

32. Click OK to exit the Parameter Properties dialog and return to the Types dialog. Scroll down to the “Lintel and Sill Thickness” parameter, and in the Formula column to the right enter “Veneer Thickness + 1” so that your dialog looks like Figure 25. When you press <ENTER> the value for the parameter will turn grey and be changed to 0’-4 5/8”. Click OK to return to the Family Editor.

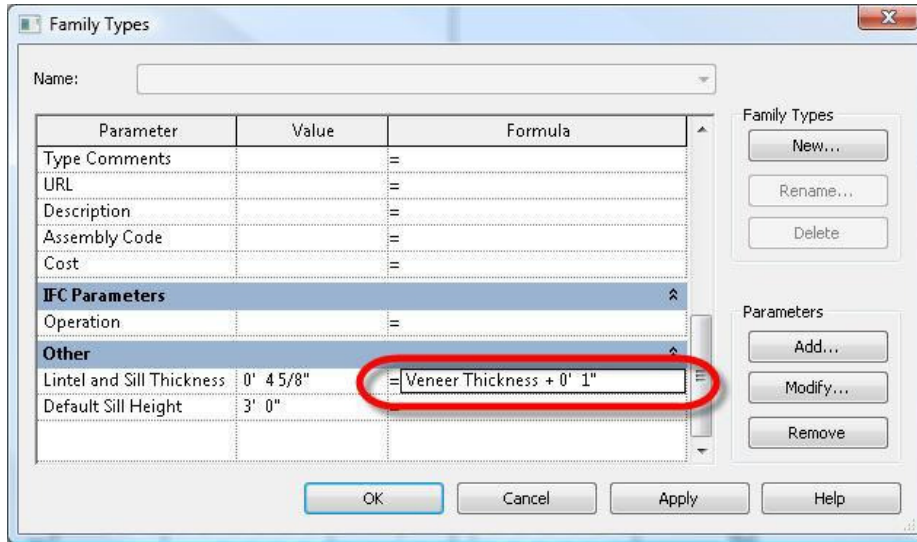


Figure 25. Creating a formula parameter.

33. Select the sill and lintel and click Element Properties from the ribbon.
34. Click the button to the right of the Extrusion End property, select the Lintel and Sill Thickness parameter as shown in Figure 26, then click OK to return to the Element Properties dialog. The Extrusion End property is now linked to the Lintel and Sill Thickness parameter. Click OK to return to the Family Editor.

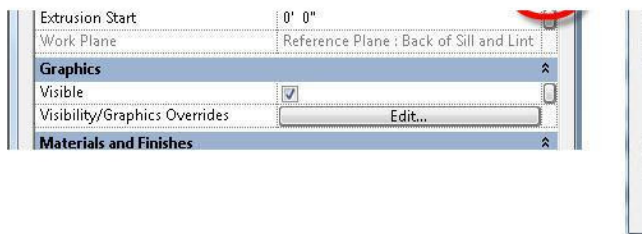


Figure 26. Linking the Extrusion End property to the Lintel and Sill Thickness parameter.

35. Navigate to the View 1 3D View and flex the family to make sure that any changes that would affect the size and position of the sill and lintel work as intended.
36. Save the Family.

Modeling the Frame

To model the frame, you will define a sweep with the path following the boundary of the window opening. Before doing so, however, you need to define all of the Reference Planes and parameters necessary to control the frame geometry, in the same general way that you defined the Reference Planes and parameters for the sill and lintel. First, you will create a Reference Plane that represents the center of the frame (between the front and back faces). This will serve as the Work Plane for the frame, the mullions and the glass.

1. Navigate to the Section 1 Section view.
2. Draw a Reference Plane from top to bottom to the right (interior) of the wall centerline Reference Plane, so that the positive side of the Reference Plane will be to the exterior of the wall, as shown in Figure 27.

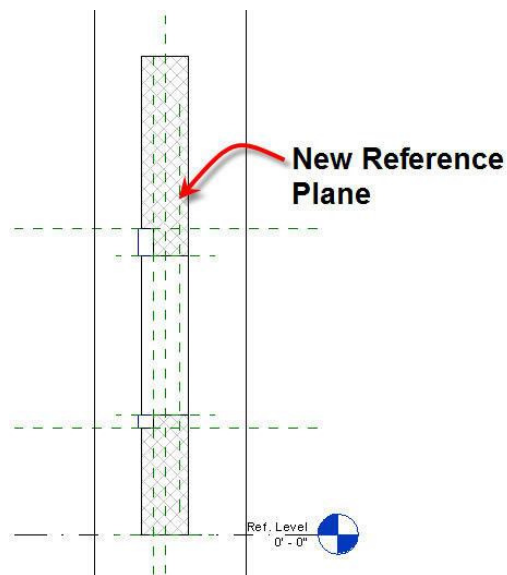


Figure 27. Creating the frame, muntin and glass Work Plane.

