

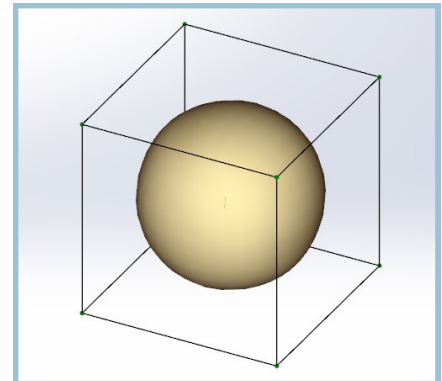
POWER SURFACING HELP



What is a Power Surface?

It is like freeform NURBS control polygon with some of the restrictions typically associated with NURBS removed. In the graphics industry it is also known as a Subdivision Surface object or SubD for short. The guys at Pixar originally developed this technology for modeling organic forms and you can see it used in all of its animated films.

Another way to think about a SubD is that it is like a soap bubble where the edges of the control polygon pull on the soap bubble. If you put two edges close together they exert more of a pulling effect and cause the soap bubble to be more curved. You can also increase the curvature of the soap bubble by increasing the weighting on an edge and pulling the soap bubble closer to that edge. If you increase the weighting on the edge all of the way to 100% then you create a creased edge that is not smooth.

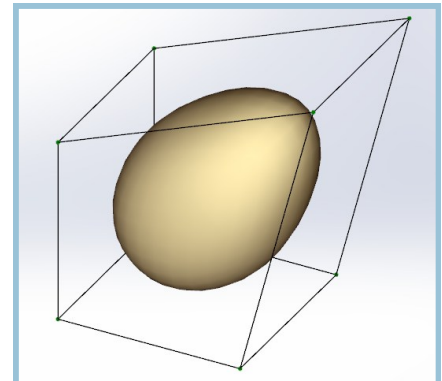


Soap Bubble With Box Control Cage

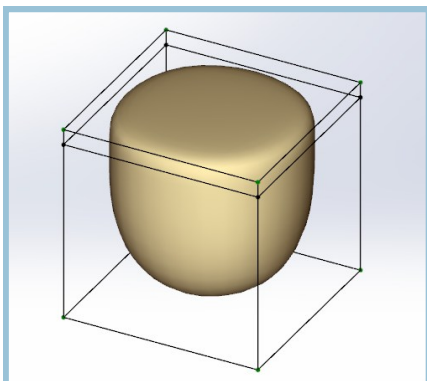
Creating SubDs

There are several ways to create SubD objects for use in SolidWorks. Power Surfacing provides several Primitive objects that can be used as starting points, you can use sketches to generate SubDs, or you can import mesh objects directly into the Power Surfacing editor.

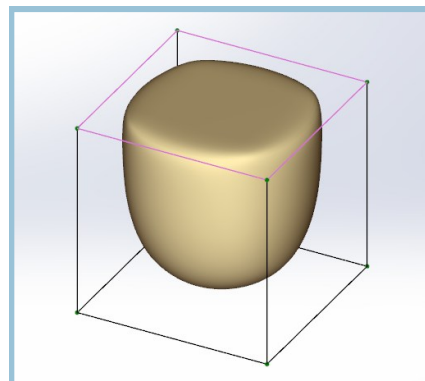
Starting in version 2.0, you can also constrain to existing surfaces from the feature tree. Please refer to the Power Surfacing 2.0 New Features section of this document for more information.



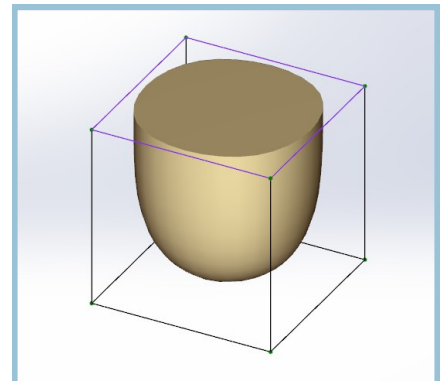
Moved Edge Changes Soap Bubble



Additional Edges More Curved



Weighted Edges Pull Harder



100% Weight Produces Creased Edges

Table Of Contents

What is a Power Surface?	1
Creating SubDs	5– 10
From the Power Surfacing Menu	5
Creation Dropdown	5
Create From Box, Torus, Cylinder, Planar Surface, Cone	6
Mid Plane, Rotation Offset	7
Create From Sketch	8
Creation Plane	9
Viewing	10
Selection	11
Region Select, General, Status Bar, Smart Selection, Soft Selection	11
Gizmos/Triad	12
The Transform Triad or Gizmo	12
Specialty Gizmos	12
Property Manager	13 - 27
Accept, Cancel, Undo, Redo	13
Feature Creation Settings	13
Command Options	14
Selection Utility Panel	14 - 17
Selection Type (Select Any, Face, Edge, Vertex, Edge Loop, Edge Ring)	14
Selection Tools (Face Ring, Select by Element, Select All, Invert, Hide Selected, Unhide)	15
Selection Options (Expand Selection, Contract Selection, Backface Cull)	16
Triad Orientation (Geometry, Screen, World)	17
Viewing Panel	20
Display Modes (Control, SubD, SubD Cage)	20
Visibility (Face, Edge Vertex)	20
Subdivision Levels, Transparency	20
Triad Panel	21
Advanced Group Fly-Out	22 - 27
Selection Options (filters)	22 - 24
Selected Vertex Editor	24
Sectioning Options	25
Advanced Triad Options	26
Alignment Tools	27 - 28
Selection Set Manager	28

Table Of Contents (continued)

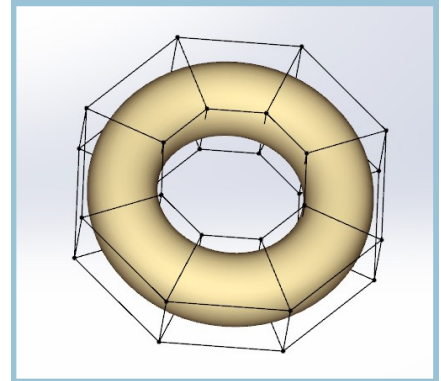
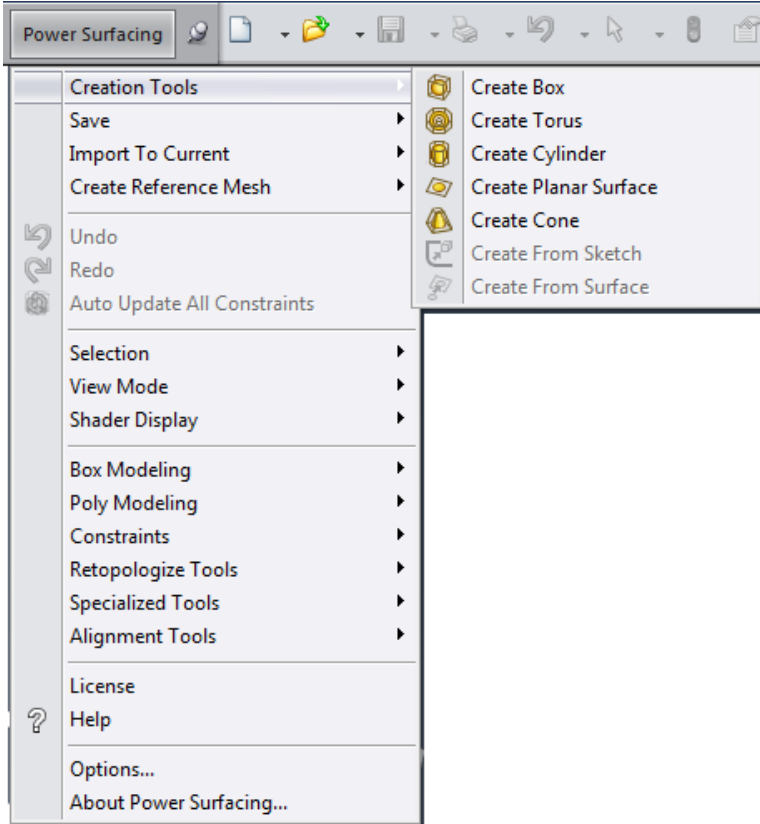
<u>Tools/Features</u>	29 - 44
<u>Edit Tools</u>	29 - 30
<u>Delete, Erase</u>	29
<u>Insert Edges, Merge Vertices</u>	30
<u>Creation Tools</u>	31 - 34
<u>Extrude</u>	31
<u>Offset Loop</u>	32
<u>Slice, Insert Loops</u>	33
<u>Bridge</u>	34
<u>Edit Topology</u>	35 - 36
<u>Bend, Subdivide All</u>	35
<u>Fill Face</u>	36
<u>Edge Attributes</u>	36- 37
<u>Smooth Edge</u>	36
<u>Hard Edge</u>	37
<u>Face Grouping</u>	37 - 38
<u>Define Boundary</u>	37
<u>Clear Boundary</u>	38
<u>Mirror Tools</u>	38 - 39
<u>Mirror, Toggle Mirror</u>	38
<u>Add To Mirror, Remove</u>	39
<u>Analysis Display Tools</u>	40
<u>Zebra, Curvature</u>	40
<u>Export Options</u>	41
<u>Save Control, Save SubD, Save Scene</u>	41
<u>Specialized Tools</u>	42 - 44
<u>Hinge, Subdivide Selected</u>	42
<u>Flip Faces, Thicken</u>	43
<u>Curve Selected</u>	44
<u>Power Surfacing 2.0 New Features</u>	45 - 74
<u>Parametric Constraints and Relationships</u>	46 - 53
<u>Selecting Constraints</u>	46 - 48
<u>Update Constraint, Clear Constraint Data, Toggle Constraint Visibility</u>	48
<u>Constraining the SubD to the Imported Reference, Constraint Types</u>	49
<u>Constraint Strategies and Tangency</u>	50
<u>Constrain To Face</u>	51 - 52
<u>Constrain To Edge</u>	52
<u>Constrain To Vertex, Remove Constraint</u>	53

Table Of Contents (continued)

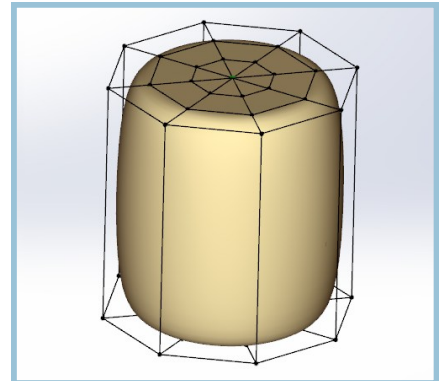
<u>Power Surfacing 2.0 New Features (continued)</u>	54 - 74
<u>Constraint Examples</u>	54 - 57
<u>Constraining to Analytics</u>	54
<u>Constraining to Multiple Surface Edges</u>	55
<u>Constraining to Non-continuous Surfaces</u>	56
<u>Constraining to Irregular Shapes</u>	57
<u>Updating Constraint Entities</u>	58 - 59
<u>Auto Update All Constraints</u>	58 - 59
<u>Update Constraint</u>	59
<u>Controlling Constraint Behavior</u>	60 - 66
<u>Retain Offset</u>	61
<u>Retain Ratio</u>	62 - 63
<u>Combining Constraint Behaviors</u>	64
<u>Spatial Constraint</u>	65 - 66
<u>Level Of Detail</u>	67 - 70
<u>Selection Set Manager</u>	71 - 72
<u>Command History Player</u>	73 - 74
<u>Hot Keys (Shift, Ctrl, A-Key, S-Key)</u>	75
<u>Options (General, Display, Zebra, Import/Export)</u>	76 - 77

From the Power Surfacing Menu

You can create both the Part file and the SubD model directly from the Power Surfacing menu when you select one of the Power Surfacing primitive objects.



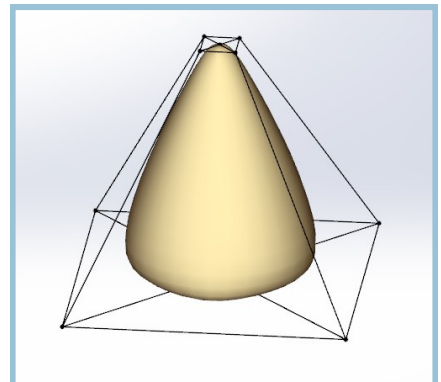
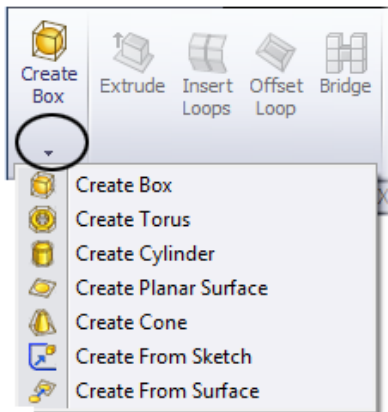
Default Torus Shape



Cylinder Shape

Creation Dropdown

With a Part file already open, in the Power Surfacing tab, at the far left, you will find the drop down that lets you create SubDs from the Primitives, a reference sketch, or an existing Surface.

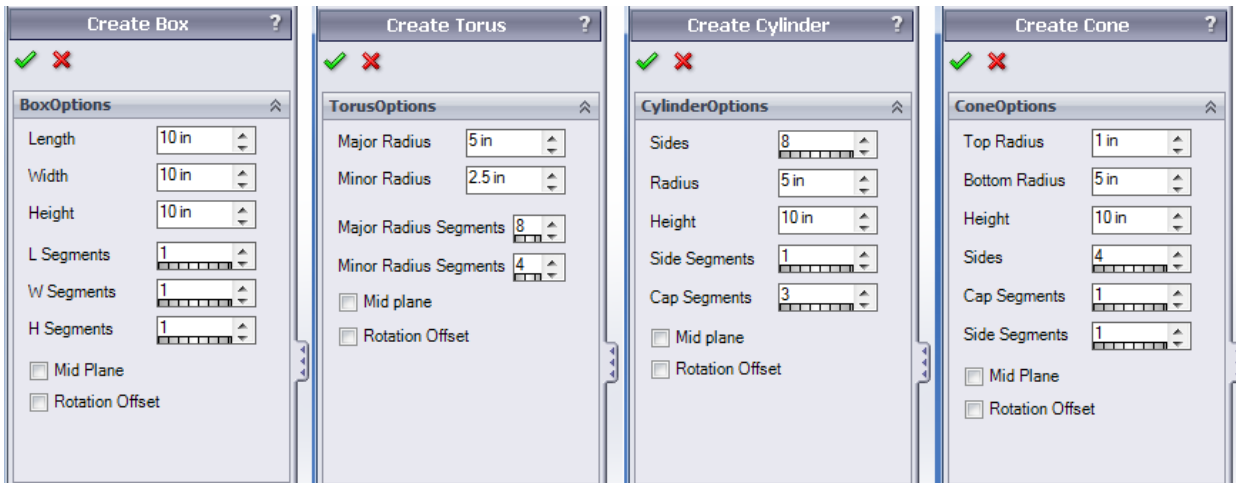


Default Cone Shape

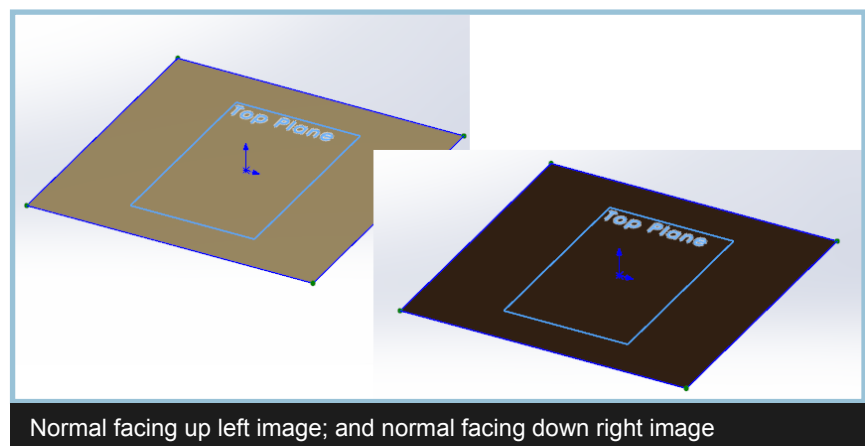
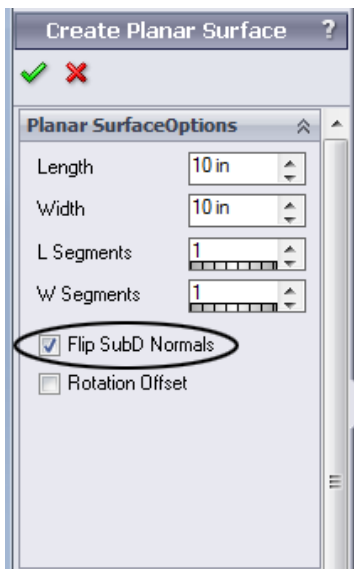
Create From Box, Torus, Cylinder, Planar Surface, Cone



Power Surfacing lets you choose between Box, Torus, Cylinder, Plane and Cone primitive objects for use as the starting Control Mesh. Each allows you to set its various parameters. You must click the Accept check mark to start editing the new SubD. You can cancel the creation by clicking the red X.

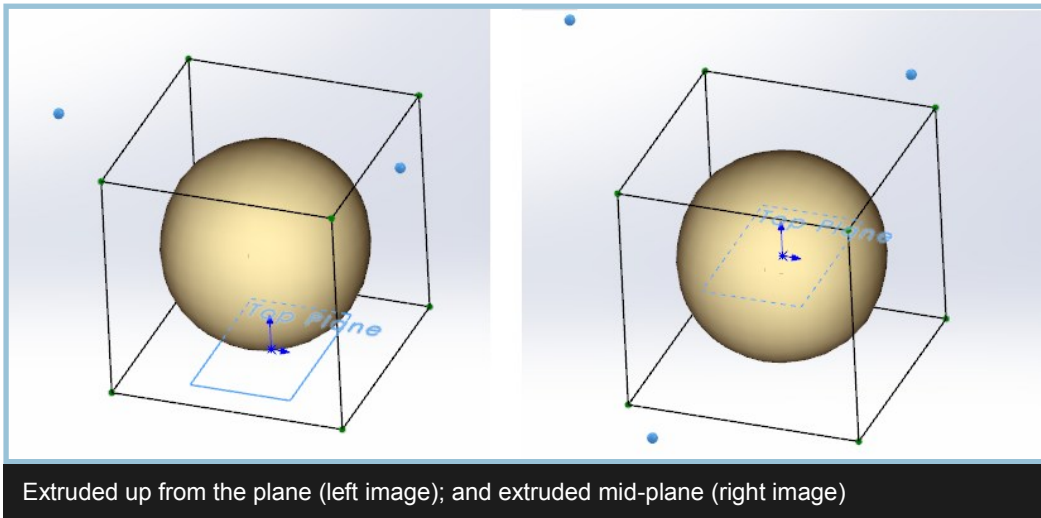


The Planar Surface is an open edged SubD object. If you are used to creating with surfaces rather than volumes you may wish to use this option to start your SubD. If you plan on extending the edges upward, you may want to use the Flip Normals option before creation.



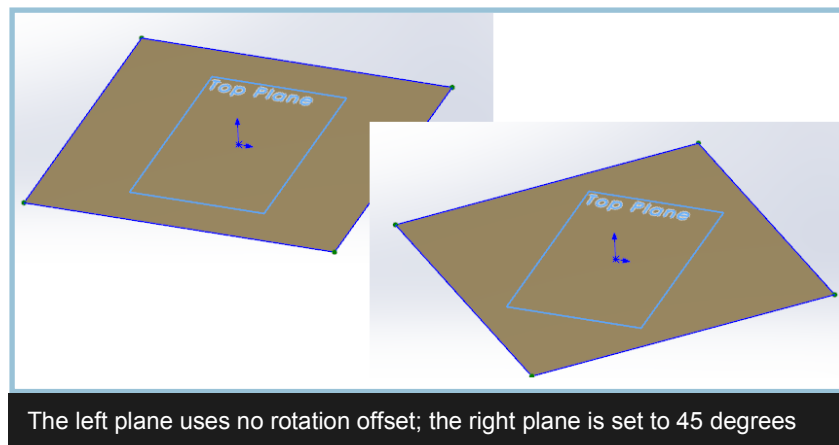
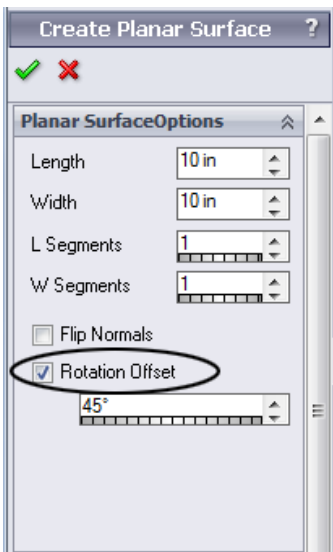
Mid Plane

All Primitives have the option to be extruded from the Create Plane upward or, if checked, from Mid Plane.



Rotation Offset

Primitive objects can also be rotated to an offset during the create process. Checking Offset Rotation brings up a text box that allows you to type in the rotation in degrees.

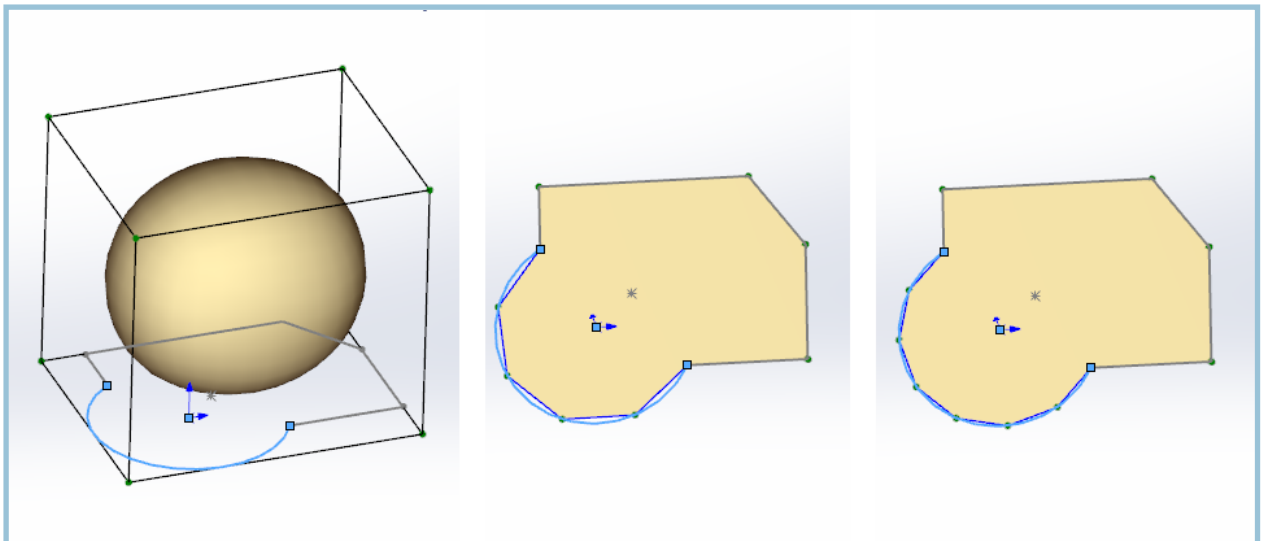
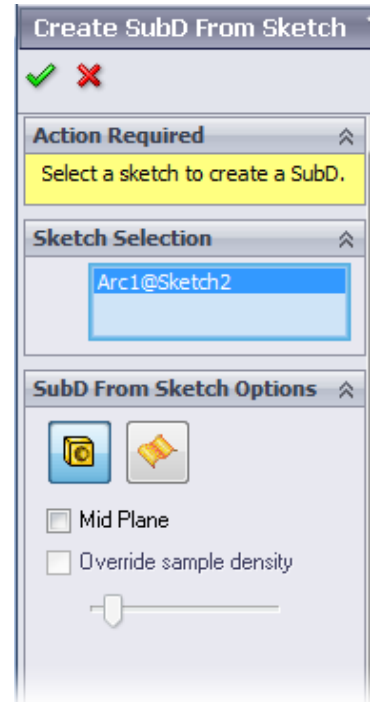


Create From Sketch

You may use sketches to create the SubD by selecting the Create From Sketch option from the creation dropdown. If the sketch was selected prior to selecting Create From Sketch, it will automatically be put into the Sketch Selection box. If it was not selected, selecting any part of the sketch is sufficient. If the sketch is not visible, you can select it from the Feature Tree in the viewport.

When you use a sketch as a base for your SubD 's control mesh, you should keep it as simple as possible. Since the optimal face configuration in SubDs is a quad or four sided face, if your sketch is over four sides, as a default, the control mesh will be created using only the sketch's bounding box. SubD From Sketch Options will allow for a sketch with more than four sides when you select Create Planar SubD From Sketch, but unless you are already familiar with SubD modeling, it is recommended that you keep your sketch simple and do your modeling in Power Surfacing.

With a sketch selected, you will need to select either Create Solid SubD From Sketch or Create Planar SubD From Sketch. With a Solid, you have the option to extrude the SubD up from the create plane or mid plane just as with the primitives. Preliminary extrusion height is calculated using the average edge length, but is easy to adjust once in Power Surface edit mode.



The sketch extruded as a solid (left image); as a planar SubD (middle image); and a planar SubD with sample density overridden to increase the number of edges (right image)

Create From Sketch (continued)

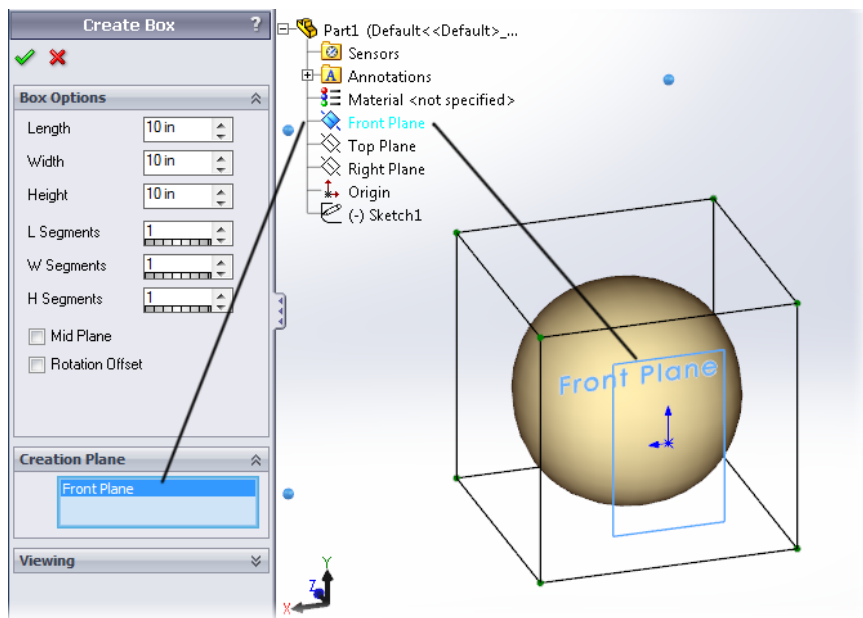
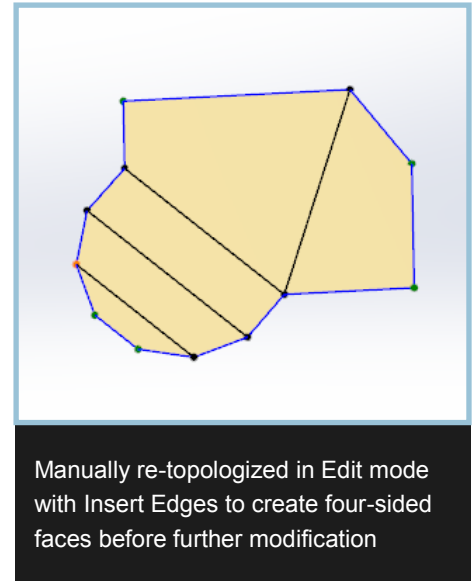
If you chose to create a surface from the sketch, you may need to manually insert edges to divide it into a meaningful SubD surface. Sketches should only contain straight sided elements whenever possible. If the sketch *does* contain curves, they will be resampled to eight segments per 360 degrees. The Override sample density slider will allow for more segments, but it is recommended that you use the default unless absolutely necessary.

Override Sample Density

If the sketch contains any non-linear sides, they will be converted to linear representations before the control mesh is created. The maximum number of sides, the far right setting on the slider, per 360 degrees is 10.

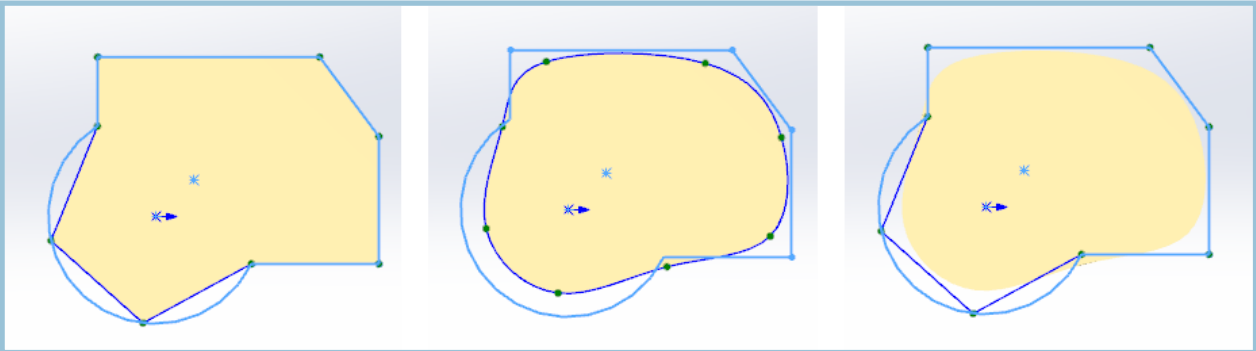
Creation Plane

In the Creation Plane section, you can set the creation plane for the Primitive by selecting it from the Feature Tree in the viewport. The selected plane will appear in both the selection list box and in the viewport.

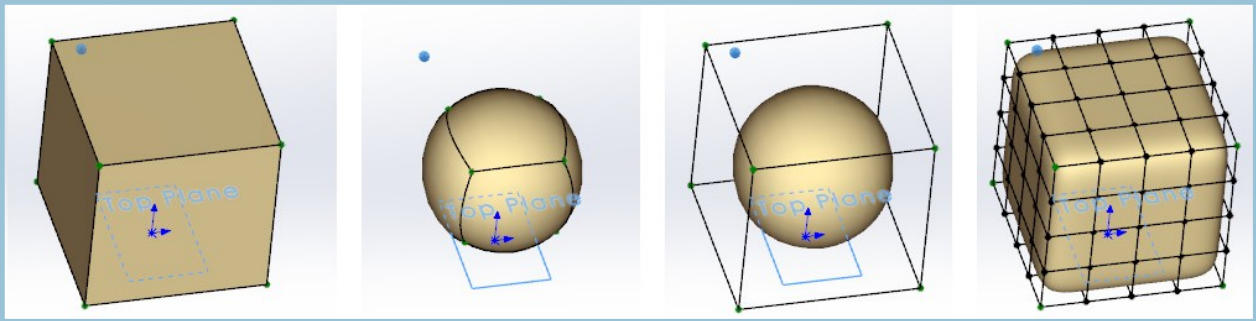


Viewing

While setting up the creation method for your SubD, you can also change the display mode. You can choose Control Mesh, SubD, or SubD plus Cage.



Images showing a planar SubD during the creation process where you can see the sketch it is being created from.



The bottom row shows a simple box primitive with a single segment. Note how the far right shows how the same SubD more closely resembles the control mesh as more segments are added.

Selection

Region Select

Power Surface follows the same conventions as SolidWorks for region select. Dragging from right to left selects in crossing mode where sub-objects crossed by the marquee will be selected. In windowed mode, dragging from left to right, only the sub-objects fully within the marquee will be selected.

When using the selection marquee, back-facing objects will be selected along with those on the front.

General

Faces, edges and vertices are previewed in hover mode with orange highlight. When selected, or picked, the sub-object or sub-objects will turn cyan colored.

To add to the selection, you can hold down the ctrl key. To remove sub-objects from the selection, you can hold the shift key down.

