AUTODESK UNIVERSITY 2014

Process Pipes in Revit – Is It Just a Pipe Dream

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MP4852 Revit is recognized as a building design tool for architectural, electrical, structural, plumbing and HVAC. At Whitman, Requardt & Associates our Water Wastewater discipline saw the benefits others were experiencing using Revit and decided to take Revit to the next level for use with large diameter pipe used in their process plants. With only AutoCAD 2d experience the switch to Revit identified changes needed within our design process and workflow. These changes ultimately led to a better coordinated design for our clients and Revit is now the tool of choice for many Water Wastewater projects. In this session I will demonstrate how WR&A's Water Wastewater disciplines utilized Revit for more than plumbing.

Learning Objectives

At the end of this class, you will be able to:

- Understand The "process" from initial design to hand-off to other disciplines
- Creating new pipe Segments, Systems and Types
- Modify and Creating content for larger pipe sizes
- Taking a look at some of the new AWWA content included with Revit 2015

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About the Speaker

Howard currently works as a CADD Systems Specialist whose primary responsibility is for supporting the BIM effort for Whitman, Requardt & Associates LLP (WR&A). WR&A is a full service Engineering, Architectural and Planning firm whose headquarters is located in Baltimore, MD. With Howard's 25 years' experience as a user and providing support for Autodesk products, he provides WR&A with support, implementation and training for Autodesk products including, but not limited to, Autodesk® Revit MEP®, Autodesk® Revit Architecture®, Autodesk® Revit Structure®, and AutoCAD®. Howard is also an AutoCAD and Revit Architecture Certified Professional in 2011 thru 2014.

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The Benefits…

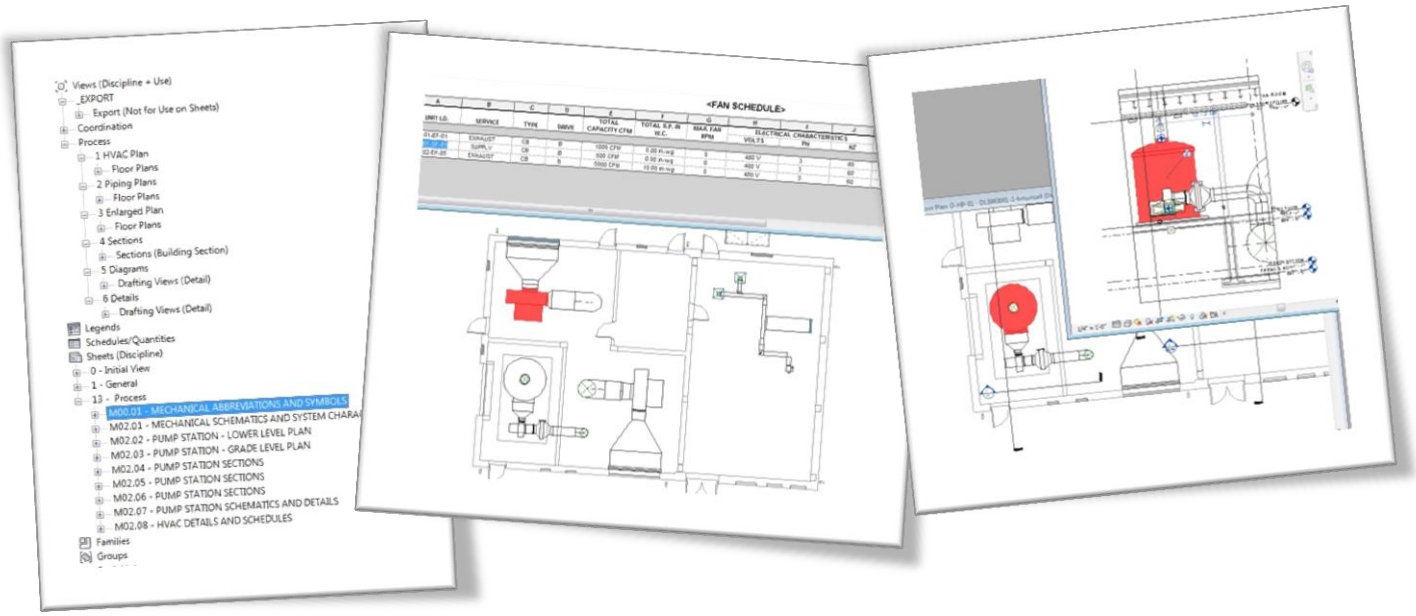
The benefits other disciplines were experiencing using Revit

Whitman, Requardt & Associates LLP. has been using Revit for about 6 years. Our Architects were the first to embrace Revit, soon followed by Structural, Mechanical, Plumbing and Electrical, as they too want to reap the benefits of Revit. The most recent group to start using Revit has been our Water Wastewater (WWW) department.

Benefits such as:

- Automatic view creation of Sections/Elevations/Details
- Intelligent Scheduling
- File Management
- Coordination
- And many more….

The Water Wastewater Group investigated AutoCAD MEP and Plant 3D but found, Revit was the best fit for their needs.

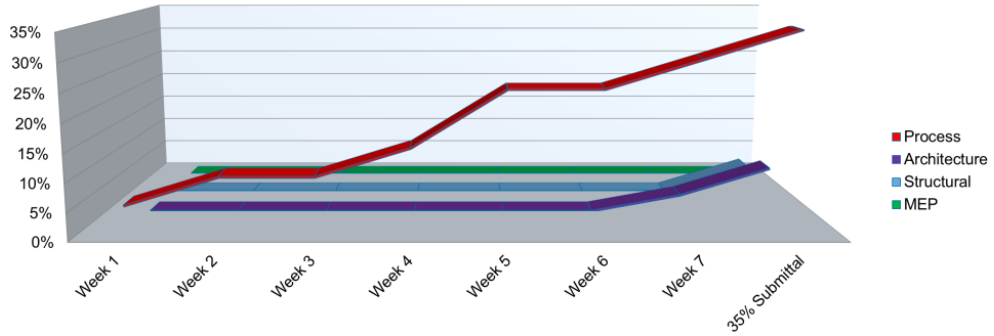


The Switch Over…

Identifying their current workflow and finding the best way for them to use Revit.

Current CADD Workflow

The first step was to identify their current CADD process. Typically, the WWW group provided design for all disciplines themselves usually up to 35%. In addition to pipe design, they would draw basic Architectural and Structural elements. All design information was drawn in the same base file using only layer separation. At 35% other disciplines would start getting involved. The existing design files were then copied and cleaned up for each discipline to continue with their design.

