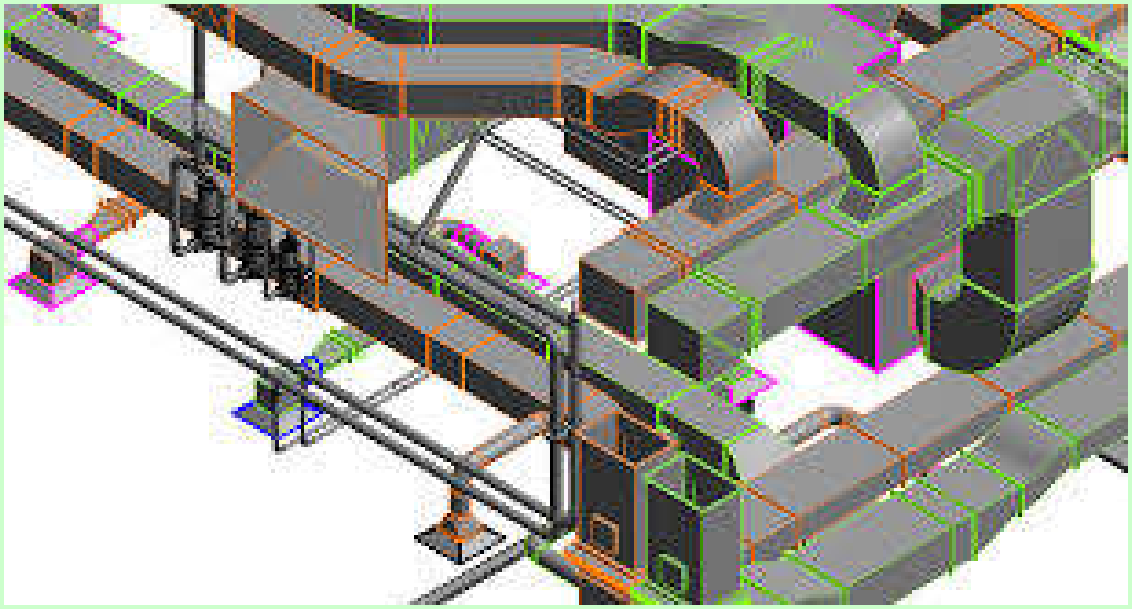
SBS5411 Building Information Modelling for BSE

http://ibse.hk/SBS5411/



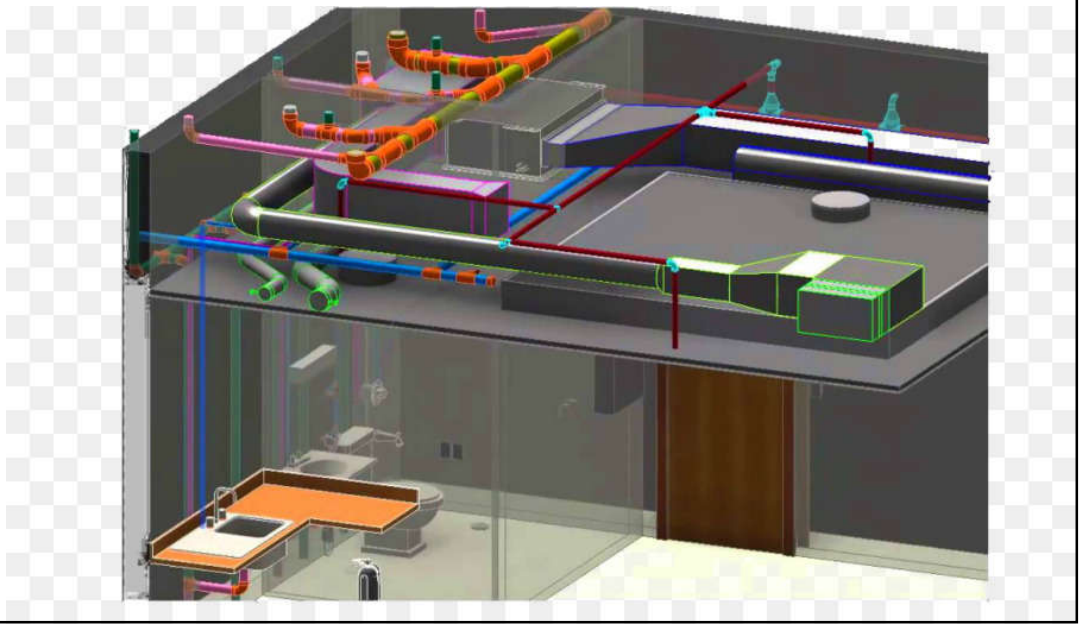
Revit Mechanical

Ir. Dr. Sam C. M. Hui
Faculty of Science and Technology
E-mail: cmhui@vtc.edu.hk

Sep 2018

Contents

- HVAC cooling & heating load analysis
- Creating logical systems
- Mechanical systems & ductwork
- Mechanical piping



HVAC cooling & heating load analysis

- Revit MEP options:
  - Model the HVAC loads within the program itself
  - To export the space load data via a Green Building XML schema (gbXML) file to an external simulation software program, such as Trane TRACE 700, DOE-2, or Carrier's Hourly Analysis Program (HAP)
- Typical analysis tasks:
  - Cooling & heating load analysis, conceptual energy analysis, duct & pipe system pressure

HVAC cooling & heating load analysis

- Creating spaces
  - Within room-bounding elements such as walls, floors, ceilings, roofs, and room separation lines
  - Enable the selected architectural links to be room bounding
  - Spaces carry the engineering data that is necessary for analysis, whereas rooms are for the information required by the architects
  - Define the MEP spaces accurately; correctly model & account for space usage, internal loads

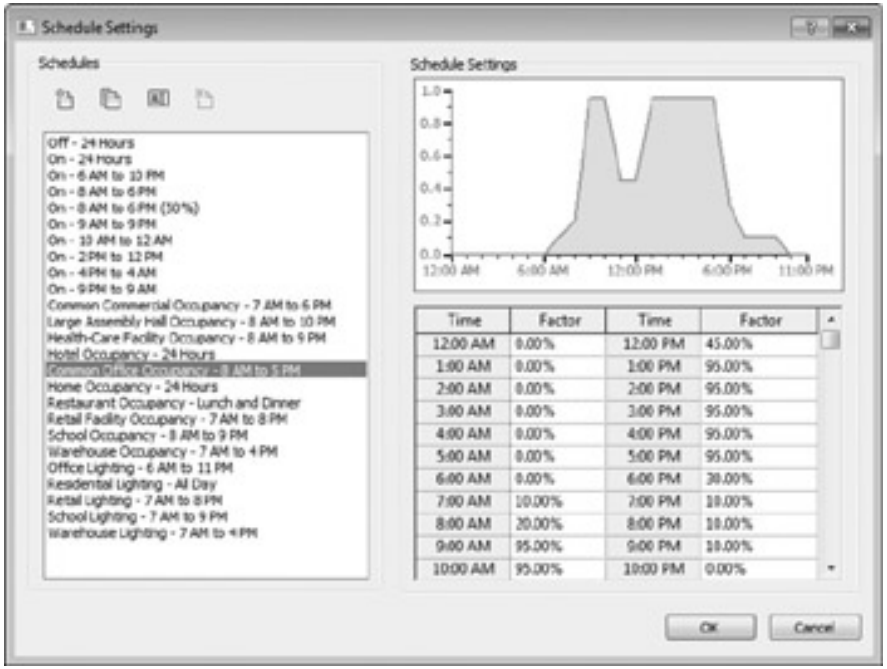
HVAC cooling & heating load analysis

- Placing spaces
  - Do it manually or letting Revit locate and place spaces automatically
  - Check that areas e.g. utility chases, columns, or air spaces in wall constructions were not included
- Space properties schedule
  - Working schedule of the building space properties
  - Generic space naming & numbering convention
  - Internal loads: people, lighting load, power load

Real world scenario

David has an issue. He has received the preliminary building model from the architect, but has not been able to set up each space to get an accurate building load takeoff prior to the next project design meeting. Knowing that Revit MEP automatically defaults to a global building type, he adjusts the building type to office, adjusts the required parameter values, and tells the program to lay out the spaces automatically.

David is able to quickly generate initial heating, cooling, and ventilation loads and, with that data, the mechanical design team will be able to analyze different system possibilities to condition the building and present options to the project team.

