Lightscape™

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

Getting Started

Lightscape Visualization System Version 3
for Windows NT and Windows 95, Getting Started

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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 Version 3 Getting Started* manual describes the basic concepts of the Lightscape technology and process, and the fundamentals of the user interface.
- The *Lightscape Visualization System Version 3 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 Version 3 Tutorials* manual provides 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 item and dialog box 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.

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 you need to provide. This typeface is shown in Courier. For example, if the instruction says your batch file should read: `lsray -aa 4 -vf view1.vw 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 menus and their submenus. For example, click Apply; choose New from the File menu.
>	The > symbol indicates that you are to choose an item from a menu or submenu. For example, File > Parameters > Load means that you are to choose Load from the Parameters submenu of the File menu.

Chapter 1

The Basics

Lightscape is an advanced visualization system for generating accurate lighting simulations of three-dimensional models. This chapter provides an introduction to the technology used in Lightscape. You should have a basic understanding of this technology to use the software effectively.

About Lightscape

Lightscape is an advanced lighting and visualization application that focuses on creating accurate images of how a 3D model of an object or space would appear if physically built. Lightscape is an application offering both radiosity and ray tracing technology combined with a physically based interface for defining lights and materials. Lightscape offers many unique advantages over other rendering technologies, including the following:

- **Lighting**
  The radiosity technology of Lightscape produces accurate photometric simulations of diffuse light propagation in an environment. Subtle but significant lighting effects, such as direct and indirect diffuse lighting, soft shadows, and color bleeding between surfaces produce images of natural realism not attainable with other rendering techniques. Because it supports industry-standard photometric formats and natural daylighting, Lightscape is a powerful tool for design visualization and analysis.

- **Interactivity**
  The result of a radiosity solution is not just a single image but a full 3D representation of the light distribution in an environment. Because the lighting is precalculated, Lightscape can display specific views of a fully rendered model much faster than with traditional computer graphic techniques. With hardware acceleration, it is often possible to move interactively through rendered environments. High-quality walkthrough animations for film or video can be generated in a fraction of the time required with other professional animation systems.

- **Progressive Refinement**
  Unlike other techniques, a Lightscape solution provides instant visual feedback, which continues to improve in quality over time. At any stage in the processing, you can alter a surface material or lighting parameter and the system will compensate and display the new results without having to start the process over. The progressive refinement radiosity algorithms implemented in Lightscape give you precise control over the quality of visualization required to perform any given design or production task.

Computer Graphics Rendering

This section provides a brief overview of computer graphics rendering and a conceptual understanding of the techniques available with Lightscape. This information will help you decide which technique is most suitable for the visualization task you want to perform.

A 3D model contains geometric data defined in relationship to a 3D Cartesian coordinate system. This system is sometimes referred to as *world space*. The model may also contain other information about the material of each of the objects and the lighting. The image on a computer monitor is made up of a large number of illuminated dots called *pixels*. The task in creating a computer graphics image of a geometric model is to determine the color for each pixel on the screen *(screen space)* based on the model information and a specific viewpoint.

The color of any specific point on a surface in a model is a function of the physical material properties of that surface and the light that illuminates it. Two general *shading algorithms*—local illumination and global illumination—are used to describe how surfaces reflect and transmit light.

Local Illumination

Local illumination algorithms describe only how individual surfaces reflect or transmit light. Given a description of light arriving at a surface, these mathematical algorithms predict the intensity, spectral character (color), and distribution of the light leaving that surface. The next task is to determine where the light arriving at the surface originates. A simple rendering algorithm considers only the light coming directly from the light sources themselves in the shading.

Global Illumination

In considering more accurate images, however, it is important to take into account not only the light sources themselves, but also how all the surfaces and objects in the environment interact with the light. For example, some surfaces block light, casting shadows on other surfaces; some surfaces are shiny, in which case we see in them the reflections of other surfaces; some surfaces are transparent, in which case we see other surfaces through them; and some surfaces reflect light onto others. *Global illumination algorithms* are rendering algorithms that take into account the ways in which light is transferred between the surfaces in the model.

Lightscape uses two global illumination algorithms. One technique is called *ray tracing;* the other is called *radiosity*. Before explaining how these techniques work, it is useful to have a basic understanding of how, in the physical world, light is distributed in an environment. Consider, for example, the simple room shown in Figure 1-1.

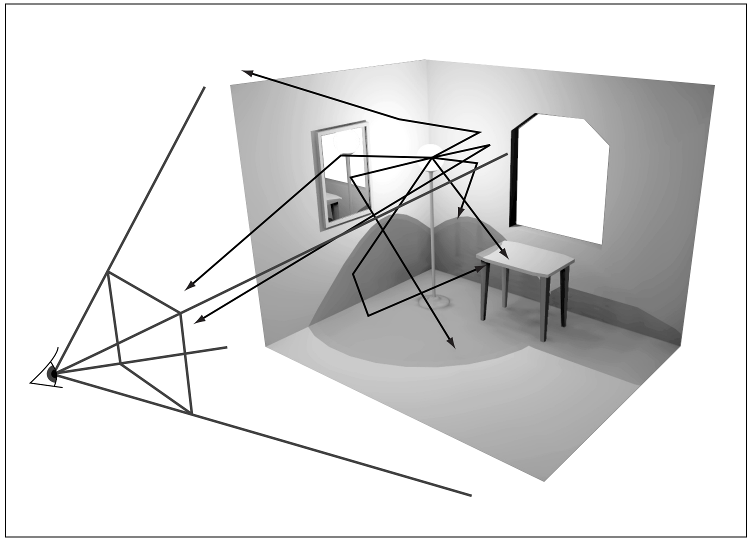


Figure 1-1. *Global Illumination in a Room*

This room has one light source. One theory of light allows us to consider the light in terms of discrete particles called *photons*, which travel out from the light source until they encounter some surface in the room. Depending on the material of the surface, some of these photons, traveling with particular wavelengths, are absorbed, while others are scattered back out into the environment. The fact that photons traveling at a particular wavelength are absorbed while others are not is what determines the color (also referred to as the *spectral reflectance*) of the surface.

The way a surface reflects photons depends primarily on its smoothness. Surfaces that are rough tend to reflect photons in all directions (Figure 1-2). These are known as *diffuse* surfaces and this type of reflection is known as *diffuse reflection*. A wall painted with flat paint is a good example of a diffuse surface.

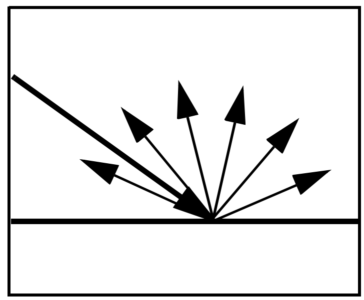


Figure 1-2. *Diffuse Reflection*

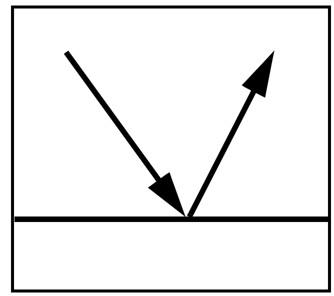


Figure 1-3. *Specular*

Very smooth surfaces reflect the photons in one direction (Figure 1-3), at an angle equal to the angle at which they arrive at the surface *(angle of incidence)*. These surfaces are known as *specular surfaces* and this type of reflection is known as *specular reflection*. A mirror is an example of a perfectly specular surface. Of course, many materials display some degree of both specular and diffuse reflection.

The final illumination of the room is determined by the interaction between the surfaces and the billions of photons that are emitted from the light source. At any given point on a surface, it is possible that photons have arrived directly from the light source *(direct illumination)* or else indirectly through one or more bounces off some other surfaces *(indirect illumination)*. If you were standing in the room, a very small number of the total photons in the room would enter your eye and stimulate the rods and cones of your retina. This stimulation would, in effect, form an image that is perceived by your brain (Figure 1-1).

Computers replace the rods and cones of a retina with the pixels of the computer screen. One goal of a global illumination algorithm is to recreate, as accurately as possible, what you would see if you were standing in a real environment. A second goal is to accomplish this task as quickly as possible; ideally in *real time* (30 images per second). There is currently no single global illumination algorithm that can accomplish both of these goals.

Ray Tracing

One of the first global illumination algorithms to be developed is known as *ray tracing*. In ray tracing it is recognized that while there may be billions of photons traveling about the room, the photons you primarily care about are the ones that enter the eye. The algorithm works by tracing rays *backward,* from each pixel on the screen into the 3D model. In this way, it computes only the information needed to construct the image. To create an image using ray tracing, the following procedure is performed for each pixel on the computer screen (Figure 1-4):

1. Trace a ray back from the eye position, through the pixel on the monitor, until it intersects with a surface.
2. The model description provides the reflectivity of the surface, but not the amount of light reaching that surface. To determine the total illumination, trace a ray from the point of intersection to each light source in the environment *(shadow ray)*. If the ray to a light source is not blocked by another object, use the light contribution from that source to calculate the color of the surface.

3. The intersected surface may be shiny or transparent. In this case the algorithm also must determine what is seen in or through the surface being processed. Steps 1 and 2 are repeated in the reflected (and, in the case of transparency, transmitted) direction until another surface is encountered. The color at the subsequent intersection point is calculated and factored into the original point.
4. If the second surface is yet again a reflective or transparent surface, the ray tracing process repeats once again, and so on, until a maximum number of iterations is reached or until no more surfaces are intersected.

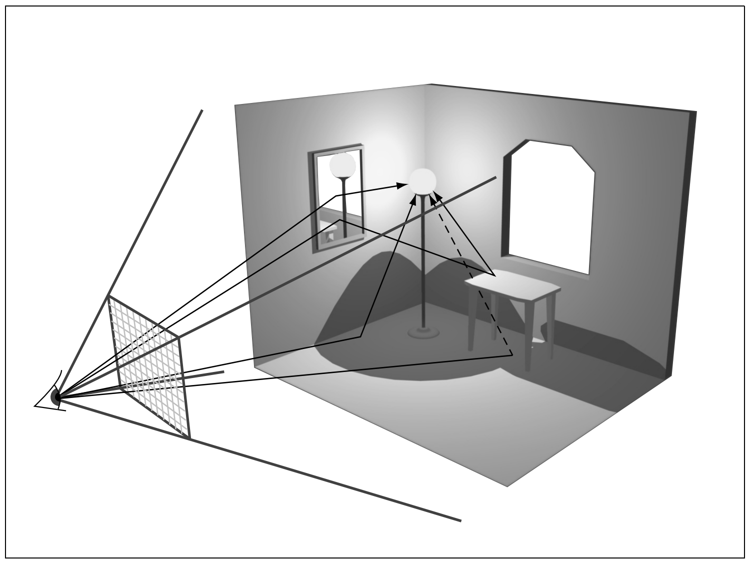


Figure 1-4. *Ray tracing*

Ray tracing is a very versatile algorithm because of the large range of lighting effects it can model. It can accurately account for the global illumination characteristics of direct illumination, shadows, specular reflections (for example, mirrors), and refraction through transparent materials. The main disadvantage of ray tracing is that the process can be slow and computationally expensive for environments of even moderate complexity.

