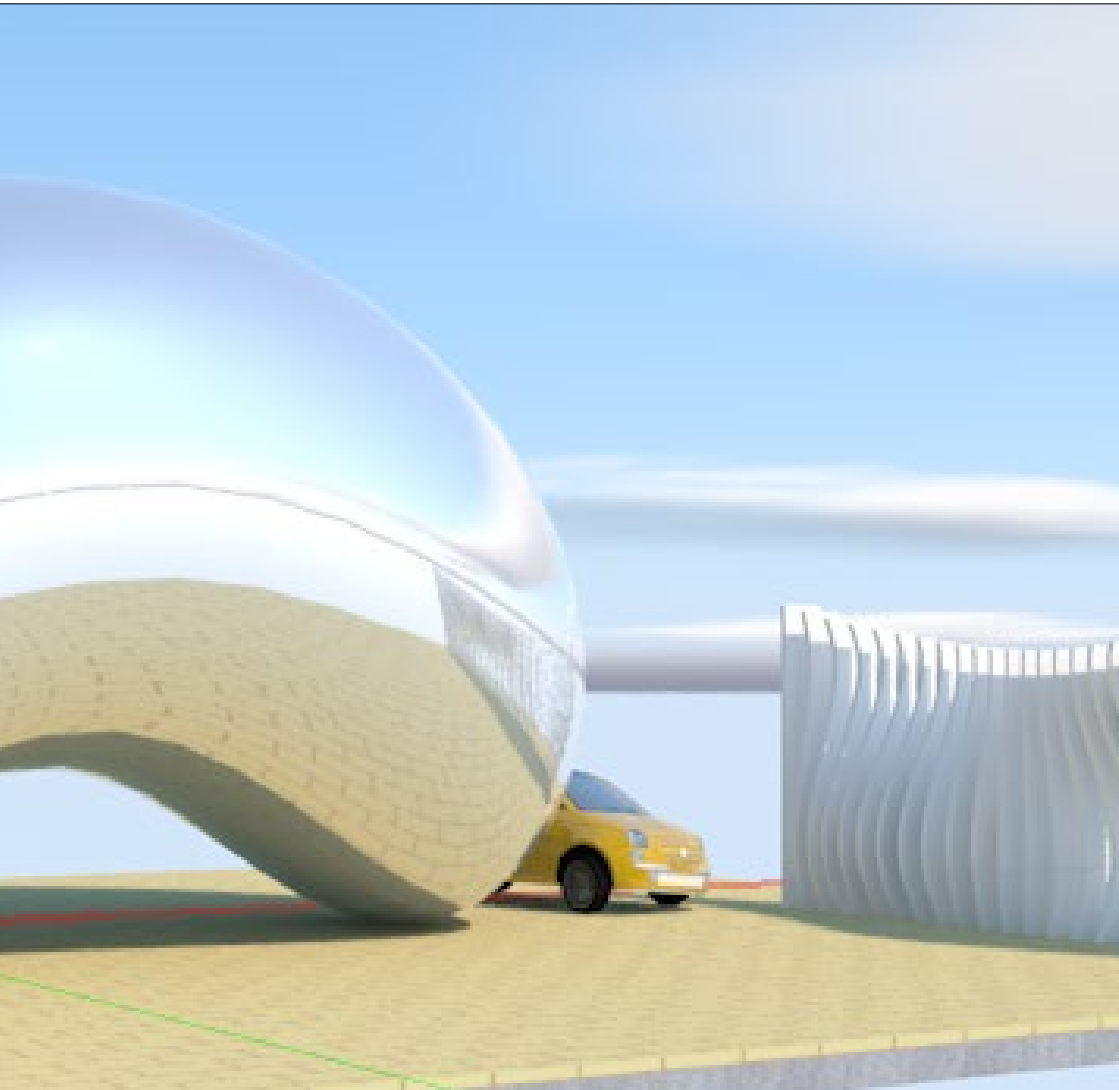


SHORT SHARP MANUALS

1604

Subdivision
Modeling



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Making Vectorworks easy!

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Contents

Introduction	4
Basic Concepts	5
Controlling Subdivision Surfaces	9
Choosing the Correct Primitive Shape	12
Edit Subdivision Tool	19
Transform Mode	23
Crease Mode	27
Face Extrude Mode	29
Face Split Mode.....	30
Face Hole Mode.....	31
Edge Extend Mode	32
Edge Split Mode	33
Creating a Shade Sail	35
Creating a Bollard	51
Bath	62
Sunscreen	65
Chicago Bean	70
Conclusion	72

Introduction

Subdivision modelling is a new area for Vectorworks. It was introduced in Vectorworks 2016 and it will allow Vectorworks to create extremely complex smooth curving shapes.

Subdivision services have been around for some time as a computer technology, but not implemented in computer programs very often. The subdivision surfacing techniques employed by Vectorworks have been developed by Pixar Inc. and Vectorworks are using their system.

“subdivision surfaces are polygon mesh surfaces generated from a base mesh object through an iterative process that smooths the mesh while increasing its density” www.holmes3d.net/graphics/subdivision/

Because this is a new technology for many Vectorworks users it may seem unusual in the way that you edit a subdivision surface. In the chapter on basic concepts I will explain this new technology and how you can edit objects.

The term subdivision surface is used to describe the actual technology that makes the object appear smooth and curving. The term subdivision modelling applies to the act of creating and changing a subdivision surface.

In this manual we will be looking at the basic concepts of subdivision modelling and how these vary from the normal or traditional 3D modelling in Vectorworks.

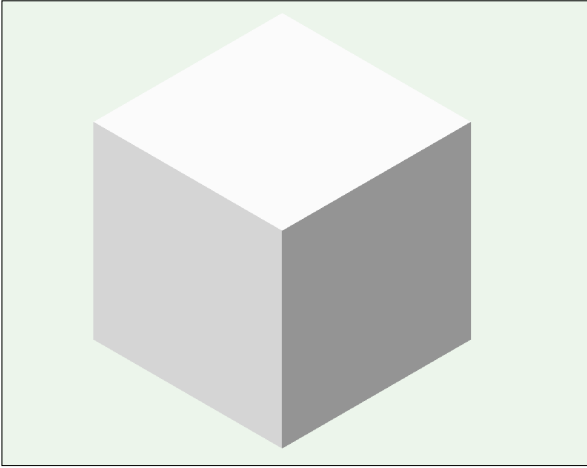
Subdivision modelling starts with a primitive shape which is then edited. Selecting the correct primitive shape is important to make it easy to build your object. We will look at examples of how to choose the correct primitive shape, then we will look at the different editing modes for subdivision modelling.

Finally we will look at some examples of subdivision modelling and how to create them.

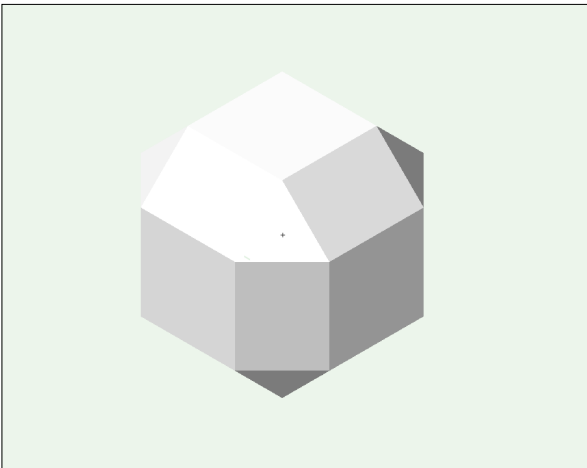
Basic Concepts

In this chapter will be looking at some basic concepts related to subdivision modelling.

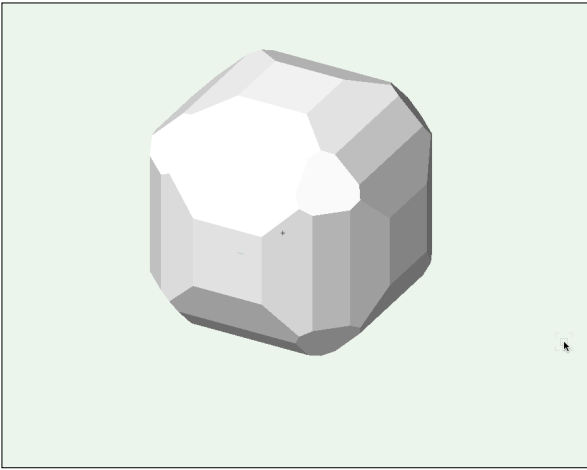
One of the basic concepts of subdivision surface is that this is a method of representing complex curved forms. Subdivision starts by applying a mesh over the form.



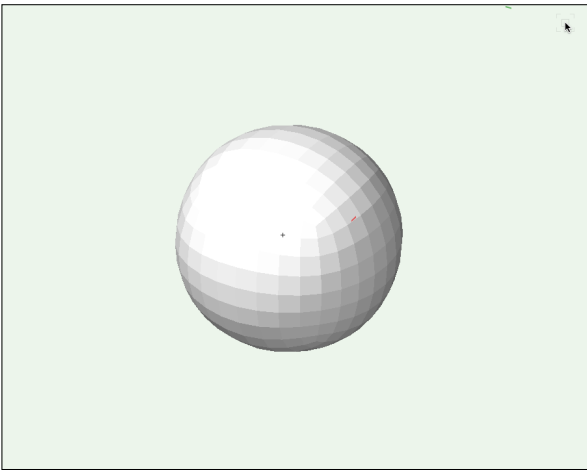
The mesh is then subdivided in the required areas to more accurately approximate the curved surface.



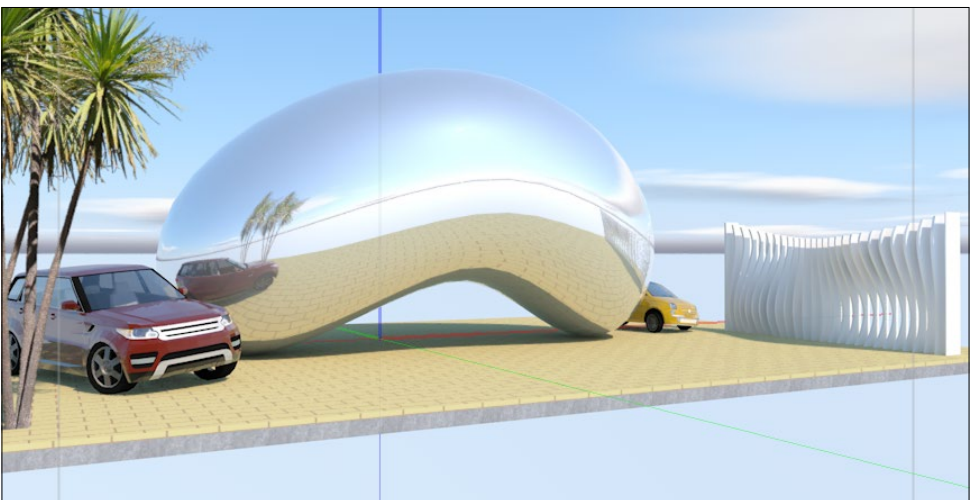
This is an iterative process which means that it carries out the same process again and again, to smooth out the shape even further.



The process carries on until the smooth surface is completed..

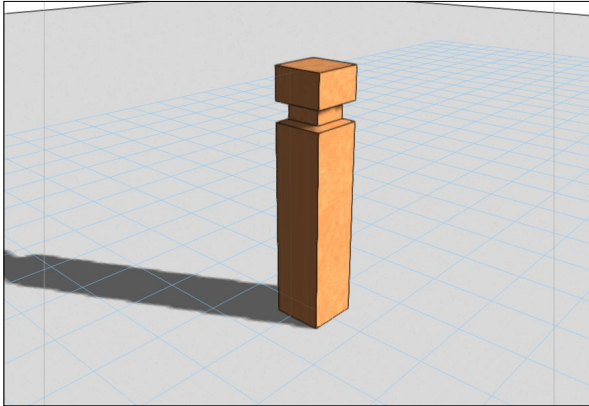


This process makes it extremely fast to generate very complex curves.

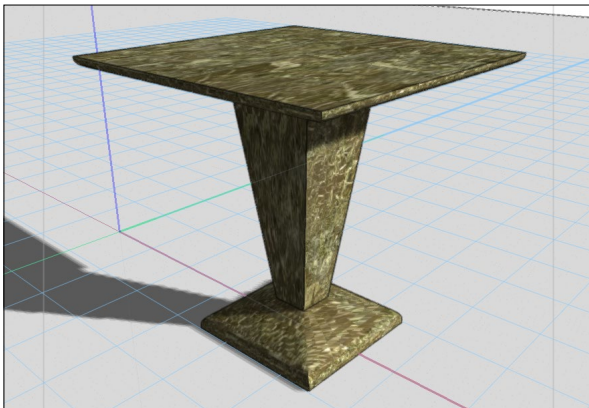


It's tempting to think that the subdivision modelling is only useful for these very curving shapes. But as I have been playing with subdivision modelling while writing this manual, I have come to appreciate that you can use the subdivision modelling for many of objects that you want to create.

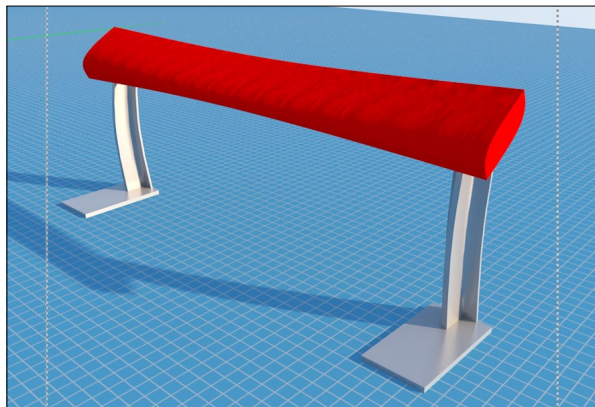
For example, this object is similar to the 3D object that I always use for an introduction to 3D modelling. But instead of building this out of extrusions, I have built this out of a subdivision surface, starting with a cube subdivision primitive.



This is another example of an object that I often use as an introduction to multiple extrusions, it's my cafe table. But this example is also been created from a cube subdivision primitive and then modified with subdivision modelling.



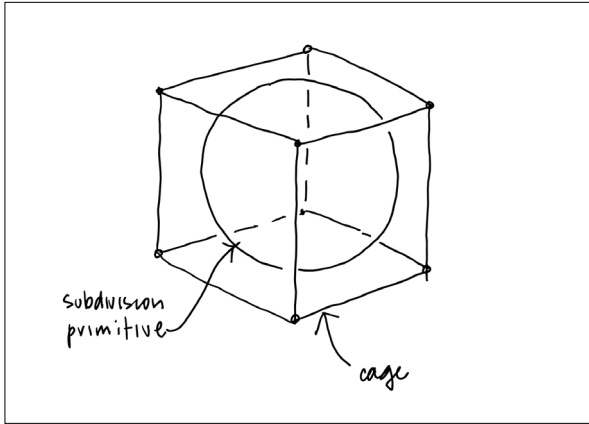
In this example though you can see that I've used subdivision modelling extensively to create the seat and the legs. The plate to support the legs as a simple extrusion, and is not created with subdivision modelling, although it could have been.



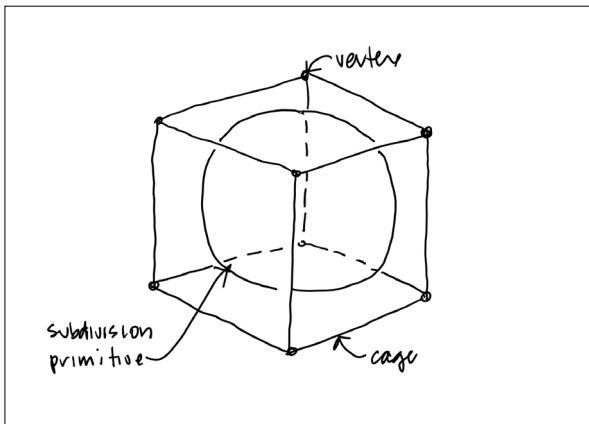
Controlling Subdivision Surfaces

The basic concept of a subdivision surface is the cage. This cage controls the extent of your subdivision surface and it has all the controls to allow you to manipulate it.

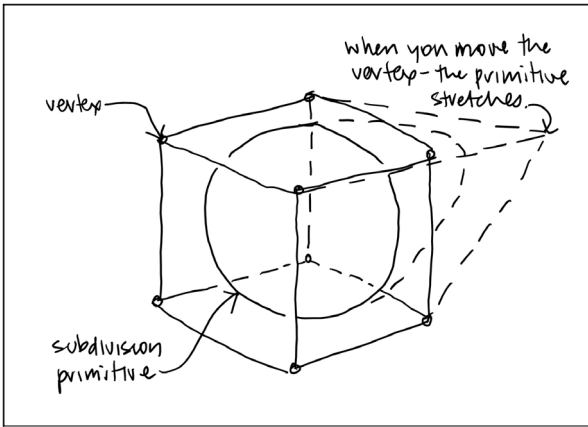
If your subdivision object is not selected it will not have the cage visible. As soon as you select the subdivision surface, you will see a bounding box. If you double-click on the subdivision surface, you will be able to see the cage.



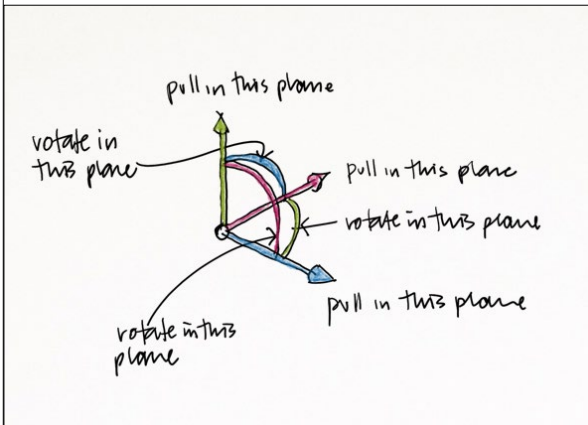
When you select the subdivision surface and you have the edit subdivision tool selected, you will see the cage and you will see small vertices at each corner.



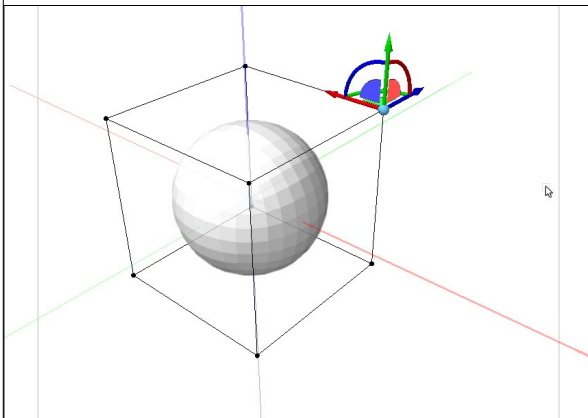
When you move near one of these subdivision vertices, it will turn red. If you click on it you will be able to select that vertex and stretch the cage.



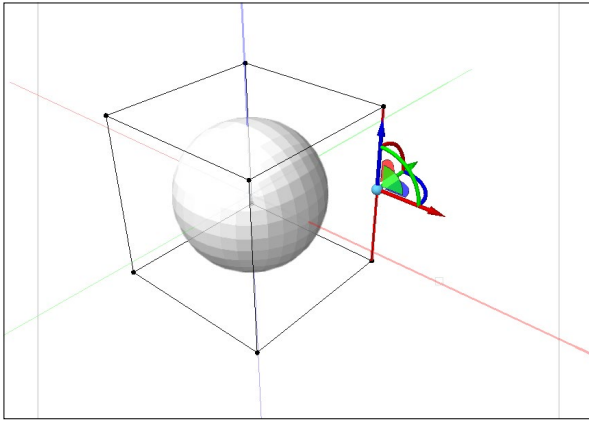
In order to manipulate your subdivision cage, you will need to use this widget. You will find this widget when you select one of the vertices, one of the edges, or one of the faces. This widget is designed to allow you to stretch and rotate the vertices, edges or faces.



