Unified Workflow: Using a Revit Model from Design through Construction

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MP6629 Are you unsure of how much detail you should show in your 3D model? See real-life examples of how a design-build mechanical contractor saved time and money by utilizing a unified workflow to produce a truly constructable 3D Revit software model from design through construction. This lecture will highlight how to set up personnel infrastructure to optimize software usage; how to describe the expectations that your design model should meet from a contractor's perspective; and how to identify techniques to incorporate early constructability feedback to enhance design. Through the use of a carefully planned unified workflow, the 3D design model can enhance your opportunities for prefabrication, utility racking, modular construction, streamlined coordination, expedited conflict resolution, and increased job site safety.

Learning Objectives

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

- Identify the appropriate level of coordination required in the 3D model by design professionals
- Learn how to form strategies that help communication between design and field to provide constructability feedback in the design process
- Create a Revit model that can be efficiently referenced by contractors to develop coordination drawings
- Learn how to sequence the 3D model level of completion to sync with construction phasing to enhance coordination

About the Speakers

Mike received his Bachelor's degree in Mechanical Engineering in 1998 from Virginia Tech, and is a Senior Mechanical Engineer with the Mid-Atlantic Division of Southland Industries, one of the nation's largest building systems experts. He spent over 10 years as a consulting engineer working for A/E firms in Washington DC and Pennsylvania, before assuming his current position as a design-build engineer at Southland over the past 6 years. He is responsible for the design of all mechanical systems from the inception of a project through construction, with the use of a 3D Revit model as his key tool for design, construction document creation, and field construction coordination. He has been using Autodesk products for the last 20 years, and this is his fifth year attending Autodesk University. He is a licensed professional engineer, ASHRAE member, and DBIA Professional.

Jason received his B.S. in Mechanical Engineering from Clemson University in 2007 and currently serves as Constructability Leader for the Mid-Atlantic Division at Southland Industries, one of the nation's largest building systems experts. Prior to his current position, Jason spent 5 years as a design engineer at Southland working exclusively on large scale Design-Build projects with stringent coordination and BIM requirements. His previous roles include design lead, commissioning manager, and coordination liaison. As the current leader of the coordination department Jason is responsible for staffing, training, and managing a team of union detailers who perform coordination activities for all the current projects under the Mid-Atlantic Division. He focuses his efforts on streamlining the coordination process, integrating the design and detailing groups, ensuring a high level of communication, and enhancing software tools available to increase team performance.

Aja has received her associate's degree for Computer Drafting and Design and is currently working on the completion of her bachelor's degree in Interior Design. With a specialized BIM and engineering knowledge base spanning 9 years from education and working in the AEC industry, Aja is now currently the active BIM Leader in the Mid-Atlantic Division at Southland Industries, one of the nation's largest building systems experts. As a BIM Leader for Southland, Aja is responsible for training the BIM group and design engineers of all skill levels in all BIM related software and strategies, improving upon her stellar presentation skills. For the past 4 years, Aja has been heavily involved in developing and continuously speaking on Southland's Unified BIM Strategy, which streamlines workflows, reduces costs, optimizes appropriate technology, and efficiently manages and shares information. She has been an active attendee at Autodesk University and is also a Revit Certified Professional.

Southland Industries

Founded in 1949, Southland Industries provides innovative engineering, construction, service, and energy service solutions through a holistic approach to building performance. Advocating a design-build-maintain model, Southland believes in offering customers the option of optimizing each stage of the building lifecycle through an integrated, customized project or by selecting any of our services and capabilities to be implemented individually. For jobs large and small, our in-house experts remain connected, sharing knowledge and information in order to produce the innovative, practical solutions that have earned Southland its unmatched reputation as one of the top design-build firms in the nation.

Utilizing a variety of progressive tools such as building information modeling (BIM) and lean methods, Southland specializes in the design, construction, and service of mechanical, plumbing, fire protection, process piping, automation and controls systems, as well as comprehensive energy services needs. As a company that has always prided itself on innovation and collaboration, Southland continues to pave the way as an industry leader in sustainability and energy efficiency so as to improve the way buildings are designed, built, and maintained.