Another significant disadvantage of ray tracing is that it does not account for one very important characteristic of global illumination—diffuse interreflections.

Traditional ray tracing techniques accurately account for only the light arriving directly from the light sources themselves. But, as shown in the room example, light does not only arrive at a surface from the light sources (direct lighting), it also arrives from other surfaces (indirect lighting). If you ray trace an image of the table, as shown in the example, the area under the table appears black because it receives no direct light from the light source. You know from experience, however, that this area would not really be completely dark because of the light it would receive from the surrounding walls and floor.

Traditional ray tracing techniques often refer to this indirect illumination as *ambient light*. They usually account for it by simply adding an arbitrary value that has no correlation to the physical phenomena of indirect illumination and that is constant throughout space. This often causes ray traced images to appear very flat. This is particularly true for architectural environments, which typically contain mostly diffuse surfaces.

Radiosity

To address some of the shortcomings of the ray tracing algorithm, researchers began investigating alternate techniques for calculating global illumination.

In the early 1960s thermal engineers developed methods for simulating the radiative heat transfer between surfaces. Their goal was to determine how their designs would perform in various applications such as furnaces and engines. In the mid-1980s, computer graphics researchers began investigating the application of these techniques for simulating light propagation.

Radiosity, as this technique is called in the computer graphics world, differs fundamentally from ray tracing. Rather than determining the color for each pixel on a screen, radiosity calculates the intensity for discrete points in the environment.

Radiosity accomplishes this by first dividing the original surfaces into a mesh of smaller surfaces known as *elements*. The radiosity process calculates the amount of light distributed from each mesh element to every other mesh element. It then stores the final radiosity values for each element of the mesh (Figure 1-5).

Once this light distribution has been calculated, specific views of the environment can be rapidly displayed on the screen (often in real time) using simple hardware-assisted scan-line techniques. This property is often referred to as *view independence,* because the light distribution is precalculated for the whole environment and does not have to be recalculated for each specific view. Ray tracing, on the other hand, is known as a *view-dependent* algorithm, because the lighting has to be recalculated for each view.

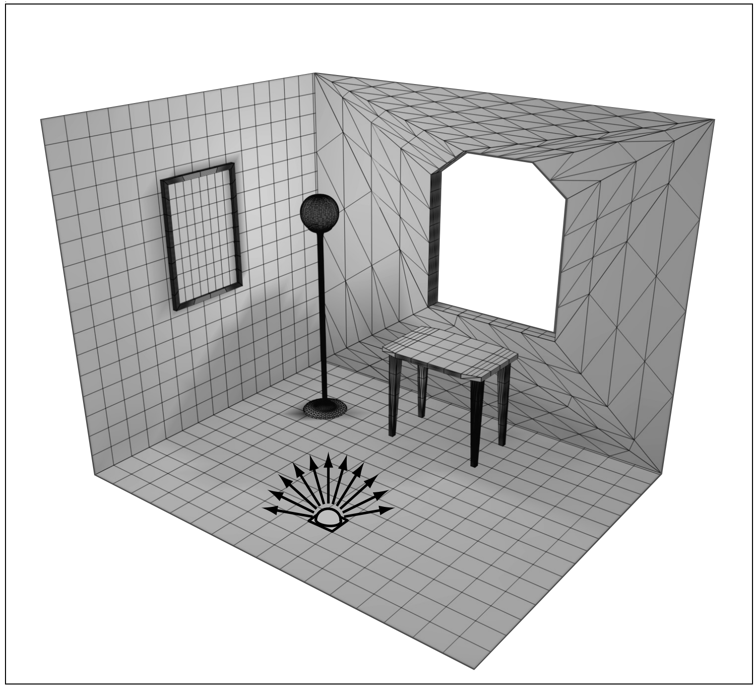


Figure 1-5. *Radiosity*

Early versions of the radiosity algorithm had to completely calculate the distribution of the light among all the mesh elements before they could display any useful results on the screen. Even though the end result was view independent, the preprocessing took considerable time. In 1988 this preprocessing portion of the radiosity algorithm was reformulated. The new technique, referred to as *progressive refinement radiosity,* allows users to obtain immediate visual results, which progressively improve in accuracy and visual quality.

The progressive refinement radiosity algorithm used in Lightscape works in the following way:

1. The surfaces are meshed into a set of relatively large elements. The initial elements can be subdivided automatically into smaller elements in areas where a significant intensity difference is detected between adjacent mesh elements (for example, across shadow boundaries).
2. Light is distributed from each luminaire to all surfaces in the environment. (A luminaire is a light fixture, with one or more lamps and housing.) In this calculation, surfaces can block other surfaces, casting shadows.
3. Depending on the characteristics of the surface material, some of the energy reaching a particular mesh element is absorbed, while the remaining energy is reflected into the environment. An important assumption in radiosity is that all the surfaces are "ideal diffuse" (Lambertian)—that is, they reflect light equally in all directions.
4. After distributing the energy from each direct light source (direct illumination), the progressive radiosity algorithm continues by checking all the surfaces and determining which surface has the most energy to be reflected. This surface is then treated as an area light source emitting the reflected energy to all the other surfaces in the environment (indirect illumination).
5. The process continues until most of the energy in the environment has been absorbed (energy equilibrium) and the simulation reaches a state of *convergence*.

Each distribution of light from a luminaire or surface, as just described, is called an *iteration*.

The number of iterations required for a simulation to reach a state of convergence varies depending on the complexity of the environment. Because the iterations are sorted to calculate the surfaces with the greatest energy first, the rate of convergence for the radiosity solution is much faster in the beginning. Toward the end, the amount of energy remaining to be distributed is so small that there is no perceptible difference in the resulting images from one iteration to the next. Therefore, while it may take a large number of iterations for a solution to reach full convergence, typically you can interrupt the process before this point is reached, because an acceptable solution has been obtained.

Radiosity and Ray Tracing Differences

Although the ray tracing and radiosity algorithms are very different, they are in many ways complementary. Each technique has its own unique set of advantages and disadvantages.

The ray tracing algorithm has the following advantages:

- Accurately rendered direct illumination, shadows, specular reflections, and transparency effects
- Memory efficiency

Ray tracing has the following disadvantages:

- Computationally expensive; the time required to produce an image is greatly affected by the number of light sources
- View dependent—Process must be repeated for each view
- Does not account for diffuse interreflections

The radiosity algorithm has the following advantages:

- Calculations of diffuse interreflections between surfaces
- View-independent solutions for fast display of arbitrary views
- Immediate visual results, which progressively improve in accuracy and quality

The radiosity algorithm has the following disadvantages:

- 3D mesh requires more memory than the original surfaces
- Surface-sampling algorithm is more susceptible to imaging artifacts than ray tracing
- Does not account for specular reflections or transparency effects

Neither radiosity nor ray tracing offers a complete solution for simulating all global illumination effects. Radiosity excels at rendering diffuse-to-diffuse interreflections and ray tracing excels at rendering specular reflections.

By merging both techniques, Lightscape offers the best of both. In Lightscape, it is possible to combine a ray-tracing postprocess with a specific view of a radiosity solution to add specular reflections and transparency effects. In this situation, the radiosity solution replaces the inaccurate ambient constant used in many programs with accurate indirect illumination values. This leads to a much more realistic image. In addition, because the direct lighting can be calculated in the radiosity solution, the ray tracer does not have to cast any shadow rays, only reflected or transmitted rays. This greatly reduces the time required to ray trace an image. By integrating both techniques, Lightscape offers a full range of visualization possibilities, from fast, interactive lighting studies to combination radiosity/ray traced images of exceptional quality and realism.

Photometry

Lightscape is founded on a physically based simulation of the propagation of light through an environment. The results are not only highly realistic renderings, but also accurate measurements of the distribution of light within the scene. This section is a brief introduction to the quantities used to characterize these measurements.

You specify the brightness of a luminaire in Lightscape using these physically based quantities. You can obtain these values directly from the manufacturers of various lamps and luminaires. A table of some common lamp types is provided in Appendix G, "Common Lamp Values," of the *Lightscape Visualization System User's Guide*.

There are several theories that describe the nature of light. For this discussion, *light* is radiant energy capable of producing a visual sensation in a human observer.

When designing a lighting system, you are interested in evaluating its performance in terms of the human visual response. Thus *photometry* was developed to measure light taking into account the psychophysical aspects of the human eye/brain system.

The lighting simulation system uses four photometric quantities:

- Luminous flux
- Illuminance
- Luminance
- Luminous intensity

Luminous flux is the quantity of light energy per unit time arriving, leaving, or going through a surface. The unit of luminous flux is the *lumen* (lm), used in both the International System (SI) of Units and in the American System (AS) of Units. If you think of light as particles (photons) moving through space, then the luminous flux of a light beam arriving at a surface is proportional to the number of particles hitting the surface during a time interval of 1 second.

Illuminance is the luminous flux incident on a surface of unit area. This quantity is useful for describing the level of illumination incident on a surface without making the measurement dependent on the size of the surface itself. The SI unit of illuminance is the *lux* (lx), equal to 1 lumen per square meter. The corresponding AS unit is the footcandle (fc), equivalent to 1 lumen per square foot.

Part of the light incident on a surface is reflected back into the environment. *Luminance* is the light reflected off a surface in a particular direction and is the quantity converted to display colors to generate a realistic rendering of the scene. Luminance is measured in candelas per square meter or candelas per square inch. The *candela* was originally defined as the luminous intensity emitted by a single wax candle.

Finally, *luminous intensity* is the light energy per unit time emitted by a point source in a particular direction. The unit of measure of luminous intensity is the *candela*. Luminous intensity is used to describe the directional distribution of a light source—that is, to specify how the luminous intensity of a light source varies as a function of the outgoing direction.

Chapter 2

The Lightscape Process

This chapter provides a summary of the general process for using Lightscape. Each step of this process is explained in greater detail in the *Lightscape Visualization System User's Guide*.

