Engineering with a Fabrication Database in a Revit Case Study

Craig Chappell – VDC Technology Specialist

Lyle Janda – VDC Technology Manager

Jacob Featherston – Mechanical Designer I

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AUTODESK. UNIVERSITY

TDIndustries is changing the face of the mechanical contracting industry through sustainable, state-of-the-art innovations that consistently produce outstanding results. True to being a leader in mechanical life-cycle solutions, we design and build with the commissioning in mind. We employ more engineers than most mechanical subcontractors, and that dedicated team of in-house engineers uses the latest technology to deliver target value design (TVD) to clients.

TDEngineering Vision

Engineer. Equip. Excel.

Delivering value-driven solutions through rewarding collaborative partnerships.

- The TDEngineering Team

TDEngineering Mission

Develop the Right Solution

Providing focused expertise that evaluates and delivers solutions consistent with project and company priorities.

Work Together

Facilitating and supporting trustworthy teams that utilize effective, transparent communication.

Teach Each Other

Sharing the skills and knowledge with all partners that empower everyone to perform better.

Challenge Ourselves

Improving processes and standards through accountability and trust.

About the speakers

Craig Chappell

VDC Technology Specialist for TDIndustries in Dallas, Texas. His role at TD includes working with Partners to advance the Engineering and VDC teams and help them learn how to work more intelligently and efficiently. He is currently an associate faculty member at Collin College in the Computer-Aided Drafting and Design Department and serves on their Faculty Advisory Board.

Lyle Janda

VDC Technology Manager at TDIndustries. He has extensive experiencing in implementing, installing, training and supporting Autodesk Fabrication products. Lyle previously worked as a Technical Adviser for an Autodesk Platinum Partner.

Jacob Featherston

Started in the field as a pipefitter/welder for 6 years and since starting at TD 15 years ago has moved into the engineering department as a mechanical designer. Along with design responsibilities, he assists with Autodesk/Revit training and maintaining Autodesk/Revit standards and templates within the engineering group.

What is the Why?

TDIndustries was awarded a large Design-Build project that provided many opportunities to explore new ideas and workflows. A major challenge from our leadership was to develop and produce one Revit model facilitating Engineering and VDC scopes.

The goal of this challenge was to gain knowledge while working jointly with Engineering and VDC Partners, moving through our workflows and to get a better understanding on how our Fabrication Database would perform in Revit.

The Ask

Can we develop an efficient workflow for a Design-Build project using one Revit model that will facilitate Engineering design workflows and VDC Coordination while supporting Estimating and Shop Fabrication scope?

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What are some of the potential impacts?

Potential Hurdles and Solutions

- TDEngineering Design-Build vs. External Engineer of Record Plan & Spec
- When to Convert from Revit Families to Fabrication ITMs if at all.
- Meet Project Milestones for Engineering and VDC Scopes
- Manage single Standard in model combined from groups

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Definitions

Families

Revit Families are modeled content that is native to Revit and developed to support basic geometry and facilitate system performance.

ITMs

Fabrication ITMs are modeled content that is native to Fabrication and developed to represent true construction properties. ITMs may also be referred to as Fabrication Parts.

VDC Coordinator

Trade specialist focused on producing clash free shop drawings for construction. May also be referred to as a Detailer.

Partners

All Employees at TDIndustries are called Partners. As an Employee owned company with an ESOP program, we are accountable to each other for the success of the company.

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When to Convert?

The goal is coordinated spool drawings in Revit using ITMs and still develop Engineering Construction Document drawings for Permit Set. Either we start initially using ITMs or convert at some point.

START IN FABRICATION

ITMs also do not carry flow information that is used in our design workflows with Families. This made it undesirable to use ITMs initially.

SCHEMATIC DESIGN (SD)

Not much is known in the project regarding systems or major layout. They are still being discussed. Not much is modeled, so a conversion would not be ideal. At this point it's too early.

CONSTRUCTION DOCUMENTS (CD)

When preparing final documents, a lot of work involves annotations. Converting after the issued Permit Set would cause all the annotation work using Revit Family Tags to be lost. At this point, it's too late.

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When to Convert?

DESIGN DOCUMENTATION (DD)

Most information is now known about the systems along with major routing. The modeling is in the early stages with most systems roughed in. This is the SWEET SPOT.

We decided to model Families through the DD phase and then begin to convert to Fabrication ITMs Sheetmetal, Piping or Plumbing components. Any purchased components would not be converted. This included Flex Duct, Flex Pipe, Mechanical Equipment and Plumbing Fixtures.

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Team Development

ENGINEERING TEAM

After the DD set was issued, VDC Coordinators began supporting the Engineering teams and provided guidance on conversion and basic coordination and constructability. It was not necessary to fully coordinate the systems yet, which was a little out of character for our VDC Partners.

The engineering team was divided into four groups to represent sheet metal, mechanical piping, plumbing and model management. This aligned with our VDC partners, so that each trade could be assigned to a specific VDC coordinator

Pencils Down!

PERMIT SET ISSUE

In the final days before issuing Construction Documents, there was a command for “Pencils Down!” with our VDC Coordinators to stop converting Families to ITMs.

This allowed the Engineering team time to finalize the Sheets and any required annotations to complete the drawings.

Coordinators did assist but were instructed not to convert any Families or worry about coordination edits.

Best Practices to Add Value

CAD STANDARDS

- Different units within the same company were using slightly different color standards to represent systems, because each separate team had not been sharing modeled content before now.
- Engineering had been modeling in Revit and producing PDFs for Estimating to take off manually.
- Estimators have upgraded to using ESTmep and now develop cost from models.
- The VDC group had been working in AutoCAD CADmep with the Fabrication Database. Any Revit content was simply exported for use as backgrounds
- The various teams had been working in silos with no overlap of work. With the teams working in new platforms that allowed for sharing modeled content, there was now the possibility to support each other.