Beginning as a Southern California-based supplier of residential heating solutions, we have organically grown and exponentially expanded our services and capabilities over the years to serve a wide variety of markets and industries. Recognized as one of the nation's largest building systems experts, today Southland delivers superior results for commercial, data center, education, healthcare, government, hospitality, industrial, life sciences, entertainment, and mixed use buildings and clients.

Definitions

Unified Workflow

A single process in which each functional group participates from the onset of design to the completion of construction. This incorporates the involvement of all internal team members including the Project Manager, Project Engineering Lead, Project BIM Lead, and Project Constructability Lead.

Project Manager

Acts as the leader and main point of contact for the project. He or she is responsible for design, trade, and subcontractor management managing the project budget, and procures all equipment on a project.

Project Engineering Lead

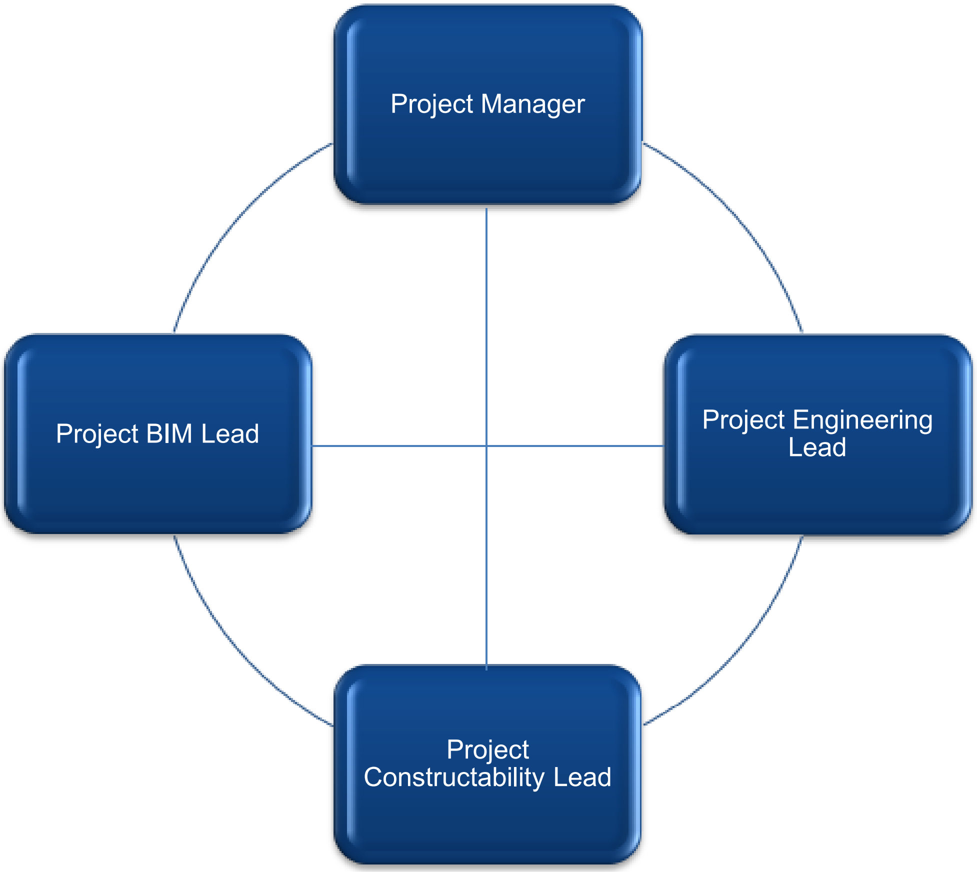
Leads the engineering team through the project design, executes BIM modeling to constructability lead standards, and creates all construction documents. He or she is also must select and approve equipment procured on a job and facilitate the coordination of design trade with other trades.