The Lightscape process consists of three major stages:

- The Preparation stage
- The Solution stage
- The Output stage

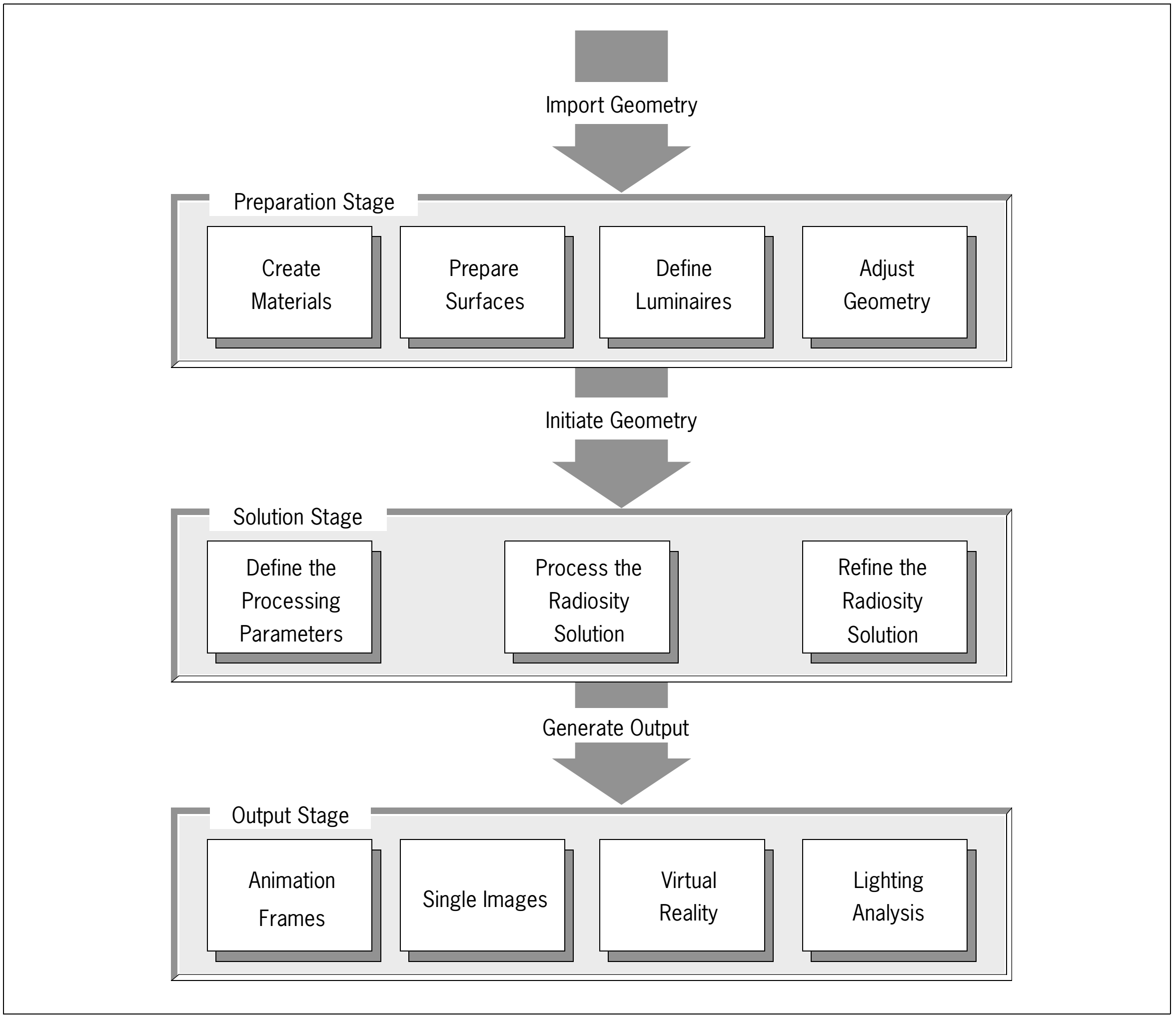


Figure 2-1. *Overview of the Lightscape Visualization Process*

The Preparation Stage

During the Preparation stage, you perform a number of operations to prepare geometric data for processing during the Solution stage. These operations include the following:

- Import the geometry.

  Lightscape provides import filters for several file formats.

- Define what materials the surfaces are made of.

  Lightscape simulates the interaction of light between surfaces in the model. Accurately representing the material properties of surfaces is important for achieving meaningful results.

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

  Some modeling systems allow for the creation of infinitely thin surfaces. Because Lightscape is a physically based lighting simulation system, it is important to indicate which side of such a surface represents the desired physical side.

- Define the photometric properties of the luminaires (lighting fixtures) used in the model.

  Lightscape uses physically based lighting values to define the artificial light sources and natural light in a 3D model.

- Add, delete, and move entities and luminaires as desired.

  Lightscape provides a limited suite of tools you can use to modify the geometry of a model before processing a radiosity solution.

All the work that you perform during the Preparation stage is saved as a Lightscape Preparation model in a Lightscape Preparation (.lp) file.

The Solution Stage

During the Solution stage you run a radiosity solution on the geometry you prepared during the Preparation stage. Steps during this part of the process include the following:

- Initiate the geometry.

  Lightscape reduces the model to a set of surfaces that are optimized for the radiosity process. Once initiated, you can no longer manipulate the model geometry.

- Define the processing parameters.

  You define the global processing parameters (those that apply to the entire model) and any desired local processing parameters (those that apply to specific surfaces). Process parameters control the quality of the resulting radiosity solution. Setting the process parameters is a balancing act. Finer settings produce more accurate solutions and better quality images, but they also require more time and memory.

- Process the radiosity solution.

  Lightscape calculates the diffuse light energy distribution for the model, both direct and indirect. This process is described in detail in Chapter 1, "The Basics."

- Refine the radiosity solution.

  You can interrupt the processing of the radiosity solution at any time to alter or fine tune the model's appearance. You cannot change the model geometry, but you can change the characteristics of a material and the photometric properties of a luminaire. Once you make your changes, you can update the results of the radiosity solution by either continuing the processing from where you left off or by restarting the processing from the beginning.

You can save the results of the radiosity solution as a 3D Lightscape Solution model in a Lightscape Solution file (.ls).

The Output Stage

There are many ways you can use the results from a radiosity solution and Lightscape offers a variety of output options to support these uses.

During the Output stage, you can render a Lightscape radiosity solution very quickly using OpenGL rendering or more accurately using the Lightscape ray tracer to add specular reflections and transparency effects to the final images. (OpenGL is an industry-standard Application Programming Interface for drawing 3D graphics.) You can also use the ray tracer to refine the definition of shadows by ray tracing direct light sources. The options you choose at this stage have an impact on the time required to generate an image; the choice you make depends on your intended use. The following uses are the most common:

- Animation Frames
- Single Images
- Virtual Reality
- Lighting Analysis

Animation Frames

With the Lightscape animation tools, you can create camera paths for generating walkthrough animations of your radiosity solutions. Even though the image-generation time is not as crucial as it is for doing real-time display, image generation time is still a significant issue because of the number of frames that must be created. The fastest display rates can be obtained by using only a radiosity solution; you can generate high-quality antialiased images very quickly with OpenGL rendering.

If you want to add specular reflections and accurate transparency effects, you can use ray tracing on each frame to render these effects. Although ray tracing increases the time required to generate a frame, it is not necessarily an impractical option for animation production. If you ray trace animation frames, you should render them using the batch ray tracing program included with Lightscape. This gives you greater efficiency in the rendering process.

Single Images

Typically, the single image demands the highest level of quality. Lightscape has the capability to produce images of any resolution. If you use the image from a radiosity solution only, you can create the image very quickly with OpenGL rendering.

To obtain the most accurate representation, however, you should ray trace the image. In addition to adding specular reflections and accurate transparency effects, you can also specify that you want the system to ray trace some or all of the light sources. Such specification produces the most accurate-looking shadows and lighting effects for those light sources and results in the highest image quality. This process also requires the greatest amount of time, especially if there are many light sources to ray trace.

Virtual Reality

If your goal is to produce a virtual reality environment for real-time walkthrough and interaction, you cannot use ray tracing. You must strive for the highest quality from the most compact and efficient model using the radiosity process alone. Because the radiosity solution results in a simple polygonal mesh with specific radiosity values (converted to RGB colors) stored at the vertices, results can be displayed very rapidly using OpenGL rendering. The speed of interaction depends on the complexity of the environment and the number of mesh elements (that is, polygons) generated during the radiosity solution. Display can also be accelerated using an OpenGL-compliant graphics accelerator board.

Lightscape supports OpenGL texture mapping, but can only display environments with texture mapping in real time on platforms that offer hardware support for it. If hardware support is present, you can use the Mesh to Texture tool to reduce geometric complexity in the environment by converting meshes and geometry into texture maps. Note that the OpenGL display libraries have been developed primarily for 3D interactive display and the rendering capabilities offered with OpenGL are not always compatible with efforts to produce physically accurate simulations. (See the *Lightscape Visualization System User's Guide*.)

For example, during normal display Lightscape uses OpenGL blending techniques to create the effect of transparency for surfaces made of transparent materials. Although this can be accomplished in OpenGL with little penalty on display rates, what you see in the display is not the same effect you would see if you were to ray trace the image. The ray traced rendering produces a much more accurate representation.

Lightscape's radiosity solution can also be exported into Inventor and VRML formats. (See the *Lightscape Visualization System User's Guide*.) This data can then be used in specialized display and virtual reality applications.

Lighting Analysis

If your primary interest is in lighting analysis, Lightscape provides a variety of tools for visualizing the lighting data contained in the radiosity solution. Generally, radiosity solutions for lighting analysis can be created coarser (and faster) than those required to produce images.

Project Management

As you work with Lightscape, you generate a considerable amount of data including Preparation files, Solution files, and library files. (All Lightscape file types are summarized in Appendix F, "Lightscape File Types," of the *Lightscape Visualization System User's Guide*.) In addition, you use files generated from other sources such as DXF files, texture maps, and photometric files. Before you start using Lightscape, you should devise a strategy for managing the large amount of data that you generate over time. Lightscape does not impose any particular structure on how to manage your data. This gives you the flexibility to establish a system that works best with any existing system you may already have implemented for other CAD or animation programs.

In general, you organize the files that you generate into two categories—files that relate to a specific project, called *local files*, and files that contain information you want to reuse or share in a number of projects, called *global files*.

Over time, as you add additional libraries and projects, your file structure may look like the example shown in Figure 2-2.

Figure 2-2 represents one possible solution. For example, you may decide to place your project folders into the folders in which you created the original model. The important concept to recognize is that an organized file structure and careful attention to maintaining it properly will save you considerable time and effort in the long term.

