

# **Mastering Lighting In TurboCAD V11**

***By Kevin Doucette***

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## What This Book Is

The reason I've included this section is basically to remind you that this book is a book on 'Lighting' in TurboCAD. It is not a book on rendering or a book on Materials (Henry O. Hubich has created a magnificent book on that) but just a book on lighting in general.

I have included a small section on Environments and how they may affect a rendering but mostly the book was created to help you more understand what lights are and how to use them in your models. The images and pictures included were created to help you visualize each lighting effect and not to show how photorealistic TurboCAD can be. Many great lighting effects can barely be seen when used correctly. Because of this I've tried putting emphasis on the lighting itself and not the degree of realism in the renderings.

I include a section on 'light' in general. Understanding how light affects us in real life can only help your understanding of it within the realm of TurboCAD. You'll see how getting the right color temperature can improve a render. You will also find out the actual meanings of many light related features including: Intensity, Luminance, Illuminance, and many others.

You will learn about standard lighting in TurboCAD as well as the LightWorks Luminace light sources. Along the way you will learn what all the controls and settings mean and how each can effect your TurboCAD renderings. Every control used in TurboCAD lighting, including Luminace, is included somewhere in this book.

I actually found myself going back to it all the time as I was writing it. I learned more about lighting in TurboCAD than I had ever imagined before writing the book. If you're ever looking for information on lighting, or any other aspect of TurboCAD, I recommend using the TurboCAD public forums.

You can find the forums at <http://forums.imsisoft.com/forums/index.cfm?CFApp=200>. If you have a question someone there most likely has a very helpful and informative answer for you. Give them a shot.

Almost every aspect of this book is the same in TurboCAD v9 through v11. Although where it differs is has been stated. Yes, there are some aspects like HDRI which started with v10.2 but the majority of the information will be the same whether you're using TurboCAD v9, v10 or even v11.

This book has been about 2 ½ years in the making. Although it's the shortest book to date, it has to be the most complex. I hope it helps with all your TurboCAD work and gets you going in the right direction.

## Introduction

You just created a model and you seem to be having a bit of trouble getting just the right effects for the design. The lighting doesn't seem to be quite right and the textures seem to be off just a bit. This dilemma is not just one problem but actually two. One of the problems may be lighting while another problem may be due to materials use in the model. Quite often it's hard to tell which the real culprit is in these cases. This book will help you understand where your problems may lie as well as how to correct these problem areas.

Another aspect of TurboCAD which has risen in popularity over the last couple of years is the use of Luminance lighting in models. Luminance lighting is just another way in which you can add lighting to your TurboCAD models. This feature, first seen in TurboCAD v8 Professional, has become an integral part of model work in TurboCAD. This aspect of the program is also discussed in full later on in the book. Hopefully by the end of this book you will have a better grasp on how and where to use lighting effects in your TurboCAD models.

One question many people have brought up to me over the years is 'How do you know if the lighting in a rendering is good enough or not?' I've thought this over many times and actually given many different answers. I would say things like "Shadows should be dark" or "Objects should be highlighted enough to see good detail but not enough to produce white outs". Over the years I've changed my mind on these areas. I've finally come to the conclusion that "I" really don't know. Every person is different and each has his own preferences on what he or she considers good lighting. My answer these days sounds more like "If it looks good to you then it looks good to me". If you're still not happy with your work and can't quite seem to get it right look into the areas mentioned below:

1. If you want to add basic 'overall' lightness to a model use either Ambient, Eye or Headlight sources.
2. Shadows should be soft yet detailed at the same time. If the edge of the shadow is zigzagged then it needs adjusting.

3. Never have too much light as to 'white out' sections of your model. Sometimes 'hot spots' can not be helped but try to keep them to a minimum.
4. It's not always the light source's settings which are the problem. It may be the lights actual location which may be the problem. Many problems can be corrected by simple repositioning a light source.
5. The problem may be with the render mode used and not the lights at all. Always try and use the best render mode possible when viewing a possible finished product.
6. The problem might not be the lights at all. In the end it may be the materials used or the location of the camera in your model. If you just can't get the right result try moving the camera around a bit or adjusting the material settings of the objects in your model.
7. Your monitor may also be part of the problem. An improperly setup monitor can cause all sorts of grief when trying to get the right outcome. Your Brightness settings should be set at around 60% to 70% while the Contrast setting should be quite high. Mine is set at 90%. A warm temperature setting is a good idea as well. Objects look more realistic and 'warm' when this is enabled.
8. The screen resolution of your monitor also has a lot to do with the final product. The higher the resolution the better the result. I would recommend never using a resolution lower than 1024x768 with any 17" monitor or 1280x1024 for any 19" monitor. 1600x1200 is a perfect resolution for a 21" monitor. Of course these settings all depend on the actual monitor.
9. Finally, it may be the fault of your graphics card. While you won't have any problems with the majority of the graphics cards on the market today, you may see that specific settings can be adjusted to help with your 3D work in TurboCAD. Having a high enough 'Refresh rate' or adjusting the Hardware Acceleration may help quite a bit in your modeling. Also check to see if there is a Quality/Performance setting incorporated into the cards controls. It may be set at a "low quality, high performance" setting which is great for rendering speed but not good at all for the final quality of a rendered image. You can probably adjust the Gamma, Contrast and Brightness used in your monitor from the graphics card settings as well. Check to make sure they are sufficient for your needs.

# **Chapter 1**

## **“Light”**

Before you learn how to use light in your TurboCAD models, I thought it might be a good idea to learn about what light really is and how it works in real life. No, I won't go into the actual physics of light. You really don't need to know that light is actually electromagnetic waves moving through space. This really doesn't help in your use of light in your models.

However a few attributes about light might help you out. Learning the differences between real light and computer light, color differences of different light sources and light angle are just a few 'real' life attributes of light which may help you in your TurboCAD designs. They will be discussed in this chapter along with a few other topics which might spark your interest.

## **Real Light vs. Computer Light**

Visible light is comprised of the complete spectrum of colors. When light strikes an object, some color is absorbed by the object while the rest of the spectrum is reflected away from it in all directions. The amount of light reflected away from the object determines what color the object looks like to you. A white object will reflect all light while a black object absorbs all light. If an object takes on a red color it is because it is absorbing the red frequencies of the spectrum of light while reflecting the remainder. This type of color creation is called a 'subtractive' model because the light you see depends on what is subtracted from the total spectrum of color.

The human eye has red, blue and green receptors in it. These receptors interpolate the three colors and send signals to the brain, telling it how much of each color is present. This is how the 'real' light RGB color model works. The eye will pick up any light which has been reflected off of an object and tell the brain which colors have been found.

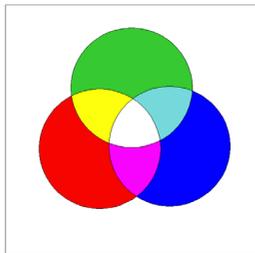
The brain then tells us which colors are left. These 'left-out' colors are what we take the color of the object to be.

Light created from a computer differs from that of 'real' light. A computer does not reflect light but instead creates its own light. While the spectrum created by a computer is not infinite as with 'real' light, it is still quite large. The average graphics card these days will produce several million colors. This should be enough for anyone!

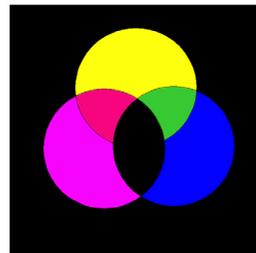
The RGB color spectrum for a computer is different than that of the real light model. The main colors in a computers RGB model are red, green and blue/violet.

This type of color creation is called an 'additive' model because the resultant color depends on the amount of red, green and blue colors added to the final product. A white color, using this method, would be created by adding the same amounts of red, green and blue colors to an object and not subtracting anything.

Of course a third color model is used when printing out your renderings. Many people have heard of the CMYK color model. This color model is comprised of four primary colors instead of the three seen in the other models. The base colors of the CMYK model are: cyan, magenta, yellow and black. This model was created because of the ink absorption qualities of paper. Because of this, it is known as a 'subtractive' color model instead of an additive one. A certain amount of each color is absorbed into the paper and what is left is what you see. The computers RGB model as well as the CMYK model can be seen in the image below.



RGB Additive



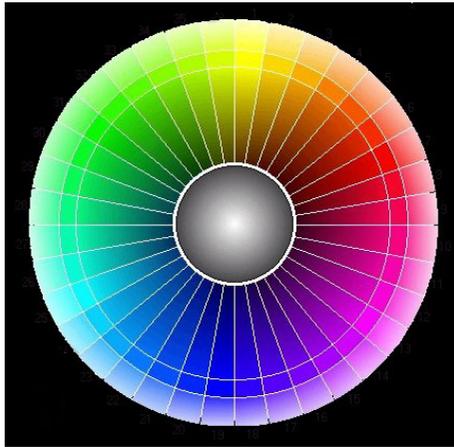
CMYK Subtractive

## The Color Wheel

A color wheel can be used to show the relationships between colors. This is just to show how the primary colors of the RGB model are grouped together. Below you can see that sequence of color in the RGB model. Blue + Green = Cyan, Blue + Red = Magenta and Red + Green = Yellow.



Finally, a 'real' color wheel can be created by taking in the factors such as luminance and brightness. A version of a 'real' color wheel or continuous color wheel can be seen below.



Of course, as mentioned before, all of these colors added together produce a 'white' color.

## Color Temperature

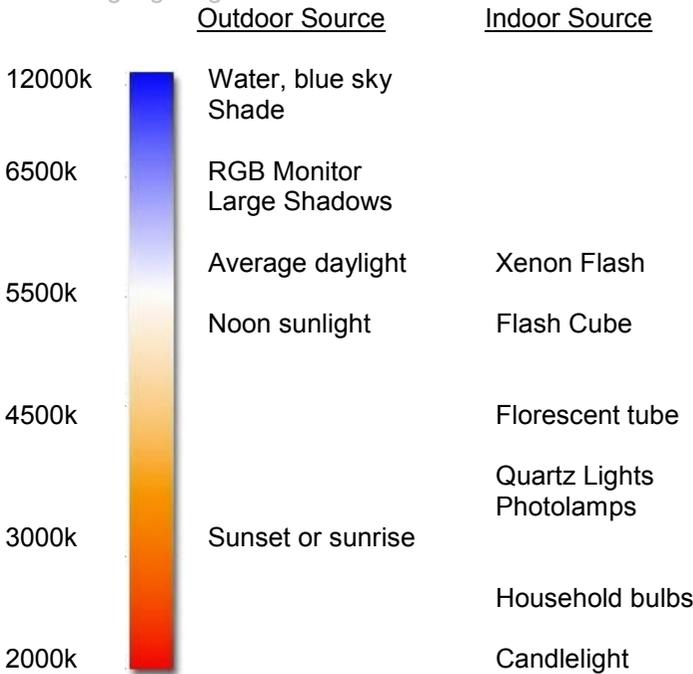
Color temperature is a straightforward way to illustrate the spectral properties of light. While real light color is determined by how much each point on the spectral curve adds to its output the outcome can be summed up in a linear scale.

The color temperature scale is used daily in the film photography field and is used for 'white balance' in all new digital cameras. Even more importantly, it is used in architectural lighting design throughout the world. Determining the right type of light for a room and how it is distributed throughout the room is an invaluable tool to architects and designers alike.

Degrees Kelvin is the standard unit used in color temperature where  $0k = -273.16^{\circ}C$ . This scale refers to the amount of heat it would take to 'black' object to produce light of the same color. In this scale lower colored temperatures (red to yellow) imply warmer light while higher colored temperatures (bluish) imply cooler light.

A good example of this scale can be seen on a good summer day. The day usually starts off with a low color temperature (blue) and ends with a higher color temperature near sunset (reddish). This knowledge can be used when deciding on the lighting of an area. Lighting with cooler light can be used during the day while lighting with warmer light can be used to supplement warmer light at night. These can be seen everywhere in real life. Even a match flame, which produces very little heat, can produce a warming effect while a fairly warm quartz lamp will produce a cooling effect to that same person.

Trying to figure out what light color you wish to add to a specific TurboCAD model may change greatly after referring to a color temperature chart. An example of a color temperature chart can be seen below.



## What is Light?

Power is a measurement which represents energy per unit of time. Power, when used for light, determines how much electric energy is produced by a light source. Of course electrical power is measured in 'watts' (volts x ampere). The amount of watts produced really has no indication on how much light is produced by a light source. To do this we must know how much power supplied to the light is transformed into visible light. This is the efficiency factor of the light source. Using the efficiency factor along with the amount of watts produced we can determine the output power of a light source.

The amount of energy emitted by a light source in a unit of time is called its luminous flux and is measured in lumens. To show an example of this a standard 100 watt light bulb produces 1600 lumens of light. The amount of lumens produced indicates the brightness of the light source. It is telling you how much energy is produced and emitted by the source.

The amount of energy emitted by a light source in a unit of time, in a specific direction, represents its luminous intensity. This is the intensity of the light source.

## Light Intensity

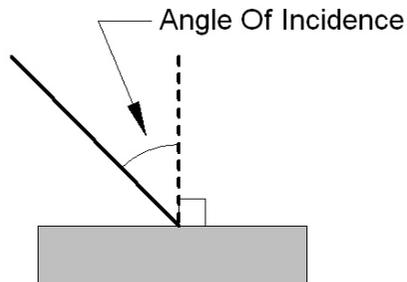
Another aspect of light which affects all CAD users is light intensity (as mentioned above). Light intensity refers to how bright or vivid a specific light is. Light intensity is measured in 'candelas'. The higher a lights intensity, the brighter the light on an object becomes. Of course, if the light intensity of a light source is too large the effect can be that of a flooded area or 'hot spot'. The specular highlights become very high and brilliant. This is often known as 'blowing out the highlights'.

While some amount of hot spotting may occur in your modeling it is advised to keep these to a minimum. If you end up with flooded areas it is probably a good idea to turn the light intensity of the specific source down a bit. Changing the light color usually does not help in this area.

In photography, a very high intensity light produces what is commonly known as 'over exposure'. The same can be said in CAD. It is sometimes possible to partially correct an over exposed image with the use of other controls such as Contrast but this really doesn't produce a better image. It instead just masks the problem areas a bit.

## Angle Of Incidence

The Angle of Incidence is 'the angle between a ray of light incident on a surface and a line drawn perpendicular to the same surface. How light is reflected off an object and into our eyes also determines how bright an object appears.



If a light source is reflected off of an object directly into your eyes the object will appear to be very bright. By adjusting the angle of incidence even a slight amount can change the appearance of the object greatly.

Keeping this in mind, you may not need to lower the light intensity of a specific source but instead simply redirect the angle of the light source slightly. Lowering, raising or moving it left or right can all change the resultant image significantly. You may find that simply repositioning a light source can do away with light 'flooding' altogether, without adjusting the light intensity at all.

In real life, and in CAD, light will not only reflect off of an object and into your eyes but will also reflect off of an object and onto other objects. These object will intern reflect the light to other objects, and so on. This effect is called 'radiosity'. Many know of the Radiosity render mode integrated into TurboCAD but do not know that this is based on a 'real life' phenomenon.

How radiosity works in TurboCAD is based on the number of polygons used in the model. Each 3D object in a TurboCAD model is made up of a series of polygons also known as 'patches'. The amount of patches found in a model determines the final result of the rendered image. Each patch absorbs a certain amount of light which it has received from a light source or from being reflected off of another object. It then reflects the remainder of the light off in many directions. The amount of light reflected away determines the light intensity of that patch. The amount that is absorbed depends on many aspects of the patches makeup. The angle of incidence and the color are just a couple of the variables taken into consideration at this point. The light keeps moving around like this until all of it has been absorbed.

What makes the 'radiosity' render mode so effective is that it is probably the most realistic mode available. Because the algorithms are relatively extensive, render times using radiosity mode can be quite lengthy. The resultant rendered image is usually worth the effort though. Shadows are more realistic and light distribution in the image should be near perfect.

## Attenuation

Another aspect of light which affects both real life objects as well as their CAD counterparts is the phenomenon known as 'Attenuation'. While the Angle of Incidence has to do with light reflecting off of other objects, attenuation has to do with light weakness or strength do to the distance an object is away from a light source. Attenuation is the deteriorating of light over a distance due to energy loss through dust or vapor in the air.

Both light and sound are affected by attenuation. As light passes through space part of it is absorbed by the dust particles or hydrometeors found in the air. TurboCAD is set up to mimic attenuation in many of its rendering modes. So another way to fight light intensity may be to move a light source closer or further away from a specific object. Hey, I never said it would be easy!

## Luminance

Put all of these qualities together and you get the 'Luminance' of an object. Luminance is actually a synonym for 'luminosity'. It the basically the amount of light, that hits an object, and bounces back at a given direction. Luminance is measured in 'candelas'.

Measuring an objects luminance depends on the attenuation, the angle of incidence and light intensity. Each of these can change the luminance of an object greatly with just a small change in value.

## Brightness

Brightness is an attribute of light which we (humans) assign to an object. We may say an object is dimly lit or brightly lit. This is how we perceive an object and it is not a measured value.

Brightness is what we see when lumens hit the eye. The sensitivity of the eye decreases as the extent of light increases. While brightness resembles luminance in some ways, it is not the same because it can not be measured in any way.

We can measure the luminance of an object using a photometer. This photometer usually has one to three photo detectors, while the human eye has many detectors. It is this high complexity of the eye which allows us to see brightness but unfortunately not be able to measure it.

An example of brightness vs. luminance can be seen everyday life. Just think of when you look at a computer screen. The luminance of any point on the screen can be measured using a photometer. To go a bit further you can take a reading at a different point on the screen. With these readings you can then calculate the differences and contrast between the two points. The human eye is much more complex and sees a lot more than basic luminance. Items such as time-dependant light and dark adaptation, simultaneous contrast, color and other specifics are all taken into consideration by the human eye. This is how brightness is registered.

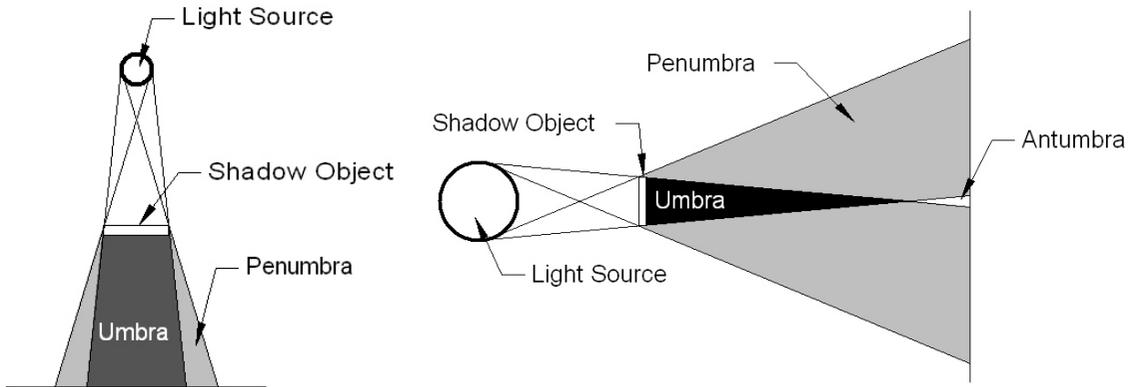
## Illuminance

Finally, the last aspect of light you need to know is 'illumiance'. This describes the amount of lumens (luminous flux) that strikes an object in a specific unit of area. Basically it is how bright a source of light (object) appears to the eye. Illuminance is measured in 'lux' or 'foot-candle'. One foot-candle is equal to one lumen per square foot. Illuminance can be very useful when needing to measure the light intensity on a specific area of surface on an object.

In real life you may need to design an office with a specific working area. Some building codes require a minimum amount of foot-candles in an office space to ensure proper lighting on a desk. A good illuminance for a desktop work space would be 30 to 50 foot-candles. Recommended illuminance levels may differ due to the tasks being performed though. You can figure this out using illuminance.

## Shadows

Another intricate element of lighting is shadows. Shadows are created when a light source is blocked from any object creating a darkened area where the light was blocked. A shadow is made up of three distinct elements; umbra, penumbra and antumbra. Each part of is located in a separate section of the shadow.



## Umbra

The Umbra is the main part of the shadow. This is the darkest part of the shadow where the majority of light is blocked by an object. The shadow density in this area is constant since no light enters this part of the shadow.

## Penumbra

The Penumbra is the boundary area or the outer section of the shadow. It appears as a hazy or partially lit shadow. This part of the shadow is not as dark as the umbra since some light can be seen in it. The penumbra gets darker the closer you get to the umbra.

## Antumbra

The Antumbra is the extension of the umbra when the light source and shadow objects are positioned at points where the extension of the umbra can occur. This part of a shadow is not as dark as the umbra but does not contain as much light as the penumbra. You are within the antumbra of a shadow if you are within a total eclipse of the sun where you can see a ring of the sun around the edges of the moon.

# Material Light Qualities

Objects (materials) have many qualities which affect how any object is perceived depending on the material makeup of the object. While this book does not deal with material aspects of the program I will discuss a few material qualities which do affect real life objects as well as TurboCAD created objects. These aspects include the: Diffuse factor of a material, the Specular factor of a material and the Ambient factor of a material. Each is a real life characteristic that is also found within TurboCAD's material settings. Each setting can be found on the Reflectance tab of the Materials Editor for any specified object. These settings represent 'real world' characteristics of objects and try to help TurboCAD create the most photo-realistic images possible.

## Diffuse Factor

The definition of 'diffused light' says "subjected to scattering by reflection from a rough surface or transmission through a translucent material; "diffused light"".

When an object is made up of a material which has a high 'diffused' factor it will look rough or have a dull (matte) finish. This is because when light strikes an object possessing a high diffused factor the light reflects off in every direction not just one (as with a mirror).

## Specular Factor

The definition of 'specular' says "Having the qualities of a speculum, or mirror; having a smooth, reflecting surface; as, a specular metal; a specular surface."

When an object has a material which has a high 'specular' factor it will look smooth and mirror like. An object will reflect light in only one direction with this material makeup. The higher the specular factor the more of a smooth mirror like appearance the object will have.

## Ambient Factor

This is the only material quality included with TurboCAD which is not a 'real world' feature is the 'ambient' factor. The definition of 'ambient' is "completely enveloping" and this explains the ambient factor of an object perfectly. In TurboCAD 'ambient' light is constant light which completely (and equally) encases all objects. No reflection, refraction or any other light quality is used in this type of lighting. An even amount of light is added to 'all' parts of a rendering.

Unfortunately there is no ambient factor of any sort in real life. The only way to produce light is through energy or reflection of some sort or another.

# **Chapter 2**

## **TurboCAD “Lighting”**

Now that you’ve learned about what real light is we can proceed to show you how light is incorporated into TurboCAD.

Lighting use in TurboCAD seems to be the one aspect of the program which many people have trouble with. Lighting actually isn’t as difficult to learn as you might think. The majority of the problems encountered when dealing with textures and colors in a model are due to Materials rather than incorrect lighting. Many people seem to have trouble distinguishing the differences between Material and Lighting problems in their models. Of course your problems may be a bit of both. Oh, the horror!

I have found that you should always deal with the lighting of your model first and worry about the actual materials used in the model later. While you may think that they should be worked on simultaneously, I do not believe this should be the case. I believe that with the correct lighting you can make almost any model look good, even if just basic materials are used. The same can not be said for having great materials but no lighting. While you will probably end up tweaking both materials and lighting just a bit, to get perfect harmony between them, it is more important to work on the lighting effects first. After inserting a positioning the right amount of lights into your model you can then proceed to the Materials used in your model.

OK, so you now know that you should work with lighting first, the next question is where do I place the lights and how do I actually utilize them. This and other points will be discussed in this section of the book. While there are no real ‘perfect’ light locations, there are some tips which can help out any TurboCAD user when dealing with light placement in your models

### **Confusion with Lighting**

One of the major problems people have with Lighting is not a Lighting problem at all. People will see renderings which others have created and wondered how they could incorporate the same effects in their models. The only problem is that many of these effects aren’t the result of lighting at all. You may see an image with an object glowing or might see an image with fire in it. While some of the effect may be actually due to the result of sufficient lighting, the majority of the effect is due to the materials incorporated into the objects within the model.

# Lights

TurboCAD gives you the ability to illuminate your rendered models with several different standard lighting tools included with the program. The use of these tools can turn your mediocre models into real photorealistic masterpieces. The right lighting, along with ideal materials, can give your renderings a whole new look. Using the light sources included with TurboCAD you can illuminate part of your model in many different ways. You can emphasize specific details with spot lighting or use Ambient lighting to brighten up every object within a model. You can get great results with shadows and other special effects just by adjusting the settings integrated into each light source.

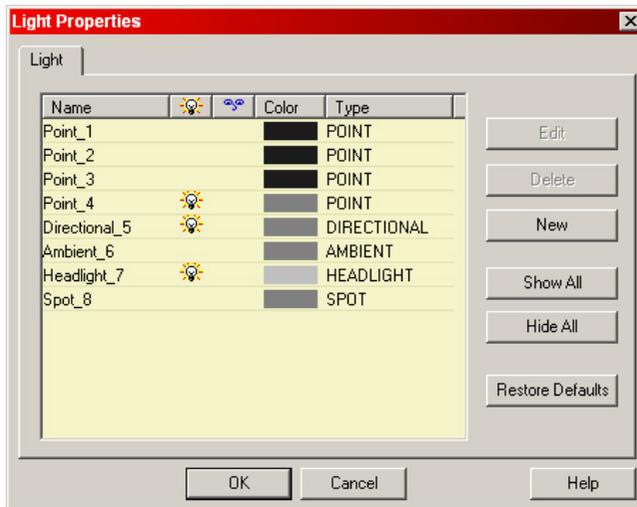
TurboCAD includes six different light types to help you with your lighting needs. They include: Ambient, Point, Directional, Headlight, Spot and Sky. You can use these types as they are or adjust the settings contained with them to produce your own lighting effects.

## Light Properties

You can access the Lights properties from View/Lights on the Menu Bar or from the Drawing Setup toolbar.



After selecting the light properties button the Light Properties dialog will appear on screen.

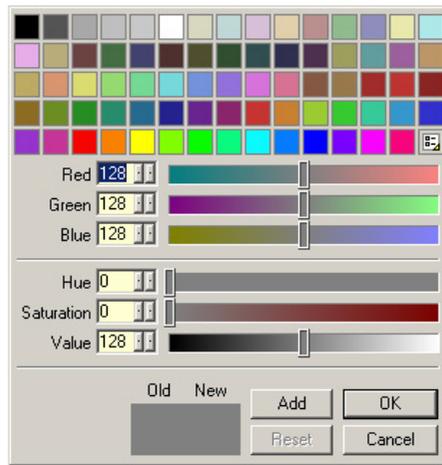


From this dialog you can choose which light sources you wish to use and how to manipulate them. The first part of the dialog is the Light Table.

**ON/OFF**  – The first column on the dialog turns the selected light source on and off. When the light bulb is present the light source is active and present on the model. When no light bulb is present, the light source is inactive.

**Visible/Invisible**  – When the option is selected for a specific light source, the actual light position (in space) is shown on screen. Each light source has its own graphic for the light it represents. When this feature is selected each light source location can actually be manipulated by its X, Y and Z axes as with any other 3D object. When this feature is not selected the light source cannot be seen on screen.

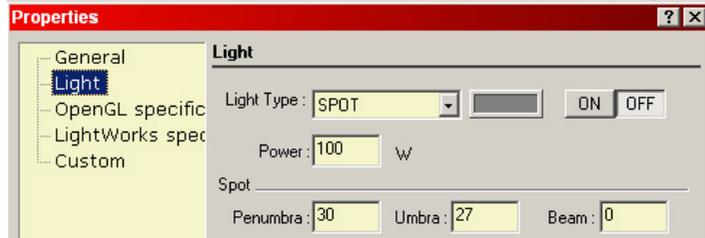
**Color** – This column specifies the actual color of light being created by the light source selected. You may change the color of the light by left-clicking on the color control. The Color dialog will appear from which you may choose a color of your choice.



**Type** – This column lets you choose which light type you wish to use (point, directional, ambient, headlight, spot or sky). After you have chosen which type to use, you may change its settings from the properties of the light source within its light parameters.

To the right of the Light Table are several other options available to the user to help control your light sources.

**Edit** – Selecting this button opens the Properties dialog for that specific light source.



**Delete** – This button will delete the selected light type from the Light Table.

**New** – Selecting this button opens the Light Parameters dialog. From that dialog you may choose the required light features you wish to use on your light source. After pressing OK, a new light type will appear on the Light Table with the parameters you specified.

**Show All** – Selecting this button makes all light sources visible on screen.

**Hide All** – Selecting this button hides all lights sources on screen.

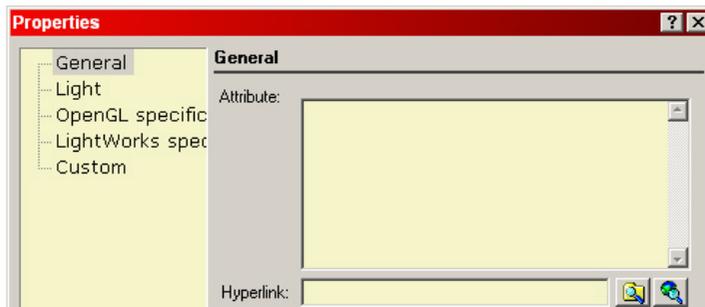
**Restore Defaults** – Selecting this button restores all the original settings to the Light Table.

## Light Source Properties

Each standard light source used in TurboCAD has its own set of settings and features. These settings can be found on the Properties dialog for that specific light source. To access the Properties dialog for a light source you can access the Light Properties dialog, select the light source you wish to edit and then select the 'Edit' button on the right side of the dialog. You may also access the properties for a selected light source by selecting a visible light source (on screen) and selecting Properties from the Local Menu. The Light Source Properties dialog contains several tabs. They are discussed below.

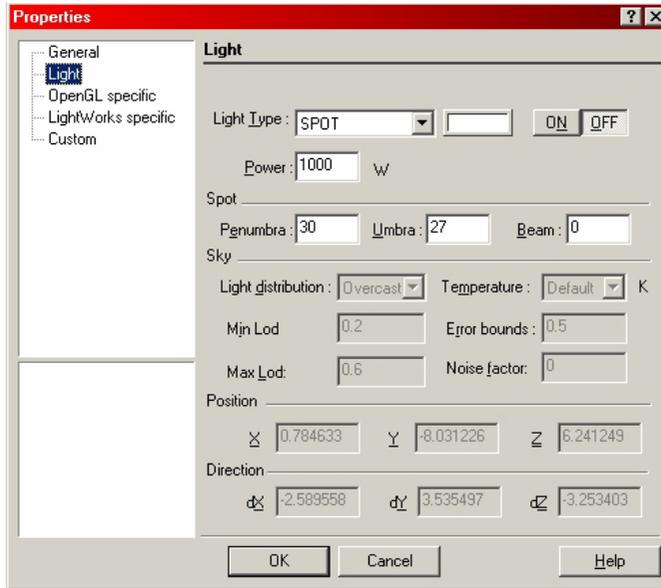
### General

The General tab contains the basic information on the light source. You can input information on the light source in the Attribute field or specify a Hyperlink to the light source.



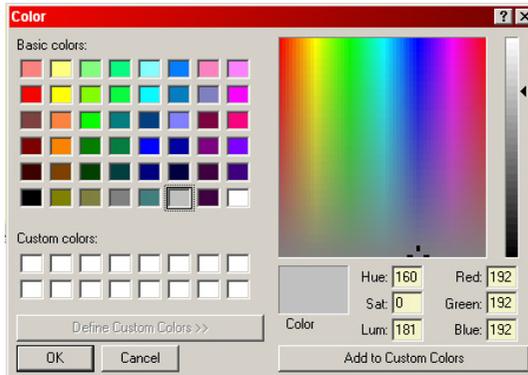
# Light

The Light tab contains all the light settings relevant to that light source. Each light source will activate specific settings (sections of the dialog) for that source. Example: the Sky settings will become available when using a 'sky' light source while the 'spot' settings will not be available. When editing a 'spot' light, the Spot, Position and Direction settings are available but the Sky settings are not.



**Light type** – From the drop-down list you may select the light source type you wish to use.

 (**Color**) – Select the color you wish to assign to the light. This setting does more than just assign a color to the light. Using the Color dialog you also determine the brightness (or darkness) of the light source. Selecting the color field will activate the Color dialog.



## Light Color

You may pick from a selection of pre-designed basic colors (left section) or design your own colors using the Color Matrix, brightness slider and color attribute fields (lower right corner of the dialog). Each of the values found in these six fields has a major impact on the creation of the light sources color AND luminance. These values are what determine the luminance of an object in a rendering (other than Radiosity). The brighter the color you choose (using these fields) the brighter the rendering will appear.

Hue, Saturation and Luminance all are all major parts of the RGB color scheme. Below is a description of what each represents.

**Hue:** Hue is the wavelength within the visible-light spectrum at which the energy output from a source is greatest. Red starts off the spectrum. It then runs through yellow, green, cyan, blue, purple, magenta and back to red.



The lower the number the closer to the beginning of the spectrum it will be. The higher the number the closer to the end it will be. Changing the Hue field will change all the values of the RGB fields simultaneously. You can specify a value from (0 to 239). This can be seen right to left in the color matrix of the dialog.

**Saturation:** Saturation is an expression for the relative bandwidth of the visible output from a light source. It determines the strength or purity of a color in a specific hue. The higher the value inputted, the purer the color. Example: A saturation value of (240) using a Hue of (0) will produce pure Red. If the saturation was changed to (0) the color will change to a black (grey) color (absence of color). You can specify a value from (0 to 240). This can be seen top to bottom in the color matrix of the dialog.

**Luminosity:** Luminosity represents the lightness or darkness of a specific color (hue and saturation). You can specify a value from (0 to 240). The lower the number the darker the color, the higher the value the brighter the color. A value of (0) will produce Black while a value of (240) will produce White. A value of (120) will produce pure color. If Saturation is set at (0) then Luminosity values will produce shades of grey. This can be seen in the luminosity slider to the right of the color matrix of the dialog.

**Red, Green and Blue:** Use these fields to input the amount of Red, Green and Blue you wish to use in any specific color. You may input values from (0 to 255) in these fields. (0) represents no color while (255) represents total (pure) color.

**ON/OFF** – Select the ON button to turn the light on (activate) and Off to turn the light source off.

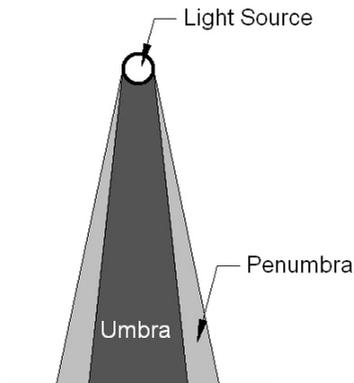
**Power** – Input the amount of power (in Watts) you wish the light source to utilize. This represents the intensity of the light. The higher the value the more luminous the light source will appear.

**Note:** The Power setting is actually only utilized in 'Radiosity' rendering. If you are using a rendering mode other than Radiosity (Preview, Full, Raytrace Full, etc.) this setting will have NO effect. In the case of the other modes the color settings for the light source will determine the luminance. The brighter the color the brighter the light will appear. You may use the far right slider on the color palette to determine the brightness or darkness of the light. The color fields, found in the lower right of the dialog, can also be used in determining the brightness of a light source.

### **Spot:**

These features are only available for Spot lighting. The Penumbra and Umbra are two of the main parts of a shadow. Though these two aspects actually deal with shadows the rules behind them can be used for affects in CAD lighting.

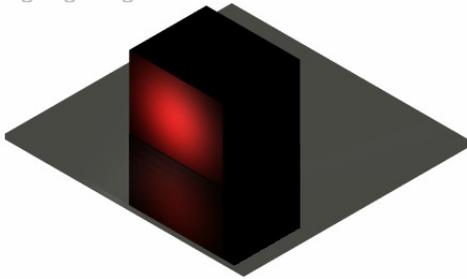
A shadow is broken up into two different areas: the umbra and the penumbra. The part of the shadow which is considered a 'full' shadow is the umbra. This is the darkest part of the shadow and is created when 'all' of the light is blocked from the shadow object. However you will notice that most shadows have an inner 'darker' area and also a lighter component around the edges. This lighter area is created when light from the shadow light source is blocked but light from another light fills in some of the shadow. This lighter area is called the penumbra.



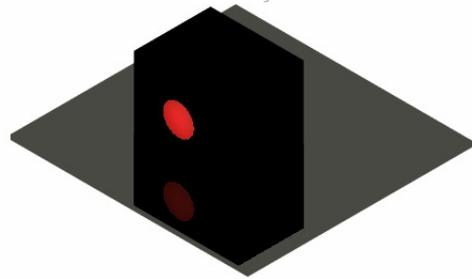
TurboCAD uses this phenomenon in its lighting techniques.

**Penumbra** – The penumbra part of a light source represents the partially lighted area around the 'fully' lighted area of the source. This area appears scattered or hazy as the penumbra part of a shadow appears the same way. In the case of a shadow the penumbra is only a partial shadow. The penumbra of a light source, in TurboCAD, is only partially illuminated.

The lower the value inputted into the field the more defined the light becomes. The higher the value the less defined (scattered) the light becomes. Remember that the Penumbra must always be at least the same size as the Umbra value being used.

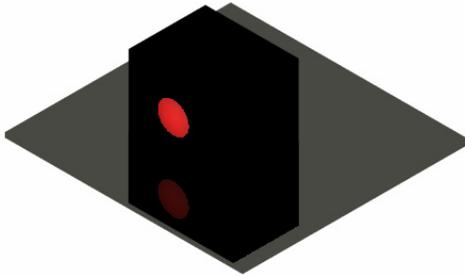


(Penumbra = 50)

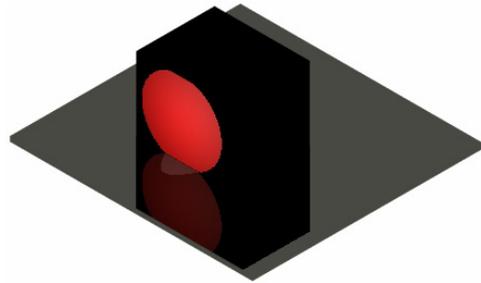


(Penumbra = 10)

**Umbral** – The umbral, in TurboCAD, is the ‘full’ part of a light source. This lighted area is fully lighted and has no hazy area. The value inputted into the Umbral field defines the actual size of the cone in which the spotlight will come out of. The lower the value the smaller the cone size becomes. The higher the value the larger the cone becomes.

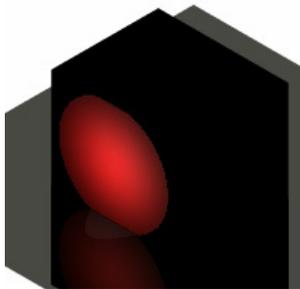


(Umbral = 10)

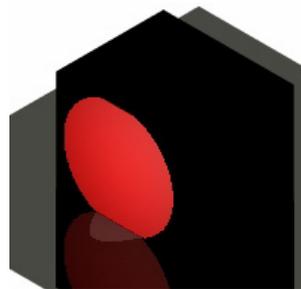


(Umbral = 25)

**Beam** – This parameter controls the variation of the intensity of the light from the axis of the cone outwards. The lower the value the higher the intensity of the light. A higher value will produce an effect where more light is concentrated at the center.



(Beam = 50)



(Beam = 5)

**Sky:**

These features are only active when the Sky light source is selected. These settings deal with Sky light features only.

**Light Distribution** – This setting gives you the option to set the sky lighting you wish to use. This parameter basically controls how the illumination is distributed over the sky. This drop-down list allows you to choose sky clarity from clear to overcast. Example: when ‘clear’ is selected the brightest part of the sky surrounds the sun. When ‘overcast’ is selected the brightest part of the sky is straight up.

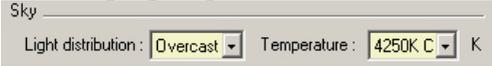
**Temperature** – This setting lets you choose the ambient temperature of the sky light used. The selections found on this drop-down list represent the color temperature discussed in Chapter 1 of this book. A temperature chart can also be found in that section of the book. Please read this section to determine what settings to use in this area.

The three renderings below show three different variations of the two settings shown above. The only light source used in these images is the ‘Sky’ light source. The only parameters changed in the three images are the Light Distribution and Temperature. No other setting has been adjusted. Each gives a distinctly different look to the outdoor scene. Remember that the temperature changes the ‘light color’. The higher the temperature (as in the first scene) the bluer the scene. The lower the temperature the redder the scene.

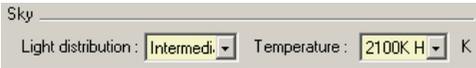
The first scene (shown below) uses the light distribution ‘Clear’ and a temperature of ‘7500 K’



The next rendering uses the light distribution ‘Overcast’ and a temperature of ‘4230 K’. See how the majority of the light seems to be shining from above. More shadow can be seen on the table than in the previous image because ‘Overcast’ was used.



The final rendering uses the light distribution 'Intermediate' and a temperature of '2100 K'. This combination produces a great 'sunset' effect.



**Min. Lod.** – This setting controls the minimum level of detail for area source decomposition. Values are usually set at between (0.0) and (1.0). This parameter determines the initial sampling for lighting calculation. If the value is set too low, shadow boundaries may not be produced correctly. If the value is set too high, rendering may take a long time. Practically you should use a value between (0.2) and (0.6).

**Max. Lod.** – Maximum level of detail for area source decomposition. This parameter determines the maximum amount of work required to illuminate any given point. This value should always be set higher than the Min Lod value. This value is usually set at between (0.2) and (0.4) higher than the Min Lod value. Example: If Min Lod is set at (0.2) then Max Lod should be set at between (0.4) and (0.6).

**Error Bounds** – When the Max Lod value is set higher than the Min Lod setting, lighting and shading will start once the initial sampling is complete. The Error bounds parameter dictates the accuracy of the solution. A value of (0.1) means that the maximum error associated with the illumination of a particular point is less than 10% of the energy associated with the illumination of that point. The default value of (0.5) discourages adaptive sampling.

**Noise Factor** – This setting allows the user to add ‘noise’ to the lighting. Adding noise provides a lighting effect which looks messy or chaotic. A value set at (0.0) means no noise while (1.0) means maximum noise

### **Position:**

These settings allow the user to position the light source, in model space, according to its X, Y and Z coordinate locations.

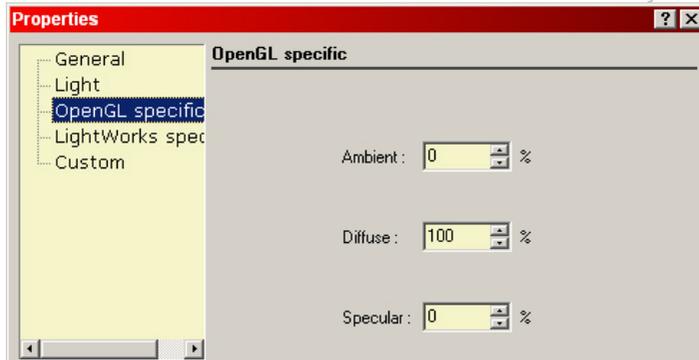
### **Direction:**

The direction a light source faces is created with two sets of coordinates. The position value sets the point at which the light is positioned while the ‘Direction’ coordinate values define the vector where the light will shine to. The vector between the two sets of coordinates is the direction at which the light will shine.

## **Open GL Specific**

The parameters found on this tab allow the user to specify the values for three light components valid only for with OpenGL rendering.

OpenGL is a powerful yet low-level rendering and modeling software library. It is available on all major platforms and has wide hardware support. It is designed for use in many graphics applications, from games to CAD. Many new computer games use OpenGL for their core graphics rendering engine. While the OpenGL library is used throughout the industry, it creates lower quality images than its LightWorks counterpart. The main advantage of OpenGL is its rendering speed. It produced much quicker rendering speeds than the LightWorks engine.



**Ambient** – This option allows the user to input the percentage of Ambient light used in an OpenGL rendering. This is the amount of light distributed equally throughout the model. Input the percentage of ambient light you would like to use in your rendering with this field.

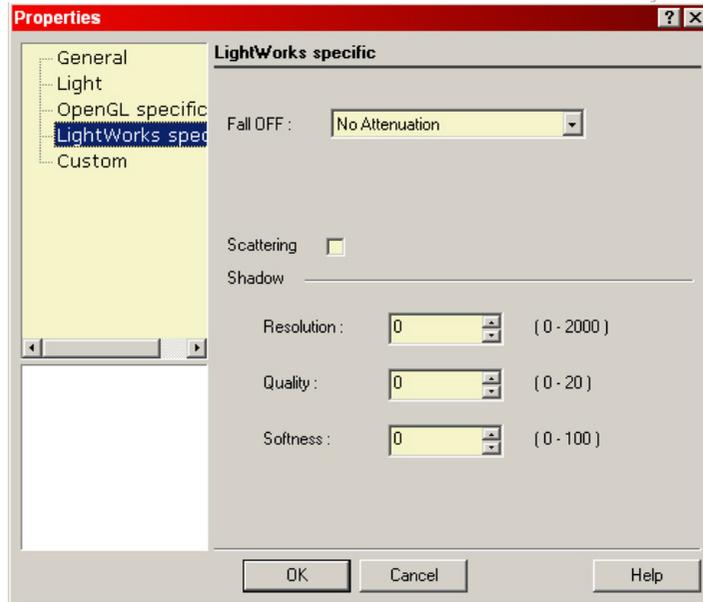
**Diffuse** – This option gives you the ability to input the percentage Diffused light (dispersed) used in an Open GL rendering. Diffuse lighting assumes that light hitting off an object is reflected in all directions. This means that the lighting should look the same no matter what the angle is. An example of diffuse lighting would be sun light. This type of light produces a matte or dull finish. Input the percentage of diffuse light used in a rendering. The higher the value the higher the percentage of diffuse light used.

**Specular** – This option gives you the ability to input the percentage specular light (reflects light like a mirror) used in an Open GL rendering. This type of light reflects light in only 'one' direction. Specular lighting is different than diffused lighting in the fact that the lighting depends on the angle at which the object is being viewed. A headlight or a spotlight would be examples of specular lighting. This type of light produces a smooth or mirror like finish. Input the percentage of specular light to be used in a rendering.

## LightWorks specific

The parameters found on this tab deal with LightWorks specific controls.

LightWorks is a collection of components which provide software developers with a large assortment of rendering features allowing the creation of high quality photorealistic images. Though the rendering created are of a higher quality than those of OpenGL, the rendering speeds can be much slower.

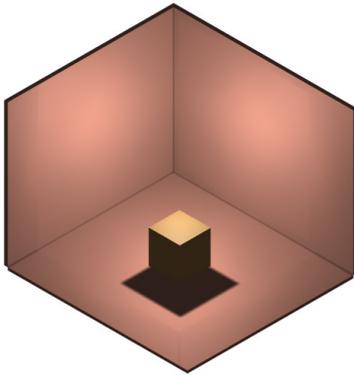


**Fall OFF** – This setting works with both Point and Spot light sources. It determines the way in which light’s intensity is attenuated (weakened) as a function of the distance from the source. By default this parameter is set to "No attenuation". When ‘No attenuation’ is set a light’s intensity is constant. You may choose from Natural Linear, Natural Quadratic, Linear and Quadratic. The following equations define each type where (d = distance from the light source).

