RENDERING WITH MICROSTATION®

by Jerry Flynn

- FOR ENGINEERS, DESIGNERS AND ARCHITECTS
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Rendering with MicroStation

Jerry Flynn

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RENDERING WITH MICROSTATION

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Foreword

Ray Bentley of Bentley Systems, Inc.

Great visualization happens when you combine inspiration with good tools and the knowledge to use those tools. You bring inspiration to your work every day, and MicroStation has all the tools necessary to generate excellent 3D renderings of your designs – renderings that help you communicate intent, describe impact and demonstrate advantages.

The release of "Rendering with MicroStation" brings the required knowledge right to your fingertips. Authored by Jerry Flynn, the world's leading MicroStation visualization expert and evangelist, this book is a product of the years that Jerry has spent practicing great visualization and sharing his knowledge with MicroStation users around the world.

I first met Jerry Flynn in the late 1980s. Back then the visualization tools in MicroStation were very primitive, but Jerry was already creating inspired, compelling renderings. Since then, Jerry has remained a visionary for visualization in MicroStation and has helped guide the evolution of its rendering tools. And over the years, he's helped hundreds of firms and thousands of AEC professionals bring their designs to color and life from within the design program.

In truth, visualization was formerly an expensive, specialized, and often outsourced portion of the design flow. Companies sometimes would spend six figures acquiring the talent and tools to make renderings from MicroStation files. Today, visualization is in the mainstream and a common part of the design team's work. No longer the stuff of Hollywood

movie magic and high-end gaming elite, excellent visualization in AEC is within reach of every MicroStation user today. This book just further proves it.

I am grateful for Jerry's enthusiasm and expertise, and with the guidance this book provides, I know you will be too.

Brian Parker of Cooper Carry, Architects

"AT LAST Jerry Flynn's vast rendering knowledge has been put to paper!

This book is a MUST HAVE for anyone, at any skill level, who is rendering and visualizing in MicroStation. Beginners will be led step by step through basic rendering techniques and onward to advanced visualization procedures... Pros will love having the book on the shelf as a reference and reminder guide for all those steps and settings we often forget. THANKS Jerry, and Bentley, for creating a training/reference book for the 3D masses!"

Contents

Exercises

Introduction

This book assumes you know nothing about rendering. It starts out slowly, covering the important basics, and then progresses to more advanced topics. The concepts in this book are laid out in order of importance, beginning with three basic requirements for rendering, *Cameras*, *Lights*, and *Materials*.

While it is intended for users that are beginners in rendering, through to intermediate, it covers many advanced topics also. Even an expert could learn many valuable tips and tricks to improve his or her renderings. This book requires a prerequisite knowledge of MicroStation 3D.

It is my belief that if you cannot master MicroStation's camera tools, you will have great difficulty taking that all-important picture of your finished project. This very important topic is covered in detail in Chapter 2.

A great deal of time is devoted to lighting, which comes in second on my list but may, in fact, be the single most important aspect of the rendering process. You should be able to make a 3D scene look good even if all your materials happen to be cardboard. Setting up the right lighting can make or break a rendering. Therefore, considerable content is devoted to this subject.

For truly photorealistic results, you will learn to master MicroStation's Material Editor and how to attach and apply these materials to a variety of 3D models, including civil, architectural, and industrial design.

Navigating through a myriad of rendering dialog boxes and settings, you will learn what these settings are and how they affect each rendering mode. Through exercises you will be able to see the effects a setting can have on your renderings. You will learn specialized procedures, such as using ArchVision® RPC™ files to add realPeople™ and realTrees™ to your 3D scenes. You will learn how to plot 3D content to Adobe® PDFs and to navigate a PDF, containing 3D content, using Adobe® Reader® 7.0.

Advanced rendering methods, particle tracing and radiosity, are covered in detail using several hands-on exercises. You will learn how to use multiple computers across a network to render a single high-resolution image in a fraction of the time normally required. You will learn all about generating image output from still images to panorama virtual reality images and image objects.

This book uses hands-on exercises to reinforce the topics covered.

