Lightscape™

Lightscape Visualization System™ Version 3 for Windows NT™ and Windows® 95

Tutorials

Lightscape Visualization System Version 3
for Windows NT and Windows 95, Tutorials
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Preface

The Lightscape Visualization System manuals are comprehensive documents that contain all the information you need to learn and use Lightscape efficiently and effectively.

There are three Lightscape Visualization System manuals:

- The *Lightscape Visualization System Getting Started* guide describes the basic concepts of the Lightscape technology and process, how to install and authorize the software, and the fundamentals of the user interface.
- The *Lightscape Visualization System User's Guide* provides in-depth explanations of the techniques and concepts required to set up, process, and render a Lightscape solution.
- The *Lightscape Visualization System Tutorials* provide step-by-step examples of the procedures discussed in the User's Guide.

The following information is available online in the Lightscape On-line Help:

- The Task List provides step by step "How to" instructions for performing the procedures discussed in the User's Guide.
- The Reference Guide provides detailed explanations of each menu in the Lightscape interface.

Conventions Used in This Book

Before you start using your Lightscape application, you should be familiar with the typographical conventions used in this manual.

Table 1. *Lightscape Typographical Conventions*

Convention	Type of Information
Boldface	Used for program commands, such as **lid2cibse** or **lid2ies**.
Italic	Used for emphasis and when a new term is introduced.
`Monospace`	Used for what you see on your screen such as field syntax and macro listings, and unspecified information, such as suggested syntax and macro samples that you need to provide. This typeface is shown in Courier. For example, if the manual says your batch file should read: `lsray -aa 4 -vf view1.vw -x 1280 -y 1024 solution1.ls image1.tif`, you would see that text in your batch file.
`Bold monospace`	Used for specific text you enter. This typeface is shown in Courier bold. For example, if the instruction says "type **`cd projects`**," you would type the letters **`cd`** followed by a space and then type projects. This typeface is also used for keys that you press on the keyboard, either singly (for example, **`Enter`**, **`Return`**, **`Esc`**) or in combination (for example **`Ctrl+C`**).
`Bold Italic monospace`	Used for place holders for items or filenames you must provide. This typeface is shown in Courier bold italic. As in the previous example, if the instruction says "type **`cd`** ***`directory_name`***," you would replace ***`directory_name`*** with the name of the directory. For a directory called "projects", you would type **`cd projects`**.
News Gothic typeface	Used for things that you click, such as buttons and icons, or that you choose from pulldown menus and their rollover menus. For example, click Accept; choose New from the File menu.
>	The > symbol indicates that you are to choose an item from a pulldown menu or rollover menu. For example, File > Parameters > Load means that you are to choose Load from the Parameters rollover menu of the File menu.

Introduction

The tutorials in this book provide a map of the Lightscape process. After completing the tutorials, you will understand the basic concepts of the Lightscape Visualization System and will have the skills you need to use the software effectively.

This book contains the following tutorials:

- *Tutorial 1, Getting Started - A Typical Workflow*

  Introduces you to the main concepts of the Lightscape Visualization System.

- *Tutorial 2, Fundamentals - Importing DXF Files*

  Introduces you to importing geometry from a CAD or modeling application. Using a DXF file, you will go through the steps you would take when working with a model in this format, including defining realistic materials and lights.

- *Tutorial 3, Exterior Models - Importing 3D Studio*

  Teaches you how to import a 3D Studio model and what steps to follow for preparing files from 3D Studio. Using the exterior model, you will set parameters and process it in a slightly different way. At the end of the tutorial, you will preview the animation imported with the 3DS file.

- *Tutorial 4, Importing, Setting Up, and Rendering*

  Teaches you advanced DXF import techniques and specialized preparation tasks such as orienting surfaces and placing and aligning textures. You will also create an animation and produce frames of the first segment of the animation.

- *Tutorial 5, Advanced Lightscape Topics*

  Teaches you how to join the model files, which you created in the preceding tutorials, to create a single solution file. You will also optimize one of the models by converting selected radiosity mesh elements into texture maps and exporting the data to VRML format.

These tutorials include procedures that range from basic to advanced. They are constructed around the task of rendering a model. To complete the model, you must complete the tasks in each lesson.

In these tutorials, a procedure that you perform is indicated by a triangle symbol (▶), followed by a functional description of that procedure.

Before undertaking these tutorials, you should read through the *Lightscape User's Guide*. This guide contains comprehensive information on all of the program features.

How the Tutorials Are Organized

Tutorial 1, Getting Started - A Typical Workflow contains the following sections, each of which contains one or more lessons:

- "How Tutorial 1 is Organized"
- "Lightscape Project Overview"
- "Importing Data"
- "Understanding the Lightscape Interface"
- "Preparing Data"
- "Creating the Solution"
- "Fine Tuning the Solution"
- "Outputting the Results"
- "Going Further"

Tutorial 2, Fundamentals - Importing DXF Files contains the following sections, each of which contains one or more lessons:

- "How Tutorial 2 is Organized"
- "Getting Data"
- "Importing DXF Files"
- "Preparing Data"
- "Organizing Data"
- "Lighting Basics"
- "Material Basics"
- "Creating the Solution"
- "Refining the Solution"
- "Outputting the Results"
- "Lighting Analysis"
- "Going Further"

Tutorial 3, Exterior Models - Importing 3D Studio contains the following sections, each of which contains one or more lessons:

- "How Tutorial 3 is Organized"
- "Getting Data"
- "Preparing Data"

- “Creating the Solution”
- “Outputting the Results”
- “Going Further”

Tutorial 4, Importing, Setting Up, and Rendering contains the following sections, each of which contains one or more lessons:

- “How Tutorial 4 is Organized”
- “Getting Data”
- “Preparing Data”
- “Creating a Solution”
- “Fine Tuning the Solution”
- “Outputting the Results”
- “Going Further”

Tutorial 5, Advanced Lightscape Topics contains the following sections, each of which contains one or more lessons:

- “How Tutorial 5 is Organized”
- “Getting Data”
- “Preparing Data”
- “Outputting the Results”

The following shows a typical tutorial lesson page.

Stage Name
(For example,
Preparation Stage)

Lesson Name
(For example, Working with Blocks)

▶ **Next procedure you will execute...**

A functional description of this procedure.

1. The first step of the procedure.

2. The next step of the procedure, and so on.

Tutorial 1 Getting Started – A Typical Workflow

In this tutorial, you will be introduced to main concepts of the Lightscape Visualization System by completing a short project from start to finish.

The goal of this tutorial is to render the model used to create the image shown in Figure 1-1.

Figure 1-1. *Sample of Rendered Image for Tutorial 1*

How Tutorial 1 is Organized

This tutorial contains the following sections and lessons:

Lightscape Project Overview

Although Lightscape projects vary in complexity and focus, you will generally perform the following tasks:

- “Importing Data”
- “Preparing Data”
- “Creating the Radiosity Solution”
- “Fine Tuning the Solution”
- “Outputting the Results”

Importing Data

Lightscape imports 3D models which are then rendered using the software. These models are generally created in specialized CAD or 3D modeling systems.

Lightscape for Windows NT and Windows 95 provides import filters for DXF, 3D Studio, and SOFTIMAGE formats. As additional filters become available, these filters will plug seamlessly into the existing Lightscape interface.

Preparing Data

During the Preparation stage, you perform a number of specific tasks to prepare geometric data for radiosity processing. These tasks include:

- Defining the materials that comprise the surfaces.

  Because Lightscape is based upon the physics of Lighting, accurately representing the material properties of the surfaces in your model is important for achieving meaningful results.

- Ensuring that the surfaces of the model are properly oriented.

- Setting special processing parameters for the surfaces in the model.

  These special properties can effect the final appearance of the model and the speed and accuracy of the radiosity process.

- Defining the photometric properties (lighting distribution, intensity, and color) of the luminaires (lighting fixtures) used in the model.

  Lightscape uses physically based lighting values to define the artificial light sources and natural light.

- Adding, deleting, and moving entities and luminaires as desired.

The model structure used during this stage is called the Lightscape Preparation Model and it is saved to a Lightscape Preparation (`.lp`) file.

Creating the Radiosity Solution

Once you have defined the material and lighting characteristics of the model, you can then start calculating the direct and indirect diffuse lighting of the model using the *radiosity process*. (For a good introduction to the concepts of radiosity and lighting, refer to *Chapter 1, The Basics* in the *Lightscape Getting Started* manual.)

During this part of the process you will:

- Initiate the geometry.

  This optimizes the model for the radiosity process.

- Define the processing parameters.

  Using the processing parameters, you can control the speed and quality of the resulting radiosity solution. Finer settings produce more accurate solutions and better quality images, but require more time and memory. Lightscape provides a wizard that lets you set the process parameters quickly and easily.

- Process the radiosity solution.

The model structure used during this stage is called the Lightscape Solution Model and it is saved to a Lightscape Solution (`.ls`) file.

Fine Tuning the Solution

In Lightscape, you can interrupt the radiosity process at any time to alter or fine tune the model's appearance. You cannot change the physical shape of the model, but you can change the characteristics of a material and the photometric properties of a luminaire.

Outputting the Results

You can output results from a radiosity solution in many ways:

- Create single images.

  You can add specular (shiny) reflections and enhanced lighting effects using the post-process ray-tracer.

- Create frames for use in animation.

  You can create camera animation paths in Lightscape or import them from other programs. Individual frames can quickly be rendered with OpenGL using the radiosity solution alone or rendered with ray tracing to add specular lighting effects.

- Export the radiosity solution as a VRML model for use in other applications.

Importing Data

In this exercise, you will perform the following tasks:

- "Starting Lightscape"
- "Opening a File"

Starting Lightscape

Start Lightscape.

Note: If you launched this tutorial from the installation program, you can skip ahead to "Understanding the Lightscape Interface" on page 11.

1. In the Lightscape Visualization System window group, double-click the Lightscape icon.

   If you are running Windows NT 4.0 or Windows 95, you can also start Lightscape by choosing it from the Start menu.

   The Lightscape graphical user interface displays on the screen.

Opening a File

Load a Preparation file.

The Preparation file for this tutorial has already been set up for you.

1. Choose File > Open.

   The Open dialog box appears. Note that the Files of Type should be set to Preparation Files (*.lp).

2. Double-click the file `tutorial1.lp`.

   If `tutorial1.lp` does not show up on the list, you should confirm that your current directory is:

   `c:\Program Files\lvs\projects\tutorial1`

   This path assumes that you performed a typical installation. You will have to adjust the path if you installed the application to a different location.

   Lightscape displays a small gallery with a number of light sources and picture frames on the walls.

Understanding the Lightscape Interface

This section introduces you to the Lightscape interface by discussing:

- "Screen Layout"
- "Graphic Window"
- "Using the Mouse"
- "Preparing Data"
- "Layers Table"
- "Materials Table"
- "Blocks Table"
- "Luminaires Table"

Screen Layout

The Lightscape interface, illustrated in Figure 1-2, consists of views into the five major components that make up the Lightscape model.

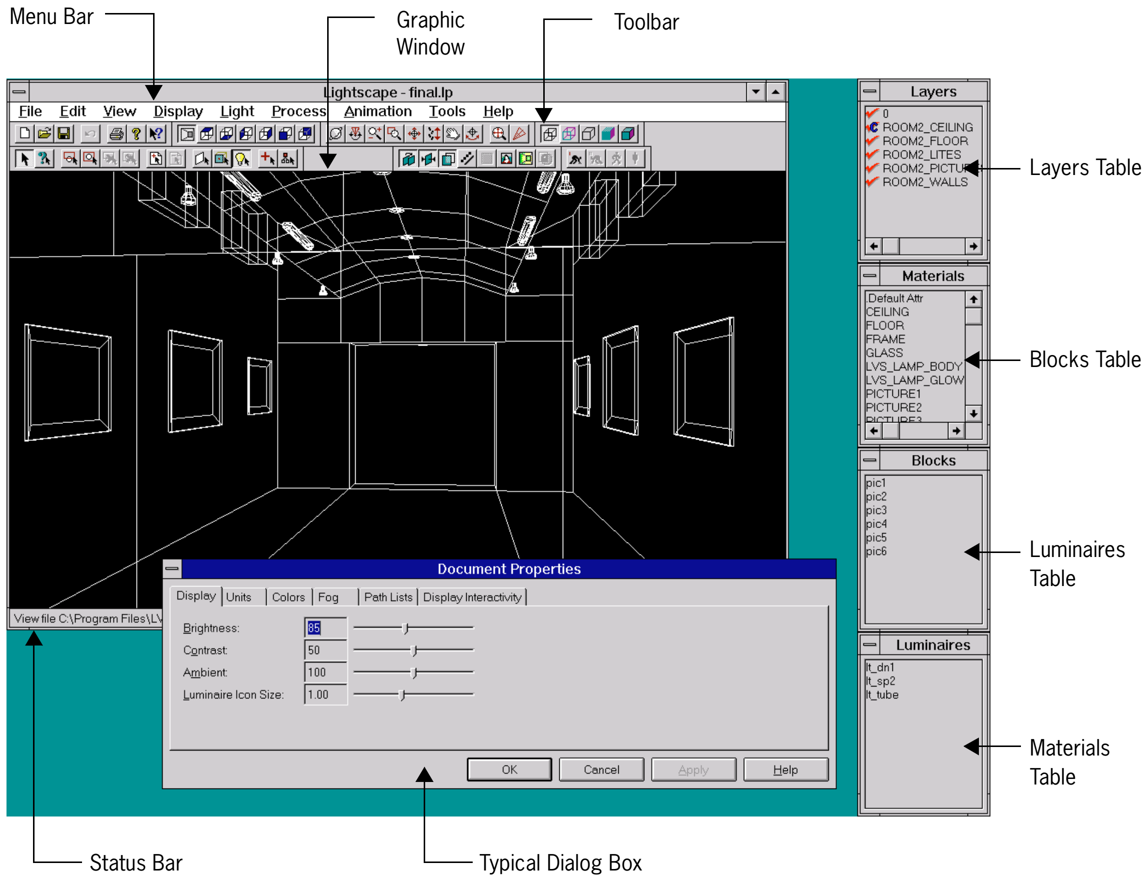


Figure 1-2. *The Lightscape Interface*

The largest is the Graphic Window. This is located, by default, on the left side of the window and occupies the majority of the screen. The four other components, the Layers, Materials, Blocks, and Luminaires Tables, are grouped together in a vertical bar of list windows on the right side of the screen. You can reposition and resize all of these windows as required.

You can find editing commands in a variety of locations—by using the pulldown menus on the Lightscape menu bar, by clicking the appropriate icon in a toolbar, or by bringing up a context menu with the right mouse button.

As you choose editing commands, additional dialog boxes pop up as appropriate.

Graphic Window

The Graphic Window is used to display and edit the geometry of the current model.

Using the Mouse

Lightscape is designed for a two-button mouse. The left button is the action button. The right button is used to bring up a context menu based on the current selection.

Using the Left Mouse Button

When you move the mouse and press the left button in the Graphic Window, Lightscape performs one of several actions, depending on the currently selected mouse mode. There are four general mouse modes:

- *Query Mode* - Clicking an entity in the Graphic Window displays information about that entity in the status bar.
- *Select Mode* - Use the mouse to select entities in the model.
- *Dynamic View Modes* - When you select a dynamic view mode such as orbit or rotate, dragging the mouse in the Graphic Window dynamically changes the display of the model in the window.

- *Special Selection Modes* - Certain functions in Lightscape will require you to perform specialized operations using the mouse. These include operations such as dragging an object to reposition it or selecting a point on a surface to indicate where you would like to aim a luminaire. The special mouse modes are typically set from the dialog box related to the functions being performed.

Using the Right Mouse Button

Clicking with the right mouse button in any window brings up a *context menu*; a popup menu that contains commands appropriate to the current window or to the entities selected in it. For example, clicking the right mouse button in the Graphic Window when a surface is selected brings up a context menu that contains commands that can only be performed on surfaces.

Layers Table

Each entity in Lightscape is associated to a layer and the Layers Table displays the names of these layers. A check mark to the left of the layer name indicates that the layer is on and that the entities associated to it are currently being displayed in the Graphic Window. Double-clicking a layer name toggles its state on/off. For more detailed information, refer to *Chapter 1* in the *Lightscape User's Guide*.

Materials Table

The Materials Table contains all of the materials currently available for use in the model. Double-clicking a material name activates the Material Properties dialog box which contains tools for editing the characteristics of the material. For more detailed information, refer to *Chapter 1* in the *Lightscape User's Guide*.

Blocks Table

The Blocks Table contains all of the blocks available for use in the model. A block in Lightscape is a group of entities that is given a common name and an insertion point. Double-clicking a block name isolates the block for display and editing in the Graphic Window. You can also enter and end isolate mode using the context menu. For more detailed information, refer to *Chapter 1* in the *Lightscape User's Guide*.

Luminaires Table

The Luminaires Table contains all of the luminaires available for use in the model. A luminaire is a special type of block used to represent light fixtures in Lightscape. A luminaire includes the photometric characteristics that control how light energy is emitted from the luminaire. Double-clicking any luminaire name isolates the luminaire editing in the Graphic Window and activates a dialog box for editing the luminaire's photometric characteristics. For more detailed information, refer to *Chapter 1* in the *Lightscape User's Guide*.

Preparing Data

In this exercise, you will perform the following preparation tasks:

- "Viewing and Displaying the Model"
- "Defining Materials"
- "Using Material Libraries"
- "Displaying Textures"

Viewing and Displaying the Model

Turn on all Toolbars.

This tutorial makes extensive use of the toolbars to quickly and easily execute operations.

1. Choose Tools > Toolbars.

   The Toolbars dialog box displays.

2. Double-click any item that does not have a check mark in front of it to turn on that toolbar.

3. Click Close when you are done.

View the full extents of the model.

Often, you want to see everything on the screen at once. Choosing View > Extents adjusts the view to fit the entire model in the Graphic Window. In Perspective mode, View > Extents orients the model so you view it from the front. In the orthogonal views, View > Extents zooms the model to fit in the Graphic Window. You should be in Perspective mode when you start the tutorial.

1. Choose View > Extents or click the View Extents button on the toolbar.

Adjust the view interactively.

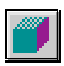
One of the many features of Lightscape is a set of camera controls which make it easy for you to interactively change your point of view.

1. Choose View > Interactive > Orbit or click the Orbit button on the toolbar.
2. Place the cursor anywhere in the Graphic Window, press the left mouse button, and drag first horizontally and then vertically.

   Notice the change of view in the model. This is *orbiting*.

Set the display mode.

Lightscape gives you a variety of modes with which to display your model. The mode at which you are looking is called *wireframe*. A wireframe representation provides the fastest display speed but can often become confusing with more complex models. Other modes provide better feedback but can be slower to display.

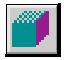


1. Choose Display>Solid or click the Solid button on the toolbar.
2. Continue to Orbit the model.

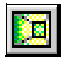
   Notice that this is somewhat slower but you can more easily understand the model.

3. To see the model more clearly, choose Display>Outlined or click the Outline button on the toolbar.

   You can further enhance both Solid mode and Outlined mode by adding some simple shading. This will create an effect as if you had a headlight mounted on the camera as you move around.



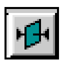
4. Choose Display > Solid or click the Solid button on the toolbar.



5. Choose Display > Enhanced or click the Enhanced button on the toolbar.

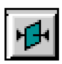
6. Notice that as you orbit the model, some of the surfaces such as the walls and ceiling disappear as you turn.

   This is a display technique called *backface culling*. With this display mode activated, surfaces that are oriented away from your viewing position are removed (*culled*) from the display.



7. Choose Display > Culling or click the Culling button on the toolbar to turn off backface culling.

   Notice the change in the display as you orbit.



8. Choose Display > Culling or click the Culling button to turn it back on.

Open the original view of the model.

It is easy to restore the view displayed when you first opened the model. The view you had when you last saved the model becomes the original view the next time you open it.

1. Choose View > Original.

Try other interactive viewing controls.

In addition to orbiting, there are a number or other camera modes you can set to interactively set your viewpoint.

1. Choose View > Interactive > Pan or click the Pan button on the toolbar.

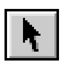
2. Place the cursor anywhere in the Graphic Window, press the left mouse button, and drag first horizontally and then vertically.

   Notice the change of view in the model. This is *panning*.

   You will often have to use a combination of viewing modes to navigate your model. The most convenient way to do this is to simply hold down the hotkey to set a view mode as you move the mouse in the Graphic Window. You can try this now. Hold down the following hotkeys as you drag the mouse:

   o for Orbit
   p for Pan
   z for Zoom
   r for Rotate
   d for Dolly
   s for Scroll
   t for Tilt

3. When you are through experimenting, choose View>Original to reset you view.



4. Choose Edit > Selection > Select or click the Select button on the toolbar.

   This sets the function of the left mouse button to Single Selection mode, your normal operating mode.

Defining Materials

Because Lightscape is based upon the physics of lighting, defining materials properly is important for obtaining meaningful results. In the following exercise, you will define a wood floor material that you will use later in this tutorial.

1. Click the right mouse button anywhere in the Materials Table to open the context menu.
2. Choose Create from the context menu.

   A new material, called "`item17`", is added to the table and highlighted in blue. You can now enter the desired name for the material.

3. Type the following and press **`Enter`**:

   `FLOOR_WOOD`

4. Using the left mouse button, double-click on `FLOOR_WOOD`.

   The Material Properties dialog box displays.

   On the Color tab, there are a number of parameters that can you can set to define the characteristics of a material. To assist you in selecting valid values for a specific type of material, you should start by selecting a template that most closely matches the type of material you are defining.

5. Select `Wood Varnished` from the Templates combo box.

   After you make your selection, the various parameter sliders are marked with red and green lines. The green portions of these lines represent the valid range of values that you should use when defining the desired material. Notice that the Hue (H) and Saturation (S) sliders of the reflective color have no lines. This means that you can use any values.

   Value (V) is used to represent the amount of energy that is reflected from a surface. A material with a Value of `.2` will reflect 20% of the energy and absorb 80% of the energy that it receives. Assigning a reasonable Value for a material is particularly important in obtaining a valid lighting simulation.

Many materials contain patterns or textures. A wood floor is a good example of such a material. To define these materials you can use image bit maps (called *texture maps*) to modify the color of a material across a surface.

6. Click on the Texture tab.
7. Click Browse.
8. Double click on `woodfloor.jpg` in the File Name list to load this texture map.

   The image of the wood floor is previewed on the texture page. Texture maps such as these are readily available from a number of suppliers (some samples are provided with the Lightscape system). When using these textures, *make sure* that the average Value of the texture is also within a valid range for the type of material it represents. This range is indicated in the Value slider that can be used to scale the Value of the texture map being used.

9. Set the Value slider scale to `.25` so that the average Value of the texture is `.209` and the Maximum Value (Max.) is `.246`.
10. Click the Fixed Tile Size check box and enter **3** (meters) in both the Width and Height input fields.

    These numbers represent the real world dimensions of the texture being used.

11. Click on the Color tab.

12. Click the Texture Average button to set the Reflective Color to the average of the texture map being used.

    Note that if a material uses a texture map, the system normally uses the texture map as the source for determining the reflectivities during the radiosity solution (although you can also specify to use the Reflective Color instead).

13. Set the Smoothness slider to `0.90`.

    This value determines how shiny the floor appears when the image is ray traced.

14. Click OK to set the new material.

Using Material Libraries

► **Save material definitions to a material library.**

Now that you have defined this material, you may want to save it to a Material Library so that you can easily access it later to use in another project.

1. Select `FLOOR_WOOD` in the Materials Table.

2. Using the right mouse button, click anywhere in the Materials Table to open the context menu.

3. Select Save from the context menu.

4. Type **`floors.atr`** in File Name and click OK.

    If you are running Windows 95 or Windows NT 4.0, you may click Save.

5. If necessary, change directory to:

    `c:\Program Files\lvs\projects\tutorial1`

6. Click Yes to confirm the creation of a new library file.

   You can add additional materials to this library at any time if you wish.

► Load material definitions from a material library.

You can also load materials from a material library to use in your project. If the name of the material you are loading already exists in your Materials Table, then that material is overridden with the new definition. This is a convenient way of storing alternate material palettes for a project.

1. Using the right mouse button, click anywhere in the Materials Table to open the context menu.
2. Select Load from the context menu.
3. Select `tutorial1.atr` in the File Name list.
4. If necessary, change directory to:

   `c:\Program Files\lvs\projects\tutorial1`

5. Click OK to open the library file.

   If you are running Windows 95 or Windows NT 4.0, you may click Open.

   A material list browser displays.

6. Click Select All to select all materials.
7. Click OK to load the material definitions.
8. In the next dialog, confirm the overwriting of all textures by clicking Yes.

   The appearance of the materials making up the ceilings, walls, and floor changes.

Displaying Textures

Turn on textures.

In this model, there are texture maps applied to areas inside the picture frames.

1. Choose Display > Textures or click the Textures button on the toolbar.

   Allow some time for the textures to load into memory. Check the status of texture loading using the status bar.

   To improve interactivity, you should turn off textures while doing the remaining exercises in this tutorial.

2. Choose Display >Textures or click the Textures button on the toolbar to turn texture display off.

Orienting Luminaires

What is a luminaire?

Lightscape creates a special class of blocks called *luminaires*, which represent light fixtures in the model. You create a luminaire by associating photometric data with an existing block. As with materials and regular blocks, you can store luminaires in libraries and use them repeatedly in different models. In this tutorial, the luminaires have been set up for you.

Orient the downlights so that they point to the picture frames.

Although Lightscape is not a modeling program, a number of tools are provided to let you easily add and position objects and luminaires in your models.

1. Choose Edit > Selection > Luminaire or click the Luminaire button on the toolbar.

   This sets selectable entities to luminaires only.

2. Select a spotlight that you want to orient.

   Notice that you can select a luminaire by picking near the desired luminaire. Lightscape highlights the selected spotlight.

3. Choose Edit > Transformation or, using the right mouse button, click anywhere in the Graphic Window and choose Transformation from the context menu.

   The Transformation dialog box displays.

4. Click the Orientation tab.

5. Click in the Pick check box to turn on this feature.

6. Pick a point roughly in the center of the picture frame under the selected luminaire.

   Lightscape orients the selected luminaire to the point you pick.

7. Click in the Pick check box to deactivate this special mouse mode.

8. Select another luminaire to orient.

9. Click in the Pick check box to reactivate this special mouse mode.

10. Pick a point roughly in the center of the picture frame under the luminaire selected.

    Note that you can greatly reduce the number of mouse movements you have to do by using hotkeys (this is generally true for most of the operations in Lightscape.)

11. Hold down the **1** key to temporarily activate Select Mode.

12. While holding down the **1** key, select another luminaire.

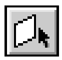
13. Release the **1** key and then select the point on the picture where you want the luminaire to aim.

14. Press the **1** key again to select the next luminaire.

15. Repeat steps 11 through 14 until all the spotlights are pointing toward their respective paintings.

    During this process, you can also easily adjust your view to make it easier to pick points by holding down the desired camera mode hotkey.

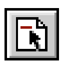
16. Click Cancel when you are done orienting luminaires.



17. Choose Edit > Selection > Surface or click the Surface button on the toolbar.

    This sets selectable entities to surfaces only.

18. Choose View > Original.



19. Click the Deselect All button on the toolbar.

    Figure 1-3 shows the model prior to radiosity processing.

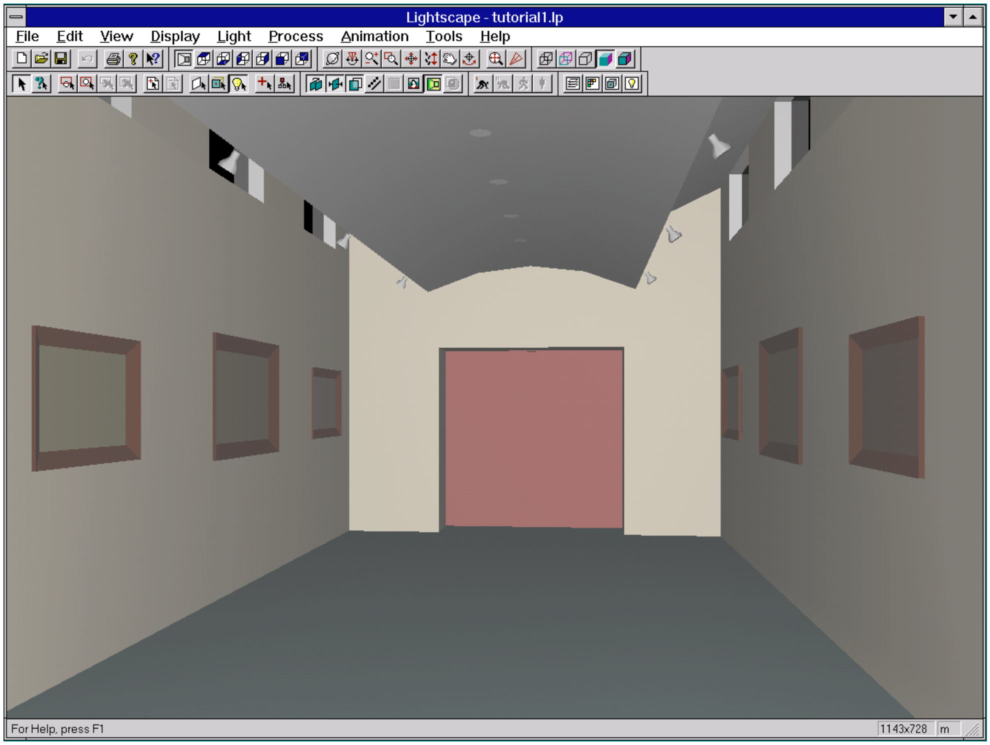


Figure 1-3. *Model Prior to Radiosity Processing*

▶ Save the file.