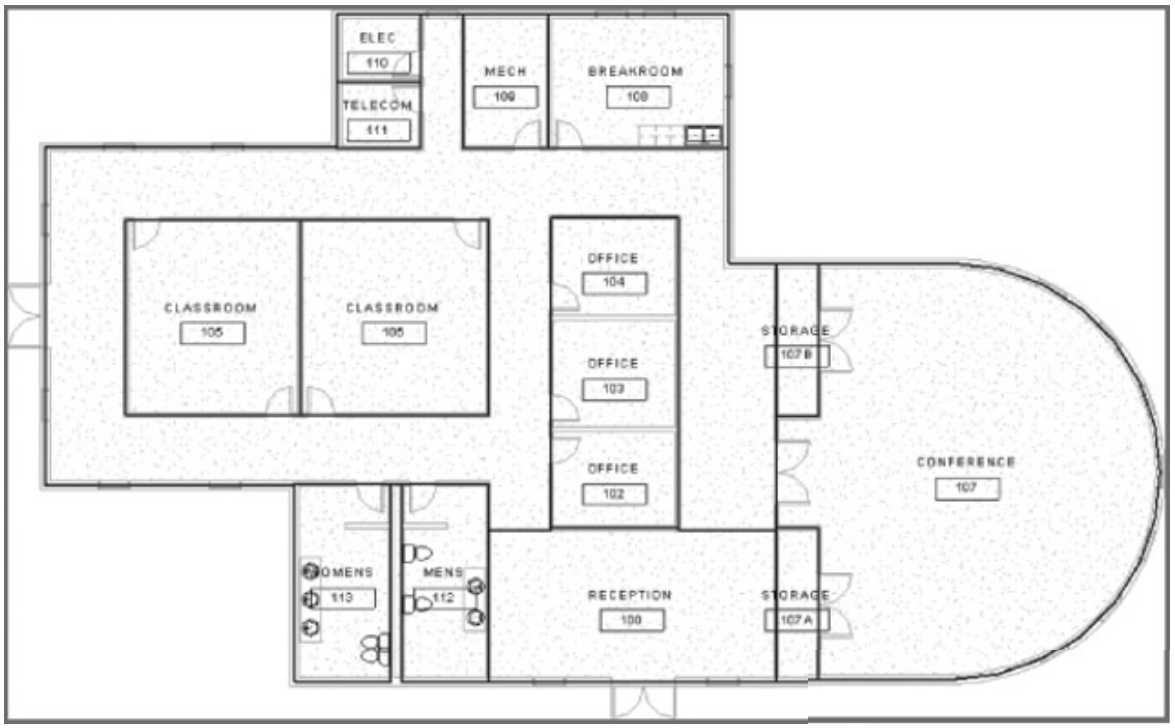


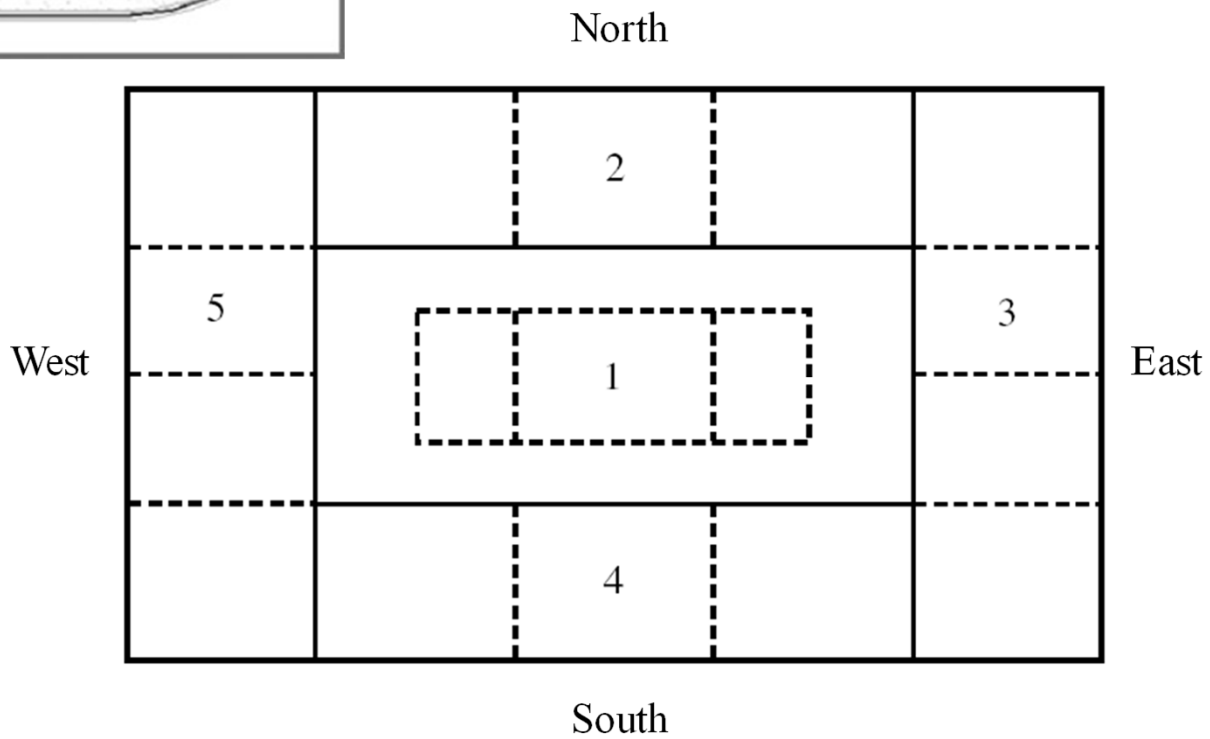
(Source: Bokmiller, D., Whitbread, S. and Hristov, P., 2013. *Mastering Autodesk Revit MEP 2014*, Sybex, Indianapolis, Ind.)

HVAC cooling & heating load analysis

- Creating zones
  - Group similar spaces into zones
    - To provide common controllability of air quality or condition within the zone's spaces
    - Outdoor air & ventilation load are computed
  - Building construction & physical properties
    - Exterior and interior constructions
    - Properties e.g. U-values, material composition
    - How heat leaves or enters your design spaces to or from the surrounding outdoor environment or adjacent spaces

Grouping spaces in the floor plan

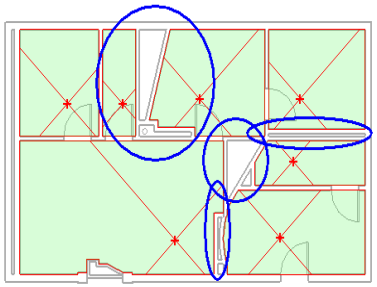




(Source: Bokmiller, D., Whitbread, S. and Hristov, P., 2013. *Mastering Autodesk Revit MEP 2014*, Sybex, Indianapolis, Ind.)

HVAC cooling & heating load analysis

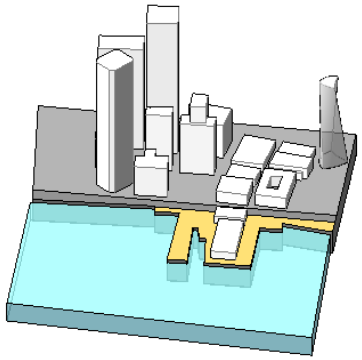
- Perform cooling & heating load analysis
  - ASHRAE Radiant Time Series (RTS) method
  - View building energy analysis information, weather data & outdoor air infiltration
  - Cooling & heating load report
  - Sliver spaces*
    - Narrow areas that are bounded by parallel interior room-bounding components (parallel interior walls). These spaces include, but are not limited to, pipe chases, HVAC shafts, furrowed columns, and wall cavities



(*See also: Spaces http://help.autodesk.com/view/RVT/2018/ENU/?guid=GUID-48509199-F248-4B61-9DC6-CEFBE2E302F2)

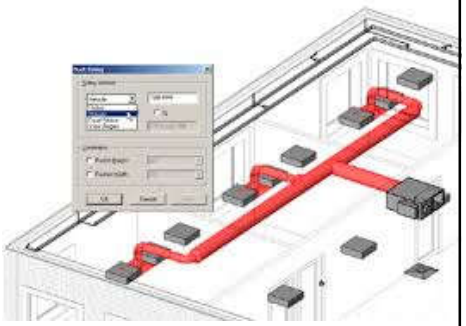
HVAC cooling & heating load analysis

- Conceptual energy analysis*
  - Analyze a simplified project building in the concept design phase (for actual building components or a conceptual mass model)
    - Allows easy analysis & comparison of design options
  - Experiment with different mass forms, orientations, envelopes, schedules, occupancy, and zoning to determine which building changes will have the greatest impact on energy performance
    - Report can be exported to DOE-2 or EnergyPlus



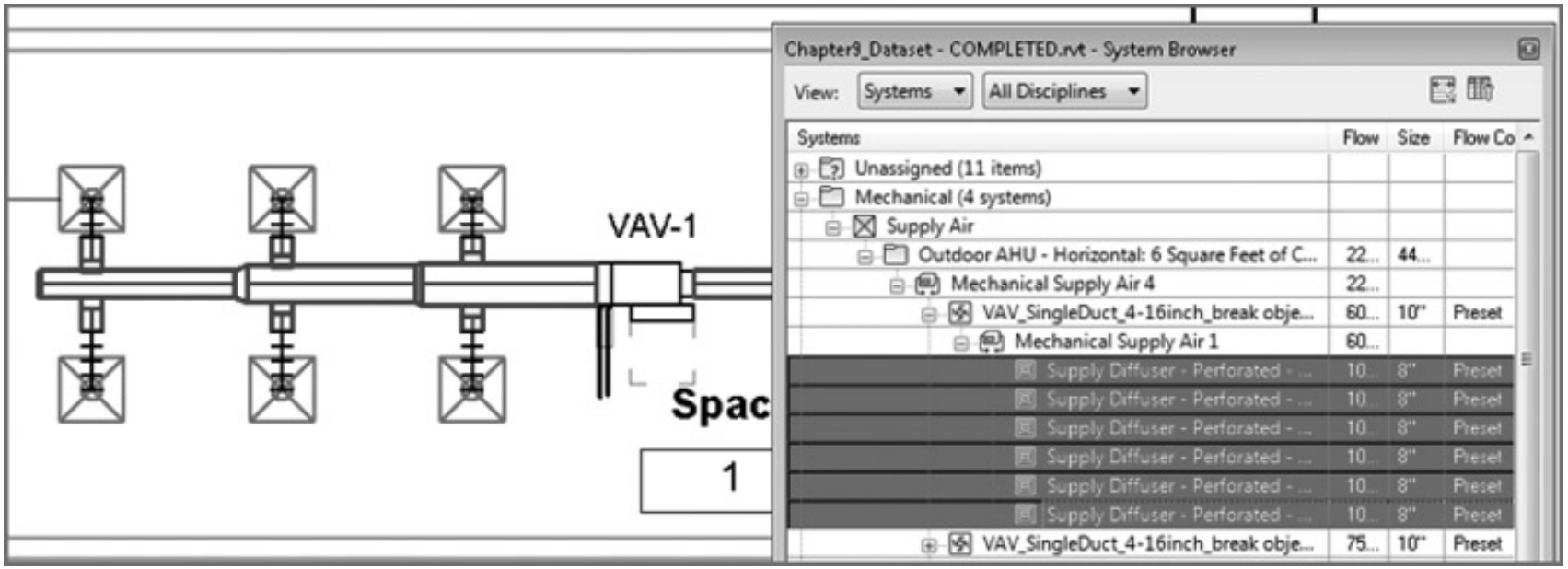
(*Video: Energy Analysis Using Conceptual Masses and Building Elements (2016) http://help.autodesk.com/view/RVT/2018/ENU/?guid=GUID-2E939328-ECFC-6BF6-4EC1-457A31877D0F)

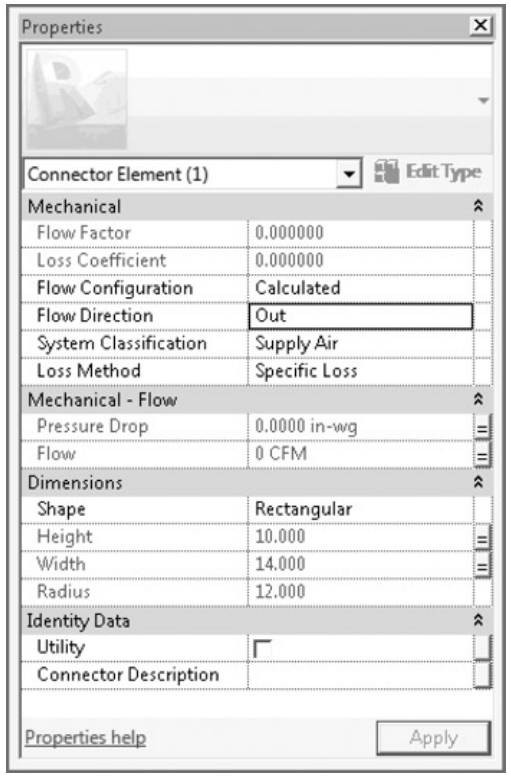
Creating logical systems



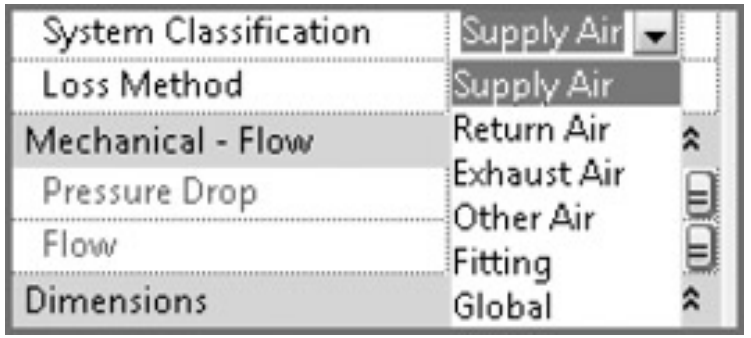
- Systems
  - They represent the transfer of information between families. They range from supply air to refrigerants to laboratory gases to anything else a building needs to operate
  - They are the logical connection between elements in the model
    - They are the link between the air terminal, the variable air volume (VAV) box, and the air handler, and they represent an additional layer of information above the physical connections made with duct and pipe

