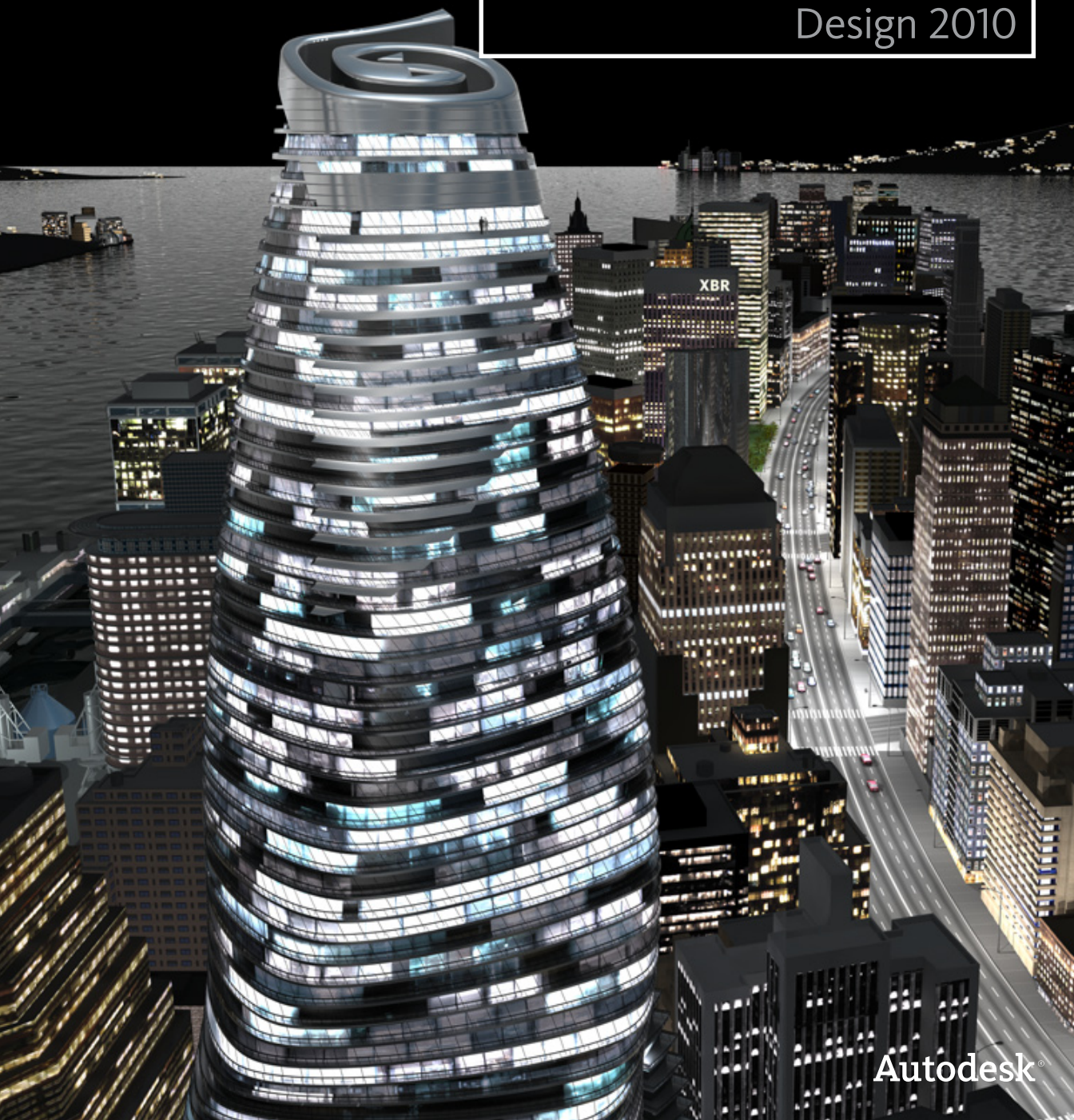


**Tutorials:
Lighting**

Autodesk® 3ds Max®

Design 2010



Autodesk®

Autodesk® 3ds® Max Design 2010 Software

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Lighting Tutorials

5

The tutorials in this section show you how to set the mood and create dramatic lighting effects for scenes built in 3ds Max Design.



A nighttime scene with artificial lighting

Features Covered in This Section

- Creation of daylight systems to illuminate a scene with geographic accuracy.
- Daylight illumination of building interiors using the Sky Portal.
- Exposure control.

- Shadow creation and definition.
- Nighttime illumination using adjustable photometric lights.
- Realistic scene illumination through use of Final Gather.
- Photon control for effective distribution of light energy.

Lighting and Rendering the Villa in Daylight

In this tutorial, you have the scene of a Mediterranean villa that requires lighting conditions for early, mid, and late-day illumination. To accomplish this task, you will create a daylight system and customize it to match a specific scene location and time. Then you'll set proper scene exposure and combine the daylight system with a Sky Portal object that will cast light into the interior of the villa. You will fine-tune the late-day illumination by adjusting the aperture setting.



After completing this tutorial, you will see how easy it is to use mental ray lighting options to create realistic daytime lighting conditions.

In this tutorial, you will learn how to:

- Use daylight systems to illuminate a scene based on its geographic location, orientation, and time of day.
- Use the Sky Portal object to gather skylight and apply it to the interior of buildings.
- Adjust scene exposure to suit different times of the day.


Skill level: Intermediate

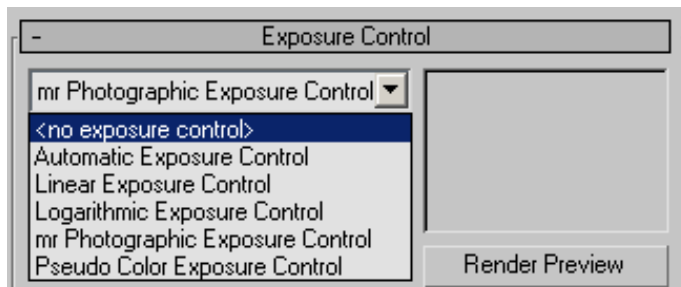
Time to complete: 1 hour

Adding Daylight Illumination

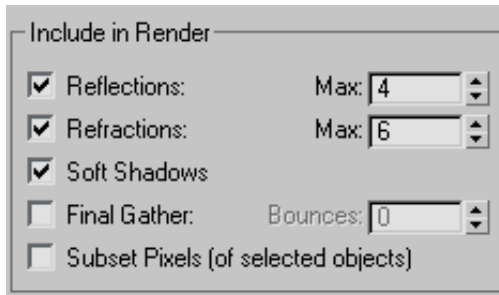
You will begin by looking at how the scene appears without any light objects. You'll then add daylight to the scene.

Set up the lesson:

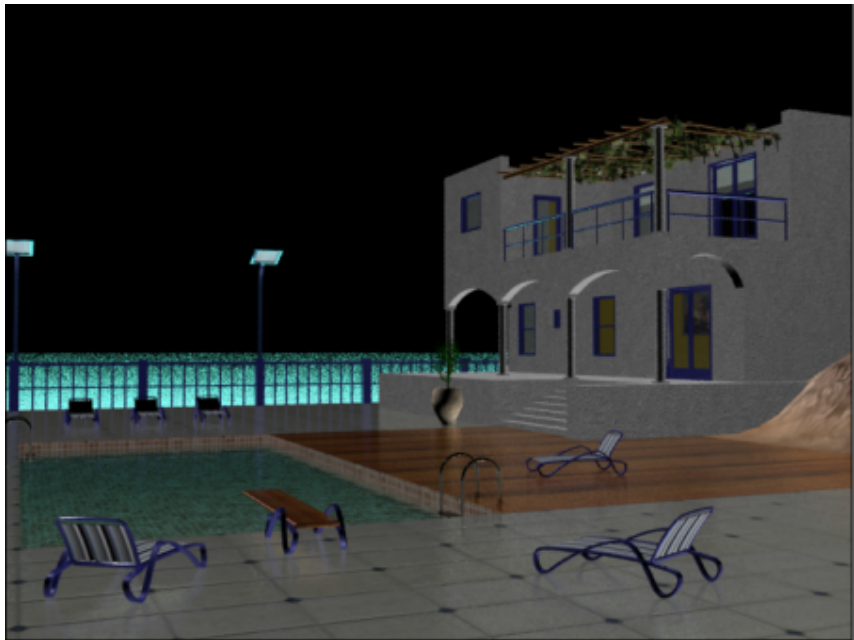
- 1  On the Quick Access toolbar, click the Open File button, navigate to the `\scenes\lighting_and_rendering\med_villa` folder, then open the scene file `med-villa-lighting-start.max`.
- 2 From the main menu, choose Rendering > Environment. In the Environment And Effects dialog > Exposure Control rollout > drop-down list, the exposure preset is set to the mr Photographic Exposure Control (“mr” is short for “mental ray”).
- 3 Choose <no exposure control> from the list.



- 4 In the Rendered Frame window > Include In Render group, turn off Final Gather, and then click Render to render the scene again.



With the exposure settings removed, you can now see the scene in a very basic way through default lighting.



The rendered result nonetheless appears flat and not very realistic. You need to add either man-made light sources or daylight to properly illuminate the scene. In this tutorial, you will create daylight by generating two mental ray photometric light sources:

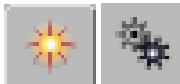
- mr Sun, which simulates direct light from the sun.

- mr Sky, which simulates indirect light created by the scattering of sunlight in the atmosphere.

These two light sources will be accompanied by the mr Physical Sky environment shader, which establishes the physical representation of the sun and sky.

Create the daylight system:

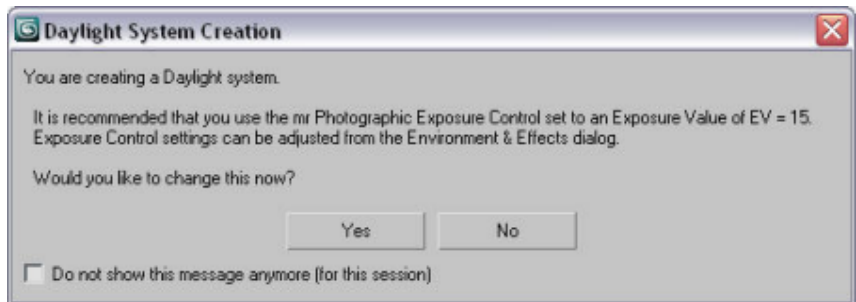
- 1 Close the Rendered Frame Window and the Environment And Effects dialog.



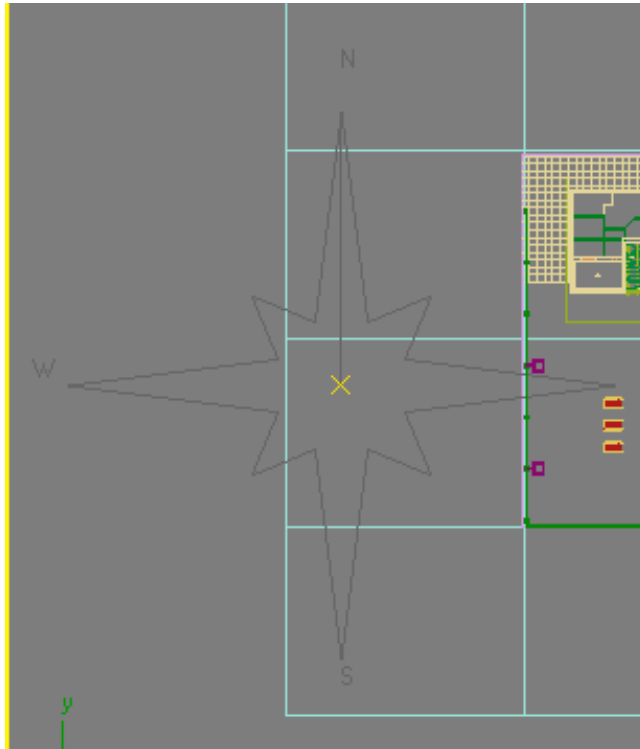
- 2 On the Create panel, turn on Systems.
- 3 On the Object Type rollout, click Daylight to turn it on.



The Daylight System Creation dialog displays, recommending an optimum exposure value for mental ray.



- 4 Click Yes to accept the settings.
- 5 In the Top viewport, click anywhere over the scene and drag slightly in any direction to create a compass rose.

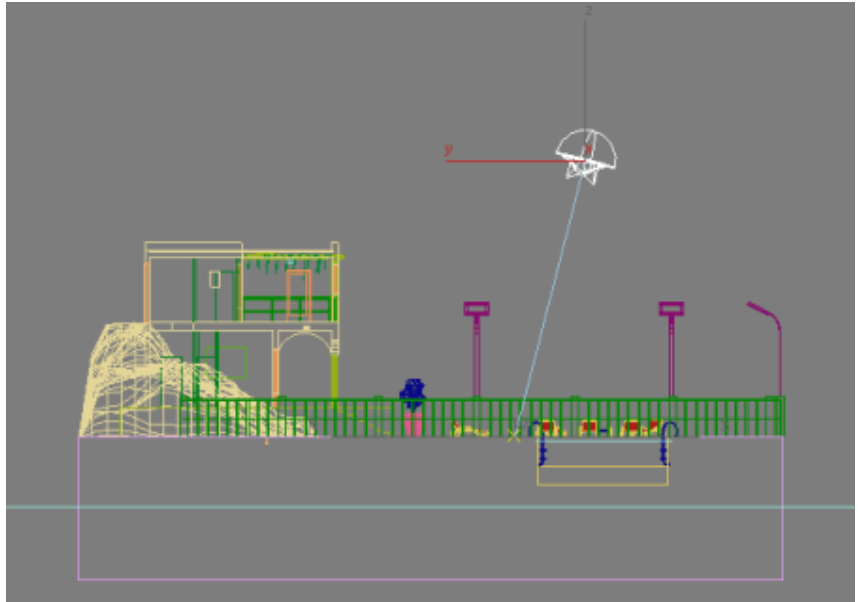


6 Release the mouse button.

As soon as you release the mouse button, the daylight object is created and the mental ray Sky dialog displays, asking you if you want to create an mr Physical Sky environment map.

The mr Physical Sky environment map is based on a gradient, whose appearance in the background of a scene will change depending on the position of the sun at any given time of day. Click Yes to accept the map.

7 Move the mouse upward to position the daylight object in the sky. You can use the left viewport to see the daylight object's vertical positioning. The exact height of the daylight object in the sky is not important.



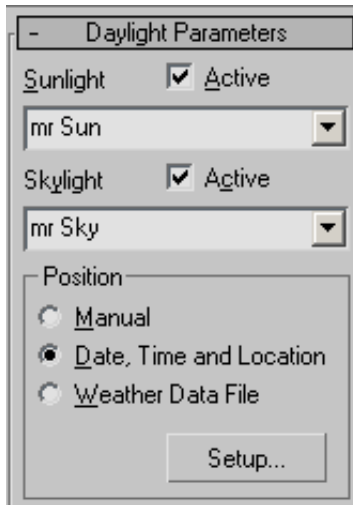
- 8 Click once to set the Daylight object position, then right-click to end Daylight creation.

Set the time and location of the light source:

Now you will reposition the Daylight object, or “sun,” so its position in the sky corresponds to the geographic location of the scene.



- 1 With the Daylight object still selected, go to the Modify panel > Daylight Parameters rollout > Position group, click Setup.



3ds Max Design opens the Motion panel.

- 2 On the Control Parameters rollout > Location group, click Get Location.

- Control Parameters

☐ Manual Override

Azimuth: 170 Altitude: 75

Time

Hours: 12 Mins.: 0 Secs.: 0

Month: 6 Day: 21 Year: 2007

Time Zone: -8

☐ Daylight Saving Time

Location

Get Location...

San Francisco, CA

Latitude: 37.795

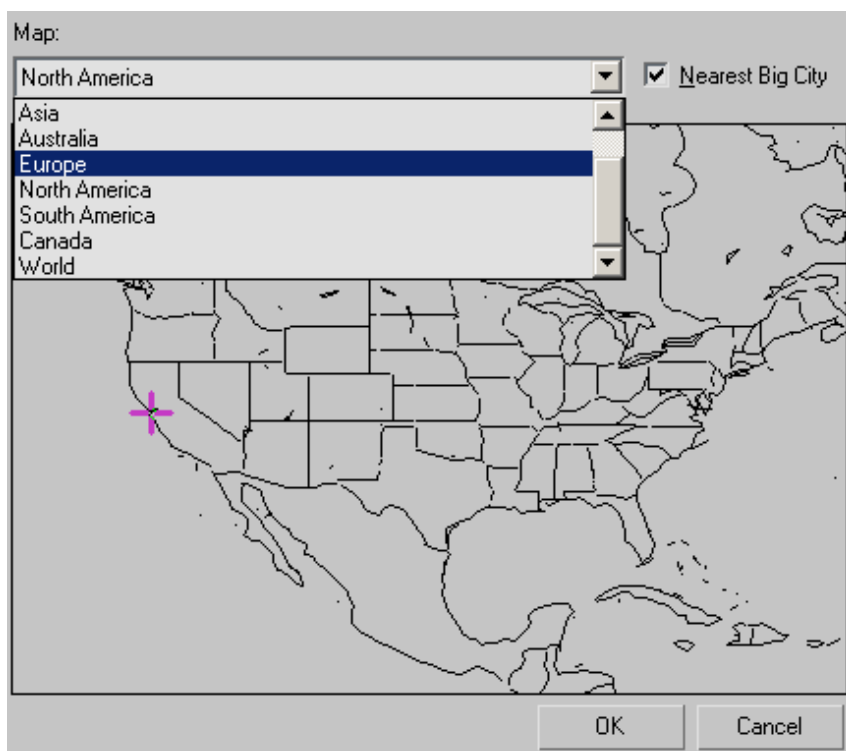
Longitude: 122.394

Site

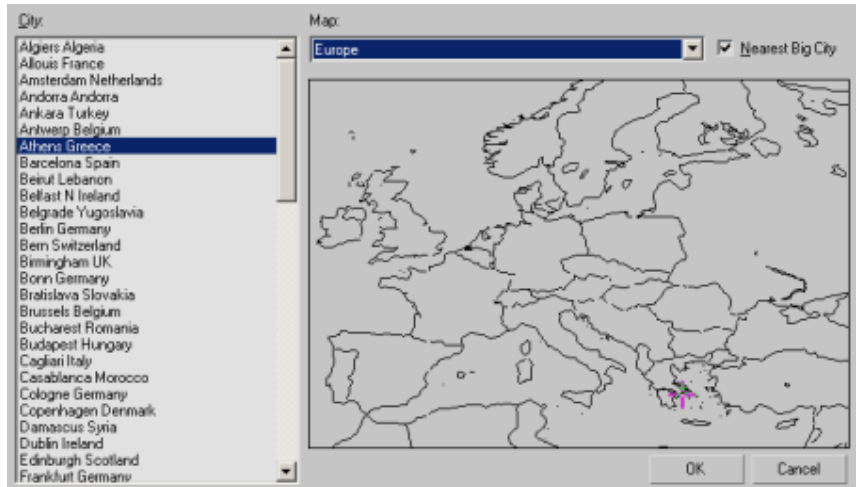
Orbital Scale: 64.878m

North Direction: -0.0

- 3 On the Geographic Location dialog, choose Europe from the Map drop-down list.



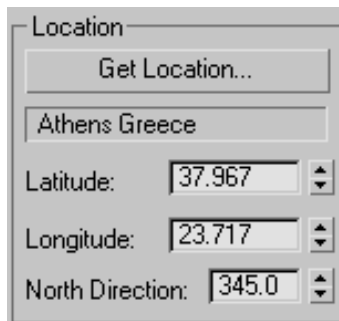
- 4 On the map, click on the country of Greece, or choose Athens Greece from the City list displayed at the left.



After you click OK, the compass rose and Daylight object are repositioned to scene coordinates that reflect the real-world latitude and longitude of Athens, Greece.

The Control Parameters > Time group displays controls that let you modify the date and time of day, settings that also affect sun position. The scene you will illuminate and render is mid afternoon at 3 PM, or 1500 hours.

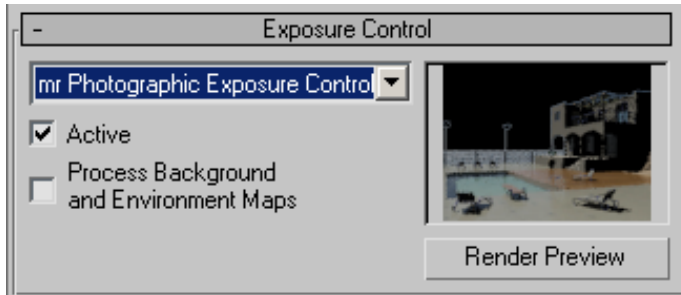
- 5 In the Time group > Hours spinner, change the time to **15**.
- 6 In the Location group, set North Direction to **345.0** degrees.



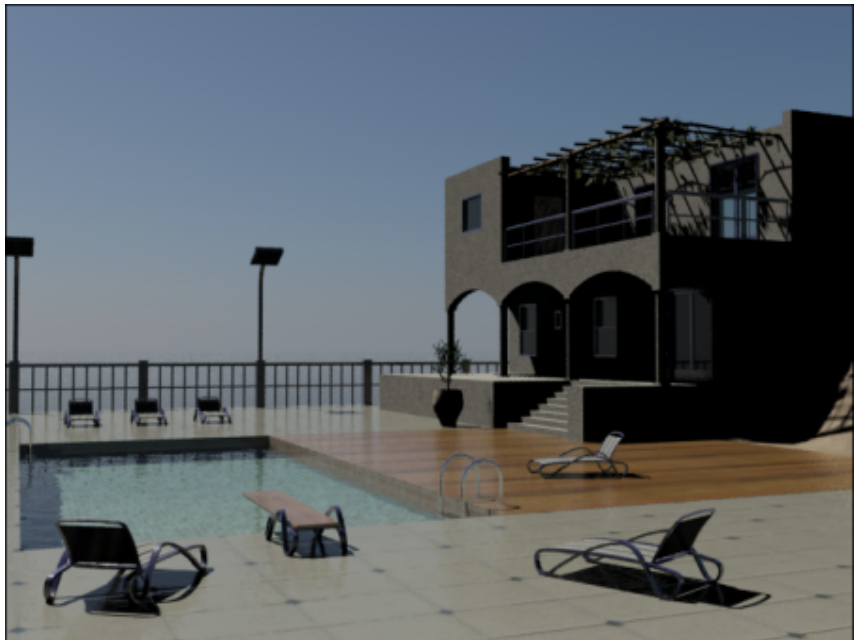
This adjustment orients the north-south position of the scene so the sun disc will appear over the sea as it prepares to set in the west.

Set exposure:

- 1 Choose Rendering > Environment to display the Environment And Effects dialog.
- 2 Click Render Preview to quickly view the result in a thumbnail.



- 3 The scene appears to be acceptable, so press F9 to get a better look.



Notice how the shadows under the lounge chairs, the villa veranda balconies, and other areas not in direct contact with the sun are solid black. Preferably, those surfaces should be partially illuminated by light rays emanating from adjacent areas.

The Final Gather option in the Rendered Frame > Include in Render group ensures that these shaded areas receive light from neighboring surfaces. By default, Final Gather is on, but you turned it off earlier so you could see the impact this option can have on a scene.



- 4 In the Rendered Frame window make a clone of the image.
- 5 In the Include In Render group, turn Final Gather back on and render your scene again.

Scene shadows are much improved, but the regions behind the windows and doorways of the villa remain unnaturally dark. In the next lesson, you will learn how to solve this problem by taking some of the outdoor light and directing it into the building.

Using Sky Portal and Photographic Exposure Control

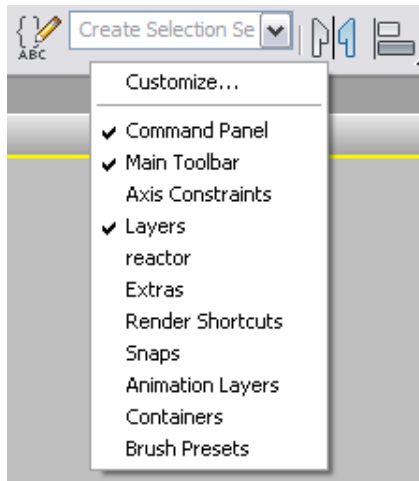
Sky Portal is a light object that gathers the sky light (as opposed to direct sunlight) generated by the daylight system. It then directs the light flow through selected objects, such as doors, glass doors, and windows, so the interior of buildings can be illuminated.

Add the Sky Portal:

- 1 Continue working on your own scene file or open the scene file *med-villa-lighting-skyportals.max*.

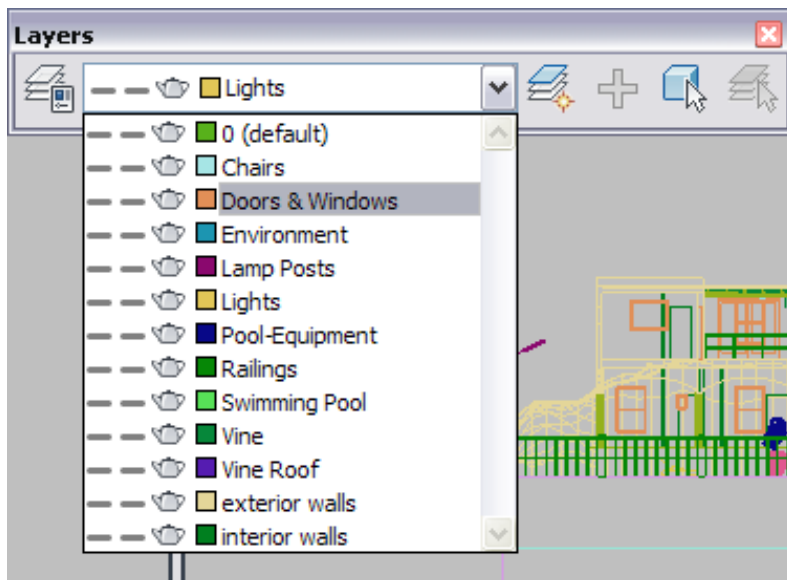


- 2 Activate the Camera-Terrace viewport, press F9 to render the scene, and in the Rendered Frame Window, make a clone of the image.
- 3 On an empty area of the main toolbar, right-click and choose Layers from the pop-up menu.



3ds Max Design opens the Layers toolbar.

- 4 Choose Doors & Windows from the drop-down list of layers.





- 5 Click Select Objects In Current Layer button to select the doors and windows.

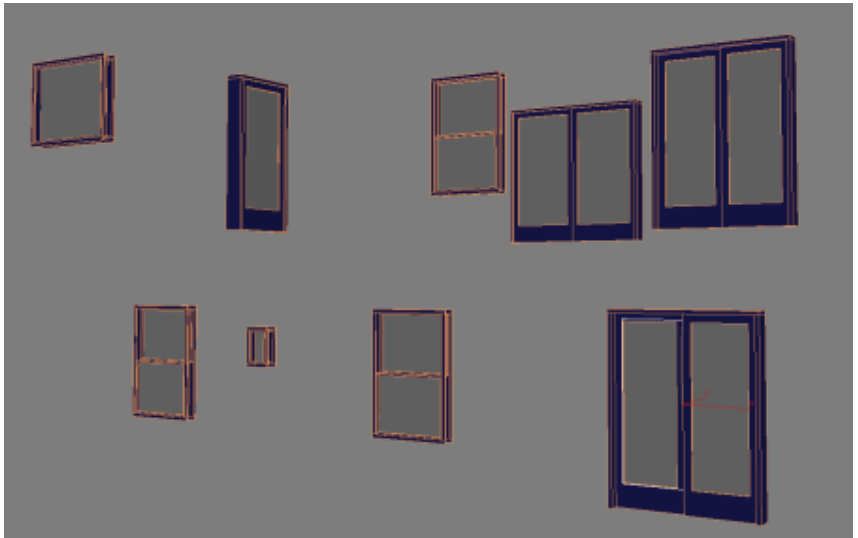
- 6 Right-click any viewport and choose Isolate Selection from the quad menu to display only the selected objects.



- 7 Activate the camera viewport, press P to switch to Perspective view, then navigate with Pan and Field-Of-View until all the windows are clearly in view.



- 8 Rotate the view so that the windows and doors face you, as shown in the next illustration.

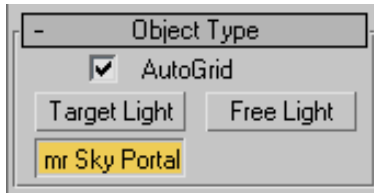


- 9 Press Alt + W to maximize the Perspective view, then press F4 to view the underlying geometry of each object.



- 10 On the Create panel, click Lights.