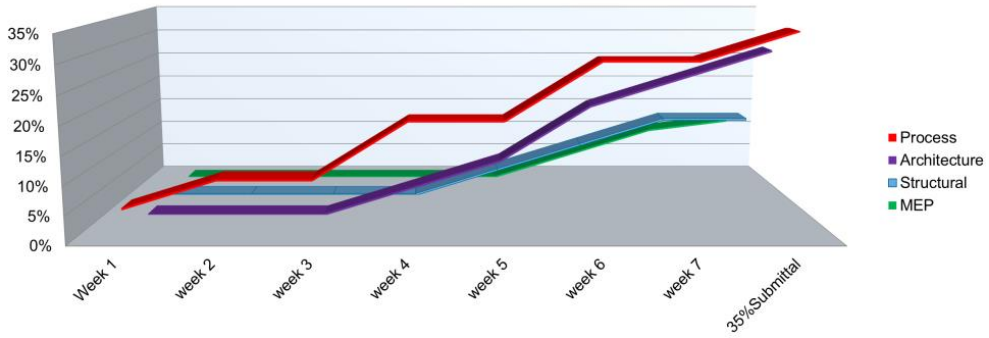


Revit Workflow

The switch to Revit forced them to change their typical workflow. Since they usually do everything themselves up to about 35%, Revit training needed to be a little more than just Mechanical. Extra time was needed to teach basic Architectural and Structural tasks within Revit as well.

The WWW group also needed to learn to work in the appropriate model for what they were designing. This was needed for ease of distribution of the appropriate model files to the appropriate disciplines. Since the WWW group typically started the project, they needed to understand model principles in order for the different the models to link properly. These principles included acquiring coordinates, copy monitoring and coordination review. In doing this they discovered other disciplines could be involved earlier in the design process, improving the overall project coordination.

The WWW group continues to start all discipline models and the initial coordination. Now other disciplines get involved just after schematic design instead of at 35%.

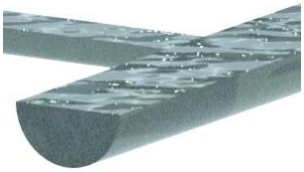


Getting Started…

The 3 components of Piping in Revit

Piping in Revit is made up of 3 main components, Segment, System and Type.

The Pipe Segment is comprised of the material, schedule or type of pipe, the Nominal, Inside & Outside diameters and roughness of the pipe.



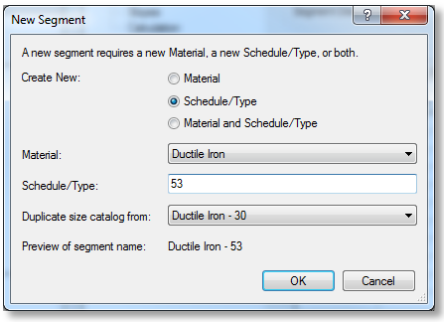
The Piping System is essentially what the pipe is being used for. The Piping System is comprised of the calculation method, the identity data and rise/drop symbology. Hydronic and Domestic Piping Systems also contain Fluid type, Temperature and Flow Conversion Method variables.

The Pipe Type combines both the pipe segment and system. The pipe type holds the Routing Preferences and how the pipe run is constructed. You can specify the pipe segment and the pipe fittings to be used for that type.

Creating a New Pipe Segment

Revit comes with many standard pipe segments "Out of the Box" (OTB). Making a segment is not difficult, but can be tedious. For our example, we used the AWWA pipe sizing chart to create the Ductile Iron class 53 pipe. The sizing chart only gave the outside and Revit requires an outside and inside diameter. Using the pipe thickness listed in the chart we had to do some math to get the inside diameter.

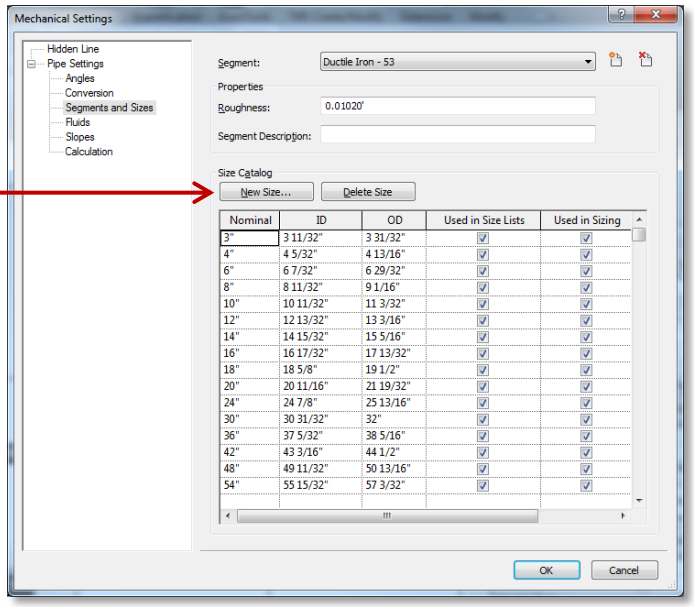
- Go to the "Systems" ribbon
- From the "Mechanical Panel" select down arrow (bottom right corner)
- Select "Segments and Sizes" from the Pipe Setting list
- Select "Create New Pipe Segments" icon (right of the selection list). The "New Segment" dialog box will appear.



- In the "New Segment" dialog box select "Schedule/Type"
- Next select your "Material".
- Next enter the "Schedule/Type"
- Lastly, select a "Duplicate size catalog from".
    - This will be what you will use as a base for the new pipe segment. (something must be selected)

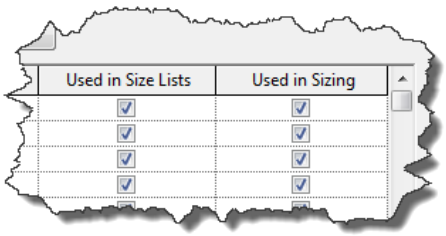
Now the pipe segment has been created and you can start making sizes:

- Select the “New Size” button
- In the “Add Pipe Size” dialog box enter the new “Nominal Diameter”.
    - DO NOT HIT ENTER or OK**.** That closes the window and you will need to delete and remake.
- For the “Inside Diameter” you may have to do some calculations.
    - If the sizing chart does give inside diameter and has a wall thickness, multiply the wall thickness by 2 and subtract that from the outside diameter and that is the inside diameter.
- Enter the “Outside Diameter”
    - Now you hit “Enter” or select “OK”



Then you can delete the remaining size(s) left from the default pipe segment you started with. Continue the above process for all needed pipe sizes for the new pipe segment.

