

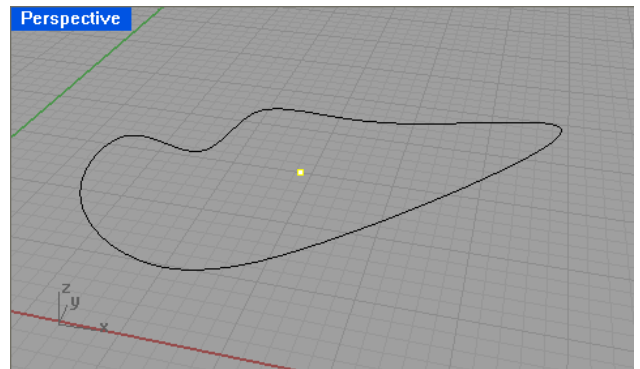
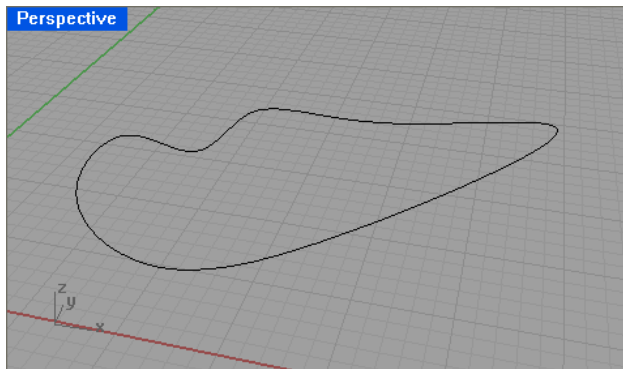
## Points and Curves from Objects

There are many cases where we may want to derive points or curves from pre-existing objects. These elements can help us measure aspects of our design. They can also be used to snap to particular areas (where the OSnaps can't help us). Of course, they can also be used as elements for splitting or creating new surfaces and geometry.

### Centroids

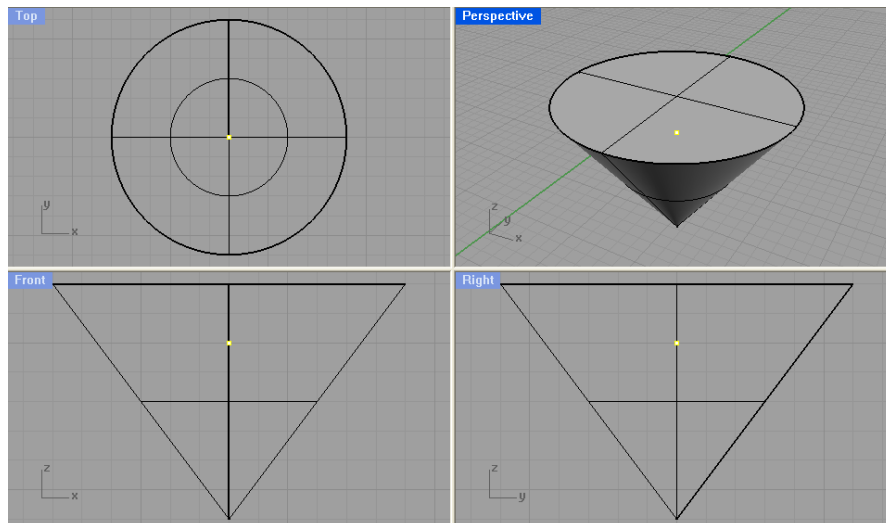
A Centroid is the center of something.

We can find the center of a closed curve by going to Analyze > Mass Properties > Area Centroid. This command places a point at the center of the curve's area...



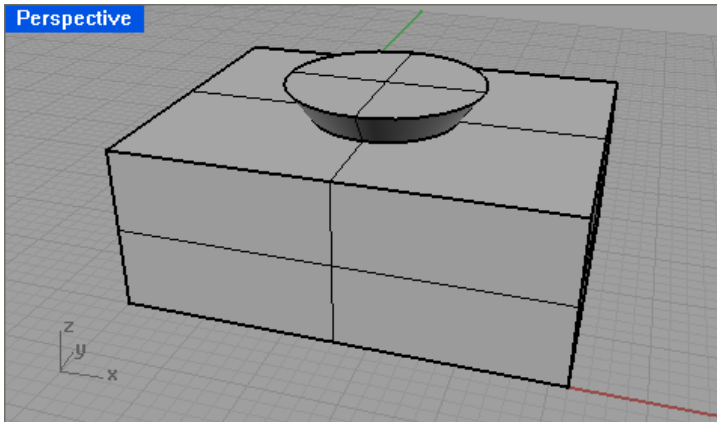
This same command also works with surfaces and solids. However, using Volume Centroid produces better results...

In the case of a solid, go to Analyze > Mass Properties > Volume Centroid and run the command. A point is placed at the center of the volume...

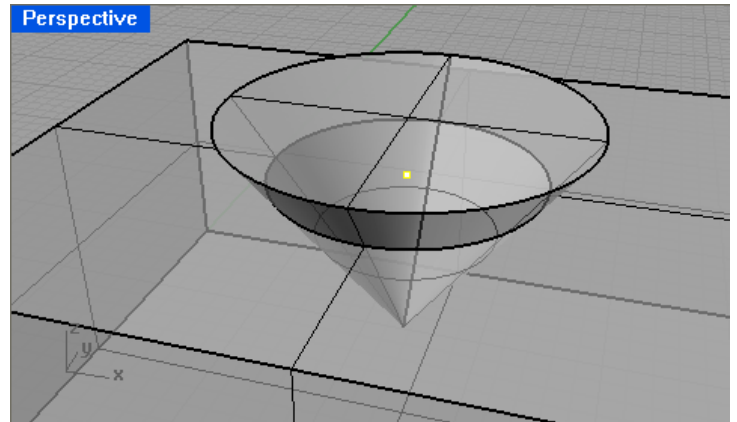


This is a very useful tool for scaling, moving, rotating or performing other commands when we want to use the object's center as a reference (and when a Center snap is not available)...