Status Bar

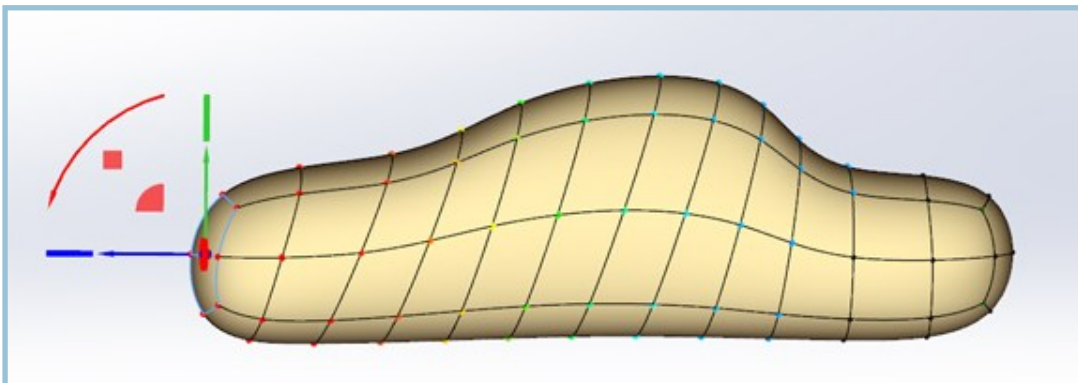
The number and type of currently selected vertices, edges or faces are shown on the status bar, lower left. Depending on the selection, it may also show location, length, weight, or other pertinent information.

Smart Selection

In Any mode, the position of the cursor over the edge will determine if an edge loop or edge ring will be selected. The outer third of the edge will select a loop, while the center third will select a ring. With faces, the edge nearest the cursor will determine the direction of the face loop. Zoom in closer for more accuracy.

Soft Selection

Selections can also be "soft." The influence of transforms can be set to expand beyond the selection, diminishing with distance. See Soft Selection in the Property Manager section. See Advanced Tools.

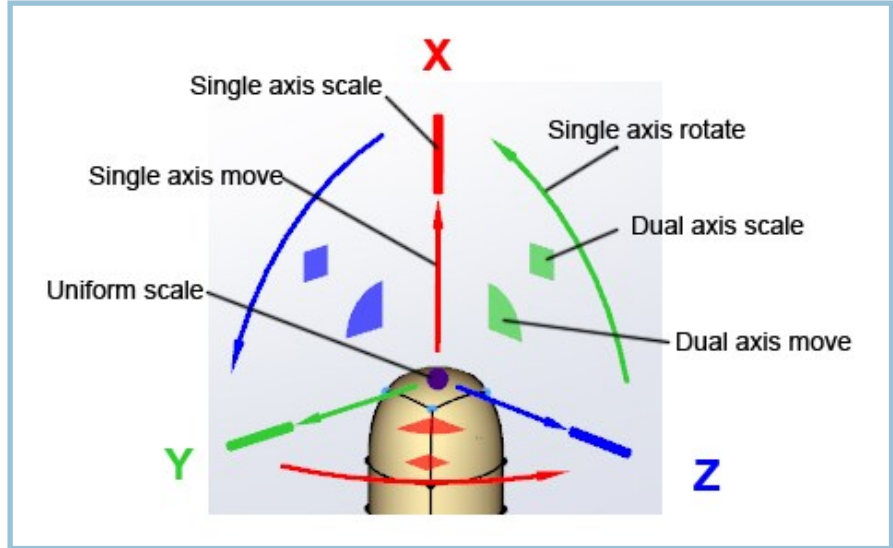


Gizmos/Triad

Power Surfacing has its own unique context aware gizmo. Besides the usual transforms, move, rotate and scale, you will be able to access many of the command's advanced parameters right in the viewport.

The Transform Triad or Gizmo

The **Transform** gizmo provides access to Move, Rotate and Scale with both single and dual axis functionality. Uniform scale is performed by using the center of the gizmo. Use the Wedge shaped portion of the gizmo for dual axis moves. Use the diamond shaped portion to perform dual axis scales.



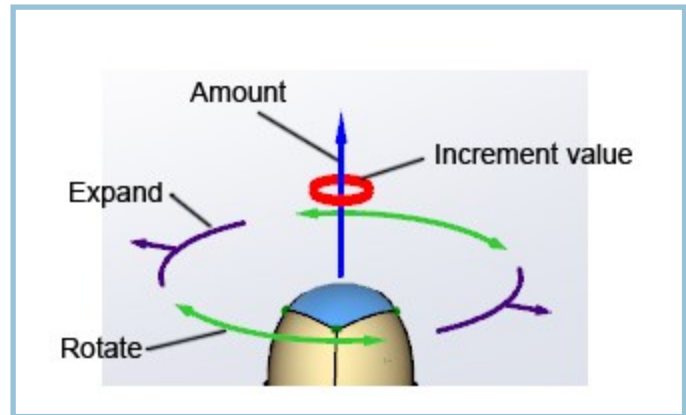
Specialty Gizmos

The **Expand** gizmo allows you to increase or decrease the size of a face or sub-object selection during extrudes or bevels.

The **Rotation** gizmo allows you to rotate the selected sub-objects while the command using it is active.

The **Increment Value** gizmo allows you to increase segments in Extrude, Bridge and Insert Loops commands. With Partial Crease activated, it lets you change the crease amount on selected edges.

The **Value Adjustment** gizmo allows you to adjust float values pertaining to the current command while active. Commands such as Bridge allow the tension at either end to be adjusted. Commands such as Insert Loops allow you to Slide or Pinch the previewed edge loops.



Property Manager

Accept, Cancel, Undo, Redo

Accept and Cancel are context sensitive commands. When you are in the middle of an operation that needs to be ended, such as Extrude or Insert Loops, the Accept command will finish or end the operation.

When no operation is in progress, the commands will act as follows:



The OK ,or Accept button, represented by the green check mark, will convert the Power Surfacing model to a BRep or NURBS model that can then be modified with the usual SolidWorks features.



The Cancel button, represented by the red check mark, will abandon any edits done to the Power Surfacing model since the last conversion.



Undo , Ctrl + Z

Undoes the last action performed on the SubD. This includes selections, but stays separate from SolidWorks commands. The SubD's construction stack remains independent of conversions allowing you to be able to undo previous actions after returning to edit the SubD after a conversion.



Redo, Ctrl + X

Reverses the last undo command.

Feature Creation Settings

Quality-> Coarse, Medium, Fine, Very Fine

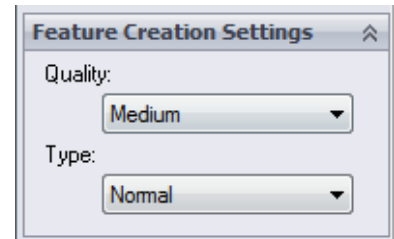
This is where you can increase the quality of the converted SubD model. Power Surfacing automatically calculates the quality based on both the setting and the partial creases used. Increase quality only if you see tears in the converted BRep and re-convert.

Type-> Normal, 1 to 1 Planar, 1 to 1 NURBS

Normal converts the SubD to a minimal number of NURBS surfaces.

1 to 1 Planar converts the control mesh to a NURBS body with only planar surfaces. Use this option for a quick way to save the part file without waiting for a full convert.

1 to 1 NURBS converts the SubD creating one NURBS surface for each face in the control mesh. Use this option when you need to register features from particular SubD edges. Some Features, such as Fillet may need the edges reselected after edits to the SubD.



Command Options

This context sensitive panel contains the parameters associated with the currently active command. When no command is being used, the rollout will be empty. See the individual features for information on their parameters and usage. When an operation is in progress, the Accept and Cancel buttons above the rollout will be associated with the current operation.

Selection Utility Panel

The Selection Utility rollout contains options pertaining to SubD selection and manipulation that are available at any time during the edit session.

Selection Type

Select Any

Allows for selection of any of the three sub-object types, Vertex, Edge, and Face. Once a sub-object is selected, Add (Shift Key) and Remove (Ctrl Key) acts only on that selection type. With nothing selected, dragging a region will select vertices. With something selected, dragging a region will select the current sub-object type only. An Edge Ring smart selection is available by double clicking in the middle half of an edge. Edge Loop smart selection is available by double clicking nearer the ends of the edge. Face Ring smart selection is available by double clicking the face near the edge in the direction of the desired ring.

Face

Allows the selection of faces only.

Edge

Allows the selection of edges only.

Vertex

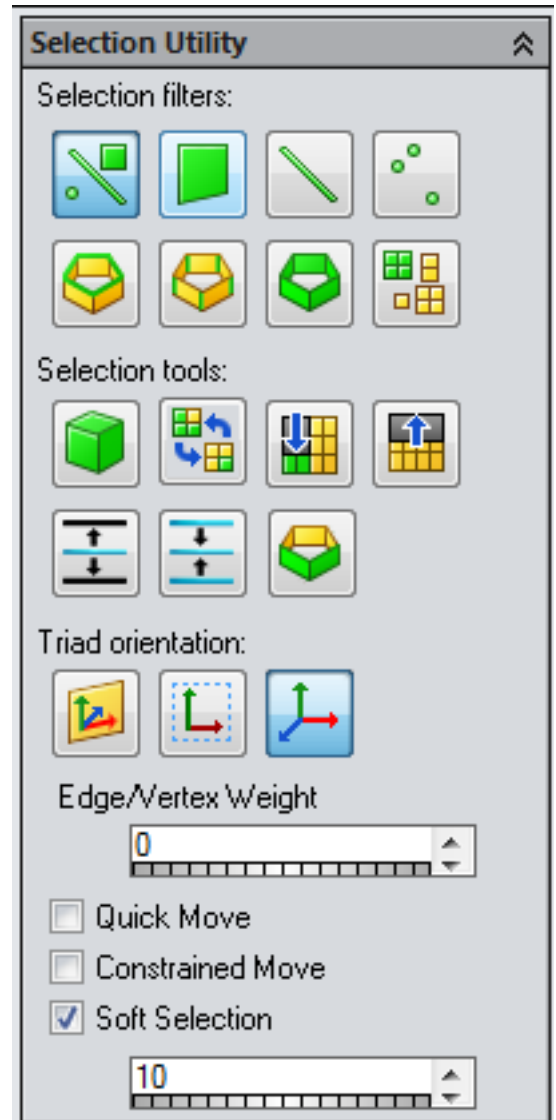
Allows the selection of vertices only.

Edge Loop

Selects a connected set of continuous edges that may form a closed loop. Interior loops stop and start at vertices that don't have exactly four edges. Exterior loops will continue around the boundary until they reach their starting point regardless of the edge count of their vertices.

Edge Ring

A set of edges between connected four sided faces, where the two edges on a given face do not share vertices. In other words, edges not connected to each other.



Selection Utility Panel (continued)



Face Ring

A connected set of four sided faces where opposite edges of each face form the connections. Face mode direction is determined by the location the face is picked.



Select by Element

Selects all the faces which are directly or indirectly connected to the given face. This is sometimes a shell or region.

Selection Tools



Select All

Selects the entire object in the current mode. If you are in Any mode, the last used selection type will be used.



Invert

Inverts the selection in whatever sub-object mode you are in.



Hide Selected

Hides selected faces. When used with vertex or edge mode, all faces associated with the vertex or edge will be hidden as well.



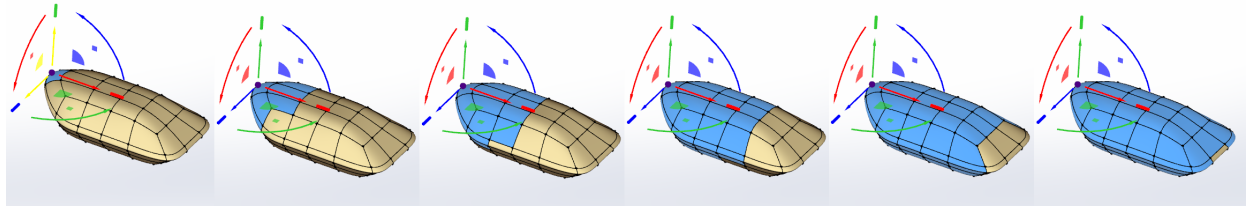
Unhide

Makes all hidden faces and their corresponding edges and vertices visible.

Selection Utility Panel (continued)

Expand Selection

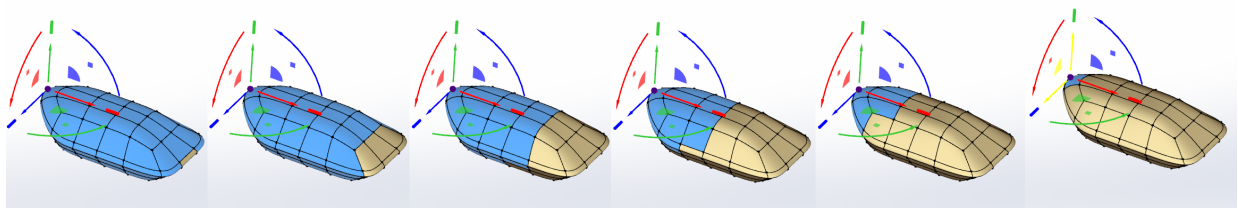
Expands the current sub-object selection one row/column in all directions each click of the button.



The selection expanded to the adjacent sub-object with each click of the button

Contract Selection

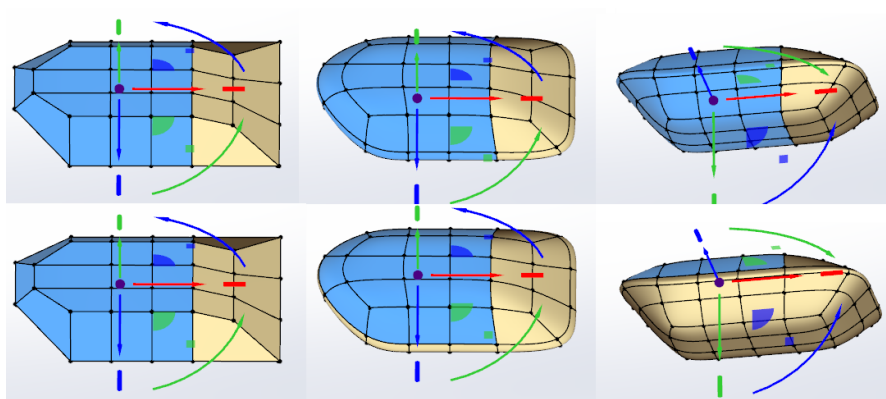
Contracts the current sub-object selection one row/column in all directions each click of the button. Contracting the selection will not necessarily give the same result as undoing an expand selection. Once expanded to include all sub-objects, Contract will not function. At that point you should use the regular undo.



The selection contracted to the adjacent sub-object with each click of the button

Backface Cull

Prevents selection of back-facing faces (in the control mesh) when using the selection marquee.



Back-facing faces selected, left. With Backface Cull turned on, back-facing faces ignored when using a selection marquee

Selection Utility Panel (continued)

Triad Orientation

These options allow you to change the coordinate system used by the transform gizmo or triad. As a default, the triad uses local or “Geometry” coordinates.



Geometry

With Faces, Z is aligned with the face’s normal or perpendicular. With a single edge, an axis is aligned with the edge. With a single vertex, the average of the faces connected to the vertex is used to orient the triad. With two adjacent vertices selected, the triad is oriented to the connecting edge. When the selection no longer has relevance to any of these scenarios, the triad reverts to world coordinates.



Screen

Y is vertical on the screen and X is horizontal.



World

Uses the coordinate system as seen with the triad in the lower left hand corner of the viewport.

Selection Utility Panel (continued)

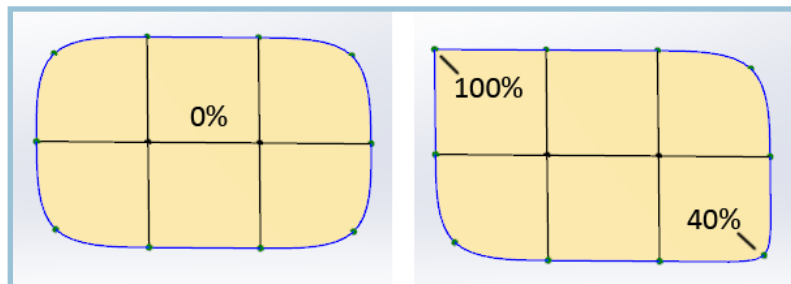
Edge/Vertex Weight

Weight allows you to adjust the weight amount on edges and vertices between 0, no weight, and 100, full hard edge or vertex. If a single edge or vertex is selected, its current value will be shown. If consecutive connected edges have weights the value is averaged across the edge to blend with the values of connecting edges. This produces a result similar in nature to a variable radius fillet.

Internal edges are added to smooth the weighting as follows: Normal conversion is two to three, between 40 and 60 crease amount, four levels are used, between 60 and 80, five levels are used, between 80 and 100, a fully hard edge, the levels drop back to the normal two or three. To improve fidelity for the conversion, you can increase the Quality setting.

Vertices can now be weighted individually. This ability is extremely useful when surface modeling. Weighting is retained after the application of Thickness. As with edges, vertices can also quickly be set to 0 or 100 using the Hard Edge and Soft Edge tools from the tool bar or right click menu.

Tip: When using edge weighting, you may want to increase the SubD levels in the viewport if the SubD model doesn't look smooth around the partial crease edges.



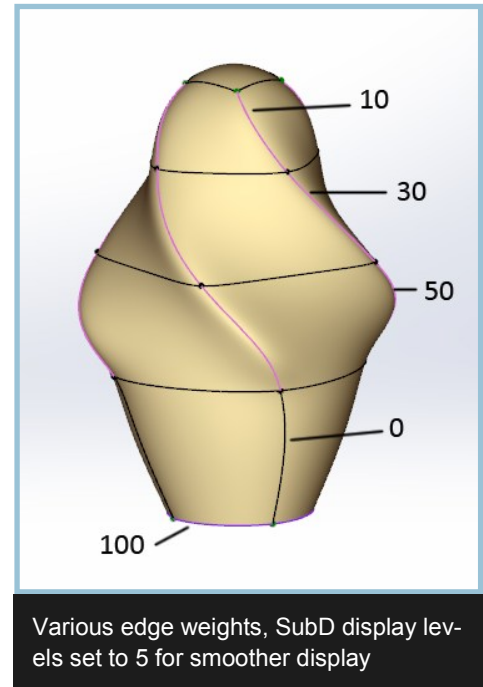
Various vertex weights on a surface. Adding Thickness automatically weights the connecting edge to the same value as the vertices.

Quick Move

This option lets you move vertices without using the triad. It operates using the last triad setting. Move a vertex with the triad before toggling Quick Move on for the first time.

Constrained Mode

When checked, this option constrains sub-objects to move along existing edges. This is especially useful for rearranging topology when the elements are not in orthographic alignment. Be aware that the selected sub-objects will not be able to cross over to overlap existing faces. The constraints also work off of the control mesh rather than the SubD's representation of where the edges currently show.

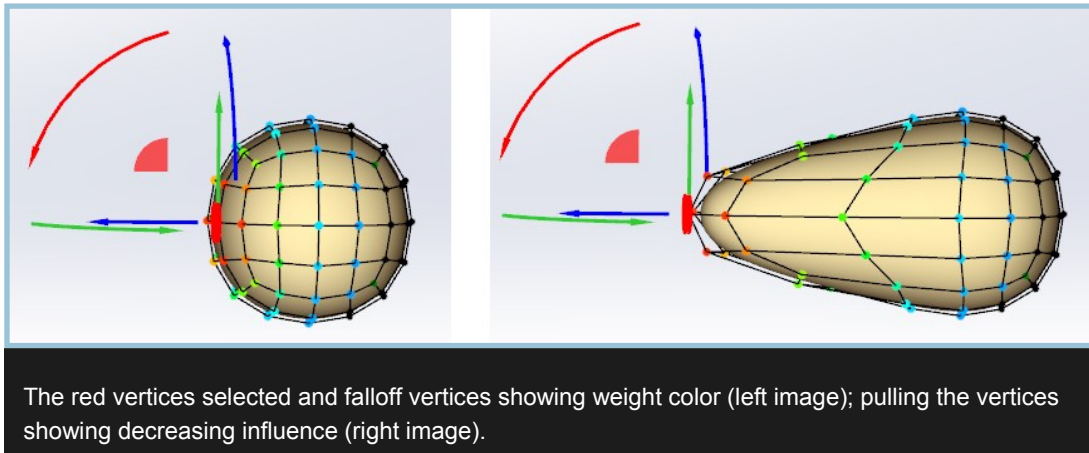


Various edge weights, SubD display levels set to 5 for smoother display

Selection Utility Panel (continued)

Soft Selection

Soft selection allows for a diminishing effect on the vertices surrounding the current selection of sub-objects. The value represents a distance based on screen space between 0 and 100. When checked, soft selection can be adjusted from both the Property Manager and by using the increment value gizmo in the viewport. The vertices are colored such that those with the highest weight are red, grading to orange, yellow, green and then blue for those least affected. The colored vertices will be visible regardless of which sub-object mode is currently being used.



Viewing Panel

Display Modes

Control

The polygonal mesh the SubD is based upon. Sub-Object selections are generally easier in this mode, but the final SubD representation may look vastly different depending on the mesh. The more faces the control mesh has, the closer the SubD resembles the control mesh, but the harder it is to edit the overall shape of the object.

SubD


Subdivision representation of the control mesh. The levels of subdivision can be adjusted for a smoother visual representation in Edit mode. This will not affect the NURBS conversion in any way.


SubD Cage

Displays both control mesh and subdivision surface. In this mode, you have the benefits of both an accurate representation of the model plus the ease of selection of the control mesh.

Visibility

When checked, the Faces, Edges and Vertices will be shown in the viewport. Choosing a selection mode that is currently hidden or suppressed automatically makes that element type visible again.

 **Face** - Shows faces in the viewport.

 **Edge** - Shows edges in the viewport.

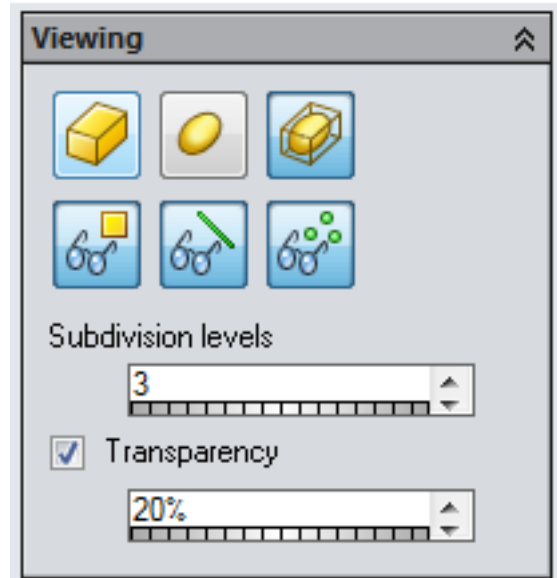
 **Vertex** - Shows vertices in the viewport.

Subdivision Levels

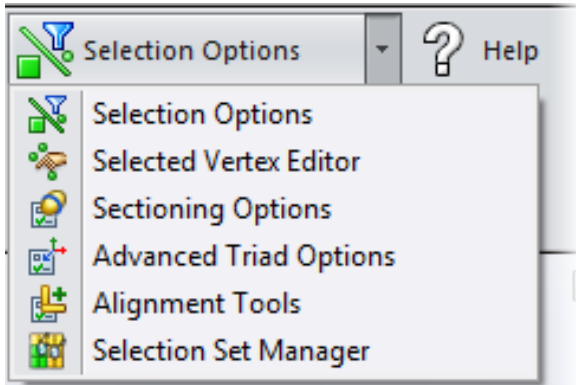
This option lets you set the subdivision levels used on the SubD representation of the model in the viewport. Three or four levels are suggested for simple models. Dense models may be better viewed in two or three levels.

Transparency

This setting allows transparency to be toggled off and on. When active, you may set the amount of transparency. Use this option when working with image planes or sketches as templates.



Advanced Group Fly-out



The advanced group fly-out gives the user access to some of the advanced features to increase productivity and provide additional functionality for more advanced modeling.



Selection Options (Filters)

This option shows the Selection Filters dialog. This is helpful for complicated crease and other edge-based operations where a large number of sub-objects are involved. The choices are as follows:

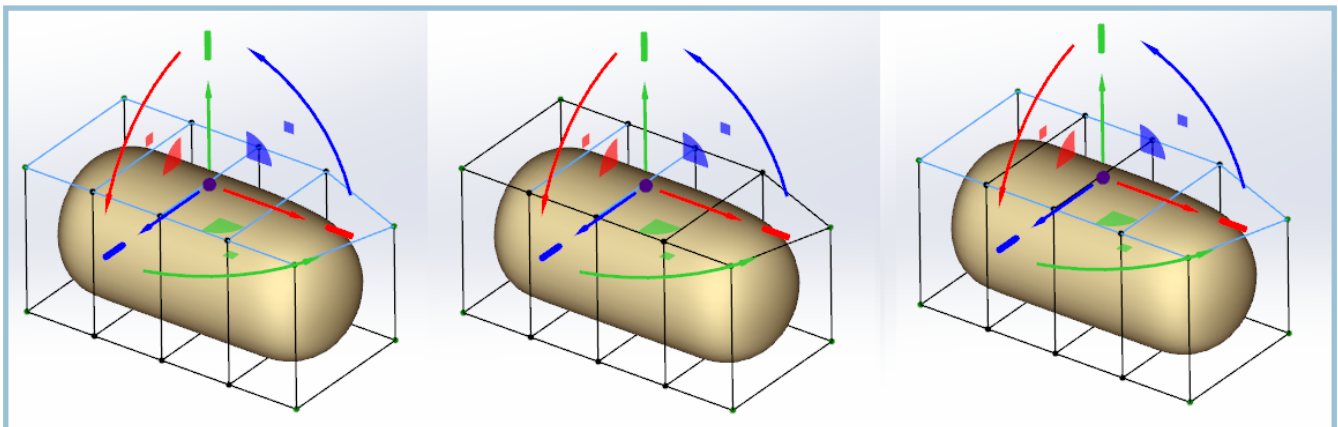
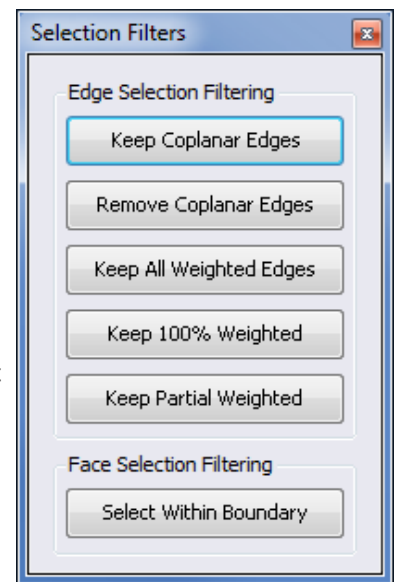
Keep Co-planar Edges: keep only edges in selection list which are between two control mesh faces which lie on the same plane.

Remove Co-planar Edges: keep only edges in selection list which are NOT between two control mesh faces that lie on the same plane.

Keep All Weighted Edges: removes all edges from selection set which have edge weight of zero value

Keep 100% Weighted: removes all edges from selection set which have edge weight less than 100%

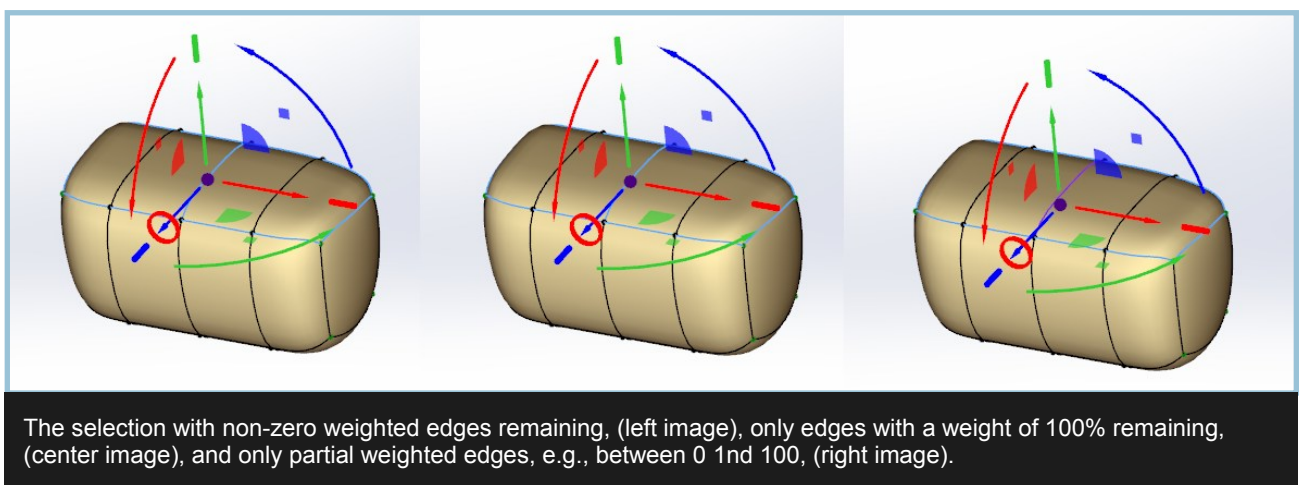
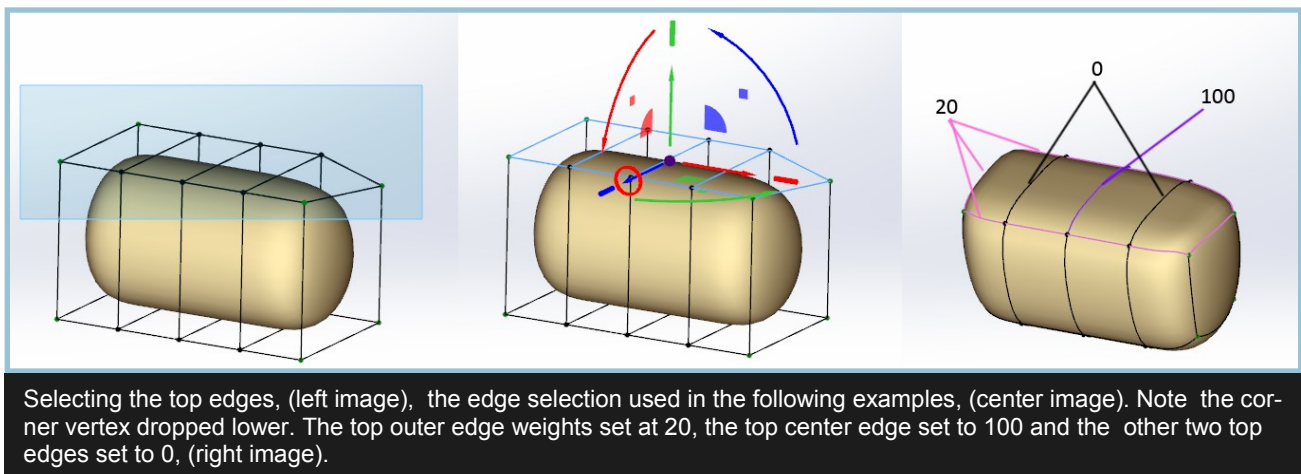
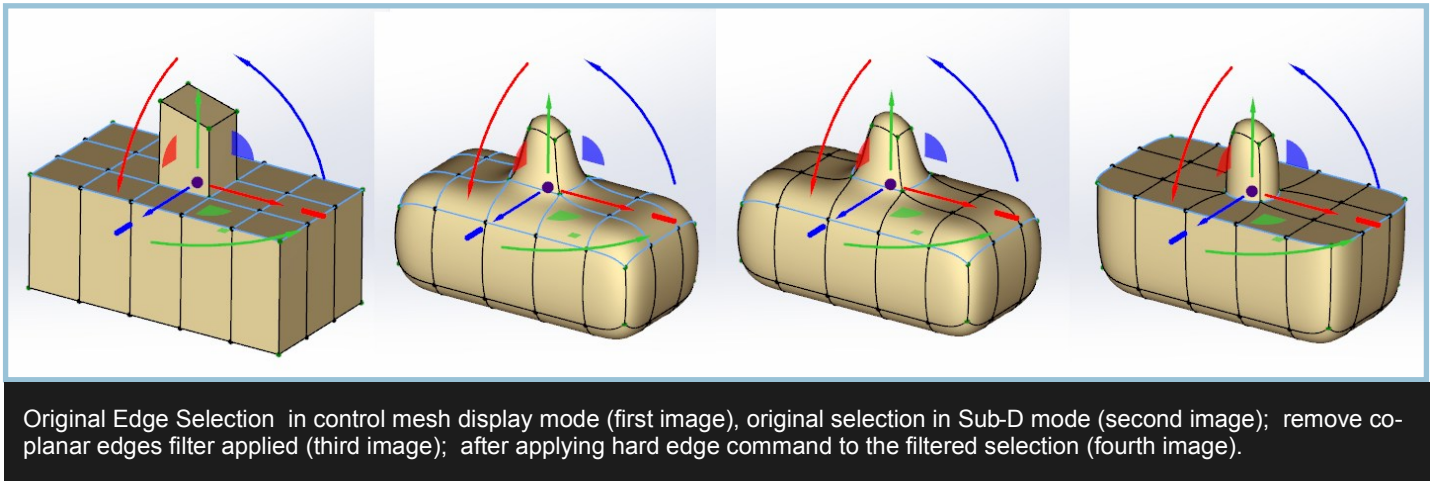
Keep Partial Weighted: removes all edges from the selection set which have an edge weight of zero or 100%.