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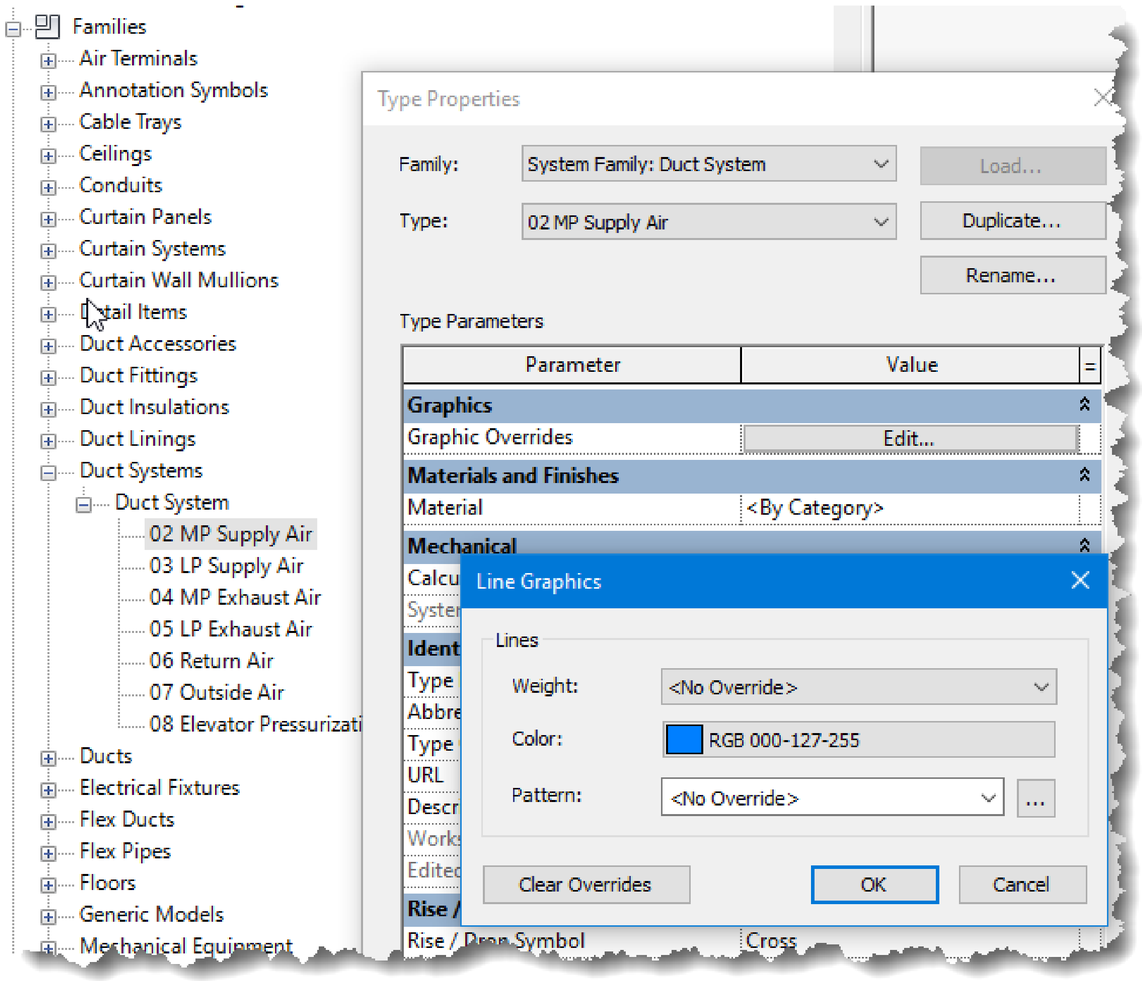
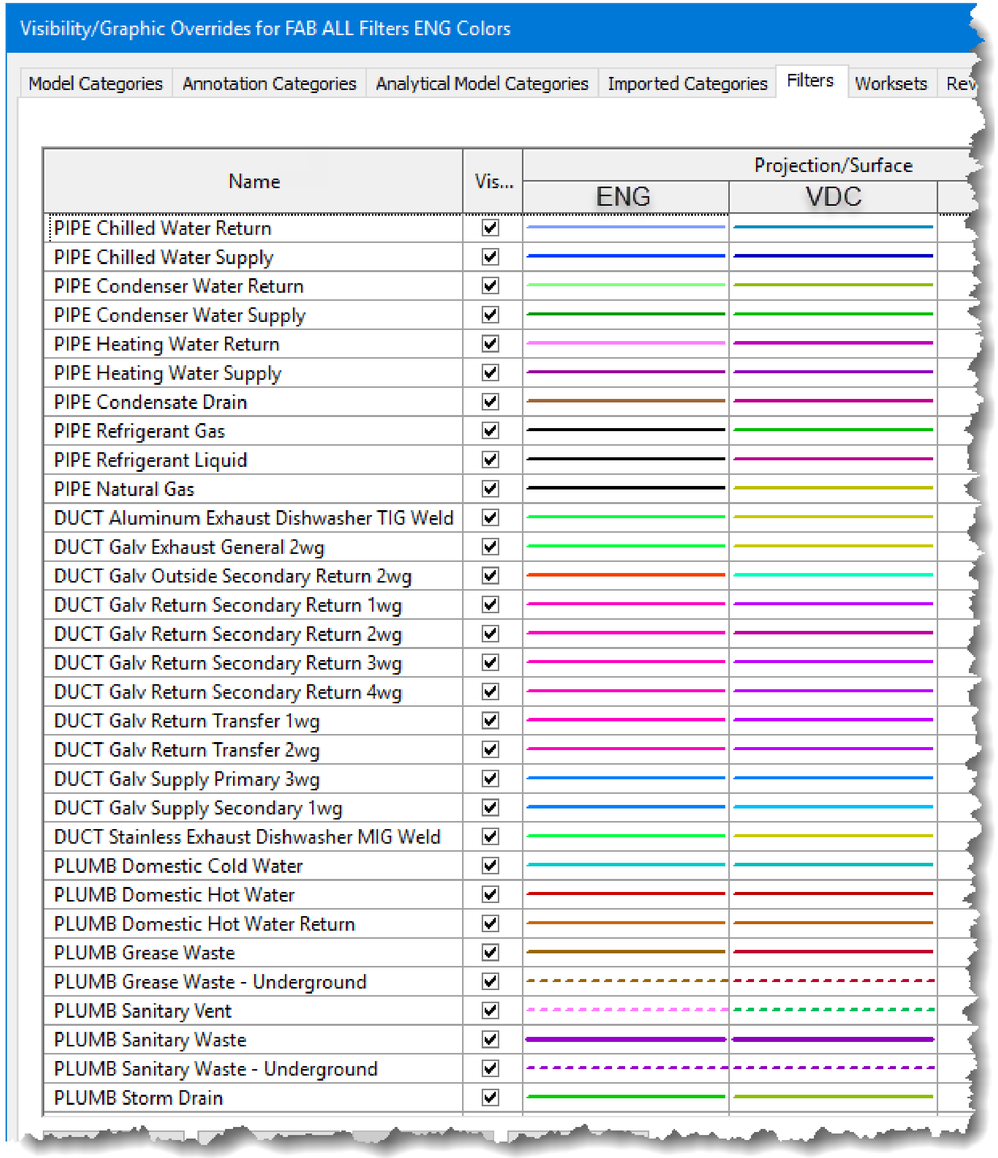
Best Practices to Add Value

- Revit System Graphic Overrides
  - Provide global control of colors in a model for Families.
  - ITMs do not follow these settings.
  - Filters must be used.



Best Practices to Add Value

- Visibility Graphics Filters
  - Engineering System Colors vs VDC System Colors
  - Filters for View Templates



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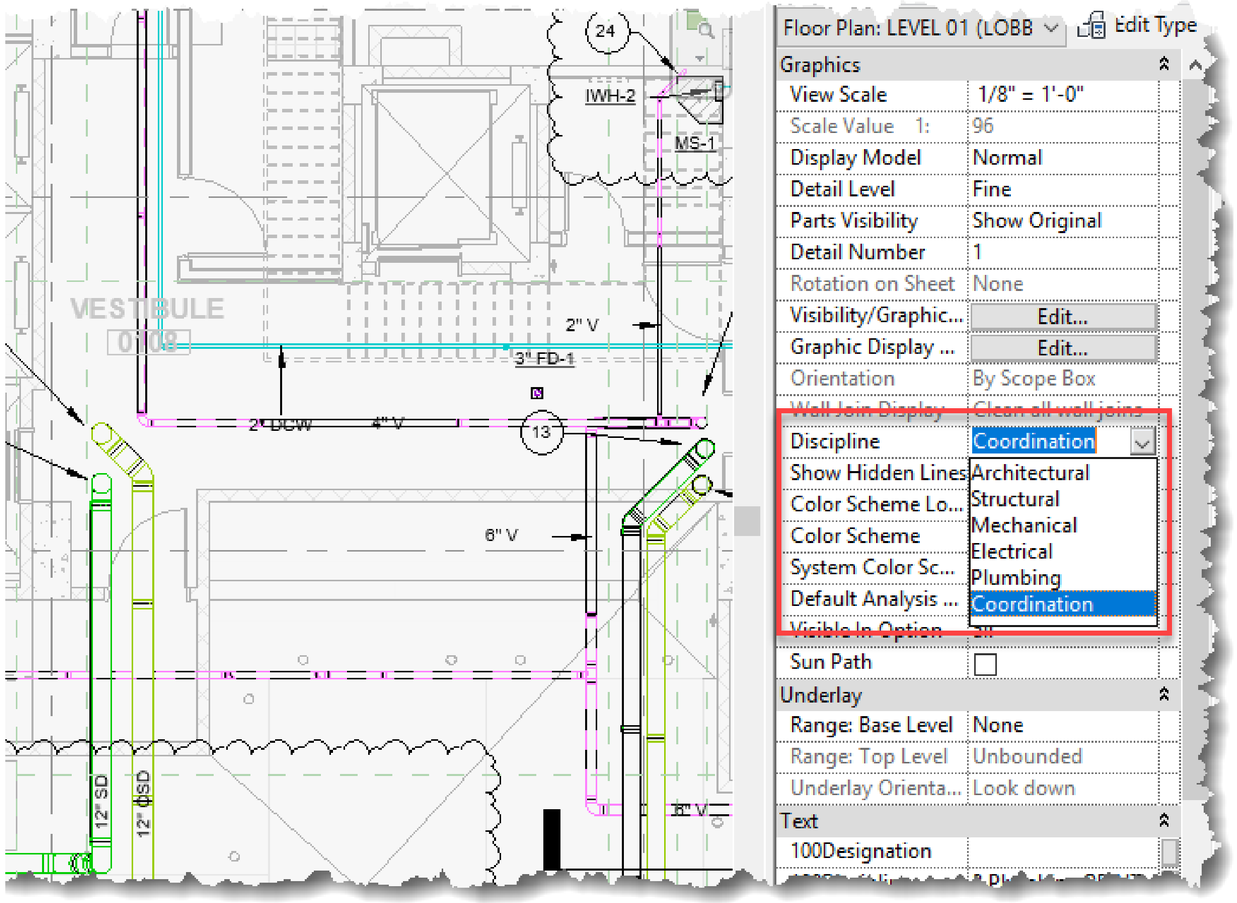
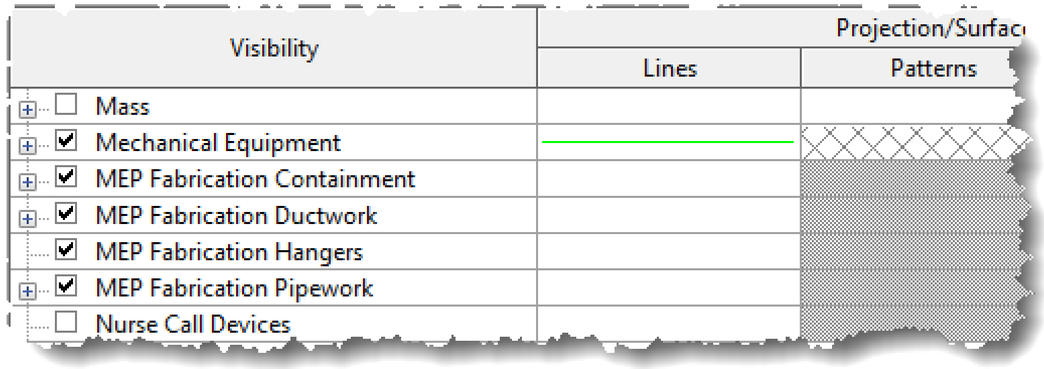
Best Practices to Add Value

