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Family Planning—from Custom Templates to Preparing for LOD and Sustainable Design

Cody Cummings
TriMark Strategic

Donnia Tabor-Hanson
TriMark Strategic

Learning Objectives

- Learn how to develop custom Family templates
- Learn about and compare Family parameters and Shared parameters and their usage
- Learn how to identify and maintain a desired level of Level of Detail (LOD)
- Discover workflow practices to speed production, manage data allocation, and categorize common causes of file bloating

Description

Family building in Revit software takes time, planning, and a lot of rules. Creating family templates for consistency and time saving can get things started off on the right foot. Building the bones and setting up the parameters will help set the structure and brains of the family. Families also need some meat on those bones in the manner of what is built. Builders should have a better-developed idea of how to maintain their desired Level of Detail (LOD) without compromising the size of their files. They should also be able to identify common scenarios where these skills can be deployed.

Speakers

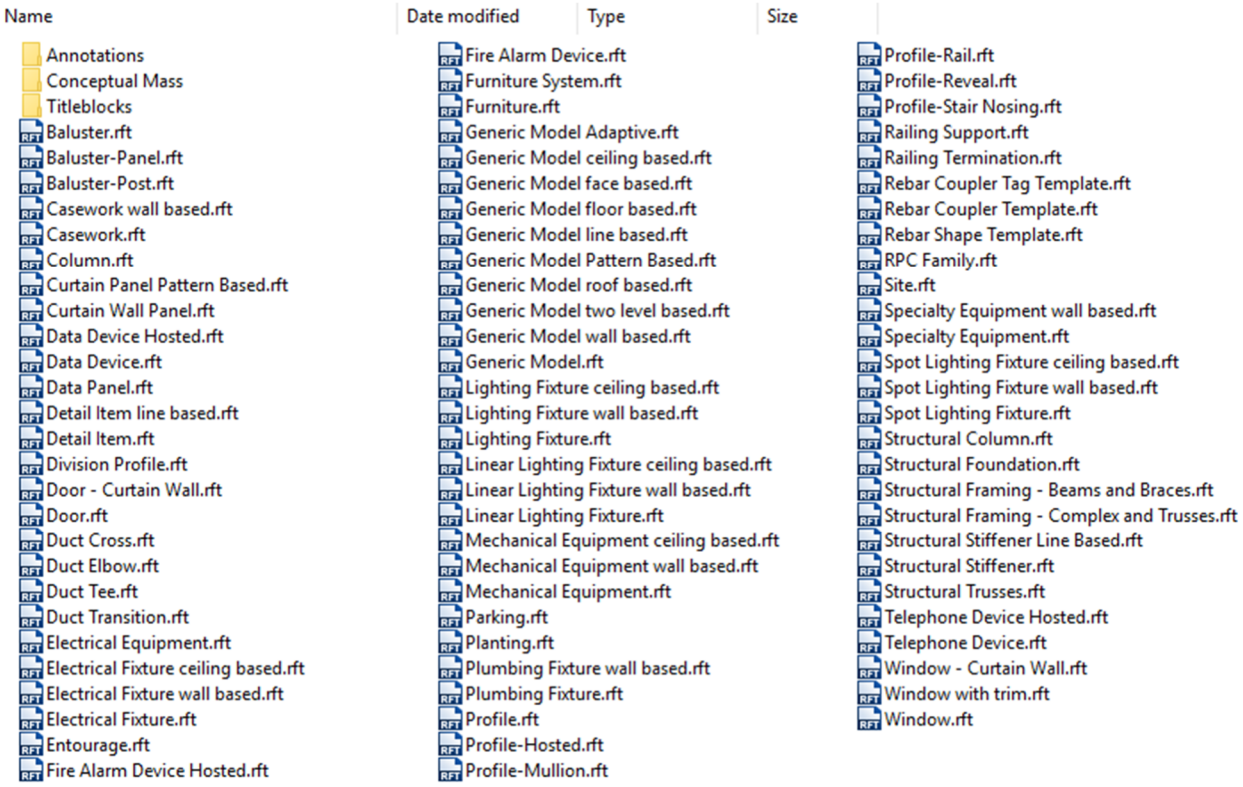
Cody Cummings
Cody is an industrial designer with over 10 years' experience in 3D modeling and CAD, and most recently in Revit Architecture. His experience spans both consumer and commercial product design, materials engineering, fabrication and commercial kitchen design. He has his Bachelor's degree in Industrial Design from Auburn University.

Donnia Tabor-Hanson
Donnia has worked extensively in Revit Architecture. She has used CAD for over 30 years, and her experience covers a variety of fields, including architecture; atomic waste removal and containment; civil; log home design; kitchen design and kitchen equipment Revit families. She has taught college-level courses and has run an Autodesk Authorized Training Center. She has Bachelor's and Master's degrees in Technological and Adult Education from the University of Tennessee. Her associate degree is in Architecture. Volunteering with the Autodesk User Group International, www.augi.com, for over 30 years has kept her in touch with industry changes and advancements. Along with her connections with AUGI she was provided chances to travel with AUGI CAD Camps for many years speaking at these conferences. Donnia was also Speaker of the year at Autodesk University 2000. She has worked with the Speaker Mentor program for years assisting others in preparation for their own times to teach.

Choose Wisely for a Starting Template

With a variety of templates available with which to start, choose the one to match, or is the closest match to the family to be built. There are many from which to choose.

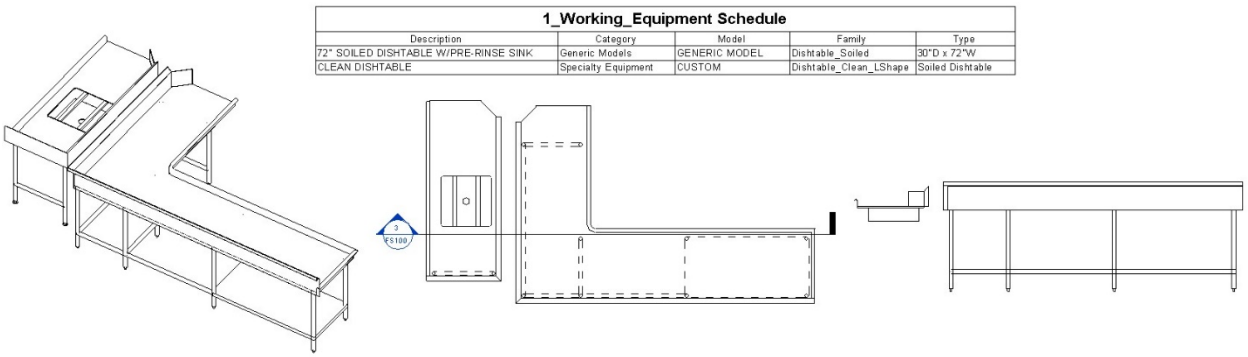
These are just the component templates. (Well, there is one Tag family that snuck in.)



Components that are based on having a host such as a wall, floor, ceiling, roof, two levels, or just face based are very restrictive when it comes to finding a host. The Profile grouping of families are required to have a host. Annotations and Titleblocks have their place for documentation and some of this class material can apply to these as well.

Caution should be taken in setting a family to be that of a "**based**" type. Know the user. Does the user work in the main model or will the model be a linked model? Will there be a wall when layout is being done by the interior designer? Will that wall be moved? Will it be deleted? If it is deleted by an architect will it be replaced with another wall? Does the family need to be set on a counter or other level? Can the **Offset** from a level be used or does it need to be based on a face of some kind?

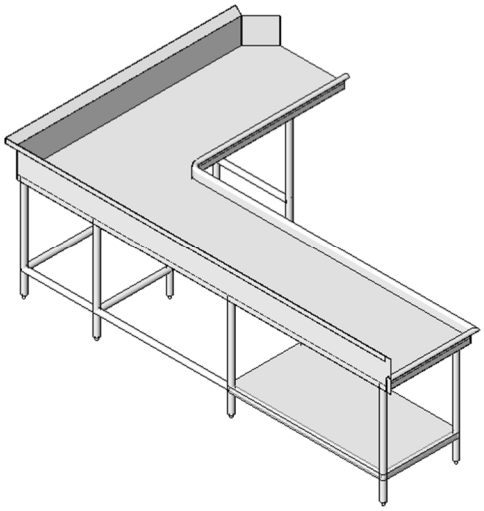
Another consideration is how and where the family is used. **Generic Model** can fill in for something but is it the right choice? A template starting choice will determine the category the family is in once it is placed in the project. **Plumbing** or **Specialty Equipment** may be great for a soiled dish table, but will there be a need for it to show in a section? That is an argument for using a **Generic Model**.