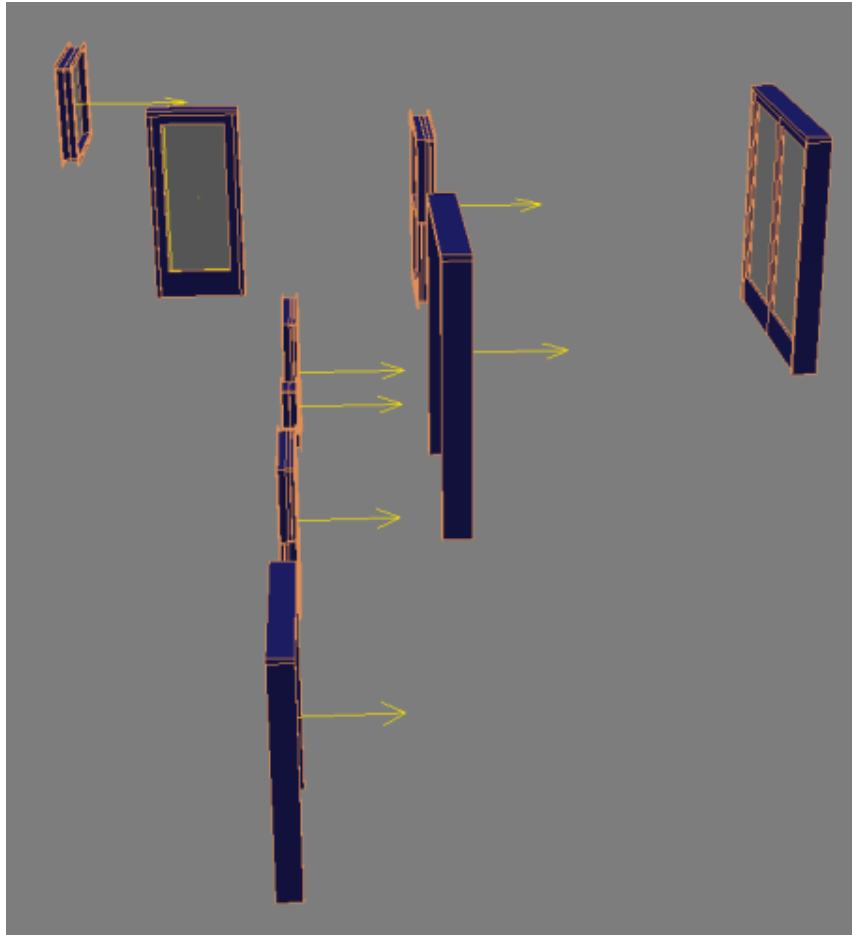
- 11 On the Object Type rollout, click mr Sky Portal, then turn on Autogrid.



- 12 In the Perspective view, create the first Sky Portal by dragging diagonally from the lower-left corner of any window to the upper-right corner, until the entire opening is covered.
- 13 Repeat the previous step for every door and window object in the scene, except for the *PivotDoor02* object (it is second from the right in the upper-right corner of the viewport).



- 14 Rotate the Perspective view so that the windows and doors are visible from their sides, as shown in the next illustration.



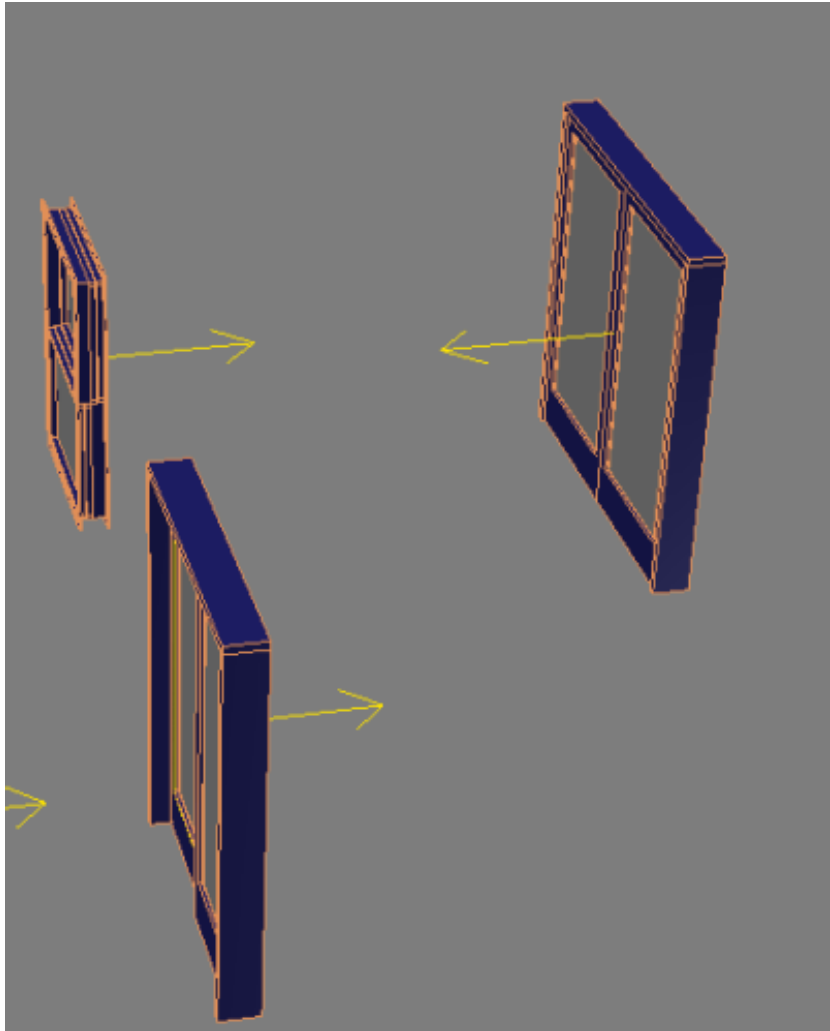
The yellow arrow in each SkyPortal object indicates the direction of the light flow, or flux. Because you drew the SkyPortal object on the exterior face of the doors and windows, the light flux arrows point in the proper direction, into the building. (If you created the SkyPortal from the inside of the building, you would have reverse the light flux either by rotating the window/door, or turning on Flip Light Flux Direction in the mr Skylight Portal Parameters rollout.)

- 15** Continue to rotate the scene until the *PivotDoor02* object is facing you. Create another Sky Portal object by dragging across the door.

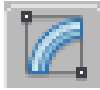
16



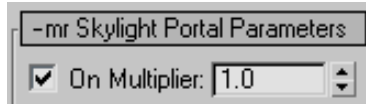
Rotate the scene one last time so that the sides of the doors and windows are visible, as shown in the next illustration. The *PivotDoor02* object should have its light flux direction pointed in the correct direction: into the room from the opposite side of the building.



17 Select any Sky Portal object you created by clicking its yellow light flux arrow.

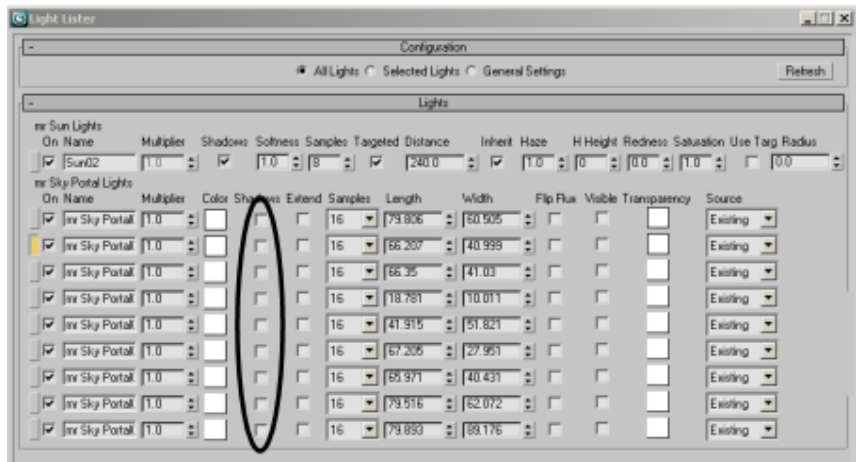


- 18** On the Modify panel > mr Skylight Portal Parameters rollout, you can increase the Multiplier value to boost the amount of light transmitted by the Sky Portal. For now however, leave the Multiplier set to 1.0.



Ordinarily, you would now go to the Shadows group and turn off the shadows option, because you do not necessarily need interior shadows for an exterior shot when viewed from a distance. Also, turning off Shadows helps to reduce render time.

- 19** However, rather than turn off shadows for each Sky Portal individually, from the main menu choose Tools > Light Lister. In the Light Lister dialog > Shadows column, turn off shadows for each of the Sky Portals in the list.



- 20** Close the Light Lister.
- 21** Click Exit Isolation Mode.

If a Select Camera dialog appears, choose Camera-Terrace and then click OK. Otherwise, click the Perspective viewport label and choose Cameras > Camera-Terrace.

- 22 Press F4 to return to regular shading mode.
- 23 Press F9 to render the image and compare the result with the rendered frame you cloned in the previous lesson.



- 24 The result is subtle, but improved. The window and door openings are now slightly lighter because the Sky Portals are now channeling sky light into the villa.
You can better understand the effects of the SkyPortal by looking at the villa from the inside.
- 25 Switch to Camera-Interior view and press F9 to render the scene.

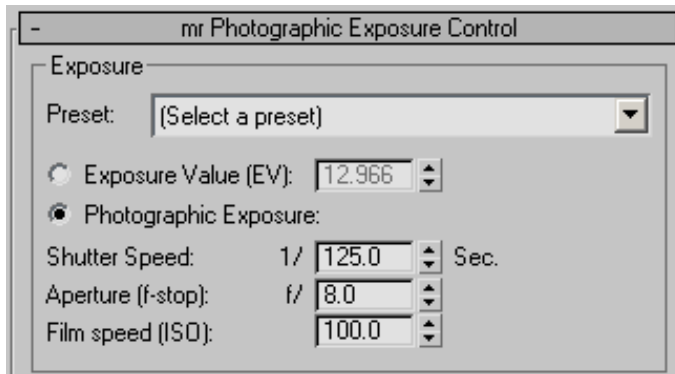


Because scene exposure is set to outdoor conditions, the outside portion of the scene is properly exposed. But the interior is very dark. You now need to adjust the exposure setting to compensate for the lower light of the building interior.

Set exposure for interior illumination:



- 1 In the Rendered Frame Window, click the Environment And Exposure Dialog button to display the Environment And Effects dialog.
- 2 On the mr Photographic Exposure Control rollout > Exposure group, make sure Photographic Exposure is chosen, then set Shutter Speed to 1/125.0. Keep the dialog open.




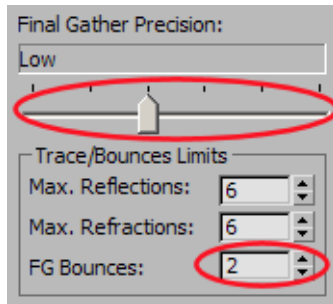
- 3  Make a clone of the rendered frame, then click Render to render the scene.




The slower shutter speed is now permitting more light to enter the camera, resulting in a better inside exposure.

You can further improve the interior lighting by increasing the number of bounces to each ray of light entering the interior.

- 4  Clone the current rendered frame and in the Include In Render group, set FG Bounces to **2**.



- 5  Render the scene and compare the result with the cloned frame. Delete the clone and create a new clone of the most recent render.



- 6 If you wish, you can take things further by dragging the Final Gather Precision and Image Precision slider bars to the right. Keep in mind that any such adjustments will affect render speed.

For this interior scene, it is appropriate for the door's Sky Portal to cast shadows. This is because room illumination would ordinarily be affected by shadows cast by the door frame.

- 7 Select the Sky Portal object by its gizmo in the center of the door. On the mr Skylight Portal Parameters rollout, turn Shadows on, then render the scene.

If you compare the result with the cloned render, you will see a subtle difference in the area where the ceiling and the facing wall meet, as well as the corner where the two walls meet. The dark corners in the latest render are thicker, caused by the shadows cast by the door frame.





- 8 Turn the Shadows off for the selected Sky Portal and return to the Camera-Terrace view.
- 9 On the Rendering menu, choose Exposure Control to open the Environment And Effects dialog.
- 10 On the mr Photographic Exposure Control > Exposure group, set Shutter Speed back to a proper exposure for an outside scene, which is 1/ **512**.




Next

[Time of Day Illumination](#) on page 443

Time of Day Illumination


You will now set the scene for late-day illumination, and adjust the exposure accordingly.

Change the time of day:

- 1   Render the scene and make a clone of the result.
- 2  Select the Daylight object (the sun object, not the compass rose), then go to the Motion panel.
- 3 On the Control Parameters rollout > Time group > Hours and Mins spinner boxes, set the time to **18** and **30** respectively (6:30 PM, or 1830 hours).
- 4 Press F9 to see the result.



The scene is fairly dark, but you can improve this by adjusting the exposure to a setting more appropriate for this time of day.

- 5  Click the Environment And Exposure Dialog button to display the Environment And Effects dialog.

- 6 On the mr Photographic Exposure Control > Exposure group, Shutter Speed is set to a proper exposure for a camera angle facing the sun. However, you can increase the amount of light entering the scene by adjusting the camera lens aperture.
- 7 In the Exposure group, set Aperture to **5.6**.



- 8 Render the scene and make a clone of the result.



The overall illumination is much improved, although the outline of the sun disc is lost.

Create a Sunset Exposure:

Here, you will adjust scene exposure so that objects are convincingly illuminated by the setting sun.

- 1 On the Control Parameters rollout > Time group > Hours and Mins spinner boxes, set the time to **19** and **40** mins respectively (7:40 PM, or 1940 hours).

2



Click Render and make a clone of the result.



The scene is extremely dark because the exposure is still set to an earlier time of day.

- 3 On the Environment And Effects dialog > mr Photographic Exposure Control rollout > Exposure group, set Shutter Speed to 1/ **100.0**.
- 4 Render the scene.



The mr Physical Sky shader produces a vivid sky gradient, and details around the pool are much more apparent.

- 5 Take a look at the two other rendered frames representing the same scene at 3 PM and 6:30 PM to see how you used mental ray exposure controls to effectively create three distinctive moods.

Summary

You can create a daylight system to simulate real-world outdoor lighting conditions at any time of day, at any location on the planet. mental ray offers a range of presets that define proper exposure settings for specific lighting conditions, which you can adjust manually as needed. A Sky Portal object can also be added to channel daylight into doorways and windows of structures, to enhance their interior illumination.

Lighting and Rendering the Villa at Night

In this tutorial, you will illuminate a mediterranean villa by night. You'll start by creating photometric lights that mimic real-world lighting systems, then import an image of a sky panorama and use it as a backdrop.



In this tutorial, you will learn how to:

- Place photometric lights in a scene and adjust light color.
- Set shadow parameters so lights cast shadows properly.
- Use render presets to quickly set exposure for a night scene.
- Use a bitmap image as the scene background and adjust its brightness and contrast levels to compensate for night lighting conditions.


Skill level: Intermediate

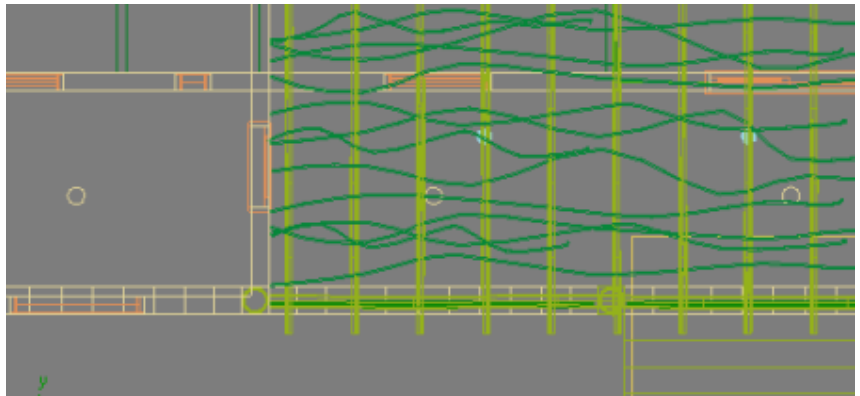
Time to complete: 1 hour

Adding Photometric Lights

You will start by adding incandescent, halogen, and fluorescent lights, whose real-world properties will illuminate the night scene.

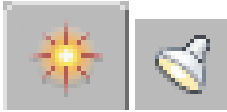
Create a group of recessed lights and set proper exposure:

- 1  On the Quick Access toolbar, click the Open File button, navigate to the `\scenes\lighting_and_rendering\med_villa` folder, then open the scene file `med-villa-lighting-start.max`.
- 2 Activate the Top viewport and zoom in to the three ceiling fixtures in the lower verandah, as shown in the next illustration.



- 3 Continue to zoom in to the far left fixture until it is clearly in view.

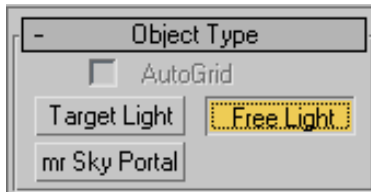




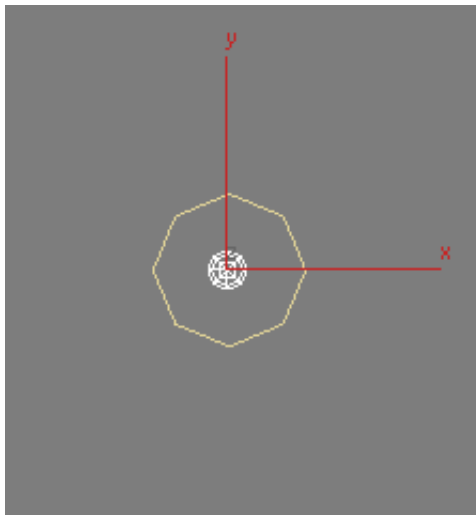
- 4 On the Create panel, choose Lights.

The lights panel is automatically set to Photometric, meaning that any light you create in this category will exhibit real-world behavior in terms of light attenuation, distribution, color, and so on.

- 5 On the Object Type rollout, click Free Light.



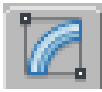
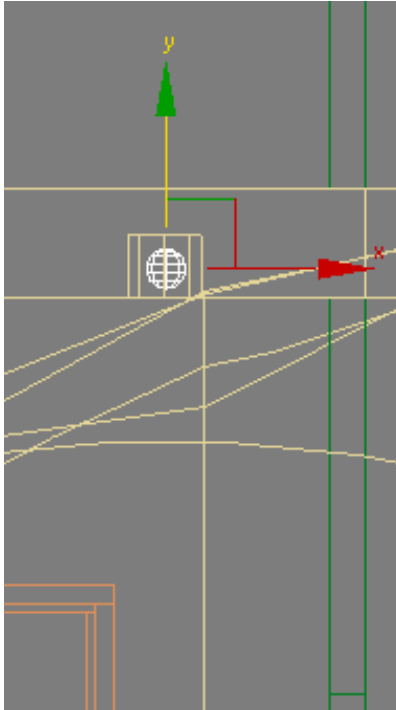
- 6 Click once on the center of the fixture to create the light object, then right-click to end object creation.



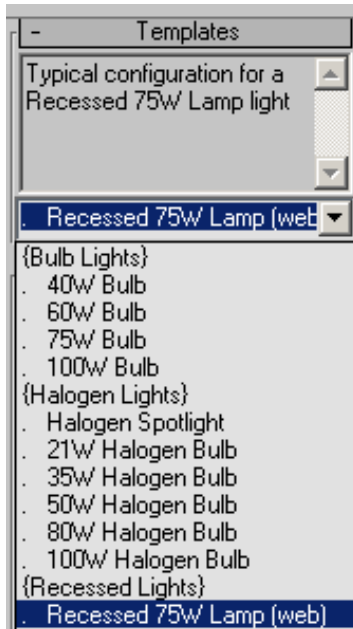
By default, the light object is created on the surface plane of the scene.



- 7 Right-click the Front viewport, zoom in to the light fixture socket, and use the Select And Move tool to move the light object on its Y axis until it is positioned inside the fixture.



- 8 On the Modify panel > Templates rollout > Select A Template drop-down list, choose Recessed 75W Lamp (Web).

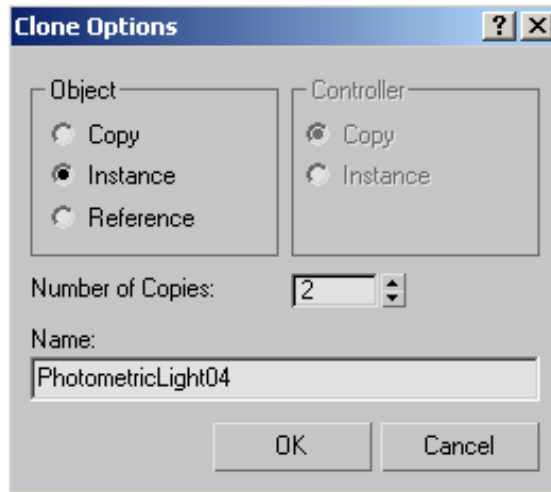
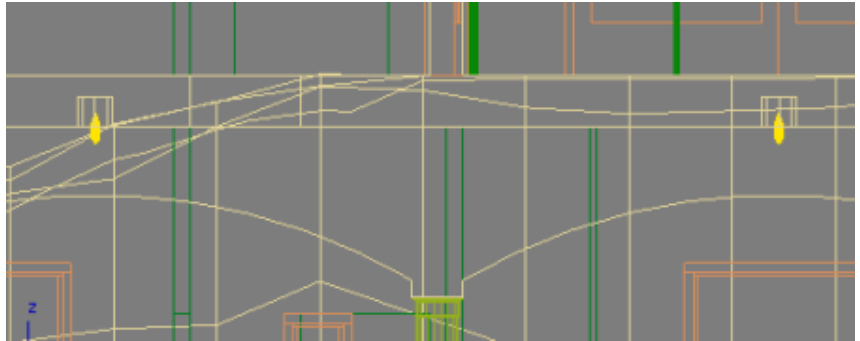


Values in the rollouts below Templates are set to match the real-world properties of the selected light. These properties can be customized as needed.

- 9 Zoom out until the light fixture to the right is visible.



- 10 Hold down Shift and use the Select And Move tool to drag the light object on its X axis until it is placed inside the neighboring light fixture, as shown in the next illustration. In the Clone Options dialog > Object group, turn on Instance. Set Number Of Copies to **2**, and then click OK.

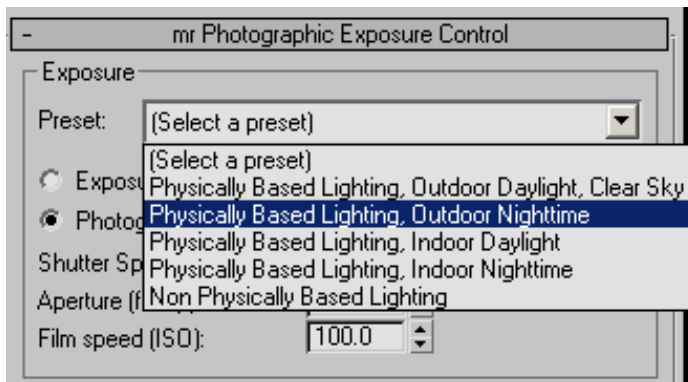


- 11 Activate the Camera-Terrace viewport and press F9 to render the scene. The image is completely black because the default exposure settings in 3ds Max Design are not suitable for the such a dimly lit scene.



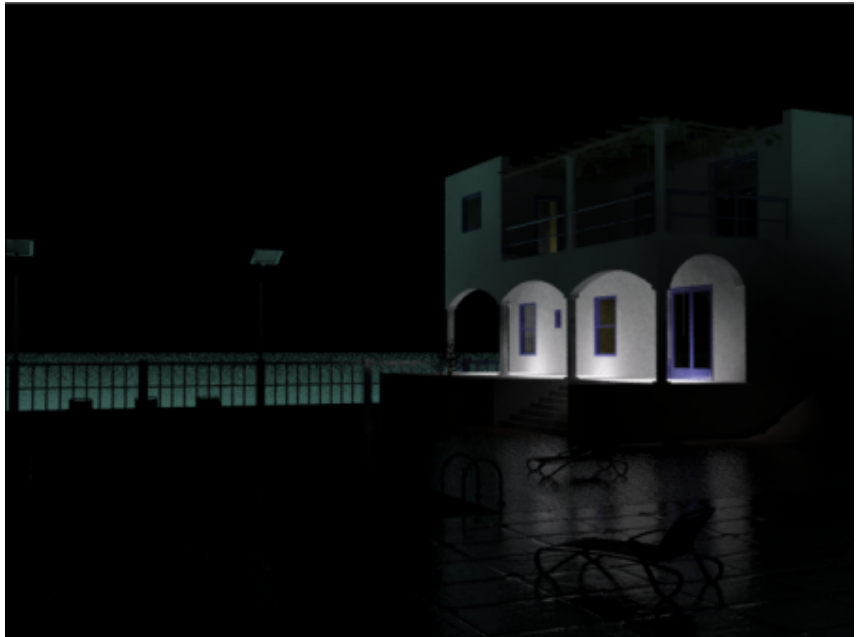
- 12 In the Rendered Frame Window, click the Environment And Exposure Dialog button.
- 13 The Environment And Effects dialog > Exposure Control rollout drop-down list shows that exposure is properly set to the mental ray mr Photographic Exposure Control, but the default shutter speed and aperture settings are wrong. This can be easily corrected by choosing the appropriate exposure preset.

- 14 From the mr Photographic Exposure Control rollout > Exposure group > Preset drop-down list, choose Physically Based Lighting, Outdoor Nighttime.




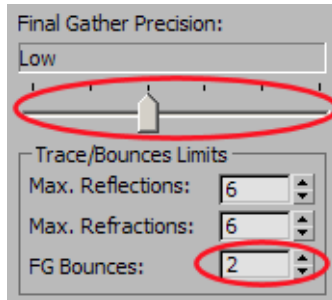
The preset has decreased the shutter speed from 1/125 to 1/0.125, and doubled the aperture size to from f16 to f8. These exposure settings are more appropriate for a nighttime scene.

- 15 Press F9 to render the scene.



The image is much improved, but there are shading anomalies under the right-most arch of the verandah.

- 16  Clone the current rendered frame and in the Rendered Frame Window > Include In Render group turn on Final Gather, set Bounces to 2, and then render the scene again.



- 17 Compare the two rendered images. The added number of light ray bounces has increased light intensity, and removed the more obvious scene artifacts.



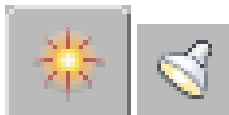


Above: The porch rendered with no final gather

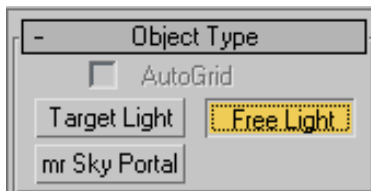
Below: The porch rendered with final gather, Bounces=2

Add more lights to the building interior and upper balcony:

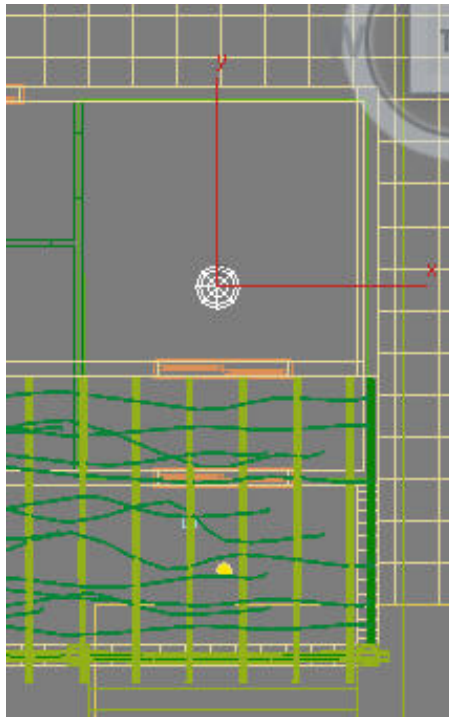
- 1 Continue working on your own scene file, or from the `\med_villa` folder, open the scene file `med-villa-lighting-bulbs.max`.
- 2 If you are using a new scene file, press F9 to render the scene.
- 3 Activate the Top viewport and zoom in to the balcony area and the right side of the house.



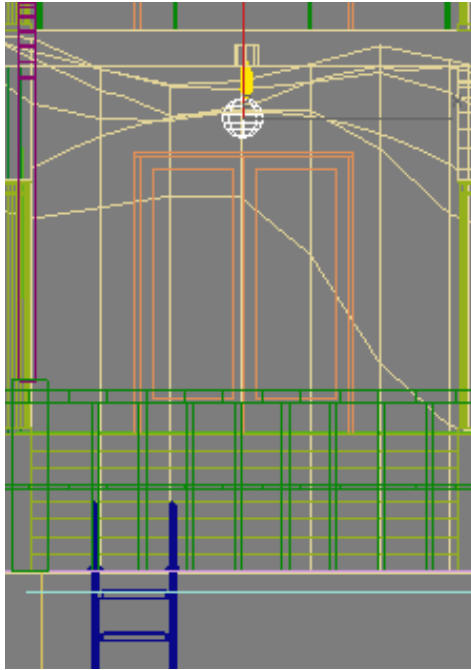
- 4 On the Create panel, choose Lights.
- 5 On the Object Type rollout, click Free Light.



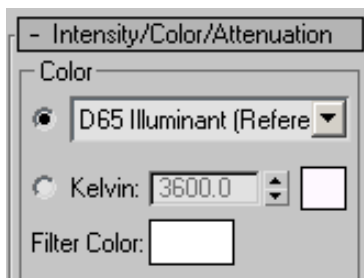
- 6 Click once above the door frame as shown below to create the light object, then right-click to end object creation.