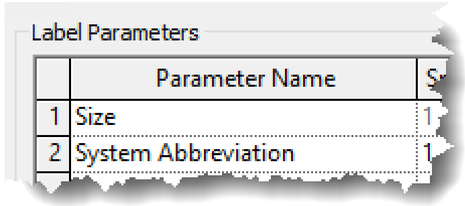
- View Discipline Settings
  - Family vs ITM visibility
  - Coordination vs Plumbing
  - Line weights

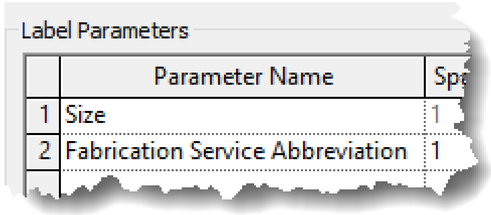


Best Practices to Add Value

- Model Categories and Tags
  - Families vs ITMs
  - Family Tags vs Fabrication Service Tags







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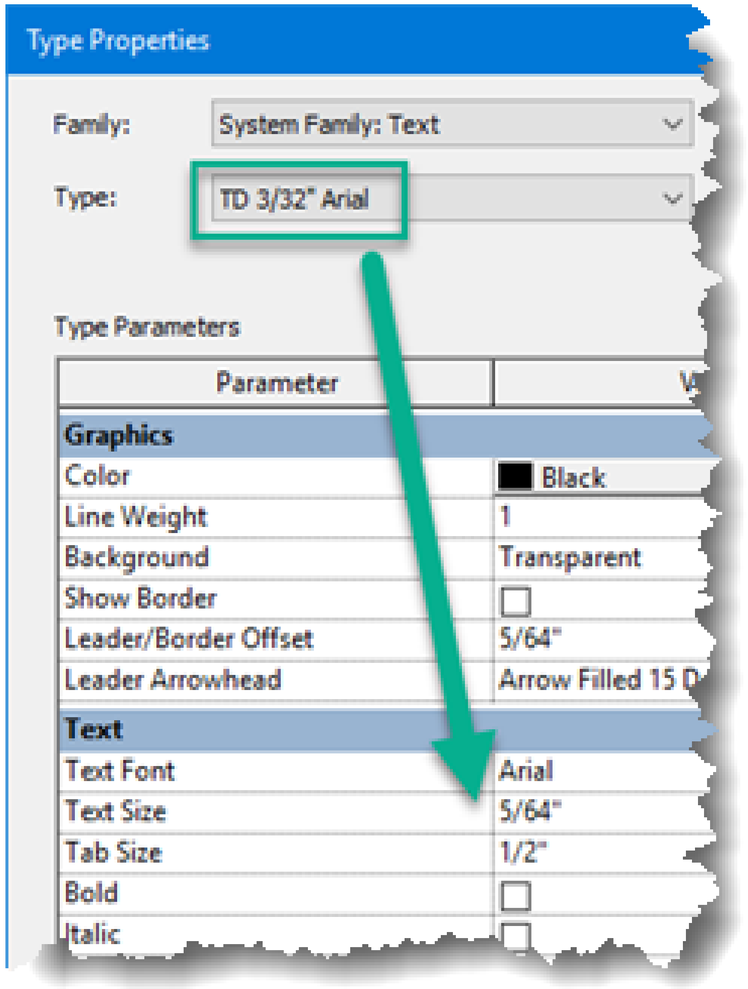
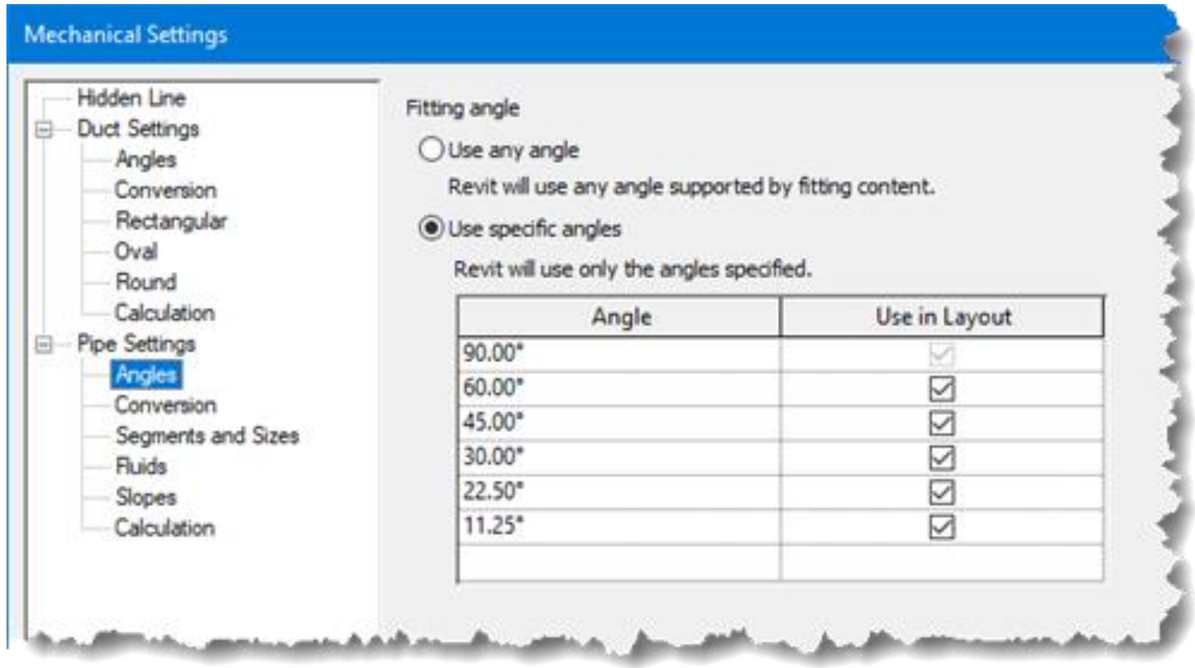
Best Practices to Add Value

- Font Type & Size
  - VDC Standard using 5/64th RomanS for AutoCAD CADmep
  - Engineering standard using 3/32nd Arial
  - Common standard to 5/64th Arial.



