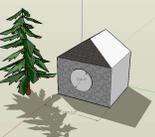


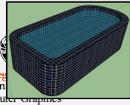
Using SketchUp !




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Mike Bailey
mjb@cs.oregonstate.edu
<http://cs.oregonstate.edu/~mjb/sketchup>



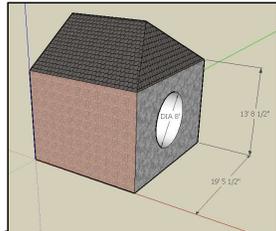
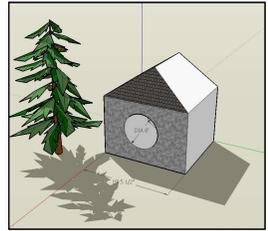

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What is SketchUp?

SketchUp is a program which lets you sketch in 3D. It is excellent for creating buildings, houses, and even mechanical designs.

And, it's easy to do. As their tagline says, SketchUp is "3D for Everyone".

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Getting SketchUp for Free

Go to:
<https://app.sketchup.com/app?hl=en>

This is a free *web-based* version of SketchUp. There are also downloadable versions of SketchUp which cost money. Go to: <https://www.sketchup.com/plans-and-pricing> for more information.



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SketchUp Student Learning Objectives

- Learn that the computer can be used to enhance *creativity*. It's not just for programmers and gamers!
- Learn that the computer can be used to design and plan.
- Learn the basics of 3D interaction. This will have further application in fields ranging from engineering CAD to art and animation.

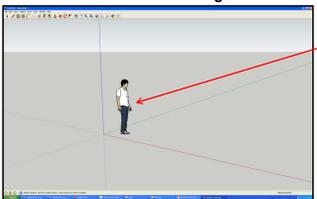
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Getting Started

In the Oregon State CGEL, double-click the SketchUp icon or click:

Start → All Programs → SketchUp 2019

The start screen should look something like this:



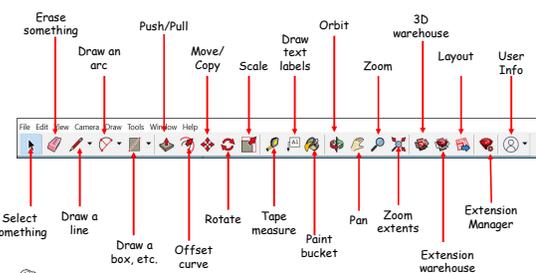
This specific person changes from version to version. They are always between 5'6" and 6' tall.

Right now, click **File → Save As** – and navigate to **C:\temp**
Hit Save often while you are editing

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Getting Started Toolbar

The icons across the top are *really* important:



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Large Toolset Toolbar

Select View → Toolbars → Large Tool Set

Select something		Make component
Paint bucket		Erase something
Draw a line		Draw freehand
Draw a box		Draw rotated rectangle
Draw a circle		Draw a polygon
Draw an arc		Draw an arc
Draw an arc		Draw an arc
Move		Push/Pull
Rotate		Follow Me
Scale		Offset Curve
Tape measure		Add Dimensions
Protractor		Draw text labels
Move axes		Add 3D Text
Orbit		Pan
Zoom		Zoom box
Zoom extents		Section plane

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The Views Toolbar

Select View → Toolbars → Views

Views

3D Top Front Right Back Left

This is a very handy toolbar to have active because it lets you change to a specific view of your scene with one mouse click!

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SketchUp "Inferences"

One of SketchUp's key strengths is that it doesn't require you to enter every little piece of information as many 3D computer programs do. Instead, it tries to infer what you really mean by how you do things. Oftentimes it uses colors to tell you what it is inferring.

- Green dots = Endpoints
- Red dots = On an edge
- Cyan dots = Midpoints of edges
- Blue dots = On a surface
- Red line = X axis
- Blue line = Y axis
- Green line = Z axis
- Magenta line = something is parallel or perpendicular to an edge

Hold **SHIFT** to capture and lock an inference

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Axis Coordinate System

This is the 3D coordinate system that SketchUp uses. This is referred to as a **Right-Handed Coordinate System**

This is called **The Origin**

- Red line = X axis
- Blue line = Y axis
- Green line = Z axis

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Moving the Scene Around in 3D

- Scroll Wheel: zoom in and out
- Middle Button: orbit
- Shift-Middle Button: pan

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Drawing a 2D Box

This is called **The Origin**

Click on the **Draw-a-Box** icon, then click on the origin, and while holding down the mouse, drag in this direction

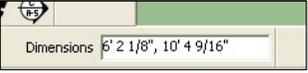
You'll end up with something like this:

We are going to build a house, so make this square an appropriate size, given that the person is almost 6 feet tall. **Hint:** also look at the box in the lower-right corner.

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Notice the Bottom-Right of the Screen 13

This is the **Measurement Toolbar**, or **MTB**



It is used to show you the dimensions, size, angle, etc. that you are currently setting

It can also be used to set exact values - just type into it while you are sizing with the mouse. But, if inputting length, be sure to use units: ' for feet and " for inches.

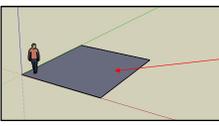


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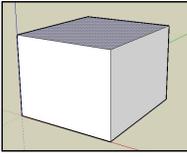
Extruding it into a 3D Box 14



Click on the **Push/Pull** icon, then click on the box you just created, and while holding down the mouse, drag in this direction



You'll end up with something like this:

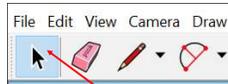


We are going to build a house, so make this height an appropriate size, given that the person is almost 6 feet tall. **Hint:** also look at the VCB box in the lower-right corner.

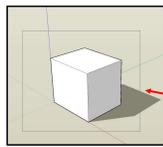
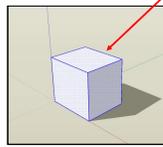


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Deleting an Object 15



1. Select the **Select** icon
2. Select the object to delete by dragging a box around it with the cursor
3. Hit the **Delete** key (*not* Backspace)

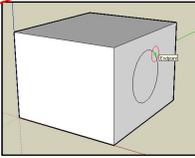




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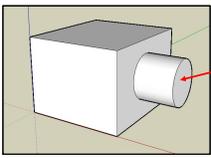
Adding more detail to an existing face 16



Click on the **Draw-a-circle** icon, then click on one face of the 3D solid you just created, and while holding down the mouse, drag in some direction

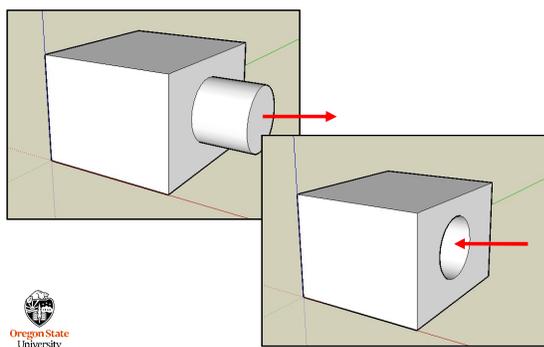


Click on the **Push/pull** icon, then click on the circle you just created, and while holding down the mouse, drag in this direction




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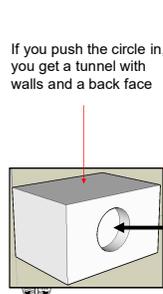
An outie or an innie :-) 17



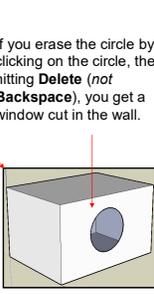

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The difference between pushing a hole and cutting a hole 18

If you push the circle in, you get a tunnel with walls and a back face



If you erase the circle by clicking on the circle, then hitting **Delete** (*not* Backspace), you get a window cut in the wall.

