

Revit MEP 2010 Families Guide

Metric Tutorials

Autodesk®

June 2009

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Introduction

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Welcome to the Revit MEP 2010 Families Guide! Families are an integral part of working in Revit MEP, and key to creating custom content.

In this guide, you learn:

- how to use families in your projects
- concepts of parametric design and family creation
- best practices to use when creating your own families

To better help you understand how to work with families, this guide contains conceptual explanations, hands-on tutorials, and reference information.

Audience and Prerequisites

This guide is intended for the beginning, intermediate, and advanced Revit MEP families user. Although any sketching and 2D or 3D modeling experience is helpful to understand how to work with families, before you begin to work with this guide, you should have a basic understanding of Revit MEP. If you do not, it is recommended that you use the tutorials included in the software. Access the tutorials by clicking Help ► Tutorials.

Training Files

The hands-on tutorials included in this guide use templates and family files that you download from <http://www.autodesk.com/revitmep-familiesguide>. Most of these files have an .rfa, .rte, or .rvt extension, and are extracted by default to folders in C:\Documents and Settings\All Users\Application Data\Autodesk\Training Files (Windows XP) or C:\Program Data\Autodesk\Training Files (Windows Vista).

Understanding Revit MEP Families

2

All of the elements that you add to your Revit MEP projects – from the mechanical and electrical equipment, lighting and plumbing fixtures, duct, and piping that you use to assemble a building model to the callouts, fixtures, tags, and detail components that you use to document it – are created with families.

By using predefined families and creating new ones in Revit MEP, you can add both standard and custom elements to your building models. Families also provide a level of control over elements that are similar in use and behavior, allowing you to easily make design changes and manage your projects more efficiently.

What Are Families?

A *family* is a group of elements with a common set of properties, called parameters, and a related graphical representation. Different elements belonging to a family may have different values for some or all of their parameters, but the set of parameters (their names and meanings) is the same. These variations within the family are called *family types* or *types*.

For example, the Sprinkler category includes families and family types that you can use to create different dry and wet sprinkler systems. Although these families serve different purposes and are composed of different materials, they have a related use. Each type in the family has a related graphical representation and an identical set of parameters, called the family type parameters.

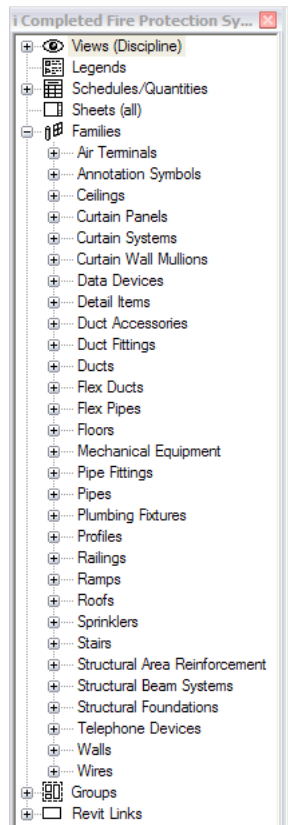
When you create an element in a project with a specific family and family type, you create an *instance* of the element. Each element instance has a set of properties, in which you can change some element parameters independent of the family type parameters. These changes apply only to the instance of the element, the single element in the project. If you make any changes to the family type parameters, the changes apply to all element instances that you created with that type.

Example: Creating a Sprinkler Element with a Family and Type

When you create an element in a project, that element is organized within the project first by element category, then by family, family type, and by instance. All 4 levels provide a different level of control of the element in your project. The following example demonstrates how you can create and control a sprinkler in a project.

Determining the Element Category

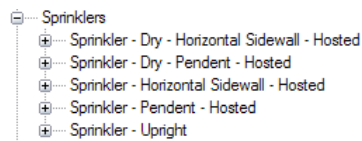
All families that are in use or are available in your projects (and templates) are visible in the Project Browser under Families, grouped by element category.



The category defines a top level of identification and behavior for the element. When you start the command to create a sprinkler, you automatically determine that the element will belong to the Sprinkler category. The category sets the basic role of the element within the building model, determines which elements it will interact with, and specifies that it will be included in any sprinkler schedules that you create.

Selecting the Family

By expanding the Sprinkler category, you can see that it includes a number of different families. All the sprinklers that you create in this project (unless it is specialized or you load other families), will belong to one of these families.

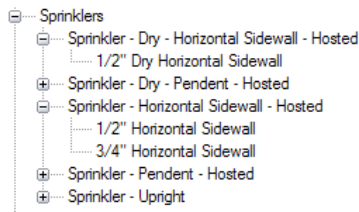


By itself, a family usually does not provide enough information to create a desired element in your project. While the family narrows the definition of the element you are creating in terms of its basic characteristics and graphic representation, it does not specify the size, material, or other specific characteristics of the element. For this reason, families include family types.

Specifying the Family Type

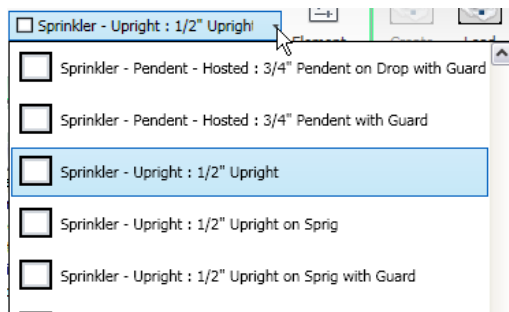
Family types are variations on the kind of element the family represents, and are shown under the sprinkler families shown below. For any of the types listed below, the family provides you with the kind of sprinkler

you want to create (pendant, upright, or horizontal sidewall), while the family type specifies the dimensions, material, and a few other characteristics of the element that you can create.



Creating an Instance

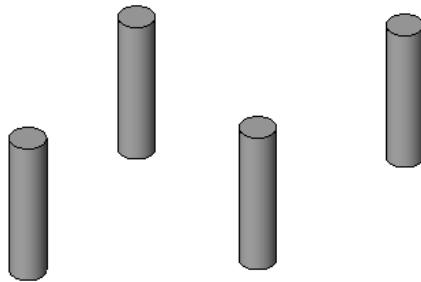
To add any of the sprinkler types in the Sprinkler family to a project, start the Component tool. The Type Selector lists the available Sprinkler family types in the project, listed first by family, then by name. You select the type that you want, and add it to the project.



When you create an element in your project, you create what is called an instance of the family type. If you create one sprinkler element, you have one instance of the type in your project.



If you create four sprinklers, you have four instances of the type in your project.



Making Modifications

After you create an element in your project, you can make a number of changes to it. If you select one or more instances of the sprinkler in the previous example, and then right-click and click Element Properties, you display the Instance Properties of the sprinkler or sprinklers. This is a location where you can make a number of changes to the element and its parameters.

Changing Instance Parameters

In the Instance Properties dialog, under Instance Parameters, scroll down to view the instance parameters of the sprinkler. You can change any of these values for the instance or instances of the sprinkler that you selected. The changes will not be applied to all the sprinklers of that type, only the instance or instances of the sprinkler that you selected.

This family contains an instance parameter that determines flow. If you specify a value for flow in the Instance Properties dialog for one of the sprinkler instances, the new value will be used to calculate the overall system flow where the sprinkler is placed.

Changing Type Parameters

In the Instance Properties dialog, click Edit Type to view the Type Parameters of the sprinkler type.

These parameters are shared by all sprinklers in the project of the same family type. Any changes that you make to these parameters are applied to all sprinklers of the same family type in the project, regardless of whether or not you selected them.

Changing the Family or Family Type

You can also change the family type, or family and family type of the sprinkler element in the Instance Properties dialog.

To change the family, at the top of the dialog, for Family, select a new family. In this example, you could change the wet or dry sprinkler family to one that creates a sprinkler for a chemical system.

To change the family type, for Type, select a different type. After you exit the dialog, the instance or instances that you selected will reflect any changes that you made to the family or family type.

Role of Families in Your Building Models

Now that you have seen the control that you have over elements that you create with families and family types, you can imagine the flexibility that families, family types, and family parameters provide when creating and documenting your building models. Families, family types, and type and instance parameters allow for variation and change in the elements that you create, which is the basis of parametric modeling in Revit MEP.

In addition to making the changes that were demonstrated in the previous section, you can use families, family types, and family parameters to:

- Add family types to existing families.
- Create your own family, and by adding family types, create a number of the same elements in a different size or that feature a different material, without having to draw the component more than once.
- Create family type parameters in a family that provide optional element geometry or material.
- Control the visibility and detail level of an element in different types of drawing views.

All families can be two-dimensional, three-dimensional, or both, but not all families have to be parametric. Elements created with families that do not need more than one size or type may remain non-parametric.

Duct and piping families are examples of 3D families, which display accordingly in isometric and plan views. Annotation detail families are examples of 2D families that do not require 3D representations. A boilerfamily is an example of a family that might need separate 3D and 2D representations: a 3D representation to display in isometric views and a simplified 2D outline to display in a plan view.

NOTE Two- and three-dimensional content from other software packages that you import into Revit MEP is not parametric, unless you recreate it as such.

Different Kinds of Families

There are 3 kinds of families in Revit MEP:

- system families
- loadable families
- in-place families

Most elements that you create in your projects are system families or loadable families. Loadable families can be combined to create nested and shared families. Non-standard or custom elements are created using in-place families.

System Families

System families create basic elements such as ducts, pipes, and other elements that you would assemble on site. System settings, which affect the project environment and include types for levels, grids, drawing sheets, and viewports, are also system families.

System families are predefined in Revit MEP. You do not load them into your projects from external files, nor do you save them in locations external to the project. If you cannot find the system family type that you need in a project, you can create a new one by changing the properties of an existing type, by duplicating (copying) a family type and changing its properties, or by copying and pasting one from another project. Any types that you modify are saved in your project.

For example, you may want to add a duct of a specific size to a project. However, the only similar duct family type features smaller ducts. You would duplicate the system family type in your project, change its name to reflect the characteristics of the new duct, and edit its properties to feature the new size. System families usually do not require you to model any new geometry.

Because system families are predefined, they are the least customizable of the 3 kinds of families, but they include more intelligent behavior than the other standard component families and in-place families. When you draw duct in your project, it automatically resizes to accommodate the space available.

Loadable Families

Loadable families are families used to create both system components and some annotation elements. Loadable families create the components that would usually be purchased, delivered, and installed in and around a building, such as boilers, water heaters, air handlers, and plumbing fixtures. They also include some annotation elements that are routinely customized, such as symbols and titleblocks.

Because of their highly customizable nature, loadable families are the families that you most commonly create and modify in Revit MEP. Unlike system families, loadable families are created in external .rfa files and imported, or loaded, in your projects. For families that contain many types, you can create and use type catalogs, which allow you to load only the types that you need for a project.

When you create a loadable family, you begin with a template that is supplied in the software and contains information about the family that you are creating. You sketch the geometry of the family, create parameters for the family, create the variations or family types that it includes, determine its visibility and detail level in different views, add system-specific connectors, and test it before using it to create elements in your projects.

Revit MEP includes a library of content in which you can both access loadable families that are supplied by the software and save the families that you create. You can also access loadable families from various sources on the Web.

Nesting and Sharing Loadable Families

You can load instances of families in other families to create new families. By nesting existing families inside other families, you can save yourself modelling time.

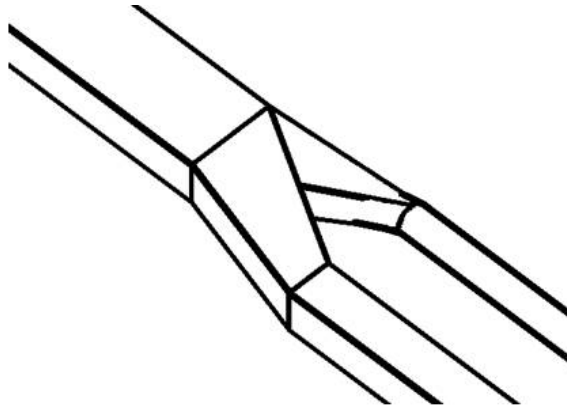
Depending on how you want instances of these families to act when you add them to your projects (as single element or as individual elements), you can specify whether the nested families are shared or not shared.

In-Place Families

In-place elements are unique elements that you create when you need to create a unique component that is specific to the current project. You can create in-place geometry so that it references other project geometry, resizing or adjusting accordingly if the referenced geometry changes. Examples of in-place elements are:

- unique or unusual geometry, such as a non-standard duct fitting

A non-standard duct fitting created as an in-place family



- a custom component that you do not plan to reuse
- geometry that must reference other geometry in your project
- a family that does not require multiple family types

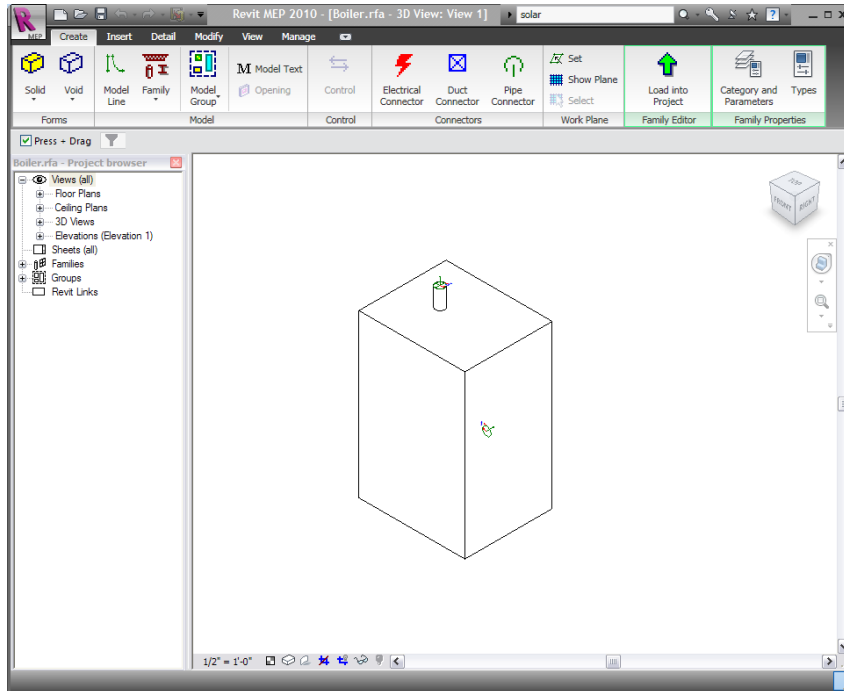
In-place elements are created similarly to loadable families, but like system families, are not loaded from or saved to external files. They are created in the context of the current project, and are not intended to be used in other projects. They can be 2D or 3D, and by selecting a category in which to create them, can be included in schedules. Unlike system families and loadable families, however, you cannot duplicate in-place family types to create multiple types.

Although it may seem easier to create all your components as in-place elements, the best practice is to use them only when necessary. In-place elements can increase file size and degrade software performance.

Design Environment for Creating Families

The Family Editor is a graphical editing mode in Revit MEP that lets you create and modify the families to include in your project. When you start creating a family, you open a template to use in the editor. The template can include multiple views, such as plans and elevations. The Family Editor has the same look and feel as the project environment in Revit MEP, but it features different tools.

A boiler family open in the Family Editor



The Family Editor is not a separate application. You access the Family Editor when you create or modify the geometry of a loadable family or an in-place family.

Unlike system families, which are predefined, loadable and in-place families are always created in the Family Editor. However, system families may contain loadable families that are modifiable in the Family Editor.

Loadable Families Overview

3

Loadable families are families used to create MEP components and annotation elements. Loadable families create the MEP components that would usually be purchased, delivered, and installed in and around a building, such as fixtures, boilers, radiators, lighting, and plumbing. They also include some annotation elements that are routinely customized, such as symbols and titleblocks.

Because of their highly customizable nature, loadable families are the families that you most commonly create and modify in Revit MEP. Unlike system families, loadable families are created in external .rfa files and are imported (loaded) into projects. For families that contain many types, you can create and use type catalogs, which let you load only the types that you need for a project.

When you create a loadable family, you begin with a template that is supplied in the software and contains information about the family that you are creating. You sketch the geometry of the family, use parameters to establish relationships between family components, create the variations or family types that it includes, and determine its visibility and detail level in different views. When you finish the family, you test it in a sample project before using it to create elements in your projects.

Revit MEP includes a library of content in which you can both access families that are supplied by the software and save the loadable families that you create. You can also access loadable families from manufacturers' web sites and from Autodesk® Seek.

Nesting and Sharing Loadable Families

You can load instances of families in other loadable families to create new families. By nesting existing families inside other families, you can save yourself modelling time.

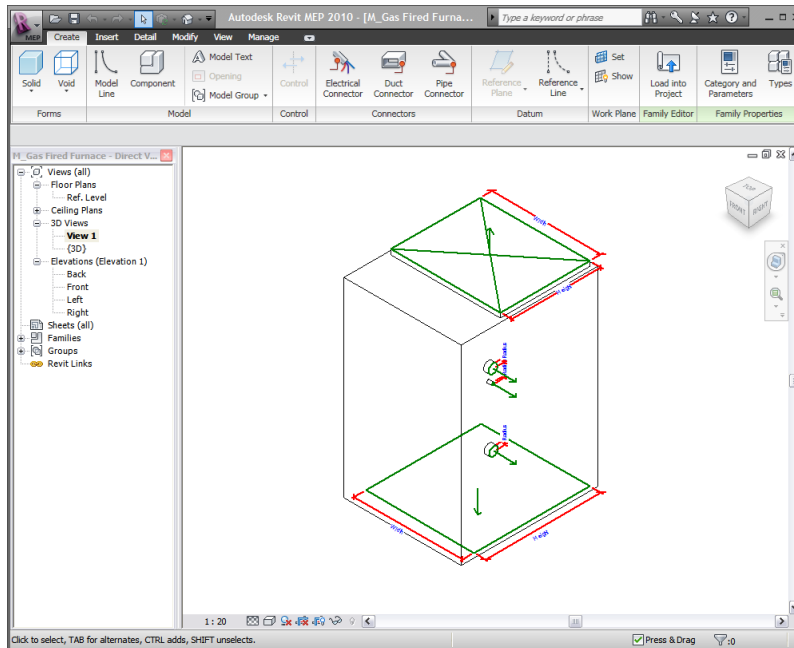
Depending on how you want instances of these families to act when you add them to your projects (as single element or as individual elements), you can specify whether the nested families are shared or not shared.

Creating Loadable Families

Using Revit MEP, you can create families for a project. The software provides many templates, including those for duct fittings, electrical equipment, and lighting fixtures, and lets you graphically draw the new family. The templates contain much of the information that you need to start creating the family and that Revit MEP needs to place the family in projects.

Understanding the Family Editor

The Family Editor is a graphical editing mode in Revit MEP that allows you to create families to include in your project. When you start creating a family, you open a template to use in the Family Editor. The template can include multiple views, such as plan and elevation views. The Family Editor has the same look and feel as the project environment in Revit MEP, but features different tools located on a single Create tab.



You can access the Family Editor by:

- Opening or creating a new family (.rfa) file.
- Selecting an element created by a loadable or an in-place family type, and then right-clicking and clicking Edit Family.

Family Editor Tools

- The **Types** tool (Create tab ► Family Properties panel ► Types) opens the Family Types dialog. You can create new family types or new instance and type parameters. See [Creating Family Types](#) on page 28.
- The **Dimension** tool (Detail tab ► Dimension panel) add permanent dimensions to the family, in addition to ones that Revit MEP automatically creates as you draw the geometry. This is important if you wish to create different sizes of the family.
- The **Symbolic Line** tool (Detail tab ► Detail panel ► Symbolic Line) lets you draw lines that are meant for symbolic purposes only. For example, you might use symbolic lines to represent the flow direction for a pipe fitting. Symbolic lines are not part of the actual geometry of the family. Symbolic lines are visible parallel to the view in which you draw them.
You can control symbolic line visibility on cut instances. Select the symbolic line, and click Modify Lines tab ► Visibility panel ► Visibility Settings. In the Family element visibility settings dialog, select Show only if instance is cut.

In this dialog, you can also control the visibility of lines based on the detail level of the view. For example, if you select Coarse, the symbolic lines are visible when you load the family into a project and place it in a view at the Coarse detail level.

TIP Use this dialog to control visibility of generic annotations loaded into model families. See [Loading Generic Annotations into Model Families](#) on page 72.

- The **Opening** tool (Create tab ► Model panel ► Opening) is available in host-based family templates only (such as wall-based or ceiling-based families). You create an opening by sketching its shape to the reference planes and then modifying its dimensions. After you create an opening, you can select it and set it to display as transparent in 3D and/or elevation views when loaded into a project. You specify transparency on the Options Bar.

NOTE The Opening tool is also available in the project environment.

- The **Reference Plane** tool (Create tab ► Datum panel ► Reference Plane) creates a reference plane, which is an infinite plane that serves as a guide for drawing lines and geometry.
- The **Reference Line** tool (Create tab ► Datum panel ► Reference Line) creates a line similar to a reference plane, but that has logical start and end points.
- The **Control** tool (Create tab ► Control panel ► Control) lets you place arrows to rotate and mirror the geometry of a family, after you add it to your design. The following arrow controls are available on the Place Control tab ► Control Type panel (multiple selections are acceptable):
 - Single Vertical
 - Double Vertical
 - Single Horizontal
 - Double Horizontal

Revit MEP rotates or mirrors the geometry about the origin. With 2 opposite-facing arrows, you can mirror horizontally or vertically.

You can place the controls anywhere in the view. It is best to place them where it is obvious what they control.

TIP Controls are useful when creating a pipe fitting family. The control arrows allow you to flip the fitting horizontally or vertically.

- The **Text** tool (Detail tab ► Annotate panel ► Text) lets you add text notes to the family. This is typically used in an annotation family.
- The **Model Text** tool (Create tab ► Model panel ► Model Text) lets you add signage to a building or letters to a wall.
- The **Section** tool (View tab ► View Creation panel ► Section) lets you create a section view.
- The **Component** tool (Create tab ► Model panel ► Component) selects the type of component to be inserted into the Family Editor. After you select this tool, the Type Selector becomes active and you can select a component.
- The **Symbol** tool (Detail tab ► Detail panel ► Symbol) lets you place 2D annotation drawing symbols.
- The **Detail Component** tool (Detail tab ► Detail panel ► Detail Component) lets you place a detail component.
- The **Masking Region** tool (Detail tab ► Detail panel ► Masking Region) lets you apply a mask that will obscure model elements when the family is used to create an element in a project. See Masking Regions in the Revit MEP 2010 Help.

- The **Solid** tool (Create tab ► Forms panel ► Form) provides access to tools that let you create solid geometry in the family.
- The **Void** tool (Create tab ► Forms panel ► Void) provides access to tools that let you cut solid geometry in the family.
- The **Label** tool (Create tab ► Annotate panel ► Label) lets you place intelligent text in the family. This text represents a family property. When the property value is specified, it will show up in the family.

NOTE This tool is available for annotation symbols only.

- The **Load into Project** tool (Create tab ► Family Editor panel ► Load Into Project) lets you load a family directly into any open project or family.

Creating a Loadable Family

Typically, the loadable families that you need to create are standard sizes and configurations of common components and symbols used in a building design.

To create a loadable family, you define the geometry and size of the family using a family template that is provided in Revit MEP. You can then save the family as a separate Revit family file (.rfa file) and load it into any project.

Depending on the complexity of the family, the creation process can be time-consuming. If you can identify a family that is similar to the one you want to create, you can save time and effort by copying, renaming, and modifying the existing family.

The topics in this section apply to the creation of model (3D) families, but some are relevant to 2D families, including titleblocks, annotation symbols, and detail components.

Workflow: Creating a Loadable Family

For best results when creating a loadable family, follow the workflow below.

- 1 Before beginning family creation, plan the family.
See [Planning a Loadable Family](#) on page 15.
- 2 Create a new family file (.rfa) using the appropriate family template.
See [Choosing a Family Template](#) on page 16.
- 3 Define subcategories for the family to help control the visibility of the family geometry.
See [Creating Family Subcategories](#) on page 19.
- 4 Create the family skeleton, or framework:
 - Define the origin (the insertion point) of the family.
See [Defining the Family Origin](#) on page 20.
 - Lay out reference planes and reference lines to aid in sketching component geometry.
See [Laying Out Reference Planes](#) on page 22 and [Using Reference Lines](#) on page 24.
 - Add dimensions to specify parametric relationships.
See [Dimensioning Reference Planes](#) on page 25.
 - Label dimensions to create type or instance parameters or 2D representation.
See [Labeling Dimensions to Create Parameters](#) on page 26.
 - Test, or flex, the framework.

See [Flexing the Family Framework](#) on page 26.

5 Define family type variations by specifying different parameters.

See [Creating Family Types](#) on page 28.

6 Add a single level of geometry in solids and voids, and constrain the geometry to reference planes.

See [Creating Family Geometry](#) on page 29.

7 Flex the new model (types and hosts) to verify correct component behavior.

See [Flexing the Family](#) on page 28.

8 Repeat previous steps until the family geometry is complete.

9 Specify 2D and 3D geometry display characteristics with subcategory and entity visibility settings.

See [Managing the Family Visibility and Detail Level](#) on page 61.

10 Save the newly defined family, and then load it into a project for testing.

See [Testing a Family in a Project](#) on page 64.

11 For large families that include many types, create a type catalog.

See [Creating a Type Catalog](#) on page 76.

Planning a Loadable Family

If you consider this list of requirements before creating a family, you will have an easier time creating it. Because there are bound to be changes as you create families, the Family Editor lets you make those changes without having to start over.

■ Will the family need to accommodate multiple **sizes**?

For a lighting fixture that is available in several preset sizes, or a duct fitting that is available in several different shapes, create a standard component family. However, if you need to create a custom piece of equipment that only comes in one configuration, you may want to create it as an in-place family, instead of a loadable family.

Size variability and the degree of complexity of the object determine whether you create a loadable family or an in-place family.

■ How should the family **display** in different views?

The way the object should display in views determines the 3D and 2D geometry that you need to create, as well as how to define the visibility settings. Determine whether the object should display in a plan view, elevation view, and/or section views.

■ Does this family require a **host**?

For objects typically hosted by other components, such as a lighting fixture, start with a host-based template. How the family is hosted (or what it does or does not attach to) determines which template file should be used to create the family.

■ How much **detail** should be modeled?

In some cases, you may not need 3D geometry. You may only need to use a 2D shape to represent the family. Also, you may simplify the 3D geometry of the model to save time in creating the family. For example, less detail is required for a wall outlet that will only be seen in interior elevations from a distance than for a sidelight that will be seen in an interior rendering.

■ What is the **origin** point of this family?

For example, the insertion point for an accessible toilet may be 18 inches off the adjacent wall to meet code. Determining the appropriate insertion point will help you place the family in a project.

Choosing a Family Template

After you plan a family, your next step is to choose the template that you will base it on. When you create a family, you are prompted to select a family template that corresponds to the type of element that the family will create.

The template serves as a building block, containing the information that you need to start creating the family and that Revit MEP needs to place the family in projects.

Different Kinds of Family Templates

While most of the family templates are named according to the type of element family created from them, there are a number of templates that include one of the following descriptors after the family name:

- wall-based
- ceiling-based
- floor-based
- roof-based
- line-based
- face-based

Wall-based, ceiling-based, floor-based, and roof-based templates are known as host-based templates. A host-based family can be placed in a project only if an element of its host type is present.

Review the following template descriptions to determine which one best suits your needs.

Wall-based Templates

Use the wall-based templates to create components that will be inserted into walls. Some wall components (such as doors and windows) can include openings, such that when you place the component on a wall, it cuts an opening in the wall. Some examples of wall-based components include doors, windows, and lighting fixtures. Each template includes a wall; the wall is necessary for showing how the component fits in or on a wall.

Ceiling-based Templates

Use the ceiling-based templates to create components that will be inserted into ceilings. Some ceiling components include openings, so that when you place the component on a ceiling, it cuts an opening in the ceiling. Examples of ceiling-based families include sprinklers and recessed lighting fixtures.

Floor-based Template

Use the floor-based template for components that will be inserted into floors. Some floor components (such as a heating register) include openings, so that when you place the component on a floor, it cuts an opening in the floor.

Roof-based Template

Use the roof-based template for components that will be inserted into roofs. Some roof components include openings, so that when you place the component on a roof, it cuts an opening in the roof. Examples of roof-based families include soffits and fans.

Standalone Template

Use the standalone template for components that are not host-dependent. A standalone component can be placed anywhere in a model and can be dimensioned to other standalone or host-based components. Examples of standalone families include duct and duct fittings.

Line-based Template

Use the line-based templates to create detail and model families that use 2-pick placement.

Face-based Template

Use the face-based template to create work plane-based families that can modify their hosts. Families created from the template can make complex cuts in hosts. Instances of these families can be placed on any surface, regardless of its orientation. See [Creating Work Plane-based and Face-based Families](#) on page 74.

Creating a Family with a Template

To create a loadable family, you select a family template, and then name and save the family file. Name the family so it adequately describes the element that it is intended to create. Later, when the family is complete and you load it into a project, the family name displays in the Project Browser and the Type Selector.

Predefined imperial and metric component families are installed by default in library folders:

Windows XP: C:\Documents and Settings\All Users\Application Data\Autodesk\RME 2010\Imperial Library or Metric Library.

Windows Vista: C:\Program Data\Autodesk\RME 2010\Imperial Library or Metric Library.

You can save families in the folders in these libraries, or you can save them to any local or network location. After you create families, you can use the Copy and Paste commands in Microsoft® Windows Explorer to move the families to different locations.

BEST PRACTICE Do not save the family to a location where others can access it until you complete and test the family.

To create a family with a template

1 Click  ➤ New ➤ Family.

NOTE If you are creating an annotation or titleblock family, click  ➤ New ➤ Annotation Symbol or Title Block.

Depending on the current drawing units, the New Family - Select Template File dialog displays the available imperial or metric family templates that are installed on your system in:

Windows XP: C:\Documents and Settings\All Users\Application Data\Autodesk\RME 2010\Imperial Templates or Metric Templates.

Windows Vista: C:\Program Data\Autodesk\RME 2010\Imperial Templates or Metric Templates.

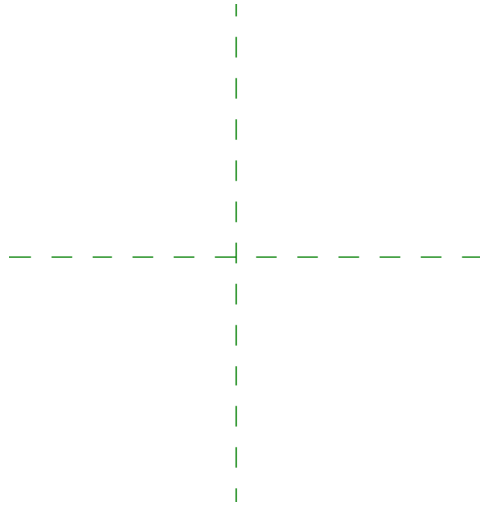
NOTE Depending on your software installation or office standards, the family templates may be installed in another location, either locally or on a network. Contact your CAD Manager for more information.

2 Optionally, to preview a template, select it.

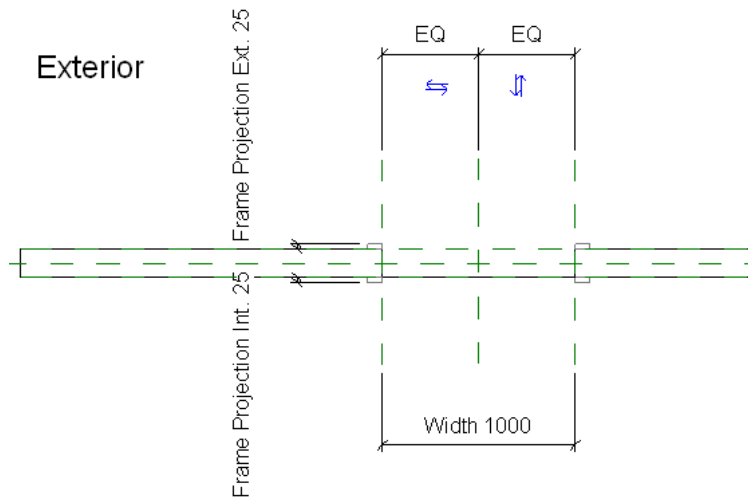
The template preview image displays in the upper right corner of the dialog.

3 Select the family template that you want to use, and click Open.

The new family opens in the Family Editor. For most families, 2 or more dashed green lines display. These are reference planes, or the working planes that you will use when you create the family geometry.



If you are creating a host-based family, such as a lighting fixture family, host geometry may also display.



4 In the Project Browser, notice the list of family views.

The family views vary depending on the type of family that you create. If necessary, you can create additional views by duplicating and renaming existing views.

5 Click  ► Save As ► Family.

6 In the Save dialog, navigate to the location in which you want to save the family, enter a name for the family, and click Save.

BEST PRACTICE Use title case for the family name.

Creating Family Subcategories

When you create a family, the template assigns it to a category that defines the default display of the family (line weight, line color, line pattern, and material assignment of the family geometry) when the family is loaded into a project. To assign different line weights, line colors, line patterns, and material assignments to different geometric components of the family, you need to create subcategories within the category. Later, when you create the family geometry, you assign the appropriate components to the subcategories.

For example, in a plumbing fixture family, you could assign the sink to one subcategory and the fittings to another. You could then assign different materials to each subcategory.

Revit MEP features some predefined subcategories for different categories of families. Other families have no subcategories, which means that you can define your own. The Object Styles dialog lists family categories and subcategories. It also displays the line weight, line color, line pattern, and material assigned to each category and subcategory.

TIP You can apply a drafting pattern to a family. When you create and define a subcategory to apply to the family, you can specify its surface and cut pattern materials to have a drafting pattern. You cannot apply a model pattern to a family. Only flat or cylindrical surfaces can have drafting patterns. See Fill Patterns in the Revit MEP 2010 Help.

- 1 With the family open, click Manage tab ► Family Settings panel ► Settings drop-down ► Object Styles.
- 2 On the Model Objects tab of the Object Styles dialog, under Category, select the family category.
- 3 Under Modify Subcategories, click New.
- 4 In the New Subcategory dialog, for Name, enter a new name.
Revit MEP automatically selects the appropriate category in the Subcategory of list.
- 5 Click OK.
Although you will not immediately create and assign the subcategory to the family geometry, you can specify the line weight, line color, line pattern, and material for the subcategory.
- 6 Specify values for line weight, line color, line pattern, and material:
 - Click in the Projection and Cut fields for Line Weight, and select values from the lists.
 - Click the button in the Line Color field, and select a color from the Color dialog. If desired, define a custom color.
 - Click in the Line Pattern field, and select a line pattern from the list. If desired, define a new line pattern for the line display.
 - Click in the Material field, and specify a material, cut pattern, surface pattern, or render appearance.
See Materials in the Revit MEP 2010 Help.
- 7 To define additional subcategories, repeat steps 3 - 6.
- 8 Click OK.

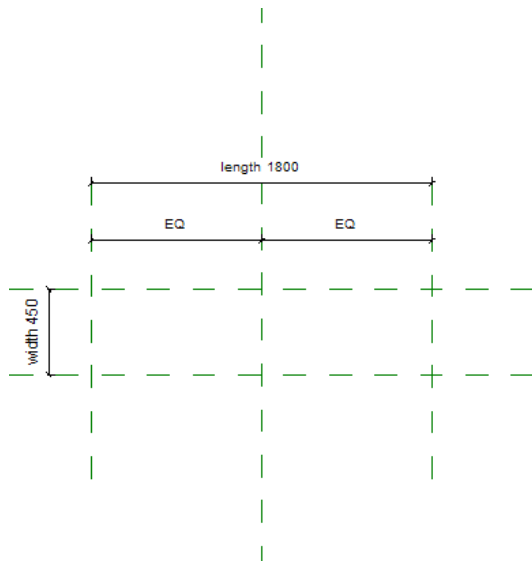
Creating the Family Framework

After you plan a family, the next step is to create the family framework (skeleton). The framework is comprised of lines and parameters in which you later create the family geometry. It also defines the origin (insertion point) of elements that you create with the family.

To create the framework, you begin by defining the family origin. You then build the framework with elements called reference planes and reference lines. Next you define family parameters. The parameters

that you define at this stage usually control the size (length, width, height) of the element, and let you add family types.

A view of a boiler family framework



When the framework is complete, you test it by changing the parameter values and ensuring that the reference planes resize. By creating solid frameworks from the information that you gather in your planning stage before you create the family geometry, you ensure the stability of the families that you create.

Defining the Family Origin

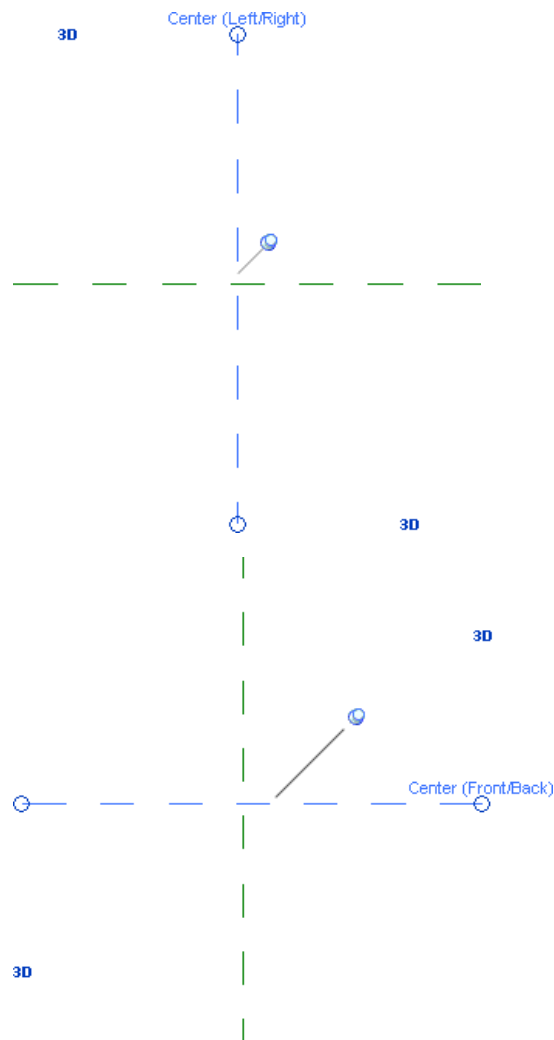
After you create a component family, define the family origin and pin (lock) it in place. Later, when you create an element with the finished family, the family origin specifies the element insertion point.

The intersection of 2 reference planes in a view defines the origin of a family. You can control which reference planes define the origin by selecting them and changing their properties. Many family templates create families with predefined origins, but you may need to set the origin of some families. For example, an accessible toilet family that creates toilet elements must always be placed a certain distance from an adjacent wall to meet code. Therefore, the family origin would need to be located at the specified distance from the wall.

To define the family origin

- 1 In the Family Editor, verify whether an origin has been defined for the family by selecting the reference planes.

If a pin displays on 2 of the reference planes, the origin is defined for the family, and you can skip the remaining steps.



2 Click Create tab ► Datum panel ► Reference Plane drop-down ► Draw Reference Plane.

3 Sketch the reference plane.

4 Select the reference plane.

5 Click Modify Reference Planes tab ► Element panel ► Element Properties drop-down ► Instance Properties.

6 In the Instance Properties dialog, under Other, select Defines Origin, and then click OK.

7 Create or open a family.

8 In a plan view, while pressing *Ctrl*, select both reference planes.

9 Click Multi-Select tab ► Modify panel ► Pin.

10 With the reference planes still selected, access their instance properties.

11 In the Instance Properties dialog, under Other, select Defines Origin.

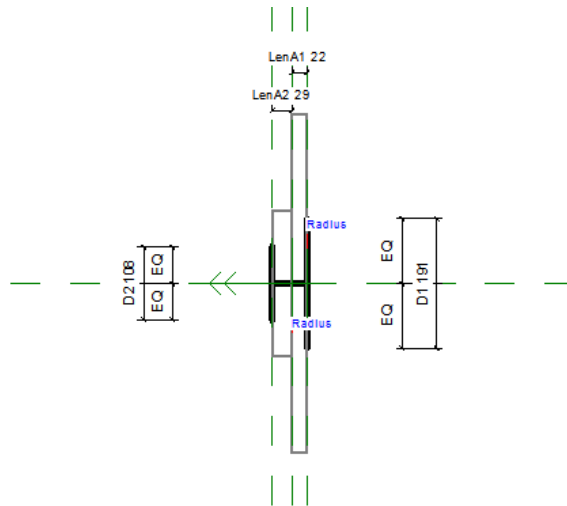
The intersection of the reference planes now defines the origin/insertion point of the family. By pinning the planes, you ensure that you do not accidentally move them, which would change the family insertion point.

Laying Out Reference Planes

Before you create family geometry, you should sketch reference planes. You can then snap sketches and geometry to the reference planes.

- Position new reference planes so that they align with the major axes of the planned geometry.
- Name each reference plane so that you can assign it to be the current work plane. The name lets you see the reference plane so that you can select it to use as a work plane.
- Specify the property for reference planes that lets you dimension to them when the family is placed in a project.

A flange family created within a framework of reference planes



To lay out reference planes

- 1 Click Create tab ► Datum panel ► Reference Plane drop-down ► Draw Reference Plane.
- 2 Specify a start point and an end point for the reference plane.
- 3 Name the reference plane so that you can identify it in when you open other views:
 - Select the reference plane, and click Modify Reference Planes tab ► Element panel ► Element Properties drop-down ► Instance Properties.
 - In the Instance Properties dialog, under Identity Data, for Name, enter a name for the reference plane.
 - Click OK.

Defining Priorities for Reference Planes

Reference planes have a property called Is Reference. By setting this property or by defining a plane as an origin, you specify that the reference plane can be dimensioned to when you place a family into a project. For example, if you create a panelboard family and want to dimension the edges of the panelboard, create reference planes at the panelboard's edges and set the Is Reference property for the reference planes. When you create dimensions for the panelboard, you can then select either the origin or the panelboard's edges or both.

Is Reference also sets a reference point for dimensions when you use the Align tool. Specifying the Is Reference parameter lets you select different lines of aligned components for dimensioning.

Available Is Reference values:

- Not a reference
- Strong reference (see [Specifying Strong and Weak References](#) on page 23.)
- Weak reference (see [Specifying Strong and Weak References](#) on page 23.)
- Left
- Center (Left/Right)
- Right
- Front
- Center (Front/Back)
- Back
- Bottom
- Center (Elevation)
- Top

If you create multiple families with the same Is Reference value for a particular reference plane, the dimensions to that reference plane apply when you switch between family components.

For example, you create a toilet family and a sink family, and specify the left side reference plane property value to Left for both of them. You place the toilet in a building and dimension it from the wall to the left side of the toilet. If you replace the toilet with the sink, the dimension to the left side would remain to the left side of the sink, because they both had a property value of Left.

Specifying Strong and Weak References

To dimension families placed in a project, you need to define family geometry references as either strong or weak in the Family Editor.

A strong reference has the highest priority for dimensioning and snapping. As you are placing the family, temporary dimensions snap to any strong references in the family. When you select the family in the project, temporary dimensions appear at the strong references.

A weak reference has the lowest priority for dimensioning. When you place the family into the project and dimension to it, you may need to press *Tab* to select a weak reference, as any strong references highlight first.

NOTE You may also be able to zoom in to the model to highlight weak references, as elements in the model appear farther apart as you zoom in.

This procedure changes references for selected line instances. It does not specify reference values for new lines.

- 1 Click Create tab ► Datum panel ► Reference Line (or Reference Plane), and sketch a line or reference plane.
- 2 Select the line or plane, and click Modify <element> tab ► Element panel ► Element Properties drop-down ► Instance Properties.

- 3 For reference line, in the Instance Properties dialog, for Is Reference, select Strong Reference. For a reference plane, for Is Reference, select Strong Reference.

NOTE The default reference property for all reference planes and sketched lines is Weak Reference.

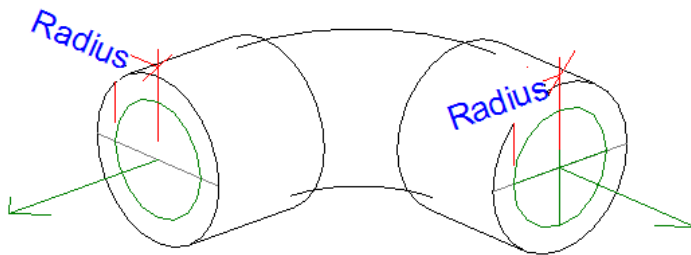
- 4 Click OK.

You can sketch lines and specify them as strong references. To create strong references for solid geometry, such as extrusions, sketch reference planes and specify them as strong references. Then sketch the solid geometry to the reference planes.

Using Reference Lines

You can use reference lines to create a parametric family framework to which elements of the family can attach. For example, you would use reference lines to control the curve of an elbow fitting.

An elbow pipe fitting family with an angle controlled by a reference line



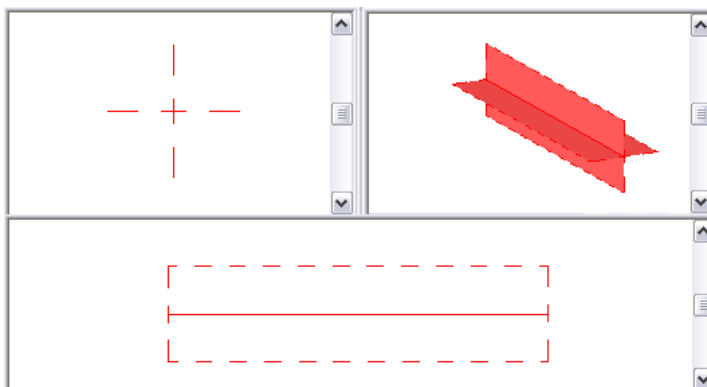
Reference lines are annotation objects with their own category. When selected, they display dual faces. When printing, their visibility is affected by the Hide ref/work planes option.

Straight reference lines provide 2 planes for you to sketch on, one that is parallel to the work plane of the line and one that is perpendicular to that plane. Both planes go through the reference line. The planes display when the reference line is selected or highlighted, or when you use the Work Plane tool. When selecting a work plane, you can place the cursor over a reference line and press *Tab* to switch between the 2 faces. The plane in which the line was sketched always displays first. You can also create arc reference lines, but they do not define planes.

Reference Line Behavior in the Project

After a family is loaded into a project, the behavior of reference lines is identical to that of reference planes. Reference lines are not visible in a project and do not highlight when the family instance is selected. They highlight and generate shape handles in the same contexts as reference planes currently do, depending on their Reference property.

Selected reference in multiple views



Controlling Angular Dimensions with Reference Lines

The preferred method to control the angular dimensions of a family is to apply a labelled angular dimension to a reference line. Unlike reference planes (with infinite extents), a reference line has specific start and end points and can be used to control the angular constraints within components (such as an elbow).

To add and dimension a reference line

- 1 In the drawing area (while in the Family Editor), add a reference line with the point of origin located at the point of expected rotation.
- 2 Add an angular dimension referring to the reference line.
- 3 Label the dimension.
- 4 Click Family Properties panel ► Types.
- 5 In the Family Types dialog, change the angular value for the labelled dimension, and click Apply. This is known as flexing the model. It is important to make sure the reference line adjusts as expected before adding model geometry to it.

To add and align model geometry to a reference line

- 6 Set the current work plane to one of the faces of the reference line.
- 7 Add the model geometry that you intend to have controlled by the angular dimension.
- 8 Flex the model to make sure the design works as expected.
The geometry moves with the reference line as the angle changes.

Adding Parameters to the Family Framework

Although you have not yet created any family geometry, you can define the main parametric relationships in the family. The parameters that you define at this stage usually control the size (length, width, height) of the element. To create a parameter, you place dimensions between the reference planes of the framework and then label them.

IMPORTANT Families in Revit MEP are not parametric until you add labeled dimensions to them.

Dimensioning Reference Planes

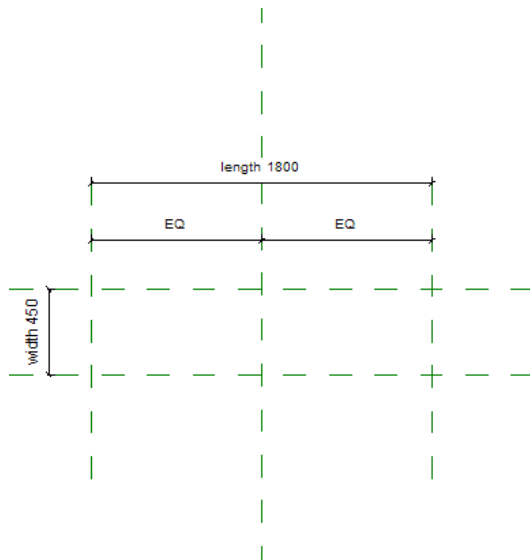
The first step to creating family parameters is to place dimensions between the reference planes of the framework to mark the parametric relationships that you intend to create. Dimensions alone do not create the parameters; you must label them to create parameters.

- 1 Identify the reference planes that you want to dimension to create parameters.
- 2 Click Detail tab ► Dimension panel, and select a dimension type.
- 3 On the Options Bar, select an option for placing dimensions.
- 4 Place the dimensions between reference planes.
- 5 Continue to dimension reference planes until all the parametric relationships have been dimensioned.

TIP You may need to open different views in the family to create some of the dimensions.

Labeling Dimensions to Create Parameters

After you dimension the family framework, you label the dimensions to create parameters. For example, the dimensions below have been labeled with length and width parameters.



If the parameters exist in the family, you can select any of them as a label. If not, you must create the parameter, specifying its type and whether it is an instance or type parameter.

To label dimensions and create parameters

- 1 While in the Family Editor, right-click the dimension, and click Edit Label.
- 2 Select a parameter from the list, or choose <Add parameter...>, and create a parameter.
See [Creating Parameters](#) on page 52.