Save the work you have done so far so that you can return to this point later if you want to make geometry modifications or add lights.

Lightscape's Undo function is limited to restoring the most recently deleted entity, if the model database has not changed in the interim. In general, use the *Save* and *Save As* functions to give yourself a point to return to when necessary.

1. Choose File > Save As.

   The Save As dialog box displays.

2. In the File Name input field, type the following:

   `temp.lp`

3. Click OK.

   If you are running Windows 95 or Windows NT 4.0, you may click Save.

Creating the Solution

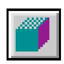
In this exercise, you will perform the following tasks:

- "Initiating the Preparation Model"
- "Setting Process Parameters"
- "Checking the Solution"
- "Processing the Solution"

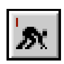
Initiating the Preparation Model

▶ **Initiate the Solution stage.**

You have now completed the Preparation stage and can proceed into the Solution stage to perform the radiosity processing. This transition takes place by *initiating* the Preparation Model.



1. Choose Display > Solid or click the Solid button on the toolbar.



2. Choose Process > Initiate or click the Initiate button on the toolbar.
3. If necessary, click No to proceed without saving changes.

   This prompt does not display if you have not made any changes to your model since you last saved.

   After initiation, the model appears dark because the processing has not yet started and no energy has been distributed from the light sources. This is referred to as the *Zero Energy State* (0 iterations).

   Notice that in the title bar of the Graphic Window the filename has an `.ls` suffix, indicating that this model can now be saved to a Solution file.

Setting Process Parameters

▶ **Set the process parameters.**

The most important part of this stage is choosing process parameters which will give you the results you desire. Process parameters control how accurately the light effects are calculated. These settings, more than anything else, determine the size of the final model (measured in polygonal elements), its quality, the accuracy of the light distribution, and the time it takes to process the model. For more information, refer to Chapter 8, Solution in the *Lightscape User's Guide*.

1. Choose Process > Parameters.

   The Process Parameters dialog box displays.

   Observe the numerical values in the various boxes of the dialog. These control the quality and speed of the Lightscape radiosity process. Although these can be set by hand, you will use a wizard in this tutorial to set them automatically.

2. Click the Wizard button to active the Process Parameters Wizard.

3. Select the radio button labeled 2 to select a moderate quality level for the model.

4. Click Next to access the next page of the wizard.

5. Select No to not consider daylighting in this model.

6. Click Next to access the next page of the wizard.

7. Click Finish to update the process parameters based on the selections made in the wizard.

   Observe the change in the numerical values in the various boxes of the dialog.

8. Click OK to close the Process Parameters dialog.

Checking the Solution

Turn on ambient to check overall light level.

Ambient light distributes all the undistributed light energy evenly to all surfaces. If the model appears overly dark or overly light when Ambient is turned on before processing, this indicates that either the luminaires are incorrectly defined or that the model has been scaled incorrectly.

1. Choose Display > Ambient or click the Ambient button in the toolbar.

   Observe that the model's overall light level is acceptable.

2. To better see how the process works, choose View > Open and double-click on `rm2.vw` in the File Name list.

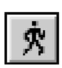
   This shows you the entire extents of the room.

3. Turn off Ambient by choosing Display > Ambient or by clicking the Ambient button in the toolbar.

Processing the Solution

Start radiosity processing.

In this step, Lightscape calculates the light distribution in the given environment.



1. Choose Process > Go or click the Go button on the toolbar.

What is progressive refinement radiosity?

Lightscape computes the simulation in successive iterations. At each iteration, the system selects the brightest light source and computes its contribution to all the surfaces in the scene. Once it accounts for all the primary light sources, the system starts computing the interreflections of light between surfaces.

At each iteration, the system selects the brightest reflecting surface and computes its contribution to the rest of the environment.

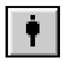
At each iteration, the radiosity solution is refined—that is, it is a progressively better approximation of the final result.

In principle, this refinement process continues until the system accounts for all the multiple interreflections of light. In practice, however, the simulation converges very rapidly toward the final result, so that visual differences between successive iterations become unnoticeable after only a fraction of the surfaces (but the most important of them) have reflected their light contribution back into the environment.

Stop the process after about 30 iterations.

It can take anywhere from several seconds to several hours to completely process the light energy distribution in a model. Processing time depends on such factors as model size, number of light sources, meshing parameters, and hardware resources.

In the current model, let the process run for about 30 iterations, which should process approximately 75% of the available energy (leaving 25% unprocessed). The number of iterations processed displays in the status bar.



1. Choose Process > Stop or click the Stop button on the toolbar.

   The process stops after the current iteration is complete. It may take a few seconds for the processing to stop. The message "`Preparing to stop processing`" displays in the status bar. When processing completely stops, the message "`Processing stopped`" displays.

Note In this tutorial, we are redisplaying the scene between each iteration so that you can better understand the process of progressive refinement radiosity. Each redraw takes time that slows down the overall processing. With a larger project, you would typically set up the model and then run the radiosity processing using the batch `lsrad` program for the fastest results. This is described in Tutorial 5.

Observe the model.

Note the color bleeding effects obtained as the system distributes the strong reflected light energy from the floor. Also note how the brightness of the room evens out as the energy is distributed among the surfaces.

Adjust your view using level of detail control.

One of the most important features of Lightscape is the ability to interactively move around in a fully rendered model.

1. Choose View > Interactive > Orbit or click the Orbit button on the toolbar.

   Note that one method of increasing the interactive display speed of a radiosity solution is to use Level of Detail control.

2. Choose Edit > Properties.
3. Click on the Display Interactivity tab.
4. Set the Level of Detail slider to approximately **25**.
5. Click Apply.
6. Continue orbiting the model.
7. Set the Level of Detail slider to **1**.
8. Click Apply and orbit the model again.
9. When you are finished moving around in the model reset the Level of Detail slider to **100**.
10. Click OK.
11. Choose View > Original.

Observe the underlying radiosity mesh.

The reason that you are able to redisplay different views of this model so quickly is that Lightscape stores the diffuse lighting distribution it calculates as an integral part of the 3D surfaces in the model. This information is stored in the form of a 3D radiosity mesh structure. Once calculated, the system can then quickly display the radiosity mesh from any point of view by interpolating the colors that are stored at the vertices of each mesh element. This simple and fast display technique (often referred to as *Gouraud shading*) is supported by OpenGL and can be further accelerated through the use of an OpenGL compatible 3D graphic acceleration board.

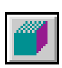
1. Choose Display > Outlined or click the Outlined button on the toolbar.

   Notice that the mesh elements are smaller and more dense around areas where there are light beams or shadows.

What is adaptive subdivision?

> *Adaptive subdivision* ensures that the sample points (the vertices of each mesh element), used for determining the energy transfer received at a surface, are created only where required. This results in the smaller, more dense mesh elements you observed.
>
> In areas where there is not a high contrast in lighting intensity, the samples can remain sparse (mesh element size is larger), whereas in areas where there are significant changes in intensity, such as along shadow boundaries and light beams, the sampling becomes more dense.
>
> The key to controlling a radiosity solution lies in the process parameters that you set. These parameters determine the meshing density and the resulting accuracy of the solution.

▶ Redisplay solid mode.



1. Choose Display > Solid or click the Solid button on the toolbar.

Fine Tuning the Solution

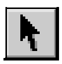
In this exercise, you will perform the following tasks:

- "Changing a Material"
- "Changing a Light Source"

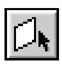
Changing a Material

▶ **Change the carpeted floor to a wood floor.**

An important feature of Lightscape is the ability to make changes to the surface materials even after starting a radiosity solution. This allows you to rapidly test various design alternatives and make adjustments to the materials and lighting to set the precise look you want.



1. Choose Edit > Selection or click the Select button on the toolbar.



2. Choose Edit > Selection > Surface or click the Surface button on the toolbar.
3. Pick a point anywhere on the floor.

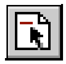
   Notice that the floor is now selected.
4. Using the right mouse button, click anywhere in the Graphic Window to open the context menu.
5. Choose Assign Material from the context menu.

   The Assign Material dialog box displays.
6. Select `FLOOR_WOOD` from the list.
7. Click OK.

   You have now set the material assigned to the floor surface to be a wood floor.

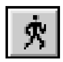
8. To see the texture map on the surface, choose Display >Texture or click the Texture button on the toolbar.

   Notice that the color of the floor changes as soon as you redefine the material, but the color of the interreflection from the floor to the ceiling and walls does not change. To update the interreflections you need to run the radiosity processing further.

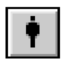


9. Click the Deselect All button on the toolbar.

Continue processing a few more iterations.



1. Click the Go button on the toolbar.



2. After a few iterations, click the Stop button on the toolbar to interrupt the processing.

Observe the change in coloration in the room.

After only a few iterations, you can observe the effects of this material change on adjacent surfaces. The color of the walls and ceiling has changed significantly. This demonstrates an important effect that various materials and lights can have on the overall aesthetics of a room, known as *color bleeding*. The ability of Lightscape to simulate this effect is one of the key advantages that the software offers over conventional rendering technologies. Another advantage is the fact that because luminaires can be specified using real-world photometric values (including specifications from manufacturers), you can perform a meaningful lighting analysis of your solution.

▶ Perform a lighting analysis.

1. Choose Light > Analysis.

   The Lighting Analysis dialog box displays.

2. Click on the Statistics tab.

   You can now use your mouse as a “virtual light meter” in your model.

3. Using the left mouse button, pick a point in the middle of one of the pictures.

   Note the information about the illumination level of the picture displayed in the dialog box. Is this too bright (most galleries would not want to see more than 20 footcandles on a picture)? In the next section, you will see how you can easily modify a luminaire to test a different intensity lamp.

4. Click on the Display tab.

5. Select `Color` from the Display combo box.

6. Enter **`75`** in the Max input field.

7. Click Apply.

   Note that your model is now displayed in a pseudo-color mode that lets you easily characterize the lighting conditions of this space. Do you see any hot-spots?

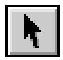
8. Select `Normal` from the Display combo box.

9. Click Apply and then Cancel.

Changing a Light Source

▶ **Change the properties of one of the luminaires.**

Just as you were able to change a material, you can also change the properties of a luminaire. Note, however, that you cannot reposition or reorient a luminaire in the solution model. You will have to return to the preparation model if you want to modify the geometry of the model.



1. Click the Select button on the toolbar.

2. Click the Luminaire button on the toolbar.
3. Pick a point on one of the spotlights oriented toward a picture.

   The system highlights the selected luminaire.
4. Using the right mouse button, click anywhere in the Graphic Window to display the context menu.
5. Choose Photometrics from the context menu.

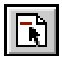
   The Luminaire Properties (instance of lt_sp2) dialog box displays. You can now adjust the photometric properties for the luminaire you have selected.
6. Set H (Hue) to **0**.
7. Set S (Saturation) to **0.5**.
8. Set V (Value) to **1.00**.

9. In the Intensity group box, set the Field Angle to **120** and the Beam Angle to **40**.

   It is important to set the field angle before setting the beam angle because the field angle acts as a maximum constraint for the beam angle.

   This changes the shape of the spotlight's distribution.

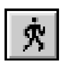
10. Click OK and confirm the overwrite.



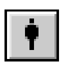
11. Click the Deselect All button on the toolbar.

Continue the process for a few more iterations.

Having redefined the selected luminaire, you must run the simulation for a few more iterations to allow Lightscape to process the new properties of the modified luminaire. The system first subtracts the original light energy from the environment and then adds the redefined light energy back into the environment.



1. Click the Go button on the toolbar.



2. After a few iterations, click the Stop button on the toolbar to interrupt the processing.

Outputting the Results

In this exercise, you will perform the following tasks:

- "Creating a Radiosity Image"
- "Creating a Ray Traced Image"
- "Saving and Exiting"
- "Viewing Image Files with LVu"

Creating a Radiosity Image

► **Create an image showing the diffuse lighting of the gallery only.**

Once you are satisfied with the radiosity solution and everything else looks the way you want, you can rapidly save images of the model using OpenGL display techniques.

OpenGL is what is typically used to display your radiosity on your screen. Using OpenGL, you can only render the diffuse lighting effects calculated during the radiosity solution. You cannot render shiny specular reflections and true transparency effects, nor can you render the effects of procedural bump or intensity maps that may be part of a material definition.

If you are satisfied with the quality of the radiosity solution you see, then OpenGL offers the fastest method for creating images. This can be particularly important if you are rendering many images (for example, animation frames).

1. Choose View > Original.

2. If necessary, click the Textures button on the toolbar to turn on textures.
3. Choose File > Render.

   The Rendering dialog box displays.

4. In the Output File group box, select Targa (TGA) from the Format combo box.

5. Type **`radiosity.tga`** in the Name input field.

6. Click OK.

   Lightscape takes a snapshot of the current view and saves the image to disk.

Note You can further improve the quality of any image you create with Lightscape by using antialiasing to remove jagged edges. The higher the level of antialiasing specified, the longer it takes to create the image.

Creating a Ray Traced Image

If you are interested in the highest quality image, then you can use the ray tracer to add specular reflections and enhanced lighting effects. Typically, the ray tracing process used in Lightscape proceeds much faster than traditional ray tracing because the ray tracer does not have to calculate the direct lighting; this is already calculated with the radiosity process. For some light sources (such as sharp spotlights and sunlight), you may want to ray trace the direct light to obtain a better quality shadow.

► **Set a luminaire to be ray traced.**

1. Click the Luminaire button on the toolbar.

2. Select on one of the spotlights oriented toward a picture.

   The selected luminaire highlights.

3. Click the right mouse button in the Graphic Window to open the context menu for the selected luminaire.

4. Select Luminaire Processing from the context menu.

   The Luminaire Processing dialog box displays.

5. Click the Ray Trace Direct Illumination check box.

6. Click OK.

► Create an image using ray tracing.

1. Choose File > Render.

   The Rendering dialog box displays.

2. In the Ray Tracing group box, click in the Ray Tracing check box to turn on ray tracing.

3. In the Ray Tracing group box, click the Ray Trace Direct Illumination check box.

   This indicates that you want to ray trace any luminaires that have been set for ray tracing.

4. In the Output File group box, type **`raytrace.tga`** in the Name input field.

   If you leave the Name input field blank, the system renders the image and displays it to the screen but does not save it to disk.

5. Select Targa (TGA) from the Format combo box.

6. Click OK.

7. Confirm that it is OK to do some additional processing before starting the ray tracing.

   Lightscape will do an iteration for each light source set for ray tracing (in this case, only one) to remove the direct contribution to the surfaces in the model. When that is complete, the ray tracing begins.

   Soon, you see the specular reflections from the floor surface that were not visible in the diffuse radiosity model or in the OpenGL rendered image. You will also see the results of the procedural intensity map that gives an “aged plaster” effect to the red wall in the niche.

   You may notice that some of the surfaces appear brighter than they did when rendered using OpenGL. This is particularly true of texture mapped surfaces and surfaces that have a self-emitted illuminance. This difference occurs because the Lightscape ray tracer handles the interaction of light with these surfaces in a different (and more accurate) way than OpenGL does.

   You can easily adjust the brightness of any material before ray tracing by adjusting the Value scale slider on the Texture tab of the material in question. To quickly test the materials in your model before committing to a long, high resolution ray trace rendering or animation, you can use the ray trace preview feature to ray trace only a selected region on your screen.

Saving and Exiting

► **Sign off.**

1. Choose File > Save As to save this file.

   The Save As dialog box displays.

2. In the File Name input field, type **`tutorial1.ls`** and click OK.

   If you are running Windows 95 or Windows NT 4.0, you may click Save.

3. Choose File > Exit and confirm that you want to exit.

Viewing Image Files with LVu

1. Double-click the LVu icon in the Lightscape Visualization System folder.

   If you are running Windows NT 4.0 or Windows 95, you can also start the LVu application by choosing it from the Start menu.

2. Choose File > Open.

3. Change directory to the following:

   `c:\Program Files\lvs\projects\tutorial1`

   If you installed Lightscape in a directory other than the default installation setup, then change directory to the appropriate location.

4. Click OK to open the images in the directory.

   If you are running Windows 95 or Windows NT 4.0, you may click Open.

   Three thumbnails of image files display.

5. Double-click the `radiosity.tga` thumbnail.

   A full-sized image displays in the window. The `radiosity.tga` file is the image of the gallery you produced using only radiosity. Notice how natural the diffuse surfaces appear, although the floor and the glass (which are specular surfaces), are less realistic.

6. Double-click the image to return to the three thumbnail images.

7. Double-click the `rayonly.tga` thumbnail.

   A full-sized image displays in the window. The `rayonly.tga` file is an image of the gallery we produced using only ray tracing. This is typical of the quality you can obtain using conventional scanline rendering and ray tracing programs. Notice that the floor and glass, which are specular surfaces, look compelling but also notice how flat non-specular surfaces, such as the walls and ceiling, appear.

8. Double-click the image to return to the three thumbnail images.

9. Double-click the `raytrace.tga` thumbnail.

   A full-sized image displays in the window. The `raytrace.tga` file uses both the radiosity and ray tracing algorithms. It is the most accurate, and therefore, the most compelling of the three images.

10. Choose File > Exit to exit the LVu image viewing application.

Congratulations! You have reached the end of Tutorial 1. At this point you should:

- Feel comfortable with the Lightscape interface.
- Have a basic understanding of the interaction between light and materials and how Lightscape simulates this.

- Understand the major steps in the Lightscape process, their sequence and interrelation.

Going Further

To learn more about the Lightscape Visualization System, you can do the following:

- **Open the sample solution files.**

  The Lightscape Installation media contains a number of sample solution files which you can use for experimenting. To install these files:

  1. Perform a Custom installation.
  2. Select only the Sample Files from the list items in the File list.
  3. Observe the way the mesh was created, the way materials were defined, the way luminaires were defined, and so on.

     This gives you a feel for the performance of larger models.
  4. Try resetting the solution and experimenting with different process parameters.

- **Read the manuals.**

  The *Lightscape Getting Started* manual and *Lightscape User's Guide* contain excellent information that describes in detail the underlying concepts of the technology used in Lightscape, as well as the basics of lighting and materials. The more you understand about these underlying concepts, the faster you will be able to master working with Lightscape.

- **Do the remaining tutorials for more experience working with Lightscape.**

Tutorial 2 Fundamentals - Importing DXF Files

In this tutorial, you will be introduced to importing geometry from a CAD or modeling application. Using a DXF file, you will go through the steps you would take when working with a model in this format, including defining realistic materials and lights.

The goal of this tutorial is to render the model used to create the image in Figure 2-1.

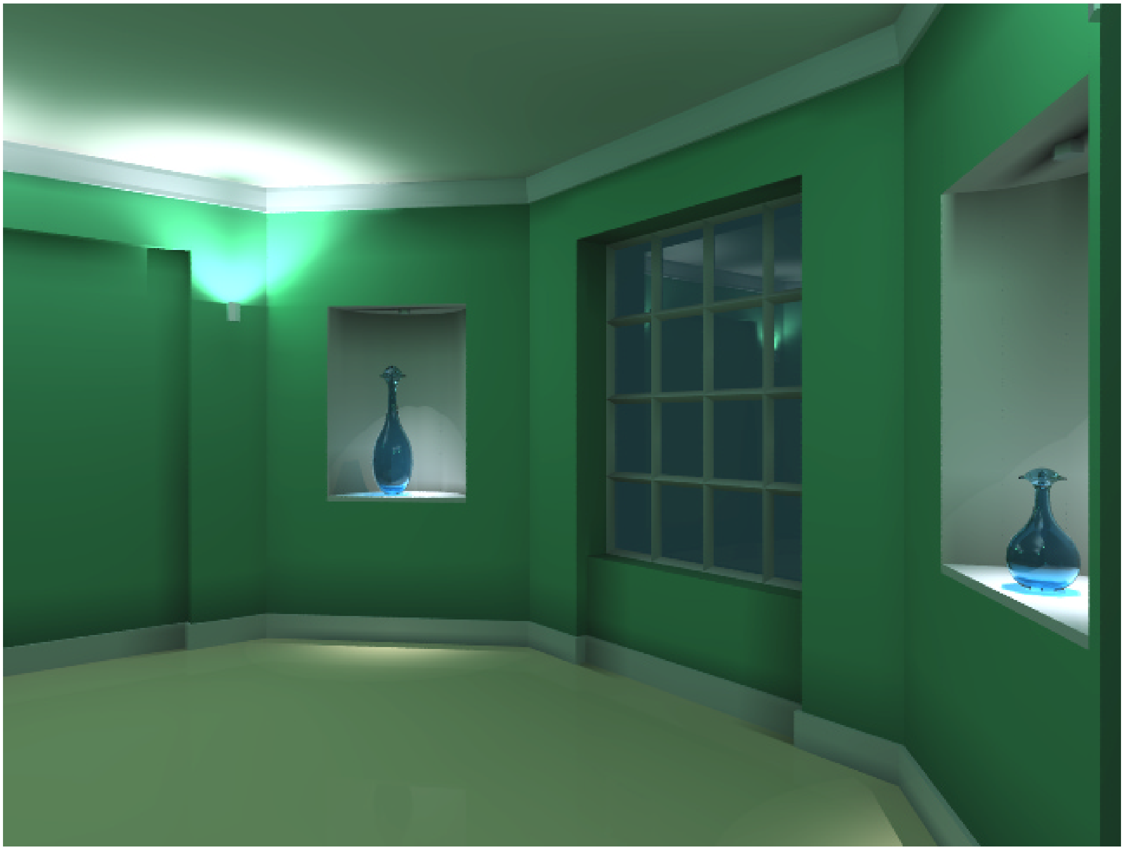


Figure 2-1. *Sample of Rendered Image from Tutorial 2*

How Tutorial 2 is Organized

This tutorial contains the following sections and lessons:

Getting Data

In this exercise, you will start Lightscape and turn on all of the toolbars.

Starting Lightscape

▶ **Start Lightscape.**

1. In the Lightscape Visualization System program group, double-click the Lightscape icon.

   The Lightscape graphical user interface displays on the screen.

▶ **Turn on all toolbars.**

This tutorial makes extensive use of the toolbars to make executing operations easier.

1. Choose Tools > Toolbars.

   The Toolbars dialog box displays.

2. Double-click any item that does not have a check-mark in front of it to turn on that toolbar.

3. Click Close when you are done.

Importing DXF Files

The DXF file format was initially described by Autodesk and is now the AEC industry standard for the exchange of geometric data; most commercial CAD and modeling applications can export DXF files.

Entities Supported by Lightscape

Lightscape currently imports most of the DXF entities that can be converted to polygons in 3D. These entities include:

- 2D Polyline (with width or height)
- 3D Polyline
- 3D Face
- 3D Polygon Mesh
- 3D Polyface Mesh
- Arc (with height)
- Circle (with height)
- Line (with height)
- Solid Trace

Lightscape does not import ACIS solids—these must be converted to 3D faces or 3D meshes before being imported. This is done using the *3dsout* command within AutoCAD to create the faces, which can be imported back into AutoCAD using *3dsin* or imported directly into Lightscape.

Import Units and Scale Factor

Many of the problems encountered by Lightscape users stem from not setting the units correctly when importing a file.

Because Lightscape is a physically based lighting renderer, correct physical measurements are vital to using the product effectively—the seat of a chair should be 16 inches from the floor, not 16 feet; and a wall should be 8 feet high, not 8 inches or 8 meters high.

- You can choose millimeters, centimeters, meters, kilometers, inches, feet, or miles as the units in which the model was created.
- You can apply a scale factor by entering a number in the Scale field, if required.

It is a good idea to confirm the scale of the model before you start to work on it. You will learn to do this in an exercise that follows.

Importing Geometry

▶ **Load the DXF file called tutorial2.dxf.**

A DXF file is one of several types of geometry files you can import into Lightscape. Lightscape is not a modeling program, so you must import the geometry from an external modeling program.

1. Choose File > Import > DXF.

   The Import DXF dialog box displays.

2. In the Name area, click Browse.

   The Open dialog box displays.

3. Change directory to:

   `c:\Program Files\lvs\projects\tutorial2`

4. Double-click `tutorial2.dxf`.

5. In the File Units area, choose Feet from the combo box.

   This model was created with one unit in the CAD program set to equal one foot in the real world.

6. Click OK.

   Note that the message box reports that the model is `30.0622 x 17.15 x 9.50054` feet.

7. Click Yes to open and display the file.

Checking the Scale of the Geometry

Check the scale of the geometry.

1. If necessary, choose View > Extents or click the Extents button on the toolbar.

   The model was probably imported with the View set to Extents.

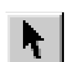
2. Choose Edit > Properties.

   The Document Properties dialog box displays.

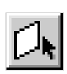
3. Click the Units tab.

   Note that the length units in the Length combo box are in feet (this information is displayed in the status bar).

4. Click OK to close the Document Properties dialog.



5. Choose Edit > Selection > Select or click the Select button on the toolbar.



6. Choose Edit > Selection > Surface or click the Surface button on the toolbar.

7. Choose Tools > Measure Distance.

   The Measure Distance dialog displays.

8. If necessary, click the Snap to Nearest Vertex check box to turn on this feature.

9. Click near the lower left corner of any wall.

   Notice that Lightscape fills in the coordinates for this point in the first set of X, Y, and Z fields of the dialog.

10. Click in the upper left corner of the same wall.

    Notice that Lightscape fills in the next set of X, Y, and Z fields and the Distance between the points is about 8.5 feet. This indicates that the room is 8.5 feet high, a reasonable size.

11. Click Close to dismiss the Measure Distance dialog.

Preparing Data

In this exercise, you will perform the following tasks:

- "Viewing the Model"
- "Setting an Explicit View"
- "Working with Display Controls"

Viewing the Model

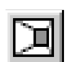
View projections.

Lightscape allows you to view the model in perspective or in one of several orthogonal projections.

1. Choose Display > Outlined or click the Outlined button on the toolbar.

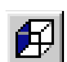
2. Choose View > Projection > Top or click the Top button on the toolbar.

   Notice that the model changes to plan or top view.



3. Choose View > Projection > Perspective or click the Perspective button on the toolbar.

   Notice that the model changes back to the previous perspective view.



4. Choose View > Projection > Left or click the Left button on the toolbar.

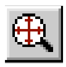
   Notice that the model changes to left view.

5. Experiment with the other projection modes which are Bottom, Right, Front, and Back.

View the full extents of the model.

You can adjust the view to fit the entire model in the Graphic Window. In Perspective mode, the model is oriented so you view it from the front. In the orthogonal views, the model is sized to fit in the Graphic Window. The extents are set based on the current entities displayed in the Graphic Window.

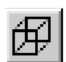
1. Choose View > Projection > Perspective.



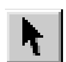
2. Choose View > Extents or click the View Extents button on the toolbar.

View hotkeys.

One of the many features of Lightscape is a set of viewing controls that make it easy to interactively change your view.



1. Choose Display > Wireframe or click the Wireframe button on the toolbar.



2. Choose Edit > Selection > Select or click the Select button on the toolbar.
3. With the cursor in the Graphic Window, press the letter "o" on the keyboard and simultaneously click the left mouse button while dragging.

   This temporarily sets the left mouse button to this interactive view mode and is the shortcut for choosing View > Interactive > Orbit. There are a number of other shortcut keys, or *hotkeys* available; refer to the *Reference Card* for a complete list.

   As you drag, notice the change of view in the model. This is known as *Orbiting*.

4. With the cursor in the Graphic Window, press the p key and the left mouse button simultaneously while dragging.

   Notice the change of view in the model. This is known as *Panning*.

5. Experiment with using R for Rotate, Z for Zoom, D for Dolly, T for Tilt, and S for Scroll operations.

A *mouse mode* refers to the mode in which the left mouse button of the mouse is engaged. There are two basic mouse mode states:

(1) Viewing operations (pan, zoom, etc.)

(2) Model manipulation operations (select surface, luminaire, etc.)

You can select a viewing mouse mode operation by using the hotkeys, pull-down menus, or toolbar icons. You can select a model manipulation operation using the pull-down menus or the toolbar icons.

When you select a viewing operation using a hotkey, that mode is in effect until the hotkey is released.

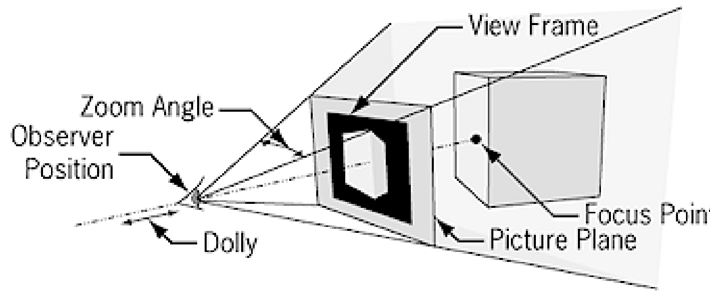
If you select a viewing mouse mode using the hot key, it is in effect until you release the key. The viewing mouse mode then returns back to the mode it was before using the hotkey. However, if you select a viewing mouse modes using the Shift key with a hotkey, it is the same as selecting the appropriate toolbar icon.