- 7 Right-click the Front viewport and use the Select And Move tool to move the light object on its Y axis until it is positioned just above the lower-story window.



- 8 Go to the Modify panel > Templates rollout and choose 100W Bulb.
You will accept most of the settings for this photometric light, but you need to change the its default color from yellow to white.
- 9 On the Intensity/Color/Attenuation rollout, choose the radio button that activates the Color drop-down list (as opposed to the Kelvin light temperature). Leave the list set to its default: D65 Illuminant (Reference White).



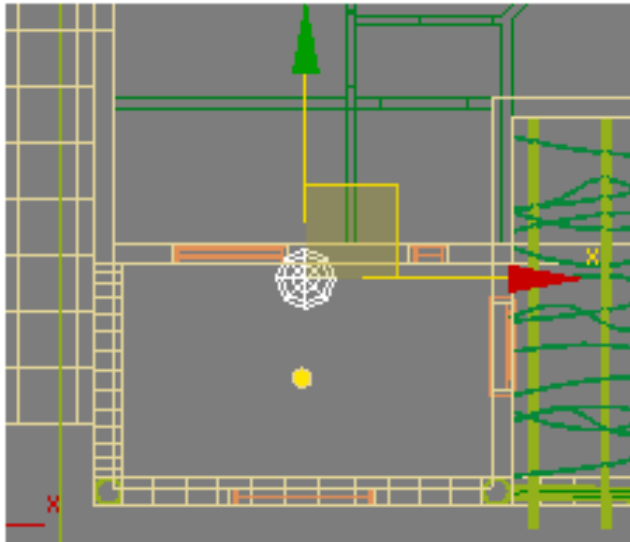
The color swatch below the drop-down list updates to show the selected color.

NOTE You could also have set light object color by specifying its light temperature in the Kelvin spinner. In degrees Kelvin, light color varies from 1000 (pink) to 20,000 (blue).

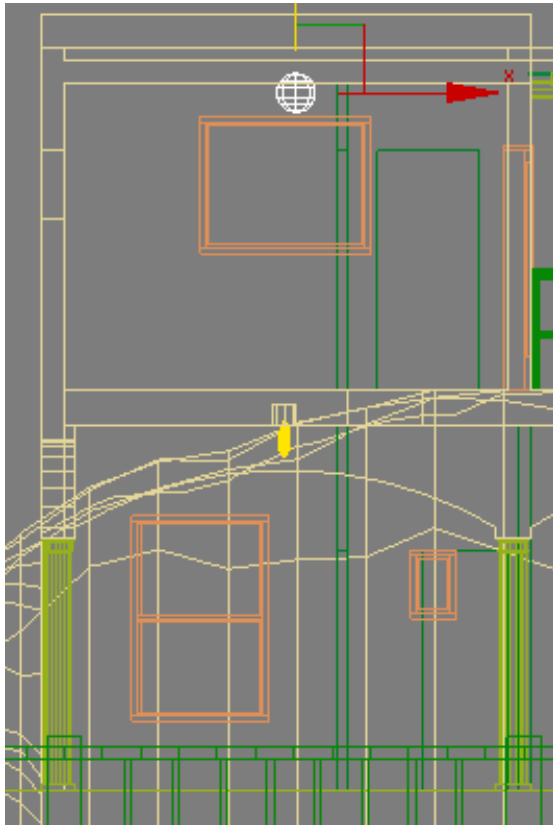
- 10** Activate the Top viewport and zoom out until the entire house is in view.



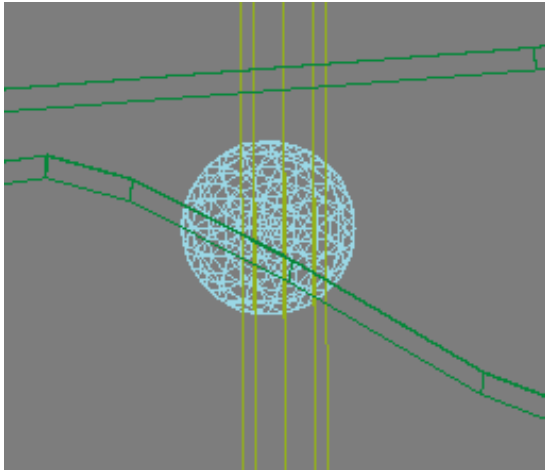
- 11** Use the Select And Move tool to Shift+clone the light object and drag the cloned light as an instance to the kitchen window on the left, as shown in the next illustration.



- 12** The kitchen is on the top floor, so activate the Front viewport and drag the light object until it is positioned just above the window.



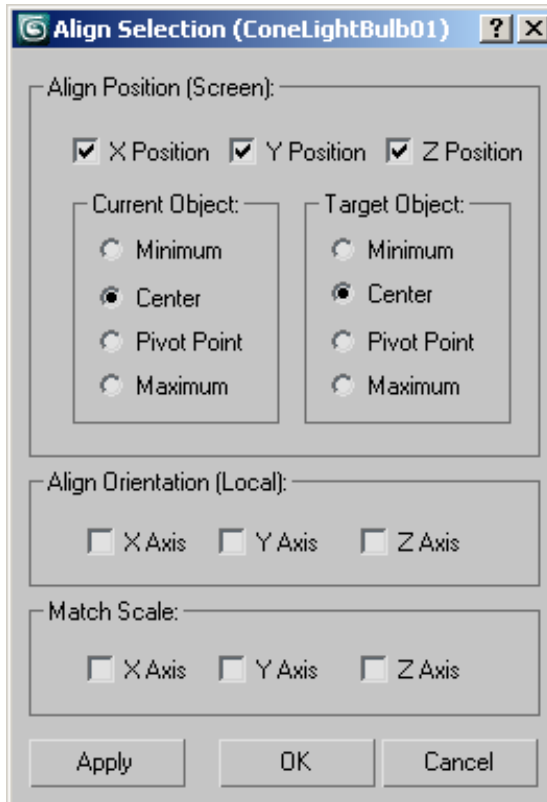
- 13 Active the Top viewport again and zoom in to one of the balcony globe objects (*ConeLightBulb01*).



- 14** On the Create panel, choose Lights.
- 15** On the Object Type rollout, click Free Light.
- 16** Click anywhere around the globe to place the light. Its exact position is not important.



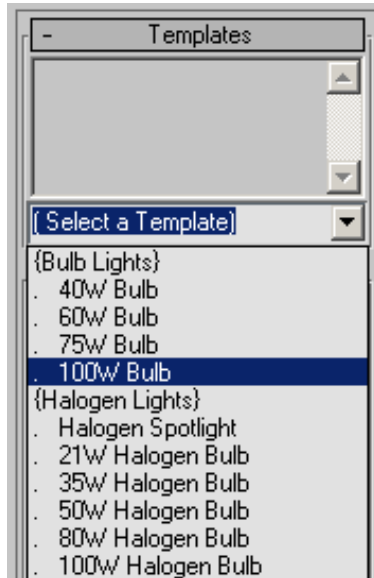
- 17** On the main toolbar, choose the Align tool, then select *ConeLightBulb01*.
- 18** On the Align Selection dialog > Align Selection group, turn on X, Y, and Z Position, and choose Center for both Current Object and Target Object. Click OK.



This aligns the center of the light object with the light fixture.

Keep in mind that because the light is set to cast shadows, the object it is placed in must include material transparent enough to have light pass through. Otherwise, rays from the light object will strike the inside of the object it is enclosed in, and travel no farther.

- 19 Go to the Modify panel > Templates rollout and choose 100W Bulb.



Keep in mind that the light you choose in this list possesses the same properties as a real-world light, and must therefore be appropriate for the area it is intended to illuminate.

In terms of light attenuation, for example, for every 10 meters distance travelled, light intensity from this 100-Watt bulb will drop off to 1/100th of its initial strength.

- 20 In Top view, zoom out until the second balcony globe to the right is visible.



- 21 Use the Select And Move tool + Shift to reposition the light as an instance to a point near *ConeLightBulb02*.

- 22 Align the cloned light object just as you did the first light object.



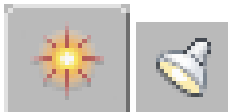
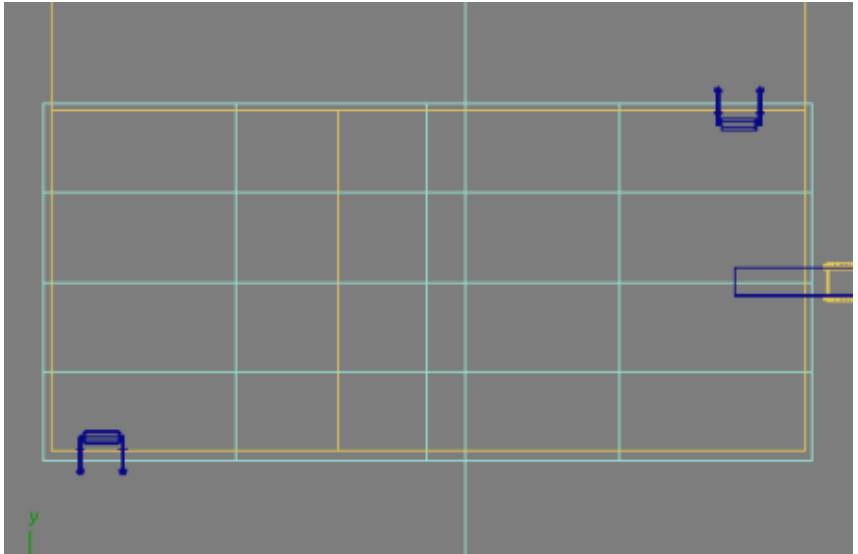
- 23 Make a clone of the currently rendered frame. Activate the Camera-Terrace viewport, then render the scene.
- 24 Compare the two rendered images.

Because you used the default color for the 100W bulb light objects, the upper balcony is bathed in a yellowish light. Also, light is now visible from the door and windows of the two rooms in which light objects were placed.



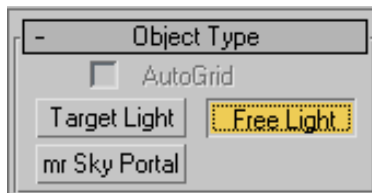
Add halogen lights for the pool:

- 1 Continue working on your own scene file, or from the `\med_villa` folder, open the scene file *med-villa-lighting-halogen.max*.
- 2 Activate the Top viewport and zoom in to the swimming pool, as shown in the next illustration.

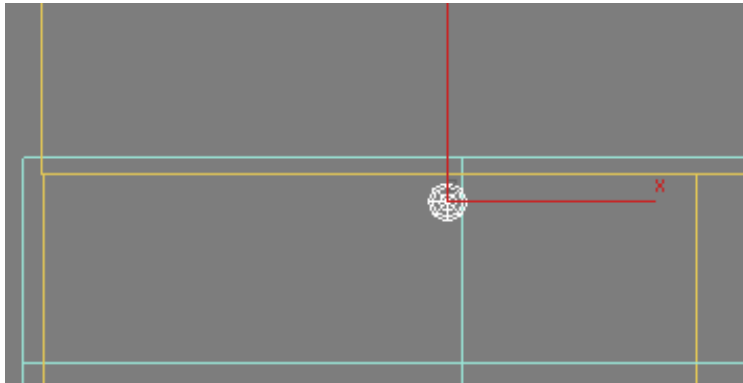


3 On the Create panel, choose Lights.

4 On the Object Type rollout, click Free Light.



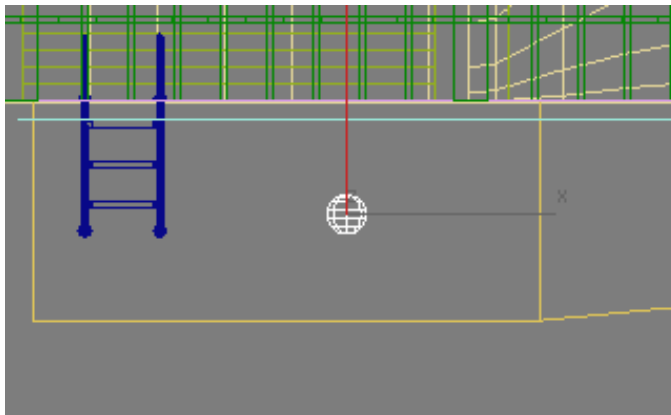
5 Click once to place the light object at the inner edge of the pool as shown in the next illustration, then right-click to end object creation.



Be sure to reposition the light so it is slightly away from the pool wall.



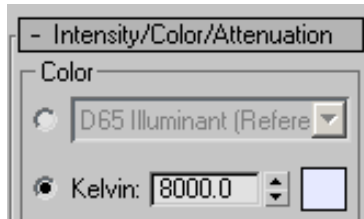
- 6 Right-click the Front viewport and use the Select And Move tool to move the light object on its Y axis until it is positioned at the midpoint between the floor of the pool and the waterline.




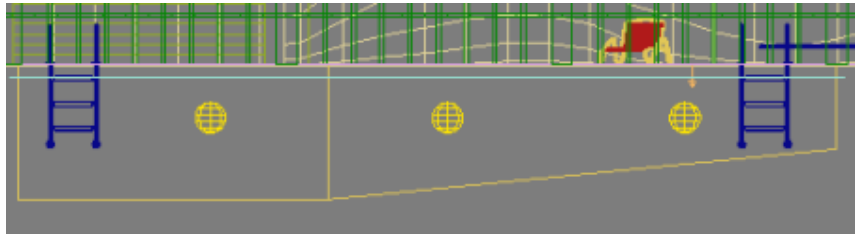
- 7 On the Modify panel > Templates rollout, choose 80W Halogen Bulb.

The default color for this type of light is 2900 degrees Kelvin, which produces a yellowish hue. A whitish-blue color is preferable, so you will now modify the light's Kelvin value accordingly.

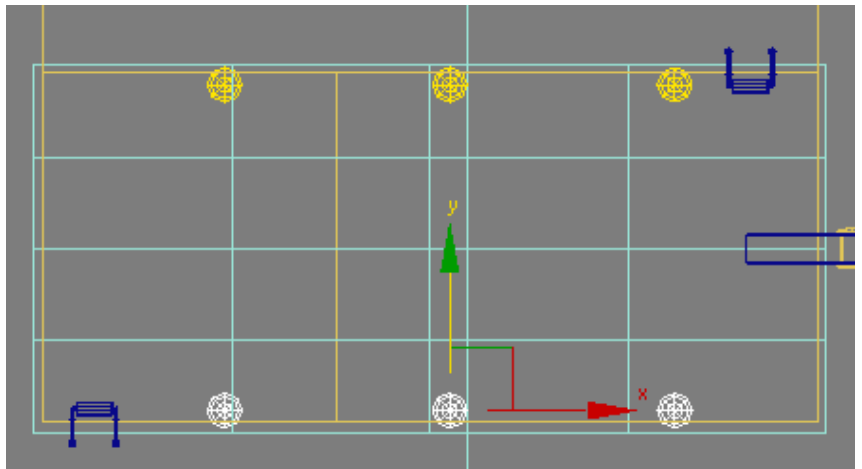
- 8 On the Intensity/Color/Attenuation rollout > Color group, set the Kelvin value to **8000.0**.





- 9  Use the Select And Move tool to Shift+clone the light object at the mid point of the pool. In the Clone Options dialog > Object group, turn on Instance and set Number Of Copies to **2**.



- 10 Activate the Top viewport, then Ctrl+select the three light objects and position their instances at the opposite side of the pool.



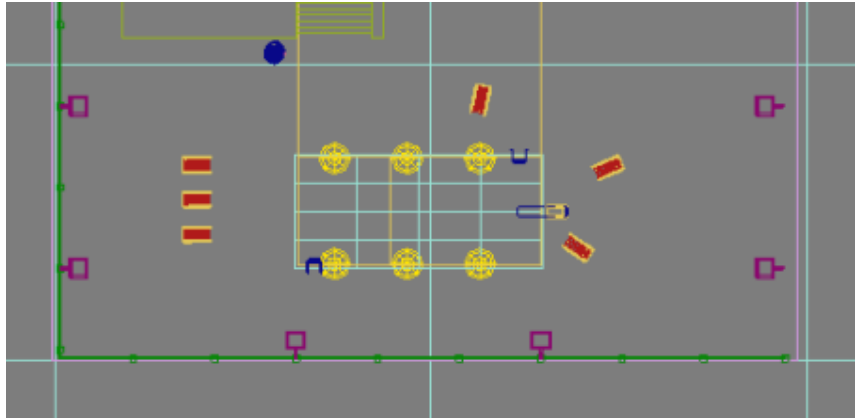
- 11   Activate the Camera-Terrace viewport, make a clone of the currently rendered frame, render the scene, then compare the two rendered images.



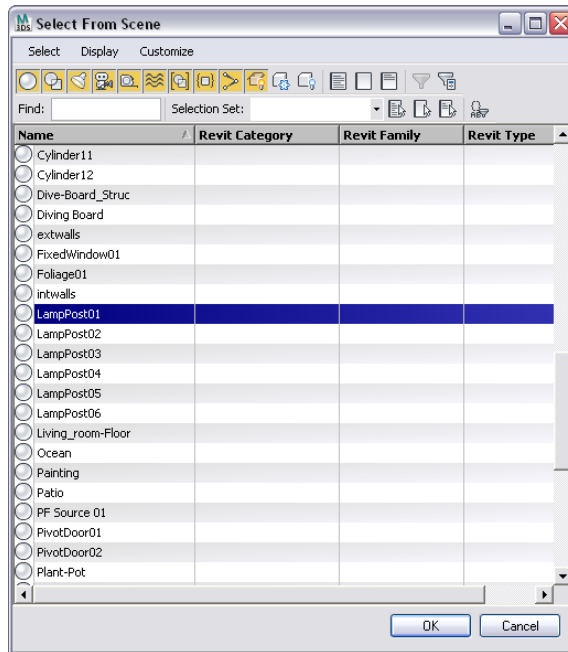
The scene is starting to take shape. Your next task is to add light objects to the lamp posts that surround the pool.

Add fluorescent lights for the pool area:

- 1 Continue working on your own scene file, or from the `\med_villa` folder, open the scene file `med-villa-lighting-fluo.max`.
- 2 Activate the Top viewport and zoom in to the area around the swimming pool so that all the lamp post objects are in view, as shown in the next illustration.



- 3 Press H and select *LampPost01* from the Select From Scene dialog.



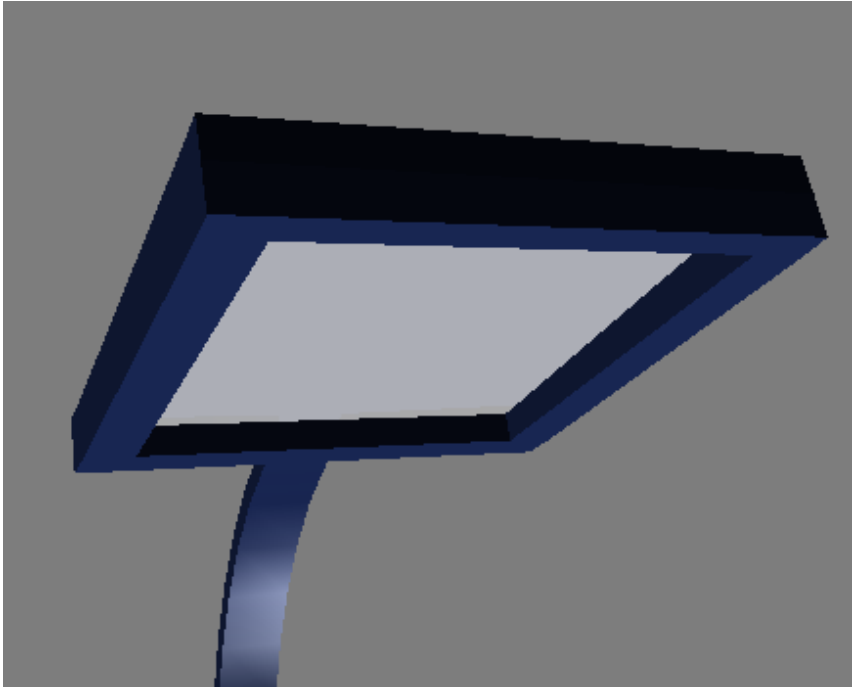
NOTE If the dialog highlights all six lamp posts, choose Select > Select Depends to turn off this option.

- 4 Right-click the viewport and choose Isolate Selection from the quad menu.

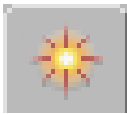
- 5 Activate the Camera-Terrace viewport and press P to display Perspective view.



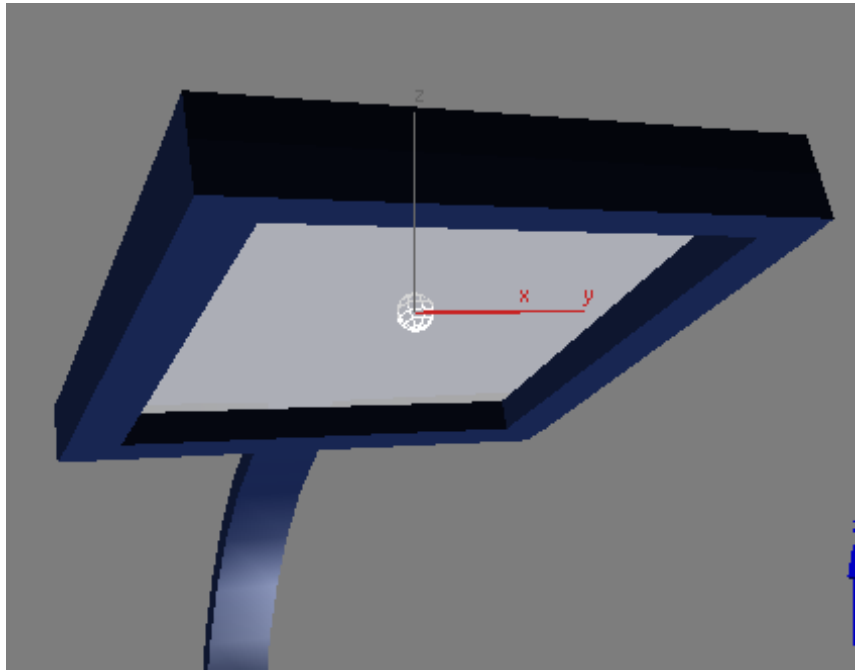
- 6 Click Zoom Extents to get a closer look at the lamp post. Continue to zoom in until the light panel is clearly in view.



- 7 Zoom in to the lamp post object in the Front and Left viewports as well.



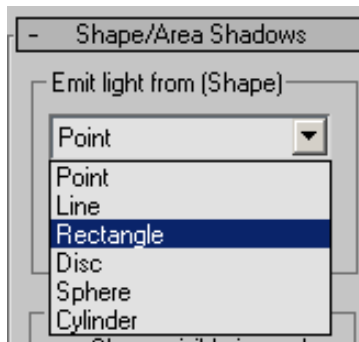
- 8 On the Create panel, choose Lights.
- 9 On the Object Type rollout, click Free Light and turn on AutoGrid.
- 10 In Perspective view, click once in the center of the light panel to place the light object on its surface. Turn off AutoGrid when you're done.



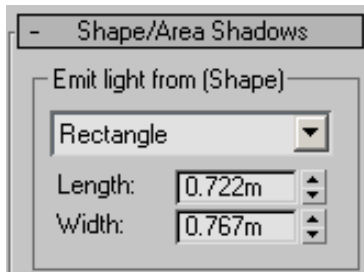
- 11 Go to the Modify panel > Templates rollout and choose 4ft Cove Fluorescent (Web).

By default, this type of object emits light as a point. However, you want the object to emit light in a rectangular area that corresponds to the geometry of the lamp post panel.

- 12 In the Shape/Area Shadows rollout > Emit Light From (Shape) group, choose Rectangle from the drop-down list.



- 13 Drag the Length and Width spinner arrows until the rectangular bounding box matches the dimensions of the lamp post light panel.

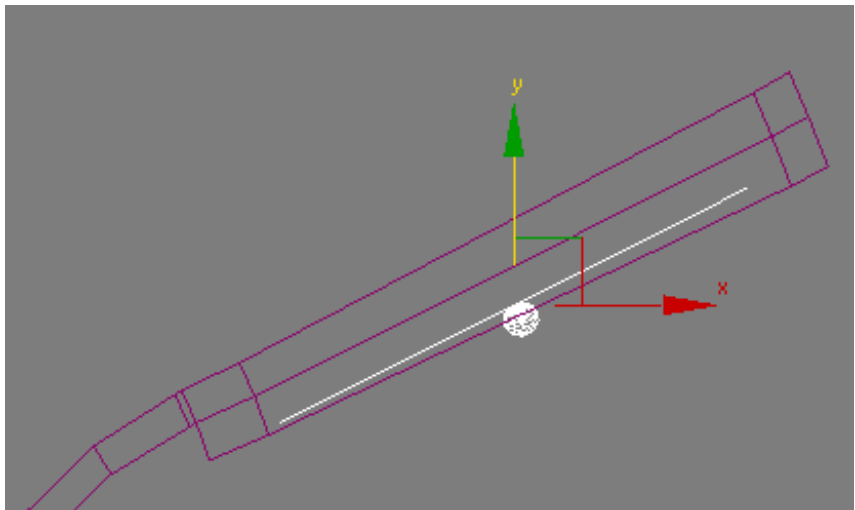


Use the Top and Left viewports to check your work. Use the Select And Move tool to adjust light object position if you need to.

NOTE Before you move the light, go to the main toolbar and choose Local as the reference coordinate system.



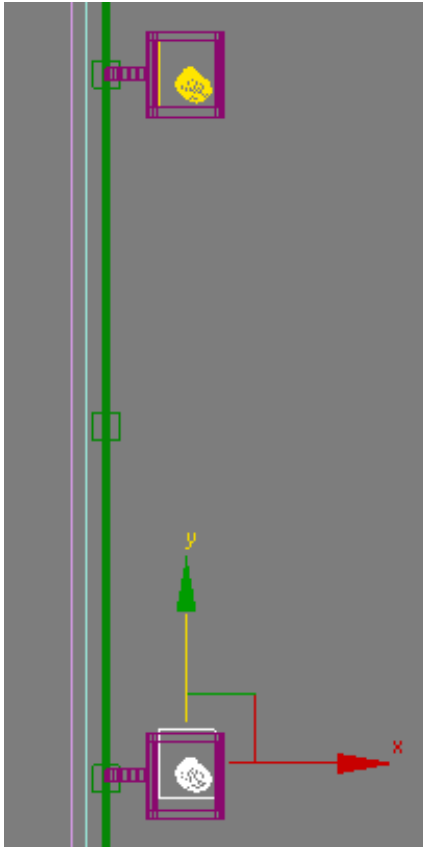
- 14 Activate the Front viewport and use the Select And Move tool to move the light object downward slightly, towards the lower surface of the fixture.



- 15 Click Exit Isolation Mode, click the Perspective viewport label and choose Cameras > Camera-Terrace.



- 16 Activate the Top viewport and use the Select And Move tool to Shift+clone the light object to the neighboring lamp post, as shown in the next illustration. (If you changed the reference coordinate system to Local, change it back to View before you Shift+clone.)

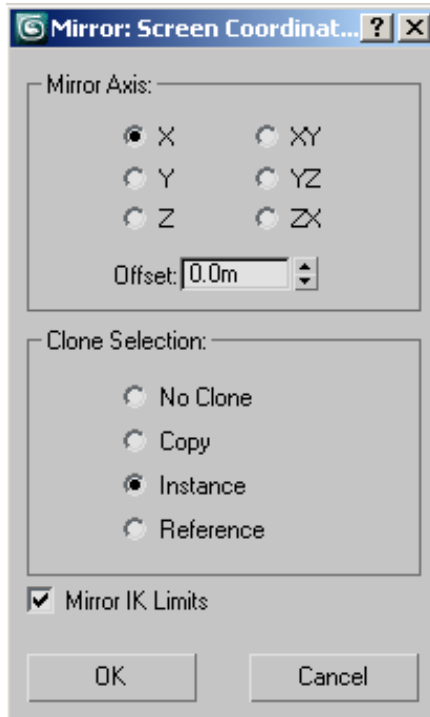


Make the cloned light an instance of the original.

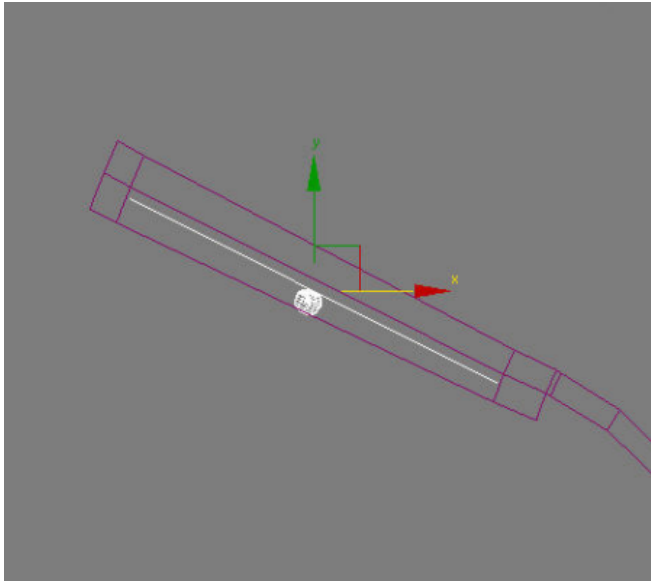
- 17 Adjust the light object position in the Left viewport.