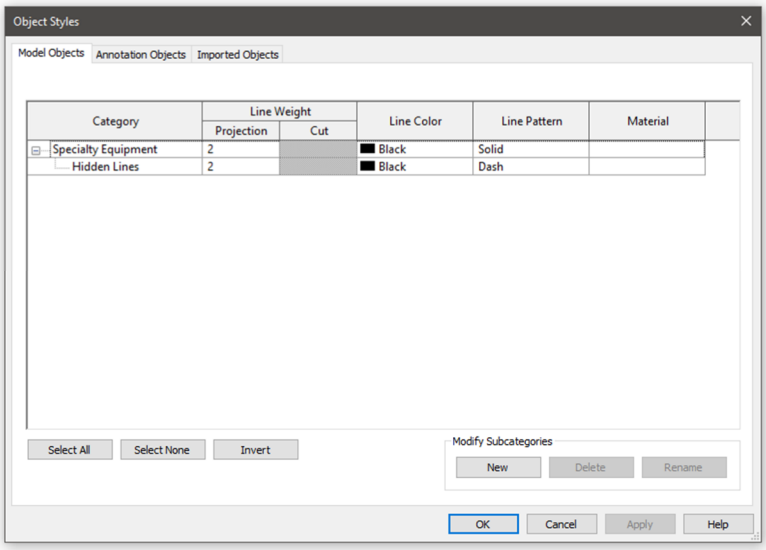


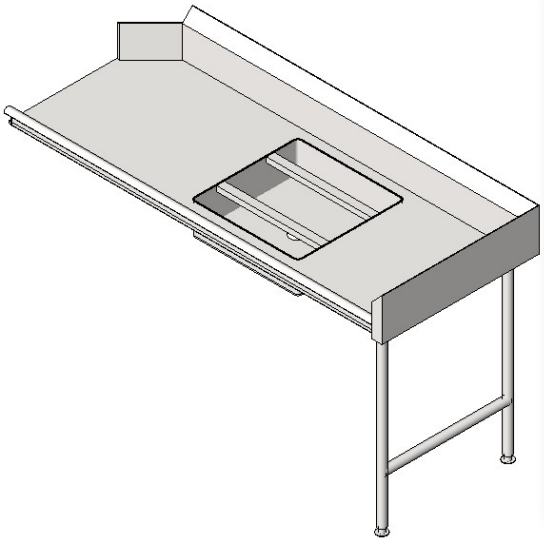
1_Working_Equipment Schedule

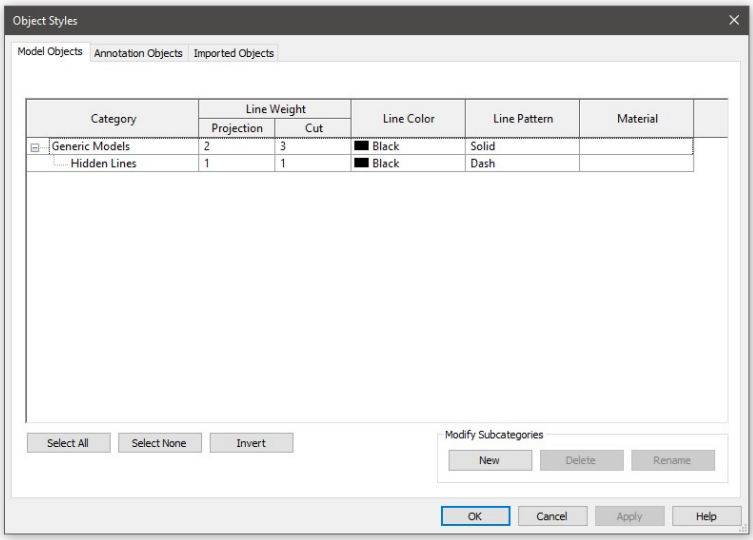
Description	Category	Model	Family	Type
72" SOILED DISHTABLE W/PRE-RINSE SINK	Generic Models	GENERIC MODEL	Dishtable_Soiled	30"D x 72"W
CLEAN DISHTABLE	Specialty Equipment	CUSTOM	Dishtable_Clean_LShape	Soiled Dishtable

Each category of template also comes with its own linetypes that will be added to projects when the family is loaded.







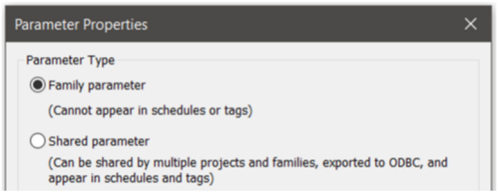


Materials, linetypes, object styles all will be added to any project when a family is loaded. Consistency on naming linetypes, naming materials, adding properties, and other parameters can be most easily done when these are developed in a template.

The Shared Parameter File



Located on the **Manage** tab and the **Settings** ribbon is the **Shared Parameters**.

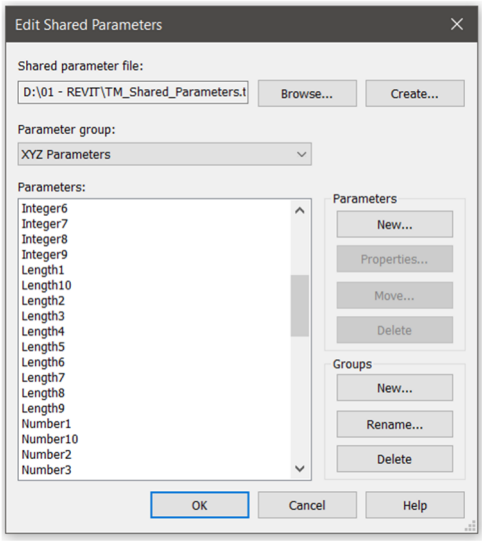


The first thing to know about the **Shared Parameters** file is whether or not users have permission to edit it. Next would be to find out who all has permission to edit this file. This file controls tags, schedule and family parameters. If a parameter does not have to be tagged or scheduled it can be a **Family parameter** and does not have to go into the **Shared parameter** file. The last thing to find out about this file is whether or not it is write protected. The VDC or BIM manager should be the one to consult in this case. This individual would know where the file is located and if the parameter file can be edited.

To allow room to grow and not be so limiting, try adding some parameters that can be used for a variety of things without actually having to create a parameter. Some parameters of various types that can be added to families, tags and schedules.

Our company has the **XYZ Parameters**. The group name forces these to the bottom of the list of parameters. These can be used by anyone building families If they need a shared parameter that will be scheduled or tagged in something custom in a project. An example would be working on a store or restaurant chain where the customer may require a certain schedule look or a custom parameter on their equipment to be tagged.

The parameter names are generic and there are 10 in each grouping. Again, this is just a suggestive sample for allowing some options.



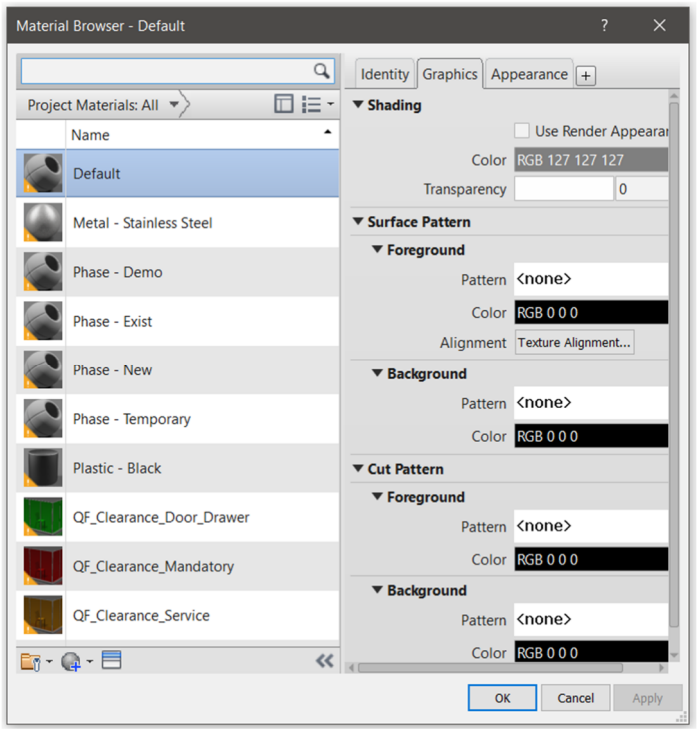
Materials

Located on the **Manage** tab and the **Settings** ribbon is the **Materials**.



Any company's standard materials can be preset in a family template. This maintains the consistency of look and feel with the families within the organization's projects.

Maintaining one family where all materials can be found is an easy way to be able to transfer materials from one family to another.

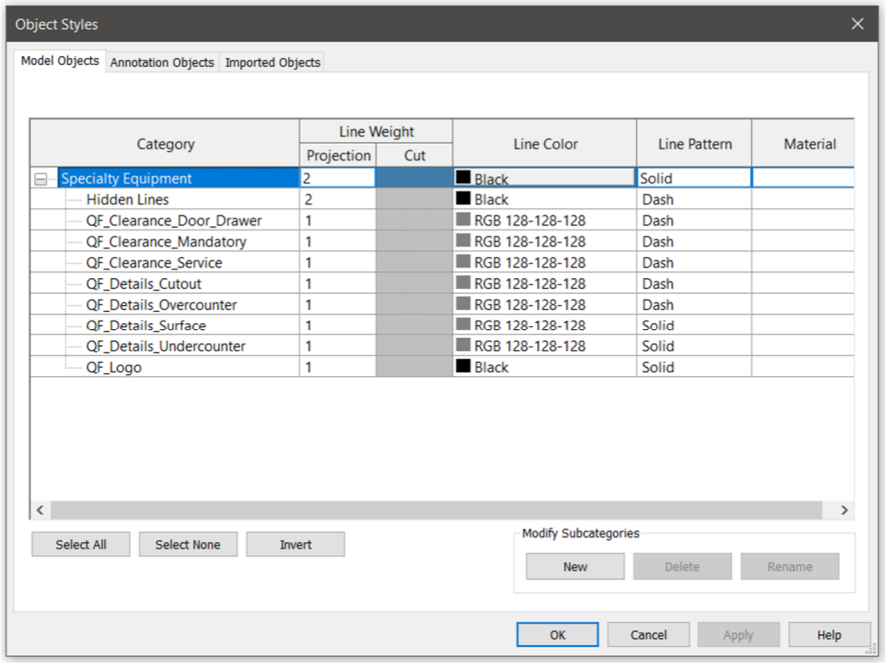


Object Styles

Located on the **Manage** tab and the **Settings** ribbon is the **Object Styles**.



