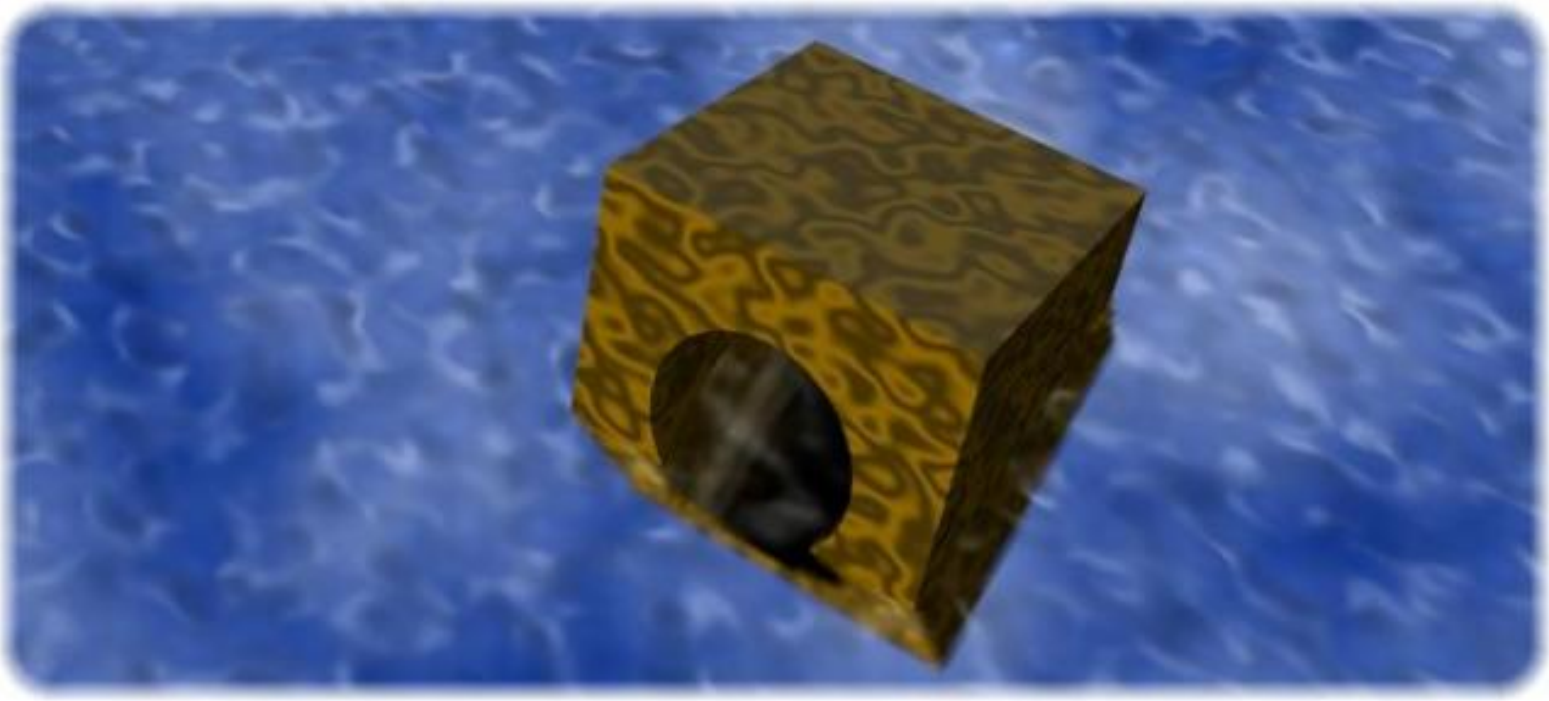

TUBE THROUGH CUBE

Constructive Solid Geometry

Creating booleans in Blender is not as simple as in many computer aided design applications. These tools which are also called constuctive solid geometry tools can be used to for example make holes and connect objects. Blender doesn't has CSG tools, only C-Key owners can enjoy of intersection tool which enables CSG style feature. Without CSG tools it is also possible to create really complex objects with holes and attachments. In the image 1 is introduced different kind of boolean operators which can be done for two spheres.

