RedSdk Materials

(LightWorks functionality is available with Only with the LightWorks Plug-in)
Available in TurboCAD Pro, Platinum and Deluxe only

By applying materials to a 3D object, you can obtain a more realistic view of the model during a render. An object's materials can be seen in **Quality and Advanced** render mode, and in certain types of **Draft** rendering. Several materials and categories are provided by default. You can create a new material via the **Render Manager**

A quick note about the Differences between LightWorks and RedSDK materials

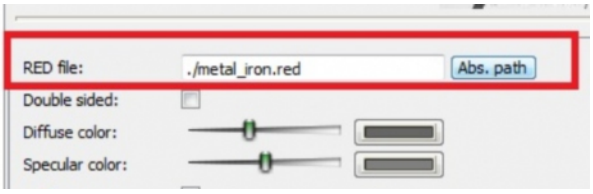
Whilst the representation, storage structures and all other elements are identical for LightWorks and RedSDK Luminances, Environments and Render Styles. There are a number of differences, which are described in more detail below:

- All information about LightWorks materials is stored in a special text file. Before the rendering process initiate a special code appends the LightWorks material definition into this text file. All information about the RedSDK materials is stored in *.RED files, and only a few special master properties are available for user to change. Therefore, RedSDK material stored in TurboCAD, are held as small text file, which contains the file path to the corresponding RED file. Without *.RED file materials will not work in RedSDK.
- In the case of LightWorks if a shader has a texture, the text representation of this shader contains only the file path to the image file. Only immediately before the rendering process is the image file loaded. In the case of RedSDK the RED file contains not only path to the texture, but the embedded image file itself. the path to the image file may not be valid, but the loaded texture inside RED file is always valid.
- RED files can be stored by the following paths:
    - Path to *propin.dat* (*Luminance.dat*, *sceneenv.dat* or *RenderStyles.dat*) / *RedSDK*
    - Path to *Default.dat / RedSDK (for materials, luminances, environments or render styles)*
    - Near active drawing file

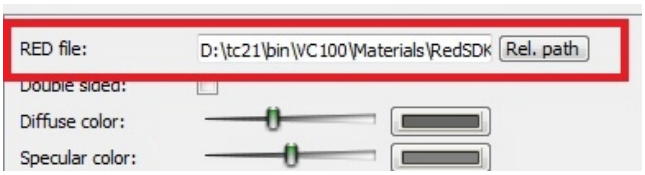
In all these cases a relative path to the RED file will be used. A user can use any other custom RED file, however, In this case, an absolute path will be used.

- When a user deletes a material, the text representation of the material also is deleted. In the case of the RedSDK material the *.RED file also is deleted except in cases when the RED file was custom or default (I.e. installed together with TurboCAD). In the case of a custom file you cannot delete the *.RED file because you did not create it.
- A user can create a new RedSDK material in two main ways.
  Create from a custom RED file.
  Create it from a special copy of the default RED file. Therefore, when the first new material is created in the Render Manager a new *.RED file is created as a copy of the default RED file.
- In the case of LightWorks, a text representation of the material is included in the *.tcw file. That is why it is possible to send just a *.tcw file to another user and that user will be able to reproduce a render.
- As mentioned, in the case of RedSDK for the *.RED file in needed for rendering. That is why it is necessary to use the e-pack functionality in the case of exchanging files that depend upon RedSDK.

There is a RedSDK material specific UI control which displays the path to the *.RED.



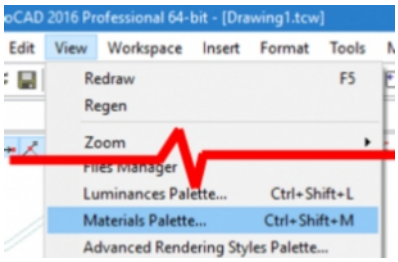
This control is used for these cases:
When the RedSDK material contains relative path to the *.RED file. Pressing the **Abs. path** button user can see the absolute path which is used for loading of the RED file.
By pressing the **Rel. path** button the user can return to the state where the relative path is displayed.

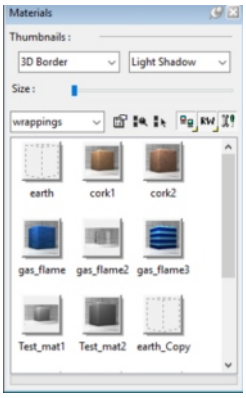


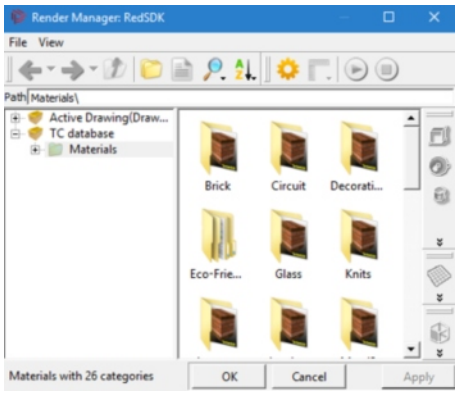
RedSdk Materials.

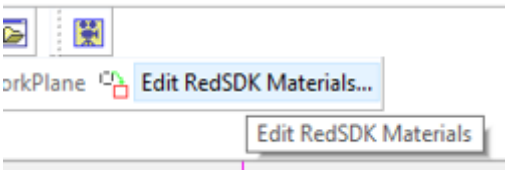
First an important difference between Lightworks and RedSdk, RedSdk is a lot less controllable as far as individual aspects of a material are concerned, using wood floor as an example, with Lightworks whilst it wasn't perfect, one could alter the board length, width, colour, gaps etc, with RedSdk its a fixed jpg image, no adjustment can be done in the program apart from scale, which when scaled quite large looks awful, therefore it is important to prepare the texture image in a paint program if non standard picture of size is required.

Materials can be accessed via a number of ways, the access path can change due to which workspace one has loaded, (in options - toolbars & Menus - options tab), and can also vary from TC versions,

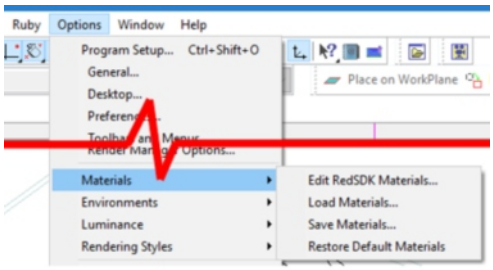






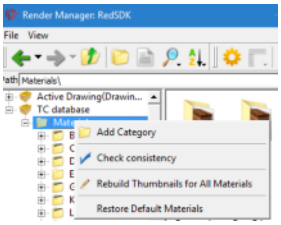


Materials palette



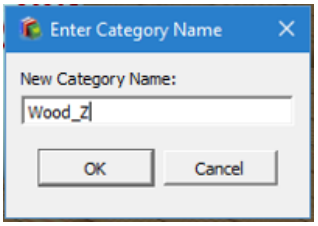
Using existing materials, this is the same as using Lightworks, and there are a few ways to access them, just a few are listed here.
1). Open the material palette and select a material to use, drag it onto the object or onto a facet (with drag on facet ticked).
2). Right click the object and choose properties - Materials, and use the drop down boxes to select the required material.
3). Select the object, Use the selection palette to expand 3D / materials select the required material.

Creating New RedSdk Materials,



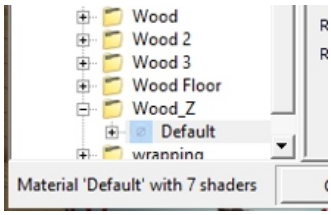
Unlike Lightworks from the past, RedSdk materials cannot be created from the materials property page, to create a new material one uses the Render Manager, accessed from the options menu or as I do from a custom toolbar

The first thing to decide is whether to use an existing category or create a new one, in this example we will create a new one as editing after that is the same as using existing,

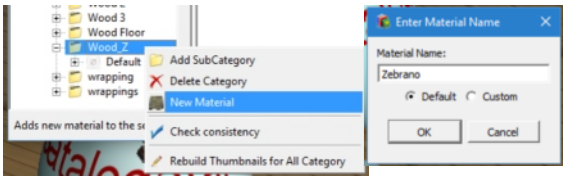


A Category is simply a folder which houses materials of a similar type for easier navigation, To create a category, expand the categories by clicking the '+' next to materials, Right click on the word Materials and in the dialog choose 'Add Category'.

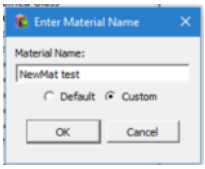
in the next box Type in your desired unique name and click OK, this will insert the category into the list and will normally open it at a default material. From here we can start to add our own material.



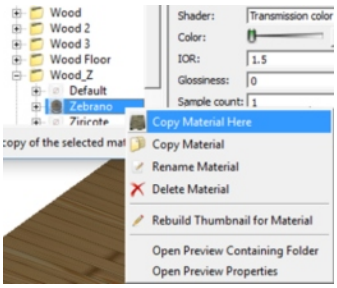
There are at least a couple of ways to add new materials.

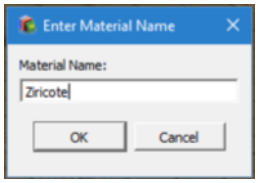


The first way to add a default new material to a category (the new category in this case), right click the category name and in the dialog select new material, a box for the name will appear, type in a name, leave the radio button set at default, clicking OK will add the new material.



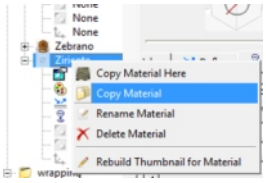
The other radio button in the New Material Name box is at present of little use to us TC users, selecting the custom radio button and clicking OK brings up the normal Windows find fil dialog, its purpose is to create a material from an existing .RED file, but at present few people will have access to new .red files.





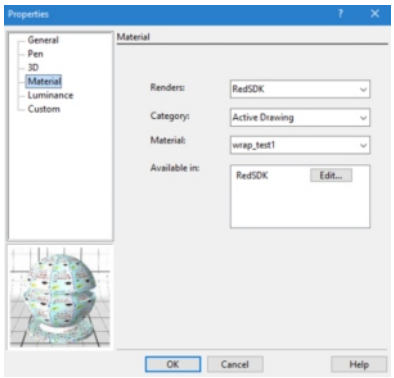
The next way is to copy an existing material which will pass all the settings from one material to a new one, in this instance we right click on material name not the category, in the drop down box select Copy Material Here.

In the dialog box, type in the desired name and click OK, this will add the new material and pre-fill in the settings, however its highly unlike it you would want exactly the same setting, so they can be customised as described later.



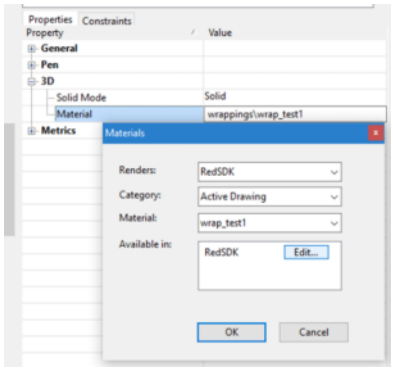
The other copy mode is simply copy material, this will copy a material to the computer windows clipboard, if one then right clicks another category, a paste option will be available, this is useful if a material is in the wrong category or simple cleaning up, but shouldn't be normally necessary as one can chose the right place from the start, one useful function of it is if one receives files from others and wish to organise the materials to your liking..

Editing materials



There are various ways to edit RedSdk materials which changed in 2016, global materials should be altered in the Render Manager accessed from the options menu (or custom toolbar), the reason for this is that when applying materials they are now copied into what is called an 'Active Drawing' category, these are edited independently of the main material and the settings saved in the drawing, there are options to get round this which will be touched on later.

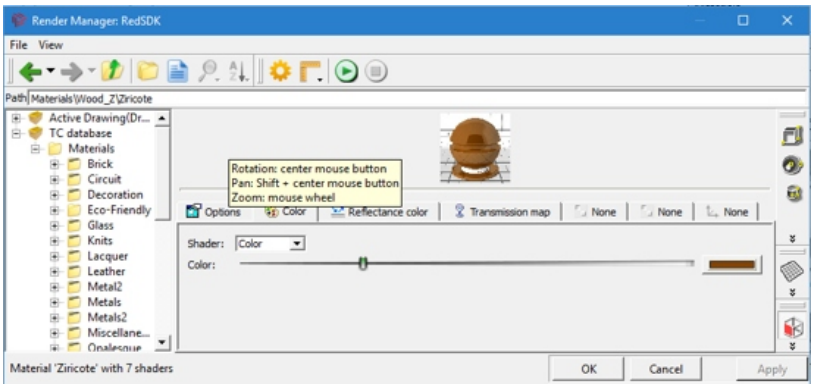
One method of editing is the Render manager discussed in 'Creating a Material' above, or, via the objects property dialog, either right click the object select Materials in the dialog locate the desired material in the drop down boxes and click the 'Edit' button, or via the Selection Palette.



Whichever method is used one is presented with seven selections (as from 2015 only - earlier versions had 5 options),

For this example we will enter using the Options - Materials - edit RedSdk Material

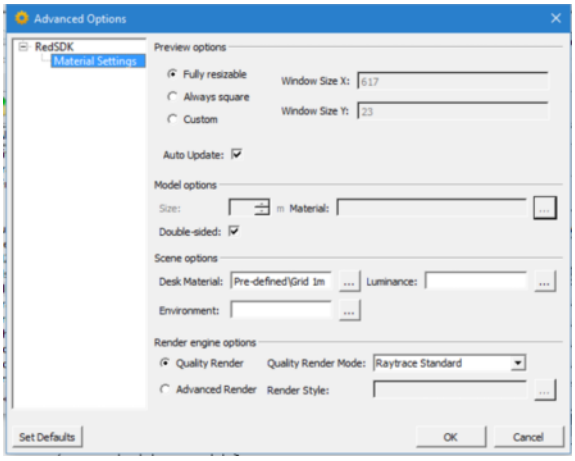
In the dialog the there are three main areas (not counting the toolbars), these are a preview image, a navigation area, and the Edit area, note - the actual layout will vary. As can be see in the image below in the navigation area are the materials, and a part called 'Active Drawing', Previously it was mentioned about 'Copy Materials' which copies to clipboard, if one copies a material and pastes it into the Active Drawing, it will then be editable via the objects properties and be independent of the original material.