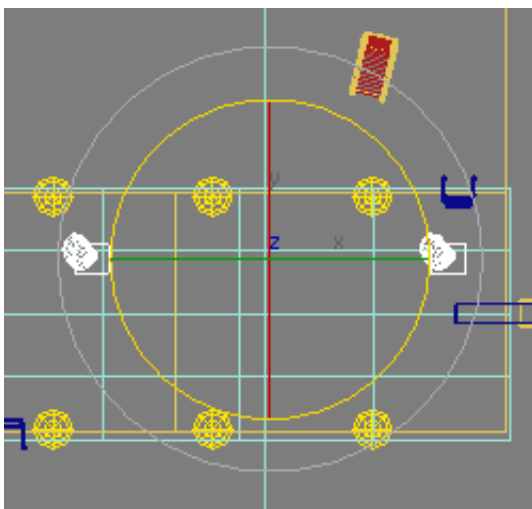
- 18 In the Top viewport, Ctrl+select the two light objects, and then click the Mirror tool.
- 19 In the Mirror dialog > Mirror Axis group, make sure X is chosen. In the Clone Selection group, turn on Instance.



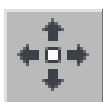
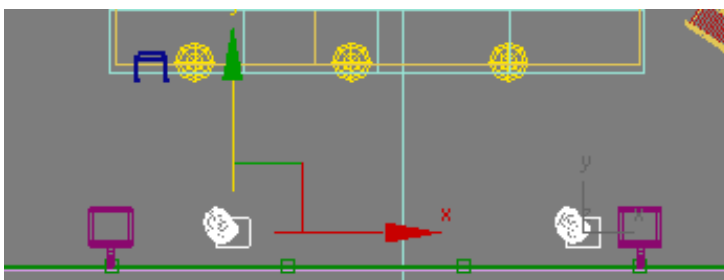
- 20 In the Top viewport, zoom out and drag the cloned light objects to the lamp posts on the opposite side of the pool.
- 21 Activate the Front viewport and zoom in to a newly cloned light object.
- 22 Drag the object on its X axis to the left until it approaches the lower surface of the fixture.



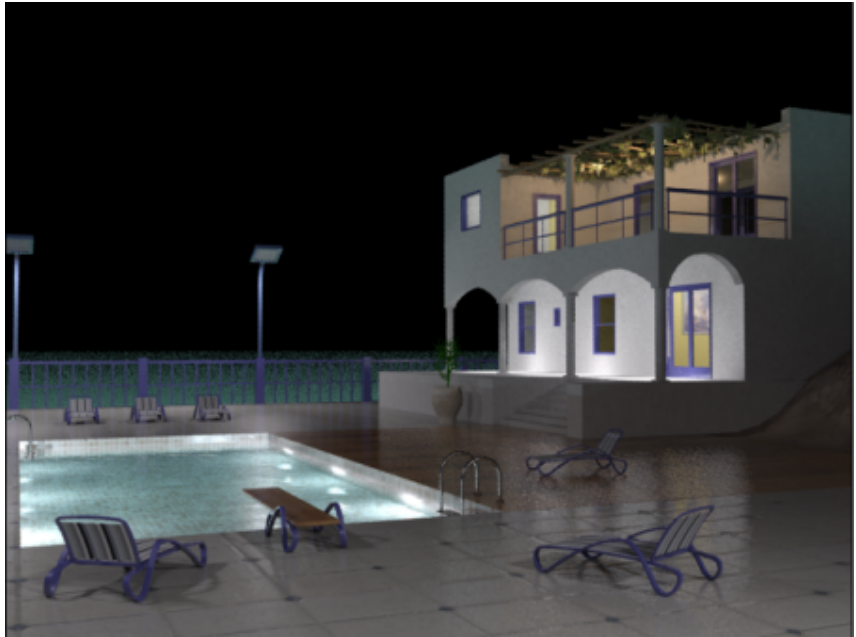
- 23** In the Top viewport, Shift+clone the light objects to the mid point between the two remaining lamp posts, as shown in the next illustration. Make the clones instances, again.



- 27 Move the lights on their Y axis until they are in line with the two remaining lamp posts, as shown in the next illustration.



- 28 Select each light individually and move them on their X axis until they are repositioned inside the remaining two lamp posts.
- 29 Activate the Left viewport, zoom in to one of the light objects you just repositioned, and drag on its X axis until it is near the outer edge of the fixture. Repeat for the other light object.
- 30 Activate the Camera-Terrace viewport and render the scene.



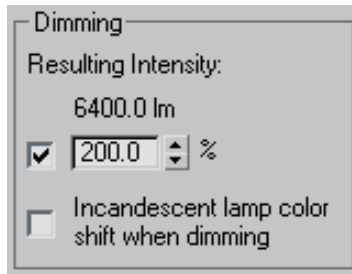
With the latest addition of these light objects, you will notice that the time it takes to render the scene has increased considerably.

The area around the pool is now illuminated, but the scene remains under-lit. The intensity of the fluorescent light objects needs some adjustment.

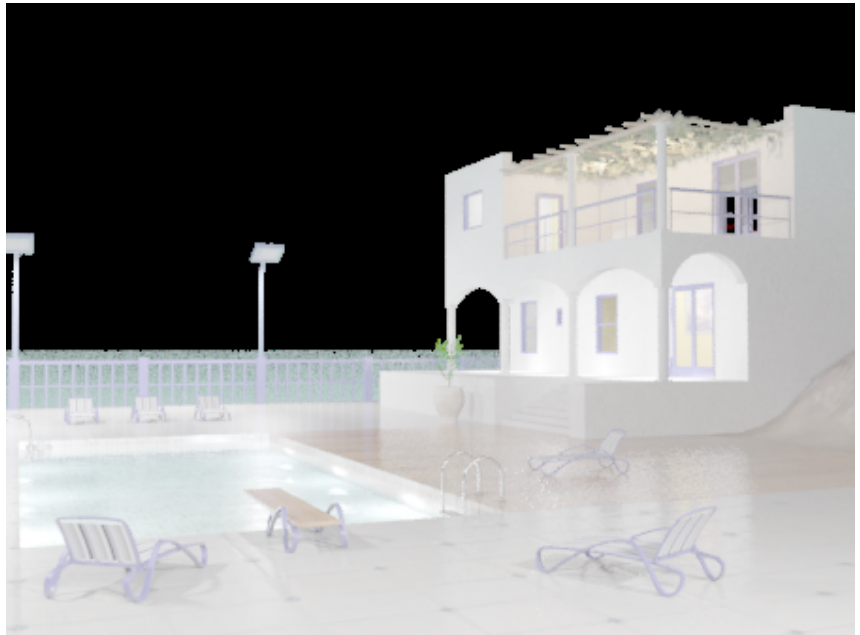
Fine-tune the fluorescent illumination:

The fluorescent light objects you created for the pool deck emit a light intensity that corresponds to their product specifications. However, you have the option of overriding this setting as needed. Here, you will increase the intensity to provide added illumination.

- 1** Select one of the fluorescent light objects.
- 2** On the Modify panel > Dimming group, double the Resulting Intensity from 100 to **200.0** percent.



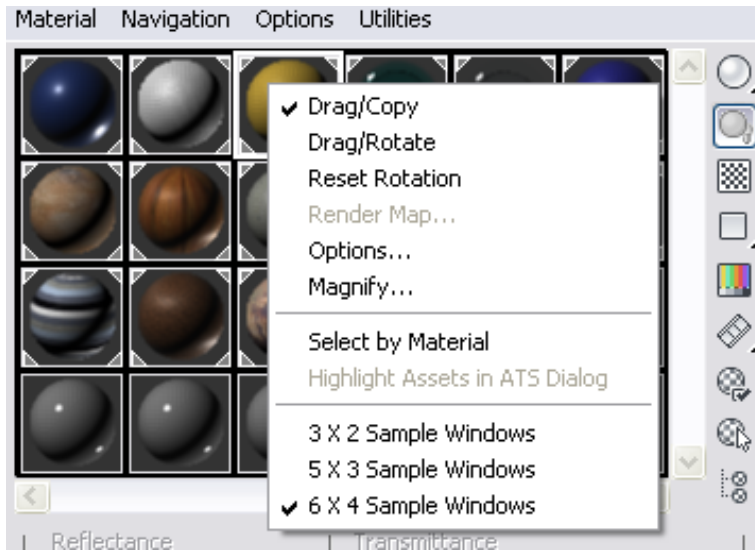
- 3 Activate the Camera-Terrace viewport and press F9 to render the scene. Because the light objects were cloned as instances, all lights are affected by the intensity setting. The amount of available light in the scene has greatly increased, rendering the shadows cast by the floor vase and diving board in greater detail.



The scene is almost complete, but one flaw remains. The frosted glass panels that cover the lamp posts do not seem to be glowing as brightly as they should, considering the lamps are the major source of your outdoor illumination.

Make the lamp post fixtures self illuminating:

- 1 Press M to open the Material Editor.
- 2 Right-click a sample slot and choose 6 x 4 Sample Windows, if you are not already using this display option.

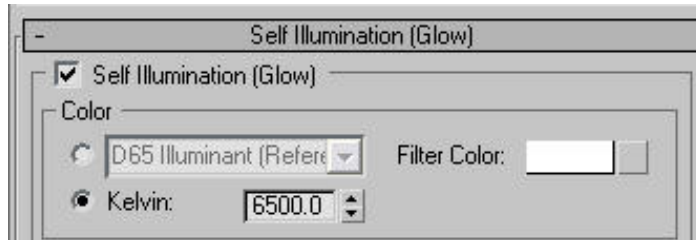


- 3 Click the Glow material sample slot to make it active.



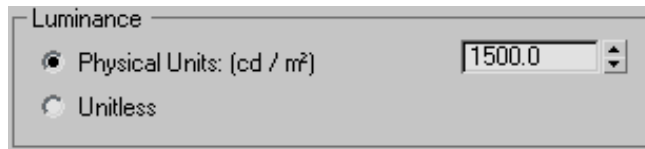
Glow is a standard mental ray Arch+Design material, which you will further customize.

- 4 On the Self Illumination (Glow) rollout, turn on Self Illumination (Glow) to trigger the glow effect on the material.

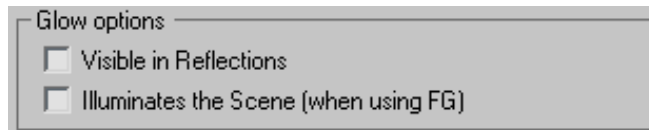


The Color group lets you specify the color of the glow material, but leave default filter color of white unchanged.

In the Luminance group, choose Physical Units (cd/m²). If you later choose to add lighting effects such as glare or halo, you can adjust this value to fine-tune the result. For now, leave the setting unchanged, at 1500 candelas per square meter.



- 5 In the Glow Options group, turn off Visible In Reflections.



Since the image already shows some reflectance of the lamp posts in the existing render, you don't need this option. The other option in this group, Illuminates The Scene (When Using FG), applies the Glow material as its own light source. But the lamps already have their light objects in place, so any additional illumination from the Glow material is unnecessary.

- 6 Press F9 to render the scene.



The light sources in the lamp posts should now emit a convincing glow.

Next

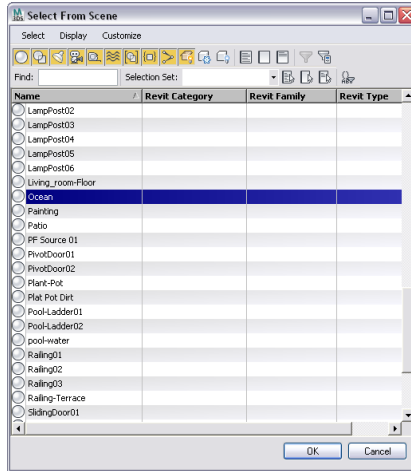
[Adding a Background Image](#) on page 482

Adding a Background Image

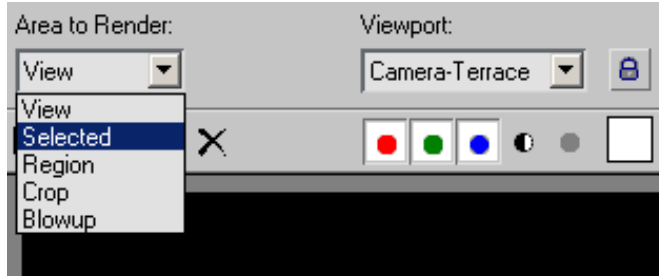
In the previous lesson, you used photometric lights to illuminate the foreground of your mediterranean night scene. In this lesson, you will complete the picture by changing the color of the ocean and using a bitmap image of a sky as a backdrop.

Add a background image and adjust for better contrast:

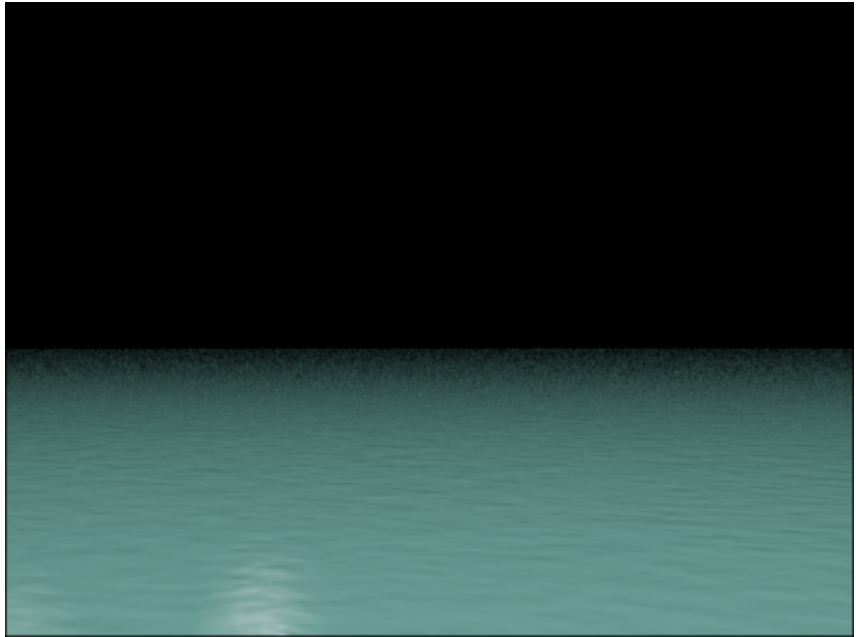
- 1 Continue working on your own scene file, or open the scene file *med-villa-lighting-env.max*.
First, you will change the sea to a more realistic color.
- 2 Press H. In the Select From Scene dialog, select the *Ocean* object.



- 3 Activate the Camera-Terrace viewport and on the main toolbar, click the Rendered Frame Window button to display the rendered frame.
- 4 On the Rendered Frame window > Area To Render drop-down list choose Selected, then click the Render button.



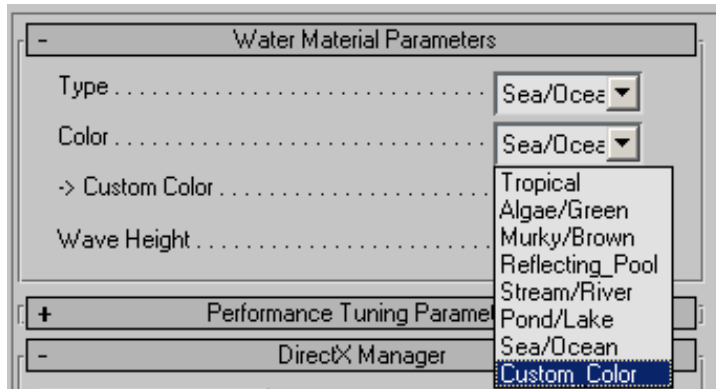
The color of the sea water is suitable for a day scene but not for nighttime.



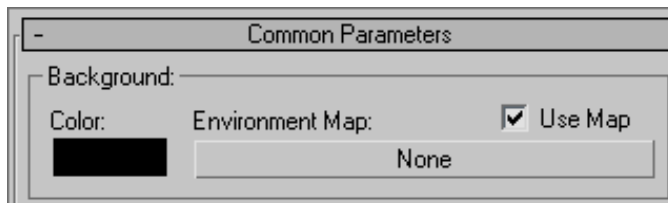
- 5 Press M to open the Material Editor.
- 6 Choose the Water - Ocean material, which is located on the top row and five sample slots to the right.



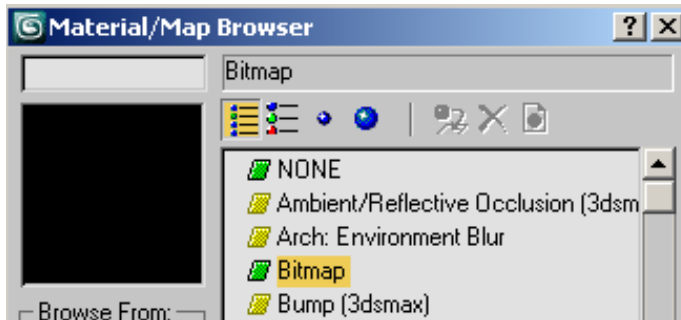
- 7 On the Water Material Parameters rollout, Color drop down list, choose Custom Color.



- 8 Click the Custom Color swatch and on the Color Selector that displays, pick a dark blue color: Red=**0.005**, Blue=**0.025**, Green=**0.1**.
- 9 Render the ocean. This may take some time, so feel free to cancel the render once you get an idea of the result.
- 10 On the Area To Render drop-down list, choose View so that the next time you render, the entire scene will be included.
- 11 Click anywhere in the background area of the Camera-Terrace viewport, taking care that no object in the scene is selected.
- 12 Right click to display the quad menu and choose Hide Unselected.
Now, only the scene background is displayed.
- 13 From the Rendering menu > Environment > Environment And Effects dialog > Common Parameters rollout, click the Environment Map button (at present, it says "None").



- 14 On the Material/Map Browser, double-click the Bitmap entry.



- 15 Navigate to the `\sceneassets\images` folder and click to highlight the bitmap *sky.jpg*.
- 16 On the Select Bitmap Image File dialog, click View.



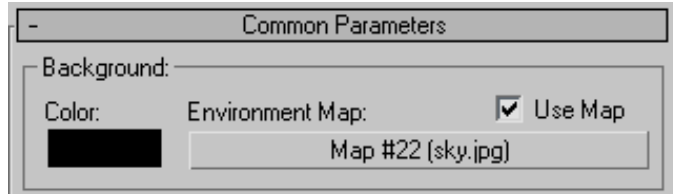
The image is a desert landscape, but only the upper portion of the image will be visible once we use it as a background. You will, however need to adjust image brightness and contrast.

- 17 Close the preview window, then click Open to add the image as a background to the scene.



18 Press M to open the Material Editor.

19 Drag the Map button (its label now includes “sky.jpg”) from the Environment And Effects dialog, and drop it on an unused sample slot in the Material Editor.



When prompted, choose Instance so the Material Editor shows an instance of the same map.

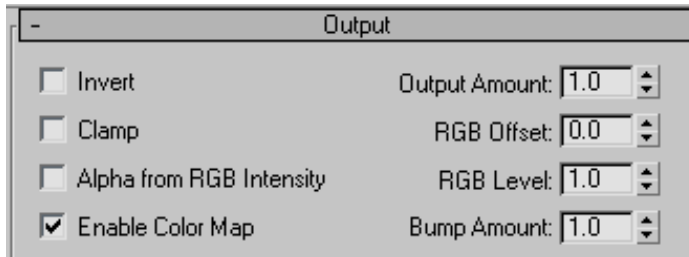
20 Close the Environment And Effects dialog, then render the scene.



The scene exposure controls have darkened the image, but the features of the clouds are somewhat washed out.


Now you will use the Material Editor to adjust the color and contrast of the bitmap to compensate for the low-exposure nighttime scene.

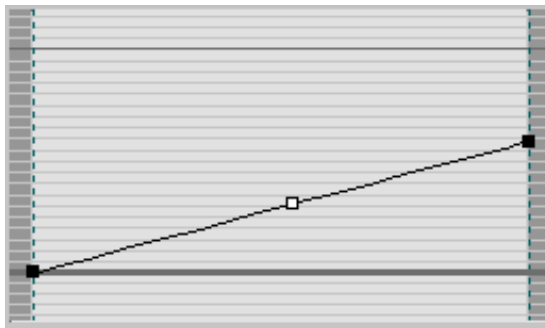
- 21 On the Material Editor > Output rollout, turn on Enable Color Map.



- 22 On the Color Map graph, drag the right anchor point downward, as shown in the next illustration.



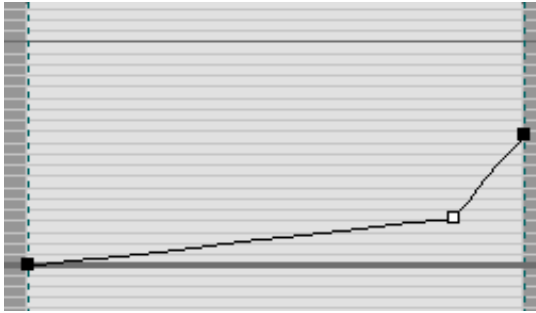
- 23  In the Color Map group, click the Add Point button, then click the midpoint of the Color Map graph.



24



Click the Move button and drag the new map point down and to the right as shown in the next illustration.



25

Render the image again.



The scene might seem too dark at first, but a closer look shows that the color map has generated more contrast, emphasizing features that are still visible in the underexposed image.

- 26 Right-click any viewport, select Unhide All from the quad menu, then render the Camera-Terrace viewport.



This completes the rendering of the villa at night. If you wanted to further reduce the amount of anti-aliasing in the scene, you could move the Rendered Frame window > Image Precision and Final Gather Precision sliders one notch to the right. However, increasing these settings requires a great deal of render time.

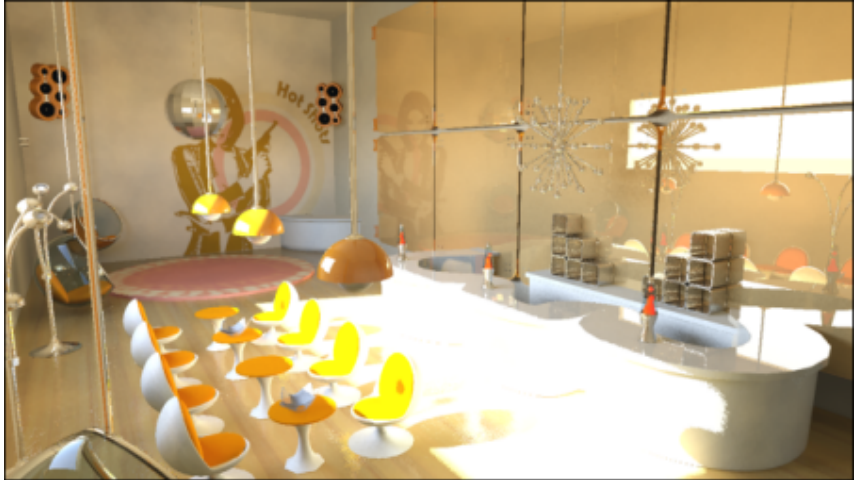
Summary

In this tutorial, you learned how to use photometric lights to illuminate a night scene. You specified the color of light sources and defined how shadows were cast. You also learned how to take a background image, adjust its brightness and contrast, and apply it as a background to the night scene.

Daylight Systems and Reflective Materials

In this tutorial, you create a daylight system and combine it with a Sky Portal object and an exposure control preset to illuminate the architectural scene of

a retro-style lounge. You will also use the materials editor to bring reflective surfaces in the scene to life. The techniques are similar to techniques in [Using Sky Portal and Photographic Exposure Control](#) on page 431, but in this tutorial, you are working with a more detailed interior.



In this tutorial, you will learn how to:

- Use daylight systems to illuminate scenes.
- Use the Sky Portal object to gather skylight and apply it to an interior scene.
- Set scene exposure and apply exposure presets.
- Set reflective, refractive, and diffusion properties of the Arch & Design material.
- Set scene illumination based on geographic location, orientation, and time of day.

Skill level: Intermediate

Time to complete: 1 hour

Adding Daylight Illumination

Start by adding daylight illumination to the lounge scene.

Set up the lesson:

- 1  On the Quick Access toolbar, click the Open File button, navigate to the `\scenes\lighting_and_rendering\lounge_scene` folder, then open the scene file `loungebar_tutorial_start.max`.



- 2 Activate the Camera01 viewport, then press F9 to render the scene.






Default lights provide basic illumination and textures and materials have been applied, but the rendered interior appears flat and not very realistic. You need to add daylight to the scene. This will be generated by a daylight system comprising two mental ray photometric light sources:

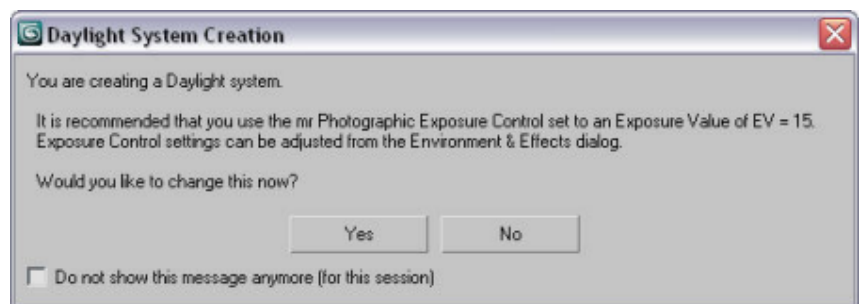
- mr Sun, which simulates direct light from the sun.
- mr Sky, which simulates indirect light created by the scattering of sunlight in the atmosphere.

These two light sources will be accompanied by the mr Physical Sky environment shader, which establishes the physical representation of the sun and sky.

Create the daylight system:

- 1   On the Create panel, click the Systems button to turn it on.

- 2  On the Object Type rollout, click Daylight.
The Daylight System Creation dialog displays, recommending an optimum exposure value for mental ray.

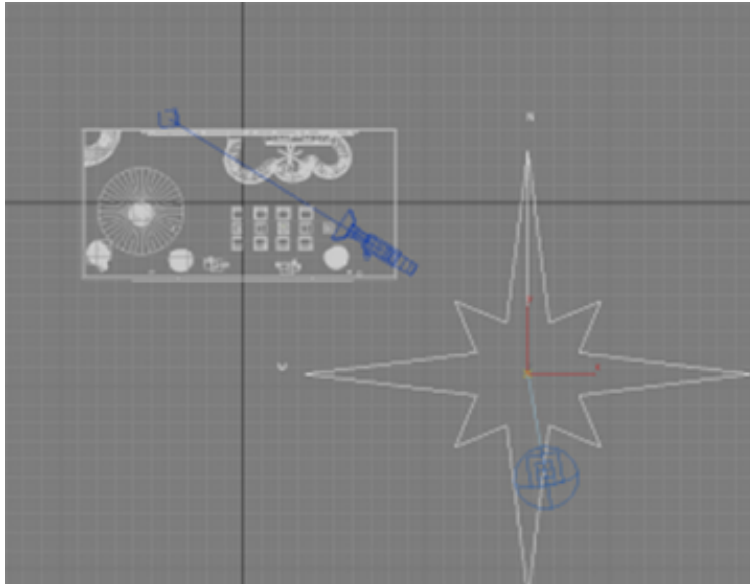


- 3 Click Yes to accept the exposure control settings.
- 4 In the Top viewport, click anywhere outside of the wireframe scene and drag in any direction to create a compass rose.
- 5 Release the mouse button.

As soon as the mouse button is released, the daylight object is created and the mental ray Sky dialog displays, asking you if you want to create an mr Physical Sky environment map.

The mr Physical Sky environment map is based on a gradient, whose appearance in the background of a scene will change depending on the position of the sun at any given time of day. Click Yes to accept the map.

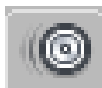
- 6 Move the mouse to position the sun object above ground level. The height doesn't matter. This simply distances the Daylight object from the compass rose, and makes it easier to select the sun by a click, later on.



- 7 Click once to set the Daylight object position, and then right-click to end Daylight creation.

Set the time and location of the light source:

Now you will reposition the Daylight object so that its position in the sky corresponds to the geographic location of the scene.

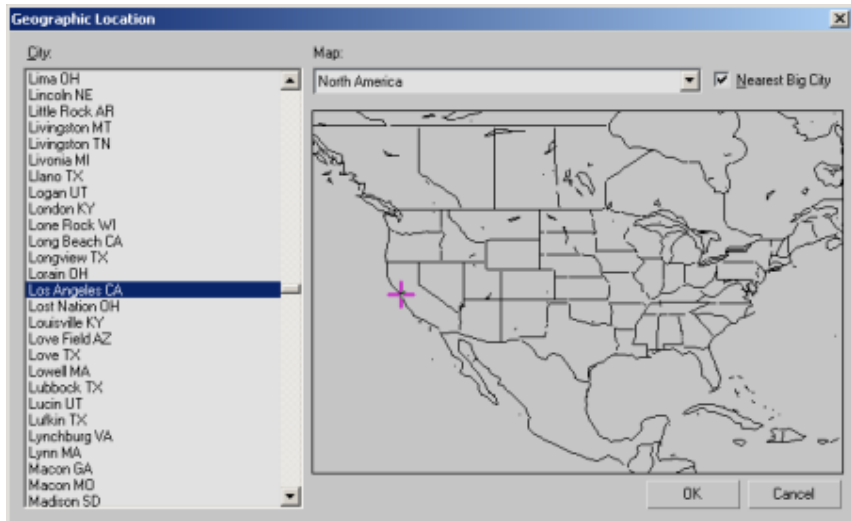


- 1 With the Daylight object still selected, go to the Motion panel.

