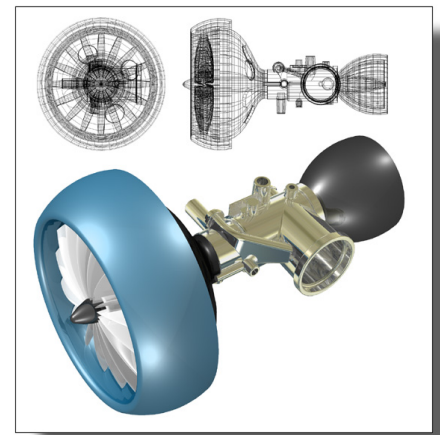


Rendering With IronCAD

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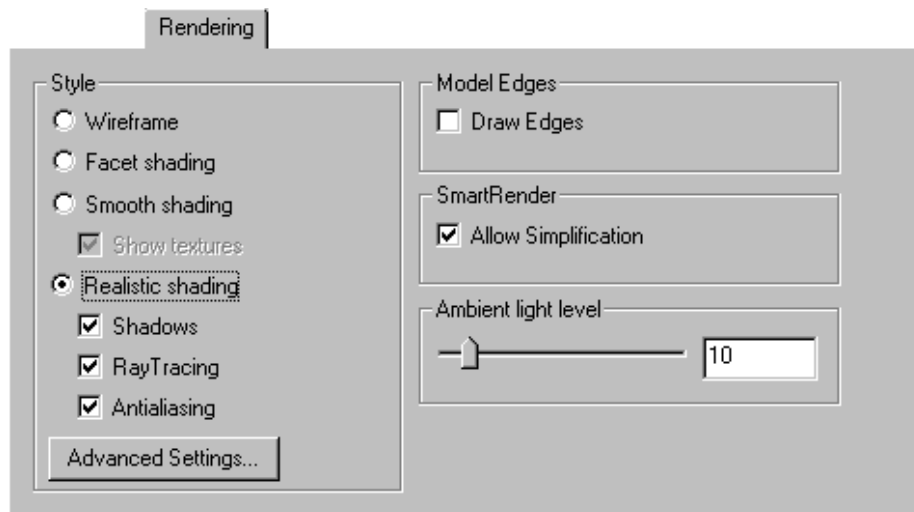


Introduction

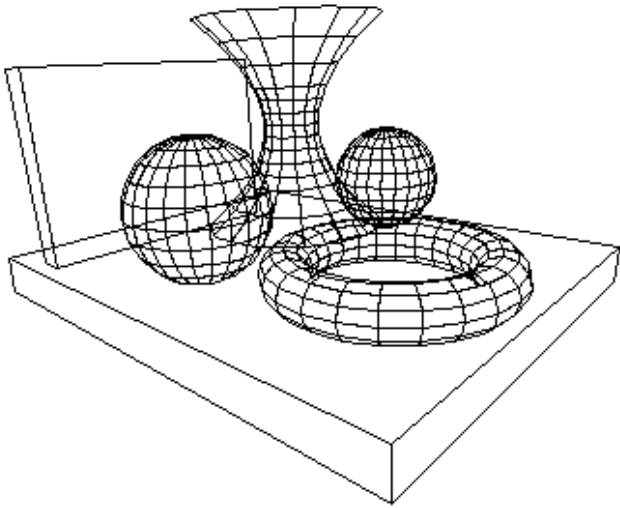
Creating effective, realistic images from 3D models sometimes requires a combination of both artistic and technical skill. This document describes how to use some of the best known practices (and some little known tricks) to create quality renderings using IronCAD. This document assumes some experience with basic operations such as using the selection and camera tools.

Rendering Levels

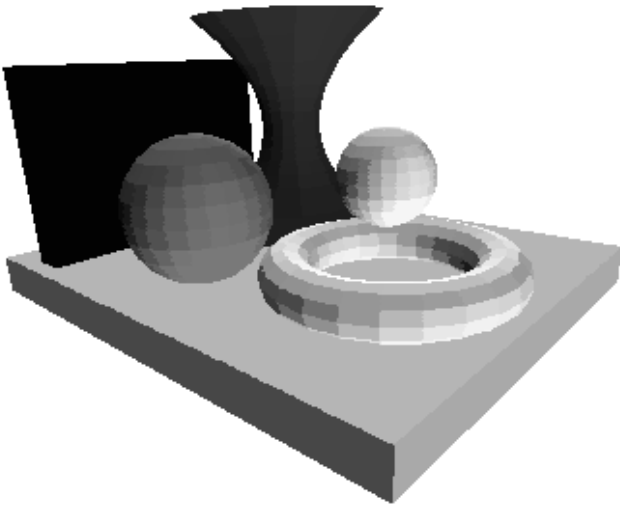
The variety of rendering styles available in IronCAD are shown in the dialog below. This dialog can be accessed from the Format menu, or by right clicking on the background of the scene and choosing 'Rendering' from the pop up menu.



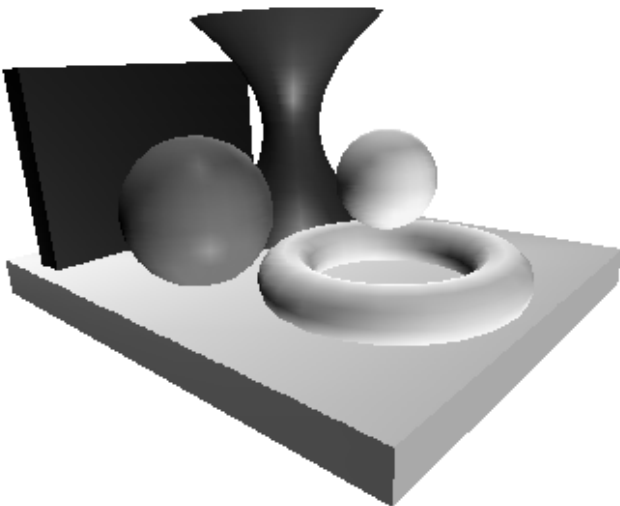
It is important to keep in mind that the best rendering style for many applications is not necessarily the 'highest' settings. The following is a series of images of the same scene, with different rendering styles and a description of when the style is most useful.



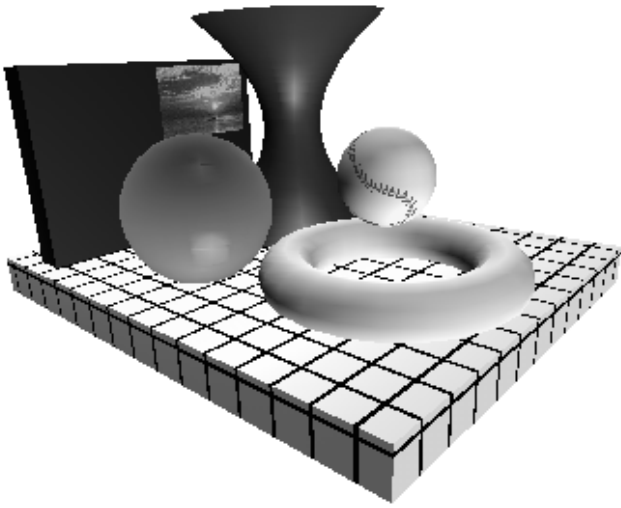
Wireframe - this style is rarely used for final renderings, unless there is a particular need to see the actual polygons on the models.



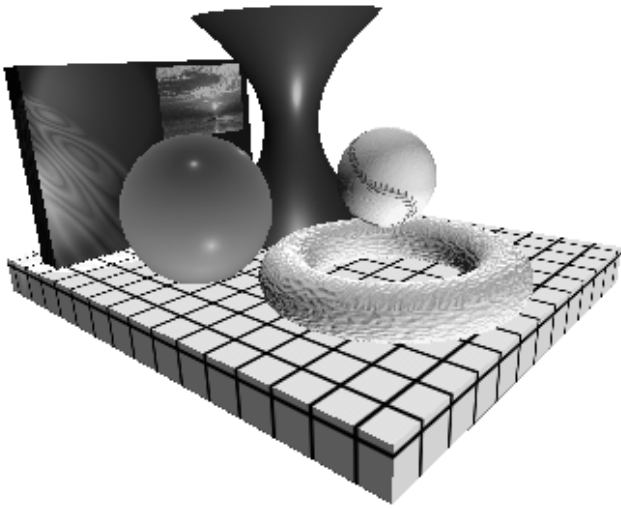
Facet Shading - as with wireframe, this style is rarely used for final renderings, unless there is a particular need to see the actual polygons on the models.



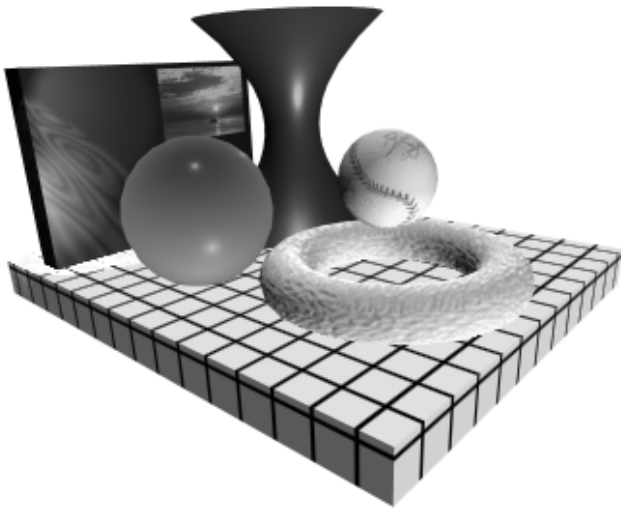
Smooth shading - this style displays models with continuously shaded smooth surfaces, which eliminates the 'faceted' look which is apparent with the wireframe and facet shading styles.



