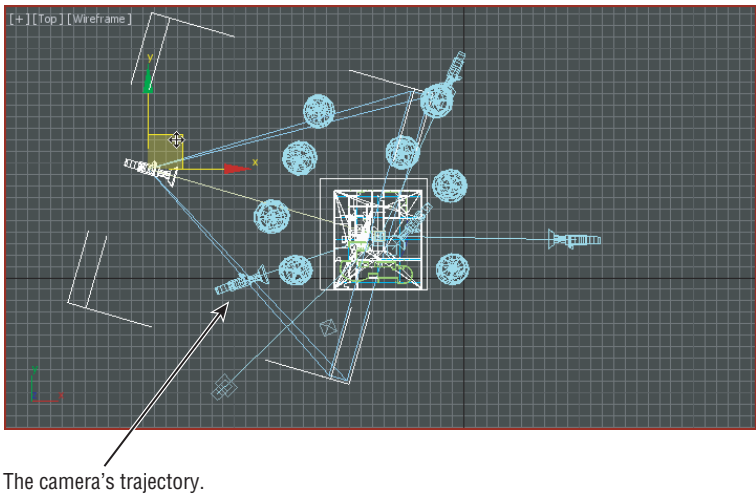
Let's assume that you don't want that effect and that you want the camera to stay as consistent a distance from the model as possible. To achieve this, you can move the Time slider to position the camera at its closest position to the model and then move the camera farther away at that point in time, with Auto Key on:

1. Move the Time slider to the middle of the slider position so that the slider shows 50/100. This places your camera at frame 50.

   You can also enter **50** in the Current Frame text box in the animation controls area next to the viewport controls at the bottom-right corner of the user interface.

2. While Auto Key is still on, use the Select And Move tool to move the camera away from the model to a location similar to the one shown in Figure 11.4. Notice the new, red key on the track bar at frame 50.

FIGURE 11.4
The camera's position at frame 50
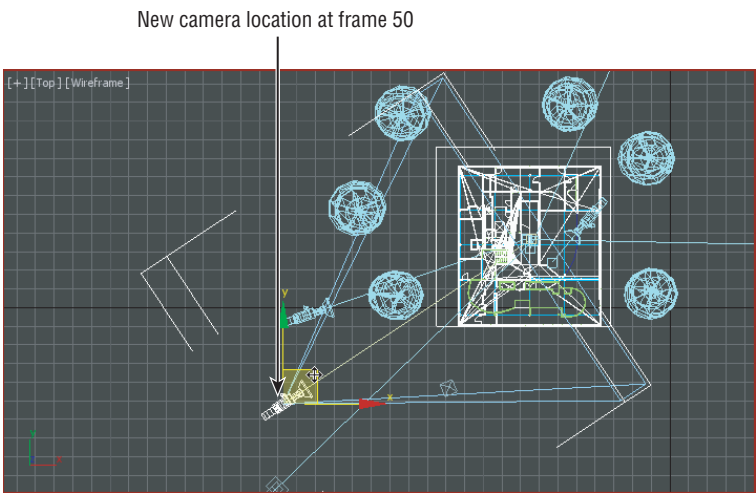
New camera location at frame 50

3. Right-click the Camera.View.3DFRONT viewport, and then click the Play Animation button in the time controls.

The viewport displays the view from the camera through the sequence of frames.

4. To stop the playback of the camera animation, click the Stop Animation button, which has replaced the Play Animation button in the time controls.

5. Right-click the Top viewport; then click Play Animation again. Notice that this time you see the camera motion in the Top viewport.

6. Click the Stop Animation button to stop the playback.

Here you see how moving the camera at a particular frame in the Time slider affects the camera motion. When you altered the camera location in this last exercise, you were actually adding a *key* or *keyframe* to the camera path. You can think of the camera path as a spline and the keyframes as control points or vertices on that spline.

The keyframes appear on the track bar only when an animated object is selected. Because the camera is selected, you can see the keyframes (see Figure 11.5). There are many ways to navigate to a precise point on the Time slider. The Go To Time command is one technique that is convenient and fast.

FIGURE 11.5
The bars below the Time slider indicate the location of a keyframe.
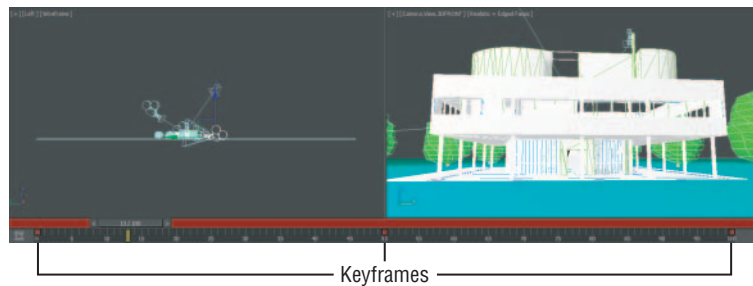
Keyframes

1. Move the Time slider away from frame 50.

2. Right-click the keyframe at frame 50 in the middle of the track bar.

3. Select Go To Time from the context menu. The Time slider moves to the keyframe location on the track bar, and the view from that location is displayed in the Camera. View.3DFRONT viewport.

The Go To Time option offers a quick way to move the current time to any keyframe location.

Viewing the Camera Trajectory

When you're working on an animation sequence, it helps to see the animation path, or trajectory, of an object. For example, if you could see the path of the camera in the last exercise, it would be easier to determine the distance between the camera and the model throughout the animation. 3ds Max offers a number of tools for displaying the camera path as well as the location of the keyframes along the path. The following exercise will show you some of those tools.

1. Make sure that the Camera.View.3DFRONT camera is still selected. Then click the Motion tab in the Command panel.

2. Click the Trajectories button near the top of the panel.

   Now you can see the path of the camera as a dotted line in the Top viewport, as shown in Figure 11.6.

FIGURE 11.6
The Top viewport showing the camera trajectory
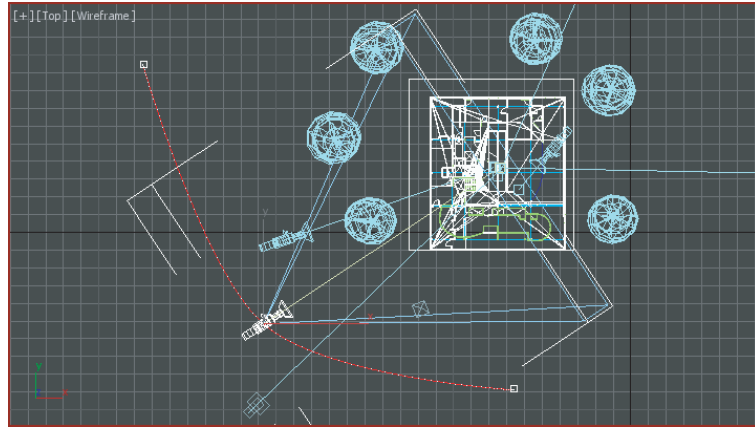
3. Right-click the Top viewport, and then click the Maximize Viewport toggle to enlarge it.

4. Move the Time slider to the 75/100 position to get a better view of the keyframes on the trajectory.

   You can see the keyframes identified as small squares in the path. The dots in the path represent the in-between frames of the animation.

5. Use the Select And Move tool to move the camera slightly to the left to create a new keyframe.

6. Move the Time slider to the 25/100 position.

By moving the camera in step 5, you added another keyframe to the path. By using the buttons in the Create Key group in the Motion tab of the Command panel, you can add a keyframe without having to move the camera:

1. Click the Parameters button next to the Trajectories button in the Motion tab of the Command panel.

2. With the Time slider at the 25/100 position, click the Position button in the Create Key group of the Look At Parameters rollout, as shown in Figure 11.7.

FIGURE 11.7
Creating a Position key using the Motion panel
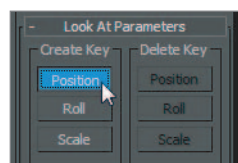
You've just added another keyframe at frame 25. Note that the Position button in the Create Key group lets you add a keyframe without changing the position of the camera. The additional keys can be used to fine-tune and manipulate the camera's trajectory:

1. Right-click the keyframe in the track bar at the 75/100 position.

2. Choose Delete Key ➢ Camera.View.3DFRONT: Position from the context menu. The keyframe is removed from the camera trajectory. Repeat this step for the keyframe you created at the 25/100 position.

3. Turn off Auto Key mode. If you're not actually working on animation motion, it's a good idea to keep it turned off because any transforms or parameter changes that you apply to objects will be automatically keyed. It's a very common problem to forget to turn off Auto Key and therefore create unintended keys that mess up your animations.

Just as with objects in your model, you can select multiple keyframes that appear in the track bar by holding down the Ctrl key when you select or by dragging a selection window around them. You can then right-click any keyframe and select an option from the context menu to edit the selected keyframes. In the preceding brief exercise, you deleted a single keyframe using the track bar context menu.

Controlling the Camera Trajectory Visibility

When you clicked the Parameters button in a previous exercise, the camera trajectory disappeared. This is because the path is typically visible only when the Trajectory button is selected. You can permanently turn on the trajectory visibility through the Object Properties dialog box.

1. Right-click the selected Camera.View.3DFRONT camera. Then click Object Properties in the quad menu. The Object Properties dialog box displays.

2. The By Object button in the upper-right corner of the Display Properties group should be turned on. If the button reads By Layer, click it until it reads By Object. This makes several of the options listed in the Display Properties group available.

3. Select the Trajectory check box, as shown in Figure 11.8. This turns on the trajectory display even when the Trajectories button is not clicked.

FIGURE 11.8
Select the Trajectory check box.
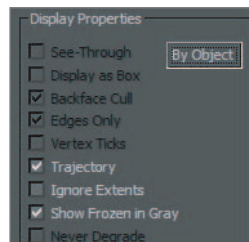
4. Click OK to accept the change, and close the dialog box.

Now you can again see the camera path and keyframes for the Camera.View.3DFRONT camera object. By turning on the Trajectory display option, you can more easily edit the camera

path. You'll want to turn it off, however, when you're editing other aspects of the scene, because the path trajectory can add to the visual clutter of a complex model.

ANOTHER TRAJECTORY VISIBILITY OPTION

Another way to control the trajectory visibility is to select the animated object, click the Display tab of the Command panel, and then place a check mark in the Trajectory option in the Display Properties rollout. Note that this only works if the object's properties are set to By Object.

Once you've established the keyframes of your animation (the beginning and end frames are also keyframes), you can edit them to refine your camera motion further. You'll see how that's done later in this chapter. For now, let's create a preview of this animation.

Creating a Preview Animation

Rendering even a short animation can be a time-consuming process, so you'll want to make sure that the motion in your animation is exactly what you want before you commit to producing a rendered animation. One tool that will help you determine what your animation will look like is *Create Animated Sequence File*. The Create Animated Sequence File tool captures the contents of a viewport, saving a preview of the animation in your scene. A preview animation is a rough facsimile of how your final animation will look. You should use it only to get a basic idea of whether your animation works in a general way. Still, it can reveal many of the flaws in your animation that might otherwise go unnoticed, such as a jerky camera motion or a camera-object collision that isn't obvious in the viewports.

Try the following exercise to create a preview animation of your work so far:

1. Click the Maximize Viewport toggle to get a view of all the viewports, if necessary. Then right-click the Camera.View.3DFRONT viewport to activate it. Use the Viewport Shading menu, or press F4 on the keyboard, to turn off Edged Faces if the display of your file included Edged Faces. Depending on the power of your video card, you can change the mode to Realistic and enable Shadows to get a better feel for how your finished rendering will look.

2. Choose Tools ➢ Views - Grab Viewport ➢ Create Animated Sequence File. The Make Preview dialog box appears, as shown in Figure 11.9.

3. Click the Create button. If this is the first time you've used this feature, you'll see the Video Compression dialog box. (You'll learn more about video compression in Chapter 12, "Creating Animations, Particles, and Dynamics.")

4. Go ahead and click OK. You'll notice that you see a small version of the scene in a floating viewport as the preview is created. After the preview is created, Windows Media Player opens and plays back the preview.

If you have another application designated to play back AVI files, you'll see that application rather than Windows Media Player.

The preview is rough, but it does give you a good feel for the camera motion through the model. The model itself isn't rendered, and the lighting effects aren't displayed completely accurately.

FIGURE 11.9

The Make Preview dialog box
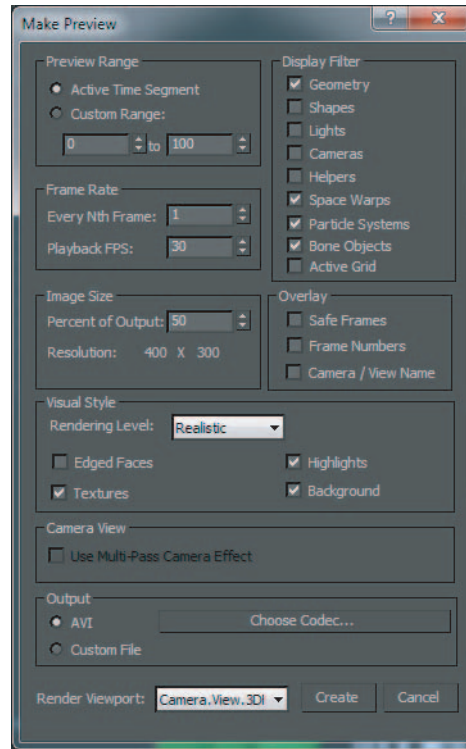
If you look at the Make Preview dialog box, you'll see that you have several options that control the preview animation. You can have the animation display the frame number, active grid, or light locations, for example, by selecting the check box next to each of these items. You can control the size of the animation relative to the current settings in the Render Setup dialog box using the Percent Of Output input box.

If you want to limit the preview to a particular range of frames, you can specify that range in the Preview Range group. The Rendering Level drop-down list lets you determine whether the preview renders a shaded view, a wireframe view, or any other viewport rendering mode. The Output group gives you control over the Audio-Video Interleaved (AVI) settings. Finally, the Render Viewport drop-down list lets you select a viewport to render. By default, the preview animation is created using the currently active viewport.

When 3ds Max creates a preview animation, it saves the animation as a file named `_scene.avi` (the filename begins with an underscore character) in the `C:\Users\Your Login\My Documents\3dsMax\previews` folder. If you are using the Project Folder feature of 3ds Max set to a custom project, the previews will be saved in that project's `\previews` directory. Every time you create a preview, 3ds Max overwrites this file without asking you whether it's okay or not. If you create a scene animation that you want to save, choose Tools ➢ Views - Grab Viewport ➢ Rename Animated Sequence File. The Save Preview As dialog box that displays lets you save the last preview animation under a different name, thereby saving the preview from being automatically overwritten when the next preview is created. After you have closed Windows Media

Player, you can choose Tools ➤ Views - Grab Viewport ➤ View Animated Sequence File to view the last preview created.

Understanding Keyframes

The exercises you just completed demonstrate that you can add and delete keyframes on the camera trajectory. The keyframe displays as a small square on the camera trajectory. It is a point along the camera trajectory that can be directly manipulated in a number of ways to adjust your camera motion. A keyframe was created at frame 50, in the middle of the series of frames, when the camera was moved so that the camera path curved around the building.

The simplest adjustment to a keyframe is to transform (move, rotate, scale) the object whose keys it identifies. Notice that there are keyframes at the end and beginning of the camera path. These were created as soon as you moved the camera at frame 100. Let's try changing the view of the last frame of this camera path by moving the camera, therefore modifying the end keyframe:

1. Click the Auto Key button again to turn it on.

2. Right-click the Top viewport to make it active. Click the Select And Move tool on the Main Toolbar.

3. With the Time slider set to frame 100 (the far right), move the Camera.View.3DFRONT camera to the location shown in Figure 11.10. Notice what happens to the camera path.

FIGURE 11.10

Moving the camera at frame 100

Move the camera here.

[+] [Top] [Wireframe]
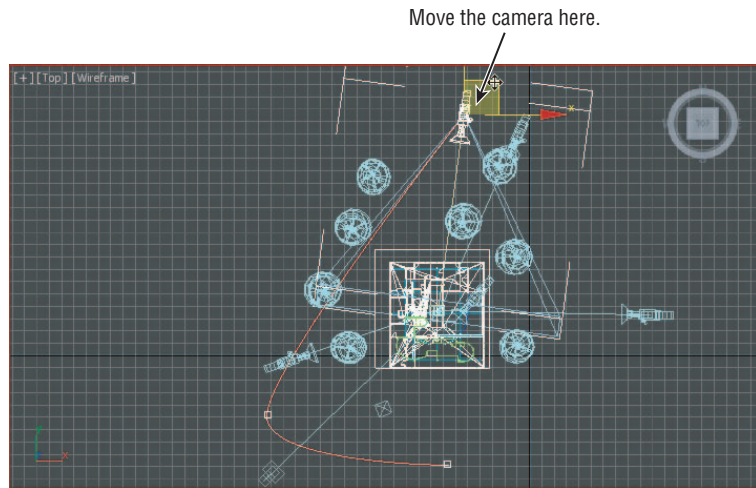
The tiny dots on the camera path show you the location of the camera at each frame. They also indicate the change in speed of your camera over time.

Notice that after you move the camera at the last keyframe, the dots are spread farther apart between the keyframe at frame 50 and the last frame at frame 100. This tells you that the camera motion is faster between frames 50 and 100 than it is between frames 0 and 50. You can see this because the distance between the camera's location at each frame is greater from frame 50 to 100

than it is between frames 0 to 50, while the length of time is equal. You can see another visual representation of this by creating another preview animation.

You might also notice that the camera path now crosses right through some trees. To smooth out the camera motion and to avoid the trees, you will want to move the camera at frame 50. You can use some tools found in the Motion tab of the Command panel to help you quickly move to keyframes.

1. With the Camera.View.3DFRONT camera still selected, click the Motion tab of the Command panel. Click the Parameters button if is not already active.

2. In the Key Info (Basic) rollout, click the left-arrow button so that key number 2 is displayed in the box to the right, as shown in Figure 11.11.

FIGURE 11.11
Moving the Time slider to the time of the camera's second key
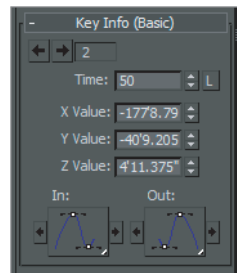
The camera moves to the second key associated with the selected camera, as does the Time slider. This key and the one immediately to the right of it cause the Time slider to jump to the next or previous keys that exist for the selected object.

3. Click the Select And Move tool; then move the camera to the location shown in Figure 11.12. There was an existing key at frame 50 that defined the location of the camera. By moving the camera with Auto Key active, the new position information replaces the old information in that key.

FIGURE 11.12
Move the camera at frame 50.
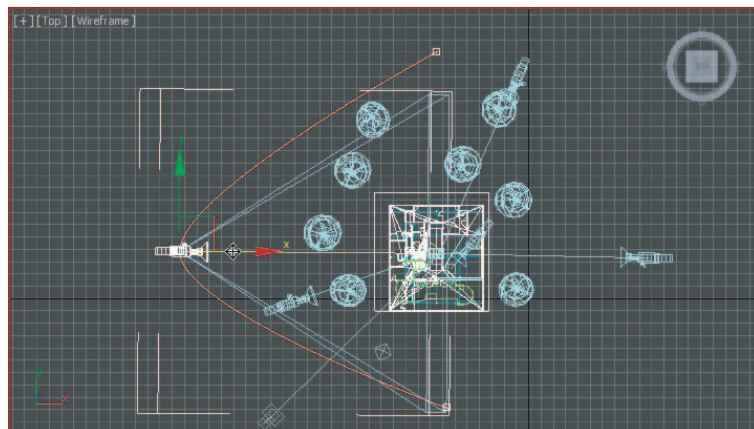
4. Right-click in the Camera.View.3DFRONT viewport, and choose Tools ➢ Views - Grab Viewport ➢ Create Animated Sequence File. The Make Preview dialog box appears.

5. Click the Create button.

6. Replay the animation to examine the results.

7. Turn off Auto Key mode.

The preview shows that your camera motion is too fast—your camera is moving around three sides of a building in just over three seconds. Also, the beginning and end are rather abrupt. Next, you'll learn how to increase the overall number of frames in the current animation to slow down the animation.

CONTROLLING THE ANIMATION LENGTH

Many beginning animators try to fit too much into too short a time segment. Slower motion is usually better in animations, and that equates to rendering many more frames. At 1,800 frames for one minute of video, a typical animation might be several thousand frames long.

Before we move on, however, we'd like to summarize the steps involved in animating an object. You can create motion in 3ds Max by turning on the Auto Key button, selecting a point in time with the Time slider, and then transforming the object by moving, rotating, or scaling it. This creates a keyframe and possibly an animation trajectory. Once a keyframe is created, you can alter that keyframe by returning to that point in time using the Time slider and then transforming the object. If you select a frame that is not a keyframe and then move the object, you create a new keyframe. This is easy to do accidentally, so be careful when moving cameras and objects with the Auto Key button active.

Keyframes can be deleted in a number of ways, the simplest of which is to right-click the keyframe in the track bar under the Time slider and select Delete Key. An animated object must be selected before the keyframe will appear. By right-clicking on the Time slider, you can also add a key at any frame without actually transforming an object. Doing so opens the Create Key dialog box.

You can select the type of keyframe as well as a source and destination time other than the default time shown in the dialog box; then click OK to accept the new keyframe settings.

If you right-click and drag on the Time slider, you can use the Create Key dialog to adjust an animation, copying keyframes from the current frame to another frame.

Increasing the Number of Frames in an Animation Segment

At the beginning of this chapter, we mentioned that the standard frame rate for video in North America is approximately 30 fps. Therefore, in order to lengthen the time in your building flyover animation, you need to increase the number of frames over the camera path. Right now, you have 100 frames, or about 3 1⁄3 seconds of animation. Let's see what you need to do to increase your current path to 300 frames for a 10-second animation.

1. Click the Time Configuration button at the bottom of the user interface. The Time Configuration dialog box displays.

2. In the Animation group, click the Re-scale Time button. The Re-scale Time dialog box appears, as shown in Figure 11.13.

FIGURE 11.13
The Re-scale Time
dialog box
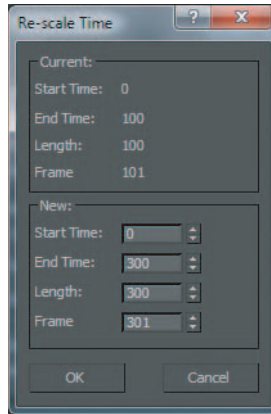
3. In the End Time input box, enter **300**. When you press Enter, the Length value changes to match the End Time value.

> **SETTING THE START TIME**
>
> There is no hard-and-fast rule that requires that an animation must begin at frame 0. If you realize that you need to add action to the beginning of your animation, you can change the Start Time value in the Time Configuration dialog box to a negative number. A Start Time of -90 adds three seconds to the beginning of your scene.

4. Click OK; then click OK again in the Time Configuration dialog box.

Notice that the Time slider now shows 300 for the total number of frames and that the existing keyframes have been spread out through the new animation length. You'll also see a greater number of dots in the Camera.View.3DFRONT trajectory. If you had just increased the End Time value in the Time Configuration dialog box, you would have appended 200 additional frames to the end of the animation length, but the existing keyframes would have remained at their current frames.

5. Create another preview animation, making sure that you have selected the Camera.View.3DFRONT viewport as the Render Viewport. The camera now takes three times as long to circle the building, and the preview takes three times as long to create.

In the Time Configuration dialog box, you saw that you have an option to set the end time as a separate value from the length of the animation. 3ds Max lets you work with active time segments. An *active time segment* is the block of time, within your animation, on which you are

currently working. Right now, that block of time includes the entire time of the animation, but you can set up 3ds Max to limit your active time segment to just a few frames of the overall time length. This feature is useful if you are working on a very large animation and want to isolate your work to a specific set of frames. You'll see how to work with active time segments in the next section. Right now, let's see how to smooth out the beginning and end of the camera path so that it doesn't seem so abrupt.

Accelerating and Decelerating the Camera Motion Smoothly

You don't want the camera suddenly to start or stop moving at its full rate or your animation will seem jarring. You want the camera motion to start out slowly and then increase speed as if you were in a car starting out from a stoplight. The same is true for the end of the camera path. You want to slow down gradually and not stop instantly. You can control the acceleration and deceleration of the camera by setting the key tangent properties. These are available in the Key Info (Basic) rollout of the Motion tab.

1. With the Camera.View.3DFRONT camera selected, set the Time slider to the first key-frame position at the far left.

2. Select the Motion tab in the Command panel, make sure the Parameters button is active, and scroll down to the Key Info (Basic) rollout. Notice that key number 1 is shown at the top of the rollout. Any changes made now will affect that key.

3. Click and hold the Out button at the bottom of the rollout. You'll see a set of buttons. These are the tangent options for the keyframe (see Figure 11.14). Tangents define the animation entering and exiting a keyframe. The tangent types are explained later in this section.

FIGURE 11.14
The available key tangents

4. Select the Slow tangent button. This is the button that looks like the top quarter of a bell curve.

   This tangent has the effect of slowing the camera motion as it approaches or leaves a keyframe. In this case, it will slow the motion as it leaves this keyframe because you used the Out tangent. Selecting the same tangent from the In flyout would cause the camera to decelerate as it approaches the key.

5. Click the Trajectories button, and then zoom into the camera in the Top viewport. You'll notice that now the dots on the camera trajectory are closer together as they exit the first keyframe, as shown in Figure 11.15.

FIGURE 11.15
The spacing of the dots on the trajectory indicates the acceleration.
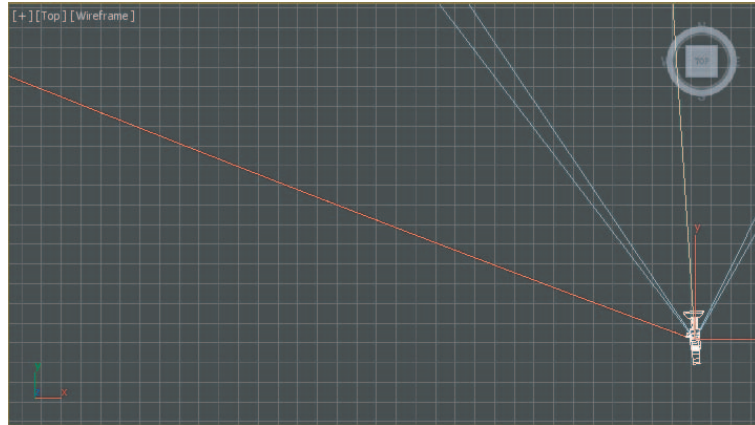
6. Create another preview animation of the camera. To see only the new beginning of the animation, choose Custom Range in the Make Preview dialog box and enter **0** and **100** in the two input boxes.

You will notice that now the beginning of the animation starts out in a gradual acceleration from a stop. The bunching up of dots near the starting keyframe shows you that the frames at the beginning are closer together and there is less motion between frames. As the frames move away from the starting keyframe, they gradually spread apart, traversing a greater distance with each frame until a uniform frame-to-frame distance is reached. The net effect of all this is a smooth acceleration from the camera starting point.

Now adjust the ending keyframe to decelerate the camera motion gradually:

1. Click the Parameters button in the Command panel. In the Key Info (Basic) rollout, click the right-arrow button until 3 is displayed in the key number box if it is not already displayed.

2. Click and hold the In button, and select the Slow button. Because you want the camera to decelerate gradually toward the keyframe, you use the In button to make the setting. Just as with the first keyframe, you see the dots in the trajectory move closer together as they approach the last keyframe.

3. Create another preview to see the results. Be sure to select Active Time Segment in the Make Preview dialog box to render the entire animation length.
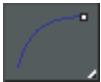
In this section's second exercise, you adjusted the camera speed for the end of the camera path in a way similar to the beginning. As the frames approach the last keyframe, they gradually become closer together. The net effect is a deceleration of the camera motion.

This latest camera motion seems to move a bit faster than before. Because the frames have been moved closer to the beginning and end keyframes, they become more spread out over the rest of the trajectory, adding some speed to the camera motion. Remember that you are

working with a fixed number of frames, so as you move frames closer to the beginning and end, the rest of the trajectory has fewer frames to define the camera's position, and fewer frames means faster motion.

Let's take a moment to get to know some of the other key tangent options. You already know what the Slow tangent option does. Here is a listing of all the tangent options for both in and out directions and what they are used for:

Smooth Creates a smooth transition through the keyframe. Smooth has a tendency to overshoot the smooth curvature beyond the key, sometimes resulting in undesirable behavior (see the Flat option).
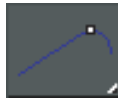
Linear Straightens the trajectory near the keyframe. If Linear is used for the Out parameter of one keyframe and the In parameter of the next, the resulting trajectory between the two keyframes is a straight line, and the intervals between frames become uniform.
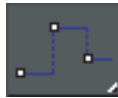
Step Causes the keyframe value to jump from one key to the next. If Step is selected for the In parameter of the current keyframe, the prior keyframe's Out parameter will automatically be changed to a Step tangent. Step has the effect of causing the animated values to hold steady at the current keyframe and then pop to the next keyframe's value when the Time slider reaches that frame.
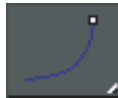
Fast Causes the rate of change to increase around a keyframe. For example, using Fast in keyframe 2 of the previous exercise will cause the camera to appear to speed up around the keyframe. The trajectory also becomes straighter near the keyframe.

Slow   Causes the rate of change to decrease around a keyframe. This has the opposite effect from that of the Fast tangent option.
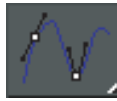
Spline   Allows you to make fine adjustments to the rate of change through a keyframe. When Spline is selected, you can edit the rate of change through a keyframe, using tangent handles, and in the Track View – Curve Editor dialog box.
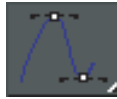
Auto Tangent   The Auto Tangent type guarantees a smooth transition between keys, and it avoids the "overshoot" problems often experienced with the Smooth type. Auto is the default tangent type. When you edit any Auto tangent handle, the tangent type converts to Spline.

You'll get a chance to use some of the other tangent options later in this chapter, including the Spline tangent option. Now let's continue with a look at some of the other ways a keyframe can be edited.

Editing Keyframes

Keyframes are not set in stone, and it's a good thing they aren't. A recurring theme in this part of the book is the cycle of editing, testing, and then editing again. This process applies to keyframes as much as it does to editing materials and lights.

OTHER WAYS OF CONTROLLING SPEED

If your animation is strictly for video or film, you have no alternative for controlling speed other than increasing or decreasing the number of frames in a segment. You must adhere to the local television frame rate standards. On the other hand, if you plan to have your animation shown exclusively on a computer monitor, you have other options.

Most video playback programs for computers allow you to vary the frame rate of your animation, although you probably would not want to go below 15 fps. Any slower and you will notice the changes between frames.

There are many variables that affect the quality of computer playback of animations. Color depth, image resolution, video card, system memory, file size, and file type all affect how well an animation will appear on your computer screen. In general, an MPEG 2 file will play back nicely at 30 fps. MPEG 2 offers full color at a frame size of 720×480. MPEG 2 is commonly used for non–High Definition satellite dish systems.

In the following exercises, you will add more keyframes and then adjust them to help you further understand how they work. You'll focus on the camera-position keyframes but, as you will learn later, these changes can be applied to keyframes for other objects in your model, such as the lights and geometry. You can also keyframe certain object parameters, such as a camera's field of view (FOV) or a door's Open parameter.

1. Move the Time slider to frame 300, and then move the camera closer to the building (see Figure 11.16).

FIGURE 11.16
Move the camera at frame 300, and the camera appears at frame 225.

Move the camera here at frame 300.

The camera appears here at frame 225.
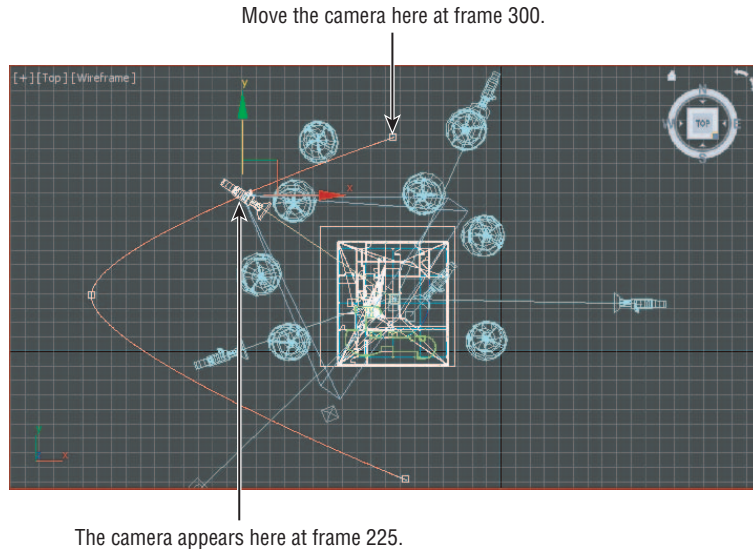
The camera path comes a bit too close to the trees. This in turn blocks out the view of the building. Let's add another keyframe to the camera trajectory so that we can pull the trajectory farther away from the trees without distorting it.

2. Move the Time slider to about frame 225. The camera should appear at the location shown in Figure 11.16.

3. Right-click the Top viewport; then click the Maximize Viewport toggle to get a better look at the camera trajectory.

4. Make sure Auto Key is still turned on, and then move the camera to the location shown in Figure 11.17, creating a new keyframe 3.

5. Click the left-arrow button in the Key Info (Basic) rollout to go to keyframe 2, and move that keyframe to the location shown in Figure 11.17.

FIGURE 11.17

Move the camera to create the new keyframe 3, and move the camera at keyframe 2.

New position at keyframe 3

New position at keyframe 2
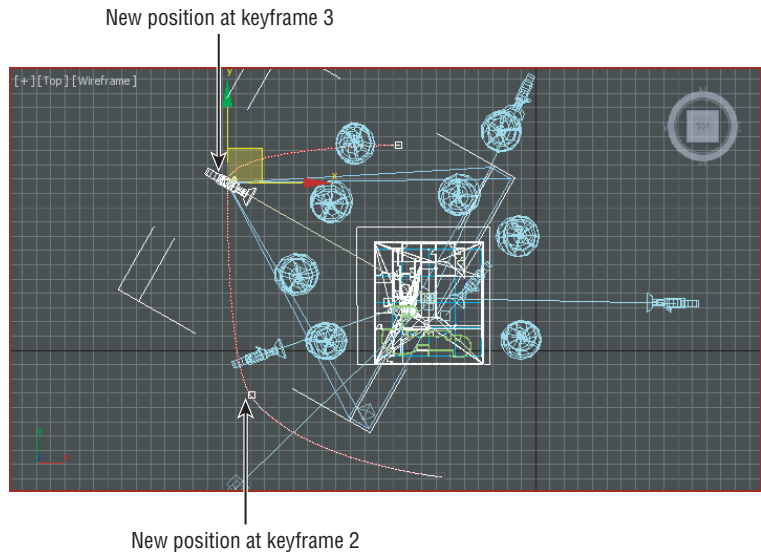
CHECKING THE AUTO KEY BEFORE EACH MODIFICATION

Verify that Auto Key mode is on before you move any keys. If you move objects when Auto Key mode is off, any changes you make apply globally to the object's entire animation. Pressing the N key will toggle Auto Key mode on and off.

Take a moment to zoom in and study the distribution of the dots along the camera trajectory. They are no longer evenly distributed over the path, except at the first and last keys. They are now crowded at the keys and spaced out as the distance from each key increases. This will create an animation that will start out slowly, and then suddenly speed up between keys.

1. To adjust keyframe 2 so that it occurs a little earlier in the trajectory, change the Time value in the Key Info (Basic) rollout to **110**.

   Notice how the trajectory changes in shape to accommodate the new setting.

2. Go to keyframe 3, and change its Time value to **200**. You now have a segment of the animation where the camera motion slows down between two keyframes.

Although the new frame numbers were provided to you in this exercise, in real projects you can use the Time spinner in the Key Info (Basic) rollout to adjust the time while watching the dots in the trajectory. As you adjust the Time spinner, the dots will change their location. When the dots appear more evenly spaced, you know that the keyframe is in an appropriate location for a smoother camera motion.

Another way to even out the frames through a keyframe is to use the Normalize Time button in the Key Info (Advanced) rollout, located just below the Key Info (Basic) rollout.

When you move to a keyframe and click this button, 3ds Max adjusts the location in time of the current keyframe so that the frames are more evenly spaced. The one drawback to using the Normalize Time button is that it makes the other keyframe parameters inaccessible. The Constant Velocity option evenly spaces the frames between the current keyframe and the next.

Adding More Frames for Additional Camera Motion

Now suppose you want to add some additional camera motion to the current animation. It may seem as though you've used up all the available frames for the tour around the building. You can, however, add additional frames at the beginning or end of a segment of frames.

Adding Frames to the End of a Segment

Adding frames to the end of a segment is a fairly straightforward operation. Here's how it's done:

1. Click the Time Configuration tool at the bottom of the user interface.

2. In the Time Configuration dialog box, enter **400** in the Length input box of the Animation group; then click OK.

Notice what happens to the Time slider. Position 300 now appears at about three-quarters of the distance from the left side of the Time slider, and the overall frame count now shows 400.

Although you added more frames to the animation, the additional frames had no effect on the existing frames. The number of frames in the camera path did not change. You simply added more frames to the end of the animation. Those additional frames are not yet being utilized.

Now let's use those extra frames:

1. Move the Time slider all the way to the right so that it reads 400/400.

2. Move the camera to the position shown in Figure 11.18.

FIGURE 11.18
Move the camera to a location in the courtyard.

The new camera location at frame 400
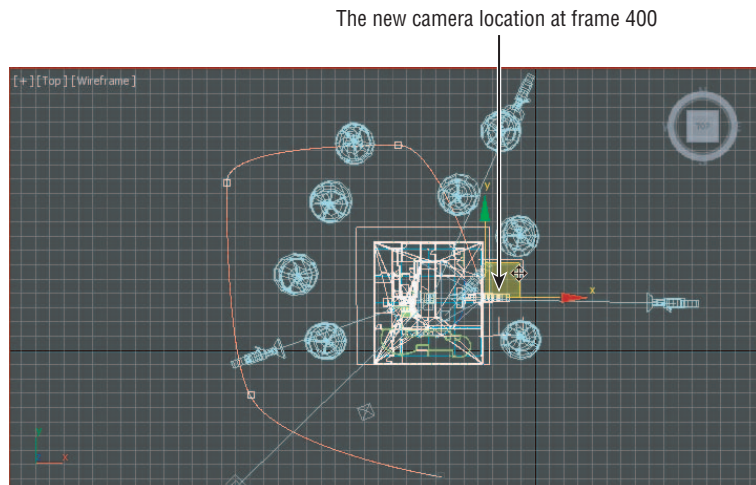
3. Click the Maximize Viewport toggle to display all of the viewports.

Remember that one way to create a new keyframe is to select a new frame number with the Time slider, and then, with Auto Key on, move the camera or other 3ds Max object or change a parameter. In this case, you added more time and then set the Time slider to the new end of the segment and moved the camera while Auto Key mode was on.

Your view at frame 400 is too low in the building. You'll want to move the end location of the camera to the courtyard level. This will create an animation that will give the impression of flying over the building.

1. With the camera still selected and the Select And Move tool still active, enter **16′** in the Z input box of the Transform Type-In at the bottom of the 3ds Max window.

2. You'll want to have the camera slow down as it approaches this last keyframe; so, in the Key Info (Basic) rollout of the Motion tab, set the keyframe to **5** and then select the Slow option for the In tangent parameter.
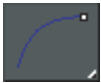
If you look at the Top viewport shown in Figure 11.18, you will see that your camera trajectory moves the camera through the wall of the courtyard. You'll want to adjust the vertical location of the other keyframes so that the camera motion brings you above the building.

1. Use the Zoom and Pan tools to adjust the Left viewport view so that you can see all of the keyframes in the camera path.

2. Go to keyframe 4 at frame 300, and use the Select And Move tool to adjust the vertical height of the camera so that it looks similar to Figure 11.19. You can use the Coordinate Display to set the camera's Z position value to 88 feet.

FIGURE 11.19
Adjust the vertical position of the keyframes as shown here.

Keyframe 4   Keyframe 3
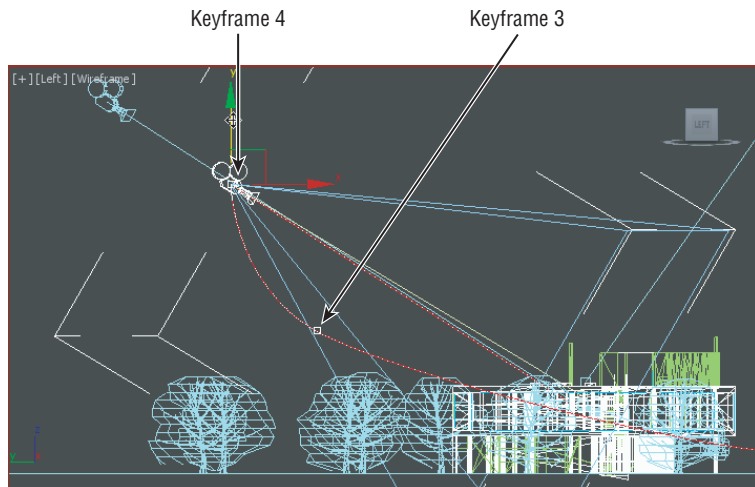
3. Adjust the vertical location of keyframe 3 so that it looks similar to Figure 11.19. The height of the camera at keyframe 3 is 36 feet.

4. Make sure the Camera viewport is currently active; then choose Tools ➢ Views - Grab Viewport ➢ Create Animated Sequence File, and make a preview animation of what you have so far.

You may also drag the Time slider from far left to right and back again. You get a sense of the motion while you watch the Camera.View.3DFRONT viewport. This is called *scrubbing* the animation.

Adjusting the Camera Motion through a Keyframe

You'll want to refine the animation a bit more. Suppose you want to add a bit more time at keyframe 4 to pause at the bird's-eye view of the villa. You'll also want to correct the part of the animation between keyframes 4 and 5 where the camera flies through the roof.

3ds Max offers a variety of tools that let you fine-tune the animation of an object through a keyframe. Each frame can hold keys on numerous animation tracks. *Tracks* are separate containers that store independent information regarding each parameter and transform for each object in a scene. This is similar to how the audio tracks in a recording studio define a signal coming from a different microphone or instrument pickup before the mixer joins the tracks into a single audio stream.

CERT OBJECTIVE

In 3ds Max, tracks store data from *animation controllers*. An animation controller is a specialized algorithm that is responsible for recording a specific kind of animation data onto a track (position, rotation, scale, object parameters, audio, mathematical expressions, and so on). The entry point to these tools is the *Track View*, which is available in two modes: the Curve Editor and the Dope Sheet.

THE ORIGIN OF THE DOPE SHEET

The term *dope sheet* comes from classical animation and was a vertical chart that displayed instructions to the cameraperson.

The Curve Editor is for function curve editing and can be used to fine-tune the change in a parameter or transform value over time. The Dope Sheet is for editing time ranges and for key management. In the following exercise, you'll be introduced to both aspects of the Track View for the camera with which you've been working.

1. With the Camera.View.3DFRONT camera selected, choose Graph Editors ➢ Track View – Dope Sheet to open the Track View in Dope Sheet mode, as shown in Figure 11.20. You can also right-click and select Dope Sheet from the quad menu to open the Dope Sheet.

FIGURE 11.20
The Dope Sheet showing the keys for the selected object
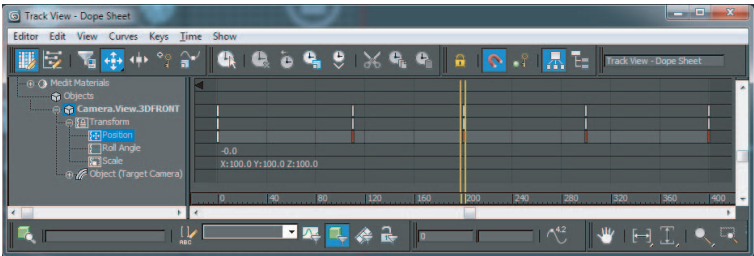
2. Scroll down in the Controller window to see the Camera.View.3DFRONT object. (See the sidebar "Auto-Expanding the Track View" if the Dope Sheet does not automatically expand the selected object's tracks.)

3. Click the Frame Horizontal Extents tool in the View toolbar in the lower-right corner of the Track View – Dope Sheet dialog box. You can also zoom and pan within this dialog box using the built-in navigation controls.

Auto-Expanding the Track View

Right-click in the Controller window on the left side of the Track View – Dope Sheet dialog box to open a quad menu that is specific to the dialog box. You can choose Auto Expand and then Selected Objects Only, Transforms, XYZ Components, Base Objects, Children, and several other options. Then you won't have to click plus (+) symbols to expand these levels manually in the hierarchy. The plus symbols disappear when you choose to auto-expand their types.
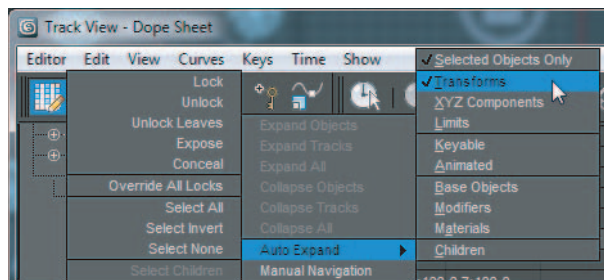
Customizing the Track View Dialog Box

Twelve modular toolbars are available for the Track View dialog box. If the Navigation: Track View toolbar with the Frame Horizontal Extents tool does not appear, right-click a blank section of the Dope Sheet title bar and then click the Show Toolbars option from the context menu. Choose any toolbars from the cascading menu to display them as floating toolbars. Any floating toolbars can be anchored to the Track View dialog box by dragging them to the bottom of the dialog box or below the menu bar.

The Frame Horizontal Extents tool expands the Track View to display the entire timeline of your animation.

Take a moment to study the Track View – Dope Sheet dialog box. In the left panel, called the *Controller window,* you see a hierarchical listing of the camera's tracks. The camera name is at the top, followed by the Transform track. Under Transform are three options labeled

Position, Roll Angle, and Scale. These correspond to the three types of transforms—Move, Rotate, and Scale—that you can apply to any object, as you've learned from earlier chapters. In this case, they represent the transforms applied to an object over time, such as the Move transform you applied to the camera. If you expand Object (Target Camera), you will see all of the animatable parameters for the camera, including another dozen parameters found under the MultiPass Effect entry. As you can see, it's easily possible to have thousands of animated parameters in a scene.

DISPLAYING THE ENTIRE TIMELINE

If at any time your Track View dialog boxes do not show the timeline as described in this book, click the Frame Horizontal Extents tool shown alongside step 3 to display the entire timeline.

In the panel to the right, called the *Key window*, you see a graph representing the keys in the scene, specifically the keys that define the camera's motion. While it may appear that there are 15 keys in the Dope Sheet, there are only 5: the 5 keys on the Position track. The keys that appear on the Transform track are only indicators that keys exist on any of the tracks (Position, Roll Angle, Scale) that exist as child tracks to the Transform track. When the Transform track (the parent track) is collapsed, it is still clear that keys exist in its child tracks by their appearance on the Transform track.

The same logic applies to the keys that appear on the Camera.View.3DFRONT track; they only indicate the fact that keys exist on the camera's Object or Transform track. The frame numbers are shown on the scale at the bottom of the panel. You see the familiar keyframes that correspond to the Position track in the left panel. These keys represent the same keys that you see below the Time slider. You'll also see a double-vertical line in the graph. That line indicates the current frame in the animation and can be scrubbed, like the Time slider, to examine the animation in the viewports.

Across the top of the dialog box, below the menu bar, you see a set of tools that lets you work on various aspects of the animation. You'll get a chance to work with some of these tools in the following exercises. At the bottom right, a set of navigation tools allows you to control the view of the graph. You can zoom in or out or pan using these tools. Two input boxes toward the bottom middle of the dialog box display the current position and value (if applicable) of a selected key. To the left of the input boxes is a message box that provides messages for the current operation.

In the preceding exercise, you opened a Track View dialog box that expanded and panned to show the tracks for the selected object. You can also pan through all the nodes for the entire scene. Pan the tree view on the left side of the dialog box by clicking and dragging a blank area of the Controller window when the cursor changes to look like a hand. Observe that all the scene nodes are considered children of the world and not children of a particular object. Other scene nodes include tracks for Sound, Environment, Renderer, and Objects, among others.

LOCATING THE TRACK VIEW DIALOG BOXES

The Track View dialog boxes are invaluable tools when creating animations in 3ds Max. Unfortunately, they consume a large amount of visual space and can clutter your screen and hamper productivity by requiring you to open and close them constantly. The best solution is to configure your workstation with a dual-monitor setup and drag the Track View to the secondary monitor. This allows you to keep the dialog boxes open without covering any of the viewports. The Track View dialog boxes can also be minimized when not in use or dragged partially off the screen to minimize their visibility.

You can also display a smaller version of the Curve Editor, in lieu of the track bar, at the bottom of the user interface by clicking the Open Mini Curve Editor button at the lower-left corner of the 3ds Max window. There is no corresponding mini-editor for the Dope Sheet.
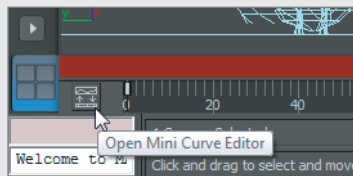
Another solution is to display the Track View in one of the viewports. You do this by right-clicking the viewport label and choosing Extended Viewports ➢ Track View ➢ Track View – Curve Editor. If your system says Track View – Dope Sheet, you can select it and then use the Editor menu to change the view to the Curve Editor.

Look at the Track View toolbars, and note the icon that looks like a gold key next to a green ball; this is the Show Keyable Icons button. It is on the Display: Dope Sheet toolbar shown in Figure 11.21. Click the Show Keyable Icons button, and notice in the Controller window on the left that red keys appear in front of the Position, Rotation, and Scale tracks of the Camera.View.3DFRONT object. Keyable tracks are those that can be animated. Once you have displayed the keyable icons, you can click the red key icon to lock keys for that track.

FIGURE 11.21
The Display: Dope
Sheet toolbar
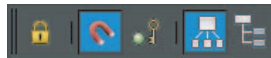
Some objects may also have an Object category that can be expanded using the round plus symbol in Controller window. In 3ds Max, only the nodes appropriate to animation have keyable object tracks. For example, Camera.View.3DFRONT has an Object category that can be expanded to expose a number of keyable tracks, such as the Field Of View (FOV), Target Distance, and many others, as shown in Figure 11.22. Notice in the figure that the Scale track has been locked.

FIGURE 11.22
Keyable tracks for
the camera target
object
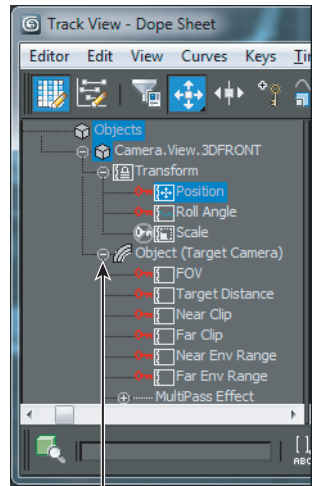
Click the round + to expose
Transform and Object tracks.

These parameters can be animated in the object itself, like those you can manually edit on the Modify tab of the Command panel. If you do create keys on object tracks, the corresponding parameters on the Modify tab of the Command panel display red outlines around their spinners, when available, to indicate their animated status. Figure 11.23 shows the Parameters group of a camera that has its Lens and FOV settings animated; notice the marks on the corners of the value spinners, offering a visual reminder that they are animated.

FIGURE 11.23
The red spinner
outlines indi-
cate animated
parameters.
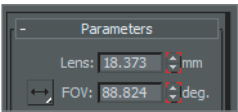
So far you have been in Edit Keys mode in the Track View – Dope Sheet dialog box. This mode is perfect for editing individual keys and their tangents.

There is another mode of the Dope Sheet that is better suited for editing the timing of entire series of keys, called *Edit Ranges*:

CERT OBJECTIVE

1. Click the Edit Ranges button next to Edit Keys at the top left of the Track View – Dope Sheet dialog box.

2. You can drag range bars from the middle to move the entire range to another time, or you can drag the starting or ending handle to change the overall duration of the range (see Figure 11.24). When the end handles are moved and the track's animation length is changed, the keys within that range are scaled proportionately. There are transforms to move, slide, or scale keys (or ranges). Scaling a parent track scales the ranges on all child tracks simultaneously. If you use the Scale Keys features on ranges, the ranges' scales use

the current frame as the scale point. This isn't intuitive or obvious, but once you understand it, it's a powerful behavior. Experiment with these features, and undo your actions after you're satisfied that you understand them.

FIGURE 11.24
The Edit Ranges mode of the Dope Sheet editor

Range bars   Time slider showing current frame

The cursor changes to allow repositioning of range bars
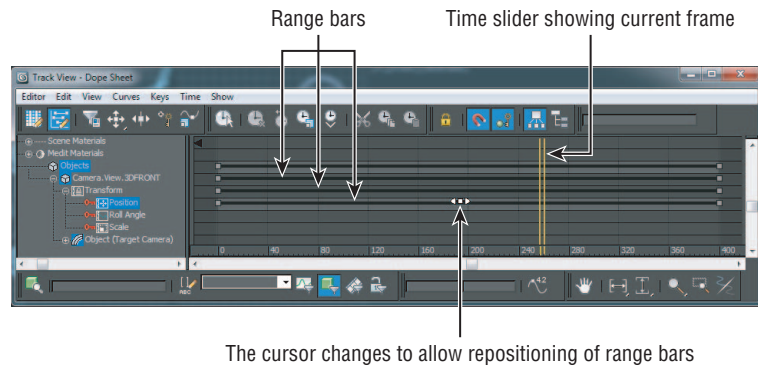
EDITING RANGES

Editing ranges becomes important when you want to adjust the timing of multiple animated objects and sequences relative to each other. It is much like nonlinear video editing in this respect.

Compressing and Expanding Time

Now let's see how the Curve Editor mode of the Track View can be used to adjust the camera's transition through keyframe 4:

1. From the Track View – Dope Sheet dialog box's menu bar, choose Editor ➢ Curve Editor. You can switch back and forth between the Dope Sheet and Curve Editor in this way.

   You can also click the Curve Editor (Open) button on the Main Toolbar or use the Menu Bar and choose Graph Editors ➢ Track View – Curve Editor to open the dialog box.

2. Move the Track View – Curve Editor dialog box down if necessary so that you can get a clear view of the Top viewport.

3. Adjust the Top viewport so that it looks similar to Figure 11.25.

4. In the Motion tab of the Command panel, make sure that the Key Info (Basic) rollout shows key number 4. You should see the camera in the Top viewport at keyframe 4.

5. In the Track View – Curve Editor dialog box, click the Position track for the selected camera in the left panel.

   Notice that there are no child tracks below Position indicating a track for each spatial direction as would normally be the case. The default Position controller in 3ds Max is the Position XYZ controller, which provides separate X, Y, and Z Position values for control of an object's position in each axis independently. The Bezier Position controller combines all three directions in one track, and it is currently assigned as this camera's Position

controller. The tracks are color coded, with red representing the X-axis, green representing the Y-axis, and blue representing the Z-axis.

FIGURE 11.25
The Top viewport

Keyframe 4
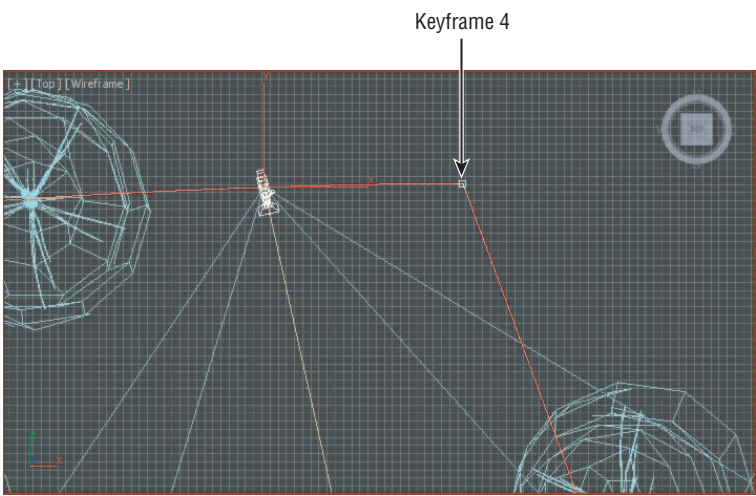
These two controllers store the animation data in different ways mathematically, but they function similarly. Chapter 12 covers the different controllers and how they are assigned.

6. From the Track View – Curve Editor menu, choose Curves ➢ Apply – Ease Curve, or press Ctrl+E on the keyboard.

If the Position track does not expand automatically, expand it. You can see an Ease Curve track indented below the Position track.

7. Click the Ease Curve track in the Controller window. The Ease Curve function curve appears in the Key window, as shown in Figure 11.26.

FIGURE 11.26
The Ease Curve track for the camera's Position track
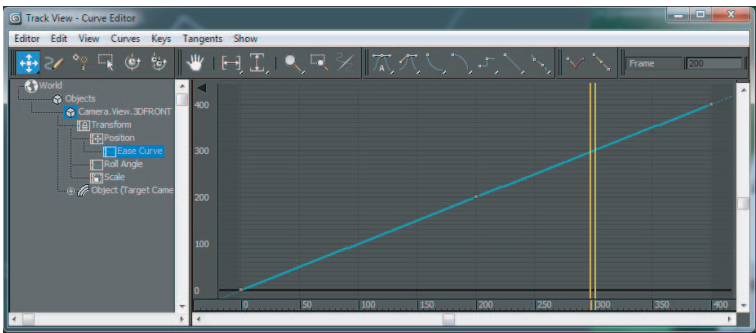
The Ease Curve graph displays a time scale in a straight line from 0 to 400. This is the current time you are using for the camera. You can adjust this curve to compress or expand time at various

points along the camera trajectory. This may seem like a peculiar concept at first, but to help you understand the Ease Curve graph more clearly, consider how you used the In and Out keyframe parameters to select a tangent option. Selecting the Slow option for the first key had the effect of *compressing*, or slowing, time around that first keyframe. You saw this graphically by the way the frame dots on the camera trajectory bunched up as they get closer to the key (see Figure 11.15).

The result is a smooth transition from a stop to the maximum velocity. Likewise, you added the Slow tangent option to the In parameter of the last key to make the camera slow to a stop instead of stopping abruptly. This is similar to compressing time before the last key.

The Ease Curve graph lets you compress or expand time in a way similar to the Slow or Fast tangent options for the In and Out key parameters. Let's try adjusting the In and Out speed around keyframe 4 to make the transition around that key a bit smoother. First, add a key to the position on the Ease Curve graph that corresponds to keyframe 4. You'll then adjust the key to compress the time around it.

1. Click the Add Keys tool on the Track View – Curve Editor toolbar.

2. Click the line in the graph at the point that corresponds to frame 300, as shown in Figure 11.27.

FIGURE 11.27
Click in the spot shown here to add a key at frame 300.

Click here at frame 300.
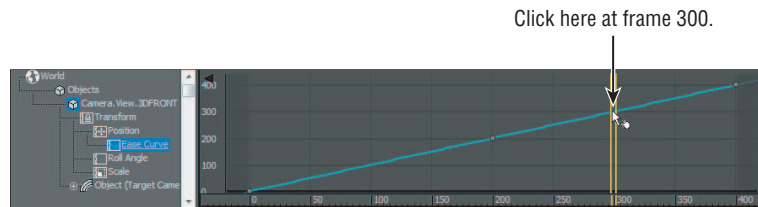
Notice that the two input boxes at the top of the Track View dialog box show the time coordinates of the key you just created. The numbers you see may be different from the ones shown here, depending on how accurately you clicked in step 2.

3. You can fine-tune the location of the key by entering the exact coordinate values in these boxes. The left input box sets the frame number for the selected key, and the right input box sets the key's value. Coincidentally, using the Ease Curve track, the two values will initially be identical. Click in the Frame input box to the left, type **300**, and press Enter; then click in the Value field input box and enter **300**.

4. Right-click the key that you just added. You'll see the Camera.View.3DFRONT\Ease Curve dialog box.

5. In the In tangent flyout, click the Slow tangent option.

6. Do the same for the Out tangent, and then close the dialog box.

7. Close the Camera.View.3DFRONT\Ease Curve dialog box.

Now notice how the ease curve looks. It levels off just before and after the new key. You may need to use the Zoom and Pan tools to get a clearer view of the changing slope of the ease curve. This leveling off indicates a compression in time around the key. A straight diagonal line as shown in the rest of the graph indicates a smooth, continuous flow of time.

Also notice that dots in the camera trajectory seen in the Top viewport are compressed a bit more than before as they approach keyframe 4. This tells you that the camera now slows down as it transitions into keyframe 4.

To use the Curve Editor effectively, you must understand the way it displays the information about an object's animation. You already know that the graph displays the frame numbers along the bottom edge of the Key window. Vertically, along the left edge of the Controller window, are numbers that correspond to the value of the current key. For example, a key with a value of 35 means that an object is located 35 units from the origin along the X-axis when you are looking at the X Position track. When looking at a key on a Door object's Open track, 35 means the door is open 35 percent or, when looking at a camera's FOV track, 35 indicates the Field-Of-View field is set to 35 degrees.

A sharp angle indicates a very fast change in value (vertical) over a short amount of time (horizontal). This can mean that the camera is moving quickly along a particular axis or a door is flying open. Flatter curves mean less change or slower transitions. Avoid sharp turns in the curves, especially when adjusting the transforms, to reduce the amount of abrupt motion in your scenes.

If you want even more control over the Ease Curve graph, you can use the Spline Tangent option:

1. With the key at frame 300 still selected, click the Set Tangents To Spline button on the Track View – Curve Editor toolbar.

   Notice that Bezier handles now appear at the key. You can adjust these handles vertically to control the shape of the curve through the key.

2. Click the Move Keys tool in the Track View – Curve Editor toolbar, as shown in Figure 11.28.

FIGURE 11.28
The Move Keys tool
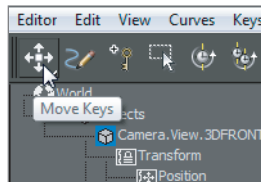
3. Click and drag up one side of the Bezier handle on the key. The curve follows the handle. Notice how the dots arrange themselves in the trajectory in the Top viewport. They start to compress and then expand again as they approach the keyframe.

BREAKING THE TANGENT HANDLES

If you hold down the Shift key while dragging tangent handles, the connection between them breaks so that they no longer move reciprocally. After they are broken apart, you can move the handles independently of one another. This creates a velocity discontinuity, and it can look jerky if the curve has a sharp point.

4. You don't really want this configuration for the key, so click the Undo Scene Operation button on the Main Toolbar to undo the change in the curve.

5. Now let's get rid of the key that's in the middle of the graph. Click that key to select it, as shown in Figure 11.29. It turns white to show that it has been selected.

FIGURE 11.29
Selecting a key on
the ease curve

Click the key in the middle of the graph.
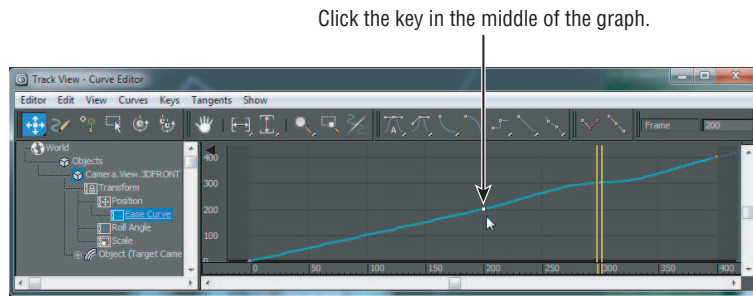
6. Press the Delete key on the keyboard.

The key disappears. Notice how the curve changes. The transition into the camera position's keyframe 4 is now more gradual.

Go ahead and make similar changes to the ease curve settings for the first and last keys:

1. Click the first key to the far left of the curve. You may need to use the scroll bars at the bottom and right side of the Controller window to access the first key. Then click and hold the Set Tangents To Slow button, and select the Slow option for the Out parameter from the flyout (Figure 11.30).

2. Click the last key to the far right of the curve, and select the Slow tangent flyout option for the In parameter. The curve now looks like a gentle slope with gradual transitions between keys.

FIGURE 11.30
Three options for
the Set Tangents To
Slow button

Set both tangents to Slow.

Set In tangents to Slow.

Set Out tangents to Slow.
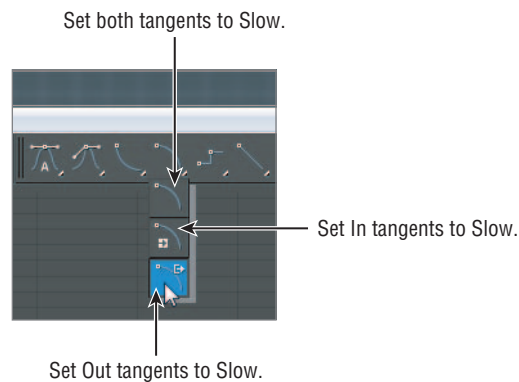
It is important to keep in mind that the Ease Curve tangent settings are independent of the Position keys. You can compress and expand time anywhere along the timeline. For example, if you wanted to have the camera slow down between keyframes 1 and 2, you could create a key in the Track View at frame 62 of the ease curve and adjust the key in a way similar to the way you adjusted the key in the previous exercises.

If you decide that you don't want to use the Ease Curve settings you've created, you can delete an ease curve by selecting the Ease Curve track in the Controller window and pressing the Delete key. You can also turn the ease curve off, choosing the Curves ➢ On/Off Ease Curve/Multiplier command from the Curve Editor menu. This way you can try different ease curves and switch between them.

CHANGING THE CAMERA'S DIRECTION

The camera will move backward along its own trajectory if the ease curve ever slopes down.

Next, let's see how to adjust the camera motion to avoid going through the roof of the villa as the camera approaches the courtyard. To do this, you'll need to use the Position track of the Track View – Curve Editor dialog box.

Adjusting the Camera Trajectory Using the Track View

Now let's take a look at another way that the Curve Editor can help you fine-tune the camera motion:

1. Move the Track View – Curve Editor dialog box up so that you can get a clear view of the Left viewport.

2. Click the Position track in the Controller window. The graph in the Key window changes to show the three position curves (see Figure 11.31).

FIGURE 11.31
The Track View – Curve Editor dialog box showing the Bezier Position track

---
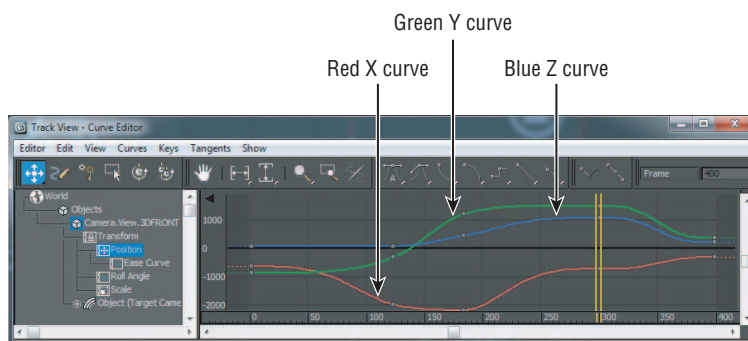
POSITION XYZ OR BEZIER POSITION CONTROLLER?

The Position XYZ controller has one function curve on each of three separate tracks. The Bezier Position controller puts all three curves on one track. Each controller has its strengths and weaknesses depending on what you are doing. You have more control over each axis with Position XYZ, but you saw how the ease curve could be simultaneously applied to all three curves with the Bezier Position controller.

The Position function curves are graphic representations of the camera motions through three-dimensional space. Unlike the camera trajectory, the Position function curves display the changes in the X-, Y-, and Z-coordinates as separate lines. Each line represents a different axis in the coordinate system. You'll see in the next exercise how you can make practical use of the function curves.

If you created a preview of the animation so far, you can see that the camera passes through the roof of the villa before landing in the courtyard. To avoid this, you can use the Position function curves to adjust the shape of the camera trajectory so that it avoids the roof. Try the following exercise to see how this works:

 1. Use the Zoom and Pan tools to adjust the Left viewport to look like Figure 11.32.

FIGURE 11.32
The Left viewport adjusted to show the camera trajectory approaching the courtyard
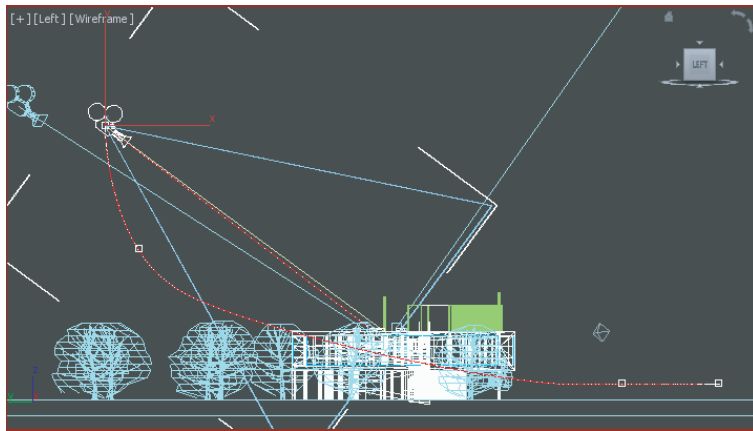
 2. Back in the Curve Editor, on the right end of the Position function curves, click the key at the far-right end of the blue curve. Remember that the blue curve represents the Z-axis for the position transform applied to the camera.

 3. Set the In tangent of this key to Spline. You'll see a Bezier handle appear at the selected key on the curve.

 4. With the Move Keys tool from the Track View – Curve Editor toolbar selected, move the Bezier handle up so that it looks similar to Figure 11.33.

FIGURE 11.33

The function curve
with the Bezier
handle pointing up,
and a view of the
resulting camera
trajectory

Moving this handle upward…

…alters the trajectory in Z here.
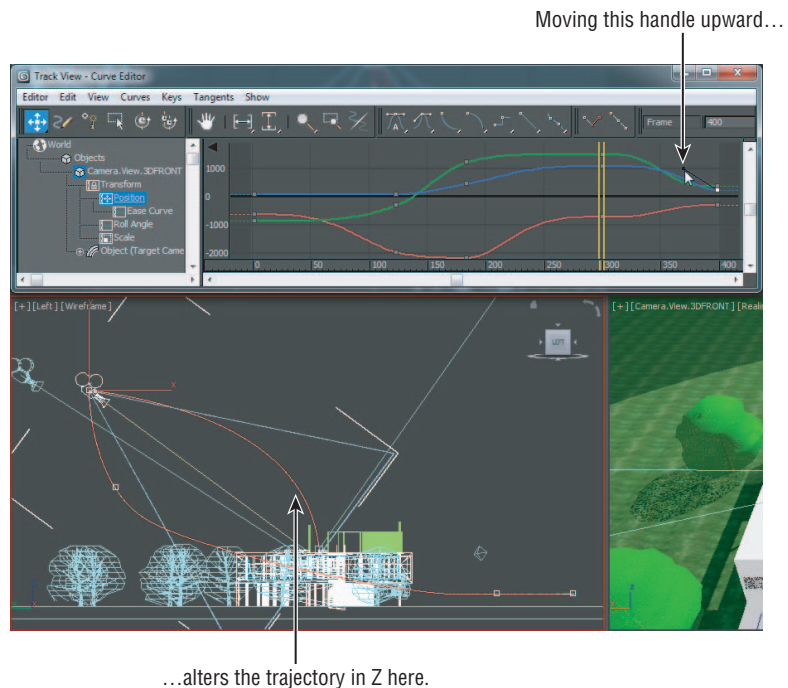
Notice what happens to the camera trajectory in the Left viewport in Figure 11.33: it now curves up. This helps move the trajectory away from the roof.

CONSTRAINING THE KEY MOVEMENTS

The Move Keys tool is actually a flyout containing two additional options that restrict the key movements vertically or horizontally.

By altering the Z curve of the Position function curve, you altered the trajectory of the camera in the Z-axis. If you take time to study the blue curve, you'll see that it is really a graph that represents the Z-coordinates of the camera over the 400 frames. The same is true for the X and Y red and green curves. You can manipulate the keys using a combination of the Spline In and Out tangents and by moving the keys vertically in the graph.

As you can see from this and the previous section, you have a great deal of control over the motion of an object through time and space. Next you'll look at ways of adjusting the time so that you can add motion to the beginning of your animation.

The Spline tangent and the resulting curve in the Position track and its resulting trajectory are affected by the prior tangent setting that the Spline tangent replaces. Had the prior In

tangent setting for keyframe 5 been the Smooth tangent instead of the Slow tangent, the result-
ing curve in the trajectory and the Z-axis curve would have been different, with the frames
biased toward keyframe 4.

RECEIVING IMMEDIATE FEEDBACK FROM THE CAMERA

You can adjust the camera trajectory while watching a playback of the animation in the Camera
viewport. Make the Camera viewport active; then click the Play Animation button in the time
controls. As you watch the playback of the animation in the Camera viewport, adjust the curve
in the Track View dialog box. The Custom tangent does not change the shape of the existing curve
when it is applied. That's why the previously used tangent makes a difference when you apply the
Custom tangent.

USING THE TCB METHOD FOR ADJUSTING KEYFRAME TRANSITIONS

If you find that the Track view is too complex, you can also use the Tension Continuity Bias (TCB)
controller for your keyframe transitions. Instead of offering a set of tangent options for the In and
Out keyframe parameters, you use three settings—Tension, Continuity, and Bias—to control a
keyframe transition. The TCB controller is the original (and most ancient) method used by 3ds
Max for key interpolation.

You can change to a TCB controller by doing the following:

1. With an animated object selected, select a keyframe key. Then, in the Motion tab of the
   Command panel, open the Assign Controller rollout.

2. In the list box of the Assign Controller rollout, expand the Transform track if necessary and click
   the Position track to select it.
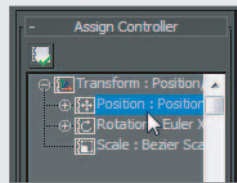
3. Next, click the Assign Controller button in the upper-left corner of the rollout.
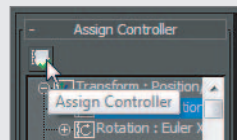
   The Assign Position Controller dialog box displays.
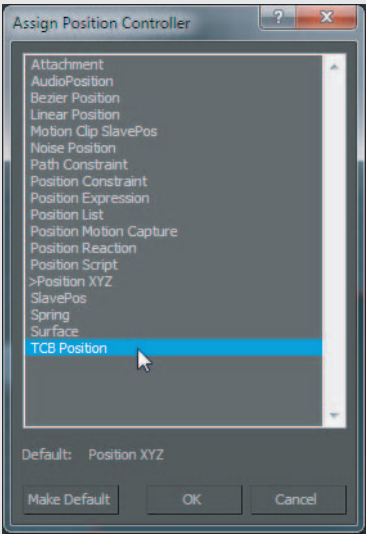
4. Select TCB Position and click OK. The Key Info rollout of the Motion tab will change to show parameters for a TCB controller.
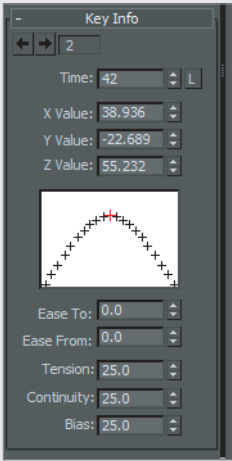
You see the familiar Time and X, Y, and Z Value spinners, but you also see a graphic and five new settings named Ease To, Ease From, Tension, Continuity, and Bias. The graphic shows you an example of how the frames approach and recede from the current keyframe. The default setting shows the keys as black crosses transitioning through a bell-shaped arc. At the top of the arc is a red cross representing the actual keyframe.

You can adjust the Ease To and Ease From settings to compress the frames around the keyframe in a manner similar to the Slow tangent option you used in an earlier exercise. Using negative numbers expands the frames around the keyframe.

The Tension option alters the duration of the frames around the keyframe. A value greater than the default 25 increases the density of the frames around the keyframe, and a 0 value spreads out the frames.
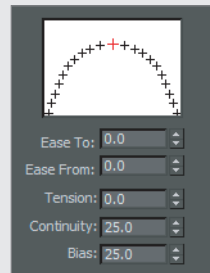
The Continuity setting affects the curvature of the trajectory through the keyframe. A value greater than 25 pushes the trajectory outward, and a value of 0 causes the trajectory to form a straight line to and from the keyframe.
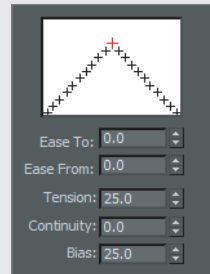
Finally, Bias pushes the trajectory curve to one side of the keyframe or the other, literally biasing the curve. A number less than 25 adds bias to the left side of the graphic, and a number greater than 25 biases the curve to the right side.
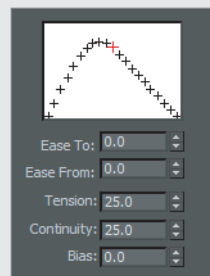
You can use the TCB controller to perform the same tasks as the Bezier Position controllers. For example, in place of the Slow tangent option in the In or Out key parameter, you can use the Ease To or Ease From setting to slow the camera as it approaches the keyframe. The TCB controller offers finer control from a single rollout than does the default Position XYZ controller. Also, you still have access to many of the same Track View functions you've used in previous exercises. You cannot, however, make changes to the individual X, Y, and Z Position function curves as you can with the Bezier and Position XYZ controllers.

Increasing the Number of Frames between Selected Keys

You saw earlier how you could increase the number of frames to increase the overall time and slow down the animation. You can also increase the number of frames in a specific range of frames through the combined use of the Time Configuration dialog box and the Dope Sheet. To see how this works, try increasing the number of frames between keyframe 4 and the end of the segment. Right now, there are 100 frames between these two keyframes, and they are numbered from 300 to 400.

The first step is to create some additional frames with which to work:

1. Click the Time Configuration button to open the Time Configuration dialog box.

2. In the Animation group, change the Length input box to read **500**; then click OK to close the dialog box.

You've just added 100 frames to the animation, although you haven't actually changed the camera motion in any way. If you look at the Track bar, you can see that the keyframes are still in the same locations relative to the frame numbers. The function curves from frames 400 to 500 are straight, meaning no change to the parameters, and dashed to show that there are no keys beyond those visible in the Curve Editor. The next step is to expand the time between keyframes 4 and 5. You do this through the Track View – Dope Sheet toolbar. You need to make sure that the Current Frame indicator is on Frame 300.

1. With the Camera.View.3DFRONT object selected, choose Editor ⏵ Dope Sheet to switch to Dope Sheet mode.

2. Click the Edit Keys button to switch from the Edit Ranges mode if necessary.

3. Select the Position track under the Camera.View.3DFRONT Transform track. Expand the Position track by clicking the round plus symbol, and note that the Ease Curve track is also visible.

4. Hold down the Ctrl key, and click the key in the Ease Curve track at frame 400 and the Position track at frame 400 as well. The keys will turn white when they are selected.

5. On the Track View – Dope Sheet toolbar, click the Scale Keys tool.

6. Now click and drag the cursor from the Position key at frame 400 to frame 500. You'll see the Position and Ease Curve keys move in the Dope Sheet graph to frame 500, as shown in Figure 11.34.

FIGURE 11.34
Scaling selected keys

Scale selected keys from frame 400 to 500.
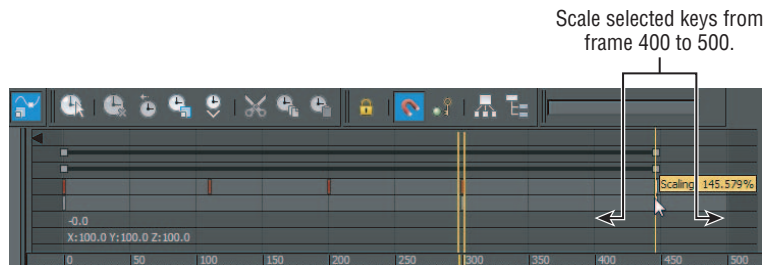
You have just scaled the keys from frame 400 to 500, without altering anything else about the animation. The camera remains hovered above the building at frame 300 (keyframe 4), and there are now 100 additional frames between keyframe 4 and the end of the animated segment. The camera's trajectory remains the same as it was before you increased the number of frames between the selected keys.

ADJUSTING THE EASE CURVE SETTINGS

If you find that, after scaling a key or range of time, an object's motion does not complete its full range of motion, check the Ease Curve settings in the Track View. Frequently, if the Ease Curve data are not adjusted correctly, portions of an animated object's trajectory will appear to be missing or misplaced. It is important that any ease curves you have maintain their one-to-one correspondence with the tracks they are affecting.

Speeding Up the Preview Rendering Time

Let's take another look at a preview of the animation. Because you've increased the number of frames, you may want to adjust the preview so that it doesn't take quite so long to process.

1. Choose Tools ➢ Views - Grab Viewport ➢ Create Animated Sequence File.

2. In the Make Preview dialog box, change the Rendering Level to Consistent Colors. This is a much faster but lower visual quality algorithm suitable for checking timing and object collisions.

3. Set the Percentage of Output value to 80 to create a 640 × 480–resolution video.

4. Click the Active Time Segment radio button in the Preview Range group to make sure that the entire animation is rendered. This is important, because you added some frames to the end of the animation.

5. Make sure that the Camera.View.3DFRONT viewport is selected in the Render Viewport drop-down list at the bottom of the dialog box; then click Create.

You will see the preview generate in the floating window and the Creating Preview progress bar in the 3ds Max Status Bar at the bottom of the user interface.

Adding Frames to the Beginning of a Segment

You've seen how to add time to the end of a time segment. Now let's look at how you add time to the beginning. You've already been exposed to some of the tools to do this. As before, you'll use the Time Configuration dialog box to add more time to the overall animation. Then you'll use the Track View dialog box to shift the animation sequence forward in the time track.

1. Click the Time Configuration button to open the Time Configuration dialog box.

2. In the Animation group, change the Length setting to **550** and then click OK.

3. Open the Track View – Dope Sheet dialog box if it isn't already open.

4. Click the Position track of the Camera.View.3DFRONT object in the Controller window.

5. Click the Edit Ranges tool on the Track View – Dope Sheet toolbar.

The Key window changes to show the range bars instead of the keys.

6. Click and drag the topmost Camera.View.3DFRONT bar to the right. As you do, watch the track bar at the bottom of the 3ds Max window and adjust the range bars so that the last key rests at frame 550. Notice that all of the bars move in unison. When your mouse is hovering over the range bars, it will appear as a double-headed arrow. When you click the track bar and move it, the mouse cursor displays as the regular select arrow.