Selecting duct systems in the System Browser





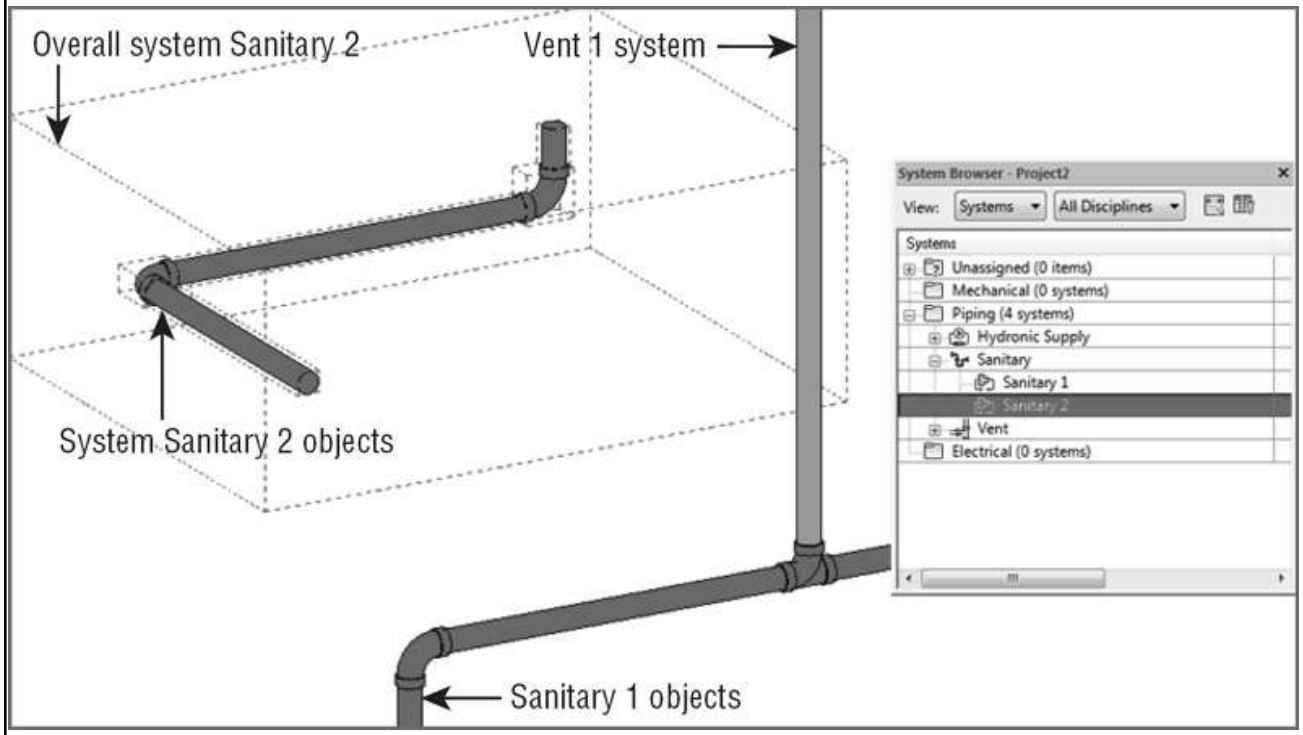
Parameters for duct connection

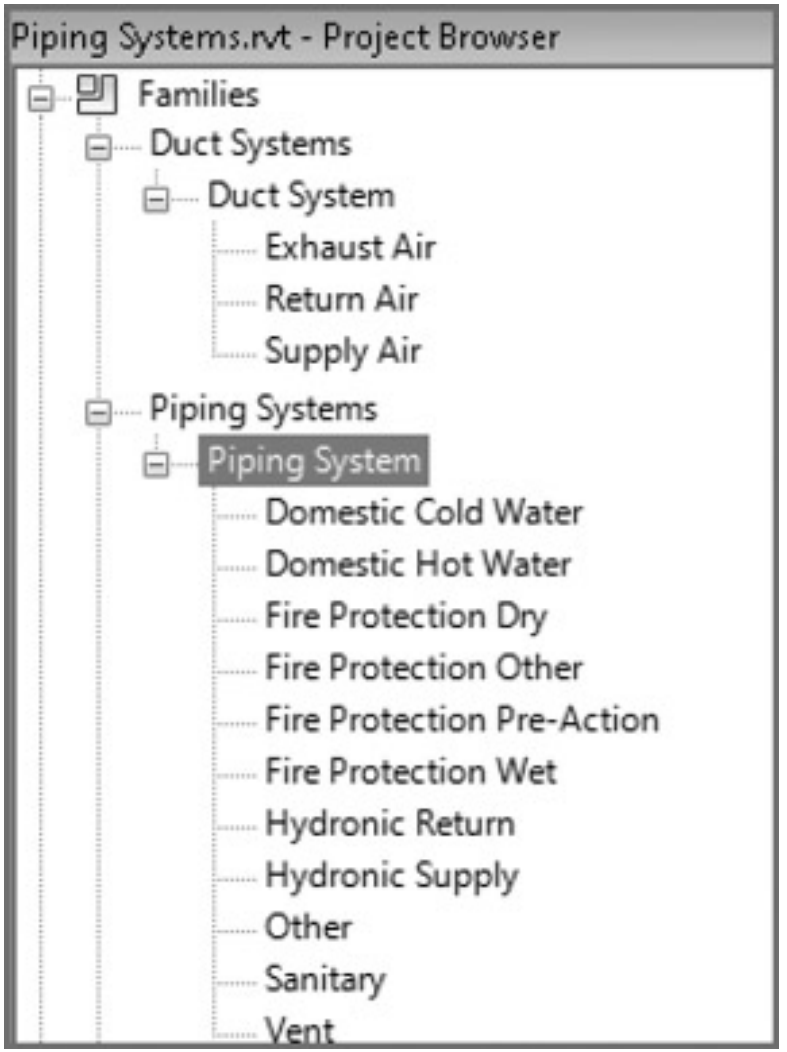


System classifications for duct connections

(Source: Bokmiller, D., Whitbread, S. and Hristov, P., 2013. *Mastering Autodesk Revit MEP 2014*, Sybex, Indianapolis, Ind.)

Set up piping (hydronic) systems & display properties (for HVAC, plumbing & fire protection)

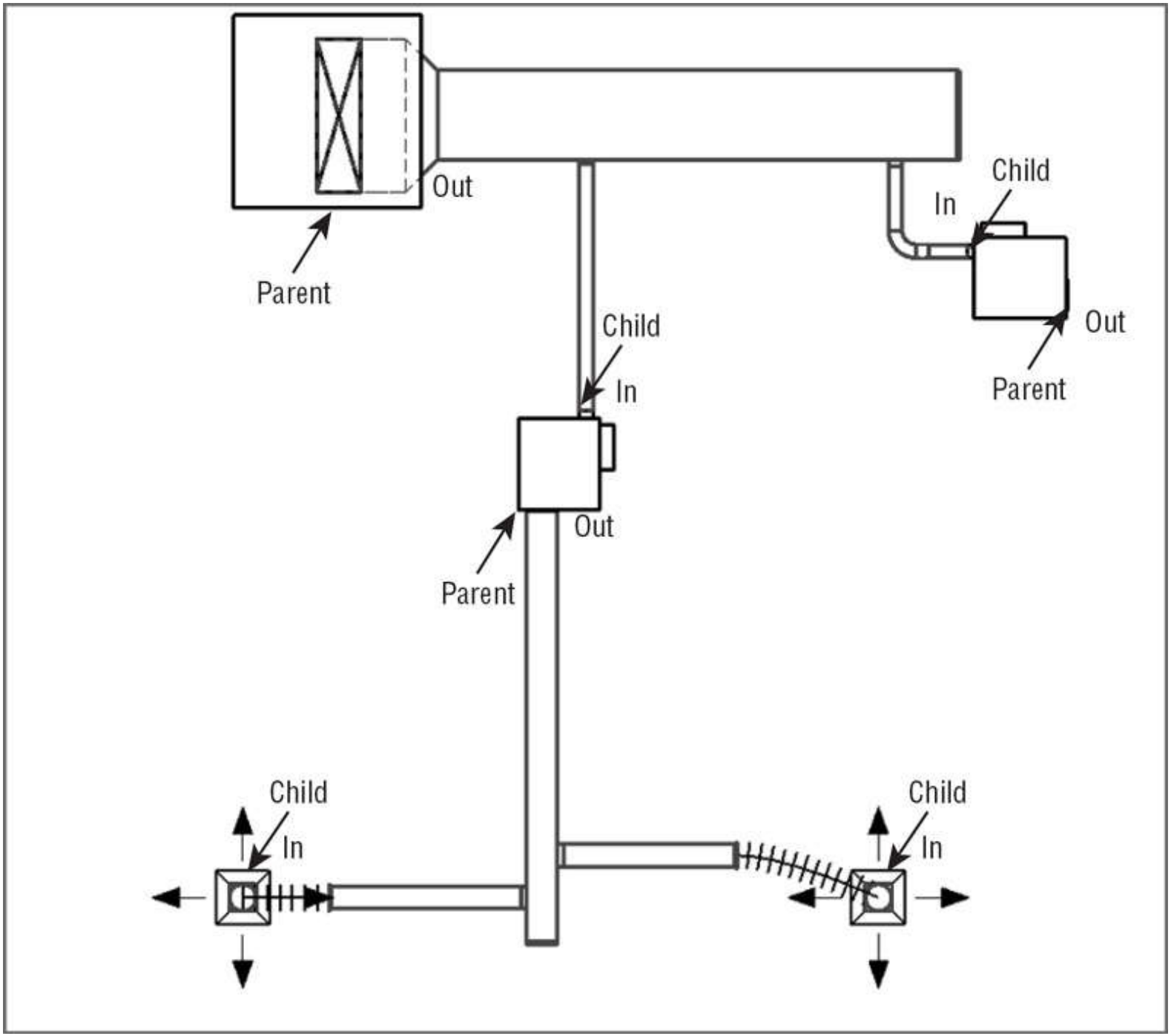




By understanding how to change and manage piping systems, the user can create and maintain different systems effectively

(Source: Bokmiller, D., Whitbread, S. and Hristov, P., 2013. *Mastering Autodesk Revit MEP 2014*, Sybex, Indianapolis, Ind.)

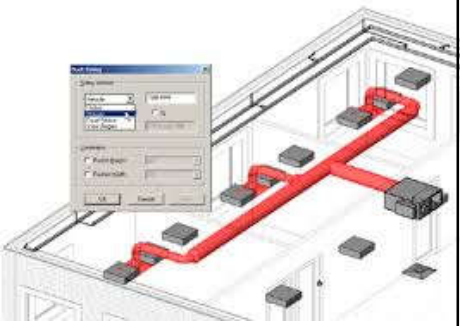
Understanding child and parent relationships in Revit systems



The system always starts with a child and ends with a parent, you could have many children but only one parent.

(Source: Bokmiller, D., Whitbread, S. and Hristov, P., 2013. *Mastering Autodesk Revit MEP 2014*, Sybex, Indianapolis, Ind.)

Creating logical systems

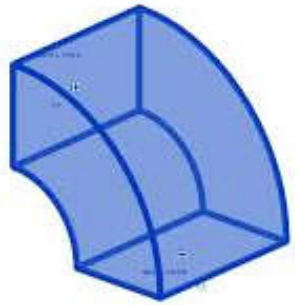


- Using System Filters
  - Control over the visibility of certain elements in views & the appearance those elements will have
  - Filters help us create high-quality documentation as well as providing a better way to examine our design and improve the coordination of our projects
  - Mastering filter options enables you to create your models with the standards that your office has developed over years of producing CAD drawings

Using System Filters

(Source: Bokmiller, D., Whitbread, S. and Hristov, P., 2013. *Mastering Autodesk Revit MEP 2014*, Sybex, Indianapolis, Ind.)