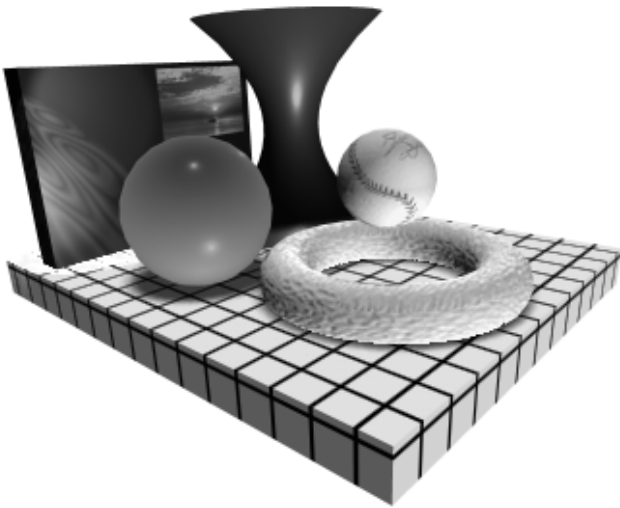
Smooth shading / show textures - this style displays models with continuously shaded smooth surfaces as well as any textures or decals that have been applied to model surfaces. Obviously if there are no textures or decals, this style will be identical to regular Smooth shading.



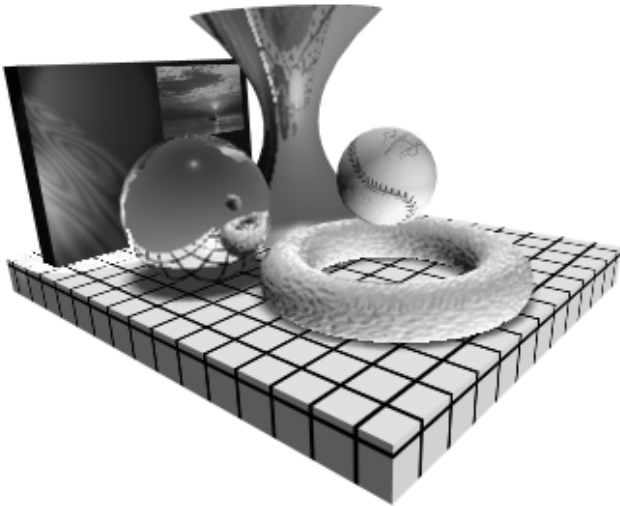
Realistic shading - this style displays more realistic highlights and textures than smooth shading. This style will also display the effects of spotlights and bump maps.



Realistic shading / antialiasing - this is the realistic rendering style with the addition of antialiasing, a rendering technique that eliminates the jagged edges to provide a much smoother, cleaner final result. This style of rendering is used frequently for final renderings and is the best choice for most purposes.





Realistic shading / shadows / antialiasing - same as above with the addition of shadows, which can add a nice touch of realism in some cases, however many times it can be distracting for visualization purposes, especially when there are multiple light sources which are casting shadows. Use with discretion.




Realistic shading / ray tracing / shadows / antialiasing - same as above with the addition of ray tracing. Ray tracing is rendering technique which is used to accurately depict reflective (e.g. chrome) and refractive (e.g. glass) surface properties. This requires much more time to render than other styles, therefore it should only be used when accurate reflective and refractive properties are absolutely necessary. In many cases, reflective surfaces can be simulated with 'reflection mapping' which does not require ray tracing.

Lighting

Proper lighting is essential for good rendering. The default lighting scheme in IronCAD consists of four directional lights, equally positioned around the center of the scene (see figure). This lighting scheme is intended to provide equal lighting from all viewing angles. While this is very desirable for modeling tasks, it is not usually the best lighting arrangement for good renderings. To quickly change the lighting for better renderings, follow these simple steps :

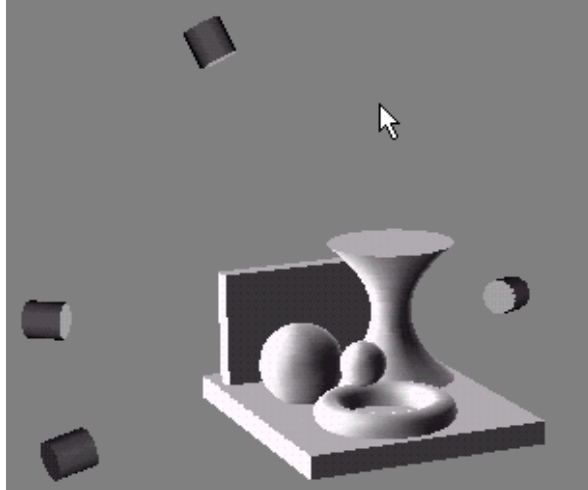
- On the camera toolbar, choose Save Camera . (saves the current view so it can be recalled later)
- From the View menu, choose Lights. (shows all lights in the scene)
- On the camera toolbar, choose Fit Scene 
- Click and drag the directional lights to get better highlights and contrast in the scene.
- From the View menu, choose Lights. (hides the lights again)

- On the camera toolbar, choose Restore Camera  (restores the previously saved view)

The figures below show an example of how dramatically simple lighting changes can improve an image. Note that both images are rendered with the same rendering style, only the default lighting has been changed slightly. Even more dramatic effects can be achieved by adding other types of lights (i.e. point lights and spotlights) and adjusting advanced light settings such as intensity, shadow softness, attenuation, etc.





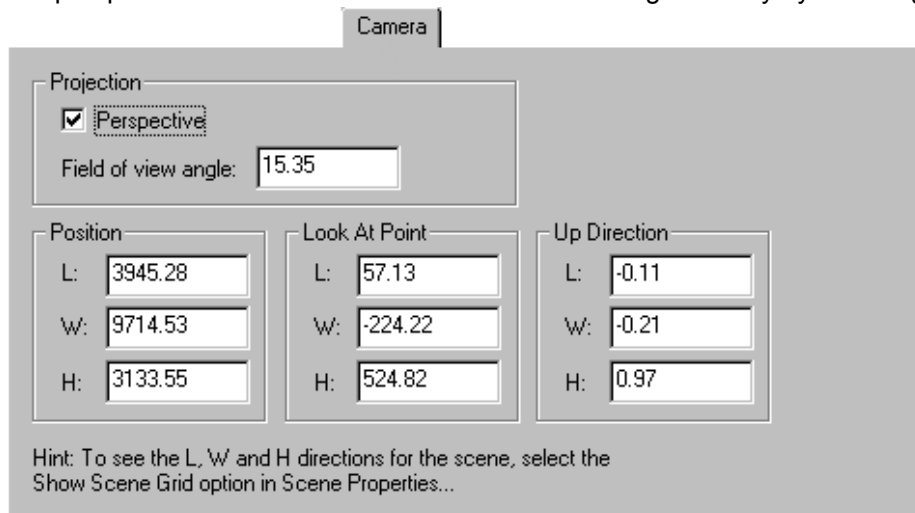
Default lighting.



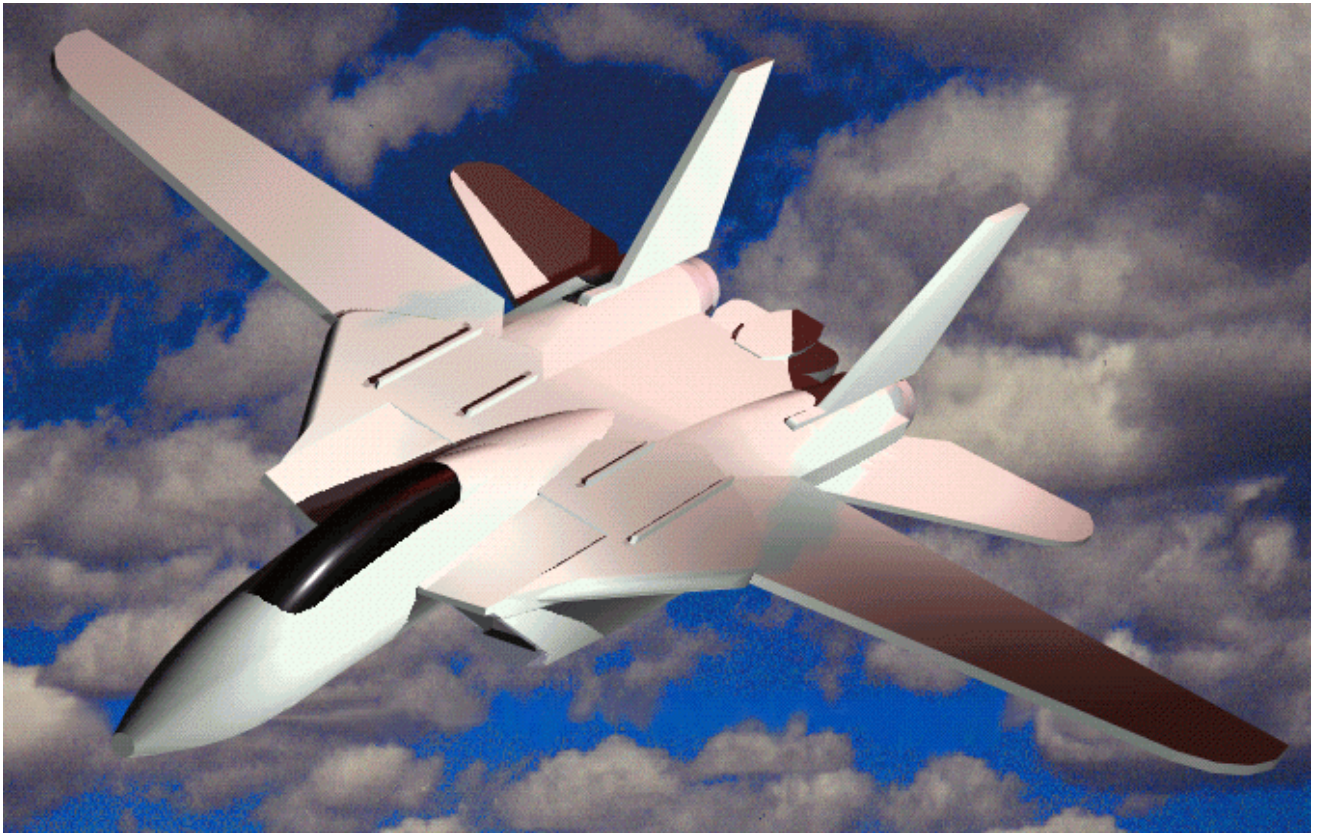
Scene after quickly repositioning the default lights.