3. Click the Modify tool from the Quick Access toolbar and select the Reference Plane you just drew. Click Element Properties and enter a Name of “Frame Center”. Click OK to return to the Family Editor.

Next you need to create a series of Reference Planes to define the edges of the frame itself.

4. From the Create ribbon, click the arrow under the Reference Plane tool and click Pick Existing Line/Edge as shown in Figure 28. In the Options bar, set the offset to 0’-2”. Pick the Reference Plane that you just created so that there is one new Reference Plane created on either side of it.

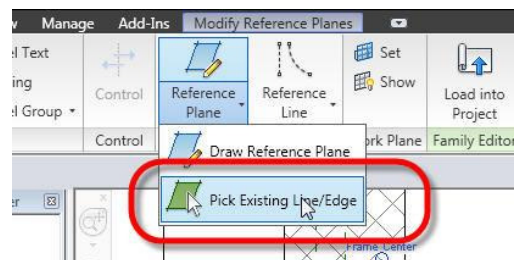


Figure 28. Using the Pick Existing Line/Edge tool to create a Reference Plane.

Note: If necessary, move all three Reference Planes so that they all fall between the interior face of the wall and the centerline Reference Plane. Make sure that the distance between them stays equal.

5. Using the Aligned tool from the Detail ribbon, create the three dimensions shown in Figure 29.

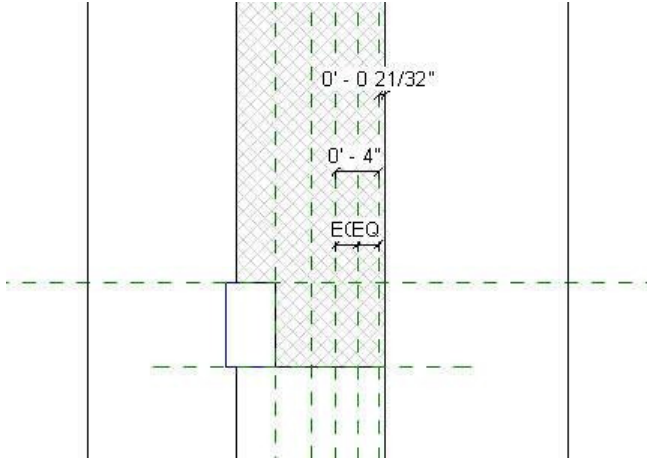


Figure 29. The frame depth dimensions.

Note that the dimension between the three Reference Planes that you created in the previous steps has been assigned an equality constraint. Note also that the overall dimension and the dimension to the face of the wall are separate strings. This is important because you will be assigning parameters to them in the next few steps.

Note: If you plan to assign an equality constraint to a dimension as in this case, you should make sure that the distances are already equal before actually placing the dimension. Failing to do so could result in a “Constraint not Satisfied” error when later trying to control the overall dimension with a parameter.

The next parameter you will create will control the frame depth. Since this parameter will potentially be used in a schedule, you will need to make it a Shared Parameter. This will involve creating a shared parameter file.

Note: Steps 6-13 assume that you have not yet established a Shared Parameter File. If this is not the case, you may need to obtain help from an administrator or CAD Manager to gain access to the Shared Parameter File for your office (or you may want to have them help you create a new one for training purposes so that you don’t edit your office standards by mistake).

6. Select the 4” dimension for the frame depth that you created in the previous step. Click Add Parameter from the Label drop down list on the Options bar.
7. In the Parameter Properties dialog, click Shared Parameter, then Select to select a parameter file as shown in Figure 30.
8. In the warning dialog box that appears, click Yes to choose a parameter file.
9. In the Edit Shared Parameters dialog, click Create as shown in Figure 30.
10. In the file dialog that appears, navigate to the folder where you want to save the file, and enter a name of “RAC Training Parameters”, then click OK.



Figure 30. Creating the Shared Parameter File.

