Creating a Cross Vault

Csaba Pozsárkó



In this SketchUp tutorial, we shall demonstrate the work-flow on how to model a cross-vault (in this case with semicircular vaults) or "groin vault" in an efficient way, avoiding problems that can occur as well as providing tips for more logical and efficient organization of the model.

Setting up the Layout and Modelling the Barrel Vault:

Cross vaults are the intersection of two, crossing barrel vaults usually in a right angle. Traditional cross-vaults (with the same span and height of the barrel vaults crossing). If the span (width) of the two barrel vaults are of the same size, the layout of a cross-vault is placed on a square. In the below image, I have already placed four columns laid out on a square pattern.

Do this on your drawing. Although exact dimensions are not necessary, the legs need to be **square** and need to be placed on a **square**!

HINT: Draw one, make it a component and then place copies of that component at the other 3 corners.



Let's start drawing an arc (half circle) along the blue axis (see the blue inference line) from the inner corners of the columns...



...then carry on with the outer arc.



Now with the line tool, close the two arcs (see highlighted edges) so that we get a face.



Now PushPull this face to the extreme endpoint of the opposite column - we have now created our first barrel vault.



We could draw the other barrel vault in the way above, too, but instead, we copy-rotate it by 90 degrees. Triple click on the vault to select everything - also see that when triple clicking, the softened edges also get highlighted. Make sure to pick the midpoint of the top edge and also that you are rotating around the blue axis (see my rotate tool turning blue).

This can be a bit hard for beginners as the rotate tool will want to get aligned t either of the neighbouring facets so see *Sketchup Aligning the Rotate and Protractor Tools* tutorial to align it perpendicular to the blue axis.



Creating the Cross Vault:

Once you managed to align the Rotate tool properly, pick a corner and start copy-rotating by snapping to the other corner (or simply enter 90 into the Measurement box and press Enter).



Now one would think that selecting everything and making an intersection will get us to somewhere so let's try it. In this case, it is all the same if you choose Intersect with model or with selected as everything is selected (save for the columns but they do not penetrate into our vaults anyway).



Let's remove excess geometry by selecting it with a right to left selection box and deleting it.



Notice however that in our cross-vault, below, there are extra edges because the top and bottom surfaces of the arches also intersected.

Now of course these can be deleted more or less tediously (or use some cleanup plugins we are nowadays spoilt with) but we can also do this properly to begin with so undo the steps until you get back to where we still have no intersection and let's try again.



Now only select the top faces (should be two, single clicks) and now make sure to use Intersect with selection only.

Repeat this step by selecting the two bottom surfaces and intersecting them with each other (selection) only.

Once we have removed the unneeded geometry, we get a nice, clean cross-vault.



Note that we have four, identical pieces in this cross-vault. Now in order to organize our model efficiently, let's turn them four instances of the same component definition. Select the top, side and bottom surfaces of *one of the quarters* by double clicking on each while holding the Shift key...

