Autodesk University 2012

Duct, duct, goose… I mean pipe.

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MP2889 This class focuses on the mechanical aspects of the industry: ductwork and piping. We will review Autodesk® Revit® MEP ductwork and piping tools to help you better understand and facilitate your design by analyzing your ductwork and piping systems. We will explore Engineering 101 fundamentals for both ductwork and piping and learn how these concepts are incorporated into Revit MEP, as well as the impacts these fundamentals have on sizing your ductwork and piping systems. We will review tools for routing and sizing your ductwork and piping systems. We will also discuss the System Inspector and explain how it can supplement the information in the Duct and Pipe Pressure Loss Reports.

Learning Objectives

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

- Better understand how engineering calculations have been incorporated into Revit MEP and how they can help facilitate your system design.
- Identify and avoid items that will negatively impact your model performance.
- Identify Revit MEP tools that can help you better understand your design.
- Analyze the design of your systems and show the analysis data graphically.
- Use Revit MEP tools to do "heavy lifting" allowing you to be "productively lazy" and "financially efficient".

About the Speakers

Darryl McClelland: BIM and Virtual Design Manager / Project Coordinator helping to refine current workflows and processes as well as implementing new technologies to leverage across MEP disciplines to help assist with project design challenges and improve collaboration amongst the project team. Graduate of Purdue University, member of ASHRAE and ASPE, LEED AP (BD+C), and co-author of 6 nationally published books on BIM. 27 years of practical design experience in the MEP industry focused on the mechanical design of complex research laboratories and institutional facilities to medical and professional office buildings, and everything in-between.

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Adam Bryson: BIM Coordinator helping to organize, develop, and improve Heapy Engineering's family library as well as streamlining automation in workflow processes through scheduling, and the overall standardization of Revit MEP. 11 years in the architectural and engineering industry and has been solely focused on the engineering aspect of the field for the past 3 years.

Duct and Pipe Calculations in Revit MEP

One of the toughest things to overcome with engineering professionals is to get them to believe in something that they might not understand. This is further compounded by the length of time the engineer has been in the industry. A saying to summarize that might be "You can't teach an old dog a new trick".

If an engineer can't see it, touch it or smell it, then they are not going to believe it. You can ask an engineer to give up their established workflows, tables and charts and do something different but that is about all you can do, ask.

With looming project deadlines, engineers are not going to take the time to "reverse engineer" something to confirm the validity of a process presented to them. The will always use their default workflows based on their previous successes.

However, what most engineers don't know is that some of those workflows and industry standards might be incorporated into a particular product. Armed with that knowledge they might be more willing to embrace products.

Giving that engineer the sense that "everything will be alright" if they use a tool is what a lot of us face on a daily basis.

Engineers rely heavily on standards established by ASHRAE. Those standards include formulas on how to size ductwork and piping. Those formulas are are incorporated into tables, charts, and graphs that the engineer might reference to size their ductwork and piping systems. Consulting those items can be a "klunky" process as you might have to put the pen down consult a table or chart. This would also apply to letting go of a mouse to consult that table or chart.

Hidden deep in Revit MEP is a knowledge base on the formulas incorporated into the product that Revit MEP uses to size ductwork and piping. It is worth to note that those formulas are the same ASHRAE formulas that the engineer uses on a daily basis to size ductwork and piping.

Sharing this knowledge with the engineer can relieve them of any anxiety and potentially open an entirely new world for them and help them complete their project faster and more efficiently.

Duct and Pipe Sizing tools

Ductwork can be sized based on Velocity, Friction, Equal Friction, or Static Regain. When sizing based on Friction and Velocity, radio buttons, Only, And, or Or, will be active in the Duct Sizing dialog box. Selecting the Only radio button will size the ductwork according to just the parameter you choose from the drop-down. Selecting the And radio button will size the ductwork according to both the parameters input. Selecting the Or radio button will size the ductwork according to the least restive parameter input.

Sizing constraints can be applied when sizing your ductwork. In the Branch Sizing drop-down, of the Duct sizing dialog, you can size your branch ductwork based on a Calculated Size Only, Match Connector Size, or the Larger of the Connector and Calculated size. Choosing Calculated Size Only will size the selected ductwork by the method indicated in Sizing Method. Choosing Match Connector Size will size the ductwork based on the size of the connector between the branch and the main. Choosing the Larger of Connector and Calculated will size the ductwork based on the larger of the 2, Calculated Size Only and Match Connector Size. This section also allows you to restrict the height and width of the ductwork if necessary.

