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BES227181-L

Perfecting the System for Revit – Piping System Exercises

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Gannett Fleming

Learning Objectives

- Learn comprehensive steps for controlling project system settings, including mechanical and electrical system project settings
- Learn how to capitalize on the system sizing and analysis tools, and learn how to maximize project performance when you don't need these features
- Understand how to create the target and source relationship between equipment without routing a duct, pipe, or wire
- Learn how to improve the quality of your construction documents by capitalizing on system-based features

Description

Revit software systems help us to define the MEP (mechanical, electrical, and plumbing) design in several ways, but the main purpose is to understand the relationships between system equipment, such as air terminals to air handling units, or from light fixture to panel. This hands-on lab will teach you the comprehensive steps needed for controlling project system settings, and then it will demonstrate how to capitalize on (or disable) sizing and analysis tools related to the system. We'll cover creating the target-source relationship between parts, and then we'll review using the systems to improve the quality of your documentation. On top of this, you'll get a project template that already defines everything in the class, so you can take advantage of these topics right away. The class will cover HVAC (heating, ventilating, and air conditioning) and piping, so come and join us for this fast-paced but thorough lab—you'll be glad you did! This session features Revit MEP and Revit.

Your AU Expert

David Butts is an Autodesk Expert Elite Team member and Building Information Modeling (BIM) specialist for Gannett Fleming with over 30 years of experience in the architecture, engineering, and construction field. He is responsible for implementation, training, BIM project support, and management for engineering design applications, including Revit, AutoCAD P&ID, AutoCAD MEP, Navisworks, and more. He was an Autodesk Authorized Training Center (ATC) training manager and application engineer for an Autodesk Reseller for 13 years, providing implementation and training services across the United States, and serving as a subject matter expert for Autodesk, Inc.'s, Building Design Solutions. He has design experience for a variety of project types, and is an Autodesk University top-rated speaker for labs and lectures. He authored training videos for 4D Technologies through the 2018 product cycle and presents BIM topics for other industry associations annually.

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Perfecting the Piping System for Revit

When you are designing a project, there's a big difference in how you approach your work in CAD project versus a BIM project. In BIM there are tasks you have to complete that never came up in a 2D project, but then there was a high likelihood of signals getting crossed, and systems being incorrectly defined. Revit's system and circuit tools, which have been around since the beginning of the MEP tools, continue to be refined and improved. That is the focus of this session, and hopefully you will take away some information to help you leverage the benefits for these tools.

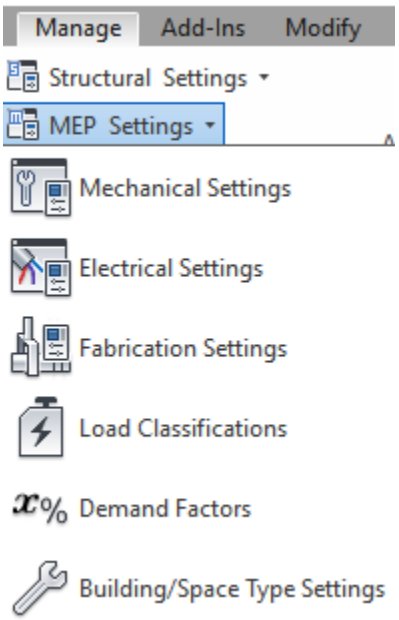
In this document, the specific steps for editing PIPING system settings, and creating the systems, are covered. Refer to the document, *BES227181-L Perfecting the System Intro - DB*, for the work process overview.

For this exercise, begin by opening the **BES227181-L-MEP.RVT** model. Make sure the **PIPE FIRST FLOOR** view is the current view.

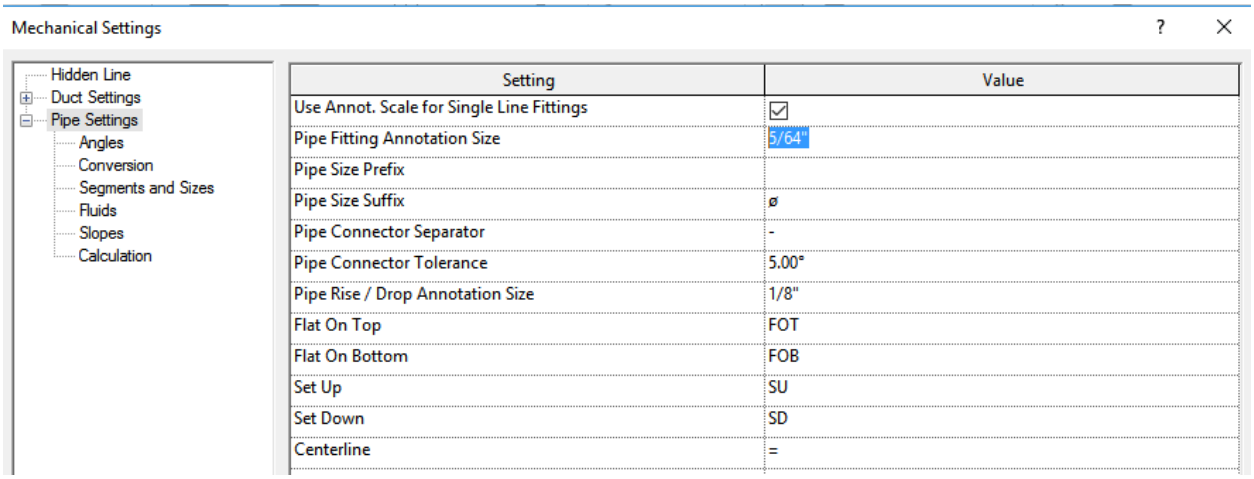
Defining Project Piping System Settings

When you start from a template, you can include predefined settings that apply to the most common project types. Behind the scenes, there are common project tools that impact how pipe, pipe, circuiting and more are defined in the project model, so it is a logical place to start when working with systems. To begin, review the MEP project settings that affect all systems in the project.

1. From the **Manage** tab, settings panel, click **MEP Settings**:

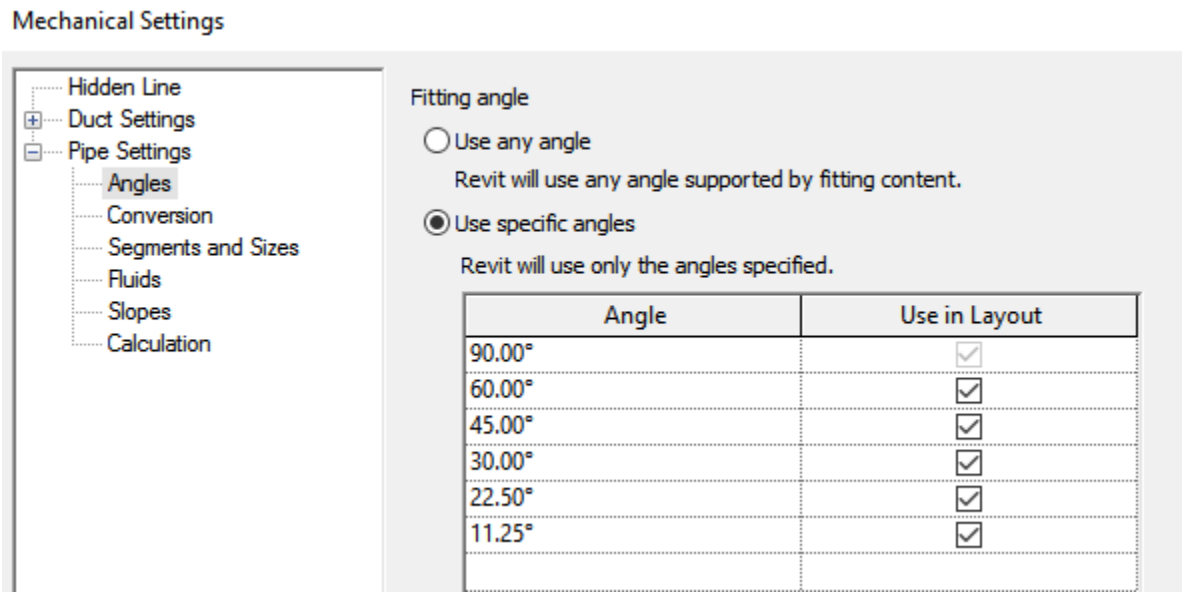


2. Click **Mechanical Settings**, and then click **Pipe Settings**:



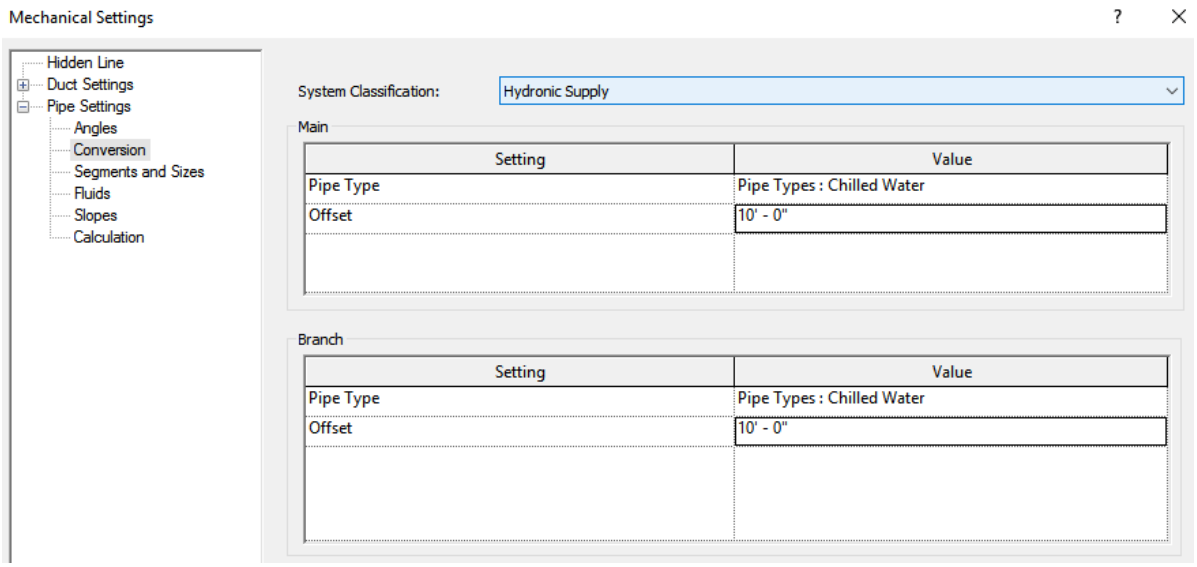
Set the **Pipe Fitting Annotation Size** to **0.0765**.
Pipe Fitting Annotation Sizes are project specific settings used in piping graphics, based on the detail level of the view.

3. Select **Angles:**



Select **Use Specific Angles** as the default for pipe elbow fitting settings, and leave the default settings as-is. This forces all pipes in a project, included layouts defined by the system, to be placed in specific angle increments.