At the top are a number of buttons, Hovering over will reveal their use, the two most important ones are -

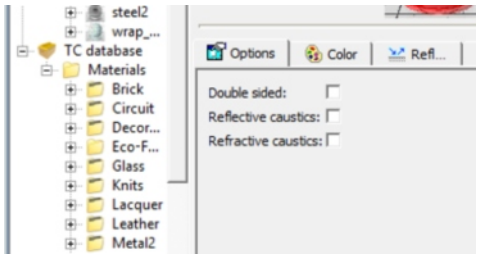
Tree View - if this is turned off the left navigation pane hides leaving either thumbnails or details, one can navigate using the toolbar arrows and by double clicking a category or material to get further options.

Options - This dialog lets one customise how the preview will appear, and I would suggest taking a look at it, as if one has no environment nor luminance's in the drawing it can give a false appearance of how the material will look, the settings I use are shown in the picture.



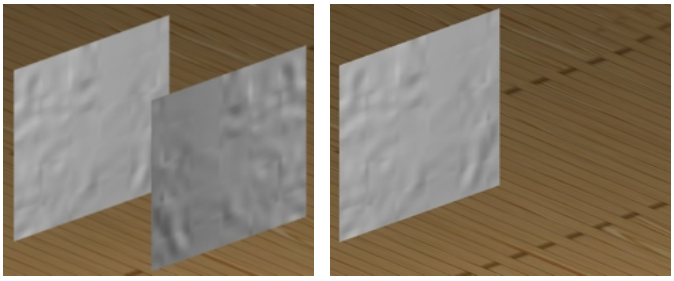
The environment and luminance drop down boxes have been changed to none, these settings are purely personal, every one will have their own favourite settings.

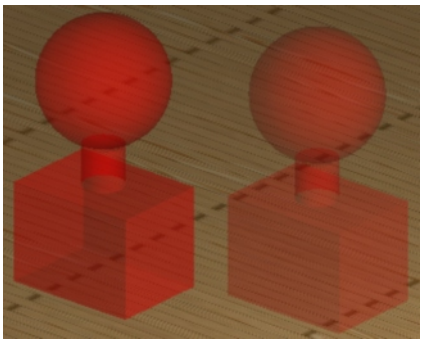
Material Editing



In the material editing section there are seven tabs, the first of which is Options,

Double sided sheets, - one thing to ensure regarding this setting is that it is almost essential to be turned on for ACIS surface 'sheet ' objects, by that it is meant a zero thickness objects. In the picture below a single 2D line was drawn, extruded and given a material, the object was then copied and rotated 180 degrees In the left hand picture, the double sided option was selected, and shows the texture was rendered on both sides, in the right hand picture double sided was turned off, and because a sheet object is a single facet it renders one of the sides invisible, this is because when rotated we are now looking at the back side of the second object, and because the material is only rendered on one side of the facet the other simply is not there.





Double sided in transparency, Double sided can also affect transparency objects look, in the picture on the right, the left hand object has double sided turned on, when light travels through the object, because the inner facets are also rendered some light is reflected, this gives clearly defined inner surfaces.

However turning off double sided as in the object on the right, and the inner facets are not rendered thus as far as the render is concerned that side is not there allowing no 'bounce back' or shadow reflectance etc., and appears washed out.

With no 'sheet' objects or no transparency, the double sided option can safely be left turned on or off. Personal preference.

Reflective Caustics -

Refractive Caustics -

Caustics are focused particles of light due to reflections and refractions, RedSDK has two tick boxes for caustics from the materials options tab, however caustics are more of a lighting setup than simply ticking some boxes, one has to have light's which will generate the caustics, for example the physical luminances, and even then there are numerous options to change how the lighting will affect the material,

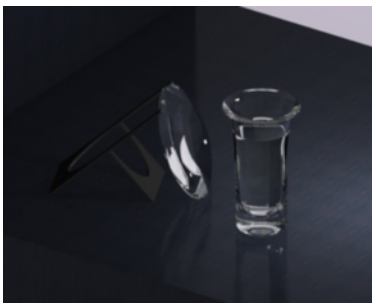
Caustics are more for reflective / refractive media like glass and water and therefore it is advisable to turn both options on, as stated, to use one needs a light with a caustic option, the three physical Luminance's fit the bill, all have a caustic tick box, this will tell the program to use photon mapping to track the light,

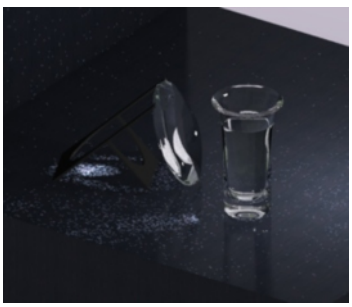
To use on a glass for example, one can have a glass material with caustics ticked, high transmission, medium to low reflectance, Fresnel optional, IOR to suit, the ones below were IOR 1.4,

Also, a base with a low reflectance, caustic not ticked, low transmission.

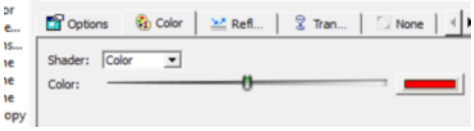
Also, (example) a sphere with a luminance property, physical luminance like spherical, caustics turned on, start with intensity 0.1, it will probably be pointing the from way, so alter the direction once it is known (after first render probably).

Ray-trace or GI render, cross fingers.



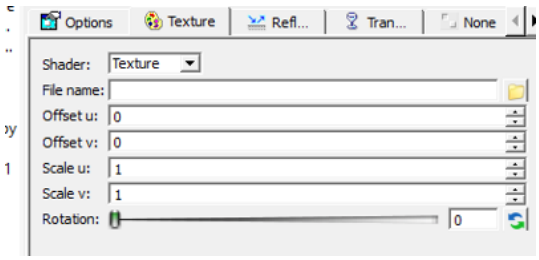


The Color or Texture changes the name of the tab depending on the shader selected.



Color (Colour) Probably the simplest option, it puts a base colour on the object, it is set by clicking the colour button to the right of the slider. This opens up a colour selector dialog. The slider is effectively a diffusion setting, when set to a pure colour, the slider is in the centre, moving it to the left darkens the colour, moving it to the right lightens the selected colour. The slider is ideal for altering the shade of metal, plastic and glass.

For realistic materials the colour should be combined with reflectance and / or transparency as required.



Texture. Changing the shader in the drop down box to texture not only change the tab name, but brings up more options. First a note regarding the textures. A Texture is simply a picture, no internal image manipulation can be carried out, i.e one cannot alter saturation, contrast etc. If a picture requires altering, it needs changing in a paint program, therefore it can occasionally be trial and error in order to get the picture to match the selected lighting.

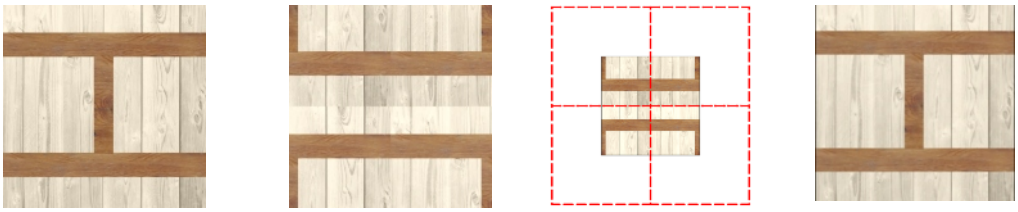
The second thing to remember, is that if a texture is to be used on a large area, the program needs to be stretch the texture to fit. Therefore if the image resolution is too low, for example 256 pixels x 256 pixels, it may produce poor results if used on a large area.

File name This is the path to the picture being used, the actual picture is not saved with the file, only the file path is saved, click the folder button st the right, to bring up the file location dialog box.

Offset u Offsets the texture horizontally by one drawing unit.
Offset v Offsets the texture vertically by one drawing unit

A value of 1, moves moves the texture one drawing unit in the x or y direction. If the scale values are set correctly then these values will normally be 0 or 0.5. Other values may be necessary if the scale factors are not set to scale to the object size, in the example below, the object size is one drawing unit x one drawing unit, whether they be inches, mm etc. it does not matter.

The left picture is the original png image, the middle one is the texture loaded and offset u and v set to ‘0’, as can be seen

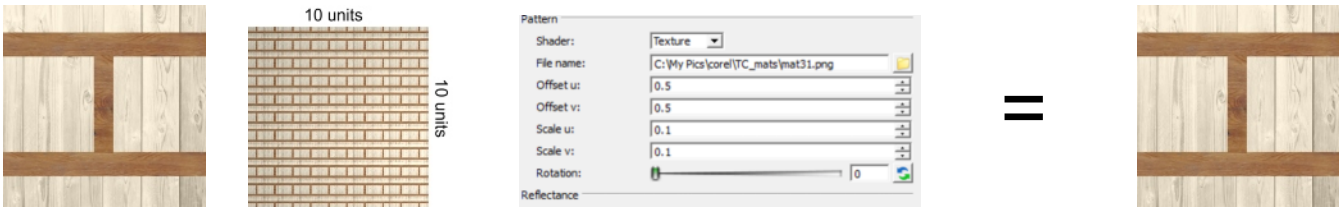


from the third picture the offset 0 value uses 4 images to produce the final render therefore for a single texture on a single drawing unit, the offset needs to be a half (0.5) in both offset u and offset v.

An easy way to think of it is, if the number of tiles required is Odd (1,3,5 etc) the offset is 0.5, if the number is even the offset is 0, but, obviously if one wished something like one and a half tiles wide, the offset would have to altered accordingly.

Scale u - scales the image (texture) in the horizontal direction by one drawing unit.
Scale v - Scales the image/Texture in the vertical direction by one drawing unit.

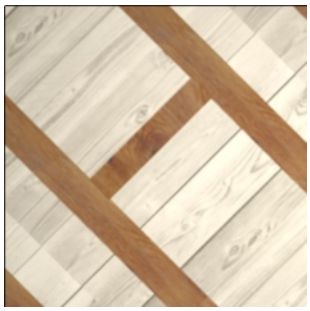
The scaling can seem counter intuitive. Normally when one thinks of scaling the larger the number the larger the image, however lets say you have an object 10 mm x 10 mm. Because both scaling and offset are per drawing unit (example 1 wrap per mm), with the scale u and v set at 1, the texture would wrap 10 times in both directions. Therefore in order to get one texture at the correct size, we must take the number of tiles we wish, which in this case would be (1) and divide it by the number of scale units in the object (10). This makes 1 / 10 = 0.1, we also need to take the offset into account, as we want one tile, offset u and v = 0.5



Obviously in the real world things aren't exactly 1 unit or 10 units, for example if the object was 42 mm x 31 mm, the scale would be scale u 1 / 42 = 0.0238 and scale v 1 / 31 = 0.032248,. What also should be mentioned is the aspect ratio of the image and object, for the texture to look OK without undue stretching, the aspect ratio's of both the object and image should ideally match or be reasonably close.

Rotation - this setting rotates the texture applied, the setting has two modes with one having up/down arrows to rotate 0 to 360, the second is slider mode is a percentage and goes from 1 to 100, effectively the slider rotates at a rate of 1 = 3.6 degrees, its personal choice which mode one selects. the image below is rotated by 30 degrees.

A note regarding rotation's link with scaling and offset, if we take the original object of one unit, and image tiled with



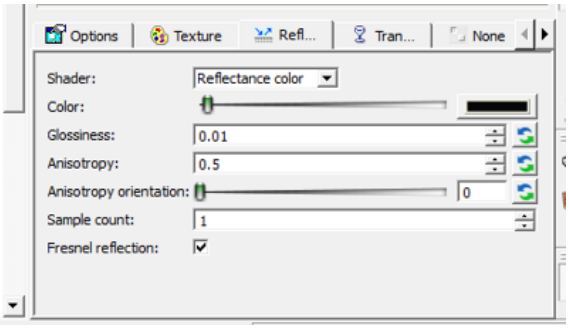
scales set to 1 unit offset 0, and apply 45 degree rotation, the image is not rotated around the centre of the object

As can be seen by the second figure this may not be what was required, the third fig has offset 0.5 added,

Because we are effectively dealing with the diagonal (a hypotenuse) the offset value need to be different, so out comes Pythagoras, taking a 45 degree case, which is the square route of 2 (1.4142) is corner to corner, divide by 2 the get the centre and this is the offset v (offset x left at 0) = 0.7071.

If only things were that simple, the above only works for 45 degree rotation, unfortunately there is an 'unwanted feature' 'flaw' or 'bug' (call it what you will), where the shift becomes more apparent to scale, and at the time of writing the correction formulae is unknown.

Reflectance.



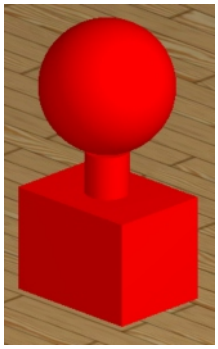
The reflectance tab houses various options with regards to how an object reflects light,

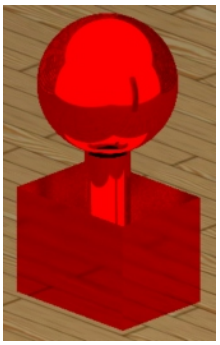
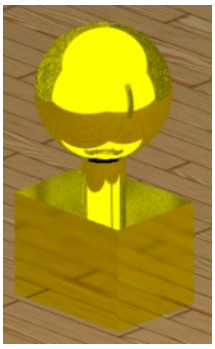
Shader - this has two options Reflectance colour and Reflectance map, so we will start with reflectance colour.

Reflectance colour is chosen by clicking the coloured button on the right, for a majority of circumstance this should be left as greyscale, (black to white), moving the slider all the way to the right gives mirror like finish, however it is also linked to the other settings in the dialog which will affect the finish.