TIP You can add formulas to parameters. A simple example would be a width parameter that is specified as twice the height of the object. See [Using Formulas for Numerical Parameters](#) on page 55.

Alternate procedure for labeling

- 1 While in the Family Editor, select the dimension value.
- 2 On the Options Bar, for Label, select a parameter, or create a parameter. See [Creating Parameters](#) on page 52.
- 3 If desired, select Leader to create a leader line for the dimension.

Flexing the Family Framework

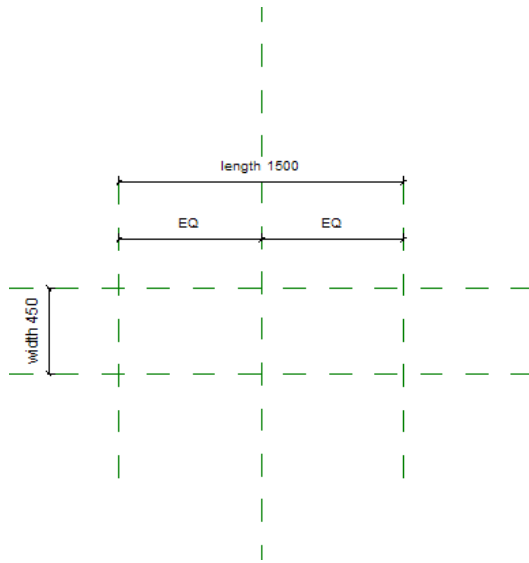
You can flex, or test, the parameters that you have applied to the family framework. To flex the framework, you adjust the parameter values, making sure that the reference planes to which you applied the parameter change accordingly. Flexing is a way to test the integrity of the parametric relationships. Flexing early and often as you create families ensures the stability of the families.

To flex the framework

- 1 Click Create tab ► Family Properties panel ► Types.

The Family Types dialog displays. Although you have not defined any family types yet, the dialog lists the parameters that you created.

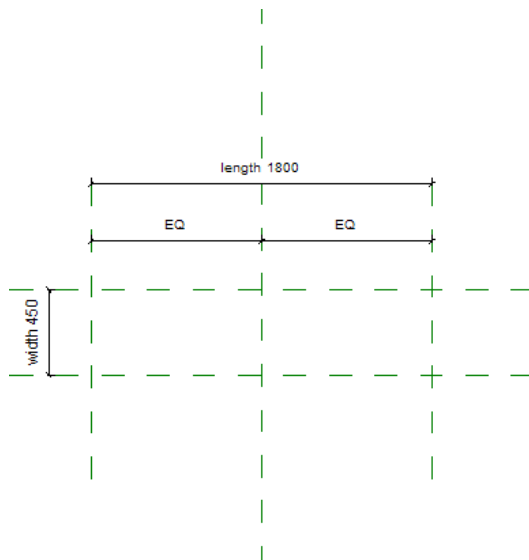
2 Reposition the Family Types dialog on the screen, so you can view the framework.



3 In the Family Types dialog, under Parameter, locate the parameters that you created previously, and enter different values in each corresponding Value field.

4 Click Apply.

The family framework should adjust to reflect the updated parameter values.



5 Continue to flex the framework by specifying different parameter values.

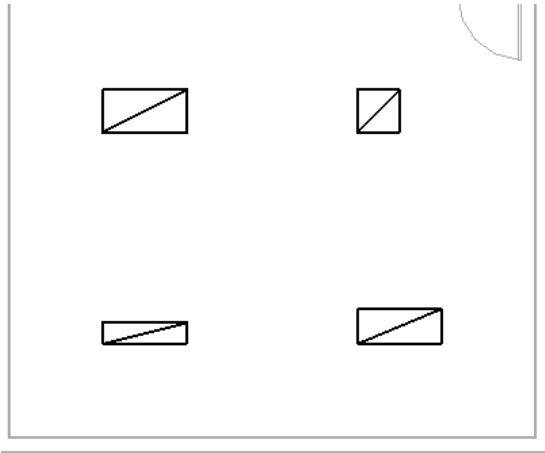
The more extensively you test the parameters, the more likely you are to create a stable family.

6 When you finish flexing the framework, click OK.

Creating Family Types

Using the Family Types tool, you can create many types (sizes) for a family. To do this, you need to have labeled the dimensions and created the parameters that are going to vary.

A lighting fixture family with 4 different types (sizes)



Each family type has a set of properties (parameters) that includes the labeled dimensions and their values. You can also add values for standard parameters of the family (such as Material, Model, Manufacturer, Type Mark, and others).

To create family types

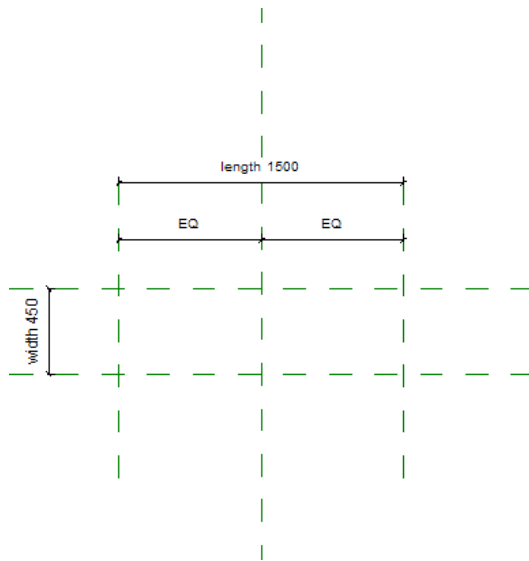
- 1 Click Create tab ► Family Properties panel ► Types.
- 2 In the Family Types dialog, under Family Types, click New.
- 3 Enter the family name, and click OK.
- 4 In the Family Types dialog, enter the values for the type parameters.
- 5 Click OK.

Flexing the Family

After you create family types, you can flex, or test, the family. To flex the family, you switch between different family types, ensuring that the family adjusts properly. You can flex the family before and after you create the family geometry. Flexing early and often as you create families ensures the stability of the families.

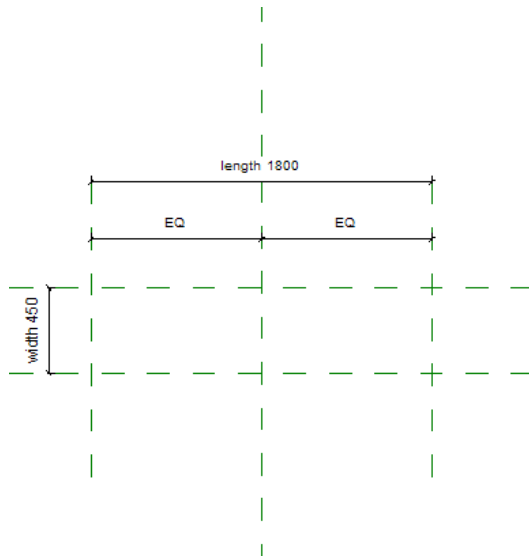
To flex the family

- 1 Click Create tab ► Family Properties panel ► Types.
- 2 Reposition the Family Types dialog on the screen, so you can view the family framework.



3 At the top of the dialog, select a family type, and then click Apply.

The family should adjust to reflect the parameter values specified in the selected family type.



4 Continue to flex the family by selecting each type in the family.

5 When you finish flexing the family, click OK.

Creating Family Geometry

You can use both 2- and 3-dimensional geometry to create families. Create solid geometric shapes to represent the element that the family is intended to create. Use 2D linework to add detail to solid geometry in certain views or to create a symbolic plan representation of an element.

As you create the family geometry, you can specify the visibility, material, and an optional subcategory of the geometry. These settings determine how and when the specific geometric components of the family display.

To ensure the stability of each parametric family, build the family geometry incrementally, testing (flexing) the parametric relationships in each increment.

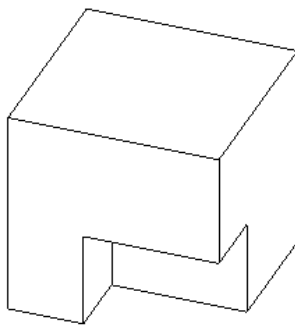
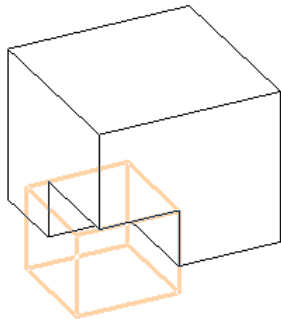
Creating Solid (3D) Geometry

To create solid family geometry, you use 3-dimensional solid and void forms. Solid forms are 3D shapes that represent the solid geometry of a family.

Extrusion for a flange



Void forms are 3D shapes that you use to cut volume from solid forms, allowing you to create complex solid forms. You can sketch void forms at the location where you want them to cut solid forms, or you can move them after you create them and then use the Cut Geometry tool to perform the cut.



You can also use the Join Geometry tool to join solid geometry to create complex forms.

The Family Editor provides you with tools that you can use to create solid and void forms. Access these tools from the Create tab ► Forms panel by clicking Solid or Void. The tools offer 5 methods that you can use to create both solid and void geometry: extrusions, blends, revolves, sweeps, and swept blends. Both sweeps and swept blends use profiles swept along a path; to create profile families that you can load and use, see [Creating and Using Profile Families](#) on page 46.

NOTE You can also create extrusions, blends, revolves, sweeps, and swept blends as mass families. See Conceptual Design with Massing Studies in the Revit MEP 2010 Help.

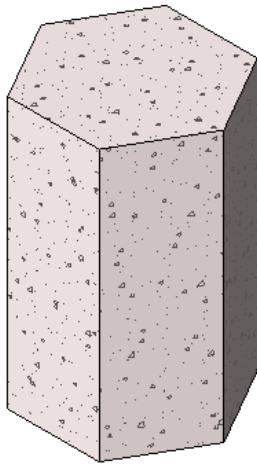
When you create geometry, you can determine how it displays in the family:

- Specify the visibility and detail level of the geometry.
See [Managing the Family Visibility and Detail Level](#) on page 61.
- Assign a material to the geometry.
See Material in the Revit MEP 2010 Help.
- Assign the geometry to a subcategory.
See [Creating Family Subcategories](#) on page 19 and [Assigning Family Geometry to Subcategories](#) on page 60.

Creating an Extrusion

A solid or void extrusion is the easiest form to create. You sketch a 2D profile of the form on a work plane, and then extrude that profile perpendicular to the plane on which you sketched it.

**Sample polygonal concrete
isolated foundation extrusion**



Before you extrude the shape, you can specify its start and end points to increase or decrease the depth of the form. By default, the extrusion start point is 0. The work plane does not need to be either the start or end point of the extrusion – you only use it to sketch on and to set the extrusion direction.

The following procedure is a general method for creating a solid or void extrusion. Steps may vary depending on your design intent.

To create a solid or void extrusion

- 1 In the Family Editor, on the Create tab ► Forms panel, do one of the following:
 - Click Solid drop-down ► Extrusion.

- Click Void drop-down ► Extrusion.

NOTE If necessary, set the work plane before you sketch the extrusion. Click Create tab ► Work Plane panel ► Set.

2 Use the sketching tools to sketch the extrusion profile:


- To create a single solid form, sketch a closed loop.
- To create more than one form, sketch multiple, non-intersecting, closed loops.

3 To extrude the profile from the default start point of 0, on the Options Bar, for Depth, enter a positive or negative extrusion depth.

This value changes the endpoint of the extrusion.

NOTE The extrusion depth is not retained after you create the extrusion. If you need to make multiple extrusions with the same endpoint, sketch the extrusions, select them, and then apply the endpoint.

4 Specify the extrusion properties:

- Click Create Extrusion tab ► Element panel ► Extrusion Properties.
- To extrude the extrusion from a different start point, under Constraints, for Extrusion Start, enter a new point.
- To set the visibility of a solid extrusion, under Graphics, for Visibility/Graphics Overrides, click Edit, and specify the visibility settings.
- To apply a material to a solid extrusion by category, under Materials and Finishes, click in the Material field, click , and specify a material.
- To assign a solid extrusion to a subcategory, under Identity Data, for Subcategory, select a subcategory.
- Click OK.

5 Click Create Extrusion Boundary tab ► Extrusion panel ► Finish Extrusion.

Revit MEP completes the extrusion and returns you to the view in which you started the extrusion.

6 To view the extrusion, open a 3D view.

7 To resize the extrusion in the 3D view, select it and use grips to edit it.

Editing an Extrusion

You can modify an extrusion after creating it.

To edit an extrusion

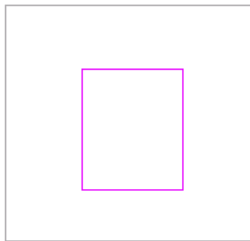
- 1** In the drawing area, select the extrusion.
- 2** If you are in the project environment:
 - a** Click Modify <Element> tab ► Family panel ► Edit Family.
 - b** Click Yes to open the family for editing.
 - c** In the Family Editor, select the extrusion in the drawing area again.

- 3 Click Modify Extrusion tab ► Form panel ► Edit Extrusion.
- 4 If desired, modify the extrusion profile.
- 5 To edit the extrusion properties, click Modify Extrusion > Edit Extrusion tab ► Element panel ► Extrusion Properties, and change the visibility, material, or subcategory of the extrusion.
- 6 To change the extrusion to a solid or a void, under Identity Data, for Solid/Void, select Solid or Void.
- 7 Click OK.
- 8 Click Finish Extrusion.

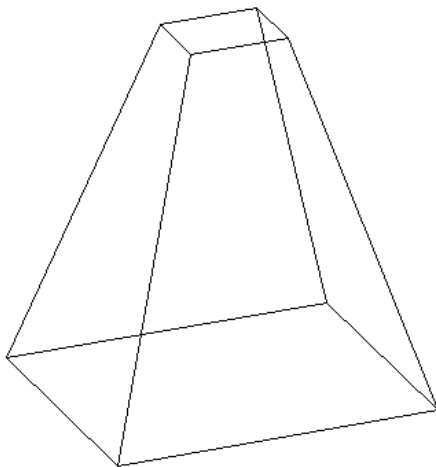
Creating a Blend

The Blend tool blends 2 profiles (boundaries) together. For example, if you sketch a large rectangle and a smaller rectangle on top of it, Revit MEP blends the 2 shapes together.

Sample base and top boundaries for a blend.



Finished blend



NOTE If you want to dimension a solid blend after you create it, you can dimension from lines at the top of the blend to lines at the base of the blend. You cannot dimension from lines at the base of the blend to lines at the top of the blend.

To create a solid or void blend

- 1 In the Family Editor, on the Create tab ► Forms panel, do one of the following:
 - Click Solid drop-down ► Blend.

- Click Void drop-down ► Blend.

NOTE If necessary, set the work plane before you sketch the blend. Click Create tab ► Work Plane panel ► Set.

2 On the Create Blend Base Boundary tab, use the sketching tools to sketch the base boundary of the blend, for example sketch a square.

3 To specify the depth of the blend, do either of the following:

- To specify a depth that is calculated from a default start point of 0, on the Options Bar, for Depth, enter a value.
- To specify a depth that is calculated from a start point other than 0, on the Create Blend Base Boundary tab ► Element panel, click Blend Properties. Under Constraints, enter new Second End and First End values.

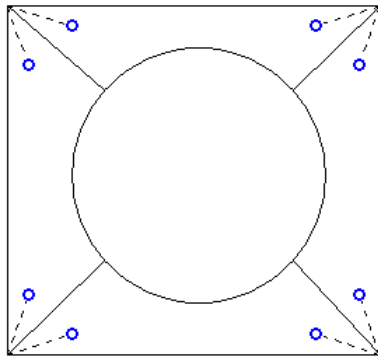
NOTE If specified, Revit MEP does not retain the end point value during creation of the blend. If you need to make multiple blends with the same end point, first sketch the blends, then select them, and then apply the end point.

4 When finished with the base boundary, on the Create Blend Base Boundary tab ► Mode panel, click Edit Top.

5 On the Create Blend Top Boundary tab, sketch a boundary for the top of the blend, for example another square.

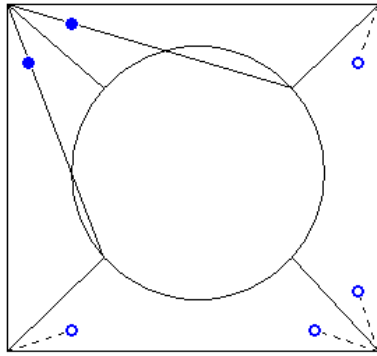
6 If necessary, edit the vertex connections to control the amount of twist in the blend:

- On the Create Blend Top Boundary tab, click Mode panel ► Edit Vertices.
- Vertex points become available on one of the blend sketches.




The dotted lines with blue open-dot controls are suggested connections. Each control is a switch between adding and removing connections.

- To display the vertex points on the other blend sketch, on the Edit Vertices tab ► Vertex Connect panel, click Controls on Base or Controls on Top (whichever option is currently unselected).
- Click a control, and the line becomes a solid connection. A filled blue control displays on the connection.



- Click a solid control to remove a connection; the line reverts to a dashed line with an open dot control.
- As you click the controls, some possible edges disappear and other ones appear.
- On the Vertex Connect panel, click Twist Right or Twist Left to twist the selected blend boundary in a clockwise or counter-clockwise direction.

7 Specify the blend properties:

- On the Element panel, click Blend Properties.
- To set the visibility of a solid blend, under Graphics, for Visibility/Graphics Overrides, click Edit, and specify the visibility settings.
- To apply a material to a solid blend by category, under Materials and Finishes, click in the Material field, click , and specify a material.
- To assign a solid blend to a subcategory, under Identity Data, for Subcategory, select a subcategory.
- Click OK.

8 On the Blend panel, click Finish Blend.

9 To view the blend, open a 3D view.

10 To resize the blend in the 3D view, select and use grips to edit it.

Editing a Blend

1 In the drawing area, select the blend.

2 If you are in the project environment:

- a On the Modify <Element> tab ► Family panel, click Edit Family.
- b Click Yes to open the family for editing.
- c In the Family Editor, select the blend in the drawing area again.

3 On the Options Bar, enter a value in the Depth text box to change depth of the blend.

4 On the Modify Blend tab ► Edit Blend panel, select an editing option:

- Click Edit Top to edit the top boundary of the blend.
- Click Edit Base to edit the base boundary of the blend.

- 5 To edit other blend properties, on the Edit Top Boundary tab or Edit Base Boundary tab, click Element panel ► Blend Properties, and change the visibility, material, or subcategory of the blend.
- 6 To change the blend to a solid or a void, under Identity Data, for Solid/Void, select Solid or Void.
- 7 Click OK.
- 8 On the Edit Top Boundary tab or Edit Base Boundary tab, click Mode panel ► Edit Vertices, and edit the blend vertices.
- 9 On the Blend panel ► click Finish Blend.

Creating a Revolve

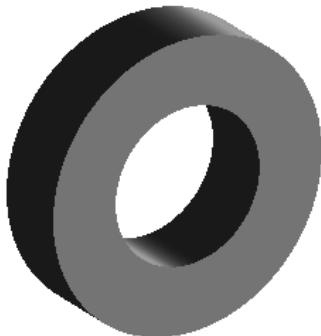
A revolve is a form that you create by revolving a shape around an axis. You can revolve the shape in a circle or any fraction of a circle. If the axis touches the revolve shape, the result is a solid.

**Solid revolved geometry
created near axis**



If you sketch away from the axis, the resulting geometry has a hole in it.

**Revolved geometry created away
from axis**



Use solid revolves to create family geometry like door and furniture knobs, columns, and dome roofs.

The following procedure is a general method for creating revolved geometry. Steps may vary depending on your design intent.

To create a solid or void revolve

1 In the Family Editor, on the Create tab ► Forms panel, do one of the following:

- Click Solid drop-down ► Revolve.
- Click Void drop-down ► Revolve.

NOTE If necessary, set the work plane before you sketch the revolve. Click Create tab ► Work Plane panel ► Set.

2 Place an axis of revolution:


- On the Create Revolve tab ► Draw panel, click Axis Line.
- Specify the start and endpoint of the axis at the desired orientation.

3 Use the sketching tools to sketch a shape to revolve around the axis:

- On the Create Revolve tab ► Draw panel, click Boundary Lines.
- To create a single revolve, sketch a closed loop.
- To create more than one revolve, sketch multiple, non-intersecting, closed loops.

IMPORTANT If the axis touches the revolve shape, the result is a solid. If the axis does not touch the revolve shape, the revolve will have a hole in it.

4 Change the properties of the revolve:

- On the Create Revolve tab ► Element panel, click Revolve Properties.
- To change the start and end points of the geometry to revolve, enter a new Start and End Angle.
- To set the visibility of a solid revolve, under Graphics, for Visibility/Graphics Overrides, click Edit.
- To apply a material to a solid revolve by category, under Materials and Finishes, click in the Material field, and click  to specify a material.
- To assign a solid revolve to a subcategory, under Identity Data, for Subcategory, select a subcategory.
- Click OK.

5 On the Revolve panel, click Finish Revolve.

6 To view the revolve, open a 3D view.

7 To resize the revolve in the 3D view, select and use grips to edit it.

NOTE You cannot drag the start and end faces of a 360-degree revolve.

Editing a Revolve

1 In the drawing area, select the revolve.

2 If you are in the project environment:

- a On the Modify <Element> tab ► Family panel, click Edit Family.
- b Click Yes to open the family for editing.

- c In the Family Editor, select the revolve in the drawing area again.

3 On the Modify Revolve tab ► Edit panel ► click Edit Sketch.

4 If desired, modify the revolve sketch.

5 To edit other revolve properties, on the Edit Revolve tab ► Element panel, click Revolve Properties, and change the start and end points, visibility, material, or subcategory.

6 To change the revolve to a solid or a void, under Identity Data, for Solid/Void, select Solid or Void.

7 Click OK.

8 On the Revolve panel, click Finish Revolve.

Creating a Sweep

A sweep is a tool for creating families that requires you to sketch or apply a profile (shape) and extrude that profile along a path. You might use a sweep to create moldings, railings, or simple pipes.

The following procedure is a general method for creating a sweep. Steps may vary depending on your design intent.

To create a solid or void sweep

1 In the Family Editor, on the Create tab ► Forms panel, do one of the following.

- Click Solid drop-down ► Sweep.
- Click Void drop-down ► Sweep.

NOTE If necessary, set the work plane before you sketch the sweep. Click Create tab ► Work Plane panel ► Set.

2 Specify the sweep path:

- To sketch a new path for the sweep, on the Create Sweep tab ► Mode panel, click Sketch Path.
The path can either be a single closed or single open path. You cannot have multiple paths. The path can be a combination of straight lines and curves, and it need not be planar.
- To select an existing line for the sweep, on the Create Sweep tab ► Mode panel, click Pick Path.
You can select edges of other solid geometry, such as extrusions or blends, or you can pick existing sketch lines. Watch the status bar to know what you are picking. This method of picking automatically locks the sketch lines to the geometry you are picking and allows you to sketch the path in multiple work planes, hence allowing for a 3D path.

3 Sketch or pick the path, and then on the Path panel, click Finish Path.

4 Load or sketch a profile:

- To load a profile:
 - a Click Modify Profile tab ► Edit panel, and select a profile from the Profile list.
If the profile you need is not already loaded in the project, click Modify Profile tab ► Edit panel ► Load Profile to load the profile.
 - b On the Options Bar, use the X, Y, Angle, and Flip options to adjust the position of the profile.
Enter values for X and Y to specify the offset for the profile.

Enter a value for Angle to specify the angle of the profile. The angle rotates the profile around the profile origin. You can enter negative values to rotate in the opposite direction.


Click Flip to flip the profile.

- c Click Apply.
- d Select the path, and zoom in to see the profile.

■ To sketch a profile:

- a Click Modify Profile tab ► Edit panel, verify <By Sketch> is displayed, and then click Edit Profile.
- b If the Go To View dialog displays, select the view where you want to sketch the profile, and click OK.
For example, if you sketched the path in a plan view, you would choose an elevation view to sketch the profile. The profile sketch can be a single-closed loop or multiple closed loops that do not intersect. Sketch the profile near the intersection of the profile plane and the path.
- c Sketch the profile. Profiles must be closed loops.
- d On the Create Profile Sketch tab ► Profile panel, click Finish Profile.

5 Specify the sweep properties:

- On the Create Sweep tab ► Element panel, click Sweep Properties.
- To set the visibility of a solid sweep, under Graphics, for Visibility/Graphics Overrides, click Edit, and specify the visibility settings.
- To apply a material to a solid sweep by category, under Materials and Finishes, click in the Material field, click , and specify a material.
- To assign a solid sweep to a subcategory, under Identity Data, for Subcategory, select a subcategory.
- Click OK.

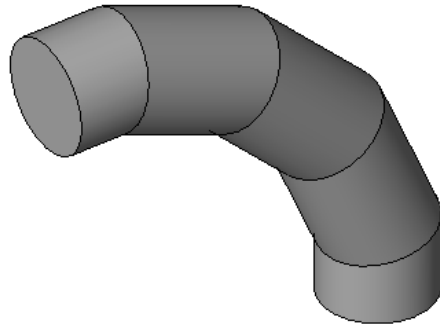
6 On the Sweep panel, click Finish Sweep.

Creating a Segmented Sweep

Segmented sweeps are useful for creating mechanical duct work elbows. You create a segmented sweep by setting 2 sweep parameters and sketching a path with arcs. The parameters affect only arcs in the path. The minimum number of segments for a sweep is 2.

- 1 In the Family Editor, begin creating a sweep.
- 2 On Create Sweep tab ► Element panel, click Sweep Properties.
- 3 In the Instance Properties dialog, under Other, select the check box for Trajectory Segmentation.
- 4 Enter a value for Maximum Segment Angle. Valid values are between 0 and 360 degrees.
- 5 Sketch or pick a path with arcs.
- 6 Click Finish Path to complete the path.
- 7 Create a profile or use a pre-loaded profile.
- 8 On the Sweep panel, click Finish Sweep to complete the sketch of the sweep.

Sample segmented sweep with 30 degree Maximum Segment Angle.



TIP You can change a segmented sweep to a non-segmented sweep by clearing the check box for Trajectory Segmentation.

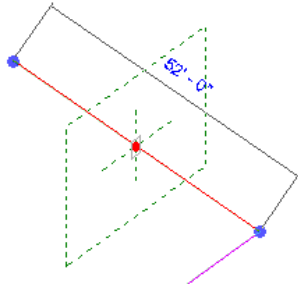
Editing a Sweep

- 1 In the drawing area, select the sweep.
- 2 If you are in the project environment:
 - a On the Modify <Element> tab ► Family panel, click Edit Family.
 - b Click Yes to open the family for editing.
 - c In the Family Editor, select the sweep in the drawing area again.
- 3 On the Modify Sweep tab ► Form panel, click Edit Sweep.
- 4 To modify the sweep path:
 - On the Create Sweep tab ► Mode panel, click Sketch Path.
 - Use the tools on the Edit tab to modify the path.
 - On the Path panel, click Finish Path.
- 5 To modify the sweep profile:
 - On the Create Sweep tab ► Mode panel, click Select Profile.
 - On the Edit panel, use the tools that display to select a new sweep profile or change the sweep profile location. You can edit the existing profile using the tools on the Modify Profile tab.
- 6 To edit other sweep properties, on the Element panel, click Sweep Properties, and change the visibility, material, segmentation, or subcategory of the sweep.
- 7 To change the sweep to a solid or a void, under Identity Data, for Solid/Void, select Solid or Void.
- 8 Click OK.
- 9 On the Sweep panel, click Finish Sweep.

Sweep Tips

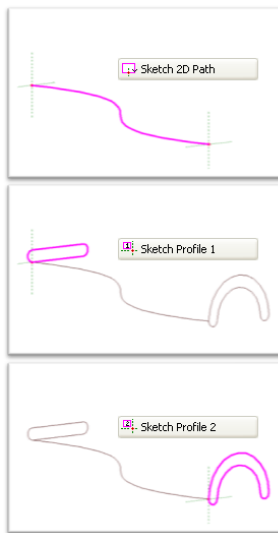
When creating a sweep with a tangent arc in the path, be sure the profile is small enough to sweep around the arc without the resulting geometry intersecting itself. An error occurs if the geometry intersects.

If you create a sweep path by using the Pick Path tool, you can drag the end points of the path lines as you are sketching it.



Creating a Swept Blend

The Swept Blend tool allows you to create a blend that has 2 different profiles and then sweep it along a path. The shape of a swept blend is determined by the 2D path you either sketch or pick and the 2 profiles you either sketch or load.



The following procedure is a general method for creating a swept blend. Steps may vary depending on your design intent.

To create a solid or void swept blend

1 In the Family Editor, on the Create tab ► Forms panel, do one of the following:

- Click Solid drop-down ► Swept Blend.
- Click Void drop-down ► Swept Blend.

2 Specify the path for the swept blend. Do one of the following on the Create Swept Blend tab ► Mode panel:

- Click Sketch Path to sketch a path for the swept blend.

- Click Pick Path to pick an existing line for the swept blend.

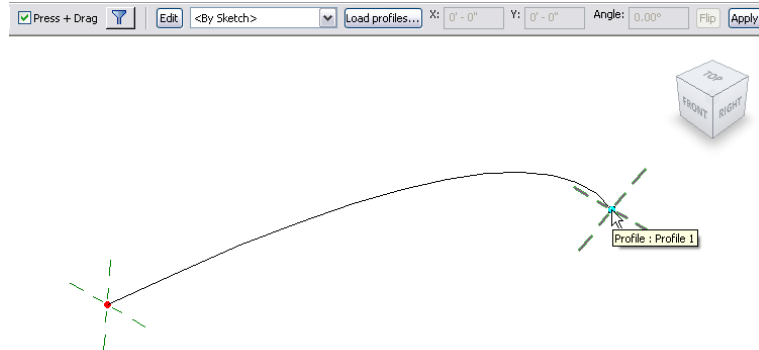
NOTE If necessary, set the work plane before you sketch or pick the path for the swept blend. Click Create tab ► Work Plane panel ► Set.

- 3 Sketch or pick the path, and then on the Path panel, click Finish Path.

NOTE A swept blend path can only have one segment.

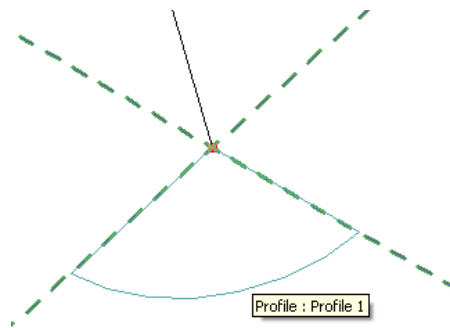
- 4 Load or sketch Profile 1.

The end point for Profile 1 on the swept blend path is highlighted.




- To load a profile:

- a Click Modify Profile tab ► Edit panel, and select a profile from the Profile drop-down. If the profile you need is not already loaded in the project, click Load Profile to load the profile.
- b Zoom in to see the profile.



- c Use the X, Y, Angle, and Flip options to adjust the position of the profile. Enter values for X and Y to specify the offset for the profile. Enter a value for Angle to specify the angle of the profile. The angle rotates the profile around the profile origin. You can enter negative values to rotate in the opposite direction. Click Flip to flip the profile.
- d Click Apply.

- To sketch a profile:
 - a On the Edit panel, verify that <By Sketch> is selected and click Edit Profile.
 - b If the Go To View dialog displays, select the view where you want to sketch the profile, and click OK.
 - c Use the tools on the Create Profile tab to sketch the profile. Profiles must be closed loops.
 - d On the Profile panel, click Finish Profile.
- 5 Click Swept Blend tab ► Mode panel ► Modify Profile 2.
- 6 Load or sketch Profile 2 using the steps above.
- 7 Optionally, edit the vertex connections. By editing vertex connections, you control the amount of twist in the swept blend. You can edit vertex connections in plan or 3D views.
- a On the Swept Blend tab ► Mode panel, click Edit Vertices.
 - b On the Edit Vertices tab ► Vertex Connect panel, select Controls on Base or Controls on Top.
 - c In the drawing area, click the blue controls to move the vertex connections.
 - d On the Vertex Connect panel, click the Twist Right and Twist Left tools to twist the swept blend.
- 8 Specify the swept blend properties:
- On the Element panel, click Swept Blend Properties.
 - To set the visibility of a solid swept blend, under Graphics, for Visibility/Graphics Overrides, click Edit, and specify the visibility settings.
 - To apply a material to a solid swept blend, under Materials and Finishes, click in the Material field, click , and specify a material.
 - To assign a solid swept blend to a subcategory, under Identity Data, for Subcategory, select a subcategory.
 - Click OK.
- 9 When finished, click Swept Blend panel ► Finish Swept Blend.

Editing a Swept Blend

- 1 In the drawing area, select the swept blend.
- 2 If you are in the project environment:
 - a On the Modify Swept Blend tab ► Edit Swept Blend panel, click Edit Family.
 - b Click Yes to open the family for editing.
 - c In the Family Editor, select the swept blend in the drawing area again.
- 3 On the Modify Swept Blend tab ► Form panel, click Edit Swept Blend.
- 4 To edit the path:
 - a On the Create Swept Blend tab ► Mode panel, click Sketch Path.

- b** Use the tools on the Sketch Path tab to modify the path, and click Path panel ► Finish Path.
- 5** To edit the profiles:
 - a** On the Swept Blend tab ► Mode panel, click Modify Profile 1 or Modify Profile 2.
 - b** On the Edit panel, select a different loaded profile from the drop-down list, or select <By Sketch> from the list to sketch a new profile.
 - c** If you selected <By Sketch>, click Edit Profile on the Edit panel.
 - d** Sketch the profile and then click Profile panel ► Finish Profile.
- 6** To edit other swept blend properties, click Swept Blend tab ► Element panel ► Swept Blend Properties, and change the visibility, material, or subcategory of the sweep.
- 7** To change the swept blend to a solid or a void, under Identity Data, for Solid/Void, select Solid or Void.
- 8** Click OK.
- 9** On the Swept Blend panel, click Finish Swept Blend.

Cut Geometry

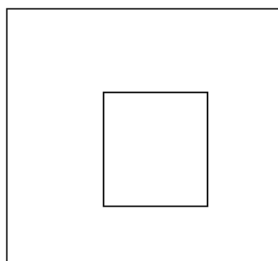
With the Cut Geometry tool, you can pick and choose which geometry gets cut and which does not, regardless of when you created the geometry.

NOTE While this tool and the UnCut Geometry tool are primarily for families, you can use them to embed curtain walls.

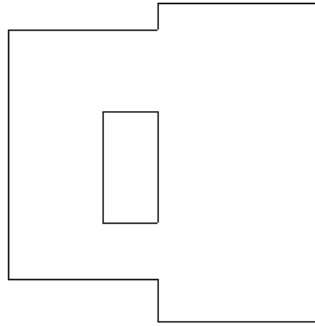
- 1** In the Family Editor, create solid geometry; it can be a single primitive or some joined primitives.



- 2** Create a void through the solid geometry.

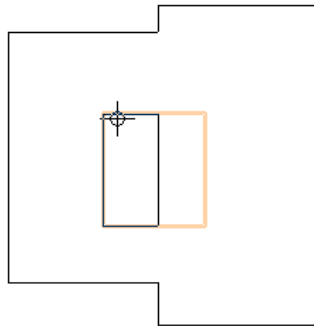


- 3** Create another solid geometry shape and join it to the existing geometry.

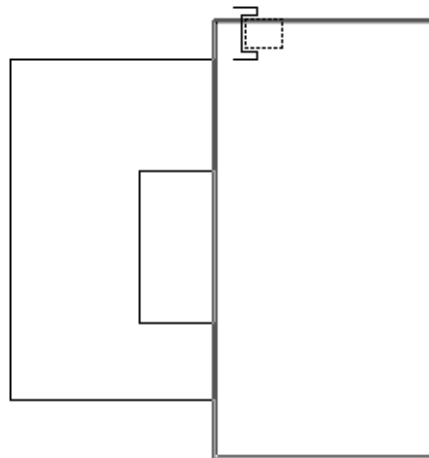


4 Click Modify tab ► Edit Geometry panel ► Cut drop-down ► Cut Geometry and select the void you created.

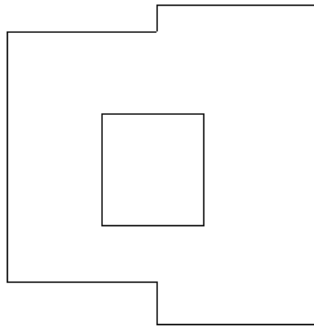
Notice the cursor changes shape.



5 Select the geometry you created in Step 3.



Revit MEP cuts the selected geometry.



Uncut Geometry

- 1 In the Family Editor, click Modify tab ► Edit Geometry panel ► Cut drop-down ► Uncut Geometry.
- 2 Select the void.
- 3 Select the appropriate solid primitives that you do not want to cut.

NOTE If you select all geometry to not be cut, then the void appears at all times in the view.

Creating 2D Geometry

To create 2D family geometry, you use the Revit MEP Model and Symbolic lines tools that are available in the Family Editor.

The **Model Line** tool on the Create tab ► Model panel lets you sketch two-dimensional geometry for when you do not need to show solid geometry. For example, you could sketch door panels and hardware as 2D rather than sketch solid extrusions. Model lines are always visible in 3D views. You can control their visibility in plan and elevation views by selecting the lines and clicking Modify Lines tab ► Visibility panel ► Visibility Settings.

The **Symbolic Line** tool on the Detail tab ► Detail panel lets you sketch lines that are meant for symbolic purposes only. For example, you might sketch symbolic lines in an elevation view to represent a door swing. Symbolic lines are not part of the actual geometry of the family. Symbolic lines are visible parallel to the view in which you sketch them.

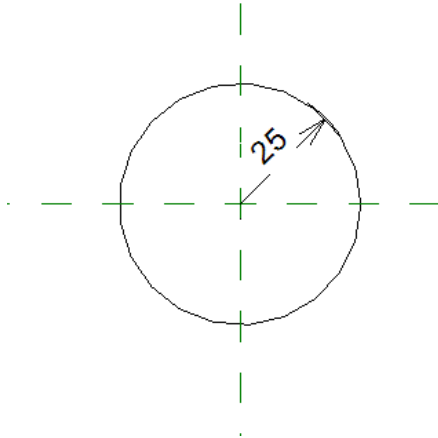
You can control symbolic line visibility on cut instances. Select the symbolic line and click Modify Lines tab ► Visibility panel ► Visibility Settings. Select Show only if instance is cut.

In the displayed dialog, you can also control the visibility of lines based on the detail level of the view. For example, if you select Coarse, that means that when you load the family into a project and place it in a view at the Coarse detail level, the symbolic lines are visible.

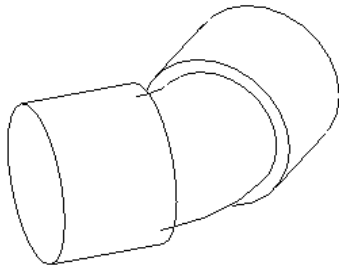
Creating and Using Profile Families

A profile family contains a 2-dimensional closed loop that you can load into a project and apply to certain building elements. For example, you can sketch the profile loop for an elbow fitting and then use that shape on an elbow fitting in your project.

Fitting profile



Elbow fitting with profile applied



Create profile families using family templates supplied with Revit MEP. For more information, see [Creating an Elbow Pipe Fitting Family](#) on page 155.

Dimensioning Family Geometry

As you create the geometry of component families, you place dimensions to define the geometric relationships that you want to control with parameters. By labeling the dimensions that you place, you create a parameter that you can control.

To add dimensions, you can use the Dimension tools on the Family Editor Create tab, or you can turn on automatic dimensions.

Automatic Sketch Dimensions

Revit MEP creates automatic dimensions to help control your design intent. These automatic dimensions are not displayed by default.

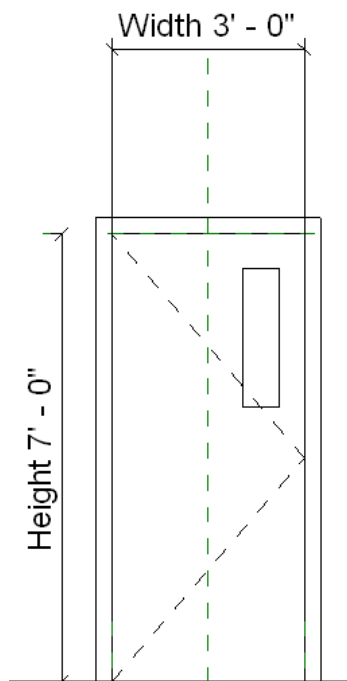
To turn them on, select Automatic Sketch Dimensions on the Annotation Categories tab of the Visibility/Graphic Overrides dialog. You can then modify the dimensions or create your own dimensions using the Dimension tools. You can also lock dimensions to keep a distance constant. This is useful if you plan to have several sizes of the family and want to keep certain dimensions constant while the family changes size.

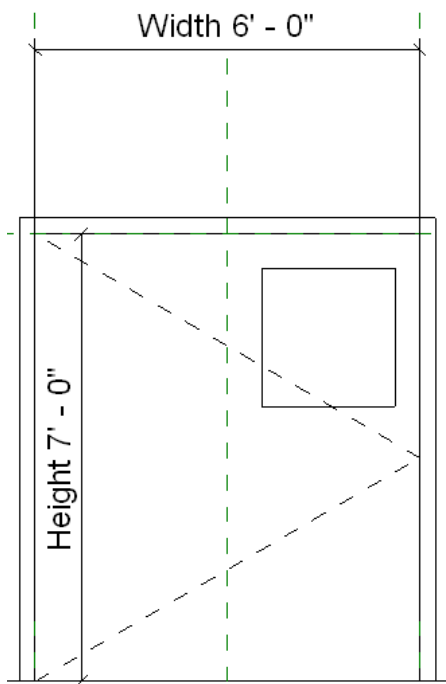
Effects of Automatic Dimensions on Your Geometry

When automatic sketch dimensions constrain geometry to reference planes, you may see some unexpected behavior in your project. The automatic sketch dimensions are Revit MEP's way of solving how to grow or shrink geometry based on changes in value of a family parameter.

For example, you have added a small extrusion on top of a large extrusion to create a panel board. The large extrusion has a labeled dimension for the height and width, but you have not dimensioned the small extrusion.

You decide to change the width of the panel board, but you want the small extrusion width to stay the same. You expect its position to remain unchanged; however, observe what happens when you increase the width of the panel board using the Family Types tool.





In this example, the small extrusion is constrained to the centerline of the panel board and the right side of the panel board, both of which are represented by reference planes. The small extrusion's position remains fixed relative to those reference planes.

To see the automatic sketch dimensions, edit the sketch of the small extrusion, and turn on the visibility of the dimensions. You will see how the vertical sketch lines of the small extrusion are dimensioned to the center and right reference planes.

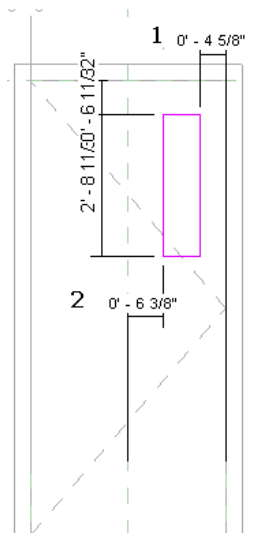


Image legend:

- 1 Auto sketch dimension to right reference plane.
- 2 Auto sketch dimension to center reference plane.

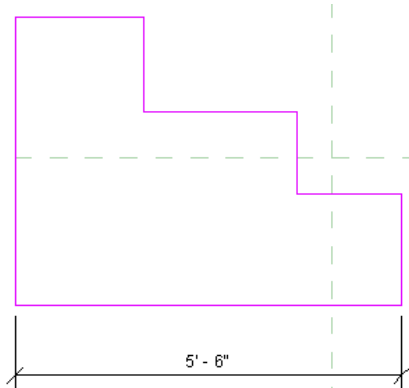
To achieve the desired results, add locked dimensions.

For example, you could add a locked dimension for the width of the small extrusion and a locked dimension from the small extrusion to the right reference plane.

Visibility of Automatic Sketch Dimensions in the Family Editor

Automatic sketch dimensions are turned off by default. They display if there is at least one labeled dimension in the family.

Notice in the following image that there is a dimension added to the geometry, but the dimension has no label.

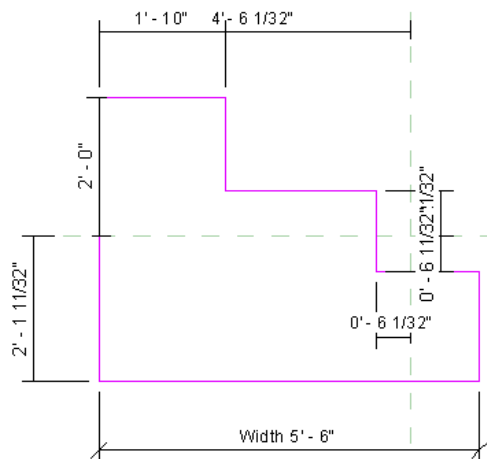


No automatic sketch dimensions are visible.

To turn on visibility of automatic sketch dimensions

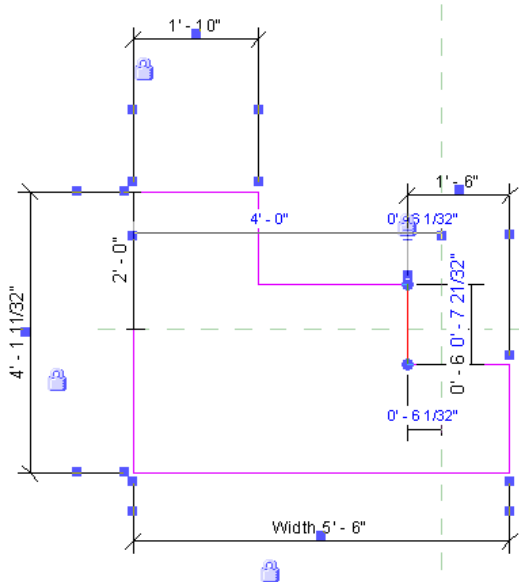
- 1 While in sketch mode, click View tab ► Graphics panel ► Visibility and Appearance, or type **VG**.
- 2 On the Annotation Categories tab of the Visibility/Graphic dialog, expand the Dimensions category, and select Automatic Sketch Dimensions.
- 3 Click OK.
- 4 Place and label a dimension.

The automatic sketch dimensions display.



Revit MEP now knows where each line of this geometry exists with respect to reference planes or other sketch lines.

As you add locked dimensions, they replace the automatic sketch dimensions, as shown.

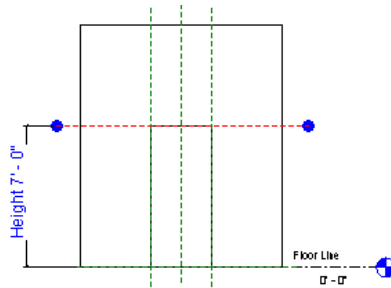


Dimensioning with Families

Families in Revit MEP are not parametric until you add labeled dimensions (parameters) to them.

Labeling dimensions

- 1 Highlight the dimension text.
- 2 Right-click the dimension, and click Edit Label.
- 3 Select a label name, or select <Add parameter...> and create a parameter.



Alternate procedure for labeling

- 1 Select the dimension text.
- 2 On the Options Bar, for Label, select a name, or create a new parameter.
- 3 If desired, select Leader to create a leader line for the dimension.

Tips for Creating Family Dimensions

- You cannot type text as a label when you select a dimension. You can only select from a list of family parameters that are of the correct type, or you can create a new parameter.

- Labeled dimensions become modifiable parameters for families. You can modify their values using the Family Types dialog. When the family is loaded into a project, you can also modify the dimensions using the Instance Properties dialog.
- Values for labeled parameters can be calculated using formulas. You create the formulas in the Family Types dialog. See [Using Formulas for Numerical Parameters](#) on page 55.
- An array number can be a parameter for a family. After you create the array, you should select it and then label it in order to create a parameter. You can then modify the parameter value and increase or decrease the number of elements in the array. See [Creating an Array in the Revit MEP 2010 Help](#).

Adding Family Parameters

You can create instance or type parameters for any family type. By adding parameters, you gain control over the information contained in each family instance or type. You can create dynamic family types for increased flexibility within the model.

Example: A fan family with parameters for voltage, power, phase, Motor FLA, and Motor HP. Within the fan family, create a type parameter named Power and assign it to the Electrical Engineering group. You can specify a formula to calculate the Power based on the shared parameters that you created.

Creating Parameters

To create parameters

- 1 In the Family Editor, on any tab, click Family Properties panel ► Types.
- 2 In the Family Types dialog, click New, and enter a name for the new type.
This creates a new family type that will be available in the Type Selector when you load it into a project.
- 3 Under Parameters, click Add.
- 4 In the Parameter Properties dialog, under Parameter Type, select Family parameter.
- 5 Enter a name for the parameter.
- 6 Select a discipline.
- 7 For Type of Parameter, select the appropriate parameter type.

| Name | Description |
|---------|--|
| Text | Completely customizable. Can be used to collect unique data. |
| Integer | A value that is always expressed as an integer. |
| Number | Used to collect miscellaneous numeric data. Can be defined by a formula. Can also have real numbers. |
| Length | Can be used to establish the length of an element or subcomponent. Can be defined by a formula. |
| Area | Can be used to establish the area of an element or subcomponent. Formulas can be used in this field. |
| Volume | Can be used to establish the length of an element or subcomponent. Formulas can be used in this field. |

| Name | Description |
|-------------|--|
| Angle | Can be used to establish the angle of an element or subcomponent. Formulas can be used in this field. |
| Slope | Can be used to create parameters that define slope. |
| Currency | Can be used to create currency parameters. |
| URL | Provides web link to user defined URL. |
| Material | Establishes parameters in which a specific material can be assigned. |
| Yes/No | Used most often for instance properties when the parameter is defined with either a Yes or No. |
| Family Type | Used with nested components and allows you to swap components after the family is loaded into a project. |

8 For Group parameter under, select a value.

After the family is loaded into a project, this value determines which group header the parameter displays under in the Instance Properties dialog.