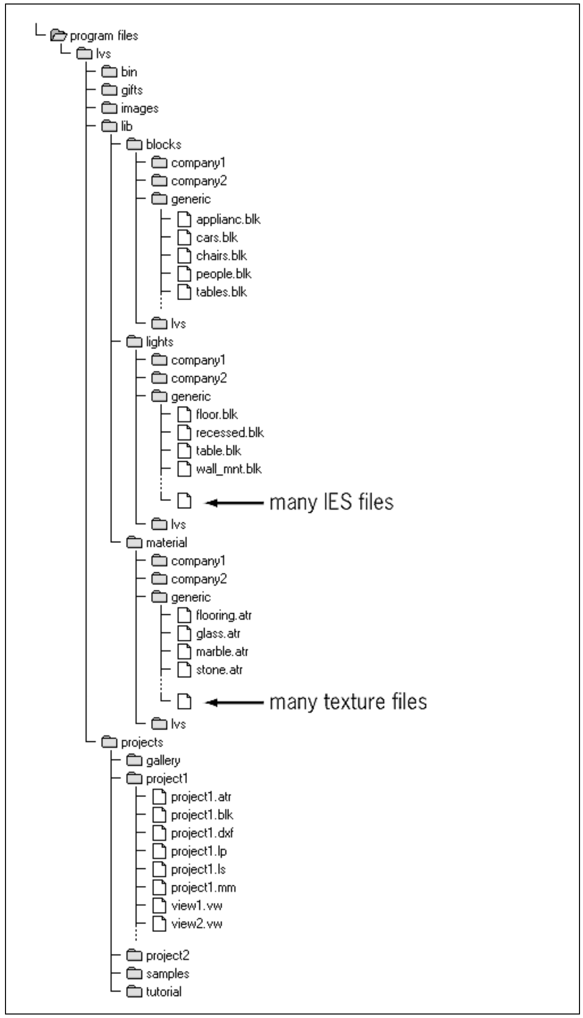


Figure 2-2. *One Possible File Structure*

Chapter 3

User Interface

The Lightscape user interface is designed to allow you easy access to a suite of interactive tools for preparing models for radiosity processing and working with the results. This chapter discusses the overall layout and general approach to using these tools.

This chapter covers the following topics:

- Starting Lightscape
- Screen Layout
- The Lightscape Interface
- Toolbars, Context Menus, and Dialog Boxes
- The Mouse
- File Controls
- Viewing the Model
- Display Controls
- Selecting Entities

Starting Lightscape

To start Lightscape, double-click the Lightscape application icon. By default, this icon is located in the Lightscape Visualization System program folder.

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

Screen Layout

Figure 3-1 shows a typical screen layout.

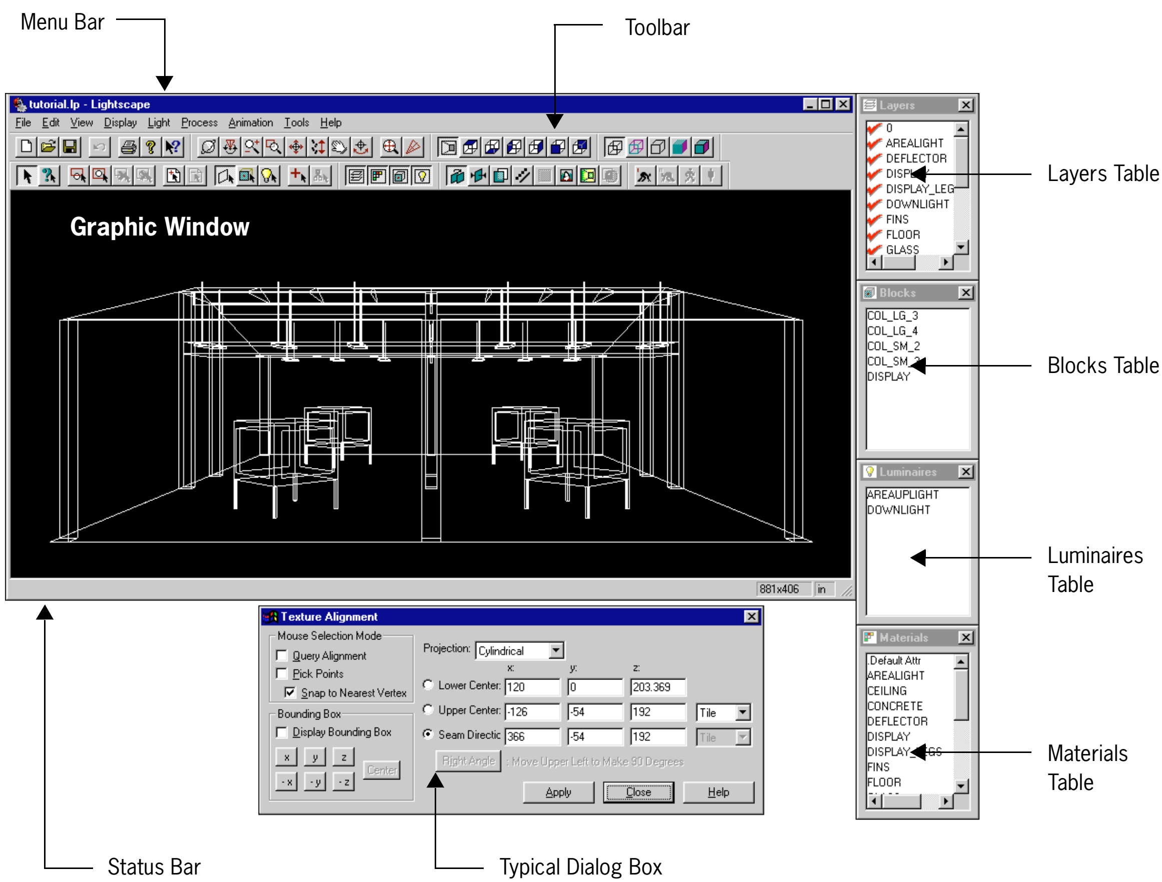


Figure 3-1. *The Lightscape Interface*

The Lightscape Interface

The Lightscape interface, shown in Figure 3-1, consists of views into the five major components of the Lightscape model. The largest and most important is the Graphic Window. This is located, by default, in the top left corner 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.

The Lightscape menu bar occupies the upper portion of the Graphic Window. Directly below the menu bar is the default area for the displayed toolbars. A status bar attached to the bottom of the Graphic Window communicates information as required. The title bar displays the name of the current file loaded and displayed in the Graphic Window.

You can find editing operations 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 using the right mouse button to bring up a context menu.

As you choose editing operations, additional dialog boxes appear as appropriate. These dialog boxes generally appear in the area across the bottom of the screen away from the five major windows.

Graphic Window

Figure 3-2 shows the Lightscape Graphic Window.

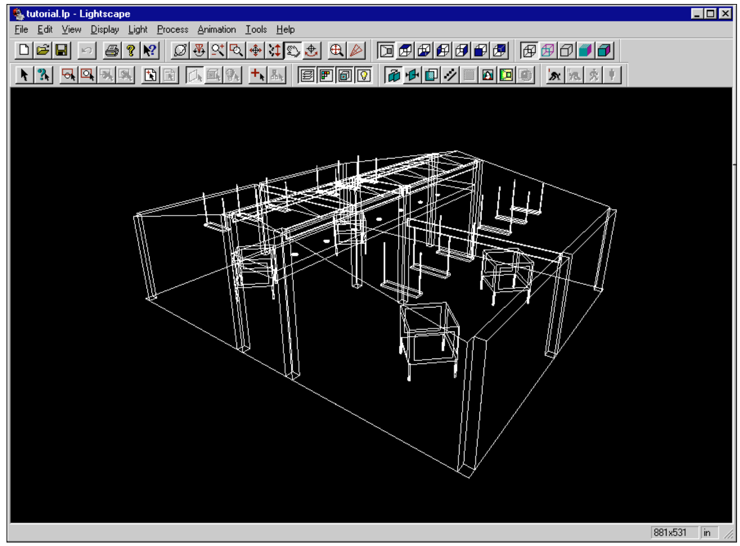


Figure 3-2. *The Graphic Window*

You display and edit the geometry of the current model in the Graphic Window. You can change how Lightscape views and displays the model using several projection and display modes described below.

In the Graphic Window, Lightscape supports several different orthogonal view projection modes, as well as perspective view projection. There are also dynamic (interactive) view controls you can use to quickly move around the model in each of the projections.

There are several modes that control the way Lightscape displays the model. For example, the model can be displayed in wireframe or solid mode.

The Graphic Window normally holds only a single view of the model at any one time. However, during animation editing, Lightscape breaks the Graphic Window into four concurrent views to aid in the creation and editing of the motion path.

An optional element of the Graphic Window is a set of X, Y, and Z axes indicating the current view orientation. Lightscape displays the X axis in red, the Y axis in green, and the Z axis in blue. You can toggle the axes display on and off by choosing Display > Show Axis. (This option does not display the scale of the model.)

You select entities in the Graphic Window by clicking them with the left mouse button.

Layers Table

The *Layers Table* contains a list of all the layers defined in the current model and indicates their state. A check mark to the left of the layer name indicates that the layer is on (active) and that the entities on that layer are currently being displayed in the Graphic Window. Double-clicking a layer name toggles its state on and off.

A "C" to the left of the layer name indicates it is the Current layer. Lightscape adds any new entities you add to the model on the Current layer.

Clicking the right mouse button in the Layers Table displays the Layers context menu, which contains functions appropriate to the layer selection set. Figure 3-3 shows an example of the Layers Table and the Layers context menu. (For detailed information on layers, see the *Lightscape Visualization System User's Guide*.)

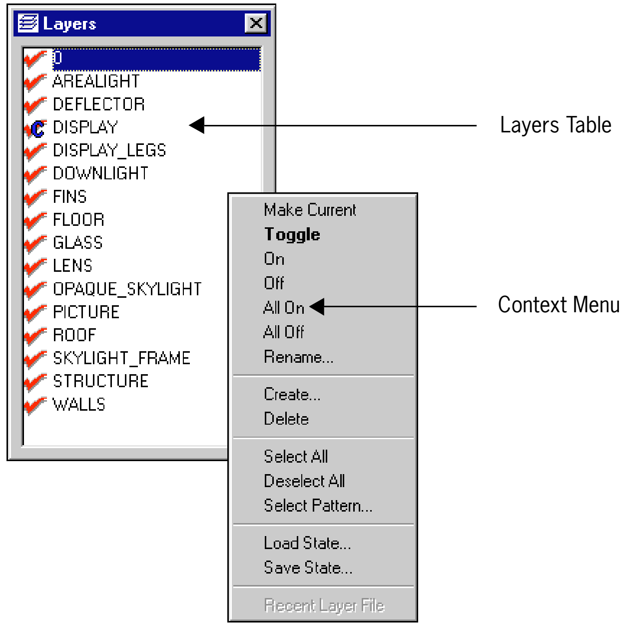


Figure 3-3. *The Layers Table*

Materials Table

The *Materials Table* contains a list of all the materials currently available in the model. You assign materials to surfaces in the model to define their appearance and how light energy incident on the surfaces behave.

Clicking the right mouse button in the Materials Table displays a context menu with functions you can use to manipulate the materials in the table. Double-clicking any material name activates the Material Properties dialog box which contains tools for editing the characteristics of the selected materials.

Figure 3-4 shows an example of the Materials Table and the Materials context menu. (For detailed information on materials, see the *Lightscape Visualization System User's Guide*.)