As can be seen from the figures below, fig 1 is the plain object, fig 2 had the slider set high (but not full) white giving an mirror like finish, , fig 3 the reflectance is about midway, with Fig 4 the reflectance colour was changed the red, giving a reflectance which is quite vibrant, fig 5 shows the reflectance colour changed to yellow which completely changes the colour, hmm what happened there - the object is red ?, A high reflectance using a colour that is neither similar no a complementary colour will saturate the normal colour, and effectively completely change the colour of the object, Anyone who used to paint programs will be aware how easy it is to change one colour based on another with Add, divide etc.

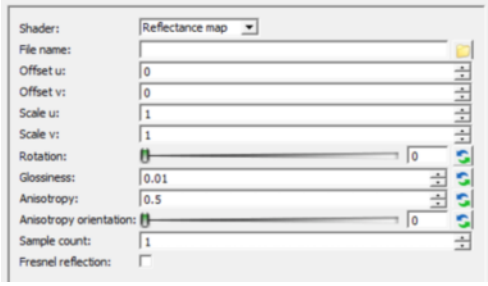
If using a colour other than grey-scale it may be more beneficial to use either similar colour as the main colour tab, or use a complementary (opposite) colour, Fig 6 uses green which is the complement to red, and prevents saturation.



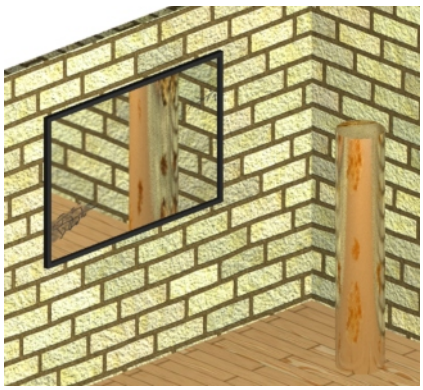
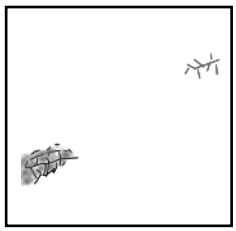
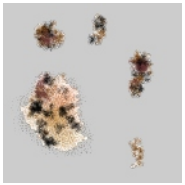

Reflectance Map

Reflectance maps use a texture (picture) as the basis for reflection, it uses a file from ones computer, simply click the folder icon at the end of the file name box.



Like the colour shader, reflectance maps use the RGB values to determine reflectance, with one important difference, because they can be a pattern, different parts of the texture will reflect light at different rates, think of a slightly rusted steel bar, most of the steel would reflect well, but the rust very little.

The image below uses two reflectance maps, one on the mirror and one one the pole, this makes it quite easy easy to add such decoration.

The beauty of using reflectance map over applying the the image as a texture is that one still has control over the diffusion (grey-scale colour) in the texture tab, which whilst of little use with mirrors, can enhance solid objects if the lighting is making them too light / dark, obviously only for use if the object has reflectance.
Because Reflectance maps allow for light to change depending on the map it can be used to good effect,

In this example the base object was simply a grey colour (this method works best on a grey-scale object), whilst we could just add a bump map, instead we will add the image as a reflectance map,. Because light will reflect differently

depending on the colour, black being non reflective, white being fully reflective, adding the map dramatically affects the appearance, fig 1 is the original object, fig 2 has simply added a reflectance map, because it is reflecting the light differently there is good definition, Fig 3 has been done the standard way of adding a Texture map and bump map.
The Offset and Scale setting are the same as for Texture Map discussed earlier.

Glossiness
The next thing under Reflectance is the Glossiness, this is one of the things which can seem 'opposite' in that at default (0.01) it is glossy and gets less glossy and introduces noise as the numbers increase, (or the slider is moved).

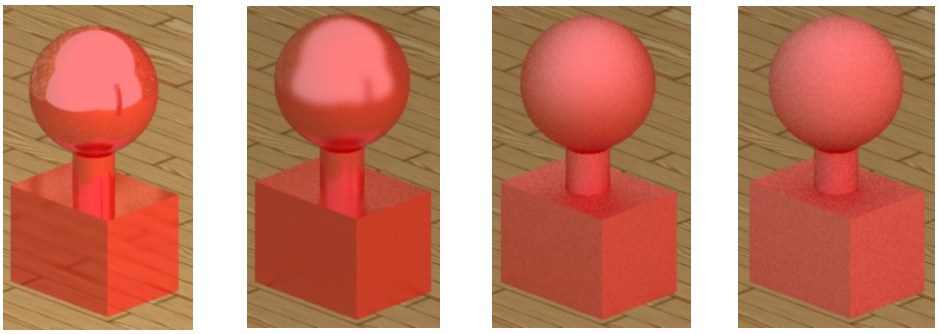
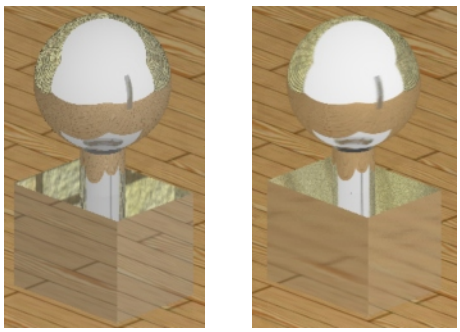


Fig1 below shows default gloss at 0.01, increasing the figure to 10 (fig 2) shows a more duller appearance like an car when it needs a good polish, by 50 (fig 3) its dull and staring to gain some 'noise', the last picture (fig 4) shows the object completely dull, and shows a distinct grain / noise..



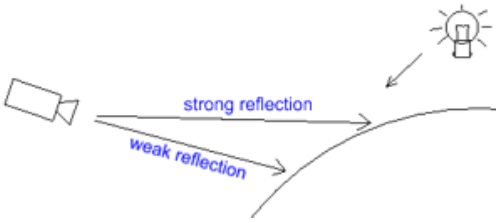
The glossiness setting can be used to blur objects, for example fig 5 shows a shiny metal, a wall is clearly reflected on the top of the box part, by adding just 0.2 glossy setting can produced a more blurred effect, this can be coupled this with an slight increase of the reflectance slider to partly compensate for the loss in reflection by the blurring action, it you look at the reflection off the rectangle top face in Fig 5, you will see its more blurred on the top face but still has a reasonable amount of reflection.

Anisotropy Used to modify the way that lights is reflected of the material surface, from the help files - *"The anisotropy parameter varies in [0, 1] and describes how the reflection is oriented regarding to the surface orientation. Some real-life materials are well-known anisotropic ones: CD-ROM surface or hairs and fur for example. By default, a value of 0.5 makes the material isotropic (i.e. reflections do not vary with the orientation of the surface). "*

Anisotropy Orientation

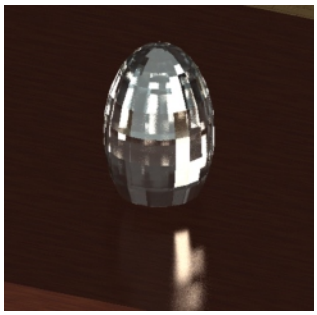
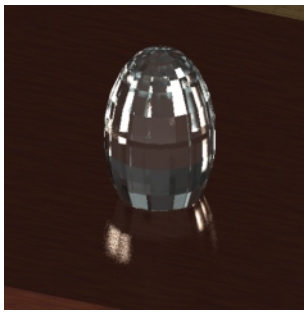
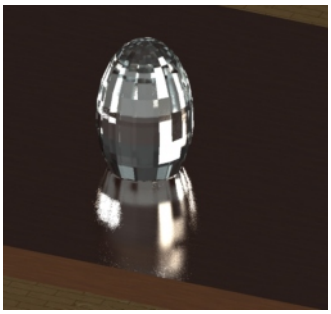
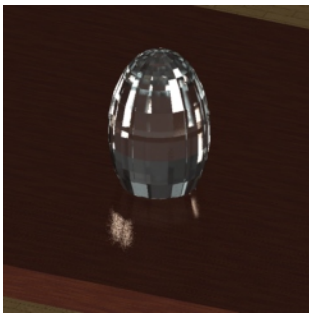
Fresnel Reflection

Redway state - *"The fresnel option is a very powerful term that is used to modulate the amount of reflection emitted by the material based on the angle of the viewing direction with the surface. This must be turned on for all glasses materials."*

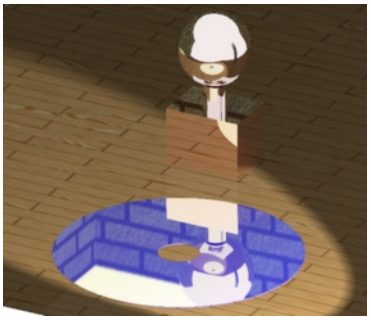
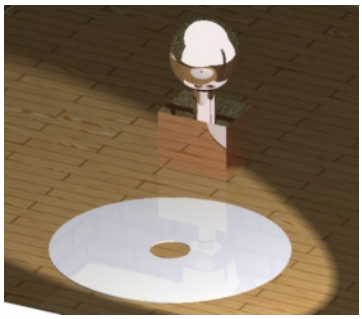


When looking at objects or the ocean for example parts appear more reflective at shallower angles than looking straight on, under natural light conditions, (i.e. your not shining a torch at something), Fresnel alters the way the reflections are seen by the camera, to try and mimic this real life scenario,

In the example below, fig 1 has no glass Fresnel applied, and there is a strong glare facing the camera, fig 2 has Fresnel applied this glare is removed and reflects more at the edges, , in fig 3 the wood has no Fresnel applied and again shows a strong reflectance towards the camera, Fresnel was applied to the wood in fig 4

In the figures to the right show a large difference in reflectance towards the camera on the circular disk between no Fresnel fig 5 and Fesnel fig 6
Many materials will have a Fresnel effect, for example wood (assuming it has a coating) glass, plastic, paint etc.

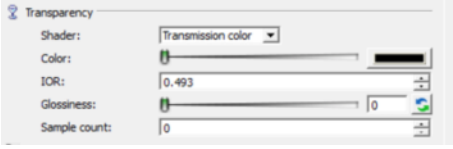
Metals can have a Fresnel attached its user preference.

One last note, whilst IOR value are in the transmission section of the render dialog box, they can have a great effect on reflectance is calculated, experiment with different IOR values to see the effect on your materials.

Transparency

Like reflectance the first option is Shader (colour or map), and effectively they do the opposite of reflectance, as they make either all or part of an object transparent.

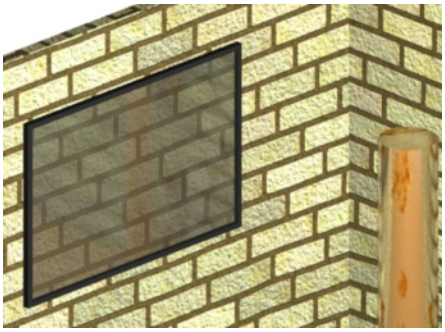
Shader



Transparency Color (Colour), this is a colour slider with black (0%) being non transparent, and white (100%) transparent,

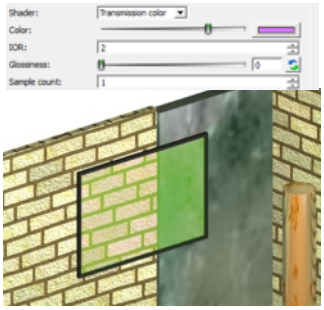
Note - if one has a high reflectance or are using a reflectance map, this can overpower the transparency, if this is the case either turn down the reflectance or check the reflectance Fresnel option.

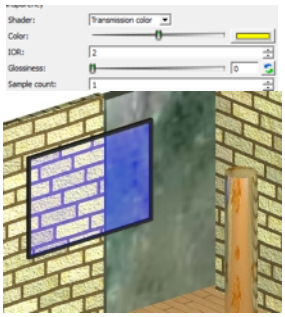
In the pictures below shows some tinted glass, the one on the left has reflectance Fresnel checked, with medium transparency colour, the right picture Fresnel was turned off, and a low reflectance set, allowing a tinted look but still have some reflectance, (Note - this actually goes against what Redway advise - but whatever works is the right way)



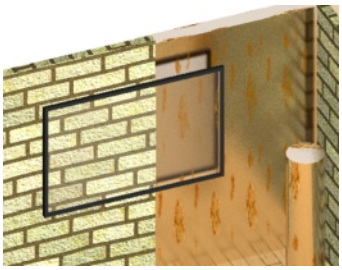
As with reflectance colour, transparency also has an adjustable colour, in general this works best if left as grey scale, the colour option can affect the way the coloured light interacts with other objects, and can show its complementary colour on dark objects, the original image show on the right which has its transparency set to grey-scale (black to white).

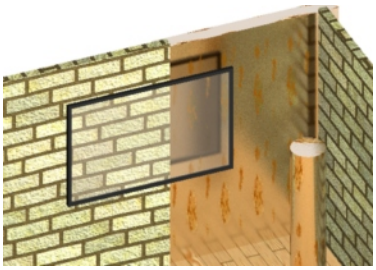
The first picture has its transparency colour set to purple, which results in the darker colours behind to show the





transparencies complement green, the next one was set to yellow and shows dark colours as blue.



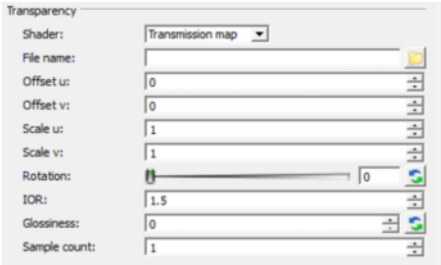


One other things needs mentioning and that is the double sided setting in the options tab, with transparent objects it is better turned on (ticked), especially when object behind has some reflectance.

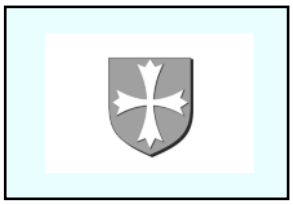
In the figures on the right the ‘door’ has some reflectance and in the left picture the glass ‘double sided’ is turned off, this results in the back side of the glass not being rendered, therefore the door has nothing to reflect except the frame.

With the figure on the right ‘double sided’ was turned on, therefore the door receives light through the glass, and also reflects the back side of the glass giving the correct render.

Shader - Transparency map.



In the first drawing we will put some etching onto the glass,.



