
THE ULTIMATE ADVANCED FAMILY

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CLASS DESCRIPTION

Are you tired of boring box families? Ever heard anyone say: "You can't do that in Revit®?" Well in this lab, we are going to model a complete Ionic column capital from start to finish. We'll look at planning the family and breaking it down into its constituent parts and pieces. We will then create the profiles required for the volutes and scrolls. These will become sweeps and swept blends defining the overall forms. But we won't stop with just modeling these forms. This will be a fully parametric family that is scalable and leverages coarse, medium and fine levels of detail. I like the challenge of building most of this geometry in the traditional family editor, but we will also discuss some ways to incorporate the completed family into adaptive components to leverage unique features like divide and repeat. If you want to kick your family editor modeling skills to the next level and break out of the basic box, come join us for this hands-on session! (You should have familiarity with Revit® essentials).

Key Learning Outcomes:

- Constructing the Ionic volute
- Creating the Ionic capital using the volute profile
- Building the scrolls and completing the capital geometry

ABOUT THE SPEAKER:

Paul F. Aubin is the author of many CAD and BIM book titles including the widely acclaimed: The Aubin Academy Mastering Series and his "deep dive" into the Revit family editor: Renaissance Revit. He is also the author of dozens of Revit video training titles on LinkedIn Learning (powered by lynda.com content) Paul's training covers all aspects of Revit from beginning to advanced. Paul is an independent architectural consultant who travels internationally providing Revit content creation, implementation, training and support services. His involvement in the architectural profession spans nearly 30 years, with experience that includes design, production, CAD management, coaching and training. He is an active member of the Autodesk user community, and has been a top-rated speaker at Autodesk University, BILT and Midwest University (MU) for many years; and he recently gave the keynote address to the Campus FM Technology Association (CFTA) annual conference. His diverse experience in architectural firms, as a CAD manager, and as an educator gives his writing and his classroom instruction a fresh and credible focus. Paul is an associate member of the American Institute of Architects, an Autodesk Expert Elite and an Autodesk Certified Professional. He lives in Chicago with his wife and their three children currently attend universities around the country.

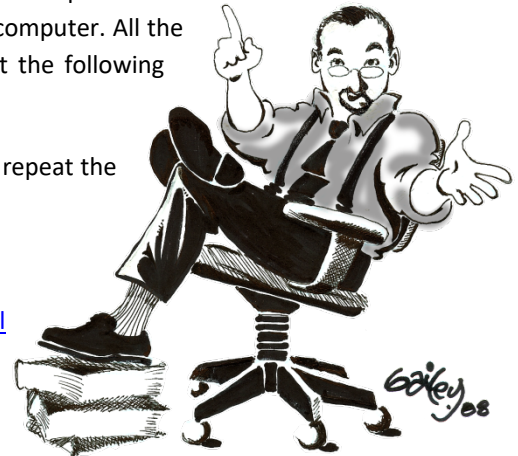
INTRODUCTION

This session is in two parts: The first part is a lecture and the second part is a hands-on lab. This is a very ambitious lab project. My aim in the first part is to walk through the entire process and build the complete model for you as I explain the steps along the way. You are meant to watch carefully, ask questions and take notes during that first part. In the second part, you will follow the steps in this document hands-on in front of your computer. All the files will be available on the lab systems. I am also providing the files online at the following location:

Please feel free to download this ZIP file and take it with you. You can then try to repeat the steps back at your home or office on your own.

A LITTLE BIT OF BACKGROUND

A few years ago, I published a book titled: [Renaissance Revit: Creating Classical Architecture with Modern Software](http://paulaubin.com/books/renaissance-revit/). You can learn more about the book here: <http://paulaubin.com/books/renaissance-revit/>



The book is a “deep dive” into the Revit family editor and uses forms taken from classical architecture for its examples. But make no mistake; the techniques covered in the book are NOT limited to classical forms. I have always liked classical and renaissance architecture and simply wanted to see if I could create these forms using Revit. This started as a simple enough goal, but quickly morphed into a much bigger project. The result of which was the published book. This lab is drawn from Chapter 10 of the above-mentioned title. We have only limited time together in this session and as such we will have to cut some corners. If you enjoy the lab and want to learn more, please consider purchasing a copy of the book. It is available in both black and white and color editions. (I recommend the color).

PREREQUISITES

Since we are starting at Chapter 10, it will be useful for me share a little bit of the approach taken to create this content. In the book I explore both the traditional family editor and the conceptual massing environment. However, the focus of this lab will be on the traditional family editor. If you have never worked in the family editor before, this lab may be a bit too advanced for you. I am going to assume that you understand the basics of family creation and can do at least the following:

- Create a new family from a pre-defined template.
- Edit the overall settings and parameters including the category.
- Are familiar with various templates like free-standing, hosted and face-based.
- Understand the importance of reference planes, can add and modify them.
- Understand how to add dimensions and set up simple labeled parameters.
- You know how to and how important it is to “flex” often.

Don't worry if you do not consider yourself an expert in family content creation or all the items on this list. I just don't want this to be the first time you have ever heard of these concepts.

APPROACH

Picture a classical column in your mind. Many books have been written on their form, structure and characteristics. I won't give you an Architectural History lesson here, but there is a complete bibliography in Renaissance Revit if you are interested. In this session, we will dive right in and start building the forms. Here is the basic structure. Each order is broken into several nested families. Generally, they are: Base, Shaft and Capital. In some cases, there is also a separate Pedestal family as well. I did not build a Pedestal for the Ionic however, so we will skip that. In addition, each order includes a Coarse detail version and, in some cases, a separate Medium and Fine as well. For Ionic, we will have two versions: Coarse and Medium/Fine. I am providing several

starting files including the coarse version of base, shaft and capital and the medium/fine version of base and shaft as well. This leaves the detailed version of the capital for us to build here in the lab portion. But don't worry, this will give us plenty to do.

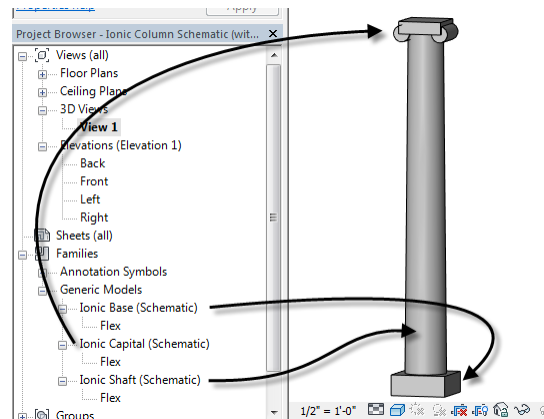


FIGURE 1—SCHEMATIC IONIC COLUMN WITH NESTED COARSE DETAIL FAMILIES

Basic Box—If you examine any of the existing families, you find that they are built using similar strategies. A simple box constrained by length, width and height is the seed of each family. In some cases, like the coarse detail base, that is all there is. In other cases, like the shaft, a blend is used instead. To convey the telltale shape of the Ionic, a few cylinders are introduced in the capital.

Sweeps and Swept Blends—While it is possible in many cases to use an extrusion, blend or revolve for simple forms, I have opted for sweeps and swept blends in many cases. This is because these two forms allow nested profile families to be used for their shape. This allows complex shapes to be created in simple 2D families and then nested in to create 3D form. Such profiles can be fully parametric making it easier to make the overall family parametric as well.

Scale and Proportion—Classical architecture is all about proportion. So, in almost all cases, when you flex a parameter, you will want that to trigger the flexing of other related parameters to maintain the desired proportions. Often, we can accomplish this with simple formulas that drive each parameter from an overall multiplier. In the families we are using, that multiplier is called: **Base Diameter**. Base Diameter defaults to 1.000 unit and represents the size of the column's diameter as measured at its base.

Decimal Units—One final note on the existing files. All files have their units set to *Decimal Feet*. I have done this to avoid messy fractions and complexities with feet and inches. This also makes the content more universal in non-US countries. So, in the lessons that follow, input only numbers in decimal format. No units are necessary.

THE IONIC CAPITAL

Let's start with a look at the schematic version of the Ionic capital. I have provided this file already. Let's open it up and explore.

1. From the *Schematic* folder, open the file named: *Ionic Capital (Schematic).rfa*.
2. On the Project Browser, open the *View 1* 3D view and then tile the windows.

Orbit the view from different angles to study the form.

Remember that the easiest way to orbit is to hold down the **SHIFT** key and then drag with the middle wheel button depressed (just like panning, only with **SHIFT** held down). The Ionic order has a very iconic look. So I think that it is important to convey this even in schematic. The cylinders here are both contained in a single simple extrusion. Its sketch is just two circles.



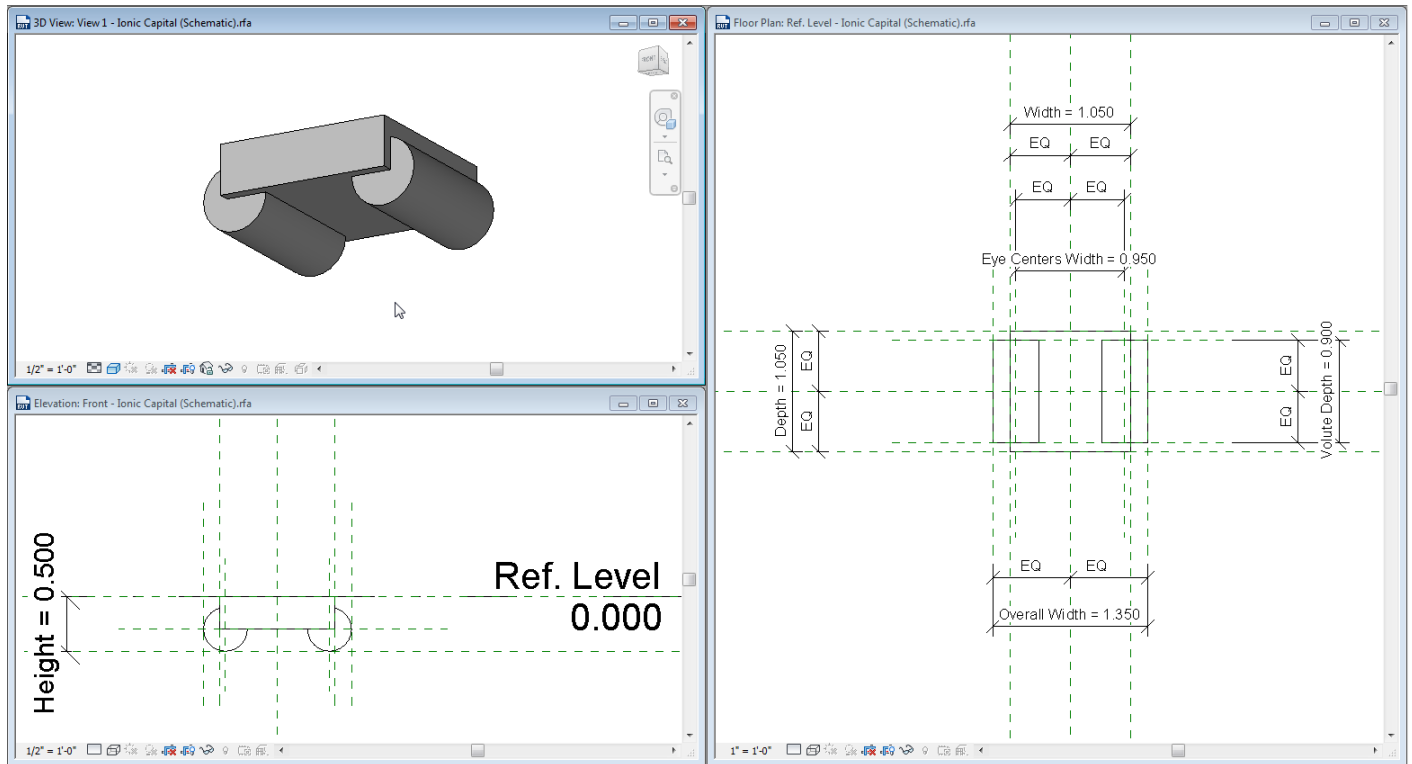


FIGURE 2—A SIMPLE EXTRUDED FORM REPRESENTS THE VOLUTES IN THE SCHEMATIC VERSION

Feel free to edit the extrusion and take a look. Use the big red “X” button on the ribbon to cancel the sketch mode when you are done without making any changes. I went with circles here, but some of the books I have use rectangles in their schematic (or block) orders instead. It is not important the specific form you choose, just that you suggest the overall form of the Order.

You’ll also notice that there are several reference planes and dimensions in this capital. Given the extra complexity of the Ionic capital, this was unavoidable. We will be able to reuse these references and parameters in our medium/fine version.

3. When you are finished exploring you can close the file without saving. (press CTRL + W).
4. Open each of the other families in this folder and explore them as well: *Ionic Base (Schematic).rfa*, *Ionic Shaft (Schematic).rfa* and then *Ionic Column Schematic (without Pedestal).rfa*.

The *Ionic Column Schematic (without Pedestal).rfa* file brings the other three together to make the complete column. We will look at this more carefully at the end. But you are welcome to explore it now if you like.

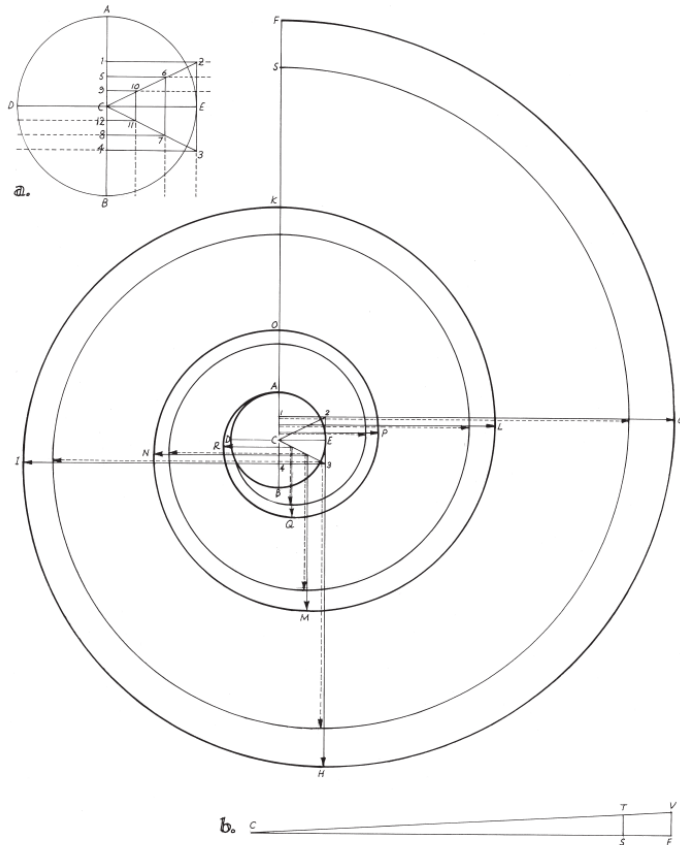
5. Close all files when you are done exploring without saving.

THE IONIC VOLUTE

To properly construct the volute of the Ionic Order, it takes no less than 24 separate arcs. Talk about putting our curve constraining strategies to the test! The volute is a spiral form made from progressively smaller arc segments. Each is 90° and reduces in radius until they converge on the “eye” (a round protrusion) in the middle region (but not exactly in the center) of the volute. If you want to learn how to construct this form, there are dozens of authorities on the subject. As I write this I have approximately seven of them spread out across my desk. Vignola uses a method of dividing an arc with diagonals and plotting these on a straight line; almost as if the line were peeled away from the arc like the arc was “unrolled” to become straight (Vignola 2011, 1669, 19). Palladio’s method uses concentric squares bisected by diagonals (Palladio 1965, 19-20). I have seen this method in several other resources as well such as Gibbs (Gibbs 1732, 15-16). These are all useful resources, but I tend to rely heavily on a book called: *The Classical Orders of Architecture* by Robert Chitham due to its being a more contemporary

source and for the author's use of decimal measurements which are easy to transfer to "Family Types." I have therefore used Chitham's method to construct the volute (Chitham 1985, 2005, 72-73). Chitham credits the method to Chambers. Chambers in turn credits his method to Goldman and gives comparison and commentary on several other masters (Chambers 2003, 1791, 52-55). So your choice of source material is vast and they all seem to borrow heavily from one another. Chitham has this to say about the Ionic volute (Chitham 1985, 2005, 148):

"The volute is the most difficult single element in the orders to draw, because the dimensional tolerances are so fine."