9 Select either Instance or Type. This defines whether the parameter is an Instance or Type parameter.

10 Click OK.

NOTE To assign a material to a family element, save the family and load it into a project. Place the family in the project and select it. On the Family Properties panel, click Types and set a value for the material parameter.

Modifying Family Parameters

In the Family Types dialog, select the desired parameter, and click Modify. You can rename the parameter and change whether it is a type or instance parameter. You can also replace it with a shared parameter.

Instance Parameters and Shape Handles

As you create families, you can specify labeled dimensions as instance parameters; the parameters are modifiable when the family instance is placed in a project. Labeled dimensions specified as instance parameters can also have shape handles that display when the family is loaded into a project.

Creating Instance Parameters

1 Sketch family geometry using Family Editor tools.

2 Create dimensions for the family geometry.

3 Label the dimensions. See [Labeling Dimensions to Create Parameters](#) on page 26.

4 Select the dimensions and, on the Options Bar, select Instance Parameter.

NOTE If you label dimensions by selecting a label on the Options Bar, you can select Instance Parameter without re-selecting the dimensions.

5 Click Modify Dimension tab ► Family Properties panel ► Types.

In the Family Types dialog, notice the new instance parameter. The (default) label indicates the value for the instance parameter when you place the family in a project. For example, if you create an instance parameter called length with a default value of 3000 mm, the family instance will have a length of 3000 mm when placed in a project.

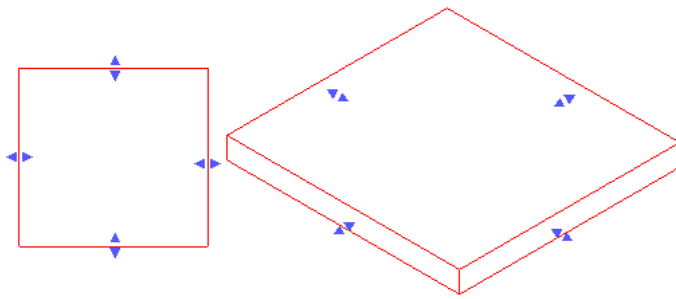
6 Save changes and load the family into a project. Select an instance of the family and click Element panel ► Element Properties drop-down ► Instance Properties.

Notice that the labeled dimensions display as parameters in the Instance Parameters pane of the Instance Properties dialog. You can change the values in the dialog.

Adding Shape Handles to a Component Family

You can add shape handles to a component family that display when the family is loaded into a project. The shape handles let you resize the component in the project, instead of creating multiple types in the Family Editor. See Controls and Shape Handles in the Revit MEP 2010 Help.

Example of a generic component in plan and 3D views with shape handles added



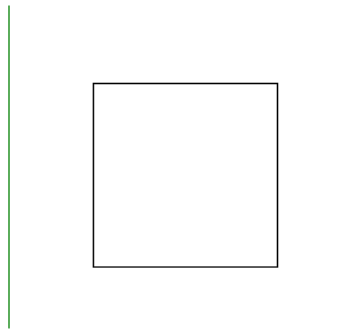
To add shape handles to a component family, you must:

- Add reference planes to the family.
- Align the reference planes to the edge of the component where you want the shape handle to display.
- Add a dimension to the reference planes.
- Label the dimension as an instance parameter.
- Save the family and load it into a project. When you select the component, shape handles display where the reference planes are aligned and dimensioned.

To add shape handles:

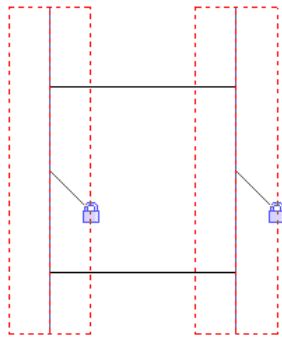
1 While in the Family Editor, add reference planes parallel to where you want the shape handles to display.

In the following image, a generic component with a simple extrusion is shown in plan view. Reference planes have been added parallel to the left and right edges.



- 2 Select each of the reference planes, and click Modify Reference Planes tab ► Element panel ► Element Properties drop-down ► Instance Properties. Verify that the Is Reference parameter is a value other than Not a Reference.
- 3 Align and lock the reference planes to the parallel edges of the component. When the family is loaded into a project, the shape handles will display at this location.

Generic component family with reference planes aligned and locked to the extrusion edges



- 4 Add a dimension between the reference planes that you aligned in the previous step.
- 5 Select the dimension.
- 6 On the Options Bar, for Label, select a label, or click Add Parameter and create a parameter for the dimension.
See [Adding Family Parameters](#) on page 52.
- 7 On the Options Bar, select Instance Parameter.

NOTE When adding a parameter, you can select Instance for the type in the Parameter Properties dialog.

- 8 Save changes and load the family into a project.

After the family is loaded into a project, select the component. Shape handles display and allow you to resize the family without the need for creating new sizes in the Family Editor.

Using Formulas for Numerical Parameters

Formulas allow you to create parameters that depend on other parameters for their values. A simple example would be a width parameter set to equal twice the height of an object. In practice, formulas can be used in

many ways, both simple and sophisticated. Typical uses include embedding design relationships, relating a number of instances to a variable length, and setting up angular relationships. For example, formulas can be used to

- Calculate area or volume of geometry
- Create a clearance dimension parameter controlled by element size
- Convert continuously variable values into integer values
- Add shelves as the height of casework increases
- Add diagonals in an open web joist as the length increases

Adding a Formula to a Parameter

- 1 In the Family Editor, lay out reference planes.
- 2 Add dimensions, as required.
- 3 Label the dimensions. See [Labeling Dimensions to Create Parameters](#) on page 26.
- 4 Add the geometry, and lock the geometry to the reference planes.
- 5 On the Family Properties panel, click Types.
- 6 In the Family Types dialog, in the Formula column next to the appropriate parameter, type the formula for the parameter. For more information about entering formulas, see [Valid Formula Syntax and Abbreviations](#) on page 56.

Valid Formula Syntax and Abbreviations

Formulas support the following arithmetic operations: addition, subtraction, multiplication, division, exponentiation, logarithms, and square roots. Formulas also support the following trigonometric functions: sine, cosine, tangent, arcsine, arccosine, and arctangent.

The valid formula abbreviations for arithmetic operations and trigonometric functions are

- Addition— +
- Subtraction— -
- Multiplication—*
- Division—/
- Exponentiation—^: x^y , x raised to the power of y
- Logarithm—log
- Square root—sqrt: sqrt(16)
- Sine—sin
- Cosine—cos
- Tangent—tan
- Arcsine—asin
- Arccosine—acos
- Arctangent—atan
- e raised to an x power—exp

■ Absolute Value—abs

You can enter integers, decimals, and fractional values in formulas, using normal mathematical syntax, as shown in the examples below:

- $\text{Length} = \text{Height} + \text{Width} + \text{sqrt}(\text{Height} * \text{Width})$
- $\text{Length} = \text{Wall 1 (11000mm)} + \text{Wall 2 (15000mm)}$
- $\text{Area} = \text{Length (500mm)} * \text{Width (300mm)}$
- $\text{Volume} = \text{Length (500mm)} * \text{Width (300mm)} * \text{Height (800 mm)}$
- $\text{Width} = 100\text{m} * \cos(\text{angle})$
- $x = 2 * \text{abs}(a) + \text{abs}(b/2)$
- $\text{ArrayNum} = \text{Length/Spacing}$

Parameter names in formulas are case sensitive. For example, if a parameter name begins with a capital letter, such as Width, you must enter it in the formula with an initial capital letter. If you enter it in a formula using lower-case letters instead, for example, width * 2, the software will not recognize the formula.

Conditional Statements in Formulas

You can use conditional statements in formulas to define actions in a family that depend on the state of other parameters. With conditional statements, the software enters values for a parameter based on whether a specified condition is satisfied. Conditional statements are useful in certain circumstances; however, they make families more complex and should be used only when necessary.

For most type parameters, conditional statements are unnecessary because the type parameter itself is like a conditional statement: If this is the type, then set this parameter to a specified value. Instance parameters are a more productive place to use conditional statements, particularly when they are used to set a parameter that does not vary continuously.

Syntax for Conditional Statements

A conditional statement uses this structure: IF (<condition>, <result-if-true>, <result-if-false>)

This means that the values entered for the parameter depend on whether the condition is satisfied (true) or not satisfied (false). If the condition is true, the software returns the true value. If the condition is false, it returns the false value.

Conditional statements can contain numeric values, numeric parameter names, and Yes/No parameters. You can use the following comparisons in a condition: <, >, =. You can also use Boolean operators with a conditional statement: AND, OR, NOT. Currently, <= and >= are not implemented. To express such a comparison, you can use a logical NOT. For example, $a \leq b$ can be entered as NOT($a > b$).

The following are sample formulas that use conditional statements.

Simple IF: =IF (Length < 3000mm, 200mm, 300mm)

IF with a text parameter: =IF (Length > 35', "String1", "String2")

IF with logical AND: =IF (AND (x = 1 , y = 2), 8 , 3)

IF with logical OR: =IF (OR (A = 1 , B = 3) , 8 , 3)

Embedded IF statements: =IF (Length < 35' , 2' 6" , IF (Length < 45' , 3' , IF (Length < 55' , 5' , 8')))

IF with Yes/No condition: =Length > 40 (Note that both the condition and the results are implied.)

Examples of Conditional Statement Usage

Typical uses for conditional statements in formulas include calculating array values and controlling an element's visibility based on a parameter value. For example, you can use conditional statements to

- Prevent an array parameter from taking a value less than 2.
In Revit MEP, arrays can only have an integer value of 2 or greater. In some situations, it may be useful to create a conditional formula that maintains an array parameter of 2 even if the calculated value is 1 or 0. With such a formula, if the calculated array value is 2 or greater, the formula retains the value. However, if the calculated value is 1 or 0, the formula changes the value to 2.
Formula: Array number = IF (Arrayparam < 2, 2, Arrayparam)
- Make muntins visible only when the number of window lights is greater than 1.
For example, if you have a Lights parameter that you want to use to control the visibility of muntin geometry, you can create a Yes/No parameter like MuntinVis, and assign it to the Visible parameter in the Instance Properties dialog of the muntin geometry. Because the MuntinVis parameter is a Yes/No (or Boolean) operation, both the condition (IF) and the results are implied. In this example, when the condition is met (true), the MuntinVis parameter value is selected, and the muntin geometry is visible. Conversely, when the condition is not met (false), the MuntinVis parameter is cleared, and the muntin geometry is not visible.
Formula: MuntinVis = Lights > 1

Duplicating Parameterized Elements

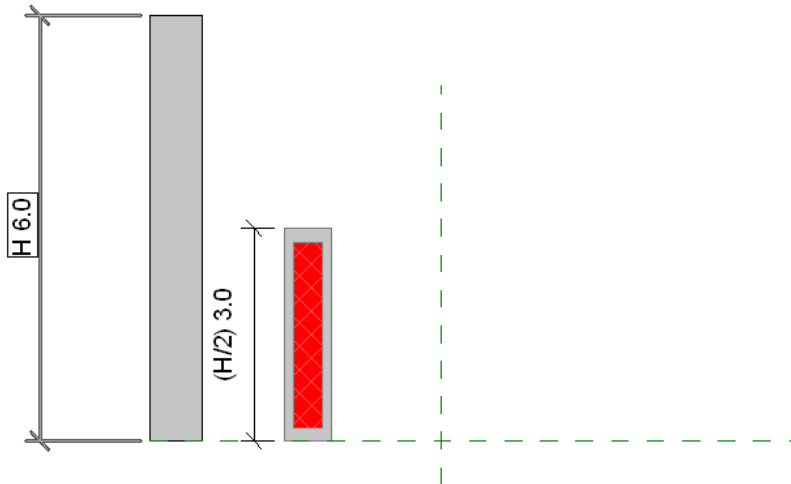
When creating a component in the Family Editor, you often need to create identical elements that are controlled by the same parameters, such as labelled dimensions or visibility parameters.

For example, if you create a lighting family with lighting fixtures controlled by a visibility parameter, you can create the first fixture, apply the visibility parameter to it, and then copy, array, or mirror the fixture. The visibility parameter or the original fixture is applied to the duplicated fixtures.

If you copy, array, or group a parameterized element, the parameters that control that element are also copied.

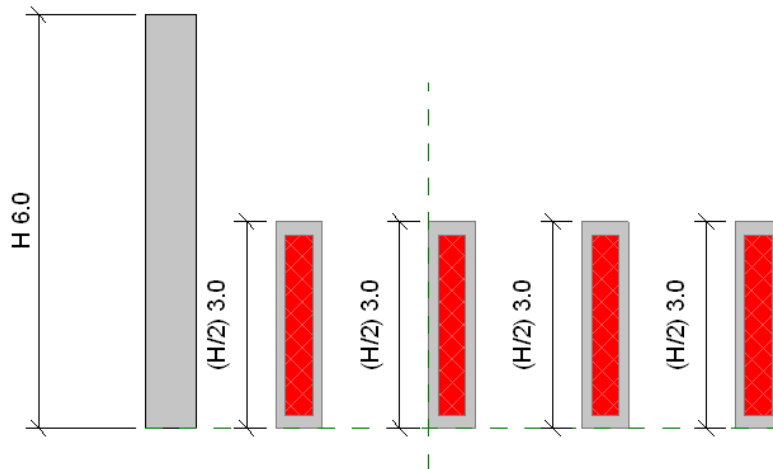
In the example shown below, a generic family was created with 2 extrusions. The bottoms of both extrusions are aligned to the horizontal reference plane. The height of the large extrusion is controlled by the labelled dimension H. The height of the smaller extrusion is controlled by the labelled dimension (H/2). In the Family Types dialog, a formula was added to the (H/2) parameter to make it equal to Height/2. In addition, a visibility parameter was created and applied to the smaller extrusion, which has a split and painted face.

Elements controlled by parameters (labelled dimensions in this case)



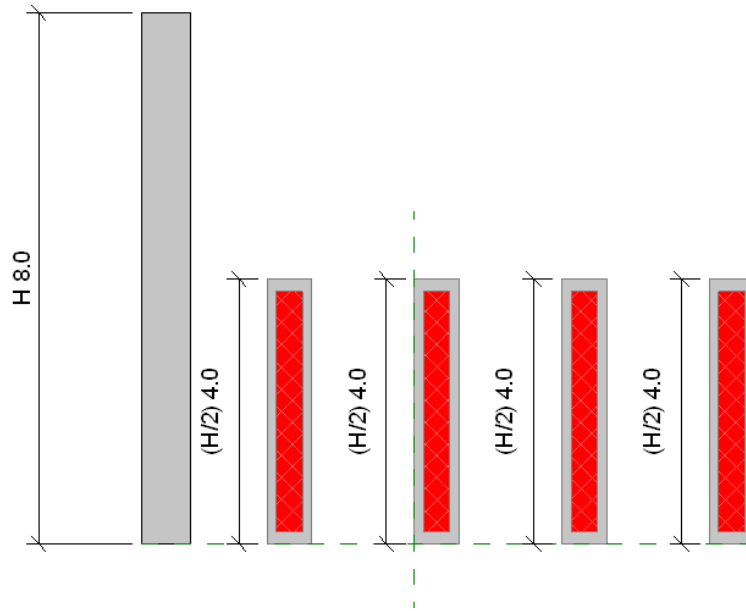
Continuing with the example shown above, to create a series of elements identical to the sub-height element, you can copy, array, or mirror the element, and the associated parameters are copied with it. In the image below, you can see that the smaller element was arrayed and the labelled dimension, painted face, and visibility parameters are applied to each arrayed element.

Array of parameterized elements



In the Family Types dialog, if the Height value in this example is changed from 6 to 8, notice that the arrayed elements adjust to the new values.

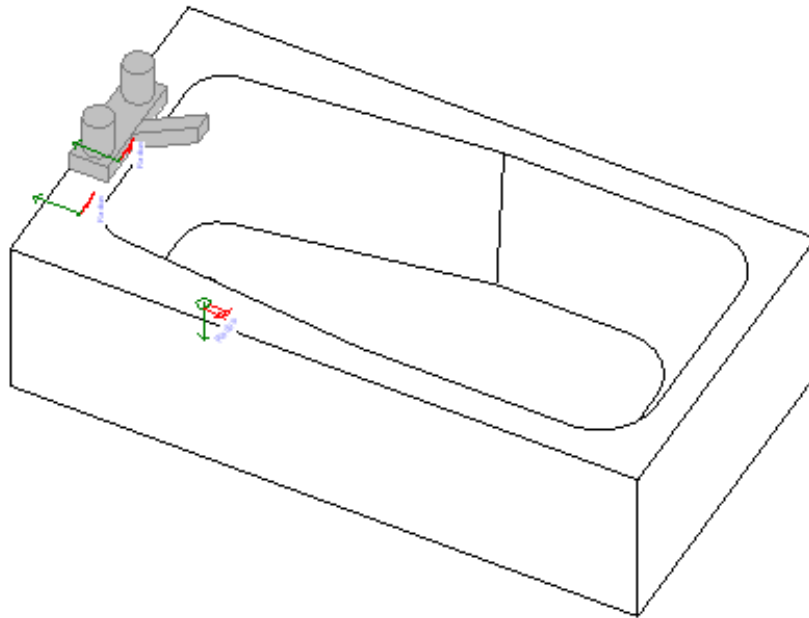
Arrayed elements adapt to changed parameter values



Assigning Family Geometry to Subcategories

You can assign different pieces of family geometry to subcategories within the family category. A subcategory controls the line weight, line color, line pattern, and material of the geometry assigned to it, independent of the family category settings. By assigning portions of the family geometry to different subcategories, you can display the portions with different line weights, line colors, line patterns, and material assignments.

For example, in a bathtub family, you could assign the faucet to one subcategory and the tub basin to another. You could then assign different materials to each subcategory to achieve the following effect.



If you haven't created subcategories or the family does not contain them by default, you can create them at any time. See [Creating Family Subcategories](#) on page 19.

To assign family geometry to a subcategory

- 1 In the Family Editor, select the family geometry that you want to assign to the subcategory.
- 2 Click Element panel ► Element Properties drop-down ► Instance Properties.
- 3 In the Instance Properties dialog, for Subcategory, select a subcategory.
- 4 Click OK.

Managing the Family Visibility and Detail Level

Visibility of a family determines in which view the family displays and what it looks like in that view. Typically, when an element is created by a family, the geometry of the element will change, depending on the current view. In a plan view, you may want to see a 2D representation of the element. In a 3D or elevation view, you may want a fully detailed 3D representation of the element. You have the flexibility to display different levels of geometry.

For example, you could create a door frame and use lines to represent it. Or you could extrude the door frame, so it has a 3D representation.

Detail Level determines the visibility of elements at different levels of detail. For example, you might create a door with certain embellishments. You then may decide that the embellishments should only appear at a certain detail level. You control the detail level in a project view with the Detail Level option on the View Control Bar.

You can set the visibility and detail level of any 2D and 3D geometry in the family before or after you create it.

- 1 Do either of the following:
 - To set the visibility before you sketch the geometry, click the tool that you want to use to create the geometry, and on the Visibility panel, click Visibility Settings.
 - If you have already created the geometry, select it, and click Visibility Settings. The name of the panel this tool appears on varies depending on the type of geometry selected.
- 2 In the Family Element Visibility Settings dialog, select the views in which you want the geometry to display:
 - Plan/RCP
 - Front/Back
 - Left/Right

NOTE All geometry automatically displays in 3D views.

- 3 If desired, select When cut in Plan/RCP (if category permits).

If you select this option, the geometry appears cut if it is intersected by the cut plane of the view. If the element is cut by a section view, it also shows if you select this option.
- 4 Select the detail levels at which you want the geometry to display in a project:
 - Coarse
 - Medium
 - Fine

Detail levels are dependent upon view scale.

NOTE The Family Element Visibility Settings dialog is different for families of profiles and detail components. For these families, you can set only the detail level.

5 Click OK.

TIP You can set family elements to be visible or not visible in the project by associating the Visible parameter of solid geometry tools with a family parameter for that element. The Visible parameter is available for solid and void geometry tools (blends, sweeps, swept blends, revolves, and extrusions). This lets you create one family type with optionally visible geometry on it. For example, you might create a door and have a coat hook or kick plate on that door be optional. Note that the family geometry still exists in the project, it is just invisible. For example, it may still be involved when you join geometry in the project.

6 If you set the visibility before you created the geometry, create the geometry.

Cuttable and Non-Cuttable Family Categories

Revit MEP families are either cuttable or non-cuttable. If a family is cuttable, the family displays as cut when the cut plane (of a plan view) or the clipping plane (or sections and elevations) intersects that family. If the family is non-cuttable, it displays in projection, regardless of whether it is intersected by the cut plane.

You can determine if a family category is cuttable in the Object Styles dialog (click Manage tab ► Family Settings panel ► Settings drop-down ► Object Styles). If the Line Weight Cut column is disabled, the category is non-cuttable.

Cuttable Families

If a family is cuttable, the family displays as cut when the cut plane of a view intersects that family in all types of views.

In the Family Element Visibility Settings dialog, there is an option called When cut in Plan/RCP. This option determines if family geometry is shown when the cut plane intersects that family. For example, in door families, the geometry for plan swing is set to be shown when the door is cut in plan views and not shown when the door is not cut.

This option is never made available and is never selected for non-cuttable families. For some cuttable families, the option is made available, and you can select it. For other cuttable families, the option is never made available, but it is always selected.

The following table lists cuttable families and whether the option is made available for that family.

NOTE Not Applicable means the category is a system family that cannot be made from a family template.

| Family Category | Option Made Available |
|---------------------|-----------------------|
| Casework | Yes |
| Ceilings | Not Applicable |
| Columns | Yes |
| Curtain Wall Panels | No |
| Doors | Yes |

| Family Category | Option Made Available |
|------------------------|-----------------------|
| Floors | Not Applicable |
| Generic Models | No |
| Roofs | Not Applicable |
| Site | Yes |
| Structural Columns | Yes |
| Structural Foundations | Yes |
| Structural Framing | Yes |
| Topography | No |
| Walls | Not Applicable |
| Windows | Yes |

Non-Cuttable Families

The following families are not cuttable and are always shown in projection in views:

- Balusters
- Detail Items
- Electrical Equipment
- Electrical Fixtures
- Entourage
- Furniture
- Furniture Systems
- Lighting Fixtures
- Mechanical Equipment
- Parking
- Planting
- Plumbing Fixtures
- Specialty Equipment

Adding a Website Link to a Family

You can add a website link to the Type or Instance properties of a family in both the Family Editor and in the project environment. Selecting the URL opens the default web browser to the selected location.


Testing a Family in a Project

After you have finished a family, load it in at least one project, and create elements with the family types to ensure it works correctly. Make sure you select a test project that contains any geometry with which the family must interact. For example, if the family is a host-based family like a lighting fixture, ensure that the test project contains the host elements (ceilings or walls).

BEST PRACTICE Until you successfully test the family, do not save it in a library where it is accessible to others.

To test a family in a project

- 1 Open a test project.

NOTE Imperial and metric testing projects are available in the Training Files folder. Click  **► Open ► Project**, click Training Files in the left pane of the Open dialog, and open Imperial or Metric. Open Imperial_Family_Testing_Template.rvt or Metric_Family_Testing_Template.rvt.

- 2 To load the family in the project, do either of the following:

- In the family, click Create tab ► Family Editor panel ► Load into Project.
- In the project, click Insert tab ► Load from Library panel ► Load Family, navigate to the location of the family, select it, and click Open.

- 3 In the project, click the Home tab, and then click the appropriate tool to begin creating an element from one of the new family types.

- 4 On the Element panel, select a type from the Type Selector drop-down.

- 5 Add the element to the project.

If the element is host-based, place it in a host element.

- 6 In the current view, test the element:

- On the View Control Bar, change the Detail Level and/or Model Graphics style to ensure that visibility settings work correctly.
- Change the scale to resize the element.
- Click View tab ► Graphics panel ► Visibility & Graphics, and change the visibility for the element by category and, if applicable, by subcategories.
- Select the element, right-click, and click Element Properties.
- In the Instance Properties dialog, change any of the instance parameters, and click OK to view and verify the changes.
- If the family contains multiple types, select the element, and on the Modify <element> tab ► Element panel, select a different family type from the Type Selector drop-down.

- 7 Open additional project views, and repeat step 6.

- 8 If the family contains more than one type, repeat steps 3-6 to test other types in the family.

- 9 If you find any errors in the family, edit the family, and retest it in a project.

- 10 When you finish testing the family, save it in the imperial or metric Revit MEP library or in another location of your choice.

Advanced Loadable Family Techniques

After you understand the basics of creating parametric families, there are more complex techniques that you can use when you create families:

- Nesting and sharing families to combine the geometry of 2 or more families
- Linking family parameters
- Creating face- and workplane-based families

Nesting and Sharing Component Families

You can nest (insert) families within other families to create new families that contain the combined family geometry.

For example, rather than model a light fixture with a light bulb family from scratch, you can create the combination-light family by loading a light bulb into a light fixture family.

Whether you share families before you nest them determines the behavior of the nested geometry in elements that you create with the family.

- If you nest a family that is not shared, components created by the nested family act with the rest of the element as a single unit. You cannot select (edit), tag, or schedule the components separately.
- If you nest a shared family, you can select, tag, and schedule the components separately.

Nesting Restrictions

There are certain restrictions regarding the type of families that you can load and nest in other families:

- Only annotation families can be loaded into other annotations.
- Only detail families and generic annotations can be loaded into details.
- Model families, details, generic annotations, section heads, level heads, and grid heads can be loaded into model families.

Nesting Families with Interchangeable Components

By applying a family type parameter to a nested component, you can create families with interchangeable subcomponents. After you load and create an element with the nested family, you can swap components at any time.

Creating a Family with Nested Components

To nest families in another family, create or open a host (base) family, and then load and insert instances of one or more family types into it. The base family can be a new (empty) family or an existing family.

To create a family with nested components

- 1 Create or open a family into which you want to nest a family.
- 2 In the Family Editor, click Insert tab ► Load from Library panel ► Load Family.
- 3 Select any families that you want to nest, and click Open.
- 4 Click Home tab ► Build panel ► Family drop-down ► Place a Family.
- 5 On the Type Selector panel drop-down, choose the component type that you want to nest.

- 6 Click in the drawing area to place the nested component in the family.
- 7 If necessary, repeat steps 4-6 to nest components in the family.
- 8 Save the family.

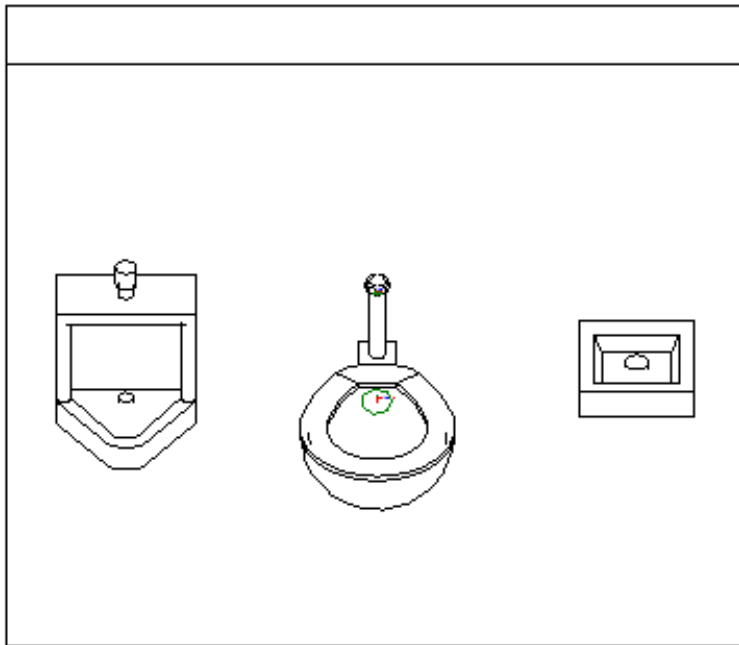
Creating a Family with Nested and Shared Components

To create a family with nested and shared components, share the families before you nest them in a host family. The host family does not need to be a shared family.

When you create a nested family of shared components, the first decision you need to make is in what category the host family will belong. This decision has many downstream implications for tagging, scheduling, and ODBC information, as described in the example below.

A bathroom unit is created as a nested and shared family. The commercial toilet was used as the host family and the wall hung urinal and sink were nested as shared families. The family was saved as mens_bathroom.rfa

Nested urinal and lavatory sink



When the bathroom unit shown above is loaded into a project and scheduled, the result is as follows:

Nested and shared families loaded into a project

| Plumbing Fixture Schedule 2 | | |
|-----------------------------|--|------|
| Family | Type | Mark |
| | | |
| mens_bathroom | Public - Flushing Greater than 1.6 gpf | 1 |
| Urinal - Wall Hung | 1" Flush Valve | 3 |
| Lavatory - Rectangular | 15"x15" - Private | 2 |
| mens_bathroom | Public - Flushing Greater than 1.6 gpf | 4 |
| Urinal - Wall Hung | 1" Flush Valve | 6 |
| Lavatory - Rectangular | 15"x15" - Private | 5 |
| mens_bathroom | Public - Flushing Greater than 1.6 gpf | 7 |
| Urinal - Wall Hung | 1" Flush Valve | 9 |
| Lavatory - Rectangular | 15"x15" - Private | 8 |
| mens_bathroom | Public - Flushing Greater than 1.6 gpf | 10 |
| Urinal - Wall Hung | 1" Flush Valve | 12 |
| Lavatory - Rectangular | 15"x15" - Private | 11 |

Notice that each urinal and lavatory sink is scheduled separately. However, notice that the mens_bathroom unit, is listed with the subcomponents.

To share a family before nesting it

- 1 Open a family to be shared, and click Manage tab ► Family Properties panel ► Category and Parameters.

IMPORTANT Annotation, profile, and in-place families cannot be shared families.

- 2 In the Family Category and Parameters dialog, under Family Parameters, select Shared.

Although you can set most families as shared families, it only becomes relevant when the family is nested into another family and loaded into a project.

- 3 Click OK.
- 4 Save and close the family.

To nest shared families in a host family

- 1 Open the host family or start a new family.
- 2 Open the families that you want to nest, and share them.
- 3 Load and place a nested component within the host family.
- 4 Repeat this process for each nested component.
- 5 Save the family.

Loading Families with Shared Components into a Project

You load families that contain nested components or nested and shared components into a project using the same methods as any other family. When you load a family comprised of nested components or nested and shared components into a project, the following rules apply:

- The host family, along with all nested and shared components, is loaded into the project. Each nested component is available within the Project Browser under its respective family category.
- A nested family can exist within a project and be shared by more than one host family.
- When loading shared families, if a version of one of the families already exists within the project, you have the option to use the version from the project or from the family you are loading.

IMPORTANT After a shared family is loaded into a project, you cannot reload an unshared version of the same family and overwrite it. You must delete the family and reload it.

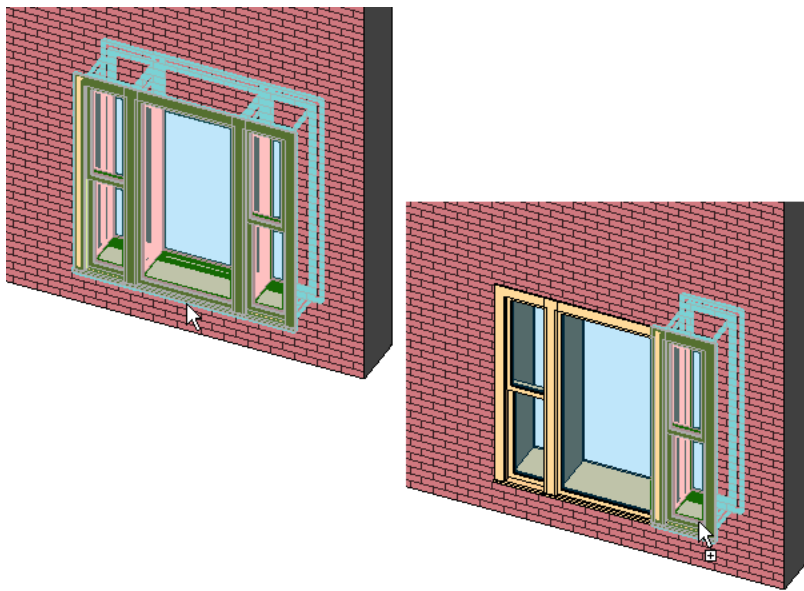
To load families with shared components into a project

- 1 Open the project into which you want to load the family.
- 2 Click Insert tab ► Load from Library panel ► Load Family.
- 3 In the Load Family dialog, select the family to load, and click Open.
- 4 Add instances of the family to your projects.

Working with Shared Components in a Project

A family that contains nested and shared families works as any other family within a project. However, you can press *Tab* to toggle to the nested and shared components.

Selecting sub-instances of a shared family



If you select a nested instance, you can do the following:

- Click Modify <Element> tab ► Element panel ► Element Properties drop-down ► Instance Properties. In the Instance Properties dialog, modify some parameters, such as Mark and Comments.
- Modify type properties. When you do this, all instances of that type also update to reflect the changes.

If you select a nested instance, you cannot do the following:

- Select and delete a nested instance.
- Mirror, copy, move, or array a nested instance.
If you do this, the entire host family adapts, not just the nested instance.
- Modify the position, the size, or shape of a nested instance.

Scheduling Shared Components

To create a schedule containing shared families, you use the same method as any other schedule. See *Schedule Views* in the Revit MEP 2010 Help.

When you nest and share families, you can schedule shared families as individual instances. A family comprised of shared and nested families allows each instance of a nested family to schedule separately. Within the schedule, you can renumber each instance of a nested family.

If a nested family contains multiple categories, each instance of a nested family displays in its respective schedule and all components will display on a multi-category schedule.

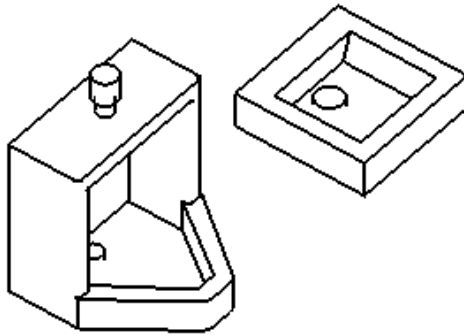
In contrast, in a family where no nested families are shared, instances of the nested families schedule only as one instance.

Creating a Nested Family with Interchangeable Components

You can create families that feature interchangeable nested components when added to your projects. To control the type of family within a nested family, you create a family type parameter that can be either an instance or type parameter. After you label a nested component as a family type parameter, subsequently loaded families of the same type automatically become interchangeable without any further work.

For example, if you add 2 sinks to a bathroom unit family, you have to position only one of the sinks, label it as a family type parameter, and then the other sink becomes part of the list of available sinks.

Bathroom family with multiple sinks assigned to a family type parameter



If you need the nested family components to tag and schedule individually, make sure each family that you load into the host family is shared.

- 1 Open a family or start a new one.
- 2 Load the components that you want to nest within the family. For example, if you are in a door family, load several transom types.
- 3 Click **Create** tab ► **Model** panel ► **Component**, and select an element from the **Type Selector** drop-down.
- 4 Click in the drawing area to place the first component at its desired location.
- 5 Select the nested component.
- 6 On the **Options Bar**, for **Label**, select **Add Parameter**.

NOTE When adding a parameter in the Family Types dialog, click Add Parameter, select Family Type as the Category, and select the category from the Select Category dialog. When you add the parameter using the Options Bar, the parameter is automatically assigned to Family Type and the respective family category is assigned.

- 7 In the Parameter Properties dialog, under Parameter Type, select Family Parameter.
- 8 Under Parameter Data, enter a name for the parameter, and select either Instance or Type parameter.
- 9 Select a value for Group parameter under.
This designates under which heading the parameter displays in the Instance (or Type) Properties dialog.
- 10 Click OK.
- 11 Save the file and load it into a project.
- 12 Add the component to the building model, select it, and click Modify <element> tab ► Element panel ► Element Properties drop-down ► Instance (or Type) Properties.
- 13 Locate the family type parameter, and select a different component from the list.

Controlling the Visibility of Families with Nested and Shared Components

You can control the visibility of nested family instances in the host family. See [Managing the Family Visibility and Detail Level](#) on page 61.

- 1 In the host family, select the nested family.
- 2 Click Modify <element> tab ► Visibility panel ► Visibility Settings.
- 3 In the Family Element Visibility Settings dialog, specify the View Specific Display and Detail Level settings.

NOTE In nested families, you cannot specify the visibility option for When cut in Plan/RCP.

- 4 Click OK.

Linking Family Parameters

By linking family parameters, you can control the parameters of families nested inside host families from within a project view. You can control either instance or type parameters.


To link parameters, they have to be the same type. For example, link a text parameter in the host family to a text parameter in the nested family.

You can link a host-family parameter to more than one nested-family parameter of the same type. Also, you can link this parameter to multiple nested families.

Creating Family Parameter Links

- 1 Create a family with instance parameters or type parameters of the available types.
- 2 Save the family and load it into a host family.
- 3 With the new family open, click Create tab ► Model panel ► Component drop-down ► Place a Component, and place as many instances of the loaded family as desired.
- 4 Click Manage tab ► Family Properties panel ► Types.
- 5 In the Family Types dialog, under Parameters, click Add.

- 6 Follow the steps for creating a new parameter of the same type as the parameter you want to control in the nested family.
- 7 Click OK to close the Family Types dialog.
- 8 Select an instance of the loaded family in the host family, and click Modify <Element> tab ► Element panel ► Element Properties drop-down ► Instance Properties or Type Properties.
For instance properties and type properties, there is a column that has an equal sign (=) in the column heading. Gray buttons next to certain parameters indicate that they can be linked to other parameters.
- 9 Click the button next to a parameter that is of the same type as the one you created in Step 6.
For example, if you created a text parameter, you must select a text parameter here.
- 10 In the dialog that appears, select the parameter you created in Step 6 to associate it with the current parameter, and click OK.

NOTE When you associate 2 parameters, an equal sign appears on the button: 

- 11 Click OK to close properties dialog.
- 12 Continue creating the host family, and save it.
- 13 Load the family into a project, and place a few instances of it.
- 14 Select an instance of the family and click Modify <Element> tab ► Element panel ► Element Properties drop-down ► Instance Properties or Type Properties.
- 15 Locate the type or instance property you created.
- 16 Set it to the desired value and click OK.
The nested family changes according to the value you entered.


Creating Parameter Links for Model Text

If you place model text into a family, it acts like a nested family. You can create parameters in the host family to control the text and depth of the model text in the project.

To control text

- 1 To place some model text in the host family, click Create tab ► Model panel ► Model Text, and then type the text in the Edit Text dialog.
- 2 On any tab, click Family Properties panel ► Types and add a family parameter that is of type text. This will be the parameter that controls the text of the model text in the project.
- 3 In the Family Types dialog, enter some text in the Value field for the new parameter. For example, if you created a parameter called Mtext, you might enter **default**.

NOTE Do not leave the Value field empty. If you do, Revit MEP issues a warning.

- 4 Click OK.
- 5 Select an instance of model text in the family, and click Modify Model Text tab ► Element panel ► Element Properties drop-down ► Instance Properties.
- 6 In the Instance Properties dialog, for Text, click .
- 7 In the Associate Family Parameter dialog, select the parameter you created to link to the model text parameter.
- 8 Click OK twice.
- 9 Continue creating the host family and save it.

- 10 Load that family into a project and place a few instances of it.
- 11 Select an instance of the family and click Modify <element> tab ► Element panel ► Element Properties drop-down ► Instance Properties.
- 12 Edit the model text parameter.

The model text updates to the new value. If you created an instance parameter, just the one instance changes. If you created a type parameter, all current and future instances of the model text change.

To control depth

Controlling model text depth is similar to controlling text, except that you create a family parameter that is of type length. Follow the above procedure to link parameters for model text depth.

Loading Generic Annotations into Model Families

You can nest generic annotation families inside host model families, so that the annotations appear in the project. This is useful if you want to include a label with a model family and display that label in the project.


Generic annotations hosted by model families scale with the view when they are loaded into the project. When you place these generic annotations on a sheet, they display at the same size, regardless of view scale. For example, a 3/32" text label in a model family always prints at that size on a sheet, even if that label appears on the sheet in a view with a 1/8" = 1'0" scale or a view with a 1/4" = 1'0" scale.

You can also control the visibility of generic annotations in the project separately from the host model family.

Adding a Generic Annotation

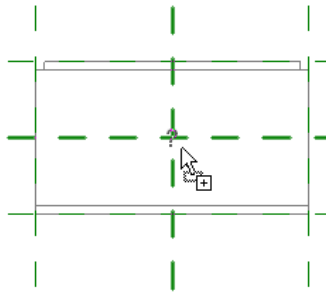
You can create a generic annotation family or load one from the available annotation families in the Revit MEP library. This procedure uses an existing annotation family.

NOTE Though this procedure uses specific family files, the steps are common to any generic annotation you may want to add to a model family.

- 1 Click  ► Open ► Family.
- 2 Open the Lighting and Appliance Panelboard - 208V MCB - Surface from the folder in the Imperial library.
- 3 Click Insert tab ► Load From Library panel ► Load Family.
- 4 . Navigate to the Annotations folder, select M_Label Annotation.rfa, and click Open.
- 5 Open a floor plan view in the panelboard file.

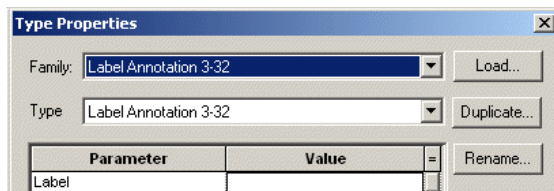
You can place a generic annotation in plan only.
- 6 Click Detail tab ► Detail panel ► Symbol, and place an instance of the label at the intersection of the 2 reference planes in the center of the panelboard.

Label snapping to intersection of reference planes



Next you associate this label with a parameter in the host family.

- 7 Click Place Symbol tab ► Family Properties panel ► Types.
- 8 In the Family Types dialog, under Parameters, click Add.
- 9 In the Parameter Properties dialog, under Parameter Type, select Family parameter.
- 10 Under Parameter Data, for Name, type **Label**.
- 11 For Type of Parameter, select Text.
This parameter will be stored by type.
- 12 Click OK twice.
- 13 Select the label instance you placed on the panelboard, and click Modify Generic Annotations tab ► Element panel ► Element Properties drop-down ► Type Properties.
- 14 Locate the Label parameter.
- 15 In the row for the Label parameter, click the button under the equal sign (=) column.



- 16 In the Associate Family Parameter dialog, select the parameter Label. This is the parameter you created in steps 6-10.
- 17 Click OK twice.
- 18 If desired, you can set at which detail level the label appears in a project. Access the instance properties for the annotation. Next to the Visibility/Graphics Overrides instance parameter, click Edit, and then select coarse, medium, or fine. If you leave a particular detail level unselected, the label will not show in a project view set at that detail level.
- 19 Save the panelboard family and load it into your project.
- 20 Open a plan view, and click Home tab ► Build panel ► Component.
- 21 Select the microwave from the Type Selector drop-down, and place an instance in the project.
- 22 Select the panelboard, and click Modify Specialty Equipment tab ► Element panel ► Element Properties drop-down ► Type Properties.
- 23 In the Type Properties dialog, for Label, enter **PB**.
- 24 Click OK.
The panelboard displays with the specified label in the view.
- 25 If desired, change the detail level of the view to change the visibility of the label.

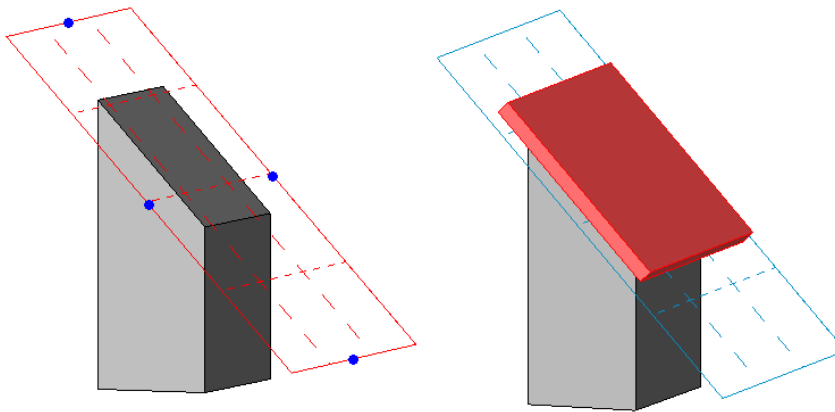
See [Managing the Family Visibility and Detail Level](#) on page 61.

NOTE You can also change the visibility of the label by turning off Generic Annotations on the Annotation Categories tab of the Visibility/Graphics dialog.

Creating Work Plane-based and Face-based Families

You can create a family that is hosted by the active work plane. This can be very useful both in a project environment and within a nested family, when it's necessary for a nested sub-component to reside on a particular plane. You can make any non-hosted family a work plane-based family. For example, a generic component, a furniture component, and a site component can all be work plane-based families because they are not required to be hosted by another component. Lighting fixtures cannot be work plane-based because they are wall-hosted components.

Example of generic component family nesting a work plane-based component. On the left, the work plane is selected; on the right, the work plane-based component was added.



Another way to create components that can be placed with any orientation is to use face-based families. A face-based family must be created from the Generic Model face based.rft template. A face-based component can be placed on any surface, including walls, floors, roofs, stairs, reference planes, and other components. If the family contains a void that cuts the host, the component will cut its host, only if the host is a wall, floor, roof, or ceiling. When a component with a void is placed on any other host, it will not cut.

Creating a Work Plane-based Family

1 Open or create a non-hosted family.

NOTE Only non-hosted components can become work plane-based families. Doors and windows, for instance, are hosted by walls and cannot become work plane-based components.

2 In the Family Editor, on any tab, click Family Properties panel ► Category and Parameters.

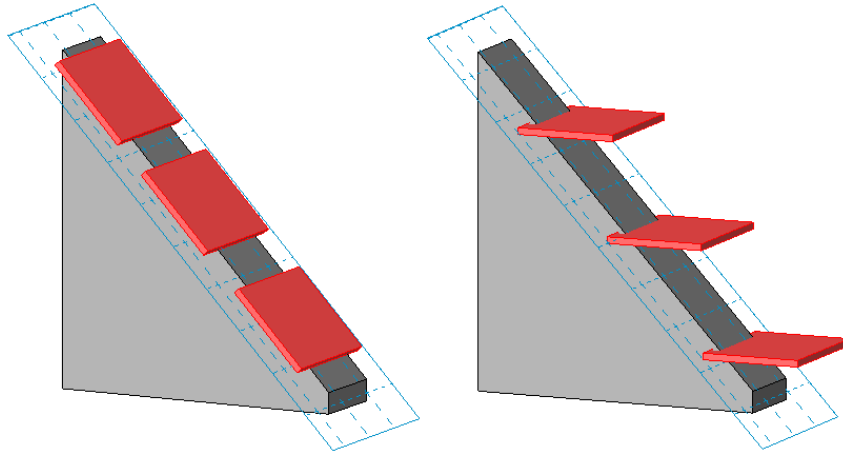
3 In the Family Category and Parameters dialog, under Family Parameters, select Work Plane-Based.

4 Click OK.

NOTE You can make a family both work plane-based and always vertical. Examples of both are shown below.

In the nested family below, the rectangular extrusion is a work plane-based component. On the left, the extrusion is work plane-based but not always vertical. On the right,

the same extrusion was reloaded into the family after designating it work plane-based and always vertical.

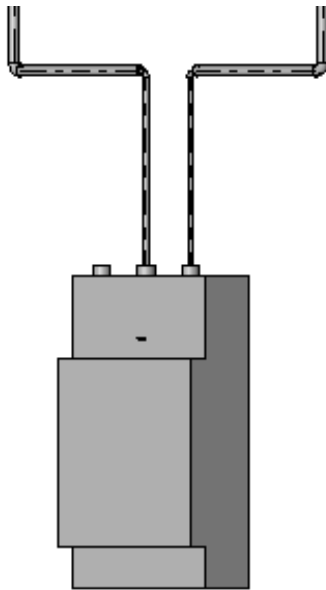


Creating Vertical Families

The option to create vertical or non-vertical families pertains only to families hosted by walls, floors, ceilings, roofs, and site surfaces. You can specify a family component, such as an air conditioner or a water heater, to Always Vertical; after it is loaded into a project, the component remains vertical regardless of the slope of the host. In the case of a sprinkler, you can specify the Always Vertical option to No, which lets the sprinkler adapt to the slope of the host.

NOTE The Always Vertical parameter does not apply to families created in non host-based templates.

Example of vertical water heater



To set the Always Vertical parameter for a family

- 1 In the Family Editor, on any tab, click Family Properties panel ► Category and Parameters.
- 2 In the Family Category and Parameters dialog, under Family Parameters, select Always Vertical.

3 Click OK.

Creating a Type Catalog

A type catalog is an external text file (TXT) that contains the parameters and their values that create the different types in a specific family.

Following is a sample type catalog TXT file:

```
,Manufacturer##other##,Length##length##centimeters,Width##length##centimeters,Height##length##centimeters
MA36x30,Revit,36.5,2.75,30
MA40x24,Revit,40.5,3.25,24
```

When loading the corresponding family, you would see the following type catalog:

| Type | Manufacturer | Length | Width | Height |
|---------|--------------|--------|--------|--------|
| MA36x30 | Revit | 36.5cm | 2.75cm | 30cm |
| MA40x24 | Revit | 40.5cm | 3.25cm | 24cm |

There are several ways to create a comma-delimited .txt file. You can type it in a text editor such as Notepad, or you can use database or spreadsheet software to automate the process.

You can export your project to a database using ODBC, and then download the element type tables in comma-delimited format. See Exporting to ODBC in the Revit MEP 2010 Help.