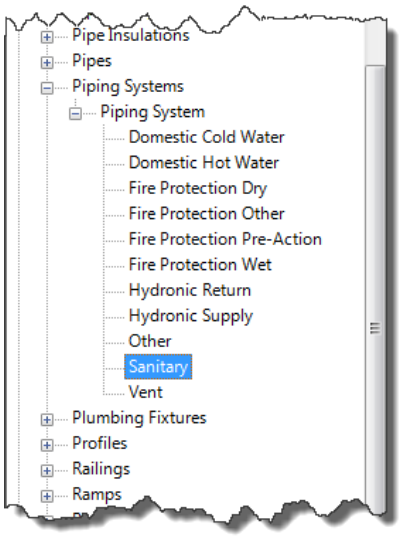
The last 2 columns in the “Size Catalog” dialog box are “Used in size lists” and “Used in sizing”.



- If “Used in size lists” is checked the sizes will show in lists throughout Revit.
- If “Used in sizing” is checked Revit’s sizing algorithm can be used to determine pipe sizes. By default they’re both checked.

New Piping System

In the "Project Browser", go to "Families" and then "Piping Systems". The Out-Of-The-Box Mechanical and Plumbing template has 11 standard Piping Systems, most of which are for building mechanical and plumbing. For Process, we need to add some of our own.



Select an appropriate pre-existing Piping System, whatever is closest to what you will be designing. Different systems have different characteristics. Hydronic return and supply along with Domestic Hot and Cold water both have options for adding fluid types and calculation of Flow. Fire protection has no fluid option and can only calculate volume. Sanitary can calculate flow but has no fluid option.

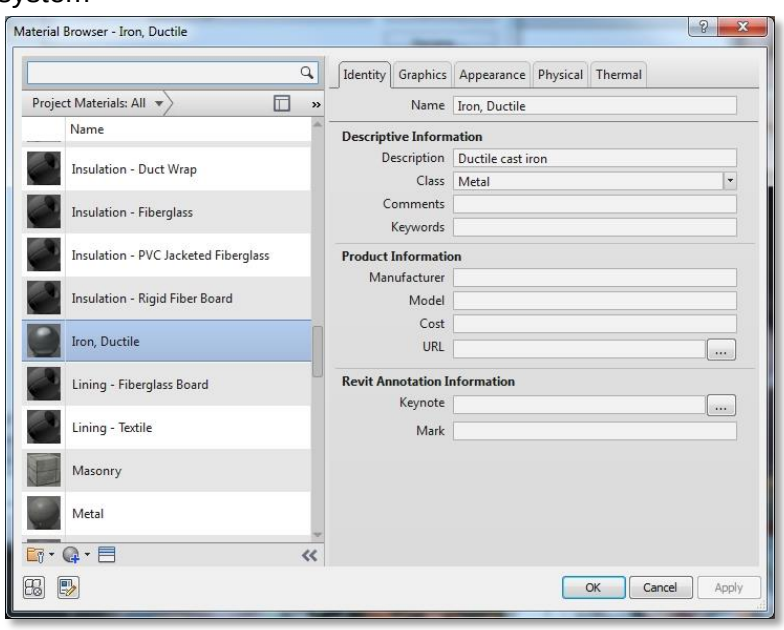
- Right click on an appropriate system and select "Type Properties"
- Select "Duplicate" in the upper right
  - Enter name of the new Piping System.
  - Select OK when done

Once the new system is added to the "Piping Systems" list you can begin making changes.

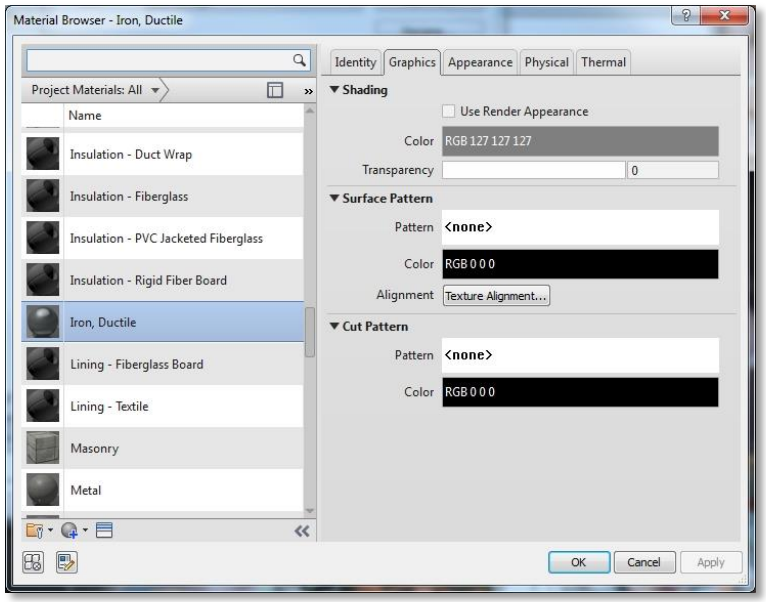
Assign A Material

You can assign materials for the pipe system as needed. There are several options all with their own unique purpose.