18. THE IONIC VOLUTE

I would be hard pressed to disagree with this statement. I have had many failed attempts before arriving at a success for this tutorial. Actually, if we were only concerned with drawing a single static representation of the volute, then it is fairly easy to accomplish using a computer program like Revit. There are many steps to be sure, but the form creation is mostly repetitive; not difficult. However, to not only draw the form, but make it fully parametric is another matter entirely. This has proved quite challenging. If you have ever tried to make a curved shape flex consistently in the family editor, then I am sure you can imagine the challenge that we are up against. **I have provided progress files along the way, so if you get stuck feel free to open a catch-up file to continue.**

FIGURE 3—THE CONSTRUCTION OF THE IONIC VOLUTE FROM CHITHAM

Note: I just wanted to remind you that this paper is extracted from Chapter 10 of Renaissance Revit. I have edited it here to make it as "stand alone" as possible, but keep in mind that the original text made reference to lessons in previous chapters. Wherever possible I will try to summarize these points herein, but given time and space constraints, complete coverage of all topics referenced will not be possible.

UNDERSTANDING THE APPROACH

Constraining curves and making them flex parametrically in Revit families is challenging. There are several strategies that can be employed for constraining curves. *(If you have a copy of Renaissance Revit, Chapter 4 is devoted to this subject. If you have access to my Revit training at <http://www.linkedinlearning.com> I have a course called: [Revit: Parametric Curvature in the Family Editor](#) devoted to the subject. Finally, recently taught a session on this topic at Autodesk University. Handouts and datasets were provided and can be downloaded at: <http://paulaubin.com/au>).*

Here is a brief summary of the approach to constraining curves: Usually it is necessary to constrain at least three aspects of the curve in a reliable and stable way to ensure that it will flex as expected. This might be the endpoints and the center. It might be the radius and the endpoints; it could even be the arc length, and center in some cases. In order to ensure that the family will not fail when flexed, you have to make certain that it can always flex without forcing the curve to break its constraints. Overall, regardless of which three items you choose to constrain, you have two basic strategies:

- Use trigonometry
- Use a nested detail item family as a “rig”

Trigonometry is VERY stable and can be used to constrain reference planes to exactly the locations needed to ensure your curves flex properly. This is often my preferred approach. However, the sheer quantity of arcs in our Ionic capital presents a practical limitation to this approach. Typically, we would want to create intersecting reference planes for each center point and each endpoint. With 24 arcs required, and three points needed to constrain each point, and two intersecting reference planes per point, that would be quite a few reference planes indeed! And most of them in a very tight space. Further the quantity of formulas could adversely affect performance. For these reasons, I am going to use the nested detail item rig approach coupled with equality dimensions instead. We will still have several reference planes to deal with; we will just hide many of them inside the nested detail item family to make it easier to work with. The good news on this approach is that we will have virtually no parameters to create! Instead, we will leverage the fact that everything is based off of proportions and rely on equality dimensions to subdivide each part into smaller and smaller parts. **There will still be plenty of detailed and meticulous work requiring patience to complete, so consider yourself forewarned.**

Let's start with a look at the rig. I have provided this as a detail item family. I have an illustration of the family in Figure 4. It is a bit intense, but remember, we have to locate 24 center points! Study the figure and open the file if you like. It is named: *Volute Eye Rig.rfa*.

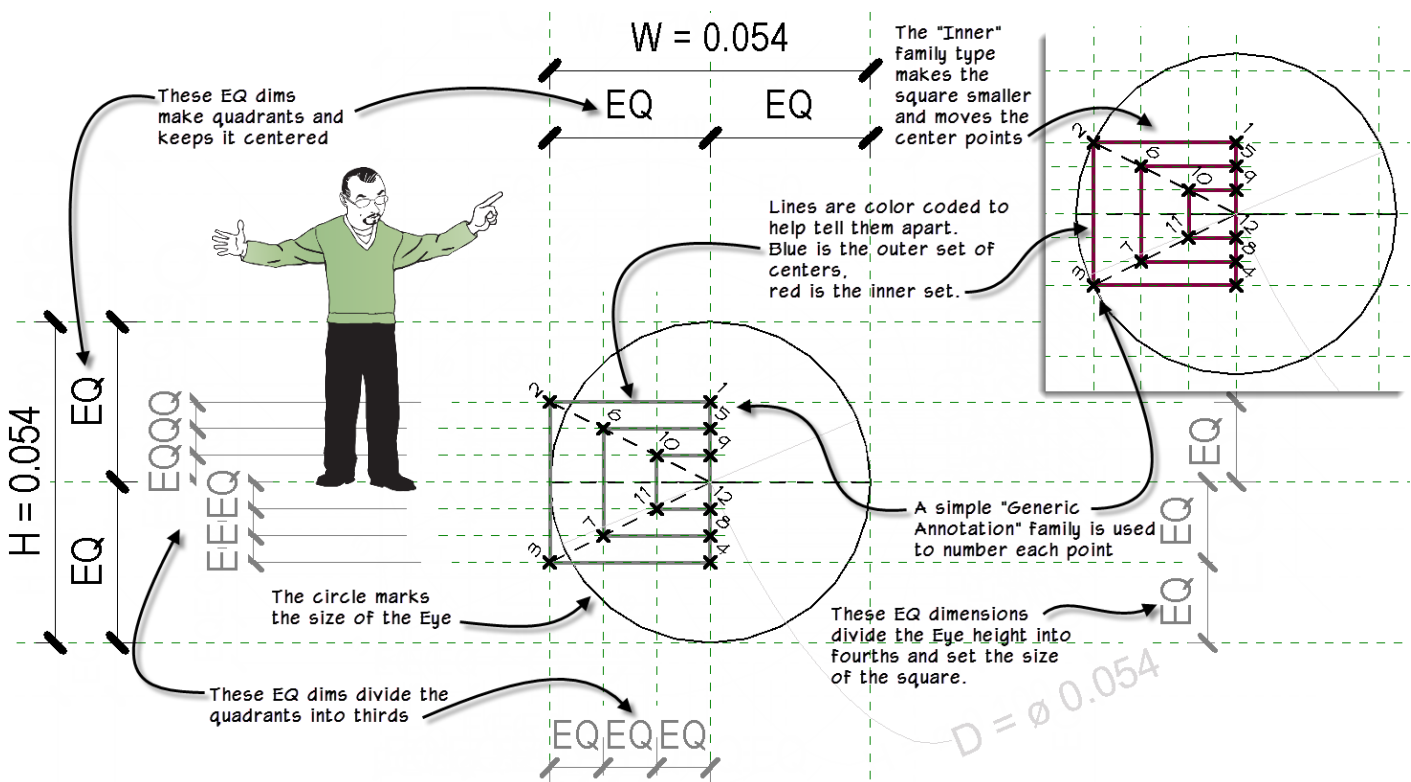


FIGURE 4—A DETAIL ITEM FAMILY USED AS A RIG LOCATES THE CENTERS IN THE IONIC VOLUTE

The layout technique starts with a circle for the eye of the volute. A square with the side equal to the radius of this circle is constructed to one side of the circle and centered vertically. The outermost reference planes describe a square shape. These have parameters H and W applied to control the width and height. The square has two diagonals from the center of the circle to the outside corners. The vertical edge of the square passing through the center is divided into six parts. I did this with reference planes and equality dimensions. Finally, the intersections of each diagonal and the dividing reference planes gives us the 12 points we need for the outside edge of the fillet. (Fillet in this context is the flat surface of the facing edge of the volute). I created some subcategories in the “Object Styles” dialog (Manage tab). I assigned them to colors to make it easier to read everything. I drew lines connecting the points and used a blue colored line to help identify the outer edge. You can use the Preview visibility icon on the View Control Bar to preview the family and show these colors.

For the inner edge of the fillet, Chitham describes a method using a small triangle to determine the proportion of reduction for the inside edge. I contemplated another rig for this, but instead opted to handle it with formulas. The trigonometry for this was fairly simple. So, if you open “Family Types” you can see the formulas and how they are applied. When you choose between the “Inner” and “Outer” types, it adjusts the scale of the family and turns on and off the correct set of colored lines.

To keep track of the center points, I created a simple annotation family to number each point. To create this family, I used the *Generic Annotation.rft* template. I drew a small “X” using two small lines. Then you click the Label button on the ribbon. A Label is a piece of text that reports a parameter. This is what tag families use. The “Edit Label” dialog will appear empty at first, but you can click the Add Parameter icon at the bottom to create a new parameter (see Figure 5). In this case, I made it an instance parameter. It can be a text parameter, but I went with type: Integer. (If you want to also be able to “letter” your points, use Text instead). This family is provided in the dataset as well named: *Point Label.rfa*.

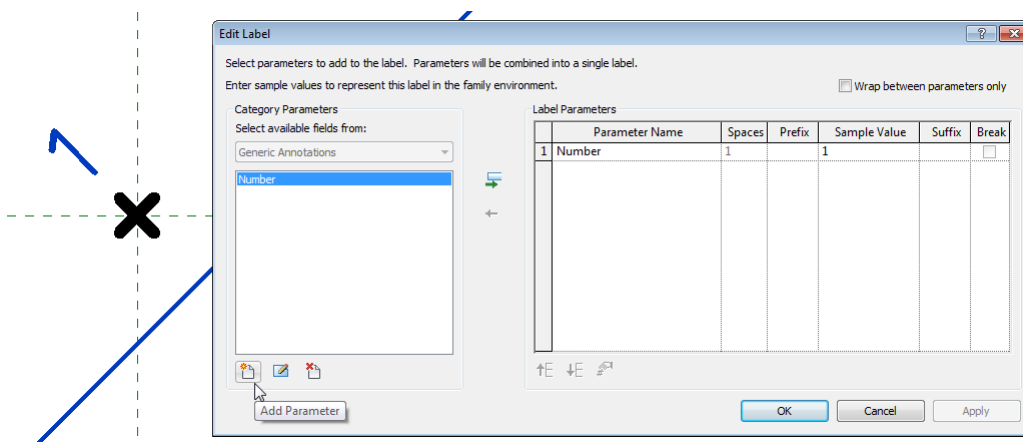


FIGURE 5—A CUSTOM PARAMETER FOR THE LABEL IN A GENERIC ANNOTATION FAMILY

Chitham has the eye diameter at 0.050. He also has the distance from the top edge of the volute to the center of the eye at 0.225 (Chitham 1985, 2005, 72). I found it necessary to adjust both of these values slightly. When using these numbers directly, many of the arcs generated radii with repeating decimals like .33333 or .66666. The trouble with this is that as noted in the Chitham quote above, when dealing with such tight tolerances, if Revit rounds off the value in your formula, it can cause the family to fail when you flex. This can be quite frustrating particularly when dealing with 5 or more decimal places and dozens of arcs. So instead, if you consider the figure again, all of the equality dimensions are dividing the spaces into thirds. So I went with a number that was cleanly divisible by three (0.054) and achieved much cleaner results.

You are welcome to recreate these families if you wish, but they have already been provided in the dataset. In fact, we will start with a profile family that I created with some basic reference planes already in place as well as some of the parameters we will need. The detail component rig is already in the file. We’ll finish a few setup items and then begin drawing the volute spiral. Once complete, we will use it to create a sweep in the Ionic capital family. To that we will add other geometry as

required. The Ionic capital offers some complex modeling challenges, but it is also one of the most beautiful of the orders. So, it provides quite a satisfying challenge.

CREATE THE VOLUTE PROFILE FAMILY

As noted in the previous passage, you can build everything from scratch with the guidance above or you can start with the provided file which has the basics already begun.

1. Open the file named: *Ionic Volute Profile_Start.rfa*.
 - ⇒ From the File menu, choose **Save As > Family** and name the new file: **Ionic Volute Profile**.

Everything will appear very small. I have set the scale to full scale given the small size of the volute eye rig. If you set the scale much larger, the numbers become illegible. So, we'll have to rely on zooming for the time being.
2. Zoom in on the Volute Eye Rig detail component.
3. Select the detail rig onscreen. On the Properties palette, click the Edit Type button.
 - ⇒ In the "Type Properties" dialog, click the Associate Family Parameter button next to Base Diameter, choose Base Diameter and then click OK twice.
4. Align the detail component rig onscreen to the intersection of the Center (Left/Right) and Center (Vertical) reference planes. Lock in both directions.

Align so the circle is centered—the square will appear off to the left (see Figure 6).

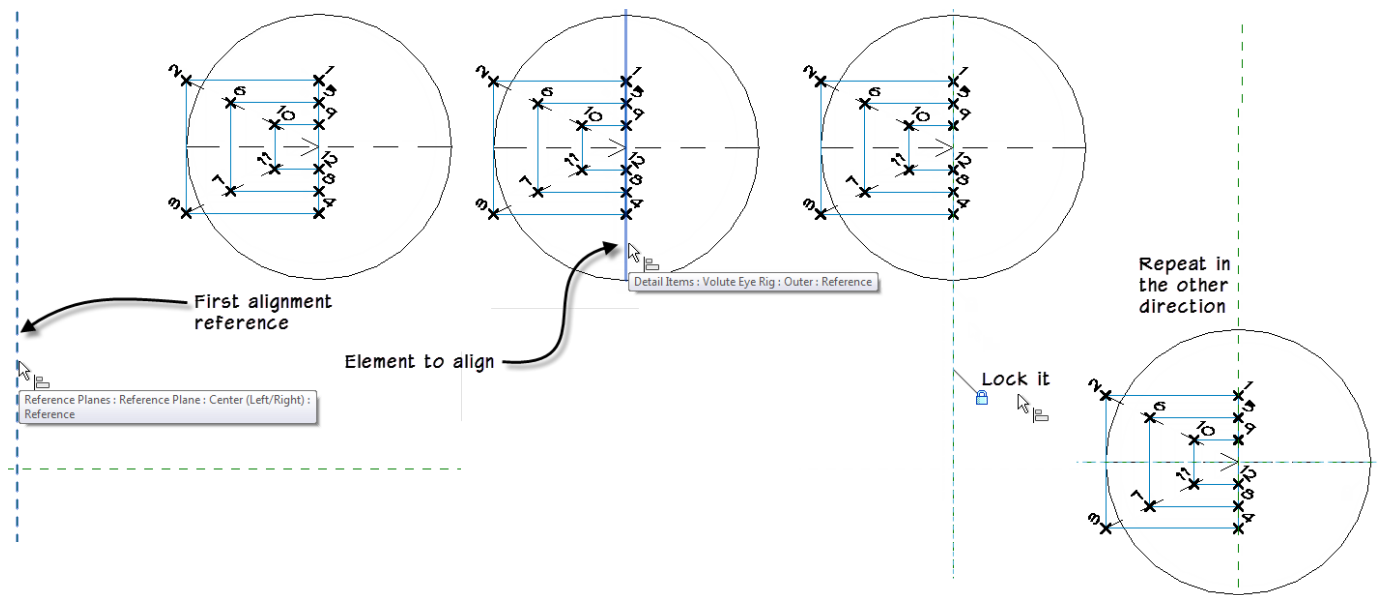


FIGURE 6—ALIGN AND LOCK THE DETAIL COMPONENT TO THE CENTERS

Zoom in closely on the detail rig.

5. On the Create tab, click the Line button and then click the **Center-ends Arc**.
 - ⇒ Snap the center point to the intersection at point 1 on the rig.
 - ⇒ Pull straight up 90° and snap to the topmost reference plane. (Make sure it is exactly 90° before you click).
 - ⇒ Pull straight to the left at 90° again and then click (see Figure 7).

You should have a quarter circle centered on point 1.

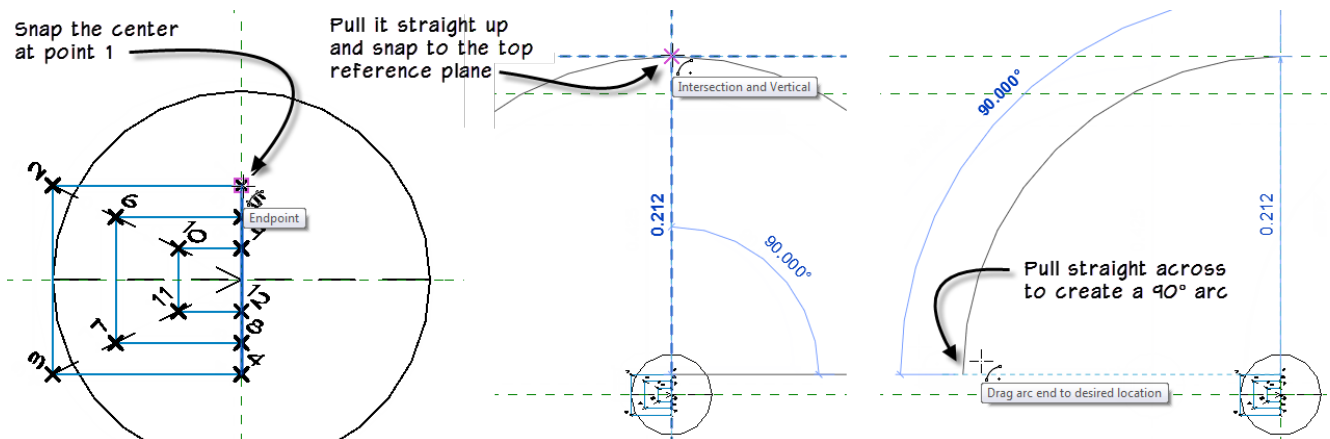


FIGURE 7—DRAW THE FIRST ARC CENTERED ON POINT 1 AND 90°

6. Cancel the command, select the arc and on the Properties palette, turn on the center mark.

7. Zoom in on the detail rig. Align and lock the center mark to the **detail rig** in two directions.

Use the vertical line in the center of the rig for the first reference. Lock it to the center mark.