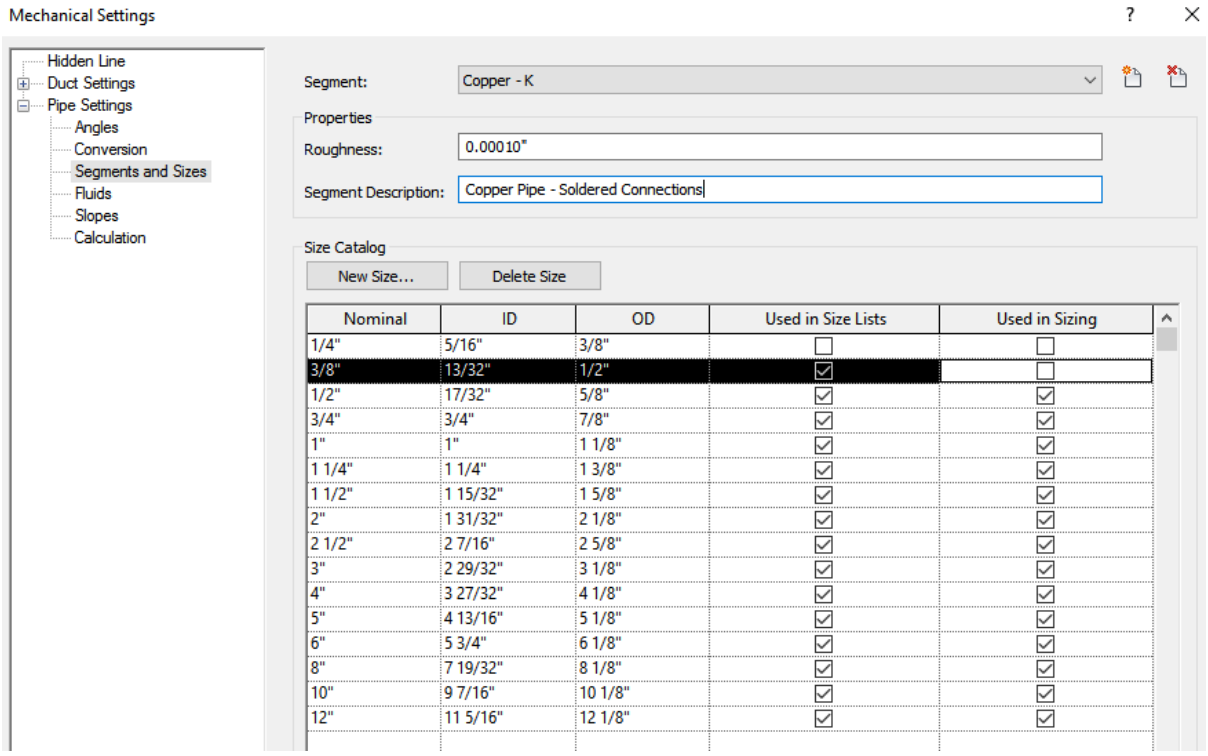
4. Select **Conversion:**



Change the **System Classification** to **Hydronic Supply**. Set the pipe type for Main and Branch to Chilled Water, and the offset elevation to 10'-0".

This sets the default pipe type and routing offset elevation for mains and branches, and comes in handy when using the auto-layout tools for connected piping system classifications (based on the default pipe system classifications).

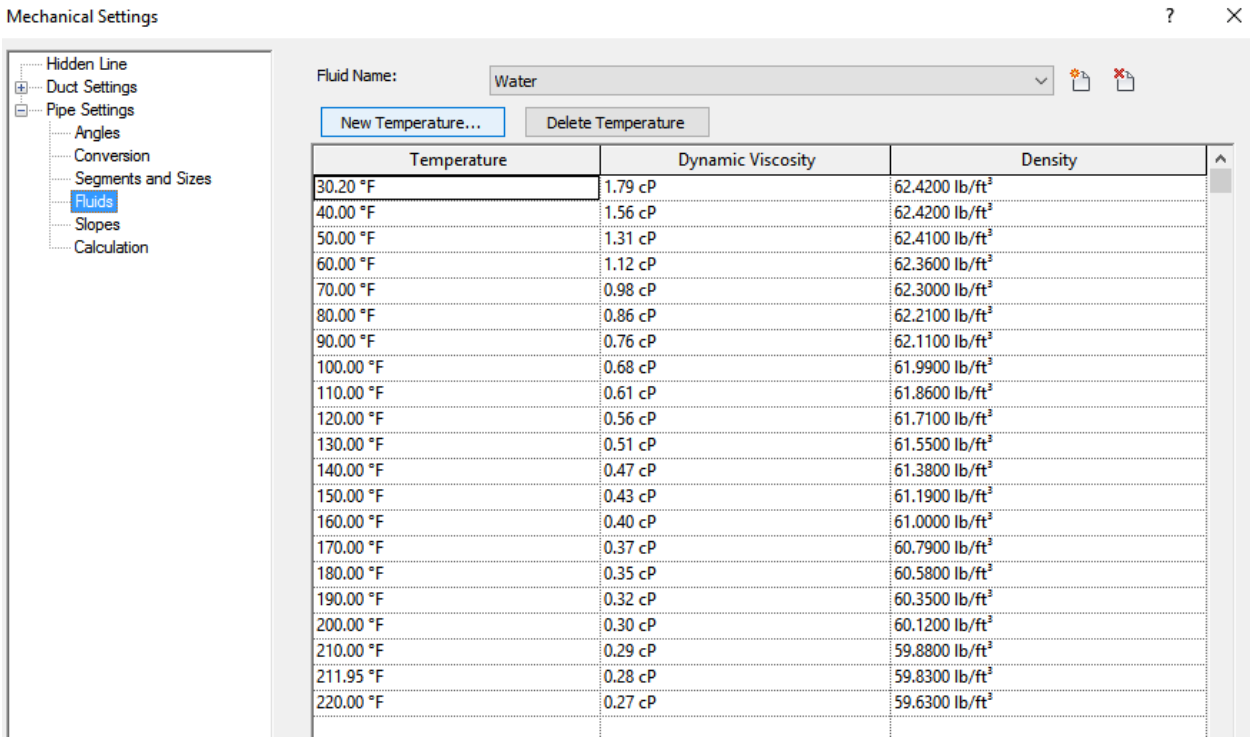
5. Select **Segments and Sizes:**



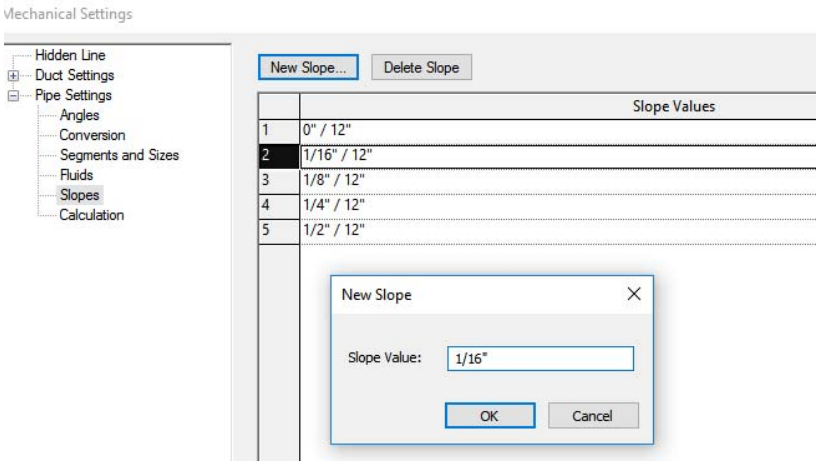
Make sure **Copper K** is the default segment. For the **Segment Description**, enter **Copper Pipe – Soldered Connections.** Deselect the **1/4”** and **3/8” sizes** from the **Used in Size Lists** and **Used in Sizing** columns.

Segments and sizes allows you to define piping by material, and then assign the nominal, inside and outside diameters of the pipe. You can also adjust the roughness of the pipe, which is used as part of the pipe sizing tool.

6. Select **Fluids.** Review the fluid name types and temperature ranges settings – leave these as is, as the values are correct for density and dynamic viscosity. You can add new fluid values as needed:

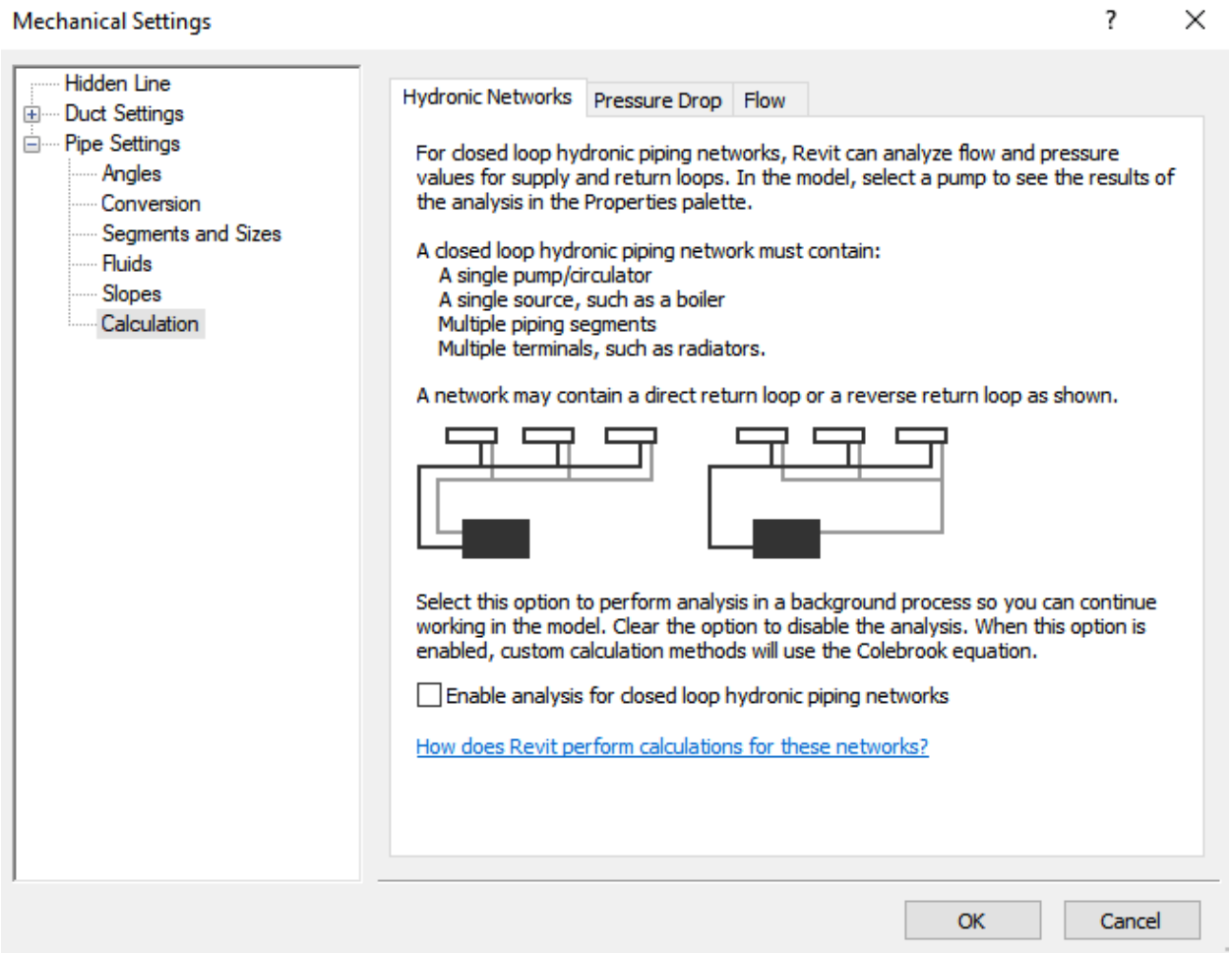


7. Select **Slopes.**



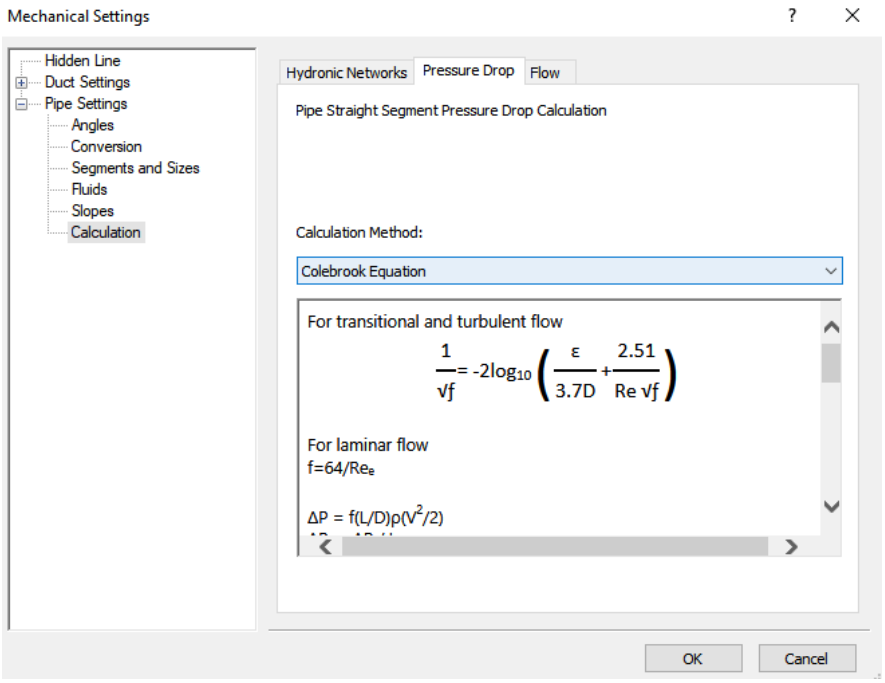
Click **New Slope** and then enter **1/16”.** The new size will automatically include the **run** value. The slope will be available when the pipe routing solutions are available.

8. Select **Calculation:**



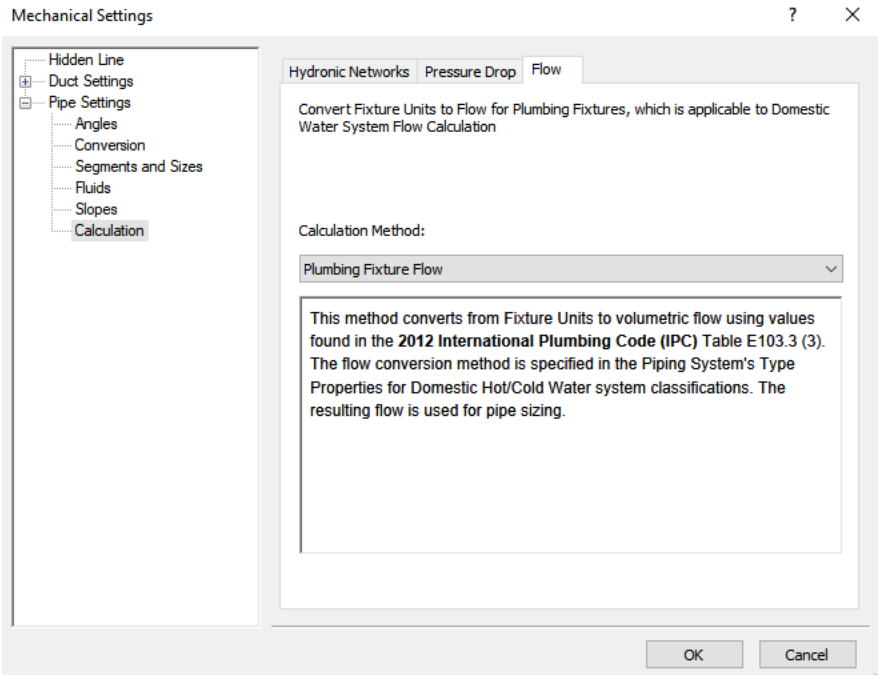
The settings allow you to set the calculation method for closed loop hydronic piping networks, for calculating pressure drop, and calculating flow based on fixture units for domestic water and sanitary systems.

Click **Pressure Drop**. For **Calculation Method**, select the **Colebrook Equation** pressure drop calculation.



In earlier releases, you could only use the built in formulas while making minor modifications in the pipe system. Now, you can choose between different methods and formulas to calculate pressure drop based on the *Colebrook, Haaland* and *Simplified Colebrook* equations.

Click **Flow**:



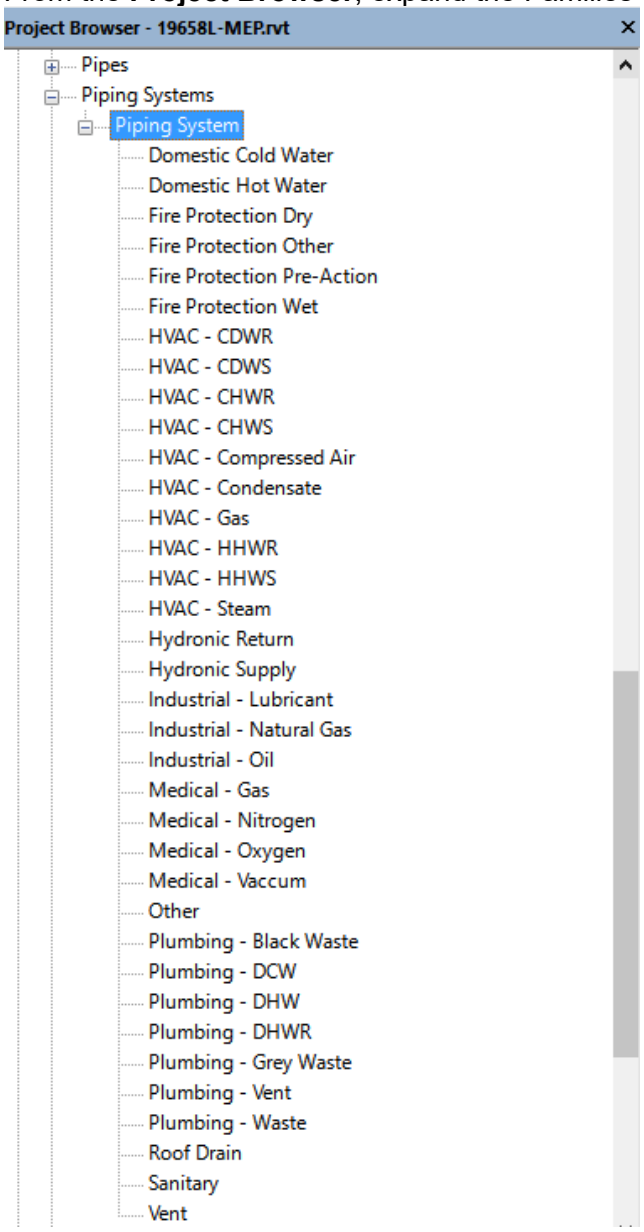
The **plumbing fixture flow** calculation method is based on the **2012 IPC table values**, and is the only method available.

Click **OK** to close the dialog and save the changes.

Defining Project Piping System Types

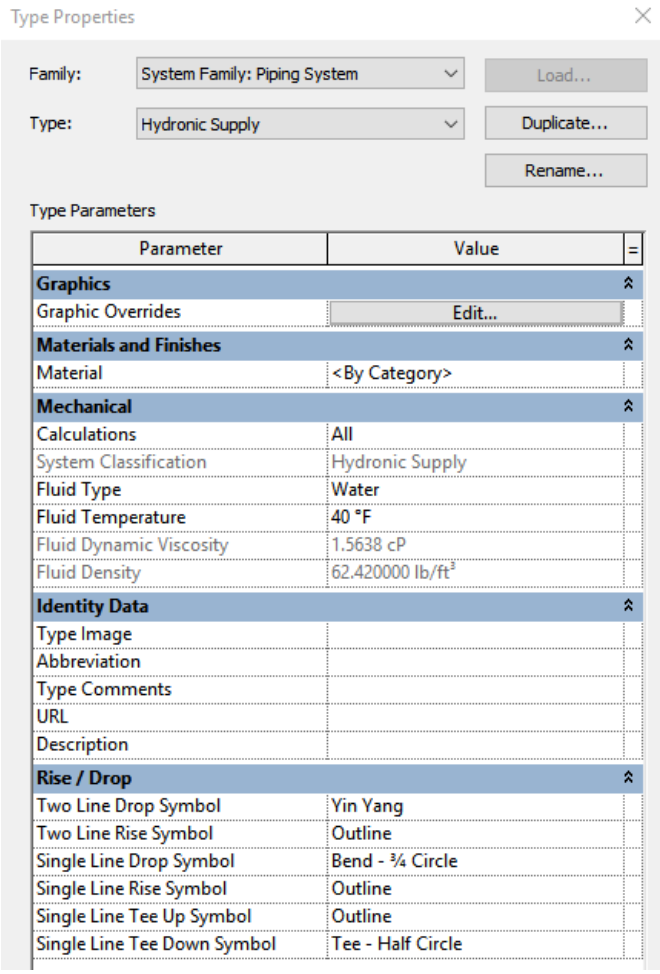
Revit gives you the ability to add your own system types, which are based on predefined system classifications. While the classifications control the calculations used, the type lets you define specific settings, such as whether calculations are performed, the graphics settings that appear in a view, the abbreviation used in a label, and rise/drop symbology. The system types can be predefined in a project, and are accessed using the Project Browser tool.

1. From the **Project Browser**, expand the Families section, and expand **Pipe Systems**:

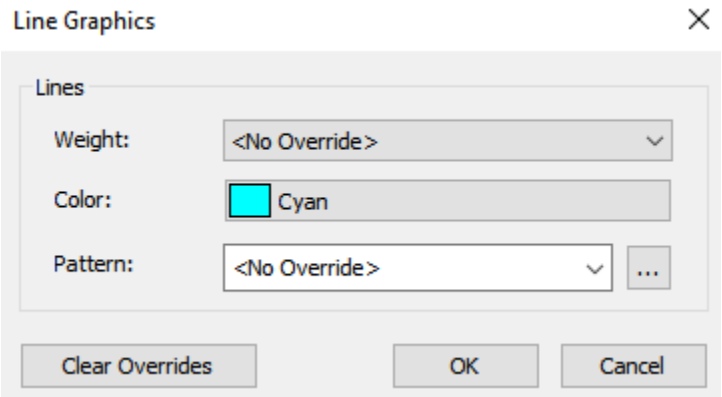


These are examples of **pipe system types** that can be used in a project, and can be added to your project template using the **Transfer Project Standards** tool located on the **Manage** tab from this project when you get back to the office.