Developing **Object Styles** in a template keeps consistency of names, line weights, colors, and patterns in these categories.

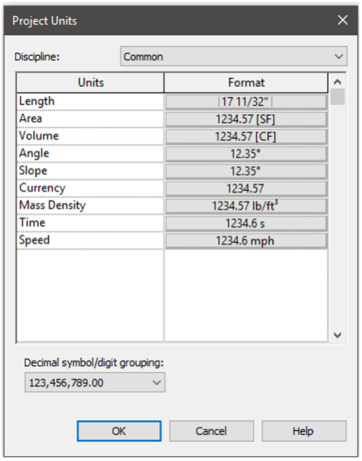


Project Units

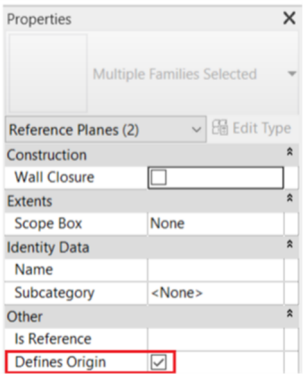
Located on the **Manage** tab and the **Settings** ribbon is the **Project Units**.



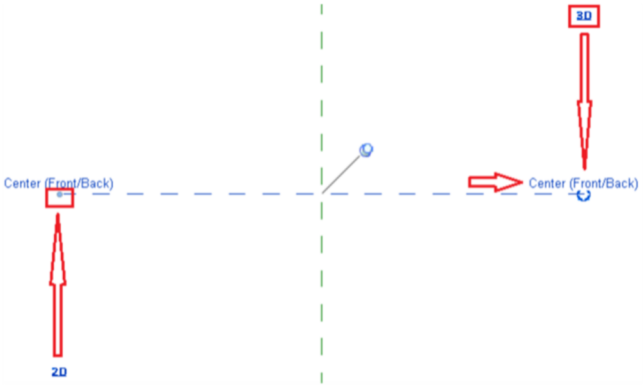
Project units can be set to match the company settings. Most will be with the Feet and Inches. Some companies do work in Inches.



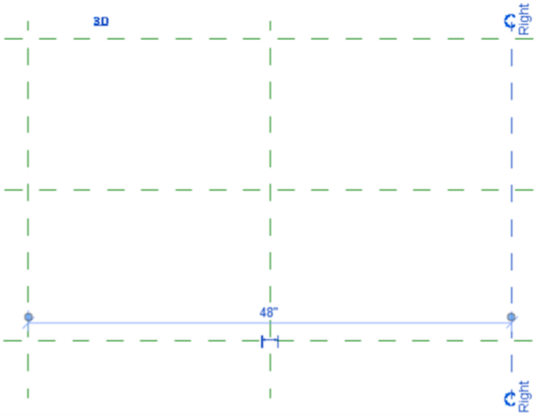
Family Framework – Reference Planes



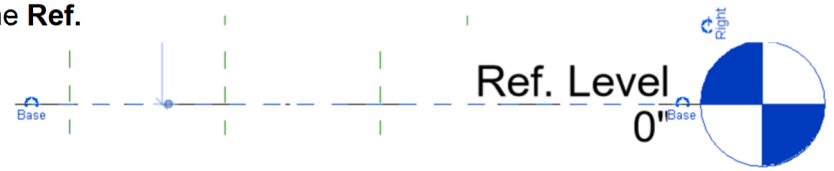
Most component and annotation family templates come with a vertical and horizontal Reference Plane with which to start. In component families they are named and are **Center (Front/Back)** and **Center (Left/Right)**. These are pinned by default. They are also set to **Defines Origin**. Defining the origin with these Reference Planes can be changed by having other Reference Planes to check for **Defines Origin**.



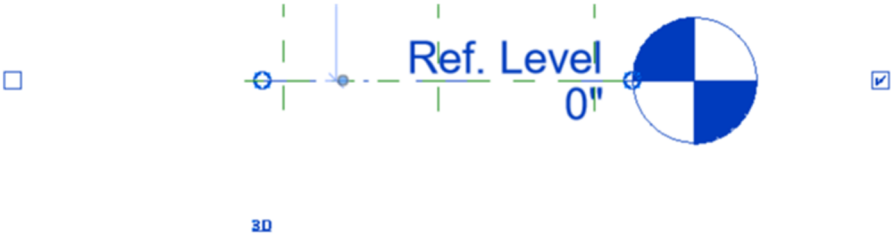
A Reference Plane reports many things once selected. Reference Planes can be **2D** or **3D**. **2D** ends have a blue dot. **3D** ends have a circle. Click on the **2D** to put it back to **3D** if circle and dot are not separated. If they get separated just bring the circle to the dot to reunite them. The name of eah Reference Plane shows up on the back of the plane. Drawing them in a counter clockwise motion around the center keeps the outside away from center.



Add and name the Reference Planes that are typically used in your families. Examples could be **Front**, **Back**, **Left**, **Right**, and **Top**.



Be sure to name the Reference Plane on the **Ref. Level**. Should there be a case of the model **Bottom** not being on the **Ref. Level**, it might be suggested to name it something like **Base**.

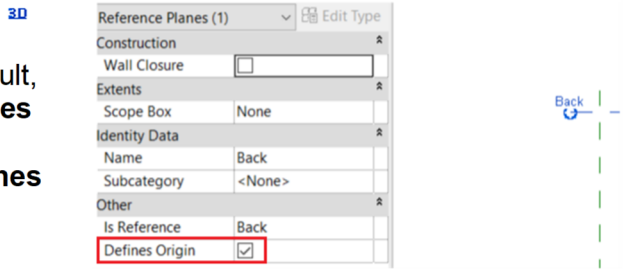


In either **Front** or **Back** and also in either **Left** or **Right** views pull in the Level line tight to your overall depth and width shown by your **Front** or **Back** and then again in your **Left** or **Right** views.

The main reason of pulling these in is that they determine how far out future Reference Planes extend when drawn.

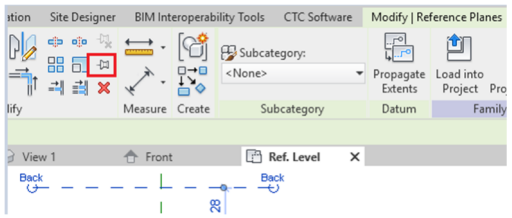


The **Ref. Level** should not be changing so the target and other information can be turned off. This helps viewing the elevation views without that info overlapping the model.

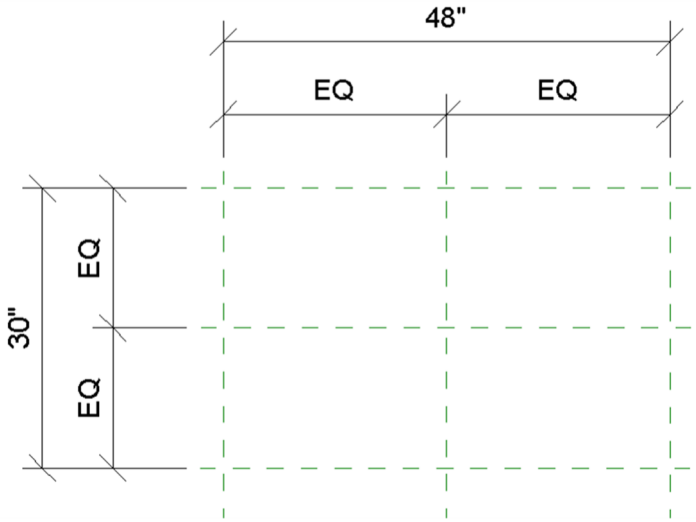


Another thing to set up with the Reference Planes is the insertion point or **Origin**. By default, the two Reference Planes in the plan view will have **Defines Origin** checked. Choose one Reference Plane going horizontal and one going vertical to determine which **Defines Origin**. By default, the reference plan on the **Ref. Level** defines the height's origin. It can be changed if desired.

These planes would be the logical planes to pin down. Pinning keeps a Reference Plane from moving when flexed by dimensional constraints. Just select the plane then choose **Pin** on the **Modify** tab.
The original Reference Planes are pinned down. Should another Reference Plane parallel to one of these be selected to **Define Origin**, it would be best to unpin the original pinned Reference Plane. The pinned planes should define the point where all dimensions to other parallel planes are based.

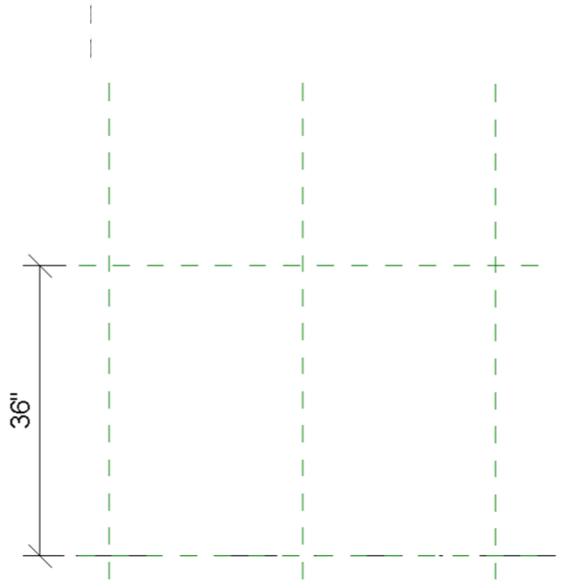


Preparing to Flex the Family



Add dimensions to the Reference Planes in preparation to adding parameters. Setting **EQ** dimensions to center line reference planes keeps them centered within the family.