Use the blue horizontal line at the top of the square for the second reference. Lock it to the center mark.

Notice that the Automatic Sketch Dimensions disappear when you lock. Be very careful about which edges you select. For the first twelve points, we only want to align and lock to the **blue lines** in the rig.

8. Zoom back out. Align and lock the endpoint at the top of the arc to the horizontal reference plane (see Figure 8).
(One direction; horizontal reference plane only this time).

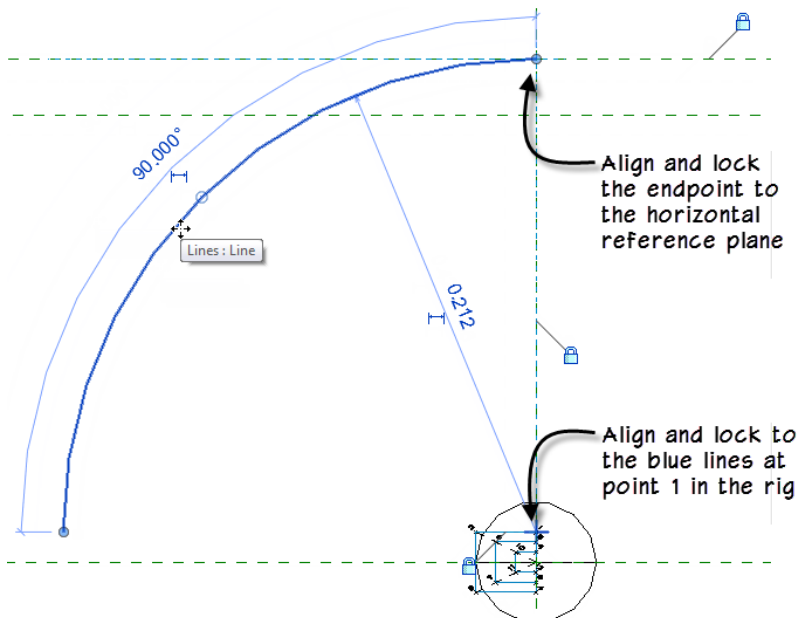


FIGURE 8—ALIGN AND LOCK THE ARC AT THE CENTER POINT AND THE FIRST ENDPOINT

9. Open “Family Types” and flex the Base Diameter to **2.000** and then click OK.

Notice that the arc adjusts as expected. The center is constrained to the detail rig. The detail rig has its internal Base Diameter parameter linked to the Base Diameter in this file, so it is flexing as well. And with the endpoint locked to the reference plane, the radius is established as well.

10. Reset the Base Diameter back to **1.000** to continue.

11. Save the file.

CATCH UP! You can open a file completed to this point named: *10_Ionic Volute Profile_A.rvt*.

12. Return to the Line command, select the Center-ends Arc again and snap the center point to point 2 this time.

⇒ Move to the left and snap to the endpoint of the existing arc.

⇒ Move straight down at 90° and then click.

13. Once again, cancel, turn on the center mark, align and lock (both directions to the blue lines of the rig, and just the horizontal reference plane down below).

In versions of Revit 2017 and later, there is a tangency lock constraint that will appear whenever two lines are touching with tangency. You can click this lock constraint to toggle it on and thereby instruct Revit to maintain the tangency condition when the family flexes. You can click these if you like as an extra precaution, but in this family, they are not required. But they certainly won't hurt anything either. So, if you wish, go ahead and toggle the tangency locks on.

⇒ Flex again.

Now here's the *really* tedious part: we must repeat this process 10 more times for the outer edge of the fillet and then 12 more times for the inner edge. **Yes, 22 more arcs, alignments and locks.** So, these two were some of the easy ones. Unfortunately, there is no shortcut. So just be patient and methodical and be sure not to miss any steps along the way or things might misbehave when you flex. I recommend **frequent** flexing as well. This way if one of the arcs is misbehaving, you will find out which one right away.

14. Repeat the process to add arcs 3 through 5.

Add each arc one at a time and stop and turn on the center mark and align and lock as you go. Align and lock any time you see an Automatic Sketch Dimension appear. Arcs 2 and 3 can be aligned to the horizontal reference plane at the bottom of the screen. Arcs 4 and 5 will sense a reference plane off screen to the left. You can align and lock to this reference plane even though it is off to the side. This helps a lot to keep the onscreen clutter in check (see Figure 9).

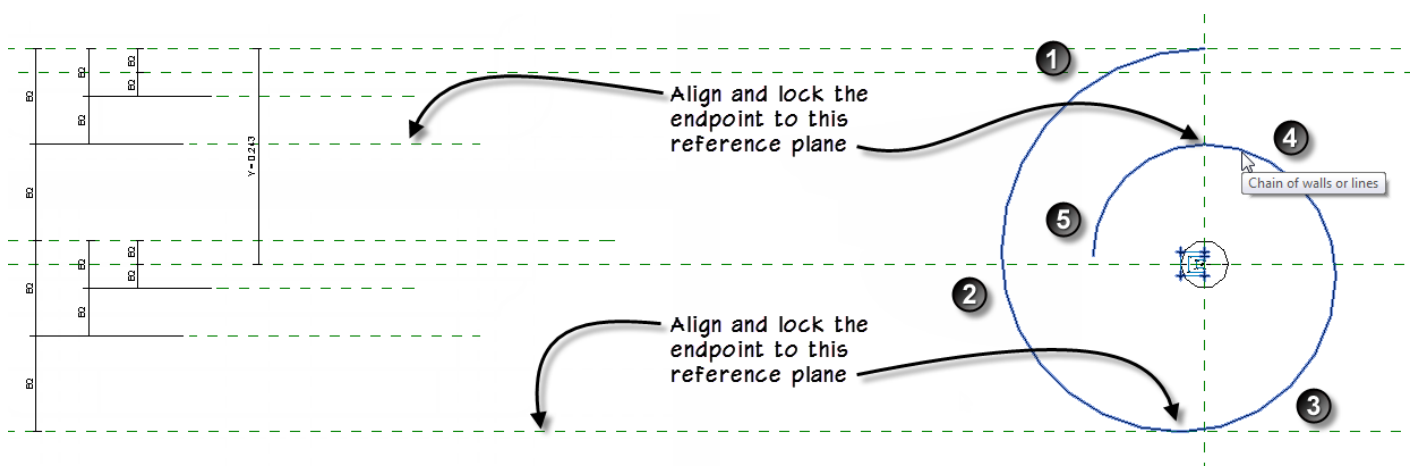


FIGURE 9—CREATE THE FIRST FIVE ARCS OF THE OUTER SHAPE OF THE VOLUTE FILLET

15. Save the file.

CATCH UP! You can open a file completed to this point named: *10_Ionic Volute Profile_B.rvt*.

ADD REFERENCE PLANES WITH EQUALITY DIMENSIONS

The collection of reference planes off to the left side at first looks somewhat chaotic. However, there is a strategy to how I have laid them out. Zoom the screen so you can see all the reference plans at the left. In Figure 10 I have added a graphic scale to the left to help illustrate the relationships of the reference planes. Note first that everything is slightly off center. The overall distance between Top and Bottom reference planes is the height of the volute. The Y parameter controls the distance from the Center (Vertical) reference plane (which is the origin of this family) and the Top reference plane. The Center (Vertical) reference plane is also the location of the volute eye. Everything else is driven by a series of nested equality dimensions.

As you study the groupings of reference planes, notice that I have varied the lengths of each set to help make them easier to understand. I also stagger the dimensions. So first we divide the total height into four. Then we subdivide the top quarter in half to make each an eighth of the total. Then subdivide it in half again to give us the size of the fillet at the top. I carried this reference plane all the way across since we start our arcs at the top. A similar subdivision occurs to locate the eye at the Center (Vertical) reference plane.

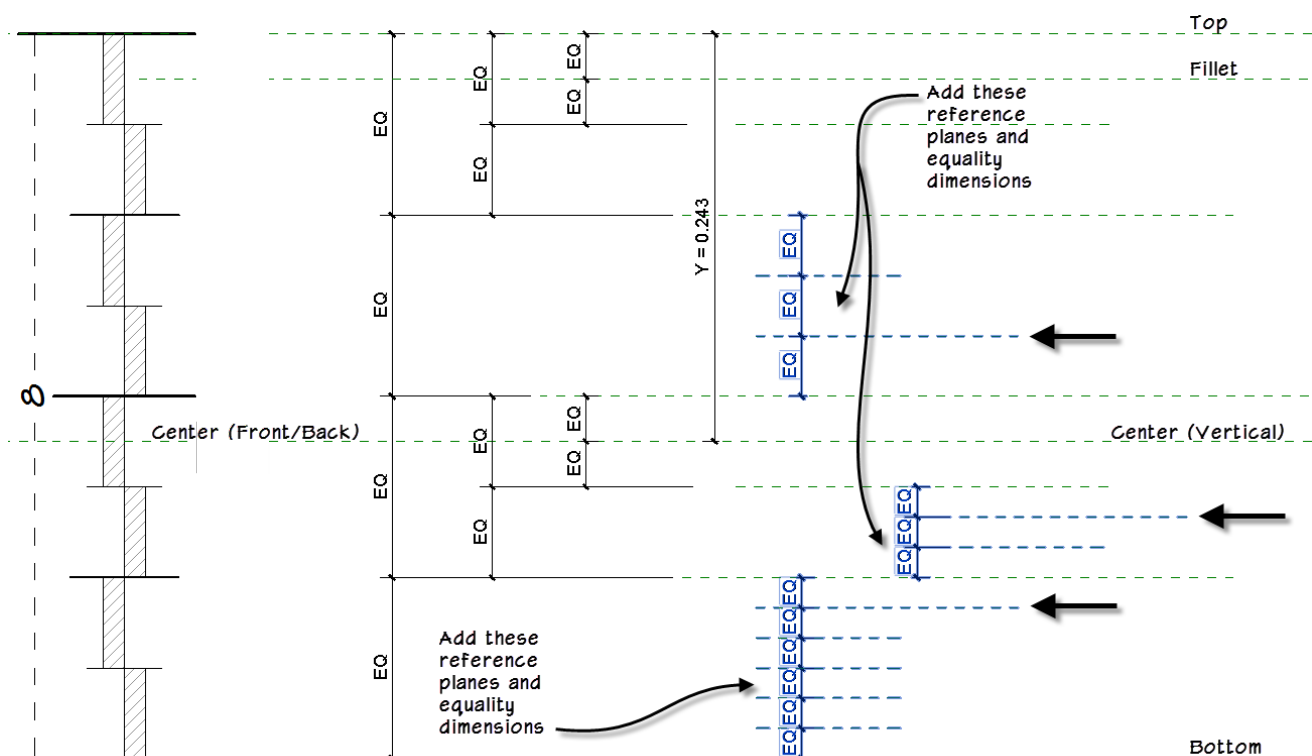


FIGURE 10—ANALYZE THE REFERENCE PLANES AND EQUALITY DIMENSIONS, ADD ADDITIONAL ONES

As you saw when creating arcs 4 and 5, even if the reference plane is off screen, you can still snap to it and lock to it. So, let's create a few more groups of equally spaced reference planes. We only need three for the purposes of snapping geometry. These are the ones indicated with the bold arrows in Figure 10. However, to use the equality dimensions, you must add additional ones as well. I like to vary the length make the important ones stand out. So, when creating the reference planes indicated in the figure, make the ones with the arrows a little longer. (Optionally you can create a new subcategory for reference planes that is a different color, line pattern or weight and assign it to the primary ones).

1. Using Figure 10 as a guide, create three groups of reference planes and equality dimensions as indicated.
 - ⇒ At the bottom, create five reference planes (for six equal spaces) with the top one longer. Add the equality dimension.
 - ⇒ In the other two areas, add two reference planes (for three equal spaces).

- Continue the procedure outlined above to add arcs 6 through 12. (You are snapping to the longer reference planes in each group you created here).

Remember, it is best to add each arc one at a time and stop and turn on the center mark and align and lock as you go. Align and lock any time you see an Automatic Sketch Dimension appear.

Be sure to flex often as you work.

- When you complete arc 12, flex again trying several different values like: **0.500**, **0.750**, **1.250**, **1.500** and **2.000**. Return to **1.000** before continuing (see Figure 11).

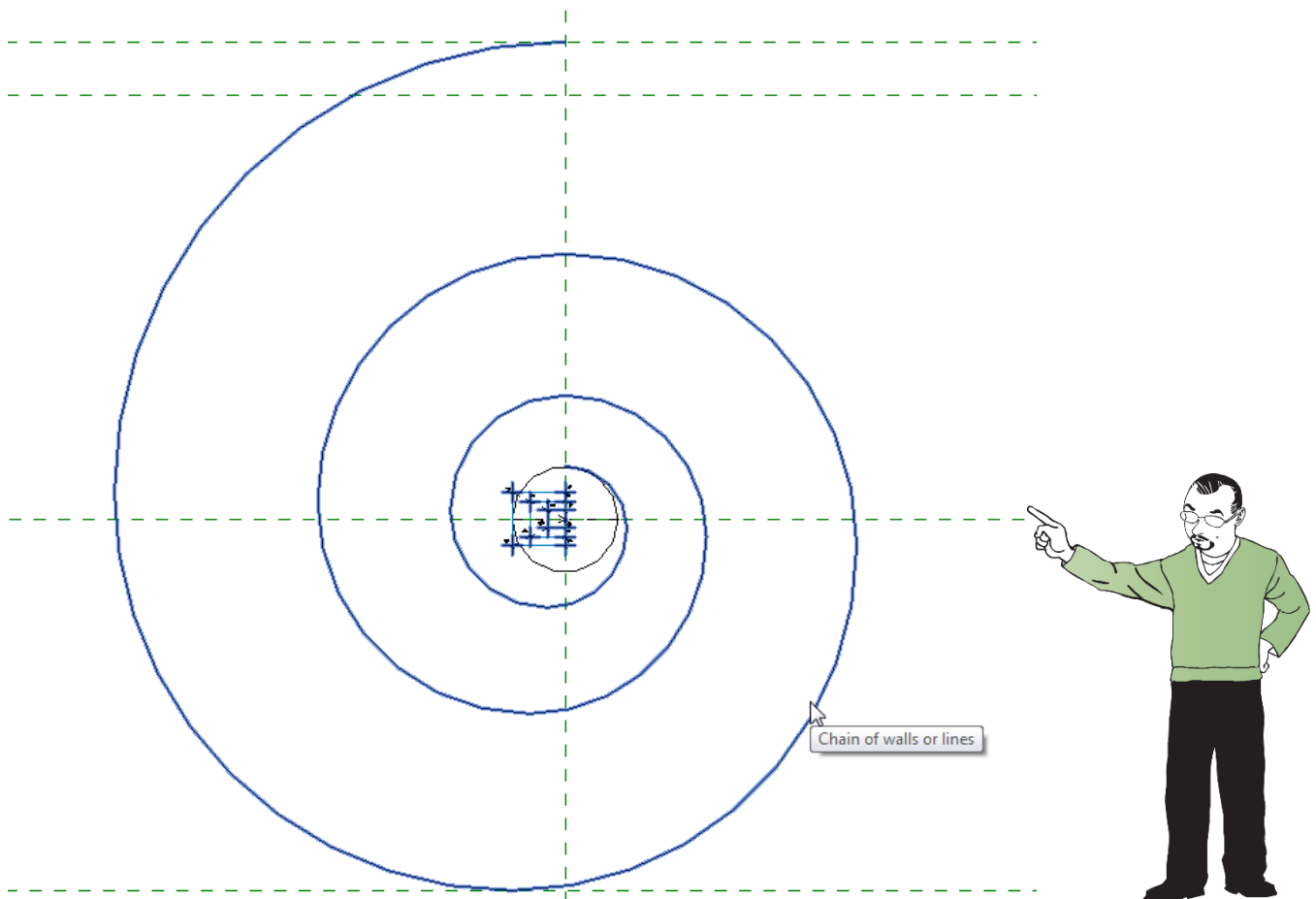


FIGURE 11—ADD THE REMAINDER OF THE 12 ARCS AND FLEX TO ENSURE IT IS WORKING

- Save the file.

CATCH UP! You can open a file completed to this point named: *10_Ionic Volute Profile_C.rvt*.

CREATE THE INNER FILLET EDGE

We are half way there! The twelve arcs we have here are the outside edge of the volute fillet. We need to create a second spiral inside of the first one that will be the inside edge of the fillet. The process is nearly the same. But this time, I'll save you some effort. I built another rig to help us along.

Continue in the same file or open the catch-up file.

- Select the Volute Eye Rig onscreen.
- ⇒ On the View Control Bar, click the Temporary Hide/Isolate pop-up (sunglasses) and choose **Hide Element**.