7. Play the entire animation in the Camera.View.3DFRONT viewport.

SPEEDING UP THE PREVIEW PROCESS

Rendering has always been one of the biggest bottlenecks that you will encounter when working on computer animations. Even short animations can require a lengthy rendering period. One option we use to speed up the preview is to change the Every Nth Frame value to 2, causing the preview to render every other frame, and then setting the Playback fps to 15 to compensate for the reduced number of frames. The preview animation isn't as smooth as it would be if every frame were played back at 30 fps, but you get a fairly good idea of the camera motion. For longer animations, you can sometimes set Every Nth Frame to 10 and render single images that can be viewed in an image-editing program. With a setting of 10, there are still three frames rendered for every 1 second of animation and this is often adequate to check for lighting, materials, and most collisions.

If your rendering is destined for video, and you plan to render to fields, it is a good idea to create a preview rendering at twice the number of frames of the final output. (Fields are the interlaced scans that make up a single frame in NTSC video.) This will help you detect any object collisions that might occur between fields. For example, a camera may momentarily collide with an object in the design, temporarily causing a blank field. This collision may occur only in a single field of your animation, and it would go undetected when turning off field rendering. Such a collision would cause an annoying flash in the final animation when you use field rendering, but it would not be detected if you created a standard preview of each frame.

Notice that the last sequence of frames is cut off; the camera seems to hang above the building and never reaches the courtyard. The camera motion that you had before is still stored in the scene, but some of the keys extend beyond the active time segment. You will fix this next.

1. Switch to the Curve Editor by choosing Editor ➢ Curve Editor from the Track View – Dope Sheet dialog box.

2. Select the Position track for the animated camera. Note how the function curves extend into the dark-gray area past frame 550, which is now the end of the active time segment, as shown in Figure 11.35.

FIGURE 11.35
The function curves extend beyond the active time segment.
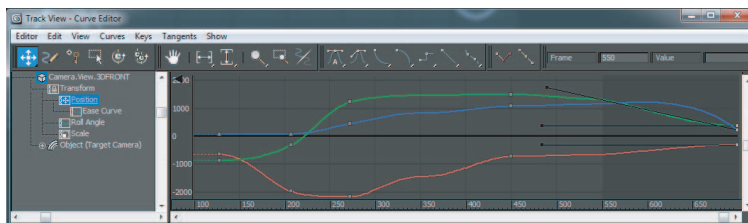
3. Hold down the Move Keys tool, and choose Move Keys Horizontal from the flyout menu.

The Move Keys Horizontal tool allows only horizontal motion in the Curve Editor graph.

4. Drag a selection window around the three keys at the ends of the function curves.

5. Zoom into the area near the end of the active time segment in the Curve Editor. You should be able to see frame 550 listed on the track bar in the dialog box.

6. Drag the selected keys to the left, and place them at frame 550.

7. Play the animation again, and observe that the camera motion is complete and the entire segment has been increased now to 550 frames.

8. It's been a long time since you've saved your work, so save the file as `My_CameraAnimation_completed.max`.

You now have a fairly smooth animation that shows off the building from several vantage points. At this point, you may want to explore some different ways to study the results of your work.

Throughout this chapter, you've created preview animations or used the Time slider to check your camera motion. The next section will show you some additional ways to preview the motion in your model.

Other Options for Previewing Your Motion

Earlier in this chapter, you learned how to create a preview animation that gives you a pretty good sense of the speed and overall time of your animation. You can also use the Time slider to get an idea of the camera motion by manually sliding it slowly and watching the result in the Camera viewport.

A third way to study the motion in your animation is to use the time controls located near the bottom of the Command panel (see Figure 11.36).

FIGURE 11.36
The time controls

Play/Stop Animation

Previous Frame   Next Frame

Go To Start   Go To End

Key Mode toggle   Time Configuration

Current Frame Number

Previous Key   Next Key

Time Controls in Key Mode
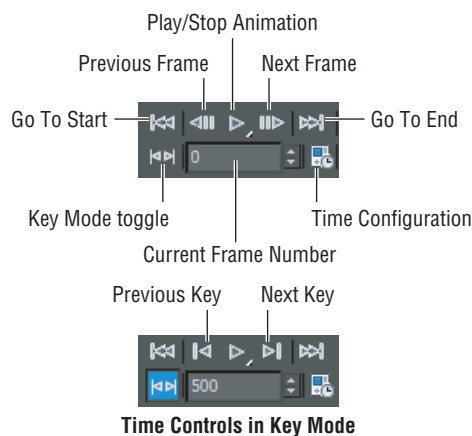
These tools work in a way similar to buttons on a DVD player, with some additions. The Go To Start button moves you to the first frame of the active segment. The Go To End button moves you to the last frame. The Next Frame and Previous Frame buttons move you one frame at a time either forward or backward. If you make the Key Mode toggle active by clicking it, the Next Frame and Previous Frame buttons become the Next Key and Previous Key buttons and will advance the Time slider to the next keyframe for the selected object. The Play Animation button plays the active segment in a continuous loop. The Play Animation button turns into a Stop Animation button when the animation is playing. The Play Animation button is also a flyout, offering you the option of playing the animation of a single selected object.

The playback is useful for getting a quick idea of how your animation is working. Try it out on what you have so far:

1. Right-click in the Camera.View.3DFRONT viewport to make it active.

2. Click the Play Animation button, and watch the playback for a few seconds.

As you've just seen, these options offer a variety of ways for previewing your animation. These tools will give you a sense of the motion in the animation at each change you make. They will help you refine your animations, so make sure to use them.

Moving the Camera Target over Time

So far in this chapter, we've touched on all the major editing activities you might run into while creating a keyframed camera path. You can also make changes to the camera target. The target can be manipulated independently of the camera to which it is attached. A camera target's trajectory can be completely independent of the camera itself, though you'll want to choreograph the motion of both the camera and the target carefully.

Try the following exercise to see the effects of camera target motion:

1. In the Top viewport, adjust the view so that you can see the villa courtyard, as shown in Figure 11.37.

FIGURE 11.37
Adjust the Top viewport to show this view.

Camera at last keyframe
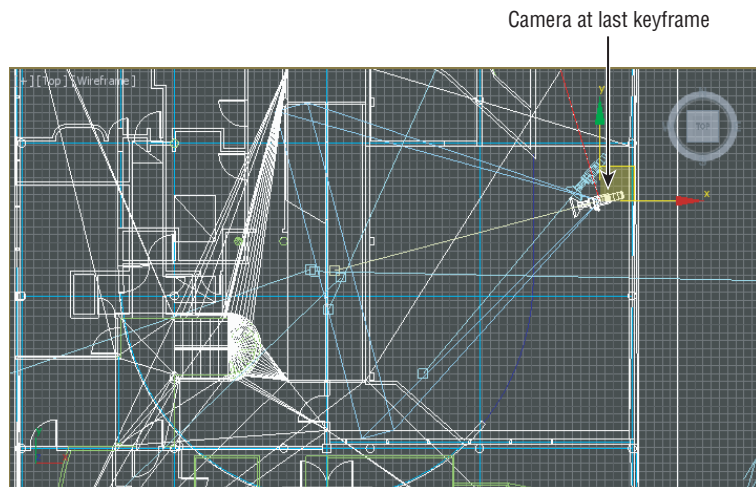
2. Move the Time slider to the last frame so that you can see the camera in the Top viewport.

3. Make sure the Camera.View.3DFRONT camera is selected; then right-click in the viewport to access the quad menu, and choose Select Camera Target from the Tools 1 list.

4. Turn the Auto Key button on; then use the Select And Move tool to move the camera target to the location shown in Figure 11.38.

Figure 11.38
Move the camera target to this location, so the camera is looking from the patio into the interior.

Move the camera target here.
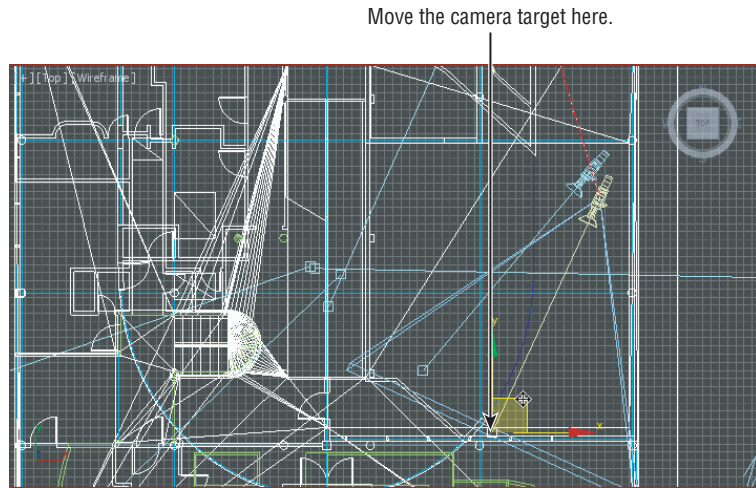
Now you've created a motion for your target. The target has just two keyframes. Just as with the camera path, you can adjust the keyframe's In and Out settings as well as the function curve settings in the Track View window:

1. In the Motion tab of the Command panel, change the In parameter flyout of the Key Info (Basic) rollout to Slow Tangent.

2. Use the keyframe selector arrows at the top of the Key Info (Basic) rollout to go to keyframe 1, and then select the Slow tangent flyout in the Out parameter.

3. Right-click in the Camera viewport, and then click the Play Animation button to see how the changes in the target affect the animation.

4. Save your scene incrementally.

The target trajectory is often forgotten as the cause of erratic camera motion. Remember that when you start to add camera target motion, you will need to pay attention to its effect on the overall animation. If part of the animation seems too jerky, and you know that you've adjusted everything for the camera path to create a smooth animation, check the target path for abrupt changes.

Controlling Lights over Time

This chapter has been devoted to showing you ways of controlling the motion of objects. In this section, you'll learn how properties of a light, such as intensity, can be changed over time.

Now let's suppose you want to fade the sunlight while simultaneously brightening the interior lights. In addition, let's suppose you want this done at the end of the animation, viewing the courtyard while the camera is no longer moving. To accomplish this in the following example, you'll use several of the tools you've already learned about in this chapter.

1. Add some time to the end of the animation. Click the Time Configuration button to open the Time Configuration dialog box.

2. Enter **600** in the Length input box, and click OK to close the Time Configuration dialog box.

3. In the Main Toolbar, click the Select By Name tool to open the Select From Scene dialog box, and then click the Display All icon, if necessary, to display all the objects in the scene.

4. Select SUN from the Name list and click OK.

5. Choose Graph Editors ➢ Track View – Dope Sheet.

6. Click the round plus symbol in front of the Object (Target Directional Light) track to expand the list of tracks.

The SUN directional light is not currently animated. In the following exercise, you'll add keyframes to the SUN through the Track View – Dope Sheet dialog box:

1. Click the Edit Keys tool in the Track View – Dope Sheet dialog box if necessary.

2. Using the Dope Sheet's navigation tools, zoom into the area near the end of the active time segment until you see frames 550 and 600 appear on the scale, as shown in Figure 11.39.

FIGURE 11.39
Place keyframes at frames 550 and 600.

Set frame number here.   Add keys here.
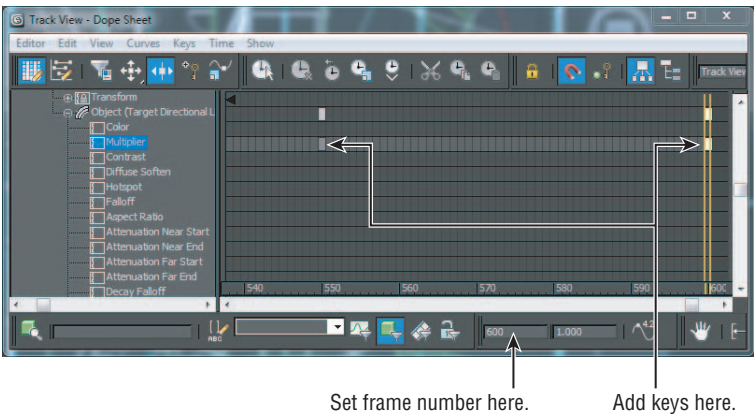
3. Select the Add Keys tool on the Track View – Dope Sheet toolbar.

4. Click the Multiplier track in the Controller window.

5. In the Key window, click the Multiplier track at a location that is close to frame 550, as shown in Figure 11.39.

6. Click the left input box at the bottom of the Track View dialog box, and enter **550↵** to set the new key to frame 550.

7. Click the Multiplier track at a location that is close to frame 600, as shown in Figure 11.39.

8. Click the Key Time box again, and this time enter 600↵ to set the new key to frame 600.

The Multiplier track of the SUN directional light now has two keys that control its value over time. These keys don't change anything yet. Remember that the Multiplier setting gives you control over a light's intensity. The final step is to adjust the Multiplier value at frame 600:

1. Right-click the key at frame 600. The SUN\Multiplier dialog box displays.

2. Change the Value input box to **0**, and close the dialog box.

You've just set up the SUN directional light to dim from full intensity to zero intensity between frames 550 and 600.

3. Switch to the Curve Editor, and then click the Multiplier listing in the Controller window if necessary. In the Key window, you see the function curve for the Multiplier value over time, as shown in Figure 11.40.

FIGURE 11.40
Multiplier curve
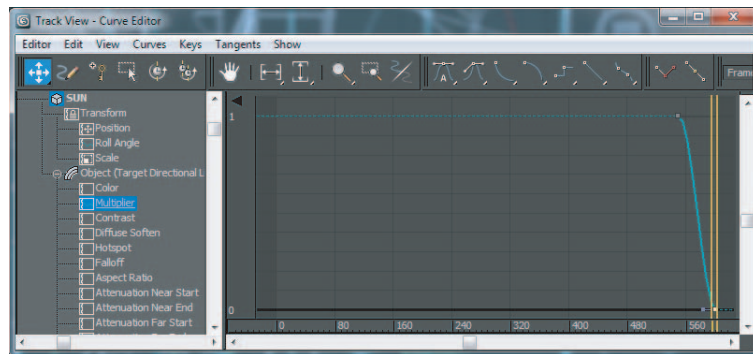
In the last exercise, you added two keys to the Multiplier track. You could have added just the last key at frame 600 and set the Multiplier value to 0 at that key. This would have caused the SUN directional light to dim gradually over the entire length of the animation. The key at frame 550 ensures that the Multiplier value stays constant at 1.0 until frame 550. The Multiplier function curve gives you a graphic representation of how this works by showing you a straight line from frame 0 to frame 550. The line then drops from frame 550 to frame 600, showing you the change in the Multiplier value from 1 to 0 between those two frames.

To see whether the modification you made really affects the model, create a preview animation of the Camera.View.3DFRONT viewport from frame 500 to frame 600.

Notice that in the last frame of the sample animation, the scene still appears lit. To truly darken the design, you'll need to change the ambient lighting over time in the same way that you changed the SUN directional light object:

1. Switch back to Dope Sheet.

ADDING KEYS IN EITHER MODE

Keys can be added in either Track View mode. The grid layout in Dope Sheet mode makes it a bit easier to select the proper frame number.

---

2. Scroll up the left panel to the Environment listing under the World node.

3. Click the plus sign next to the Environment track to display its children, and then click the Ambient Light track.

4. Click the Add Keys button and add two keys, at frame 550 and at frame 600, in the Ambient Light track, just as you did for the Multiplier track of the SUN directional light.

5. Right-click the key at frame 600. The Ambient Light dialog box displays, as shown in Figure 11.41.

FIGURE 11.41
The Ambient Light dialog box
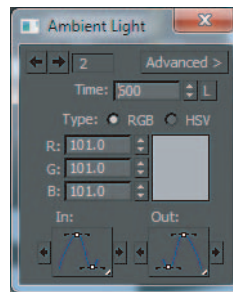
6. Right-click the spinners for the R, G, and B input boxes to set their values to 0. You can also click the color swatch to open the Color Selector, and then adjust the Value setting to 0.

7. Close the Track View – Dope Sheet dialog box, and then re-render a preview animation. This time the design darkens to a greater extent.

8. Save the file as **My_CameraAnimation_Completed01.max**.

You still have the Omni court lights illuminating the courtyard and the Omni interior lights lighting the interior of the villa. You can perform the same steps you used with the SUN directional light to change the Omni lights' multiplier over time.

The Bottom Line

Create a quick-study animation.   Viewing an animation, rather than individual still images, can give you a greater sense of the size, scope, and proportion of a design project. Initial, quick-study animations usually consist of short animations with changes made to the camera's location and orientation.

Master It   Create a camera at the mezzanine level of the condo scene, C11_MasterIt_01. max, oriented toward the tall windows. Animate the camera moving to the lower level and changing orientation to look into the kitchen.

Change the number of frames in an animation. The 101 frames provided in the default 3ds Max scene are rarely adequate to display any significant amount of animation. It's an easy process to increase or reduce the number of frames in a scene, and this is a task that you will do often.

Master It Continuing with the previous exercise, increase the number of frames to 300. Adjust the keyframes so that the animation occurs over all 300 frames.

Add and edit keyframes. Keyframes determine the point in time and value of nearly any parameter change in 3ds Max. Adding and editing them properly is an essential task when finalizing your animation.

Master It Continuing from the previous exercise, add two keys to the camera's animation, one that raises its position before descending to the lower level and one that adjusts its rotation so that it looks at the kitchen earlier. The camera should ease into and out of its peak height.

Preview the animation. Animations can take a significant amount of time to render and, unless you have a render farm setup, you may lose the ability to continue working on a scene while it renders. Creating preview animations can quickly identify animated conflicts prior to your spending the time creating a final animation.

Master It Create a preview animation, at a resolution of 640 × 480, showing the modified camera path from the previous exercise. Display the frame numbers in the images, and save the animation as an AVI file using the Microsoft Video 1 codec.

Control lights over time. Clarifying the results of the lighting in a scene is often identified as a priority early in the project cycle. Not only is a satisfactory lighting scheme required, but animated variations, such as the onset of dusk, may also need to be viewed and observed.

Master It Add a quick lighting scheme to the condo scene. Animate the lights, holding their intensity for 100 frames and then reducing the intensity to zero while turning the lights slightly red.

Chapter 12

Creating Animations, Particles, and Dynamics

In the previous chapter, you got a fairly detailed look at how you can animate camera motion. In this chapter, you'll continue your exploration of animation by looking at methods for saving your animations as files. You'll explore how using render presets can save you time.

You'll also see how animations differ from still images in the way you put an Autodesk® 3ds Max® scene file together. The arrangement of objects and methods you use to create a still image has different requirements from those of an animation. You'll examine some of those differences and their effect on your work.

In this chapter, you will learn to

- ◆ Render an animation
- ◆ Output a still image
- ◆ Render a shadow study
- ◆ Create a walkthrough
- ◆ Choose an animation file output option
- ◆ Set up a dynamics simulation
- ◆ Create a Particle Flow event-driven particle system

Rendering the Animation

Let's take a look at the options you have for animation output. This is a big subject, so you'll start with the basics of study animations versus finished animations.

Before you get to a point where you think you're ready for a final animation, you should generate study animations to make sure that all the elements are working together. You'll want to do this because of the time it takes to generate a full, finished animation. For an elaborate project, a 20-second animation can take an extremely long time to render, so before you commit your computer to hours or days of nonstop rendering, you'll want to be completely sure that everything is perfect.

You can create a study animation by turning off some key rendering features that may not be crucial for studying the motion of objects in your animation. You can also reduce the resolution of the study animation to help speed things up.

Creating a Study Animation

In the following exercise, you'll create an animation file to be viewed in 3ds Max. It won't be a finished product by any means. The advantage of using the Renderer output, as opposed to making a Preview animation (see Chapter 11, "Understanding Animation"), is that you will be able to see the lighting change over time better, and you'll also see how the shadows affect the animation.

The first animation you'll do will focus on the last few frames of the animation to ascertain that the spotlight is indeed dimming at the end.

1. Open C12_Firstanimation.max. This is similar to the file that you saved in the previous chapter but with a Skydome object added.

2. Right-click the Camera.View.3DFRONT viewport to make it active if it is not already.

3. Click the Render Setup button on the Main Toolbar.

4. At the bottom of the Render Setup dialog box, click the Preset drop-down list, as shown in Figure 12.1.

FIGURE 12.1
Rendering presets
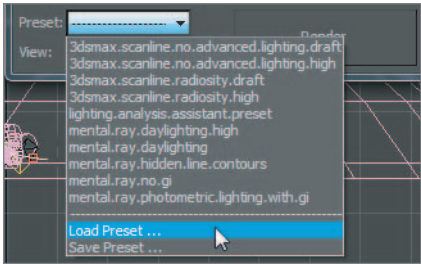
Rendering presets are settings from the Render Setup dialog box saved as named items in the Preset drop-down list. 3ds Max lets you maintain multiple rendering presets, as you can see from the Preset list.

5. Select Load Preset from the drop-down list. In the Render Presets Load dialog box, navigate to the renderpresets folder under the 3ds Max 2013 folder, select 3dsmax .scanline.no.advanced.lighting.draft.rps, and click Open.

RENDER PRESET LOCATIONS

The Render Presets Load dialog box may display the contents of the C:\Users*Your Name*\ Documents\3dsMax\renderpresets folder. This is not the correct location for the render presets that install with 3ds Max 2013. You must navigate to the C:\Program Files\Autodesk\3ds Max 2013\renderpresets folder to find these. If you use the Project Folder feature of 3ds Max, your system will default to looking in that directory structure for the renderpresets folder.

---

6. The Select Preset Categories dialog box appears. Here you can select which categories of settings from the selected preset you would like to load. Leave all three categories

selected (Default Scanline Renderer, Advanced Lighting, and Raytracer), and click the Load button.

The appropriate settings are loaded from the `3dsmax.scanline.no.advanced.lighting.` `draft.rps` settings file.

In this case, the Default Scanline Renderer was chosen, and settings were altered in the Advanced Lighting and Raytracer tabs of the Render Setup dialog box. Of course, these are settings that you could have changed manually in the Render Setup dialog box, but it saves time to load them all from a file. In addition, if you are working in a group environment, a common preset file can be distributed or placed on an accessible network drive so that all users can make sure that they render their portions of a project with the proper settings.

1. In the Render Setup dialog box, make sure that the Common tab is selected. In the Time Output group of the Common Parameters rollout, click the Range radio button and enter a range from **550** to **600** in the Range input boxes.

2. Click the 320 × 240 button in the Output Size group to reduce the resolution of the output if it is not already set to that output size. Fewer pixels take less time to render.

SETTING DEFAULT OUTPUT SIZES

You can right-click the resolution buttons in the Output Size area to change their default sizes.

---

3. Click the Renderer tab of the Render Setup dialog box, and note that the Antialiasing check box in the Antialiasing group isn't selected. It was deselected when you loaded the preset earlier. This will greatly improve the speed of the rendering, but it will create a rendering that shows jagged edges on objects.

ENABLING SSE

In the Options group of the Default Scanline Renderer rollout, you will see Mapping, Shadows, and Enable SSE. Both Mapping and Shadows are enabled, so you will see the mapping used in materials and shadows in your scene. SSE stands for Streaming SIMD Extensions and SIMD is an acronym for Single Instruction, Multiple Data. SSE is not enabled by default, but if your CPU hardware supports SIMD, enabling SSE can improve your render times.

---

4. Switch back to the Common tab. Scroll down to the Render Output group, and then click the Files button in the Render Output group. In the Render Output File dialog box, select the AVI File (`*.avi`) option from the Save As Type drop-down list and enter **My"rstanimation** as the filename. Use the Save In drop-down list to browse to the folder where you've been saving your project files.

5. Click Save. You'll see the AVI File Compression Setup dialog box.

6. Set the Compressor to MJPEG Compressor and the Quality to 90 and then click OK (see Figure 12.2).
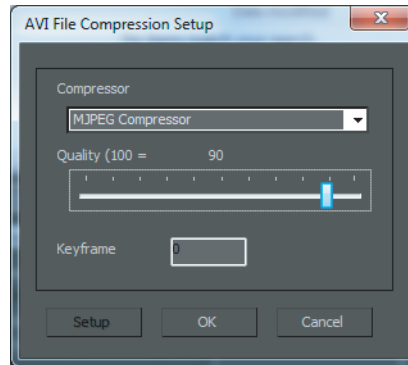
This dialog box allows you to select the method of compression and the amount of compression (quality) for your saved animation. You'll get a closer look at these issues in the section "The AVI Codecs" later in this chapter.

7. Click Render at the bottom of the Render Setup dialog box. The rendering process begins.

Notice your rendering time. Here it's blindingly fast, about one second a frame. If you have a much slower render time, go take a quick break.

Once the animation is created, you can view the rendered animation from within 3ds Max by using the View Image File command or by locating the AVI file using Windows Explorer and double-clicking it. Unlike the Create Animated Sequence File feature, the player doesn't automatically launch when the rendering is complete.

1. Choose Rendering ➢ View Image File. The View File dialog box displays.

2. Locate and select `Myfirstanimation.avi`, and then click Open. You will see the Windows Media Player open and play back the animation. If you have another application set to play back AVI files, that application will open and play the AVI file.

As you can see, the animation is short and pretty crude, but at least you can tell whether the lights are doing what you want them to do.

Creating a Quick Overall Study Animation

Now suppose you want to get a quick view of the overall animation to make sure that everything is working as planned. In the next exercise, you'll adjust some of the frame output settings to limit the number of frames that are animated. This will help reduce the total animation time so that you'll see the results quickly. You'll use a different file format that offers you a bit more control:

1. Make sure the Common tab is selected in the Render Setup dialog box, and then click the Active Time Segment radio button in the Time Output group.

2. In the Every Nth Frame input box, enter **3**. This will cause the renderer to create an animation that renders only every third frame. Consequently, the animation will take approximately one-third of the time to render all the assigned frames.

3. Click the Files button in the Render Output group; then, in the Render Output File dialog box, enter **Mysecondanimation** for the filename.

4. Select MOV QuickTime File (*.mov) in the Save As Type drop-down list and click Save. As you'll see in a moment, the QuickTime file format lets you set the playback frame rate.

QuickTime Rendering on Windows 64-Bit Systems

New in 3ds Max 2013 on Windows 64-bit systems, Autodesk has created a workflow to enable rendering to the Apple QuickTime MOV format. You must have the latest version of Apple QuickTime installed on your system to view or create QuickTime files. If you don't have QuickTime, you can get it at www.quicktime.com.

---

5. In the Compression Settings dialog box, change the Frames Per Second setting to **10**. Note that you can set the Quality slider and also select the color depth for the MOV file. The lower the Quality setting, the smaller the file size will be. Decreasing color depth can also reduce file size. Set the Quality setting to Medium. Click OK to close the Compression Settings dialog box and return to the Render Setup dialog box.

Changing the File-Saving Parameters

After rendering a scene to a particular still image or animated file format, the dialog boxes used to set the file's parameters (compression, frame rate, and so on) no longer appear. To change the file's parameters without changing the file's type, click the Setup button in the Render Output File dialog box.

---

6. Click the Render button in the Render Setup dialog box. This time the rendering will take a good deal more time because you will be rendering about 200 frames overall (one-third of 600 frames). Check the Time Remaining field in the Common Parameters rollout of the Rendering dialog box that opens to see an estimate of the remaining rendering time.

7. Close the Rendered Frame Window and the Render Setup dialog box.

8. Use Windows Explorer to browse to the file you just rendered, and double-click it to open in it QuickTime Player.

Lowering the Frames per Second

Rendering at 10 frames per second (fps) is near the limit of flicker fusion, where you start to perceive individual frames rather than the illusion of continuous motion. The animation will be a bit jerky but it will still be a valuable sample and allow you to get a sense of timing in the segment without rendering every frame.

This animation is still crude, and you may detect that it is not quite as smooth in the playback as the previous animation, but it gives you a far better idea of how the final rendering will look than did the preview animations you used in the previous chapter, because it includes rendered light and shadow. The test animations that you render may also show you problems that need

fixing. This is exactly the kind of feedback you want from tests before you commit all the time required to render the entire animation at high-quality settings.

Adding a Moving Car

Your animation work so far has involved moving a camera around the villa. Of course, you can animate other objects in your model. Let's add a car to the animation to see how to control the behavior of objects other than cameras. By animating a car, you'll explore how you can rotate an object through time. You'll use a simple car model to see how you can make an object move smoothly in an animation.

First, you will insert a Container that has the car model inside it:

1. Right-click the Top viewport, and then click the Maximize Viewport toggle to enlarge the view.

2. Select the Skydome object.

3. Right-click; then, in the quad menu, click Hide Selection.

4. Click the Application button, and choose References ➤ Inherit Container.

5. In the Inherit Container dialog box, select the LowResCar_Container01.maxc file that you downloaded with this chapter's resources and click Open.

3DS MAX CONTAINER FILES

3ds Max uses the extension *.maxc to identify models that have been prepared as Container files.

The car appears in the scene near the lower-right corner of the villa, just out of view of the Camera.View.3DFRONT at frame 0.

Now that you have the car in the scene, it's time to animate it. Just as with the camera, you'll need to enter Auto Key mode, select a time with the Time slider, and then move the car:

1. With the Container01 object still selected, click the Select And Move tool; then use the Absolute Mode Transform Type-In field and move the car to X = 15′ and Y = 150′.

2. Deselect the Container01 object.

3. Click the Auto Key button at the bottom of the interface.

4. Move the Time slider to frame 200.

5. Click the Select By Name tool.

6. Select the Container01 object from the list, and click OK. If Container01 does not appear in the list, click the Display Containers toggle on the Select From Scene toolbar.

7. Click the Selection Lock toggle so that you don't have to worry about accidentally deselecting the car's Container while you are animating it.

8. Click the Select And Move tool, and then move the car to the position between the two trees, as shown in Figure 12.3

FIGURE 12.3
Move the car to the
new location at
frame 200.
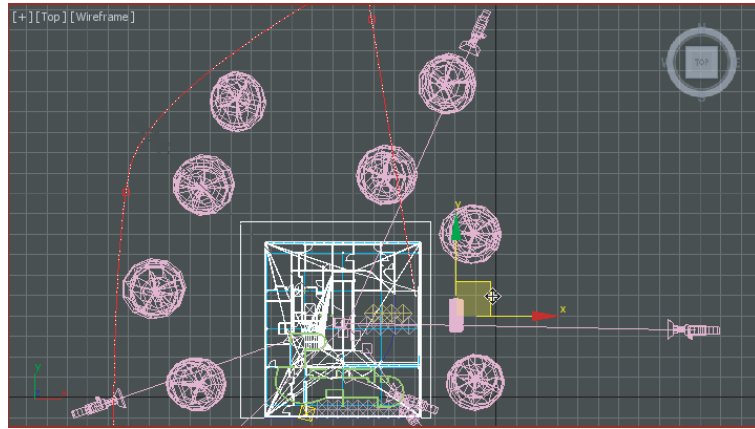
To help you visualize the path of the car, turn on its trajectory:

1. Right-click in the viewport, and select Object Properties.

2. In the Display Properties section of the Object Properties dialog box, click By Layer to change the display properties of the car to By Object.

3. Click the Trajectory check box and click OK.

Now you have a visible trajectory. Let's adjust the beginning and ending keyframes so that the car starts and stops smoothly on its path:

1. Click the Motion tab in the Command panel.

2. In the Key Info (Basic) rollout, click and drag the In flyout and select Slow.

3. Click the left-facing arrow in the upper-left corner of the Key Info (Basic) flyout to go to keyframe 1.

4. Select the Slow tangent option for the Out parameter.

5. Move the Time slider from frame 0 to frame 200, and watch what the car does.

You can see that the car moves in a straight line between the two keyframes. The orientation of the car has not changed, so the car looks like it is moving slightly sideways. Finally, the car is driving through a tree.

Next, you'll modify the trajectory of the car so that it gives the tree a wider berth. You'll also add some rotation to the car so that it looks like it's turning into the building.

1. Move the Time slider to frame 120. This is where you'll add another keyframe in order to move the trajectory away from the tree.

2. With the Select And Move tool still active, move the car to the location shown in Figure 12.4.

3. Click the Select And Rotate tool, and rotate the car so that it is aligned with the trajectory at this keyframe. By rotating the car at this point, you are adding a rotation key.

FIGURE 12.4
Moving the car
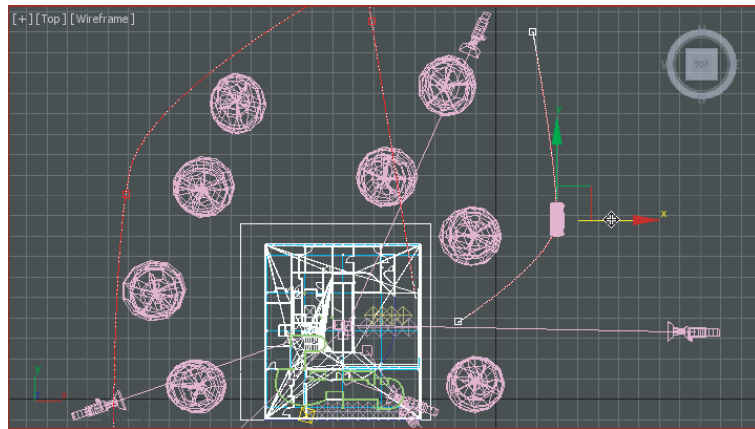
4. Now click and drag the Time slider between frames 0 and 200 to see the motion of the car.

The car moves around the tree and turns, although the turning is not well coordinated with the trajectory. The car also does not complete its turn at frame 200, where it comes to rest. You need to add a few more rotation keys to make the car's motion fit its trajectory better:

1. Go to frame 200, which is now keyframe 3 of the trajectory.

2. Using the Select And Move and Select And Rotate tools, move and rotate the car so that it is nearer to the entrance of the building and oriented with the trajectory, as shown in Figure 12.5.

FIGURE 12.5
Move the end location, and orient the car with the trajectory at keyframe 3.
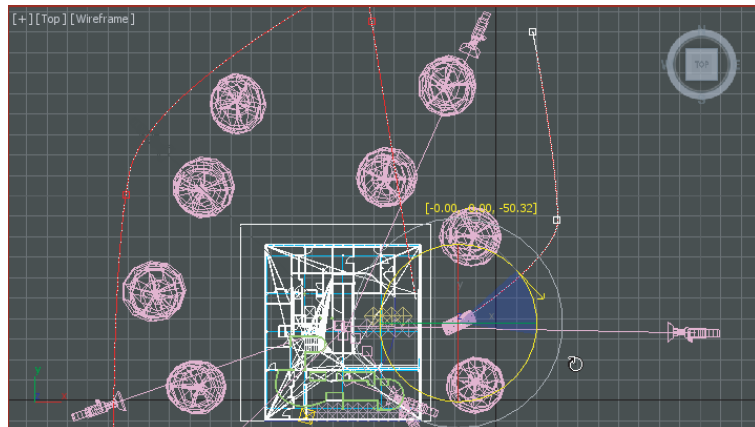
3. Go to frame 0, and orient the car with the trajectory.

4. Now check the animation again by moving the Time slider between frames 0 and 200.

The car now turns, but it is still somehow out of sync with the trajectory. To fine-tune the car's motion, you'll need to add some additional key locations for the rotation:

1. Set the Time slider to about frame 108; then use the Select And Rotate tool to orient the car to the trajectory. This location was chosen because it is about where the car begins to increase its turning rate, and it may be different in your scene.

2. Now test the animation again by sliding the Time slider from 0 to 200 and back.

3. Add additional keyframes if necessary to make the car rotate properly along its trajectory.

The car now follows the trajectory in a more natural, car-like fashion.

You've added several rotation keys in this exercise. Unlike the position keyframes, rotation keys do not appear on the trajectory. They do, however, appear on the track bar, below the Time slider, while the car object is selected. Notice how several keys in the track bar are both green and red, indicating that both position and rotation tracks exist at that frame. The rotation keys also have parameters that can be adjusted in the Motion panel and in the Track Views.

1. With the Time slider set to 200, click the Rotation button at the bottom of the PRS Parameters rollout (not the Rotation button in the Delete Key group), as shown in Figure 12.6. The Rotation key parameters will appear in the Command panel.

FIGURE 12.6
Click the Rotation
button.
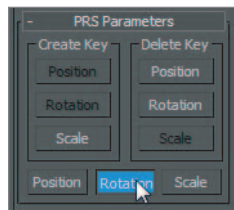
2. Scroll down to the Key Info (Basic) rollout. You now see the settings for the rotation parameters.

   If you expand the Assign Controller rollout, you will notice that the Rotation Controller is an Euler XYZ (pronounced "oiler") controller instead of the Position XYZ controller that you worked with in the camera animation. You can change the Rotation controller to TCB Rotation if you prefer. (See Chapter 11 for more on the TCB controller.) You can fine-tune the rotation of the car using the TCB parameters at each key, although the current settings may be just fine for this project. You've seen how you can use the Rotate transform tool over time to make the car move through its trajectory as a car normally would. You have the same types of control over the rotation of the car as you do over the position. You can also use the Curve Editor or Dope Sheet of the Track View dialog box to fine-tune the car's motion, just as you did with the camera in Chapter 11.

3. Save your scene as **MyFirstanimation.max**.

Automating the Output of Multiple Still Images

Animations are great tools for presenting information, be it narrative story, forensic reconstruction, or a design for a new building or consumer product. 3D animations can help people understand what it will ultimately feel like to interact with a given design. However, animations can take a great deal of time to keyframe, preview, study, and, finally, to render. The tools you use for animation can also be used to help you automate the creation of still images. In particular, they can be great time-saving tools for creating the more traditional elevation views of a building or the top, front, and side views of objects for technical illustrations. When you automate the rendering of stills, you can leave the computer unattended while each one of the stills you specify is rendered.

In this section, you'll see how you can automate the creation of elevation views of the villa by animating another camera in the scene. Generating elevation, or orthogonal, views of models can be an important task in a game or film's development as the Art department is developing and checking environments, characters, or props, in addition to being critical to architectural or civil engineering projects.

Setting Up a Camera for Elevations

The first step in this automation project is to set up a camera to display an orthographic projection instead of a perspective view:

1. Click the Auto Key button to turn off Auto Key mode, and click the Selection Lock toggle to deactivate it.

2. Adjust the Top viewport so that it looks similar to Figure 12.7.

FIGURE 12.7
The Top viewport and new camera
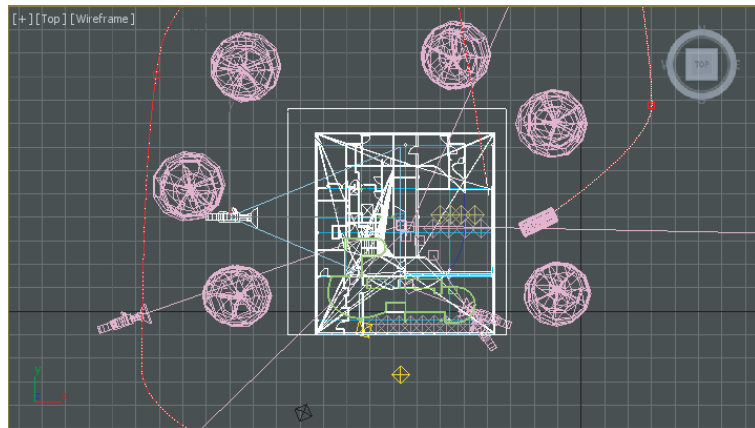
3. Click the Create tab in the Command panel; then click the Cameras button.

4. Click Target in the Object Type rollout; then click and drag the point indicated in Figure 12.9, directly to the left of the villa.

5. Drag the cursor to the center of the villa and release the mouse.

6. Rename this new camera **Elevation001**.

The Camera parameters need to be altered so that the camera will display a typical elevation view, which is a type of orthographic projection view:

1. Click the Maximize Viewport toggle to view all the viewports.

2. Right-click the Camera.View.3DFRONT viewport to make it active; then click the POV menu in the upper-left corner of the Camera viewport, and choose Cameras ➢ Elevation001. This will allow you to see the changes you make to the Elevation001 camera settings.

3. With the Elevation001 camera still selected, click the Modify tab of the Command panel; then, in the Parameters rollout, select the Orthographic Projection check box.

   Notice that the Elevation001 viewport changes to show a side view of the building.

4. Adjust the FOV spinner (FOV stands for *field of view*) so that you can see the entire building in the Elevation001 viewport.

   You'll need to make one more adjustment to the camera—lower the view in the Elevation001 viewport; it is a bit too high. You will accomplish this by using the Truck Camera tool.

5. Use the Truck Camera tool in the Elevation001 viewport to drag the building to the center of the viewport, as shown in Figure 12.8. This has the effect of moving the Elevation001 camera and its target up above the ground to the center of the building.

6. In the Elevation001 viewport, the background is displaying the gradient color. To see the color gradient that was added to the Environment Background, click the Viewport Shading menu, and select Viewport Background ➢ Environment Background.

FIGURE 12.8
The Elevation001 viewport showing the orthographic projection of the villa with the Environment Background
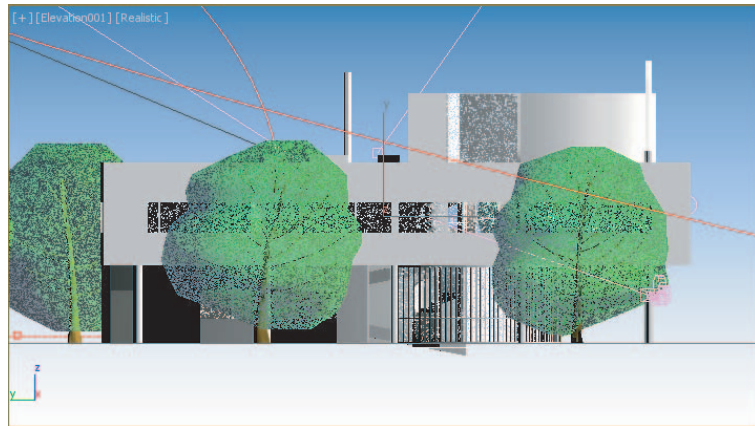
Setting Up the Four Elevations

With the Elevation001 camera created and its parameters set, the final step is to set up the four views using the animation features of 3ds Max. You'll turn on the Auto Key mode, and then, at three different frames, you'll set up three camera positions, one for each of the other three elevations.

1. Turn on the Auto Key button.

AUTO KEY DEFAULT FRAME

One difference between 3ds Max and 3ds Max Design is the default setting for creating keyframes when Auto Key is turned on. By default 3ds Max uses frame 0 as the default frame and 3ds Max Design uses frame 1. You can change this setting using Customize ➢ Preferences. Then go to the Animation tab of the Preference Settings dialog box; at the bottom in the Auto Key Default Frame group, you can set a desired frame number and, if you want, turn off automatically creating keys at the start frame.

---

2. Move the Time slider to frame 1 because it is the next frame after frame 0, the Auto Key default frame.

3. In the Top viewport, move the Elevation001 camera to the location shown in Figure 12.9. Make sure that you move only the camera and *not* the camera *and* the target. You can use the Elevation001 viewport to help align the camera.

FIGURE 12.09
Move the camera to this location for the second elevation.
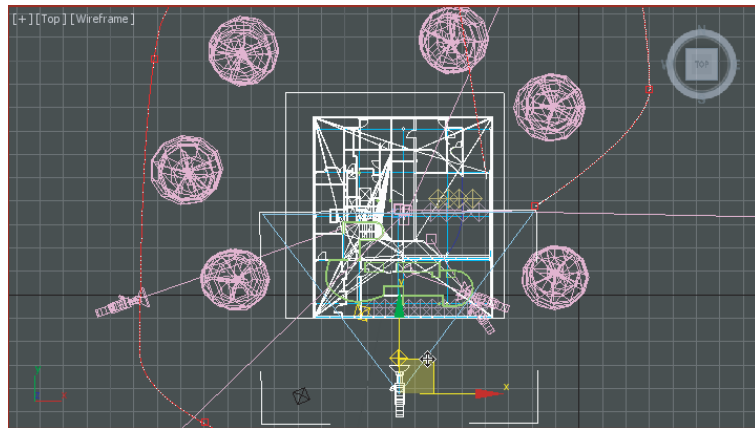
4. Move the Time slider to frame 2; then move the camera to the position shown in Figure 12.10. Again, make sure that the camera is perpendicular to the surface of the building. You can also use the Elevation001 viewport to make sure that the camera includes the entire building in its view.

5. Move the Time slider to frame 3, and then move the camera to the last elevation position, as shown in Figure 12.11.

You now have four frames (frames 0 through 3) that show the villa's four elevations. As a final step, you'll need to create a copy of the SUN directional light that follows the camera.

Typically, rendered elevation views use a light source from the upper corner of the view behind the camera, so you'll need to create a copy of the SUN to simulate that orientation:

FIGURE 12.10
Move the camera to this location for the third elevation.
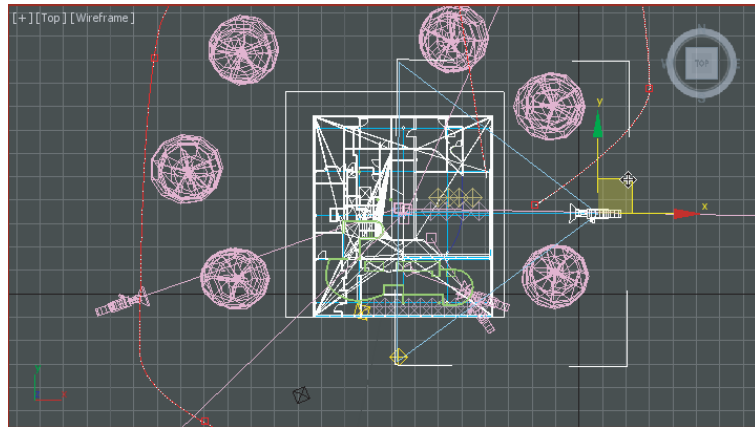
FIGURE 12.11
Move the camera to this location for the last elevation.
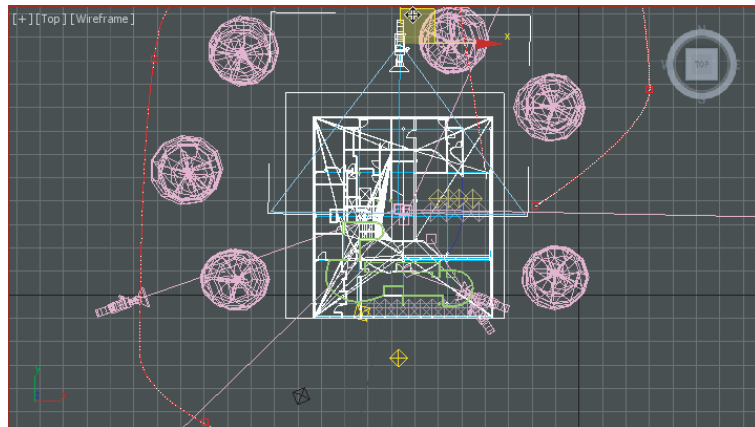
1. Move the Time slider to frame 0.

2. Shift+click and drag the SUN directional light to the location shown in Figure 12.12.

3. In the Clone Options dialog box, give the new directional light the name **SUNelevation001**.

4. Click the Copy radio button to make the clone unique and click OK.

5. Move the Time slider to frame 1; then move the new SUNelevation001 directional light to the location shown in Figure 12.13.

FIGURE 12.12
Copying the SUN

Make a copy here.
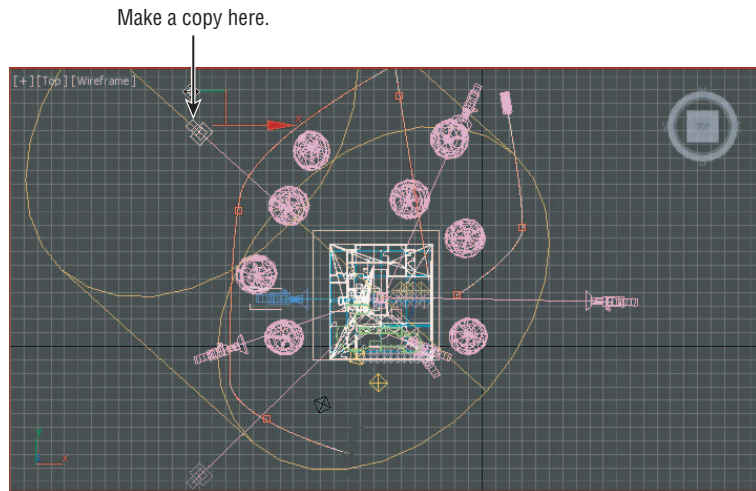
FIGURE 12.13
Positioning the SUN
for each elevation

Position at frame 4

Position at frame 2   Position at frame 3
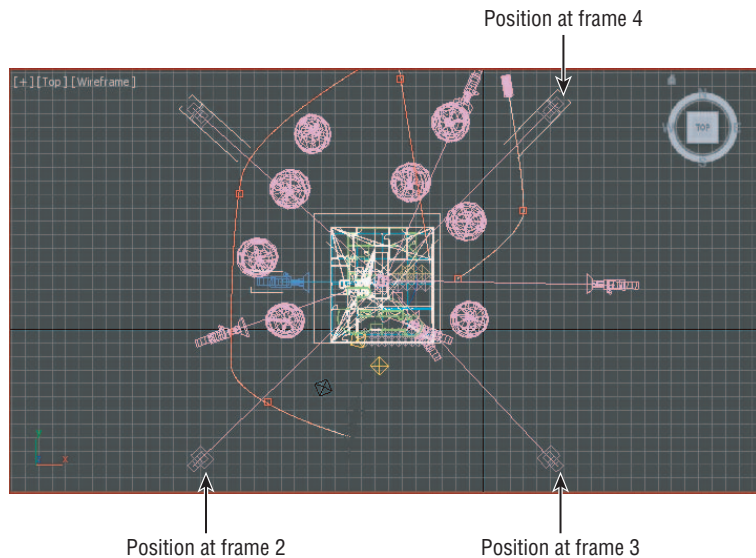
6. Repeat step 5 for frames 2 and 3. Use Figure 12.13 to guide you in the location of the SUNelevation001 directional light.

7. Select the original SUN directional light; then, in the Modify tab of the Command panel, select the On check box in the General Parameters rollout to turn off this light. You don't want the original SUN directional light to over-illuminate the scene now that the elevations have their own animated SUN light source.

8. Turn off the Auto Key button.

BACKBURNER

Rendering animation sequences or a large number of still images can take a significant amount of time and seriously hamper your productivity. You may have even heard the term *render wander*, referring to a 3ds Max artist's habit of walking around the office while waiting for a render process to complete.

When a project's rendering time is expected to be unacceptably long, consider using Backburner to assist the rendering process. *Backburner* is an Autodesk utility that allows one workstation to control another, using its processor to render assigned frames from the Render Setup dialog box. This process is called *network rendering*. Larger companies often have render farms set up, consisting of several or even hundreds of workstations with no other purpose than to be used as network rendering nodes as required by the current projects. Systems in the render farm usually do not need monitors, keyboards, mice, or other peripheral devices. Another option is to use other computers that are used for day-to-day tasks in the company as a render farm in the evening.

Systems used in a network rendering setup do not need to be in a render farm; any system capable of running 3ds Max 2013 can be used; however, you should make sure that all machines on the render farm are running either a 32-bit or 64-bit version of Windows and 3ds Max—you should not intermix your render farm. All machines in the setup must have 3ds Max 2013 installed, but this does not require purchasing additional licenses of the software. Only the controlling system, called the manager, must have an authorized copy of 3ds Max 2013 installed. If you use third-party plug-ins, you will have to check with the manufacturers to see if you will need to purchase additional licenses of the plug-ins to use network rendering. The systems being used by the manager, called servers, are not required to be authorized. Backburner can also be used in a single-system setup. This allows you to continue working in 3ds Max and the manager while a second session of 3ds Max is opened as the server; however, in this setup, the performance degradation is often too significant to make any productivity gains. All image maps used in the rendering must be available to all the computers rendering a project.

Now that you have the scene set up with a camera for the elevations, the rendering part is simple. 3ds Max gives you the option to render selected frames of an animation instead of the entire sequence of frames. You'll use this feature to create your elevations.

1. Stop and save your work as **MyElevationAnimation.max** before you begin the rendering process. 3ds Max has been known to crash when it runs out of memory, and rendering can use lots of memory. It's a good habit to always make sure that you've saved before you start to render.

2. Click the Render Setup button on the Main Toolbar to open the Render Setup dialog box.

3. In the Render Setup dialog box, click the Frames radio button in the Time Output group.

4. In the Frames input box, enter **0-3**. This tells 3ds Max to render only frames 0, 1, 2, and 3.

5. Click the Files button in the Render Output group; then, in the Render Output File dialog box, browse to where you want to save your rendered images, enter **Myelevations** for the name, and select TIF Image File (*.tif) in the Save As Type drop-down list.

6. Click Save. In the TIF Image Control dialog box, click 8-bit Color and then click OK.

7. Click the 640 × 480 button in the Output Size section of the dialog box.

8. Make sure that Quad 4 - Elevation001 is selected in the View drop-down list at the bottom of the Render Setup dialog box, and then click Render. 3ds Max proceeds to render the four elevation views.

3ds Max will create four files, each with `Myelevations` as the first part of the name. A four-digit number is appended to the name to indicate which frame of the animation the rendering represents (for example, the third frame will be called `Myelevations0002.tif`).

9. Save your scene.

Of course, you can use 3ds Max's animation tools to automate the rendering of a set of perspective or isometric views. You can now walk away and take care of other things while 3ds Max renders your views unattended. If your views take a long time to render, you may want to set things up to render overnight.

GETTING NOTIFIED ABOUT RENDERING PROGRESS

Nobody likes to stare at the slowly moving render progress bar or leave the office with a critical render in progress. Luckily, you can set up 3ds Max to notify you, by email, when a render job is complete, when it fails, or when specific frames are rendered. To do this, expand the Email Notifications rollout in the Render Setup dialog box, and then check the Enable Notifications option.
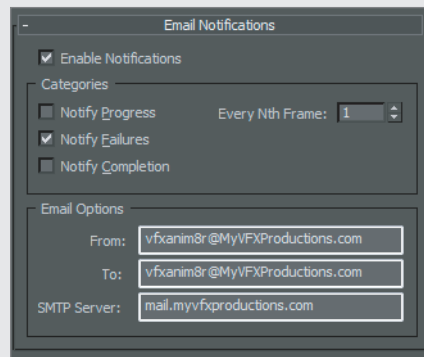
In the Categories section, select the frequency or cause for an email notification. Finally, in the Email Options section, enter the relevant email information, including the SMTP server through which the email is to be sent.

The elevations you render will look a bit stark. You can add fountains, cars, peripheral objects, and people to inject some life into the images. The addition of landscaping, people, and cars to liven up a rendering or scene is referred to as *entourage*. You can add entourage to your still images later in an image-editing program, or you can include trees and people in the model to be rendered with the building. Several plug-ins are available for this purpose; the RPC plug-ins from ArchVision are widely used to this end.

Rendering a Shadow Study

Another great traditional way to use the animation tools of 3ds Max is to create shadow studies. *Shadows studies* are very much like the time-lapse videos used in televisions and movies as ways to indicate the passage of time in a location. In many architectural or urban planning situations, a project may require a shadow study of a building to make sure that its shadows do not adversely impact a landscape feature or another building nearby. You may also be called upon to create a shadow study to help analyze a building's heat gain and energy usage. The Daylight System tool in conjunction with the Animation tools can make quick work of such a task.

In the following section, you'll learn how to use the animation features to create both stills and animations of the building's shadows over time.

Adjusting for True North

Chapter 14, "Advanced Rendering Using metal ray," shows you how to place a Daylight System into your scenes. Instead of reading the same instructions here, you'll use a file that has the Daylight System already placed for you. The `C12_Shadowstudy.max` file has a Daylight System placed in the scene with the sun position set for 2 p.m. on September 21, 2012, and for the location of Paris, France. No adjustment has been made for true north yet, so you need to orient the sun correctly in relation to the building. For the villa, north is actually in the lower-left corner of the Top viewport. You can change the orientation of the compass rose and thereby change the true north direction for the project site.

1. Open the file `C12_Shadowstudy.max`.

CERT OBJECTIVE

2. Click the Select By Name tool in the Main Toolbar, click the plus symbol in front of Compass01, and select Daylight01 from the list.

3. Click the Motion tab in the Command panel, and notice that the setting is set to Date, Time, and Location at the top of the Control Parameters rollout. These options influence how you interact with the Control Parameters settings.

4. Scroll down to the Location group of the Control Parameters rollout.

5. Change the North Direction setting to **225**. You'll see the compass rose and Daylight01 system change orientation and position to reflect the new north direction.

The North Direction setting interprets values as degrees in a clockwise direction, so to point north directly to the right in a positive X-axis direction, you would enter **90**. The North Direction input box does not accept negative values, so to point true north to the lower-left corner of the Top viewport, you need to enter **225**.

Now let's set up some times for the shadow study. Suppose you want to see the shadows at three-hour intervals, starting at 6 o'clock. You'll want to set the first hour a bit before the 6 o'clock time in case you want to create an animated study of the sunlight.

1. With the Daylight01 system still selected, set the Hours parameter in the Time group of the Control Parameters rollout to **3**.

2. Click the Auto Key button to turn it on.

3. Move the Time slider to frame 90, and change the Hours setting to **21**. Note that all of the time-related spinners turn red to show they have been keyframed.

4. Turn off Auto Key mode.

You now have a range of time that you can use to generate single images or a three-second animation showing the movement of shadows across the ground on September 21, 2012. There is one more detail you'll need to adjust before you create your study renderings.

Changing from an IES Sun to a Standard Light

You may recall from Chapter 7, "Light and Shadow," that the Daylight System uses an IES Sun, which is a photometric light. Such a light produces a coarse-looking shadow when not used with the Radiosity renderer. You'll want to change the Daylight System from IES Sun to a standard directed light to get a smooth, even shadow when you're using the Default Scanline Renderer:

1. Click the Modify tab.

2. In the Daylight Parameters rollout, change the IES Sun selection in the Sunlight drop-down list to Standard.

3. You don't need the Skylight option, so turn off the Active option for Skylight in the Daylight Parameters rollout.

4. Scrub the Time slider bar back and forth between frame 0 and frame 90 to see your animated Daylight system in the viewports; leave the Time slider on frame 45, the halfway point of the animation.

Now you are ready to create the shadow study renderings:

1. In the Top viewport, adjust the view to look like Figure 12.14.

FIGURE 12.14
Adjust the Top viewport so that it looks like this figure.
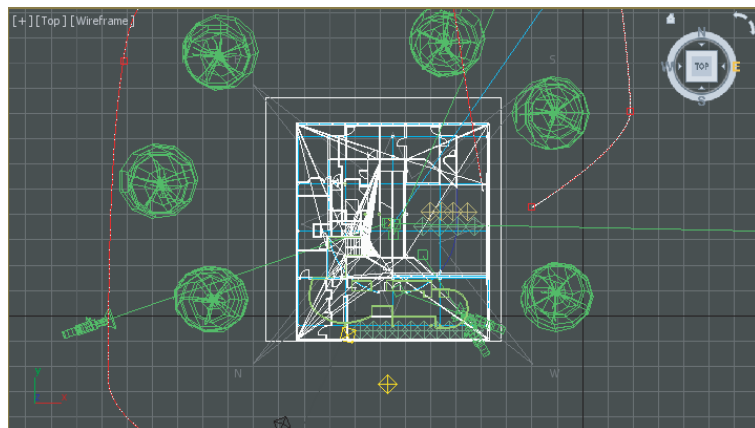
2. Open the Render Setup dialog box, and select 3dsmax.scanline.no.advanced.lighting.high from the Preset drop-down list.

3. Make sure all options are selected, and then click Load in the Select Preset Categories dialog box.

4. Click the Frames radio button in the Time Output group on the Common tab of the Render Setup dialog box.

5. Enter the frame numbers that correlate with the times of day you want to render, separated by commas. For four single views at three-hour increments, enter **25,38,52,65** without spaces.

6. Click the Files button, enter **MyShadowstudy** for the filename, and select TIF as the file type. Use the Save In drop-down list to browse to the folder where you've been saving your project files; then click Save. Sample renderings of these frames have been provided with the resources you downloaded.

7. Make sure that Quad 4 - Top is selected in the View drop-down list at the bottom of the dialog box and click Render. These renderings will take longer than before; you've picked the high setting, so the quality improves and the rendering progress slows accordingly.

ADD EXPOSURE CONTROL TO ADJUST FOR BRIGHTNESS

If your scene renders out too bright or too dark, you can use exposure control to compensate. Choose Rendering ➢ Environment, or press the 8 key in the top row of keys on the keyboard, to open the Environment tab of the Environment And Effects dialog box. In the Exposure Control rollout, expand the drop-down list and choose Logarithmic Exposure Control. In the Logarithmic Exposure Control rollout, select the Exterior Daylight option and then click Render Preview to see a thumbnail of the scene. Adjust the Brightness value in the Logarithmic Exposure Control rollout to about **70** to fine-tune the brightness in the scene. You can also increase the physical scale to brighten the scene.

3ds Max will render four views of the Top viewport, each showing the shadows of the building on the ground at the times indicated for each frame.

To create a short, animated shadow study or time-lapse animation, do the following:

1. In the Camera.View.3DFRONT viewport, click the POV viewport label, and select Cameras ➢ Camera.View.3DGROUND.

2. Open the Render Setup dialog box, click the Range radio button, and enter a range from frame 15 to frame 75.

3. Click Files, enter **Shadowstudy** for the filename, choose .AVI from the Save As Type drop-down list, and click Save.

4. Click Render to create the shadow study animation.

5. When the rendering is complete, save your scene as **MyShadowStudy.max**.

The still images and the animation can be helpful tools in your work and, as these exercises demonstrate, they may not take that much time to generate.

As you've seen from the exercises in this chapter, you can have several animation sequences in a single scene. You just have to select an object to animate, depending on which animation you want to use, and then select the time range or set of frames for your final output.

You've also seen how you can create a wide variety of animations, from flybys to shadow studies. There's another method for creating animations that you'll want to know about. You can generate a more intimate look at a design, called a *walkthrough*, by simulating the view of an environment as you walk along a path. Let's see how it is done.

Creating a Walkthrough

Walkthroughs can give you a sense of what an interior space is really like. For architects, interior designers, or planning professionals, they can play a major role in selling a project to a client. They can also show you what is good or bad about a design in ways that still images cannot. Walkthroughs or flythroughs are often used in video games and films to establish fantastic and unbelievable locations so that the players or viewers believe they are in a different place or time. This type of animation is usually created using a Path Constraint, so you'll need a spline that indicates the walkthrough path. The camera will be created and assigned to the path using the Walkthrough Assistant.

Start by creating a path for your walkthrough using a line shape:

1. Open the C12_Corridors.max file you downloaded with this chapter's resources from the book's website. This file could represent an environment in a game or movie, such as the inside of a huge spaceship or a secret underground research facility.

2. Use the Maximize Viewport toggle to enlarge the Top viewport.

3. Click the Create tab in the Command panel, click the Shapes button, and then click Line. In the Creation Method rollout, change Drag Type to Bezier.

4. You'll want a curved path, so click and drag the start of the line at the point indicated in Figure 12.15.

FIGURE 12.15
Draw this spline for the camera path.

Click and drag these points to complete the spline.

Click and drag the start of the spline from here.
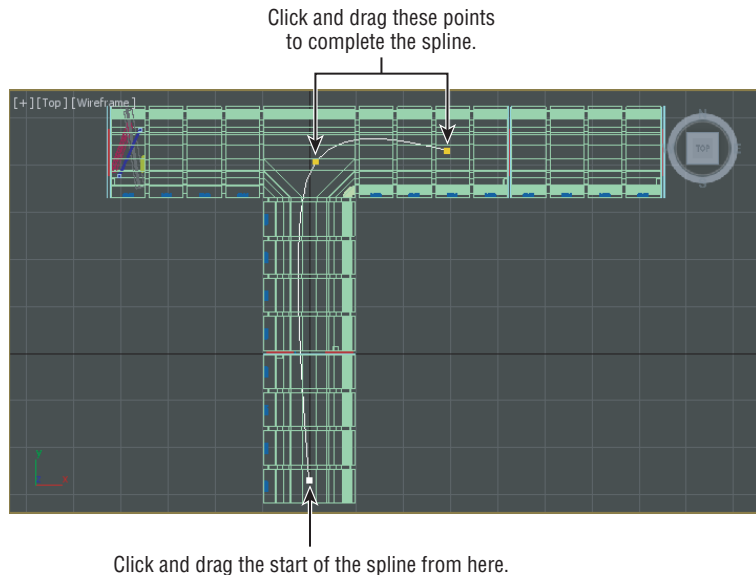
5. Click and drag two more points to form the curved spline shown in Figure 12.15. Right-click to complete the path.

6. Give your new line the name **Walkthroughpath** in the Name And Color rollout on the Command panel.

You've just created the path for the walkthrough. Remember that you can edit the curve using the Vertex option at the sub-object level in the Modify tab. You don't have to worry if your path isn't perfect. You can edit the spline to fine-tune the walkthrough animation path even after you've created the animation.

Now you're ready to create a camera for the walkthrough:

1. From the Menu Bar, choose Animation ➢ Walkthrough Assistant to open the Walkthrough Assistant dialog box shown in Figure 12.16.

FIGURE 12.16
The Walkthrough
Assistant dialog box
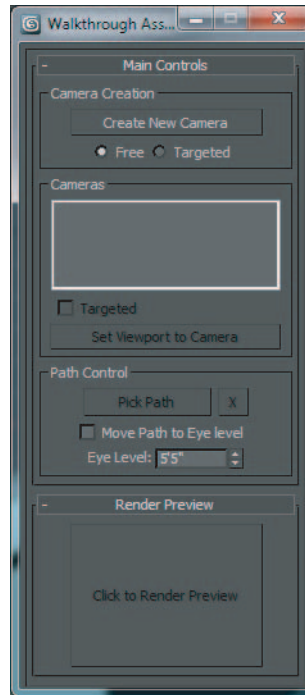
2. In the Camera Creation section of the Main Controls rollout, ensure the Free option is selected, and then click the Create New Camera button. The new camera, named Walkthrough_Cam001, is created and added to the list of cameras in the Cameras section.

CHANGING A CAMERA'S SIZE IN THE VIEWPORTS

If your cameras are larger than you prefer, you can change their sizes using the Non-Scaling Object Size option in the Viewports tab of the Preference Settings dialog box. This changes all cameras' sizes along with all other nonscaling objects, such as light icons and Assembly Head gizmos.

---

3. In the Path Control section, click the Pick Path button; then select the Walkthroughpath spline that you drew in the previous exercise. The camera moves to the first vertex on the designated path.

The camera should be 6′ 3″ above ground so that it is at eye level on the raised part of the floor. You can't, however, move the camera, because its position is now controlled through the position of the path that it is designated to follow. You must move the path instead.

4. In the Path Control section, set the Eye Level value to **6′ 3″**; then select the Move Path To Eye Level option. The elevations of the path and camera change.

Fine-Tuning the Camera's Orientation

The Walkthrough Assistant assigned the Path Constraint as the controller that determines the position of the camera, based on a percentage along the path. When the Path Constraint was applied, the camera moved to the beginning of the path and its orientation shifted to aim in the direction of the path. The Path Constraint controls the position of the object, and by default, the orientation of the camera follows the path. You have the option of keyframing its orientation to customize the view at any point in time, as you'll see next:

1. Drag the Time slider from frame 0 to frame 600. Observe that the Walkthrough_Cam001 object follows along the path to which it is constrained, and it arrives at the end vertex of the line at frame 600.

2. Display all four viewports, and then right-click in the Perspective viewport to make it active. In the Cameras section of the Walkthrough Assistant dialog box, click Set Viewport To Camera. The Walkthrough_Cam001 view now occupies that viewport.

Using Multiple Paths

Using the Path Constraint controller, you can assign more than one shape as the path for an object to follow. When more than one shape is selected, each is given a weight that determines the influence each has on the object's motion. For example, if an arc and a straight line are both assigned as the path that a camera (or any other object) must follow, with the arc having a weight of 10 assigned while the line has a weight of 2 assigned, the object will follow neither path perfectly. It will follow the arc to a degree five times greater than it follows the line, creating a trajectory that is somewhat flattened. Were the weights to be swapped, the trajectory would be fairly straight, with a bump to indicate the smaller influence of the arc.

---

3. Select the Walkthrough_Cam001 camera, and then click the Motion tab of the Command panel. Make sure Position is selected at the bottom of the PRS Parameters rollout, and scroll down to the Path Parameters rollout.

There are several important options in this rollout that define the motion of an object assigned to a path constraint. The Follow option, which is checked by default, determines whether the camera changes orientation to match the tangency of the path, and the Bank option allows the object to tilt as it travels through a curved segment of the path. If your constrained object follows a vertically looping path, like a roller coaster, you need to select the Allow Upside Down option or the object will instantly flip at the apex of the loop.

4. You can set rotation keys to define the camera's orientation and override the orientation set by the Follow option. Drag the Time slider to frame 290, a point before the camera enters the curve and turns toward the end of the path.

5. With Auto Key on, click the Rotate transform and, in the Top viewport, rotate the camera about 20 degrees clockwise until you can see the upcoming corridor leading to the end of the path. A rotation key appears in the track bar.

THE CAMERA SHOULD MIMIC THE EYES

When you walk down a street or through a building, try to notice where you look. A few steps before a turn, you generally look in the direction of the turn for obstacles or impediments. Before you open a door, you may look down toward the knob or bar and then up into the room. You are looking for details as you anticipate an action. Your camera movements should closely mimic the movements and focus of a person's eyes in the same situation.

---

6. Drag the Time slider to frame 525, just past the end of the curve, and you'll notice that the camera is rotated too far and not oriented along the path. The previous rotation key caused a 20-degree skewing of the camera's orientation, which is carried through the remainder of the camera's trajectory because of the active Follow option. You need to correct for that.

7. Rotate the camera about 20 degrees counterclockwise until it is facing along the path. When you scrub the Time slider, you'll see the camera look into the turn and then straighten out as it exits.

8. You can also adjust the orientation of the camera using the Turn Head and Head Tilt Angle options in the View Controls rollout of the Walkthrough Assistant, as shown in Figure 12.17. Add more rotation keys to the animation using this method if you like.

FIGURE 12.17
The Walkthrough Assistant View Controls rollout
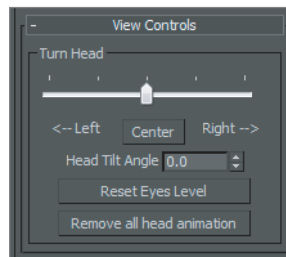
9. Turn off Auto Key mode.

You can use the Head Tilt angle to create a Dutch angle when turning through the corridor. The Dutch angle is frequently used in movies and television programs to create a sense of uneasiness, tension, or disorientation in the viewer.

Now let's adjust the rendering settings to make the camera feel a bit more cinematic:

1. Click the Render Setup button on the Main Toolbar.

2. On the Render Setup dialog box, scroll down to the Output Size group of the Common tab, click the drop-down menu, and select 35mm 1.85:1 (Cine), as shown in Figure 12.18.

3. Click the Walkthrough_Cam001 POV menu, and select Show Safe Frames.

FIGURE 12.18
Select 35mm
1.85:1 (Cine).
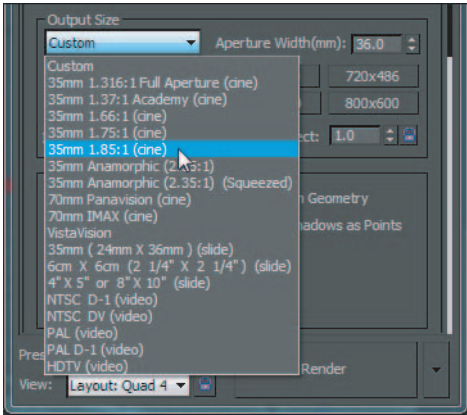
> **DELETING ROTATION KEYS**
>
> To delete all the rotation keys assigned to the walkthrough camera, click the Remove All Head Animation button in the View Controls rollout of the Walkthrough Assistant.

Adjusting the Camera's Timing

Notice that the Walkthrough_Cam001 object is animated across the entire active time segment. If you'd like the walkthrough to take less time, you can keyframe the percentage the camera has progressed along its path to end at an earlier frame.

1. Drag the Time slider to frame 60.

2. With Auto Key mode on and the Walkthrough_Cam001 object still selected, change the % Along Path parameter in the Path Options group to **0** (zero) on the Motion tab of the Command panel, as shown in Figure 12.19.

FIGURE 12.19
Set the % Along
Path value to 0.
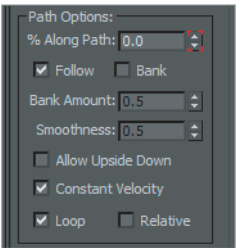
3. Go to frame 510, and change the % Along Path parameter to **100**.

4. Scrub the Time slider. Now the camera pauses for 2 seconds, takes 15 seconds (450 frames) to travel the length of the path, and pauses at the end for 3 seconds.

5. Toggle Auto Key off.

6. The time the camera takes to travel the length of the path is shortened, and now the rotation keys are not located properly. Click the rotation key at frame 290 in the track bar, and drag it to frame 330. Use the feedback from the Prompt line to move the key accurately, as shown in Figure 12.20.

FIGURE 12.20
The 3ds Max
Prompt line as you
move the keyframe
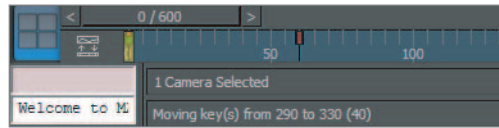
7. Move the rotation key at frame 525 to frame 575.

The Walkthrough Assistant contains its own method for rendering previews of the current frame, eliminating the need to create them using the Render Production button:

1. Drag the Time slider to the desired frame.

2. In the Render Preview rollout of the Walkthrough Assistant dialog box, click the large Click To Render Preview button. If the results in this window are less than pleasing, go to Exposure Control (press **8** to launch the Environment And Effects dialog box), and use Render Preview there.

THE OFFICE WALKTHROUGH

A while back, a company that was moving their corporate offices from several small floors in one building to a single, large floor in another building needed some animation assistance. Because of the nature of the company's business, there is a lot of foot traffic through their office space. The owner needed to provide a method for visitors to find the staff members they were looking for, but he did not feel that there was enough workload for a full-time receptionist to direct traffic. He also wanted to reduce the amount of time that his employees were away from their desks just to usher the visitors back to their workspaces. A decision was made to provide an interactive display for the visitors that would show an animation from the elevator lobby to the destination. Upon selection of a staff member's name from a list, the eye-level animation would play through and then ask the user if the animation was to be repeated. We were asked to provide animations from the elevator to each cubicle or office while another consultant put together the program, complete with a touch-screen interface.

The office was designed but not constructed; however, access was provided to the CAD files of the construction documents (see Chapter 5, "Working with External Design Data," for information on using CAD files with 3ds Max). Rather than design and render hundreds of separate animations, each taking time to load when requested, lines were drawn from the elevator lobby down the major corridors and then stopping at every intersection. Wherever one line stopped, one or more lines started from the same location, branching down another corridor or turning to face an office or cubicle. This allowed for the major runs, which were common to many of the destinations, to exist as independent videos, while shorter animations were available for the end runs.

Based on the requested staff member's office location, the other consultant's software loaded and played the first section of animation. While it was playing, the remaining animations were loaded and then played in sequence, appearing to be a single, seamless video.

Adjusting the Path

One of the best things about using the Path Constraint is that you can easily change the camera's trajectory by editing the path:

1. Right-click in the Top viewport. Select the Walkthroughpath spline object.

2. Switch to the Vertex sub-object level by right-clicking and using the quad menu. Notice that if you don't have the Modify tab visible on the Command panel, you can't get to the sub-object modes with the context menus.

3. Select the middle vertex, and move it about 3 feet down toward the first corridor.

4. Drag the vertex handle to the left, as shown in Figure 12.21. You may have to set your Axis constraints to the X-axis.

FIGURE 12.21
Editing the walkthrough path to control the camera trajectory
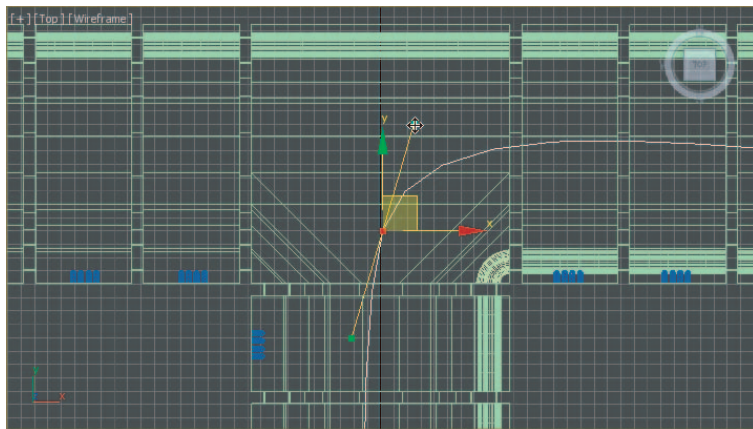
5. Exit the Vertex sub-object level.

6. Right-click the Walkthrough_Cam001 viewport and play the animation.

7. Save your file as **MyWalkthroughAnimation01.max**.

Observe the camera following the new trajectory from frames 60 through 500. You may keep editing the spline path as needed to complete an entire walkthrough animation.

Take some time to try creating different animations using these corridors, such as moving the keys on the door objects so that the doors open when the camera is closer to them, or rotating the camera to peek down the left corridor before turning and walking to the right.

CHANGING ELEVATIONS WITH A PATH

You can get a camera to go up or down stairs by constraining it to a path that has its vertices moved in the Z direction to accommodate the changing elevation. It is best to use Bezier or Smooth vertices in a walkthrough path to ensure gradual and continuous motion.

The Animation File Output Options

Before you render a production file, you'll want to know the animation file formats available in the Render Output File dialog box. Most of these formats are the same as those for single still images, with a few twists.

CERT
OBJECTIVE

You have several format options for animation file output, each with its advantages and disadvantages:

AVI File (`*.avi`)   AVI stands for Audio Video Interleaved, and it is perhaps the most common type of animation file on the Windows platform. You can use AVI files for both animated materials and animated backgrounds.

These AVI files can use any number of compression schemes, known as codecs (*codec* is short for compressor-decompressor). When you use this file format, a dialog box appears, allowing you to select a codec. The usual choices are Cinepak, Intel Indeo 3.2, Microsoft Video 1, MJPEG, and IYUV. On Windows 64-bit systems, you will have fewer options. You may also install other codecs onto your system, such as MJPEG or Motion JPEG codecs for specialized video output devices. (A complete discussion on codecs is beyond the scope of this section, but a brief discussion is available in "The AVI Codecs" section of this chapter.) You may want to experiment with the codecs you have available to see which one gives you the best results.

Other AVI file settings include compression quality and the Keyframe Every Nth Frames option. The Compression Quality slider offers a trade-off between image quality and file size: the better the image quality, the larger the AVI file will be. Keyframe Every Nth Frames lets you control AVI keyframes that are not the same as the keyframes you've encountered in 3ds Max animations; AVI keyframes have more to do with the way animation files are compressed.

TARGA Image File (`*.tga, *.vda, *.icb, *.vst`)   This is perhaps the most universally accepted format for high-quality video animation. Rendering to the TARGA format produces a single file for each frame. Because a typical TARGA file is close to 1 MB in size (for NTSC video), you will consume disk space in a hurry using this format. A high-definition video frame (1920 × 1080 pixels) in the TARGA format can be over 6 MB in size. Still, it is the format of choice when you want the best-quality video output. It offers a wide variety of resolutions and color depth up to 32-bit color (24-bit plus alpha channels). TARGA was developed by Truevision and was the first true-color file format. You can use TARGA files for still images, and it is a good format for transferring to Apple Macintosh systems because it usually requires little if any translation for the Mac platform.

TIF Image File (`*.tif`)   This file format offers high-quality color or monochrome output. It is similar to the TARGA true-color format in quality, although TIF files are used primarily for still images and prepress. This format also produces one file per frame of animation. If your images are destined for print, this file format is the best choice, but be aware that PC and Mac versions of this file format exist and there are subtle differences between the two. If you're sending your file to a Mac, make sure that you've translated it into a Mac TIFF file. This can be done easily with Photoshop or with another high-end image-editing program.

BMP Image File (`*.bmp`)   The BMP format is the native Windows image format. It is not as universally used as the TARGA format for video animation; still, most Windows graphics programs can read BMP files.

JPEG Image File (*.jpg, *.jpe, *.jpeg) This format is a highly compressed, true-color file format. JPEG is frequently used for color images on the Internet. The advantage of JPEG is that it is a true-color format that offers good-quality images at a reduced file size. One draw-back of JPEG is that it does introduce artifacts into the image. The greater the compression used, the more artifacts are introduced.

GIF Image File (*.gif) Although GIF files are not supported by 3ds Max as an output file format, it is an important one that should be mentioned here. This is a highly compressed image file format that is limited to 256 colors. This file format is popular because it is eas-ily sent over the Internet, and it is frequently used for graphics on web pages. GIF files can also contain very small animations. You can convert a series of animated frames into a GIF animation by using a number of software tools, including Adobe Photoshop. Also, free and shareware products can turn a series of animation frames into animated GIF files.

PNG Image File (*.png) The PNG file format is similar to GIF and JPEG in that it is primar-ily used for web graphics. It has a variety of settings, mostly for controlling color depth, loss-less compression, transparency, interlacing, and animation.

Encapsulated PostScript File (*.eps, *.ps) EPS is a file format devised by Adobe for describing page layouts in the graphic arts industry. If you intend to send your renderings to a prepress house, EPS and TIF are both popular formats.

Kodak Cineon (*.cin) The Kodak Cineon file is a 10-bit format intended for the film industry. It is a standard format for converting motion picture negative film into a digital format. Many special effects houses use this format and other software to help create the special effects you see in movies. Frames rendered to this format are recorded as individual files.

MOV QuickTime File (*.mov) QuickTime is Apple's standard format for animation and video files. Its use is not limited to the Mac OS, however. It is somewhat equivalent to the AVI file format native to the PC, but MOV animations are of generally better quality.

Although not directly related to animations, MOV files can also be QuickTime VR files. QuickTime VR is a kind of virtual reality that uses images stitched together to simulate a sense of actually being in a location and being able to look around. QuickTime VR is fre-quently used on Internet real estate sites to show the interiors and exteriors of homes. It is also popular at auto sales sites that show a 360-degree view of the interiors of new cars. Photo stitching applications are available to construct QuickTime VR files from a set of images.

SGI's Image File Format (*.rgb, *.sgi) The Silicon Graphics Image (SGI) file format has a following in the film and video industries, and Silicon Graphics has developed a format designed to work with their own animation software and hardware. The RGB (red, green, blue) format offers 16-bit color and alpha channels.