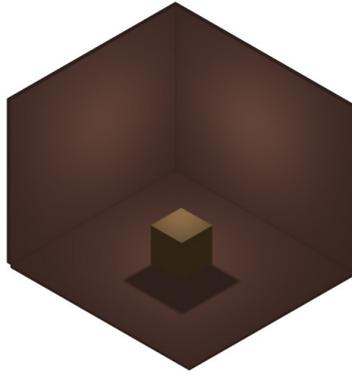
In the real world light intensity weakens in proportion to the square of the distance from the light source (it falls off quadratically). In rendering this is often just too fast so linear attenuation is often used. Chapter 1 includes a section on the attenuation of light.

- ◆ Natural Linear:  $1/(d+1)$  (This means the brightness of the light diminishes at a constant rate as the distance increases)
- ◆ Natural Quadratic:  $1/(d*d+1)$  (With this type, the initial drop in brightness is very rapid, but the dimmed light is sustained for a much greater distance)
- ◆ Linear:  $1/d$
- ◆ Quadratic:  $1/d*d$

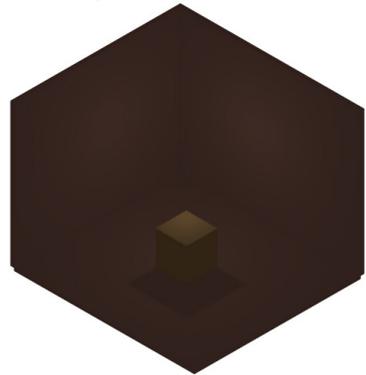
You will notice that the Linear and Quadratic selections create a bit more illumination than their ‘Natural’ counterparts. The three images below show how attenuation can change a rendered model. A single Point light source is positioned near the center of the image.



(No Attenuation)



(Linear)



(Quadratic)

**Scattering** – Selecting this checkbox will create an effect of light being scattered in a foggy or hazy atmosphere. This option works in conjunction with the Fall Off option selected.

**Shadow:** These settings deal with how shadows are displayed. These parameters can change the makeup of a shadow significantly. You can create high quality soft shadows but the consequences are that the softer the shadow the longer the rendering time. Keep this in mind when setting these parameters.

**Resolution** – This parameter allows you to smooth the edges of a shadow. The higher the value the smoother the edges. Choose from (0-2000)

**Quality** – This setting gives the ability to control the quality of the shadow created. The higher the value inputted the higher the quantity of pixels used to create a shadow. Choose from (1-16).

**Softness** – This setting gives the ability to control the softness of the shadow created. The higher the value the more of a scattering affect is created. (More penumbra is used) Choose from (0-20).

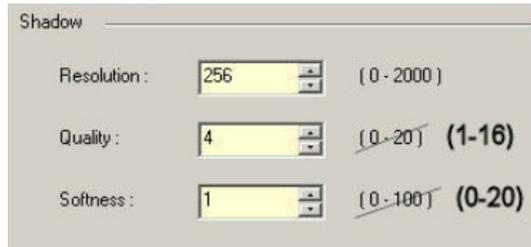
## Soft Shadows

Another issue which seems to affect TurboCAD users is the ability to create high quality soft shadows. While shadows can easily be created with the use of several light sources, on any 3D object, the results can sometimes be anything but satisfactory. These shadows can often have jagged edges which seem to stay that way no matter what settings or options are manipulated.

You can adjust the setting to create high quality shadows but in doing so, rendering times will increase exponentially. When a shadow is made 'softer' it is actually using many more pixels to create the same image. The more points that are used the longer it takes TurboCAD to render the image. With this in mind you should play around with these settings to get a good ratio of quality vs. rendering speed.

## Using the Shadow Settings

Now that you have accessed the Shadow settings for the light source in use you can now manipulate them accordingly.



**Resolution** – This setting adjusts the smoothness of the actual shadow. The higher the number the smoother the shadows edges will be. The default is set at (256). This is the reason most shadows are not very smooth. Inputting a higher number will create a smoother edge.

The highest value (2000) will produce the highest quality shadow effect. The edges of the shadow will become smooth and free of jags.



Resolution = 300 (jagged)

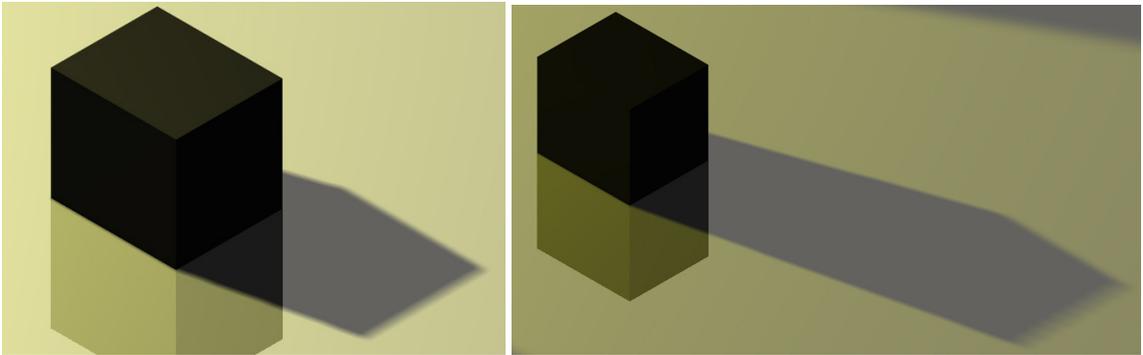


Resolution = 2000 (Straight)

Unfortunately using such a high value could increase rendering times by astonishing amounts. I have found that the value used in this area has more to do with the screen resolution of your monitor than anything else. I recommend using a value between (1.25) and (1.5) of the height of the screen resolution you are using for your monitor. Example: If you are using a screen resolution of 800w x 600h then a good value would be between (750) and (900). A screen resolution of 1600w x1200h would produce values from (1500) and (1800).

I have also found that the longer an actual shadow is the higher the resolution should be set at. The longer a shadow is the more you notice the imperfections in the shows makeup. The images below are of the same object but with a light source placed at different heights. The light source in both is the same and both are using a Resolution = (1000). The first image shows a light source high above the object so only a short shadow is produced.

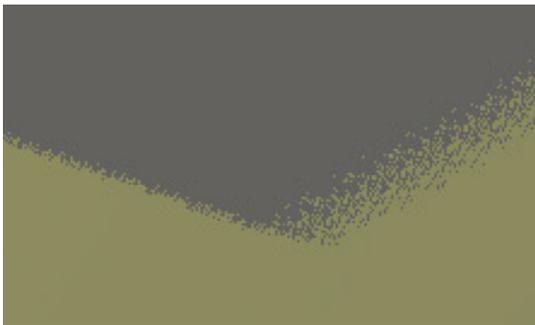
The second image shows the object with the projecting light source placed lower to the ground. This in turn creates a longer and lower quality shadow affect.



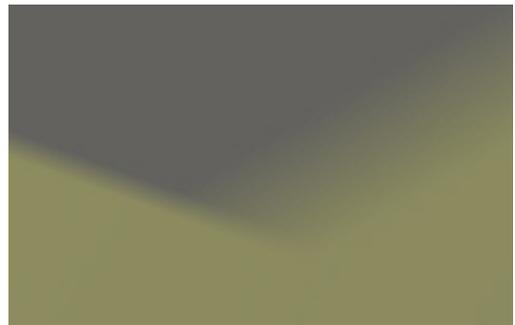
My recommendation to you in this case is to use a value which is closer to (1.5) times the screen resolution height, possibly even higher, when longer shadows are being used. If you have shadows of varying lengths, use the one with the longest length for your parameters.

Of course many other factors may change the look of a shadow; texture or color of the object the shadow is on, attenuation, light intensity and light settings are just a few of the variables that could affect the final product.

**Quality** – This setting determines how many points (pixels) are used in the makeup of a shadow. The higher the value inputted, the more pixels are used in the creation of the shadow. A larger amount of pixels produces a denser and softer feel to the shadow. A lower value inputted into this field will produce a shadow using fewer pixels and will produce a less dense and grainy look.



Quality = 1 (Grainy)



Quality = 16 (Smooth)

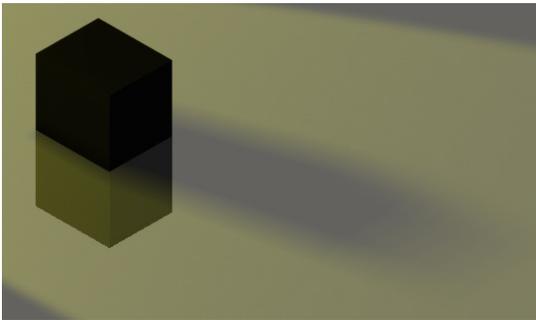
You will find that the higher the Resolution value used the lower the Quality setting has to be. I would recommend using a value of no lower than (5). A value of (10 to 12) is sufficient in most instances but higher or lower values can be used as needed.

Remember, as with Resolution, the higher the value the longer the rendering time. The dialog states that you can use values between (0-20). This is incorrect though. The real values you can choose from are between (1-16).

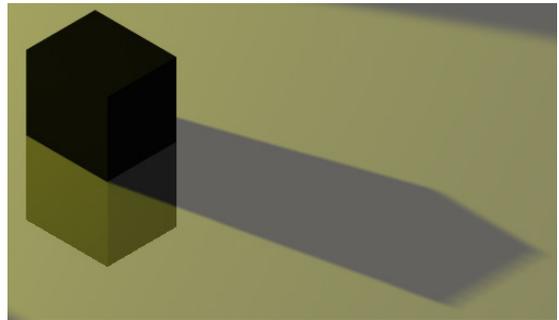
**Softness** –This parameter adds a scattering effect to the shadows produced. The lower the value the more scattered the shadow appears. The higher the number, the more defined the shadow appears.

This setting basically sets the umbra and penumbra areas of a shadow. The umbra and penumbra were discussed earlier in this chapter when dealing with a light source (see the Light tab area of this section). In this case a 'real' umbra and penumbra are used. The umbra being the main part of the shadow with the penumbra being the partially lit section of a shadow. The higher the value set the more penumbra is created in the formation of a shadow.

As with the Quality setting, the dialog is incorrect in the values it states you may choose from. The dialog shows that you may choose values from (0-100). This is incorrect though. The real values you can choose from are (0-20). Any values over (20) will react as (0) does.



Softness = 16



Softness = 0

The more defined you want your shadow to be the lower the value you should use. In real life a brighter light source will produce a more defined shadow. A darker or scattered light will produce a softer effect with more penumbra present. This may not look good but may represent a genuine affect if used at the right instance. Hazy sunlight will produce this effect. Remember this when setting the option. For a realistic, and good looking, shadow in almost any light I would recommend using a value from (0) to (2). One good thing about this setting is that it does nothing to the render speed. Render speed should be the same no matter what value you use.

Each light source can be adjusted separately so the affect does not need to be used in an entire rendering.

Now that you have seen how to use the options you can turn this:



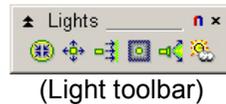
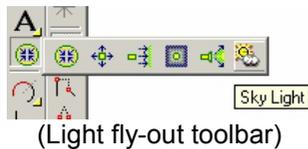
Into this!



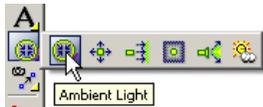
# Chapter 3

## “Light Sources”

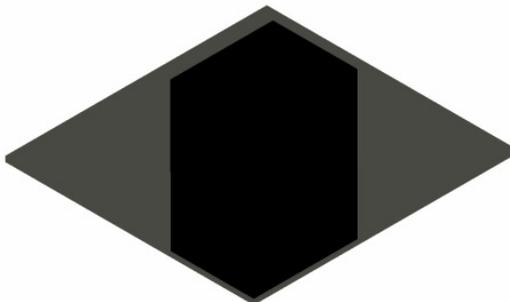
TurboCAD includes six different Light source types for all your lighting needs. Each projects light in different ways. The six types include: Ambient, Point, Directional, Headlight, Spot and Sky. These light types can be found on the Lights toolbar as well as at View/Lights on the Menu Bar.



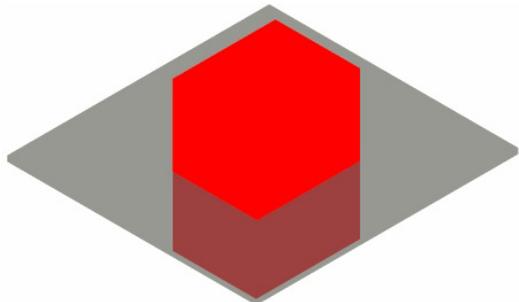
### Ambient



Ambient lighting is probably the easiest form of lighting used in TurboCAD. Ambient light provides a constant illumination to every surface in a rendering. A basic color and intensity is added to every surface in a model for rendering. Ambient lighting is simple since every surface of an object is the same shade, because of this TurboCAD needs only to calculate the lighting equation once. Ambient light is used to represent light that reflects from object to object in a way which is ignored by the majority of lighting models for efficiency reasons. Below you can see two renderings, one without light and the other with just Ambient light used.

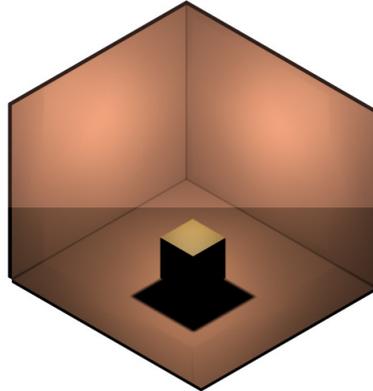


(no light used)

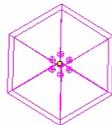


(Ambient light used)

As you can tell, ambient light on its own is not a very useful light source but used in conjunction with other light sources it can be a very useful one indeed. The image below shows how a rendering can change by adding an ambient light. The image is shown rendering as an ambient light has been added to an already rendered image.



The color and intensity of the ambient light used in a rendering are determined by the color, hue, saturation and luminance selected from the color dialog. (See 'Light Color' earlier in this chapter). When the Visible button is used on the light it will appear as  on screen. Selecting the Ambient light symbol will produce the graphic shown below.



(Ambient light source object)

## **Ambient Light Uses**

The Ambient light source is the most basic of the light sources incorporated into TurboCAD and because of that the uses for such a source are very basic as well. The main use is to increase the overall basic illumination of a rendering. You can also use this light source to: Prevent totally dark shadows and brightening up a scene without adjusting other light sources.

## **Ambient Light Positioning**

Positioning the ambient light source in a TurboCAD model is the easiest of all light sources. This is because you don't need to position it at all. The lighting effect will be the same no matter where the light source is positioned. Simply activate the source and render.

## Ambient Light Settings

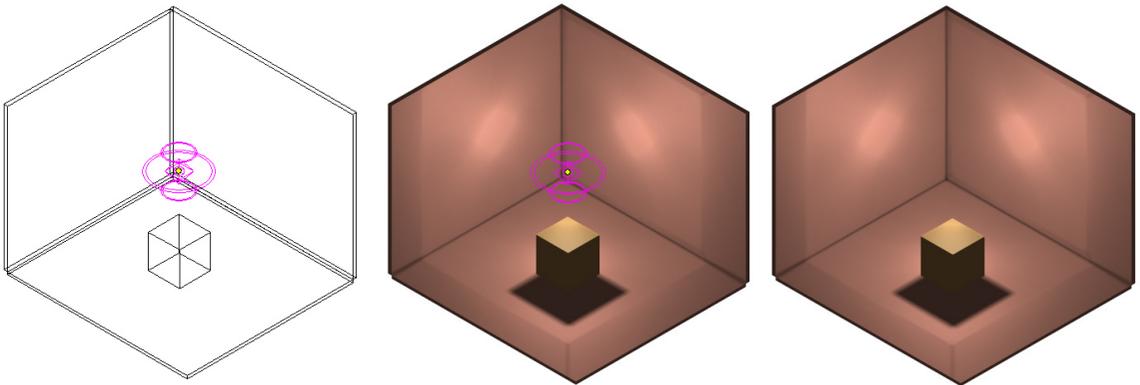
The only settings available to the user for an Ambient light source is the Color and Power fields, found on the Light tab of the Light Properties dialog. Although all of the settings found on the OpenGL and LightWorks tabs are active they have no effect on any lighting in a model.

## Point

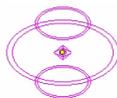


The Point light source casts light evenly in all directions from a specified point in space. Light from this source will illuminate every object in a rendering depending on the location of the surface to the light source. A surface which is perpendicular to the light source will receive more light than an object which is positioned at any other angle. The further the angle is away from perpendicular the less it will be illuminated. A surface facing away from the source will be dark.

The images shown below illustrate how a Point light source works. A Point light source is positioned near the center of the boxed object. The center of the walls and floor (and top of box) receive more light since they are positioned at 90° to the source. The further away from center you go, the less light is seen.



When the Visible button is used on the light it will appear as  on screen. Selecting the Point light symbol will produce the graphic shown below.



(Point light source object)

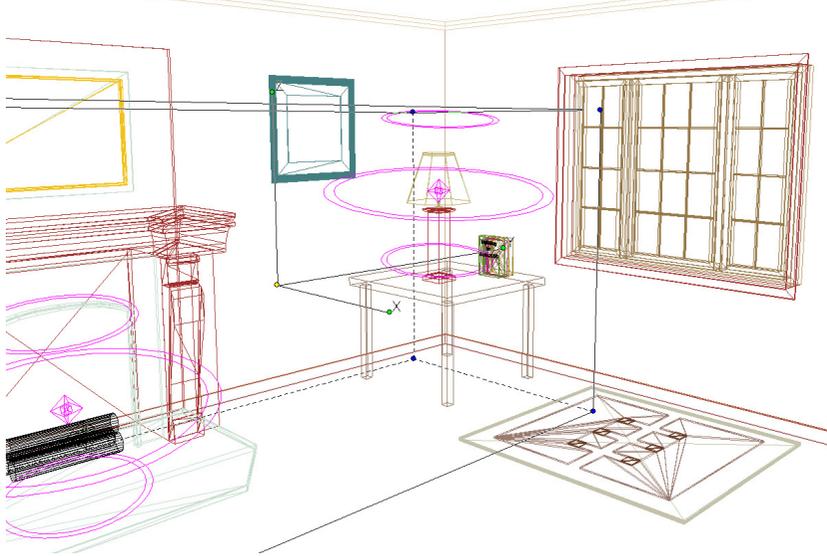
## **Point Light Uses**

The Point light source is one of the most versatile light sources incorporated into TurboCAD. This source can be used in all sorts of ways. These light sources are often used to represent 'real life' lights (light bulbs) in renderings.

Not just light bulbs but they can be used almost anywhere a point of light is needed. A Point light source can be placed under a lampshade to act as a light bulb. A Point light source can be placed off-screen to imitate the glow of a fire or of a street light. An example of Point lighting can be seen below. Only four light sources were used in the image below. An Ambient light source and three Point light sources (one in the lamp and two in the fireplace).

The image below it shows the wireframe image and the two Point lights selected.





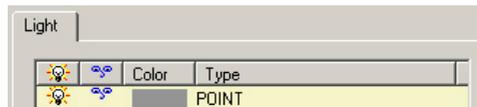
## **Point Light Positioning**

Positioning a Point light source is actually quite easy. If using the light source as an actual 'light bulb' you simply place the source in the location that the bulb would be placed. For other locations, use the Inspector Bar fields to position the source.

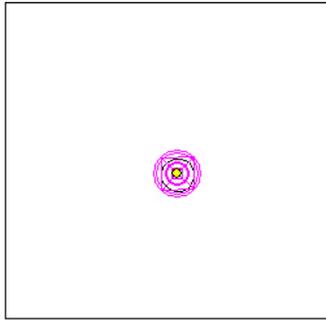
You will find that when using a Fall Off setting other than "No Attenuation" that the light source must be quite close to an object to take advantage of the lighting effect. If 'No Attenuation' is selected then the amount of light will not change.

When positioning a Point light source in a model you should always use the mouse and Inspector Bar fields. You should try not using the mouse solely since 'snapping' the source to a new point will usually place the source on the current workplane.

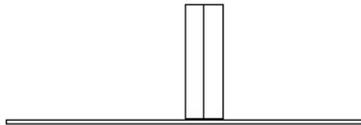
First activate the source on the Light Properties dialog and make it visible on screen.



Next, close the dialog and find the light source on screen. Switch the view to 'World Plan' or 'Bottom' and select the source. Move the source to the desired (x,y) position using the mouse or by inputting the desired values into the (Pos) fields on the Inspector Bar.



To position the Z axis of the light source switch the view to a side view (front, back, right or left). <TAB> to the Inspector Bar, to the (Pos Z) field and input the value you wish set the height of the light source at. You may need to zoom in or out to get the correct location.



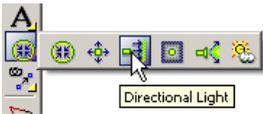
**Note:** You can also position a Point light source using the Position fields found on the Light tab of the Light Properties dialog for that source.



## Point Light Settings

The settings for a Point light source include the Color and Power fields, found on the Light tab of the Light Properties dialog as well as the Position fields found on the same tab. All of the settings found on the OpenGL and LightWorks tabs are also active and can be adjusted as you see fit. See the sections on these settings found in chapter 2.

## Directional



Directional light is similar to sunlight, where parallel rays of light from a given direction are incident across an entire scene. The position of the light source in the drawing does not matter. All that matters is the direction of the source. Light will be produced in that direction. The length of the light is infinite and the light will not fade with distance. Think of it as if you were placing an infinitely large 'wall' of light and facing it towards an object.

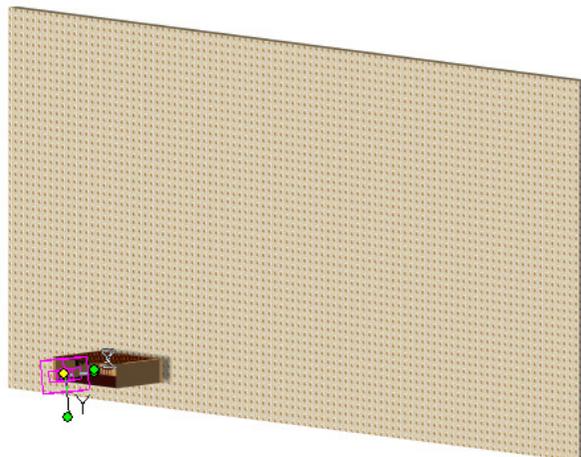
When the Visible button is used on the light it will appear as  on screen. Selecting the Directional light symbol will produce the graphic shown below. You can move and rotate the Directional light source by the reference point and rotation handles. You can also use the Inspector Bar fields.



(Directional Light source)

Below is a rendering showing Directional lighting in use. Only an Ambient light and one Directional light were used. The Directional light was placed on the far side of the room and positioned to face towards the wall with the window. Anything in that direction is lit up.

The second image shows the room in the lower left hand corner of the image with a large wall behind it. The light is selected and highlighted in magenta. The entire wall is lit up as well. This shows the extend of the 'wall of light'.

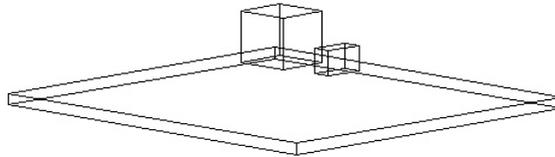


## Directional Light Uses

Directional lighting can be used in many ways but is more often than not used as the sun or some other high intensity light. This type of lighting can be used when a large overall lighting or shadow effect is needed. If you have an image where you believe a rendering needs an effect of lighting from one specific direction then this is the light source to use.

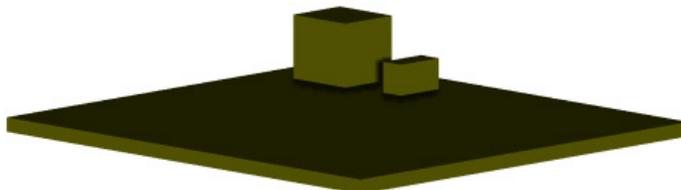
## Directional Light Positioning

Positioning a Directional light source is actually not that hard to do as you might think. The thing you want to do is position the light source so that is parallel to the direction (or surface) you wish to illuminate. The model below shows two boxes on a flat plane. We want to position the light as to illuminate the view shown.



1. First, activate the directional light source and select the 'show' icon so that the source can be seen on screen.
2. Change the View to face the direction you wish to illuminate.
3. Zoom Out to find the light source object.
4. Select the light source and just move it closer to the model, to make it easier to work with.
5. Select the 'Plane By Active View' button on the Workplane toolbar. This will position a new workplane in the direction of the current view.
6. Select the Directional light source and right-click.
7. Select the 'Set Selector By UCS' option on the Local Menu. The light source will now reposition itself parallel with the current view. The problem is that it will be facing the screen and not away from it.
8. To fix this simply select the light source. <TAB> the Inspector Bar and ADD (180) to the value found in the (Rot Y) field. This will flip the light source around to aim at the desired direction.

Example: If a value of (47.23) is in the (Rot Y) field then add (180) and change the value to (227.23). The view will become illuminated. As shown below.



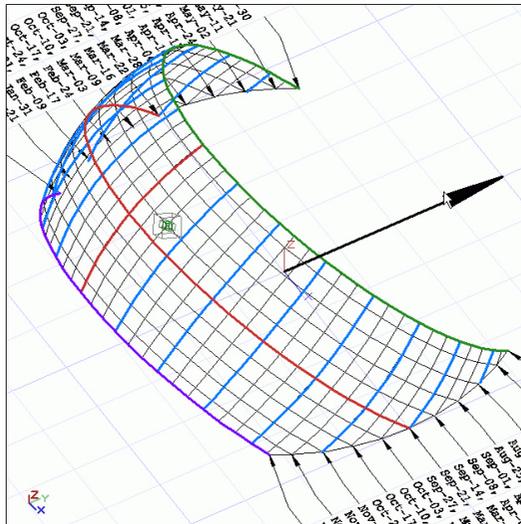
**Note:** You may also just use the position and direction fields found on the Inspector Bar or the Light Properties dialog to position the light source. The Rotation Handles may also be used. This method is not as easy and usually requires using several window views at the same time.

## **Directional Light Settings**

The settings for a Directional light source include the Color and Power fields, found on the Light tab of the Light Properties dialog as well as the Position fields found on the same tab. All of the settings found on the OpenGL and LightWorks tabs are also active and can be adjusted as you see fit. See the sections on these settings found in chapter 2.

## **Sun Pointing Symbol**

One of the best uses for Directional lighting can be seen in Winston Mitchell's 'Sun Pointing Symbol'. Winston is a long time TurboCAD user and is known as one of the top users worldwide. His TurboCAD web site can be found at <http://www.cadcourse.com/winston/index.htm>. While all of the articles found on this website are useful, the article regarding the Sun Pointing Symbol has to be one of the paramount, concerning lighting anyway.



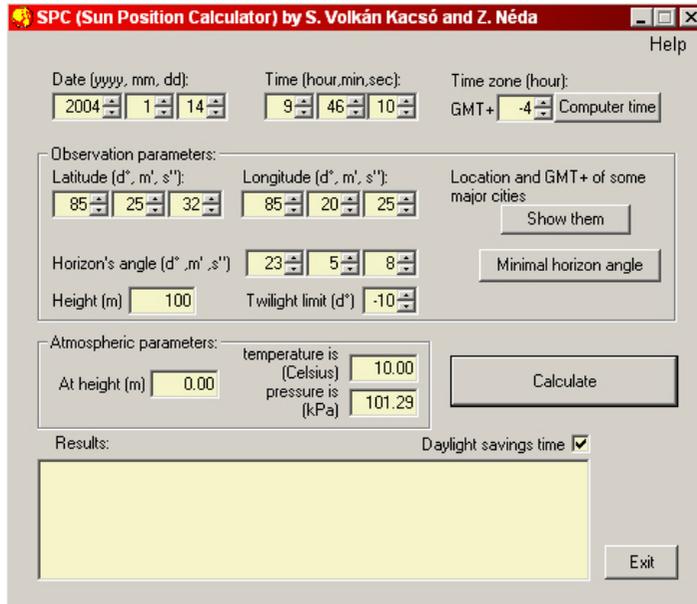
While TurboCAD is equipped with a Sky light source there are times where an accurate (in real life) sun placement is needed in a rendering. This symbol was created to do just that. You must find the 'sun location' through a sun location calculator and position the directional light where needed using the symbol. This effect will give a more realistic view of your model in 'real world' conditions.

## Sun Position Calculator

You can use the 'sun pointing' symbol to place a Directional light source to accurately portray sunlight at a specific time of day and time of year. You will need to find the 'real world' placement information for the sun at any given time of the year but there are several places on the internet to find this. Several calculators can be found at:

<http://home.online.no/~jensts/Satellite/sunposauto.htm> and [http://www.geocities.com/senol\\_gulgonul/sun/](http://www.geocities.com/senol_gulgonul/sun/).

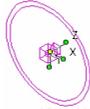
A free downloadable version can be found at <http://www.fi.uib.no/~neda/suncalc/spc.html>. A screenshot of this calculator can be seen below.



## Headlight



The Headlight light source illuminates everything from the same point as the viewing position. Basically the Headlight light source is a Directional light positioned at the camera and towards the model. A headlight is always perpendicular to the camera view. 'See Directional above'



(Headlight light object)

Below is a rendering showing Headlight lighting. No other light source was used in this rendering. As you can see, everything in the view of the screen is illuminated. If you move the camera the light source will move with it. The light source will always position itself perpendicular to the camera.



## Headlight Light Uses

The Headlight light source is used in the same manner as the Directional light source. It can be used for an overall illumination tool to brighten up a scene but differently than with an ambient light where reflectance and shadow can be created in this method. This light source can be used as a 'sunlight' tool or as any other form of high intensity light.

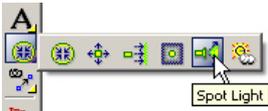
## Headlight Light Positioning

The Headlight light source is the easiest of all light sources to position since no positioning is done at all. No matter where the source object is placed on screen the light will always commence from the camera.

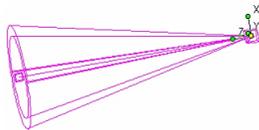
## Headlight Light Settings

The only settings available to the user for an Headlight light source is the Color and Power fields, found on the Light tab of the Light Properties dialog. Although all of the settings found on the OpenGL and LightWorks tabs are active they have no effect on any lighting in a model.

## Spot



The Spot light source is a light which originates from a point and is constrained to a cone shape in a specified direction. The size and composition of the cone of light produced will depend on the parameters chosen on the Light Properties dialog. Selecting the Spot light symbol will produce the graphic shown below. You can move and rotate the Spot light source by the reference point and rotation handles.

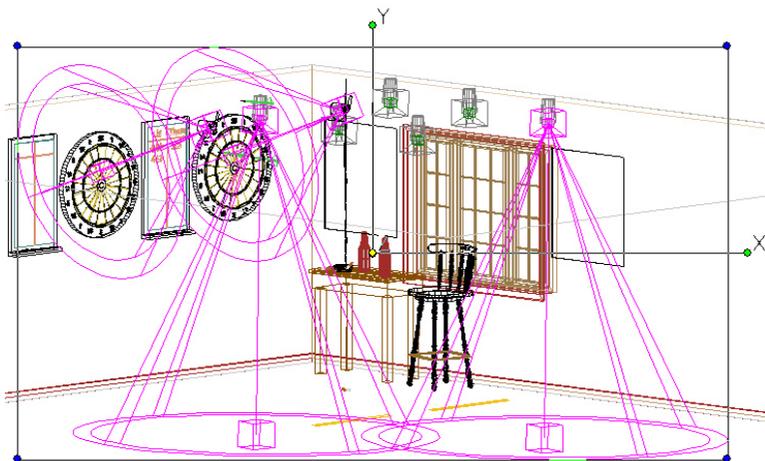


(Spot Light source)

Below is a rendering which shows the Spot light is use. An ambient light source was also used. Two spot lights were positioned in the lights directed at the dart boards and six spot lights were placed in the recessed light fixtures seen on the ceiling.



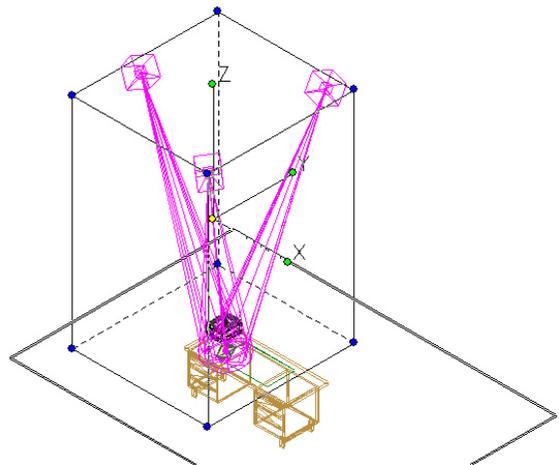
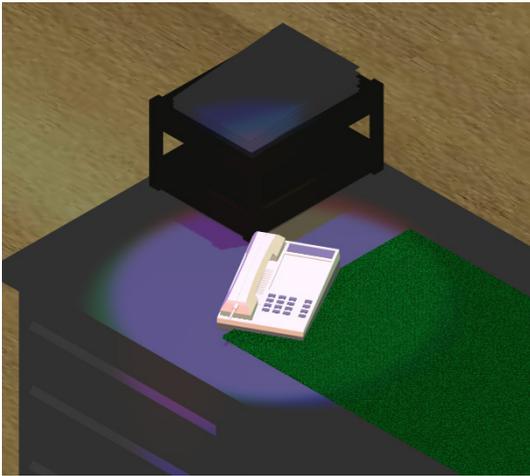
The image below shows the positioning of some of the spotlights in the model.



## **Spot Light Uses**

The Spot light source can be one of the most useful light source included with TurboCAD. Because of the 'cone' parameters you can accomplish all sorts of lighting techniques with this one source. A basic circular 'spot' light effect can be created but you can also produce a hazy, barely illuminated lighting effect by just adjusting the Beam setting on the Light Properties dialog.

This tool can be used as basic lighting in illuminating a scene. It can be used in a spotlight, flashlight, a vehicles headlight, as an outside light source being seen inside a building, and in many other ways. The Spot light is a great addition to your basic lighting model. Several Spot lights aiming at an object from different points can create a great rendering.



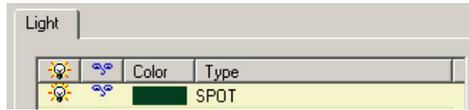
## **Spot Light Positioning**

The Spot light source may seem like the hardest one to position but it actually isn't that difficult at all. The hardest part of the positioning of a Spot light source is the x/y/z positioning and not the aiming of the cone.

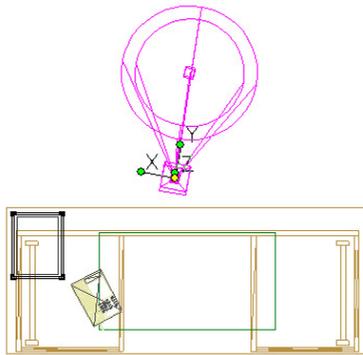
You will find that when using a Fall Off setting other than "No Attenuation" that the light source must be quite close to an object to take advantage of the lighting effect. If 'No Attenuation' is selected then the amount of light will not change.

The first part of Spot light positioning works exactly the same way Point light positioning does. When positioning a Spot light source in a model you should always use the mouse and Inspector Bar fields. You should try not using the mouse solely since 'snapping' the source to a new point will usually place the source on the current workplane.

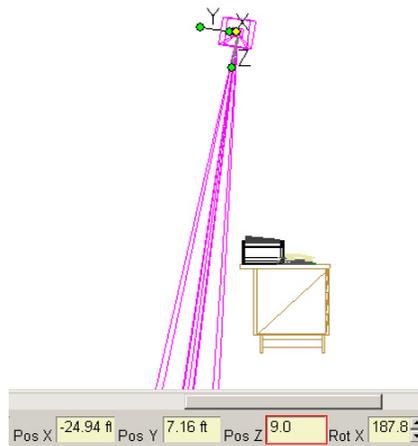
1. First activate the source on the Light Properties dialog and make it visible on screen.



2. Next, close the dialog and find the light source on screen. Switch the view to 'World Plan' or 'Bottom' and select the source.
3. Move the source to the desired (x/y) position using the mouse or by inputting the desired values into the (Pos) fields on the Inspector Bar.



4. To position the Z axis of the light source switch the view to a side view (front, back, right or left). <TAB> to the Inspector Bar and to the (Pos Z) field. Input the value you wish set the height of the light source at. You may need to zoom in or out to get the correct location. (as shown below).

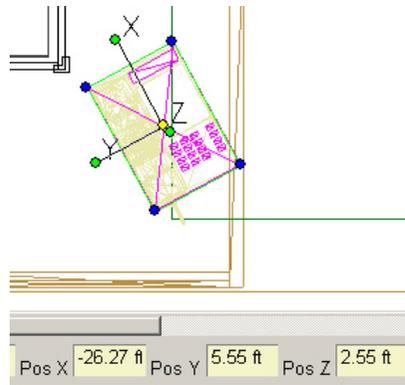


**Note:** You can also position a Spot light source using the Position fields found on the Light tab of the Light Properties dialog for that source.

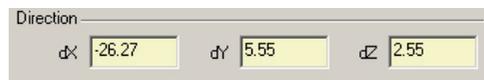


Now to aim the cone. You must first find the (x/y/z) point you wish to aim to. In the image below we will be trying to aim to the middle of the phone.

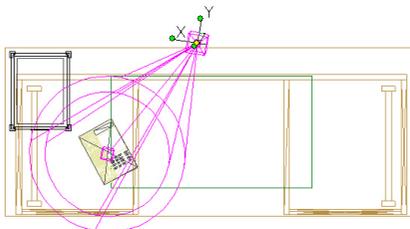
5. Switch to World Plan View. Select the phone and place the cursor over the Reference Point. Note the (Pos) fields on the Inspector Bar.



6. Go back and select the Spot light source. Right-click and select 'Properties' to access its Properties dialog.
7. Select the Light tab and input the same coordinates into the (dx), (dy) and (dz) Position fields.



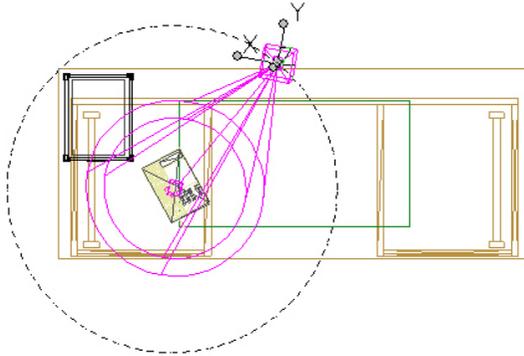
8. Select OK. The light source should now be aimed directly at the midpoint of the phone.



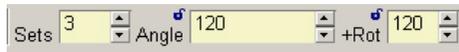
## Spot Light Model

Many Spot lighting models include three or more spot light sources aimed at one spot. They are usually positioned radially around an object. To do this in the model above you would:

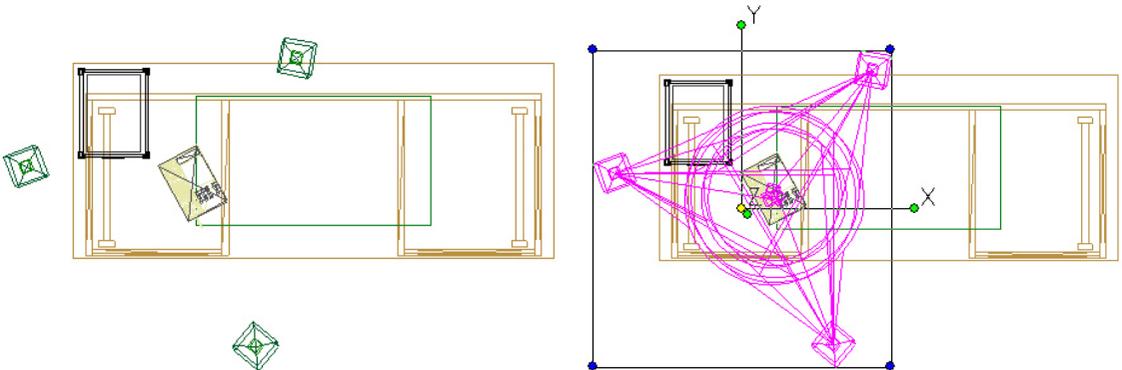
1. Switch to World Plan view.
2. Select the light source and then select Edit/Copy Entities/Radial from the Menu Bar (or select the Radial copy button from the Copy toolbar).
3. Select the middle of the phone as the radial point.



4. Input the appropriate values into the Inspector Bar fields. (seen below) Enter.

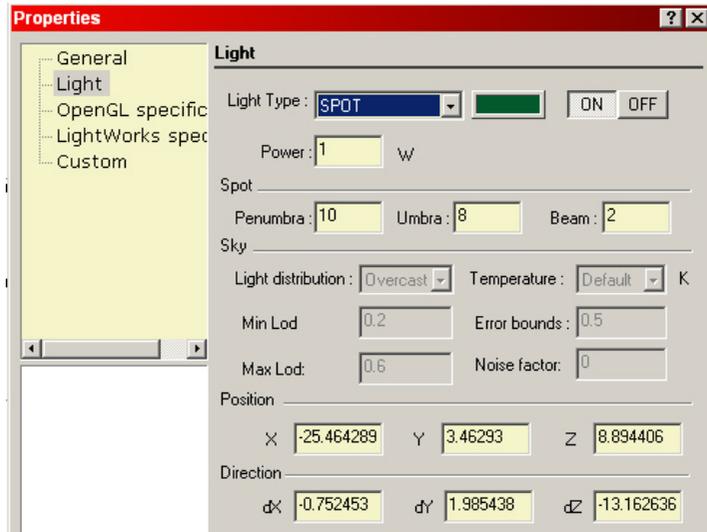


All three lights should now be pointing towards the phone. You can adjust each lights parameters as you see fit.



## Spot Light Settings

There are more parameters available to a Spot light source than any other.

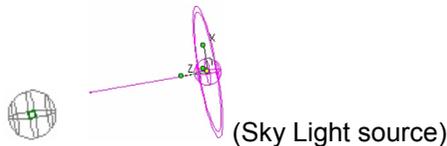


As with the other light sources you can change the color and power settings for the specified light source. You can also adjust the 'Spot' lighting settings seen near the middle of the dialog. You can view information on these settings in chapter 2.

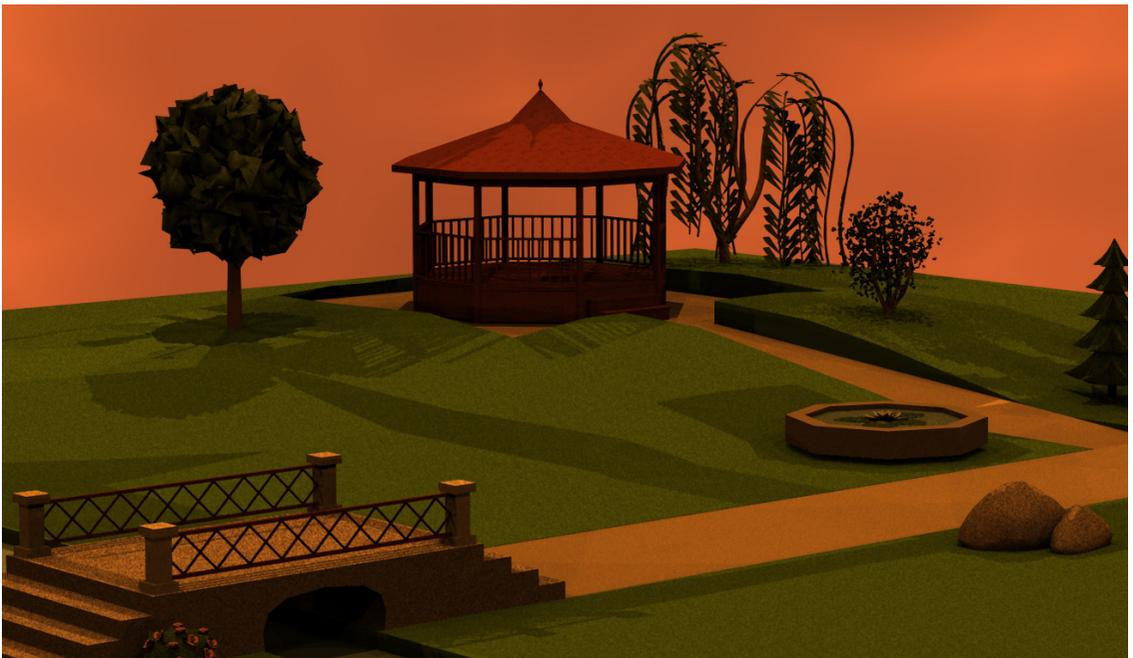
## Sky



The Sky light source resembles the use of an actual 'sky' in your TurboCAD renderings. When the Visible button is used on the light it will appear as the symbol shown at left below. Selecting the Sky light symbol will produce the graphic shown below right.



Two renderings can be seen below. Both are identical except for the background color and the Sky light parameters. Nothing else has changed. For more information see chapter 2.



## Sky Light Uses

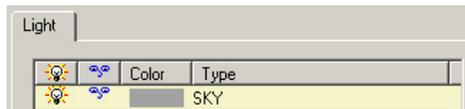
You could probably use the Sky light source in all kinds of situations but the main one would be as an actual 'sky' light source. While the Directional light source can be used as a 'sun' light tool the Sky light source reacts much more realistic and effects many more elements of a rendering.

## Sky Light Positioning

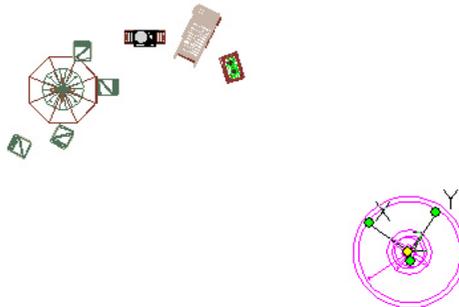
The Sky light source is positioned in the same way that the Spot light source is. You must first position the x/y/z axes of the source and then aim it. Progression

The first part of Sky light positioning works in exactly the same way Spot light positioning does. When positioning a Sky light source in a model you should always use the mouse and Inspector Bar fields. You should try not using the mouse solely since 'snapping' the source to a new point will usually place the source on the current workplane.

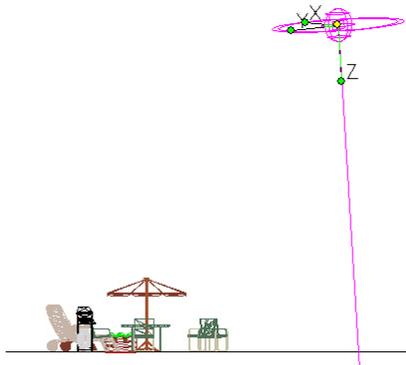
1. First activate the source on the Light Properties dialog and make it visible on screen.



2. Next, close the dialog and find the light source on screen. Switch the view to 'World Plan' or 'Bottom' and select the light source.
3. Move the source to the desired (x/y) position using the mouse or by inputting the desired values into the (Pos) fields on the Inspector Bar.



4. To position the Z axis of the light source switch the view to a side view (front, back, right or left). <TAB> to the Inspector Bar and to the (Pos Z) field. Input the value you wish set the height of the light source at. You may need to zoom in or out to get the correct location. (as shown below).



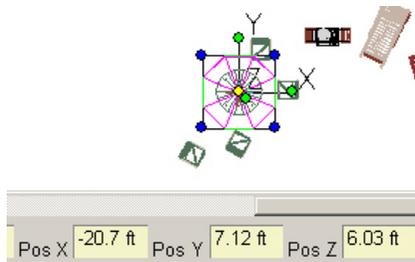
**Note:** You can also position a Sky light source using the Position fields found on the Light tab of the Light Properties dialog for that source.