Project BIM Lead

Manages BIM technology from concept to project completion, reviews RFP BIM requirements, and facilitates the creation of the BIM Execution Plan based on the projects requirements.

Project Constructability Lead

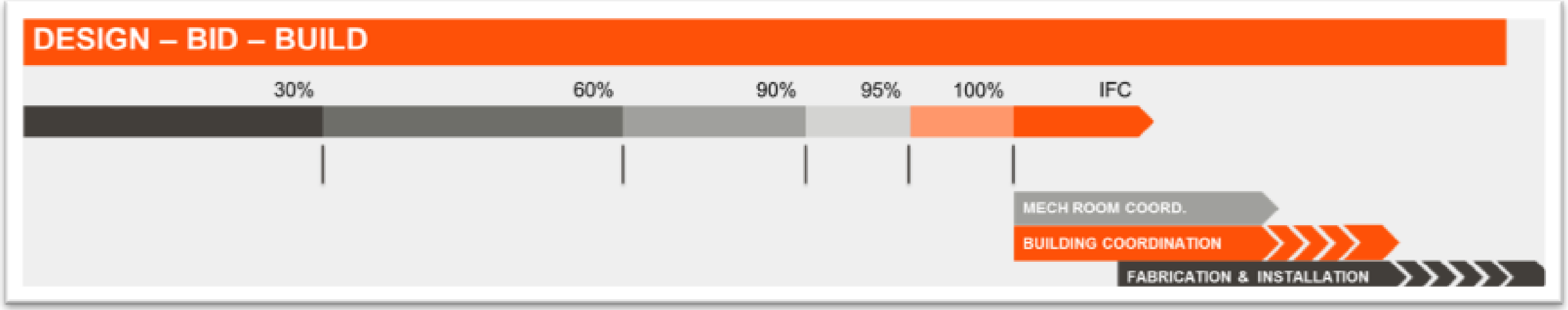
Acts as the liaison between engineering and project foreman for project standards and proper installation techniques to shape design. This involves project material standards, specifications, repeatable unity layouts, modular construction/pre-fabrication opportunities, and routing standards. He or she also manages the constructability review, coordination, and spooling processes.



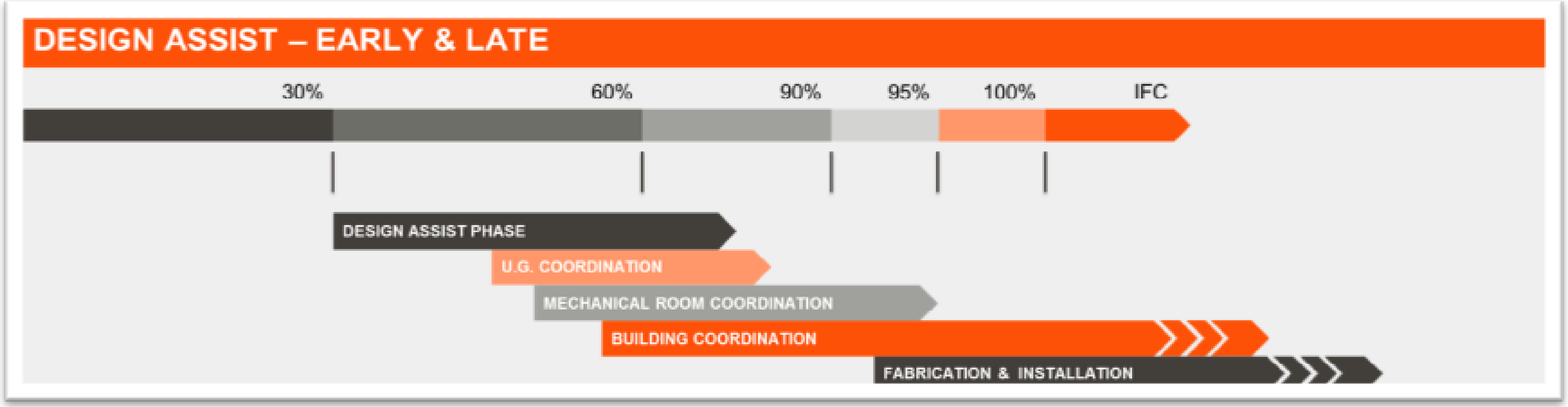
All four roles are in constant communication throughout the lifecycle of the project. Process in a unified workflow is circular, not linear. The need for the Project Constructability lead to provide constant feedback throughout the life cycle of the design process is key