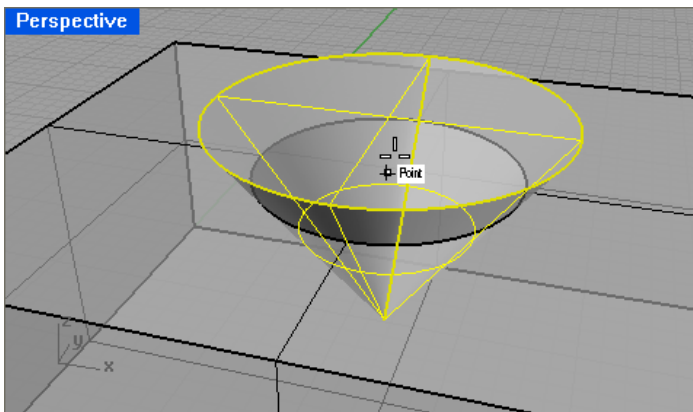
The cone cut the box using the Boolean subtract command.



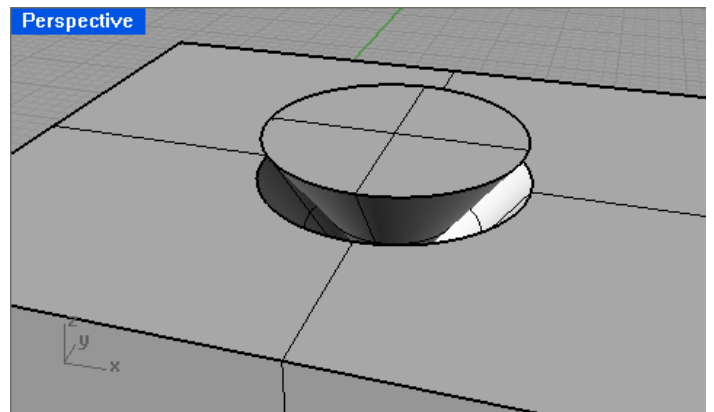
Volume Centroid created a point at the center of the cone...



Scale 3D was then started, and the point was snapped to as the origin point ...



After scaling...

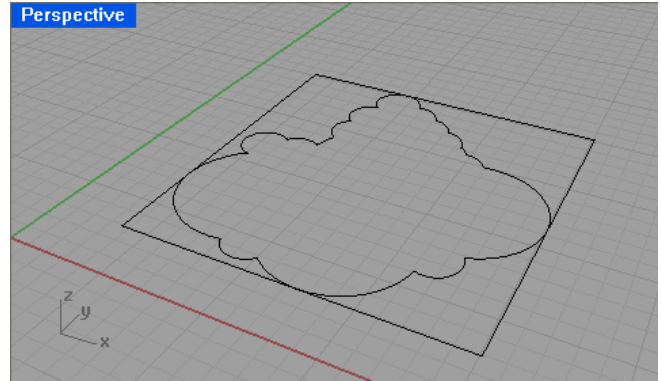
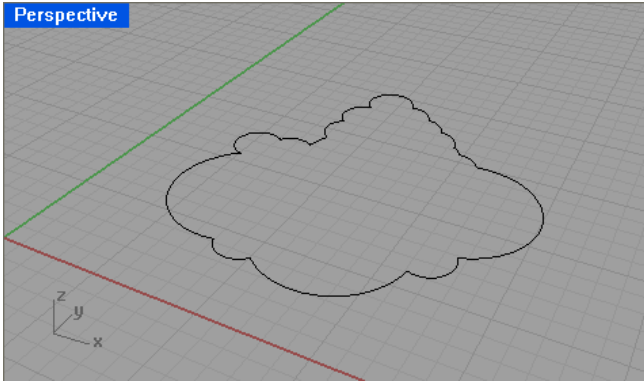


## Bounding Box

A bounding box is a box which completely surrounds an object or group of objects. It can be used on Points, curves, surfaces, and solids...

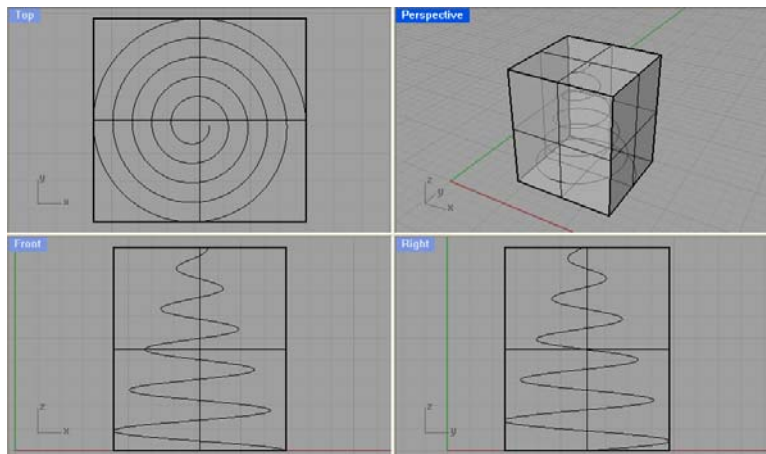
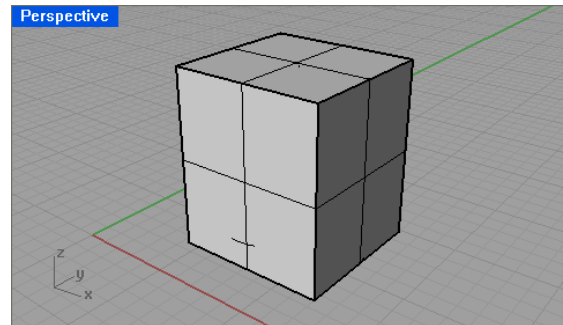
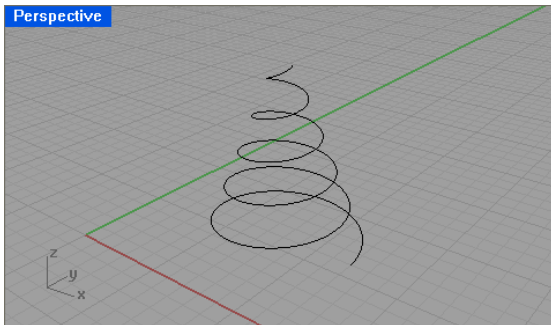
For elements that are flat and parallel to any of the construction planes, the bounding box is displayed as a simple rectangle...