2. Highlight one of the arcs, press TAB (they will all highlight) and then click to select the chain.
- ⇒ From the Temporary Hide/Isolate pop-up choose **Hide Element** again.
3. On the Create tab, click the Detail Component button.
4. From the Type Selector, choose **Inner** and then click at the intersection of the two center reference planes to place it (see Figure 12).

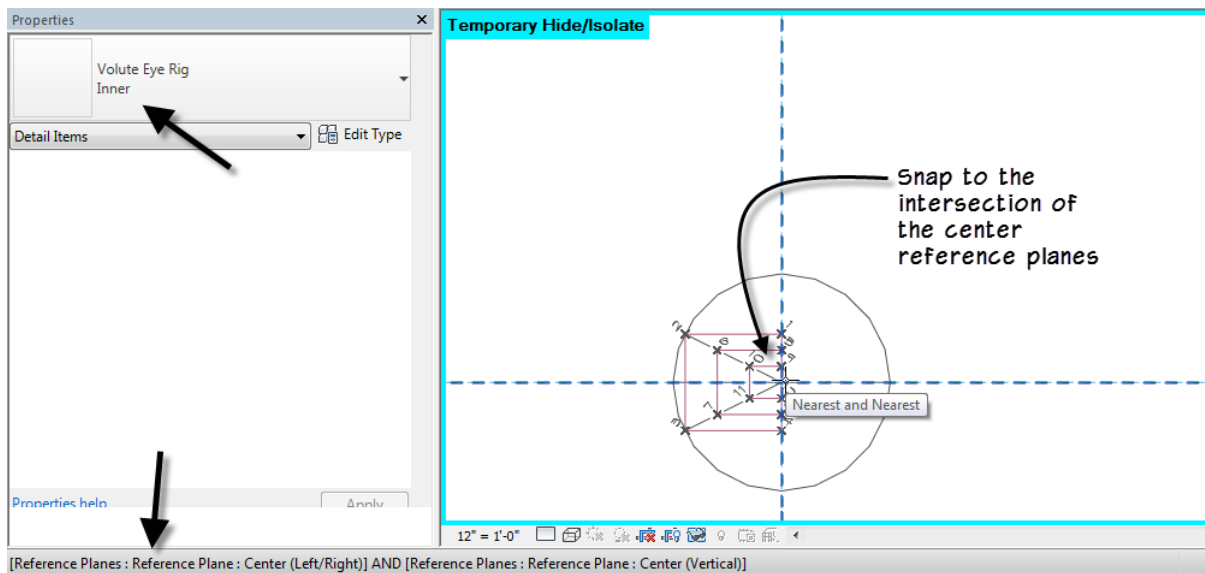


FIGURE 12—PLACE ANOTHER RIG FOR THE INNER POINTS

5. Align and lock this rig in both directions.
- ⇒ Select the element onscreen, on the Properties palette, click the Edit Type button and link up the Base Diameter parameter.

We'll also need another collection of reference planes like the ones on the left in the same proportions but slightly closer together. We could simply layout more reference planes, carefully place them in groups, add dimensions, toggle on equality, etc. But I have created another detail item family for this instead. The family contains a copy of all the reference planes and equality dimensions on the left. In fact, I have set up two types in this family like the Volute Eye Rig, so if you wanted to, you could use it for both the inner and outer fillet arcs. But since we already built the outer ones I would suggest leaving them as is. You can use this rig for any future volutes you might need to create however.

6. On the Create tab, click the Detail Component button again.
- ⇒ On the Modify | Place Detail Component tab, click the Load Family button.
- ⇒ Select the *Reference Rig.rfa* file and then click Open.
7. On the Type Selector, make sure that **Inner** is chosen and then place an instance at the intersection of the two center reference planes.
- ⇒ Align and lock in both directions. (Pay close attention to the Status Bar to make sure you are selecting the correct alignment edges).
- ⇒ Select the element onscreen, and then on the Properties palette, click the Edit Type button and link up the Base Diameter parameter (see Figure 13).
8. Flex the family. Reset to **1.000** before continuing.

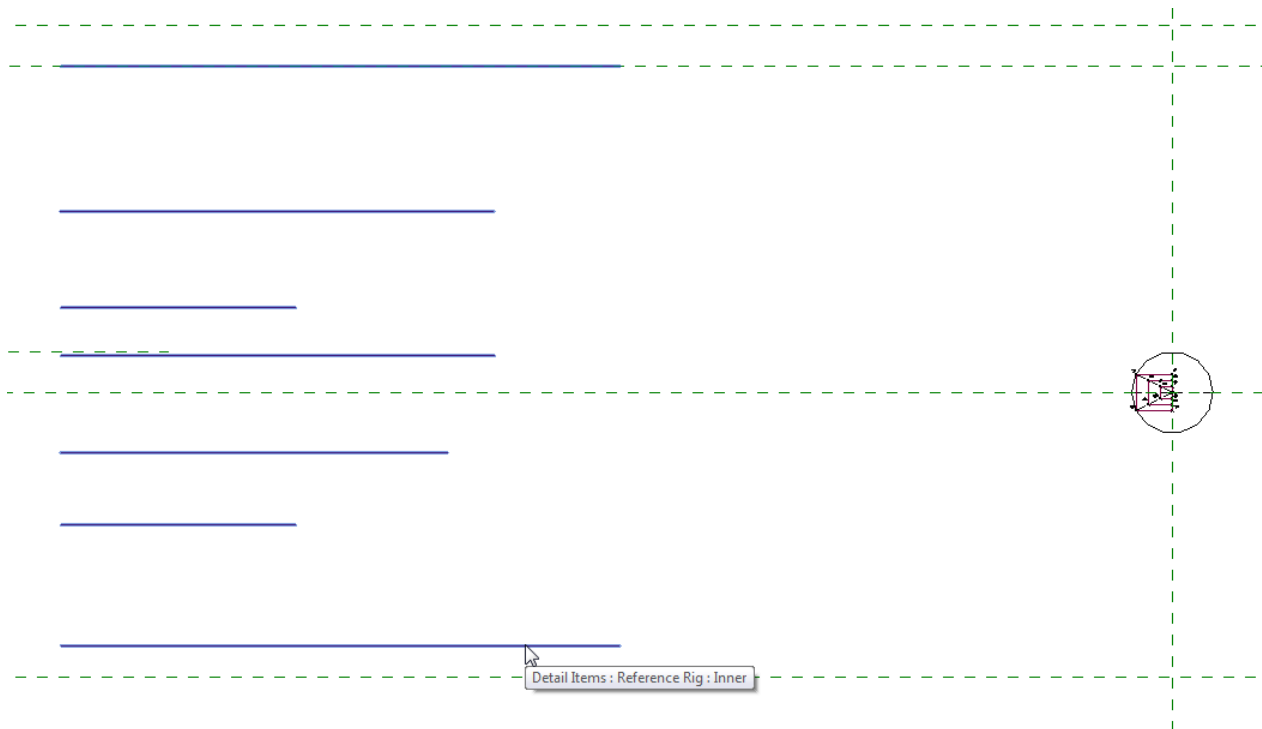


FIGURE 13—INSERT THE REFERENCE RIG TO CONTROL THE RADII OF THE INNER FILLET ARCS

Following the procedure above, create all the arcs.

Zoom in closely on the detail rig.

9. On the Create tab, click the Line button and then click the Center-ends Arc.
 - ⇒ Snap the center point to the intersection at point 1 on the rig.
 - ⇒ Pull straight up 90° and snap to the topmost reference plane. (Make sure it is exactly 90° before you click).
 - ⇒ Pull straight to the left at 90° again and then click (like Figure 7 above).
 - ⇒ Enable the center mark and then align and lock the endpoints at each end in both X and Y directions.

You should have a quarter circle centered on point 1.

10. Repeat the process to add arcs 2 through 12.

Remember, take your time. Align everything carefully. Try to eliminate all Automatic Sketch Dimensions as you go. It is possible to draw all the arcs and then align and lock everything, but if you are not extra diligent in doing so, you can easily miss some. So even though it is more tedious, I recommend doing one arc at a time. Save and flex regularly.

11. On the View Control Bar, from the Temporary Hide/Isolate pop-up, choose **Reset** (see Figure 14).

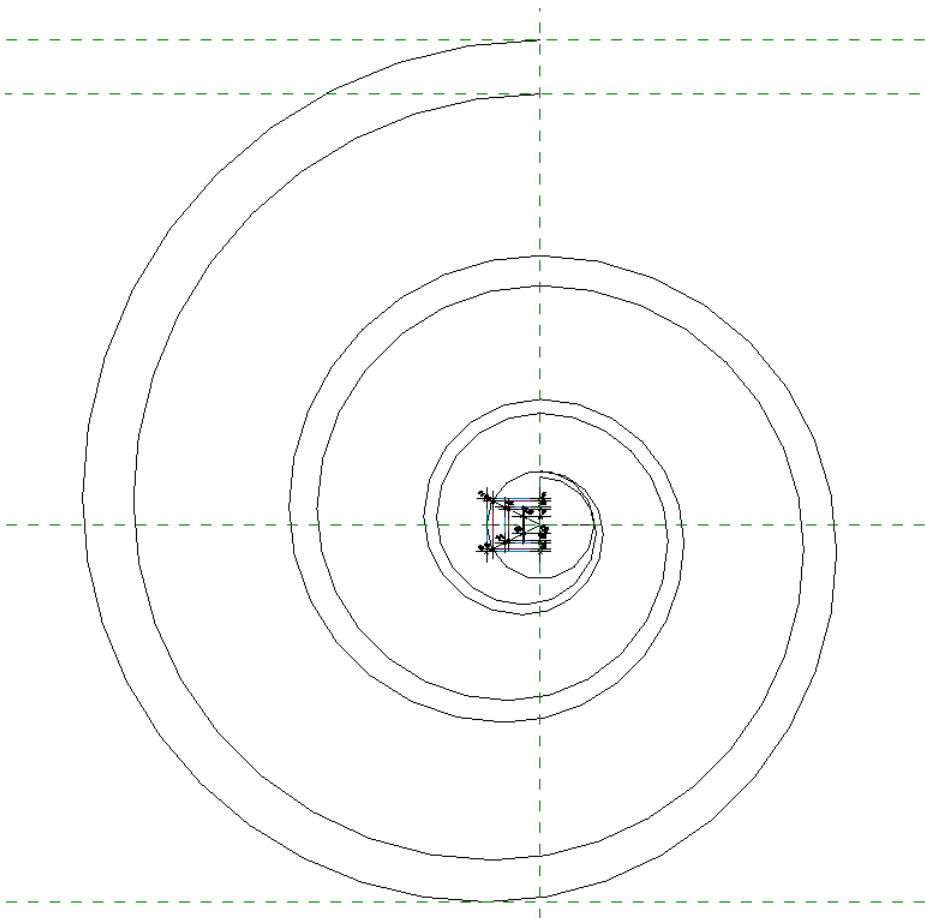


FIGURE 14—ALL OF THE ARCS COMPLETE

12. Save the file.

CATCH UP! You can open a file completed to this point named: *10_Ionic Volute Profile_D.rvt*.

COMPLETE THE PROFILE

We've completed the hard part. All that remains is to add a few additional line segments to close off the profile. Off to the right in this file is a vertical reference plane named: "Centerline of Column." There is a labeled dimension (X1) connecting this to the Center (Left/Right) reference plane. Some authorities put the centerline of the eye directly over the outside edge of the column at the base, others have the edge of the eye lined up with the column edge or even the center of the eye lined up with the edge of the entablature. Since these variances exist, I have added a multiplier to the formula for the X1 parameter. You can open "Family Types" to see this.

Another consideration is the type of capital you are creating. The Ionic capital can be four sided (with the volutes at 45° angles) or two sided (where the volutes are flat to the viewing plane and parallel to one another). There are even some variations that combine the two for corner conditions. (One corner will project out at a 45° angle and the other faces will be flat). I am demonstrating the flat or 2-sided version here. However, it is possible to reuse this volute profile in the other contexts as well. So, this is another reason why the multiplier on X1 is important. As you might expect, the distance of the projection along X1 would vary in each type of capital.

Let's add the remaining lines needed to enclose this profile.

Continue in the Ionic Volute Profile file or open the catch-up file.

1. Zoom in close on the eye.
2. Draw a small straight line to connect the endpoints of the inner and outer arc 12.
- ⇒ Align and lock it to the vertical reference plane (see the left side of Figure 15).

TIP: If you have trouble selecting the vertical reference plane to align, use Temporary Hide/Isolate to hide the rig detail families.

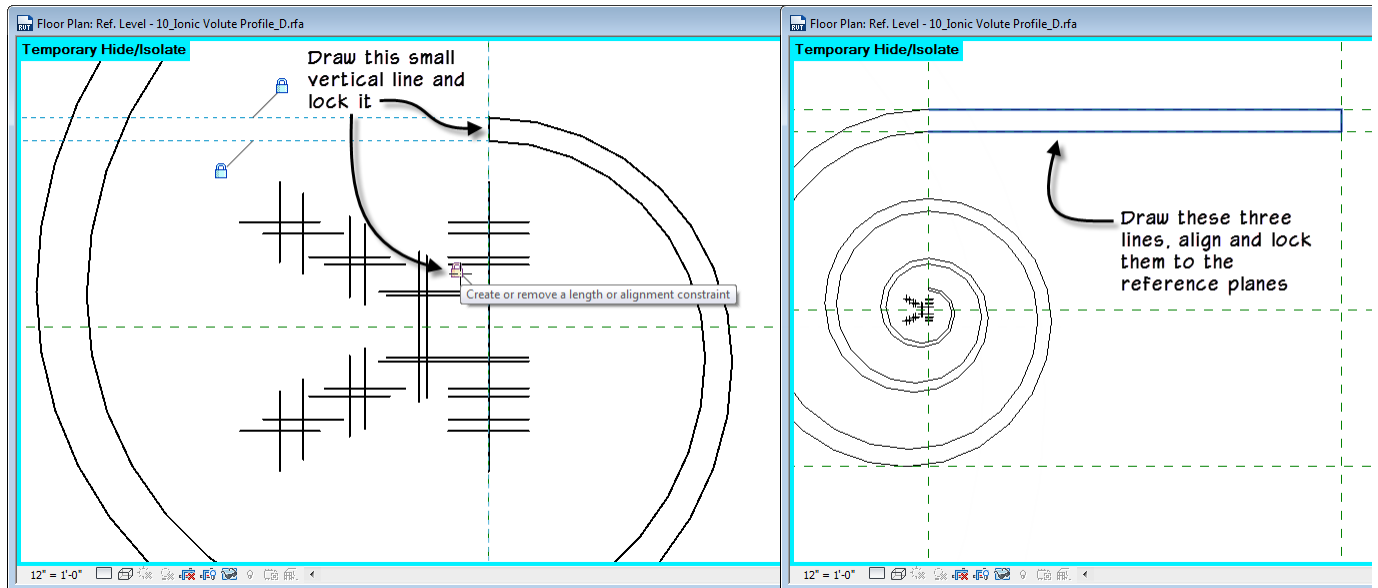


FIGURE 15—ADD A VERTICAL LINE TO CLOSE THE ENDS OF INNER AND OUTER ARC 12. COMPLETE THE HORIZONTAL PORTION AT THE RIGHT

3. Add three straight lines at the right:
 - ⇒ One aligned and locked with the Top reference plane.
 - ⇒ One aligned and locked to the Centerline of Column reference plane.
 - ⇒ The last one aligned and locked to the Fillet reference plane.
4. Open “Family Types” and flex the Distance Center to Eye parameter. Reset to **0.500** before continuing.
5. Reset the Temporary Hide/Isolate and then save the file.

Congratulations! That was the toughest part. But there is much more to do.

CATCH UP! You can open a file completed to this point named: *10_Ionic Volute Profile.rvt*.

CREATE THE SECOND VOLUTE PROFILE

I know what you’re thinking, “second profile?” Don’t worry, this one is much simpler than the first. The volute we will be creating is made up of two pieces. The profile we just built is for the fillet that spirals around the edge of the volute. This new profile is the backup material from which the fillet will rise. Here’s the best part; we only need to save the current file with a new name and delete what we don’t need. So, it will be much simpler indeed.

Continue in the Ionic Volute Profile file or open the catch-up file.

1. From the File menu, choose **Save As > Family** and name the new file: **Ionic Volute Back Profile**.
2. Zoom in on the eye and delete the small vertical segment that we drew in the previous exercise.

⇒ Zoom back out and delete arc 1 for the inner edge (see the left side of Figure 16).