11. In the Edit Shared Parameters dialog, click New under Groups. Name the new parameter group “Window Parameters” and click OK.
12. Click New under Parameters to create the first window parameter. For the name, enter “Window Frame Depth” and set the Type to Length, as shown in Figure 31, then click OK to return to the Edit Shared Parameters dialog.

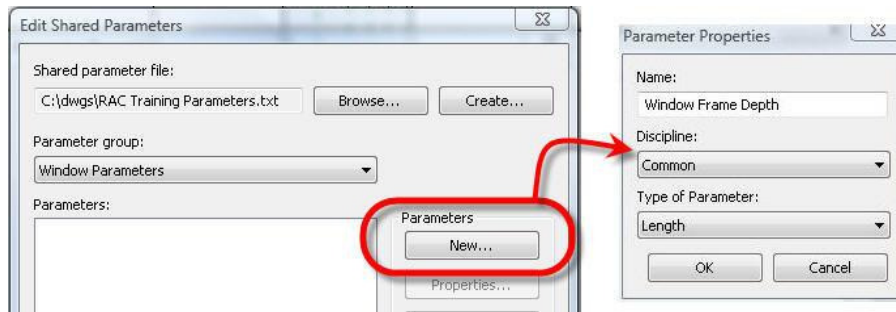


Figure 31. Creating the Window Frame Depth parameter.

13. Use the same process to create the following additional parameters, which will be used a bit later so that your dialog looks like Figure 32, then click OK:
 - Window Frame Width, Type = Length
 - Lintel and Sill Material, Type = Material
 - Glazing Material, Type = Material
 - Frame Material, Type = Material

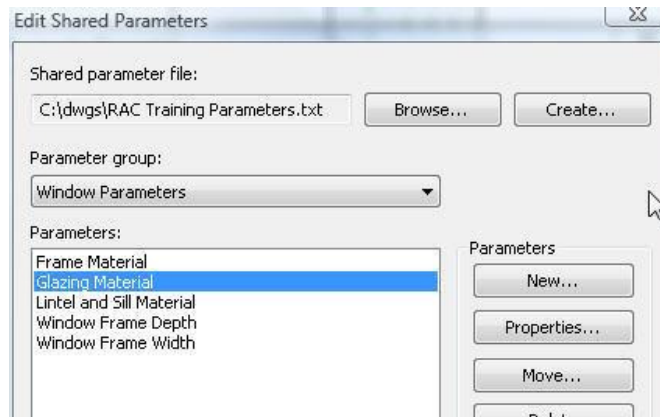


Figure 32. Creating the remaining Shared Parameters.

Now that the Shared Parameter File has been created, you simply need to select which parameter you need to use for the Dimension.

14. In the Shared Parameters dialog, select the Window Frame Depth parameter and click OK.
15. Make sure your Parameter Properties dialog looks like Figure 33 and click OK to return to the Family Editor.

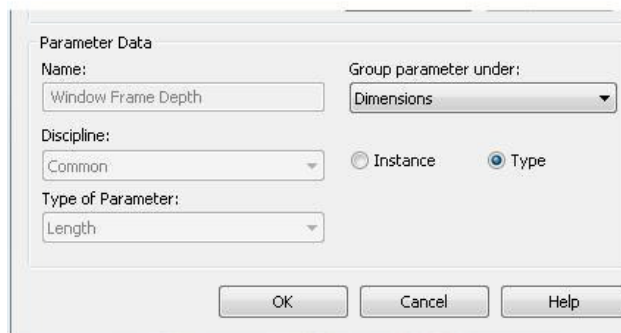


Figure 33. Finishing the Window Frame Depth parameter.

16. Select the dimension between the interior edge of the frame and the interior face of the wall and click Add Parameter from the Label drop down list in the Options bar. In the Parameter Properties dialog, leave the Parameter Type setting to Family and enter “Frame Offset” for the name. Group the parameter under Other and leave it Type based. Click OK to return to the Family Editor.
17. Flex the Family. Click the Types tool from the ribbon and change the value of the Frame Offset parameter to 0'-1". Change the value of the Window Frame Depth parameter to something else and click Apply. Note the changes and if the Reference Planes react as expected, then set the values back to 0'-1" and 0'-4" respectively again. Click OK.
18. Save the Family.
19. Navigate to the Exterior Elevation View.
20. Use the Pick Existing Line/Edge tool as done previously in Step 4 to create the Reference Planes to define the four inner edges of the window frame as shown in Figure 34. Use an offset of 1 1/2".
21. Use the Aligned tool from the Detail ribbon to create the dimensions shown in Figure 34.
22. Select all four dimensions and click Add Parameter from the Label drop down list in the Options dialog. In the Parameter Properties dialog, click Shared, then click Select. In the Shared Parameters dialog, select the Window Frame Width parameter and click OK.
23. Back in the Parameter Properties dialog, group the parameter under Dimensions and leave it Type-based. Click OK to return to the Family Editor.