As you create the type catalog, follow these rules:

- Save the type catalog file name with a .txt extension; the file must have the same name and same directory path as the Revit MEP family (for example, Sprinklers/Sprinkler-Dry-Hosted.rfa and Sprinklers/Sprinkler-Dry-Hosted.txt).
- Use the left column to list types.
- Use the top row of the file for parameter declaration. Format is columnname##type##unit.
- Use decimals.
- Parameter names are case sensitive.
- You can use single or double quotes. If you are using double quotes, you need to enter "" for Revit MEP to understand it as double quotes.
- Valid unit types are length, area, volume, angle, force, and linear force.
- Valid units: Valid units and suffixes:
 - For length: feet, feet, inches, inches, meters, centimeters, millimeters, meters
 - For hvac_duct_size: feet, feet, inches, inches, meters, centimeters, millimeters, meters
 - For hvac_roughness: feet, feet, inches, inches, meters, centimeters, millimeters, meters
 - For pipe_size: feet, feet, inches, inches, meters, centimeters, millimeters, meters
 - For piping_roughness: feet, feet, inches, inches, meters, centimeters, millimeters, meters
 - For area: square_feet, square_inches, square_meters, square_centimeters, square_millimeters, acres, hectares

- For hvac_cross_section: square_feet, square_inches, square_meters, square_centimeters, square_millimeters, acres, hectares
- For volume: cubic_yards, cubic_feet, cubic_inches, cubic_meters, cubic_centimeters, cubic_millimeters, liters, gallons
- For piping_volume: cubic_yards, cubic_feet, cubic_inches, cubic_meters, cubic_centimeters, cubic_millimeters, liters, gallons
- For angle: degrees, degrees
- For force: newtons, decanewtons, kilonewtons, meganewtons, kips, kilograms_force, tonnes_force, pounds
- For linear_moment: newton_meters_per_meter, decanewton_meters_per_meter, kilonewton_meters_per_meter, meganewton_meters_per_meter, kip_feet_per_foot, kilogram_force_meters_per_meter, tonne_force_meters_per_meter, pound_force_feet_per_foot
- For linear_force: newtons_per_meter, decanewtons_per_meter, kilonewtons_per_meter, meganewtons_per_meter, kips_per_foot, kilograms_force_per_meter, tonnes_force_per_meter, pounds_force_per_foot, kips_per_inch
- For pont_spring_coefficient: newtons_per_meter, decanewtons_per_meter, kilonewtons_per_meter, meganewtons_per_meter, kips_per_foot, kilograms_force_per_meter, tonnes_force_per_meter, pounds_force_per_foot, kips_per_inch
- For hvac_pressure: inches_of_water, pascals, kilopascals, megapascals, pounds_force_per_square_inch, inches_of_mercury, millimeters_of_mercury, atmospheres, bars
- For area_force: newtons_per_square_meter, decanewtons_per_square_meter, kilonewtons_per_square_meter, meganewtons_per_square_meter, kips_per_square_foot, kilograms_force_per_square_meter, tonnes_force_per_square_meter, pounds_force_per_square_foot
- For piping_pressure: pascals, kilopascals, megapascals, pounds_force_per_square_inch, inches_of_mercury, millimeters_of_mercury, atmospheres, bars, feet_of_water
- For stress: pascals, kilopascals, megapascals, pounds_force_per_square_inch, bars, newtons_per_square_meter, decanewtons_per_square_meter, kilonewtons_per_square_meter, meganewtons_per_square_meter, kips_per_square_foot, kilograms_force_per_square_meter, tonnes_force_per_square_meter, pounds_force_per_square_foot, kips_per_square_inch
- For linear_spring_coefficient: inches_of_water, pascals, kilopascals, megapascals, pounds_force_per_square_inch, inches_of_mercury, millimeters_of_mercury, atmospheres, bars, newtons_per_square_meter, decanewtons_per_square_meter, kilonewtons_per_square_meter, meganewtons_per_square_meter, kips_per_square_foot, kilograms_force_per_square_meter, tonnes_force_per_square_meter, pounds_force_per_square_foot, feet_of_water, kips_per_square_inch
- For hvac_energy: british_thermal_units, calories, kilocalories, joules, kilowatt_hours, therms
- For moment: newton_meters, decanewton_meters, kilonewton_meters, meganewton_meters, kip_feet, kilogram_force_meters, tonne_force_meters, pound_force_feet
- For hvac_friction: inches_of_water_per_100ft, pascals_per_meter
- For piping_friction: pascals_per_meter, feet_of_water_per_100ft
- For unit_weight: pounds_force_per_cubic_foot, kips_per_cubic_inch, kilonewtons_per_cubic_meter
- For area_spring_coefficient: inches_of_water_per_100ft, pascals_per_meter, feet_of_water_per_100ft, pounds_force_per_cubic_foot, kips_per_cubic_inch, kilonewtons_per_cubic_meter, kips_per_cubic_foot
- For thermal_expansion_coefficient: inverse_degrees_fahrenheit, inverse_degrees_celsius

- For rotational_pont_spring_coefficient: kips_per_degree, kilonewtons_per_degree
 - For rotational_linear_spring_coefficient: kips_per_degree_per_foot, kilonewtons_per_degree_per_meter
 - For hvac_density: kilograms_per_cubic_meter, pounds_mass_per_cubic_foot, pounds_mass_per_cubic_inch
 - For piping_density: kilograms_per_cubic_meter, pounds_mass_per_cubic_foot, pounds_mass_per_cubic_inch
 - For hvac_power: watts, kilowatts, british_thermal_units_per_second, british_thermal_units_per_hour, calories_per_second, kilocalories_per_second
 - For hvac_heat_gain: watts, kilowatts, british_thermal_units_per_second, british_thermal_units_per_hour, calories_per_second, kilocalories_per_second
 - For electrical_power: watts, kilowatts, british_thermal_units_per_second, british_thermal_units_per_hour, calories_per_second, kilocalories_per_second, volt_amperes, kilovolt_amperes, horsepower
 - For electrical_apparent_power: watts, kilowatts, british_thermal_units_per_second, british_thermal_units_per_hour, calories_per_second, kilocalories_per_second, volt_amperes, kilovolt_amperes, horsepower
 - For hvac_power_density: watts_per_square_foot, watts_per_square_meter
 - For electrical_power_density: watts_per_square_foot, watts_per_square_meter
 - For hvac_temperature: fahrenheit, celsius, kelvin, rankine
 - For piping_temperature: fahrenheit, celsius, kelvin, rankine
 - For hvac_velocity: feet_per_minute, meters_per_second, centimeters_per_minute
 - For piping_velocity: meters_per_second, feet_per_second
 - For hvac_air_flow: cubic_feet_per_minute, liters_per_second, cubic_meters_per_second, cubic_meters_per_hour, gallons_us_per_minute, gallons_us_per_hour
 - For piping_flow: liters_per_second, cubic_meters_per_second, cubic_meters_per_hour, gallons_us_per_minute, gallons_us_per_hour
 - For piping_viscosity: pascal_seconds, pounds_mass_per_foot_second, centipoises, pounds_mass_per_foot_hour
 - For hvac_viscosity: pascal_seconds, pounds_mass_per_foot_second, centipoises, pounds_mass_per_foot_hour
 - For electrical_current: amperes, kiloamperes, milliamperes
 - For electrical_potential: volts, kilovolts, millivolts
 - For electrical_frequency: hertz, cycles_per_second
 - For electrical_illuminance: lux, footcandles, footlamberts, candelas_per_square_meter
 - For electrical_luminous_intensity: candelas, lumens
 - For electrical_luminous_flux: lumens
- You can enter a value for parameters of type Family Type. To declare the Family Type parameter in the parameter declaration, you would enter column-name##other##. The column name is the same as the Family Type parameter name. In the type catalog file, enter values as Family Name : Family Type. Be sure

there are spaces before and after the colon. For example, a family file called Chair-Executive.rfa with a type called Big Boss would be entered as Chair-Executive : Big Boss. If the family file has only one type and it is the same name as the family, you do not need to include the Family Name.

- Revit MEP applies project unit settings to type catalogs when you load a family.

Deleting Unused Families and Types

You can delete families or unused family types from your projects and templates using either of 2 methods: you can select and delete the families and types in the Project Browser, or you can run the Purge Unused tool.

Select and delete families and types when you have only a few families or types that you need to delete. Use the Purge Unused tool when you need to “clean up” your projects. Removing all of the unused families and types usually decreases the project file size.

Method 1: Selecting and deleting families and types in the Project Browser

- 1 In the Project Browser, expand Families.
- 2 Expand the category that contains the family or type that you want to delete.
- 3 If you want to delete a family type, expand the family.
- 4 Select the family or type that you want to delete.

TIP To select more than one family or type, press and hold *Ctrl* while selecting.

- 5 Do either of the following:

- Right-click, and click Delete.
- Press *Delete*.

The family or type is deleted from the project or template.

If you are deleting a family or type from a project, and there is one or more instances of a type in the project, a warning displays.

- 6 In the alert dialog:

- Click OK to delete any instances of the type.
- Click Cancel, change the type, and repeat the previous step.

Method 2: Using the Purge Unused command

- 7 Click Manage tab ► Project Settings panel ► Purge Unused.

The Purge unused dialog lists all of the families and family types that you can unload from the project, including system and in-place families. By default, all unused families are selected for purging.

IMPORTANT If the project is workset-enabled, all worksets must be open to use this command.

- 8 Do either of the following:

- To purge all unused family types, click OK.
- To purge only the types that you select, click Check None, expand the families and subfamilies that contain the types that you want to purge, select the types, and click OK.

Creating Revit MEP Content

4

The tutorials that follow this section expand your knowledge of the Family Editor by introducing several unique features in Revit MEP. Before completing the tutorials, you should have a working knowledge of Revit MEP and experience with the actual components that you will be modeling. Revit MEP operation and the behavior of your components depends to a great extent on how you create specific components.

In the tutorials, you begin by modifying existing families to create new types. After learning to modify an existing family, you create new families for a lighting fixture, an annotation symbol, and 2 pipe fittings.

Revit MEP Content

The primary difference between content for Revit MEP and content for Revit Architecture or Revit Structure is the concept of connectors. All Revit MEP content requires connectors for it to be intelligent Revit MEP components. Components created without connectors cannot participate in a system topology.

Three disciplines can be assigned to connectors that are added to a family.

- Duct connectors are associated with ductwork, duct fittings, and other elements that are part of the air handling systems.
- Electrical connectors are used for any type of electrical connections, including power, telephone, alarm systems, and others.
- Pipe connectors are used for piping, pipe fittings, and other components that are meant for transmitting fluids.

NOTE The term fluid does not necessarily limit the use of piping systems to liquids. Steam, medical gases, and other non-fluid materials are often transmitted using piping systems.

The discipline assigned to a connector determines its behavior and the types of systems with which it can interact. Connectors are primarily logical entities that allow calculating loads within the building. Selecting the correct discipline is critical to the content working correctly, as after this selection is made, it cannot be changed without first deleting the connector and adding it again with the correct discipline.

For more information on using connectors in Revit MEP, refer to the following Autodesk University presentation: Getting into the Flow: Understanding Connectors in Revit MEP Content, http://au.autodesk.com/?nd=class&session_id=3212.

Family Editor

Creating a family requires careful thought, not only for the geometry, but also to understand how the settings in the Family Editor affect the family. Although the exercises in the tutorials describe settings that are specific to a particular

mechanical, electrical, or plumbing component, it is important to recognize how components interact to affect the overall design. For example, the heat released by a light fixture affects the cooling requirements for a space.

There are several ways to create a family with the Family Editor. You can modify an existing component. You can create a component from scratch. At times, it is easier to modify a component, instead of creating a new one. If you can find a component that is similar to the family that you want, open it in the Family Editor, modify it as needed, and then load it into the project. If a family you are creating is very similar to an existing family, you may want to create multiple types within the existing family instead of creating a new family.

The process you use to create the family will determine how a part flexes as geometric parameters are modified. Finally, although it may be easier to modify an existing family, there are times when it is best to create a new family instead of attempting to create a single family with types to address every application.

Revit MEP Family Editor Concepts

Connectors

A defining feature of Revit MEP content is the concept of connectors. Connectors allow Revit MEP content to participate in specific systems and facilitate calculations for a variety of parameters.

Connector Properties

The discipline assigned to a connector determines the connector’s properties. The following tables show the different connector parameters, by property group, for each discipline and a brief description of their functionality.


| | |
|---------------------------|---|
| Electrical | |
| Constraints | |
| Edge loop centered | Connector placement method (read only). |
| Graphics | |
| Size on screen | Size of the connector display inside the Family Editor. |
| Electrical - Loads | |
| True Load Phase 3 | Calculated based on (Apparent Load Phase 3) x (Power Factor). |
| True Load Phase 2 | Calculated based on (Apparent Load Phase 2) x (Power Factor). |
| True Load Phase 1 | Calculated based on (Apparent Load Phase 1) x (Power Factor). |
| Power Factor | Percentage of power attributed to this connector. Active only when Power is specified as System Type. |

| | |
|--------------------------|--|
| Apparent Load Phase 3 | Calculated based on (Voltage) x (Current - Phase 3). Active only when Balanced Load is False and System Type is Power, and Number of Poles >2. |
| Apparent Load Phase 2 | Calculated based on (Voltage) x (Current - Phase 2). Active only when Balanced Load is False and System Type is Power, and Number of Poles >1. |
| Apparent Load Phase 1 | Calculated based on (Voltage) x (Current - Phase 1). Active only when Balanced Load is False and System Type is Power. |
| Apparent Load | Calculated based on (Voltage) x (Current). Active only when Balanced Load is True and System Type is Power. |
| Voltage | The voltage specified on the connector. Active only when the System Type is Power. |
| System Type | Possible values are: Data, Power - Balanced, Power - Unbalanced, Telephone, Security, Fire Alarm, Nurse Call, Controls, Communication. |
| Load Classification | Possible values are: HVAC, Lighting, Power, Other. |
| Power Factor State | Possible values are: Lagging, Leading. |
| Number of Poles | Possible values are: 1, 2, or 3. |
| Identity Data | |
| Index | A unique identifier for a connector in a family (read only). |
| Primary Connector | Possible values are: True or False (read only). A single connector of each discipline is allowed to be primary in each family. The family's electrical data that displays in a schedule is derived from the primary connector. |
| Connector Description | A description of the connector |
| Mechanical (HVAC) | |
| Constraints | |
| Edge loop centered | Connector placement method (read only) |
| Angle | Used for adjustable angle families (such as elbows and adjustable tees) to push the angle value into the family from connected components |
| Graphics | |
| Size on screen | Size of the connector display inside the Family Editor. |
| Mechanical | |

| | |
|-----------------------------|--|
| Flow Factor | Percentage of the system flow attributed to this connector. Active only when the Flow Configuration is System. |
| Loss Coefficient | Active only when the Loss Method is Coefficient. |
| Flow Configuration | Possible values are: Calculated, Preset, System. |
| Flow Direction | Possible values are: In, Out, Bidirectional. |
| System Type | Possible values are: Supply, Return, Exhaust, Other, Un-defined. |
| Loss Method | Possible values are: Not Defined, Coefficient, Specific Loss. |
| Mechanical - Airflow | |
| Pressure Drop | Active only when the Loss Method is Specific Loss. |
| Flow | The amount of air flowing at this connector. |
| Dimensions | |
| Shape | Possible values are: Rectangular or Round. |
| Height | The height of the connector when the Shape is defined to be rectangular. |
| Width | The width of the connector when the Shape is defined to be rectangular. |
| Radius | The radius of the connector when the Shape is defined to be round. |
| Identity Data | |
| Index | A unique identifier for a connector in a family (read only). |
| Primary Connector | Possible values are: True or False (read only). A single connector of each discipline is allowed to be primary in each family. The family's HVAC data that displays in a schedule is derived from the primary connector. |
| Link Connector Index | The index of the linked connector, -1 if none. (read only) |
| Connector Description | A description of the connector |
| Mechanical (Piping) | |
| Constraints | |
| Edge loop centered | Connector placement method (read only). |

| | |
|-------------------------|--|
| Angle | Used for adjustable angle families (such as elbows and adjustable tees) to push the angle value into the family from connected components |
| Graphics | |
| Size on screen | Size of the connector display inside the Family Editor. |
| Mechanical | |
| Fixture Units | Active only when the System Type is Sanitary, Domestic Hot Water, or Domestic Cold Water and the Flow Configuration is Fixture Units. |
| K Coefficient | K Coefficient (K Factor) is only editable if Loss Method is specified as "K Coefficient". |
| Flow Factor | Percentage of the system flow attributed to this connector. Active only when the Flow Configuration is System. |
| Flow | Volumetric flow rate of fluid through connector. |
| Pressure Drop | Active only when the Loss Method is Specific Loss |
| Flow Configuration | Possible values are: Calculated, Preset, System. |
| Flow Direction | Possible values are: In, Out, Bidirectional. Bidirectional is active only when the Flow Configuration is Calculated. |
| Loss Method | Possible values are: Not Defined, K Coefficient from Table, K Coefficient, Specific Loss. |
| Allow Slope Adjustments | Possible values are: Checked or unchecked. |
| System Type | Possible values are: Undefined, Hydronic Supply, Hydronic Return, Sanitary, Domestic Cold Water, Domestic Hot Water, Fire Protection, Other. |
| K Coefficient Table | Possible values are: Bell Mouth Inlet or Reducer, Inward Projecting Pipe, Outlet, Square Edged Inlet. Active only when the Loss Method is K Coefficient from Table. |
| Dimensions | |
| Radius | The nominal size of the connector. |
| Identity Data | |
| Index | A unique identifier for a connector in a family (read only). |
| Primary Connector | Possible values are: True or False (read only). A single connector of each discipline is allowed to be primary in each family. The family's piping data that displays in a schedule is derived from the primary connector. |

System Types

When a Revit MEP component that is not a member in a system is selected in a building model, the ribbon contextual tab displays create system buttons. The specific buttons depend on the component and the type(s) of connectors in the family. If there are multiple connectors of the same type and you want to connect to a specific connector, you can right-click on the connector control  to create the appropriate type.

Electrical

When a component with an electrical connector is selected, the ribbon contextual tab displays one or more buttons, which allow you to create a specific electrical system: Power, Data, Telephone, Fire Alarm, Nurse Call, Communication.

Duct

When a component with an Duct connector is selected, the Modify Mechanical Equipment tab ► Create Systems panel displays one or more buttons, which allow you to create a specific HVAC system: Supply, Return, Exhaust.

Pipe Connector

Pipe connectors are used with hydronic systems, plumbing systems, fire protection systems.

When a component with a hydronic pipe connector is selected, the Modify Mechanical Equipment tab ► Create Systems panel displays one or more buttons, which allow you to create a specific hydronic piping system: Hydronic Supply, Hydronic Return, Other.

When a component with a plumbing (pipe) connector is selected, the Modify Plumbing fixtures tab ► Create Systems panel displays one or more buttons, which allow you to create a specific plumbing system: Sanitary, Domestic Hot Water, Domestic Cold Water, Other.

When a component with a fire protection (pipe) connector is selected, the Modify Sprinklers tab ► Create Systems panel displays one or more buttons, which allow you to create a specific fire protection system: Fire Protection Wet, Fire Protection Dry, Other.

Load Classifications

Revit MEP maintains information about loads associated with the rooms in a project. As devices and equipment are placed in rooms, Revit MEP keeps track of the loads based on load type: HVAC, Lighting, Power, Other. The loads associated with the room can be viewed in the Element Properties for each room, and displayed in schedules.

Connector Placement


Connector placement options allow you to specify two basic connector placement methods:

■ Place on Face

This option (Edge loop centered=true) will maintain its point at the center of the edge loop. In most cases this is the preferable method for placing a connector. Typically the Place on Face option is easier to use, and is suitable for most cases.

■ Place on Work Plane

This option allows placement of the connector on a selected plane. For many cases it would be possible to imitate the place on face option by specifying a plane and using dimensions to constrain the connector to the desired location. However, this method generally requires additional parameters and constraints to be used effectively.

NOTE Fittings (pipe and duct fittings) expect the instance origin of the family to be the intersection of the connectors. In most cases for fittings, there is a point on the fitting where all of the connectors (if extended into the fitting) will collide. Fittings expect this collision to be placed at the original intersection of the Center (Front / Back), Center (Left / Right), and Reference Level work planes. For this reason, it is good practice to pin these reference planes before beginning to build the family. Do this by selecting the reference plane(s) and clicking the Pin icon .

Hosts

Objects that are placed in a model are often hosted by other components. Hosting components include ceilings, floors, roofs, and walls, as well as lines, and faces. Even components that are not hosted by one of these components are still hosted by the level on which they reside.

When creating a family from a template, it is important that you consider what type of hosting behavior you want for the family. For example, you may intuitively think that a new light fixture should be ceiling hosted. However, there may be cases where you want to use that family in a wall mount configuration, or even freely suspended. You cannot change the hosting of a family after it is created; the hosting setting is hard-set based on the template from which the family originated. Plane hosting provides the ability for the family to be hosted by walls, floors, or ceilings, and provides a high level of flexibility. Plane hosted elements will even move with their hosting elements through linked models. Non-hosted families are actually hosted by the level they are inserted on and provide the ability for the element to be placed anywhere. Their height is defined relative to their level, but there is no association established with elements, linked models or otherwise.

When using linked files, only face-hosted families will be able to be hosted by the linked file's geometry.

Templates

As described above, the hosting of an element is defined based on the template that is used when the family is originally created. Templates also determine the type of family as an annotation family, model family, titleblock family, or a profile family. In some cases, the template also defines particular characteristics of how the family works, such as linear versus spot lighting characteristics.

NOTE You cannot change these characteristics once you have created the family. For example, you cannot change a linear lighting fixture into a spot lighting fixture, or redefine an annotation symbol to be a model element. You must start the family with the appropriate template.

Lookup Tables

Lookup tables are used to define parameter values in an external .csv file. This lets you specify multiple part sizes that are based on a table without creating a separate family type for each size. Revit MEP provides a `text_file_lookup` function that can be used to read the necessary values from a comma-separated values (.csv) file. The location of Lookup Table files is defined by the `LookupTableLocation` parameter in the `Revit.ini` file.

The syntax for the `text_file_lookup` function uses the following format:

```
result=text_file_lookup(LookupTableName, LookupColumn, DefaultIfNotFound, LookupValue)
```

| Where: | Is: |
|-------------------|---|
| result | the returned value. |
| LookupTableName | the name of the CSV file to lookup. |
| LookupColumn | the name of the column from which the result value is to be returned. |
| DefaultIfNotFound | the value that will be returned if LookupValue is not found. |
| LookupValue | the value to find in the first column of the table. |

CSV File Structure

The first row of values in the CSV file is for header information, to describe the contents of subsequent columns. The headers are of the format `ParameterName##ParameterType##ParameterUnits`



Acceptable parameter types are: NUMBER, LENGTH, AREA, VOLUME, ANGLE, and OTHER

For example, a column may have the following header: `TotalArea##AREA##INCHES` to represent the total area in square inches.

The first column in the file contains a description. The Lookup Function processes the information in the file starting with column 2.

Parameter Mapping

Many properties for objects, such as the depth of an extrusion and the voltage of a connector, can be mapped (associated) to a family parameter or to a shared parameter to provide flexibility to the family. The associated parameter can be defined as an instance parameter or a type parameter. Parameters are mapped by clicking

 (small button) in the  column in the Element Properties dialog for the object. When an object's parameter is mapped to another parameter, its Value column cannot be edited.

The example below shows that the Power Factor and Number of Poles parameters are currently not mapped to a parameter. Their values can be edited directly in the Value column. The Apparent Load Phase 1 and Voltage parameters are mapped to other parameters, and their values assume the values specified for the parameters to which they have been mapped.

| Parameter | Value | |
|---------------------------|--------------------------|--|
| Electrical - Loads | | |
| True Load Phase 3 | 0.00 VA | |
| True Load Phase 2 | 0.00 VA | |
| True Load Phase 1 | 91.20 VA | |
| True Load | 91.20 VA | |
| Power Factor | 0.950000 | |
| Apparent Load Phase 3 | 0.00 VA | |
| Apparent Load Phase 2 | 0.00 VA | |
| Apparent Load Phase 1 | 96.00 VA | |
| Apparent Load | 96.00 VA | |
| Voltage | 277.00 V | |
| System Type | Power | |
| Load Classification | Lighting | |
| Power Factor State | Lagging | |
| Balanced Load | <input type="checkbox"/> | |
| Number of Poles | 1 | |

Category

Revit MEP components fall into general categories (pipe fittings, lighting fixtures, and so on). The Family Category specified when a family is created determines which Family Parameters are activated. The settings for these family parameters affect the behavior for the part and identifies the type of component. In Family Editor, the Family Category and Parameters settings are found in the Settings menu. Depending on the Family Category and the type of template that the family was derived from (host-based, generic model, detail component, generic tag, and so on), different Family Parameters apply. The following table lists each Family Category, and indicates the applicable Family Parameters.

| Family Category | Family Parameter | | | | | |
|------------------------|------------------|--------------------|--------------|-----------|---------------------------------|--------|
| | Work Plane Based | Always Vertical ** | Light Source | Part Type | Maintain Annotation Orientation | Shared |
| Air Terminals | X | X | | X | | X |
| Communications Devices | X | X | | X | X | X |
| Data Devices | X | X | | X | X | X |
| Duct Accessories | X | X | | X | | X |
| Duct Fittings | X | X | | X | | X |
| Electrical Equipment | X | X | | X | | X |
| Electrical Fixtures | X | X | | X | X | X |
| Fire Alarm Devices | X | X | | X | X | X |
| Generic Models | X | X | | | | X |
| Lighting Devices | X | X | | X | X | X |
| Lighting Fixtures | X | X | X | X | | X |
| Mechanical Equipment | X | X | | X | | X |
| Nurse Call Devices | X | X | | X | | X |

| Family Category | Family Parameter | | | | | |
|-------------------|------------------|--------------------|--------------|-----------|---------------------------------|--------|
| | Work Plane Based | Always Vertical ** | Light Source | Part Type | Maintain Annotation Orientation | Shared |
| Pipe Accessories | X | X | | X | | X |
| Pipe Fittings | X | X | | X | | X |
| Plumbing Fixtures | X | X | | X | X | X |
| Security Devices | X | X | | X | X | X |
| Sprinklers | X | X | | | X | X |
| Telephone Devices | X | X | | X | X | X |

Family Parameters

- **Light Source:** See [Light Source](#) on page 90.
- **Part Type:** See [Part Types](#) on page 90.
- **Maintain Annotation Orientation:** Use this option when the family has a nested annotation family, as is the case with receptacles and switches.

Light Source

A light source is the part of a lighting fixture that emits light (such as a light bulb). In general, each lighting fixture family has one light source. To create a lighting fixture that uses multiple light sources (such as a chandelier or a set of track lights), create a nested family.

When light source is selected in the Family Category and Parameters dialog, you can specify the shape of the light element (point, line, rectangle, circle), and the light distribution (spherical, hemispherical, spot, or photometric web). You can also define photometric characteristics, such as Light Loss Factor, Initial Intensity, and Initial Color Control. In a project, you can adjust the position and brightness of each light source to achieve the desired lighting effects.

Part Types

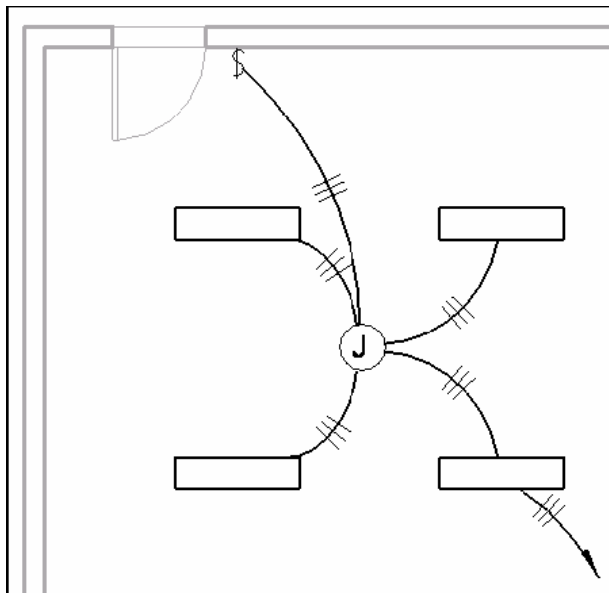
The Part Type parameter provides additional subclassification of a family category, and determines the behavior for the parts in the family. The part type serves 2 functions:

- To only allow replacing a particular part with a similar part in a building project. Generally the Type Selector allows you to replace a family of one category with any other family of the same category. However, there are times when this is not appropriate. For example, for fittings it would not be valid to replace a cross with a transition. So there is a level of filtering built into the Type Selector for Revit MEP.
- To determine the part type family. The ASHRAE Duct Fitting database is integrated with Revit MEP. This allows calculating fitting losses based on a loss table. To accurately look up the correct fitting in the database, the part type must be defined.

If a family category provides a Part Type parameter, the Part Type values available depends on the family category. The following table shows which part types apply to which family categories:

| Family Categories | Part Types |
|--|--|
| Air Terminals, Duct Accessories, Duct Fittings, Mechanical Equipment, Pipe Accessories, Pipe Fittings, Plumbing Fixture | Damper, Duct Mounted Equipment, Elbow, Entry, Exit, Equipment, Fan and System Interaction, Hood, Junction, Obstruction, Transition, Undefined, Valve |
| Communication Devices, Data Devices, Electrical Equipment, Electrical Fixtures, Fire Alarm Devices, Lighting Devices, Lighting Fixtures, Nurse Call Devices, Security Devices, Telephone Devices | Normal, Panelboard, Transformer, Switchboard, Data Panel, Switch Junction Box |

- **Damper:** Used to control flow volume.
- **Duct Mounted Equipment:** Smoke detectors, steam generators.
- **Elbow:** A bend or elbow type fitting.
- **Entry:** Point at which fluid enters the system: louvers, grills, grates.
- **Exit:** Point at which fluid leaves the system.
- **Equipment:** Generic equipment.
- **Fan and System Interaction:** AHUs, inline fans.
- **Hood:** Kitchen, lab or other exhaust hoods.
- **Junction:** Intersection of 3 or more segments (tee, cross, wye).
- **Obstruction:** Anything that causes a pressure drop, such as an inline filter.
- **Transition:** Shape or size change.
- **Undefined:** No specific functionality.
- **Valve:** Valves and similar accessories.
- **Data Panel:** Panels used to connect devices with connectors of System Type Data, Telephone, Security, Fire Alarm, Nurse Call, Controls, and Communication.
- **Normal:** Devices such as receptacles, fire alarm components, and light fixtures.
- **Panelboard:** Used to connect devices/equipment with connectors with a System Type value of Power and to generate branch circuit type schedules.
- **Switch:** Control device such as a switch where wiring is typically not drawn through the devices. As indicated in the image, the automatically generated wiring branches to the switch.
- **Junction Box:** Wire management devices through which wiring is generally drawn through the device. As indicated in the image, the automatically generated wiring branches through the junction box.



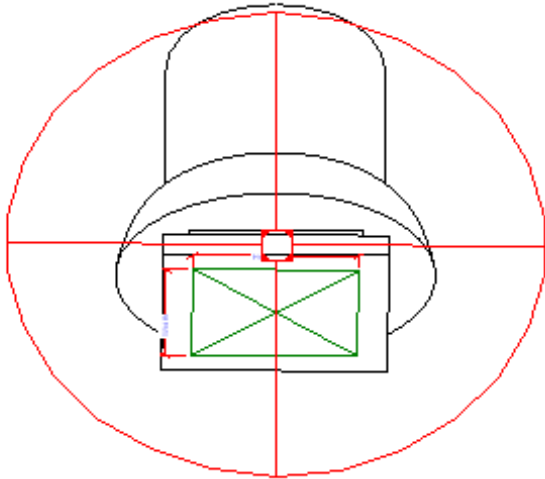
- **Switchboard:** Used to connect devices/equipment with connectors with a System Type value of Power and to generate branch circuit type schedules.
- **Transformer:** Used to interconnect Panelboards and/or Switchboards of differing voltages.

Revit MEP Families Tutorials

Modifying a Fan Family

5

In this tutorial, you modify a fan family for use in a power system. First you copy an existing exhaust family, and then you create and add shared parameters to newly created family types. After saving your new fan family, you then add an electrical connector and map the family type parameters to the connector.





Skills used in this tutorial:

- Modifying an existing family
- Defining shared parameters
- Creating formulas for parameters
- Placing connectors
- Mapping parameters
- Creating multiple types within a family

Modifying a Fan Family

Create a copy of the family

- 1 Click  ► New ► Family.
- 2 In the Left pane of the New Family - Select Template File dialog, click training files, and open Metric ► Family Editor ► M_Exhaust Ventilator - Downblast.rfa.
- 3 Click  ► Save As ► Family.
- 4 In the Save As dialog, navigate to a folder of your choice, and save the family as M_Exhaust Ventilator - Downblast .rfa.

Set project units

Now you will specify the display format for the family's units of measure.

- 5 Click Manage tab ► Family Settings panel ► Project Units.
- 6 In the Project Units dialog, for Discipline, select Electrical, and for Current, click the Format column.
- 7 In the Format dialog, for Rounding, select 1 decimal place, and click OK.
- 8 Click OK to close the Project Units window.
- 9 Save the family.

Create Shared Parameters

Shared parameters are parameters that you can add to families or projects and then share with other families and projects. They give you the ability to add specific data that is not already predefined.

Shared parameters are stored in a file independent of any family file or project.

- 10 Click Manage tab ► Family Properties panel ► Types.
- 11 In the Family Types dialog, under Parameters, click Add.
- 12 In the Parameter Properties dialog, click the Shared parameter option, and click Select.
- 13 If you have not already created a shared parameter file, you will be prompted to choose a file from another project or to create a new file.
Click Yes.
- 14 In the Edit Shared Parameters dialog, click Create.
- 15 Browse to a folder, enter a File name (for example, Shared_Parameters) for the shared parameter file, and click Save.

NOTE The parameter values stored in the shared parameter file will remain after completing this tutorial. To reuse this tutorial, you must remove the shared parameter text file created in the previous step.

- 16 In the Edit Shared Parameters dialog, under Groups, click New.
- 17 For Name, enter **MEP**, and click OK.
- 18 Under Parameters, click New.
- 19 In the Parameter Properties dialog, specify the following:
 - For Name, enter **Motor HP**
 - For Discipline, enter **Common**
 - For Type of Parameter, enter **Text**

20 Click OK.

21 Using the same method, create additional shared parameters with the following properties:

| Name | Discipline | Type |
|-----------------|------------|----------------------|
| Voltage | Electrical | Electrical Potential |
| Motor FLA | Electrical | Current |
| Power | Electrical | Power |
| Phase | Common | Integer |
| Number of Poles | Electrical | Number of Poles |

22 Click OK.

Add shared parameters to the Family Type

Now you will add the shared parameters that you created to the family type.

23 In the Shared Parameters dialog, under Parameters, select Motor FLA, and click OK.

24 In the Parameter Properties dialog, for Group parameter under, select the Electrical Engineering, select the Type option, and click OK.

The new parameter is added to the Family Types dialog under the Electrical Engineering category.

25 In the Family Types dialog, under Parameters, click Add.

26 In the Parameter Properties dialog, select the Shared parameter option, and click Select.

27 In the Shared Parameters dialog, for Parameter Group, select MEP, under Parameters, select Voltage, and click OK.

28 In the Parameter Properties, under Parameter Data, for Group parameter under, select Electrical Engineering, select the Type option, and click OK.

29 Using the same method, add the following shared parameters to the family type, as defined below:

| Parameter | Group | Instance/Type |
|-----------------|------------------------|---------------|
| Phase | Electrical Engineering | Type |
| Number of Poles | Electrical Engineering | Type |
| Motor HP | Mechanical | Type |
| Power | Electrical Engineering | Type |

Create a parameter formula to calculate power

Formulas are case sensitive. Ensure in step 30 that you use the same case as the name of the parameter you created.

30 In the Formula column for Power, enter the following formula:

```
Voltage * Motor FLA * sqrt(if(Phase = 3, 3, 1))
```

Create New Family Types

Now you will add new types to the family and change the parameters for these types.

31 Under Family Types, click New.

32 For Name, enter **1/6 HP - 115 V - 1 Ph.**

33 Click OK.

34 Specify the following values for the shared parameters in the Family Types dialog:

- Voltage = 115
- Phase = 1
- Number of Poles = 1
- Motor FLA = 4.4
- Motor HP = 1/6

The value for Power is calculated from the parameter values specified.

35 Using the same method, create additional Family Types with the following parameter values:

| Name | Voltage | Phase | Number of Poles | Motor FLA | Motor HP |
|---------------------|---------|-------|-----------------|-----------|----------|
| 1 HP - 208 V - 1 Ph | 208 | 1 | 2 | 8.8 | 1 |
| 2 HP - 208 V - 3 Ph | 208 | 3 | 3 | 7.5 | 2 |
| 3 HP - 460 V - 3 Ph | 460 | 3 | 3 | 4.8 | 3 |

36 Click OK.

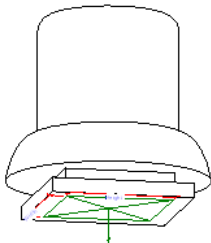
37 Save the family.

Add an electrical connector

38 Electrical connectors are used for a variety of electrical systems, including power, telephone, alarm systems and others. The electrical connector that you add here will ultimately be used in a power system. Connections between components in a power system must have connectors with the same, system type, number of poles and the same voltage specified. See Connectors.

Click and drag the View Cube at the upper right corner of the view to spin the ventilator as shown.

TIP You can also hold the right mouse button, while pressing *Shift*, and dragging the cursor to spin a model.



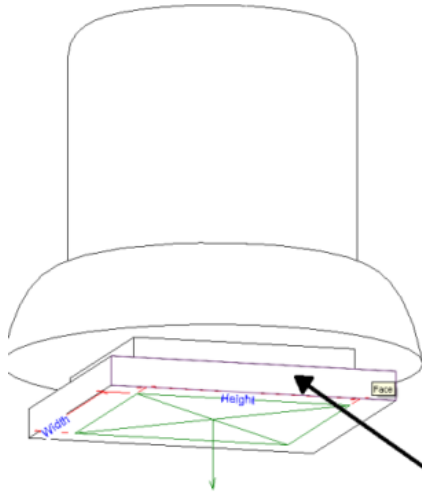
39 Click Create tab ► Connectors panel ► Electrical Connector.

40 On the Options Bar, select Power - Balanced.

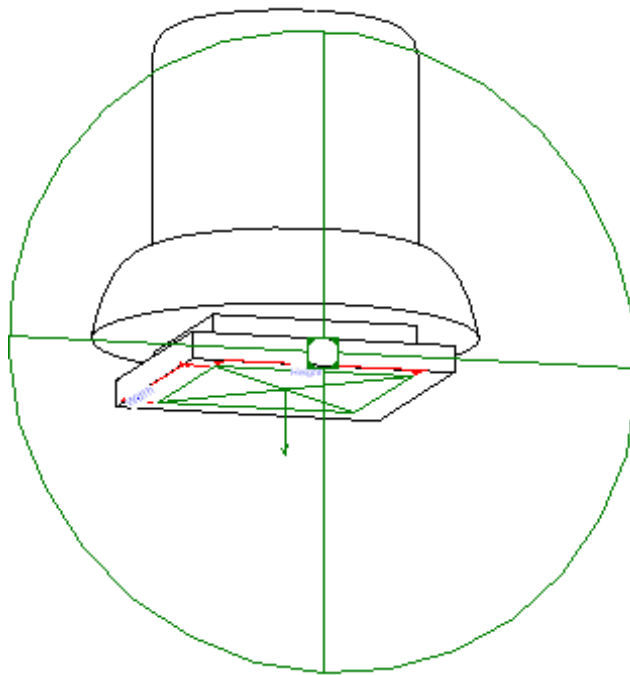
41 Click Place Electrical Connector tab ► Placement panel and verify that Face is selected.

Connectors can be placed on a Face or on a Work Plane. See Connector Placement.

- 42 Highlight the narrow face at the base of the fan housing and click to place the connector on the center of the face.



NOTE If necessary, press *Tab* to cycle through the active faces until the narrow face at the base of the fan is highlighted.




- 43 Click Modify.

Map Parameter Values to Connector

Now you will associate shared family parameters to Electrical connector parameters that you created.

- 44 Click Create tab ► Family Properties panel ► Types.
- 45 In the Family Types dialog, for Name, select 3 HP - 460 V - 3 Ph, and click OK.
- 46 Select the Electrical connector created in the previous section.

47 Click Modify Connector element tab ► Element panel ► Element Properties drop-down ► Instance Properties.

48 In the Instance Properties dialog, for Voltage, click  in the = column.

49 In the Associate Family Parameter dialog, select Voltage, and click OK.

50 Using the same method, specify an associated family parameter for the following parameters:

| Parameter | Associated (shared) Parameter |
|-----------------|-------------------------------|
| Number of Poles | Number of Poles |
| Apparent Load | Power |

51 Under Electrical Loads, for Load Classification, select HVAC.

52 Click OK.

53 Save the family.

Test the part

Now you will load the family into a sample project and verify that its parameters correspond to the types that you created.

54 Click  ► Open ► Project.

55 In the left pane of the Open dialog, click the Training Files icon.

56 Open Metric ► Family Editor ► m Sample Project.rvt.

57 Click View tab ► Windows panel ► Switch Windows ► M_Exhaust Ventilator - Downblast.rfa to make the family the active view.

58 Click Create tab ► Family Editor panel ► Load into Project.

The m Sample Project.rvt displays in the drawing area.

59 In the Project Browser, expand Views (Discipline) ► Mechanical ► HVAC ► Floor Plans, and double-click 2 - Mech.

60 Click Home tab ► Mechanical panel ► Mechanical Equipment.

61 Click Place Mechanical Equipment tab ► Element panel ► Type Selector drop-down ► M_Exhaust Ventilator Downblast : 1/6 HP-115 V-1 Ph.

62 Move the cursor into the drawing area and click to add the M_Exhaust Ventilator Downblast : 1/6 HP-115 V-1 Ph. (The exact location is not important.)

63 Click Place Mechanical Equipment ► Selection Panel ► Modify to end the command.

64 Select the fan, and click Modify Mechanical Equipment tab ► Element panel ► Element Properties drop-down ► Type Properties, and observe the values in the Type Parameters list.

65 For Type, select 1 HP-208V-1 Ph, and again observe the Type Parameter values.

The values should correspond to the values entered when you created the new family types.

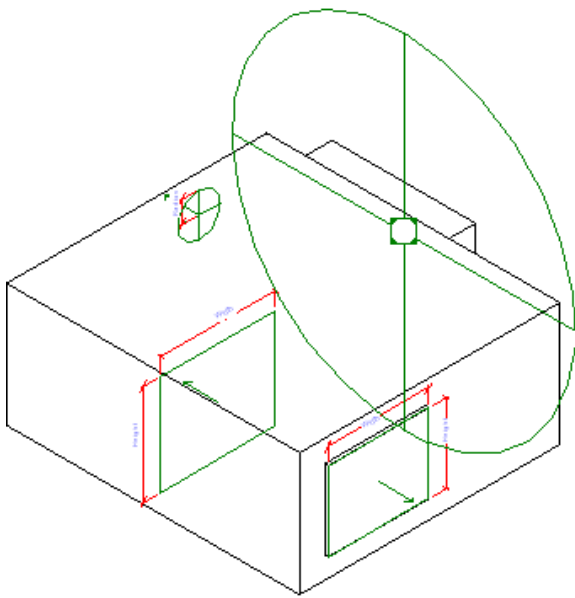
66 Click OK.

67 Save the family. (It is not necessary to save the m Sample Project.rvt file.)

Modifying a Fan Powered VAV Box Family

6

In this tutorial, you modify a variable air volume (VAV) box with electric heat family. You will create new parameters, place an electrical connector, and specify flow configuration for use in a sample supply air system.




Skills used in this tutorial:

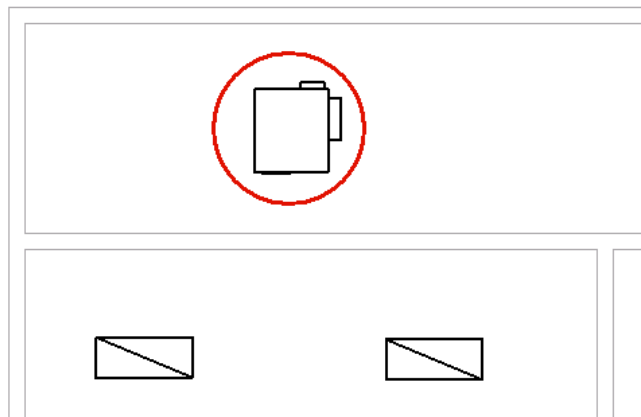
- Using various settings on the electrical connector to define a fan powered box with variable power requirements for electric heat and motor size
- Using shared parameters and parameter mapping

Modifying a Fan Powered VAV Box Family

NOTE If you have not already completed the previous tutorial, you will need to complete that tutorial to create shared parameters that are used in this tutorial. See *Modifying a Fan Family*.

Open the family and create parameters

- 1 Click  > Open > Project and in the left pane of the Open dialog, click the Training Files icon.
- 2 Open Metric > Family Editor > m Sample Project.rvt.
- 3 In the Project Browser, expand Views (Discipline) > Electrical > Power > Floor Plans, and double-click 1 - Power.
- 4 Select the VAV box.



- 5 Click Modify Mechanical Equipment tab > Family panel > Edit Family.
- 6 Click Yes when prompted to open the family for editing.
- 7 Click Create tab > Family Properties panel > Types.
- 8 In the Family Types dialog, under Parameters, click Add.
- 9 In the Parameter Properties dialog, select the Shared parameter option, and click Select.
- 10 In the Shared Parameters dialog, for Parameter group, select MEP.

NOTE

The MEP group was created in the *Modifying a Fan Family* tutorial and the parameters created in that tutorial are listed under Parameters. If this is not the case, go back and complete the previous *Modifying a Fan Family* tutorial.

- 11 Click Edit.
- 12 In the Edit Shared Parameters dialog, for Parameter group, select MEP.
- 13 Under Parameters, click New.
- 14 In the Parameter Properties dialog:
 - For Name, enter **Apparent Power Phase 1**.
 - For Discipline, select Electrical.
 - For Type, select Power.

15 Using the same method, create the following additional shared parameters as defined below:

| Name | Discipline | Type |
|------------------------|------------|---------|
| Apparent Power Phase 2 | Electrical | Power |
| Apparent Power Phase 3 | Electrical | Power |
| Electric Heat Power | Electrical | Power |
| Motor On Phase | Common | Integer |

16 Click OK.

17 In the Shared Parameters dialog, select Apparent Power Phase 1, and click OK.

18 In the Parameter Properties dialog, under Parameter Data, for Group parameter under, select Electrical Engineering, select the Instance option, and click OK.

Apparent Power Phase 1 is added as an instance parameter under the Electrical Engineering group in the Family Types dialog. Instance parameters have (default) appended to the parameter name.

19 In the Family Types dialog, under Parameters, click Add.

20 In the Parameter Properties dialog, select the Shared parameter option, and click Select.

21 In the Shared Parameters dialog, select Apparent Power Phase 2, and click OK.

22 In the Parameter Properties dialog, under Parameter Data, for Group parameter under, select Electrical Engineering, select the Instance option, and click OK.

23 Using the same method, add the following shared parameters to the family type, as defined below:

| Name | Group parameter under | Instance/Type |
|------------------------|------------------------|---------------|
| Apparent Power Phase 3 | Electrical Engineering | Instance |
| Electric Heat Power | Electrical Engineering | Instance |
| Motor FLA | Electrical Engineering | Type |
| Motor HP | Electrical Engineering | Type |
| Motor On Phase | Electrical Engineering | Instance |
| Number of Poles | Electrical Engineering | Type |
| Phase | Electrical Engineering | Type |
| Voltage | Electrical Engineering | Type |

24 In the Family Types dialog, verify that M_Size 2 - 150mm Inlet is selected for Name.

25 Now you will specify formulas for parameters that you created. Formulas are case sensitive. Use the same case for the names in formulas as the names entered when you created the parameters.

In the Formula column, specify formulas for the following parameters:

■ For Voltage, enter **480**.

■ For Phase, enter **3**.

- For Apparent Power Phase 1, enter **Electric Heat Power / 3 + if(Motor On Phase = 1, Motor FLA * 277 V, 0 VA)**.
- For Apparent Power Phase 2, enter **Electric Heat Power / 3 + if(Motor On Phase = 2, Motor FLA * 277 V, 0 VA)**.
- For Apparent Power Phase 3, enter **Electric Heat Power / 3 + if(Motor On Phase = 3, Motor FLA * 277 V, 0 VA)**.

26 Under Electrical Engineering, in the Value column, specify the following parameter values for the M_Size 2 - 150 mm Inlet VAV:

- For Number of Poles, enter **3**.
- For Motor On Phase, enter **1**.
- For Motor HP, enter **1/6**.
- For Motor FLA, enter **1.3**.

27 Under Family Types, click New.

28 In the Name dialog, enter **M_Size 3 - 200mm Inlet**, and click OK.

29 In the Family Types dialog, in the Value column, specify the following parameters for the M_Size 3 - 200mm Inlet type:

- For Number of Poles, enter **3**.
- For Motor On Phase, enter **1**.
- For Motor HP, enter **1/4**.
- For Motor FLA, enter **2.2**.