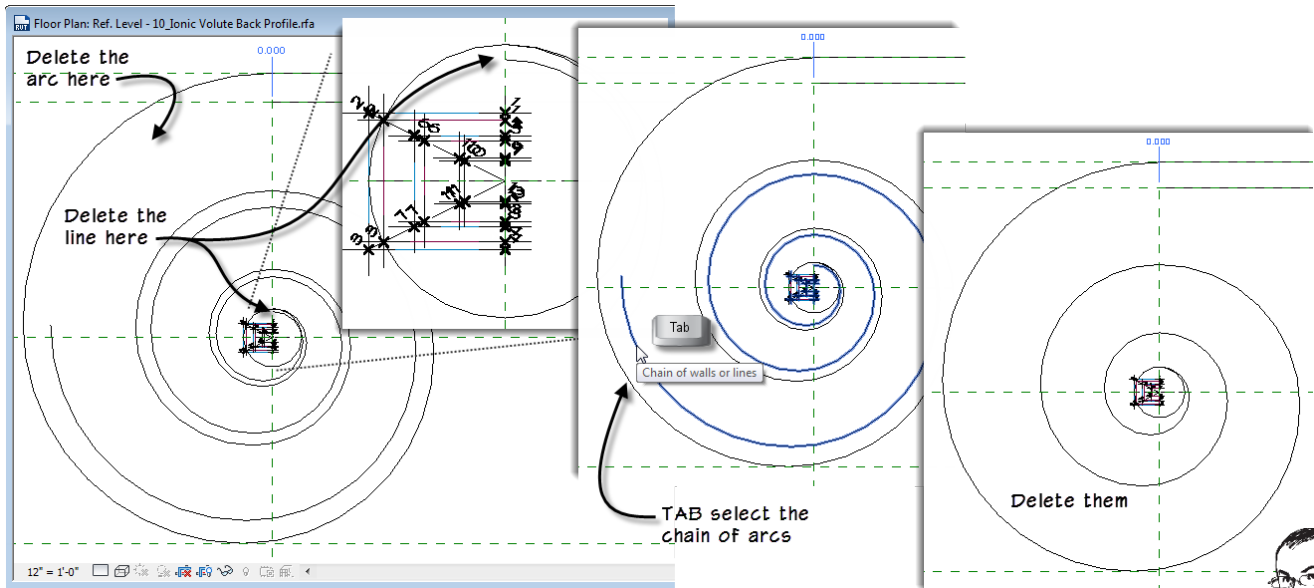


FIGURE 16—DELETE THE UNNEEDED LINES

3. Highlight arc 2, press TAB to highlight all the inner arcs and then click to select the chain.
- ⇒ Delete this chain of arcs (see the right side of Figure 16).
4. Delete arc 5.
- ⇒ Chain select arcs 6 through 12 and delete these as well.
- ⇒ Delete the Inner Reference Rig onscreen. (The one with the horizontal red lines).
- ⇒ Zoom in close on the eye. Delete *only* the Inner Volute Eye Rig.



Important: Do *not* delete the Outer one (the one with blue lines).

5. Zoom out. On the Modify tab, click the Align tool.
 - ⇒ For the reference line, click the horizontal reference plane that lines up with the endpoint of arc 4 (this is the fourth horizontal reference plane from the top).
 - ⇒ For the entity to align, click the horizontal line on the Fillet reference plane.
 - ⇒ In the warning that appears, click the Remove Constraints button.

The element is currently locked to the Fillet reference plane. So, we must unconstrain it before we can lock it to a different reference plane.
6. Lock the alignment (see Figure 17).

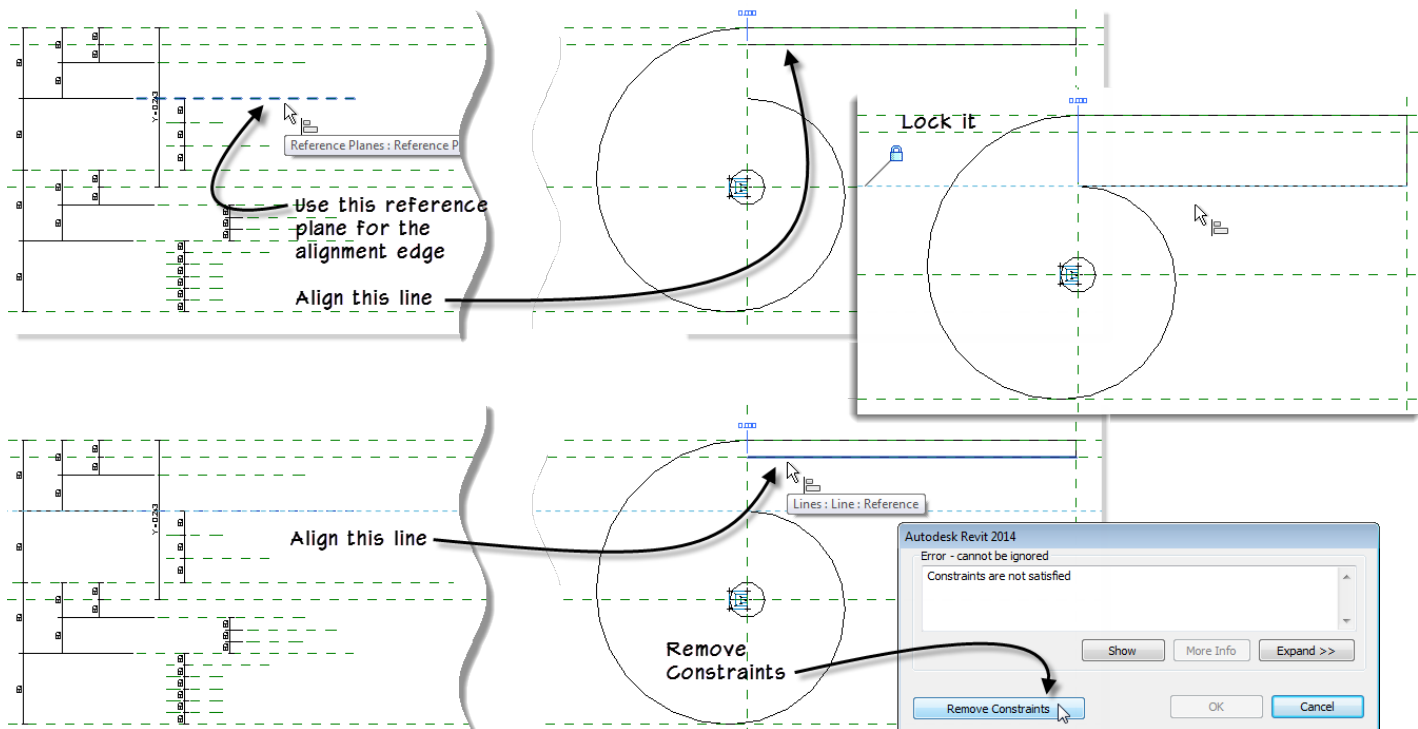


FIGURE 17—ADJUST THE SHAPE OF THE PROFILE

7. You will notice one Automatic Sketch Dimension remains. Align and lock the endpoint of the horizontal line to eliminate this.
8. Open “Family Types” and flex. Reset all values before continuing.
9. Save the file.

If you like, you can clean up the file a little by deleting the reference planes that are no longer needed. But this is not necessary.

CATCH UP! You can open a file completed to this point named: *10_Ionic Volute Back Profile.rvt*.

CREATE THE IONIC CAPITAL

Much of the basic structure we need for the Ionic capital (minus the volutes) is similar to the Doric capital. However, since we are only considering the Ionic here, allow me to describe briefly what was created in the Doric that we are reusing. The abacus (topmost molding) is square in plan with a cyma reversa molding all the way around. Below that there is an ovolo molding. The Doric had more moldings below that which are not needed. With these removed, if you examine the provided file, there are two solids and one void. The abacus with its cyma reversa is an extrusion with a void sweep around it. The ovolo below that is a sweep that uses a nested profile for the ovolo shape.

I have provided another starting file for this part. I have deleted the unneeded moldings and adjusted the type properties of the profiles that we are keeping. In Figure 18 I have included an image of the Doric capital side by side with the Ionic starter for comparison. I have also included the “Type Properties” dialogs for both moldings that remain in the file.

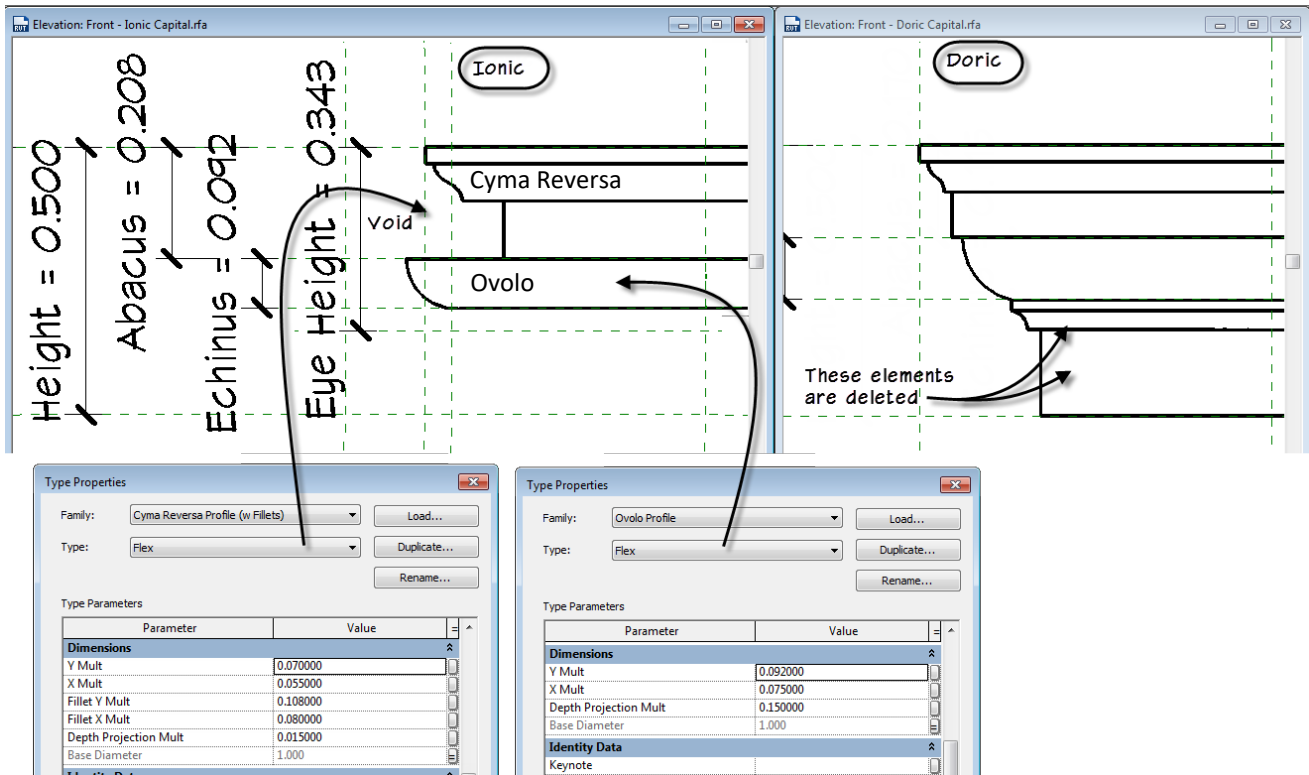


FIGURE 18—A COMPARISON OF THE MOLDINGS IN THE IONIC START AND DORIC CAPITALS

ADJUST THE ABACUS

We still need to make one adjustment to the abacus. Look carefully at the left side of the figure and you will see that we have quite a deep recess above the ovolo. This is controlled by the **Fillet X Mult** parameter in the Type Properties of the Cyma Reversa Profile. I chose this depth because it is what is needed on the front and back of the capital to accommodate the depth of the volutes. However, as you can see, this might be too deep on the sides. So, let's rework the void at the abacus.

1. Close any open files and then open the file named: *Ionic Capital_Start.rfa*.
2. Save the file as: **Ionic Capital**.

Feel free to explore the file a bit before continuing.

3. On the Project Browser, expand *Families > Profiles > Cyma Reversa Profile (w Fillets)*.
 - ⇒ Right-click Flex and choose **Duplicate**. Name it: **Sides**.
 - ⇒ Right-click Flex again and choose **Rename**. Name it: **Front and Back**.
4. Right-click *Sides* and choose **Type Properties**.
 - ⇒ Change the Fillet X Mult to: **0.005**, link up the Base Diameter parameter and then click OK.
5. In the 3D view, select the void form. (Use TAB if necessary).
 - ⇒ On the Modify | Void Sweep tab, click Edit Sweep. Click Pick Path and delete the left, back and right sides leaving a single line along the front edge. (Use the ViewCube to assist you in orientation).
 - ⇒ Click the Finish Edit Mode twice.

The void now only cuts the front edge. We now need to make three copies and modify each one.

6. Keep the void sweep selected. On the Modify | Void Sweep tab, on the Clipboard panel, choose Copy to Clipboard and then from the Paste drop-down, choose **Aligned to Same Place**.
 - ⇒ Click Edit Sweep and then Pick Path again. Delete the existing path line and then click the Pick 3D Edges button.
 - ⇒ Click only the right edge at the top of the extrusion. (Use the ViewCube to assist you in orientation).
7. Click the Finish Edit mode button once.
 - ⇒ Click the Select Profile button, and then on the Modify | Sweep tab, choose **Cyma Reversa Profile (w Fillets):Sides** from the Profile list.
 - ⇒ Click the Finish Edit Mode button.

We now have two different voids cutting the extrusion at the top. They each cut at a different depth (see Figure 19).

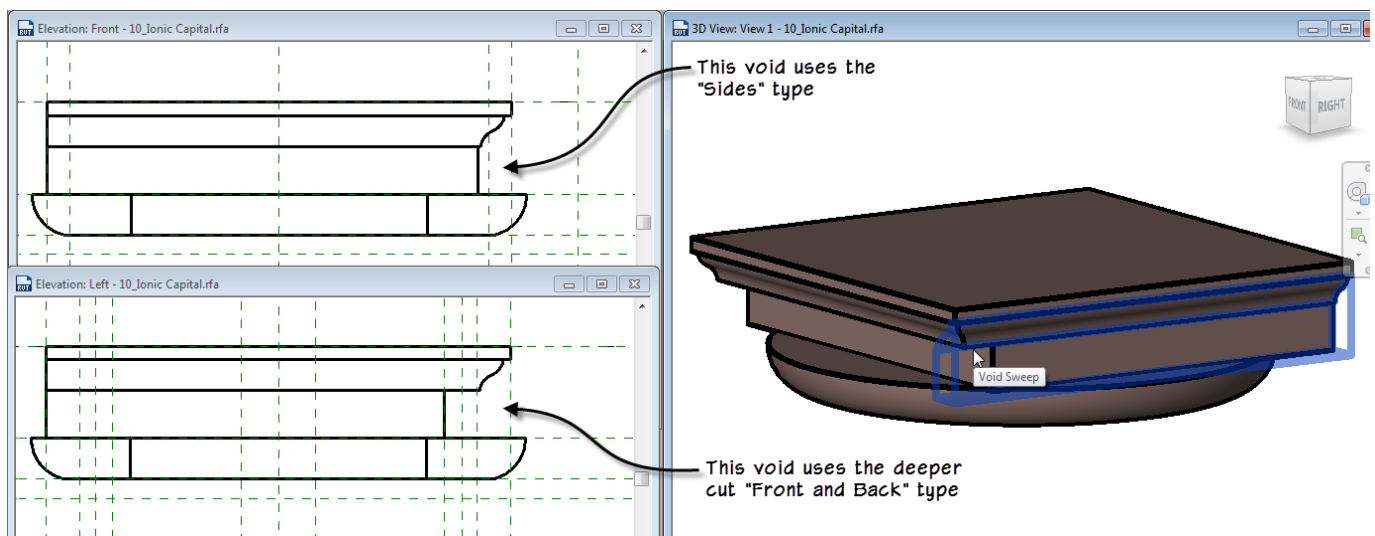


FIGURE 19—MODIFY THE FIRST SWEEP, COPY AND PASTE IT TO MAKE A VARIATION

8. Repeat the process twice more.
 - ⇒ Copy and paste the one on the right. Edit the path, delete the existing and pick the left side instead. Finish Edit Mode.
 - ⇒ Copy and paste the one on the front. Edit the path, delete the existing and pick the back side instead. Use the technique above to switch the profile back to “Front and Back.”
 - ⇒ Finish Edit Mode.
9. Flex Base Diameter to be sure everything is working. Return the value to **1.000** before continuing. Save the file.

While not completely necessary, these modifications will give a much nicer result when we are done adding the volutes and scrolls.

CREATE THE VOLUTE SWEEPS

If you completed the previous exercise, you are probably anxious to create some geometry from the scrolling profile that we built. So, let's get to work.

Continue in the *Ionic Capital* file.

1. Open the *Ref. Level* floor plan view.

As you can see, I have transferred the extra reference planes and parameters from the schematic capital that we discussed at the start of the chapter. I have also added a couple additional ones that we will use for creating the volutes.

2. On the left side, near the bottom of the screen, select each reference plane in turn to familiarize yourself with their names.

The first sweep will be drawn from Volute Scroll Front to Volute Fillet Front.