2. Double click on **Hydronic Supply** to open the **type properties:**



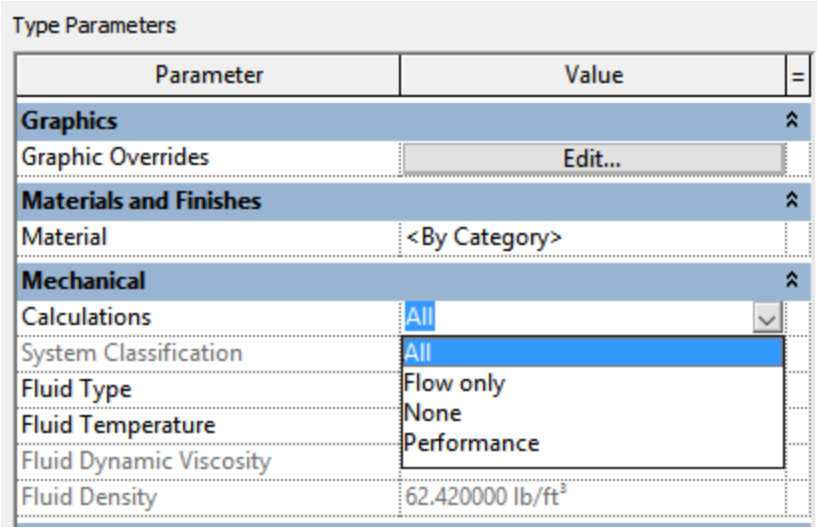
3. Click **Edit** for **Graphics Overrides:**



Select **Color**, and then choose **Cyan** as the color for the line graphics. Click **OK** to exit the Line Graphics dialog.

This will override the default object style settings for any view the pipe appears in (but can be overridden by a view filter or object override)

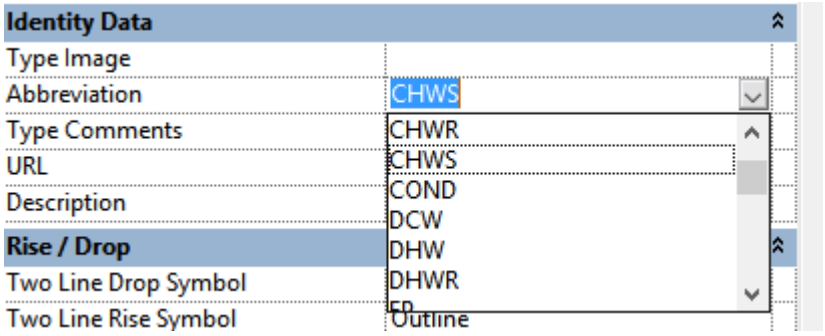
4. Click **Calculations:**



Choose **All** for the default.

If you are not using pipe sizing, leave this set to **None** or **Performance** only. Revit runs calculations as items are placed, and continues running when set to **All**, but P**erformance** only runs calculations on demand. When the **fluid type** and **temperature** is set, the values for dynamic viscosity and density that are defined in the **MEP Settings** tool are populated.

5. Set the **Abbreviation** to **CHWS**:



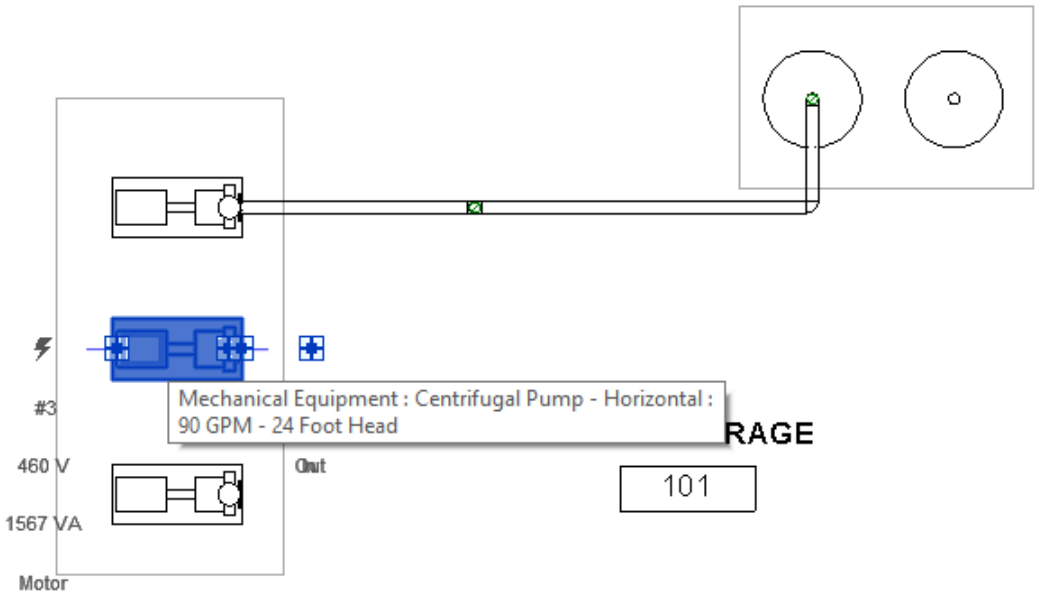
Revit will track the abbreviations stored as a list in a project, allowing you to select from different options as the project progresses.

6. Click **OK** to exit the system type properties dialog.

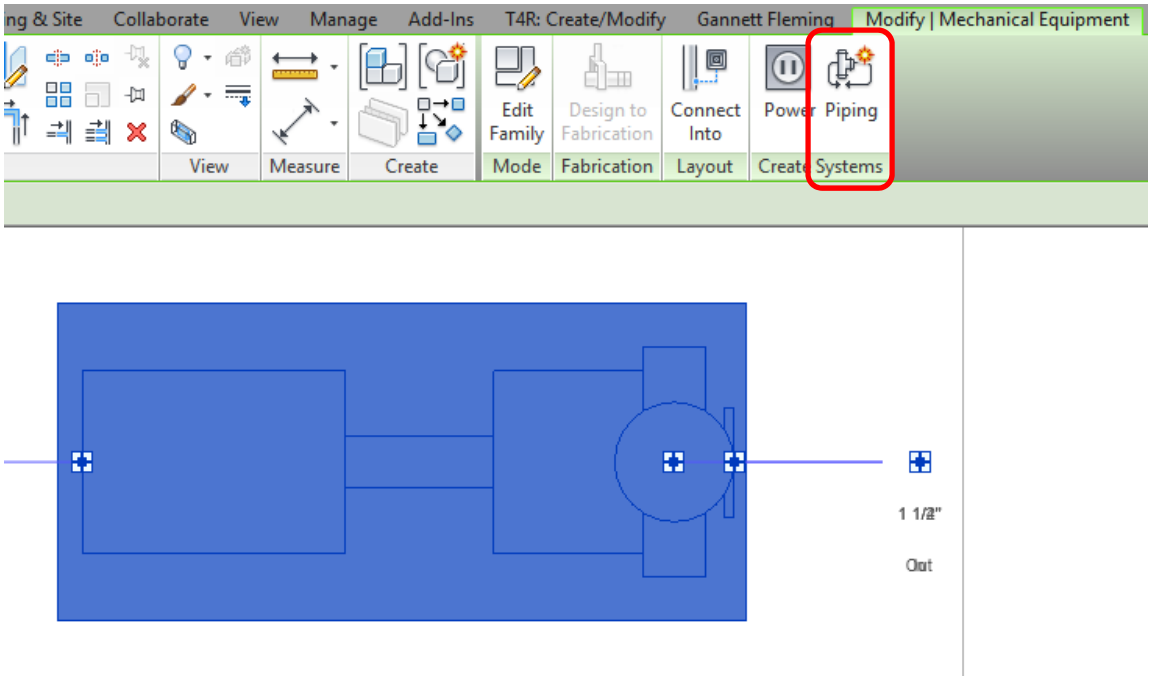
Defining an Piping System

In a project, a system is defined by a target, which is a piece of equipment that receives air, fluid or power. When associated with a system, the target defines the flow or load associated with the system. In order to have a well-formed system, a piece of equipment may be required, and be the source for the air, fluid or power. When sizing systems, a well-formed system is defined by having a target and source associated with each other. When defining the system, the place to start is with the target.

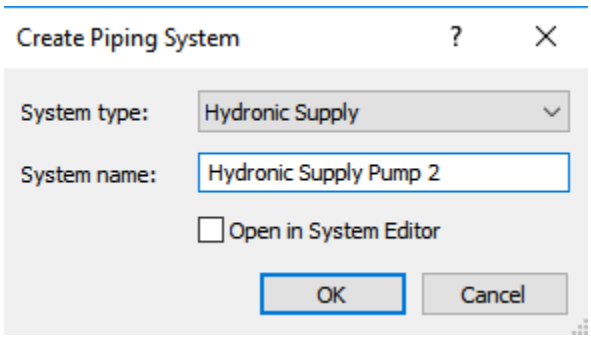
1. From the **PIPING FIRST FLOOR VIEW**, navigate to the Chemical Storage room. Select the **center pump**:



2. Once the pump is selected, click **Piping** from the **Modify | Mechanical Equipment** tab:

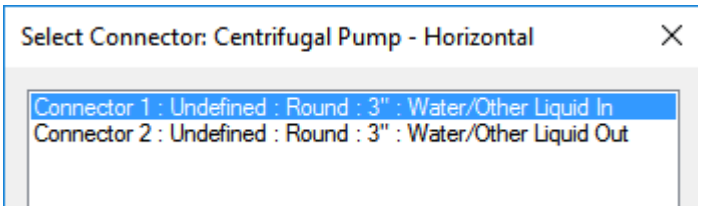


3. When the **Create Pipe System** dialog appears, enter then name **MEETING ROOM SUPPLY AIR**, and then click **OK**.

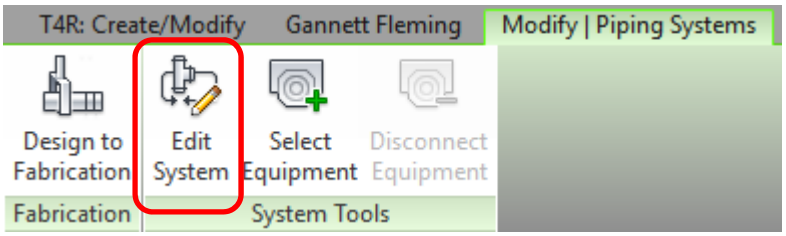


Naming the system makes it easier to track when adding schedules or using the System Browser.

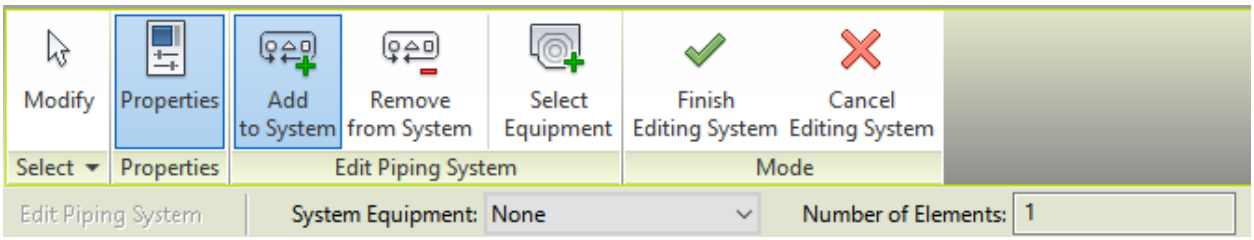
4. When a family has more than one connector, you will be prompted to select the **connection** used to define the system. Select **Connector #1: Undefined: Round: 3": Water/Other Liquid Out:**



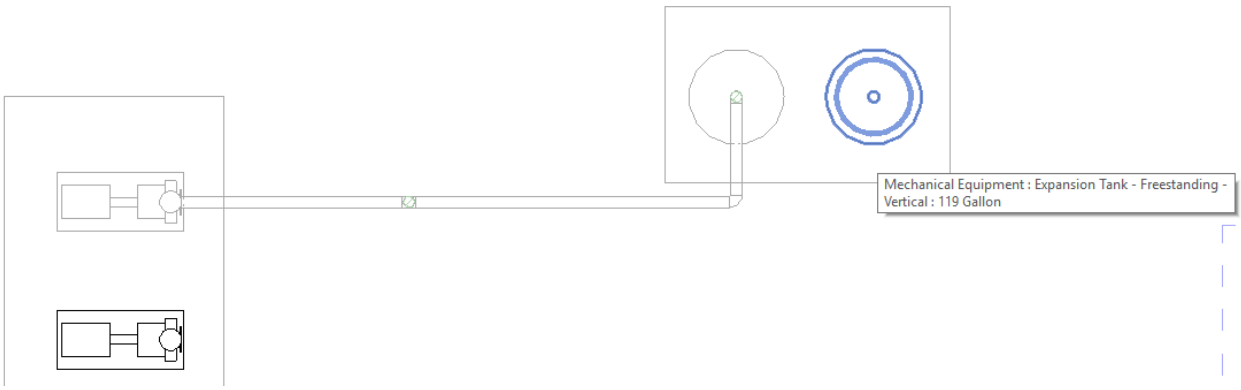
5. Click **OK** to finish defining the system. Next, select the **Edit System** tool from **Modify | Piping Systems** tab, **System Tools** Panel:



The source equipment can be selected at several different points, including the **Modify | Pipe System** tab when the system is first defined, or after the initial system has been created.