Edges in Selection Set (left image); Filtered to keep co-planar interior Edges (middle image); filtered to keep edges which are not co-planar (right image)



Selection Options (continued)

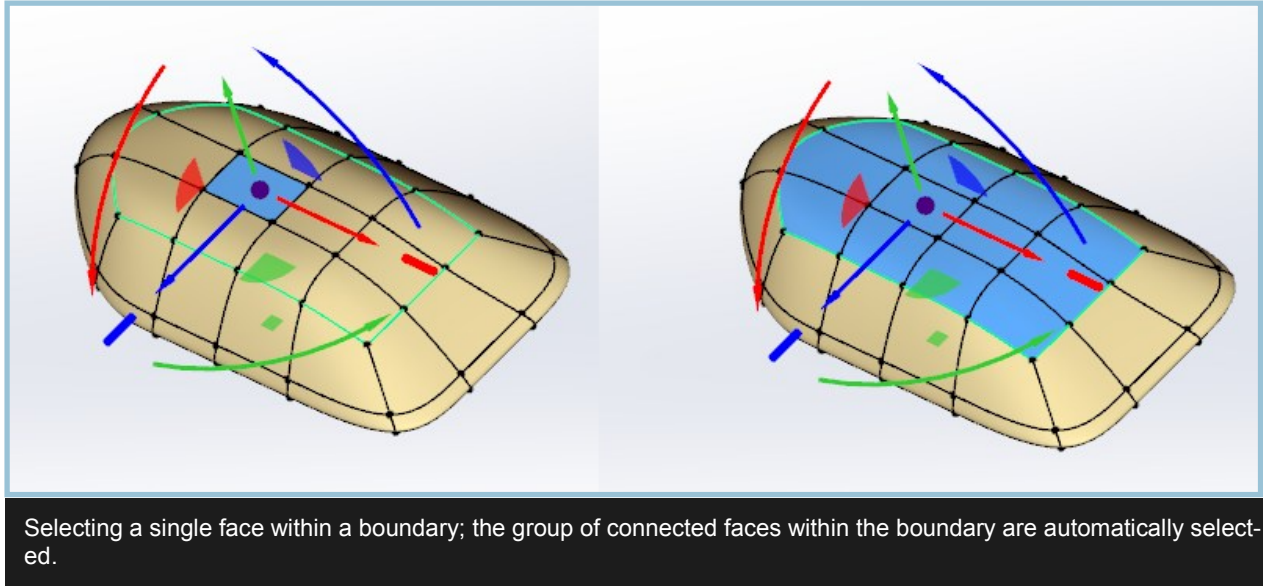




Selection Options (Filters)

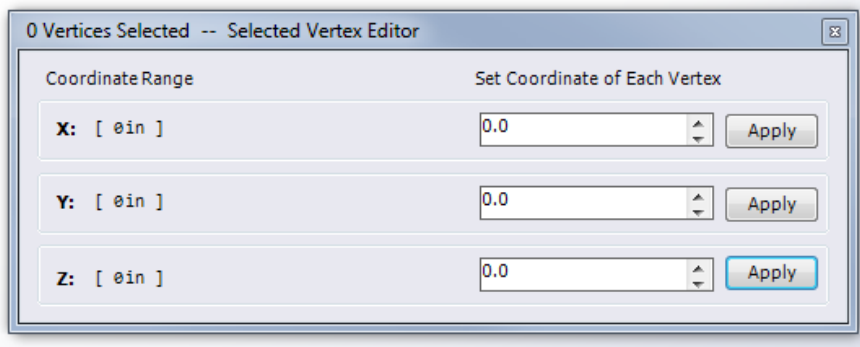
Select Within Boundary

Selects all faces within the boundary of the selected face. You will need to utilize the Define Boundary command to create boundaries from groups of faces.



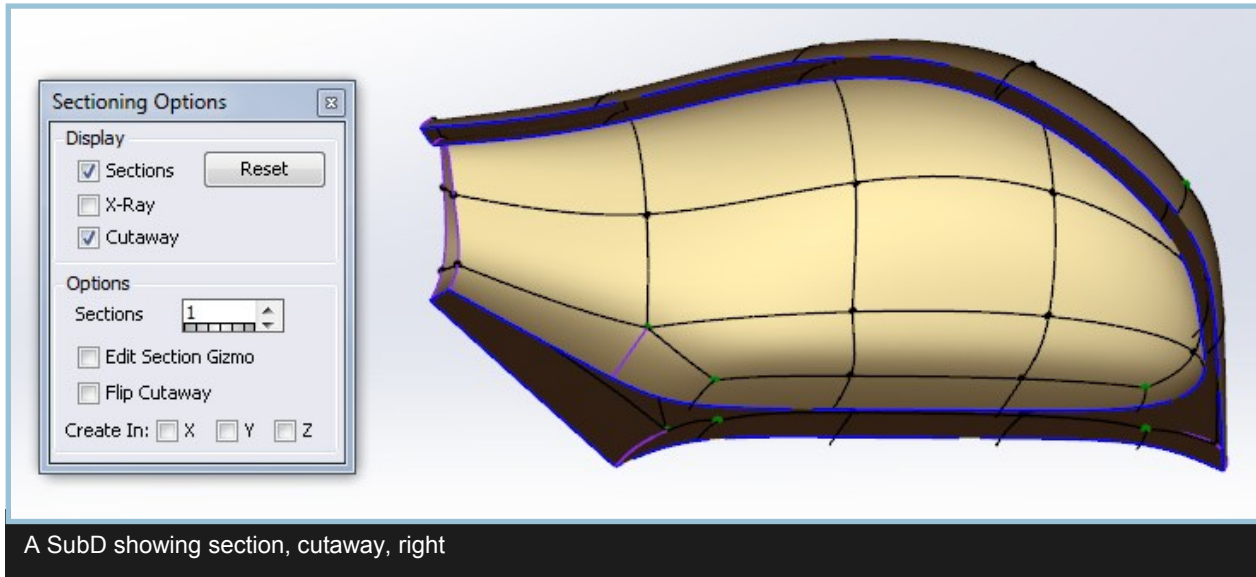
Selected Vertex Editor

This editor allows you to manually set the location in the world coordinate system on a per vertex basis. Note that you may choose one or more vertices.





Sectioning Options



A SubD showing section, cutaway, right

You can use Section View to help you get a feel for your SubD's shape regardless of topology. Note that sections are display mode helpers only and do not refine or change your mesh in any way.

Display

Sections- Checking Sections shows the section or sections in the viewport.

X-Ray- Shows the full section through the model even when the SubD is fully opaque.

Cutaway- This option hides the faces, but leaves the edges showing on the mesh on one side of the section through the SubD model.

Options

In this area, you can adjust the number of sections and how and where they are drawn through the model.

Sections- You may adjust the number of sections drawn on the model. If you set this value to more than one, Cutaway is automatically disabled.

Edit Section Gizmo- When checked, a triad/gizmo appears to allow you to manually position and orient the section plane. If you are using more than one section, all sections will be parallel to the transformed section.

Flip Cutaway- This check box toggles the side of the model that is cutaway.

Create-In: - This option lets you turn on sections for any or all of the section plane's X, Y and Z directions.



Advanced Triad Options

These settings give you control over where and how transforms are performed on the SubD. You can specify specific transformations and specify how the triad acts under different conditions.

Prevent Reorientation: As a default, the triad reorients itself to give clear access to its individual components. When checked, Prevent Reorientation will prevent the triad from changing orientation so that it always represents the currently selected coordinate system. It is recommended that you turn on this option while typing in transform values in this section.

Translation: As a default, translation is relative. When checked, **Absolute** will position the selected sub-object or sub-objects' center point to that location in world space.

Rotation: With Rotation, you may choose the axis you wish to affect with the X,Y, and Z buttons. Rotation is always relative.

Rotation Snap: Rotation Snap can be toggled off and on here. The snap value will show as 0 when the option is off, but the previous snap value will be retained for the next time Rotation Snap is turned on in this session.

Scale: For Scale, you may choose the axis or axes you wish to affect with the X,Y, and Z buttons.

Rotation Snap: Rotation Snap allows you to choose from several preset snap degrees. As a default, the snap is set to 90 degrees. This is a proximity snap, not a forced snap.

Triad Placement: The options in this section allow you to transform selections using different pivot points. Power Surfacing will keep a static transform location that you can adjust and use any time you need it.

Dynamic: With Dynamic, the default setting, the triad is on the selected sub-object or at the center of multiple sub-objects. It changes as your selections change.

Static- Move Objects: With this setting chosen, you can transform the selection relative to the static triad or gizmo.

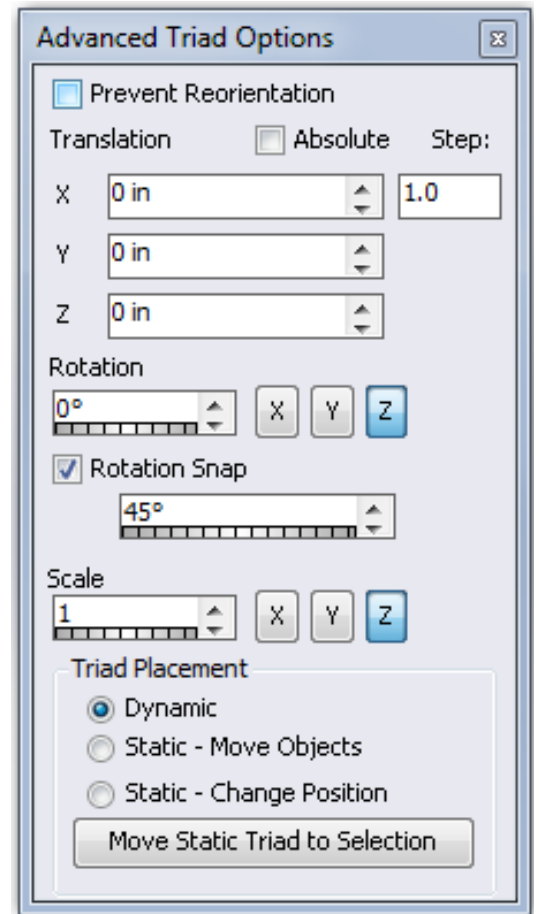
Static- Change Position: With this setting checked, you can manually position the triad to a custom location.

Move Static to Current Selection: This option provides a quick and accurate way to position and align the static triad or gizmo. It may be used in any mode. Select the desired sub-object or sub-objects and click the button to move the static gizmo to the desired location.

General: Units are derived from the Document Settings, but can be overridden during type-in.

If you are using the Geometry, or local, coordinate system, multiple selections work as per the viewport triad. The World coordinate system will be used if a meaningful average cannot be found. If you are not in Absolute mode, the local coordinate system should be respected for all three transform types. Absolute translation will always use World coordinates.

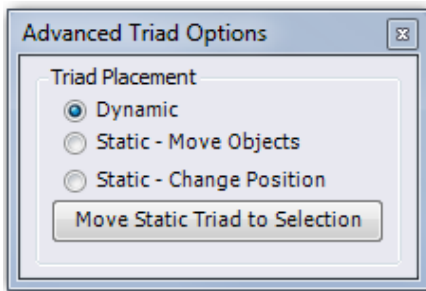
In Relative mode, until you select a different *axis*, *transform* or *sub-object*, the changes will be relative to the starting value since the last selection change was made.





Advanced Triad Options

These settings give you control over where and how transforms are performed on the SubD.



Triad Placement

The options in this section allow you to transform selections using different pivot points. Power Surfacing will keep a static transform location that you can adjust and use any time you need it.

Dynamic

With Dynamic, the default setting, the triad is on the selected sub-object or at the center of multiple sub-objects. It changes as your selections change.

Static- Move Objects

With this setting chosen, you can transform the selection relative to the static triad or gizmo.

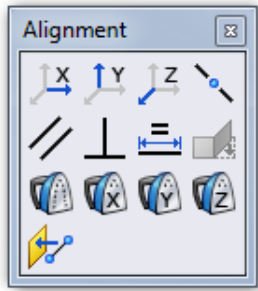
Static- Change Position

With this setting checked, you can manually position the triad to a custom location.

Move Static to Current Selection

This option provides a quick and accurate way to position and align the static triad or gizmo. It may be used in any mode. Select the desired sub-object or sub-objects and click the button to move the static gizmo to the desired location.

Alignment Tools



With the alignment tools, the first sub-object selected becomes the target for the alignment.



Creates a linear alignment along the world coordinate system X axis.



Creates a linear alignment along the world coordinate system Y axis.



Creates a linear alignment along the world coordinate system Z axis.



Makes the selected vertices or edges collinear. If vertices are used, the first two selected define the line. If edges are used, the first edge defines the line.



Makes the selected edges or faces parallel to the first one selected.



Makes the selected edges or faces perpendicular to the first one selected.



Makes the selected edges the same length as the first one selected.



Make faces coplanar to the first face selected.

Alignment Tools (continued)



Makes the selected sub-objects planar on the control mesh by averaging the positions of the vertices involved. The SubD representation will not appear flat unless the faces are also bounded by a creased edge.



Creates a planar alignment on the world coordinate system perpendicular to the X axis. The SubD representation will not appear flat unless the faces are also bounded by a creased edge.



Creates a planar alignment on the world coordinate system perpendicular to the Y axis. The SubD representation will not appear flat unless the faces are also bounded by a creased edge.



Creates a planar alignment on the world coordinate system perpendicular to the Z axis. The SubD representation will not appear flat unless the faces are also bounded by a creased edge.



Snaps the selected sub-objects to the specified plane.

Selection Set Manager

Power Surfacing's Selection Set Manager provides a means to retain and name selection sets of vertices, edges and faces. Additionally, face visibility can be managed in the floating window as well. See details of the [Selection Set Manager here](#).

Tools/Features

General

Tools and commands can be accessed either from the tool bar or from the right-click menu. Once in a command you will be able to use the specialized Gizmos to take advantage of the command's advanced features. The advanced features window can be opened from the bottom section of the Property Manager.

The Power Surfacing toolbar can be customized just like any other SolidWorks toolbar.

Edit Tools

The Edit Tools are tools which modify an existing Sub-D but don't create any new topology directly. The edit tools allow you to delete, erase, insert new edges and merge existing vertices.

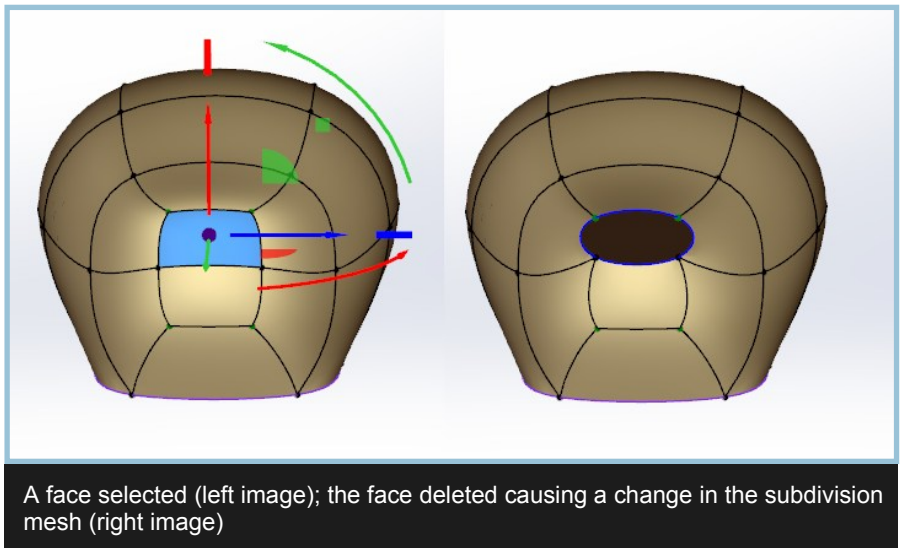
Delete

Deletes the selected sub-object. If the selection is a face, the face will be deleted. If the selection is an edge, the two faces sharing the edge will be deleted. If the selection is a vertex, all faces sharing the vertex will be deleted.

The resulting geometry will be a hole with open edges. These edges can be extruded as is, or the hole can be refilled by first selecting the edges, then using the Fill Face tool.

Gizmo: None

Available for Edges, Vertices and Faces

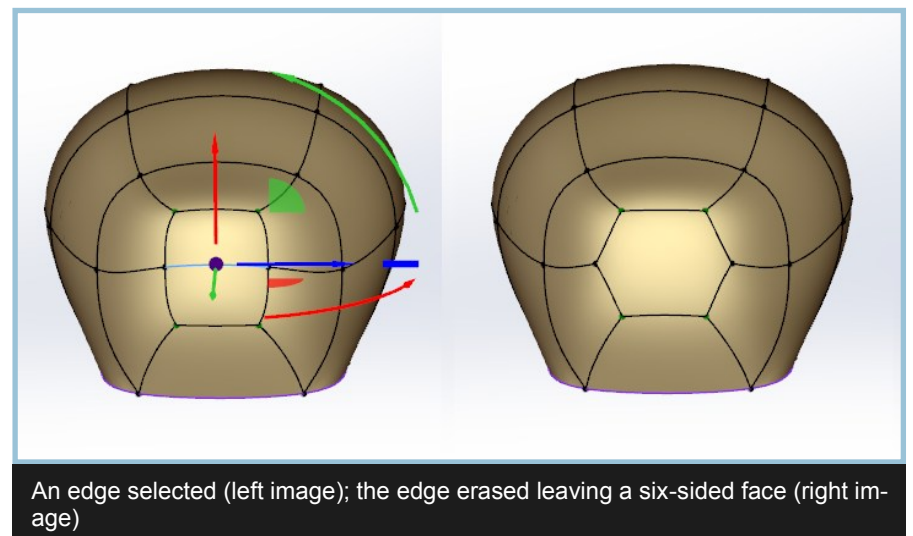


Erase

The erase tool removes selected edges and any isolated vertices.

Gizmo: None.

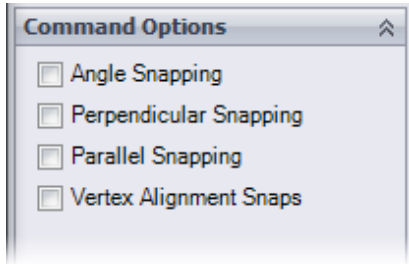
Available for edges, vertices.



Edit Tools (continued)

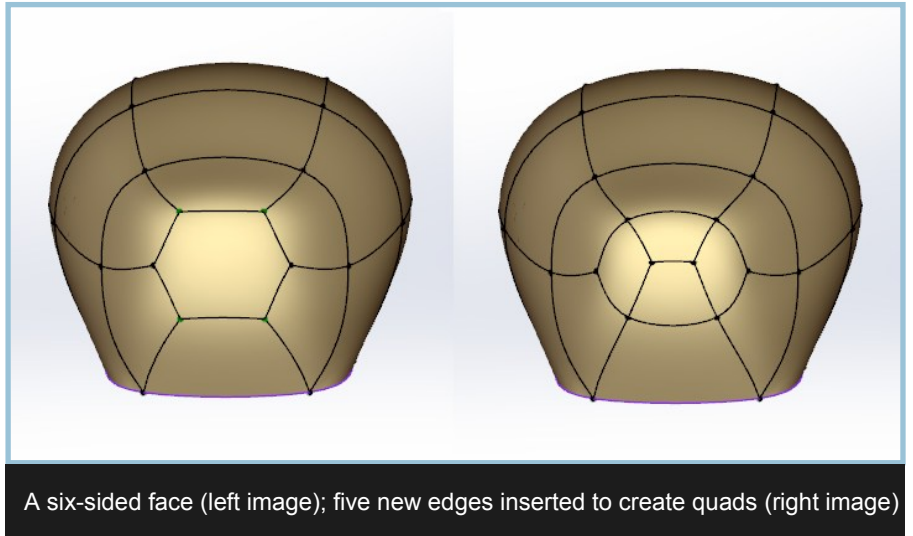


Insert Edges



Insert Edges allows you to create new edges by clicking on existing edges, faces and vertices. This mode is active until you right click. It will create vertices anywhere it crosses an existing edge and will automatically snap to vertices and edge centers. Zoom in if the snapping is too strong. Right click or Escape ends the command.

Gizmo: Shows red preview line.



A six-sided face (left image); five new edges inserted to create quads (right image)



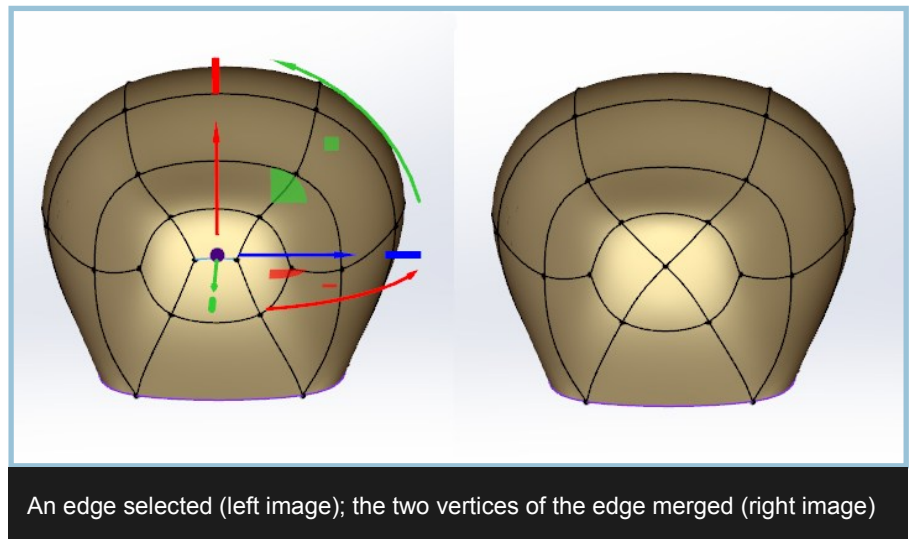
Merge Vertices

Collapses two or more vertices into one. If Edge mode is used, the vertices that define the selected edge or edges are collapsed or merged. In Face mode, the vertices defining the face or faces are merged into one.

When sub-objects are region selected all at once, their average position is used as the merge point. If one is selected first, then the others added to the selection, the first selection's location is used as the merge point.

Gizmo: None

Available in Face, Edge and Vertex mode.



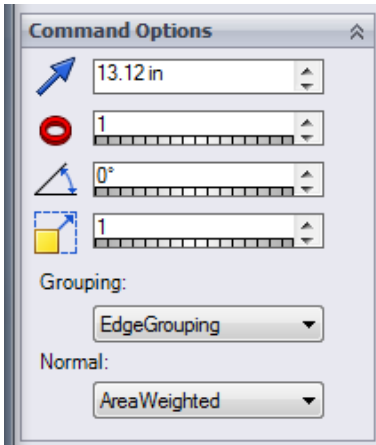
An edge selected (left image); the two vertices of the edge merged (right image)

Creation Tools

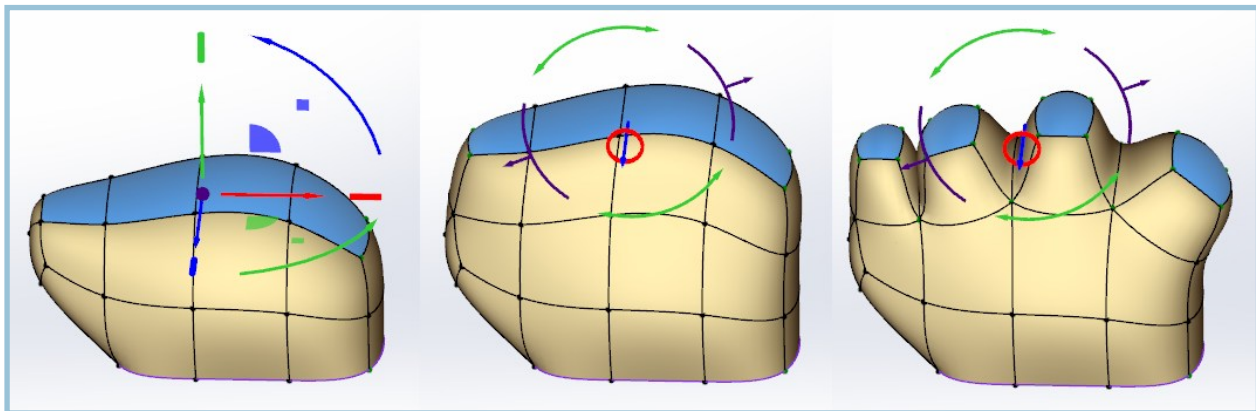
The creation tools allow you to change the shape of the object by adding geometry in some way to the existing SubD control polygon.



Extrude



Most common use is to extrude face or faces from a selected face or faces. If Grouping Type is set to NoGrouping, a face will be extruded from each of the selected faces.



The selected faces (left image); a simple extrude (center image); no grouping (right image)

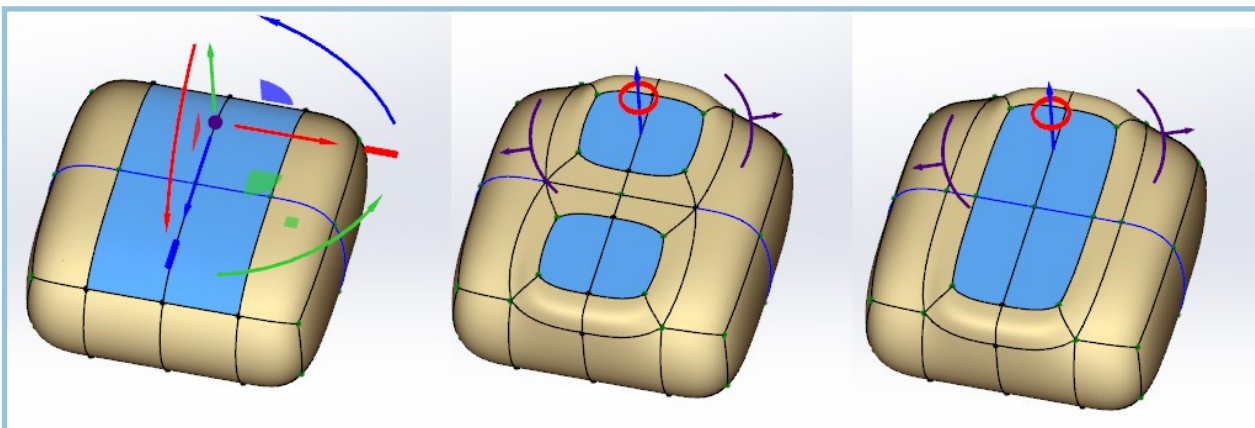
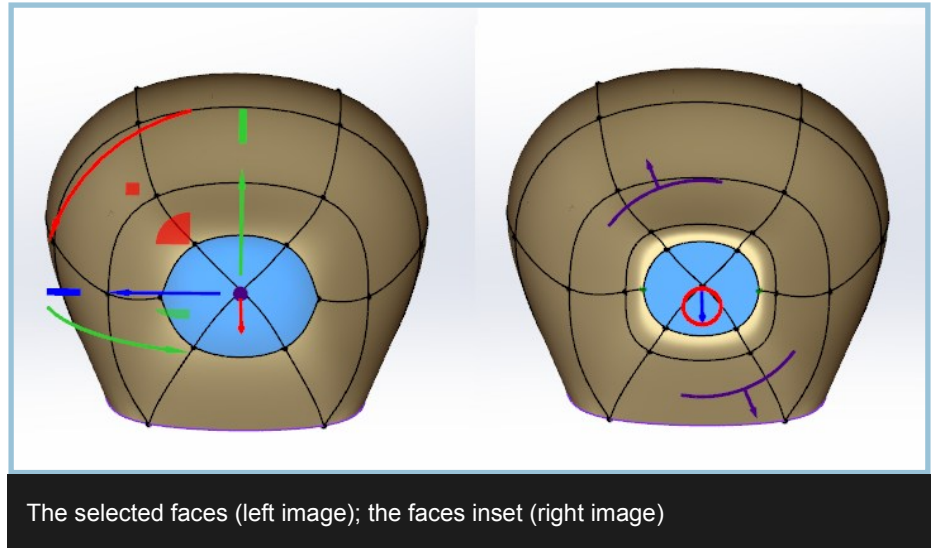
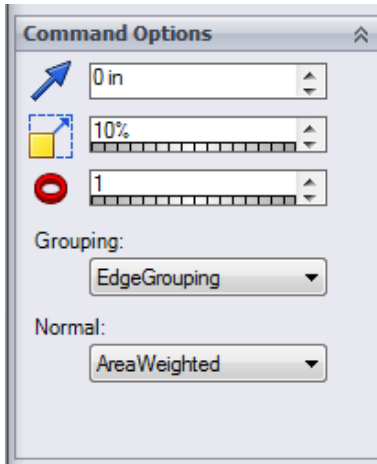
Gizmo: The extrude distance and bevel amount can be adjusted once the inset has been initialized. The number of segments can be increased and there is an option to rotate the selection that works as a soft selection. Right clicking or picking the Accept check mark ends the command.

Available in Face and Edge mode.

Creation Tools (continued)



Offset Loop



With Mirror, the selected face[s] (left image); offset with Grouping type set to EdgeGrouping (middle image); and set to MirrorCrossing (right image)

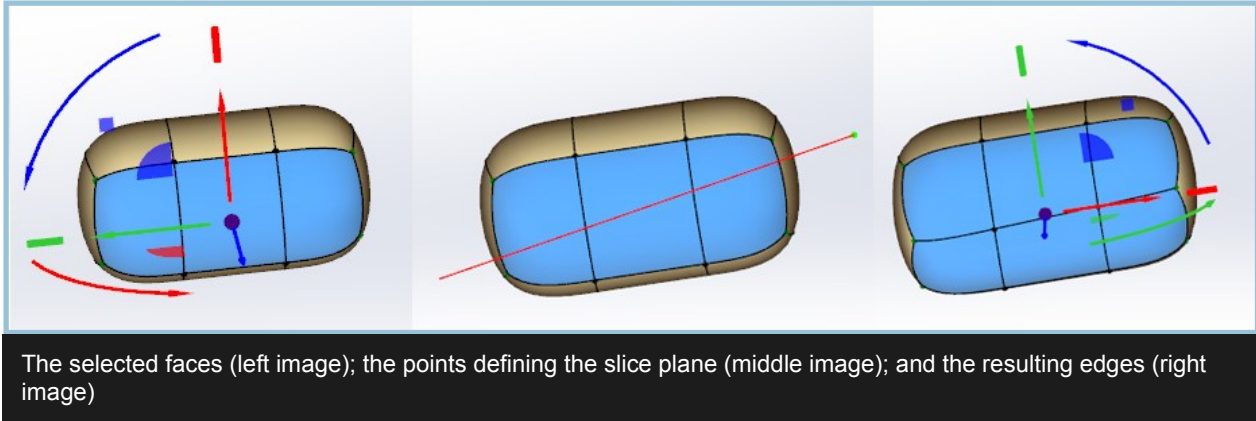
Creates an offset loop from a selected face or faces. If Grouping Type is set to NoGrouping in the Command Parameters window, a loop will be offset on each of the selected faces. Edges can have Offset Loop applied to them to create new faces on either side of the selected edge with additional faces on each end of the edge.