Project Delivery Types

Design-Bid-Build: Typically very RFI intensive, involves large amounts of re-work in engineering, long construction administration phase, longer project delivery schedule. Longer project delivery schedule due to Coordination and construction activities not beginning until after construction documents are 100%.

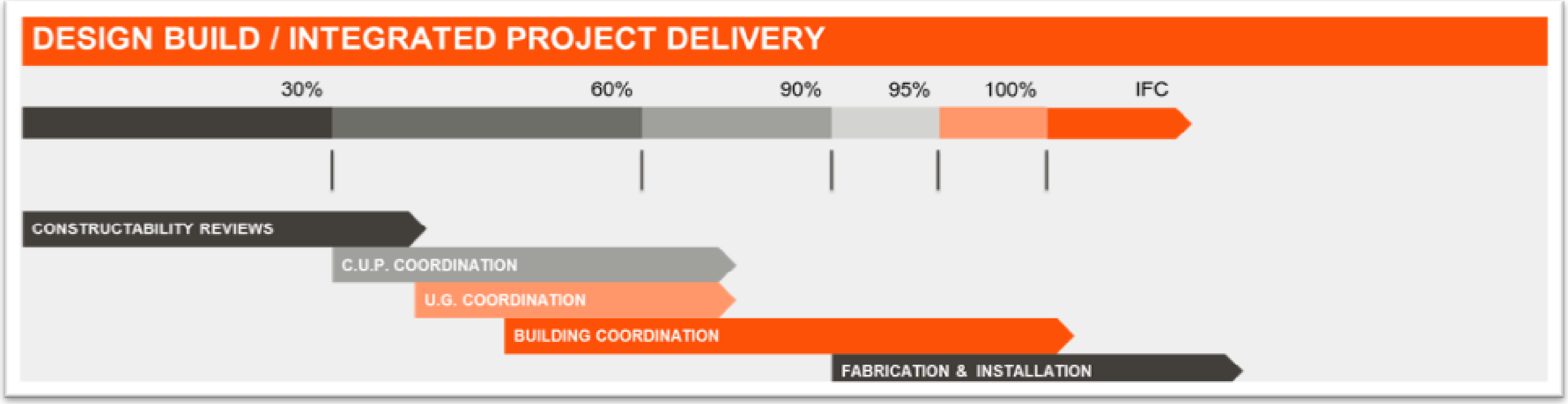


Design Assist: Reduction in the amount of RFI's, less design re-work, more cost impact designed into the job, compressed project delivery schedule. Project delivery schedule shorter than Design-Bid-Build, but still longer than optimal based on how early contractor involvement begins.



Design Build / Integrated Project Delivery

Very few RFI's, minimize drafting re-work in engineering, constructability is built into the design model, very compressed project delivery schedule. Project delivery expedited due to contractor involvement from the beginning.



Level of Development

LOD 100	The Model Element may be graphically represented in the Model with a symbol or other generic representation, but does not satisfy the requirements of LOD 200. Information related to the Model Element (i.e. cost per square food, tonnage of HVAC, etc.) can be derived from other Model Elements.
LOD 200	The Model Element is graphically represented within the Model as a generic system, object, or assembly with approximate quantities, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.
LOD 300	The Model Element may is graphically represented within the Model as a specific system, object or assembly in terms of quantity, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.
LOD 350	The Model Element is graphically represented within the Model as a specific system, object, or assembly in terms of quantity, size, shape, orientation, and interfaces with other building systems. Non-graphic information may also be attached to the element.
LOD 400	The Model Element is graphically represented within the Model as a specific system, object or assembly, in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information. Non-graphic information may also be attached to the Model Element.
LOD 500	The Model Element is a field verified representation in terms of size, shape, location, quantity, and orientation. Non-graphic information may also be attached to the Model Elements.