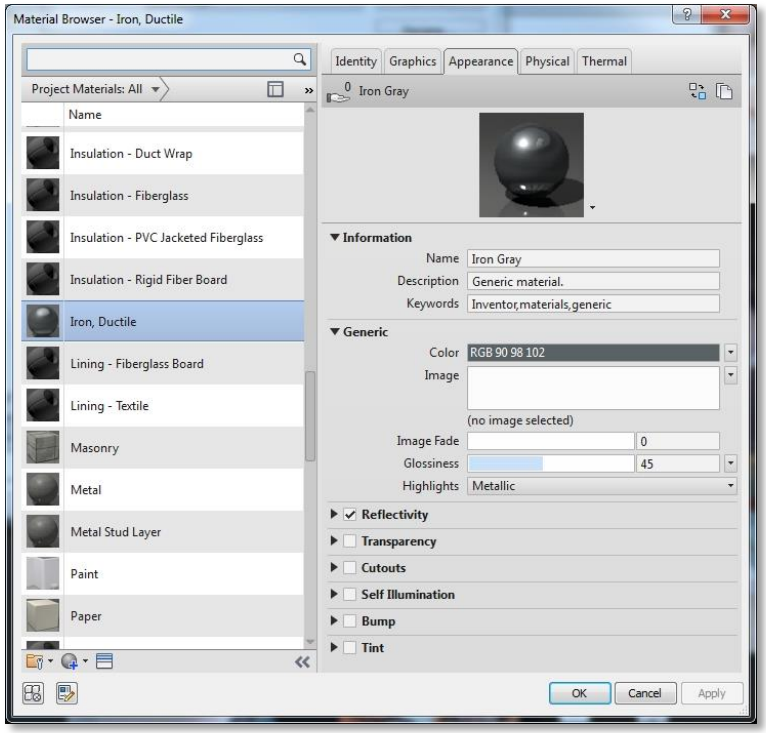
<u>The Identity tab</u> is for the basic information about the Material that is being assigned to the pipe system



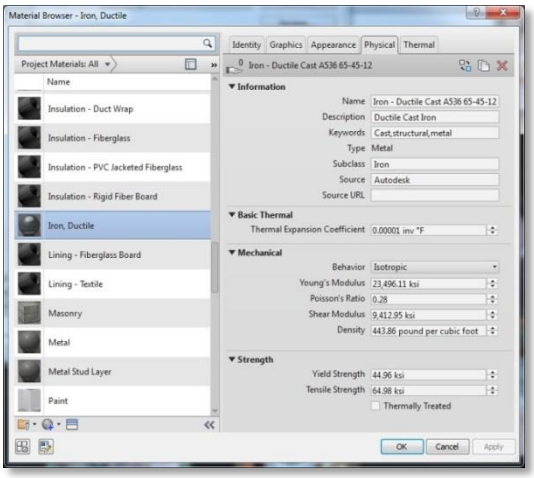
<u>The Graphics tab</u> is how the Material will be represented in a Shaded view. In the graphics tab you also have options to assign a Surface pattern and color along with a Cut pattern and color.

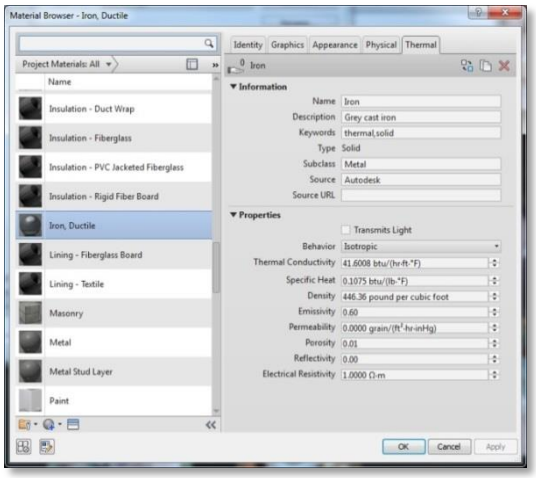


<u>The Appearance tab</u> is how the Material will be represented in a rendered view. This tab gives you options to change the rendered color, add an image, and adjust all the render properties of the Material.



If not already specified, you can also apply Physical and Thermal properties to the Material. Physical are typically used for doing structural analysis. Thermal properties can be used for doing energy analysis. Typically though, these properties are not usually needed in Process design.





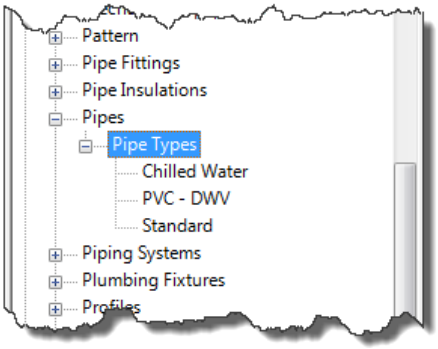
With your materials set, you can now set your Calculation method. Depending on the pipe system you selected initially, you will have different calculation options.

	Calculations Setting				
System Classification	**All**	**Flow Only**	**Volume Only**	**None**	**Performance**
Supply Air	✔	✔		✔	✔
Return Air	✔	✔		✔	✔
Exhaust Air	✔	✔		✔	✔
Domestic Cold Water	✔	✔		✔	✔
Domestic Hot Water	✔	✔		✔	✔
Hydronic Supply	✔	✔		✔	✔
Hydronic Return	✔	✔		✔	✔
Sanitary		✔		✔	✔
Vent			✔	✔	✔
Other			✔	✔	✔
Fire Protection Wet			✔	✔	✔
Fire Protection Dry			✔	✔	✔
Fire Protection Pre-Action			✔	✔	✔
Fire Protection Other			✔	✔	✔

After the Material and Calculation Method is set, you can now set any Identity data and adjust the Rise/Drop symbology if desired. Repeat this as needed for any new Piping Systems you need. For our template we added grit, overflow and reclaimed water, others are made as needed.

New Pipe Type

Revit includes most of the pipe types needed to start a building project. The Revit Systems template has 2 default Pipe types Mechanical and Plumbing templates each have 1 Pipe type. Lastly the Construction template only has a "Default" Pipe type. None of these are useful for Process Piping.

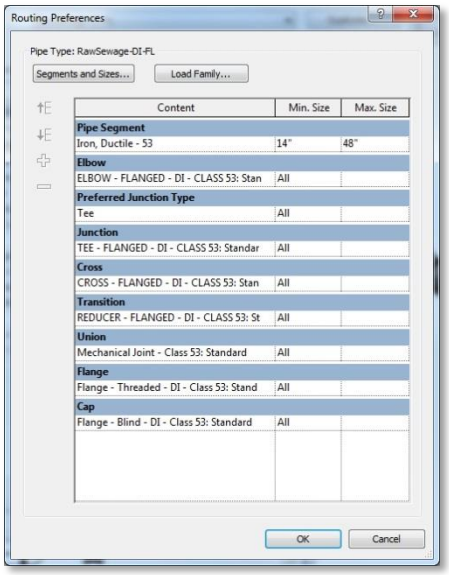


Pipe Types needed for a process facility are not in any of the standard Revit templates, so they need to be created. Creating new Revit pipe types is pretty straight forward.