Gizmo: The inset size can be adjusted once the inset has been initialized.

Available from Face and Edge mode.

Creation Tools (continued)

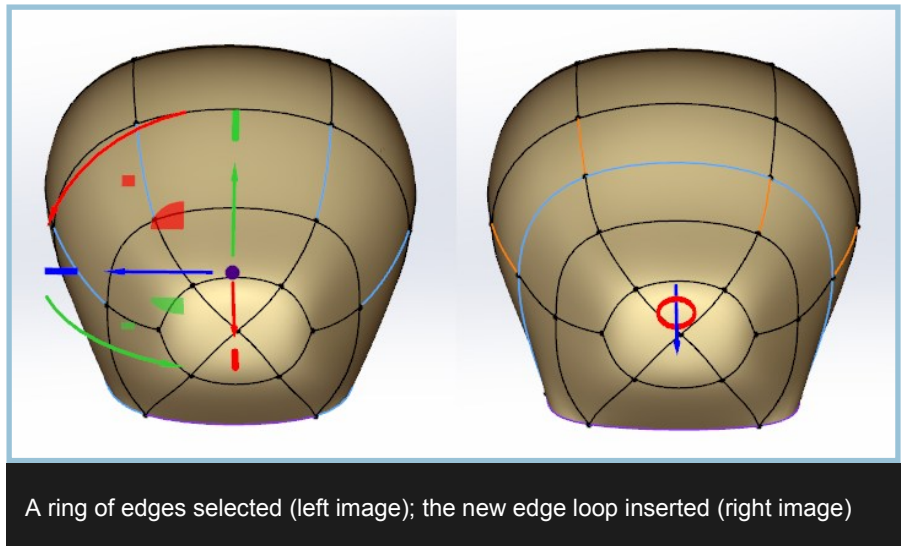
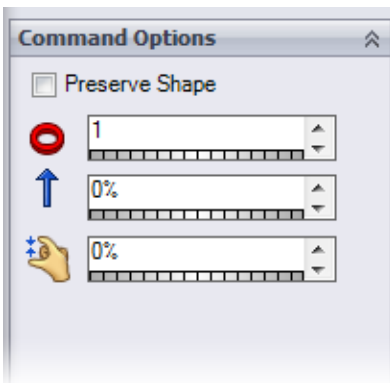
Slice



Slices through the mesh or selected faces creating new edges using a plane defined by two points in screen space, perpendicular to the current view.

Gizmo: None

Insert Loops



Insert Loops adds one or more edge loops to the selected edge ring. After initializing the tool, you can set the number of segments or loops, slide them to one side or the other, or pinch them closer or farther apart. Right clicking or picking the Accept check mark ends the command.

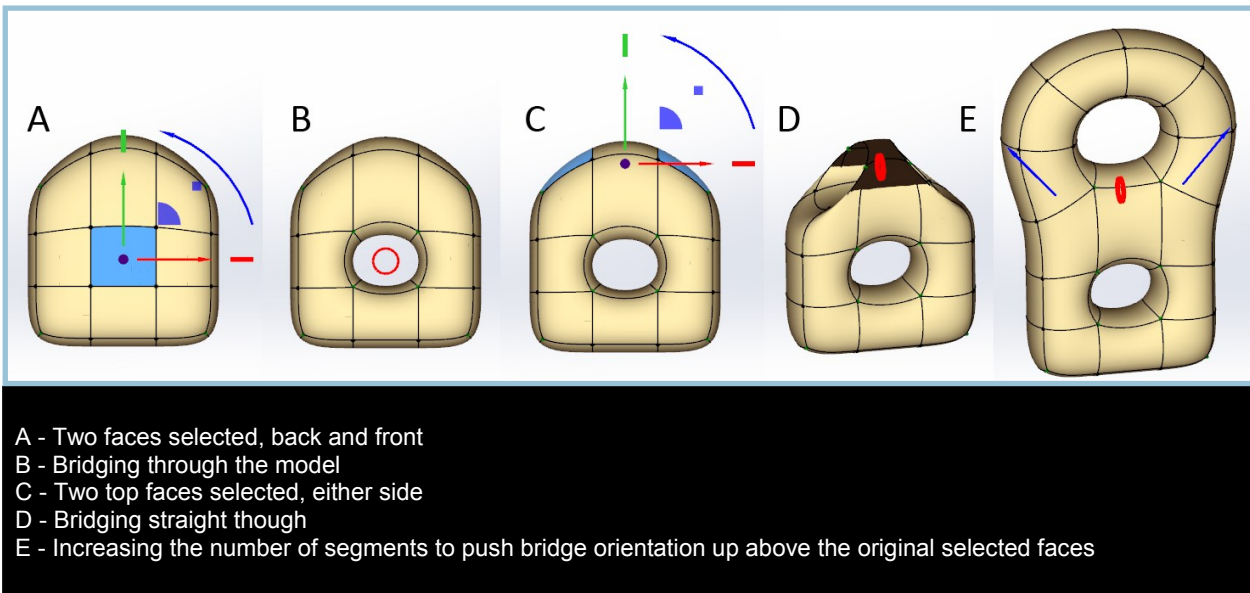
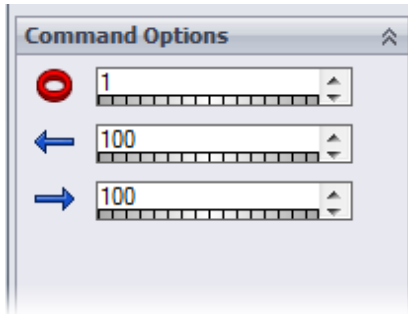
Requires at least two edges selected, but works best when selecting with Edge Ring.

Gizmo: Allows for more segments, pinching and sliding of the new loops

Available from Edge or Edge Loop mode.

Creation Tools (continued)

Bridge



Connects two faces or two groups of faces in face mode, or connects two open edges. After the initial Bridge, you can adjust the number of segments and adjust the tension from either end. Right clicking or picking the Accept check mark ends the command.

Gizmo: Allows for more segments, adjusting of tension from either end

Available from Face or Edge Mode.

Edit Topology



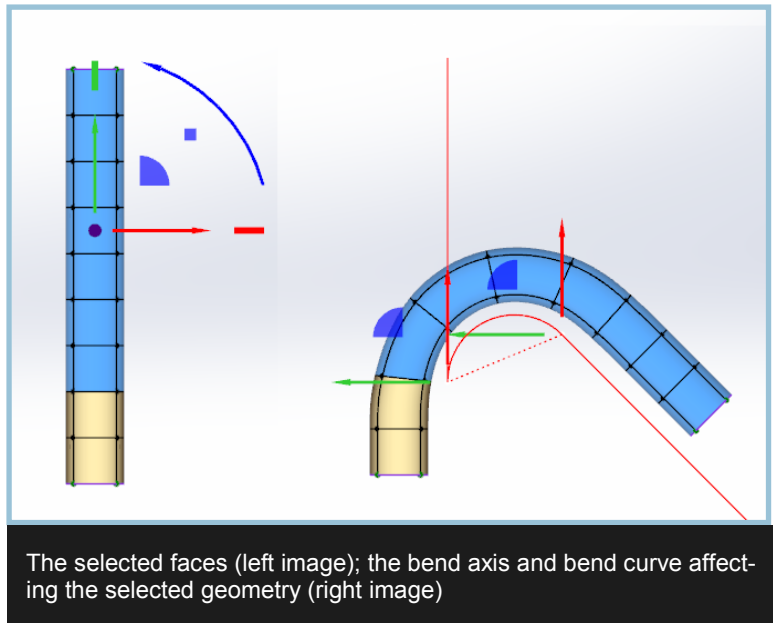
Bend

Bends the selected sub-objects using screen space as the defining Plane.

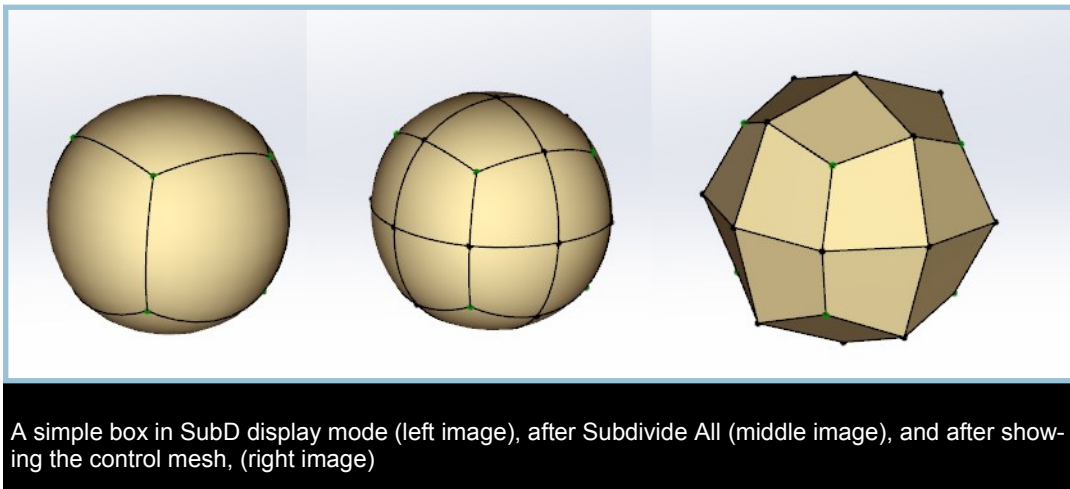
To use, select the sub-objects you wish to affect. Click the Bend tool icon. Now click in the viewport to define the start of the bend axis, then click again to define the end of the axis. As soon as the axis is defined, move the mouse to bend the selection. Click to finalize and accept the bend.

Gizmo: Bend axis and Bend Curve.

Available from Vertex, Edge and Face modes.



Subdivide All



Subdivides the entire object regardless of current sub-object mode.

Gizmo: None

Available from Vertex, Edge and Face modes.

Edit Topology (continued)

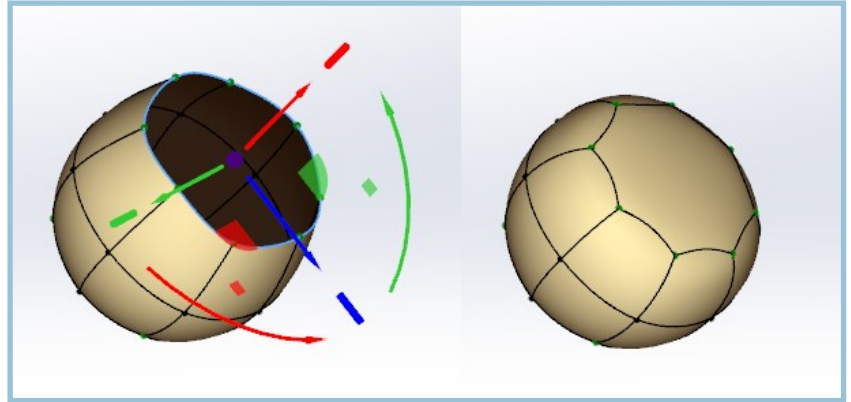


Fill Face

Creates a face to fill an opening. Only one of the open edges need be selected to fill the hole. The resulting multi-sided face may need further editing to produce quads.

Gizmo: None

Available from Edge or Edge Loop mode.



An object with open edges selected (left image); and the face filled (right image)

Edge Attributes

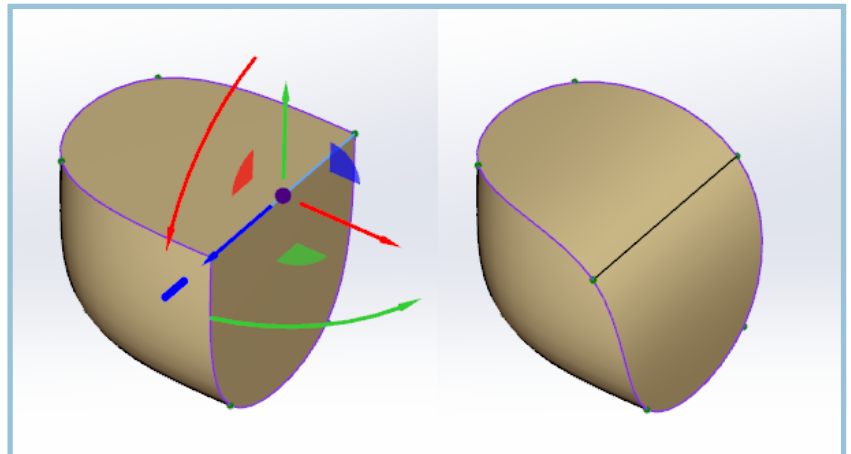


Smooth Edge

Sets the selected edges or vertices to a crease value of 0. Partial creasing can be set through the Property Manager. When faces are selected, only the boundary edges between the selected faces and unselected faces are affected. When faces are selected, only the boundary edges between the selected faces and unselected faces are affected.

Gizmo: None

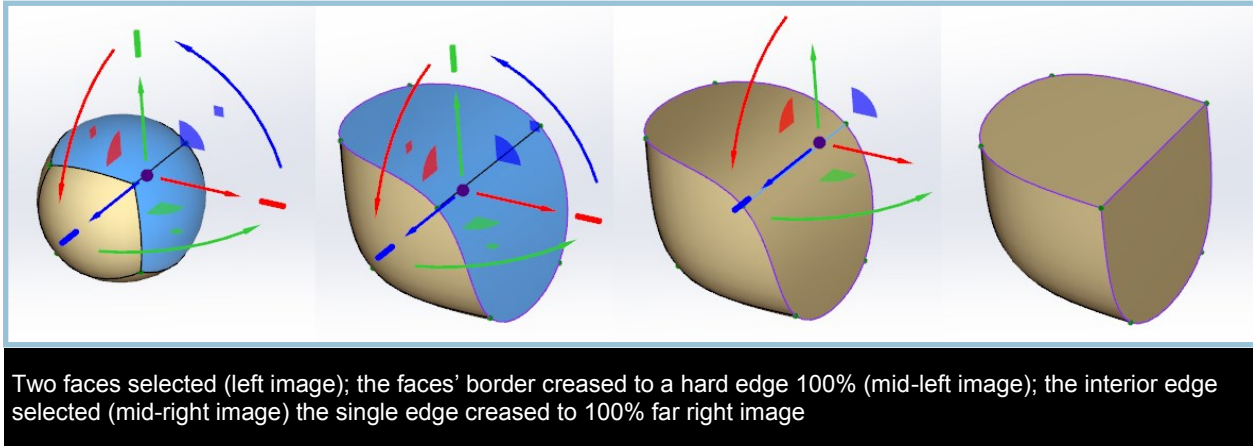
Available from Vertex, Edge or Face mode.



A hard edge selected, weight 100, (left image); the edge smoothed- a weight of 0 (right image)

Edge Attributes (continued)

Hard Edge



Sets the selected edges or vertices to a weight value of 100 for a fully hard edge or a sharp vertex. Use a hard edge before conversion to be able to use the standard SolidWorks's Fillet Feature. Partial weighting can be set through the Property Manager. When faces are selected, only the boundary edges between the selected faces and unselected faces are affected.

Gizmo: None

Available from Vertex, Edge or Face mode.

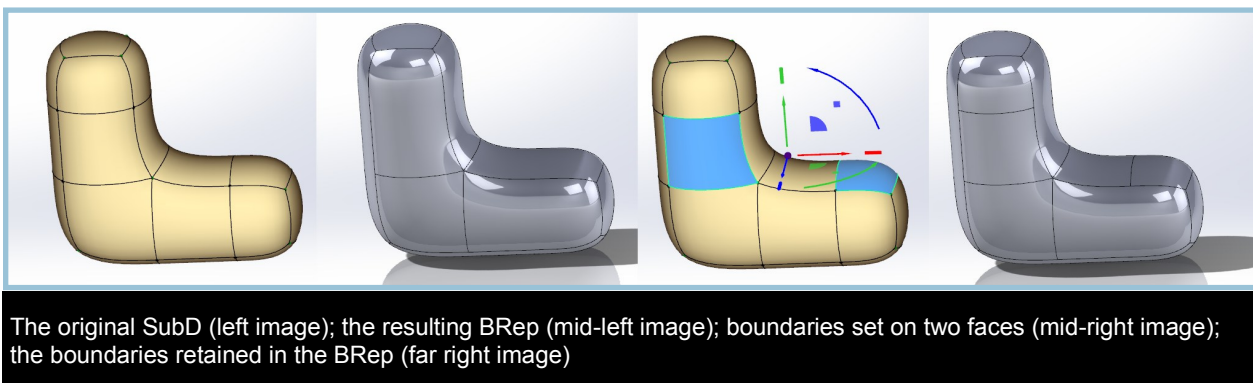
Face Grouping

Define Boundary

Defines an edge boundary that will be retained in the SolidWorks BRep. This can be helpful in retaining SolidWorks features during repeated editing of the SubD.

Gizmo: None

Available from Face or Face Ring modes.



Face Grouping (continued)



Clear Boundary

Clears the boundary assigned to the selected face or faces.

Gizmo: None

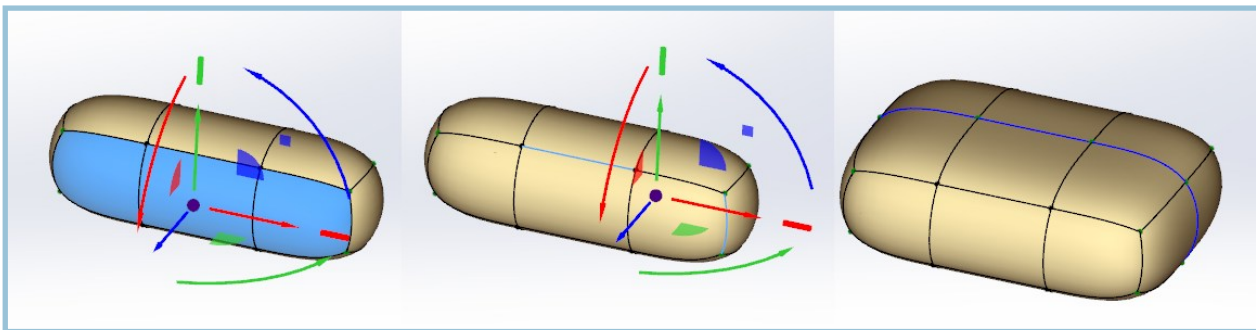
Available from All Modes.

Mirror Tools



Mirror

Creates a mirror image of the model using the average of the selected faces and the closest orthographic plane (x, y, or z) for its orientation.



Selecting faces (left image) or two edges (center image) to define the mirror plane, the object mirrored on the specified plane (right image)

Gizmo: None

Available from Edge and Face modes.

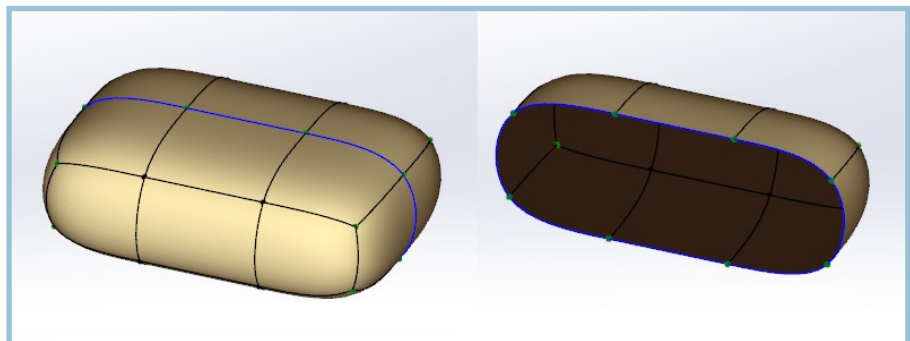


Toggle Mirror

Toggles the visibility of the mirrored side of the model on and off. Editing done while the mirrored side is hidden will be seen once the hidden side is toggled back to visible.

Gizmo: None

Available from all modes.

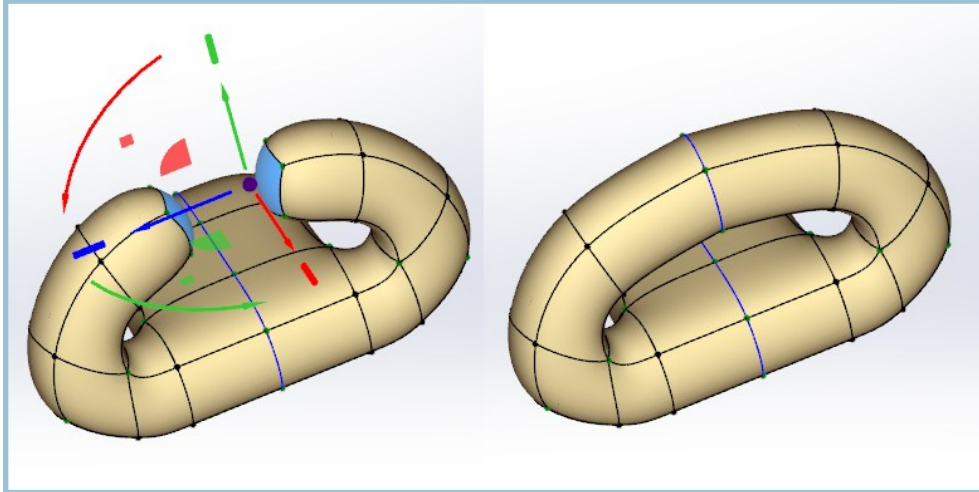


The mirrored object (left image); the mirror side visibility toggled off (right image)

Mirror Tools (continued)



Add To Mirror



The face[s] selected (left image); extended out to the mirror plane and added to it (right image)

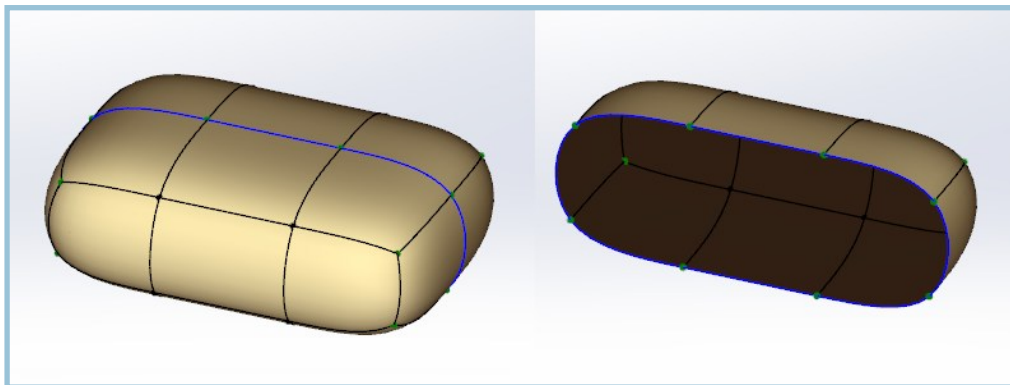
Adds more faces to the mirror plane.

Gizmo: None

Available from all modes.



Remove



The mirrored object (left image); the mirror side removed (right image)
Note the remaining hard, open edge after the operation

Removes the mirrored side when Mirror is active.

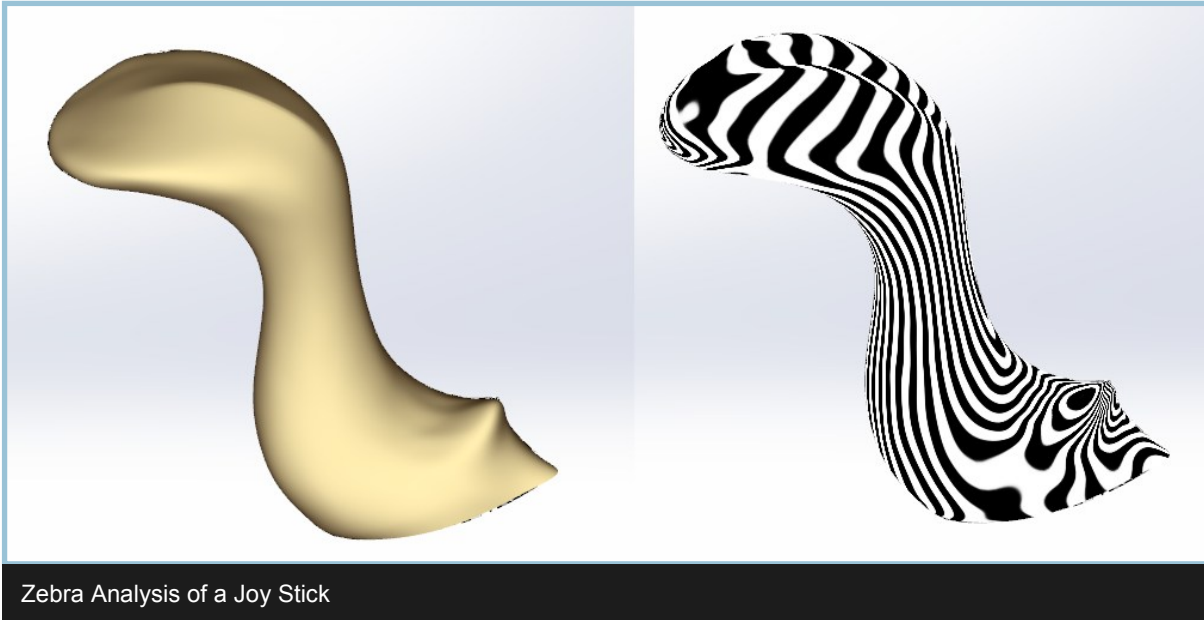
Gizmo: None

Available from all modes.

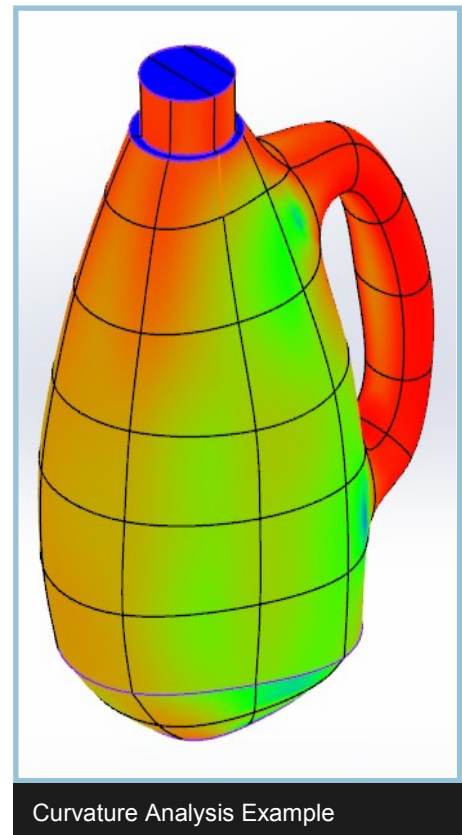
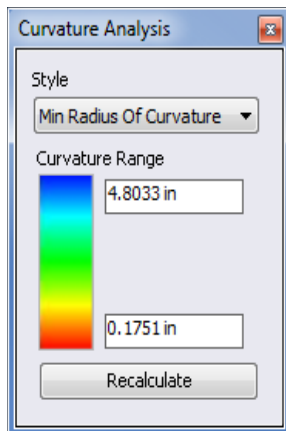
Analysis Display Tools



The zebra tool displays an analysis view that allows you to see changes in continuity and curvature. Additional options to control the zebra display settings are available in the Options Panel [shown here](#).



The curvature analysis tool displays curvature in a color coded manner so you can visualize areas of high and low curvature. This tool is highly interactive so you can perform modeling updates such as moving vertices and see the curvature update dynamically. You may change the curvature range values in the curvature dialog to detect different radius of curvature values or update them automatically using the Recalculate button..



Export Options



Save Control

Exports the control mesh only from the Power Surface model.

Formats: Autodesk .fbx, or Wavefront .obj

Available during editing only.



Save SubD

Exports the Power Surface model with the current SubD level.

Formats: Autodesk .fbx, or Wavefront .obj

Available during editing only.



Save Scene

Exports the Power Surface model and all of its attributes.

Format: nPower's Internal Power Model Format .pmodel

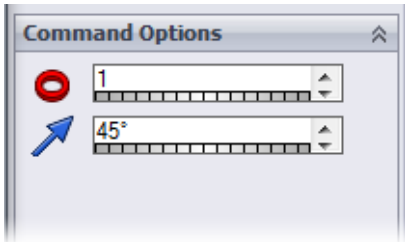
Available during editing only.

Specialized Tools

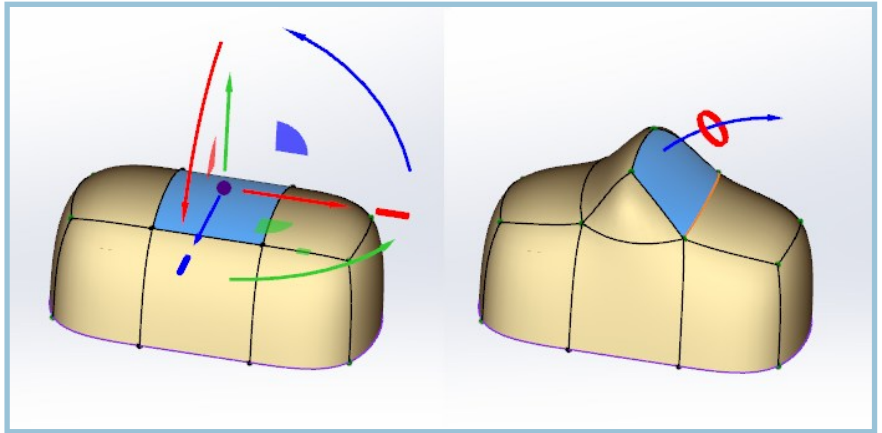
These tools can only be accessed through the Power Surfacing menu > Specialized Tools. Note that it is possible to create less than optimal geometry that may require extra editing to achieve the desired result.



Hinge



Extrudes a face or faces hinging from the specified edge. After initializing the tool, you can set the number of segments and affect the angle of the final face. You must select the hinge edge to initialize the tool. The hinge axis does not have to be on the selected face or faces. Right click or Escape ends the command.



The face selected (left image); the hinge edge selected (orange) and the face 'hinged' from that edge (right image)

Gizmo:

Available from Face mode.



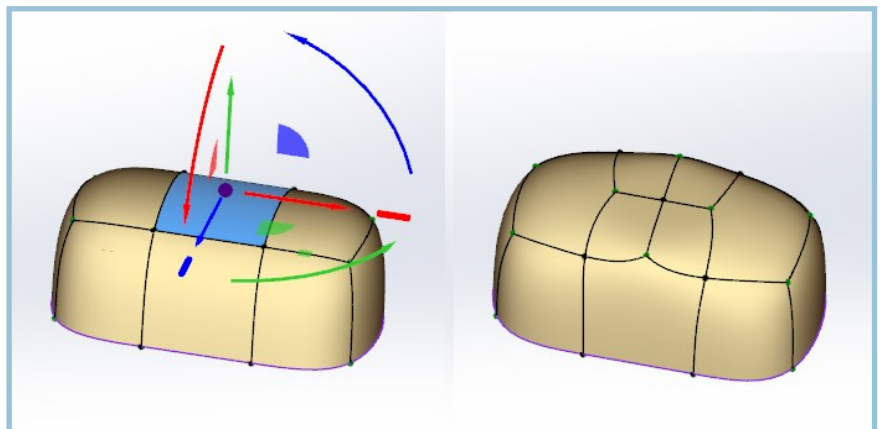
Subdivide Selected

The face selected, left, the face sub-divided right - note the five-sided faces created as a result

Subdivides the selected face or faces.