- 2 On the Motion panel > Control Parameters rollout > Location group, click Get Location.

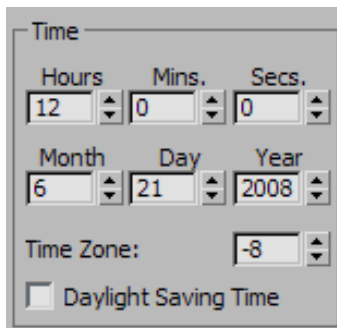
The screenshot shows a software interface with a 'Control Parameters' rollout. It contains several sections: 'Manual Override' with 'Azimuth' (170) and 'Altitude' (75) fields; a 'Time' section with 'Hours' (12), 'Mins.' (0), 'Secs.' (0), 'Month' (6), 'Day' (21), 'Year' (2007), 'Time Zone' (-8), and a 'Daylight Saving Time' checkbox; a 'Location' section with a 'Get Location...' button (circled in red), a text field containing 'San Francisco, CA', 'Latitude' (37.795), and 'Longitude' (122.394); and a 'Site' section with 'Orbital Scale' (64.878m) and 'North Direction' (-0.0).

- 3 In the Geographic Location dialog, choose Los Angeles, CA as the physical location of the scene, then click OK.



The compass rose and Daylight object are repositioned to scene coordinates that simulate the real-world latitude and longitude of Los Angeles, California.

The Control Parameters > Time group contains controls that let you modify the date and time of day, which also affects the sun position. For now, leave these values at their default settings: noon on June 21st, the year's midpoint.



- 4 Activate the Camera01 viewport and press F9 to render the scene.





The scene is too dark: not enough photons are entering the scene to properly illuminate the interior.

Using a Sky Portal and Exposure Control

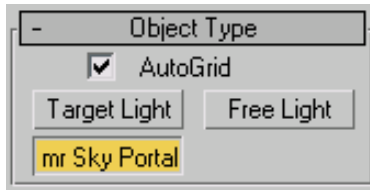
You will now use a Sky Portal to gather existing sky lighting and direct its flow to the interior of the scene.

NOTE The Sky Portal generally requires less render time than the Global Illumination option. It is an effective alternative to quickly visualize a scene.

Add the Sky Portal:

1   On the Create panel, click Lights.

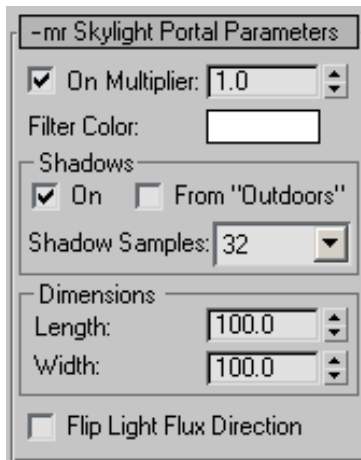
2 On the Object Type rollout, click mr Sky Portal, and then turn on Autogrid.



- 3 In the Front viewport, choose Smooth + Highlights, then maximize the viewport by pressing Alt+W.
- 4 Create the Sky Portal by dragging diagonally from the upper-left corner of the window to the lower-right corner, until the entire window is encompassed by the box.
The Sky Portal should not be much larger than the window.
- 5 Right-click to complete creating the Sky Portal, then press Alt+W to view all four viewports again.



- 6 With the Sky Portal object still selected, go to the Modify panel. In the mr Skylight Portal Parameters rollout > Shadows group, make sure Shadows is on and set Shadow Samples to 32.



Increasing the Shadow Samples value improves shadow accuracy, but also increases rendering time.

- 7 Activate the Camera01 viewport and press F9 to render the scene.

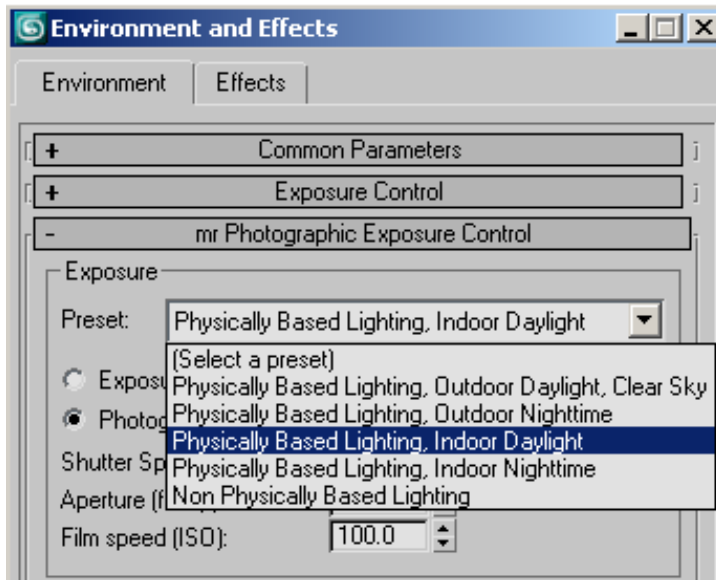


The scene is a little better than before, but it is still too dark. You need to adjust the exposure to get a good result.

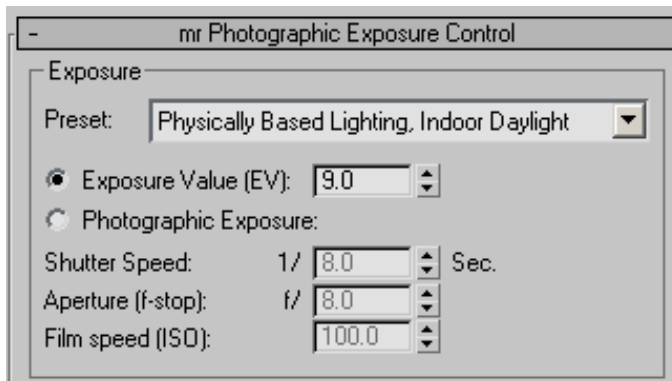
Set exposure:

Proper exposure can improve mid-tones and shadows, and produce more realistic colors.

- 1 On the Rendering menu, choose Exposure Control to open the Environment And Effects dialog.
- 2 On the mr Photographic Exposure Control rollout > Exposure group > Preset drop-down list, choose Physically Based Lighting, Indoor Daylight.



- 3 Choose Exposure Value (EV), and change the value from 10.0 to **9.0**.
Lower exposure values add more light to the scene.



- 4 Close the Environment And Effects dialog.
- 5 Press F9 to render the scene.

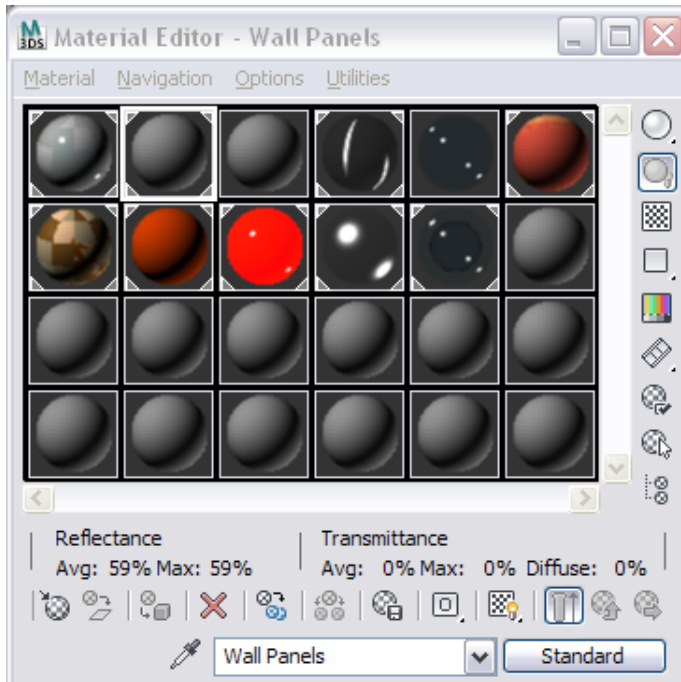


mental ray re-renders the lounge using an exposure preset suitable for indoor illumination. The result is much improved.

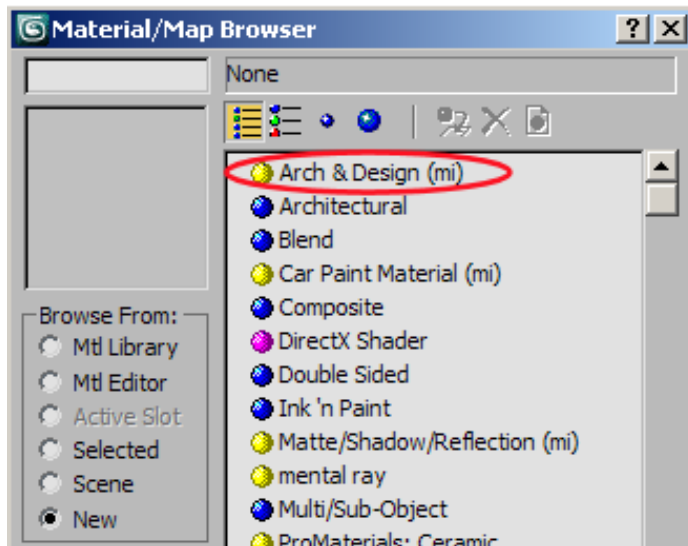
Add an Arch & Design material:

Despite all that you've done to this point, the scene still looks a little dull. In this part of the lesson, you'll take advantage of the mental ray Arch & Design material to add more interesting lighting effects. You'll switch the original wall panel material on the wall behind the bar with that of frosted glass, then optimize its reflective attributes.

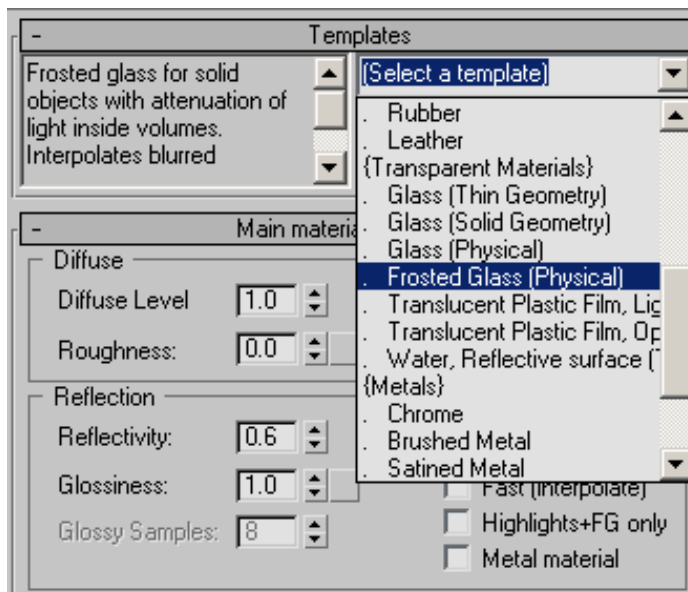
- 1 Select any wall panel behind the bar, in any viewport.
- 2 Press M to open the Material Editor.



- 3 The material currently applied to the wall panels is indicated by a white triangle at each corner of its sample slot. If this isn't already active, click it to activate it.
- 4 Click the button labeled Standard to display the Material/Map Browser.
- 5 Choose Arch & Design (mi) from the list, then click OK.

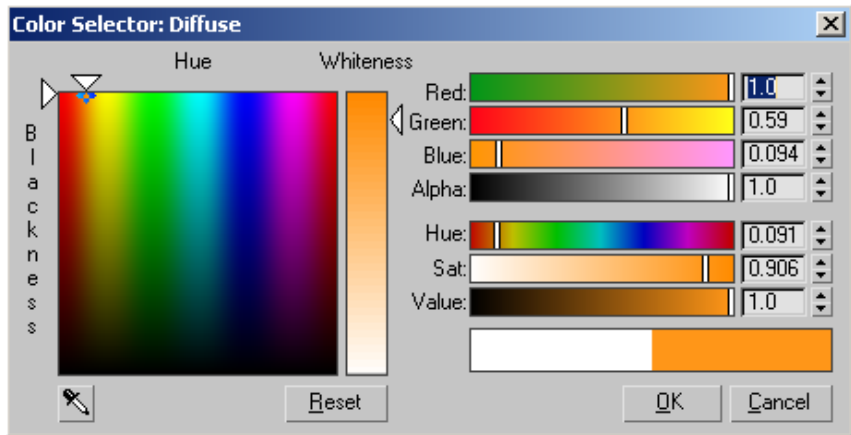


- 6 On the Material Editor > Templates rollout, choose Frosted Glass (Physical).

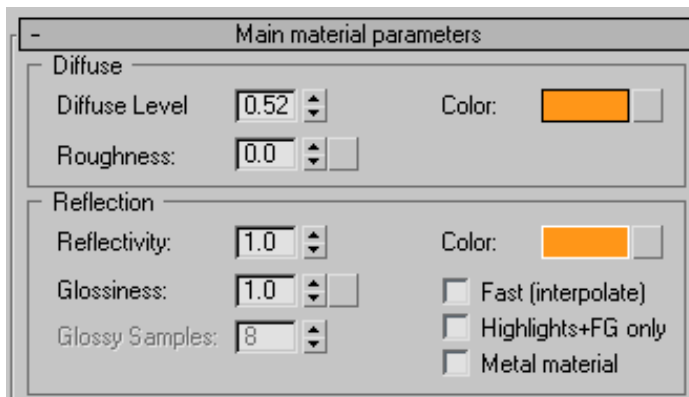


The glass properties are displayed in the Main Material Parameters rollout. Here, you will customize the glass material by adjusting its light diffusion, refraction, and reflection attributes.

- 7 In the Main Material Parameters rollout > Diffuse group, click the Color switch to open the Color Selector. Use the controls to choose an orange color, then click OK.

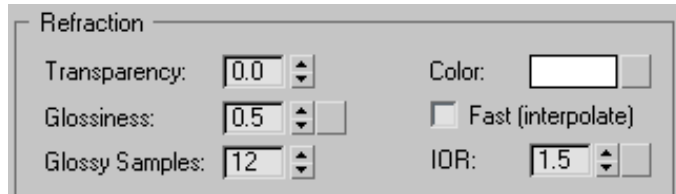


- 8 Drag the orange color swatch from the Diffuse group to the color swatch in the Reflection group. A Copy Or Swap Colors dialog appears: click Copy.



The light diffusion and reflection properties of the wall panel material now simulate tinted glass.

- 9 Right-click the Refraction group > Transparency spinner arrows to set refractive transparency to **0.0**.

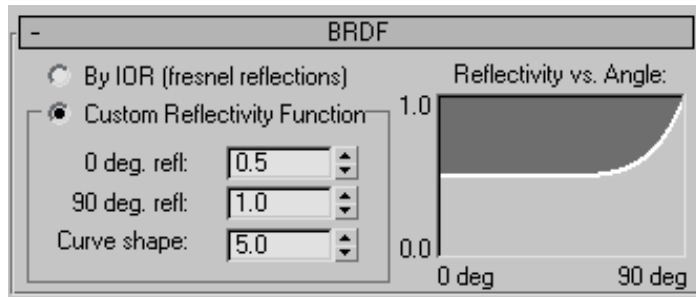


At zero, light will bounce off the material surface rather than penetrate it. This results in more sharply-defined reflected images in the glass.

- 10 Scroll down to the BRDF rollout.

BRDF, which stands for *bidirectional reflectance distribution function*, is a property that lets the material's reflectivity be determined by the angle from which the object surface is viewed.

- 11 Choose Custom Reflectivity Function to activate these controls. In the 0 deg refl. field, specify a value of **0.5**.



Viewing material reflections using the By IOR setting is fine if you are viewing reflective surfaces straight on. The Custom Reflectivity Function option is a better choice, however, since it better calculates reflectance from the 45-degree position of the camera.

- 12 Activate the Camera01 viewport and press F9 to render the scene.



The newly-applied wall panel material has added considerable interest to the scene.

Changing the Time of Day

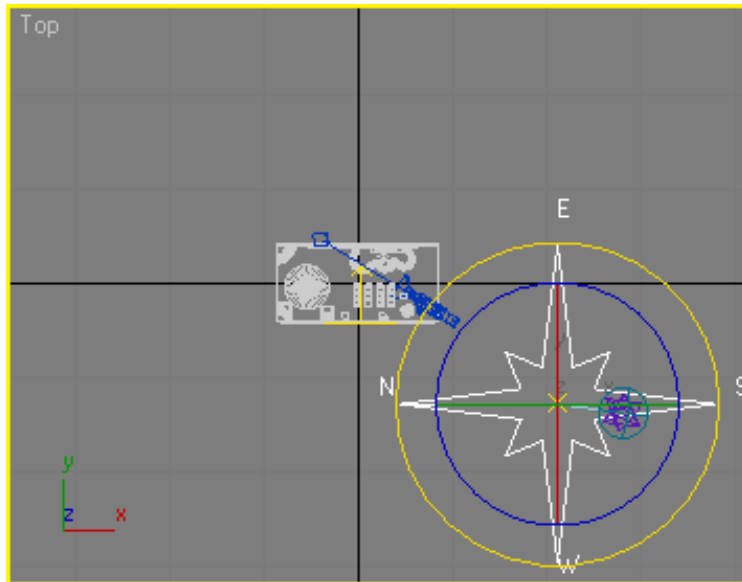
Despite having changed the wall panel material to glass, the scene is still fairly dim. In your latest render, notice how the light is cast almost directly downward, illuminating just the left-most fringe of the lounge floor. This is the result of two problems: it is high noon in Los Angeles and the architectural scene is not oriented correctly. In this lesson, you'll change the scene so that the window is facing the proper direction: west. You'll also reset the time of day to produce a late-afternoon ambience.

Adjust scene orientation and time of day:


- 1 In the Top viewport, click the compass rose to select it.




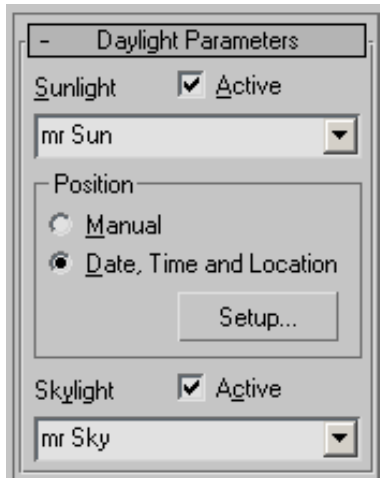
- 2 On the toolbar, click Select And Rotate.
- 3 Rotate the compass 90 degrees counterclockwise.



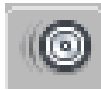
The western point of the compass rose should now point downward, so that the lounge window, where daylight illumination enters the lounge, faces west.

- 4  On the main toolbar, click the Select Object button, then select the *Daylight01* object.

- 5  On the Modify panel > Daylight Parameters rollout, click the Setup button.



This takes you to the daylight controls on the Motion panel.



- 6 On the Motion panel > Control Parameters rollout > Time group > Hours spinner controls, click the up-arrow button to increment the hour setting.

- Control Parameters

☐ Manual Override

Azimuth: 170 Altitude: 75

Time

Hours: 12 Mins.: 0 Secs.: 0

Month: 6 Day: 21 Year: 2007

Time Zone: -8

☐ Daylight Saving Time

Location

Get Location...

San Francisco, CA

Latitude: 37.795

Longitude: 122.394

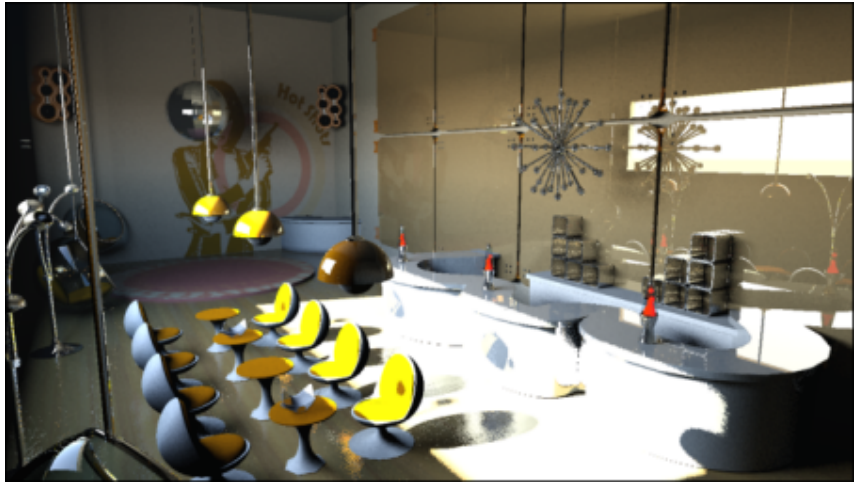
Site

Orbital Scale: 64.878m

North Direction: -0.0

Notice how the shadows in the lounge scene update as you change the time of day.

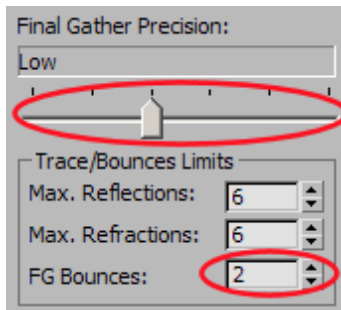
- 7 Continue incrementing the Hours value until you reach **16** (4 P.M.).
- 8 Right-click the Camera01 viewport, and press F9 to render the scene.



Add final gather:

Your scene is almost done. All you need to do now is add final gather to better distribute light entering the lounge. Final gather generates a specified number of light bounces.

- 1 Make sure the Camera01 viewport is active.
- 2 In the Rendered Frame Window > Include In Render group, move the Final Gather precision slider to Low and leave Bounces set to its default value of 2. (More bounces can improve accuracy, but they take longer to render.)



- 3 Press Render.



Your rendered scene should resemble this illustration.

You can compare your result by opening and rendering the scene file *loungebar_tutorial_final.max*.

Summary

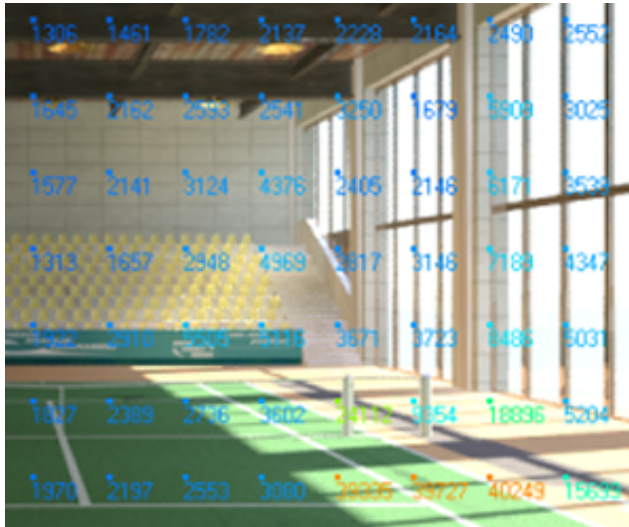
This tutorial provided another demonstration of the mr Sky Portal, this time in an interior scene that has a lot of shiny, reflective surfaces.

Indoor Lighting Analysis

The 3ds Max Design lighting analysis feature can help designers and other specialists evaluate how interior or exterior space is illuminated at different times of the day, or how interiors are affected by various man-made lighting systems.

In this tutorial, you will use 3ds Max Design Light Meter objects to evaluate how light intensity from a daylight source affects the lighting of an indoor tennis court.

You will export the Light Meter data to an Excel file, making it available for analysis by third parties. You'll then render the scene and overlay the image with a layer of Light Meter readings for a more visual representation of lighting intensity.



In this tutorial, you will learn how to:

- Use the Lighting Analysis Assistant to prepare a scene for lighting analysis
- Create a daylight system
- Use a weather data file to set daylight system light intensity
- Create Light Meters and adjust their sampling point density
- Process Light Meters and adjust the range of their color feedback
- Convert Light Meter data to spreadsheet format
- Overlay Light Meter data onto a rendered image of the scene

Skill level: Intermediate


Time to complete: 1 hour

Prepare the Scene



The scene consists of an indoor tennis court. Materials have already been applied to its surfaces.

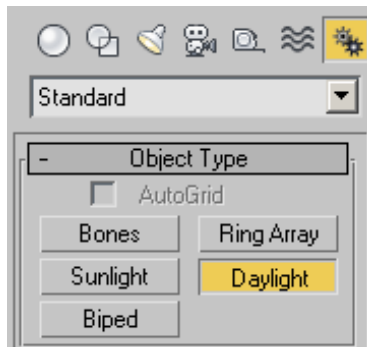
First, you will create a daylight system. (If the model were imported from AutoDesk Revit, a daylight system would already be present.) You'll then perform a test render to check image quality.

Create a daylight system:

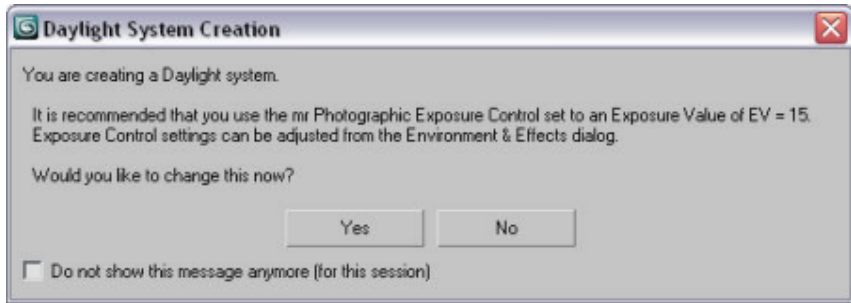
- 1  On the Quick Access toolbar, click the Open File button, navigate to the `\scenes\lighting_and_rendering\lighting_analysis` folder, then open the scene file *arena_start.max*.

NOTE If a dialog asks whether you want to use the scene's Gamma And LUT settings, accept the scene Gamma settings, and click OK. If a dialog asks whether to use the scene's units, accept the scene units, and click OK.

- 2   On the Create panel, click Systems.



- 3 On the Object Type rollout, click Daylight.
The Daylight System Creation dialog displays, recommending an optimum exposure control setting for mental ray.



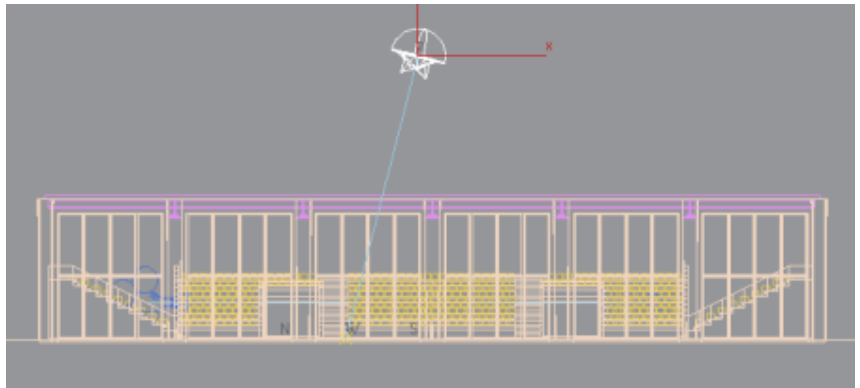
Exposure Control is comparable to the shutter and aperture settings of a camera. It adjusts the brightness and contrast in a rendered image. It does *not* affect the actual amount of lighting in a scene.

- 4 Click Yes to accept the “mr Photographic” Exposure Control.
- 5 In the Top viewport, click anywhere over the scene and drag slightly in any direction to create a compass rose.
- 6 Release the mouse button.

The mental ray Sky dialog opens, asking if you want to automatically create an mr Physical Sky environment map for the background of your scene.

NOTE 3ds Max Design displays this dialog only if you are using the default set of tool options. To revert to this default setting, from the Customize menu choose Custom UI And Default Switcher, and on the Choose Initial Settings dialog > Initial Settings For Tools Options, choose DesignVIZ.mentalray.

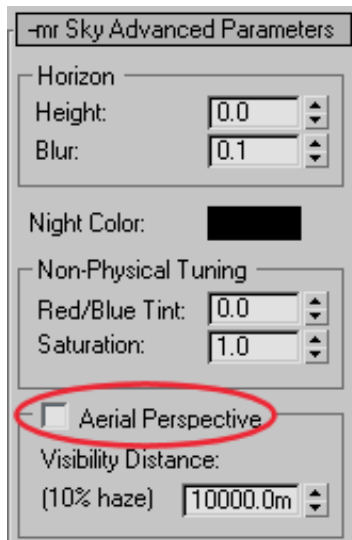
- 7 Click Yes.
The sky map is cosmetic, and while it will create a nicely shaded background to the scene exterior, it will not affect scene interior lighting levels in any way.
- 8 Move the mouse upward to position the daylight object in the sky. The exact height of the daylight object in the sky is not important, as long as it is above the model. Daylight object height has no affect on scene lighting or rendering.



- 9 Click once to set the Daylight object position.
- 10 In the Top viewport, right-click to end Daylight creation.