When you select the viewing mouse mode using the pull-down menus or toolbar icons, the mouse mode remains in effect until you explicitly select another mode.

Setting an Explicit View

The Lightscape perspective model uses a viewer position, a focus point, and a picture plane to create perspective views. Both the view setup and the dynamic view controls are built around these conventions.

When you select View > Setup, Lightscape displays the model in plan view with a red triangle. This triangle is known as the view frustum. It describes, in two dimensions, the currently active perspective view.



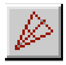
The bottom vertex of the triangle represents the *viewer position*, or the point where the viewer is standing. (This point is called the camera position in some programs).

The opposite end point of the line protruding out from the viewer position is the *focus point*, or the point where the viewer is looking.

The side of the triangle opposite the viewer position is the *far clipping plane*. The *near clipping plane* is the line parallel to the far clipping plane between the viewer position and the far clipping plane. Only the portions of the model that fall within the trapezoid formed by the frustum and the near and far clipping planes will be visible.

Set up an explicit view.

In this procedure, you set up a specific view that you want to return to in the future.



1. Choose View > Setup or click the View Setup button on the toolbar.

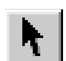
   The View Setup dialog box displays and the view of the model switches to the top projection. You can move the dialog box out of the way if necessary.

2. Make the Graphic Window active by clicking on the Title Bar of the Graphic Window.

3. With your cursor at the top of the Graphic Window, hold down the z key, press the left mouse button, and drag downward.

   This is the hotkey for choosing View>Interactive>Zoom. For a list of available hotkeys, refer to the *Reference Card*.

4. Keep zooming out until the red triangle is fully visible.



5. Click the Select button on the toolbar.

6. In the dialog box, click the Viewer Position radio button.

7. Pick a point on the screen where you want to place your viewer position.

8. Click the Focus Point radio button.

9. Pick a point on the screen where you want to place your focus point.

10. Move the Near Clip Plane slider all the way to the left.

11. Click OK.

    Notice the new view of the model.

12. If you are satisfied with this view, go to the next procedure. If not, keep experimenting.

    If you want to change the height of the viewer position or the focus point, enter the explicit values in the Z input field. Remember, you can use the other view controls to help set up a view you like.

▶ Save this view.

You need to save the view so that you can return to it. A saved view is a file containing only the information described earlier, such as viewer position and focus point. It does not contain any information about the geometry seen in the view when you saved it.

1. Choose View > Save As.

   The Save As dialog box displays.

2. If necessary, change directory to:

   `c:\Program Files\lvs\projects\tutorial2`

3. In the File Name input field, type **`view1.vw`**.

   You do not need to type the **`.vw`** file extension; the program provides it for you if you leave it off.

4. Click OK and confirm the overwrite if necessary.

   If you are running Windows NT 4.0 or Windows 95, you may click Save instead of OK.

▶ Open the view you just saved.

Open the view file you just saved. This does not change anything contained in the model you are currently using.

1. Choose View to display the View menu.

   Notice that `view1.vw` appears at the bottom of the pulldown menu in the Most Recently Used List. When a view is saved to disk, a copy of that view is also added to the active view list. This view list is erased when you exit Lightscape. Selecting `view1.vw` from the View List Functions is the same as selecting it from the disk.

   Notice also that the view list contains `Original`. This represents the viewing parameters for the model when it was initially imported into Lightscape. You can always return to this by selecting `Original` from the View pull-down menu.

▶ Change your view.

2. Choose View > Open.

   The Open dialog box displays.

3. Double-click `view1.vw`.

   The view you saved earlier redisplays on the screen.

Working with Display Controls

There are five different modes for viewing the model:

Wireframe Mode displays the model with only the edges of surfaces displayed.

Colored Wireframe Mode displays the surface edges in their appropriate material color.

Hidden Line Mode displays only those edges not blocked by other surfaces closer to the viewer.

When the Antialiasing option is on (Display>Antialiasing), lines displayed in the above modes (and *Outlined Mode* described below) are displayed antialiased and should appear smoother.

Solid Mode displays the surfaces of your model in their material color.

Outlined Mode displays the model in solid mode with the addition of the surface edges being outlined.

When *Enhanced* is turned on (Display>Enhanced), the Preparation model is displayed using simulated lighting.

When *Double Buffer* is on (Display>Double Buffer), double buffering is used to eliminate screen refresh artifacts when interactively viewing a model.

When *Culling* is on (Display>Culling) the surfaces that are oriented away from the viewer position are not displayed.

When *Blending* is on (Display>Blending), transparent surfaces appear transparent using OpenGL transparency.

Display the model in Outlined mode.

You can view an outlined, flat-shaded version of the model. This is often more useful than viewing the model in Wireframe mode.

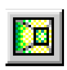
1. Choose Display > Outlined or click the Outlined button on the toolbar.

Display the model in the other modes.

You will find that these different modes have various strengths and weaknesses. Try experimenting with them all.

Display the model in Outlined mode, then turn on Enhanced Mode and adjust the view.

1. Choose Display > Outlined or click the Outlined button on the toolbar.



2. Choose Display > Enhanced or click the Enhanced button on the toolbar.

   With enhanced mode, the Preparation model is displayed using simulated lighting. This provides a more desirable display of the Preparation model but is comparatively slow.

Display the model in the other modes.

Experiment with the other Display Mode controls such as culling, antialiasing, and double buffering. It would not help to experiment with blending at this time since there are not any transparent surfaces in the model. *Blending* is a display mechanism that allows surfaces to appear transparent.

Change the brightness and contrast settings.

Because all monitors are not created equal, Lightscape allows you to adjust brightness and contrast. These settings help to fine tune the way you perceive the solution. These changes will not be perceptible in preparation mode.

1. Choose Edit > Properties.
2. Click the Display tab.
3. Set Brightness to **65**.
4. Set Contrast to **50**.

Change the background color.

With Lightscape, you can alter colors of items such as the background color, wireframe color, and mesh outline color.

1. Click the Colors tab.
2. Set H (Hue) to **180**.
3. Set S (Saturation) to **0.40**.
4. Set V (Value) to **0.70**.
5. Click the left arrow button that corresponds with Background to assign the HSV values to the background color.
6. Click OK.

Organizing Data

Layers and blocks are the two of the most powerful tools for organizing data in Lightscape. You can isolate layers or blocks, allowing you to work on only part of the model at any given time. This can reduce the complexity and confusion when working on large and complex models.

In this exercise, you will perform the following tasks:

- “Working with Layers”
- “Selecting Surfaces”
- “Working with Blocks”

Working with Layers

Each entity in Lightscape is associated to a layer. You can use layers to manage the large amounts of data that may make up your model. For example, you can associate all the surfaces that define the walls of a model to a layer named “walls.”

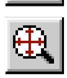
All the layers that exist in a Lightscape model are listed in the Layers Table.

In Lightscape, a layer can be either on or off. Only entities associated to layers that are on are displayed in the Graphic Window.

► **Display the model in Outlined mode and view the full extents of the model.**

This helps you view the model correctly for the next few procedures.

1. Click the Outlined button on the toolbar.



2. Click the View Extents button on the toolbar.

▶ Turn off all layers except the layers named ROOM3_WALLS.

1. Using the right mouse button, click anywhere in the Layers Table to open the context menu.

   If the Layers Table is not already displayed, choose Edit>Tables>Layers to display it.

2. Choose All Off from the context menu.
3. Select ROOM3_WALLS from the Layers Table.
4. Using the right mouse button, click anywhere in the Layers Table.
5. Choose On from the context menu.

   All layers are now turned off except the ROOM3_WALLS layer.

6. Adjust your view so that you are looking down at the model.

   Notice that only the walls are visible, and that some walls seem to appear and disappear when you orbit around the model. This is because Lightscape displays only the front side of a surface (when culling is set to on), a technique known as *backface culling*.

▶ Turn all layers back on.

1. Using the right mouse button, click anywhere in the Layers Table to open the context menu.
2. Choose All On from the context menu.

▶ Turn off the layer named ROOM3_WALLS.

1. Select ROOM3_WALLS from the Layers Table.
2. Using the right mouse button, click anywhere in the Layers Table to open the context menu.
3. Choose Toggle from the context menu.

   The ROOM3_WALLS layer is now turned off (the walls disappear).
4. Using the right mouse button, click anywhere in the Layers Table.
5. Choose Toggle from the context menu.

   The ROOM3_WALLS layer is now turned back on (the walls reappear).

▶ Set Layer GLASSWARE to be the current layer and turn off all other layers.

Setting a layer to be the current layer makes it the layer to which all new geometry is associated. For example, if you create a new surface in the model, it is associated to, and displayed on, the current layer.

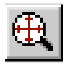
1. Select GLASSWARE from the Layers Table.
2. With the right mouse button, click anywhere in the Layers Table to open the context menu.
3. Choose Make Current from the context menu.

   A colored C appears adjacent to the GLASSWARE layer indicating it is the current layer.
4. Using the right mouse button, click anywhere in the Layers Table.

5. Choose All Off from the context menu.

6. Double-click GLASSWARE in the Layers Table to turn on this layer.

   The check mark reappears beside the layer name.

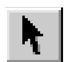


7. Click the Extents button on the toolbar.

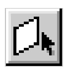
   A single vase or urn is now the only entity in the Graphic Window.

Selecting Surfaces

Select a single surface.



1. Choose Edit > Selection > Select or click the Select button on the toolbar.



2. Choose Edit > Selection > Surface or click the Surface button on the toolbar.

   This sets the selection filter to select only surfaces (as opposed to blocks and luminaires).

3. Click a surface on the vase.

   A red highlight displays indicating it is selected.

Add other surfaces to the selection.

1. If not already selected (there is no check mark next to the menu item), choose Edit > Selection > Accumulate Pick or click the Accumulate Pick button on the toolbar.

   When on, this allows you to add entities to the current selection set.

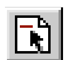
2. Click another surface on the vase.

   A red highlight displays indicating it is also selected.

Remove surfaces from the selection set.

1. Click one of the selected surfaces on the vase.

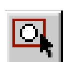
   The red highlight disappears indicating it has been removed from the selection set.



2. Choose Edit > Selection > Deselect All or click the Deselect All button on the toolbar.

   This clears the current selection set.

Select groups of surfaces.



1. Choose Edit > Selection > Select Area All or click the Area All button on the toolbar.

2. Drag a window to enclose all the surfaces of the vase.

   All of the surfaces are now highlighted in red indicating they are selected.

Working with Blocks

A block is a collection of entities (surfaces and/or other blocks) that are grouped together to form a single entity. Each block has a unique name. Once defined, a block can be inserted or instanced as many times as you desire in the Lightscape Model. *If you change the definition of the block, every instance of the block in the model inherits that change.*

► **Create a block from the selected surfaces.**

In order to insert several copies of the vase into the model, you will first turn the individual surfaces into a block.

1. Make sure that all surfaces of the vase are still selected.

1. Using the right mouse button, click anywhere in the Graphic Window to open the context menu.

2. Choose Create Block from the context menu.

   The Create Block dialog box displays.

3. Type **VASE** in the name field and click OK to create the block.

   Notice that a new block called VASE is added to the Blocks table. The existing geometry in the Graphic Window has been collected together to form a new single block entity (see Figure 2-2).

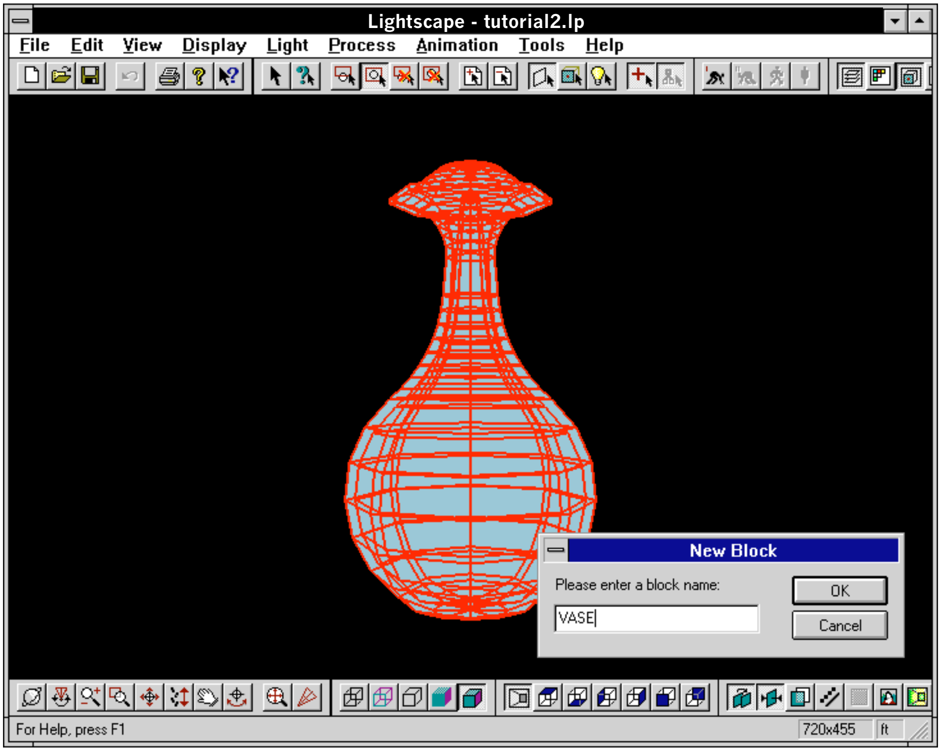
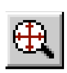


Figure 2-2. *Creating the VASE Block*

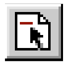
▶ **Reposition the VASE block to sit in one of the niches in the model.**

1. Turn on all of the layers in the model.



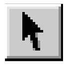
2. Click the Extents button on the toolbar.

   The entire model is visible. Orbit to look down on the model.



3. Choose Edit > Selection > Deselect All or click the Deselect All button on the toolbar.

   This clears the current selection set.



4. Choose Edit > Selection > Select or click the Select button on the toolbar.

5. Choose Edit > Selection > Block or click the Block button on the toolbar.

   This sets the selection filter to select only blocks.

6. Click a surface on the vase.

   The entire vase highlights in red indicating the block is selected.

7. Choose Edit > Transformation, or using the right mouse button, click anywhere in the Graphic Window and choose Transformation from the context menu.

   The Transformation dialog box displays.

8. Click the Position tab.

9. Choose Pick from the Values combo box.

10. Click in the center of the shelf within one of the four niches in the model (you may need to modify your view).

    The vase moves to this location. (You may pick again to move to another location.)

Duplicate the VASE block and move it to sit in another niche.

1. Using the right mouse button, click in the Graphic Window to open the context menu.
2. Choose Duplicate from the context menu.

   This creates a second copy of the vase in exactly the same location as the first vase. You can now reposition the copy.
3. On the Position tab of the Transformation dialog, choose Drag from the Values combo box.

   As it is only possible to drag in an orthographic view, the model is displayed in plan or top view.
4. Using the left mouse button, drag the vase to the center of one of the other niches.

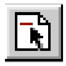
Add a copy of the VASE block by dragging and dropping from the Block table.

1. Click VASE in the Blocks Table and hold the left mouse button down.
2. Drag the mouse into the Graphic Window and move the cursor until it is over one of the empty niches.
3. Release the mouse button.

   A copy of the vase block is added at that location.
4. Repeat steps 1, 2, and 3 to place a copy of the block in the remaining niche.

   If necessary, use the Transformation dialog to position each of these new vases more precisely.

Scale and rotate blocks.



1. Choose Edit > Selection > Deselect All or click the Deselect All button on the toolbar.

   This clears the current selection set.

2. Select one of the VASE blocks.
3. Click the Scale tab in the Transformation dialog box.
4. Change the x value to **`1.5`** and click Apply.

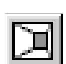
   The vase is now oval in shape. However, it is not turned to face into the room.

5. Click the Rotation tab in the Transformation dialog box.
6. In the Values combo box, choose Absolute.
7. In the Z input field, type **`135`**. (Depending on the vase you selected, it might be **`45`**.)
8. Click Apply to rotate the display.

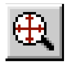
9. Click the Deselect All button on the toolbar.
10. Repeat steps 4 through 9 until you have varied the size and shape of the vases in a pleasing manner. Experiment with changing the x, y, and z scale values.

Note Remember, each time you click Apply, objects are scaled relative to their last edit; *not* relative to their original form. Rotations, on the other hand, are relative to their original form.

11. Click OK to close the Transformation dialog box.



12. Click the Perspective button on the toolbar.



13. Click the Extents button on the toolbar.

Figure 2-3 shows the view that is displayed.

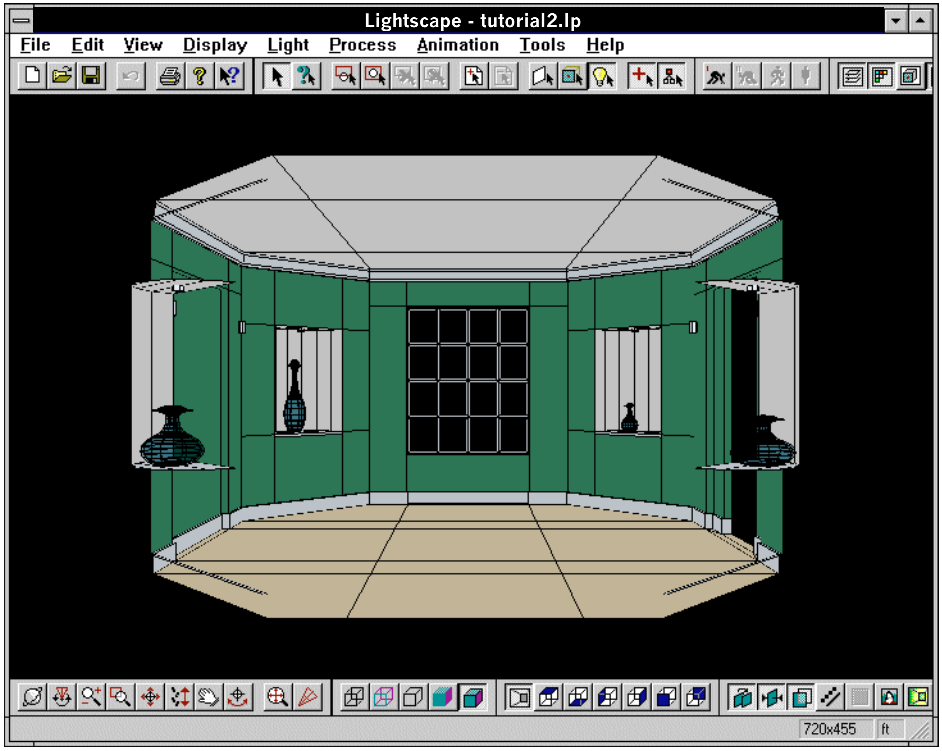


Figure 2-3. *Model After the Insertion and Scaling of the Blocks*

Save your work up to this point.

1. Choose File > Save As.
2. If necessary, change directory to:

   `c:\Program Files\lvs\projects\tutorial2`

3. Type **`temp.lp`** in the File Name input field.
4. Click OK.

   If you are running Windows NT 4.0 or Windows 95, you may click Save instead of OK.

5. If necessary, click Yes to confirm the overwrite.

Lighting Basics

In this section, you will learn about the following:

- "Understanding Luminaires"
- "Photometric Properties of a Luminaire"

You will perform the following task:

- "Setting up Photometric Properties"

Understanding Luminaires

A luminaire in Lightscape is a special type of block that has photometric attributes associated with it. When you create a luminaire, the block is removed from the Blocks Table and placed in the Luminaires Table. All instances of the block are changed into luminaires.

- A luminaire is the basic lighting primitive in Lightscape.
- It represents both the physical appearance and the photometric characteristics of a lighting fixture—that is, it includes the geometry of the fixture, the color intensity, and directional distribution of the light energy emitted from the fixture.
- A luminaire is made by associating photometric data with an existing block definition.

Photometric Properties of a Luminaire

You can set the following photometric properties of a luminaire:

- "Light Source Type"
- "Lamp Type"
- "Intensity Magnitude"
- "Intensity Distribution"
- "Photometric Web"

Light Source Type

The light source type sets the most general lighting characteristics of a luminaire. You can select a source type using the Source Type combo box, which offers the following choices:

- *Point Light* - A point light is a light source that distributes energy from a single point. The filament in an incandescent bulb is a good example of such a source.

- *Linear Light* - A linear light source distributes energy from a straight line segment. A fluorescent tube is a good example of a linear light source.

- *Area Light* - An area light source distributes energy from a triangular or convex quadrilateral surface. A typical area light is a fluorescent fixture that emits light fairly evenly over the entire surface of its diffuser panel.

Lamp Type

Lightscape provides the following common lamp colors which you can select using the Lamp Color Specification combo box:

- D65White
- Fluorescent
- Deluxe warm white
- Deluxe cool white
- Warm white

- Cool white
- White fluorescent
- Daylight fluorescent
- Incandescent
- Xenon
- Halogen
- Metal halide
- Mercury
- Phosphor mercury
- High-pressure sodium
- Low-pressure sodium

Intensity Magnitude

You can enter a value in the Intensity Magnitude field to set the strength or brightness of the light source. Three methods are available:

- *Luminous Intensity* - The maximum luminous intensity of the luminaire usually along the direction of aim. This value is measured in candelas (cd).
- *Luminous Flux* - The overall output power of the luminaire. This value is measured in lumens (lm).
- *Illuminance at a Distance* - The luminous flux density incident on a differential area (a point) at a given distance along the aim direction of the luminaire.

Intensity Distribution

You can set how light is distributed from the light source (that is, how much light is being distributed in any given direction). Four methods are available:

- *Isotropic* - Light is distributed equally in all directions (valid for point lights only).

- *Spot* - A spotlight distribution is defined by a beam angle and a field angle. The beam angle is defined as the angle at which the intensity of the light is 50% of the maximum intensity at the center of the beam (valid for point lights only).
- *Diffuse* - Light is distributed from a surface with the intensity greatest at right angles to that surface and falling off at increasingly oblique angles. This distribution can be used with linear and area lights only.
- *Photometric Web* - Light is distributed using a photometric web or IES distribution, which is a complex 3D representation of the luminous intensity distribution of a light source. This distribution can be used with point, linear, and area lights only.

Photometric Web

The distribution from most light sources in the real world is more complex than the simple spot, isotropic, and diffuse light models. The shape of the reflector, the nature of the lens, and the type of lamp combine to make the distribution from a source quite interesting and unique.

This kind of data is often depicted using goniometric diagrams. These diagrams provide a 2D visual representation of how the luminous intensity of a source varies. A photometric web or IES distribution is a 3D representation of how the intensity of a source changes. Many lighting manufacturers can supply IES files for their fixtures. Figure 2-4 shows a sample photometric web.

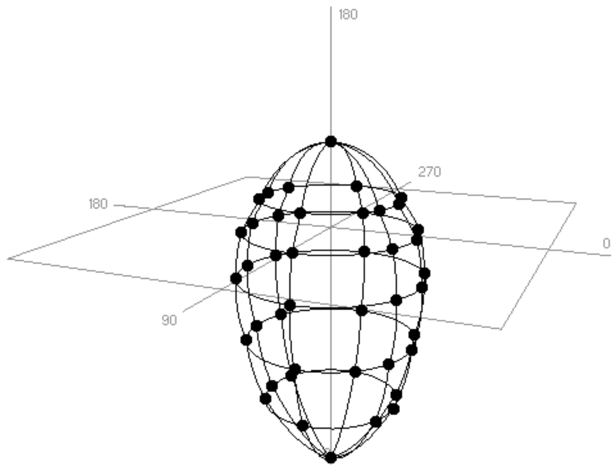


Figure 2-4. *Sample Photometric Web File*

Setting up Photometric Properties

▶ **Define the block called LITE_NARROW1 as a luminaire and set up its photometric properties.**

In this procedure you convert the block `LITE_NARROW1` into a luminaire. This causes the block to be removed from the Blocks Table and added to the Luminaires Table. This luminaire is set up as a *spotlight*, a type of point light that is directional.

The `LITE_NARROW1` will contain a R-40 150 Watt wide beam bulb with the manufacturer-specified parameters shown in Table 2-1.

Table 2-1. *LITE_NARROW1 Photometric Properties*

Source Type	Lamp Color Spec.	Color Filter (H Value)	Color Filter (S Value)	Color Filter (V Value)	Intensity Mag'tude (Lum. Int.)	Intensity Dist.	Beam Angle	Field Angle
Point	Halogen	0	0.00	1.00	5400 cd	Spot	22	50

1. Select `LITE_NARROW1` from the Blocks Table.
2. Using the right mouse button, click anywhere in the Blocks Table to open the context menu.
3. Choose Define as Luminaire from the context menu and confirm that you wish to continue.

   The Luminaire Properties for LITE_NARROW1 dialog box displays. You are now looking at the isolated luminaire.
4. In the Source Type combo box, choose Point.
5. Define the luminaire using Table 2-1.

   Set the Intensity Distribution settings before the Intensity Magnitude settings.
6. Click OK and confirm the overwrite.

   The complete model displays in the Graphic Window. `LITE_NARROW1` is removed from the Blocks Table and added to the Luminaires Table. All of the instances of `LITE_NARROW1` are now defined as luminaires.

▶ Define the block called LITE_UPLITE1 as a luminaire.

The block `LITE_UPLITE1` represents the four wall sconces. A manufacturer's IES file will be used to describe the distribution of this fixture.

The `LITE_UPLITE1` will have the parameters shown in Table 2-2.

Table 2-2. *AREAUPLIGHT Photometric Properties*

Source Type	Lamp Color Spec.	Color Filter (H Value)	Color Filter (S Value)	Color Filter (V Value)	Intensity Magnitude (Lum. Int.)	Intensity Distribution
Point	Incand.	0	0.00	1.0	3550 cd	Photo. Web

1. Select `LITE_UPLITE1` from the Blocks Table.
2. Using the right mouse button, click anywhere in the Blocks Table.
3. Choose Define as Luminaire from the context menu and confirm that you wish to continue.

   The Luminaire Properties for LITE_UPLITE1 dialog box displays. You are now looking at the isolated luminaire.
4. In the Source Type combo box, choose Point to define this luminaire as a point light.
5. In the Distribution combo box, select Photometric Web.
6. In the Name area, click Browse.

   The Open dialog box displays.
7. If necessary, change directory to:

   `c:\Program Files\lvs\projects\tutorial2`

8. Double-click `Phillips-103a.ies`.

   This selects the photometric web distribution for this particular manufacturer's fixture.

9. Define the remaining properties as shown in Table 2-2.

10. Click OK and confirm the overwrite.

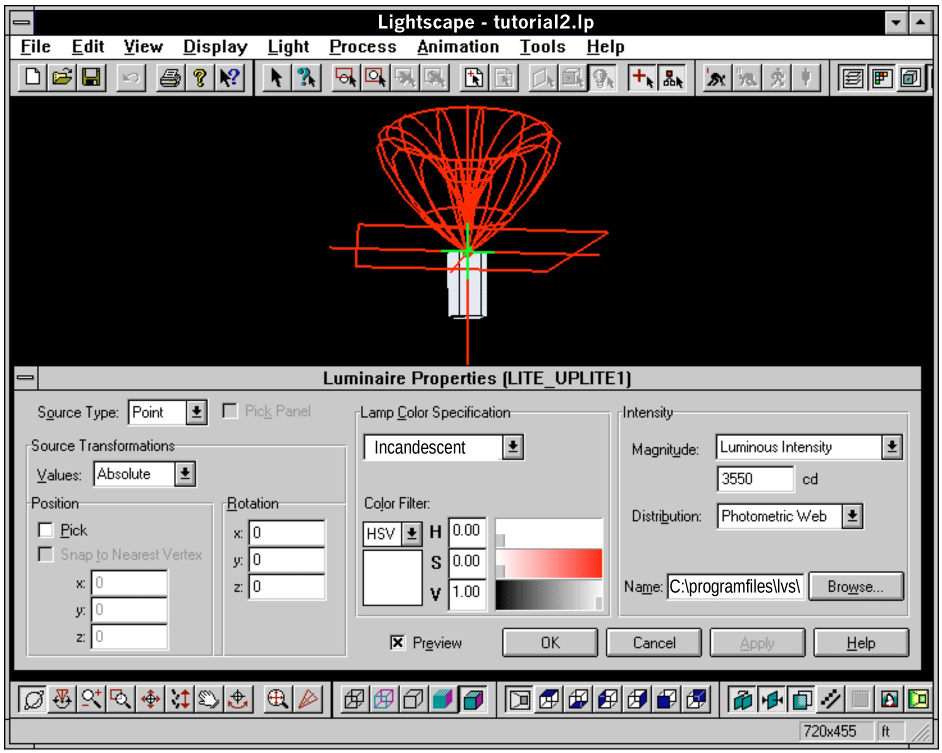


Figure 2-5. *Creating the LITE_UPLITE1 Luminaire*

The complete model displays in the Graphic Window. `LITE_UPLITE1` is removed from the Blocks Table and added to the Luminaires Table.

Save your work up to this point.

1. Choose File > Save As.
2. Change directory to:

   `c:\Program Files\lvs\projects\tutorial2`
3. Type **`temp.lp`** in the File Name input field and confirm the overwrite.
4. Click OK.