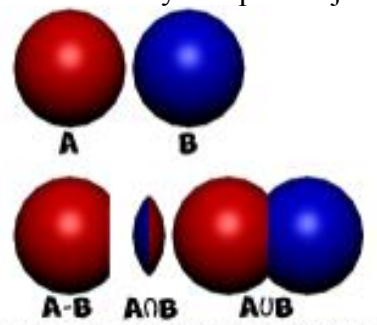

IMAGE 1. BOOLEAN OPERATIONS

This tutorial will explain how to make simple CSG manually. Selected objects are cube and tube which are easily done in Blender and objects doesn't need complex manipulation to achieve the result. It always needs some imagination to achieve really complex CSG without proper tools.

How to do the object in Blender then

Start Blender and you will see the startup screen showed in Image 2. First thing is to erase the plane. This is done by selecting the plane and pressing XKEY and then ERASE SELECTED button which will be shown on the screen. After the 3D view is all empty except the cursor, it is time to change the the view to Front view which can be achieved by pressing PAD_1 or selecting the button pressed with "F" option in image below.

The Cube

Now the camera is seen from behind but the area is still empty, so it is good time to create the first object, the cube. Press SPACEKEY and the menu will appear on the 3D window. Select ADD Mesh buttons and new menu will be shown, the Cube button should be selected. Menu selections are introduced in image 3.


IMAGE 2. STARTUP SCENE

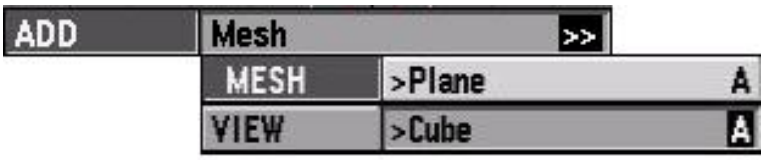

IMAGE 3. CREATING THE CUBE

The Blender menu can be shown as well by pressing the question mark character in the blue triangle at the top right corner of the Blender window.

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After creating the the cube, looks the 3D view just like there would be a plane. So it might be better to check that the object really is a cube. Moving the mouse cursor over the 3D window pressing mouse middle button down and same time moving the mouse a little bit, the 3D world rotates like in image 4. That is anyway not the way the cube is easiest to be edited so, pressing the 1_PAD key the 3D view is changed back to front view. In this point the edit mode could be leaved, but it is **not** recommended because cube and tube should be anyway to be joined together later.

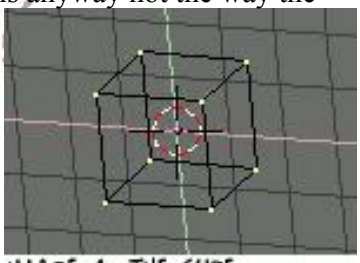

IMAGE 4. THE CUBE

The Tube

Making the tube is just as hard as making the cube. By presing the SPACEKEY mesh menu will appear on the screen. And because the previous object which was created was from mesh class the Blender offers that this object could be mesh as well. This makes the tube selection really simple (image 5).

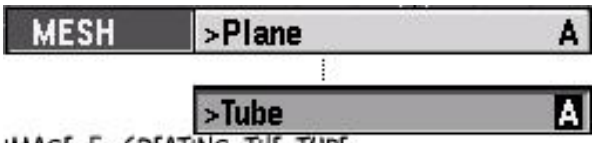

IMAGE 5. CREATING THE TUBE

By selecting the tube from the menu another menu will appear on the screen asking how many vertices there should be in the tube. The default value 32 is just ok, accepting the value is done by pressing the OK button next to the number. Now the tube will appear around of the cube. Because the tube is wanted to be inside the cube it has to be scaled so it fits into the cube. Of course the cube could be scaled bigger but then much of great modelling techniques would be without teaching. Scaling is done by pressing SKEY and same time moving the mouse. It has to be done so the mouse is moved toward the middle point. While scaling pressing the CTRL button down the scaling will use grids. In this tutorial scaling factor was 0.4 for all axises. The result should be something like in the image 6, if the 3D view is rotated. Now the tube should be edited so the tube is exactly same length as the side of the cube. This can be easily done from side view which can be achieved by pressing 3_PAD key.

