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Tutorials

Refraction

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Materials in general

First I want to start off by saying a little something about materials in general. A good material, in my opinion, is a material, which makes a model appear believable, or realistic. I love it when I'm looking at an animation and I get the feeling I can really touch the models. Creating such 'good' materials can be pretty tough, since Blender offers you a great amount of control over a materials properties.It takes a lot of tweaking to get your material to look *just* right and you shouldn't expect perfect results at the push of a button. Getting to know Blender's settings and the way different variables interact with each other is crucial, but it's also very important to have a keen eye for the real world. You'll never be able to make a realistic looking material just by tweaking the many variables if you don't study the appearance of the object you're trying to recreate.

Also note that it's the animator's objective to create effects that appear to be realistic or believable, not effects that are physically correct! This holds true for almost everything in 3D animation. But of course that doesn't mean that some knowledge about the real world doesn't help.

One other thing: there's no such thing as a perfect material. A wood material may look very nice in one scene, but might look horrible in another. A materials settings need to be adjusted according to the rest of the scene, according to lighting and surrounding materials (this holds true especially for the refraction technique discussed in this tutorial). It's very important to set up good lighting for your materials, because materials interact with Blenders lights.

TIP: When experimenting with different settings it can be very useful to compare renderings. Luckily Blender has two render buffers: Render your image. Hide the render window and change your settings. Press J to toggle the render buffer. Render the second image and now you can toggle between the before/after images with J. You can also press Z to zoom on images to examine artifacts.

Okay, so much for the philosophical part. Let's get to the fun stuff! This tutorial is about making realistic looking glass, so I've spent a lot of time examining glass (or it's appearance, actually) closely - and I have to say the bartender from the bar around the corner has started to like me a lot... Taking a closer look at the glasses there I noticed a few key points, of which most importantly that glass is never truly transparent.

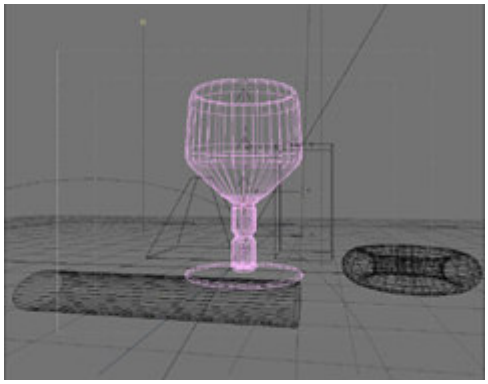
This means that glass:

- refracts it's environment,
- reflects it's environment,
- has imperfections.

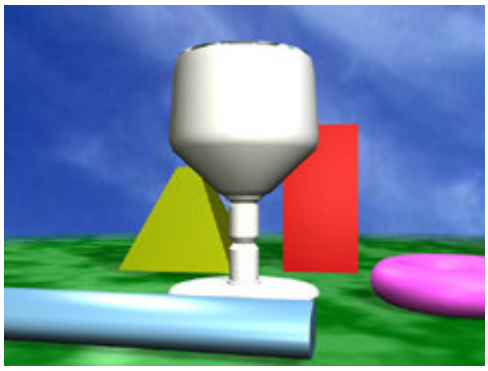
The basic settings

I've set up a little scene for you, so download the file 'glass.blend' and load it into Blender. You'll see the scene I set up, containing a few basic objects and the glass.