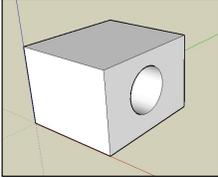



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Want to see it from a different view? 19



Click on the **Orbit** or **Pan** icon, then click in the scene, and while holding down the mouse, drag in some direction



You can also **Orbit** by pushing down on the middle button on the mouse. On many mice, the middle button is also the scroll wheel.



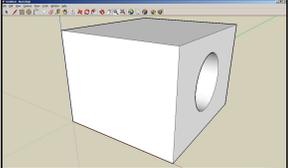
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Want to zoom in? 20



The **Zoom extents** icon will zoom in as much as possible without making any of your object disappear off the screen

The **Zoom** icon will allow you to zoom as much or as little as you want



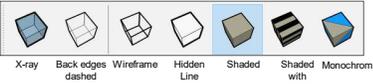
You can also **Zoom** in and out with the scroll wheel on the mouse



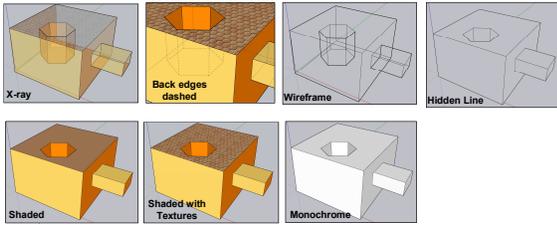
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Style Menu 21

View → Toolbars → Style



X-ray Back edges dashed Wireframe Hidden Line Shaded Shaded with Textures Monochrome

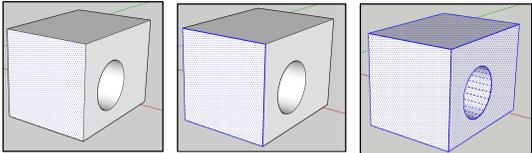


X-ray Back edges dashed Wireframe Hidden Line
Shaded Shaded with Textures Monochrome

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One, Two, and Three Clicks 22

Single-click (selects just the face or edge)
Double-click (selects the face and the edge)
Triple-click (selects everything on that object)

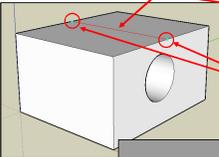


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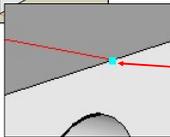
Let's give it a roof 23



Click the **Draw-a-Line** icon to draw a line across the top of the solid. But, you want the line to go midpoint-to-midpoint, which is a good place to raise the roof line from.



So, before clicking to draw the line, slide the pencil back and forth until the cyan dot appears, indicating that you've found this edge's midpoint.

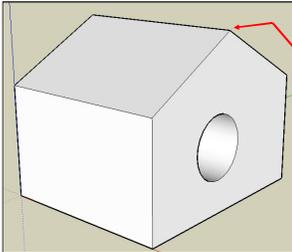


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Let's give it a roof 24

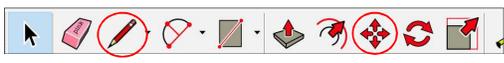


Now click on the **Move/copy** icon, then click on the line you just drew, hold down the **up-arrow key**, and drag upwards

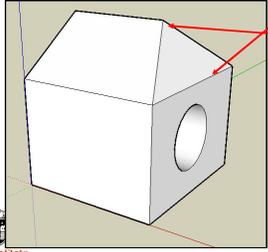


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Want to Bevel the edge of the roof? 25



1. Draw a line here
2. **Move** the point at the tip of the roof

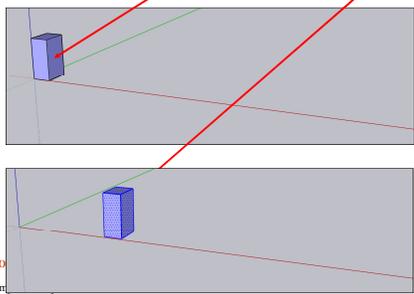


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The Move Icon is Good to Get to Know! 26



1. Create an Object
2. Select it
3. Click the **Move** and slide it in one of the red, green, blue directions

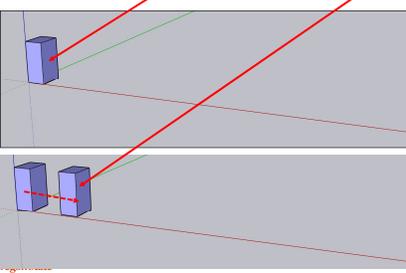


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The Control-Move Does a Copy 27



1. Create an Object
2. Select it
3. Click the **Move** while holding down the **Ctrl** key



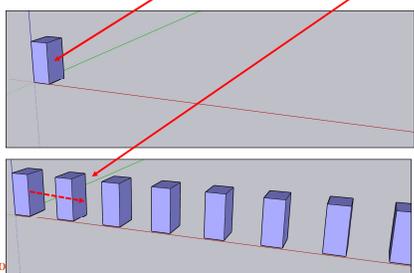
You can move the object interactively, or you can type a distance in the MTB. For example, try typing **5'** (5 feet).

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The Control-Move Does a Copy 28



1. Create an Object
2. Select it
3. Click the **Move** while holding down the **Ctrl** key



You can move the object interactively, or you can type a distance in the MTB. For example, try typing **5'** (5 feet).

You can also generate more than one copy by typing, for example, **10x**, into the MTB.

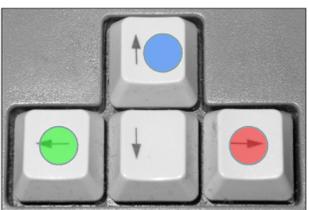
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A Move/Copy Trick 29



You can get SketchUp to move/copy in one of the three principal directions (red, green, or blue) by moving in that direction. SketchUp's "inference engine" will figure it out. But, you can also...