RLA Image File (*.rla) The RLA (Run Length Encoded, version A) format, also of SGI origin, offers a greater set of options, up to 32 bits per channel Floating Point color precision, and includes additional channels that are used for post-processing, compositing, and special effects.

RPF Image File (*.rpf) The RPF (Rich Pixel Format) file format is an Autodesk 3ds Max file format that supports arbitrary image channels for special effects and other types of post-processing of images. It is similar to the SGI and RLA formats. This file format is often used in conjunction when compositing scenes using Autodesk Combustion.

Radiance Image File (HDRi) (`*.hdr, *.pic`)   Also known as high dynamic range images (HDRi), radiance image files are used for high-contrast data sets that capture a greater dynamic range than can be displayed on a monitor. HDRi files are usually composited from multiple shots taken from the same point of view at different exposure settings into one data set. Generally, you shouldn't use them in animation output because of increased memory requirements. HDR files can be used as backgrounds and reflection maps within animated scenes. See Chapter 10, "Organizing Objects and Scene Management," for more information.

DDS Image File (`*.dds`)   The DirectDraw Surface format, developed by Microsoft, is used to store both textures and cubic environment maps. With DirectX 9 installed on your system, you can render to the DDS format and use the files in materials, but without it you can only use DDS files in materials.

OpenEXR Image File (`*.exr, *.fxr`)   Similar to HDRi files, OpenEXR image files contain additional lighting information than can be displayed on a monitor. OpenEXR was developed and is used by Industrial Light & Magic in the production of all of their feature films. OpenEXR has been extended in this release so that all the G-Buffer and Render Element channels can be included within the single `.exr` file. If you use 3ds Max Composite with the EXR file format, you gain access to these individual channels for modification quickly and easily.

Several of these file formats create a single animation file, like the AVI and MOV file formats. Other file formats, such as the TGA and CIN formats, are intended as single files per frame. The single-frame formats require an application, such as Adobe Premiere, Adobe Aftereffects, or Autodesk 3ds Max Composite, to turn them into viewable animations, although for short clips you can use the built-in RAM Player or Video Post feature inside 3ds Max to create viewable animations. Their chief advantage is that you can maintain a high level of quality in your animation files and then use the files as a source to produce other formats for different applications. TARGA files, for example, can be rendered for the highest level of resolution and picture quality. The TARGA files can then be processed through Adobe Premiere to generate AVI or MPEG-1 files for the Internet, or Motion JPEG for video output.

VIDEO POST

You can use the Video Post feature to perform nonlinear video editing of your animated sequences, including advanced transitions. This is not nearly as powerful as commercially available editing programs, but it will do in a pinch when some quick editing is necessary and no other programs are readily available.

True Color vs. 256 Colors

Two of the formats we have discussed—GIF and BMP—offer 256-color output. You can get some very impressive still images from 256 colors, but when you start to use animation, the color limitation begins to create problems. One major problem is called *color banding*. This occurs when an image has a gradient color. Instead of a smooth transition of colors over a surface, you see bands, as shown in Figure 12.22. The effect is similar to that of the Posterize option in many paint programs.

FIGURE 12.22
Two images rendered in 3ds Max. The one on the left shows what the image should look like under good conditions. The one on the right shows color banding caused by a limited color palette.
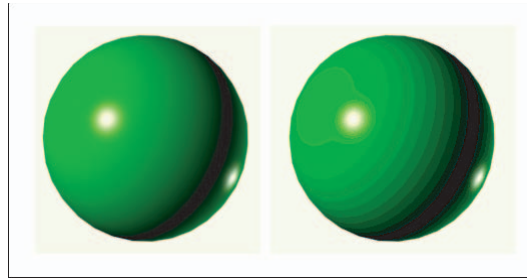
This color banding may be fine for limited applications such as previewing animations, but you will want to use true-color output for your finished product. True-color images, such as those offered by TARGA, TIF, and JPEG files, do not suffer from banding. They also offer smoother edges on models with lots of straight edges. If you don't need the absolute best quality, you might consider the JPEG output option. It provides high resolution and true color in a small file size. You can render a 10-second animation with higher-quality JPEG files and, in some cases, use less than 40 MB of disk space. Most of today's desktop graphics and video-editing software can read JPEG files.

File Naming in Animations

When you choose any of the file formats other than AVI or MOV, 3ds Max generates a separate file for each frame of your animation. The name of each frame is given a number so that the frame sequence can be easily determined by video-editing programs such as Adobe Premiere or Autodesk Combustion.

3ds Max will use the name you provide in the Render Output File dialog box. For the rest of the name, 3ds Max will add a numeric suffix. For example, if you enter the name **Savoye** for the animation file output using the TARGA file format, 3ds Max will create a set of files with the names Savoye0000.TGA, Savoye0001.TGA, Savoye0002.TGA, and so on.

Choosing an Image Size

Still image resolution will vary depending on the medium of presentation. A minimum resolution for 8 × 10-inch prints, for example, is 1000 × 800 pixels. This results in a print that has only 100 pixels per inch, which is quite a low resolution, maybe good for early project proofs. If you are rendering for high-quality prints for a portfolio or advertising piece, you will need resolutions of 300 pixels per inch or higher. Larger poster-size prints will require significantly larger resolutions, since the typical theatrical movie poster is 27″ × 42″, which at only 100 pixels per inch is a final resolution of 2700 × 4200. The resolution you need to render at for print pieces is also controlled by the typical distance it will be viewed at. A movie poster for the next huge summer blockbuster hanging in a theatre hallway will likely have excited viewers getting very close to it to study the finest details; therefore the render will require the highest pixel resolution you can render. A rendering for a billboard that will typically be viewed from hundreds of feet away only requires renderings calculated at pixels per feet.

There isn't room in the book to go into the many details and specifics that are required for high-resolution color output, and many settings will be determined by the output usage/method and the vendor's specific printing equipment. Video animations for traditional VHS or DVD purposes usually will not exceed 720 × 480. The resolution will be determined by the type of device you are using to record to videotape or the software used to master your DVD. For example, if you were using the step-frame recording method that recorded a single frame at a time directly to videotape, you would typically render to an image size of 512 × 486. Other real-time video playback devices can use seemingly odd sizes such as 320 × 486 or 352 × 240. The horizontal resolution is stretched to fit the size of the screen, so the higher the horizontal resolution you use, the more detail appears in the final output. The aspect ratio of the animation does not change. You should check the documentation that comes with your video recording board for the specific sizes that you can use for rendering for videotape.

If you are rendering for output that will go to the high-definition Blu-ray Disc format, you will generally be rendering using the HDTV (video) resolution setting and using either 1920 × 1080 or 1280 × 720 pixels for your final renderings. However, there are many other issues regarding output for high definition or film. Are you rendering to 24P (24 frames per second Progressive Scan) for a real film-like feel, 60i (30 interlaced frames per second) for broadcast, or are you rendering for something that will be multipurposed or heavily post-processed and requiring different output specifications? It is always recommended to render out to the highest resolution/frame rate that the project will be used at and then use post-processing methods to create all lower-resolution/lower–frame rate alternatives, such as web streaming or viewing on mobile devices. Again, those topics are far too specialized to go into in this book and are generally the concerns of the producer, editor/compositor, or distribution agency.

You can use the Print Size Wizard dialog box, shown in Figure 12.23, to quickly determine the proper rendering resolution when the final destination for the image is printed media. To open the dialog box, choose Rendering ➤ Print Size Assistant.

FIGURE 12.23
The Print Size Wizard is used to determine the correct rendering size for image output to print an image properly.
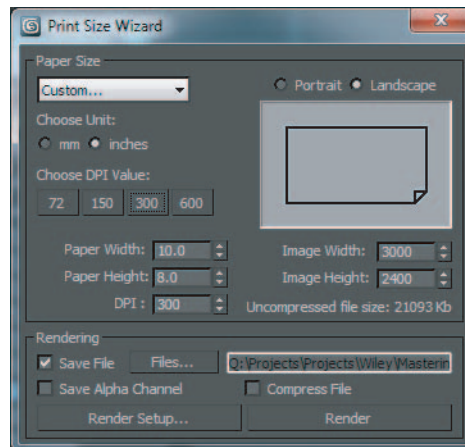
In the Paper Width and Paper Height fields, enter the printable dimension for the artwork. This may not be the same as the paper size in situations where the printer, like most office models, does not print to the extents of the paper. In the DPI field, enter the dots-per-inch value

at which the image will be printed. Click the Render Setup button at the bottom of the Print Size Wizard dialog box to transfer the values and open the Render Setup dialog box. Choose a filename and type, and then click Render in the Render Setup dialog box to create your image.

The AVI Codecs

Earlier in this chapter, you had to choose a video-compression method for your animation files. Many methods are available, all of which degrade the video quality to some degree. Some of the methods are intended for presenting video only on a computer, while others are intended for TV monitors.

THIRD-PARTY CODECS

Several third-party codecs are available free or for purchase; one of the most popular is the DivX codec. When using a codec that does not ship with Windows, keep in mind that anyone who wants to view your animations must have that codec installed on their system as well. Be aware of this if you send an animated portfolio or demo reel to a potential employer using a third-party codec that they may not have.

If your animation is destined for computer presentation, chances are that you'll use the AVI file format. AVI allows you to select from a variety of compression/decompression methods, commonly known as *codecs*. You've already been introduced to a few of these codecs, but as a reminder, here's a rundown of the most common codecs and their uses. Depending on your operating system (32-bit or 64-bit) and other applications you have installed on the system, you may see fewer or additional codecs available:

Cinepak   Designed for high-quality video playback from a computer. This codec is considered to produce the best quality.

DV Video Encoder   This is the default video encoder for 3ds Max on Windows 64-bit systems and only supports rendering to the 720×480 output resolution.

Intel Indeo   Designed for high compression ratios, it is best suited for multimedia.

Intel Indeo RAW   Applies no compression to video. Use this to maintain the highest level of image quality while transporting your file to other digital video programs such as Adobe Premiere.

Microsoft RLE   Designed to keep file size down by reducing the color depth. It is primarily designed for 8-bit animations.

Microsoft Video   Similar to RLE in that it reduces the color depth of the file. It is designed for 8- and 16-bit animations and videos.

MJPEG Compressor   The MJPEG (Motion JPEG) Compressor essentially uses the JPEG still image file format to compress each frame of the animation.

Uncompressed/None   Applies no compression at all to your file. Like the Intel Indeo RAW format, this option is for storing image files at their best level of quality, sacrificing disk storage space.

Again, it is always the best practice to render out to individual uncompressed frames at the highest bit depth possible and then use a video editing program to compile your final animated files.

> **Burning Animations to DVDs**
>
> You can render sizable animations and burn them onto an inexpensive DVD-ROM that holds 4.7 GB of data. You can buy a DVD writer for under $25, and blank DVDs can cost as little as $0.50 apiece. Practically all new computers have them as standard equipment if not the newer 25-GB capacity Blu-ray burners. Many DVD and Blu-ray burners come with the software needed to produce discs that are viewable on consumer DVD/Blu-ray players connected to television sets.

Using MassFX to Animate Objects

CERT OBJECTIVE

3ds Max has an internal dynamics engine, called *MassFX*, that is used to create animations that feature collisions between objects. Prior to 3ds Max 2012, the software included the *reactor* physics software by Havok (`www.havok.com`). Originally, reactor began as a third-party plug-in that could be purchased to add physics simulation capabilities to 3ds Max. As often happens, it was licensed by Autodesk as part of the software program and, for a number of releases, everyone who bought 3ds Max got reactor included. Reactor has been superseded in 3ds Max 2012 with the NVIDIA MassFX system based on the NVIDIA PhysX engine. If you open a file from a previous release of 3ds Max that used reactor (2011 and earlier) in 3ds Max 2012 or 2013, you will get a missing plug-in error, and the complete file may not load or it may crash 3ds Max. If you need to use those files with the reactor solutions in 3ds Max 2013 (or 2012), you must first open the files in 3ds Max 2011, bake the Physics solution to keyframes, and then remove all instances of the reactor plug-ins from the scene. Havok still manufactures and sells Physics and other plug-ins for 3ds Max that you can purchase. Using MassFX, you can roll one object across a floor into another object and let 3ds Max figure out their movements based on the physical properties that you assign to the objects. Objects used in a dynamics simulation can take on a few shapes:

- Rigid bodies, such as a set of pool balls bouncing off the edges of a pool table
- Ragdoll objects that can be attached to characters to help animate them reacting to dynamic or static objects in a scene, such as bombs or pushing the ragdoll down a staircase
- Cloth, such as comforters and tablecloths
- Inflated objects such as tires or balloons

Objects can be fixed in place, free to move, or constrained to other objects. In this exercise, you'll dump a box of toys down the stairs of the condo that you've worked on in several other chapters.

Assigning Properties to Simulation Objects

All the objects that are considered in a simulation must contain the physical information, including mass and friction, for each object. Depending on the accuracy requirements of your simulation, you don't always need to input precise data into the parameters of the simulation:

1. Open the `C12_DynamicsStart.max` file from this book's accompanying web page.

   This is similar to the condo files that you worked with in earlier chapters but with much of the geometry deleted and the Default Scanline Renderer assigned as the renderer. These changes are for rendering speed only; MassFX works equally well regardless of the rendering engine chosen.

The sliding door at the bottom of the stairs is mostly open, and the railing is gone in case one of the simulation objects decides to find its way outside. A box of simple toys, blocks, and balls is positioned at the top of the stairs and animated to dump its contents.

2. Right-click a blank area on the Main Toolbar, and choose MassFX Toolbar from the context menu to expose the MassFX Toolbar (shown in Figure 12.24). You can dock the menu to the left side of the 3ds Max window or leave it floating.

FIGURE 12.24
The MassFX toolbar

3. In the Orthographic viewport, select the six large spheres, as shown in Figure 12.25, or use the Select From Scene dialog box to select the objects named Ball through Ball05.

FIGURE 12.25
Select the six large spheres.
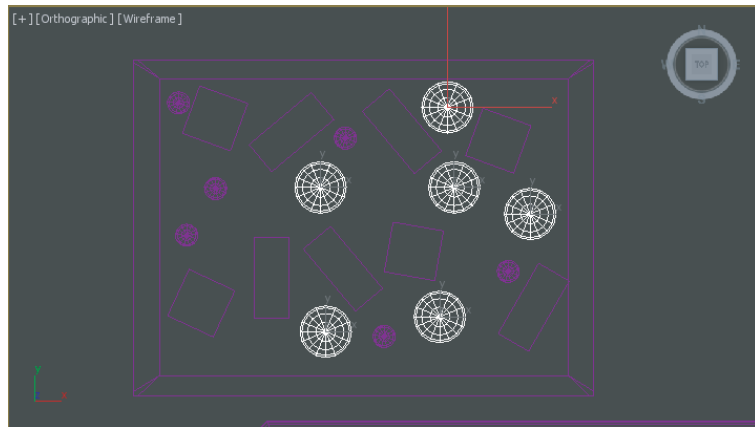
4. Click the Set Selected As Dynamic Rigid Body button on the MassFX Toolbar.

5. Click the World Parameters button on the MassFX Toolbar. This opens the MassFX Tools dialog box.

6. Select the Multi-Object Editor tab, scroll down to the Physical Material rollout and, from the Preset drop-down, select Rubber. Notice that the values in the Physical Material Properties rollout change.

7. In the Physical Mesh rollout, change the Mesh Type from Convex to Sphere.

8. Select the six smaller spheres, named Ball06 through Ball11. Then, on the MassFX Toolbar, click the Set Selected As Dynamic Rigid Body button. On the Multi-Object Editor tab in the Physical Material Properties rollout, change the Static and Dynamic Friction values to **0.1** and Bounciness to **1.0**; then change the Mesh Type to Sphere.

9. Select all nine boxes, named Block through Block08. On the MassFX Toolbar, click the Set Selected As Dynamic Rigid Body button. On the Multi-Object Editor tab, notice that the

Mass property appears blank. This is because the different boxes that are selected are of different sizes but the other values are the same for all boxes. Also notice in the Physical Mesh rollout that MassFX has automatically assigned the Mesh Type as Box so that you don't have to do so.

10. Select the Toy Box object. On the MassFX Toolbar, click and hold the Set Selected flyout and select the Set Selected As Kinematic Rigid Body button. Now, because the Toy Box is a Container, you need use a different method to tell MassFX how to calculate its shape.

11. Choose the Modify tab, and click the MassFX Rigid Body entry in the stack. This is very similar to the Multi-Object Editor tab of the MassFX Tools dialog box. First, in the Physical Material rollout, assign the Toy Box the Cardboard preset.

12. Scroll down to the Physical Shapes rollout, and change the Shape Type from Box to Concave; then you will see the Physical Mesh Parameters rollout appear, as shown in Figure 12.26.

FIGURE 12.26
The Physical Mesh Parameters rollout
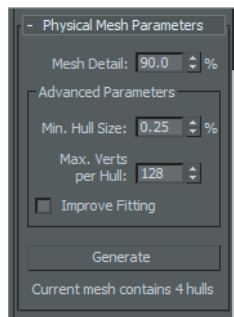
13. In the Physical Mesh Parameters rollout, change the Mesh Detail value to **100**%, click to check the Improve Fitting parameter, and then click the Generate button. You will see the interface flash as MassFX calculates the shape of the Toy Box object. When it is done, the readout at the bottom of the rollout should say "Current mesh contains 8 hulls."

The box and toys are part of the simulation, and now you need to add the scene objects with which the toys may collide. To do so, follow these steps:

1. Clear your selection set, and then select the following objects: Wall_Den, Wall06, Window_Den (which is a sub-object of Wall_Den), Floor407, Door_Patio_East, Patio_East, Planter, and StraightStair01.

2. With the items selected, on the MassFX Toolbar, click and hold the Set Selected flyout and select Set Selected As Static Rigid Body. On the Multi-Object Editor tab, select Original for the Mesh Type in the Physical Mesh rollout.

3. You may need to select these objects again, so type **Fixed Objects** in the Named Selection Sets field in the Main Toolbar. Press Enter after typing the name in the field.

4. You should save the file as `MyDynamicsStart.max` now before running the simulation in case 3ds Max crashes.

Setting Up and Running the Simulation

Your scenes and simulations could take place in many different settings—from Earth with normal gravity to extraterrestrial locales with different amounts of gravity. Using the World Parameters tab of the MassFX Tools, you can set the parameters for your simulation.

1. Click the World Parameters tab on the MassFX Tools dialog box.

2. In the Scene Settings rollout, leave Use Ground Collisions checked, but change the Ground Height Value to **-2′-0″**. This way, if something bounces out the door and off the patio object, you'll see it drop and eventually settle on the assigned ground height.

3. Scroll down to the Engine rollout; notice in the Options group that there are settings for Use Multithreading and Hardware Acceleration. MassFX is developed by NVIDIA, and the programmers have included the ability to leverage the power of their advanced graphics cards when solving dynamics simulations. For now, leave these boxes unchecked. You can go back on your own and experiment with turning on those features and see how they affect the processing of your simulations.

4. Click the Simulation Tools tab on the MassFX Tools dialog box.

5. Make sure that the CamTop viewport is active, and then, in the Simulation rollout, click the Start Simulation button.

After a brief pause, the animation starts in the viewport. You see the Toy Box object move up, pitch over, and spill the toy contents over the top of the stairs. However, as the simulation continues, you see the majority of the objects pass through the stairs and even the floor object, only stopping at the Ground Height value that you set a few steps before. Next, you will adjust the simulation parameters to get a better solution.

Refining the Settings

Four objects (Wall06, the planter, the sliding door, and the stairway) are designated as Original for their Mesh Type objects. This uses the object's actual geometry as the Physical Mesh to calculate the simulation instead of a lower-resolution mesh object. In the Advanced rollout, you can check Enable Backface Collision, which can help with generating an acceptable solution, especially for thinner objects.

1. Select the Floor407 object and, on the Modify tab, scroll down to the Advanced rollout of the MassFX Rigid Body modifier and check Enable Backface Collision.

2. Select the StraightStair01 object, and activate the Enable Backface Collision parameter.

3. On the MassFX Tools dialog box, choose the World Parameters tab and, in the Rigid Bodies group of the Scene Settings rollout, look at the Substeps items. The Substeps value indicates how many additional times the simulation is analyzed each second. Set this value to **30**. Change the Solver Iterations value to **30** as well.

4. Some of the toy objects might still be traveling fast enough to essentially pass through other objects of the simulation, so to try to prevent this, check the box in front of Use High Velocity Collisions to enable it.

5. Some of the objects may be getting stuck in the Toy Box because of its Friction settings. Select the Toy Box object. In the Physical Material rollout on the Multi-Object Editor tab, change the Preset from Cardboard to (none). This will keep the Cardboard settings but enable you to modify them. Change the Static and Dynamic friction both to **0.0**.

6. On the Simulation Tools tab, click the Reset Simulation button; then click the Start Simulation button and watch the results. If the results of the simulation look good to you, on the Simulation Tools tab of the MassFX Tools dialog box, go to the Simulation Baking group and click the Bake All button. This will restart the simulation and then bake each object's transform at each frame of the animation.

   If you don't like the results of the baked simulation, you can click Unbake All, readjust any parameters you want to change, and then rerun the simulation until you get a satisfactory animation. Then bake the results to save the animation.

7. When you're satisfied with the baked animation, render the scene as an animated file. You can see the sample animations `MassFX_CamTop.avi` and `MassFX_CamFloor.avi`, available on this book's web page.

8. Save your file as **MyCondo_MassFXComplete.max**. If you had trouble, open `Condo_MassFXComplete.max` to see a file with the dynamics animation in place.

Using MassFX mCloth

New with MassFX in 3ds Max 2013 is mCloth, which fully participates in MassFX simulations. mCloth can be used to create clothing for characters, tablecloths, flags, and more. In the following exercise, you will create a large piece of cloth and use mCloth and 3ds Max Forces to drape the cloth over an object in a scene.

1. Open the `C12_clothStart.max` file from this book's website. This scene is just like the condo scene you used in the previous exercise, but the Toy Box and its contents have been removed. In the scene, you will notice a large Torus Knot object on the floor of the condo, as shown in Figure 12.27.

FIGURE 12.27
The Torus Knot
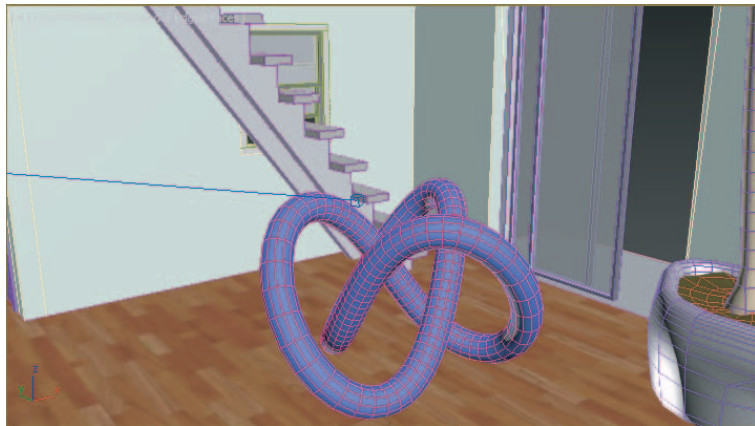
2. In the Top viewport, create a 6-foot by 8-foot plane and rename the object **ClothSheet001**. Draw the plane over the Torus Knot. Leave the Segments values at the defaults for now.

3. In the Front viewport, move the ClothSheet001 object up about 6 feet in the Z direction. The Plane should appear near the top of the CamWindows viewport.

4. Open the MassFX Toolbar if you had closed it and, with the ClothSheet001 object selected, click the Set Selected As mCloth Object button.

5. Select the Floor407, Wall_Den, Wall06, Planter, StraightStair01, and Torus Knot; then on the MassFX Toolbar, click the Set Selected As Static Rigid Body button. Then change each object's Mesh Type to Original so that the geometry itself is used in the dynamics simulation.

6. Select the Create tab of the Command Panel, and click the Space Warps category.

7. Click the drop-down menu, and make sure that Forces is selected, as shown in Figure 12.28. You can see that there are other types of Space Warps available in 3ds Max.

FIGURE 12.28
Make sure that
Forces is selected.
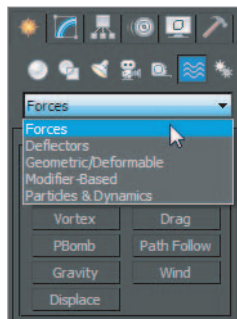
8. Click the Wind button.

9. In the Top viewport, click and drag to place a Wind Space Warp object near the open sliding glass door, as shown in Figure 12.29. Don't worry about the exact position, because you will adjust that in the next step.

FIGURE 12.29
Place the Wind
Space Warp object.
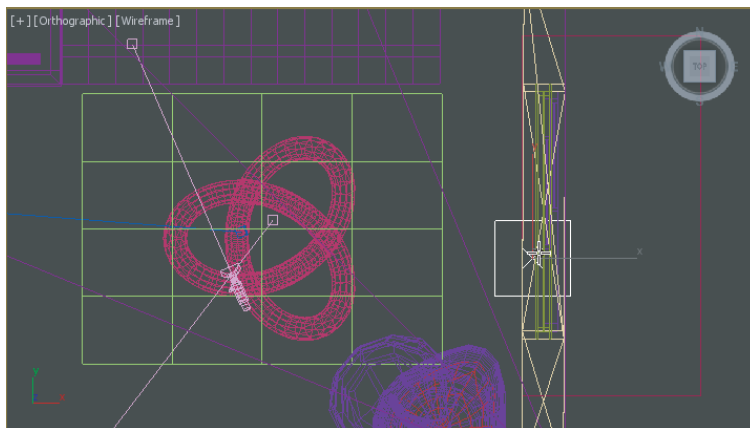
10. Move and rotate the Wind Space Warp object so that it is facing inside the condo and positioned in the opening of the sliding glass doors.

11. On the MassFX Toolbar, click the World Parameters button to open the MassFX Tools dialog box.

12. Click the Simulation Tools tab.

13. Click the Start Simulation button, and watch the ClothSheet001 object fall because of the effects of the simulation.

14. Click the Start Simulation button again to pause the simulation process. Notice that the ClothSheet001 object is stuck on top of the Torus Knot and Planter objects, as shown in Figure 12.30. It's not a great simulation just yet.

FIGURE 12.30
The mCloth simulation so far
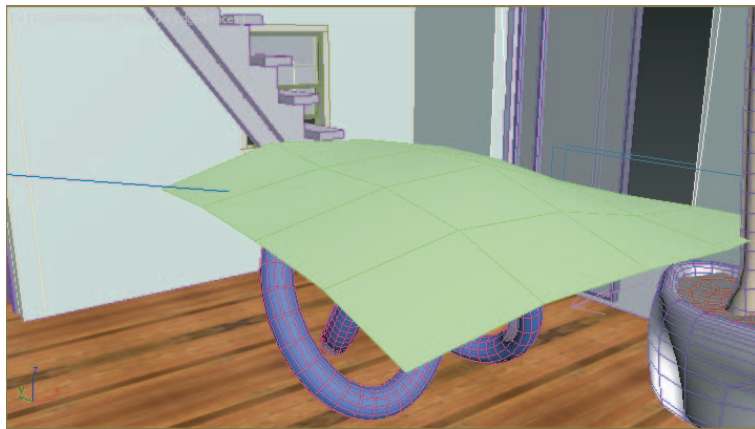
You need to adjust the parameters of the ClothSheet001 object so that it behaves more like cloth:

1. Click the Reset Simulation button on the MassFX Tools dialog box.

2. Select the ClothSheet001 object and, in the modifier stack, select Plane.

   You will see the Warning dialog box telling you that the mCloth modifier depends on topology and changing parameters could have undesirable effects. Click Yes.

3. On the Parameters rollout, change the Length Segs value to **24** and the Width Segs value to **32**.

   If you changed the parameters of the ClothSheet001 object without resetting the simulation first, you may see a distorted object in the viewport, and you will have click Undo a few times until you get to the state before you started changing the parameters. Then try resetting the solution and adjusting the plane's parameters again.

4. Select the mCloth entry in the ClothSheet001's modifier stack, click Start Simulation, and let the simulation run until about frame 300, or until the ClothSheet001 object is on the floor, as shown in Figure 12.31.
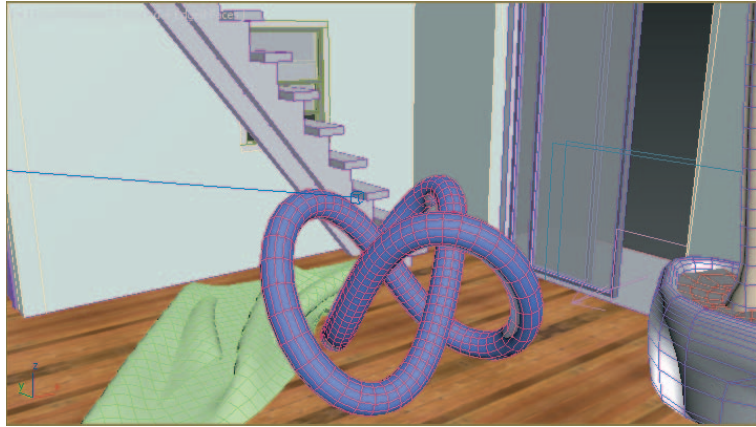
This simulation is much better than before, but you want the cloth to stay more on the torus knot. You may have to try moving the ClothSheet001 object in the Top viewport to get a more satisfactory simulation:

1. Click the Reset Simulation button.

2. Select the ClothSheet001 object, and then click the mCloth entry in the modifier stack.

3. Scroll down to the Physical Fabric Properties rollout, and change the Bendiness value to **.25**, the Damping to **0.8**, and the Friction to **1.0**.

Notice the Load and Save buttons. These enable to you to load presets and to create and save your own fabric profiles to use again and again. If you click the Load button, the mCloth Presets dialog box opens, and you should see Cotton listed in the Cloth Presets window. Close the mCloth Presets dialog box without loading the settings.

4. Scroll down the rest of the mCloth modifier's properties, and you can see a dizzying set of parameters. Unfortunately, there isn't enough room in this book to go through each one, but you should take note of them now and try them out on your own when you finish these exercises.

5. Scroll up to the Forces rollout, and click the Add button. In the CamWindows viewport, move your cursor over the Wind Space Warp, and when the cursor changes to the select prompt, click the Wind Space Warp.

Support for 3ds Max Space Warps in MassFX simulations is a new feature for 3ds Max 2013:

1. Use the Select Object tool, and select the Wind Space Warp.

2. Go to the Parameters rollout for the Wind Space Warp on the Modify tab, and change the Strength to **10**. You can play with the effects of Turbulence, Frequency, and Scale on your own.

3. Select the Torus Knot001 object and, in the Physical Material rollout, change both Friction values to **1.0**.

4. Deselect all objects in the scene.

5. On the MassFX Tools dialog on the Simulation Tools tab, scroll down to the Simulation Settings rollout. In the Playback group, select the Stop Simulation option.

This is an important set of options to know because if you leave Continuous Simulation set, MassFX will keep running until you stop it. And if you aren't watching the Current Time indicator, you may be simulating well past the end of the number of frames currently set in the scene.

6. Click the Start Simulation button, and watch your viewports.

You will see the fabric gently reacting to the wind force that you added; however, you may see some undesirable geometry artifacts on the ClothSheet001 object in the viewport, as shown in Figure 12.32.

FIGURE 12.32
A rendering of the last frame of the simulation showing geometry artifacts

The fabric clearly shows the polygons of which it is constructed, and this can be highly undesirable in a finished animation. The sheet is made up of 1536 faces. You could greatly increase the number of polygons using the Plane's segment values, which would give you a much greater number of polygons that would have to be simulated. Instead of doing that, you will add a MeshSmooth modifier on top of the stack, which will cause the mesh to be reevaluated and smoothed after the simulation in each frame, creating a much more fabric-like result and saving you processing time during the simulation process:

1. Select the ClothSheet001 object, and then select the Modifier List drop-down, scroll down the list, and select the MeshSmooth modifier.

2. On the Subdivision Amount rollout, find the Render Values section, check the empty box in front of Iterations, and change it to **2**. This allows the viewport to show you only one iteration of smoothing while your renderings will use two iterations of subdivision. Using a higher value will smooth the object even more, but it will result in longer rendering times and could create a low memory situation, potentially crashing 3ds Max.

3. Click the Reset Simulation button, and then click the Start Simulation button on the MassFX Tools dialog and watch your viewports.

4. When the simulation stops, render the last frame as a single still image; it should look like Figure 12.33.

FIGURE 12.33
The last frame of
the simulation

If you like the result of the simulation, you need to bake the cloth simulation so that you can render it:

1. Select the ClothSheet001 object.

2. On the MassFX Tools dialog in the Simulation Baking group, choose Bake Selected to bake only the mCloth object's animation.

3. When the simulation is finished processing, save your scene as **My_clothAnimation.max**.

4. Use Windows Explorer, and browse to where you saved this file. You will notice that the file is extremely large due to the animation keyframes on the ClothSheet001 object.

5. If you like, you can render your animation as **My_clothAnimation.avi**. You should note that since the ClothSheet001 object is just a plane, for parts of the animation, you may see through the back side of the object if you don't use the Force 2-Sided mode when rendering. Alternatively, you can watch the animation that you downloaded from this book's website as **C12_clothAnimation.avi**. This animation uses a Rendering Value iteration value of 4 so that you can see how smooth the fabric can look with the higher setting.

For an advanced dynamics simulation, you could take the first MassFX animated scene on which you worked, add a cloth object, use mCloth, and have the toys bouncing down the stairs into some cloth rustling in a breeze coming in through the open sliding glass doors or the open window right next to the staircase.

Using Particle Systems

CERT OBJECTIVE

Particle systems are a means of projecting many (often more than 500,000) objects into a scene without the requirement of actually creating or inputting that much geometry. Particle systems can be used to create weather conditions such as snow or rain, fountains, hoses, a barrage of arrows, spurting blood, sparks from a white-hot forge or malfunctioning electronics, or even a lava lamp. The 3ds Max particle systems have evolved over the years, but there are basically only a few general components to consider: the emitter, the particles, and any space warps involved.

The Emitter This is the object that emits the particles into the scene. Emitters are usually nonrendering objects, but scene objects can be used to emit objects as well.

The Particles   When emitted, these can range from single pixel–sized dots to planes that hold images and maintain an orientation perpendicular to the viewport to instances of geometry that exists in the scene—imagine a fire hose that emits little firemen from the nozzle. Special consideration must be given as to how many particles could exist at one time and how long each particle exists in the scene before being deleted and then sent through the emitter again.

Space Warps   These are nonrendering objects that affect the trajectory of the particles. They can be forces, like gravity or wind, or deflectors that change the motion of a particle upon impact with the deflector.

The 3ds Max particle systems have continually evolved over the years. In their earliest form, the Spray and Snow particle systems were basically invisible planes that dropped dots onto the scene objects. Third-party developers often took on the task of creating more powerful systems that a user could purchase and add to their seat of 3ds Max. Several of these plug-ins were purchased by Autodesk and integrated into the base product. Some of the early particle systems are shown in Figure 12.34, and they are still part of 3ds Max. However, they are considered legacy features that are kept around for compatibility purposes and only simple projects.

FIGURE 12.34
The legacy particle systems that are still available in 3ds Max
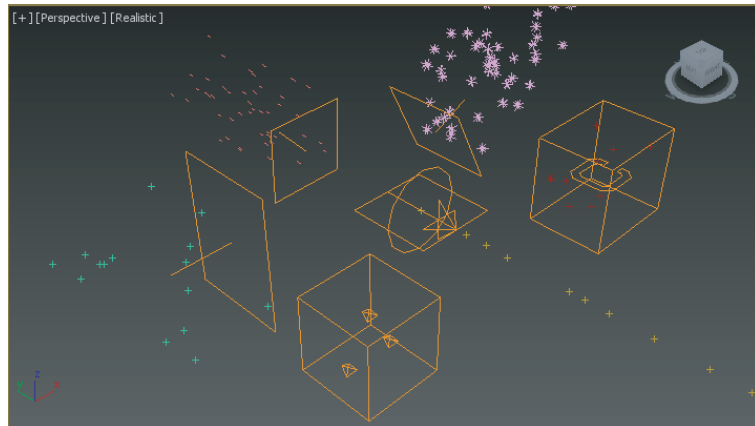
The addition of Particle Flow as a particle system in 3ds Max presented a huge increase in the capabilities of the particles, but it required a change in the approach as to how the systems were designed and implemented. Rather than binding a particle emitter to a series of space warps, all of which can affect the particles at one time, Particle Flow uses a flowchart-style model to control the particle behavior. Within the chart, called an Event, the particles are born and then pass down the list through a series of operators and tests. Operators affect the particles in many ways, such as by defining the speed, material, or applied forces. Tests determine whether a specific condition is met, such as the particles' age or whether they've impacted a specific object. When a particle meets the conditions of a test, it's passed on to the next item in the flow or sent to another flow if directed. When a particle is passed to a test and doesn't meet the conditions, it's recycled through the same flow.

In the next section, you'll add gently falling snow outside one of the patio doors in the condo. You'll use a Particle Flow emitter to create the particles and then use a Gravity space warp to control the direction of the particle emission.

Creating the Initial Flow

Particle Flow particle systems are dragged into a scene from the Create panel and then constructed and edited in the Particle View dialog box. The following exercise shows how to do this:

1. Open the `C12_Particles.max` file from this book's accompanying web page.

   This is similar to the condo files with which you've worked in this and other chapters, but with much of the geometry hidden and a background image assigned. The Default Scanline Renderer is assigned as the current renderer. These changes are made to speed up the rendering process only. Particle systems work equally well with the Default Scanline Renderer and the mental ray renderer.

2. From the Command panel, choose Create ➤ Geometry ➤ Particle Systems ➤ PF Source.

3. Click and drag a PF Source icon, located in the Top viewport, as shown in Figure 12.35.

FIGURE 12.35
Create a Particle Flow particle system in the Top viewport.
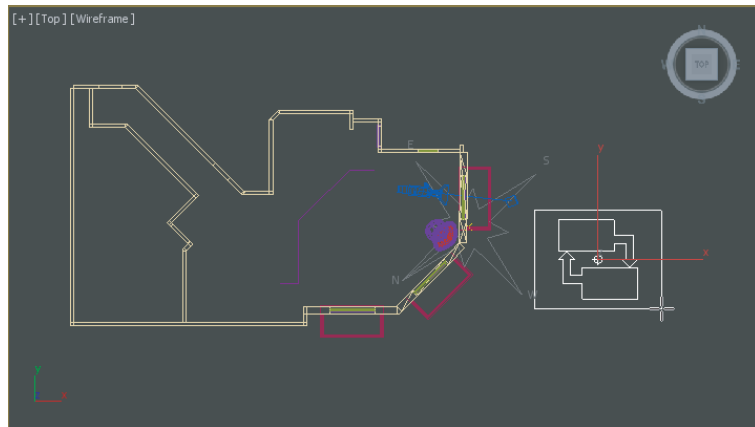
4. Zoom into the PF Source in the Front or Right viewport, and you'll see an arrow pointing in the negative Z direction. This arrow indicates the initial direction in which the particles will be emitted.

5. With the PF Source selected, change the object's name to **Particle Snow** and set the Length and Width to 15′ 0″.

6. Move the PF Source so that it's over the far right patio as well as a small portion of the roof, and raise it above the level of the roof, as shown in Figure 12.36.

7. From the Menu Bar, choose Graph Editors ➤ Particle View, or press **6** on the keyboard. The Particle View dialog box opens with the default particle system forces in place (see Figure 12.37).

FIGURE 12.36
Move the PF Source over the patio and above the roof.
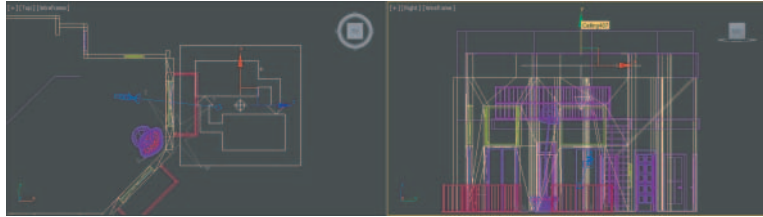
FIGURE 12.37
The Particle View dialog box
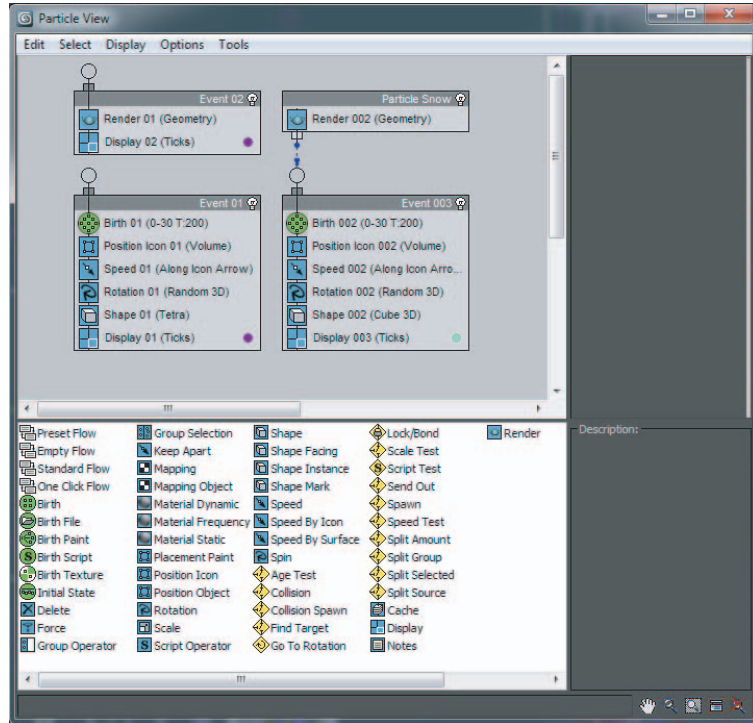
8. Select and delete the two events that are not part of the Particle Snow particle system. They are labeled Event 01 and Event 02.

9. Click one object in the depot, the lower window, and its description appears to the right of the depot. The upper, smaller event is the global event and represents the parameters for the PF Source that you created in the scene. The lower event contains the operators that control the particles. Click an operator in an event, and that operator's parameters appear to the right of the event window.

10. Click the Modify panel; then, in the Quantity Multiplier area, set the Viewport % to **25** to require that only 25 percent of the total number of particles be displayed in the viewports. This will tax your video card much less than if you were to display all 20,000 particles in each viewport. If your video card has trouble with this many particles, change the Viewport % to 10.

Adding and Editing the Operators

Each operator in the event has several parameters that can be edited to accomplish the desired result. Additional operators can be dragged from the depot and dropped anywhere in the event. There is no practical limit to the number of operators that a single event can hold.

1. Select the Birth operator in the lower event to expose its parameters.

2. Set the Emit Start value to **–150** and the Emit Stop value to **450**. The first parameter causes the emitter to start emitting particles at frame -150, exactly 150 frames before the animation begins, even though that is outside the range of the active time segment. This results in the particles reaching the patio by the time the active time segment starts.

3. Set the Amount to **20000** to create a fairly dense snowstorm.

DISPLAYING THE PARTICLES

If the particles stop appearing in the viewports or in renderings, make sure that the Enable Particle Emission option is checked in the Modify panel's Setup rollout when the PF Source is selected.

---

4. Skip the Position Icon operator. In the Speed operator's parameters, set the Speed to **10″** and make sure Along Icon Arrow is selected as the direction. These parameter settings slow the flow of particles and force them to leave the emitter in the direction of the arrow you saw in the previous section.

5. Delete the Rotation and Shape operators by right-clicking them and then choosing Delete from the context menu. The particles will always face the camera or viewport, so a rotation is unnecessary and the shape will be changed.

6. Drag a Shape Facing operator from the depot to the space between the Speed and the Display operators in the Event, as shown in Figure 12.38. A blue line and tooltip appear to indicate the location and operator being added.

   The Shape Facing operator causes the particles to be represented, at rendering time, by planes that continuously face a selected object or camera.

7. Right-click the Shape Facing operator in the event, choose Rename from the context menu, and then rename it to **Shape Facing Snowflakes**.

8. Click the None button in the Shape Facing Snowflakes rollout's Look At Camera/Object section, and then press **H** on the keyboard to select the CameraFloor camera in the Pick Object dialog box.

9. Drag the Time slider to frame 450, and then render the CameraFloor viewport (see Figure 12.39). The particles don't reach the bottom of the viewport (which might be easier to see in the Front or Right viewports), and they are much too dark. You'll address these issues in the next section.

FIGURE 12.38
Add the Shape
Facing operator to
the event.
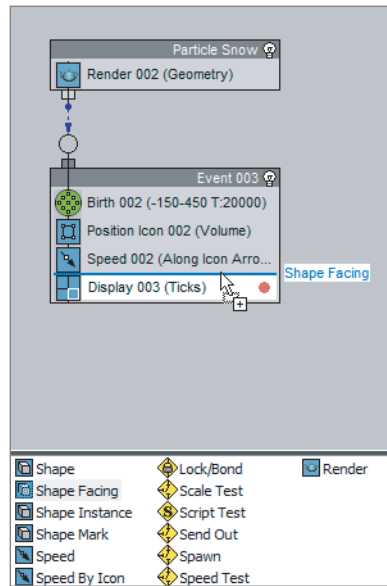
FIGURE 12.39
The CameraFloor
viewport showing
the snowflakes
so far

Adding Materials and Space Warps

The particles must be told which material is assigned to them, and this is done through an operator rather than by dragging and dropping from the Material Editor. Space warps can affect how the particles move through the addition of gravity, wind, and several other options, as shown in this exercise:

1. Drag a Material Static operator below the Shape Facing Snowflakes operator, and change its name to **Material Snowflake**.

2. To assign a material, click the None button in the operator's parameters. Then open the Scene Materials rollout in the Material/Map Browser, locate the Snowfall material, and click OK.

3. Render the viewport again, and you'll see that the planes have a much more snow-like appearance, as shown in Figure 12.40.

FIGURE 12.40
The Rendered Frame Window showing the particles with the Snowfall material assigned

Currently, the particles are falling perpendicular to the emitter, and they follow a straight and unrealistic trajectory. You'll add two space warps, Gravity and Wind, to alter the paths that the particles follow:

4. From the Create panel, click the Space Warps button and then click the Gravity button in the Object Type rollout.

5. Click and drag in the Top viewport to create the Gravity space warp, as shown in Figure 12.41. The size and location don't matter, but the direction it's facing does. Gravity space warps are created facing away from the viewport in which they're made.

FIGURE 12.41
Drag a Gravity space warp in the Top viewport.
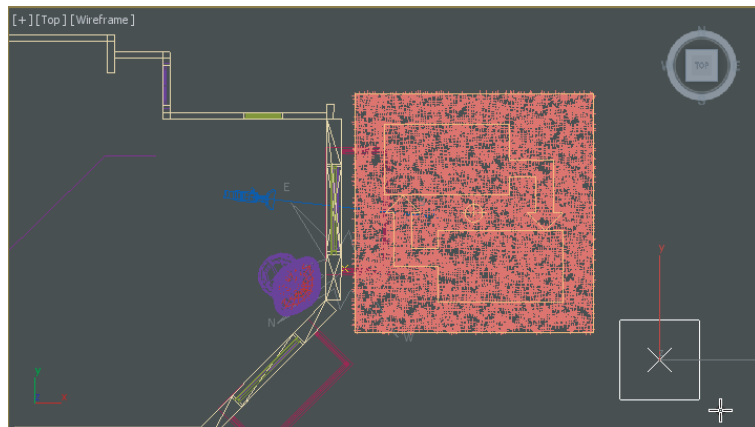
6. Click the Wind button, and then drag a Wind space warp in the Front viewport. Rotate the wind so that it is slightly blowing toward the building and then, for clarity, move it so that it's not located within the particle system at the top of the Front viewport (see Figure 12.42).

FIGURE 12.42
Rotate and move the Wind space warp.
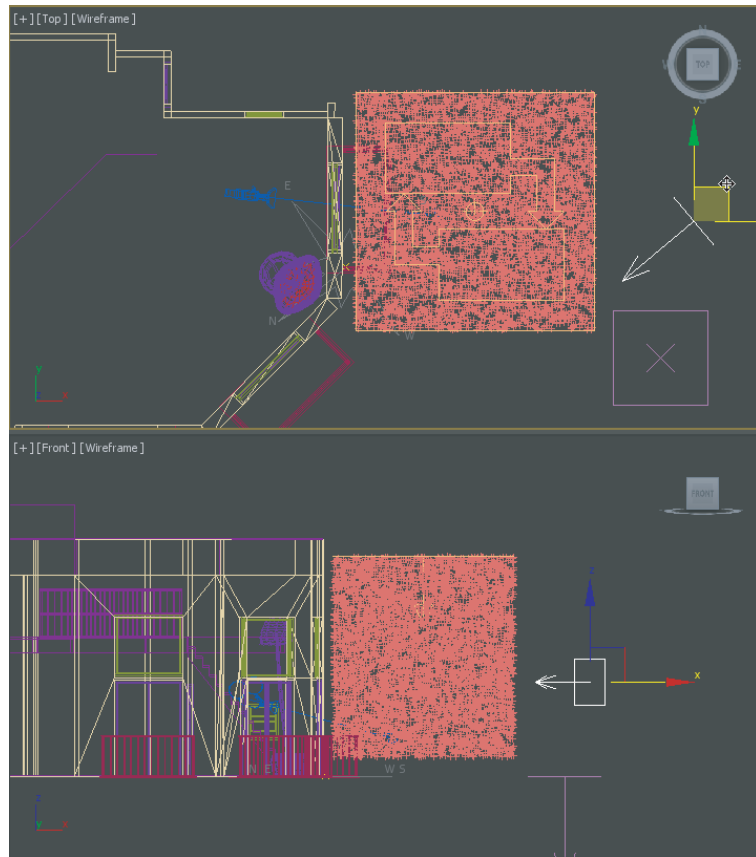
7. In the Particle View dialog box, drag a Force operator below the Speed operator in the event. Force events are how you tie space warps to Particle Flow particle systems.

8. Rename the operator **Force Gravity**. In the Force Space Warps section on the operator's parameters, click the Add button and then select the Gravity space warp in the viewports. If you play the animation, you'll notice that the particles are moving much faster.

9. Change the Influence % value to **10** to slow down the particles.

10. Add another Force operator below the first one, rename it **Force Wind**, and then add the Wind space warp to the operator.

USING THE SAME FORCE OPERATOR FOR MULTIPLE SPACE WARPS

One Force operator can hold many space warps, but this will require that they all use the same operator parameters.

11. Change the operator's Influence % value to **7**.

12. In the Top viewport, move the PF Source in the positive Y direction so that the patio is within the stream of particles; then render the CameraFloor viewport. As you can see in Figure 12.43, the snowstorm is looking better, but flakes are coming into the condo from the ceiling and walls.

FIGURE 12.43
The rendered scene after adding the space warps to the event

Adding Deflectors

While the Gravity and Wind space warps globally affect particle direction, they do not account for the particles colliding with objects in the scene. To do this, you need to add deflectors to the scene and also to the event as operators called Tests. *Tests* determine whether a particle has met a certain condition and what to do with it if it has. To do this, follow these steps:

1. Hide the particle system. It will be easier to maneuver in the viewports if it isn't visible.

2. Choose Create ➢ Spacewarps ➢ Deflectors, and then click the POmniFlect button.

3. Drag the deflector in the Top viewport, as shown in Figure 12.44. It should overhang the front edge of the condo roof slightly.

FIGURE 12.44
Drag the deflector in the Top viewport.
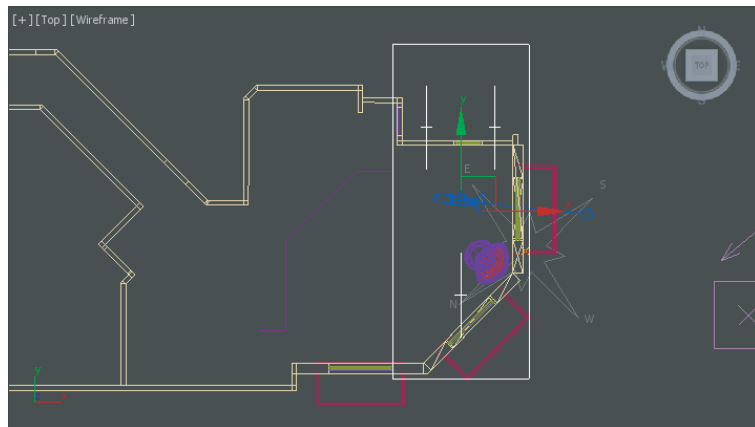
Unlike the other space warps you've used, the location, size, and orientation of deflectors are important. The particles must impact the deflectors for them to have any effect.

4. Use the ViewCube® or Orbit tool to get an orthographic view of the outside of the condo, and switch to the Shaded mode.

5. Rotate the deflector so that its arrows, which indicate the deflection direction, are pointing upward, and then move the deflector to the top of the roof, as shown in Figure 12.45.

FIGURE 12.45
Move the deflector to the top of the roof.
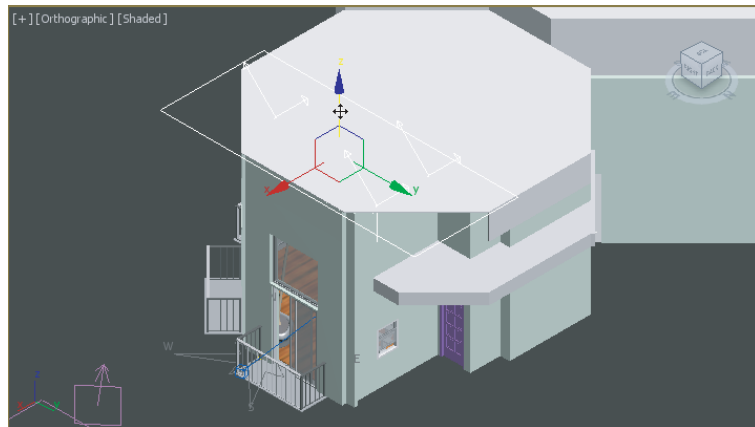
6. Click the POmniFlect button again, check the AutoGrid option, and then create two more deflectors, one on each of the walls. Rotate them so that the arrows point outward, as shown in Figure 12.46. It's OK if the deflectors overlap.

FIGURE 12.46
Add two more deflectors on the condo walls.
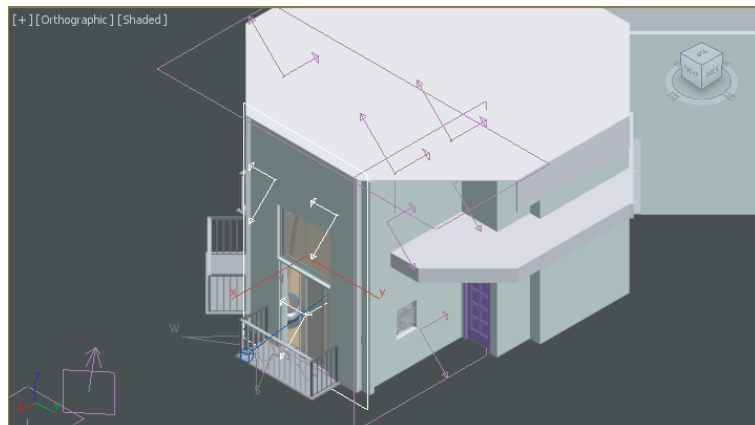
7. Select one of the deflectors, open the Modify panel, and then change the Time On value to **–150** and the Time Off value to **450**. This causes the deflector to deflect particles during

the entire time that the PF Source is emitting particles. Repeat this for the other two deflectors.

THE DIFFERENT DEFLECTOR TYPES

Deflector names that start with *P* are plane shaped, *S* are sphere shaped, and *U* use a scene object as a deflector. Deflectors with *Omni* in the name are improvements over the legacy deflectors.

---

8. Create another POmniFlect deflector, sized and placed on the patio. Set the Time On to **–150** and Time Off to **450**. Also set the Bounce value to **0**. This deflector will hold the particles that impact it.

9. Drag a Collision test below the Material Snowflake operator, and change its name to **Collision Delete**.

10. Click the Add button in the operator's parameters, and then click one of the three large deflectors. Click the By List option and add the other two large deflectors to the operator.

11. Drag a Delete operator to a blank area of the Event window (not inside the event) to create a new event. Delete the Display operator from this new event.

12. Drag from the handle on the side of the Collision Delete test to the ring at the top of the Delete event, as shown in Figure 12.47.

FIGURE 12.47
Link the Collision Delete test to the new event.
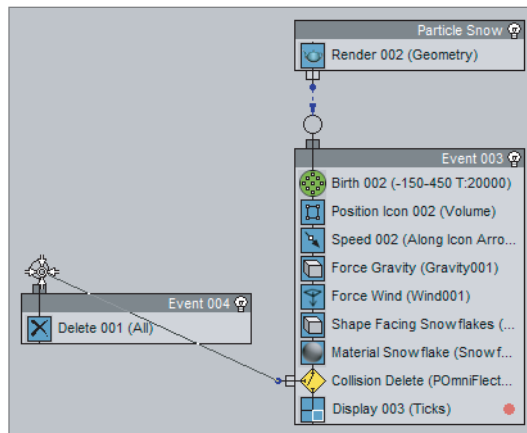
This links the Collision test to the new event that contains only a Delete operator. Any particles that pass the test, by colliding with one of the three large deflectors, are sent to the new event and deleted. All particles that don't pass the test, by avoiding the large deflectors, continue in the scene.

13. Add another Collision test below the Collision Delete operator, and rename it **Collision Hold**.

14. Add the deflector over the patio to the Deflectors list. You can use the By List button to select the space warp from a list.

15. In the Test True If Particle section, make sure the Collides option is selected, and then choose Stop from the Speed drop-down list to stop the particles that collide with the patio.

16. Unhide the particle system.

17. Render the CameraFloor viewport for the duration of the active time segment, and save it as an AVI file. You'll see the snow fall outside the window and collect on the patio (see Figure 12.48).

FIGURE 12.48
Snow collects on the patio.

Save your scene as **My_Snowfall.max.**

The Bottom Line

Render an animation. Animations can often give viewers a sense of size and composition unachievable using still images. Being able to produce a quality animation can mean the difference between a project being accepted or rejected.

> **Master It** Place a new camera above and to the left of the building entrance. Render a 10-second animation of the camera descending and approaching the building, and set the camera to a cinematic aspect ratio.

Output a still image. Still images have the benefit of allowing the viewer to spend time examining a particular viewpoint and a specific time. The images are generally produced at a much higher resolution than animations to create a better-quality printed image.

> **Master It** Use the Print Size Assistant and the Render Setup dialog box to render four images from the camera created in the previous "Master It" exercise. The images are to be 300 dpi on an 8 1⁄2″ × 11″ paper with a 1⁄4″ unprintable border around the perimeter. Repeat the process creating 150-dpi images on 30″ × 42″ paper with no unprintable area.

Render a shadow study. Shadow studies can help determine the need for additional or reduced detail, foliage, and the effects of artwork or open ceiling designs on light patterns. Producing a shadow is often a requirement when projects involve freestanding structures.

Master It   Using the Shadowstudy.max file, change the location of the building to Cleveland, Ohio, and create images at 30-minute intervals from 6 a.m. to 9 p.m.

Create a walkthrough.   Walkthroughs are special animations that attempt to define the animation from the point of view of an individual walking through the structure.

Master It   Assign a camera to a path that approaches the building from the front, passes through the entrance, and then turns to the left.

Choose an animation file output option.   The files that you can output from 3ds Max vary greatly in their quality and file size, and you must find an acceptable compromise between the two. A 60-second-long, 1280 × 1024 AVI using no compression may be a high-quality choice, but it can result in a file several gigabytes in size that is unplayable on most older systems. The key to outputting acceptable animations is selecting appropriate file types and settings.

Master It   Render 90 frames of the same animation four times, saving the output as different files. With each repetition, change the codec and/or settings; then compare the output quality and file sizes. Leave the resolution the same for all the animations.

Set up a dynamic simulation.   Creating complex animations involving many collisions between scene objects can be very time-consuming and not very realistic. Using MassFX, you can assign properties to the objects involved in the animation and let 3ds Max quickly create the animation.

Master It   Using the C12_DynamicsStart.max file, create two Teapot primitives and two OilTank extended primitives and place them a few feet above the ground. Use MassFX to animate them dropping to the floor and colliding with each other.

Create a Particle Flow event-driven particle system.   Particle systems can be used for a wide variety of applications in design visualization. Any time you need to have a multitude of similar objects, you can consider using a particle system. You can create things like cars in traffic, trees in forests, pedestrians in airports, and so on. Particle systems also are useful for water in fountains or simulations of gas particles flowing through tubes.

Master It   Create a particle system for a fountain. You don't actually have to create the fountain; just practice how the particles and forces can be used to generate it.

Rigging for Animation

In the previous chapters, you learned how you can animate simple scene objects to create lighting effects, walkthroughs, and time-lapse animations and to park a car in front of the villa. You can use those lessons as the basis to create many different types of animation in 3ds Max. Many times, however, you will need to animate more complex assemblies or scene objects. Autodesk® 3ds Max 2013® offers a number of comprehensive systems that allow for the animation of complex assemblies through the use of hierarchies, that is, parent-child relationships that let groups of objects be animated as a single object. The hierarchies can be animated both through *forward* and inverse kinematics.

In this chapter, you'll create hierarchies to animate a small solar system and create a hierarchy and add inverse kinematic controllers to a model of a light fixture.

In this chapter, you will learn to

◆ Create parent–child hierarchies

◆ Create a morph animation

◆ Create a simple IK rigged hierarchy

◆ Create bones

◆ Create a biped

Creating Parent–Child Hierarchies

In this first section, you will create a simple hierarchy structure to animate the inner planets and the moon of a fictitious solar system that could represent a holographic navigational system for a science fiction TV series, film, or computer game.

If you have been working continuously from the previous chapters, save any work that you have open and close and restart 3ds Max to clear your system's memory. You will want to set the Units to Generic for this exercise before starting.

1. Once you have restarted 3ds Max and set the Units to Generic, on the Command panel choose Create ➢ Geometry ➢ Standard Primitives ➢ GeoSphere.

One of the nice features of the GeoSphere is that, because of the way the polygons are arranged across its surface, from any viewing angle you get a smoother-looking surface with fewer polygons than if you were using the regular Sphere primitive with the same number of polygons.

2. On the Create Tab, scroll down and open the GeoSphere's Keyboard Entry rollout, set the Radius to **1**, and click Create.

3. Rename the new GeoSphere001 object as **Sun**, and change its Object color to one of the yellows.

    The Sun object you just created is at **0, 0, 0**.

4. Using the Keyboard Entry rollout, create four more GeoSphere objects with radii of **.125**, **.33**, **.08**, and **.25**.

5. Name the four GeoSpheres in the order in which you created them, **Planet_01**, **Planet_02**, **P2_Moon_01**, and **Planet_03**.

6. Deselect all objects in the scene by choosing Main Menu ➢ Edit ➢ Select None or by pressing the Ctrl+D combination on your keyboard.

7. Click the Zoom Extents All button to see your five concentric GeoSpheres.

Before moving any of the planetary GeoSpheres, you need to create Point Helper objects that you will use to create the hierarchy that will provide you with separate helpers that you can use to separate the components of your animation to make it easier to control.

1. You don't need to see the planetary objects for now so, on the Command panel, choose Display ➢ Hide Unselected.

2. On the Command panel, choose Create ➢ Helpers, as shown in Figure 13.1.

FIGURE 13.1
The Create Helpers panel
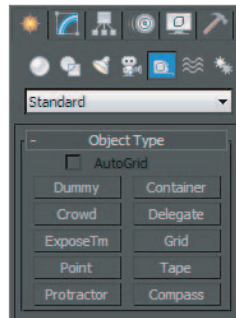
Among all the helpers, you see Dummy and Point. You can use either the Dummy or the Point helper to create this hierarchy. The Point helper can be the better choice because you can directly control its visual representation in the viewports and its Size parameter. The size of Dummy objects can be adjusted only at the time of creation, and the Dummy object displays only as a box.

3. Click Point and then, in the viewport, click once to create the first Point helper. It doesn't matter exactly where you put it for now, because you will move the Point helper after you look at some of its properties, which are shown in Figure 13.2.

FIGURE 13.2
The Point helper
Parameters
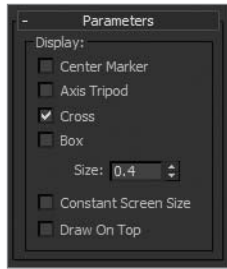
On the Point helper's Parameters rollout, you can select how the Point helper will be displayed in the viewports—as a Center Marker that looks like an X in all viewports, as an Axis Tripod, as a Cross, or as a Box. The basic Point helper displays are shown in Figure 13.3. You can use all four modes at once or any combination of modes to help visually differentiate Point helpers in complex scenes.

FIGURE 13.3
The four basic Point
helper Display
options
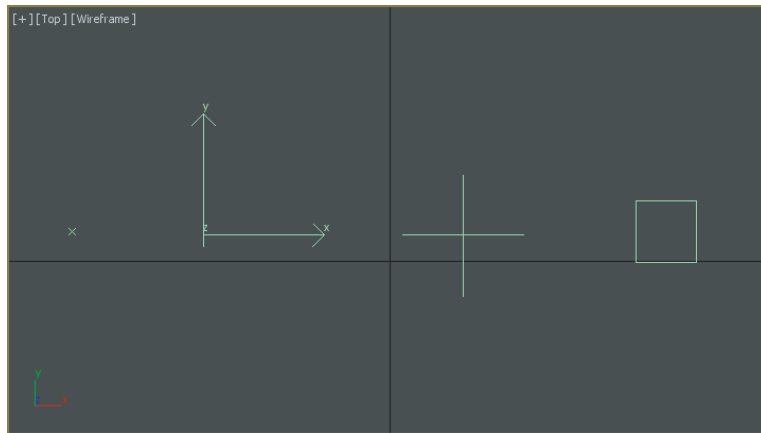
4. Rename the Point helper as **Solar_System_Pos**, for Solar System Position. This helper will allow you to adjust the position of the entire solar system easily without affecting the animation of the other elements of the hierarchy.

5. With the Solar_System_Pos helper selected, right-click the Move tool and set the position values for the helper to **0,0,0**.

6. Create four more Point helpers with the Cross display option, and name them **Planet_01_POS**, **Planet_02_POS**, **P2_Moon_POS**, and **Planet_03_POS**.

7. Select the Planet_01_POS helper, right-click the Move tool, and set its position to **6,0,0**.

8. Select the Planet_02_POS helper, and use the floating Move tool to set its position to **10,0,0**.

9. Select the Planet_03_POS helper, and use the Move tool to set its position to **15,0,0**.

10. Create five more Point helpers using the Box display option, and name them **Sun_ ROT**, **Planet_01_Orbit_ROT**, **Planet_02_Orbit_ROT**, **P2_Moon_Orbit_ROT**, and **Planet_03_Orbit_ROT**.

11. Move all the ROT helpers, except P2_Moon_Orbit_ROT, so that they are centered at 0,0,0.

12. Save your scene as `My_Solar_System_001.max`.

It may appear that you are creating an awful lot of helpers just to animate a few spheres, but you will see how helpful using helpers can be in just a moment.

1. Select the Planet_01_POS helper, and then click the Select And Link tool on the Main Toolbar.

2. Press **H** on the keyboard, or click the Select By Name tool on the Main Toolbar.

3. In the Select Parent dialog box, select Planet_01_Orbit_ROT and then click Link.

4. Repeat steps 1 through 3 for the Planet_02_POS and Planet_03_POS helpers, linking them to their respective Orbit_ROT helpers.

You may have noticed that you haven't done anything with the P2_Moon helpers that you created. You will rectify that now:

1. Click the Select Object tool to exit the Select And Link tool.

2. Select the P2_Moon_Orbit_ROT helper, and then choose the Align tool from the Main Toolbar, or press Alt+A on the keyboard and then click the Planet_02_POS helper.

3. On the Align Selection dialog box that appears, make sure to select X, Y, Z in the Align Position group, set the Current And Target Object setting to Pivot Point, and then click OK to dismiss the dialog box.

4. Repeat the previous two steps, starting with the P2_Moon_POS helper, and center it on the Planet_02_POS helper.

5. Click the Select By Name tool or press **H** on the keyboard, and in the Select From Scene dialog box, select P2_Moon_Orbit_ROT and click OK.

6. With the moon's orbit rotation helper selected, click the Select And Link tool. Then press **H** on the keyboard and, in the Select Parent dialog box, select Planet_02_POS and choose Link.

7. Select the Select Object tool from the Main Toolbar to deactivate the Select And Link tool. Then press **H** on the keyboard, select the P2_Moon_POS helper, and click OK.

8. Choose the Select And Link tool again, and in the Select Parent dialog box, select Display ➢ Display Children to see the hierarchy that you have been setting up. You may have to click the plus symbols to expand the hierarchy that you set up.

9. From the cascading hierarchy, select P2_Moon_Orbit_ROT, as shown in Figure 13.4, and click Link.

Now that you have a number of helpers linked, let's test some of the functionality:

1. Choose the Select Object tool on the Main Toolbar to deactivate the Select And Link tool.

FIGURE 13.4
Select the second
planet's moon orbit
rotation helper.
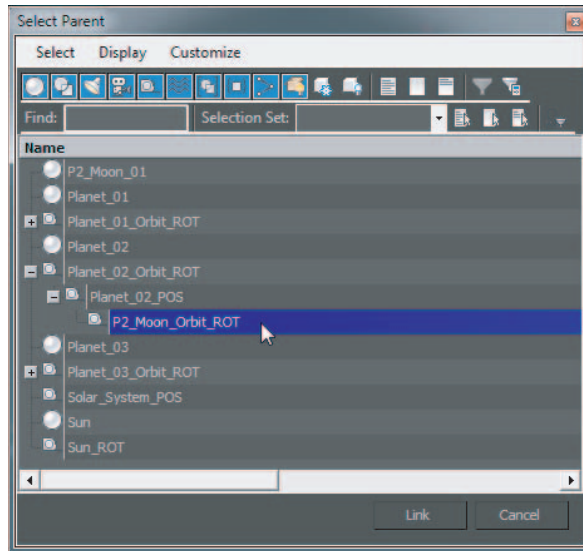
2. Choose the Select By Name tool and, in the Select From Scene dialog box, select the
   Planet_02_Orbit_ROT helper and then click OK.

3. Choose Zoom Extents All so that all the helpers are visible in all four viewports.

4. Choose the Select And Rotate tool, and make sure that the mode is set to Use Pivot Point
   Center.

5. In the Perspective viewport, put your cursor over the blue ring that represents the Z-axis,
   hold down the mouse button, and drag to the right. You should see the Planet_02_POS
   and two P2_Moon helpers orbit the origin point, as shown in Figure 13.5.

FIGURE 13.5
Test the rotation of
the Planet 2 helpers.
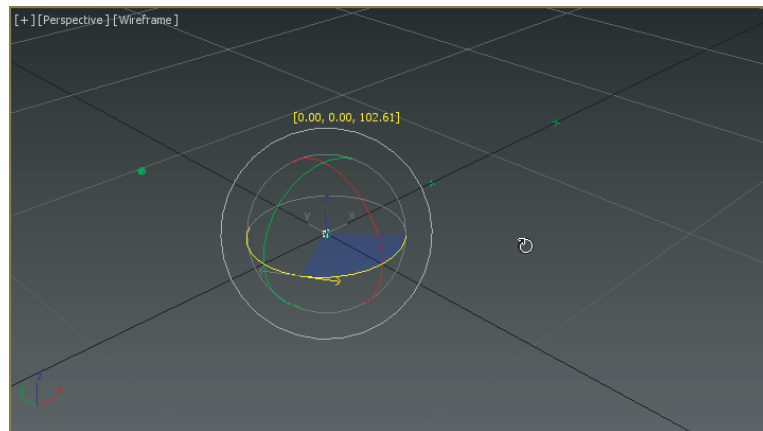
6. Click the Undo Scene Operation button to reset the rotation of the Planet_02_Orbit_ROT helper.

Based on testing the rotation of the Planet_02_Orbit_ROT helper, it is time to unhide the Planet objects:

1. On the Command panel, choose the Display tab and click Unhide All.

2. Press **H** on the keyboard to bring up the Select From Scene dialog box. Select the Planet_03 object, and click OK.

3. On the Main Toolbar, select the Align tool and then, in the Top viewport, select the outer-most helper, which is the Planet_03_POS object. In the Align Selection dialog box, select X, Y, Z for the Position, select Pivot Point for both Current and Target Object settings, and then click OK.

4. With the Planet_03 object still selected, choose the Select And Link tool and then press **H** on the keyboard to access the Select Parent dialog box. Next, click the plus symbol in front of the Planet_03_Orbit_ROT item to expand the hierarchy, and then select Planet_03_POS and click Link, as shown in Figure 13.6.

FIGURE 13.6
Link Planet_03 to its position helper.
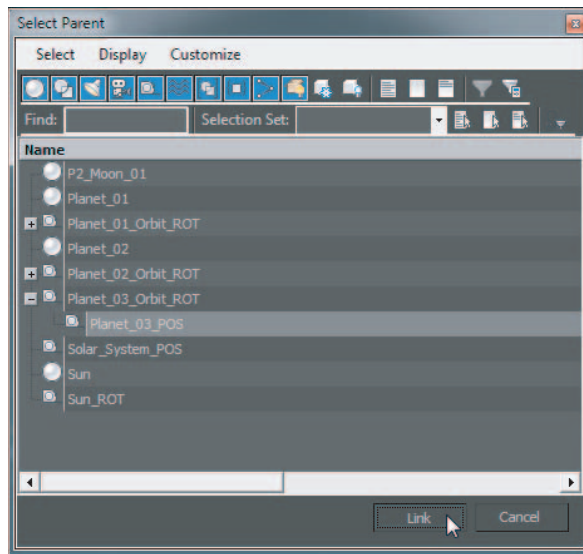
5. Click the Select Object tool to deactivate the Select And Link tool, and press the **H** key to select Planet_02.

6. With Planet_02 selected, choose the Select And Link tool, press the **H** key, and then select the Planet_02_POS helper as you did in step 4 for Planet_03.

7. With Planet_02 still selected, choose the Align tool; then press **H** on the keyboard, select Planet_02_POS, and click Pick. In the Align Selection dialog box, check X, Y, Z in the Align Position (Screen) group and set both the Current and Target groups to Pivot Point; then click OK.

8. Choose the Select Object tool, press the **H** key, and from the Select From Scene dialog box, choose the P2_Moon_01 object and click OK.

9. With the P2_Moon_01 object selected, choose the Select And Link tool, expand the Planet_02 hierarchy, select the P2_Moon_POS helper, as shown in Figure 13.7, and click Link.

FIGURE 13.7
Link P2_Moon_01 to its position helper.
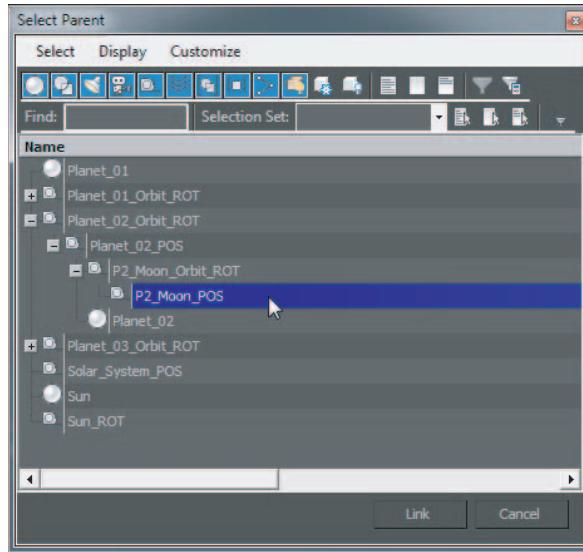
10. With P2_Moon_01 still selected, choose the Align tool and then press **H** on the keyboard. In the Pick Object dialog box, select the P2_Moon_POS entry from the Planet_02 hierarchy and click Pick.

11. In the Align Selection dialog box, select X, Y, Z, and Pivot Point for both the Current and Target Object settings and then click OK.

The Moon object moves to its position helper, inside Planet_02. You still have one more planet to link, and then you will adjust the position helper for the Moon object and animate the solar system.

1. Press the **H** key and, from the Select From Scene dialog box, select the Planet_01 object and click OK.

2. With the Planet_01 object selected, choose the Select And Link tool and then press the **H** key to bring up the Select Parent dialog box. Expand the Planet_01 hierarchy, select the Planet_01_POS helper, and then click Link.

3. With the Planet_01 object still selected, click the Align tool, and then, in the Top viewport, click the Planet_01_POS helper, as shown in Figure 13.8.

FIGURE 13.8
Align Planet_01 to
its position helper.
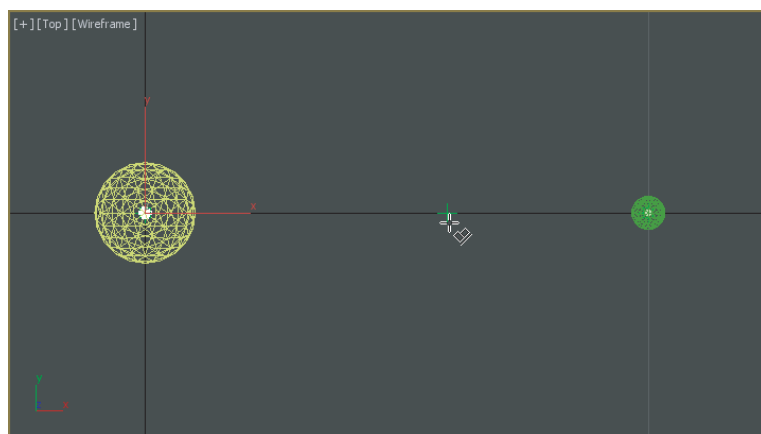
4. In the Align Selection dialog box, check the X, Y, Z, and Pivot Point options for Current and Target Objects and then click OK.

All the objects in the scene are now properly linked and aligned, so now would be a good time to save your scene incrementally.

1. Use the zoom and pan tools to adjust the Top viewport so that you can see Planet_02 and its moon, as shown in Figure 13.9.

FIGURE 13.9
Pan and zoom to
show Planet_02 in
the Top viewport.
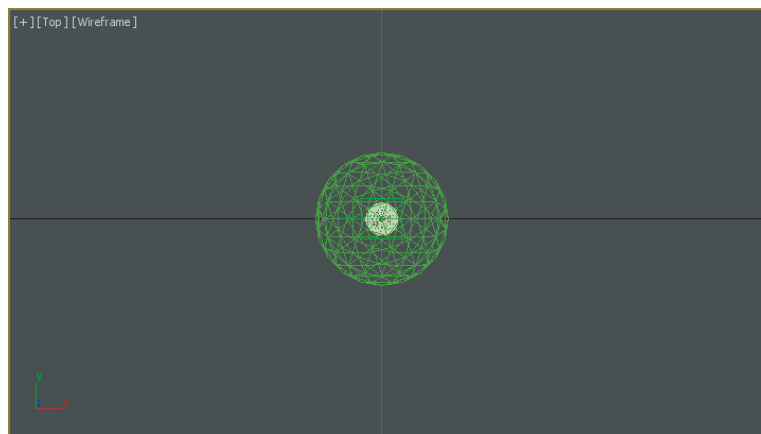
2. Press **H** on the keyboard, expand the Planet_02 hierarchy, and select the P2_Moon_POS helper, as shown in Figure 13.10, and then click OK.

FIGURE 13.10
Select the moon's
position helper.
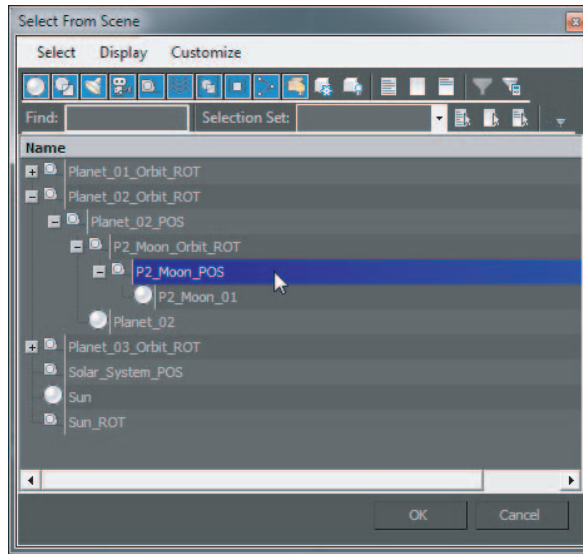
3. Click the Selection Lock toggle, so that you don't accidentally deselect the helper, and select and move any other objects in the scene.

4. Click the Select And Move tool; then click the X-axis of the transform gizmo, and move the helper and linked Moon object to the right until the readout in the X position indicator at the bottom of the screen reads 1.25.

5. Click the Selection Lock toggle to deactivate it.

6. Press the **H** key to open the Select From Scene dialog box, select the P2_Moon_Orbit_ROT helper, and then click the Selection Lock toggle.

Before you start to animate your solar system, you need to give yourself some more time to work with.
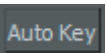
1. Click the Time Configuration tool and, in the Animation group, change the Length to **1000** and click OK.

2. Click the Go To End button to advance the time slider to frame 1000.

3. Click the Auto Key button to turn on the Animate mode of 3ds Max.

4. Click the Select And Rotate button and, in the Perspective viewport, rotate the helper about 1000 degrees in the Z-axis.

5. Right-click the key created at frame 1000, and select P2_Moon_Orbit_ROT from the context menu.

6. Change the In keyframe to Linear, and then click the left-arrow key next to the In keyframe to assign Linear interpolation to the Out tangent of the key at frame 0.

7. Deselect the Selection Lock toggle, select the P2_Moon_01 object, and then rotate it 3600 degrees on the Z-axis.

8. Change all the keyframes for the Moon's Z rotation to Linear.

9. Select the Planet_02 object, and rotate it on its Z-axis 131400 degrees; then set all its keyframes to Linear.

10. Press the **H** key, select the Planet_02_Orbit_ROT helper from the Select From Scene dialog box, and click OK.

11. Rotate the Planet_02_Orbit_ROT helper 720 degrees on its Z-axis, and then change all its keyframes to Linear.

12. Press the **H** key, and select the Planet_03_Orbit_ROT helper.

13. Rotate the Planet_03_Orbit_ROT helper 360 degrees on its Z-axis, and set all its keyframes to Linear.

14. Click the Auto Key button to stop animating; then right-click the key at frame 0, and change the Z Rotation value to **40** so that it doesn't start in line with all the other planets.

15. Choose the Select By Name tool; then select the Planet_01_Orbit_ROT helper from the Select From Scene dialog box, and click OK.

16. Rotate the Planet_01_Orbit_ROT helper about 130 degrees on the Z-axis.

17. Turn on Auto Key mode, and click the Go To End button to move the time slider to frame 1000 if it is not already there.