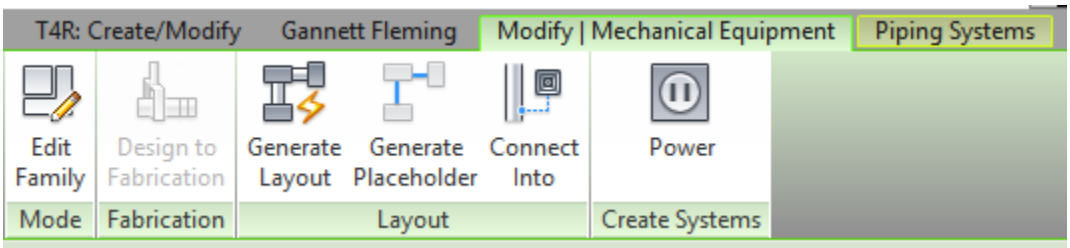


Click **Select Equipment** and then choose the right tank**:**



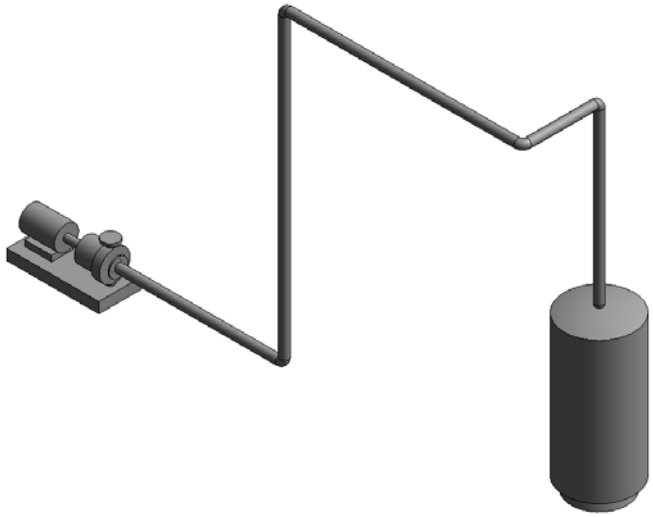
6. Click **Finish Editing System** to complete the command and close the tab.

Note: You can also edit a pipe system by selecting any equipment that belongs to the system, and then clicking the Pipe System tab when it appears:



The system is now a well-formed system, and includes **targets** (the pump) and a **source** (the tank).

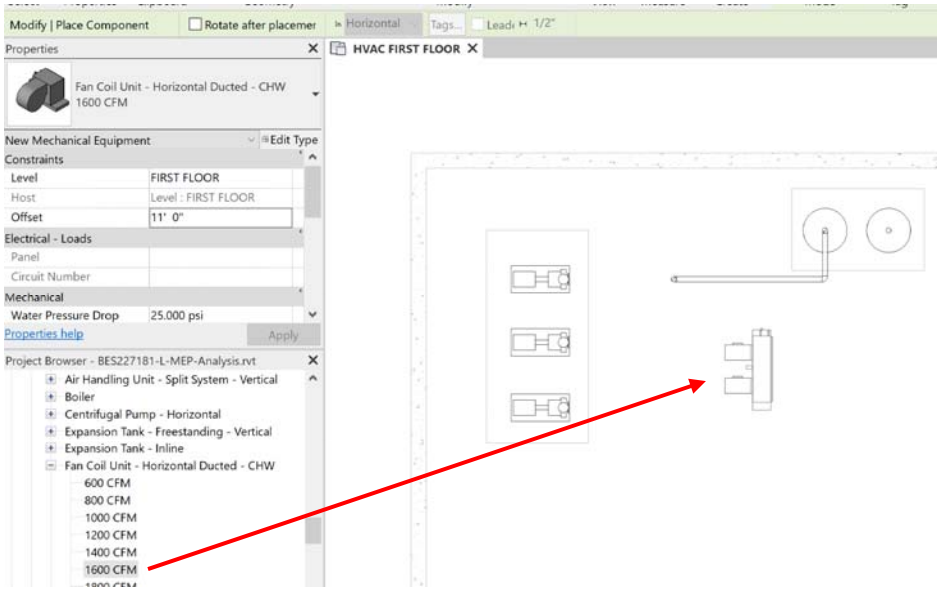
At this point, you can choose to use the **Generate Layout** tool, which uses the system settings to route the pipe based on variety of solutions, or you can **manually** add pipe to the view. When the system is not defined, the act of routing the pipe will create the system – so either method can be used.



Creating an Analytical Pipe Connection

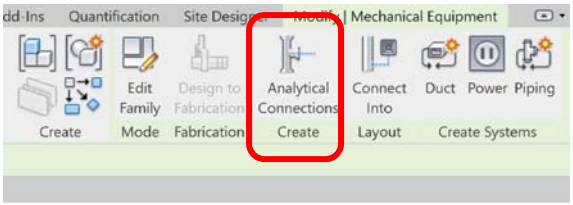
Use the following steps to create an analytical connection between equipment and a pipe run. Use this when you do not want to show higher level of detail pipe connections but want to indicate the connection between equipment that contains a pipe connection, and the main pipe run where it should be connected.

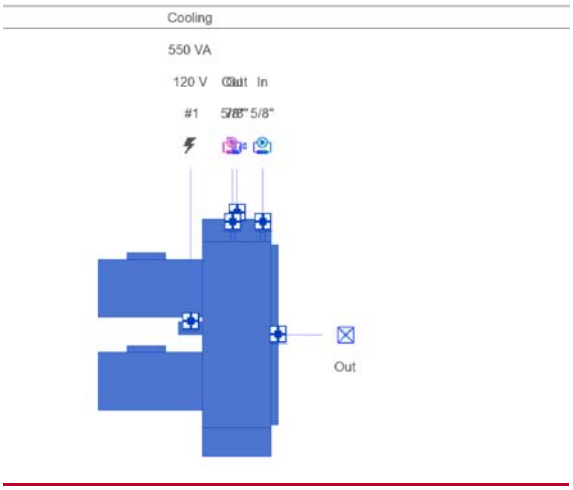
1. In the **HVAC First Floor** view, use the drag and drop feature to place a **Fan Coil Unit – Horizontal Ducted – CHW** family, using the **1600 CFM** type:



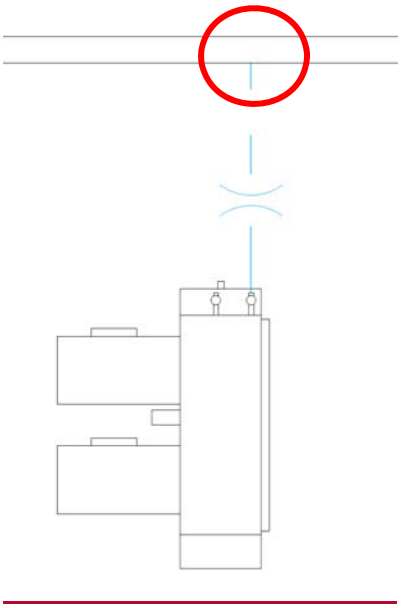
Place the unit 11’ above the First Floor Level. Make sure the unit is rotated so the connections are pointing at the pipe.

2. Select the fan coil unit – from the ribbon, **Modify | Mechanical Equipment** tab, click **Analytical Connections**:

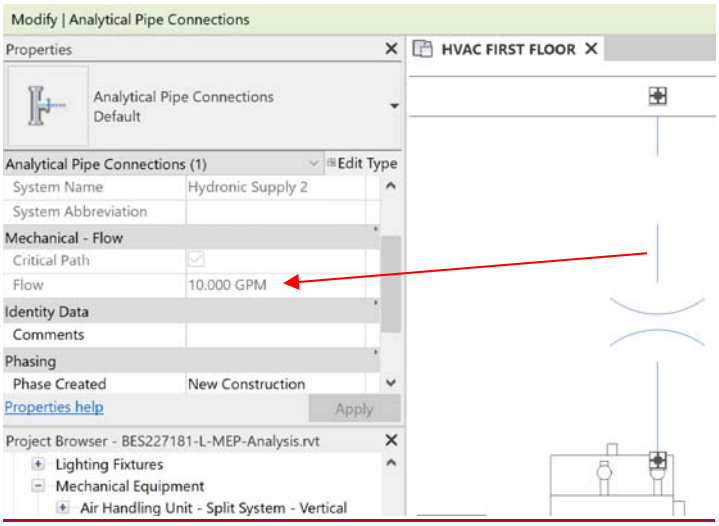




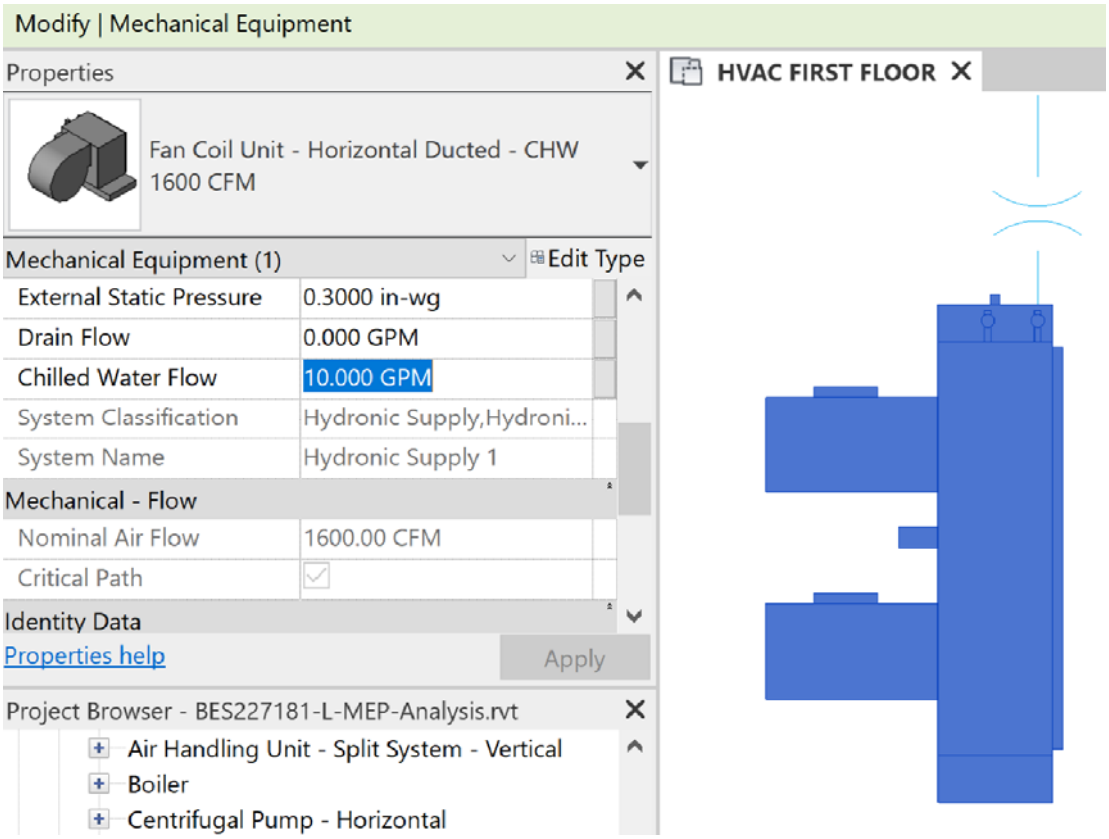
3. Next, select the pipe where the connection should be made. The pipe should be the same **system classification** as a pipe connector in the model – if there is more than one connection, the connection that matches the system classification for the pipe connector is used, and the connection is defined:



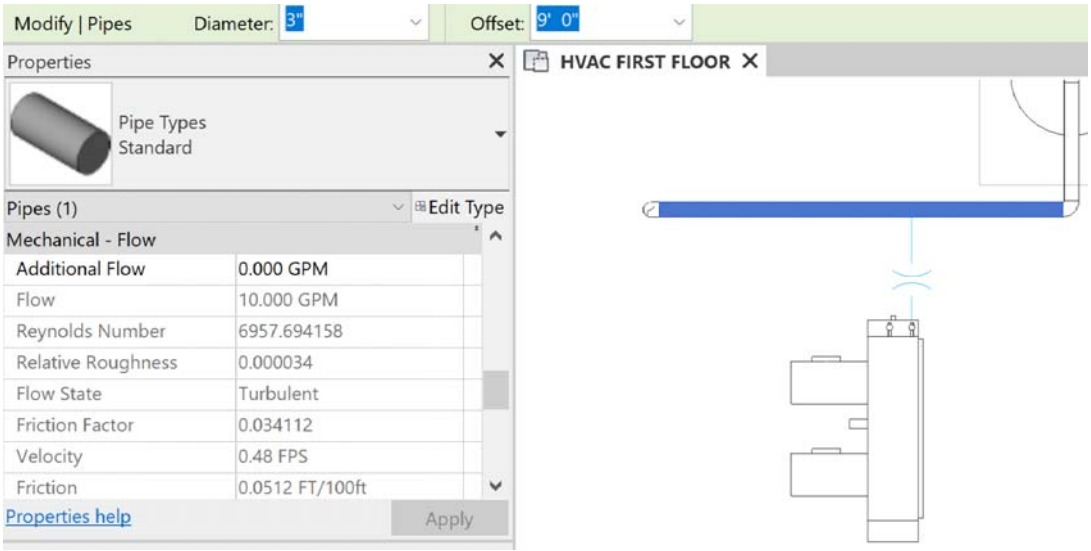
4. Select the analytical pipe connection and review the properties. The flow assigned to the connector is displayed:



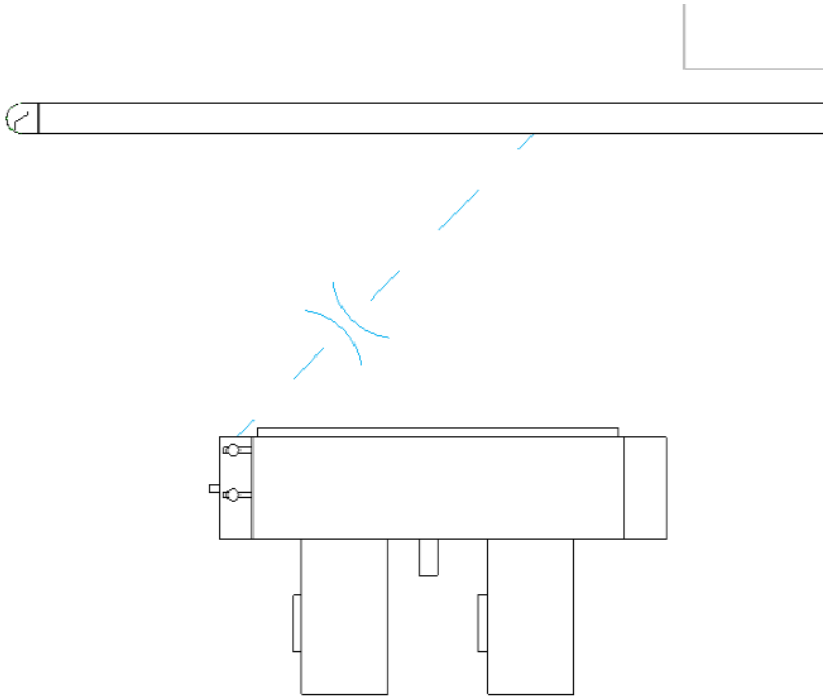
5. To change this value, select the equipment and review the **Chilled Water Flow** instance property. Change the **flow** to **10** gpm:



6. Next, select the **pipe** the analytical connection is associated with, and review the **instance property** for **flow**:



7. Rotate the fan coil unit 90 degrees – the connection will be maintained:

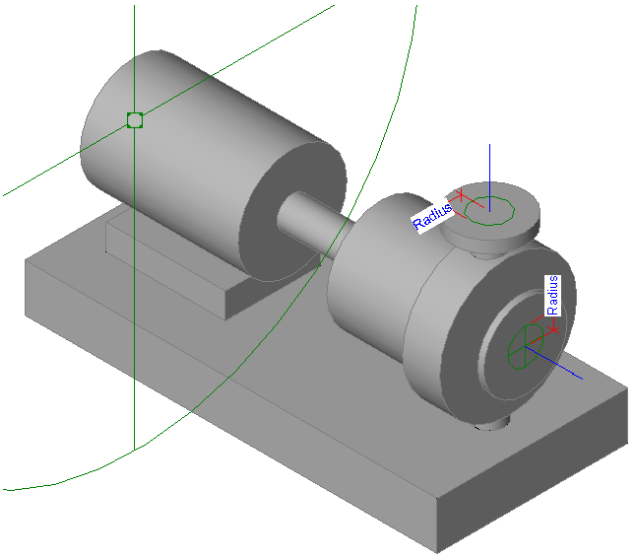


8. The connection can be broken by simply **deleting** the line indicating the connection, which also removes the flow from the pipe.

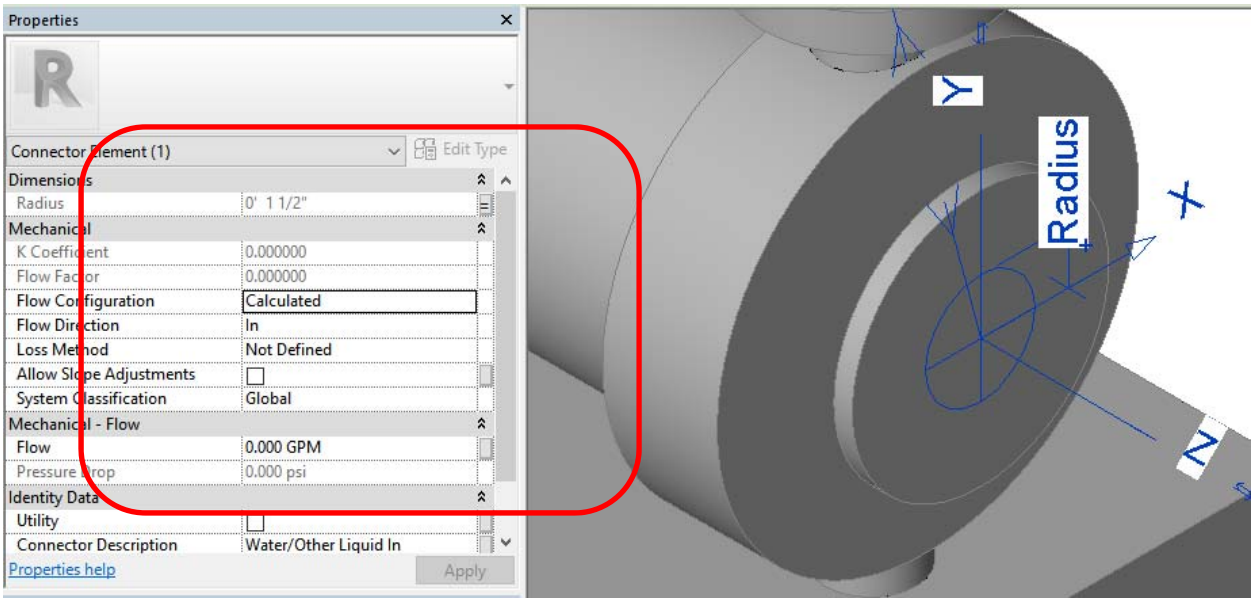
The Role of the Connector

The MEP connector is what distinguishes engineering content from architectural versions. The connector defines the system and key parameters that help share key data needed for analysis and sizing.

The connector is edited in the Revit family. Begin by opening the **Centrifugal Pump – Horizontal.rfa** family by selecting it in the Project Browser, and then right click – select **Edit**.