For instance, with the following curves, if we go to Analyze > Bounding Box and start the command, we get the following...

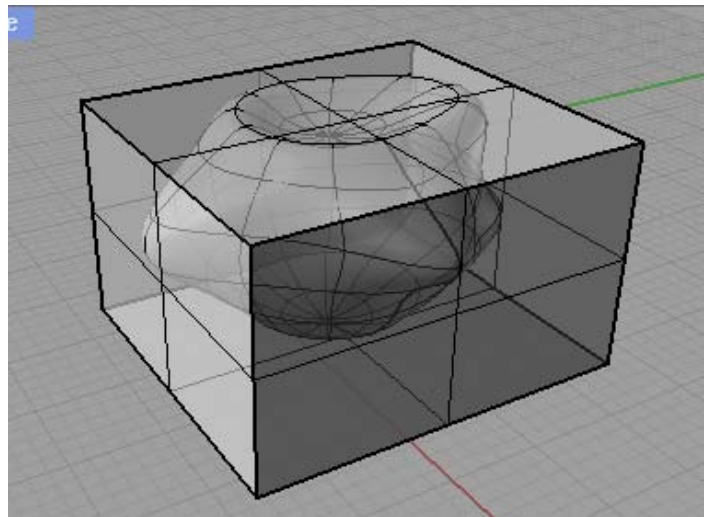
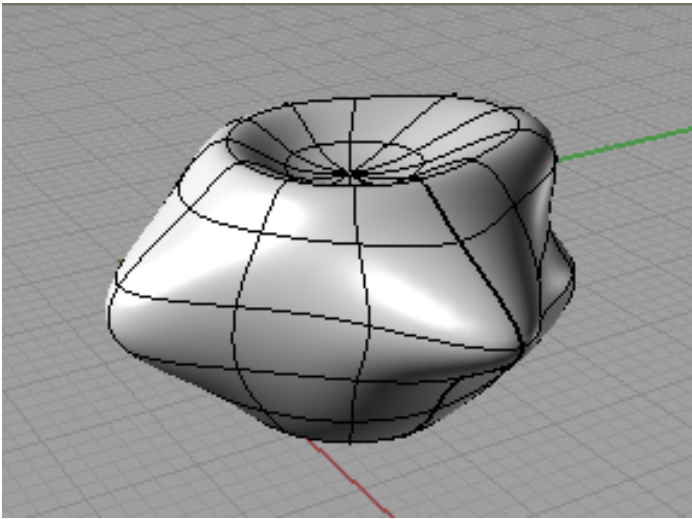


The box is a set of joined curves (separate from our original input curves).

When we use curves or elements that are not planar, and not parallel with one of the construction planes, the result is an actual box (again, this is fully editable, just like the other solids we are already familiar with)...

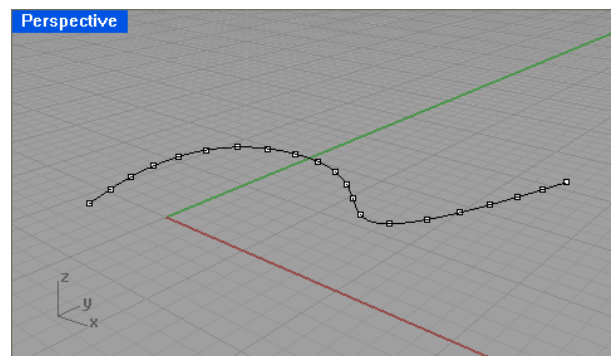
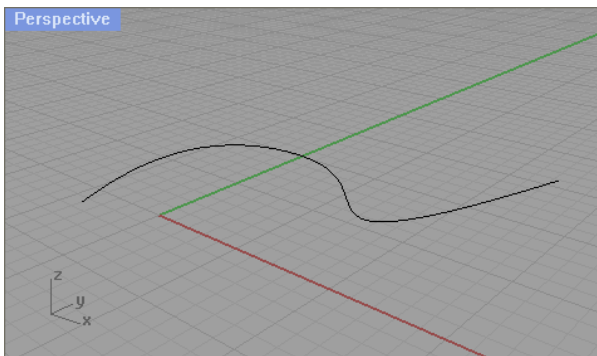


An example using an organic shape...