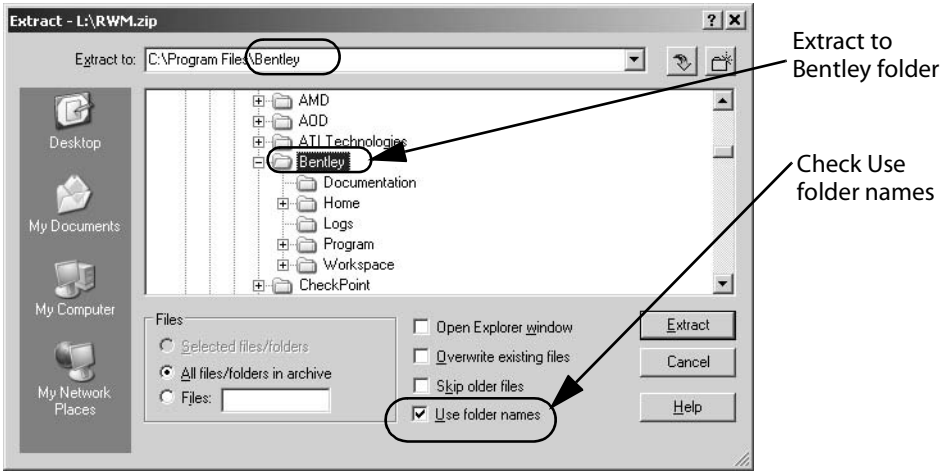
Included with the book is a CD with a workspace containing all the models and materials used in the course. Bonus materials on the CD include a complete image library of textures, skies, environment boxes, and bump maps. Also included are several sample RPC content files, provided courtesy of ArchVision, Inc.

Extracting the Data Sets

Before doing any exercises, you need to extract the data sets from the accompanying CD. The CD contains the Workspace you will be using for all the exercises, including design files, palettes, materials, and image library.

Extract all the files from the *RWM.zip* file into the folder where MicroStation in installed on your computer. By default, MicroStation is installed in *\Program Files\Bentley* folder, but this could be different on your computer.

Extract the files using the folder names. Select to overwrite the existing files since the Workspace folder already exists.



MySELECT CD

Bentley SELECT Subscribers can order the data set and supporting files through the MySELECT CD program. MySELECT CD allows you to select the Bentley software or documents you need and have a CD delivered to your door.

To become a Bentley SELECT Subscriber, go to *http://www.selectservices.bentley.com*. Bentley SELECT is a subscription program that features product upgrades and updates.

About the Author

Jerry Flynn is a visualization specialist at Bentley Systems. He has more than 17 years of visualization experience, and over 24 years of experience working with 3D computer models.

As a design engineer with Planning Research Corporation (PRC), at the Kennedy Space Center, Jerry designed launch support equipment and access platforms for the Space Shuttle. Using a highly accurate 3D computer model of the Space Shuttle's outer mold lines, Jerry was able to design critical access equipment and verify the designs on the computer prior to fabrication. In his own words "I was hooked on 3D" from that point, in 1981, on.

When the design and construction phase for the Shuttle facilities ended in 1987, Jerry left PRC and went to work for McDonnell Douglas Space Systems. At that time McDonnell Douglas provided all support and processing of flight hardware in preparation for launch of the Space Shuttle. As a senior design engineer at McDonnell Douglas, Jerry brought his experience in 3D computer graphics to an even higher level. Using MicroStation, version 2.01.3, and an 8 MHz 286 PC, he created the first accurate 3D models of a processing facility and the Magellan spacecraft. These models then were used to perform access studies and fit checks, far in advance of the spacecraft's actual arrival at the Kennedy Space Center. This effort proved to NASA that computer modeling would be a tremendous time saver over existing methods.

From Jerry's pioneering efforts, a new Visualization Group was born. This group performed complex tasks and expanded their responsibilities to include conceptual design and advanced studies for future missions to the moon, Mars, and beyond. This group now has more than 11 full-time employees dedicated to various visualization tasks.

During his time at McDonnell Douglas, Jerry won 14 Golden Mouse awards in InterGraph's computer art competition and a Best in Application, from Kodak, during the 1991 SIGGRAPH convention. The Design Visualization Group that Jerry was instrumental in forming won the Silver Eagle award in 1993, the highest award achievable at the Space Systems division.

Jerry Flynn departed McDonnell Douglas in November of 1994 to join Bentley Systems. He was responsible for much of the animation and graphics used on the Discovery CD-ROMs to launch MicroStation 95, GeoGraphics, Modeler, and TriForma. He continues to work closely with development on improving and adding new visualization features to MicroStation. He also played a major role in the development of "Model City Philadelphia" a virtual reality model of Philadelphia, which was shown at AEC Systems and SIGGRAPH in 1997.