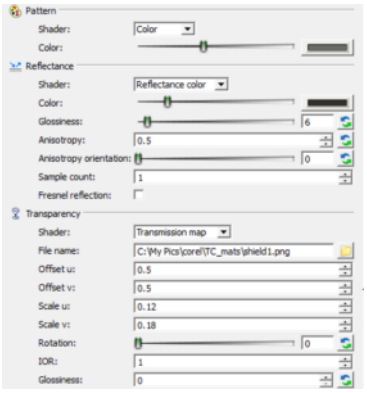
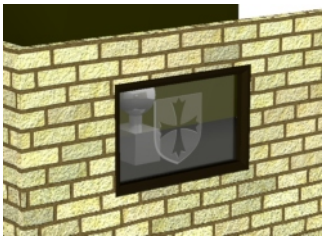


Fig shows the image used for transparency - Note the blue background is not part of the image, its been put here to show the white part of the texture.

By using a texture map, one still has control over colour and reflectance to get the desired render, one thing to keep in mind is that RedSdk uses white as a transparent colour,



After selecting the required image, adjust the scale and offset to suit, one thing to note is the IOR setting, because we don't want any distortion from the glass, it has been set to 1 (air - well a vacuum actually), adjust reflection and colour to suit.

The next example is a classic transparency used for trees, the setup can be single sheet or multiple, in this example we will use two, it is a good idea to ensure that the aspect ration is equal for the image and object, there are many ways to check this, one way is to divide the width of the image by the height, or vice versa, or use the object dimensions.

1) image W 314, pixels / H 500 pixels = 0.628, object W 15 units, Object H = 15 / 0628 = 23.8854 units
2) Image H 500 pixels, / W 314, = 1.59236, object H 24 units, Object W = 24 / 1.59236 = 15.072 units
3) Object W 15 units / H 24, = 0.625, image width - 314 pixels, image height = 314 / 0.625 = 502.4 (502) pixels
4) Object H 24 units / W 15, = 1.6, Image Height - 500 pixels, image width = 500 / 1.6 = 312.5 (313) pixels

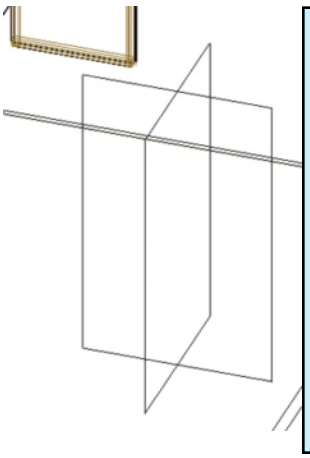
Whatever method used whether one of the above of a free conversion tool, the point being the more accurate the aspect matches the better the results.

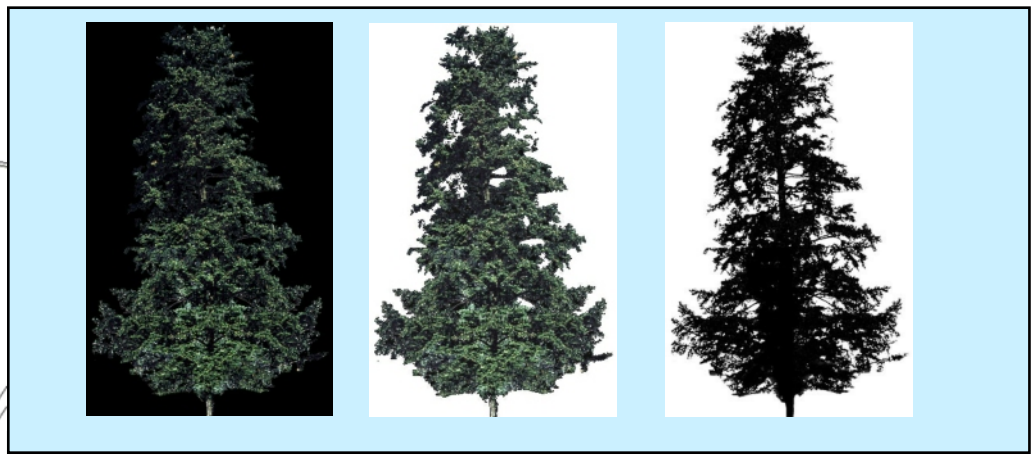
Draw a single line the correct width and extrude it to the height , select it, activate make copy and rotate 90 degrees, as shown in the fig

The next step is to set up two tree images, as RedSdk uses white as the transparency colour, Of the three trees below, the third which is a black tree against a white background is used for the transparency, Be careful about jpg images, the compression of jpg can add stray coloured pixels which will affect the transparency, if using a jpg image check for errors, this is same as if one was using masks on jpg images in a paint program.

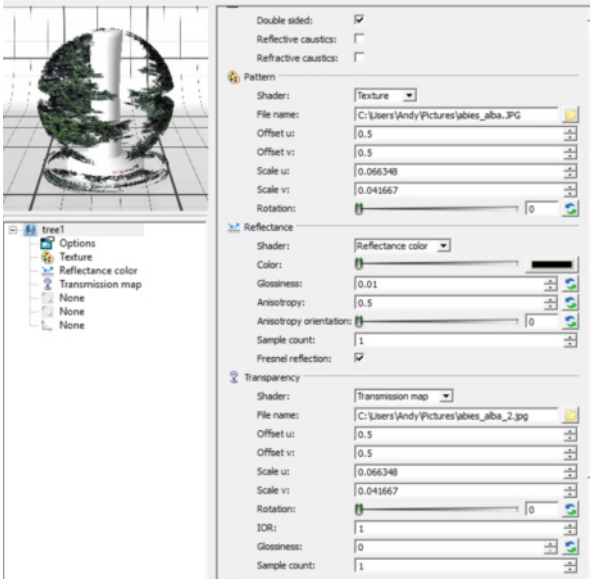
Of the first and second ones, in theory is doesn't matter which on is the texture, but in practice number 1 will give better results this is mainly due to the paint program used the turn the image black and white, if the paint program produces a mismatch in the black and white image white will show up as an error a lot more than black in the finished texture wrap.

As can be seen below the black & white is not an exact match, so the first image is best as any non-transparent pixels will show black and be part of the tree.





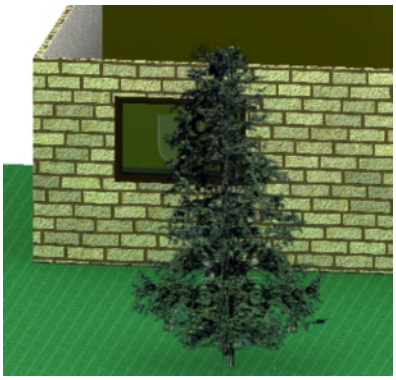
The next step is to simply set up the texture map and transparency map in the material dialog, to use a normal Texture map, for this we need two images, one for the texture and a second black and white for the transparency to clear the background.



The fig right shows the setup for this render, the offset and scale are the same in both texture and transparency, select the appropriate image file ensuring the black and white one is in transparency.

We don't really want any or at least very littler reflectance, turn on Fresnel reflectance, set IOR to 1 to prevent any distortion, ensure double sided is checked in options,.

Render the image to check results.



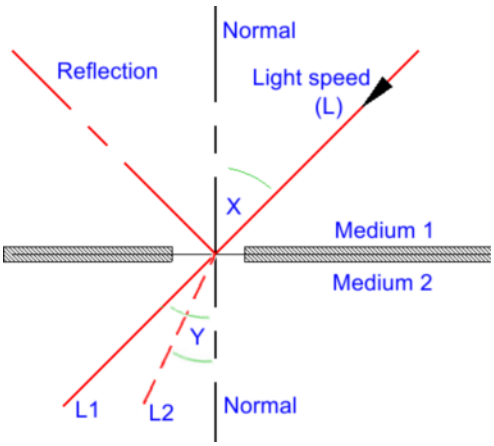
One could also try adding a bump map, but in practice it doesn't add much to his type of image so I would not bother, but feel free to experiment.

IOR

In the dialog box is the usual offset, scale and rotation as discussed previously, one new setting is IOR (Index of Refraction), this is default set to 1.5 which is an average for Glass
OK what is IOR,

The help file states "What makes the transmission effect acting like a magnifying/minifying glass is the Index of Refraction (IOR) of the material. Users can enter the value they need in the IOR field of choose one in the drop-down list (amongst various"

Important note - the writer is not a scientist, information about IOR is obtained from the internet and experiments. The information is included here as a guide for anyone who does not wish to trawl the internet or the library.



Refraction index is the difference in velocity between light passing in a vacuum and passing in any other substance. This difference in index can also cause light to bend when it strikes at an angle to the substance,

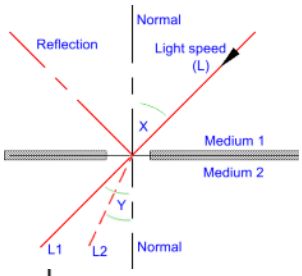
Referring to the diagram, imagine a single beam of light (L) passing through a vacuum (Medium 1), it strikes Medium 2 at an angle, if the two mediums are the same refractive index, the light would pass though at angle (X = Y) and exit at (L1), thus there would be no bending of the light, i.e. Medium would appear not to be there.

If Medium 1 was Air and Medium 2 was Water and the light entered on the normals there would be a slowing down of the light in terms of velocity but no bending as the angle of entry and exit would both be 90 degrees

If the light enters at an angle as it is slowed down and there would be bending of the light (L2) due to water having a higher refractive index of 1.333 compared with Air 1.0003, thus altering the angle (Y).

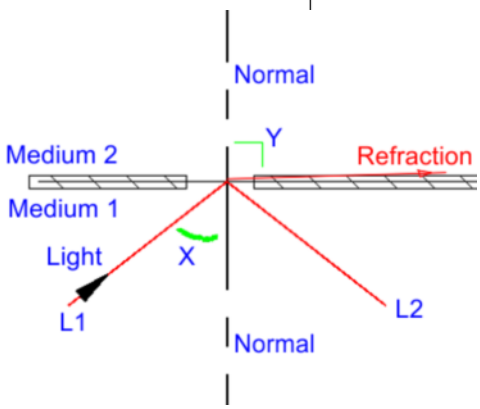
Substances can have exactly the same refractive index, for example put one inside another and it cannot be seen, it hasn't disappeared, but the light is not bent and thus the eye cannot see it, there is another anomaly in the form of manmade materials which have a negative refractive (not possible in nature) which deliberately bend the light in a pre-determined way around the object way and make the object appear invisible.

If anyone wants to do some maths to work out the refraction angle the formulae is n (index) = Sine(Ø1) / Sine(Ø2) or from the diagram n = Sine(x) / Sine(y), if x = 35 degrees, Sine(y) = sine(35°) / 1.33, or Sine(y) = 0.57357644 radians / 133, = Inverse Sine(0.38755165), leading to Y = 22.205 degrees (after conversion), which is quite a bit less than the 35 degree light entry angle.



There is also something called the **critical angle**, this is where the light is passing through a denser medium exits into a less dense medium, (does not apply going from less dense to higher density), these is a certain angle which causes the light to become trapped inside its current medium is called total internal reflection, as it and cannot pass into Medium 2, think of optical fibres,

This does not apply going from a less dense one into a dense one. Each material has its own critical angle for light passes through a dense material into a less dense material



Taking the picture on the right, light passing from Medium 1 into the less dense Medium 2 the light is refracted (it can exit), however when the light angle X is such that the refracted angle becomes greater than 90 degrees (Y), no more refraction can take place and the light is reflected to L2. This angle varies with materials but can be calculated.

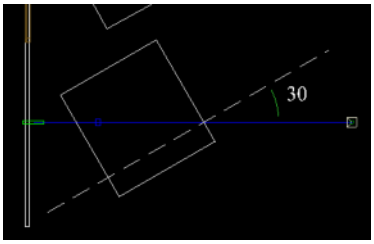
The calculation is Sine(Øc) = Medium 2 / Medium 1, or from the diagram Sine(Øc) = Y / X, (Y and X are the index of refraction for each Medium), as an example Water to air (taken as 1.0003 and 1.333 index respectively), transposing the calculation using Inverse Sine becomes Øc = Inverse Sine(1.0003 / 1.333) = 0.851251 radians, giving us 48.62613 degrees, therefore if angle X is greater the 48.6 degrees the light will reflect, instead of refract (assuming perfect conditions).

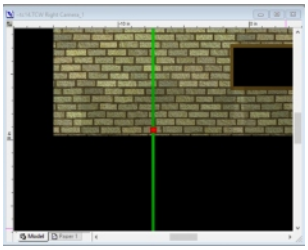
Of course light is never just a single beam, it is bouncing around all over the place, in the case of optical fibre it is specially manufactured to cause this total internal reflection

A last note on objects like diamonds, the reflective index is so great (around 2.4) that it produces a critical angle of just 24 .43 degrees when compared against air, therefore as light enters very little will escape through and most will be internally reflected until such time as it finds the angle to escape (this can depend on how the diamond has been cut), and is the reason why diamonds appear differently than other gems in the same light conditions,

OK what has all this got to do with TC.

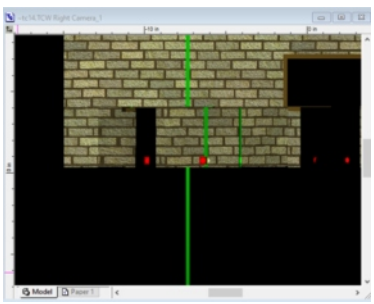
Well RedSdk has an IOR setting so one has to presume its been programmed to take refraction into account when calculating the render and indeed in practice it does.

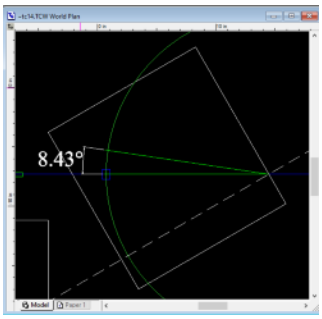




This test was done to prove refraction between air and water, the setup involved a a point light for overall illumination, and single spotlight, the camera was positioned in line of sight with the spotlight.

A large box to refract the light (material IOR 1.0003, a small box (shown blue in the wire-frame picture but has a red material (my error) and a green box depicting line of sight on the wall, as the IOR is the same as air ho deviation in light occurs..