- 11 Go to the Modify panel, scroll down to the mr Sky Advanced Parameters rollout, and turn off Aerial Perspective.



This option, which simulates atmospheric haze and reduces the visibility of distant objects, can interfere with lighting analysis.

Do a test render:

- 1 Activate the camera viewport.

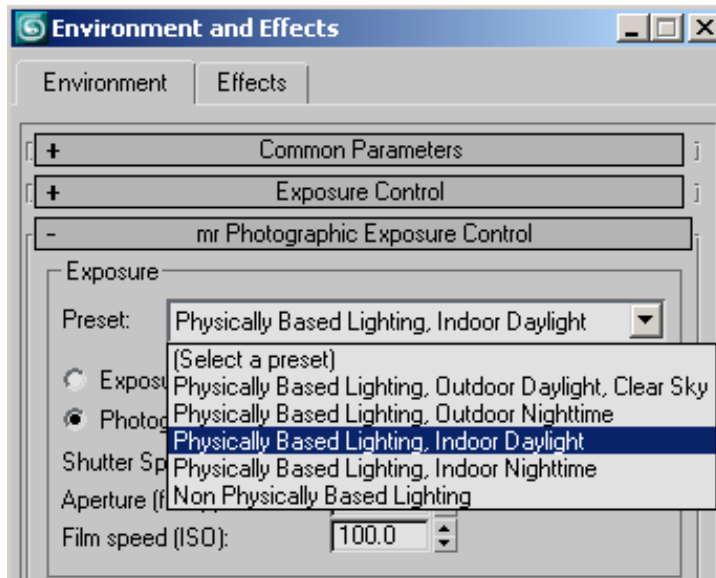
NOTE Lighting analysis is always performed from a camera's perspective and therefore requires a camera object in the scene.

- 2 From the Rendering menu, choose Exposure Control to open the Environment And Effects dialog.
- 3 On the Exposure Control rollout, click Render Preview.
The preview thumbnail takes a moment or two to render. The resulting image is quite dark because the default Exposure Value of 15 is not suitable for an indoor scene.

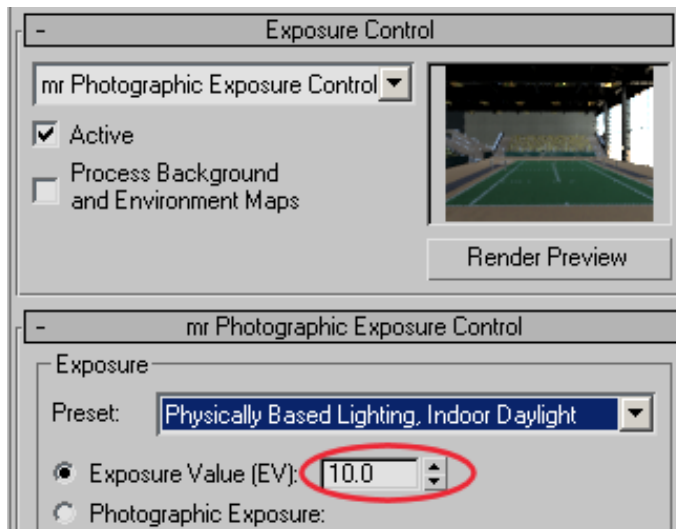


**Render preview with
Exposure Value set to
15.**

- 4 From the mr Photographic Exposure Control rollout > Exposure group > Preset drop-down list, choose Physically Based Lighting, Indoor Daylight.

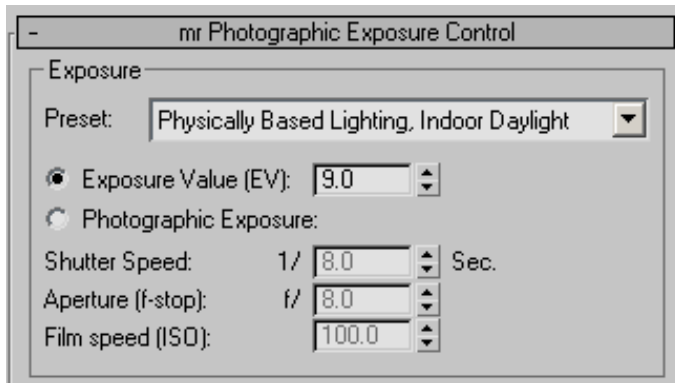



The Exposure Value changes from 15 to 10 and the render preview thumbnail appears somewhat lighter.

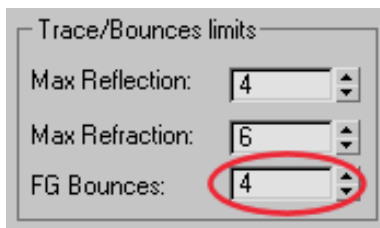


- 5 Change the Exposure Value (EV) from 10.0 to 9.0.

Specifying even lower exposure values causes the scene to appear brighter. You will now enhance scene illumination by adding light bounces.



- 6  On the main toolbar, click Rendered Frame Window.
- 7 In the Trace/Bounces Limits group, set FG Bounces to 4.

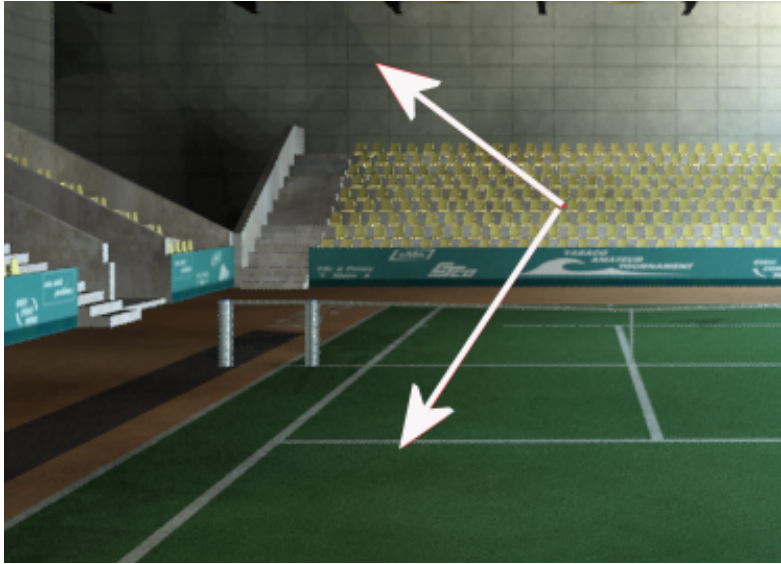


This increases the number of times a ray of light bounces on object surfaces in a scene. Values of 4 through 7 are the most effective. Values under 4 produce less noticeable results, while values over 7 require a great deal of render time, with limited added benefit.

- 8 On the Environment And Effects dialog > Exposure Control rollout, click Render Preview again to see how the added bounces have brightened up the interior of the model.



- 9 Click Render (or press F9) to render a full-size frame.



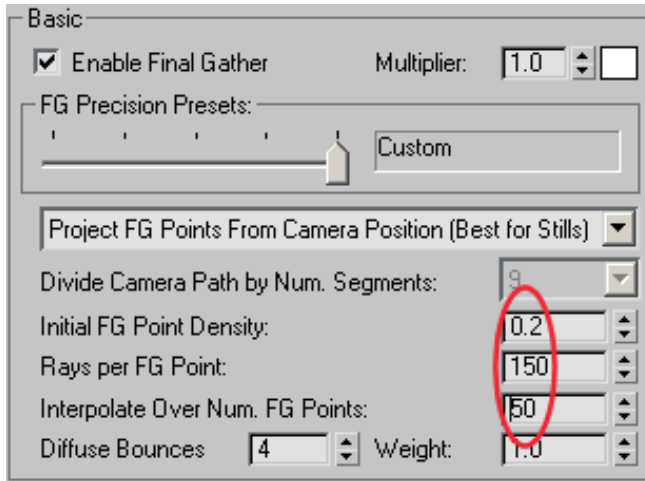
Artifacts present in the scene

The model renders well, but there are some noticeable artifacts on the back wall as well as on the court floor near the stands to the left.

You could improve the render quality by adjusting the Image Precision and Final Gather Precision sliders in the Rendered Frame Window. Each slider position represents a preset group of Final Gather settings. In this lesson, however, you will perform your adjustments manually.




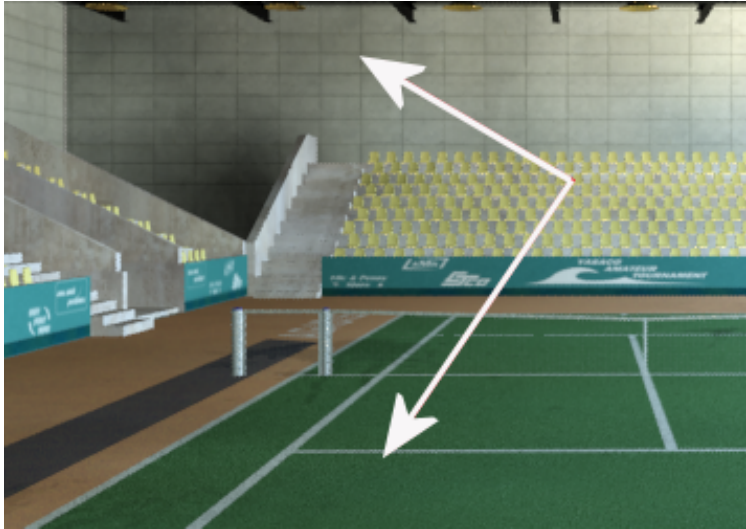
- 10 On the Rendered Frame Window toolbar, click Render Setup.
- 11 In the Render Setup dialog > Indirect Illumination tab > Final Gather rollout > Basic group, set Initial FG Point Density to **0.2**, Rays Per FG Point to **150**, and Interpolate Over Num FG Points to **50**.



These values will eliminate most of the noise artifacts in the scene while ensuring a reasonably fast calculation time.

To learn more about Final Gather and each of its settings, refer to the 3ds Max Design Help.

- 12  In the Rendered Frame Window make a clone of the rendered image, then press F9 to render again.
This time, your image will take roughly three times as long to render.
- 13 Compare the two images to see how your edits to Final Gather have affected image quality.
Some artifacts remain, but the overall image is much improved.



Artifacts reduced after adjustments made to Final Gather


- 14 Close the rendered frames and all dialogs.

Add a Light Meter

In this lesson, you will use the Lighting Analysis Assistant to check your scene's render settings, then make the needed adjustments so that lighting analysis can take place.

Next, you'll create invisible helper objects called Light Meters. These objects perform the lighting analysis by calculating luminance over a specific area in a scene. Light Meters can calculate direct luminance, indirect luminance, or a combination of the two.

Open the Lighting Analysis Assistant and update the seat material:

- 1  Continue working with the scene from the previous lesson, or open the scene *arena_01.max*.

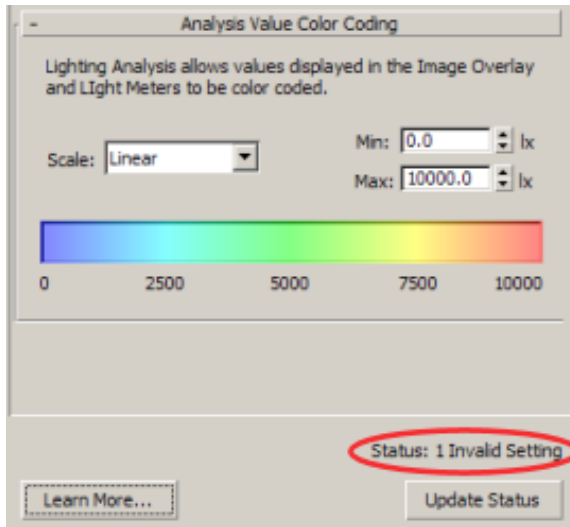
NOTE If a dialog asks whether you want to use the scene's Gamma And LUT settings, accept the scene Gamma settings, and click OK. If a dialog asks whether to use the scene's units, accept the scene units, and click OK.

- 2 From the main menu, choose Lighting Analysis > Lighting Analysis Assistant.

The Lighting Analysis Assistant dialog opens. This is where you activate and edit the tools used to analyze lighting in a scene.

NOTE The Lighting Analysis Assistant is available in 3ds Max Design only.

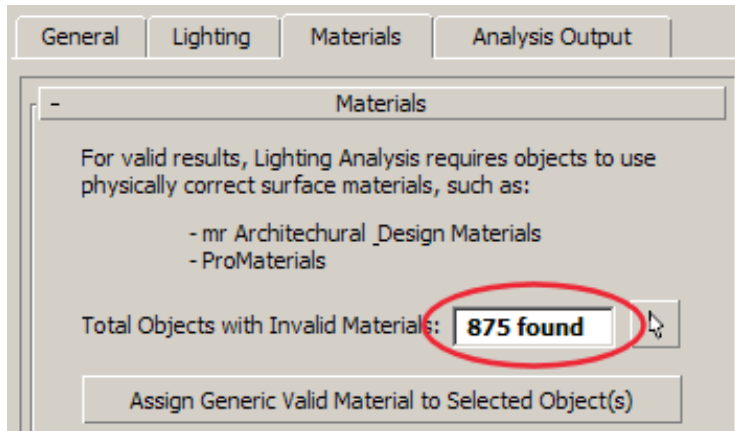
The status line at the bottom of the dialog indicates the number of invalid settings, if any, that you must correct.



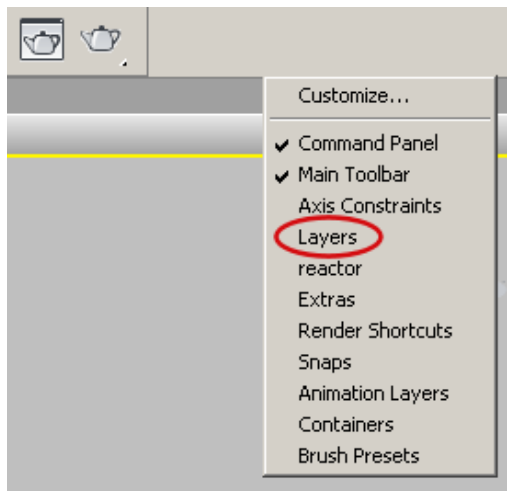
- 3 Go to the Materials tab.

The Lighting Analysis tool requires that all objects in the scene use physically correct surface materials. Only objects with materials with the mr Arch & Design material or materials from the ProMaterials library are permitted. All other materials are considered invalid. Objects with no material assigned are also treated as invalid.

The Materials rollout > Total Objects With Invalid Materials box indicates the presence of 875 invalid materials in the scene, which you must now correct.

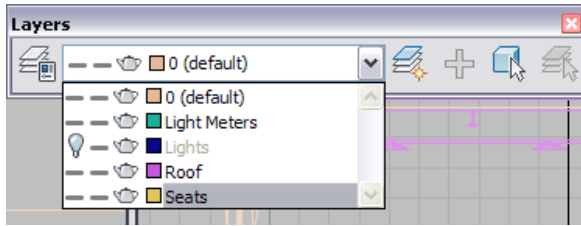


- 4 Click the arrow button next to Total Objects With Invalid Materials.
This selects all objects in the scene that have an invalid material. Most of the problem objects are the arena seats.
- 5 Right-click an empty gray area of the main toolbar and choose Layers.

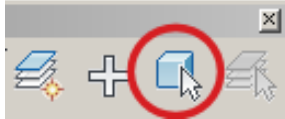


3ds Max Design opens the Layers toolbar. A layer called Seats has already been created for you.

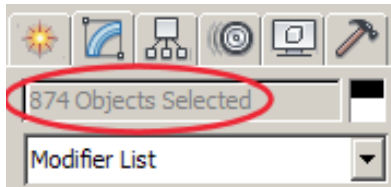
- 6 Open the layer list and choose Seats from the list.



- 7 On the Layers toolbar, click Select Objects In Current Layer.

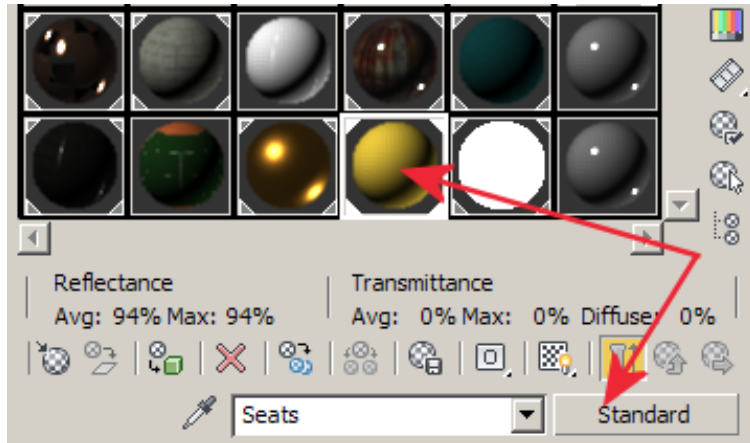


All seat objects are selected. The Modify panel shows 874 objects selected, just one short of the 875 total number of objects with invalid materials.

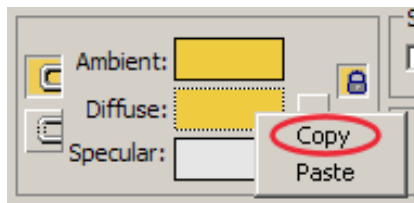


- 8 Press M to open the Material Editor.

The Seats sample slot is active, indicating that a material has been applied to the seat objects. However, the Material Editor also indicates that the material used is Standard, not physically-based, as is required for lighting analysis.

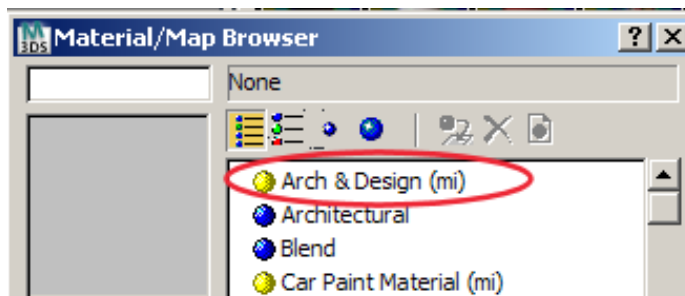


- 9 On the Blinn Basic Parameters rollout > Diffuse option, right-click the color swatch and choose Copy.

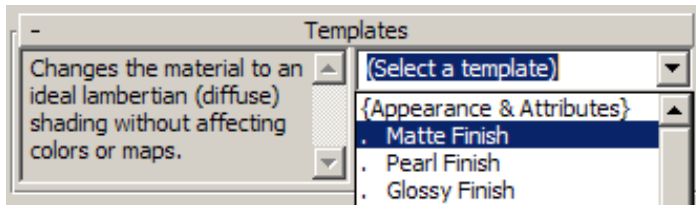


This saves the color for use in the new material you will now apply to the seats.

- 10 Click the Material Type button (now labeled “Standard”) to open the Material/Map Browser.
- 11 Click the Arch & Design (mi), then click OK.



- 12 On the Templates rollout, choose Matte Finish from the list.



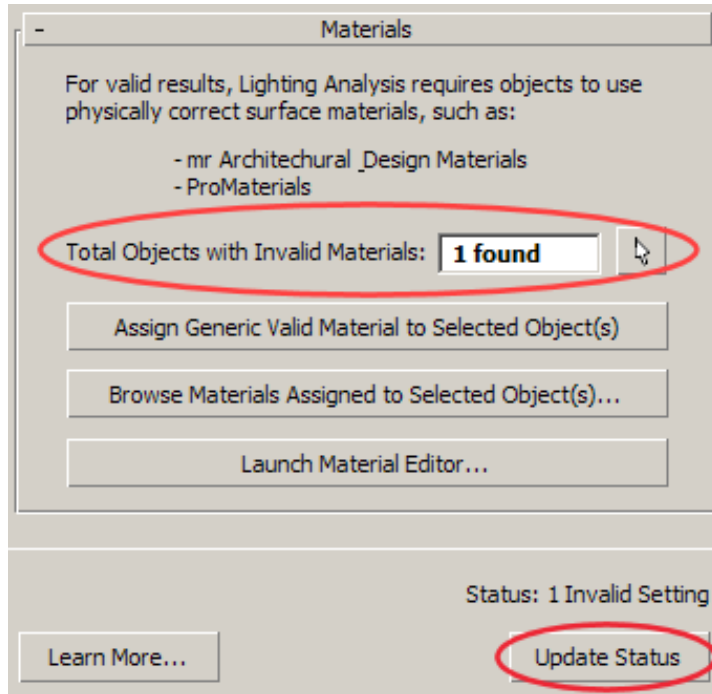
This gives the material a neutral reflectivity.

- 13 On the Main Material Parameters rollout > Diffuse group, right-click on the color swatch and choose Paste.




This copies the color from the Standard material to the Arch & Design material.

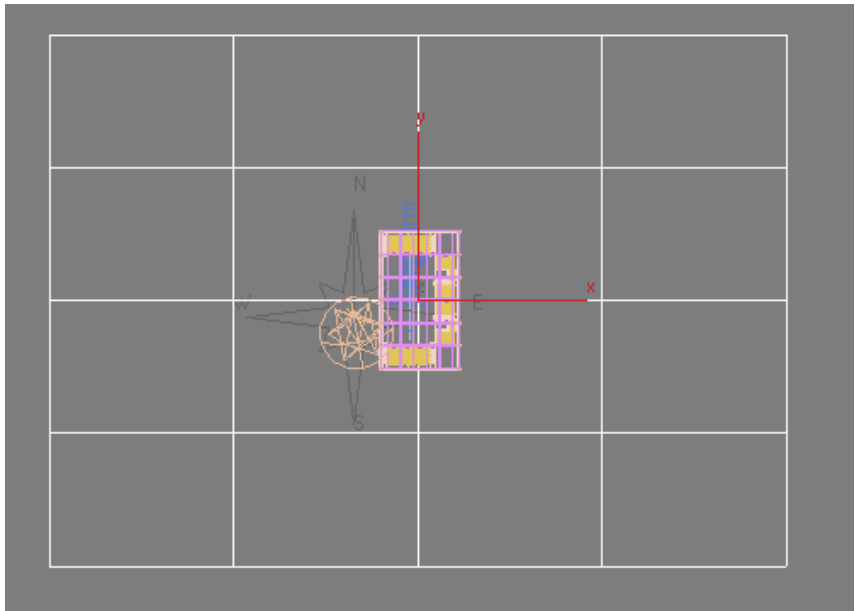
- 14 On the Lighting Analysis Assistant dialog, click Update Status.



The Total Objects With Invalid Materials box updates to show only one remaining object with an invalid material.

Update the grid material:

- 1  Activate the Top viewport and click Zoom Extents.
- 2 On the Lighting Analysis Assistant dialog > Materials rollout > Total Objects With Invalid Materials, click the Arrow button.
The grid object, which is the ground on which the indoor arena stands, is selected.

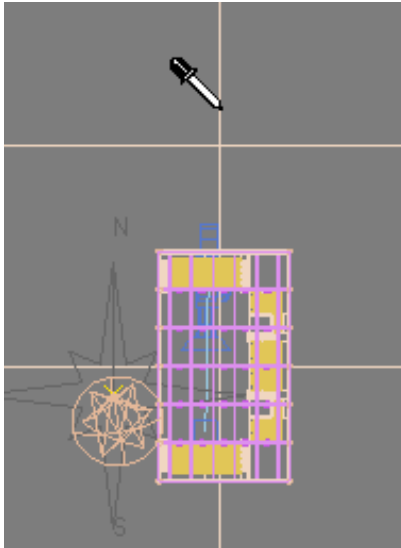


Top view of scene with grid object selected

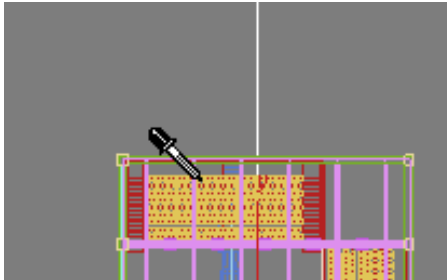
- 3 On the Material Editor, activate an unused sample slot.



- 4 On the Material Editor, click Pick Material From Object and position the eyedropper cursor over a grid line on the ground object.

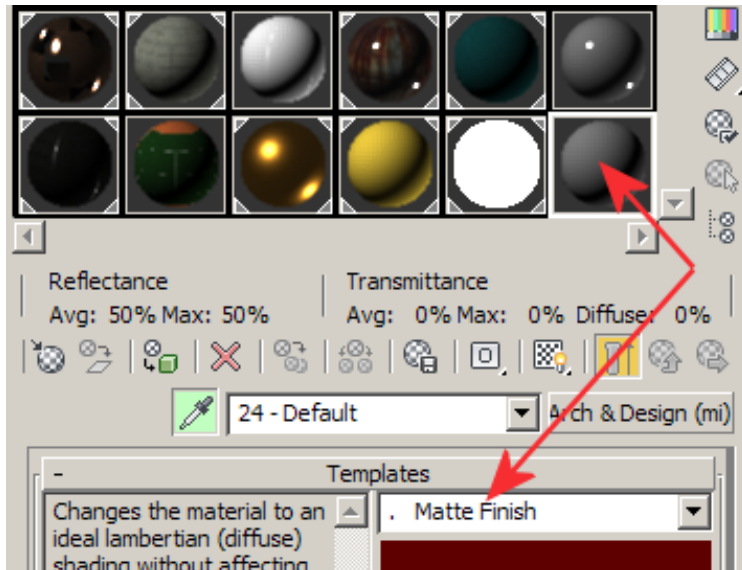


The eyedropper barrel is empty, indicating that no material exists. If you position the eyedropper over the arena model it appears full, indicating that material is present.

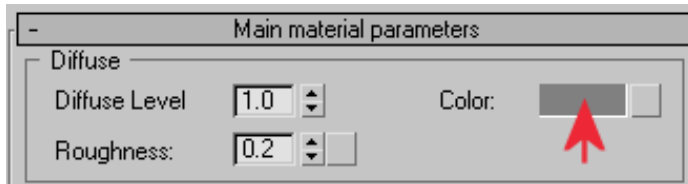


Because the ground object has no material applied to it, it is considered as having an invalid material.

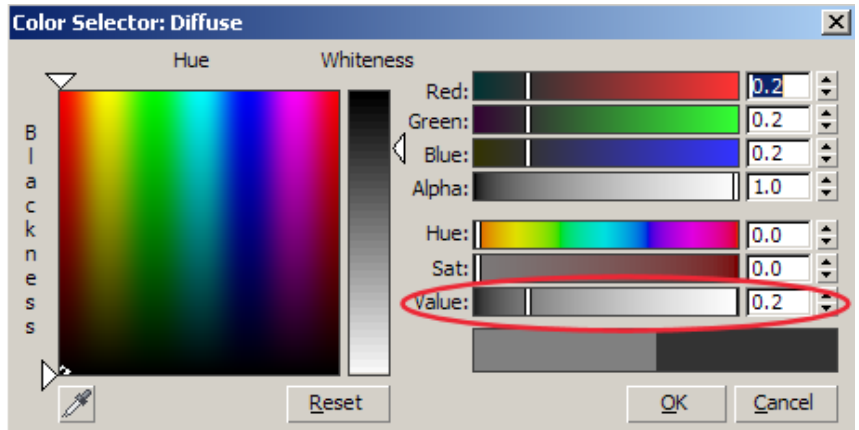
- 5 On the Templates rollout, choose Matte Finish from the list.



- 6 On the Main Material Parameters rollout > Diffuse group, click the color chip.



- 7 On the Color Selector, change the Value to 0.2.



This gives the material low reflectivity.

- 8  Click Assign Material To Selection to apply the material to the ground object.

- 9 On the Lighting Analysis Assistant, click Update Status.

The Status line should display “0 Invalid Settings”.


Now that you have the scene properly set up, you must create a Light Meter. For lighting analysis to take place, at least one Light Meter must be present in the scene.

- 10 Close the Material Editor.

Create a Light Meter:

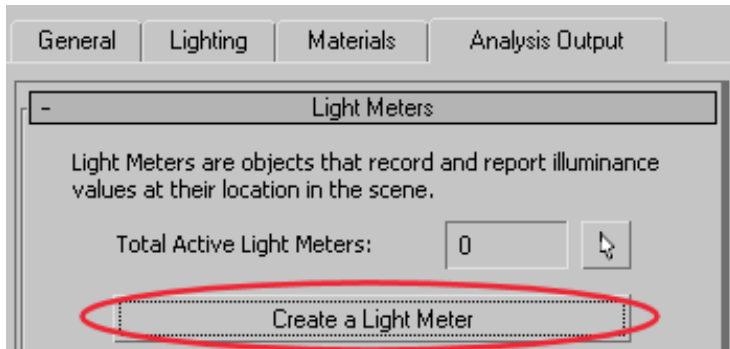
- 1 From the Layers toolbar > Layers list, choose Light Meters.
Any light meter you now create will be added to this layer for easy selection later on.

- 2 Press Alt+W to maximize the Top viewport.