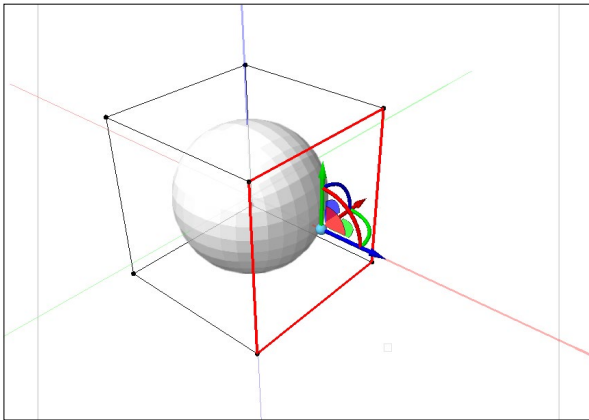
This image shows a subdivision primitive with a vertex selected. You can see the 3D dagger at the top right corner of the cage.



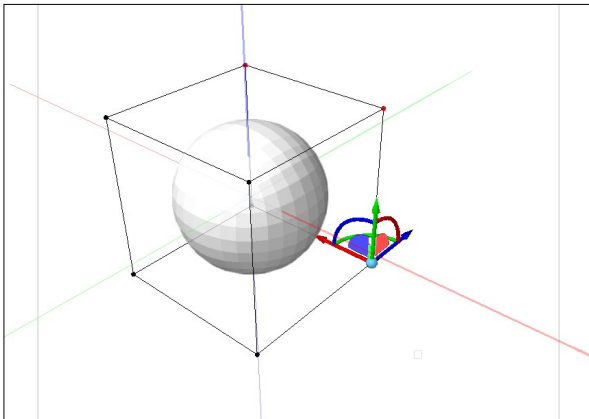
This image shows the edge of the cage selected. Your notice that the 3D dagger is in the centre of the edge.



This image shows the face of a cage selected. You will notice that the 3D dagger is in the centre of the face.



In this image two vertices have been selected. The 3D dagger will appear on the last selected vertex.



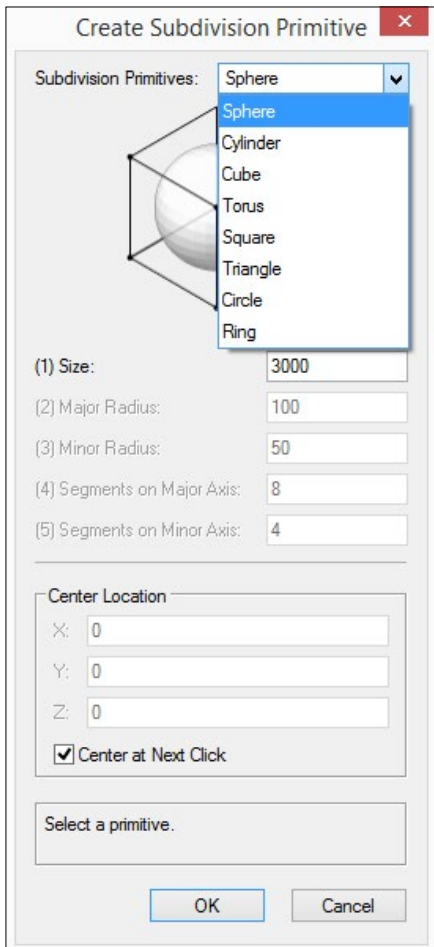
Unlike your normal Vectorworks modelling, you will start with a primitive shape and then modify the shape as desired. You will not be using tools and commands like add solid, intersect solid, et cetera, you will be taking this primitive shape stretching it, splitting it, pushing it, pulling it, et cetera in order to get the desired shape.

Choosing the Correct Primitive Shape

There are several primitive shapes that you can use to start your subdivision surface. Starting a project with the correct primitive shape will make it easier for you to model. For example, if you want to create something like the bean in Chicago (the image I have used on the cover of this manual), then starting off with a sphere would make it easier than starting off with a square.

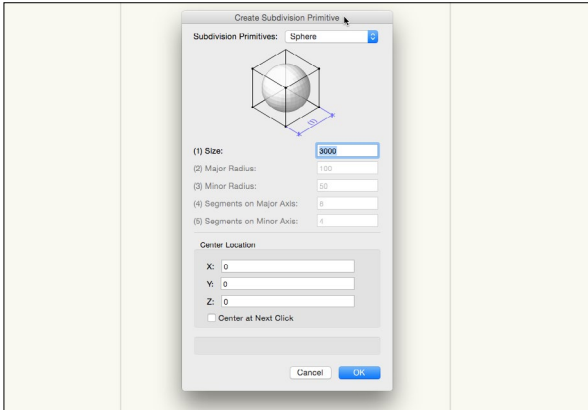
You can start a subdivision project using:

- Sphere
- Cylinder
- Cube
- Torus
- Square
- Triangle
- Circle
- Ring

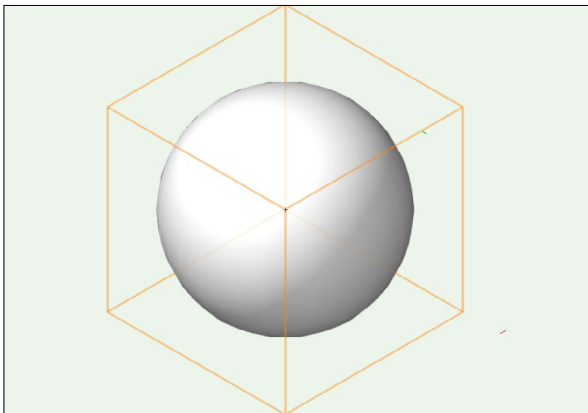


In this image I have shown a sphere subdivision primitive.

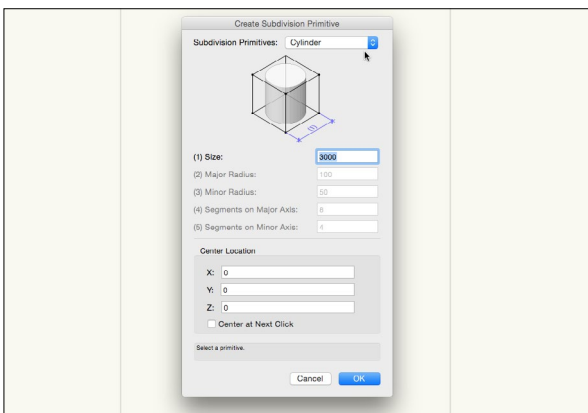
This dialog box is similar to several of the Create Object dialog boxes in Vectorworks. At the bottom of this dialog box you can choose the coordinates for the centre of this object or you can choose to place it at the next mouse click.



When you click on the **OK** button, Vectorworks will place the subdivision primitive where you have specified.

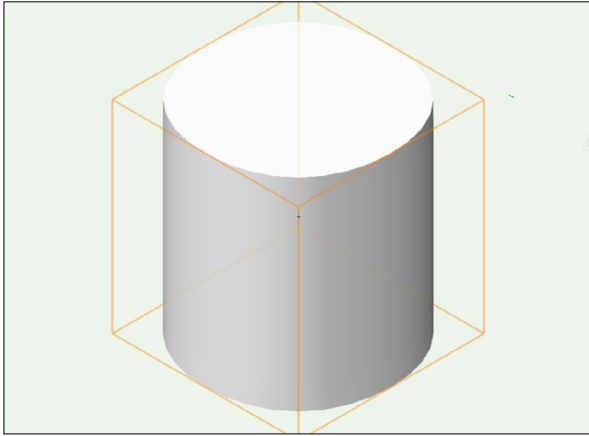


In this image I have shown a cylinder subdivision primitive.

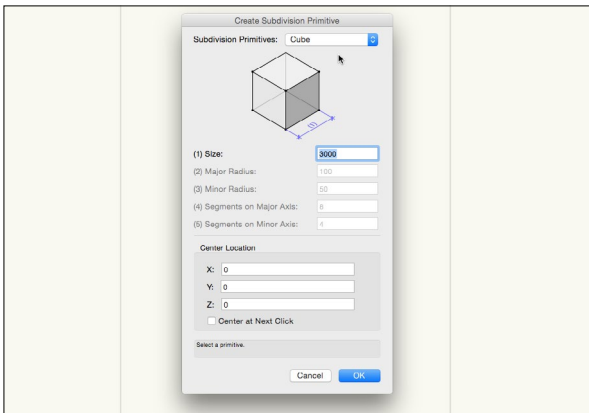


When you click on the **OK** button, Vectorworks will place the subdivision primitive

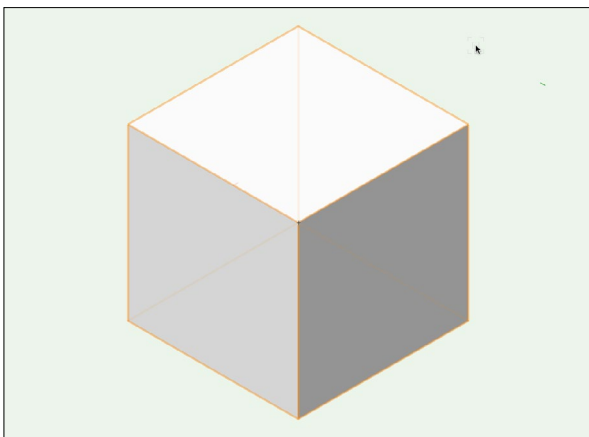
primitive where you have specified.



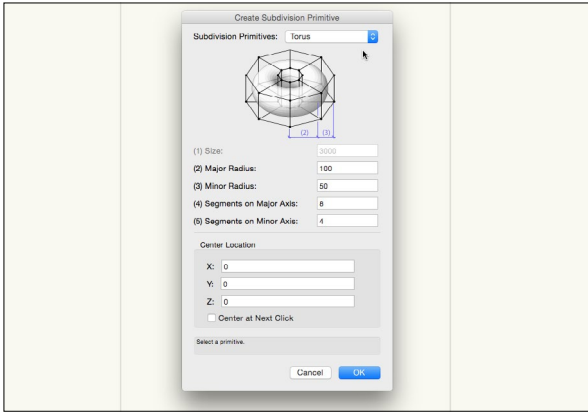
In this image I have shown a cube subdivision primitive.



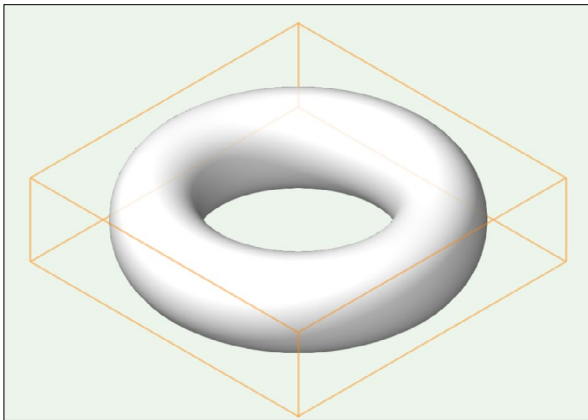
When you click on the **OK** button, Vectorworks will place the subdivision primitive where you have specified.



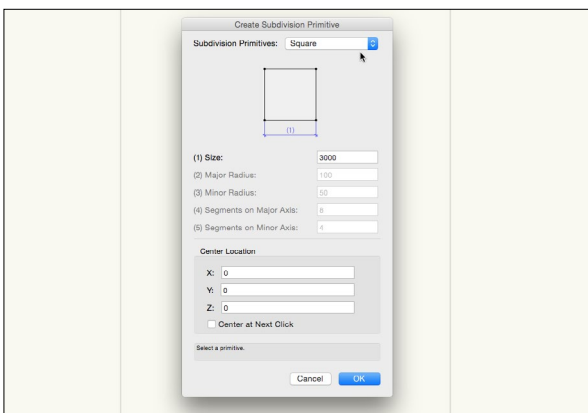
In this image I have shown a torus subdivision primitive.



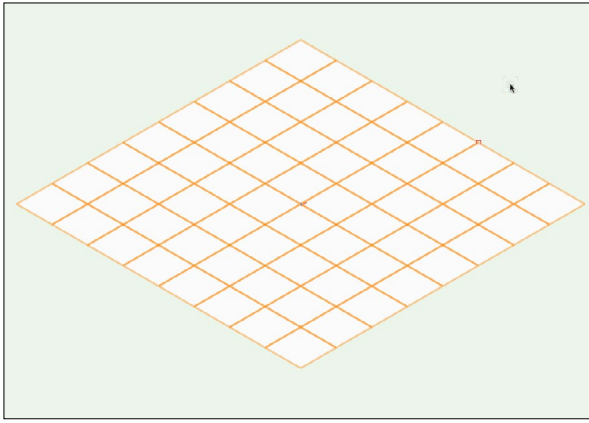
When you click on the **OK** button, Vectorworks will place the subdivision primitive where you have specified.



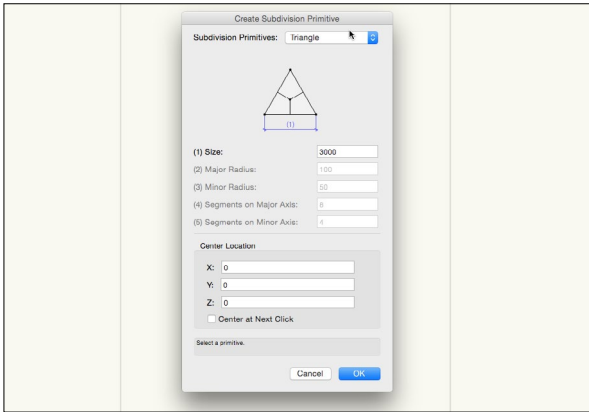
In this image I have shown a square subdivision primitive. This primitive does not have a thickness like the previous primitives. This type of primitive is ideal for creating flat objects.



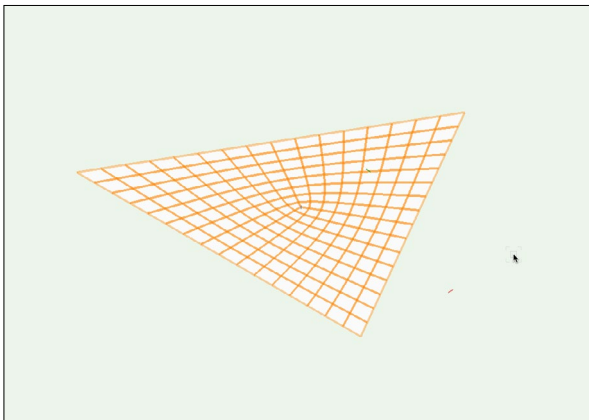
When you click on the **OK** button, Vectorworks will place the subdivision primitive where you have specified.



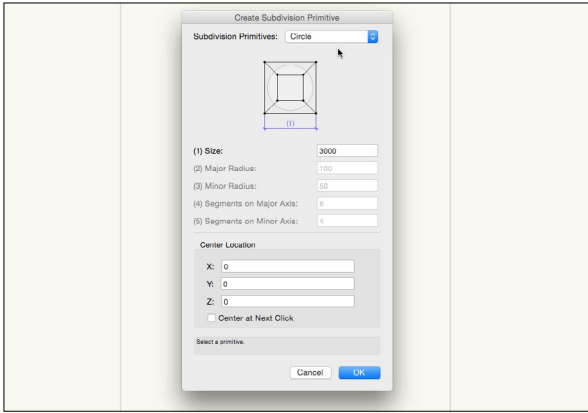
In this image I have shown a triangle subdivision primitive.



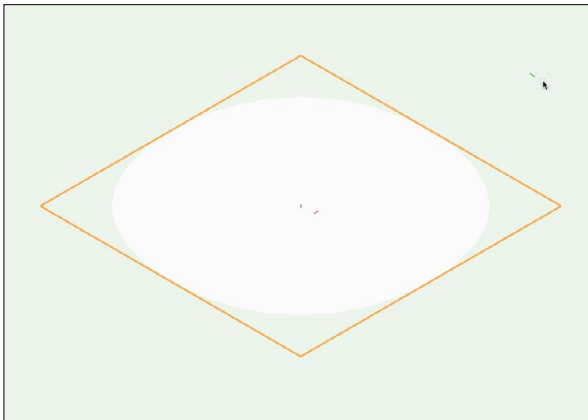
When you click on the **OK** button, Vectorworks will place the subdivision primitive where you have specified.



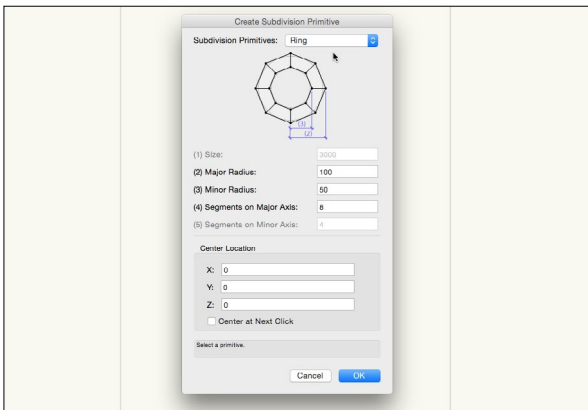
In this image I have shown a circle subdivision primitive.



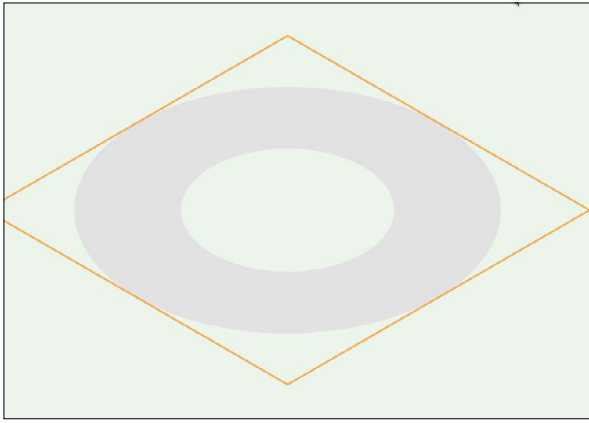
When you click on the **OK** button, Vectorworks will place the subdivision primitive where you have specified.



In this image I have shown a ring subdivision primitive.



When you click on the **OK** button, Vectorworks will place the subdivision primitive where you have specified.



Choosing a suitable primitive will speed up your modelling. However, there is no golden rule, no perfect answer that I can give you to help you understand what shape to start with.

There are some rules of thumb, some of which I think are obvious. For example, if you wanted to create a shade object without a hole in the centre, it would be difficult to create if you started with the ring or the torus. Flat shapes are better for making thin objects.

One of the examples I will be creating is a bath object. It may seem that you need to start with a sphere and cut the sphere and half in order to create a bath shape. But the bath is just as easy to create if you start with a circle. This might seem strange considering the circle is a flat object. But even though it starts out flat, you can pull the edges up to easily create the bath shape.

Some things are not so obvious. For example, you could start with a sphere and use some of the editing tools to turn it into a cylinder or even a cube. You can start with a cube and turn it into a cylinder or a sphere.

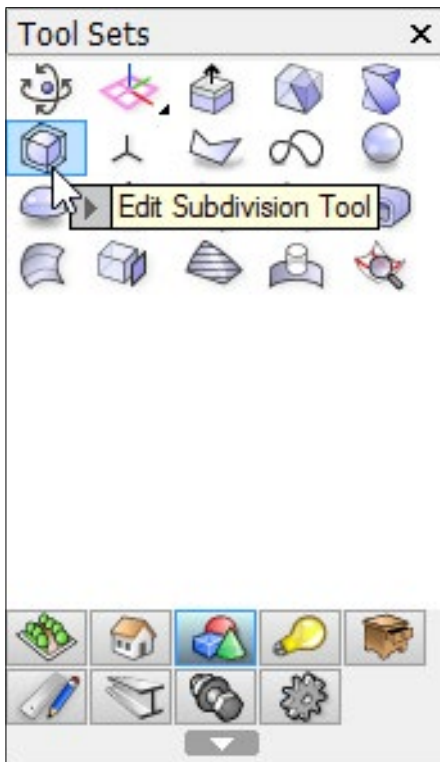
The more I work on my subdivision modelling, the more flexible I am finding it.

Edit Subdivision Tool

You can access this tool by double-clicking on a subdivision surface or you can find this tool in the 3D modelling tool set. This tool is going to be your main way of interacting with a subdivision surface. It is a tool that you will be using to stretch, pull, push, squeeze, or in some way edit the subdivision surface.

Although this is a single tool there are several modes which we will look at briefly.

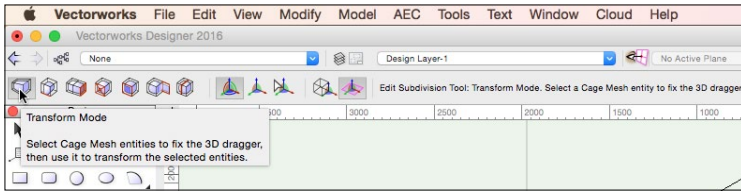
Activate this tool by double-clicking on a subdivision surface or by finding the tool in the 3D model toolset.