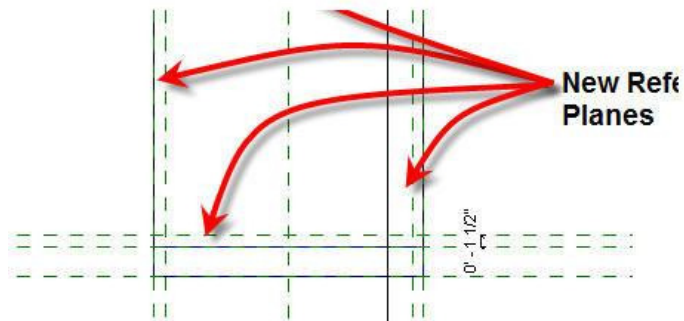


Figure 34. The window frame width Reference Planes and dimensions (before assigning the Window Frame Width parameter).

24. Flex the Family to make sure the Window Frame Width parameter is acting correctly.
25. Save the Family.

Now that the Reference Planes and parameters are in place, you can create the actual frame geometry.

26. Navigate to the Exterior Elevation View if you're not already there.
27. From the Create ribbon, click Solid, then Sweep.
28. Using the same procedure as that used for the lintel and sill, set the current Work Plane to Reference Plane: Frame Center.
29. Click Sketch Path from the Sweep ribbon, then click the Rectangle tool from the ribbon. Draw the rectangle by picking Point A in Figure 35, then Point B. Make sure that you lock all sketch lines to the appropriate Reference Planes.



Figure 35. Creating the Sweep Path.

Note: It is important to create the Sweep Path in such a way as to make sure that the Work Plane for the Profile is positioned in a place where you can view it from an angle that will allow you to sketch the Profile easily. In this example, creating the Rectangle in the manner shown above will ensure that you can sketch the Profile from the Section view.

30. Click Finish Path from the ribbon.
31. Navigate to the Section 1 Section View, then click Edit Profile from the ribbon.
32. Use the Rectangle tool from the ribbon to create the sketch shown in Figure 36. Again, don't forget to lock all sketch lines to the appropriate Reference Plane.

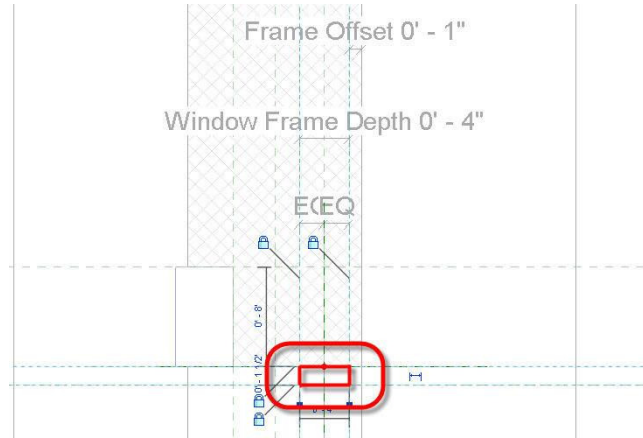


Figure 36. Creating the Sweep Profile Sketch.

33. Click Finish Profile, then Finish Sweep from the ribbon.
34. Navigate to the View 1 3D View and flex the Family to make sure that the geometry is constrained to all Reference Planes.
35. Save the Family.

Modeling the Muntins

The muntins can be created with a simple extrusion. The Work Plane will be the same as that used for the frame.

1. Navigate to the Exterior Elevation View.
2. Create the Reference Planes shown in Figure 37, along with the equality constraint dimensions shown, using the procedures described earlier in this tutorial.