Download: glass.zip



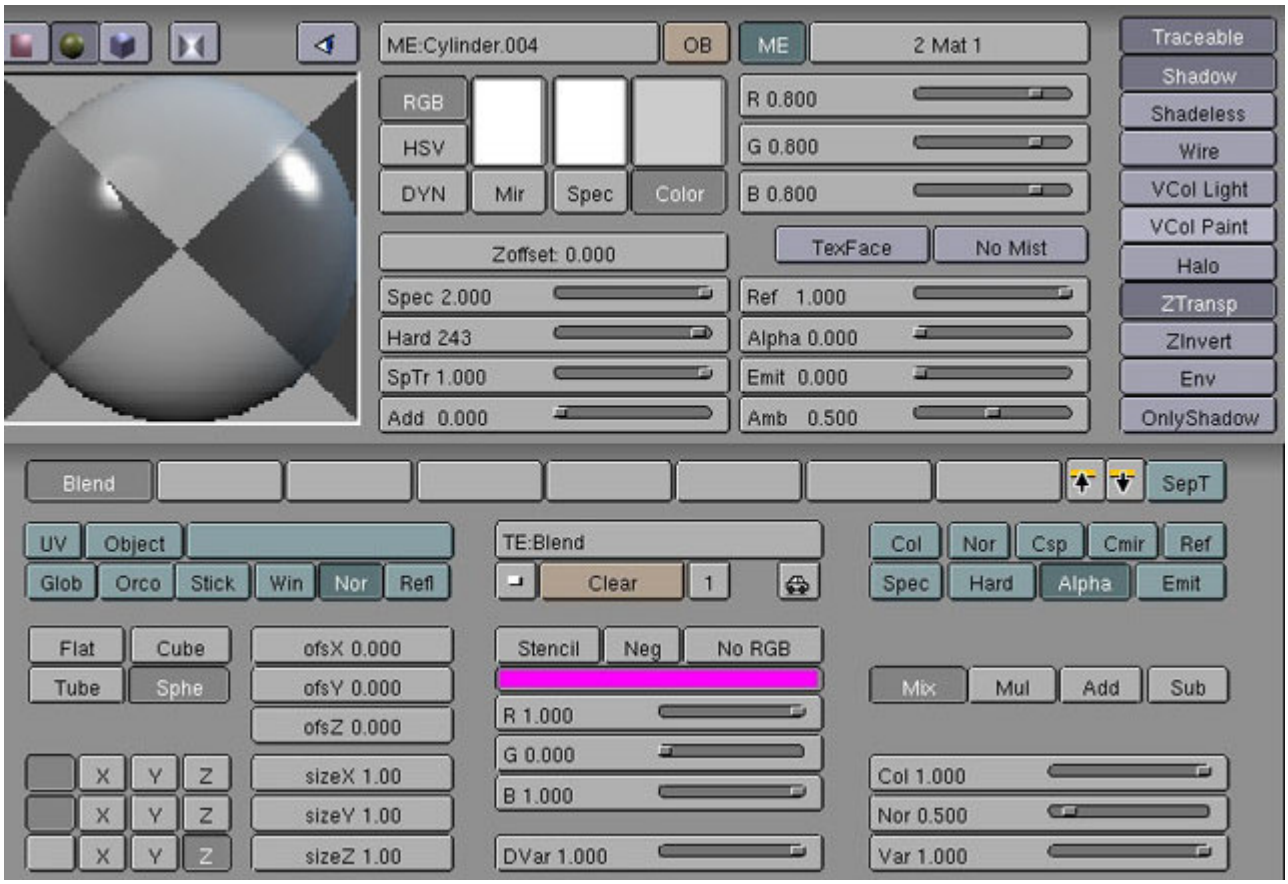
There are a few things to take notice of in the scene.
First the glass I modeled has no inner wall. I removed the inner wall afterwards because the final result looked much better without it (if you ever tried making a glass material with Ztransp turned on you probably know you always see the inner wall as well and you can't see the inner wall like that with a real glass).

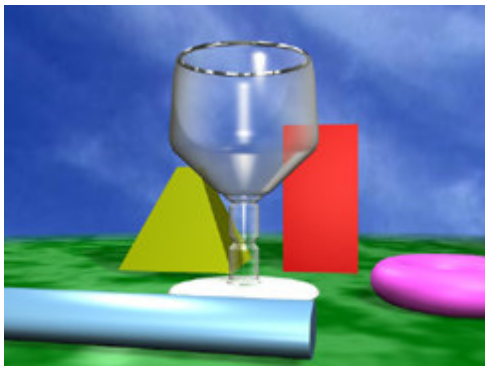


The second thing is the glass has two material indices, but only one has a material assigned to it. If you do a test render you'll see the second material index is the chrome edge of the glass and that the rest of the glass has the default material, which Blender uses to render (parts of) objects without a material assigned to it.

Okay, time to get to work. We'll start by assigning a new material to the glass. With the first material index selected, select 'Add new' in the MaterialButtons F5 and name it 'Glass'. Set Spec, Hard, SpTr, and Ref to full. A 'simple' way to fake glass can be found in the file 'tutor_1.6.zip' available from ftp://ftp.blender.nl/pub/.

Let's use this as a starting point: add a spherical blend texture with a spherical nor mapping. Disable all mapping except for the Z-axis. Select 'Mix' and 'Alpha' for the output mapping. You'll have to turn down the materials alpha and select Ztransp to see the effect. If this is a load of nonsense for you take a look at the screenshot for the settings.