Pipe can be sized based on Velocity or Friction. When sizing based on Friction and Velocity, radio buttons, Only, And, or Or, will be active in the Pipe Sizing dialog. Selecting the Only radio button will size the pipe according to just the parameter you choose from the drop-down. Selecting the And radio button will size the pipe according to both the parameters input. Selecting the Or radio button will size the ductwork according to the least restive parameter input.

Sizing constraints can be applied when sizing your piping. The behavior of the piping constraints is similar in nature to the ductwork constraints.

System Inspector

The System Inspector tool helps you better understand your ductwork and piping systems. The System Inspector allows you to query components of your ductwork and piping systems to view their properties and flow characteristics.

Flow and pressure are calculated separately for each sub-segment of your ductwork and piping. To view the calculated results of your ductwork and piping system with System Inspector you will need to make sure that your systems are properly connected and that you do not have any open ends in your systems.

Flow arrows will appear onscreen within the ductwork and piping system. The red arrows indicate the path through the system with the greatest pressure drop. The blue color indicates a portion of the system which is not in the critical path.

Pressure Loss Reports

The System Inspector allows you to visually view pressure and flow characteristics of your ductwork and piping systems. However, this information cannot be maintained in our View once the System Inspector tool is closed. There is another option to review pressure and flow characteristics of your ductwork and piping systems within Revit MEP. This is accomplished with the Duct or Pipe Pressure Loss Report tool.

Pressure Loss Reports can be generated for a single duct or pipe segment or for a complete system. The report can then be saved in either a HTML or CSV file format making them available for anyone on the project to review.

Within the Duct or Pipe Pressure Loss Report Settings dialog you have the ability to add or remove fields to the overall report. You can also choose to display your system information or the critical path of your piping systems.

In addition, you can display detailed information on straight segments of ductwork or piping by sections or you can display fitting and accessory loss coefficients by sections as well. Each of those items has fields that can be added or removed from the report. To do this simply click the Settings button associated with the item.

Color Fill Legend

Applying a Color Fill Legend can help you visually identify characteristics of an object based on the Properties of the object. For example, after you place pipe in your project you would like to verify that you did not exceed a particular velocity in the pipe. However, you do not want to select each object and review the Properties of the object nor do you want to use the System Inspector to inspect every piece of pipe. This is where a Color Fill Legend can come in quite handy.

Warnings

If the Service Engine Soon warning light comes on in your car do you drive another 3,000 miles before you address it? Typically, you address this warning as quickly as possible in order to avoid long term damage to your engine. Warnings in Revit should be handled in the same manner in an effort to help you avoid long term performance issues with your model.

Some Warnings in Revit MEP are more severe than others. Other Warnings can be simply dismissed. Warnings that involve calculations, or something calculated like area, etc., are the most severe Warnings and those types of Warnings should be immediately addressed as they tend to affect your overall model performance.

Check Duct/Pipe System

The Check Duct/Pipe System tool allows you to verify that each component is assigned to a system and is properly connected.

Once the Check Duct/Pipe Systems tool is active, Warnings markers, and their associative web lines, will indicate where there are potential failures in your ductwork/piping system that will require your attention.

The Warning Markers indicate a System that is not well connected, a Flow or Demand configuration mismatch, and/or a Flow direction mismatch.

Clicking a Warning marker will force the Warning dialog to appear indicating any warnings that you need to address. There are some small icons on the right side of the Warning dialog. The arrow icons let you scroll to the next and previous warnings in situations where there are multiple warnings. If you want to learn more about a particular warning, you can click the Expand Warning Dialog icon.

From there you can select a particular Warning to have Revit MEP show you were that Warning is in your project, obtain more information on the issue, delete the item in question, or export the Warnings to HTML file for review by the project team.

Duct/Pipe System Calculations

As you place your ductwork/piping and associate flow to those system components, Revit MEP performs certain calculations "behind the scenes". Depending on the size of your project these calculations could bog down the performance of your model. If you do not plan to use the calculation portion of Revit MEP you can simply turn the calculation functionality off. This can be done through the Type Properties of the Duct/Pipe System. From there you will have three choices in the Calculations drop down: All, Flow only, and None.