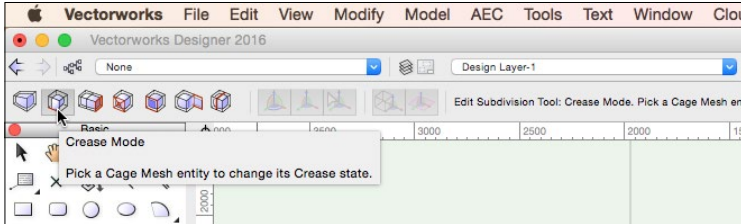
The first group of modes are for choosing how to deal with your subdivision surface. The second group of modes only works with the transform mode, and the third group of modes also works with the transform mode only.

The first mode to look at is the **Transform Mode**. This mode will be your main tool for manipulating your subdivision surface. This mode is also used with the last two groups of modes.

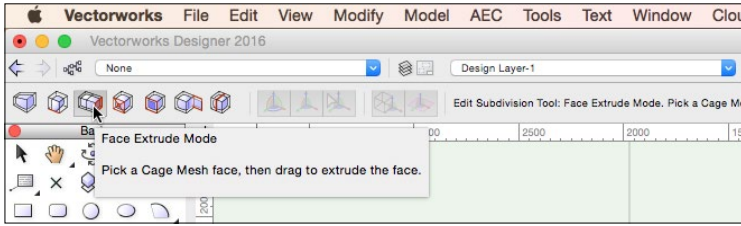
Use this mode for pushing, pulling, or changing the size of your subdivision surface.



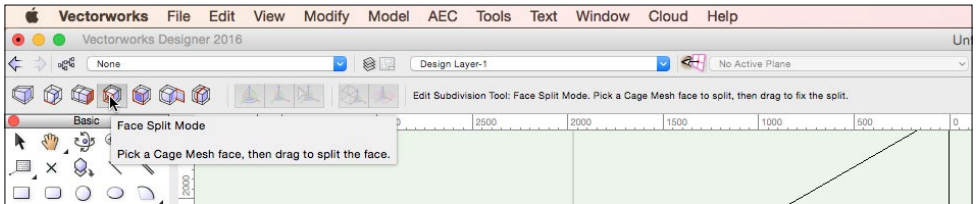
The second mode is the **Crease Mode**. Use this mode to change the crease at the edges of the subdivision cage.



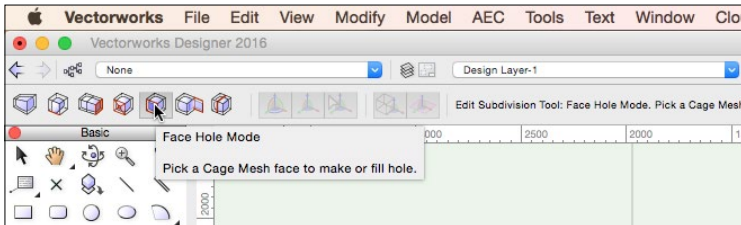
The third mode is the **Face Extrude Mode**. Use this mode to pull out a face of the object, much like using the Push/Pull tool in the extrude mode



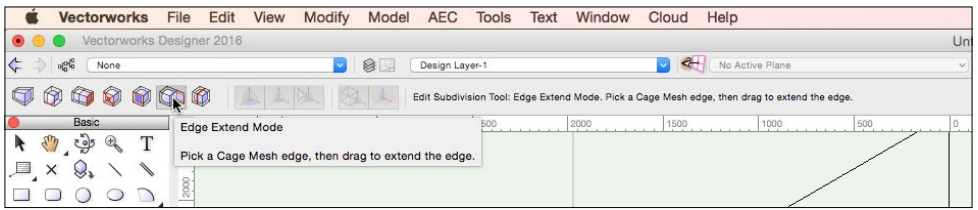
The fourth mode is the **Face Split Mode**.



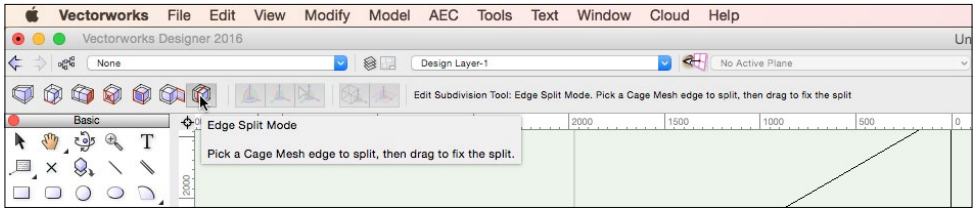
The fifth mode is the **Face Hole Mode**. Use this mode to create a hole in your subdivision primitive.



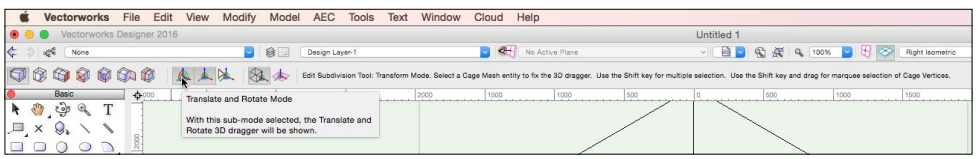
The sixth mode is the **Edge Extend Mode**. This mode works with the flat subdivision primitives (square, circle, ring, et cetera) and allows you to extend and each of one of these primitives



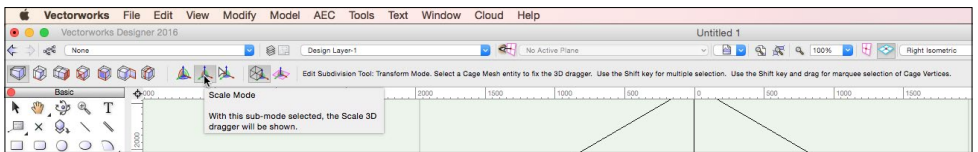
The last mode in this group is the Edge Split Mode. This mode is extremely useful for splitting the edges of your subdivision primitive to give you more vertices to control.



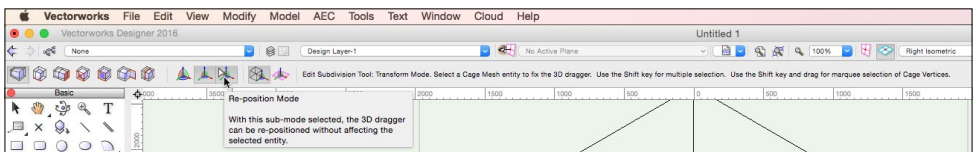
The three modes in this group only work with the **Transform** mode. The first of this group is the most common, and you use this to move and rotate the vertices.



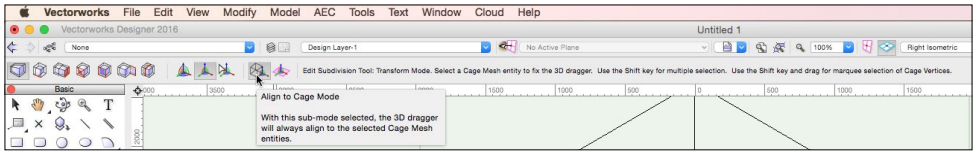
The second mode is the scale mode and can be used to change the scale of a part of your subdivision.



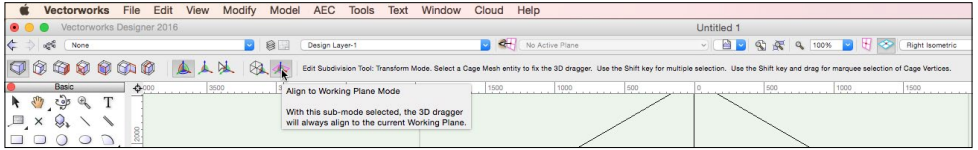
The third mode can be used to reposition the 3D dagger (widget) to a suitable location.



The two modes in this group only work with the **Transform** mode. The first mode in this group is the **Align to Cage Mode**. In this mode your 3D dragger will rotate to suit the rotation of the cage..



The second load in this group aligns the 3D dagger to the working plane. If you haven't set a working plane then this mode will align the dagger to the layer plane.

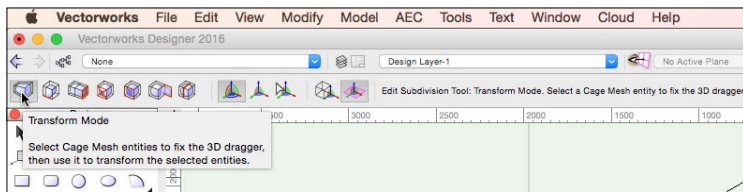


Transform Mode

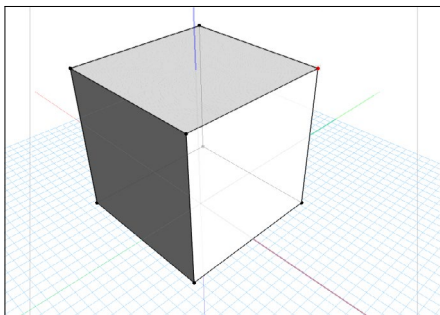
This is the most common mode to use, it is the mode that you will use to move stretch, pull, or reshape the primitive object. It allows you to select a vertex, an edge, a face, or several vertices.

This mode has the most options, so we will have to spend more time on this option than the other modes. while the other modes do specific jobs, this is the mode that you use to change the size, shape, or rotation of the vertices on the subdivision surface.

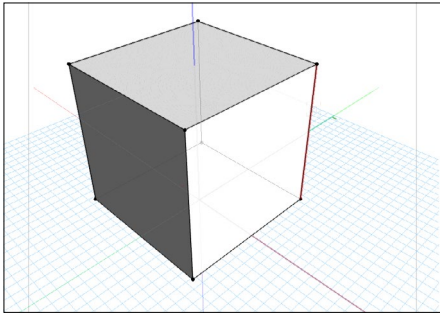
- Double-click on your subdivision surface.
- Go to the **Tool** bar.
- Click on the first mode, the **Transform** mode.



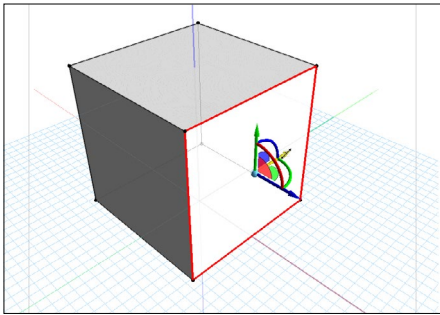
- The transforming mode works on vertices, sides, or faces. In this picture the cursor is close to the top right hand corner vertex.
- When you get close to this vertex it will turn red.
- To select this vertex, click once.



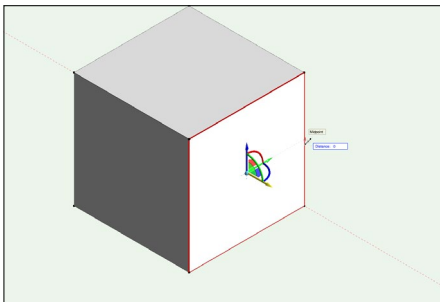
- In this image the cursor is close to the right hand edge of the subdivision cage. Because this is a cube, the edge of the cage is also the edge of the subdivision surface. If this was a cylinder or a sphere, you would clearly see the edge separated from the subdivision surface.
- When you get close to the edge of the subdivision cage, the edge turns red.
- To select the edge, click once.



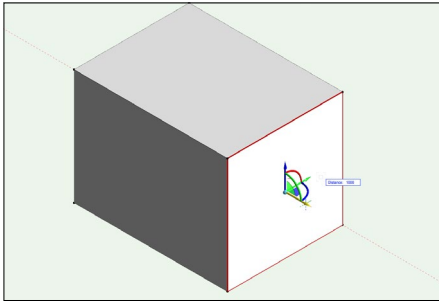
- If you move to the face of a subdivision cage, the entire face of the cage will highlight, all four edges will highlight in red.
- When you click once to select the vertex, edge, or face (as in this image) you will see a new cursor shape known as the 3D dagger.
- This dagger object is used to move the selected part of your subdivision surface. You can move it in X, Y, Z, or you can rotate it in these planes as well. There is an explanation of the 3D dagger on page 10.



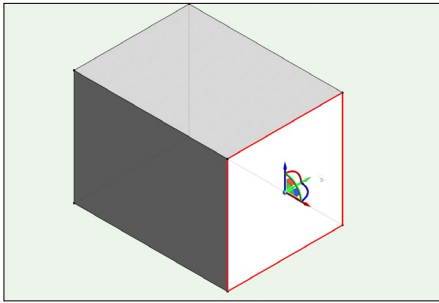
- To transform the object click on the arrow for the required direction change.



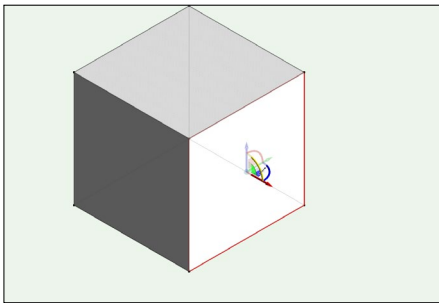
- Move the cursor in the direction of the required change. You can also use the floating data bar to accurately control the change.



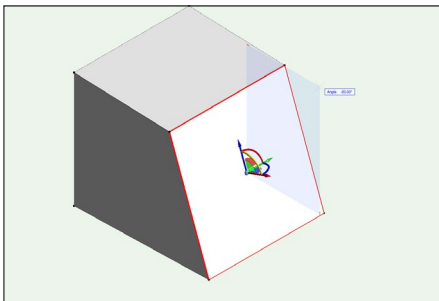
- Click once to confirm the transformation.



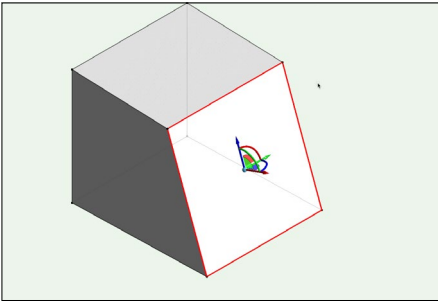
- Instead of clicking on one of the arrows, you could click on one of the project is to control the angle of this vertex, edge, or face.



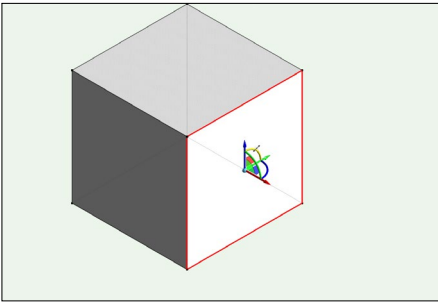
- Move your cursor to define the change in angle. Remember you can use the floating data bar to control this more accurately.



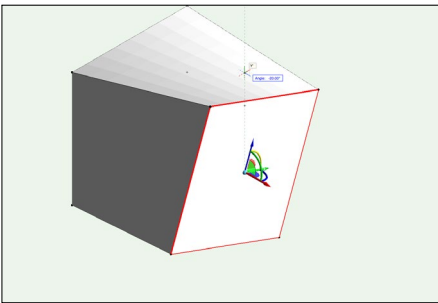
- Click once to confirm the change.



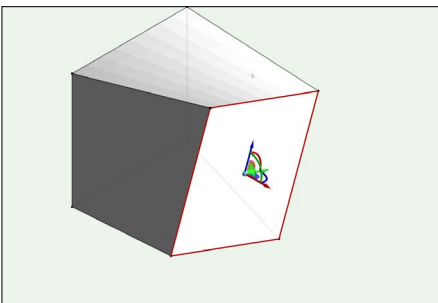
- The rotation depends on which protractor you click on.



- In this image you can see that I have clicked on the protractor to twist the face of the object.



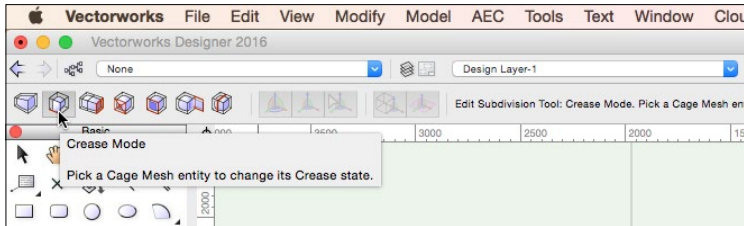
Click once to confirm the change.



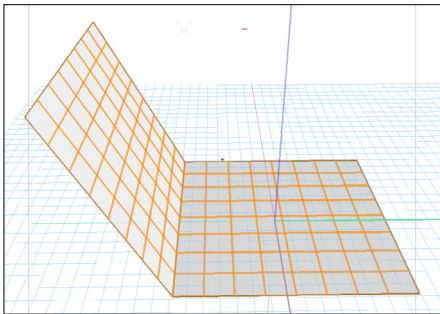
Crease Mode

The **Crease mode** controls the change in direction between faces of the subdivision surface.

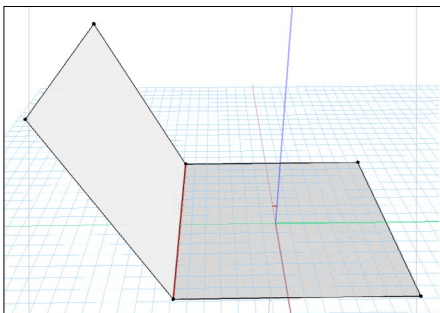
- Double-click on your subdivision surface.
- Go to the **Tool** bar
- Click on the second mode, the **Crease** mode.



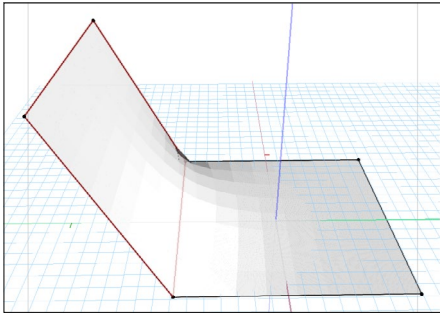
- In this image you can see a grid on each face of the subdivision surface. You might also notice the crease at the edge between the two faces. In this image the object looks like a piece of paper that has been folded. The fold line is what you might call the crease.



- Move your cursor to the edge between the two faces.
- The edge will highlight in red.



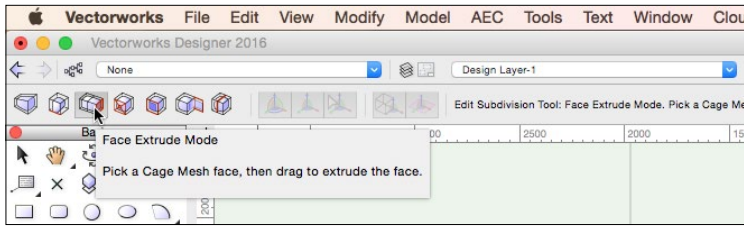
- Click once to remove the crease between the two faces. Notice how there is now a smooth transition between the two faces.



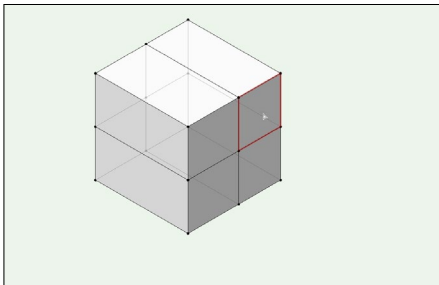
Face Extrude Mode

This mode is ideal for adding apart to your model by extruding a face. If you have used Push/ Pull tool, then you might be familiar with the concept of extruding a face. When using this concept with subdivision surfaces, the results can be slightly different, but the concept is still the same: the extruded face mode will extrude the face of the object perpendicular to the plane of it.

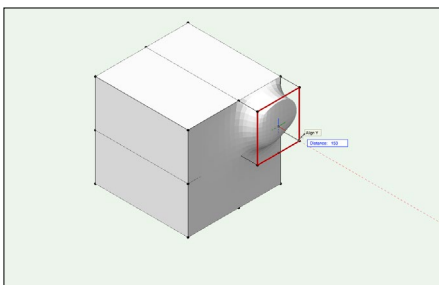
- Double-click on your subdivision surface.
- Go to the **Tool** bar
- Click on the third mode, the **Face Extrude** mode.



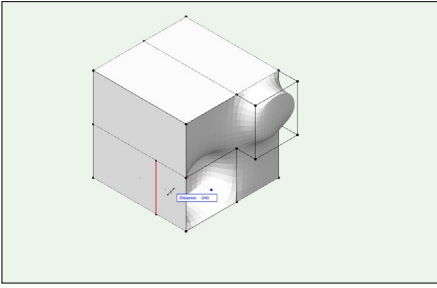
- Move to the face of your subdivision surface.
- The face will highlight with red around the edges.
- Click once to start.