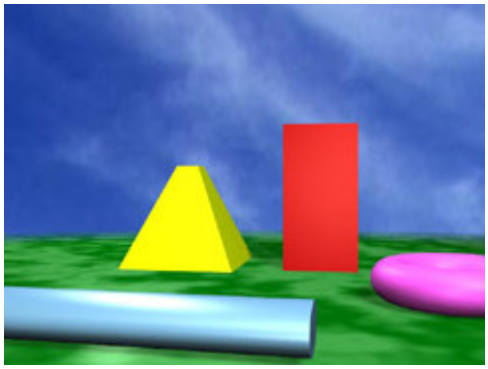
If you render the image you'll see the glass is starting to look better, but we're far from done. After all we wanted to have refraction.

A suggestion offered for this is to use an environment map with a negative SizeZ value. This can turn out pretty nice as long as you're working with spheres or other basic shapes, but when the geometry becomes more complex the fiddling with the settings becomes very cumbersome.

Think about this (I did, anyway): what does refraction really mean here? The way I see it, refraction means that anything behind the glass should be visible, but it should be distorted according to the glasses geometry and imperfections. When you're trying to use inverted environment maps you're seeing the objects behind the glass from the glasses perspective, which results in very extreme distortions not suitable for thin, hollow glass like we're trying to create here. What I really want to see is the scene without the glass and to distort that image according to the glasses geometry and imperfections.

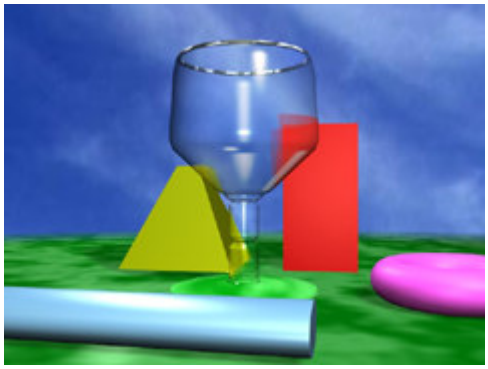
Refraction

That sounds like a nice idea, so let's render the image without the glass. Move the glass to layer two using M > 2 > Enter and hit F12 to render. Press F3 and save the image as 'refmap1.jpg', add a new texture to the glass material and name it 'RefMap'. Choose image in the TextureButtons F6 and load the image we just saved. Press Shift+2 (mouse over the 3D Window!) to reveal layer 2 with the glass and render the image to see what it looks like.



refmap.jpg

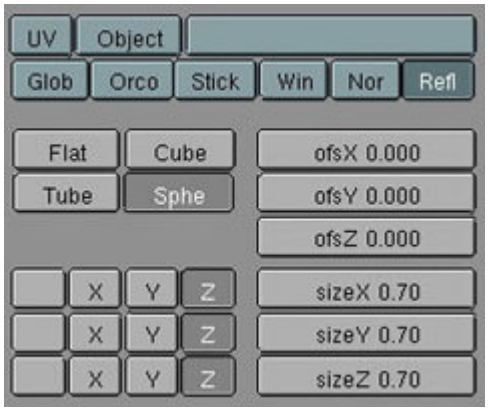
It's not much yet is it? If you play around with the different mapping types, you'll notice that finding the right look appears somewhat impossible, with the exception of the 'win' mapping. However this mapping is undesirable because it doesn't allow much deforming. After a good afternoon of tweaking the different settings I finally found the solution. Use the camera for the texture coordinates! The only things that need adjustment are the SizeX and SizeY parameters, which relate to the distance between the camera and the refracting object. This is no real problem for stills, but when animating you'll have to keyframe these parameters. Perhaps it would be nice to write a python script to link the Size to the distance, like Iceman's script that automatically places the empty for planar reflections.



Set SizeX and Y to 0.40 for now, and it should look okay. Well... maybe not, but at least the refraction map looks okay.

My glass doesn't look like glass yet!

Now we've got the refraction set up, but the whole thing does not look like glass yet. One thing that doesn't look right is this blend texture. Like I said, making a material look good requires much tweaking, and finally I found the following



settings look best for this glass.

Another thing that needs to be taken care of is the shading on the glass. If you look at glass closely, you'll notice that it doesn't receive any shadows. The first thing we can do to fix that is to click the button labeled 'Shadows' which controls whether or not an object is able to receive shadows from other objects. Though it looks better this doesn't solve it completely, because the shading from the lamps is still visible.

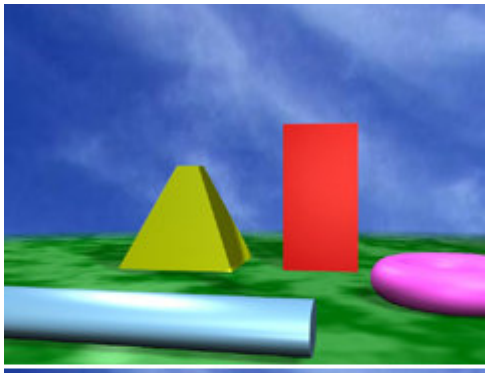
Now we don't want to set the 'shadeless' option, because then we'd lose the specularity as well. A quick way to fix this is to set 'emit' as output mapping for the refraction map. This, however, is a setting that makes your glass very sensitive to its surrounding materials!