... force the Move/Copy to move along one of the 3 principal directions (red, green, or blue) by holding down one of the arrow keys as follows:

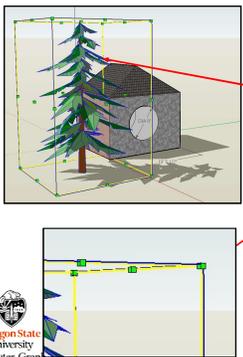


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Scaling 30



1. Select the **Select** icon
2. Select the object to scale
3. Select **Tools** → **Scale** or click the **Scale** icon
4. Grab a grip point and scale the object




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Rotating an Object

31

1. Select the entire object (triple-click)
2. Click on the **Rotate Tool**
3. Click the **Protractor** onto the object
4. If necessary, hit arrow keys to change the Protractor direction
5. Rotate the Protractor with the mouse to align it with something (e.g., a key point) -- click when ready.
6. Rotate the object. Click when done.

Once you've started rotating, you can also type in an exact angle into the Measurement Toolbar (MTB)

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A Rotation Trick

32

We want to rotate this group by 180° (i.e., we want to flip it over). To do this, we want the rotation protractor to be vertical.

But we can't get this, because the inference engine can only find a horizontal surface to latch onto

So we move over to another object that has vertical walls, or we make a dummy box, and get the inference engine to latch the protractor onto a vertical surface, and hold down the Shift Key to lock it

We then proceed to use the protractor on the original object.

Now rotate that object 180°, and then delete the dummy box

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Want to make the house look more interesting?

33

Click **Materials**

1. Click on a category
2. Click on a specific color or pattern
3. Click on the surface(s) you want to apply it to.

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Pure colors are considered Materials too

34

1. Select **Colors**
2. Treat the color just like you did the material

Scroll up and down to get more colors

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You Could Even Put Vegetation on the Roof!

35

But, who would ever think to do that?!

Well, the Vancouver (British Columbia) Convention Center would!

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Dimensions

36

Click **Tools**→**Dimensions**

1. Click on an edge
2. Drag where you want the dimension to be drawn

Dimensions are useful if you are giving your design to someone so that they can build it

1. Click on the circumference of a circle
2. Drag where you want the dimension to be drawn

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Styles

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Click Styles

Each one of these will bring up several more styles to experiment with

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Try Some of the Assorted Styles – They're Fun!

38

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Setting Shadows in SketchUp

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Window → Model Info → Geo-location → Set Manual Location

Model Info

Geographic Location

Country: USA
Location: Corvallis, OR
Latitude: 44.570000N
Longitude: 123.270000W

Set Manual Location...

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Setting Shadows in SketchUp

40

If you live in the Corvallis, Oregon area, type these values:

Set Manual Geo-location

Country: USA
Location: Corvallis, OR
Latitude: 44.570000N
Longitude: 123.270000W

OK Cancel

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Setting Shadows in SketchUp

41

Click Shadows

Click this box to turn shadows on

Set time of day and day of year

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Projections

42

Click Camera → Parallel Projection

Click Camera → Perspective

"Vanishing Point"

In perspective, things get smaller as they get farther away, which is more realistic. In parallel, they don't. But parallel helps you see if front and back faces line up.

Perspective Parallel

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Exporting an Image File

Click **File**→**Export** →**2D Graphic**

Your image can be exported in one of 4 formats:

1. BMP
2. JPEG ← Web browsers all know about this format
3. TIF ←
4. PNG ←
5. PDF

You would do this, for example, to email someone an image of your scene, to import it into a document, or to put it on your website



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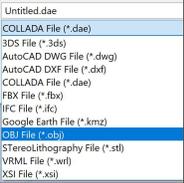
44

Exporting a 3D Object

Click **File**→**Export** →**3D Model**

Your image can be exported in one of 11 formats. The ones you *really* care about are:

1. OBJ – as close to a universal 3D file format that there is
2. STL – used for 3D printing
3. DAE – Collada format, compatible with many artist programs
4. 3DS – compatible with AutoDesk's 3D Studio Max




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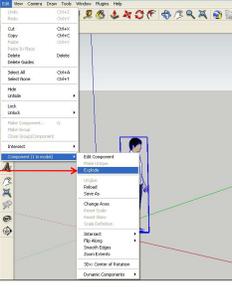
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Changing the Person's Clothing

The person in the default scene is a SketchUp "Component", that is, he is a group of geometry collected together. To change his clothing, you need to first break, or "Explode", the collection apart.

Even easier, right-click on the person and select **Explode** from the pop-up menu.



After that, you can click on **Materials** and re-color or re-pattern the clothing



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Creating Groups

Sometimes you would like to collect several pieces of geometry together and be able to treat them as a single unit. This is called a SketchUp **Group**.

Create a SketchUp Group by first clicking on the **Select** icon.

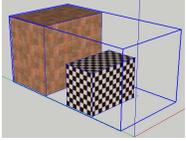
Then, click on the first object you want in the Group. It will turn blue.

Then, hold down the **Shift** key and click on all other objects you want in the group. They will also turn blue. If you select the wrong item, just click it again to un-select it.

You can select many things at once by creating a rectangle around all of them with the Select cursor.

When you are done, right-click and select **Make Group** from the pop-up menu.

To ungroup the objects, right click on them and select **Explode** from the pop-up menu.




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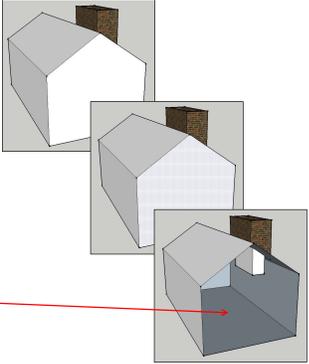
Hiding Geometry

Sometimes it would be nice to temporarily eliminate some geometry so that you could see inside something. This is referred to as **Hiding**.

To hide one or more pieces of geometry, select all of them as if you were about to create a group.

Then, right-click and select **Hide** from the pop-up menu. The selected objects look like they are gone, but they aren't. They're just hidden.

This is useful for putting things into an object (such as furniture) or for editing the object (as is needed here).




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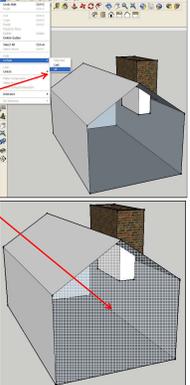
48

Un-Hiding Geometry

There are two ways to bring back hidden geometry.

The first is to select **Edit**→**Unhide**→**All**, like this:

The second is to select **View**→**Hidden Geometry**. This will make hidden geometry show up like this: From there, you can right-click on it and select **Unhide** from the pop-up menu.