Check elevation views for any dimensions that should be placed in those views. Dimension each option only once. It could be detrimental to try to dimension the **Front** to the **Back** planes in plane and in elevations if they have already been done in plan view.



Adding Parameters

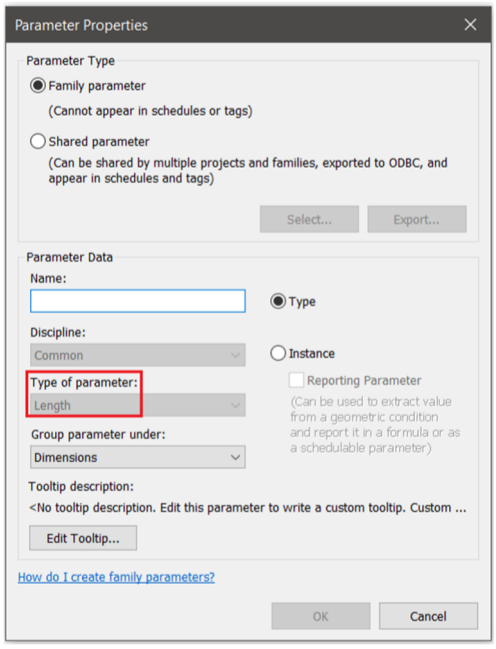
Add parameters to dimensions by selecting the dimension and then choosing the **Create Parameter** command.



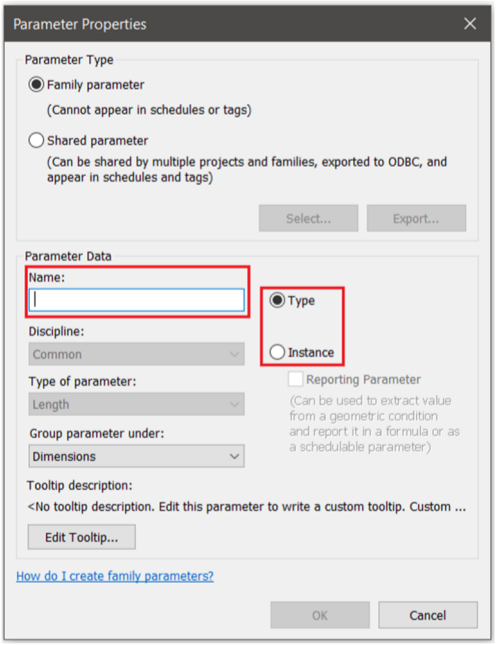
For most dimensional parameters they can be a **Family parameter**. Be consistent among the families being created. Use the same phrase for the different basic dimensions:

Height
Width
Depth

It may not be a good choice for the word **Length** to be used as a parameter. After all, **Height** is a **Length** as well as **Depth** and **Width**.



The **Shared parameter** file may need to be located. Use the **Browse** button for this if necessary. A **Shared parameter** can be added to a component family's parameters, a **Tag** family as a **Label**, and a **Schedule** in a project. Using a **Shared parameter** in any of these will prompt for selecting the parameter from the existing **Shared parameter file**.



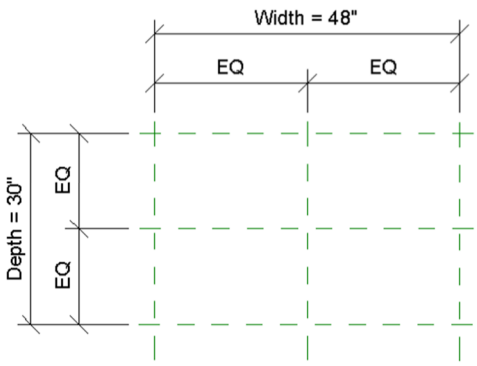
A **Family parameter** cannot be tagged or scheduled.

Back to adding the parameter to the dimensions.

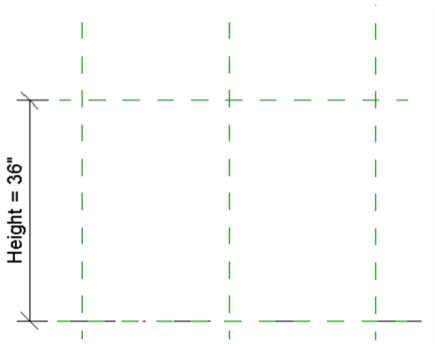
Give the parameter a **Name:** and choose whether it will be a **Type** or an **Instance** parameter.

Suggested names for overall parameters:

Height
Width
Depth

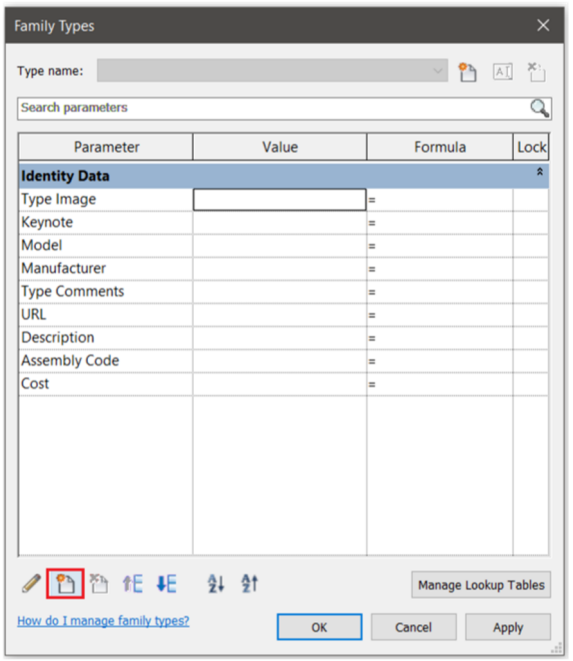


Plan



Front Elevation

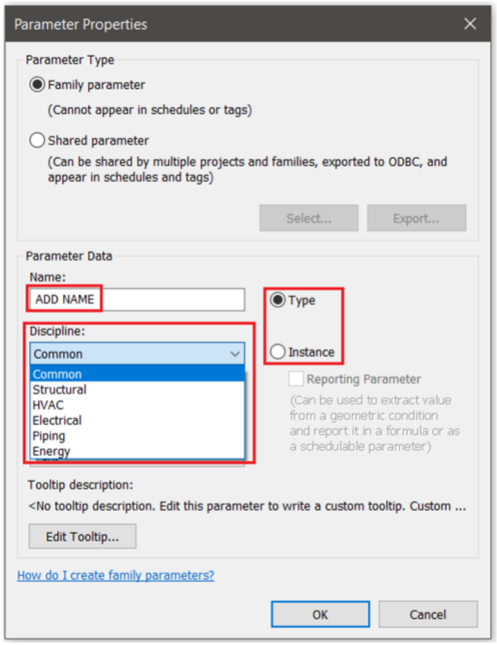
If there are any other company specific parameters these can be added during development. Start with the **Family Type** command to bring up the dialog box. The best way to find out what parameters are needed would be to review the template schedules.



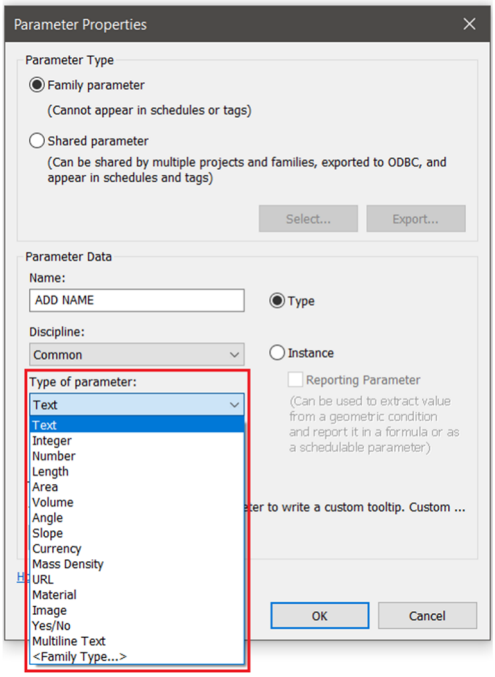
Select the **New Parameter** button to begin adding parameters.

If choosing the **Family parameter** option give the parameter a **Name:** and choose **Type** or **Instance**.

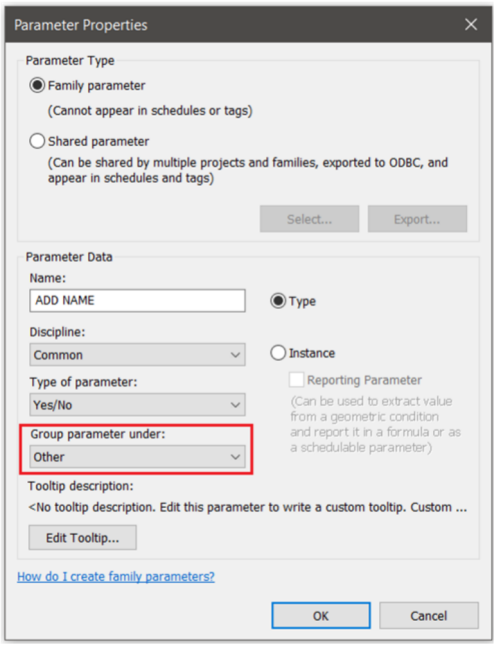
Next, select the **Discipline:** as needed.