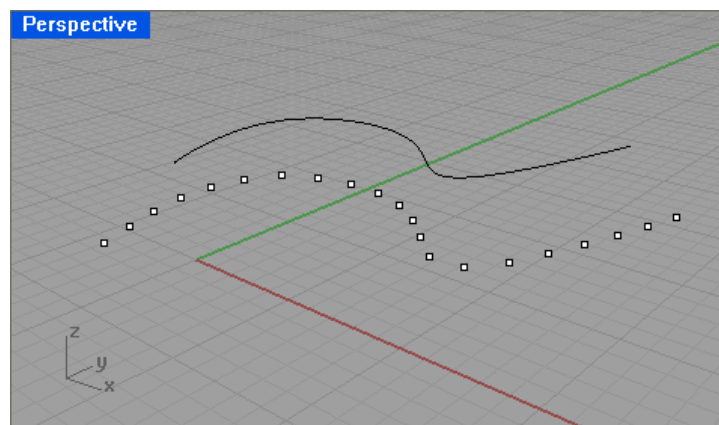


### Points from curves

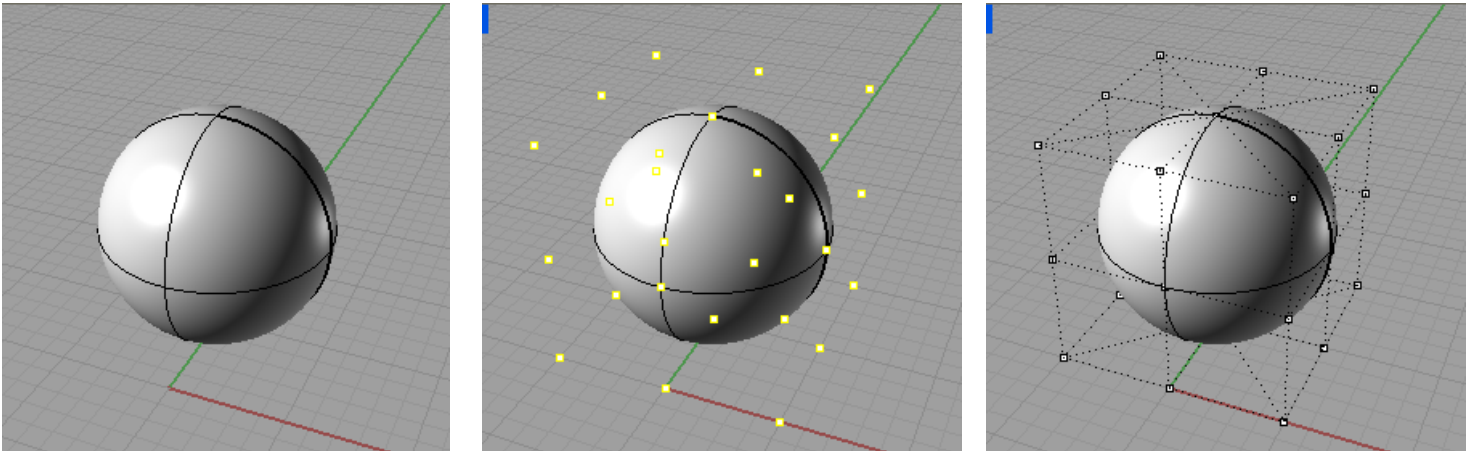
With a curve already drawn, go to Curve > Point Object > Divide Curve by > Number of Segments. Select the curve you want to use, and then specify the number of points...



The points are drawn on the line. These are separate individual points...

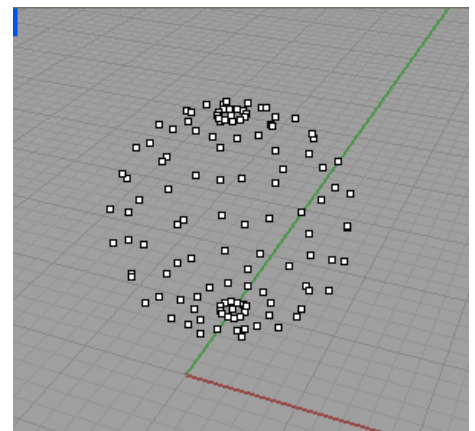
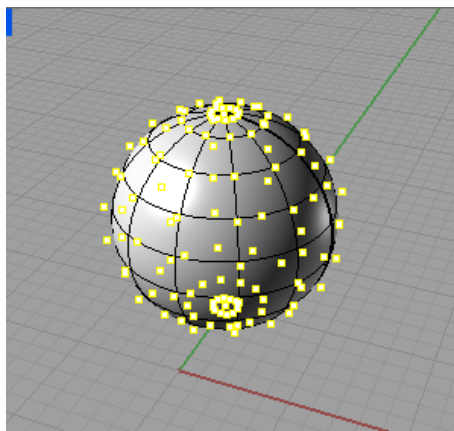
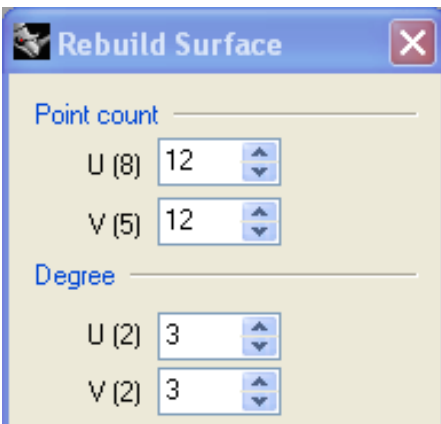


We can also derive points from the control points of surfaces and polysurfaces (or curves, for that matter). For example, starting with a sphere, go to Curve > Curve From Objects > Extract Points...



The control points for the sphere are translated into points (top center). We can verify this by comparing this with the control points of our original sphere (top right)...

If we rebuild our original sphere and use more UV curves, the points fall closer to the sphere's surface and we get something that more closely resembles a sphere...



### Creating Curves from Objects

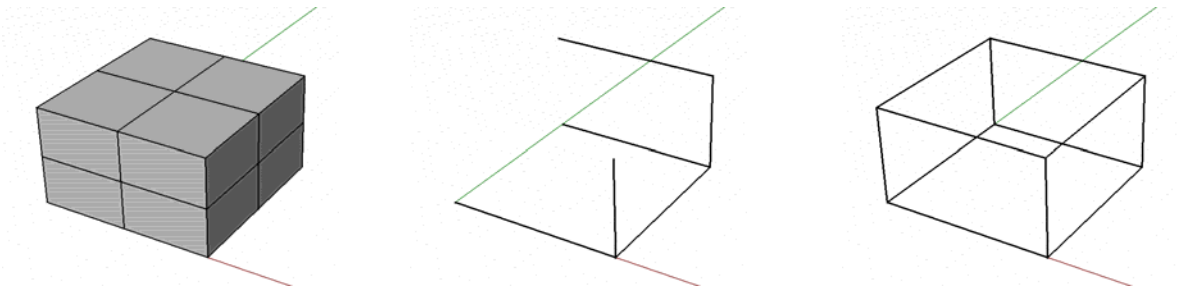
The following commands are all found under the Curves > Curves From Objects menu.

Note that by default, some of these commands will create individual line segments. These can be joined using the Join command, or within the command itself by toggling the JoinCurves option. Also the original objects have been removed in some of the resulting images for illustrative purposes...

### **Duplicate Edge**

`_DupEdge`

Allows you to extract lines from edges of objects. You can select edges individually by left clicking or select the entire object to extract all edges...