18. Rotate the Planet_01_Orbit_ROT helper about 700 degrees on the Z-axis, and then change all its keyframes to Linear.

19. Select the Sun_01 object, rotate it about 100 degrees on its Z-axis, and then change all its keyframes to Linear.

20. Turn off Auto Key.

21. Use the Orbit and Pan View tools to get a good view of the solar system in the Perspective viewport, similar to Figure 13.11.

FIGURE 13.11
Set the Perspective viewport to look like this.
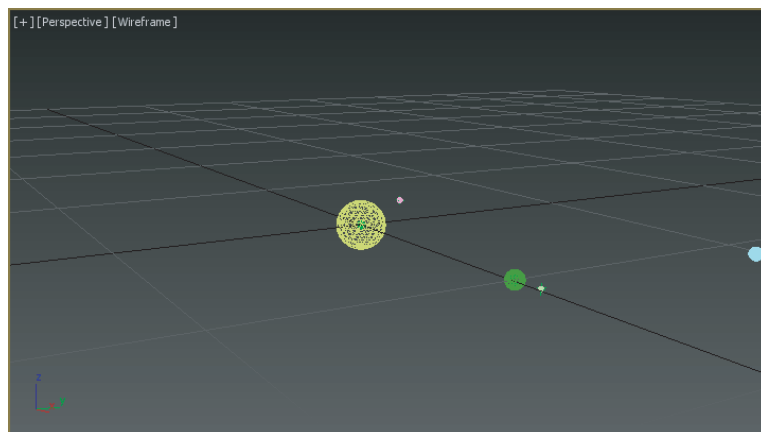
22. Click the Play Animation button, and watch your animation of the solar system in the Perspective viewport.

23. Save your scene.

You could have accomplished some of what you see by simply moving the planet's or moon's pivot points to the center of the solar system or Planet_02, but then you couldn't control the rotation of the moon around Planet_02. This would be fine for our terrestrial moon, where the same side consistently faces us on Earth, but if you needed to rotate the moon, you would need a more complex hierarchy like the one created in this exercise.

Knowing how to plan and develop good, flexible hierarchies for animation is a crucial skill you will need to develop for advancing within a studio food chain, and it can eventually lead to becoming an animation technical director (TD).

To take this exercise further, use what you learned in Chapter 8, "Enhancing Models with Materials," and find some appropriate image maps online to use as texture maps and create materials for the sun, planets, and moon. Then you can render a more finished animation of your mini solar system.

Using the Morpher Modifier

Many times, you will need to animate the characteristics of a single object, such as making a 3D character talk and exhibit other facial expressions, or some other organic animation that would be impractical to set up with a hierarchical system.

Morphing is the process of changing one image or object into another. An early example of a 2D morph visual effect was in the 1988 movie *Willow*. In this example, you will animate morphs on a 3D character.

1. Open the file `C13_MorpherModifier.max` and, with the Camera001 viewport active, click the Render Production button. Your rendering should look like Figure 13.12.

FIGURE 13.12
Rendering of the sphere
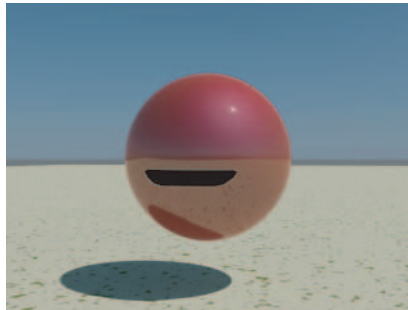
This file is a simple sphere that has had a mouth of sorts cut into it. You will unhide some modified versions of the sphere model that represent different mouth shapes, called phonemes. *Phonemes* represent the common sounds used in a spoken language and the typical mouth shaped created when that sound is uttered. Each language has its own phonemes. You will apply the Morpher modifier and animate the sphere.

Using phonemes and an X sheet is a common method for creating talking and emoting characters, be they humanoids or anthropomorphic talking vehicles. An *X sheet*, also known as a camera instruction sheet or dope sheet from traditional animation, is typically a graph that

represents the sequence of frames in an animation down the length of the page and has columns breaking down dialog into sounds/phoneme mouth shapes to be used at specific frames. X sheets also usually indicate other facial expressions, character poses and action, camera movements, and sometimes special effects.

The Morpher modifier provides you up to 100 channels or targets of the model that you can mix in percentages to create the animations you want. Another important aspect of the Morpher modifier is that all targets must have the same vertex/polygon count as the base object; otherwise unpredictable things will happen.

2. On the Command panel, choose the Display tab and click Unhide All to reveal the three additional Sphere objects.

3. Use the viewport zoom and pan tools to get a good look at the three additional spheres in the Front viewport. The modifications to the sphere may be hard to see in the viewport, so the view has been rendered for you in Figure 13.13.

FIGURE 13.13
Rendering of the morph targets
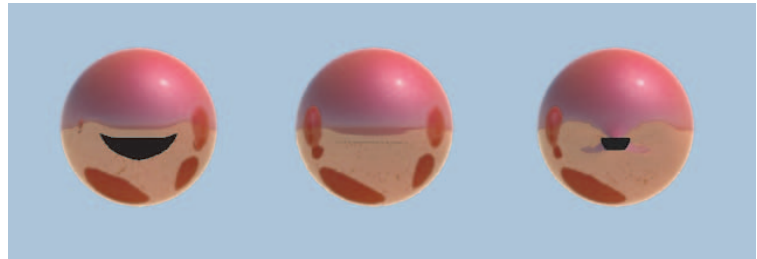
The three morph targets represent a big smile, a closed mouth, and a mouth shape typical of making an "O" sound.

4. Zoom out in the Front viewport so that you can see all four spheres.

5. Select the sphere to the far left—the one that is visible in Camera001.

6. On the Command panel, choose the Modify tab, click the Modifier List drop-down menu, and select the Morpher modifier. You will see the Morpher properties in the Command panel, as shown in Figure 13.14.

7. On the Morpher modifier, right-click the first slot on the Channel List labeled - empty - and, in the context menu that pops up, select Pick From Scene.

8. In the Front viewport, pick the sphere with the big smile, or you can press the H key to activate the Pick Object dialog box and select the sphere by name, Talking_Character_BigSmile.

As with most things in 3ds Max, it is important to name your objects and materials appropriately so that you know what they are to be used for later on. Naming the model variations as to how they will be used for lip-syncing will help assure that you put the right mouth shape or expression where you need it.

9. In the Channel List rollout on the Morpher modifier, select the second slot so that it is highlighted.

10. Scroll down in the modifier to the Channel Parameters rollout, as shown in Figure 13.15.

FIGURE 13.14
The Morpher
modifier
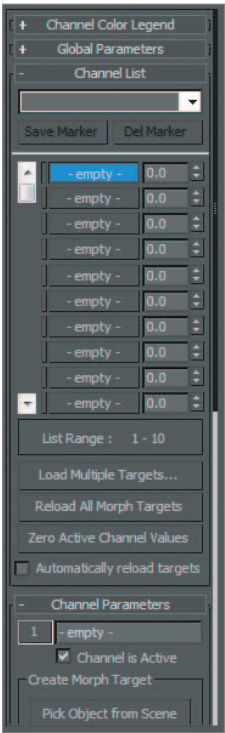
FIGURE 13.15
The Channel
Parameters rollout
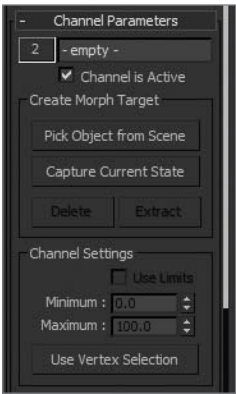
11. In the Channel Parameters rollout, click the Pick Object From Scene button, and then, in the Front viewport, pick the middle sphere of the three spheres, Talking_Character_ClosedMouth, as shown in Figure 13.16.

FIGURE 13.16
Pick the
closed-mouth
morph target.
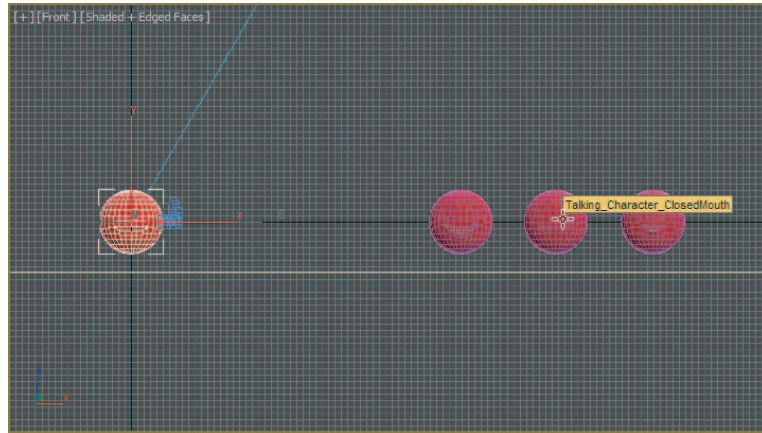
12. Scroll back up, and select the third slot in the Channel List. Right-click and select Pick From Scene, and then, in the Front viewport, pick the last sphere, Talking_Character_RoundMouth.

   You have now selected all the objects that will be used in the morph animation.

13. In the Front viewport, select the three morph targets, right-click, and select Hide Selection from the display quad menu.

14. It's a good idea to save your file now, so save it as **My_MorpherModifier.max.**

Animating the Morpher Modifier

In the next section of this exercise, you will animate the percentages of each morph target in the scene.

1. Turn on Auto Key mode.

2. Select the Talking_Character_01 object if you have deselected it.

3. Click the Go To Start button on the Animation Controls to make sure that you are at frame 0.

4. In the Channel List rollout, change the Character_ClosedMouth value to **80** and watch the model change in your Camera001 viewport.

5. Move the time slider to frame 20, and change the value of the third channel, RoundMouth, to **100**.

6. Adjust the time slider to frame 25, and change the second morph target's percentage to **0**.

7. Move the time slider to frame 33, and set the first channel to **100** and the third channel to **33**.

8. Move the time slider to frame 42, and set the third channel to **0**, revealing the initial sphere.

9. Move the time slider to frame 57, and make the ClosedMouth and RoundMouth channels both **100**.

10. Move the time slider to frame 70, and make the ClosedMouth value **0**.

11. Move the time slider to frame 75, and make the RoundMouth value **13**.

12. Move the time slider to frame 79, and make the BigSmile value **100**.

13. Move the time slider to frame 82, and make the RoundMouth value **0**.

14. Move the time slider to frame 85, and make the ClosedMouth value **100**.

15. Move the time slider to frame 91, and make the RoundMouth value **7**.

16. Move the time slider to frame 94, and make the ClosedMouth value **50** and RoundMouth value **0**.

17. Move the time slider to frame 99, and make the ClosedMouth value **0**.

18. Turn off Auto Key.

19. Play the animation in the Camera001 viewport.

    The animation is pretty awful, but you can see how easy and fun it can be to create morph animations.

20. Save your scene.

With 100 possible morph targets, you need to plan out what expressions and phonemes you are potentially going to need on a project. This is where it is crucial to have storyboards, a script, and hopefully a rough audio recording of the dialog you will be lip-syncing before you start creating the target shapes.

When creating morph targets, sometimes it might be better to create certain expressions on each half of the face separately. For example, you can mix half a smile on one half of the face and a neutral or frowning expression on the other half to create a smirk, instead of having to create the whole smirk as one target. Similarly, you can create two targets, one for closing the right eye and another for closing the left eye. These can then be used individually for having a character wink or in tandem for the character's regular blinking. This way, you only have to create two morph targets instead of three, and you can use the targets for multiple expressions.

There are many methods for animating the Morpher modifier. You can use Wire Parameters and non-rendering geometry in a scene to control the animation of the Morpher modifier in the viewport instead of on the Parameters rollout or with one of the Animation Editors. You can also use the Curve Editor that you learned about in Chapter 12, "Creating Animations, Particles, and Dynamics," to further enhance the animation you created. Because these methods are beyond the scope of this book, you will have to explore them on your own.

Assembling an Articulated Luminaire

In this section, you will learn how to make an *assembly* that wires important parameters from a light source together with a light fixture shown with a streamlined user interface. The assembled structure is called a *luminaire* in 3ds Max.

CERT OBJECTIVE

You will also learn the basics of kinematics in this section in order to link the joints of an articulated desk lamp in a realistic fashion. *Kinematics* is the study of articulated motion, and you will be learning the differences between forward and inverse kinematics with the desk lamp model. When you have finished, you will have a luminaire that you can quickly drop into a working scene and adjust in a user-friendly manner.

Transforming Pivot Points

You begin by adjusting the pivot points of the sample model in preparation for linking its joints together in a hierarchy. Each one of these objects (except the base) has a joint where two parts meet. The pivot point of each part must coincide with that object's axis of rotation.

1. Open the file C13_Luminaire01.max from the book's website. The scene appears, as shown in Figure 13.17.

FIGURE 13.17
Desk lamp
geometry
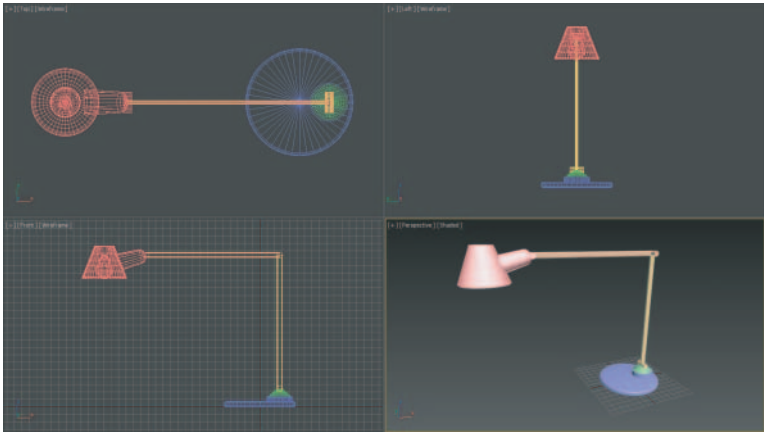
2. Examine the parts of this simple desk lamp model. Press **H** on the keyboard to open the Select From Scene dialog box. There are five parts to this lamp: Arm01, Arm02, Base, Hood, and Swivel, as shown in Figure 13.18. Select each object in turn and identify it on the screen.

FIGURE 13.18
Desk lamp parts
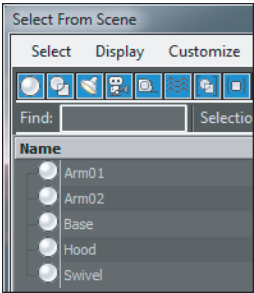
3. Switch to the Front viewport, and select the Hood object. Zoom into the area where Hood meets Arm02, as shown in Figure 13.19.

4. Click the Hierarchy tab of the Command panel. Click the Pivot button, and turn on Affect Pivot Only in the Move/Rotate/Scale group (other options are Affect Object Only and Affect Heirarchy Only).

FIGURE 13.19
The lamp Hood and
Arm02
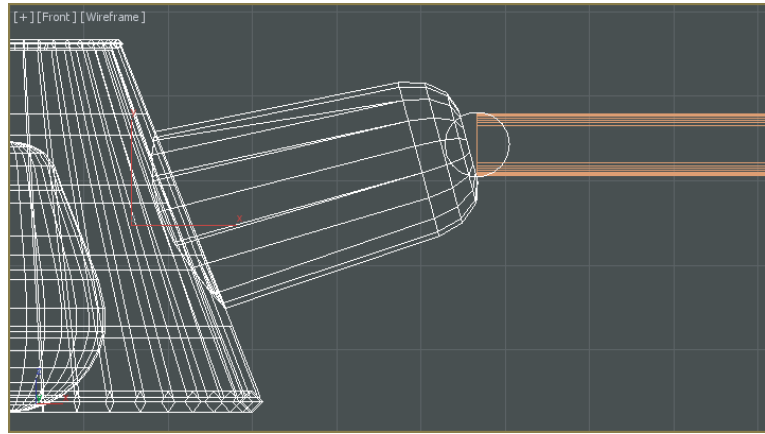
5. Click the Select And Move tool. Move the Hood's pivot to the center of the round joint on the right by dragging the transform gizmo, as shown in Figure 13.20. Turn off the Affect Pivot Only button when finished.

FIGURE 13.20
Adjust the pivot
position.
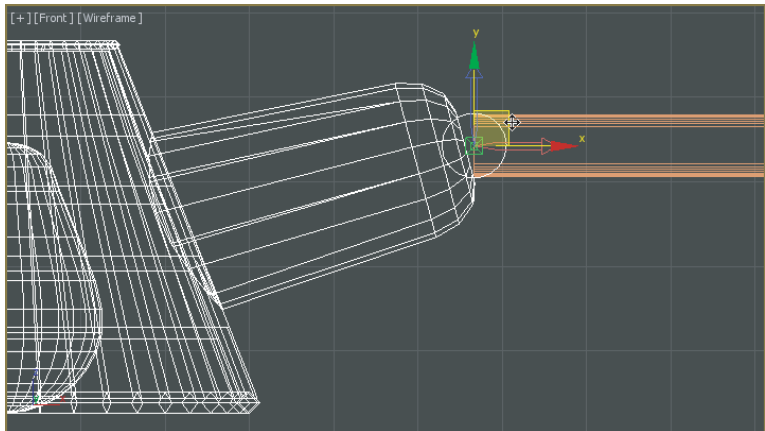
6. Repeat steps 3–5 for Arm01 and Arm02 by moving their respective pivots to the center of each of their round joints. If you need precision, you can use the Align tool to align to another pivot or the center of another object.

Aligning the Light Source with the Fixture

You may notice that a lightbulb geometry has been modeled to fit inside the desk lamp's hood. Next you'll add the light source:

1. Click the Create tab of the Command panel, and select the Lights category button. Select Photometric from the drop-down list if it isn't visible currently, and click Target Light in the Object Type rollout.

2. Drag out a target light in the Top viewport without regard to its position or the position of its target.

3. Move the point source itself inside the lightbulb in both the Top and Front viewports.

4. Right-click the Top viewport to activate it; then select TPhotometricLight001.Target, and press Alt+A to invoke the Align command.

5. Instead of trying to click the alignment object, press **H** to use the Pick Object dialog box, which is nearly identical to the Select From Scene dialog box. Select TPhotometricLight001 from the list and then click Pick.

6. In the Align Selection dialog box, check the X Position and Y Position options and clear the Z Position. Choose Center for both the Current and Target Object radio buttons to align the target directly below its source. Click OK to accept the changes, and close the dialog box when you've finished.

7. Select TPhotometricLight001, and switch to the Modify tab of the Command panel.

8. In the General Parameters rollout on the Light Distribution (Type) group, choose Spotlight from the drop-down list. In the Intensity/Color/Attenuation rollout, change the bulb Color to Halogen.

9. Change the Intensity to 3,000 candelas, and click the Resulting Intensity check box to activate the Dimming feature; 100 percent is now 100 percent of 3,000 candelas.

10. Rename TPhotometricLight001 to **Light001**.

Using Schematic View

Schematic View is a 3ds Max window that helps you visualize the relationships between *nodes* in a scene. Nodes are containers for objects' geometry, transforms, modifiers, materials, relationships, and so on. Visualizing nodes can be especially helpful when establishing parent–child hierarchical links, as you are about to do with the desk lamp.

The Connect and Unlink Selected tools are available in Schematic View, allowing you to set up hierarchies causing one object's (the parent) transforms to affect other objects (the children) based on the parent's pivot point. You can arrange nodes in a structure resembling the model you are linking, which gives you a visual reference to the kinematic chain you want to animate.

1. Click the Schematic View (Open) button on the Main Toolbar. The Schematic View 1 window and the Display floater open, as shown in Figure 13.21.

FIGURE 13.21
The Schematic View of your lamp
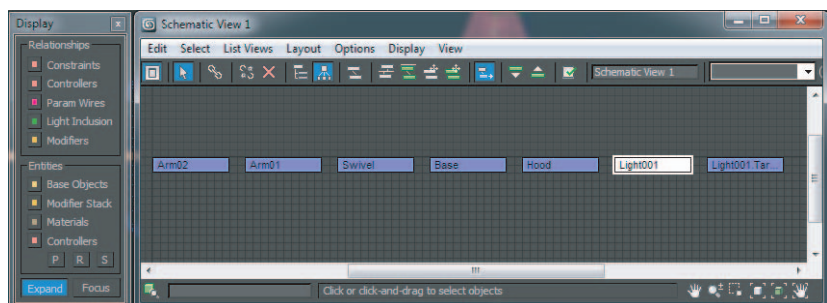
2. Click the Connect button on the Schematic View toolbar.

3. Click the Light001 node, and then drag a link to the Hood node in Schematic View. Your cursor will change to the Connect icon while you are dragging, and a rubber band will connect your cursor and the Light001 node.

DRAGGING NODES IN SCHEMATIC VIEW

Always drag nodes from the child to the parent in Schematic View. In the case of the lamp, you want the Hood's transforms to be passed on to the Light001 object.

---
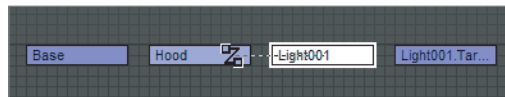
4. Connect the Light001.Target with the Hood also by dragging a link between these two nodes. The Hood is now said to be the parent of the light and its target. Light001 and Light001.Target are siblings in this family hierarchy metaphor (see Figure 13.22).

FIGURE 13.22
The Schematic View of your lamp after creating the hierarchy
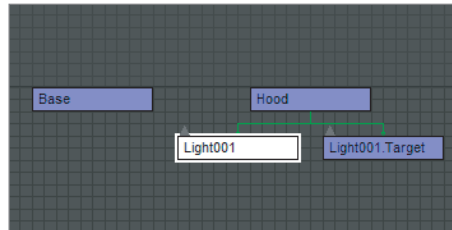
5. Continue making relationships in Schematic View by linking Hood to Arm02 next. Then connect Arm02 to Arm01. Arm01 should be linked to Swivel and, finally, Swivel should be the child of Base. When finished, your hierarchy should look like Figure 13.23. Notice that the whole family is made up of children of Base. This is as intended so that you will be able to move the entire model with the base.

CORRECTING NODE LINKS

If you make any mistakes connecting nodes, you can use the Unlink Selected button to make corrections, or you can use the `C13_Luminaire02.max` file from the Sybex website, `www.sybex.com/go/mastering3dsmax2013`.

FORWARD KINEMATICS

So far, you have established links between various nodes in your model. These links establish what is called a *kinematic chain*. Kinematics is the study of moving objects or systems.
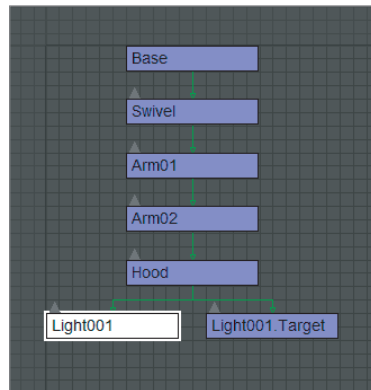
In forward kinematics (FK), you transform the top node in the hierarchy to affect the entire chain. For example, rotating your upper arm at the shoulder (the top node in your arm) affects your forearm, hand, and fingers, but you can rotate your hand without affecting your upper arm. Let's see what this means with your lamp:

1. Close the Schematic View dialog box. Choose Edit ➢ Hold to experiment without worrying about altering the scene.

2. Right-click to select the Perspective viewport, and then press F4 to turn on Edged Faces mode. Select the Base object, and move it in the viewport. Observe that all the objects move together because they are linked to this top ancestor.

3. Select Arm02 and move it. Notice that Arm02, Hood, the light, and its target move as one. However, Arm01, Swivel, and Base remain behind. Only the object and its children are affected. The object's parents stay where they were, as shown in Figure 13.24.

FIGURE 13.24
Children and
descendants move
together.
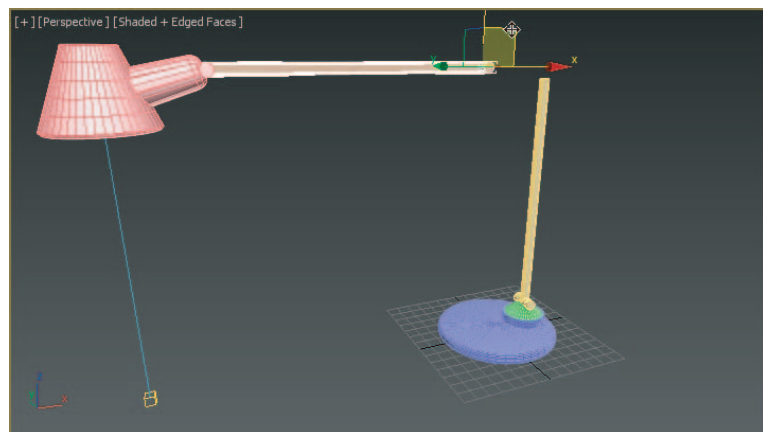
INVERSE KINEMATICS

3ds Max has a range of *inverse kinematics (IK)* systems available for your use. The oldest is the IK system found on the Hierarchy tab. This system lets you animate a hierarchical chain by moving the child rather than the parent. In inverse kinematics, the chain is resolved in reverse fashion. You transform the bottom node in the hierarchy and thereby affect all of its ancestors. Instead of all moving with the child, the nodes in IK try to stay connected while the top node stays behind. This is similar to lifting somebody's hand over their head, causing the forearm and upper arm to rise as well. Again, an example is the best way to understand this concept:

1. Switch to the Hierarchy tab of the Command panel.

2. Click the IK button, and then click the Interactive IK button to turn on this feature, as shown in Figure 13.25. Any transforms you now perform are in IK mode until you turn this button off.

FIGURE 13.25
Turn on Interactive IK.
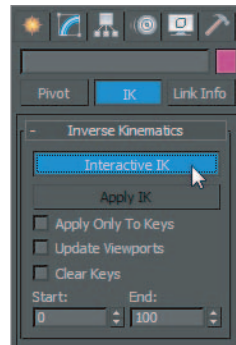
3. Select Light001.Target, and move it in the XY plane. Observe how all the nodes move as they need to in order to stay connected with all the other nodes in the chain (see Figure 13.26). All nodes move except the Base node, which is called the *terminator* of the IK chain.

FIGURE 13.26
Moving the target animates the chain.
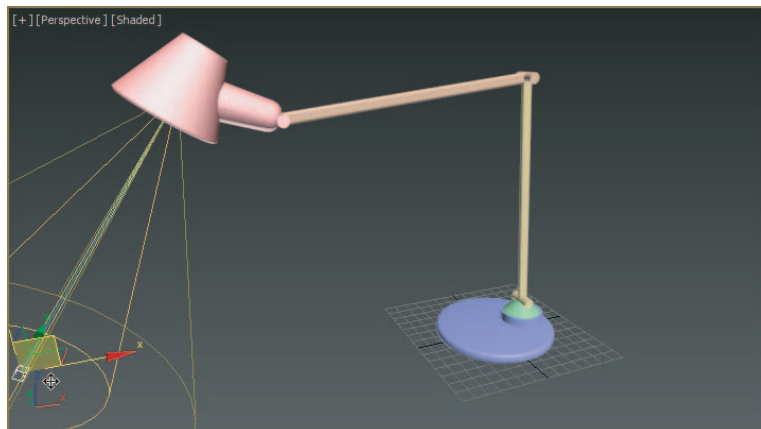
4. Turn off Interactive IK mode, and choose Edit ➢ Fetch to end your experiment. A dialog box will appear asking if it's OK to restore. Click Yes.

USE HOLD TO SAVE YOUR SCENE TEMPORARILY

Choosing Edit ➢ Hold saves a file called `maxhold.mx` into the `/autobak` folder, which contains a complete copy of your scene. There is only one `maxhold.mx` file available, and every time a Hold is performed, the file is overwritten. Choosing Edit ➢ Fetch replaces your current scene with the contents and settings from the last `maxhold.mx` file created. The Fetch command is not undoable.

IK SOLVERS

The more advanced and recent IK systems use a type of controller called an *IK solver*. IK solvers are applied via the Animation menu. Four different IK solvers are available:

◆ The HI (History Independent) solver works best for character animation.

◆ The HD (History Dependent) solver is most frequently used for animation of machine parts that require sliding joints or use joint constraints.

◆ The IK Limb solver is designed for fast animation of two jointed parts (an arm and a leg, for example).

◆ The Spline solver lets you animate an IK chain by moving vertices in a line.

JOINT CONSTRAINTS

You may have noticed that when you were experimenting with moving the light's target in IK mode, even though the lamp parts stayed connected, they got twisted out of shape. We all know that in the real world, these kinds of simple mechanical joints have a limited range of motion. When you specify *joint constraints*, you set up each joint with information about how it is allowed to rotate, how far, and how easily. Joint constraints help make the desk lamp's motion more realistic.

1. Click the Select And Rotate tool; then switch to the Parent Reference Coordinate System in the drop-down list on the Main Toolbar (see Figure 13.27) when working with joints. This is especially important if any of your objects have rotated pivots that do not align to the World Coordinate System.

FIGURE 13.27
Select the Parent
Reference
Coordinate System.
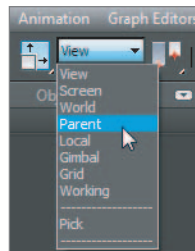
2. Select the Hood object and, if necessary, switch to the Hierarchy tab of the Command panel. Make sure that the IK button is still selected and Interactive IK mode is off. Scroll down to the bottom rollout called Rotational Joints. Right-click in the Perspective viewport, and perform a Zoom Extents Selected on Hood.

3. Notice that the green Y-axis ring of the transform gizmo indicates the direction this joint should rotate. Deselect the Active check boxes in the X Axis and Z Axis groups in the Rotational Joints rollout. Now this joint will be allowed to rotate in only one direction, as designed.

4. In the Y Axis group, select Limited. Then drag the From spinner down to about -45 degrees. The Hood will rotate in the viewport as you set this joint limit and then return to its original orientation when you release the spinner.

5. Drag the To spinner to about 45 degrees to set the upper rotation limit, as shown in Figure 13.28.

FIGURE 13.28
Set the rotation
limits.
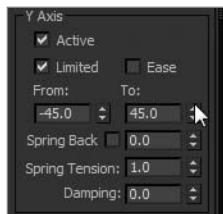
6. Set Damping to **0.5** to give this joint 50 percent resistance to being rotated.

7. Select Arm02 and deselect Active for both the X- and Z-axes since this joint should also rotate only in the Y direction. Check Limited, and set the limits from -45 to 45 degrees. Give this joint 50 percent damping also.

8. Press the Page Up key to move to the next ancestor up the hierarchy (Page Down moves down the hierarchy). You should now have Arm01 selected.

9. Deselect Active for both the X- and Z-axes for this joint. Limit this joint to a range of motion between -30 and 30 degrees without damping.

10. Press the Page Up key again to advance to the Swivel object. This time, deselect its X- and Y- Active axes. You don't need to set limits for the swivel joint because it can spin all the way around.

11. Page up to the Base object. Uncheck Active for all three rotational joint axes since the base shouldn't rotate at all.

12. Switch the Reference Coordinate System back from Parent to View now that you have finished setting joint constraints (see step 1).

13. Finally, you must select Base as the terminator of the kinematic chain. Select the base in the viewport. The terminator will not move relative to the rest of the chain. Open the Object Parameters rollout near the top of the IK Hierarchy panel. Check Terminator, as shown in Figure 13.29, and you are finished.

You have now set up the joint constraints for the articulated desk lamp model. The lamp moves in a realistic fashion, based on what each one of the mechanical joints' range of motion allows.

TESTING IK JOINT CONSTRAINTS

Now that you have gone to all the trouble of specifying how each joint is allowed to rotate, how far, and how easily, it is time to test the model and see whether it meets your expectations.

1. Choose Edit ➢ Hold whenever you are testing. There are some things in IK that cannot be undone, so holding is always a good idea.

2. Click the Hierarchy tab, then the IK category button, and turn on Interactive IK mode.

3. Select the Light001.Target object, click the Selection Lock toggle at the bottom of the UI or press the spacebar to lock your selection, and move the target around in all directions. Observe the motion of all of the parts of the desk lamp model. If you want to tweak anything in its settings, now is the time to do it.

4. When you are satisfied with the behavior of the desk lamp, turn off Interactive IK mode and choose Edit ➢ Fetch.

The lamp should move in an accurate and realistic fashion. You can easily transform all the parts of the fixture by dragging the light's target wherever you want illumination.

USING THE HISTORY DEPENDENT SOLVER

One problem with investing so much time into building an articulated model is that it requires your colleagues to share the same high level of knowledge to take advantage of your work. If they don't understand IK, then they won't be able to articulate the model as you intend.

One thing you can do to make your model more user-friendly is to apply the History Dependent (HD) solver to the IK chain. No longer will users of your model need to understand the difference between forward and inverse kinematics in order to use your functioning model.

The HD solver makes it unnecessary to switch in and out of Interactive IK mode to transform the articulated model. All the IK calculations are applied to your model permanently, and people can articulate it right away without understanding the technicalities of IK.

1. Select the Light001.Target object. You must select the child end of the chain in this step.

2. Choose Animation ➢ IK Solvers ➢ HD Solver. A rubber band will attach to your cursor. Instead of trying to click an object, you can be more specific by selecting it by name. Be careful not to make a mistake; this step is not undoable.

3. Press **H** to open the Pick Object dialog box. You may have to expand the hierarchy. Select Swivel and click Pick (see Figure 13.30).

You selected the Swivel object in step 3, and not the Base object, because the HD solver should not be bound to the terminator (that's just how it works). Remember to bind it to the second object from the top of the hierarchy. The HD solver will now display in the viewport. A small pink cross appears by Light001.Target; additional orange crosses and angular limit icons indicate joint positions, as shown in Figure 13.31. Moving the pink cross will show you the IK system in action.

FIGURE 13.31
Animating with the
HD solver
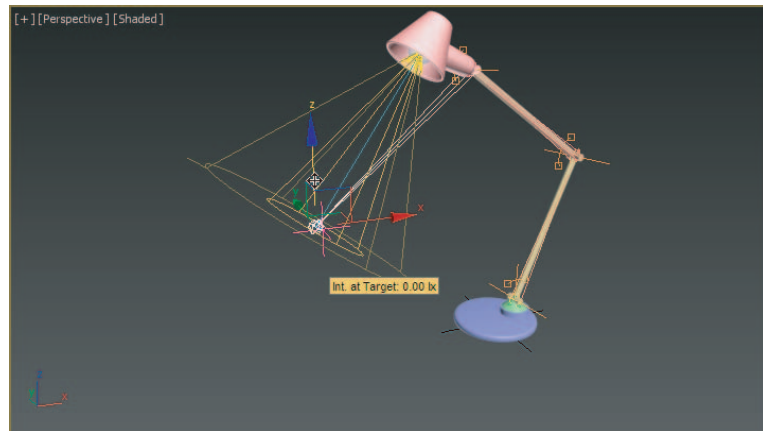
INDENTING THE HIERARCHY

Check Display Children in any Select Objects (or similar) dialog box to display the hierarchy as indents in the list.

BINDING THE END EFFECTOR TO ITS PARENT

The *end effector* is the object that you move to transform the chain when you're using the HD solver. In this case, the end effector is the light's target.

You will find that you cannot move Light001.Target away from where it was when you applied the HD solver. Fortunately, the lamp is not "stuck" in this position forever. The simple solution is to link the end effector to its parent:

1. Select the Light001.Target object.

2. Switch to the Motion tab of the Command panel. Click the Parameters button if it's not already selected, and then scroll down near the bottom of the IK Controller Parameters rollout. Click the Link button under the End Effector group, as shown in Figure 13.32.

FIGURE 13.32
Select the Link button.
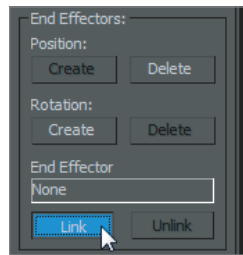
3. Select the Base object from the Perspective viewport. The Base is now linked as the parent to the end effector. In other words, you have linked the bottom and top of the chain together, making a complete mathematical unit.

TESTING THE ARTICULATED CHAIN

Now that you have applied the HD solver to the kinematic chain and bound the end effector to its parent, it is important to test the behavior of the system to make sure it works the way you designed it. If you discover any problems in the testing, you will have to go back and fix them before you assemble the luminaire in the next section. If the desk lamp moves in a realistic fashion without using Interactive IK mode, it passes the test. Let's test the articulated chain now:

1. Choose Edit ➢ Hold for this test.

2. Move the Base object. The entire desk lamp hierarchy should move freely. If the light's target seems stuck in position, go back and bind the end effector to the top parent as described in the previous section, "Binding the End Effector to Its Parent."

3. Move the light target with Interactive IK mode turned off. The parts of the desk lamp should articulate to keep up with the target object. The joints should move in a realistic way, where each joint moves within prescribed limits, with damping where appropriate.

4. Press **H** on the keyboard to have a look at the object hierarchy. The Base is the terminator and the top-level parent. Light001.Target is the end effector, and it is a sibling with Light001 at the bottom of the hierarchy. If the indentation of the list isn't visible, go to the

Select From Scene dialog box's Display menu and choose Display Children; then close and expand the Base object to display the hierarchy.

5. Choose Edit ➢ Fetch once you are satisfied that your scene is working properly. If you made any mistakes, go back and correct them or open the C13_Luminaire05.max file to continue.

ASSEMBLING THE LUMINAIRE

An *assembly* is a data structure that organizes a light fixture and its light source into a simplified interface called a *luminaire*. You can think of an assembly much like a group but with an added feature called a head. The *head* is classified as a helper object that contains the simplified user interface. Let's assemble the luminaire now:

1. Select all the objects except for Light001.Target. Remember to leave the light's target out of the assembly so that you'll be able to transform it independently later on. Everything going into the assembly will be treated as one object (much like a group).

2. Choose Group ➢ Assembly ➢ Assemble. The Create Assembly dialog box appears.

3. Type **DeskLamp001** in the Name box. Notice that Luminaire is the only head object listed because there is only one head helper that ships with 3ds Max 2013. Click OK.

CREATING HELPERS WITH MAXSCRIPT

It is possible to create custom assembly head helpers with the MAXScript programming language. You can learn more about MAXScript in Bonus Appendix 2, which is found at the end of the book.

---

4. Click the Modify tab of the Command panel. Observe the simplified interface of the assembly object, as shown in Figure 13.33.

FIGURE 13.33
The luminaire's
Modify tab
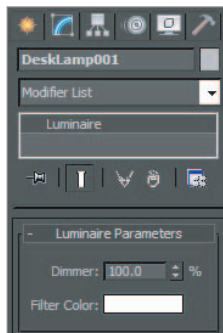
5. Press **H** on the keyboard, and notice that the assembly shows up as a group in the list.

WIRING PARAMETERS

The assembly's interface is very simple and contains only the Dimmer spinner and Filter Color swatch. The only problem with the interface of the assembly is that it doesn't actually work yet.

Right now, there is no behind-the-scenes connection between the user interface components of the assembly head and the actual parameters of the light source they represent. To make this connection, you will *wire* the parameters now:

1. Select the DeskLamp001 assembly.

2. Choose Group ➤ Assembly ➤ Open. Red selection brackets appear around the opened assembly.

IDENTIFYING OPEN ASSEMBLIES

An open assembly displays red selection brackets in the Perspective view whereas an open group displays pink selection brackets. Remember these colors; they'll help you identify and differentiate among the various ways of organizing objects.

Notice that there is a green 2D symbol of a lamp that appears on the grid near the base. This symbol represents the assembly head itself and appears only in an opened assembly object. Here we've isolated the symbol so that it's easier to see, as shown in Figure 13.34.

FIGURE 13.34
Assembly symbol
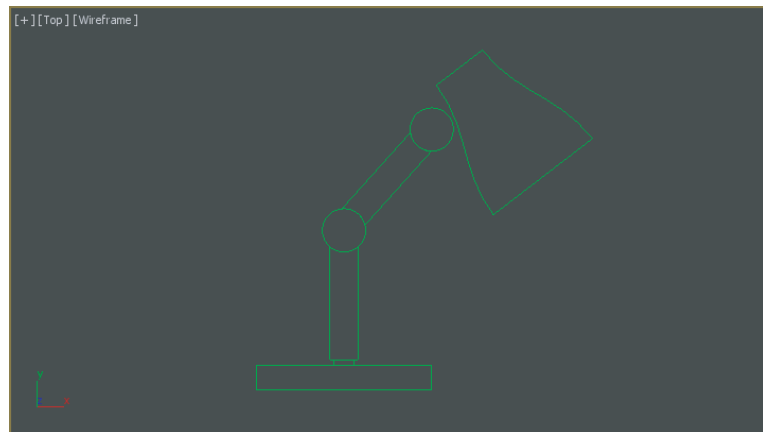
3. Select the head helper symbol. Press **H** to examine the hierarchy. The assembly head is the DeskLamp001 object itself when the assembly is opened, as shown in Figure 13.35. Close the Select From Scene dialog box.
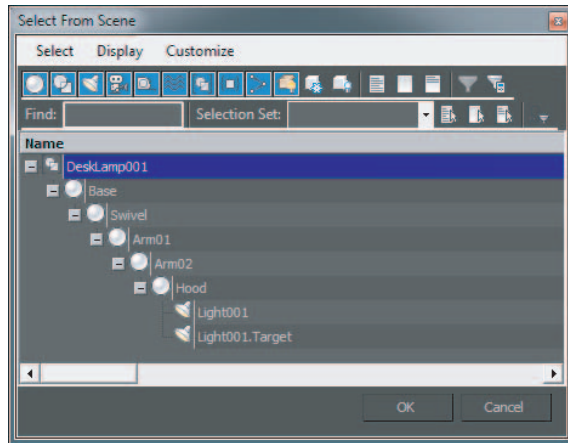
4. Right-click in the Perspective viewport on the assembly head, and select Wire Parameters from the transform quad.

5. A small context menu will appear. The parameters are organized into two categories: Transform and Object (see Figure 13.36). From this small menu, choose Object (Luminaire) ➢ Dimmer.

FIGURE 13.36
Select the parameter
in the context menu.
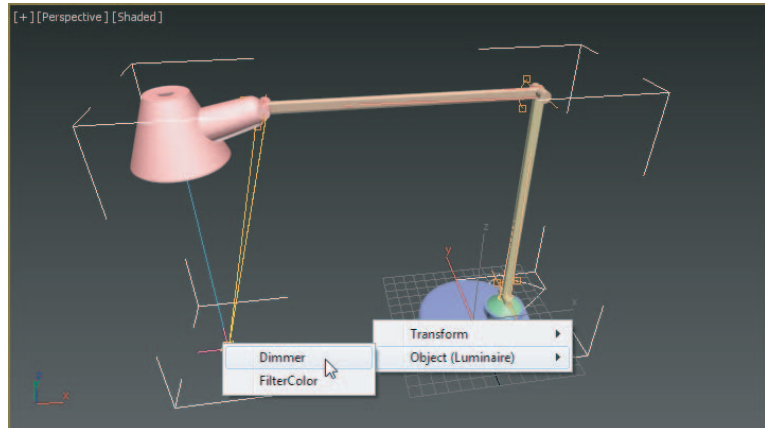
6. A rubber band will be attached to your cursor. Click the Light001 light source object. If you have difficulty selecting the Light001 object, you can hide the Hood object and then create the link, unhiding the Hood when you have finished.

> **ORBIT USING THE KEYBOARD**
>
> You may have to Orbit so that you can see under the lamp if you can't see the spotlight symbol. You can Orbit in the middle of any function by holding down the Alt and Shift keys and then dragging with the middle mouse button/scroll wheel pressed. The Orbit gizmo does not appear in the viewport, but the functionality is available.

7. Again, from a small context menu, choose Object (Target Light) ➤ Multiplier.

8. The Parameter Wiring dialog box appears with the Dimmer in the head selected in the left window and the Multiplier for the light selected in the right column. Click the Two-Way Connection button, and then click the Connect button to wire these parameters together. Close the dialog box.

9. Right-click the head object again, and select Wire Parameters from the quad menu.

10. Choose Object (Luminaire) ➤ FilterColor from the context menu.

11. Click the Light001 object with the rubber band. Choose Object (Target Light) ➤ FilterColor.

12. Establish a two-way connection between the FilterColor parameters as you did in step 8 (see Figure 13.37). Click Connect, and close the Parameter Wiring dialog box.

FIGURE 13.37
Wiring parameters

Click here to establish two-way control.

Then click Connect to wire the parameters.
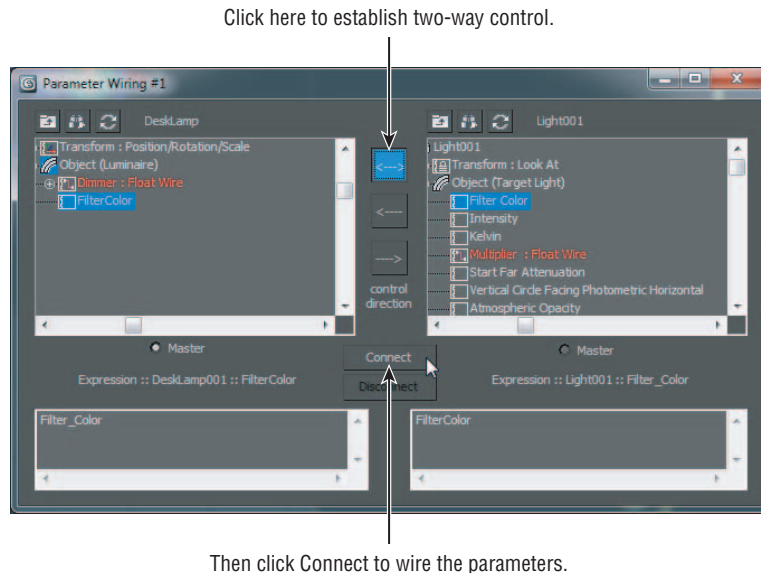
13. The last step is to close the assembly. With the DeskLamp001 head still selected, choose Group ➤ Assembly ➤ Close.

The parameters from the assembly head are now wired together with the light source parameters they represent.

14. Save your work as **My_Luminaire.max**. (Also provided on the Sybex website for reference is C13_Luminaire07.max, which includes additional lighting to illuminate the lamp and a Floor object to catch the light and shadows.)

> **ALTERING THE LIGHT SOURCE PARAMETERS**
>
> Try changing the Filter Color and Dimmer in the assembly and render the scene to see how the light source responds. Or you can see it interactively in the viewport if you select the viewport POV menu and choose Lighting And Shadows ➢ Illuminate With Scene Lights and Enable Hardware Shading.

The desk lamp model is complete. The complexities of the articulated IK hierarchy and the photometric luminaire are hidden within the user-friendly assembly, where you can easily adjust the intensity and filter color of the light source. You can articulate the desk lamp by moving the light target in an intuitive fashion.

Understanding Bones

Sometimes you want to animate something, and a hierarchy based on separate objects won't be sufficient. Animating animals, certain mechanical assemblies, characters, and other organic things is best accomplished using bones.

Bones get their name because they perform exactly like the bones in your body. They are the structural component that when moved, usually by a rotation at the "root" of the bone, deform the skin and contents of your body, allowing you to do things like stand up, walk, throw a ball, or do a cartwheel. You won't be animating those actions in this book, but you will learn how to use bones so that you can animate your own projects.

Bones work as a hierarchical system, like the arms of the lamp you rigged earlier in this chapter. You can actually use any 3ds Max geometry as bones to animate other objects, but the Bones system has many of the features you need already built in, making the process much easier. Bones also work with forward and inverse kinematics (FK/IK), like the rigged lamp you created previously.

CERT OBJECTIVE

1. Reset 3ds Max 2013 so that you are working in a new empty scene.

2. On the Command panel, choose Create ➢ Systems, and click Bones, as shown in Figure 13.38.

FIGURE 13.38
Click Bones on the Create tab.
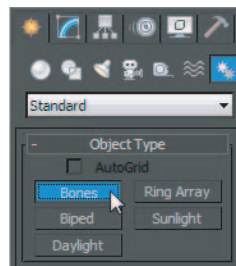
3. In the Top viewport, click near the origin and then move the mouse downward. You'll see an elongated diamond shape stretch between the first point you clicked and the cursor's current position. This is a bone.

4. In the Top viewport, move the cursor so that it is below the first point you clicked in step 2, and click the left mouse button once to place the bone.

5. Because bones work in hierarchical chains, the tool is ready to create the next bone, as shown in Figure 13.39.

FIGURE 13.39
The Top viewport after creating the first bone
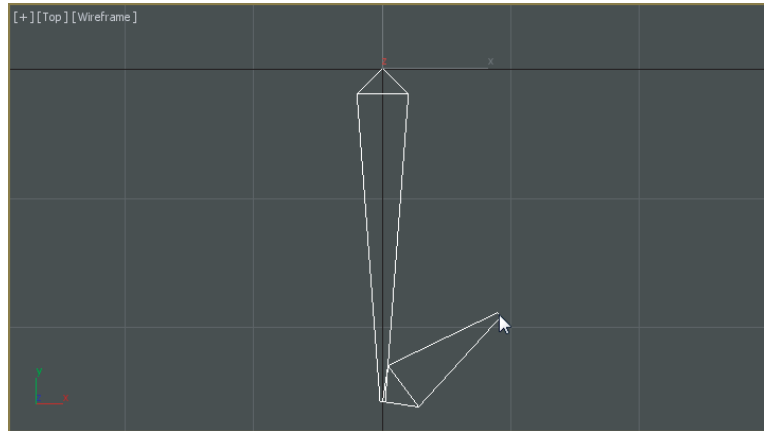
6. You only want to look at one bone for now, so right-click in the Top viewport to end the Bones command.

7. Your viewport should look like Figure 13.40. You see the first bone you created, and attached to the end of the first bone a second bone is automatically created.

FIGURE 13.40
The two bones created
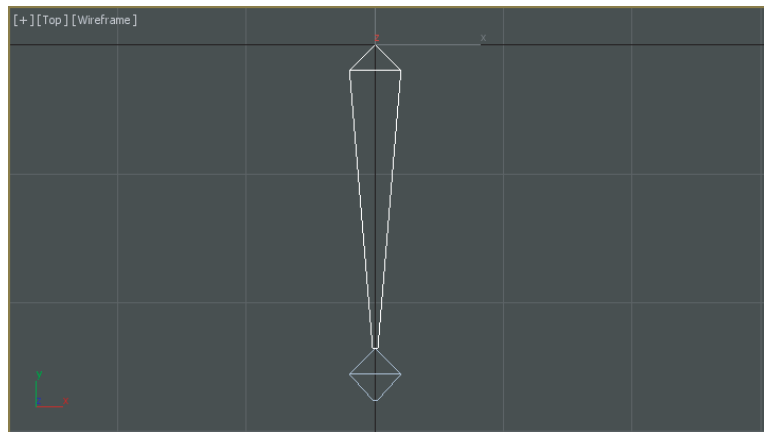
8. Click Select Object on the Main Toolbar to deactivate the Bones tool.

9. Select the first bone you created, Bone001, and open the Modify tab to see its parameters, as shown in Figure 13.41.

FIGURE 13.41
Bone001's
parameters
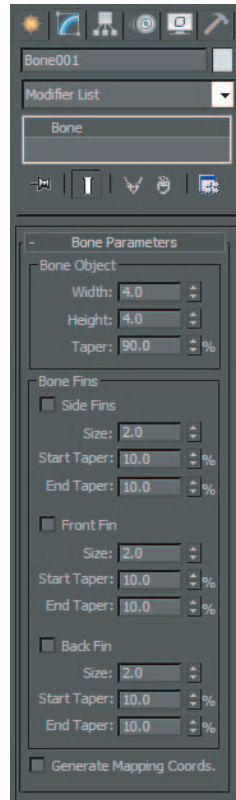
You can see that a bone has a number of parameters you can set, controlling its appearance. You can even have 3ds Max automatically create mapping coordinates for bones. You will adjust some of Bone001's parameters in the next few steps.

10. Adjust the Taper parameter to 33.3% so that the bone doesn't get so narrow at the end.

11. Check the box next to Side Fins in the Bone Fins group. Notice where the fins appear.

12. Set the End Taper value to -10%. Notice how the ends change.

13. Check the box for Front Fin. The fin appears on the right side of the Top viewport, as shown in Figure 13.42.
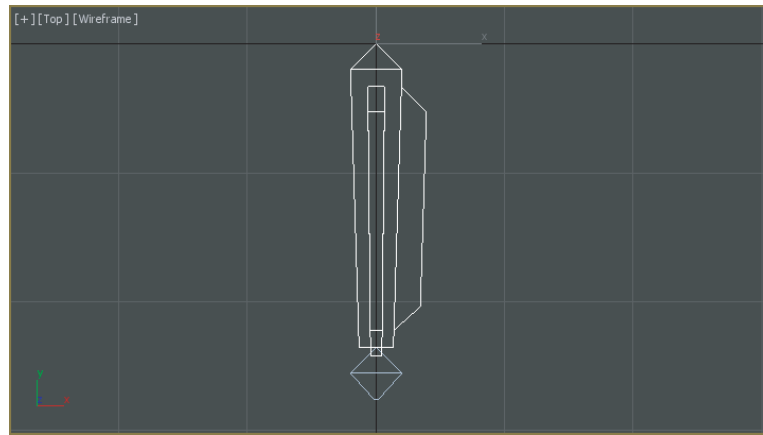
This is an important concept to recognize; that is, when you create a bone, you are looking at what will be the right side of the bone, whatever viewport you are using. Understanding this will help you greatly when you start rigging.

14. Adjust the Perspective viewport so that it looks like Figure 13.43.

FIGURE 13.43
Bone001 in the
Perspective
viewport
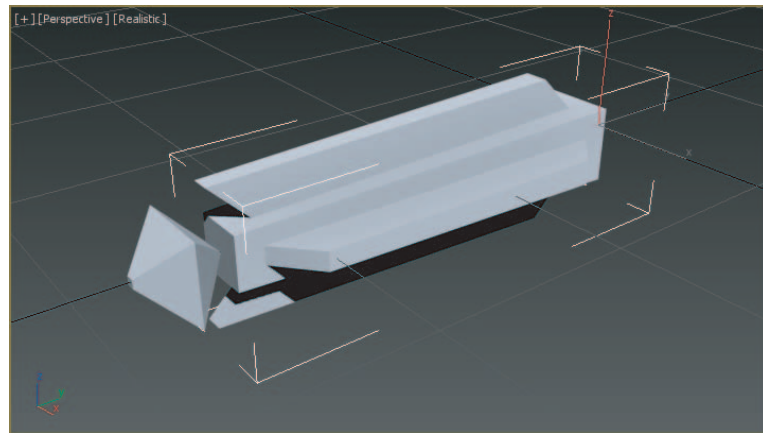
15. Click Render Production on the Main Toolbar.

You see nothing in the Rendered Frame Window. This is because, by default, Bone objects are set to non-renderable in their Object Properties. This keeps bones from rendering, which is great to keep them from showing through on rigged objects in your final renderings. However, this also keeps them from appearing in test renderings (the Views – Grab Viewport tools have a setting to enable rendering bones when generating previews) that you may want to create without the rigged object in order to check the animation quickly without rendering the rigged character or object itself.

You have just learned the basic parameters that will help you identify, create, and interact with bones. Next, you will create a simple bone IK chain and apply a skin modifier and weights to animate a character's arm.

1. Open the file C13_CharacterArm.max.

This is a low-poly model of a cylinder that could represent the arm of a humanoid character. A MeshSmooth modifier has been applied to the model to increase its geometry.

2. Click in the Front viewport to make it active.

3. Click the Create tab of the Command panel if it is not currently open, and click the Systems button.

4. Click the Bones button and, in the IK Chain Assignment rollout, click the IK Solver drop-down menu to see the choices: History Dependent, IKHISolver, IKLimb, and SplineIKSolver. These are different controllers you can select and use to determine how 3ds Max will calculate the hierarchy chain of bones.

5. Click the IKHISolver if it isn't already selected.

THE IK SOLVERS

As you saw when creating the bone chain, 3ds Max offers a number of solvers that you can use for your rigging needs to control how the bones rotate in the chain.

History Dependent　The History Dependent IK solver is good to use when rigging machines, including ones that have joints that slide over each other that require animation. The solver has controls so that you can set up joint precedence and limits. However, this solver is best used for shorter animation sequences. The longer the animated sequence and the farther along in the sequence, the longer it takes to resolve the hierarchy chain.

IKHISolver　The History Independent (HI) solver is the suggested solver to use for characters using IK animation and any long sequence animations that require IK. The HI solver allows you to set up multiple chains in a single hierarchy. This solver is very fast because it is history independent, and it is stable and free of "jitter" in 3ds Max viewports. The solver contains a swivel angle that is used to set elbow and knee solver planes. The swivel angle manipulator can be displayed in the viewports so that it can be adjusted. To help with elbow and knee type joints, the HI solver allows you to set a preferred angle that defines the direction of rotation.

IKLimb　The IK Limb solver is a very fast analytical solver that responds quickly in the 3ds Max viewports. However, it can only be used on two bones in a chain, making it well suited for arms and legs of humanoid characters. The IK Limb solver is also a good choice when exporting IK hierarchies to game engines. This solver is similar to the History Independent solver, and it takes advantage of most of its features and benefits. The IK Limb solver can have its swivel angle targeted to another object to help the animation. This solver gives you the ability to toggle between IK and FK by setting key frames for the IK Enabling setting.

SplineIKSolver　The Spline IK solver lets you use a spline to control the shape of a hierarchy of bones. This solver is much more flexible than the other IK solvers. The vertices on a spline used with the Spline IK solver are called nodes, and the vertices can be animated to adjust the shape of the bone chain. The number of nodes on a Spline IK system can be lower than the number of bones to make posing and animating long chains simpler.

6. Check the box in front of Assign To Children, and also leave the Assign To Root option checked.

7. In the Front viewport, click once near the center of the start of the arm to start creating the bone chain, as shown in Figure 13.44.

FIGURE 13.44
Starting the bone chain
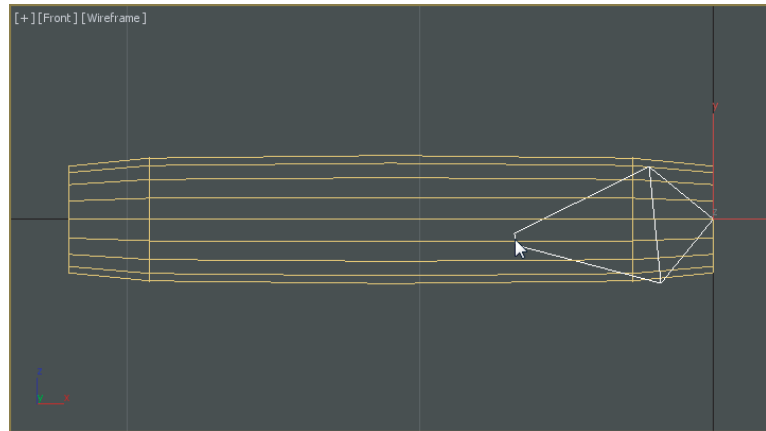
8. Drag the first bone to the about the middle of the arm, but slightly lower than the center of the arm, and click again.

9. Click at the end of the arm slightly higher in the Y-axis to create the second bone, as shown in Figure 13.45. Then right-click to end the bone chain, and click the Select Object tool to exit the Bones command.

FIGURE 13.45
The finished bone chain
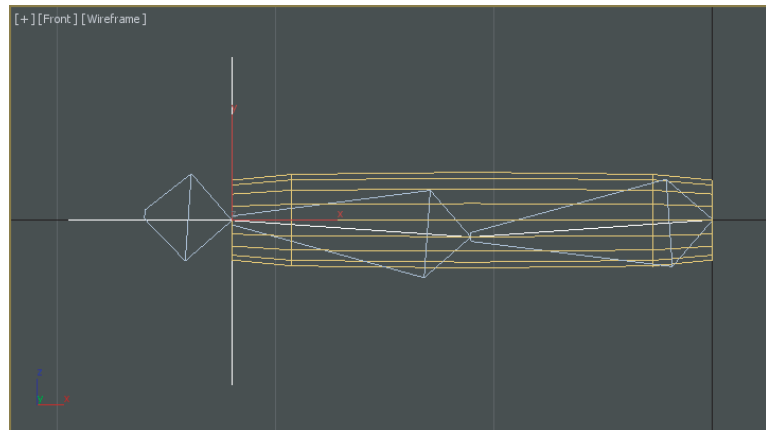
Look at the bone chain carefully. You see a large plus sign at the end of the last bone you created. This is the end effector, just like you saw previously in the exercise with the lamp. If you select the end effector, you will see the IK link between it and the root bone.

You could have also created the bone chain by using the Bone Tools dialog box, shown in Figure 13.46, which is accessed from the Animation menu on the Menu Bar.

FIGURE 13.46
The Bone Tools dialog box
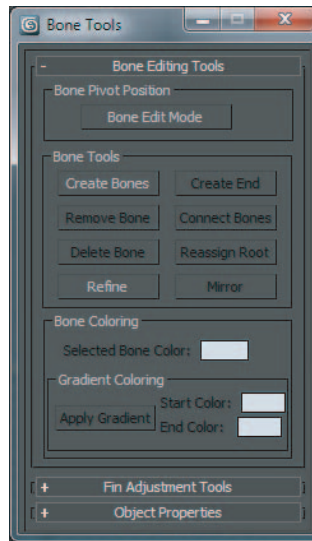
1. Click the Select And Move tool, and then select the end effector.

2. Using the X-Y Plane handle of the Move gizmo, move the end effector in the Front viewport. Notice how the bone chain moves, as shown in Figure 13.47.

FIGURE 13.47
Moving the end effector
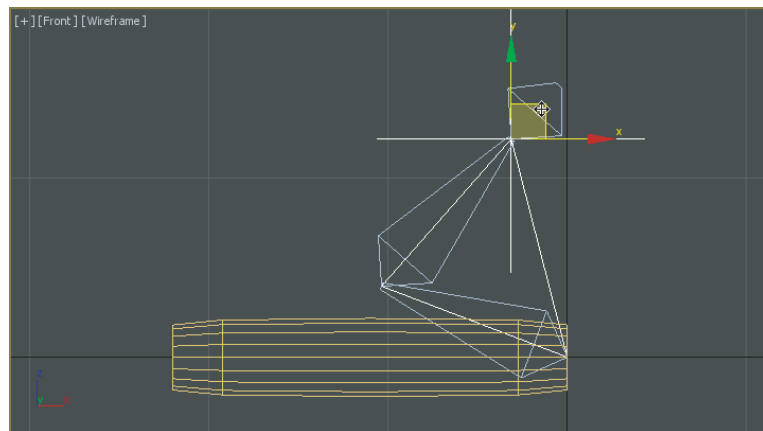
Figure 13.47 shows an extreme amount of movement for the arm's end effector, but it also shows you how easy it is to work with bone chains.

3. Click the Undo Scene Operation button to return the end effector to the position it was at before you moved it.

4. Select the CharacterArm object.

5. Click the Modify tab of the Command panel and, from the modifier stack, select the Cylinder object.

6. From the Modifier List, select the Skin modifier to apply it to the CharacterArm object. This puts the Skin modifier below the MeshSmooth modifier. Your modifier stack should look like Figure 13.48.

FIGURE 13.48

The CharacterArm modifier stack
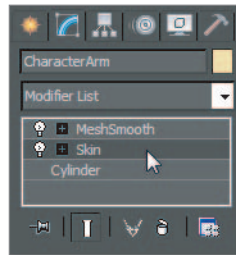
By placing the Skin modifier under the MeshSmooth modifier, the Skin modifier works on the lower polygon count of the Cylinder object and the deformation will be smoothed last.

7. Select the Skin modifier from the stack, scroll down in the Parameters rollout to below the Select group, and click the Add button next to Bones.

8. The Select Bones dialog box opens.

9. On the Select Bones dialog box, select Display ➢ Expand All.

10. The bone chain's hierarchy is expanded for you to see, as shown in Figure 13.49.

FIGURE 13.49

The bone chain hierarchy
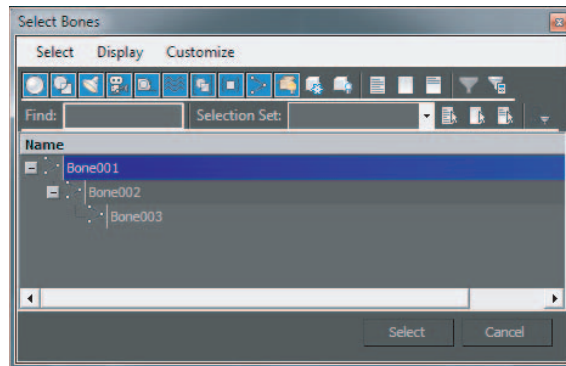
11. Select all three bones, and click Select.

You will see the three bones appear in the Parameters rollout for the Skin modifier.

12. Click the Auto Key button, and then click the Go To End button to move the time slider to frame 100.

13. In the Front viewport, click the IK Chain001 end effector and move it to the right as you did in step 2.

14. You will see that the bone chain moves as it did before and the CharacterArm object reacts, as shown in Figure 13.50, but not as you would like.

FIGURE 13.50
The result of moving the end effector
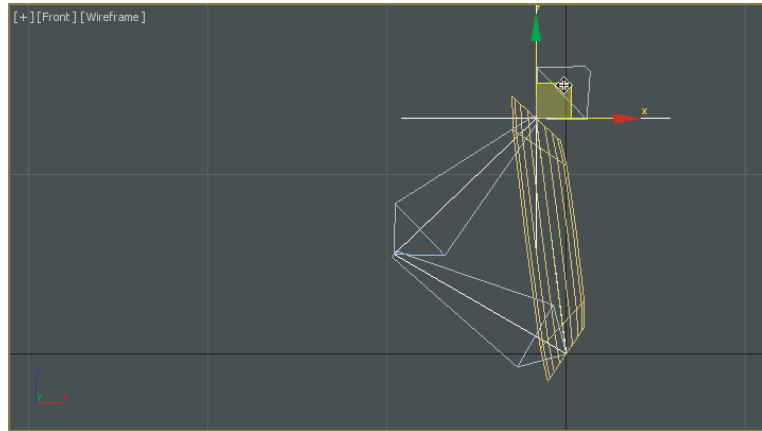
The CharacterArm object's ends move and react to the movement of the bone chain, but the arm doesn't bend at the elbow joint as you would expect. This is because there isn't enough geometry in the arm object to support the deformation, just as when you tried to apply the Bend modifier to an unsegmented box in Chapter 2, "Introducing Objects." You will adjust that in the following steps:

1. Click Auto Key to turn it off.

2. Click the Select Object tool, and select the CharacterArm object.

3. On the modifier stack, select the Cylinder object.

4. In the Parameters rollout for the Cylinder, change the Height Segments value to **4**. You will see the CharacterArm object bend at the elbow, as shown in Figure 13.51. Adjust your Perspective viewport if necessary to see the arm bending.

FIGURE 13.51
The result of adjusting the Cylinder object
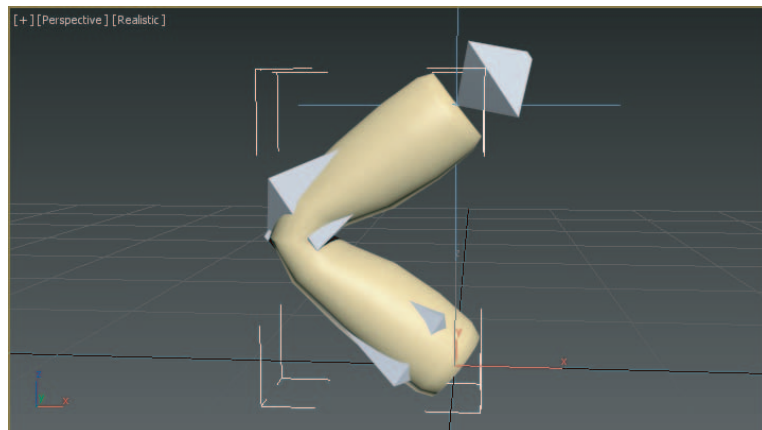
The arm is now bending at the elbow, but not extremely well and there is some undesired pinching happening to the geometry.

5. On the Cylinder object's Parameters rollout, change the Height Segments value to **6**. The arm deforms even better, but it is still pinched at the elbow. You need to adjust the envelopes associated with each bone and how the bones affect the skinned object:

1. Click the Go To Start button on the animation playback controls area of the UI.

2. Select the CharacterArm object if it isn't selected.

3. Click the Zoom Extents All Selected button to make the CharacterArm object as large as possible in all four viewports. You may have to adjust some of the viewports manually to get as large a view of the whole arm object as possible.

4. Select the Skin modifier from the modifier stack.

5. In the Bones list, select Bone001 if it isn't selected.

6. Click Edit Envelopes at the top of the Parameters rollout. Your Perspective viewport should look like Figure 13.52.

FIGURE 13.52
The envelope for Bone001
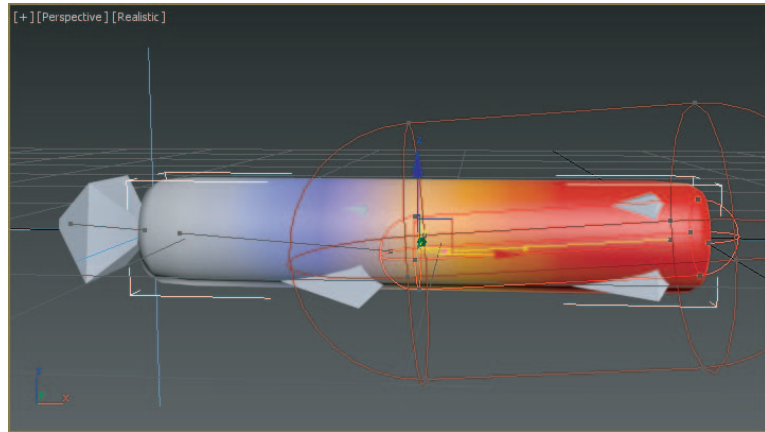
You'll see two, concentric capsule-like objects, called *envelopes*, surrounding Bone001. The inner, brighter red capsule represents the maximum strength of the bones effect, and the darker red capsule is the outer limit of the bones effect. The vertex weight colors presented on the CharacterArm object represent the strength or weighting of the bones deformation on the vertices of the object. Red means 100 percent strength and blue means 0 percent strength. In areas where vertices are contained in envelopes from multiple bones, the effect of the animation will be blended based on a ratio of the vertex weight colors.

The vertex weights go a little too far on the second bone, so you will adjust the envelope to lessen the effect.

7. Make a window selection around the top vertex of the outer envelope, as shown in Figure 13.53.
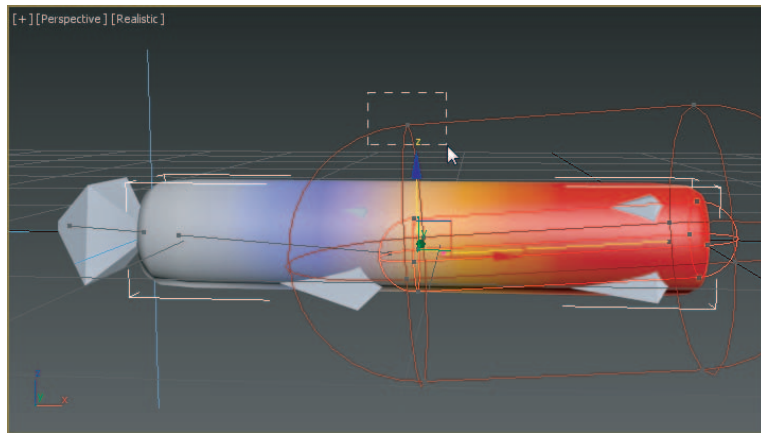
You will see the transform gizmo move to the vertex you selected, and the circle the vertex is on will highlight.

8. Highlight the Z-axis of the transform gizmo, and click and drag downward to reduce the size of the envelope, as shown in Figure 13.54.

9. Select Bone002 from the Bones list on the Modify tab.

10. Select the top vertex on the Bone002 envelope above the elbow.

11. Use the Z-Axis constraint and reduce the size of the Bone002 envelope, as shown in Figure 13.55.
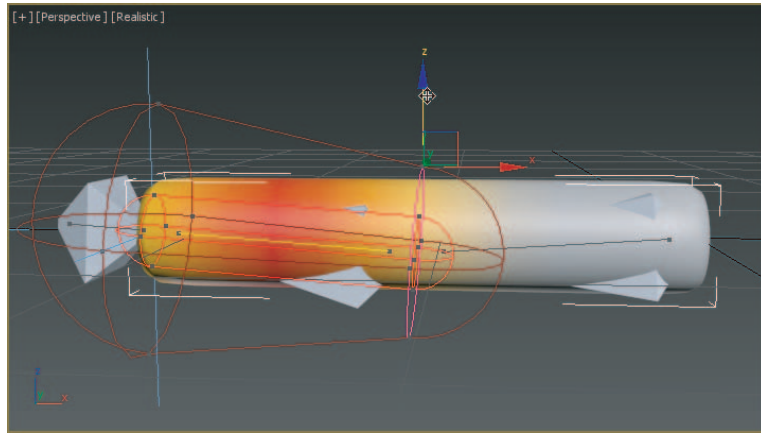
12. Click the Edit Envelopes button to turn it off.

13. Scrub the time slider to see the CharacterArm object animate.

14. Save your scene as **My_CharacterArm.max**.

You can see that the joint deformation still needs some work. You can add an Edit Poly modifier to the Cylinder object. Then in the Skin modifier, enable the Select Vertices option under the Edit Envelopes button and add a Joint Angle or Bugle Angle deformer to the vertices to better control how they respond to the animation.

You can also add a Morph Angle deformer and create a Morph target that could represent the bicep of the arm growing to add more depth to the animation.

When working on productions, finding smart ways to optimize scenes and rigs so that you are only animating and rendering what will be visible in particular shots can be a great way to save on production time, be it modeling, texturing, lighting, rigging, animating, rendering, or in post-production.

If you are creating and rigging a character or creature's limbs, you will want to put a slight bend between the bones of joints, such as the elbows and knees, as you did when you created the bones in this exercise, to give the IK solver the proper direction for the rotation/bending movement.

TIP If you need to edit a Bone system's hierarchy, don't use the Select And Link tool. Use the Bone Tools dialog box that was shown in Figure 13.46.

Understanding Biped

If you are creating a humanoid character in 3ds Max, instead of rigging the entire bone system by hand, you will probably want to take advantage of Biped. As its name implies, the Biped tool creates a two-legged character that stands upright like a human being. Biped was originally part of Character Studio, a character animation plug-in for 3ds Max that was eventually incorporated into the shipping software.

1. Reset 3ds Max or, if you have been working for a long time, quit and restart the program to get to a new empty scene.

2. Use the viewport's pan view and zoom tools to make your Front viewport so that the Z-origin axis line is near the bottom of the viewport and that you have about nine grids above the origin axis.

3. On the Command panel, choose Create ➢ Systems and click Biped.

4. Scroll up on the Create panel so that you can see the entire Create Biped rollout, as shown in Figure 13.56, or as much of it as your screen resolution will let you see.

FIGURE 13.56
The Create Biped rollout
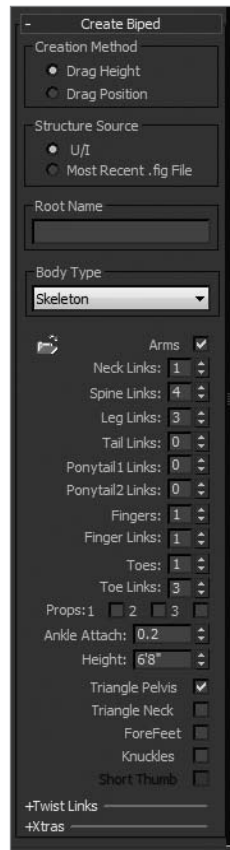
Notice that there are a significant number of options on the Create Biped rollout. The first group is Creation Method. This option determines if you will click and drag to position and then size the biped, or if you will set a Height (around two-thirds of the way down the rollout) and just click and drag to position the biped.

5. Without changing any parameters on the Create Biped rollout, in the Front viewport, put the cursor as near to the origin as you can. Using the coordinate readout at the bottom of the screen as a guide, click and then drag out a 6'-tall biped, as shown in Figure 13.57.

It is okay if your biped isn't exactly 6' tall. As long as you don't deselect the biped, you can still adjust its parameters on the Create rollout. If you need to, scroll down to the Height parameter and enter **6**'. Try not to deselect the biped or navigate away from the Create tab while reading the following paragraphs.

Look carefully at the biped in the viewports; the right-side limbs are green, and the left-side limbs are lavender/purple. In the Create Biped rollout, you can see that the Name And Color rollout and the Root Name rollout have Bip001 listed. This is the default name for the biped, and it will be the prefix for all components of the biped.

If you look in the viewports, you will see that the Root object that is selected is located within the pelvis of the character and represents the biped's Center of Mass (COM).

The Structure Source group determines if 3ds Max will create the biped based on the user interface settings or based on the last figure (`*.fig`) file that you have created and saved. Figure files save the parameters and pose you have entered and saved for a biped in Figure mode, but they do not contain the actual biped geometry of that figure. Below the Root Name group is the Body Type drop-down menu. This allows you to select how the biped will look.

6. Click the Body Type drop-down menu.

The biped you created used the Skeleton type. Figure 13.58 shows you the body types in order from left to right: Skeleton, Male, Female, and Classic biped.

FIGURE 13.57
Click and drag out a 6'-tall biped.
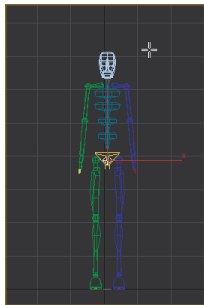
FIGURE 13.58
The biped default body types (left to right): Skeleton, Male, Female, and Classic
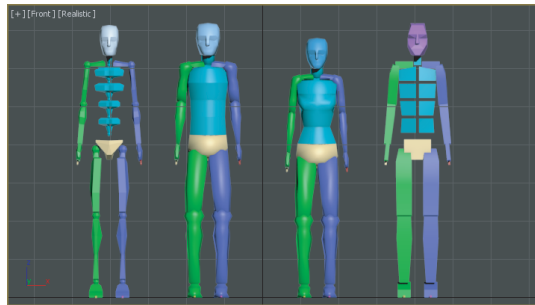
You can also load a figure file with the Load File tool that is located just under the Body Type group.

If you deselect the biped after creating it (often by selecting any other tool in 3ds Max, such as the Select And Move tool to reposition the biped), and you need to adjust its physical characteristics, you have to select the biped's root/(COM) object and then switch to the Motion tab of the Command panel. From there, you must enter Figure mode and then use the Structure rollout that appears only when Figure mode is active.

1. From the Body Type drop-down, select the Female body type.

2. In the list of properties for the biped, find the Fingers value and change it to **5**.

3. Change the Finger Links value to **3**.

4. Use the zoom tool to adjust the Perspective view to get a closer view of the hands, as shown in Figure 13.59.

FIGURE 13.59
The female biped with five fingers, each with three links
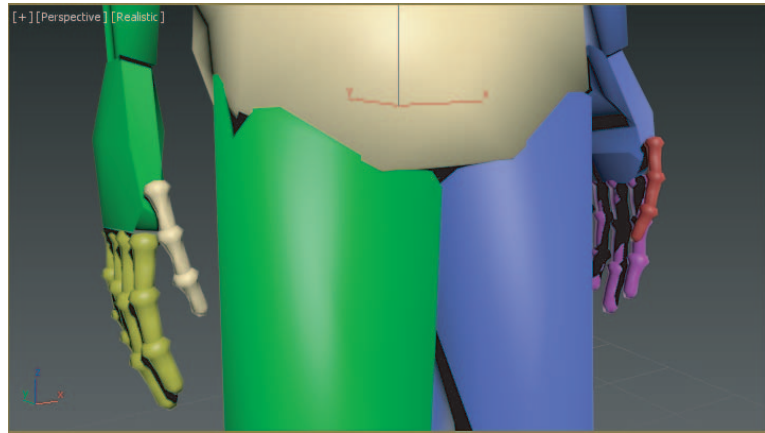
As you can see from the list of parameters available for Biped, you can create very detailed hierarchical structures to animate your characters.

5. Scroll down to the very bottom of the Create Biped rollout. You will see additional rollouts for Twist Links and Xtras, as shown in Figure 13.60.

FIGURE 13.60
The Twist Links and Xtras rollouts
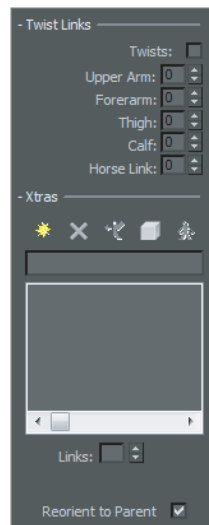
The Twist Links option and parameters allow you to add the ability to rotate the limbs of the biped so that they react more like your arms. The Xtras rollout allows you to add additional tails to the biped. The additional tails behave like the ponytails. They use only forward kinematics.

6. Save your scene as `My_FemaleBiped.max`.

Now that you are familiar with the basics of Biped, you will study a character rigged with Biped and then make the character walk:

1. Open the file `CMan0002-M3-CS.max` that comes with your 3ds Max 2013 install. You will be presented with the File Load: Gamma & LUT Settings Mismatch dialog box. Select the Keep The System's Gamma And LUT Settings? radio button and click OK. You will also see a File Load: Units Mismatch dialog box appear. Select the Rescale The File Objects To The System Units Scale? option. The file should be found in your `C:\Users\`*UserName*`\ Documents\3dsMax\scenes` folder. This file is provided from XYZ Design, and it comes from their Metropoly 3 set of prerigged characters. You can purchase many prerigged vehicles, characters, Mocap (Motion Capture) files, textures, and even sound effects from their website at `www.aXYZ-design.com`. Notice that there are some other fantastic files provided for you to study and play with in 3ds Max 2013.

2. Click the Maximize Viewport toggle to display all four viewports, and then click Zoom Extents All to show the character in all four viewports.

3. Press **H** on the keyboard to open the Select From Scene dialog box. Expand the Hips entry, Spine entry, and Spine1.

4. Select the Hips object, as shown in Figure 13.61. You can see from the Select From Scene dialog box that the components of the Biped object have an icon that represents a bone system. Click OK.

FIGURE 13.61
Select the Hips item.
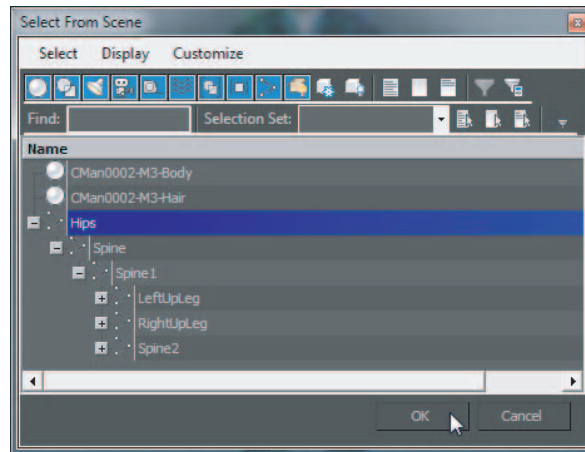
The Hips item is the Bip001 (COM) object that has been renamed in this hierarchy.