30 Using the same method, create additional types, and specify the parameters for each size listed below:

| Name | Number of Poles | Motor On Phase (Default) | Motor HP | Motor FLA |
|------------------------|-----------------|--------------------------|----------|-----------|
| M_Size 4 – 250mm Inlet | 3 | 1 | 1/3 | 2.9 |
| M_Size 5 – 300mm Inlet | 3 | 1 | 1/2 | 3.2 |
| M_Size 6 – 350mm Inlet | 3 | 1 | 3/4 | 5.4 |

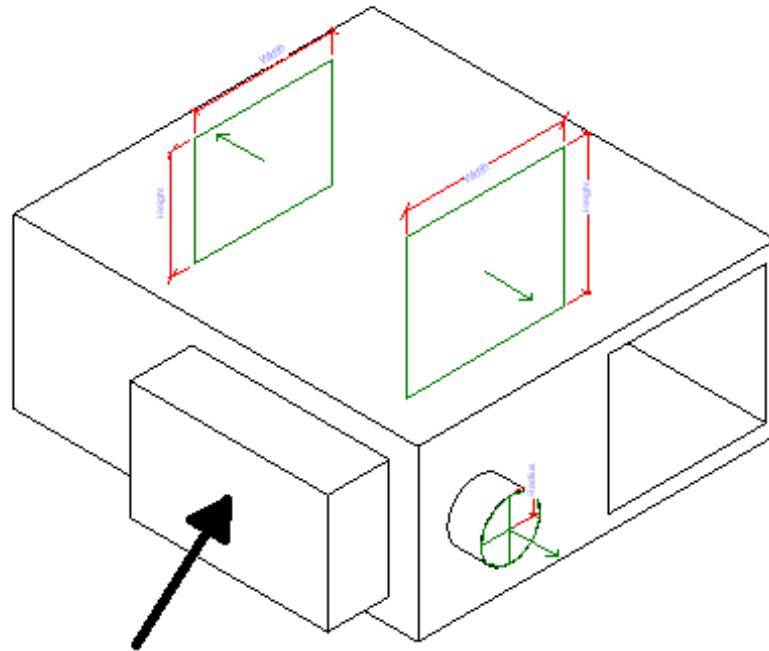
31 Click OK to close the Family Types dialog.

32 Save the family as M_Parallel Fan Powered VAV.rfa.

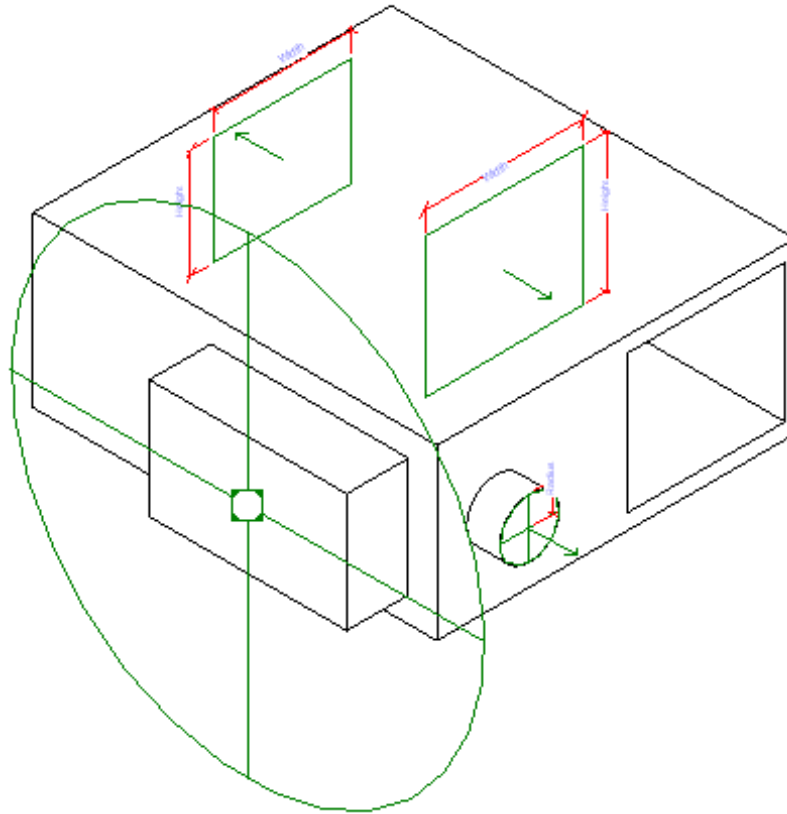
Place connector and map parameters

Now you will add an electrical connector and specify its shared parameters.

33 Click and drag the view cube to spin the model around so you can see the controls box as shown.



- 34** Click Create tab ► Connectors panel ► Electrical Connector.
- 35** Click Place Electrical Connector tab ► Placement panel ► Face.
- 36** On the Options Bar, select Power - Unbalanced.
- 37** Highlight the large face on the controls box, and click to add the connector on the face.













38 Click Place Electrical Connector tab ► Selection panel ► Modify to end the command.

39 Select the connector.

40 Click Modify Connector Element tab ► Element panel ► Element Properties drop-down ► Instance Properties.

41 In the Instance Properties dialog, specify values for the following parameters:

- For Number of Poles, click  in the  column, and in the Associate Family Parameter dialog, select Number of Poles, and click OK.
- For Voltage, click  in the  column, and in the Associate Family Parameter dialog, select Voltage, and click OK.
- For Apparent Load Phase 1, click  in the  column, and in the Associate Family Parameter dialog, select Apparent Power Phase 1, and click OK.
- For Apparent Load Phase 2, click  in the  column, and in the Associate Family Parameter dialog, select Apparent Power Phase 2, and click OK.
- For Apparent Load Phase 3, click  in the  column, and in the Associate Family Parameter dialog, select Apparent Power Phase 3, and click OK.
- For Load Classification, enter **HVAC**.
- For System Type, verify that Power - Unbalanced is selected.

42 Click OK to close the Instance Properties dialog.

43 Save the family.

Test the family

Now you will load the family into a sample project and test the shared parameters.

44 Click Create tab ► Family Editor panel ► Load into Project.

45 If prompted, select Override the existing version and its parameter values.

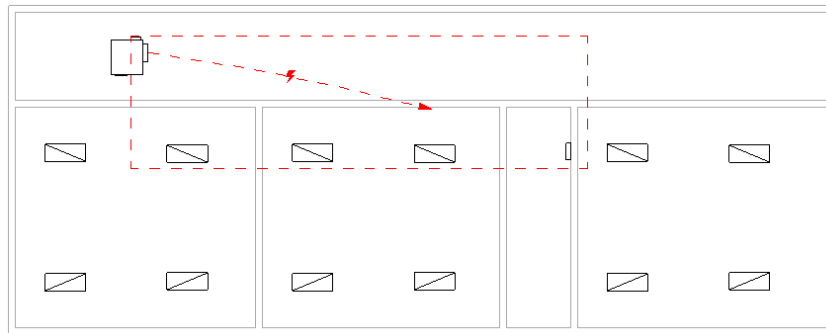
The Sample Project is activated in the drawing area.

46 In the Project Browser, expand Views (Discipline) ► Electrical ► Power ► Floor Plans, and double-click 1 - Power.

47 Select the VAV box, and click Modify Mechanical Equipment tab ► Create Systems panel ► Power.

48 Click Modify Electrical Circuits tab ► System Tools panel ► Select Panel.

49 On the Options Bar, for Panel, select panel HA.



50 Select the VAV box, and click Modify Electrical Equipment tab ► Element panel ► Element Properties drop-down ► Instance Properties.

51 Verify that Parallel Fan Powered VAV : M_Size 2 - 150mm Inlet is selected in the Type Selector.

52 In the Instance Properties dialog, specify the following parameters:

- For Motor On Phase, enter **1**.
- For Electric Heat Power, enter **3000**.

53 Click OK.

54 Select panel HA.

55 Click Modify Electrical Equipment tab ► Electrical panel ► Circuits.

The loads on phases A, B, and C are 1360, 1000, and 1000, respectively.

56 Click OK.

57 Select the VAV box.

58 Click Modify Electrical Equipment tab ► Element panel ► Element Properties drop-down ► Instance Properties.

59 In the Instance Properties dialog, for Type, select M_Size 6 – 350mm Inlet, and specify the following parameters:

- For Motor On Phase, enter **2**.
- For Electric Heat Power, enter **11000**.

60 Click OK.

61 Select panel HA.

62 Click Modify Electrical Equipment tab ► Element panel ► Element Properties drop-down ► Type Properties.

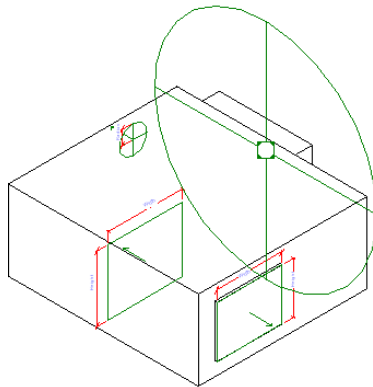
The loads on phases A, B, and C have updated to 3667, 4027, and 3667, respectively.

63 Click OK.

Specify Flow Configuration for the VAV

64 Click View tab ► Windows panel ► Switch Windows ► M_Parallel Fan Powered VAV.rfa.

65 Use the view cube in the upper right corner of the view to spin the model around so you can see the air supply connector, as shown.



66 Select the supply air connector, and click Modify Connector Element tab ► Element panel ► Element Properties drop-down ► Instance Properties.

67 In the Instance Properties dialog, under Mechanical, verify that Calculated is selected for Flow Configuration.

When the Flow Configuration for the connector is set to Calculated, the air flow value for SupplyAirflow is the aggregate air flow for the downstream components.

68 Click OK.

69 Click Modify Connector Element tab ► Family Editor panel ► Load into Project.

70 If prompted, select Override the existing version and its parameter values.

The Sample Project is activated in the drawing area.

Create a supply air system

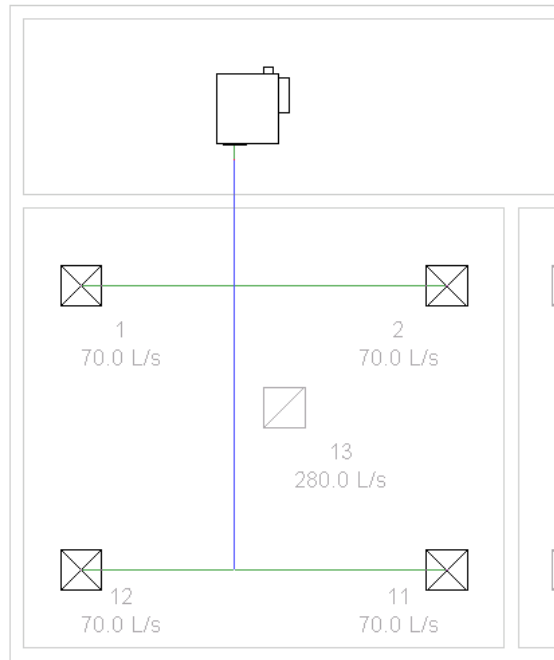
Now you will connect the VAV box to supply air terminals to create a supply air duct system and specify its settings.

71 In the Project Browser, expand Views (Discipline) ► Mechanical ► HVAC ► Floor Plans, and double-click 1 - Mech.

72 Select the 4 supply air terminals in the left room, and click Modify Air Terminals tab ► Create Systems panel ► Supply.

73 Click Modify Duct Systems tab ► System Tools panel ► Select Equipment, and in the drawing area, select the VAV box.

74 Click Modify Duct Systems tab ► Layout panel ► Generate Layout.



75 On the Options bar, click Settings.

76 In the Duct Conversion Settings dialog, verify the following Main and Branch settings:


Main

- For Duct Type, verify that Rectangular Duct: Mitered Elbows/Taps is selected.
- For Offset enter **3750 mm**.

Branch

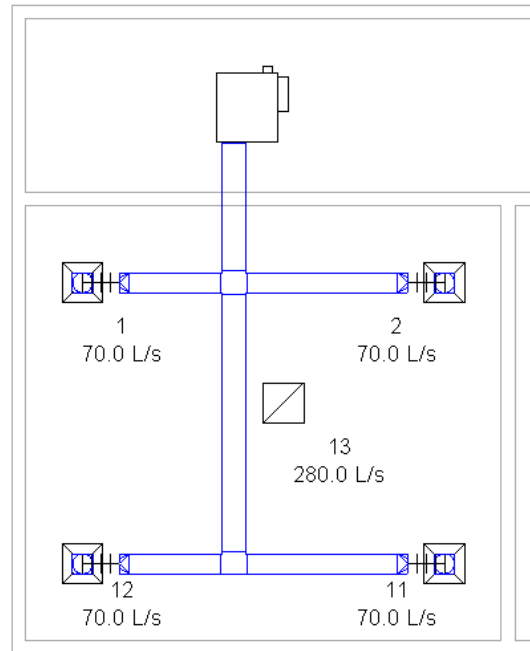
- For Duct Type, verify that Rectangular Duct: Mitered Elbows/Taps is selected.
- For Offset enter **3750 mm**.
- For Flex Duct Type, verify that Flex Duct Round : Flex - Round is selected.
- For Maximum Flex Duct Length, enter **1800 mm**.

77 Click OK.

78 On the Options bar, verify that Network is selected for Solution Type, and click  to select layout 6 of 6. an

79 Click Generate Layout tab ► Generate Layout panel ► Finish Layout.

Ductwork is created for the selected solution.



80 Click Analyze tab ► System Browser panel ► System Browser.

81 In the System Browser, expand Mechanical (1 systems) ► Supply Air ► M_Parallel Fan Powered VAV: M_Size 2 - 150 mm Inlet VAV.

82 Right-click Mechanical Supply Air 1, and select Properties.

83 In the Instance Properties dialog, scroll down to Mechanical Airflow, and notice that the SupplyAirFlow parameter value is 280 L/s.

Because the Flow Configuration for the connector is set to Calculated, the air flow value for SupplyAirflow is the sum of the air flow for the downstream air terminals—in this case 280 L/s (4 X 70 L/s).

84 Click OK.

85 Double-click a tag associated with one of the air terminals supplied by the VAV, enter **100**, and press *Enter* to modify the air flow for the air terminal.

86 Again, right-click Mechanical Supply Air 1, and select Properties.

87 In the Element Properties dialog, scroll down to Mechanical Airflow and notice that the SupplyAirFlow parameter value is updated to 310 L/s, the new sum of the air flow for the downstream air terminals.

88 Click OK.

The Preset and System settings for Flow Configuration are used together to allow specifying a percentage of the system flow to be allocated to each downstream component. This allows specifying a different portion of the system flow to each downstream subsystem. When Flow Configuration is set to System, the Flow Factor parameter is active. The Flow Factor parameter is specified as a value between 0 and 1, with the total for all downstream components equal to 1.

For example, a boiler may have its supply preset to 70 L/s (system supply = 70 L/s) and the connectors at 2 downstream zone valves set to System, but one with 0.4 specified for Flow and the other with 0.6 specified for Flow. In this case the first downstream zone would receive a flow of 28 L/s (0.4 X 70 L/s), and the other would receive a flow of 42 L/s (0.6 X 70 L/s). Using

the combination of Preset and System settings on connectors lets you distribute flow according to the demands of a particular space.

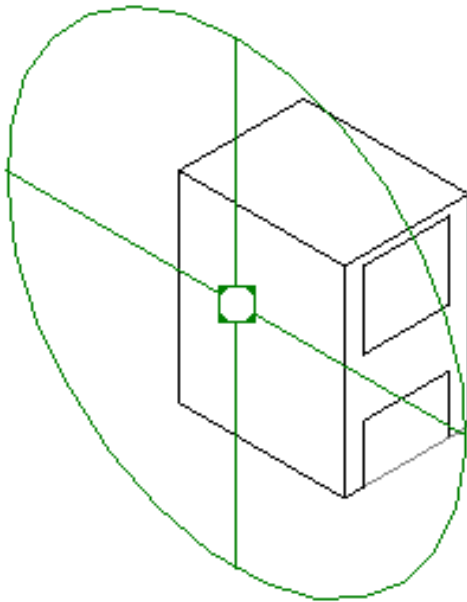
NOTE Because Flow Factor and Flow Configuration are properties of the connector, all instances of the family in a project will have the same factor. To create unequal percentages for several downstream subsystems, you must create 2 additional instance parameters for the component family, and then map the Flow Factor to the value specified for each instance of the component used in the project.

89 Close the Family and m Sample Project files.

Modifying Electrical Equipment Families

7

In this tutorial, you modify existing electrical equipment families to create new families, and then you use the new families in a project. In the first section, you modify a 208V/3Ph panel to create a 240V/3Ph family. Then in the following section, you modify a 480V/3Ph primary transformer to create a 480V/1Ph to 240V/1Ph secondary transformer as shown here.




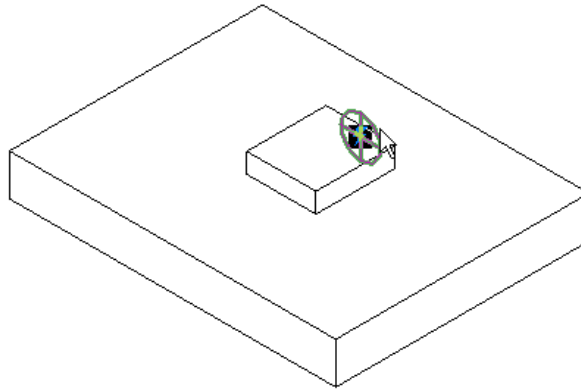
Skills used in this tutorial:



- Modifying existing panel and transformer families to create new families
- Loading, inserting, and connecting components of the newly created families in a simple project

Modifying Electrical Equipment Families

Open and modify an existing panel family


- 1 Click  ➤ Open and in the left pane of the Open dialog, click the Training Files icon.
- 2 Open Metric ➤ Family Editor ➤ M_Lighting and Appliance Panelboard - 208V MCB - Surface.rfa.
- 3 In the Project Browser, expand Views (all) ➤ 3D Views, and double-click {3D} to make it the active view.
- 4 In the drawing area, select the connector.



- 5 Click Modify Connector Element tab ➤ Element Properties drop-down ➤ Instance Properties.
- 6 In the Instance Properties dialog, under Electrical - Loads, specify values for the following parameters:
 - For Number of Poles, enter **2**.
 - For Voltage, enter **240**.
- 7 Click OK.
- 8 Click  ➤ Save As ➤ Family.
- 9 In the Save As dialog, navigate to a folder of your choice and save the family as **M_Lighting and Appliance Panelboard - 240V MCB - Surface.rfa**.
- 10 Click  ➤ Close.

Modify an existing transformer family

Now you will modify an existing transformer by changing its properties and then resaving it to create a new family.

- 11 Click  ➤ Open.
- 12 In the left pane of the Open dialog, click the Training Files icon.
- 13 Open Metric ➤ Family Editor ➤ M_Dry Type Transformers - 480-208-120V - NEMA Type 2.rfa.
- 14 Click Create tab ➤ Family Properties panel ➤ Types.
- 15 For Name, select 112.5 kVA.
- 16 Under Family Types, click Delete.
- 17 Using the same method, delete all of the remaining types, except for 15 kVA.

Next, you modify an existing family type.

18 In the Family Types dialog, for Name, verify that 15 kVA is selected.

19 Under Electrical, for Primary Number of Poles, enter **2**.

20 Click Apply.

Next, you create a new family type.

21 Under Family Types, click New.

22 In the Name dialog, for Name, enter **3 kVA**, and click OK.

Notice that the new family type is selected for Name.


23 Under Electrical, verify the following:

- Primary Voltage is 480.00 V.
- Primary Number of Poles is 2.

24 Under Dimensions, do the following:

- For Length, enter **165 mm**
- For Height, enter **265 mm**
- For Width, enter **220**

25 Click OK.

26 Click  ► Save As ► Family.

27 In the Save As dialog, navigate to a folder of your choice and save the family as **M_Single Phase Transformer - 480V Primary.rfa**.

28 Click  ► Close.

Load the new panel and transformer families into a project

Now you will place the modified families into a project file.

29 Click  ► Open.

30 In the left pane of the Open dialog, click the Training Files icon.

31 Open Metric ► Family Editor ► m Simple Room.rvt.

32 Click Home tab ► Electrical panel ► Electrical Equipment.

33 Click Place Equipment tab ► Model panel ► Load Family.

34 In the Open dialog, navigate to the folder where you saved the new families, then while pressing **CTRL**, select M_Lighting and Appliance Panelboard - 240V MCB - Surface.rfa and M_Single Phase Transformer - 480V Primary.rfa, and click Open.

The new families are loaded into the project and the project becomes active.

TIP You can verify that the electrical families were loaded by expanding Families ► Electrical Equipment in the Project Browser.

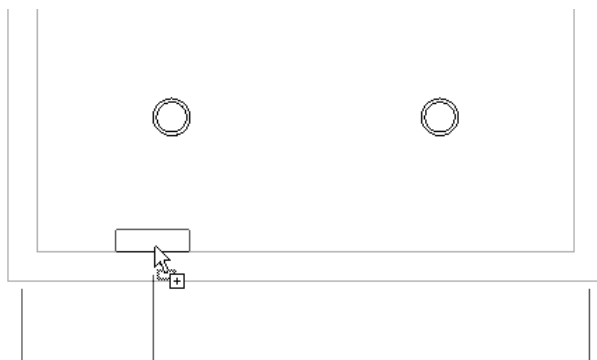
Test the new electrical equipment in a project

35 In the Project Browser, expand Views (Discipline) ► Electrical ► Power ► Floor Plans, and double-click 1 - Power to make it the active view.

36 Click Home tab ► Electrical panel ► Electrical Equipment.

37 Click **Place Equipment** tab ► **Element** panel drop-down and select **M_Lighting and Appliance Panelboard - 240V MCB - Surface : M_100A**.

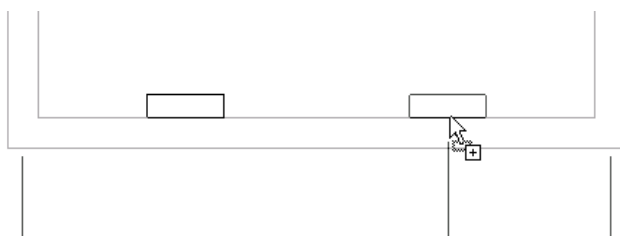
38 Move the cursor over the wall, and after the panel snaps to the inside face of the wall, click to place the panel on the wall as shown.



NOTE The panel is a wall-hosted family—it can only be placed on a wall.

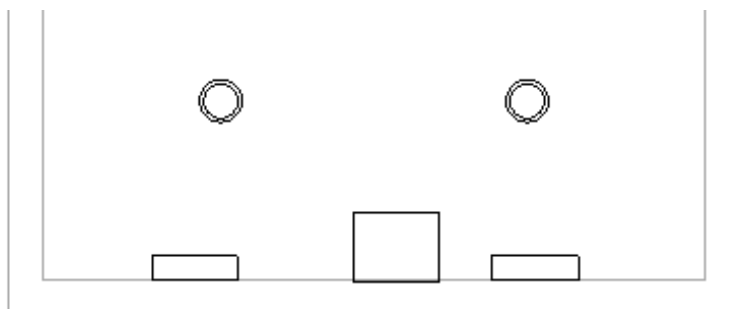
39 Using the same method, do the following:

- Place a **M_Lighting and Appliance Panelboard 480V MLO : 125A** panel on the wall to the right of the first panel.



TIP You can press *Spacebar* to rotate a family if placement seems difficult.

- Place a **M_Single Phase Transformer - 480V Primary : 15kVA** transformer on the wall between the panels.



40 Click **Modify** to end the command.

Create a system

Now you will create a system to logically connect the panels to the transformer.

41 Select the **M_Lighting and Appliance Panelboard 480V MLO : 125A** panel.

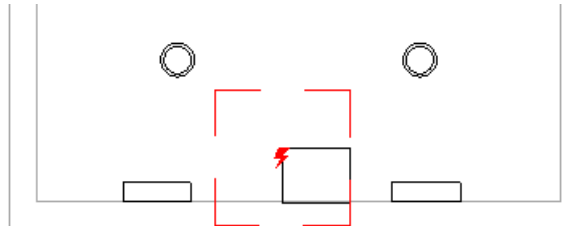
42 On the **Options Bar**, for **Distribution Sys**, select **480/277 Wye**.

- 43 Click Modify Electrical Equipment tab ► Element panel ► Element Properties drop-down ► Instance Properties.
- 44 In the Instance Properties dialog, under Electrical - Loads, for Panel Name, enter **DP**, and click OK.

Create a new distribution system

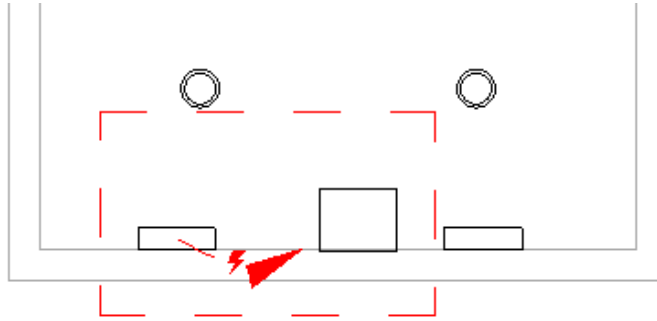
Electrical panels and transformers must be configured for a distribution system before they can be used with circuits. Now you will create a new distribution system and then specify its properties.

- 45 Click Manage tab ► Project Settings panel ► MEP Settings drop-down ► Electrical Settings.
- 46 In the left pane of the Electrical Settings dialog, select Distribution Systems.
- 47 Click Add.
- A new row is added in the right pane.
- 48 In the right pane, do the following:
- For Name, enter **480 Wye**.
 - For Phase, verify that Single is selected.
 - For Wires, select 3.
 - For L-L Voltage, select 480.
 - L-G Voltage, select 277.
- 49 Click OK.
- 50 In the drawing area, select the Single Phase Transformer.
- 51 Click Modify Electrical Equipment ► Element panel ► Element Properties drop-down ► Instance Properties.
- 52 In the Instance Properties dialog, under Electrical - Loads, do the following:
- For Secondary Distribution System, select 120/240 Single.
 - For Panel Name, enter **T-LC**.
 - For Distribution System, select 480 Wye.
 - Click OK.
- 53 In the drawing area, select the transformer.
- Notice that 480 Wye is selected for Distribution Sys on the Options Bar. This indicates that the transformer is associated with that distribution system.
- 54 With the transformer selected, click Modify Electrical Equipment tab ► Create Systems panel ► Power to create a new circuit.
- 55 Click Modify Electrical Circuits ► System Tools panel ► Select Panel.
- 56 On the Options bar, for Panel, select DP.
- The DP panel is logically connected to the transformer.



- 57** Select the M_Lighting and Appliance Panelboard - 240V MCB - Surface : M_100A panel.
- 58** On the Options Bar, for Distribution Sys, select 120/240 Single.
- 59** Click Modify Electrical Equipment tab ► Element panel ► Element Properties drop-down ► Instance Properties.
- 60** In the Instance Properties dialog, under Electrical - Loads, for Panel Name, enter **LC**, and click OK.
- 61** Select the M_Lighting and Appliance Panelboard - 240V MCB - Surface : M_100A (LC) panel.
- 62** Click Modify Electrical Equipment tab ► Electrical panel ► Power to create a new circuit.
- 63** Click Modify Electrical Circuits ► System Tools panel ► Select Panel.
- 64** On the Options Bar, for Panel, select T-LC.

This creates a logical circuit between the LC panel to the transformer.

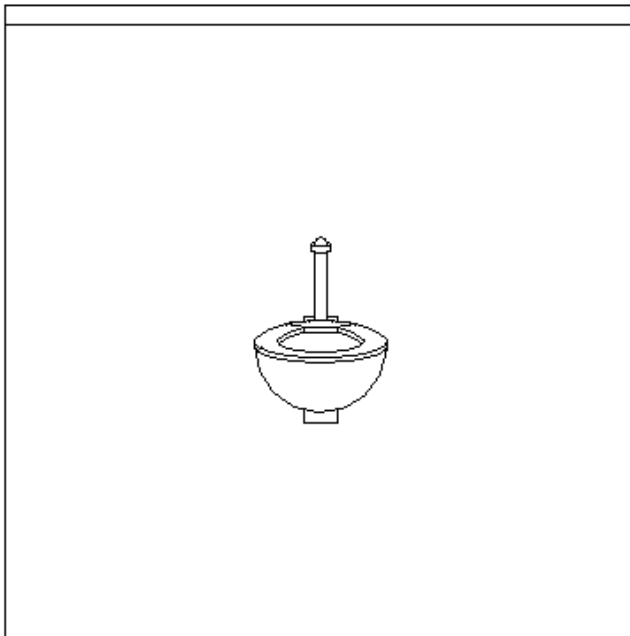


- 65** Close the Simple Room without saving.

Modifying a Toilet Family

8


In this tutorial, you modify a commercial toilet family. You add piping connectors to a wall-hosted toilet family, and set typical connector properties for domestic cold water and sanitary systems.



Skills used in this tutorial:

- Hiding wall element to modify a wall-hosted component
- Adding connectors to a family
- Setting connector properties for a system

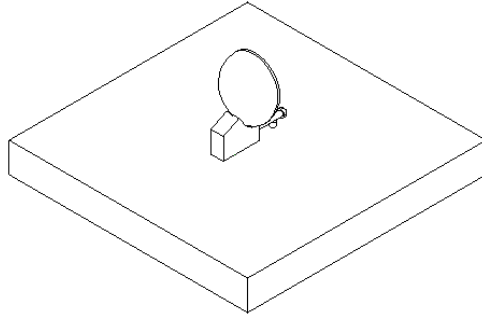
Modifying a Toilet Family

1 Click  ► Open and in the left pane of the Open dialog, click the Training Files icon.

2 Open Metric ► Family Editor ► **M_Commercial - Toilet - Wall Mount Flush Valve.rfa**.

The family opens in the Family Editor.

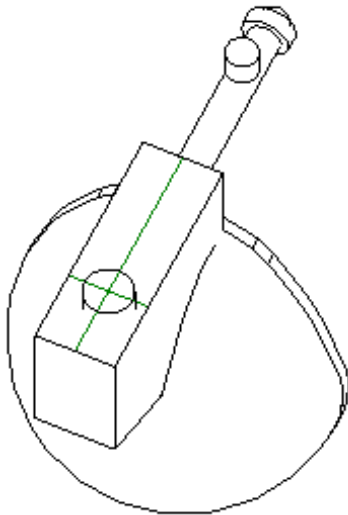
3 The toilet is a wall-hosted component, and the extrusion that represents the wall is visible in the view. However, you will be working at the back of the toilet, so you must hide the wall in the view.



Select the wall, and on the View Control Bar, click  (Temporary Hide/Isolate) ► Hide Element.

4 On the View Control Bar, click  (Model Graphics Style) ► Hidden Line.

5 Use the view cube in the upper right corner of the view to orient the model as shown here.

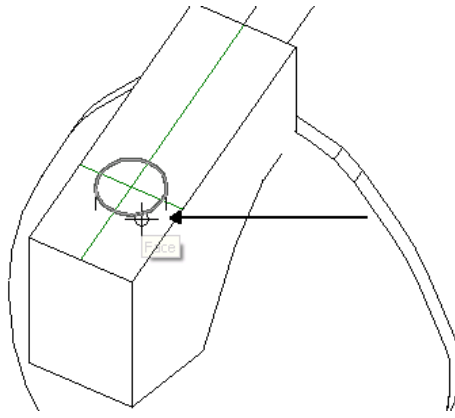


6 Click Create tab ► Connectors panel ► Pipe Connector.

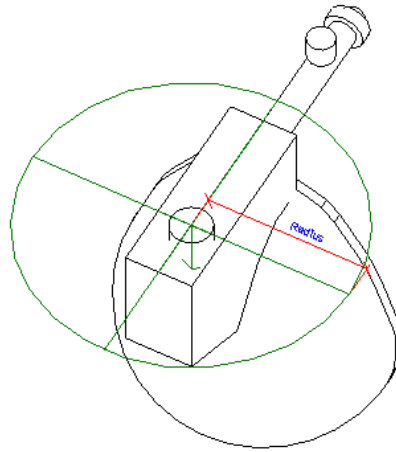
7 On the Options Bar, for System Type, select Sanitary.

8 On the Placement panel, verify that Face is selected.


9 Zoom in, and move the cursor over the larger of the 2 round extrusions at the back of the toilet as shown, highlight the round face, and click to add the connector.



10 Click Modify to end the command.



11 Select the connector.

12 If the arrow is pointing in toward the toilet bowl, click  so that the connector direction is pointing away from the bowl.

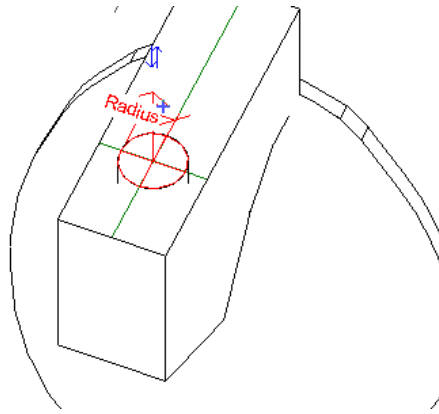
The arrow indicates the connector direction, not the flow direction. The connector direction determines the direction from which it will accept connections from other components.

13 Click Modify Connector Element tab ► Element panel ► Element Properties drop-down ► Instance Properties.

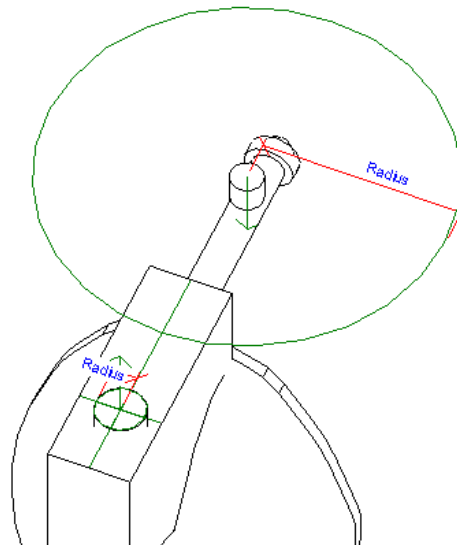
14 In the Instance Properties dialog, specify values for the following parameters:

- For Flow Configuration, select **Fixture Units**.
- For Flow Direction, select **Out**.
- Select **Allow Slope Adjustments**
- For Fixture Units, enter **4**.
- For Radius, enter **40 mm**.

15 Click OK.



16 Using the same method, add a Domestic Cold Water system Piping Connector, in the location shown, and click Modify. Ensure that you set the system in the Options bar.



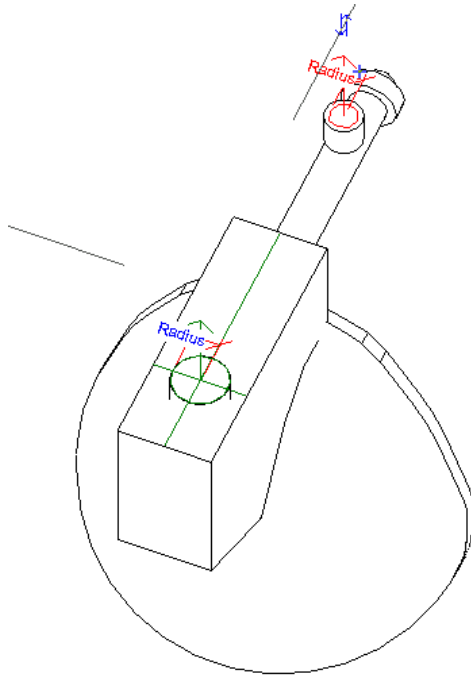
17 Select the connector, click  to specify connector direction.


18 Click Modify Connector Element tab ► Element panel ► Element Properties drop-down ► Instance Properties.

19 In the Instance Properties dialog, specify values for the following parameters:



- For Flow Direction, select **In**.
- For Flow Configuration, select **Fixture Units**.
- Clear **Allow Slope Adjustments**
- For Fixture Units, enter **2.5**.
- For Radius, enter **20 mm**.

20 Click OK.



- 21 Click  ► Save As ► Family, and in the Save As dialog, navigate to a folder of your choice and save the family as **M_Toilet - Commercial Wall Mount Flush Valve.rfa**.

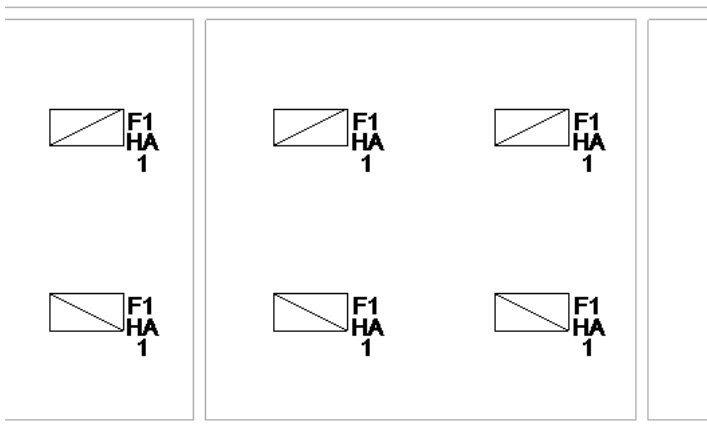
Load the toilet family into a project

- 22 Click  ► Open ► Project.
- 23 In the left pane of the Open dialog, click the Training Files icon.
- 24 Open  Imperial ► Family Editor ► i Sample Project.rvt.
- 25 Click View tab ► Window panel ► Switch Windows ► Metric ► Family Editor **M_Commercial - Toilet - Wall Mount Flush Valve.rfa** to make the family the active view.
- 26 Click Create tab ► Family Editor panel ► Load into Project.
- 27 The i Sample project displays in the drawing area.
- 28 In the Project Browser, expand Views (Discipline) ► Plumbing ► Floor Plans, and double-click 1 - Plumbing.
- 29 Click Home tab ► Plumbing & Piping panel ► Plumbing Fixture.
- 30 Click Place Plumbing Fixture tab ► Element panel ► Type Selector drop-down ► Toilet - Wall Mount Flush Valve.
- 31 Click Plumbing Fixture tab ► Placement panel ► Place on Vertical Face.
- 32 Move the cursor over a wall, and click to place the toilet on the wall.
- 33 Right-click a pipe connector and click Draw Pipe to verify that the connector works as expected.
- 34 Close the Sample project without saving.

Modifying a Light Fixture Annotation Tag Family

9

In this tutorial, you modify a light fixture tag family to include panel and circuit information. Then you load the revised tag into a sample project.




Skills used in this tutorial:

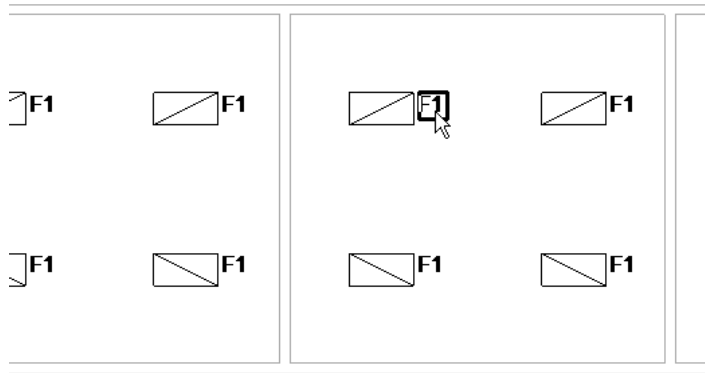
- Adding parameters to labels
- Loading label family into sample project

Modifying a Light Fixture Annotation Tag Family



- 1 Click  ► Open and in the left pane of the Open dialog, click the Training Files icon.
- 2 Open Metric ► Family Editor ► m Sample Project.rvt.
- 3 In the Project Browser, expand Views (Discipline) ► Electrical ► Lighting ► Floor Plans, and double-click 1 - Lighting.

4 In the drawing area, select a light fixture tag.



5 Click Modify Lighting Fixture Tags tab ► Family panel ► Edit Family, and click Yes when asked to open the light fixture tag for editing.

The Family Editor opens.

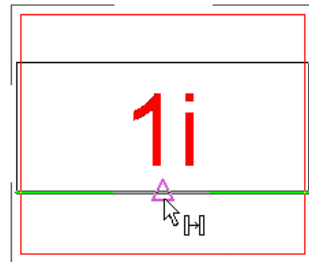
The light fixture tag is composed of a label that is associated with a parameter.

6 In the drawing area, select the 1i label.

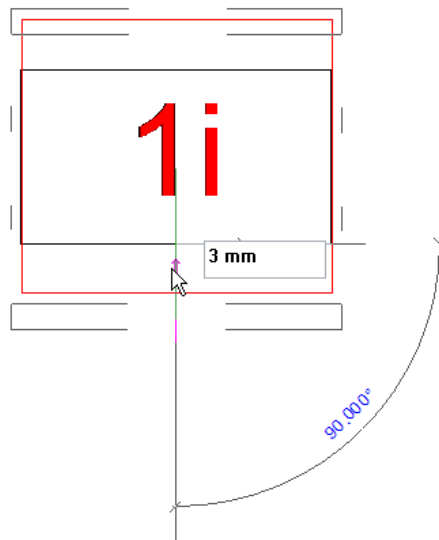
7 Click Modify Label tab ► Modify panel ► Copy.

8 On the Options Bar, click Multiple.

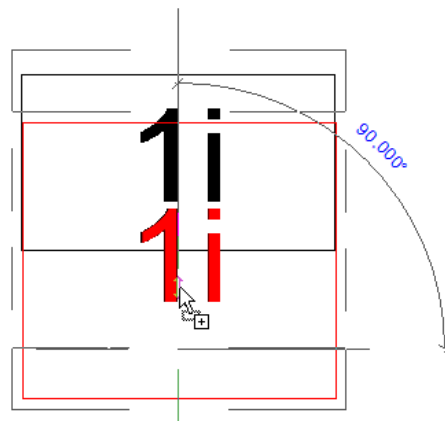
9 Click the midpoint of the label to specify the copy start point.



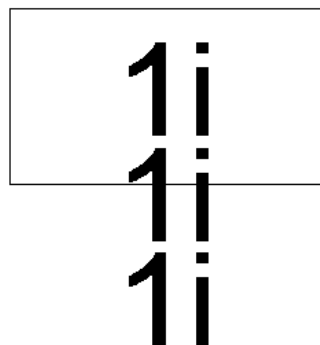
10 Move the cursor straight down, and after listening dimensions display, enter **3 mm**, and press *Enter* to specify the copy end point.



The label is copied.

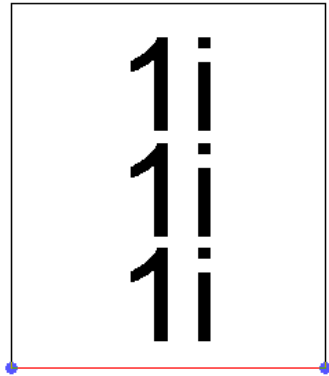
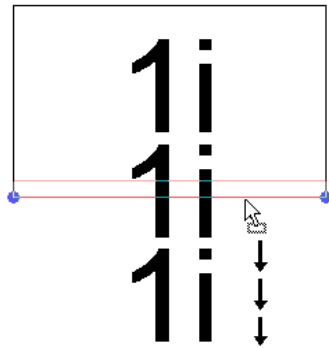


11 Repeat the previous steps to create a second copy of the label.




12 Notice that the bounding box contains only the first label. You need to modify this box.


13 Select the bottom line of the box, and drag it down so that the box contains all 3 labels.



Next, you modify 2 labels.

14 Select the middle label, and click Modify Label tab ► Label panel ► Edit Label.

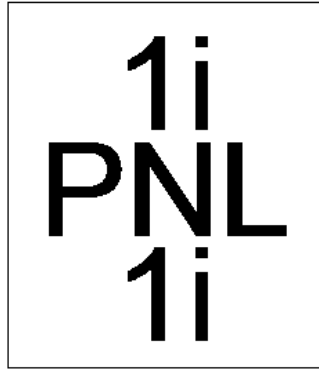
15 In the Edit Label dialog, under Label Parameters, select Type Mark, and click  (Remove parameter from label).

16 Under Category Parameters, select Panel, and click  (Add parameter to label).



17 Under Label Parameters, for the Panel parameter, enter **PNL** in the Sample Value column.
The sample value is the text that identifies this label in the Family Editor.

18 Click OK.

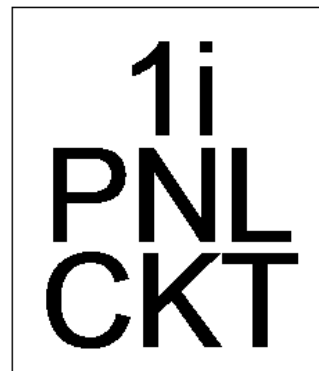
The middle label text changes to PNL and the label is associated with the Panel parameter.



19 Using the same method, modify the bottom label with the following Edit Label dialog:

- Under Label Parameters, select Type Mark, and click  (Remove parameter from label)
- Under Category Parameters, select Circuit Number, and click  (Add parameter to label).
- For the Circuit Number parameter, enter **CKT** in the Sample Value column.

The 3 light fixture labels are as shown.



Load the light fixture tag family into a project

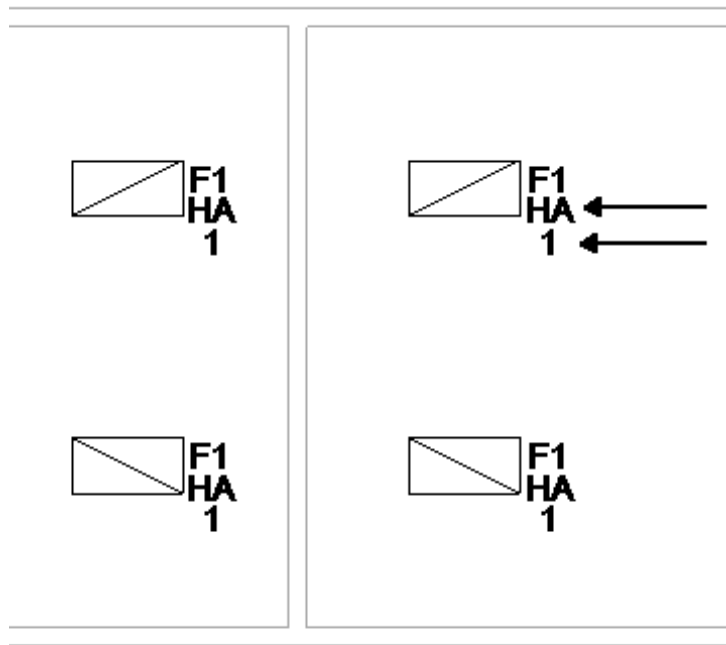
Now you will load the family into a sample project and verify that the tags update to correspond with the changes to the tag family.


20 Click Create tab ➤ Family Editor panel ➤ Load into Project.


If more than one project is open, in the Load into Projects dialog, select m Sample Project.rvt, and click OK.

21 If prompted, select Override the existing version and its parameter values.

The Sample Project is activated in the drawing area, and the light fixture tags update to display the panel and circuit information.



22 Click  ➤ Close as you do not need to save the project.

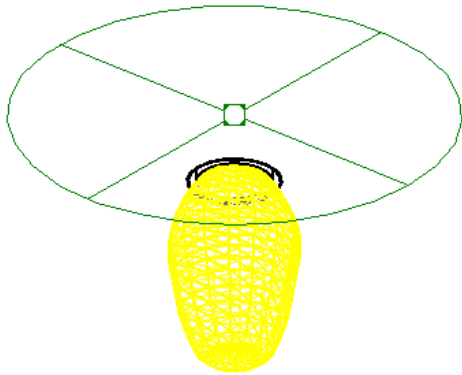
23 Click  ➤ Close again to close the tag family, without saving.

Creating a Light Fixture Family

10

In this tutorial, you create an ceiling hosted recessed downlight.

Completed ceiling hosted recessed downlight



Skills used in this tutorial:

- Creating a lighting family from a template
- Placing IES files for use by lighting families
- Defining family and connector properties

Creating a Light Fixture Family

Locate IES data file

When creating a lighting family, you can specify an .ies file. This file contains engineering data that can be used to calculate the coefficient of utilization of the fixture. The .ies file is not used for rendering. Lighting manufacturers often allow you to download .ies files from the Web for their fixtures.

- 1 Using Windows Explorer, navigate to the Family Editor folder and copy the Ltl9815.ies file, and paste it into the <install_path>\RME 2010\IES folder. (This is the location from which the .ies files are retrieved if Revit MEP is installed in the default path.)

NOTE If Revit MEP was not installed in the default path, you must determine the correct path to the IES file as defined by the IESFileLocation parameter in the Revit.ini file (within the <install_path>\RME2010\Program folder).

Create a new lighting family

There are various light fixture family templates available in Revit MEP. If you expect to render your lighting designs, it is important that you start your lighting family with one of these templates, as they have reference planes that define the location of the light source. For more information on reference planes, see [Understanding the Family Editor](#) on page 12. For generic (Lighting Fixture*.rft) and linear (Linear Lighting Fixture*.rft) lighting templates, these planes are Light Source Axis (F/B), Light Source Axis (L/R), and Light Source Elevation. For spot light templates (Spot Lighting Fixture*.rft), these planes are Light Source Axis (L/R), Tilt Plane, and Light Source Elevation. Each family has additional parameters depending on whether it is a linear fixture, a spot fixture, or a generic fixture.

2 Click  ► New ► Family.

3 In the New Family - Select Template File dialog, navigate to the Metric Templates folder, select Metric Linear Lighting Fixture ceiling based.rft, and click Open.
The Family Editor opens.

4 Click Manage tab ► Family Properties panel ► Category and Parameters.

NOTE Family Category and Parameters settings determine the component type and provide a set of parameters that affect its behavior within Revit MEP. See Help for a complete list of Revit MEP categories and parameters.