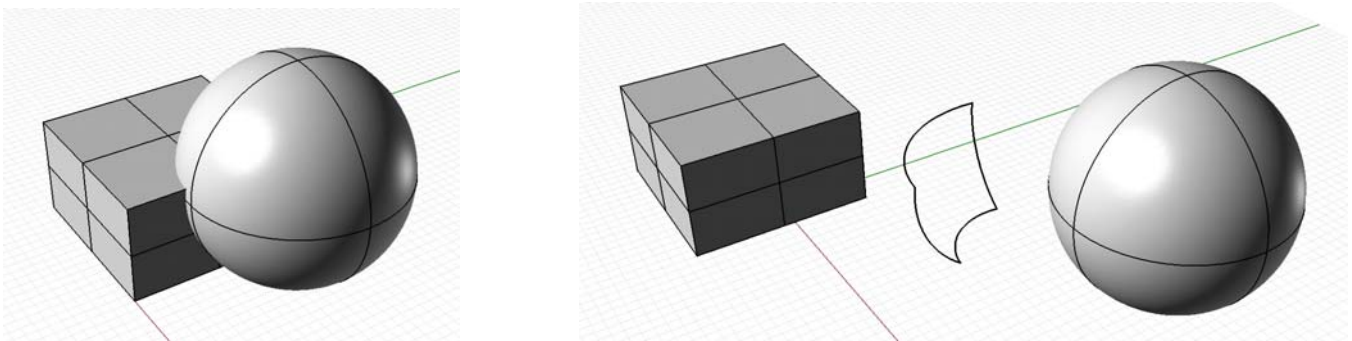


### **Intersection**

`_Intersect`

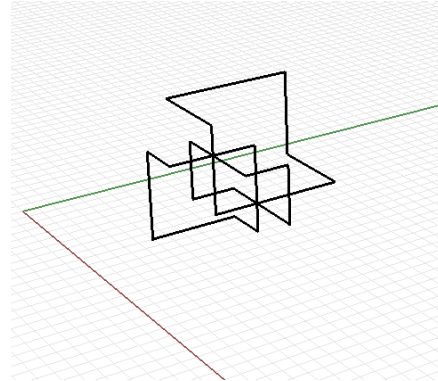
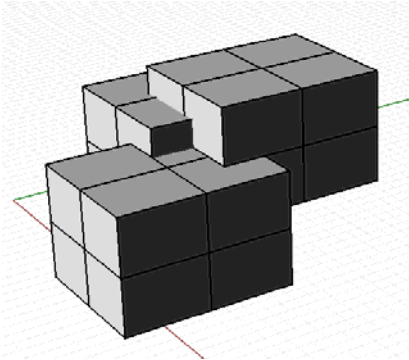
Creates a curve at the intersection of two or more surfaces, polysurfaces or lines...

Intersection of two solids

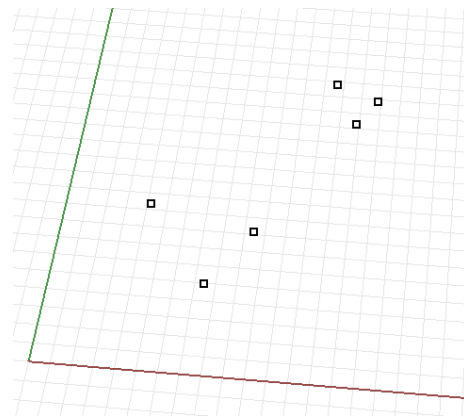
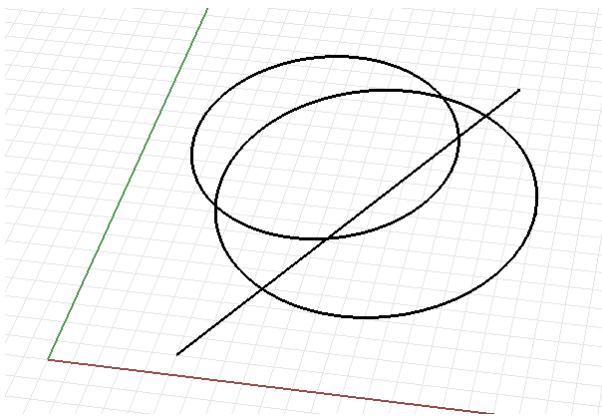




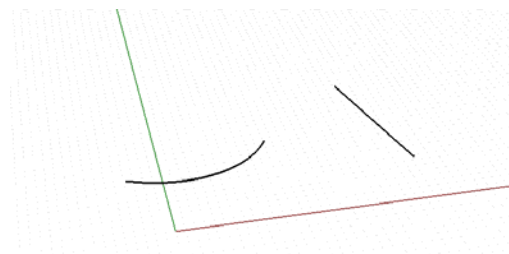
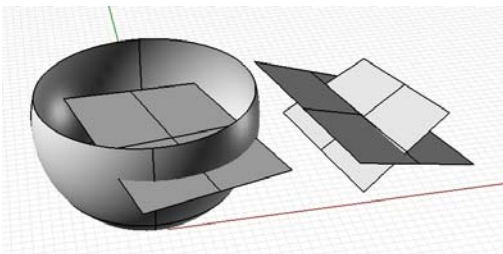
## Intersection of multiple solids