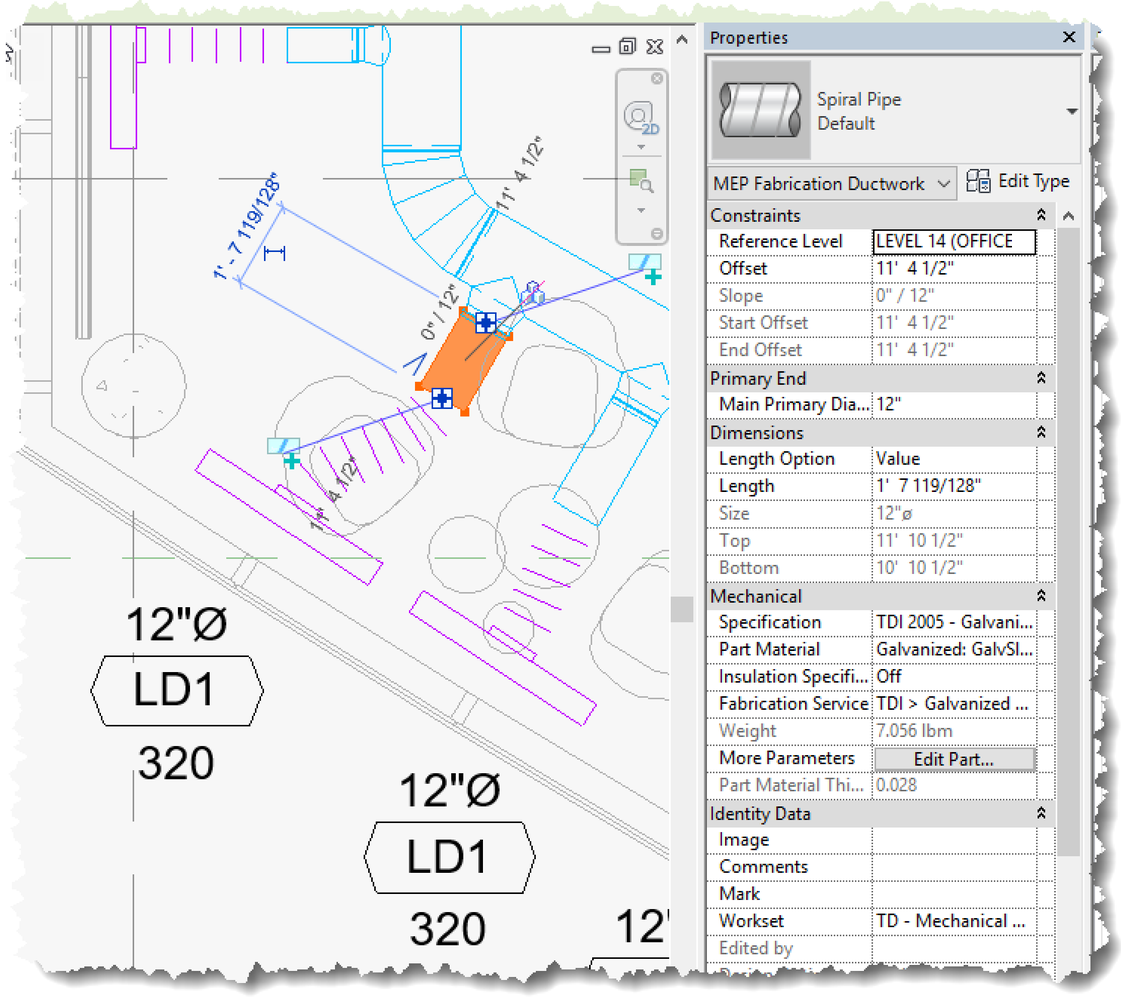
Best Practices to Add Value

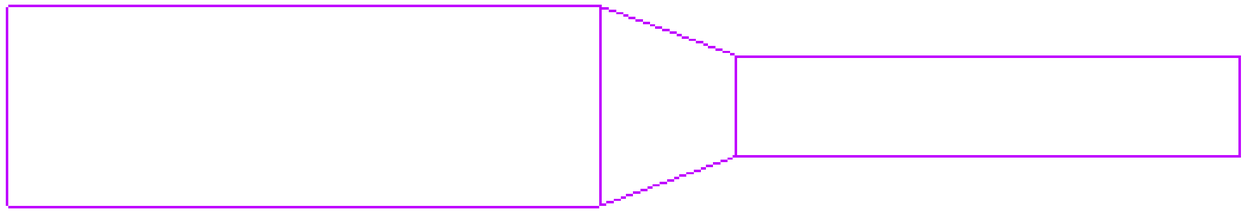
- Mechanical Settings for Angles
  - Some Engineering models are set to ‘Use any angle’ for Duct and Pipe.
  - Disastrous for conversions
  - Angles need to be locked to specific angles in layout.



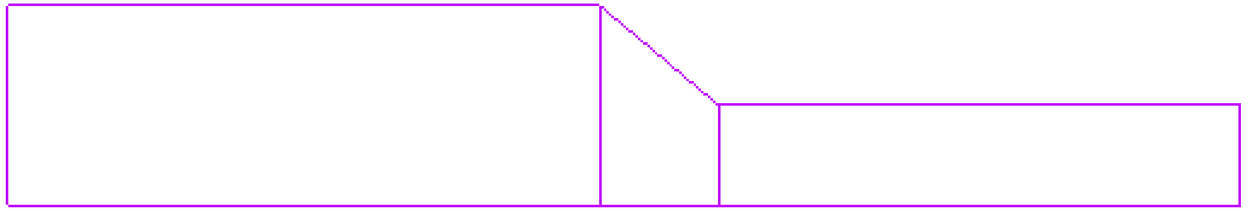
Best Practices to Add Value

- ITMs and Flow
  - Flow information is lost in conversion to ITMs.
  - Live Schedules in use.
  - After conversion, updates are manual
  - Experimenting with Dynamo Graphs





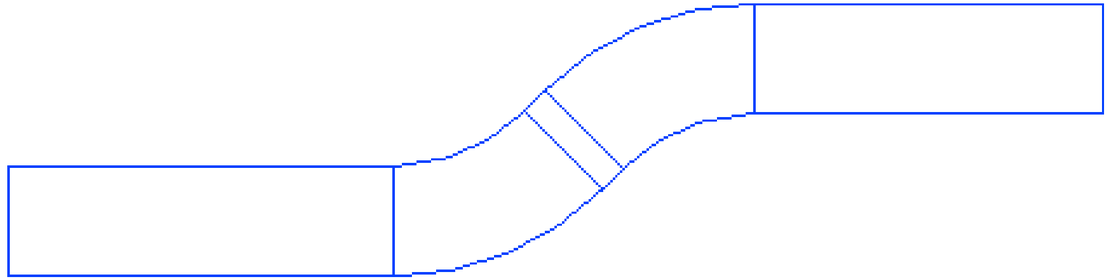
CENTER JUSTIFIED



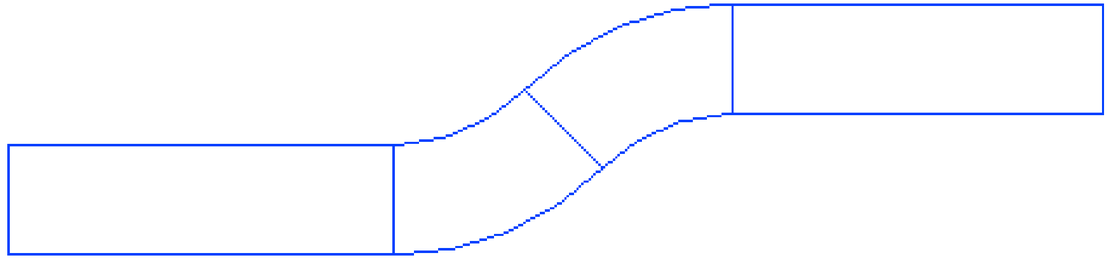
FLAT ON RIGHT JUSTIFIED

Justification

All HVAC fittings, pipe fittings and plumbing fittings that are not center justified during a size change or shape change will not covert.