Position

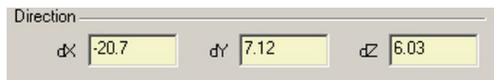
X	Y	Z
-1.307514	7.461544	12

Now to aim the source in the desired direction. You must first find the (x/y/z) point you wish to aim to. In the image below we will be trying to aim to the center of the umbrella.

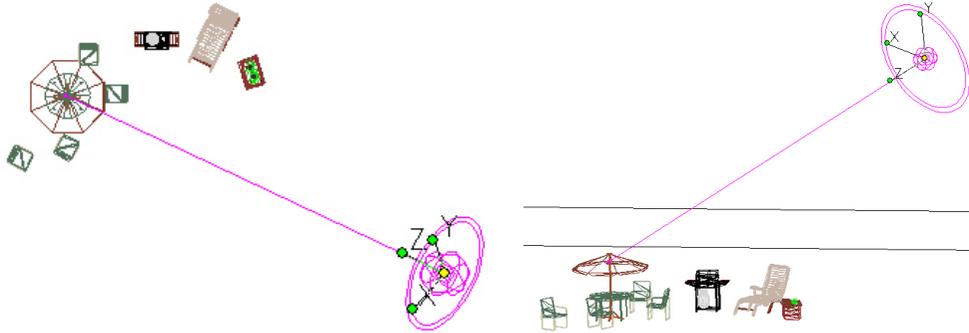
5. Switch to World Plan View. Select the umbrella and place the cursor over the Reference Point. Note the (Pos) field values on the Inspector Bar.



6. Go back and select the Sky light source. Right-click and select 'Properties' to access its Properties dialog.
7. Select the Light tab and input the same coordinates into the (dx), (dy) and (dz) Positioning fields. (as seen below)



8. Select OK. The light source should now be aimed directly at the midpoint of the umbrella.



## Sky Light Settings

Almost all the settings included on the Light tab of the Light Properties dialog are active for a Sky light source. In fact the only parameters not active are the Spot settings. All of the Sky settings are active as are the color, power and positioning fields.

# Lighting Models

A lighting model defines various aspects of the way lighting for a specific image should be calculated. These calculations are determined by the settings and parameters available to the user for each light source used in a model. With these settings you can determine if light should fall according to some specific law or just a basic non-physical computer generated method. The specific model can determine if the camera distance has any effect on a rendered model as well.

All of the parameters and settings used in a specific model will affect the speed and photorealistic quality of the rendered image. A tradeoff is usually done with these settings so that your renderings speeds are reasonable and quality is as good as possible.

TurboCAD includes a basic default model for each and every 3d object created in the program. The default lighting model includes four Point light sources (darkly lit), an Ambient light source and a Headlight light source. While these specific light sources make a pretty good model, you will most likely need to adjust the light source positions as well as color for almost every 3d model you create.

The two main components of a lighting model are the Light source characteristics and the surface properties of the objects. The light source characteristics include the: position of the actual light sources, the intensity of each light source color and the directional allocation of the light sources in the model.

The surface properties are another thing altogether though. Many factors of an objects makeup (material usage) can contribute to the lighting effect of a model. Many of these characteristics are color and texture related but some are also light related. Henry O. Hubich has written an exceptional book on 'Materials' usage in TurboCAD and should be looked into if you plan on doing any major 3D work with TurboCAD.

# Chapter 4

## “Environments”

‘Environments’ have been integrated into TurboCAD for some time now and although they really don’t have much to do with lighting itself, they play a major part in rendering. Environments also have a major role in a new part of TurboCAD’s framework “Image Based Lighting”. This will be talked about, in full, in Chapter 6. Environments are actually only included with TurboCAD Professional. If you happen to have the Deluxe edition then you will not be able to use this feature.

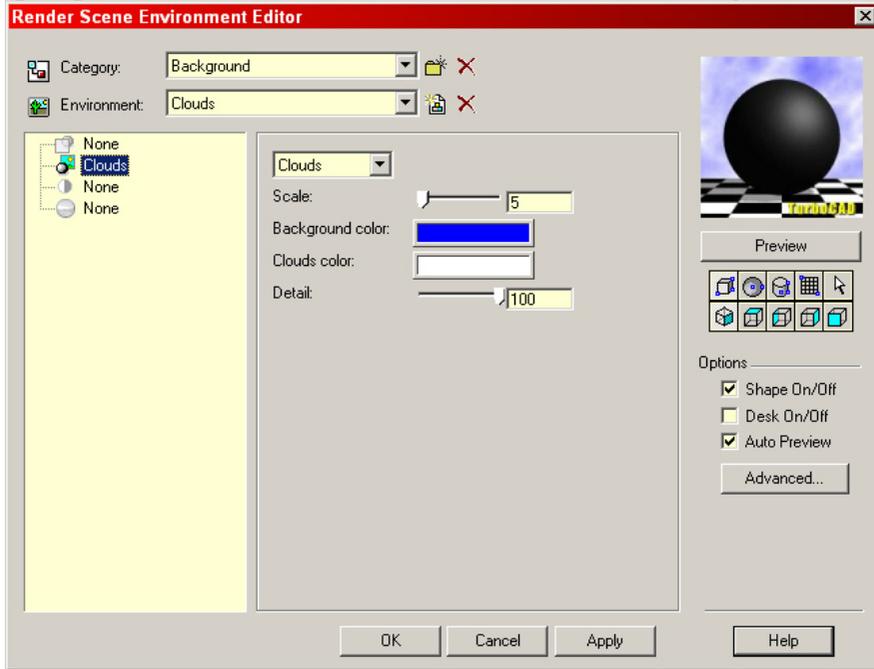
Environments give you the ability to manipulate the background, foreground and overall tone of a rendering. With Environments you can add background images or even clouds to your designs. With the foreground options you can add items such as: snow, fog or ground fog. Each part has its own special settings which affect the structure of the environment itself.

## Render Scene Environment

You access the Render Scene Environment Editor from the Drawing Setup. When you select Options/Render Scene Environment on the Menu Bar the Drawing Setup dialog will appear with the Render Scene Environment tab active. From this tab you can pick from several pre-set categories as well as Environments for those categories from the two drop-down lists.

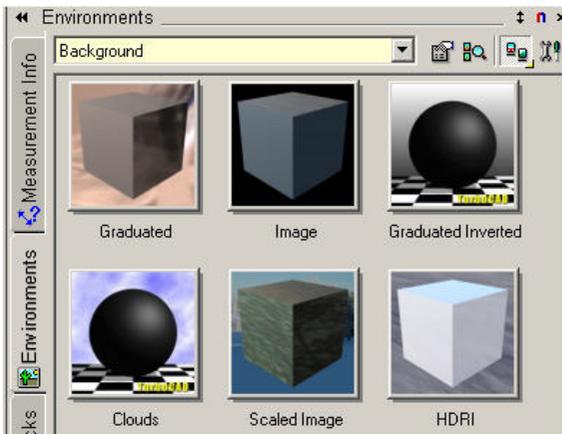


From this tab you can also activate the Render Scene Environment Editor by selecting the ‘Edit Environment’ button. After doing so the Render Scene Environment Editor dialog will appear. The Environments editor is similar to that of the Materials editor except that the features found on this editor deal with the different environments that can be used in your models.



The categories of environments include: backgrounds, cubical maps, foregrounds, Images, Plain and Tone. Each category has a selection of environments to go along with them.

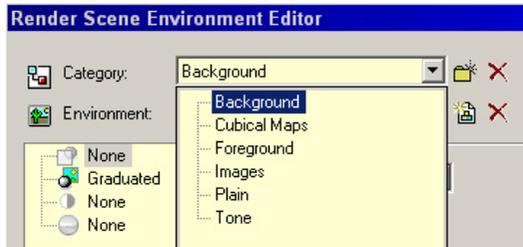
Another place to activate Environments is through the Environments palette. You can activate the palette by selecting View/Environments palette on the Menu Bar and the palette will appear. Simply select the Category you want from the drop-down list and then the Environment you want from the palette list.



(Environment Palette)

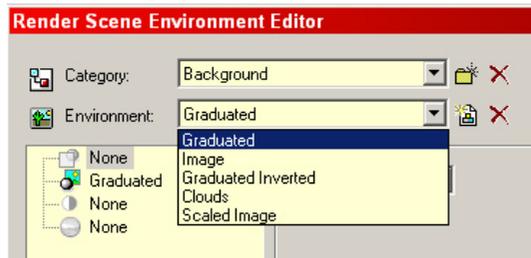
# Render Scene Environment Editor

The Render Scene Environment Editor dialog has changed from that of TurboCAD v10.5. There used to be four tabs which included: Foreground, Background, Tone and Global Environment. In TurboCAD v11 the tabs depend on the category type being used. You still have the same six categories to pick from but the tabs will change depending on which category type is in use.



The top of the dialog consists of two drop down lists. The first is Category. As mentioned above you should see six different pre-set categories to pick from this drop-down list. You can create a new category by selecting the 'New' button to the right of the list and then inputting the new category name into the New Category dialog that will appear. You can also delete an existing category by selecting the category from the list and then selecting the Delete button to the right of the drop-down list.

After selecting an Environment category you next select an Environment, for that category, from the Environment drop-down list. Again a selection of pre-set Environments is included with each category. As an example the Background category includes: Graduated, Image, Graduated Inverted, Clouds, Scaled Image and HDRI as pre-made Environments.



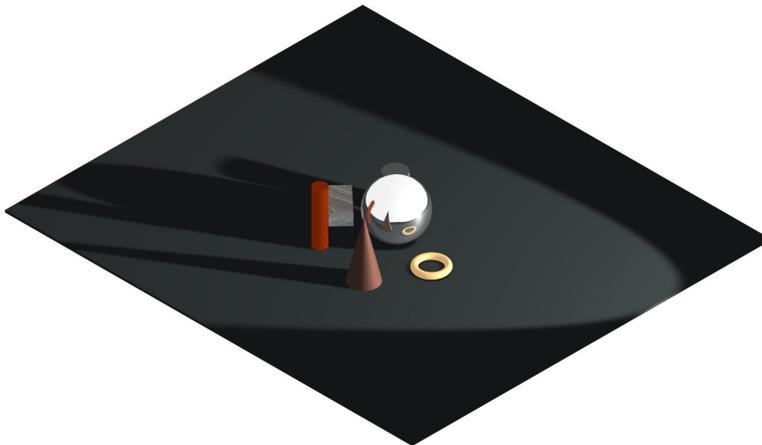
Although these Environments are very useful you may want to make a few more of your own. To do so you select the category you wish to use and then select the 'New' button next to the Environment drop-down list. Input the name of your new Environment in the dialog and select OK.



You can now change any and all of the settings and parameters found on the lower tabs to make up your new Environment.

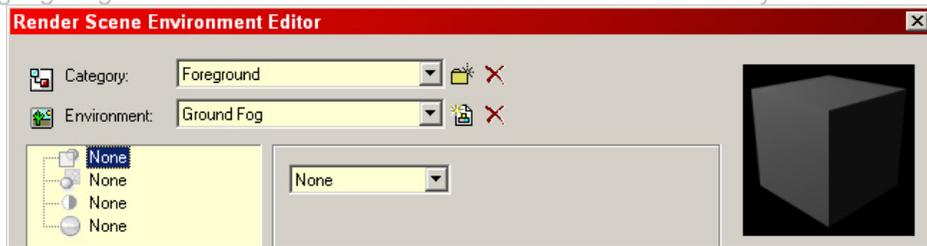
**Note:** It is advantageous to ALWAYS make a new Environment any time you wish to change even one setting on an existing Environment. This is because once you adjust an existing environment you no longer have that one to work with. The only way to get it back is to select Options/Environments/Restore Default Environments from the Menu Bar. The problem with this is that all new Environments will be deleted at the Restore.

Below is an image of several basic 3D objects with a Spot light and an Ambient light used to illuminate it. The following sections will show how each is affected by different Environments.

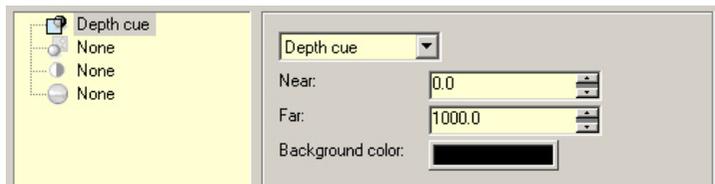


## Foreground Category

The settings found in this category make it possible to produce environmental effects in the foreground of renderings. These effects include: Depth Cue, Fog, Fog Light, Ground Fog, Light Scattering, Medium Scattering and Snow. Each environment has settings so you can create the desired effect.



## Depth Cue



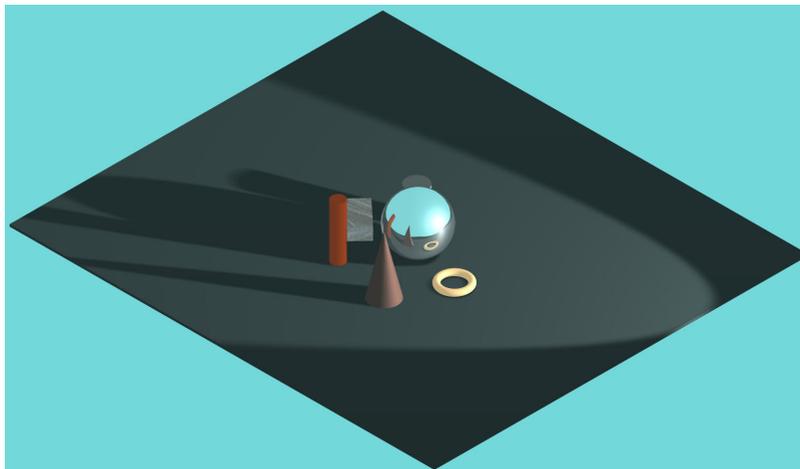
The 'Depth Cue' shader adds a background color according to the distance of the surface from the viewer.

**Near:** At distances less than input in this box, no background color is added.

**Far:** At distances more than input in this box, the background color is returned.

Between the two distances, the output is linearly interpolated between the surface and background colors. The effect is that depth information in the geometry is enhanced in the final image.

**Background Color:** Select what color you wish to use from the color dialog.



## Color Dialog

Select the color box and choose the color you want from the Color dialog. You can select a pre-set color from the upper section of the dialog. The colors found in this section are the standard pre-set colors included with TurboCAD.

**Red, Green and Blue:** Use these fields to input the amount of Red, Green and Blue you wish to use in any specific color. You may input values from (0 to 255) in these fields. (0) represents no color while (255) represents total (pure) color. You can input values directly into the fields or use the sliders to the right of the fields to adjust on the fly.



Along with the actual color you can choose the Hue, Saturation and Value of the color selected.

**Hue:** Hue is the wavelength within the visible-light spectrum at which the energy output from a source is greatest. Red starts off the spectrum. It then runs through yellow, green, cyan, blue, purple, magenta and back to red.



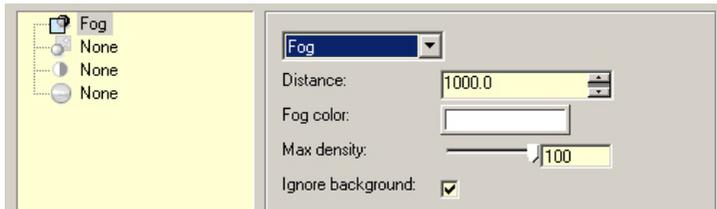
The lower the number the closer to the beginning of the spectrum it will be. The higher the number the closer to the end it will be. Changing the Hue field will change all the values of the RGB fields simultaneously. You can specify a value from (0 to 359). Again you can input a value directly into the field or use the slider to adjust the value.

**Saturation:** Saturation is an expression for the relative bandwidth of the visible output from a light source. It determines the strength or purity of a color in a specific hue. The higher the value inputted, the purer the color. Example: A saturation value of (255) using a Hue of (0) will produce pure Red. If the saturation was changed to (0) the color will change to a black (absence of color). You can specify a value from (0 to 255). This can be seen top to bottom in the color matrix of the dialog.

**Value:** Value represents the lightness or darkness of a specific color (hue and saturation). You can specify a value from (0 to 255). The lower the number the darker the color, the higher the value the brighter the color. A value of (0) will produce Black while a value of (255) will produce the lightest a specific color could be.

You will also be able to see the 'old' color along with the new 'adjusted' color in the bottom section of the dialog. The 'old' color will always stay the same while the 'New' color will change with every modification you make.

## Fog



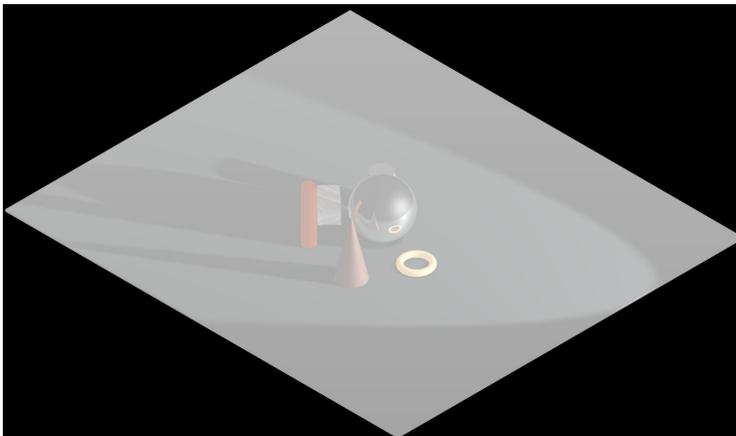
The 'Fog' shader creates a foreground fog effect.

**Distance:** Increasing this value advances the fog further from the camera.

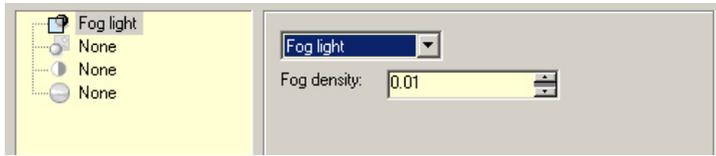
**Fog Color:** Selecting this box opens the Color Dialog. This dialog allows the use to not only choose an existing pre-set color but adjust the precise amount of Red, Green and Blue is included in a color. You can also adjust the Hue, Saturation and Value of the color as well. For more information on the Color Dialog please see the 'Color Dialog' heading shown earlier in this chapter.

**Max Density:** The density of the fog is fixed to the value set in this box. Default is (100) representing 100%.

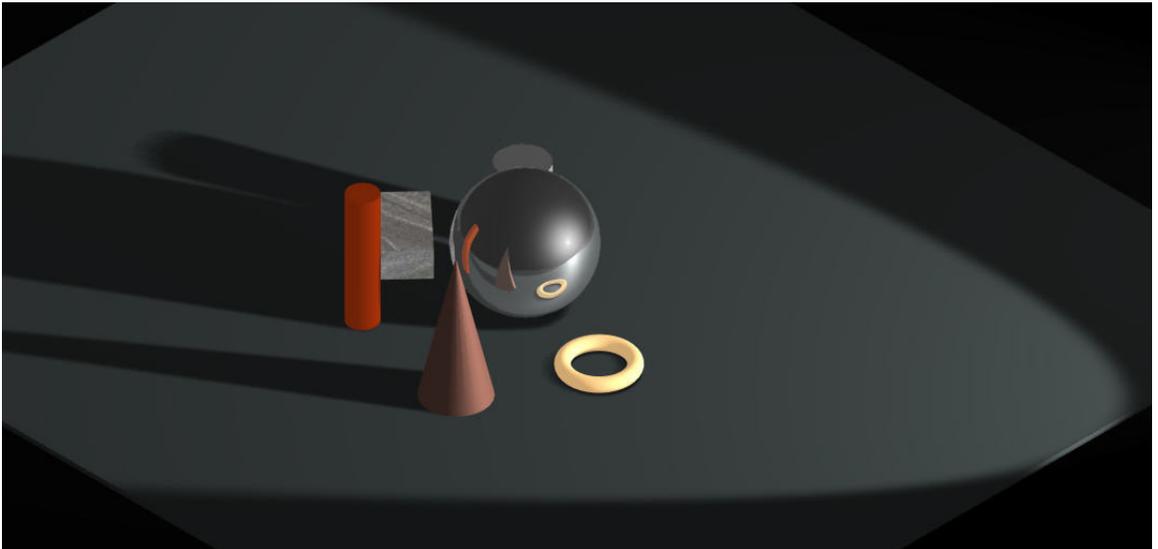
**Ignore Background:** When selected the fog effect is not applied to the background pixels.



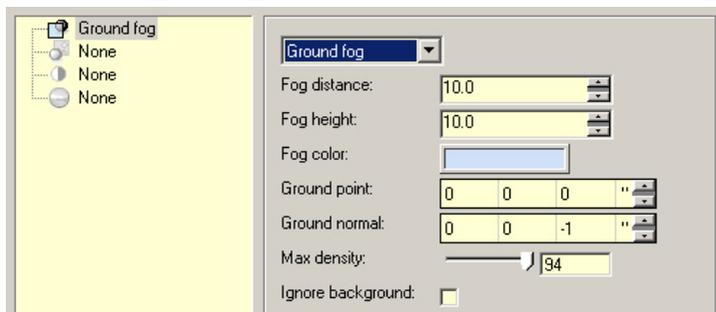
## Fog Light



The 'Fog Light' shader creates an atmospheric scattering from both Point and Spot light sources. The higher the number (Fog Density) the foggier the look. You can really see the effect in the mirrored ball in the image shown below.



## Ground Fog



The 'Ground Fog' shader produces an effect where fog decreases with height.

**Fog Distance:** Increasing this value advances the fog further from the camera.

**Fog Height:** This value sets the rate of decrease of the fog effect.

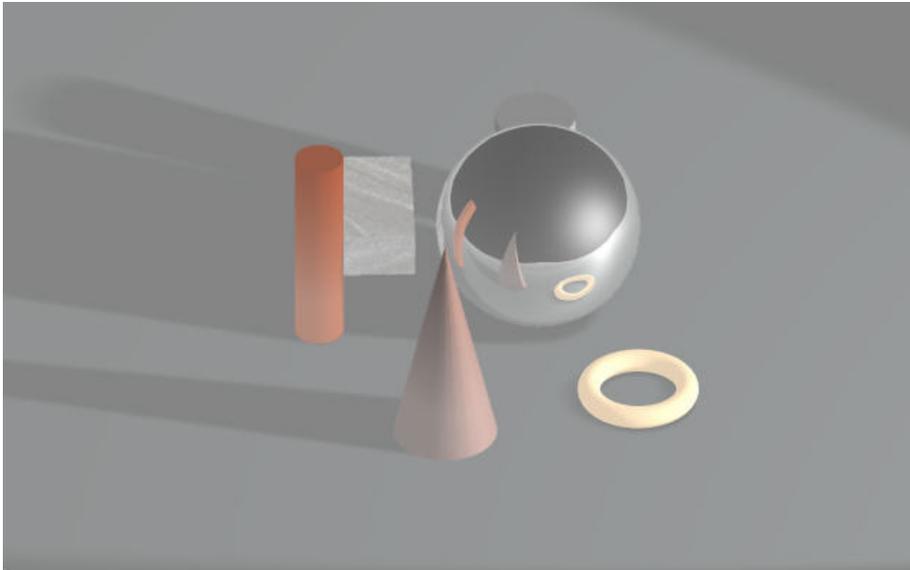
**Fog Color:** Selecting this box opens the Color Dialog. This dialog allows the use to not only choose an existing pre-set color but adjust the precise amount of Red, Green and Blue is included in a color. You can also adjust the Hue, Saturation and Value of the color as well. For more information on the Color Dialog please see the 'Color Dialog' heading shown earlier in this chapter.

**Ground Point:** Specifies where the fog lies. Default is set at  $z=0$ .

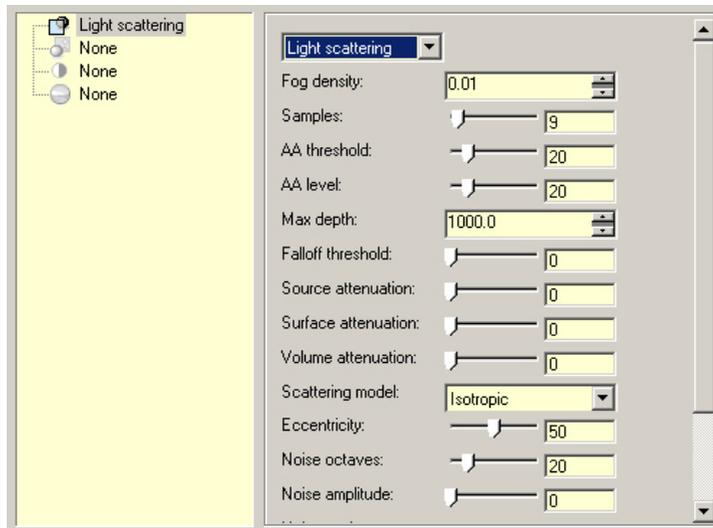
**Ground Normal:**

**Max Density:** The density of the fog is fixed to the value set in this box. Default is (100) representing 100%.

**Ignore Background:** When selected the fog effect is not applied to the background pixels.

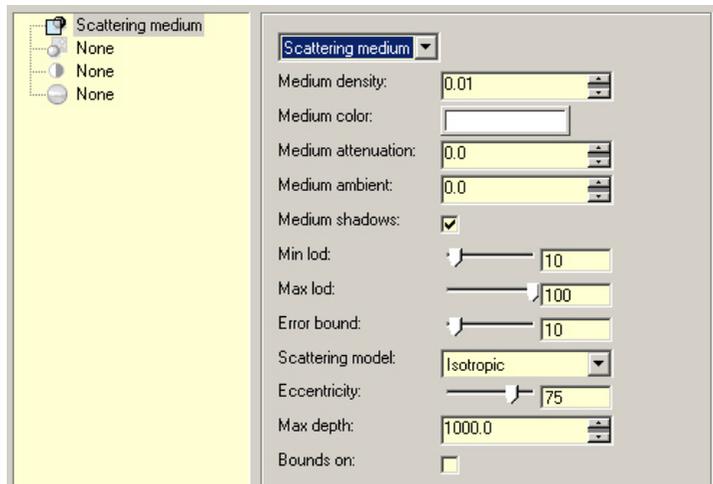


## Light Scattering



This shader is now obsolete through LightWorks. The new shader “Scattering Medium” should be used instead.

## Scattering Medium



The ‘Scattering Medium’ shader simulates a full range of effects occurring in a specific medium. This may include: attenuation within a medium or light filtration through a colored medium.

**Medium Density:** The higher the value the more intense the scattering.

**Medium Color:** Selecting this box opens the Color Dialog. This dialog allows the use to not only choose an existing pre-set color but adjust the precise amount of Red, Green and Blue is included in a color. You can also adjust the Hue, Saturation and Value of the color as well. For more information on the Color Dialog please see the 'Color Dialog' heading shown earlier in this chapter.

**Medium Attenuation:** this parameter affects how the medium absorbs light on its way. The behavior of attenuation depends also on medium color.

**Medium Ambient:** This setting allows the effect of uniform light scattering through the medium.

**Medium Shadows:** Select if you wish the Medium to accept shadows.

**Min Lod and Max Lod:** These settings describe the minimum and maximum levels of detail in the calculation of light scattering.

**Error Bound:** This is an accuracy control. It defines acceptable relative error of estimate of medium contribution to pixel value. The default is set at 10(%).

**Scattering Model:** This parameter allows you to select a reflectance model for your medium.

**Eccentricity:**

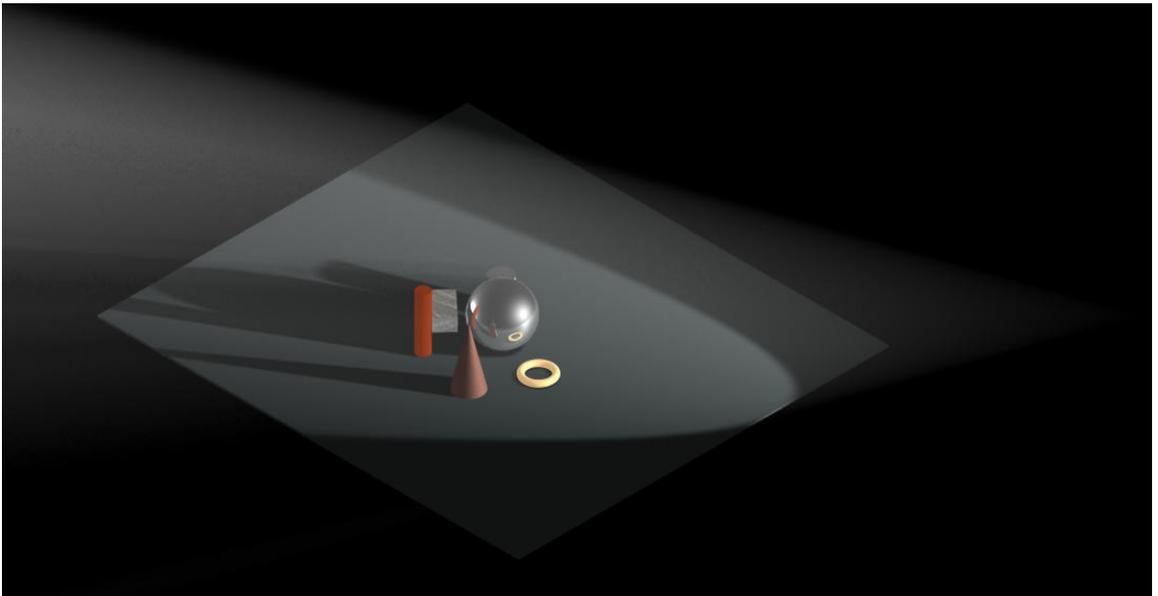
**Max Depth:**

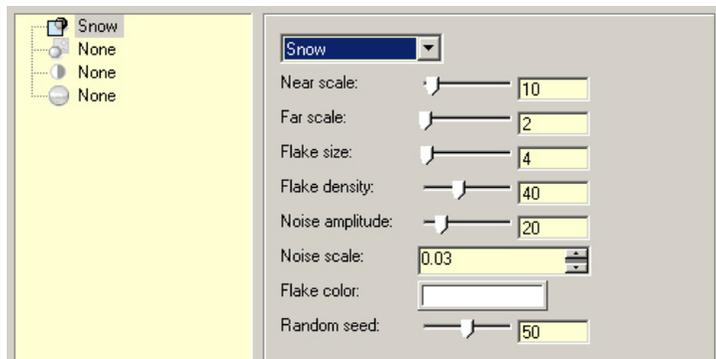
**Bounds On:**

Refer to

[http://download.graphisoft.com/ftp/techsupport/documentation/developer\\_docs/BasicLibraryDoc/LightWorksIntegration/LW\\_Programmers\\_ref/scatteringmedium.html](http://download.graphisoft.com/ftp/techsupport/documentation/developer_docs/BasicLibraryDoc/LightWorksIntegration/LW_Programmers_ref/scatteringmedium.html) for more information on these last four parameters.

You can really see the scattering effect in the image shown below.



**Snow**

This shader gives the effect of snow falling in front of the camera.

**Near Scale and Far Scale:** The snow actually is created on two different planes. The scale of these planes is determined by these two parameters.

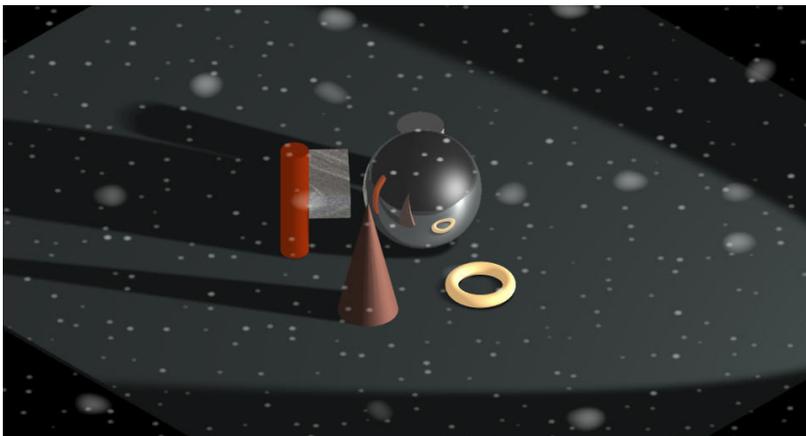
**Flake Size:** The size of the flakes is determined with this parameter.

**Flake Density:** The flake density is determined using this parameter.

**Noise Amplitude and Noise Scale:** These two parameters determine the irregularity of the flakes.

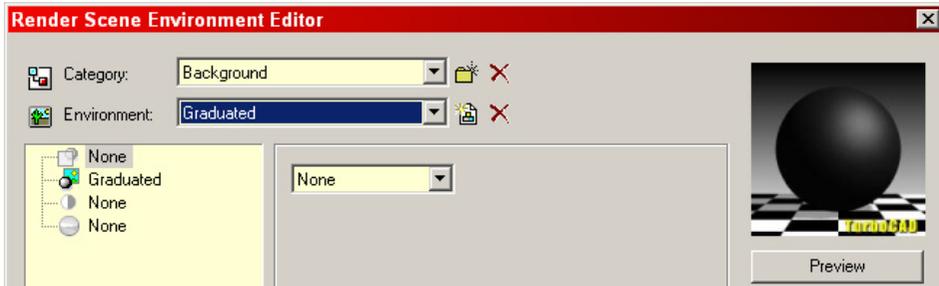
**Flake Color:** Select the color of the flakes from the color dialog. Selecting this box opens the Color Dialog. This dialog allows the use to not only choose an existing pre-set color but adjust the precise amount of Red, Green and Blue is included in a color. You can also adjust the Hue, Saturation and Value of the color as well. For more information on the Color Dialog please see the 'Color Dialog' heading shown earlier in this chapter.

**Random Seed:** It is possible to change the distribution of the snow flakes from the default by changing this parameter. This provides an initial seed value for the random distribution.

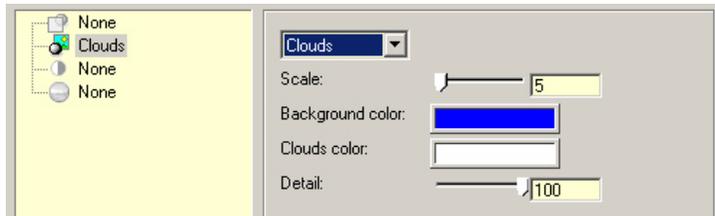


## Background Category

The settings found in this category make it possible to produce environmental effects that can enhance the backgrounds of your renderings. These effects include: Clouds, Environment, Graduated, Image, Plain and Scaled Image. Each environment has settings so you can create the desired effect.



## Clouds



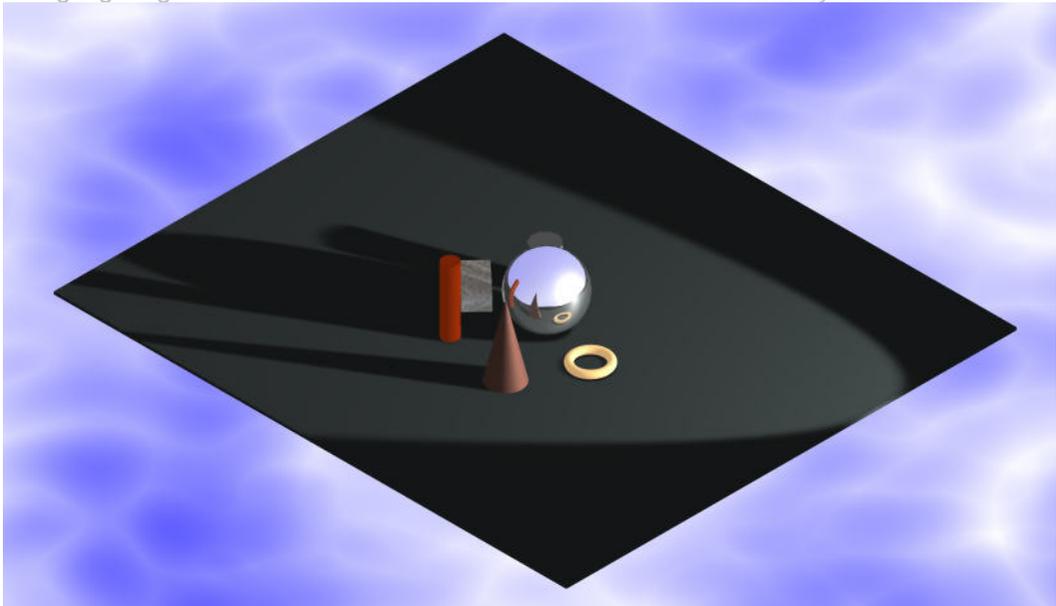
The 'Clouds' background gives a cloudy appearance. Of course if the colors are changed then the effect changes too. By using red and yellow you can produce a fire like look.

**Scale:** This sets the size of the clouds.

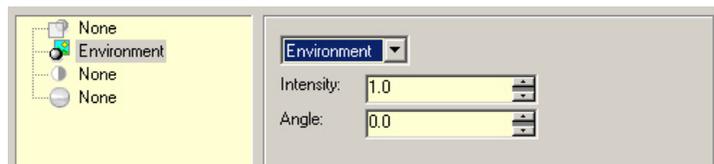
**Background Color:** The background color used in the effect.

**Clouds Color:** The color used as the foreground 'cloud' effect. Selecting this box opens the Color Dialog. This dialog allows the use to not only choose an existing pre-set color but adjust the precise amount of Red, Green and Blue is included in a color. You can also adjust the Hue, Saturation and Value of the color as well. For more information on the Color Dialog please see the 'Color Dialog' heading shown earlier in this chapter.

**Detail:** The higher the number the more detail is given to the cloud effect. Basically the higher the number the higher number of lines make up the cloud effect.



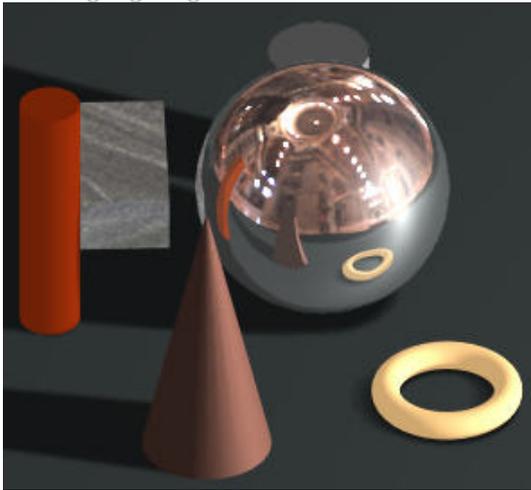
## Environment



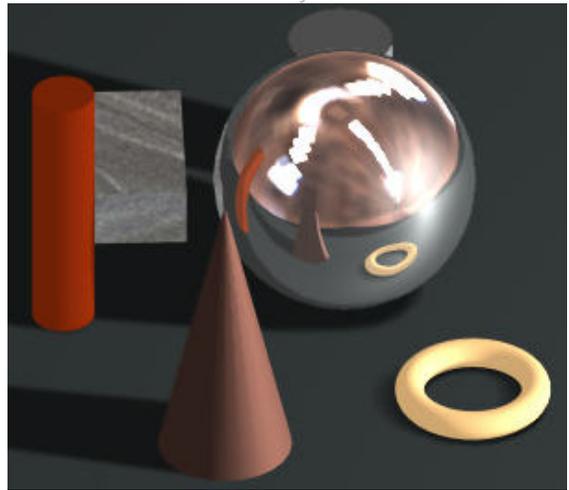
This is a reflectance model which provides environment mapping. This setting comes in to use when using a Global Environment. This shader uses the Global Environment as a background light source for rendering.

**Intensity:** Increase the level of brightness of the background shader by inputting a higher value.

**Angle:** This setting specifies the angle, in radians, over which the environment map is sampled for each pixel of background. The higher the value input the more blurred the background appears.



Angle = 0



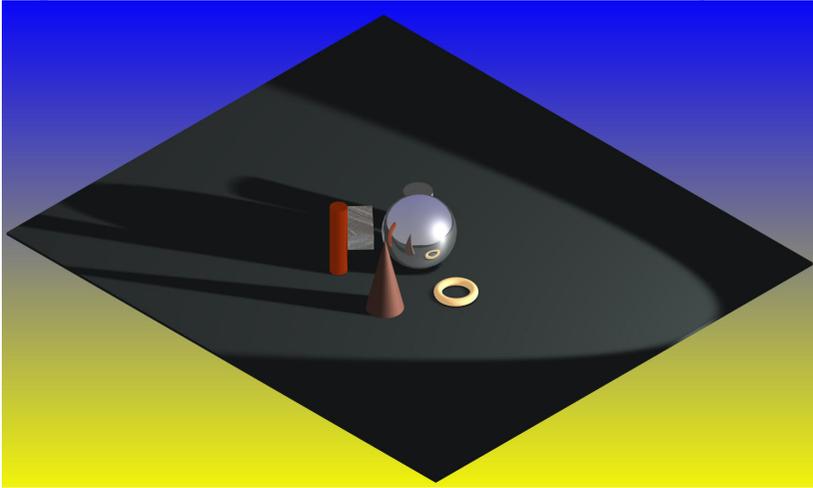
Angle = 0.06

## Graduated

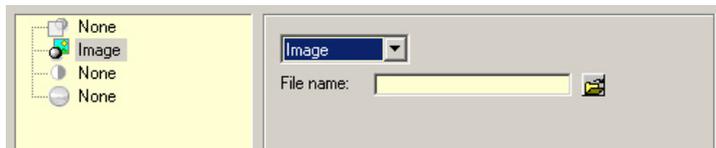


The Graduated background produces a gradation of color change between two colors from the top of the page to the bottom. Simply pick the two colors and render.

**Top Color** and **Bottom Color** – Selecting these boxes opens the Color Dialog. This dialog allows the use to not only choose an existing pre-set color but adjust the precise amount of Red, Green and Blue is included in a color. You can also adjust the Hue, Saturation and Value of the color as well. For more information on the Color Dialog please see the 'Color Dialog' heading shown earlier in this chapter.

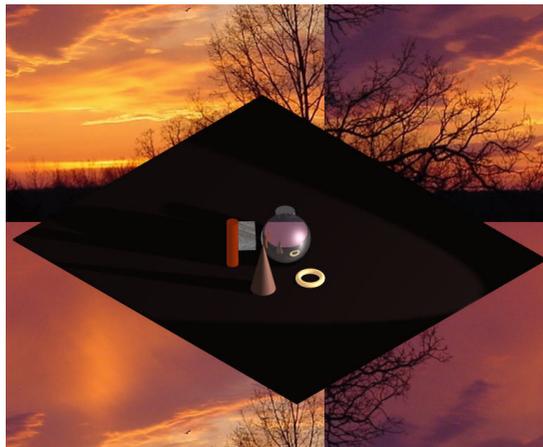


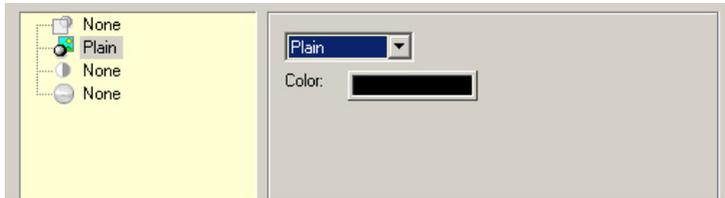
## Image



An actual image is used as a background shader. The image will tile on the screen if need be.

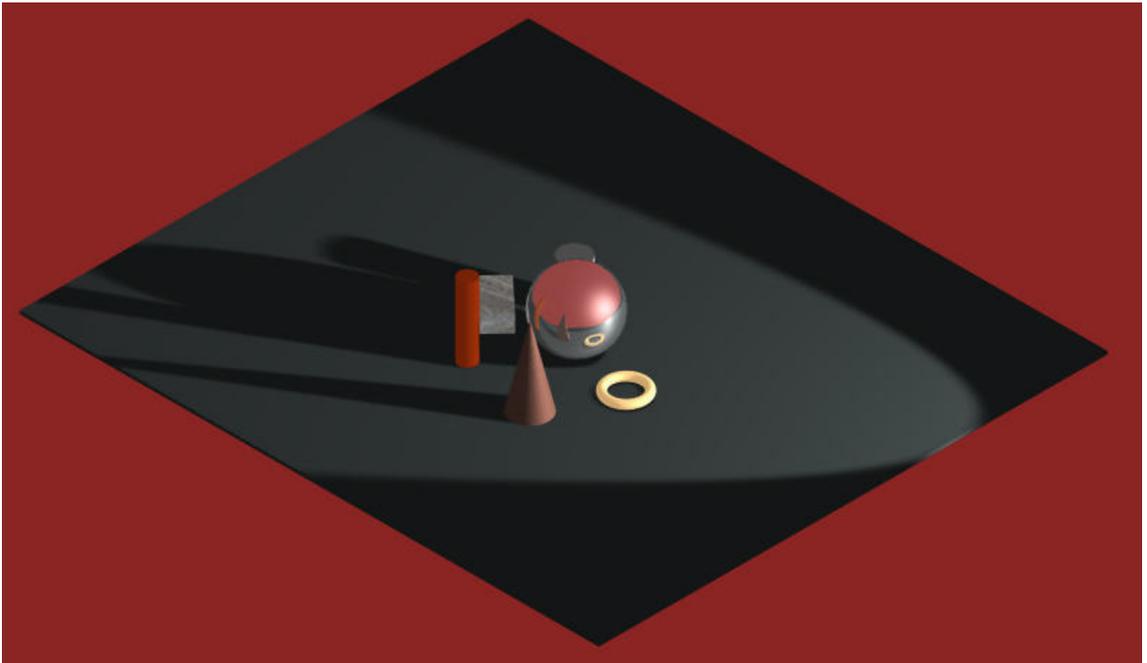
**File name:** Use the Open File button to find the file you wish to use. It will appear in the File Name window when selected.

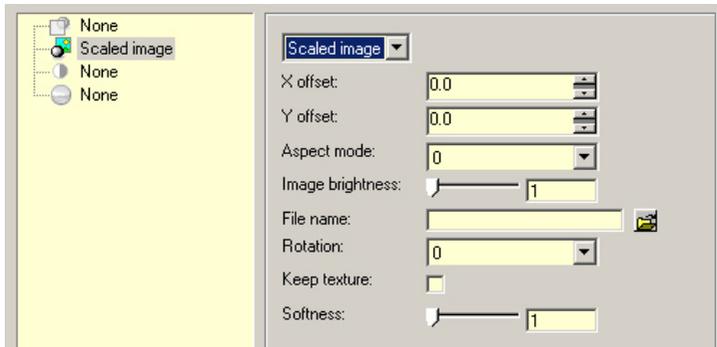


**Plain**

A specified color is used as the background.

**Color:** Selecting this box opens the Color Dialog. This dialog allows the use to not only choose an existing pre-set color but adjust the precise amount of Red, Green and Blue is included in a color. You can also adjust the Hue, Saturation and Value of the color as well. For more information on the Color Dialog please see the 'Color Dialog' heading shown earlier in this chapter.



**Scaled Image**

An image is used as a background shader but the image can be adjusted and manipulated to suit the needs of the user.

**X Offset:** Use this setting to move the image along the X axis (left or right).

**Y Offset:** Use this setting to move the image along the Y axis (up or down).

*For these setting to work the Aspect Mode must be set to (1).*

**Aspect Mode:** Set which Aspect mode you wish to use.

0. Stretch – The image is stretched to fit the screen.
1. Aspect Ratio – The actual aspect ratio of the image is kept as it is still stretched to fit the screen.
2. Letterbox – The aspect ratio of the image is preserved with the image centered in the viewport. The image is always visible this way.
3. View – The aspect ratio of the image is preserved with scaling and positioning being consistent with changes in the viewports size.