When making Pipe Types, you will be combining a Piping System and a Pipe Segment, which should be created first. There are 2 ways to make pipe types. First is by using the Project Browser and the second is via the Properties Palette. The Project Browser method was explained in the Pipe System section. Below is the example of using the Properties Palette:

- From "Systems" ribbon select "Pipe" tool from the Plumbing & Piping panel.
- In the Properties palette, select "Edit Type".
- In the Edit Type window, select "Duplicate" and enter new pipe name.

After the Pipe Type is created, the Routing Preferences need to be updated. As a reminder, routing preferences control how the pipe runs are constructed. From the Type Properties window, select the "Edit" button to the Right of the Routing Preferences parameter. The Routing Preferences window offers several options:



- Select a "Pipe Segment" to use from the Pipe Segment dropdown.
- Continue to specify fittings to be used for the Pipe Type
    - Elbows, Preferred Junctions, Junctions, Crosses, Transitions, Unions, Flanges and Caps.
    - Fittings can be loaded as needed by selecting the "Load family" button at the top of the window.
- Set minimum and maximum restrictions for the different pipe and fitting sizes

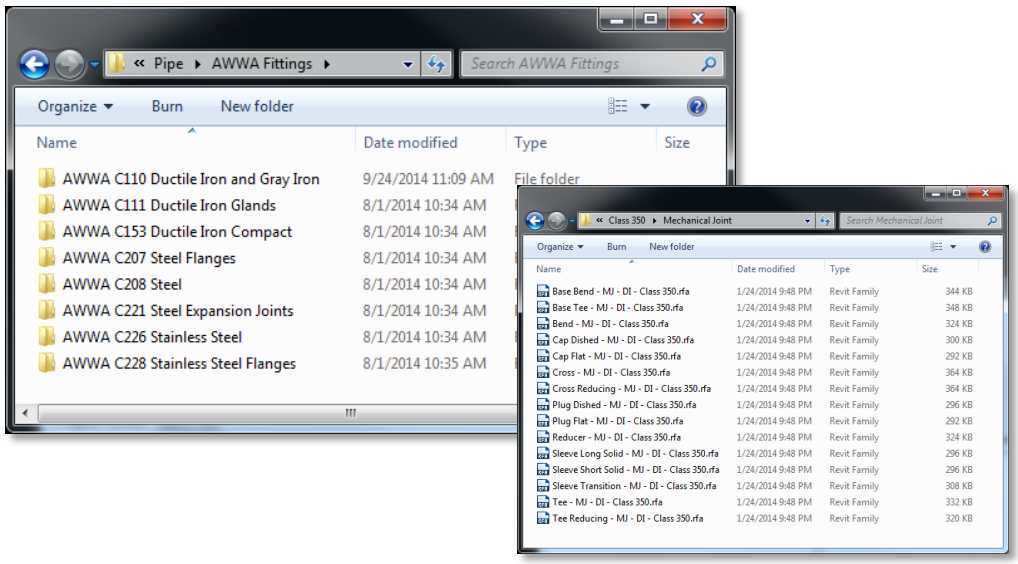
The Identity Data information is optional. However, it is recommended to put the pipe type abbreviation in the type comments field for tagging purposes. Repeat this as needed. WRA has added up to 7 additional pipe types to our template to accommodate process piping. You may need more or less depending on your work flow.

Adapting Out-of-The-Box families…

Every release there is more content added for Process, but there will be situations where you will need to customize existing content.

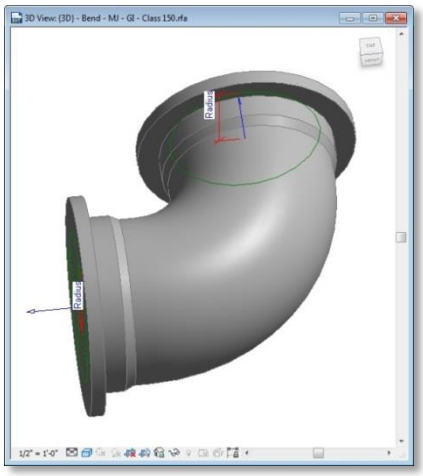
AWWA Fittings

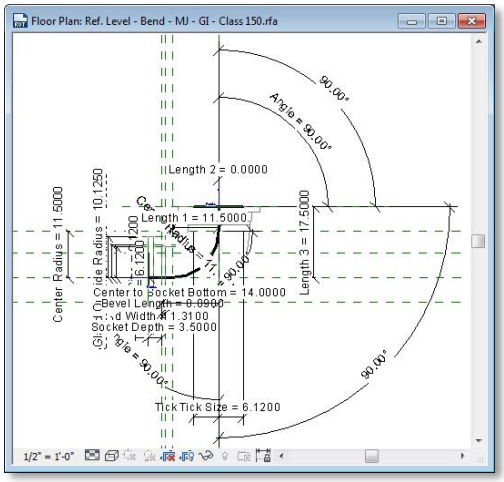
This year Revit included American Water Works Association (AWWA) content to their out of the box families. Now you have access to pipe fittings for Ductile Iron, Grey iron, Steel and Stainless Steel.



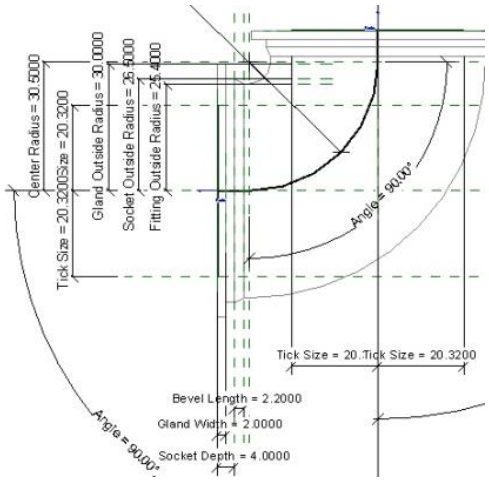
Resizing an Elbow

For example, I selected the out of the box AWWA Elbow “Bend - MJ - GI - Class 150”.





The initial shaded view looks pretty straight forward. The plan view looks like a mess of overlapping dimensions. These are constraints that allow the family to flex and move based on different parameters and rules.