In this second the only alteration was to set the large box IOR setting to 1.333, which the calculation tells us should (in perfect circumstances) result in an 8 degree shift in the 'apparent' position of the box.

As can be seen there is a definite shift, in practice it appears to be approximately 8.43 degrees, however the accuracy is difficult to be accurate + I had to have a 2 degree perspective on the camera to view properly, so this 8.43 is probably +/- 2 degrees.

What it does show is that IOR appears to be working well in RedSdk.

Will it mimic real life.

The simple answer is no, It will have a go but only specialised software can do that, for example there is no way to tell the program the density of a material for light absorption and scattering, the best quote I saw (though this was for vray) was *"Creating materials in Vray is EYE-BALLING, nothing more, nothing less"*, so I wouldn't get bogged down trying to create the perfect material - it just ain't gonna happen.

One last thing to consider, is that one is not limited to actual IOR values, Whilst IOR is normally linked to refraction, it is also linked to the Reflection setting and Fresnel, for example increasing IOR counteracts some of the Fresnel properties, increasing the IOR

IOR in TC Some IOR effects in TurboCad

There are many sources of IOR value on the internet, however different site may have different values, for example take silver, one site I saw had 0.18, another 1.3 and a science site as 1.5016, personally I'd say use the values as a guide only, indeed one one post on a vray forum said turn IOR to 1.6 and lock it there except for metals, In TC different lighting situation will affects the final scene a lot more than a few decimals off in IOR.

I wouldn't get bogged down by trying to get the exact refractive index, for three reasons, we are restricted to whatever algorithm the software programmers have used to calculate the IOR, second, we are dealing with computers and printers, what looks good on one computer may not look exactly the same on another, and lastly, real life ain't perfect.

OK enough theory were's the pictures gone.

Out of the ordinary - mostly the IOR one sees is between 0.5 and 2.5, that's not to say you have to stick between these limits,

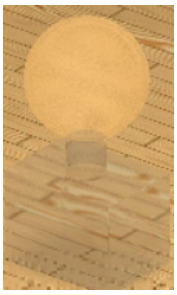
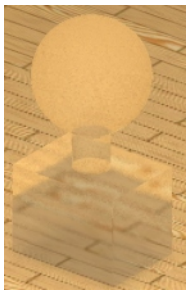
Vacuum	1.0000
Air	1.0003
Bronze	1.180
Copper	1.100 2.430
Diamond	2.418
Glass	1.500
Gold	0.470
Ice	1.309
Iron	2.950
Milk	1.350
Oil, vegetable (50deg C)	1.470
Plastic	1.460
Water (35deg C)	1.325

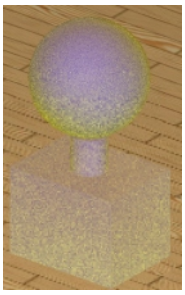
OK what's after IOR - Oh yes, Transparency Glossiness.

Just like reflective glossy there are two modes, slider = 1 to 100% (1 = 0.01), and numbers only from 0 to 1, important as if one types in 0.2 in the numbers box thinking that isn't much, its actually 20% (grainy).

For me Glossiness is an odd concept, as my normal thinking is hmm, I want it more glossy - turn up the slide, Oops,

Transparency glossy produced transparency noise, which varied depending on the object, spheres gain noise almost immediately as the value is increased, effectively the light bounces around inside, cylinders are the next, and boxes the last to suffer.

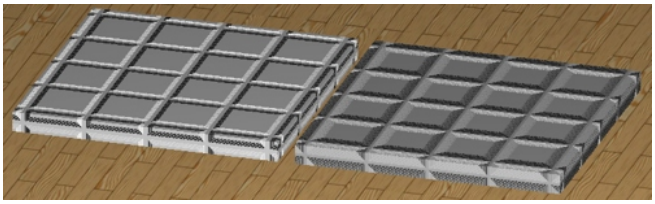






The images below show the transparency glossiness setting fig 1 = 0, fig 2 = 0.1, fig 3 = 0.2 fig 4 above 0.2, fig 5 has an added transparency colour

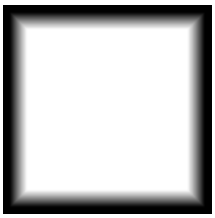
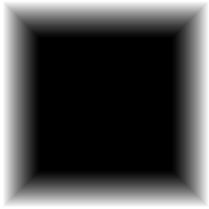
To be honest unless one is creating a frosted transparent material I can't think of any reason for wanting a lot of noise to appear so soon after changing the setting from 0 (0 to 0.1).

Sample count



Bump Map

A bump map is a purely visual appearance of a raised or lowered surface, unlike displacement maps (discussed later) it does not alter the geometry, it calculates shadows based on the bump map image, when rendered, the program alter the areas where it finds the difference between light and dark areas of the map, which is much quicker than actually altering the geometry (which is what displacement maps do).

Bump maps are 2D pictures which are calculated based on the RGB colour value, it is calculated to show white areas (RGD 0,0,0) as high areas and black (RGB 255,255,255) as low areas, with varying degrees in between these values. Although any image can be used I prefer grey scale images (24 bit RGB) as its easier to judge which areas will be high and low.

Why use a bump map instead of drawing,

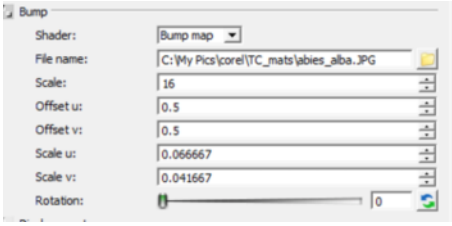
Two reasons, first many things are just not practical to draw, take a piece of wood, if you wished to roughen up a piece of wood then to draw all the wood fibres is not a job anyone would relish, the second is speed, taking the same example applying a bump map takes minutes, drawing wood fibres possibly hours, (or in the case of human hair - probably days to draw every strand)

What images can be used.

The best images for bump maps have good contract and shading, whilst black and white can be used the results are often disappointing, rgb grey-scale or rgb colour give good results, users have a choice of using them on top of a plain colour or over a texture map, you can use the same image for texture map and bump map, however it depends on the image, the Tree we used in the transparency section would make a bad bump map on top of the tree as it lacks contract between light and dark, it can be used on top of a plain colour.

The Bump Maps input is very similar to other maps with the same scale and offset boxes, indeed the only difference is the scale box, this tells the program how deep would would like it to try and make the

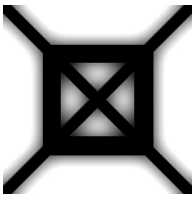
relief, I say try, because as the relief is purely visual there is a limit as to what can be achieved, although the scale will allow high numbers it can't work miracles.

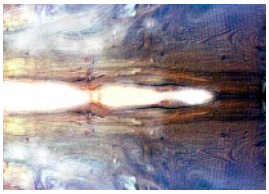


A couple of simple example

On the right is a simple tile image in grey-scale you will notice the transition from black to white this will give the appearance of depth, when applied to a box the program alters the light where it strikes the bump map depending on the RGB value, there is one drawback with bump maps, they can be sensitive to physical light and colour changes and can get washed out.

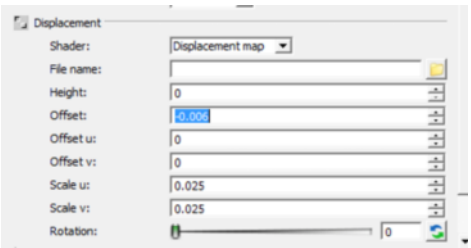
Second example uses a coloured texture image, the first is the image to wrap, the second fig is without any bump map, the second uses the same image as the bump map, notice there a little more definition the bump map was scale 16, the third fig is an inverted and modified picture with some white paint added, resulting in the last fig at the same scale, lastly for fun I upped the scale to 50 unfortunately my paint program smoothed it out a bit..





Displacement map,

It should not be any surprise that the controls are like all the others, the only differences are scale has changed to height and a new box called offset..



What's the difference

Displacement maps alter the actual geometry when rendering (no worries though - this doesn't mean your actual part will suddenly acquire lumps), but it does mean the render will be less affected by light changes and allow for more definition, sound good eh, but, there is a downside, because they are altering the geometry at rendering time they can take significantly longer to render, this obviously depends on the complexity of the map and object.

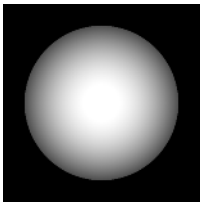
Displacement maps use RGB values like bump maps from the low point black (RGB 255,255,255) to high point white (RGB 0,0,0), it uses a special mapping system however fortunately we don't have to supply a special map, the program does it automatically.

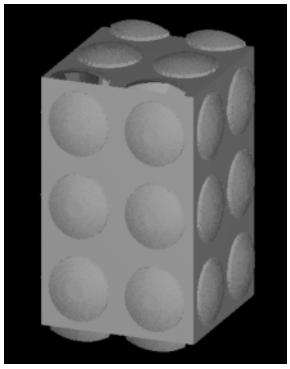
Using the same image as for bump we can see the vast difference in the finished render didn't exactly go to plan but you get the idea, (I exaggerated the settings your's won't normally look like this)

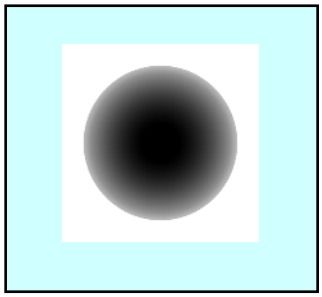
So what do the figures mean,

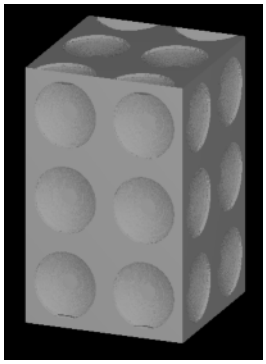
Height alters the actual depth between high and low points in world units, which one needs to keep in mind when re-using materials, especially if the units are different from what you are used to, also bear in mind to keep the scale boxes correct, by this I mean, say you normally draw in mm, and draw a box 200 x 100, then at some point decide to change your space units to cm, you need to go into the material and change the scale, so it will render correctly, (actually that is the same for all material scales)

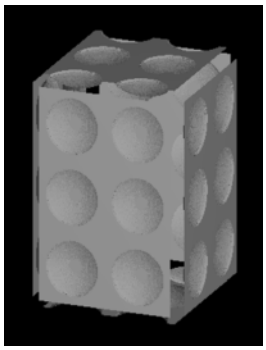
Maps can be produced to be raised or lowered however you cannot set a minus height, to change this one needs to reverse the image map in a paint program (quite easy), the example below shows two maps, in both displacements the height was set to 2, as previously the blue area is simply to show the extents of the white area.







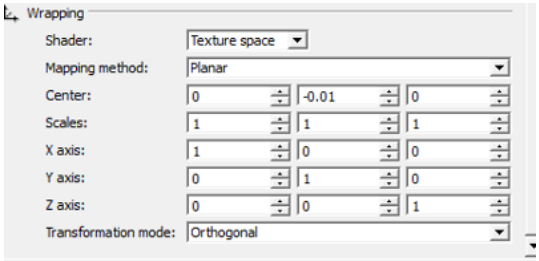




Offset determines where the map will start to displace, think of a small piece of dowel on a plank f wood, if you wish it to be raised it can just be left there (offset = 0), if you wish it to be sunk into the wood you need drill a hole the depth of the dowel (offset = height)

You can vary these figures for different effects, indeed if the object is simply an extruded line (sheet object) it may not matter leaving it as 0, each scene will vary. The picture on the right was given a height of 2 but the offset was left at 0, as can be seen, instead of being 'sunken' The back of the recess is at object position and the face has been moved to a height of 2, to make it correct we should use an offset of -2.

Displacement maps don't have to be greys, colours can be used and the amount will be determined by the difference in RGB vales,

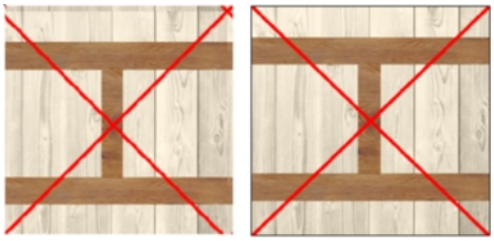


The last section is the
Texture space (wrapping)

NOTE - At the time of writing there is a minor glitch in that the texture shifts as can be seen from fig x, if this happens try this calculation to reset the offset under the texture map section as previously described

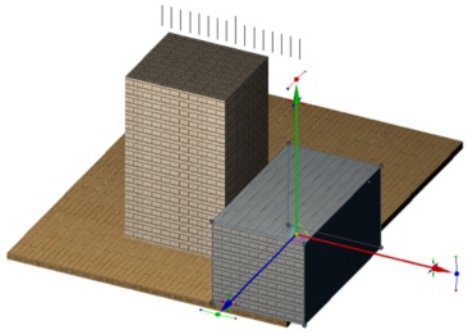
New offset u = old offset u - (scale u / 2)
New offset v = old offset v - (scale v / 2)

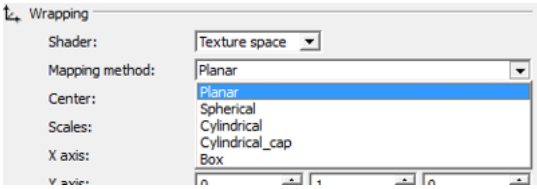
One could alter the centre boxes, but I find it better to fix it under offset, then its only typed in one,



This section is completely different to the rest, its function is to wrap the texture onto the object based on the settings applied here, however everything you learned about scale u and scale v go out the window if you use the scale settings within wrapping, they will work in conjunction but it will get confusing if you are altering two different scale factors, .

For these scale settings to work correctly the scale u and scale v should be left at 1, and offsets left at zero, whilst they can be altered they alter whatever settings you apply here.