5. On the Command panel, click the Modify tab and see that the Hips item is a Biped object.

1. Press **H** on the keyboard and, from the Select From Scene dialog box, select the CMan0002-M3-Body object.

2. On the Modify tab, notice that the Cman0002-M3-Body object is an Editable Poly object with the Skin modifier applied, similar to the Arm object you worked on earlier in this chapter.

3. Scroll down the Modify tab until you get to the Weight Properties group, as shown in Figure 13.62.

FIGURE 13.62
The Weight
Properties rollout

1. Click the Weight Table button to open the Skin Weight Table dialog box. The Skin Weight Table dialog box gives you another alternative for controlling how bones affect the vertices of your character mesh object.

2. Put your mouse over the vertical line that divides the column headers for Spine and Spine1. See how it turns into a double-headed arrow? You can use this to reduce or enlarge the width of the columns, like on a spreadsheet.

3. Click with the double-arrowhead icon, and drag to the left to reduce the width of the columns so that you can see more columns on the dialog box; from Spine to Head would be a good range.

4. On the lower-left side of the Skin Weight Table dialog box is the Vertex selection drop-down menu that currently says All Vertices. This menu filters what vertices are displayed in the dialog box based on your selection.

5. On the Vertex selection drop-down menu, click Selected Bone.

6. Click the Spline2 column header near the top center of the dialog box to show the mesh vertices that are associated with that bone.

7. Using the vertical scroll bar along the right edge of the dialog box, scroll until you see Vertex #465 in the middle of the dialog box.

8. Click the #465 line to highlight it. Your dialog box should look like Figure 13.63.

FIGURE 13.63
The Skin Weight
Table dialog box
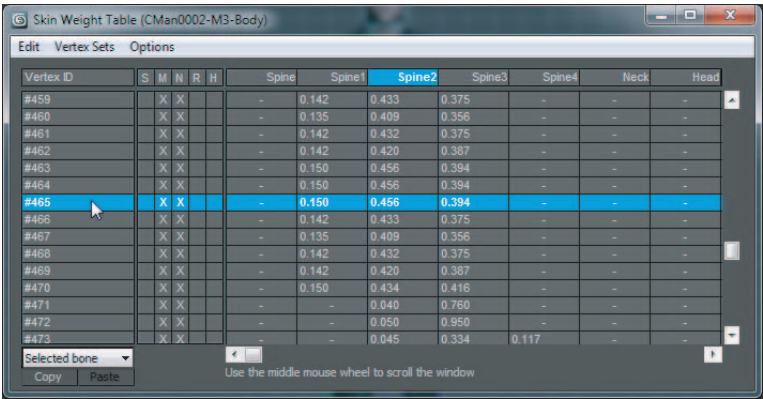
The Skin Weight Table is showing you that Vertex #465 is affected by three bones: Spine1, Spine2, and Spine3. You can use the horizontal scroll bar at the bottom of the dialog box to make sure that no other bones have any influence over the vertex.

1. You can see that the values displayed in the table represent the influence each bone has on the vertex. If you add up all three values, the sum is 1.

   If you needed to, you could click in a field of the table to adjust the values or click the Copy button in the lower-left corner of the dialog box, then select another field, and paste the value in that field with the Paste button.

2. Without changing any of the values on the table, click the Weight Table button on the Modify tab to close the Skin Weight Table dialog box.

When you are rigging characters with the Skin modifier, being able to easily control the vertex weights on the mesh will be crucial for getting the animated deformations you want for your finished projects.

Now you will see how you can animate the rigged character quickly:

1. Click the Motion tab on the Command panel.

2. Press **H** on the keyboard, select the Hips object, and click OK.

3. Click the Motion tab, and then expand the Assign Controller rollout, right-click the Transform : Body entry, and click Expand Tracks. The Assign Controller rollout should look like Figure 13.64.

FIGURE 13.64
The Assign Controller rollout for the biped
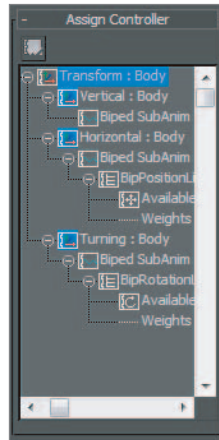
You can see that the biped uses its own Body controllers for Vertical, Horizontal, and Turning. You can assign controllers of your choice to the BipPositionList and BipRotationList channels.

1. Scroll down on the Motion tab; after the Assign Controller rollout is the Biped Apps rollout. If you expand that rollout, you'll see two buttons, Mixer and Workbench.

The Motion button opens the Motion Mixer dialog box, which allows you to edit multiple motion clip files (`*.bip` and `*.XAF`) together the way you would use a nonlinear editor to transition, layer, and retime clips, and save the resulting animation to one file. The Workbench button

opens the Animation Workbench dialog box, which is a special curve editor designed just for working with Character Studio.

2. Keep scrolling down in the Motion tab; the next rollout is Biped.

This is where you will find the Figure Mode button, which you will use to align the Biped components to your character and creature models. You also have access to the Footsteps Mode button, which is a quick way to get your biped (and linked character) moving through your scenes.

Other important tools in this rollout are the Biped Playback tool, which causes the active viewport to display the links of the biped only as stick figures, so you can easily study the animation you have applied to the character.

The Load File button allows you to load `*.BIP` (Character Studio biped animation file) and `*.STP` (Step files contain footstep animations) files onto your biped.

The Save button is used to save your animation as a BIP or STP file so that you can reuse the animation and apply it to other characters.

1. Click the Footstep Mode button. You will see the Footstep Creation and Footstep Operations rollouts appear, as shown in Figure 13.65.

FIGURE 13.65

The Biped rollout in Footstep mode with the Footstep rollouts
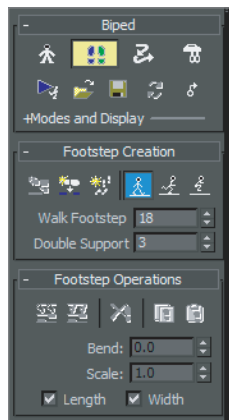
2. On the Footstep Creation rollout, click the Create Multiple Footsteps button.

3. On the Create Multiple Footsteps dialog box that opens (shown in Figure 13.66), set the Walk Footstep value to **15**. Leave all the other values unchanged.

FIGURE 13.66

Set the Walk Footstep value to 15.
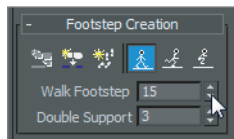
4. Click OK to close the Create Multiple Footsteps dialog box.

5. Use the zoom tool and, in the Top and Left viewports, zoom out so that you can see the footsteps that were created.

6. On the Motion tab, scroll down so that you can see the whole Footstep Operations rollout if you can't see it all.

7. Click the Create Keys For Inactive Footsteps button. You will see the character adjust its stance in the viewports.

8. Right-click in the Perspective viewport to make it active.

9. Click the Play Animation button, and watch the character walk stoically off the screen.

   You have just taken your first steps, with the help of Biped, on the journey of character animation.

10. Save this scene with the rest of your Chapter 13 files as **My_CharacterWalk.max**.

Much of what you learned from rigging the solar system and lamp earlier in the chapter also applies to rigging complex characters or mechanical objects with bones. This book doesn't cover rigging a full character in depth, however. *Autodesk 3ds Max 2012 Essentials* by Dariush and Randi Derakhshani (Sybex, 2011) dedicates an entire chapter to rigging a low-poly SWAT-like character model with Biped and another chapter to animating the completed rig.

3ds Max 2013 comes with the Character Animation Toolkit (CAT), which is accessed on the Command panel by clicking Create ➢ Helpers ➢ CAT Objects ➢ CATParent and then clicking and dragging in the viewports. CAT features a number of predesigned character and creature rigs that you can load and immediately start to work with.

Autodesk has released a number of experimental and technology previews available on their Autodesk Labs website (labs.autodesk.com). In the Media & Entertainment section, you can find information about Project Geppetto, which is designed to help 3ds Max and 3ds Max Design users quickly and easily create crowd animations. From the Labs site, you can download Project Geppetto and watch a number of videos that will help you get started.

The Bottom Line

Create parent–child hierarchies. Creating parent–child hierarchies is an effective way to link objects together that allow any transformations applied to the parent to be transferred to the children in the link structure in order to create dynamic and interesting animations.

   Master It Create a simple hierarchy representing a sun, planet, and moon, which are parented and ready to animate with the moon orbiting the planet, and both the planet and moon orbiting the sun.

Create a morph animation. To create an animation of an object or creature that is not well suited to using hierarchical rigs or IK bone chains, creating morph targets and using the Morpher modifier is a way to make such things as talking characters with lip-sync techniques.

   Master It When creating an animation with the Morpher modifier, what is the one requirement that must be met for the Morpher modifier to work?

Create a simple IK rigged hierarchy. Rigged hierarchies that take advantage of one of the IK solvers that 3ds Max provides is a fundamental way to create models for your scenes that can be animated.

Master It   Rigged hierarchies on which you want to use inverse kinematic solvers must be created only with 3ds Max bone objects. True or False?

Create bones.   Bones can be created and linked to objects to create all manner of hierarchies to animate your models.

Master It   When you create bones to build hierarchies for animating your models, the bones are set to renderable by default. True or False?

Create a biped.   Using the Biped feature originally brought to 3ds Max by the Character Studio plug-in is a fast and fun way to create an advanced hierarchical system for animating characters in 3ds Max.

Master It   Create a biped that is 5′ 5″ tall with a female body type, five fingers on the hands, three toes on the feet, and a tail with five segments.

Chapter 14

Advanced Rendering Using mental ray

In Chapter 7, "Light and Shadow," you learned how to light the Villa Savoye model with standard lights, set up "fakiosity," and render the scene with the Default Scanline Renderer. That fundamental information still applies to the mental ray rendering engine in the Autodesk® 3ds Max® platform; however, mental ray gives alternative light sources that give you even more options for rendering your scenes.

3ds Max 2013 ships with the new 3.10 version of the robust mental ray renderer. It includes Final Gather presets for quickly assigning situation-specific parameters; the Arch & Design, Car Paint, and Autodesk materials; global quality sliders on the Reveal toolbar for fine-tuning renderings; and mr Proxy to help make your renderings process more efficiently. 3ds Max 2013 also includes updates and improvements to the iray renderer.

In this chapter, you will learn how to use some of the advanced features of the mental ray renderer.

Because you use them in conjunction with mental ray, high dynamic range (HDR) image files, which are another hot topic in computer graphics, will also be covered in this chapter.

In this chapter you will learn to

◆ Apply final gathering

◆ Create a contour rendering

◆ Use the Multi/Sub-Map material

◆ Use Skylight global illumination

◆ Use mr Proxy objects

◆ Use IES files

Understanding mental ray

mental ray is an optional renderer that you can use in 3ds Max 2013. It is the default renderer in 3ds Max Design 2013. More than just a renderer, mental ray uses special materials, photometric lights, and rendering controls. Ideally, you should decide whether to use the scanline renderer or the mental ray renderer before you begin lighting and applying materials in your scene.

If you use standard materials, mental ray will be able to use them; if you use mental ray materials, the scanline renderer won't be able to render the scene correctly.

---

mental ray Is a Complete Rendering System

It is up to you to educate yourself on the numerous arcane settings that can help refine the mental ray rendering process. If you plan to use it professionally, reading the technical details on mental ray in the 3ds Max 2013 User References is worth the effort.

Radiosity and the Scanline Renderer

If you are not using mental ray, you can obtain global illumination for the scanline renderer by using radiosity. A radiosity solution can be calculated in conjunction with the scanline renderer. The Scanline Advanced Lighting Radiosity System stores the indirect illumination data directly in the model file, and then the scanline renderer processes only the direct illumination.

Not only can mental ray create a physically correct lighting simulation, but it can also render all imaginable visual phenomena (including some not possible to simulate with the Default Scanline Renderer and the Radiosity Advanced Lighting plug-in) through its fully programmable libraries of shaders.

You may remember from Chapter 8, "Enhancing Models with Materials," that shaders are the algorithms that enable the primary components of a material (the ambient, diffuse, and specular colors, for example) to be blended in different ways. With the mental ray renderer, shaders take on the expanded definition of any algorithms used in rendering.

mental ray's shaders are used in materials, lights, cameras, and the renderer itself. The fact that shaders are programmable allows advanced animation and effects companies to push the computer graphics bar even higher. The larger firms in the film, computer game, and visualization markets have resources to hire programmers to write subroutines for shader libraries that feature new procedural textures, new materials, new lighting models, and much more.

Programmers can also repackage existing shaders in new ways as mental ray phenomena (scripted shader trees). Many shader libraries and phenomena (including the LumeTools Collection and Physics phenomena) ship with the version of mental ray integrated with 3ds Max 2013, so you'll have a lot from which to choose. Most smaller firms (including most architects and interior designers) don't have the resources to hire programmers for their projects, but they still benefit from the interest and continued shader development that mental ray enjoys in larger markets.

Many 3D Software Packages Include mental ray

NVIDIA's mental ray has been integrated into many of Autodesk's products including 3ds Max, Autodesk® Maya® software, Autodesk® AutoCAD® software, the Autodesk® Revit® family of products, and the Autodesk® Softimage® application. mental ray has also been included with Side Effects Software's Houdini, SolidWorks' PhotoWorks, Dassault Systèmes' CATIA products, and other software packages. You can find more information about mental ray and see the impressive rendering galleries at www.nvidia.com.

mental ray is a complete rendering system that can calculate almost any visual phenomenon that you want to simulate, including both direct and global illumination, caustics, ray-traced reflections and refractions, and more. In fact, mental ray is a renderer of such power and depth that entire volumes have been written on the subject. We will concentrate on the basic features of mental ray in this chapter so that you can get started on a sample project.

OTHER MENTAL RAY INFORMATION SOURCES

Please refer to *mental ray for Maya*, *3ds Max, and XSI*: *A 3D Artist's Guide to Rendering* by Boaz Livny (Sybex, 2007) and *Mastering mental ray*: *Rendering Techniques for 3D & CAD Professionals* by Jennifer O'Connor (Sybex, 2010) for the definitive texts on using the mental ray renderer.

---

mental ray takes great advantage of parallelism in information processing systems. Multiple threads of data can run in parallel (at the same time) on one or more processors in one machine or can run across several computers on a network to process your rendering.

In addition, only the incremental changes to the scene database are rendered in the sequential frames of an animation. This can save a huge amount of time as compared to radiosity rendering, whose solution often needs to be recalculated entirely for each frame under changing lighting conditions.

NETWORK RENDERING WITH MENTAL RAY

Contact a skilled network administrator to set up mental ray for rendering in parallel across your network. Refer to Help ➢ Autodesk 3ds Max Help, and search for "network rendering" for additional information.

When you render an image with mental ray, you'll notice a few big differences in the Rendered Frame Window (RFW). You are probably used to the way the default renderer processes scanlines from the top of the frame down. mental ray processes frames in buckets—small rectangular blocks of pixels. As the buckets are processed, the RFW changes from black to display the rendered image. This provides visual feedback regarding the progress of each frame as it is rendering.

RENDERING WITH BUCKETS INCREASES EFFICIENCY

Processing a frame in buckets creates greater modularity that allows the massive parallelism that the mental ray renderer enjoys; each bucket can be given to a different thread for processing. Therefore, mental ray can take advantage of parallel distributed processing more efficiently than most renderers.

Figure 14.1 shows how the buckets appear in the RFW. You will see the buckets firsthand in the next section when you render with mental ray using the sample project.

Buckets that have already been rendered

Buckets yet to be processed

Reveal toolbar

Current buckets being rendered
(4 buckets on a quad-core system)
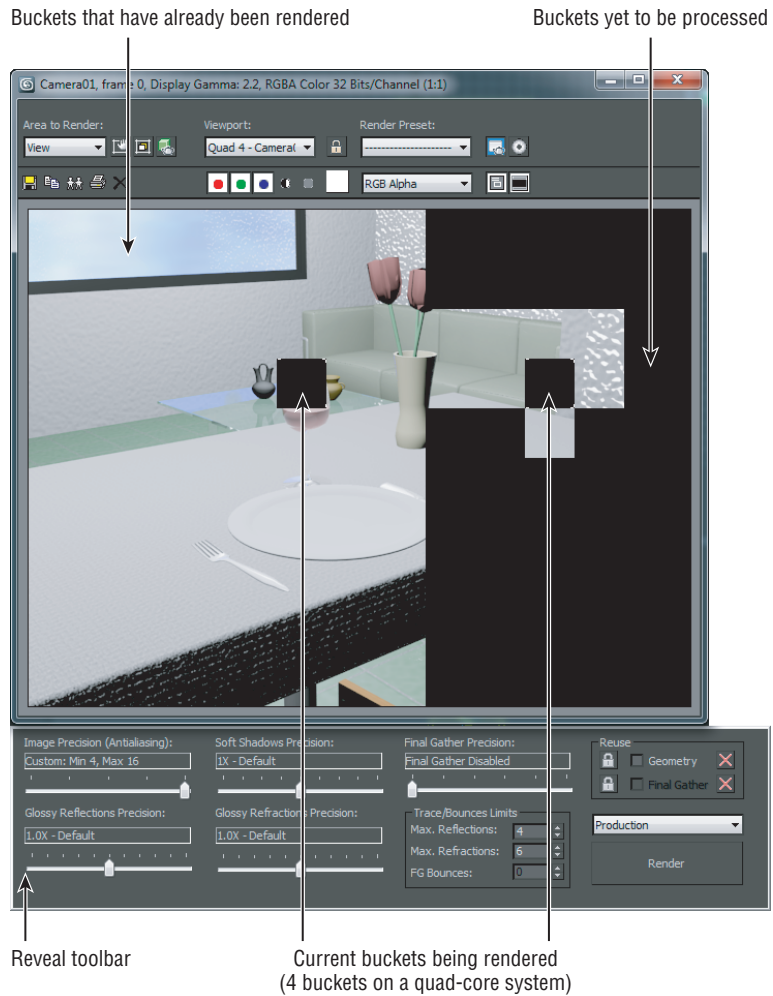
The order in which the buckets are rendered may seem like a mystery to you at first. By default, mental ray chooses the bucket order based on minimizing the memory cost of switching to the next one. If you're rendering buckets across a network, bucket order also is influenced by the need to minimize traffic and load-balance the processors, so the buckets may seem to appear in the RFW at random.

You may notice the addition of the Reveal toolbar underneath the RFW that contains the global quality sliders. The quality control sliders give you the ability to globally change the antialiasing, material reflection/refraction, soft shadow, and Final Gather precision settings so that you can easily change settings to speed up render times for tests and then increase the quality settings to fine-tune your final renderings. You will use the Reveal toolbar later in this chapter.

Setting Up mental ray

Now that you understand what mental ray can do and how it renders, there are two things you will need to do to start working with mental ray in 3ds Max. You'll need to verify a setting in the Preference Settings dialog box, and then you'll need to assign the renderer in the Render Setup dialog box.

VERIFYING YOUR PREFERENCE SETTINGS

In Chapter 1, "Getting to Know Autodesk® 3ds Max® 2013," you saw how to change the 3ds Max 2013 defaults; now you need to change the defaults so that 3ds Max is set to the appropriate settings for using mental ray.

If 3ds Max is running, save any current work you have open and then quit and restart 3ds Max before starting these steps.

1. Once you have restarted 3ds Max, choose Customize ➢ Custom UI And Defaults Switcher.

2. Select the `DesignVIZ.mentalray` item in the Initial Settings For Tool Options section in the upper left of the dialog box. Then click the Set button.

3. A dialog box will indicate that the settings will take effect the next time you start 3ds Max.

4. Quit and restart 3ds Max 2013.

ASSIGNING THE RENDERER

Now that you have set the mental ray defaults for 3ds Max 2013, you are ready to proceed with this chapter's exercises. Even though you have set up 3ds Max to use the mental ray preferences, you still have to assign mental ray as the Production renderer for scenes that are currently set to use the scanline renderer. In the following exercise, you will assign the mental ray renderer to a scene.

1. Open the `Room.max` file. The sample file contains a single room interior with furnishings. The materials have already been set up for the scanline renderer and, currently, no light sources are in the model.

2. Choose Customize ➢ Preferences. Click the mental ray tab.

   Make sure Enable mental ray Extensions is selected in the General section. This option should already be selected, since it is active by default. It is important to be aware of this setting in case you ever encounter a scene where this has explicitly been turned off (otherwise mental ray will not work).

3. Click OK to close the Preference Settings dialog box. The next step to finish enabling mental ray is to assign it as the Production Renderer in this scene.

4. Press the **F10** key, or choose Rendering ➢ Render Setup, to open the Render Setup dialog box and then click the Common tab. Scroll down to the bottom of the dialog box, and open the Assign Renderer rollout.

5. Click the Choose Renderer (…) button next to Production, which currently is assigned to the scanline renderer, as shown in Figure 14.2.

FIGURE 14.2
Click the Choose Renderer button.
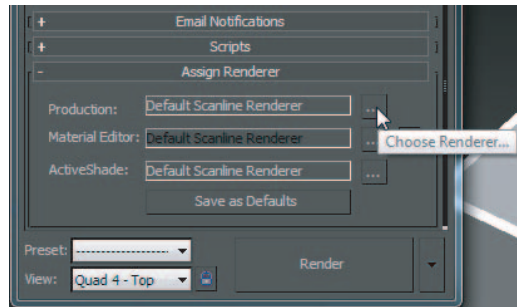
USING DIFFERENT RENDERERS FOR PRODUCTION AND THE MATERIAL EDITOR

Although it is possible to assign different Production and Material Editor renderers, doing so is not recommended (they are locked together by default). It makes more sense to view materials in the same way that you will render them.

---

6. The Choose Renderer dialog box appears. Select NVIDIA mental ray, from the short list, and click OK.

The scene is now enabled for rendering with mental ray, both for the Production renderer and in the Material Editor. Notice that the tabs in the Render Setup dialog box changed after you switched renderers. Now the Indirect Illumination and Processing tabs replace the Raytracer and Advanced Lighting tabs. In addition, the controls that were on the Renderer tab have changed—they are now specific to mental ray, as shown in Figure 14.3.

FIGURE 14.3
The Render Setup dialog box
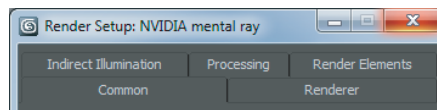
7. Close the Render Setup dialog box without rendering.

The Material Editor and mental ray

When you set up a scene to use mental ray, new materials and maps become available to you in the Material Editor—you read about some of these in Chapter 8. In addition, you can use light and camera features specific to mental ray.

Let's take a quick tour of the Slate Material Editor to see what changes when you're using the mental ray renderer:

1. Open the Slate Material Editor.

2. Right-click in the View1 window, and choose Materials ➢ mental ray. This gives you a list of the mental ray-compatible materials, as shown in Figure 14.4.
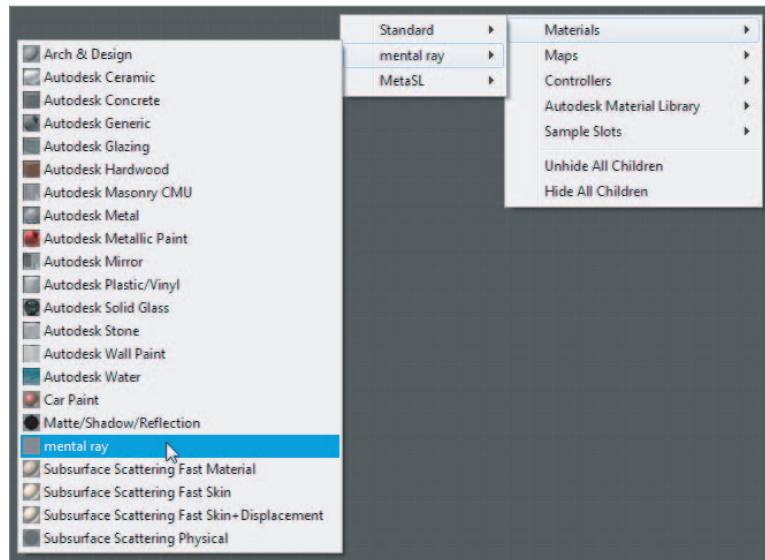
3. Select the mental ray material to add a mental ray material node to the View1 window.

4. Double-click the mental ray node to display its settings in the Parameter Editor section of the Slate Material Editor.

   The mental ray material shaders are grouped into these categories: Basic Shaders, Caustics And GI, Extended Shaders, and Optimization. Two more options appear in the Advanced Shaders rollout, as shown in Figure 14.5.

5. In the Material/Map Browser section of the Slate Material Editor, scroll down to the Scene Materials rollout and double-click the ceiling material sample slot; this adds it to the View1 window.

   Note that you can have multiple materials in an active View window.

6. Double-click the Architectural material node, and expand the mental ray Connection rollout at the bottom of the panel (see Figure 14.6).

FIGURE 14.5
Inside the
mental ray material
shaders
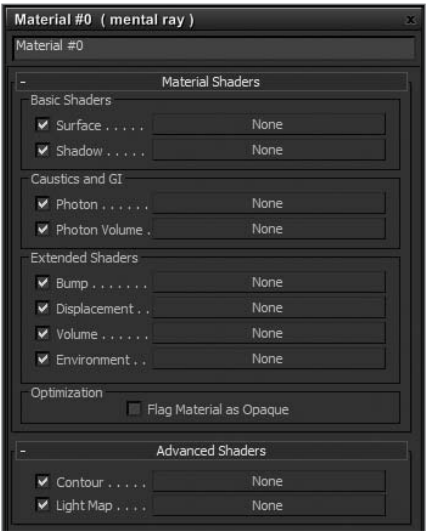
FIGURE 14.6
The mental ray
Connection
rollout from an
Architectural
material
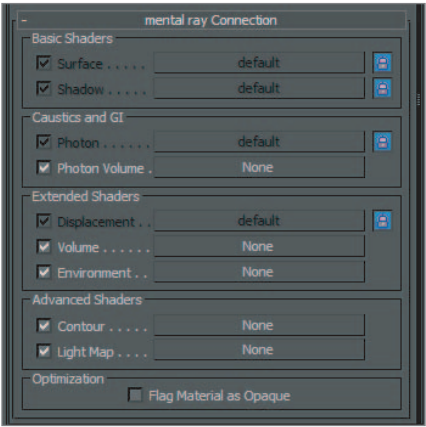
Shaders are organized into the same categories in which they appeared in the mental ray material. The difference is that the mental ray Connection rollout provides access to these shaders from within the Architectural material. Before mental ray was integrated into 3ds Max, the mental ray Connection was a method to use mental ray shaders with Standard or Architectural materials.

ACCESSING MENTAL RAY CAPABILITIES FROM A STANDARD MATERIAL

You can also find the mental ray Connection rollout in the Standard material. Using this rollout can be helpful in legacy scenes that were originally created in earlier versions of 3ds Max.

Notice that some of the shaders are grayed out because their effects are locked to features in the host material. For example, in the Basic Shaders section, the Surface shader is locked because any map or shader applied to the diffuse map in the Physical Qualities rollout would be automatically translated to act as a Surface shader by mental ray.

These settings were not grayed out in the mental ray material because there is no host material from which to translate this information. The mental ray material itself can be used to describe a material's surface completely by choosing the appropriate shaders.

1. Double-click the mental ray material's node in the View1 window.

2. In the Material Shaders rollout, click the None button next to Surface in the Basic Shaders group.

   The Material/Map Browser appears again. Expand the Maps group and then the mental ray group, which displays mental ray-compatible maps and shaders (see Figure 14.7). You can also use materials and maps from the Standard and MetaSL groups. Maps that are incompatible with mental ray will not show in any groups unless you select Show Incompatible from the Material/Map Browser Options menu.

FIGURE 14.7
The Material/Map Browser showing the mental ray–compatible maps
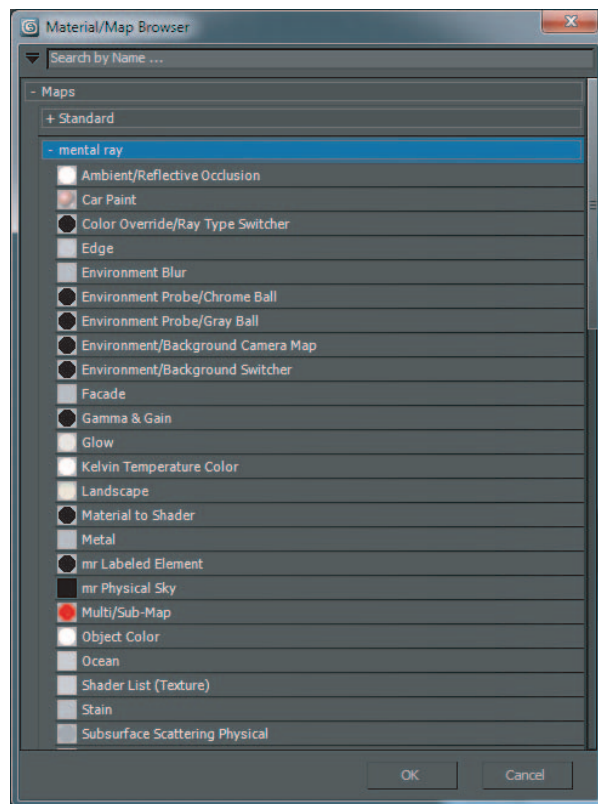
3. Alternatively, you can right-click in the View1 window and choose Maps ➢ mental ray to scroll down the list of compatible maps and see how long the list is.

4. Close the Material/Map Browser and the Slate Material Editor. This completes the quick tour of the changes made to materials with mental ray.

5. Save the scene as `My_Room.max`.

SHADERS ARE BOTH MATERIALS AND MAPS IN MENTAL RAY

mental ray shaders can act as both materials and maps in 3ds Max. As if that isn't confusing enough, shaders can be used in lights, cameras, and the Render Setup dialog box as well.

ADDITIONAL SHADER LIBRARIES ARE AVAILABLE

Several shader libraries are included in implementations of mental ray in 3ds Max; you can mix and match these shaders as you see fit. There are shader libraries from Autodesk (3ds Max) and mental images (base, contour, and physics); the LumeTools Collection (lume) is also included. Each shader library has its own technical help file that you can access from Help ➢ Additional Help ➢ mental ray Help.

USING 3DS MAX MATERIALS WITH MENTAL RAY

For the most part, mental ray interprets 3ds Max materials and maps in the same way as the scanline renderer. However, you will get the most reliable results with mental ray by using its own purpose-built shaders, which act as both materials and maps in 3ds Max.

Because mental ray completely takes over from the scanline renderer, there are many small gaps, errors, and omissions in mental ray's ability to faithfully reproduce your intentions if you are still using the "regular" materials and maps you are accustomed to using from your experience with other renderers.

In order to use the 3ds Max materials and maps, you must translate them into mental ray's own scene description language prior to rendering—a process too complex to detail here.

USING 3DS MAX MATERIALS IN MENTAL RAY

To learn how to translate 3ds Max materials and maps for proper use with mental ray, read the extensive, detailed notes in the User Reference. Choose Help ➢ Autodesk 3ds Max Help. Click the Contents tab, and then expand the navigation nodes for Rendering ➢ Renderers ➢ mental ray Renderer. Read "Getting Good Results with mental ray Rendering" and "3ds Max Materials in mental ray Renderings." You can find the complete mental ray manual by choosing Help ➢ Additional Help ➢ mental ray Help.

If you haven't been scared off by the warnings associated with using mental ray in 3ds Max, you should understand that mental ray is an extremely complex and rich renderer and, although its marriage with 3ds Max is a happy one, it is not without its issues. The next section discusses one of the most innovative technologies used in mental ray.

Using Photon Maps

The use of the photon map in mental ray was pioneered by mental images. To understand what the photon map does, you should first review how the Radiosity renderer stores global illumination data. The Scanline Radiosity Renderer creates a mesh overlaying the geometry in the scene

that stores the data from the lighting simulation, as shown in Figure 14.8. In fact, each vertex in this mesh stores a color (called the vertex color). When these vertex colors are blended together, you see the global illumination in the viewport and rendering. A denser radiosity mesh can hold greater lighting detail, but it also requires more memory and longer render times, and it creates significantly larger files.

FIGURE 14.8
Radiosity rendering uses elements of a mesh to help determine the reflection of light within a model. Light that is reflected from one element illuminates other elements.
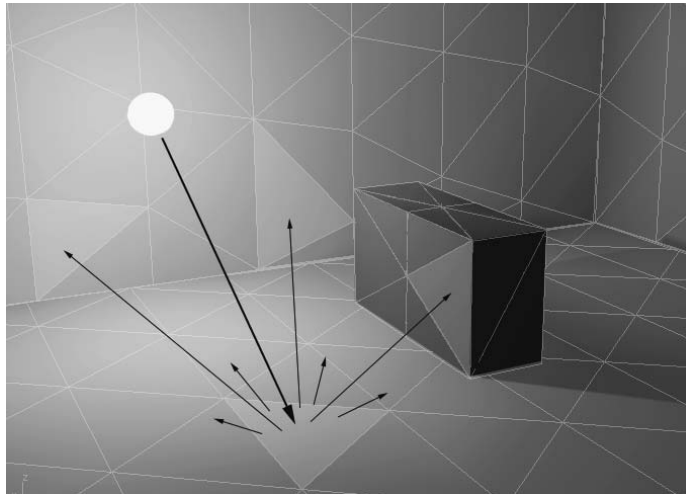
Instead of using a geometric mesh to store lighting data, mental ray can store indirect illumination in a single map that covers all the surfaces of the model that photons (light particles) strike.

Because indirect illumination can be stored in a map rather than a mesh, it requires far less memory. On the downside, a photon map cannot be displayed in the viewport as the radiosity mesh can. You can, however, display the photon map in a rendered scene by choosing Render Setup, clicking the Processing tab, selecting the Diagnostics rollout, checking the Enable option, and clicking the Photon radio button. In mental ray, selected light sources can emit photons, which are traced through the scene. These photons are either reflected off opaque surfaces or transmitted through transparent or translucent surfaces. Depending on the Trace Depth settings, which control the number of bounces to be calculated, these photons eventually strike a diffuse surface much as a paintball would. The photons leave the intensity and color that is picked up in the interactions encountered in each photon's trajectory where they strike in the photon map. Very few of these photons actually hit the picture plane (think of it as the camera lens itself), but it doesn't matter because the photons leave their mark right where they strike—on the wall or floor, for example.

UNDERSTANDING RAY TRACING

Ray tracing works a little like a photon map but in reverse. Particles (rays) are traced backward from the picture plane, the equivalent of the camera's film or sensor plane, through various bounces and transmissions through surfaces in the scene, ultimately reaching the light sources that emitted them. Unlike a photon map, only the particles that hit the picture plane are considered in ray tracing. Mental ray uses a process called *final gather* that similarly shoots out points from the picture plane onto the surfaces visible from that particular point of view.

If you shoot only a small number of photons, the room might look like a paintball war zone. The genius of this technique is that when the photons overlap (you can also control their size), mental ray smoothes them together with a sampling algorithm. When you shoot a large number of photons (10,000 is the default), a lot of smoothing will occur in the photon map, and the indirect illumination built up by the smoothed photons begins to look good.

An important consideration to keep in mind when using a photon map is that the space in your model should be fully enclosed by geometry. Otherwise, photons would escape and, therefore, would never get recorded in the photon map. Photons must reflect or refract the number of times set by the trace depth before they are recorded in the photon map.

For example, an interior architectural space must have a ceiling to use the photon map technique effectively. For outdoor scenes, you can enclose the entire model in a sky-dome (see Chapter 9, "Using the Camera"), and the photons will be contained in the modeled environment.

CERT OBJECTIVE

SIMULATED ILLUMINATION

Direct illumination is light emitted from a source that reflects off a surface and travels directly to the picture plane, and it is easily calculated by any renderer. Computer graphics programs have been able to simulate direct light since the earliest days of Phong shading.

Indirect illumination is much more difficult to simulate and accounts for 99 percent of the light in a scene, representing all the light that is emitted from sources that does not end up hitting the picture plane. However, indirect illumination influences light that does hit the picture plane (so you see its influence in your rendering), and it is critical in making realistic images.

One aspect of indirect illumination is called *global illumination* (*GI*), which can realistically represent the ambient light in the scene through light inter-reflection. Both mental ray and radiosity can simulate GI, although they do so in different ways. GI effects include color bleeding, which occurs everywhere but is clearly evident when a red wall is next to a white one, for example. Some red color will bleed over and give the white wall a pinkish tint. These subtle visual cues give rendered images a feeling of realism, even if you are not consciously aware of them.

With the photon map, mental ray can simulate another aspect of indirect illumination that radiosity cannot simulate—that of a phenomenon referred to as *caustics*. In the science of optics, caustics are the effects of light cast upon a diffuse surface via reflection off of or refraction through other surfaces.

You will notice caustics effects in the bright spots on the ground when you are looking through a magnifying glass, for example. Another example of caustics is the bright spots that appear on a tablecloth through a wineglass that is lit by a spot light. Caustics effects are focused, stronger light that appears on a surface.

In the real world, light can be thought of as a wave phenomenon, rather than existing as particles, rays, or photons. All the light in a physical space is experienced simultaneously. You cannot separate a portion of light in a room (thinking of it as individual rays) and say that it doesn't influence the rest of the light at the same time. All the light in a space is actually expressed as a single wave equation in quantum physics. Light is a marvelously complex phenomenon that we can only begin to simulate with computers.

Testing the Photon Map Effects

To see the effects of photon maps, as well as global illumination and caustics, let's make our first series of mental ray renderings. As a reference point, we'll begin with a single direct light source without enabling photon maps. You will first have to add a light source to the model:

1. Open the file mentalray.max. This is the same sample project you saw in the previous section with its materials converted to mental ray shaders.

2. Click the Create tab of the Command panel, and click the Lights category button. The drop-down has defaulted to Photometric. Photometric lights are the most appropriate lights to use to create real-world lighting simulations with 3ds Max 2013. Click the Target Light button in the Object Type rollout, as shown in Figure 14.9.

FIGURE 14.9
Select the Target Light button.
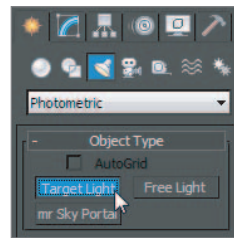
Two nonphotometric light sources have been designed to work with mental ray: the mr Area Spot and mr Area Omni, which can be found in the Standard drop-down. Although you can use the other standard lights with mental ray, you will get the most reliable results by using photometric lights and the mr Area lights.

3. Drag the target light out in the Top viewport, as shown in Figure 14.10.

FIGURE 14.10
Creating a photometric target light

Drag from here…

…to here.
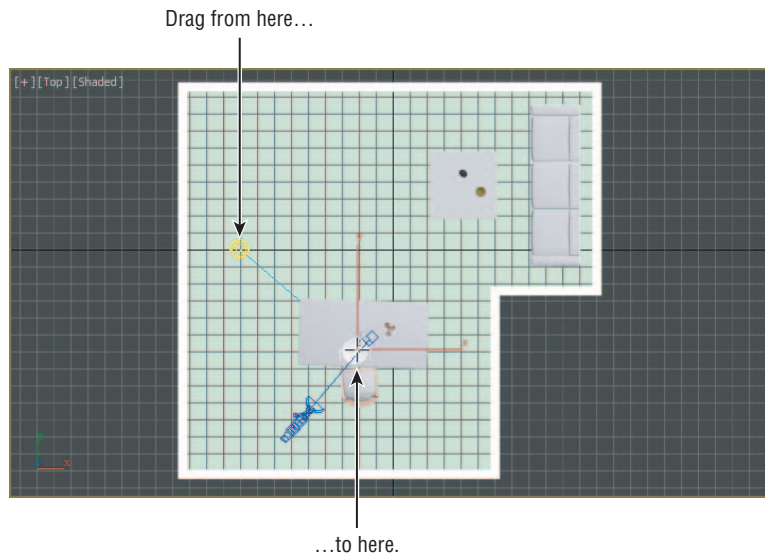
4. If it is not still selected, type **H** to open the Select From Scene dialog box. Select TPhotometricLight001 from the list and click OK.

5. Right-click the Left viewport to activate it. Using the Select And Move tool, drag the target light up just below the ceiling, as shown in Figure 14.11.
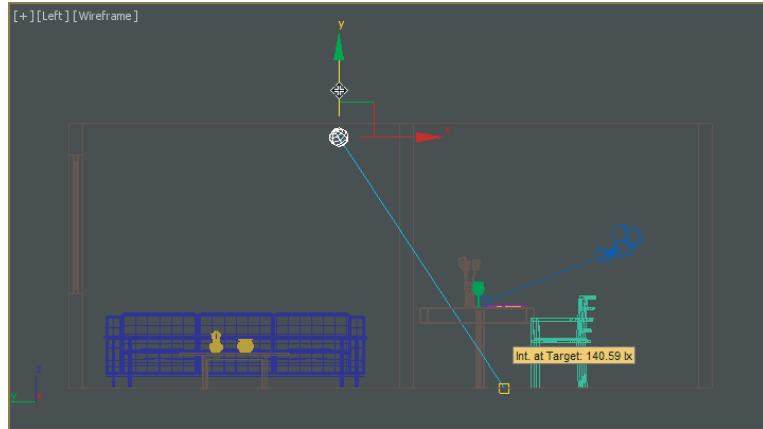
Now that you have a light in the scene, you are going to make a few changes to improve the viewport display of 3ds Max 2013. Taking advantage of the viewport display improvements in 3ds Max 2013 will help you get a better idea of how your scene will appear in the final render and can help you get to that final render faster because you will have to do fewer test renders to evaluate your lighting and materials.

1. Click in the Camera001 viewport to activate it.

2. Click the Shading Viewport label, and select Realistic.

3. Click the Shading Viewport label, and choose Lighting And Shadows ➢ Illuminate With Scene Lights.

The viewport displays the Camera001 viewport as if it were lit by the light you placed previously. Your Camera001 viewport should look like Figure 14.12.

FIGURE 14.12
Camera001
viewport with
scene lighting and
shadows displayed

The photometric light that you placed earlier supports a number of distribution methods to allow you to simulate various lighting types to increase the realism and accuracy of your renderings. The default distribution type is Uniform Spherical; here are the different types of light distributions available with the photometric lights:

Uniform Spherical   This projects light evenly throughout a scene, much like a traditional household light bulb.

Uniform Diffuse   This sends light into a scene from a hemisphere and acts much like a boxed light fixture, such as the type of fluorescent light fixtures you might have in your office.

Spotlight   The Spotlight distribution acts like a focused light source such as your vehicle's headlights or a flashlight.

Photometric Web   This distribution allows you to select an IES file that represents the way a specific real-world light fixture emits light. We will use this distribution later in the chapter.

For now, we will change the distribution type for the photometric light that you placed earlier from Uniform Diffuse to Spotlight. To do this, follow these steps:

1. If the TPhotometricLight001 object is not currently selected, click the Select By Name tool, pick the light from the Select From Scene dialog box, and click OK.

2. Go to the Modify tab, and find the Light Distribution (Type) section of the General Parameters rollout.

3. Select the drop-down menu, and choose the Spotlight option. Notice how the viewports change and the icon for the TPhotometricLight001 changes in the viewports, as shown in Figure 14.13.
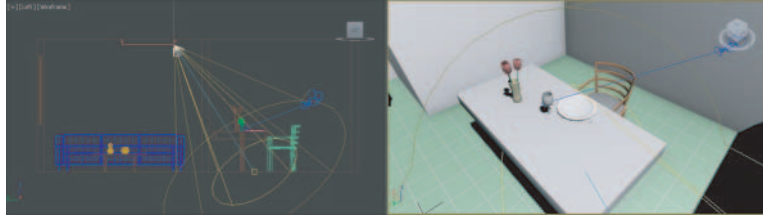
4. Right-click the Perspective viewport to activate it. Then click the View label to open the viewport menu. Choose Lights ➢ TPhotometricLight001 from this menu to look through the new spotlight in this viewport, as shown in Figure 14.14.

FIGURE 14.14
Looking at the table
through the light
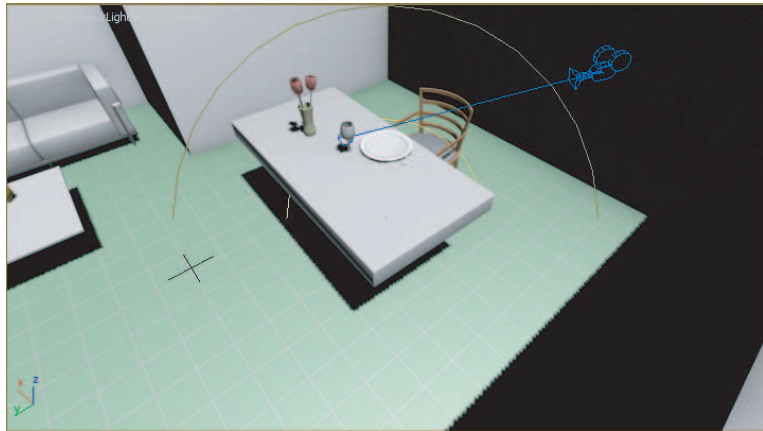
5. Note that the TPhotometricLight001 viewport is displaying with the default lights. Because you want to change it to display the scene lights, click Shading Viewport Label ➢ Lighting And Shadows ➢ Illuminate With Scene Lights. Your TPhotometricLight001 viewport should now look like Figure 14.15.

6. Using the Light Hotspot tool, located in the lower-right corner of the user interface with the other navigation tools, drag the mouse up to decrease the hotspot size in the TPhotometricLight001 viewport. You should be able to see the Hotspot gizmo decrease in size in the viewports. Temporarily change the viewport-rendering mode to Edged Faces, if necessary, to see the gizmos; then change the mode back when you have finished.

7. Right-click twice to stop the Hotspot tool and bring up the quad menu, and click Select Light Target (see Figure 14.16).

FIGURE 14.15
The
TPhotometricLight001
viewport
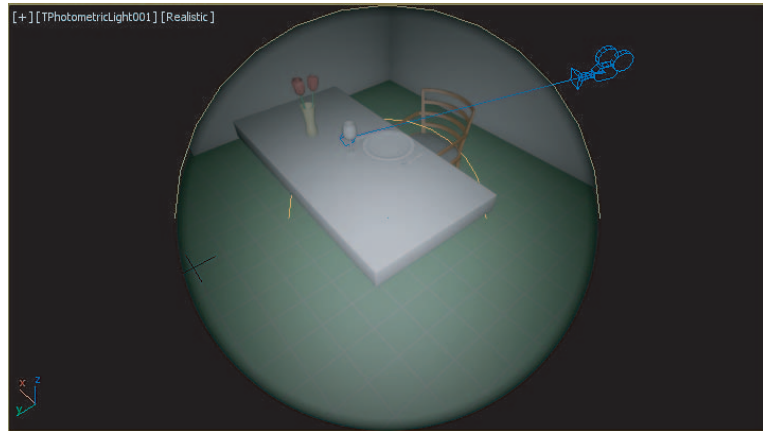
FIGURE 14.16
Select the target in
the quad menu.
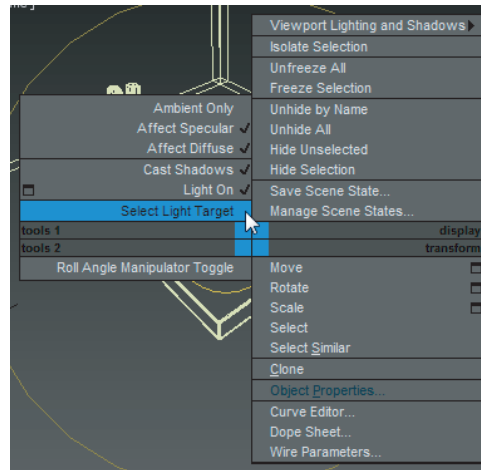
8. Press Alt+A, or click the Align button in the Main Toolbar, to invoke the Align tool, and then click the dinner plate from any viewport. The Align Selection (Plate) dialog box appears.

9. Click all three check boxes for the X, Y, and Z Position options, and make sure that the radio buttons for the current and target objects are set to Center, as shown in Figure 14.17. Click OK to perform the alignment.

FIGURE 14.17
The Align Selection
dialog box
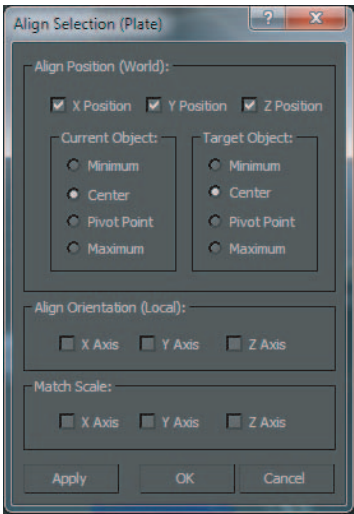
Now the spotlight is aiming directly at the plate.

10. Make the TPhotometricLight001 viewport active, if it isn't currently. Using the Light Falloff tool (near the Light Hotspot tool), drag down in the TPhotometricLight001 viewport to increase the size of the spot's falloff. The scope of the viewport adjusts to match the diameter of the falloff circle. Your viewport should look similar to the one shown in Figure 14.18.

FIGURE 14.18
The
TPhotometricLight001
viewport
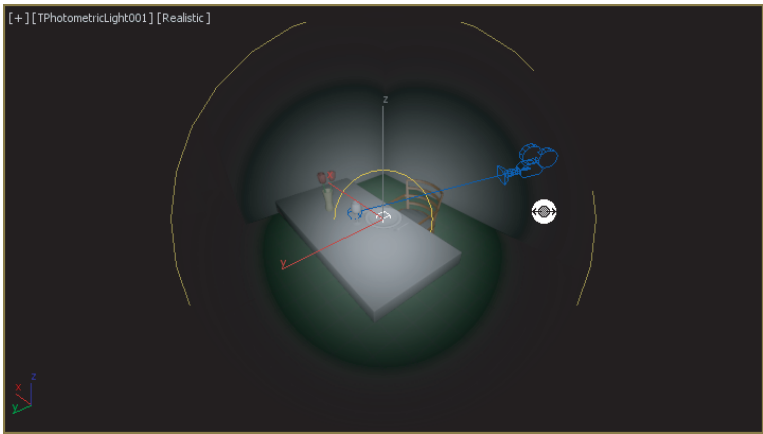
The Falloff gizmo should completely surround the table so that it will be fully illuminated.

You placed a photometric light in this scene, so you should now set mental ray to use an exposure control method that will simulate how a real camera would respond to the physically based lighting you are using in these exercises:

1. Choose Rendering ➢ Exposure Control to open the Environment tab of the Environment And Effects dialog box.

2. Navigate to the Exposure Control rollout, and change the exposure control to the mr Photographic Exposure Control system, as shown in Figure 14.19.

FIGURE 14.19
Set Exposure
Control to mr
Photographic
Exposure Control
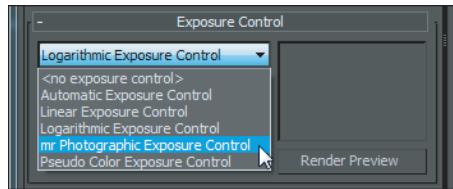
3. Right-click the Camera001 viewport to activate it.

4. Click the Render Preview button in the Exposure Control rollout, and watch as a small thumbnail sample of your rendering appears in the gray window, as shown in Figure 14.20.

FIGURE 14.20
The rendered
preview
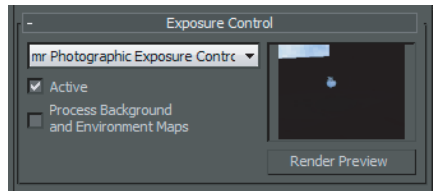
RENDER PREVIEW WITH EXPOSURE CONTROLIMPORTANT

If you are an experienced 3ds Max user, you need to retrain yourself not to just render but instead to use Exposure Control and Render Preview before rendering. Exposure Control is critical, and using Render Preview saves time and anguish.

5. The preview render is very dark. In the mr Photographic Exposure Control group, select the radio button in front of Exposure Value (EV), and then change the Exposure Value to **4** to brighten the image. Note how the Render Preview window and viewports set to Realistic mode change immediately after you adjust the Exposure Value setting.

6. Press the F10 key to open the Render Setup dialog box. Click the Render button at the bottom of the dialog box to begin your first mental ray rendering.

The rendering will appear progressively in the Rendered Frame Window as buckets are processed. After a few seconds, you will see a rendering similar to Figure 14.21.

FIGURE 14.21
Your first mental
ray rendering

The rendering in Figure 14.21 is very dark because mental ray is only rendering direct illumination and ray tracing the scene by default. There is only one photometric light source in this model, and it illuminates the surfaces it strikes directly. There is no bouncing of light with direct illumination.

Let's experiment with a photon map next. This will allow you to render indirect illumination. More specifically, let's consider GI first, because it will have the largest effect.

1. Click the Indirect Illumination tab of the Render Setup dialog box. In the Caustics and Global Illumination (GI) rollout, select Enable in the Global Illumination (GI) group.

2. In the Geometry Properties group at the bottom of this rollout, select the All Objects Generate & Receive GI And Caustics box.

   By default in 3ds Max 2013, no objects are set to generate caustics and GI (although they can all receive both forms of indirect illumination). By checking the box, all objects in the scene generate and receive both forms of indirect illumination. However, you must manually select which lights in the scene you want to generate caustics. You will render with caustics later in this chapter.

3. Select the green tiled floor by clicking it in the Camera001 viewport. Right-click in the viewport to open the quad menu. Select Object Properties from the transform quad.

4. Click the mental ray tab of the Object Properties dialog box. Select the Generate Global Illumination box to enable this feature for the floor object, as shown in Figure 14.22. Click OK to close the dialog box.

FIGURE 14.22
Select the Generate Global Illumination box.
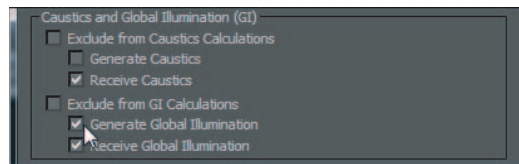
5. In the Render Setup dialog box, scroll down to the Light Properties group of the Caustics And Global Illumination (GI) rollout. Change the Average GI Photons Per Light setting to **1000**, as shown in Figure 14.23. This reduces the number of photons that will be emitted from all the light sources in the model from the default of 10,000.

FIGURE 14.23
Set the Average GI Photons Per Light value.
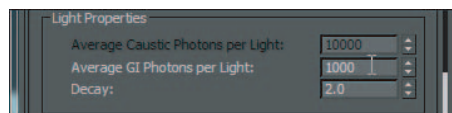
SELECTIVELY CHOOSING OBJECTS THAT GENERATE AND RECEIVE CAUSTICS

Generating photon maps is time-consuming, especially in complex scenes. You can save time by specifying exactly which objects are to generate and/or receive caustics and/or global illumination. In general, the largest surfaces in the model are the most important participants in indirect illumination. For this example, steps 3 and 4 in the previous procedure are not strictly necessary because you set all objects (including the floor) to generate GI in step 2. The sample project is so small that it doesn't take much time for all objects to generate GI. However, the amount of time needed would become more important in a complex scene. Under those conditions, you could save time by being selective about which objects generate and which objects receive both caustics and GI as set via the Object Properties dialog box.

CREATE TEST RENDERS WITH FEWER PHOTONS

It is a good idea to do test renders with fewer photons to get an idea of how they will appear in the space. Greater numbers of photons take ever-greater amounts of time to render, and rendering them may not be necessary at the beginning of a project's lighting phase.

---

6. Click the Render button at the bottom of the Render Setup dialog box. A rendering similar to Figure 14.24 will appear, showing the result of using 1,000 GI photons.

FIGURE 14.24
The rendering using
1,000 GI photons

You are able to see indirect illumination in areas that were dark in Figure 14.21. These areas are being lit exclusively by the GI photons in the photon map. Notice that some of the photons on the table and walls are greenish, indicating that they picked up that color by being reflected off the floor. You will need to make some changes to make this rendering look better.

By default, the photon size is set to one-tenth the size of the scene extents. This is usually close to the right size, but you can manually override the photon size by using the Radius parameter for better results.

7. Check Maximum Sampling Radius in the Global Illumination (GI) group. This enables the adjacent spinner. Change the radius size to **6″** in the spinner.

8. Do another test render by clicking the Render button at the bottom of the Render Setup dialog box. The rendering will display smaller photons, as shown in Figure 14.25.

The rendering is looking more like a paintball war zone. You can deduce that the default photon radius was approximately 1′ 6″ by comparing Figures 14.30 and 14.31 (based on the fact that you know the radius was 6″ in Figure 14.25).

The best results from a photon map occur when the photons are numerous enough and sized so that about half of their diameters overlap. It is only when the photons overlap that their colors are sampled and smoothed together.

If the photons overlap too much, there will be too much smoothing and subtle variations in lighting will be lost. If the photons do not overlap enough, they won't be smoothed, so they will still be apparent as photons in the rendering (as in Figure 14.25).

Choosing the right settings is usually a matter of doing a few test renders and observing carefully.

9. Change the Maximum Sampling Radius in the Global Illumination (GI) group to **2′**. Change the Average GI Photons Per Light in the Light Properties group to **100000**. Click Render, and watch as the rendering appears in the Rendered Frame Window (see Figure 14.26). This could take half a minute or so to render on most computers.

10. Close the Render Setup, RFW, and Environment dialog boxes.

USING COMMAS TO DELINEATE LARGER NUMBERS

You can't use a comma to delineate large numbers in the spinner fields.

This time, the photons are adjusted so that they are numerous enough and sized properly to blend successfully. You are now able to see much of the room that is illuminated solely by the indirect light of the photon map. Notice the color bleeding that is happening between the saturated green floor and the white walls—a characteristic and desirable effect of global illumination. Color bleeding happens in the real world and is something GI can simulate.

EXPOSURE CONTROL

It's imperative that Exposure Control be used when rendering using mental ray, especially when you are trying to simulate real-world physical conditions. To activate it, choose Rendering ➢ Environment, and then expand the drop-down list in the Exposure Control rollout and select either Logarithmic Exposure Control (when using the scanline renderer) or mr Photographic Exposure Control (when using the mental ray renderer). You can then adjust the settings to control the appearance of your renders.

Let's take a look at caustics next. You will be adding another light source to the scene because Figure 14.26 still looks a bit dark. The room could use more general lighting.

1. Click the Create tab of the Command panel, and click the Lights category button. Click the Free Light tool in the Object Type rollout, as shown in Figure 14.27.

FIGURE 14.27
Create a free light in the scene.
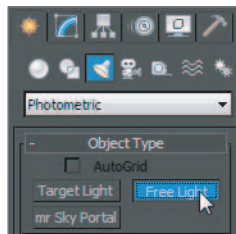
2. Click the middle of the top half of the room in the Top viewport to place the light source as shown in Figure 14.28. Notice how the lighting in the viewports changes.

3. Using the Select And Move tool, move the light up to the correct height in the Z direction by entering **7′ 6″** in the Z field of the transform type-ins at the bottom of the interface, as shown in Figure 14.29.

FIGURE 14.28
The new light as
shown in the Top
viewport
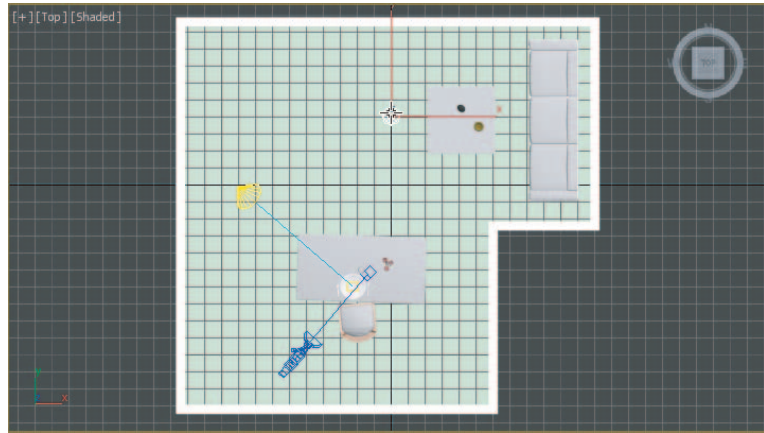
FIGURE 14.29
Adjust the height of
the new light.

PhotometricLight001 is now positioned just below the ceiling.

4. Click the Modify tab of the Command panel. In the General Parameters rollout, change
the Light Distribution (Type) setting to Uniform Diffuse, to simulate a flush-mounted
ceiling light.

MENTAL RAY CONVERTS INCOMPATIBLE SHADOW TYPES

In mental ray, essentially only two shadow types are available: ray-traced shadows and mental
ray shadow map shadows. The other types still appear in the Shadows drop-down list; however, if
selected, they are automatically converted to one of the other two types at render time. Because this
is confusing, it is best to choose one of the explicitly supported types. You will get the best results
with ray-traced shadows in mental ray.

---

5. Scroll down and open the Shape/Area Shadows rollout. You can choose from six area
light types: Point, Line, Rectangle, Disc, Sphere, and Cylinder. Change the Emit Light
from (Shape) setting to Rectangle, and make its Length and Width both **2′**, as shown in
Figure 14.30.

A Rectangle gizmo that represents the area light shape will appear in the viewport.

6. Scroll down farther on the Modify tab of the Command panel, and open the mental ray
Indirect Illumination rollout (this rollout never appears on the Create tab). In the Global
Multipliers group, change the Energy multiplier to **0.8**, as shown in Figure 14.31.

FIGURE 14.30
Change the light's
Emit Light From
(Shape) parameters.
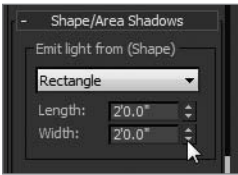
FIGURE 14.31
Change the light's
Energy multiplier.
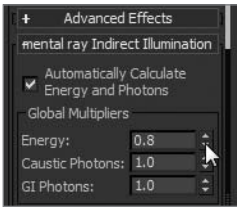
This reduces the indirect illumination energy that this particular light source will emit, but it does not affect the direct illumination cast by the light.

7. Open the Intensity/Color/Attenuation rollout, and select the check box in the Dimming group. This will allow you to change the value to 40 percent. This reduces the amount of direct illumination that this light source will contribute to the scene.

CONTROL THE INTENSITY OF YOUR LIGHTS

If light sources have too much direct illumination intensity, they will wash out the subtle indirect illumination effects.

8. Open the Render Setup dialog box, and deselect Enable in the Global Illumination (GI) group. To test caustics, it is helpful not to get distracted by other forms of indirect illumination.

9. Select Enable in the Caustics group, as shown in Figure 14.32.

FIGURE 14.32
Enable Caustics in
the Render Setup
dialog box.

**CERT
OBJECTIVE**
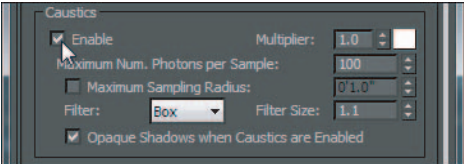
10. Change the viewport drop-down list at the bottom of the Render Setup dialog box to Quad 4 - Camera001. Change the Area To Render drop-down list on the Common tab of the Render Setup dialog box to Region, as shown in Figure 14.33. By only rendering a small region of your image, you will save time by rendering fewer buckets in your test renders.

FIGURE 14.33
Set the Area To
Render option to
Region.
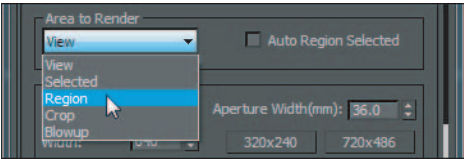
VIEWING MENTAL RAY MESSAGES

You can see what is going on with the rendering process (including any warnings) by opening the Message window. From the Main menu, choose Rendering ➢ Render Message Window and leave it open when you are rendering.

---

11. A selection region appears in the Camera001 viewport. Drag the opposite corners of this region to enclose a smaller region around the wineglass, silverware, and plate, as shown in Figure 14.34.

FIGURE 14.34
Drag the Region box around the wineglass, silverware, and plate.
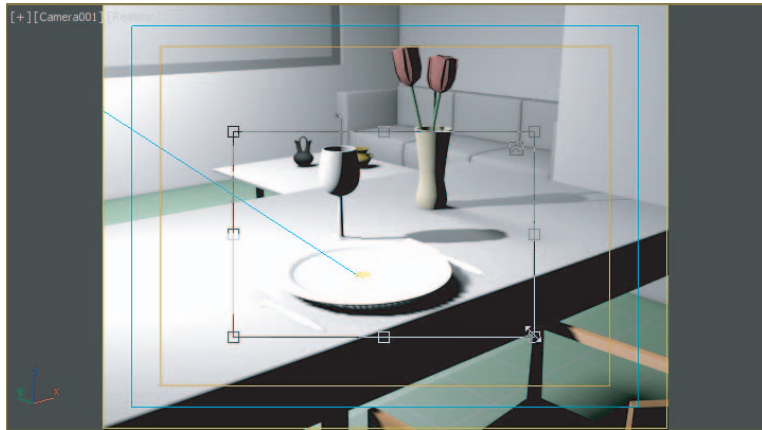
12. Click the Render button to start the rendering.

You should hear an error sound and be presented with a mental ray dialog box that says there are no caustic photon emitters in the scene, with OK and Cancel buttons. The All Objects Generate & Receive GI And Caustics check box you selected earlier in the Geometry Properties section of the Indirection Illumination tab of the Render Setup dialog box pertains only to object geometry. This is a change from the behavior of releases prior to 3ds Max 2011, in which this check box would affect lights as well, making lights generate caustics when this check box was enabled. This is a positive change because now you have to manually specify which lights you want to generate caustics instead of automatically having all lights generating caustics and thereby greatly slowing down your renderings. You will now set the Spotlight in the scene to generate caustics on the tabletop. Click the Cancel button on the dialog box.

13. Click the Select By Name tool on the Main Toolbar, and select TPhotometricLight001.

14. Right-click and select Object Properties from the transform quad menu.

15. Click the check box next to Generate Caustics and click OK.

16. Click the Render button to start the rendering. The RFW shows only the changes made within the region you selected in the previous step.

The overall rendering is much brighter now that you have added the new light source (compare with Figure 14.26). Caustic effects are usually much subtler than GI effects, so pay close attention to your test renders to perceive them. Your Rendered Frame Window should look like Figure 14.35.

FIGURE 14.35
The rendering with caustics in the region you selected

Two areas exhibit caustic indirect illumination effects: one brighter caustic area surrounds the stem and base of the wineglass, and the other caustic area makes the shadow of the wineglass on the tablecloth appear brighter.

Increasing the number of caustic photons may give the effects slightly more definition, but the results attained with 10,000 caustic photons are acceptable.

INCREASING PHOTONS CAN BRING OUT THE CAUSTICS

If you don't see any caustic areas where you expect to see them (near glass or water usually), try increasing the number of caustic photons that your light sources emit. Be careful not to boost the number of photons too high, however, because extremely long render times may result.

17. Now that you have tested both caustics and GI, it is time to combine them in a full rendering. Enable Global Illumination in the Render Setup dialog box. Change the Area To Render Type drop-down list on the RFW to View and click the Render button. Figure 14.36 shows the results so far.

18. Save your work as `MymentalrayGI.max`.

FIGURE 14.36
Final rendering
showing caustics
and GI effects

SAVING PHOTON MAPS AS FILES

You can save a lot of time in rendering an animation by saving the photon map as a file. That way, the photon map will not be recalculated for each frame. The controls for saving and loading photon map files (*.pmap) are in the Reuse (FG and GI Disk Caching) rollout on the Indirect Illumination tab of the Render Setup dialog box. There are a few modes you can choose from, depending on the type of rendering you are doing. A new feature in 3ds Max 2010 was the ability to reduce the render flicker in animations by using the Project FG Points From Positions Along Camera Path option in the drop-down in the Final Gather rollout. Using this setting along with the Single File or One File per frame options in the Mode group of the Reuse rollout, you can get flicker-free GI and Final Gather illumination in your animations.

In this section, you learned how to approach indirect illumination slowly by doing test renders and making the necessary adjustments to GI and caustics separately. This approach yields faster visual feedback by rendering many quick tests. Figure 14.36 shows the impressive results you have been able to achieve using a photon map in mental ray.

The next section introduces you to a technique that can improve the quality of your renderings beyond what is possible with a photon map, and you may also save rendering time.

Final Gathering

Final gathering (FG) is another technique for calculating global illumination. Originally, it was used as an additional calculation used after photon map generation; now you can often skip the photon mapping and get excellent results with just final gathering alone. When you are doing exterior shots, mental ray daylighting and Final Gather will give spectacular results, without the need for any photon generation. Interior shots can also be achieved this way, especially if you use mental ray sky portals. Often interior shots are improved with photon generation combined with Final Gather and, if there are caustics in the scene, you'll have to rely exclusively on the photon map to simulate that aspect of indirect illumination. Therefore, FG is useful in scenes with overall diffuse lighting but is not very helpful in scenes where caustics play a major role.

Using a photon map alone for GI often leaves dark corners where photons did not reach and patchy areas of light variation where photons did not get smoothed properly. You can smooth all these rendering artifacts by using FG.

When a scene uses FG, fewer GI photons are needed, so the GI photon map can be calculated more quickly. However, FG usually increases render time overall, because additional calculations are performed after the photon map is complete.

FG works by gathering very precise GI data for a few points and then averaging the data from these points. The technique samples GI data that has already been calculated, so it should be used after you generate a photon map for the most accurate results.

Using Final Gather presets in mental ray, you can load common FG settings based on the quality of the Final Gather results required.

USING FINAL GATHER WITHOUT GENERATING A PHOTON MAP

You'll learn how to use FG without generating a GI photon map in the "Skylight Global Illumination" section. FG is conceptually very similar to the concept of regathering in radiosity.

Let's take a look at using FG in the sample project:

1. Open `mentalrayGI.max`, or continue from where you left off in the previous section.

2. Open the Render Setup dialog box if it is not already open. Click the Indirect Illumination tab.

3. Disable caustics while you are testing FG to save time by deselecting the Enable box in the Caustics group.

4. Make sure GI is set to Enable in the Global Illumination (GI) group. Also check Maximum Sampling Radius, and set the value to **1′ 6″**.

5. Check the Optimize For Final Gather (Slower GI) option.

6. Enable FG by selecting the Enable Final Gather check box in the Basic group near the top of the Final Gather rollout. Also select Draft Mode (No Precalculations) in the Advanced group, as shown in Figure 14.37.

FIGURE 14.37
Enable the Draft Mode setting on the Final Gather rollout.

CERT
OBJECTIVE
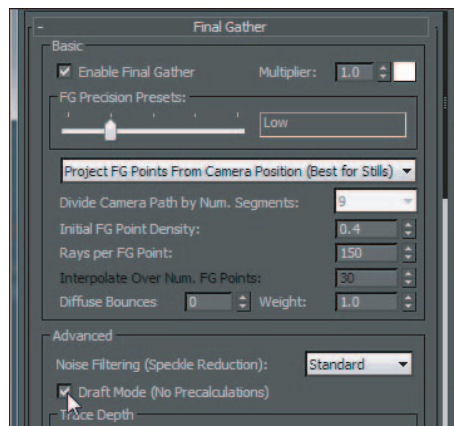
DRAFT MODE IS FASTER BUT LEAVES ARTIFACTS

Use the Draft Mode (No Precalculations) setting only when doing test renders. It renders much faster but leaves rendering artifacts.

---

7. Make sure that the Camera001 viewport is selected. Then click the Render button at the bottom of the dialog box, and then wait a short time for the rendering to be processed. Look closely at the rendering, particularly around the perimeter of the glass, and you might see artifacts visible in the preview.

If you look closely at the tablecloth, for example, you might see rendering artifacts, which are variations in light that are apparent at the borders of the buckets. It is usually worth doing a quick preview rendering to be sure that the overall illumination looks good before doing the lengthy, finished final gathering calculations.

One other setting can improve the quality of your final output—sampling, an antialiasing technique.

ANTIALIASING REDUCES JAGGED EDGES

There are no curves in digital images, just a mosaic of different-colored pixels. Antialiasing algorithms smooth out the jagged edges that appear in the grid of pixels.

Sampling in mental ray is equivalent to 3ds Max's SuperSampling feature that is part of the materials. In mental ray, sampling is done at the scene level, so you don't have to turn on SuperSampling in any materials.

1. Click the Renderer tab of the Render Setup dialog box. In the Samples Per Pixel group, select 4 from the Minimum drop-down. Then change the Maximum drop-down list to 16. Now many additional samples will be made for each pixel, most likely eliminating any jaggedness from the rendering.

2. Change the Filter type to Triangle by selecting the drop-down menu. Box is the default filtering mode and the fastest. The filtering algorithms provide more image sharpening as you move down the list. The sharpening filters also add more time to renderings as you move down the list in the drop-down menu.

SETTING THE SAMPLES PER PIXEL VALUES

Antialiasing in mental ray is controlled by the Samples Per Pixel setting. You should always set the Maximum Samples Per Pixel setting to a higher value than the Minimum setting. For test renders, try using 1/4 for the Minimum and 1 for the Maximum, because this will render much faster.

---

3. Click the Indirect Illumination tab. Select Enable in the Caustics group. The final output will also render the caustic effects that you tested in the last section.

4. Deselect Draft Mode (No Precalculations) in the Final Gather rollout.

5. At the top of the Final Gather rollout, click and drag the FG Precision Presets slider to the right and choose the High option. Several parameters in the Final Gather rollout are changed to increase the quality of the FG solution.

6. Because you are rendering with Final Gather and you added the free light to the scene, you should go to the Environment tab of the Environment And Effects dialog box and adjust the mr Photographic Exposure Control slightly so that the rendered image isn't too bright. A value of 4.5 should be about right.

7. Click the Render button at the bottom of the Render Setup dialog box to do another rendering. Be prepared to wait a few minutes for this to process. If you don't get up and walk away from your computer to stretch or get a fresh cup of coffee, you will see three iterations of processing in the RFW. During the first two processing passes, the Final Gather points are computed and refined. In the third pass, the actual rendering is completed.

8. Save your work as `MymentalrayFG.max`.

Figure 14.38 shows the results of all your hard work in the final output. If you don't want to wait for the render to process (which took 8 minutes and 15 seconds on my Quad-Core workstation), you can see the results as `Figure1446.tif`, which you downloaded with this chapter's archive from the book's website.

FIGURE 14.38
The final rendering

Reviewing the Basic mental ray Workflow

Now that you have experienced the entire rendering workflow in mental ray, we'll take a moment to summarize the steps usually taken to produce final output in mental ray before moving on to more specialized topics. The first thing to do is make sure your 3D models are as precise as possible; they should all be airtight. Then assign mental ray materials to the objects in your scene. Next, add photometric or mental ray lighting. Neither of these last two steps is strictly necessary because most of the 3ds Max materials and lights are automatically converted to passable mental ray versions by the renderer, but you should add or convert them manually for the most reliable results.

If your scene is an exterior, you can skip photon generation. If your scene is an interior that is not illuminated by an exterior light source, you can consider generating a photon map. Then try a test rendering with a low number of GI photons. Adjust the size and number of the photons until you achieve acceptable results. If you expect caustics to play a role in your image, do more tests with a low number of caustic photons and adjust their size and number as necessary with further tests. If you feel that the photon map quality is acceptable, you are finished. Use

Photographic Exposure Control to "dial in" your rendering values so that you have a good range of lights and darks.

You should generally add Final Gather at this point to interiors. If your scene is an exterior or is an interior illuminated by exterior sunlight, you can skip photon generation and just use Final Gather. Start with the lowest settings for Final Gather Precision and Sampling Quality. Gradually increase these values until you are pleased with the results. Adjust sampling if you notice aliasing, and then process the final output.

If you can, render your job in parallel to save time. mental ray is perfect for render farming. If you plan on using it professionally, it may pay to consider hiring someone to set up a network of rendering processors to ensure that you get your work done by the deadline.

MENTAL RAY LED TO A POSITION

A few years ago there was a large project that was expected to take about three months to complete. The scope of the project included both interior and exterior animations of a small housing complex and still images suitable for both web and print media. The size of the project required temporarily taking on an additional staff member on a consulting basis. The response to the job posting was very large, with only about 10 percent of the respondents qualified for the position. Replies and portfolios came in from architects, students, artists, hobbyists, and (inexplicably) an electrician. Only a few respondents were called in for an interview.

Of those interviewed, all were good modelers with experience in architectural modeling. One applicant stood apart from the others, though, because of the quality of her renderings. She stated that she used mental ray exclusively and had displayed her extensive knowledge of the mental ray toolset. She was brought on board and ended up handling more of the project than was initially intended, freeing up employees to continue to work on the other projects in the pipeline. In the end, the client was pleased with the quality of the project, and the temporary consultant became a full-time employee. Without her expertise with mental ray and the ability to generate high-quality renderings, the company might have hired a different consultant.

Contour Renderings

mental ray contour renderings are like technical line drawings of 3D geometry. Not to be confused with wireframe renderings that show all the objects' topology, contour renderings show only the outlines of objects, and often they can look very appealing—with a hand-drawn quality. One of the best things about them is that they generally do not take a lot of time to set up or process. When using the scanline renderer, the Ink 'n Paint material will create a similar effect.

You will be using mental ray Contour shaders in the Render Setup dialog box and in a single material assigned to the Material Override setting in this nondestructive rendering technique. Once the Contour shaders are activated, you can control their settings by instancing them into the Material Editor. Let's set up the sample project for a contour rendering:

1. Open the file `mentalrayContour.max`. This is the original `Room.max` sample project with the mental ray renderer already assigned.

2. Press the **F10** key to open the Render Setup dialog box if it is not already open. Click the Renderer tab, and open the Camera Effects rollout.

3. Enable contours by selecting the Enable box in the Contours group.

Three shaders are enabled, corresponding to the channels: Contour Contrast, Contour Store, and Contour Output.

4. Click the button marked DefaultContourOutputShader in the Contour Output channel. The Material/Map Browser appears.

5. Select the Contour Only shader from the list, as shown in Figure 14.39, and click OK.

FIGURE 14.39
Select the Contour Only shader.
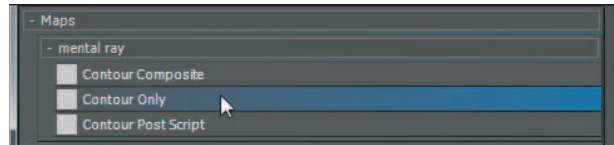
6. Open the Slate Material Editor. Drag the Contour Only shader from the button in the Contour Output channel to the View1 window in the Slate Material Editor.

7. Select Instance from the small Instance (Copy) Map dialog box and then click OK.

8. Double-click the Map# Contour Only item in the View1 window to display it in the Parameter Editor of the Slate Material Editor.

9. Right-click the Map# Contour Only node in the View1 window, and select Show All Additional Params, as shown in Figure 14.40.

FIGURE 14.40
Select Show All Additional Params.
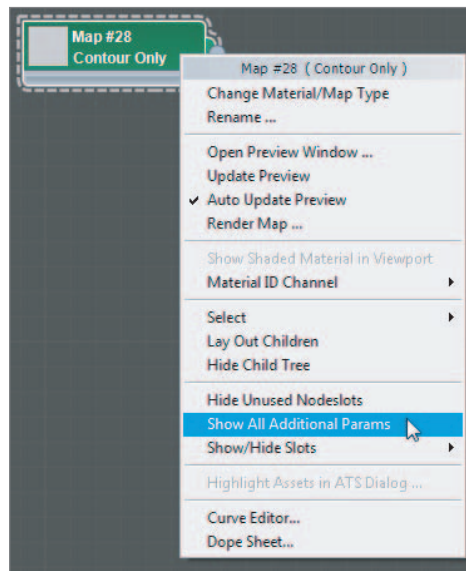
10. The Additional Params bar displays on the node in View1. Click the plus sign to expand the parameters list.

11. Click the Background Color swatch on the Contour Only node of the instanced map in View1, as shown in Figure 14.41. These parameters are the same as what are shown in the Parameter Editor you saw in step 8.

12. If necessary, change the color to white in the Color Selector: Background Color dialog box that appears. Close this dialog box after you select the color. Notice that the numerical values for the color properties go from 0.0 to 1.0 and not 0 to 255.

13. Drag the Contour Contrast Function Levels shader from the Contour Contrast channel in the Render Setup dialog box into the View1 window.

14. Choose Instance from the small Instance (Copy) Map dialog box again.

15. Change the Angle Step Threshold to **5.0** in the Contour Contrast Function Levels Parameters rollout. Also select Color Contrast Contours, as shown in Figure 14.42.

FIGURE 14.41
Click the Background Color swatch.
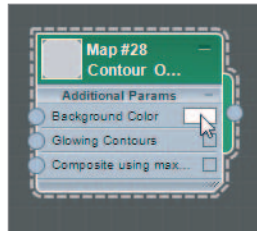
FIGURE 14.42
Set the Contour Contrast Function Levels parameters.
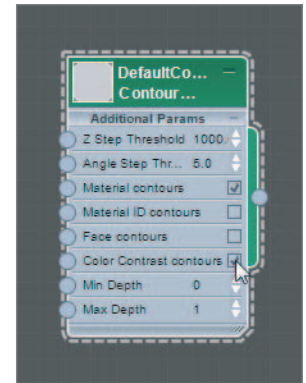
16. Double-click the ceiling material in the Scene Materials group of the Material/Map Browser section of the Slate Material Editor to add it to the View1 window. Double-click the ceiling node to have its properties display in the Parameters Editor. Rename this material to **ContourOverride**.

17. Open the mental ray Connection rollout in the ContourOverride material. Click the None button in the Contour channel in the Advanced Shaders group.

18. Choose Contour Simple from the Material/Map Browser that appears. Click OK to close the dialog box.

19. Double-click the Contour Simple node and change the Width (%) to **0.1** on the Contour Simple node, as shown in Figure 14.43.

20. Keeping the Slate Material Editor open, go to the Processing tab of the Render Setup dialog box and check the Enable box in the Material Override group.

21. Now click and drag the output socket on the ContourOverride material from the Slate Material Editor to the material slot you just activated on the Render Setup dialog box, as if you were wiring them together. Choose Instance from the Instance (Copy) Map dialog box that appears and click OK.