Jerry is the author of the Bentley Institute's "Animating with MicroStation" and "Rendering for Building Design" courses and provides 3D and visualization training for users in the US and sites around the world. Jerry Flynn also supports Bentley's Professional Services Group. In this capacity, he provides professional consulting and services, including onsite training, 3D modeling, animation, rendering, multimedia, and video editing services.

Jerry Flynn's graphics have been on the covers of 16 MicroStation books. He has been the creator of seven MicroStation Manager covers, and his photorealistic images have made the covers of *Road & Bridges, Computer Aided Engineering* and *Computer Graphics World* magazines. He is responsible for the "Orbiter, Oldhotel, Livroom and Lobby" example DGN files that were shipped with MicroStation. He was instrumental in the development of the texture library that is delivered with MicroStation.

Acknowledgments

I would like thank several people for their help in turning what was originally planned as a new Bentley Institute course into a complete published book. It is a much-needed self-study guide and classroom workbook which now, for the first time, is available to all users, with or without an instructor.

I would like to sincerely thank David Wilkinson for being a contributing editor and for being one of only a handful of visualization experts within Bentley's ranks capable of ensuring that this book is ready to put into the hands of any MicroStation 3D user. Without David's help, this book would not have made it to fruition.

A huge thanks to Ray Bentley, my long-time friend and someone who shares the passion for visualization and for being instrumental in assuring that MicroStation's visualization capabilities are among the best in the world. Even before I joined Bentley, while at McDonnell Douglas Space Systems, Ray was there to help in a crunch. I remember at the time you could not put a hole in a surface. The workaround was to split the surface along the hole centers. This looked okay when rendered, but it seemed odd not to have this modeling ability. I called Ray and explained what we needed. The very next day we had a tool to test. You will all know this as the Group Hole tool.

Thanks to Peter Segal, Bentley's lead visualization developer. Without Pete's help I could never have become an expert at visualizing with MicroStation. Kudos to the entire visualization development team, which includes Pete Segal, David Zareski, Paul Chater, and Dennis Bragg. They have provided help and guidance in one way or another over my last ten years with Bentley.

Visualization requires a 3D model, and I must say I have built many over the years. Some of these have been fairly complex and, at times, pushed

the limits of MicroStation's modeling tools, sometimes even requiring a nonexistent tool or command. When this occurred, I could always count on Brien Bastings or Lu Han to make it happen, providing either the tools, methods, or both, to accomplish the task at hand.

I would like to thank the following content contributors:

- Peter Yeh and the South Carolina Department of Transportation's Roadway design team for providing the photomatch data set used as a civil example in Chapter 11.
- Randall Stevens and Archvision for providing example "Rich Photorealistic Content" (RPC) files included on the accompanying CD-ROM. Additional information can be obtained at *www.archvision.com*.
- Pjer Zanchi with OnyxTree for providing OnyxTree Garden Suite, including the newly released OnyxFlower for those times you really need a 3D tree to get under in a scene. Examples can be seen in *Villa.dgn* or by visiting their website, *www.onyxtree.com*.
- Sebastion Volkamer at *www.vb-visual.com* for providing "VBexteriors 3D Plants" used in *SB Motors landscape.dgn* and also *main st trees.dgn*. The best example can be seen in *environment map2.dgn* which references the *main st trees.dgn*. The trees are mixed in with some RPC trees, but it will be pretty obvious which ones are VB, as they appear much more detailed in the wireframe view.

I would like to thank the Bentley Institute Press Team: Gilda Cellini, Frank Conforti, Charley Ferrucci, Lissa Jennings, Drew Knox, Carol Leyba, Maureen Rhoads, and Chris Rogers, without which this book would have never gotten off the ground.

9 Exterior Rendering

Renderings of exterior models are affected by several factors, including the choice of materials and the lighting settings, both Global Lighting and Source Lighting. Even an outstanding model can look dull if it is poorly illuminated. This chapter shows you how to set up lighting for both day and nighttime renderings.

In addition to lighting, you will use fog and depth cueing as both of these rendering view attributes can add a great deal of realism to your exterior renderings.

For exterior renderings to look photorealistic, you will want to include images of the sky. You can do this by adding a background image, using a sky cylinder, or using environment maps in conjunction with a sky box. These techniques are presented in this chapter.