- Move your cursor to define the extent of the extrusion. notice how the edges of your extruded face are not square to the original subdivision surface. This is because those edges have a crease. you can change this crease by using the Crease mode.
- Remember to use the **Floating Data** bar to accurately control your extrusion.



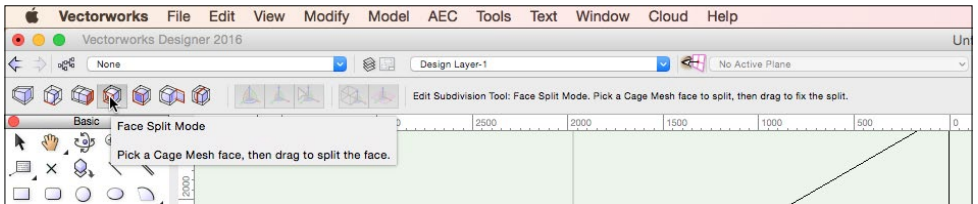
- Click once to confirm the extrusion.
- The extrusion can be either positive (out from the face of the subdivision surface) or negative (into the face of the subdivision surface).



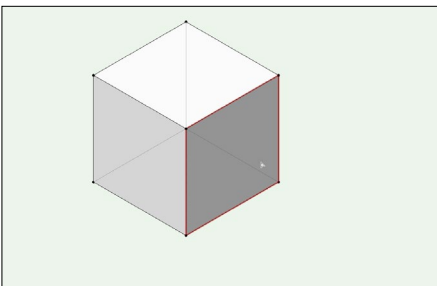
Face Split Mode

There are times when you are using your subdivision surface where you want to control just a small part of the face. That's what this mode is for, it allows you to split up the face into smaller parts.

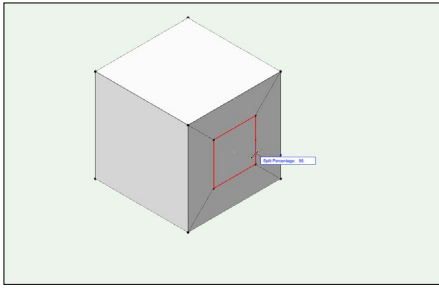
- Double-click on your subdivision surface.
- Go to the **Tool** bar
- Click on the fourth mode, the **Face Split** mode.



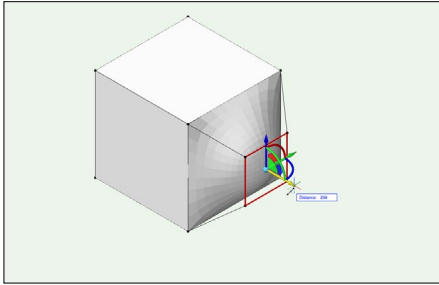
- Move to the face of your subdivision surface.
- The face will highlight with red around the edges.
- Click once to start.



- Move your cursor to control the area to split. As you move left and right you'll find that the centre red square gets larger or smaller.
- Click once to confirm the size of the face split.



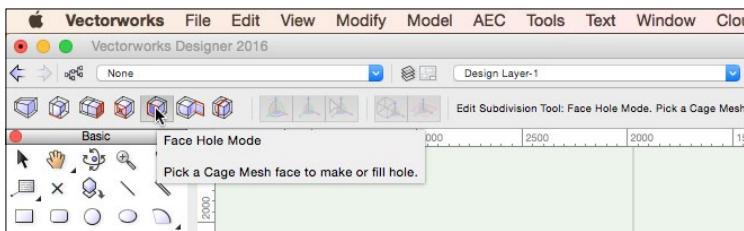
- Once you have created the split, you can use other modes like the Extrude Face mode.



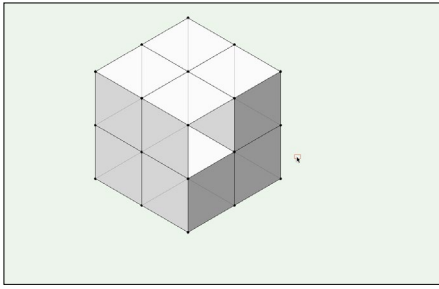
Face Hole Mode

This mode will remove a portion of your subdivision face.

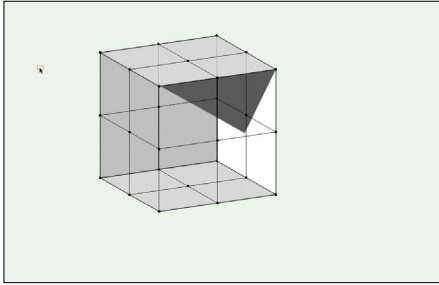
- Double-click on your subdivision surface.
- Go to the **Tool** bar
- Click on the fourth mode, the **Face Split** mode.



- Move to the face of your subdivision surface.
- The face will highlight with red around the edges.
- Click once to create a hole.



- Click once on each face that you want to remove.

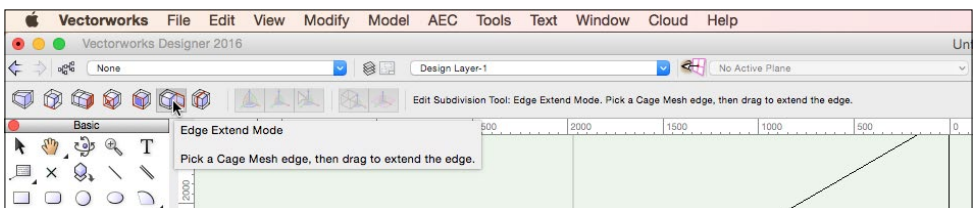


- If you want to remove the holes that you have created, click once again on each face, the face will be reinstated.

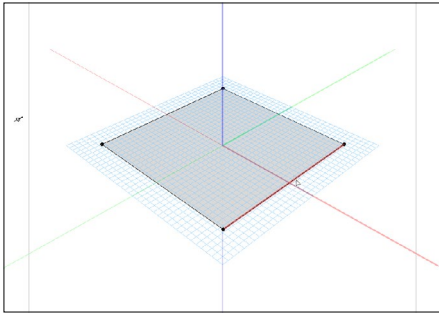
Edge Extend Mode

This mode works mainly with flat subdivision primitives such as the square, circle, ring, et cetera.

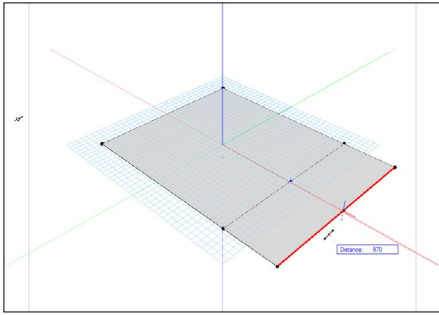
- Double-click on your subdivision surface.
- Go to the **Tool** bar
- Click on the fifth mode, the **Edge Extend** mode.



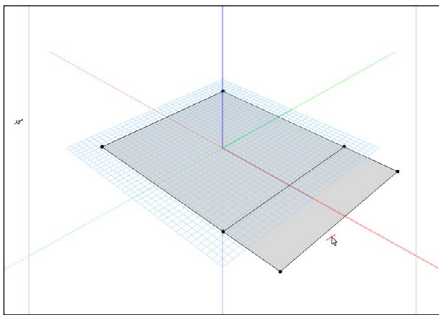
- Move to the edge of your subdivision surface.
- The edge will highlight in red.
- Click once to start.



- Move your cursor to define the extension of the edge.



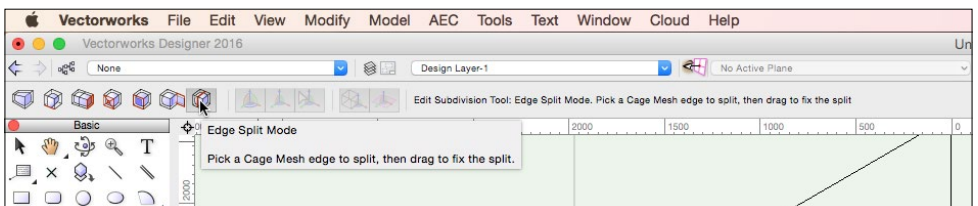
- Click once more to confirm the change.



Edge Split Mode

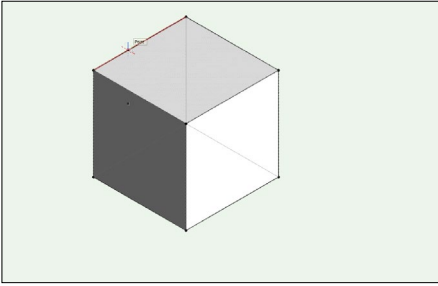
I find this to be an extremely useful mode as it will split your object up allowing you to modify different parts of the subdivision surface.

- Double-click on your subdivision surface.
- Go to the **Tool** bar
- Click on the sixth mode, the **Edge Split** mode.

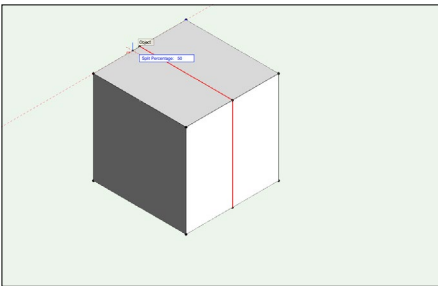


- Move to the edge of your subdivision surface.

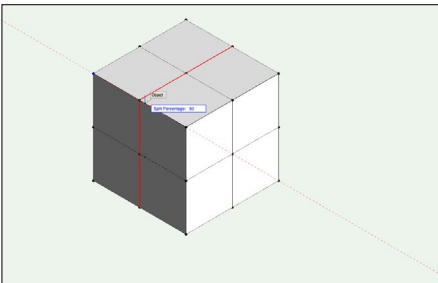
- The edge will highlight in red.
- Click once to start.



- Move your cursor along the edge to define the percentage of the split. 50% is right in the middle of the edge.
- Remember to use your **Floating Data** bar to accurately control the percentage of your split.



- Click once more to confirm the Split.
- Move to another edge and click once more to split your object again.

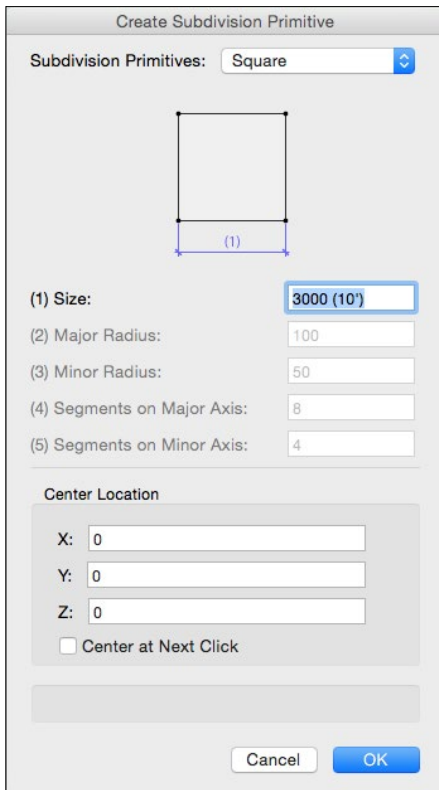


Creating a Shade Sail

Now that we have looked at these modes in detail, it will be useful to look at how to create an actual object by using the various modes. Subdivision modelling is extremely powerful and it might seem strange that we only use one tool to do all of our changes. We will be changing between various modes in order to create the models that we want.

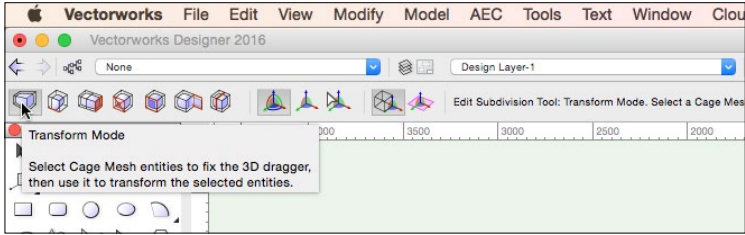
In this exercise we are going to build a shade sail. To start with I'm going to assume that the columns have already been created, but later on in the exercise I will show you how you could create those as well.

- Subdivision modelling will always start with a primitive. You can create a primitive by using the command from the model menu, or you can create it by double clicking on the **Edit Subdivision Tool** from the 3D modelling tool set.
- Put on the size for the start of your subdivision primitive. You do not have to worry about being very accurate at this stage, the shade sail will be stretched to suit the columns.
- You might notice that I have given a centre location at 0,0,0 (X, Y, Z). You can use the centre next click option if you have a location that you know. For this example, I'm going to start in the centre of my page.

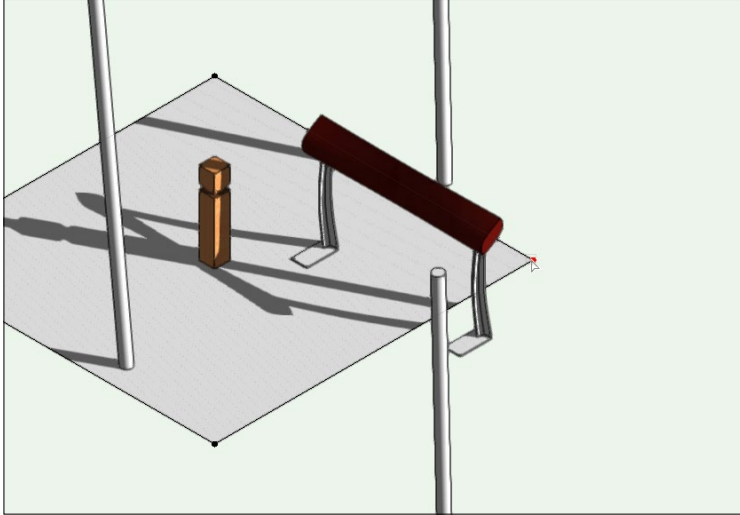


- Click on the **OK** button to place the subdivision primitive
- Go to the **Tool** bar.

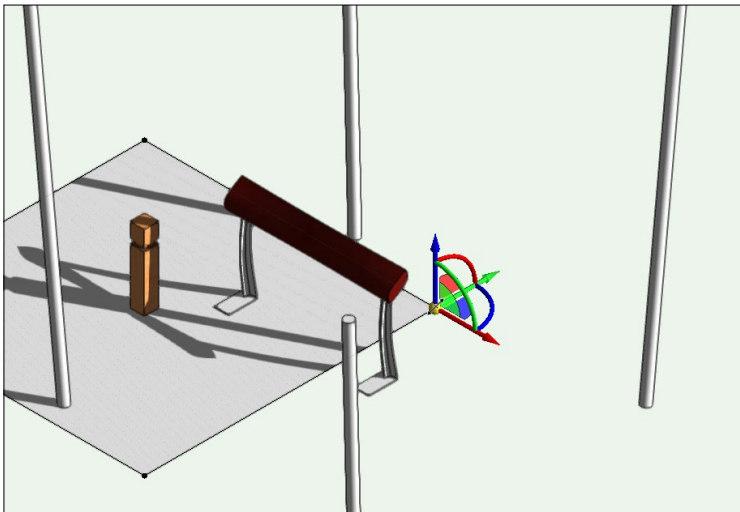
- Click on the first mode.



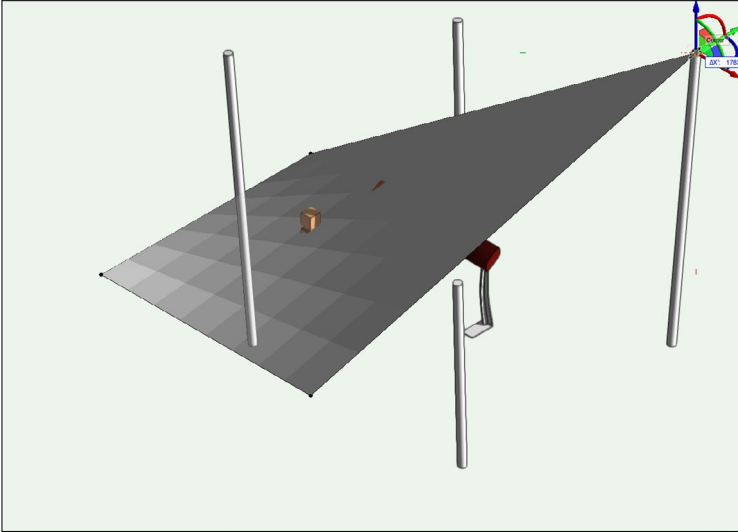
- Move your cursor to the first vertex.
- Click once.



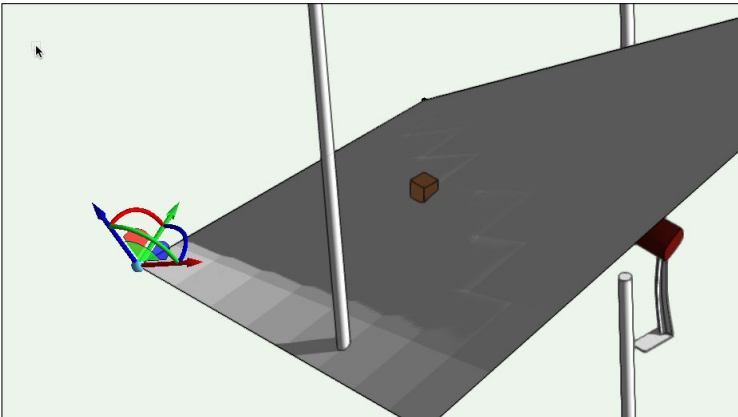
- The 3D Dagger will appear.
- At the center of the 3d Dagger is a control that will allow you to move this vertex in any direction.
- When you move to this control handle, it will turn yellow.
- Click on this control handle to move it.



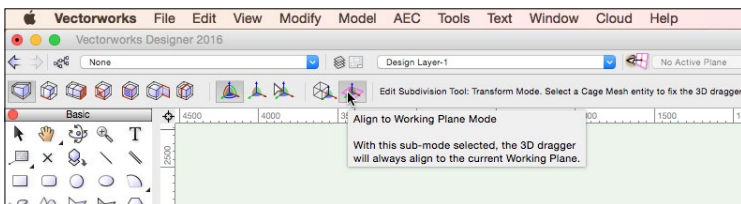
- Click once more at the required location.



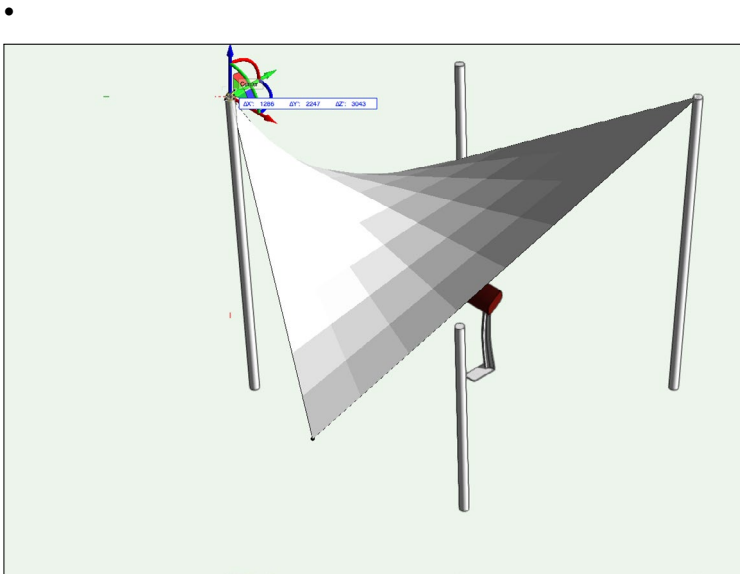
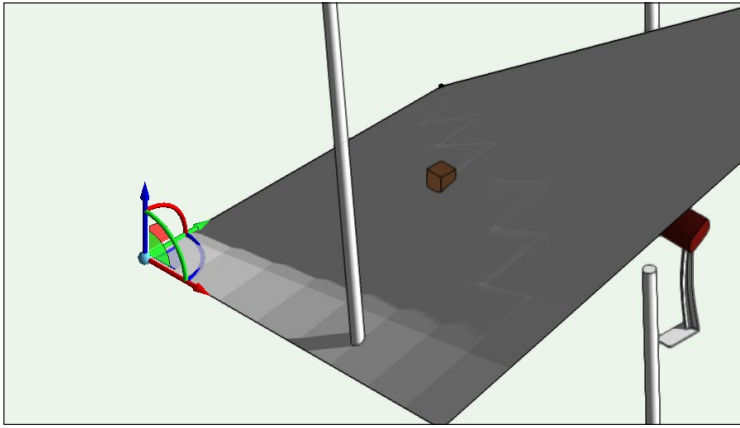
- Select the next vertex to be moved. Notice that the 3D dagger has been rotated to match the slope of the subdivision surface.
- In this case, the tool bar has the mode selected to align the dagger with the subdivision cage.