Revit Model Types from Architects and Engineers

Presentation Model

Generic design intent is conveyed, estimated locations of equipment, high detail equipment is used to convey a low LOD, used to create renderings, walkthroughs, and other presentation materials

Spatially Coordinated Model

In design, trade zones are enforced, general routing guidelines are followed, Constructability Lead's standards are followed, and there is coordination of the design trade with other trades

In coordination, clash detection with other trades is completed in small scale magnitude. Placement of small scale details, placement of hangers and supports, and drawing of highly complex connections are completed.

Constructable Model

A model that meshes design intent with what will be built in the field. Model is drawn to the level that requires minimal rework from the contractor's coordination team.

Design Overview

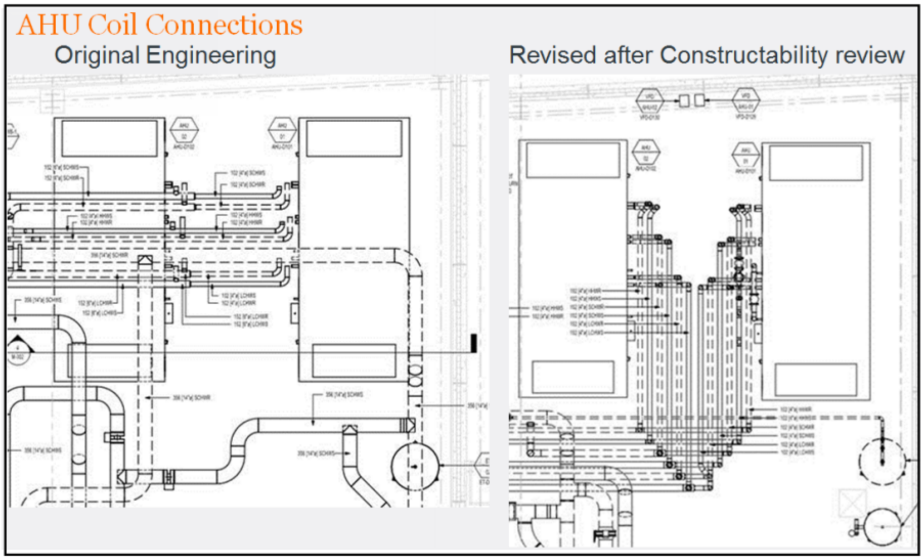
Pre-Design

During the Pre-Design phase, a presentation Revit model is created to sell the design intent to the owner/client. This model is also used for estimation purposes to bid the job. The Pre-Design phase can also be used to identify modular construction, pre-fabrication, and racking opportunities.

The Pre-Design phase is an important phase used for planning. The effort identifies key areas that need to go through the constructability review process and gives the contractor an opportunity for early involvement for feedback about the engineer of record’s design intent in a design-bid-build process. The effort also educates the design team on the constructability standards and methods.

The Pre-Design phase also gives the contractor a chance for early review and pricing feedback to the architect and engineer. Usually, constructability feedback is provided in the form of value engineering, which is typically met with resistance from the architect and engineer on the job. It is looked at as if it’s not their idea, but it is now their risk. Meeting with a contractor early and getting feedback, pricing information, and value engineering ideas up front allow the architect and engineer to have ownership of the process.

During the Pre-Design phase, modular construction, pre-fabrication, and racking opportunities are identified. This allows early involvement and coordination between all trades on the project.