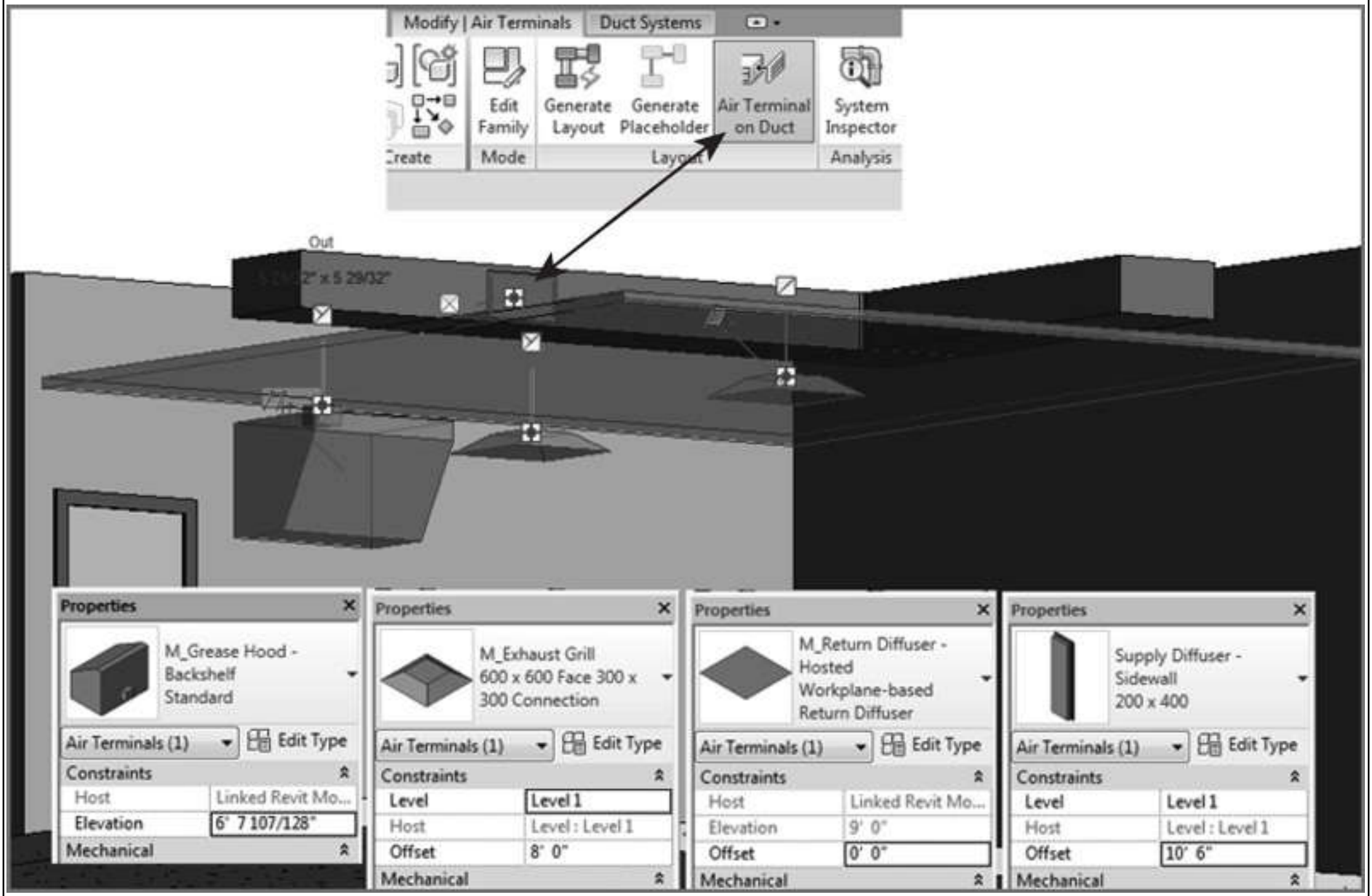
Mechanical systems & ductwork



- Ductwork*
  - Duct is presented as a single line at concept design or as a fully coordinated double line for a construction issue
  - Three main types: rectangular, round, and oval
- Air distribution components
  - Diffusers in a ceiling, duct-mounted sidewall diffusers, wall mounted, suspended
  - Diffuser hosting methods in Revit

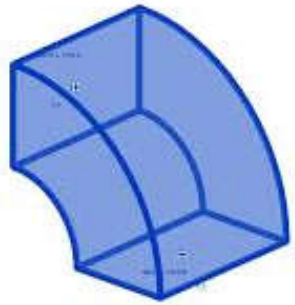
(*See also: Mechanical Systems http://help.autodesk.com/view/RVT/2018/ENU/?guid=GUID-39E76FDE-AD7F-43CE-914D-2CA2AB1C2680)

Diffuser hosting methods



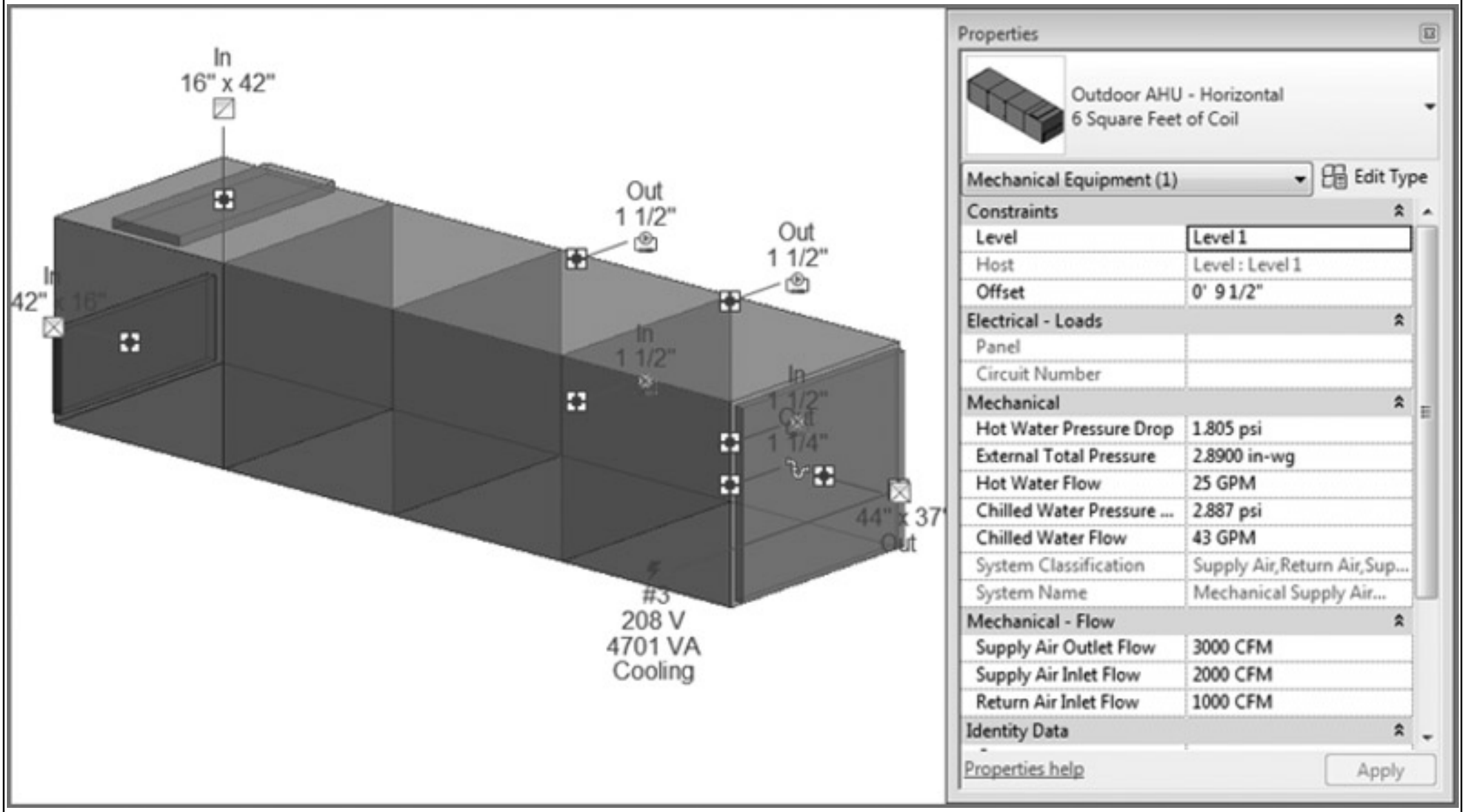
(Source: Bokmiller, D., Whitbread, S. and Hristov, P., 2013. *Mastering Autodesk Revit MEP 2014*, Sybex, Indianapolis, Ind.)

Mechanical systems & ductwork



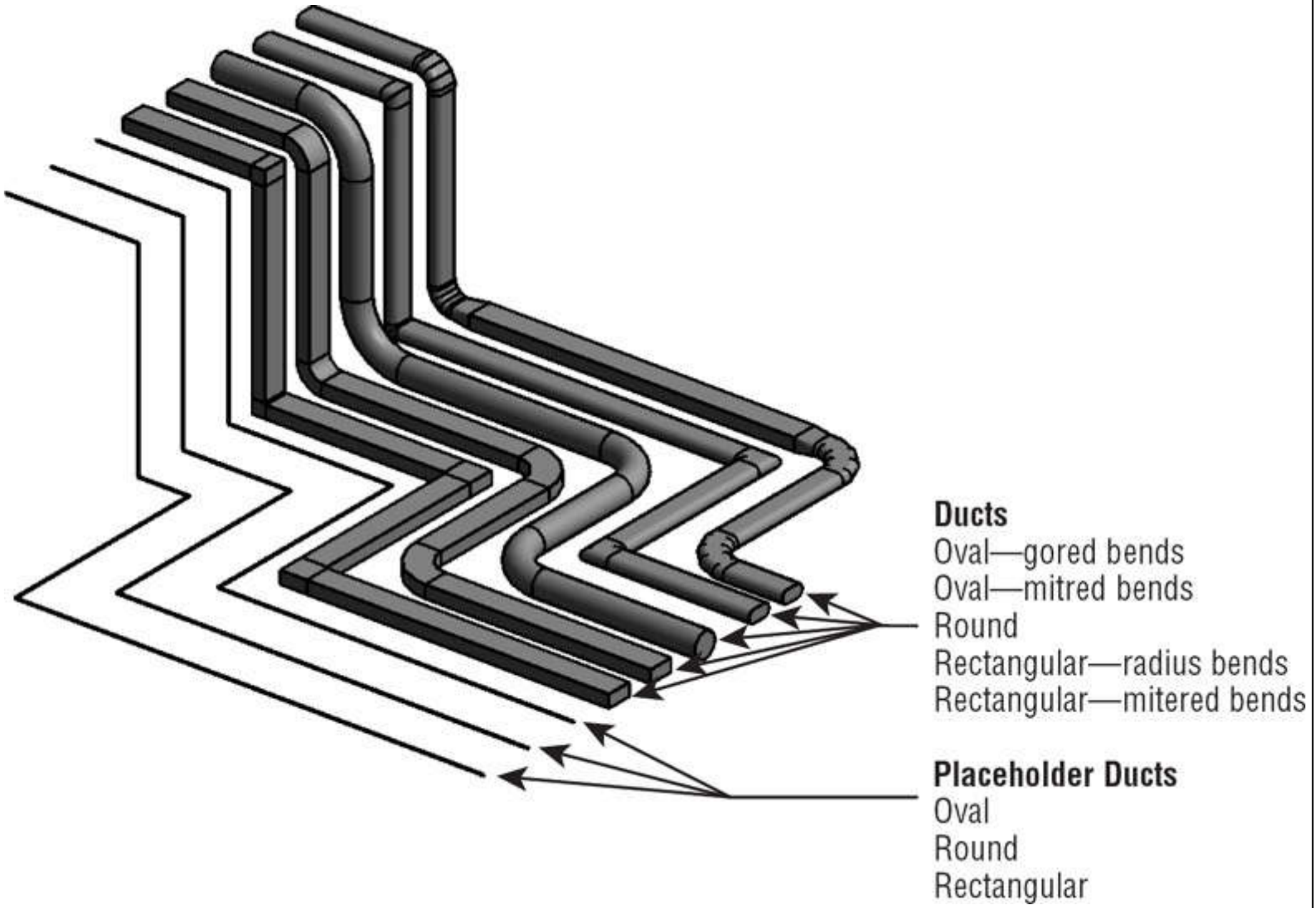
- Mechanical equipment components
  - Air conditioning/handling units
    - Floor mounted, skid mounted (w/ an offset or rail)
  - VAV boxes
    - Connection to water (chilled/hot) & electrical systems
  - Ductwork
    - Create using Duct Tool or Placeholder Duct Tool
    - Break up large systems to avoid slowing down the design process
    - Interference check for ducts and pipes