OFFSET: WITH PUP PIECE



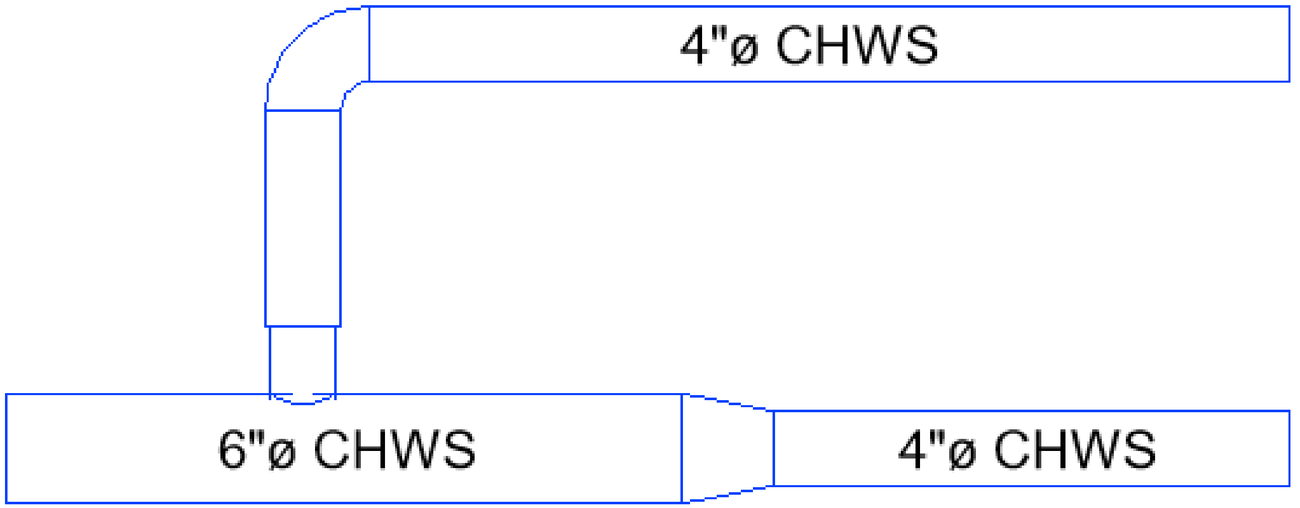
OFFSET: BACK-TO-BACK

Back-to-Back Fittings

All HVAC, piping, and plumbing back-to-back fittings

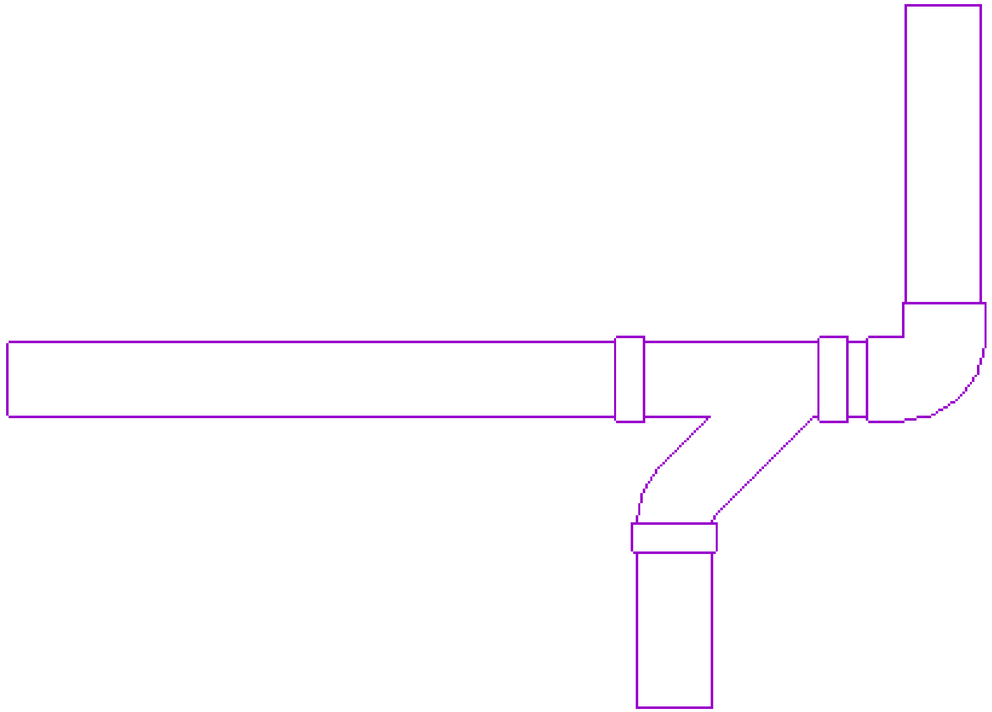
(fittings without a piece of duct or piping in between the fittings) will not covert

and have an undesired effect on the rest of the system.



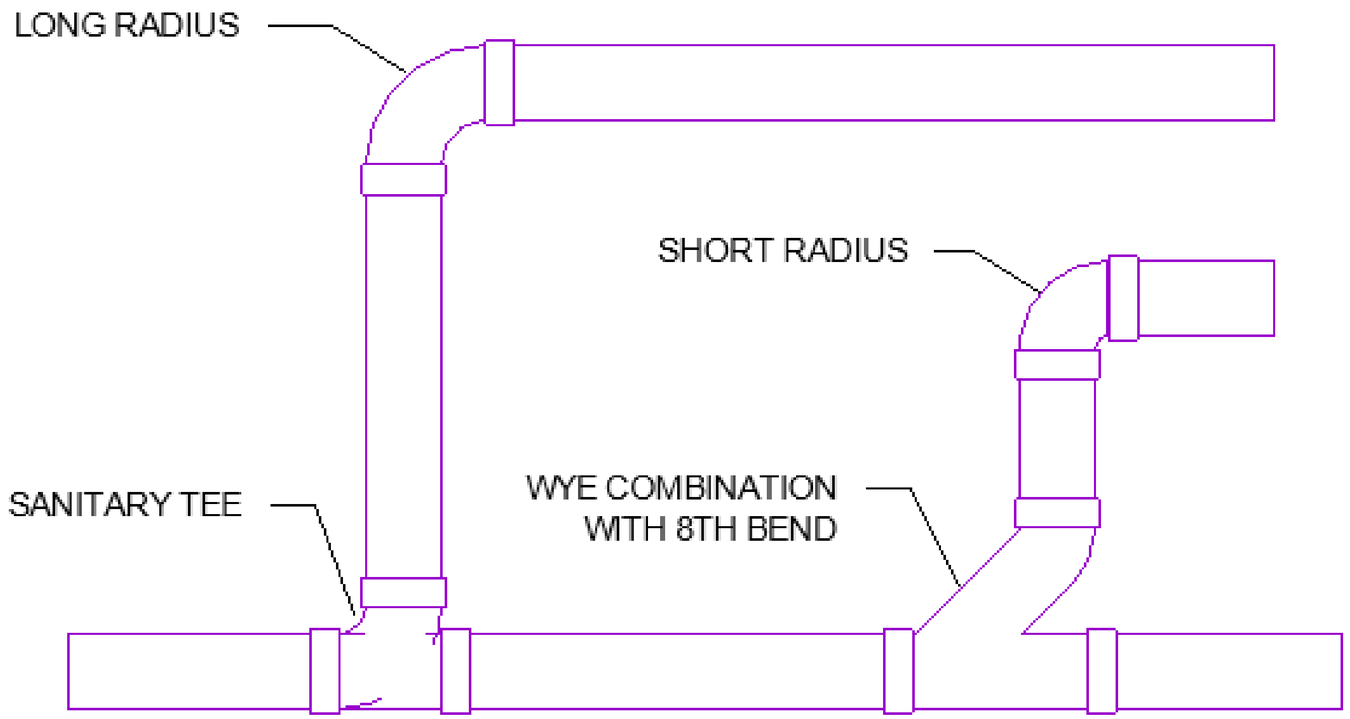
Annotations (Detailing)

During the conversion process, all tags associated with HVAC, piping, and plumbing content is removed from **ALL** views.



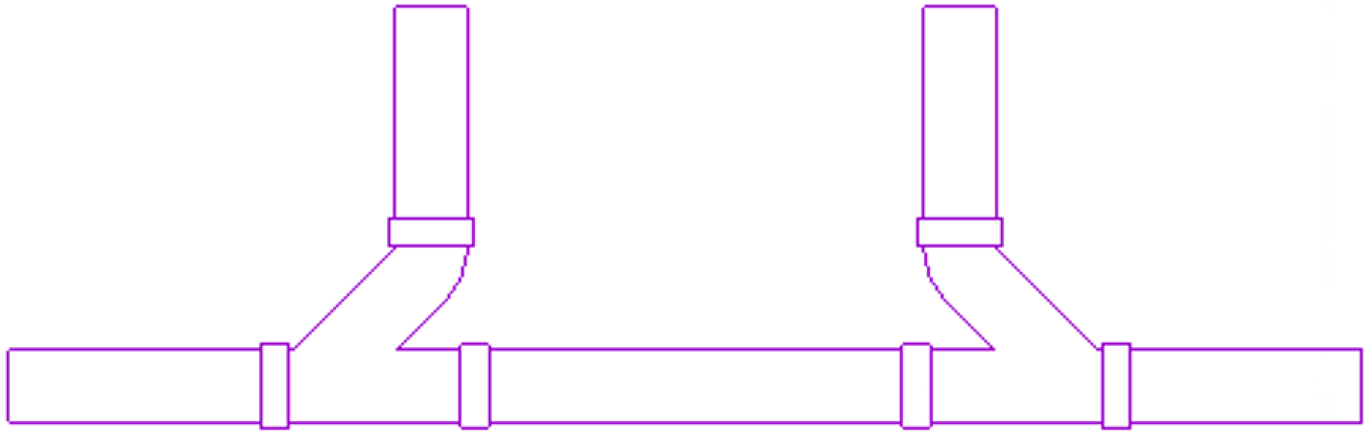
Physical Space

Because Revit families are not always modeled to physical construction dimensions, the conversion can have some unexpected results if the fabrication ITM doesn’t have enough physical space to populate the correct fittings.



Fitting Types

Fabrication cannot differentiate between different types of bends (short radius, long radius, mitered, radius) or types of tee's (wye, wye combination with 8th bend, sanitary tee). During the conversion process all bends and tee's are converted using only **ONE** type of bend and **ONE** type of tee.