## Intersection of multiple lines creates points



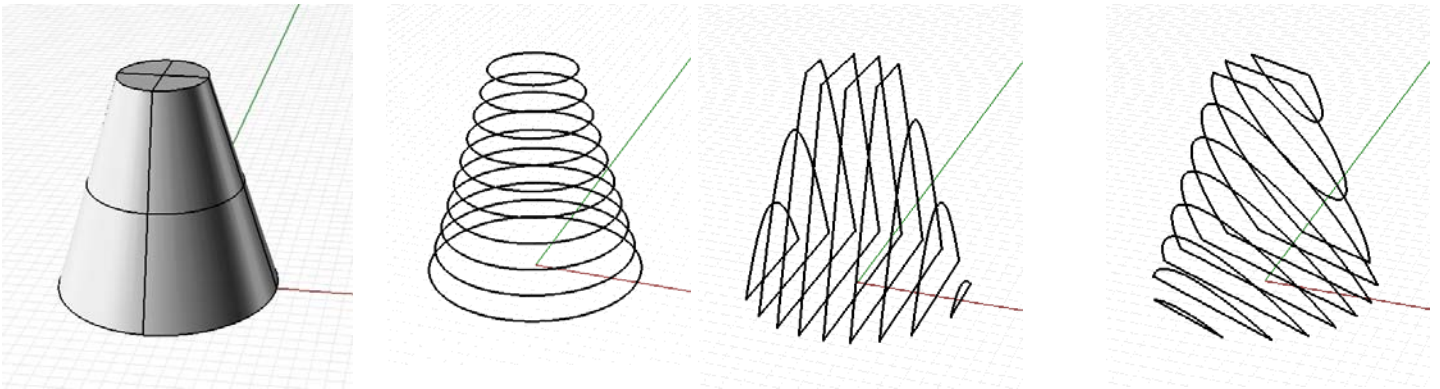
## Intersection of surfaces



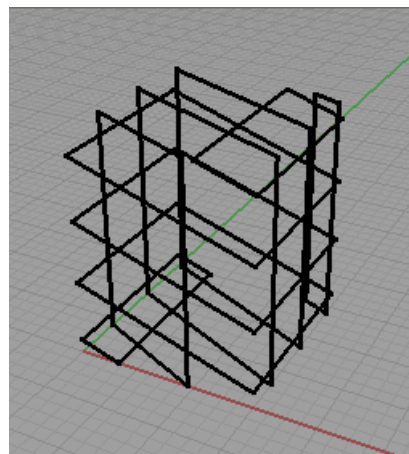
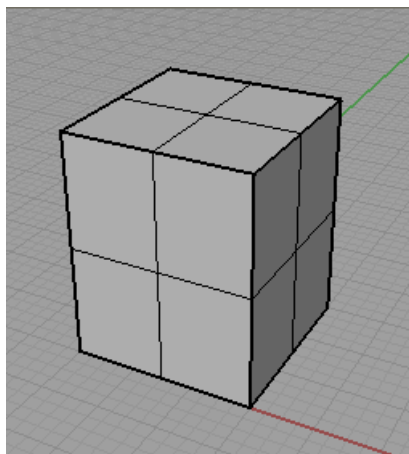
## Contour

### \_Contour

Allows the user to specify a direction and spacing for a series of lines that trace the surfaces of an object. This command, and the one that follows, is viewport dependent! Make sure the option for JoinCurves is set to BY contour planes (so all curves are joined after creation)...



Of course you can run this command several times from different directions to articulate different aspects of the same subject...

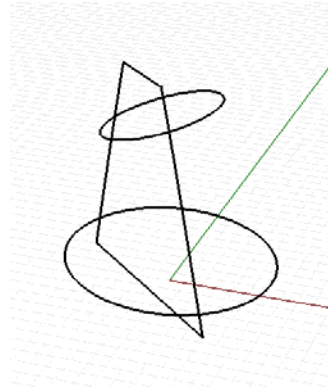
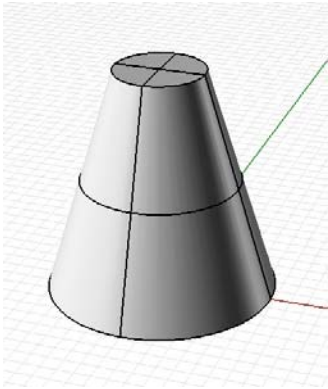


## Section

### \_Section

Like the contour command, but only traces one set of lines at a time...

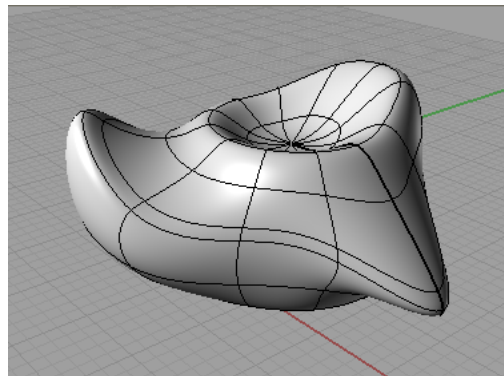




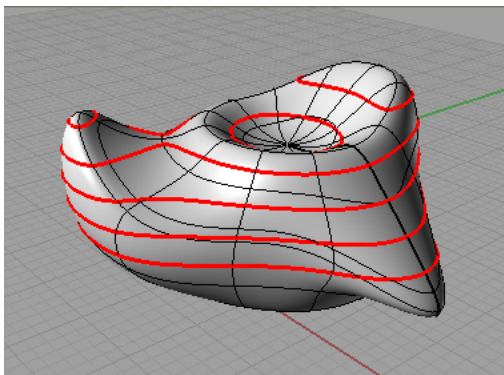
## Extract Isocurve

`_ExtractIsocurve`

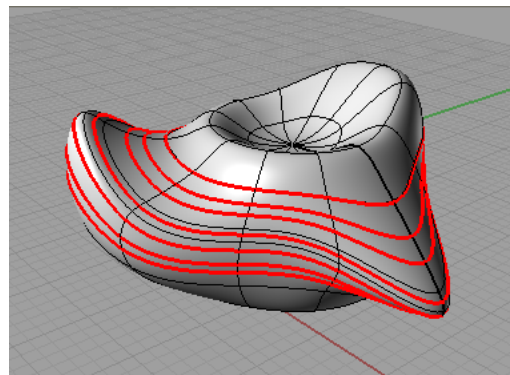
Unlike the last two commands, this one extracts curves based on the direction of the surfaces. The resulting curves are not planar.