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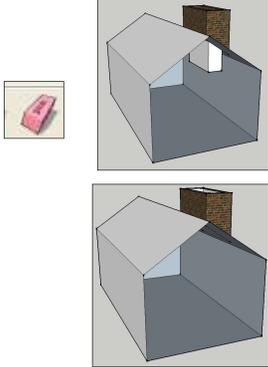
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Eliminating Geometry 49

Sometimes extruding geometry results in it existing in places it shouldn't.

To eliminate any geometry, take the **Eraser** tool and click on the edges of the geometry you want to eliminate.

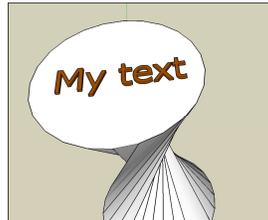
As soon as an edge of a surface has been eliminated, the surface will disappear too.




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Adding 3D Text 50

1. Click on **Tools--3D Text**
2. Type the text into the dialog box
3. Make any text settings you want
4. Place the text by clicking on an object




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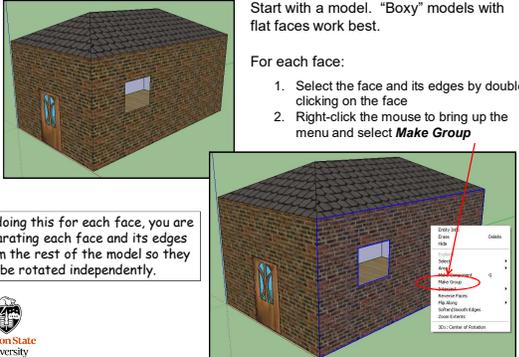
An Interesting Use for Rotation -- Building a Real Model from Paper! 51

Start with a model. "Boxy" models with flat faces work best.

For each face:

1. Select the face and its edges by double-clicking on the face
2. Right-click the mouse to bring up the menu and select **Make Group**

By doing this for each face, you are separating each face and its edges from the rest of the model so they can be rotated independently.



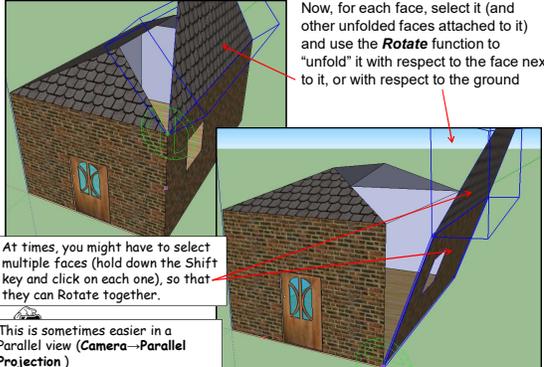

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An Interesting Use for Rotation -- Building a Real Model from Paper! 52

Now, for each face, select it (and other unfolded faces attached to it) and use the **Rotate** function to "unfold" it with respect to the face next to it, or with respect to the ground.

At times, you might have to select multiple faces (hold down the Shift key and click on each one), so that they can Rotate together.

This is sometimes easier in a Parallel view (**Camera--Parallel Projection**)

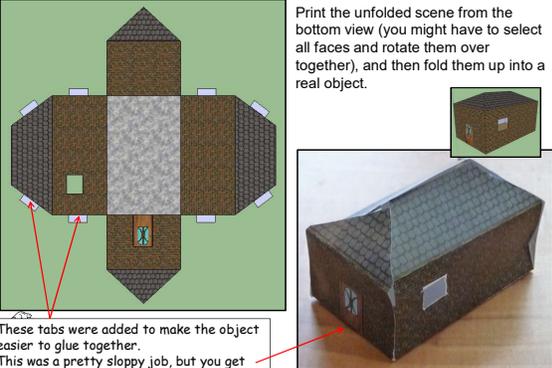



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An Interesting Use for Rotation -- Building a Real Model from Paper! 53

Print the unfolded scene from the bottom view (you might have to select all faces and rotate them over together), and then fold them up into a real object.

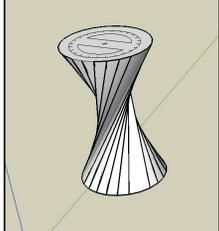
These tabs were added to make the object easier to glue together. This was a pretty sloppy job, but you get the point...




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Rotating a Face 54

Strange as it may seem, you can also rotate just a face. Follow the same procedure, but select only the face.




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You can also scale a face

55

1. Select a face
2. Select **Tools**→**Scale**
3. Move the grips with the mouse
4. Hold down the **Control** key if you want scaling about the object's center

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Drawing an Arc

56

1. Click on the Arc Tool
2. Select two points for the chord
3. Select a third point that shows SketchUp where to "bulge" the arc

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Arcs are Often used to Round Corners

57

1. Click on both edges surrounding a corner. The line will turn purple when you are the same distance from the corner.
2. When you place the third point, the inference engine will also tell you when the arc is tangent to (aligned with) the edges.

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Want to create Crown Molding?

58

1. Draw an arc in the corner
2. Click **Tools**→**Follow Me**
3. Click on the arc area

With the left button still down, move the cursor along the perimeter – don't click again until you are done with the full path

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Another use for Follow Me – Extruding a Surface

59

1. Create an object
2. Draw a line and some arcs from one corner of the object
3. Select **Follow Me**
4. Click on one face of the object and, with the left mouse button still down, slide the cursor along the curve
5. Using the pink eraser, erase the connecting lines

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Another use for Follow Me – make a Sphere

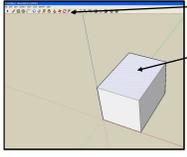
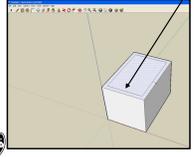
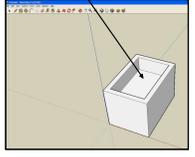
60

1. Create a circle
2. Copy the circle using the Move Tool with the Control key held down
3. Rotate the upper circle 90°
4. Move the upper circle so that its bottom is at the lower circle's center
5. Select the lower circle, select **Tools**→**Follow Me**, and then select the upper circle
6. Delete the lower circle

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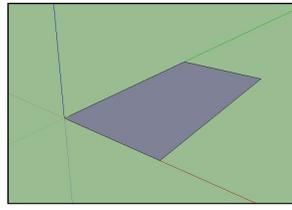
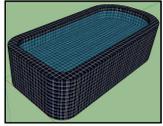
Offsetting a Surface

1. Click on the Offset Tool 
2. Select the surface to offset on 
3. Move the mouse to show how much to offset – click when ready 
4. This only creates offset edges – you need to use the Push-Pull Tool to do something with it. 