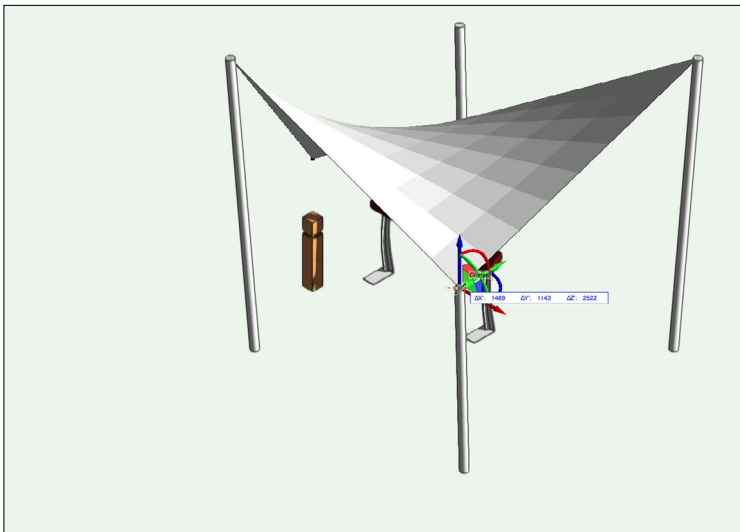
- Go to the **Tool** bar and choose the mode to align the 3D dagger to the working plane.



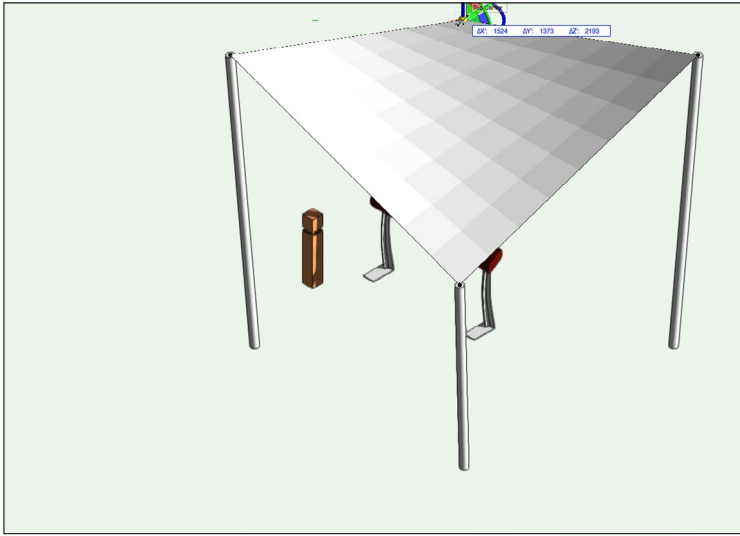
- Notice the change to the 3D Dagger.



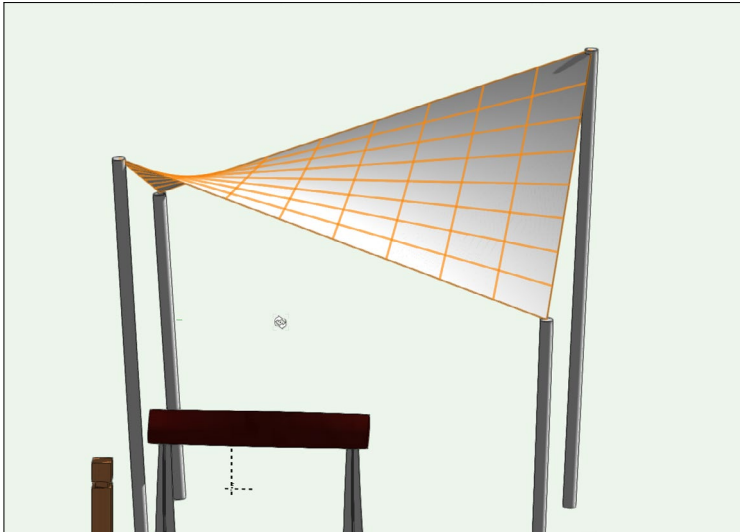
- Move this vertex (3D dagger) to the required location.
- Go to the next vertex and move that to the correct location.



- Finally, move the last vertex to the required location.

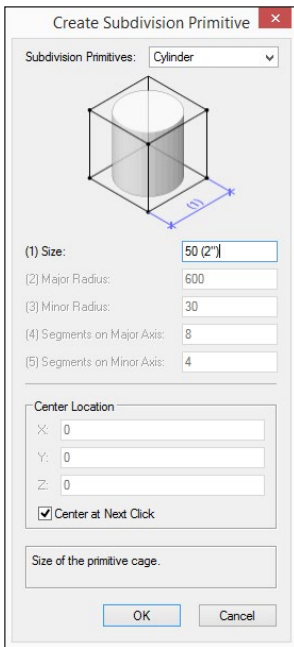


- Change the view to ensure that your vertices are where you want them.

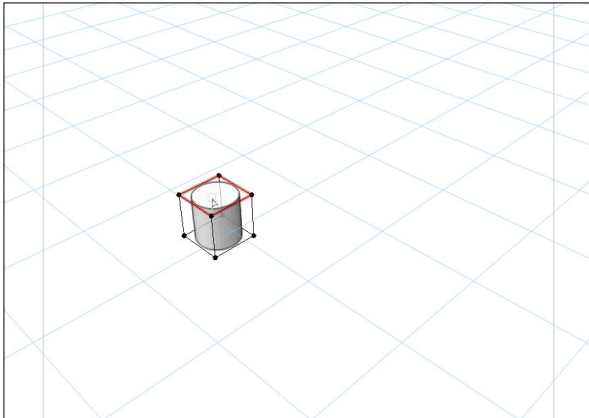


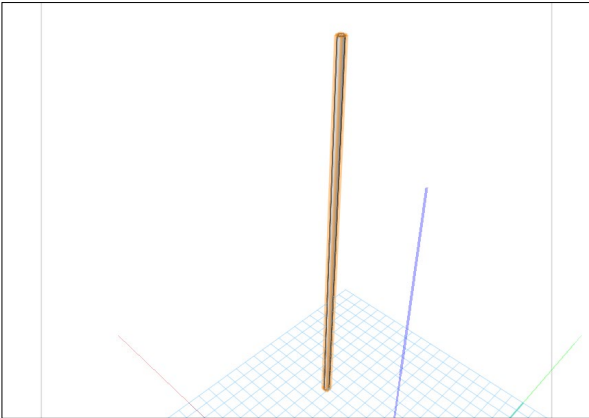
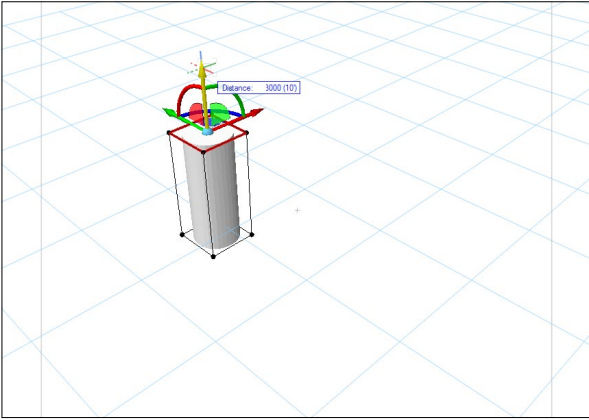
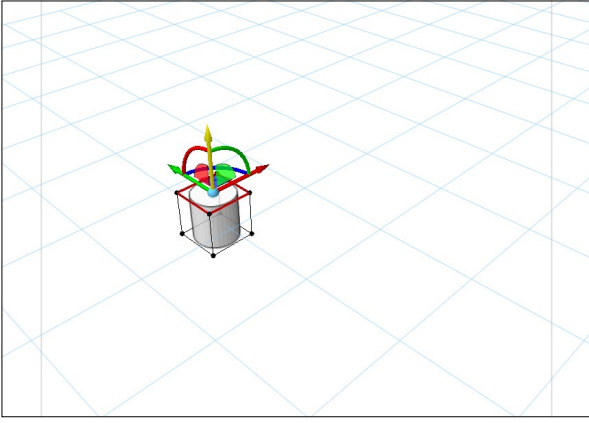
In this exercise we started with the columns already created. If you used to modeling and Vectorworks you might think that you would start with an extrusion to create those columns. In this part of the exercise I like to start with a blank file and show you how you can use the subdivision modeling to create your columns as well as the shape sail.

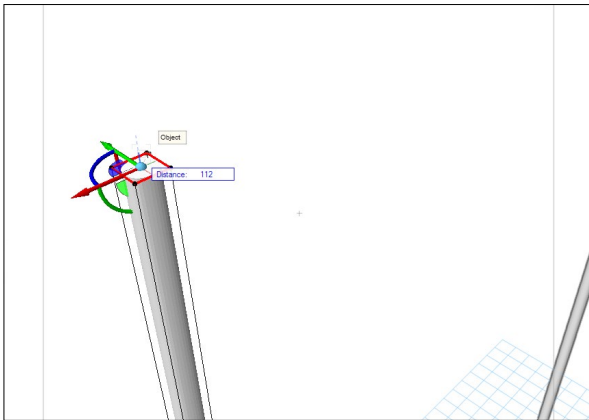
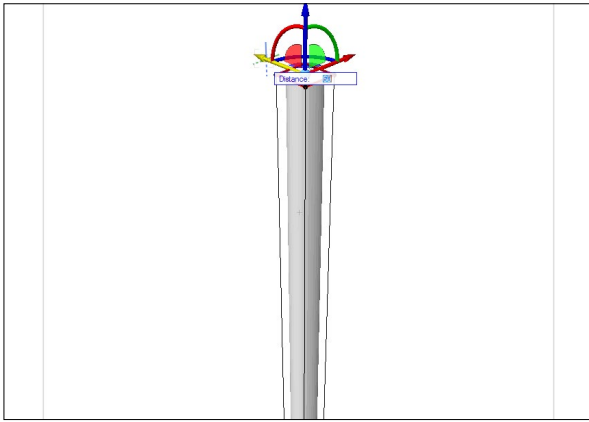
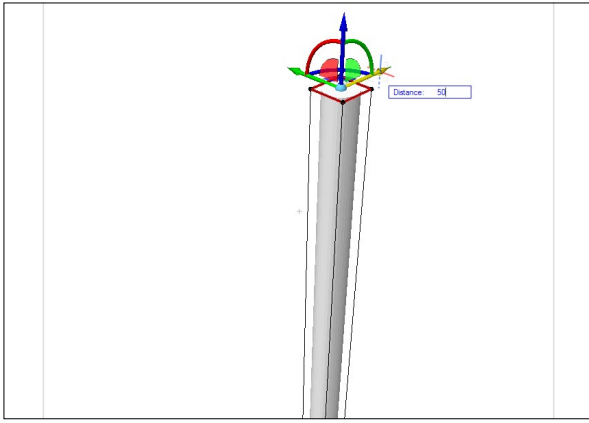
- Double-click on the Edit Subdivision tool to create a subdivision primitive.
- Choose the cylinder primitive and set the size to about 2 inches.

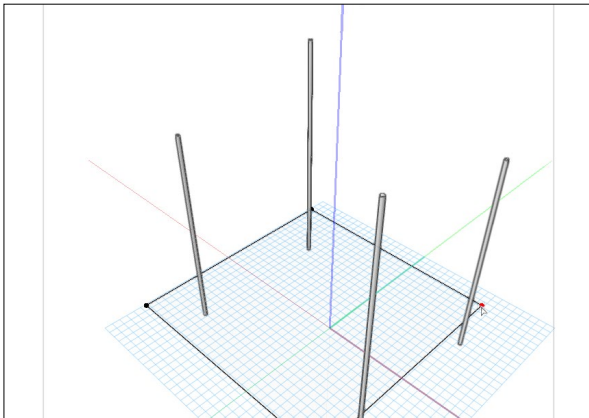
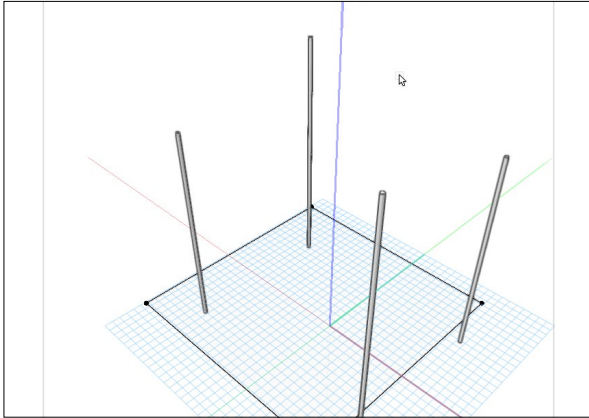
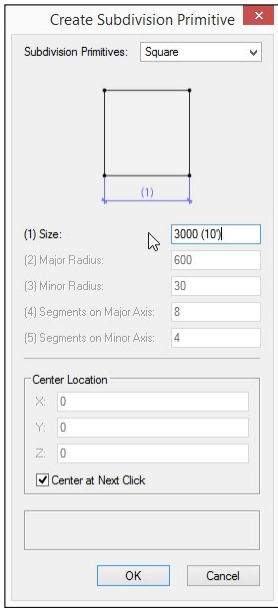


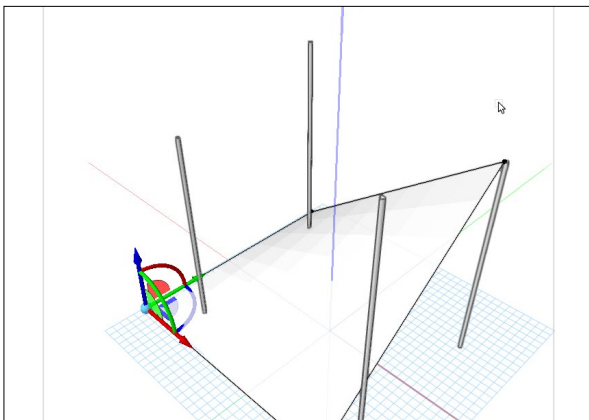
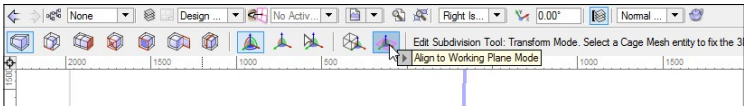
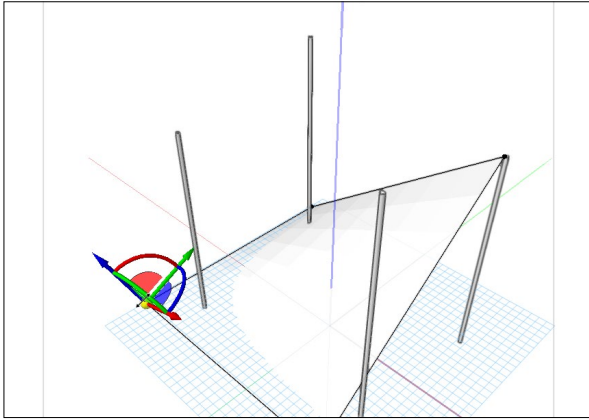
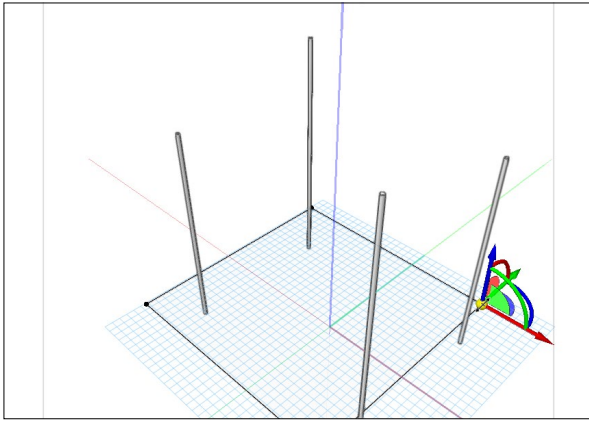
- Click on the **OK** button.
- Click at a suitable location to place your starting object. You might wonder how we going to create a column with an object that is so small.
- Still using the Edit Subdivision tool, use the transform mode and select the top face.

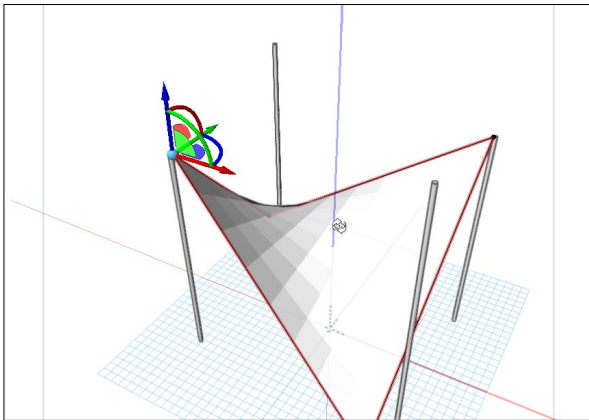
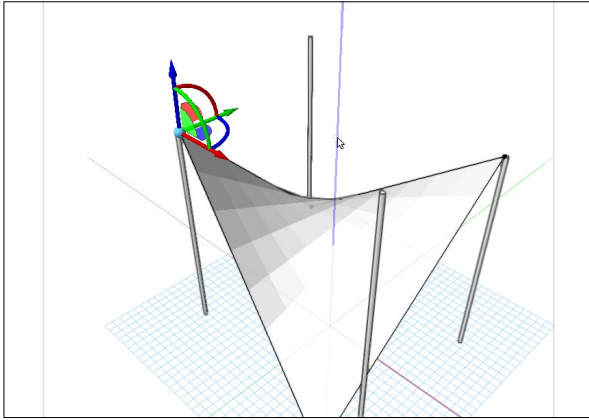
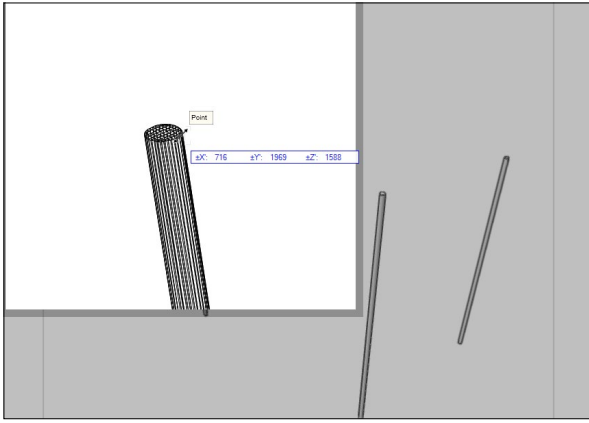


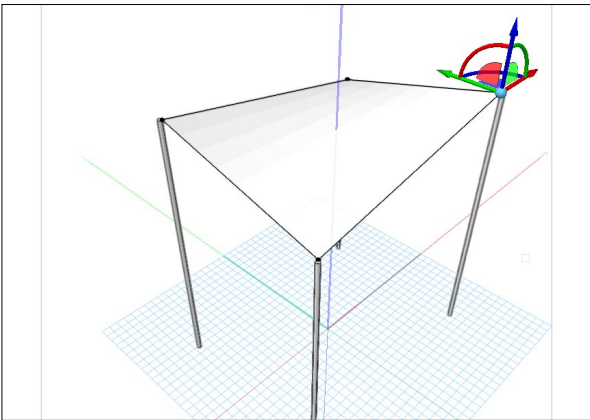
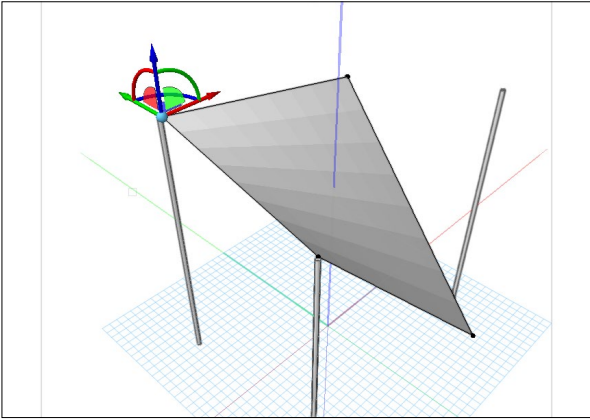
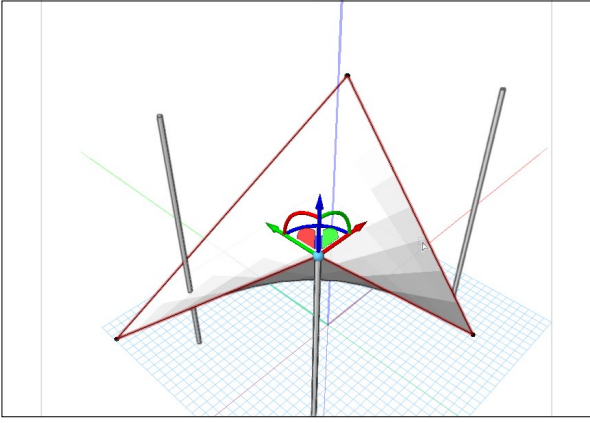