22. Right-click in the Camera001 viewport to activate it, and then click Render at the bottom of the Render Setup dialog box. Figure 14.44 shows the resulting contour rendering.
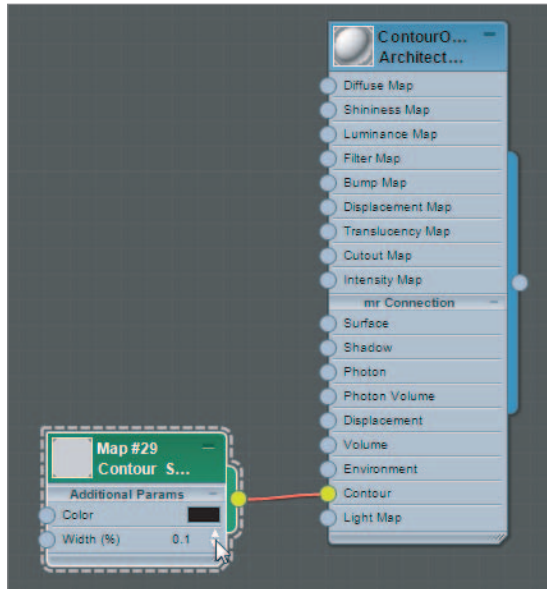
The rendering is processed very quickly without complicated materials, lights, or indirect illumination to calculate. Notice that the contours appear only after the diffuse rendering is completed in the RFW. The Contour shaders are applied after the rendering is complete based on information gathered during the rendering process.

23. Save your scene as **MyMentalRayContourDone.max**.

Using the Material Override setting in the Processing tab of the Render Setup dialog box is a powerful way to create multiple renderings of scenes quickly using single materials for testing lighting or checking your composition without worrying about changing any materials in your scene. The technique could also be used for creating renderings that look like gessoed or basswood physical models without having to assign new materials to all the objects in your scenes. You could even use this method to render out an ambient occlusion pass of your scene to use in

an image-editing or compositing program to enhance the shadow detail of your still renderings or animations.

RENDERING SPECIAL EFFECTS WITH MENTAL RAY

mental ray can render several special effects, including depth of field, motion blur, and displacement, as well as volumetric light and fog effects. Many of these effects are also available in 3ds Max with the scanline renderer, but the mental ray versions of them are often more efficient. Some of these special effects will be covered in Chapter 15, "Finishing It Off: Atmosphere, Effects, and Compositing."

CONVERTING STANDARD 8-BIT COLORS TO FLOAT COLORS

You may have noticed that the mental ray materials you are now using display color values differently than the standard materials. The values for assigning colors in mental ray materials are displayed as a range from 0.0 to 1.0 instead of the traditional 0 to 255. This allows you to select from significantly more color variations, since the 0–255 triplet color system allows you to select from 16,777,216 colors, also known as 24-bit or true color (8 bits per color channel Red, Blue, and Green). The 0.000 to 1.000 floating point system of mental ray allows you to pick from a billion possible colors. To convert a color from 0–255 to 0–1, the easiest method is to take the original value and divide it by 256, resulting in the new color value. You can also use the Color Clipboard utility, found on the Utilities tab of the Command panel, to copy 8-bit color values and paste them in Float color values, and vice versa.

Using the mr Multi/Sub-Map Material

Another feature in 3ds Max 2013 that is very helpful in adding a sense of natural variation to your mental ray renders is the Multi/Sub-Map material. The Multi/Sub-Map material can be applied anywhere a map can be used in mental ray. In the following exercise, you will apply a Multi/Sub-Map material to an object in a scene:

1. Open the `mentalmayMultiMap.max` file, available from this book's website.

2. Click the Camera002_CoffeeTable viewport to make it active.

   The scene is set up with mental ray materials and GI and caustics. Final Gather is set to the High preset, and the area shadows from the light fixture near the ceiling are set to 128 samples.

3. Click the Render Production button on the Main Toolbar.

   With the render settings set to high-quality final render values, the rendering will take a long time to complete. (For example, it takes 4 hours and 9 minutes on a Quad-Core workstation to render.) The file is provided with your downloads as `mentalrayMultiMap_HQ_Settings.tif` for you to compare with the renderings that you

will do later in this chapter). If you don't want to see the finished frame, you can cancel the render once you get an idea of what the scene will look like, but don't close the RFW.

4. On the Reveal toolbar, shown in Figure 14.45, click and drag the slider to change the Image Precision (Antialiasing) value down to Low: Min 1/16, Max 1.

FIGURE 14.45
The Reveal toolbar
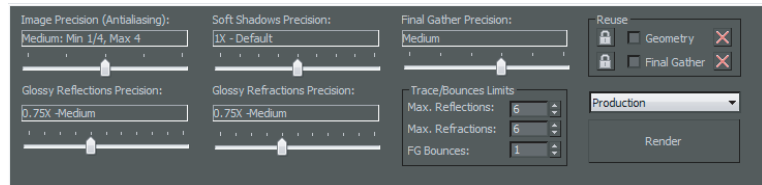
5. Set the Glossy Reflections and Glossy Refractions Precision settings both to 0.25X – Low.

6. Set the Soft Shadows Precision to 0.25X - Low.

7. Set the Final Gather Precision to Draft.

8. Click the Render button on the Reveal toolbar.

This rendering will process significantly faster because you used the global quality sliders on the Reveal toolbar to change the values in the Render Setup dialog box. This time, the render completed in only forty seconds on the Quad-Core system, and the file is provided as `mentalrayMultiMap_Draft_Settings.tif`. Note that dragging the slider all the way to the left is not the lowest setting; this will actually turn the feature off.

Now that the rendering processes quickly, you can adjust the material on the Vessel objects on the coffee table, making quick test renders as needed without taking up unnecessary time. You can see that the assortment of cylindrical objects on the coffee table all share the same material.

9. Click the Slate Material Editor button on the Main Toolbar.

10. Double-click the VesselMaterial sample to add it as a node to the View1 window , and then double-click the node to display its properties.

11. Click the Map button to the right of the Color (Reflectance) color swatch to open the Material/Map Browser.

12. In the Material/Map Browser, click the Maps ➢ mental ray ➢ Multi/Sub-Map material and then click OK.

You will see a Multi/Sub-Map node appear wired to the Color (Reflectance) channel in the View1 window. Double-click the Map# Multi/Sub-Map node in View1, and you will see the Multi/Sub-Map Parameters rollout in the Parameter Editor. There are a number of settings in the Multi/Sub-Map Parameters rollout, as shown in Figure 14.46. The Multi/Sub-Map parameters default to creating the maximum of 20 Color/Map slots. This value can be reduced with the type-in field or by using the spinners.
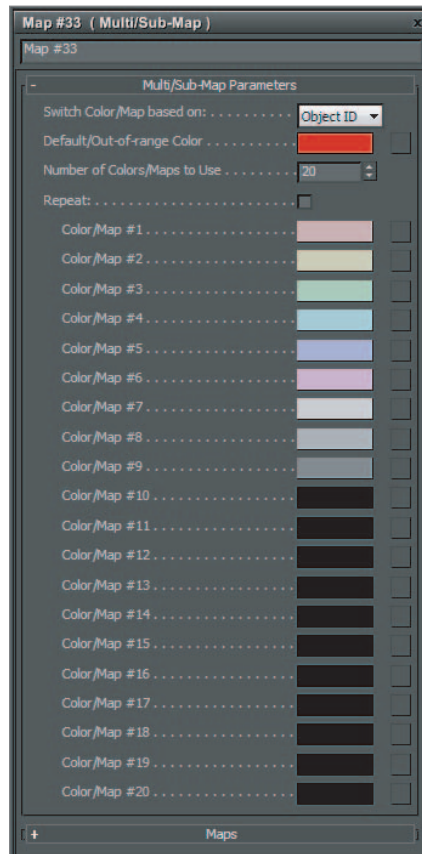
13. Click the Switch Color/Map Based On drop-down, and change the value to Random.

14. Click the Render button on the Reveal toolbar to start another test render. The cylinder objects now have different colors than the ones they had before.

15. Change the Number Of Colors/Maps To Use setting to **12**.

16. Change the values for Color/Maps #10, #11, and #12 and any of the other color maps (between 1 and 9, of course) to colors you like.

17. Click the Render button on the Reveal toolbar to start another test render.

18. Find the associated Color/Map value for the color on one of the cylinders that you can see in the test rendering, and click its Map button, as shown in Figure 14.47, to open the Material/Map Browser.

FIGURE 14.47
Click the Map
button.
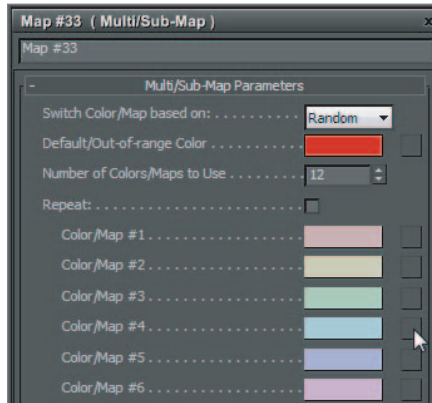
You can apply any of the maps that appear in the Material/Map Browser to the sub-map color.

19. Select the Maps ➢ Standard ➢ Marble map and click OK.

20. Double-click the Map# Marble node and, in the Marble Parameters rollout, change the Size value to **0.25**.

21. Click the Render button on the Reveal toolbar.

You can continue adjusting the different maps of the Multi/Sub-Map material as you like.

22. On the Reveal toolbar, change the values you adjusted in steps 4 through 7 to those shown in Figure 14.45.

23. Click the Render button on the Reveal toolbar to start rendering a final high-quality scene.

24. Save your scene as `MymentalrayMultiMapDone.max`.

Your final render should look similar to Figure 14.48, which is also provided with this chapter's download archive.

FIGURE 14.48
The finished
rendering

If you don't want to complete this render, click Cancel to stop the process. In the previous exercise, you saw how using the Multi/Sub-Map parameters in the mental ray renderer allows you to create a lot of variations of materials to apply to objects in your scene. This saves you from having to create a large number of unique materials and then apply them individually to objects in your scene to add a sense of randomness.

You also used the global quality sliders on the Reveal toolbar to reduce the render settings, allowing you to create quick test renderings without going through the various tabs and roll-outs of the Render Setup dialog box or selecting each soft shadow-casting light and changing its parameters. You could also use the toolbar to select even higher settings than are available on the Render Setup dialog box if you need to address issues with antialiasing or the appearance of glossy reflections or glossy refractions.

Skylight Global Illumination

Using a Skylight to produce global illumination is a technique that has been quite popular in computer graphics. Skylight is scattered light that does not come from any particular direction, simulating the luminosity of the sky itself. Skylight emanates from a dome of infinite radius that surrounds the scene everywhere above the horizon.

ILLUMINATING A SCENE WITH NO INTERIOR LIGHTS

When you solely use a Skylight to illuminate a scene, light will not enter interior spaces that are not open to the sky. You can still render interiors using this technique by hiding the ceiling and/or roof objects, thereby allowing the scattered light from the sky to illuminate the scene softly.

If you remember the section on using photon maps, you know that global illumination is simulated with photons, and photons are emitted from light sources. However, no photons can be emitted from a Skylight because they cannot come from any particular direction, by definition.

Rendering GI with a Skylight is tricky because you must use FG to provide the GI without the benefit of a photon map. From the section on FG, you might recall that it was designed to be used after the photon map calculated at least some GI. It turns out that the FG algorithm itself can calculate GI but for one bounce only. This means that using FG exclusively to generate GI won't yield accurate results because only the first reflection of the photons can be considered. If you are striving to make an accurate lighting simulation, do not use this method. This method is great for producing beautiful abstract renderings with little fuss.

USING FINAL GATHER ONLY

Because generating a photon map in a complex scene can be time consuming, many of those in the film industry started using FG only and skipped the more accurate photon map process to save precious time, which is often equivalent to money.

Remember, this trick won't work for caustics because FG doesn't consider caustic phenomena. Using the Skylight for GI guarantees that soft and gentle illumination will be everywhere. It also simplifies lighting because there are no other traditional lights in this trick. Let's see how it works in our now-familiar sample project:

1. Open the file `mentalraySkylightGI.max`.

2. Type **H** to open the Select From Scene dialog box. Select the Ceiling object and click OK.

3. Right-click in the Camera001 viewport to make it active, and then right-click again to access the quad menu and choose Hide Selection from the display quad.

4. Click the Create tab of the Command panel, and click the Lights category button. Use the drop-down to select the Standard lights option, and then select the Skylight tool in the Object Type rollout, as shown in Figure 14.49.

FIGURE 14.49
Create a Skylight in the scene.
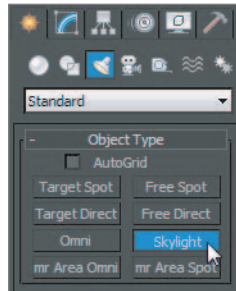
5. Click a point under the table in the Camera001 viewport to locate the Skylight, as shown in Figure 14.50. It doesn't matter where this object is placed as long as it is oriented dome up. The Skylight will emanate light in all directions from the inside of a hemisphere corresponding to the form of its gizmo in the viewport.

FIGURE 14.50
Place the Skylight under the table.

6. Click the Modify tab of the Command panel. In the Skylight Parameters rollout, click the Sky Color swatch, as shown in Figure 14.51.

FIGURE 14.51
Change the Skylight
color.
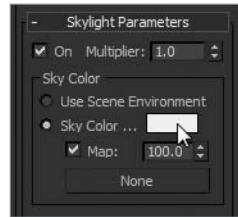
The sky color is currently a pale blue, which is perfect for an exterior rendering. However, you are using it in an interior, so it is better to choose a pale warm color to simulate the light in the space.

7. Drag the Hue slider over into the yellow tones to warm up the scene and click OK.

USE MUTED COLORS FOR THE SKY

Do not use a highly saturated color for the Sky Color setting, because it will interact strangely with the materials in the scene.

---

8. Press the F10 key to open the Render Setup dialog box, if it is not already open, and click the Indirect Illumination tab. In the Final Gather rollout, check Enable Final Gather and check Draft Mode (No Precalculations), as shown in Figure 14.52.

FIGURE 14.52
Set the Final Gather
options.
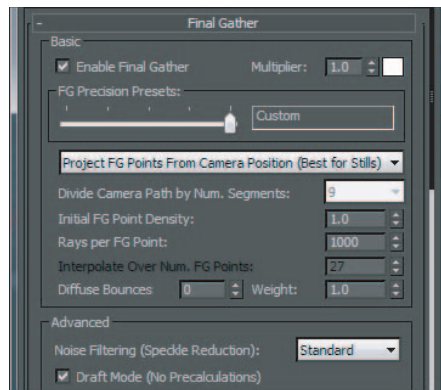
9. Click the Render button at the bottom of the Render Setup dialog box to make a test render.

10. Watch the image appear in the RFW. Click the Cancel button in the Rendering dialog box after enough buckets are processed and you have had a chance to verify that there is an acceptable level of illumination, as shown in Figure 14.53.

Figure 14.53
Verify that there is
an acceptable level
of illumination
from the Skylight.
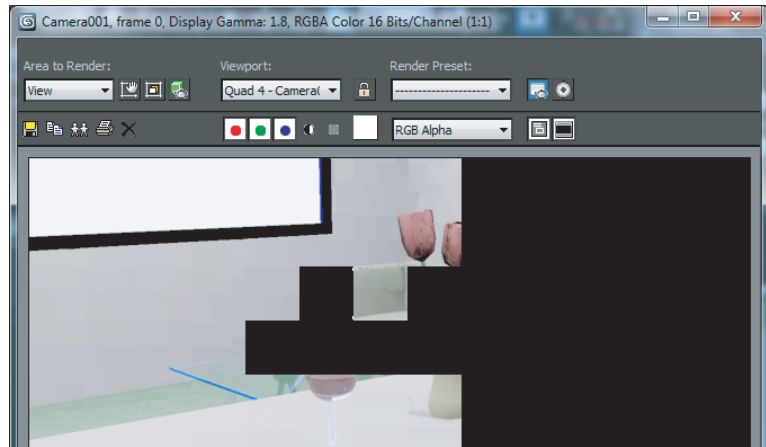
11. Deselect Draft Mode (No Precalculations) in the Render Setup dialog box, and then make another rendering. Prepare to wait a few minutes for this rendering to finish. Figure 14.54 shows the result.

Figure 14.54
Skylight GI

Increasing the Samples Value Increases the Render Time

This rendering could be improved by increasing the Samples Per Pixel value on the Renderer tab, as you did in a previous section, to antialias the final output. You could also increase the number of Final Gather samples on the Indirect Illumination tab. However, increasing sampling requires far more rendering time, and the decision to improve the rendering quality and time depends ultimately on your computing resources and deadline.

Image-Based Lighting and Skylight

As an alternative to using a solid color in the Skylight, you can get more varied results by using an environment map to illuminate the scene. This way, there will be variations in color and

intensity in the scattered light throughout the scene. This technique is called *image-based lighting (IBL)* in computer graphics circles. Let's try using IBL now:

1. Press the **8** key on the keyboard to open the Environment tab of the Environment And Effects dialog box. Click the None button below Environment Map.

2. Select Bitmap from the Material/Map Browser and click OK, as shown in Figure 14.55.

FIGURE 14.55
Select Bitmap from the Material/Map Browser.
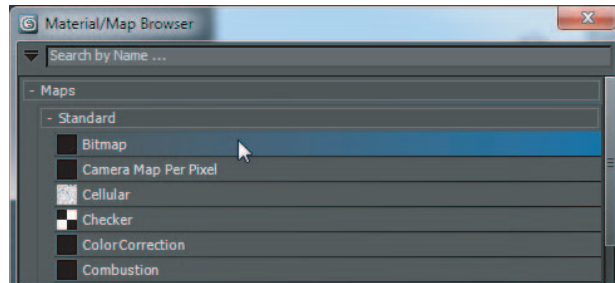
3. In the Select Bitmap Image File dialog box, browse to and select SphericalPanorama.jpg and then click Open.

4. Open the Slate Material Editor if it is not already open. Click and drag the environment bitmap from the Environment and Effects dialog box to the View1 window in the Slate Material Editor.

5. Choose Instance from the Instance (Copy) Map dialog box that appears.

6. Double-click the Map# Bitmap node in the View1 window, and click the View Image button in the Bitmap Parameters rollout to have a look at the image you'll be using as an environment map, as shown in Figure 14.56. Close the Specify Cropping/Placement dialog box when you have finished.

FIGURE 14.56
The Spherical Panorama.jpg image
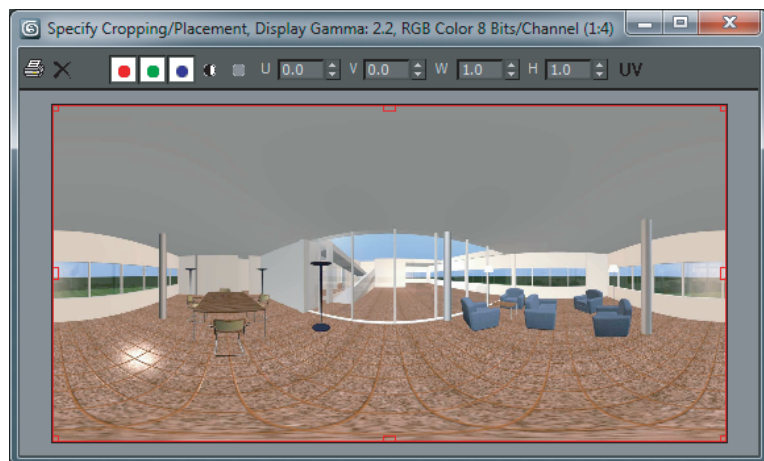
7. In the Slate Material Editor, change the Mapping type in the drop-down list in the Coordinates rollout to Spherical Environment to match the distortion in the panoramic bitmap, as shown in Figure 14.57.

FIGURE 14.57
Set the Mapping type to Spherical Environment.
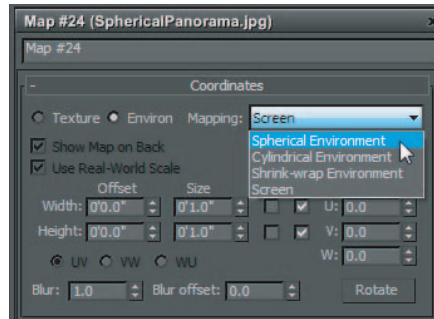
Close the Environment And Effects dialog box. To make IBL, you still need to instance the environment map into the Skylight.

8. Type **H** to open the Select From Scene dialog box, select Sky001, and then click OK. Click the Modify tab of the Command panel.

9. Click the Use Scene Environment radio button, as shown in Figure 14.58, in the Skylight Parameters rollout.

FIGURE 14.58
Click the Use Scene Environment radio button.
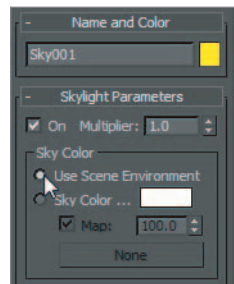
10. On the Environment tab, in the Logarithmic Exposure Control Parameters rollout, change the Physical Scale value to **7500** to brighten the image. The Physical Scale parameter allows you to set a "real" value for the brightest light source in the scene for scenes that don't use photometric lights.

11. Click the Render Production button to do another Skylight GI rendering, but this time with image-based lighting. Figure 14.59 shows the result.

Notice how you can see part of the environment map outside the window. This map is what is lighting the scene through the Skylight, with FG providing GI.

12. Save your work as **MymentalraySkylightIBL.max**. The mentalraySkylightIBL.max file is also provided on this book's website for your convenience.

USE HDRI FOR IMAGE-BASED LIGHTING

You can get more realistic image-based lighting by using an HDR image in the Skylight and Environment Map settings. The mental ray sky is also an HDR system.

Using High Dynamic Range Images

HDR images store more information than can be displayed on a computer monitor. Monitors can display only 256 variations in light intensity for each color channel (from the blackest blacks to the whitest whites). In the real world, our eyes can perceive enormous dynamic range, from subtle candlelight to direct sunlight that is millions of times more intense.

In Photoshop, you may have experienced data loss in your image by making various adjustments to the brightness, contrast, and color balance; by sharpening; and so on. For example, when you brighten a traditional 8-bit photo, eventually you will get burnout where the pixels turn all white and there is no more tonal information. After all, how much brighter can pure white get? The answer is now many orders of magnitude brighter if you are using HDR images.

HDR images can store exposure data that varies across many orders of magnitude in brightness. You can't see all this data on the monitor at one time, but 3ds Max can use this information in a rendering. 3ds Max can also save renderings in the `.hdr` and other high dynamic range formats to preserve this more extensive visual information.

HDR IMAGE FILES CAN BE QUITE LARGE

HDR images have variable bit depth based on how much exposure data is stored. Images that store many f-stops of exposure can grow to massive file sizes that may overwhelm the available memory in your rendering pipeline.

It is easy to use HDR images in 3ds Max. Simply select an `.hdr`, `.pic`, or `.exr` image, and you will see a dialog box like the one in Figure 14.60.
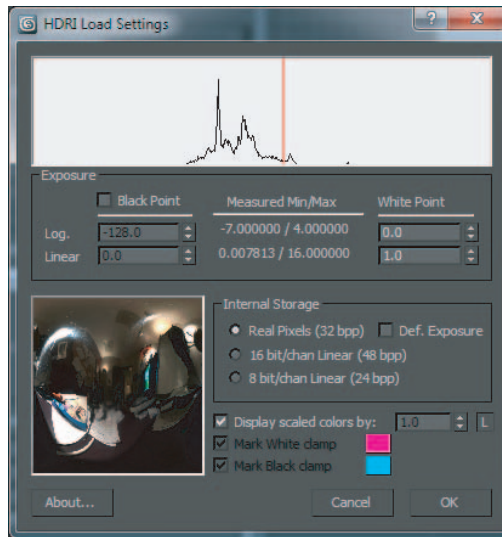
Use the spinners to move the vertical red bars to different positions within the histogram to bracket a narrower dynamic range that can be displayed on the monitor. The preview image will get brighter or darker depending on which portion of the dynamic range you select.

Various techniques can be used to capture HDR data from the real world. One way is to take multiple photographs with different exposure levels (you want to make sure to modify only the shutter speed of the exposures, not the f-stops, which will cause a change in the depth of focus in each exposure and create artifacts in the resulting HDR image) in each shot. You can then composite all this data together using special HDR software (see the "HDR Links" sidebar). Adobe Photoshop CS6 allows you to merge a number of low-dynamic range images into an HDR image. Spheron VR makes the SceneCam, an HDR-friendly camera system that can capture 26 f-stops of exposure in a single shot (talk about bracketing!).

USING HDR IMAGES IN 3DS MAX

You can use HDR images anywhere you use bitmaps in 3ds Max. The most common uses of HDR images are in Skylight IBL, backgrounds, and reflection maps.

HDR LINKS

Here are a few websites to explore for more information about HDR images:

HDRView   This software is used to view HDR images on Windows and is free for not-for-profit use.

http://www.pauldebevec.com/FiatLux/hdrview/

HDR Shop   This site offers HDR processing and manipulation software.

www.hdrshop.com

Photomatix   This site also offers HDR processing and manipulation software.

www.hdrsoft.com

Adobe Photoshop   Photoshop allows you to process and manipulate HDR images.

http://www.adobe.com/photoshop/

Radiance   This rendering software supports HDR images, and it was developed by the U.S. Department of Energy with additional support from the Swiss federal government.

http://radsite.lbl.gov/radiance/

RealTexture   This site offers collections of HDR images on CD, plus an HDR photo-shooting service.

http://www.realtexture.com/hdri1.htm

Spheron VR   This company produces the SceneCam, which captures 26 f-stops in a single shot.

www.spheron.com

Industrial Light & Magic's OpenEXR   Learn about how the top-notch film-effects pros use HDRI.

www.openexr.com

There are a number of ways to create HDR images for use with 3ds Max. Some use software, such as Autodesk® Stitcher™ Unlimited software, to stitch together panoramas that wrap around the greater part of a sphere. In still another technique, some photograph a chrome sphere ball to get an entire hemispherical panorama reflected in one shot (called a light probe).

In short, HDR images are popular in computer graphics today, and you can explore the cutting edge of technology if you so choose. The big film-effects production companies are using HDR workflows exclusively nowadays, so it makes sense that this technology is finding its way into 3ds Max.

The holy grail of IBL is to use real HDR environment images to illuminate virtual models using light data from the real world. At least in theory, there is no better way to illuminate a virtual scene realistically. Now you can combine all the acronyms used in this chapter by using

HDR images in IBL by FG the Skylight GI (in English that is "using high dynamic range images in image-based lighting by final gathering the Skylight global illumination").

Using mr Proxy Objects

3ds Max scenes with a significant number of copies of the same object, or objects with extremely high polygon count, can benefit from the use of the mr Proxy object. The mr Proxy object allows you to convert a 3ds Max object to a native mental ray object. This is helpful because you don't have to have the 3ds Max object in the scene, and you don't have to spend time converting to a mental ray object at rendering, which saves system resources and, more important, time.

In the following exercise, you will create an mr Proxy object, place a number of instances of the mr Proxy around a scene, and then render the scene.

1. Open the `mentalrayProxy.max` file that you downloaded from this book's website.

   This should be a familiar view of the Villa Savoye model that you have been working with throughout the book.

2. Click the Camera.View.3DGROUND viewport to make it active, and then click the Render Production button. Make a note of how long it takes to render the scene.

3. On the Create tab of the Command panel, click the Geometry button and then the drop-down menu, and select mental ray from the list.

4. Click the mr Proxy button, and then click and drag in the Top viewport to place the mr Proxy object.

5. With the mr Proxy object still selected, click the Modify tab of the Command panel.

6. In the Source Object group, click the None button and then click the tree object in the lower-left corner of the villa (as seen from the Top viewport).

   You will see the Foliage01 object listed now in the Source Object group, as shown in Figure 14.61. The options in the Parameters rollout of the mr Proxy object allow you to define how the mr Proxy object will appear in the scene. You can select to show the object as a point cloud and set the number of points used to represent the object, or you could show it as a bounding box.

7. Click the Write Object To File button to open the Write mr Proxy File dialog box, navigate to where you are saving this chapter's files, and save file as **MyTreeProxy.mib**.

8. In the mr Proxy Creation dialog that appears, click the radio button in front of Current Frame and make sure the two check boxes in the Preview Generation group are checked.

9. Click OK.

   You will see mental ray render a preview of the tree object and a point cloud that represents the mr Proxy object appear in the viewports.

10. Move the mrProxy001 object so that it is in the same location as the tree you used to create it.

11. Rename the mrProxy001 object **MyTree_mrProxy001**.

12. Create instance copies of the MyTree_mrProxy001 object, and place them at each of the existing trees in the scene.

FIGURE 14.61
The Parameters
rollout of the mr
Proxy object
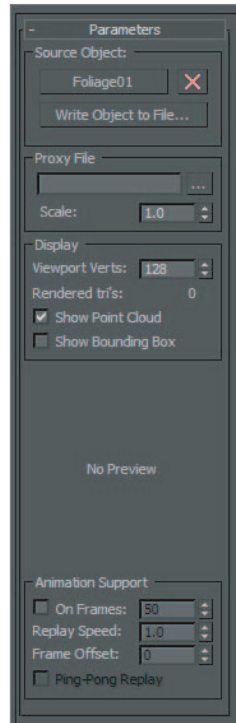
13. Select the tree object you picked in step 6. From the Application menu, choose Save As ➤ Save Selected.

14. In the Save File As dialog box, save the selected tree as **MyTree001.max**.

15. Click the Select By Name button on the Main Toolbar. In the Select From Scene dialog box, select all eight of the Foliage objects and click OK.

16. Press the Delete key on your keyboard to remove the selected objects from the scene.

17. Click in the Camera viewport to make it active, and then click the Render Production button.

The scene should now render much faster than it did in step 2; however, the trees do not have any materials applied to them. You will fix that in the following steps:

1. Click the Compact Material Editor button on the Main Toolbar.

2. Click and select an unused material sample slot; then click the Material Type button to open the Material/Map Browser.

3. Click and select Materials ➤ Standard ➤ XRef Material and click OK.

4. Rename the material **TreeXRefMat**.

5. In the Parameters rollout of the XRef material, click the Browse For File button that has an ellipsis mark on it under the File Name field.

6. In the Open File dialog box, browse to and select the `MyTree001.max` file you saved in step 14 of the previous exercise.

7. In the XRef Merge dialog box, select the Foliage01 object, as shown in Figure 14.62, and click OK.

FIGURE 14.62
Select the Foliage01 object.
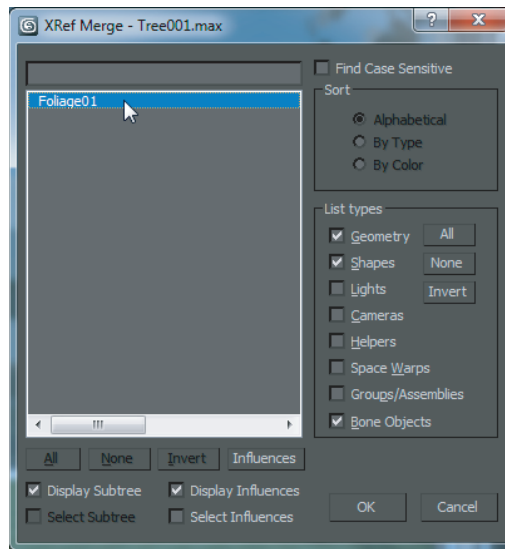
8. Select any one of the mr Proxy objects, and then click the Assign Material To Selection button in the Compact Material Editor.

9. Click the Camera.View.3DGROUND viewport to make it active.

10. Click the Render Production button to render the scene, and verify that the mr Proxy objects render with the tree texture. The file should still be rendering faster than it did with the regular Foliage objects.

11. Save your scene as `MymentalrayProxy.max`.

You can now fill the background of the camera's field of view with a large number of instances of the mr Proxy object tree without suffering as much of a performance hit at rendering time as you would if you had used regular 3ds Max foliage objects. You have also seen how you can apply a material to mr Proxy objects that externally references its texture parameters from a separate saved file.

Using IES Files

Using the photometric lighting available in 3ds Max provides you with a great tool for visualizing how lights will affect your scenes. Earlier you changed the TPhotometricLight001 object that you placed into a scene from using the default Uniform Spherical distribution model to using the Spotlight distribution type. To create an even more accurate render of what a scene will look like with specific lights, you can change the distribution type of lights to the Photometric Web setting and specify a file that is a 3D representation of the light intensity generated by a certain fixture. These Photometric Web files are Illuminating Engineering Society (IES) files that can often be acquired from the lighting fixture manufacturers. There are some sample IES files that ship with 3ds Max in the \SceneAssets\photometric folder and with the \Luminaires sample content that you can also install.

In the following exercise, you will change the distribution type of a light in a scene:

1. Open the mentalrayIESLighting.max file from this book's website.

2. Click the Select By Name button on the Main Toolbar, and select the TPhotometricLight001 from the Select From Scene dialog box.

3. Go to the Modify tab of the Command panel and, in the Light Distribution (Type) group, click the drop-down menu and select Photometric Web.

4. In the Distribution (Photometric Web) rollout, click the Choose Photometric File button, and choose the cooper.ies file that you downloaded with the Chapter 14 content from this book's website.

5. You will see a small thumbnail graphic called a goniometric diagram appear in the rollout, as shown in Figure 14.63.

FIGURE 14.63
The loaded
cooper.ies file
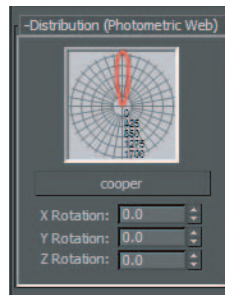
You can see how the icon for the TPhotometricLight001 object changed in the viewport to represent the new light distribution model you assigned.

Figure 14.64 shows the same cooper.ies file applied to a light and how it shines on two adjacent walls.

6. The Cooper light is more intense than the values the TPhotometricLight001 object had before, so you should go to the mr Photographic Exposure Control group in the Environment And Effects dialog box and adjust the Exposure Value to **5**.

FIGURE 14.64
The Cooper light shining on two surfaces.
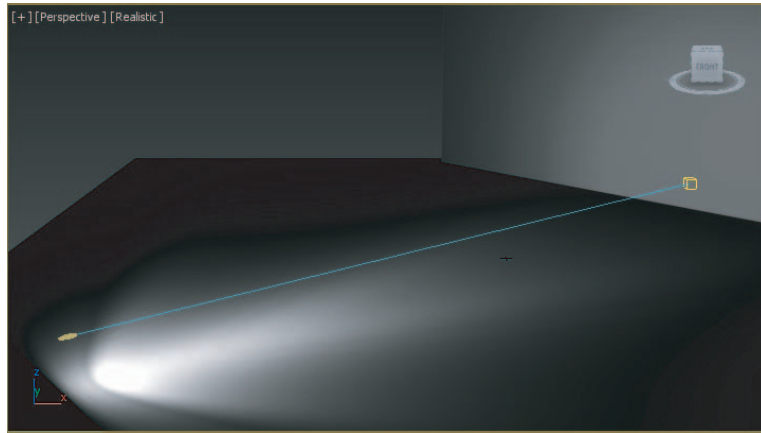
7. Click the Render Production button, and compare the results of this rendering with your previous renderings using the Spotlight distribution type.

8. Save your scene as **MymentalrayIESLighting.max**.

You can see that by using the appropriate Photometric Web files for the light fixtures in your scenes, you can greatly increase the accuracy and realism of your final renderings.

The Bottom Line

Apply final gathering.   Final gathering is an optional step in calculating global illumination that can reduce the appearance of unwanted variances or rendering artifacts in the lighting.

> **Master It**   Apply final gathering to an exterior view of the Savoye project from this chapter.

Create a contour rendering.   Contour renderings display dark strokes along the contours of a scene's objects. This is an effect caused by using the mental ray Contour shaders and the parameters in the Camera Effects rollout.

> **Master It**   Using the same techniques covered in this chapter, create a contour rendering of the interior of a condo scene.

Use the Multi/Sub-Map material.   Creating a large number of unique maps to apply to repetitive objects in a scene to add a sense of variation or randomness can take a lot of effort. The Multi/Sub-Map material allows you to create one material with a number of internal variations that you can apply to objects in your scene to achieve that sense of natural randomness.

> **Master It**   Create a 25×25 array of 1' radius spheres, offset 3' from each other, with a single material that will randomly change the color of the spheres through the use of the mental ray Multi/Sub-Map material.

Use Skylight global illumination.   Global illumination can enhance the appeal of a scene by simulating bounced light. This can include the color bleeding effect where color is transferred from one surface to another.

> **Master It**   Add global illumination to an exterior shot of the Villa Savoye.

Use mr Proxy objects.   Using mental ray Proxy objects in scenes that require a considerable number of identical high-poly objects can save you significant file size, system resources, and render time.

> **Master It**   Create and render a 25 × 50 array of mr Proxy teapots using an eight-segment teapot as the source object.

Use IES files.   Using Photometric Web distribution files for your photometric lights can greatly increase the realism and accuracy of your final rendered images.

> **Master It**   Using the `MymentalrayIESLighting.max` file you saved near the end of the chapter, change the light distribution type of PhotometricLight001 from Uniform Diffuse to Photometric Web, and select the `cooper.ies` file. Then render the scene.

Chapter 15

Finishing It Off: Atmosphere, Effects, and Compositing

The Autodesk® 3ds Max® 2013 platform has several features for adding the appearance of objects in your scene without actually adding any geometry. These features fall into one of two categories: atmospheric effects and rendering effects. *Atmospheric effects* are effects that appear to show particulate matter in the air (such as mist, smoke, or even fire). *Rendering effects* change the appearance of a rendered scene by adding objects such as glows and starbursts, but they can also be used to add hair or fur to an object in the scene. The Hair And Fur effect can be used to add hair to characters or creatures and to simulate grass in a scene.

You can also render images simulating such real-world camera effects as glare from extremely bright reflections or light sources and the depth of field created by adjusting the aperture of a camera lens.

Included with 3ds Max 2013 is Autodesk ® Composite®, which is a node-based compositing application based on the Autodesk Toxik compositor. *Compositing* is the process of layering image elements on top of each other and adjusting how they are blended together to create your final image. Autodesk Composite features a comprehensive toolkit to maximize your creativity, including keying, color correction, motion tracking, paint features, full HDR support, and depth-of-field effects—all at resolutions up to 4K film resolution. This chapter cannot go into all the features of Autodesk Composite, but it will give you an idea how you can work with your images, and then you can use the Composite help and learning resources to increase your understanding of Autodesk Composite.

In this chapter, you will learn to

- ◆ Add an atmospheric effect
- ◆ Add an effect using Hair And Fur
- ◆ Add the Glare effect to a rendering
- ◆ Use DOF / Bokeh
- ◆ Create stereo-pair images
- ◆ Create render passes for compositing
- ◆ Import images into Autodesk Composite 2013
- ◆ Composite the stereo pair into an anaglyph image

Adding Atmospheric Effects

When a scene is rendered in 3ds Max, the renderer calculates the effect of the scene's lights on the surfaces of the geometry, among other things. By default, the scene is rendered as if the air surrounding the objects is clear and free of any particulates. In many cases, this is the correct assumption, and you wouldn't want to add pollution, fog, or airborne particles to the scene. Yet many times adding atmospheric effects is necessary to make the scene look more realistic, that is, lived in and used, which is particularly true when dealing with lighting, fog, and fire.

3ds Max has a set of features, called *atmospheres,* that can add the appearance of airborne particles. Real-world lights cast light into their surrounding environment, and you can see the effect of the lights as both direct and indirect illumination, but you can't see the actual light rays or light cone. When the light cone appears to be visible, such as a spotlight at a movie premiere or a car's headlights on a foggy road, what you're actually seeing is the light rays diffusing after hitting airborne particles such as dust, smog, or water vapor. The Volume Light atmosphere adds the light-diffusion effect to selected lights in a scene.

Atmospheric effects are also helpful when adding fog to a scene, which can give the impression of desolation, eeriness, or cold/wet weather conditions. In reality, fog comprises an immeasurable number of minute particles that capture and diffuse light rays. This would be difficult to calculate and display accurately. You can represent fog in your scenes, including density changes and color variations, using the Fog atmosphere.

As you can guess, the Fire Effect renders as a ball or tendril type of combusting material that can change color with distance from the fire's center. Be aware that the Fire Effect atmosphere, like Fog and Volume Light, appears only in rendered scenes and not in the viewports. Also note that the Fire Effect does not contribute any illumination to the scene.

CERT OBJECTIVE

These effects are designed to work with the scanline renderer. If you use mental ray, you may find that the scanline effects don't always work correctly. Volume Light in particular is best reserved for the scanline renderer. To create volume lights in mental ray, you can use a specialized shader called the *Parti Volume Photon* shader, placed on the Volume channel of the mental ray Camera Shaders group. The use of that shader is outside the scope of this book.

Creating a Volume Light

There are many times when you can use a Volume light. Any time a light beam is visible as an object in a scene, this is a chance to use a volume light. Whether it's dappled light streaming through the leaves in a forest, rays casting through a window, or even car headlights or parking lot streetlamps at night, all of these are a good uses of volume lights.

In the following exercise, you'll add the Volume Light atmosphere to existing lights in a 3ds Max scene. After adding the atmosphere in the Environment And Effects dialog box, you'll pick the lights that will display the effect and then render the scene:

1. Open C15_VolumeLight.max. This file is similar to the Savoye files you worked with in other chapters but with a darker environment and downward-facing spotlights added to the overhang.

FILE LOAD: GAMMA SETTINGS

If you get a File Load: Gamma And LUT warning when you open this file, choose the setting that enables Gamma/LUT Correction.

---

2. If it is not already the active viewport, right-click the Camera001 viewport and then render the scene. The contents of the Rendered Frame Window should look like Figure 15.1 and show the light pools beneath each spotlight.

FIGURE 15.1
The first rendering
of the scene
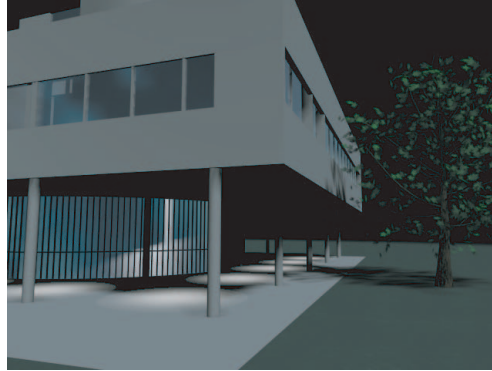
RENDER CAMERA OR PERSPECTIVE VIEWPORTS

The result of atmospheric effects can be seen only in rendered Camera or Perspective viewports and not in rendered axonometric or orthographic viewports.

---

3. Press the **8** shortcut key, or choose Rendering ➤ Environment to open the Environment tab of the Environment And Effects dialog box, or you can click the Environments And Effects Dialog (Exposure Controls) button in the Rendered Frame Window.

4. In the Atmosphere rollout, click the Add button to open the Add Atmospheric Effect dialog box.

5. Click the Volume Light option and then click OK. Volume Light is added to the Effects field in the Atmosphere rollout.

6. In the Lights section of the Volume Light Parameters rollout, click the Pick Light button. At this point, you could select each light in the scene by picking them in the viewports. Some of the lights aren't easily selected in the viewports, so you'll need to use the Pick Object dialog box.

7. Click the Select By Name button, or press the **H** key to open the Pick Object dialog box. Because only lights can be assigned to the Volume Light atmosphere, only lights appear in the list.

8. Highlight all the lights with names that begin with *TPhotometricLight* and then click Pick. The names of all the selected lights can be displayed by expanding the drop-down list in the Lights area.

9. Render the scene again (see Figure 15.2). This time the light cone can be seen from the source half the distance to the ground.

FIGURE 15.2
The rendered scene after adding the Volume Light effect
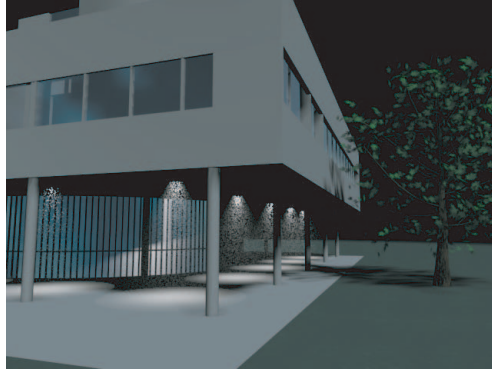
PHOTOMETRIC VOLUME LIGHTS ON 64-BIT SYSTEMS

If you are using photometric lights with the Volume Light Atmospheric effect in the scanline renderer on a 64-bit system, be aware that there are reports of render artifacts or errors and that the volumetric effects don't properly respond to the Noise parameters. We hope this will soon be remedied with a Product Update. If you run into this error or any other errors using the software, please submit a defect report against 3ds Max 2013 to Autodesk. Submitting Problem Reports is covered in Chapter 1, "Getting to Know Autodesk® 3ds Max® 2013."

Adjusting the Volume Light Parameters

Like most features in 3ds Max 2013, there are many parameters that you can adjust to tweak the appearance of the Volume Light effect. The most notable are those that modify the effect's density and color. You can change the color of the volume of light to inject emotion into a scene—for example, yellow for warmth or blue for moonlight. Use density to make the effect more visible if needed. Here you will experiment with each of those parameters:

1. In the Volume area of the Volume Light Parameters rollout, click the Fog Color swatch to open the Color Selector dialog box.

2. Select a pale yellow color (255,255,230 works well), and then click OK to close the Color Selector.

3. Render the scene again. This time the hue of the lights' cones is shifted toward yellow.

NOT ALL INSTANCES ARE AFFECTED

All the lights selected in this exercise are instances; therefore, adjusting one light's parameter adjusts that parameter for all lights. However, just because an instance is a volume light, not all the instances are volume lights, so each light must be added to the Volume Light effect.

---

4. Increase the Density value to **8** to increase the amount of light captured by the effect. Make sure that the Exponential option is deselected, and then render the scene again. With Exponential checked, the light's density falls off exponentially with distance

rather than linearly, as it does when the option is off. The rendering in the Rendered Frame Window (RFW) should look similar to Figure 15.3.

FIGURE 15.3
The scene after adjusting the Density parameter

The Exponential check box is critical to use if you intend to render transparent objects within the Volume Light or Volume Fog. You can adjust the Volume Light's parameters further as you want.

One nice tip to know is that if you put a bitmap in the Projector Map channel of a standard Spotlight (found in the Advanced Effects rollout), you will get the bitmap throughout the volume of the light. If you need to accentuate streaks of light in a scene, this is a helpful technique.

Adding Fog

3ds Max fog comes with two different fog styles: Volume Fog and Fog. With Volume Fog, a spherical, cylindrical, or box-shaped gizmo called an *atmospheric apparatus* is added from the Helpers category on the Create tab. The fog is then created and constrained to the boundaries of that gizmo. This fog type is good for clouds or when representing a smoke or fog effect that must be limited to a specific volume.

The other type of fog atmosphere, the one that is used in this exercise, is unlimited in its extents and fills the area viewed through the camera.

ADDING THE FOG ATMOSPHERIC EFFECT

Fog is another atmospheric effect similar to the volume light but is not constrained to a helper object. Let's try it:

1. If you've closed any of the windows, you can reopen the Environment tab of the Environment And Effects dialog box and then click the Add button in the Atmosphere rollout.

2. In the Add Atmospheric Effect dialog box, double-click the Fog option to select it; the dialog box should close automatically.

   With the Fog option selected in the Effects window, the Fog Parameters rollout replaces the Volume Light Parameters rollout (see Figure 15.4). If you need to go back and adjust the Volume Light effect's parameters, simply select Volume Light in the Effects window.

FIGURE 15.4
The parameters for
adjusting the fog
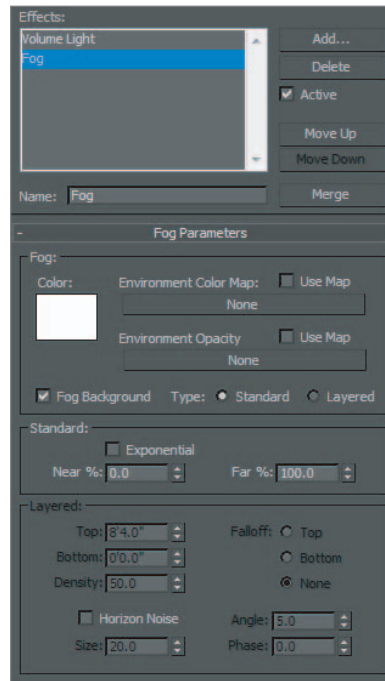
3. Render the Camera001 viewport. As you can see in Figure 15.5, the Fog effect starts at the camera's viewing plane and increases in density with distance.

FIGURE 15.5
The rendered scene
after adding the Fog
atmospheric effect
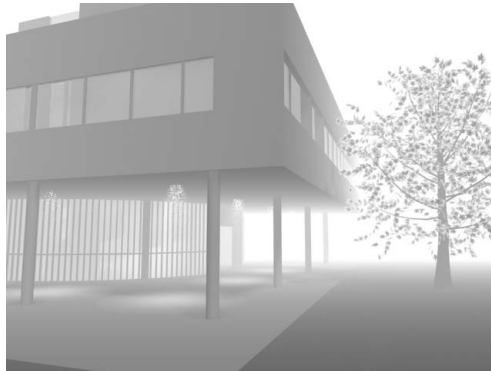
4. Although this effect frames the leaves on the tree nicely, in this case you want to just show some ground fog around the building. In the Fog area of the Fog Parameters rollout, click the Layered radio button. The Standard group grays out, and the Layered parameters become available.

5. Layered fog has Top and Bottom parameters that set its vertical limits. Set the Top parameter to **3′ 0.0″** by clicking and dragging the spinners, and leave the Bottom value set to **0′ 0.0″**.

Don't Obscure the Scene

Make sure the camera is above the top level. If the camera's Z position is between the Top and Bottom parameters, then it is within the fog itself and much of the scene may be obscured.

---

6. Set the Falloff option to Top so that the fog gets thinner as it reaches its upper limit. Render the scene again. Your rendering should look like Figure 15.6. The scene looks better, but you still need to work on the color and density of the fog.

Figure 15.6

The rendered scene after switching to layered fog and adjusting the falloff

7. Click the Color swatch in the Fog area, choose a dark gray/green color for the fog, and then click OK. Here we are using RGB values 60,100,60 for a very toxic-looking fog.

8. In the Layered group, change the Density values and render. Do this repeatedly until you find a good combination of density and color.

Assigning Patches of Opacity

Rather than controlling the density with the Density parameter, which results in an even density throughout the fog, here you'll use a map to assign patches of opacity randomly. This will add to the illusion of the fog, because it will not appear as an even, computer-generated effect. Whenever you can add randomness to something, it tends to mimic reality more naturally.

1. Open the Compact Material Editor by clicking the Material Editor button or pressing **M** on the keyboard. Select an unused sample slot, and then assign a Standard material to that slot.

2. Expand the Maps rollout, and then click the None button next to the Diffuse color channel to open the Material/Map Browser.

3. Double-click the Noise Map option to select it. The Material/Map Browser will close and return you to the Compact Material Editor.

4. Click the Go To Parent button, and then drag the Noise map from the Compact Material Editor's Maps rollout to the Environment Opacity map button on the Fog Parameters rollout, as shown in Figure 15.7.

…to here. Drag from here…
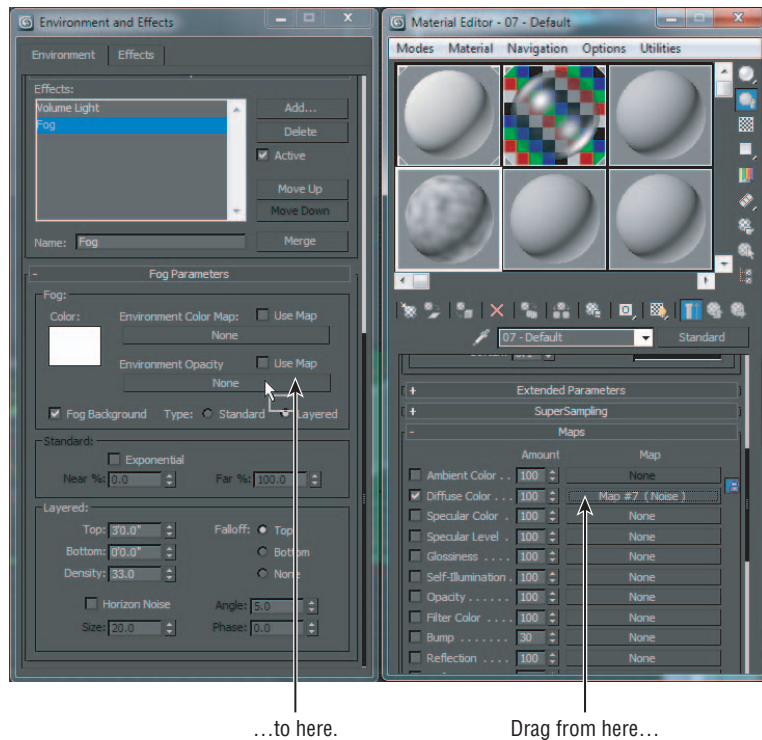
5. Choose Instance in the Instance (Copy) Map dialog box and then click OK. Because you chose Instance, any changes made to the map in the Compact Material Editor are reflected in the scene when it is rendered.

6. Render the scene again. It's a little better, but the changes in the fog's density are spaced too far apart.

7. On the Compact Material Editor, click the Diffuse Color map button in the Maps rollout to get to the material's Noise map.

8. In the Noise Parameters rollout, set the Size value to **10** and the Noise type to Fractal to make the noise effect smaller and sharper. Then render the scene. Your RFW should look similar to Figure 15.8.

9. Close the Material Editor.

CONTROL THE FOG'S COLOR WITH A MAP

Instead of using the Color swatch in the Fog area to control the fog color, you can use a map. Similar to the way that you assigned a map to the Environment Opacity Map option, you could assign one to the Environment Color Map option as well. The fog would then get its colors from the map's colors, whether the map is a bitmap or a procedural map.

FIGURE 15.8
The scene after add-
ing a Noise map to
control the opacity
of the fog
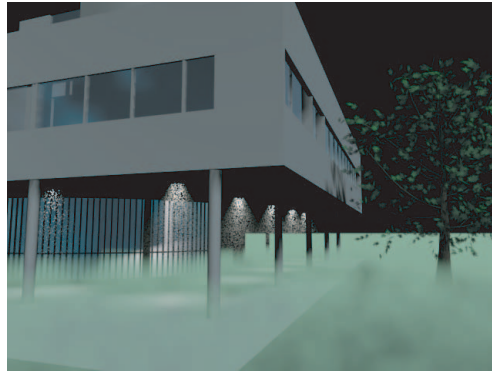
HELPING YOUR FOG INTERACT WITH THE HORIZON

The last feature that you want to address is how the fog interacts at the horizon. If you look in the Camera001 viewport, you'll see a black line in the background that sits just above the top of the land on which the building sits. This is the horizon line, and its visibility is controlled with the Show Horizon option in the camera's Parameters rollout. You can add noise at the horizon to break up the regularity of the computer-generated effect.

1. In the Layered area of the Fog Parameters rollout, select the Horizon Noise option.

2. Reduce the Size parameter to **10**, and then change the Angle value to **6**. The Angle value determines how many degrees below the horizon the horizon noise begins.

3. Render the scene one more time, and you should see the fog at the horizon line now broken up, as shown in Figure 15.9.

FIGURE 15.9
Horizon Noise
controls the appear-
ance of the fog at
the horizon
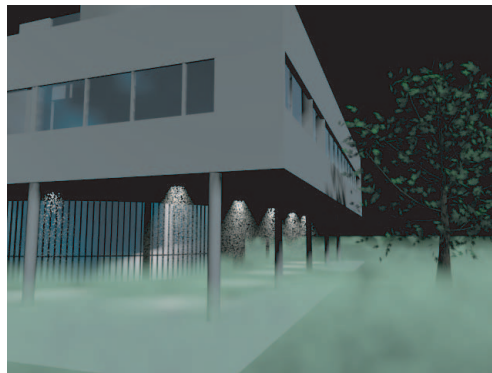
4. Save your file as `My_VolumeEffects_A.max`.

Adding a Fire Effect

Like the Volume Fog effect mentioned earlier, the Fire Effect atmospheric effect requires a gizmo to contain it. You can control whether the flames are reaching upward with tendrils or whether the flame is formed into a ball. Unlike real fire, the Fire Effect does not cast any light into the scene and is almost always accompanied by a light. In this section, you'll create a Fire Effect,

which you'll add to a fire next to a debris pile in a section of corridor similar to the one you used in Chapter 12, "Creating Animations, Particles, and Dynamics."

1. Open C15_Corridor.max from this book's accompanying web page.

2. Click the Helpers button under the Create panel, expand the drop-down list, and select Atmospheric Apparatus.

3. Click the SphereGizmo button. In the Top viewport, click near the center of debris pile in the corridor and drag the gizmo until it is about the size of the center-raised section of the corridor (see Figure 15.10).

FIGURE 15.10
Creating the gizmo
in the Top viewport
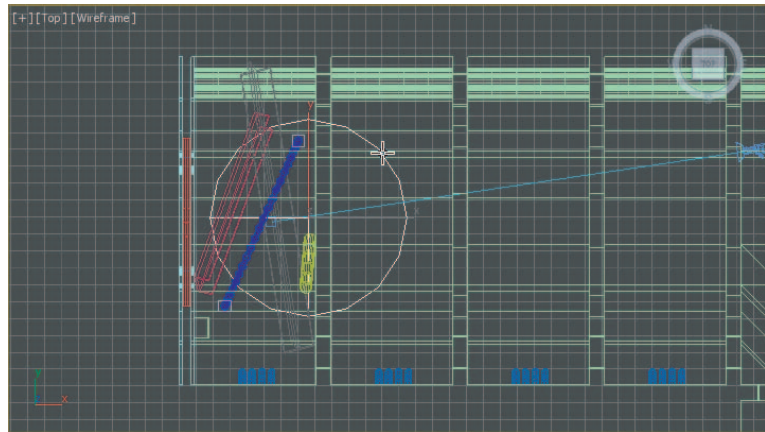
4. Click the Modify tab of the Command panel, and then select the Hemisphere option for the SphereGizmo.

5. In the Left viewport, move the gizmo upward until its flat bottom is on the top of the walkway portion of the corridor.

6. Set Radius to **3′ 0.0″**.

CHANGING THE FIRE'S SHAPE

Gizmos are subject to the same transforms as other objects, so you can use the Scale transform to change the sphere shape to more of a capsule shape.

---

7. Right-click in the Camera001 viewport to make it active. With the gizmo selected, click Select And Non-uniform Scale and then drag the Z-axis handle upward, as shown in Figure 15.11, to scale the gizmo non-uniformly along the Z-axis only.
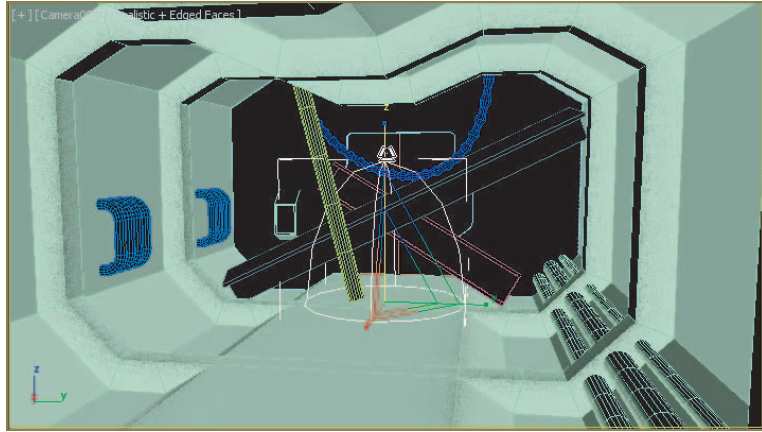
8. In the Modify panel, on the Atmospheres & Effects rollout, click the Add button.

TURNING OFF AN ATMOSPHERIC EFFECT

You can turn off any atmospheric effect by selecting it and deselecting the Active option in the Atmosphere rollout of the Environment And Effects dialog box. You can force 3ds Max not to render any atmospheric effects by opening the Render Setup dialog box, selecting the Common tab, opening the Common Parameters rollout, locating the Options group, and deselecting the Atmospherics option.

---

9. In the Add Atmospheric Effect dialog box, double-click the Fire Effect option to select it. The dialog box closes automatically.

10. Open the Environment And Effects dialog box. With the Fire Effect option selected in the Effects window, the Fire Effect Parameters rollout (see Figure 15.12) appears below the Effects window.

11. Render the scene. Your rendering should look like Figure 15.13.

12. In the Fire Effect Parameters rollout's Shape section, change Flame Type to **Tendril** and increase the Stretch value to **3**. Stretch elongates the tendrils along the Z-axis.

13. In the Characteristics section, change Flame Size to **5** and Flame Detail to **5** to give the effect well-defined tendrils. Finally, increase the Density to **33**.

14. Render the scene again to see the result of your parameter changes. Your rendering should look similar to Figure 15.14.

FIGURE 15.12
The Fire Effect
Parameters rollout
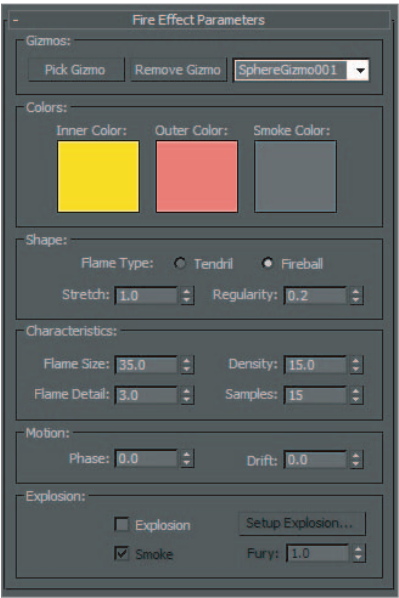
FIGURE 15.13
The rendered scene
after adding the
Fire Effect
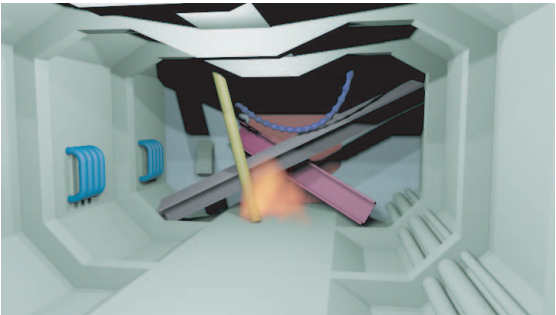
FIGURE 15.14
The Fire Effect
after adjusting the
parameters
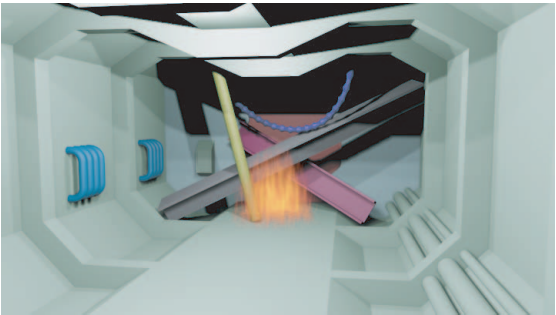
ADDING A LIGHT TO THE SCENE

As mentioned earlier, the Fire Effect does not add illumination to the scene. In the real world, the light from the flames would spill onto the building and ground. You therefore need to add a light to complete the illusion. To do this, just follow these steps:

1. From the Command panel, choose Create ➢ Lights ➢ Photometric ➢ Free Light, and then click near the Atmospheric Apparatus gizmo in the Top viewport.

2. Click the Align button on the Main Toolbar, and align the center of the light with the center of the gizmo.

3. Click the Modify tab. In the Intensity/Color/Attenuation rollout, click the Kelvin option and then click the Filter Color swatch.

4. In the Color Selector that opens, choose a bright yellow or orange color and then click OK to set the light color.

5. In the Intensity area, set the Candelas (cd) value to **3000** to double the light's intensity.

6. Scroll up on the Modify tab, and click the check box to turn on Shadows for the light.

7. In the Shadow Map Params rollout, change the Bias to **0.01** and the Size to **1024**, and turn on 2-Sided Shadows.

8. In the Colors section of the Fire Effect Parameters rollout, on the Environment And Effects dialog box, click the red Outer Color swatch and increase the redness by changing the RGB values to **237,12,12**. Click OK.

9. Scroll up in the Environment tab and, in the Logarithmic Exposure Control Parameters rollout, reduce the Brightness value to **50** to darken the scene a bit and make the fire pop.

10. Render the scene. Your RFW should look similar to Figure 15.15.

FIGURE 15.15
The rendered scene after adding a light
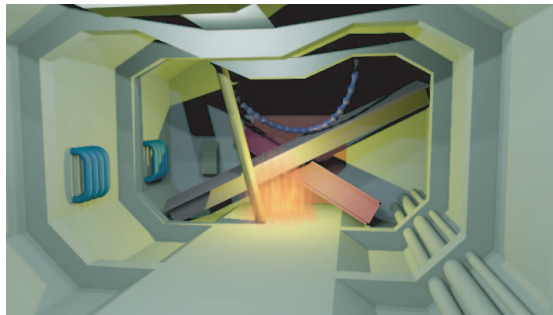
ANIMATING THE SCENE

Fires are not static; they are continuously churning and moving elements. To sell this effect in an animation, follow these steps to animate both the fire and the light:

1. Move the time slider to frame 100, and then click the Auto Key button.

2. In the Motion area of the Fire Effect Parameters rollout, set the Phase value to **12** and the Drift value to **20**.

3. Select the light in the debris pile, and change the Filter color to a brighter yellow red and the intensity to **4000** cd.

4. Move the time slider to frame 50, and then set the filter color to a light red and the intensity to **2700** cd.

5. Select the SphereGizmo, and then add a Noise modifier to it. In the Strength area, change the X, Y, and Z values to approximately **35′**, **-30′**, and **4′**, respectively.

6. Move the time slider back to frame 100, and then change the X, Y, and Z values so that the Noise modifier distorts the gizmo differently over time.

7. Click the Auto Key button to turn it off.

8. Open the Render Setup dialog box, and choose Active Time Segment in the Output area.

9. Save your file as **My_FireEffect.max**.

    It's always prudent to save your file before you begin a render. That way, if the computer crashes during a render, you haven't lost any work on your 3ds Max file.

10. Click Files in the Render Output section, browse to where you are working with this chapter's files, and give the file the name **My_FireEffect.mov**. Choose MOV as the file type, make any setup changes you prefer, and then click the Render button.

    Generally, rendering directly to a movie format is not a smart way to work. When you are rendering a large number of frames, you will lose the entire movie if 3ds Max or your system crashes. Also, rendering directly to a movie file bakes the compression into the file. You should render to a sequence of uncompressed frames (then, if the system crashes, you haven't lost too much time and you can restart the rendering at the last completed frame) and then use the Video Post tool in 3ds Max 2013 or the Composite application to generate a movie file from the sequentially numbered frames. In this case, you'll take a chance and render directly to a movie. This could take some time, so you might want to take a short break here.

11. Play your rendered animation in Apple QuickTime—or you can choose View Image File from the Rendering menu, and this will automatically launch the correct player from within 3ds Max.

The fire churns well, and the colors change nicely. You should consider taking this exercise a little further by animating the position of the light, adding more keyframes and changing the color and intensity of the light, adding more keyframes and adjusting the parameters of the Fire Effect, adding more lights with variations in color, and adjusting the radius and position of the gizmo to really make the fire flicker. You could even use soft selection to put a noise modifier on the Hose object and animate the Noise modifier, similar to the one on the SphereGizmo, to give the appearance of the hose swaying in the waves of heat from the fire.

Using Hair And Fur

3ds Max has several non-atmospheric effects that are added through the Effects tab of the Environment And Effects dialog box. Although most of these are rendering effects, such as Motion Blur, Film Grain, and Lens effects (stars, glows, lens flares, and so on), there is also the

Hair And Fur effect. The effect can be used for more than for creating hair on characters or animals; it can also be used to create convincing grass and other ground cover. Like the atmospheric effects, the Hair And Fur effect can be rendered only in Perspective and Camera viewports. Rendered hair or fur is a combination of applying the Hair And Fur modifier to an object or spline in your scene and applying the Hair And Fur render effect, which is automatically added to the Environment And Effects dialog box when you apply the modifier.

1. Open `C15_CharacterHead.max`.

   This file is a simple, low-poly character head. The assigned renderer for this file is the NVIDIA mental ray renderer.

2. Select the Head object, that is, the object named CharHead001.

3. Apply the Hair And Fur (WSM) world space modifier to the Head. A small percentage of the actual number of hairs appears in the viewports. As you can see in Figure 15.16, the hairs cover the entire head.

FIGURE 15.16
The hairs as they first appear in the viewport
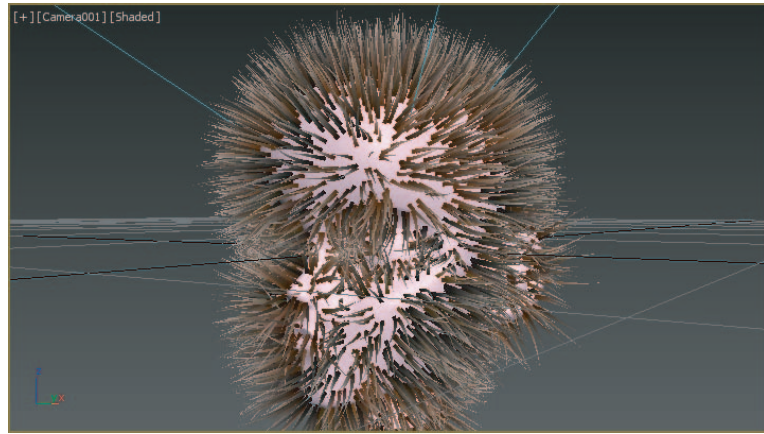
4. Open the Effects tab (not the Environment tab that you've used so far) of the Environment And Effects dialog box, and you'll see that the Hair And Fur effect was automatically added to the Effects window.

5. Select the Hair And Fur effect. The Hair And Fur rollout appears at the bottom of the Effects tab.

Adjusting the Hair And Fur Parameters

The hair looks like spikes coming off the character's entire head, and the color needs some work as well. In this section, you'll size the hair better and change the color.

1. With the CharHead001 object selected, expand the Hair And Fur (WSM) General Parameters rollout on the Modify tab.

2. Set Rand. Scale to **20** so that each hair's length is not exactly the same, and it can vary 10 percent above or below the standard length.

3. Increase the Hair Segments value to **7**. If you are rendering close-ups of characters with hair, you will need to increase the Hair Segments value so that the hairs look smooth.

   Hair And Fur gets its color from the Material Parameters rollout and not the Material Editor. You can control the color at the base of the blade (Root Color) and the tip (Tip Color) and allow a variance between the blades.

4. Expand the Material Parameters rollout.

5. Click the small gray button to the right of the Root Color swatch. This is how you assign a map, rather than a color, as the source for the hair color.

6. In the Material/Map Browser that opens, choose the Sample Slots Rollout to display only the maps that exist in the sample slots of the Material Editor.

7. Double-click the Diffuse Color: Map #0 (`Tiger.bmp`) map.

8. Choose the Instance radio button in the Instance or Copy? dialog box and then click OK. A capital *M* appears on the button to indicate that a map is controlling the color.

9. Click the Tip Color swatch, and then in the Color Selector assign something similar to **190,167,154** and click OK. The hair will now transition from the map's color at the root of the hair to the assigned tip color.

MUTANTS ARE ALLOWED

If you want to have random hairs that possess their own color, much different than the Root and Tip Color values, assign a color to the Mutant Color swatch and increase the Mutant % to more than 0.0.

---

10. Render the Camera001 viewport. The scene is not quite where we want it (see Figure 15.17).

FIGURE 15.17
The rendered scene after changing several Hair And Fur parameters

Refining the Hair And Fur Parameters

One huge problem exists in the scene: the hair is growing all over the character's head. In this exercise, you'll limit the area on the model where the hair appears.

1. With the CharHead001 object selected, scroll up to the General Parameters rollout of the Hair And Fur (WSM) modifier and click the button next to the Density entry.

2. In the Material/Map Browser, choose Maps ➤ Standard and double-click Bitmap.

3. In the Select Bitmap Image File dialog box, browse to the folder where you downloaded this chapter's files and select `Hair_Map.tif`.

   The hair now only appears in areas painted white in the selected bitmap, which was crudely painted on the CharHead001 object using the Vertex Paint tool. Your viewport should look like Figure 15.18.

FIGURE 15.18
Hair placement now limited by the applied map
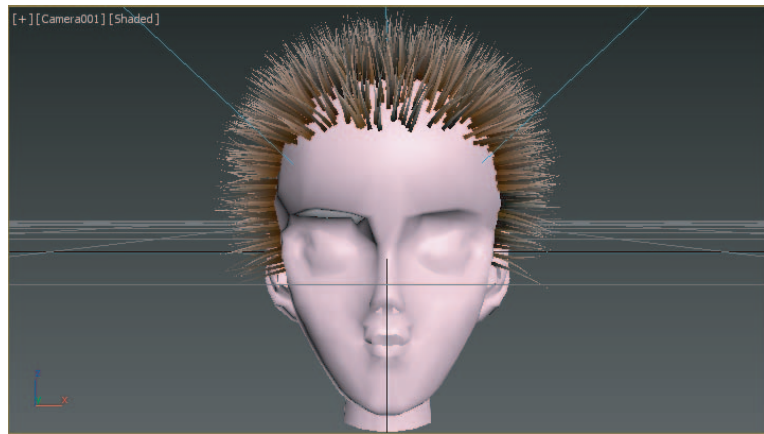
The hair is still fairly sparse on the model head, and the roots are very thick.

4. Reduce the Root Thick value to **10**.

5. Change the Hair Count value to **30000** to triple the numbers of hairs on the model and fill in some of the thin spots.

6. Move the time slider to frame 33, and click the Render Production button. Your rendering should look like Figure 15.19.

FIGURE 15.19
The hair on the head model

7. Save your file as **My_Hairmodel.max**.

Using Glare

Earlier in this chapter, you rendered a Volume Light effect and read about the Parti Volume Photon shader, which can re-create the dispersion of light against particulates in a medium. Other effects can also be simulated with the mental ray renderer in 3ds Max.

Assigning the Glare Output Shader

In a physical camera, be it film or digital, extremely bright lights or reflections that are viewed through the camera lens can reflect and refract on the film emulsion or on the surface of the digital sensor. This effect is called *glare*.

1. Open the C15_Glare.max file from this book's accompanying web page.

   This is similar to the Villa Savoye files that you worked with earlier in this chapter but with some additional detail around the villa and some spheres of various sizes and with different materials placed out in the grass. This file is configured to use the mental ray renderer and the HDTV Output Size preset to create a more cinematic image aspect ratio.

2. Right-click the Camera.View.3DFRONT viewport to select it.

3. Click the Render Production button to have mental ray render the viewport. The Rendered Frame Window should look like Figure 15.20.

FIGURE 15.20
The rendered view

4. Right-click in the Rendered Frame Window. The mouse cursor turns into an eyedropper, and you are presented with the pixel data dialog box, which tells you about the pixel that the eyedropper is sampling. Move the eyedropper over the bright portion of the large white sphere, and look at the numbers in the pixel data floating dialog box. The dialog box should look similar to Figure 15.21.

   Notice that the RGB values for that pixel in the Real column are greater than 1.0. You may have to use the Zoom feature of the RFW and move the mouse very precisely to see the higher values. This is because the Rendered Frame Window is set to 32 Bits Per Pixel and is displaying floating-point values of the High Dynamic Range rendering.

FIGURE 15.21
The pixel data
dialog box
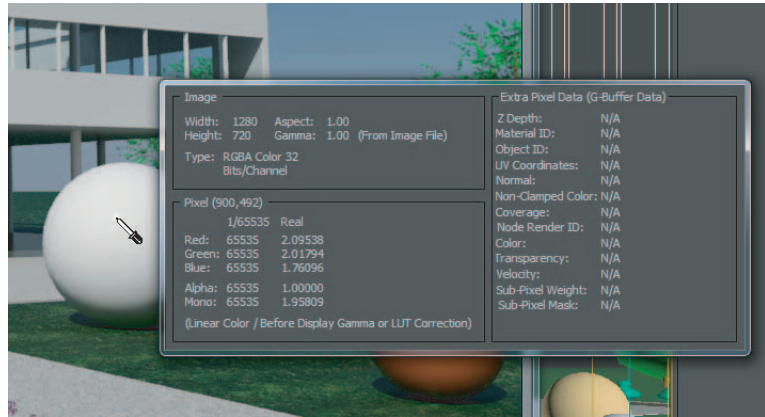
5. Right-click again in the Rendered Frame Window, and put the eyedropper over the reflection of the sun on the brass sphere (it's the middle one). You might have to use the scroll wheel on your mouse to zoom into the image to pick the hot spot accurately.

This time the RGB values are much higher; they almost reach 9.0. In a real film or digital camera, when extremely intense light hits the film or the sensor, the light can disperse through the celluloid or reflect off the surface of the sensor, creating a halo around the bright areas. You can simulate this effect in mental ray with the Glare shader.

You will re-create this effect now.

6. Click the Render Setup button on the Main Toolbar. Select the Renderer tab, and scroll down to the Camera Shaders group of the Camera Effects rollout, as shown in Figure 15.22.

FIGURE 15.22
The Camera
Shaders group in
the Camera Effects
rollout
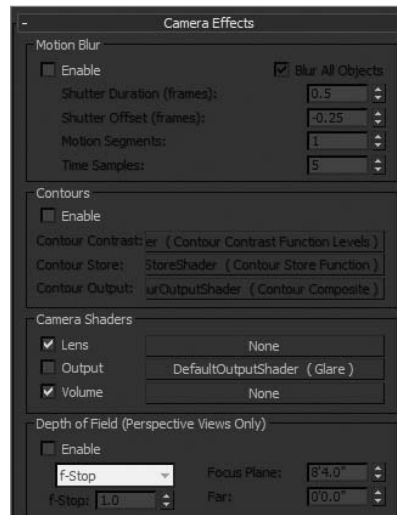
7. Click the check box in front of the button labeled DefaultOutputShader (Glare) to enable that shader channel.

8. Open the Slate Material Editor.

9. Click and drag the DefaultOutputShader (Glare) button to the View1 window of the Slate Material Editor, select Instance, and click OK on the Instance (Copy) Map dialog box.

10. Right-click the DefaultOutputShader item in the View1 window and, from the context menu, select Show All Additional Params.

11. Click the plus symbol next to Additional Params on the DefaultOutputShader (Glare) node, as shown in Figure 15.23.

FIGURE 15.23
Click to display the additional parameters.
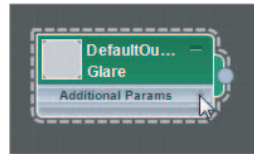
12. Click the up arrow next to Quality, and set it to **3**.

13. Click the up arrow next to Spread, and change it to **3** as well.

14. Click the 500 next to Resolution For, and change the value to **1280**, the horizontal resolution at which you have been rendering the scene, and check the box to enable Streaks.

15. Click Clone Rendered Frame Window so that you will have a copy of the first rendering to compare with the new rendering. Click the Render button to see the image with the glare applied. You will see the effect on the three spheres, as shown in Figure 15.24. This scene uses gamma so the effect at these settings is very subtle, but it lets you increase the quality the glare blows out extremely quickly.

FIGURE 15.24
Glare on the three spheres

When you are rendering outdoor scenes using mr Sun And Sky, be careful when using the Glare shader. The Sky itself is so intense that it will often be affected by the shader as well, and there can be an especially bright section near the horizon.

To see the effect of just the Glare on the rendering, you can check the Replace Rendered Image With Glare Only option in the Glare Parameters, and if you render again when the processing is complete, the contents of the RFW will be replaced with just the Glare component. If you wanted to composite the Glare effect manually with the background image and other effects, you could render out a Glare pass and save it as a separate image file sequence. Compositing will be covered later in this chapter.

16. Save your scene as `My_Glare.max`.

Using Depth of Field

Another camera effect that you can simulate with the mental ray renderer is depth of field. Depth of field (DoF) is created by light rays hitting the image plane from many different directions when the aperture in the lens is wide open. When the aperture is small, only parallel rays of light can hit the image plane and the depth of focus is not as pronounced.

1. Open the `C15_DepthofField.max` file from the book's website.

2. Right-click the Camera002_CoffeeTable viewport to make it active.

3. Click the Render Production button on the Main Toolbar to render the camera view. The Rendered Frame Window should look like Figure 15.25.

FIGURE 15.25
The rendered view
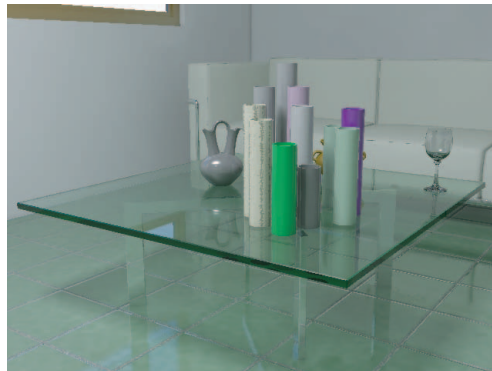
4. Click the Render Setup button on the Main Toolbar, and click the Renderer tab.

5. Scroll down to the Camera Effects rollout, and click the button labeled None next to the checked Lens shader.

6. On the Material/Map Browser, expand the Maps ➢ mental ray group if it isn't expanded already, and select Depth Of Field/Bokeh, as shown in Figure 15.26. Then click OK.

DEPTH OF FIELD / BOKEH

Bokeh is the name for an effect found in physical cameras that represents the quality of the out-of-focus elements in the image. Most often bokeh is associated with the out-of-focus highlights/reflections in the image. The effect takes place in all out-of-focus areas of an image. It is often much easier to recognize it in the highlights. The appearance of bokeh in an image is the result of the type, number, and shape of the aperture blades and the size of the aperture of the camera lens and other imperfections in the glass or construction of the camera lens. The use of creative bokeh in images has become extremely popular in both traditional photography/filmmaking and computer-generated images.

FIGURE 15.26
Select Depth Of Field / Bokeh.
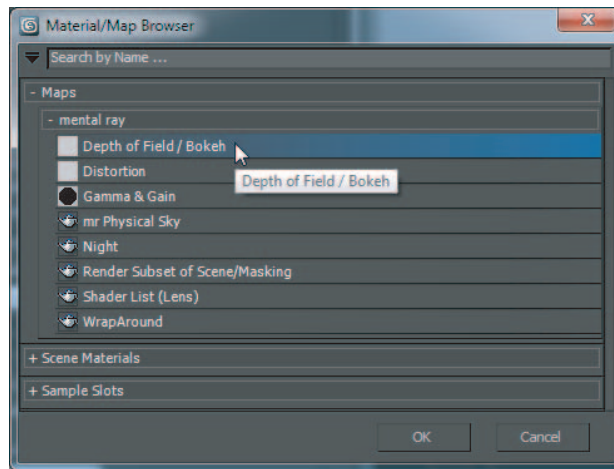
Next, you'll adjust the depth of field:

1. Open the Slate Material Editor.

2. Drag the Depth Of Field/Bokeh shader to the View1 window of the Slate Material Editor. Remember to select the Instance method from the Instance (Copy) Map dialog box and click OK.