AHU Coil Connections

Original Engineering

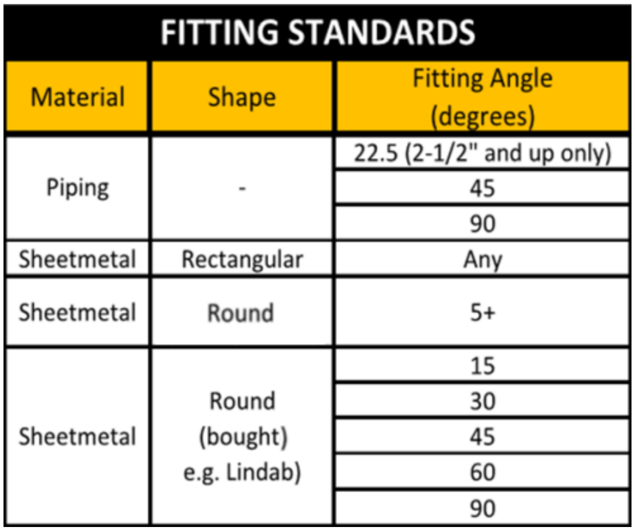
Revised after Constructability review

Pre-Modeling

During the Pre-Modeling phase, a BIM plan is assembled to execute the project effectively. Scheduling, level of development, model setup, and RFP review documents are a few examples of what should be highlighted in the plan.

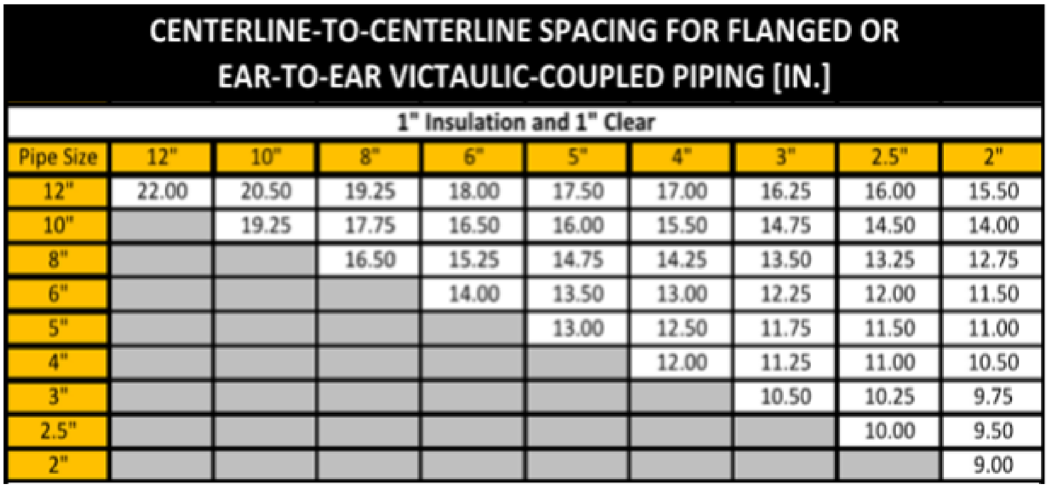
Design & Modeling

During the Design & Modeling phase, equipment is placed with accurate service and code clearances, trade zones are enforced for every discipline, systems are logically connected, and space is accounted for overly detailed components. Duct and pipe routing guidelines are followed such as fitting standards, system layering, and proper spacing between pipes, duct, and fixed objects based on size. Planning for racking opportunities should be taken into consideration. Alignment of ductwork and piping to the same bottom elevation allow for proper rack sizing and layering. Elements should be located at whole number increments from column lines as walls will not be placed yet during construction. All ductwork and piping should be tagged with actual dimensions which account for lining and insulation to avoid future conflicts in clash detection.