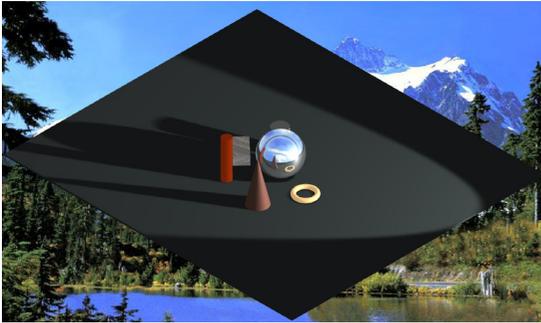
**Image Brightness:** Increase the brightness of the image by selecting a higher value.

**File Name:** Select the image you wish to use from the Open File dialog.

**Rotation:** Select the rotation you which to set the image at (0, 90, 180 or 270) from the drop-down list.

**Keep Texture:** Actually this setting does nothing since the LightWorks setting 'Image' is not incorporated into this dialog in TurboCAD.

**Softness:** This setting controls the degree of blurring of the image.

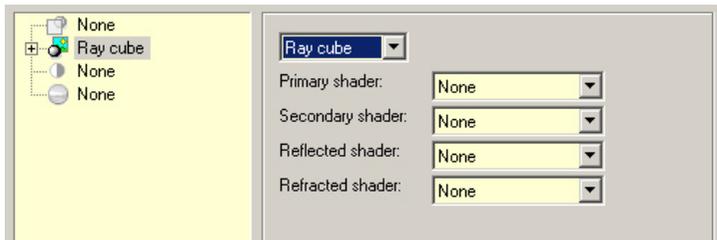


Aspect Mode = 0



Aspect Mode =1

## Ray Cube



The Ray Cube environment is new to TurboCAD v11. This new environment allows the user to define multiple environments at the same time. You can define 'primary' and 'secondary' environments. You can also define reflected and refracted environments.

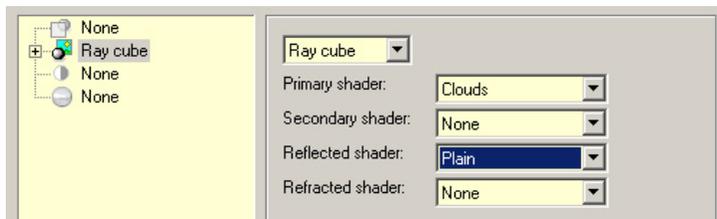
**Primary shader:** The main environment used in a rendering.

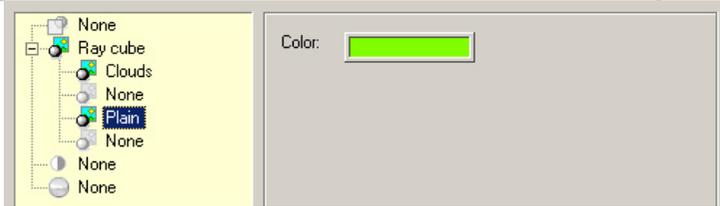
**Secondary shader:** A secondary environment used in a rendering.

**Reflected shader:** An environment used for reflectance's.

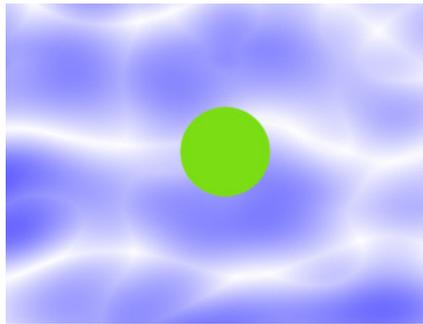
**Refracted shader:** An environment used with refracted light.

In the example below you can see that two shaders were used. The primary shader was 'Clouds' while the Reflected shader was set to Plain. The color green was set in the sub-category tab.

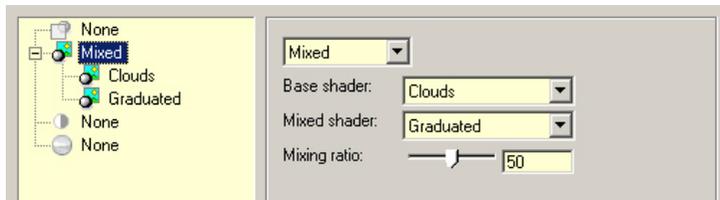




The image shows a plain sphere with a mirror texture attached. While the background is clouds, they are not reflected. Instead the color green is.



## Mixed



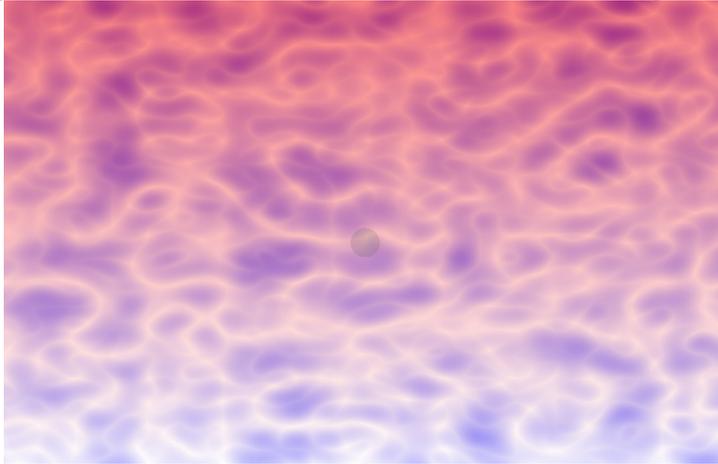
The 'Mixed' environment is also new to TurboCAD v11. This shader basically mixes two existing environments together.

**Base shader:** The main environment used in the model.

**Mixed shader:** The secondary shader to be mixed with the main one.

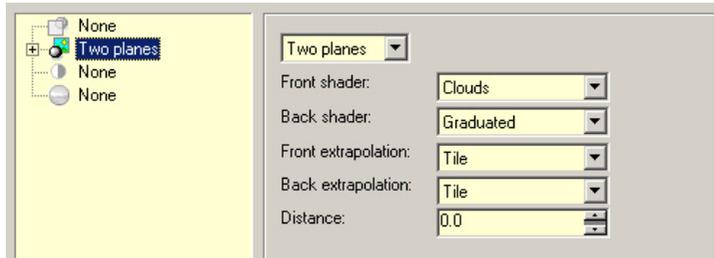
**Mixing ratio:** Percentage the Mixed shader is combined into the Base shader.

In the example below 'Clouds' is used as the Base shader and a red/white Graduated shader is used as the Mixed shader. The ratio is set to 50%. They are combined to look like that shown below.



If the percentage is raised to 75% then more of the Graduated environment will show through. If set to 25% then less will show through.

## Two Planes



The Two Planes environment is the last of the new shaders included with TurboCAD v11. With this environment, two separate planes are setup in the model, a background plane (behind the camera) and the regular foreground plane. The background plane is set behind the camera so it can't be seen, only through reflected objects. This environment works more like in real life where background image can only be seen in reflectance.

**Front shader:** The environment used as the front shader (in front of the camera).

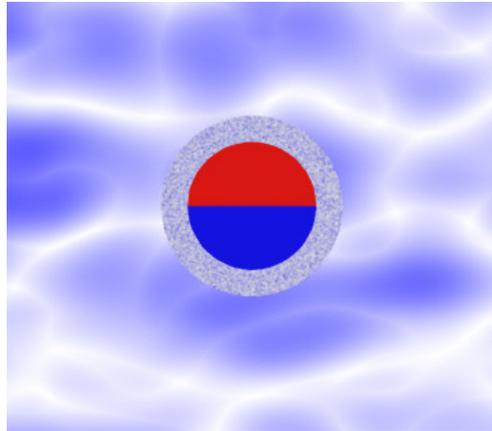
**Back shader:** The environment used as the rear shader (in back of the camera).

**Front extrapolation:** For 'clouds' use 'None', for graduated use 'Smear', for image use 'Tile'.

**Back extrapolation:** For 'clouds' use 'None', for graduated use 'Smear', for image use 'Tile'.

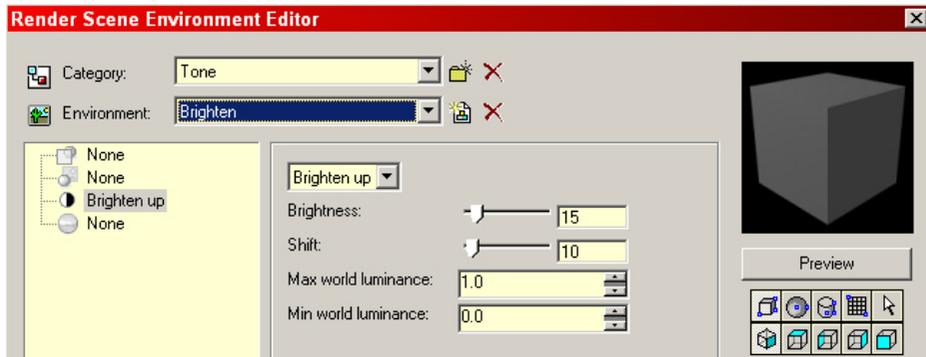
**Distance:** The distance the two planes are apart (from the camera).

In the example shown 'clouds' are used as the foreground shader with a graduated (red/blue) is used as a background shader. The result looks like that shown below.

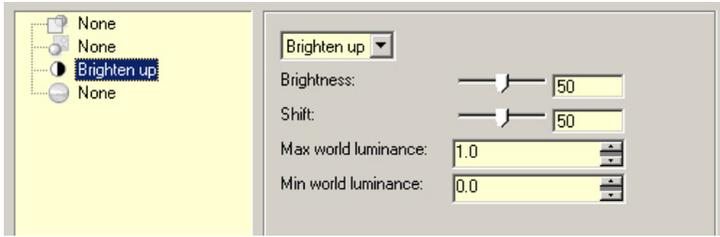


## Tone Category

The settings found in this category make it possible for the user to change the tone of the rendering. You are given two options. The first lets you Brighten Up the image and the second lets you change the tone of the rendering by Scale (a percentage of the original). The Tone tab can be seen below.



## Brighten Up



This shader changes the light intensity of an image by brightening or darkening the low intensity areas.

**Brightness:** This parameter determines the amount of to brighten or darken the render, the higher the value the brighter the render.

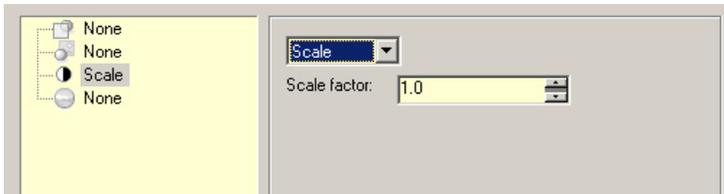
**Shift:** This setting changes how brightness is affected. Values below (50) will brighten up darker regions of an image while values higher then (50) will darken the brighter areas of an image.

**Max World Luminance:**

**Min World Luminance:**

The Max and Min World Luminance are mapped onto the display range (0.0 to 1.0)

## Scale



This tone mapping shader will change the display luminance value by multiplying the world luminance value by the value specified in the 'Scale Factor' field.

## **Cubical Maps Category**

The Cubical Maps category tab was created for use with Image Base Lighting. This new style of lighting is discussed, in full, in Chapter 6. These parameters allow the user to select a High Dynamic Range Image as a global environment used in lighting.



You select the type of image file you wish to use as the global environment. You can choose from Cube, Fixed Cube, Cross, Fixed Cross, Panorama and Light Probe. You then select the image you wish to use from the File Name field.

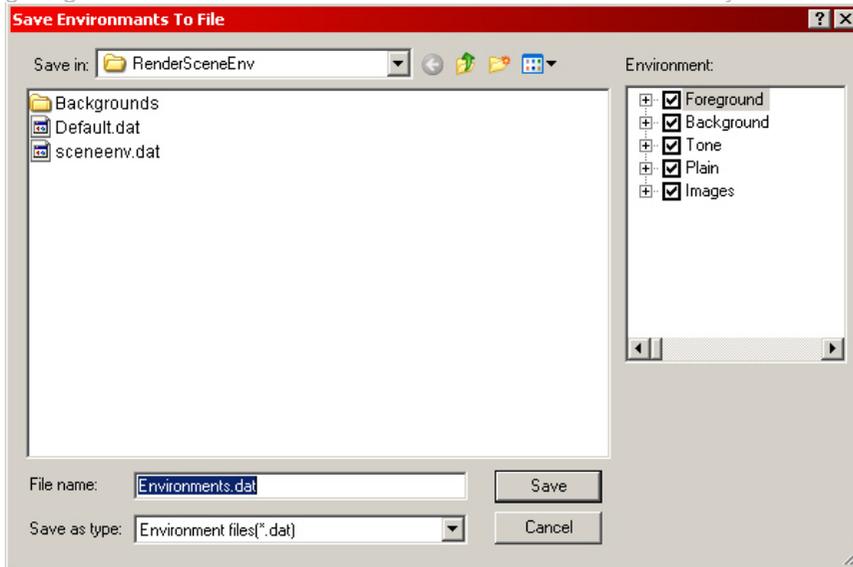
## Restore Default Environments

Included with TurboCAD is an option which will restore all default Environments for you. This can be a blessing if you happen to change an environment by mistake and need to get it back. To restore all the default environments go to Options/Environments/Restore Default Environments on the Menu Bar.

The problem with this method is that all new environments that you have made will all be deleted. Luckily there is another method for restoring environments.

## Save Environments

There is also a method to save Environments you have edited or new ones you may have created. You can accomplish this with the help of the Save Environments To File dialog. Simply save the Environments with a .DAT extension using the dialog.



You can access the dialog from Options/Environments/Save Environments on the Menu Bar. This will open the dialog.

After the dialog has opened, specify the path and type the file name in the File name field. Use the expandable list to select all or several categories of materials to save. Select the Save button to save the environments file.

## Load Environments

You can also load new Environments lists using the Load Environments From File dialog. Basically it's the same dialog as the Save Environments dialog. You can access the dialog from Options/Environments/Load Environments on the Menu Bar. This will open the dialog.

After the dialog has opened simply select the list you wish to load, from the folder window and then select the Open button. The new Environments list will be inserted into the program.

# Chapter 5

## “Luminance”

You have already learned that Luminance is ‘the amount of light, which hits an object, and bounces back at a given direction. Well, that’s in the ‘real’ world. Within the TurboCAD world ‘Luminance’ is just another component which allows the user to add lights to their 3D models.

These lights can be affixed directly to 3D objects or to the overall coordinate system you are working in (UCS or WCS). Luminance lighting can be manipulated and positioned as with regular lighting too.

Luminance, like Lights, has specific property parameters integrating within the program. These properties integrate the LightWorks rendering engine into the Luminance lighting. One positive is that you can actually accomplish many more illumination effects with Luminance than you could with Lights alone. Luminance can produce such effects as light going through glass, a neon glow, projector beam lighting, fluorescent lighting and much more. The use of Luminance with different materials can create a multitude of effects and designs for use with your 3D designs.

As with Lights, Luminance lighting can only be viewed in either Quality or Draft rendering modes. A LightWorks rendering mode must be used for the Luminance to be seen. Several luminance and categories are provided by default. You can create a new luminance via the Luminance Editor.

TurboCAD allows the user to add Luminance to a model through the properties of a 3D used in the model or through the Render Scene Luminance Tab of the Drawing Setup dialog.

## Luminance Properties Tab

We will first discuss using the Luminance tab found on the properties dialog of any 3D object. To access the Luminance available for use with TurboCAD 3D objects you must access the properties dialog for any existing 3D object(s) or the default properties dialog for any 3D object tool. After opening the Properties dialog you will see a tab called ‘Luminance’. Select this tab and you will see several settings. From this tab you will be able to select from several pre-set Categories and Luminance for those categories.



You will also see a button called 'Edit Luminance' on the dialog. Selecting this button will activate the Luminance Editor. The Luminance Editor allows the user to edit and manipulate the luminance lighting of the selected 3D objects. The last setting found on dialog is called "Load Render Luminance Only".

## Category

The Category field gives the user the option to choose from three preset luminance categories which are: Complex, Fluoresc Architec AV, HDR and Single.

## Luminance

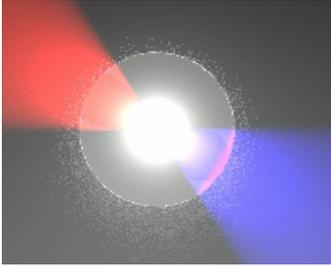
What appears in this drop-down list depends on the category you choose. If **Complex** is chosen as the Category then you will have four pre-set choices from this list. They include: SpotPointDistance, SpotPoint, SpotPointSpot and Spots. If **Fluoresc Architec AV** is chosen as the Category you will have twelve different choices. If **HDR** is selected then the only Luminance option found will be HDRExample. Finally, if **Single** is selected as the Category then you will have three pre-set choices to select from, they include: Spot, Projector and Point.

## Edit Luminance Button

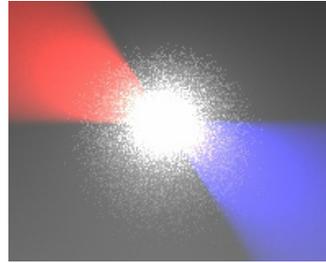
Selecting this button activates the Luminance Editor. This editor lets you edit and manipulate the pre-set luminance options included with the program.

## Load To Render Luminance Only

Selecting this checkbox allows TurboCAD to only render the actual Luminance when rendering is performed on an object using the luminance features. Not selecting this option and the object as well as the luminance will be rendered. Below you can see two images. The first shows a sphere with Luminance attached, the second shows the same image with the “Load Render Luminance Only” checkbox selected. You can only see the Luminance and NOT the sphere itself.



(Object (sphere) and Luminance rendered)



(Only Luminance rendered)

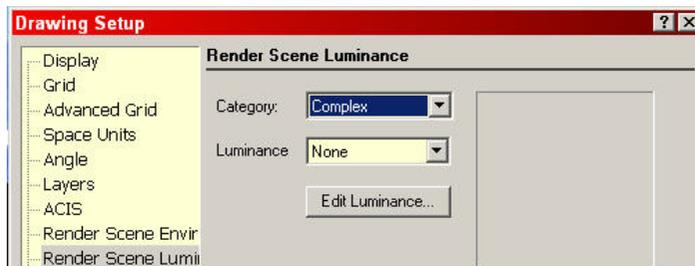
This option can be very helpful when positioning a luminance light. You can create an object and position it where you wish the light to be located. Select the option and the object will become invisible while the light source will be positioned where you want it.

## Render Scene Luminance

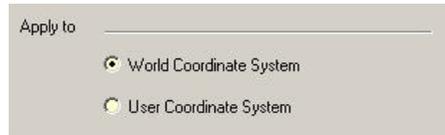
The other way to use Luminance in your models is through the Drawings Setup. When you select Options/Render Scene Luminance from the Menu Bar the Drawing Setup dialog will appear with the Render Scene Luminance tab active.

The Render Scene Luminance differs from the Luminance added to 3D objects in a model in that from here you can add Luminance to an entire model. With the Render Scene Luminance you can add Luminance to the WCS or UCS.

As from the Properties dialog, you can pick from several pre-set Categories and Luminance for those categories from the two drop-down lists.



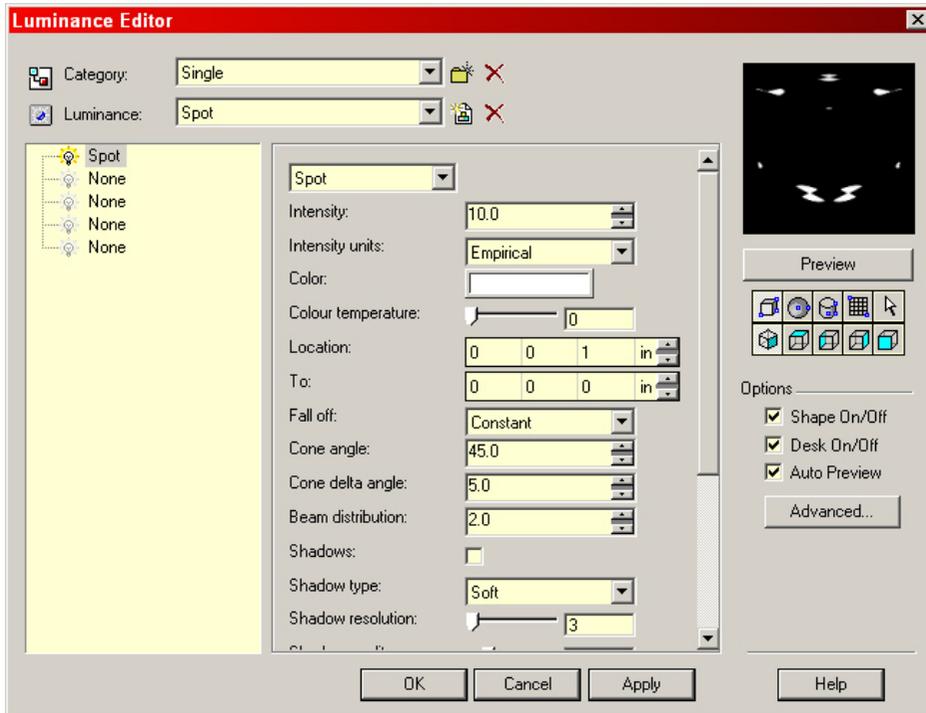
Located in the lower half of this dialog you will a section called “Apply To”. It is here where you decide if the Luminance you select is to affect the WCS or the UCS it is applied to. Simply select the radio button beside the desired system to make your choice.



From this tab you can also activate the Render Scene Luminance Editor. You do this by selecting the ‘Edit Luminance’ button found on the dialog. The Render Scene Environment Editor dialog will appear. The Luminance editor is similar to that of the Materials editor except that the features found on this editor deal with the different Luminance lights that can be used in your models.

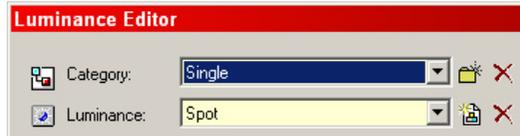
## Luminance Editor

The Luminance Editor gives the user the ability to use existing Luminance’s or edit and manipulate any pre-set luminance already available with TurboCAD to create your own new ones.



## Category and Luminance:

The Luminance Editor dialog is divided into several sections. The first section, at the top-left corner of the dialog is the same two Category and Luminance drop-down boxes found on the 3D tab of a Properties dialog.



Three pre-set categories are included with TurboCAD. These three categories are: Complex, Single and Floresc Architec AV.

**Complex** – The Complex Luminances allocate two or more lights at the same time. These lights can be assigned to an object or to the model as a whole through the Render Scene Luminance tab in the Drawing Setup.

**Single** – Only one light source is assigned using this category.

**Floresc Architec AV** – The lights found in this category representing realistic lights, based on \*.ies files from Lithonia Lighting.

Next to each window can be seen two buttons. One indicates “New” and the other “Delete”. The New button opens the new Category or Luminance dialog. This allows the user to create new categories or Luminance so that you can manipulate the existing preset options without changing the pre-set Luminance included with the program.



**Note:** Renaming an existing Luminance before adjusting its parameters allows you to easily return to the default settings and it helps prevent future installs from overwriting custom made Luminance settings.

The Delete button allows you to delete an entire category or any Luminance found in the drop-down list. After selecting the Delete button a warning will appear, asking if you are sure you want to delete the selected category or Luminance. Select “Yes” if you wish to do so.

## Preview

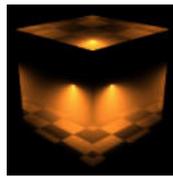
To the right of the Category and Luminance section can be seen the Preview window and its options.



(Preview Window)

The Preview window shows a preview of the selected Luminance and how it would appear on selected objects. Just below the Preview button you will see two rows of buttons. The first row (buttons outlined in blue) is for selecting a preview object shape. The second row (outlined in green) is for selecting which view you would like to preview the object from. The Box and Isometric view are the default options for the two rows of options.

The Shape row contains four standard objects to choose from.  They include: Box, Sphere, Cylinder and Mesh. The last button is the Selection button. This button will display the 3D object you have selected as the object previewed in the window. Simply select the object(s) you wish to view the luminance on and it will appear in the preview window. Two examples can be seen below.



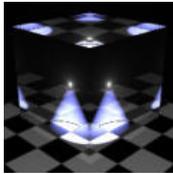
(Box)



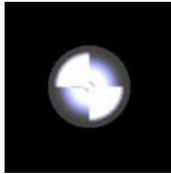
(Sphere)

The second row of buttons is for selecting a standard view  from which to preview the selected 3D object from. The standard views included are: Isometric SE, World, Left, Right and Front. Simply select the standard view you wish to preview the object from and it will appear from that view in the preview window.

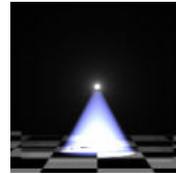
Below you can see a cube with a SpotPointDistance Luminance applied to it. You can see from three different views: Isometric, World and Front.



(Isometric)



(World)



(Front)

## Preview Window Options

Below the Preview window, at the lower-right corner of the dialog can be seen the Preview Window Options.

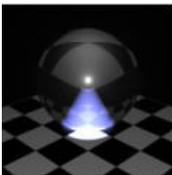


(Preview Window Options)

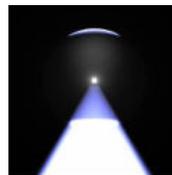
Three areas of the preview window can be controlled from these options.

**Shape On/Off** – When this option is selected the Shape row of controls found below the Preview Window will appear. If the checkbox is not selected then the Shape row of buttons becomes inactive.

**Desk On/Off** – When this checkbox is selected the displaying desk (seen below the objects be previewed) is shown. When this checkbox is not selected the desk disappears.



(With Checkerboard desk)



(Without Desk)

**Auto Preview** – When this checkbox is selected the preview window will refresh as soon as soon as a new parameter has been changed for the previewed object. When this checkbox is not selected you must select the "Preview" button (directly) below the preview window to view the new object.

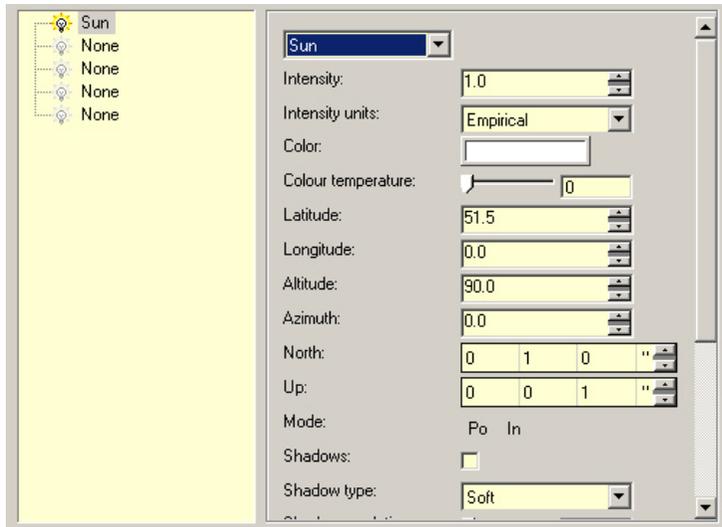
**Advanced Button** – Select the ‘Advanced’ button and the Advanced Options dialog will appear. You can manipulate what entity material, desk material and environment is used (if any) in the preview window.



# Luminance Settings

Every Luminance light source has a collection of settings allowing the user to control many aspects of the lighting process. As with standard lighting there are controls to manipulate shadows, color, scattering, etc. On a whole Luminance lighting is much more versatile than standard lighting though. There are actually many more controls to work with.

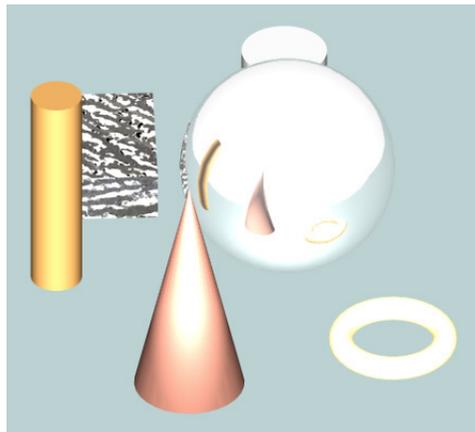
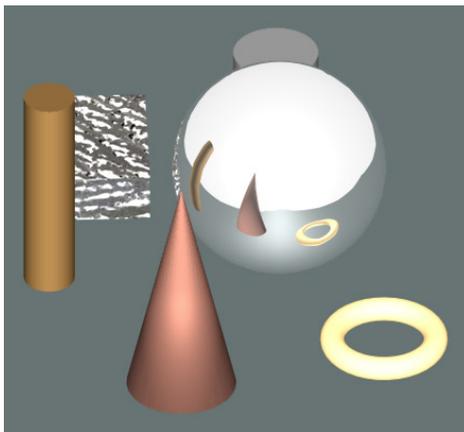
These controls are found on the Luminance Editor. Each light type has its own set of controls for you to work with. The Luminance ‘Point’ light source dialog can be seen below. All of the controls shown after the dialog can be found on one of the light source dialogs on the Luminance Editor.



**Color** – Selecting this box opens the Color Dialog. This dialog allows the user to not only choose an existing pre-set color but adjust the precise amount of Red, Green and Blue included in a color. You can also adjust the Hue, Saturation and Value of the color as well. For more information on the Color Dialog please see the ‘Color Dialog’ heading in Chapter 4.



**Intensity** – (0 - 1e+006) Input a value which represents the intensity (brightness) of the specified color. The higher the value used the brighter the color. The image below left shows an Eye light with an Intensity set at (1.0) the one to the right has Intensity set at (2.0). You can see that the right one is much brighter.



**Intensity Units** – This drop-down list determines what units the light intensity is controlled in.

**Empirical:** If this selection is used then no real interpretation of ‘intensity’ is given. All LightWorks guarantees is that higher values will result in a brighter light intensity while lower values will result in a less bright light. All other ‘units’ enforce an actual significant interpretation on the brightness of the source.

**Lux:** First, as you know (from chapter 1) that the Lumen is the standard unit for luminous flux of a light source. The lux is indentified as a lumen per square meter. It is a measure of illuminance.

**Kilolux:** The Kilolux is equal to 1,000 lux.

**Lumen:** As mentioned above. The Lumen is the standard unit for luminous flux of a light source.

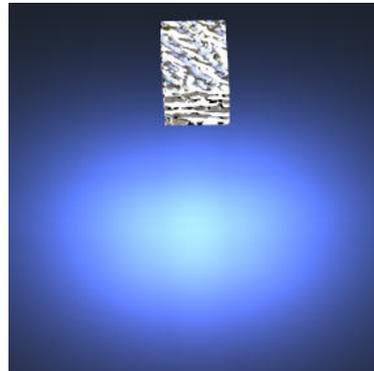
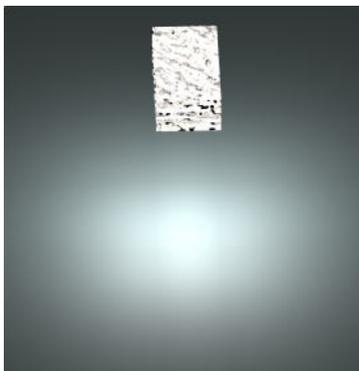
**Kilolumen:** A kilolumen is equal to 1,000 lumen.

**Footcandle:** The footcandle is indentified as a lumen per square foot. It is a measure of illuminance.

**Nit:** The Sky light source includes this unit type. A Nit is equaled to a candela per square meter ( $cd/m^2$ ). CANDELA is a measure of how much light is produced (luminous intensity) at its source. A candela is the metric equivalent of the light output of that one candle.

When using lux or kilolux you should realize that even small changes in an object (or model) can create huge changes in the lighting of the model. The lumen and the kilolumen basically describe how much luminous power of light is being produced by the light source. Unless you really know what these setting do or represent then it is probably best to use Empirical or Lumen in your renderings.

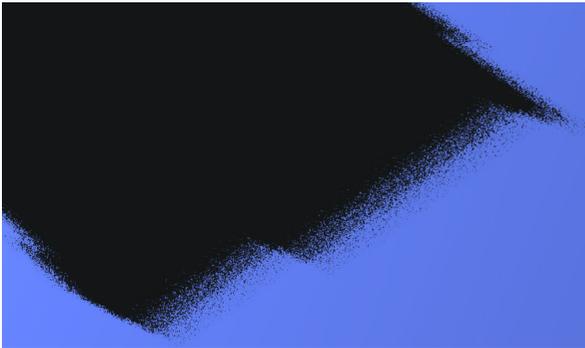
**Color Temperature** – (0-100) although this setting is named ‘Color Temperature’ it really doesn’t represent color temperature, at least not fully. Temperature color ranges from red (hot) to blue (cool). In this setting the color ranges from white to blue, roughly the same as 5500k to 12000k on the temperature scale. It ends up representing about half of the temperature color scale. A value of (0) (first image shown below) will produce a white accent while setting the slider at (100) (second image shown below) will produce a blue accent.



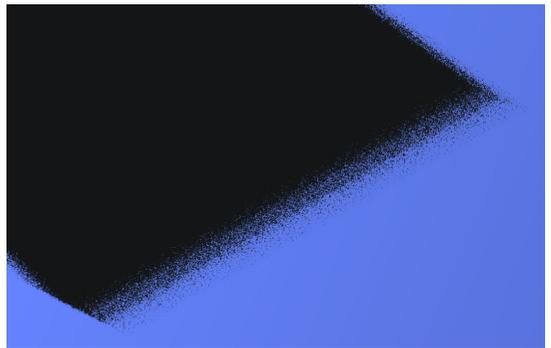
**Shadows** – Select the checkbox if you wish shadows to be produced from the light source.

Note: for all the 'shadow' settings to work you must first select the 'Shadows' checkbox on the dialog.

**Shadow Resolution** – (0-100) this setting determines how smooth the edge of the shadow appears. The higher the value the smoother the edge of the shadow becomes. A lower value produces a jagged effect on the shadows edge. As with many controls, the higher value you use the longer the render time will be. Try using as low a value as possible. Values over (70) will make render times almost unbearable.

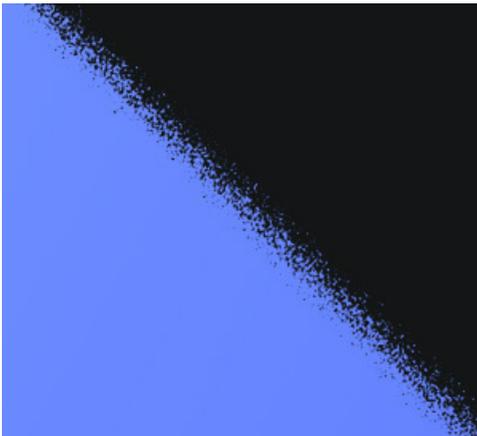


Resolution = 8 (Jagged)



Resolution = 95 (Straight)

**Shadow Quality** – (0-100) this setting determines exactly how many pixels are used in the shadow itself. The higher the value the more pixels used, creating a much denser and realistic shadow. Of course with higher values comes higher rendering times.

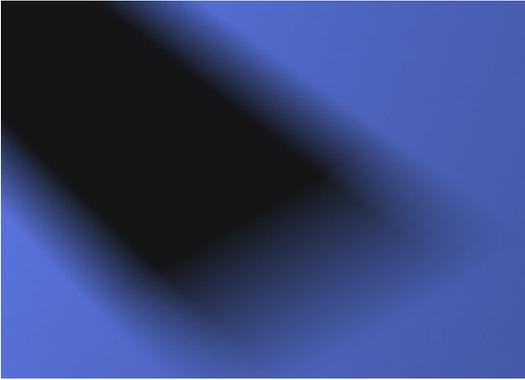


Quality = 1 (Grainy)

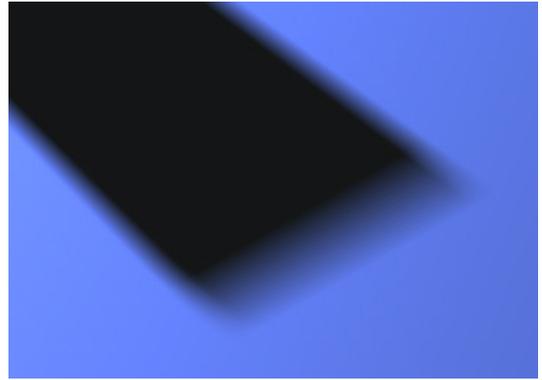


Quality = 16 (Smooth)

**Shadow Softness** – (0-100) this setting determines how ‘soft’ the edges of the shadow appear. The higher the value the more of a scattering effect is used on the shadow. The biggest problem with this setting is that it doesn’t work correctly in TurboCAD v11.



Softness = 16



Softness = 0

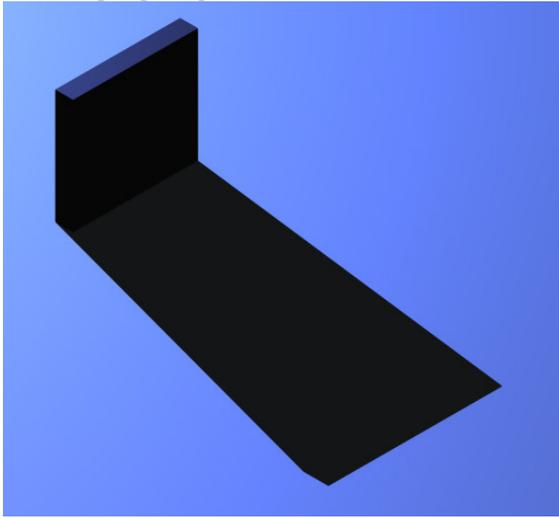
**Shadow Type** – You can choose from ‘Soft’ or ‘Hard’ from the drop down list. What this parameter really does is determine how the shadows are produced within the program.

**Hard:** If ‘Hard’ is selected then hard edged shadows are produced by the program using ray casting to produce the shadow effect. There is no haziness to the shadow with all shadow edges being perfectly defined.

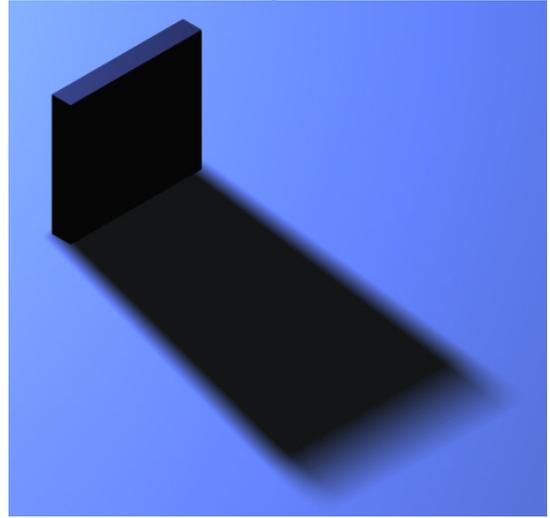
**Ray Casting:** In Ray Casting the program checks every grid point to see if light (ray) from the light source intersects the object.

**Soft:** If ‘Soft’ is selected then soft edged shadows are created with the use of shadow mapping by the program. Without getting too technical I’ll try to describe each.

**Shadow Mapping:** in Shadow Mapping a map (picture) of the model is captured from the viewpoint of the light. When rendering the model from the perspective of the camera, depth values are mapped to the light source to determine if points (pixels) are lit or in shadow. This depth test produces a binary result for each pixel. The procedure is quicker than Ray Casting too. The biggest advantage of Shadow Mapping is that it is an image based approach which requires no additional geometry information for the rendering.



Hard



Soft

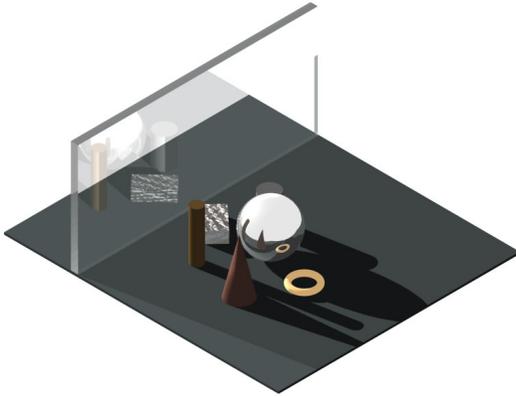
**Shadow Transparency** – (On, In, Di, GI) you use this setting to control the amount of transparency of the shadows being produced from a light source. You have four controls to pick from with each producing a different effect. Using the 'On' control allows shadows to go through transparent objects but it also turns off 'soft' shadows. All shadows become 'hard' shadows when this option is selected.

**On:** This setting turns 'on' basic transparency functionality. If you want light to shine through translucent geometry then this control must be selected.

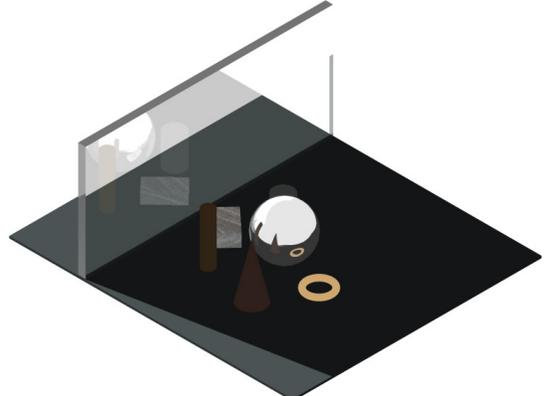
**In (Interpolate):** Turns on more advanced functionality for those blockers whose transparency shaders require the initialization of more than the default set of shader. This control is to be used in conjunction with the 'On' control. The 'In' control makes the transparency shader use a more precise mathematical equation (using interpolation of values) when determining transparency. Basically you get a more realistic effect but rendering times can take a bit longer.

**Di (Displacement):** Switches on the most advanced functionality, for those blockers whose transparency shaders include effects due to displacement. This control is to be used in conjunction with the 'On' control. The 'Di' control is even more precise. It uses a mathematical equation including displacement of values to arrive at the final lighting effect.

**GI (Global):** When selected, light will look at the value of the control when deciding whether or not to cast transparent shadows. 'GI' refers to the Lightworks Global Illumination technologies. LightWorks Global Illumination lets your users simulate the soft, subtle lighting characteristics of interiors and exteriors using global illumination technologies. It goes beyond 'pretty pictures' by also being physically accurate. When 'GI' is selected, the program will use the Global settings for shadows. *(Make sure that 'GL' is NOT activated if you want to view shadows from light shining through glass. If 'GI' is active then it will cancel out 'ON')*



With 'On' control selected



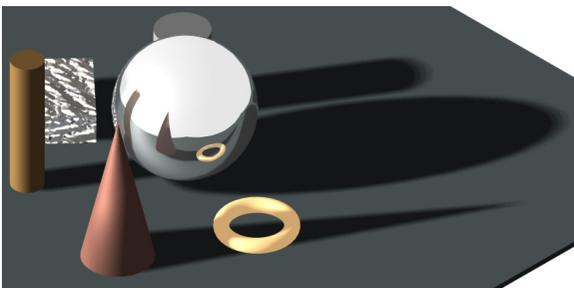
Without 'On' control selected

**Shadow Acceleration** – (Au, Ma, Ca, Re, Es) When 'Hard' (Ray Casting) is selected as the 'Shadow type' you can select any or all of these five settings to accelerate the rendering process.

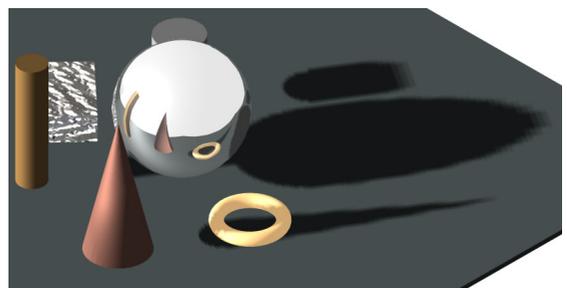
**Ma (Maps):** When selected, shadow maps, made for a light source prior to rendering, can be used to optimize the ray tracer's performance.

(This control is not implemented in TurboCAD. While it is a LightWorks control it has not been incorporated into the program.)

**Shadow Tolerance** – (0-100) This setting is only used when 'Soft' is used in the Shadow Type setting. This parameter modifies the sampling distance in shadow mapping. This setting is used to help alleviate artifacts that sometimes can be seen in some renderings. If you set the slider to (0) then no effect is seen. If you set it at (100) then all shadows are eliminated. Setting the slider somewhere between (5) and (10) is best, the smaller the better.



Control set to (0)

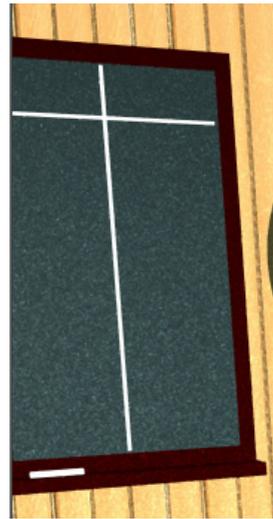


Control set to (22)

**Noise Factor** – (0-100) This setting allows the user to add ‘noise’ to the lighting. Adding noise provides a lighting effect which looks messy or chaotic. A value set at (0) means no noise while (100) means maximum noise. Again this setting can help with artifacts. Adding a bit of ‘noise’ can take away from the artifacts in a rendering.



Noise Factor (0)



Noise Factor (100)

**Min. Lod** – This setting is actually the only one which affects image quality. The Min Lod control dictates how many initial samples are taken. No matter what the value of any other argument, the light will always do as much work as is specified for every point being illuminated. This setting controls the minimum level of detail for area source decomposition. Values are usually set at between (0.0) and (1.0), you can use higher values though. This parameter determines the initial sampling for lighting calculation. If the value is set too low, shadow boundaries may not be produced correctly. If the value is set too high, rendering may take a long time. Practically you should use a value between (0.2) and (0.6).

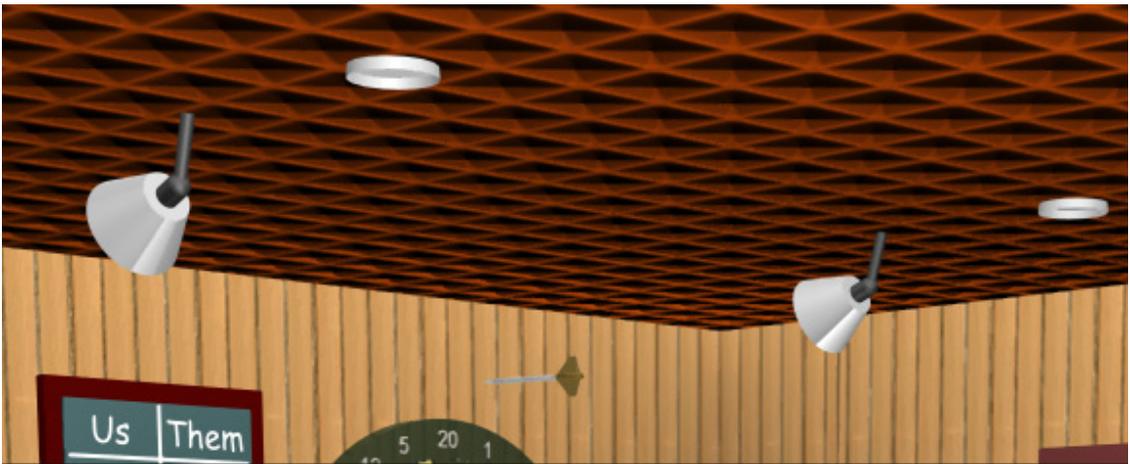
**Max Lod** – Maximum level of detail for area source decomposition. This parameter determines the maximum amount of work required to illuminate any given point. This value should always be set higher than the Min Lod value. This value is usually set at between (0.2) and (0.4) higher than the Min Lod value. Example: If Min Lod is set at (0.2) then Max Lod should be set at between (0.4) and (0.6).

