N3D Safety Code

All posted safety guidelines must be followed at all times.

Introduction

This tutorial walks through the creation of a 3D model using SketchUp. It is intended for beginners to 3D modeling.

Installing SketchUp

Download SketchUp from http://www.sketchup.com/ (You want to download SketchUp Make)

Introduction to SketchUp

Launch the program. You may need to select a template. Any template should work, but I usually choose “Simple Template – Feet and Inches”.

- You will see a screen with a ground, a horizon, a man (for scale), and lines for the axes.

Creating the ND Monogram
Modifying the Camera
- Camera modification is done in a similar way to all 3D modeling programs. The easiest method is to use a 3-button mouse.

Orbit Tool:
- Click the middle mouse button and drag to rotate the camera.
- If not using a 3-button mouse, this can also be done by pressing O or clicking on the Orbit tool at the top of the screen. Then click and drag the mouse to rotate the view.

Pan Tool:
- Hold the shift key, then click the middle mouse button and drag to move the camera laterally.
- This can also be done by pressing H or by clicking on the Pan Tool at the top of the screen, and then clicking and dragging.

Zooming:
- Roll the scroll wheel to zoom in and out.
- This can also be done by typing Z, or by clicking on the Zoom Tool in the toolbar. Then click and drag up or down to zoom in or out.

Preset Views:
- You can modify the camera in additional ways using the camera menu at the top of the screen, including selecting a standard camera view, such as top, bottom, front, etc.

Go ahead and modify the camera so that you have a good view of the origin.
Adding 2D Shapes

- All of the 2D primitive shapes are listed in the toolbar at the top of the screen. Select Rectangle. Click on the origin to specify the first corner of the rectangle.

- You can specify the dimensions of the rectangle now, including the units. Dimensions are separated with a comma.
  - For example, you could type 6’6”,6.5’ for 6 foot-6 inches x 6 foot-6 inches or 5m,24cm for 5 meters x 24 cm

- Type in 0.73”,0.81” to specify a rectangle that is 0.73 x 0.81 inches. You can see that the dimensions you type appear in a box in the very bottom right corner of the screen. Press enter to finalize the dimensions and create the rectangle. Also, feel free to delete the man by clicking on him and pressing the Delete key.

- You will likely have to zoom in very far to get a good view of the new rectangle, as it is so small.

- Rather than typing in dimensions, you could also use the mouse to specify the opposite corner. The dimensions displayed in the lower right corner will change as the mouse is moved. However, this is less accurate than typing in the dimensions you would like.

Tape Measure Tool

- The tape measure tool can be used to create guidelines for use in drawing.
- Click on the Tape Measure Tool in the toolbar, or press T.
- Click once on the left edge of the rectangle, then move your mouse inside the rectangle and type 0.2”, and press enter. This creates a guideline that is .2 inches from the edge.

- Create three more guidelines: One offset 0.20” from the right side of the rectangle, and two offset 0.11” from the top and the bottom.

**Line Tool**
- Draw a horizontal line on the top guideline that is 0.078” long, off the left edge. Do this by first clicking on the Line Tool, then clicking on the intersection between the guideline and the left edge. Then move your mouse out along the guideline. It will snap to the guideline and a popup will say “On Line”. Type in the measurement and press enter.

- Then draw a line all the way down to the bottom guideline. It will turn green to indicate that you are drawing parallel an axis. Lastly, draw a line to the left edge of the rectangle.
Next, draw a 0.078” line from the right side, and draw a vertical line all the way to the bottom edge.

Draw two lines that extend the length of the rectangle along the vertical guidelines.

**Protractor Tool**
- Use the Protractor Tool to create an angled guideline that is offset 30 degrees from the vertical axis. Do this by selecting the Protractor, then click on the Endpoint shown. Next, click upward along the guideline. Then type 30 and press enter.
• Draw a line from the endpoint along the new angled guideline until it meets the left guideline.

Selection and Move Tools
• Choose the Selection Tool (Shortcut: Spacebar), and then click on the diagonal line we just drew.

• Select the Move Tool (Shortcut: M). Next, hold down the Ctrl key (Option on Mac). Drag the line by the endpoint until it meets the top edge. Holding down the Ctrl Key creates a copy of the line. If Ctrl does not work, try the Alt key.
- Draw a 0.078" horizontal line from the edge shown. Next draw a line that meets the bottom edge.

- Repeat for the top edge.

- We no longer need the guidelines. Under the Edit Menu, select Delete Guides.
Using the Eraser Tool (Shortcut: E), delete the highlighted lines. Delete them one by one. If you make a mistake, use Undo under the Edit menu or press Ctrl+Z.