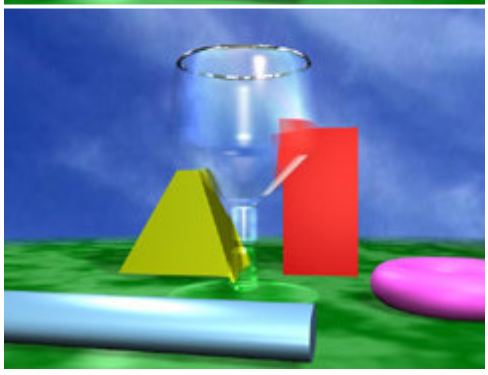
If you think the refraction looks too bright you can adjust the amount of 'emit' with the 'Var' slider.

We're still not done, so what else is wrong? You might have noticed that the yellow pyramid doesn't receive a shadow from the glass in the refraction map. To fix this we'll need to render the refraction map again, but this time we'll need to do it with the shadow from the glass.

Here goes: duplicate the glass and move it to layer 3. Name it something like 'Glass.Shadow'. Add a new material to it and name it 'Shadow'. We only want the shadow, so this duplicate has to be invisible. The problem is that if you set the Alpha to 0 and click Ztransp it wont cast a shadow anymore! A little trick to solve this is to set the Alpha to 0.001 instead of 0.000. That way it's still (practically) invisible, but shadows are still cast. Now go to the EditButtons F9 and delete the second material index. Make sure '2 Mat: 2' is selected (if you're using my file it'll say 'Chrome' above this button) and click the pink button labeled 'Delete'.

Now render our new refraction map by selecting layers 1 and 3 and hitting F12. Save the new map as refmap2.jpg or overwrite the old one. Disable layer 3 and enable layer 2 again. Select the glass and reload the RefMap image in the TextureButtons F6. If you did everything correctly up to now you should have a pretty glassy looking glass now.





The little things...

Wow! Almost done... now it's time to add two more details (I mentioned them earlier): reflection and imperfection!

The imperfection will be done with a stucci texture. But to make it work the stucci texture needs to be on texture channel 1 (a texture can only affect textures in higher channels), so we'll need to move the other textures up. Now

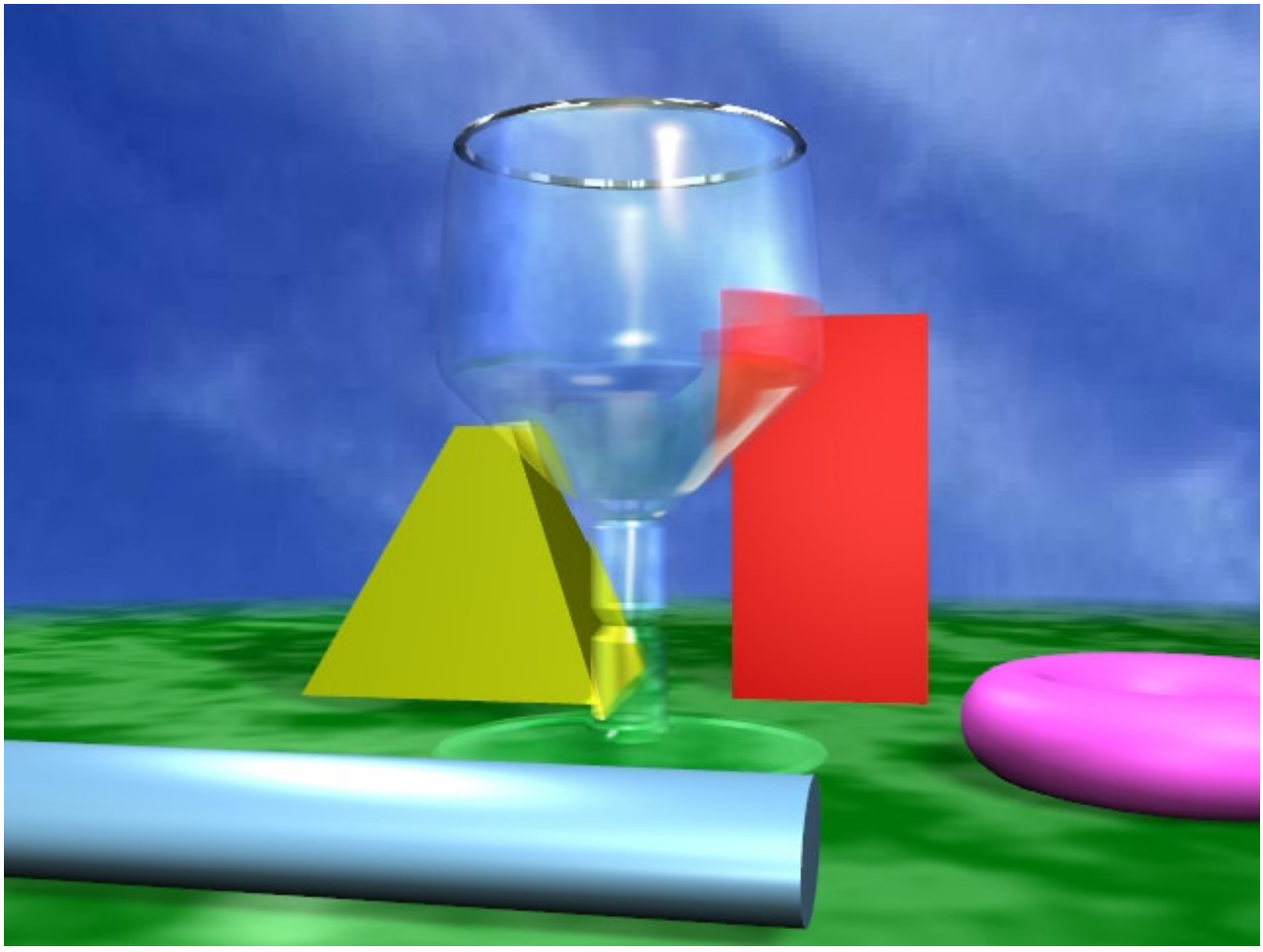
you're probably thinking 'Oh no! Now I have to memorize all those little settings and enter them again and I don't wanna!' Luckily Blender has a copy/paste buffer for this sort of thing, which makes it pretty simple to move textures around in the different channels.