**Error Bound** – This setting is only used when ‘Shadows’ is checked and ‘Shadow Type’ is set to ‘Hard’. This determines how much ‘work’ is done beyond the stated in the Min. Lod. parameter. The Min. Lod. parameter determines the minimum amount of work the shader must do to create the light. The Error Bounds setting determines how keen the shader is to do more work. The shader will check the error associated with each sample. if the largest error is less than that stated in the Error Bound then nothing else is done.

However if the largest error is more than that shown in the Error Bound then more sample will be taken in that given area. Samples will then be evaluated again at this point. The default is set at (0.2) with smaller values causing longer rendering times and larger values causing shorter rendering times. This means that the maximum error associated with the illumination of a particular point of interest is less than 20% of the energy associated with the illumination arriving at the point.

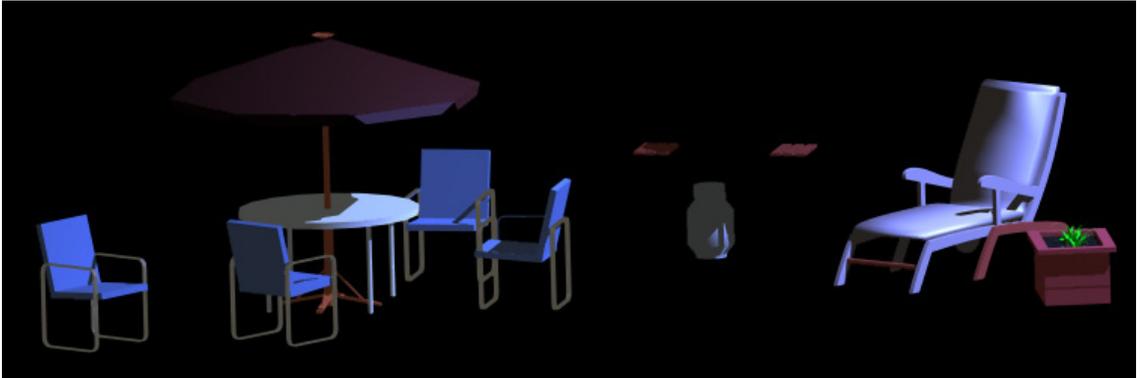


(Min Lod (0.1), Max Lod (0.3), Error Bound (0.2))



(Min Lod (0.4), Max Lod (0.7), Error Bound (0.2))

**Scattering** – Selecting this checkbox will create an effect of light being scattered in a foggy or hazy atmosphere. You can use the setting when using atmospheric foreground shaders such as fog, ground fog or scattering medium. If you want the light to be scattered, you must select this checkbox, otherwise the light will not scatter.



(Scattered NOT selected using a Scattered Medium foreground)



(Scattered 'selected' using a Scattered Medium foreground)

**Forwards** – This control, while on many dialogs, is not in use by TurboCAD. This is a setting which is now reserved by LightWorks.

**Fall Off** – This setting determines how light weakens as it moves further away from the light source.

**Constant:** The light remains constant with no Fall Off at all.

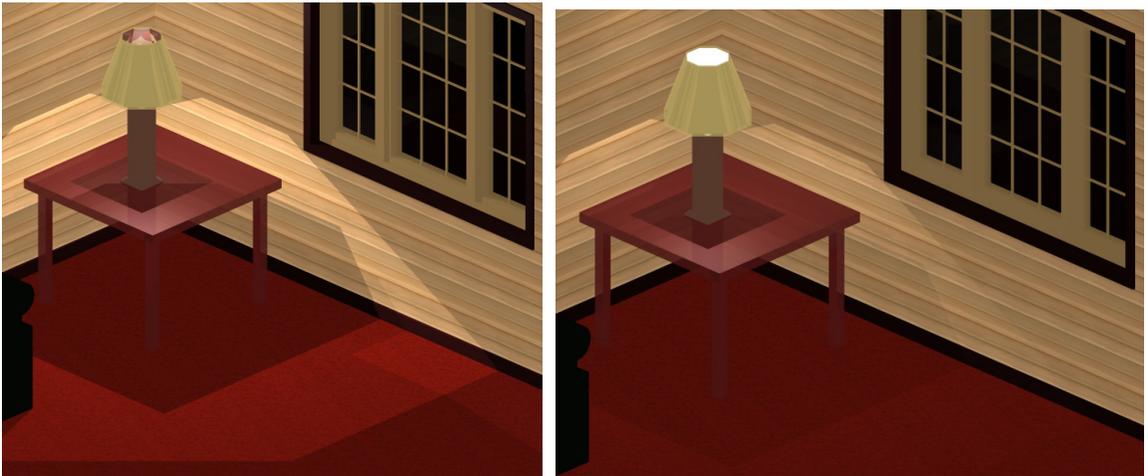
**Inverse:** With this type, the initial drop in brightness is very rapid, but the dimmed light is sustained for a much greater distance.

**1st (Inverse Square Law):** This means the brightness of the light diminishes at a constant rate as the distance increases.

**Inverse No Clamp:** Initial drop in brightness but dimmed light is sustained without end.

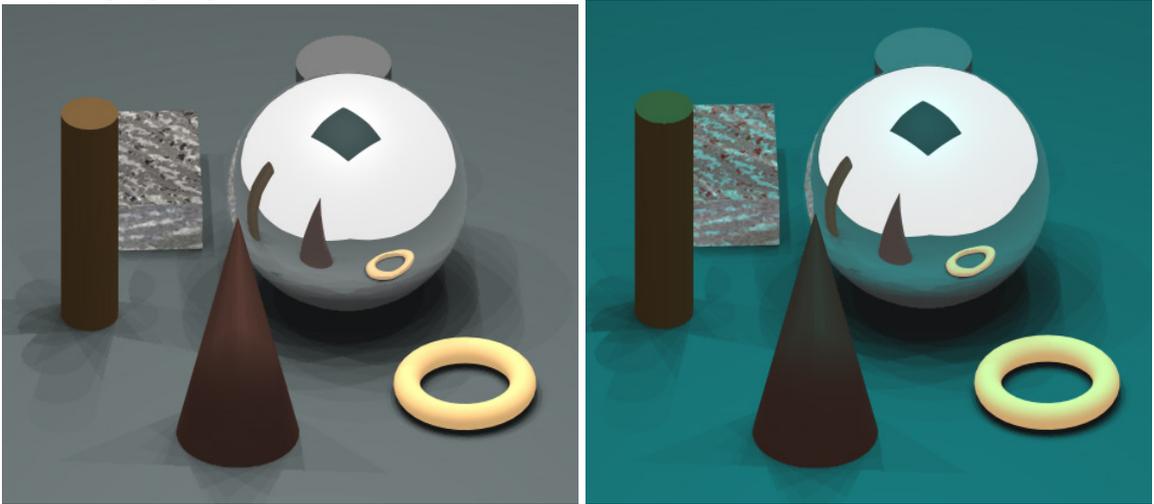
**Isl No Clamp:** This setting is the closest to reality. In this method light will diminish in proportion to the square of the distance from the light (quadratically).

The two images below show completely different ways of using Fall Off. The first image uses 'Constant' where the light does not weaken at all. A relatively dim light lights up the entire area. The second image uses 'Isl No Clamp'. The intensity is actually eight times higher in the second render but the light falls off very realistically. The light is very bright inside the lamp but as it gets further away from the light it gets weaker and weaker. If you're looking for realistic then use a control other than 'Constant'



**Colour Filtering** – When selected, the color of an object is used in the determination of light color in a render. If the checkbox is not selected then the objects color is not used in determining output light color. This will allow different colored lights to be produced from different faces of a single area light source by having different colors on each face.

Below you see two renderings. Each uses a box with an 'Area' light attached to illuminate the objects. The color of the box is Cyan. In the first image 'Colour Filtering' is NOT activated and the cyan color is not visible in the lighting but the option IS selected in the second image and the Cyan color is used in the actual lighting of the model.



**Location** – This is the actual location of the light source. You input the (x, y and z) Position points of the location you wish to place the light source. These same fields can be seen as the (Pos.) fields on the Inspector Bar. To see where an object is located simply select the object and view the (Pos.) fields on the Inspector Bar.

Location:	7	3.5	3	in
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**To** – You input the (x, y and z) Position points of the location which you would like the light source to point to. The direction of the light will be cast from the 'Location' coordinates to the 'To' coordinates.

To:	7	3.5	0	in
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**Equator Zero** – This parameter defines where "The Greenwich meridian crosses the equator" on the WCS. The 'Location' and 'To' parameters give all the data needed to define one of the spherical angles. Zero will also be near 'To' and at max 2 x 'Location' – 'To'. From those two arguments we know where the equator is, around which we measure our other spherical angle. With all that we still can't say where on this equator the other spherical angle is at zero. The 'Equator Zero' parameter provides the missing information, allowing all points to be assigned spherical polar coordinates, centered at 'Location' and orientated with 'To' and 'Equator Zero'.

Equator zero:	1	0	1	in
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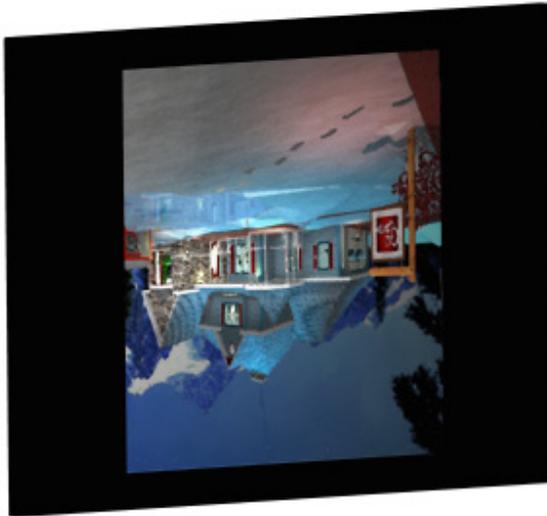
**File Name** – With this parameter you define a file to be used with the specific light source selected. When a 'Goniometric' light source is being used, this parameter defines a photometric file specifying, via a spherical polar distribution, how much light is emitted in different directions. \*.ies files are usually used. When 'Projector' is being used this parameter defines the image which is being projected using the light source.



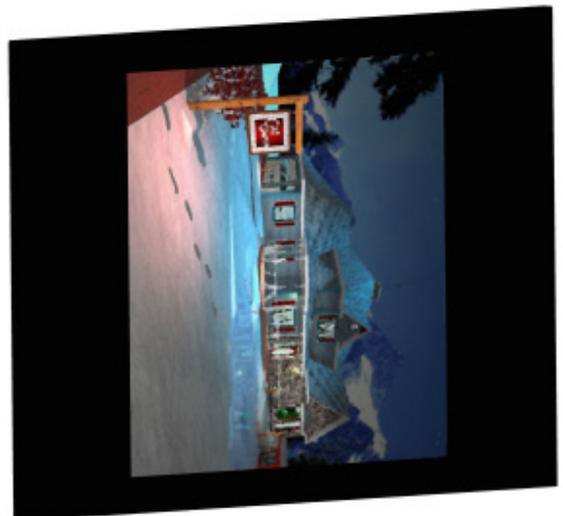
**Power From File** – This parameter defines the power of the goniometric light (measured in Lumens) as reported in the photometric file.

**Up** – (Projector) It defines the orientation of the image. This setting makes certain that the image is projected correctly. By changing the values you can change the orientation of the image. By inputting (1) or (-1) into the x, y and z fields you can change the rotation of the image. Below are a few images and the values that went along with them.





-1 0 -1 in



1 0 0 in

With (Sky, Simple Sky and Sun) lights. With these light sources the 'Up' parameter defines where 'Up' is. It defines the Z axis for the sun.

Up: 0 0 1 in

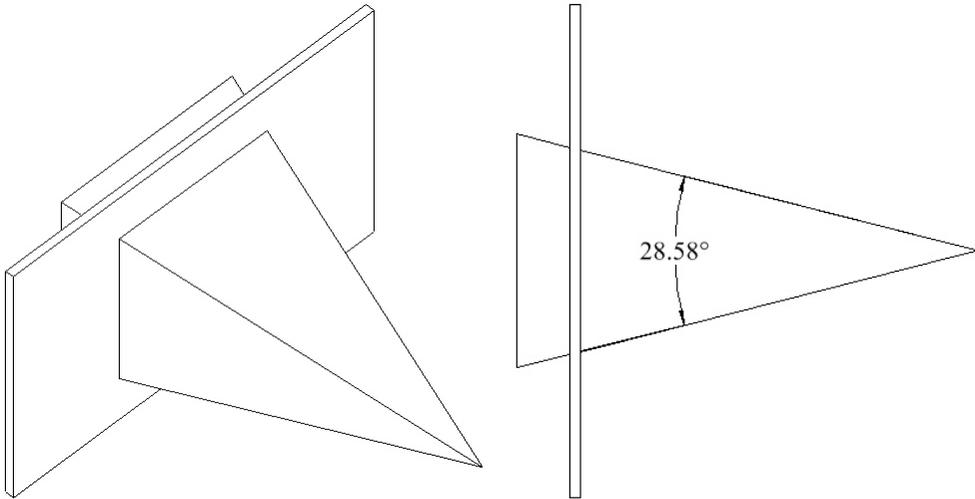
**Softness** – This parameter defines the amount of blurring seen in a projected image. In the image shown below left a value of (0) was set. The image to the right was produced using a Softness value of (10). It's a lot blurrier.



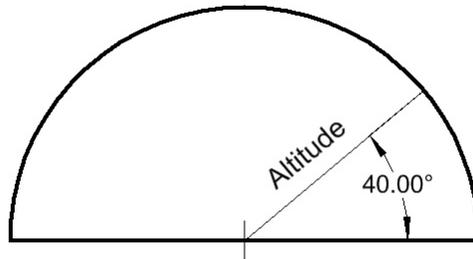
**Number Of Samples** – A ‘Sample’ is essentially a sub-unit of a pixel. For an example, the amount of blue in a pixel would be a sample. A pixel can have one or more samples in its makeup. This parameter basically lets you define how many samples are to be used in the framework or a render. More samples will result in a much better render but will also produce much longer rendering times. The two groups of images below show a rendered model using only a ‘Simply Sky’ light source. The left images use a value of (0) for ‘Number of Samples’ while the second uses a value of (10). The rendering time was a twenty times longer for the second image. While there are differences in the two renderings they aren’t that major. You can keep the ‘Number Of Samples’ quite low and still get a quality render. Number of Samples always takes president over the ‘Intensity’ control. After the Number of Samples is calculated then each is illuminated using the Intensity control.



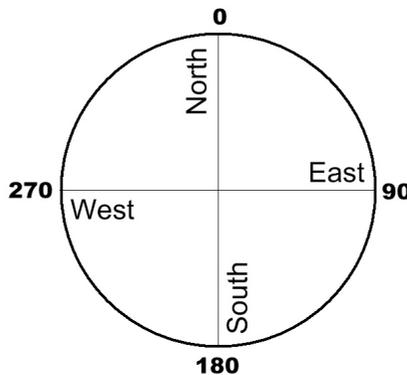
**Angle** – This parameter refers to the angle of the cone produced to project an image using the ‘Projector’ light source. It projects an image on to another object at the frustum. Adjust the angle to change the size of the frustum. The frustum is the part of a cone or pyramid which is cut by a plane. You can see below how the frustum of a cone intersects a plane. The angle is the angle shown in the second image. To make the image larger you simply make the ‘angle’ value larger.



**Sun Altitude** – (Sky light) Use this parameter to define the angular distance of the sun above the WCS.



**Sun Azimuth** – (Sky light) This parameter defines the angular difference from North.



**North** – Use the position fields to specify where the North direction is compared to the WCS.

**Type** – (Sky light) The 'Type' control defines how the illumination is distributed over the sky. Six preset models are included to help you illuminate your models.

**CIE\_OVERCAST:** A Commission Internationale de L'Éclairage model which resembles a cloudy day where most of the light is straight up. Easiest to model, less complex.

**CIE\_CLEAR:** A Commission Internationale de L'Éclairage model which resembles a clear cloudless day where most of the light surrounds the sun. Longest to model, most complex.

**CIE\_INTERMEDIATE:** A Commission Internationale de L'Éclairage model which resembles a partially cloudy day where a lot of the light is around the sun but not the majority.

**IESNA\_OVERCAST:** An Illuminating Engineering Society of North America model which resembles a cloudy day where most of the light is straight up.

**IESNA\_CLEAR:** An Illuminating Engineering Society of North America model which resembles a clear cloudless day where most of the light surrounds the sun.

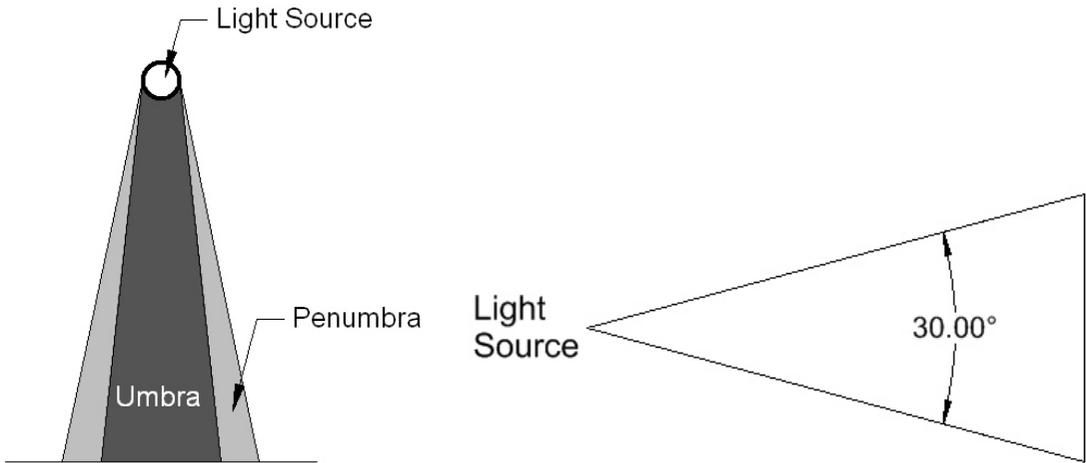
**IESNA\_INTERMEDIATE:** An Illuminating Engineering Society of North America model which resembles a partially cloudy day where a lot of the light is around the sun but not the majority. The first image below uses the CIE Overcast model while the second uses the CIE Clear model.



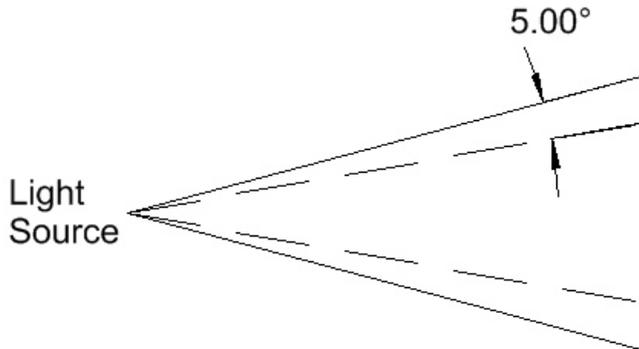
**Cone Angle** – (Spot light) This parameter defines the angle of the cone of light being cast from the light source. It is basically the same as the 'Angle' parameter used with the 'Projector' light source. This angle will include both the Penumbra and Umbra as used in standard Spot lighting. The Penumbra and Umbra are two of the main parts of a shadow. Though these two aspects actually deal with shadows the rules behind are used in Spot luminance lighting.

A shadow is broken up into two different areas: the umbra and the penumbra. The umbra is the part of a shadow which is considered a 'full' shadow. This is the darkest part of the shadow and is created when 'all' of the light is blocked from the shadow object. However you will notice that most shadows have an inner 'darker' area and also a lighter component around the edges. This lighter area is created when light from the shadow light source is blocked but light from another light fills in some of the shadow. This lighter area is called the penumbra.

In Spot lighting the Umbra is considered the part of the light which is fully illuminated while the penumbra is the part which is partially illuminated. Almost the opposite as with shadows. (See examples after the Beam Distribution setting below)

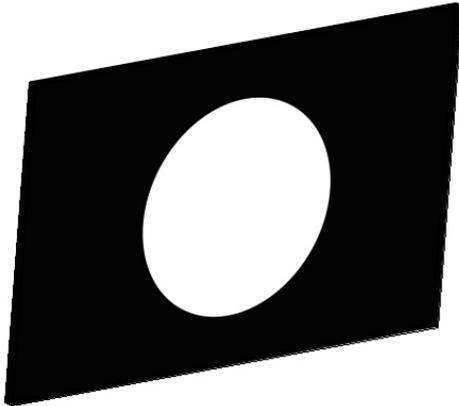


**Cone Delta Angle** – (Spot light) This parameter is basically the penumbra of the light source. It is the partially illuminated part of the light. This area of the light will appear hazy and dissipate as it goes towards the edge of the Cone Angle. The Cone Delta Angle is taken from the Cone Angle edge towards the axis. The Cone Delta Angle can never be higher than the Cone Angle. (See examples after the Beam Distribution setting below)

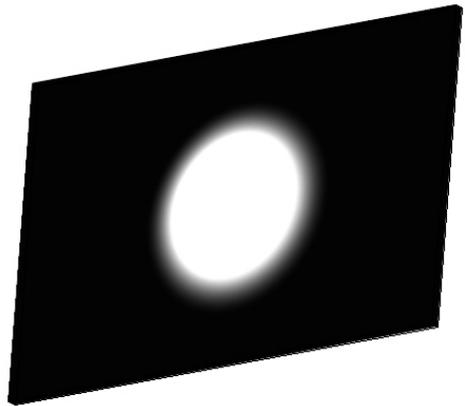


**Beam Distribution** – (Spot Light) This parameter determines how much the light intensity will disperse as it gets closer to the Cone Angles edge. A value of (0.0) means there won't be any change in the intensity. The higher the value, the faster the intensity diminishes with the angle.

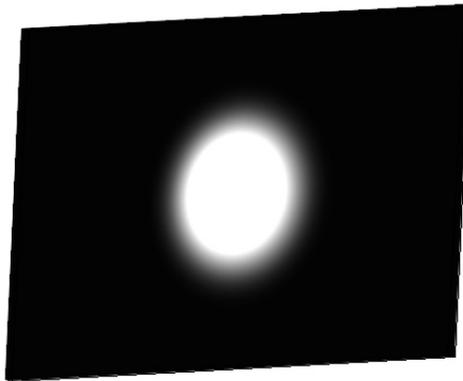
Below are several examples of Spot lighting using the three parameters listed above.



(Cone Angle = 45, Delta Angle = 0)



(Cone Angle = 45, Delta Angle = 20)

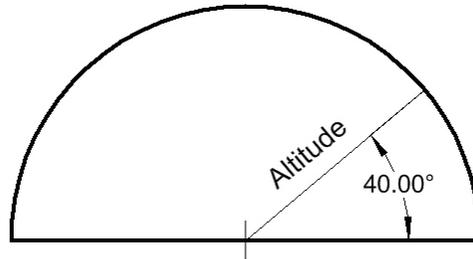


(Cone Angle = 45, Delta Angle = 20, Beam Distribution = 30)

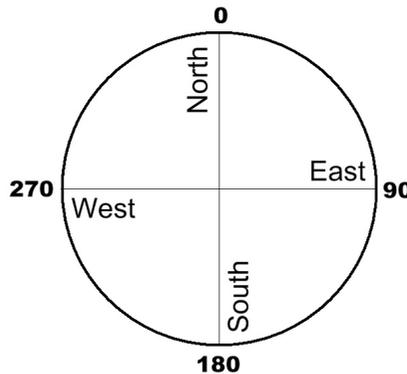
**Latitude** – (Sun light) The latitude and longitude parameters define the model location within the created world. Positive values signify points in the northern hemisphere while negative values indicate points in the southern hemisphere.

**Longitude** – (Sun light) The latitude and longitude parameters define the model location within the created world. Positive values signify points in the eastern hemisphere while negative values indicate points in the western hemisphere.

**Altitude** – (Sun light) This parameter defines how high, above the horizon the sun lies. Input the distance from the WCS origin to the sun. A value of (90) corresponds to being directly overhead.



**Azimuth** – (Sun light) This parameter defines at what angle from North the sun lies. Azimuth values of (0), (90), (180) and (270) degrees correspond to North, East, South and West respectively.



**Mode** – The Sun light source automatically illuminates a model after being given a position, color and atmospheric data. You can turn on or off the calculation for intensity and color independently of calculation of position of sun using the 'Mode' parameter.

**Nothing Selected:** When neither of the controls is selected the 'sky type', latitude' and 'longitude' have no meaning. They are not taken into consideration when rendering. The position and color of the sun are taken from the 'altitude', 'azimuth', intensity' and 'color' controls.

**Position (Po):** When this mode is selected; 'altitude' and 'azimuth' are calculated automatically according to 'latitude' and 'longitude'. 'Altitude' and 'azimuth' are not used in calculations when this mode is selected.

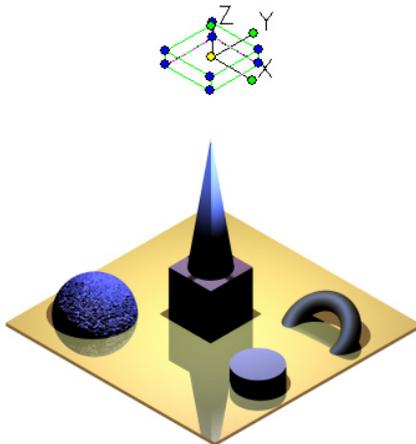
**Intensity (In):** When this mode is selected the color and intensity of the sun is calculated using the 'sky type' and the 'altitude'. The settings 'intensity', 'color', 'color temperature' and 'intensity units' are not used in the calculations for rendering.

# Luminance Light Types

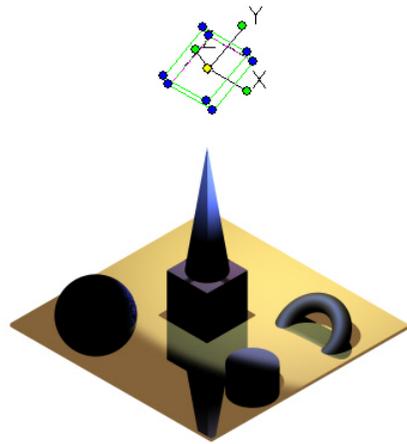
Luminance lighting in TurboCAD consists of twelve different light types. As with standard lighting, each of these types has its own set of parameters which can be adjusted to create an unlimited amount of lighting affects. Some of the lighting affects are basically the same as with standard lighting. Ambient, Point, Sky and Spot react relatively the same as standard lighting of the same name does. The Luminance 'Eye' light type is basically the same as the standard 'Headlight' light source

Luminance lighting does have several other types which are quite a bit different than those of standard lighting. These light types include: Area, Distant, Goniometric, Projector and Sun. Each of these styles creates its own special effects dissimilar to any other light type. All twelve of these light types will be discussed in full in this section. All settings and parameters associated with these light types will be stated and examples of how to each light type will also be shown.

Luminance lighting does differ from standard in one major way though. It is not possible to view the actual 'light source' in your model. Standard lights are treated the same as any other 3D object in your models. You can select them, reposition them, rotate them and delete them if you want. This can not be done with Luminance lighting. While the lights react in the same as standard lighting you can not manipulate them in the same way. To do any type of manipulation to a Luminance light you must do so through the parameters found in the Luminance Editor. You do have the option to also attach a luminance light source (with certain sources such as Point and Spot) to an object and using the 'Load Render Luminance Only' option to make the object invisible. In this way you can pretend the object is the light source itself. Moving the object will move the light source as well. Rotating the object rotates the light source, etc.



Object with Spot light attached



Object rotated and light rotates

One advantage of Luminance lighting is the fact that you can create multiple groupings of lights within the Luminance Editor. You can include up to seven different light types in one lighting sequence. They can include any number of Luminance types in the same grouping. You could use all Spots or Points if you wanted to. Of course by selecting different objects you can include an unlimited amount of lights into your model. Another advantage of Luminance lighting over standard lighting is the fact that Luminance lighting can shine through windows (translucent objects). Standard lights can not do this.

Of course there are negatives associated with Luminance lighting as well. Probably the biggest negative is the inability to produce high-quality 'soft' shadows. Both the Shadow Resolution and Shadow Quality work fine but the Shadow Softness control, found in the properties dialog for any Luminance light does not work correctly. It's even worse when dealing with shining through glass or translucent objects. Soft shadows will not shine through at all, only 'Hard' shadows will shine through such objects. The luminance light source will shine through but no shadows will be seen. This happens when Shadow Transparency is turned on. It allows shadows to show through glass but all shadows turn to 'hard'. A negative associated with Area lighting is rendering time. Rendering a model with an area light in it can take forever. If possible try using rectangular objects in this luminance type. The results can be exceptional but you must be patient!

Later on in the book a few examples of lighting will be shown. You will be able to see how each light is used and how it affects each rendering.

## Ambient Light (Luminance)

As with the standard Ambient light type, this lighting affect illuminates all surfaces of a model equally, regardless of size, position or orientation. Again this is the simplest and easiest form of lighting that can be used in TurboCAD.

What this light type does is not only illuminate every surface in a model but also adds a specified color at the same time. Ambient lighting is a lighting type made exclusively for computer use. This type of lighting does not exist in real life and was created to simply and quickly illuminate a model. This form of lighting is not really useful on its own but can be very useful when used in conjunction with additional lighting.

### Ambient Light Settings



The settings used to control Ambient lighting are pretty basic. Your only controls are for color and intensity.

## **Ambient Light Uses**

As with the standard Ambient light type, the only real use for Luminance Ambient lighting is to increase the overall basic illumination of a rendering.

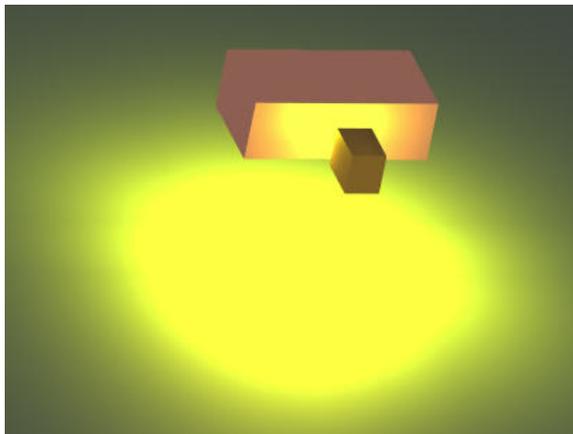
## **Ambient Light Positioning**

There is no positioning of the Luminance Ambient light source. You can use the Render Scene Luminance or add the light type to any object through its properties dialog. You simply select the color and intensity and the light is activated.

## **Area Light**

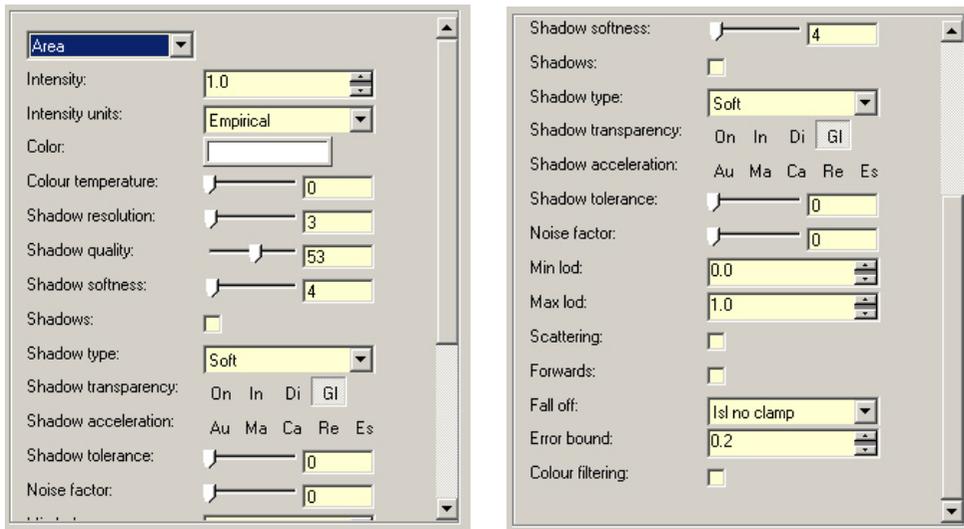
The Luminance Area light is a type which is unlike anything available in standard lighting. What an Area light does is attach a light to a TurboCAD object. The light is always attached to the front face of the object. Essentially the light always faces the UCS that the object was created on.

In the image below you see two cubes over a floor. The larger cube was created on a workplane created on top of the floor. The smaller cube was created on a workplane created on the side of the larger cube where it appears. Both cubes then have an Area light attached within the Luminance found in their Properties dialog. You can see that the light from the larger cube floods down on the floor while the light from the smaller cube shines on the side of the larger cube.



## Area Light Settings

See section on Luminance Settings for information on all the controls found on this dialog.



## Area Light Uses

Area lighting can be used in all sorts of ways. A couple examples can be seen below.

### **Neon**

One of the most unique uses for Area lighting is to give a 'neon' or 'fluorescent' lighting effect. This can be seen easily in the image below. You can accomplish a similar effect using solely an Area light. Whether you want to produce an actual neon effect or just a small glow, as with fluorescent lighting, you can easily use Area lighting to produce such a result. You will see an example of how to create such an effect in Chapter 7.



The only problem with this method is that rendering times can be very lengthy. Any time Area lighting is used with objects with curved surfaces you will see rendering times slow considerably.

## Interior Lighting

Another use for Area lighting is for interior lighting. Many people have found it very difficult to illuminate a large interior space using basic TurboCAD lighting. Area lighting works perfectly for situations such as these. The image below was illuminated with Area lighting only. One Area light was used and that's it. No other lighting was used in this rendering. By NOT activating Shadows on the dialog you can get superb illumination without the worry of shadows. You can then add other lights to get the shadows effects sought after.



## Area Light Positioning

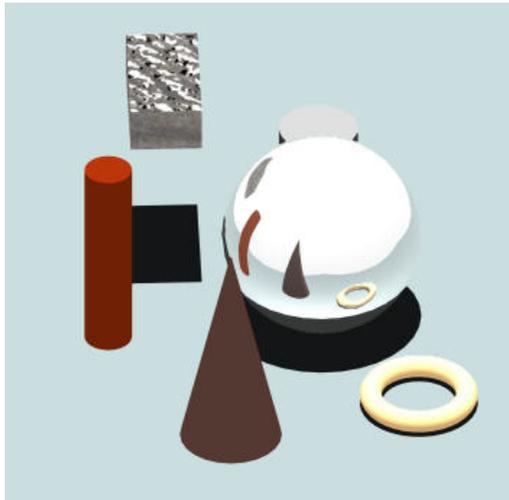
As with the Luminance Ambient light source there is no positioning for the Area light source. This luminance type should always be attached to an object on screen. While you can use the Render Scene Luminance dialog, you can't control from there. The light is always attached to the workplane face of the object it is attached to. If the object has curved surfaces then it will cast light on all surfaces around the object. This is what causes lengthy rendering times with this light type.

## Distant Light

The Luminance light type “Distant” is similar to the ‘Directional’ light type included with standard lighting. What Distant lighting does is produce light from a given direction and not a given point. You could think of a Distant light as an infinitely large wall of light emitting light all in the same direction.

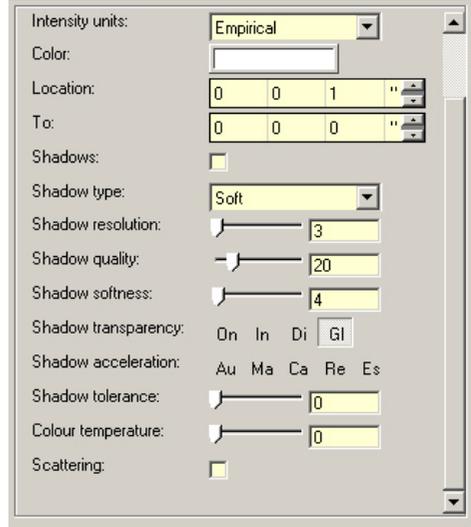
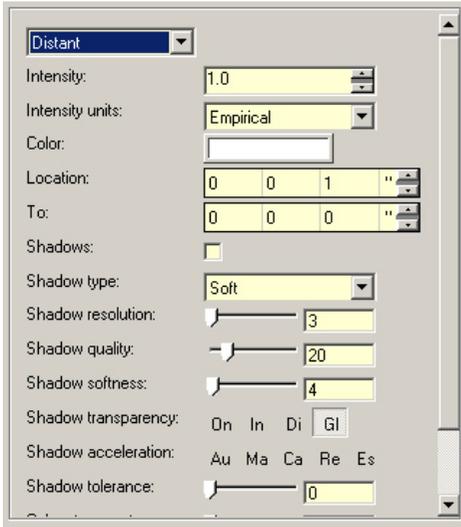
In standard lighting you don’t have to position the ‘Directional’ light source, only the direction. This differs with Distant lighting. The location of this light has to be entered along with the point at which it is directed to. This gives you much more flexibility and offers a greater amount of effects than using ‘Directional’ lighting.

The image below shows some objects being illuminated with a Distant light source. The light is directed downward onto the objects causing shadowing below them (shadows are on).



## Distant Light Settings

See section on Luminance Settings for information on all the controls found on this dialog.



## Distant Light Uses

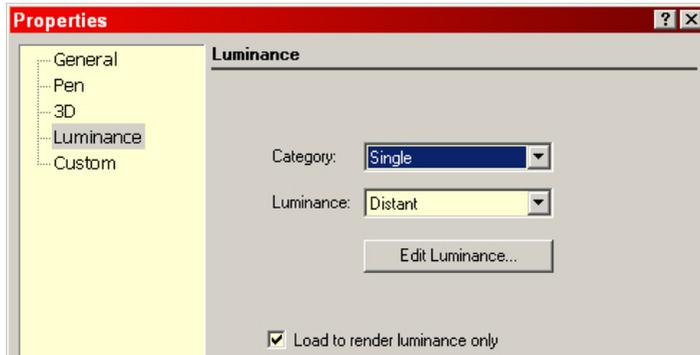
Distant lighting can be used any time a large light source is needed in a rendering. This light source can be used as sun light or a large light source of any kind. It's a great source to use when a large shadow effect is needed.

## Distant Light Positioning

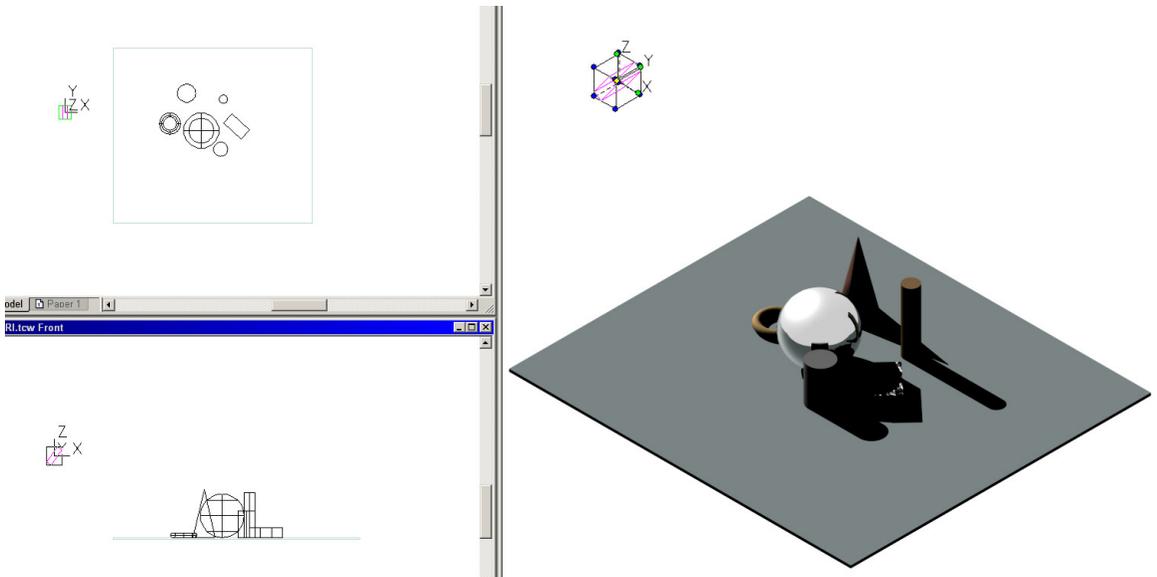
If you use this light type through the Render Scene Luminance dialog you must position it through the 'Location' and 'To' controls on the dialog. This isn't easy and can be accomplished much easier using an object on screen.

The easiest way to insert a 'Distant' luminance light source is by attaching it to an object on screen and treating that object as the light itself. By default the light will position itself in the center of the object and faces down the Z axis. If you rotate the object (using the rotation) handles the light will rotate as well. This is the closest you will get to having Luminance lighting react in the same way as standard lighting.

Since the object itself may block out the light you could use the 'Load to render luminance only' checkbox found on the Luminance tab of the Properties dialog for that object. This will make the object disappear but leaving the light to illuminate the drawing.



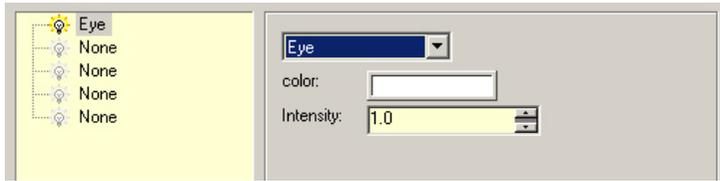
You will find that it's probably easier to use multiple windows to maneuver the light object (as seen below). The object can be seen because it is selected. It would not be seen in the rendered window if it was not.



# Eye Light

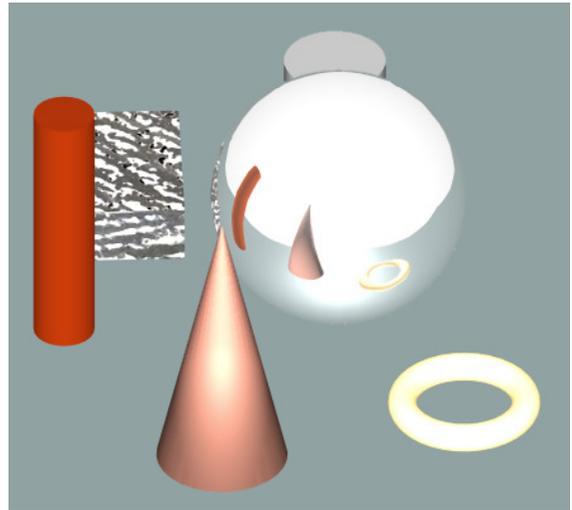
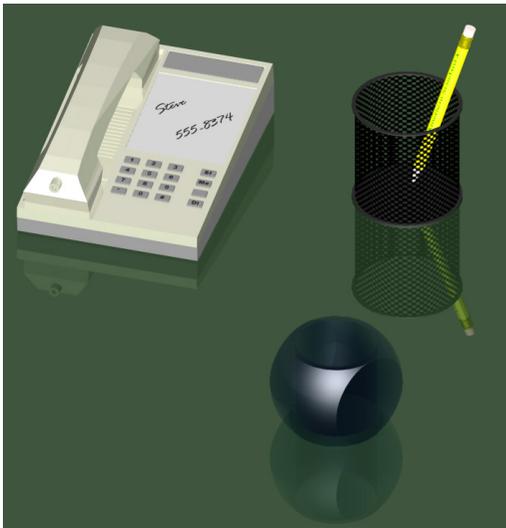
The Luminance light type “Eye’ is a light source which emits light from the camera view position. It’s a great light source to use if you want to illuminate everything from the point of view of the camera. The Eye light source also does not produce shadows of any kind. Since the light is coming directly from the view of the camera there is really no way shadows could be seen anyway.

## Eye Light Settings



The Eye light source has the same controls as the Ambient light source. The only settings you can manipulate are Color and Intensity.

Below are two images showing Eye lighting in use.



## Eye Light Uses

You can use an ‘Eye’ light to illuminate any model. It reacts as a flash bulb from a camera would. Everything facing the camera is illuminated. It would be a great help if the position of the camera

was supposed to be at a light source. Many have used this light source when the camera is positioned at a window looking in to a building.

## Eye Light Positioning

You don't need to position an 'Eye' light. It is always positioned at the camera and directed perpendicular to the screen.

## Goniometric Light

The Goniometric light source included with TurboCAD has to be the most versatile of all light sources. It can be basically any type of light you want it to be. It can look like a 'spot' light one time and a 'point' light the next. The goniometric light source allows the user to direct varying amounts of light energy in different directions. This allows for an unlimited amount of lighting effects.

A goniometric light source obtains its intensity and distribution calculations from an IESNA industry-standard photometric file (\*.ies). You can also use EULUMDAT (\*.ldt) files or CIE/CIBSE (\*.txt) formats.

**IESNA** (\*.ies) – (Illuminating Engineering Society of North America) this format is a North American standard

**EULUMDAT** (\*.ldt) – This is a commonly used European format for transferring photometric data.

**CIE** (\*.txt) – (Commission Internationale de L'Éclairage) this is a standard international format used for transferring photometric data.

**CIBSE** (\*.txt) – (Chartered Institution of Building Services Engineers) This is a British standard for transferring photometric data.

All of these formats are formatted ASCII text files containing key words to identify the data within. TurboCAD include four sample (\*.ies) from Lithonia Lighting for you to work with. All of these files can easily be opened using Word, Wordperfect, Wordpad, Notepad or almost any other word processor program. They can be found in the (ies) folder shown below.

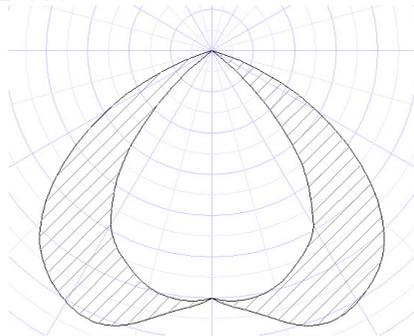


They all produce different light types. An example of one of the files can be seen on the next page. You can also find all kinds of these files by simply looking on the internet. Many companies create their own photometric files and some companies will create ones for you if need be.