Gizmo: None

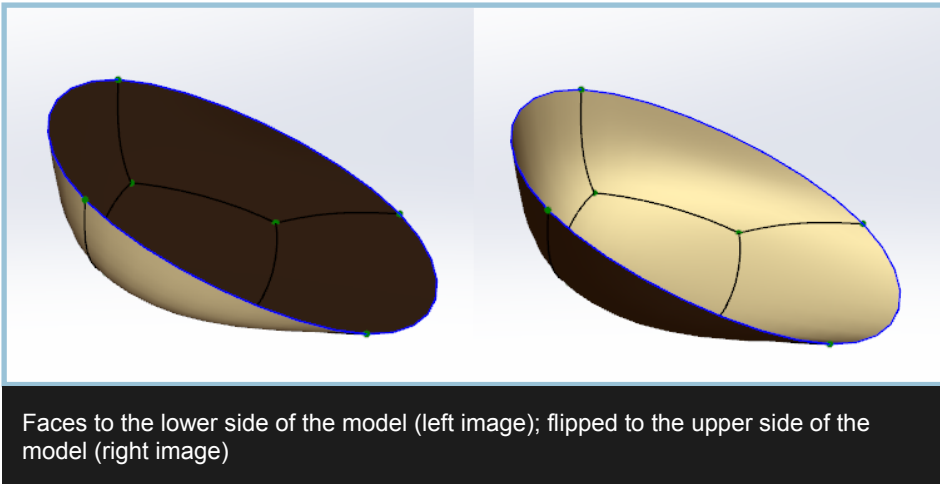
Available from Face mode.



The face selected (left image); the face sub-divided right- note the five-sided faces created as a result (right image)

Specialized Tools (continued)

Flip Faces

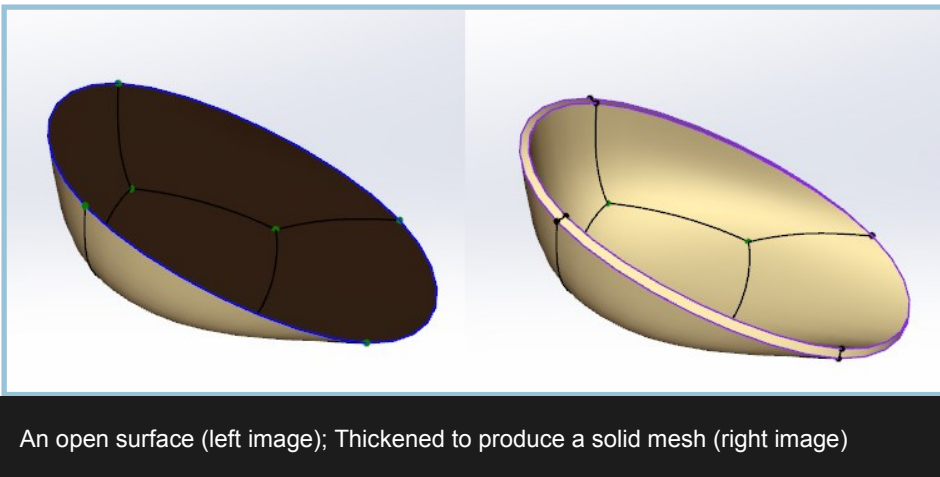


Flips the selected face or faces' normals.

Gizmo: None

Available from Face mode.

Thicken



Extrudes open edges and caps the resulting hole with a matching surface. Note the creased edges.

Gizmo: None

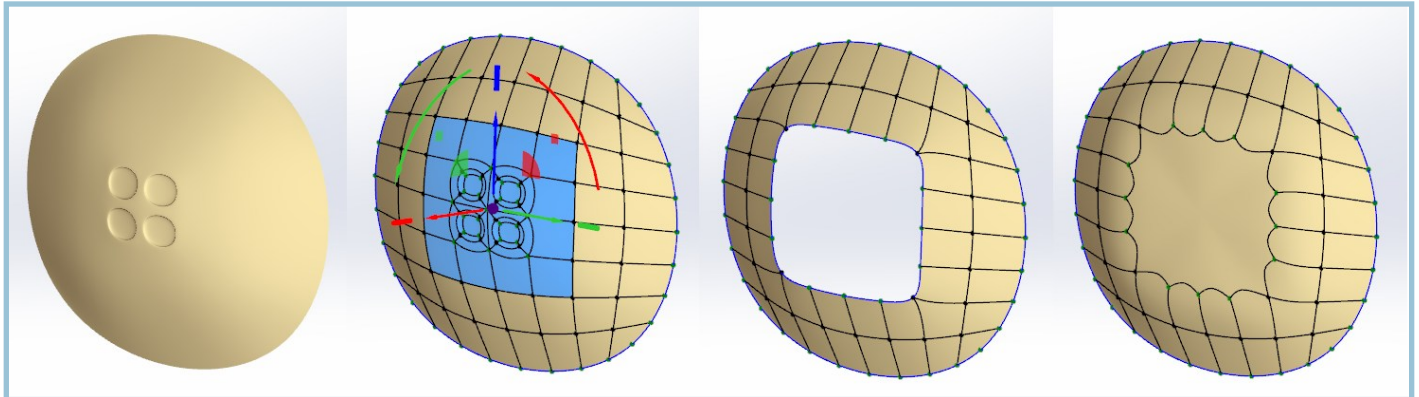
Available from Face mode.



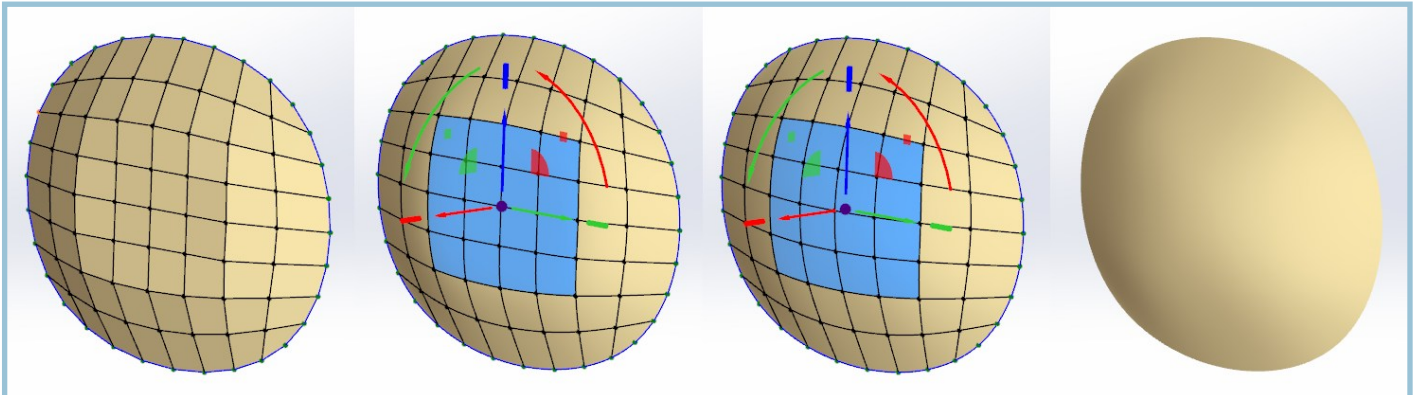
Curve Selected

Curve Selected uses the curvature of the selected faces' boundary and attempts to create tangency. This workflow is particularly useful for removing detail from existing surfaces.

The following images outline a typical workflow:



Existing area of high detail (left image)
The detail faces to remove selected (mid-left image)
The faces deleted (mid-right image)
The hole after using the Fill Face command (right image)

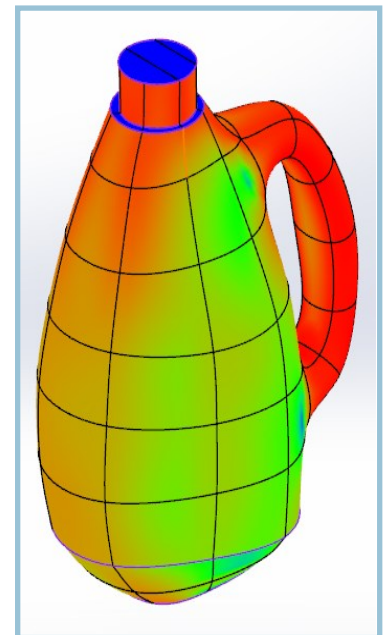
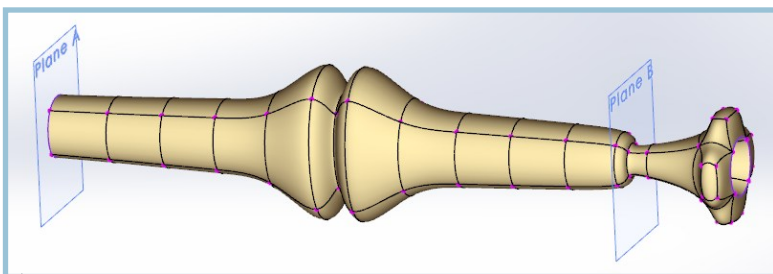
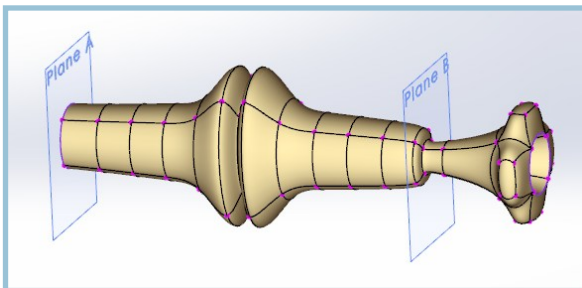
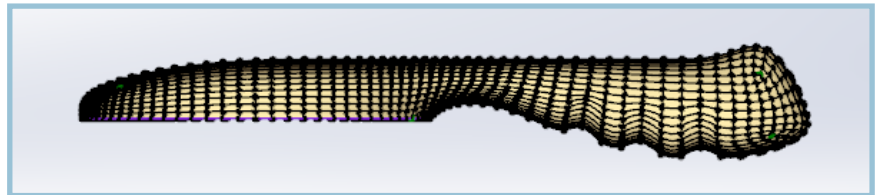
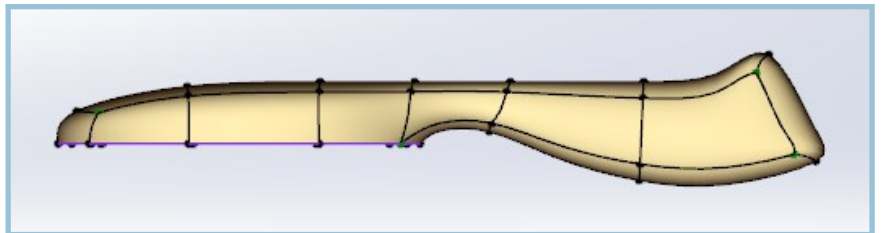
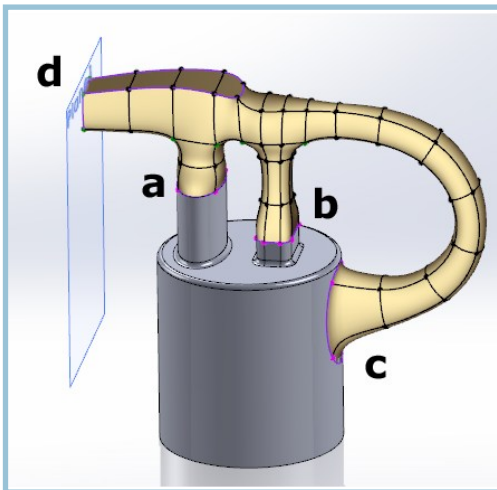


Re-topologized with Insert Edges (left image)
The new faces selected (mid-left image)
The new faces after using Curve Selected (mid-right image)
The surface with vertices and edges turned off (right image)

Power Surfacing 2.0 New Features

Power Surfacing 2.0 has added a significant set of new features. The major changes include the following:

- Parametric Constraints and Relationships. You may now connect Power Surfacing Sub-D objects to existing Solidworks curves and surfaces. By default the connections will be tangent to existing surfaces. When the history changes the connections between the Sub-D and Solidworks objects will be maintained. Parametric Constraint documentation starts [here](#).
- You may also control parametric updating free standing Sub-D vertices utilizing the spatial constraint tools. This essentially gives you the ability to drive the Sub-D shape parametrically. Spatial Constraint documentation starts [here](#).
- Level of Detail gives you the ability to apply small detailed shape changes to an object without losing the high level shape control. Level of Detail documentation starts [here](#).
- Curvature analysis gives you the ability to display curvature of the Sub-D object dynamically as you make modifications. Information about the curvature analysis tool can be found [here](#).



Parametric Constraints and Relationships

With Power Surfacing 2.0 comes our most requested feature; the means to constrain your SubD meshes to existing solids or surfaces. The SubDs can retain a relationship to analytically defined shapes such as circular and ellipse-based cylinders (Figure 1a) or complex multi-surface elements (Figure 1b), maintain tangential connections to curved surfaces (Figure 1c), and use both orthogonal and user defined construction planes as constraints, (Figure 1d).

Depending on whether or not the SubD's surface is retained and if the constrained edge is set to hard or fully weighted, the SubD's surface can also be tangentially blended to the constraining surface or edge.

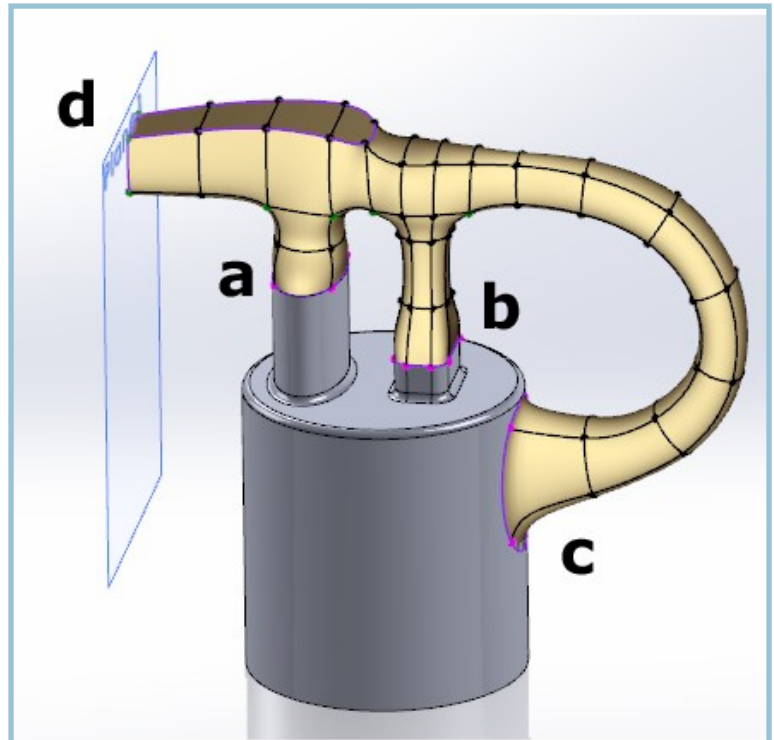


Figure 1 – Constraints and relationships; constrained to a single surface's edge, a, multiple surfaces' edges, b, tangentially to a curved surface, c, and relative to any construction plane, d

Selecting Constraints

The first step in setting up a relationship with a SubD is to decide on the surface[s] or construction plane[s] that the constraint will be derived from. Because you will make your selections in SubD Edit mode, you will have to make sure the objects will be visible.

1. From the Power Surfacing menu, Options, under General, activate Show SolidWorks' bodies while editing a Sub-D, (Figure 2).

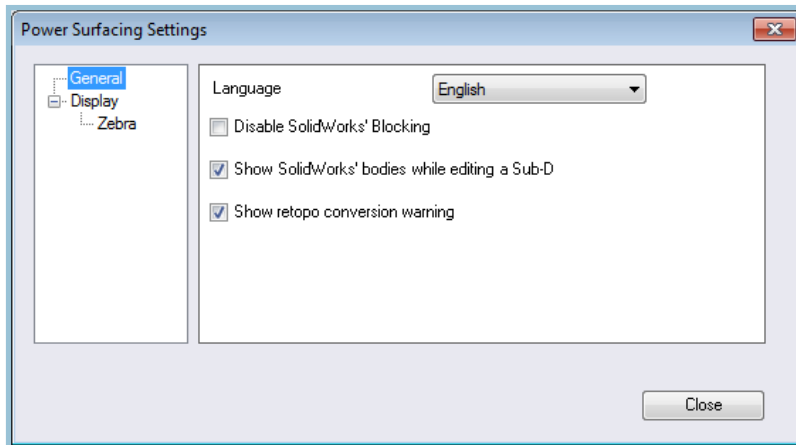


Figure 2 - Setting SolidWorks visibility in the Power Surfacing Options dialog

Tip: By checking Disable SolidWorks' Blocking, you will be able to go back and forth between the SolidWorks feature tree and the Power Surfacing edit mode, allowing you change visibility on SolidWorks surfaces and solids at will.

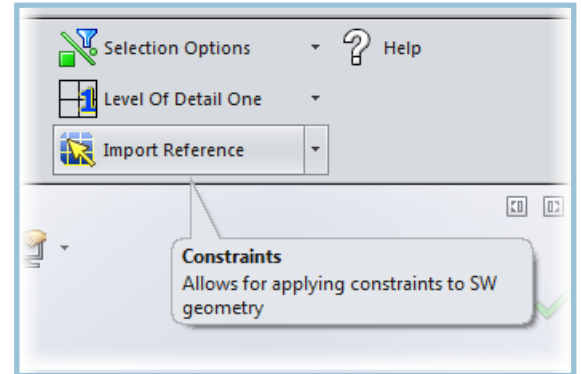


Figure 3 – Selecting Import Reference

2. Hide any SolidWorks bodies that are not required for constraints or reference.
3. Create the base SubD object. You will now have entered SubD edit mode
4. From the Power Surfacing tab, select Import Reference (Figure 3).

The Command Panel now has a Reference Entities box. You may now select surfaces and planes as needed. Note that re-picking a surface or plane will remove the selection. A yellow grid representation of the referenced surface will now appear in the viewport over the selected surface or plane, (Figure 4).

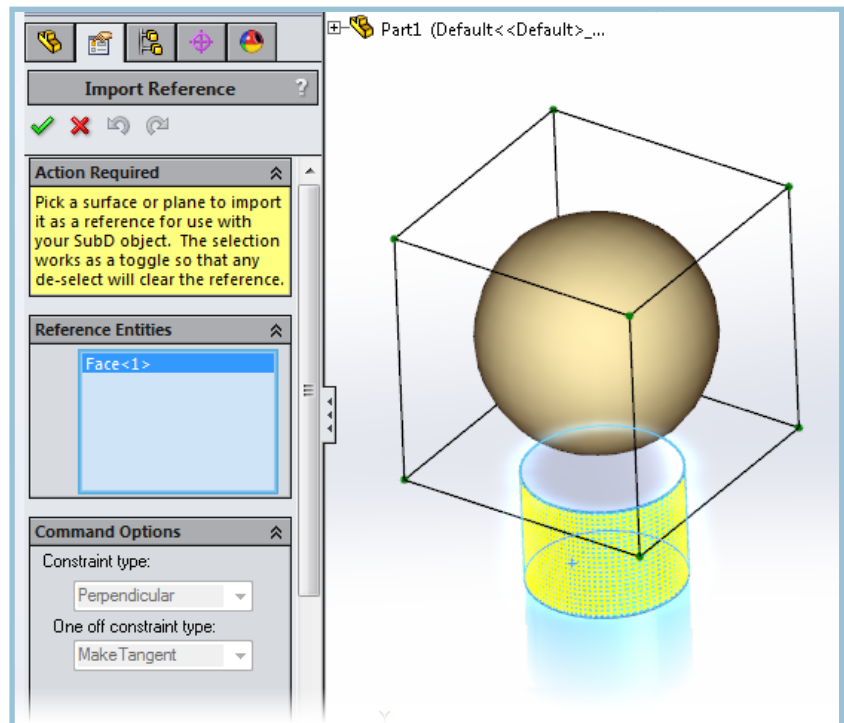


Figure 4 – Adding a surface to use as a constraint or Reference

Selecting Constraints (continued)

5. Add the surfaces you wish to reference as constraints.

In Figure 4, the bottom of the SubD will be constrained to the *upper edge* of the cylinder so the side surface is selected as the reference rather than the top surface. This will provide tangency with the sides of the cylinder.

Because planes consist of a single surface, you can select them directly from the expanded list tree in the viewport whether or not they are hidden, (Figure 5).

6. When you are finished selecting the reference surfaces, you must click the green check mark to end the Import Reference mode.

You can add to or remove from the reference list at any time by selecting Import Reference again. Note that you now have several new options, (Figure 6)

Update Constraint

This command updates the SubD's constraints after the reference entity has been altered or transformed. Note that constraints are not handled automatically after changes in the reference object.

While there is an update constraint option, Auto Update All Constraints, in the Power Surfacing, Constraints sub-menu, the recommended procedure is to update from within the SubD edit mode. The reason is that drastic changes in the Reference entities could result in solutions that require tweaking of the SubD to repair the constraint.

Clear Constraint Data

This command removes all of the constraint references. Be aware that once the Reference constraints have been removed, the SubD may return to its normal configuration.

Toggle Constraint Visibility

This option toggles the visibility of all Reference constraints in current edit session. This can be extremely useful when using several planar constraints. To make the SubD modeling process even easier, you can also go back and Hide the reference entities as well as the imported constraint surfaces generated from them.

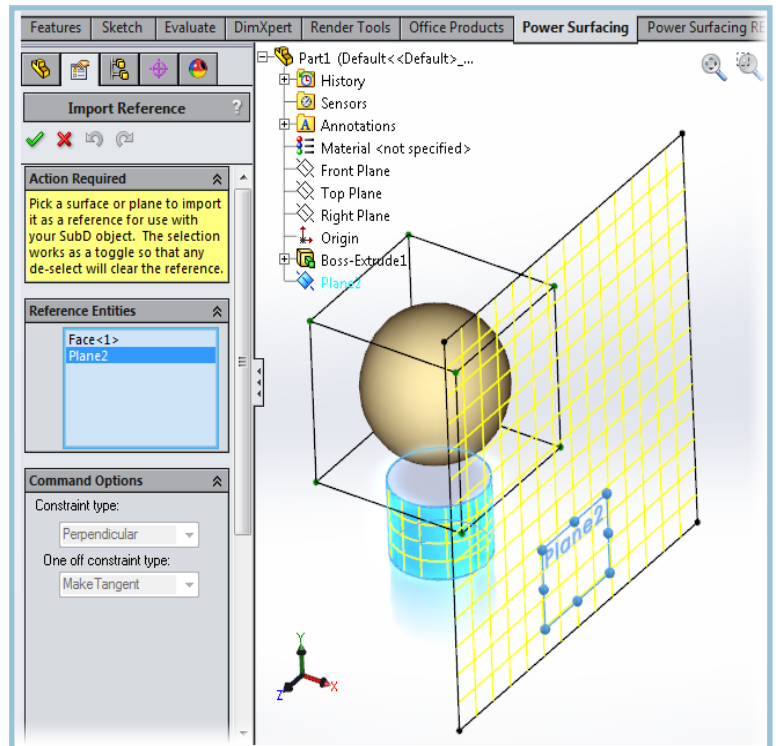


Figure 5— Adding a plane as a Reference from the expanded list tree

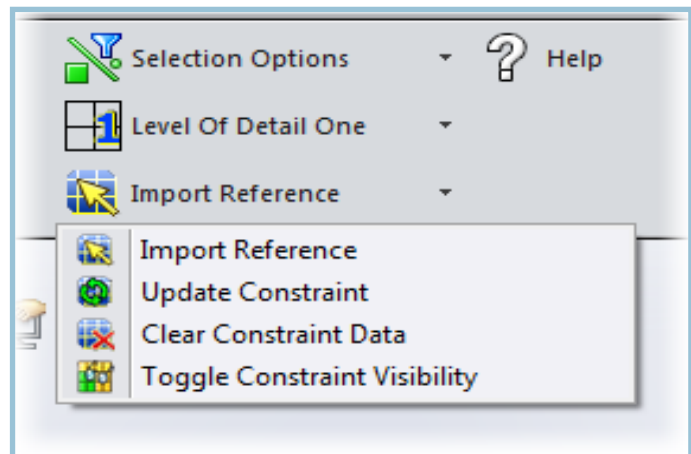


Figure 6— New Reference options

the

Constraining the SubD to the Imported Reference

Once the Reference surfaces or planes have been selected and the constraint grid generated, you will have to decide how and where the SubD will be constrained. Upon adding the constraint attribute to edges, vertices or faces, the specified sub-objects are constrained to the *nearest* reference grid. Because you cannot select which Reference surface a particular part of your SubD should be constrained to, it is important to move the desired parts close enough to the target reference surface to avoid ambiguity. It is also advisable to make adjustments to the SubD while in SubD + Cage or Control Mesh display modes as the connected edges or vertices will use their Control Mesh locations to match to the Reference grids, (Figure 7).

Constraint Types

Once the SubD has been moved into position and you select one or more of the SubD's sub-objects, you will be able to see the new constraint options available to you in the same constraints dropdown, (Figure 8).

These options will be available regardless of what type of sub-object[s] you have selected on the SubD. The 'Constrain to' options refer to the sub-objects on the reference or constraint grids. They are *not* filtered to prevent you from making less than useful choices as there may be several types of constraints possible with multiple Reference constraint grids.

Example: In this example, the bottom face of the SubD has been deleted, (Figure 9, center/left). You can select the open *edges* on the SubD and use Constrain to Edge to constrain them to the constraint grid's edge or edges, (Figure 9, far left). You can constrain the same SubD edge selection to a constraint grid's face for a totally different result, (Figure 9, center/right). The type of constraint is stored on the SubD's individual sub-objects' (vertex, edge, face) attribute parameters.

Note that constraining edges to vertices where only one or two vertices exist will result in 'zero length edge' errors and you will be prompted to fix the problem or undo, (Figure 9, far right).

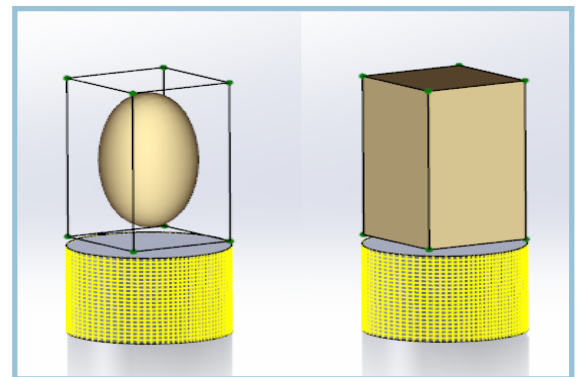


Figure 7 – Using SubD + Cage or Control Mesh display modes to position the SubD to the Reference grid

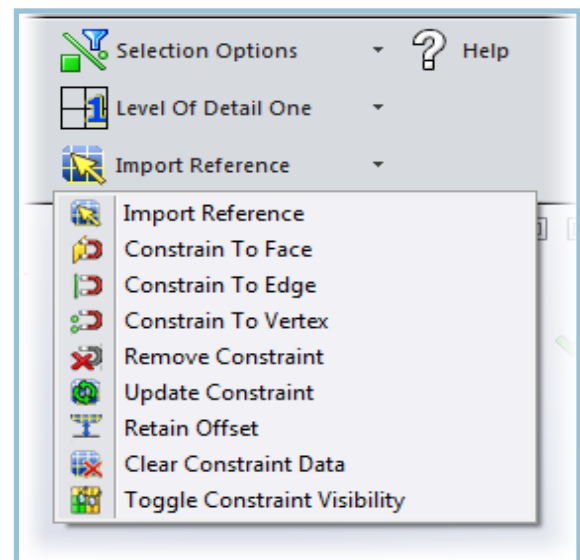


Figure 8 – The new Constrain To and Remove Constraint options

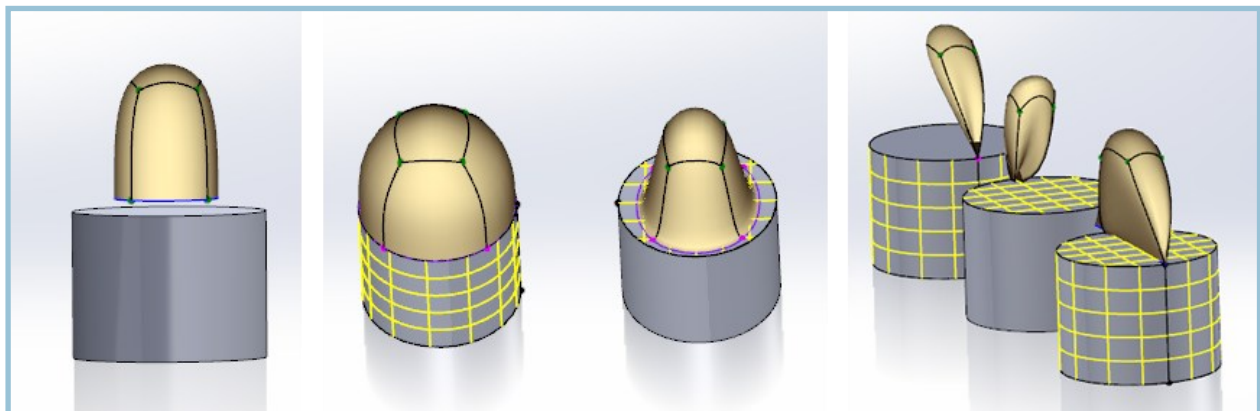


Figure 9 – The SubD, where the bottom face has been removed leaving the four edges that will be constrained, far left, the selected edges constrained using Constrain to Edge, center/left, Constrain to Face, center/right, and constrain to Vertex, far right

Constraint Strategies and Tangency

You will also have to decide on what type of connection to make. If you plan on knitting the surfaces of your SubD with the referenced surface, you will want to remove the face, (Figure 10, left). When the SubD face is not removed and the connecting face set to fully weighted or hard edge, there is no tangency with the Reference grid (Figure 10, center). Neglecting to remove the face *or* set the edges to fully weighted produces an undesirable result, (Figure 10, right). In this example, the bottom four edges of the SubD have been “Constrain[ed] to Face” where the closest part of the Reference grid’s face is its top edge.

Tip: If you want the SubD to be a separate, solid body entity *with* tangency, you should remove the face on the SubD and replace it *after* conversion using regular SolidWorks functionality.

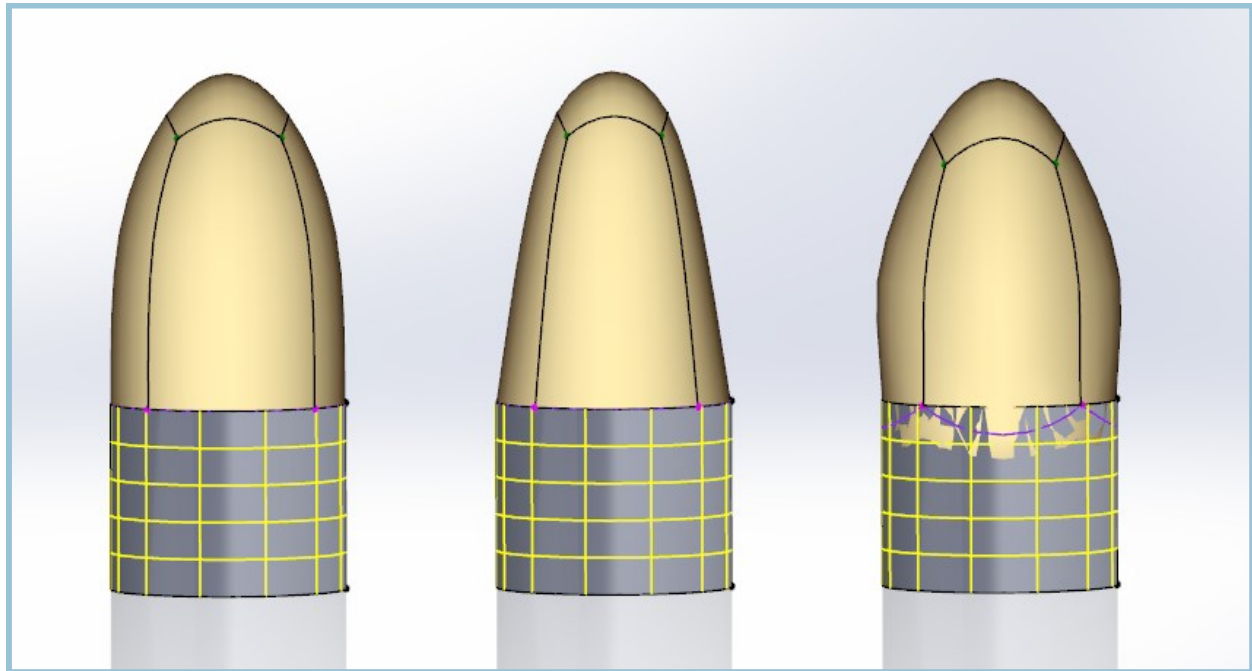


Figure 10 – Bottom face removed, left, bottom face set to hard edge (fully weighted), center, and bottom edge with no treatment, right

Constrain To Face

Constrains the SubD's selected vertex, edge or face selection to the closest Reference grid face or surface. If the face is roughly perpendicular to the selected sub-objects, the SubD's sub-objects will probably also constrain to the face's edge, as in the previous example. Figure 11, shows the reference constraint face roughly parallel with the selection, (the top face of the cylinder has been used as the reference constraint).