Daytime Lighting Setup

Using solar lighting alone can provide good lighting for those surfaces that are directly illuminated by solar light, but it also can leave the shadowed areas much too dark. To solve this problem, you could use the particle tracing or radiosity routines to obtain a more complete lighting solution for your model. These rendering modes take into account the light reflected by the surfaces in the model and thereby illuminate the shadow areas with indirect lighting.

While either of these routines can provide the most realistic results, they require much more computational time to complete a rendering. Instead of using these more complex rendering modes, you will first learn how to effectively illuminate exterior scenes, generating excellent results, using the ray trace rendering method.

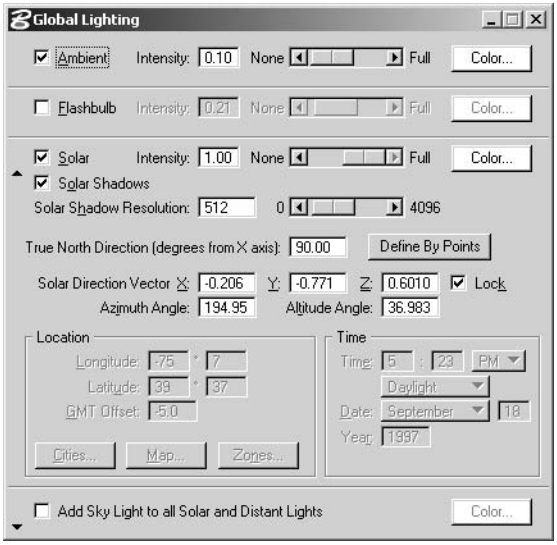
✔ Exercise 9-1: Check the global lighting

1 Open model ***Site_Exterior***, in DGN file ***site.dgn***.

2 Select Global Lighting.

Note the current settings.

NOTE: *The azimuth angle associated with the solar direction is measured in degrees clockwise with North (0°) along the y-axis, in the Top view. For example, an azimuth angle of 0.0 would shine directly on the North face, 90.0 would shine directly on the East face, 180.0 on the South face, and 270.0 on the West face. The altitude angle is a measurement of the sun angle in degrees off the horizon. The current settings mean the sun is to the SW and at about 37° above the horizon.*



3 Apply the saved view *south side* to View 2 (Utilities > Saved Views).

4 Ray trace View 2, creating a new solution, and adjust the Brightness slider until the grass texture looks good.

NOTE: *After you interactively adjust the brightness, you will need to redisplay the current solution to correctly render the sky cylinder since the main illumination for the sky cylinder is ambient.*

Rendering of saved view *south side*.

The lighting looks fairly good, but these faces are directly illuminated by solar lighting.

5 Apply the saved view *from right* to View 4.

6 Ray trace the current solution in View 4.

The view from the right is rendered, and now you can see that this side of the building is in the solar shadow and appears much too dark.

Building viewed from the right side.

Using Sky Light

One option for providing more uniform light is to turn on the setting Add Sky Light to all Solar and Distant Lights, which is located in the Global Lighting dialog box. With this setting enabled, you can add atmospheric lighting from the sky. A Color button lets you define the color of the sky light.

While this feature was discussed in an earlier chapter, it is important for exterior renderings. Hence, we will again look at its use here.

When this setting is turned on with solar lighting, the intensity of the light is modified by the angle of the sun (providing a more realistic solar study). As cloudiness increases, the direct sunlight decreases and the lighting becomes more diffused. On a clear day, for example, the sky is not uniformly lit—more sky light comes from the direction of the sun, thus producing darker, sharper shadows. Alternatively, on a cloudy day, the sky is uniformly lit—producing softer, less pronounced shadows. These same rules are applied to the light from any distant light sources in the model.

Additionally, the amount of coloring from the sky lighting varies. With Air Quality (Turbidity) set to Perfectly Clean, there is a small amount of coloring from the sky lighting. When Air Quality (Turbidity) is set to Industrial, the coloring effect of the sky lighting is more pronounced.

Using the controls in the Global Lighting dialog box, you can set the amount of Cloudiness and the Air Quality (Turbidity) to create the desired conditions for your image.