5 In the Family Category and Parameters dialog, under Family Category, select Lighting Fixtures.

6 Under Family Parameters, verify that:

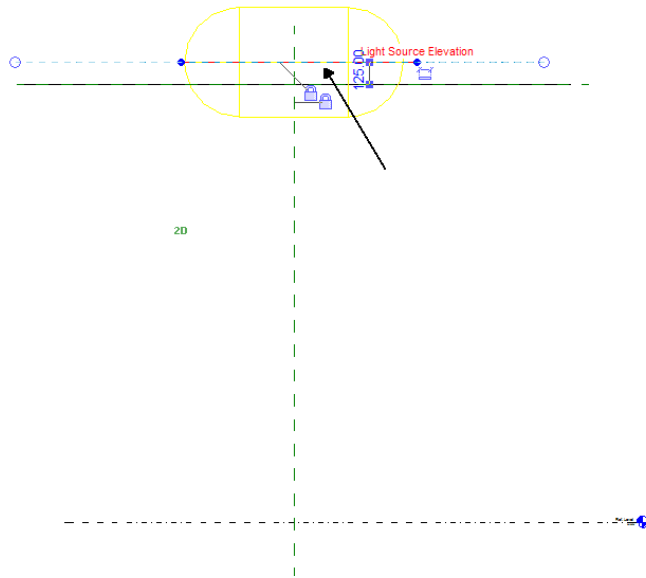
- Always Vertical is selected.
- Light Source is selected.
- For Part Type, Normal is selected.
- Shared is deselected.


7 Click OK.

8 In the Project Browser, expand Views (all) ► Elevations (Elevation 1), and double-click Front.

TIP You may want set the scale to 1 : 5 and zoom in very close to create the Solid ► Revolve.

9 Select the Light Source Elevation Plane, and drag it up to a point 75 mm above the Basic Ceiling and Ceiling Plane as shown.



10 Click  ► Save As ► Family.

11 In the Save As dialog, navigate to a folder of your choice and save the family as **200mm Open Downlight 42w TRT.rfa**, and click OK.

Define the fixture geometry

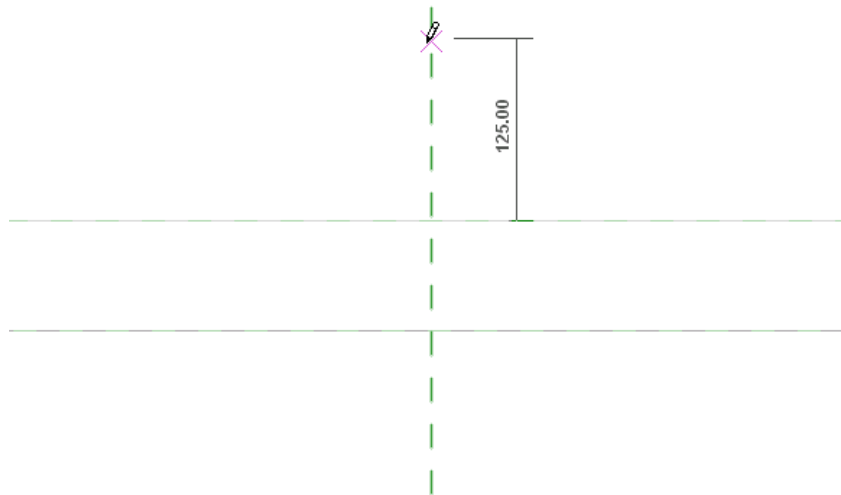
12 Click Create tab ► Forms panel ► Solid drop-down ► Revolve.

13 Click Create Revolve tab ► Draw panel ► Line.

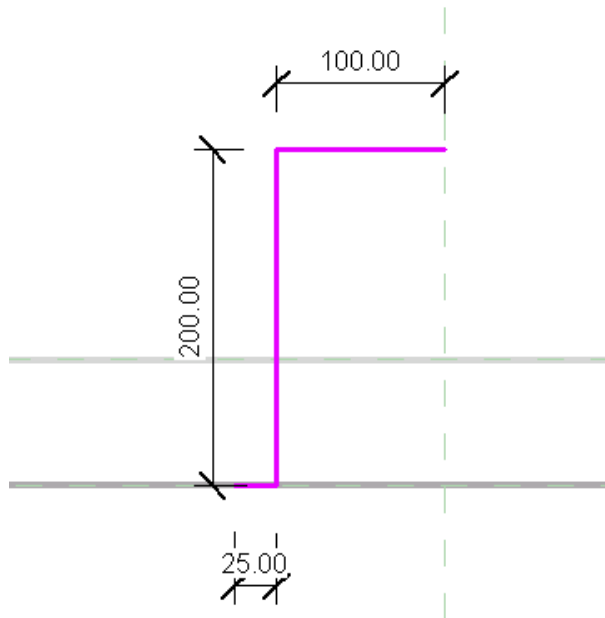
14 On the Options Bar, click Chain, and for Offset, specify 0.0.

15 Zoom in on the Light Source Elevation, and sketch the shape of the fixture as shown.

Starting at the Center (Left/Right) vertical reference plane, 125 mm above the Light Source reference plane, draw a 100 mm horizontal line to the left of the center.



16 Then draw a vertical line segment down to the ceiling (200 mm), and finish with a 25 mm horizontal line segment to the left.



17 On the Selection panel, click Modify to end the command.

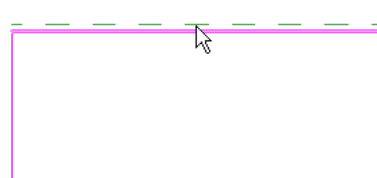
Next you will duplicate the original outline, offset by 1.5 mm to define the thickness of the light fixture housing.

18 Click Create tab ► Forms panel ► Solid drop-down ► Revolve.

19 On the Draw panel, click Pick Lines.

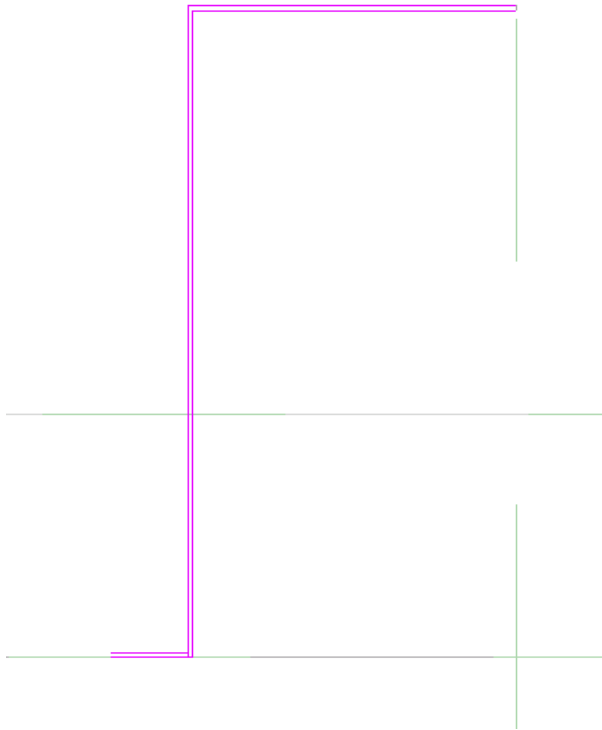
20 On the Options Bar, for Offset, enter **1.5 mm**.

21 Click just above the upper horizontal line to add a line **1.5 mm** above the existing line as shown.



22 Using the same method, click just to the left of the vertical line and just above the lower horizontal line to define the thickness for the fixture as shown.

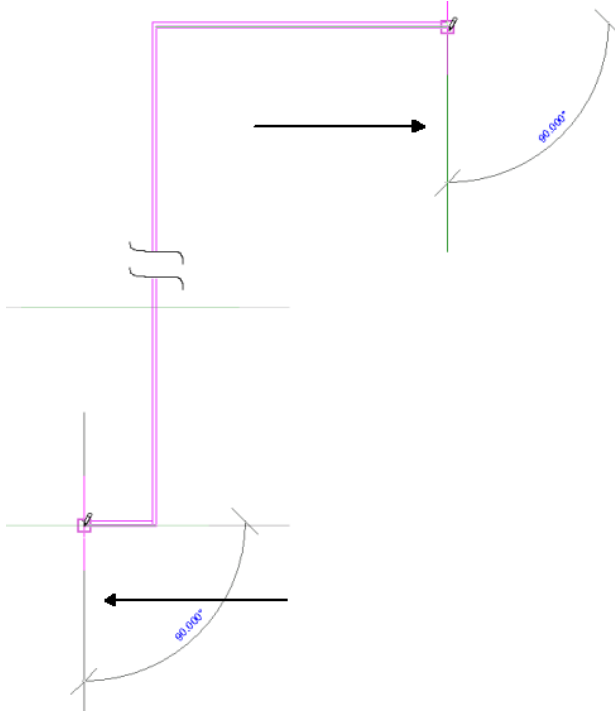
TIP If you have difficulty selecting the short horizontal line at the base, move the cursor over the line, press *Tab* to highlight the short line, then click just above the line.



23 On the Draw panel, click Line.

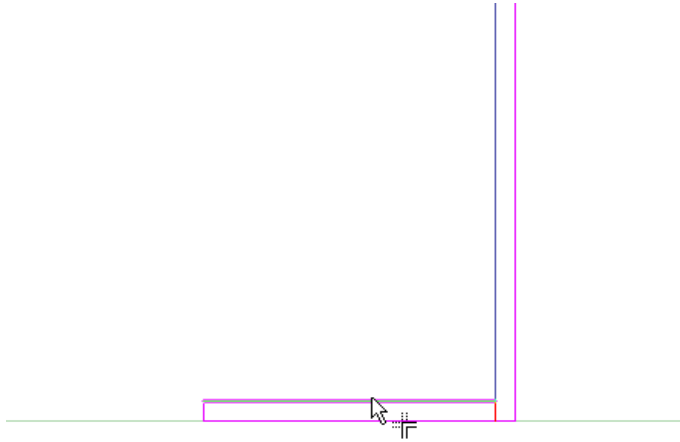
24 On the Options Bar, clear Chain, and for Offset, enter 0.0.

25 Draw lines to close the outline at the top right and lower left as shown.

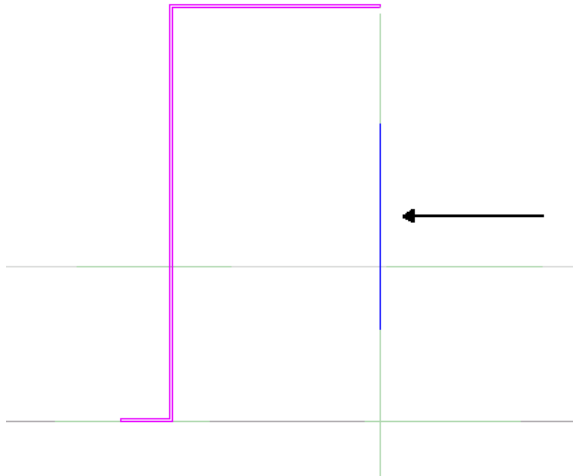


26 On the Selection panel, click Modify to end the command.

27 On the Edit panel, click Trim, and clean up the inside corner as shown.

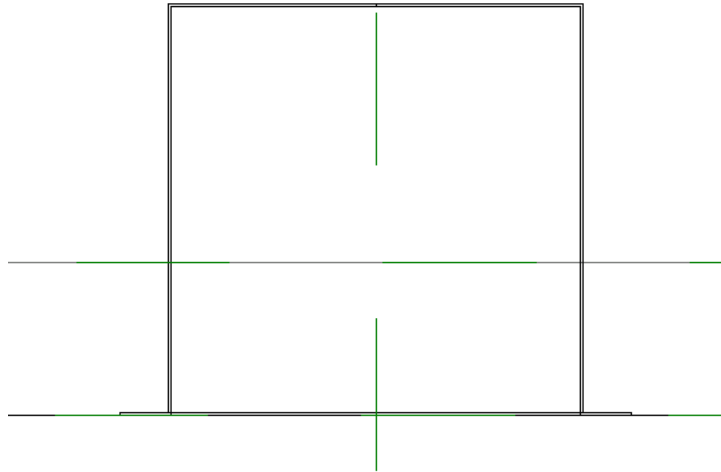


28 On the Draw panel, click Axis Line, and sketch the axis line for the revolve as indicated below by the dark line.



The length of the line and its exact location are not important, but make sure it is coincident with the vertical plane.

29 Click Finish Revolve.





30 Save the family.

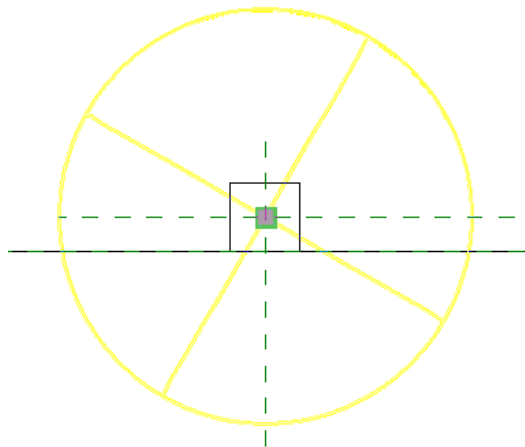
Define family and connector properties

Connectors allow Revit MEP connect to participate in specific systems and facilitate load calculations your design. Connector properties determine the behavior of the connector for the discipline it is assigned to.

31 In the drawing area, select the (yellow) Light Source.

32 Click Modify Light Source tab ► Lighting panel ► Light Source Definition.

33 In the Light Source Definition dialog, for Emit from Shape, click  (Point), for Light distribution, click  (Photometric Web), and click OK.



34 Click Modify Light Source tab ► Family Properties panel ► Types.

35 In the Family Types dialog, specify values for the following parameters:

Under Electrical - Lighting

- Select Calculate Coefficient of Utilization.


Under Electrical - Loads

- For Apparent Load, enter **44.21 VA**.

Under Electrical

- For Lamp, enter **CF42TRT**.

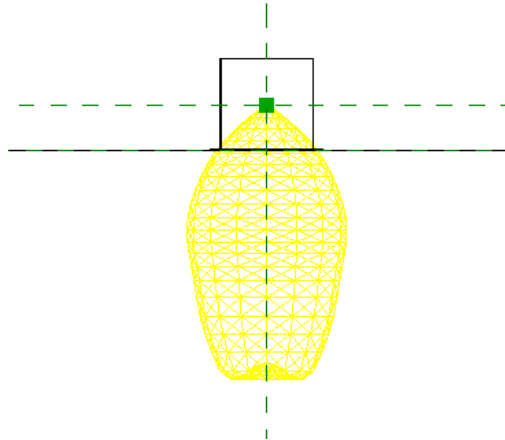
Under Photometrics

- For Tilt Angle, enter **90**.
- For Photometric Web File, click the Value column, click , and select M_Lt19815.ies in the file browser.
- For Light Loss Factor, click the Value column, and in the Light Loss Factor dialog, click Simple for Method, enter **0.85** for Value, and click OK.
- For Initial Intensity, click the Value column, and in the Initial Intensity dialog, click Luminous Flux, enter **3200**, and click OK.
- For Initial Color, click the Value column, and in the Initial Color dialog, for Color Preset, select <Custom>, for Color Temperature, enter **3000 K** and click OK.

A fixture's Coefficient of Utilization may be calculated based on the geometry of the space, or a static value may be entered. Lighting objects in a space contribute to the room's Average Estimated Illumination. This illumination is based on the lumen method using the total lumen output of the lighting fixtures in the room, and is affected by the following fixture properties:

- Coefficient of Utilization (Instance)
- Initial Intensity (Type)
- Light Loss Factor (Type)

36 Click OK.



37 In the Project Browser, expand View (all) ► 3D Views, and double-click View 1.

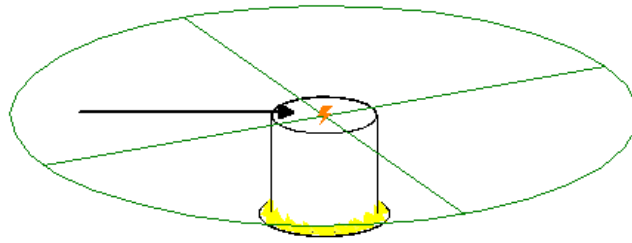
38 Use the view cube in the upper right corner of the view to spin the model to view the top of the fixture.



39 Click Create tab ► Connector tab ► Electrical Connector.

40 On the Options Bar, select Power - Balanced.

41 Click Place Electrical Connector tab ► Placement tab ► Face.


- 42 Highlight the face at the top of the fixture, and click to place the connector on the top of the fixture.

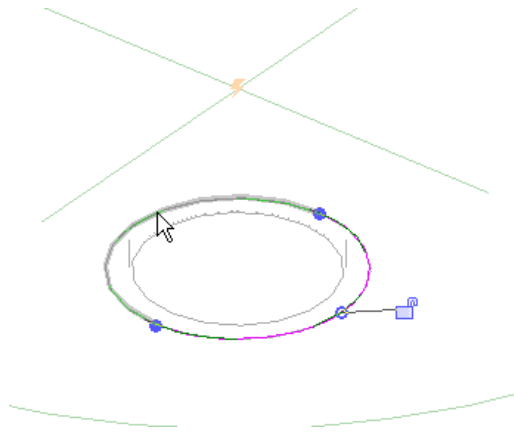


- 43 On the Selection panel, click Modify to end the command.
- 44 Select the connector, and click Modify Connector Element tab ► .Element panel ► Element Properties.
- 45 In the Instance Properties dialog, specify values for the following parameters:
- For Power Factor, enter **0.95**
 - For System Type, verify that **Power - Balanced** is specified
 - For Apparent Load, click  in the  column, and in the Associated Family Parameter dialog, select Apparent Load from the list, and click OK.
 - For Voltage, enter **277**
 - For Load Classification, select **Lighting**
- 46 Click OK.
- 47 Save the family.


Cut a hole in the ceiling

Next you cut a hole in the ceiling. Although the hole is not necessary for construction documents, it permits light to function as expected in renderings. (Light at the intersection of planes is able to pass through the ceiling.)

- 48 In the Project Browser, expand Views (all) ► 3D Views, and double-click View 1.
- 49 Spin the model to view the bottom of the ceiling.
- 50 Select the yellow Light Source, and on the View Control Bar, click  (Temporary Hide/Isolate), and select Hide Element.
- 51 Click Create tab ► Model panel ► Opening.
- 52 On the Draw panel, click Pick Lines, and select the 2 arcs that make up the outside edge of the trim ring as shown.



53 Click Finish Opening.

54 On the View Control Bar, click  (Temporary Hide/Isolate), and select Reset Temporary Hide/Isolate.

55 Save the family.

Test the light fixture in a project

Load the light fixture family into a project and test it to verify the correct component behavior.

56 Click  ► Open.

57 In the left pane of the Open dialog, click the Training Files icon.

58 Open Metric ► Family Editor ► m Simple Room.rvt.

59 In the Project Browser, expand Views (Discipline) ► Electrical ► Lighting ► Ceiling Plans, and double-click 1 - Ceiling Elec.

The space tag indicates 212 lx and 135 W.

60 Click View tab ► Windows panel ► Switch Windows drop-down ► 200 mm Open Downlight 42w TRT.rfa to return to the Family Editor and make the family the active view.

61 Click Manage tab ► Family Editor panel ► Load into Project.

The new lighting fixture is loaded into the current project.

62 On the Selection panel, click Modify to end the command.

Next you change the existing lighting fixtures to the new lighting fixture.

63 Select the 4 downlights in the room, and on the Element panel, in the Type Selector, select 200 mm Open Downlight 42w TRT.rfa.

The lighting level increases to 325 lx, and the wattage increases to 168 W.

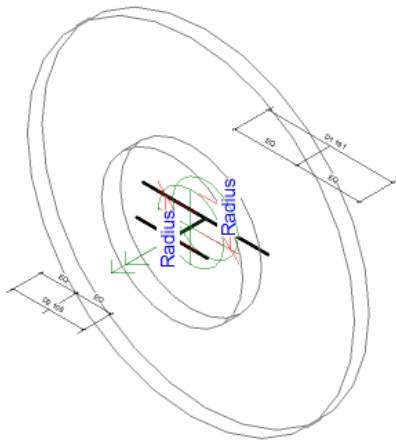
64 Add additional light fixtures as desired.

Creating a Flange Family

11

In this tutorial, you will create a flange connector to model pipe flanges for model coordination. The flange will be based on a 1 Mpa pressure class slip on flange, and uses a Lookup Table to define several sizes for the flange.

Completed flange



Lookup tables are used to define parameter values in an external .csv file. This lets you specify multiple part sizes that are based on a table without creating a separate family type for each size. Revit MEP provides a `text_file_lookup` function that can be used to read the necessary values from a comma-separated values (.csv) file. The location of Lookup Table files is defined by the `LookupTableLocation` parameter in the `Revit.ini` file.

The `M_Generic 1 Mpa Slip Flange.csv` file defines multiple sizes for this flange. When installed in the default path, Revit MEP looks in `C:\Documents and Settings\All Users\Application Data\Autodesk\RME 2010\LookupTables` (Windows XP users) or `C:\Program Data\Autodesk\RME2010\LookupTables` (Windows Vista users) to retrieve size information.


Skills used in this tutorial:

- Creating a flange family from a template
- Adding connectors
- Using a lookup table

Creating a Flange Family

Create a new flange family

There are various family templates available in Revit MEP. To create the flange family, you will use the Generic Model template. The Generic Model template is a standalone template that is used for components that are not host-dependent.

- 1 Click  ► New ► Family.
- 2 In the New Family - Select Template dialog, navigate to the Metric Templates folder, select Metric Generic Model.rft, and click Open.
The Family Editor opens.
- 3 Click Manage tab ► Family Properties panel ► Category and Parameters.

NOTE Family Category and Parameters settings determine the component type and provide a set of parameters that affect its behavior within Revit MEP. See Help for a complete list of Revit MEP categories and parameters.

- 4 In the Family Category and Parameters dialog, under Family Category, select Pipe Fittings.
- 5 Specify the following settings under Family Parameters:
 - Clear Work Plane-Based.
 - Select Always Vertical.
 - For Part Type, select Transition.
 - Clear Shared.

- 6 Click OK.

- 7 Click  ► Save As ► Family.

- 8 In the Save As dialog, navigate to a folder of your choice and save the family as **M_Generic 1 Mpa Slip Flange.rfa**.

NOTE Be sure to save the family with the same name as the Lookup Table file name specified in the next step.

Use a lookup table file to define multiple sizes

A lookup table file is a CSV (comma separated value) text file that contains pipe size information. Revit MEP uses this pipe size information to define pipe fitting size after you specify a pipe diameter. Lookup tables are not used to determine pipe sizes as a result of using the Pipe Sizing tool—these pipe sizes are determined by various project-specific factors.

- 9 Using Windows Explorer, navigate to the Family Editor folder and copy the M_Generic 1 Mpa Slip Flange.csv lookup table file, and paste it into the <install path>\RME 2010\LookupTables folder. (This is the location from which the LookupTable files are retrieved if Revit MEP is installed in the default path.)

NOTE If Revit MEP was not installed in the default path, you must determine the correct path to the Lookup Table file as defined by the LookupTableLocation parameter in the Revit.ini file (within the <install_path>\RME2010\Program folder).

Create family parameters

Each family has a set of properties (parameters) that includes labeled dimensions and their values. You can also add values for standard parameters of the family (such as material, model, manufacturer, type mark, and others).

- 10 Click Create tab ► Family Properties panel ► Types.
- 11 In the Family Type dialog, under Parameters, click Add.
- 12 In the Parameter Properties dialog, verify that Family parameter is selected for Parameter Type and specify the following parameter data:
 - For Name, enter **NR**.
 - For Discipline, select Piping.
 - For Type of Parameter, select Pipe Size.
 - For Group parameter under, select Dimensions.
 - Select Type.
- 13 Click OK.
- 14 Using the same method, create Instance parameters named D1, D2, LenA1, LenA2, LenA3, ND, R1, R2 and specify the following parameters for each one:
 - For Parameter Type, select the Family parameter option.
 - For Discipline, select Piping.
 - For Type of Parameter, select Pipe Size.
 - For Group parameter under, select Dimensions.
 - Select the Instance option.
- 15 In the Family Types dialog, in the Value column, specify the following:
 - Under Dimensions, for NR (default), enter **150 mm**.
 - Under Other, for Lookup Table Name, enter **M_Generic 1 Mpa Slip Flange.csv**.
 - Click Apply.
- 16 In the Family Types dialog, in the Formula column, specify the following under Dimensions:
 - For ND, enter **NR * 2**.
 - For R1, enter **D1 / 2**.
 - For R2, enter **D2 / 2**.
 - For LenA3, enter **LenA2 – LenA1**.
 - For D1, enter **text_file_lookup("M_Generic 1 Mpa Slip Flange.csv", "D1", 0', ND)**.
 - For D2, enter **text_file_lookup("M_Generic 1 Mpa Slip Flange.csv", "D2", 0', ND)**.
 - For LenA1, enter **text_file_lookup("M_Generic 1 Mpa Slip Flange.csv", "LenA1", 0', ND)**.
 - For LenA2, enter **text_file_lookup("M_Generic 1 Mpa Slip Flange.csv", "LenA2", 0', ND)**.

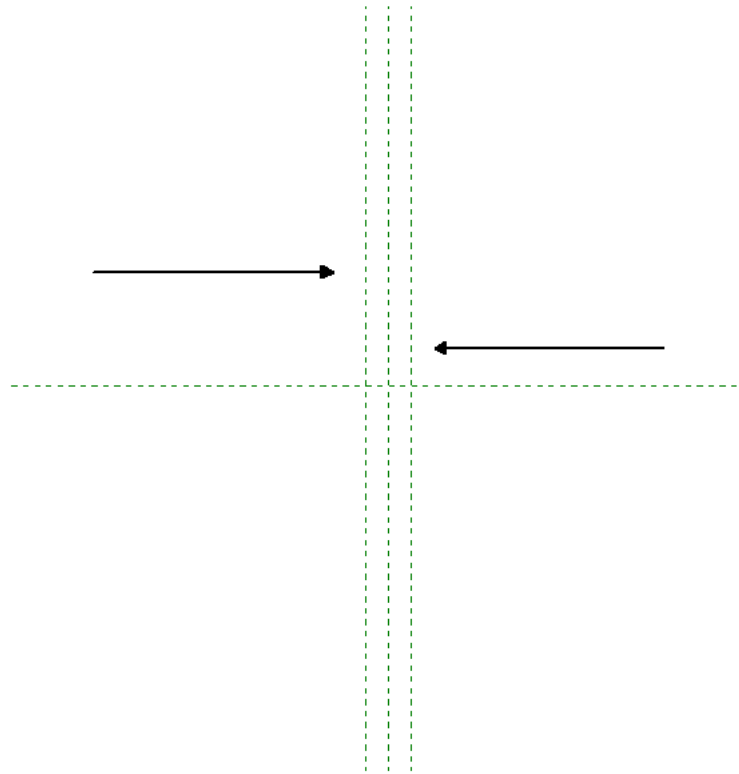
For more information on entering formulas, see [Valid Formula Syntax and Abbreviations](#) on page 56.

- 17 Click OK.
- 18 Save the family.

Define reference planes


Reference planes are used as an aid for sketching component geometry. For more information on reference planes, see [Understanding the Family Editor](#) on page 12.

- 19 In the Project Browser, expand Views (all) ► Floor Plans, and double-click Ref. Level.
- 20 Click the scale on the View Control Bar, and select 1 : 5.
- 21 Click Create tab ► Datum panel ► Reference Plane drop-down ► Draw Reference Plane.
- 22 On the Options Bar, for Offset, enter **50 mm**.
- 23 Click to the right of the Center (Left/Right) reference plane to add a reference plane 50 mm to the right of the center line.
- 24 Click again to the left of the Center (Left/Right) reference plane to add a reference plane 50 mm to the left of the center line as shown.



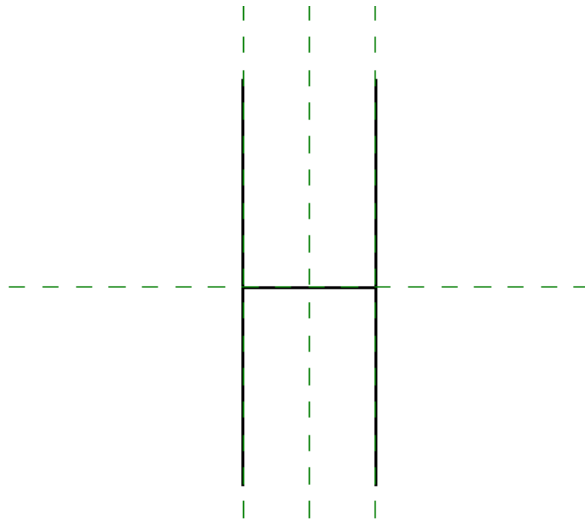
- 25 Select the left plane and, click Modify Reference Planes tab ► Element panel ► Element Properties.
- 26 In the Instance Properties dialog, under Identity Data, for Name, enter **Pipe**, and click OK.
- 27 Using the same method, enter **Connector** for the Name of the right plane.
- 28 Click Detail tab ► Dimension panel ► Aligned.
- 29 Create a dimension between the Center (Left/Right) plane and the Connector (right) plane.
- 30 Create another dimension between the Center (Left/Right) plane and the Pipe (left) plane.



- 31 Select the dimension between the Center (Left/Right) plane and right plane (Connector).
- 32 Click Modify Dimensions tab ► Element panel ► Element Properties.
- 33 In the Instance Properties dialog, under Other, click the Value column for Label, click , and select LenA1 from the list.
- 34 Using the same method, select the dimension between the left (Pipe) plane and Center (Left/Right) plane, and label it LenA2.
- 35 Select the horizontal reference plane and the 3 vertical reference planes.
- 36 Click Modify Reference Planes tab ► Element panel ► Element Properties.
- 37 In the Instance Properties dialog, under Other, for Is Reference, click the Value column, and select Not a Reference.
This option disables grips at the intersection of reference planes and specifies that the reference plane cannot be dimensioned to when you place a family into a project.
- 38 Click OK.
- 39 Save the family.

Define geometry

- 40 Click View tab ► Graphics panel ► Visibility and Appearance.
- 41 On the Model Categories tab, click Object Styles, and set the Projection Line weight of each category to 5.
- 42 Click OK twice.
- 43 Click Create tab ► Model panel ► Model Lines.
- 44 On the Options Bar, clear Chain.
- 45 Draw a vertical line on both the left (Pipe) and the right (Connector) vertical reference planes.
The length is not important, but be careful to sketch them on the reference planes.
- 46 Draw a horizontal line on the horizontal plane, between the intersections with the right and left vertical planes as shown.



47 On the Selection panel, click Modify to end the command.

48 Select the 3 model lines, and click Modify Lines tab ► Visibility panel ► Visibility Settings.

49 In the Family Element Visibility Settings dialog, clear Fine, and click OK.

NOTE Piping objects generally show as linework in Coarse and Medium view, and in Fine view the solid model elements are shown. Thus, we shut off the linework in Fine view.

50 With all 3 lines still selected, click Modify Lines tab ► Element panel ► Instance Properties.

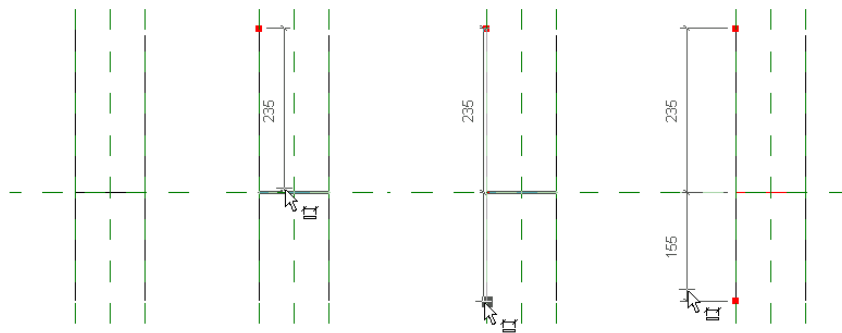
51 In the Instance Properties dialog, under Other, for Reference, click the Value column, and select Not a Reference.

52 Click OK.

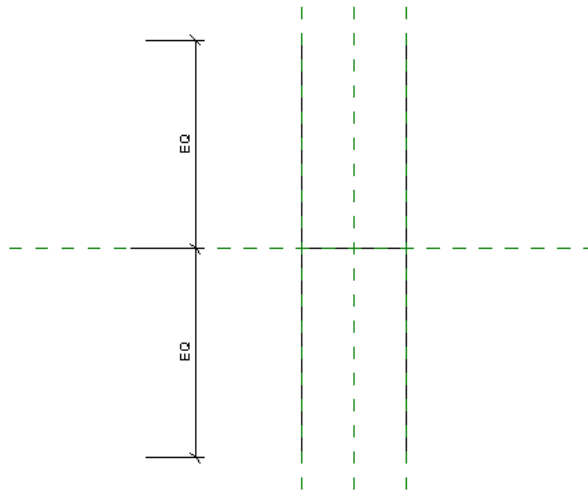
53 Click Detail tab ► Dimension panel ► Aligned.

54 Move the cursor over an endpoint on the left vertical line, press *Tab* to highlight the endpoint, and click to specify the endpoint for the dimension.

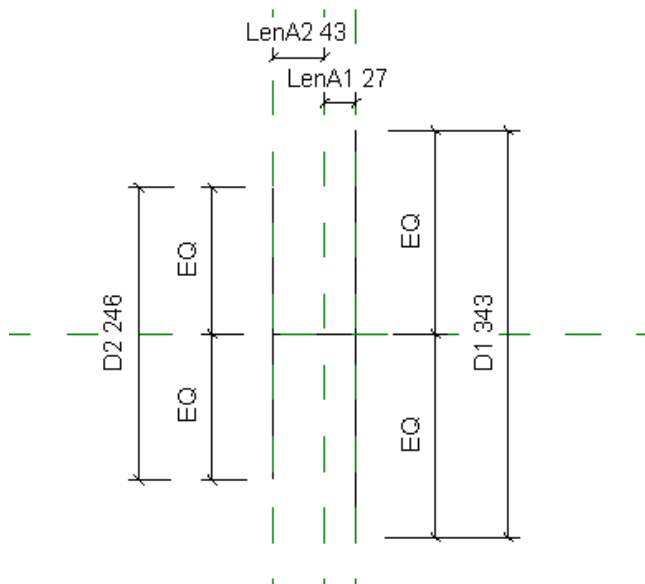
55 Select the horizontal reference plane, then select the other endpoint, move the cursor to the left, and click to place the dimension.



56 Click  .



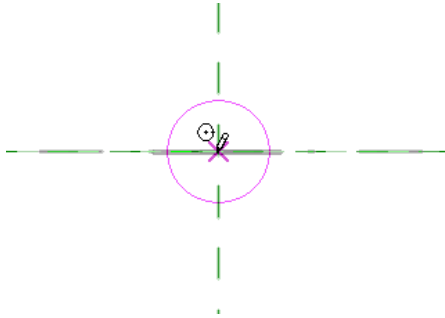
- 57 Using the same method, create dimensions for the right vertical line.
- 58 Click Detail tab ► Dimension panel ► Aligned.
- 59 Using the same method, create dimensions for the overall length of each vertical line, from endpoint to endpoint.
- 60 On the Selection panel, click Modify to end the command.
- 61 Select the dimension for the overall length of the left line, click Modify Dimension tab ► Element panel ► Element Properties.
- 62 In the Instance Properties dialog, under Other, for Label, click the Value column, and select D2.
- 63 Using the same method, select the dimension for the right line and label it D1.




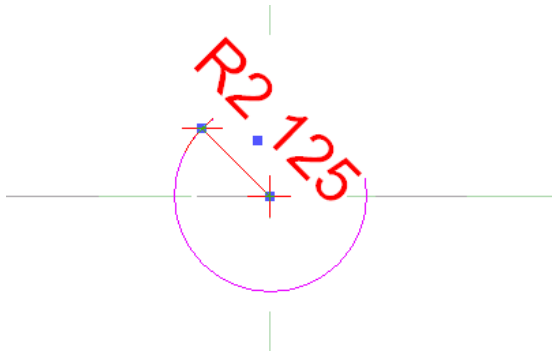
Create the first extrusion for the flange



- 64 In the Project Browser, expand Elevations (Elevation 1), and double-click Left.
- 65 Click Create tab ► Forms panel ► Solid drop-down ► Extrusion.
- 66 Click Create tab ► Work Plane panel ► Set.
- 67 In the Work Plane dialog, specify Reference Plane : Pipe, and click OK.

- 68 Click Create Extrusion tab ► Draw panel ► Circle.
- 69 On the Options Bar, click Radius, and enter **125 mm**.
- 70 Place the circle on the intersection of the horizontal and vertical reference planes.



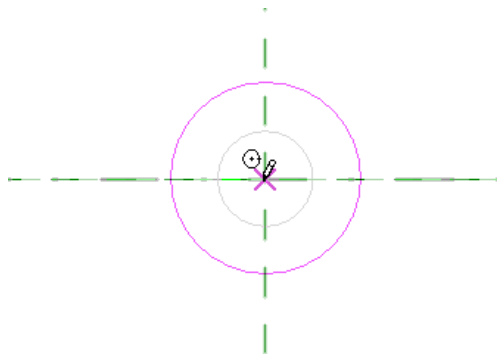
- 71 On the Selection panel, click Modify to end the command.
- 72 Select the circle, and in the drawing area, click .
- 73 Select the dimension line, click Modify Dimension tab ► Element panel ► Element Properties.
- 74 In the Instance Properties dialog, under Other, for Label, click the Value column, and select R2.
- 75 Click OK.




- 76 Click Create Extrusion tab ► Element tab ► Extrusion Properties.
- 77 In the Instance Properties dialog, under Constraints, for Extrusion End, click  in the  column.
- 78 In the Associate Family Parameter dialog, select LenA2, and click OK.
- 79 Under Graphics, for Visibility/Graphics, click Edit.
- 80 In the Family Element Visibility Settings dialog, clear Coarse and Medium, and click OK twice.
- 81 Click Finish Extrusion.

Create the second extrusion for the flange

- 82 Click Create tab ► Forms panel ► Solid drop-down ► Extrusion.
- 83 Click Create tab ► Work Plane panel ► Set.
- 84 In the Work Plane dialog, specify Reference Plane : Center (Left/Right), and click OK.
- 85 Click Create Extrusion tab ► Draw panel ► Circle.
- 86 On the Options Bar, click Radius, and enter **250 mm**.
- 87 Place the circle on the intersection of the horizontal and vertical reference planes.



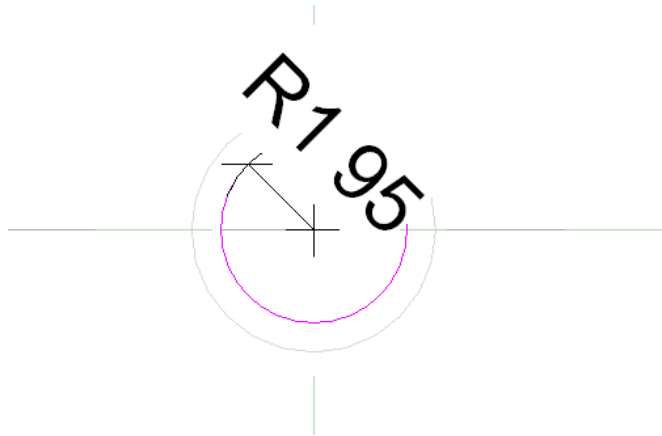
88 On the Selection panel, click Modify to end the command.

89 Select the circle, and in the drawing area, click .

90 Select the dimension line, click Modify Dimension tab ► Element panel ► Element Properties.

91 In the Instance Properties, under Other, for Label, click the Value column, and select R1.

92 Click OK.



93 Click Create Extrusion tab ► Element tab ► Extrusion Properties.

94 In the Instance Properties dialog, under Constraints, for Extrusion End, click  in the  column.

95 In the Associate Family Parameter dialog, select LenA1, and click OK.

96 Under Graphics, for Visibility, click Edit.

97 In the Family Element Visibility Settings dialog, clear Coarse and Medium, and click OK twice.

98 Click Finish Extrusion.

99 Save the family.

Add connectors and define properties

Connectors allow Revit MEP connect to participate in specific systems and facilitate load calculations your design. Connector properties determine the behavior of the connector for the discipline it is assigned to.

100 In the Project Browser, expand 3D Views, and double-click View 1.

101 Click the scale on the View Control Bar, and select 1 : 2.

102 On the View Control Bar, click  (Model Graphics Style), and select Wireframe to view both extrusions.

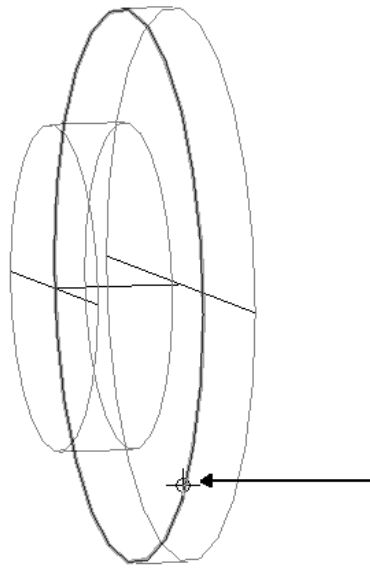
103 Spin the flange to view the face of both extrusions.

104 Click Create tab ► Connector tab ► Pipe Connector.

105 Click Place Pipe Connector tab ► Placement panel ► Place on Face.

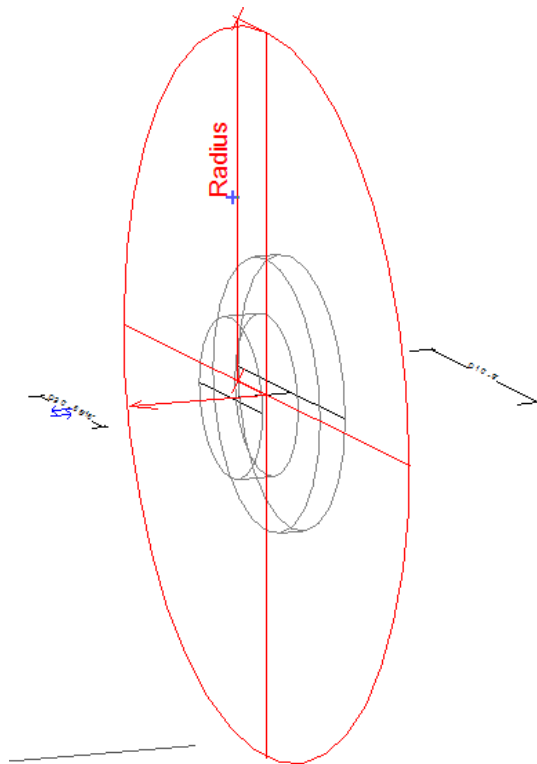
106 On the Options Bar, for System Type, select Fitting.

107 Highlight the large diameter face of the flange, where the 2 extrusions meet.




108 Click to add the connector.

Connector added to extrusion



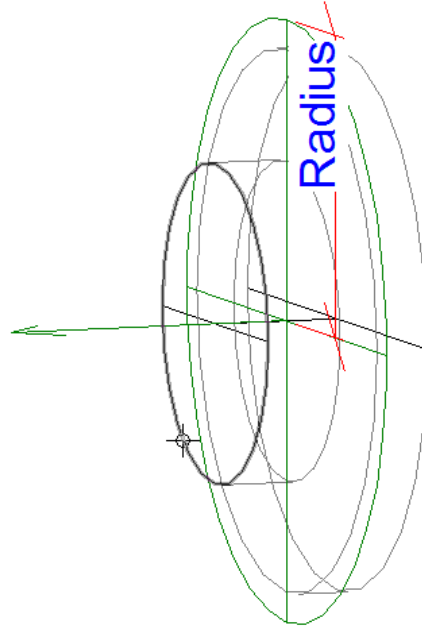
109 On the Selection panel, click Modify to end the command.

110 Select the connector, click  and, if necessary, to change the direction of flow.

The arrow indicating the connector direction should be pointing toward the smaller diameter face.

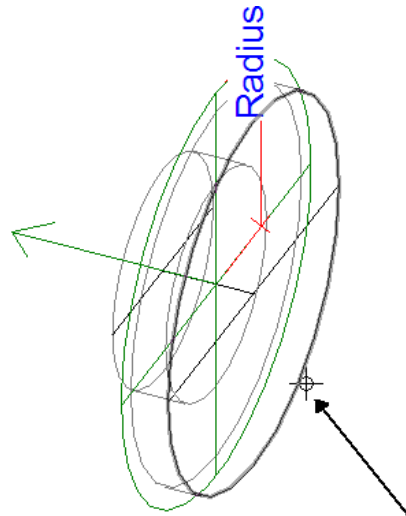
111 With the connector selected, click Modify Connector Element tab ► Element panel ► Element Properties.

112 In the Instance Properties dialog, under Dimensions, for Radius, enter **250 mm**, and click OK.

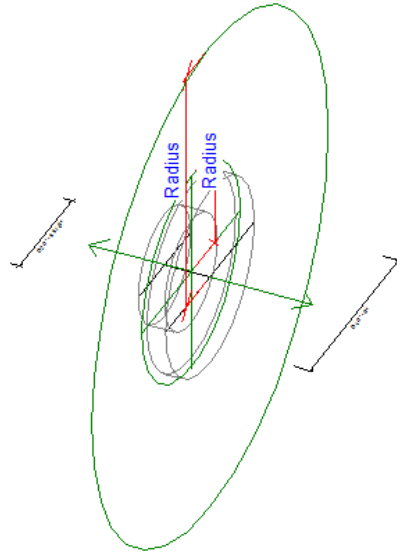


113 Spin the flange to view the back of the larger extrusion.


114 Click Create tab ► Connector tab ► Pipe Connector, and using the same method, add a connector to the larger extrusion.



Connector added to larger extrusion



115 On the Selection panel, click Modify to end the command.

116 Select the connector, click  and, if necessary, to change the direction of flow.

The arrow indicating the connector direction should be pointing toward the smaller diameter face.

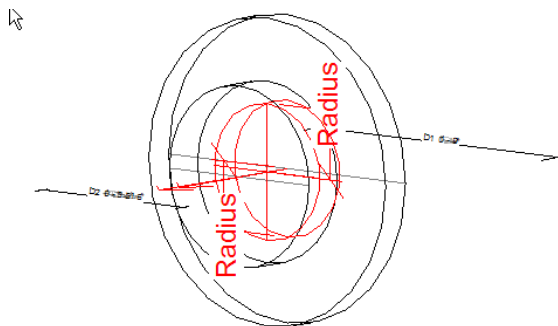
117 Select the first connector, click Modify Connector Element tab ► Connector Links panel ► Link Connectors, and click the second connector.

118 On the Selection panel, click Modify to end the command.

119 Select both connectors, and click Modify Connector Element ► Element panel ► Element Properties.

120 In the Instance Properties dialog, under Dimensions, for Radius, click  in the  column.

121 In the Associate Family Parameter dialog, select NR, and click OK twice.



122 Save the family.

Test the flange in a project

Load the flange family into a project and test it to verify the correct component behavior.

123 Click  ► Open.

124 In the left pane of the Open dialog, click the Training Files icon.

- 125** Open Metric ► Family Editor ► m Simple Room.rvt.
- 126** In the Project Browser, expand Views (Discipline) ► Mechanical ► HVAC ► Ceiling Plans, and double-click 1 - Ceiling Mech.
- 127** Click View tab ► Windows panel ► Switch Windows drop-down ► M_Generic 150 psi Slip Flange.rfa to make the family the active view.
- 128** Click Manage tab ► Family Editor panel ► Load into Project.
The new flange is loaded into the project.
- 129** Click Home tab ► Plumbing & Piping panel ► Pipe and draw a length of pipe.
- 130** Click Home tab ► Plumbing & Piping panel ► Pipe Fitting.
- 131** Click Place Pipe Fitting ► Element panel and in the Type Selector, select M_Generic 150 psi Slip Flange .
- 132** In the drawing area, click to insert the flange at the end of the pipe.
- 133** On the Selection panel, click Modify to end the command.

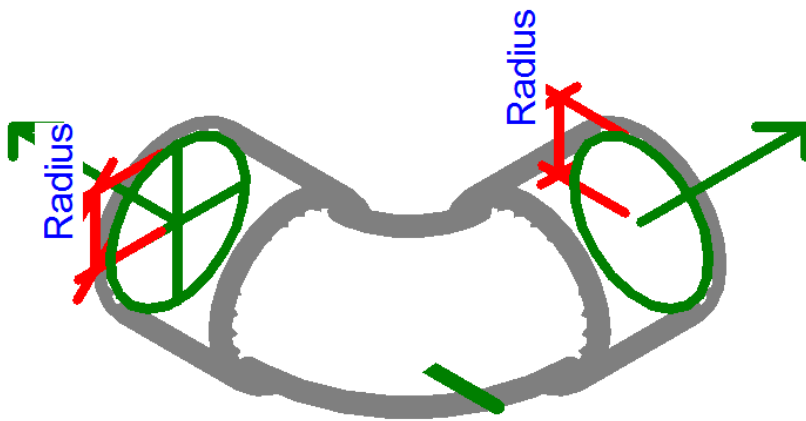
Creating an Elbow Pipe Fitting Family

12

In this tutorial, you create an elbow pipe fitting family. First, you create the physical fitting geometry by using reference planes and lines, and by defining fitting size parameters. You then create single line geometry for the elbow, test the fitting geometry, and set the object visibility. After completing the pipe fitting family, you can use the same method to create a duct fitting family for air systems.

NOTE Fittings are among the most complex families to create. It is recommended that you methodically follow the steps and periodically check your work against the tutorial. It may take a longer to complete this tutorial as compared to the other tutorials. Even if you have created parametric families before, creating system families typically takes more time to complete.

Completed elbow pipe fitting family




Skills used in this tutorial:

- Creating a pipe fitting family from a template
- Using a lookup table
- Creating a fitting profile
- Adding connectors

Creating an Elbow Pipe Fitting Family

Create a new elbow pipe fitting family


There are various family templates available in Revit MEP. To create the elbow fitting family, you will use the Generic Model template. The Generic Model template is a standalone template that is used for components that are not host-dependent.

- 1 Click  ► New ► Family.
- 2 In the New Family - Select Template File dialog, navigate to the Metric Templates folder, select Metric Generic Model.rft, and click Open.
The Family Editor opens.