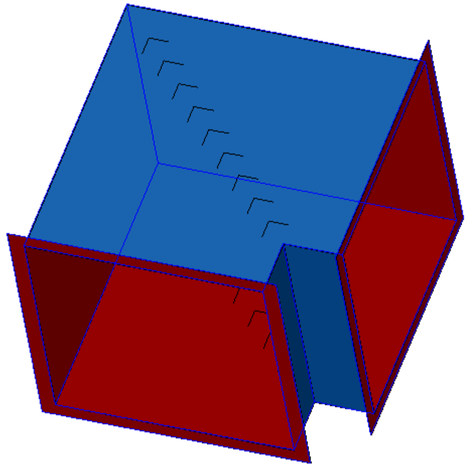
Flow Fittings

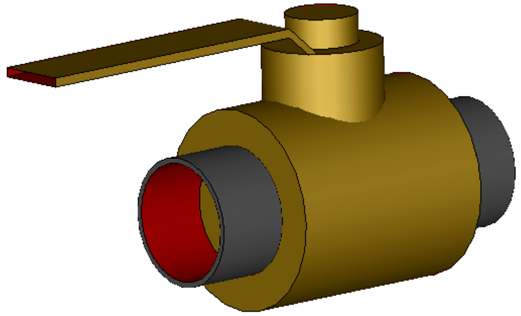
Flow is not always observed when modeling. When this happens, flow fittings will show flow in the incorrect direction. The quick fix is to flip the fitting so the flow appears to be correct, but during the conversion process fabrication will populate all flow fittings according to flow ….not how the fitting appears in the model.

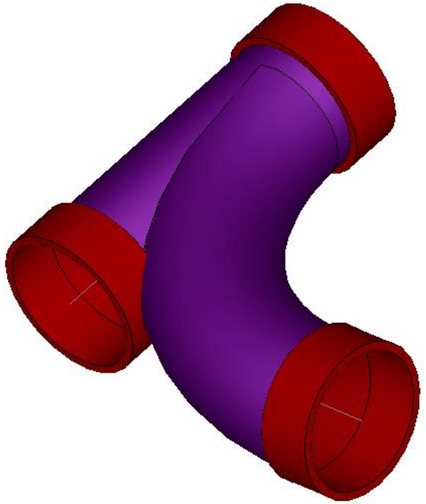
Tips for Converting Revit Families for Fabrication

Use the Design to Fabrication tool to convert a design model with Revit MEP elements to an MEP fabrication model with LOD 400 MEP fabrication parts.

You can convert selected parts or an entire run of duct or pipe. The Design to Fabrication tool provides a more efficient workflow, since the fabrication model does not need to be redrawn from scratch. The result of the conversion is based on the Design Line algorithm used by the Autodesk Fabrication products, and uses the same content available in the Autodesk Fabrication products.







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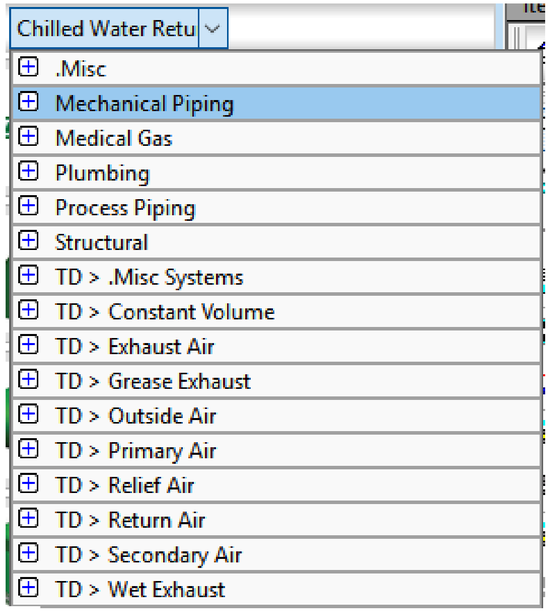
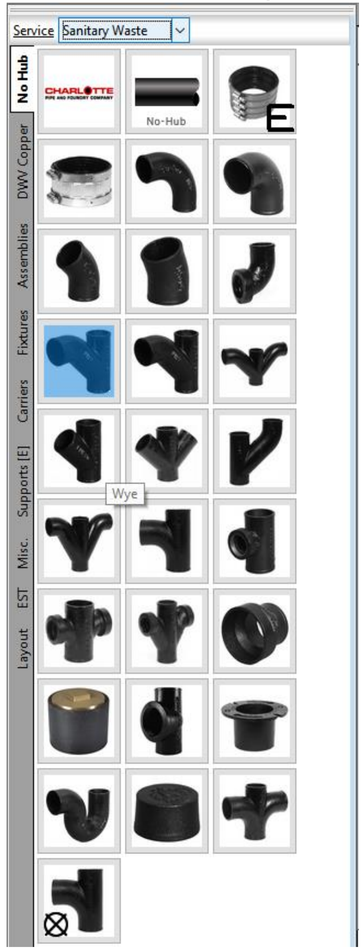
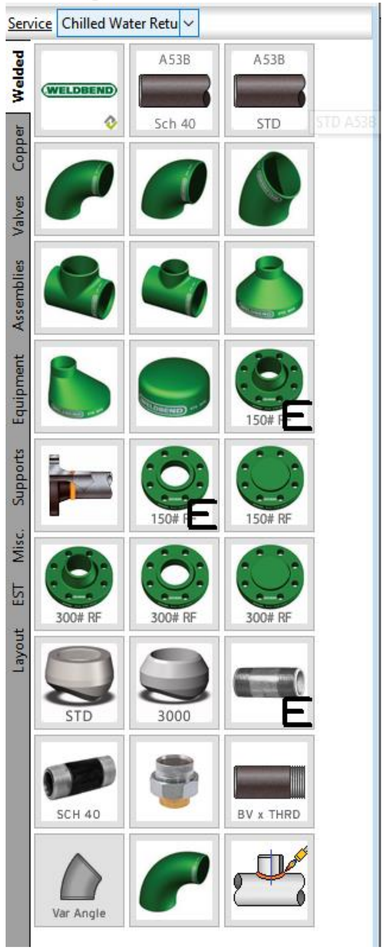
Fabrication Database

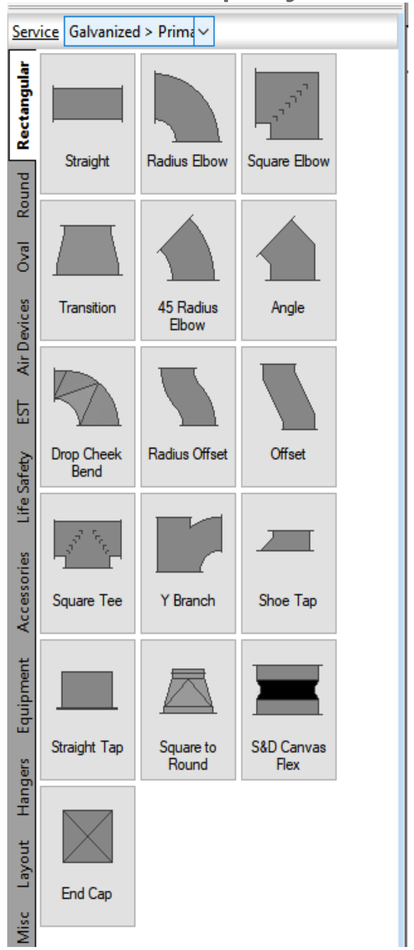
ONE COMMON DATABASE

When setting up the Fabrication Database, make sure to setup one primary configuration that contains Plumbing, Piping and Sheet metal. Revit only allows one configuration to be loaded into one project.