3. Double-click the Depth Of Field/Bokeh node to access the settings in the Parameter Editor.

4. Set the Focus Plane to **5′ 10.0″**, as shown in Figure 15.27.

RADIUS OF CONFUSION

The *radius of confusion* is a physical quality of a camera system involving the lens and the focal distance, and it is extremely mathematical and difficult to describe. If you are interested in reading about this concept and aren't scared off by extreme math, you can find a number of wiki articles about the radius or circle of confusion online.

FIGURE 15.27
Set the Focus Plane.
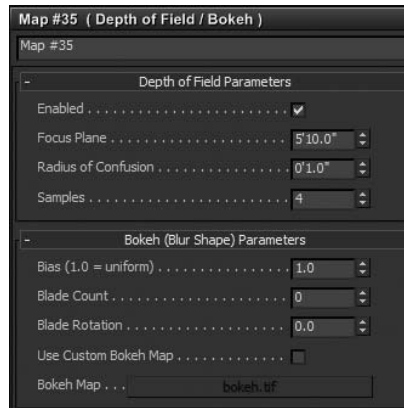
5. Change Blade Count to **7**. If you have a DSLR or 35mm film camera, you can find the Blade Count of your camera's lenses and enter that value.

6. Save the scene as **My_DepthofField.max**.

7. Click the Render button on the Render Setup dialog box. When the Missing Map Files dialog box opens, click Continue. The finished rendering in the Rendered Frame Window should look like Figure 15.28. There is a bug that has existed for a few years in 3ds Max, where 3ds Max still expects to find a "custom" bokeh map, `bokeh.tif`, even though the settings for the blur are set with numeric parameters. If you enable Use Custom Bokeh Map, you will need to select an image to use since no `bokeh.tif` map ships with 3ds Max, and the numeric parameters in the Bokeh (Blur Shape) Parameters rollout will no longer have any effect on the rendering. I have provided a custom bokeh map, named `Sony_Alpha_7blade_Bokeh.tif`, for you to try based on one of my older Minolta lenses.

8. Save your scene.

FIGURE 15.28
The rendering with
DOF/Bokeh

This rendering will take significantly longer than the previous rendering because of the Depth Of Field/Bokeh shader, even with only four samples and the low antialiasing settings. If you don't want to wait for this image to render, you can look at `Figure1528.tif`, which you can download from this book's website.

When you look at the finished rendering, or `Figure1528.tif`, you should see that the gray dual-spouted vessel and the wineglass are sharp and detailed and that everything in front of or behind those two objects is out of focus. Increasing the Samples value in the Depth Of Field Parameters rollout of the shader and increasing the Minimum and Maximum Samples Per Pixel values in the Render Setup dialog box can greatly increase the quality of the out-of-focus areas but at a significant cost of greatly increased render time.

A more efficient way to create the appearance of depth of field in this rendering would be to render out the image with a Z-Depth channel (also called a render pass) and then use a compositing or image-manipulation application to create the out-of-focus effect you desire.

RENDERING PASSES

You will now render an image that has a Z-Depth channel and other channels that you could use on your own in Autodesk Composite, The Foundry's NUKE, or Adobe After Effects to create different effects:

1. Open the `C15_CompositeRender.max` file to prepare for the next section of exercises.

2. Open the Render Setup dialog box. In the Camera Shaders group, right-click the Depth Of Field/Bokeh shader and select Clear to remove it, as shown in Figure 15.29.

FIGURE 15.29
Clear the Lens shader.
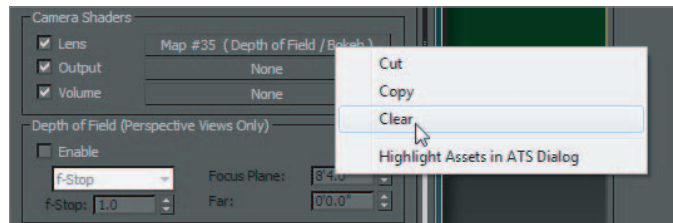
3. Click the Render Elements tab, and click the Add button.

4. Hold down the Control key to multiselect the Diffuse, Lighting, Material ID, Reflection, Refraction, Shadow, Specular, and Z Depth Render Elements options, and then click OK.

5. In the Render Elements rollout, click each of the eight selected elements and then click the check box for Enable Filtering.

6. Click the Z Depth element, and then scroll down to find the Z Depth Element Parameters rollout.

7. Minimize the Render Setup dialog box.

8. Click the Create tab of the Command panel, and select the Helpers button.

9. Click Tape and, in the top viewport, create a tape from near the camera to the back corner of the room behind the couch.

10. Looking at the Parameters rollout on the Command panel, you can see that the Length of the Tape001 object is about 13′.

11. Restore the Render Setup dialog box and, in the Z Depth Element Parameters rollout, change the Z Minimum value to **0′ 0″** and the Z Maximum value to **13′ 6″**, just to make sure you don't clip anything in view out of the Z Depth pass.

You have now set up a number of render elements, or as they are known in the filmmaking and compositing worlds, render passes. Render passes are used by compositors to complete shots by adjusting lighting, depth of field, and material colors and adding backgrounds or background extensions, visual effects, and many other components necessary for the final image.

You will now finish setting up and rendering the scene with the render element passes:

1. Click the Common tab of the Render Setup dialog box, and click the Files button in the Render Output group.

2. In the Render Output File dialog box, browse to the folder where you saved the files from the book's website and, in the File Name field, enter `MyTableTopElements`.

3. Click the Save As Type drop-down menu, and select OpenEXR Image File (`*.exr`, `*.fxr`) from the list.

4. Click the Save button, and the OpenEXR Configuration dialog box will open.

5. In the Main Render Output group, select the drop-down menu and make sure the Format is set to Full Float (32 Bits/Channel). Set the Type to RGBA and Compression to No Compression.

6. In the Render Elements group, click the Add button, select all the render elements listed, and click OK.

7. The OpenEXR Configuration dialog box should look like Figure 15.30. Click OK.

8. Save your scene.

9. Make sure the Camera002 CoffeeTable viewport is active, and click the Render button to have mental ray render and save the file. This file is also provided as `TableTopElements .exr` with the rest of the files from this chapter in case you do not want to render it. A high-resolution `TableTop_DOF_HQ.tif` file with higher-quality sampling on the Depth Of Field/Bokeh shader and the camera's antialiasing is also provided with this chapter's downloads.

When the rendering is finished, you will see additional Rendered Frame Windows open for each of the render elements that were selected. Carefully study each render element (the windows are labeled with their content) of the rendering to see how each element, such as the Specular, Reflection, and Lighting, contributes to the completed rendering.
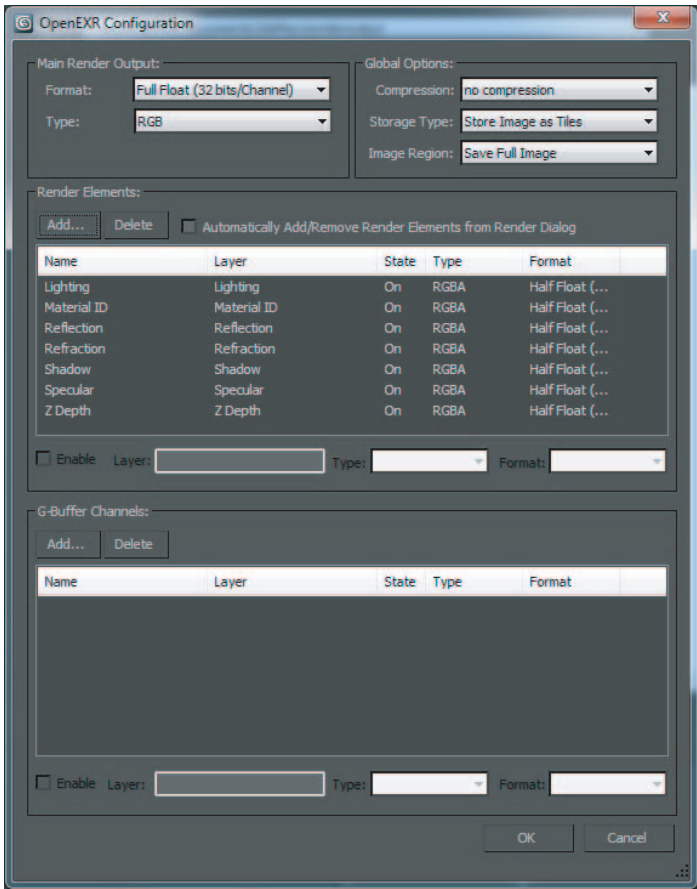
Creating Stereoscopic Renders in 3ds Max

One of the most popular effects of the day in film, games, and even some TV commercials is the resurgence of 3D, aka stereoscopic presentation. Many movies are being released in 3D nowadays—from children's and family movies to big action extravaganzas. *Stereoscopy* was first developed back in the 1830s, and it involves giving each of the viewer's eyes its own unique view of a scene. Each view is separated by the interocular distance—in other words, the distance between the viewer's two eyes. The interocular distance for the average adult is about 2.5″. This brings up some interesting possibilities and phenomena because stereo-pair images created for viewing by children should be designed with a smaller interocular distance in mind. Also, certain types of images will need to be designed with a larger interocular distance to exaggerate the perception of depth. Your brain interprets the two images and, using cues from the perspective of each image, you perceive a sense of depth from the stereo pair.

Stereographic images are also now being used in architectural and engineering graphics. Whether this is just a fad or not, we won't know for a while. This book cannot go into the rules,

theory, or philosophies of stereography, and there are many, many of them involving whether to use the camera plane as a window into a world with depth, to focus the action of the screen plane, or to have objects popping out into space poking you in the eyes. 3D moviemakers also need to determine how to deal with objects that cross the top/bottom edges of the screen as opposed to how to deal with objects that cross the left/right edges of the screen, and those are just a few of the many considerations for stereoscopic 3D productions.

Here you will get a quick tutorial of how to set up a scene with two cameras and how to render the scene in stereographic 3D. If you don't have a pair of anaglyph stereo glasses to view the finished renders, it is easy to find a store online that will sell you red/blue stereo glasses for the format of stereovision that we will be using. Other methods of displaying stereographic imagery require polarized lenses, dual-synced projectors, or very high-end computer displays with synced LCD-shutter glasses.

1. Open the C15_Stereoscopic.max file, and move the time slider to frame 20, so that the doors are fully open.

   This is very similar to the corridor file you used earlier in this chapter. You will rename the existing camera in the scene and then add a new camera.

2. Click the Select By Name button from the Main Toolbar. In the Select From Scene dialog box, select the Camera001 object and click OK.

3. On the Modify tab, rename the camera to **Right-Eye**.

STEREOGRAPHIC RENDERING IN 3DS MAX

There are a number of resources on the Internet for creating stereoscopic renderings using 3ds Max. Louis Marcoux has an eight-part video tutorial that goes into much greater detail on the topic, including creating camera rigs and compositing the resulting images in Video Post using MAXScript. You can find those videos and more tutorials on his website: www.louismarcoux.com. Louis also has a number of tutorials available at area.autodesk.com/blogs/louis.

---

4. With the Right-Eye camera selected, choose the Edit menu and select Clone.

5. In the Clone Options dialog box that appears, select the Instance option and, in the Name field, enter **Left-Eye**, as shown in Figure 15.31. Then click OK.

FIGURE 15.31
Clone the selected camera.
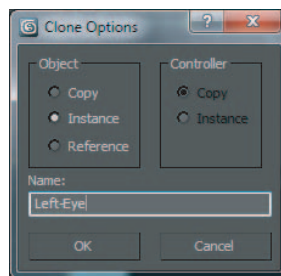
6. With the Left-Eye camera selected, click the Select And Move tool from the Main Toolbar.

7. Click the Reference Coordinate System drop-down menu, and change it to Local.

8. Make sure the Transform Type-In is set to Absolute mode, and enter **-2.5″** in the X Coordinate type-in field. Then press Enter on the keyboard.

You now have two cameras targeted at the same point in the scene, and you are ready to render out the Right and Left eye views, as shown in Figure 15.32, which presents the Left-Eye and Right-Eye cameras in the lower two 3ds Max viewports. Changing the two side-by-side viewports to display the stereo-pair cameras is often a good check to see how well the stereo effect is composed. This quick technique will let you render a stereo pair once you have determined the view you want with one camera. If you want to have a camera rig where you can change the focal target or change the views, you will need a more robust setup to allow you to rotate the views and adjust the target positions without affecting the interocular distance.

FIGURE 15.32
The stereo-pair cameras in adjacent 3ds Max viewports
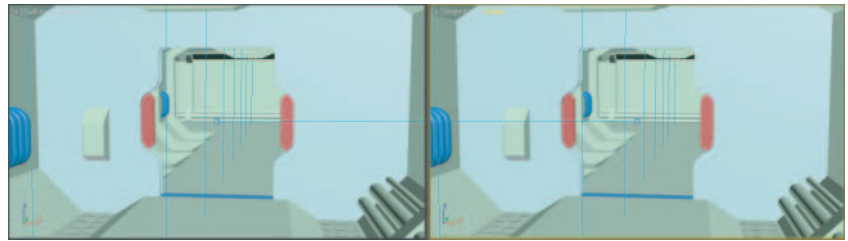
When planning stereo-pair renders, it is important to know that objects between the cameras and the camera targets will appear to float out of the final composited image, and objects farther away than the camera targets will be pushed back into the image frame. Also, objects that are closer than half the distance to the camera targets may diverge so much that they appear doubled in the resulting stereo image. One last topic you'll need to be aware of when preparing stereo-pair renders is that you want to avoid cutting off objects on the perimeter of your renders, because those objects can often break the appearance of depth in your renderings. You will need to be conscious of how objects diverge and converge in your stereo images to avoid creating excessive eyestrain for the viewers of your stereoscopic images or animations.

Now you will render your stereo-pair images using the Batch Render functionality of 3ds Max:

1. Choose Rendering ➢ Batch Render from the Main Menu.

2. In the Batch Render dialog box, click the Add button twice to create View01 and View02 in the task queue window, as shown in Figure 15.33.

3. Click and select the View01 item from the task queue window.

4. In the Selected Batch Render Parameters group, use the Camera drop-down menu to select the camera named Right-Eye.

5. Click the Output Path button, and browse to where you are saving your files for Chapter 15. Then resave the image as **MyStereo_Right-Eye.tif**. Click Save, and then select 8-Bit Color and No Compression on the TIF Image Control dialog box that opens and click OK.

FIGURE 15.33
The Batch Render
dialog box
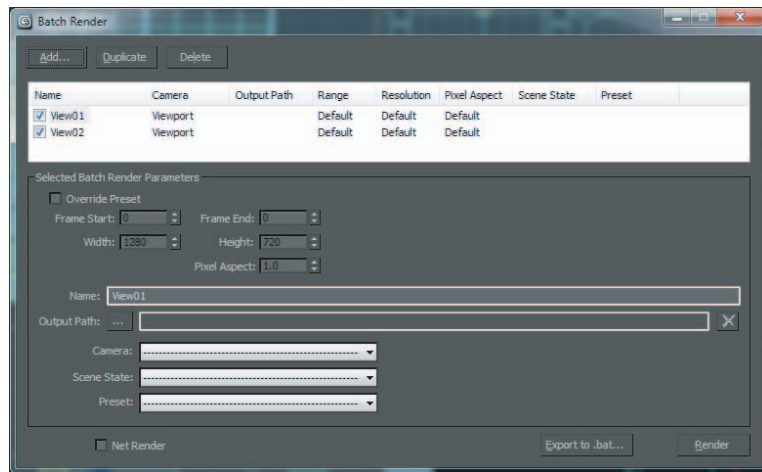
6. Repeat the steps starting with step 3, but this time select the View02 item, and select the Left-Eye camera, and rename the output file to `MyStereo_Left-Eye.tif`.

If you wanted to render an animated sequence, you could click the Override Preset check box and change the Frame Start and Frame End values or the resolution and Pixel Aspect ratio, which come from the Render Setup dialog box. For now, you just want single still images, so leave those values unchanged.

7. Click the Render button in the lower-right corner of the Batch Render dialog box, and watch mental ray render the two camera views.

8. Save your scene as `MyStereoscopic.max`.

Now that you have the two stereo-pair images rendered, you can view them separately in the Rendering View Image File dialog box, or you can load them both into the RAM player and slide the divider over the two stacked images to see how different the two perspectives are.

Keep the two images that you rendered in this exercise because you will need them later in this chapter when you load them into Autodesk Composite 2013 to create the red/blue anaglyph stereo image.

Using Autodesk Composite 2013

This portion of the chapter will go briefly into how you can use Autodesk Composite 2013 to adjust and improve your final rendered images from 3ds Max. Autodesk Composite is a full-featured node-based compositing application that is based on the Autodesk Toxik compositor technology. Each node in the data flow is an operator that performs a function on the data (image frames in our case) in the flow. Input nodes for Composite can be rendered frames from Autodesk 3ds Max, including Render Elements files, Multi-Channel EXR, still images from high-resolution digital cameras, footage sequences (as sequentially numbered frames) from HD or 6K digital film cameras, or even art that you create in 2D painting or drawing applications.

The data flow in Autodesk Composite progresses from left (the input sources) to right (the output nodes). The bottom of the Autodesk Composite interface is the tabbed workspace.

Each tab in the workspace is set up for the different phases of the compositing workflow. The Autodesk Composite user interface is completely customizable for your workflow needs. The primary interface for working with Autodesk Composite is the Gate UI. To access the Gate UI, you can press the ~ (tilde) key on the keyboard or click the middle mouse button. The Gate UI is intended to help you maximize your speed and efficiency when using Autodesk Composite. Once you have opened the Gate UI, you sweep in a direction (usually north, east, west, or south) to access different components within the software.

Autodesk Composite features a comprehensive toolkit to maximize your creativity, including keying, color correction, motion tracking, paint features, full HDR support, and depth-of-field effects—all at resolutions up to 4K (or above) film resolution. This chapter cannot go into all the features of Autodesk Composite but it will give you an idea how you can work with your images, and then you can use the Composite help and learning resources to increase your understanding of Autodesk Composite.

Thoroughly learning Autodesk Composite would require studying a whole book as long as or longer than *Mastering Autodesk 3ds Max 2013*. However, there are a few places to find help for Autodesk Composite 2013. The first is the built-in Help menu, which runs in an Internet browser. Some of the resources on the Help menu for Composite 2013 require Internet access to function. You can also find resources for Autodesk Composite in the Autodesk Toxik/Combustion discussion forums at the Area (`http://area.autodesk.com`), the Digital Entertainment & Visualization Community for users of Autodesk software. Check the Autodesk Support website for any Autodesk Composite updates. Download and install them before proceeding with these exercises.

1. Close 3ds Max if it is still running. If your computer system does not have a lot of RAM, it may help to reboot the computer too.

2. Start Autodesk Composite 2013.

   When you start Autodesk Composite 2013, you should be presented with the Composite Essential Skills Movies dialog box, similar to when you start Autodesk 3ds Max 2013, as shown in Figure 15.34. Composite has a very different interface and workflow than 3ds Max, so it is highly suggested that you watch all the movies.

FIGURE 15.34
The Composite
Essential Skills
Movies

3. Create a new composition by clicking the File menu and selecting New, as shown in Figure 15.35.
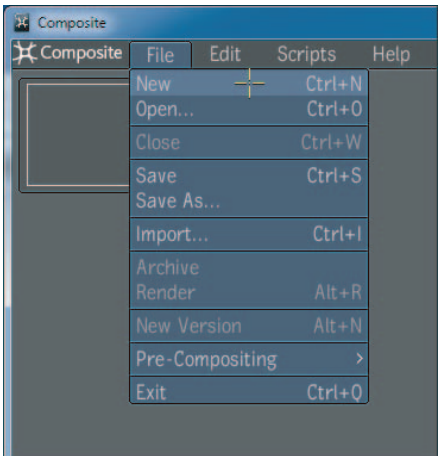
4. In the Create Composition dialog box, use the Folders area on the left side of the dialog box to browse to where you are working with your Chapter 15 downloads. You can see where you are going to create the new composition in the Destination field near the bottom of the dialog box.

5. In the Name field of the Create Composition dialog box, enter **MyComposition**, as shown in Figure 15.36.
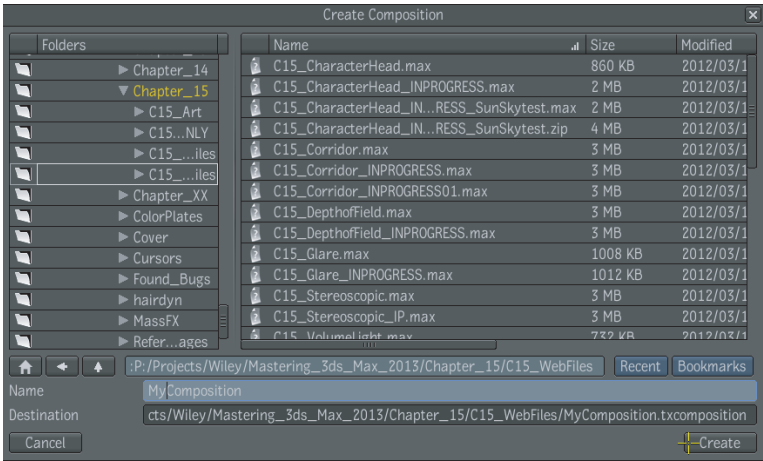
6. Click the Create button.

7. You will see an Output node appear on the left side of the interface. The right side is the preview area, as shown in Figure 15.37.

FIGURE 15.37
The Output node and Composite interface
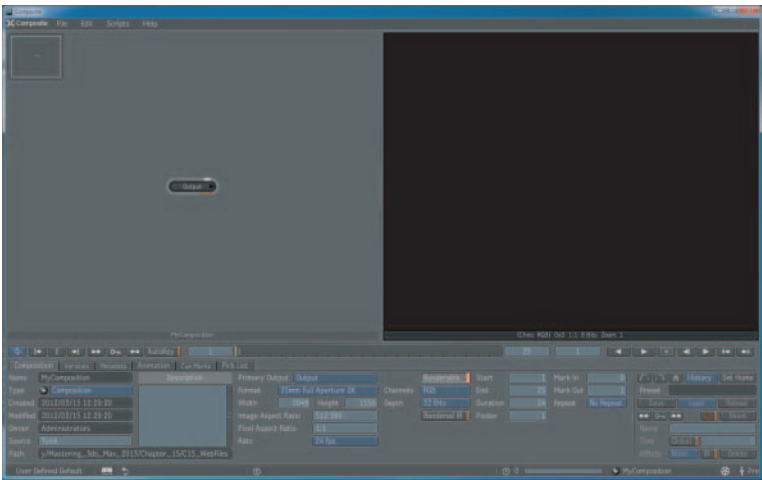
At the bottom of the interface, you will see the tabbed workspace area that was mentioned previously in the chapter. Composite expects you to have a large, high-resolution monitor, so you may have to enlarge the application's window to see all of the features of the Composite user interface.

8. On the Composition tab of the workspace, click the Format button, use the scroll button on your mouse or the gray slider bar to the right of the list to scroll down the presets, and select HD 480p, as shown in Figure 15.38. This prepares the composition for the data that you will be importing.

FIGURE 15.38
Set the format for your composite.
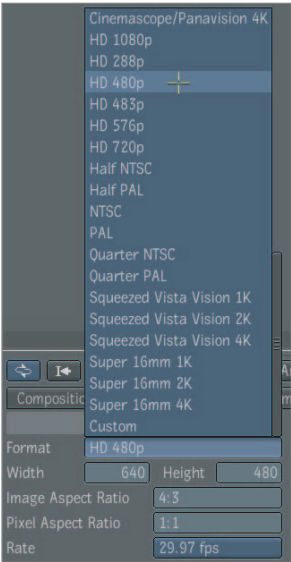
Now you are ready to start importing your elements for compositing:

1. Choose File ➢ Import to open the File Browser dialog box. Use the Folders window to browse to where you downloaded the files for this chapter from the book's website.

   Depending on your system's firewall security settings, you may get a Windows Security Alert dialog box that says it has blocked some features of the program. Click the Allow Access button if this happens.

IMPORTING FILES INTO AUTODESK COMPOSITE

If you are working with a series of sequentially numbered images, Composite's File Browser may collapse the list of files to display only the first numbered image file in the series. If you want to display all the images in the sequence, click the View button at the bottom of the dialog box and uncheck the Collapsed Sequence option.

---

2. Select the MyTableTopElements.exr image that you rendered earlier in this chapter and click Import.

3. Click the button in the upper-right corner to close the File Browser dialog box.

   Your interface should look like Figure 15.39.

   If your MyTableTopElements image node appears to the right of the Output node, click and drag it to the left of the Output node so that it looks like Figure 15.39.

FIGURE 15.39
The imported file in Autodesk Composite
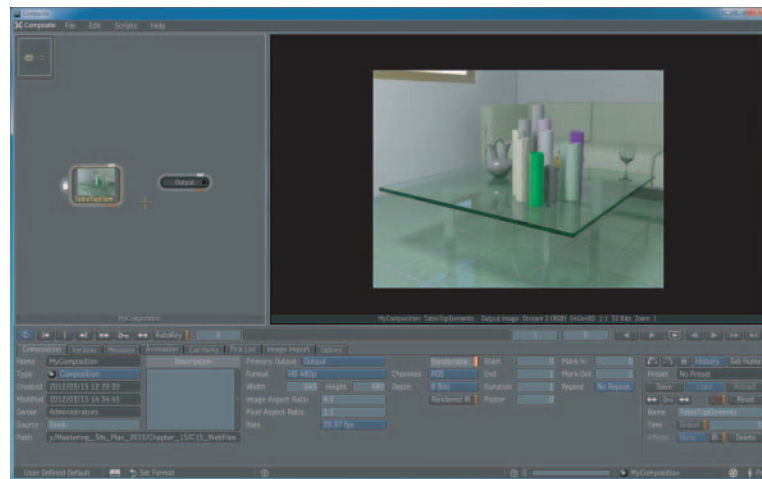
4. Hover your cursor over the spacer between the left and right portions of the Composite interface. The cursor changes to indicate that you can stretch the window to see more of one side or the other. Move the spacer to the left so that you can see more of the rendered image.

5. Press the ~ (tilde) key on your keyboard, or the middle button on your mouse, to activate the Gate UI, as shown in Figure 15.40.

FIGURE 15.40
The Gate UI
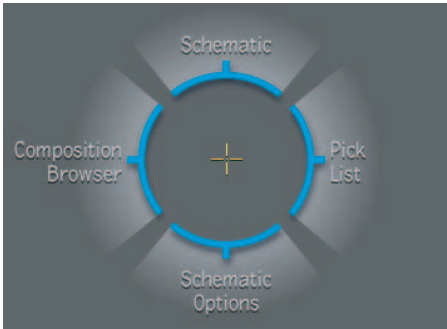
6. Move your cursor through the East Gate labeled Pick List. The Tools menu opens on the right edge of the screen, as shown in Figure 15.41.

FIGURE 15.41
The Tools menu

7. Click the Color Correction folder, and you will see the Color Correction tools listed in the bin at the bottom of the screen.

    You can scroll through the list to see the available Color Correction tools.

8. Click and drag the Photo Lab node to the MyComposition schematic view, and place it between the MyTableTopElements (Image Import) node and the Output node, as shown in Figure 15.42, without letting go of the mouse.

FIGURE 15.42
Drag the Photo Lab node between the Image Import and Output nodes

As you drag the Photo Lab node over the MyTableTopElements input node, if you touch the right side of the input node (called *kissing* in Composite parlance), it will connect those two nodes when you drop the node by releasing the mouse button. If you dropped the Photo Lab node between the Image Import and Output nodes without kissing them first to connect them, click and drag the right edge of the MyTableTopElements node and wire it to the upper-right edge of the Photo Lab node as you wired nodes in the Slate Material Editor.

9. Once you have dropped the Photo Lab node, you can connect it to the Output node by hovering the mouse cursor over the right edge of the Photo Lab node until you see it highlight. Then click and drag to connect it to the Output node, as shown in Figure 15.43.

FIGURE 15.43
Connect the Photo Lab node to the Output node.

10. Click the Photo Lab node to open its tab in the workspace area. You will see the Exposure, Contrast, Pivot, and Lift tools, as shown in Figure 15.44.

FIGURE 15.44
The Photo Lab node controls

With the Photo Lab node, you can adjust the exposure/contrast of all three color channels simultaneously using the lock buttons or individually by disabling the locks. The locks are to the right of each color channel identified by the gray and orange buttons, and they are on by default. You can also use the Luminance channel to change the overall brightness of the image.

11. Bring the Exposure up by a quarter stop—in other words, 0.25—by clicking any one of the RGB values and dragging the mouse to the right. You could also click one of the numbers, type **0.25** on the keyboard, and then press **Enter**.

You should see the highlight on the vase spread out slightly and the image get brighter.

12. Click one of the Contrast values, and drag the mouse to the right. Watch as the contrast changes the appearance of the image.

13. Click the Reset button under both Contrast and Exposure to remove your edits.

14. Click the trackball under Exposure, and drag the reticle (center of the ball), indicated by the cross-hairs, to the right and slightly down, giving the image a slightly blue tint. Using the trackball, you can essentially adjust the RGB channels individually even if the channel locks are on.

15. Right-click the Photo Lab node, and select Reset from the menu.

16. Click the middle button on your mouse to activate the Gate UI again, sweep through the Pick List gate, and choose Grain Management ➢ Add Grain. Then drag the node and place it on the connection between the Photo Lab node and the Output node, as shown in Figure 15.45.

FIGURE 15.45
Place the Add Grain operator.
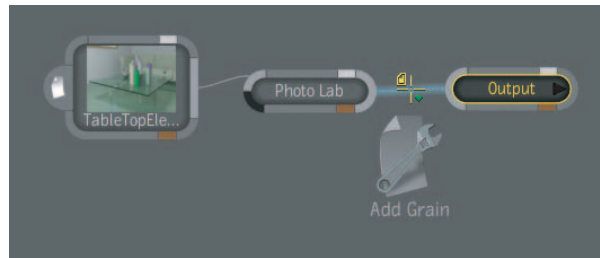
With the Add Grain operator, you can analyze grain from one image (or sequence), such as a background plate, and add that grain to a digitally rendered foreground image so that they blend together better. Alternatively, you can just add grain to a completely digital rendering to make it look more like an image shot on film. You can also adjust the grain individually per color channel.

17. Click the Grain values for the R, G, and B channels and adjust them slightly. You may have to use the scroll wheel on your mouse to zoom into the preview window to see the grain, especially if you are making subtle value changes.

Autodesk Composite allows you to save grain profiles so that you can load them quickly to apply to many projects.

18. Right-click the Add Grain node, and select Delete from the menu.

19. Right-click the Photo Lab node, and select Delete from the menu.

20. Save your composition.

You have just learned how you can import an image file into Autodesk Composite, connect it to the Output node, and start adding effects to adjust the appearance of the image before outputting your final image.

Recall that when you rendered the `MyTableTopElements.exr` image earlier in this chapter, you included render passes in the EXR file. However, you are not seeing those passes in what

you imported into Autodesk Composite. Next, you will see how you can get Composite to load in included Render Element passes and use those passes to adjust the image before outputting a final image:

1. Choose File ➢ Save As and add **02** to the end of the filename in the Save Composition As dialog box to save the current composition as a new file.

2. Select the MyTableTopElements (Image Import) node, right-click, and select Delete from the menu.

3. Choose File ➢ Import, select the `MyTableTopElements.exr` file again, and then right-click. From the context menu that appears, select the Import All Channels item, as shown in Figure 15.46.

FIGURE 15.46
Select Import All Channels.
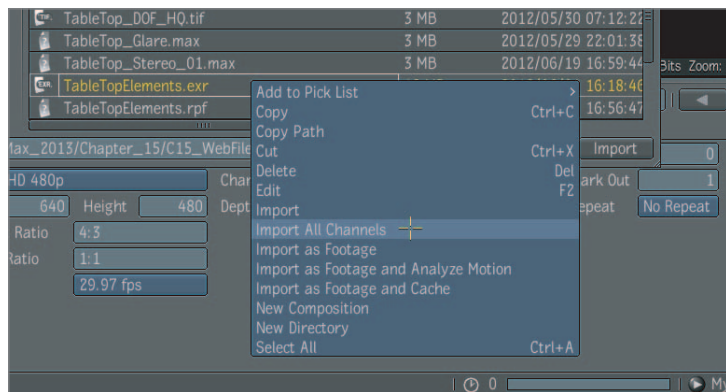
4. Click the Close button in the upper-right corner of the File Browse dialog box to dismiss it.

5. You should see the MyTableTopElement (Import Node) in the schematic window, as shown in Figure 15.47.

FIGURE 15.47
The `MyTableTopElements` `.exr` file with Import All Channels selected

Notice how the imported MyTableTopElements node looks different than when you imported it before. The right edge of the node now shows many segments instead of being one large block. The small boxes represent the passes in the imported file.

6. Use the mouse scroll wheel to zoom in on the MyTableTopElements node. Move the mouse cursor over each of the boxes on the right side of the MyTableTopElements node and you will see a tooltip pop-up that lists each element pass and shows all available passes, as shown in Figure 15.48.

FIGURE 15.48
The channels
available in the
MyTableTopElements
.exr file

Now you will create a dependency graph that uses the different render elements in the EXR file to create a new image, remap colors in the image, and create a depth-of-field effect using the Z-Buffer render element that was saved in the file.

1. Double-click the MyTableTopElements node, and it will display the passes in the EXR file.

2. The list looks rather messy. Right-click in the schematic window, and select Layout All.

3. You can use the pan and zoom controls in the Schematic view to see the different passes.

4. Double-click in an empty area of the Schematic view, and you will be returned to the top level of the composition.

5. Press ~ (tilde) or the middle mouse button to access the Gate UI, and move the mouse through the right gate to access the Tools menu.

6. Click the Composition folder and, from the Tool list at the bottom of the screen, click and drag a Blend & Comp operator to the Schematic view.

7. Click and drag the Lighting element from the MyTableTopElements node, and wire it to the Front input on the Blend & Comp operator.

8. Click and drag the Diffuse element, and wire it to the Back input on the Blend & Comp operator.

9. Click to select the Blend & Comp operator and, in the Method group, set the Blend mode to Multiply. You will see the image in the display viewport.

10. Press the middle mouse button to access the Gate UI and drag the mouse to the right to get to the Tools menu.

11. From the Composition group, click and drag a Math Ops operator to the Schematic view.

12. Click and drag the output of the Blend & Comp operator to the B input on the Math Ops operator.

13. Click and drag the Reflection element from the MyTableTopElements node to the A input on the Math Ops operator.

14. Click the Math Ops operator, and set the Operator mode to Screen.

You can see the final image taking shape in the Player viewport.

15. Access the Gate UI and, from the Composition tools menu, drag another Math Ops operator to the Schematic view.

16. If you need to pan the Schematic view, hold down the spacebar and then click and drag to compose the view.

17. Connect the output of the first Math Ops operator to the B input of the second Math Ops operator.

18. Click and drag the Specular element from the MyTableTopElements node to the A input of the new Math Ops operator.

19. Select the second Math Ops, and set the Operator mode to Screen.

As in 3ds Max, keeping track of the elements in your compositions is crucial for being able to work efficiently. When you have a node selected, you can use the Name field in the lower-right corner of the Composite interface to help identify the element or what it is used for in the composition.

The image doesn't look exactly like what was rendered out of 3ds Max, but you can fine-tune the image on your own. Next, you will use the Z Depth Pass that was rendered out of 3ds Max to create the appearance of depth of field:

1. Access the Gate menu and, from the Pick List Tools menu, select Filtering and then click and drag a Blur operator to the Schematic view.

2. Click and drag from the last Math Ops operator to the Input Image slot of the Blur operator.

3. Click and drag the Z Depth element of the MyTableTopElements node to the Masking input of the Blur operator.

4. Click to select the Blur operator.

5. Click the Masking tab in the lower portion of the Composite interface, and change the Channel from Alpha to Red.

6. Select the Blur tab, and then click and drag the X Radius value to the right to increase it to about 6.

Notice how the foreground of the image blurs, but the back corner of the room doesn't blur. This is the opposite of what you want.

7. Access the Gate menu, drag though the Pick List, and click the Color Correction folder.

8. Click and drag an Invert operator to the Schematic view, and drop it on the line that connects the Z Depth element to the Blur operator.

Now the foreground of the image is in focus and the back corner of the room is blurred.

9. Access the Gate menu, and then drag through the Pick List, click the Color Correction folder, and then click and drag a Remap Color operator to the Schematic view and drop it on the output of the Blur operator to connect them.

10. Select the Remap Color operator and the Remap Color tab if needed.

In the center of the Remap Color tab you will see a histogram that represents the color distribution on the image. Notice the white line that goes from the lower left of the histogram to the upper right and the three boxes on the line. This is very similar to the Color Map graph that you worked with in Chapter 9, "Using the Camera."

1. In the histogram, click the box in upper-right corner and drag it to the left. You will see the histogram start to stretch to the right. A dark histogram stays in the background to show you the original state of the image. You want the right end of the histogram to touch 1.0 on the graph.

2. Click and drag the box at the lower left of the histogram to the right until the left end of the histogram stretches to 0.

3. Since you are working on a high-dynamic range image, click the Clamp button at the left side of the tab to turn Clamping off. You will see the white line in the histogram change, and it will no longer go flat where it crosses 0 or 1 on the graph.

The adjustments you made on the curve increased the contrast in the image, making the dark shades darker and the light shades lighter. You can see from the histogram that the image is still somewhat dark.

1. Click the box in the middle of the line, and drag it slightly to the left. You will see the histogram slide to the right and the image in the Player window brighten.

2. To the right of the histogram, in the Curves group, you should see the curve selector labeled RGB. Click the curve selector, and pick Red to adjust only the red channel of the image.

3. Drag the lower-left point on the red curve to the left so that the low peak on the histogram is to the right of 0.

4. Click and drag the upper-right point on the red curve to the left to brighten the red channel.

5. Click and drag the middle of the red curve to the left so that the bulk of the red channel is almost centered on the graph.

6. Click the curve selector, pick Green, and then adjust the green color curve as you like.

7. Click the curve selector again, and this time pick the blue channel.

8. Adjust the blue color curve as you see fit.

9. Click the curve selector, and pick RGB. You will now see all three color curves in the histogram, and you can adjust them individually.

10. Zoom out in the schematic view so that you can see all the nodes, and then click and drag a selection window around the PhotoLab, Add Grain, and Output nodes.

11. Click and drag the selected nodes to the right of the Remap Color operator.

12. Click the output of the Remap Color operator, and connect it to the input of the PhotoLab operator.

13. Save your composition.

You have quickly learned how you can build up a final image based on the render elements that you generated from 3ds Max. Almost all images can benefit from some careful post-production, and many effects, such as depth of field, can be applied faster and with more control in a compositing application than can be accomplished directly inside 3ds Max.

Composite the Stereo Pair into an Anaglyph Image

Next, you will create a new composition, import the left- and right-eye stereo-pair images you rendered earlier in this chapter, and composite the images into an anaglyph 3D image that you can enjoy with red-blue stereo glasses:

1. Click the File menu and select New. In the Create Composition dialog box, set the Destination to the location on your hard drive where you are working with the Chapter 15 files. Name your composition **MyAnaglyphComposition** and click Create.

2. Click OK to dismiss the Composition Saved notification.

3. Click the Composition tab if needed, and set the Format to HD 720p—the format used when your rendered the stereo-pair images earlier in this chapter.

4. Click File ➤ Import, select the `MyStereo Left-Eye.tif` image, and then hold down the Ctrl key, select the `MyStereo_Right-Eye.tif` image, and then click Import.

5. Click the X button in the upper-right corner of the File Browser to close the dialog box.

6. Click on an empty area of the Schematic view to deselect the two imported images, and then click and drag to move the `MyStereo_Left-Eye.tif` node above the `MyStereo_Right-Eye.tif` node, as shown in Figure 15.49.

FIGURE 15.49
Position the input nodes.
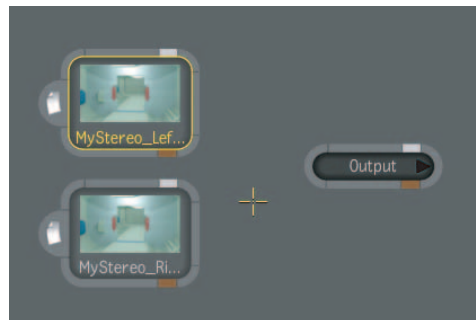
7. Press the middle mouse button or the ~ (tilde) key on the keyboard to active the Gate UI; then sweep through the Pick List gate, and select the Pixel Expressions category.

8. Click and drag the PXL operator, and place it between the image nodes and the Output node, as shown in Figure 15.50.

FIGURE 15.50
Place the PXL
operator.
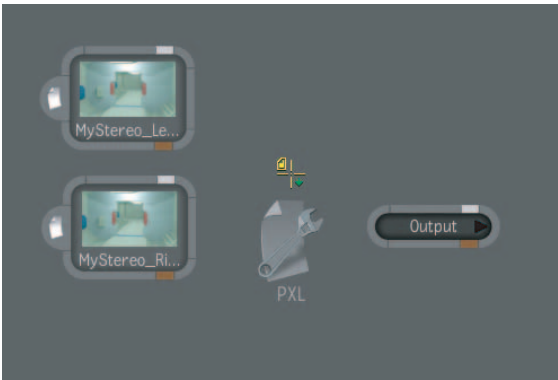
9. In the Preset section of the workspace, the lower-right corner of the UI, click the Load button and select the Stereo Anaglyph preset from the list, as shown in Figure 15.51.

FIGURE 15.51
Load the Stereo
Anaglyph preset.
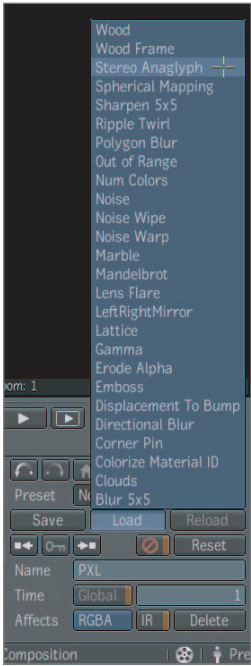
10. Click the right edge of the MyStereo_Left-Eye node, and connect it to the In slot node of the Stereo Anaglyph node, as shown in Figure 15.52.

FIGURE 15.52
Connect the left eye image to the Stereo Anaglyph operator.
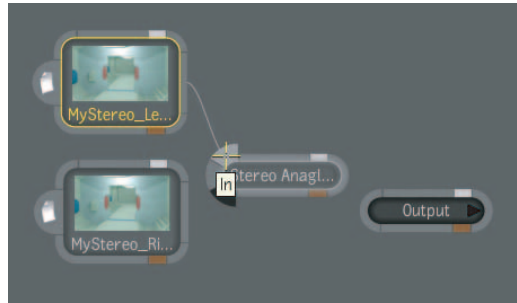
11. Click the right edge of the MyStereo_Right-Eye node, and drag it to the RightImage slot on the Stereo Anaglyph node, as shown in Figure 15.53.

FIGURE 15.53
Connect the right eye image to the Stereo Anaglyph operator.
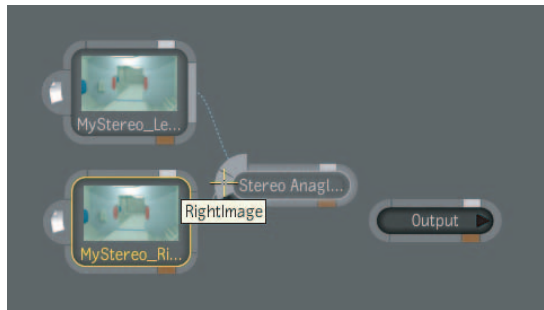
12. Click and drag the right edge of the Stereo Anaglyph node, and connect it to the Output node, as shown in Figure 15.54.

FIGURE 15.54
Connect the Stereo Anaglyph operator to the Output node.
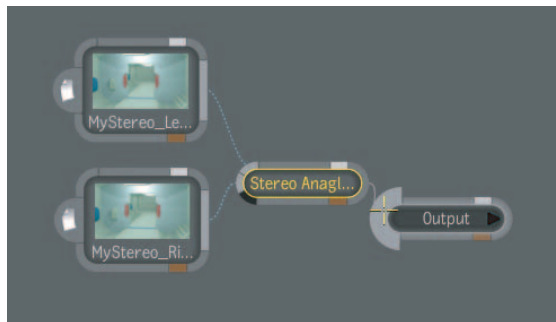
13. Click the Output node, and you will see a black and white image with some teal and red where the images diverge. This is because of the mode of the Stereo Anaglyph node.

14. Click the Stereo Anaglyph node to open the PXL tab in the workspace area of the Composite interface.

15. Click the Method value and change it to **2**, as shown in Figure 15.55.

FIGURE 15.55
Change the Method value to 2.

16. Click the Output node again, and you should see a full-color stereo anaglyph image (see Figure 15.56).

FIGURE 15.56
The full-color stereo anaglyph
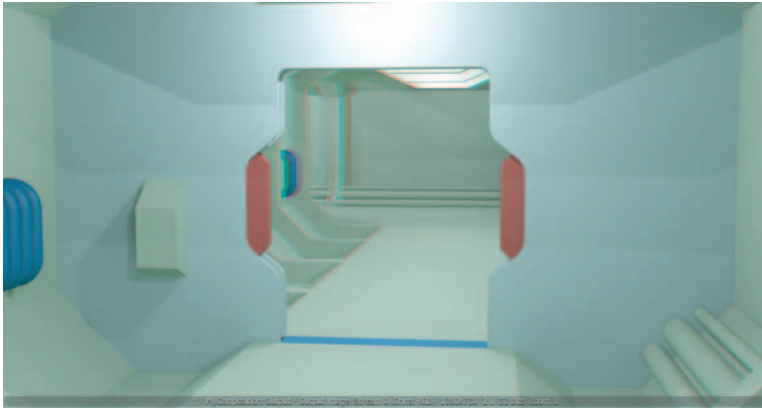
17. The Output tab on the workspace should be open; change Pixel Format Depth to be 8 Bits and, in the Time parameters, set the End frame to **1** so the duration is 1.

18. Click the Render tab of the workspace area and, in the File Name field, change the output name to **MyAnaglyph**. The system will add `.<FrameNo>` to suffix the rendered image name with the frame number. Change the File Format to TIFF. The frame numbering is crucial if you are outputting sequences that you intend to convert to a movie file with Video Post in 3ds Max or with another video-editing program.

19. Click the icon with the magnifying glass and folder at the end of the File Name field, use the Render File Path dialog box to browse to the directory where you are using the Chapter 15 files, and then click OK. Your Render tab should look like Figure 15.57.

FIGURE 15.57
Set the path, filename, and file format for your rendered image.
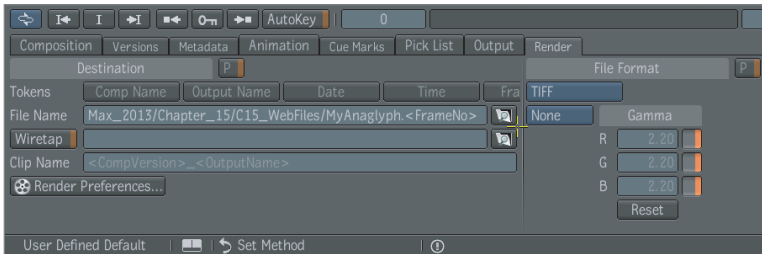
20. Choose File ➢ Render, and then click the Start button in the lower-right corner of the Render dialog box, as shown in Figure 15.58.

FIGURE 15.58
Click the Start button in the lower-right corner of the Render dialog box.
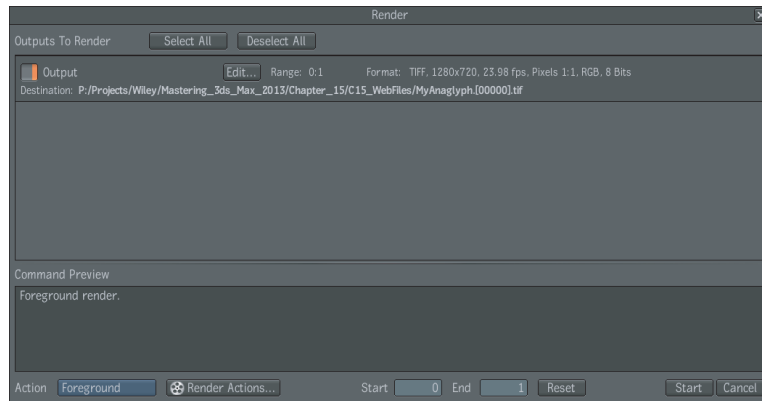
21. You won't see anything happen. The Render dialog box will dismiss itself. Open the folder where you told it to save the file, and you should see `MyAnaglyph.00001.tif`. Open it with Photoshop or the 3ds Max View Image File command, find your red/blue stereo glasses, and enjoy.

22. Save your composition in Composite, and close the program.

Adjusting your images in Composite to fine-tune and achieve the look you want is much faster and more efficient than continually tweaking settings and re-rendering the images in 3ds Max in order to try to get a perfect render. For example, you could take the `MyTableTopElements.exr` file that you rendered earlier in this chapter and, in Autodesk Composite, add highlight glare and create a depth-of-field look much faster with the Z-Depth channel and the Reaction 3D compositing tools than it would take to re-render the image. You can also adjust the reflections or refractions using the two channels that you added as render elements, and you can create an object-specific Matte pass to use as a mask for a PhotoLab operator to modify the color of the vessel.

If you rendered out discreet image passes for each light source in your scene, you could use Autodesk Composite to blend those images together to get an almost infinite number of different lighting looks without having to adjust each light and then render out the same number of images. The power of using a compositing application with your 3ds Max workflow is very impressive and can save you countless hours of re-rendering when an employer or client wants to see a slightly different render.

In addition to the nodes and workflows you have seen in these exercises, Autodesk Composite can be used to key footage off blue or green screens; project camera mapping onto low-poly objects to create 3D matte paintings; apply spline-based warping to create a variety of visual effects; modify sequences with raster and vector paint to clone parts of the image, or *rotoscope*, that is, paint new information into the scene; use multiple modes of motion tracking to place new objects into an image sequence; replace computer screens, billboards, posters, or any flat elements; add motion blur to a sequence using vector channels; and add depth of field to sequences using Z-depth map channels.

Autodesk Composite can take advantage of the Backburner network-rendering application that ships with Autodesk 3ds Max 2013 so that you can leverage the power of many machines to complete the rendering of a long or very complex compositing job.

The Bottom Line

Add an atmospheric effect.   Atmospheric effects add the appearance of particulate matter in the air. With them, you can represent volumetric lights, fog, smoke, clouds, and even fire.

> **Master It**   Add a second fog to the My_VolumeEffects_A.max file with a bottom just below the top of the building's overhang and the top 6′ above that. Give the fog a purple color, and make sure the fog is not a straight line at the horizon.

Add an effect using Hair And Fur.   Hair And Fur is a rendering effect that appears to add strands to an object at rendering. These strands can look like long, thin hair; short, thick fur; or even grass.

> **Master It**   Zoom into the tree in the C15_Grass.max file. Create a mound that rises out of the ground and covers the base of the tree. Use Hair And Fur to add grass to the mound so that it appears to be caused by a root ball under the lawn.

Add the Glare effect to a rendering.   Glare is an effect that is seen in real-world cameras when the intensity of the lights or reflections/refractions captured by the camera causes the light to reflect/refract within the film emulsion or on the surface of a sensor.

> **Master It**   Open the TableTop_Glare.max file. Add the Glare camera shader, and render the Camera002_CoffeeTable viewport.

Use DOF/Bokeh.   Depth of field is the result of using a camera with a large aperture setting during the image exposure. The effect is seen in real-world cameras, and often a rendering will appear much more realistic when there is some DOF in the image.

> **Master It**   Continue with the TableTop_Glare.max file from the previous exercise. Add the Depth Of Field/Bokeh shader, and render the Camera002_CoffeeTable viewport. Using Glare and DOF with good sampling settings will make the rendering take quite a while.

Create stereo-pair images.   Stereo 3D images are incredibly popular again, even in the architectural and engineering industries. As a visualization specialist, the odds are very high that you will encounter situations where you need to take a scene and render it for stereo viewing.

> **Master It**   Using the TableTop_Stereo_01.max file, create an additional camera for the right eye with a 2.5″ intraocular distance, and then render the two cameras using the Batch Render command.

Create render passes for compositing.   Productions are often finished in compositing applications, such as Autodesk Composite, because slight changes and adjustments can be accomplished much easier by adjusting render elements (passes) than by repeatedly adjusting parameters and re-rendering frames in 3ds Max.

Master It   Use 3ds Max to generate Material ID, Z Depth, Velocity, and Lighting Render Elements that can be loaded into Autodesk Composite for finishing an image or image sequence.

Import Images into Autodesk Composite 2013.   Modeling, lighting, texturing, and rendering your images from 3ds Max are just the beginning of creating a final image or video project. Often additional elements or tweeks are needed to really make an image or video feel finished. Actions such as color balancing, adjusting contrast, adding titles, or compositing additional layers can be accomplished in programs like Adobe Photoshop, Premiere, or AfterEffects. 3ds Max 2013 comes with the Autodesk Composite application, which can help you finish most of those tasks without having to purchase additional software.

Master It   Use Autodesk Composite to import a rendering that you want to adjust to create your final image.

Composite the stereo pair into an anaglyph image.   Once you have stereo-pair images, you need to combine them into one image that you can look at with red-blue anaglyph glasses.

Master It   Use Autodesk Composite to take the two images you rendered in one of the previous "Master It" exercises, and render out a single anaglyph stereo image.

The Bottom Line

Each of The Bottom Line sections in the chapters suggest exercises to deepen skills and understanding. Sometimes there is only one possible solution, but often you are encouraged to use your skills and creativity to create something that builds on what you know and lets you explore one of many possible solutions.

Chapter 1: Getting to Know Autodesk® 3ds Max® 2013

Navigate and configure the viewports.   The 3ds Max viewports can be configured in several ways, including setting the quantity and configuration of the viewports.

Master It   Configure the viewports so that there are three small viewports stacked on the left side and one larger viewport on the right. From top to bottom, set the three stacked viewports to Top, Front, and Right, respectively; then set the large viewport to a Perspective viewport.

Solution

1. Click the general Viewport Label menu (the plus button) at the upper-left corner of the viewport, and choose Configure Viewports from the context menu.

2. Click the Layout tab.

3. In the second row of viewport configuration options, click the third option from the left.

   The viewport configuration changes to display three viewports stacked on the left and one larger viewport to the right.

4. Click in the top viewport on the left, and choose Top from the context menu.

5. Click in the middle viewport on the left, and choose Front from the context menu.

6. Click in the bottom viewport on the left, and choose Right from the context menu.

7. Click in the large viewport on the right, and choose Perspective from the context menu.

8. Click OK to close the dialog box and reconfigure the viewports.

Dock and float toolbars.   The 3ds Max user interface has several customizable features, including the ability to hide or expose and dock or float the program's toolbars.

Master It Detach the Command panel from the right side of the 3ds Max window, and release it so that it floats in the middle of the 3ds Max window. Select the Command panel again, and attach it to the left side. Expose a hidden toolbar, and dock it to the left of the Command panel.

Solution

1. Place your cursor to the right of the Utilities tab. The tooltip will read "Command Panel."

2. Click and drag the Command panel, and release it over the viewports. The Command panel is now floating.

3. Right-click the floating Command panel title bar, and choose Dock ➤ Left.

4. The Command panel is now docked to the left side of the viewports.

5. Right-click the blank area of any toolbar.

6. From the context menu that appears, select any of the unchecked toolbars. That toolbar appears in the UI.

7. Click the new toolbar's title bar, drag it to the far left boundary of the viewports, and release the mouse. The toolbar docks to the right of the Command panel.

Copy objects and use the transform tools. The transform tools (Move, Rotate, and Scale) are the most commonly used tools in 3ds Max. With them, you can position, orient, and scale your objects as required in the scene. You can quickly create a copy in 3ds Max, a process called *cloning*, by holding down the Shift key while using any of the transform tools.

Master It Make a box that is 3′ long, 10′ wide, and 8″ high. Make five instance clones of the box, and rotate each clone 20 degrees more than the previous clone. Stack the boxes like a spiral staircase, with an increasing amount of swing with each stair and leaving no vertical or horizontal gaps in the stairs.

Solution

1. Create a box and, in the Parameters rollout, set Length to **3′**, Width to **10′**, and Height to **8″**.

2. Click the Select And Move tool in the Main Toolbar.

3. Hold down the Shift key, and drag the Z-axis handle upward until the Z readout in the Transform Type-In reads approximately 8″. Then release the mouse.

4. In the Clone Options dialog box that appears, set Object to Instance, set Number Of Copies to **5**, and then click OK. The five clones appear in the viewports.

5. With the Move transform still active, select the first clone, the second box from the bottom, and then enter 8. If the box moves out of sight, undo the command. Then, in the Units Setup dialog box, set Default Units to Inches and move the box again.

6. Repeat the process with the remaining steps, setting each one's height exactly 8″ higher than the previous one.

7. Click the Select And Rotate tool in the Main Toolbar.

8. Starting with the second box up, select each box and then enter a Z rotation value 20 degrees higher than in the previous step in the Transform Type-In.

9. Switch to a four-viewport layout, and set the Top viewport to the Wireframe rendering mode.

10. Using the Select And Move tool, select each box in the Perspective viewport, and move it into position in the Top viewport.

11. Save your scene.

Create a named selection set.   Whenever any objects are selected in 3ds Max, the selected objects are referred to as a *selection set*. Often, you may need to select the same objects repeatedly for different operations. By creating named selection sets, you can quickly select objects by selecting the selection set name from a drop-down list.

Master It   Continuing from the previous "Master It" exercise, rename the boxes to **Step1**, **Step2**, **Step3**, and so on, starting with the bottom step. Make and test two named selection sets — one containing the lower three steps and another containing the even-numbered steps.

Solution

1. Rename all six boxes as **Step***x*.

2. Select the boxes named Step1, Step2, and Step3.

3. In the Named Selection Sets input box in the Main Toolbar, enter a name for the selection set containing the lower three steps and then press Enter key.

4. Click a blank area of the viewports to clear the selection set.

5. Expand the Named Selection Set drop-down list; then click the name that you just entered. The three lower stairs are selected.

6. Select the boxes named Step1, Step3, and Step5.

7. In the Named Selection Sets input box in the Main Toolbar, enter a name for the selection set containing the three odd-numbered steps and then press the Enter key.

8. Click a blank area of the viewports to clear the selection set.

9. Expand the Named Selection Set drop-down list; then click the name that you just entered. Every other step is selected.

10. Save your scene.

Chapter 2: Introducing Objects

Create and modify standard primitives.   3ds Max provides users with a number of standard primitives that can be used to start creating more complex objects. Understanding the shapes of the standard primitives, you can see how more complex objects can be created by the arrangement of simpler standard primitives.

Master It   True or False:

Once you have created a standard primitive in 3ds Max you cannot modify it.

Solution   Answer: False

All the standard and extended primitives in 3ds Max are parametric objects, meaning that their appearance is controlled by a number of options with values that you can adjust at any time as long as the objects remain 3ds Max primitives and are not converted or collapsed to EditMesh or EditPoly objects.

Apply a modifier.   Modifiers provide many ways to manipulate an object that may not be possible by manually transforming the object's sub-objects. The order in which the modifiers appear in the modifier stack determines the final result.

Master It   Create a Teapot primitive, and apply the Slice modifier to it. Raise the Slice plane sub-object until it passes through the middle of the object. Choose the Remove Top option from the Slice Parameters rollout to delete everything above the Slice Plane. Add a Cap Holes modifier to the top of the stack.

Solution

1. Create a Teapot primitive and then apply the Slice modifier to it.

2. To access the Slice Plane sub-object, click the plus (+) symbol next to the Slice entry in the modifier stack.

3. Select the Slice Plane sub-object level in the modifier stack, and then click the Select and Move transform in the Main Toolbar.

4. Drag up the Z-axis handle of the Move Transform gizmo to raise the level of the Slice Plane.

5. In the Slice Parameters rollout of the Modify panel, select the Remove Top option. Everything above the Slice Plane disappears.

6. To exit the Slice Plane sub-object level, click Slice in the modifier stack, or press the **1** key in the top row of your keyboard and not the numeric keypad.

7. Expand the modifier list, and apply the Cap Holes modifier. The holes at the top of the teapot are covered with faces. Your scene should look similar to the following image.
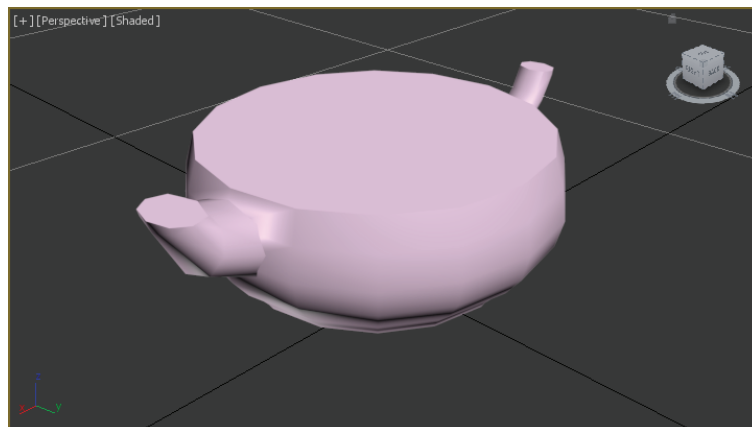
Make a clone of a 3ds Max object. The type of clones you make determines whether modifiers and parameter changes affect the clones as well as the original. Copies are distinct objects, instances maintain the changes between all clones, and references maintain all changes below the reference bar.

Master It Select the teapot from the previous exercise, and make two clones: one instance and one reference. Turn off the Slice modifier for the instance, and then apply a Twist modifier and increase the amount of twist reflected in the objects. Select the reference clone, and apply a Spherify modifier to the top of the stack.

Solution

1. Use the Move transform to make a clone of the teapot by dragging it with the Shift key pressed.

2. In the Clone Options dialog box, choose the Instance option.

3. Clone the original teapot again, but this time choose Reference in the Clone Options dialog box.

4. Select the instance clone, and turn off the Slice modifier by clicking the lightbulb next to the Slice entry in the modifier stack. The Slice modifier is disabled for all three clones.

5. Expand the modifier stack, and choose Twist from the list of available modifiers. You can press the **T** key several times to locate the modifier in the list.

6. In the Parameters rollout, increase the Angle value until the teapots show a significant twist.

7. Select the reference clone, expand the modifier list, and apply a Spherify modifier. The following image shows the result when a 115-degree twist is applied to all the teapots and the Spherify modifier, set to 50 percent, is applied to the reference clone only.
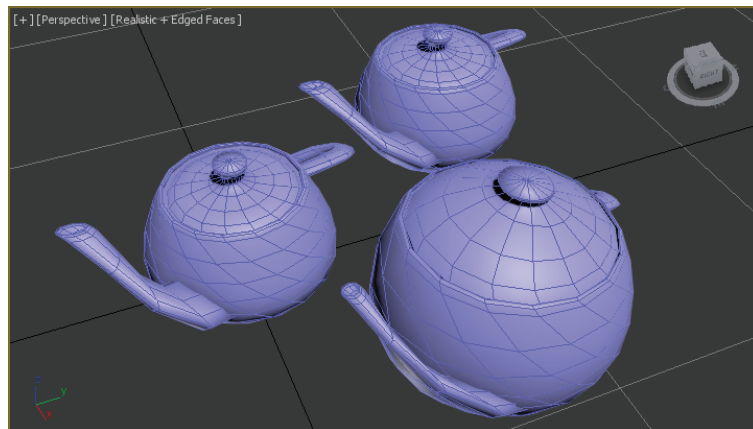
Manipulate a group. Groups provide a method for associating separate objects so that they act as if they are a single object. Groups can be opened, allowing individual member objects to be selected or exploded, or the members associated with it to be changed.

Master It   Make one clone each of the teapots from the previous exercise. Select the three original objects, and make them into a group. Remove the spherified teapot from the group, and then add the remaining two non-spherified teapots to the group.

Solution

1. Select all three teapots, hold down the Shift key, and use the Move transform to create the clones. The type of clone selected does not matter for this exercise.

2. Use the Select Object tool or the Select From Scene dialog box to select the original three teapots.

3. On the Group menu, choose Group. Name the group **teapot group**.

4. To remove the teapot from the group, choose Group ➢ Open, select the spherified teapot, and then choose Group ➢ Detach.

5. Select one of the remaining teapots in the group, and choose Group ➢ Close.

6. To add the other teapot objects to the group, select the two non-spherified teapots, choose Group ➢ Attach, and click the group to add it to the group.

Chapter 3: Creating Shapes with Splines

Draw shapes with splines.   Two-dimensional splines can be used as the building blocks for more complex, three-dimensional objects. You can draw splines from scratch using the Line tool or start with a parametric shape and then collapse it to an editable spline.

Master It   Create a rainbow-shaped set of splines — in other words, a series of concentric arcs.

Solution   Using the Line tool, do the following:

1. Create a line with three vertices: one at each end of the arc and one at the middle.

2. At the Vertex sub-object level, change all the vertices to Bezier.

3. Adjust the handles to create the initial arc shape; then exit the sub-object level.

4. Click the Select And Uniform Scale transform from the Main Toolbar.

5. Hold down the Shift key, click the spline, and drag toward its center point.

6. In the Clone Options dialog box, enter the number of arcs that you want and then click OK.

   The arc's clones are created. You also could have started the exercise using the Arc parametric shape. The Arc method offers the advantage that the arc endpoints remain in line with each other when they are scaled.

Outline and extrude splines.   Outlining splines provides a way to create a new spline sub-object that parallels the original. This is faster and more accurate than creating the second spline manually and then attaching it to the original. Extruding splines is the most common method for creating 3D objects from 2D splines.

Master It A column surround is a shell that covers a structural column to give it a more appealing appearance. Create a 16'-tall, 2"-thick, semicircular column surround with a 16" outside radius.

Solution

1. Use the Arc tool (Create ➤ Shapes ➤ Arc) to create an arc in the Top or Perspective viewport by clicking to set the start point, dragging and releasing to set the endpoint, and then clicking to place the middle of the arc.

2. In the Parameters rollout, set the Radius to **16"** and the From and To values to **0** (zero) and **180** respectively. This creates a 16" outer radius over a 180-degree span.

3. Convert the arc to an editable spline.

4. Access the Spline sub-object level, and then select the single spline that makes up the arc.

5. In the Geometry rollout, type **2"** in the Outline field, and then press ↵.

6. Exit the Spline sub-object level.

7. From the Modifier List drop-down list, apply the Extrude modifier to the spline; then set the Amount parameter to **16'**.

8. Save your scene.
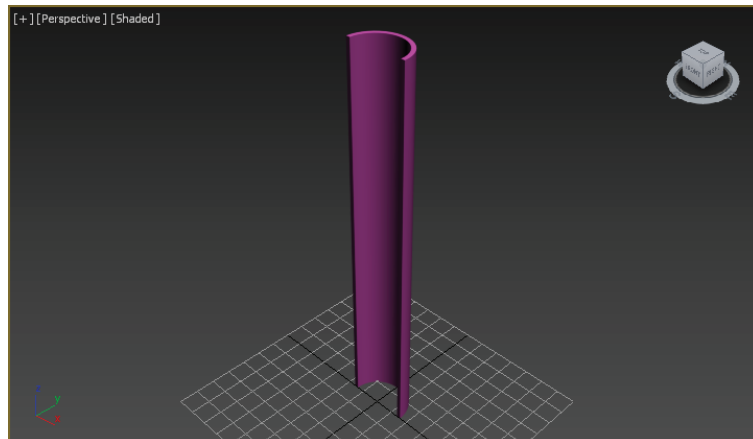
Modify closed splines with Boolean tools. Nearly any shape can be formed using the standard Editable Spline tools. Rather than adding, deleting, and adjusting vertices, it is often faster and easier to create two or more simple shapes and combine them for a more complex shape.

Master It Using the spline Boolean tools, create the cross-sectional shape of a fluted column, similar to the shape shown here.
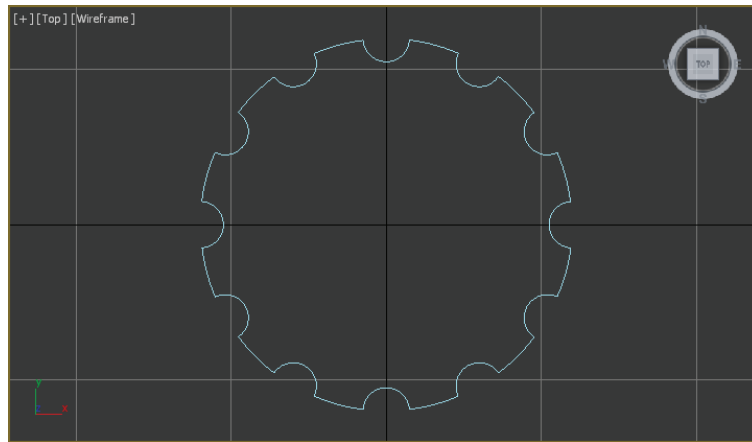
Solution

1. Reset 3ds Max to start in a New scene.

2. In the Top viewport, use the Circle tool to draw a circle that will represent the outermost radius of the column. Move the circle to the origin.

3. Create a smaller circle that encroaches into the larger circle. The smaller circle will be used to form the flutes themselves.

4. With the smaller circle still selected, on the Main Toolbar, click the Select And Rotate tool.

5. Set the Reference Coordinate System to World; if it is set to View, change it to World.

6. Click and select Use Transform Coordinate Center from the Coordinate Center flyout in the Main Toolbar. This will cause the smaller circle to rotate about the origin, which is currently also at the center of the larger circle.

7. Turn on the Angle Snap toggle on the Main Toolbar.

8. Hold down the Shift key, and drag the blue Z ring of the Rotate Transform gizmo until the smaller circle is copied and rotated 30 degrees.

9. In the Clone Options dialog box, set Number of Copies to **11** and then click OK. Twelve smaller circles now surround the larger circle and are evenly spaced 30 degrees apart.

10. Select the larger circle, and convert it to an editable spline.

11. In the Geometry rollout, click the Attach Mult. button; then, in the Attach Multiple dialog box that appears, select all the smaller circles. Click Attach to attach all the smaller circles as spline sub-objects to the larger circle, and close the dialog box.

12. Access the Spline sub-object level, and select the larger circle.

13. In the Geometry rollout, click the Subtraction button to the right of the Boolean button.

14. Click the Boolean button, and then click each of the smaller circles anywhere outside of the larger circle. The smaller circles and any areas shared with the larger circle are deleted, leaving the fluted shape.

15. Exit the Spline sub-object level.

16. Save your file.

Chapter 4: Editing Meshes and Creating Complex Objects

Create openings with ProBoolean operations. Using the ProBoolean tools, you can join meshes (union), delete one object and any volume it shares with another object (subtraction), or delete two objects while retaining the volume that the objects share (intersection).

Master It Using the ProBoolean tools, cut an archway into a box primitive representing a wall. The archway is to be 3′ wide and 8′ high at the top of the arch.

Solution

1. Set your units to US Standard Feet w/Decimal Inches.

2. Create a long box in the Perspective viewport that is 6″ wide and at least 8′ 6″ tall.

3. Create another box that is 3′ long, 2′ thick, and 6′ 6″ tall. This will be the straight section of the archway.

4. Make a cylinder with a radius of 18″ and a height of 2′; change Height Segments to **1**.

5. Turn on Slice and slice the cylinder from 90 degrees to 270 degrees. You are left with half a cylinder.

6. Click the Rotate tool in the Main Toolbar, and then enter **-90** in the Y field of the Transform Type-In at the bottom of the UI. The cylinder rotates so that the flat surface is facing down.

7. Click the Move transform tool, right-click the Snaps toggle, press Clear All, turn on the Vertex snap, close the Grid And Snap Settings dialog box, and then click the Snaps toggle to turn it on.

8. Select the cylinder object, and press the spacebar on the keyboard to turn on the Selection Lock toggle.

9. Place the mouse near one of the corners of the cylinder and watch for the Vertex Snap icon.

10. When the Vertex Snap recognizes the corner, click and move the cylinder to the top of the archway box.

11. Select one of the objects, and then click Create ➢ Geometry ➢ Compound Objects ➢ ProBoolean.

12. Select Union in the Operation section, click the Start Picking button, and then pick the other archway object. The two objects are combined as a single object. Click the Start Picking button again to turn it off.

13. Move the archway object so that it protrudes from either side of the wall.

14. Select the wall, and then click Create ➢ Geometry ➢ Compound Objects ➢ ProBoolean.

15. Select Subtraction in the Operation section, click the Start Picking button, and then pick the archway object. The archway object disappears, leaving an archway-shaped void in the wall.

16. Save your file.

Designate a modeling template image.   Using a template image applied to geometry, such as a plane or a box, can be very helpful in the modeling process. These image planes can be used to display reference information, such as plans, sections, or elevations that are needed to aid the modeling process.

Master It   So that you can use it to model the building's elevation, add an image plane that uses the `House.jpg` file provided with 3ds Max to your Front viewport.

Solution

1. Start a new 3ds Max scene, and right-click in the Front viewport.

2. Click the Create tab and the Geometry button, and then make sure Standard Primitives is selected from the drop-down.

3. Click the Plane button, and then, in the Front viewport, draw out a plane object. Set the Length and Width Segments to **1**.

4. In the Compact Material Editor, create a new Standard material and name it **ElevationTemplate**.

5. Click the Diffuse Color Map slot, and select Bitmap from the Material/Map Browser.

6. In the Select Bitmap Image File dialog box, browse to your 3ds Max program directory, open the `Maps` folder, and then open the `Backgrounds` folder.

7. Select the `House.jpg` file and click Open.

8. In the Coordinates rollout of the material, set the U and V Tiling to **1**, and deselect the Tile box for both.

9. Click the Go To Parent button to get to the top of the ElevationTemplate material.

10. Select the plane object, click the Assign Material To Selection button in the Material Editor, and then click the Show Shaded Material In Viewport button.

11. With the Plane001 object selected, rename it to **ElevationTemplate**. The `House.jpg` file will now display in the Realistic, Shaded, Consistent Color, and Hidden Line viewports.

12. Reviewing the image, you can see the two front doors. If you estimate that the doors are standard 6′ 8″ in height and are about 70 pixels tall, the entire image is 512 pixels by 480 pixels. This would make the image plane 45.6′ tall and 48.64′ wide.

13. Make the ElevationTemplate plane 45′ 7″ in length and 48′ 7″ in width.

14. With the ElevationTemplate object selected, right-click the Select And Move tool to bring up the Move Transform Type-In dialog box, and set the X value to **0** and the Z value to **22′ 9.5″** to set the image plane on the zero Z elevation.

15. To keep from accidentally moving, scaling, or rotating the ElevationTemplate object, with it selected go to the Hierarchy tab of the Command panel, click the Link Info button and check all nine boxes in the Locks rollout.

16. Save your scene.

Create and modify objects using box modeling. Virtually any real-world object can be created using box modeling methodology. Instead of combining primitive objects, you can take a plane or a box and extrude/bevel, inset, and otherwise build up new polys to model anything you wish.

Master It Create any object you want using box-modeling techniques.

Solution

1. Choose any object you want to model.

2. Collect reference materials — either photos or drawings.

3. If possible, find an actual object that you can hold in your hand as a 3D reference.

4. Once you have the reference materials, mentally dissect the object to determine how you might model it.

5. If you have 2D reference photos or drawings, map them to planes in the viewport.

6. Create a box or plane, and add an Edit Poly or Edit Mesh modifier, or convert to an Editable Poly or Editable Mesh object.

7. Use various box modeling methods such as Extrude, Bevel, and Inset to build up polygons.

8. Use transforms to select and move, select and rotate, or select and scale these polys.

9. Switch to Edge or Vertex mode, and use these tools to refine your model. Chamfer edges to round corners.

10. Use Smoothing groups to define hard edges and smooth curved surfaces on the model.

11. Save your scene.

Attach objects to a mesh. The Attach option of an Editable Poly object causes objects to become Element sub-objects of an existing Editable Poly. This creates a single object from multiple objects and reduces the memory requirements of the object.

Master It Create a short tube primitive to act as a simple, round picture frame. Taper the tube. Create a short cylinder to represent the picture backing. Use the Attach option to attach the backing to the frame.

Solution

1. Choose Create ➢ Geometry ➢ Standard Primitives ➢ Tube.

2. Create a tube in the Top viewport.

3. Increase the number of sides to smooth the tube a bit, and note the smaller of the two Radius values.

4. Click the Move tool, and then enter **0** in each of the Transform Type-In fields. This moves the tube to the origin.

5. Click the Modify tab, expand the Modifier List drop-down, and choose Taper.

6. Lower the Amount value until you achieve a slight inward taper.

7. Choose Create ➢ Geometry ➢ Standard Primitives ➢ Cylinder.

8. Create the cylinder in the Top viewport. Enter Radius and Sides values equal to the smaller Radius and Sides values for the tube. Height Segments can be set to **1**, and the cylinder's height should be miniscule.

9. Click the Move tool, and then enter **0** in each of the Transform Type-In fields. This moves the cylinder to the origin and centers it on the tube.

10. Select the frame, right-click, and choose Convert To ➢ Convert To Editable Poly.

11. Click Attach in the Edit Geometry rollout, and then click the cylinder. The cylinder is attached to the tube.

12. Click Attach to turn off the tool.

Create clones with Array and Snapshot.   The Array and Snapshot tools both provide a method of creating many clones of scene objects. The Array tool creates them in patterns of rows and columns, and the Snapshot tool creates clones by capturing their appearance at any point in time.

Master It   Create a window that's 4′ wide by 6′ tall. In the Front viewport, create an array of windows that are spread out 8′ on center horizontally and 12′ on center vertically.

Solution

1. Using box primitives, create a 4′ × 6′–tall window. Group it if necessary.

2. With the window selected, click the Array tool from the Extras toolbar.

3. In the Incremental X Move field at the top-left corner of the dialog box, enter **8′**.

4. Enter **10** for the number of windows to be created horizontally in the 1D Count field.

5. Click the 2D radio button.

6. Enter **3** for the number of rows of windows to be created vertically in the 2D Count field.

7. Enter **12′** in the Z field in the Incremental Row Offsets area.

8. Preview the array, and then click OK.

Chapter 5: Working with External Design Data

Create topography with splines.   Using the Terrain compound object, you can create flowing or layered surfaces defined by the height, shape, and location of the included splines.

> **Master It**   Create a Terrain object in a shape that represents a valley that extends between two peaks. The summit of the peaks should be approximately 1,000' above the ground plane, and the valley should extend approximately 200' below it. Contour lines should be present for every 100' of elevation change.
>
> **Solution**
>
> 1. Using the Line tool, draw two long, thin contour lines to represent the valley. One contour line should completely encompass the other. Be sure to drag the cursor whenever you place a vertex so that the vertices are smooth rather than sharp. Use several vertices to define an area. In this exercise, whenever a dialog box appears asking if 3ds Max should close the spline, click Yes.
>
> 2. Draw one more line around the valley line to represent the land at ground level. The area of this shape should be large enough to encompass the valley and both mountains.
>
> 3. On one side of the valley, draw a large closed spline representing the base of the mountain.
>
> 4. Draw nine more somewhat concentric shapes that will become the incremental contour lines.
>
> 5. Repeat steps 3 and 4 on the other side of the valley.
>
> 6. Using the Move tool and the Transform Type-In, move the outer and inner valley contours to -100' and -200', respectively.
>
> 7. Move the outer contour lines for the mountains up 100', and then move each subsequent line 100' higher than the previous.
>
> 8. Select the lowest valley line, and then from the Command panel choose Create ➢ Geometry ➢ Compound Objects ➢ Terrain.
>
> 9. Click the Pick Operand button.
>
> 10. Click each contour line in sequence from lowest to highest. When picking the mountain contours, alternate peaks when selecting contours at the same altitude.
>
> 11. Select the type of surface to display in the Form section of the Parameters rollout.

Import AutoCAD plans into 3ds Max.   The Manage Links dialog box allows you to incorporate AutoCAD drawings into a 3ds Max scene while maintaining a link between the two files. Changes made to the DWG file are reflected in the 3ds Max scene whenever the drawing is reloaded.

> **Master It**   Create a File-Link preset so that you can repetitively use the same settings when you file-link a drawing file into the 3ds Max scene.

Solution You must create a file-linking preset that contains the file-linking parameters that you want to retain. Here is the procedure:

1. Click the Application menu, and choose References ⯈ Manage Links.

2. On the Attach tab, click the File button and then locate and select the DWG file to link; then click Open.

3. Click the Presets tab, and then click the New button.

4. Give the new preset a unique name, and then click OK.

5. Select the preset, and then click Modify.

6. Set the desired parameters in the three tabs of the File Link Settings dialog box, and then click Save.

7. Click the Attach tab.

8. Expand the Preset drop-down list, and select the new preset.

9. Click Attach This File.

Import Adobe Illustrator files into 3ds Max. When working on 3D projects, it is very likely that you will frequently get files that were originally created in Adobe Illustrator. When working with Illustrator files, you need to make sure that they are prepared properly before attempting to import them into 3ds Max, which involves simplifying the art as much as possible, converting text to outlines, and saving the file down to the Adobe Illustrator 8 format.

Master It Using the Import workflow, bring a properly prepared Adobe Illustrator file into 3ds Max and add a simple Bevel modifier to the imported data.

Solution

1. Reset 3ds Max.

2. In the empty scene, click the Application menu and choose Import.

3. In the Select File To Import dialog box, use the Look In drop-down menu to navigate to where you have saved this chapter's files.

4. Select the `Circle_Logo_AI8.ai` file and click Open.

5. The AI Import dialog box opens. Select Completely Replace Current Scene and click OK.

6. The Shape Import dialog box appears in the Import Shapes As group. Select Single Object and click OK.

7. With the object selected, click the Modify tab and add the Bevel modifier.

8. Set the Start Outline value to **-0′0.125″**.

9. Change both the Level 1 Height value and Outline value to **0′0.125″**.

10. Click the check boxes to enable Level 2 and Level 3.

11. Set the Level 2 Height value to **1**″.

12. Set the Level 3 Height value to **0′0.125**″ and the Outline value to **-0′0.125**″.

13. Save your scene as `My_Circle_Logo.max`.

Import Autodesk Inventor files into 3ds Max.   Autodesk Inventor is a software program that is often used to design complex mechanical components, test the models in virtual situations, and then prepare documentation for manufacturing or files for 3D artists to render and even animate.