Material Basics

A material defines the appearance of a surface. Defining a material in Lightscape requires that you set both the diffuse and specular behavior of the material.

- The diffuse behavior is set by manipulating the reflective color for the material.
- The specular behavior is set by manipulating the Refractive Index, Smoothness, and Transparency sliders.

In this section, you will learn about the following:

- "Setting Specular Reflection"
- "Setting Diffuse Reflection"

You will perform the following task:

- "Changing and Refining Materials"

Setting Specular Reflection

- The amount of light reflected from a material is set by the Refractive Index slider. Typical values range between `1.0` (no specular reflection) and `2.5` (the Refractive Index for diamond)—the more light is reflected, the larger the refractive index.
- The character, how shiny or dull the reflection, is set by the Smoothness slider. If the surface is perfectly smooth, reflected images appear as they would in a mirror. A less smooth surface scatters the light in many directions and reflected images are more indistinct and appear as highlights.

- The Transparency slider controls how much of the incident energy, that is not reflected from the surface, passes through the body of the material. As it passes through the material, the energy is modulated by the reflective color of the material.

Setting Diffuse Reflection

The amount and character of the absorption and diffuse reflection of a material is set by the reflective color. Generally these should be set using HSV values which have the following effects:

- *Hue* controls the color of the absorbed and reflected light. For example, a blue material reflects more energy in the blue wavelengths and thus appears blue in color, while a red material reflects more energy in the red wavelengths and appears red in color.
- *Saturation* controls the degree of colorization of the reflected and absorbed light. Increasing the saturation deepens the color of the material and increases the amount that reflected light is colored by the surface.
- *Value* controls the amount of light reflected versus the amount of light absorbed. A value of `0.7` indicates that 70% of the incident energy is being reflected and 30% is being absorbed. Increasing the value increases the amount of light reflected by the material and should almost never be greater than `0.8`.

Changing and Refining Materials

Display the model in Outlined mode.

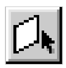
1. Adjust your view so that you are "standing" inside the room.

2. Click the Outlined button on the toolbar.

Rename the material assigned to the walls to a new name, PAINT_FLAT_DARKGREEN.

In this procedure, you will rename the materials from AutoCAD color index numbers to names. In general, you should give your materials names that are meaningful to you.

1. Click the Query Select button on the toolbar.



2. Choose Edit > Selection > Surface or click the Surface button on the toolbar.
3. Pick a point on a wall.

   The wall highlights in green and material 115 is highlighted in the Materials Table.
4. Using the right mouse button, click anywhere in the Materials Table to open the context menu.
5. Choose Rename from the context menu.

   A blinking cursor displays at the end of the item 115.
6. Type **`PAINT_FLAT_DARKGREEN`** and press Enter.

   Material 115 is renamed to `PAINT_FLAT_DARKGREEN`.

Edit the properties of this material.

1. Double-click PAINT_FLAT_DARKGREEN in the Materials Table.

   The Material Properties for PAINT_FLAT_DARKGREEN dialog box displays.

2. Click the Color tab.

   Notice the current values in the fields. Note especially that Saturation is set to 0.95 indicating that light reflected from the surface will be extremely green, changing the color of the rest of the room. Also note that Value is set to 0.45 indicating that 55 percent of the incident energy will be absorbed and 45 percent reflected. You will change both the saturation and the value.

3. Set S (Saturation) to **0.60**.

4. Set V (Value) to **0.40**.

5. Click OK.

   Notice the slight change of color on all the walls of the model.

Rename the material assigned to the trim to a new name, PAINT_OIL_WHITE.

1. Pick a point on the trim.

   The trim is highlighted in green and material 7 is highlighted in the Materials Table.

2. Using the right mouse button, click anywhere in the Materials Table to open the context menu.

3. Choose Rename from the context menu.

   A blinking cursor displays at the end of the item `7`.

4. Type **`PAINT_OIL_WHITE`** and press Enter.

▶ **Edit the properties of this material.**

1. Double-click `PAINT_OIL_WHITE` in the Materials Table.

   The Material Properties for PAINT_OIL_WHITE dialog box displays.

2. Click the Color tab.

   Observe the current values in the fields. Note especially that Value is set to `0.85` indicating that only 15 percent of the incident energy will be absorbed and 85 percent reflected. You will change only the Value as the other numbers are acceptable.

3. Set V (Value) to **`0.75`**.

4. Set the Refractive Index slider to `1.2` and the Smoothness slider to `0.5`.

   This makes the material a little specular (shiny) and makes the bounced light display as highlights rather than reflections.

5. Click OK.

▶ **Rename the material assigned to the floor to a new name, WOOD_WHITEASH.**

1. Pick a point on the floor.

   The surface highlights in green and material `43` highlights in the Materials Table.

2. Using the right mouse button, click anywhere in the Materials Table.

3. Choose Rename from the context menu.

   A blinking cursor displays at the end of the item 43.

4. Type **WOOD_WHITEASH** and then press Enter.

► Edit the properties of this material.

1. Double-click WOOD_WHITEASH in the Materials Table.

   The Material Properties for WOOD_WHITEASH dialog box displays.

2. Click the Color tab.

   Observe the current values in the fields. Note especially that Saturation is set to 0.95 indicating that light reflected from the surface will be extremely yellow, changing the color of the rest of the room.

3. Set S (Saturation) to **0.25**.

4. Set the Refractive Index slider to 1.2 and the Smoothness slider to 0.7.

   This makes the material a little specular (shiny) and makes the bounced light appear as highlights with some reflective effect.

5. Click OK.

► Rename the material assigned to the ceiling to a new name, PAINT_FLAT_WHITE.

1. Pick a point on a ceiling.

   You may need to change your view to do this.

   The surface highlights in green and material 253 highlights in the Materials Table.

2. Using the right mouse button, click anywhere in the Materials Table to open the context menu.

3. Choose Rename from the context menu.

   A blinking cursor displays at the end of the item `253`.

4. Type **`PAINT_FLAT_WHITE`** and then press Enter.

► Edit the properties of this material.

1. Double-click `PAINT_FLAT_WHITE` in the Materials Table.

   The Material Properties for PAINT_FLAT_WHITE dialog box displays.

2. Click the Color tab.

3. Set V (Value) to **`0.70`**.

4. Click OK.

► Rename the material assigned to the vases and windows to a new name, GLASS_BLUE.

1. Pick a point on one of the vases.

   The surface highlights in green and material `140` highlights in the Materials Table.

2. Using the right mouse button, click anywhere in the Materials Table to open the context menu.

3. Choose Rename from the context menu.

   A blinking cursor displays at the end of the item `140`.

4. Type **`GLASS_BLUE`** and then press Enter.

Edit the properties of this material.

1. Double-click GLASS_BLUE in the Materials Table.

   The Material Properties for GLASS_BLUE dialog box displays.

2. Click the Color tab.

   Observe the current values in the fields. Note especially that Saturation and Value are both set to extremely high values.

3. Select the Glass template in the Templates combo box.

   The template sets the specular sliders to appropriate values for a particular class of materials—here, making the material quite specular (shiny) and the bounced light appear as reflections rather than highlights.

4. Set S (Value) to **0.30**.

5. Set V (Value) to **0.8**.

   For transparent materials like glass, Value controls what is generally called the *transmissivity* of the material, or the amount of energy absorbed as the light passes through the body of the material.

6. Click OK.

Rename the material assigned to the light fixtures to a new name, PAINT_METAL_WHITE.

1. Pick a point on one of the light fixtures.

   The fixture highlights in green and material 9 highlights in the Materials Table.

2. Using the right mouse button, click anywhere in the Materials Table to open the context menu.

3. Choose Rename from the context menu.

   A blinking cursor displays at the end of the item 9.

4. Type **PAINT_METAL_WHITE** and then press Enter.

Edit the properties of this material.

1. Double-click PAINT_METAL_WHITE in the Materials Table.

   The Material Properties for PAINT_METAL_WHITE dialog box displays.

2. Click the Color tab.

   Observe the current values in the fields. Note especially that Value is set to 0.85 indicating that only 15 percent of the incident energy is absorbed and 85 percent reflected.

3. Select the Metal template in the Templates combo box.

   This deselects the Refractive Index and Transparency sliders. The Refractive Index of metals is approximated using the reflective color of the material and metals cannot be transparent.

4. Set the Smoothness slider to **0.5**.

   This makes the bounced light display as weak highlights rather than reflections.

   As metals tend to be more highly reflective than other classes of material, leave the Value unchanged.

5. Click OK.

Save your work up to this point.

You have concluded the Preparation stage and are about to enter the Solution stage. The model you are currently working on is going to be radically transformed during the initiation process. It is a good idea to save your work at this time.

1. Choose File > Save As.
2. Change directory to:

   `c:\Program Files\lvs\projects\tutorial2`

3. Type **`temp.lp`** in the File Name input field and confirm the overwrite.
4. Click OK.

Creating the Solution

In this section, you will learn about the following:

- "Understanding Process Parameters"

You will perform the following tasks:

- "Setting the Process Parameters"
- "Initiating the Preparation Model"
- "Checking the Solution"
- "Processing the Solution"

Understanding Process Parameters

During the radiosity process, the surfaces of your model are subdivided into a mesh of energy sample points. The number of mesh elements required to capture the illumination of a surface depends upon the complexity of the illumination on that surface. The greater the lighting detail, the greater the number of mesh elements that are needed to capture it accurately.

This section discusses the following process parameters:

- "Adaptive Subdivision"
- "Initiation"
- "Processing"

Adaptive Subdivision

In order to represent variations of illumination across a surface, the surface is automatically broken down into smaller pieces (elements). The radiosity process then computes the illumination from a light source to each of the corners (vertices) of each element. To maintain as efficient a solution as possible, the system starts with a coarse mesh. It automatically refines the mesh locally where large differences in light level are detected (see Figure 2-6).

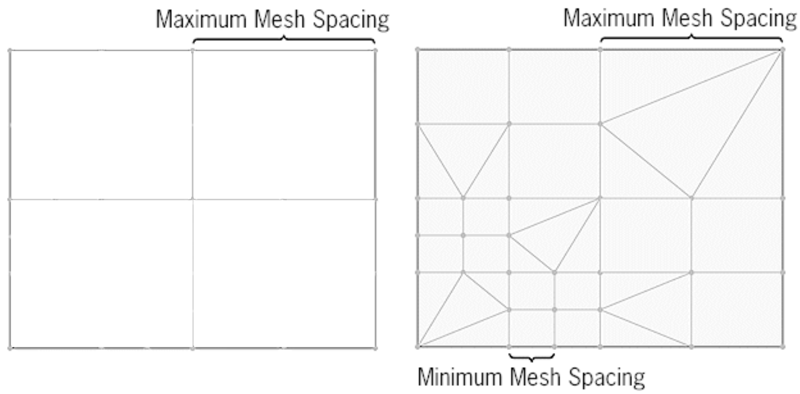


Figure 2-6. *Adaptive Subdivision*

Initiation

Initiation is the process that simplifies the geometry, materials, and lights, and produces a model that the radiosity calculations can work their magic on.

Processing

After initiation, your model is ready for the radiosity lighting simulation which is started by choosing Process > Go. The simulation is computed in successive iterations.

At each iteration, the system selects the brightest light source and computes its contribution to all the surfaces in the scene. Once all the primary light sources are accounted for, the system starts computing the interreflections of light between surfaces. At each iteration the system selects the brightest reflecting surface and computes its contribution to the rest of the environment.

This process is called progressive *refinement* because, at each iteration, the radiosity solution is refined—that is, it is a better approximation of the final result.

Setting the Process Parameters

► **Set the process parameters.**

1. Choose Process > Parameters.

   The Process Parameters dialog box displays.

   Observe the numerical values in the various boxes of the dialog. These values control the quality and speed of the Lightscape radiosity process. Although these can be set individually, you will use a wizard to set these automatically.

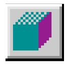
2. Click the Wizard button to activate the wizard.
3. Select the second radio button (labeled 2) to select a lower than average quality for the model.
4. Click Next to access the next page of the wizard.
5. Select No to not consider daylighting in this model.
6. Click Finish to update the process parameter based on the answer given to the wizard.

   Observe the change in the numerical values in the various boxes of the dialog.

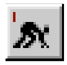
7. Click OK to close the Process Parameters dialog.

Initiating the Preparation Model

Initiate the Solution stage.



1. Choose Display > Solid or click the Solid button on the toolbar.



2. Choose Process > Initiate or click the Initiate button on the toolbar.
3. Click Yes to save changes.

   This updates the `temp.lp` model with the latest changes and causes the program to create the solution model. Notice that the filename changes to `temp.ls` when the initiation process completes. The model is dark because no light has been distributed to the scene.

Checking the Solution

Turn on ambient to check overall light level.

Ambient light distributes all the undistributed light energy evenly to all surfaces. If the model appears overly dark or overly light when Ambient is turned on before processing the model, this indicates that either the luminaires are incorrectly defined or that the model is incorrectly scaled.

1. Choose Display > Ambient.

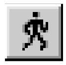
   Observe that the model's overall light level is acceptable.

2. Turn off Ambient by choosing Display > Ambient.

Processing the Solution

▶ **Start the radiosity processing.**

In this step, Lightscape calculates the light distribution in the given environment.



1. Choose Process > Go or click the Go button on the toolbar.

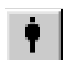
▶ **Observe the statistics as the processing continues.**

Among the statistics that display at the bottom of the Graphic Window at this time are:

- Number of iterations
- Percentage of the total energy distributed

Observe the green highlight on the screen. This lets you know which light source is being distributed at the current time.

▶ **Stop processing when the percentage of energy distributed exceeds 75%.**



1. When the percentage of energy shot exceeds 75%, choose Process > Stop or click the Stop button on the toolbar.

   The processing stops after the current iteration finishes. This may take awhile (depending on the speed of your computer).

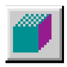
▶ **Display the model in Mesh mode and observe the way the mesh was formed.**

Lightscape gives you complete control over the quality of a solution. A quick design study does not require the same degree of quality as a final production graphic. The next several exercises compare the various process parameter settings to demonstrate the differences in processing speed and image quality.

1. Click the Outlined button on the toolbar.

Display the model in Solid mode and move it around.

Get a feel for the interactive display speed by adjusting your view.



1. Click the Solid button on the toolbar.
2. Adjust your view.

Document the statistics and take a mental snapshot of the picture.

You should, using these parameters, have approximately 14,000 mesh elements.

1. Choose Process > Statistics.

   Notice the number of mesh elements in your model as indicated in the status bar.

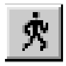
Reset the solution, increase the meshing parameters, and start processing again.

1. Choose Process > Reset or click the Reset button on the toolbar.
2. Choose Process > Parameters.

3. In the Receiver group box, set Mesh Spacing Min. to `0.13`.

   This will half the size of the smallest mesh element, increasing the quality of the solution, but also increasing the amount of meshing.

4. Click OK.



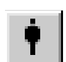
5. Click the Go button on the toolbar.

▶ Observe the difference in the length of time it takes to process the solution.

The time it takes to process increases proportionally to the increase in mesh density.

▶ Again, stop processing when the percentage of energy distributed exceeds 75%.

How much longer did it take? How much better does it look? Chances are it took a lot longer and looks only a little better. You will notice that the boundaries between the lighter and darker areas look better. This is because more mesh elements were used to represent a smoother transition.



1. Click the Stop button on the toolbar.

▶ Display the model in Mesh mode and observe the way the mesh was formed.

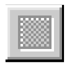
Observe where the geometry was meshed more finely.

1. Click the Outlined button on the toolbar.
2. Choose Process > Statistics.

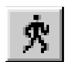
   Note the number of mesh elements in the model.

Turn on the ambient approximation, and continue the solution.

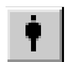
Ambient approximation takes the remaining unshot energy and distributes this evenly over all of the surfaces of the model. The model should lighten when this feature is turned on and the remaining 25% of the energy is distributed to the remaining surfaces.



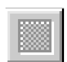
1. Choose Display > Ambient or click the Ambient button on the toolbar.



2. Click the Go button on the toolbar.



3. Click the Stop button on the toolbar when the percentage of energy distributed exceeds 85%.



4. Choose Display > Ambient or click the Ambient button on the toolbar to turn off the ambient feature.

Optimize the display speed of the solution.

As the radiosity process adds considerable additional geometry to the solution, moving the model around interactively in solution mode may be slow and cumbersome. Setting the display interactivity features allows you to increase the speed and smoothness of redraws when you are moving through the model. There are two primary ways to control the display speed:

- *Draw every nth polygon* - This only displays a certain percentage of the polygons in the model. Setting this to 2 will draw every 2nd polygon effectively doubling the display speed.

- *Level of Detail* - This only displays part of the mesh information for each original polygon. Where surfaces are distant from you in the model, only the top level lighting data is displayed. This makes these surfaces appear more crude but they will redisplay faster.

These settings only effect the display during interactive movement; the screen will redraw in full display mode once the left mouse button is released

1. Select a view of the model where you are looking through the door from outside the model.
2. Choose Edit > Properties.
3. Click the Display Interactivity tab.
4. Set the Draw Every Nth Face slider to **2**.
5. Click the Preview check box and note that only every second polygon is displayed.
6. Click Apply and then Orbit the model.

   Note the increased smoothness and speed of the display.
7. Return to the view selected above.
8. Set the Level of Detail slider to **50**.
9. Click the Preview check box.

   Note that the nice lighting detail from the up lights is now displayed much more crudely.
10. Click Apply and then Orbit the model.

    Note the increased smoothness and speed of the display.
11. Reset the sliders to their default values and click OK to close the dialog.

Refining the Solution

In this section, you will learn about the following:

- "Using Natural Lighting"

You will perform the following tasks:

- "Setting Up a Window"
- "Turning Off Lights"

Using Natural Lighting

Lightscape uses two daylight algorithms: Interior Daylight and Exterior Daylight. Each method provides the fastest and most efficient algorithms for the appropriate situation. When you are using the Interior Daylight algorithm, daylight and sunlight are only calculated through surfaces that are specified as a window or an opening.

- A window is defined such that the properties of the material assigned to a window (i.e. the material should be transparent) affect the amount and color of the light that enters the space.

- An opening is treated as if there is no surface there at all.

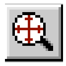
You can modify the following sun and daylight parameters by choosing Light > Daylight:

- Direction of north
- A city location
- Latitude and longitude
- Time zone
- Day of the year
- Time of day
- Daylight saving time on/off

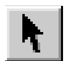
- Sun color
- Sky color
- Sky conditions

Setting Up a Window

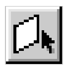
▶ **Select the surface that will be turned into windows.**



1. Choose View > Extents or click the Extents button on the toolbar.



2. Choose Edit > Selection > Select or click the Select button on the toolbar.



3. Choose Edit > Selection > Surface or click the Surface button on the toolbar.

   This sets the selection filter to select only surfaces.

4. Select the surfaces that are window panes.

   There are 16 of these. A red highlight displays as you select each one.

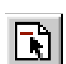
5. Using the right mouse button, click in the Graphic Window to open the context menu.

6. Select Process Control in the context menu.

   This is where you can control specific processing parameters for individual surfaces.

7. Click the Window check box to turn on this feature and click OK.

   The surfaces are now defined as windows.



8. Click the Deselect All button to clear the selection set.

Turn on Interior Daylight and then set up the Daylight parameters.

1. Choose Process > Parameters.

   The Process Parameters dialog box displays.

2. In the Process group box, click the Daylight (sunlight + skylight) check box to turn on daylight.

3. Click the Daylight through Windows and Openings only check box to turn on this feature.

4. Set the Skylight Accuracy slider to **`0.30`**.

5. Click OK.

6. Choose Light > Daylight.

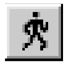
   The Daylight Setup dialog box displays.

7. Using the appropriate tabs and fields in the Daylight Setup dialog box, enter the information shown in Table 2-3.

Table 2-3. *Interior Daylight Parameters*

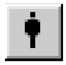
Direction of North	City Location	Latitude/ Longitude	Time Zone	Day of the Year	Time of Day	Daylight Saving Time	Sun/Sky Colors	Sky Condition
90	New York	41/74	GMT-5	6/21	5:00pm	On	Defaults	0.3

8. Click OK.



9. Click the Go button on the toolbar.

   As the processing continues, the direct energy from the sun will be distributed first. Next, the diffuse skylight component will be calculated for each of the window panes.



10. Click the Stop button on the toolbar after about 25 more iterations.

Turning Off Lights

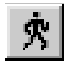
Turn off the LITE_UPLITE1 fixtures.

Although lights cannot be added or moved in the solution stage, they can be changed or deleted. With the sunlight added to the scene, the four uplites can be turned off. Once turned off, the solution must run for several iterations to remove the light energy that was emitted from the modified light sources.

1. Click the Extents button on the toolbar.
2. Select `LITE_UPLITE1` from the Luminaires Table.
3. Using the right mouse button, click anywhere in the Luminaires Table to open the context menu.
4. Choose Photometrics from the context menu.

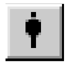
   The Luminaire Properties for LITE_UPLITE1 dialog box displays.

5. In the Magnitude area, change the intensity from `3550` to `0` cd and click OK.
6. Confirm the overwrite of the existing luminaires.



7. Click the Go button on the toolbar.

   As the processing continues, the energy from the four lights is subtracted creating a dark patch on the walls and ceiling.



8. Click the Stop button on the toolbar after several iterations.

Outputting the Results

In this section, you will learn about the following:

- "Understanding Rendering"

You will perform the following tasks:

- "Creating a Single High Quality Image"

Understanding Rendering

Rendering is the process of taking the three-dimensional radiosity solution and converting it into a two-dimensional image. With Lightscape, you can perform this operation in two ways:

- Rendering the radiosity solution as it stands.
- Adding specular and reflection lighting effects using ray tracing.

A rendering is created by selecting File > Render and setting the appropriate rendering options. The resulting images can be of any resolution. They can also be antialiased to produce higher-quality output.

Rendering Options

Lightscape can produce images of any resolution that can be output in a variety of standard file formats. The following options control the rendering process:

- *Format Type* - The Format Type selects the file format of the image. Most standard formats are supported.

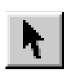
- *Resolution (size)* - The Resolution (size) of the image can be set by selecting a standard image size from the Resolution combo box or by entering values in the Width and Height input fields.
- *Antialiasing* - The level of antialiasing is used to eliminate image artifacts such as the "stepping" or "jaggies" of polygon edges.
- *Ray tracing* - Ray tracing is used in Lightscape to add specular lighting effects to the radiosity solution. This more accurately shows transparency effects and refines the primary shadows from light sources.
- *Ray Trace Direct Shadows* - The Ray Trace Direct Shadows option recomputes the direct energy contribution of the sun and selected light sources using the ray tracer. This eliminates image artifacts such as the "jaggies".
- *Ray Bounces* - The Ray Bounces input field sets the number of ray bounces used when ray tracing an image.

Creating a Single High Quality Image

► **Create a single high quality image using the ray tracer.**

1. Select a desirable view of the model.

   Be sure to include at least one of the vases in the view.



2. Choose Edit > Selection > Select or click the Select button on the toolbar.

3. Choose Edit > Selection > Luminaire or click the Luminaire button on the toolbar.
4. Select a luminaire that is positioned directly over a vase in one of the niches.

5. Using the right mouse button, click in the Graphic Window to open the context menu.
6. Select Luminaire Processing from the context menu.
7. Click the Ray Trace Direct Illumination check box to turn on ray tracing for these luminaires and click OK.
8. Choose File > Render.

   The Rendering dialog box displays.
9. Choose the Targa (TGA) format from the Format combo box.
10. Type **`ray`** in the Name input field in the Output File group box.
11. Select Two in the Antialiasing combo box.

    Antialiasing over- samples pixels to remove "jaggies" along the edges of objects.
12. In the Resolution combo box, choose Full Window.
13. Click the Ray tracing check box to turn on ray tracing.
14. Click the Ray Trace Direct Illumination check box to turn on this feature.

    This will create better direct shadows by ray tracing the sun and the luminaires selected above.
15. Type **`10`** in the Ray Bounces field.
16. Click OK and confirm the additional processing.

    Lightscape now ray traces the model. Soon you will see the specular reflections from the vases that were not visible in the diffuse radiosity model. In addition to displaying the ray traced results in the Graphics Window, they are saved to the `ray.tga` filename above. You can use the LVu utility to view the `ray.tga` file.

Lighting Analysis

The radiosity solution contains all the information necessary for performing lighting analysis:

- You can visualize the distribution of light over the surfaces in the environment by using pseudo-coloring techniques.
- A grid of illumination values can be superimposed over selected surfaces.
- Statistical data such as averages, minima and maxima, and criterion ratings are presented interactively for any surface in the scene on the Statistics tab in the Lighting Analysis dialog.

In this section, you will perform the following tasks:

- “Performing Lighting Analysis”
- “Saving and Exiting”

Performing Lighting Analysis

▶ **Check the lighting analysis of the solution.**

1. Choose View > Extents.
2. Choose Light > Analysis.
3. Click the Display tab.
4. Select Color from the Display combo box.
5. Set Scale Max to **`2000`** lx.

   Lux is an international unit for specifying luminance. To display in foot candles, choose Edit > Properties, click the Units tab, and choose American in the Lighting combo box.

6. Click Apply.
7. Click the Statistics tab.

8. Pick a point on a wall.

   Notice the values that appear on the Statistics page.

9. Click the Grid tab.

10. Click the Grid check box to turn on this feature.

11. For X, Y, and Z, set the spacing to **3**.

12. Set Grid Labels Precision to **4** digits.

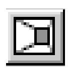
13. Click Apply.

14. Choose View > Projection > Top.

15. Pick a point on the floor.

    Notice the grid of illuminance values that displays on the floor.

16. Click Cancel.



17. Click the Perspective button on the toolbar.

Saving and Exiting

Congratulations! You have completed Tutorial 2.

1. Choose File > Save As to save this file.

   The Save As dialog box appears.

2. In the File Name input field, type a name for the new file and click OK.

3. Choose File > Exit and confirm.

Going Further

You have reached the end of Tutorial 2. At this point you should understand:

- How to import DXF files
- Basics of setting materials
- How to create luminaires
- Adaptive meshing and how to control the quality of a radiosity solution
- How to set up interior daylighting options
- How to perform an analysis of the lighting data in the model

To learn more about the Lightscape Visualization System, do the following:

▶ **Open the sample solution files.**

The Lightscape Installation media contains a number of sample solution files which you can use for experimenting. To install these files:

1. Perform a Custom installation.
2. Select only the Sample Files from the list items to install.
3. Once installed, open one of these sample files in Lightscape.
4. Observe the way the mesh was created, the way materials were defined, the way luminaires were defined, and so on.

   This gives you a feel for the performance of different models.
5. Try resetting the solution and experimenting with different process parameters.

▶ **Do the remaining tutorials for more examples of working with Lightscape.**

Tutorial 3 Exterior Models - Importing 3D Studio

In this tutorial, you will import a 3D Studio model and follow the typical steps for preparing files from 3D Studio. Additionally, as this is an exterior model, you will set parameters and process it in a slightly different way. At the end of the tutorial, you will preview the animation imported with the 3DS file.

The goal of this tutorial is to render the model used to create the image in Figure 3-1.

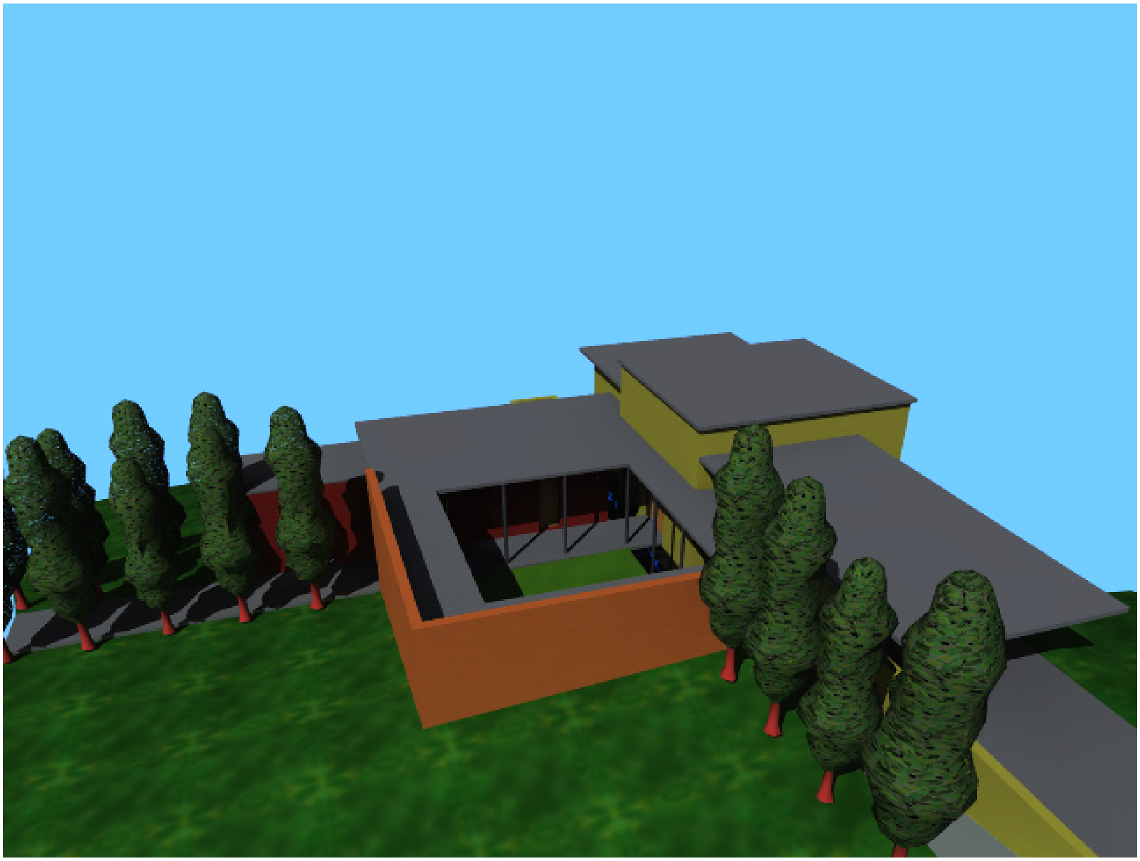


Figure 3-1. *Sample of Rendered Image from Tutorial 3*

How Tutorial 3 is Organized

This tutorial contains the following sections and lessons:

Getting Data

In this exercise, you will perform the following tasks:

- "Starting Lightscape"
- "Importing 3D Studio Files"
- "Importing Geometry"

This section also includes "Using Good Modeling Practices" on page 5. This discussion provides information about modeling practices to keep in mind when you use Lightscape.