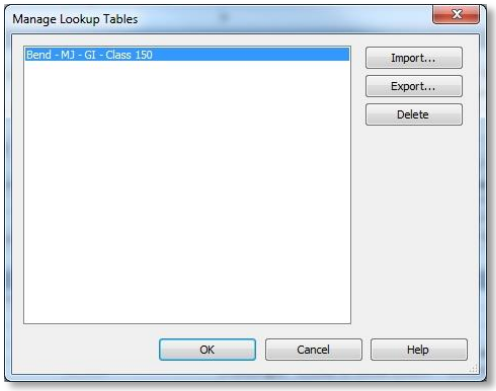


When constraints are cleaned up, you can clearly see what is going on. Each constraint has a name, function and typically attached to a specific reference plane or surface. The challenge is identifying each constraint and matching it with a parameter in the properties window. For most fittings, the parameter will have a formula that references a Lookup Table.

Look Up Tables…

In the type properties window, you will see the different parameters and most have formulas associated with them. Many of these refer to “Lookup Table Name”.

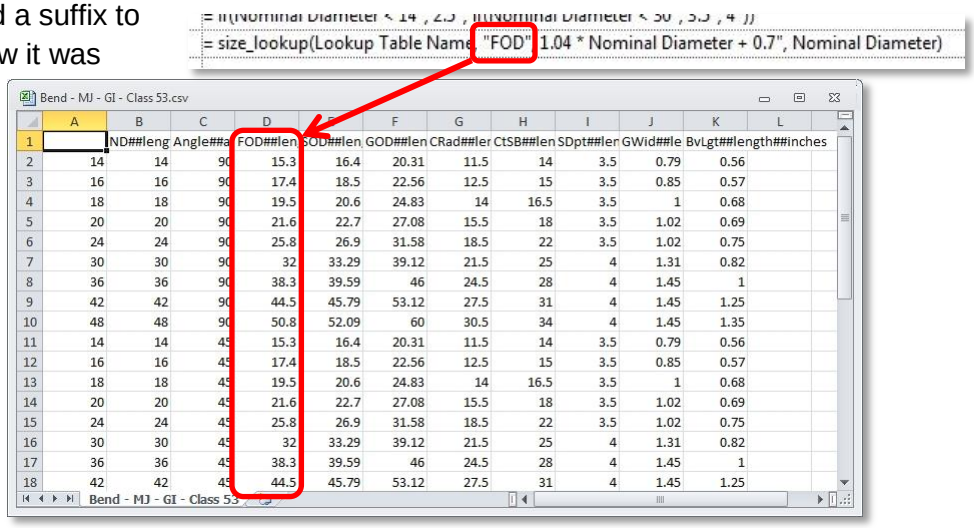
Dimensions		
Tick Size (default)	6.1200"	= Fitting Outside Diameter * 0.4
Socket Outside Diameter (default)	16.1900"	= size_lookup(Lookup Table Name, "SOD", 1.08 * Nominal Diameter + 1.12", Nominal Diameter)
Socket Depth (default)	3.5000"	= if(Nominal Diameter < 14", 2.5", if(Nominal Diameter < 30", 3.5", 4"))
Fitting Outside Diameter (default)	15.3000"	= size_lookup(Lookup Table Name, "FOD", 1.04 * Nominal Diameter + 0.7", Nominal Diameter)
Nominal Radius (default)	7.0000"	=
Nominal Diameter (default)	14.0000"	= Nominal Radius * 2
Bevel Length (default)	0.8900"	= size_lookup(Lookup Table Name, "BvLgt", 0.04 * Nominal Diameter + 0.43", Nominal Diameter)



The lookup table is a chart of information that can be used by the parameter to fill it in automatically. To access the lookup table for editing, on the right hand side of the Type Properties window you will see a Lookup Tables category with a “Manage…” button can be found. Selecting the Manage Button will give you access to select and export the lookup table.

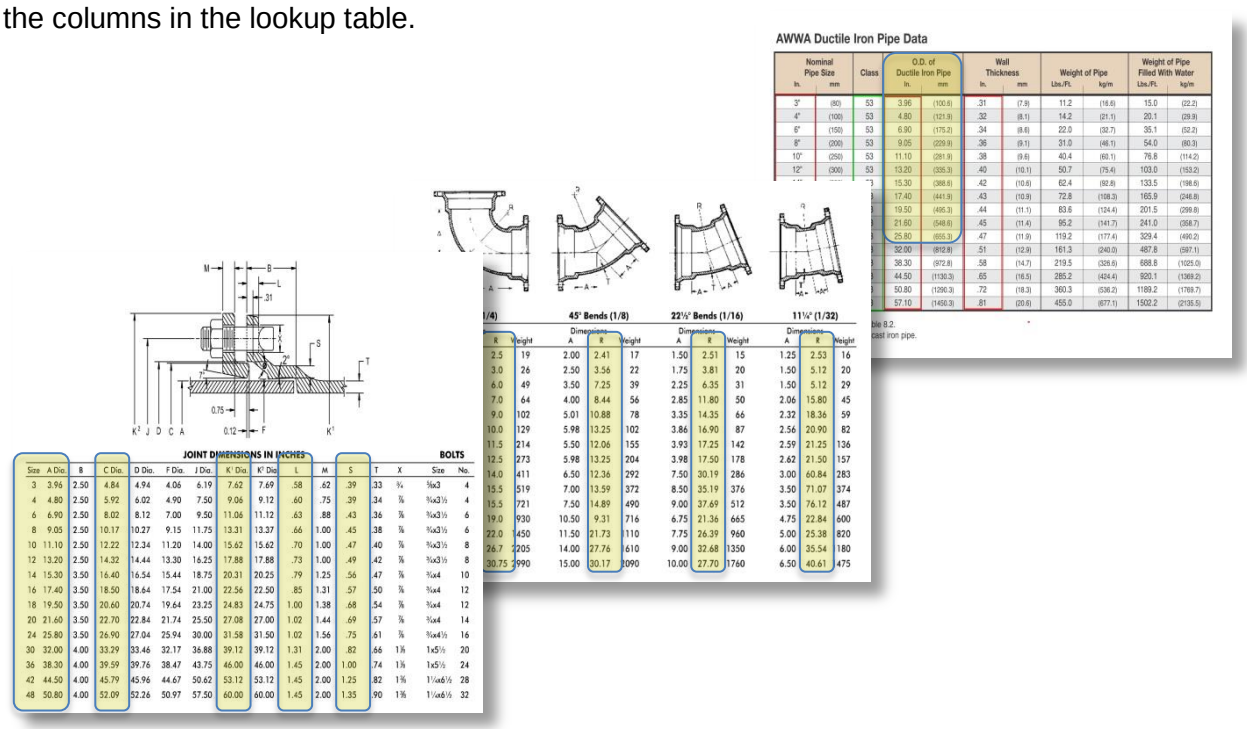
Once you export the lookup table, it is highly recommended to rename it. file even if you're editing an existing table. Add a suffix to the file name letting you know it was modified.