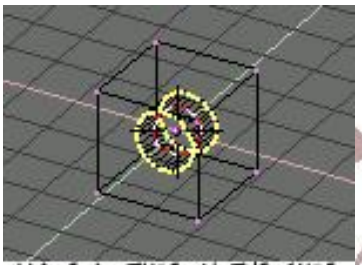

IMAGE 6. TUBE IN THE CUBE

As noticed from side view the tube is too short so it should be stretched. Scaling the whole tube is not accurate enough for this action, so both ends of the tube should be moved to same level as sides of the cube.

The object is still in EditMode but all vertices of the tube are still selected, which is shown by yellow color. By pressing AKEY all vertices will be deselected. Next the left side vertices of the tube will be moved exactly to same y location as the left vertices of the cube. This is done by setting the cursor to the other side of the cube and selecting the side with BKEY and growing the selection rectangle over left side vertices of the cube (image 7).

IMAGE 7. SELECTING VERTICES

IMAGE 8.

The cursor still sits on the middle of the 3D view but can be easily moved to the middle of all those four side points which just were selected by pressing SHIFT-S and selecting *Curs -> Sel* from the menu. Image 8 shows rotated view of the 3Dwindow after the 3Dcursor has been moved to right place. Scaling vertices using 3Dcursor as zero point will move all selected vertices towards the 3Dcursor and eventually move all vertices to one point which is the 3DCursor. But because the meaning is move vertices so their y-coordinate will be same as the y-coordinate of left vertices of cube the scaling will be done disabling all other axis scaling except the y-axis. So how this all can be done ? Now the situation is approximately like in image 8, but the view point is from side view (3_PAD). Now all vertices should be deselected (AKEY) and tube's left vertices should be selected (BKEY and rectangle over tube's left vertices). The 3DCursor should be selected as zero point and this can be done by pressing DOTKEY or selecting the button activated in image below.

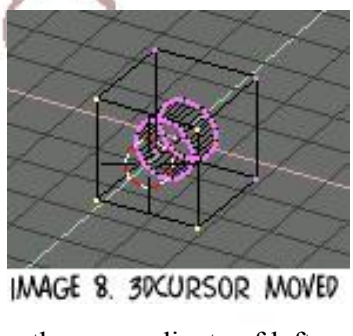

IMAGE 8. 3DCURSOR MOVED

Time for scaling vertices y-coordinate to correct place. First the mouse cursor should be moved to left or right side of the 3DCursor then the SKEY should be pressed and the mouse cursor has to be moved to left or right and same time when moving the mouse pressing mouse middle button.

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All vertices has been moved to same y coordinate after the Sizey is 0.000. The CTRL (the grid mode) should be pressed down before accepting the scaling by left mouse button. Image 9 shows how the vertices are moved to correct place and also there are all values of the sizes of object axises. Now it is time to move right vertices of the tube to same y coordinate as right vertices of the cube. This is done exactly same way as left side. First AKEY to deselect all vertices, then BKEY and rectangle over right side of the cube and SHIFT-S and *Curs->Sel* to move the 3DCursor. Then BKEY to select right vertices of the tube and SKEY to move vertices towards the 3DCursor. Because the cursor is already set to be the midpoint of scaling and rotating the DOTKEY doesn't has to be pressed. At last it is time to exit the EditMode by pressing the TABKEY. Same time the EditMode is exited the object data is saved to Undo Buffer. So next time EditBuffer is entered and the object is edited the saved data could be returned by pressing UKEY.