Note how the first example's faces are now tangent to the new orientation of the Reference grid constraint.

As a quick test, pulling a vertex away from the edge, will show that the vertices are not constrained to the top edge of the cylinder.

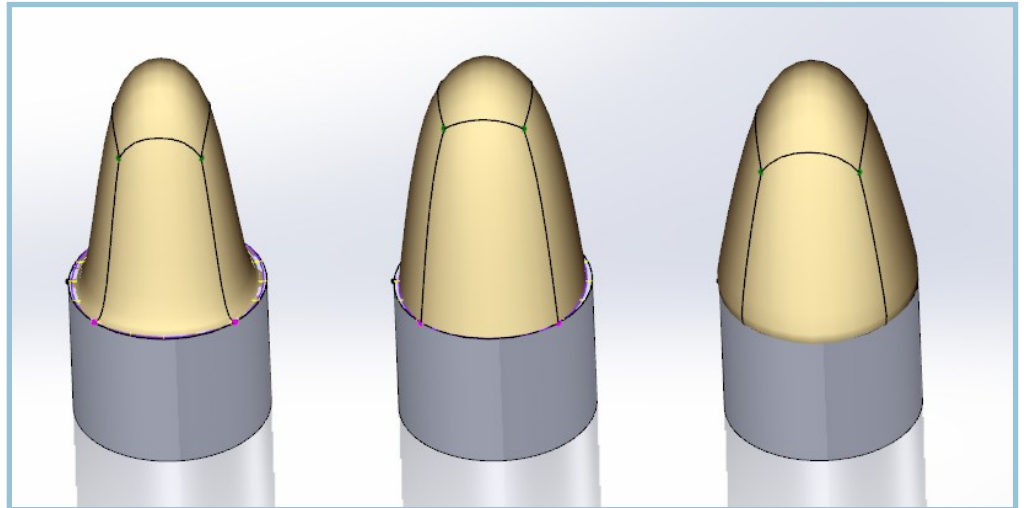


Figure 11 – Constraining to the Cylinders' top surface; Bottom face removed, left, bottom face set to hard edge (fully weighted), center, and bottom edge with no treatment, right

Tip: You can test constraints by trying to move selected sub-objects. Adjacent vertices will be correctly repositioned as soon as the transform is completed (mouse button released) as shown in Figure 12. Viewing the operation in Control Mesh display would show you that the adjacent vertex never moved.

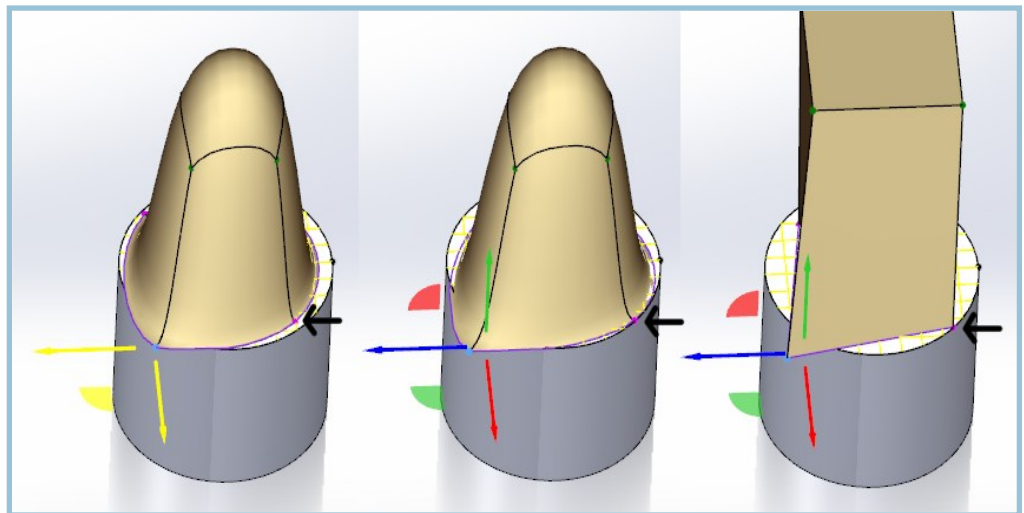


Figure 12 – An adjacent vertex 'affected' when adjusting its neighbor, left, its position recalculated after the transform is completed, center, the control mesh showing that the vertex never actually moved, right

Constrain To Face (continued)

A more typical use of Constrain to Face is add detail onto a face without involving its edges, (Figure 13). With this use case, you will almost always want to remove the bottom face of the SubD.

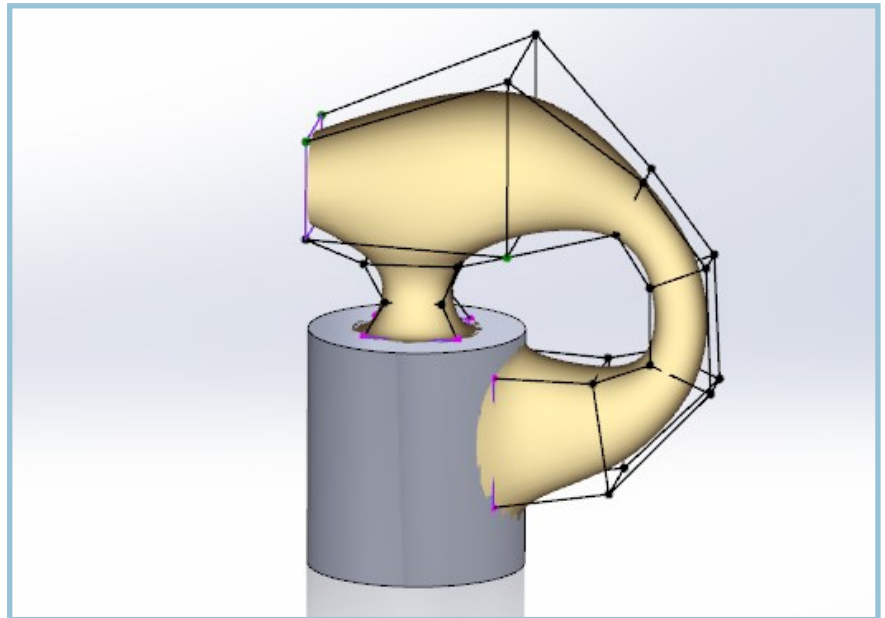


Figure 13 – Constraining open edges to a flat face and a curved face

Constrain To Edge

Constrain to Edge constrains the selected sub-objects to the closest *edge* of the closest Reference grid. With a single closed surface (e.g. the top edge of a cylinder) providing the edge, vertex alignment is not necessary. To constrain to multiple edges, there must be at least one SubD edge to correspond to the reference grid edge. See Constraint Examples for more details.

In this example, Figure 14, pulled vertices will stay on the edge.

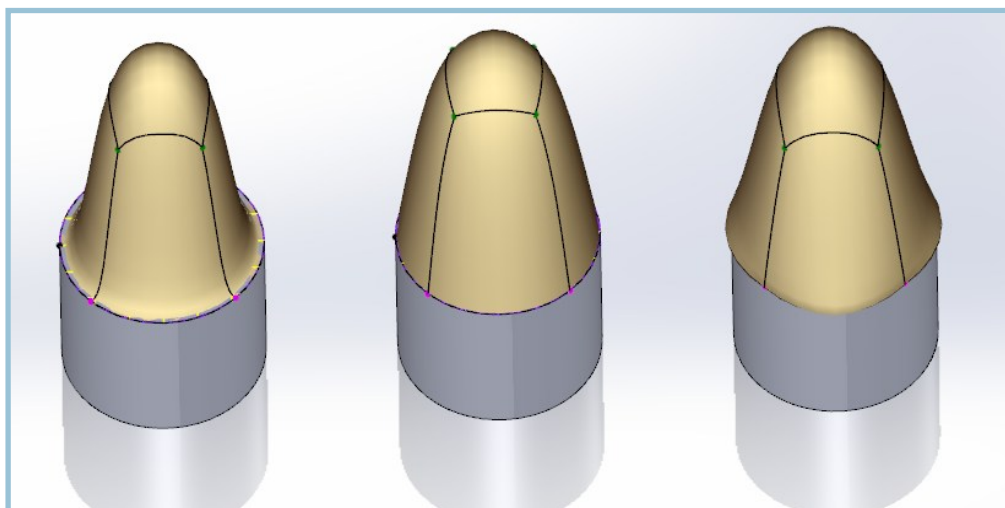
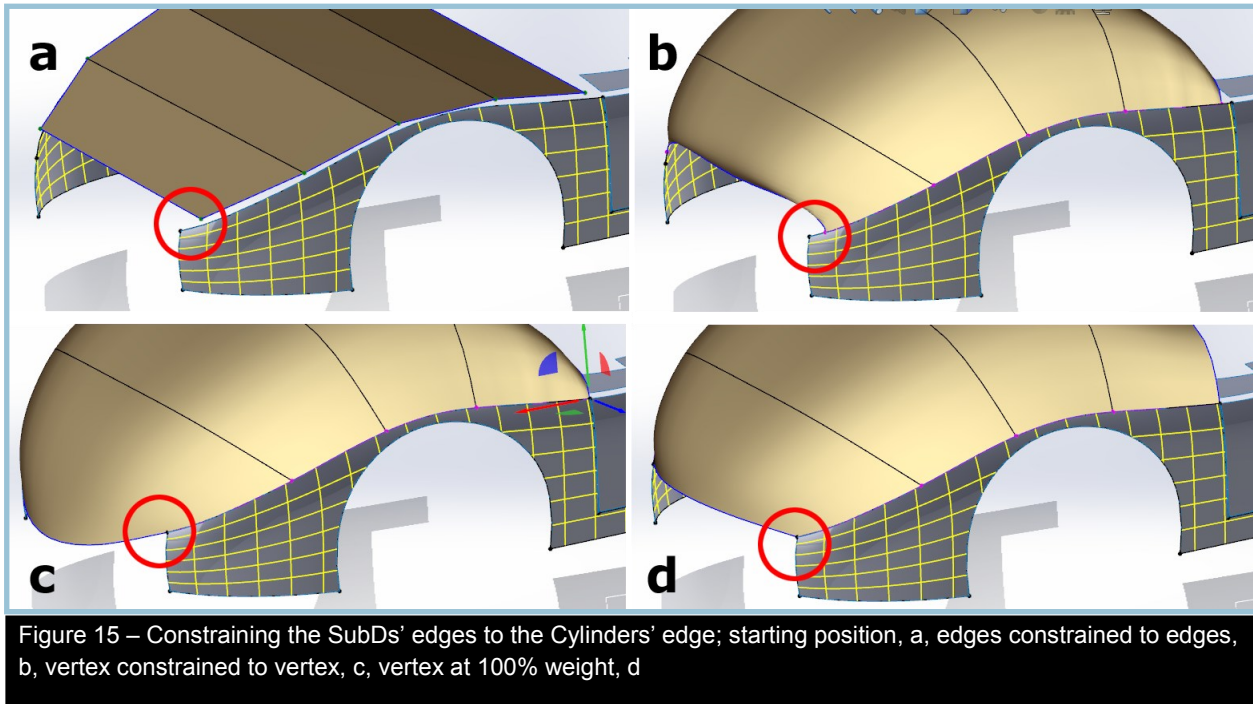


Figure 14 – Constraining the SubDs' edges to the Cylinders' top face edge where the left example has had its bottom face removed, the center example has the bottom face with edges fully weighted (hard edge), and the far right example has a bottom face with no weighting

Constrain To Vertex

Constrain to Vertex is used to align and constrain specific vertices from the SubD to the nearest vertices on the Reference grid. They are generally used in conjunction with Constrain to Edge where you are constraining surface models. Best practice is to align one vertex at a time to prevent multiple vertices constraining to the same position and then constrain the edges afterwards.

In this example, the vertices are positioned near the edges, (Figure 15a). The edges are constrained, leaving all vertices free to slide up and down the edges, (Figure 15b). In Figure 15c, the corner vertices have been constrained to the corresponding Reference grid's vertices. In Figure 15d, the SubD's constrained vertices have been set to 'hard' or fully weighted, 100%.



Remove Constraint

Remove Constraint will remove the constraint attribute from the selected sub-object[s] of the SubD. Note that removing the constraint from the selected edges will remove it from the edge's vertices and but not vice-versa. Removing constraints from faces will remove the constraints from faces, edges and vertices.

Constraint Examples

In this section you can see examples of various constraint types and the strategies used to create them.

Constraining to Analytics

The simplest relationship is that of the SubD with the top edge of an analytic surface or solid such as a circle or ellipse, (Figure 16). With this type of constraint, where a single surface is involved, there is no need to worry about the location of the SubD's vertices or edges.

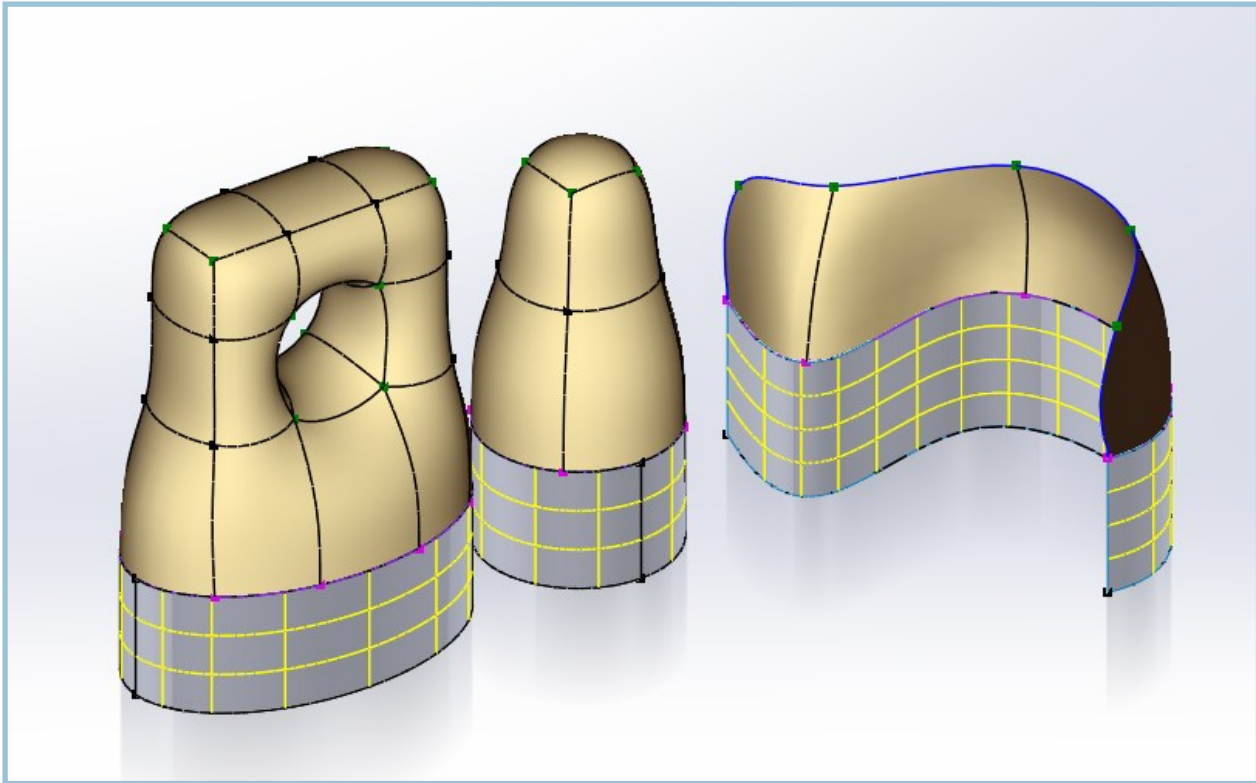


Figure 16 –SubDs constrained to analytically-based objects

Constraining to Multiple Surface Edges

When the SubD is constrained to more complicated shapes, you will have to match and then constrain the SubD vertex locations to the surface vertex locations before constraining the edges. Figure 17 shows a series of attempts to match a SubD with a multi-surfaced constraint entity. In 17b-c, there are not enough vertices to match the constraint grid surfaces. In 17d, the edge vertices have been increased to match and Constrain to Edge re-applied, but even if the vertices have automatically been constrained to their constraint grid counterparts, the edge positioning may require correcting. When updating edges on the SubD, the best practice is to remove the edge constraints, constrain the vertices and then re-apply the edge constraints.

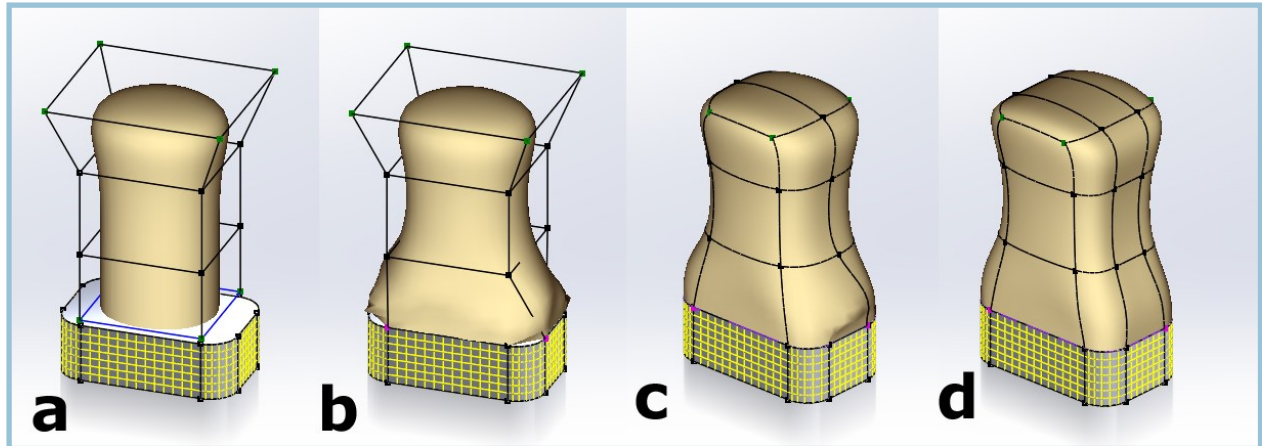


Figure 17 – Constraining SubDs to multiple reference constraint grids; the 4 sided SubD and the 8 constraint grids, a, constraining edges, b, constraining vertices first, then edges, c, increasing the SubD edges and re-constraining

Figure 18 shows the proper procedure for multiple surface constraints. The SubD vertices are first constrained to the constraint grid's vertices, left, and then the edges are constrained to the constraint grid's edges, completing the process correctly, right.

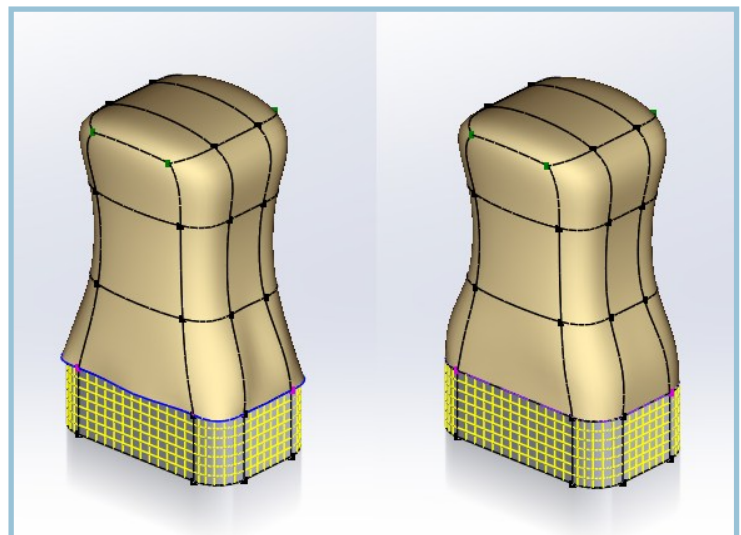


Figure 18 –Using the proper procedure for constraining SubDs to multiple reference grids; constraining the vertices first, left, and then the edges afterwards, right

Constraining to Non-continuous Surfaces

When constraining to non-continuous surfaces, you will generally require vertex constraints and possibly weighting to control the position of the SubD on the surface's end edges. With multi-surface scenarios, you will also want to match and constrain interior vertices as well before constraining edges, (Figure 19). The vertices from extra SubD edges are not constrained.

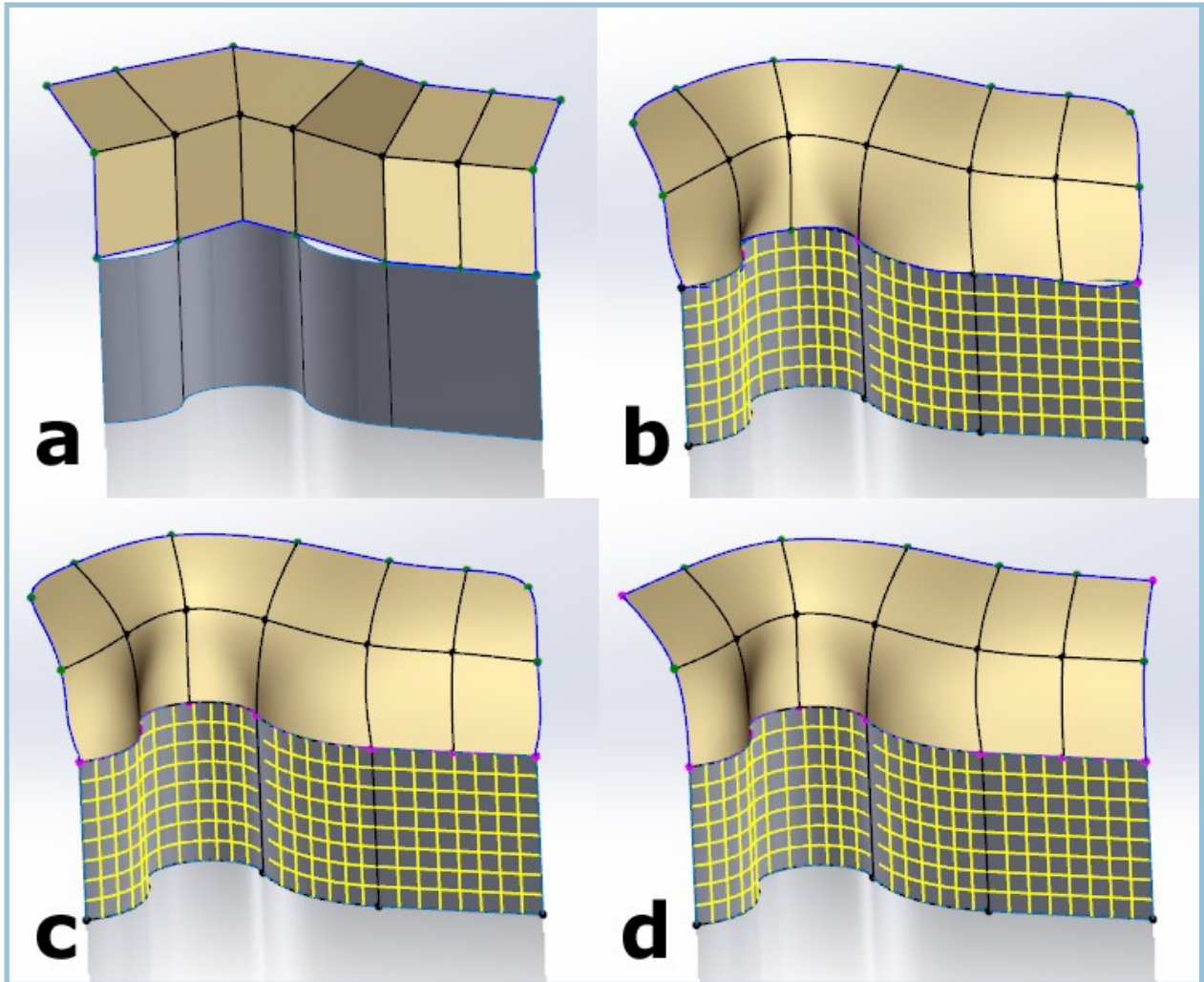


Figure 19 –SubDs constrained to non-continuous edges: positioned, a, matching vertices constrained, b, edges

Constraining to Irregular Shapes

When the SubD must constrain to a shape with irregular curvature, you may have to increase the SubD's vertices to better fit the shape. Another alternative is to It is recommended that you have one vertex for each 90 degree change in curvature. In Figure 20, the subD is constrained to a kidney shape where the back side has less curvature than the front side. With a standard 4 sided SubD the front indent is not handled well (figure 20, left) and will not be able to knit to the base object. Inserting a new edge gives a better fit, but disrupts the top of the SubD, (Figure 20, center). In Figure 20, right, the front edges have been moved closer together to accommodate the higher curvature and the back vertices have been moved farther apart.

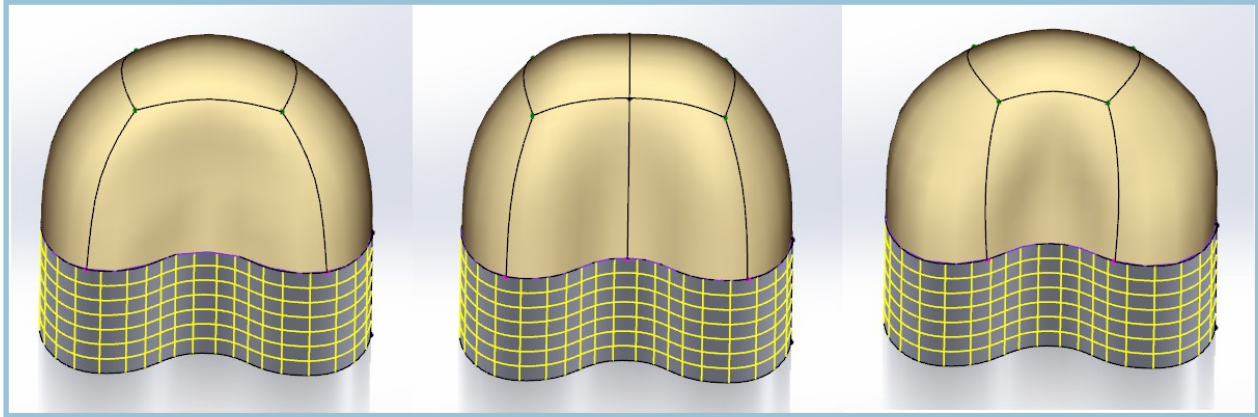


Figure 20 – A bad configuration, left, inserting an extra edge Rearranging vertices to better fit the surface grid shape

Updating Constraint Entities

As you have seen, constraining SubD elements to existing SolidWorks surfaces or solids is extremely useful. The true power of the Power Surfacing SubD constraint system, however, is the ability to make changes in the constraining entities and have the SubD[s] updated to match.

Auto Update All Constraints

In all but a few extreme cases, you can alter the constraining surface or solid and the SubD can be updated to match with the simple press of a button.

1. Make minor changes to the constraining entities, (Figure 21).
2. From the Power Surfacing menu (shown to right), select Auto Update All Constraints

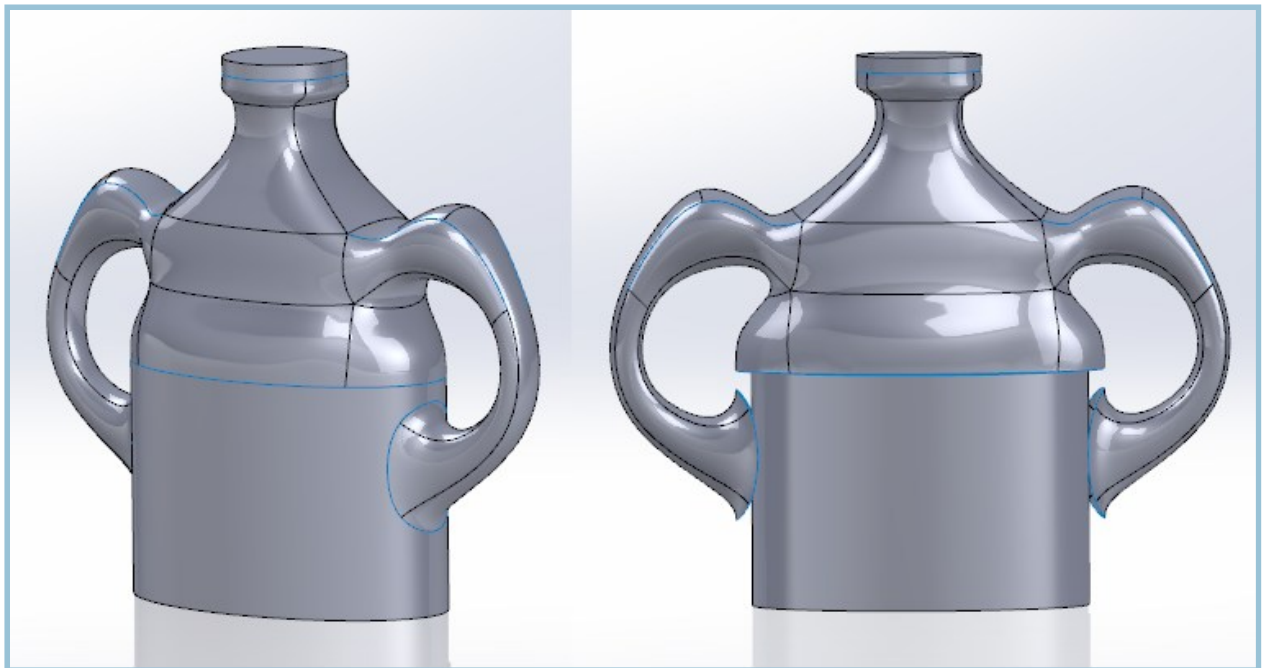
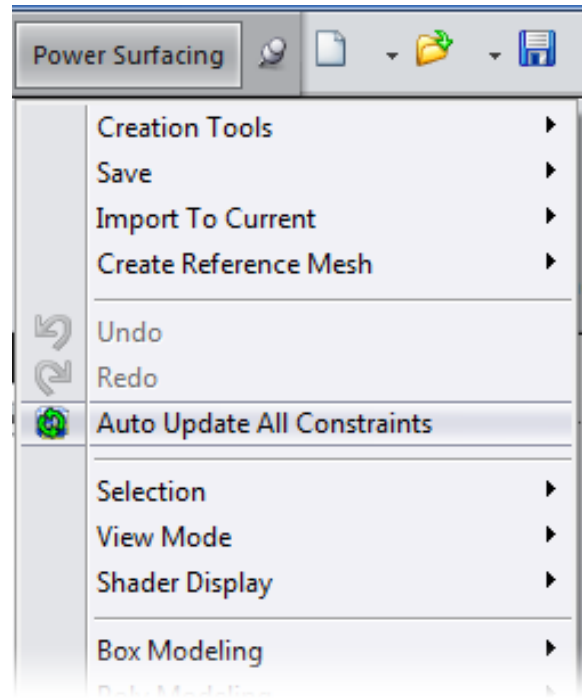


Figure 21 – The original configuration, left, and the extruded ellipse, edited to be rounder, right

Auto Update All Constraints (continued)

The SubD based entities are recreated and converted, (Figure 23). If the constraints are all edge type, you should be able to do trimming, knitting and additional updating without any problems. If you are using Constrain to Surface and are trimming the holes *afterwards*, you should wait until you are happy with the results before trimming and knitting. Additional updating may require the trim tools (3d Sketches) to be re-identified.