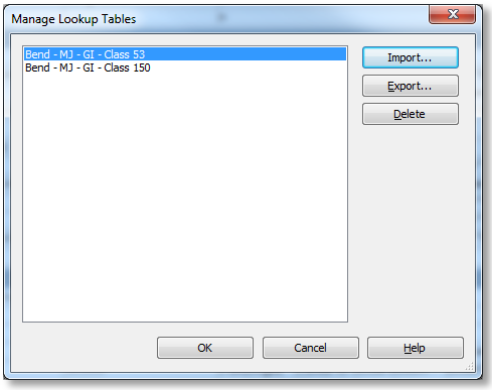
With the look up table open, compare the name in the parameter to the fields in the lookup table.



	A	B	C	D	E	F	G	H	I	J	K	L
1		ND##leng	Angle##a	FOD##len	SOD##len	GOD##len	CRad##ler	CtSB##len	SDpt##ler	GWid##le	BvLgt##length##inches	
2	14	14	90	15.3	16.4	20.31	11.5	14	3.5	0.79	0.56	
3	16	16	90	17.4	18.5	22.56	12.5	15	3.5	0.85	0.57	
4	18	18	90	19.5	20.6	24.83	14	16.5	3.5	1	0.68	
5	20	20	90	21.6	22.7	27.08	15.5	18	3.5	1.02	0.69	
6	24	24	90	25.8	26.9	31.58	18.5	22	3.5	1.02	0.75	
7	30	30	90	32	33.29	39.12	21.5	25	4	1.31	0.82	
8	36	36	90	38.3	39.59	46	24.5	28	4	1.45	1	
9	42	42	90	44.5	45.79	53.12	27.5	31	4	1.45	1.25	
10	48	48	90	50.8	52.09	60	30.5	34	4	1.45	1.35	
11	14	14	45	15.3	16.4	20.31	11.5	14	3.5	0.79	0.56	
12	16	16	45	17.4	18.5	22.56	12.5	15	3.5	0.85	0.57	
13	18	18	45	19.5	20.6	24.83	14	16.5	3.5	1	0.68	
14	20	20	45	21.6	22.7	27.08	15.5	18	3.5	1.02	0.69	
15	24	24	45	25.8	26.9	31.58	18.5	22	3.5	1.02	0.75	
16	30	30	45	32	33.29	39.12	21.5	25	4	1.31	0.82	
17	36	36	45	38.3	39.59	46	24.5	28	4	1.45	1	
18	42	42	45	44.5	45.79	53.12	27.5	31	4	1.45	1.25	

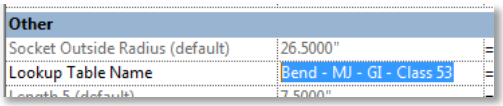
Once you have made all the appropriate associations, you can use your sizing charts to fill in the columns in the lookup table.





After the new lookup table has been updated, it can be saved and reimported into the family.

Identify the look up table parameter in the type parameter window and change the name to the new lookup table. You can now delete the old lookup table out of the Manage lookup table window.



Your family should now be working off of the modified lookup table. Usually for a fitting all you need to do is alter the diameter property and all the other parameters will adjust accordingly. Verify the various parameters are using the correct settings per the new lookup table.

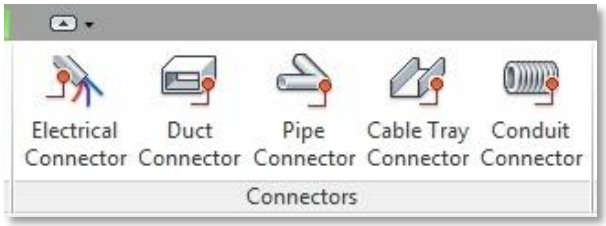
Connecting It All Together…

Without connectors, pipes will just be adjacent to each other and not actually attached and transferring information through your systems.

Connector Types

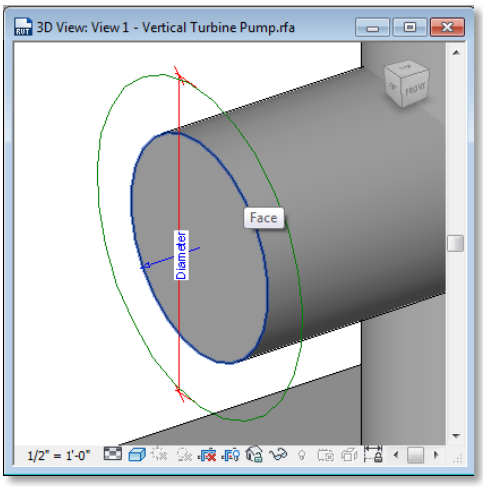
Connectors hace 5 basic types:

- Electrical Connectors
- Duct Connectors
- Pipe Connectors
- Cable Tray Connectors
- Conduit Connectors



Connectors are placed in families to allow other elements with the same connector type to be attached to each other. In the case of a pump or a motor, you may have multiple connectors of different types for the different utilities to attach to. For this example, were going to look at the Pipe connectors for a Vertical Turbine Pump.

Adding connectors



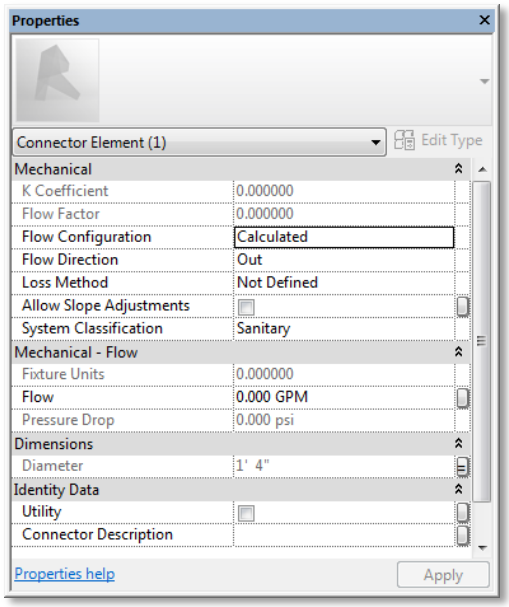
Connectors can be added by selecting the appropriate type and selecting a face on the family to host the connector. For a pipe connector, this should be the end of an extrusion representing a pipe.