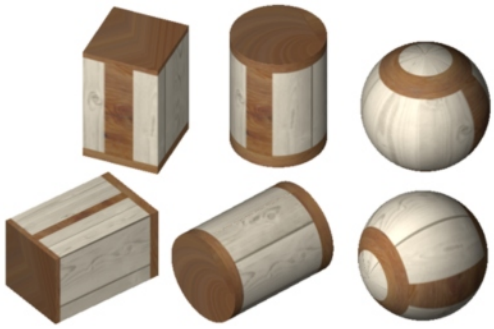




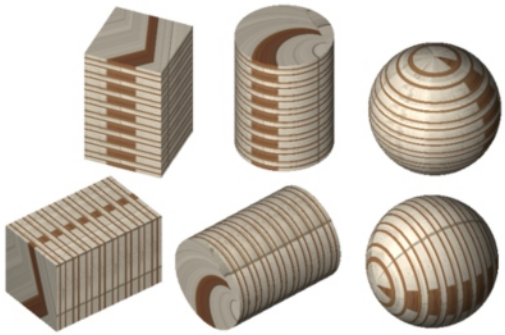
The mapping method has 5 options as follows

Planar, this lies the texture map onto the x / y plane of a facet (object) by default, Note this is the entity coordinate system not the world,

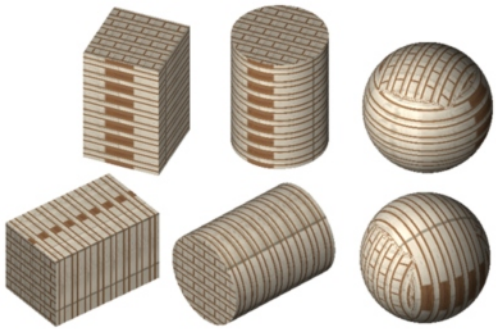
Spherical, this wraps the texture around a sphere it will also wrap around other objects but its primary function is for a sphere, the image u axes is follows horizontally, whilst image v axes is wrapped vertically (object z axes), unlike planer it is preset to wrap 1 instance of the texture around the object, Therefore under normal circumstances do not use texture space scale u and scale v set both to 1



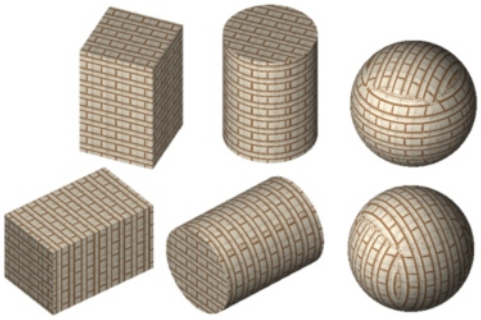
Cylindrical, this wraps an image around an object based on stretching 1 instance of the texture going round the object (x/y) but multiple copies vertically (Z) texture scale,



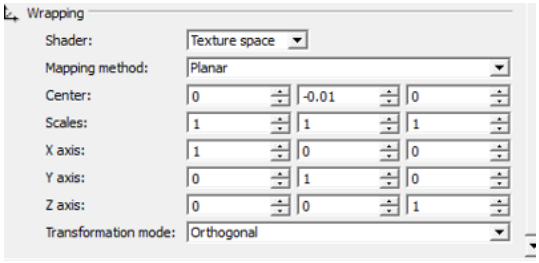
Cylinder Cap, like cylinder but it places / caps the end object with a planer image,



Box, the last option is box which wraps a planer type image onto all surfaces of the object, the sides are wrapped, with the top and bottom being single planer surefaces.

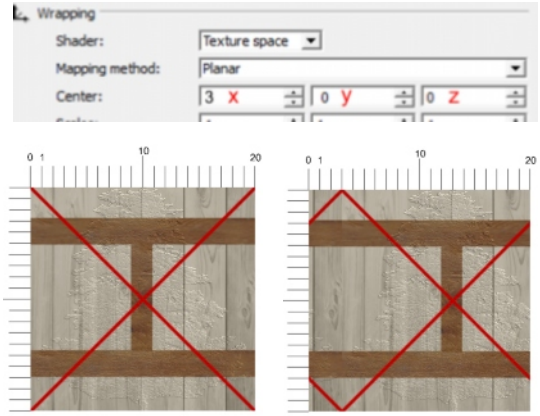


Back to the dialog, what are the other options. One of the first thing you may have noticed is there are more scale boxes, but more on that next - One point to note, the first part of this document will discuss using these boxes in conjunction with the other texture spaces as opposed to a standalone Setup area



Center (Centre),

Centre moves the texture x, y, z, in drawing units, this can be used to tweak your texture in any direction without having the alter the offset, and the beauty is that if one has previously set up a texture space and bump map for example, the control will act on both so no need to alter the offsets every time.



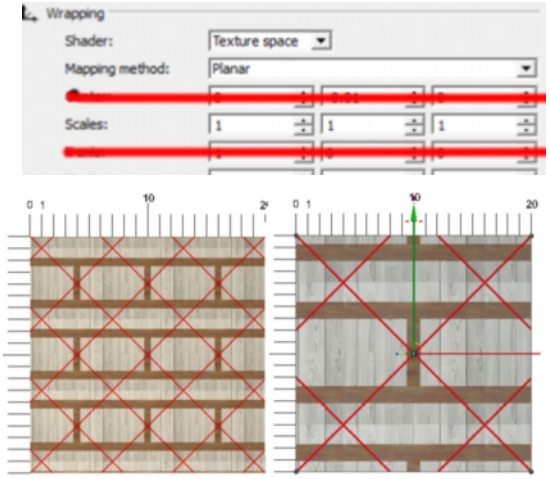
Center - planer mode uses x & y, as the image is not mapped around the z axes, the z box is available but ignore it. the images on the right have been moved by typing 3 into the first box

Centre - Sphere mode, set the texture space scale u and v to 1 as this automatically scales the texture

Centre - Cylinder mode, Centre - Cylinder Cap mode, Centre - Box mode, these can used in conjunction with texture scale u and v, and offset values,

Scale

The scale boxes can be used in conjunction with texture map scaling or independently, it allows altering the scales in one place instead of each scale u and scale v boxes,



Scales works opposite to the other scale u and v boxes, in that increasing the scale is the same as zooming in, for example on a 20 unit by 20 unit square to get one instance of the texture -

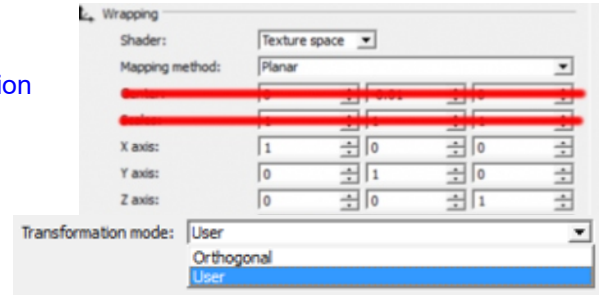
Texture map scale u = 0.05, texture map scale v = 0.05
OR
Wrapping scale x = 20, Y = 20

Scale - planer mode uses x & y, as the image is not mapped around the z axes, the z box is available but ignore it. the images on the right have been moved by typing 3 into the first box

Scale - Sphere mode, set the texture space scale u and v to 1 as this automatically scales the texture

Scale - Cylinder mode, Scale - Cylinder Cap mode, Scale - Box mode, these can used in conjunction with texture scale u and v, and offset values, can be used to sale an individual face though more of use with box mode.

X Axes, Y Axes, Z Axes, hmm bit nondescript as a title,

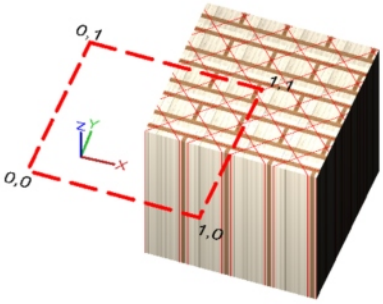


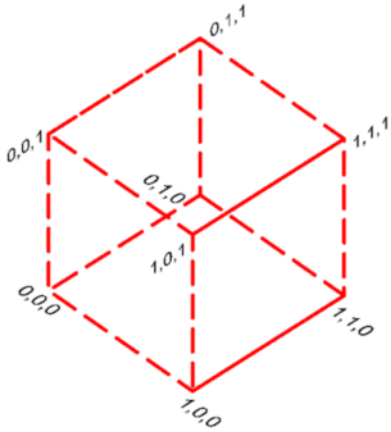
IMPORTANT, at the time of writing there has been no definitive explanation from IMSI, nor anyone else as to the correct operation, Redway have a wrapping explanation but not stated if Orthogonal or user.

Therefore what is written below is a personal observation. And written with the best intentions, Suggest doing your own experiments and decide yourself if the following is an accurate.

This appear to do two different functions depending on whether the transformation mode is set to User or Orthogonal, (at the time of writing)

Orthogonal, - Planar
when in orthogonal mode it orientates a plane to the coordinates set in the x axes and y axes boxes, in planar node it ignores the z axes boxes. Although you can type in any figure into the boxes, I'd suggest using 0 & 1 at least until you are comfortable.

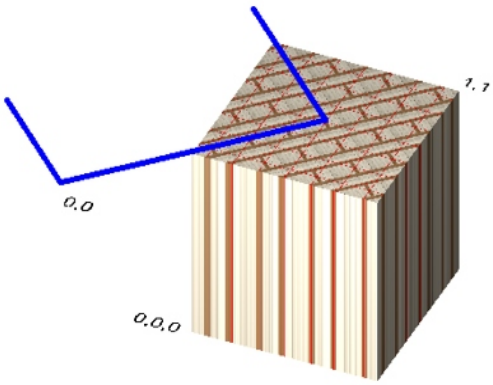




Imagine the box shape in fig, , and the figures which are x,y,z, now look at the square which has only two numbers x,y, in fig, planer mode places texture using x,y, and this square is the bottom of the 3D box,

Fig , shows how this is orientated (shown at the top of the box for clarity only)

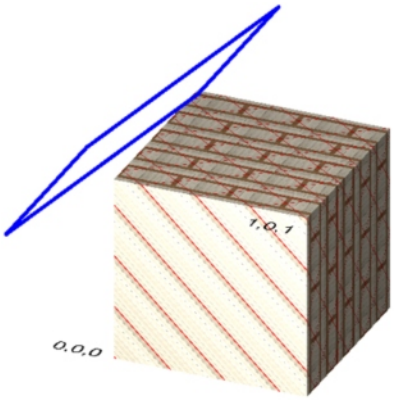
By manipulating the figures the texture can be rotated, the texture starts bottom left corner at 0,0, it then draws to +x and +y, in the x axes boxes it will be 1,0,0 meaning it draws from 0,0 to 1,0 and in the y axes it is 0,1,0 (draws from 0,0 to 0,1) for a normal planer setting as in fig,



Now imaging instead of x going from 0,0 to 1,0 it goes 0,0 to 1,1 i.e. it is rotated diagonally so the texture is wrapped from 0,0 to 1,1 in x axes will be 1,1,0, leaving y alone we get fig,
(Figures drawn in as a guide only), what has actually happened is X has been rotated by degrees = (Inverse Tangent (x2 / x1)) / PI()*180, (the last bit is just converting radians to degrees), x1 and x2 are just a name given the boxes alongside the x axes for clarity the actual name is unknown

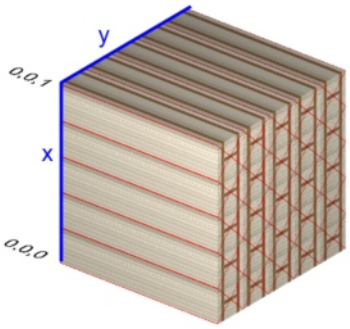
Whilst one can calculate the rotation I find it easier just to visualise what direction the x axes will be rotated towards.

INPORTANT - some values will not work, for example if x1, x2, x3 are all zero 0,0,0 this cannot work as the image cannot be drawn from 0,0 to 0,0 so the render will display an arbitrary colour (often red).



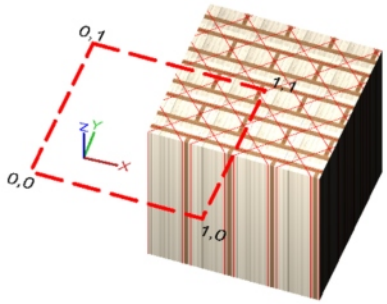
This next example will go a step further, looking the the box in fig, imaging a line from 0,0,0 to 1,0,1, y still goes to 0,1,0 therefore we have simply rotated the square around the actual y axes, planer mode still only draws a 2D image but because the texture 'profile it at 45 degrees it will wrap around more faces, fig

In the last example on Planar mode, the x axes is changed to 0,0,1, looking at fig, shows the x axes will be drawn vertically, the y axes still being y = 0,1,0 means it will planar the texture on the side of the box (the blue line shows the texture wrap) fig



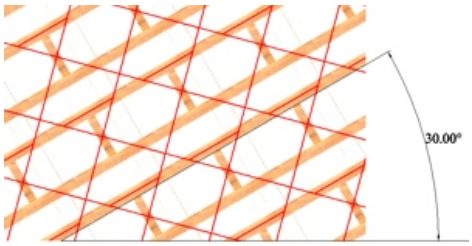
Ok, it was mentioned earlier about the numbers being 0 and 1, these can be varied but the results are not easy to predict, for example taking the first wrapping fig, as we know x image axes = 0,0, to 1,0,0 , we also know that 1,1,0 rotates it 45 degrees, so because the wrapping in on a normal world x,y plane it should be possible to rotate in between the figures.

We can, unfortunately at the time of writing it is unknown what calculation the programmers have used for rotation, an example of one way would be
x1 = Tangent (Radians(90 - angle), for example normally for 45 degrees one uses 1,1,0 for x1,x2, x3,



therefore x1 =Tan(90 - 30 degrees) = Tan(1.047198 radians), = 1.732, one would enter 1.732, 1 ,0 as the x1,x2,x3 boxes

However this fails if one changes both the x1 and x2 boxes, feel free to experiment.



What about other Orthogonal modes, -

The above rotation characteristics apply to other modes equally as well, however because spherical and cylindrical wraps the image around the object, the most notable difference is when using x1,x2,x3 = 1,0,1

Box bode will rotate but normally the rotation only affects one face in orthogonal mode, more manipulation of the figures could result in more rotation.

,
Texture space User Mode

Changing the drop down box from orthogonal to **User** mode, adds another variation in that one can scale individual faces, Fig has been set up as x axes 3,0,0, y axes 0,2,0 and z axes 0,0,1

However one has to remember this is still a single wrapping tool, it is not a facet editing tool, nor a UV mapping tool, so changing one face will affect the look of other faces.