Configure the elbow pipe fitting family

- 3 Click Manage tab ► Family Properties panel ► Category and Parameters.

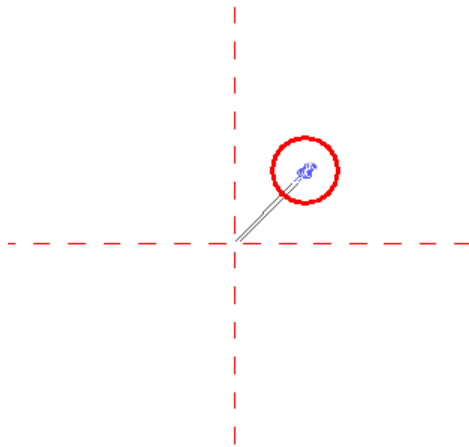
NOTE Family Category and Parameters settings determine the component type and provide a set of parameters that affect its behavior within Revit MEP. See Help for a complete list of Revit MEP categories and parameters.

- 4 In the Family Category and Parameters dialog, under Family Category, select Pipe Fittings.
- 5 Under Family Parameters, do the following:
 - Verify that Work Plane-Based is cleared.
 - Verify that Always vertical is selected.
 - For Part Type, select Elbow.
 - Verify that Shared is cleared.
- 6 Click OK.
- 7 Click  ► Save As ► Family.
- 8 In the Save As dialog, navigate to a folder of your choice, and save the family as **M_Threaded - Generic Elbow**.

Define reference planes

Reference planes are used to define relationships between the geometric components within the Family Editor. They are not displayed when the family is used in a building model.

- 9 In the Project Browser, expand Views (all) ► Floor Plans, and double-click Ref. Level to make it the active view.
- 10 Maximize the Ref. Level floor plan window.
- 11 Click View tab ► Windows panel ► Close Hidden.
Close Hidden closes all of the hidden windows for a project. However, if you have other projects open during a session, one window for each open project remains open.
- 12 Enter **ZF** to zoom the view to fit the window.
Refer to Keyboard Shortcuts in the Revit MEP Help for more information on using keyboard commands.
- 13 On the View Control Bar, click the current scale value, and select 1 : 2.
- 14 Select the 2 reference planes, and verify that both reference planes have been pinned. If necessary, click Modify Reference Planes ► Modify panel ► Pin.

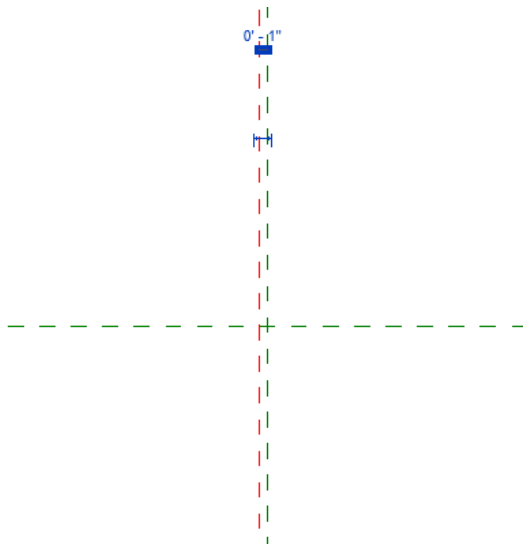


Pinning prevents accidentally moving the reference planes.

15 Click Create tab ► Datum panel ► Reference Plane.

16 On the Options Bar, for Offset, enter **-25**.

17 Zoom in and click to the left the vertical Center (Left/Right) reference plane to place a new reference line to the left of the vertical Center (Left/Right) reference plane.

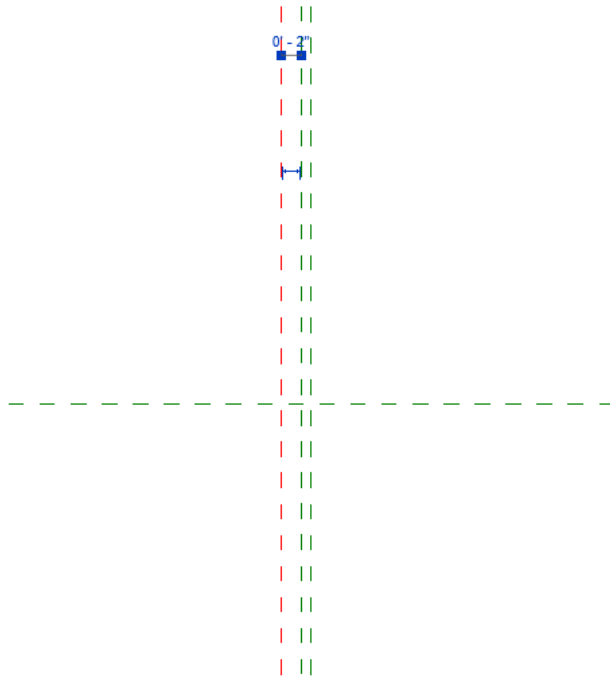


TIP You can identify an object in the drawing area by placing the cursor over the object. A tooltip and the Status Bar (which is located below the Project Browser) displays the object's name.

18 Select the left plane, and click Modify Reference Planes tab ► Element Panel ► Element Properties.

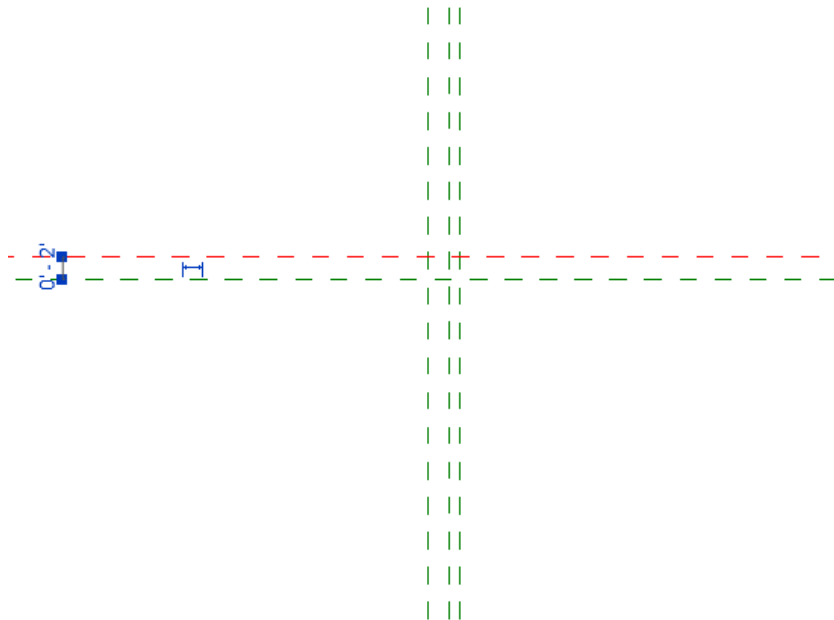
19 In the Instance Properties dialog, under Identity Data, for Name, enter **Fitting**, and click OK.

20 Using the same method, add another vertical plane 50 mm to the left of the left (Fitting) plane, and in the Instance Properties dialog, for Name, enter **Coupling**.




21 Select the horizontal Center (Front/Back) reference plane.

22 Add new reference plane 50 mm above the Center (Front/Back) reference plane as shown.



23 Right-click the new reference plane, and click Element Properties.

24 In the Instance Properties dialog, for Name, enter **Radius**, and click OK.

25 Click  Save to save the family.

Create reference lines and dimension them

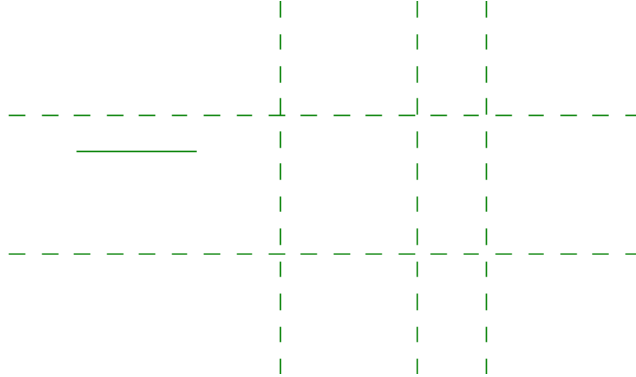
Reference lines are used to define the basic geometry of the family. They are not displayed when the family is used in a project. You create reference lines in order to create sweeps for the fitting geometry.

26 Click Create tab ► Datum panel ► Reference Line.

27 On the Options Bar, do the following:


- For Offset, verify that 0.0 is specified.
- Verify that Radius is cleared.

28 In the drawing area, draw a horizontal line of the approximate length and location as shown.



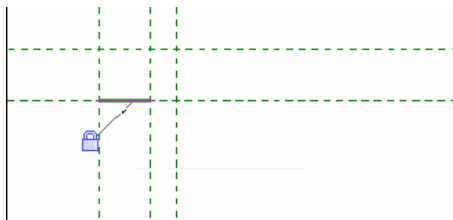
29 Click Modify tab ► Edit panel ► Align.

30 Select the middle vertical reference plane (Fitting), and click the right end of the reference line to align the right end of the reference line to the Fitting reference plane.

31 Click  to lock the end of the reference line to the Fitting plane.

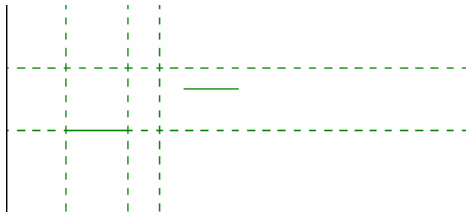
32 Using the same method, align and lock the left end of the reference line to the left vertical reference plane (Coupling).

33 Align and lock the reference line to the Center (Front/Back) reference plane as shown.



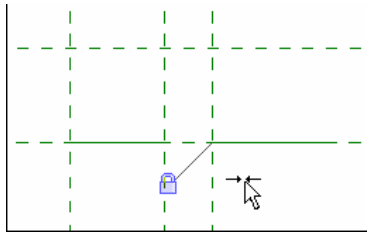
TIP A tooltip displays the name of the reference plane.

34 Using the same method, draw another reference line to the right of the Center (Left/Right) reference plane as shown.



35 Align and lock the left end of the right reference line to the Center (Left/Right) reference plane.

36 Align and lock the right reference line to the Center (Front/Back) reference plane as shown.



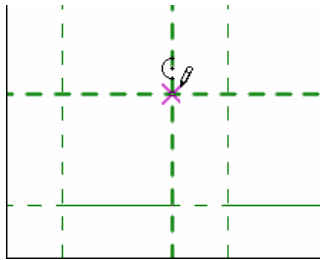
Next, you draw an arced reference line.

37 Click **Create** tab ► **Datum** panel ► **Reference Line** drop-down ► **Draw by Arc from Center and End Points**.

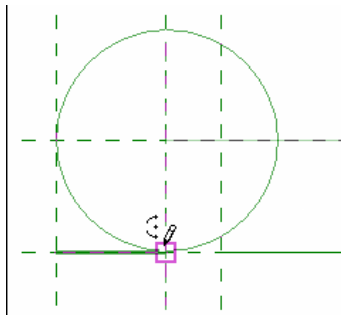
38 On the **Options Bar**, do the following:

- For **Offset**, verify that **0.0** is specified.
- Verify that **Radius** is cleared.

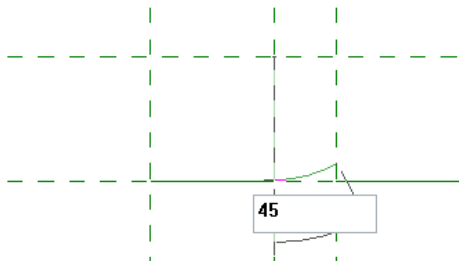
39 In the drawing area, click the intersection of the **Fitting** and the **Radius** reference planes to specify the center of the arc.




40 Move the cursor directly down, and after the endpoint snap displays, click the right end of the left reference line to specify the first endpoint of the arc.



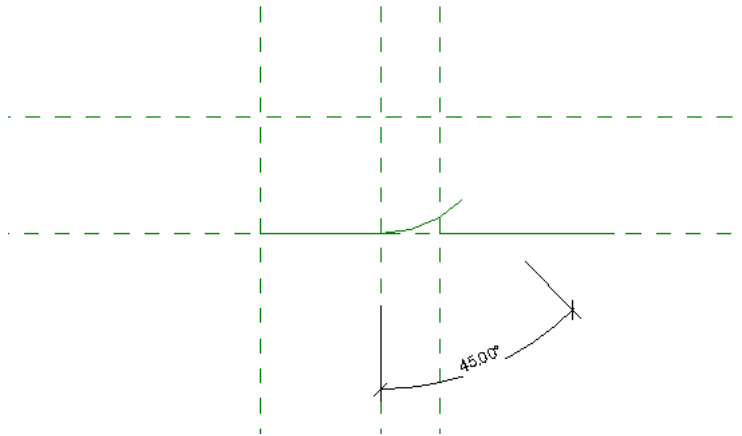
41 Move the cursor to the right to begin drawing the arc, enter **45**, and press *Enter* to specify a 45 degree radius for the arc.



42 Select the arc reference line, and zoom out to view 2 dimension controls ().

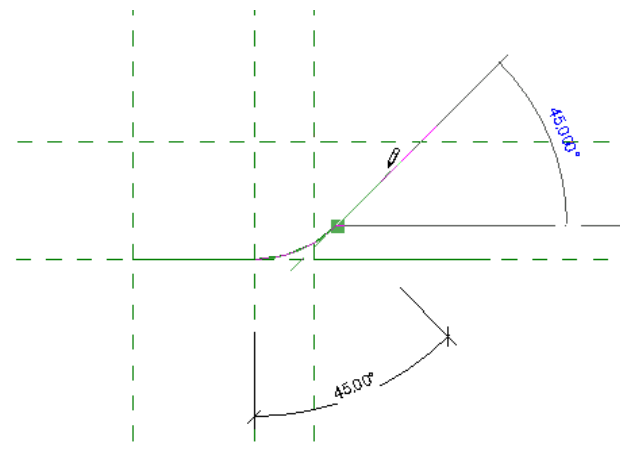
NOTE Temporary dimensions have two dimension controls that allow you to convert the temporary dimension to a permanent dimension. By default, dimensions are temporary—they only display when selected. The dimension control that is located perpendicular to the line being dimensioned represents the overall length of that line. The dimension control located near the reference plane represents the projected length of that line relative to the reference plane.

- 43 Click the dimension control that controls the overall dimension (located to the lower-right of the arc).
- 44 Drag the permanent dimension annotation away from the arc reference line, and adjust the length of the witness lines as shown.

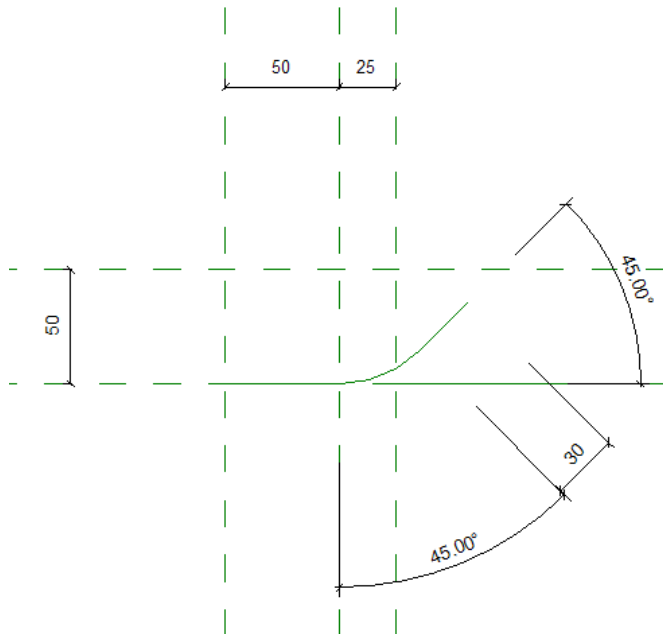



Next, you draw a diagonal reference line.

- 45 Click Create tab ► Datum panel ► Reference Line.
- 46 On the Options Bar, do the following:
 - For Offset, verify that 0.0 is specified.
 - Verify that Radius is cleared.
- 47 Click the right end of the arced reference line to specify the diagonal reference line start point.
- 48 Draw a diagonal reference line to extend the arc at a 45 degree angle toward the Radius reference plane, and click to specify the reference line end point at an approximate line length as shown. While drawing the diagonal reference line, the Tangent Extension tooltip may display to indicate that the diagonal reference line is tangent to the arced reference line.



- 49 Select the diagonal reference line, zoom the view to display the 2 dimension controls.
- 50 Using the same method, convert the temporary dimension for the overall length of the diagonal reference line to a permanent dimension. This is important if you want to create different sizes of the family.
- 51 Drag the dimension line down and to the right to move it out of the way, and clean up the witness lines as necessary.
- 52 Click Detail tab ► Dimension panel ► Aligned.
- 53 Add the following aligned dimensions:
 - Between the Radius and the Center (Front/Back) horizontal reference planes.
 - Between the Coupling and the Fitting vertical reference planes.
 - Between the Fitting and the Center vertical reference planes.
- 54 Click Place Dimension tab ► Dimension panel ► Angular.
- 55 Add an angular dimension between the diagonal reference line and the right horizontal reference line (which is located below the diagonal reference line).
- 56 Position the dimension annotations and witness lines as shown.



- 57 Click  ► Save to save the family.

Create family parameters and assign them to dimensions

- 58 Click Create tab ► Family Properties panel ► Types.
- 59 In the Family Properties dialog, under Parameters, click Add.
- 60 In the Parameter Properties dialog, under Parameter Type, verify that Family parameter is selected.
- 61 Under Parameter Data, do the following:
 - For Name, enter **LenA1**.
 - For Discipline, select Piping.
 - For Type of Parameter, select Pipe Size.

- For Group parameter under, select Dimensions.
- Select Instance to create an Instance Parameter.

62 Click OK.

The new family parameter, LenA1, is listed under Dimensions in the Family Types dialog.

63 Using the same method, create the following family parameters:

| Name | Discipline | Type of Parameter | Group parameter under | Instance/Type |
|--------|------------|-------------------|-----------------------|---------------|
| LenA2 | Piping | Pipe Size | Dimensions | Instance |
| BdyRad | Piping | Pipe Size | Dimensions | Instance |
| CplRad | Piping | Pipe Size | Dimensions | Instance |
| NomDia | Piping | Pipe Size | Dimensions | Instance |
| NomRad | Piping | Pipe Size | Dimensions | Instance |
| Ang | Common | Angle | Dimensions | Instance |

Next, you specify values and formulae for the family parameters that you added.

64 In the Family Types dialog, specify that following values and formulae:

- For CplRad, in the Value column, enter **30 mm**.
- For NomRad, in the Value column, enter **50 mm**.
- For LenA2, in the Formula column, enter **LenA1 * tan(Ang / 2)**.
- NomDia, in the Formula column, enter **NomRad * 2**.


NOTE When specifying formulae, the calculated length defines the geometry. Fittings must have their connectors (which you place later in this tutorial) on lines that intersect the Center (Left/Right) and Center (Front/Back) reference planes.

For more information on entering formulas, see [Valid Formula Syntax and Abbreviations](#) on page 56.

65 Click OK.

66 In the drawing area, select the (left) dimension that is dimensioning the Center (Front/Back) and Radius reference planes.

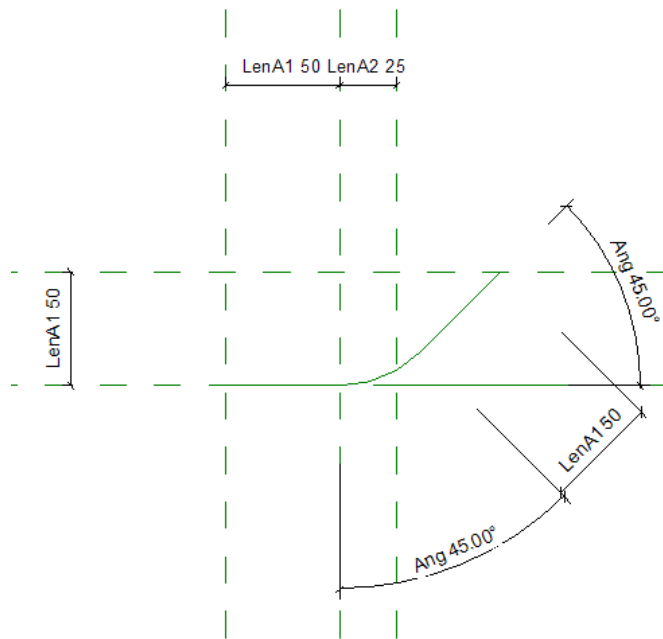
67 Click Modify Dimensions tab ► Element panel ► Element Properties.


68 In the Instance Properties dialog, under Other, click the Value column for Label, click , and select LenA1 from the list.

The dimension is associated and controlled by the LenA1 family parameter. Notice that the parameter name displays as part of the dimension annotation.

69 Using the same method, select each dimension and associate it to a family parameter as shown.

NOTE Associate each dimension separately. Do not select multiple dimensions and associate them to a parameter as this will cause errors.



70 Click  ► Save to save the family.

Use a lookup table file to define multiple sizes

Lookup tables are used to define parameter values in an external .csv file. The location of Lookup Table files is defined by the LookupTableLocation parameter in the Revit.ini file. This lets you specify multiple pipe sizes that are based on a table without creating a separate family type for each size. Revit MEP uses this pipe size information to define pipe fitting size after you specify a pipe diameter. Lookup tables are not used to determine pipe sizes as a result of using the Pipe Sizing tool—these pipe sizes are determined by various project-specific factors.

71 Using Windows Explorer, navigate to Family Editor folder and copy the M_Threated Generic Elbow.csv lookup table file, and paste it into the <install path>RME 2010\LookupTables folder. (This is the location from which the LookupTable files are retrieved if Revit MEP is installed in the default path.)

NOTE If Revit MEP was not installed in the default path, you must determine the correct path to the Lookup Table file as defined by the LookupTableLocation parameter in the Revit.ini file (within the <install_path>\RME2010\Program folder).

Next, you specify formulae that use the lookup table file to determine pipe size.

Create family parameters

Each family has a set of properties (parameters) that includes labeled dimensions and their values. You can also add values for standard parameters of the family (such as material, model, manufacturer, type mark, and others).

72 Click Create tab ► Family Properties panel ► Types.

73 In the Family Types dialog, in the Value column, for Lookup Table Name, enter **M_Threated Generic Elbow.csv** and click Apply.

74 In the Formula column, enter the following formulae:

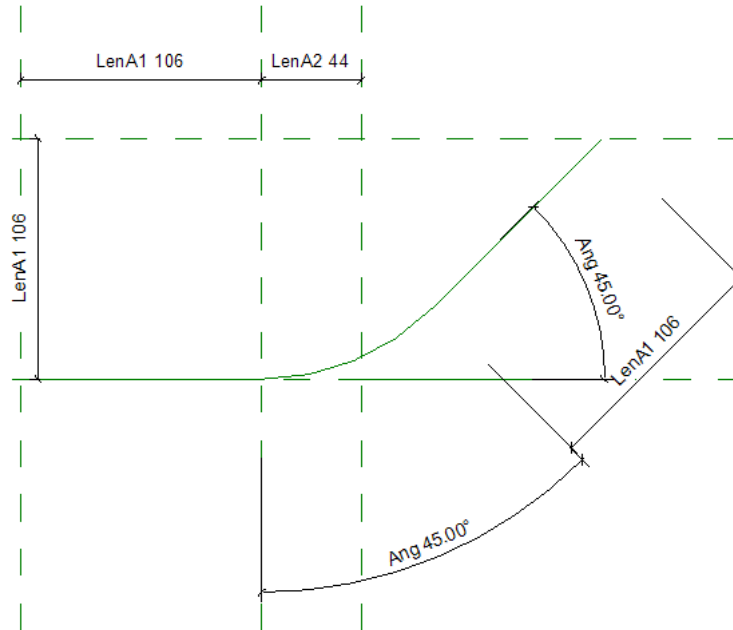
- For LenA1, enter `text_file_lookup("M_Threated Generic Elbow.csv", "LenA1", 0, NomDia)`.
- For CplRad, enter `text_file_lookup("M_Threated Generic Elbow.csv", "CplRad", 0, NomDia)`.


- For BdyRad, enter `text_file_lookup("M_Threated Generic Elbow.csv", "BdyRad", 0, NomDia)`.

TIP You can use the copy and paste commands to enter formulas for each parameter.

75 Click OK.

The formulae are applied and the dimensions are adjusted.



76 Click  ➤ Save to save the family.

RELATED During fitting creation, if specific pipe sizes that you need are not present in the lookup table file by default, you can add them according to manufacturers' specifications. However, you must save the lookup table file in a plain text format. If the file is saved in a proprietary format, Revit MEP may not be able to read it and any family type parameter formulae that refer to that lookup table will most likely return a value of 0 and errors will occur. If you encounter this type of issue, copy the lookup table data from the problematic lookup table file and paste it into a new text file. Save the text file with the file name including the .csv file extension and copy it to the LookupTables folder.

Next, you begin creating the fitting geometry.

Create a fitting profile

You create a fitting profile in order to provide a geometrical shape for the sweep extrusion. This sweep uses the profile and the reference lines to create the elbow fitting geometry.

77 Click  ➤ New ➤ Family.

78 In the New Family - Select Template dialog, navigate to the Metric Templates folder, select Metric Profile.rft, and click Open.

79 In the Project Browser, verify that the Ref. Level floor plan is the active view.

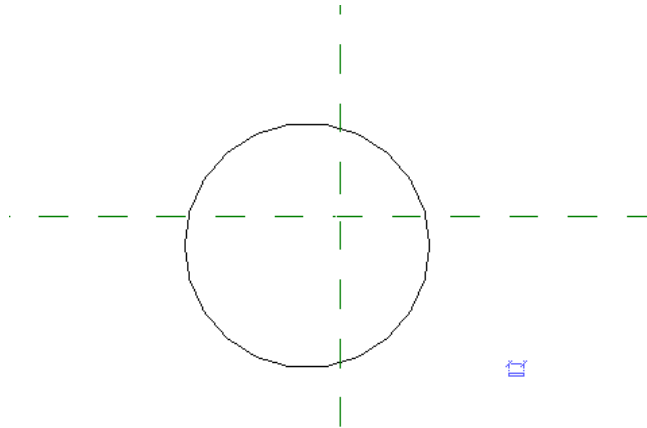
80 Click Create tab ➤ Detail panel ➤ Line.



81 On the Element panel, in the Type Selector, verify that Line Style: Profiles is selected.

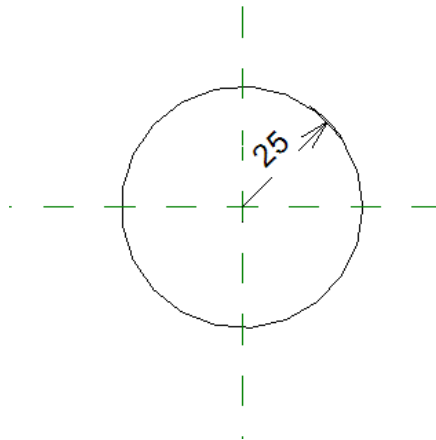
82 Click Place Lines ➤ Draw panel ➤ Circle.

- 83** On the Options Bar, do the following:
- For Offset, verify that 0.0 is specified.
 - Verify that Radius is cleared.

84 In the drawing area, draw a circle with any radius in the approximate location as shown.



- 85** On the Selection panel, click Modify to end the command.
- 86** Select the circle, right-click, and click Element Properties.
- 87** In the Instance Properties dialog, under Graphics, select Center Mark Visible, and click OK.
The center mark displays allowing you to align the circle to the reference planes.
- 88** Click Modify tab ► Edit panel ► Align.
- 89** Click the Center (Front/Back) reference plane, and then click the circle center mark to align the circle horizontally.
- 90** Click  to lock the circle to the horizontally.
- 91** Using the same method, align and lock the circle vertically.
- 92** Select the circle, zoom out, and click the dimension control ().
The temporary dimension converts to a permanent dimension.
- 93** Click the dimension value, enter **25 mm**, and press *ENTER*.
- 94** On the View Control Bar, click the current scale, and select 1 : 2.
- 95** Zoom in to view the sketch.



96 Click Create tab ► Family Properties panel ► Types.

97 In the Family Types dialog, under Parameters, click Add.

98 In the Parameter Properties dialog, under Parameter Data, do the following:

- For Name, enter **Rad**.
- For Discipline, select Piping.
- For Type of Parameter, select Pipe Size.
- For Group parameter under, select Dimensions.
- Verify that the Type option is selected to create a Type parameter.
- Click OK.

The new family parameter is listed under Dimensions.

Next, you create a new family type.

99 In the Family Types dialog, under Family Types, click New.

100 Name the new family type, **Fitting**, and click OK.

The new family type is listed in the Name list.

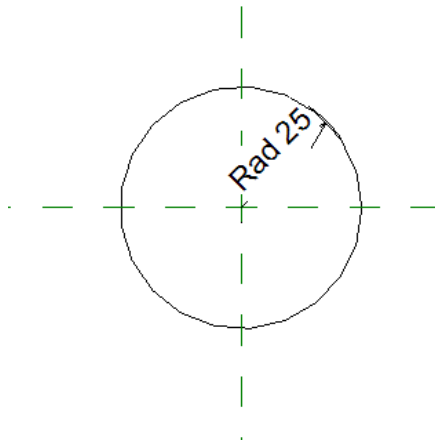
101 Using the same method, create a family type named **Coupling**.


102 In the Family Types dialog, click OK.

103 In the drawing area, select the dimension.

104 On the Options Bar, for Label, select Rad.

The dimension is now associated to and controlled by the Rad family parameter. Notice that the parameter name displays as part of the dimension annotation.



105 Click  ► Save As ► Family and save the family as **M_Threated Pipe Profile.rfa**.




Next, you load the fitting profile into the project.

106 Click Create tab ► Family Editor ► Load into Project to load the M_Threated Pipe Profile into the M_Threated – Generic Elbow family.

Notice that the M_Threated - Generic Elbow project becomes active.

Associate family parameters to a profile parameter

You associate family parameters to the Rad profile parameter for each family type in order to control the radius of the elbow fitting geometry. This allows for parametric changes in the fitting geometry to occur.

- 107** In the Project Browser, expand Families ► Profiles ► M_Threated Pipe Profile, right click Coupling, and click Properties.
- 108** In the Type Properties dialog, under Dimensions, for Rad, click .
- 109** In the Associate Family Parameter, under Existing family parameters of compatible type, select CplRad, and click OK.
- 110** In the Type Properties dialog, click Apply.
- 111** For Type, select Fitting.
- 112** Under Dimensions, for Rad, click .
- 113** In the Associate Family Parameter, under Existing family parameters of compatible type, select BdyRad, and click OK twice.
- 114** Click  ► Save to save the family.

Next, you create the fitting geometry.

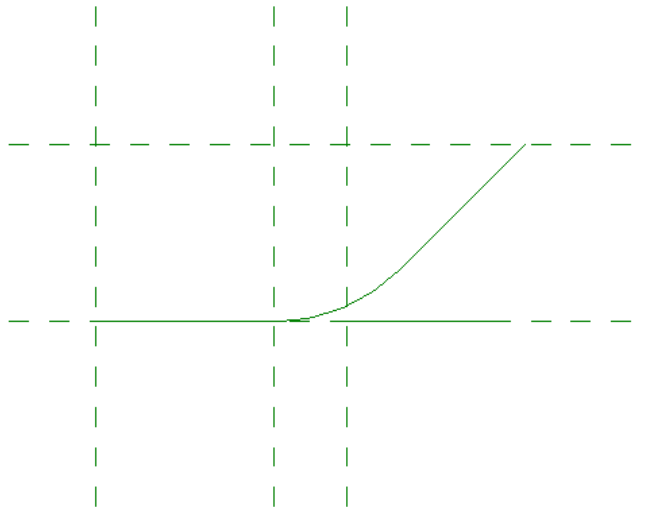
Create sweeps using reference lines

The elbow fitting geometry consists of 2 couplings connected by the fitting body. You create sweeps using the reference lines as sweep paths to create the fitting geometry. Each sweep is based on the profile that you created and loaded into the project.

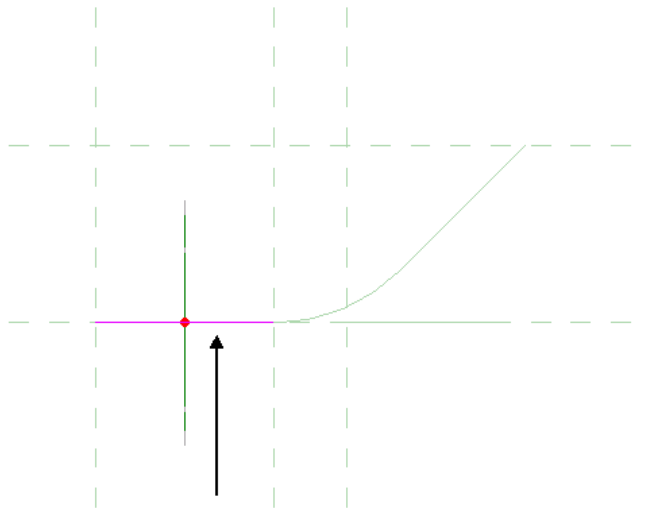
- 115** In the drawing area, cross-pick (drag from right to left) to select everything in the drawing.

TIP Remember that when you use cross-picking (drag right to left) to select an object, the cross-picking border only needs to intersect an object in order to select it. The object does not need to be fully contained within the border. In contrast, an object must be fully contained when using a pick box (drag left to right).

- 116** Click Multi-Select tab ► Filter panel ► Filter.
- 117** In the Filter dialog, clear Reference Lines and Reference Planes, and click OK.
- 118** On the View Control Bar, click Temporary Hide/Isolate ► Hide Element.
Only the reference lines and reference planes display.



- 119** Click Create tab ► Forms panel ► Solid drop-down ► Sweep.
- 120** Click Sweep tab ► Mode panel ► Pick Path.
- 121** In the drawing area, select the left horizontal reference line.



122 Click Sweep>Pick Path tab ► Path panel ► Finish Path.

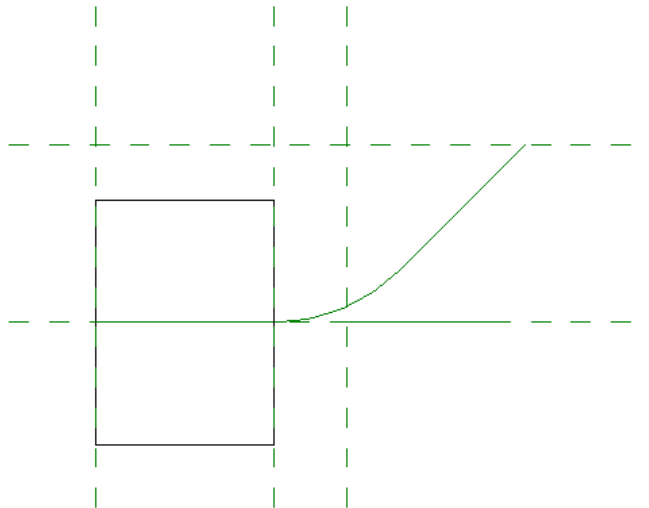
123 In the drawing area, click the red dot on the horizontal reference line.

124 On the Options Bar, do the following:

- For profile, select M_Threated Pipe Profile: Coupling.
- Verify that the X, Y, and Angle options are specified at 0.

125 Click Sweep tab ► Sweep panel ► Finish Sweep.

The geometry for the left coupling is created.

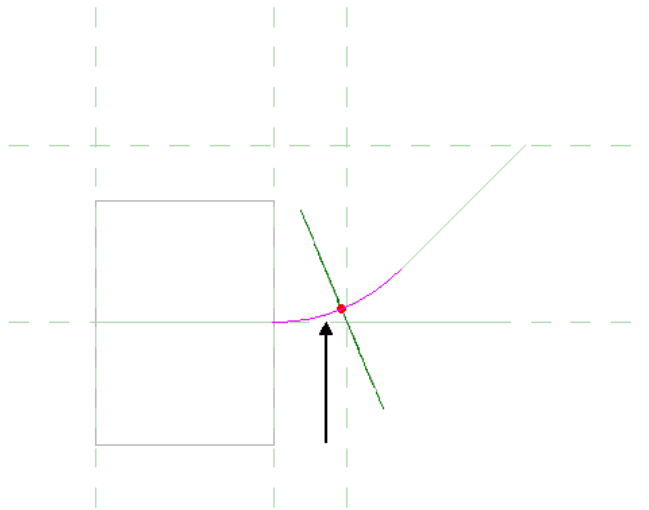


Next, you create the geometry for the fitting body.

126 Click Create tab ► Forms panel ► Solid drop-down ► Sweep.

127 Click Sweep tab ► Mode panel ► Pick Path.

128 In the drawing area, select the arced reference line.



129 Click Sweep>Pick Path tab ► Path panel ► Finish Path.

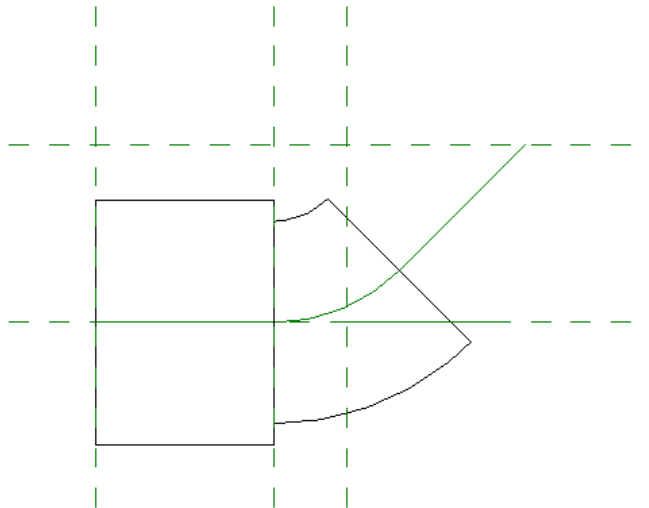
130 In the drawing area, click the red dot on the arced reference line.

131 On the Options Bar, do the following:

- For profile, select M_Threated Pipe Profile: Fitting.
- Verify that the X, Y, and Angle options are specified at 0.

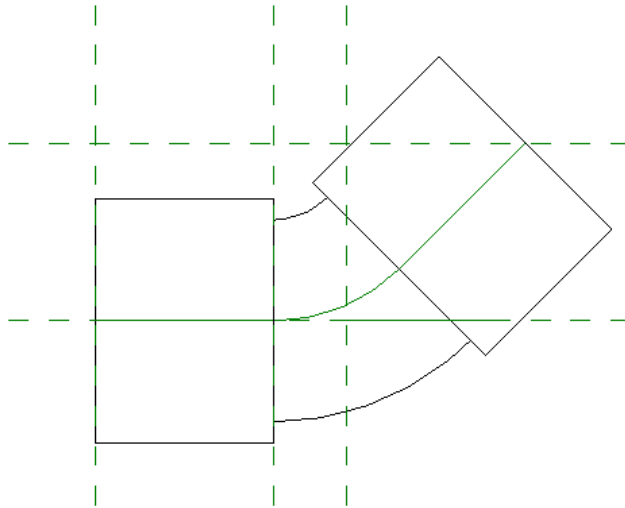
132 Click Sweep tab ► Sweep panel ► Finish Sweep.

The geometry for the fitting body is created.



Next, you create the right coupling geometry for the elbow fitting.

133 Using the same method, add a solid sweep, and select M_Threated Pipe Profile: Coupling from the profile list to the right reference line to create the geometry for the right coupling.



The elbow fitting geometry is created.

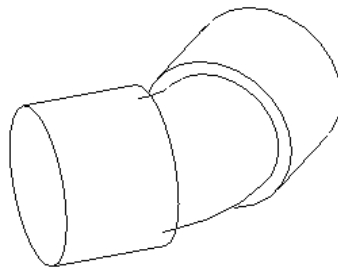
Next, you verify the fitting geometry.

134 In the Project Browser, expand Views (all) ► 3D Views ► View1 to make the 3D view active.

135 With the 3D view active, enter **VG**.


136 On the Annotation Categories tab of the Visibility Graphics Overrides dialog, clear all annotation categories, and click OK.

The fitting geometry displays.



137 While pressing **SHIFT** and the middle mouse button, drag the cursor to spin the model, and verify the fitting geometry.

138 In the Project Browser, double-click Floor Plans ► Ref. Level to make it the active view.

139 Click  ► Save to save the family.

Create detail level geometry

Detail level geometry is the geometry that displays when you select a detail level. In Revit MEP, Coarse and Medium detail levels display pipe and pipe fittings as single line. The Fine detail level displays pipe and pipe fittings as double line.

In this section, you draw model lines to create the single line fitting geometry. This fitting geometry displays when the Coarse and Medium detail level settings are used. First, you need to hide some of the geometry in the family to make it easier to create model lines for the single-line display.

140 In the drawing area, cross-pick (drag from right to left) to select everything in the drawing.

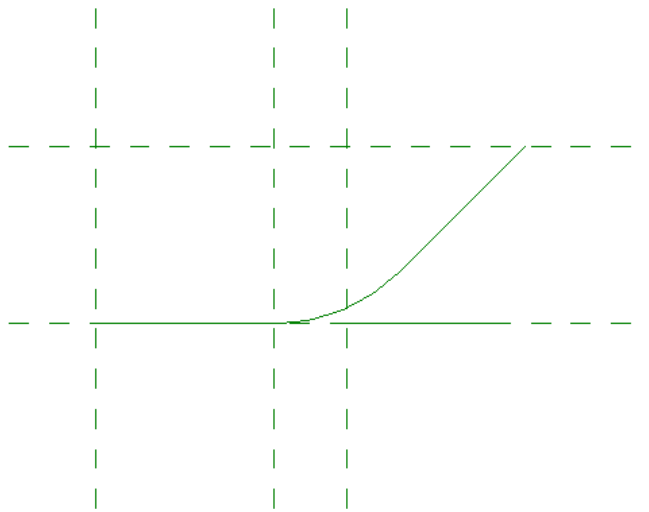
141 Click Multi-Select tab ► Filter panel ► Filter.

142 In the Filter dialog, click Check None, select Other, and click OK.

The 3 sweeps are selected.

143 On the View Control Bar, click Temporary Hide/Isolate ► Hide Element.

Only the reference planes and reference lines display.



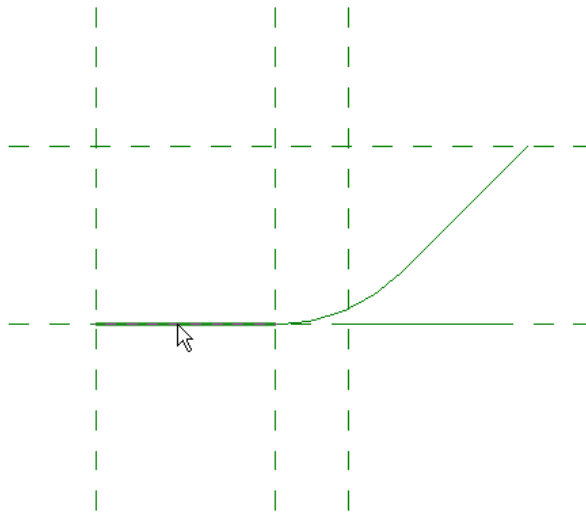
144 Click Create tab ► Model panel ► Model Lines.

145 On the Element panel, in the Type Selector, verify that Pipe Fittings is selected.

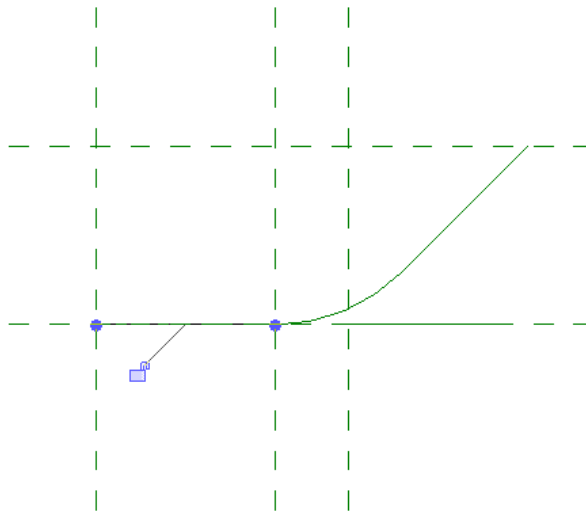
146 On the Options Bar, do the following:

- For Placement Plane, verify that Level : Ref Level is selected.
- For Offset, verify that 0.0 is specified.
- Verify that Lock is cleared.

147 In the drawing area, select the left horizontal reference line.



A model line is created over the reference line.




148 With the model line selected, click  to lock the model line to the reference line.

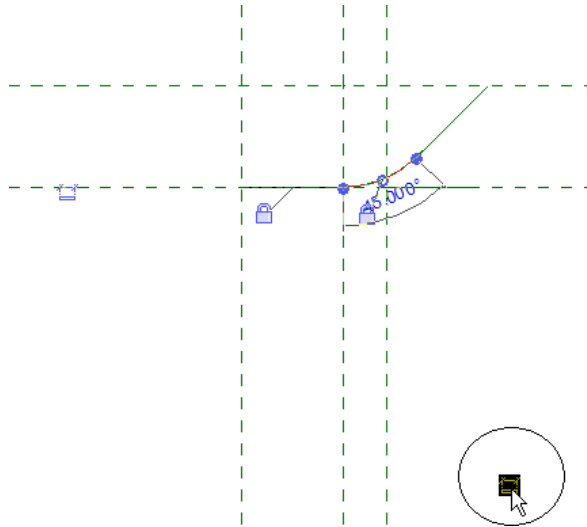
TIP You can identify objects that are located under other objects by placing the cursor over an object and press *Tab*. Each time you press *Tab*, you highlight through the vertical hierarchy of objects (from top to bottom). A tooltip and the Status Bar display the name of the object.

149 With the Model Lines tool active and using the same method, select the arched reference line to create an arched model line, and lock the model line to the arched reference line.

150 On the Selection panel, click Modify to end the command.

151 Select the arched model line to display its temporary dimension.

152 Zoom out, and click the dimension control () that is located at the lower-right.



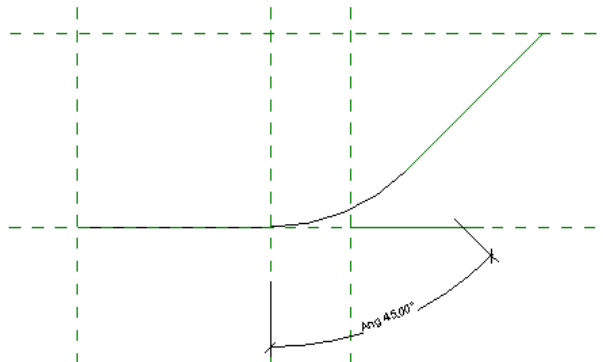
This converts the overall angle temporary dimension to a permanent dimension.

153 On the Selection panel, click Modify to end the command.

154 Select the permanent dimension, and on the Options Bar, for Label, select Ang.

This associates the angle dimension of the arced model line to the Ang family parameter.

155 Relocate the dimension annotation, and modify the witness lines as shown.



156 Using the same method, create a diagonal model line by picking the diagonal reference line (located at the right end of the arced model line).

NOTE Do not lock the diagonal model line. If you lock it, Revit MEP warns you that locking the alignment would over constrain the sketch.

157 On the Selection panel, click Modify to end the command.

158 Select the diagonal model line.

159 Using the same method, convert the diagonal model line overall length temporary dimension to a permanent dimension, and associate it to the LenA1 family parameter.

Next, you dimension the diagonal model line.

160 Click Detail tab ► Dimension panel ► Aligned.

161 On the Element panel, in the Type Selector, verify that Angular Dimension Style : Linear angular style is selected.

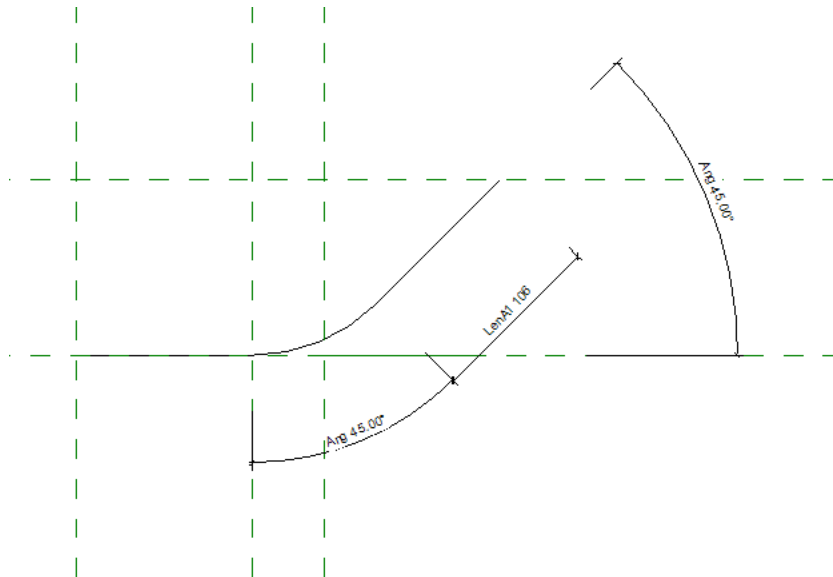
- 162** In the drawing area, click the diagonal model line, then click the Center (Front/Back) reference plane, and finally move the cursor and click to place the dimension.

NOTE Make certain that you select the model line and not the reference line. If necessary, press Tab to locate the model line.

- 163** On the Selection panel, click Modify to end the command.

- 164** Using the same method, associate the new angular dimension to the Ang family parameter.

- 165** Relocate the dimension annotations, and modify the witness lines as shown.



- 166** On the View Control Bar, click Temporary Hide/Isolate ► Reset Temporary Hide/Isolate.