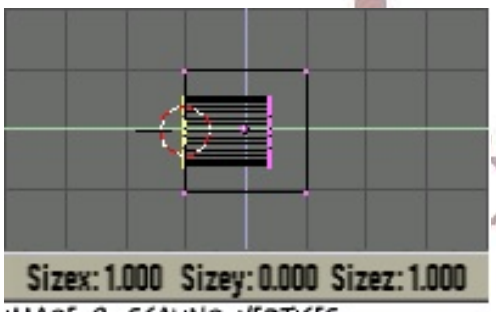

IMAGE 9. SCALING VERTICES

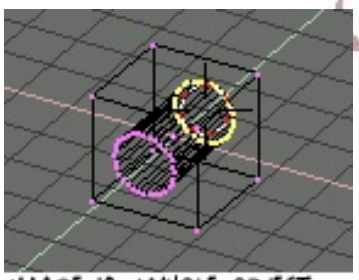
IMAGE 10. WHOLE OBJECT

Cutting the Hole

So EditMode should be entered immediatelly after it was leaved, just because the object data was saved to Undo Buffer. Entering the EditMode is done by pressing TABKEY. So how to cut the hole to the cube ? The technique is pretty simple. First both side faces of the cube should be erased and then those sides have to be created again but this time so the tubes hole is in the face. The easiest way to erase side faces is to enter the side view with 3_PAD and then select left vertices of the cube using BKEY and drawing rectangle over vertices. It doesn't matter if left vertices of the tube are selected as well, because there are no faces.

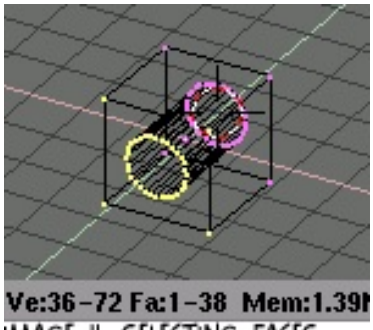

IMAGE 11. SELECTING FACES

This can be verified from top row which tells how many faces has been selected. The count should be "1", image 11 shows the rotated 3Dwindow and part of the top row. After all vertices has been selected the face should be removed by pressing XKEY and selecting the "Only Faces" from the popdown menu, which is shown in image 12. After face has been erased new faces with hole in the middle can be created by pressing SHIFT-F which is seen in image 13. After left side faces have been created the right side should be done, by first deselecting all vertices AKEY then selecting right side vertices BKEY, erasing face XKEY and creating new ones with SHIFT-F.

IMAGE 12. ERASE FACE

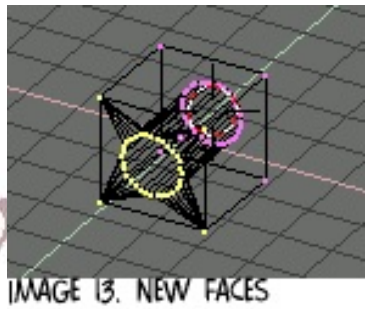
IMAGE 13. NEW FACES

Ready Cube with Hole

Now there is ready cube with hole in it. The whole cube can be seen by pressing the TABKEY to exit the EditMode and then selecting the ZKEY to see the shaded version of the cube. In the image 14 can be seen rotated view of the cube. If trying to create three tubical holes through the cube so tubes will cross in the middle of the cube, would make this tutorial really complex. It is possible with C-Key pretty easily but even with it, it needs some imagination, so how should it be done without C-Key ? Maybe this question will be tutorialized some day. So see you in advanced tutorial section after some time.

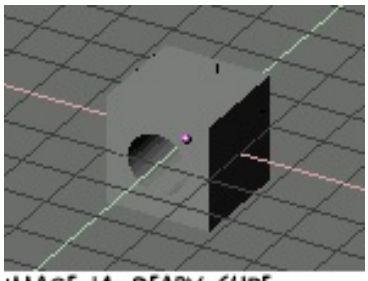
IMAGE 14. READY CUBE

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