Starting Lightscape

▶ **Start Lightscape.**

1. In the Lightscape Applications window group, double-click the Lightscape icon.

   If you are running Windows NT 4.0 or Windows 95, you can also start Lightscape by choosing it from the Start menu.

   The Lightscape graphical user interface displays on the screen.

▶ **Turn on all toolbars.**

This tutorial makes extensive use of the toolbars to execute commands more easily.

1. Choose Tools > Toolbars.

   The Toolbars dialog box displays.

2. Double-click any item that does not have a check mark in front of it to turn on that toolbar.

3. Click Close when you are done.

Using Good Modeling Practices

There are several modeling habits to get into when creating models for import into Lightscape. Because Lightscape calculates the relationship between light and surfaces, it is important to:

- Model only those surfaces that are physically apparent.

  During each iteration, Lightscape looks at each and every surface to calculate the effect of the current light source on it. Extraneous surfaces (such as the inside surfaces of walls which never receive light) will increase processing time.

- Create large contiguous surfaces rather than many small discrete surfaces.

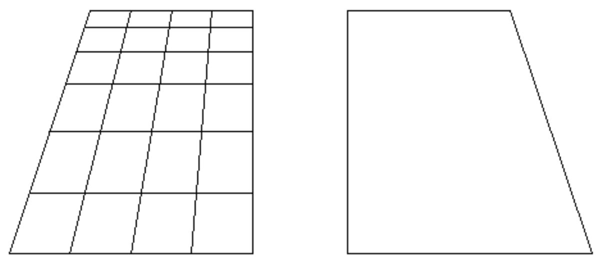


Figure 3-2. *Surface on the Right Processes More Efficiently*

  Where more than one surface is used to represent a plane, each of the surfaces must be considered separately when reflecting energy into the environment, increasing processing time.

- Surfaces that are occluded by other surfaces should be modeled as two or more separate surfaces.

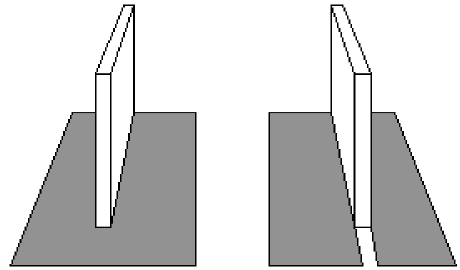


Figure 3-3. *Floor on the Right Reduces Occlusion Artifacts*

For example, where a wall intersects a floor plane, the floor surface should be made of two surfaces, not one.

- Model surfaces in the most efficient way possible.

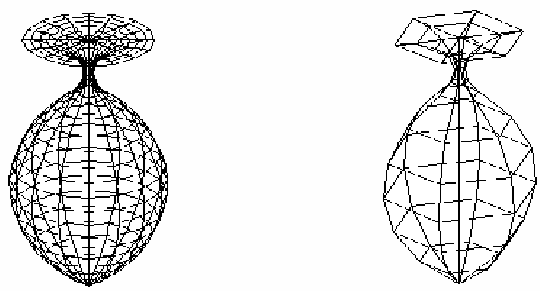


Figure 3-4. *Complex Geometry Processes Faster When Modeled Efficiently, As Shown on the Right*

When creating a revolved surface, set the tessellation complexity of the object to a coarse value, and use smoothing within Lightscape to get the volumetric effect.

- Where possible, surfaces should be modeled as regular polygons.

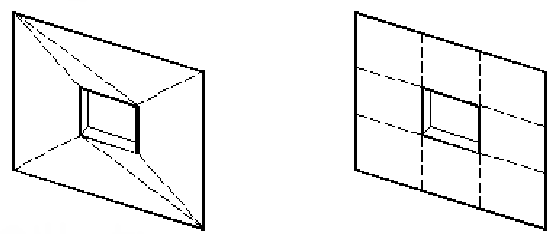


Figure 3-5. *Surfaces with Openings Are Best Modeled As Shown On the Right*

Many shadow artifacts are the product of meshing strangely shaped surfaces (such as adjacent, long, thin, triangular surfaces). Rectangular polygons and equilateral triangles produce the best effects.

Importing 3D Studio Files

Lightscape imports 3D Studio scenes, creating a polygonal mesh based on the objects stored in the 3D Studio file.

Blocks and Layers

Setting how 3D Studio mesh objects are organized in the block and layer structure of Lightscape is important for organizing data efficiently. By default, each mesh object is associated to its own separate layer. This breaks the model into discrete parts, which can then be easily edited. Blocks can be created from each mesh object as an alternate organizing strategy.

Maximum Light Intensity Scale

When 3D Studio lights are imported into Lightscape, their luminous intensity is scaled by the value indicated in the input field. For example, a 3D Studio light with an intensity of 128 (half-way across the slider) is set to 1250 candela if the default value of 2500 candela is selected.

Materials

When 3D Studio materials are imported into Lightscape, they are mapped into Lightscape materials of the same name. If a diffuse color has been assigned in 3D Studio, this will be used to create the Reflective color for the material. Shininess and shininess strength are used to set the Refractive Index and Smoothness values. Where it exists, Texture 1 is assigned as the single texture map in Lightscape.

Camera Paths

3D Studio camera paths are imported into Lightscape, creating `.la` files (Lightscape animation files) whose name is a combination of the 3DS file name and the camera number in 3D Studio.

Importing Geometry

► **Load the 3D Studio file called `tutorial3.3ds`.**

1. Choose File > Import > 3D Studio.

   The Import 3D Studio dialog box displays.

2. In the Name area, click Browse.

   The Open dialog box displays.

3. Change directory to:

   `c:\Program Files\lvs\projects\tutorial3`

4. Double-click `tutorial3.3ds`.

5. In the File Units area, choose Feet in the combo box.

   This is the unit of measurement with which the model was created.

6. Change the Maximum Light Intensity Scale to **`100000`**.

   This is an exterior model with a single light source representing the sun. If you want to render the scene using the artificial sun source, it is important that you scale the light source accordingly. Later in this tutorial, we will remove this source and use Lightscape's implementation of natural daylight instead.

7. Click OK.

   Notice that the message box reports that the model is `165 x 137 x 60.9249 feet`.

8. Click Yes to open and display the file.

Preparing Data

In this exercise, you will perform the following tasks:

- "Assigning Procedural Textures"
- "Loading and Placing Light Fixtures From a Library"
- "Setting the Local Process Parameters"
- "Setting the Global Process Parameters"

Assigning Procedural Textures

A procedural texture modulates the color of a surface, making it appear visually more interesting. While Lightscape reads much of the material data when importing 3D Studio files, it does not read procedural textures. You will need to re-create these in Lightscape.

There are two methods for generating procedural texture maps in Lightscape:

- "Intensity Mapping"
- "Bump Mapping"

Intensity Mapping

Intensity mapping varies the reflectance of the material, resulting in smooth variations in intensity over the surface. These variations can have the effect of making a surface look dirty or slightly wavy.

- The Width (specified in real units) controls the size of each intensity patch.
- The Amount controls the variation in intensity.

- The Layers controls the number of intensity layers of slightly different period to be added together. When several layers are added together, the intensity has fractal-like properties, sometimes called *turbulence*.

Bump Mapping

Bump mapping creates the appearance of bumps or dimples on the surface.

- The Width (specified in real units) sets the distance between bumps on the surface.
- The Height sets the height of the bumps relative to their width. A negative value turns every bump into a depression.
- The Clamp sets the amount of the surface that will have the bump map applied to it. The smaller the value, the less of the surface that will have bump mapping applied to it.

▶ **Assign a wavy procedural texture to the water.**

1. Choose Display>Textures or click the Textures button on the toolbar to turn off textures, if necessary.

   This avoids redraws as the materials are updated.

2. Double-click `WATER` from the Materials Table.

   The Material Properties dialog box displays with the `WATER` properties.

3. Click the Procedural Texture tab in the Material Properties dialog.
4. Turn on Bump Mapping.
5. Enter **`0.25`** in the Width input field.
6. Adjust the Height slider to **`1.0`**.

7. Adjust the Clamp slider to **1.0**.

8. Click OK to update the material and close the dialog.

   The procedural texture is only apparent when an image is ray traced. The water will have a wavy appearance.

▶ **Assign a noise procedural texture to the ground.**

1. Double-click GROUND from the Materials Table.

   The Material Properties dialog box appears with the GROUND properties.

2. Click the Procedural Texture tab in the Material Properties dialog.

3. Turn on Intensity Mapping.

4. Enter **3.0** in the Width input field.

5. Adjust the Amount slider to **0.3**.

6. Adjust the Layers slider to **3**.

7. Click OK to update the material and close the dialog.

   The procedural texture is only apparent when an image is ray traced. The grass will have a color variation over its surface.

▶ **Assign stucco procedural textures to the walls.**

1. Select WALLS, WALL_RED, and WALL_ORANGE from the Materials Table.

   You can select more than one object from a table by holding down the **Ctrl** key while selecting objects.

2. Using the right mouse button, click in the Materials Table and select Edit Properties from the context menu.

   The Material Properties for Multiple Selections dialog box shows those properties which are common to the three materials. Notice on the Color tab there are no numeric settings for the diffuse color, for example, but the Refractive Index slider is set to `1.0`, which is how all three materials are currently set.

3. Click the Procedural Texture tab in the Material Properties dialog.
4. Turn on Bump Mapping.
5. Enter **`0.05`** in the Width input field.
6. Adjust the Height slider to **`0.5`**.
7. Adjust the Clamp slider to **`1.0`**.
8. Click OK to update the three materials and close the dialog (see Figure 3-6).

   The procedural texture is only apparent when an image is ray traced. The walls will have a stucco-like finish.

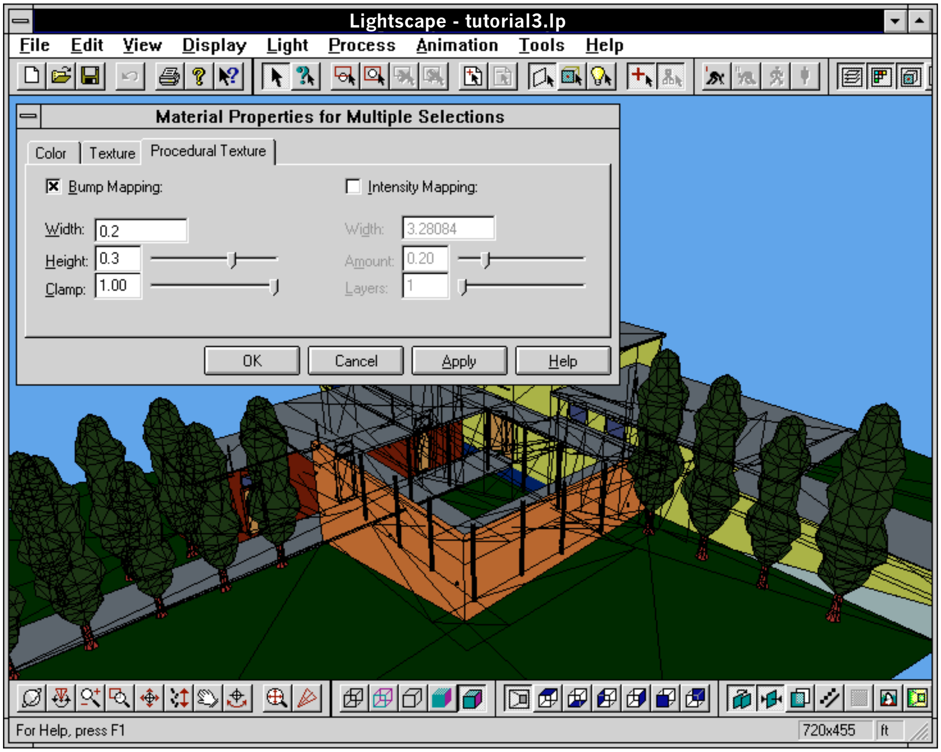
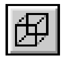


Figure 3-6. *Setting Bump Mapping for Multiple Materials*

Loading and Placing Light Fixtures From a Library

Lightscape can store blocks and luminaires from any model in a block library. The library contains the complete definition of the entity—its geometry, material, surface properties, and, in the case of luminaires, the photometric definition of the source. Once stored in a library, blocks and luminaires can be accessed in any Lightscape model. Where an instance of the block already exists, the new definition of the block overwrites the definition in the file. This is a powerful feature that allows you to change from one version of a block to another—from a simple to a complex representation of the same object, for example.

Load two luminaires from the Block Library tutorial3.blk.



1. Click the Wireframe button on the toolbar.
2. Using the right mouse button, click anywhere in the Luminaires Table to open the context menu.
3. Choose Load from the context menu.

   The Open dialog box displays.
4. Change directory to:

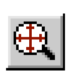
   `c:\Program Files\lvs\projects\tutorial3`
5. Double-click `tutorial3.blk`.

   The Available Luminaires dialog box displays.
6. Select `LITE_EXTERIOR1` and `LITE_EXTERIOR2` from the Available Luminaires dialog box.
7. Click OK.

   The two luminaires are added to the Luminaires Table.

Add an instance of the LITE_EXTERIOR1 luminaire at the front entrance.

1. Turn off all layers except `DOOR1` and make this the current layer.
2. Ensure that you are in perspective view.



3. Choose View > Extents or click the Extents button on the toolbar.

4. Select LITE_EXTERIOR1 from the Luminaires Table.

5. Using the right mouse button, click anywhere in the Luminaires Table to open the context menu.

6. Choose Create Single Instance from the context menu.

   An instance of the light is added and highlighted.

7. Choose Edit > Transformation, or using the right mouse button, click anywhere in the Graphic Window and choose Transformation from the context menu.

   The Transformation dialog box displays.

8. Click the Position tab.

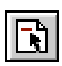
9. Choose Pick from the Values combo box.

   Ensure that the Snap to Nearest Vertex option is turned off.

10. Using the left mouse button, pick a point in the ceiling of the alcove centered above the door.

    This places the luminaire on the frame pointing down towards the ground.

11. Click Cancel to close the Transformation dialog box.



12. Click the Deselect All button on the toolbar.

Replace the surfaces on the LITE layers with the block LITE_EXTERIOR2.

When a modeling program supports a block structure, the most efficient way to create luminaires is to create blocks, which can later be turned into luminaires. In modeling packages that do not support a block structure, the best technique is to create a single surface as a placeholder for each luminaire. That surface is then replaced by a luminaire within Lightscape.

1. Using the right mouse button, click anywhere in the Layers Table to open the context menu.
2. Choose All Off from the context menu.
3. Using the right mouse button, click in the Layers Table and choose Select Pattern from the context menu.
4. Type **LITE*** in the select field and click Select.

   This selects all layers beginning with the string “LITE”.
5. Using the right mouse button, click anywhere in the Layers Table to open the context menu.
6. Choose On from the context menu.

7. Choose View > Extents or click the Extents button on the toolbar.

   There are now 13 triangular surfaces on the screen. You may wish to orbit and look at the model from above to confirm this.
8. If you orbited, then choose Edit > Selection > Select, otherwise go to step 9.

9. Choose Edit > Selection > Surfaces or click the Surface button on the toolbar.

10. Click the Select All button on the toolbar.

    The surfaces on the layers are highlighted.
11. Using the right mouse button, click in the Graphic Window to open the context menu.

12. Choose Replace With Block/Luminaire.
13. Select `LITE_EXTERIOR2` from the block/luminaire list.
14. Click OK.

    The selected surfaces are replaced with the luminaire.

15. Turn all layers back on.

Delete the 3D Studio Sun.

Because Lightscape uses a “real” sun, you can now delete the `Light01` light (representing the sun) that was created in 3D Studio.

1. Choose View > Extents or click the Extents button on the toolbar.

   The view of the model gets quite small on the screen. This is because the `Light01` object was placed a large distance from the model.

2. Select `Light01` in the Luminaires Table.
3. Using the right mouse button, click anywhere in the Luminaires Table to open the context menu.
4. Choose Query Instances from the context menu.

   A small green light icon displays in the upper right corner of the screen identifying the luminaire.

5. Using the right mouse button, click in the Luminaires Table and select Delete.

   The 3D sun source is deleted from the model and the Luminaires Table.

6. Choose View > Extents or click the Extents button on the toolbar.

   The model now occupies a more reasonable portion of the screen.

Setting the Local Process Parameters

Local process parameters alter the global settings for selected surfaces. This allows you to make the meshing more accurate in areas of interest or need, and less accurate in other areas of the model. This is especially important in the exterior model, which has some very large surfaces. Where these contribute negligibly to the scene (the roof which reflects light up to the sky but doesn't reflect light on any surface in the model), you can set them to be largely ignored in the solution. The parameters that you can control locally are:

- *Mesh Resolution* - this parameter scales the minimum and maximum mesh spacing for the selected surfaces and is used to improve the quality of a radiosity mesh on individual surfaces or economize the number of mesh elements on other surfaces where they are needed less. A value of 2 will decrease the size of the Receiver Mesh Spacing Min and Max values for this surface by half thereby potentially quadrupling the number of mesh elements on this surface. A value of 0.5 will increase the size of the Receiver Mesh Spacing Min and Max values for this surface by two thereby potentially decreasing the number of mesh elements on this surface by 75%.
- *No Mesh* - the surface is not meshed at all. Only the original vertices will be used in the radiosity calculation.
- *Occluding* - controls whether a surface casts a shadow or light goes straight through it unaffected.

- *Receiving* - when receiving is off, the surface is not calculated in the radiosity solution. You can turn this parameter off to save computation time on a surface that is self-emitting (for example, an area light source).
- *Reflecting* - when reflecting is off, a surface will not reflect the light incident on it back into the environment.

Remove meshing for all surfaces on the TREE (TREE01, TREE02…) layers.

This prevents any adaptive subdivision meshing from taking place on these surfaces. It is a way of economizing on the number of total mesh elements in the model.

1. Using the right mouse button, click anywhere in the Layers Table to open the context menu.
2. Choose All Off from the context menu.
3. Using the right mouse button, click in the Layers Table and choose Select Pattern from the context menu.
4. Type **TREE*** in the Select field and click Select.

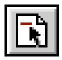
   This selects all layers beginning with the string “TREE”.
5. Using the right mouse button, click anywhere in the Layers Table to open the context menu.
6. Choose On from the context menu.

   Only the trees in the model are displayed.

7. Choose View > Extents or click the Extents button on the toolbar.

8. Choose Edit > Selection > Surface or click the Surface button on the toolbar.

9. Click the Select All button on the toolbar.
10. Using the right mouse button, click anywhere in the Graphic Window to open the context menu.
11. Choose Process Control from the context menu.
12. Click the No Mesh check box to turn on this feature.
13. Click OK.

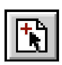


14. Click the Deselect All button on the toolbar.

Turn on the ROOF layers and set all of the visible surfaces to nonreflecting.

This prevents Lightscape from computing the light energy that is reflected from these surfaces. The actual amount of light that would be reflected from these surfaces is insignificant in proportion to the rest of the model, so you can save some computational time.

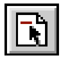
1. Select EXTROOF1 and EXTROOF2 in the Layers Table.
2. Using the right mouse button, click anywhere in the Layers Table to open the context menu.
3. Choose On from the context menu.



4. Click the Select All button on the toolbar.

   The roof and the trees are now selected.
5. Using the right mouse button, click anywhere in the Graphic Window to open the context menu.
6. Choose Process Control from the context menu.
7. Turn off Reflecting.

8. Click OK.



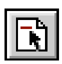
9. Click the Deselect All button on the toolbar.

Minimize the amount of meshing on the ROOF layer.

Assuming that you will normally view the building from eye level, the roof does not need to be meshed to the same level of detail as the rest of the building.

1. Turn off all layers except `EXTROOF1` and `EXTROOF2`.

2. Click the Select All button on the toolbar.
3. Using the right mouse button, click anywhere in the Graphic Window to open the context menu.
4. Choose Process Control from the context menu.
5. Slide the Meshing slider to the left until you reach `0.2` or enter **`.2`** in the entry field.
6. Click OK.



7. Click the Deselect All button on the toolbar.

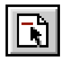
Make the surfaces on the GROUND layers non-occluding.

This prevents Lightscape from computing whether these surface create shadows on other surfaces. Since there are no surfaces below the ground onto which to cast shadows, there will be no shadows, so again you can save some computational time.

1. Turn off all layers.
2. Double-click `GROUND` in the Layers Table to turn on the layer.

3. Click the Select All button on the toolbar.

4. Using the right mouse button, click anywhere in the Graphic Window to open the context menu.
5. Choose Process Control from the context menu.
6. Turn off Occluding.
7. Click OK.



8. Click the Deselect All button on the toolbar.
9. Turn all of the layers back on and return to the original view of the model.

Setting the Global Process Parameters

Set the process parameters.

1. Choose Process > Parameters.

   The Process Parameters dialog box displays.

   Observe the numerical values in the various input fields of the dialog. These values control the quality and speed of the Lightscape radiosity process. Although you can set these manually, you will use a wizard to set them automatically. You may refine one or more parameters at any time.

2. Click the Wizard button to activate the wizard.
3. Select the first radio button (labeled 1) to select the lowest quality for the model.
4. Click Next to access the next page of the wizard.
5. Select No, do not consider daylighting in this model.

   You are creating a night solution first, so you do not consider daylighting.

6. Click Next to access the next page of the wizard.

7. Click Finish to update the process parameters based on the answers given to the wizard.

   Observe the change in the numerical values in the various boxes of the dialog.

8. In the Receiver group box, set the Mesh Spacing Min to **`0.25`**.

   This will allow for finer meshing.

9. In the Tolerances group box, set the Initialization Minimum Area to **`12`**.

   This helps to improve the proportions of the geometry during initiation.

10. Click OK to close the Process Parameters dialog.

▶ Save your work up to this point.

1. Choose File > Save As.

2. Change directory to:

   `c:\Program Files\lvs\projects\tutorial3`

3. Type `temp.lp` in the File Name input field.

4. Click OK to save the file.

   If you are running Windows NT 4.0 or Windows 95, you may click Save.

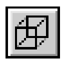
Creating the Solution

In this exercise, you will perform the following tasks:

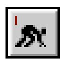
- "Initiating the Preparation Model"
- "Creating a Night Solution for the Courtyard"
- "Processing the Solution"
- "Creating a Daytime Solution for the Full Model"

Initiating the Preparation Model

▶ **Initiate the Solution stage.**



1. Choose Display > Wireframe or click the Wireframe button on the toolbar.



2. Choose Process > Initiate or click the Initiate button on the toolbar.

Creating a Night Solution for the Courtyard

▶ **Turn off some layers.**

It is possible to consider only part of the model when creating a solution. This can be used to create multiple solution options or to quickly test illumination levels with only rudimentary parts of the model displayed. Since the only illumination at night in this model is in the courtyard, you will turn off all the layers that cannot be seen from the courtyard; the trees, ground plane, and the windows.

1. Select a view inside of the courtyard.
2. Double-click GROUND in the Layers Table to turn off this layer.
3. Using the right mouse button, click in the Layers Table and choose Select Pattern from the context menu.

4. Type **TREE*** in the Select field and click Select.

   This selects all layers beginning with the string "TREE".

5. Using the right mouse button, click anywhere in the Layers Table to open the context menu.

6. Choose Off from the context menu.

   This turns the tree layers off.

7. Using the right mouse button, click in the Layers Table and choose Select Pattern from the context menu.

8. Type **WIND*** in the select field and click Select.

   This selects all layers beginning with the string "WIND".

9. With the right mouse button, click anywhere in the Layers Table to open the context menu.

10. Choose Off from the context menu.

    This turns off the window layers.

▶ Save a Layer State.

When you are working with many layers that are being switched on and off, it is beneficial to save the state of these layers in a separate file for use at a later time. This file is known as a Layer State file and has the file extension `.lay`. It records all of the layer names and their current state—whether off or on—and also whether the layer is the Current layer.

1. Using the right mouse button, click in the Layers Table and choose Save State from the context menu.

2. Change directory to:

   c:\Program Files\lvs\projects\tutorial3

3. Type `noland.lay` in the File Name input field.

4. Click OK to save the file.

   This will allow you to easily return to this state by choosing Load State from the Layer Table context menu. This layer state file will also appear in the Most Recently Used list at the bottom of this context menu.

▶ **Adjust the brightness.**

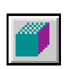
Brightness adjusts the color range of the displayed image for your monitor. It does not affect the actual lighting levels in the model. Some scenes, such as exterior models, contain extreme differences between the brightest and dimmest regions of the environment. You can use brightness and contrast to achieve a more appealing balance of light levels in such cases.

Brightness and contrast affect the display of solution files only.

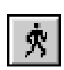
1. Choose Edit > Properties.
2. Click the Display tab.
3. Set Brightness to **75**.
4. Set Contrast to **50**.
5. Click OK.

Processing the Solution

▶ **Start the radiosity processing.**



1. Choose Display > Solid or click the Solid button on the toolbar.



2. Choose Process > Go or click the Go button on the toolbar.
3. Continue processing for about 35 iterations and stop the process.

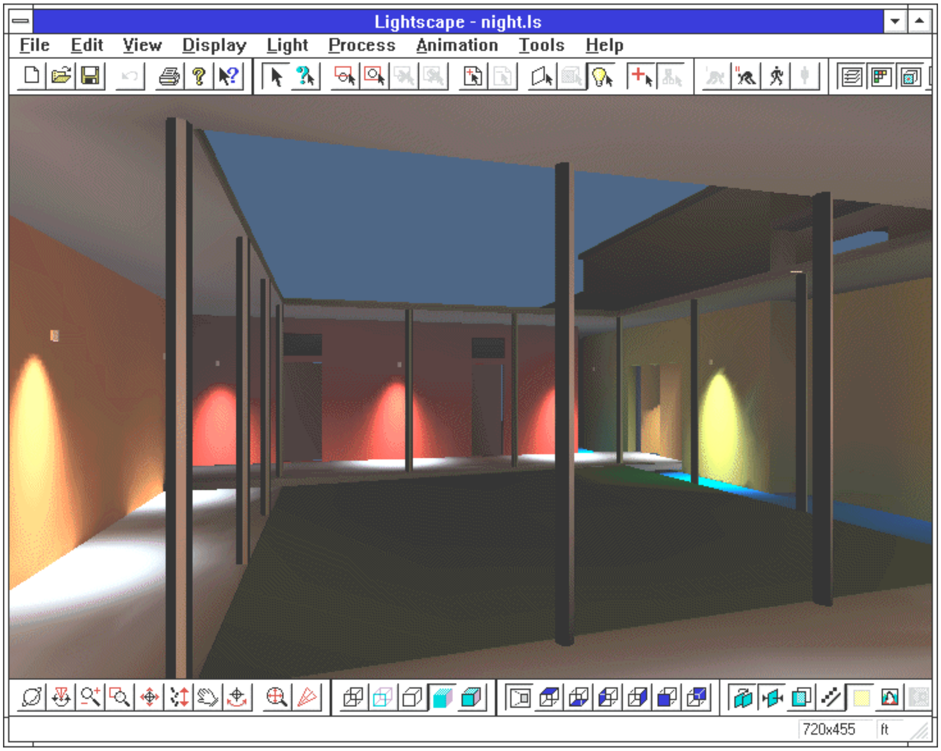


Figure 3-7. *A Night Time View of the Courtyard*

▶ Save the night solution.

1. Choose File > Save As.
2. Change directory to:

   `c:\Program Files\lvs\projects\tutorial3`

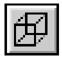
3. Type **`night.ls`** in the File Name input field.
4. Click OK to save the file.

   If you are running Windows NT 4.0 or Windows 95, you may click Save.

▶ **Reset the solution and turn on all of the layers.**

1. Choose Process > Reset or click the Reset button on the toolbar.

   The model displays black.



2. Choose Display > Wireframe or click the Wireframe button on the toolbar.
3. Using the right mouse button, click in the Layers Table to open the context menu.
4. Choose All On to turn all of the layers back on.