It is beyond the scope of this wiki to cover all the hundreds of different scenario's, its best just to have a play and see what you like,

The modes planar, spherical etc. operate the same in user mode, most of the time you will probably use box setting.

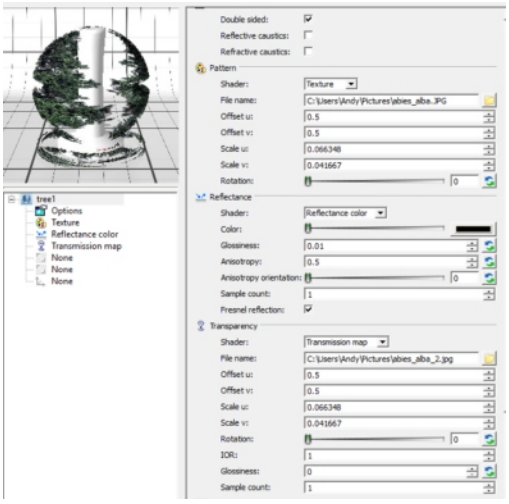
As a last example on the subject of scaling, the image on the left was wrapped using
X axes = 3,3,0
Y axes = 0,3,3
Z axes = 0,0,3

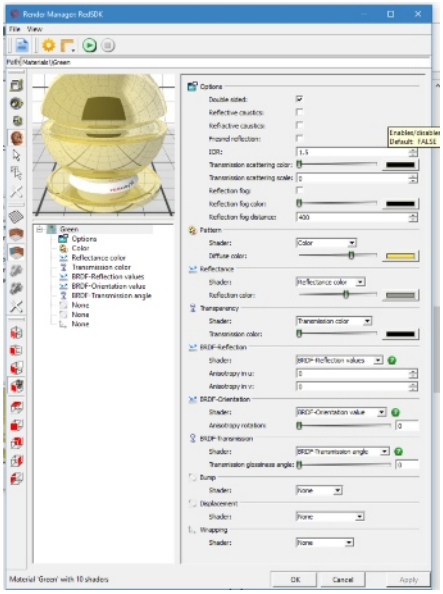
As can be see, as before tying two figures into one axes causes rotation and increasing the numbers causes scaling. unfortunately the 'magic' formulae for exactly predicting the wrapping is unknown.

Differences in TC 2017 (version 24)

The material dialog box has been redesigned in 2017, though many options work the same, for example, double sided, caustics, normal reflection, transmission, IOR, bump, displacement and texture space.

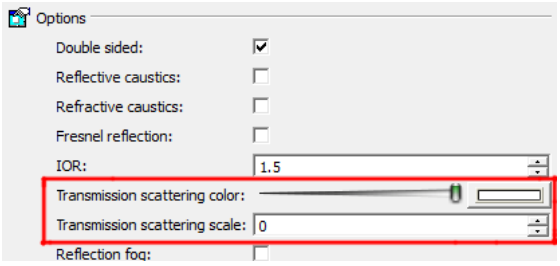
The changes in 2017 are the addition of Transmission scattering, reflectance fog, and BRDF information, BRDF (Bidirectional Reflectance Distribution Function) is used to provide greater control over glossiness and Anisotropy, whilst in 2016 and previous versions glossiness and Anisotropy were controlled with simpler adjustment.





Transmission Scattering Color - *This is an extra absorption term that can be specified for the material transmission. It uses an out-scattering color and an out-scattering scale used to specify the amount of energy being absorbed along the path of a ray for each unit length crossed in the model media volume.*

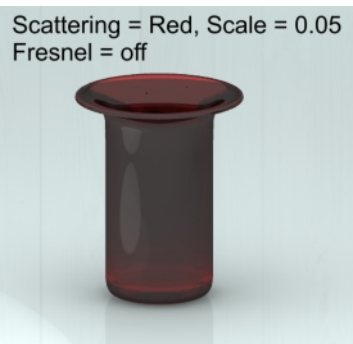
Transmission scattering scale - *Scales the effect of the transmission scattering color*



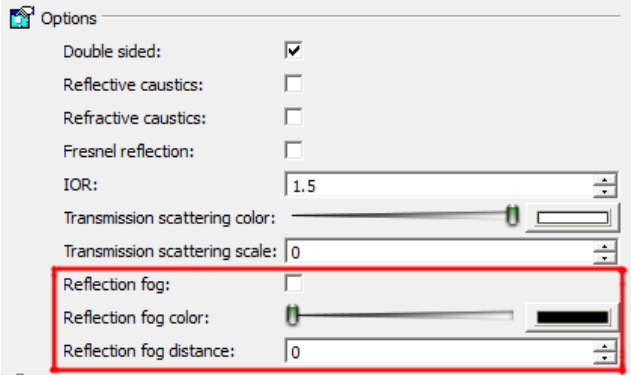
These two values are normally used together, when light passes through an object it is often deflected based on the IOR value which in effectively means the light is bent within the object, with scattering an extra level of light bending occurs with the light beam bending at multiple angles as a light beam passes through the object.

The scattering colour changes the light colour within the object whilst the scale increases the amount of scattering, the scale factor should be changed in small increments as a large scale can 'black-out' the light, Fresnel also plays a part in how the light enters the object, thus affecting the scattering.

Example of different settings with and without Fresnel are shown below.

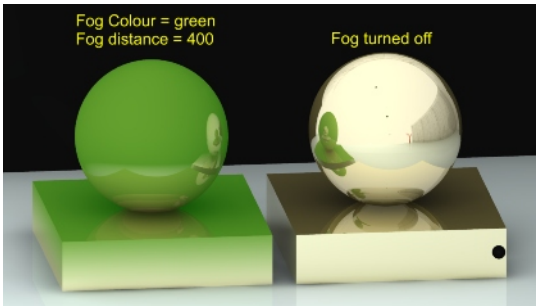


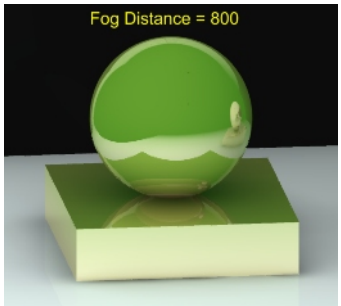
Reflectance Fog - *This is fade-out term that can be specified for reflections. At a certain distance, the color of the reflection becomes equal to the specified reflection fog color, and any other visible reflection is lost.*
Reflectance Fog Colour - *Controls the color of the reflection fog*
Reflectance Fog Distance - *Defines the distance at which the true reflection color gets replaced by the reflection fog color*



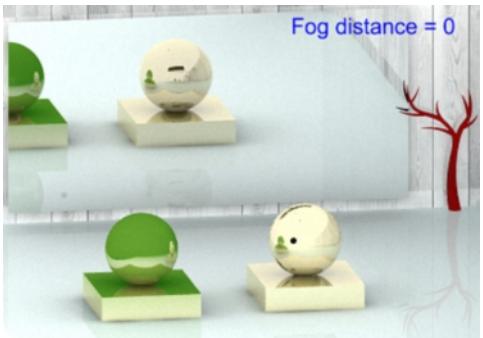
Unlike environmental fog, Reflectance Fog is specific to an object, and only affects the fog applied to the object materials not neighbouring objects if their material fog is turned off.

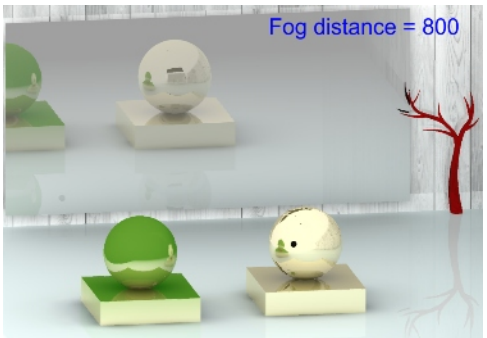
The fog effect is controlled by a colour (Green in the example below) and distance from the object, therefore a low distance figure can fog out the whole object, whereas a high figure can allow the original reflectance to show up before the fog takes affect.





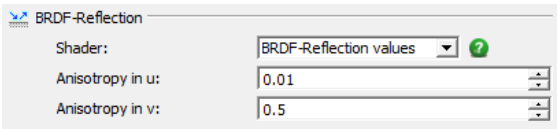
When Fog is attached to a mirror material the fog effect can clearly be seen.

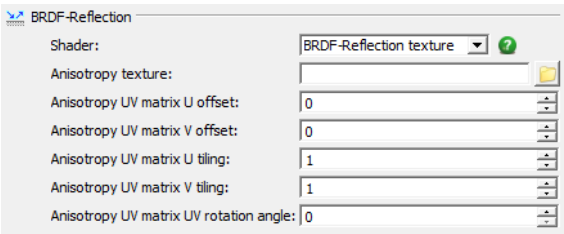




BRDF Reflection - *The Bidirectional Reflectance Distribution Function is a function that defines how light is reflected at an opaque surface.*

This controls the Anisotropy / Glossiness settings which were part of the normal reflection section in Pre-2017 dialogs, in 2017 Glossiness has been incorporated into Anisotropy which has been put separately with more controls added, The various settings let you set the glossiness parameter of reflection. The glossiness parameters control how much the reflections/transmissions are blurry. Depending on the chosen glossiness values, the results may vary a lot:



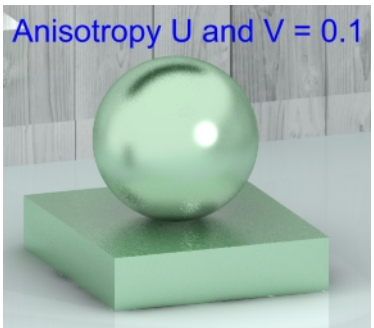


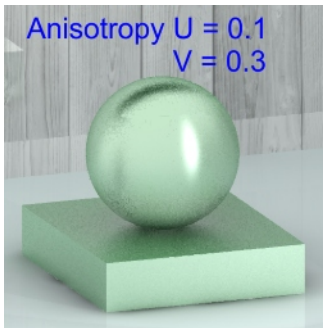
Glossiness is achieved by increasing the "Anisotropy in U" and "Anisotropy in V" parameters. If both parameters are identical, then, the reflection is isotropic. If both parameters have different values, the reflection is anisotropic, like on a CD-ROM surface or on hairs and furs.

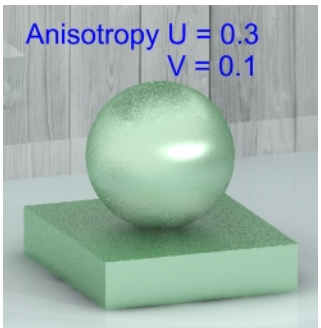
Like the normal reflectance settings, there are two modes,

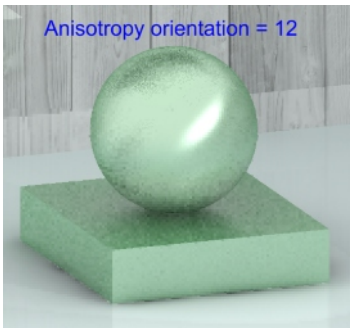
The simplest one will adjust the two Anisotropy U and V values, If both values are the same then the reflection is Isotropic, for high Anisotropy reflection could be U= 0.1, V = 0.95, or u = 0.95, v =0.01.

As with previous versions, Anisotropy shows up well when light / view are at different angles to the object, the images below show variations in U, V and BRDF orientation. The light is shining at an angle from above the object.









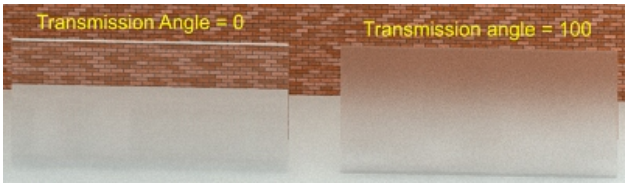
Anisotropy Reflection Texture - Controls the anisotropy texture
Anisotropy UV matrix U offset: - Controls the translation of the texture along U
Anisotropy UV matrix V offset: - Controls the translation of the texture along V
Anisotropy UV matrix U tiling: - Controls the number of texture repetitions along U
Anisotropy UV matrix V tiling: - Controls the number of texture repetitions along V
Anisotropy UV matrix UV rotation angle: - Controls the rotation angle of the texture

This addition in 2017, applies a texture in the same way Reflectance texture works, however the texture is used to vary the glossiness settings, a variable glossiness is applied to the lighter areas (white = high glossiness = Grainy) and glossiness reduced or omitted from the darker / blacker areas, the tiling, offset etc. operate the same as standard reflection texture,

BRDF Orientation - Controls the rotation of the anisotropy

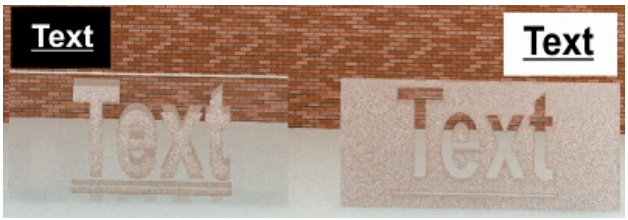
BRDF Transmission - Controls the glossiness of the transmission (Transparency)

There are two modes, simple transmission glossiness angle, which will increase / decrease the glossiness (grain) of the transparency, as can be seen increasing the glossiness setting increases the grin.

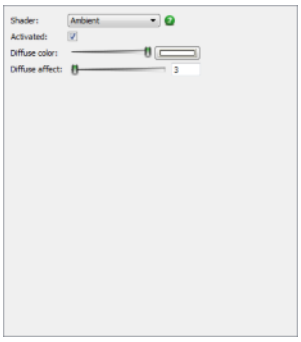


Prior to 2017 this setting was included as a single transparency option, in 2017 it allows for a separate glossiness texture to be applied.

Glossiness texture - The sub values (offset, tiling and rotation) operate the same as other sections in the material set-up for example transmission texture, BRDF can be used to add a sort of frosted appearance to a transmission, where black or dark areas are transparent, white or light areas being grainy.