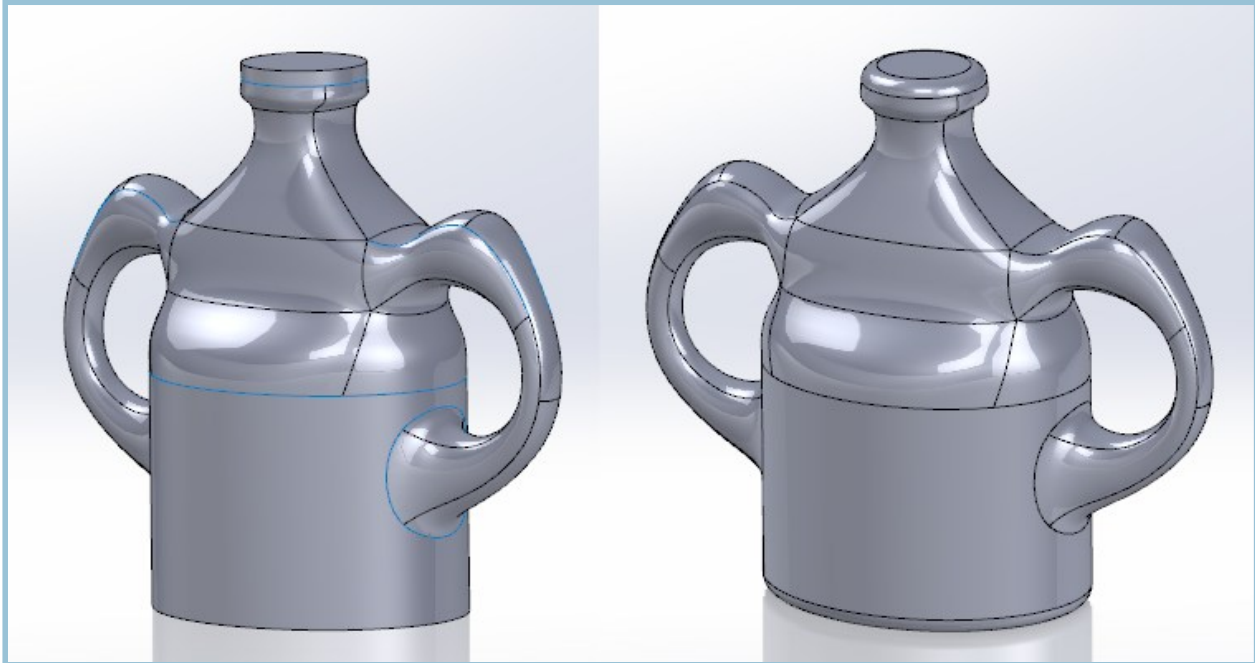
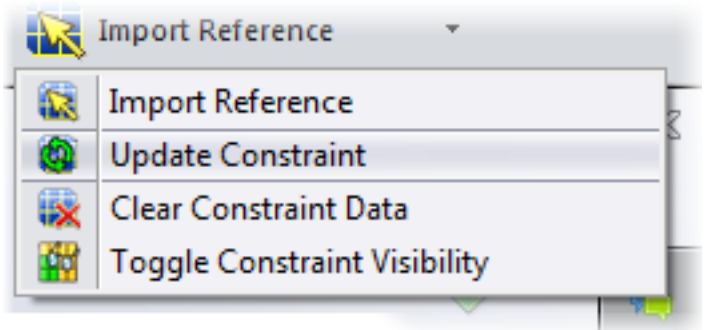


Figure 22 – The face and edge constraints, updated, left, and the object trimmed, knit, and filleted, right

Update Constraint (within SubD edit mode)

While the auto update is fine for minor changes, it is recommended that you update from within SubD Edit mode in anticipation of tweaking the SubD for more aesthetically pleasing blends or aligning the SubD closer to the newly altered constraint grids for more accurate referencing. The preferred procedure is as follows:

1. Make changes to the constraining entities.
2. Select the SubD and go into Edit mode.
3. Tweak the SubD where necessary to better match the edges and vertices to the new configuration.
4. From the Constraints fly-out, select Update Constraint
5. Adjust the SubD to improve blending where necessary.



Controlling Constraint Behavior

Depending on what you are altering, you may be faced with a decision as to how the various parts of the SubD will react. As a default, only the constrained elements will move when the referenced planes or surfaces are transformed or altered, (Figure 23). We provide three different options to allow you to control what happens to the other vertices in the mesh. Retain Offset, Retain Ratio, and Spatial Constraint. These give you the ability to parametrically control the shape of the SubD.

Note that vertices that are constrained with one of these three options will be colored the same reddish color as the constrained vertices set by Constrain To Face/Edge/Vertex. (see Figure 24)

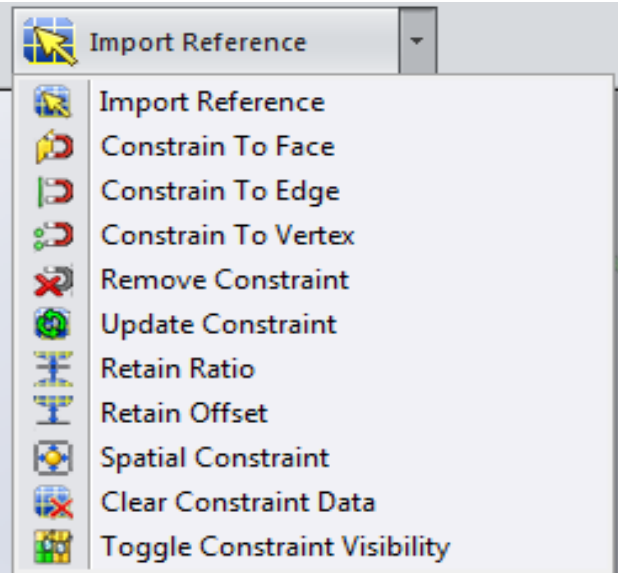


Figure 23 – The original cap position, left, moving the cap plane position up, center, only the con-

Retain Offset

When you want a portion of the SubD to remain intact when a constraint surface is moved or changed, you can specify which parts of the SubD will be affected. Keeping in mind that SubD elements affect their neighbors, you will want to select one edge loop's worth of the SubD beyond your target area.

The process is as follows:

1. Go into Edit mode with the SubD.
2. Select the vertices plus a one extra loop or ring of vertices that should be offset with the update, (Figure 24a).

Tip: When selecting parts of the SubD for constraint behaviors, use vertices rather than edges or faces. If you need to remove the behavior constraints, you can use Remove Constraint on the vertices without losing the regular constraints on edges or faces.

3. From the Constraints fly-out, select Retain Offset.
4. Convert.
5. Make the changes to the constraining objects or planes, (Figure 24b).
6. Go into Edit mode with the SubD and select Update Constraint from the fly-out.

The selected SubD is updated to reflect the new location, (Figure 24c) and the final operations can be added, or, if already present, repaired if necessary, (Figure 24d).

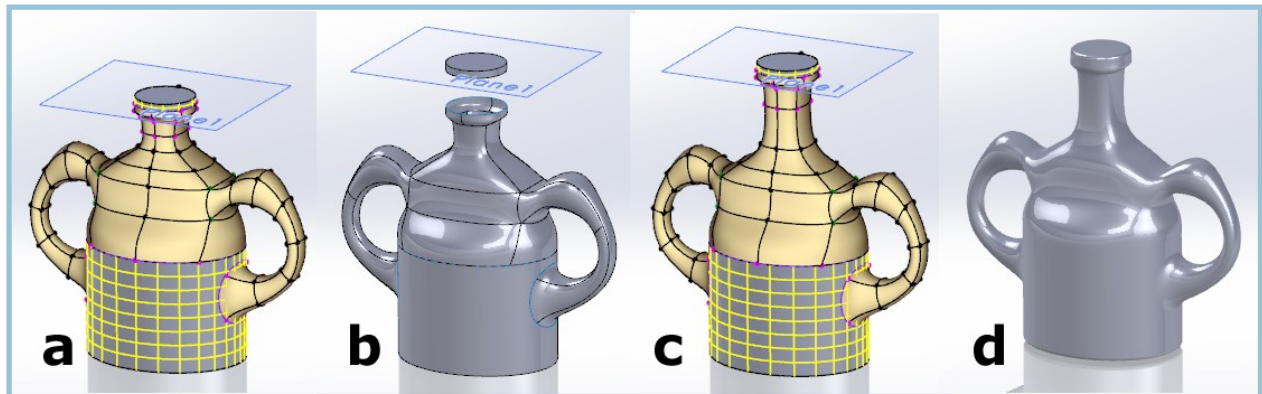


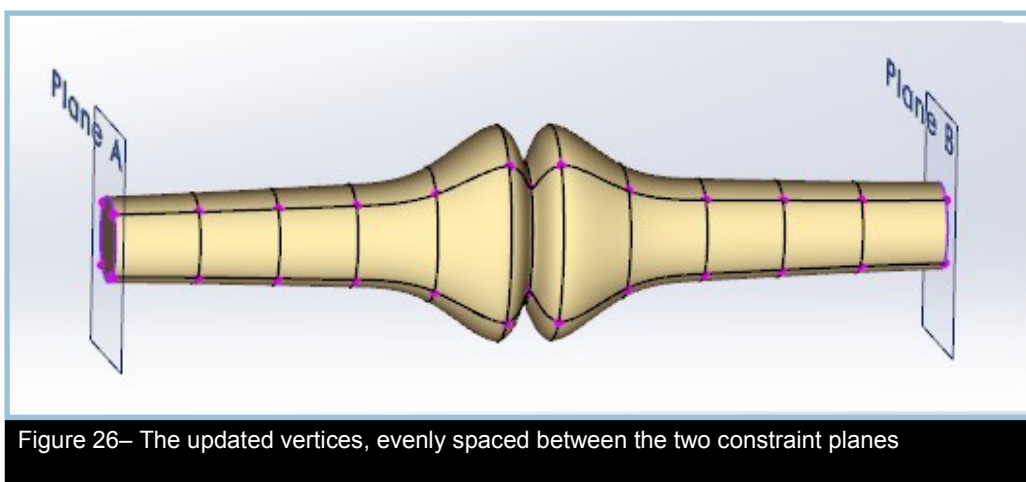
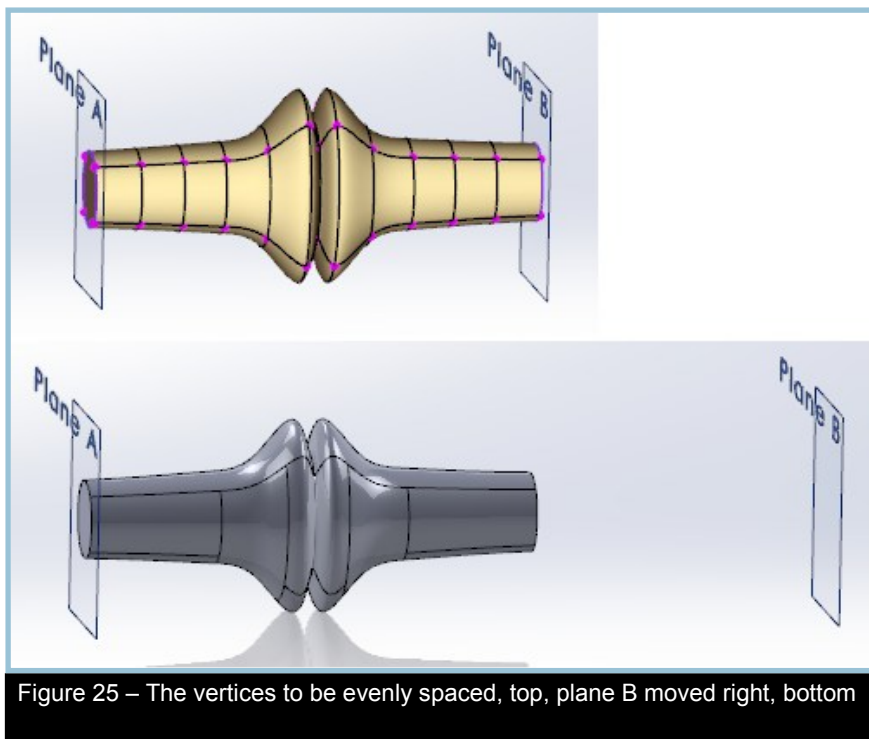
Figure 24 – *The vertices to be offset, a, the cap plane moved up, b, the constraints updated, c, and the trims, knit, and fillets applied, d*

Retain Ratio

When there are two, roughly parallel, constraining entities, you can choose to have the SubD stretched evenly between the two. As with the Retain Offset option, you must also mark the part of the SubD you wish to be affected.

The process is as follows:

1. Go into Edit mode with the SubD.
2. Select the vertices that will define the update area, (Figure 27, top).
3. From the Constraints fly-out, select Retain Ratio.
4. Convert.
5. Make the changes to the constraining objects or planes, (Figure 25, bottom).
6. Go into Edit mode with the SubD and select Update Constraint from the fly-out.



Retain Ratio (continued)

Note that the selects part of the SubD are evenly spaced between the two planes, (Figure 25).

Different results can be obtained when setting parts of the SubD to Retain Ratio. In Figure 25, the vertices on the right side are set to Retain Ratio and stretch from the center as expected. If vertices on the left are marked as Retain Ratio, they will be pulled through the static right side of the SubD with only the constrained edges on the right side end moving with the plane, (Figure 27). If the vertices on the left side are marked as Retain Ratio you could produce invalid results which self intersect, (Figure 28).

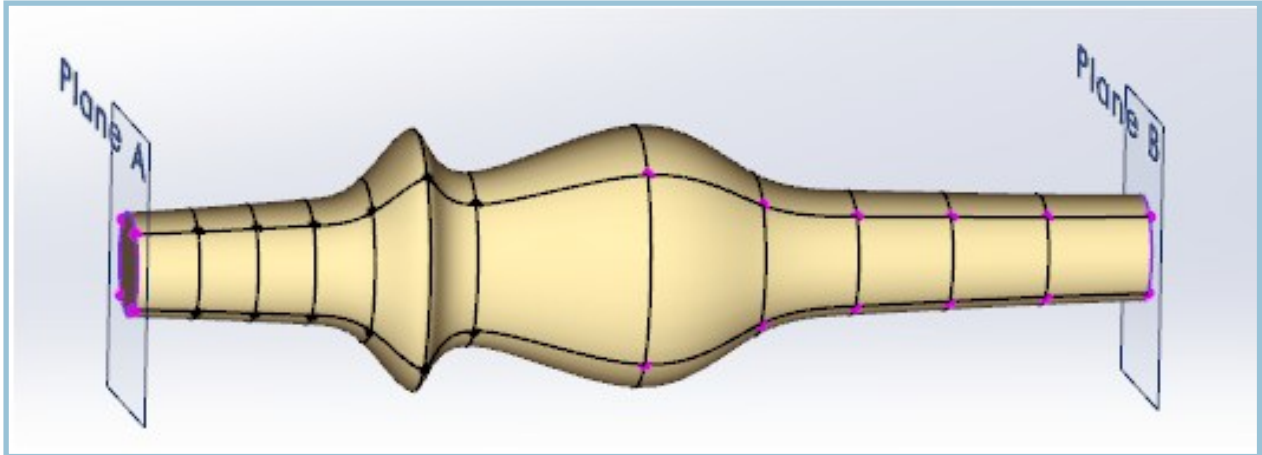


Figure 27 – Only the vertices on the right half of the SubD are set to Retain Ratio and are recalculated to absorb the increased length

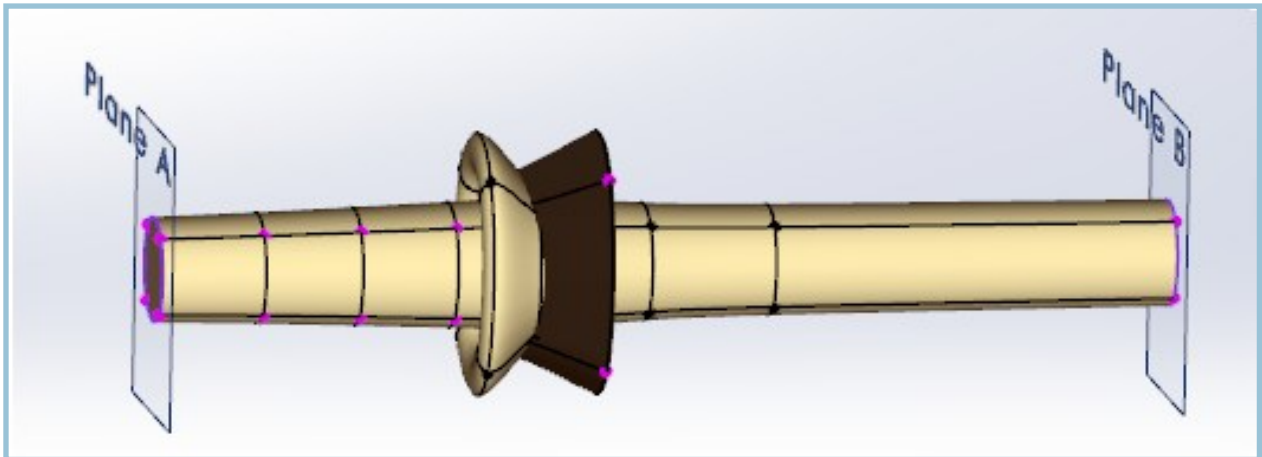


Figure 28 – Only the vertices on the left half of the SubD are set to Retain Ratio and are pulled through the now static right side

Combining Constraint Behaviors

It is possible to have different vertices in a model have different behaviors for more precise control. In Figure 29, the vertices on the left side of Plane B are set to Retain Ratio. The vertices on the right side of plane B are set to retain Offset. The edge constraint to Plane B was removed. You can see the results in Figure 30 from this update.

The important thing to remember about controlling constraint behavior is that however the vertices are set to behave, they will be controlled according to the proximity to the constraint entities. You may not, at this time, assign the control constraints manually.

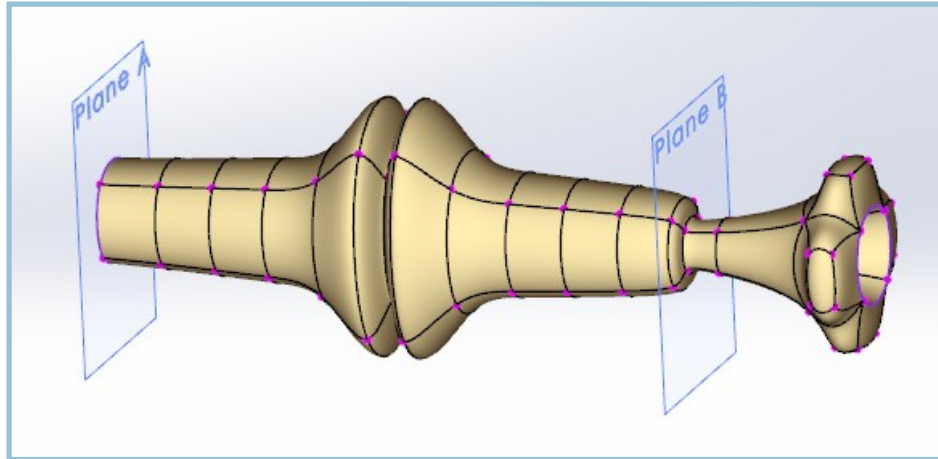


Figure 29 – The vertices between the planes are set to Retain Ratio while the vertices on the right side of Plane B are set to Retain Offset

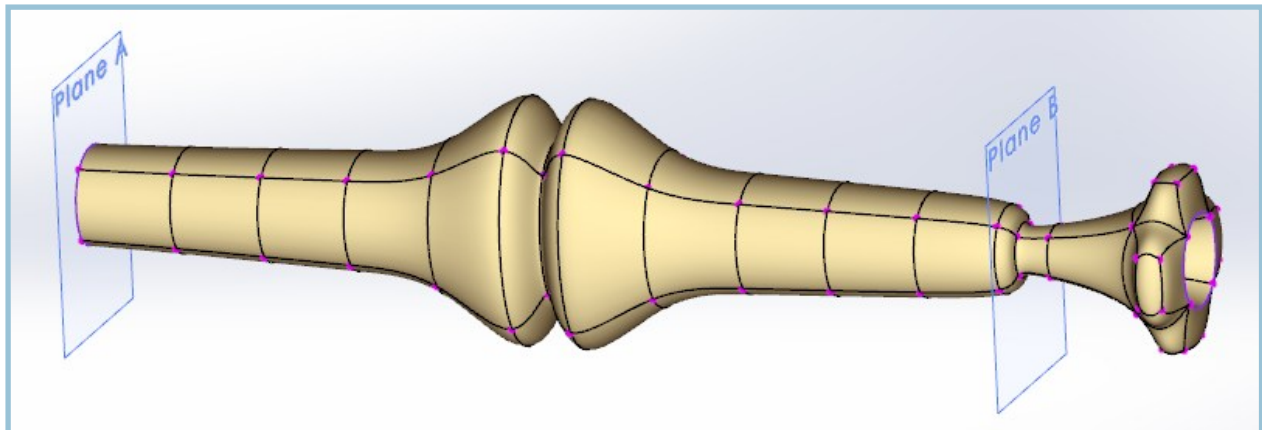


Figure 30 – The constraints updated, stretching the SubD between the planes and offsetting the parts on the right of Plane B

Spatial Constraint

The Spatial Constraint is similar to the previous two constraint tools in that the parts of the SubD to which it is assigned are influenced by proximity. With this tool, however, you may *only* use orthogonal planes for the constraint entities. Because it works spatially, it is particularly useful for objects that will have variations that are not necessarily uniformly scaled. With multiple planes, you can easily achieve parametric adjustments in volume. In fact it is even possible to control the X, Y, and Z coordinates of the points by different sets of planes.

In the following example, an image was used in a sketch picture to create a template for a size 8 flip-flop sole. Construction lines were also created for a size 12, (Figure 32). The SubD was built using the template image for the size 8 sole.

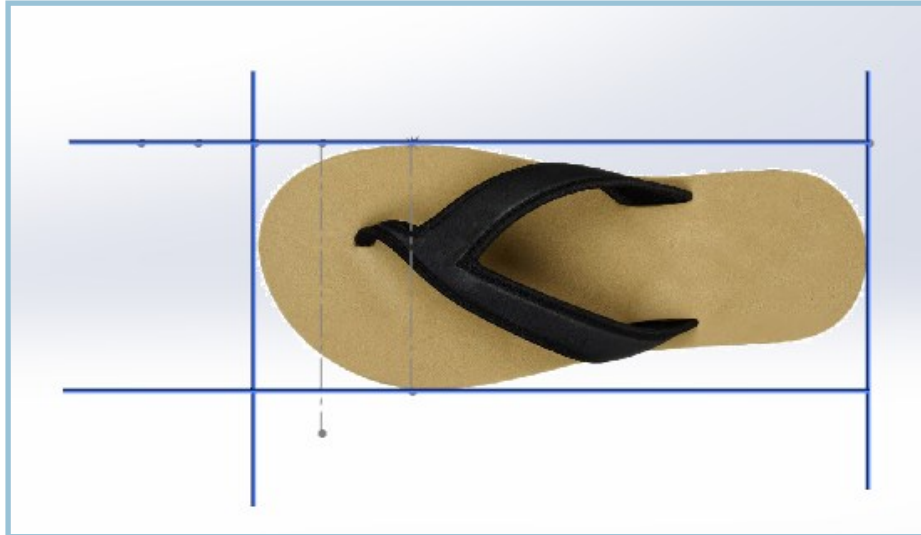


Figure 31 – Planes created for the size 8 shoe with construction lines for the size 12

The procedure to adjust shoe is as follows:

just it for a size 12

1. Go into Edit mode with the SubD.
2. Add the planes as constraints using Import Reference.
3. Select all of the vertices that will be scaled and add Spatial Constraint, to them, (Figure 32).

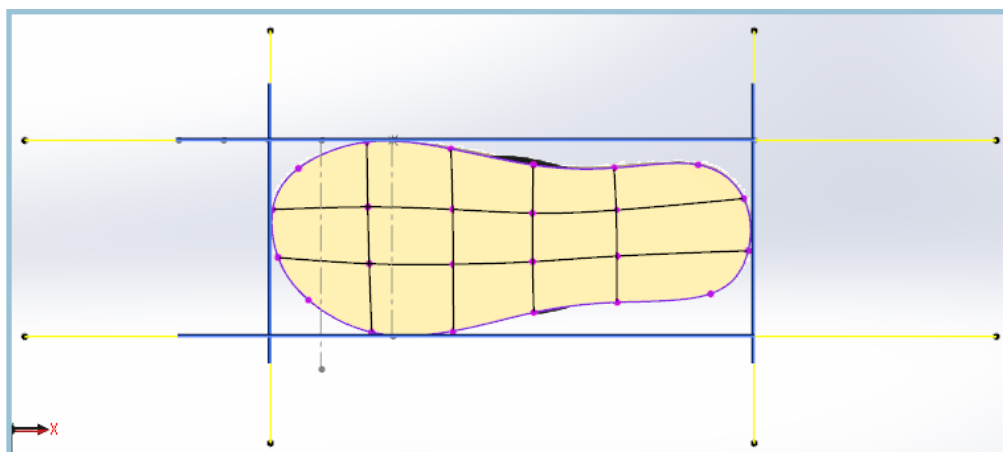


Figure 32 – The sizing planes added using Import Constraint, the SubD created to match the image template and the vertices set to Spatial Constraint

Spatial Constraint (continued)

4. Convert.
5. Move the two planes to the distances for the size 12 sole, (Figure 33).
6. Return to Edit mode for the SubD.
7. Select Update Constraints in the Constraints fly-out.

The SubD moves out to fit into the constraints set by the four planes, (Figure 34).

This example shows only the top view changes, but you could also sculpt the Y direction of the sole and control its thickness with a top and bottom constraint plane.

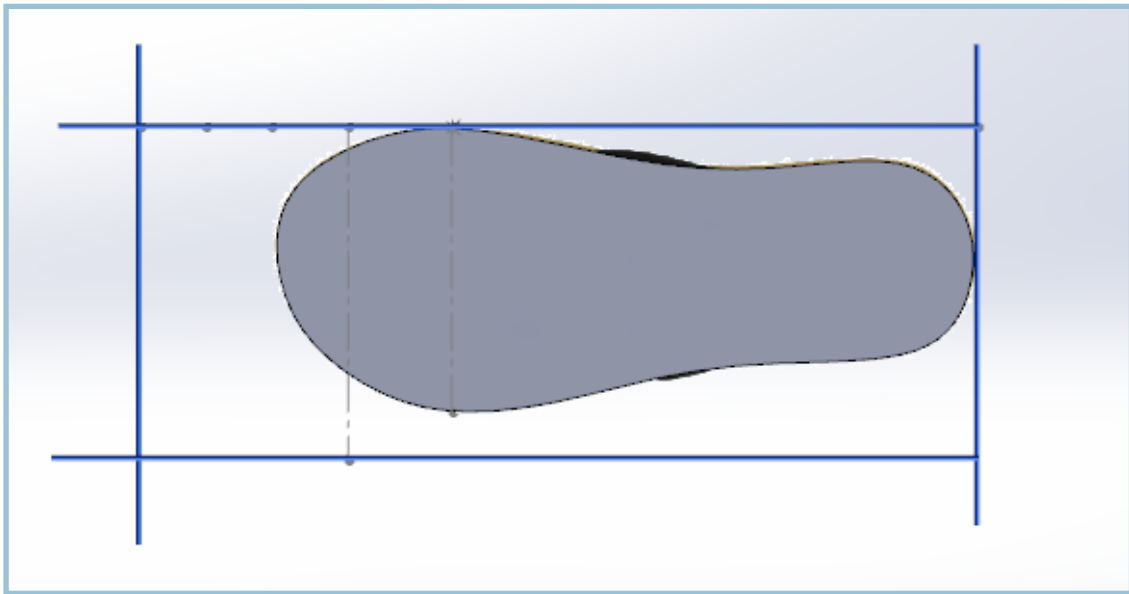


Figure 33– The planes moved out to the Size 12 distances

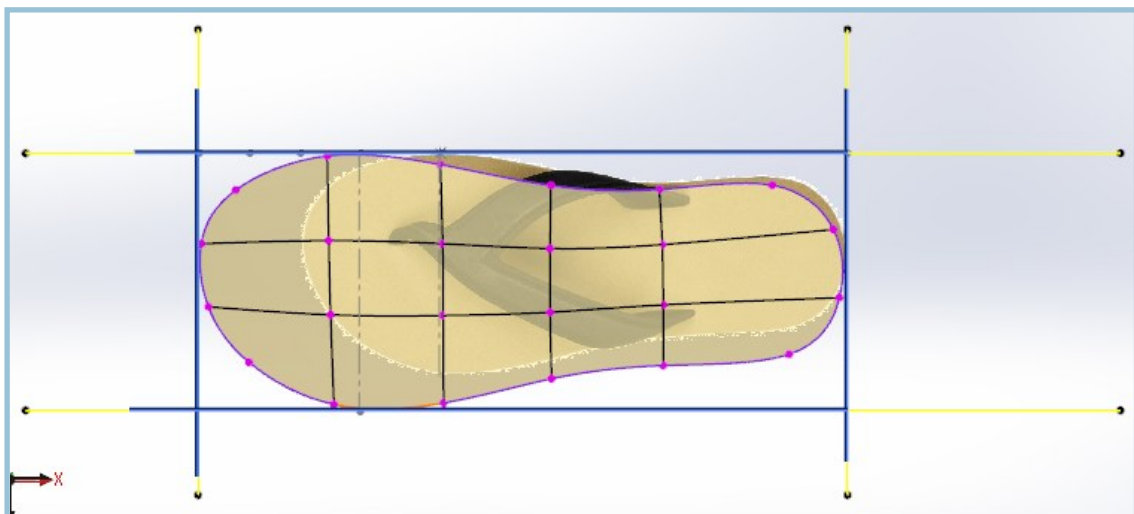


Figure 34 – The SubD resized to the newly moved constraint planes, transparency on the SubD shows the 'before' and 'after' results

Level of Detail

Level of Detail (LOD) provides you with a means to add more detail to the SubD without losing the ability to make broader changes to original version. It essentially adds up to four Subdivide Alls to the SubD while allowing editing at any level individually. The base level is considered to be level 0.

Be aware that aside from the base level, the level of detail geometry (vertices, edges and faces) can *only* be transformed (move, rotate, scale). You may *not* use any tools that change the vertex count of the SubD (Weld, Insert Edges, Extrude, Offset Loop, etc.).

When you first use Level of Detail, the fly-out will give you a choice of level to work in, (see figure to right)

The procedure is as follows:

1. Block in your SubD model, (Figure 35).
2. Select Level of Detail One and make some changes, (Figure 36).

To edit a different level, you must first exit the level you are currently on.