> **Master It**   Use the Import dialog to bring an Autodesk Inventor file into 3ds Max.
>
> **Solution**

1. Reset 3ds Max.

2. In the empty scene, click the Application menu and choose Import.

3. In the Select File To Import dialog box, use the Look In drop-down menu to navigate to where you have saved this chapter's files.

4. Select the `01_Finger Engine.iam` file and click Open.

5. The Autodesk Inventor File Import dialog box opens.

6. Leave all the defaults as is, but set the Inventor File Vertical Direction to Z Axis and then click OK.

7. Save your scene as `My_FingerEngine_01.max`.

Use the Substitute modifier.   It is best to use your CAD application and 3ds Max to each of their strengths: drafting 2D plans with blocks for laying out space arrangements and then linking that plan into 3ds Max, extruding walls, and then using the Substitute modifier to replace 2D CAD blocks with the appropriate 3D models for rendering your views and presenting to the designers or clients.

> **Master It**   Using the Manage Links dialog box, attach `Classroom01.dwg` into a new 3ds Max scene. Using the Substitute modifier, replace the circles of the StudentDesk blocks with the `Chair.max` file and the rectangles with the `Worktop.max` file.
>
> **Solution**

1. Reset 3ds Max.

2. In the empty scene, click the Application menu and choose References ➢ Manage Links.

3. Click the File button, and select the `Classroom01.dwg` file. Select the Entity Blocks preset that you created earlier in this chapter, and click Attach This File. Close the Manage Links dialog box.

4. Select one of the rectangles, and choose the Modify tab.

5. Apply a Substitute modifier to the rectangle.

6. From the Parameters rollout of the Substitute modifier, click the Select XRef Object button.

7. Using the Open File dialog box, browse to and select the `Worktop.max` file and click Open.

8. In the XRef Merge dialog box, select Worktop01, click OK, and click Yes on the Substitution Question dialog box asking if you want to assign the Substitute Object's material.

9. Select one of the circles, and repeat steps 6 through 9. Use the `Chair.max` file to replace the circles in the AutoCAD blocks

10. Save your scene as **`MyClassroom_01.max`**.

Link Revit files into 3ds Max.   Revit is Autodesk's premier building information modeling (BIM) software. Using Revit, every element of a building's construction is modeled as a 3D component. The lights, materials, and views from Revit can all be incorporated into a 3ds Max scene.

Master It   What is one method of bringing the components of a Revit file into 3ds Max?

A. Use the Link Revit command to link the native Revit RVT file into the 3ds Max scene.

B. Save the Revit file in Revit 2009 or earlier, and then use the Manage Links dialog box to link the Revit file to the 3ds Max scene.

C. Save the Revit file in Revit 2009 or earlier, and then click the Application menu and choose References ➢ Import to import the Revit file to the 3ds Max scene.

D. Use the Layer Manager to define the Revit layers to import, and then drag the file from Windows Explorer to a 3ds Max viewport.

Solution   The correct answer is A.

Link FBX files into 3ds Max.   When you are working on projects with other 3D artists who don't use 3ds Max, or you are getting resource files from sites on the Internet, you will very likely get files in the Filmbox (`.FBX`) format and then have to bring those files into 3ds Max.

Master It   Use the Link FBX workflow to bring the `Singing_Tear.fbx` character object model into 3ds Max.

Solution

1. Reset 3ds Max.

2. In the empty scene, click the Application menu and choose Import.

3. In the Select File To Import dialog box, navigate to where you saved the Chapter 5 files, select the `Singing_Tear.fbx` file, and click Open.

4. On the FBX Import dialog box and in the Presets group, set the Current Preset to Autodesk Media & Entertainment. Select the Autodesk FBX (Generic) preset from the drop-down menu and, at the bottom of the dialog box, click OK.

The contents of the FBX file display in the viewports.

5. Use the Modifier list to apply a MeshSmooth modifier to the Singing Teardrop object.

6. Save your Scene as **MyTearDrop.max**.

Chapter 6: Organizing and Editing Objects

Loft a shape.   Lofting is the practice of extruding a two-dimensional shape along the length of another two-dimensional shape. There are few restrictions on the shape component of the loft object, but the path component must consist of a single spline.

Master It   Use the Loft tool to create a table leg that is 32″ tall. The table leg is to start as a 1″-diameter circle and end as a square that is 1 ~1/2″ on a side.

Solution

1. In the Perspective viewport, draw a circle with a Radius value of 0.5″.

2. Draw a rectangle, and set the Length and Width values to 1.5″.

3. Click the Line tool, and expand the Keyboard Entry rollout.

4. Click the Add Point button.

5. Enter **32**″ in the Z field, and then click Add Point again.

6. With the line still selected, choose Create ➢ Compound ➢ Loft from the Menu Bar.

7. Click Get Shape, and then pick the circle in the viewport. The circle is lofted along the line.

8. Expand the Path Parameters rollout.

9. Make sure the Percentage radio button is selected, and then enter **100** in the Path field.

10. Click the Get Shape button again, and then select the rectangle. The circle transitions to the square.

Organize objects with layers.   By assigning the objects in your scenes to layers, you can define which layers are hidden, frozen, rendered, and subject to a radiosity calculation. New objects are always created in the current layer using the current layer's color.

Master It   Make three instance clones of the table leg from the previous Master It exercise. Also, make two teapot primitives and a 32″-long, 32″-wide, 2″-tall box. Place the two-dimensional shapes in one layer and hide the layer. Place the legs in one layer, the box in one layer, and the two teapots in one layer. Assign each layer a unique name and layer color.

Solution

1. Select the table leg, and click the Move tool in the Main Toolbar.

2. Hold the Shift key down, and then drag the X or Y transform handle.

3. In the Clone Options dialog box, choose the Instance options, set the number of copies to 3, and then click OK.

4. Choose Create ➢ Standard Primitives ➢ Teapot, and then create two teapots in the Perspective viewport.

5. Choose Create ➢ Standard Primitives ➢ Box, and then drag a box out in the Perspective viewport.

6. Without deselecting the box, in the Parameters rollout, enter **32**″ in the Length and Width fields and **2**″ in the Height field. Rename the box **TableTop**.

7. Click the Layer Manager button in the Main Toolbar.

8. Select the two 2D shapes and the line; then, in the Layer dialog box, click the Create New Layer (Containing Selected Objects) button.

9. Double-click the newly created layer in the Layer dialog box, and enter the descriptive layer name **Shapes**.

10. Repeat steps 8 and 9 for the table legs, tabletop, and teapots. If any colors in the Color column on the Layer dialog box are identical or similar, select the color swatch and then pick a new color in the Layer Color dialog box.

11. Click the dash icon in the Hide column for the layer containing the 2D shapes. The shapes disappear in the viewports.

Deform an object with the Noise modifier. Applying the Noise modifier to any object adds apparent randomness to the object's surfaces. This can often add a sense of realism to a scene by eliminating the perfect roundness and flatness of many objects created in 3ds Max.

Master It Select the potted tree in the last condo scene you saved, add the Noise modifier to it, and then adjust the Noise parameters so that the trunk of the tree is slightly more jagged than it is at present.

Solution

1. Select the Planter_Yucca object you renamed previously.

2. In the Modify tab, expand the Modifier List drop-down list and assign the Edit Mesh modifier.

3. Activate the Vertex sub-object mode, and select the lower one-third of the tree.

4. In the Soft Selection rollout, check the Use Soft Selection option.

5. Increase the Falloff until the tree is affected just below where the fronds start.

6. Go back up to the Modifier List drop-down, and add a Noise modifier to the stack.

7. Adjust the Strength setting in the X and Y values, and then reduce the Scale setting until you get the results you desire.
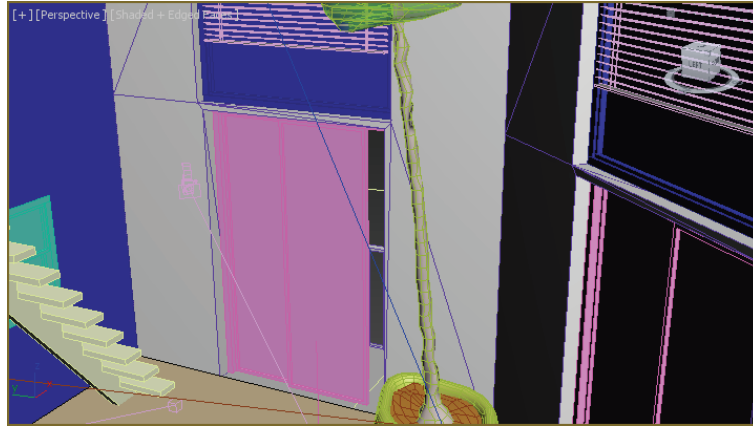
Model with the Symmetry modifier. In many cases, objects are symmetrical across one or more axes. Rather than attempting to model both sides of an object, you can model one side and then, using the Symmetry modifier, adjust the other side automatically to appear as its reciprocal.

Master It Being able to modify objects you have already built quickly to create new objects is an important skill. Open the last condo scene in which you modified the pedestal. Create a clone of the first pedestal you built, modify one side of the pedestal, and then make the new pedestal model symmetrical.

Solution

1. Open the last condo scene you were in when you were working on the pedestal loft object.

2. Click the Select And Move tool on the Main Toolbar, and then select the pedestal loft object.

3. Hold down the Shift key, and then click and drag a clone of the pedestal to the right. Set the Object settings to Copy on the Clone Options dialog, and name the clone **NewPedestal**.

4. Add an Edit Mesh modifier to the NewPedestal object.

5. Select and expand the Edit Mesh modifier from the stack.

6. Activate the Vertex sub-object mode.

7. Select the front view.

8. Select some vertices along the right side of the pedestal, and move them in the positive X direction.

9. Deselect the points you selected and moved.

10. Close the Edit Mesh modifier.

11. Add a Symmetry modifier to the top of the stack.

12. Select the Flip option in the Parameters rollout. Your new pedestal should be symmetrical now.

Extrude with the Sweep modifier.   Similar to the Loft compound object, the Sweep modifier extrudes one 2D object along the length of another. While the Loft tool is more powerful, with more controls and features, the Sweep modifier is faster, can be applied to multiple objects, and comes with a library of 2D shapes.

Master It   The goal of this exercise is to make a round bumper to fit around the TableTop that you made in the second "Master It" exercise. The large, flat surfaces of the box should transition seamlessly into the bumper. Use the Sweep modifier to extrude a half-round shape that fits precisely around the box.

Solution

1. Continuing from the second "Master It" exercise, create a 32" × 32" rectangle in the Top viewport.

2. In the Modify tab, expand the Modifier List drop-down list and assign the Sweep modifier to the rectangle.

3. In the Section Type rollout, select the Half Round shape from the Built-In Section drop-down list.

4. In the Parameters rollout, set the Radius value to 1".

5. In the Sweep Parameters rollout, set the angle to -90, and then set the Pivot Alignment area by clicking the button in the middle of the left column.

Align objects.   3D modeling or layout specialists frequently must move one object so that it sits directly on, or butts precisely against, another object — with no gaps or overlaps. The Align tool is often the best choice when you need to align the minimum or maximum axis values of different objects.

> **Master It**   Continuing from the previous exercise, you need to align the table legs with the box so that the top of each leg is aligned to the bottom of the table and two of the rectangular edges at the top of each leg are aligned with the outside edges of the box. Move the teapots so that they lie within the perimeter of the box, and then align the bottom of the teapots with the top of the box. Align the bumper so that it is centered on the box.
>
> **Solution**
>
> 1. If necessary, click the Maximize Viewport toggle to display four viewports, and switch the Top viewport to Wireframe mode.
>
> 2. In the Perspective viewport, select a table leg, click the Align tool in the Main Toolbar, and then pick the box to which you will align the table leg.
>
> 3. In the Align Selection dialog box, select the X Position and Y Position options, and then select the Maximum options in both the Current and Target Object columns. The top-right corner of the leg, as shown in the Top viewport, is aligned to the top-right corner of the box.
>
> 4. Click OK.
>
> 5. Select another table leg, click the Align tool in the Main Toolbar, and then pick the box to which you will align the table leg.
>
> 6. In the Align Selection dialog box, select the X Position and Y Position options, and then select the Minimum options in both the Current and Target Object columns. The bottom-left corner of the leg, as shown in the Top viewport, is aligned to the bottom-left corner of the box.
>
> 7. Click OK.
>
> 8. Select another table leg, click the Align tool in the Main Toolbar, and then pick the box to which you will align the table leg.
>
> 9. In the Align Selection dialog box, select only the X Position option and then select the Minimum options in both the Current and Target Object columns. The left edge of the leg is aligned with the left edge of the box.
>
> 10. Click Apply. Select only the Y Position option, and then select the Maximum options in both the Current and Target Object columns. The top-left corner of the leg, as shown in the Top viewport, is aligned to the top-left corner of the box.
>
> 11. Click OK.
>
> 12. Select the last table leg, click the Align tool in the Main Toolbar, and then pick the box to which you will align the table leg.

13. In the Align Selection dialog box, select only the X Position option, and then select the Maximum options in both the Current and Target Object columns. The right edge of the leg is aligned with the right edge of the box.

14. Click Apply. Select only the Y Position option, and then select the Minimum options in both the Current and Target Object columns. The bottom-right corner of the leg, as shown in the Top viewport, is aligned to the bottom-right corner of the box.

15. Click OK.

16. To align the bottom of the box to the top of the legs, select the box, click the Align tool, and then pick one of the legs. Select the Z Position option only. Select Minimum for the current object and Maximum for the target object. The box moves to the top of the legs.

17. Click OK.

18. In the Top viewport, move the teapots so that they are within the perimeter of the box.

19. In the Perspective viewport, select both teapots, click the Align button, and then pick the table. The settings from the previous alignment option (Z Position, Current Object: Minimum, Target Object: Maximum) are retained and appropriate for this operation. Click OK.

20. Select the bumper object, click the Align tool, and then pick the table. To align the bumper to the box, select the X, Y, and Z Position options, and then select Center for both the current and target objects. The bumper is centered on the box.
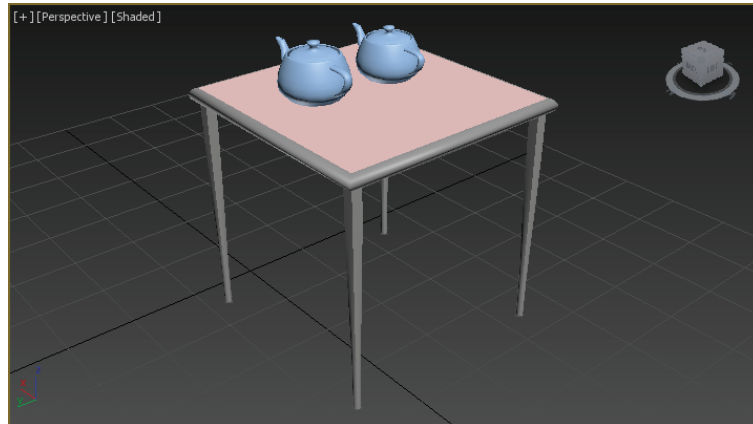
Rename objects.   A good naming convention is invaluable when a scene becomes complicated, with many objects to control and select. The Rename Objects tool is invaluable for quickly renaming several objects to a standard naming convention.

Master It   Again continuing from the previous exercise, use the Rename Objects tool to rename the four table leg clones to objects named Table_Leg_01, Table_Leg_02, Table_Leg_03, and Table_Leg_04.

Solution

1. Click the Manage Layers icon in the Main Toolbar to open the Layer dialog box.

2. In the Layer dialog box, highlight the layer upon which you previously placed the table legs, and click the Select Highlighted Objects And Layers button. The four table legs should highlight. If the Table Bumper highlights, deselect everything. Select the Table Bumper, and then highlight the TableTop layer and click Add Selected Objects To Highlighted Layer. If necessary, reselect the objects on the layer that the table legs are on.

3. Choose Tools ➢ Rename Objects to start the Rename Objects tool.

4. In the Rename Objects dialog box, make sure the radio button next to Selected is selected.

5. Select the box in front of the Base Name field.

6. Select the box in front of the Numbered field, and set Base Number to 1.

7. In the Base Name field, enter **Table_Leg**.

8. Click the Rename button.

9. Click the Select By Name button from the Main Toolbar. You should see your properly named table legs highlighted in the Select From Scene dialog box.

Chapter 7: Light and Shadow

Create and adjust the different light types. Lighting is an important component of any 3ds Max scene, and proper lighting schemes add to its quality. The various types project light into the scene in different ways.

Master It What is the difference between a spotlight's falloff and its far attenuation?

Solution *Falloff* is the angular limit within which a spotlight will cast illumination. The amount of illumination falls off from 100 percent at the limits of the hotspot to 0 percent at the perimeter of the falloff.

Attenuation defines the distance the light travels from its point of origin. Attenuation is defined by a Start distance and an End distance. The light has full intensity from its point of origin to the Start distance, declining intensity from the Start distance to the End distance, and zero illumination beyond the End distance.

Render a scene. 3ds Max scenes are generally output to image files or animated files for viewing. Choosing the proper output file type is important to manage the file size and quality.

Master It Render a camera view, and save the file as a JPEG file with a Quality value of 100. Render it three more times with Quality values of 90, 50, and 30. Compare the four files for both quality and file size.

Solution

1. Open a 3ds Max scene.

2. Open the Render Setup dialog box.

3. Click Files in the Render Output section.

4. In the Render Output File dialog box, specify the file location and name, and then click the Setup button.

5. In the JPEG Image Control dialog box, set the Quality to **100** and then click OK.

6. Click Save, and then click Render in the Render Setup dialog box.

7. Repeat steps 3 through 6 three times, changing the Quality value and filename each time.

8. Open the files in your favorite image editor or viewer, as well as Windows Explorer. You'll see image quality degrading as the Quality value lowers, while the file size reduction is even more severe.

Define shadow effects. Shadows are an important feature of any 3ds Max scene. They convey information regarding the intensity and type of illumination. Shadows also define where in the scene an object resides by tying it to the surrounding objects.

Master It What is the procedure for causing an object not to cast shadows from a specific light?

Solution

1. Select the light.

2. In the General Parameters rollout, click Exclude.

3. In the Exclude/Include dialog box that appears, select the object in the left window.

4. Click the right-pointing double-arrow button to move the object to the right window.

5. Make sure both the Exclude and Shadow Casting radio buttons are selected.

6. Click OK.

Save and restore scene states. Scene states let you save and restore the parameters of the lights in a scene. They can save a great amount of time by eliminating the need to note each light's parameters, on/off status, and other parameters to accommodate different lighting conditions.

Master It Open the file you saved in the "Using Scene States" section in this chapter. Save the light parameters as a lighting scheme, change the parameters, and then restore the new scheme.

Solution

1. Open the file.

2. Choose Tools ➢ Manage Scene States.

3. In the Manage Scene States dialog box, click Save.

4. In the Save Scene State dialog box, enter a name for the scene state.

5. Select the Light options in the window, and then click Save.

6. Modify the parameters of the lights in the scene.

7. In the Manage Scene States dialog box, select the scene state that you just created.

8. Click Restore.

Chapter 8: Enhancing Models with Materials

Create and edit materials. Quality materials can add significantly to the quality of a scene. Materials are constructed by choosing a shader, setting its parameters, and then adding and adjusting maps.

Master It Using the `Masonry.Unit.Masonry.Brick.Modular.Running.Grey.jpg` file in the `3ds Max 2013/maps` folder installed with 3ds Max as the diffuse color map, create a Standard material and assign it to an object.

Solution

1. Start a new 3ds Max file.

2. Open the Compact Material Editor.

3. Click an unused material sample and name it **MyBrickMaterial**.

4. Expand the Maps rollout, and click the None button next to the Diffuse Color option.

5. In the Material/Map Browser, expand the Maps and Standard rollouts; then double-click Bitmap.

6. In the Select Bitmap Image File dialog box, navigate to the /maps folder from the 3ds Max install, select `Masonry.Unit.Masonry.Brick.Modular.Running.Grey.jpg`, and then click Open.

7. Create a Sphere object in the scene and select it.

8. In the Material Editor, click the Assign Material To Selection button.

9. Click the Render Production button in the Main Toolbar to review the material on the object.

10. Go back to the Compact Material Editor, and on the material click Go To Parent.

11. Change the Specular Level to **90** and the Glossiness to **50**.

12. Render the scene again.

13. Save your scene.

Select shaders. The shader that you select determines how a material appears when a scene is rendered. The most obvious difference between the different shaders is the appearance of the specular highlight.

Master It   Using the material from the previous "Master It" exercise, examine the result of assigning the different shaders to the material. Which shader results in a stretched-out specular highlight? Which shader has the most diffused highlight?

Solution

1. Create six copies of the sphere in the scene.

2. In the Material Editor, create six copies of the material you created previously.

3. Set each of the six new materials to one of the shaders in the Shader Basic Parameters rollout, using each one once, and name each material appropriately.

4. Apply one of new materials to each the new spheres.

5. Adjust the viewport so that you can see all seven spheres; then render the scene and observe the result of the shaders on the objects.

6. The shader that stretches out the specular highlight is the Anisotropic shader. The shader that diffuses the specular highlight the most is the Oren-Nayar-Blinn shader.

Use bump maps.   Image maps assigned to the diffuse color channel of a material tend to look flat, like decals or wallpaper. Adding a bump map can add apparent detail without increasing the complexity of the models.

Master It   Continuing from the previous "Master It" exercise, add a noise map to the material's Bump channel to roughen the surface. Copy and rename the material in the Material Editor, and then replace the Noise bump map with the same map used as the diffuse color map. Apply the new material to a copy of the sphere in the scene. Compare the differences in the viewport.

Solution

1. Select the first material you made, and expand the Maps rollout in the Material Editor.

2. Click the None button next to the Bump label.

3. In the Material/Map Browser, navigate to and select Noise and then click OK.

4. Adjust the values in the Noise Parameters rollout to your liking. Then click Go To Parent.

5. Render the scene.

6. Copy the sphere in the scene, making sure not to create an instance.

7. Copy the material in the Material Editor by dragging it to another unused slot.

8. Rename the new material.

9. In the new material, drag any of the None buttons in the Maps rollout over the Bump Map button to clear it, or right-click it and select Clear.

10. Drag the Diffuse Color Map button, and drop it over the Bump Map button.

11. Choose Instance in the Copy (Instance) Map dialog box.

12. Assign the new material to the new sphere.

13. Render the scene, and compare the two materials.

Create a material with sub-materials. Often, a model that is constructed as a single object may represent a structure composed of several objects, each with its own material. The multi/sub-object material is used to assign several distinct materials to a single object.

Master It What is one procedure for creating a multi/sub-object material?

Solution

1. Select a material slot.

2. Click the Material button, and choose Multi/Sub-Object from the Material/Map Browser.

3. Choose whether to discard or keep the existing material.

4. Set the number of sub-materials.

5. Click a sub-material button, and then set that sub-material's parameters.

6. Click the Go To Sibling button, and then adjust the parameters of the next sub-material.

7. Repeat step 6 for the remaining sub-materials.

Add entourage. Adding entourage to your scenes can make them seem like they are inhabited and help create a sense of scale to which viewers can relate.

Master It Using the Tree01AM.tif and Tree01op.tif files you downloaded with this chapter's materials, create a new entourage material with the Compact Material Editor and apply it to a plane so that you can render it.

Solution

1. Reset 3ds Max.

2. Open the Compact Material Editor.

3. Click the Material button, and select Architectural from the Material/Map Browser.

4. Rename the material to **TreeEntourage**.

5. Expand the Maps rollout, and click the None button next to the Diffuse Map option.

6. Double-click the Bitmap map type in the Material/Map Browser, navigate to the folder where you downloaded the Chapter 8 files, select Tree01AM.tif, and then click Open.

7. Uncheck the Use Real-World Scale option if needed, set the Tiling values to **1**, and deselect the Tile options for both U and V mapping directions.

8. Click the Go To Parent button.

9. Scroll down and in the Special Effects rollout, select the None button in the Cutout slot of the material.

10. Double-click the Bitmap map type in the Material/Map Browser, navigate to the folder where you downloaded the Chapter 8 files, select `Tree010P.tif`, and then click Open.

11. Uncheck the Use Real-World Scale option if needed, set the Tiling values to **1**, and deselect the Tile options for both U and V mapping directions.

12. Click the Go To Parent button.

13. In the Front viewport, create a Plane object, deselect the Real-World Map Size option, and keep the plane selected.

14. In the Compact Material Editor, select Assign Material To Selection.

15. Click the Render Production button in the Main Toolbar to review the entourage tree material.

16. Save your scene.

Use the Autodesk Materials.   The Autodesk Materials provide high-quality materials that can help you better simulate real-world materials to enhance the accuracy and realism of your renderings.

> **Master It**   Using the `My_C08_Condo_mentalray.max` file that you worked on in this chapter, change the Standard Metal_Chrome_Han material into the Chrome – Polished Brushed Autodesk Material, and render the scene.

> **Solution**

1. Open your `My_C08_Condo_mentalray.max` file.

2. Select one of the Cab Handle objects in the background of the CamCounter viewport.

3. Click the Compact Material Editor button on the Main Toolbar.

4. Select one of the unused material sample slots, and then click the Get Material button.

5. In the Material/Map Browser, scroll down to the Scene Materials group and expand it.

6. Right-click the Scene Materials group, and select Filter Selected Objects to see only the material(s) applied to the currently selected object.

7. Double-click the Metal_Chrome_Han material to select it; then right-click the Scene Materials Group, deselect Filter Selected Objects, and then close the Material/Map Browser.

8. In the Material Editor, select the next unused material sample slot.

9. Click the Get Material button to open the Material/Map Browser, navigate to the Autodesk Material Library group, and then expand the Metal group. Scroll down and double-click Chrome – Polished Brushed to place it in the selected Compact Material Editor sample slot. Close the Material/Map Browser.

10. Select the Metal_Chrome_Han material sample, and click the Select By Material button.

11. The Select Objects dialog box opens, showing the DoorHandlex objects selected; click Select.

12. Select the Metal Chrome – Polished Brushed material sample, and click the Assign Material To Selection button.

13. Deselect all objects.

14. Save and then render the scene. You will see a Missing Map Coords warning.

15. Click OK to continue rendering. You can add UVW mapping to all the DoorHandlex objects on your own.

Use the Displace modifier.   Applying the Displace modifier or applying materials using displacement maps to simple objects can be a powerful way to create highly detailed or irregular forms without taking the time to build the complex geometry.

> **Master It**   Create a 50′ × 50′ plane, with 100 Length and Width segments. Apply a Displace modifier that uses the `Bench_d.jpg` image, which tiles six times across the surface.
>
> **Solution**

1. Reset 3ds Max.

2. Create a 50′ × 50′ plane.

3. Set the Length and Width Segments to **100**.

4. Apply a Displace modifier to the plane.

5. In the Image group, select the None button in the Bitmap area and browse to the `Bench_d.jpg` image.

6. Set U Tile to **2.0**.

7. Set V Tile to **3.0**.

8. Adjust Displacement Strength to **6″**.

9. Save and then render the scene.

Chapter 9: Using the Camera

Understand the camera.   The virtual cameras in 3ds Max follow the analogy of real-world SLR cameras. You can set the focal length, set the field of view, and adjust several other parameters. Targeted cameras are oriented by moving a target object, and free cameras are oriented using the Rotate transform.

> **Master It**   Create a new camera that focuses on the lower-level main entranceway, flanked by the tall, thin windows. Switch between a target and a free camera to familiarize yourself with manipulating each type.
>
> **Solution**

1. Open the last villa file on which you worked.

2. In the Top viewport, zoom into the main entrance at the peak of the curved glass walls, leaving room to place the camera.

3. Choose Create ➢ Cameras in the Command panel, and then click Target.

4. Click to place the camera outside the building, and then drag and release near the entrance to place the target.

5. Move the camera up so that it does not rest on the ground plane.

6. Change the camera and target locations to adjust the orientation of the camera.

7. Click the Modify tab.

8. In the Parameters rollout, expand the Type drop-down list and choose Free Camera. The target disappears.

9. Change the orientation of the camera using the Rotate transform.

10. Save your scene.

Set up an interior view. Interior cameras are more difficult to place properly than exterior cameras. The scene must be framed properly while maintaining an acceptable field of view and working within the space limitations frequently found indoors.

Master It Make two clones of the camera that focus on the outside of the entranceway. Move the new cameras and, if necessary, the targets inside the structure. Manipulate each camera so that each displays one side of the entranceway. Show as much of the windows as possible without excessive distortion.

Solution

1. In the Top viewport, select the camera that focuses on the outside of the entranceway.

2. Click the Select And Move tool in the Main Toolbar.

3. Hold down the Shift key, and move the camera so that it is inside and to the left side of the entranceway.

4. Choose Copy in the Clone Options dialog box, and click OK.

5. Click the label for the current Perspective viewport; choose Cameras and then the name of the new camera.

6. In the Top and Right viewports, move the camera and rotate it to frame the scene properly, focusing on the right side of the entranceway's interior. You can also adjust the camera's properties as required.

7. Repeat steps 1 through 6, cloning the last camera made, to create the camera that focuses on the left side of the entranceway's interior.

8. Save your scene incrementally.

Create an environment. Most image formats can be used as the background for a rendered scene. Once an image map is selected, it can be positioned and manipulated through the parameters found in the Material Editor.

Master It Select another sky image map, and replace the map used in this chapter. Choose another map provided with 3ds Max 2013, or create your own with a digital

camera. Use the controls located in the Output rollout to change a darkened sky to a brighter one, or vice versa.

Solution

1. Continue from your previous file.

2. Open the Compact Material Editor.

3. Select the sample slot containing the Skydome material.

4. Expand the Maps rollout.

5. Click the Diffuse Color Map button containing the `CLOUD2.jpg` map.

6. In the Bitmap Parameters rollout, click the Bitmap button.

7. In the Select Bitmap Image File dialog box, navigate to and select a different sky image. Some images can be found in the `3ds Max Subscription Sample Files` folder you may have downloaded, or create our own with a digital camera.

8. Expand the Output rollout.

9. Make any adjustments that you prefer.

10. Render the scene to display the changes.

11. Save your scene incrementally.

Render elements for compositing. 3D still images and animations must often go through a postproduction compositing process to achieve a higher level of quality or realism. Using the Render Elements feature, you can automatically create many of the required element types at the same time the images are being rendered. Advanced image-processing software, such as Autodesk Composite, can manipulate and composite the different images and create the final output.

Master It Open the most recent Savoye scene, and create two more render elements: one for the shadows and one for the reflections.

Solution

1. Continue with the open file.

2. Open the Render Setup dialog box.

3. Click the Render Elements tab.

4. In the Render Elements rollout, click the Add button.

5. In the Render Elements dialog box, click the Shadow and Reflection options and then click OK.

6. Set the output path for the Render Elements to the location where you are saving this chapter's files.

7. In the Render Setup dialog box, go to the Common tab and make sure the Render Output destination for the rendered file is set properly to where you are working with

this chapter's files, and click Render. Four Rendered Frame Windows open, with two of them appearing blank.

8. In each of the blank Rendered Frame Windows, click the Display Alpha Channel button in the toolbar. You'll see the areas in shadow or the faces that reflect the environment in white while the other areas remain in black.

Use the Camera Match utility. When a building's model must be incorporated into a background image, you must match the 3ds Max virtual camera to the camera that took the background picture. This is accomplished by placing CamPoint helper objects in the scene and using the Camera Match utility.

Master It What is the difference between adding a CamPoint helper in the scene and assigning the position of a CamPoint helper in the scene?

A. Nothing. The terms are interchangeable.

B. *Adding* the CamPoint helper consists of locating the object accurately in the scene, while *assigning the position* of the CamPoint helper refers to selecting its proper location relative to the background image.

C. *Assigning the position* of the CamPoint helper consists of locating the object accurately in the scene, while *adding* the CamPoint helper refers to selecting its proper location relative to the background image.

D. None of the above.

Solution The correct answer is B.

Chapter 10: Organizing Objects and Scene Management

Use external references. Using XRefs can increase productivity by breaking a project into smaller parts that individual artists can work on, and it allows you to disassociate parts of the project as system performance decreases.

Master It Extract the trees in the `mysavoye10.max` file as a new 3ds Max file. Change the number and arrangement of the trees in this new scene, save the configuration, and then reopen `mysavoye10.max`, delete the existing foliage, save the scene as a new file, and then XRef the new tree file you made.

Solution

1. Open the `mysavoye10.max` file.

2. Delete everything in the scene except the trees. You can do this quickly by selecting all the objects with names that begin with "Foliage" in the Select From Scene dialog box and then clicking the Select Invert button.

6. Rearrange, copy, or modify the trees, noting the boundary of the villa.

7. Choose File ⊳ Save As and save the file under a new name, such as `MyVillaTrees.max`.

8. Reopen the `mysavoye10.max` file that you opened in step 1.

9. Select and delete all the trees.

10. From the Application menu, choose References ➢ XRef Scene.

11. Click the Add button, navigate to the new tree file you saved in step 7, and then click Open. The trees, in their new configuration, surround the building.

12. Save the file as `MySavoye10_Trees.max`.

Use the Rendered Frame Window options.   Using the Rendered Frame Window, you can save, print, and compare the result of your 3ds Max renderings.

Master It   Render the MyCamera01 viewport in the `MySavoye10_Trees.max` file. Make changes to the lighting, render the viewport again, and then compare the two renderings using the RFW.

Solution

1. Open the `MySavoye10_Trees.max` file, and right-click in the MyCamera01 viewport.

2. Choose Rendering ➢ Render Setup, or click the Render Setup button to open the Render Setup dialog box.

3. Make sure Single is selected in the Time Output section.

4. Click the Render button. The render is displayed in the RFW.

5. In the RFW toolbar, click Clone Rendered Frame Window. A copy of the RFW opens.

6. Make changes to the lighting by selecting the lights and changing their parameters, or make the changes in the Light Lister.

7. Render the viewport again. The RFW is overwritten with the new rendering, but the clone remains. Compare the two renderings.

Use the Asset Browser.   With the Asset Browser, you can insert one 3ds Max scene into another using the dialog box to see the names of and thumbnails for the assets in any folder locally, on a network, or on the Internet.

Master It   Create several 3ds Max scenes consisting of a single, unique tree each. Use the Asset Browser to bring one or more of each of the trees into the `MySavoye10_Trees` scene.

Solution

1. Open the `MySavoye10_Trees.max` file that you created in the first "Master It" section of this chapter.

2. Select one tree in the file, and click Application menu ➢ Save ➢ Save Selected to save the tree as a new file.

3. Open the new file you just saved, click the Modify tab, and using the Parameters rollout, change the parameters of the tree object, and then save it as another new file.

4. Repeat step 3 several times until you have a significant library of unique but similar trees.

5. Open the `MySavoye10_Trees` file that you saved in step 12 of the first "Master It" exercise.

6. Remove the external reference containing the tree file.

7. Choose Utilities ➢ Asset Browser in the Command panel.

8. Navigate to the folder containing your new trees.

9. Drag each of the new trees into the scene, placing them around the villa.

10. Save your scene as `MySavoye10_Trees_02.max`.

Create a panorama.   By creating a panorama, you can allow anybody to view the rendered result of a 3ds Max scene through the free Apple QuickTime viewer. Users can zoom and pan within the viewer to view the scene from different orientations from the original camera's location.

> **Master It**   Open the `Condo.max` file from this chapter's downloads. Add a free camera centered in the main room, 6′0″ above the floor, and create a panorama and export it to a QuickTimeVR file.
>
> **Solution**
>
> **1.** Open the `Condo.max` file.
>
> **2.** Choose Create ➢ Cameras ➢ Free, and then place a free camera in the Front viewport.
>
> **3.** Rename the camera to **MyPanoramaCamera**.
>
> **4.** Adjust the camera's location so that it is centered in the room and 6′0″ above the main floor.
>
> **5.** Choose Utilities ➢ More ➢ Panorama Exporter.
>
> **6.** In the Panorama Exporter rollout, click the Render button.
>
> **7.** In the Render Setup Dialog, set the Output Size to a value large enough to show detail in the panorama, and make sure that `MyPanoramaCamera` is selected in the Viewport drop-down list.
>
> **8.** Click the Render button.
>
> **9.** In the Panorama Exporter Viewer dialog box, choose File ➢ Export ➢ Export QuickTimeVR or Export Cylinder. In the QuickTimeVR Output File dialog box, browse to where you are saving this chapter's files and enter **MyCondoPanorama.mov** as the filename; then click the Save button.
>
> **10.** Save your scene as **MyCondoPanorama.max**.

Publish a scene to the DWF format.   DWF files are gaining popularity as a means to distribute interactive access to 3ds Max scene files, so users who don't have 3ds Max can review the objects.

> **Master It**   Open the `Condo.max` file from this chapter's downloads. Export the condo scene as a DWF file. Open the resulting DWF in Autodesk Design Review and, using the

ribbon, add a Cross Section XY Slice plane to cut away a wall and see into the condo from top to bottom.

Solution

1. Open the `Condo.max` file.

2. From the Application menu, choose Export ➢ Export to DWF, name the file **MyCondo. dwf**, and then click Save.

3. Accept the default options in the DWF Publish Options dialog box. Click OK.

4. Open the `MyCondo.dwf` file in Autodesk Design Review 2013.

5. In the Autodesk Design Review ribbon, select the Tools tab and then choose the Section XY tool.

6. Drag or rotate the cross-section tripod until one of the exterior walls is removed.

Chapter 11: Understanding Animation

Create a quick-study animation.   Viewing an animation, rather than individual still images, can give you a greater sense of the size, scope, and proportion of a design project. Initial, quick-study animations usually consist of short animations with changes made to the camera's location and orientation.

Master It   Create a camera at the mezzanine level of the condo scene, `C11_MasterIt_01. max`, oriented toward the tall windows. Animate the camera moving to the lower level and changing orientation to look into the kitchen.

Solution

1. Open the `C11_MasterIt_01.max` file. (These files are available on this book's website at `www.sybex.com/go/mastering3dsmax2013`.)

2. In the Top viewport, place a target camera in the mezzanine and the target near the windows.

3. Change the Perspective viewport to view the scene through the new camera.

4. In the Front or Left viewport, adjust the height of the camera to match a person's eye level at the mezzanine for the camera and the lower level for the target.

5. Move the Time slider to frame 100, and then click the Auto Key button.

6. Change the locations of the camera and target so that the camera is at eye level of the lower level, near the windows, and the target is in the kitchen.

7. Turn off the Auto Key button, and then play the animation.

8. If necessary, place the Time slider at frame 100, turn on Auto Key mode, and make any adjustments to the camera and target locations.

9. Save your file.

Change the number of frames in an animation.   The 101 frames provided in the default 3ds Max scene are rarely adequate to display any significant amount of animation. It's an easy process to increase or reduce the number of frames in a scene, and this is a task that you will do often.

Master It   Continuing with the previous exercise, increase the number of frames to 300. Adjust the keyframes so that the animation occurs over all 300 frames.

Solution   There are two ways to complete this task: increase the number of frames and move the keys, or scale the animation and keys at the same time. To adjust the scene using the first method, follow these steps:

1. Click the Time Configuration button in the time controls area.

2. In the Animation section of the Time Configuration dialog box that opens, set the Frame Count to **300** and then click OK.

3. Select both the camera and target.

4. In the track bar at the bottom of the 3ds Max window, select the keys at frame 100 and drag them to frame 299. Watch the status bar for visual feedback as you move the keys. This method should be used when the animation of only certain objects should be altered.

5. Play the animation.

To scale the animation and keys at one time, follow these steps:

1. Click the Time Configuration button in the time controls area.

2. In the Animation section of the Time Configuration dialog box that opens, click the Re-scale Time button.

3. In the Re-scale Time dialog box, set the Length value to **299**, and then click OK. Use this method when the animation of all objects in the scene must conform to the new animation length. Click OK to close the Time Configuration dialog box.

4. Play the animation.

5. Save your file.

Add and edit keyframes.   Keyframes determine the point in time and value of nearly any parameter change in 3ds Max. Adding and editing them properly is an essential task when finalizing your animation.

Master It   Continuing from the previous exercise, add two keys to the camera's anima-tion, one that raises its position before descending to the lower level and one that adjusts its rotation so that it looks at the kitchen earlier. The camera should ease into and out of its peak height.

Solution

1. Continuing from the previous exercise, drag the Time slider to approximately frame 70.

2. Click the Auto Key button, and then raise the height of the camera above its initial height.

3. Right-click the new key at frame 70 on the track bar, and then choose Camera001: Z Position from the context menu that appears.

4. In the Camera001: Z Position dialog box, click the In tangent button and choose the Slow tangent option. Choose the Slow tangent for the Out option as well.

5. Move the Time slider to approximately frame 200.

6. The animated camera is a target type, so its orientation is determined by the location of its target object. Select the camera's target, and raise it in the Z-axis until the kitchen starts to come into the view.

7. Turn off Auto Key mode and play the animation. The camera raises, easing into and out of the peak position, and lowers to its final position, showing the kitchen earlier than in the previous exercise.

Preview the animation. Animations can take a significant amount of time to render and, unless you have a render farm setup, you may lose the ability to continue working on a scene while it renders. Creating preview animations can quickly identify animated conflicts prior to your spending the time creating a final animation.

Master It Create a preview animation, at a resolution of 640 × 480, showing the modified camera path from the previous exercise. Display the frame numbers in the images, and save the animation as an AVI file using the Microsoft Video 1 codec.

Solution

1. Right-click in the Camera001 viewport to make it active.

2. Choose Tools ➤ Views – Grab Viewport ➤ Create Animated Sequence File from the Menu Bar.

3. In the Make Preview dialog box, check the Frame Numbers option in the Overlay section.

4. In the Image Size section, increase the Percent Of Output value to **100**.

5. In the Output section, choose AVI, and then click the Choose Codec button.

6. In the Video Compression dialog that appears, select Microsoft Video 1 as the compressor and then click OK.

7. In the Make Preview dialog box, make sure that Active Time Segment is selected in the Preview Range section.

8. Click the Create button. 3ds Max creates the preview animation.

9. Close the open preview, and click Tools ➤ Views – Grab Viewport ➤ View Animated Sequence File to examine the preview animation that you made.

10. Save your file.

Control lights over time.   Clarifying the results of the lighting in a scene is often identified as a priority early in the project cycle. Not only is a satisfactory lighting scheme required, but animated variations, such as the onset of dusk, may also need to be viewed and observed.

Master It   Add a quick lighting scheme to the condo scene. Animate the lights, holding their intensity for 100 frames and then reducing the intensity to zero while turning the lights slightly red.

Solution

1. Place four instance clones of an Omni light near the ceiling.

2. Create four Omni lights below the floor. The second set of lights should be instanced to each other but not to the lights near the ceiling.

3. The lights below the floor should be weak and not cast shadows. Their purpose is to illuminate the horizontal faces opposite the ceiling lights, which would appear dark with only the upper lights in the scene.

4. Adjust the upper lights so that they don't wash out the scene, but don't spend too much time adjusting them, because that isn't the focus of this exercise.

5. Move the Time slider to frame 99, turn on Auto Key mode, and then select one of the upper lights.

6. Change the light's Multiplier value, and then reset it to its original value. This doesn't result in an animated change in the value, but it does place a key for the multiplier at frame 99 and cause the value to hold steady for the first 100 frames.

7. Click the color swatch in the Intensity/Color/Attenuation rollout, note the Hue value in the Color Selector dialog box, change the Hue value, and then click Close. Reopen the Color Selector dialog box, and then change the value back. Similar to the previous step, this sets a key that will hold the color value steady for the first 100 frames.

8. Repeat steps 6 and 7 for one of the instances of the lights below the floor.

9. Move the Time slider to frame 299, and then open the Light Lister.

10. Change the Multiplier for both of the lights listed to **0** (zero).

11. Select each of the color swatches in the Light Lister, and drag the Blackness and Whiteness sliders to something in the red range.

12. Close any open dialog boxes, turn off Auto Key mode, and then render the animation as a preview. The lights hold their values for the first 100 frames and then slowly turn off and turn slightly red.

Chapter 12: Creating Animations, Particles, and Dynamics

Render an animation.   Animations can often give viewers a sense of size and composition unachievable using still images. Being able to produce a quality animation can mean the difference between a project being accepted or rejected.

Master It   Place a new camera above and to the left of the building entrance. Render a 10-second animation of the camera descending and approaching the building, and set the camera to a cinematic aspect ratio.

Solution

1. Open one of the Villa Savoye scenes from this chapter.

2. Right-click in the Top viewport and zoom out so that you can see the front of the building and a good amount of area outside the building.

3. Choose Create ➢ Cameras ➢ Target from the Command panel.

4. Click in the lower-left corner of the Top viewport to place the camera, and then drag toward the building and release to place the target.

5. Rename the camera **CinematicCamera001**.

6. In the Left viewport, move the camera up until it is well above the building.

7. Click the POVt label for the existing Camera viewport, and switch that viewport to the view from the new camera.

8. Move the Time slider to frame 300.

9. Click the Auto Key button.

10. Move the camera toward the building and lower. Move the target to achieve the final animation view that you prefer.

11. Turn off Auto Key mode.

12. Click the Render Setup button in the Main Toolbar.

13. In the Common tab of the Render Setup dialog box, click the Range radio button and set the Range values to **0** and **300**, respectively.

14. In the Output Size section, select 35mm Anamorphic (2.35:1) and set the resolution to 640×272.

15. In the Render Output section, click the Files button.

16. Enter a filename and type, and then click Save and Render to close the two open dialog boxes. Additionally, you may need to address the parameters available in a settings dialog box.

17. The animation renders to the specified file.

Output a still image.   Still images have the benefit of allowing the viewer to spend time examining a particular viewpoint and a specific time. The images are generally produced at a much higher resolution than animations to create a better-quality printed image.

Master It   Use the Print Size Assistant and the Render Setup dialog box to render four images from the camera created in the previous "Master It" exercise. The images are to be 300 dpi on an 8 1⁄2″ × 11″ paper with a 1⁄4″ unprintable border around the perimeter. Repeat the process creating 150-dpi images on 30″ × 42″ paper with no unprintable area.

Solution

1. Make sure the Camera viewport is active.

2. Choose Rendering ➢ Print Size Assistant.

3. In the Print Size Wizard, make sure Custom is selected at the top of the Paper Size section, and then click the Inches option in the Choose Unit section.

4. Enter **10.5** for the Paper Width, **8** for the Paper Height, and **300** for the DPI.

5. In the Rendering section, make sure that the Save File option is checked and then click the Files button.

6. Enter a filename and file type in the dialog box that opens, and then click Save.

7. Your Print Size Wizard should look similar to the following screen shot. Click the Render Setup button in the Rendering section.
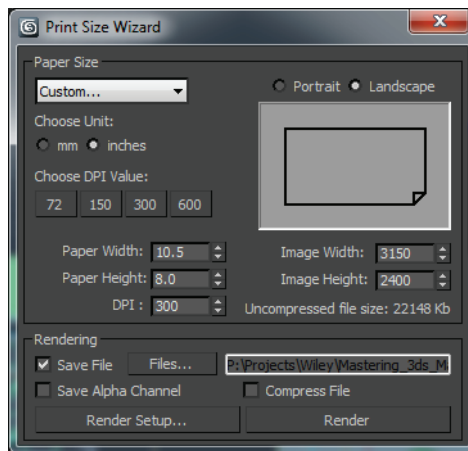
8. In the Time Output section of the Common Parameters rollout, choose the Frames option and then enter four frame numbers to render, each delineated with a comma.

9. Click the Render button at the bottom of the Render Setup dialog box.

10. The four selected frames are rendered to 10.5″ × 8″ images at 300 dpi.

11. Repeat steps 2 through 9 using **42** for Paper Width, **30** for Paper Height, and **150** for the dpi in step 4.

12. The selected frames are rendered to a 40″ × 32″ image at 150 dpi.

Render a shadow study.   Shadow studies can help determine the need for additional or reduced detail, foliage, and the effects of artwork or open ceiling designs on light patterns. Producing a shadow is often a requirement when projects involve freestanding structures.

Master It   Using the Shadowstudy.max file, change the location of the building to Cleveland, Ohio, and create images at 30-minute intervals from 6 a.m. to 9 p.m.

Solution

1. Open the `C12_Shadowstudy.max` file.

2. Use the Select From Scene dialog box to select the [Daylight01] group, and then click the Motion tab in the Command panel.

3. Select the Date, Time, And Location radio button.

4. In the Location section of the Control Parameters rollout, click the Get Location button.

5. In the Geographic Location dialog box that opens, expand the Map drop-down list and choose North America.

6. Select Cleveland OH in the City list, and then click OK.

7. In the Time section, set the Hours value to **6**.

8. Turn on Auto Key mode, and drag the Time slider to frame 600.

9. In the Time section, change the Hours value to **21** (9:00 p.m.). Turn off Auto Key mode.

10. Right-click in the Top viewport.

11. Open the Render Setup dialog box.

12. The time frame for the shadow study is 15 hours, or 30 half-hour increments. With a 600-frame available animation length, the increment between renderings is 20 (600/30).

13. In the Time Output section, select the Active Time Segment option, and then set Every Nth Frame to **20**.

14. Enter the resolution in the Output Size section.

15. Click the Files button in the Render Output section, and give the renderings a filename and type.

16. Click Render.

17. The shadow study file is rendered and saved.

Create a walkthrough.   Walkthroughs are special animations that attempt to define the animation from the point of view of an individual walking through the structure.

Master It   Assign a camera to a path that approaches the building from the front, passes through the entrance, and then turns to the left.

Solution

1. Open one of the Villa Savoye scenes from this chapter.

2. Right-click in the Top viewport and zoom out so that you can see the front of the building and a good amount of area outside the building.

3. In the Top viewport, draw a line that begins well outside the building, passes through the entrance, and then turns to the left.

4. Choose Animation ➤ Walkthrough Assistant.

5. In the Camera Creation section of the Walkthrough Assistant dialog box's Main Controls rollout, select the Free option and then click Create New Camera.

6. Make sure that the new camera is selected; then, in the Path Control section, click Pick Path and select the line that you drew in step 3.

7. Set the Eye Level parameter to **5′5″**, or whichever height you prefer, and then check the Move Path To Eye Level check box.

8. Right-click in an existing Camera viewport, and then click Set Viewport To Camera.

9. Check the scene, make any required adjustments, and then render the animation.

Choose an animation file output option. The files that you can output from 3ds Max vary greatly in their quality and file size, and you must find an acceptable compromise between the two. A 60-second-long, 1280 × 1024 AVI using no compression may be a high-quality choice, but it can result in a file several gigabytes in size that is unplayable on most older systems. The key to outputting acceptable animations is selecting appropriate file types and settings.

Master It Render 90 frames of the same animation four times, saving the output as different files. With each repetition, change the codec and/or settings; then compare the output quality and file sizes. Leave the resolution the same for all the animations.

Solution

1. From this chapter's files, open one of the Savoye scenes that had an animated camera.

2. Make the camera's viewport active; then open the Render Setup dialog box.

3. Set Time Output Range to span 90 frames.

4. In the Render Output section, click the Files button, name the file, and assign AVI as the file type.

5. Click the Setup button. In the AVI File Compression Setup dialog box, choose a compressor and quality. Leave Keyframe Rate at its default.

6. Click OK and then Save to close two of the open dialog boxes.

7. Click Render to render the scene to the specified AVI file.

8. Repeat steps 4 through 7 three times, changing the filename in step 4 and the Compressor and Quality parameters in step 5.

9. Open each of the files in Windows Media Player and compare their qualities. Look at the file sizes in Windows Explorer, and see if there is a correlation between file size and file quality.

Set up a dynamic simulation. Creating complex animations involving many collisions between scene objects can be very time-consuming and not very realistic. Using MassFX, you can assign properties to the objects involved in the animation and let 3ds Max quickly create the animation.

Master It Using the `C12_DynamicsStart.max` file, create two Teapot primitives and two OilTank extended primitives and place them a few feet above the ground. Use MassFX to animate them dropping to the floor and colliding with each other.

Solution

1. Open the `C12_DynamicsStart.max` file.

2. In the Top viewport, create two Teapot primitives and two OilTank extended primitives.

3. Move them all above the floor.

4. Select the two teapots and the two OilTank objects, and then open the MassFX Toolbar and select the Set Selected As Dynamic Rigid Body button.

5. Deselect the two OilTank objects, and then open the MassFX Tools dialog box and go to the Multi-Editor tab. Set Mass to **1.0**, and choose the Convex option in the Physical Mesh rollout.

6. Deselect the teapots, and then select the two OilTank objects. Set Mass to **1.0**, and choose the Mesh Type Capsule option.

7. Deselect the OilTank objects, select the Floor407 object; then select Set Selected As Static Rigid Body and, on the Modifier tab, set its Shape Type to Original.

8. Click the Bake All button in the Simulation Baking group.

9. Render the scene.

Create a Particle Flow event-driven particle system. Particle systems can be used for a wide variety of applications in design visualization. Any time you need to have a multitude of similar objects, you can consider using a particle system. You can create things like cars in traffic, trees in forests, pedestrians in airports, and so on. Particle systems also are useful for water in fountains or simulations of gas particles flowing through tubes.

Master It Create a particle system for a fountain. You don't actually have to create the fountain; just practice how the particles and forces can be used to generate it.

Solution

1. Reset 3ds Max 2013.

2. On the Create panel, choose Particle Systems from the drop-down list.

3. Create a PF Source in the Perspective viewport.

4. Turn on Angle Snap, and rotate the PF Source 180 degrees so it is emitting up the Z-axis.

5. Play the animation. The particles fly up into the air.

6. Create a Gravity space warp in the viewport, centered beneath the PF Source emitter.

7. Open Particle View by pressing **6** on the keyboard.

8. Adjust the emit Start and Stop values, and increase the amount. Set the emit Start and Stop so that the particles appear throughout the default 101 frames.

9. Adjust the Size and Divergence settings to create a tapered effect.

10. Add an Age test below the Shape operator. Set the age to 12 frames.

11. Create a new event, and add a Force operator to it.

12. Select the Force operator, and add the Gravity space warp to the Force operator.

13. Adjust Strength of the gravity to a low value like **0.5**.

14. Drag a Collision test after the Force operator.

15. Add a POmniFlect into the viewport to catch the falling particles. Rotate it and position it below the PF Source emitter.

16. Add the POmniFlect to the Collision test.

17. Set Bounce to **0** and Friction to **100**, so that the particles will collect on the deflector.

18. Create a camera view that looks at the particles and add a Shape Facing operator to the Event. Click the None button in the Look At Camera/Object group, and select the camera you created.

19. Add a Material Static operator to adjust the material.

20. Create a material with an opacity-mapped gradient, and assign the material via the Material Static operator.

Chapter 13: Rigging for Animation

Create parent–child hierarchies.   Creating parent–child hierarchies is an effective way to link objects together that allow any transformations applied to the parent to be transferred to the children in the link structure in order to create dynamic and interesting animations.

Master It   Create a simple hierarchy representing a sun, planet, and moon, which are parented and ready to animate with the moon orbiting the planet, and both the planet and moon orbiting the sun.

Solution

1. Reset 3ds Max to start with an empty scene.

2. Create three spheres (or geospheres) of descending size. Name them **Sun**, **Planet**, and **Moon**.

3. Create five Point helpers in the scene.

4. Name the Point helpers **Sun_POS**, **Planet_POS**, **Planet_ROT**, **Moon_POS**, and **Moon_ROT**.

5. Position all objects and Point helpers at 0,0,0.

6. Select the Planet_POS helper, and move it away from the origin on the X-axis until you get a distance away from the Sun that you like.

7. Select the Moon_POS helper, and move it on the X-axis until it is past the Planet_POS helper by about twice the diameter of the Planet object.

8. Select the Moon_ROT helper, and click the Align tool.

9. Click the Planet_POS helper as the target for the Moon_ROT helper. Select X, Y, Z, and Pivot Point for all options and click OK.

10. Select the Planet_POS helper, click the Select And Link tool, press **H** on the keyboard, and, from the Select Parent dialog box, select the Planet_ROT helper and click Link.

11. Click the Select tool, and pick the Moon_POS helper.

12. Click the Select And Link tool, press **H** on the keyboard, and, from the Select Parent dialog box, pick the Moon_ROT helper and click Link.

13. Click the Select tool, and pick the Planet_ROT helper.

14. Click the Select And Link tool, press **H** on the keyboard, select the Sun_POS helper from the Select Parent dialog box, and click Link.

15. Click the Select tool, and pick the Moon_ROT helper.

16. Click the Select And Link tool, and press **H** on the keyboard. From the Select Parent dialog box, select the Planet_POS helper and click Link.

17. Click the Select tool, and pick the Sun object.

18. Click the Select And Link tool, press **H** on the keyboard, click the Sun_POS helper from the Select Parent dialog box, and click Link.

19. Click the Select tool, and pick the Planet object.

20. Click the Select And Link tool, press **H** on the keyboard, pick the Planet_POS helper, and click Link.

21. Click the Select tool and then, with the Planet object still selected, click the Align tool, press **H** on the keyboard, select Planet_POS, and click Pick.

22. On the Align Selection dialog box, click X, Y, Z, and Pivot Point for Current and Target objects and click OK.

23. Click the Select tool, press **H** on the keyboard, select the Moon object, and click OK.

24. Click the Select And Link tool, press **H** on the keyboard, select the `Moon_POS` helper from the Select Parent dialog box, and click Link.

25. With the Moon object still selected, click the Align tool, press **H** on the keyboard, select Moon_POS helper, and click Pick.

26. Select X, Y, Z, and Pivot Point for both Current and Target objects, and then click OK.

27. Save your scene as `My_C13_MasterIt_Solution_01.max`.

You now have a small solar system consisting of a Sun, Planet, and Moon that is ready to animate.

Create a morph animation.   To create an animation of an object or creature that is not well suited to using hierarchical rigs or IK bone chains, creating morph targets and using the Morpher modifier is a way to make such things as talking characters with lip-sync techniques.

> **Master It**   When creating an animation with the Morpher modifier, what is the one requirement that must be met for the Morpher modifier to work?
>
> **Solution**   Choose the correct answer:
>
> **A.**   The base object and all morph targets must start with the name Morph.*Target.name.*
>
> **B.**   The morph targets must all have the same vertex count, and the vertex order must be the same as for the base object.
>
> **C.**   The Morpher modifier must have and use all 100 morph target channels.
>
> **D.**   You can only use the Morpher modifier on editable mesh objects.
>
> The correct answer is B.

Create a simple IK rigged hierarchy.   Rigged hierarchies that take advantage of one of the IK solvers that 3ds Max provides is a fundamental way to create models for your scenes that can be animated.

> **Master It**   Rigged hierarchies on which you want to use inverse kinematic solvers must be created only with 3ds Max bone objects. True or False?
>
> **Solution**   The correct answer is False. Rigged hierarchies that use any of the 3ds Max IK solvers can be created with any 3ds Max objects linked into hierarchies.

Create bones.   Bones can be created and linked to objects to create all manner of hierarchies to animate your models.

> **Master It**   When you create bones to build hierarchies for animating your models, the bones are set to renderable by default. True or False?
>
> **Solution**   The correct answer is False. Bones by default are visible in the 3ds Max viewports but do not render. This can be changed by selecting all the bones in your hierarchy, right-clicking in the viewport to access the quad menu, and, on the transform quad, selecting the Object Properties dialog box and then clicking the Renderable check box in the Rendering Control group of the General tab.

Create a biped.   Using the Biped feature originally brought to 3ds Max by the Character Studio plug-in is a fast and fun way to create an advanced hierarchical system for animating characters in 3ds Max.

> **Master It**   Create a biped that is 5′ 5″ tall with a female body type, five fingers on the hands, three toes on the feet, and a tail with five segments.

Solution

1. Start 3ds Max with a new empty scene.

2. Click Create ➢ Systems ➢ Biped.

3. Set Body Type to Female.

4. In any viewport, click and drag out the biped.

5. On the Create Biped rollout, set the Height to **5′ 5″**.

6. Set the Fingers value to **5**.

7. Set the Toes value to **3**.

8. Set the Tail Links value to **5**.

9. Save your scene as `My_C13_MasterIt_Solution_05.max`.

Chapter 14: Advanced Rendering Using mental ray

Apply final gathering.   Final gathering is an optional step in calculating global illumination that can reduce the appearance of unwanted variances or rendering artifacts in the lighting.

Master It   Apply final gathering to an exterior view of the Savoye project from this chapter.

Solution

1. Open `SavoyeExterior_MasterIt.max`, and save it as `MyCh14_MISol_01.max`.

2. Assign mental ray as the renderer.

3. Click the Indirect Illumination tab of the Render Setup dialog box.

4. Disable Caustics if necessary, and enable both Global Illumination and Maximum Sampling Radius.

5. Increase the Maximum Sampling Radius value to about 1′ and turn on Optimize For Final Gather (Slower GI).

6. In the Final Gather rollout, check the Enable Final Gather option and, in the Advanced group, check Draft Mode (No Precalculations).

7. Create a Daylight System, and then delete all the standard lights in the scene.

8. Do a test render.

9. Make any adjustments to the lights, deselect Draft Mode (No Precalculations), and then render the scene again.

10. Save your scene.

Create a contour rendering. Contour renderings display dark strokes along the contours of a scene's objects. This is an effect caused by using the mental ray Contour shaders and the parameters in the Camera Effects rollout.

Master It Using the same techniques covered in this chapter, create a contour rendering of the interior of a condo scene.

Solution

1. Open the `CondoContours.max` scene.

2. Assign the mental ray renderer to the scene.

3. In the Render Setup dialog box's Renderer tab, enable the Contours option in the Camera Effects rollout.

4. Click the Contour Output button.

5. In the Material/Map Browser that appears, click the Contour Only shader. Click OK to close the Material/Map Browser.

6. Open the Compact Material Editor, and then drag the shader from the Contour Output button to a sample slot. Choose Instance in the Instance (Copy) Map dialog box that appears.

7. Click the Background Color swatch in the Contour Only Parameters rollout in the Compact Material Editor, and then set the color to white.

8. Drag the shader from the Contour Contrast button from the Render Setup dialog box to a sample slot in the Compact Material Editor. Make this an instance as well.

9. Lower the Angle Step Threshold parameter in the Compact Material Editor.

10. Select another unused sample slot. Rename the material **ContourOverride**. Change the Diffuse Color to white.

11. In the white material's mental ray Connection rollout, click the Contour button in the Advanced Shaders area, and then select the Contour Simple shader from the Material Map Browser.

12. Reduce the Width (%) value in the Compact Material Editor.

13. Create and position a camera or press Ctrl+C in the Perspective viewport to create a camera from that view.

14. Go to the Processing tab on the Render Setup dialog box, and enable the Material Override setting. Then drag the ContourOverride material from the Compact Material Editor into the Material button of the Material Override area of the Render Setup dialog box and choose Instance.

15. Render the Camera viewport.

The viewport renders and then displays the contours. Your rendering should look similar to the following image.

16. Save your scene.

Use the Multi/Sub-Map material. Creating a large number of unique maps to apply to repetitive objects in a scene to add a sense of variation or randomness can take a lot of effort. The Multi/Sub-Map material allows you to create one material with a number of internal variations that you can apply to objects in your scene to achieve that sense of natural randomness.

Master It Create a 25 × 25 array of 1' radius spheres, offset 3' from each other, with a single material that will randomly change the color of the spheres through the use of the mental ray Multi/Sub-Map material.

Solution

1. Reset 3ds Max 2013.

2. Create a 1' radius sphere primitive near the World Origin.

3. Open the Material Editor, and select an unused material sample.

4. Click the Map button for the material's Diffuse color channel.

5. Select the Multi/Sub-Map material, and set the Switch Color/Map Based On Value option to Random.

6. Apply the material to the sphere.

7. Click the Array button on the Extras toolbar.

8. Use the Array dialog box to create a 25 × 25 array, offsetting the spheres so that they don't overlap.

9. Adjust the Perspective viewport so that you can see the entire array.

10. Render the Perspective viewport.

The Perspective viewport renders, showing you the array of spheres with the colors from the Multi/Sub-Map feature randomly applied to the different spheres.

11. Save your scene.

Use Skylight global illumination. Global illumination can enhance the appeal of a scene by simulating bounced light. This can include the color bleeding effect where color is transferred from one surface to another.

Master It Add global illumination to an exterior shot of the Villa Savoye.

Solution

1. Open `SavoyeExterior_MasterIt_04.max`.

2. Create a new camera that views the exterior of the building.

3. On the Environment tab of the Environment And Effects dialog box, change the Ambient value to **0**.

4. Assign the mental ray renderer to the scene.

5. Under the Lights category of the Create tab of the Command panel, select Standard from the drop-down menu and click the Skylight button.

6. Place a Skylight on the ground outside the building.

7. Change the sky color by clicking the Sky Color swatch in the Skylight Parameters rollout.

8. Choose a pale magenta color.

9. Render the scene.

10. Save your scene.

Use mr Proxy objects. Using mental ray Proxy objects in scenes that require a considerable number of identical high-poly objects can save you significant file size, system resources, and render time.

Master It Create and render a 25 × 50 array of mr Proxy teapots using an eight-segment teapot as the source object.

Solution

1. Reset 3ds Max 2013.

2. In the Top viewport, create a teapot primitive and set Segments to 8.

3. From the Create tab of the Command panel, select Geometry from the mental ray list of objects.

4. Click the mr Proxy button.

5. Click and drag in the Top viewport to create the Proxy object.

6. With the mrProxy001 object selected, click the Modify tab of the Command panel.

7. In the Source Object group, click the None button and then click the Teapot001 object.

8. In the Proxy File group, click the Write Object To File button.

9. In the Write mr Proxy File dialog, name the Proxy object and click Save.

10. Click OK to accept the mr Proxy Creation dialog box settings.

11. Select and delete the Teapot001 object.

12. Using the Array tool from the Extras toolbar, create an array of your mrProxy teapots — 25 across and 50 deep.

13. Click in the Perspective viewport to set up a view you like.

14. Render the scene.

15. Save your scene as **MyTeapotParade.max**.

Use IES files.   Using Photometric Web distribution files for your photometric lights can greatly increase the realism and accuracy of your final rendered images.

> **Master It**   Using the MymentalrayIESLighting.max file you saved near the end of the chapter, change the light distribution type of PhotometricLight001 from Uniform Diffuse to Photometric Web, and select the cooper.ies file. Then render the scene.
>
> **Solution**
>
> 1. Open the MymentalrayIESLighting.max file.
>
> 2. Render the Camera001 viewport, and then minimize the RFW window.
>
> 3. Select PhotometricLight001.
>
> 4. Click the Modify tab, and scroll down to the Shape/Area Shadows rollout.
>
> 5. Click the Emit Light From (Shape) drop-down button, and change it to Point.
>
> 6. Click the Light Distribution (Type) drop-down menu, and select Photometric Web.
>
> 7. In the Distribution (Photometric Web) rollout, click the < Choose Photometric File > button.
>
> 8. Browse to the 3ds Max \sceneassets\photometric folder, and select a different IES file. Adjust the Exposure Control if necessary.
>
> 9. Restore the RFW window, and click Clone Rendered Frame Window.
>
> 10. Click the Render button on the Reveal toolbar, and compare this rendering to the previous rendering you did with this file.
>
> 11. Save your scene as **MymentalrayIESLighting2.max**.

Chapter 15: Finishing It Off: Atmosphere, Effects, and Compositing

Add an atmospheric effect.   Atmospheric effects add the appearance of particulate matter in the air. With them, you can represent volumetric lights, fog, smoke, clouds, and even fire.

Master It Add a second fog to the `My_VolumeEffects_A.max` file with a bottom just below the top of the building's overhang and the top 6' above that. Give the fog a purple color, and make sure the fog is not a straight line at the horizon.

Solution

1. Open the `My_VolumeEffects_A.max` file.

2. Open the Environment tab of the Environment And Effects dialog box.

3. Click the Add button, and then add a second Fog atmospheric effect to the scene.

4. In the Fog section of the Fog Parameters rollout, click the Fog Color swatch and then select a purple color from the Color Selector that opens.

5. Click the Layered radio button.

6. Set the Bottom value to **16'** and the Top value to **22'**.

7. Click the Horizon Noise check box.

8. Render the scene.

Add an effect using Hair And Fur. Hair And Fur is a rendering effect that appears to add strands to an object at rendering. These strands can look like long, thin hair; short, thick fur; or even grass.

Master It Zoom into the tree in the `C15_Grass.max` file. Create a mound that rises out of the ground and covers the base of the tree. Use Hair And Fur to add grass to the mound so that it appears to be caused by a root ball under the lawn.

Solution

1. Open the `C15_Grass.max` file.

2. In the Top viewport zoom into the base of the tree that you see in the Camera001 viewport.

3. Create a large sphere at the base of the tree. Use the Hemisphere parameter and the Select And Move tool to reduce the volume of the sphere by chopping off most of the portion that remains underground, and move it into place.

4. Convert the sphere to an editable poly, and then delete the polygons at the flat bottom of the sphere.

5. Add a UVW Map modifier to the sphere, deselect Real-World Map Size, and choose Spherical as the Mapping type.

6. In the Material Editor, get the material from the ground and assign it to the sphere.

7. From the Modify panel, add the Hair And Fur (WSM) modifier to the sphere.

8. Set Scale to approximately **20**.

9. In the Material Parameters rollout, click the gray button next to the Root Color parameter and then choose the Scene Materials rollout in the Material/Map Browser.

10. Double-click the `Grass2.jpg` map listed, choose Instance in the Instance Or Copy? dialog box, and then click OK.

11. Render the scene.

Add the Glare effect to a rendering. Glare is an effect that is seen in real-world cameras when the intensity of the lights or reflections/refractions captured by the camera causes the light to reflect/refract within the film emulsion or on the surface of a sensor.

> **Master It** Open the `TableTop_Glare.max` file. Add the Glare camera shader, and render the Camera002_CoffeeTable viewport.
>
> **Solution**
>
> 1. Open the `MyTableTop_Glare.max` file.
>
> 2. Click the Render Setup button.
>
> 3. On the Renderer tab, scroll down to the Camera Effects rollout and the Camera Shaders group.
>
> 4. Click the Output shader button.
>
> 5. From the Material/Map Browser, open the Maps ➢ mental ray rollout.
>
> 6. Select the Glare shader and click OK.
>
> 7. Open the Slate Material Editor.
>
> 8. Drag the Glare shader to the View1 window in the Slate Material Editor, select Instance, and click OK.
>
> 9. Right-click the Glare shader node, and select Expand Additional Params.
>
> 10. Adjust the Quality, Spread, and Resolution For Glare Processing options, and then close the Slate Material Editor. Save your scene. Render the scene.

Use DOF / Bokeh. Depth of field is the result of using a camera with a large aperture setting during the image exposure. The effect is seen in real-world cameras, and often a rendering will appear much more realistic when there is some DOF in the image.

> **Master It** Continue with the `TableTop_Glare.max` file from the previous exercise. Add the Depth Of Field / Bokeh shader, and render the Camera002_CoffeeTable viewport. Using Glare and DOF with good sampling settings will make the rendering take quite a while.
>
> **Solution**
>
> 1. Continue with the `TableTop_Glare.max` file.
>
> 2. Click the Render Setup button to open it if necessary.
>
> 3. On the Renderer tab, scroll down to the Camera Effects rollout and the Camera Shaders group.
>
> 4. Click the Lens shader button.

5. From the Material/Map Browser, open the Maps ➢ mental ray rollout.

6. Select the Depth Of Field / Bokeh shader and click OK.

7. Open the Slate Material Editor.

8. Drag the Depth Of Field / Bokeh shader to the View1 window in the Slate Material Editor, select Instance, and click OK. You can leave the Glare shader in the View1 window.

9. Double-click the Depth Of Field / Bokeh shader to access its properties in the Parameters Editor.

10. Adjust the Focus Plane setting so that its distance will make an object in the image the focal point.

11. Change Blade Count to **7**.

12. Increase Samples to **8**.

13. Save your scene.

14. Render the scene.

Create stereo-pair images.   Stereo 3D images are incredibly popular again, even in the architectural and engineering industries. As a visualization specialist, the odds are very high that you will encounter situations where you need to take a scene and render it for stereo viewing.

Master It   Using the `TableTop_Stereo_01.max` file, create an additional camera for the right eye with a 2.5″ intraocular distance, and then render the two cameras using the Batch Render command.

Solution

1. Open the `Tabletop_Stereo_01.max` file.

2. In the Top viewport, zoom in and select the Camera002_CoffeeTable camera.

3. Clone the camera as an instance, and name the new camera **Camera002_CoffeeTable_R**.

4. With the new camera still selected, choose the Select And Move tool.

5. Change the Reference Coordinate System to Local.

6. In the Absolute Transform Type-In, move the new camera 2.5 inches along the X-axis.

7. On the Rendering menu, select Batch Render.

8. Add two views to the task queue.

9. Select the View01 item, and change the Camera to Camera002_CoffeeTable.

10. Set Output Path to the folder where you have been working on the Chapter 15 files, set the filename to **Camera002_CoffeeTable_L.tif**, set Save As Type to TIF Image File, and accept the default TIF Image Control settings.

11. Select View02 from the task queue, and set Camera to Camera002_CoffeeTable_R, Output Path to the correct folder, and the filename to `Camera002_CoffeeTable_R.tif`. Set Save As Type to TIF Image File, and accept the default TIF Image Control settings.

12. Click the Render button to render both images.

Create render passes for compositing. Productions are often finished in compositing applications, such as Autodesk Composite, because slight changes and adjustments can be accomplished much easier by adjusting render elements (passes) than by repeatedly adjusting parameters and re-rendering frames in 3ds Max.

> **Master It** Use 3ds Max to generate Material ID, Z Depth, Velocity, and Lighting Render Elements that can be loaded into Autodesk Composite for finishing an image or image sequence.
>
> **Solution**
>
> 1. Open the `C15_Stereoscopic.max` file, and save it with a new name before proceeding with the exercise.
>
> 2. Open the Compact Material Editor.
>
> 3. Create a new Standard material, and name it **Corridor_Doors**.
>
> 4. Click the Material ID channel button, and select 7.
>
> 5. Apply the Corridor_Doors material to the Door_Right and Door_Left objects in the scene.
>
> 6. Click Render Setup.
>
> 7. On the Render Setup dialog box, click the Render Elements tab.
>
> 8. Click the Add button and, from the Render Elements dialog, select Lighting, Material ID, Velocity, and Z Depth.
>
> 9. Click OK to close the Render Elements dialog.
>
> 10. Select each render element displayed, and click the Enable Filtering check box.
>
> 11. Select the Z Depth Render Element, and set the Z Min value to **13′** and the Z Max value to **67′**.
>
> 12. Click the Common tab of the Render Setup dialog, click the Files button in the Render Output group, and browse to where you are saving your Chapter 15 files.
>
> 13. Name the file `MI_RenderElements.exr`, and select the OpenEXR Image File format from the Save As Type drop-down menu.
>
> 14. Set the Gamma to Override 1.0 and click Setup.
>
> 15. In the OpenEXR Configuration dialog box, click the Automatically Add/Remove Render Elements From Render Dialog check box and click OK.
>
> 16. Click Save to close the Render Output File dialog.
>
> 17. Move the time slider to frame 15 where the doors are almost completely open.

18. Save your scene so that you don't lose any work if 3ds Max crashes during the render-
    ing process.

19. Make sure the Camera001 viewport is active, and click the Render button to start
    rendering.

20. When the rendering process finishes, four additional RFWs open, showing you the
    render elements you selected. Take time to study each render element before closing
    the RFWs.

Import Images into Autodesk Composite 2013.   Modeling, lighting, texturing, and ren-
dering your images from 3ds Max are just the beginning of creating a final image or video
project. Often additional elements or tweeks are needed to really make an image or video
feel finished. Actions such as color balancing, adjusting contrast, adding titles, or composit-
ing additional layers can be accomplished in programs like Adobe Photoshop, Premiere, or
AfterEffects. 3ds Max 2013 comes with the Autodesk Composite application, which can help
you finish most of those tasks without having to purchase additional software.

> **Master It**   Use Autodesk Composite to import a rendering that you want to adjust to cre-
> ate your final image.
>
> **Solution**
>
> 1. Save your work in 3ds Max, and close the program. Then start Autodesk Composite.
>
> 2. Create a new composition called **MyMasterItComposition** and save the file in your
>   working directory.
>
> 3. Click File ➤ Import to open the File Browser dialog box.
>
> 4. Use the Folders window to navigate to your working directory for this chapter's files.
>
> 5. Find the **MI_RenderElements.exr** file you rendered in one of the previous Master It
>   problems from this chapter and select it.
>
> 6. Right-click on the MI_RenderElements.exr file and from the context menu select
>   Import All Channels.
>
> 7. Close the File Browser.
>
> 8. You have imported the OpenEXR formated rendering and all the Render Elements
>   channels that you created with the rendering. Now you can use Autodesk Composite
>   to adjust the image to your liking, add film grain, or apply some color or contrast
>   adjustments before outputting your final image.
>
> 9. Save your Composition.

Composite the stereo pair into an anaglyph image.   Once you have stereo-pair images, you
need to combine them into one image that you can look at with red-blue anaglyph glasses.

> **Master It**   Use Autodesk Composite to take the two images you rendered in one of the
> previous "Master It" exercises, and render out a single anaglyph stereo image.

Solution

1. Save your work in 3ds Max, and close the program. Then start Autodesk Composite.

2. Create a new composition called **TableTop**, and save it in your working directory.

3. Import the stereo-pair images. If you would like you can use the stereo-pair images with the _POKE suffix, these images have an object in the scene that is placed to stick out of the image frame.

4. From Pixel Expressions, add a PXL operator to the composition panel.

5. Select the PXL operator, and load the Stereo Anaglyph preset.

6. Connect the _L image to the In slot of the Stereo Anaglyph operator, and then connect the _R image to the RightImage slot.

7. Select the Stereo Anaglyph operator and change Method to **2**.

8. Connect the output of the Stereo Anaglyph operator to the Output node.

9. On the Composition tab, change the Format to Custom, the Width to **640**, and the Height to **480**.

10. Click the Output node and then, on the Output tab, change the pixel Depth to 8 Bits.

11. On the Output tab, change the End value to **2**.

12. On the Render tab, change the file format to TIFF and the folder to your working folder.

13. Choose File ➢ Render.

14. Verify the destination folder and filename.

15. Click the Start button.

16. View your rendered anaglyph stereo image with red/blue glasses and enjoy.

Appendix B

Autodesk® 3ds Max® Certification

Autodesk certifications are industry-recognized credentials that can help you succeed in your design career—providing benefits to both you and your employer. Getting certified is a reliable validation of skills and knowledge, and it can lead to accelerated professional development, improved productivity, and enhanced credibility.

This Autodesk Official Training Guide can be an effective component of your exam preparation for the Autodesk® 3ds Max® 2013 certification exam. Autodesk highly recommends (and we agree!) that you schedule regular time to prepare, review the most current exam preparation roadmap available at www.autodesk.com/certification use Autodesk Official Training Guides, take a class at an Authorized Training Center (find ATCs near you here: www.autodesk.com/atc), take an assessment test, and use a variety of resources to prepare for your certification—including plenty of actual hands-on experience.

To help you focus your studies on the skills you'll need for these exams, Table B.1 shows the objective and in what chapter you can find information on that topic—and when you go to that chapter, you'll find certification icons like the one in the margin here. You are encouraged to learn all of the objectives, however, the objectives that are shown in bold in the table are most likely to appear on the exam.

At publication time, Autodesk was in the process of finalizing the objectives and the exam for 3ds Max 2013.

Please refer to www.autodesk.com/certification for the most current exam roadmap and objectives.

Good luck preparing for your certification!

> **NOTE** You are encouraged to learn all of the objectives, however, the objectives that are shown in bold in the table are most likely to appear on the exam.

TABLE B.1:   3ds Max 2013 Exam Objectives

TOPIC	EXAM OBJECTIVE	CHAPTER OR APPENDIX
Animation	Analyze the animation of an object using the Curve Editor	Chapter 11
	Change interpolation methods	Chapter 11
	Create a path animation and evaluate an object along the path	**Chapter 12**
	Differentiate Dope Sheet from the Curve Editor	Chapter 11

	Explain how to edit tangents with the Curve Editor	Chapter 11
	Identify Controller types	**Chapter 11**
	Identify playback settings	**Chapter 1**
	Identify the constraint used for an animation	Chapter 12
	Locate the value of keys in the Time Slider	**Chapter 11**
	Use animation passes and animation editors	Chapter 11
Cameras	**Differentiate camera types**	**Chapter 9**
	Edit FOV (Field of View)	**Chapter 9**
	Explain Near and Far Clip Plane for your camera	Chapter 9
Compositing	Demonstrate how to composite multiple layers together	Chapter 15
	Demonstrate how to remap the color output for an image	Chapter 15
Data Management / Interoperability	**Differentiate common file types and usages**	**Chapters 5, 12**
	Use the import feature to import model data	**Chapter 5**
Dynamics / Simulation	Use modifiers for soft body simulation	Chapter 12
Effects	Identify an atmosphere effect	Chapter 15
	Identify an event	Chapter 12
	Identify particle systems	Chapter 12
	Identify Space Warp types	**Chapter 12**
Lighting	**Compare Attenuation and Decay**	**Chapter 7**
	Differentiate light functions in a scene	Chapter 7
	Identify parameters for modifying shadows	Chapter 7
	Use the Daylight System	Chapter 7
	Use the Light Lister	Chapter 7
Materials / Shading	Identify Shader parameters	Chapter 8

	Identify standard materials	**Chapter 8**
	Use Blending Modes	Chapter 8
	Use the Material Editor	**Chapter 8**
Modeling	**Differentiate reference coordinate systems**	**Chapters 1, 2**
	Differentiate workflow	**Chapter 2**
	Identify Clone types	**Chapter 2**
	Identify Vertex types	**Chapter 3**
	Use object creation and modification workflows	**Chapter 2**
	Use polygon modeling tools	**Chapter 4**
	Use ProBoolean	**Chapter 4**
Rendering	**Differentiate Renderers**	**Chapter 12**
	Identify pass types	Chapter 15
	Identify rendering parameters	**Chapter 12**
	Use Render to render an effect pass	Chapter 15
Rigging / Setup	Describe common Biped features	Chapter 13
	Identify Bones	Chapter 13
	Identify Controller usage	Chapter 13
	Identify IK Solvers	Chapter 13
	Use Weight Table	Chapter 13
Scripting	**Apply (run) Scripts**	**Bonus Appendix 1**
	Describe common use of scripts	Bonus Appendix 1
UI / Object Management	**Describe and use object transformations**	**Chapter 1**
	Identify Selection Regions	**Chapter 1**
	Describe View configuration and ViewCube navigation	**Chapter 1**

Index

Note to the Reader: Throughout this index **boldfaced** page numbers indicate primary discussions of a topic. *Italicized* page numbers indicate illustrations.