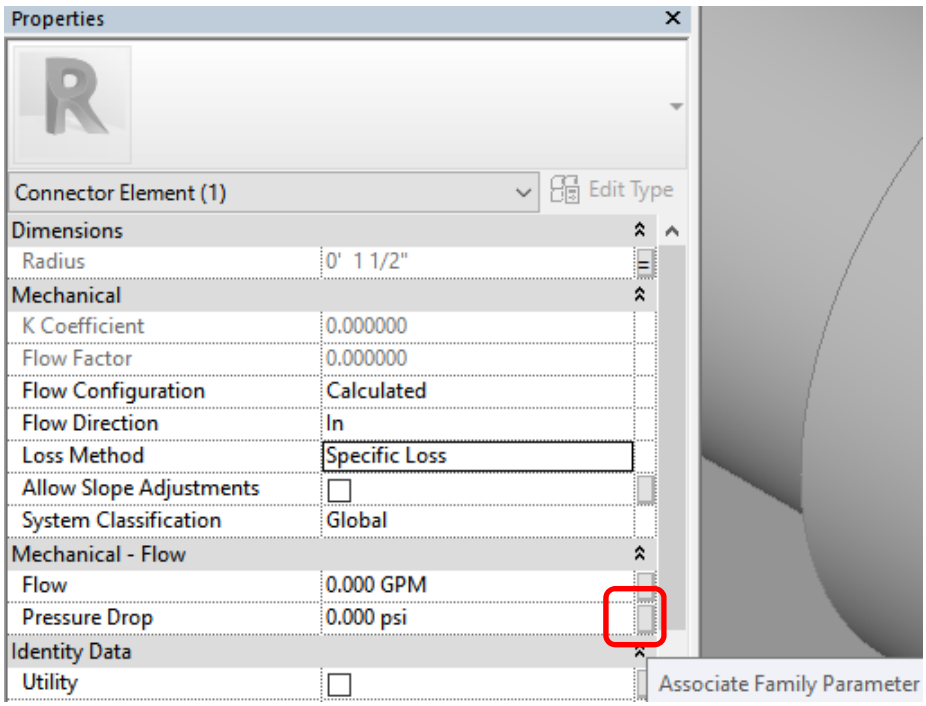


1. From the 3D view, rotate the view to show the **suction connector**. Select the **pipe connector element** and then review the **Properties**:

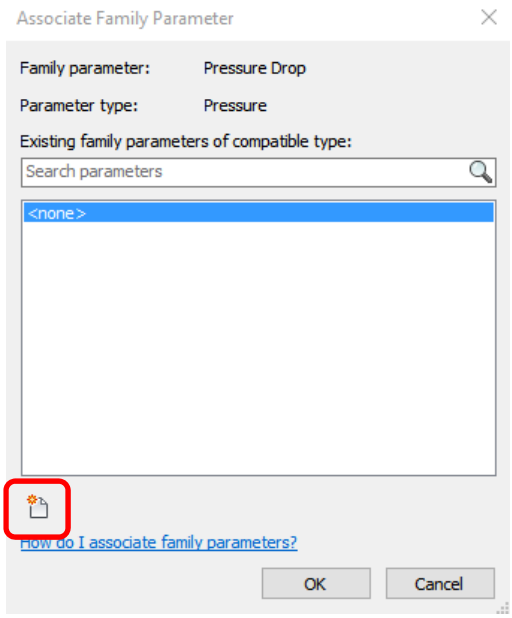


2. The connectors in this family are considered the **child** connection in a system, since the tank is the source (parent). But, a pump can be both a target and source, so it depends on how the connection is defined. If the pump was selected as the source in this system, then it would be considered the parent. Understanding this relationship is key to understand the role of the flow values.
3. **Flow configuration** determines how the flow is calculated, and **flow direction** is the data associated with the connector. For example, the fluid flow is considered *out* from the tank and *in* to the pump suction connection, so leave the direction set to **in**.
4. **Loss method** can be set to **specific pressure loss** (provided by the manufacturer), loss **coefficient** and **not defined**. The last option should only be set when the **system calculation method** is set to **none**. Since this part requires that specific loss value be entered, change the **Loss Method** to **Specific Loss**, so the **Pressure drop** parameter is **active**.

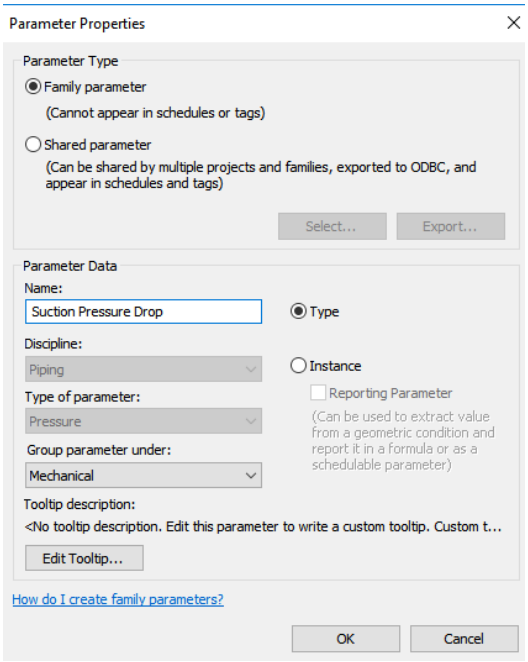
To allow the part to be edited in a project (instead of opening the family to make a change), you must **associate** the parameter to either a family parameter or shared parameter. Select the **icon** on the right side of the **Pressure drop** line in **Properties**:



5. The **Associate Family Parameter** dialog appears. Select the **New Parameter** icon:

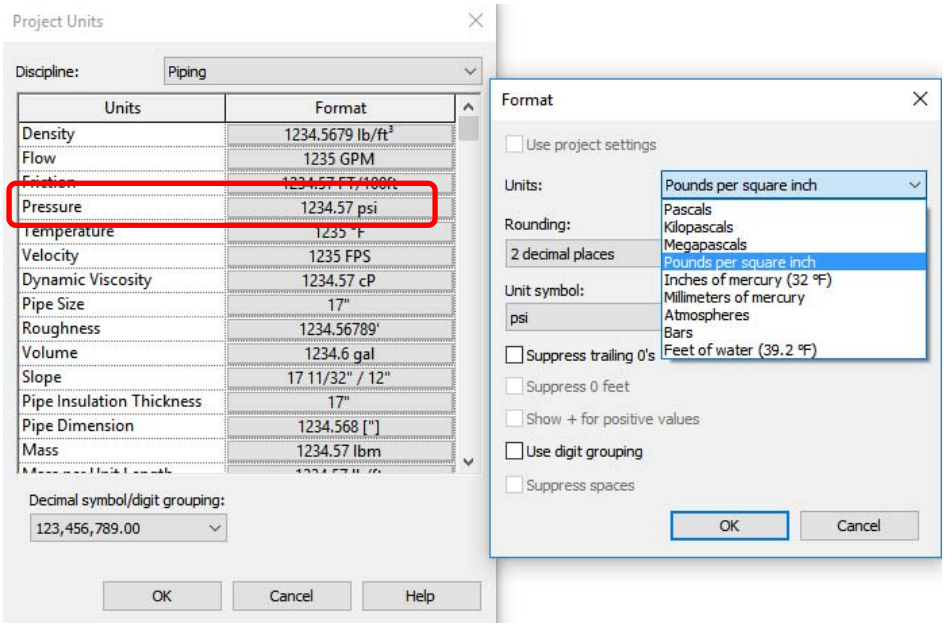


6. The Parameter Properties dialog appears. Normally you would use a shared parameter to control this data, if the information is intended to be included in a schedule. For this class, leave it as a family parameter, so it can still be exposed and edited in a project. Name the new parameter **Suction Pressure Drop**, and leave all of the remaining settings as is:

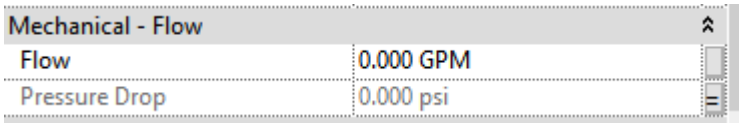


7. Click **OK** to close the dialog and the parameter will be selected in the **Associate Family Parameter** dialog. Click **OK** to complete the command.

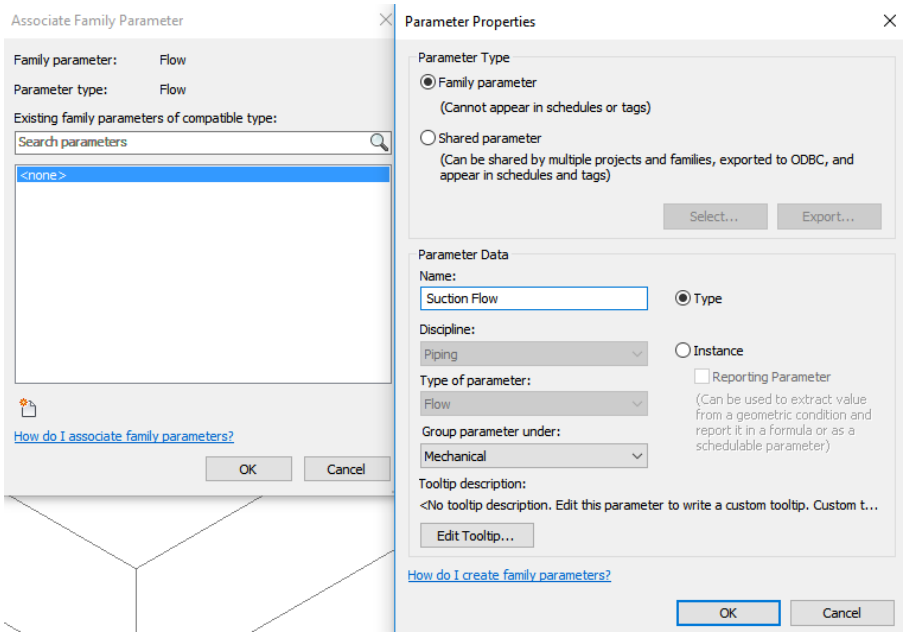
*Note: this value can be changed from "PSI" to other format from the **Manage** tab, **Settings** panel, **Project Units** tool, and selecting the **Piping** discipline, **Pressure value:***



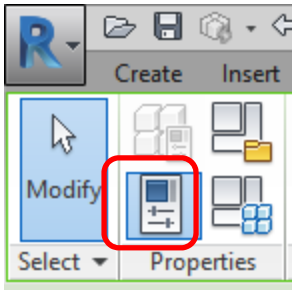
8. After selecting the parameter, the **pre-assigned value** will appear on properties, and will be **greyed out**:



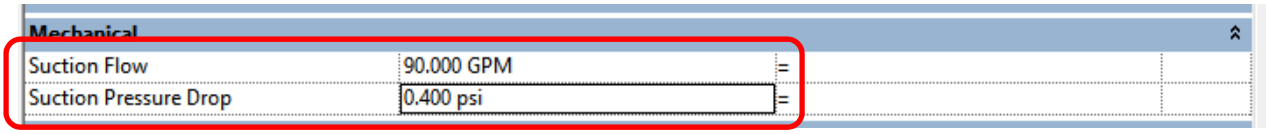
9. Repeat the steps for associating the parameter, and add a family parameter to the **Flow** value named **Suction Flow**:



10. Click OK to save the changes after associating the parameter.
11. To change these values, select the **family types** tool located on the **Properties** panel:

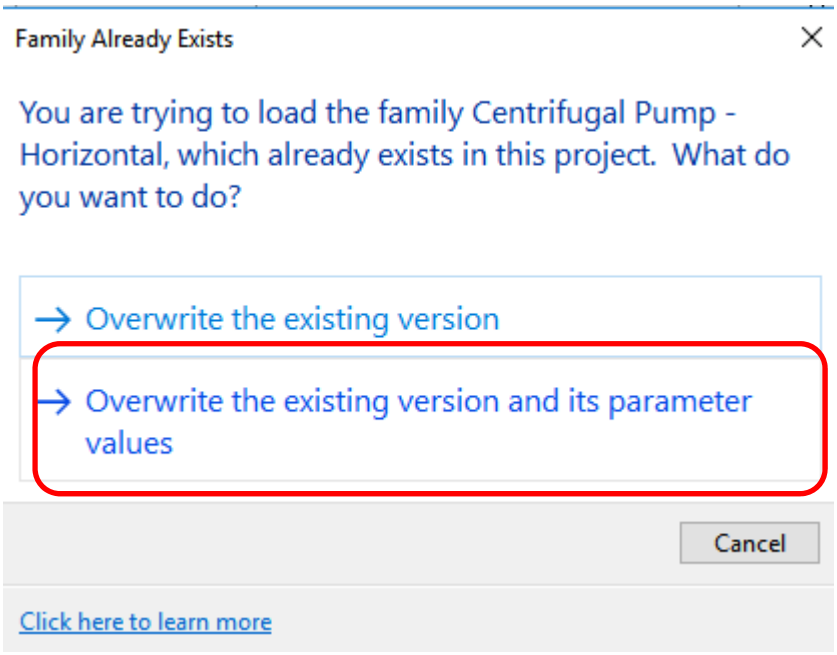


12. The default type is the **90 GPM – 24 Foot Head** type. Under **Mechanical**, for **Suction Pressure Drop**, change the value to **0.4**. Change the Suction Flow to 90:



13. After making the adjustments, click **OK** to save the changes. Next, load the unit into the model. From the **Modify** tab, **Family Editor** panel, click **Load into Project and Close**

(do not save the file if prompted). When prompted, click **Overwrite the existing version and its parameter values**:



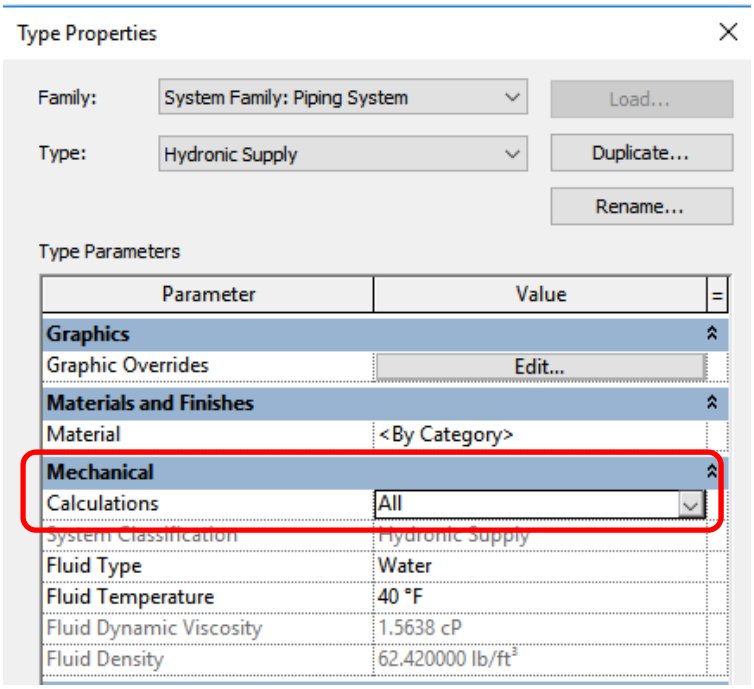
The current version in the model will be updated. You're now ready to start reviewing the pipe sizing tools.

Using the Pipe Sizing Tools

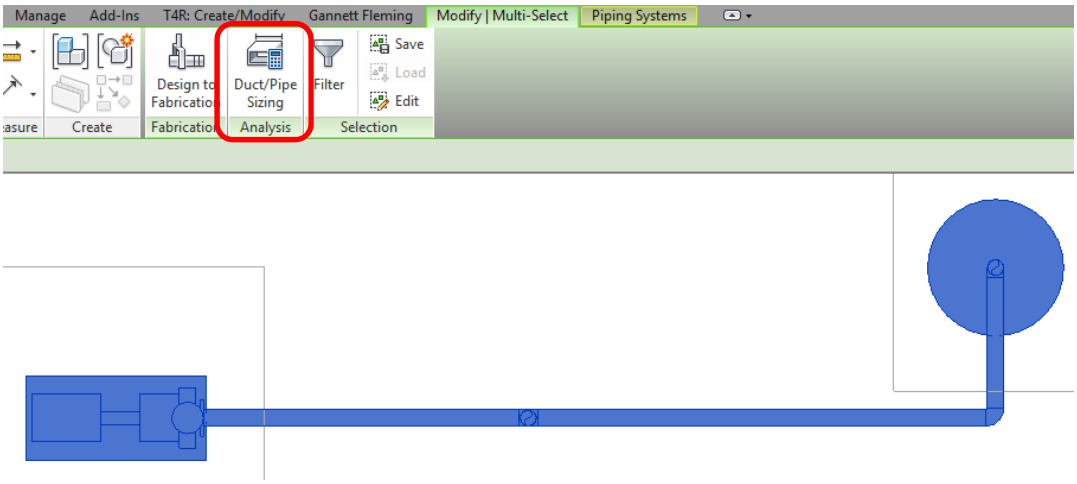
Once you have all of the systems types, connectors and systems defined, the next step is to leverage the system to check the pipe sizes. While most pipes are sized using external analysis programs such as PIPING Solutions, Trace, IES and more, it's nice to be able to make adjustments as needed, without having to return to the analysis application.

Begin by opening the model, **BES227181-L-MEP-Analysis.rvt**. Open the view, **PIPE FIRST FLOOR**.

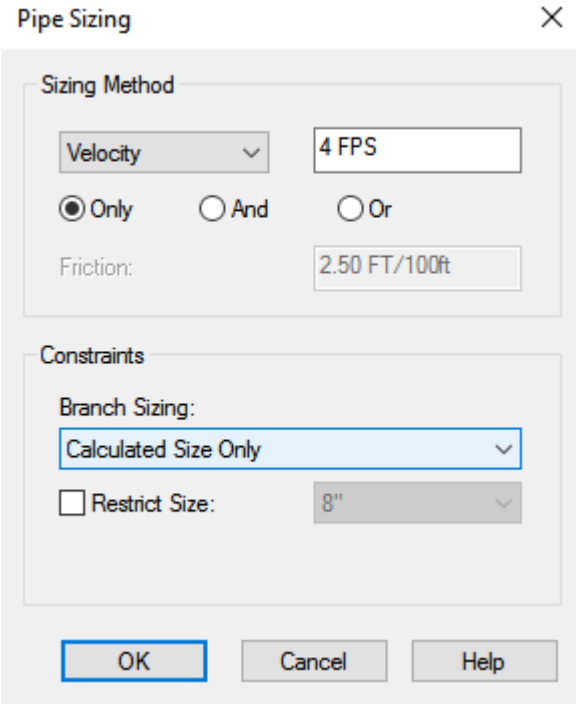
1. From the **Project Browser**, expand **Families**, and then expand **Pipe systems**. Double click **Hydronic Supply**, or right click and select **Type Properties**. Change the **Calculations** parameter to **All**:



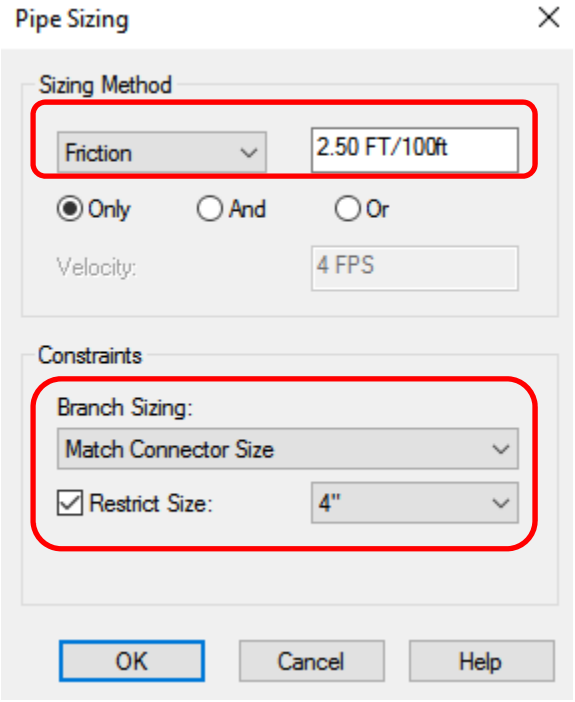
2. Click **Ok** to close the dialog.
3. From the **PIPE FIRST FLOOR** view, use the **TAB** selection method to select the pipe and tank:



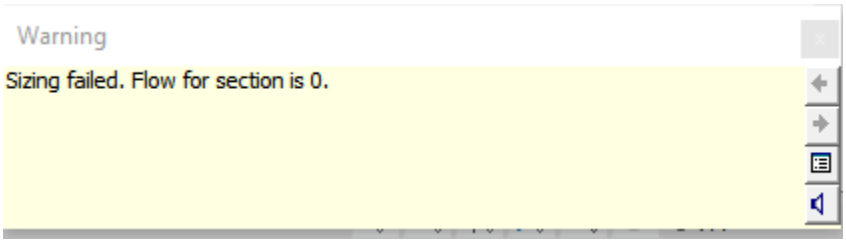
4. Select the **Pipe/Pipe Sizing** tool from the **Analysis** panel. The **Pipe Sizing** dialog will appear:



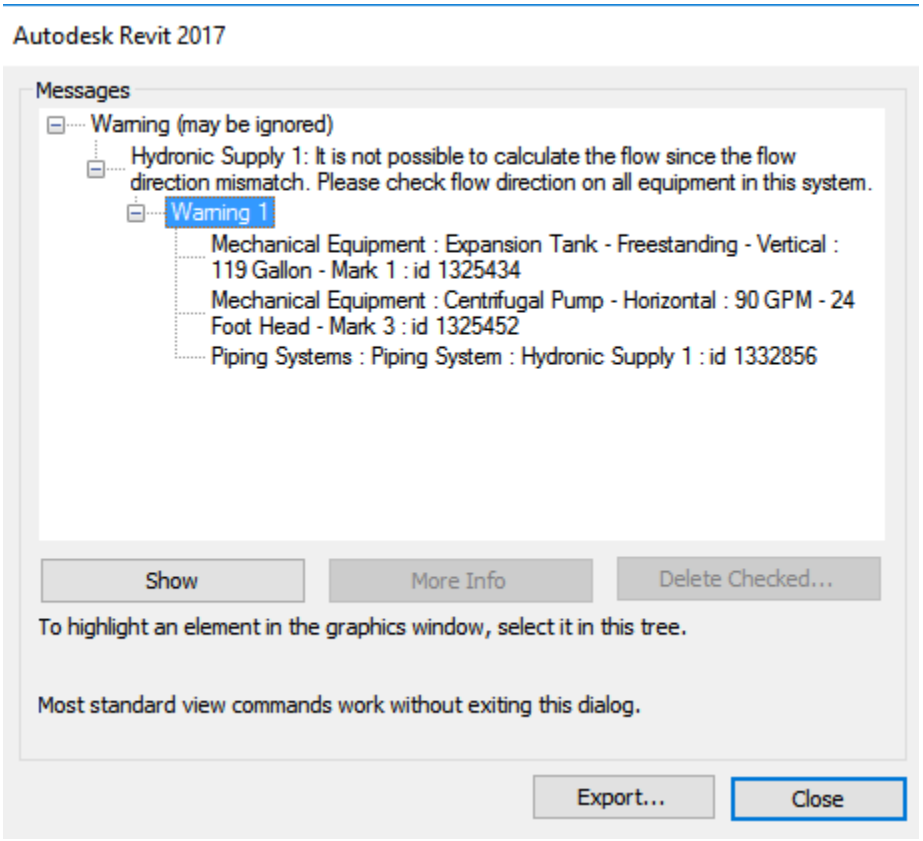
5. Change the **Sizing Method** to **Friction**, making sure the value is set to **2.5**; and then set the **Branch Sizing** to **Match Connector Size;** and then **Restrict the Size** to **4”**:



6. Click **OK**, and the pipe will be resized if needed. If the sizing fails, or nothing changes, check for an error message in the lower right corner:



Directions will be provided for how to fix the problem, such as adding flow to the tank. Other errors, such as a flow direction mismatch, may result due to the configuration of the connectors:



Make sure you don't ignore these warnings – expand them, follow them and perform the calculations again.