5. Choose View > Extents or click the Extents button on the toolbar.

Creating a Daytime Solution for the Full Model

Lightscape uses two daylight algorithms: Interior Daylight and Exterior Daylight. For an exterior model, you need to indicate the sun position and set the exterior daylight options on the Process Parameters dialog. Although you can set the sun location by specifying latitude, longitude, and time of day, you can also set the sun location directly. Lightscape calculates both the direct sunlight and diffuse skylight contributions. The diffuse skylight contribution looks at the entire sky when performing this calculation - the light on south facing surfaces being different than that on north facing surfaces. This calculation can be expensive in exterior models so controlling its accuracy is important.

It is also possible to set the system so that daylight can be recalculated by the ray tracer when rendering. This can be important with exterior models which tend to have large ground planes, which if they were meshed extremely finely (to capture shadow boundaries) would create a prohibitive number of mesh elements. A cruder mesh (sufficient for calculating the interreflection of light) can be set instead and the fine shadow detail later created in the ray tracer.

► **Set the Daylight parameters.**

1. Choose Process > Parameters.

   The Process Parameters dialog box displays.

2. Click the Wizard button to activate the wizard.
3. Select the first radio button (labeled 1) to select the lowest quality for the model.
4. Click Next to access the next page of the wizard.
5. Select Yes, to consider daylighting in this model.
6. Click in the radio button next to the item The model is an exterior of a building or object.
7. Click Next to access the next page of the wizard.
8. Click Finish to update the process parameters based on the answers given to the wizard.

   Observe the change in the numerical values in the various boxes of the dialog.

9. Click OK to close the Process Parameters dialog.
10. Choose Light > Daylight.

    The Daylight Setup dialog box displays.

11. Click the Direct Control check box to turn on this feature.

    The Direct Control tab replaces the Time and Place tabs in the dialog.

12. Click the Direct Control tab in the Daylight Setup dialog.
13. Set the Rotation of the sun to **`315 degrees`**.
14. Set the Elevation of the sun to **`45 degrees`**.
15. Set the Sun Illuminance to about **`131835 lux`** or full brightness.
16. Click the Processing tab in the Daylight Setup dialog.
17. Ensure that all the check boxes, except the Ray Trace Direct Illumination in the Sky Light area, are turned on.

    This sets up the model so that sunlight and skylight are both calculated and displayed in the radiosity solution, and only the direct sunlight ray traced during image processing.

18. Click OK to update the sun parameters and close the dialog.

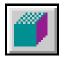
▶ Save your work up to this point.

1. Choose File > Save As.
2. Change directory to:

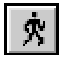
    `c:\Program Files\lvs\projects\tutorial3`

3. Type **`day.ls`** in the File Name input field.
4. Click OK to save the file.

▶ Process the solution.



1. Choose Display > Solid or click the Solid button on the toolbar.



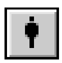
2. Choose Process > Go or click the Go button on the toolbar.

   The first iteration which calculates the direct sunlight should be fairly quick. The next iteration calculating the skylight contribution may take some time.

3. Let the process run for several iterations.

   Because the direct contribution from the sun is extremely large compared to the bounced light from the surfaces in the model, there will be little visible change as the process continues to run.

▶ Stop the processing and save your work.



1. Choose Process > Stop or click the Stop button on the toolbar.
2. Choose File > Save.

Outputting the Results

In this exercise, you will perform the following tasks:

- "Ray Tracing a Region"
- "Previewing an Existing Animation"
- "Saving and Exiting"

Ray Tracing a Region

Ray trace a part of the screen to partially preview the final image.

It is possible in Lightscape to preview the effects of ray tracing for only part of the image displayed on the screen. This is useful when only part of an image contains interesting ray trace effects and you wish to ensure that these are going to be displayed correctly.

1. Choose a view of the model where surfaces (the walls of the buildings and the water) that have procedural textures applied to them are visible.

   To best see these effects the view should be relatively close to the building.

2. Choose Display > Ray Trace Area Options.

   The Ray Trace Area Options dialog displays.

3. Ensure that Antialiasing Samples is set to **One** and Ray Bounces is set to **10** and that all the other options are turned off.

4. Click OK to close the Ray Trace Area Options dialog.

5. Choose Display > Textures or click the Texture button on the toolbar to turn this feature on.

6. Choose Display > Ray Trace Area or click the Ray Trace Area button on the toolbar.

7. Drag a window over part of the model in the Graphic Window.

   The area in question now ray traces displaying the bump and intensity effects from the ray tracer.

8. Choose Display > Ray Trace Area Options.

   The Ray Trace Area Options dialog displays.

9. Click the Ray Trace Direct Illumination check box to turn this option on.

   This more accurately displays the shadows from the sun when the area is ray traced.

10. Click OK to close the Ray Trace Area Options dialog.

11. Drag a window over part of the model in the Graphic Window.

12. Click OK to accept the additional processing.

    The area in question now ray traces displaying the bump and intensity effects as well as ray traced sun shadows.

Previewing an Existing Animation

▶ **Load an animation and preview it.**

A Lightscape animation file named `tutorial3.la` was created when the 3D Studio file was imported into Lightscape. This animation file contains an animation path based on CAMERA01 motion in 3D Studio.

1. Choose Animation > Open.

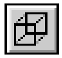
   The Open dialog box displays.

2. Change directory to:

   `c:\Program Files\lvs\projects\tutorial3`

3. Double-click `tutorial3.la`.

   This loads the animation file into memory.



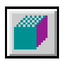
4. Choose Display > Wireframe or click the Wireframe button on the toolbar.

5. Choose Animation > Edit.

6. Click the Preview tab.

7. Move the Animation dialog box out of the way.

8. Click the Play button.



9. Choose Display > Solid or click the Solid button on the toolbar.

10. Click the Rewind button.

11. Click the Play button.

    Note that the animation was smoother in wireframe mode. This is because more frames per second can be displayed in non-solid modes.

12. Click Close when you are done viewing the animation.

Saving and Exiting

Congratulations! You have just completed Tutorial 3.

1. Choose File > Save to save this file.

2. Choose File > Exit.

Going Further

You have reached the end of Tutorial 3. At this point you should be able to:

- Import 3D Studio files.
- Assign procedural textures to materials.
- Create radiosity solutions of selected portions of a model.
- Set up for lighting an exterior model.
- Set local process parameters to speed up and control the quality of the radiosity solution.

To learn more about the Lightscape Visualization System, do the following:

► **Open the sample solution files.**

The Lightscape Installation media contains a number of sample solution files which you can use for experimenting. To install these files:

1. Perform a Custom installation.
2. Select only the Sample Files from the list items.
3. Observe the way the mesh was created, the way materials were defined, the way luminaires were defined, and so on.

   This gives you a feel for the performance of larger models.
4. Try resetting the solution and experimenting with different process parameters.

► **Do the remaining tutorials for more experience working with Lightscape.**

Tutorial 4 Importing, Setting Up, and Rendering

In this tutorial, you will begin by working through advanced DXF import techniques. Next, you will undertake some specialized preparation tasks such as orienting surfaces and placing and aligning textures. Finally, you will create an animation and produce frames of the first segment of the animation.

The goal of this tutorial is to render the model used to create the image in Figure 4-1.

Figure 4-1. *Sample of Rendered Image from Tutorial 4*

How Tutorial 4 is Organized

This tutorial contains the following sections and lessons:

Getting Data

In this exercise, you will learn:

- "Understanding the Advanced DXF Import"

You will perform the following tasks:

- "Starting Lightscape"
- "Importing Geometry"

Starting Lightscape

▶ **Start Lightscape.**

1. In the Lightscape Applications program group, double-click the Lightscape icon.

   The Lightscape graphical user interface displays on the screen.

▶ **Turn on all toolbars.**

This tutorial makes extensive use of the toolbars to make executing operations easier.

1. Choose Tools > Toolbars.

   The Toolbars dialog box displays.

2. Double-click any item that does not have a check-mark in front of it to turn on that toolbar.

3. Click Close when you are done.

Understanding the Advanced DXF Import

Lightscape contains a number of tools to optimize a model that you import using the DXF translator. In part, this is because the DXF file format is missing support for material definitions, but you may also need to import revised versions of the model into Lightscape. This would minimize the preparation tasks that you might have to repeat.

Material Maps

By default, Lightscape assigns a material to a surface whose name and color match the color number in the DXF file. Not only are the names of these materials nondescript (usually 0 through 255), but the colors are generally not suitable for producing acceptable Lightscape results.

With the material map technique you can:

- Associate Lightscape materials to the color numbers used in the DXF file.
- Load a material map in conjunction with a DXF file. This substitutes all the colors defined in the DXF file with the associated Lightscape material. For example, you can map a material called “wood” onto every surface that is drawn with color 1.

Block Libraries

By default, Lightscape creates a new block definition for each block when importing a DXF file. If you have pre-existing Lightscape blocks defined, you can use these block definitions instead. This saves considerable time and effort in the Preparation stage.

During DXF import:

- Pre-existing Lightscape block and luminaire definitions can be mapped onto incoming DXF blocks of the same name.
- The system searches through all the loaded block libraries and replaces each block encountered in the DXF file with a block of the same name stored in the libraries.

Overwrite/Append to the Current Model

When importing geometry, you can choose either to append to or overwrite the current model:

- Overwriting creates a new model from the imported surfaces. If you choose to overwrite, the existing model displayed in the Graphic Window is replaced by the model you import.
- Appending adds the imported surfaces to the current model displayed in the Graphic Window.

Importing Geometry

▶ **Load and examine the DXF file called tutorial4.dxf.**

Although we will eventually be using advanced tools for loading this DXF file, import it now using basic settings and familiarize yourself with it.

1. Choose File > Import > DXF.

   The Import DXF dialog box displays.

2. In the Name area, click Browse.

   The Open dialog box displays.

3. Change directory to:

   `c:\Program Files\lvs\projects\tutorial4`

4. Double-click `tutorial4.dxf`.

5. In the File Units area, choose Feet from the combo box.

   This model was created with one unit in the CAD program set to equal one foot in the real world.

6. Click OK and confirm that the model is 26 x 29 x 25 feet in extent.

   If you turn on solid display (Display>Solid), you will notice the material colors which are taken from the default AutoCAD color scheme (see Figure 4-2). You will also notice that many of the surfaces of the piano are missing (actually oriented incorrectly).

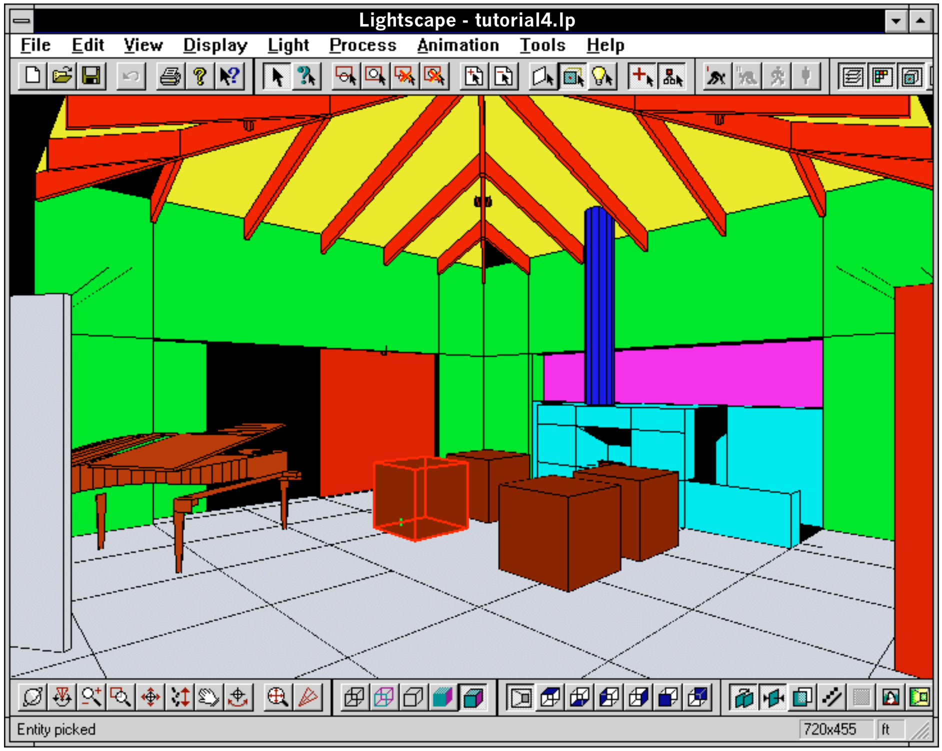


Figure 4-2. *Basic Imported DXF File*

7. Select CHAIR in the Blocks Table.
8. Using the right mouse button, click in the Blocks Table to open the context menu.
9. Select Isolate from the context menu.

   Notice that this is a simple cube, a rather unlikely shape for a chair.

10. Using the right mouse button, click in the Blocks Table and select Return to Full Model to end the block isolate mode.

    Notice that the two light fixture blocks, `LITE_FIRE1` and `LITE_SPOT1`, are just blocks and not luminaires.

11. Choose File > New to open a new, empty Lightscape file.
12. Click No to not save changes.

Load materials from an existing material library.

Lightscape materials can be stored in libraries that can be accessed from within any Lightscape model.

1. Using the right mouse button, click in the Materials Table to open the context menu.
2. Choose Load to load materials from a library.

   The Open dialog box displays.

3. Change directory to:

   `c:\Program Files\lvs\projects\tutorial4`

4. Double-click `tutorial4.atr`.

   A material browser displays several materials.

5. Choose Select All to select all of the materials and click OK to load them.

   They now display in the material browser.

▶ Assign the newly loaded materials to a Material Map and save as tutorial4.mm.

1. Choose Tools > Material Map.

   The Material Map dialog box displays.

2. In the Materials list of the dialog, click `WOOD_PINE_VARNISH`.

3. In the Color Indices list, click `Index: 001`.

4. Click Assign.

   `Index: 001` now has the material `WOOD_PINE_VARNISH` assigned to it.

5. Repeat steps 2 through 4 until all materials listed in Table 4-1 have been assigned to their respective indices.

Table 4-1. *Material Mapping Assignments*

Color Index	Material
001	WOOD_PINE_VARNISH
002	STUCCO_WHITE
003	BRICK_ROMAN_TAN
004	PAINT_FLAT_WHITE
005	PAINT_METAL_TAN
006	GLASS
007	CARPET_AREARUG
009	VINYL_GREEN
010	WOOD_CHERRY_BURLED

6. When you are done assigning materials, click in the Show Only Assigned Colors check box to turn on this feature.

   You can easily use this feature to check the assignments that you have made against Table 4-1.

7. Click Save.

   The Save As dialog box displays.

8. Change directory to:

   `c:\Program Files\lvs\projects\tutorial4`

9. If necessary, type the following in the File Name input field:

   `tutorial4.mm`

10. Click OK to close the Save As dialog box.

11. Click Close to close the Material Map dialog box.

▶ Open the block library and examine the predefined Lightscape blocks.

1. Using the right mouse button, click in the Blocks Table to open the context menu.

2. Choose Load to load blocks from a library.

   The Open dialog box displays.

3. Change directory to:

   `c:\Program Files\lvs\projects\tutorial4`

4. Double-click `tutorial4.blk`.

   A list browser displays several block names.

5. Choose Select All to select all of the blocks and click OK to load them.

   They now display in the block list.

6. Using the right mouse button, click in the Luminaires Table to open the context menu.
7. Choose Load in the context menu to load luminaires from a library.

   The Open dialog box displays.
8. Change directory to:

   `c:\Program Files\lvs\projects\tutorial4`
9. Double-click `tutorial4.blk`.

   A list browser displays several luminaire names.
10. Choose Select All to select all of the luminaires and click OK to load them.

    They display in the luminaires list. Note that the two luminaire blocks, `LITE_FIRE1` and `LITE_SPOT1`, have been converted to luminaires.
11. Select `CHAIR` in the Blocks Table.
12. Using the right mouse button, click in the Blocks Table to open the context menu.
13. Select Isolate from the context menu.

    Notice that now a properly defined Breuer chair appears in the Graphic Window.
14. Using the right mouse button, click in the Blocks Table to open the context menu.
15. Select Return to Full Model from the context menu to end the block isolate mode.
16. Choose File > New to open a new, empty Lightscape file.
17. Click No to not save changes.

Reimport the file tutorial4.dxf and use the Material Map and Block library.

1. Choose File > Import > DXF.

   The Import DXF dialog box displays.

2. In the Name area, click Browse.

   The Open dialog box displays.

3. Change directory to:

   `c:\Program Files\lvs\projects\tutorial4`

4. Double-click `tutorial4.dxf`.

5. In the Material Map area, click Browse.

   The Open dialog box displays.

6. Double-click `tutorial4.mm`.

7. In the Block and Luminaire Library area, click Add.

   The Open dialog box displays.

8. Double-click `tutorial4.blk`.

9. In the File Units area, choose Feet from the combo box.

10. Click OK and confirm that the model is 26 x 29 x 25 feet in extent.

    The reimported version of the DXF file is now properly scaled and has the correct material names and definitions set up. Many of the blocks are now correctly defined (see Figure 4-3).

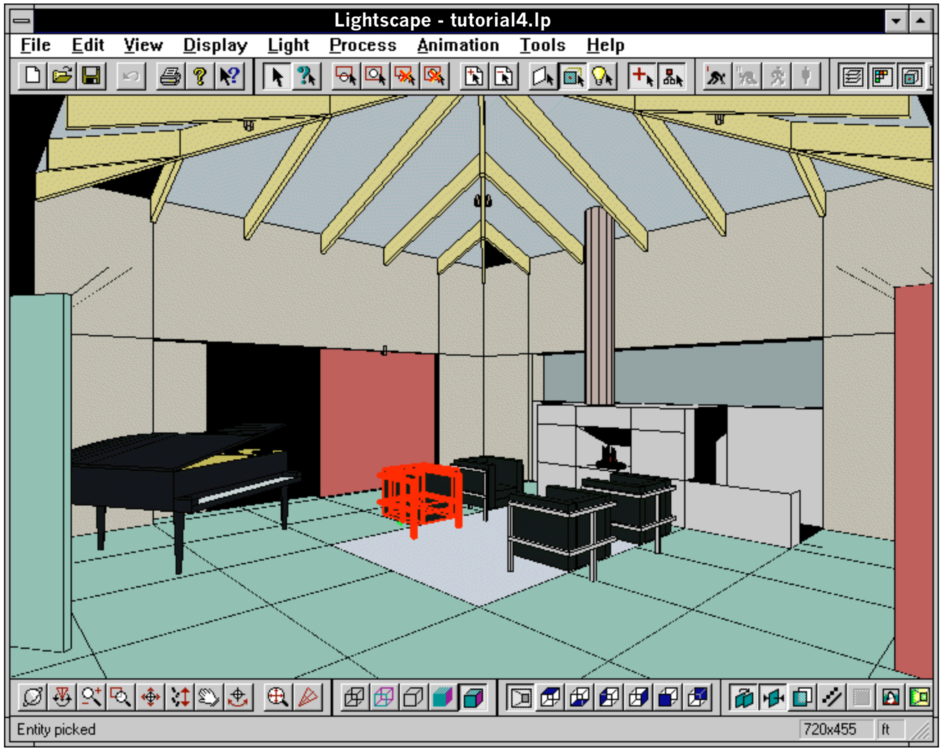


Figure 4-3. *Advanced DXF Import*

Append the file tutorial4a.dxf.

The file you are going to append contains some additional up lights located in the four corners of the room. Rather than re-importing the entire model during a design revision, you can merely import the changes into Lightscape.

1. Choose File > Import > DXF.

   The Import DXF dialog box displays.

2. In the Name area, click Browse.

   The Open dialog box displays.

3. Change directory to:

   `c:\Program Files\lvs\projects\tutorial4`

4. Double-click `tutorial4a.dxf`.

5. Adjacent to the Name area, select Append from the Overwrite combo box.

   This sets the import options so the new geometry is added to the existing geometry in the model.

6. In the Material Map area, click Browse.

   The Open dialog box displays.

7. Double-click `tutorial4.mm`.

8. In the Block and Luminaire Library area, click Add.

   The Open dialog box displays.

9. Double-click `tutorial4.blk`.

10. In the File Units area, choose Feet from the combo box.

11. Click OK, answer No, you do not want to save changes.

12. Confirm that the appended model is of a reasonable size.

    The additional lights appear in the four corners of the room.

13. Adjust your view so that you are inside of the room.

Preparing Data

In this exercise, you will learn:

- "Understanding Texture Alignment"

You will perform the following tasks:

- "Orienting Surfaces"
- "Smoothing Surfaces"
- "Displaying and Aligning Textures"

Orienting Surfaces

Geometry in Lightscape, as in many modelers, is represented by infinitely thin surfaces. Like a piece of paper, these surfaces clearly have two sides. Generally, however, only one of these sides is visible; for example a surface representing a wall has one face which looks into the room and a second face which faces outwards. It is extremely useful to tell the program which side of the surface is the visible one, so that it looks only at one side of the surface; effectively halving the number of objects to be considered in each iteration. This is done by setting the orientation of the surface.

If surface orientation is not set or preserved then when importing files, Lightscape attempts to orient the surfaces, occasionally getting the orientation wrong. This is apparent when you are in solid mode with backface culling on because surfaces that *should* be visible, disappear. They are there but are facing the wrong direction. When you activate the Orientation dialog box, the display of the model in the Graphic Window changes so that backfacing surfaces are no longer culled and are displayed in bright green. This helps you to identify those surfaces whose orientation is incorrect.

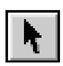
The Orientation tool offers four methods for changing a surface's orientation:

- Automatically orienting all surfaces visible to the current viewer position to face that direction using the Auto-Orient tool.
- Reversing a surface's orientation.
- Orienting a surface toward or away from a specific (focus) point in the model.
- Making surfaces double-sided. This option should be used sparingly; it is computationally expensive and, for a material such as glass, modeling both sides of the plate of glass with correct thickness between them is important in rendering accurate refraction effects.

Select surface orientation mode.

This mode turns off culling and displays, in green, the backfaces of all of the surfaces. This color helps you determine which surfaces are oriented correctly and which ones are not.

1. Choose Display > Outlined or click the Outlined button on the toolbar.

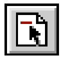


2. Choose Edit > Selection > Select or click the Select button on the toolbar.

3. Choose Edit > Selection > Surface or click the Surface button on the toolbar.
4. Pick a point on a wall in the Graphic Window.
5. Using the right mouse button, click anywhere in the Graphic Window to open the context menu.

6. Choose Orientation from the context menu.

   The Surface Orientation dialog box displays and surface backfaces are displayed in green.



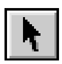
7. Click the Deselect All button on the toolbar.

▶ Adjust the view and spin the model around 360 degrees to observe which surfaces are green and which ones are the correct color.

Make mental notes about which surfaces should have their orientations reversed. The correct orientation of a wall is tan on the inside, green on the outside.

1. Click the Orbit button on the toolbar.

   Orbit around the model to view the orientation of all of the surfaces.



2. When you are through orbiting, click the Select button on the toolbar.

▶ Select any surface that is not tan colored on the inside of the building and reverse the orientation.

Since all of the tan surfaces are on the `ROOM1_WALLS` layer, you can start by turning off all other layers.

1. Using the right mouse button, click anywhere in the Layers Table to open the context menu.
2. Choose All Off from the context menu.
3. Select `0` and `ROOM1_WALLS` from the Layers Table.
4. Using the right mouse button, click anywhere in the Layers Table.

5. Choose On from the context menu.

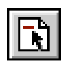
   All layers are now turned off except for the `ROOM1_WALLS` layer and layer `0`.

6. If you see a surface that is not oriented correctly, select it.

7. Make sure that Accumulate Pick is turned on.

8. Click Reverse in the Surface Orientation dialog box to reverse the orientation of the selected surfaces.

   The selection set remains active so that you can reverse the operation you just performed or perform another operation on the same set of surfaces.



9. Click the Deselect All button on the toolbar.

Use auto-orient to orient the other surfaces on the layer.

1. Choose View > Setup.

2. Select a view where the observer position is in the lower right corner of the room and the focus point is in the center.

3. Set the Field of View to **`80`** (to see as much of the model as possible) and click OK to set the view.

4. Observe which surfaces are colored green in the model.

   These will be reversed by the Auto-Orient tool, so you may wish to select a better view.

5. In the Surface Orientation dialog box, click Auto Orient.

   The green surfaces are reversed.

   Repeat steps 2 through 4, selecting other views, and orienting the rest of the surfaces on the ROOM1_WALLS layer.

▶ Turn off the ROOM1_WALLS layer, turn on the ROOM1_FIREPLACE layer, and orient the surfaces of isolated blocks.

In this procedure, you orient the surfaces of the fireplace elements and add one more step. All of the surfaces are part of blocks so they can be isolated and worked on individually.

1. Select ROOM1_WALLS in the Layers Table.

   Press the **Ctrl** key to select the ROOM1_FIREPLACE layer as well.

2. Using the right mouse button, click anywhere in the Layers Table to open the context menu.

3. Choose Toggle from the context menu.

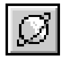
   The ROOM1_WALLS layer turns off and the ROOM1_FIREPLACE layer turns on (layer 0 should still be on).

4. Select TREAD1 in the Blocks Table.

5. Using the right mouse button, click anywhere in the Blocks Table to open the context menu.

6. Choose Isolate from the context menu.

   At this point, the block TREAD1 is isolated as if this were your entire model. Some of what you just did to the model is now going to be performed on a single block.



7. Click the Orbit button on the toolbar and orbit around the tread.

   Observe that there are four surfaces on this block and that only one of them is oriented incorrectly. Reverse its orientation.

8. Using the right mouse button, click in the Blocks Table and choose Return to Full Model.

   Notice that the stair treads are all correctly oriented.

   You should also orient the rest of the surfaces that make up the fireplace. You may need to do this by reversing their orientation and not by using the auto-orient tool.

Repeat the previous procedures until all surfaces on all layers have been oriented.

Be sure to check the layer `ROOM1_CEILING` which still has some incorrectly orientated surfaces. Close the Orientation dialog when you are finished.

Smoothing Surfaces

Turn on the ROOM1_FIREPLACE layer and smooth the surfaces of the chimney.

In this procedure, you will smooth the surfaces of the fireplace chimney. It currently is made of 12 facets. However, since this is a round tube you would like it to display as smooth volume not as separate surfaces.

1. Turn off all of the layers.
2. Select `ROOM1_FIREPLACE` in the Layers Table and turn this layer on.

3. Select the surfaces that make up the fireplace chimney.

   This can be done quickly using the Area Any Vertex picking option and dragging a box across the top end of the chimney.

4. Using the right mouse button, click in the Graphic Window to open the context menu.

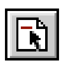
5. Choose Smoothing from the context menu.

6. Set the Smoothing Angle to **60** and click Make Smooth.

7. Click Close to close the Smoothing dialog box.

   The surfaces of the chimney now appear smoothed. You can turn on Enhanced display mode to confirm this.

8. Turn on all of the layers.



9. Click the Deselect All button on the toolbar.

Understanding Texture Alignment

The texture assigned to a material can be positioned, rotated, and stretched during the alignment process. This alignment defines how this texture will be applied to a particular surface.

There are five different ways of projecting a texture onto a surface:

- Orthographic - projects the texture as on a flat surface.
- Cylindrical - wraps the texture around a cylinder.
- Spherical - wraps the texture around a sphere.
- UV - uses coordinates that were imported with the model.
- Reflection - simulates reflection on objects.

Aligning an Orthographic Texture

Most, if not all textures in a typical model will be applied to flat surfaces and aligned using orthographic projection. An orthographic texture is aligned by choosing points for the lower left corner, the lower right corner, and the upper left corner (see Figure 4-4). This information is used to create a plane. This plane is then projected onto the selected surfaces, applying the first copy of the texture map. Additional copies will be in a grid on the surface based on the selected mapping mode.

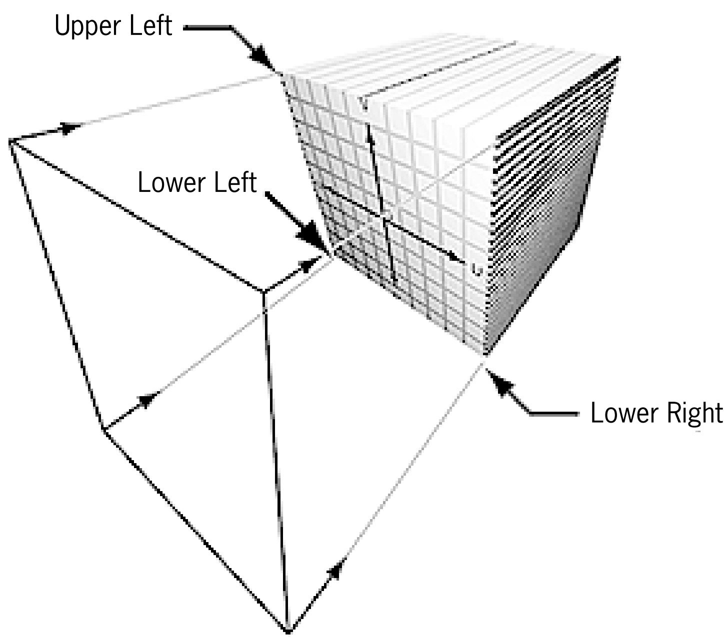


Figure 4-4. *Aligning an Orthographic Texture*

Mapping Modes

Mapping Modes determine where additional copies of the texture should be placed. Each mapping mode can be applied separately in the horizontal and vertical directions. For example, it is possible to tile horizontally and clip vertically to create a single row of tiles along the base of a wall. The modes are displayed in Figure 4-5.