FITTING STANDARDS

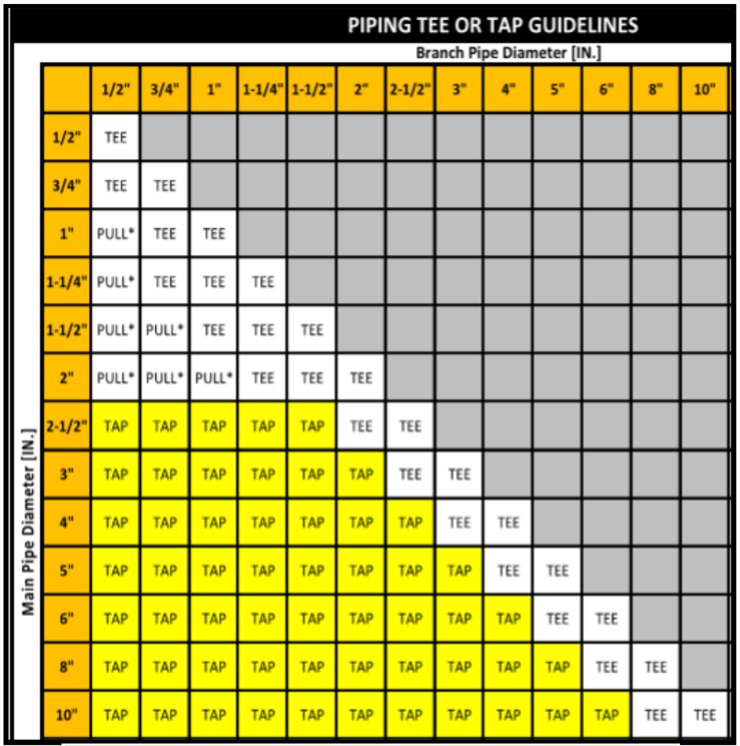
Material	Shape	Fitting Angle (degrees)
Piping	-	22.5 (2-1/2" and up only)
		45
		90
Sheetmetal	Rectangular	Any
Sheetmetal	Round	5+
Sheetmetal	Round (bought) e.g. Lindab)	15
		30
		45
		60
		90



CENTERLINE-TO-CENTERLINE SPACING FOR FLANGED OR EAR-TO-EAR VICTAULIC-COUPLED PIPING [IN.]

1" Insulation and 1" Clear

Pipe Size	12"	10"	8"	6"	5"	4"	3"	2.5"	2"
12"	22.00	20.50	19.25	18.00	17.50	17.00	16.25	16.00	15.50
10"		19.25	17.75	16.50	16.00	15.50	14.75	14.50	14.00
8"			16.50	15.25	14.75	14.25	13.50	13.25	12.75
6"				14.00	13.50	13.00	12.25	12.00	11.50
5"					13.00	12.50	11.75	11.50	11.00
4"						12.00	11.25	11.00	10.50
3"							10.50	10.25	9.75
2.5"								10.00	9.50
2"									9.00

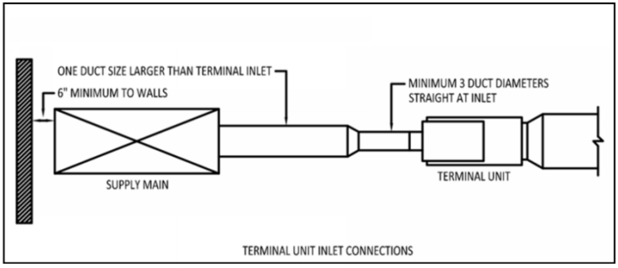


PIPING TEE OR TAP GUIDELINES

Branch Pipe Diameter [IN.]

Main Pipe Diameter [IN.]

	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	4"	5"	6"	8"	10"
1/2"	TEE												
3/4"	TEE	TEE											
1"	PULL*	TEE	TEE										
1-1/4"	PULL*	TEE	TEE	TEE									
1-1/2"	PULL*	PULL*	TEE	TEE	TEE								
2"	PULL*	PULL*	PULL*	TEE	TEE	TEE							
2-1/2"	TAP	TAP	TAP	TAP	TAP	TEE	TEE						
3"	TAP	TAP	TAP	TAP	TAP	TAP	TEE	TEE					
4"	TAP	TAP	TAP	TAP	TAP	TAP	TAP	TEE	TEE				
5"	TAP	TAP	TAP	TAP	TAP	TAP	TAP	TAP	TEE	TEE			
6"	TAP	TAP	TAP	TAP	TAP	TAP	TAP	TAP	TAP	TEE	TEE		
8"	TAP	TAP	TAP	TAP	TAP	TAP	TAP	TAP	TAP	TAP	TEE	TEE	
10"	TAP	TAP	TAP	TAP	TAP	TAP	TAP	TAP	TAP	TAP	TAP	TEE	TEE