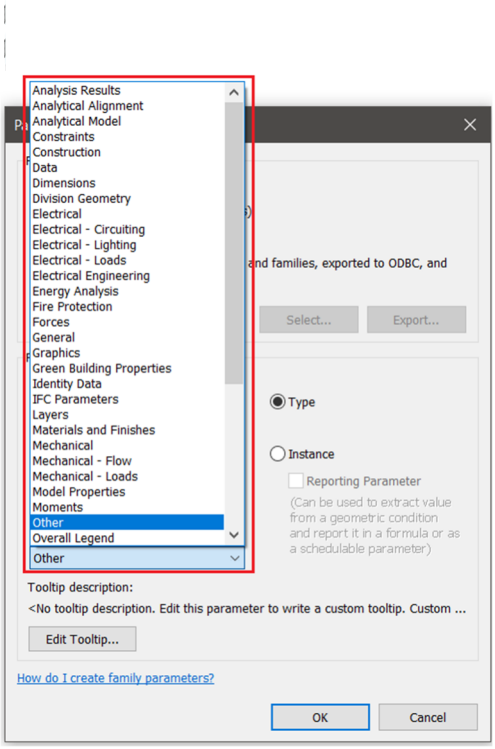
The **Type of parameter:** will be a limiting factor as to what type of information can be used for the new parameter. When using a dimension to select a parameter it will default to **Length**.



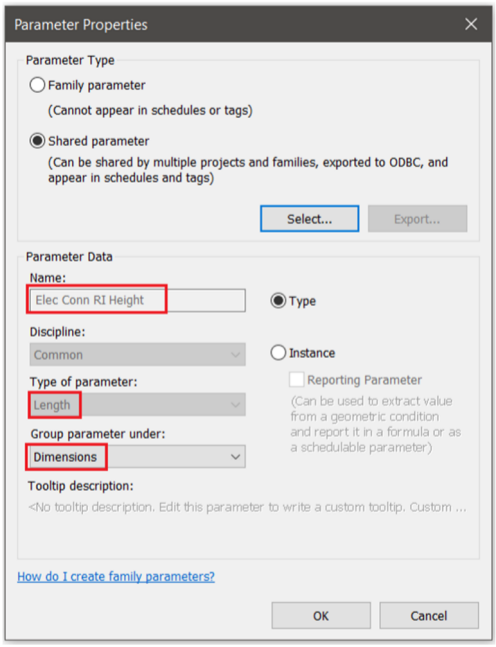
Some parameters will default to a certain **Group parameter under:** option. It depends on the **Type of parameter:** that was selected as to the group in which it defaults.



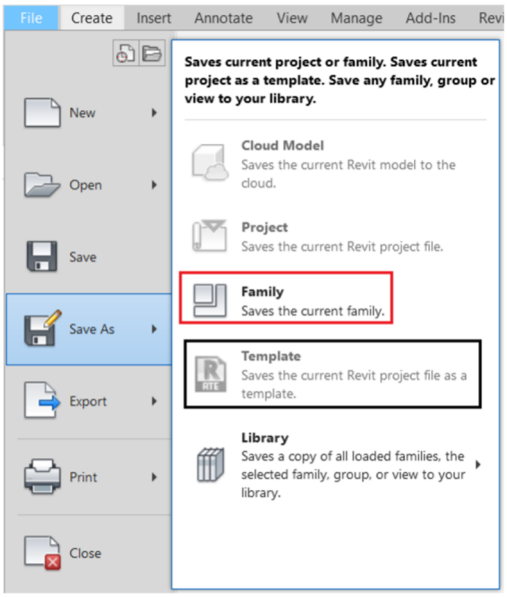
The **Group parameter under:** can be changed as required.



Group the parameters consistently in all families. For example, **Elec Conn RI Height** defaults under the **Dimensions** because it is a **Length**. It might appear to fit better under **Electrical** with the other parameters concerning **Electrical** properties.

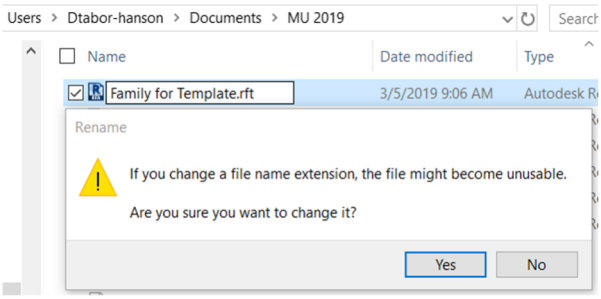


RFA vs RFT



Using **Save As** there is only one option of a type of file to use and that is to save as a **Family**. The **Template** option is greyed out. A **Family** file is an **RFA** file type. A **Family Template** is an **RFT** file type.

If the file is kept as an **RFA** file it can be opened and used as a starting point. The problem is that hitting the **Save** will overwrite that file. Using a **Save As** is the way to start a new **Family** file from an **RFA** file. Keep a back up copy somewhere else if using this method. Encourage users to put a copy in their local directory for use is yet another method to keep the originals safe.



Creating an **RFT** or **Family Template** file is as easy as renaming the file extension to **RFT** on the file previously saved as an **RFA**. Best practice is to use lower case letters for consistency.

There will be an alert box with a message in it warning of changing a file name extension. **Yes** is the option to complete the renaming.

What kind of family is needed?

When starting a family, the first and most important question should be “What does my family need to do?”

The answer to this should fall under the following three categories: **Detail**, **Function** or **Size** Each of these considerations will drive the way the family will be built.

Detail
Suppose a project places a high importance on graphically detailed renderings for use in promotional materials. In this case the project’s families should be modeled to have a higher level of **detail**. While this may seem time intensive, there are several tips that can be used to save time.

Hierarchy of visibility – When rendering a view, there will be families or features that draw the eye, whether due to its prominence in the view, the color of the materials or location in the natural flow that the viewer takes when looking through the image. Knowing which pieces of equipment stand out in these rendered views will allow you to delegate which families need a higher level of detail. The caveat to following this concept is that all supporting equipment in the view needs to have an established minimum level of detail to prevent them from detracting from the overall composition.

Utilize Bitmaps – A great way to add a higher level of detail without adding modeled detail is to insert bitmaps into family’s material properties. These can be used to add to the level of realism that can fool the eye into ignoring shortcuts in the actual geometry. This can be used to insert logos, texturing, or realistic “Flaws” in the model to help draw the eye to a specific part of the model and away from areas of low detail.

Don’t Sweat the Small Stuff – Keep in mind that simply having small items in a rendering adds to the level of detail, but there is no sense in spending hours modeling a high level of detail when creating small families unless they are the focus of a close-up rendering. A good way to think of this is to use items in your immediate surroundings, look at something from 10, 20, 30 ft away and note what stands out to you. That’s the level of detail you should add to your model.

Function
A family does not have to be a solitary work of art. Families can be built in a way that it can bend and conform to your needs for many instances in a project. A family that places a high importance on function should be one that repeats itself frequently and in many differing configurations. These families can be some of the hardest to construct but have the most return on investment when it comes to large projects or chain builds. Place a heavy focus on defining, naming and dimensioning reference planes, as these will drive the family’s functionality. It is imperative that all the information covered in the first half of this handout is considered when establishing a functional family. There are several questions that need to be answered in order to identify how to build this type of family.

- Do multiple graphically different variations of this family need to schedule?

- Does this family have a manufacturer's established catalog?
- Is this a family that is customizable?
- Does this family have optional schedulable accessories/components?
- Does this family need to flex in one or more dimensions when being inserted into a project?
- Do options need to toggle on and off depending on a live variable from project-to-project?

If any of these fit the family in question, then the object falls into the category of a functional family.

Addressing these questions one-by-one we can look at strategies to aid in the creation of a family that suits the functional requirements.

Do multiple graphically different variations of this family need to schedule?
There can be many cases where a family has multiple variations that need to be scheduled as different items but is essentially the same object. I.e. a table with varying dimensions or a lighting fixture with varying arrays of bulbs.

This can be accomplished by establishing what about features that need to change between options and what parts are stationary or do not change between types. From here reference planes with parameter driven dimensions can be placed to flex as a type parameter. Yes/No parameters can also be set to toggle on and off type-based visibilities for components or nested families needing to be distinguished one type from another. If the count of a component needs to change depending on the type, and array can be utilized in combination with an integer type parameter to drive the array count.

Does this family have a manufacturer established catalog?
If a specified piece of equipment is part of a catalog of equipment and has specified models denoted by a manufacturer, a catalog family can be created to drive the parameters of the family. This can be any of the afore mentioned controls. A catalog will also reduce the time needed to create all the necessary family types, and regardless of whether all models are needed for any one project, a catalog makes for a great asset in a Revit library.

***note*: Catalogs should be used when exceeding 5 types in a family regardless of an established manufacturer catalog.**

Is this a family that is customizable?
A common occurrence in quoting equipment for space utilization is the need for custom fabricated or modularly constructed equipment. These families also lend themselves to either catalog driven files or a flexible family that has a few types. I.e. Site-specific millwork or a custom kitchen island.