Entity Info Erase Hide Explode Select Area Make Component Make Coropy Intersect Faces Flip Along Convert to Polygon Explode Soften/Smooth Edges Zoom Extends Hole Punching Hole Punching BZ - Convert to Joint Push Pull FreedoScale Convert to Joint Push Pull FreedoScale Canvert to Joint Push Pull FreedoScale Canvert to Joint Push Pull FFD Select Select Select Select (h) Select (
Entty Info Erase Hide Explode Select Area Make Component Make Component Make Component Intersect Faces Reverse Faces Flip Along Convert to Polygon Explode Curve Soften/Smooth Edges Zoom Extro Dolygon Explode Curve Soften/Smooth Edges Zoom Extro Delygon BZ - Convert to Joint Push Pull FreedoScale Generate Faces 2 faces + path FFD Select Select Twilight Set as Revito Light Source	
Erase Frade Hide Explode Select Alace Component Make Group Intersect Faces Flip Along Convert to Polygon Explode Curve Soften/Smooth Edges Zoom Extents Hole Punching BZ - Convert to Joint Pull FredoScaP Generate Faces 2 faces + path FFD Select Sele	Entity Info
Hide Explode Select , Area , Make Coroup Intersect Faces , Reverse Faces Flip Along , Compto Polygon Explode Curve Soften/Smooth Edges Zoom Extents Hole Punking , BZ - Convert to , Joint Push Pull , FredoScale , Generate Faces Z faces + path FFD , Select) Select Only , Deselect , Twilight , Set as Revizto Light Source	Frace
Select Area Make Component Interset Faces Reverse Faces Flip Along Convert to Polygon Explode Curve Soften/Smooth Edges Zoom Extents Hole Punching Hole Punching BZ - Convert to Jaint Push Pull Jaint Push Pull FredoScale Generate Faces Z faces + path FFD Select Only Deselect Twillight Set as Revizto Light Source	Hide
Select Area Make Component Intersect Faces Reverse Faces Flip Along Convert to Polygon Explode Curve Soften/Smooth Edges Zorne Etents Hole Punching Hole Punching BZ - Convert to Joint Push Pull FredoScale Generate Faces 2 faces + path FFD FedoScale Select Select Select Twilight Twilight Set as Revizot Light Source	
Area Area Make Component Make Group Intersect Faces Filip Along Convert to Polygon Explode Curve Soften/Smoth Edges Zoom Extents Hole Punching BZ - Convert to Joint Push Pull FredoScale Cenerate Faces 2 faces + path FFD Select Select Select Twilight Set as Revixto Light Source	Explode
Area Make Group Intersect Faces Reverse Faces Flip Along Convert to Polygon Explode Curve Soften/Smooth Edges Zoom Extents Hole Punching BZ - Convert to Joint Push Pull FredoScale 2 faces + path FFD FFD Select Convert Select	Select
Make Groupehr Make Group Reverse Faces Flip Along Convert to Polygon Explode Curve Soften/Smooth Edges Zoom Extents Hole Punching , BZ - Convert to , Joint Push Pull , FredoScale , Generate Faces 2 faces + path FFD , Select , Select , Select , Select , Twilight , Set as Revizto Light Source	Area
Intersect Faces Reverse Faces Flip Along Convert to Polygon Explode Curve Soften/Smooth Edges Zoom Extents Hole Punching) BZ - Convert to Joint Push Pull FredoScale 2 faces + path FFD) Select Select Select Twilight Set as Revizto Light Source	Make Component
Reverse Faces Flip Along Convert to Polygon Explode Curve Soften/Smooth Edges Zoom Extents Hole Punching BZ - Convert to Joint Push Pull FredoScale Cenerate Faces Z faces + path FFD Select Se	Interest Eases
Flip Along > Convert to Polygon Explode Curve Soften/Smooth Edges Zoom Extents Hole Punching > BZ - Convert to > Joint Push Pull > FredoScale > Generate Faces 2 2 faces + path FFD FFD > Select > Select Only > Deselect > Select Only > Select Only > Select Dily > Select Dily<	Preverse Excer
Convert to Polygon Explode Curve Soften/Smooth Edges Zoom Extents Hole Punching > BZ - Convert to > Joint Push Pull > FredoScale > Generate Faces 2 faces + path FFD > Select >	Flin Along
Explode Curve Soften/Smooth Edges Zoom Extents Hole Punching BZ - Convert to Joint Push Pull FredoScale Generate Faces 2 faces + path FFD Select Select Twilight Select	Convert to Polygon
Soften/Smooth Edges Zoom Extents Hole Punching) BZ - Convert to) Joint Push Pull) FredoScale) Generate Faces 2 faces + path FFD Select) Select) Deselect) Twilight) Set as Revizto Light Source	Evolution Folgon
Zoom Extents Hole Punching > BZ - Convert to > Joint Push Pull > FredoScale > Generate Faces 2 faces + path FFD > Select > Select > Select > Select > Twilight > Set as Revizto Light Source	Soften/Smooth Edges
Hole Punching Hole Punching BZ - Convert to Joint Push Pull FredoScale Generate Faces 2 faces + path FFD Select Select Select Select Twilight Set as Revizto Light Source	Zoom Extents
BZ - Convert to Joint Push Pull FredoScale Generate Faces 2 faces + path FFD Select Select Select Twilight Set as Revizto Light Source	Hole Punching
Joint Push Pull FredoScale Generate Faces 2 faces + path FFD Select Select Twilight Set as Revizto Light Source	BZ - Convert to
Joint Push Pull FredoScale Generate Faces 2 faces + path FFD Select Select Twilight Set as Revizto Light Source	
FredoScale Generate Faces 2 faces + path FFD Select Deselect Twilight Set as Revizto Light Source	Joint Push Pull
Generate Faces 2 faces + path FFD Select Select Deselect Twilight Set as Revizto Light Source	FredoScale
2 faces + path FFD Select Select Only Deselect Twilight Set as Revizto Light Source	Generate Faces
FFD Select Select Only Deselect Twilight Set as Revizto Light Source	2 faces + path
Select Select Only Deselect Twilight Set as Revizto Light Source	FFD +
Select Only Deselect Twilight Set as Revizto Light Source	Select +
Deselect Twilight Set as Revizto Light Source	Select Only
Twilight Set as Revizto Light Source	Deselect +
Set as Revizto Light Source	Twilight
	Set as Revizto Light Source

...and turn it into a component. Make sure that "Replace selection with component" is checked (not checked by default as there is touching geometry).

Create Component	

Delete all the other parts and again, carefully aligning the Rotate tool, make a radial array of the component.



Texturing curved surfaces for instance is often a tedious job so if we only need to do it once using components and enjoying that all the other instances pick up the material automatically, we can save a lot of time.