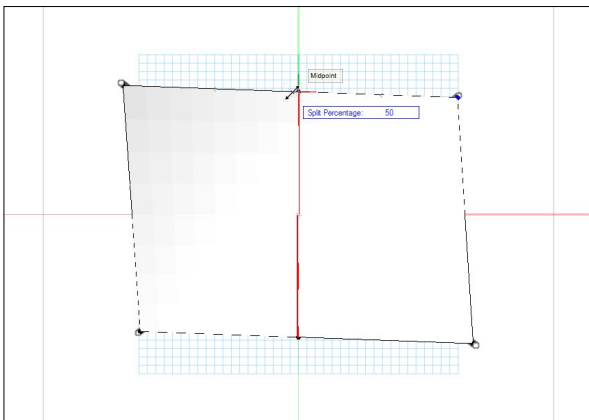
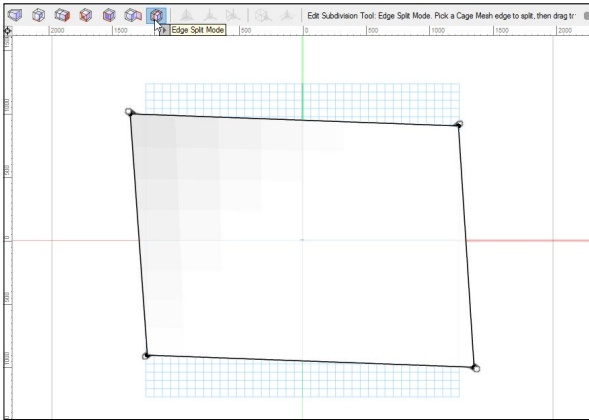
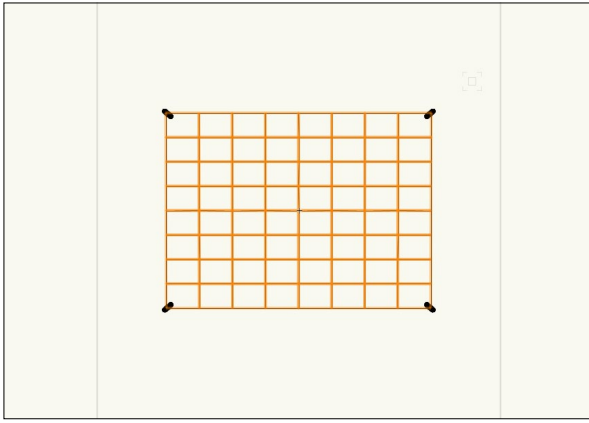


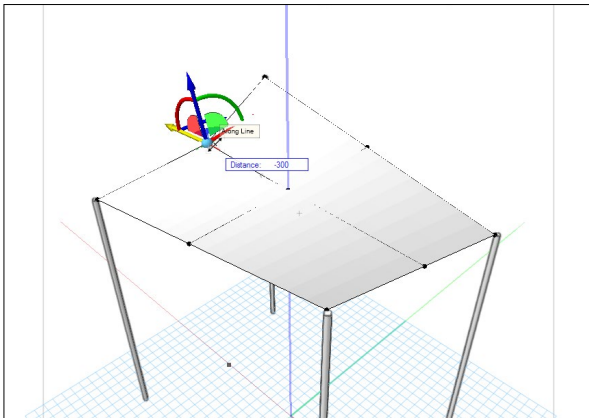
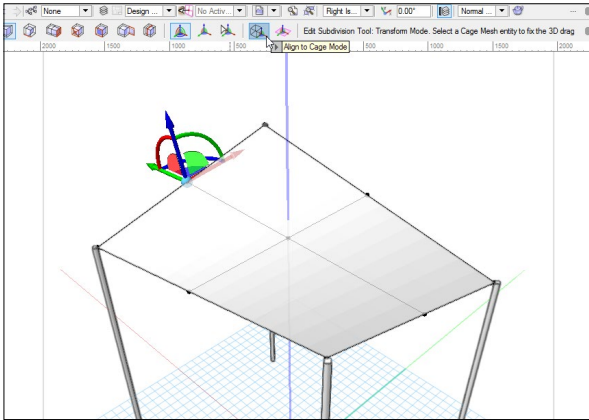
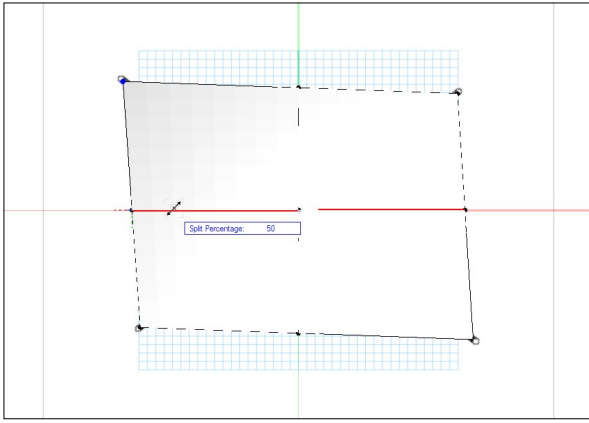


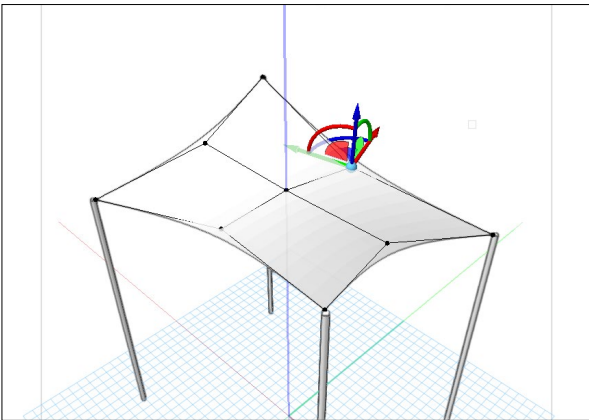
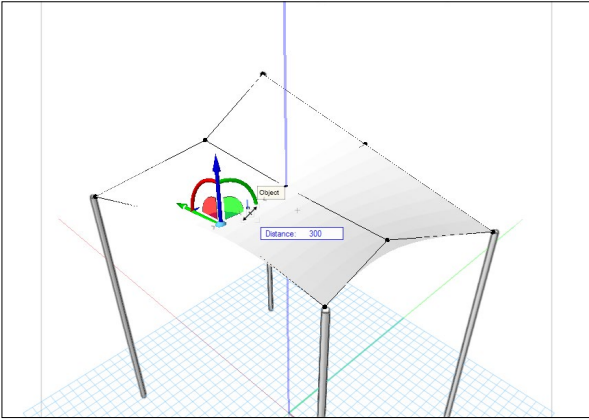
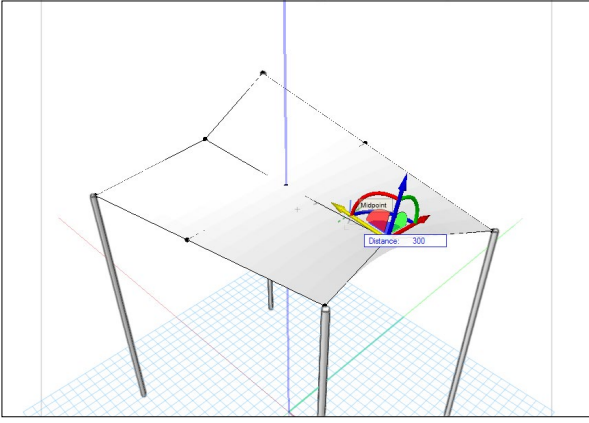


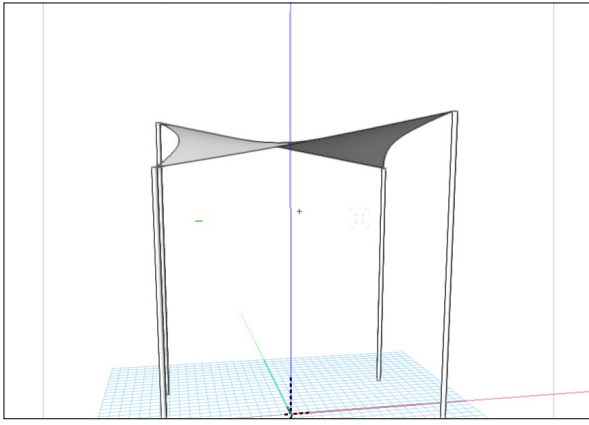




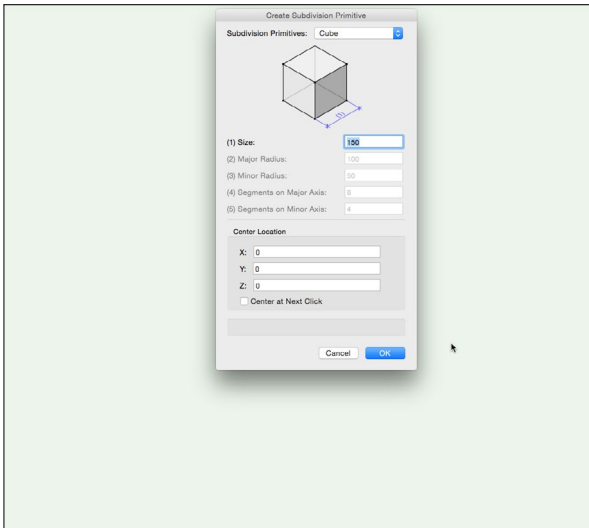
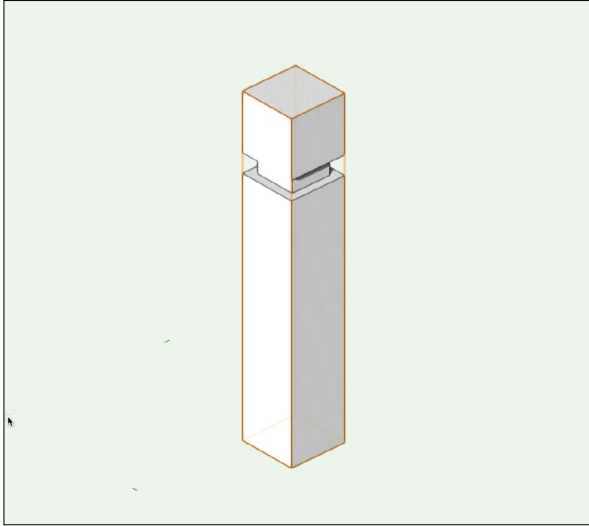


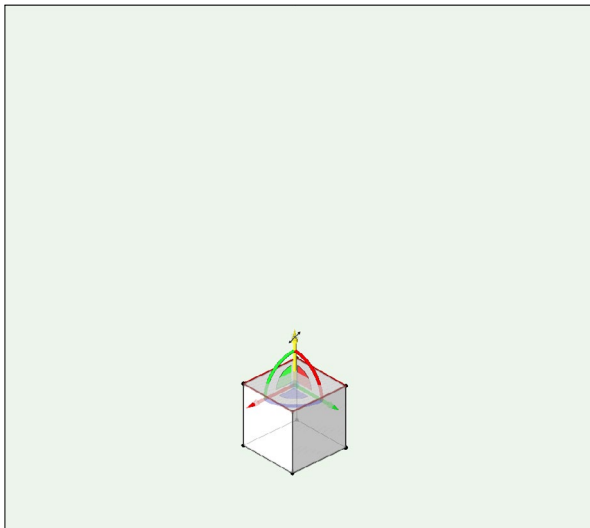
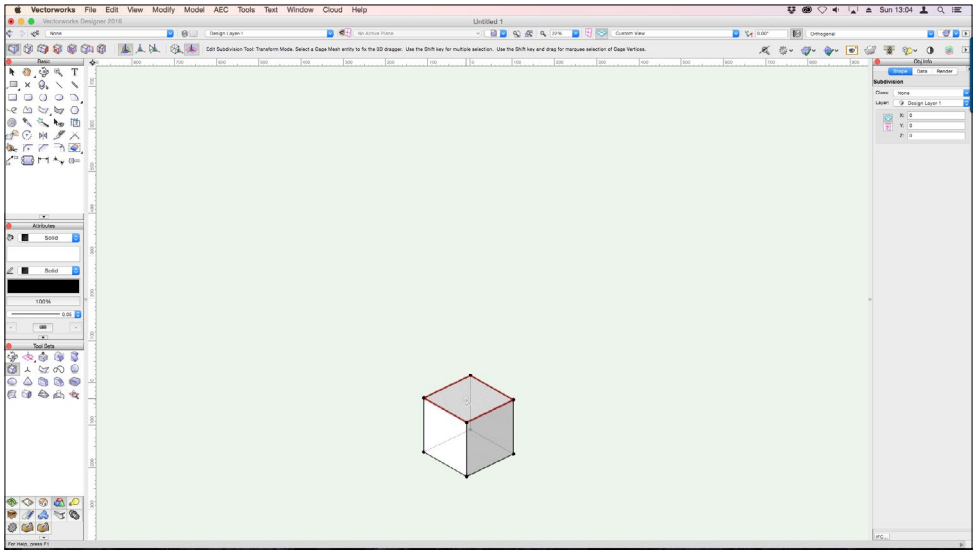


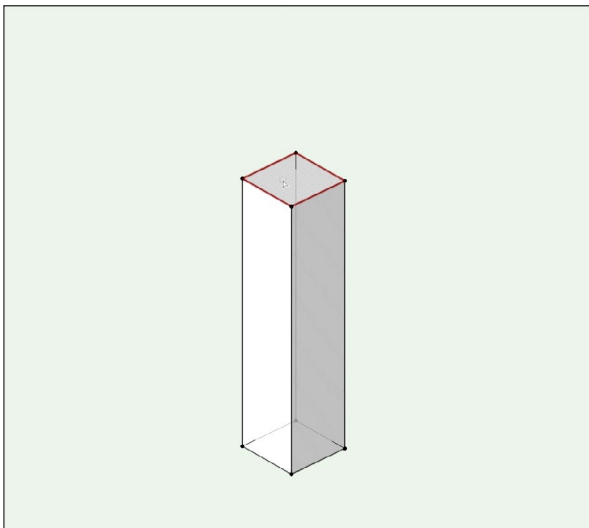
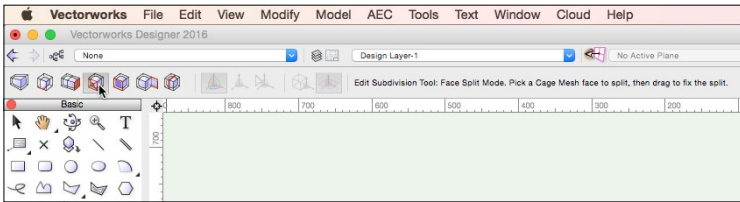
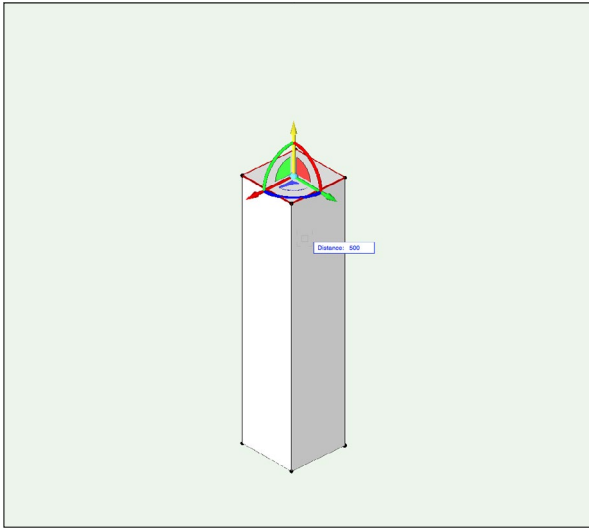


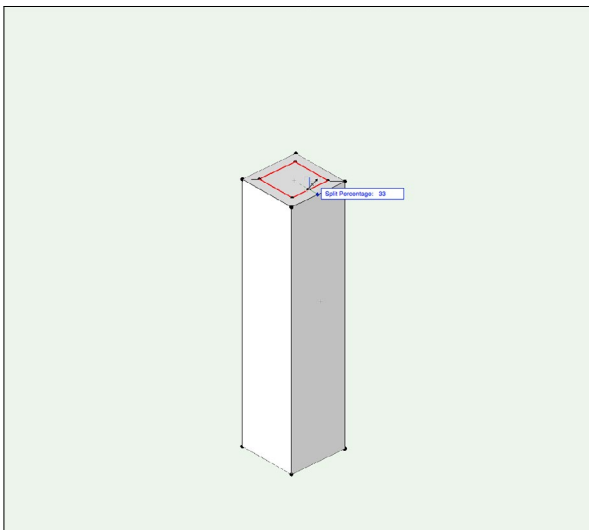
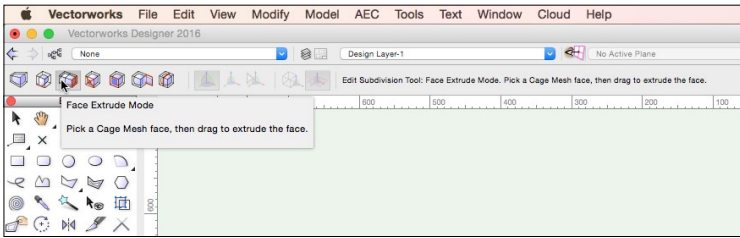
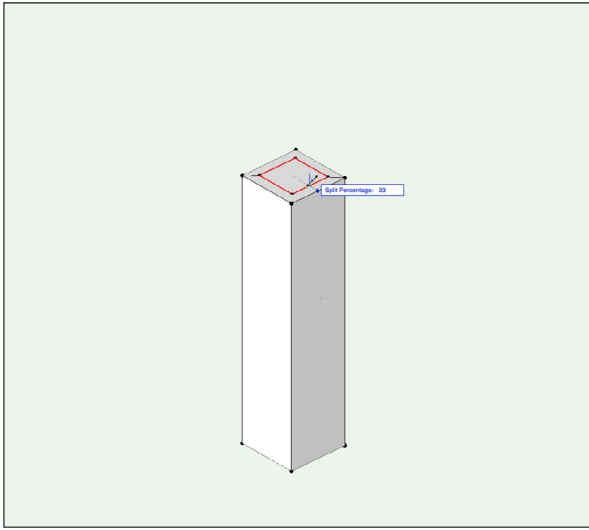