Basic AHU and type parameters



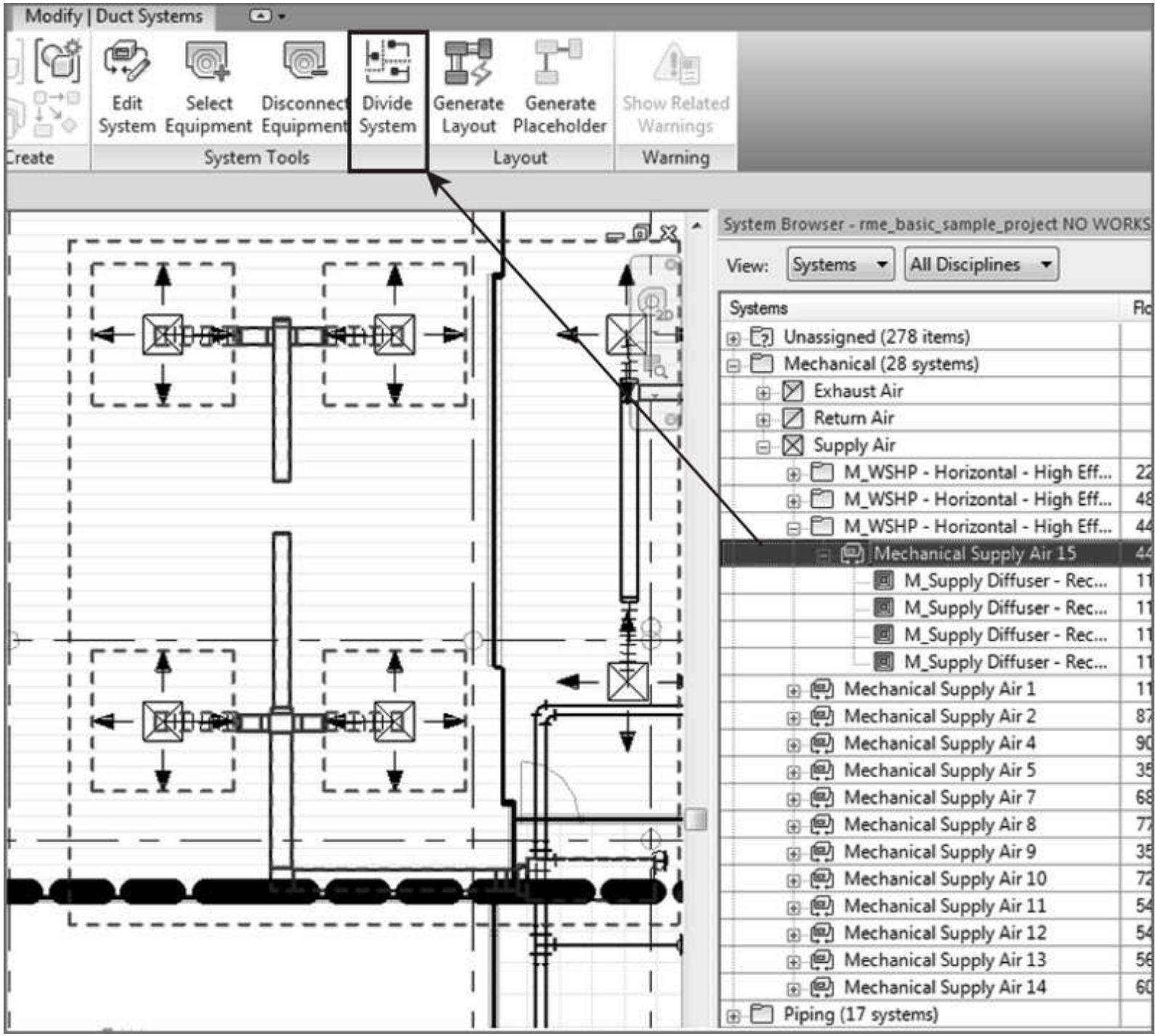
(Source: Bokmiller, D., Whitbread, S. and Hristov, P., 2013. *Mastering Autodesk Revit MEP 2014*, Sybex, Indianapolis, Ind.)

Ductwork



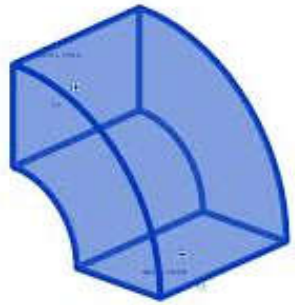
(Source: Bokmiller, D., Whitbread, S. and Hristov, P., 2013. *Mastering Autodesk Revit MEP 2014*, Sybex, Indianapolis, Ind.)

Divide system using System Browser

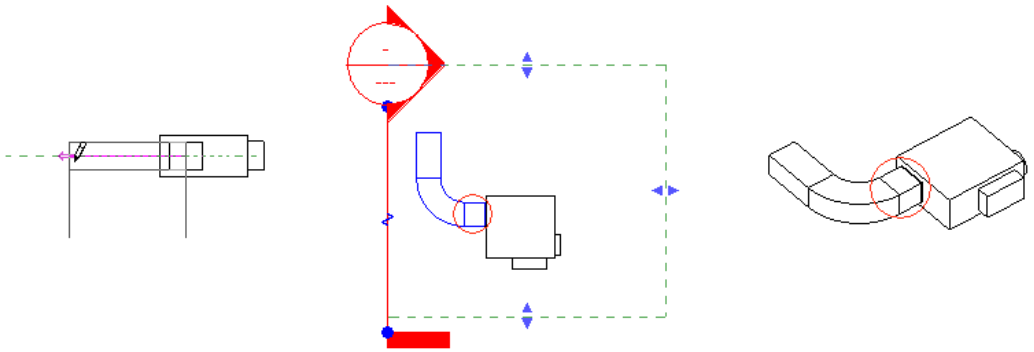


(Source: Bokmiller, D., Whitbread, S. and Hristov, P., 2013. *Mastering Autodesk Revit MEP 2014*, Sybex, Indianapolis, Ind.)

Mechanical systems & ductwork

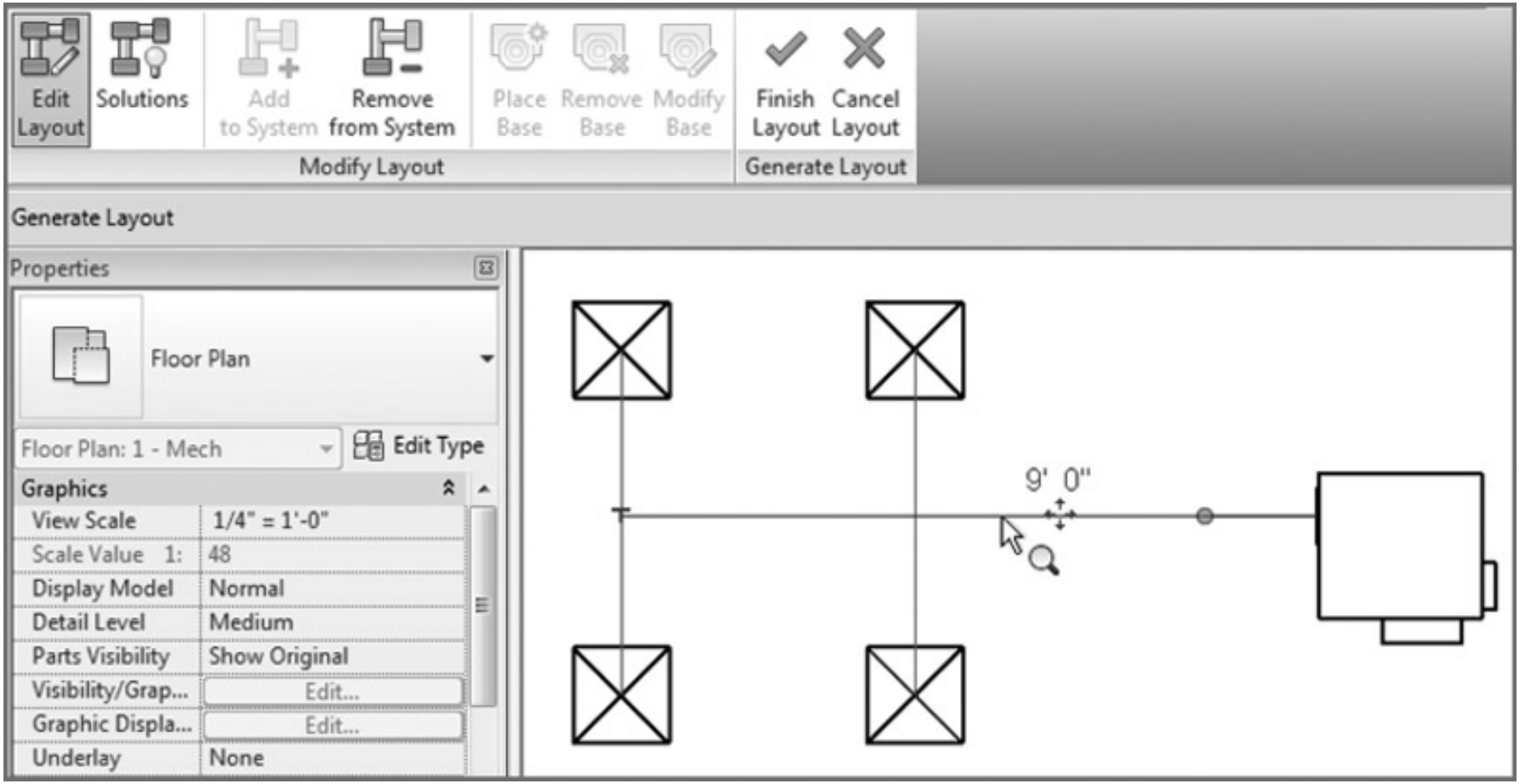


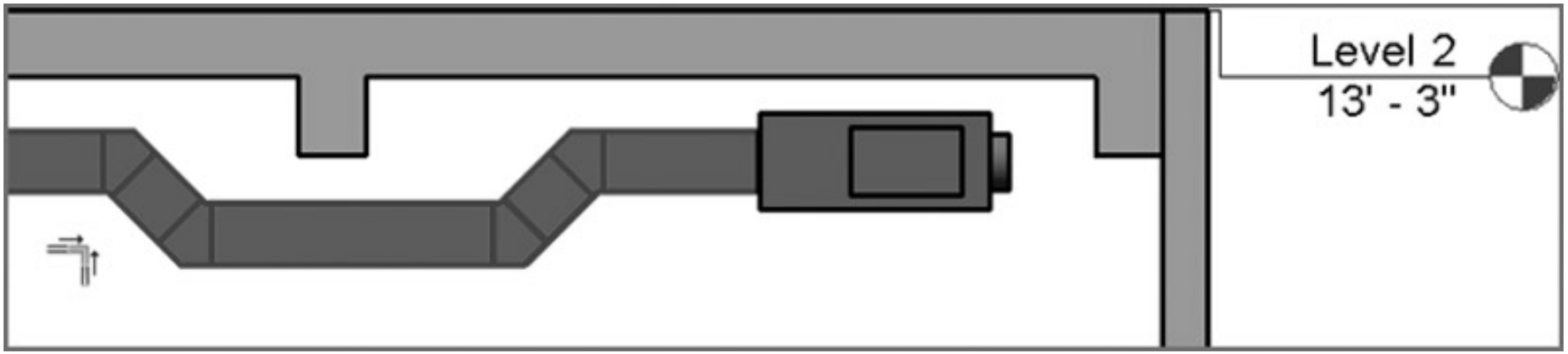
- Duct types & routing*
  - Create duct types (Extract and Supply)
  - Schematic layouts
  - Automatic duct routing
  - Manual duct routing
  - Adjust fittings & extend the design