Perspective

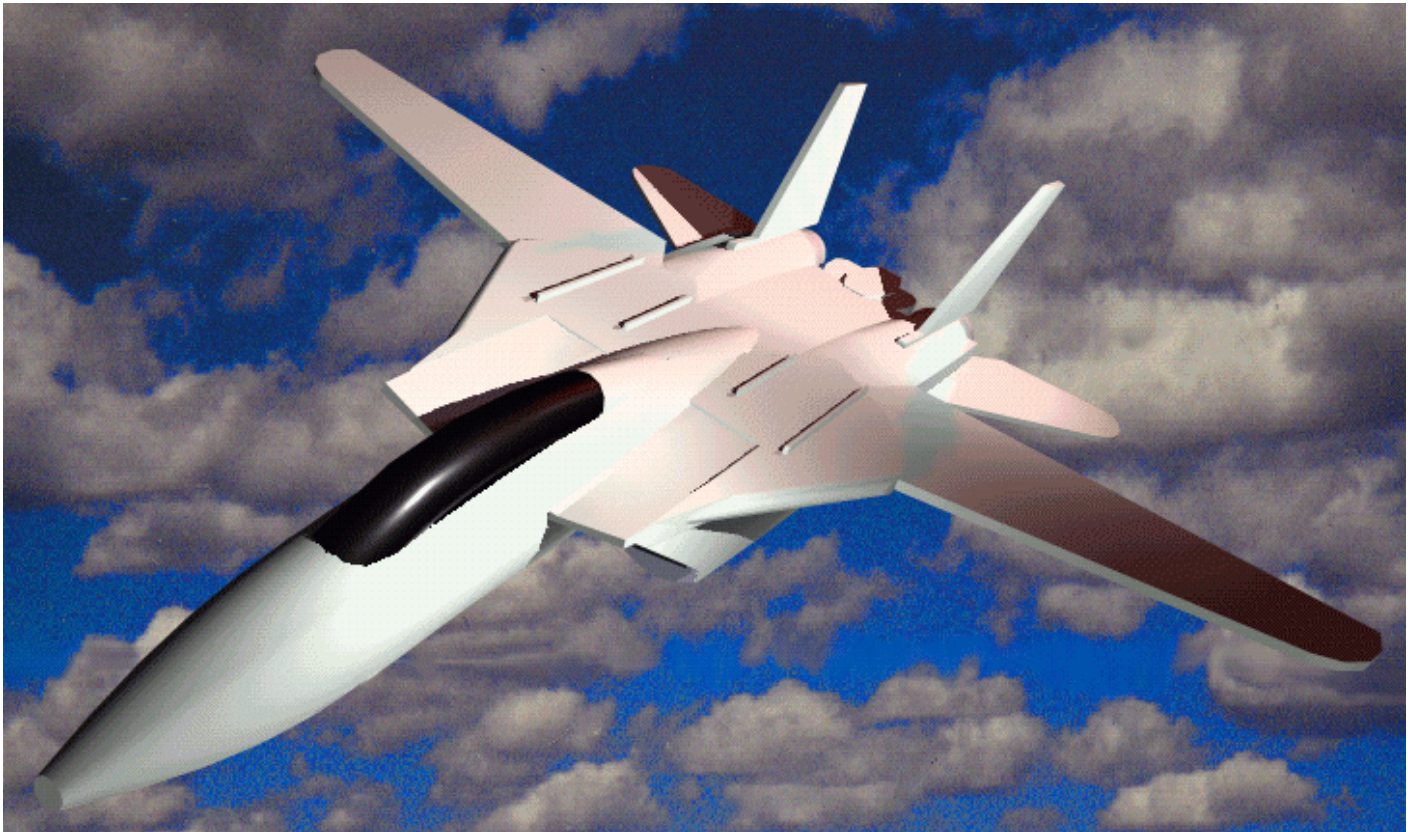
Adjusting the camera's perspective is an easy way to add a touch of realism to your rendering. To do this, use the zoom camera tool  to zoom out, then use the dolly camera tool  to move the camera forward. This will increase the 'field of view' of the camera, which will amplify the perspective. You can also edit the field of view angle directly by choosing Format / Camera.



Simply zooming in on a model or performing a fit scene does not produce an accurate perspective of a model.

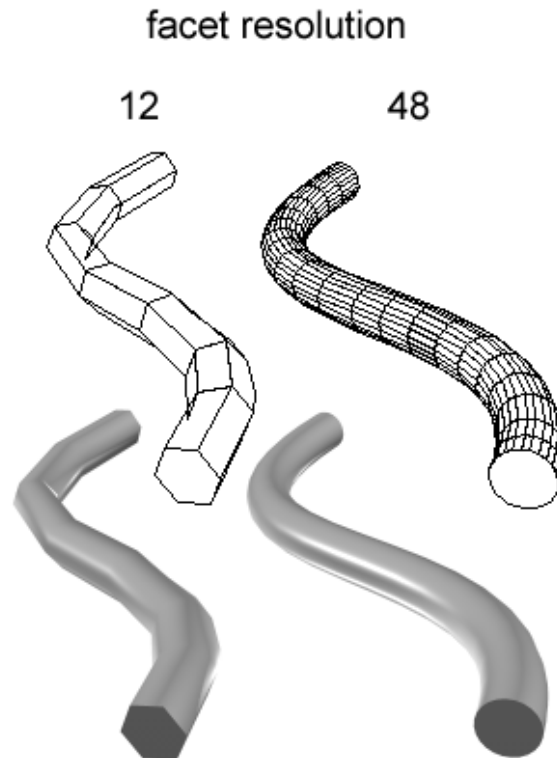
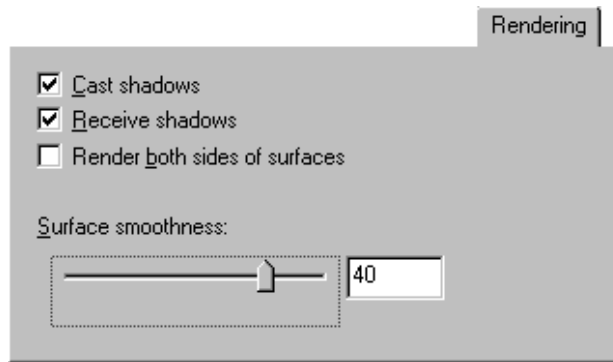


This image was created using a field of view angle of 45 degrees.



Surface Smoothness

If you have a solid or surface model, IronCAD allows you to increase the surface smoothness, a feature which is useful when rendering photo-realistic images within IronCAD. To do this, right click on a model and choose Model Properties. Choose the Model tab and increase the Surface Smoothness slider bar. The image below shows the effect of changing the surface smoothness. The slider stops at 50, for higher values type directly into the box.



Printing Images

When printing directly to a printer, IronCAD can sometimes create extremely large print spool files. As shown in the examples below, lowering the DPI settings in your printer setup can greatly reduce the size of the spool file. The following formula can be used to determine the size of your print spool file when printing from IronCAD.

Width (in.) x Height (in.) x printer DPI x Printer DPI x 3 (3 bytes per pixel)

Example: A user prints an 8.5 x 11 image at 600 DPI to an HP Inkjet

$8.5 \times 11 \times 600 \times 600 \times 3 = 96.3$ MB print spool file

Example: A user prints an 8.5 x 11 image at 300 DPI to an HP Inkjet

$8.5 \times 11 \times 300 \times 300 \times 3 = 24.1$ MB print spool file

Another way to get good printed output is to export an image file, then print from another image application (e.g. Adobe Photoshop, JASC Paint Shop Pro, Microsoft ImageComposer, Microsoft Paint, Corel Photopaint). This has proven to be a very effective way of getting high quality output.

Example:

Export an image as a .bmp image (1024 x 768 pixels).

Open the image in Microsoft Paint (automatically installed with Windows95 and NT).

Print the image to printer.