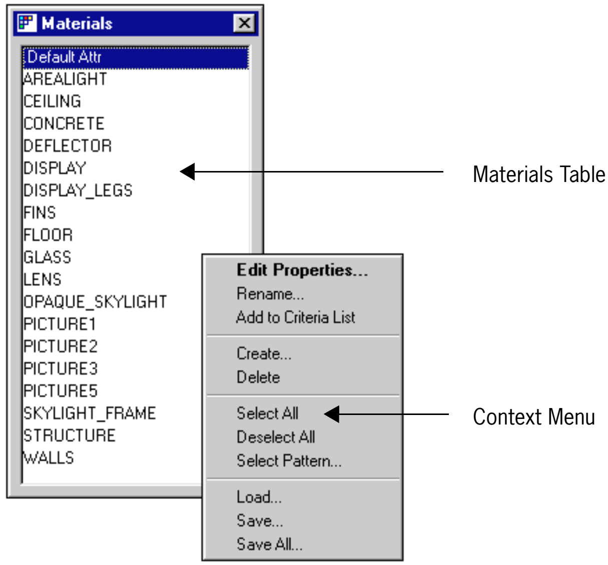


Figure 3-4. *The Materials Table*

Blocks Table

The *Blocks Table* contains a list of all the blocks available in the model. A *block* in Lightscape is a grouping of entities (surfaces or other blocks) given a common name and an insertion point. Once you have defined a block, you can make repeated instances of it and place them into the model at a variety of locations, sizes, and orientations. Double-clicking any block name isolates the block for display and editing in the Graphic Window. The Blocks Table is only available during the Preparation stage.

Clicking the right mouse button in the Blocks Table displays a context menu with functions you can use to manipulate the blocks in the table. Figure 3-5 shows an example of the Blocks Table and the Blocks context menu. (For detailed information on blocks, see the *Lightscape Visualization System User's Guide*.)

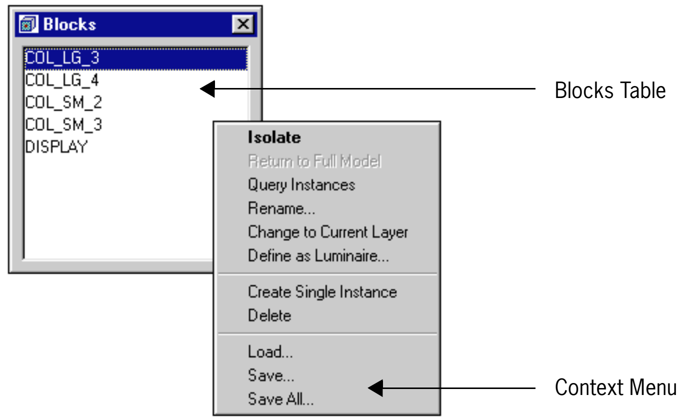


Figure 3-5. *The Blocks Table*

Luminaires Table

The *Luminaires Table* contains a list of all the luminaires available in the model. A luminaire is a special type of block used to represent light fixtures in Lightscape. A luminaire includes a definition of photometric characteristics that control how light energy is emitted from the luminaire. In Preparation mode, double-clicking any luminaire name isolates the luminaire for display and editing in the Graphic Window and activates the Luminaire Properties dialog box, which contains settings for editing the luminaire's photometric characteristics.

Clicking the right mouse button in the Luminaires Table displays a context menu with functions you can use to manipulate the luminaires in the table. Figure 3-6 shows an example of the Luminaires Table and the Luminaires context menu. (For detailed information on luminaires, see the *Lightscape Visualization System User's Guide*.)

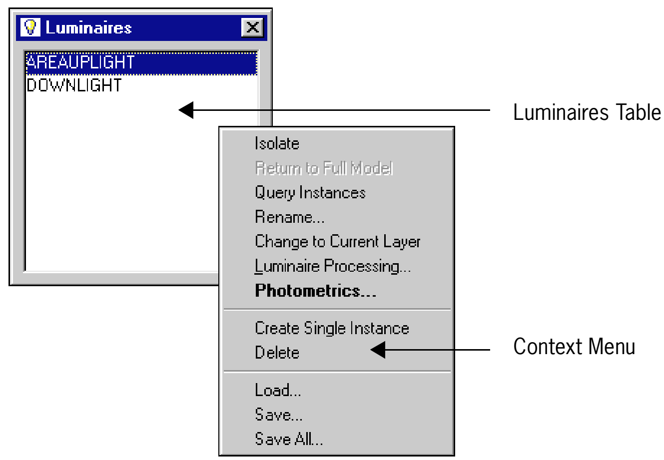


Figure 3-6. *The Luminaires Table*

Toolbars, Context Menus, and Dialog Boxes

Toolbars contain icons that represent specific operations. Context menus contain functions appropriate to the current window or to the selected entities. Dialog boxes contain additional functions and parameters related to the selected menu or toolbar icon.

Toolbars

When you position (or hold) the mouse cursor over a toolbar icon, a Tooltip below the cursor displays the name of the operation associated with that icon. Clicking the icon executes the operation. The default toolbars, which contain the most commonly used operations, are normally docked at the top of the Graphic Window.

You can display multiple toolbars at one time and float or dock them as required. A docked toolbar is attached to any edge of the Graphic Window. A floating toolbar can be positioned anywhere on the screen. You can select which toolbars are displayed by choosing Tools > Toolbars.

You dock a toolbar by positioning the cursor over the border of the toolbar and dragging it to an edge of the Graphic Window. You undock a toolbar by dragging it away from the edge of the Graphic Window.

Context Menus

Clicking with the right mouse button in the Graphic Window or one of the list windows displays a context menu.

For example, clicking the right mouse button in the Graphic Window when a surface is selected displays a context menu of functions that can be performed on the selected surface. Clicking the right mouse button in one of the list windows displays a context menu of functions that can be performed on the selected entities or on the list itself.

Dialog Boxes

Certain operations display a dialog box you can use to access various related options.

Some dialog boxes disappear once the operation has been completed. Other dialog boxes are persistent and remain until you explicitly close them, so you can make additional selections and repeat operations without having to reopen the dialog box. You can close persistent dialog boxes by double-clicking the control menu icon in the upper-left corner.

Dialog boxes may contain several overlapping pages. You access the different pages by clicking the page tabs along the upper edge.

The Mouse

Lightscape is designed for use with a two-button mouse. The left button is the action button. The right button displays a context menu based on the current location or selection.

Moving the mouse and pressing the left button in the Graphic Window performs one of several actions, depending on the currently selected mouse mode. There are three general mouse modes:

- **Query Mode**
  In Query mode, clicking an entity in the Graphic Window displays information about that entity in the status bar. Layers and materials associated with the entity are also highlighted in the appropriate tables.

- **Select Mode**
  In Select mode, you use the mouse to select entities in the model. Selection options are discussed in “Selecting Entities” on page 3-32.

- **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. The specific dynamic display modes are Orbit, Rotate, Zoom, Zoom Window, Pan, Dolly, Scroll, and Tilt.

File Controls

Through the Standard toolbar, Lightscape provides tools for file and Help functions as well as an Undo function. The file control and Help functions are also available from the File and Help menus. The Undo function is also available from the Edit menu.

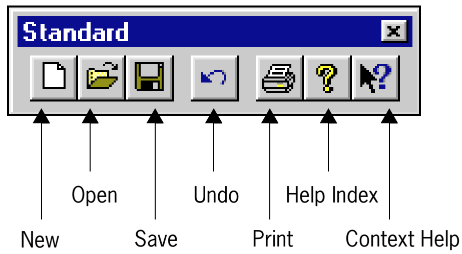


Figure 3-7. *Standard Toolbar*

New

Creates a new, empty Lightscape model. If any data is currently in memory, it is erased. In such cases, you are prompted to save the data if you have made changes since the last time you saved the model.

Open

Loads an existing Lightscape model file. The file can be either a Preparation file (.lp) or a Solution file (.ls). If any data is currently in memory, it is erased. In such cases, you are prompted to save the data.

The Append option in the Open dialog box lets you combine two or more Preparation or Solution files (you cannot mix the file types). The default is to overwrite any file currently loaded.

Additionally, the Scale option (available when loading Preparation files) lets you specify a numeric factor by which all objects in the file will be scaled.

Save

Saves the current Lightscape model. If the model has not been saved previously, this function defaults to Save As and Lightscape prompts you for a filename and location. If your model was previously saved, the Save function overwrites the previous file. To preserve the previous file, use Save As from the File menu.

Undo

Offers one level of undo for destructive actions. You can use the Undo function immediately after deleting items in the Layers, Materials, Blocks, or Luminaires tables. You can also use Undo after deleting surfaces or block/luminaire instances in the Graphic Window.

The Undo function restores the most recently deleted entity or entities even after you perform view modifications such as changing the projection mode or using the dynamic view controls. If, however, after deleting an entity you perform any function that involves a change to the Lightscape database, such as renaming a material, adding a block instance, or saving the file, the Undo buffer is emptied and you can no longer reverse the previous action.

There is no Redo function. Also, the Undo function is not related to the Undo Zoom Window function in the View menu or the Undo button in the Create Surface dialog box.

Print

Prints the current view of the model.

Help Index

Displays the Help index. This is equivalent to selecting the Index option in the Help menu.

Context Help

Enables getting quick help on any on-screen interface element. When you select the Context Help tool, the mouse cursor changes to a replica of the tool. Clicking on any toolbar item, table, or the Graphic Window displays information on that item. The Context Help function must be invoked separately for each time you request information on an item.

Viewing the Model

Lightscape offers the following options for controlling the view of your model:

- View Projection Modes
- Dynamic View Controls
- View Setup
- View Extents
- View Align
- Set Viewport Size
- View Files
- Original
- Undo Zoom Window

View Projection Modes

Lightscape provides the following view projections for viewing the model as shown in Figure 3-8:

- Perspective view
- Orthographic views

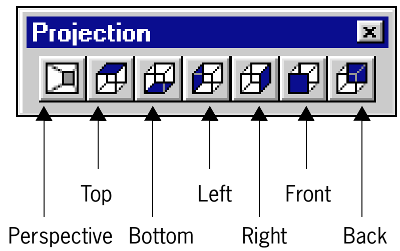


Figure 3-8. *View Projection Toolbar*

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, shown in Figure 3-9.

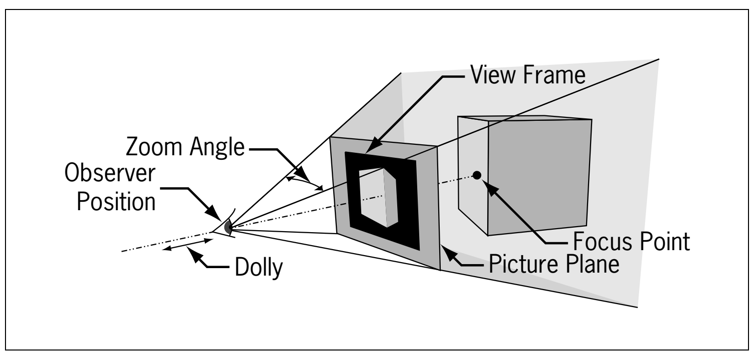


Figure 3-9. *Perspective Conventions*

You can set up a view by specifying the locations for the viewer position, focus point, view angle, and picture plane, using the View Setup controls. There are also dynamic controls for moving around the model.