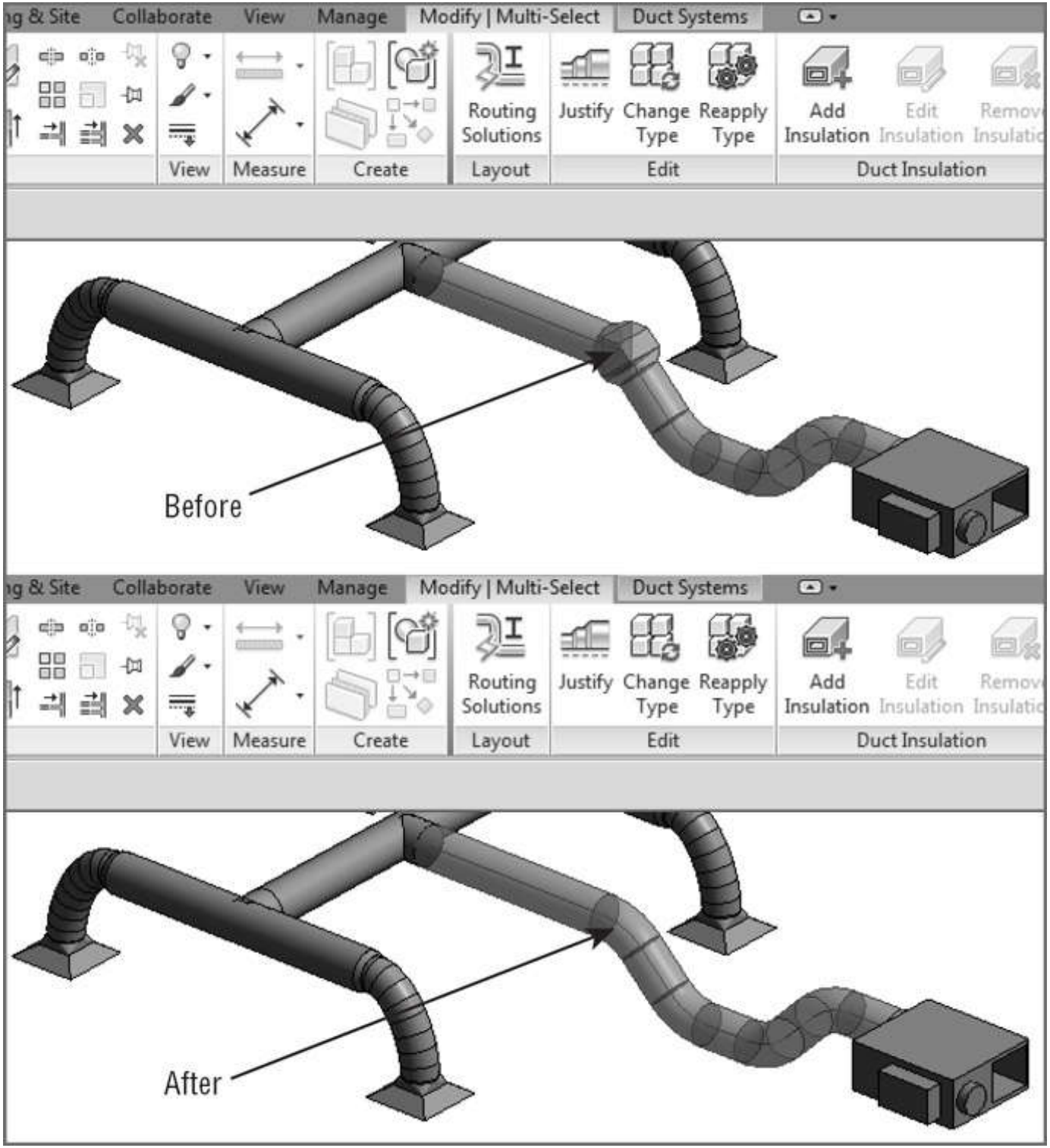
(*See also: Duct http://help.autodesk.com/view/RVT/2018/ENU/?guid=GUID-CD01C176-8435-4C20-A87E-F7B975E9599C)

Automatic duct routing & manual editing





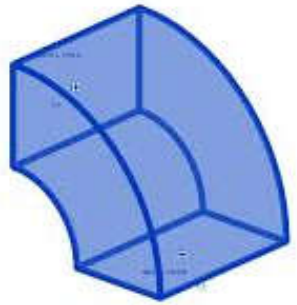
(Source: Bokmiller, D., Whitbread, S. and Hristov, P., 2013. *Mastering Autodesk Revit MEP 2014*, Sybex, Indianapolis, Ind.)



Adjusting & modifying duct fittings

(Source: Bokmiller, D., Whitbread, S. and Hristov, P., 2013. *Mastering Autodesk Revit MEP 2014*, Sybex, Indianapolis, Ind.)

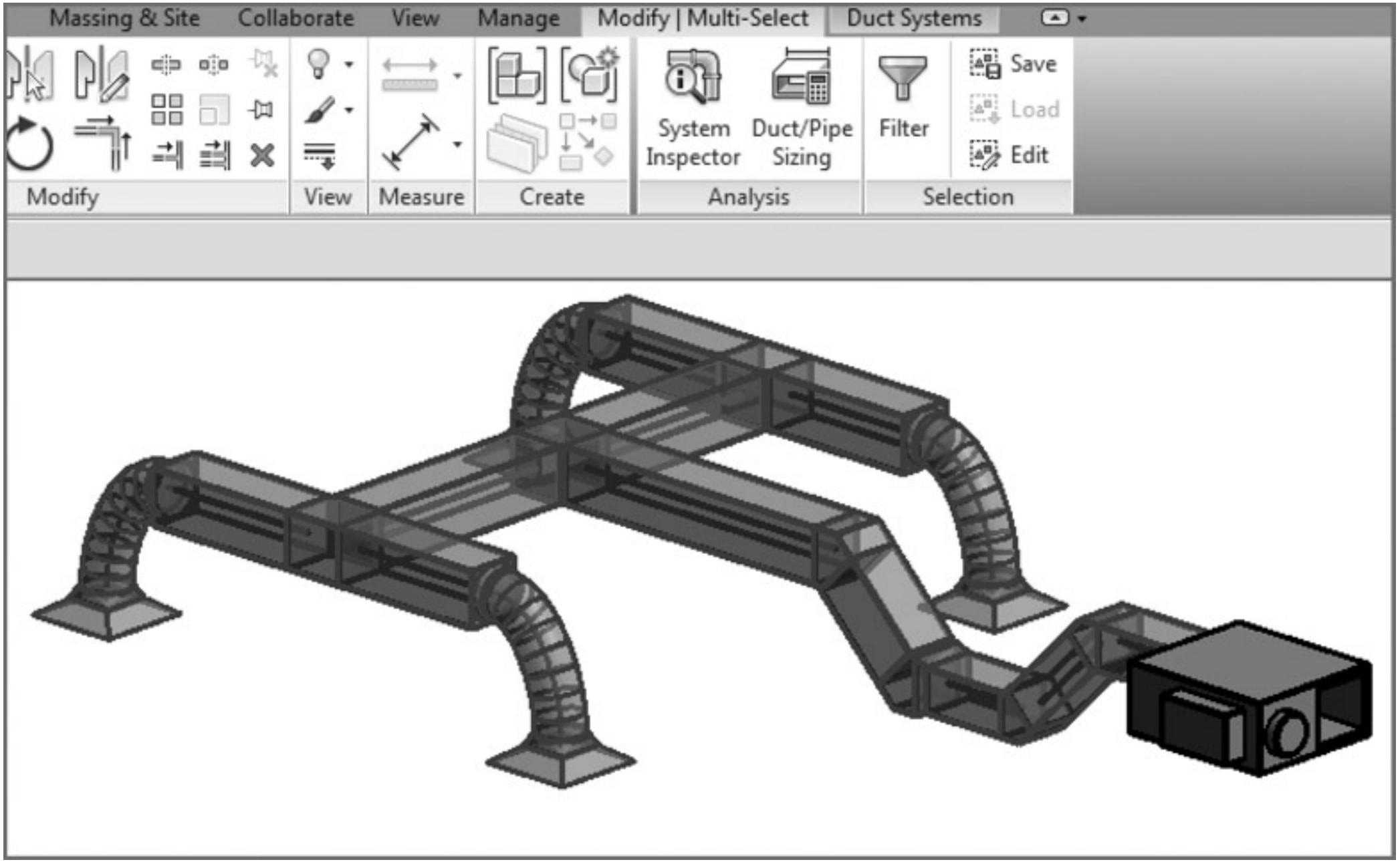
Mechanical systems & ductwork



- Duct sizing*
  - Choosing a duct sizing method (see HVAC notes)
    - Friction
    - Velocity
    - Equal friction
    - Static regain
  - Add duct insulation & lining
- System Inspector tool: to inspect the duct system for airflow, pressure, and pressure loss

(*See also: Duct Sizing and Calculation Methods http://help.autodesk.com/view/RVT/2018/ENU/?guid=GUID-EFD12EAC-F54F-4C13-9E0A-7901CFE644C0)

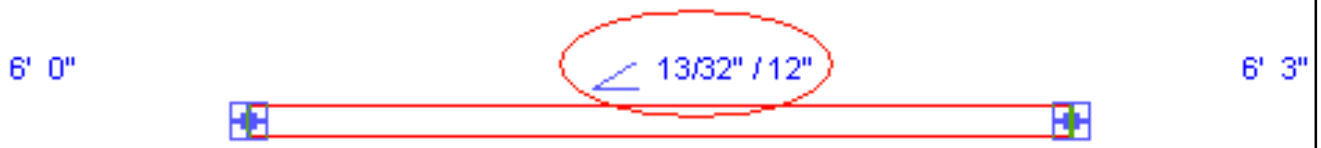
Duct sizing tool



(Source: Bokmiller, D., Whitbread, S. and Hristov, P., 2013. *Mastering Autodesk Revit MEP 2014*, Sybex, Indianapolis, Ind.)