Creating the “D”
- Off to the right of the “N”, create a 1” x 0.5” rectangle.
- Make three guides: One offset 0.185” from the left edge and two 0.11” offset from the top and bottom edges.
- With the line tool: On the top guide, draw a 0.06” horizontal line from the left edge. Continue that line downwards until the bottom guide. Finish it off on the left edge.
• Draw a rectangle that intersects the guides and is 0.7” wide. Do this by selecting the Rectangle Tool, clicking in the upper left intersection, then moving your mouse to the right and to the lower guideline. Then type in 0.7” and press enter.

• Create two guides that are offset 0.033” vertically from the rectangle that was just drawn. Next, click on the intersection between the guide and the right edge of the inner rectangle. Move your mouse left along the top/bottom edge of the rectangle until it turns pink. This indicates that it is a 45 degree angle. Do this at both the top and the bottom.

• Repeat this for the outer rectangle, using the upper/lower guideline this time.
- Delete the guidelines using the edit menu. Then erase the highlighted lines below (one by one). Also erase the inner surface.

- Erase the inner surface. This can be done by right clicking on it and clicking Erase.

Assembling the Monogram
- Create a guideline that is offset 0.168” to the left of the top left corner of the “N”. Then create a guideline that is offset 0.15” below the top left corner.
With the Selection Tool, double-click the “D”. Then, with the Move Tool, drag it by the upper left corner to the intersection of the newly created guidelines.

Erase the highlighted edges (One at a time). Using the selection Tool, double-click the monogram. Right-click it and click Make Group.

Save the file as `monogram.skp` using File -> Save

**Creating the Coin**
- Open a New file.
- Create a circle at the origin with a 0.675” radius (Again, you will have to zoom very far in to see this).
Extruding Shapes
- Select the Push/Pull Tool. Click on the circle, type 0.125”, and press Enter. This extrudes the circle upwards to form a cylinder.

Offset Tool
- Select the Offset Tool (Shortcut: F). Click the edge of the circle. Then, move your mouse towards the inside of the circle, type 0.05” and press Enter.
- Select the Push/Pull Tool again, and push the inner circle inwards 0.0625”.
- With the Select Tool, Triple-click the model. Right-click and select Make Group.
- Save your model as coin.skp
Assembling the Coin

Importing Models

- Create a new file. Under the File menu, select Import…
- Look for coin.skp and import it. Make sure to set the File Type to SketchUp Files.

- Click on the origin, and zoom in to view the coin. Next, import monogram.skp. This time, click on the coin, and ensure that the cursor popup says “On Face in Group”. Just estimate the placement of the monogram so that it is roughly centered.

- Double click on the monogram to enter the group. Double click again until dots appear in the monogram, meaning that it can be edited. Use the Push/Pull tool to pull it up to the height of the coin. One method to accomplish this is to start pulling it, and then to hover your cursor over the edge of the coin until the cursor snaps to that height.

- The coin is now finished. Save the file as ND_Coin.skp
Exporting an STL

- SketchUp does not by default support importing/exporting STL models, but these are a very commonly used format for 3D models, particularly when 3D printing. There is a plugin that you can add which implements this functionality.

- Go to Window->Extension Warehouse

- We want the SketchUp STL extension. Beneath the Welcome box, in the ‘Categories’ area, click on ‘3D Printing’. SketchUp STL should be listed here. If not, use the search bar to find it.

- After selecting this extension, click on the Install button in the upper right-hand corner. If this button instead says ‘Sign In’, then you can go ahead and sign in with a Google account, such as your ND account. After signing in, the button should change to say ‘Install.’ Click on it.
You now have the ability to both import and export STL files with SketchUp.

Be sure to delete the man who is standing in the scene before exporting, or he will be exported as well. This can be done by clicking on him with the Select tool and pressing Delete.

With ND_Coin.skp open, select the ‘Export STL’ menu option. A popup asking whether to export entire model should appear. Select Yes.

An Export Options dialog appears. Make sure you change export unit to Millimeters. Though we designed our model in inches, an STL file is unit-less, and MakerWare assumes models are specified in millimeters. Select OK.
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- Save the file as ND_Coin.stl and press Enter. A final popup will appear summarizing the export.
- The file can now be opened in MakerWare for 3D Printing. See the 3D Printing tutorial for details.
- If you would like additional tutorials for using SketchUp, there is an excellent series of videos at http://www.sketchup.com/learn/videos