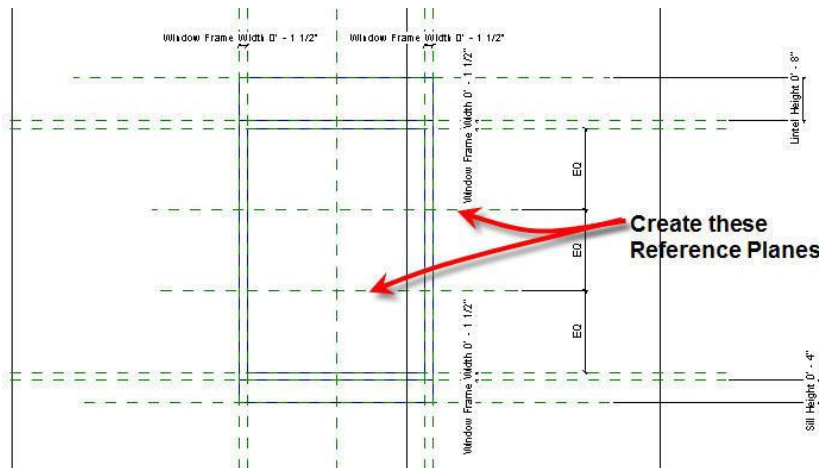


Figure 37. Creating the muntin centerline Reference Planes.

3. For each muntin centerline Reference Plane, create the Reference Planes, equality constraints and dimensions shown in Figure 38. Note that the overall dimension for the muntin width is locked at 1". Also, remember to make sure that the Reference Planes on either side of the centerlines are created using the Pick Lines/Edges tool with the offset pre-set to 1/2". As shown in Figure 38, you should have three sets of these Reference Planes: two horizontal and one vertical.



Figure 38. Finishing the muntin Reference Planes and constraints.

4. Flex the Family, changing the Window Width and Height to make sure that all of the muntin Reference Planes are acting as expected.

Again, now that all of the necessary Reference Planes and constraints are in place, you can create the model geometry.

5. Make sure the Work Plane is still set to Reference Plane: Frame Center.
6. Click Solid, then Extrusion from the Create ribbon.
7. Create the sketch shown in Figure 39. Make sure that all sketch lines are locked to a Reference Plane.

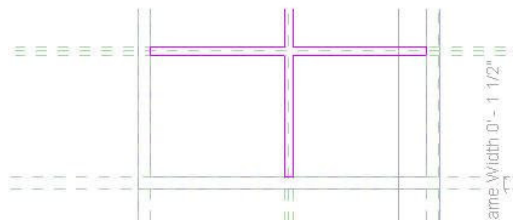


Figure 39. The muntin sketch.

8. Click Extrusion Properties from the Create Extrusion ribbon. In the Instance Properties dialog, set the Extrusion Start value to $-0'-0\frac{3}{4}"$ and the Extrusion End value to $0'-0\frac{3}{4}"$ as shown in Figure 40. This will cause the muntins to be centered on the Work Plane. Click OK to return to the Family Editor.

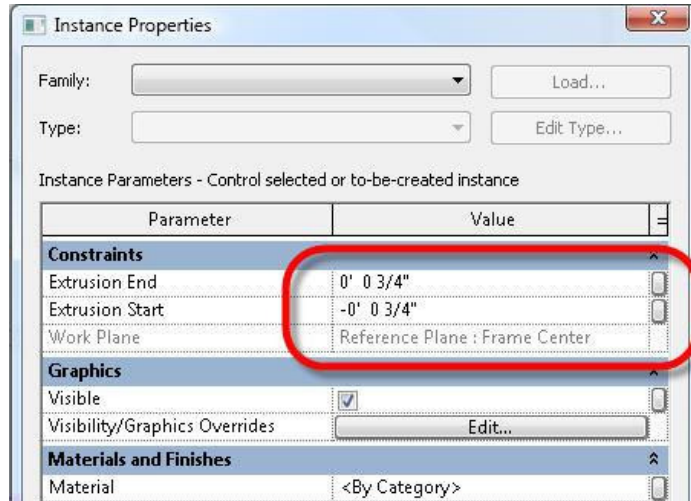


Figure 40. Establishing the muntin thickness so that it will be symmetrical about the Frame Center Work Plane.

9. Click Finish Extrusion from the ribbon.
10. Navigate to the View 1 3D View and flex the Family again to make sure that all frame and muntin geometry is properly constrained.
11. Save the Family.

Modeling the Glass

The final piece of geometry that needs to be modeled is the glazing. This will also be done as an extrusion. Since all of the Reference Planes and parameters needed for this are already in place, you can immediately begin the modeling process.