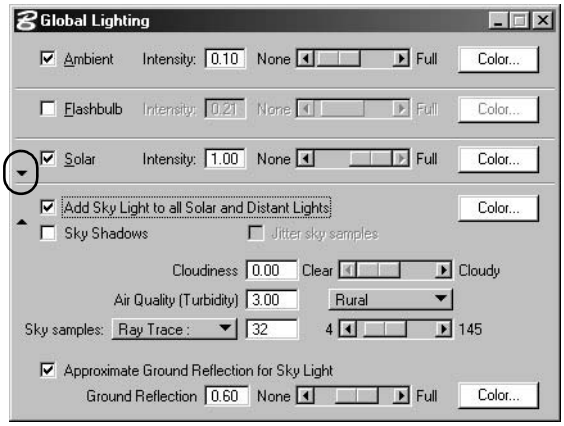
Sky light is a directional light, coming from an imaginary sky hemisphere and pointing in toward the center. The precision of the hemisphere is determined by the Sky samples setting: the slider control range is from 4 to 145, with larger numbers increasing precision. You can enter a number higher than 145 by entering a value directly into the field.

✔ Exercise 9-2: Adding Sky Light

1 Continuing in model ***Site_Exterior***, open the Global Lighting dialog box if not already open from the previous exercise.

2 In the Global Lighting dialog, click the small down arrow located left of the Add Sky Light to all Solar and Distant Lights setting.

The dialog box expands to display the Sky Light settings.



Sky Light settings.

3 Turn on Add Sky Light to all Solar and Distant Lights.

4 If necessary, turn off Sky Shadows.

NOTE: *Turning off Sky Shadows will dramatically improve rendering speed. Sky Shadows work best with particle tracing, and you will not be able to see much of a difference in the final rendering when just ray tracing. It is therefore recommended that you disable this feature for ray trace rendering.*

5 Verify that Sky samples for Ray Trace is 32 (which is the default setting).

6 Turn on Approximate Ground Reflection for Sky Light with the following settings:

Ground Reflection: 0.60.
Color: White (RGB set to 255, 255, 255)

7 Attach the Saved View *from right* to View 5.

8 Ray trace View 5, creating a new solution.

Model rendered with added sky light.

As you can see, the image is much brighter in the shady areas and the entire building model is more uniformly lit.

Using Light Ring and Solar Cluster

In this section, you will be reintroduced to an alternate method for achieving uniform global illumination using a ring of distant light sources. In addition, this method will provide softer shadows than would be provided by solar light alone.

Distant light sources produce directional light, like the sun, with parallel light rays that travel throughout the design. That is, the orientation of the light source defines the direction of uniform light that illuminates all surfaces facing in its direction. This applies whether the surfaces are in front of, or behind, the distant light source in the design. By default, distant light sources have the same brightness as solar lighting.

Distant lights do not shine if pointed upward, when used with ray tracing (with Real World Lighting enabled), particle tracing, or radiosity. This is because they behave identically to the sun and would be below the horizon if they were pointing upward. They will, however, shine upward while ray tracing if Sky Lighting and Real World Lighting are disabled. They also will shine, if pointing upward, for constant, smooth, and phong rendering modes.

In the next exercise, you will add distant light sources to fill in the shadows with additional light. These light sources already have been placed in a DGN file that is referenced to the main model file.

✔ Exercise 9-3: Add distant lights to fill in shadows

1 Continuing in model ***Site_Exterior***, in the Global Lighting dialog box, set the following:

Solar: Off
Add Sky Light to all Solar and Distant Lights: On
Sky Shadows: Off

2 Open the References dialog box (File > Reference).

3 Enable display of *lightring10.dgn*.

Now the reference file lights will be used. These consist of 18 non-shadow-casting distant lights and 10 shadow-casting distant lights.

4 Ray trace View 4, creating a new solution.

5 Adjust the brightness slider so that the grass matches that of the previously rendered View 5 where solar and sky light were used.

6 Ray trace current solution in View 4.

The dynamic adjustment may not accurately represent the rendered view. Ray tracing the current solution will provide an accurate representation of the image.

View 5, with solar light and sky light.

View 4, with light ring and sky light.

By comparing the results, you can readily see that the light ring method in conjunction with sky light provides even more uniform illumination than that produced using solar light and sky light.

Now you can move the camera to any exterior vantage point and get good results, even in the solar shadows.

7 Try applying the other saved views such as *across pond*, and use the Ray Trace current solution tool to view other aspects of the model using the light ring solution.

(Left): Image with solar light and sky light. *(Right):* Image with light ring and sky light.

In two ray traced images from the saved view *across pond* above, it's clear that shadows appear to be much softer with the light ring method than when using solar lighting.