Rendering Time

There are many factors which can affect the amount of time required to render an image. The major factors are:

Rendering Style

Resolution (# of pixels)

Number of models

Complexity of models

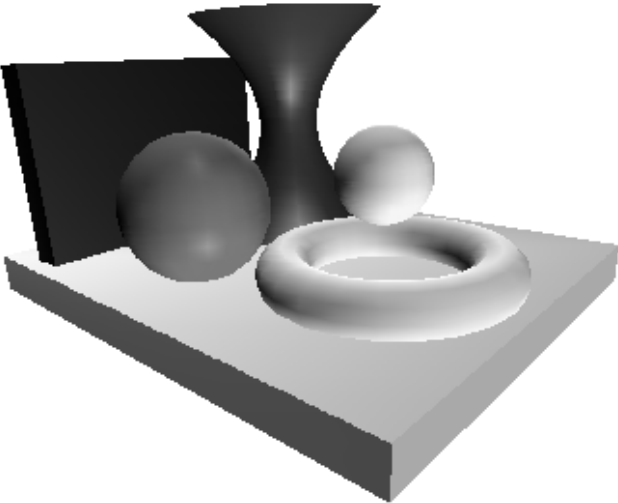
Surface properties (reflection and/or transparency)

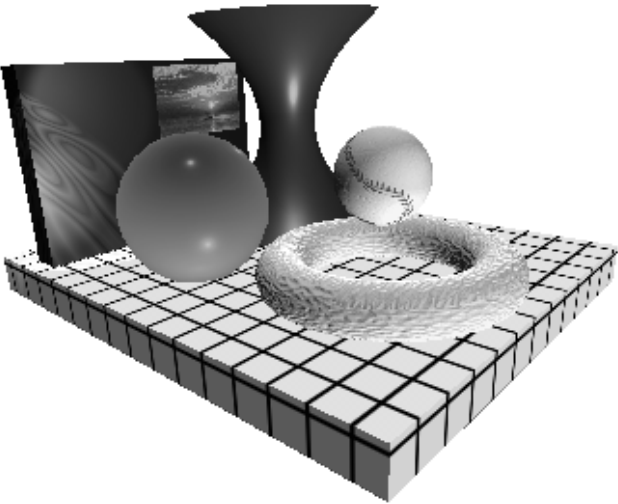
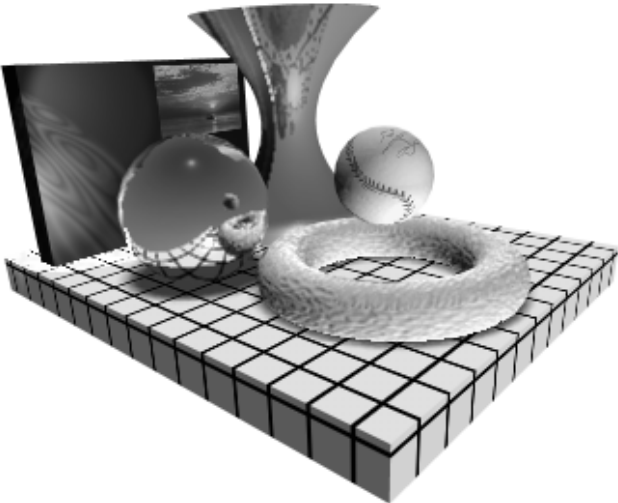
Texture image file size

The following is a table of rendering times for a sample scene.

System Configuration - 200 Mhz Pentium Pro with 64M RAM

Image resolution - 800x600 pixel, TIFF format

Rendering Style		Rendering Time
Smooth		< 1 sec

Realistic		7 sec
Realistic w/ AntialiasingShadows & Raytracing		66 sec

Exporting Images

In order to determine the best possible image export settings, it is helpful to know how the image will be used. The following table gives a few general guidelines on what settings to use for some different applications.

INTENDED USE OF IMAGE	SUGGESTED RESOLUTION	FILE FORMAT & advanced option settings	COMMENTS
Web Publishing	200x150 pixels (DPI unimportant)	JPEG (.jpg) - Medium quality - Progressive loading GIF (.gif) - min.storage depth	Small file size is extremely important. JPG is best for photo-realistic renderings.

		- interlaced	
High Quality Printing	??? x ??? inches 200 DPI minimum	TIFF (.tif) - 24 bit color	Specify the final print size size in inches. Obtain the DPI from the printer
General Viewing on desktop PC (e.g. embedding into MS Word / PowerPoint)	640x480 pixels (DPI unimportant)	BMP (.bmp) - min. storage depth JPEG (.jpg) - Highest quality	Use JPEG if possible to save on disk space. BMP is most universal.

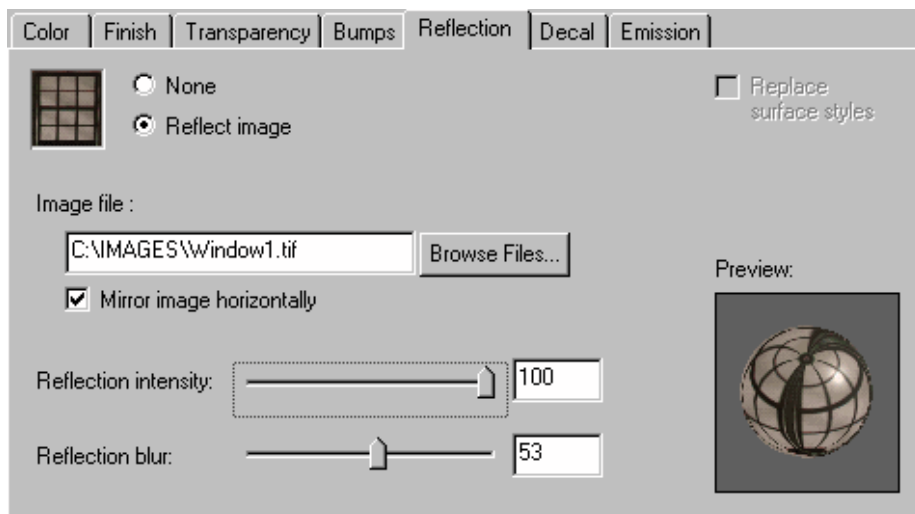
Reflectivity: Ray tracing & Reflection Mapping

As described previously, ray tracing is rendering technique which is used to accurately depict reflective (e.g. chrome) and refractive (e.g. glass) surface properties. This requires much more time to render than other styles, therefore it should only be used when accurate reflective and refractive properties are absolutely necessary. In many cases, reflective surfaces can be simulated with 'reflection mapping' which does not require ray tracing.

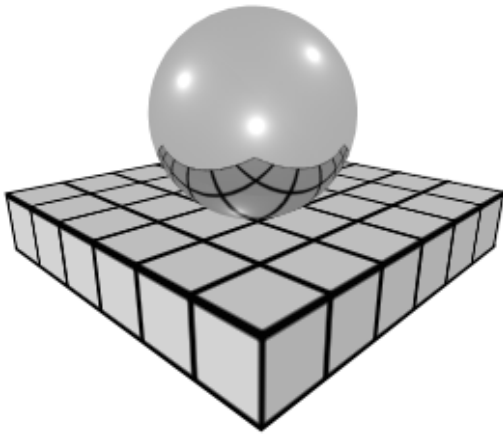
Reflection mapping is a rendering technique used to simulate reflections without using raytracing. This method requires an image 'map' of the environment to be reflected. Let's say for example you wanted a 'chrome' sphere to reflect a window pane. An image file of the window (e.g. 'winpane.bmp') would be specified as the reflection map for the sphere. Now the 'reflection' can be simulated without having to use the slower raytracing rendering style. This technique is also useful for simulating reflections of environments/objects that don't actually exist in the 3D scene.

To add a reflection map to an object, right click on it an choose SmartPaint then choose the Reflection tab. Specify the appropriate reflection settings. Note: if None is selected, The Reflection intensity and Reflection Blur settings will only be visible when using the 'ray tracing' rendering style.

Warning: The default red and white surfaces in IronCAD have a reflection intensity of 25. This value should be adjusted to an appropriate value (set to zero in most cases) before using the ray tracing rendering style, otherwise the rendering time may be greatly increased.



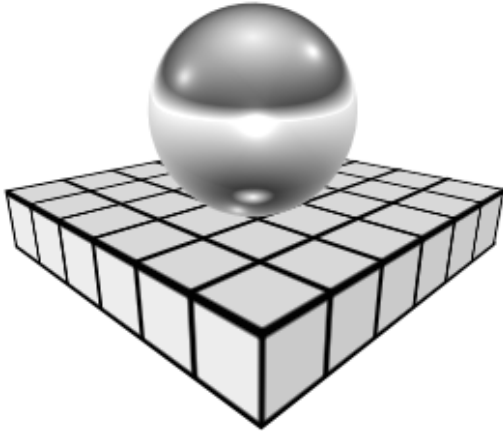
The following images are examples of the difference between the two techniques and also shows how the they can even be used simultaneously.