It is a good idea to build custom fab families on a solid framework depending on what kind of object it is, especially if there is the chance that a similar item needs to be fabricated by a different equipment provider. A solid framework built around reference planes and basic geometric components can serve as a basic model for future fab work. A great example is a

stainless-steel prep table for commercial kitchens. Most kitchens will have several variations of these, and while many can be spec'd as standard models, many are fabricated by the manufacturer to suit specific requirements. There are a multitude of optional components and dimensional constraints that can change depending on what is needed, so creating a basic family that plans ahead for these options can allow for quick family generation on a tight deadline.

- **Does this family have optional schedulable accessories/components?**
  This question serves a similar question as the one above, but this addresses the possibility of integrating other existing families that may or may not schedule. The driving factor is having all the options in one family so the type can be selected during a project without having to slow down to build it from the base model or find it in a directory. This can also aid users in a team setting as they can confidently select the base file and find the specific type they need.

- **Does this family need to flex in one or more dimensions when being inserted into a project?**
- **Do options need to toggle on and off depending on a live variable from project-to-project?**
  These last two questions go together and were already mentioned as part of first question but can stand alone as good reasons to create a functional family. The need to flex or change components visibility depending on a family's type is an immediate flag to the user that the family needs to have a higher functionality apart from a static model.

File Size

The file size of a family can seem like an ignorable attribute, but given enough items and a large enough project scope, what appears to be a small file size can bloat a file tremendously. An ideal file size for a typical family should fall between **500Kb-800Kb** and for very complex geometry or core components with high levels of functionality between **900Kb-1.2Mb.** The Purge command is the best way to keep file bloat down, and file should always be thoroughly purged before saving. There are, however, some more nuanced practices to keep the file weight to a minimum.

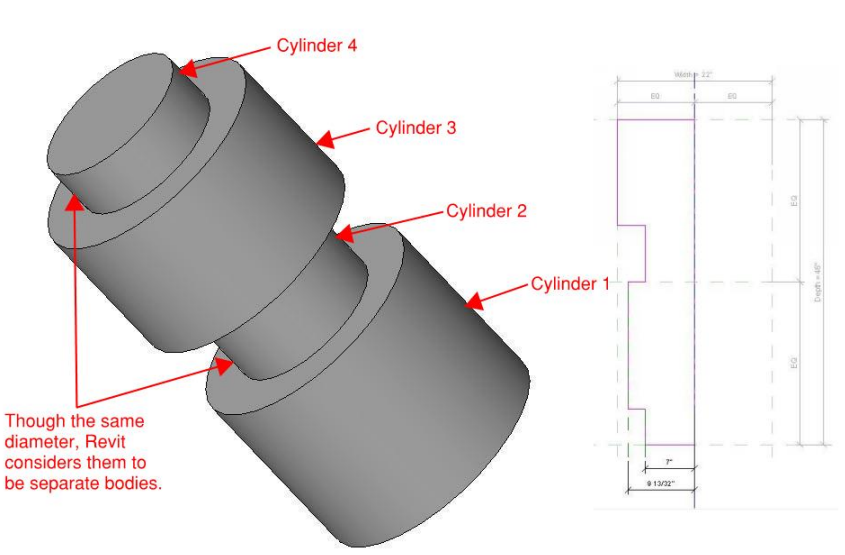
Extrudes

An extrusion has a weight of roughly 4Kb. This is a fairly reliable way to estimate the amount of file space of a given object when planning out how to build any given family. (# of extrudes*4Kb + empty file base weight)

Revolves

A revolved shape that could also be extruded, like a cylinder will weigh the same as that extrusion, but the geometry's weight grows proportionally to the complexity of the revolves profile. This correlates to the general number of differing sections in the revolve.

For instance, in the image below a single revolve made of 2 short cylinders pierced by a longer cylinder. When saved this object has the same weight as a file that has 4 extrusions in it even though you could make the same geometry with 3 extrusions. The benefit here is that no joining is required, and the dimensions can be constrained much more easily. The additional 4KB is a small price to pay for convenience and future manipulation.



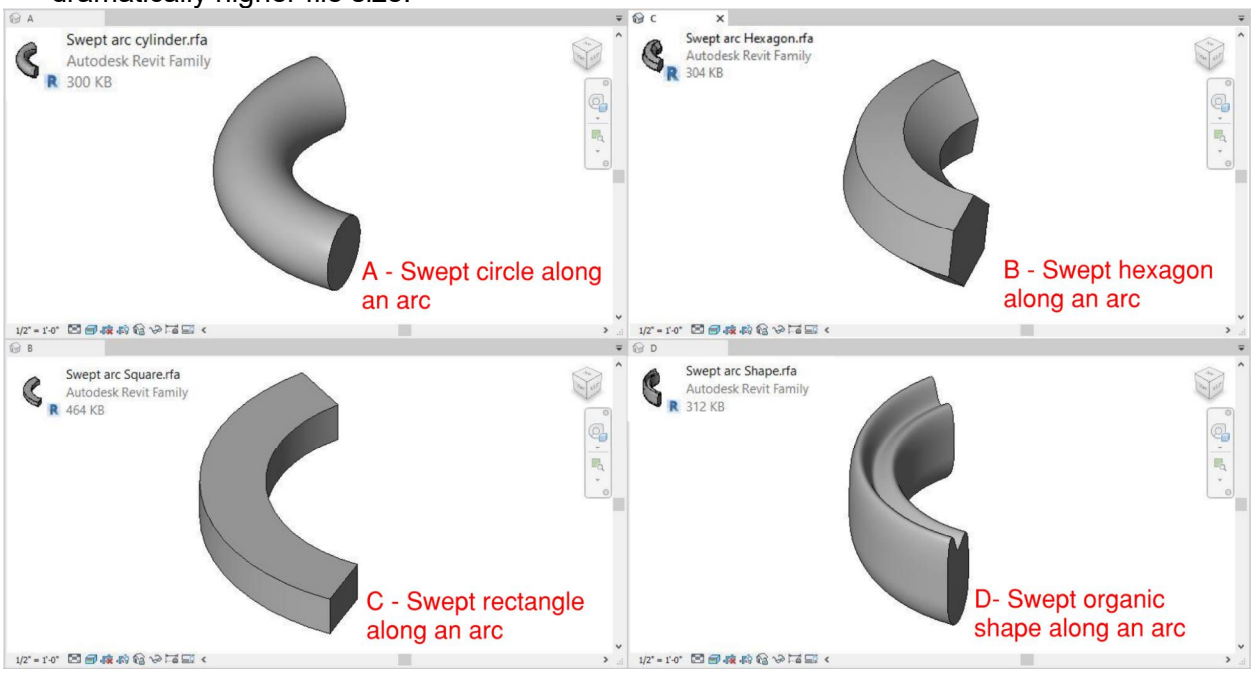
Using splines in the profile is a bit trickier, depending on the severity and complexity of the curvature. The revolve can grow in file weight considerably more than the previous rules would dictate. The number of curved surfaces created by the revolve will also affect the file size as seen in the images below.



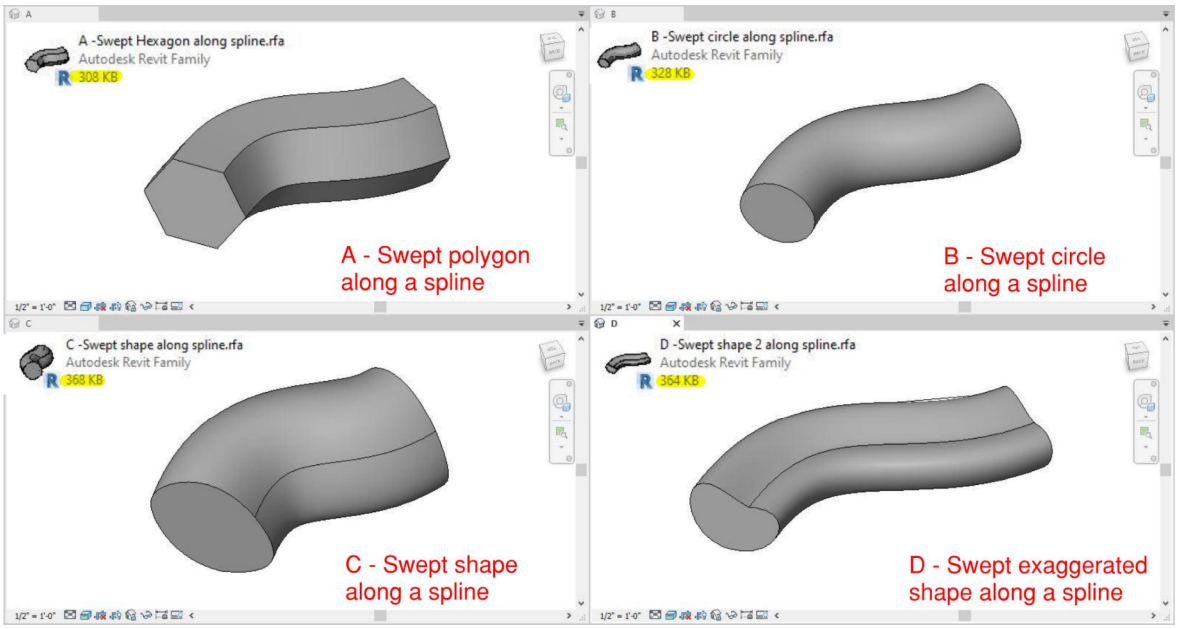


Sweeps

Sweeps have the same initial condition as revolves. If it cab be made with an extrusion, then it will weigh the same as said extrusion. A path created with a smooth arc will weigh more than a straight linear sweep, and a sweep with a profile created with a spline will have a dramatically higher file size.