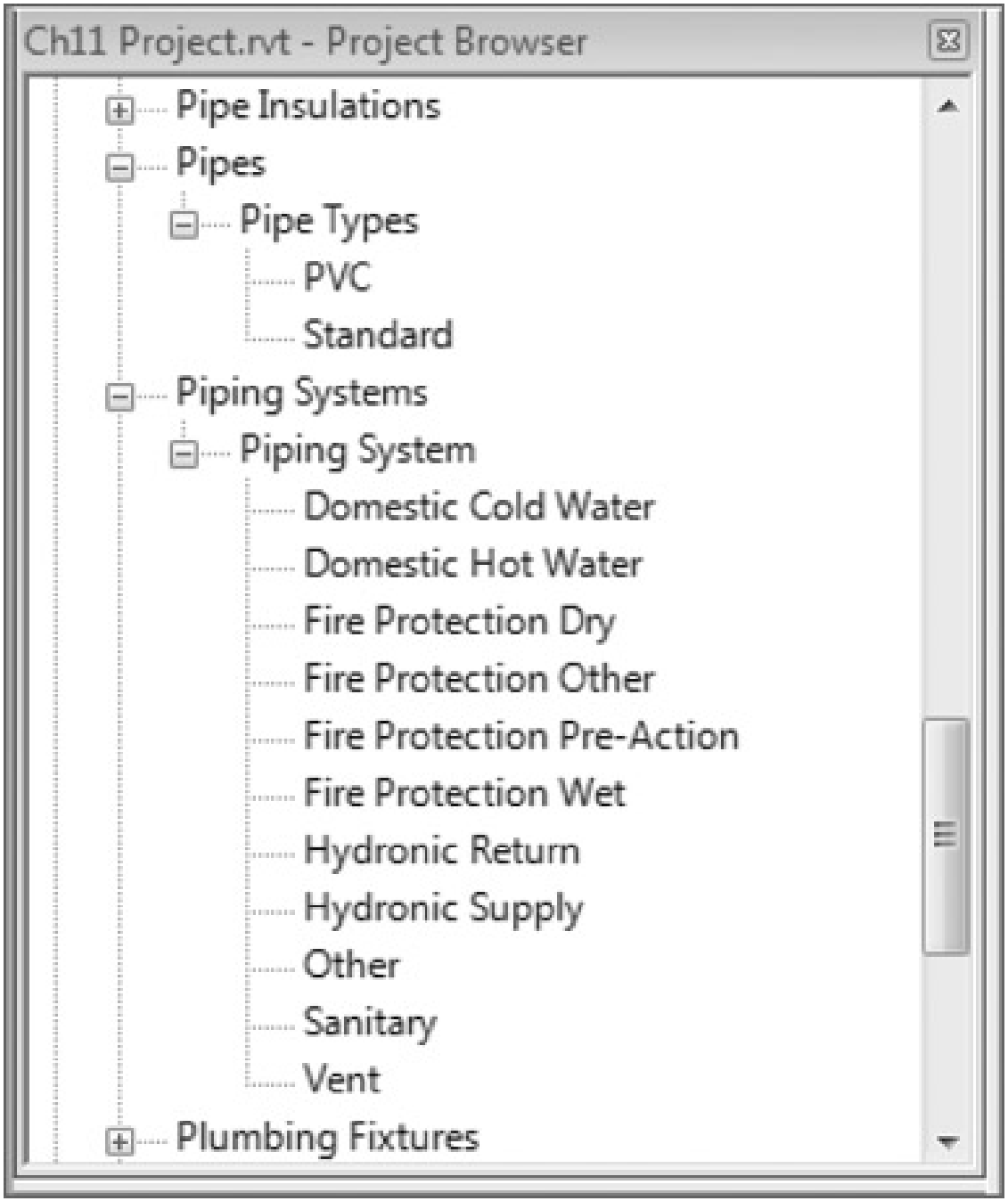
Mechanical piping

- Piping systems*
  - Simple two-pipe or complex multi-pipe
  - Pipe settings:
    - Piping systems
    - Pipe types (materials & fittings)
    - Pipe segments & sizes (nominal sizes)
    - Fluid table (for sizing pipes, determine pressure drop)
    - Slope table
    - Fitting angles



(*See also: Pipe http://help.autodesk.com/view/RVT/2018/ENU/?guid=GUID-EEB121ED-6C1F-4728-A615-B3AF36DD6A61)

Creating piping systems



Domestic piping systems:

- Domestic cold water
- Domestic hot water
- Sanitary
- Vent

Fire-protection piping systems:

- Fire protection dry
- Fire protection wet
- Fire protection pre-action
- Fire protection other

Mechanical piping systems:

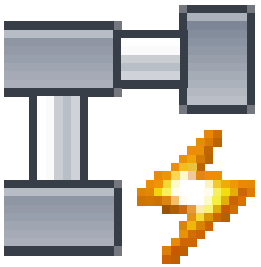
- Hydronic return
- Hydronic supply

Other (e.g. medical gas)

(Source: Bokmiller, D., Whitbread, S. and Hristov, P., 2013. *Mastering Autodesk Revit MEP 2014*, Sybex, Indianapolis, Ind.)

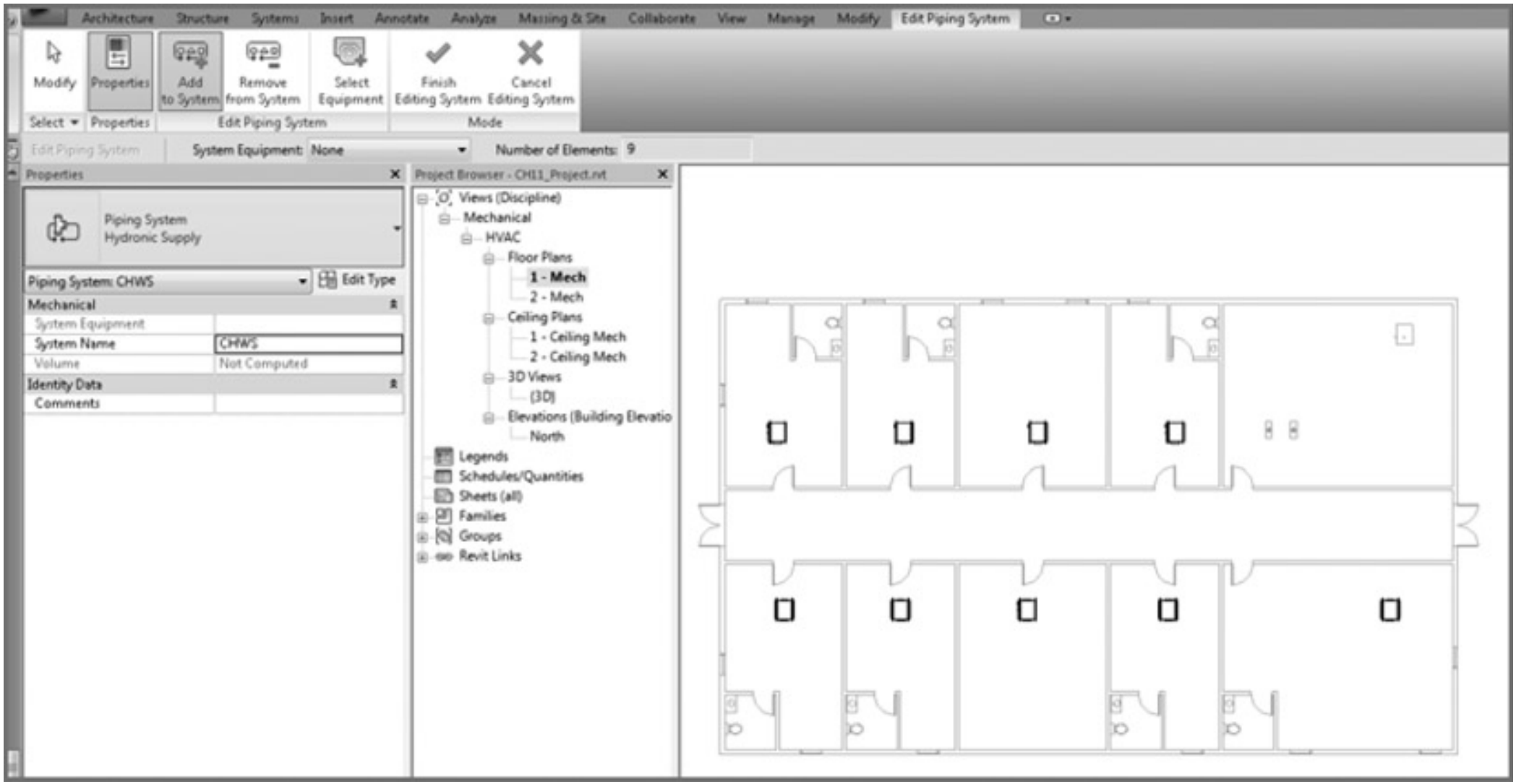
Mechanical piping

- Pipe routing options:
  - Automatic pipe routing
  - Manual pipe routing



- Design tips:
  - Colour-coded systems & interference checking
  - Use project templates in piping layouts to improve productivity
  - Automate with pipe connectors & improve coordination