Ambient Light

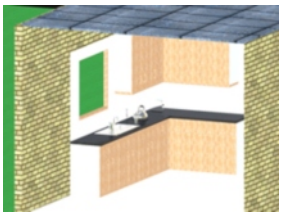
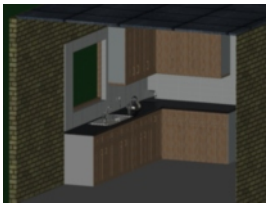
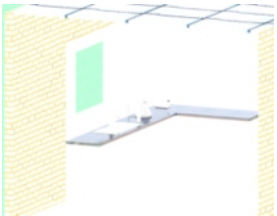


An ambient light adds a constant overall light source which affects the whole scene, the ambient light is generally used in conjunction with other lights, and can be used to eliminate black areas, If Overdone, Ambient will 'wash out' a render, it should (in my opinion) be used for subtle changes in lighting

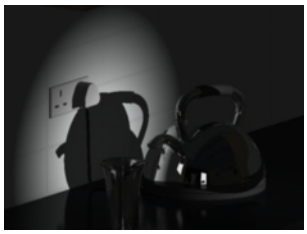
PARAMETERS

- **Diffuse color** – Sets the diffuse colour of the light.
- **Diffuse affect** – Sets the relative intensity (power) of the diffused light.

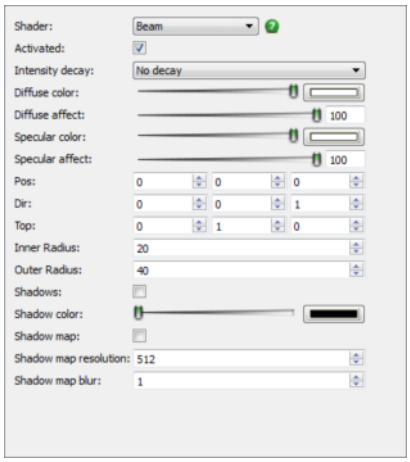
The two settings are effectively interlinked and are used together, mostly the diffuse affect can be set to 1 or two, and the diffuse colour left at greyscale set towards the black (left) end of the scale, higher values can wash out the scene.

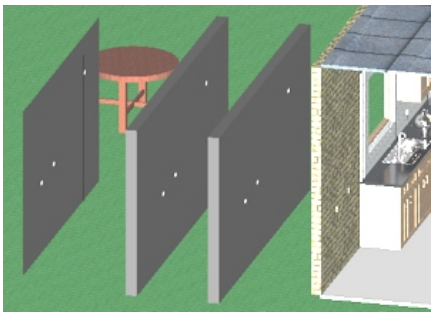
In the images below the first has just a beam light, the second has a bean light + added ambient set to Diffuse affect = 3, allowing one to just make out the electric cord, in the last one again with a beam + Ambient but the diffuse colour was set to a brown, by adding a touch of ambient one can see detail not available with beam light alone.


Beam Light



A Beam light creates a single beam of light. This light, in it's normal state, is of infinite length which can pass through objects, as can be seen from the white dots in fig,

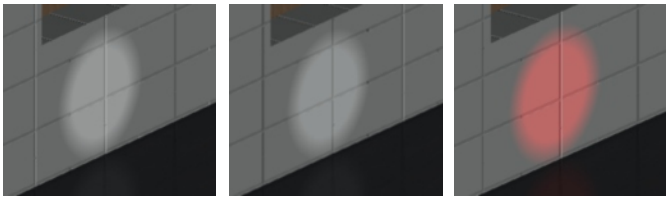


The light is held in check by use of the shadow tick box (with limitations), or by using the Intensity decay. Intensity decay reduces the light power as distance increases.

The beam Light is defined by an inner and outer radius with the inner being bright and the light decaying to the outer radius.

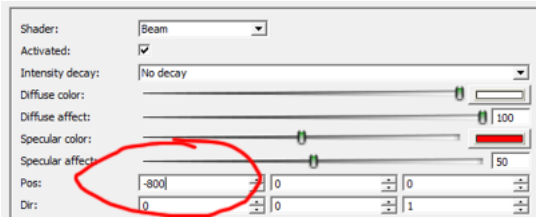
PARAMETERS

- **Intensity decay** – This Set the rate at which the lights power diminishes with distance. See separate intensity decay page
- **Diffuse color** – Sets the diffuse colour of the light.
- **Diffuse affect** – Sets the relative intensity (power) of the diffused light.

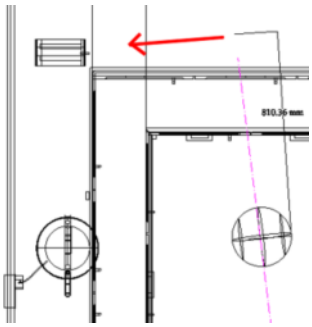


Diffuse colour and affect, do a similar job in black to white colour, the difference comes when one uses a non grey colour, the diffuse colour midpoint of the slider is the selected colour, moving the slider toward 0% darkens the colour, moving towards 100% lightens the colour eventually reaching white, the setting of these is trial and error and personal preference.

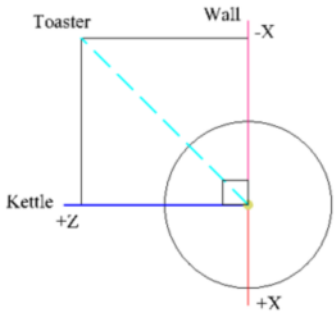
- **Specular color** – Sets the specular color of the light.
- **Specular affect** – Sets the relative intensity (power) of the Specular light.



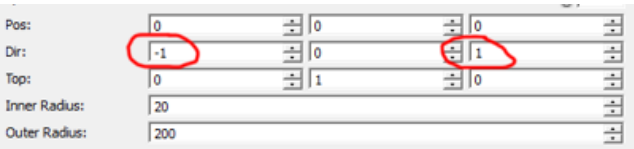
Specular works on per coloured objects, i.e. objects with no material attached, it is ignored when materials are applied, the effect of specular colour can be subtle or non existent, the specular affect alters the amount of light (shiny area) on a curved object.



Pos – This Sets the X,Y,Z position of the light relative to the object being used as the luminance i.e. it sets the position from which the light will emanate,

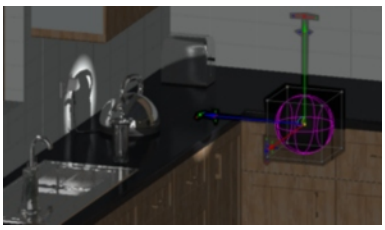


iIn this example the light is moved to the toaster without moving the source (black sphere), why would you want do this ?, Well, this is just an example and



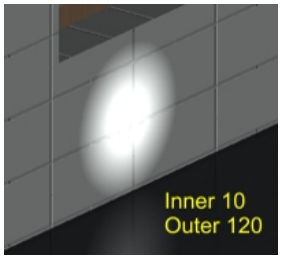
you wouldn't normally do it, but say you have set a scene and the luminance was from a fixed object like the bottom of the cupboard, if you them moved the kettle a few mm you couldn't move the cupboard, therefore one changes the position to compensate.

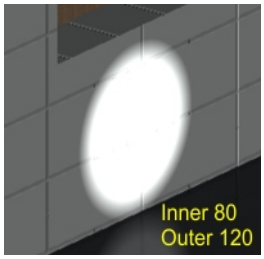
- **Dir** – Sets the X,Y,Z direction of the light relative to the position.



Dir determines where the light will be pointing, if our beam is pointing towards the kettle, and we wish it pointing towards the toaster but for whatever reason we cannot move nor rotate the luminance object, this setting will allow the scenario to be completed.

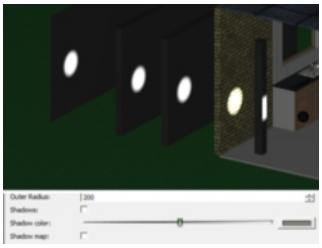
In this example I've made it easy, the toaster is 45 degrees from the luminance source, looking at the first figure, the toaster is lies at +Z but lies in the -X direction, +Z is already at 1, therefore for a 45 degree angle, X must also = 1, however as we are wanting it in the minus direction this becomes X = -1, as can be seen below this is input into the Dir row, andf the resultant beam is angled accordingly.

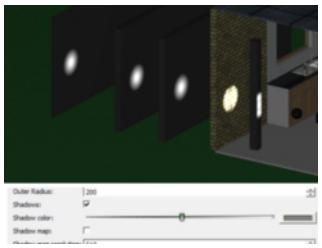


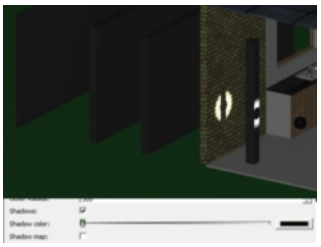


- **Top –** Defines a second axis which is perpendicular to the direction, used for the rotation, if the lights display is not circular.

This is an odd one, in theory it sounds like one can switch from default 0,0,0 to 1,0,0 and the light would just rotate, unfortunately it isn't that simple,







- **Inner Radius** – Sets the inner radius for the light.
- **Outer Radius** – Sets the outer radius for the light.

The inner radius defines the bright spot, the light then decrease between inner and outer, with no light beyond outer radius,

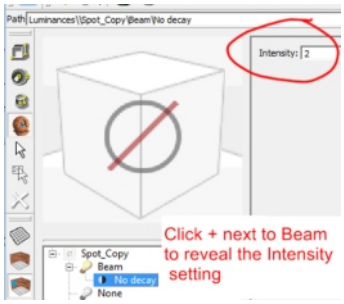
- **Shadows** – Sets whether the light will generate shadows, or not.

As can be seen below, on the left we have no shadows the beam is constant as it passes through objects, in the centre, shadows is turned on with the shadow

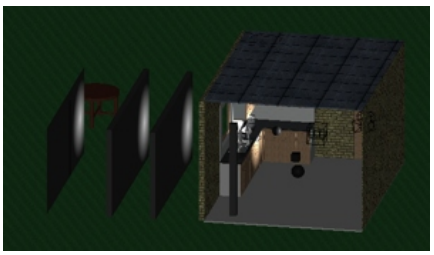
colour at medium, the beam / shadows are muted as they pass trough objects, on the right the shadow colour is set to black, the beam still passes through, but the black shadow cast by objects / walls means the beam is no longer visible.

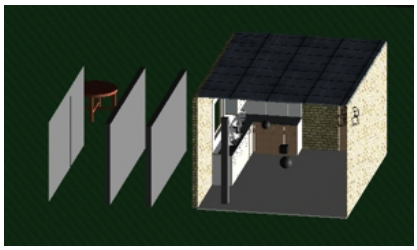
- **Shadow Color** – Specifies the color of shadows created by the light.

As can be seen above, if the colour is a grey colour it will act like diffusing the bean, however change the colour and some unusual lighting can be achieved, in this example we change the colour to light yellow, which completely changes how the rendering will look, this setting is purely personal preference as to what colours one finds appealing.



- **Shadow Map** – Shadow maps are generated by testing whether or not each specific pixel is visible from the light source. This accomplished by





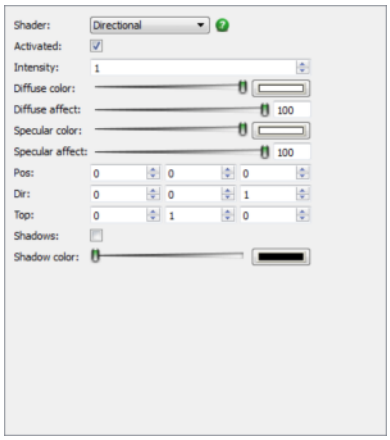
comparing each pixel to a depth image (z-buffer) of the light source's view, stored in the form of a texture file. Shadow maps can accelerate the rendering of shadows, but usually as the cost of some quality.

- Shadow Map Resolution – Sets the resolution of the shadow map. Values must be a multiples of 2.
- **Shadow Map Blur** – Sets a blur factor on the shadow map, reducing jagged edges and transitions.

Intensity

A last setting is Intensity, accessed by clicking the '+' sign against Beam in dialog,box this increases or decreases the light / luminance in the same way a dimmer switch works, its trial and error which value is best in any given situation.

Directional Light



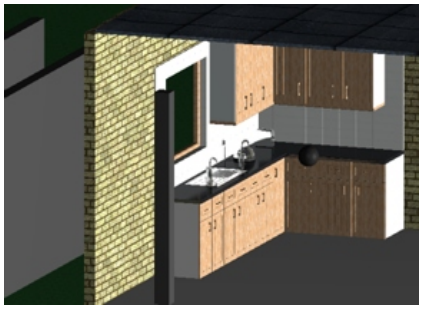
A Directional light shines a along a path defined by Dir. and continues infinitely in that direction and at the same intensity, it is also an infinitely wide light, ahich acts , .
Directional lights can't cast shadow maps. Beam lights are also directional lights but thy are able to use shadow mapping.

Directional luminance differs from the normal directional lighting in that it is infinite in length and width and, irrespective of position, extends before and after the model. The standard directional light as reported by Design Director, is more like a bean light, Directional luminance doesn't have any of the same restrictions if shadows is not selected, its a bit like the light goes around the world an comes back to itself.

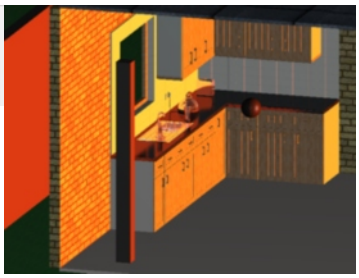
PARAMETERS

- **Intensity** – Set the intensity of the light.

As the name suggests it alters how bright the light will shine, this should be adjusted with the diffuse affect as one affects the other, the left picture is intensity =1 the right has intensity = 5, NOTE shadows is turned off.



- **Diffuse color** – Sets the diffuse color of the light.



The majority of the time one would leave this at a grey colour, however changing to another colour can produce unusual effects, below the colour was changed to red,
Note - when selecting a colour the slider will be at the middle, moving the slider up or down makes the selected colour lighter or darker.

- **Diffuse affect** – Sets the relative intensity (power) of the diffused light.

- **Specular color** – Sets the specular color of the light.
- **Specular affect** – Sets the relative intensity (power) of the Specular light.

The Specular effect is over-ridden by material settings but shows up well on non-material faces (pen / brush coloured objects),