Dynamic View Controls

Lightscape provides dynamic view controls for changing the view of the model in the Graphic Window. You can access these controls by choosing the menu item, clicking the View Control tools shown in Figure 3-10, or by pressing a keyboard hotkey, as specified in Table 3-1.

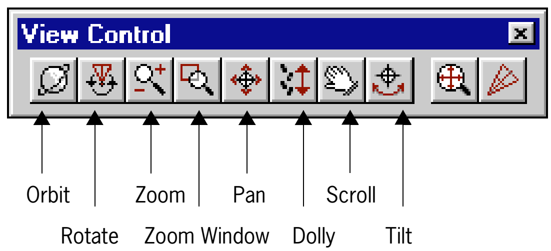


Figure 3-10. *View Control Icons*

When you select a View Control tool (or when you press the **`Shift`** key and a hotkey together), the current left button mode is terminated and the left button is used solely to dynamically change the view. Any action with the mouse in the display area is interpreted as an attempt to change the view, based on the view control selected. To return to the previous left button mode, you must explicitly reselect that mode.

When you press a hotkey without the **`Shift`** key, the current left button mode is suspended as long as the hotkey is pressed. Any action with the mouse in the display area is used to change the view. When you release the hotkey, the left button mode returns to the previous state.

Only meaningful view controls are allowed for specific view projections, as described in Table 3-1.

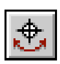
Table 3-1. *Dynamic View Control*

View Control	Toolbar Button	Hotkey	Description
Orbit		o	Rotates the viewer position about the focus point in all three axes. The direction of the mouse movement directly indicates the angle of the orbit motion. Perspective projection only.
Rotate		r	Rotates the viewer position about an axis passing through the focus point and parallel to the Z axis. Again, the direction of the mouse movement directly indicates the angle of rotation. Perspective projection only.
Zoom		z	The focal angle of the camera changes, but the viewer position and the focus point do not change. This is similar to a zoom lens on a photographic camera. Lightscape adjusts the size of the view frame on the picture plane accordingly. Use a vertical mouse movement when zooming. Dragging upward on the screen reduces the field of view and zooms into the scene. Dragging downward increases the field of view and zooms out from the scene. In perspective projections, zooming out a lot leads to distortions in the image (similar to a wide-angle lens on a camera). All projections.

Table 3-1. *Dynamic View Control*

Zoom Window		w	Drag a rectangle in the Graphic Window to zoom directly to a specific area. Use the View > Undo Zoom Window menu item to reset the view to the view that was used before the last zoom window. The Undo Zoom Window operation supports 10 levels of undo.
Pan		p	Moves the viewer position and the focus point together in the opposite direction from the direction you are dragging. The model appears to move with the mouse. Perspective projection only.
Dolly		d	Moves the viewer position forward or backward along the view path. Dragging upward moves the viewer position forward. Dragging downward moves the viewer position backward. You cannot dolly forward past the focus point. The dolly speed depends on the distance to the focus point. Perspective projection only.

Table 3-1. *Dynamic View Control (continued)*

View Control	Toolbar Button	Hotkey	Description
Scroll		s	In orthographic projections, Scroll behaves exactly like a pan behaves in perspective projection. In perspective projection, however, Scroll behaves differently. Unlike the other view options, scroll does not alter the perspective projection. Any lines that appeared parallel before the scroll remain parallel after the scroll. The result of a scroll is an off-center projection. It is generally difficult to predict the behavior of an off-center projection. If your camera behaves strangely, for example, zooming about a point not at the center of the window, it has probably been scrolled. In architectural photography, you often use a perspective correction lens to maintain parallel vertical lines in the image. You can obtain this effect in Lightscape by first setting a specific perspective view with the camera position and focus point at the same height. You can then scroll the resulting view to adjust the image plane as desired. All projections.
Tilt		t	Rotates the model around an axis perpendicular to the screen. Change the View Tilt by dragging the mouse around an imaginary center point on the screen. The model rotates in the same direction as the mouse movement.

View Setup

You can define a specific view of your model by using the View Setup controls (View > Setup), as shown in Figure 3-11.

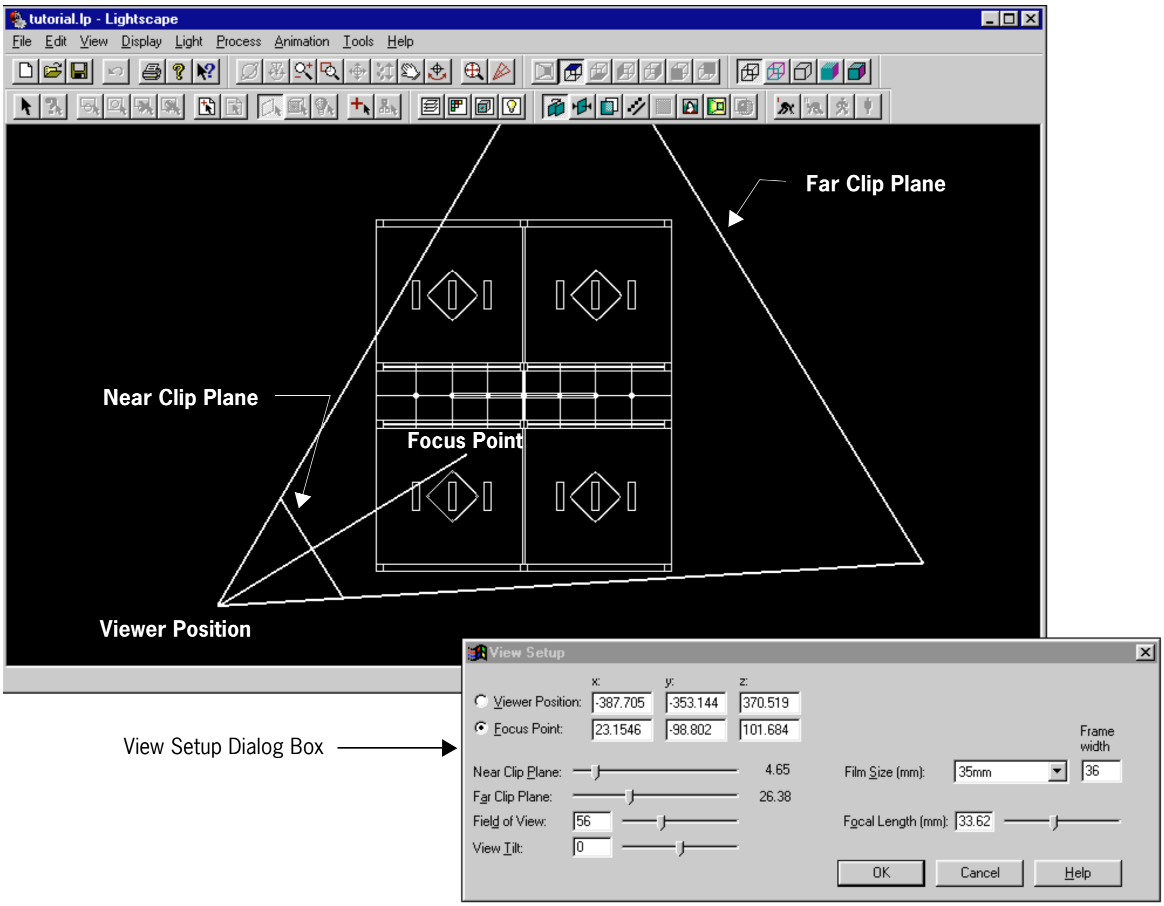


Figure 3-11. *View Setup Controls*

When you click the View Setup tool or choose the View > Setup menu item, the display changes to Top View mode and Lightscape displays a view frustum in red, superimposed on the model (Figure 3-11). Table 3-2 shows the controls that View > Setup provides for setting the view frustum.

Table 3-2. *View Setup Controls*

Controls	Position
Viewer Position	Sets the "camera" position. Select the Viewer Position option, if necessary, and click in the Graphic Window. You can also type explicit values in the input fields. Selecting a point in the Graphic Window does not set the Z (height) value.
Focus Point	Sets the "Focus" point. Click the Focus Point option, if necessary, and click in the Graphic Window. You can also type explicit values in the input fields. Selecting a point in the Graphic Window does not set the Z (height) value.
Near Clip Plane	Defines the location of the near clipping plane. Set the near clipping plane by entering the desired values in the input field or by adjusting the slider adjacent to the input field. Lightscape does not display entities in the model that are between the viewer position and the near clipping plane.
Far Clip Plane	Defines the location of the far clipping plane. Set the far clipping plane by entering the desired values in the input field or by adjusting the slider adjacent to the input field. Lightscape does not display any entities in the model that are beyond the far clipping plane.

Table 3-2. *View Setup Controls (continued)*

Controls	Position
Field of View	Adjusts the view angle of the view frustum. This changes the size of the view frame in relation to the picture plane. Change the Field of View by entering the desired values in the input field or by adjusting the slider adjacent to the input field. Lightscape computes the Field of View from the Focal Length and the Film Size. If you explicitly change the Field of View, Lightscape adjusts the Focal Length and leaves the Film Size alone.
Tilt	Rotates the model around an axis perpendicular to the screen. Change the Tilt by adjusting the slider from -180° through 180°.
Film Size (mm)	Sets the virtual camera's film size. If you explicitly change the Film Size, Lightscape adjusts the Focal Length and leaves the Field of View alone
Focal Length (mm)	Sets the virtual camera's focal length. If you explicitly change the Focal Length, Lightscape adjusts the Field of View and leaves the Film Size alone.

View Extents

View Extents displays all the entities in the model. It sets the focus point to the center of all visible entities and views the model from the front. Choose View > Extents to invoke this operation.

View Align

View Align uses an image file as the background in the Graphic Window. Interior models with windows show this background image through their transparent surfaces. This gives the illusion that the model sits in a particular exterior environment. The background image can be offset on the screen to correspond to an appropriate location in the model.

The background image is only visible when the View Align dialog box is open. If you choose to render an image from the Rendering dialog box, the background image will not be included in the rendered image.

Set Viewport Size

The viewport is the area of the Graphic Window containing an image of the model. The default value is Full Window. Use the Set Viewport Size option to select a different image size. You can choose from a number of different industry-standard image sizes, or type Width and Height values in the input fields.

You can also set the viewport size using the Resolution option in the Rendering dialog box.

View Original

In addition to stored view files, there is one “built-in” view, called the *Original view.* The original view was the view setup when the model file was loaded. This view is always the first selection in the list of views.

Undo Zoom Window

Undo Zoom Window restores the view to the view that was used before the last zoom window operation. Up to 10 levels of undo zoom window are supported.