TERMINAL UNIT INLET CONNECTIONS

Design Coordination

During the Design Coordination phase, engineers should pay attention to shaft sizing, architectural design around distribution areas, recognition of sloped systems, leaving space for non-modeled systems, and pull-planning for area coordination.

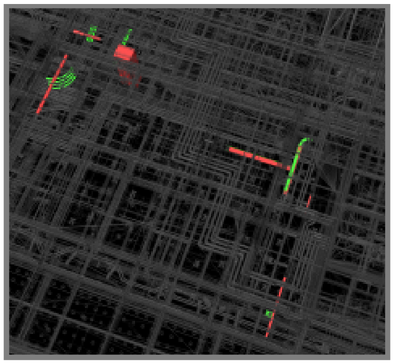
Coordination Overview

Pre-Coordination

During the Pre-Coordination phase, the team will review or create a project schedule, material specifications, and coordination standards. The team will also review the projects specifications provided by the engineer of record usually during the coordination kick-off meeting.

Coordination

During the Coordination phase, final approved submittals are collected and LOD 400 information is modeled. All trades will then meet in coordination meetings to run through several clash detections before signing off the coordination models.



Shop Drawings

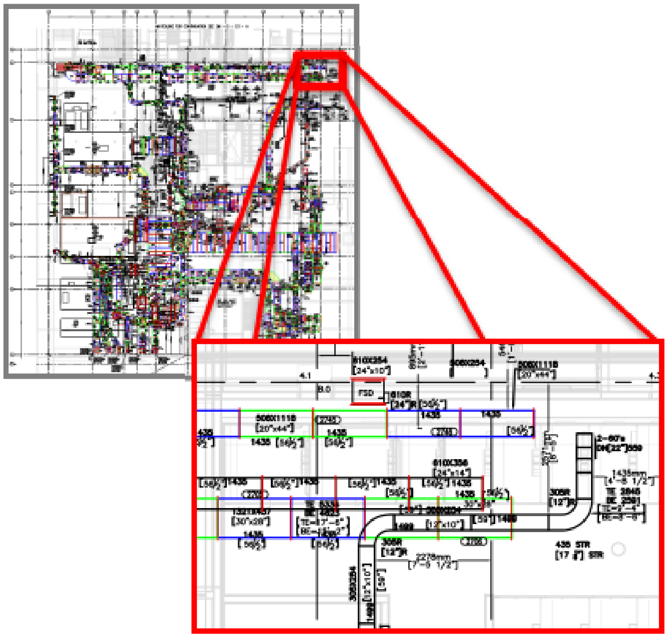
During the Shop Drawing phase, ¼" scale drawings are created and annotated for use during installation. This includes insert and hanger drawings, as well as details and sections of highly complex areas.

Pre-Spooling

During the Pre-spooling phase, areas are identified for pre-fabrication during the pre-fabrication kick-off meeting. All field points of contact should be present and the delivery schedule of materials should be reviewed

Spooling

During the spooling phase, the model is sectioned into smaller parts for pre-fabrication. Those parts are then sequenced and tagged for installation in the field.



Conclusions

In conclusion, creating construction documents in a 2D world was primarily based on communicating design intent in a clear and concise manner. Producing a truly constructable Revit model is far more involved than merely using Revit as a platform to create construction documents. Taking a more active approach to constructability through people, process, and technology will improve the Revit model, the construction documents, and the success of the entire project team. On fast track projects, re-think your construction document creation process. As a team, align how you populate the model with the proposed flow of construction.