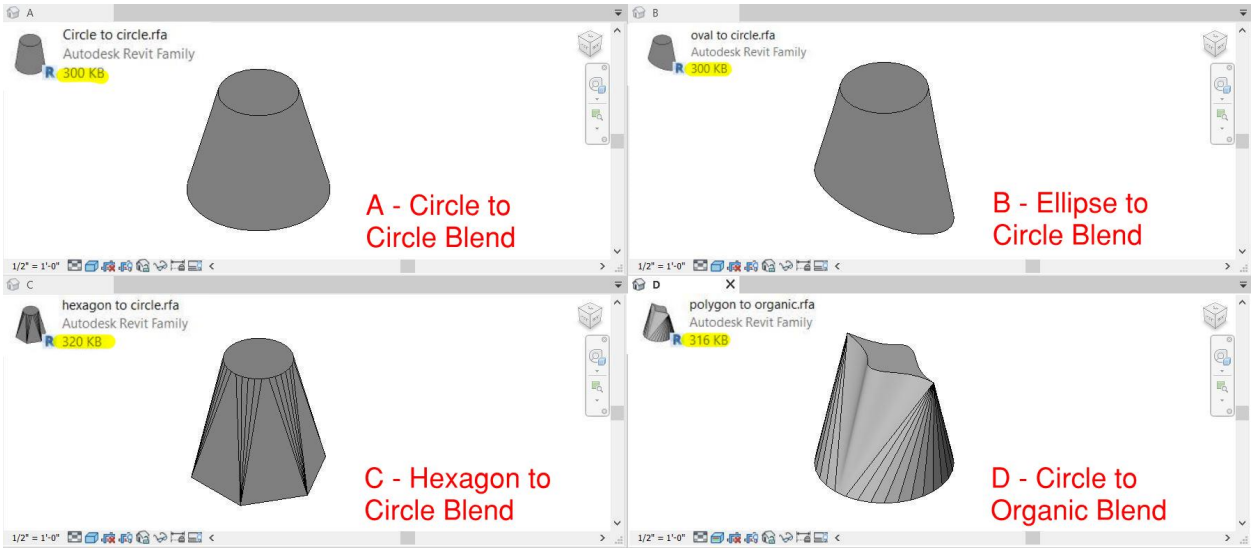


The models below show the correlation between file size and increasingly more complex profiles along a spline-based path.



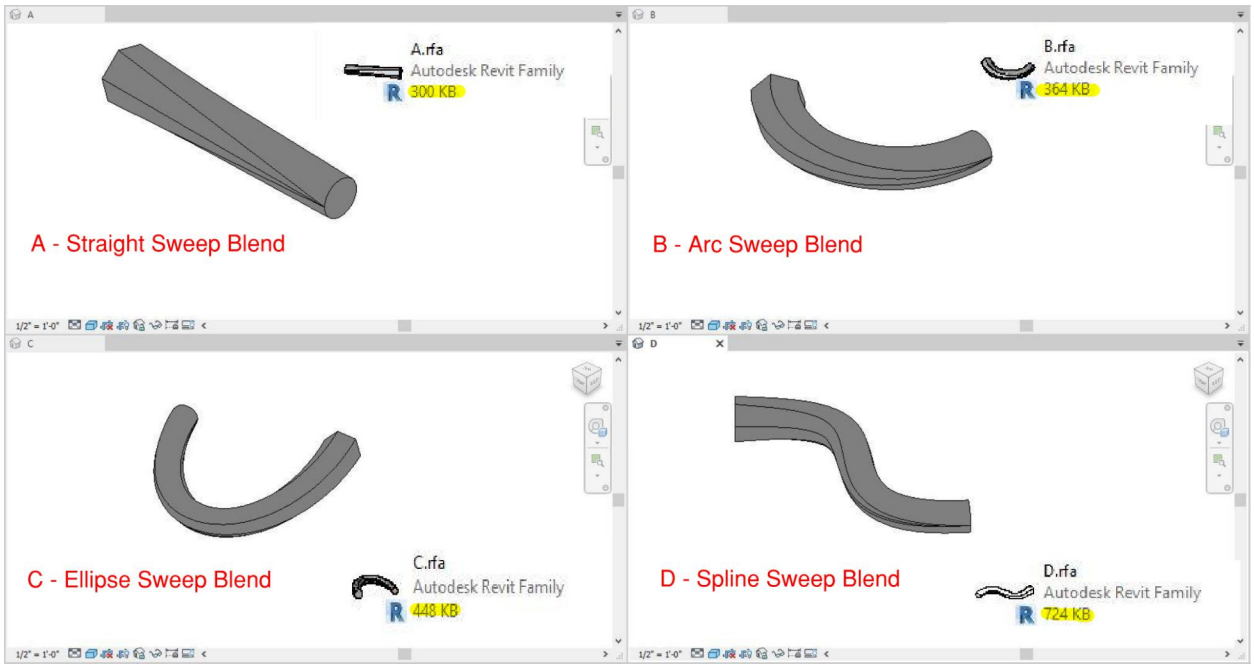
Blends

Blends are generally going to be double the size of an extrusion, with the exception of when the top or bottom of a blend has exaggerated spline based profiles or when blending polygons with many aides. Expect about 10-20Kb more depending on severity.



Swept Blend

Just stay away from them! They bloat families by a ridiculous amount. A single spline based blended sweep used 340Kb of information to generate the solid. Only use them if necessary.

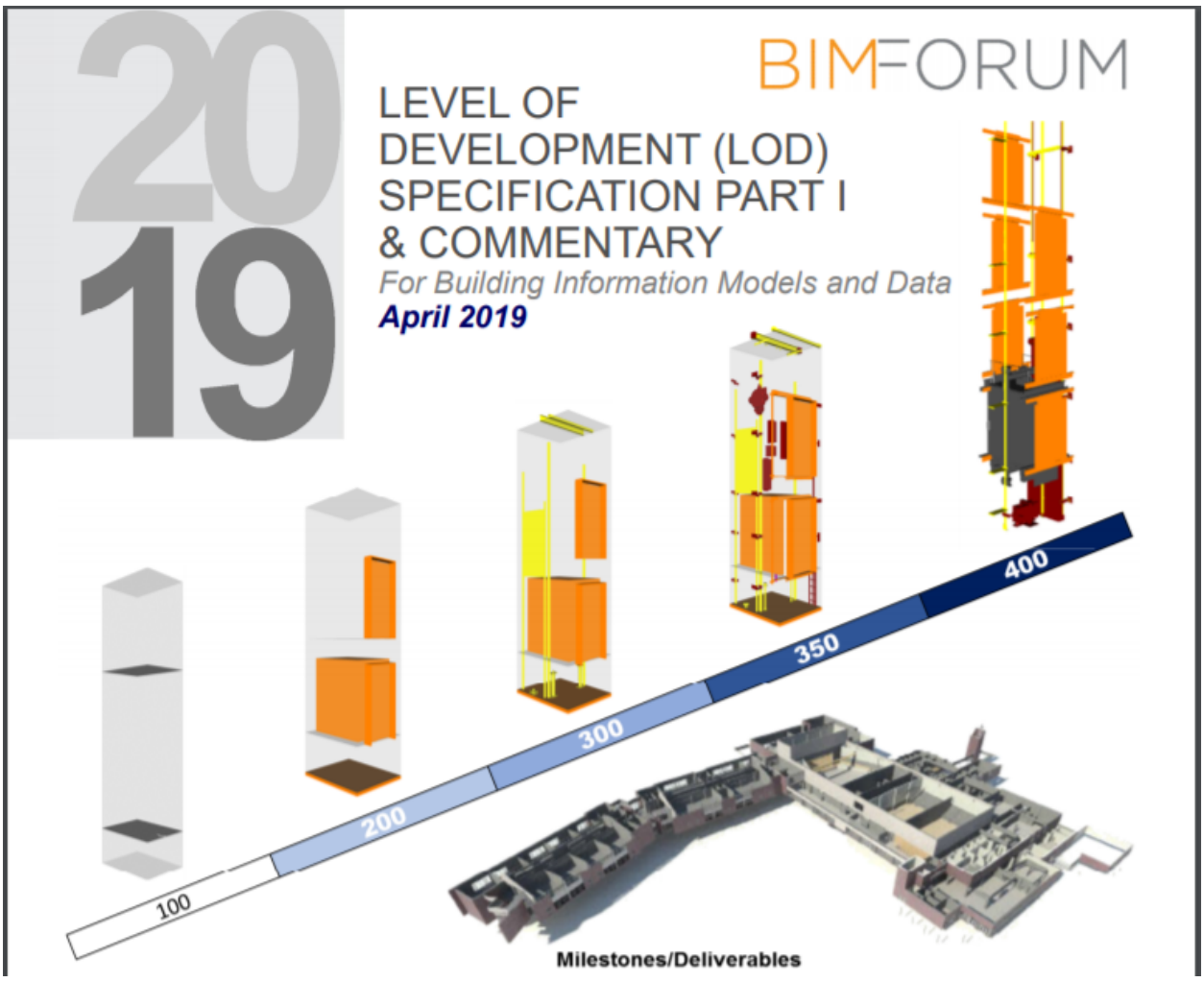


Joining
Joining geometry adds extra weight to your family as Revit is trying to create a new piece of geometry while retaining the geometry from the original bodies that make up the newly joined item. Use this tool sparingly.