- 167** Press **CTRL+S**.

Next, you flex the part to validate the design.

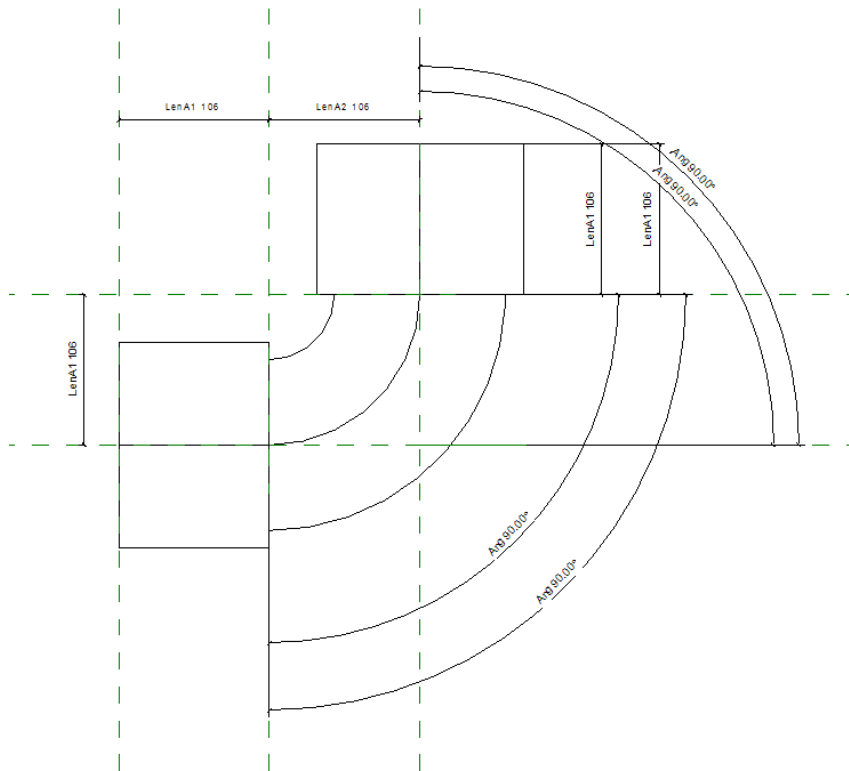
Flex the part

Flex the part by adjusting the parameter values to make sure that the reference planes to which you applied the parameter change accordingly.

- 168** Click Create tab ► Family Properties panel ► Types.

- 169** In the Family Types dialog, under Dimensions, for Ang, enter **90**, and click Apply.

The part flexes to become a 90 degree elbow fitting.



NOTE If the part does not flex and errors occur, this is usually caused by a constraint issue. Check all constraints and verify that model lines were created and properly constrained.

170 Restore the Ang parameter to **45**, and click OK.

Next, you create tick marks.

Add tick marks and dimension them

You create tick marks to indicate the end of the fitting when viewing the fitting in either the Coarse or Medium (single line) detail level.

171 In the drawing area, cross-pick (drag from right to left) to select everything in view.

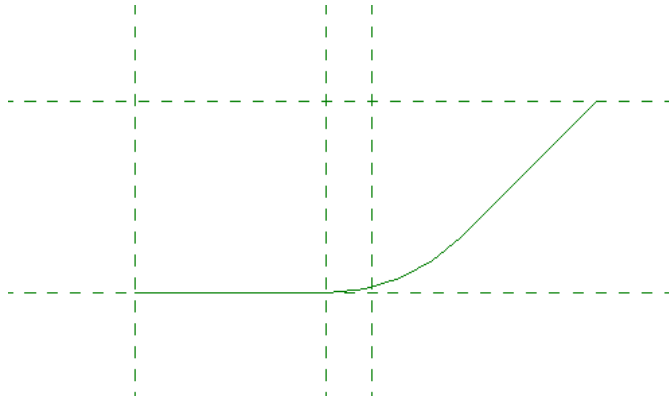
172 Click Multi-Select tab ► Filter panel ► Filter.

173 In the Filter dialog, clear Lines (Pipe Fitting) and Reference Planes, and click OK.

Everything except for model lines and reference planes are selected. Lines (Pipe Fittings) are the model lines.

174 On the View Control Bar, click Temporary Hide/Isolate ► Hide Element.

Only model lines and reference planes display.



175 Click Multi-Select tab ► Filter panel ► Filter.

176 On the Element panel, in the Type Selector, verify that Pipe Fittings is selected.

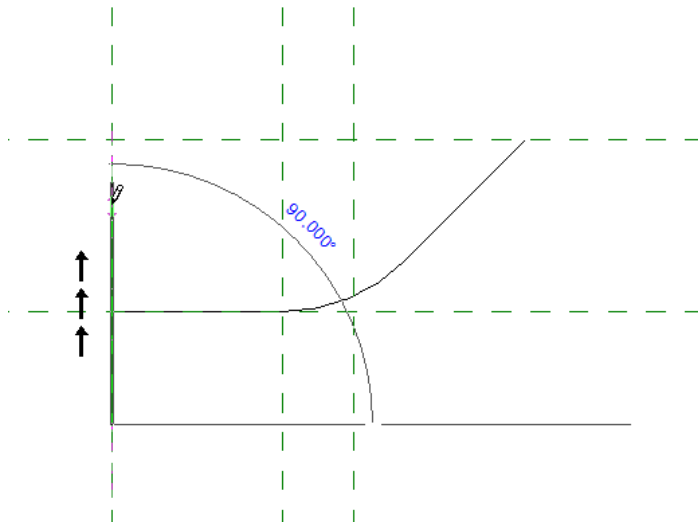
177 On the Options Bar, do the following:

- For Placement Plane, verify that Level : Ref Level is selected.
- For Offset, verify that 0.0 is specified.
- Verify that Radius is cleared.

178 At the left end of the fitting, draw a model line that is perpendicular and tangent to the end of the horizontal model line as shown.

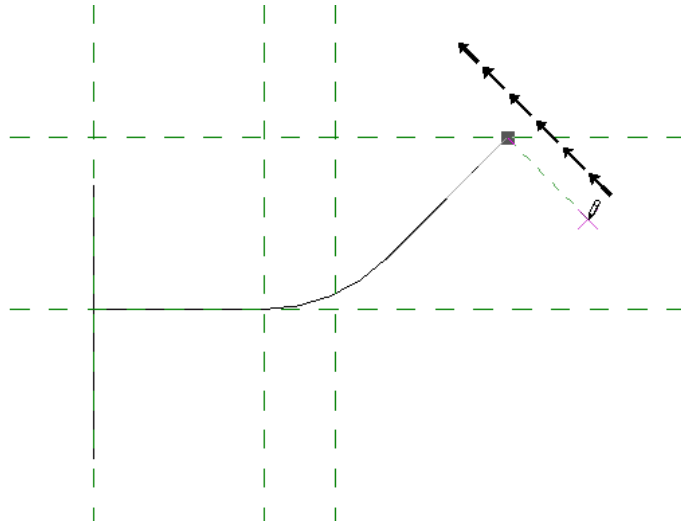
Line length is approximate.

TIP You draw this model line on top of the Coupling reference plane.

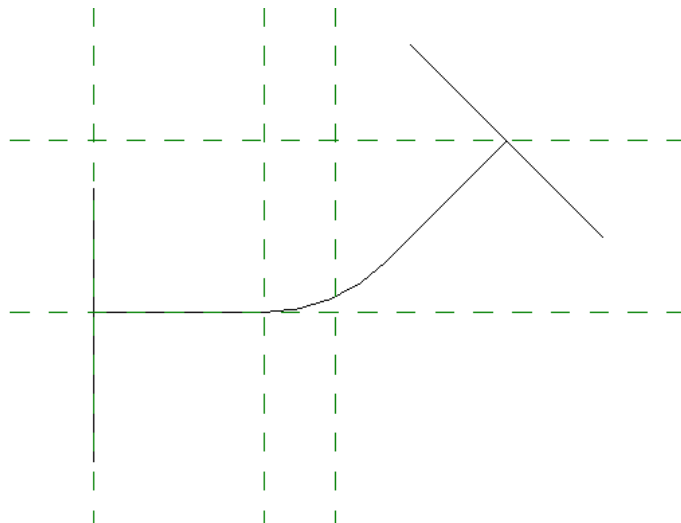


179 At the right end of the fitting, draw another model line that is perpendicular and tangent to the end of the diagonal model line as shown.

Again, length is approximate.



The 2 tick marks are drawn.



Next, you dimension each side of the 2 tick marks.

180 Click Detail tab ► Dimension panel ► Aligned.

181 On the Element panel, in the Type Selector, verify that Linear Dimension Style : Linear is selected.

182 On the left end of the fitting, click the Center (Front/Back) reference plane and click the top end point of the model line (tick mark), then move the cursor to the left and click to place the dimension.

NOTE You must click the reference plane first to dimension this model line.

The top half of the model line (tick mark) is dimensioned.

183 Using the same method, dimension the bottom half of the left model line.

184 Using the same method, dimension both halves of the right model line (tick mark) by clicking the diagonal model line first, and then clicking an endpoint of the model line (tick mark).

You place 2 dimensions for the right model line.

185 On the Selection panel, click Modify to end the command.

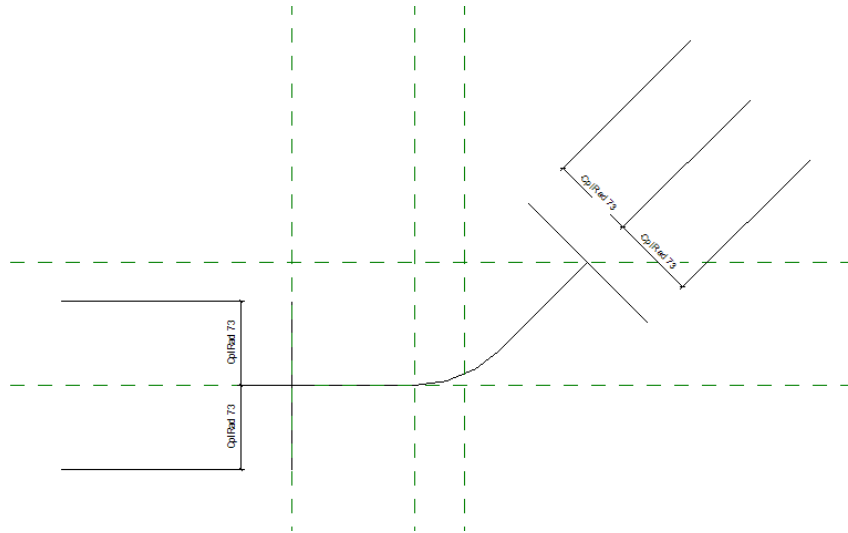
- 186** Select the lower dimension for the left model line, and on the Options Bar, for Label, select CplRad.

This associates that dimension to the CplRad family parameter.

- 187** Using the same method, associate the other 3 model line dimensions to the CplRad parameter.

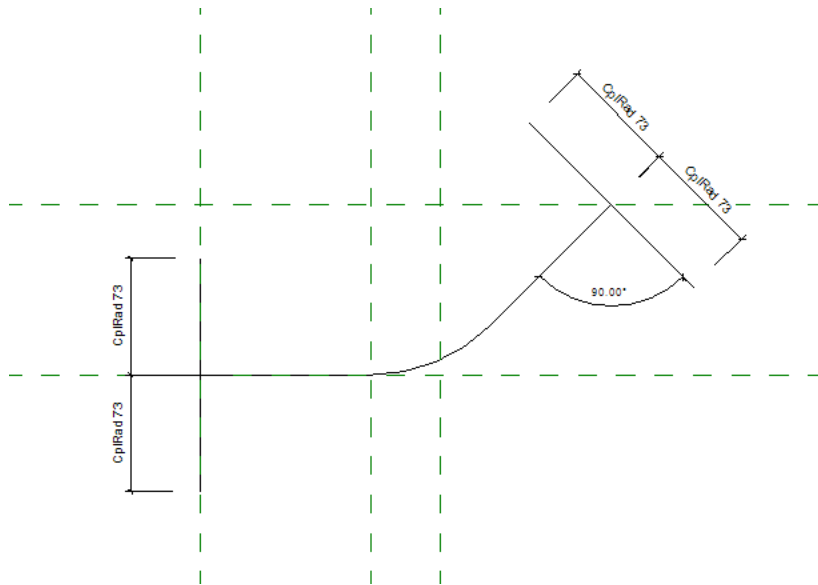
NOTE You must associate each dimension separately. You cannot select multiple dimensions and associate them to a parameter.

The dimension are as shown.




Next, you create an angular dimension between the diagonal model line and the right model line tick mark.

- 188** Click Detail tab ► Dimension panel ► Aligned.
- 189** Click Place Dimension tab ► Dimension panel ► Angular.
- 190** Click the diagonal model line and then click the right model line tick mark, move the cursor down and click to place the dimension.
- 191** On the Selection panel, click Modify to end the command.
- 192** Select the angular dimension, and lock it to 90 degrees.
- You may need to zoom out to locate the lock.
- 193** Relocate the dimension annotations, and modify the witness lines as shown.



194 On the View Control Bar, click Temporary Hide/Isolate ► ,Reset Temporary Hide/Isolate.

195 Click  ► Save to save the family.

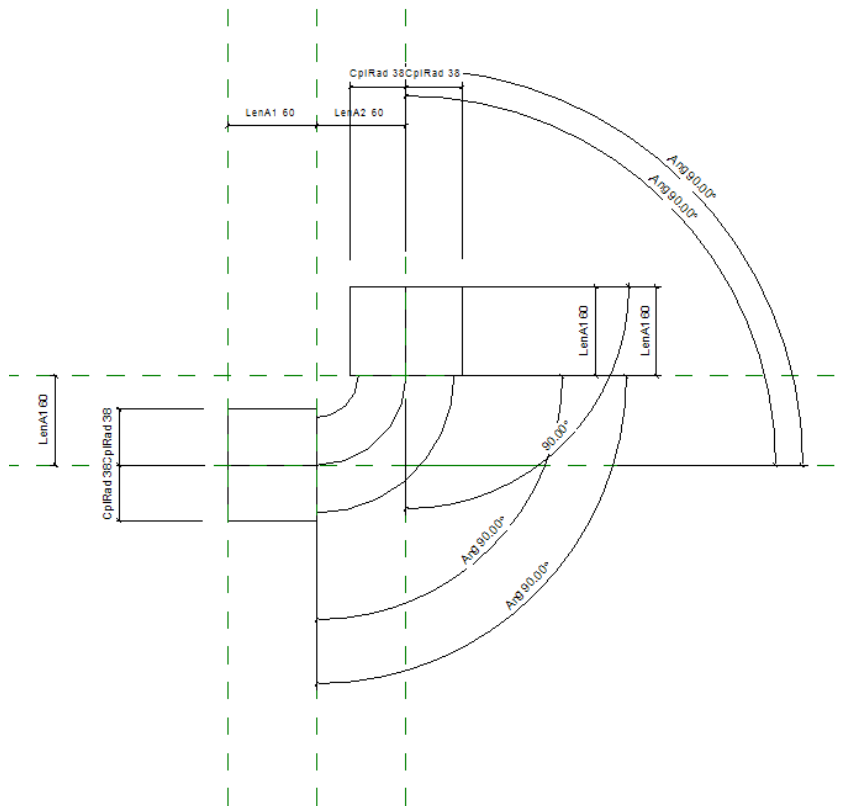
Flex the part

Flex the part by adjusting the parameter values to make sure that the reference planes to which you applied the parameter change accordingly.

196 Click Create tab ► Family Properties panel ► Types.

197 In the Family Types dialog, for Ang, enter **90**, and for NomRad enter **25 mm**, and click Apply.

The elbow fitting flexes into a 90 degree elbow that has a 50 mm diameter.



198 Continue to flex the fitting by changing the Ang and NomRad parameter values.

NOTE If errors occur while flexing the fitting, the NomRad value that you specified required a pipe diameter that is not included in the lookup table file. You may want to refer to the M_Threated Generic Elbow.csv lookup table file for the valid pipe diameters or add new pipe diameters based on the manufacturers' specifications.

You created the detail level geometry for the elbow fitting and flexed this geometry to validate it. Next, you set object visibility.

Specify object visibility

You specify object visibility to determine the type of elbow fitting geometry that displays for each detail level setting.

199 In the drawing area, cross-pick (drag from right to left) to select everything in the drawing.

200 Click Multi-Select tab ► Filter panel ► Filter.

201 In the Filter dialog, click Check None, select Lines (Pipe Fittings), and click OK.

Only model lines are selected. Next, you specify this single line geometry to a detail level setting.

202 With the model lines selected, click Modify Lines tab ► Visibility panel ► Visibility.

203 In the Family Element Visibility Settings dialog, verify that Coarse and Medium are selected, clear Fine, and click OK.

This specifies that the single-line fitting geometry will display when only the Coarse and Medium detail level settings are selected. Next, you specify the 2-line geometry for the Fine detail level setting.

204 In the drawing area, cross-pick (drag from right to left) to select everything in the drawing.

205 Click Multi-Select tab ► Filter panel ► Filter.


206 In the Filter dialog, click None, select Other, and click OK.

Only the 3 sweeps are selected.

207 With the sweeps selected, click Modify Lines tab ► Visibility panel ► Visibility.

208 In the Family Element Visibility Settings dialog, clear Coarse and Medium, verify that Fine is selected, and click OK.

The 2-line fitting geometry will display only when the Fine detail level setting is selected.

209 Click  ► Save to save the family.

Next, you add connectors to the elbow fitting family.

Add connectors

Connectors allow Revit MEP connect to participate in specific systems and facilitate load calculations your design. Connector properties determine the behavior of the connector for the discipline it is assigned to.

210 In the Project Browser, expand Views (all) ► 3D Views ► View1 to make the 3D view active.

211 In the drawing area, cross-pick (drag from right to left) to select everything in the view.

212 Click Multi-Select tab ► Filter panel ► Filter.

213 In the Filter dialog, click None, select Dimensions, and click OK.

214 On the View Control Bar, click Temporary Hide/Isolate ► Hide Element.



The fitting displays.

215 Spin the model to view the faces at the ends of the fitting.

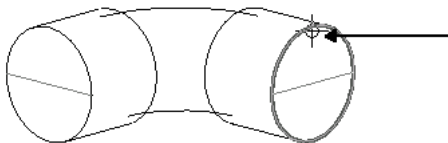
216 Click Create tab ► Connector panel ► Pipe Connector.

217 Click Place Pipe Connector tab ► Placement panel ► Place on Face.

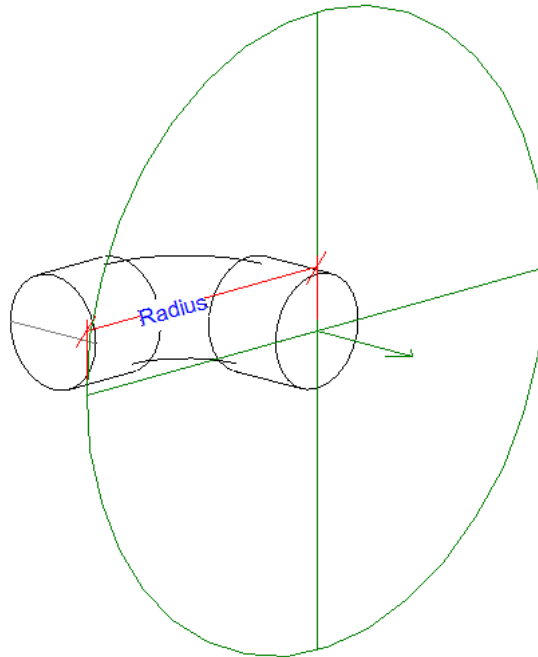
218 On the Options Bar, for system type, select Fitting.

You begin by placing the primary connector.

219 Place the cursor on the edge of the right face of the fitting, and after the edge highlights, click to place the primary connector.



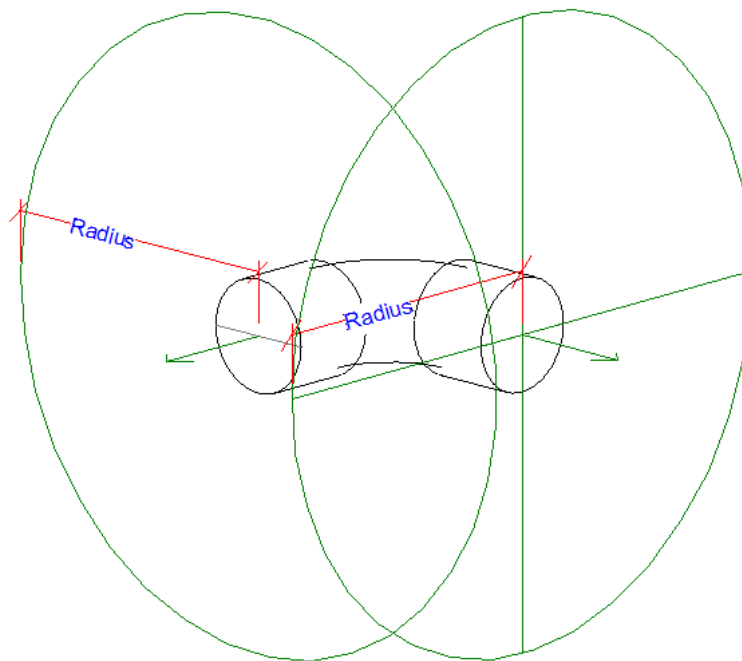
The primary connector is placed.



You place the primary connector on the right face because this face is on the X-axis. Notice that crosshairs display indicating that this is the primary connector.

NOTE When you place fitting connectors, the primary connector must be placed on the face that is on the X-axis. You can verify this by viewing the face in a floor plan view. Unexpected behavior can result if the primary connector is not properly placed relative to the other connectors, and that if all connectors are not properly rotated and linked.

220 Using the same method, place a connector on the left face of the fitting.



221 On the Selection panel, click Modify to end the command.

Next, you link both connectors.

222 Select the primary connector (indicated by crosshairs).

223 Click Modify Connector Element tab ► Connector Links panel ► Link Connectors, and click the other connector.

The 2 connectors are linked. Next, you specify connector properties.


224 In the drawing area, select the 2 connectors.


The 2 selected connectors display in red.

225 Click Modify Connector Element tab ► Element panel ► Element Properties.

226 In the Instance Properties dialog, under Instance Parameters, do the following:

- For System Type, verify that Fitting is selected.

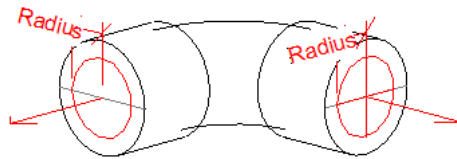
- For Angle, click , in the Associate Family Parameter dialog, select Ang, and click OK.

- For Radius, click , in the Associate Family Parameter dialog, select NomRad, and click OK.

The connector angle constraint and radius dimension are now associated to parameters. This allows the fitting radius to change after you specify a pipe diameter or perform pipe sizing. It also allows the fitting angle to change as a result of modifications to the pipe layout. Notice that values are assigned to both associated parameters, and that these parameters cannot be edited in the Element Properties dialog.

- Click OK.

The connector radii change.

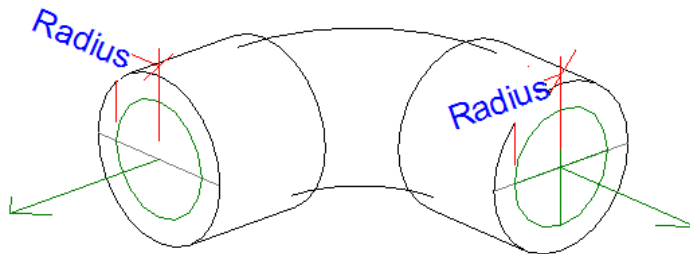


Next, you rotate the connectors.

Rotate connectors

227 In the 3D view, enter **ZF** to zoom the view to fit the window.

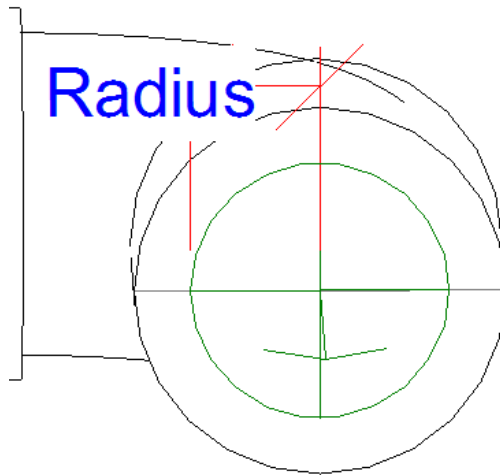
Notice that the connectors are oriented horizontally.



Although the connectors are round, it is recommended that you rotate them so that they are oriented vertically.

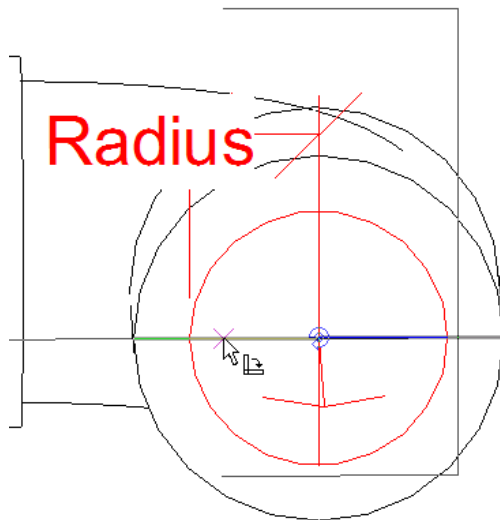
IMPORTANT Connector rotation is a critical part of connector placement. The connector orientation determines the correct orientation of the objects that are automatically inserted on the part. Although this is not as important for round connectors, it is extremely important for rectangular connectors such as those on rectangular duct fittings. Remember that for rectangular connectors, the rectangular connector must be oriented so that the width is assigned to the face that is on the X and Y axes. The height is not on these axes. If rectangular connectors are not rotated properly, the rectangular duct fitting will be inserted improperly, creating an unexpected result. You may find it easier to rotate connectors in a 3D view, where the part geometry is clearly visible.

228 Spin the fitting to view the entire primary connector.

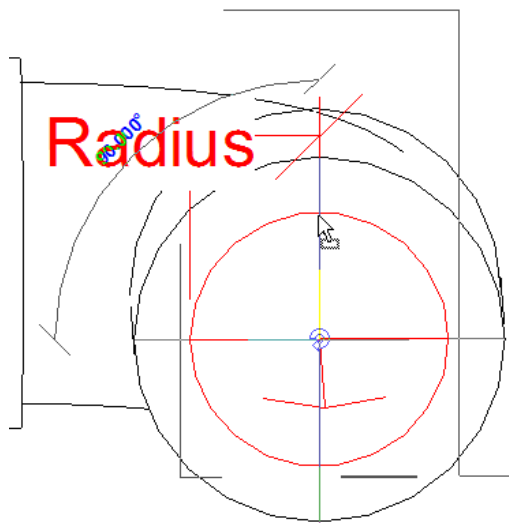


229 Select the connector, and click Click Modify Connector Element tab ► Modify panel ► Rotate.

230 Move the cursor over the model line and to the left of the connector arrow, and after the intersection snap displays, click to specify the rotation start point.

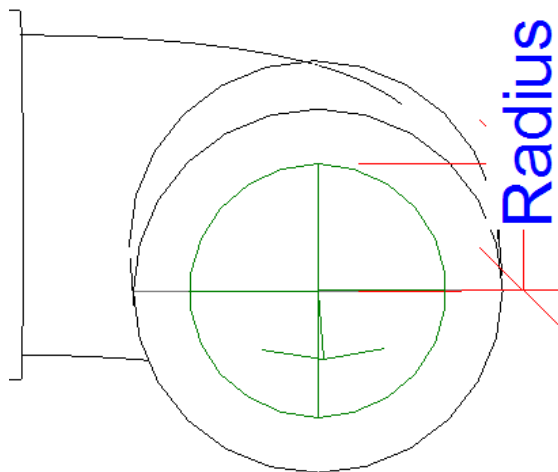


231 Move the cursor clockwise 90 degrees, and click to specify the rotation end point.

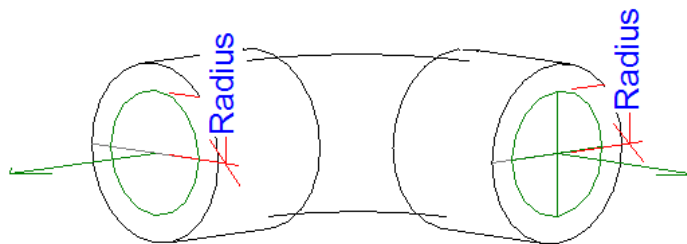



NOTE Do not use the flip arrows to flip the connector with respect to its reference plane. This also flips the connector arrow. You will learn more about connector arrows in the next section.

The primary connector is rotated and now has a vertical orientation.



232 Using the same method, rotate the secondary connector so that it has a vertical orientation.

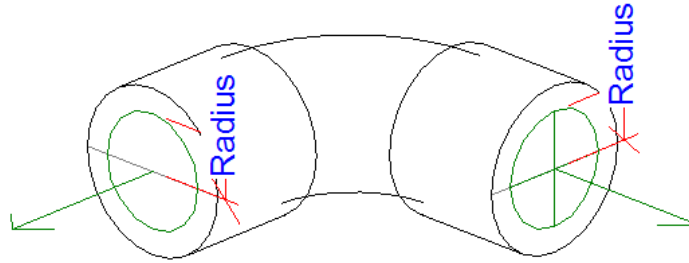


233 Click  Save to save the family.


Next, you verify the connector arrow direction.

Verify connector arrow direction

234 In the 3D view, verify that each connector arrow indicates an outward direction from its connector as shown.



IMPORTANT Connector arrows indicate the direction of a duct or pipe (extrusion) when it is being created to complete a connection. It does not indicate flow direction. In most instances, a connector arrow points outward away from the object to which the connector is associated. Otherwise, the duct or pipe when created will pass through the object geometry instead of away from it. You can modify the connector arrow direction by selecting the connector and clicking the flip arrows.

235 Click  ► Save to save the family.


Test the elbow fitting in a project

Load the elbow fitting family into a project and test it to verify the correct component behavior.

236 Click  ► New ► Project.

237 In the New Project dialog, do the following:

- Under Template file, verify that the path points to the Systems-Default_Metric.rte template file.
- Under Create New, verify that Project is selected.
- Click OK.
If the template file path does not point to the Systems-Default_Metric.rte template, then click Browse, and locate this template file.

TIP You can also set the project template file path for all new projects on the File Locations tab of the Options dialog (click  ► Options).

Next, you load the threaded elbow family into the new project.

238 Click View tab ► Windows panel ► Switch Windows ► M_Threaded Generic Elbow.rfa - 3D View to switch back to the threaded coupling family.

239 Click View tab ► Family Editor panel ► Load into Project.

If more than one project is open, select the project that you just created from the Load into Projects dialog, and click OK.

The elbow family is loaded into the new project and the new project becomes active.

240 In the Project Browser, verify that the 1 - Mech mechanical floor plan is the active view.

This is the default view when a project, based on the systems default template, opens. The 1 - Mech view is located under Mechanical ► HVAC ► Floor Plans in the Project Browser. Because

it is associated with the mechanical discipline, both ducts and pipe can be created in the 1 - Mech view.

241 Click Home tab ► Plumbing & Piping panel ► Pipe.

Next, you assign the new threaded generic elbow fitting to a pipe type.

242 On the Element panel, in the Type Selector, verify that Pipe Types: Standard is selected.

243 On the Element panel, click Element Properties.

244 In the Instance Properties dialog, click Edit/New.

245 In the Type Properties dialog, under Mechanical, for Elbow, select M_Threaded – Generic Elbow: M_Threaded – Generic Elbow, and click OK twice.

246 On the Placement Tools panel, verify that Automatically Connect is selected.

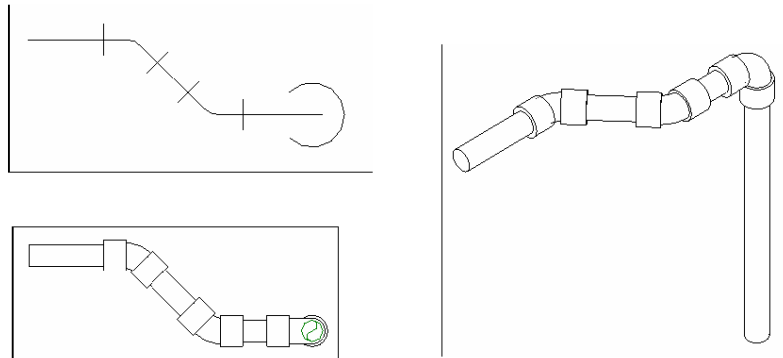
247 On the Options Bar, do the following:

- For D: (diameter) select 80 mm.
- Verify that the Offset elevation is specified at 2750.0 mm

248 In the drawing area, draw some piping, using various angles and offset elevations.

NOTE Remember that if errors occur during fitting insertion, it is usually because the specified pipe diameter was not in the Threaded Generic Elbow lookup table file.

249 On the View Control Bar, for Detail Level, click Coarse, Medium, and Fine to see how the new elbow fitting geometry displays in both the floor plan and the 3D views.



You have verified that the threaded elbow fitting was correctly inserted, that the pipe was created in the correct direction away from the elbow, and that the detail level geometry displayed properly. Next, you check connectivity.

Check connectivity

250 Place the cursor over the piping, and press *Tab* to check connectivity.

The piping highlights indicating that it is connected.

251 On the Selection panel, click Modify to end the command.

Hide shape handles

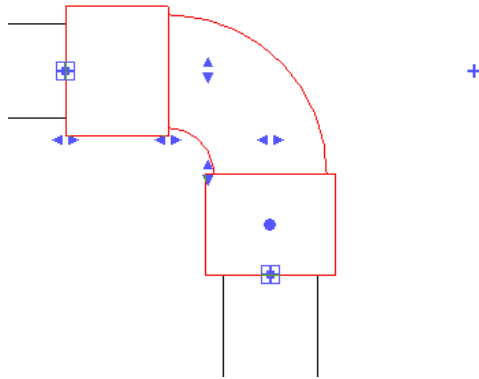
252 In the Project Browser, double-click the 1 - Mech view to make it the active view.

253 In the drawing area, select an elbow from your test piping layout.

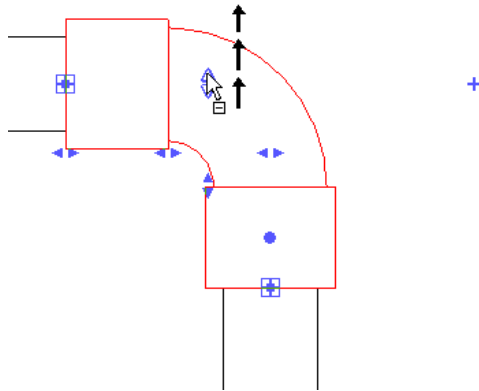
254 Enter **ZR**, and draw a zoom region around the elbow.

Notice that triangular and dot shape handles display on the elbow along with the 2 connectors.

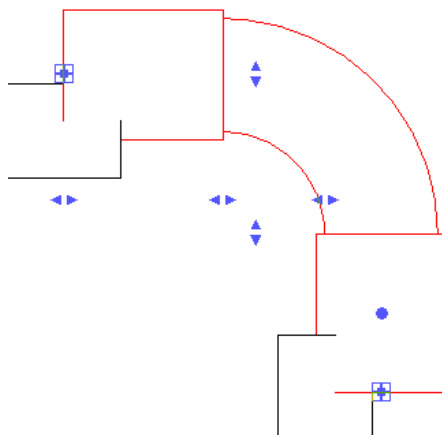
Refer to Keyboard Shortcuts in the Revit MEP Help for more information on using keyboard commands.



255 Drag the upper triangular shape handle upward as shown.




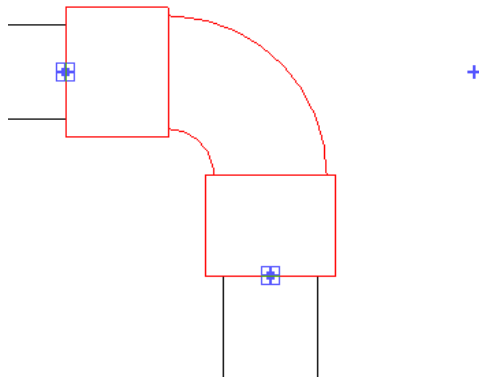
Notice that this shape handle modified the fitting geometry.



Other shape handles can modify aspects of the fitting such as location. These modifications can violate the design intent of the elbow fitting.

IMPORTANT Shape handles are not used for Revit MEP system families but they display by default when you create a new family. If shape handles are not hidden and they are inadvertently dragged during your modeling session, the geometry or placement of the family will be adversely affected. This can create unexpected results, especially for duct fittings. This is because, unlike pipe fittings, duct fittings use formulae that reside in the family rather than in an external lookup table file to determine size. It is highly recommended that you hide all shape handles for Revit MEP families before using them in a project. To hide the shape handles in a system family, you need to open the family in the Family Editor and specify the Is Reference instance parameter as Not a Reference for all reference lines and all reference planes that are used for that family.

- 256** Press **CTRL+Z** to undo the modification.
- 257** Click **View** tab ► **Windows** panel ► **Switch Windows** ► **M_Threaded - Generic Elbow.rfa - Floor Plan: Ref. Level** to switch to the elbow family floor plan view.
- 258** In the drawing area, cross-pick (drag from right to left) to select everything in the drawing, including reference planes.
- 259** Click **Multi-Select** tab ► **Filter** panel ► **Filter**.
- 260** In the Filter dialog, click **Check None**, select **Reference Planes**, and click **OK**.
Only the reference planes are selected.
- 261** On the **Element** panel, click **Element Properties**.
- 262** In the **Instance Properties** dialog, under **Other**, for **Is Reference**, select **Not a Reference**, and click **OK**.
- 263** Using the same method, specify **Not a Reference** for all reference lines.
- 264** Click  ► **Save** to save the family.
- 265** Click **Create** tab ► **Family Editor** panel ► **Load into Project**.
If more than one project is open, in the **Load into Projects** dialog, select the test project in which you tested the elbow fitting, and click **OK**.
- 266** After a message informs you to overwrite the existing version of the threaded generic elbow, click **Override parameter values of existing types**, and click **Yes**.
The test project becomes active.
- 267** In the **1 - Mech** floor plan view, zoom in and select an elbow from your piping layout.
Notice that all shape handles are hidden.



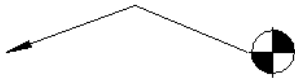
The threaded elbow is ready to be used in a project.

RELATED Although the physical geometry of this fitting is accurate, it is inconsistent with a real-world threaded elbow in that the connectors on this elbow fitting are on the outer face of the threaded portion of the fitting. This prevents the pipe from engaging the fitting. You can use the Hidden Line model graphics style to verify this. If the part were modeled so that the pipe engaged the fitting, proper performance of Revit MEP would be impacted due to the way hidden lines are calculated and drawn.

Creating an Annotation Symbol Family

13


In this tutorial, you create an annotation symbol family. For example, for your project, you may need to create an annotation symbol that is not part of a building model, such as a New to Existing Connection callout.



Skills used in this tutorial:

- Creating an annotation symbol family from a template
- Loading, inserting, and testing the symbol in a sample project

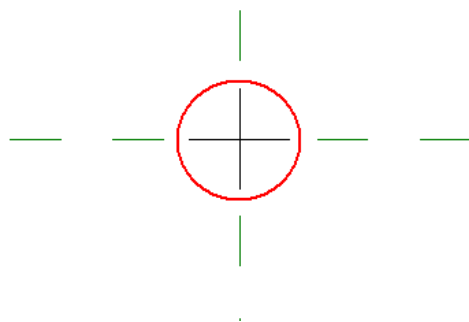
Creating an Annotation Symbol Family

- 1 Click  ► New ► Family.
- 2 In the New Family - Select Template dialog, select M_Generic Annotation.rft, and click Open.
The Family Editor opens.
- 3 Maximize the window, and in the drawing area, zoom in to view the note (located near the intersection of the reference planes).
This note contains key points to remember when creating an annotation family.
- 4 Select the note and delete it.
- 5 Enter **ZR**, and draw a zoom region around the intersection of the 2 reference planes.

Draw lines

Now you will draw lines to create the basis of the annotation symbol.

- 6 Click Create tab ► Detail panel ► Line.
- 7 Click Place Lines tab ► Element panel and verify that Generic Annotations is selected from the Type Selector drop-down.
- 8 Click Create tab ► Detail panel ► Line.
- 9 On the Options Bar, do the following:
 - Clear Chain.
 - For Offset, verify that 0.0 is specified.
 - Verify that Radius is cleared.
- 10 Click the intersection of the 2 reference planes to specify the line start point, move the mouse to the right, and after listening dimensions appear, enter **3**, and press *Enter*.
This creates a 3 mm line to the right of the intersection. The line is over the reference line.
- 11 Click Place Lines tab ► Selection panel ► Modify to end the command.
- 12 Using the same method, draw 3 more 3 mm lines located above, below, and to the left of the intersection as shown.



TIP You can also mirror the opposite lines instead of drawing them.

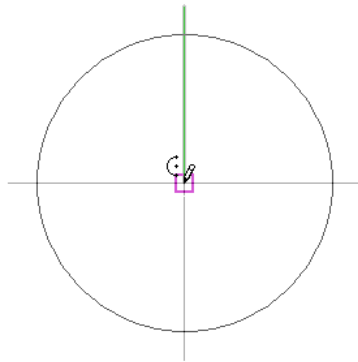
- 13 In the drawing area, while pressing *CTRL*, select the 2 reference planes.
- 14 On the View Control Bar (located at the lower-left under the drawing area), click Temporary Hide/Isolate ► Hide Element.
This hides the reference planes allowing you to display the drawn lines.



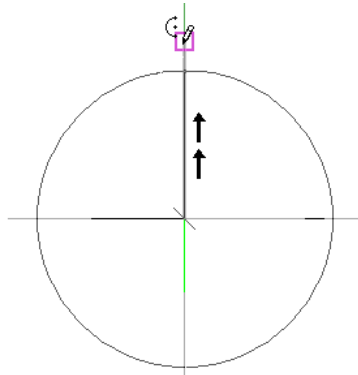
Create filled regions

Now you will create the filled regions for the annotation symbol.

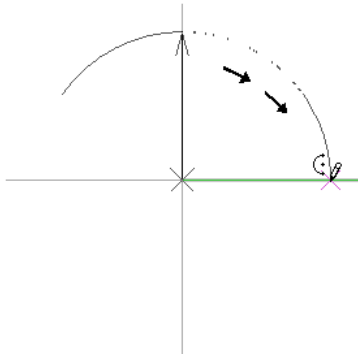
- 15 Click View tab ► Graphics panel ► Thin Lines. Using thin lines enables easier line selection and more precise line placement.
- 16 Click Create tab ► Detail panel ► Filled Region.
- 17 Click Create Filled Region Boundary tab ► Draw Panel and verify that Lines is selected.
- 18 Click Place Lines tab ► Element panel and verify that Generic Annotations is selected from the Type Selector drop-down.
- 19 Click Create Filled Region Boundary tab ► Draw panel ► Center-ends Arc to select the center-ends arc command.
- 20 On the Options Bar, do the following:
 - Click Radius, and enter **2.5 mm**.
- 21 Zoom the view, place the cursor over the intersection of the 4 lines, and after the end point snap displays, click to specify the center of the arc.



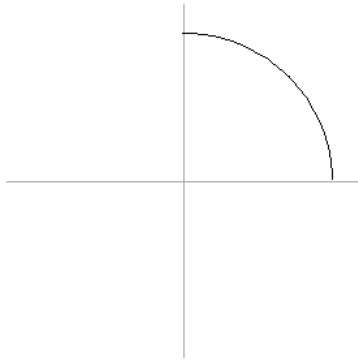
- 22 Move the cursor directly up and over the end of the upper vertical line, and after the end point snap displays, click to specify the start point of the arc.



- 23 Move the cursor over the right horizontal line, and after the intersection snap displays, click to specify the end point of the arc.



An arced line is drawn. Click Create Filled Region Boundary tab ► Selection panel ► Modify to end the command.

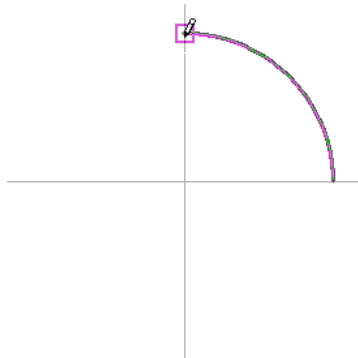


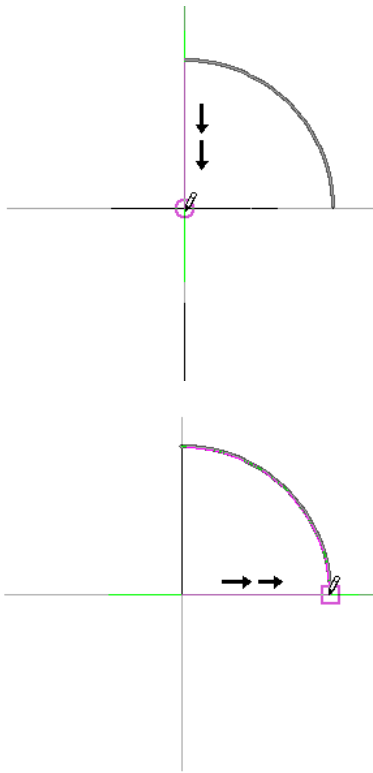
24 Click Create Filled Region Boundary tab ► Draw panel ► Line.

25 On the Options Bar, do the following:

- Verify that Chain is selected.
- For Offset, verify that 0.0 is specified.
- Verify that Radius is cleared.

26 In the drawing area, click the upper end point of the arced line, then click the intersection of the 4 lines, and finally click the lower end point of the arced line.



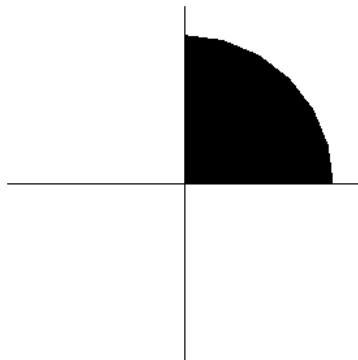


A chain of 2 lines is drawn.

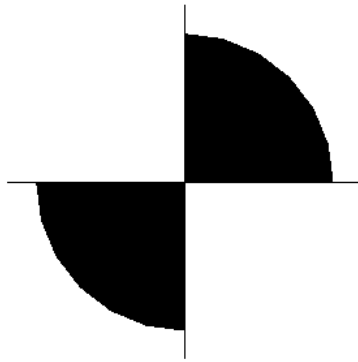
27 Click Create Filled Region Boundary tab ► Selection panel ► Modify to end the command.

28 Click Create Region Filled Boundary tab ► Region panel ► Finish Region.

This filled region is created.



29 Using the same method, draw a filled region on the opposite lower-left quadrant.



Next, you draw a circle around the 2 filled regions.

30 Click Create tab ► Detail panel ► Line.

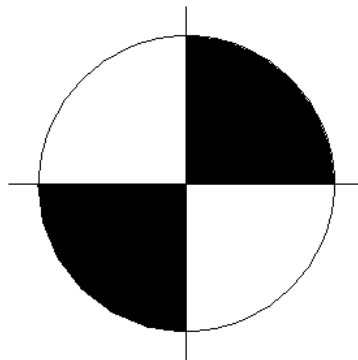
31 Click Place Lines tab ► Draw panel ► Circle.


32 On the Options Bar, do the following:

- For Offset, verify that 0.0 is specified.
- Click Radius, and verify that 2.5 is specified.

33 In the drawing area, place the cursor over the intersection of the 4 lines, and after the end point snap displays, click to specify the center of the circle.

34 Click Places Lines tab ► Selection panel ► Modify to end the command.



35 Click  ► Save As ► Family, and save the family as **M_New to Existing.rfa**.

Test the annotation symbol in a project

36 Click  ► Open.

37 In the left pane of the Open dialog, click the Training Files icon.

38 Open Metric ► Family Editor ► m Sample Project.rvt.

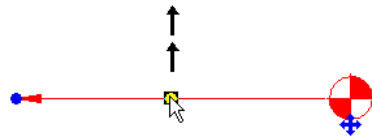
39 Click View tab ► Switch Windows ► M_New to Existing.rfa - Drawing Sheet to switch to the new annotation symbol family.

40 Click Create tab ► Family Editor panel ► Load into Project.

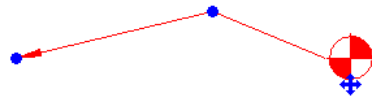
41 In the Project Browser, expand Views (Discipline) ► Mechanical ► HVAC ► Floor Plans, and double-click 1 - Mech to make it the active view.

42 Click Annotate tab ► Detail panel ► Symbol.

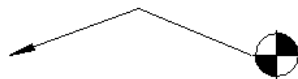
- 43 Click Place Symbol tab ► Element panel and verify that in the Type Selector drop-down M_New to Existing is selected.
- 44 Click Place Symbol tab ► Element panel ► Element Properties drop-down ► Instance Properties.
- 45 In the Instance Properties dialog, click Edit Type.
- 46 In the Type Properties dialog, under Graphics, for Leader Arrowhead, select Arrow Filled 15 Degree, and click OK twice.
- 47 On the Options Bar, for Number of Leaders, enter 1.
- 48 In the drawing area, zoom in, and click to place the annotation symbol in the project.
- 49 Press *ESC* twice.
Next, you modify the symbol leader.
- 50 Select the leader to display shape handles.




- 51 Drag the middle shape handle up to modify the middle of the leader.



- 52 Drag the end shape handle to modify the annotation symbol as shown.



- 53 Select the symbol, and drag the cross-arrows to relocate the symbol.
- 54 Click  ► Close. You do not need to save the project.