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Combining Several Techniques: Making a Swimming Pool

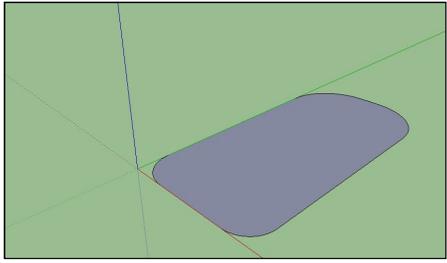
Start by creating a rectangle on the floor

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63

Use the Arc Tool and the Erase Tool to Create 4 Arcs to Round the Corners

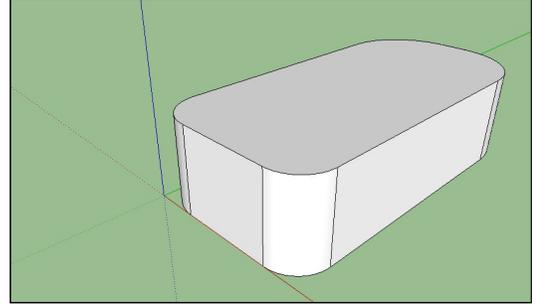




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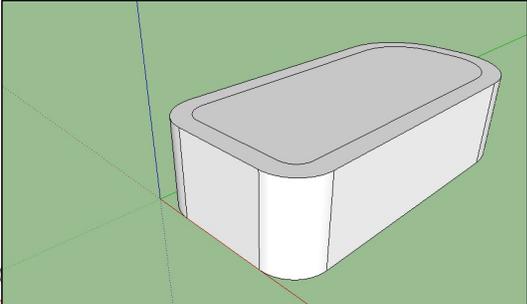
Use the Push/Pull Tool to Lift it into 3D

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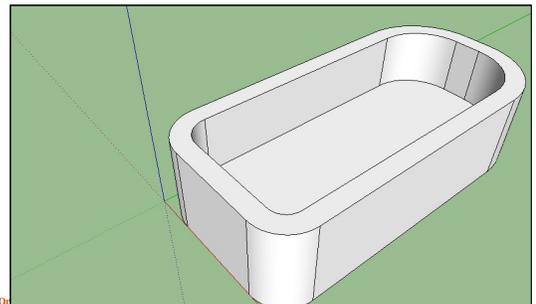
Use the Offset Tool to Create an Inner Edge

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66

Use the Push/Pull Tool to Push the Middle Down

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67

Use the Move Tool with the Control Key Pressed, to Copy the Floor of the Pool and Raise it Up

This will become the water surface

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68

Select Materials→Tile to Apply a Surface to Your Pool

If you hold down the Control Key when adding the tile pattern, it will apply it to all surfaces, not just one. This saves you a lot of time.

This isn't right - the top surface of the water is currently tile instead. We'll fix this next.

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Select Materials→Water and click on the top surface to change it to water

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Make the Water Surface Translucent

In the Materials→Water dialog box, click on the Edit tab.

Then lower the Opacity until the water surface looks properly translucent.

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Adding Fog

Click Fog

Click here to turn the fog feature on

This slider adjusts how far in front of your eye the fog starts. Items closer to you than this will not be fogged at all.

This slider adjusts how far in front of your eye the fog completely hides your scene. Items farther away than this will not be visible at all.

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Adding Fog

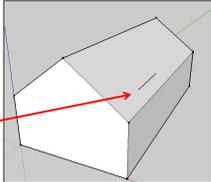
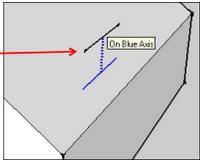
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Adding a Vertical Chimney to a Sloped Roof

73



1. Draw a line along the roof using the pencil tool. SketchUp's inference engine will try to force it to be parallel to an axis. Let it do that.
2. Select the line you just drew. Use the **Move/Copy** icon with the Control Key held down to lift it up in the air. (The Control key will force it to do a Copy.) Wiggle it a little bit until you get the phrase "On Blue Axis" to appear. This indicates that you are lifting it straight up.



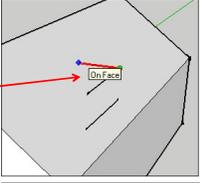
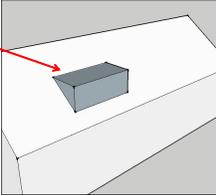

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Adding a Vertical Chimney to a Sloped Roof

74



3. Draw lines using the pencil tool from the ends of this new line to the face of the roof. SketchUp will tell you when you are there. Be sure the line is a color (red in this case) to indicate that you are parallel to an axis.
4. Using the pencil tool, connect up all the points to form edges. You should have 9 lines in all. (Don't forget to look at the back of the chimney.) SketchUp will turn the edges into faces as you complete them. There should be 4 faces in all.




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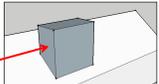
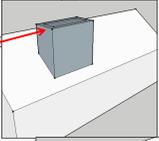
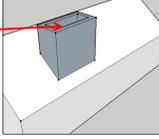
Adding a Vertical Chimney to a Sloped Roof

75





5. Use the Push/Pull tool to lift the top surface.
6. Use the Offset tool to make an inner surface on that top surface.
7. Use the Push/Pull tool to push that inner surface down.

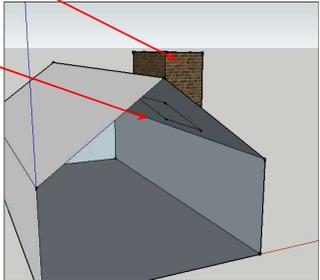



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Adding a Vertical Chimney to a Sloped Roof

76

8. Add whatever **Material** decoration you want
9. Get rid of the excess chimney under the roof by hiding an end face and erasing those edges.
10. Unhide the end face when you are done



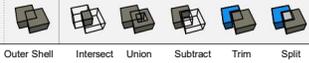



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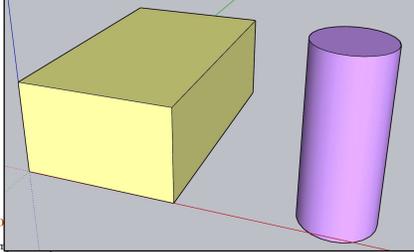
Solid Tools

77

View→Toolbars→Solid Tools



1. Start with two objects
2. Select the box (triple-click), then right-click and select **Make Group**
3. Select the cylinder (triple-click), then right-click and select **Make Group**



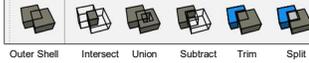



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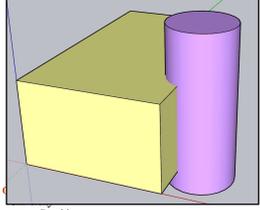
Solid Tools

78

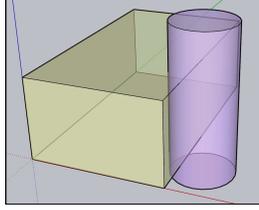
View→Toolbars→Solid Tools



Overlap them in 3D:



View→Face Style→X-ray:






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Solid Tools 79

View→Toolbars→Solid Tools

Outer Shell Intersect Union Subtract Trim Split

Select them both, then select **Intersect**:

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Solid Tools 80

View→Toolbars→Solid Tools

Outer Shell Intersect Union Subtract Trim Split

Select them both, then select **Union**:

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Solid Tools 81

View→Toolbars→Solid Tools

Outer Shell Intersect Union Subtract Trim Split

Select the cylinder, then select **Subtract**, then select the box:

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Section Planes 82

View→Toolbars→Section

Create Section Plane Toggle Section Planes Toggle Section Cuts Toggle Section Fill

Start with something like this
(shown here in X-ray style so you can see what is inside it)

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Section Planes 83

Create Section Plane Toggle Section Planes Toggle Section Cuts Toggle Section Fill

You can use the **arrow keys** to change the orientation of the section plane

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Section Planes 84

Create Section Plane Toggle Section Planes Toggle Section Cuts Toggle Section Fill

Use the **Move** icon to move the section plane down into the object

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You Can Create Section Planes in All Three Directions

85

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Creating a Flying Animation

86

To create an animation:

1. Create a view of the scene
2. Select **View→Animation→Add Scene**
3. Create a different view
4. Select **View→Animation→Add Scene**
5. ...

To play the full animation:

1. Select **View→Animation→Play**
2. Pause or stop the scene with these buttons

As you add scenes, SketchUp will list them. You can click on any of them to get back to that view.

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Animation Settings

87

Set how long each scene transition lasts

How long to wait before starting the animation

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Exporting Your Animation

88

To save an animation to a file:

1. Select **File→Export→Animation**
2. Save as an MP4 file

To play the animation file:
Double-click on your MP4 file

To import your animation into PowerPoint:

1. Select **Insert→Video→Video on My PC**
2. Double-click on the image when editing the slide
3. Click on the image in Slide Show mode

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Be Sure that Internet Explorer is not your Default Browser (I like FireFox)

89

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Logging into the 3D Warehouse

90

Click 3D Warehouse

mjb@engr.oregonstate.edu
Corv@llis72542

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3D Warehouse Example -- Adding Picture Windows

91

Click 3D Warehouse

Type what you hope to find
Click on the one you'd like

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Adding Picture Windows

92

Load Into Model?
Load this directly into your SketchUp model?

Yes No Cancel

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Adding Picture Windows

93

Put it where you want it.
You might have to scale and/or rotate it.

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Use 3D Warehouse to Add other Components

94

But, be careful!
Too much scene detail will overwhelm your graphics card!

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The SketchUp Extensions

95

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Corv@llis72542

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The SketchUp Sandbox

96

View → Toolbars → Sandbox

Create a Sandbox grid

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The SketchUp Sandbox 97

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The SketchUp Sandbox 98

Sandbox

Create smooth hills

Double-click

Type a number to change the smoothing radius

Radius 3'

Radius 5'

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The SketchUp Sandbox 99

Lift up or push down

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The SketchUp Sandbox 100

Select Stamp

Hover a 3D object over the terrain to create a flat area to place that object down on

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The SketchUp Sandbox 101

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SketchUp Quick Reference Card 102