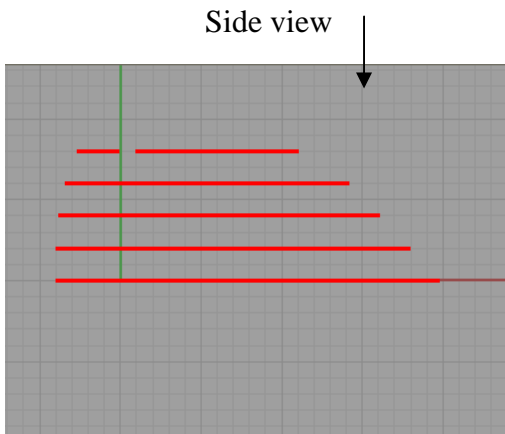


Using the section command

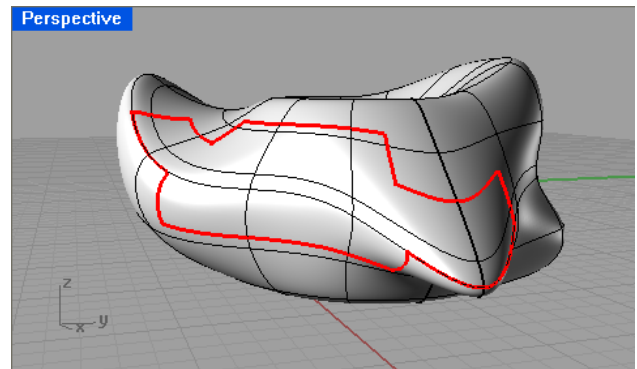
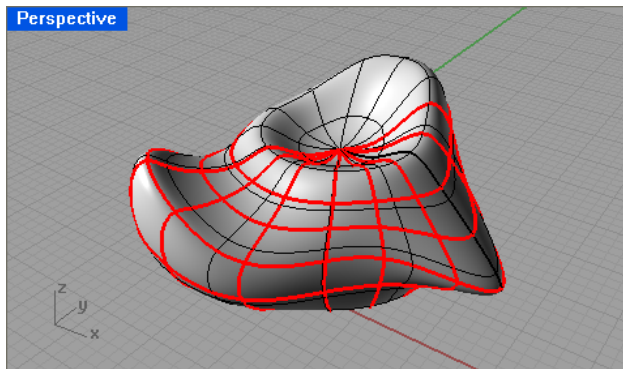


Using the extract isocurve command

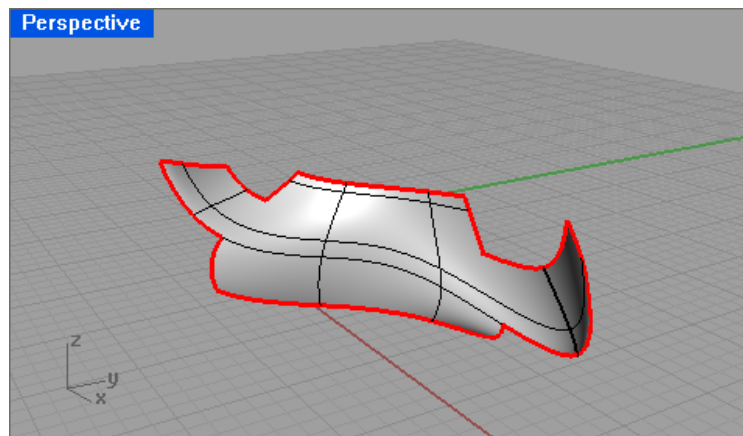


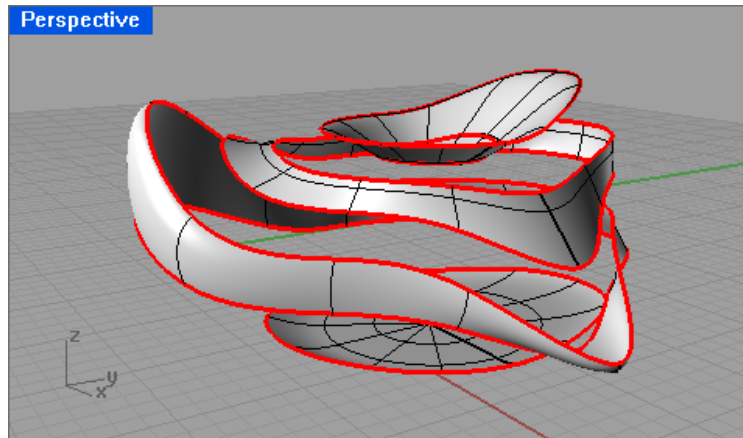


Within the command, you can toggle the direction of the curves (U or V directions)...



These lines can then be trimmed (using the trim command) to arrive at curves which can be used to trim the object itself, or as starting points for other commands. The two examples below were derived from the subject above...

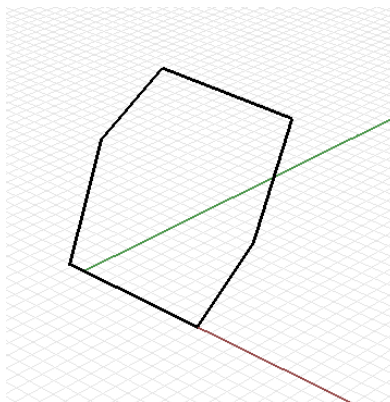
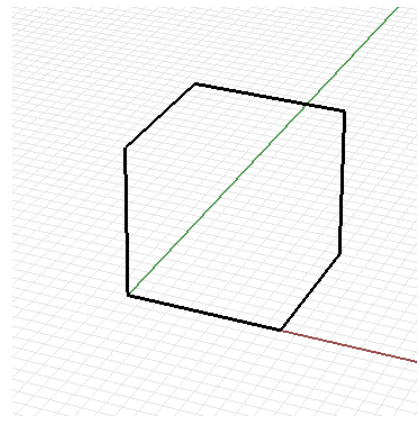
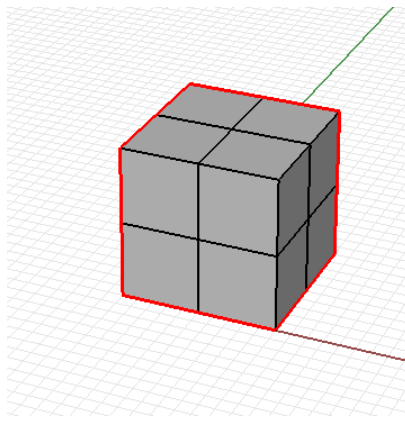
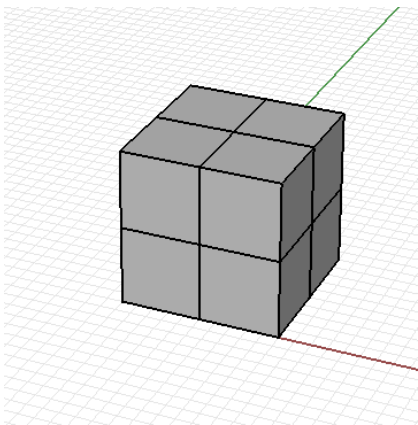