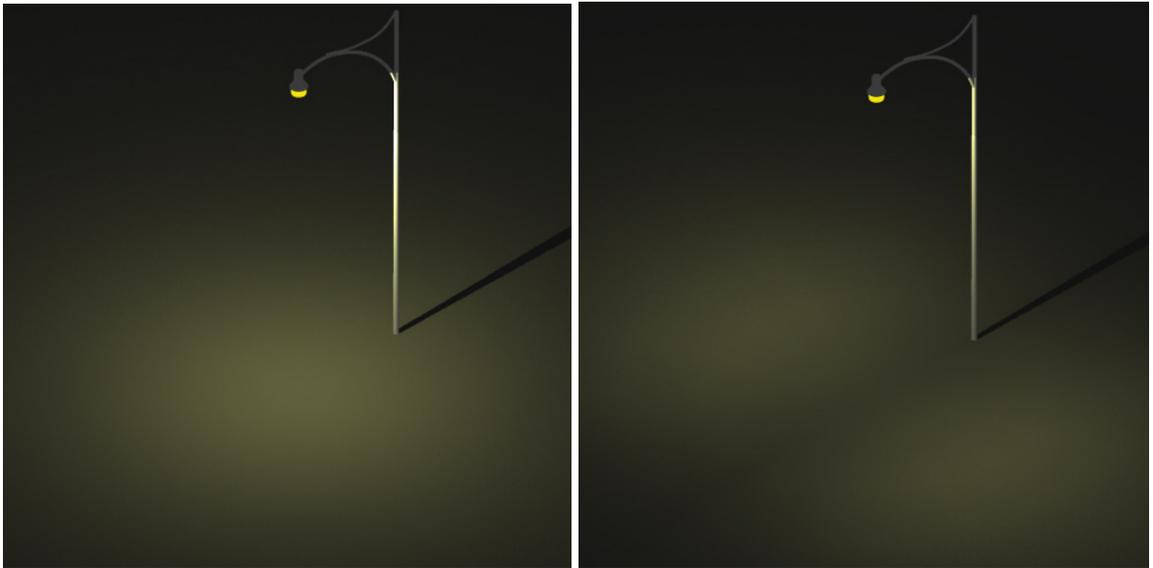
```

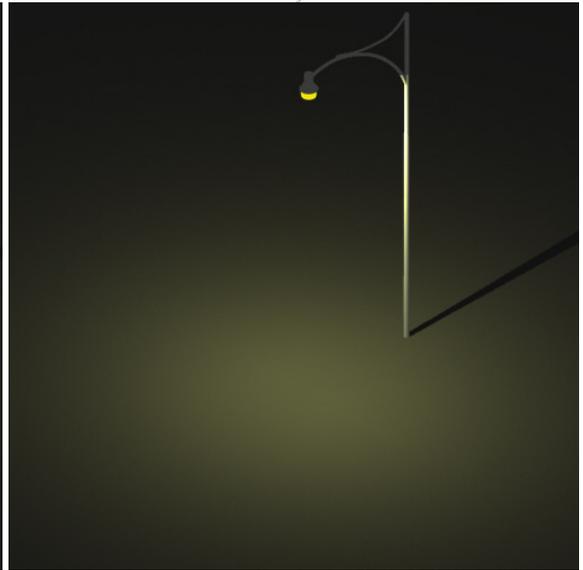
IESNA91
[TEST] LTL7181
[MANUFAC] Lithonia Lighting, Lithonia Fluorescent
[LUMCAT] 2AV G 2 17 SBL ASR
[LUMINAIRE] AVANTE 2' X 2' SYMMETRIC WITH OPTIONAL ALUMINUM
[MORE] STEPPED REFLECTORS, 2 17WATT T8 LAMPS
[MORE] STRAIGHT BLADE LOUVER WITH STAGGERED ROUND HOLES
[MORE] BACKED WITH WHITE ACRYLIC DIFFUSER
[LAMP] F017 LAMPS RATED 1350 LUMENS
[OTHER]Version: 05/01/1999 - 12:00:00
[_INFOLINK] www.lithonia.com/visual/ies/ies.asp?vfile=
TILT=NONE
2 1350 1 37 5 1 1 1.90 1.92 0.00
1 1 33
0.0 2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0 22.5 25.0 27.5 30.0
32.5 35.0 37.5 40.0 42.5 45.0 47.5 50.0 52.5 55.0 57.5 60.0 62.5
65.0 67.5 70.0 72.5 75.0 77.5 80.0 82.5 85.0 87.5 90.0
0.0 22.5 45.0 67.5 90.0
412 407 406 400 393 385 376 367 356 345 332 318 305
289 275 259 243 226 211 193 177 161 143 128 114 101
89 77 66 56 45 36 28 21 13 4 0
412 407 404 400 394 386 378 369 359 348 334 321 309
295 281 265 250 234 220 204 187 171 156 142 126 113
101 89 76 65 54 44 34 20 12 5 0
412 412 410 406 402 395 387 379 369 359 347 336 323
310 298 284 269 254 238 225 207 191 176 161 148 136
122 111 98 83 65 49 37 24 13 6 0
412 415 413 410 405 400 391 386 378 369 360 349 340
328 316 302 288 271 256 241 226 214 200 188 176 164
148 131 109 84 69 52 39 26 13 6 0
412 418 416 414 411 405 399 392 385 377 368 359 349
338 326 313 296 279 265 251 238 226 213 202 189 175
156 132 103 85 67 50 37 23 12 4 0
    
```

These light files determine light intensity and the distribution of that light. An example of a goniometric lights intensity distribution can be seen in the image shown below. This image shows a lighting effect where it appears two lights are used to illuminate a model. By varying the values in the 'light file' you can create all sorts of strange lighting effects.



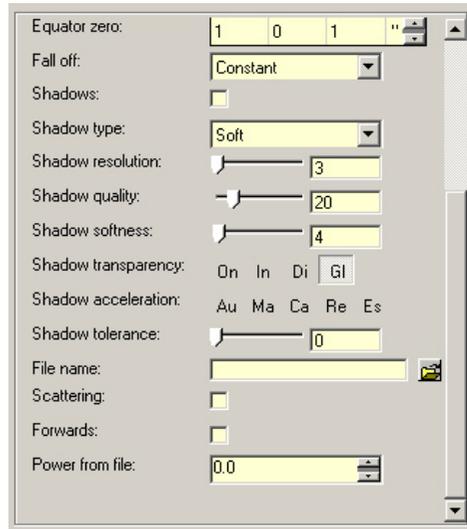
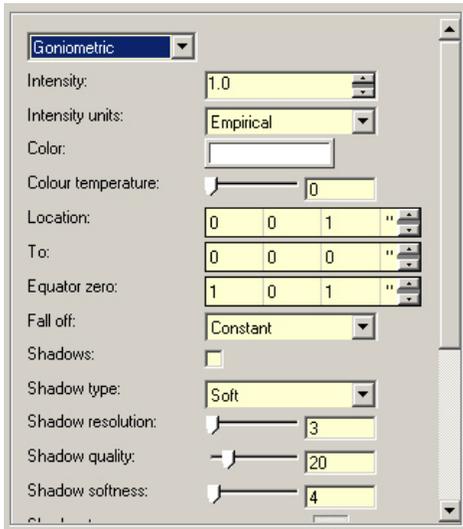
The images below show the four sample (\*.ies) files included with TurboCAD in use. A basic street light scene is used to show the different light sources. Although you would not use all of these files in a model like this, you can at least see how each differs and how they can be manipulated.





## Goniometric Light Settings

See section on Luminance Settings for information on all the controls found on this dialog.



## Goniometric Light Uses

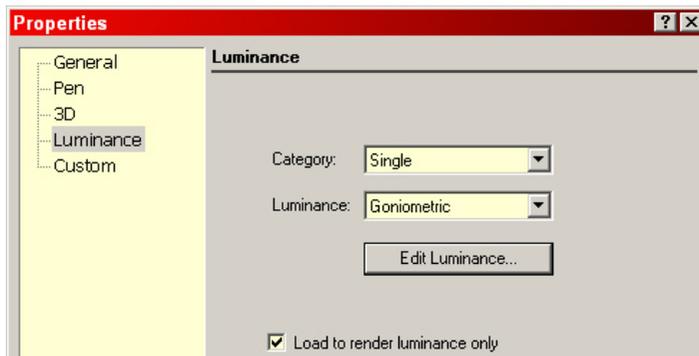
The Goniometric light source is probably the most versatile source incorporated into TurboCAD. It can be used in almost any application if the right photometric file is available. You can use a photometric light for a street light or the light for a double motion sensor light. You could use one for a floodlight or even as a basic light bulb light. The uses are unlimited.

## Goniometric Light Positioning

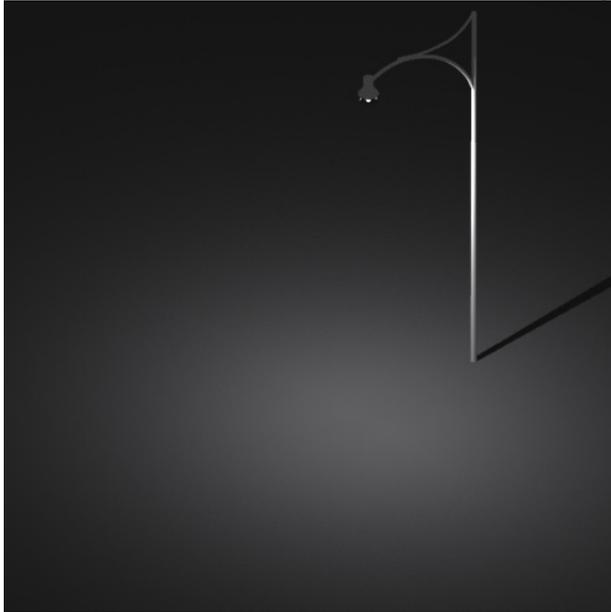
If you use this light type through the Render Scene Luminance dialog you must position it through the 'Location' and 'To' controls on the dialog. This isn't easy and can be accomplished much easier using an object on screen.

The easiest way to insert a 'Goniometric' luminance light source is by attaching it to an object on screen and treating that object as the light itself. By default the light will position itself in the center of the object and faces down the Z axis. If you rotate the object (using the rotation) handles the light will rotate as well. This is the closest you will get to having Luminance lighting react in the same way as standard lighting.

Since the object itself will block out the light you should always use the 'Load to render luminance only' checkbox found on the Luminance tab of the Properties dialog for that object. This will make the object disappear but leaving the light to illuminate the drawing.



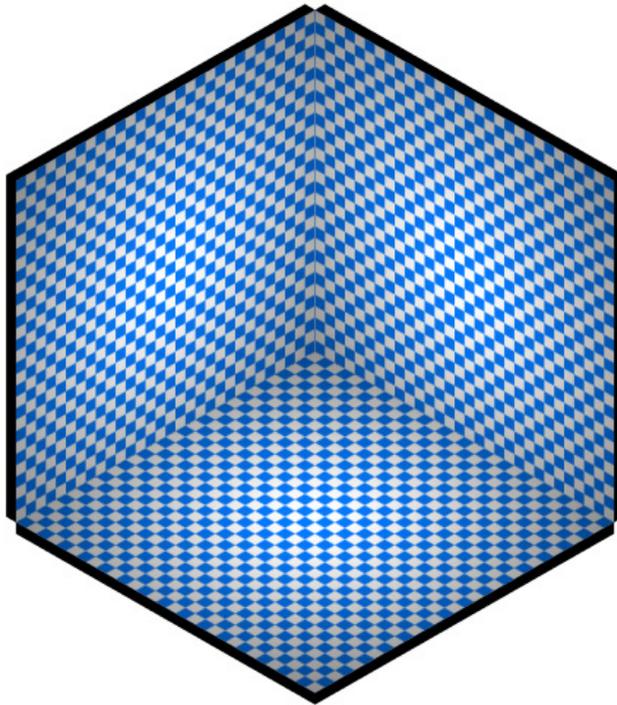
You will find that it's probably easier to use multiple windows to maneuver the light object. In the image below you see a street light with a goniometric light attached to the light itself. In this case the object is translucent so you can keep the object visible. By default the light source is directed down so the object does not need to be moved. In some cases this is not possible and the object should be made invisible using the 'Load to render luminance only' checkbox or even another object must be used and made invisible.



## Point Light (Luminance)

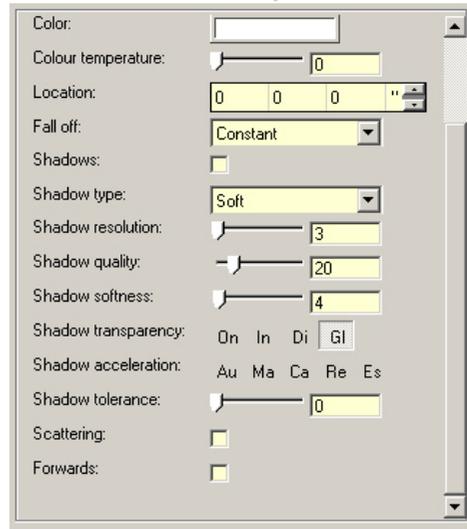
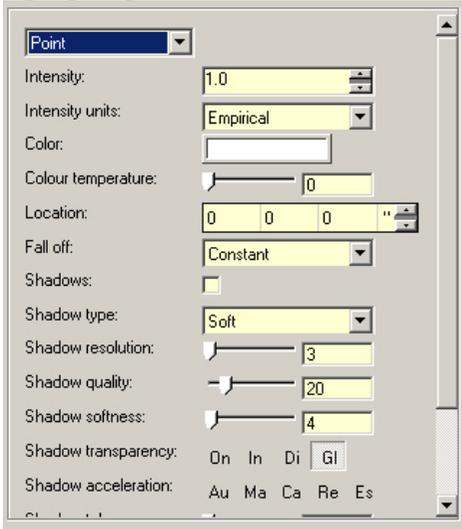
The Point light Luminance source is essentially identical to the standard Point light source. The Point light is basically a 'point' of light which transmits light in all directions. All objects within sight of the light source will be illuminated as long as it is within 'Fall Off' parameters. A surface which is perpendicular to the light source will receive more light than an object which is positioned at any other angle. The further the angle is away from perpendicular the less it will be illuminated. Surfaces facing away from the light source will not be illuminated directly from the source although they may be indirectly illuminated, via reflection, from another object.

You can see in the image shown below how a Point light source works. A Luminance Point light source is positioned near the center of the walled in area. The center of the walls and floor receive more light since they are positioned at  $90^\circ$  to the source. The further away from center you go, the less light is seen.



### **Point Light (Luminance) Settings**

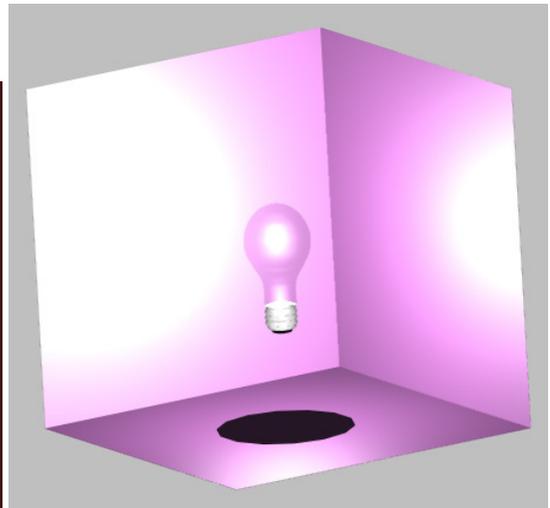
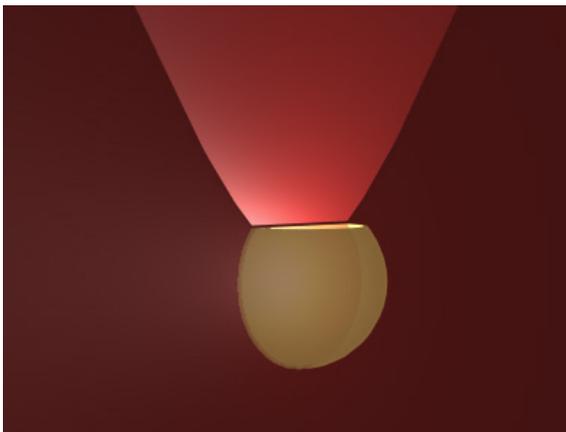
See section on Luminance Settings for information on all the controls found on this dialog.



## Point Light Uses

The first thought that many people think of when referring to Point light is for use with a light bulb. A Point light source would be the perfect choice when creating a model with a standard table lamp or similar lamp in it. A Point light source can be used to imitate the glow of spark or fire too.

The images below shows a wall sconce with a Point light source placed within the object and a light bulb. Both use the Point light source.

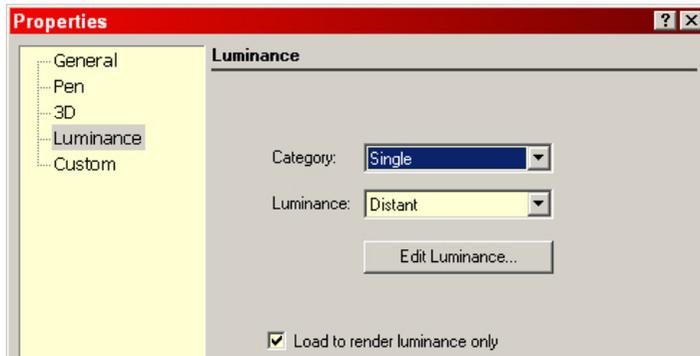


## Point Light (Luminance) Positioning

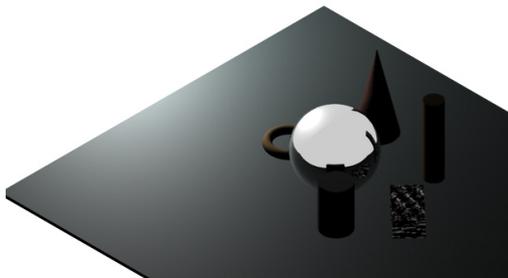
If you use this light type through the Render Scene Luminance dialog you must position it through the 'Location' control on the dialog. This isn't easy and can be accomplished much easier using an object on screen.

The easiest way to insert a 'Point' luminance light source is by attaching it to an object on screen and treating that object as the light itself. By default the light will position itself in the center of the object. You never need to rotate the object since a Point light illuminates in all directions equally. This is the closest you will get to having Luminance lighting react in the same way as standard lighting.

Since the object itself may block out the light you could use the 'Load to render luminance only' checkbox found on the Luminance tab of the Properties dialog for that object. This will make the object disappear but leaving the light to illuminate the drawing.



The image below shows a box (selected) with a Luminance Point light attached.



## Projector Light

The Projector light source has to be the most unique of all the light sources included with TurboCAD. While identified as a light source it actually isn't a light source at all. What the Projector light source does is project a graphic image onto solid objects within a model. While this may seem simple enough, it can be used in all sorts of ways. The images below show a few ways you might use this light source.



The image above shows how the Projector light source can be used to simulate the reflection of water from a pool on the wall of a room.



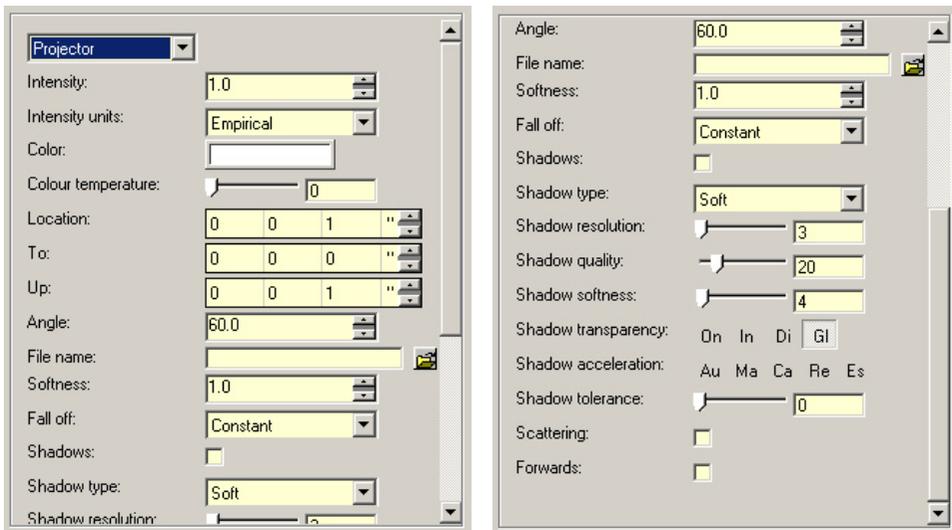
The image above shows how a Projection light source can be used to create a simulated caustic effect when light is reflected through a wine goblet.



Finally, the last image shows a basic use where an image can easily be displayed on another object. This can be used to simulate a TV, computer screen, painting, etc.

### **Projector Light Settings**

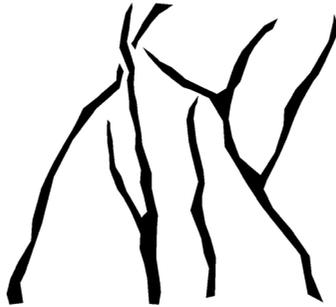
See section on Luminance Settings for information on all the controls found on this dialog.



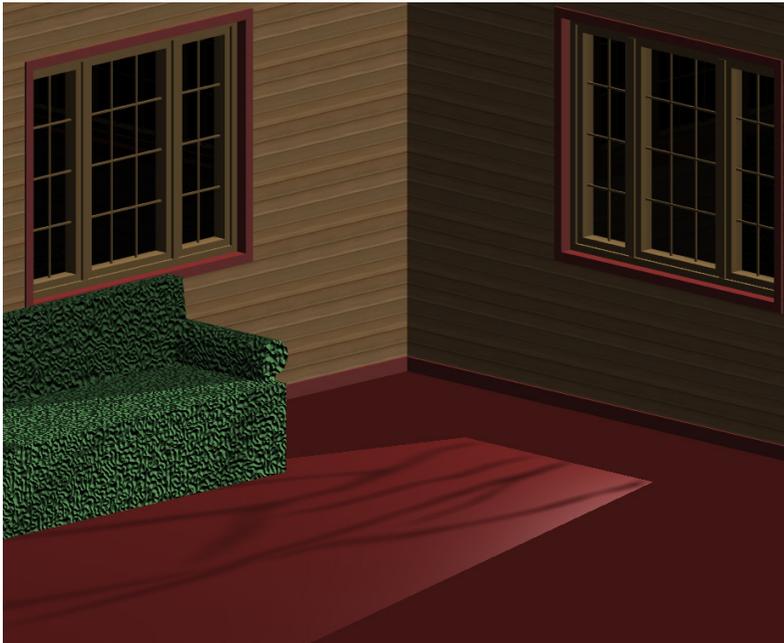
## **Projection Light Uses**

As mentioned earlier, you can use the Projection Light source in all sorts of ways. One of the biggest uses is with caustics. I've seen images where people have used projection light sources to create the effect of light reflecting off of a diamond.

You can easily use the light source to create images on a television screen, computer screen or a painting. Use it to give the effect of posters on a wall or a rug on a floor. One last image can be seen below. It shows a room where a light is shining into it through a group of trees. The image that was used for the effect can be seen below. It's just a simply 2D image of some basic trees.



Using the image in a projection light source can produce an effect as shown below.

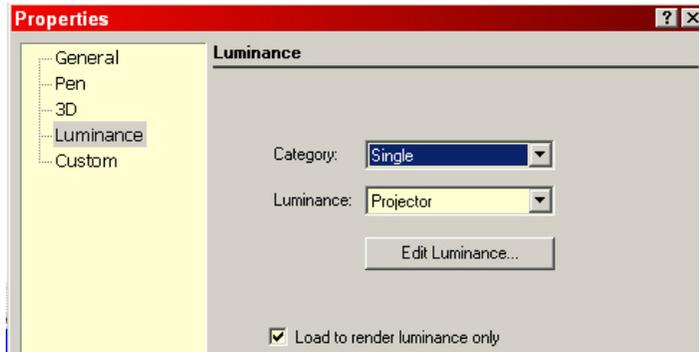


## **Projection Light Positioning**

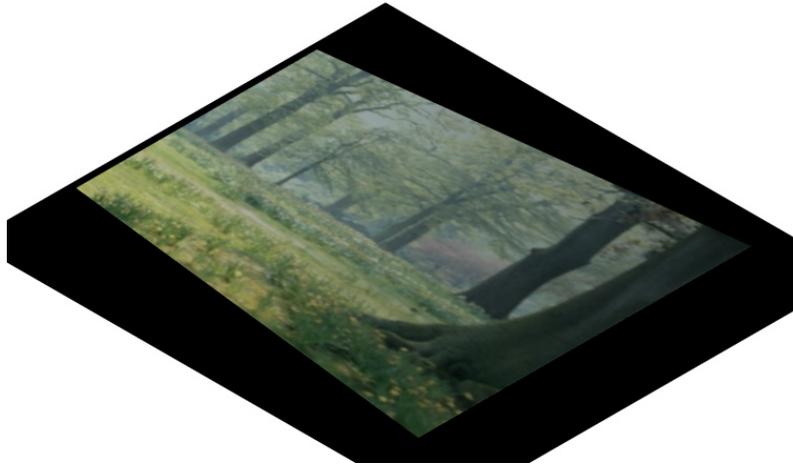
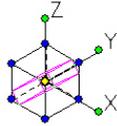
If you use this light type through the Render Scene Luminance dialog you must position it through the 'Location' and 'To' controls on the dialog. This isn't easy and can be accomplished much easier using an object on screen.

The easiest way to insert a 'Projection' luminance light source is by attaching it to an object on screen and treating that object as the light itself. By default the light will position itself in the center of the object and faces down the Z axis. If you rotate the object (using the rotation) handles the light will rotate as well. This is the closest you will get to having Luminance lighting react in the same way as standard lighting.

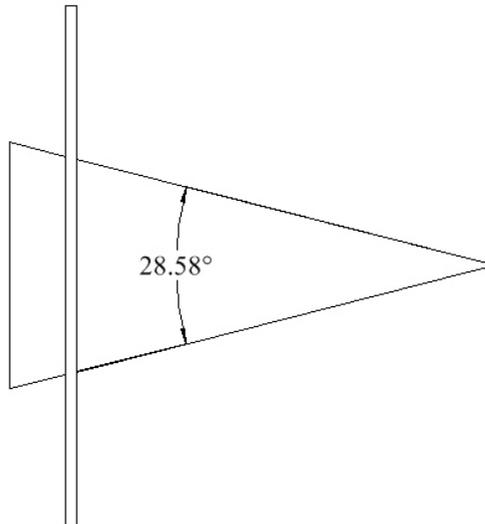
Since the object itself will block out the light you should always use the 'Load to render luminance only' checkbox found on the Luminance tab of the Properties dialog for that object. This will make the object disappear but leaving the light to illuminate the drawing.



You will find that it's probably easier to use multiple windows to maneuver the light object. In the image below the object can be seen because it is selected. It would not be seen in the rendered window if it was not.



You can now adjust the settings including the 'Angle' of the cone. You specify how large the cone is using the 'Angle' field. You can see this in the image shown below. An angle of  $28.58^\circ$  is set. If an angle was set at  $45^\circ$  then the base of the cone would be bigger and the image would therefore be larger in size. The larger the angle the larger the image it projects.



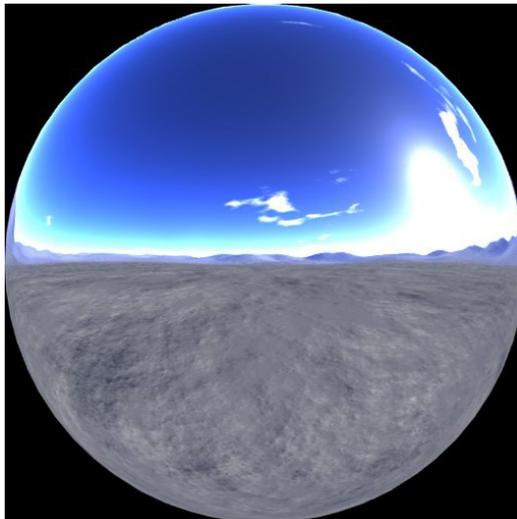
## Simple Environment Light

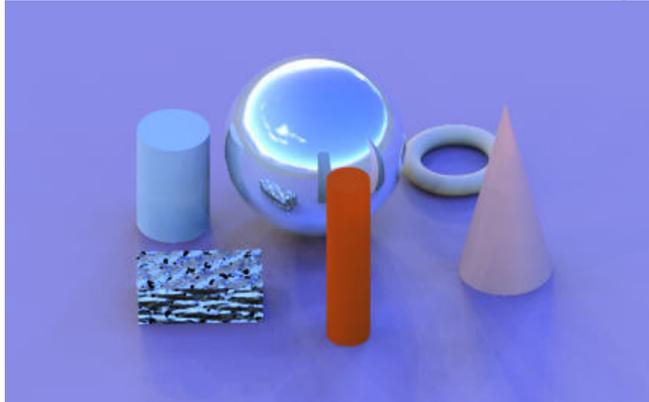
The Simple Environment shader was new to TurboCAD v10.2. This new shader is used specifically in Image Based Lighting. This is discussed fully in Chapter 6. What Image Based Lighting does is take a High Dynamic Range Image and uses this image to illuminate your model. No lights per se are used but instead the image is used to calculate illumination within the model when rendered.

The Simple Environment shader must be used in conjunction with a Global Environment in the Render Scene Environment dialog. The Global Environment specifies which HDR image is to be used in the light source. The Simple Environment shader then uses this image to illuminate the model.

High Dynamic Range Images go beyond the normal controls of (0-255) used by standard Low Dynamic Range Images. With LDR Images you can choose light settings which range from (0-255) with HDR Images you can produce real world intensities which can be more than 100 million times brighter than normal standards. This helps create much more realistic rendered images when used. You can use several different types of images for your rendering.

The most common type is the 'Light Probe'. A Light Probe is a spherical image which looks like it's a picture taken of a gazing ball. In fact many HDR Images are created in that exact way. Gazing balls are positioned in the area that is to be used as the image and a picture is taken of the gazing ball using a digital camera specifically created to take HDR Images. The gazing ball part of the picture is then cut out and used in IBL. The image below shows a light probe take in the desert. The image below the light probe shows a rendered model using the light probe in IBL. Note: you can see the reflection of the image in the sphere in the rendering.



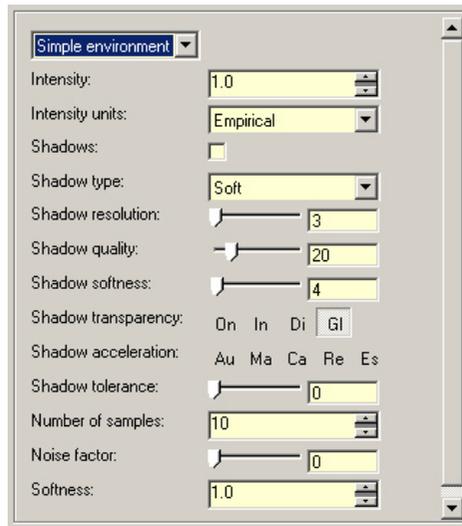


What Image Based Lighting does is take the image and break it up into pieces. Each piece then becomes a light specific light source. The number of pieces and there size of each is determined by controls found on the Simple Environment dialog.

One thing you should know is that you can only activate this light source through the Render Scene Luminance tab. The setting will not take effect if you try to use this shader through the properties tab of a 3D object. If you want to use Image Based Lighting then you must do so through the Render Scene Luminance tab on the Drawing Setup dialog (Options/Drawing Setup/Render Scene Luminance).

### **Simple Environment Settings**

See section on Luminance Settings for information on all the controls found on this dialog.



## **Simple Environment Light Uses**

There is really only one use for the Simple Environment light source and that is for use with Image Based Lighting. You use a High Dynamic Range Image to calculate the illumination for a rendered model.

## **Simple Environment Positioning**

This is extremely easy since there is no real positioning at all. Now changing the 'Number Of Samples' will change the way the final rendering will appear, there is no real way to position the HDR Image itself.

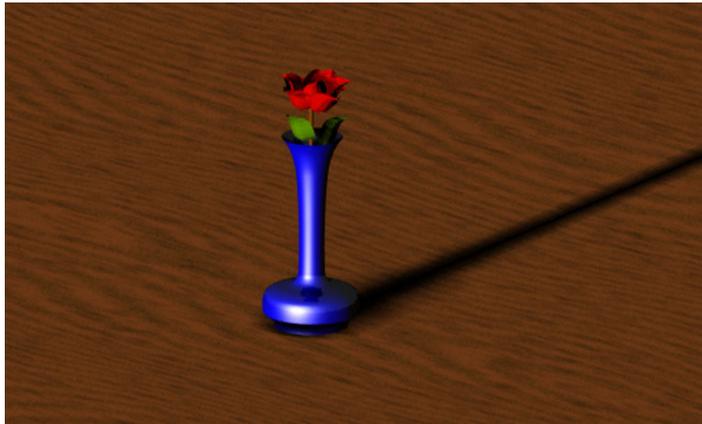


## **Simple Sky Light**

The Simple Sky light source is exactly that, a 'simple sky' light. This new shader produces a basic 'sky' light which renders much quicker than the more complex 'Sky' light source. What really takes place with the Simple Sky light source is a hemispherical dome is created over your model. This dome is uniformly bright and of all the same color. This is different from the Luminance 'Sky' shader where it produces a non-uniform distribution of light across the dome.

While this shader is much quicker than the 'Sky' light source, it is not as realistic. It is also much easier to use than the 'Sky' light source. The 'Sky' light source enables the user to use different types of cloud conditions to create a relatively realistic light source. All the 'Simple Sky' light source does is illuminate a basic color over the entire sky.

One thing that must be done for the 'Simple Sky' light source to work correctly is that Samples must be set at a value higher than (0). By default 'Samples' is set at (0). You will not get a correct rendering using this value. You must at least set the value to (1). A value of (0) will not produce a uniform light across the entire sky. Instead the light will be cast from one specific area (like a Distant light). It will produce a large shadow from the side as the image shown below.



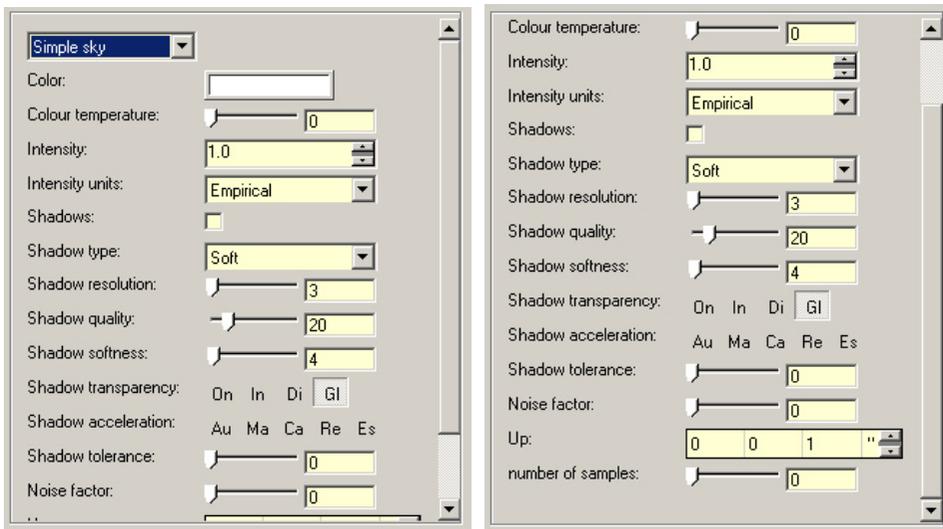
With a value set at (1) the same model appears as the one shown below. This is the way a rendered model using the 'Simple Sky' light should look, with the light coming from the top and all around the object.



One last thing that you should know is that even though the ‘Simple Sky’ shader is quite a bit faster than the normal ‘Sky’ Luminance shader, it can be unbearably slow when rendering. If you really want to use a Sky light source I would recommend the Standard ‘Sky’ source. Renders will complete in a fraction of the time that either of the Luminance Sky sources will. In some cases you’re saving “hours” in rendering time and the images don’t look much different. Of course there is a downside to using the Standard ‘Sky’ light source. It won’t shine through glass. You may have to play around with other lighting to get the right effect but I would still recommend using the standard source.

## **Simple Sky Settings**

See section on Luminance Settings for information on all the controls found on this dialog.



## **Simple Sky Light Uses**

While you may think that the only real use for the Simple Sky light shader would be as a basic ‘Sky’ light you would be wrong. It can be used for virtually any instance where a large lighting effect is needed.

## **Simple Sky Light Positioning**

The only real positioning of this light source is deciding which way is ‘up’. I’m guessing that the majority of the time it will be along the WCS X-axis which happens to be the default for the shader. If you do happen to need to relocate the hemisphere it’s quite easy using the ‘Up’ fields.

## Sky Light (Luminance)

The Luminance 'Sky' light shader is relatively the same as the standard 'Sky' light source. It produces a light effect which resembles sun light which has been scattered through the atmosphere. This shader creates a relatively realistic representation of sky light. It does not take the actual sun into account though. You will need to use a 'Sun' shader to include actual sun light.

This shader produces a very realistic 'sky' light source which can even create a sky lighting effect where certain portions of the sky are brighter than other areas. You can adjust the controls to make your sky appear like a bright sunny day or a hazy overcast day. The shader is quite realistic and practical but render times using this shader can be quite lengthy.

This light shader positions a light source relative to a scene rather than within a scene itself. It is like the Distant and Simple Sky shaders in this way. The 'Sky' light shader, like the 'Simple Sky' shader, produces a hemisphere of light positioned around your model. You decide where to place the hemisphere and what type of light it will produce.

Using the 'type' control you can create skylight which resembles that of a bright clear day, a partially cloudy day or an overcast day. If you choose 'overcast' then the brightest part of the sky is directly overhead regardless of where the sun is positioned. If 'clear' is chosen then the brightest part of the sky will be where the virtual sun is located. You have six different sky types to choose from, three from the Illuminating Engineering Society of North America and three from Commission Internationale de l'Éclairage's formulae. These are actual mathematical models created by these groups.

One thing you should know about the Luminance 'Sky' light shader is that shadows are created from Ray Casting and not using shadow maps. This is why you will not see as many shadow options as some other light shaders do.

Unless the rendering you are creating has to be 100% realistic and people with real knowledge of lighting will see the difference. I really wouldn't go with this 'Sky' shader unless you really want to. The 'Simple Sky' light source is much easier to work with and renders much quicker as well. Still, the best route would probably be the standard 'Sky' light source. The resulting lighting effect is virtually the same as the Luminance 'Sky' shader but the rendering time can be much shorter. The main difference is that the standard light source simulates the actual sun at the lights position while the Luminance 'Sky' shader does not include actual sun light in its use.

The image below shows a model rendered using only one light source, a standard 'Sky' source. The shadow effects are not perfect but can be adjusted to suit your needs. The overall rendering time was 3:34.

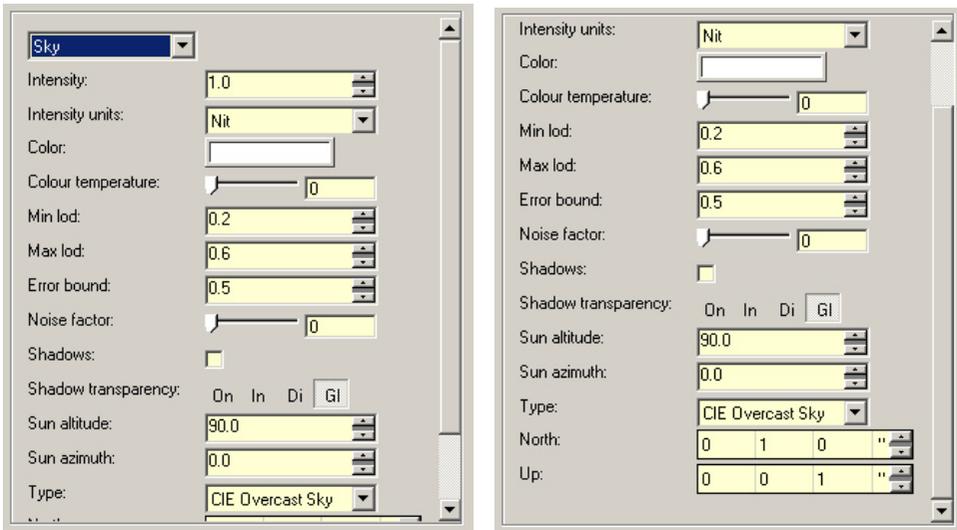


Now the rendering below only used one light source as well. It used a Luminance 'Sky' shader with the same settings as used in the first image. The shadows can not be adjusted (because of a flaw in the Lightworks design of the shader) and the render time was a staggering 11:01. I'll let you decide if it's worth the wait!



## **Sky (Luminance) Settings**

See section on Luminance Settings for information on all the controls found on this dialog.



## **Sky Light (Luminance) Uses**

The Luminance 'Sky' light source can be used for any type of skylight needed for a rendering. It can simulate a clear, intermediate or overcast sky. This shader is so realistic that you not only decide where 'Up' is but also where North is.

## **Sky Light (Luminance) Positioning**

Positioning and using the Luminance 'Sky' light source may seem like it has an awful lot of controls but the light source is actually quite easy to use. As with the 'Simple Sky' light shader the sky is actually just a hemisphere of light positioned over your model.

You determine where 'Up' is via the Up control on the Luminance editor dialog. More often than not 'up' will be along the Z axis. This is the default and most likely will not need to be changed. The 'North' control defines where North is in respect to the WCS.

The Sun Altitude and Sun Azimuth controls determine where the actual hemisphere of light will be positioned. The Sun Altitude control defines the angular distance from the sun above the WCS. The Sun Altitude control defines the angle of the sun from North. A value of (0) would place the sun due north. Although these controls determine where the hemisphere is to be placed the actual light contributions of the sun are NOT determined with this light source.

If you wish to include actual sun light you must use the Luminance 'Sun' shader or use a standard 'Sky' light source instead.

The 'Min Lod', 'Max Lod' and 'Error Bound' controls affect the image quality of a rendering. These settings determine how much work is done by the program to illuminate every point in a render. Low values for Min Lod. may produce errors in shadows while higher values may produce long rendering times. Basically, the higher the values the better the image quality but also the longer the rendering times. Changing these values can change render times from minutes to hours. Please check out the section on Luminance Settings seen earlier in this chapter for a full explanation on these controls. Look at the two images shown below. Notice the difference in detail, especially in the shadows.

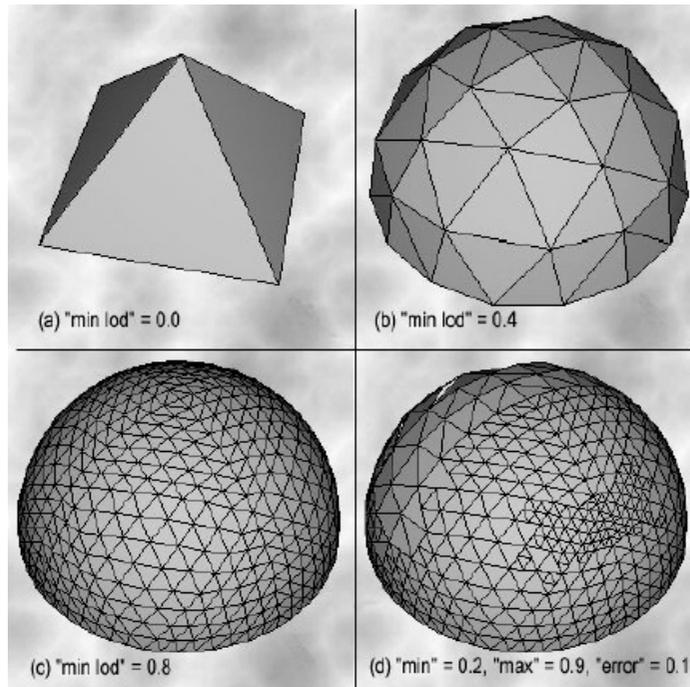


(Min Lod (0.1), Max Lod (0.3), Error Bnd (0.2))



(Min Lod (0.4), Max Lod (0.7), Error Bnd (0.2))

The image below (courtesy of LightWorks) shows how adjusting the Min. Lod., Max. Lod. and Error Bound controls will effect a rendering. Each segment (or facet) represents an area which will help illuminate the model. The higher the number the more complex the lighting effect becomes.



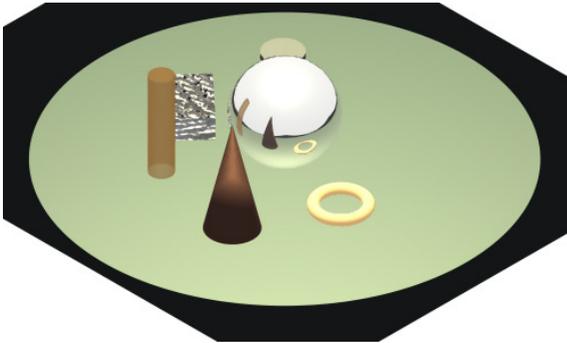
As mentioned earlier, if you're looking for a light source which will create a very realistic image then go for the Luminance 'Sky' shader. If you're looking to save a bit of time on rendering then you may want to try the 'Simple Sky' or standard 'Sky' light sources.

## Spot Light (Luminance)

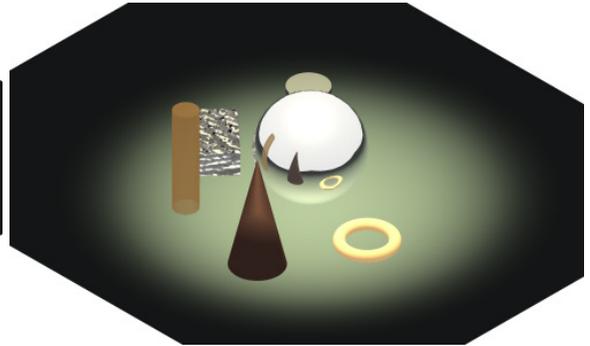
The Luminance 'Spot' light source is virtually the same as the standard 'Spot' light source. Both produce a virtual cone of light. The size, makeup and direction of the cone are defined by the controls on the Luminance editor dialog.

This light shader can be a very useful light source when used correctly. While the light produced is always in the form of a cone you have quite a bit of control over how the lighting effect will look. With the use of the controls found on the Luminance editor dialog you can not only make the cone larger and smaller but you can adjust the beam distribution and delta angle. These controls give you the ability to adjust the light so the outside edges appear crisp or hazy.

The two images below show the same model with only the use of a 'Spot' Luminance light source to illuminate it. The only change to the two renders was in the Beam Distribution and Delta Angle controls.



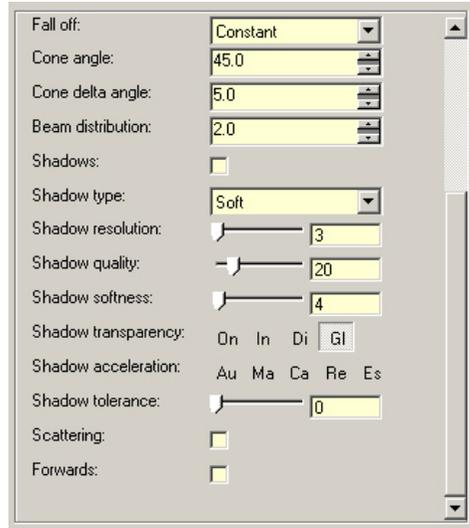
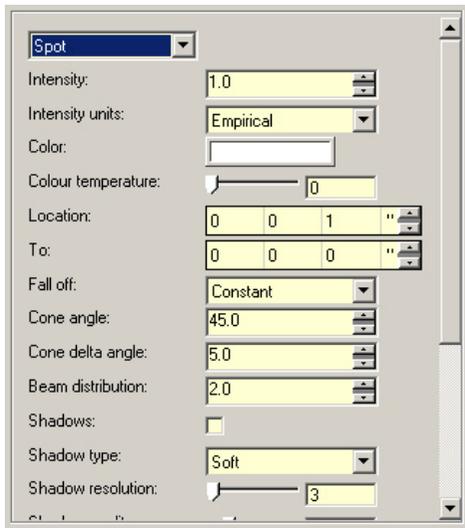
(Beam Distribution=0, Delta Angle=0)



(Beam Distribution=10, Delta Angle=20)

### **Spot Light (Luminance) Settings**

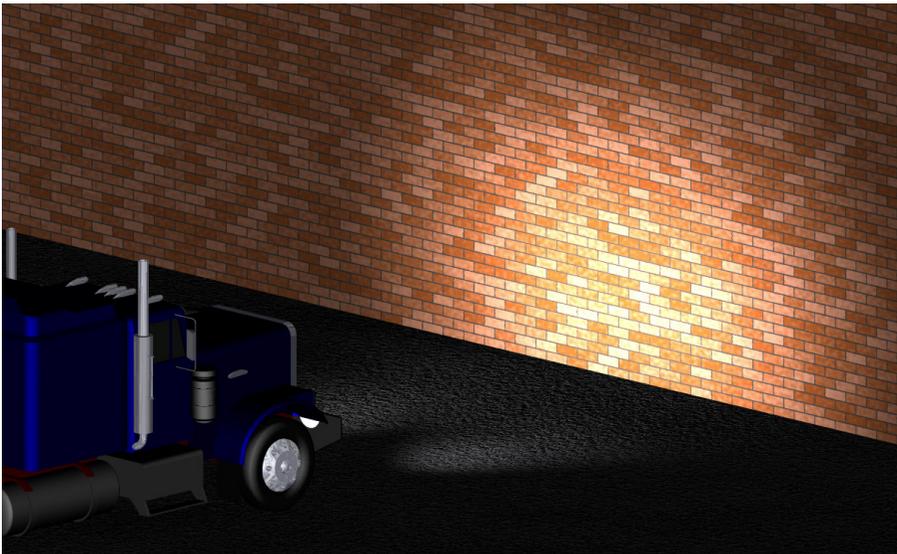
See section on Luminance Settings for information on all the controls found on this dialog.