Reflection : 100

Reflection Map: NONE

Rendering Style: Ray tracing w/
antialiasing

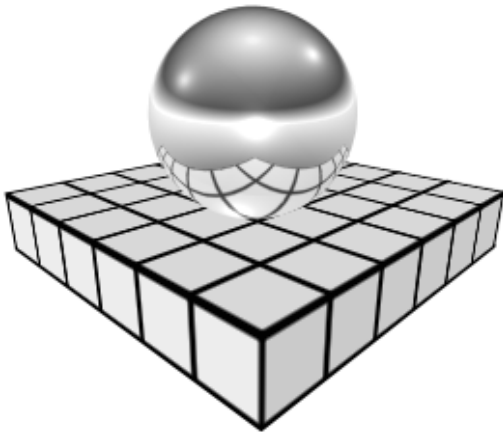


Reflection : 100

Reflection Map: 'chrome.tif'

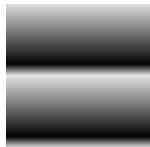


Rendering Style: Realistic w/ antialiasing



Reflection : 100

Reflection Map: 'chrome.tif'

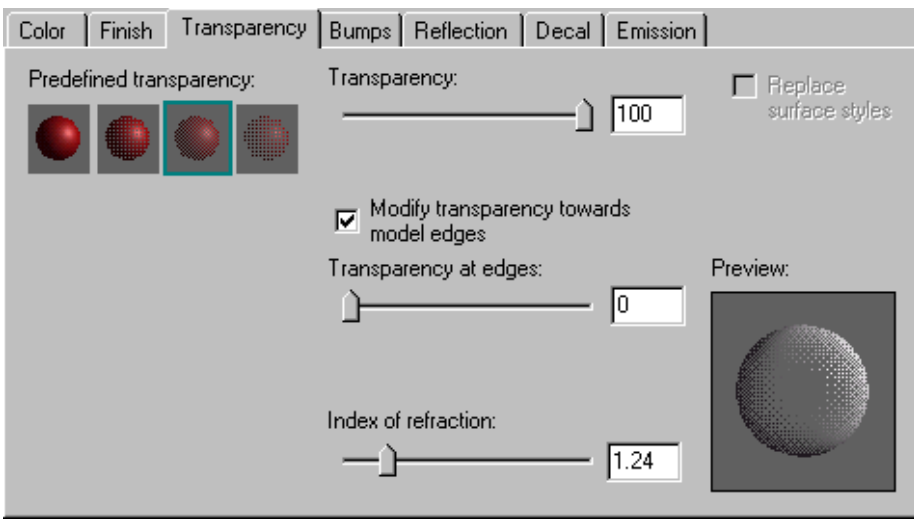


Rendering Style: Raytracing w/
antialiasing

Note: here Reflection mapping and
raytracing are used together to create a
realistic surface.

Transparency Effects

A variety of transparency effects can be achieved in IronCAD, depending on the surface and rendering style settings. To change the transparency of an object, right click on it and choose SmartPaint, then choose the Transparency tab.



The transparency setting controls how transparent the object is, with 0 being opaque and 100 being completely transparent.

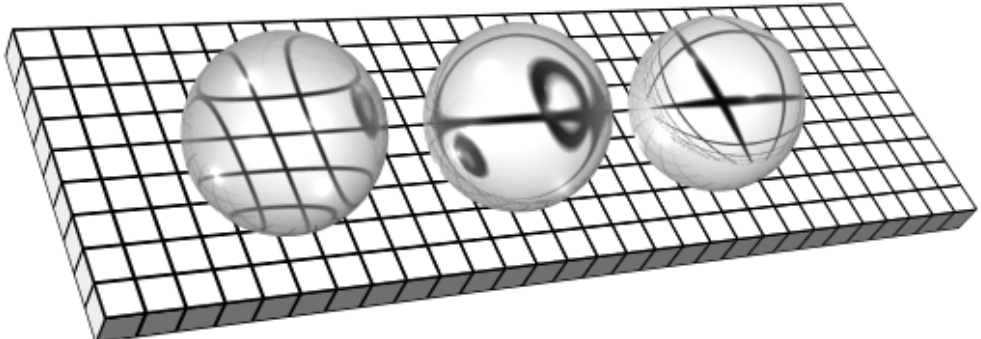
The Transparency at edges setting can be used to give a realistic 'glassy' effect to the edges. Ray tracing is not required for this effect.

The Index of refraction setting controls how transparent objects distort the light rays passing through them. This property can be thought of as a 'magnifying' property, and it can be varied to simulate real world materials such as:

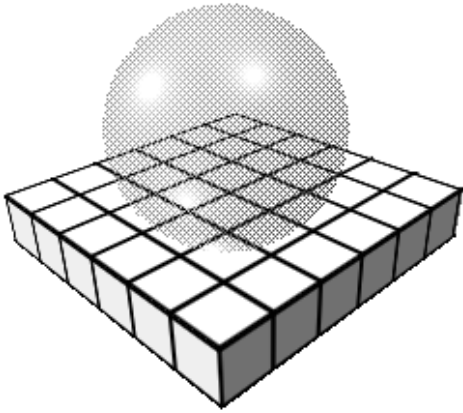
- Flint Glass: 1.71
- Crown Glass: 1.51
- Diamond: 2.47
- Water: 1.33
- Air: 1.00

index of refraction

1.1 1.3 1.7

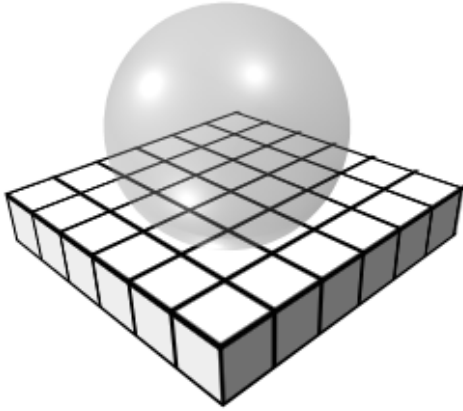


The most important point to understand about transparency is that for most situations, ray tracing is not needed to produce acceptable transparency effects. In fact, the refractive effects caused by ray tracing can be very distracting in situations where the transparency is being used for visualization purposes.



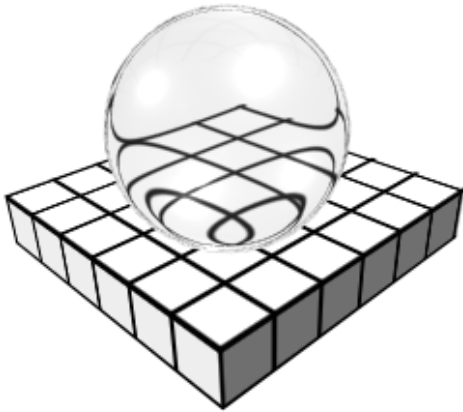
Transparency : 80

Rendering Style : Realistic



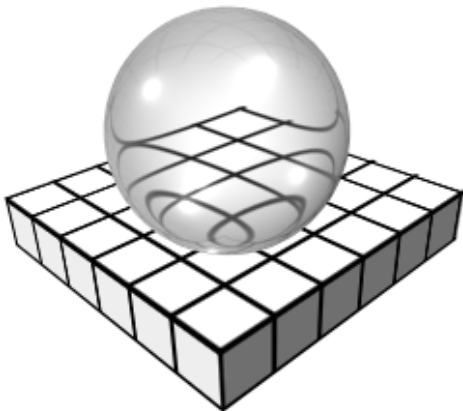
Transparency : 80

Rendering Style: Realistic w/ antialiasing



Transparency : 100

Rendering Style: Ray tracing w/
antialiasing



Transparency : 100 w/ modification at
edges

Rendering Style: Ray tracing w/
antialiasing

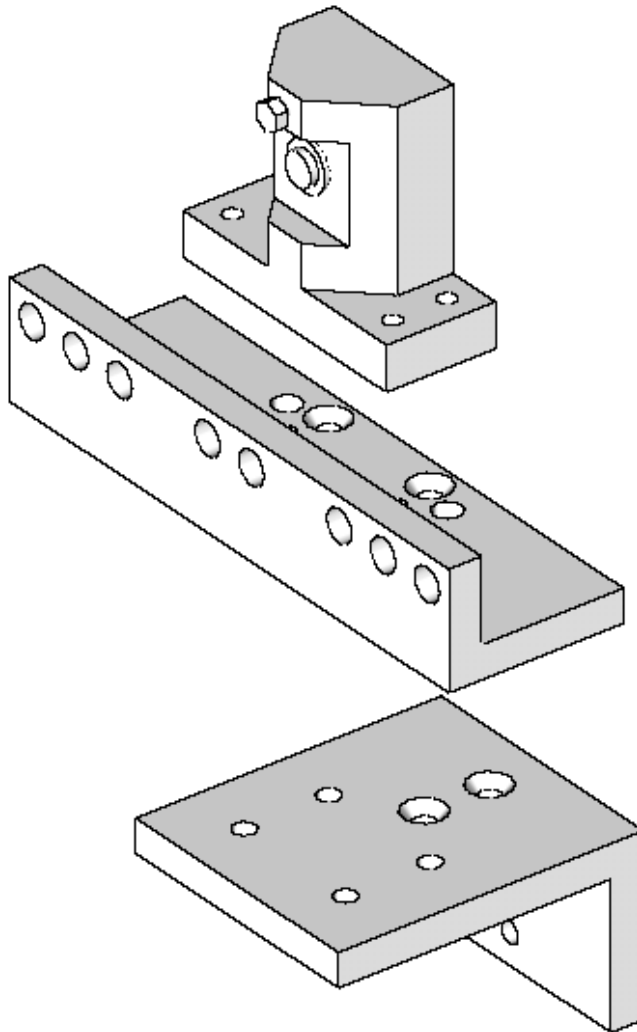
Draw Edges, Emission, and Technical Publications

Emission is a surface property that controls the 'brightness' of a surface. This property is intended to give surfaces a glowing effect, but it can also be used in conjunction with the 'draw edges' feature in situations such as technical publications to produce hidden line 'style' images. Although IronCAD cannot produce true hidden line drawings in the traditional sense, the following technique can be very effective in environments such as technical publications. To achieve this effect, follow these steps:

Change the background to white: choose Format / Background then choose white as the color.