View Files

You can save a specific view into a view file for use later in the project. For example, you may want to return quickly to a particular camera view or select a particular view when outputting an image.

When you save a view file, Lightscape adds its name to the bottom of the View pulldown menu. To change to a stored view, choose the view file from this menu.

Display Controls

Lightscape offers a number of different display modes that change how the model appears in the Graphic Window. There are also display options that have an additional effect on the model's appearance.

Display Modes

You can select one of the following modes in which to interactively display the model.

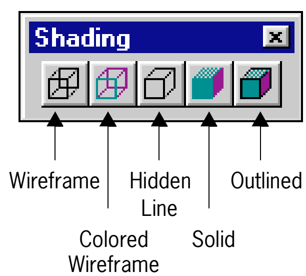


Figure 3-12. *Shading Toolbar*

Wireframe Mode

This option displays the model in wireframe mode. Lightscape displays only the edges of surfaces as white lines. (You can change this color choice in the Document Properties dialog box.)

Colored Wireframe Mode

This option displays the model in colored wireframe mode. Lightscape displays all surface edges in their appropriate material color.

Hidden Line Mode

This option displays the model in hidden line mode. This mode looks similar to wireframe mode except surfaces block (hide) the display of other surfaces behind them. Lightscape displays all surface edges visible to the user in white. (The color you select in the Document Properties dialog box for wireframe mode will affect the color displayed in hidden line mode.)

During the Solution stage, Lightscape superimposes on hidden line mode the mesh structure of the model generated during the radiosity processing.

Solid Mode

This option displays the surfaces of your model. Lightscape displays all surfaces in the material color. Display speed is greatly influenced by the number of surfaces in the model, as well as by the computer hardware. For complex models, it may be more convenient to move interactively in wireframe mode and then display the surfaces in solid mode once the desired view is established.

Outlined Mode

This option displays the model in solid mode with the addition of the surface geometry being outlined. Lightscape displays all polygon surfaces in the material color and displays all polygon edges in black.

During the Solution stage, this option displays the solution mesh. This is useful for checking the impact of process parameter settings.

Display Options

The following display options affect the appearance of the model in the display modes just discussed. In most cases, turning off these display options increases the display speed at the expense of image quality. The following display options can be toggled on and off.

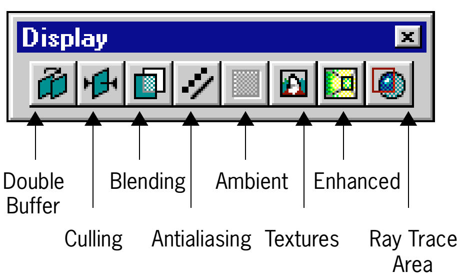


Figure 3-13. *Display Options Toolbar*

Double Buffer

During interactive viewing, double buffering produces a smooth display effect. With this option off, you'll see the model as Lightscape draws it. This can cause a severe flicker.

However, on some systems, turning double buffer off allows Lightscape to use more colors, which may greatly improve image quality.

Culling

Culling is a technique whereby the surfaces oriented away from the viewer position are not displayed on the screen. This technique is effective for looking "through" the walls of a room from an outside or aerial position.

Blending

When the blending option is on, transparent surfaces are blended with those behind them, giving the effect of transparency during the display of a file. (True calculation of transparency requires ray tracing.) When this option is off, all surfaces are displayed opaque (that is, as if transparency were set to zero).

Antialiasing

When the antialiasing option is on, lines displayed in wireframe modes are displayed antialiased which makes them appear much smoother.

Ambient

During the Solution stage, you can use this option to approximate the effect of undistributed light energy in the environment. This makes it possible to visualize the model more effectively during the early stages of the processing. (For a complete discussion of the ambient approximation, see the *Lightscape Visualization System User's Guide*.)

Textures

In both the Preparation and Solution stages, you can turn texture maps on and off. Having the texture mapping on slows down the interactive display rates considerably, unless hardware-supported mapping is available.

Enhanced

During the Preparation stage, you can turn this option on to display objects in the model with shading. This display mode makes it easier to see the smoothing of objects and to better determine where surfaces meet.

Ray Trace Area

During the Solution stage, you can use this toolbar icon/menu item to drag a rectangle over an area of the Graphic Window, and then ray trace only that area. The results of the ray trace will be displayed to the screen. You can use this option to test the results of ray trace settings on a selected area before you ray trace your entire model, or to test the effect of material properties changes in the current model. You cannot save the results of the Ray Trace Area operation. The results will remain on the screen until the model is redrawn.

Ray Trace Area Options

During the Solution stage, this menu item displays a dialog box for setting Ray Trace Area options. You set these options before you select the area you wish to ray trace. See the *Lightscape Visualization User's Guide* for more detailed information on these settings.

Show Axis

This menu item turns on the display of a set of X, Y, and Z axes which indicate the current view orientation. The axes appear in the lower-left corner of the model. Lightscape displays the X axis in red, the Y axis in green, and the Z axis in blue.

Auto-Redraw

When this menu item is on, Lightscape redraws the model in the Graphic Window after every change to the model. If you do not need to see your changes immediately, you can improve performance by turning off this option so changes in material editing or texture alignment don't cause an automatic redraw.

Auto-Orbit

This menu item turns on an orbiting view of the model. The model continuously rotates around the focus point of the current view. Turn off auto-orbiting by deselecting this option in the Display pulldown. This option is only available for Perspective view.

Reload Textures

This menu item reloads all image files into materials that incorporate them. Use this function when you've modified an image map, changed an image map fileaname, or changed the Fixed Tile Size option and settings in the Material Properties dialog box.

Selecting Entities

Before you can perform any action on an entity or entities, you need to create a *selection set* of the entities that you want to manipulate. A selection set can consist of a single entity or it can be a more complex grouping—for example, a group of surfaces on a single layer defined with the same material.

Using the options in the Edit > Selection pulldown menu or the tools in the Selection toolbar, you can access various selection modes to build a selection set. Additionally, selection filters give you the ability to limit selection sets by entity type and material and luminaire properties. You can select a single entity or multiple entities when forming a selection set. When a selection set is defined, operations are performed on all of the entities in the set.

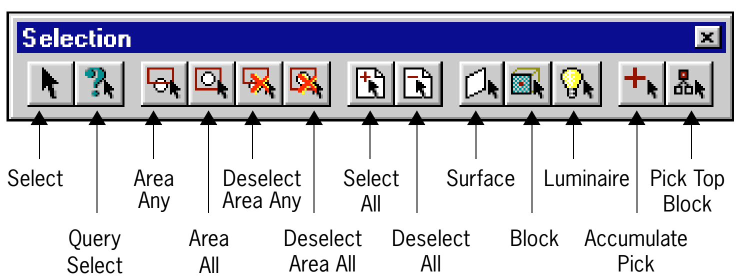


Figure 3-14. *Selection Toolbar*

Selection Modes

Lightscape provides three selection modes for building selection sets:

- Select Exclusive
- Select Additive
- Pick Top Block

Select Exclusive

In this mode, any entity you click becomes the selected entity and all other entities are deselected. The currently selected entity is now the selection set. All selection filters affect this mode except for the Criteria selection filter.

Select Additive

In this mode, any entity you click is added to the existing selection set. Clicking on a selected entity, deselects that entity and removes it from the selection set. You can also use the Deselect All button to deselect the existing selection set. All selection filters are active for this mode except the Criteria selection filter.

Pick Top Block

Picks the top block in a block hierarchy. Where the currently selected block is a nested block, this mode selects the top block.

Selection Tools

Lightscape provides several selection tools for building and modifying selection sets. These include:

- Select Single
- Area Any
- Area All
- Select All
- Deselect Area Any
- Deselect Area All
- Deselect All

Select (Single)

With this tool, you select single entities in the Graphic Window. Depending on the selection mode, the entity either becomes the selection set or is added to (or subtracted from) the current selection set. You can only select entities that meet the current filter setup. (See “Selection Filters” on page 3-35). In additive mode, entities can be deselected by selecting them a second time.

Area Any, Area All/Deselect Area Any, Deselect Area All

With these tools you can drag an outline box over the model, selecting or deselecting multiple entities at one time. Releasing the mouse button sets the outline box.

Area Any selects or deselects all entities that have any one of their vertices inside the selection outline box. Area All selects or deselects only those entities that have all of their vertices inside the selection outline box.

Only entities that meet the current filter setup are selected or deselected.

Select All/Deselect All

With these tools you can select or deselect all entities in the model (not just the current view) that meet the current filter settings. For example, if you set the Blocks filter on and then invoke Select All, all blocks in the model are selected. If you are in Select Exclusive mode, then the current selection set is all the blocks in your model. If you are in Select Additive mode, then all the blocks are added to the existing selection set.

Selection Filters

Lightscape provides selection filters for building selection sets:

- Surface, Block, Luminaire
- Criteria

Surface, Block, Luminaire

When one of these filters is selected, only the specified entity type can be selected. Only one of these filters can be selected at a time. The default is Surface.

Criteria

You open the Criteria list dialog box by choosing Edit > Selection > Criteria.

Only those surfaces whose material matches the materials in the Criteria list or the luminaires whose settings match those in the list can be selected.

The Criteria filter is used only when the Surface or Luminaires filter is selected and the Area Any/Area All or Select All operations are invoked. You can also select the Ignore Settings option to ignore any settings in the dialog box while using Area Any/Area All or Select All.

You add a material to the list by highlighting a material in the Materials Table and then choosing Add to Criteria List from the Materials context menu. You can remove materials from the list by clicking the right mouse button while on the Materials page in the Criteria dialog box and choosing Remove. You can also remove materials by double-clicking the material name on the Materials page in the Criteria dialog box.

Using the settings on the Luminaires page, you can choose to search for luminaires that have their Cast Shadows, Store Direct Illumination, or Ray Trace Direct Illumination options on or off. Simply select the settings you wish to use for the selection filter.

Chapter 4

Properties

Properties are general parameters and defaults stored with each model. This chapter describes the properties used in Lightscape.

Choose Edit > Properties to open the Document Properties dialog box.

The document properties are located on the following property pages:

- Display
- Units
- Colors
- Fog
- Path Lists
- Display Interactivity

Display Properties

The Display properties control how Lightscape displays a model on your monitor. Figure 4-1 shows the Display page.