## **Spot Light (Luminance) Uses**

The Luminance 'Spot' light can be used any time you wish to throw a beam of light on any specific spot. You can use the 'Spot' light as any actual real life spot light or even just to throw some indirect light in a rendering. With the ability to produce a hazy light source you can even produce an effect where the spot light doesn't even look like a spot at all.

Of course some common uses for a 'Spot' light would be for use in a flashlight or for use in a headlight of a car. You could use one in a street light or in a wall sconce. If you can think of it, then the 'Spot' light can probably be used to illuminate it. It's very useful

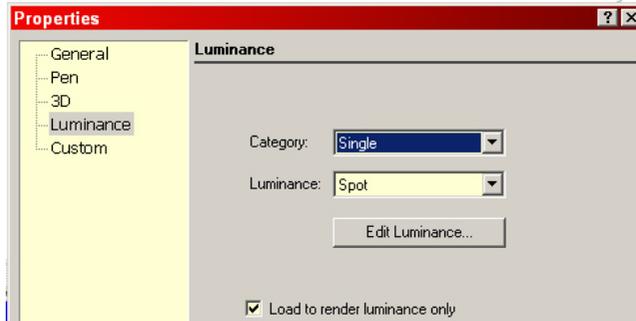


## **Spot Light (Luminance) Positioning**

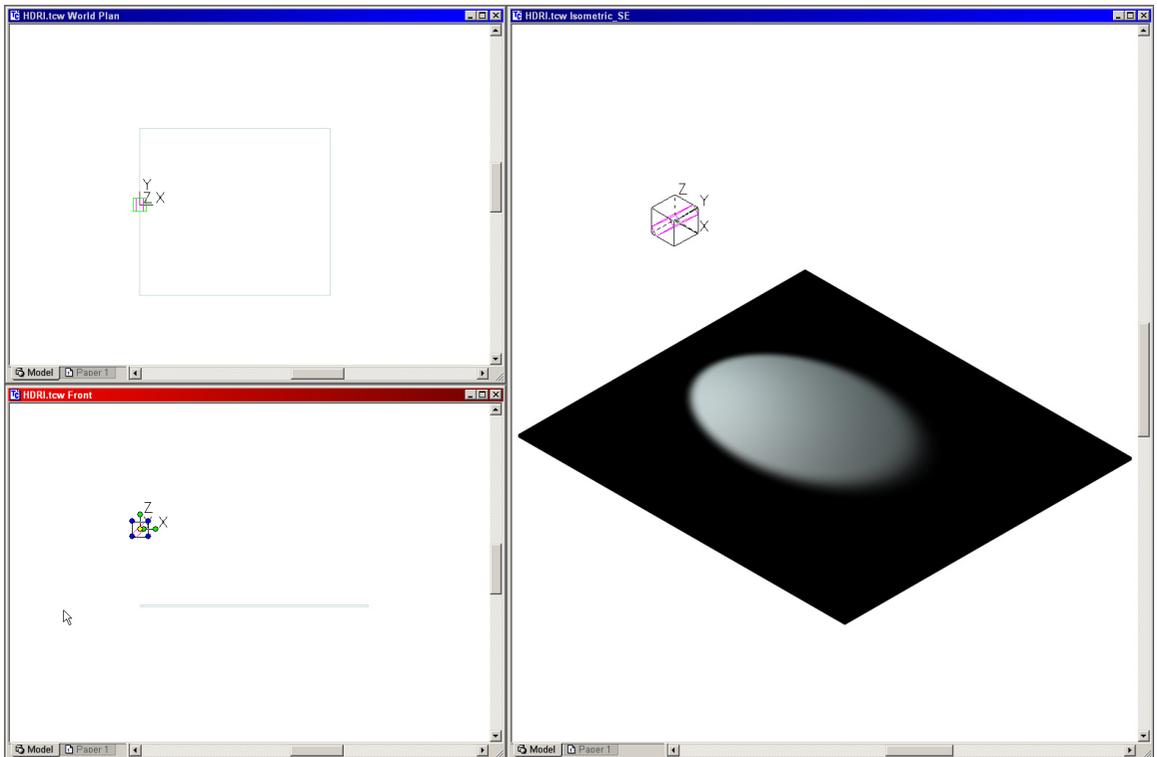
If you use this light type through the Render Scene Luminance dialog you must position it through the 'Location' and 'To' controls on the dialog. This isn't easy and can be accomplished much easier using an object on screen.

The easiest way to insert a 'Spot' luminance light source is by attaching it to an object on screen and treating that object as the light itself. By default the light will position itself in the center of the object and faces down the Z axis. If you rotate the object (using the rotation) handles the light will rotate as well. This is the closest you will get to having Luminance lighting react in the same way as standard lighting.

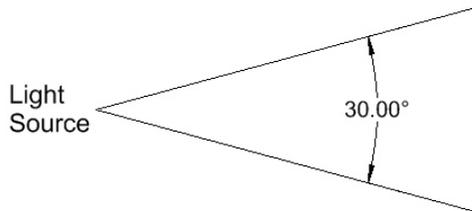
Since the object itself may block out some light you could use the 'Load to render luminance only' checkbox found on the Luminance tab of the Properties dialog for that object. This will make the object disappear but leaving the light to illuminate the drawing.



You will find that it's probably easier to use multiple windows to maneuver the light object (as seen below). The object can be seen because it is selected. It would not be seen in the rendered window if it was not.

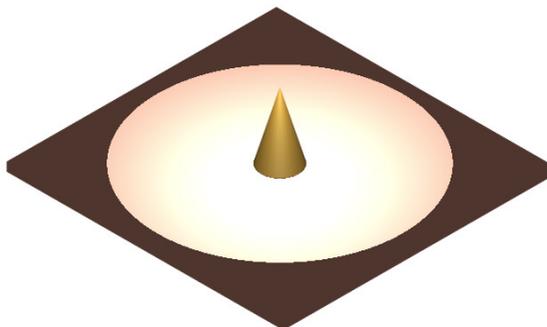


After positioning the 'spot' light source you can then manipulate the settings. The size of the cone is determined through the 'Cone Angle' parameter. Input the angle of the cones opening. Remember that the further away an object is from the apex the larger the light will appear. The image below shows an angle of 30°. You would input (30) into the Cone Angle field.

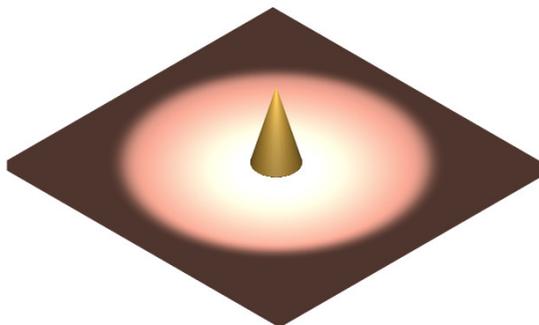


Lastly you can use the 'Cone Delta Angle' and the 'Beam Distribution' parameters to adjust the amount of haziness in the spot light. The 'Cone Delta Angle' determines how much of the cone will appear hazy, always from the cones edge towards its axis. The 'Beam Distribution' control determines how much of the lights intensity will diminish towards the cones edge.

Below are several examples of Spot lighting using the three parameters listed above. The color fading in the bottom image is due to reflected light off of the cone centered in the picture.



(Cone Angle=45, Delta Angle=0)



(Cone Angle=45, Delta Angle=5, Beam Distribution=5)

# Sun Light

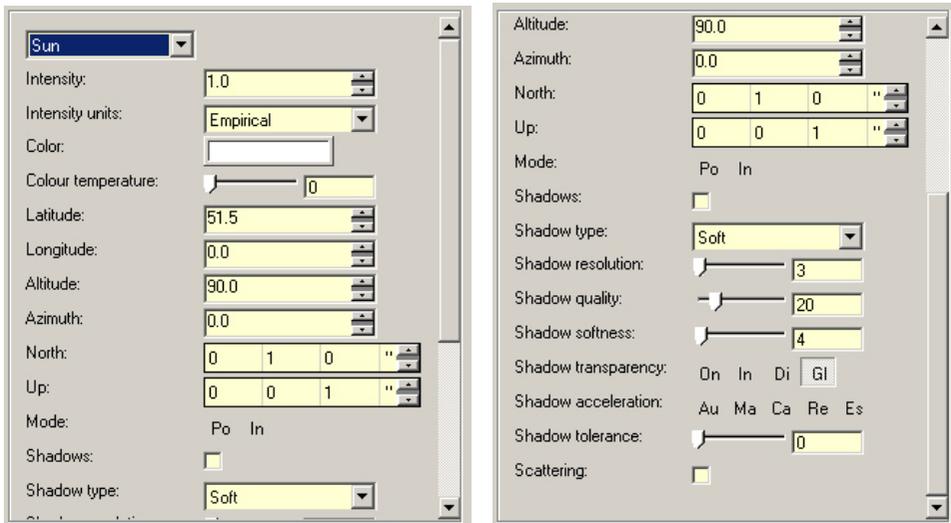
This shader pretty well explains itself. It is designed to create a light source which mimics that of sunlight. With all the available settings it is possible to precisely position a 'Sun' light source as in real life. This light shader is so realistic that even takes into consideration the atmospheric property such as pressure and air particles. This shader, used together with a Luminance 'Sky' light source can produce a remarkably accurate and realistic sunlight effect.

The image below shows a rendering using both 'Sun' and 'Sky' light sources. The 'Sky' light illuminates everything while the 'Sun' casts the shadow on the trees.



## Sun Light Settings

See section on Luminance Settings for information on all the controls found on this dialog.



## Sun Light Uses

Of course the main use for the 'Sun' light shader is to produce a light which mimics sunlight. You could use this light source as a large spot light but it probably wouldn't be that practical.

## Sun Light Positioning

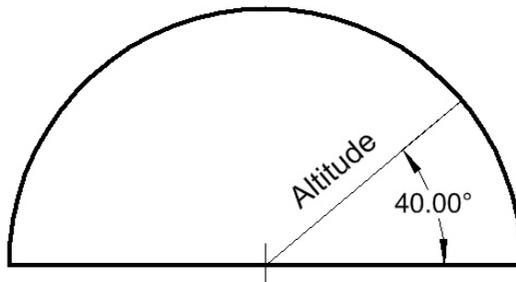
Position a 'Sun' light source can be a bit overwhelming if you don't really know what you're doing. All the controls needed to position a 'Sun' light source according to the actual location of the sun in real life are there. You just have to know what they all mean and how to use them.

First you will need to know the real life location of the sun in relation to a specified point on the earth. From there you have two options to position your light source. You will need to know the position of the sun by an angle from the horizon AND a compass direction or you will need to know the actual grid location on Earth.

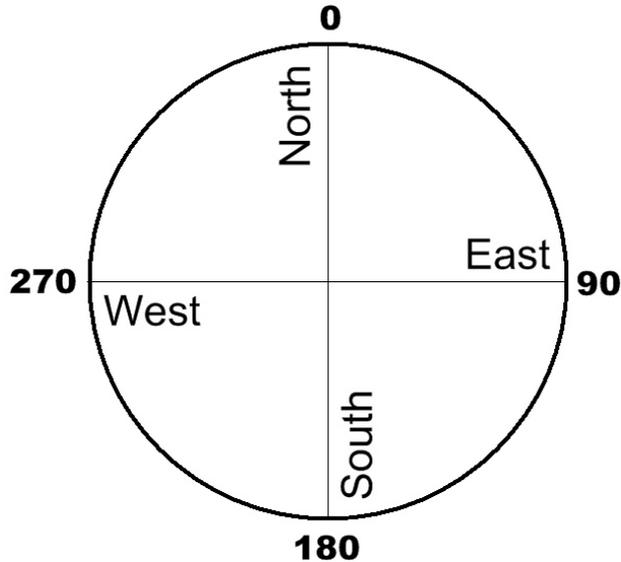
First you must decide which Mode to use. The 'Mode' control can be seen on the Luminance Editor dialog. You can choose either 'Po' or 'In'. When neither is selected then 'sky type', latitude and 'longitude' have no meaning and they are not taken into consideration when rendering. The position and color of the sun are taken from the 'altitude', 'azimuth', intensity and 'color' controls. If 'Po' is selected the 'altitude' and 'azimuth' are calculated automatically according to 'latitude' and 'longitude' values entered. 'Altitude' and 'azimuth' are not used in calculations when this mode is selected. If 'In' is selected the sun is calculated using the 'sky type' and the 'altitude' only.

When using Latitude and Longitude - You can use values from (-90, Northern hemisphere) to (90, Southern hemisphere) in the Latitude fields. Lines of latitude start at the equator (0). A value of (90) would indicate the North Pole while (-90) would be the South Pole. Longitudinal values start at Greenwich, England (0) and go (180°) West and East.

If you don't know the actual latitude and longitude of the sun then you can indicate the position of the sun via the Altitude and Azimuth fields. The Altitude parameter defines how high, above the horizon the sun lies. Input the distance from the WCS origin to the sun. A value of (90) corresponds to being directly overhead.



The Azimuth parameter defines at what angle from North the sun lies. Azimuth values of (0), (90), (180) and (270) degrees correspond to North, East, South and West respectively.



When using this method you will also need to define both North and Up on the dialog. Once North is defined then the other parameters can take hold.

For the Latitude and Longitude of actual places in North America (and the rest of the world) check out <http://www.bcca.org/misc/qiblih/latlong.html>.

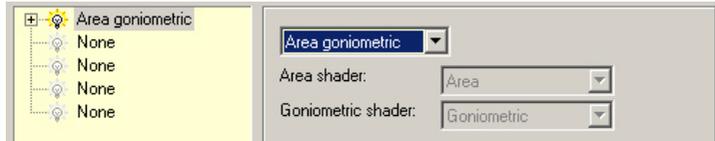
## Area Goniometric Light

This new Luminance light source is new to TurboCAD v11. While it is a new light source there really isn't that much new about it. It basically puts together two existing Luminance light sources (Area and Goniometric). It saves you from having to use a complex category to put both together. With this new source you can now emit a Goniometric light source from an area of space rather from a single point (as with the regular Goniometric light source).

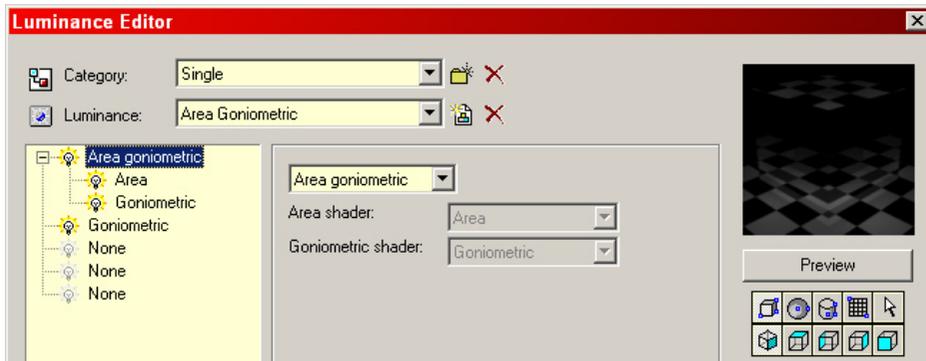
## Area Goniometric Light Settings

The settings for the Area Goniometric are basically the same as they are for the original single light source. See the original sources for the settings. Although the settings are the same, they are a bit harder to find with this source.

You select the light source, as you normally do, but there doesn't seem like you can do anything. You have to open the sub-category from the list first. Next to the Luminance type you will see a <+> sign. Select it to open the sub luminances.



When you do this you will see the two luminance types. Selecting either one will open their corresponding settings dialogs.



## Area Goniometric Light Uses

This source can be used at any time where both an Area light and a Goniometric light source is needed at the same time.

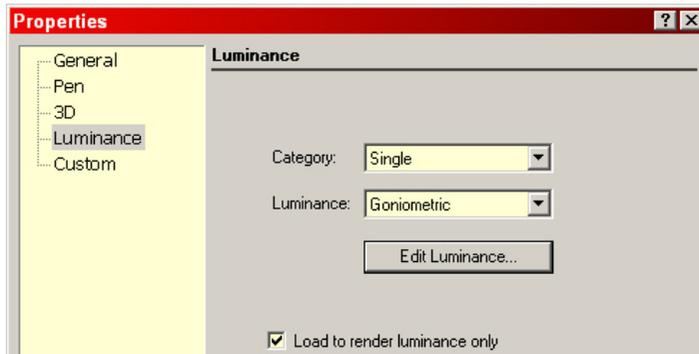
## Area Goniometric Light Positioning

To use the light source you first create the 'Area' light to define the area which the light will project from, then you create the Goniometric light to define the actual shape of the light being cast.

There is no positioning for the Area light part of this source. An Area light always attaches itself to an object on screen. The light is always attached to the workplane face of the object it is attached to. If the object has curved surfaces then it will cast light on all surfaces around the object. This is what causes lengthy rendering times with this light type.

The Goniometric light part of this source reacts in the same way the regular Goniometric light source does. The 'Goniometric' luminance light source is attached to the object and positioned in the same way the standard one does. By default the light will position itself in the center of the object and faces down the Z axis. If you rotate the object (using the rotation) handles the light will rotate as well. You can leave it on the object or move it around using the 'Location' and 'To' fields on the dialog. This is the closest you will get to having Luminance lighting react in the same way as standard lighting.

Since the object itself will block out the light you should always use the 'Load to render luminance only' checkbox found on the Luminance tab of the Properties dialog for that object. This will make the object disappear but leaving the light to illuminate the drawing.



## Area Sky Light

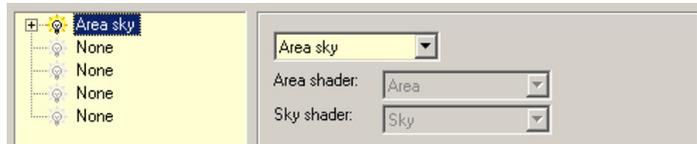
The new 'Area Sky' light source has been recently added to TurboCAD v11. This new light source, as with the 'Area Goniometric' source is pretty easy to understand. You basically combine an Area light and a Sky light in the same light source. The Area part of the source defines the area from which the light will project from, while the Sky part defines the portion of the sky to be sampled (lit up). Think of the area selected as a cut-out or a window which allows sky light through. This new source is great in that you don't have to sample the entire semi-circle of sky but instead just the area selected. This can save quite a bit of time when rendering.

With the standard 'Sky' light source the position of the light is determined from the settings found in the properties dialog and is cast from a semi-circle surrounding the model. With this new light source you can position the source where you want and as large or as small as you need.

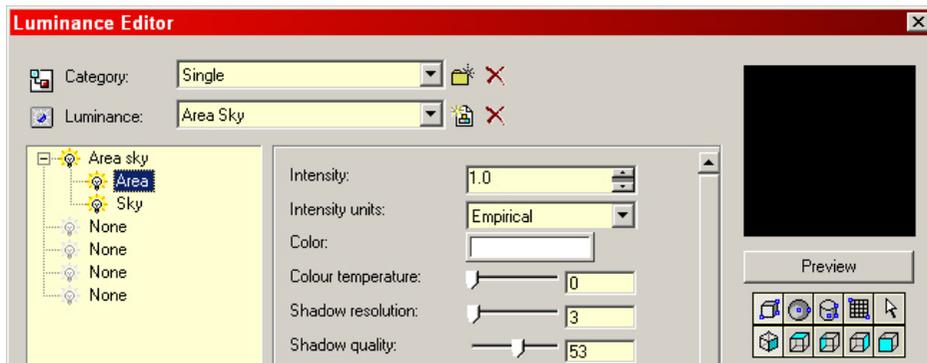
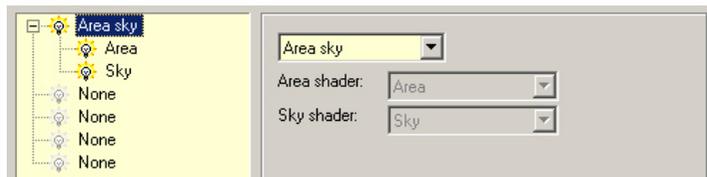
## Area Sky Light Settings

The settings for the Area Sky are basically the same as they are for the original single light source. See the original sources for the settings. Although the settings are the same, they are a bit harder to find with this source.

You select the light source, as you normally do, but there doesn't seem like you can do anything. You have to open the sub-category from the list first. Next to the Luminance type you will see a <+> sign. Select it to open the sub luminances.



When you do this you will see the two luminance types. Selecting either one will open their corresponding settings dialogs.



## Area Sky Light Uses

You can use this new light source any time you want to use the regular 'Sky' light source. Rendering times will probably be quicker since the entire sky is not sampled when rendering. Of course the more sky used the more realistic the rendering but when it doesn't have to be perfect, this is still better than the 'Simple Sky' source.

## Area Sky Light Positioning

Positioning the Area Sky light source can be very simple. You position your object anywhere on screen. You specify the Area and Sky light settings from the dialog. The sky will now only shine from the area defined by the object. The bigger the object the more light will be produced. As mentioned before, you could think of the area of the object as a window allowing sky light through to your rendering.

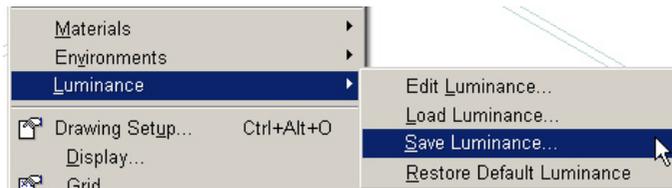
# Restore Default Luminance

Included with TurboCAD is an option which will restore all the default Luminance settings for you. This can be a blessing if you happen to change a Luminance by mistake and need to get it back. To restore all the default materials got to Options/ Luminance /Restore Default Luminance on the Menu Bar.

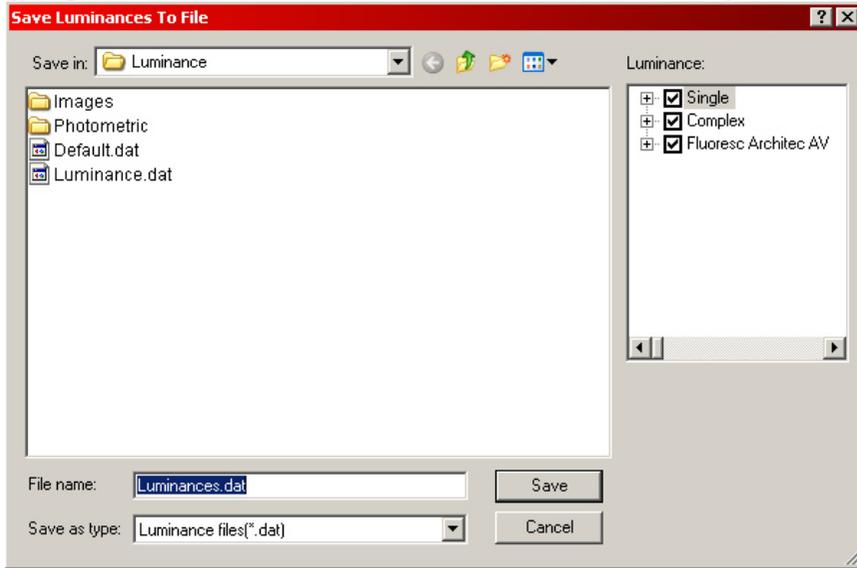
The problem with this method is that all new Luminance that you have made will all be deleted. Luckily there is another method for restoring Luminance.

## Save Luminance

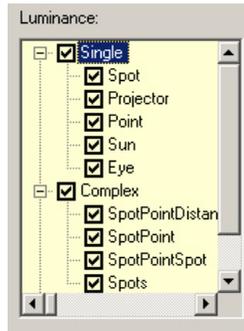
There is also a method to save the Luminances that you have edited or new ones you may have created. You can accomplish this with the help of the 'Save Luminance To File' dialog. You can access the dialog from 'Options/ Luminance /Save Luminance' on the Menu Bar. This will open the dialog.



The dialog will appear. You can choose from several existing luminance files (\*.dat) or enter a new name in the 'File Name' field. After the dialog has opened specify the path and type the file name in the File name field.

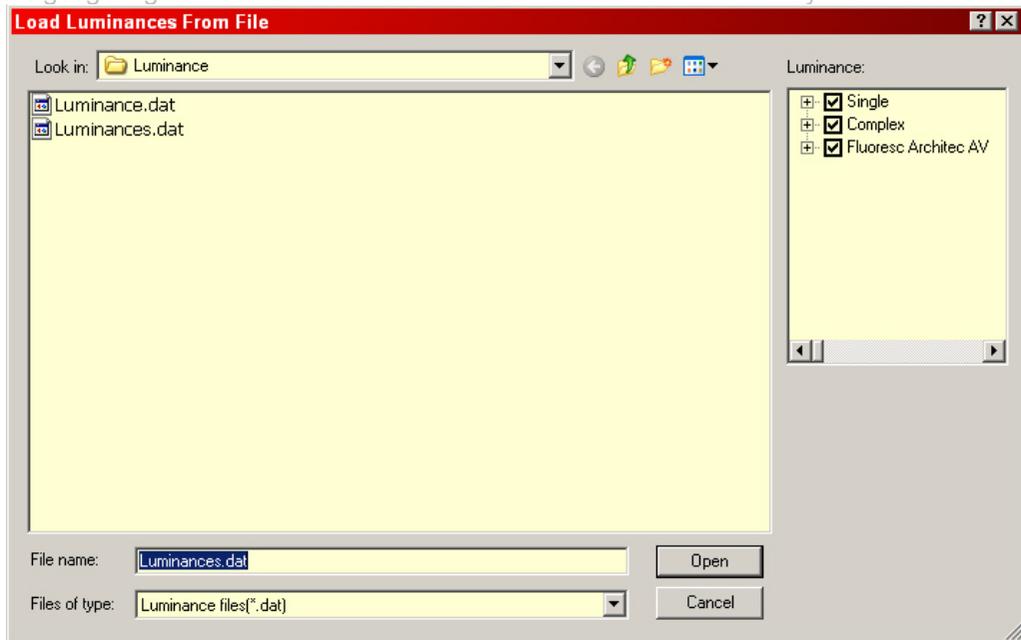


You can select which luminance's you wish to include from the 'Luminance window at the right of the dialog then save the DAT file in the folder of your choice.



## Load Luminance

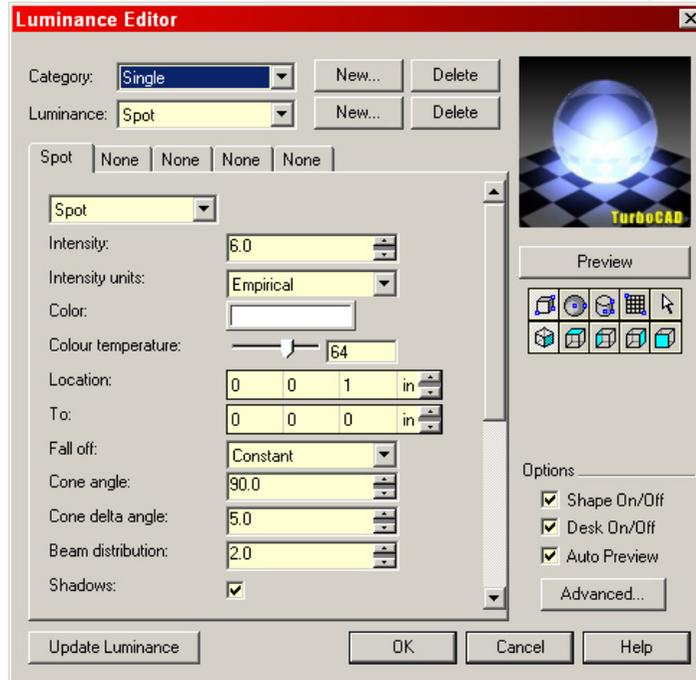
You can also load new Luminance lists using the Load Luminance From File dialog. It is basically the same dialog as the Save Luminance dialog except that you're bringing new luminances into the program and not saving them. You can access the dialog from 'Options/ Luminance /Load Luminance' on the Menu Bar. This will open the dialog.



After the dialog has opened simply select the list you wish to load, from the folder window and then select the Open button. The new Luminance list will be inserted into the program.

## Edit Luminance

The final of the Luminance group of controls is 'Edit Luminance'. This can be found at 'Options/Luminance/Edit Luminance' on the Menu bar. Selecting this option will open the Luminance Editor dialog. You select this option if you wish to edit or create a new Luminance within the program.



Once the dialog has opened you can edit an existing Luminance or create a new one. The new Luminance's created are not placed in a model though. To do that you must use the Render Scene Luminance tab or select Luminance from an objects Properties dialog.

# Chapter 6

## “HDRI and IBL”

A normal JPEG image (or most other computer based images) can only use controls from 0-255. This means the brightest point in an image can only be 255 times brighter than the darkest point in that image. Real world intensities can be as much high as 100,000,000 times brighter (or more). This was a huge disparity that has finally seemed to have been overcome with HDRI.

HDRI stands “High Dynamic Range Image”. Before HDRI came along we used what were known as “Low Dynamic Range Images”. These conventional image formats used a restricted range of intensity values. Each pixel commonly used values from 0-255 for each of red, green and blue controls. These controls were adequate for onscreen images but became inadequate when dealing with printed images.

So LightWorks Design came up with the new format now known as HDRI. What HDRI does is surpass the values used in LDRI. These greater intensity values are created by using floating point values for each pixel. This technique allows such a range of intensity values that images can now represent light intensities found in the real world. With HDRI you can now accurately capture the extreme intensities found in very dark and very light portions of a rendering. Even more impressive is that you can now create images that accurately define real world lighting without the use of any lights at all.

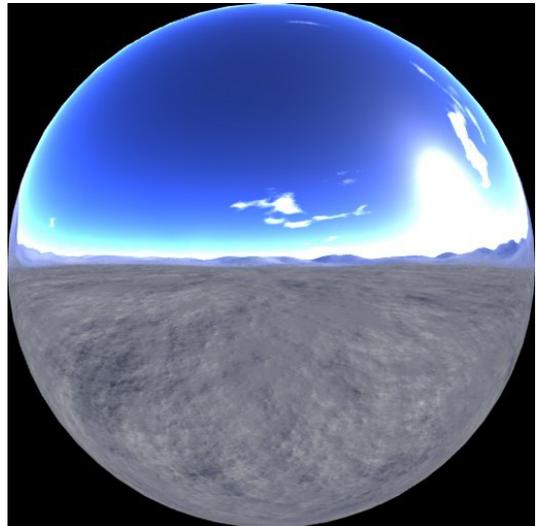
HDRI was first used in digital cameras. These cameras were created to record the extreme intensities and store them in new HDRI file formats. LightWorks (incorporated into TurboCAD) can read these formats and use them as a virtual light source to light a rendered model. It does this without the use of even one light. If you wish to change the lighting of the model you simply need to use a different HDRI format. One other helpful advantage of using HDRI is that rendered images will perfectly match any background images used since these images themselves are used in the lighting of the model.

This new technique of using HDRI to produce lighting effects is called IBL (Image Based Lighting). This new form of lighting was first introduced in TurboCAD v10.2. This new lighting technique was created to produce unbelievably realistic lighting effects in your TurboCAD renderings and can be used on its own or in conjunction with traditional lighting techniques. While IBL seems like the perfect way of lighting a model it still is not perfect and does have some rules that must be followed. When using IBL in TurboCAD you must always have at least one regular light source in your model but make sure it’s turned off. This light source will not be used in modeling but keeps default lighting from taking over the image.

While you can use IBL and standard light sources in the same model you must recognize that any standard light source used will take away from the IBL source being used. This may or may not affect the model and is up to the user to decide if the second light source is needed in the rendering.

## How It Works

Ok, so now you why IBL is better but we still haven't touched on how IBL works. What IBL does is take an image, known as a light probe, and uses it to project a radiosity calculation throughout your model. These images can be of almost any type and size of your choosing but a unique 'spherical' design has been specifically designed for use with HDRI renders. The two images below are examples of what are commonly known as 'Light Probes'.



These spherical images were created with the use of a 'Gazing Ball', specifically for use as a light probe in IBL renders. 'Gazing balls' are stainless steel balls that were originally made as ornaments for gardens. It was found that an image taken of a gazing ball would work perfectly in IBL.

What IBL does is take this image and uses it as a light source in your rendering. The image is broken up into parts. Each part then becomes a light source. The number of pieces and the size of those pieces are determined by parameters found within the program. I'll get to them later. Each light source then reflects separately on each item in the model. While spherical light probes were created specifically for IBL, other formats can also be used. TurboCAD incorporates six new environments shaders into its Environment settings. These include: cube, fixed cube, cross, fixed cross, panorama and Light Probe. A panoramic image can be seen below.



Many people have asked what the purpose of HDRI is when the second that an HDRI image appears on a computer monitor it is transformed into a LDR image. The thing is that the HDR image itself is not displayed on the screen; instead the image is used to calculate illumination within the model when rendered. So while a HDRI image can be used in TurboCAD it can actually only be of benefit when used in IBL. Basically the only place HDRI can be used within TurboCAD at this time is in lighting.

Others have asked if HDR images can be used as backgrounds and textures. The basic answer is 'yes' but since there really is no advantage in using an HDRI as a background or a texture it really is not worth doing so. HDRI files are much larger in size than their LDRI counterparts and render speed would slow down considerably. I would recommend only using HDRI files in as illumination and nothing else (at this time anyway).

## New Formats

For IBL to work correctly two new HDRI formats had to be added to TurboCAD. These two new extensions are (\*.exr and \*.hdr). How these two HDRI formats differ from other image formats is that each stores color as a real number and not just a figure between 0 and 255. These format images are larger in size, due to all the added information, but they produce a much greater range of color and when transformed into light it becomes a wider range of luminosity.

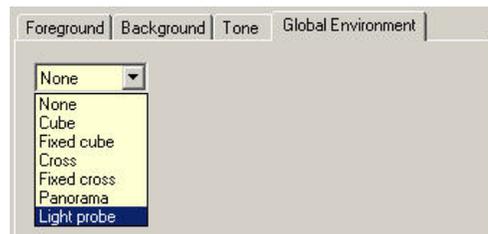
A good place to start in finding images in these new formats would be at: [http://www.lightworks-user.com/hdri\\_starter\\_collection.htm#hdrimaps](http://www.lightworks-user.com/hdri_starter_collection.htm#hdrimaps). You can also find free copies of light probe files throughout the internet. Another place to find light probes and info on them is at: <http://www.debevec.org/Probes/>.

## Global Environment

In Chapter 5 we briefly discussed how the Global Environment tab on the Render Scene Environment Editor worked. It will be discussed a little more in depth here. For Image Based Lighting to work you must have a Global Environment. The Global Environment is actually an HDR image that is used in the lighting of a rendering.

The lighting conditions found in the image are now used in the lighting of the model. With the use of HDR images your rendering will match the lighting conditions found in the HDR image exactly. Because of this, the resultant render will look exceptionally realistic. The lighting effect of the rendered object should be exactly the same as the real life lighting conditions existing at the time the HDR image was taken.

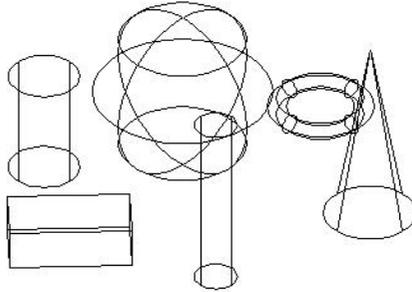
From the drop-down list you can choose one of six different types of images for use with your lighting. These types include: Cube, Fixed Cube, Cross, Fixed Cross, Panorama and Light Probe.



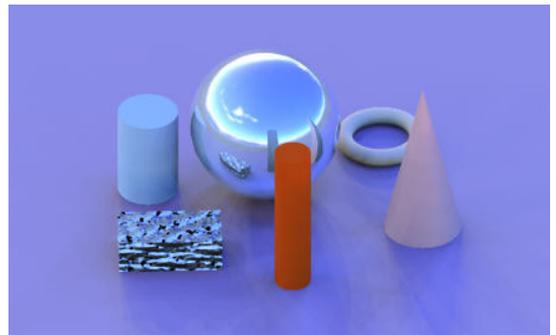
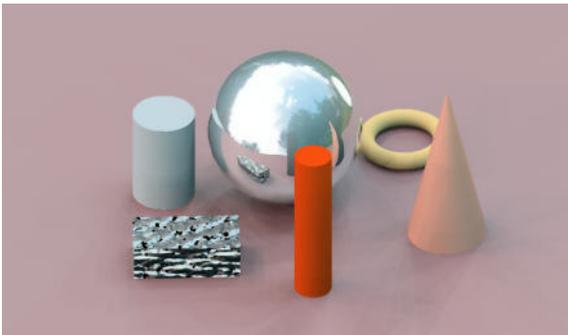
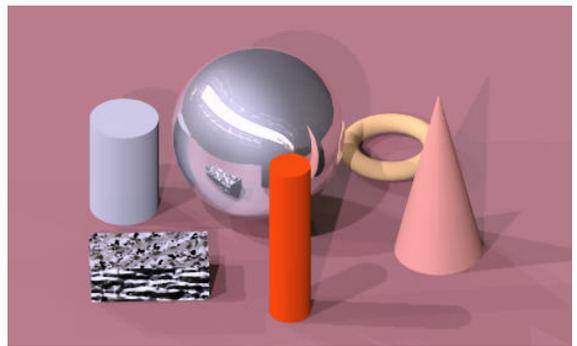
After selecting what type of image to use, you then select the actual image you wish to use from the Open File dialog. Select the file you wish to use and it will now be used in IBL. Either of the two new formats (\*.exr and \*.hdr) can be used. You can actually use other image types (\*.jpg, \*.gif, etc.) but since these images are LDR images they will not create the same lighting effects as the HDR images.

## The Results

So you now know what HDRI and IBL are but how do their images look. Below you see a simple image using several basic 3D objects.



Next you can see four rendered images where four different light probes were used in the lighting of the model. None of the images use even one light to illuminate its rendering. The only source of light is the light probes. You can see by just changing the probe you can get a completely different lighting effect for your renderings.



After you have inserted your light probe you can then manipulate the settings to produce the desired lighting effect. The image below shows the same image above right but with the Tone settings adjusted.



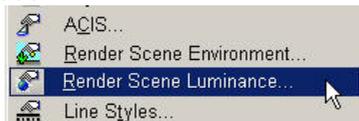
## Tutorial:

This tutorial will show you how to set up TurboCAD so that you can use IBL to illuminate your models.

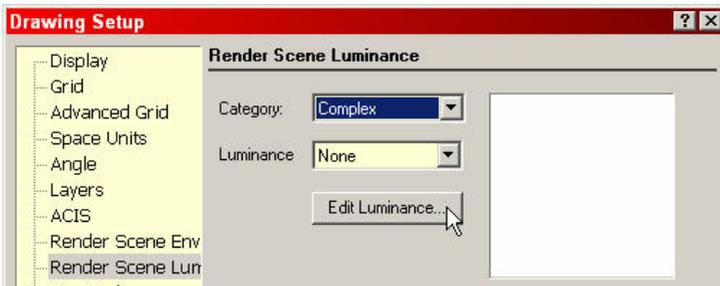
1. This first part is easy; just create a model using any method you like.
2. Add objects to the model. For this tutorial I'm going to use the model shown in the images above. A few basic 3D objects are placed on screen.
3. The next thing you should do is add one light to your drawing. You don't actually use the light but you add one just to make sure that the 'default' lights don't get inserted into the model for rendering. Insert the light but make sure it's 'Off'. If you bypass this procedure then the 'default' lights will be inserted into the model, even if you selected 'No' to the warning message which appears.



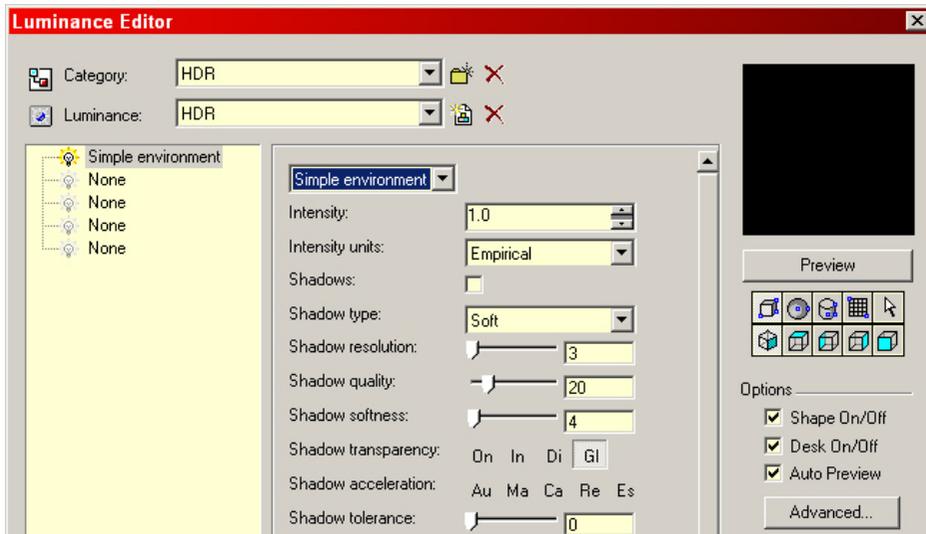
4. The first thing you have to do is create a Global Luminance. You do this through the "Render Scene Luminance". Select Options/Render Scene Luminance from the Menu Bar.



- The Drawing Setup will appear at the Render Scene Luminance tab. Select the 'Edit Luminance' button to access the Luminance Editor.



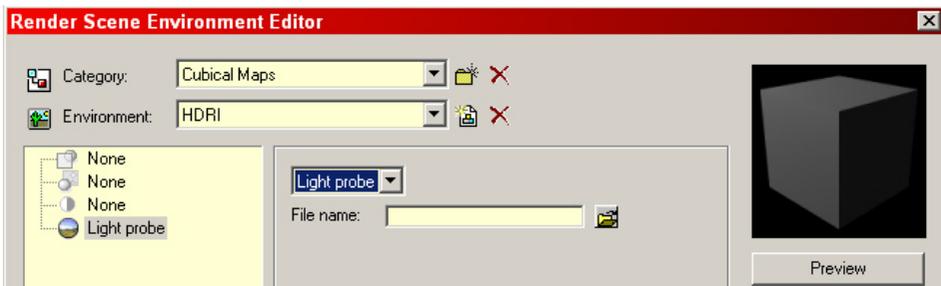
- In TurboCAD v10.2 or v10.5 you can select 'HDR' from the Category drop-down list. 'HDRExample' will appear in the Luminance field. In TurboCAD v11 you can create a new category and Luminance type if you wish. Just make sure you select 'Simple Environment' from the environment list. The Luminance Editor should look like the one shown below. Select OK button on the Luminance Editor and then on the Drawing Setup. If the category and luminance do not exist then you will have to create your own and match the settings shown below.



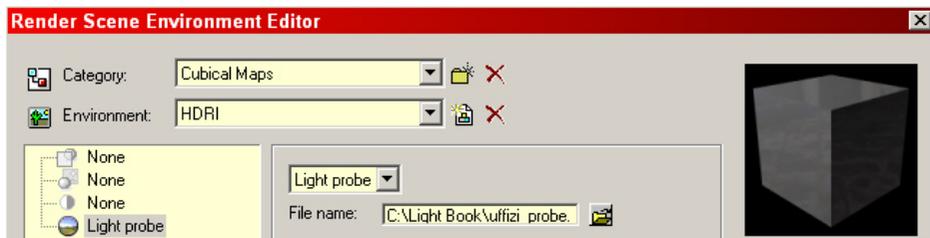
7. The next thing you have to do to get Image Based Lighting to work is to create a Global Environment. Select Options/Render Scene Environment on the Menu Bar. The Drawing Setup dialog will open to the Render Scene Environment tab.
8. Select the 'Edit Environment' button. This will open the Render Scene Environment Editor.
9. Select 'Cubical Maps' from the Category drop-down list.
10. Create a new Environment selecting the 'New' button next to the Environment field.
11. Input "HDRI" into the New Environment dialog and select OK button.



12. Next select the last tab. Select 'Light Probe' from the drop-down list. (or any other one you wish to use). Foreground and Background should be set to 'None'



13. Now select the 'Open File' button next to the File Name field. The Open dialog will appear. Find the \*.hdr or \*.exr file you wish to use as the Global Environment and select OK. This will become the HDRI used in your IBL.



14. You may add a Background if you wish and you may change the Tone settings as well. These settings are explained in full
15. Select 'Raytrace Full' rendering mode and render your model. You should be pleased with the results.

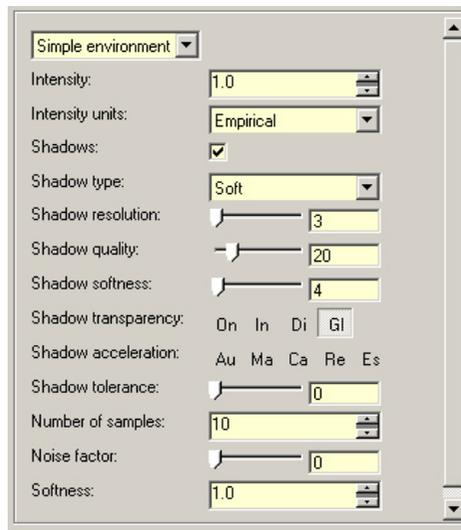
## Shadows and Illumination

Two of the main parts of IBL include shadows and amount of illumination. Both of these effects can be adjusted using settings on the Luminance Editor.

To view shadows with your IBL models you must adjust a few of the shadow settings in the Simple Environment. Open the Luminance Editor. Make sure HDR is selected in the Category field again. Simple Environment will come up again.

The first thing you have to do is make sure that the Shadows checkbox is selected. Also make sure that the Shadow type is set at 'Hard'. The last thing that you should do is set the Shadow Resolution to (0).

Shadow Quality and Shadow Softness work the same as they do with regular lighting. With Shadow Quality the higher the number the higher the amount of pixels used in the shadow, producing a much better quality shadow effect. The Shadow Softness parameter adds a scattering effect to the shadows produced. The lower the value the more scattered the shadow appears. The higher the number, the more defined the shadow appears.