3. On the Create tab, click the Sweep button. Then click the Sketch Path button.
 - ⇒ On the Work Plane panel, click the Set button.
 - ⇒ In the “Work Plane” dialog, from the Name list, choose: **Reference Plane : Eye Height** and then click OK.
 - ⇒ Draw a single short line segment running vertically along the “Volute Eye Center Left” reference plane.

Snap its length between the intersection of “Volute Scroll Front” and “Volute Eye Center Left” to the intersection of “Volute Fillet Front” and “Volute Eye Center Left” (see Figure 20). (Draw from top to bottom in plan view).

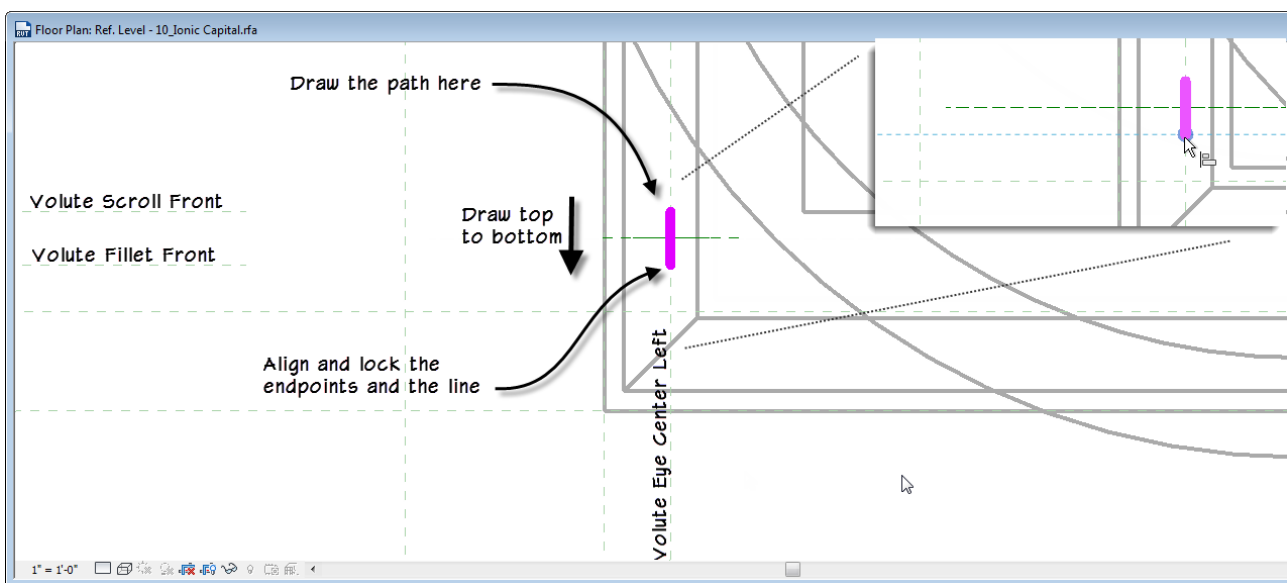


FIGURE 20—SKETCH THE SWEEP PATH AND LOCK IT TO THE REFERENCE PLANES

4. Align and lock the sketch line to the “Volute Eye Center Left” reference plane.
 - ⇒ Align and lock each endpoint to the horizontal reference planes as well.
5. Click the Finish Edit Mode button.
6. On the Modify | Sweep tab, click the Load Profile button.
 - ⇒ Load your *Ionic Volute Back Profile.rfa* file (or use the catch-up file).
 - ⇒ From the Profile drop-down, choose the **Ionic Volute Back Profile:Flex** profile.
7. Finish Edit Mode.

Take a look at the results in elevation and 3D.

8. Back in plan view, repeat the process to create the scroll in front of the backing sweep.
 - ⇒ Draw the path on the same line, but this time snap it between the intersection of “Volute Fillet Front” and “Volute Eye Center Left” to the intersection of “Volute Front” and “Volute Eye Center Left.”
 - ⇒ Be sure to lock the edge and both end points.
 - ⇒ Load the *Ionic Volute Profile.rfa* file (or use the catch-up file) for the profile.
9. Add a small cylinder at the eye location.

The eye cylinder has a radius of 0.027 times the Base Diameter. I have already included a parameter in the file for this named: **Eye R**. You can either switch to *Front* view, and draw a cylindrical extrusion, or you can stay in plan and do another sweep. The cylinder should protrude slightly beyond the front of the scrolls. I reused the **Scroll Backing** parameter for this which achieves the result. If you prefer, you can define new reference planes and parameters (see Figure 21).

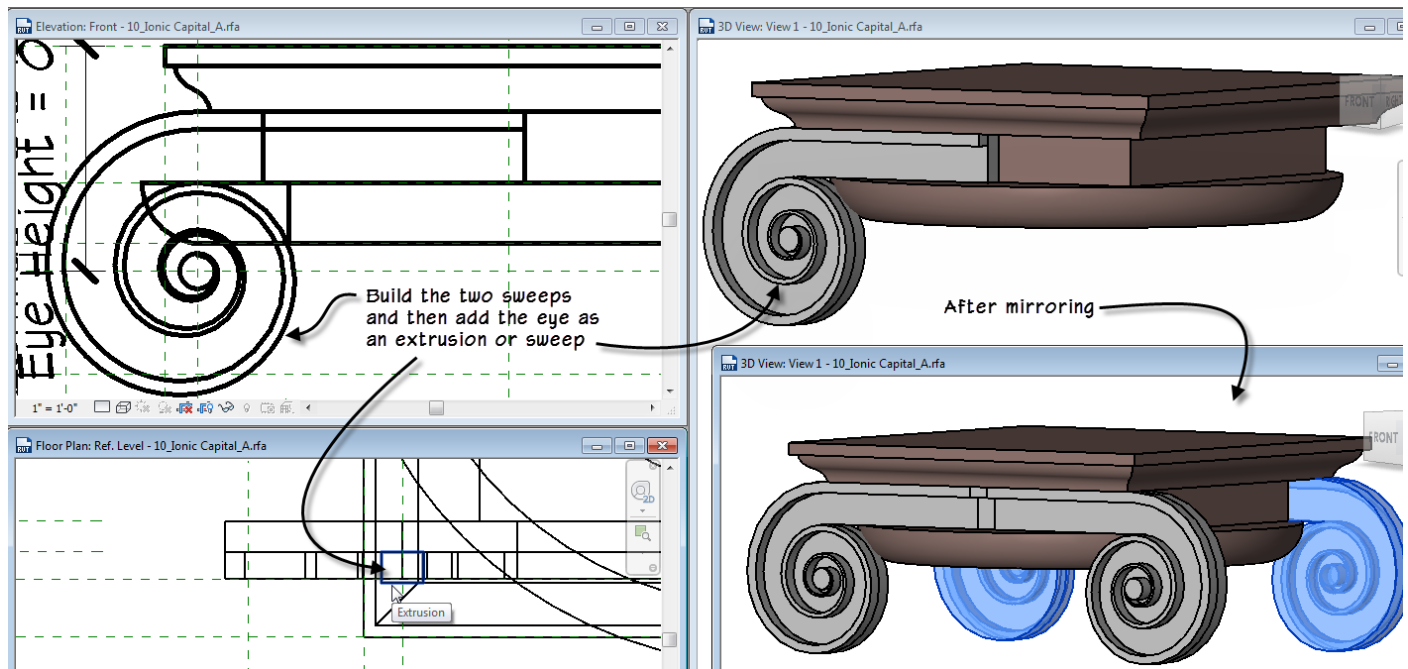


FIGURE 21—CREATE SWEEPS FOR THE VOLUTE, AN EXTRUSION FOR THE EYE AND THEN MIRROR

10. Select both sweeps and the eye (extrusion or sweep).
- ⇒ Mirror them to the right.
- ⇒ Select the originals and the copies (6 elements) and mirror to the back.

Now we have something that looks like an Ionic capital! All that hard work begins to pay off. There are a few finishing touches.

11. On the Project Browser, edit the Type Properties of both volute profiles.
- ⇒ Link up the Base Diameter parameter and change the value of Distance Center to Eye to: **0.475**.
12. Use Join Geometry and join all parts of the volute together.
13. Edit each sweep, edit the paths and align and lock them and their endpoint to the appropriate reference planes. Do the same for the extrusions.
14. Select the volutes and link up their Material to the **Capital Material**.

TIP: Use the TAB key to highlight and select Solid Joined Geometry before linking up the material parameter.

15. Flex Base Diameter to be sure everything is working. Return the value to **1.000** before continuing. Save the file.

CATCH UP! You can open a file completed to this point named: **10_Ionic Capital_A.rvt**.

CREATE THE SCROLLS

The last piece we need in the model is the scrolls that span across the depth connecting the two volutes together. The form of these is somewhat challenging. In plan, they follow the curvature of the column shaft on the inside. The outside shape is a little more flattened but still freeform. The same is true in elevation. I tried a lot of variations for this form. Ultimately, I settled on a swept blend. Swept blends can use two profiles and blends between them along a single segment path. While the path of a swept blend can only be a single segment, it can be nearly any shape. I experimented with an arc, an ellipse and spline path shapes. I settled on the picked path because it proved a nice compromise between the other options and it stays constrained to the picked form when flexing which is a big help. We'll need to do a little setup; a few reference planes and dimensions.

IMPORT THE PROFILE FAMILIES

To save some steps, I have created the profiles already and provided them in the dataset.

Continue in the *Ionic Capital* file or open the catch-up file.

1. Open the *Ref. Level* floor plan view.
2. Draw a section from right to left along the center line. (It will cut right through the capital and look down).

Adjust the crop region to crop a little closer. Set the scale as desired and zoom in (see Figure 22).

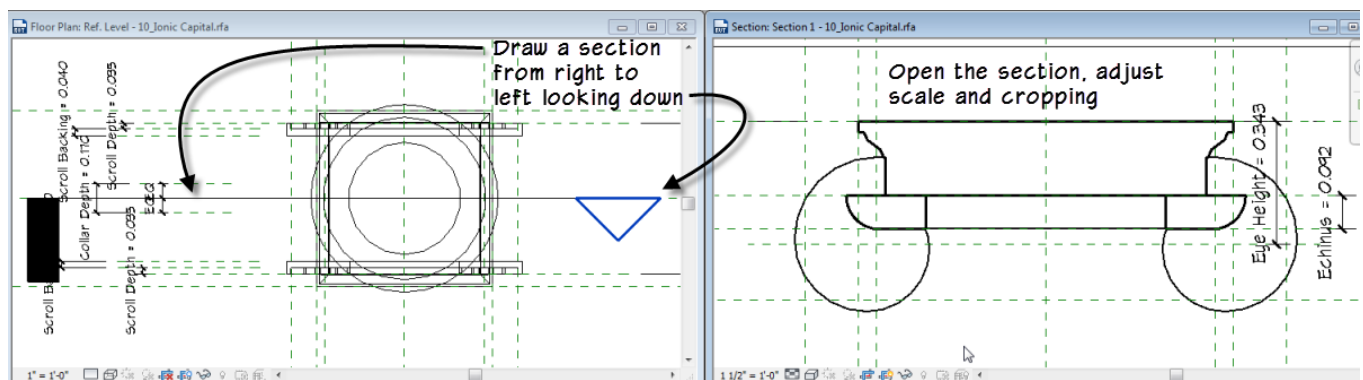


FIGURE 22—CREATE A SECTION VIEW

I have created three profiles for this task. Let's load them now.

3. On the Insert tab, click the Load Family button.
⇒ In the "Load Family" dialog, hold down the CTRL key, select the *Ionic Collar.rfa*, *Ionic Scroll Inside.rfa* and *Ionic Scroll Outside.rfa* files and then click Open.

On Project Browser these three files will now be listed with the other Profiles.

4. Edit the Type Properties of each of these three loaded profiles and link up their Base Diameter parameters.

If you like, you can right-click any of these files and choose **Edit** to open the files and explore them. The parameters are very basic; mostly X and Y offsets and widths. Each of these files uses a spline for the freeform part of the curve. The reason for this is that you only need to lock the endpoints of the spline in both directions. With it constrained this way, it will scale proportionally and maintain its shape as you flex (see Figure 23). This is VERY useful!

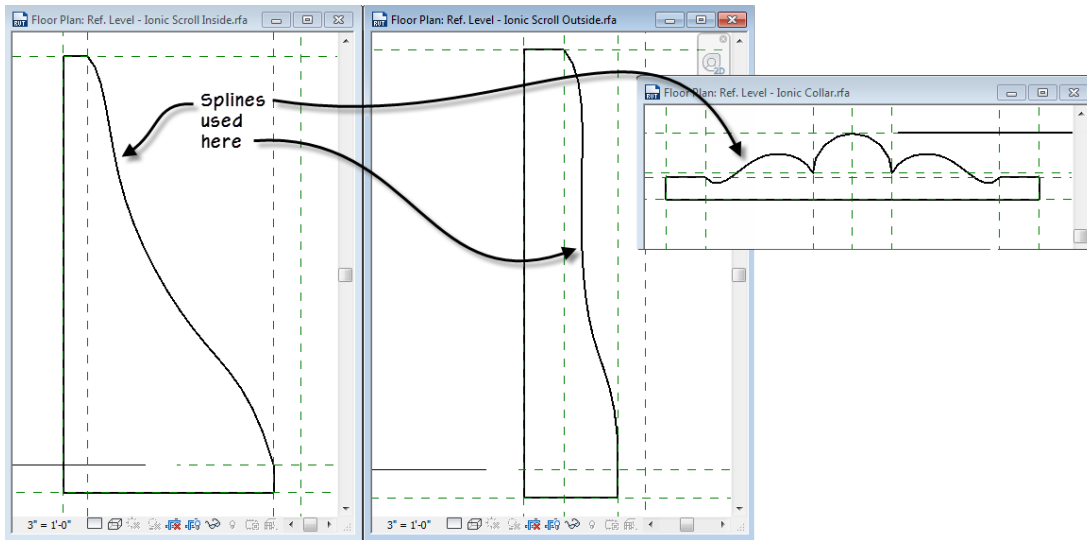


FIGURE 23—OPEN THE PROFILES; THEY USE SPLINES FOR THE FREEFORM EDGES

CREATE THE SCROLL FORMS

The scroll form will be constructed from the loaded profiles using a sweep and a swept blend.

5. In the *Section 1* view, create a new Sweep.
 - ⇒ Click the Pick Path button. On the left side of the screen, click the inside bottom edge. (This was arc 3 above).
An arc will be created along the picked edge.
6. Click Finish Edit Mode, and then from the Profile drop-down choose **Ionic Scroll Inside:Flex**.
 - ⇒ Click Finish Edit Mode (see Figure 24).

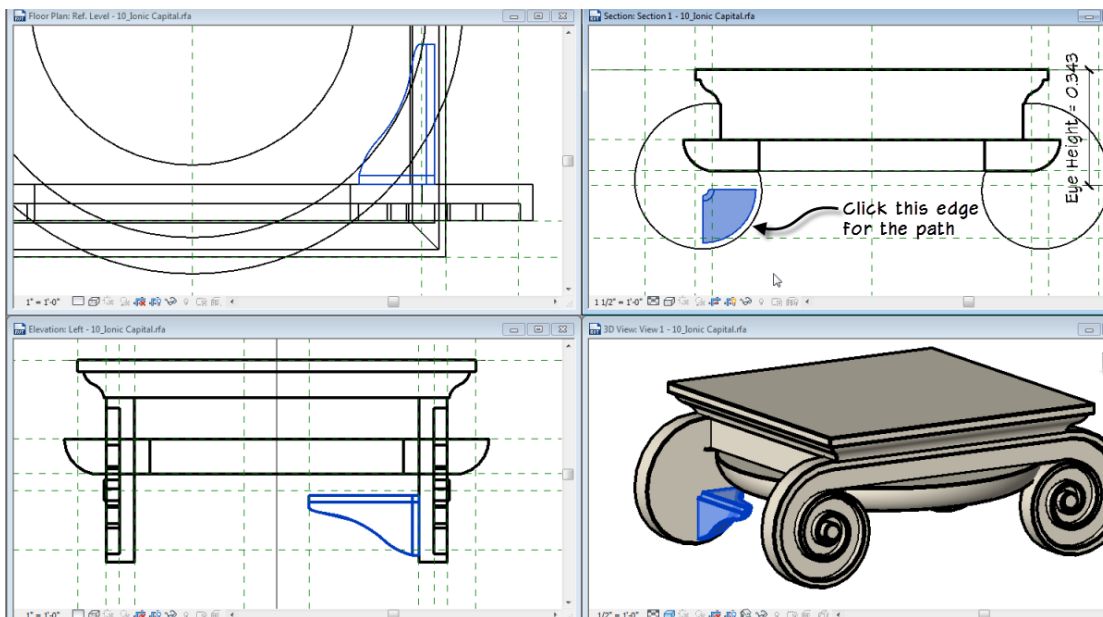


FIGURE 24—CREATE A SWEEP USING THE PICK PATH OPTION

Next to this form, we'll create a swept blend.