Voids
Joining brings up the topic of **Voids.** Voids as a singular geometric entity hold the same data allocation (roughly 4Kb of space); however, when cutting a geometric element with a void, this joins the two bodies creating the above scenario. A better solution to cut geometry than using voids is to put the feature that is needing to be created through this test. If the negative space created by the feature is a linear shape, then it can be incorporated into the sketch of the geometry that is needing to be cut. The only caveat is if the negative space does not penetrate the entire geometric shape.

Your functionality and file size will suffer, but your family will look great. This does not mean the family has to be complex, but it does mean that more time will be spent refining the geometry

Levels of Development Prep for Families



In preparing the LOD Prep section, the *2019 Level of Development Specification Part 1 and Commentary – For Building Information Models and Data* was referenced. (BIMForum)

Preparing families that conform and fall in line with LOD specifications should follow the basic linear progression from level 200 to 400. This example's data set involves the commercial kitchen industry, but the principles explored here are focused on the broad principles used across all industries utilizing LOD.

LOD Prep – Place Holder Families (LOD 200)

E1010 21-05 10 10 Vehicle and Pedestrian Equipment

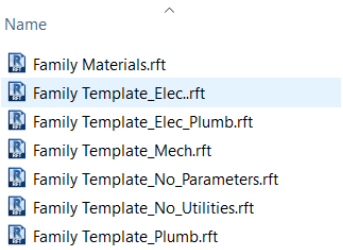
Associated Masterformat Sections: 11 10 00

100	See E10	
200	Schematic layout with approximate size, shape, and location of equipment; design performance parameters as defined in the BXP to be associated with model elements as non-graphic information.	

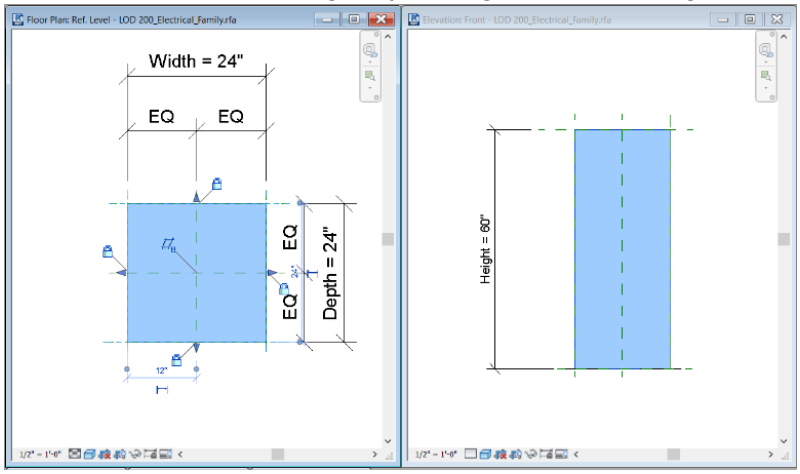
In the early stages of a project, place holder families can be used as a stop-gap for equipment that may not have been spec'd but general information about the object may be known, i.e. LOD 200 families. Following the same structure as any other family, a template with the correct **category** should be selected and named in a way that denotes basic information about the family e.g. *Stand_Toaster_Level 1.rfa*

In the LOD 200 phase of a project, families need to contain minimal information, and will serve as three-dimensional place holders until items can be spec'd by a PM for a quote.

Start with a blank family template with the correct category needed for the future piece of equipment. In this example, the **Family Template_Elec.rft** will be used to create the initial electrical family.



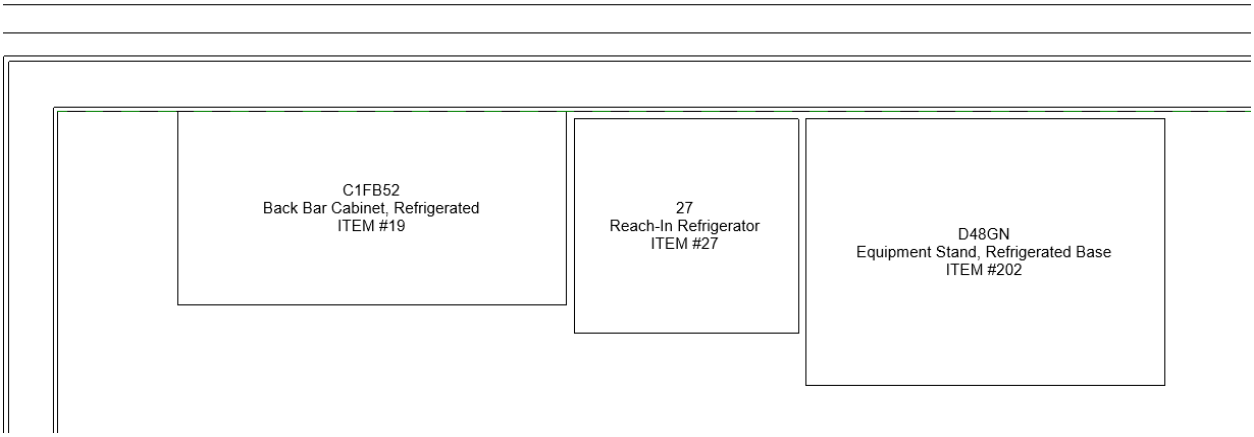
Once the file is open, begin by saving the file with a generic name such as,



LOD200_Electrical_Family.rfa, in order to designate it from all other families in the project library. Once saved, create a basic **extrusion** in the **Ref. Level** plane making sure to **align** and **lock** the sketch to the bounding reference planes (**Left**, **Right**, **Front**, **Back**). After completing the extrusion, be sure to **align** and **lock** the ends of the extrusion to the **Top** and **Base** reference planes. This will allow for the flexing of the basic dimensions.

From here this family can be duplicated and renamed over and over in order to create your LOD200 Library or the base file can be copied and renamed to be a catalog. By doing this, Excel™ files can be used to generate a library in seconds.

Each family type represents a scheduled piece of equipment. These types can be saved out as individual families at later stages or simply replaced all together by existing families in your current directory.



LOD Prep – Basic Geometric Detail and Specs (LOD 300)

When moving to level 300 the existing level 200 families can be modified to add appropriate geometry and more specified information. The fastest way to accomplish this is by importing any existing CAD files for the specific model needed and building the families reference planes around the CAD. Then geometry can be modeled based on the CAD and/or specs. This will include all mandatory clearances and physical attributes that are specific to the model.

LOD Prep – Refined Detail and Mechanical Connections (LOD 350)

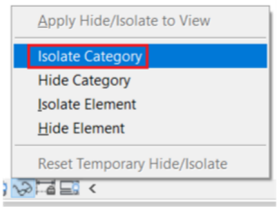
Level 350 in most cases is the highest level that families need to be taken to in Revit. This level is for the final application of detail that needs to be added, as well as adding in any mechanical connectors that need to be linked to the project model.

Tips

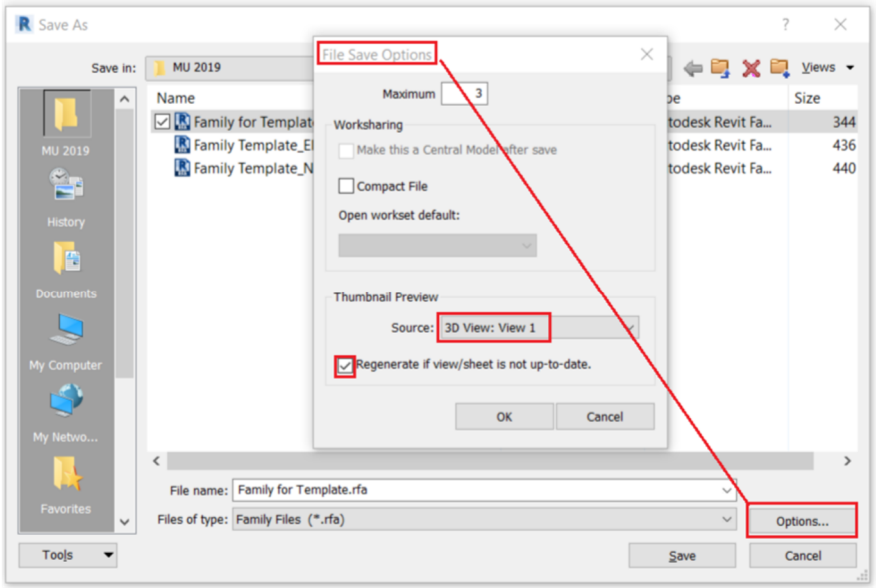
1. Keeping one **Materials.rfa** family can help keep all the material names and assets the same throughout a project. To get one material from a family into this one is as easy as copy and pasting an extrusion, or another modeling type, into the **Materials.rfa** family then deleting the modeled piece.
2. To keep from seeing the **Unpin** symbol on the **Center (Front/Back)** Reference Plane just rename the **Center (Front/Back)** Reference Plane to the **Back**, for example. Create a new **Center (Front/Back)** after that.



3. Put parameters that are to be used for flexing under **Constraints Instance Parameters** so that they show up at the top of the **Instance Parameters**. This consistency lets users know to look there for flexing the family.
4. When cleaning up families, use **Isolate** to highlight only the Reference Planes to pull them in tighter.



5. Set the preview of any new families by always saving in a named 3D view and use **SAVE AS** to bring up the dialog box where the save **Options** can be set. Select the 3D view and check the **Regenerate if view/sheet is not up-to-date.** option. Doing this every time a family is saved is a best practice to preset the preview view.



More References:

BIMForum,*(2019 Level of Development Specification Part 1 and Commentary – For Building Information Models and Data)*

Advanced Loadable Family Techniques

Conditional Statements in Formulas