SketchUp Pro Quick Reference Card | Windows

SketchUp 2020

Shortcut	Description
Ctrl+N	New
Ctrl+O	Open
Ctrl+S	Save
Ctrl+P	Print
Ctrl+Z	Undo
Ctrl+Y	Redo
Ctrl+W	Close
Ctrl+Q	Quit
Ctrl+R	Reset View
Ctrl+F	Find
Ctrl+G	Group
Ctrl+U	Unhide
Ctrl+I	Intersect
Ctrl+J	Join
Ctrl+K	Knockout
Ctrl+L	Lock
Ctrl+M	Move
Ctrl+O	Offset
Ctrl+P	Push/Pull
Ctrl+Q	Quick Select
Ctrl+R	Reset View
Ctrl+S	Save
Ctrl+T	Translate
Ctrl+U	Unhide
Ctrl+V	Paste
Ctrl+W	Close
Ctrl+X	Copy
Ctrl+Y	Redo
Ctrl+Z	Undo
Ctrl+AA	Align
Ctrl+AB	Align Bottom
Ctrl+AL	Align Left
Ctrl+AR	Align Right
Ctrl+AT	Align Top
Ctrl+AV	Align Vertical Center
Ctrl+AW	Align Width
Ctrl+AZ	Align Z
Ctrl+BA	Bring Forward
Ctrl+BB	Bring Backward
Ctrl+BC	Bring to Front
Ctrl+BD	Bring to Back
Ctrl+BE	Bring to Back (Bottom)
Ctrl+BF	Bring to Front (Top)
Ctrl+BG	Bring to Front (Bottom)
Ctrl+BH	Bring to Front (Horizontal)
Ctrl+BI	Bring to Front (Vertical)
Ctrl+BJ	Bring to Front (Z)
Ctrl+BL	Bring to Front (Left)
Ctrl+BR	Bring to Front (Right)
Ctrl+BT	Bring to Front (Top)
Ctrl+BU	Bring to Front (Bottom)
Ctrl+BV	Bring to Front (Vertical)
Ctrl+BW	Bring to Front (Width)
Ctrl+BX	Bring to Front (X)
Ctrl+BY	Bring to Front (Y)
Ctrl+BZ	Bring to Front (Z)
Ctrl+CA	Copy Attributes
Ctrl+CB	Copy Back
Ctrl+CC	Copy Center
Ctrl+CD	Copy Dimensions
Ctrl+CE	Copy Edges
Ctrl+CF	Copy Faces
Ctrl+CG	Copy Groups
Ctrl+CH	Copy Hidden
Ctrl+CI	Copy Images
Ctrl+CJ	Copy Joints
Ctrl+CK	Copy Keys
Ctrl+CL	Copy Lines
Ctrl+CM	Copy Materials
Ctrl+CN	Copy Normals
Ctrl+CO	Copy Objects
Ctrl+CP	Copy Properties
Ctrl+CQ	Copy Quads
Ctrl+CR	Copy Rectangles
Ctrl+CS	Copy Sections
Ctrl+CT	Copy Text
Ctrl+CU	Copy Units
Ctrl+CV	Copy Vertices
Ctrl+CW	Copy Widths
Ctrl+CX	Copy X
Ctrl+CY	Copy Y
Ctrl+CZ	Copy Z
Ctrl+DA	Default Attributes
Ctrl+DB	Default Back
Ctrl+DC	Default Center
Ctrl+DD	Default Dimensions
Ctrl+DE	Default Edges
Ctrl+DF	Default Faces
Ctrl+DG	Default Groups
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Ctrl+DI	Default Images
Ctrl+DJ	Default Joints
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Ctrl+DM	Default Materials
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Ctrl+DO	Default Objects
Ctrl+DP	Default Properties
Ctrl+DQ	Default Quads
Ctrl+DR	Default Rectangles
Ctrl+DS	Default Sections
Ctrl+DT	Default Text
Ctrl+DU	Default Units
Ctrl+DV	Default Vertices
Ctrl+DW	Default Widths
Ctrl+DX	Default X
Ctrl+DY	Default Y
Ctrl+DZ	Default Z
Ctrl+EA	Entity Attributes
Ctrl+EB	Entity Back
Ctrl+EC	Entity Center
Ctrl+ED	Entity Dimensions
Ctrl+EE	Entity Edges
Ctrl+EF	Entity Faces
Ctrl+EG	Entity Groups
Ctrl+EH	Entity Hidden
Ctrl+EI	Entity Images
Ctrl+EJ	Entity Joints
Ctrl+EK	Entity Keys
Ctrl+EL	Entity Lines
Ctrl+EM	Entity Materials
Ctrl+EN	Entity Normals
Ctrl+EO	Entity Objects
Ctrl+EP	Entity Properties
Ctrl+EQ	Entity Quads
Ctrl+ER	Entity Rectangles
Ctrl+ES	Entity Sections
Ctrl+ET	Entity Text
Ctrl+EU	Entity Units
Ctrl+EV	Entity Vertices
Ctrl+EW	Entity Widths
Ctrl+EX	Entity X
Ctrl+EY	Entity Y
Ctrl+EZ	Entity Z
Ctrl+FA	Face Attributes
Ctrl+FB	Face Back
Ctrl+FC	Face Center
Ctrl+FD	Face Dimensions
Ctrl+FE	Face Edges
Ctrl+FF	Face Faces
Ctrl+FG	Face Groups
Ctrl+FH	Face Hidden
Ctrl+FI	Face Images
Ctrl+FJ	Face Joints
Ctrl+FK	Face Keys
Ctrl+FL	Face Lines
Ctrl+FM	Face Materials
Ctrl+FN	Face Normals
Ctrl+FO	Face Objects
Ctrl+FP	Face Properties
Ctrl+FQ	Face Quads
Ctrl+FR	Face Rectangles
Ctrl+FS	Face Sections
Ctrl+FT	Face Text
Ctrl+FU	Face Units
Ctrl+FV	Face Vertices
Ctrl+FW	Face Widths
Ctrl+FX	Face X
Ctrl+FY	Face Y
Ctrl+FZ	Face Z
Ctrl+GA	Group Attributes
Ctrl+GB	Group Back
Ctrl+GC	Group Center
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Ctrl+GH	Group Hidden
Ctrl+GI	Group Images
Ctrl+GJ	Group Joints
Ctrl+GK	Group Keys
Ctrl+GL	Group Lines
Ctrl+GM	Group Materials
Ctrl+GN	Group Normals
Ctrl+GO	Group Objects
Ctrl+GP	Group Properties
Ctrl+GQ	Group Quads
Ctrl+GR	Group Rectangles
Ctrl+GS	Group Sections
Ctrl+GT	Group Text
Ctrl+GU	Group Units
Ctrl+GV	Group Vertices
Ctrl+GW	Group Widths
Ctrl+GX	Group X
Ctrl+GY	Group Y
Ctrl+GZ	Group Z
Ctrl+HA	Hide Attributes
Ctrl+HB	Hide Back
Ctrl+HC	Hide Center
Ctrl+HD	Hide Dimensions
Ctrl+HE	Hide Edges
Ctrl+HF	Hide Faces
Ctrl+HG	Hide Groups
Ctrl+HH	Hide Hidden
Ctrl+HI	Hide Images
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Ctrl+HK	Hide Keys
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Ctrl+HP	Hide Properties
Ctrl+HQ	Hide Quads
Ctrl+HR	Hide Rectangles
Ctrl+HS	Hide Sections
Ctrl+HT	Hide Text
Ctrl+HU	Hide Units
Ctrl+HV	Hide Vertices
Ctrl+HW	Hide Widths
Ctrl+HX	Hide X
Ctrl+HY	Hide Y
Ctrl+HZ	Hide Z
Ctrl+IA	Import Attributes
Ctrl+IB	Import Back
Ctrl+IC	Import Center
Ctrl+ID	Import Dimensions
Ctrl+IE	Import Edges
Ctrl+IF	Import Faces
Ctrl+IG	Import Groups
Ctrl+IH	Import Hidden
Ctrl+II	Import Images
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Ctrl+IT	Import Text
Ctrl+IU	Import Units
Ctrl+IV	Import Vertices
Ctrl+IW	Import Widths
Ctrl+IX	Import X
Ctrl>IY	Import Y
Ctrl+IZ	Import Z
Ctrl+JA	Join Attributes
Ctrl+JB	Join Back
Ctrl+JC	Join Center
Ctrl+JD	Join Dimensions