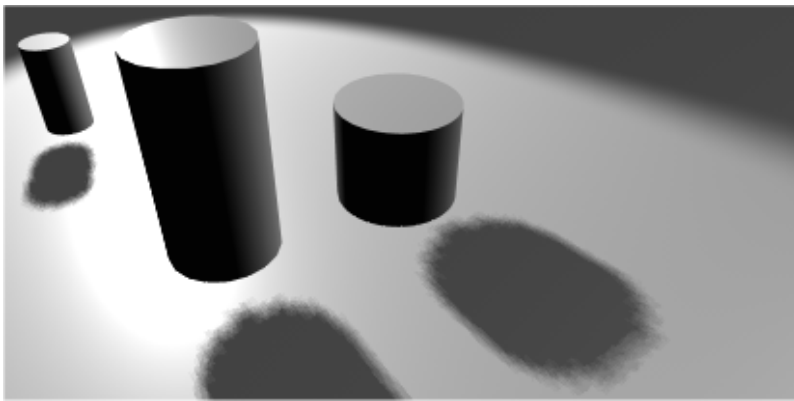
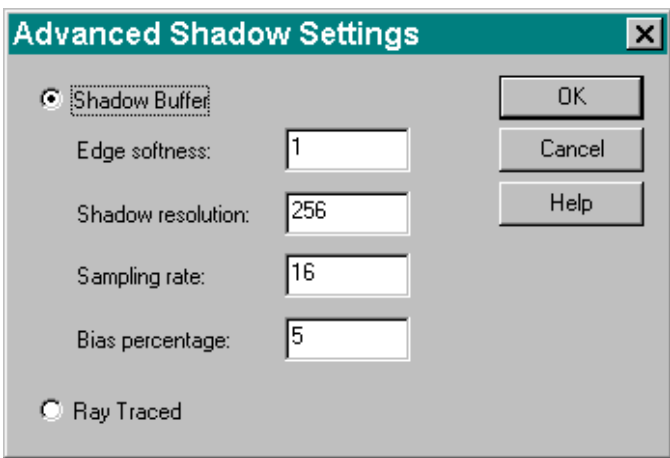
Change all surface colors to emissive white: right click on the model(s), choose Smartpaint, then choose white as the color, then under the emission tab change the value to 100 (for subtle shading effects, enter a lower value such as 20)

Turn on edges: choose Format / Rendering then check the box labeled 'draw edges'



Advanced shadow settings

The default shadow settings for lights are adequate for most cases, but sometimes shadow effects don't always turn out as expected. Here are a few common problems, with tips on how to eliminate them using the advanced shadow settings. These settings can be accessed by right clicking on a light and choosing Light Properties, then under the Light tab, choose shadow advanced settings.



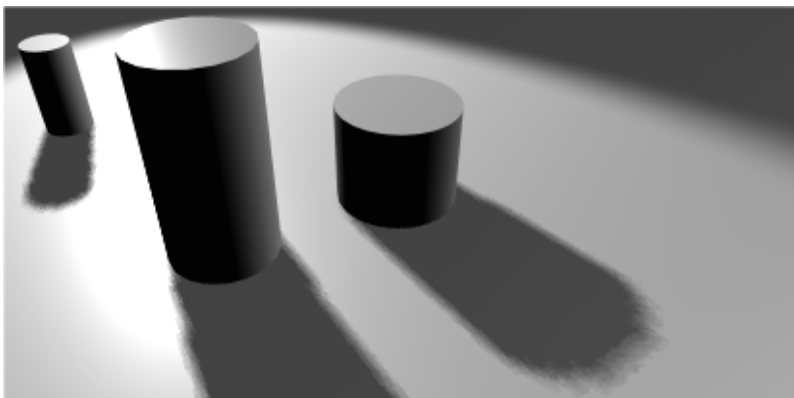
Edge softness: 1

Shadow resolution:
256

Sampling rate 16

Bias percentage: 5

In the image above, although the cylinders are actually touching the flat surface, the shadows are 'floating' away from the base of the object. Also notice the poor quality of the shadow edges.



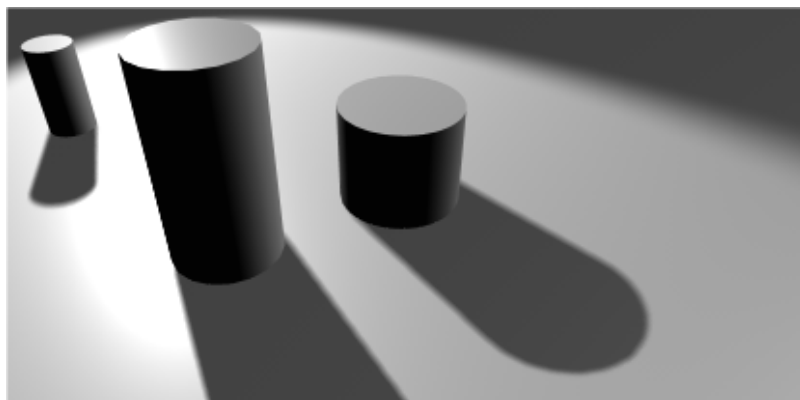
Edge softness: 1

Shadow resolution:
256

Sampling rate 16

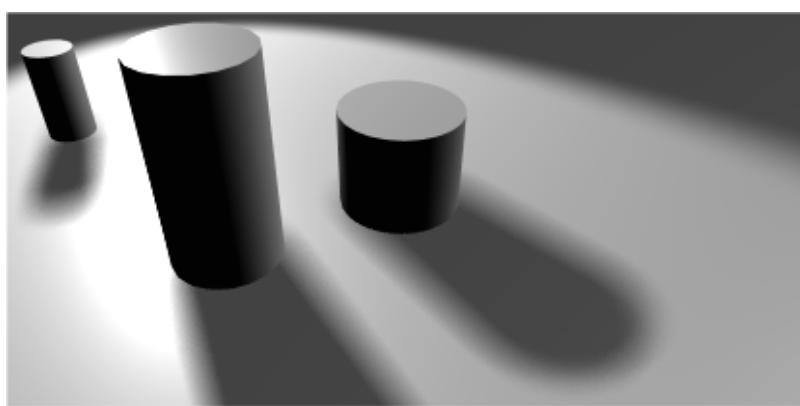
Bias percentage: 1

In this image, the 'floating' problem is eliminated by decreasing the shadow 'bias' setting. However the quality of the shadow edges is still poor.



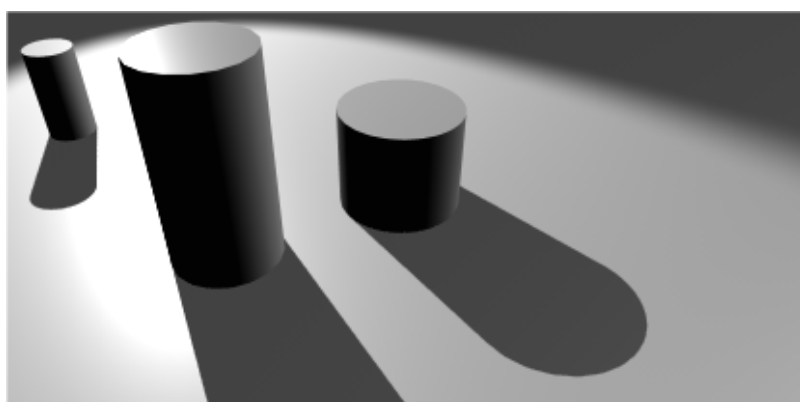
Edge softness: 1
Shadow resolution:
1000
Sampling rate 32
Bias percentage: 1

Here the quality of the shadow edges has been greatly improved by increasing the shadow 'sampling rate' and 'resolution' settings.



Edge softness: 15
Shadow resolution:
1000
Sampling rate 32
Bias percentage: 1

In this image the shadow 'edge softness' setting has been increased to produce a blurry shadow effect.



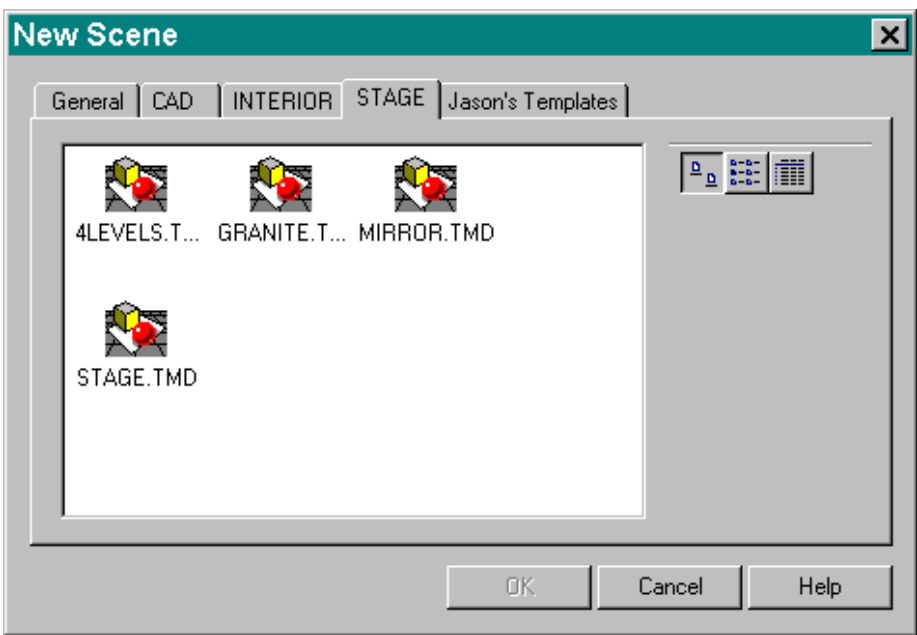
Ray traced shadows

This image shows the effect of 'ray traced' shadows. Ray traced shadows will eliminate the 'floating' effect and solve shadow edge quality problems, however this method can only produce sharp shadows.