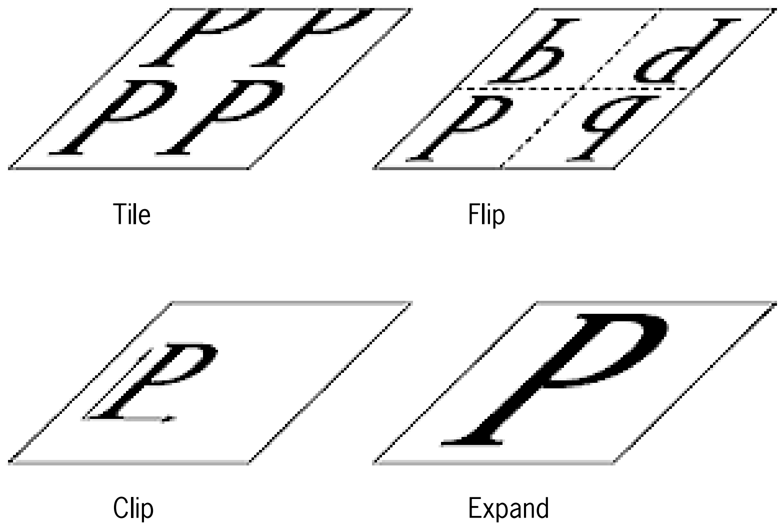


Figure 4-5. *Texture Mapping Modes*

Displaying and Aligning Textures

Associate a texture with a material and then align it.

To view textures that are associated with materials, you need to turn texture display on. Currently, none of the materials in the model have textures associated with them (that's why there is no visible change in the model). In the next task, you will be associating a texture with a material and then aligning it.

1. Choose Display > Textures or click the Textures button on the toolbar.
2. Select `BRICK_ROMAN_TAN` from the Materials Table.
3. Using the right mouse button, click anywhere in the Materials Table to open the context menu.
4. Choose Edit Properties from the context menu.

   The Material Properties dialog box displays.
5. Click the Texture tab.
6. In the Name area, click Browse.

   The Open dialog box displays.
7. Change directory to:

   `c:\Program Files\lvs\projects\tutorial4`
8. Double-click `BRICK_TAN.TGA`.
9. In the Filter Method area, select Point MM from the Minimize combo box.

   This increases the quality of the sampling of the texture (in this case making the block edges more clearly defined).

10. In the Tile Size area, click Fixed Size to turn on this feature and set the Width to **3** and set the Height to **1.5**.

    The concrete texture repeats every 3 feet in the horizontal direction and every 1.5 feet in the vertical direction. When you know the area represented by the image file, this option allows you to accurately size the texture, creating maps of a believable scale.

11. Click OK.

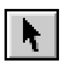
12. Using the right mouse button, click anywhere in the Layers Table to open the context menu.

13. Choose All Off from the context menu.

14. Select ROOM1_WALLS from the Layers Table.

15. Using the right mouse button, click anywhere in the Layers Table.

16. Choose On from the context menu.



17. Choose Edit > Selection > Select or click the Select button on the toolbar.

18. Choose Edit > Selection > Surface or click the Surface button on the toolbar.

19. Select all of the brick surfaces that make up one of the sides of the room.

    Notice that although correctly aligned, the texture is not continuous but begins from the lower left corner of each surface.

20. Using the right mouse button, click anywhere in the Graphic Window to open the context menu.

21. Choose Texture Alignment from the context menu.

    The Texture Alignment dialog box displays.

22. Choose Pick Points in the Mouse Select Mode area and turn on Snap To Nearest Vertex.

23. Pick a point in the vicinity of the lower left corner of the wall selected.

    You do not have to be precise; Lightscape looks for the nearest vertex (if you selected Snap To Nearest Vertex).

    Notice that Lightscape uses icons to represent the lower left, lower right, and upper left points. These icons aid in understanding how a texture has been aligned.

24. Pick another point in the lower right corner.

25. Pick one more point in the upper left corner.

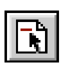
26. In the Lower Right combo box, choose Tile.

27. In the Upper Left combo box, choose Tile.

28. Click Apply.

    The brick texture now appears to be continuous.

29. Click Close.



30. Click the Deselect All button on the toolbar.

► **Repeat this procedure for all the walls.**

All the walls have a brick texture applied to them that you will need to align as well.

1. To align the brick textures, repeat steps 18 through 29 in the above task, "Associate a texture with a material and then align it."

Note You need to turn off Pick Points in the Texture Alignment dialog box to select other surfaces.

2. When you are finished aligning textures, close the Texture Alignment dialog box.
3. Turn on all of the layers.

► **Save your work up to this point.**

You have concluded the Preparation stage and are about to enter the Solution stage. The model you are currently working on is going to be changed during the Initiation process. It is a good idea to save your work at this time.

1. Choose File > Save As.
2. Change directory to:

   `c:\Program Files\lvs\projects\tutorial4`

3. Type **`temp.lp`** in the File Name input field.
4. Click OK.

   If you are running Windows NT 4.0 or Windows 95, you may click Save instead of OK.

Creating a Solution

In this exercise, you will learn about the following:

- "Understanding the Global Process Parameters"
- "Rules of Thumb"
- "Testing Primary Lights"
- "Testing Overall Light Levels"

You will perform the following tasks:

- "Refining Global Meshing Parameters"
- "Setting Process Parameters"
- "Processing the Solution"

Understanding the Global Process Parameters

The adaptive meshing process is controlled by the following parameters:

- "Receiver Group"
- "Source Group"

You can set these parameters by choosing Process>Parameters.

Receiver Group

The parameters in the Receiver Group area determine how surfaces are subdivided when they receive light, based on the following settings:

- Mesh Spacing Maximum - Sets the initial (coarse) size of the receiver mesh. A value of 36 inches creates an initial mesh where the longest side of each mesh element is less than or equal to 36 inches.

- Mesh Spacing Minimum - Sets the smallest size into which the mesh can be subdivided. A value of 4 inches means that the longest side of the smallest mesh element is greater than or equal to 4 inches.
- Subdivision Contrast Threshold - Sets the contrast level where subdivision occurs. The greater this value, the less likely that subdivision will take place. Subdivision continues until the contrast is no longer great enough, or the Mesh Spacing Minimum value is reached.

Source Group

Just as surfaces are subdivided (sampled) when they receive light, they are also sampled when they reflect or emit light. When a surface is a light source, it is subdivided based on the Direct Source controls. When a surface is reflecting light it is subdivided based on Indirect Source controls.

- Source Subdivision Accuracy Parameters - Controls how many emitter points are used when shooting light energy from a source.
- Direct Source Minimum Value - Sets the minimum size that an area or linear source can be subdivided.
- Indirect Source Minimum - Sets the minimum size that a reflecting surface can be subdivided.

Rules of Thumb

Generally, when starting to run a radiosity solution, you will want to run several tests to find what the optimum meshing parameters should be. To test the radiosity mesh, you should start with fairly coarse settings (which gives quick results but often produces a large number of mesh artifacts), then refine the solution by selecting less coarse global parameters and setting the local mesh parameters for selected individual surfaces.

Finding the right mesh parameters for a particular model may require several tests, a little practice and a degree of patience. You should set these initial test parameters using one or all of the guidelines that are outlined in the next sections.

Receiver Group Guidelines

To determine the Mesh Spacing Maximum and Minimum:

Model size ratio 1-10-100 - Estimate or determine the average of the length, width, and height of the model. For example, a room 30 feet long x 15 feet wide x 10 feet high would have an average of [30 + 15 + 10]/3 = 18 1/3 feet.

- The Mesh Spacing Maximum should be 1/10 of this value (1.8 feet in the example above).
- The Mesh Spacing Minimum should be 1/100 of this value (.18 feet in the example above).
- The Subdivision Contrast Threshold should be set to 0.8.

Source Group Guidelines

To determine Source Group parameters:

- Direct Source Min - Set to the Receiver Mesh Spacing Minimum value.
- Direct and Indirect Source Subdivision Accuracy - Set to 0.4.
- Indirect Min - Use the same values that you set for the Receiver Mesh Spacing Minimum.
- Shadow Grid Size - Set to Two.

Testing Primary Lights

To test the primary lights:

- Once the values have been set based on these rules, run the solution.
- Stop the processing after all of the primary lights have shot.

  Examine the model to see if the lights are positioned and pointed as desired, and check that their photometric properties are more or less correct. They can be changed at this point.
- Display the model in Outline mode and note the mesh spacing.

  In general, you are unlikely to adjust the mesh parameters during these early tests, but if the mesh spacing is so coarse that lighting effects are not appearing at all, you should decrease the Mesh Spacing values.

Testing Overall Light Levels

To test the overall light level:

- Continue to run the solution allowing the secondary light sources to shoot.

  The percentage of energy distributed is displayed in the status bar. If this is less than 65-75%, you should continue to run the solution and stop it only when that threshold has been reached.

- Turn on Ambient (to distribute the remaining light energy evenly over all surfaces) and examine the model to see whether the overall light level is acceptable.

  If the light level is not acceptable, adjust the luminaire and material properties.

- After making the appropriate changes, reset and rerun the solution.

  You may find that you will need to repeat this process several times.

Refining Global Meshing Parameters

Now that the general lighting and material characteristics are set as desired, it is time to try to refine the solution to remove general mesh artifacts. A general mesh artifact is one which is endemic to the model as a whole; for example, where the shadow boundaries from many lights in the environment appear to be "jagged". You can remove these general artifacts by gradually changing the global process parameters.

► **Set the pre-mesh value.**

Lightscape uses this value to determine if surfaces should be subdivided into smaller, more regular polygons before the actual radiosity calculations. Generally this can be set to ½ the mesh space maximum number.

1. Choose Process > Parameters.

   The Process Parameters dialog box displays.

2. In the Tolerances group box, set Initialization Min Area to **`1.3`**.

3. Click OK.

▶ Save your work up to this point.

1. Choose File > Save As.
2. If necessary, change directory to:

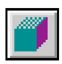
   `c:\Program Files\lvs\projects\tutorial4`

3. Type **`temp.lp`** in the File Name input field.
4. Click OK.

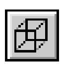
   If you are running Windows NT 4.0 or Windows 95, you may click Save instead of OK.

5. If necessary, click Yes to confirm the overwrite.

▶ Begin the Solution stage by initiating the geometric data.



1. Choose Display > Solid or click the Solid button on the toolbar.
2. Choose Process > Initiate or click the Initiate button on the toolbar.



3. Choose Display > Wireframe or click the Wireframe button on the toolbar.

   Note the effects of pre-meshing on the surfaces of the model.

Setting Process Parameters

▶ **Set up the receiver meshing controls in the process parameters.**

When this model was imported its size was indicated as 26 x 29 x 25 feet. This gives an average length of a side of 26 2/3 feet. This would indicate a mesh maximum space of 2.6 feet and a minimum of 0.26 feet

1. Choose Process > Parameters.

   The Process Parameters dialog box displays.

2. In the Receiver group box, set Mesh Spacing Min. to **`0.26`**.

3. In the Receiver group box, set Mesh Spacing Max. to **`2.6`**.

   In the Receiver group box, set Subdivision Contrast Threshold to **`0.8`**.

▶ **Set up the source meshing controls in the global process parameters.**

1. In the Source group box, set Direct Source Min. to **`0.26`**.

2. In the Source group box, set Indirect Source Min. to **`0.26`**.

▶ **Set up the Source Subdivision Accuracy in the global process parameters.**

1. In the Source group box, set Direct Source Subdivision Accuracy to **`0.4`**.

2. In the Source group box, set Indirect Source Subdivision Accuracy to **`0.4`**.

3. In the Source group box, set Shadow Grid Size to **`Two`**.

▶ Set up Lightscape to use textures to filter the color of reflected light.

1. In the Process group box, click in the Textures check box to turn on this feature.
2. Click OK.

▶ Save your work up to this point.

1. Choose File > Save As.
2. If necessary, change directory to:

   `c:\Program Files\lvs\projects\tutorial4`

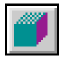
3. Type **`temp.ls`** in the File Name input field.
4. Click OK.

   If you are running Windows NT 4.0 or Windows 95, you may click Save instead of OK.

5. If necessary, click Yes to confirm the overwrite.

Processing the Solution

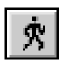
▶ **Start processing the solution and stop to test the primary lights.**



1. Choose Display > Solid or click the Solid button on the toolbar.
2. Choose Process > Direct Only.

   Let the solution run 14 iterations as there are 14 lights in the model. It will stop after it has distributed the direct sources.
3. View the model to ensure that the lights are pointing predictable places and that the mesh is acceptable.

▶ **Continue processing the solution and stop to test the overall light level.**



1. Choose Process > Go or click the Go button on the toolbar.

   Let the solution run roughly 35 further iterations or until at least 65% of the energy has been distributed.
2. Choose Display > Ambient to distribute the remaining energy.
3. View the model to ensure that the general light level and the mesh are acceptable.
4. Continue processing if desired.

Fine Tuning the Solution

Sometimes, the lighting and material characteristics that you have selected for the model will produce exactly the desired effect when a solution is created. You can interrupt the processing of the radiosity solution at any time to alter or fine tune the model's appearance. You will not fine tune this model.

Outputting the Results

In this exercise, you will learn about the following:

- "Understanding Lightscape Animation"

You will perform the following tasks:

- "Creating an Animation"
- "Creating Animation Images"
- "Saving and Exiting"

Understanding Lightscape Animation

Lightscape provides a robust set of tools for defining and generating walk-through animations. Depending on the complexity of the model and the display hardware you use, it may be possible to show a real-time animation. In other situations, it may be more appropriate to save individual frames and display them using a movie-playing utility.

Generating a walk-through animation in Lightscape involves the following steps:

- Defining a 3-D camera path by setting a sequence of keyframes.
- Defining the speed of the camera as it travels along this path.

- Previewing the animation and adjusting the path and speed if necessary.
- Generating the individual frames and storing them on disk.
- Transferring the frames to a movie file format on disk or exporting the images to video or film.

It is easier and quicker to use Wireframe display mode rather than Solid display mode when setting up the animation. Also, because the Preparation file (`.lp` extension) is more compact, it is faster to create the animation using the Preparation model.

Animation Path

When creating the animation path, the Graphic Window is split into the following:

- Four windows
- Three orthographic views
- One perspective view that defaults to a view called the Director's view:

You can toggle between the Director's view that shows the current model view and a Keyframe view that shows a view of the model as seen from the currently selected keyframe (see Figure 4-6).

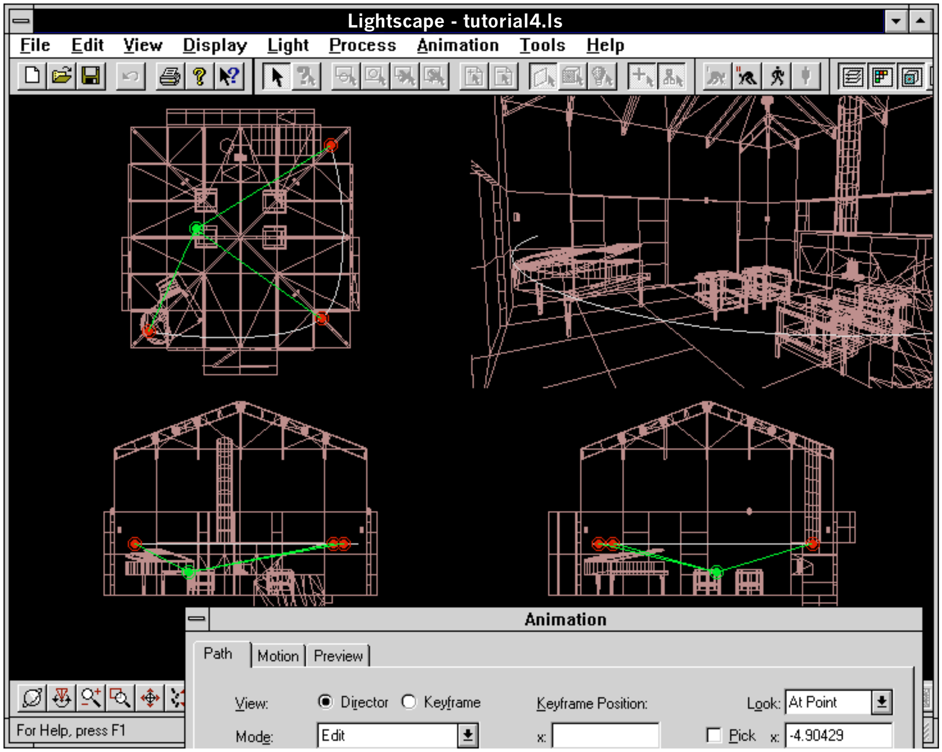


Figure 4-6. *Creating an Animation Path*

You create a camera path by:

- Adding keyframe points to a path by choosing the Add After or the Add Before mode on the Path tab in the Animation dialog and picking a point in any of the orthogonal view windows.
- Using the Edit option to move the keyframes and adjust the camera path. To select a keyframe, click on it in the Graphic Window and drag it to the desired position.

- Changing the shape of the camera path curve by adjusting the handles of a keyframe. The handles are dumbbell-shaped objects that are displayed tangent to the camera path at the keyframe location. To move a handle, select a single keyframe in Edit mode and then drag the handle.

Animation Motion

When setting the speed that the camera moves along the path, the display shows three views (see Figure 4-7):

- The lower Distance Graph view displays a graph of camera speed that you can edit. The vertical axis of the graph represents the distance along the camera path, and the horizontal axis represents time.
- The top left camera view shows the camera's view at the current time in the animation, indicated by a vertical green line on the camera speed graph. You can change the current time by clicking in the time legend of the graph.
- The top right view shows the Director's view of the model.
- By setting the Grid mode to on, you can display a light blue grid on the graph where the horizontal grid lines represent the location of keyframes.

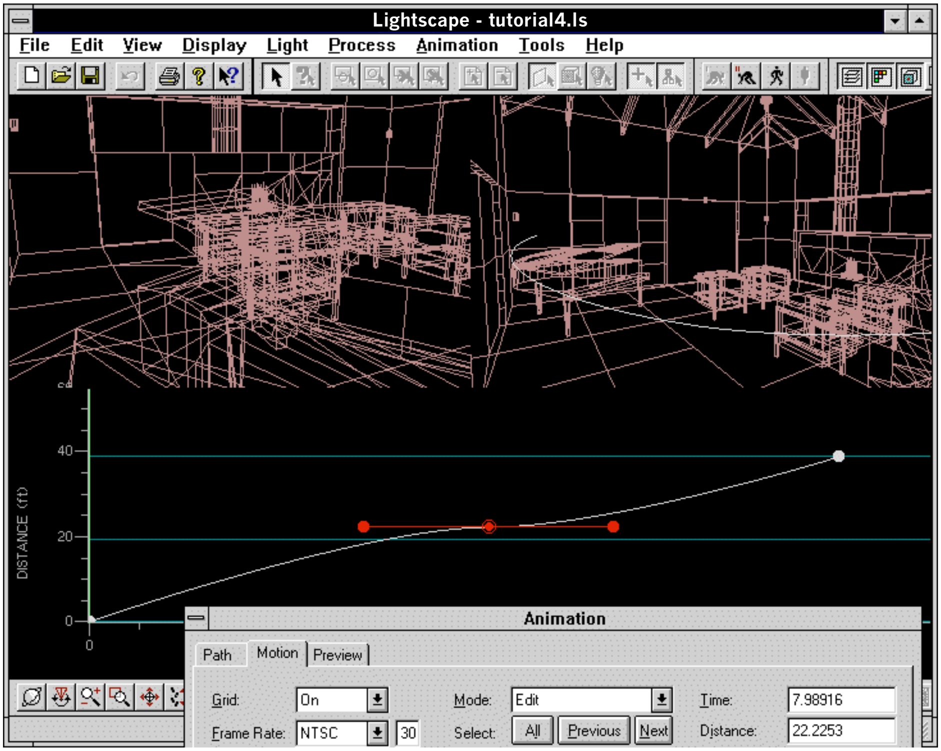


Figure 4-7. *Creating Animation Motion*

You define the camera speed by adding control points on the camera speed curve. You can do this by selecting Insert and clicking locations in the Distance Graph view (see Figure 4-7).

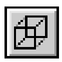
- You use the Edit option to move the control points and adjust the motion path.
- You can change the shape of the motion path curve by adjusting the handles of a keyframe. Changing the curvature changes the acceleration, where the slope is

steep, the camera moves quickly and where flat, the camera moves slowly. If the curve dips from left to right, the camera motion moves backward.

Creating an Animation

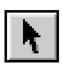
You will create an animation which starts near the piano in the bottom left of the model and moves around the edge of the room to the top right. Then, you will set the speed such that the animation slows down during the middle portion of the animation.

► **Create animation path.**



1. Choose Display > Wireframe or click the Wireframe button on the toolbar.
2. Choose Animation > New.
3. Choose Animation > Edit.

   The Animation dialog box displays.
4. Click the Path tab in the Animation dialog box.
5. Select Add After in the Mode combo box.



6. Choose Edit > Selection > Select or click the Select button on the toolbar.
7. In the top view sub-window in the Graphic Window, click a point in the lower left corner to add a Keyframe to the animation path.
8. Enter **5** in the Z input field and click Apply.

   This sets the height of this and all subsequent points to 5 feet above the floor.

9. In the top view sub-window, click a point near the lower right corner to add a Keyframe to the animation path.
10. In the top view sub-window, click a point in the upper right corner to add a Keyframe to the animation path.
11. Select Edit in the Mode combo box.
12. Click on the middle keyframe in the top view sub-window.
13. Drag the handles associated to the keyframe to a 45 degree position to begin to form a "C" curve.
14. Click on the first keyframe in the top view sub-window.
15. Drag the handles associated to the keyframe to a horizontal position to continue to form a "C" curve.
16. Click on the last keyframe in the top view sub-window.
17. Drag the handles associated to the keyframe downward to finish forming a "C" curve.

► Identify the Lookat path.

Not only do you need to specify where the camera is at any time during its motion but also the direction that the camera is looking. In this case, you will set the camera to look at the same point (on one of the chairs) through the length of this animation.

1. Choose All in the Select area.

   This selects all three keyframe points.

2. Select At Point in the Look combo box.

   Three green Look At icons are added to each keyframe. By default, these look to the origin of the model, so you will need to move them.

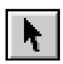
3. Turn on the Pick check box adjacent to the combo box.
4. Select a point on the arm of one of the chairs.

   The green look at lines now point to the selected location.
5. Turn off the Pick check box to end the pick sub mode.

Create a motion path.

1. Click the Motion tab in the Animation dialog box.
2. Select On in the Grid combo box.
3. Select View > Interactive > Zoom and zoom the Camera Speed graph to show all keyframe points.

   The three keyframes are represented by three horizontal blue lines on the graph. One of these blue lines usually overlaps the 0 distance axis along the bottom of the graph.
4. Select Insert on the Mode combo box.



5. Choose Edit > Selection > Select or click the Select button on the toolbar.
6. In the Camera Speed graph, click in the middle of the line to add a Control Point.
7. Select Edit in the Mode combo box.
8. Click on the middle Control Point and drag the handles, associated to the keyframe, to a horizontal position to form an “S” curve.

   The animation starts, comes to a stop in the middle of the room (horizontal position), and then restarts moving the rest of the way across the room.

▶ **Preview your animation.**

1. Click the Preview tab in the Animation dialog box.
2. Click the Rewind button to rewind to the beginning of the animation.
3. Enter **`-1`** in the End Time input field.

   This sets the end time to the last frame of the animation.
4. Click the Play button to preview the animation.

   You may also wish to view the animation in solid mode.
5. Click Close to end the animation editing session.

▶ **Save your animation.**

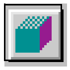
1. Choose Animation > Save As.
2. Change directory to:

   `c:\Program Files\lvs\projects\tutorial4`
3. Type **`tutorial4.la`** in the File Name input field.
4. Click OK to save the file.

Creating Animation Images

You will save animation images of the model using *OpenGL*. OpenGL represents a set of operations performed in hardware to display a rendered image. It is not as accurate or as full-featured as the Lightscape ray tracer but it makes the image's appearance more consistent with a non-ray traced image.

▶ Save animation images of the model using OpenGL.



1. Click the Solid button on the toolbar.

2. Choose Display > Textures or click the Textures button on the toolbar.
3. Choose File > Render.

   The Rendering dialog box displays.
4. Make sure that `Windows Bitmap (BMP)` is selected in the Format Type combo box.
5. Type **`rad`** in the Name input field in the Output File group box.

   The animation files are saved with the names `rad0001.bmp`, `rad0002.bmp`, etc.
6. In the Resolution combo box, choose `Test (300 x 300).`
7. Make sure that Ray Tracing is not selected.
8. In the Frame Generation area, choose Animation File in the Source combo box.
9. Enter **`0`** in the From input field to set the first frame to be rendered.
10. Enter **`14`** in the To input field to set the last frame to be rendered.
11. Click OK.

    15 images (½ second of animation) now process and the files are saved to the current working directory.

▶ Save animation images of the model using the ray tracer.

In this procedure, you render the same view but turn on ray tracing to add the specular floor component and the procedural textures.

1. Choose File > Render.

   The Rendering dialog box displays.

2. Make sure that `Windows Bitmap (BMP)` is selected in the Format Type combo box.
3. Type **`ray`** in the Name input field in the Output File group box.
4. In the Resolution combo box, choose `Test (300 x 300)`.
5. Choose Animation File from the Source combo box in the Frame Generation dialog area.
6. Enter **`15`** in the From input field to set the first frame to be rendered.
7. Enter **`29`** in the To input field to set the last frame to be rendered.
8. Click the Ray Tracing check box to turn on ray tracing.
9. Enter **`1`** in the Ray Bounces field.
10. Click OK.

    Lightscape is now ray tracing the model. Soon you will see the specular reflections and procedural textures that were not visible in the diffuse radiosity model or in the OpenGL rendered image.

Saving and Exiting

Congratulations! You have completed Tutorial 4.

1. Choose File > Save As to save this file.

   The Save As dialog box displays.

2. In the File Name input field, type a name for the new file and click OK.

3. Choose File > Exit and confirm.

Going Further

You have reached the end of Tutorial 4. At this point you should be able to:

- Load DXF files using libraries
- Append DXF Files
- Orient and smooth surfaces
- Display and align textures
- Set global processing parameters by hand
- Create an animation
- Create animation images

To learn more about the Lightscape Visualization System, do the following:

► **Open the sample solution files.**

The Lightscape Installation media contains a number of sample solution files which you can use for experimenting. To install these files:

1. Perform a Custom installation.
2. Select only the Sample Files from the list items to install.
3. Open one of these sample files in Lightscape.
4. Observe the way the mesh was created, the way materials were defined, the way luminaires were defined, and so on.

   This gives you a feel for the performance of larger models.
5. Try resetting the solution and experimenting with different process parameters.

► **Do the remaining tutorials for more examples of working with Lightscape.**

Tutorial 5 Advanced Lightscape Topics

In this tutorial, you will join the model files, which you created in the preceding tutorials, to create a single solution file. You will also optimize one of the models by converting selected radiosity mesh elements into texture maps and exporting the data to VRML format.

The goal of this tutorial is to render the model used to create the image in Figure 5-1.

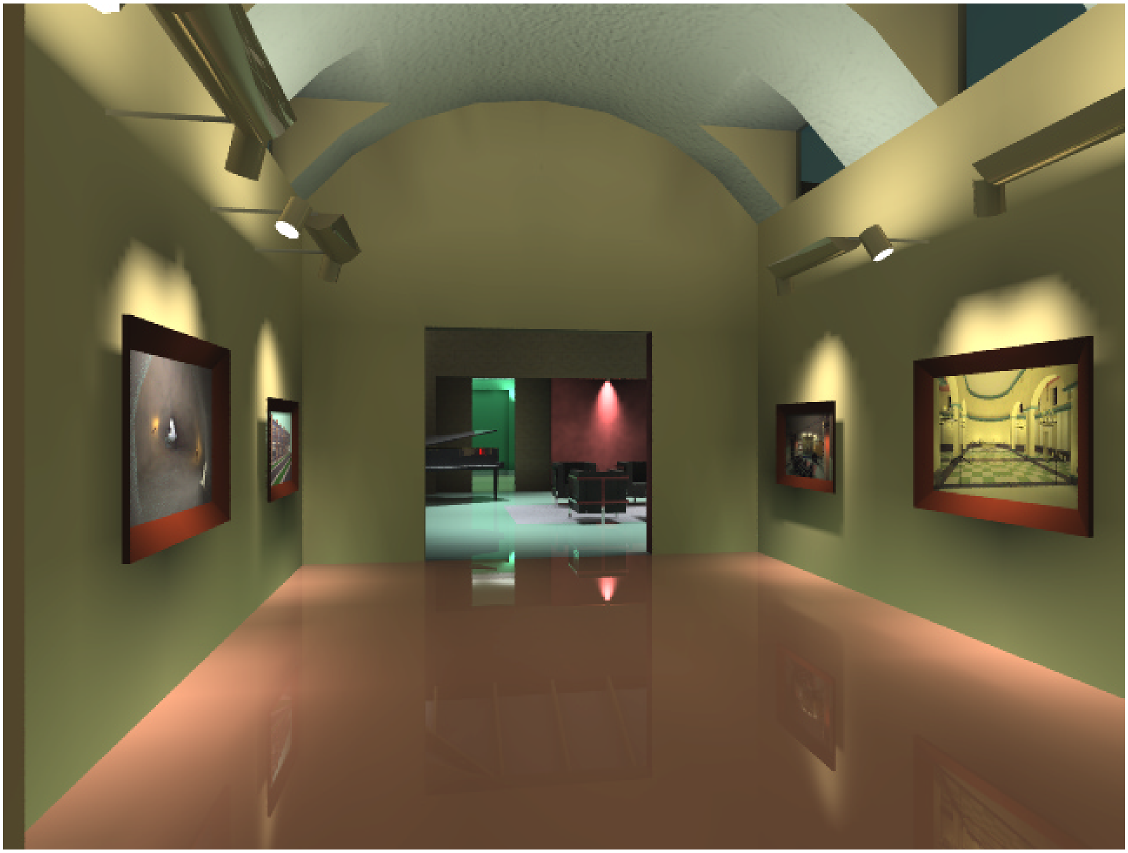


Figure 5-1. *Sample of Rendered Image from Tutorial 5*

How Tutorial 5 is Organized

This tutorial contains the following sections and lessons:

Getting Data

In this exercise, you will perform the following tasks:

- "Starting Lightscape"
- "Opening a File"
- "Appending Files"

Starting Lightscape

Start Lightscape.