Ctrl+JE	Join Edges
Ctrl+JF	Join Faces
Ctrl+JG	Join Groups
Ctrl+JH	Join Hidden
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Ctrl+JJ	Join Joints
Ctrl+JK	Join Keys
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Ctrl+JP	Join Properties
Ctrl+JQ	Join Quads
Ctrl+JR	Join Rectangles
Ctrl+JS	Join Sections
Ctrl+JT	Join Text
Ctrl+JU	Join Units
Ctrl+JV	Join Vertices
Ctrl+JW	Join Widths
Ctrl+JX	Join X
Ctrl+JY	Join Y
Ctrl+JZ	Join Z
Ctrl+KA	Knockout Attributes
Ctrl+KB	Knockout Back
Ctrl+KC	Knockout Center
Ctrl+KD	Knockout Dimensions
Ctrl+KE	Knockout Edges
Ctrl+KF	Knockout Faces
Ctrl+KG	Knockout Groups
Ctrl+KH	Knockout Hidden
Ctrl+KI	Knockout Images
Ctrl+KJ	Knockout Joints
Ctrl+KK	Knockout Keys
Ctrl+KL	Knockout Lines
Ctrl+KM	Knockout Materials
Ctrl+KN	Knockout Normals
Ctrl+KO	Knockout Objects
Ctrl+KP	Knockout Properties
Ctrl+KQ	Knockout Quads
Ctrl+KR	Knockout Rectangles
Ctrl+KS	Knockout Sections
Ctrl+KT	Knockout Text
Ctrl+KU	Knockout Units
Ctrl+KV	Knockout Vertices
Ctrl+KW	Knockout Widths
Ctrl+KX	Knockout X
Ctrl+KY	Knockout Y
Ctrl+KZ	Knockout Z
Ctrl+LA	Layer Attributes
Ctrl+LB	Layer Back
Ctrl+LC	Layer Center
Ctrl+LD	Layer Dimensions
Ctrl+LE	Layer Edges
Ctrl+LF	Layer Faces
Ctrl+LG	Layer Groups
Ctrl+LH	Layer Hidden
Ctrl+LI	Layer Images
Ctrl+LJ	Layer Joints
Ctrl+LK	Layer Keys
Ctrl+LL	Layer Lines
Ctrl+LM	Layer Materials
Ctrl+LN	Layer Normals
Ctrl+LO	Layer Objects
Ctrl+LP	Layer Properties
Ctrl>LQ	Layer Quads
Ctrl+LR	Layer Rectangles
Ctrl+LS	Layer Sections
Ctrl+LT	Layer Text
Ctrl+LU	Layer Units
Ctrl+LV	Layer Vertices
Ctrl+LW	Layer Widths
Ctrl+LX	Layer X
Ctrl+LY	Layer Y
Ctrl+LZ	Layer Z
Ctrl+MA	Move Attributes
Ctrl+MB	Move Back
Ctrl+MC	Move Center
Ctrl+MD	Move Dimensions
Ctrl+ME	Move Edges
Ctrl+MF	Move Faces
Ctrl+MG	Move Groups
Ctrl+MH	Move Hidden
Ctrl+MI	Move Images
Ctrl+MJ	Move Joints
Ctrl+MK	Move Keys
Ctrl+ML	Move Lines
Ctrl+MM	Move Materials
Ctrl+MN	Move Normals
Ctrl+MO	Move Objects
Ctrl+MP	Move Properties
Ctrl+MQ	Move Quads
Ctrl+MR	Move Rectangles
Ctrl+MS	Move Sections
Ctrl+MT	Move Text
Ctrl+MU	Move Units
Ctrl+MV	Move Vertices
Ctrl+MW	Move Widths
Ctrl+MX	Move X
Ctrl+MY	Move Y
Ctrl+MZ	Move Z
Ctrl+NA	Normal Attributes
Ctrl+NB	Normal Back
Ctrl+NC	Normal Center
Ctrl+ND	Normal Dimensions
Ctrl+NE	Normal Edges
Ctrl+NF	Normal Faces
Ctrl+NG	Normal Groups
Ctrl+NH	Normal Hidden
Ctrl+NI	Normal Images
Ctrl+NJ	Normal Joints
Ctrl+NK	Normal Keys
Ctrl>NL	Normal Lines
Ctrl+NM	Normal Materials
Ctrl+NN	Normal Normals
Ctrl+NO	Normal Objects
Ctrl+NP	Normal Properties
Ctrl+NQ	Normal Quads
Ctrl+NR	Normal Rectangles
Ctrl+NS	Normal Sections
Ctrl+NT	Normal Text
Ctrl+NU	Normal Units
Ctrl+NV	Normal Vertices
Ctrl+NW	Normal Widths
Ctrl+NX	Normal X
Ctrl+NY	Normal Y
Ctrl+NZ	Normal Z
Ctrl+OA	Offset Attributes
Ctrl+OB	Offset Back
Ctrl+OC	Offset Center
Ctrl+OD	Offset Dimensions
Ctrl+OE	Offset Edges
Ctrl+OF	Offset Faces
Ctrl+OG	Offset Groups
Ctrl+OH	Offset Hidden
Ctrl+OI	Offset Images
Ctrl+OJ	Offset Joints
Ctrl+OK	Offset Keys
Ctrl+OL	Offset Lines
Ctrl+OM	Offset Materials
Ctrl+ON	Offset Normals
Ctrl+OO	Offset Objects
Ctrl+OP	Offset Properties
Ctrl+OQ	Offset Quads
Ctrl+OR	Offset Rectangles
Ctrl+OS	Offset Sections
Ctrl+OT	Offset Text
Ctrl+OU	Offset Units
Ctrl+OV	Offset Vertices
Ctrl+OW	Offset Widths
Ctrl+OX	Offset X
Ctrl+OY	Offset Y
Ctrl+OZ	Offset Z
Ctrl+PA	Paste Attributes
Ctrl+PB	Paste Back
Ctrl+PC	Paste Center
Ctrl+PD	Paste Dimensions
Ctrl+PE	Paste Edges
Ctrl+PF	Paste Faces
Ctrl+PG	Paste Groups
Ctrl+PH	Paste Hidden
Ctrl+PI	Paste Images
Ctrl+PJ	Paste Joints
Ctrl+PK	Paste Keys
Ctrl+PL	Paste Lines
Ctrl+PM	Paste Materials
Ctrl+PN	Paste Normals
Ctrl+PO	Paste Objects
Ctrl+PP	Paste Properties
Ctrl+PQ	Paste Quads
Ctrl+PR	Paste Rectangles
Ctrl+PS	Paste Sections
Ctrl+PT	Paste Text
Ctrl+PU	Paste Units
Ctrl+PV	Paste Vertices
Ctrl+PW	Paste Widths
Ctrl+PX	Paste X
Ctrl+PY	Paste Y
Ctrl+PZ	Paste Z
Ctrl+QA	Quick Select Attributes
Ctrl+QB	Quick Select Back
Ctrl+QC	Quick Select Center
Ctrl+QD	Quick Select Dimensions
Ctrl+QE	Quick Select Edges
Ctrl+QF	Quick Select Faces
Ctrl+QG	Quick Select Groups
Ctrl+QH	Quick Select Hidden
Ctrl+QI	Quick Select Images
Ctrl+QJ	Quick Select Joints
Ctrl+QK	Quick Select Keys
Ctrl+QL	Quick Select Lines
Ctrl+QM	Quick Select Materials
Ctrl+QN	Quick Select Normals
Ctrl+QO	Quick Select Objects
Ctrl+QP	Quick Select Properties
Ctrl+QQ	Quick Select Quads
Ctrl+QR	Quick Select Rectangles
Ctrl+QS	Quick Select Sections
Ctrl+QT	Quick Select Text
Ctrl+QU	Quick Select Units
Ctrl+QV	Quick Select Vertices
Ctrl+QW	Quick Select Widths
Ctrl+QX	Quick Select X
Ctrl+QY	Quick Select Y
Ctrl+QZ	Quick Select Z
Ctrl+RA	Reset Attributes
Ctrl+RB	Reset Back
Ctrl+RC	Reset Center
Ctrl+RD	Reset Dimensions
Ctrl+RE	Reset Edges
Ctrl+RF	Reset Faces
Ctrl+RG	Reset Groups
Ctrl+RH	Reset Hidden
Ctrl+RI	Reset Images
Ctrl+RJ	Reset Joints
Ctrl+RK	Reset Keys
Ctrl+RL	Reset Lines
Ctrl+RM	Reset Materials
Ctrl+RN	Reset Normals
Ctrl+RO	Reset Objects
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Ctrl+RQ	Reset Quads
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