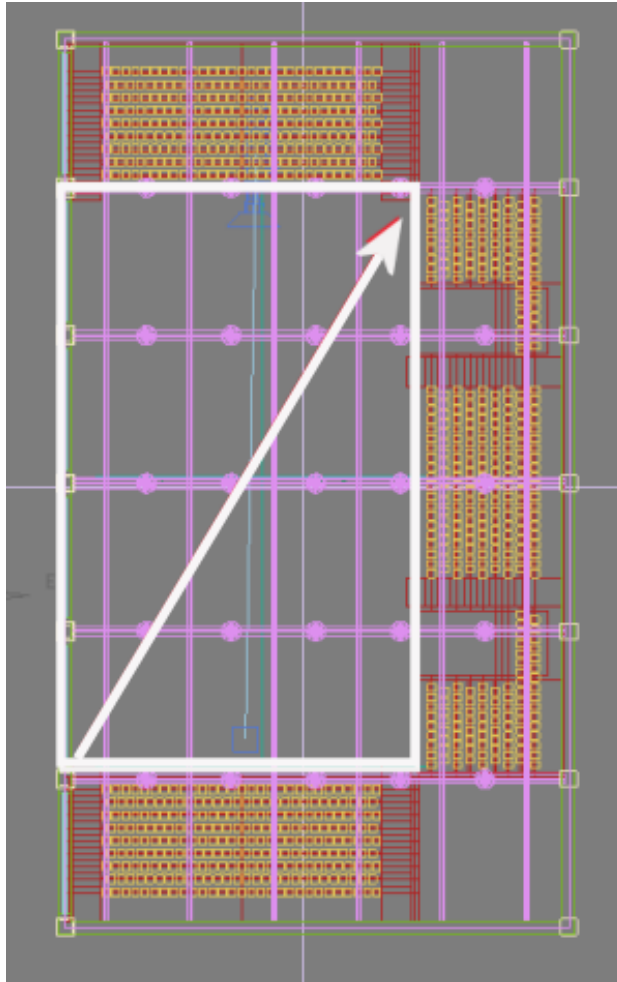
- 3  Zoom in so you can see the floor plan of the arena.

Now you will create a Light Meter for the tennis court area.

- 4 On the Lighting Analysis Assistant dialog, go to the Analysis Output panel and on the Light Meters rollout, click Create A Light Meter.




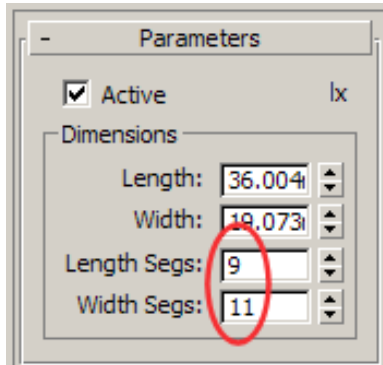
- 5 In the Top viewport, click on the bottom left corner of the tennis court and drag diagonally until the Light Meter gizmo covers the entire surface of the court.



Tennis court surface to receive lighting analysis

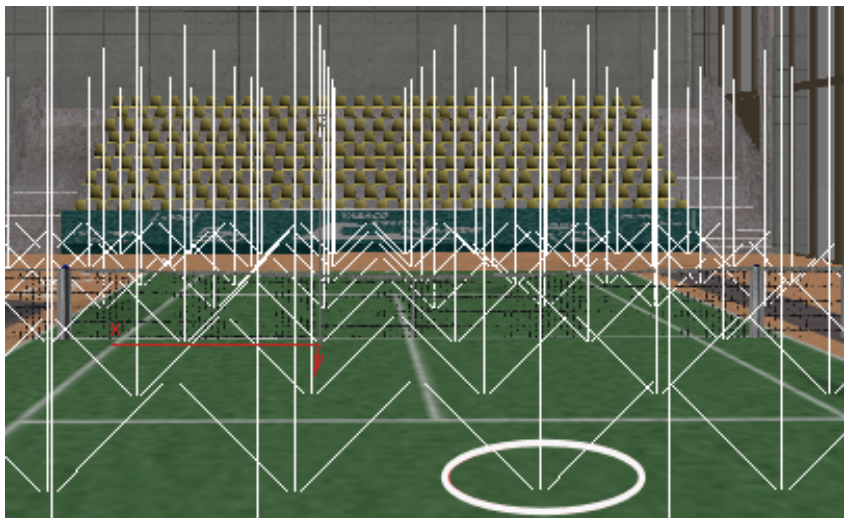
- 6 Right-click to end creation of the Light Meter helper object.
By default, a 3 x 3 grid of light sampling points is created. You need to increase the sampling density.

- 7  Press Alt+W to return to a four-viewport view, and in the Modify panel > Parameters rollout > Dimensions group, set Length Segs to **9** and Width Segs to **11**.




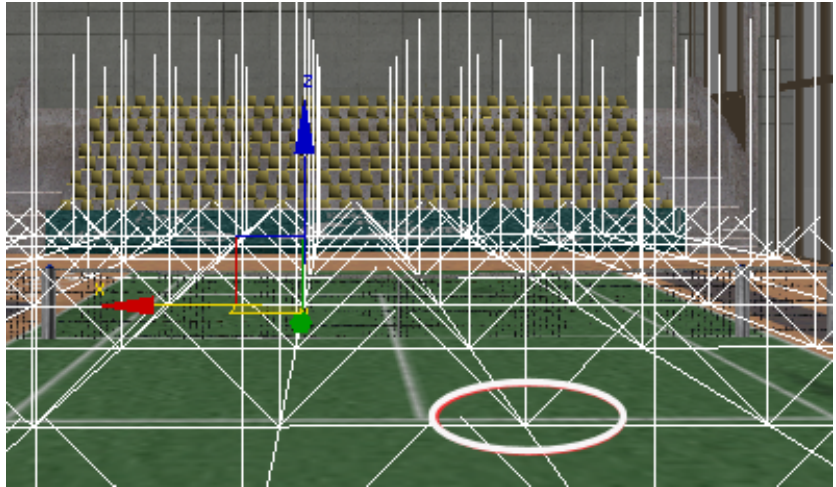
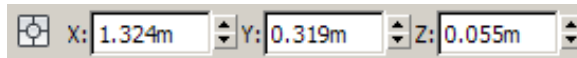
In any viewport, you can see each light sampling point as a vertical pointer. Because Light Meters are helper objects, you can move them around like any other object in a scene.

- 8 In the Camera01 viewport, notice how the Light Meter sample points appear slightly embedded in the court surface. This might hinder their ability to analyze light, so you need to raise them slightly upward.



Light Meter helper object with sampling points embedded in court surface

- 9  On the main toolbar, click Select And Move, then on the Z axis transform field, type **0.055** and press Enter.



Light Meter helper object after adjustment of its Z-axis position

The ground object is five centimeters thick, so the 0.055 value places the sampling points a half centimeter above it.

Performing Lighting Analysis


Now that you have created a Light Meter and adjusted the distribution of its sampling points in your model, you are ready to use the points to calculate the lighting intensity.

You will process the Light Meter for midday, then take another reading for a period later that day to see how the change in sun position affects light distribution in the model interior.


Choose a sky model:

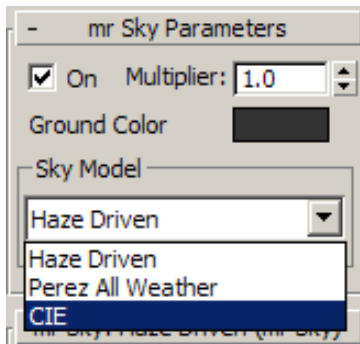
Sky models are a set of luminance distributions that model the sky under a range of conditions, from overcast to clear sky. 3ds Max Design comes with three available sky models: Haze-Driven, Perez All-Weather, and CIE.

Perez All Weather and CIE are the models best suited to lighting analysis.

- 1  Continue working with the scene from the previous lesson, or open the scene *arena_02.max*.

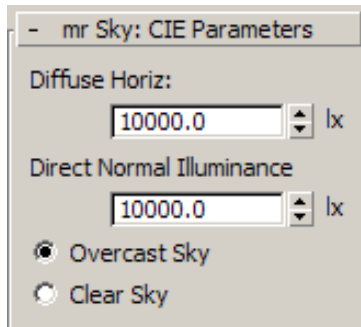
NOTE If a dialog asks whether you want to use the scene's Gamma And LUT settings, accept the scene Gamma settings, and click OK. If a dialog asks whether to use the scene's units, accept the scene units, and click OK.

- 2  In any viewport, select the Daylight system, then go to the Modify panel and in the mr Sky Parameters rollout > Sky Model group list box, choose CIE.



CIE stands for *Commission Internationale de l'Éclairage*, which is a body responsible for the international coordination of lighting-related technical standards. This sky model uses the CIE-based standard of luminance distribution.

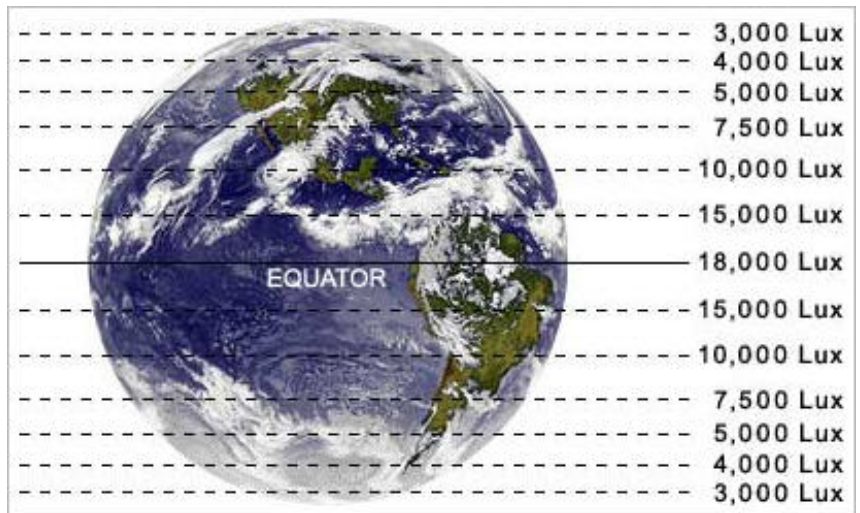
- 3 Scroll down to the mr Sky: CIE Parameters rollout.



By default, Overcast Sky is chosen. This ensures that the lighting analysis can evaluate light when its intensity is at its lowest.

The Diffuse Horiz: control is set to 10,000 lux. This value establishes the distribution of daylight along the horizon, with no direct sunlight taken into account.

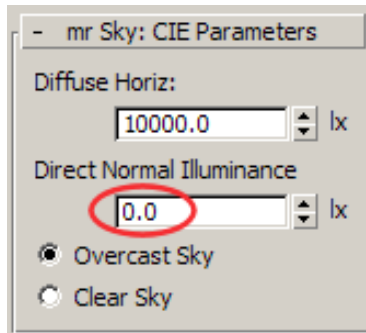
This value corresponds to the light intensity for the geographic location of your model. Light intensity increases, the closer you are to the equator, approximately by the values provided in the next illustration.



Global daylight intensity levels

The Direct Normal Illuminance control beneath Diffuse Horiz lets you set sun intensity, as if the light meter was pointed directly at the sun.

- 4 Set the Direct Normal Illuminance to **0.0**, because you are using the Overcast Sky option.

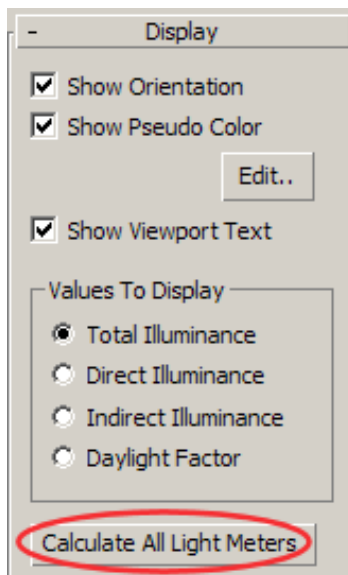


Process the Light Meter:

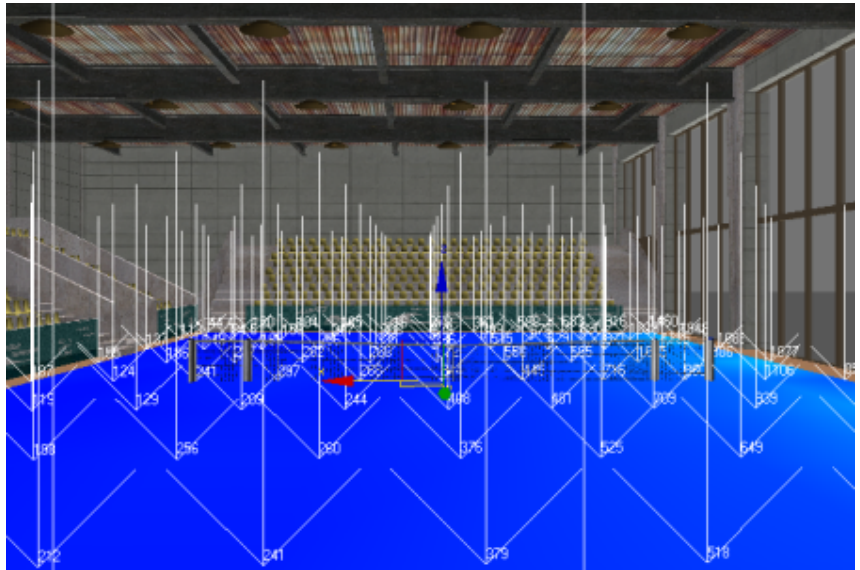
- 1 In the Camera01 viewport, select the Light Meter Helper object. If you prefer, press H and from the Select From Scene dialog, select LightMeter Helper01.



- 2 Go to the Modify panel > Display rollout and click Calculate All Light Meters.



After a few moments, the viewport updates to display the readings calculated by each sample point based on the lighting data you defined for the CIE sky model.



Camera viewport shows light meter readings based on luminance from the CIE sky model

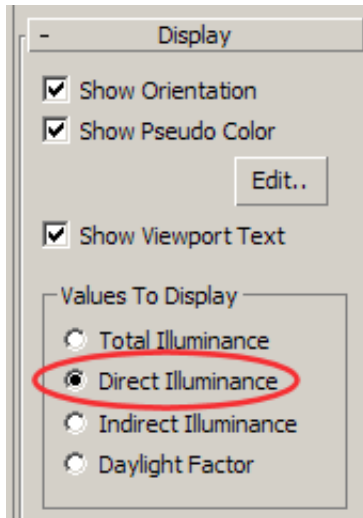
- 3 Press Alt+W to maximize the Camera01 viewport.

Sample point data is more clearly visible, with combined direct and indirect luminance values ranging from almost 2000 for points next to the window to less than 120 for points farther in the model interior.

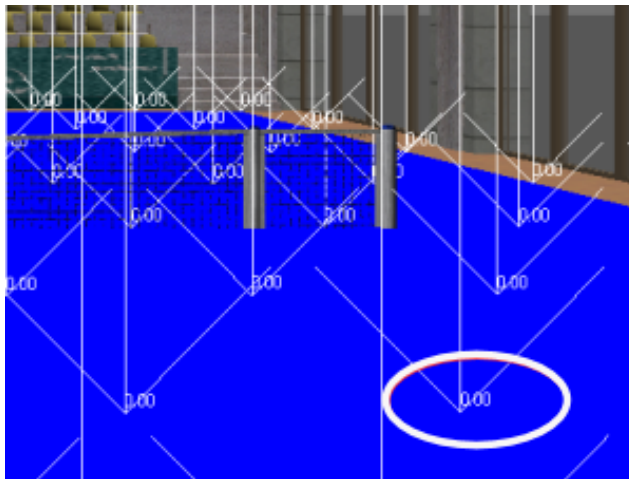
It is generally recognized that for everyday use, interior spaces should not fall below 250 lux. This means the tennis court interior, under overcast conditions, would require artificial, man-made lighting systems to provide added illumination.



- 4 Go to the Modify panel and in the Display rollout > Values To Display group, choose Direct Illuminance.



The sample points all return a value of 0 because, being an overcast day, there is no direct sunlight to record.

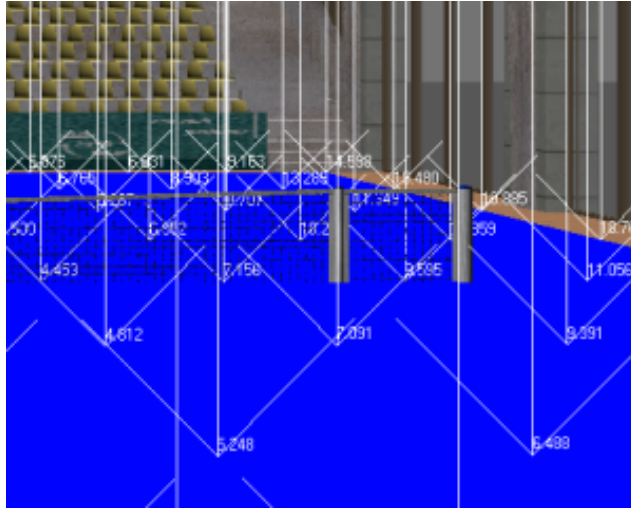


Light meter readings detect no direct luminance

5 Choose Indirect Illuminance.

The values are identical to those of step 2, because Total Luminance measured no direct sunlight.

6 Choose Daylight Factor.

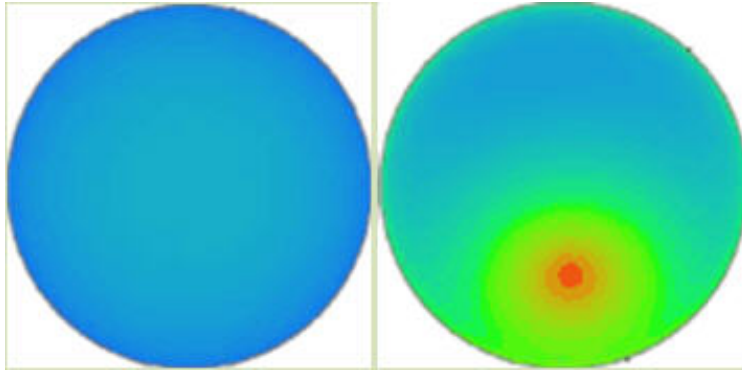


Light meter readings showing Daylight Factor

The values show the percent of outdoor sun striking the area occupied by each sample point. The values from 5.2 to 6.5 returned by the front right sample points equal roughly five to six and a half percent of the 10000 lux value of estimated outdoor horizontal diffuse light intensity you set earlier. If you choose the Total Illuminance option again, that percentage value is expressed in lux units.

NOTE 3ds Max Design displays Daylight Factor values only when you are using the Overcast Sky model.

The next graphic illustrates how light can be cast differently in a scene, depending on which CIE sky model you choose. The left sky dome shows a light gradient generated by the Overcast Sky model, the right shows a gradient under the Clear Sky model.



Left: Light gradient of an Overcast Sky model

Right: Light gradient of a Clear Sky model

A problem exists, however, when you use either the Overcast Sky or Clear Sky option. For the light meter to return accurate values that correspond to the geographic location of your model, you need to make a sometimes arbitrary decision to set the scene for clear or overcast conditions. You also need to specify a corresponding lux value in the Direct Normal Illuminance spinner box based on the geographic location of the model. You might not always know this value.

A better alternative is to use a weather file, one that takes into account weather variations on an hourly or monthly basis based on real-life meteorological observations.

Set daylight parameters from a weather data file:

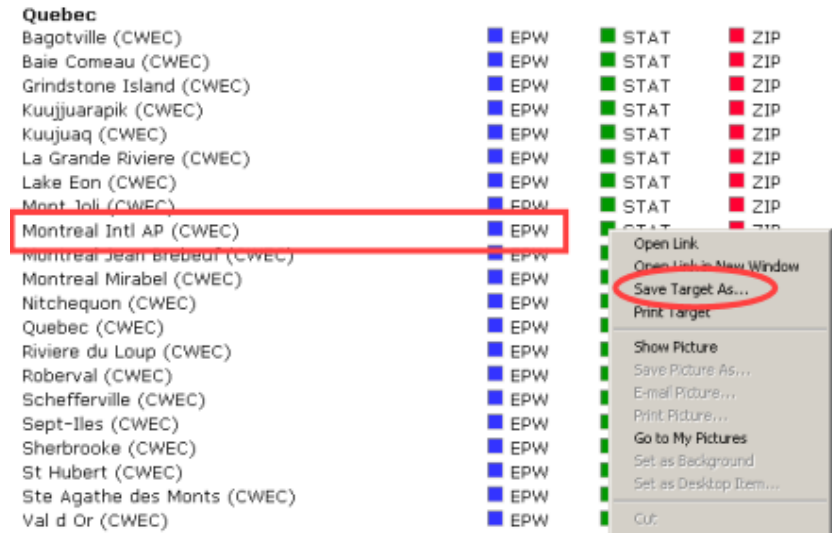


- 1 Press Alt+W to return to a four-viewport view, then in any viewport, select the Daylight system, go to the Modify panel, and in the mr Sky Parameters rollout > Sky Model group list box, choose Perez All Weather. Unlike the CIE Sky Model, Perez All Weather does not include the Overcast Sky and Clear Sky options. This information is provided by the weather data file you will use to define the sky illumination gradient.
- 2 Open a Web browser and type **www.eere.energy.gov/buildings/energyplus/cfm/weather_data.cfm**. The U.S. Department of Energy Web site opens to the EnergyPlus Energy Simulation Software Weather Data Web page.

- 3 Click the North and Central America hyperlink, then click the Canada hyperlink.

The weather data might take a moment or two to display.

- 4 Scroll down to the Quebec section, locate the Montreal Intl AP weather site, right-click the blue EPW file icon, and choose Save Target As.



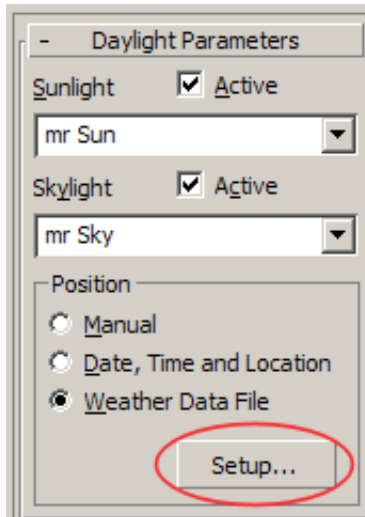
The EPW file contains all the data you need to perform the lighting analysis.

- 5 On the Save As dialog, specify where you want to save the EPW file, click OK, then close the Web browser.

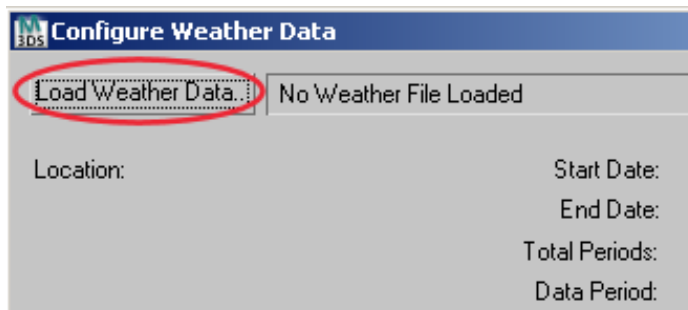
NOTE A copy of this file is saved in the `\sceneassets\photometric` folder. You can use this version if you have difficulty accessing the weather data from the Web.



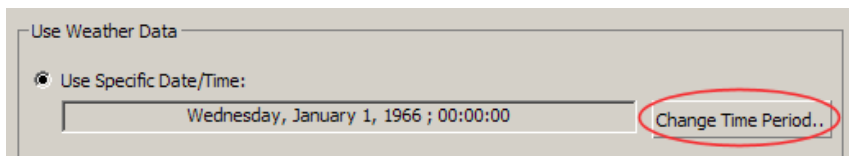
- 6 In the Modify panel > Daylight Parameters rollout > Position group, choose Weather Data File, then click Setup.



- 7 On the Configure Weather Data dialog, click Load Weather Data.

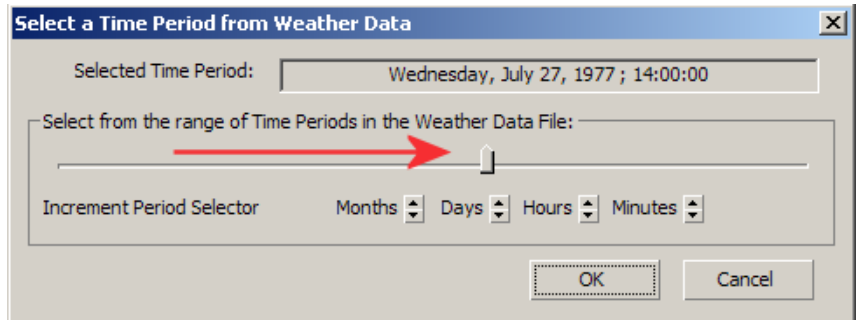


- 8 On the Open Weather File dialog, choose the weather file you just saved from the Web, then click Open.
- 9 In the Configure Weather Data dialog > Use Weather Data group, click Change Time Period..



By default, the weather data is set to January 1st, 1966, at noon, but you will choose a summer date.

- 10 On the Select A Time Period From Weather Data dialog, drag the Time Period slider until the Selected Time Period box displays Wednesday, July 27, 1977; 14:00:00.

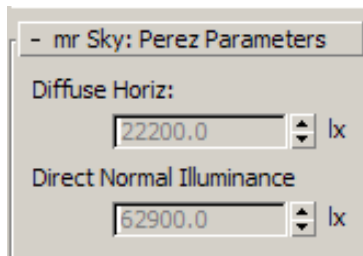


Use the Increment Period Selector controls to narrow down the selection if needed. Click OK.

NOTE If you wish to use a date that is unavailable from the weather data files, you can contact the U.S. Department of Energy from its Web site.

- 11 On the Configure Weather Data dialog, click OK to add the weather data to the scene.

The mr Sky: Perez Parameters rollout Diffuse Horizontal and Direct Normal Illuminance boxes display the bounce lighting and direct lighting applied to the Perez model by the weather data file.



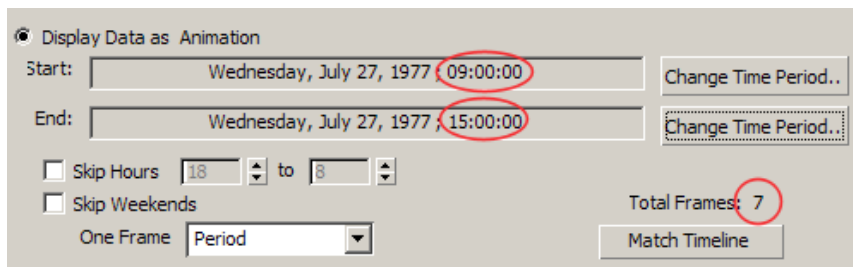
NOTE Luminance values can change considerably between one data file and another, depending on whether the readings were taken under clear or cloudy conditions. To obtain a more representative set of luminance values for your model, it is a good idea to review weather data from several different dates at a given time of year, and choose the data file with the median luminance values.

Next, you will extract a range of weather data to see how the illuminance values change over a six-hour period of time, ranging from mid morning to mid afternoon.


Choose a range of weather data:

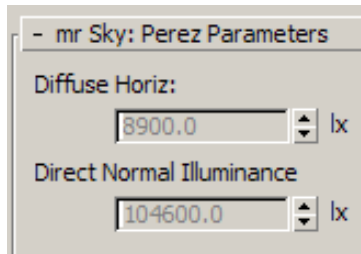


- 1 With the Daylight object selected, go to the Modify panel and in the Daylight Parameters rollout > Position group, click Setup.
- 2 In the Use Weather Data group, choose Display Data As Animation.
- 3 For the Start value, click Change Time Period and in the Select A Time Period From Weather Data dialog, use the slider and spinner controls to set the date and time to Wednesday, July 27, 1977; 9:00:00, then click OK.
- 4 Repeat the previous step for the End value and set the time to **15:00:00**. The Use Weather Data group indicates a total of seven frames created as a result of the selection range.



- 5 Click Match Timeline, then click OK.
The timeline updates to show seven frames.

- 6  On the Modify panel, scroll to the “mr Sky: Perez Parameters” rollout and see how the illumination values now reflect the 9am sampling time.




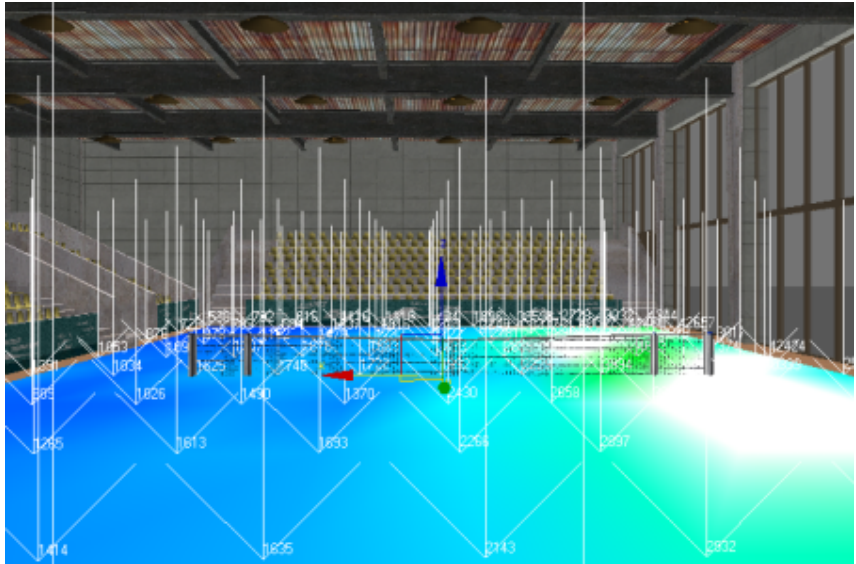
The Diffuse Horiz value is not that high, indicating low ambient luminance, but the high value in the Direct Normal Illuminance box suggests exposure to a great deal of direct sunlight for that particular morning in 1977.