1. In the Lightscape Applications window group, double-click the Lightscape icon.

   If you are running Windows NT 4.0 or Windows 95, you can also start Lightscape by choosing it from the Start menu.

   The Lightscape graphical user interface displays on the screen.

Turn on all toolbars.

This tutorial makes extensive use of the toolbars to execute commands easier.

1. Choose Tools > Toolbars.

   The Toolbars dialog box displays.

2. Double-click any list item that is not checked.

3. Click Close when you are done.

Opening a File

▶ **Load a Solution file.**

You will perform this tutorial with a file that has already been created in Lightscape.

1. Choose File > Open.

   The Open dialog box displays. List Files of Type should be set to Preparation Files (*.ls).

2. Change directory to:

   `c:\Program Files\lvs\projects\tutorial5`

3. Double-click the file `tutorial1.ls`.

   This is a similar solution file to the one you created during Tutorial 1.

4. Choose Display>Solid or click the Solid button on the toolbar.

   The model now displays in Solid mode.

5. Choose File > Save As, type **`tutorial5`** in the input field, and click OK to save the file.

Appending Files

▶ **Append the file tutorial2.ls.**

The second file you will add to the model is a file similar to the one you created in Tutorial 2.

1. Choose File > Open.

   The Open dialog box displays.

2. Change directory to:

   `c:\Program Files\lvs\projects\tutorial5`

3. In the lower left corner of the dialog, click Append to turn on this option.

   This sets the loading options so the new geometry is added to the existing geometry in the model.

4. Double-click the file `tutorial2.ls`.

5. Choose View > Extents or click the Extents button.

   The two models now both display on the screen.

Append the file tutorial4.ls.

The third file you will add to the model is a file similar to the one you created in Tutorial 4.

1. Choose File > Open.

   The Open dialog box displays.

2. Change directory to:

   `c:\Program Files\lvs\projects\tutorial5`

3. Choose the file `tutorial4.ls`.

4. Below to the Name area, click Append to turn on this option.

   This sets the loading options so the new geometry is added to the existing geometry in the model.

5. Click OK and click Yes to confirm saving the file `tutorial5.ls`.

   The third room now displays between the first two rooms.

6. Adjust your view so that you are inside of the building.

Append the file tutorial3.ls.

The last file you will add to the model is the exterior view of the model.

1. Choose File > Open.

   The Open dialog box displays.

2. Change directory to:

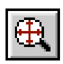
   `c:\Program Files\lvs\projects\tutorial5`

3. Below to the Name area, click Append to turn on this option.

   This sets the loading options so the new geometry is added to the existing geometry in the model.

4. Choose the file `tutorial3.ls`.

5. Click OK and click Yes to confirm saving the file, `tutorial5.ls`.



6. Choose View > Extents or click the Extents button.

   The exterior model now displays on the screen. It appears extremely bright, because the display settings are currently optimized for an interior model.

7. Choose Edit > Properties and click the Display tab.

8. Change the Brightness to `15` and click Apply.

   This displays the exterior more appropriately. The interior portions of the model are displayed darker than usual. Setting the Brightness back to `55` corrects this.

▶ **Save your work up to this point.**

1. Choose File > Save As.
2. Change directory to:

   `c:\Program Files\lvs\projects\tutorial5`

3. Type **`tutorial5.ls`** in the File Name input field.
4. Click OK and confirm the overwrite.

   On Windows NT 4.0 or Windows 95, click Save and confirm the overwrite.

5. Close the Document Properties dialog.

Preparing Data

In this exercise, you will perform the following tasks:

- "Opening a File"
- "Converting Surfaces to Texture Maps"

Opening a File

▶ **Load a Solution file.**

You will perform this tutorial with a file that has already been created in Lightscape.

1. Choose File > Open.

   The Open dialog box displays. List Files of Type should be set to Preparation Files (*.ls).

2. Change directory to:

   `c:\Program Files\lvs\projects\tutorial5`

3. Double-click the file `tutorial1.ls` and click Yes to confirm saving the file `tutorial5.ls`.

Converting Surfaces to Texture Maps

In order to optimize the display of Lightscape models, it is important to keep the number of polygons in a given model to as few as possible. For example, if your CPU can display 100,000 rendered polygons a second, and you wish to show a smooth animation (at 15 frames per second, for example), the model should contain no more than 6666 polygons (100,000 / 15).

By carefully setting global and local process parameters, you can achieve this in some models. A second method, converting polygonal meshes to texture maps, is also available in Lightscape.

In this procedure, an image is created of a surface that contains many mesh elements and saved to a file. The image is then applied as a texture map to the surface and the underlying mesh is removed from the model.

These texture maps can also be exported to display radiosity lighting data in modeling programs and rendering engines that cannot display vertex-colored mesh data.

There are three methods available for converting selected geometry to textures:

- Creating a separate texture for each selected surface (Texture per Surface).
- Taking existing texture maps and remaking them with the radiosity lighting data included as part of the texture (Relight Textures).
- Creating a single texture from a group of selected surfaces (Project all Textures).

With the last option you may wish to delete some of the geometry from the model. For example, a wall surface may have several pictures hanging on it and windows through it. In this case, a single surface (the wall) may be all the geometry you wish to display - with the pictures and windows appearing as decals on the wall surface.

When you use the mesh to texture utility you create two selection sets:

- The first selection set is generally empty. It contains geometry that you will be projecting onto another surface and that you wish to delete from the model once it has been projected.
- The second selection set contains the geometry where you will be placing the textures. It generally contains all the geometry you wish to map into the texture, less the geometry in the first selection set, if any.

▶ Note the number of polygonal mesh elements in the model.

1. Choose Display > Outlined or click the Outlined button on the toolbar.

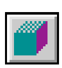
   The mesh on each of the surfaces displays. Notice how simple surfaces, such as the wall in the alcove, have been subdivided to capture the lighting in the model.

2. Choose Process > Statistics.

   Notice the number of mesh elements in the model. Write down this number for future reference.

3. Choose Display > Textures or click the Textures button on the toolbar.

▶ Create a single texture map to replace the floor.



1. Choose Display > Solid or click the Solid button on the toolbar.
2. Choose Tools > Mesh to Texture.

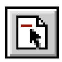
   The Mesh To Texture wizard displays.

3. Select the Convert each surface to a single texture per surface radio button.

   This makes a single texture for each individual surface that is selected.

4. Click Next to advance to the Select Projected Geometry page of the wizard.

   This is the page where you select the geometry for the first selection set. This is the geometry that you intend to delete from the model. In this case, leave the selection blank.

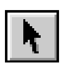


5. If necessary, choose Edit > Selection > Deselect All or click the Deselect All button on the toolbar to ensure that the selection set is empty.

   If the selection set is empty, then both the menu item and the toolbar button are grayed out.

6. Click Next to advance to the Select Target Geometry page of the wizard.

   This is the page where you select the geometry for the second selection set. This is the geometry that you intend to apply the texture to and keep in the model.



7. Choose Edit > Selection > Select or click the Select button on the toolbar.

8. Choose Edit > Selection > Surface or click the Surface button on the toolbar.

9. Pick a point on the floor to select this surface and click Next to advance to the Use Existing Texture Filenames page of the dialog.

10. Ensure that the Use Existing Texture Filenames button is turned off and click Next to advance to the Texture Output page of the wizard.

    Use existing file names when the floor already has a texture map applied to it.

11. Choose JPEG (JPG) from the Format combo box.

12. Type **`floor`** in the New Texture Base Name input field.

    This creates a texture called `floor000.jpg` when you create the texture.

13. Ensure that the Manual Size radio button is selected and type **`256`** in the Width input field and **`128`** in the Height input field.

    The floor is about twice as wide as it is long.

14. Click Next to advance to the Rendering Options page of the wizard.

15. Type **`0`** in the Ray Bounces input field.

    Although it is possible to create texture maps that have specular lighting, generally these will look odd from most views as the reflections will be calculated from only a single point of view.

16. Click Next to advance to the Replace/Delete page of the wizard.

17. Select the Replace Textures on target geometry option.

    This places the texture map on the floor surface.

18. Select the Reset Mesh on Target geometry option.

    This removes the radiosity mesh from the floor.

19. Click Finish to create the texture map.

A new material with the name `M2T FLOOR-> floor000.` is created and added to the material list. The floor surface is now replaced with a texture map.

▶ View the texture and note the change number of polygonal mesh elements in the model.

1. Double-click `M2T FLOOR-> floor000.` in the Materials Table.

   The Material properties for M2T FLOOR-> floor000. dialog box displays.

2. Click the Texture tab.

   Observe the display of the texture file.

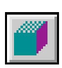
3. Choose Display > Outlined or click the Outlined button on the toolbar.

   The mesh on the each of the surfaces now displays. Notice how the floor surface is no longer meshed.

4. Choose Process > Statistics.

   Notice the number of mesh elements, as compared to the number you wrote down earlier. It should be much less.

▶ Create a single texture map for each surface in a group of surfaces.



1. Choose Display > Solid or click the Solid button on the toolbar.
2. Turn off all layers except `ROOM2_WALLS`.
3. Choose View > Original to return to the original view of the model.

4. Choose Tools > Mesh to Texture.

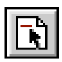
   The mesh to texture wizard displays.

5. Select the Convert each surface to a single texture per surface radio button.

   This makes a single texture for each individual surface that is selected.

6. Click Next to advance to the Select Projected Geometry page of the wizard.

   This is the page where you select the geometry for the first selection set. This is the geometry you intend to delete from the model. In this case, leave the selection blank.



7. Choose Edit > Selection > Deselect All or click the Deselect All button on the toolbar to ensure the selection set is empty.

8. Click Next to advance to the Select Target Geometry page of the wizard.

   This is the page where you select the geometry for the second selection set. This is the geometry you intend to apply the texture to and keep in the model.

9. Choose Edit > Selection > Select Area Any or click the Area Any Vertex button on the toolbar.

10. Select all the surfaces that make up the end wall facing towards you in the model.

    You can do this by dragging a window across the upper part of the alcove (see Figure 5-2).

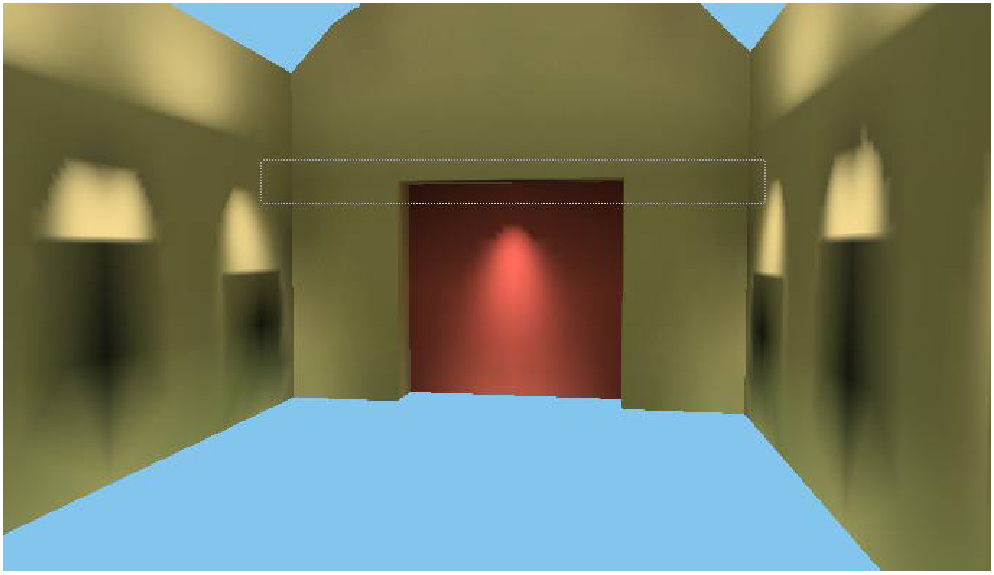


Figure 5-2. *Selecting the End Wall Surfaces*

11. Click Next to advance to the Use Existing Texture Filenames page of the wizard.

12. Ensure the Use existing texture filenames button is turned off and click Next to advance to the Texture Output page of the wizard.

13. Choose JPEG (JPG) from the Format combo box.

14. Type **`east`** in the New Texture Base Name input field.

    This creates several textures called `east000.jpg`, `east001.jpg`, and so on, when you create the textures.

15. Ensure the Manual Size radio button is selected and type **`128`** in the Width input fields and **`128`** in the Height input field.

    This creates square texture maps.

16. Click Next to advance to the Rendering Options page of the wizard.

17. Type **0** in the Ray Bounces field.

    Although it is possible to create texture maps that have specular lighting, generally these will look odd from most views as the reflections will be calculated from a single point of view.

18. Click Next to advance to the Replace/Delete page of the wizard.

19. Select the Replace Textures on target geometry option.

    This places the texture map on the wall surface.

20. Select the Reset Mesh on Target geometry option.

    This removes the radiosity mesh from the walls.

21. Click Finish to create the texture map.

    Seven new materials with the names `M2T WALLS-> east000.`, `M2T WALLS-> east001.`, and so on, are created and added to the material list. The wall surfaces are now replaced with texture maps.

► **View the textures and note the change in the number of polygonal mesh elements in the model.**

1. Double-click `M2T WALLS-> east001.` in the Materials Table.

   The Material properties for M2T WALLS-> east001. dialog box displays.

Note The numbers at the end of the material names (000, 001, etc.) are determined by the order in which you select the surfaces.

2. Click the Texture tab.

   Observe the display of the texture file.

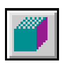
3. Turn on all of the layers.
4. Choose Display > Outlined or click the Outlined button on the toolbar.

   The mesh on the each of the surfaces now displays. Notice how the wall surface is no longer meshed.

5. Choose Process > Statistics.

   Notice that the number of mesh elements in the model has decreased again.

Map many surfaces into a single texture map and apply the single texture back onto the surfaces. Delete some of the geometry.



1. Choose Display > Solid or click the Solid button on the toolbar.
2. Turn off all layers except `ROOM2_WALLS` and `ROOM2_PICTURES`.
3. Orbit the view so that you can see all of the surface making up the south wall of the room (right hand side of the screen).
4. Choose Tools > Mesh to Texture.

   The Mesh to Texture wizard displays.

5. Select the Project all selected geometry into one texture radio button.

   This makes a single texture from all the surfaces you select.

6. Click Next to advance to the Select Projected Geometry page of the wizard.

   This is the page where you select the geometry for the first selection set. This is the geometry you intend to delete from the model. In this case, you will select the pictures and picture frames. These surfaces will be deleted from the model and an image of them pasted onto the wall surface.

7. Click the Deselect All button then select the surfaces of the pictures and the picture frames (see Figure 5-3).

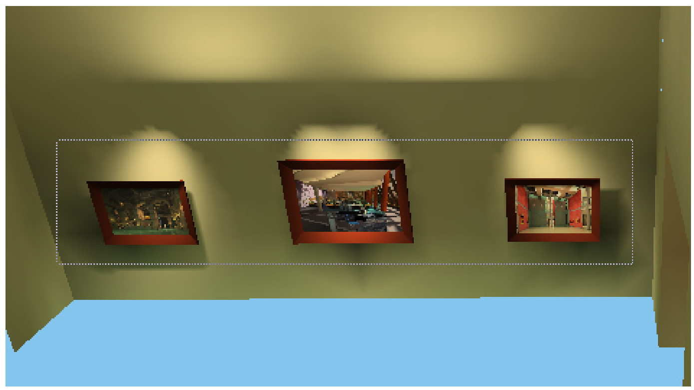


Figure 5-3. *Selecting Surfaces of Pictures and Picture Frames*

8. Click Next to advance to the Select Target Geometry page of the wizard.

   This is the page where you select the geometry for the second selection set. This is the geometry you intend to apply the texture to and keep in the model.

9. Choose Edit>Selection>Deselect All or click the Deselect All button on the toolbar to ensure that the selection set is empty.

10. Select the wall surface behind the pictures.
11. Click Next to advance to the Select Projection Method page of the wizard.
12. Choose Orthographic in the Projection combo box and choose Snap to Nearest Vertex to turn on this feature.
13. Ensure the Lower Left Radio button is selected and pick a point in the vicinity of the lower left corner of the wall.

    You do not have to be precise; Lightscape looks for the nearest vertex (if Snap To Nearest Vertex is selected).
14. Pick another point in the lower right corner of the wall.
15. Pick a third point in the upper left corner of the wall.
16. Click Next to advance to the Texture Output Information page of the wizard.
17. Type **`south`** in the New Texture Base Name input field.

    This creates a texture called `south000.jpg` when you create the textures.
18. Ensure the Manual Size radio button is selected and type **`512`** in the Width input fields and **`256`** in the Height input field.
19. Click Next to advance to the Rendering Options page of the wizard.
20. Type **`0`** in the Ray Bounces field.
21. Click Next to advance to the Replace/Delete page of the wizard.
22. Select the Replace Textures on the Target Geometry option.

    This places the texture map on the wall surface.
23. Select the Reset Mesh on Target Geometry option.

    This removes the radiosity mesh from the walls.

24. Select the Delete the Projected Geometry From the Model option.

    This removes the pictures and their frames from the model once the texture has been created.

25. Click Finish to create the texture map.

    A new material with the name `M2T WALLS-> south000.` is created and added to the material list. The texture map replaced the pictures and was applied to the wall surface.

▶ View the textures and note the change number of polygonal mesh elements in the model.

1. Double-click `M2T WALLS-> south000.` in the Materials Table.

   The Material Properties for M2T WALLS-> south000. dialog box displays.

2. Click the Texture tab and observe the display of the texture file.

3. Choose Display > Outlined.

   The mesh on the each of the surfaces now displays. Note how the wall is no longer meshed and the geometry of the picture frames is gone.

4. Choose Process > Statistics.

   Notice the number of mesh elements in the model. Again, there should be a significant reduction.

Map many surfaces into a single texture map and apply the single texture back onto the surfaces.

1. Choose Display > Solid.
2. Turn off all layers except `ROOM2_WALLS` and `ROOM2_PICTURES`.
3. Orbit the view so that you can see all of the surface making up the north wall of the room.
4. Choose View>Extents.
5. Choose Tools > Mesh to Texture.

   The mesh to texture wizard displays.

6. Select the Project all selected geometry into one texture radio button.

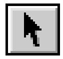
   This makes a single texture from all the surfaces that you select.

7. Click Next to advance to the Select Projected Geometry page of the wizard.

   This is the page where you select the geometry for the first selection set. This is the geometry you intend to delete from the model. In this case, leave the selection blank.

8. Choose Edit > Selection > Deselect All or click the Deselect All button on the toolbar to ensure that the selection set is empty.
9. Click Next to advance to the Select Target Geometry page of the wizard.

   This is the page where you select the geometry for the second selection set. This is the geometry you intend to apply the texture to and keep in model.



10. Choose Edit > Selection > Select or click the Select button on the toolbar.
11. Select both the wall surface and the surfaces of the pictures (including the frames).
12. Click Next to advance to the Select Projection Method page of the dialog.
13. Choose Orthographic in the Projection combo box and choose Snap to Nearest Vertex to turn on this feature.
14. Ensure the Lower Left radio button is selected and pick a point in the vicinity of the lower left corner of the wall.

    You do not have to be precise; Lightscape looks for the nearest vertex (if Snap To Nearest Vertex is selected).
15. Pick another point in the lower right corner of the wall.
16. Pick a third point in the upper left corner of the wall
17. Click Next to advance to the Texture Output Information page of the wizard.
18. Choose JPEG (JPG) from the Format combo box.
19. Type **`north`** in the New Texture Base Name input field.

    This creates a texture called `north000.jpg` when you create the textures.
20. Ensure the Manual Size radio button is selected and type **`512`** in the Width input fields and **`256`** in the Height input field.
21. Click Next to advance to the Rendering Options page of the wizard.
22. Type **`0`** in the Ray Bounces field.
23. Click Next to advance to the Replace/Delete page of the wizard.

24. Select the Replace Textures on target geometry option.

    This places the texture map on the wall surface.

25. Select the Reset Mesh on Target geometry option.

    This removes the radiosity mesh from the walls.

26. Make sure that the Delete the projected geometry from the model option is turned off.

27. Click Finish to create the texture map.

    A new material with the name `M2T WALLS-> north000.` is created and added to the material list. The texture map is wrapped around the pictures and applied to the wall surface.

► View the textures and note the change number of polygonal mesh elements in the model.

1. Double-click `M2T WALLS-> north000.jpg` in the Materials Table.

   The Material Properties for M2T WALLS-> north000. dialog box displays.

2. Click the Texture tab and observe the display of the texture file.

3. Choose Display > Outlined.

   The mesh on the each of the surfaces now displays. Notice how the wall and picture surfaces are no longer meshed.

4. Choose Process > Statistics.

   Notice the number of mesh elements in the model. Compare this to the original number of mesh elements without any texture conversions.

Save your work up to this point.

1. Choose File > Save As.

   The Save As dialog box displays.

2. Change directory to:

   `c:\Program Files\lvs\projects\tutorial5`

3. In the File Name input field, type the following:

   `M2T.ls`

4. Click OK.

Opening a File

Load a Solution file.

You will perform this part of the tutorial with a file which has already been created in Lightscape.

1. Choose File > Open.

   The Open dialog box displays. Note that List Files of Type should be set to Preparation Files (*.ls).

2. Change directory to:

   `c:\Program Files\lvs\projects\tutorial5`

3. Double-click the file `tutorial2.ls`.

▶ Make a cylindrical texture map of the entire room.

A cylindrical or spherical image map can be used with a number of display engines that wrap a single texture map to represent all of the geometry in a space. You can make such a map in the following manner.

1. Choose Display > Solid.
2. Turn on all layers.
3. Choose Tools > Mesh to Texture.

   The mesh to texture wizard displays.
4. Select the Project all selected geometry into one texture radio button.

   This makes a single texture from all the surfaces that you select.
5. Click Next to advance to the Select Projected Geometry page of the wizard.

   This is the page where you select the geometry for the first selection set. This is the geometry you intend to delete from the model. In this case, leave the selection blank
6. Choose Edit > Selection > Deselect All or click the Deselect All button on the toolbar to ensure that the selection set is empty.
7. Click Next to advance to the Select Target Geometry page of the wizard.

   This is the page where we select the geometry for the second selection set - geometry we intend to apply the texture to and keep in model.
8. Choose Edit > Selection > Surfaces or click the Surfaces button on the toolbar.

9. Choose Edit > Selection > Select All or click the Select All button on the toolbar.

   This selects all of the surfaces in the model.

10. Click Next to advance to the Select Projection Method page of the dialog.

11. Choose Cylindrical in the Projection combo box.

12. Ensure the Lower Center radio button is selected and type the following:

    -21.5 in the x field

    -4 in the y field

    0 in the z field

    These are the coordinates for the exact center of the floor.

13. Ensure the Upper Center radio button is selected and type the following:

    -21.5 in the x field

    -4 in the y field

    9.5 in the z field

    These are the coordinates for the exact center of the ceiling.

14. Ensure the Seam Direction radio button is selected and type the following:

    -13.5 in the x field

    -4 in the y field

    0 in the z field

    These are the coordinates for a point on the wall.

15. Ensure the Project Inward button is turned off.

    This sets the projection so that the surfaces are understood to be looking towards the center of the mapping system.

16. Click Next to advance to the Texture Output Information page of the dialog box.

17. Type **round** in the New Texture Base Name input field.

    This creates a texture called `round000.jpg` when you create the textures.

18. Ensure the Manual Size radio button is selected and type **512** in the Width input fields and **128** in the Height input field.

    As the texture wraps around the room it is considerably wider than it is high.

19. Click Next to advance to the Rendering Options page of the wizard.

20. Type **10** in the Ray Bounces field.

    As this is a cylindrical texture seen from a single point of view, you can display specular lighting effects (the reflections from the vases).

21. Click Next to advance to the Replace/Delete page of the wizard.

22. Deselect the Replace Textures on target geometry option.

    You will not place this texture in the model.

23. Deselect the Delete the projected geometry from the model option.

24. Click Finish to create the texture map.

    A new image with the name `round000.jpg` is created. You can view this texture using the LVu utility and choosing the `c:\Program Files\lvs\projects\tutorial5` directory.

Exit without saving.

1. Choose File > Exit.
2. Click No and do not save changes.

Outputting the Results

In this exercise, you will perform the following task:

- Using Command Line Utilities

Using Command Line Batch Utilities

In addition to the main Lightscape GUI program, the Lightscape Visualization System supports a number of utilities that can be run at the command line or in batch files. Using batch files, you can set up a series of procedures and have them run sequentially over an extended period of time. The command line utilities are generally run from a DOS window and take the form:

`COMMAND [options]` *`Lightscape_file`*

The most common command line utilities are:

- `lsray` - Creates a ray traced image of a Lightscape file.
- `lsrad` - Runs the radiosity process.
- `lsrender` - Creates a non ray-traced image of a Lightscape file.
- `ls2vrml` - Creates a VRML file from a Lightscape model.

► **Create a VRML file from a Lightscape solution file.**

VRML is a 3D file format designed to view 3D models over the World Wide Web (WWW). There are a number of browsers available for viewing files of this type.

1. In the Main window group within the Program Manager, double-click the MS-DOS icon.

   If you are using Windows 95 or Window NT 4.0, choose Start > Programs> MS-DOS Prompt.

2. Change directory to the following:

```
C:\Program Files\lvs\projects\tutorial5
```

The quotation marks are required. If you have installed Lightscape in a place other than the default location, you will need to alter the path accordingly.

3. Type the following:

```
..\..\bin\ls2vrml -o tutorial1.wrl
tutorial1.ls
```

A file called `tutorial1.wrl` will be created in the current directory. This is the non-optimized version of the model.

4. Type the following:

```
..\..\bin\ls2vrml -o M2T.wrl M2T.ls
```

A file called `M2T.wrl` will be created in the current directory. This is the optimized version of the model, using texture maps in the place of the radiosity mesh.

5. If you have access to a VRML viewer, open the files. (You will need to turn the headlight off in most VRML viewers).

► **Run a batch file that creates both a radiosity and ray-traced image of a Lightscape model.**

Batch files are special files in DOS that contain a sequence of instructions to be performed one after another. The batch file next will first call `lsrad` - the radiosity process command line utility and run several iterations of the radiosity process. It will then render and display a view of the model using the radiosity data only. Finally, it will do a ray-trace rendering of the model.

1. In the Main window group within the Program Manager, double-click the File Manager icon.

2. Change directory to:

`C:\program files\lvs\projects\tutorial5`

If you installed Lightscape in other than the default location, you will need to alter the path accordingly.

3. Double-click `makeimage.bat`.

This executes a batch file called `makeimage.bat`. It should open a DOS window and execute four commands in sequence.

That file contains the following lines:

```
..\..\lsrad -term 10  -v tutorial1.ls

..\..\lsrender -aa 2 -x 645 -y 486 -v
tutorial1.ls radiosity.tga

..\..\lsray -aa 2 -x 645 -y 486 -w -v
tutorial1.ls raytraced.tga

..\..\bin\lvu ..\tutorial5
```

The first line calls the radiosity program (`lsrad`), runs ten iterations (`-term 10`) using the file `tutorial1.ls`.

The second line calls the radiosity renderer (`lsrender`), sets the antialiasing to 2 (`-aa 2`), creates an image of 645x486 pixels (`-x 645 -y 486`), uses the same `tutorial2.ls` file and creates an image called `radiosity.tga`.

The third line calls the ray-trace renderer (`lsray`), sets the antialiasing to 2 (`-aa 2`), creates an image of 645x486 pixels (`-x 645 -y 486`), uses the same `tutorial1.ls` file, and creates an image called `raytraced.tga`. The `-w` option paints the results to the screen.

The last line opens the LVu utility and automatically loads the images created by `makeimage.bat`.

You may wish to look at the contents of the batch file using a simple text editor.

Congratulations! You have reached the end of Tutorial 5. At this point you should be able to:

- Combine models
- Simplify models using the mesh to texture utility
- Create and use batch files