The only other setting which really makes a major change in a model is the Number of Samples field. The higher the number the more parts that the HDRI is broken into, creating more actual light sources.

Below are three images. The first has the Number of Sample set at (10); the second has the Number of Samples set at (40) and the third set at (200). You can see a huge difference in the illumination and shadows of these models. The other thing to realize is rendering speed. The third image took almost thirty times longer to render than the first one.



# Chapter 7

## “Tips And Tricks”

This chapter includes some basic and not so basic “tips and tricks” about lighting that could help almost any TurboCAD user. Some of these tips have to do with actual lighting effects while some deal with improving the TurboCAD interface. While some of these tips may be for very basic lighting effects, they were put together based on the most common questions brought up about lighting in TurboCAD.

Many people just starting out with TurboCAD or at least with 3D do not know even the simplest procedures used in illuminating your 3D models. I believe the most common question concerning lighting in TurboCAD concerns shining light through glass or any transparent material. While the solution is very straightforward if you’re just starting out then there’s no way to know how this can be done.

Probably the best place to get help on TurboCAD is from the IMSI public forums. Many knowledgeable users frequent the forums and answer any and all questions. Many of the tips and tricks mentioned here were first mentioned on those forums and I thank all forum members for producing such an extraordinary environment to help out all TurboCAD users. You can find them at: <http://forums.imsisoft.com/forums/index.cfm?CFApp=200>

## Light through Glass

As I mentioned, I believe that the problem of trying to shine light through an object with a transparent material, has to be the one that is brought up more than any other lighting problem associated with TurboCAD. The first thing new users do is create their new 3D model. They painstakingly work at their model, adding, subtracting and editing it until it is just right. This can sometimes take days or weeks. All the right materials are added to get just that right look. Finally it’s time to add lighting. Along with materials they are probably the two hardest components in TurboCAD.

One of the first things these people will find out is that no matter how hard they try and how many settings they change they just can’t find a way to shine light through a window or any other transparent material. You seem to manipulate every setting associated with Reflectance and Transparency but nothing seems to work.

The image below shows the cover image that was on my 'Mastering TurboCAD v8 3D' book. It shows a building with a window in it. Light is shining through the window producing a shadowing effect on the motorcycle seen outside the building. This can be accomplished pretty simply by just changing the light types you use.



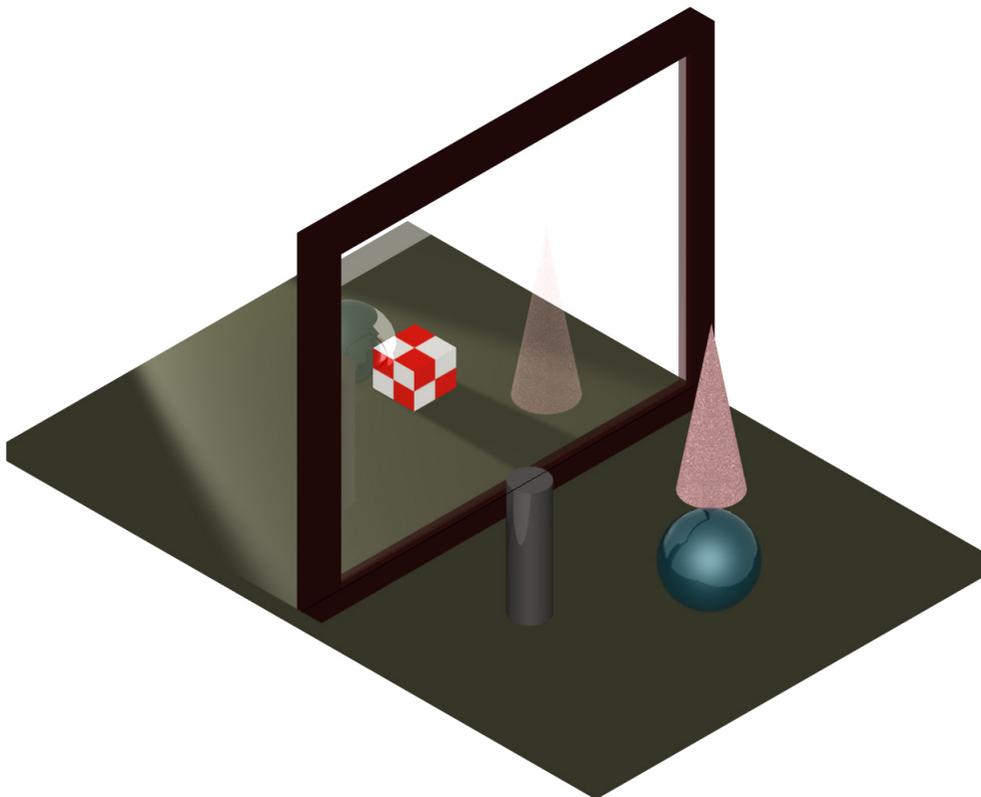
The main reason people can't seem to produce a rendering with light shining through a transparent material is because they are using standard lights. These light types do not produce a lighting effect which shines through glass. While it is possible to create a material which is transparent and will act like a window, there still is no way to formulate a material that will allow light to pass through. Do not be discouraged though because there still is a way to produce this effect. Instead of using Materials you utilize the Luminance features instead.

If you want to shine a light through glass you must use Luminance lighting. Luminance lighting, produced by LightWorks, is the only light type which will shine through transparent materials. Of course, just selecting a Luminance light won't solve your problem either. You have to make sure the right controls are used to get the desired effect.

## Luminance Lighting

While you can not create a material which allows standard lighting to pass through, you can create the effect using Luminance lighting. You can accomplish this feat with the use of the Luminance Editor. Below is a model showing four 3D objects sitting on a base with a pane of glass set near the center of the base.

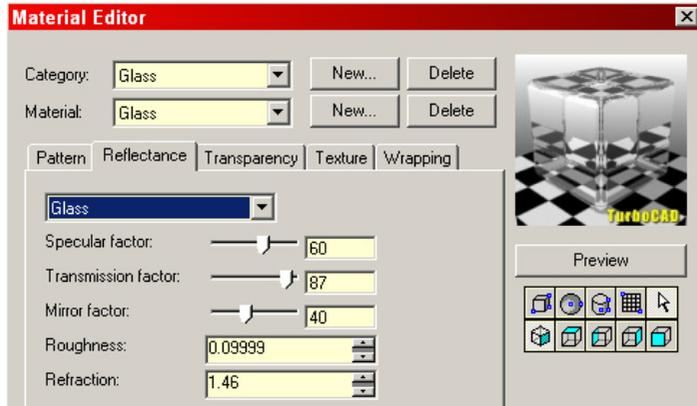
This first example shows a standard Spot light being used behind the glass. No Luminance is used in this example. You can see a small cube producing a shadow from the light but the light does not pass through the glass. Even though the glass is invisible it still will not allow the light through.



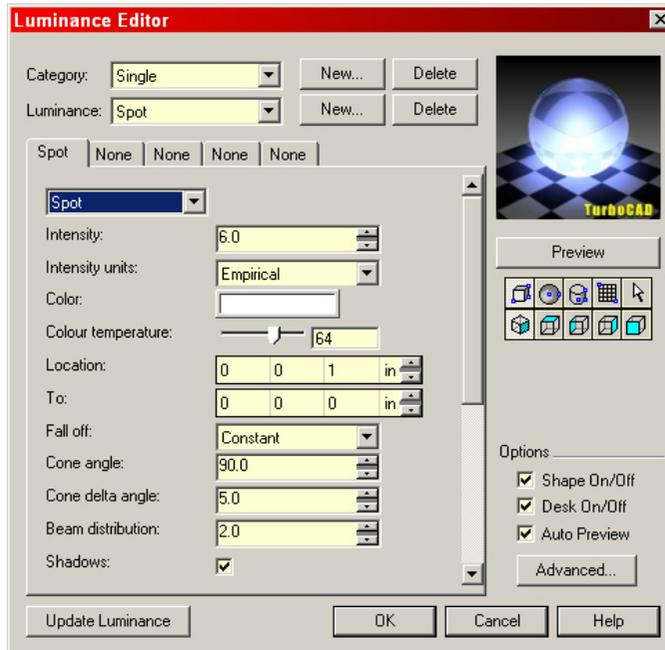
To create an image which produces a rendering which shows light passing through the glass we must use the Luminance Editor.

## Using the Luminance Editor

To produce the desired affect you must first create the 3D object you wish to use as the pane of glass and add a transparent material to it to produce a glass like look. You may choose an exiting Glass material or create a new one.

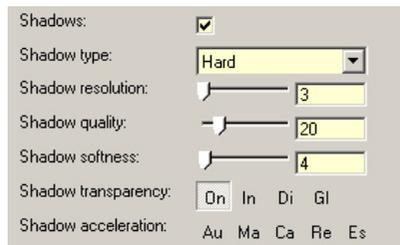


After you add the material to the 3D object you must access the Luminance tab for any object on screen or through the Render Scene Environment dialog.



Once the dialog appears select “Single” from the Category drop-down list, at the top of the page, and “Spot” from the Luminance drop-down list. This will activate a Luminance ‘Spot’ light on screen.

You could use the ‘Spot’ light as is, but it probably still would not shine through the glass. You will need to adjust a few parameters to get the desired effect. First make sure to select the ‘Shadows’ checkbox. If this is not done then no shadows will appear on screen. You might get the light to shine through the glass but you won’t see any shadows. This actually is a good feature as I have found many times where I need a light at a specific spot but I don’t want it really seen. This way you can illuminate an area without getting unwanted shadows.

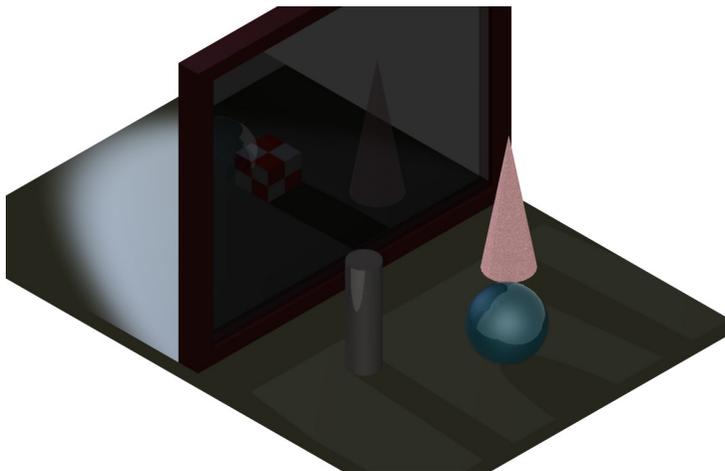
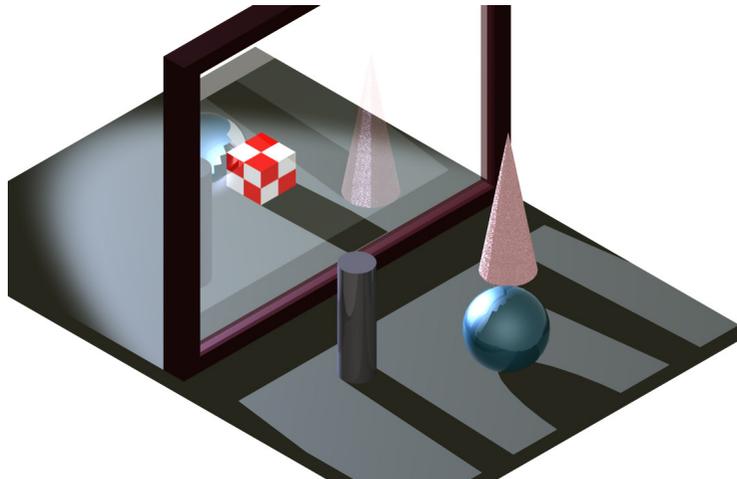
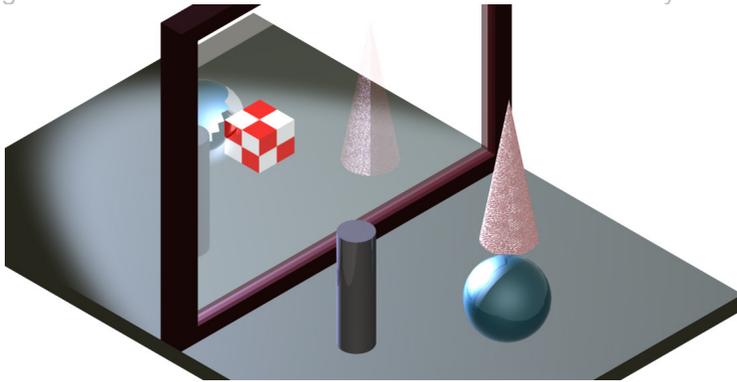


One thing to note is that a Luminance ‘Spot’ light will not produce ‘soft’ lighting. It does produce some sort of hazy lighting effect but it looks so awful that it isn’t even worth trying. I would suggest selecting ‘hard’ and leaving it there. The only Luminance type which produces a good ‘soft’ lighting effect is the ‘Area’ light. This is a LightWorks bug which hopefully will be fixed sometime soon.

The main control you need to select on the Luminance tab is the ‘On’ button in Shadow Transparency. This will finally allow a Luminance light to shine through a transparent material. You will find that the effect is quite good too. If the material is only partially transparent then only a small amount of light will shine through. The more transparent the material is, the more light will shine through.

The one control that you want to make sure that you do NOT have activated is the Global ‘GI’ button in Shadow Transparency. If this control is activated, it will basically de-activate the ‘On’ control. Both the ‘In’ and “Di” controls can be used in conjunction with the ‘On’ control but not the ‘GI’ control.

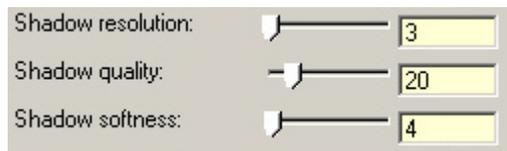
Below you will see three images. The first is a rendering where the ‘Shadows’ checkbox was not selected. The second shows the same rendering but ‘Shadows’ is selected. Finally the third shows the same model with a tinted glass in use. Note the little amount of light let through.



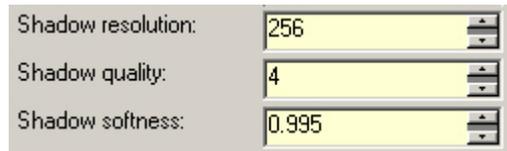
# Luminance Editor Manipulation

This tip was originally posted on the TurboCAD forum by John R. Sollman. John, a master TurboCAD user and beta tester, is extremely knowledgeable in the inner workings of TurboCAD. I thank him for letting me include his tip here. What this tip does is change all the 'slider' controls to 'Integer Bar' (aka Spinners) controls. The advantage of an Integer Bar over a Slider is the precision that can be achieved.

When sliders are used, you can choose a value from (0) to (100) as a value for that control. The image below shows three controls which normally used sliders as the control type. You are limited to only (100) values which you can use in the control.



The Integer Bar control is a much superior control because you are not limited to only (100) values for that parameter. An example of this can easily be seen in the image shown below. The 'Shadow Resolution' control actually can use values from (1) to (8000). Since a Slider control can only accommodate (100) values in its settings, each point is actually (80) on an Integer Bar. You have much more control over the controls this way. You see a value of (256) set below. You could not set a value for that using a Slider control. A value of (3) on a slider would equal to (240) on an Integer Bar. The value (256) would actually be about (3.2) and you can't input a decimal value in a Slider.



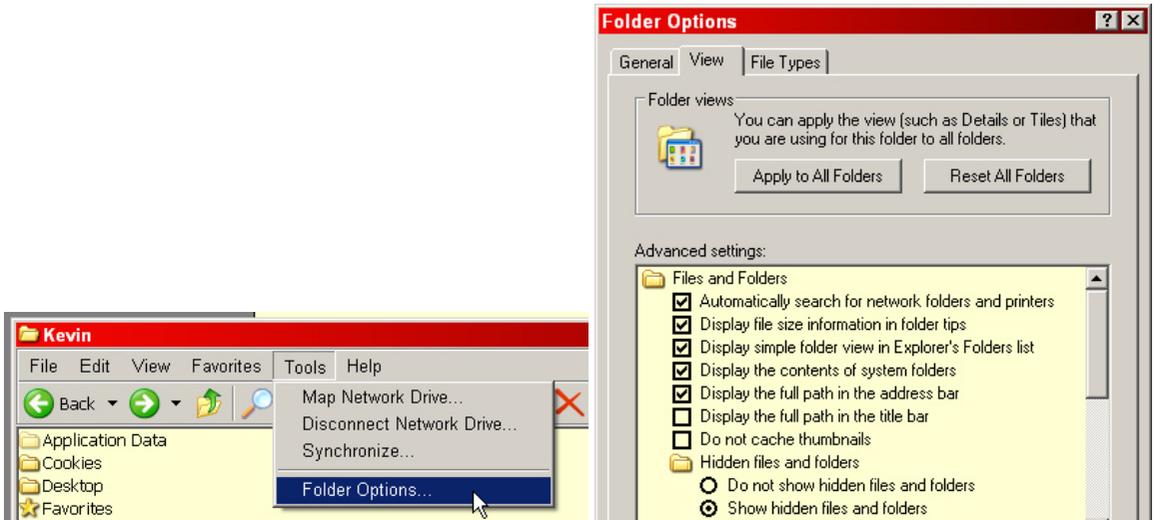
You just have much more flexibility and a higher degree of accuracy using an Integer Bar.

## Changing the Luminance.dat File

Manipulating the Luminance dialog to change the Sliders to Integer Bars is actually rather simple. You only change two types of values within the Luminance.dat file. The file "Luminance.dat" can be found in the TurboCAD 'Setting Files'. These files are normally found under the 'Documents And Settings' folder. The full location of the file can be seen in the image shown below. Before doing anything you should create a backup file of the original Luminance.dat file. Just in case anything goes wrong.



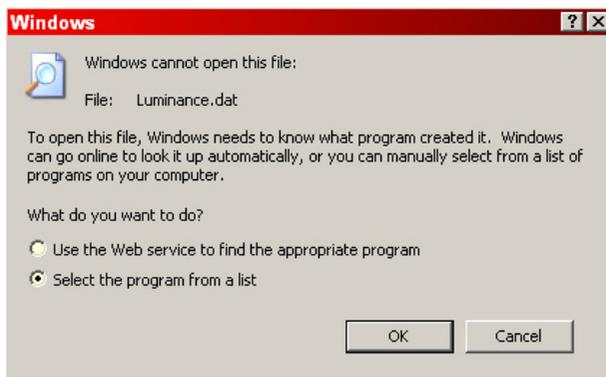
The folder 'Kevin' will be different on your computer. It will be whatever name was given to user of the computer. The above image is for a computer running Windows XP. Earlier versions of Windows may differ slightly. The 'Application Data' folder may be a Hidden Folder. You may have to go into your 'Folder Options' and select the 'Show hidden files and folders' radio button. This will make the folder appear, although faded. You can activate the Folder Options dialog by opening any folder and selecting 'Tools/Folder Options' from the Menu Bar.



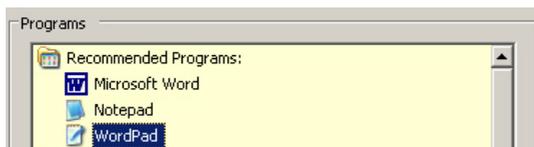
Once you get to the Luminance folder you will see a list of several files. The majority will be image files but there will be a couple of \*.dat files. The file you want is 'Luminance.dat'. You may actually see a file named 'Luminances.dat'. This is not the file you want. Double-click on the Luminance.dat file and a Caution dialog will appear.



Select the 'Open with' button. Another dialog may appear asking how you would like this file to be opened. Select the 'Select the program from a list' radio button and select 'OK'.



The 'Open With' dialog will appear. You can choose from any program which will open a \*.dat file. Programs such as Microsoft Word, Notepad and Wordpad will all work fine. Scroll-down the list and select the program you wish to use. The file will open in that program.



The file will now open in that program. The file will appear as a basic text file. The Luminance light type can be see at the top of each set of controls. The image below shows the controls for a Luminance 'Spot' light. You can see the name just below <shader>. All the controls seen on the Luminance Editor for that light type can be seen in the list below the name.

**Note:** Only Luminances found in the Luminance category will be available in this file. By default, only Spot, Projector and Point are available. To change all the Luminance light types you must first create a new Luminance type for each one and then go into the \*.dat file and change the parameters there.

```

<Luminance>;
Single, Spot, -1;
Lw Version, 7040300;
  <Shader>;
    spot, 8;
  <Properties>;
    intensity, 8, 0, 1e+006, 6;
    intensity units, 11, 0;
    colour, 4, 255, 255, 255;
    colour temperature, 2, 0, 50000, 32000;
    location, 6, 0, 0, 1;
    to, 6, 0, 0, 0;
    fall off, 11, 1;
    cone angle, 8, 0, 179, 90;
    cone delta angle, 8, 0, 89.5, 5;
    beam distribution, 8, 0, 1e+006, 2;
    shadows, 13, 1;
    shadow type, 11, 1;
    shadow resolution, 3, 0, 8000, 256;
    shadow quality, 3, 1, 16, 4;
    shadow softness, 2, 0.1, 20, 0.995;
    shadow transparency, 12, 1;
    shadow acceleration, 12, 0;
    shadow tolerance, 2, 0, 1, 0;
    scattering, 13, 1;
    forwards, 13, 0;
  <EndProperties>;

```

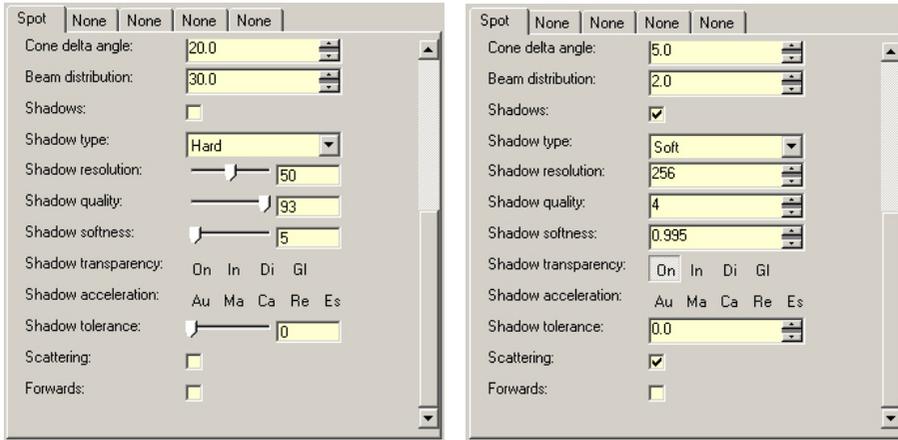
What you must do to change Slider controls to Integer Bar controls is change all the controls which start with the number (2) or (3). In the list above you can see that 'colour temperature', 'shadow softness' and 'shadow tolerance' all start with (2) and 'shadow resolution' and 'shadow quality' both start with (3). What you need to do is change the 2's to (8) and the 3's to (9). An edited list can be seen below. Save the file and start TurboCAD.

```

<Luminance>;
Single, Spot, -1;
Lw Version, 7040300;
  <shader>;
    spot, 8;
  <Properties>;
    intensity, 8, 0, 1e+006, 6;
    intensity units, 11, 0;
    colour, 4, 255, 255, 255;
    colour temperature, (8), 0, 50000, 32000;
    location, 6, 0, 0, 1;
    to, 6, 0, 0, 0;
    fall off, 11, 1;
    cone angle, 8, 0, 179, 90;
    cone delta angle, 8, 0, 89.5, 5;
    beam distribution, 8, 0, 1e+006, 2;
    shadows, 13, 1;
    shadow type, 11, 1;
    shadow resolution, (9) 0, 8000, 256;
    shadow quality, (9) 1, 16, 4;
    shadow softness, (8) 0.1, 20, 0.995;
    shadow transparency, 12, 1;
    shadow acceleration, 12, 0;
    shadow tolerance, (8) 0, 1, 0;
    scattering, 13, 1;
    forwards, 13, 0;
  <EndProperties>;

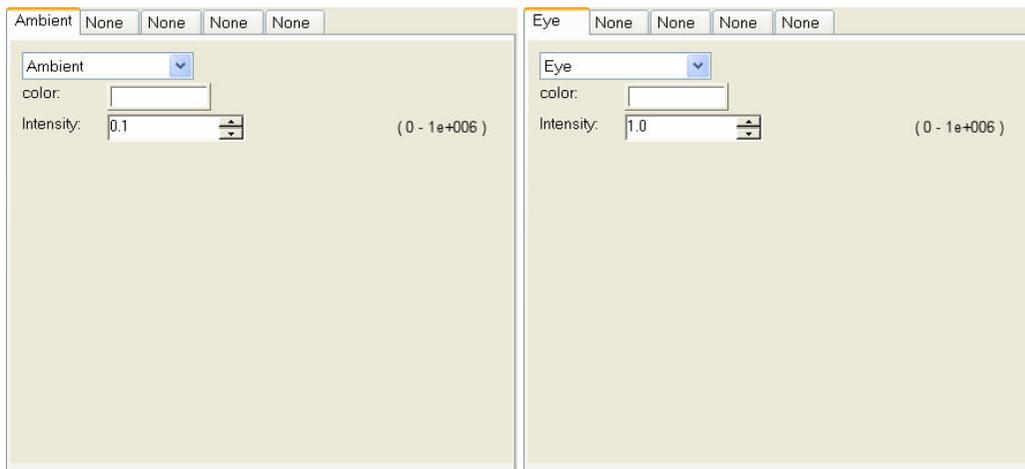
```

This editing will change all Sliders to Integer Bars. This will only work in TurboCAD v10 or v11. In v9 changing a (3) to a (9) will cause an error although changing a (2) to an (8) will work. Below you can see how the controls of a 'Spot' light have been adjusted.



## Luminance Editor Control Values

Another aspect of Luminance manipulation concerns the control values themselves. Many people have no idea what to input into some of the control fields. The images below will help you in manipulating your renderings. Each Luminance light dialog is shown below. Beside each control, which enables a numerical value, are the minimum and maximum values for that control. The images show the dialogs using the edited Integer Bars. Images courtesy of John R. Sollman. All dialogs are shown in TurboCAD v10 mode. All settings are the same for TurboCAD v11.



Distant None None None None

Distant

Intensity: 1.0 (0 - 1e+006)

Intensity units: Empirical

Color:

Colour temperature: 0.0 (0 - 50,000)

Location: 0 0 1 in

To: 0 0 0 in

Shadows:

Shadow type: Soft

Shadow resolution: 256 (0 - 8,000)

Shadow quality: 4 (1 - 16)

Shadow softness: 0.995 (0.1 - 20)

Shadow transparency: On In Di **Gl**

Shadow acceleration: Au M... Ca Re Es

Shadow tolerance: 0.0 (0 - 1)

Scattering:

Point None None None None

Point

Intensity: 1.0 (0 - 1e+006)

Intensity units: Empirical

Color:

Colour temperature: 0.0 (0 - 50,000)

Location: 0 0 0 in

Fall off: Inverse no clar

Shadows:

Shadow type: Soft

Shadow resolution: 256 (0 - 8,000)

Shadow quality: 4 (1 - 16)

Shadow softness: 0.999 (0.1 - 20)

Shadow transparency: On In Di **Gl**

Shadow acceleration: Au M... Ca Re Es

Shadow tolerance: 0.0 (0 - 1)

Scattering:

Forwards:

Simple environment None None None None

Simple environment

Intensity: 1.0 (0 - 1e+006)

Intensity units: Empirical

Shadows:

Shadow type: Hard

Shadow resolution: 256 (0 - 8,000)

Shadow quality: 4 (1 - 16)

Shadow softness: 0.995 (0.1 - 20)

Shadow transparency: On In Di **Gl**

Shadow acceleration: Au M... Ca Re Es

Shadow tolerance: 0.0 (0 - 1)

Number of samples: 10 (1 - 8,000)

Noise factor: 0.0 (0 - 1)

Softness: 1.0 (0 - 1e+006)

Simple sky None None None None

Simple sky

Intensity: 1.0 (0 - 1e+006)

Intensity units: Empirical

Color:

Colour temperature: 0.0 (0 - 50,000)

Shadows:

Shadow type: Hard

Shadow resolution: 256 (0 - 8,000)

Shadow quality: 4 (1 - 16)

Shadow softness: 0.995 (0.1 - 20)

Shadow transparency: On In Di **Gl**

Shadow acceleration: Au M... Ca Re Es

Shadow tolerance: 0.0 (0 - 1)

Noise factor: 0.0 (0 - 1)

Up: 0 0 1 in

number of samples: 10 (1 - 8,000)

Area	None	None	None	None
Area	▼			
Intensity:	1.0	▲▼	(0 - 1e+006)	
Intensity units:	Empirical	▼		
Color:	[Color Picker]			
Colour temperature:	0.0	▲▼	(0 - 50,000)	
Fall off:	Isl no clamp	▼		
Shadows:	<input type="checkbox"/>			
Shadow type:	Soft	▼		
Shadow resolution:	256	▲▼	(0 - 8,000)	
Shadow quality:	9	▲▼	(1 - 16)	
Shadow softness:	0.995	▲▼	(0.1 - 20)	
Shadow transparency:	On In Di	GI		
Shadow acceleration:	Au M... Ca Re Es			
Shadow tolerance:	0.0	▲▼	(0 - 1)	
Min lod:	0.0	▲▼	(0 - 1e+006)	
Max lod:	1.0	▲▼	(0 - 1e+006)	
Error bound:	0.2	▲▼	(0 - 1e+006)	
Noise factor:	0.0	▲▼	(0 - 1)	
Colour filtering:	<input type="checkbox"/>			
Scattering:	<input type="checkbox"/>			
Forwards:	<input type="checkbox"/>			

Goniometric	None	None	None	None
Goniometric	▼			
Intensity:	1.0	▲▼	(0 - 1e+006)	
Intensity units:	Empirical	▼		
Color:	[Color Picker]			
Colour temperature:	0.0	▲▼	(0 - 50,000)	
Location:	0	0	1	in ▲▼
To:	0	0	0	in ▲▼
Equator zero:	1	0	1	in ▲▼
Fall off:	Constant	▼		
Shadows:	<input type="checkbox"/>			
Shadow type:	Soft	▼		
Shadow resolution:	256	▲▼	(0 - 8,000)	
Shadow quality:	4	▲▼	(1 - 16)	
Shadow softness:	0.995	▲▼	(0.1 - 20)	
Shadow transparency:	On In Di	GI		
Shadow acceleration:	Au M... Ca Re Es			
Shadow tolerance:	0.0	▲▼	(0 - 1)	
File name:	[Text Field]			
Power from file:	0.0	▲▼	(0 - 1e+006)	
Scattering:	<input type="checkbox"/>			
Forwards:	<input type="checkbox"/>			

Projector

Projector

Intensity:  ( 0 - 1e+006 )

Intensity units:

Color:

Colour temperature:  ( 0 - 50,000 )

Location:    in

To:    in

Up:    in

Angle:  ( 0 - 179 )

File name:

Softness:  ( 0 - 1,000 )

Fall off:

Shadows:

Shadow type:

Shadow resolution:  ( 0 - 8,000 )

Shadow quality:  ( 1 - 16 )

Shadow softness:  ( 0.1 - 20 )

Shadow transparency:

Shadow acceleration:

Shadow tolerance:  ( 0 - 1 )

Scattering:

Forwards:

Sky

Sky

Intensity:  ( 0 - 1e+006 )

Intensity units:

Color:

Colour temperature:  ( 0 - 50,000 )

Min lod:  ( 1 - 1e+006 )

Max lod:  ( 1 - 1e+006 )

Error bound:  ( 1 - 1e+006 )

Noise factor:  ( 0 - 1 )

Shadows:

Shadow transparency:

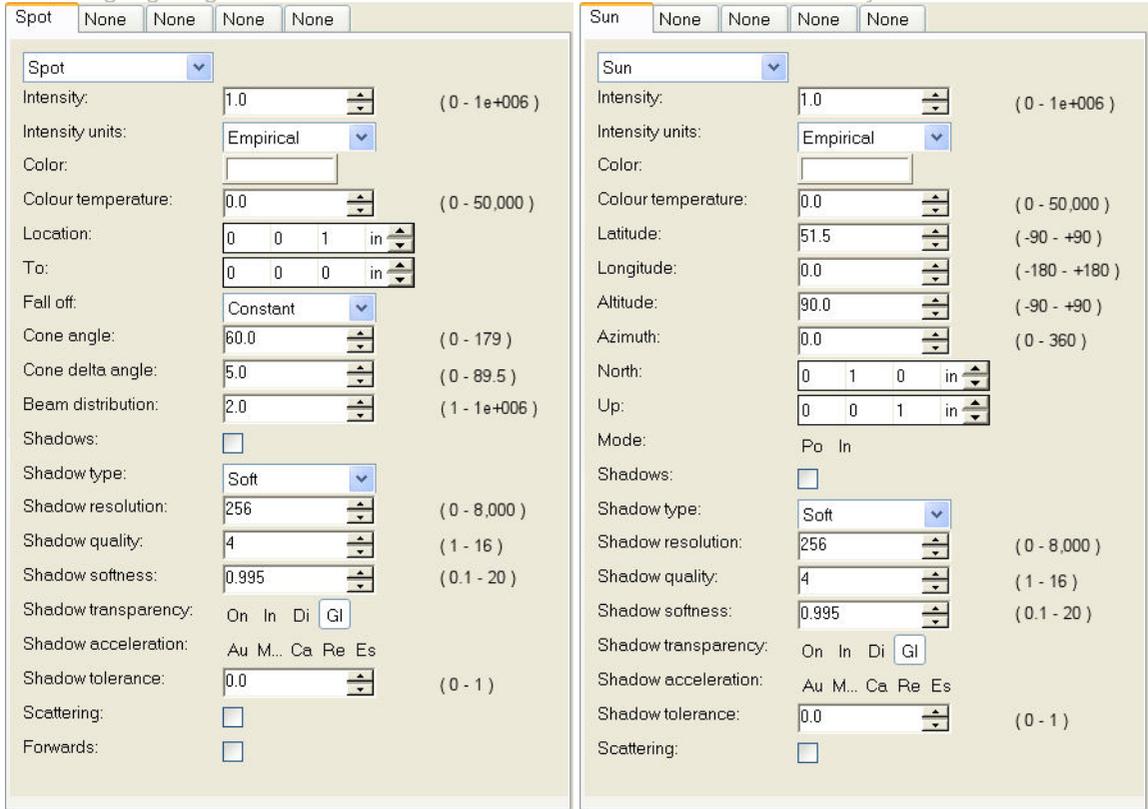
Sun altitude:  ( 0 - 90 )

Sun azimuth:  ( 0 - 360 )

Type:

North:    in

Up:    in



## Standard Lighting Control Values

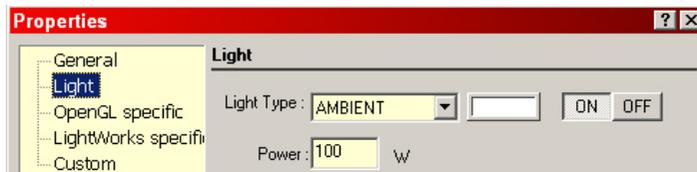
Below you will see the standard lighting ‘LightWorks Specific’ dialog. While the settings on this dialog do work, the values stated next to both the Quality control and the Softness control are wrong. I have indicated the correct values to the right of each control field. For a better explanation of these controls and how to use them please see “Using the Shadow Settings” in Chapter 2.



## Enabling the 'Power' Setting (v9 only)

This tip only works with TurboCAD v9. The \*.ini file was changed in TurboCAD v11 and does not allow this manipulation.

You should know by now that the 'Power' control used with basic lighting has no effect unless used when rendering in Radiosity mode.



It was found that in TurboCAD v9 it became possible to change this. Double-click on the tcw90.ini found in the Program folder of the TurboCAD v9 directory. It should open in Notepad. On the Menu Bar select 'Edit/Replace'. The Replace dialog will appear. Input 'LIGHT\_POWER\_ENABLE=0' into the 'Find What' field and LIGHT\_POWER\_ENABLE=1 into the 'Replace With' field. Select the 'Replace' button. Save the file and restart TurboCAD v9.



Now TurboCAD v9 will take both the Power setting and light color into consideration when rendering in a mode other than Radiosity.

## Area Lighting Effects

Area lighting is a very basic light source but can produce some dramatic lighting effects. Two of those include lighting up an entire room and the other is creating a neon or fluorescent lighting effect. The light is used in exactly the same way; the only difference is the distance the source object is away from what is illuminating.

Lighting Up A Room – It's very simple to light up a room (or area) using an Area light source. In the image shown below only one Area light was used to illuminate the room. The Area light was attached to the ceiling. With it's large area it easily illuminates the entire room.

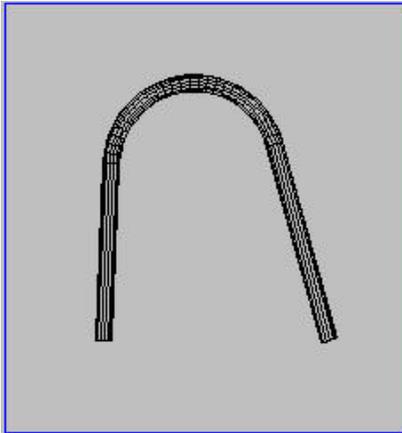


Turning 'off' shadows will really give a realistic effect. The room will light up without shadows. You can then place other lights to get your shadow effects.

Neon – Many people have asked if there is a way to produce a neon or fluorescent light effect using standard or luminance lighting. The quick answer is 'yes' but it's not that easy. I have found that using an 'Area' light you can accomplish such a result if done correctly. You use it the same as you do when illuminating a room but you place the source object right next to the object it is to illuminate. It's that easy.

Usually an 'Area' light produces a circular light shining towards the UCS workplane of that object. There is a way to change the effect though using a tubular object. But even using a basic Cylinder or Extruded object won't work correctly. The best way I found to produce such an effect was to first use a polyline and create a basic 2D representation of the object. Next use the 'Pipe' tool to turn the 2D polyline into a 3D pipe. You then add an 'Area' light to the 'pipe'.

Below you can see the results. The image to the left shows a wireframe image of a 3D pipe. The image to the right shows the same image with an 'Area' light attached to it. The color has been changed to red and a pipe itself has had a red material added to it which uses a 'constant' reflectance.



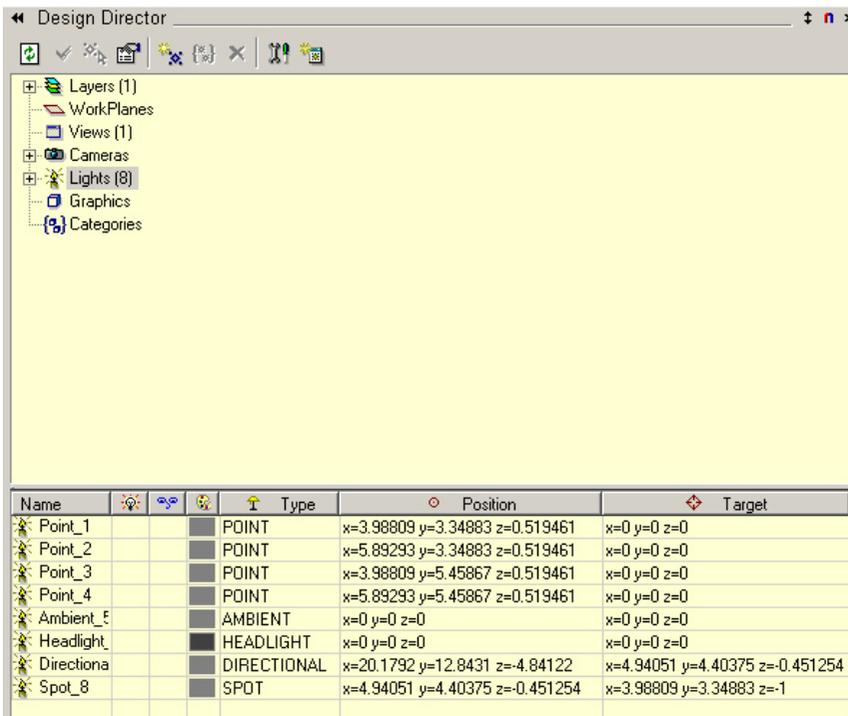
The tube is placed just above a plain (box). A 'Mostly Clear Glass' material was added to the tube as well. The only problem with this method is that rendering times can be very lengthy. Any time Area lighting is used with objects with curved surfaces you will see rendering times slow considerably.

# Design Director: Lights

Another aspect of TurboCAD which might help you out with you lighting in TurboCAD is the use of the Design Director. The Design Director is a palette which was created to help out with many functions associated with layers, workplanes, lights, etc.

With the Design Director you can: add and manipulate Layers, change workplanes, change views or add and edit Lights. Though it does show lights that are in a model it does not show Luminance lights, only standard lights. This is still a big help. With the help of the Design Director you can add or delete lights, turn them on or off, make them visible or invisible, change the lights color, change the light type, the position of the light or the target position which the light is to shine too.

The image below shows the Design Director with Lights selected.



# Design Director Palette

The Design Director palette is divided into three sections. They include the Options toolbar, upper Display window and the lower Data window. Each serves a different purpose when dealing with 3D design. You can activate the Design Center palette from View/Design Center on the Menu Bar.

## Options Toolbar

Nine option buttons are available with the Design Director palette.

**Refresh**  – This option allows the user to refresh the information found within the Design Director.

**Activate Selected Object**  – Activates the selected objects properties in the program.

**Select By**  – You use this option to select objects on screen by specified parameters found in the Lower Data windows. Example: Select a Layer name from the Lower Data window and then select the “Select By” button. All objects found on that layer will become selected.

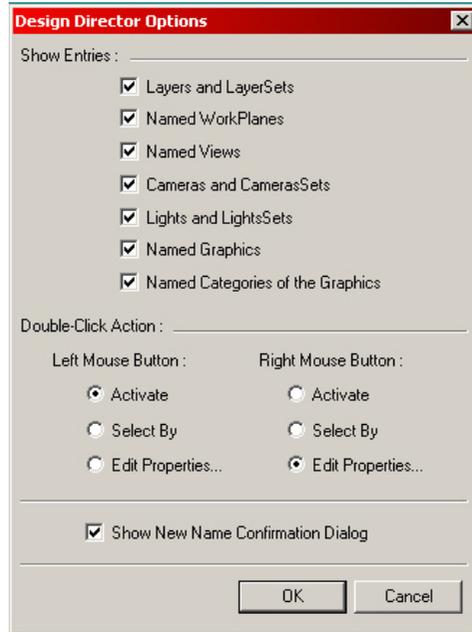
**Edit Object Property**  – This option opens the Properties dialog for the selected items.

**Add New**  – This option allows the user to add a new component to the selected section of the Display window. Example: if you have Layers selected in the Upper Display window and you select the “Add New” option, a new layer will be added to the Layers table.

**Create Set From Selection**  – This option works with the Layer category of the Upper Display window. Selecting this option creates a Layer set from the selected 3D objects.

**Delete Selected Object**  – This option can be used to delete a selected parameter from the Lower Data window.

**Design Director Options**  – This option opens the Design Director Options dialog. This dialog gives the user the ability to select certain features found on the dialog.



**Show Entries** – This section allows the user to check off which fields they wish to view in the Lower Data window of the Design Director palette.

**Double-Click Action** – This option allows the user to determine what action will be activated by double-clicking on the mouse.

**Open As A Separate Palette**  – Opens the selected topic in a separate palette

## Upper Display Window

The Upper Display Window of the Design Director palette shows several property aspects of the selected objects. The parts of the design you can choose to work with are: Workplanes, Views, Layers, Cameras, Lights and Categories. You can open each category into each of its sub-categories where the data associated with each one displayed in the Lower Data window.

## Lower Data Window

Selecting any of the choices found in the upper window will open a table of parameters in the Lower Data Window. With the use of these parameters you may change many aspects of your TurboCAD designs directly through the palette, saving a lot of time and effort.

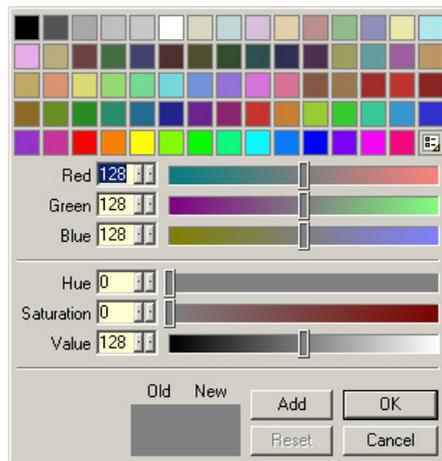
This use of the Design Director can be much more efficient than the standard Lights dialogs. When selecting Lights in the Upper Display window, you will see various controls available for Lights in the Lower Display window. This makes using the Design Director to manipulate light much better than through the standard method. You would have to access several dialogs to manipulate the same controls that you can on this one palette. The first part of the lower window is basically the same as the standard Light Properties dialog.

**Light Name** – This is the name given to a specific light. Use the default name or create a new one yourself.

**ON/OFF**  – The first column on the dialog turns the selected light source on and off. When the light is present the light source is active and present on the model. When no light is present, the light source is inactive.

**Visible/Invisible**  – When the option is selected for a specific light source, the actual light position (in space) is shown on screen. Each light source has its own graphic for the light it represents. When this feature is selected each light source location can actually be manipulated by its X, Y and Z axes as with any other 3D object. When this feature is not selected the light source cannot be seen on screen.

**Color** – This column specifies the actual color of light be created by the light source selected. You may change the color of the light color by left-clicking on the color control. The Color dialog will appear from which you may choose a color of your choice.



**Type** – This column lets you choose which light type you wish to use (point, directional, ambient, headlight, spot or sky). After you have chosen which type to use, you may change its settings from the properties of the light source within its light parameters.

The next two controls on this palette are the same two that can be seen on the Properties dialog for a given light.

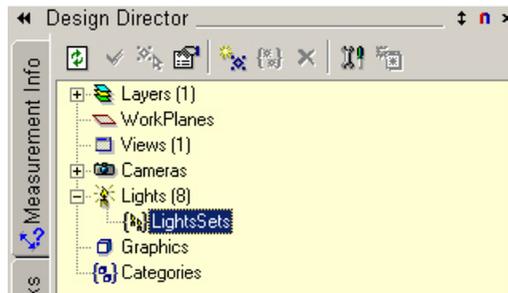
**Position** – This field allows you to input the X, Y and Z coordinate location of the light in Model Space.

**Target** – The Target control is actually the same as the ‘Direction’ control on the Light tab of a lights Properties dialog. You can input the direction the light source is pointing to, in model space, according to the dX, dY and dZ coordinate locations.

## Light Sets

A light set is simply, a group of lights. What’s good about creating light sets is that you can manipulate every light in the group with just one control. An example of this would be having three Spot lights all in one set. By having them as a set you could turn on or off the set all at once, you could make them all visible or invisible all at once or even change the parameters for each one of the lights all at the same time.

You can create Light Sets through the Design Director. Opening the Director you will see the Lights category. Opening that category and you will see the Light Sets sub-category.



To create a light set you:

1. Select 'Lights' from the upper display window of the Design Director.
2. In the lower data window, select the lights you want to include in your camera set.
3. Select 'Create Set' in the Design Director Options toolbar or from the local menu.
4. The 'Lights Sets' dialog will appear. Input the name you would like to call your light set into the Name field.



5. Next, select 'Light Sets' in the upper display window in order to view the light sets available. Each light in the set will be seen in the lower data window.
6. Manipulate any properties you wish and have them affect every light in the set.

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