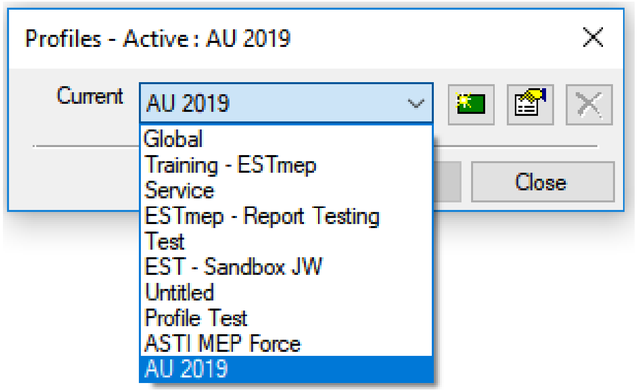
Fabrication Database

PROFILES

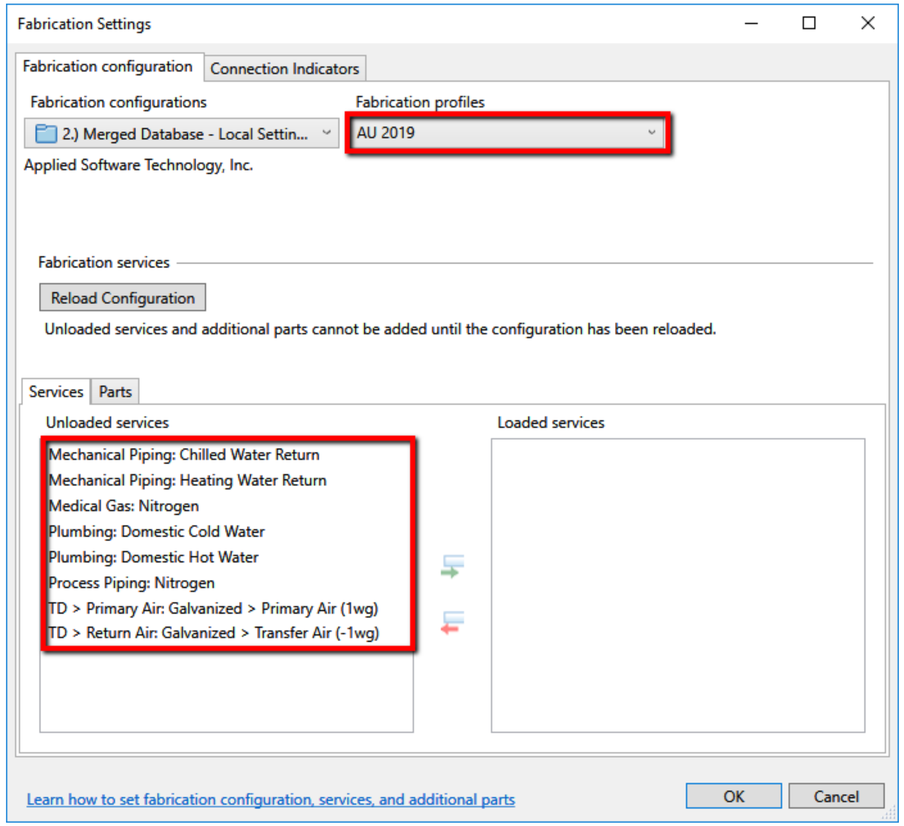
Profiles can be used to create individual system configuration settings that can be applied to separate jobs or projects. Creating a new profile lets you create separate service, sections and or items relating to the specification of the job or project.

- Profiles are accessible inside of Revit.

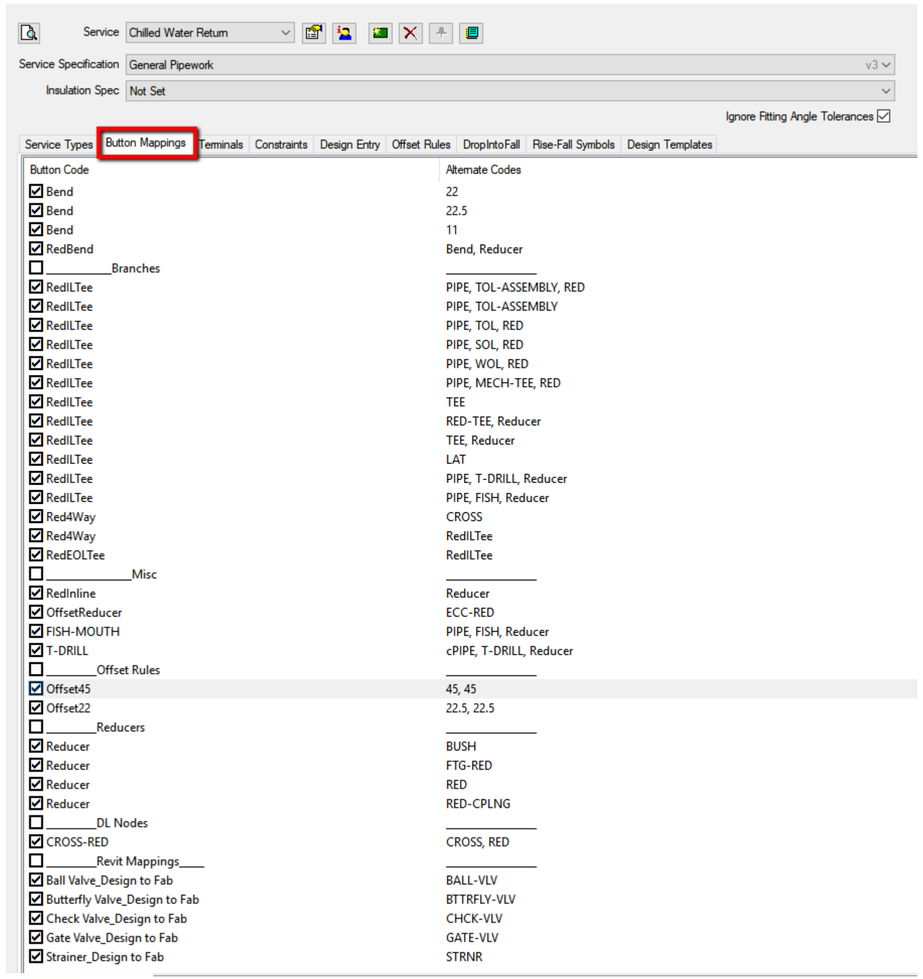
PROFILES INSIDE OF FABRICATION

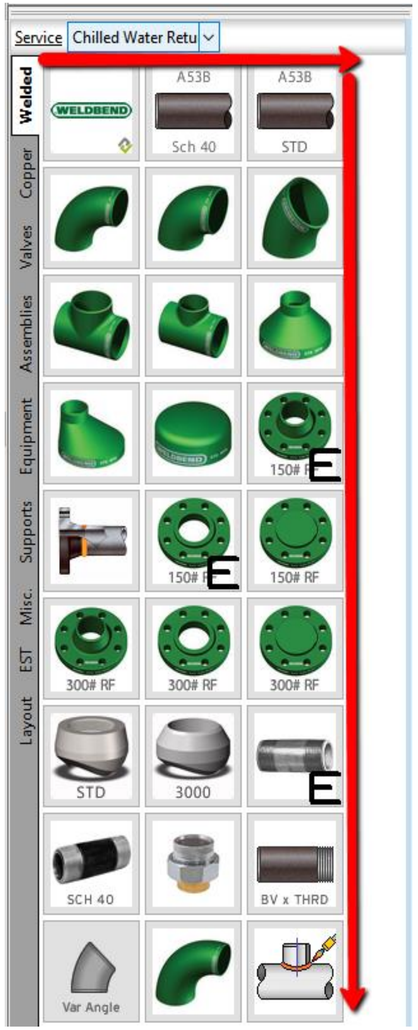


PROFILES INSIDE OF REVIT



Fabrication Database





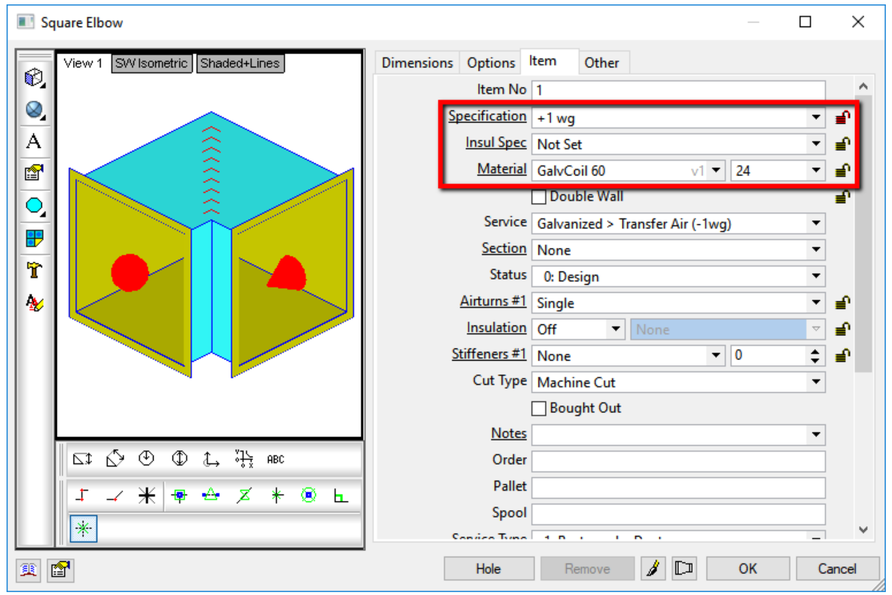
SERVICE SETUP

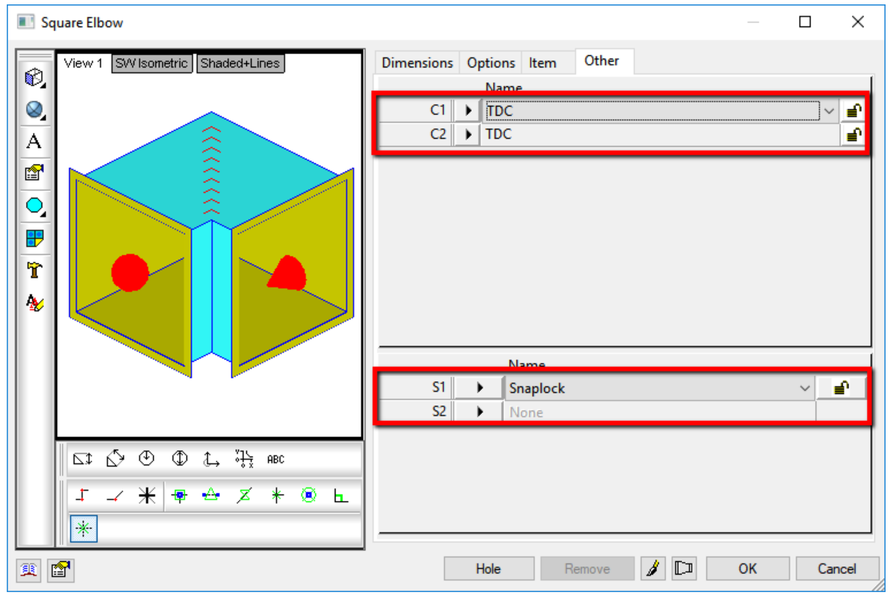
Services provide control over the placement of each Item and it's individual components. For example, each Item inserted into a drawing is actually made of several components, including the item shape, material, connectors and more.