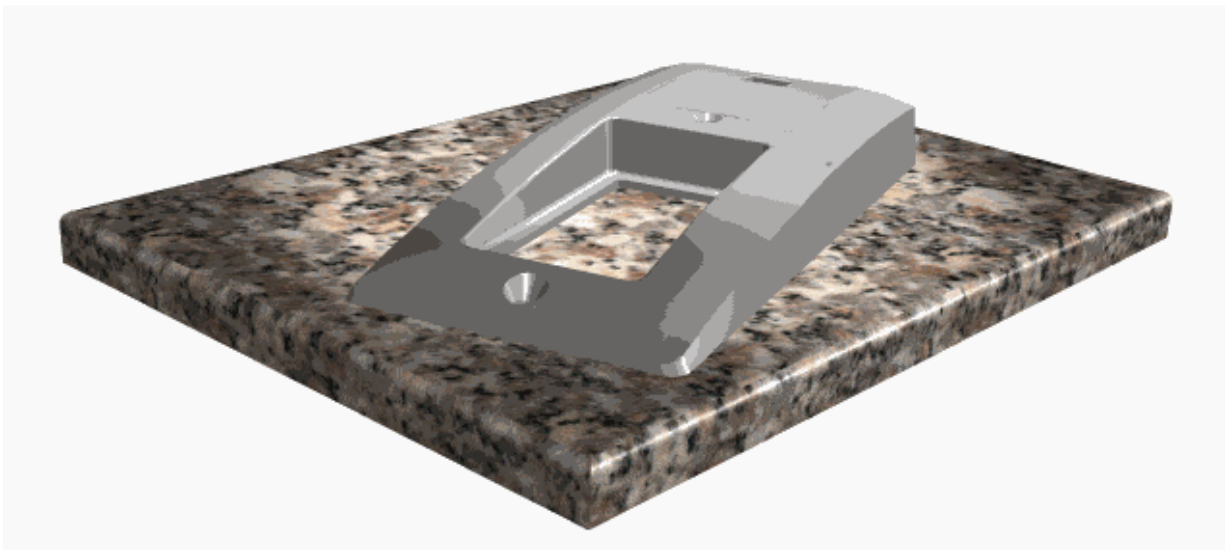
Templates

One of the quickest and easiest ways to create quality renderings is by using templates. IronCAD templates are simply blank scenes which have been 'preset' with various types of props, lights and rendering settings. To open a template, simply choose File / New, then choose the appropriate tab / file. Custom templates can be created by simply adding IronCAD files to the 'Templates' directory


where IronCAD is installed. Custom template 'tabs' can also be created by simply creating subdirectories under the 'Templates' directory.



For example, the image below was created in just a few seconds by opening the GRANITE.TMD template from the STAGE tab and dropping a part from a catalog directly onto the slab of 'granite'. The template already has the appropriate textures, lighting, and rendering settings to produce a high quality image.



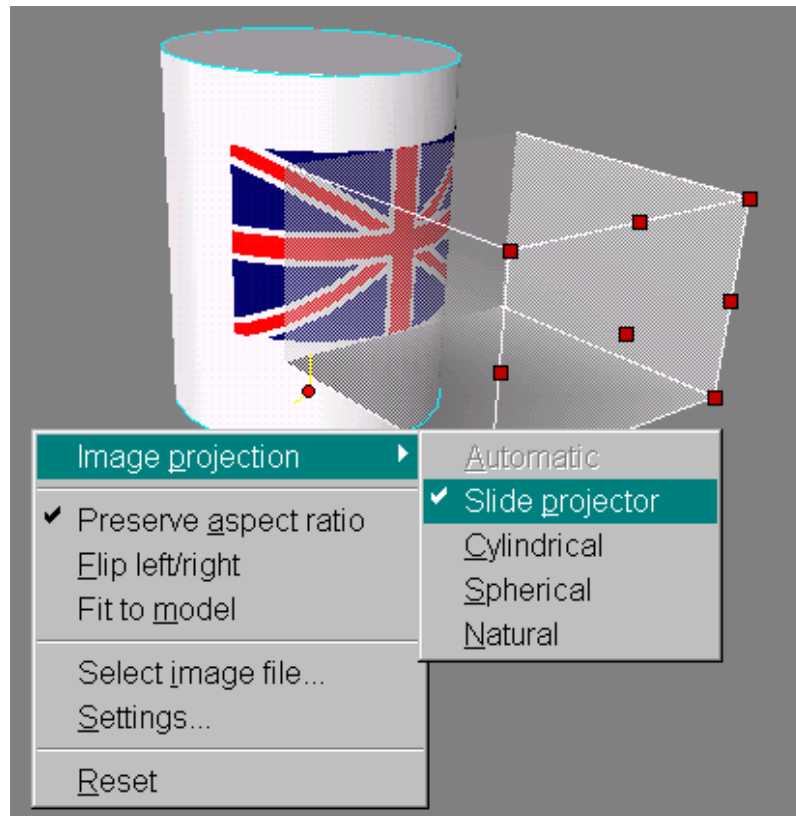
Projection Types

When applying any texture, decal, or bump map in IronCAD, a projection method is used to determine how the image is 'wrapped' onto the surface(s). There are a variety of interactive projection tools in IronCAD which allow the user to manipulate, position, and orient images directly on the object itself. When an object is selected, the appropriate projection type(s) will be highlighted on the editing toolbar (move texture, move bumps, or move decal).  These buttons can be selected to activate the interactive projection tool. As shown below, each projection type has an on-screen representation which can be manipulated with 'handles' (except for 'Automatic' and 'Natural' - see the IronCAD documentation).

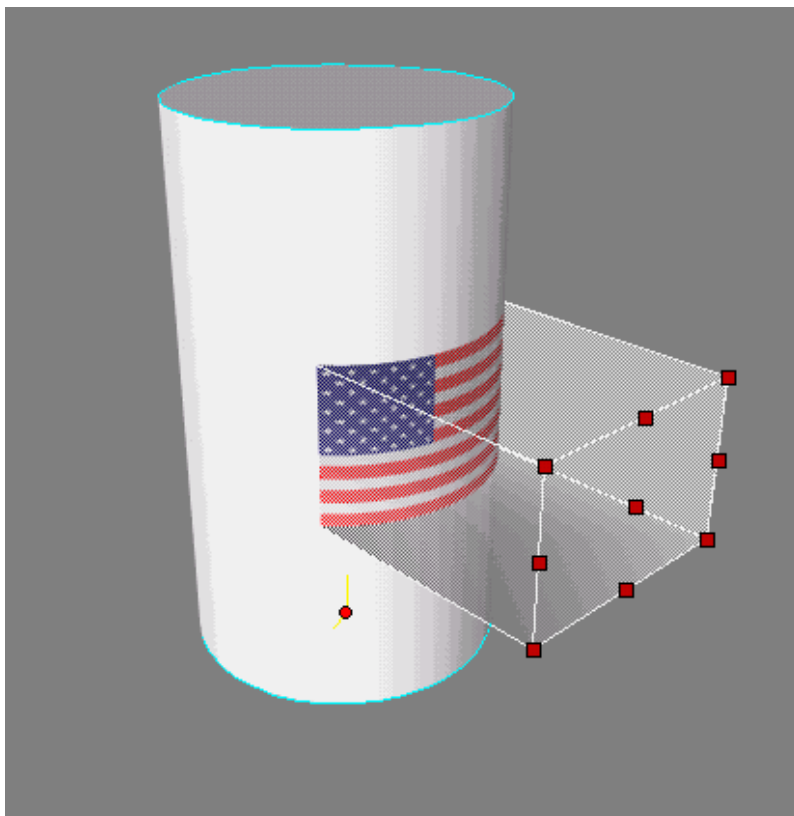
Tip: In addition to using the handles, the TriBall can also be used to manipulate the projection tools. To do this, just turn on the TriBall

when a projection tool is active.

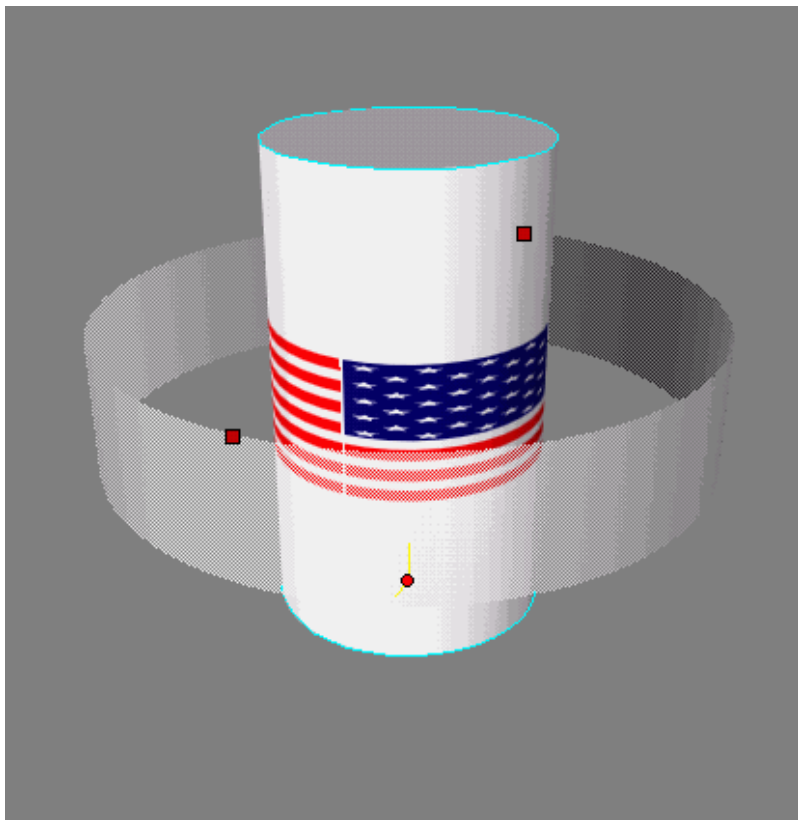
Tip: The projection type can be changed 'on the fly' by right clicking when a projection tool is active.