Adding Background Images

Now that you have learned about lighting setups, the next step is to learn about adding sky backgrounds for a photorealistic touch. One method is to add a background image to the view(s) that you use for rendering.

✔ Exercise 9-4: Add background images

1 Open the DGN file ***Bridge Daytime.dgn***.

2 Apply the saved view *River* to View 2 and View 4.

3 Ray trace View 2.

The view renders with just a background color.

4 Select Setting > Design File to open the DGN File Settings dialog box.

5 Select the Views category, and set the following:

View: 4
Background: On

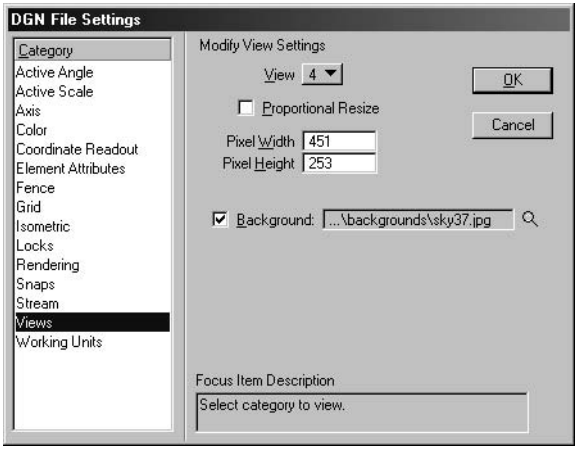
6 Click the magnifying glass icon to browse.

7 In the Select Background Image dialog box, set the following:

List Files of Type: All Supported Image Formats
Preview option: On

8 Navigate to the course *image library\Backgrounds* folder and select *sky37.jpg*.

Click OK.



9 In the DGN File Settings dialog box, click OK.

Sky37.jpg becomes the background image for View 4.

NOTE: *Once you have applied a background to a view, you can open the Select Background Image dialog using the key-in:* active background. *The display of a background image is a view attribute. You can open the View Attributes dialog by holding down the <Ctrl> key and entering* b *from the keyboard.*

10 Ray Trace View 4 using the current solution.

Since only the background was changed, you can use the ray tracing solution from the previous rendering.

Notice how much more realistic the rendered image appears with the added background image.

Rendered view without *(left)* and with *(right)* background image.

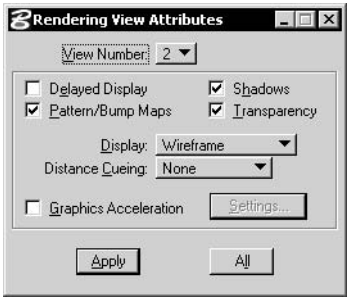
Applying Fog to Add Realism

Now that you have added a background, you can make the rendering look even more realistic by adding a touch of fog. One problem with computer images is that they tend to look a little too perfect. Adding a touch of atmospheric fog improves the final appearance of the rendered image.

Exercise 9-5: Apply fog

1. Continuing in model ***Bridge***, turn on the background image for View 2 (Settings > Design File and turn on Background in the Views category).
2. Open the Rendering View Attributes dialog box (Settings > Rendering > View Attributes) and set the following:

   View Number: 2
   Distance Cueing: Fog



3. Click Apply to apply the view attribute settings to View 2.

4. Ray trace View 2 using the current solution.

The view is rendered with fog. Since fog only affects how the image is viewed and does not change the solution, you can make adjustments to the fog without having to recompute the ray trace solution.

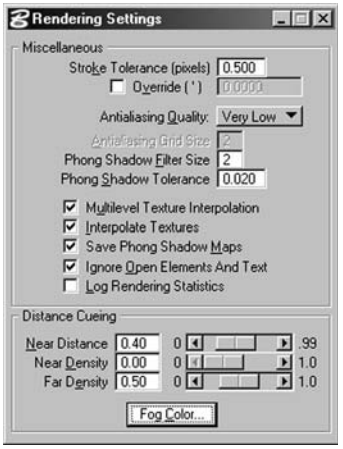
Bridge after applying fog.

You can see that adding a little fog adds additional realism to the rendered model. Items farther back in the view, including the background image, now look slightly hazy compared to the items that are in the foreground.

Remember that display depth affects the depth cueing of a view. Changing the back clipping plane adjusts where the fog is at a maximum, or far density. You also can change the values for the fog, as you will do now.

✔ Exercise 9-6: Adjust the values for fog

1 Open the Rendering Settings dialog box (Settings > Rendering General).



The Rendering Settings dialog box is where you make changes to distance cueing and change the density and appearance of fog and depth cueing.