- Item placement inside of the service template is important.
- Design line and the Design for Fabrication tool uses button mappings and the order of which the items are placed.
- When converting Families to ITM's, the conversion tool will look at Button Mappings first and than item placement from left to right and top to bottom, tab to tab. If the size and shape fit and the button code corresponds with the design, the item will fill and convert.
- Keep multiple service materials to a minimum. If sizing overlaps, you will have undesired conversions.
- Sheet Metal services work best based off pressure class.
  - Service Specification (pressure class) define how sheet metal items are built.
  - Material, seams, connectors etc.

Fabrication Database

SERVICE SPECIFICATION





Specification +1 wg

Material Galvanized

Library Rectangular

Valid for Fittings Only

Entries

<= Dim	Gauge	STD Straight	Connector (In)	Connector (Out)	Connector (End Cap)	Connector (Sq-Rnd)	Seam	Seam (Sq-Rnd)	Stiffener	Spacing	Support	Spacing	Sealant	Splitter	Airtum
16.000	26	60.000	S&D	Not Used	Not Used	Not Used	S-Pits	1/2" Lap	None	0.000	None	0.000	Duct Seal	None	4" Double Vane
30.000	26	60.000	TDC	Not Used	TDC Cap	Ductmate 35	S-Pits	1/2" Lap	None	0.000	None	0.000	Duct Seal	None	4" Double Vane
42.000	24	60.000	TDC	Not Used	TDC Cap	Ductmate 35	S-Pits	1/2" Lap	None	0.000	None	0.000	Duct Seal	None	4" Double Vane
60.000	24	60.000	TDC	Not Used	TDC Cap	Ductmate 35	S-Pits	1/2" Lap	MPT	30.000	None	0.000	Duct Seal	None	4" Double Vane
72.000	22	60.000	TDC	Not Used	TDC Cap	Ductmate 35	S-Pits	1/2" Lap	MPT	30.000	None	0.000	Duct Seal	None	4" Double Vane
96.000	18	60.000	TDC	Not Used	TDC Cap	Ductmate 35	S-Pits	1/2" Lap	MPT	30.000	None	0.000	Duct Seal	None	4" Double Vane
120.000	18	60.000	TDC	Not Used	TDC Cap	Ductmate 35	L-Pits	1/2" Lap	JTR - 2-1/2x1/8	30.000	None	0.000	Duct Seal	None	4" Double Vane

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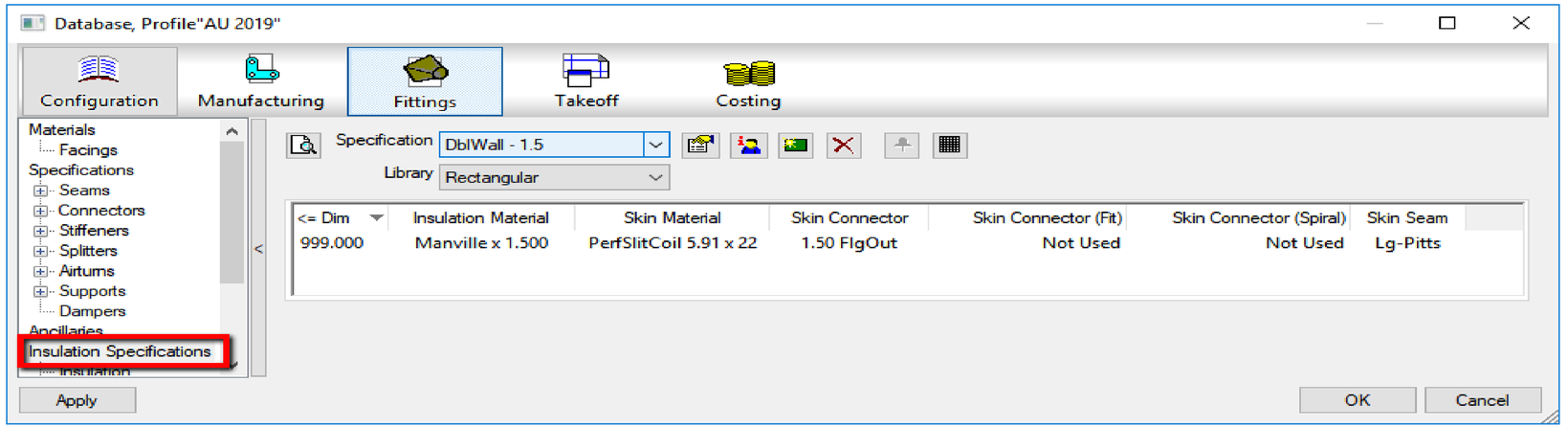
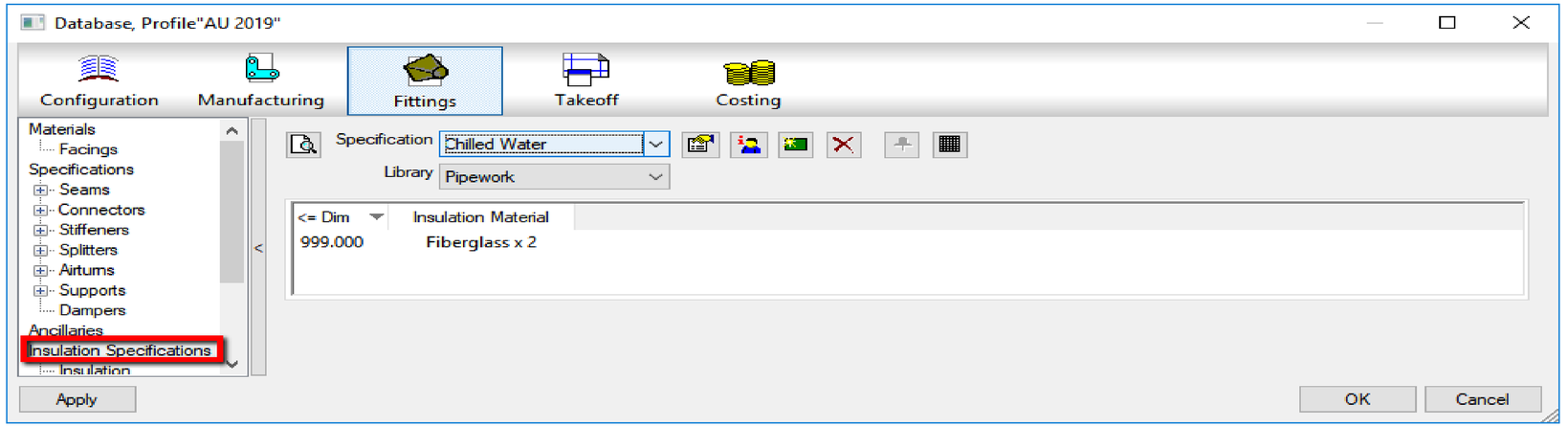
Fabrication Database

INSULATION SPECIFICATION

A Specification allows the software to determine certain information automatically, instead of the user having to choose each of these factors individually





Hurdles

Peer to Peer Mentoring

- One of the best results from this project and testing was the natural support we provided internally to each other.
- With the silos falling, we naturally found a support occurring across teams that typically were not involved jointly in a project.
- This allowed everyone to maintain good production speed without getting slowed down by inexperience.

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Hurdles

Key Takeaways

- Engineering is adapting design workflows to better assist our Estimating and VDC Partners.
- Working together has created opportunities to develop common standards across the company that improve our efficiencies.
- Using Fabrication ITMs in Revit has pushed us to develop solutions to hurdles regarding the use of the two merging technologies.

Looking to the Future

Key Takeaways

- The goal is to win more Design Build projects working with our community.
- A common Master Database in use across the entire company allows us to share modeled content, supporting each other and reducing rework.
- We are looking to the future of technology in construction to be prepared for new abilities such as Design Automation API for Revit and other opportunities.

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Questions?

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THANK YOU!

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