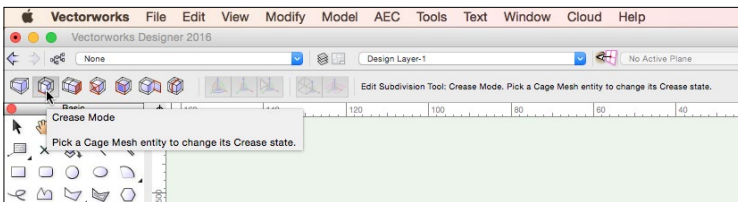
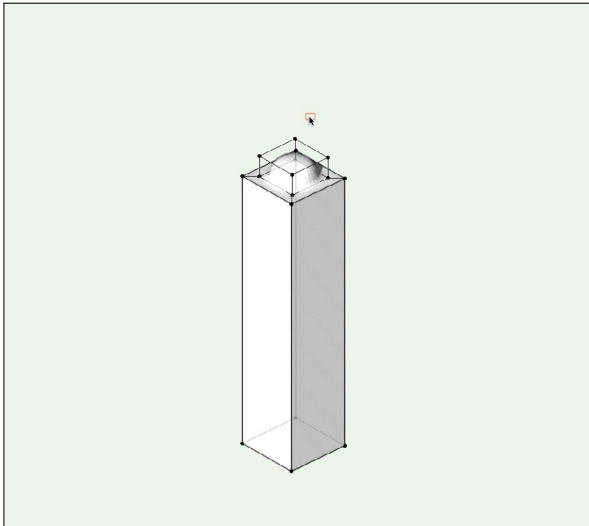
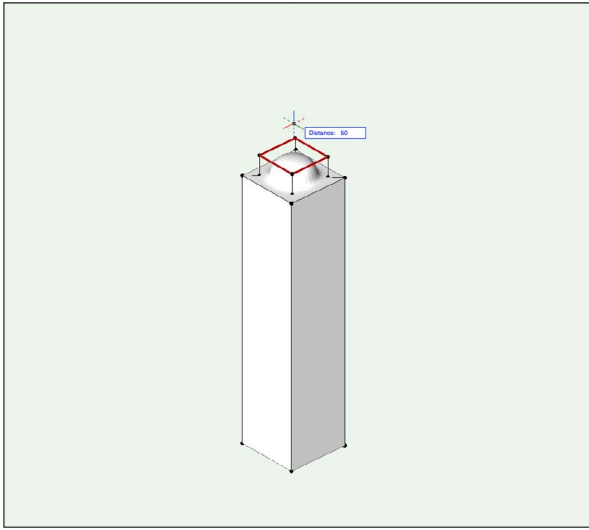
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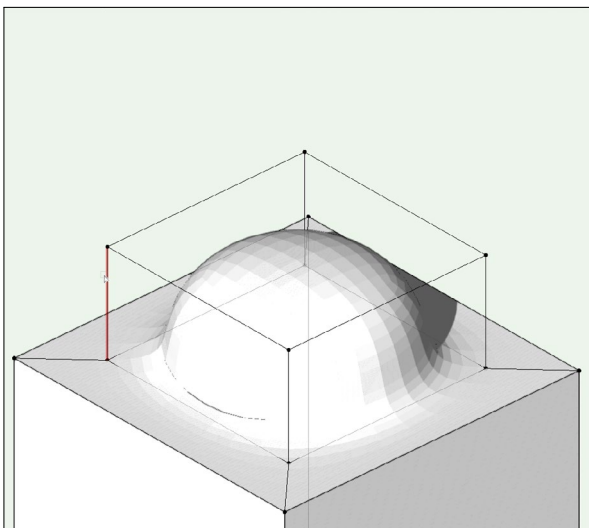
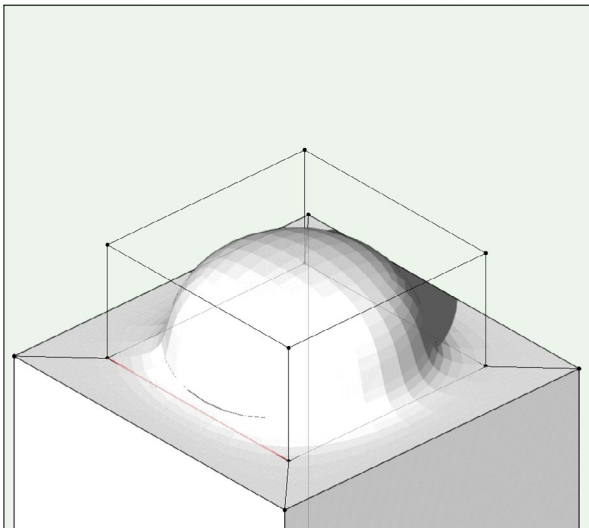
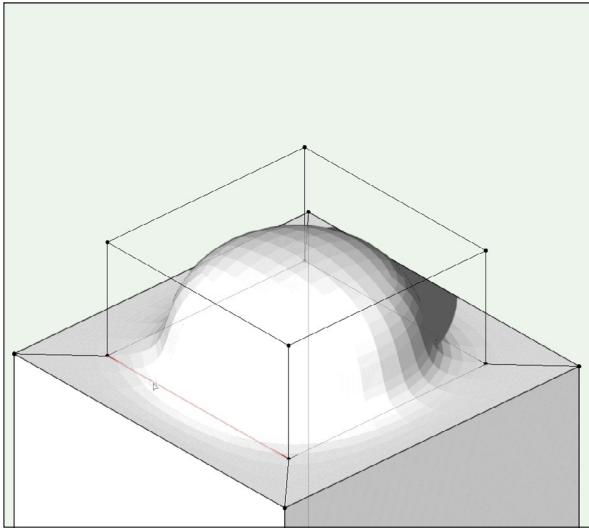


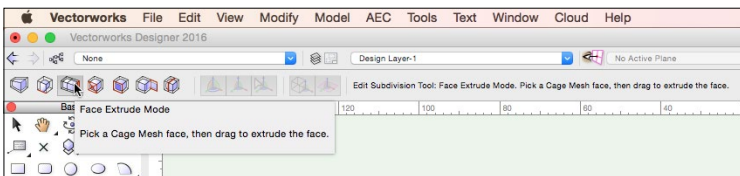
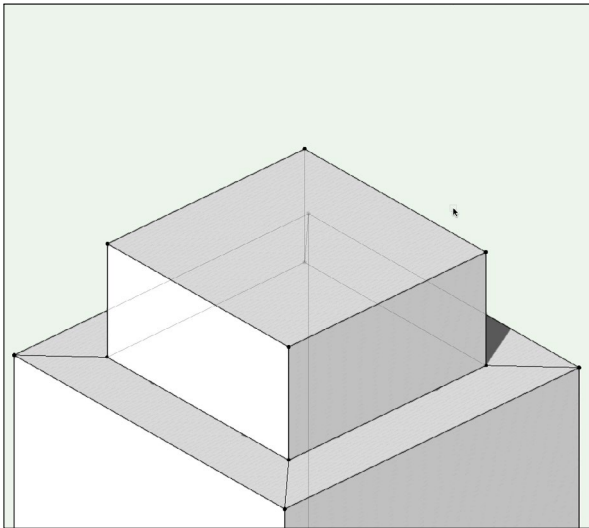
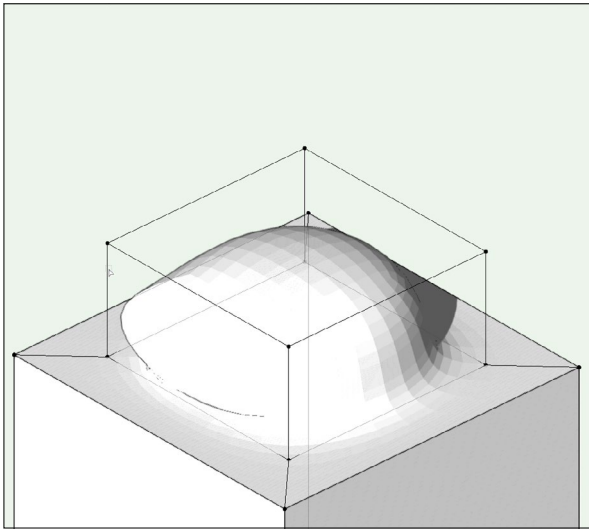


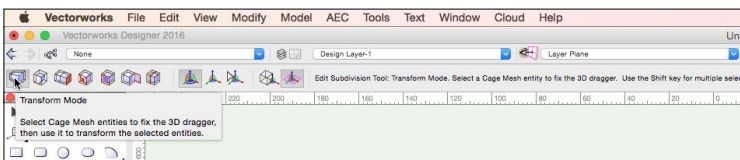
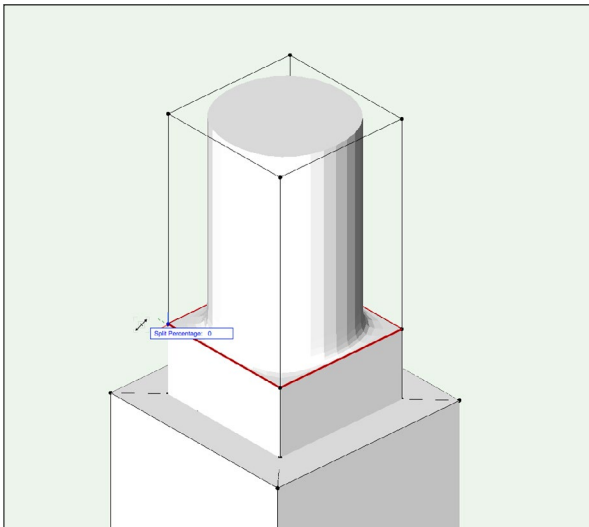
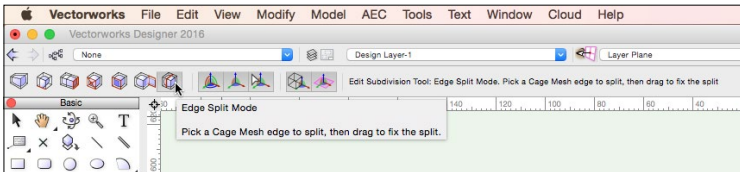
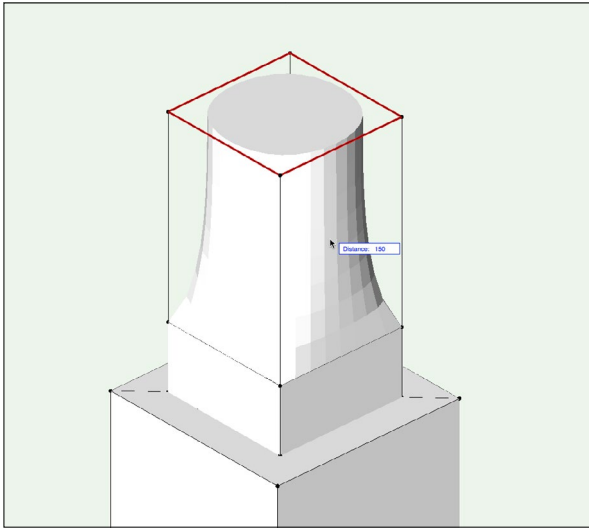


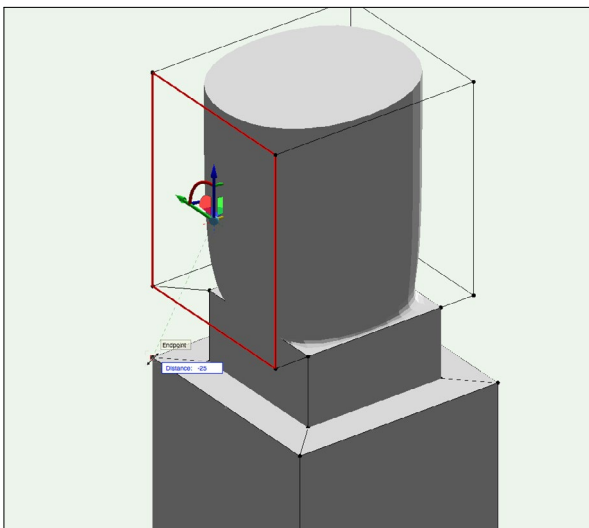
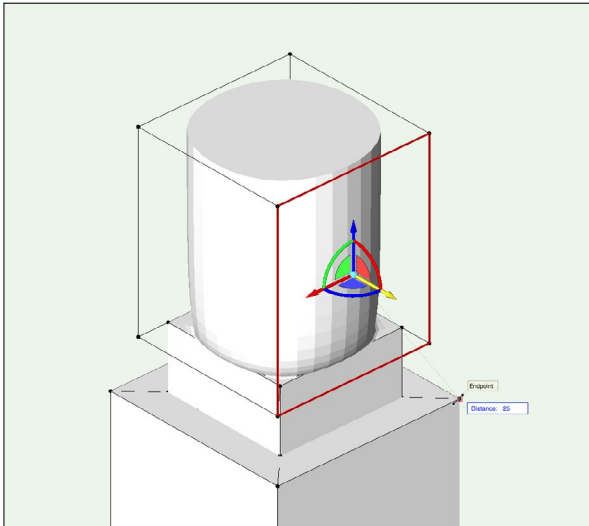
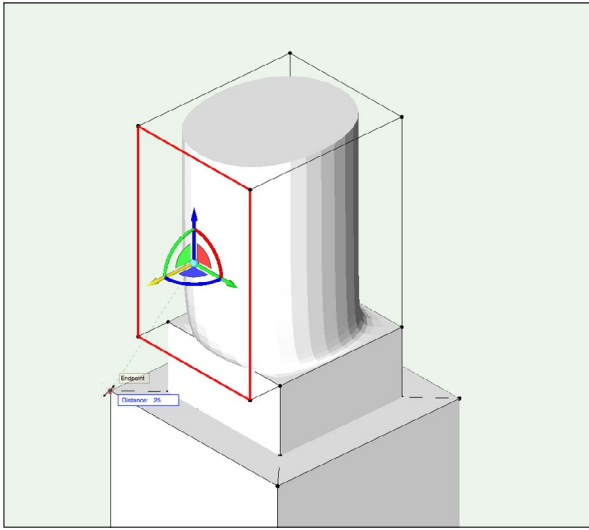


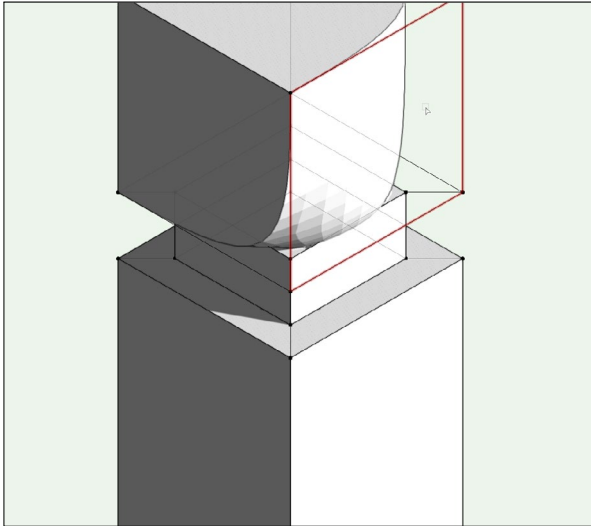
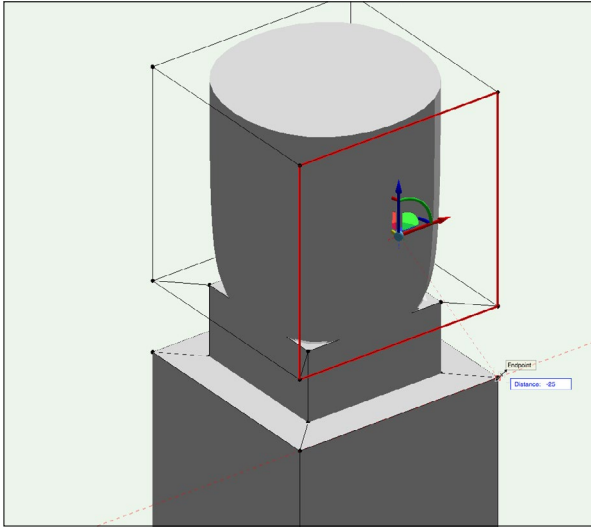


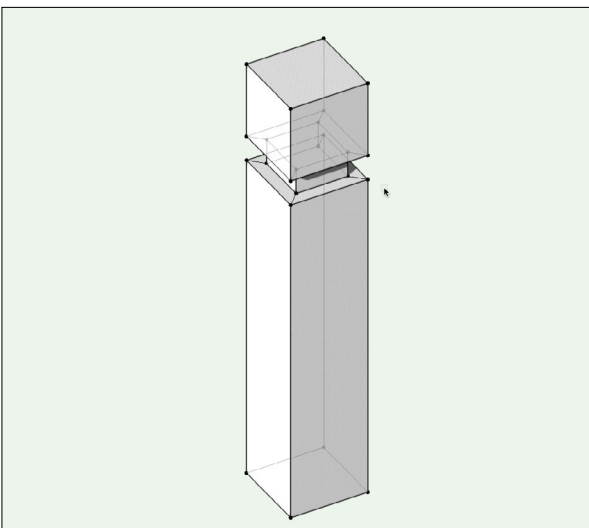
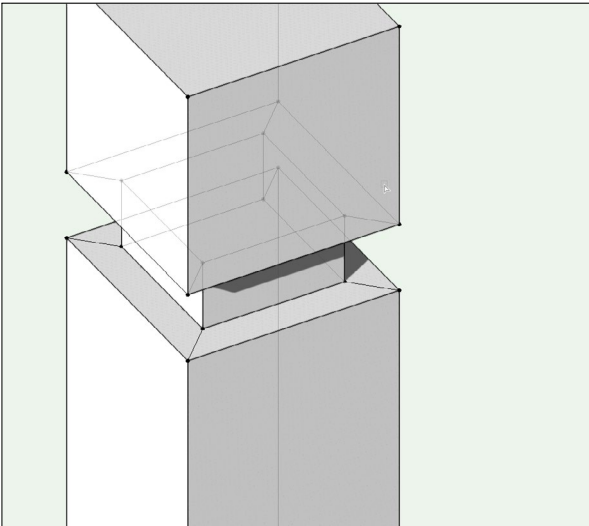
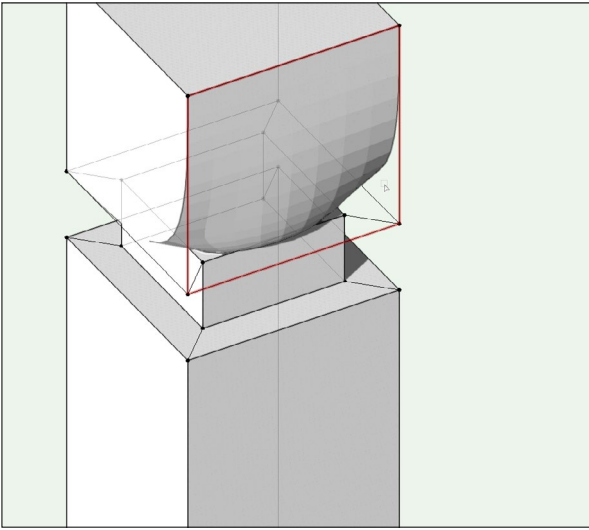




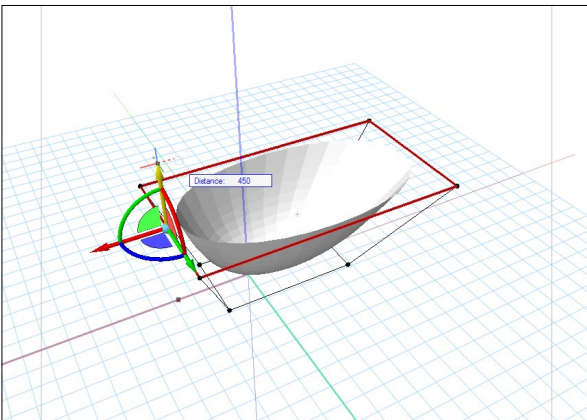
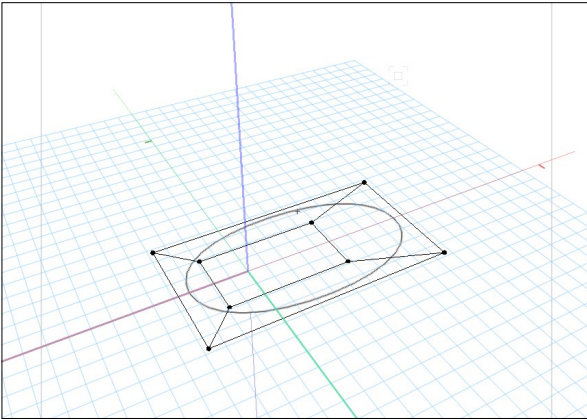
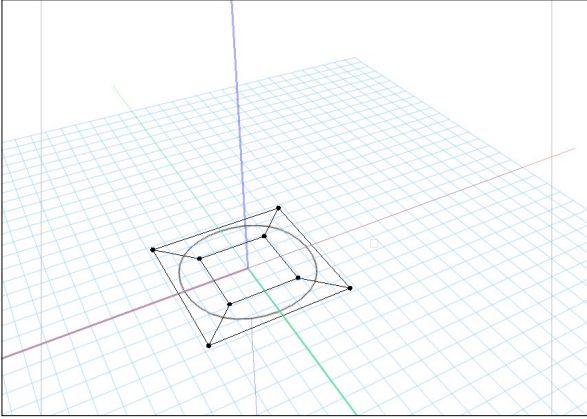