2 Change Near Distance to 0.20.

Near Distance is a percentage of the distance measured from eye point to far clipping plane. This distance when set is seen as clear air before the fog begins.

3 Change the Far Density setting from 0.30 to 0.50.

4 In the Rendering View Attributes dialog box, turn on Fog for View 4.

5 Ray trace the current solution in View 4.

The view is rendered with the new Far Density setting, and you can see the fog is much heavier than before. The far density occurs at the back clipping plane for the view. The back clipping plane can be set using the Set Display Depth tool. Also you can see there is some clear air in the foreground before the fog begins.

Bridge with fog Far Density of 0.5 and Near Distance of 0.2.

Defining and Using Sky Cylinders

In the previous exercise, you used a background image which works well for still images. However, they do not work so well if you intend to create an animation or save a panorama. If, for example, you are animating a camera through a scene, the scene will move and change while the background image remains constant. This gives a very unnatural look to the animation. In addition, background images are not saved in panorama views. If you want a sky background to be saved as part of a panorama, you need to use either a sky cylinder or an environment map.

NOTE: *The procedure used to save a panorama image is covered in Chapter 12.*

Using a sky cylinder is an easy way to add a seamless sky background around a model. Several sky cylinder images are included in the image library data set delivered with this course.

✔ Exercise 9-7: Create a new material for the sky cylinder

1 Open ***sky cylinder.dgn***.

The design file consists of a large cylinder with the *bridge* render model and other models, attached as references, within the cylinder.

2 Select the Define Material tool.

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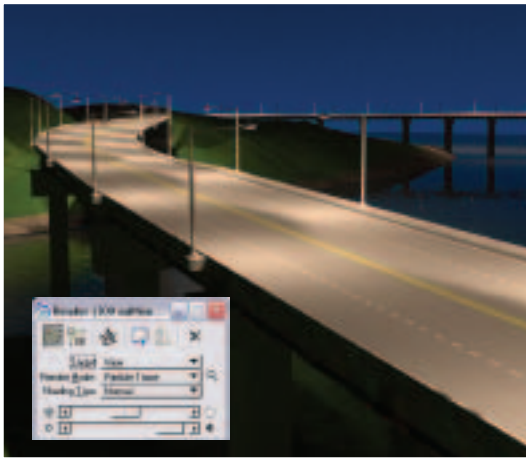
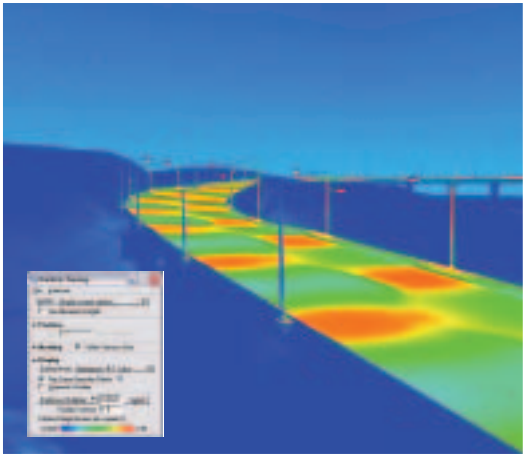


PARTICLE TRACED BRIDGE DESIGN



PARTICLE TRACED LIGHTING ANALYSIS

-"Rendering with MicroStation" is a must-have for architects, engineers, and CAD operators involved with 3D design. Through illustrations and hands-on exercises, this book covers every aspect of rendering in detail – including cameras, materials, lighting, environment maps, and rendering settings. Learn to use environment maps, sky cylinders, and procedural textures effectively, and to apply photorealistic atmospheric effects. Create photorealistic materials such as water, glass, trees, grass, brick, and stone. Apply different lighting techniques for rendering any interior or exterior scene, day or night, including sunset and twilight setups. Achieve photorealistic results by creating custom materials, and learn advanced rendering techniques for creating lighting solutions using ray tracing and particle tracing. Also included are inside tips for generating quality still images, network rendering, panoramas, and 3D content in PDF files.

"Rendering with MicroStation" is a must-have for architects, engineers, and CAD operators involved with 3D design.

INCLUDED ON CD-ROM:

All data sets used in exercises

RPC samples

Image library containing over 1500 textures

- patterns
- objects
- backgrounds
- environment boxes
- and more!

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