1. Navigate to the Exterior Elevation View.
2. Click Solid, then Extrusion from the Create Ribbon.
3. Make sure that the current Work Plane is still Reference Plane: Frame Center.
4. Create the sketch shown in Figure 41, making sure that all lines are locked to the appropriate Reference Plane.
5. Click Extrusion Properties from the Create Extrusion ribbon. In the Instance Properties dialog, set the Extrusion Start value to $-0'-0\frac{1}{4}"$ and the Extrusion End value to $0'-0\frac{1}{4}"$. Click OK to return to the Family Editor.
6. Click Finish Extrusion from the ribbon.
7. Flex the Family to make sure that all geometry is properly constrained.
8. Save the Family.

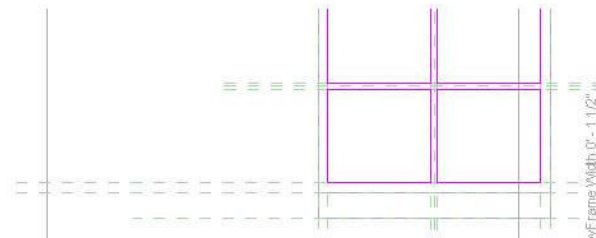


Figure 41. The glazing sketch.

Setting Wall Wrap Conditions

You can use Reference Planes in a window or door family to control the wrapping points for wall layers.

1. Navigate to the Ref. Level Floorplan View.
2. Select the Reference Planes that are attached to the exterior and interior faces of the frame as shown in Figure 42.
3. Click Element Properties from the ribbon. In the Instance Properties dialog box, click the check box next to Wall Closure as shown in Figure 42. Click OK to return to the Family Editor.

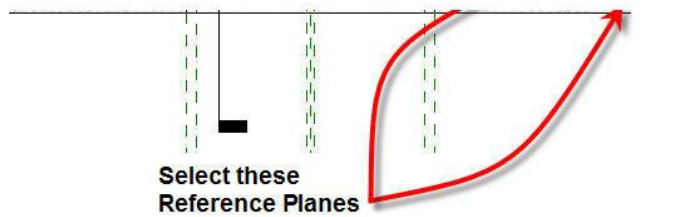


Figure 42. Establishing the wall layer wrap control points.

Now the inner face of the frame will be the point that interior wall layers will wrap to, and the exterior face will be the wrap limit for the exterior wall layers. You could also have defined Reference Planes for the sole purpose of controlling wrapping, however in this exercise the frame will suffice as a control point. The only thing left to do is determine when wall components will wrap.

4. From the ribbon, click the Types tool. In the Family Types dialog, set the Wall Closure property to Both and click OK.

This will ensure that regardless of the settings on the wall itself, this Family will force wrapping when inserted into it. In this way, you can leave a wall set to not wrap by default when objects are inserted into it, but when the Family includes the proper wrapping controls override that setting and allow wrapping.

5. Save the Family

You will test the wall wrapping after assigning materials to the family components.

Assigning Materials

A common mistake when creating custom families is to leave all components on the main category of the family. For example, in this case, the family is categorized as a window, and will therefore act like a window when interacting with other objects, and will obey the settings for windows as specified in the Object Styles and Visibility / Graphics Overrides settings. However, none of the components in the family are currently assigned to a subcategory, so the glass does not “know” that it’s glass, the frame does not “know” that it’s a frame, etc. Once these components are assigned to subcategories (you can create new ones if necessary), they will then take on the material that is assigned to that subcategory in a given project’s Object Style settings. You will take it further however, providing parameters to control their materials independently of the Object Styles settings if the user desires.

1. Navigate to the View 1 3D View.
2. Select the lintel and sill, then select Element Properties from the ribbon. In the Instance Properties dialog, set the Subcategory value to Sill/Head as shown in Figure 43.
3. Click the button to the far right of the Material property and click Add Parameter in the Associate Family Parameter dialog. In the Parameter Properties dialog, click Shared Parameter, then click Select. In the Shared Parameters dialog select Lintel and Sill Material, then click OK.
4. In the Parameter Properties dialog group the parameter under Materials and Finishes and leave it Type based. Click OK until you return to the Instance Properties dialog. Double check your settings with Figure 43 and click OK.