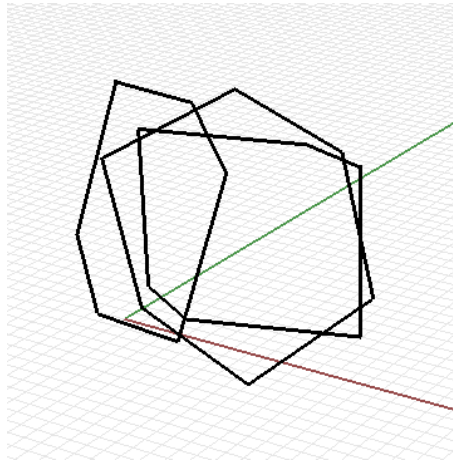
## Mesh Outline

`_MeshOutline`

This command creates planar curves around the silhouette of the object based on the current view. This is especially interesting in perspective view...



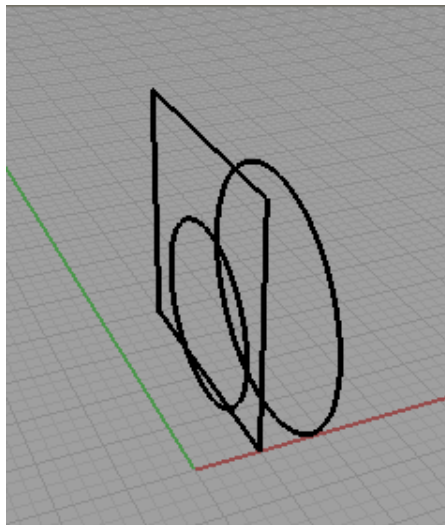
Running this command from various different views in perspective view creates a collage of lines in 3D space based on those perspectives...



### Caveat

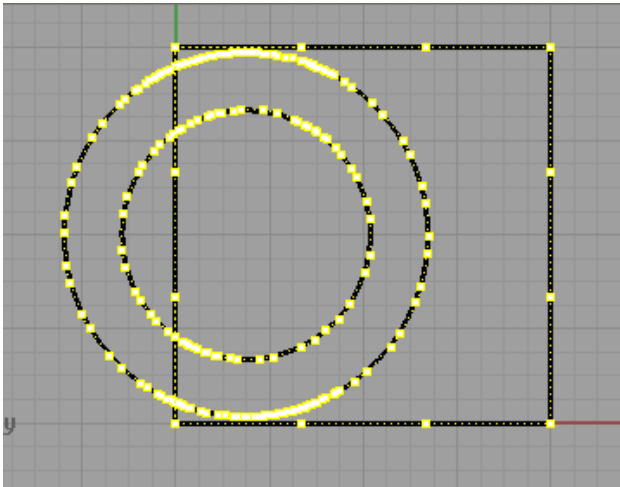
The curves derived from the examples above are often much more complex than they appear at first glance.

In the example below, the circles and square were derived from the contours of a box and sphere.

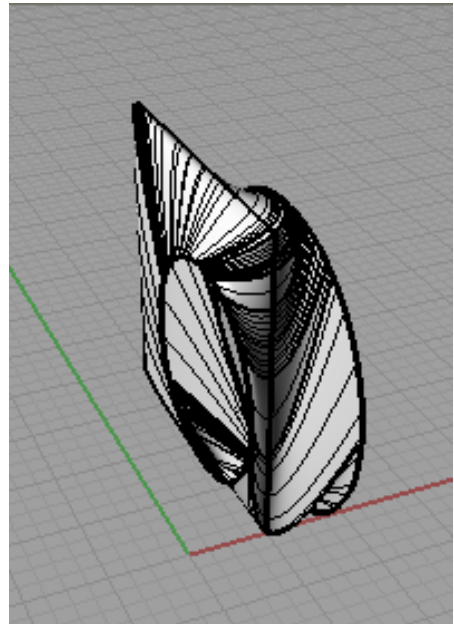


If we turn on control points for these curves, we will notice that the circles in particular have WAY more points than we need...When we try to use these curves for a surface command (loft in this case), we will end up with a very heavy looking surface. To be sure, this is not how we want to be creating our surfaces. Instead, we want to first run the following at the command prompt: **SimplifyCrv**. This will greatly reduce the number of control points on our curves. The resulting surface will be much cleaner and easier to work with...

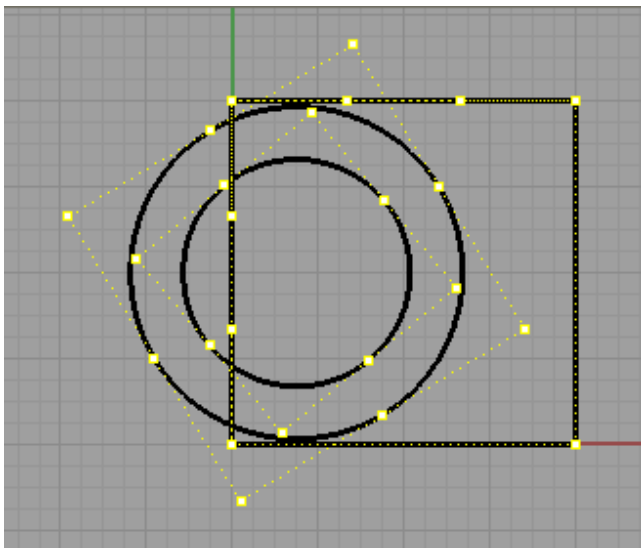
Original curves and lots of control points



A heavy surface results



Curves after running the **SimplifyCrv** command. Note the fewer control points.



A light surface results