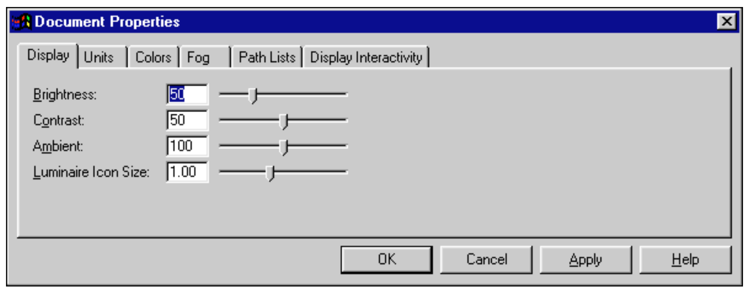


Figure 4-1. *Display Page*

Brightness	Controls the brightness of the displayed image on your monitor. The setting of this control does not affect the actual lighting levels in the model.
Contrast	Controls the contrast of the displayed image on your monitor.
Ambient	When you use the Ambient Approximation technique during the Solution stage, this control sets the percentage of the available ambient light to use. (Ambient Approximation is discussed in detail in the *Lightscape Visualization System User's Guide*.)
Luminaire Icon Size	Controls the size of the icon that represents the energy distribution assigned to a luminaire. By default, Lightscape sizes these icons to correspond to the size of the luminaire. To confirm the luminaire placement of small lights in large models you may need to increase the icon size.

Units Properties

Units properties determine the default units you work with in the model. Figure 4-2 shows the Units page. Lightscape displays the current length units in the Status Bar.

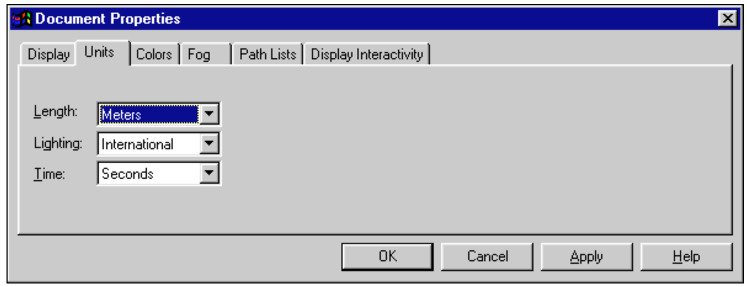


Figure 4-2. *Units Page*

Length — Selects the units of length. Your choices are millimeters, centimeters, meters, kilometers, inches, feet, and miles.

Note that changing the units does not change the size of the model. For example, a surface that is 1 meter long will be 3.28 feet if feet are the selected units.

Lighting — Selects the unit system to use for lighting. Your choices are International and American.

Time — Selects the time units to use for an animation setup. Your choices are seconds, minutes, and hours.

Colors Properties

The Colors properties set the default colors for your display. Figure 4-3 shows the Colors page.

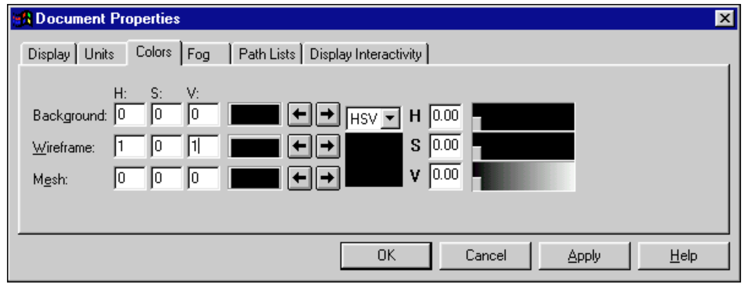


Figure 4-3. *Colors Page*

Background	Sets the color displayed in the background of the Graphic Window.
Wireframe	Sets the color of the lines in wireframe display mode.
Mesh	Sets the color of the mesh in outlined display mode.

Use the color sliders to choose the color you want for each setting. You can use HSV or RGB values.

As you adjust the color sliders, Lightscape displays the new color in the box adjacent to the sliders. When you are satisfied with the selected color, click one of the left arrow buttons to apply the color to a particular setting.

You can make further adjustments to each color by clicking the right arrow button corresponding to the color you wish to edit. Lightscape displays the color you selected in the box adjacent to the color sliders. The color is now the active color so you can edit it.

Fog Properties

Fog provides better depth cueing by making items that are at a distance appear dimmer. Fog is simply a display technique; it does not affect, nor is it affected by, the lighting of the scene. Figure 4-4 shows the Fog page.

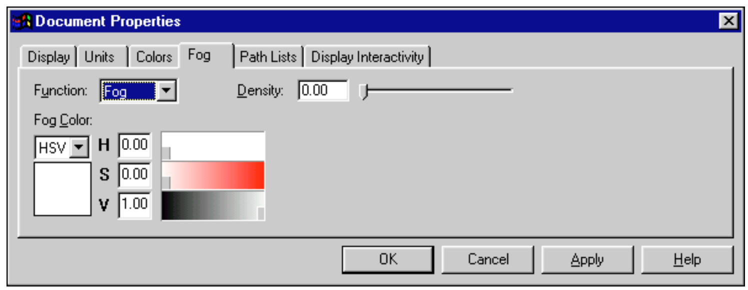


Figure 4-4. *Fog Page*

Function	Selects the type of Fog function. Your choices are Disabled, Fog, Haze, and Linear. Disabled is the default setting and indicates not to use the fog function. Linear fog is completely clear at the near plane and completely opaque at the far plane (as set in the View Setup dialog box). The density increases linearly from the near plane to the far plane. This is useful for depth cueing but does not look like real fog. Fog looks like a uniformly dense fog and becomes completely opaque at some distance, depending on the density setting. This is what fog usually looks like in reality. Haze is like fog except that the opacity changes in a more complex way. For the same density setting, fog appears to have a uniform density and obscures things nearby, while haze seems to get much denser in the distance and leaves nearby objects almost unobscured.
Density	Sets the density of the selected Fog function. The range is 0 to 1, with 1 representing the densest fog effects.
Fog Color	Selects the color for the selected Fog function. You choose the color you want using HSV or RGB values.

Path Lists

Path Lists properties control the specification of the path lists for your model. The path list is a list of directories Lightscape searches to find a file. You can specify Luminaire and Texture path lists, as well as add and delete directories from these paths on the Path Lists page. Figure 4-5 shows the Path Lists page.

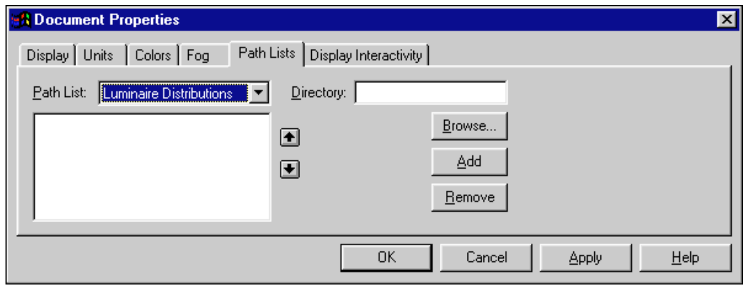


Figure 4-5. *Path Lists Page*

Path List — Selects the path list to edit. Your choices are Luminaire Distributions and Textures. The directories currently included in the path list are shown in the single selection list.

You can select an entry in the current path list and use the up and down arrow buttons to change the order of the paths. Lightscape searches the paths in order, starting from the top of the list and going down.

Directory — An input field for editing a single path. The directory list shows the subdirectories (if any) of the path currently displayed in the input field. Select an entry from the path list box to place it in the input field as a starting point for editing.

Browse	Starts a directory browser which allows you to select a path to add to the list.
Add	Adds to the path list the path that is in the Directory input field. If the path is already in the list, nothing changes.
Remove	Removes from the list the path you have selected.

The Browse Directory dialog box allows you to easily select a directory to add to your path list. You can select any local or network drive.

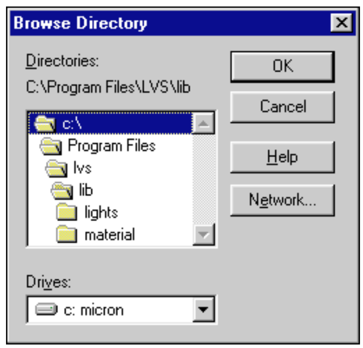


Figure 4-6. *Browse Directory*

Directories	Shows the current directory displayed in the browser.
Drives	Allows you to select alternate local or network drives.
Network	Allows you to connect to network drives which you can then select from the Drives combo box.

Display Interactivity Properties

Navigating through complex models with a large number of surfaces in real time requires more processing power than many desktop computers have. By choosing to decrease the quality of the display, you can usually increase performance. The Display Interactivity properties control the amount of redrawing required while working in your model. Figure 4-7 shows the Display Interactivity page.

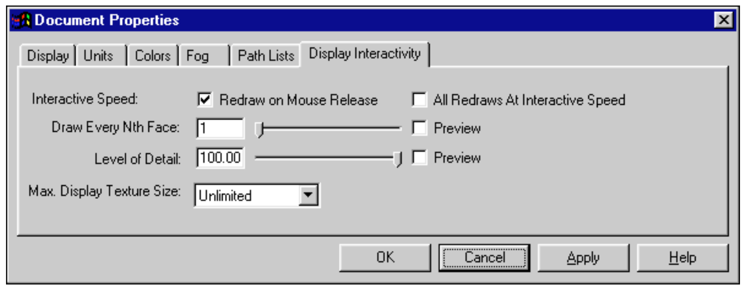


Figure 4-7. *Display Interactivity Page*

Interactive Speed	Selecting Redraw on Mouse Release causes a redraw at full quality at the end of user interaction (releasing the mouse button after interactively adjusting the view of the model). Selecting All Redraws at Interactive Speed redraws the Graphic Window according to the Draw Every Nth Face or Level of Detail settings. For example, if you set Draw Every Nth Face to 2, all redraws will display only every second face. You can press F7 to redraw the Graphic Window at full quality display at any time.
Draw Every Nth Face	To retain interactive display speeds when working with complex models (models with a large number of surfaces), you can use this control to reduce the number of surfaces displayed. For example, setting Draw Every Nth Face to 2 displays every second surface, with a corresponding increase in display speed. The default setting is 1 (display every surface). In Solution stage, adjusting Draw Every Nth Face resets the value of Level of Detail to 100.

Click Preview to preview your changes without exiting the dialog box.

Level of Detail	During the Solution stage, you can use this option to control display quality more selectively than with the Draw Every Nth Face option. The Level of Detail option controls the amount of detail displayed, rather than simply controlling the number of surfaces displayed. This allows you to retain a more faithful view of the scene while accelerating interactivity. When the Level of Detail is set below 100, Lightscape begins to degrade the quality of the image. The system avoids redrawing distant objects and smaller polygons. At lower settings, more detail is dropped from the display. The default setting is 100 (maximum level of detail). Adjusting Level of Detail resets the value of Draw Every Nth Face to 1. Click Preview to preview your changes without exiting the dialog box.
Max. Display Texture Size	Scales the size of the textures used for interactive display. (This option does not effect the size of textures used for radiosity or ray tracing.) Choices include: Unlimited, which displays textures at normal size; 256 x 256; 128 x 128; 64 x 64; and 32 x 32. At lower settings, the texture is scaled down and Lightscape attempts to display an accurate representation of the texture with less detail. Reducing the size of the texture can significantly improve display speed.

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