3. From the Level of Detail fly-out, select Level of Detail Off.

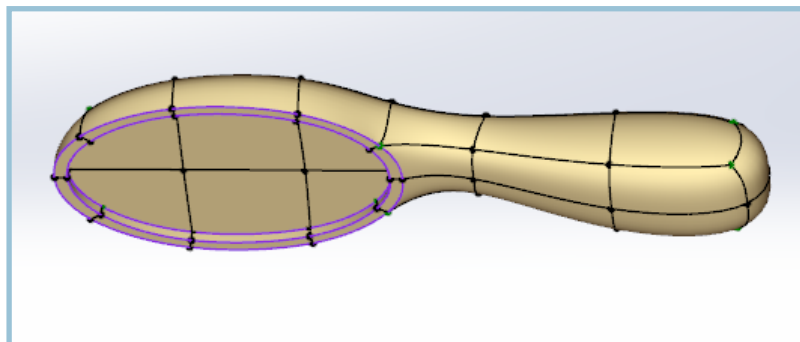
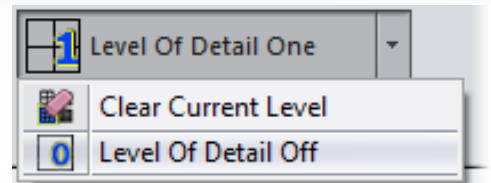
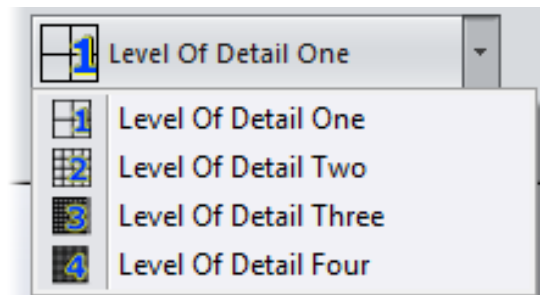


Figure 35– Level of Detail levels available to a new SubD

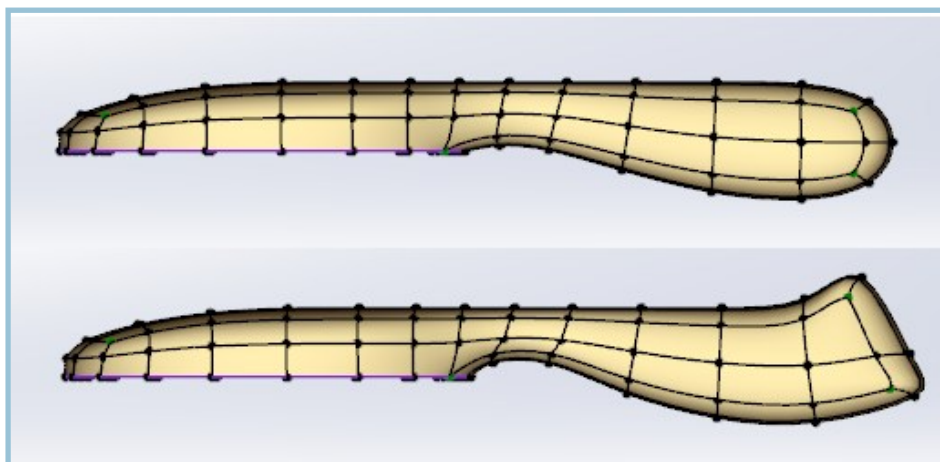


Figure 36– Level of Detail One with the original subdivision, top, and with changes,

Level of Detail (continued)

The SubD retains the LOD One changes, but the base level edges are the only edges shown, (Figure 37).

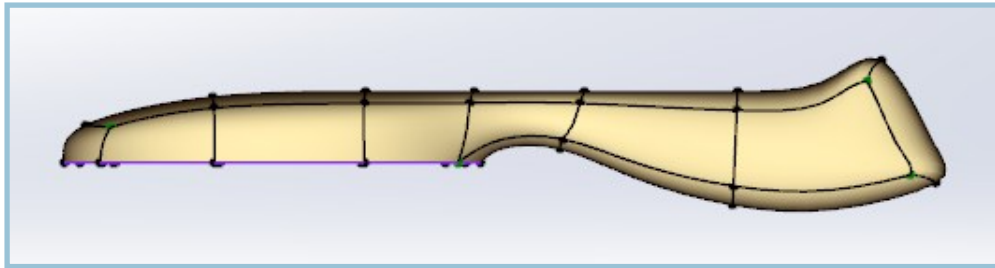


Figure 37 – The SubD showing the Level One editing without the Level One edges and vertices

4. Select Level of Detail Two and make a couple of mistakes, (Figure 38).

When you have made some mistakes on a level, you have three choices to get rid of them. You can undo until they have been cleared, but will risk losing the parts you want to keep. Another option is to clear the entire level with Clear Current Level. This insures that you will lose any other edits made to the current level.

A third option is to return to the base level, select the faces you want to clear and use Remove Selected, (Figure 44). This method will remove edits from all levels, but only on the selected sub-objects.

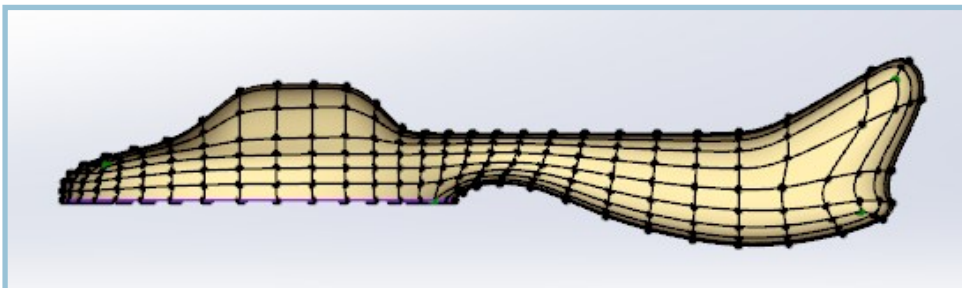
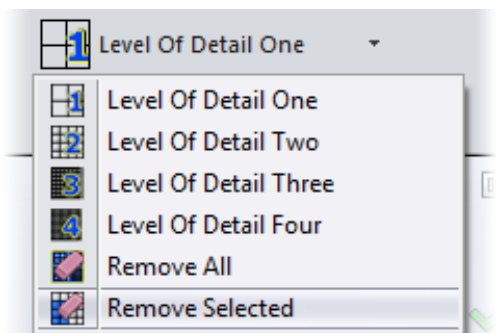
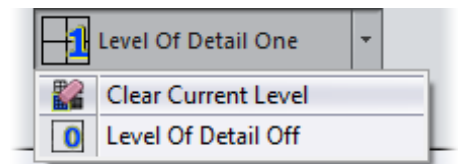


Figure 38 – A couple of mistakes on Level of Detail Two

For this example, the best choice is to clear the entire Level of Detail Two.

5. In Level of Detail Two, select Clear Current Level.
6. Select Level of Detail Off or press the Accept checkmark.

Level of Detail (continued)

7. Select Level of Detail Three and add more detail, (Figure 39).
8. Select Level of Detail Off or press the Accept checkmark.

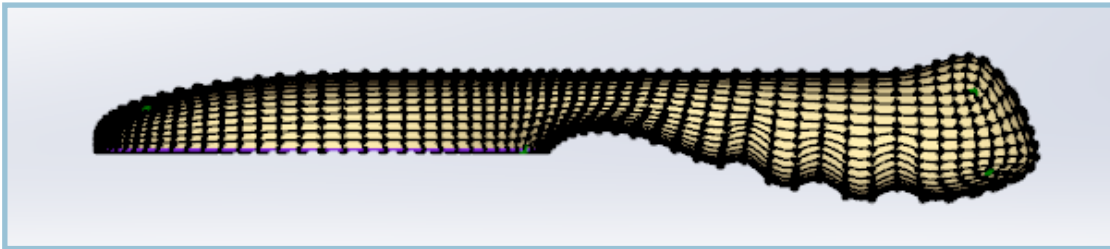


Figure 39 – Editing LOD Three

9. Make a change in the base level to see how the LOD levels respond, (Figure 40).

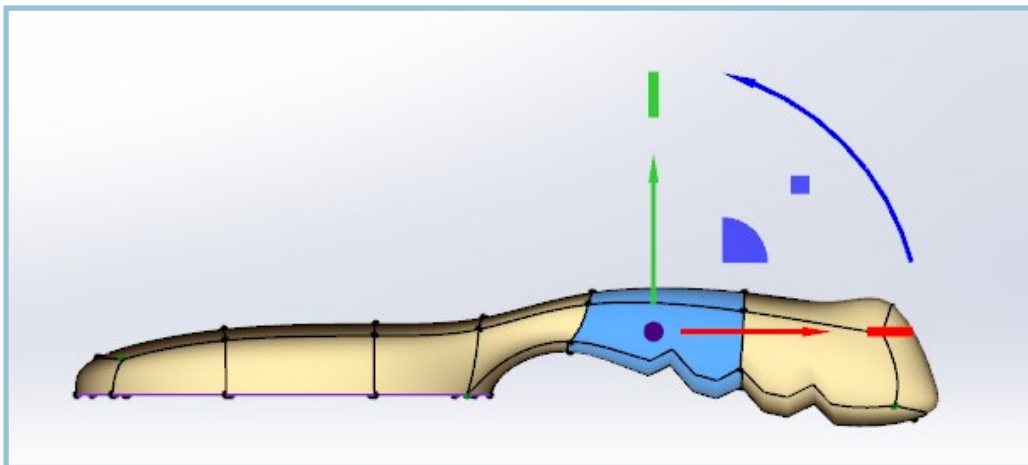


Figure 40 – Editing the base level after adding detail to some of the LOD levels

10. In Level of Detail One, adjust the shape of the handle end, (Figure 41).

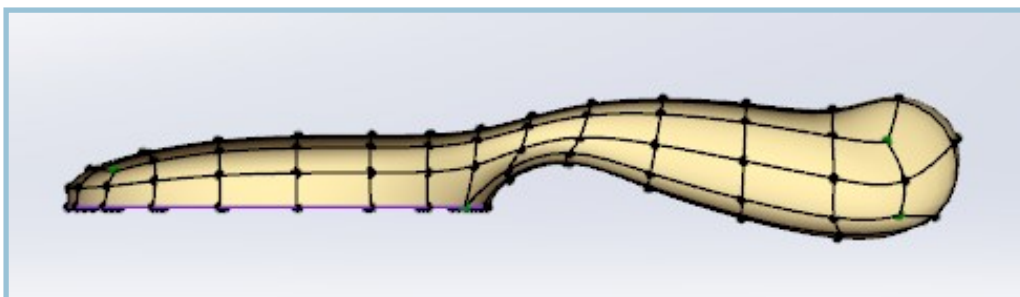


Figure 47 – Returning to Level of Detail One- the higher levels are not shown

Level of Detail (continued)

Note that detail is only shown up to the active level during level editing.

11. Select Level of Detail Off or press the Accept checkmark.
12. Convert the SubD.

The conversion process adds extra subdivisions smoothing out the grip edits on level three, (Figure 42).

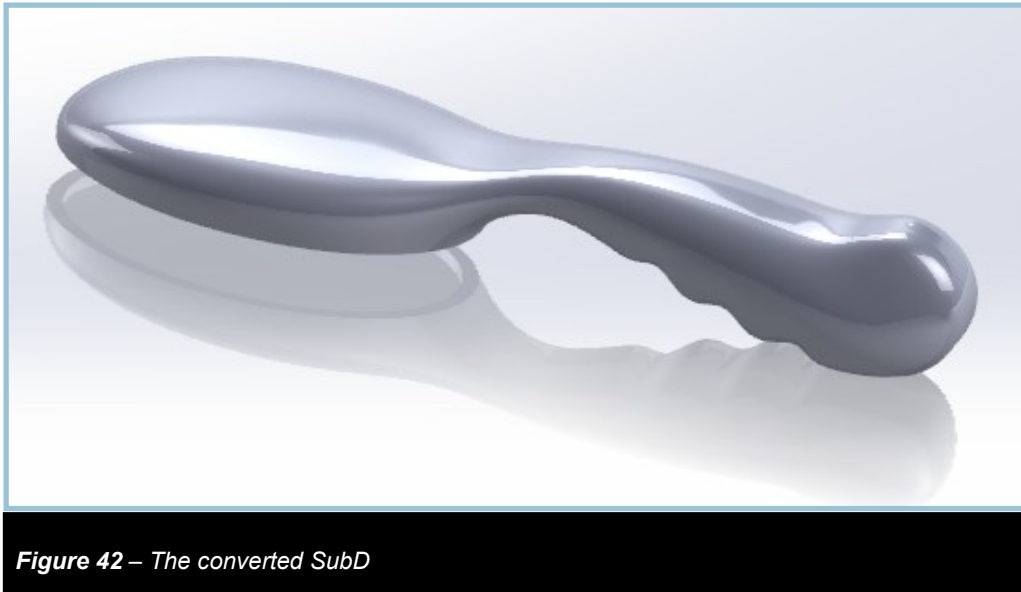


Figure 42 – The converted SubD

Selection Set Manager

Power Surfacing's Selection Set Manager provides a means to retain and name selection sets of vertices, edges and faces. Additionally, face visibility can be managed in the floating window as well.

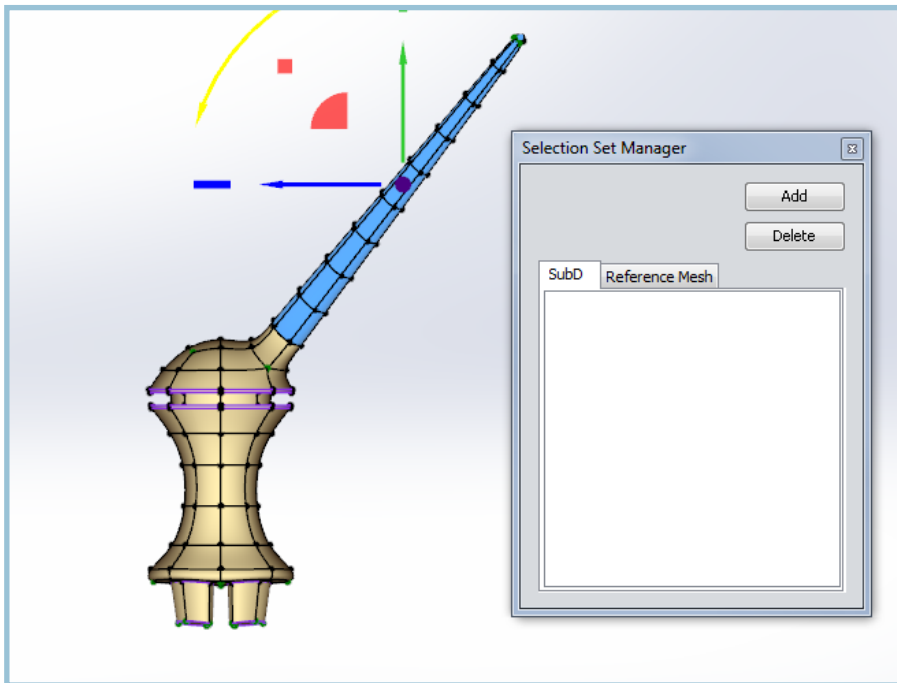
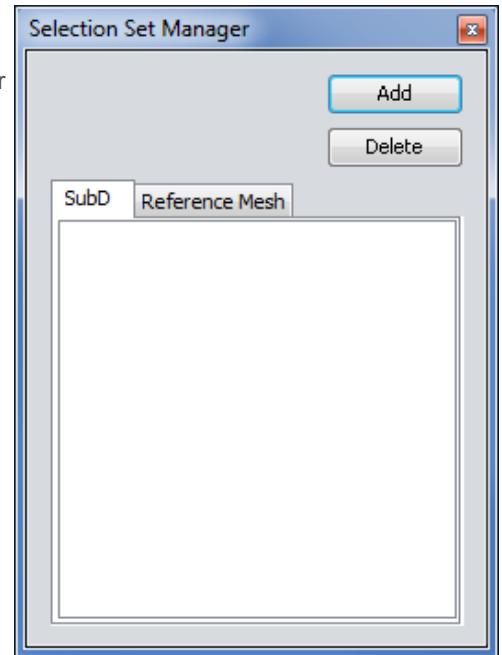
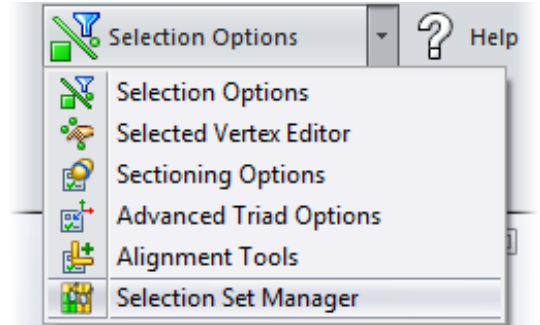
The Selection Manager is accessed through the advanced tools fly-out (see the first image on right side)

The Selection Set Manager opens in a floating window (see second image on right)

In the floating window, you will see two tabs and an Add and Delete button. The SubD tab is where you can create, name and manage sub-object selections on the SubD. The Reference Mesh tab comes into play when you are preparing reference meshes for retopologizing with Power Surfacing RE. All selection sets start out in the SubD tab. When converting a SubD to a Reference mesh for the retopologizing process, SubD selection sets are transferred to the Reference Mesh tab.

Typically, selection sets are created when the sub-objects in question are difficult to access and/or are frequently used during the modelling process. An example is the handle that is shaped with the Bend tool. As the Bend must be undone before it can be re-calculated, it is handy having the selection available at the click of the mouse. To create a selection set, the process is as follows:

1. Open the Selection Manager through the advanced tools fly-out.
2. Select the vertices, edges or faces you wish to have quick access to (see the image below)



Selection Set Manager (continued)

3. In the Selection Set Manager, click the Add button.

The selection set is created with a generic name, (see top right image)

4. Click on the default name to enter re-name mode and rename the newly created selection set to something meaningful (see second image on right)

5. Click in the viewport to deselect the faces.

6. In the Selection Set Manager, click on the selection selection's name or face icon to select the handle selection.

The handle can now quickly be shaped using the Bend tool even if it takes a few tries to get the curve you want.

7. Toggle the faces off and on by picking the check box to the left of the face icon (image on lower right)

8. Select a group of vertices and click Add.

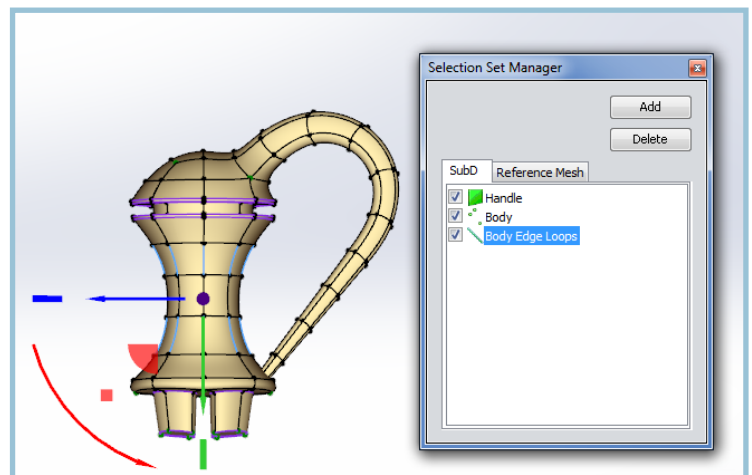
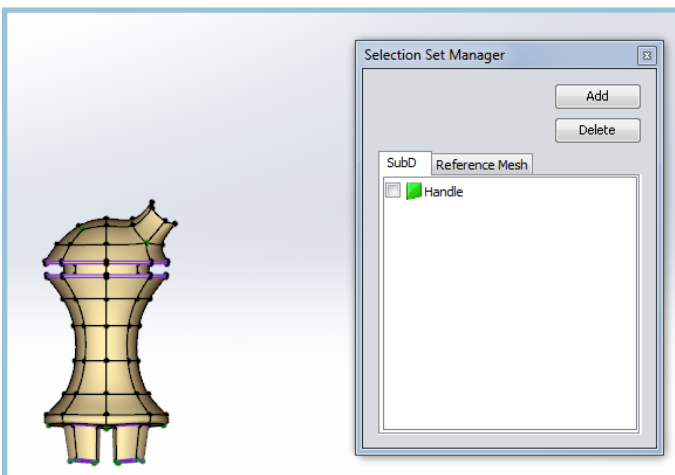
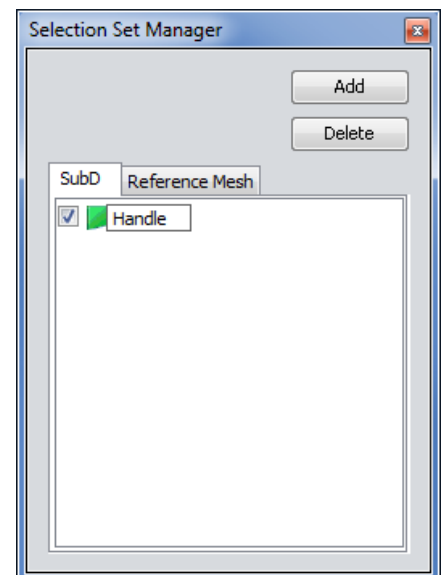
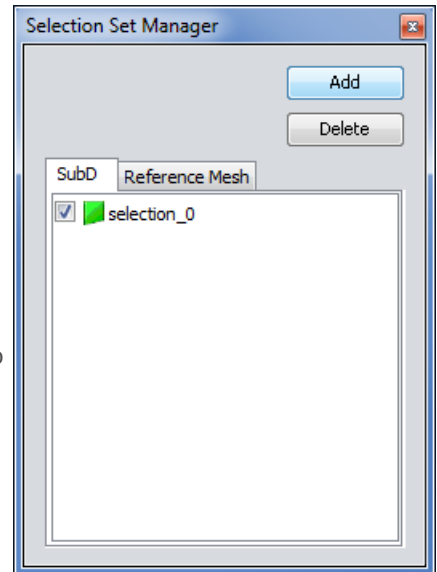
9. Select a group of edges and click Add.

The Selection set icons reflect the type of sub-objects contained in a set (lower left image)

10. Select the vertex selection set in the manager.

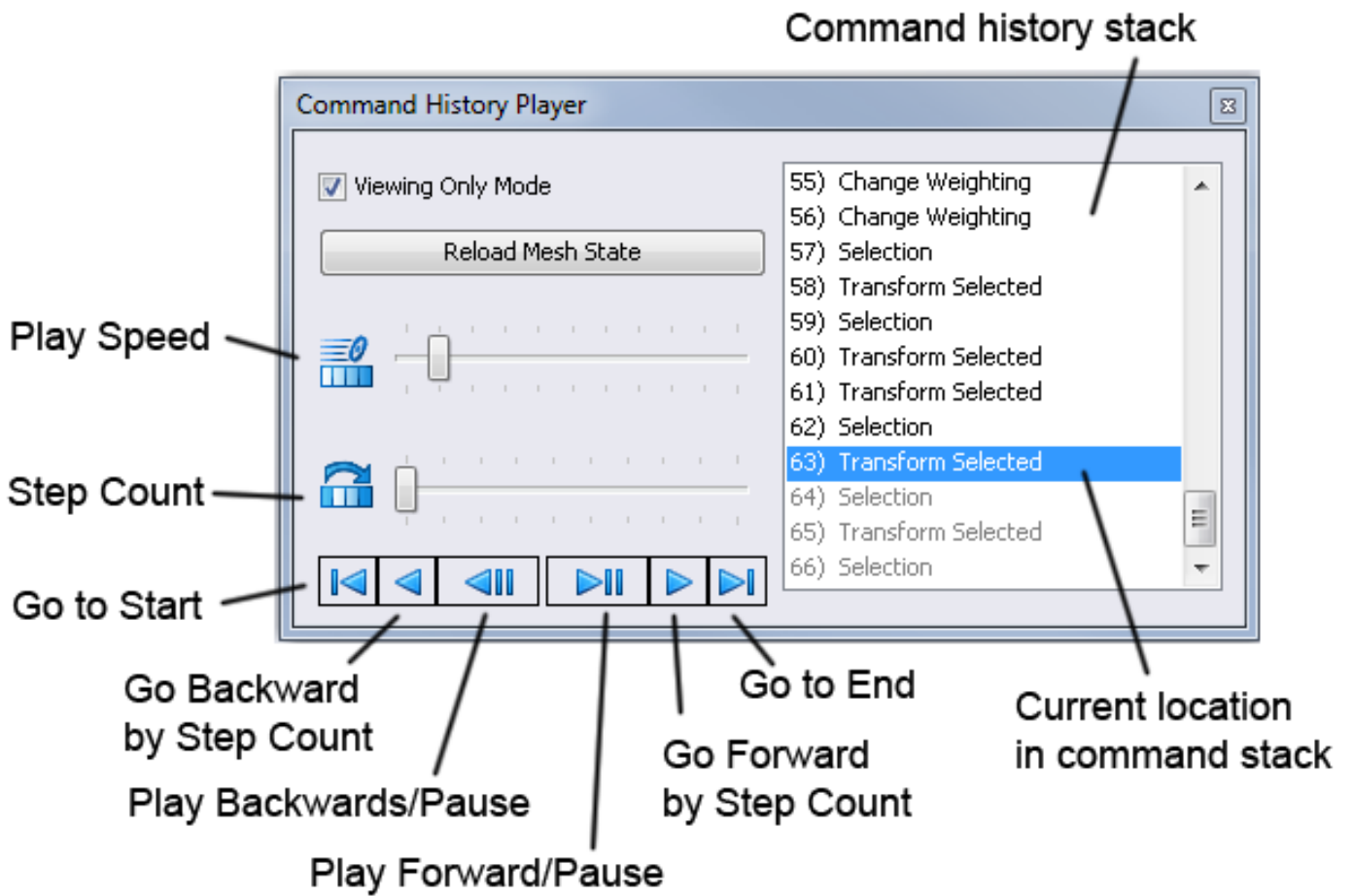
11. Click the Delete button to remove it.

Sub-objects can exist in several different selection sets at the same time. For face selection sets, visibility will be controlled by the last set made visible or invisible.



Command History Player

The Command History Player gives access to the Power Surfacing undo stack where you can use several different options to review the command history of a subD model. You can play through the command stack manually or automatically, forward or backward, from any position. You can select any command in the list to see what the model looks like at that particular point in its creation process.



Because Power Surfacing is undergoing regular changes, you will be able to step back through older models, but may not be able to read or play through the stack forward.

Viewing Only Mode allows you to investigate creation workflows of existing models without being able to actively alter the mesh. When unchecked, you can continue editing the mesh from any point in the stack.

Reload Mesh State will reload the mesh into the state it was in when you last opened the player. If you are experimenting with different solutions to your model, you may save them through the Power Surfacing menu > Save > Save Scene. This will save the model in the native .pModel format.

The **Speed** slider lets you adjust playback speed when using Play Forward/Pause or Play Backward/Pause.

The **Step Count** slider allows you to specify how many steps to skip when using step forwards or backwards by step count and also when using the regular Play/Pause or Play Backward/Pause. A maximum of nine steps can be skipped at a time.

Go to start sets the stack to the Initial state.



Command History Player (Continued)

Go to start sets the stack to the Initial state.

Step backward by step count allows you to step backward through the stack manually one command at a time or by multiples if Step Count is more than 1.

Play Backward/Pause will automatically play back through the command stack one command at a time or by multiples if Step Count is more than 1. You may pause playback and continue by pressing the same button.

Step forward by step count allows you to step forward through the stack manually one command at a time or by multiples if Step Count is more than 1.

Go to End sets the current command to the final command.

Hot Keys:

Shift

When held down while picking, sub-objects will be added to the current selection.

Ctrl

When held down while picking, sub-objects will be added to the current selection or removed if they are already selected.

A

The **A** key adds geometry depending on the mode and when the key is pressed. Additive mode can also be turned on in the Property Manager.

In **Face** mode, with a face selected, if the A key is held down, when you click and drag on the move arrows, a face is extruded.

In **Edge** mode, if the A key is held down and you hover over an edge, a preview of a new edge loop at that location is shown in red. When the edge is picked, the loop will be inserted at that point.

In **Edge** mode, if an *open* edge is selected and the A key held down, the edge or edges will be extruded as a surface only.

S

The **S** key will toggle the right-click menu on.

Options

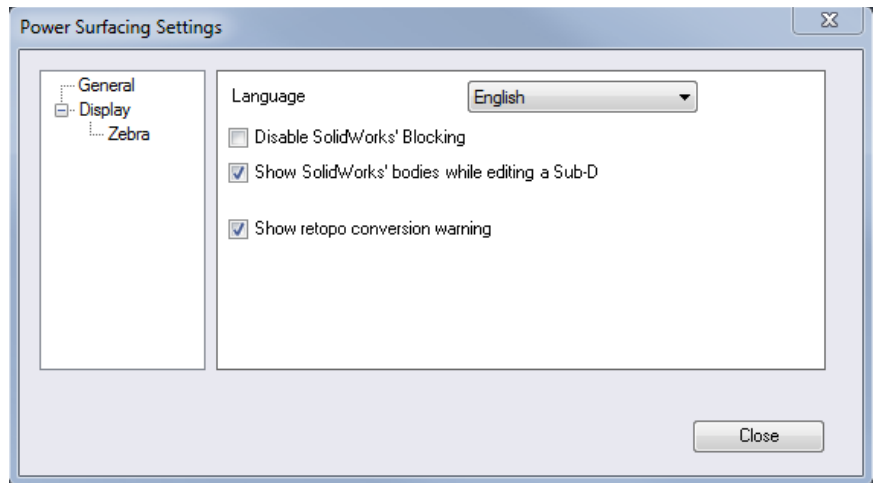
From the Power Surfacing menu, Options, you can change several of the default settings.

General

Power Surfacing lets you select from three language options. English, Spanish and XXX.

Disable SolidWorks' Blocking will allow you access to many options generally blocked when you are actively setting up or editing a feature. You will be able to save the part file, XXX

Show SolidWorks' bodies while editing a SubD allows you to keep other SolidWorks bodies visible while creating and editing your SubD model.



Display

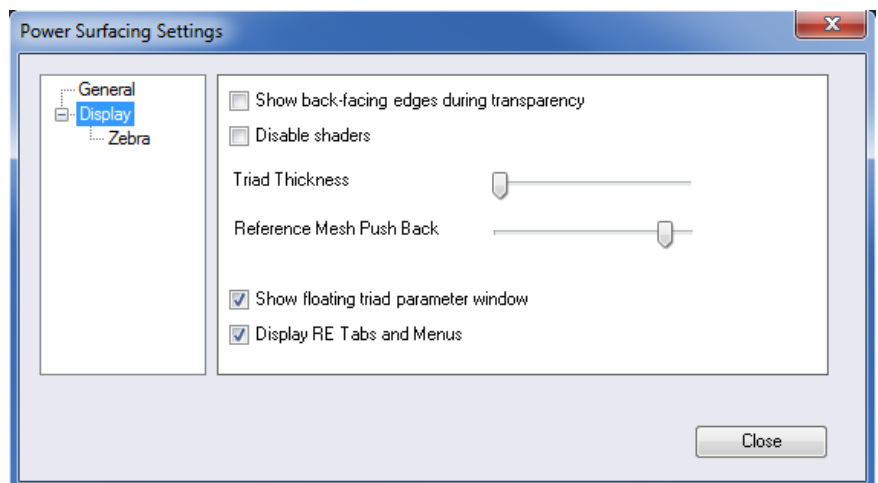
From Display, you have an option to show or hide back-facing edges when using transparency.

Disable Shaders will disable shaders in SubD edit mode only. This is useful for investigating graphics card compatibility issues. With shaders disabled, you will no longer have access to transparency options.

Triad Thickness allows you to adjust the thickness of the triad gizmo. Note that changing the thickness will affect the pick zone.

Show floating triad parameter window will show or hide the instant, in viewport, value feedback widget when using the triad and other specialty gizmos.

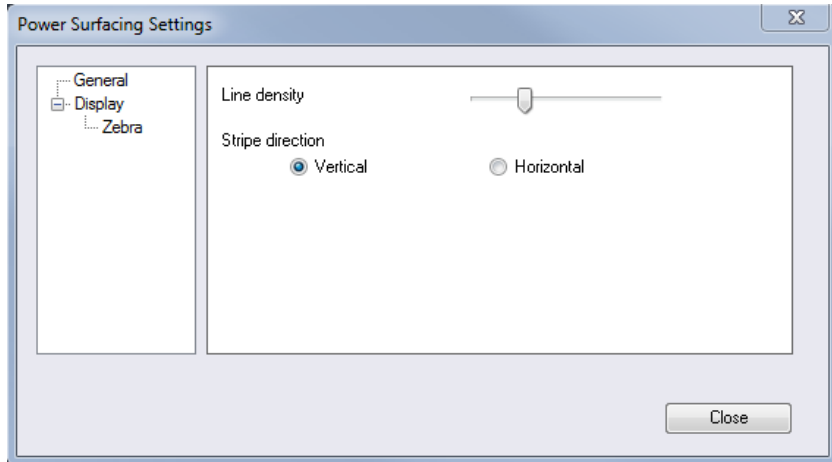
Display RE Tabs and Menus will show or hide the Power Surfacing RE (Reverse Engineering) tabs and menus.



Options, (continued)

Zebra

The Zebra shader option in the Viewing tools section allows you to edit your SubD while observing the reflection pattern as you work.



Line Density allows you to control the overall scale of the stripes.

Stripe direction you can select either Vertical or Horizontal for the stripe orientation.

Import

Import/Export options allow you to choose the units associated with .Obj and .Fbx file types. If an object comes in too small or too large it is likely an issue with the units. Delete the object and import the object again with different units.