7. On the Create tab, click Swept Blend.

- ⇒ Click the Pick Path button. On the left side of the screen, click the outside bottom edge. (This was arc 2 above).
An arc will be created along the picked edge.
- 8. Click Finish Edit Mode, and then from the Profile drop-down choose **Ionic Scroll Inside:Flex**.
- ⇒ Click the Select Profile 2 button, and then from the Profile drop-down choose **Ionic Scroll Outside:Flex**.
- ⇒ Click Finish Edit Mode (see Figure 25).

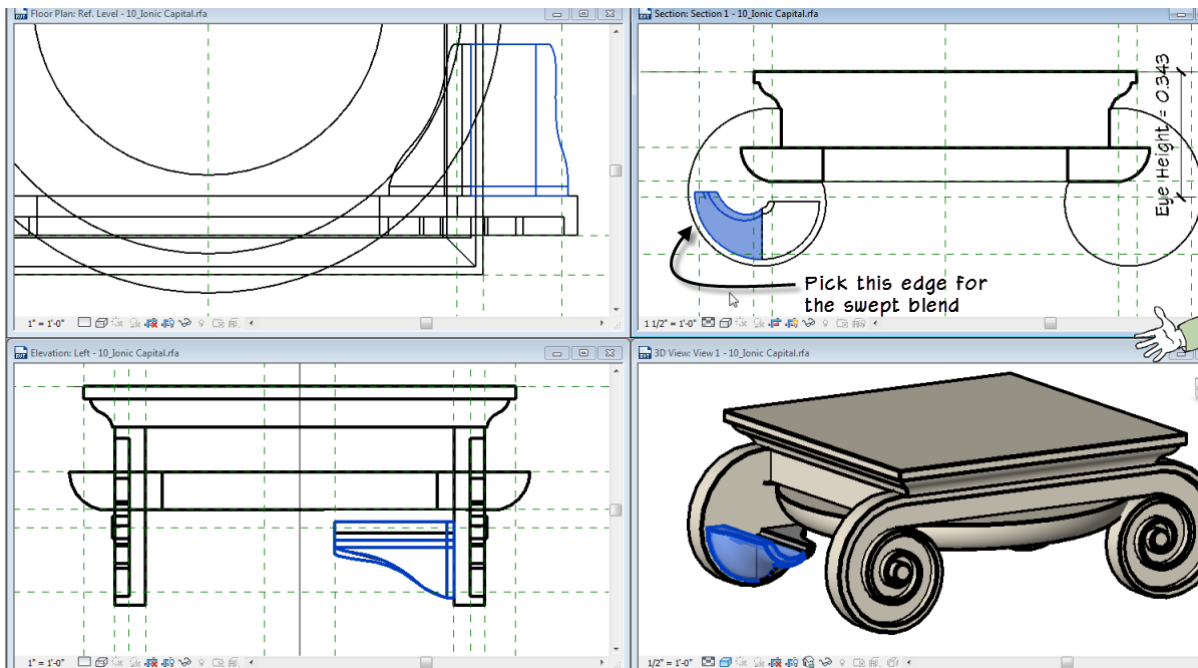


FIGURE 25—CREATE A SWEEP USING THE PICK PATH OPTION

Obviously, this form needs a little work. But let's flex everything first before we continue.

9. Flex Base Diameter to: **2.000** to be sure everything is working. Return the value to **1.000** before continuing. Save the file.

Note: If you try to flex below a value of 0.900, the volute profile will fail. The tolerances at that size become a little too small. But if we consider that a base diameter of 0.900 would yield a column that is about 8 feet tall (2,400 mm), this seems an acceptable lower limit size for most practical applications.

EDITING SWEEP AND SWEEP BLEND PATHS

Here's the interesting thing about Pick Path; we can adjust the length of these lines. This means that we can take these two forms and adjust them directly by adjusting the path. Remember, sweeps can have more than one segment in their path. *Swept blends cannot*. But in both cases, I opted for a single segment picked path and then manual adjustments because in my experiments this yielded the best results.

1. In the *Section 1* view, select the swept blend. On the ribbon click the Edit Swept Blend button.
 - ⇒ Click the Pick Path button.
 - Make sure that on the ribbon, the Pick 3D Edges button is *not* activated.
2. Click on the existing path sketch line onscreen.

- ⇒ Grips will appear at both ends. Drag the grip handle at the top until it curves around and snaps to the abacus above (see the left side of Figure 26).

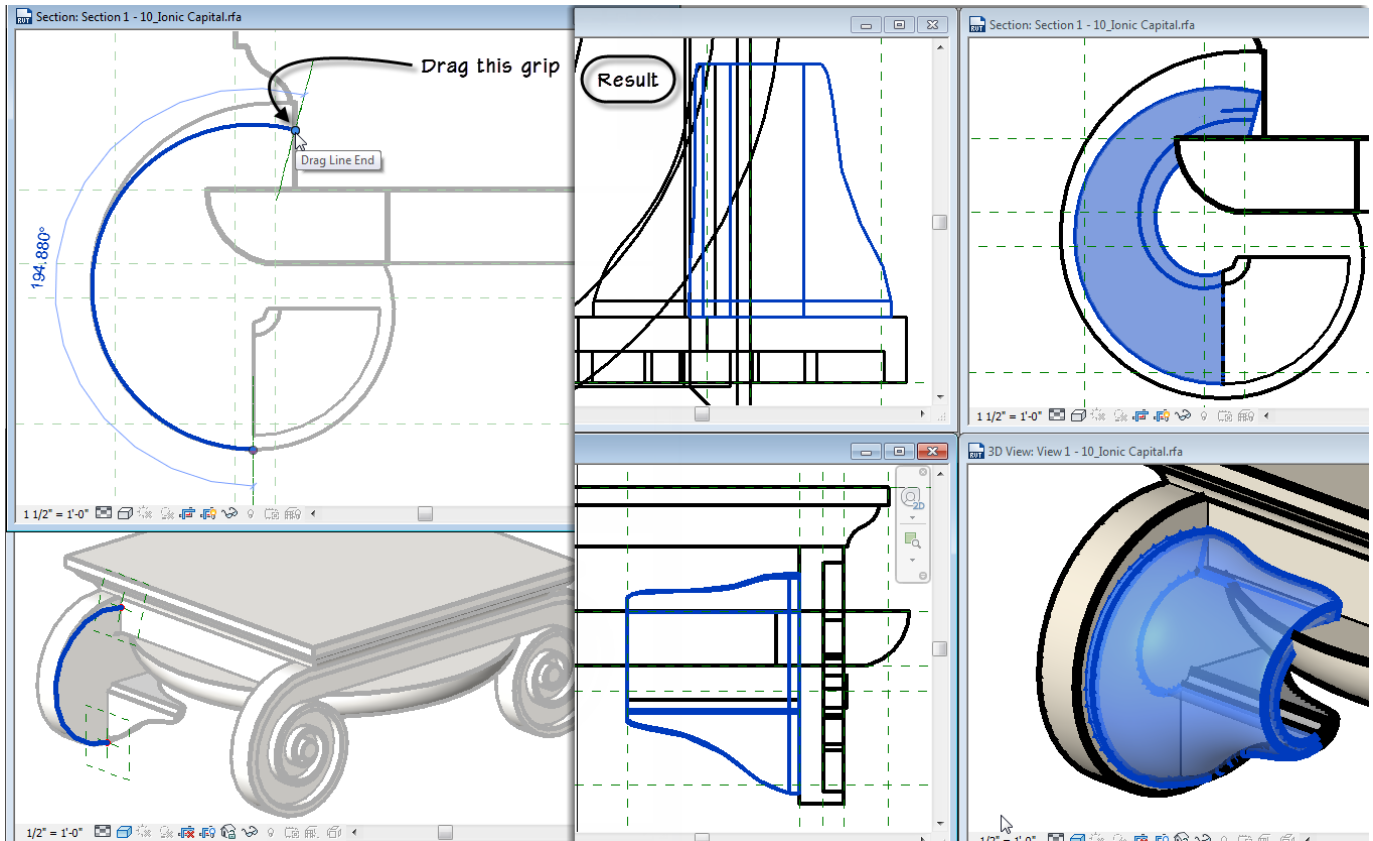


FIGURE 26—ADJUST THE PICKED PATH OF THE SWEEP BLEND

- ⇒ Click the Finish Edit Mode button twice (see the right side of Figure 26).

I especially like the way it looks in the plan view. In my experiments with these forms, I found that one view was always nicer than the others. I think that the plan view currently looks best and closest to the source materials I am trying to emulate. The elevation view is also very close. In the section view the compromise is obvious; we are using a single arc for the path, but the volute form that it sits against uses a compound curve made of more than one arc. I tried other variations as well. I tried sketching the path instead of picking it. When sketching, you must set your path work plane. I used the “Volute Scroll Front” work plane. Remember that with a swept blend you must use a single curve for the path. A spline is an obvious choice. You can get the spline shape very close to the existing curve. An elliptical arc actually produced better results in my test. But ultimately, I decided that the tradeoff here with the picked arc curve was acceptable. You are welcome to experiment with other paths if you wish. Just keep in mind that if you sketch the path, you will have to constrain the sketch to be able to flex the model. This will likely require some additional reference planes, dimensions and parameters.

Let’s adjust the sweep path the same way. This one we are going to stretch around to make a half circle.

3. Select the sweep. Edit it and then click Edit Path.
 - ⇒ Like we did for the swept blend, drag the top endpoint up until the angle of the arc is 180° and then click Finish Edit Mode twice.

The inner curve looks a bit odd, but except for the small kink where the two curves come together it matches the source material very closely. The outer form is shaping up quite nicely. Despite the very detailed descriptions, images and proportions that all the sources have for the orders, there are only illustrations and some overall dimensions for the scroll form. You will also find a great deal of variation from one Ionic column to the next. So, just choose one that you wish to emulate and build

your profiles to match. As noted previously, Chitham is my primary source, but Chitham does not provide a section cut through the scroll. J. M. Mauch's "The Architectural Orders of the Greeks and Romans" is a treasure trove of intricately detailed plates and provides many examples of actual Ionic orders complete with section cuts through the scrolls and other key parts of the order (Mauch 1910, 1845, 51-52). In this absolutely stunning work, the author has meticulously documented some of the most famous works of the ancients in 100 plates. You can find the work as a digital reprint, but the scanning does not do the original illustrations justice. If you have the means, I highly recommend searching out an original or non-scanned reprint from a second-hand book reseller.

4. Save the file.

CATCH UP! You can open a file completed to this point named: *10_Ionic Capital_B.rvt*.

ADDING THE COLLAR

If you look at the Left elevation view, you will notice that if we mirror these two forms, there will still be a sizable gap between them. (Don't mirror them now; we'll discuss mirroring and copying them in the next topic). In this space is another form that is like a band or a cord that wraps around the form like a belt or cincture. You could almost image that the scrolls started off as more cylindrical form and then someone tied a cord around the middle and tightened it, which scrunched the middle.

To add this band or collar, we'll do another sweep. In my first attempt, I tried to use pick lines again and build the sweep from the scroll forms. The trouble is that given the irregular shape of the curve at this point, we are unable to stretch the endpoints of the path like we did for the other two above. Furthermore, even though it is a sweep, the complex curve again presents a limitation and Revit will not let us pick more than one edge for the path. So, if you use pick path, you will end up with the collar ending in a sort of unnatural way. It would look OK from elevation, but not from other views. So, for this last sweep, we will instead sketch the path with a spline to follow the curve as closely as possible.

However, since there might be some trial and error involved, it is sometimes easier to draw the path first as a model line. This way you can focus on perfecting the shape without having to worry about finishing the sweep to test it out. Once you have the shape of the curve to your liking, you can then use it as the source for pick path. In this way we achieve the best of both approaches: sketching and picking the path.

Remember that all we need to constrain a spline, and have it scale proportionally is to lock down its endpoints. To do this, we'll add a few reference planes. It turns out we can get away with a single parameter to lock down the new reference planes. I have already included the parameter in the file. It is called "Spline Offset" and is set to a value of Base Diameter * 0.030. We'll work in the section view.

Continue in the *Ionic Capital* file or open the catch-up file.

5. Open the *Section 1* view.
 6. Add three reference planes in the locations indicated in Figure 27.
- ⇒ Add a dimension to each one and label all three dimensions with the Spline Offset parameter.

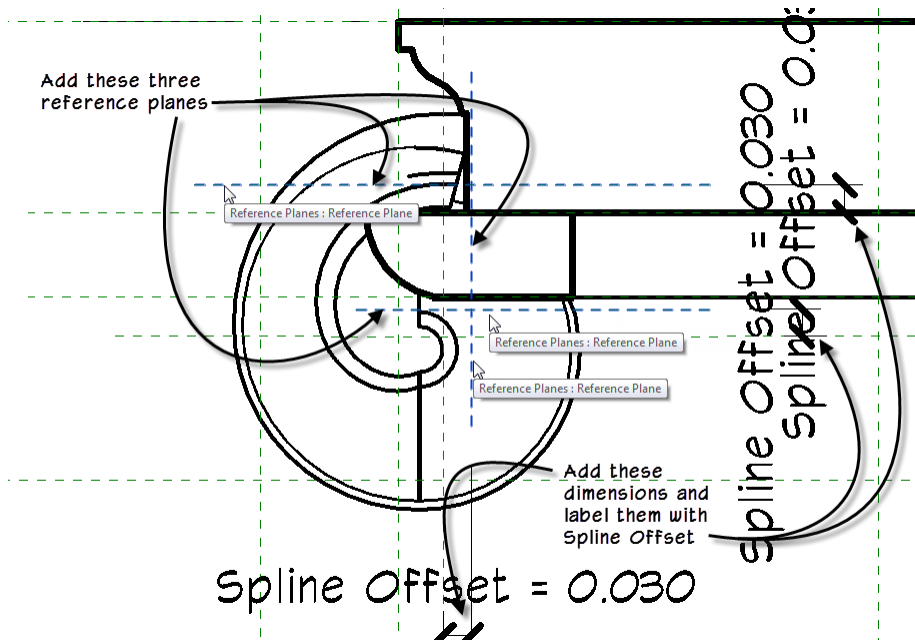


FIGURE 27—ADD NEW REFERENCE PLANES AND DIMENSIONS

7. On the Create tab, on the Work Plane panel, click the Set button.
 - ⇒ In the “Work Plane” dialog from the Name list, choose: **Reference Plane : Center (Front/Back)** and then click OK.
8. On the Create tab, click the Model Line tool and then click the Spline icon.
 - ⇒ Snap the first point of the spline to the intersection of the two new reference planes above the ovolo.
 - ⇒ Snap the last point to the intersection of the existing reference plane named: “Right” and the other new one.
 - ⇒ Add as many control points as needed to closely match the curved shape of the scroll forms (see Figure 28).

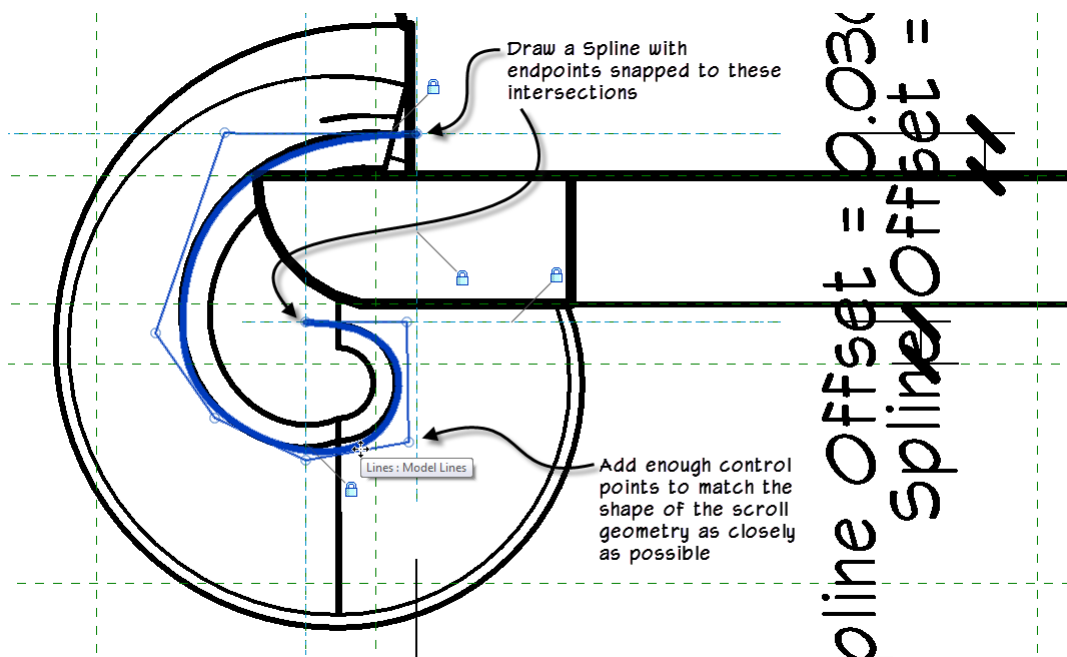


FIGURE 28—MATCH THE SHAPE AT THE END OF THE SCROLL FORMS WITH A SPLINE MODEL LINE

It is best to rough out the shape with several points first, (I used six control points) and then come back and fine-tune their placement. If you need to move the endpoint and do not want the whole spline to stretch, be sure to **TAB** before selecting it. You do not need to **TAB** for the other control points. Only the endpoints. Take your time to get the curve to match but keep it as smooth as possible. Notice that I did not replicate the small kink at the bottom but instead kept the curve smooth.