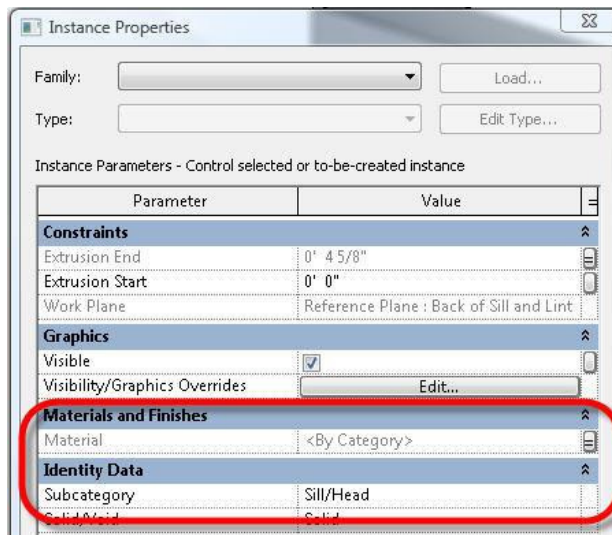


Figure 43. Setting the subcategory of the lintel and sill, and assigning it to the Lintel and Sill Material parameter. Note that the default value is still set to “<By Category>” but it can now be changed by simply changing the linked parameter.

5. Follow the same procedure as in Steps 2, 3 and 4 to assign the frame and muntins to the Frame/Mullion subcategory and link the material to the Frame Material Shared Parameter. Don't forget to group the parameter under Materials and Finishes and keep it type-based.
6. Follow the same steps to assign the glass component to the Glass subcategory and the Glazing Material Shared Parameter.
7. Save the Family.

Create Family Types

Once the geometry has been defined and tested and all parameters are in place, you should create multiple Family Types. This will prevent the user from having to repetitively create new types in each project that they use the Family in. In the case of Windows and Doors you should create Family Types that define the most commonly used sizes. For this example you will create 3 new types.

1. Navigate to the View 1 3D View if you're not already there.
2. Click Types from the Create ribbon. Click New under Family Types. Enter a name of 3' x 4' and click OK. Verify that the Width is already set to 3'-0" and the Height is 4'-0" and click Apply to create the type. Make sure you click Apply even if you don't have to change any parameters.
3. Click New under Family Types again. Enter a name of 3' x 5' and click OK. Change the Height to 5'-0" and click Apply.
4. Click New under Family Types. Enter a name of 3'-6" x 5' and click OK. Change the Width to 3'-6" and click Apply. Click OK to return to the Family Editor.
5. Save the Family.

Test the Family

While the Family is not quite finished yet, as you will soon see, now is a good time for some testing.

1. Start a new Project using the default template.
2. Create a wall using the Exterior – Brick on Metal Stud wall type.
3. Set the view to a scale of 1/4"=1'-0" and set the detail level to Medium.
4. Select the wall you just created and edit its Type properties. Edit the Structure and turn off the wrapping for all layers except for the interior and exterior finish layers. Make sure that the wrapping at inserts remains set to "Do not wrap" as shown in Figure 44.

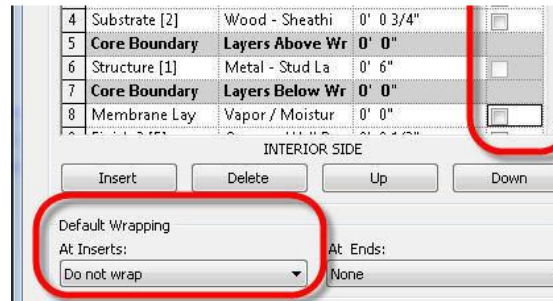


Figure 44. Establishing the wrap properties of the wall type.

5. Click OK until you return to the Project.
6. From the Insert ribbon, click Load Family. Navigate to the Family (.rfa) file that you have been editing, select it, and click OK.
7. Use the Window tool on the Home ribbon to place an instance of your new window Family in the wall you just created so your screen looks similar to Figure 45.

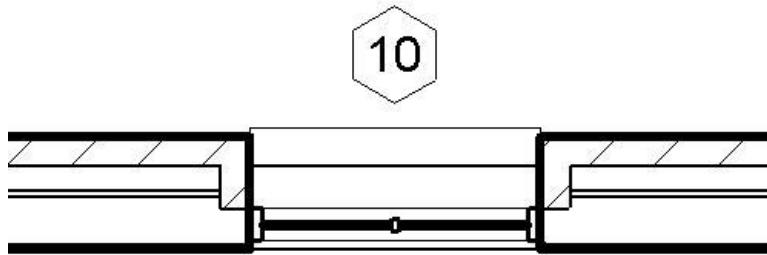


Figure 45. Testing the Window Family.