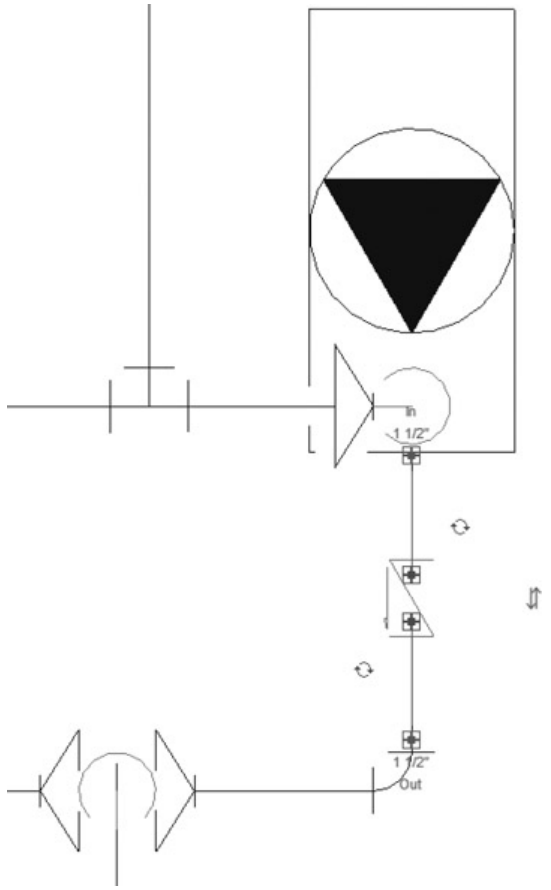
Create & edit piping systems



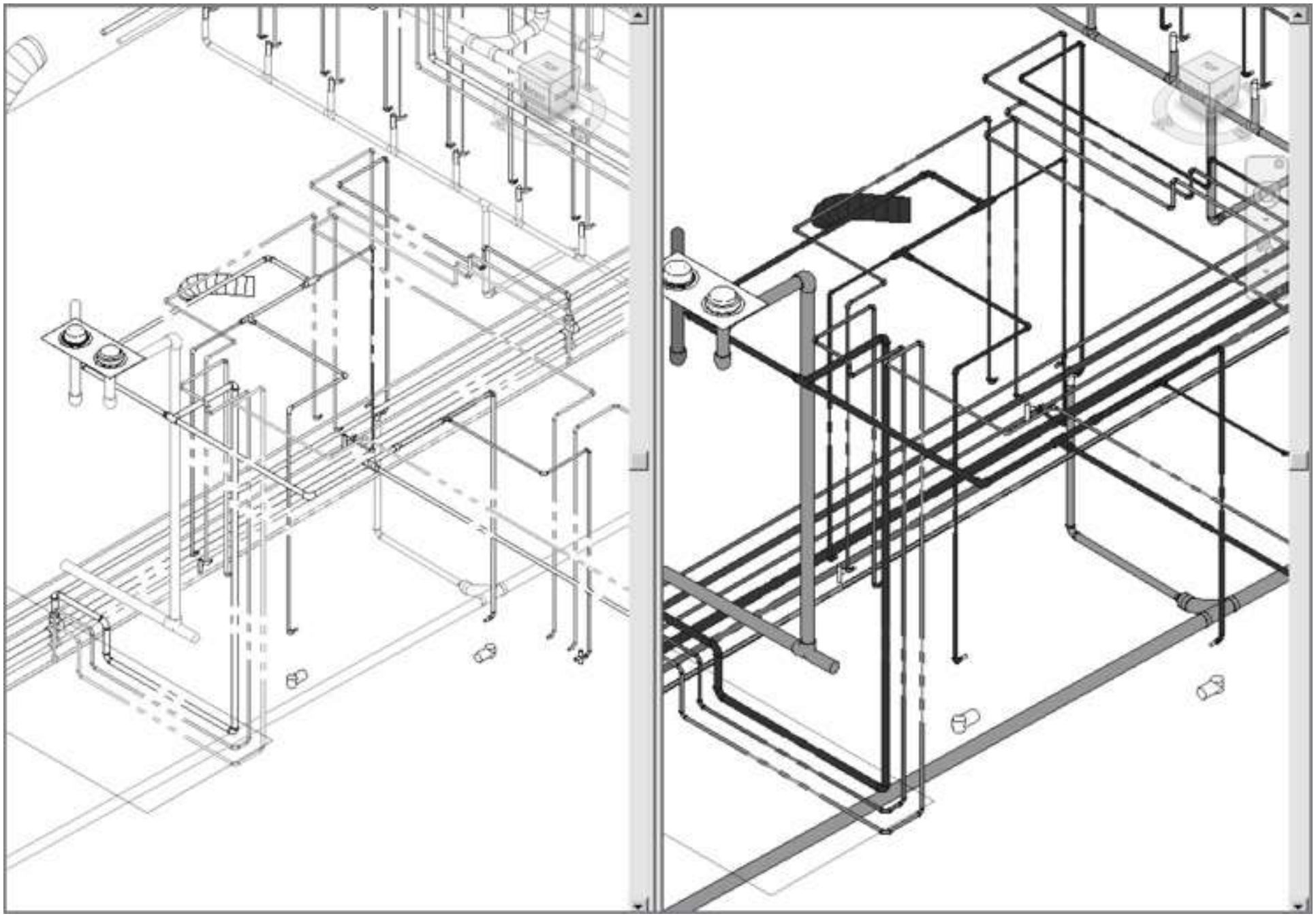
(Source: Bokmiller, D., Whitbread, S. and Hristov, P., 2013. *Mastering Autodesk Revit MEP 2014*, Sybex, Indianapolis, Ind.)

Mechanical piping

- Pipe fittings
  - End caps
  - Tee, tap, wye or cross
  - Transitions, couplings, or unions
  - Flange
- Placing valves
- Adding piping insulation
- Defining systems visibility through filters

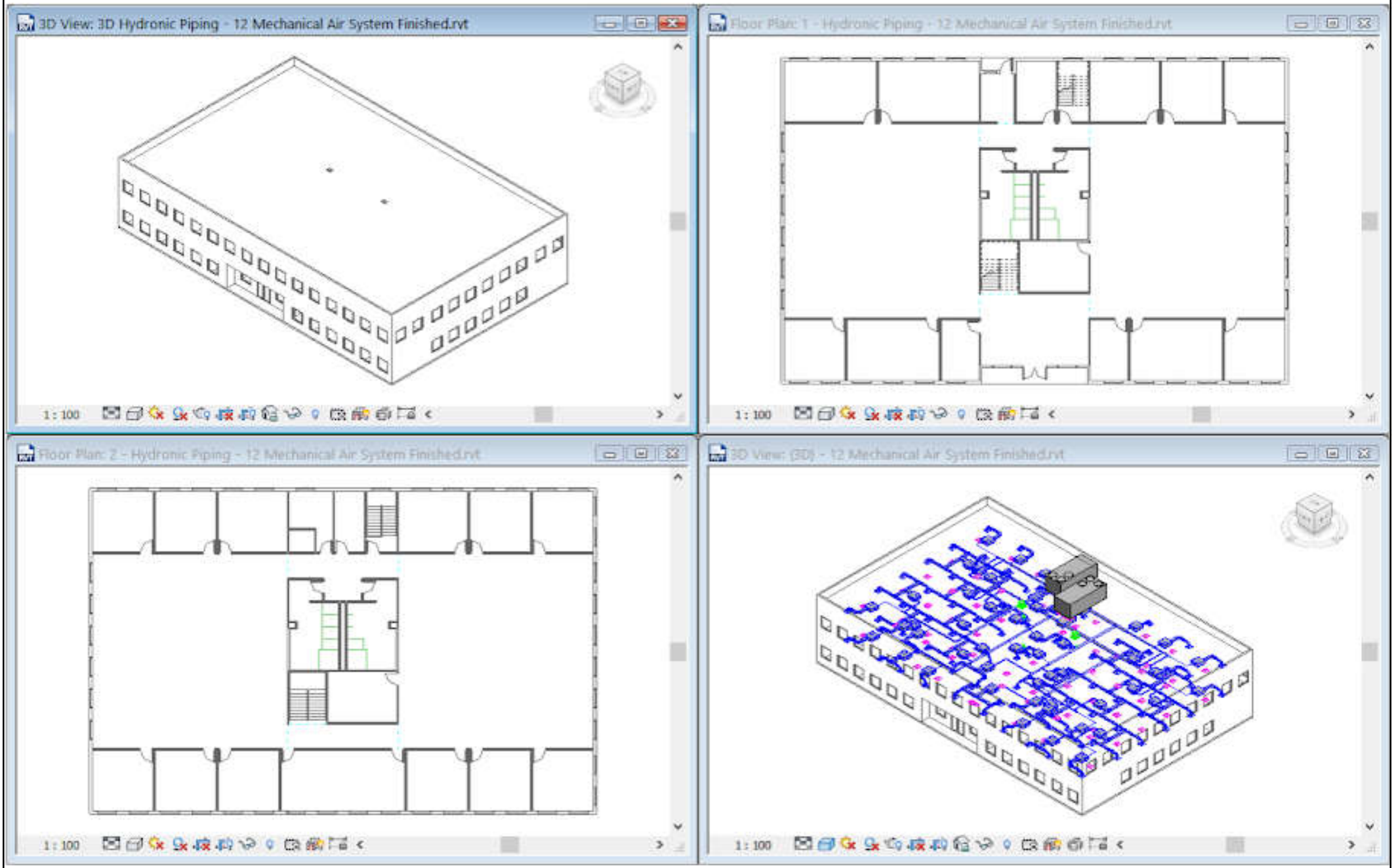


The same model displayed without filter overrides (on the left) and with overrides (to the right)



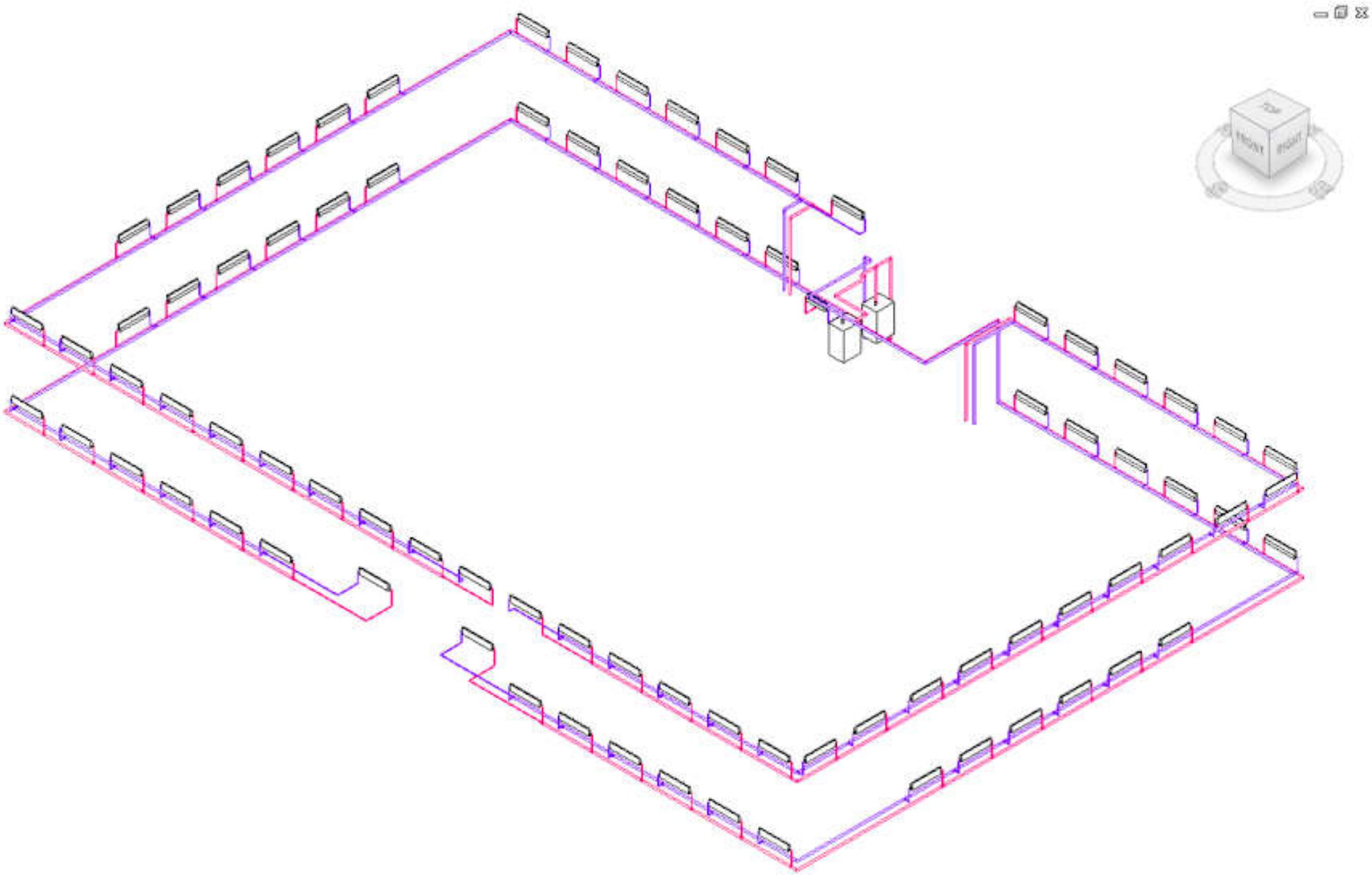
(Source: Bokmiller, D., Whitbread, S. and Hristov, P., 2013. *Mastering Autodesk Revit MEP 2014*, Sybex, Indianapolis, Ind.)

Different views of hydronic piping systems



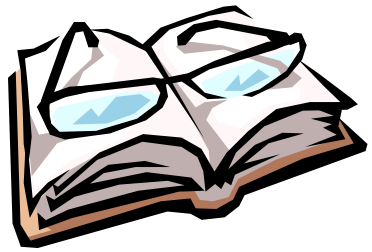
(Source: Chang, Lu-Yen, 2017. *Revit MEP Step by Step*, 2018 Metric Edition. (ebook) https://books.google.com.hk/books?id=tndJDwAAQBAJ)

3D view of hydronic piping systems



(Source: Chang, Lu-Yen, 2017. *Revit MEP Step by Step*, 2018 Metric Edition. (ebook) https://books.google.com.hk/books?id=tndJDwAAQBAJ)

Further reading



- Bokmiller, D., Whitbread, S. and Hristov, P., 2013. *Mastering Autodesk Revit MEP 2014*, Sybex, Indianapolis, Ind. [TH 6010 .B65 2013 (ebook)]
  - Chapter 8 - HVAC Cooling and Heating Load Analysis
  - Chapter 9 - Creating Logical Systems
  - Chapter 10 - Mechanical Systems and Ductwork
  - Chapter 11 - Mechanical Piping
- Chang, Lu-Yen, 2017. *Revit MEP Step by Step*, 2018 Metric Edition. (ebook) https://books.google.com.hk/books?id=tndJDwAAQBAJ
  - Chapter 2 Mechanical Air Systems
  - Chapter 3 Hydronic Piping Systems