9. Align and lock the two endpoints in both directions to the reference planes. Use **TAB** if necessary.
 10. Flex Base Diameter to: **2.000** to be sure everything is working. Return the value to **1.000** before continuing.
 11. Select the Model Line and then on the Properties palette, uncheck the Visible checkbox.
- ⇒ Save the file.

The curve should flex and maintain its shape. If it did not, go back and adjust and make sure the two endpoints are locked to the reference planes in both directions.

12. On the Create tab, click the Sweep button.
- ⇒ Click the Pick Path button, click the model line spline we just drew and then click Finish Edit Mode.
- ⇒ For the Profile, choose **Ionic Collar:Flex**.
- ⇒ On the Options Bar, for the Angle, type: **-90** (negative) and then click Finish Edit Mode (see Figure 29).

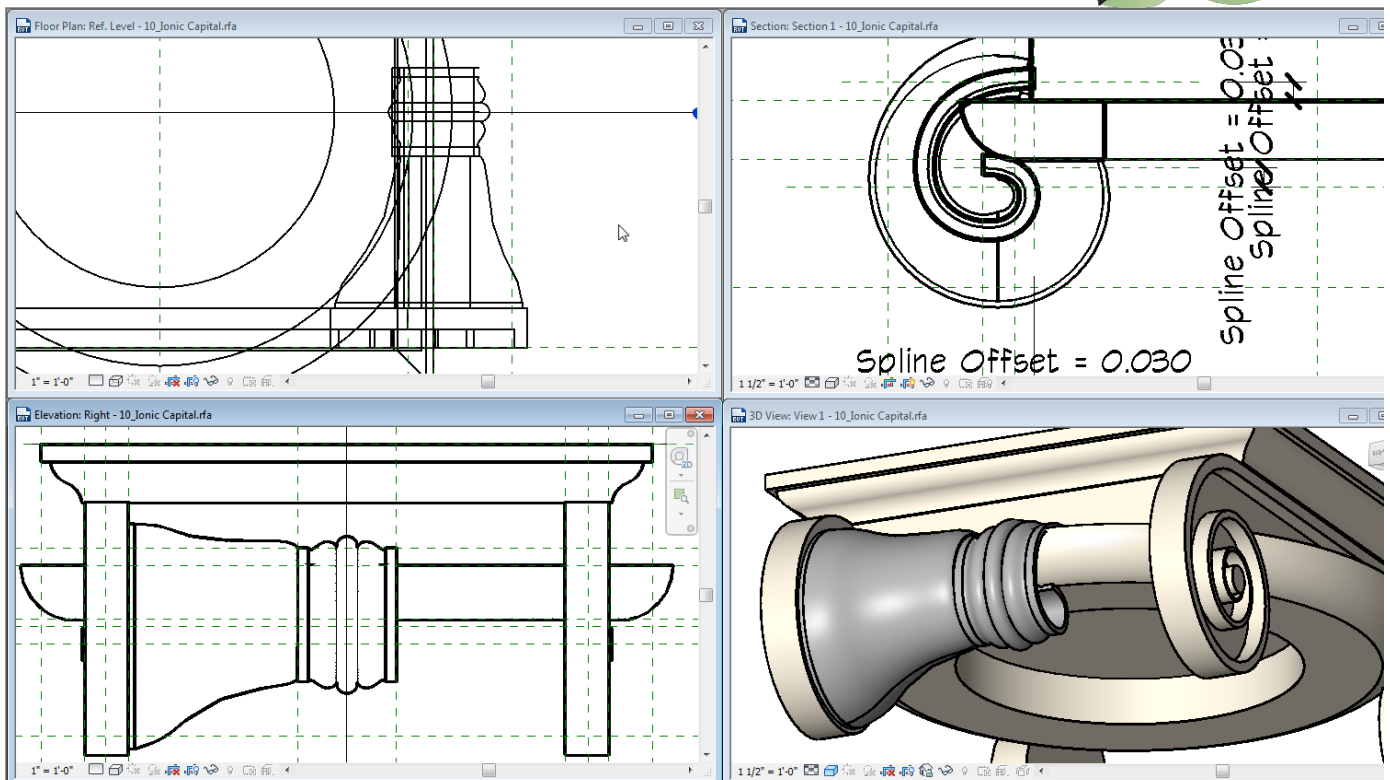


FIGURE 29—ADD THE COLLAR SWEEP

13. Flex Base Diameter to: **2.000** to be sure everything is working. Return the value to **1.000** before continuing.
- ⇒ Save the file.

COPY AND ADJUST

You will need to repeat the steps to create the remaining three pieces for the scrolls and the other collar. You can mirror the forms, but you will need to make adjustments to each one when you do. For example, remember that when copying forms that rely on Pick Path, you must reestablish the path manually or they will not flex properly. So, mirror the forms, then edit each one, erase the existing path, and then pick it again. You must manually stretch the endpoints again as we did above after picking the new path. Also, sometimes the profiles will flip when you mirror. Be sure to pick the new path first, as most of the time this will correct the flipped profiles as well. However, in cases where they are still flipped, it is easy to fix. Select the form, and then on the Properties palette, check or uncheck the “Profile is Flipped” checkbox. The swept blend might also reverse the profiles. So, they will appear on the wrong ends. You can easily fix this on the Properties palette as well.

When adjusting the paths, finding a good view can be tricky. Tile a few windows like the section the 3D and the *Front* elevation. If necessary, you can use Temporary Hide/Isolate to hide elements while you work. It might also be easier to pick the basic path first, finish the form and let it update. Then go back in to adjust the endpoint.

Before mirroring the collar, be sure you have all the reference planes you require. The two horizontal ones are all set. You can extend them across if you want, but they can be snapped and locked to even without lengthening them. This means you should only need to mirror the vertical one we added above. Be sure to add the dimension labeled with the Collar Offset parameter. Don’t forget to lock the endpoints of the mirrored spline to the reference planes in its new location. Also, you will need to adjust the Angle of the profile for the collar sweep after mirroring. Like the other settings, you can do this on the Properties palette. Simply set the Angle to 90° (positive) instead of negative 90°.

1. Select all the sweeps and apply the Capital Material property to them (see Figure 30).
2. Flex Base Diameter to be sure everything is working. Return the value to **1.000** before continuing. Save the file.

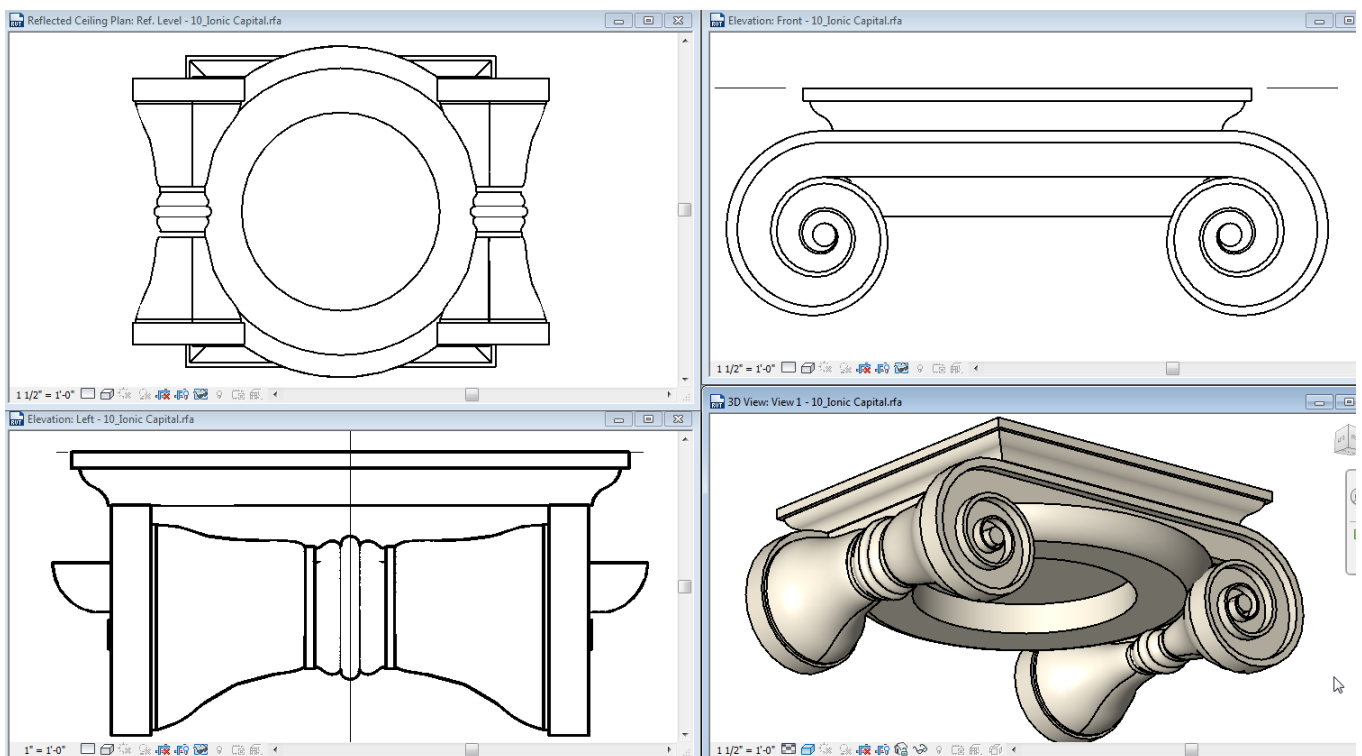


FIGURE 30—THE COMPLETED IONIC CAPITAL

The file should flex just fine with a Base Diameter of 0.860 or higher. The problem is in the Volute Profile that we built above. It has something to do with a minimum thickness allowable by the sweep. As the profile spirals in, it gets progressively smaller.

So, we are hitting the minimum thickness that Revit finds allowable. For our purposes however, the 0.860 value places the column that uses this family within an acceptable minimum. This is about 10 ½ inches for the Base Diameter and would yield a column height only seven and half feet. There shouldn't be too many situations where we need a column that short.

CATCH UP! You can open a file completed to this point named: *10_Ionic Capital.rvt*.

COMPLETING THE ORDER

Feel free to experiment further with this file before continuing and when you are ready, you can load the capital into the provided *Ionic Column (without Pedestal).rfa* file and update the existing one. The easiest way to do this is to right-click the Ionic Capital item on the Families branch of the Project Browser and then choose **Reload**. Reload the file with your new capital family. I have also provided a sandbox file: *10_Sandbox_Colonnade.rvt* into which you can load your completed column (see Figure 31).

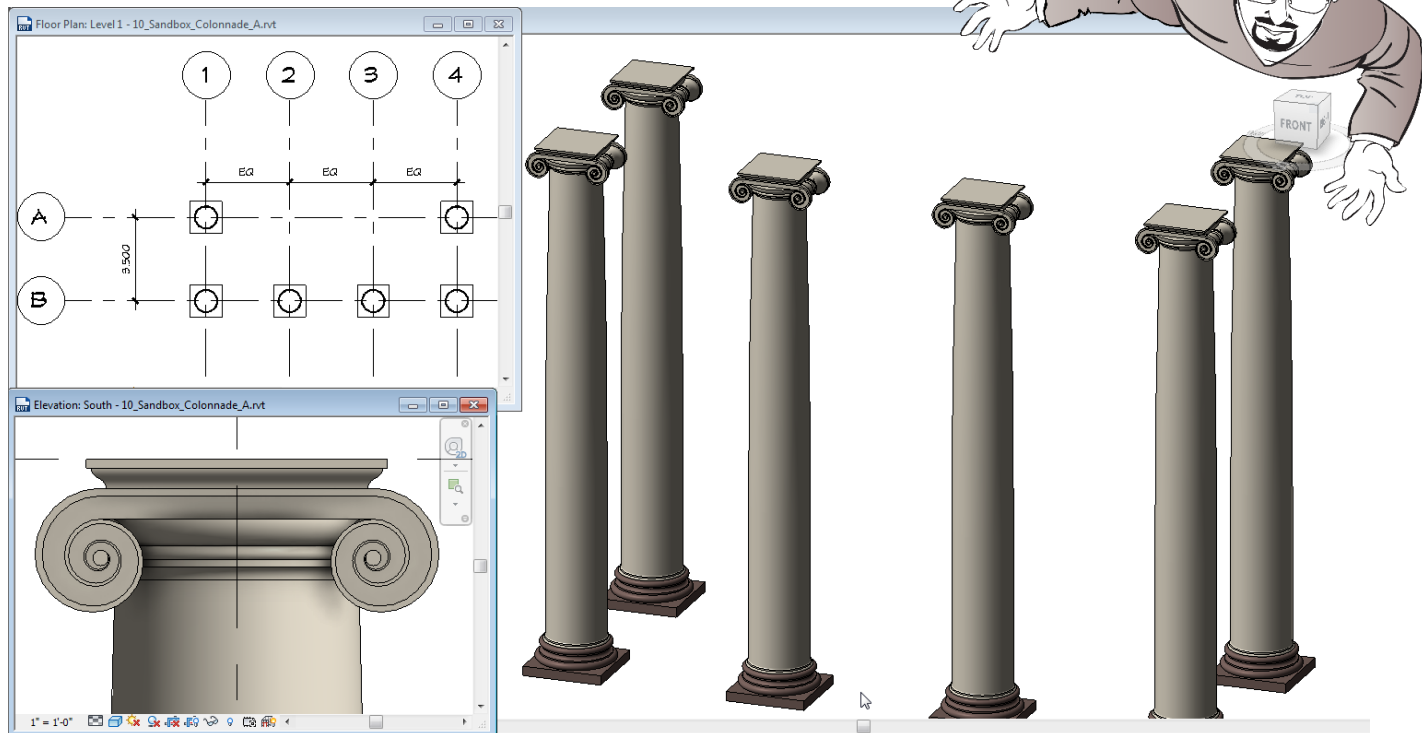


FIGURE 31—THE IONIC SANDBOX FILE WITH THE COLUMN LOADED

1. Save and close all files.

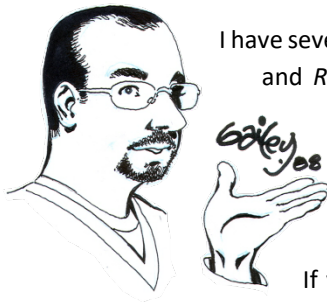
As you can well imagine, there is plenty more we can do. Getting this far in the time we have for this class was going to be a challenge regardless. So, if you completed everything, congratulations! If you had to use catch-up files, no worries. You can repeat the steps back at the office after the workshop.

FURTHER STUDY

You can find more information and tutorials in my books and video training. Please visit my website at: www.paulaubin.com for more information on my books.

To learn more about *Renaissance Revit*, visit: <http://paulaubin.com/books/renaissance-revit/>

I also have Revit video training available at LinkedIn Learning. To learn more, please visit: <https://www.linkedin.com/learning/instructors/paul-f-aubin>.



I have several courses in the library including: *Revit Essential Training*, *Revit Family Editor* and *Revit Architecture Rendering*, *Advanced Modelling in Revit Architecture*, and many more.



And of particular interest to the content of this paper: ***Revit: Parametric Curvature in the Family Editor*** and ***HBIM: Historic Building Re-creation***.

If you have any questions about this session or Revit in general, you can use the contact form at www.paulaubin.com/contact to send me an email.

Follow me on twitter: **@paulfaubin**

Thank you for attending.

INDEX

- abacus, 19, 20, 27
- associate family parameter, 8
- Chambers, 5
- Chitham, Robert, 5, 7, 28
- dimensions
 - automatic sketch, 10, 11, 15
- entablature, 16
- equality dimensions, 11
- family types, 7
- flex, 7, 10, 15, 27, 28, 30, 31, 32
- formulas, 7
- Gibbs, 5
- Ionic order, 4
- Mauch, J. M., 28
- moldings, 19
 - cyma reversa, 19, 20
 - fillet, 7, 10, 11, 13, 14, 17
 - ovolo, 19, 20
- Palladio, 5
- parametric, 5
- reference planes, 6, 24, 28, 29, 32
- template files
 - generic annotation, 7
- trigonometry, 7
- Vignola, 5
- volute
 - eye, 11
 - fillet, 13
 - Ionic, 5
 - layout, 7
 - profile, 16, 32
 - scroll, 25, 28
 - spiral, 8
 - sweeps, 22

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