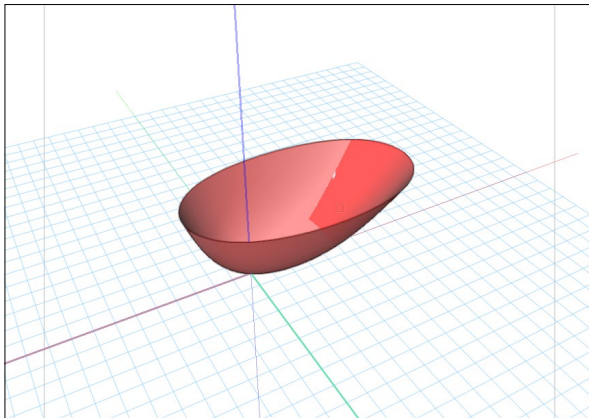
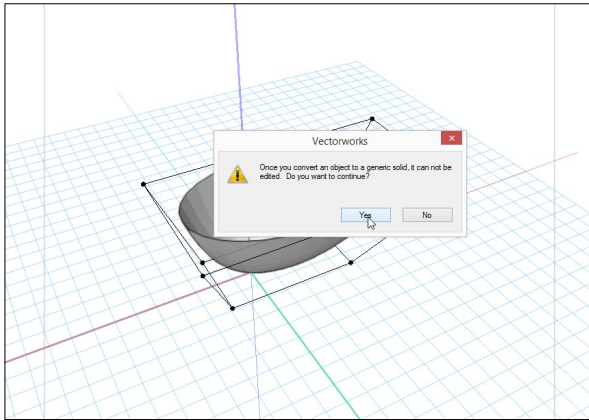
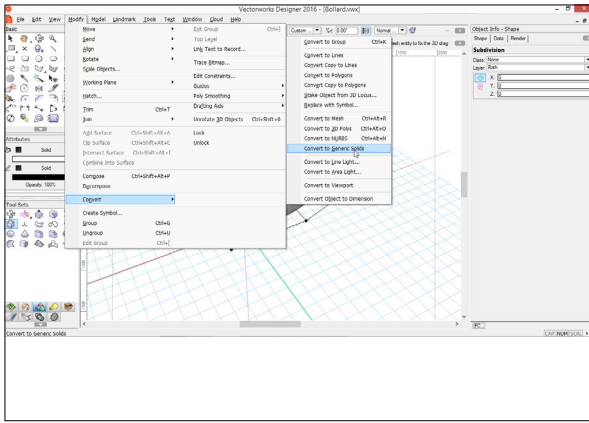


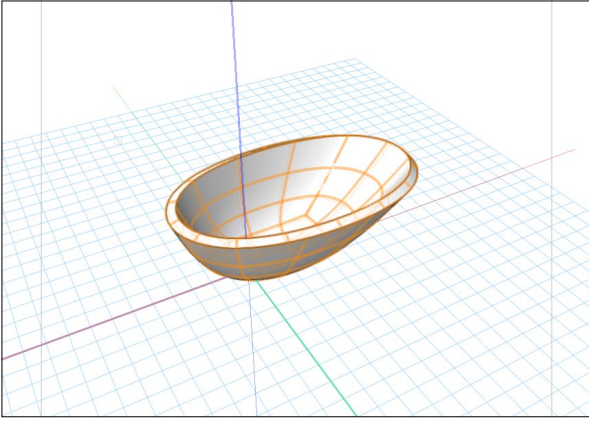




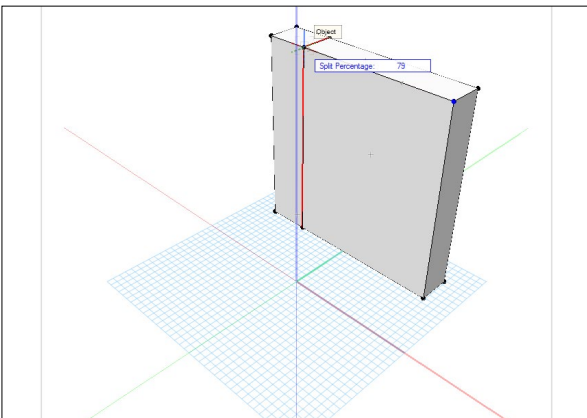
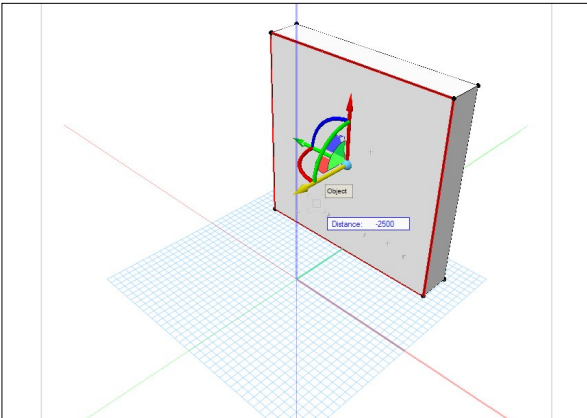
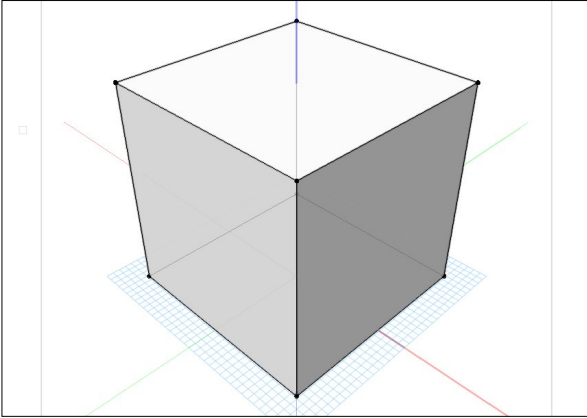
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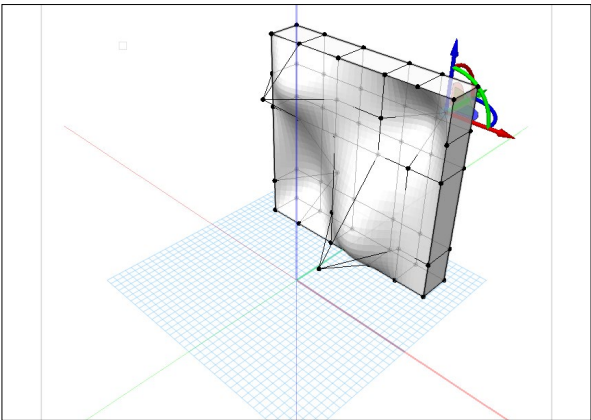
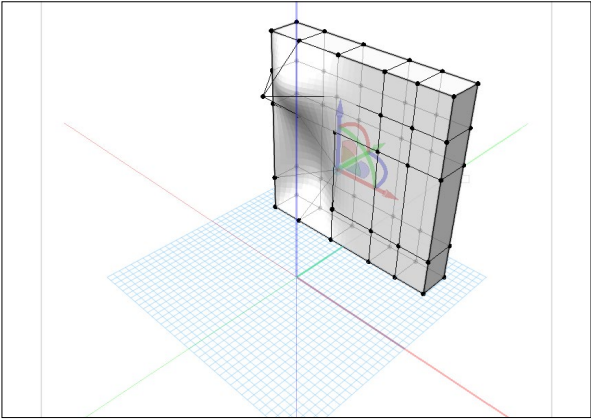
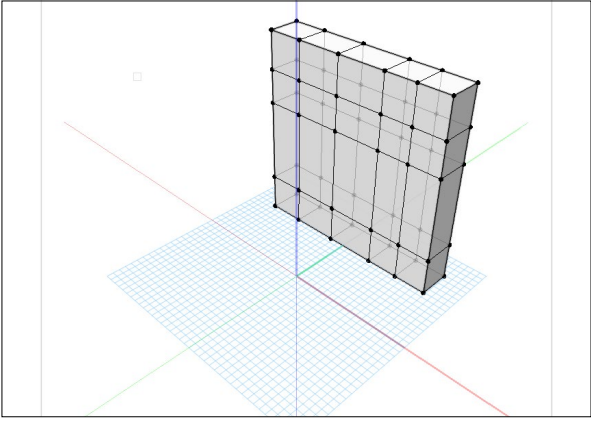


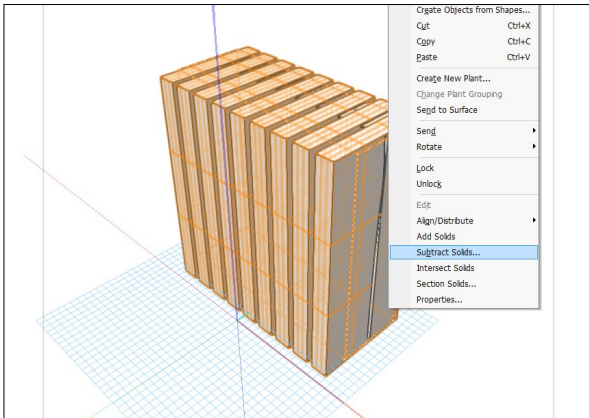
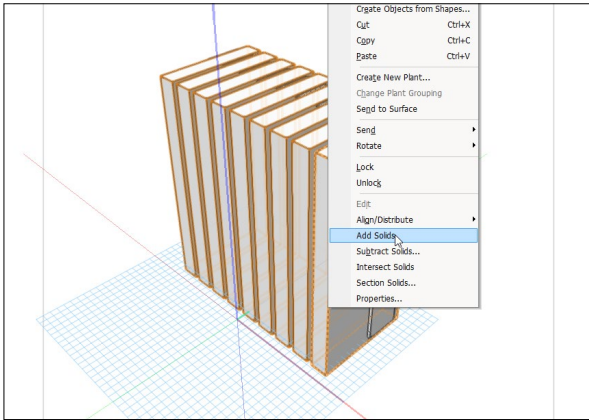
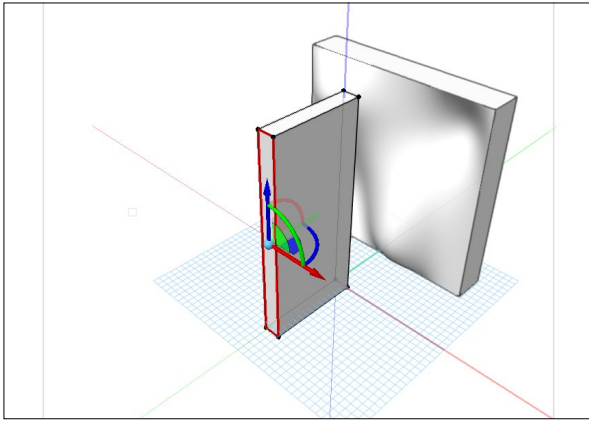


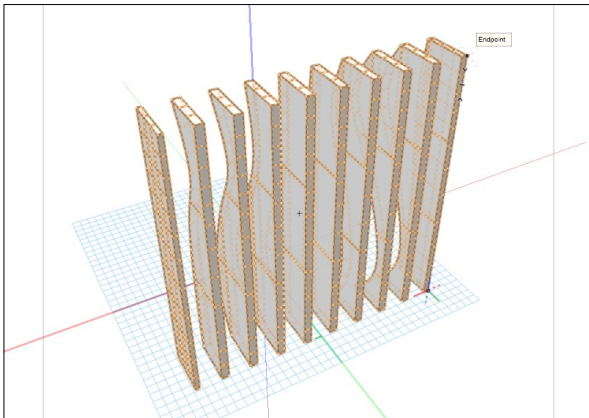
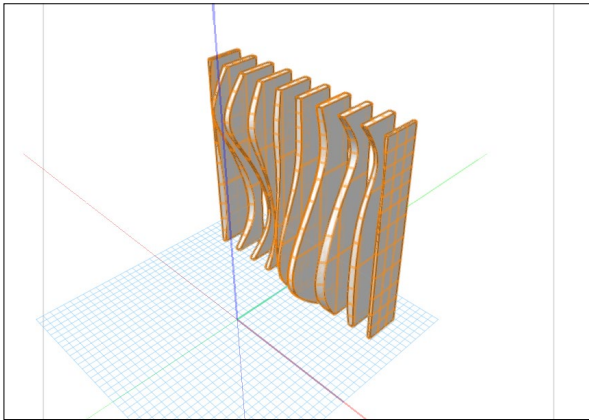
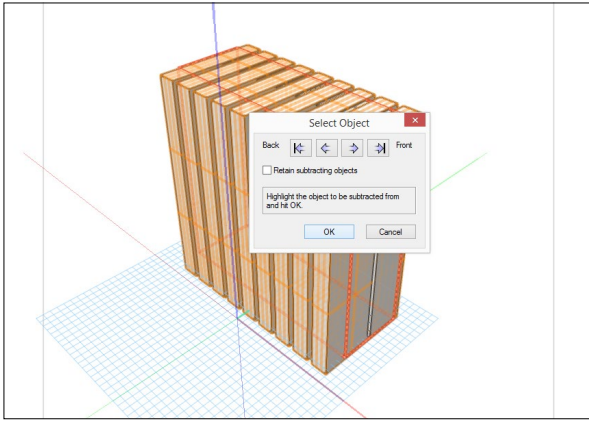


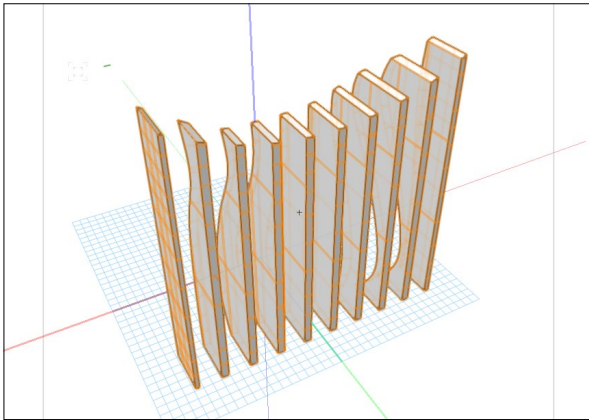
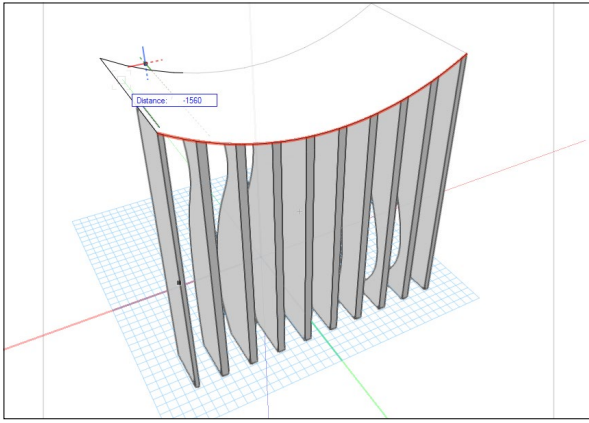
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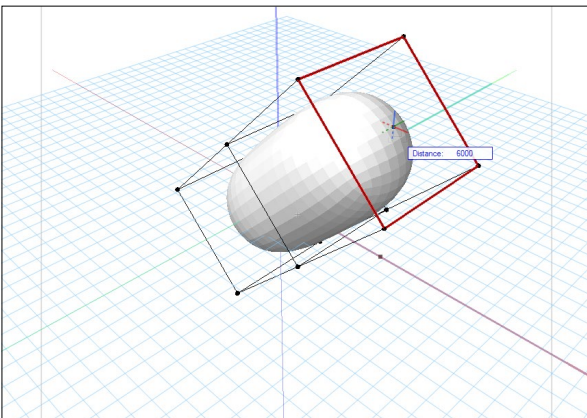
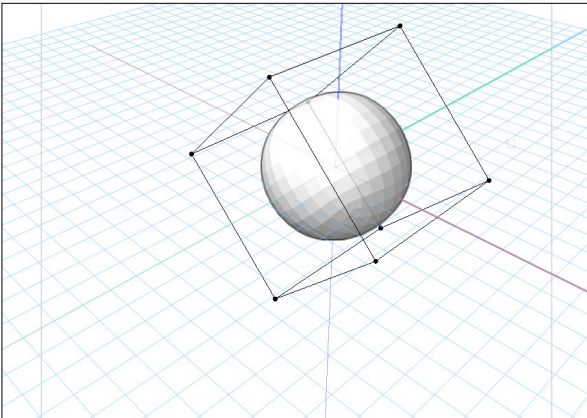
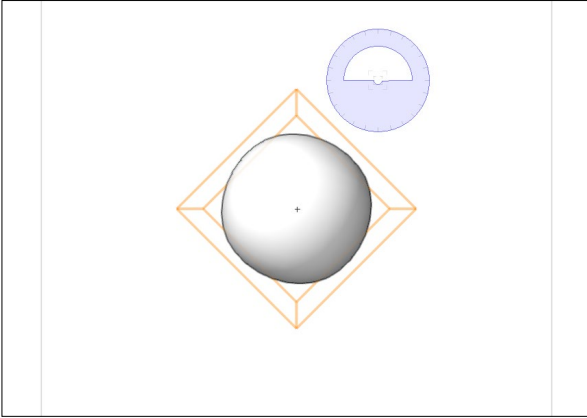


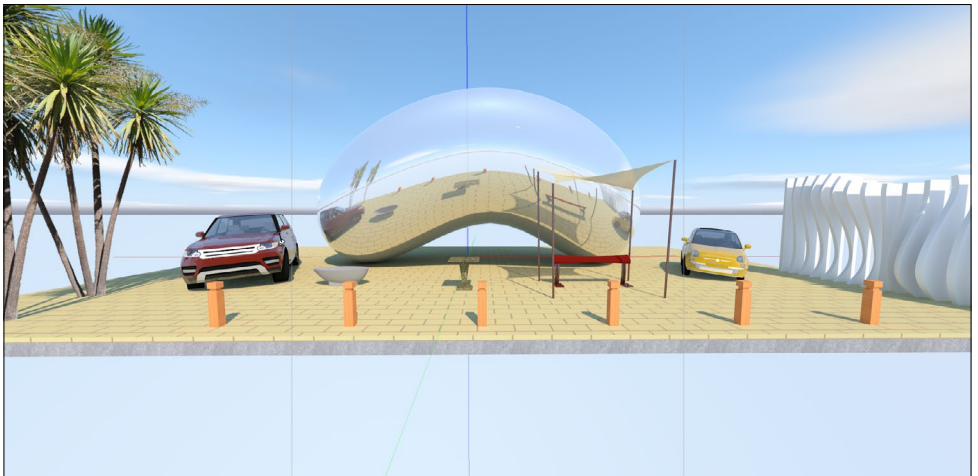
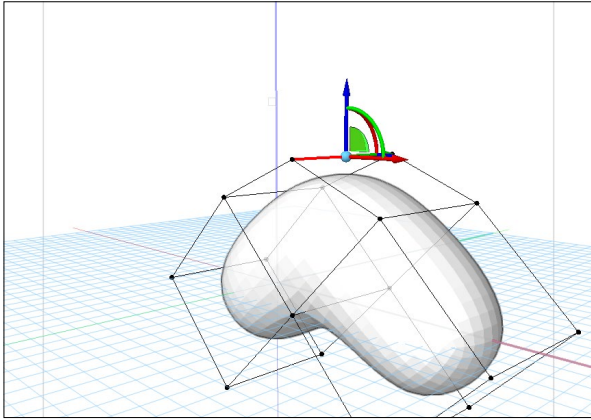
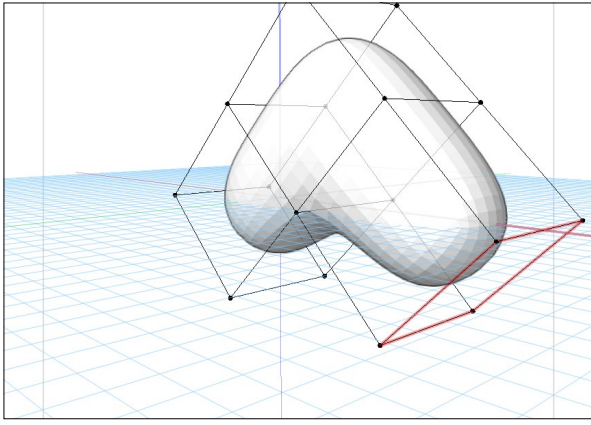






Chicago Bean





Conclusion

When you first look at this modelling, you might think that it's only for experts or for people who want to do very complex modelling. The more you use subdivision modelling, the more you will realise just how powerful this is. It makes building objects extremely quick, but like all new tools in Vectorworks you are going to have to invest some time in learning how to use it.

Jonathan Pickup

April 2016