Note that the brick and gypsum board layers in the wall wrap to the edges of the frame, which is where the “Wall Closure” Reference Planes are located.

8. Set the detail level to Coarse and the scale to 1/8”=1’-0”.

At this scale and detail level, the window looks a bit busy. There is too much detail in the plan representation.

Fine-Tuning Visibility

By controlling visibility of various components in your Family, you can accommodate among other things, different levels of detail.

1. Using the Switch Windows tool on the View ribbon, navigate to the View 1 3D View of your Window Family.
2. Select the frame component and Click the Visibility Settings tool from the ribbon as shown in Figure 46. Clear the check mark for the “Coarse” Detail Level as shown in Figure 46 and Click OK.

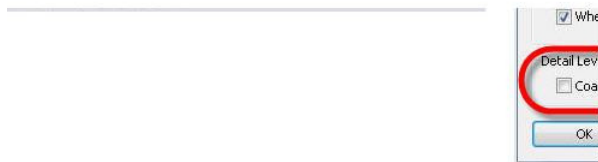


Figure 46. Setting the display of objects based on detail level.

Note: While in the Family Editor, you will still see objects that you have set to be invisible. The settings will not be evident until you actually test them in a Project.

3. Follow the same procedure to turn off the muntins and the glass in the coarse detail level.

Note: You can also control the visibility of objects by creating a Yes/No parameter and linking their “Visibility” property to that parameter. This allows the user to control visibility by simply turning items off and on the the Family’s element or type properties dialog box.

Now that you have suppressed the display of the frame, muntins and glass in the course detail level, you need to replace them with Symbolic Lines, which are 2D lines that will only display when you are in a view that is perpendicular to the plane in which they are drawn.

4. Navigate to the Ref. Level Floorplan View.
5. From the Detail ribbon, click Symbolic Line. From the ribbon, change the Line Style to “Glass (Cut)”. Draw the Symbolic Line shown in Figure 47 on top of the Frame Center Reference Plane.

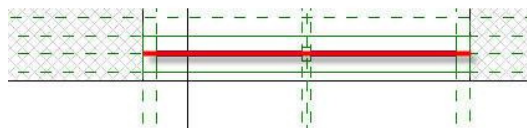


Figure 47. The Symbolic Line representing the glass.

6. Use the Align tool from the Modify ribbon to lock the Symbolic Line to the Frame Center Reference Plane.
7. Select the Symbolic Line and click Visibility Settings from the ribbon. Turn off the visibility in the Medium and Fine detail levels. Place a check mark in the box for “Show only if instance is cut”. Check your settings with Figure 48 and click OK.

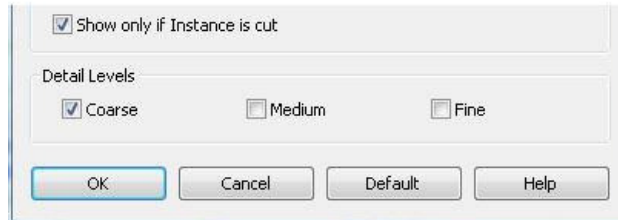


Figure 48. Setting the visibility of the Symbolic Line.

8. Use Visibility/Graphics Overrides to turn on “Automatic Sketch Dimensions” in the Annotation tab. Note that Revit is “assuming” a constraint of 0” at the start and end points of the Symbolic Line. This will ensure that the line will change length when the width of the window changes.
9. Save the Family.
10. From the ribbon, use the Load Into Project tool to reload the Family into your Project. Choose to overwrite any existing versions and parameters.
11. Switch the detail level of the view from Coarse to Medium to Fine and back to Coarse again. Note that when you switch between Coarse and Medium or Fine, the 3D geometry is replaced by the Symbolic Line and back again.
12. Take a few minutes to test the rest of the parameters. Move to a 3D view and adjust the sizes of the window, the frame, etc. Also play with assigning different materials to the sill and lintel, the frame and mullions and the glass.

Summary

The preceding tutorial outlines the typical process for creating a custom Window Family. The same process would be used for a Door Family as well. While the geometry and parameters may differ, the process will remain the same. Other types of families will be created using the same workflow and similar processes. You might find it useful to open some existing Families and explore them to see if you can “reverse engineer” how some of them were created.