Back in the MaterialButtons F5, select the blend texture. To the right of the texture channels you can see two buttons with arrows on them. The one with the up arrow is the copy button. Click it and Blender informs you with a popup, 'Copied!' Click it or move the mouse away. Click the pink button labeled 'Clear', select channel 2 and paste the blend texture with the button with the down arrow on it.

Now move the RefMap texture to channel 4 (!) and add a new texture in channel 1. Choose stucci in the TextureButtons F6. Choose 'nor' as the output mapping in the MaterialButtons F5. You might want to play with the NoiseSize and Turbulence, but for now I left them at the default setting.

Now all that remains is the reflection.

Add a new texture in channel 3 and choose envmap and enter 'Glass' in the Ob: field. To get a nice and clear reflection the cube res has to be quit high and filter should be low, but that increases the render time... At a resolution of 640x480 I found cube res at 250 and filter at 0,10 (the lowest setting) looked best. Select Col, Alpha and Cmir as output mapping and set the Col and Var sliders to 0,250. Finally you might want to play a bit with the Offset of the reflection to make it look more natural. I found OffsY: 0.100 and OffsZ: 1.200 looked nice.



In closing

Pfew! That's quite a tutorial (to write, anyway). Render the scene and marvel at your glass... you might

want to try the Unified Renderer, which gives stronger highlights and clearer transparency (rendering magic!).

A little note on animation: of course you can animate the refraction map as well, but you'll have to render the entire animation without the glass first. You'll have to adjust the Clipsta value of the camera so any objects in front of the glass won't be rendered. Load the animation as a texture and don't forget to set the number of frames. If you saved the animation as AVI you'll also need to click the green movie button. You can download the animation below. You can also download the finished .blend file.

A little note on caustics: if you want the glass to really look realistic then you should also add caustics to it. Unfortunately this is beyond the scope of this tutorial, so you'll have to find a nice way to do this yourself (or maybe I'll write another tutorial, who knows!).

Of course you can always send me an email if you get stuck or have any questions or suggestions. Don't hesitate to contact me at: willem@blender.nl

I hope you enjoyed this tutorial,

Zycho

Download: glass_done.zip

Download: glass.mpeg

Feedback

dmx 2000 12 06

Finally i can i can make the glass for my F-14 Tomcat!!!

jaf 2000 12 05

VERY USEFUL! THANX

WCFireball 2000 12 05

Nice! Now I can finaly complete my house! (Up to now it was without windows!)

Taylor 2000 12 05

let there be glass!! finaly i can do good glass.:-)