- 7 Drag the timeline slider to frame 3, which is noon, and look at the illumination values again.

The light is more evenly distributed between direct and indirect illumination.

As you can see, by specifying a range of sampling times, you can get an idea of how daylight illumination can affect a model at different times of the day.

- 8  Drag the animation slider to the last frame in the sequence, then in any viewport select the light meter object.
- 9 On the Modify panel Display rollout, make sure Total Illuminance is chosen, and then click Calculate All Light Meters.



Light meter readings based on direct sunlight conditions

The level of illumination is much higher than that detected using the CIE Sky Model, even in the areas farthest from the windows. This is because the scene illumination is based not on an overcast day, but on a day of direct sunlight.

The Light Meter object uses color coding to help you visualize the lighting intensity in a scene. Lower intensities are displayed in cool colors such as blue and green, while higher intensities are shown in orange and red.

The tennis court interior displays cool blue to the left, with even the lowest values in the acceptable illumination range, greater than 250 lux. To the right, by the windows, the color ramps up to pure white. White areas indicate that the illumination values are outside the color-coding range. You now need to adjust the color coding to obtain a more even gradient, so you can evaluate better the areas of high illumination.

Adjust lighting analysis color feedback:

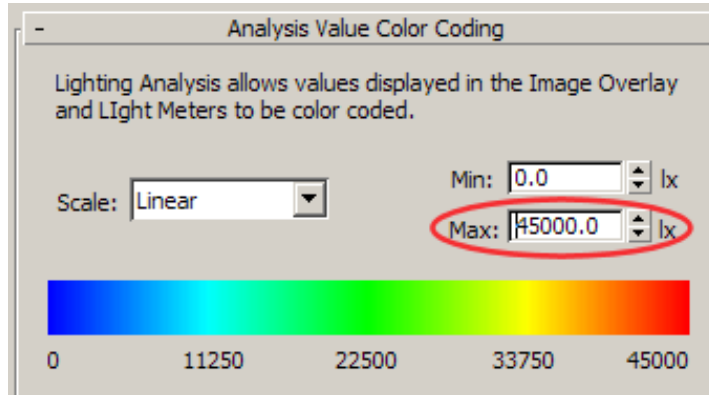
- 1 From the main menu, choose Lighting Analysis > Lighting Analysis Assistant, and go to the General panel.

The Analysis Value Color Coding rollout displays a color ramp. The ramp intensity range is currently set between 0.0 and 10000.0 units. The units are in lux (lx), the international unit of measure. If you prefer, you can

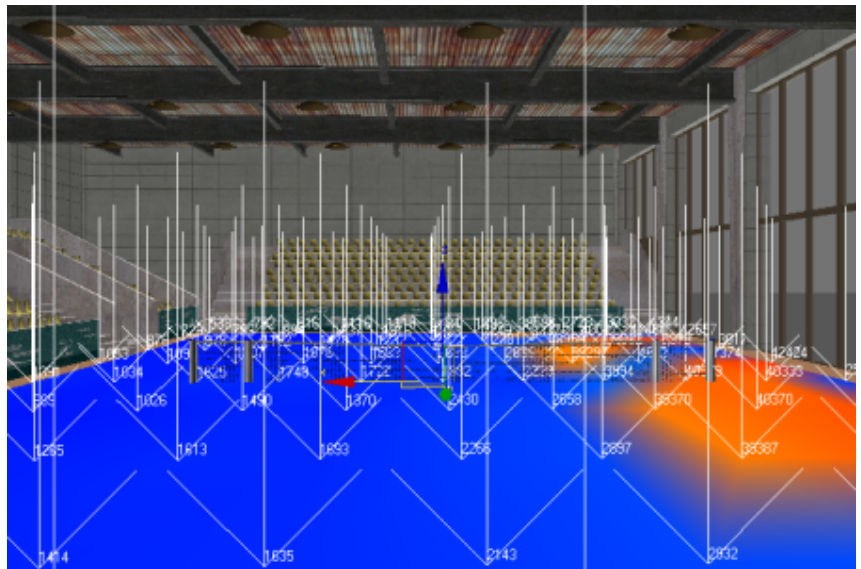
switch to the American unit of measure, foot-candles (fc) on the Units Setup dialog.

Given the scene illumination is over 42,000 lux in places, the color range is currently too narrow. You therefore need to widen the color ramp range.

- 2 Change the value of the Max spinner to **45000.0**, and press Enter.



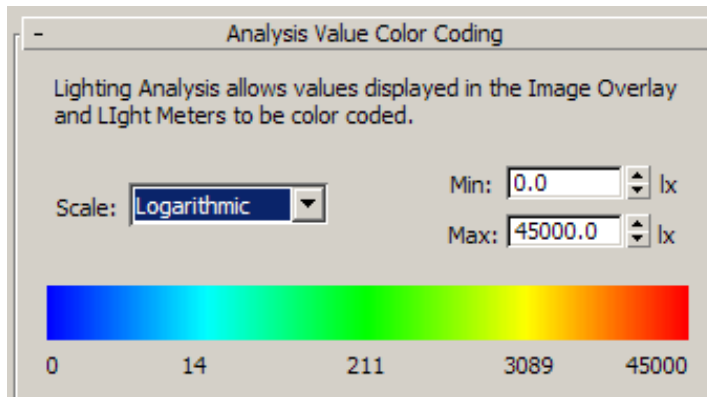
In the viewport, the color range now shows light intensity much more effectively.



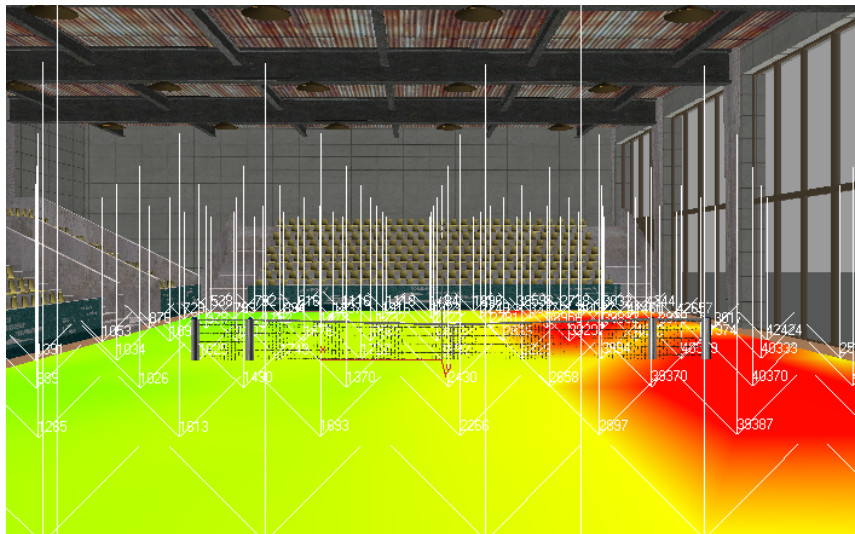
Light meter readings showing improved color coded feedback

The orange areas of the tennis court interior show direct sunlight for this time of day, while the blue areas show indirect sunlight.

- 3 From the > Scale drop-down list, choose Logarithmic.



The color-coded areas update to provide a different visualization of the light intensity, but the intensity values themselves remain unchanged.



- 4 From the Scale list, choose Linear again.
- 5 Activate the Camera01 viewport, then press F9 to render the scene.

Computers with average processing capabilities will typically take five minutes or so to complete this task.



Rendered interior scene showing mid-afternoon illumination


The Perez All-Weather Sky model and weather data provide bright scene illumination. Some image detail near the windows is washed out, but the interior shows up in good detail.

NOTE The Perez model is suitable for daytime, but not for twilight or night scenes. For scenes where the sun is low or absent, use the CIE model if you are concerned with photometric accuracy.

Exporting Light Meter Data and Rendering Light Meter Data


In this lesson, you will learn how to export your Light Meter readings so that others can view them either in an Excel spreadsheet, or as a rendered image overlaid with light meter data.

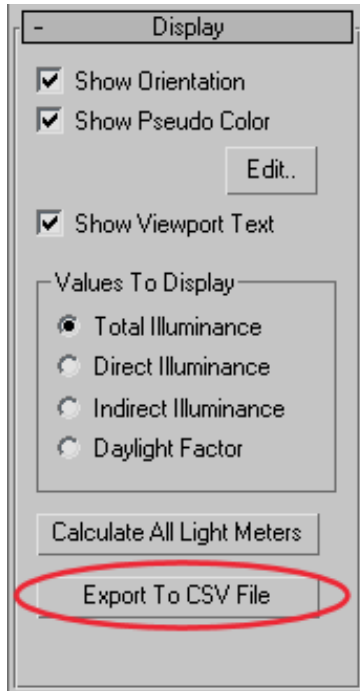
Export the Light Meter data in spreadsheet format:

- 1  Continue working with the scene from the previous lesson, or open the scene *arena_03.max*.

NOTE If a dialog asks whether you want to use the scene's Gamma And LUT settings, accept the scene Gamma settings, and click OK. If a dialog asks whether to use the scene's units, accept the scene units, and click OK.

- 2 In the Camera01 viewport, select the Light Meter helper object.

- 3  Go to the Modify panel > Display rollout and click Export To CSV File.



- 4 On the Save Light Meter Output As CSV File dialog > File Name box, type **arena01** and click Save.

Data generated by the Light Meter object is saved in CSV format to the Export folder of your working directory.

- 5 Navigate to your Export folder and open the newly saved file. Keep the folder open for now.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Name	ID	Frame	Location	Date	Direct	Indirect	Total	Illum. Unit	Daylight	Pos X	Pos Y	Pos Z	Unit	Orient. X	Orient. Y	Orient. Z
2	LightMeter	1	7	Montreal	15:00:00 \	0	4344	4344 lx		0	-970.85	-1730.63	5.5	Millimetre	0	0	1
3	LightMeter	2	7	Montreal	15:00:00 \	0	3032	3032 lx		0	-970.85	-1730.63	5.5	Millimetre	0	0	1
4	LightMeter	3	7	Montreal	15:00:00 \	0	2728	2728 lx		0	-571.64	-1730.63	5.5	Millimetre	0	0	1
5	LightMeter	4	7	Montreal	15:00:00 \	35875	2723	36596 lx		0	-172.43	-1730.63	5.5	Millimetre	0	0	1
6	LightMeter	5	7	Montreal	15:00:00 \	0	1896	1896 lx		0	-172.23	-1730.63	5.5	Millimetre	0	0	1
7	LightMeter	6	7	Montreal	15:00:00 \	0	1484	1484 lx		0	25.98	-1730.63	5.5	Millimetre	0	0	1
8	LightMeter	7	7	Montreal	15:00:00 \	0	1118	1118 lx		0	225.19	-1730.63	5.5	Millimetre	0	0	1
9	LightMeter	8	7	Montreal	15:00:00 \	0	1116	1116 lx		0	426.4	-1730.63	5.5	Millimetre	0	0	1
10	LightMeter	9	7	Montreal	15:00:00 \	0	616	616 lx		0	623.61	-1730.63	5.5	Millimetre	0	0	1
11	LightMeter	10	7	Montreal	15:00:00 \	0	792	792 lx		0	822.82	-1730.63	5.5	Millimetre	0	0	1
12	LightMeter	11	7	Montreal	15:00:00 \	0	538	538 lx		0	1622.69	-1730.63	5.5	Millimetre	0	0	1
13	LightMeter	12	7	Montreal	15:00:00 \	35875	6783	42657 lx		0	-970.86	-1299.1	5.5	Millimetre	0	0	1
14	LightMeter	13	7	Montreal	15:00:00 \	35875	5065	40940 lx		0	-790.85	-1299.1	5.5	Millimetre	0	0	1
15	LightMeter	14	7	Montreal	15:00:00 \	35875	4132	40007 lx		0	-571.64	-1299.1	5.5	Millimetre	0	0	1
16	LightMeter	15	7	Montreal	15:00:00 \	0	3337	3337 lx		0	-172.43	-1299.1	5.5	Millimetre	0	0	1
17	LightMeter	16	7	Montreal	15:00:00 \	0	2249	2249 lx		0	-173.23	-1299.1	5.5	Millimetre	0	0	1
18	LightMeter	17	7	Montreal	15:00:00 \	0	1923	1923 lx		0	25.98	-1299.1	5.5	Millimetre	0	0	1
19	LightMeter	18	7	Montreal	15:00:00 \	0	1918	1918 lx		0	225.19	-1299.1	5.5	Millimetre	0	0	1
20	LightMeter	19	7	Montreal	15:00:00 \	0	1337	1337 lx		0	426.4	-1299.1	5.5	Millimetre	0	0	1
21	LightMeter	20	7	Montreal	15:00:00 \	0	894	894 lx		0	873.61	-1299.1	5.5	Millimetre	0	0	1

The file opens in an Excel spreadsheet, showing light data gathered by each point in the Light Meter helper. This data, formulated for technical specialists such as lighting engineers, is described in detail in the following table.

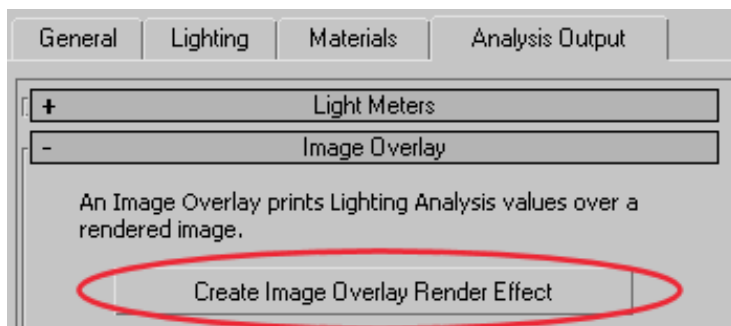
Column	Definition
A: Name	Name of the Light Meter helper.
B: ID	Number of the Light Meter helper sampling point.
C: Frame	Number of the frame in an animated sequence where the light source was sampled. (A value of 0 indicates no animation.)
D: Location	Geographic location of the scene.
E: Date	Time and date on which weather data used by the lighting source was recorded.
F: Direct	Value of direct illumination detected by the Light Meter sampling point.
G: Indirect	Value of indirect illumination detected by the Light Meter sampling point.

Column	Definition
H: Total	Combined value of direct and indirect illumination detected by the Light Meter sampling point.
I: Illum. Units	Unit of measurement used to display light illumination values in columns F through H (lx = lux, fc = foot-candles).
J: Daylight Factor	Value of daylight detected by the Light Meter sampling point, excluding direct or indirect luminance.
K-M: Pos X/PosY/Pos Z	Position coordinates of the Light Meter sampling point.
Unit	Unit of measure used to display the Light Meter sampling point position in columns K through M.
O-Q: Orient X - Z	Rotation coordinates of the Light Meter sampling point.

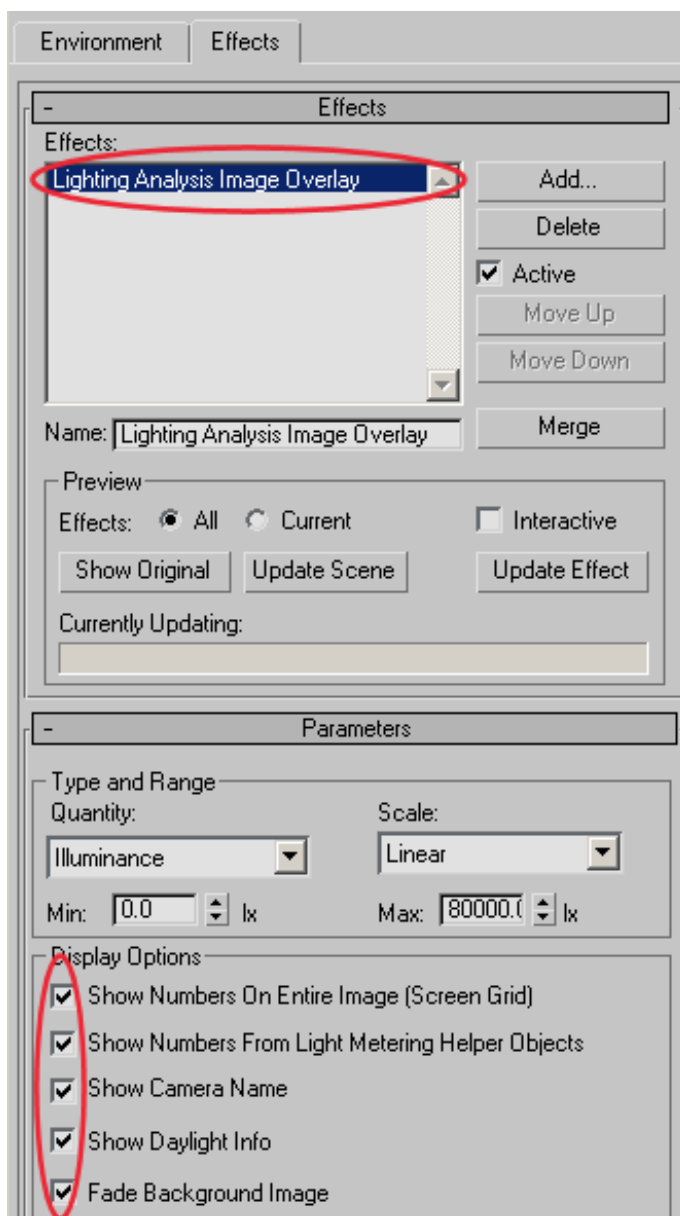
6 Close the Excel file and the Export folder.

Create an image overlay:

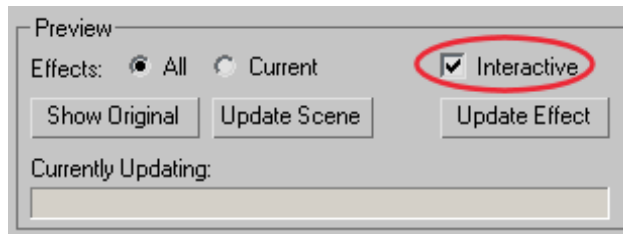
- 1 Drag the animation slider to frame 7 and from the Lighting Analysis menu, choose Lighting Analysis Assistant to open the Lighting Analysis Assistant dialog.
- 2 Go to the Analysis Output panel if it is not already open, and on the Image Overlay rollout, click Create Image Overlay Render Effect.



- 3 On the Environment And Effects dialog > Effects panel > Effects rollout, click Lighting Analysis Image Overlay to highlight it, and then in the Parameters rollout > Display Options group, make sure all the options are turned on. Keep the dialog open.



- 4 In the Effects rollout > Preview group, turn on Interactive.



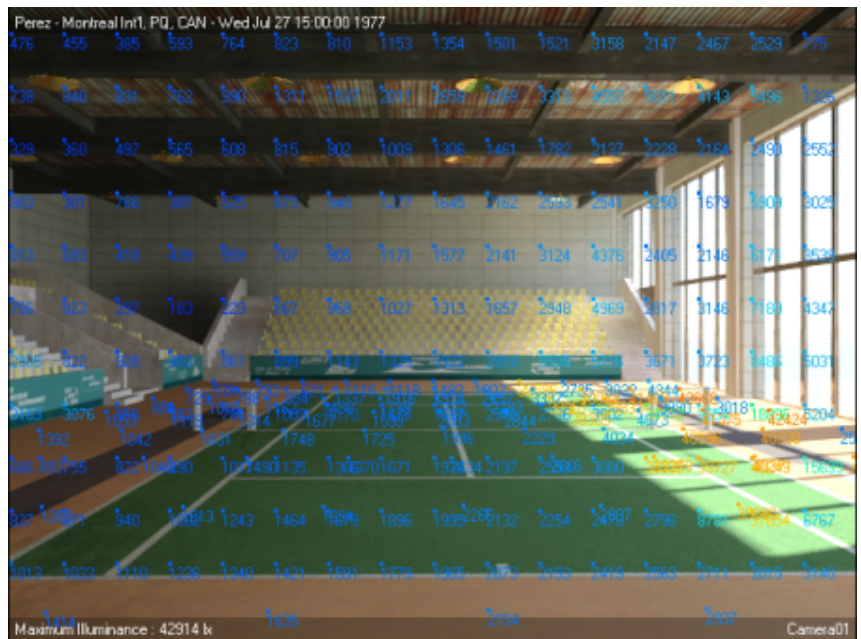
The scene starts to render.

As soon as the calculation is complete, two rendered frames display.

The first frame renders entirely in yellow. It is used to create the overlay image but contains no usable information. Close this window.

The second rendered frame includes a layer of luminance data derived from the lighting analysis. The numbers are dense and not easy to read because they include lighting values in a grid, as well as values generated by the Light Meter sample points.

NOTE If your rendering displays luminance data in a grid only, render the scene a second time.

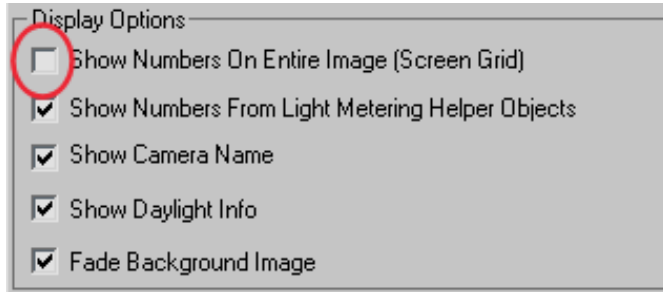


Overlay shows combination of grid and sample point light meter data

- 5 Keep the rendered frame open for now.

Adjust the display of Light Meter data:

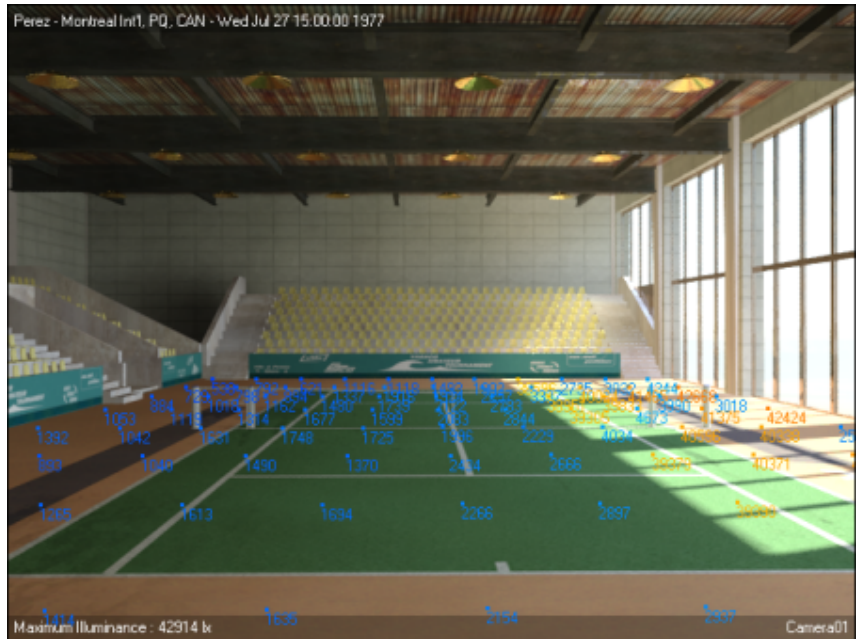
- 1 In the Environment And Effects dialog > Parameters rollout > Display Options group, turn off Show Numbers On Entire Image (Screen Grid).



Now only the luminance values returned by the sampling points of the Light Meter you created for the court surface are displayed.

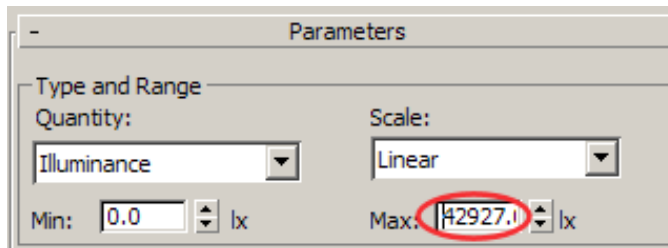
The rendering updates instantly after you make your choice because you turned on Interactive in the Effects rollout > Preview group.

Notice how the maximum luminance values display in the lower-right corner of the rendered frame.

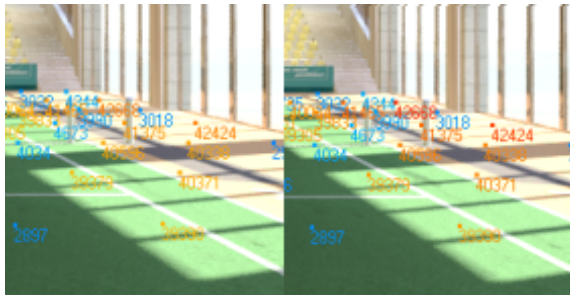


Overlay shows sample point light meter data only

- 2 In the Environment And Effects dialog > Effects panel > Parameters rollout > Type And Range group > Max spinner, type **42927.0**, and then press Enter.



By lowering the maximum range, the sample values display in their full color-coded range, from blue (low luminance) to red (high luminance).



Left: Color range before adjustment

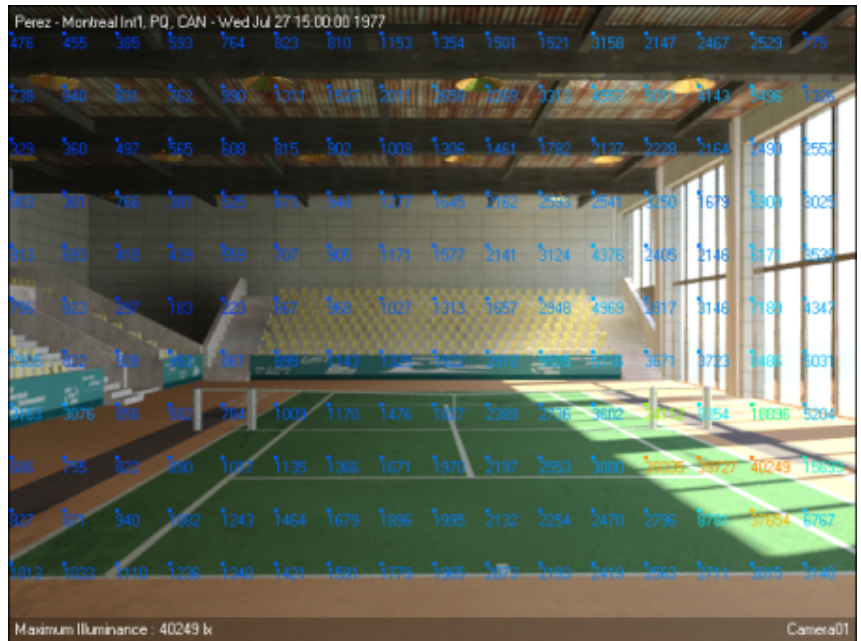
Right: Color range after adjustment

- 3 In the Display Options group, turn off Fade Background Image. The scene shows the actual light intensity of the rendered image. This, however, makes the Light Meter data harder to read.



- 4 Turn the Fade Background Image option back on.

- 5 In the Display Options group, turn off Show Numbers From Light Metering Helper Objects and turn on Show Numbers On Entire Image. The Light Meter luminance data is now sampled from 2D points on the image surface. You can set the density of sampling points on the surface plane.

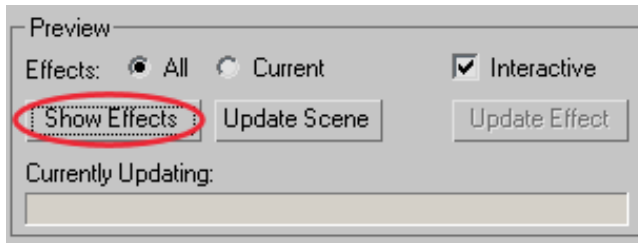


Overlay shows light meter data arranged in a 40 by 40 grid

- 6 In the Screen Grid Layout Options group, change the Vertical Spacing and Horizontal Spacing values to see how the overlay is affected.



- 7 In the Effects rollout > Preview group, click Show Original to view the scene without the lighting data. Click Show Effects to redisplay the data.



- 8 On the Rendered Frame Window toolbar, click Save.
On the Save Image dialog, you can save the rendered image in a number of formats to a location of your choosing.
- 9 If you like, you can view a completed version of this lesson by opening the scene file *arena_completed.max*.

Summary

In this tutorial, you learned how to create a Daylight system and set the exposure to effectively illuminate an indoor scene. You then opened the Lighting Analysis Assistant and prepared the scene for lighting analysis using a helper object called a Light Meter, which evaluates the amount of direct and indirect illumination that enter a scene.

You also learned how to introduce realistic lighting conditions by downloading weather data containing real-world meteorological observations, and applying these luminance values to your Daylight system. You then took the light meter readings generated by the new luminance values, and converted them into spreadsheets and rendered overlays for subsequent analysis.