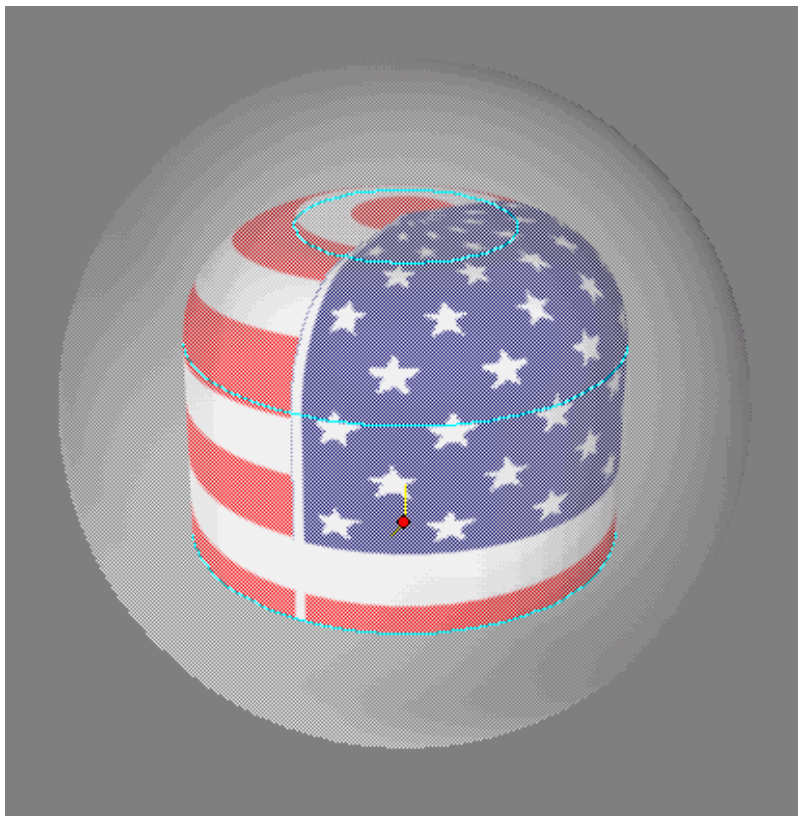
The Projection Tools:



SLIDE
PROJECTOR



CYLINDRICAL

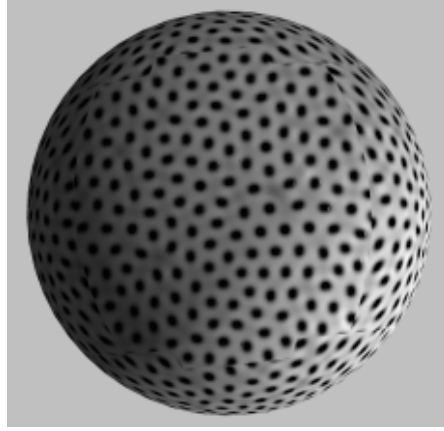


SPHERICAL

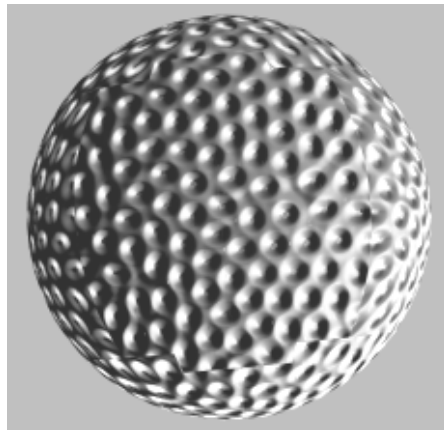
Bump Maps

Bump mapping is a rendering technique that uses an image file to give the illusion of a 3D 'bump' appearance to a surface. The image file and placement of a bump map is the same as that of normal textures / decals, but the way it is rendered is quite different. The following two images show the difference between using an image as a texture and as a Bump Map. The third image illustrates how Image Maps and Bump Maps can be used together to create very realistic surfaces. Rendering must be set to Realistic to see bump effects.

'SPOTS1.tif' applied as a Image Texture



'SPOTS1.tif' applied as a Bump Map

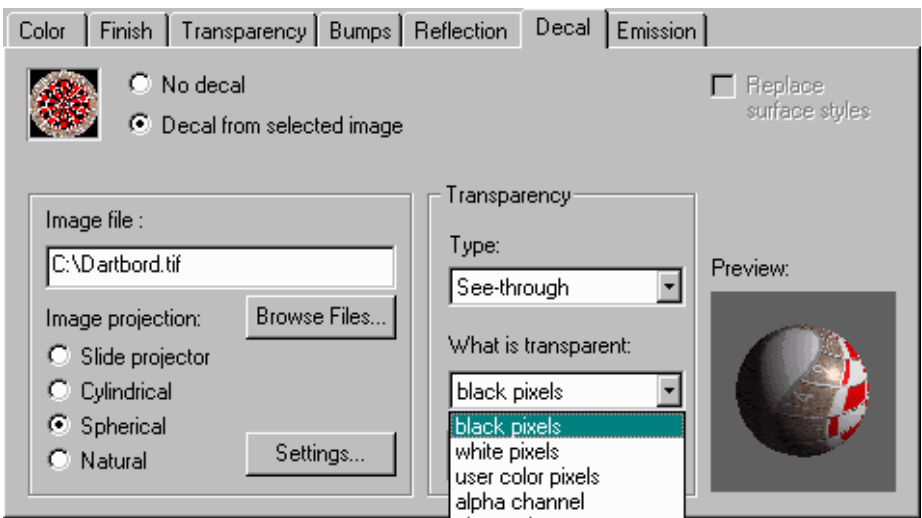


'RUST.gif' applied as an Image Texture AND Bump Map simultaneously Decals

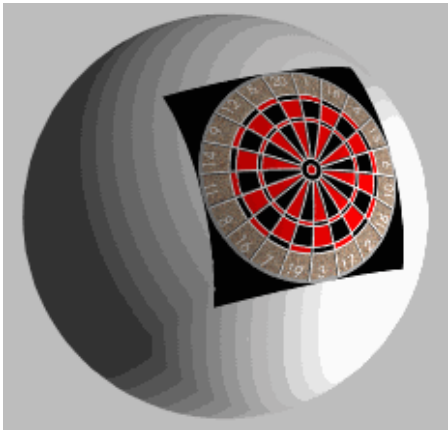


IronCAD allows the application of 'decals' to surfaces. Decals can be useful in applying company logos, labels, etc. to surfaces and/or models. Decals are different from textures in two significant ways: 1) decals are not repeated, or 'tiled' on the model surface. 2) decals have advanced transparency effects such as 'cut away' and 'see through'. Decals can be positioned and oriented in the same way as image textures and bump maps. To access the decal properties of an object, right click on it and choose SmartPaint, then choose the Decals tab.

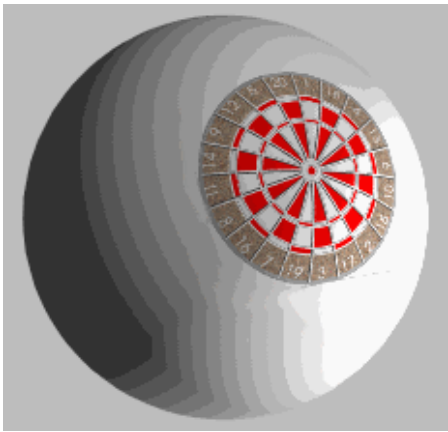
Warning: Decals can also be applied by dragging from a catalog, however this will override the other properties of the object such as color, finish, transparency, etc.



The most common use for decal transparency effects is to 'cut away' the background color of a decal image as shown in the second image below. The transparency effects can be applied to black pixels, white pixels, custom user colors or alpha channels (alpha channel is a 'masking layer' feature supported by some image formats such as TIFF and Targa). The custom user color can be very useful if the user knows the exact RGB values for the color they want to become transparent. Programs such as Adobe Photoshop can be used to determine alpha channels, RGB color values etc.



Transparency type: None



Transparency type: See through
 What is transparent: Black pixels



Transparency type: Cut away

What is transparent: Black pixels

Adding a custom SmartPaint surface to a catalog

1. To add a custom SmartPaint surface to a catalog do the following:
2. Open the textures catalog (or any catalog which contains a surface element)
3. Right click on any of the textures in the catalog and select Copy in the menu that appears
4. Create a new catalog by going to the Catalogs menu and selecting New.
5. Right click in the new catalog and in the menu that appears select Paste. This creates a new surface object in the catalog. The surface object will use the default IronCAD icon* in the catalog.
6. Double click on the surface object in the catalog. A SmartPaint dialog box similar to the one at right appears.
7. You can now adjust any of the settings in the SmartPaint Properties tabs to get the desired surface finish. For example, if you want a different image texture simply browse to the texture's location using the browse button, then click OK on the dialog box.
8. Note: To use your own custom icon, right click on the object in the catalog and choose 'change icon'. Then browse for the icon file (.ico) that you wish to use (there are a variety of shareware programs that will allow you to create your own custom icon files, e.g. Image Alchemy).