Pipe connectors are usualy sized by Diameter. Unfortunately the pipe extrusion is made by radius. In the example, we have 2 connectors, one for Suction and one for Discharge. They have Radius parameters to specify their size. What this means is to get the connector Diameter to match the Pipe Radius, we need to make a parameter for the Pipe Diameter. This parameter will have a simple formula assigned to it. The formula takes the Radius and multiplies it by 2 (=*Discharge Pipe Radius * 2*). We will use this parameter later when we go over the connector properties.

Connector Properties

Different connectors have different configurable properties. Setting these properties will allow the system information to flow from device to device as the different pieces are connected together.

For a standard pipe connector there are a handful of options that can be set.

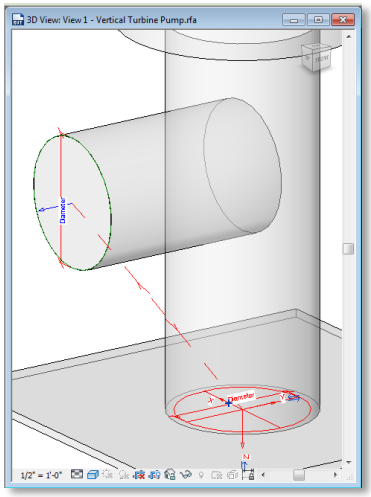


- The **Mechanical** heading has options for: Flow Configuration, Flow Direction, Loss Methods and System Classification.

- The **Mechanical-Flow** heading has options to specify the flow of the system. These options may change depending on the system and flow configuration selected.

- The **Dimensions** heading has an option to specify the connector diameter. This is typically tied to a parameter in the family using the Associate Family Parameter option so the connector adjusts with the pipe diameter.

- The **Identity Data** heading has options for a connector description and a check box for Utility. If the utility box is checked and the file is exported to an ADSK file, <u>that</u> connector will be exported as a connector (other connectors will not).

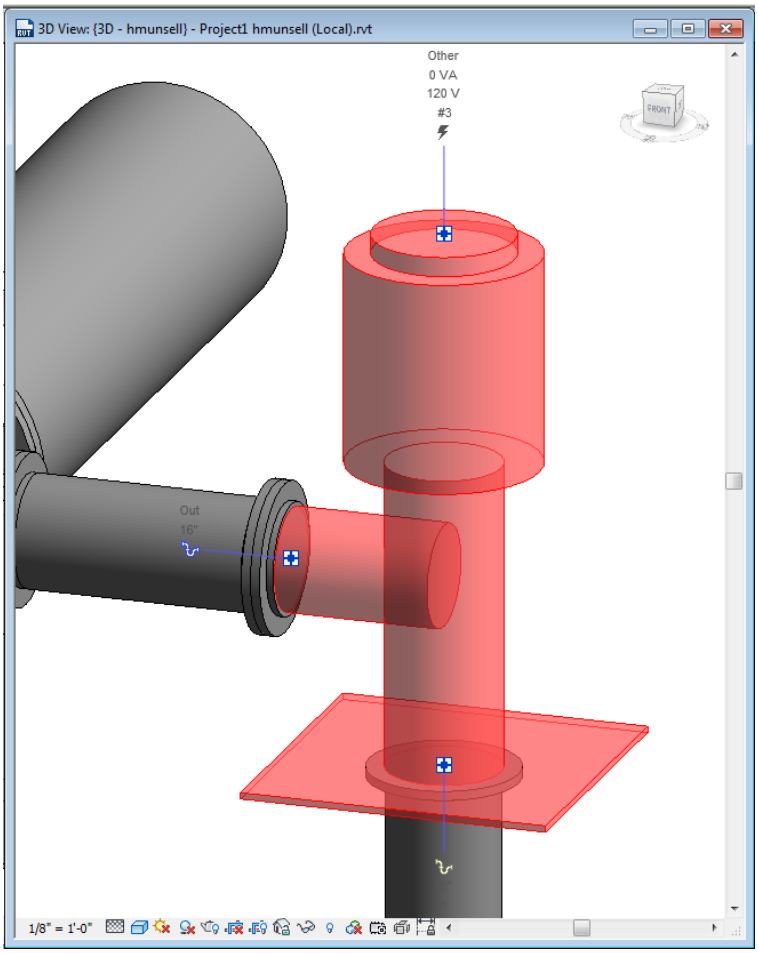


The first connector placed for a specific type is assigned as the primary connector. Once all connectors are placed and the properties are set, you can reassign a primary connector and link two of them together if needed. For Pipe Connectors, we typically place the primary connector as the Flow “In” connector. Once the Primary connector has been assigned, you can link two connectors together to designate flow through the family.

After the family is created, the properties are set and the connectors have been placed, you can save the family and load it into a project.

In this example, we have 2 pipe connectors. One 16” connector with the flow configuration set to IN on the bottom and one 16” connector set to OUT on the side of the pump. There has also been an electrical connector added for power.

The vertical turbine pump can be attached to the Plumbing and Electrical systems when these three connectors are placed and configured properly.



Wrapping it up…

So back to the initial question, "Are Process pipes in Revit just a pipe dream?"

- With the ability to create Pipe Segments of different material and sizes
- With the ability to differentiate systems
- With the ability to assign different routing preferences for different configurations
- And with the ability to adapt existing content and create new content as needed

ABSOLUTELY NOT!

Is Revit right for your specific needs?

You'll have to try it for yourself and find out…

Planning for the future

When starting a Process Project in Revit, a couple things to keep in mind:

Pick the right project

Your "first" process Revit project should be something manageable. Revit is very intuitive and it's easy to bite off more than you can chew. Pick a project that can be easily done by two people. Also, keep in mind you will need the time and budget to accommodate a software learning curve.

Training

Get proper training, don't install the software and say good luck. There are many online webinars and tutorials, but nothing is better than Instructor lead training. Schedule training at the start of a project, do not train anyone too far in advance. If they do not use it, they will lose it.

Make It As You Go

You do not need to have all your content created before you start. As I demonstrated, things are easy to create as you go. Anything created can then be placed in the Revit process library for use on future projects.