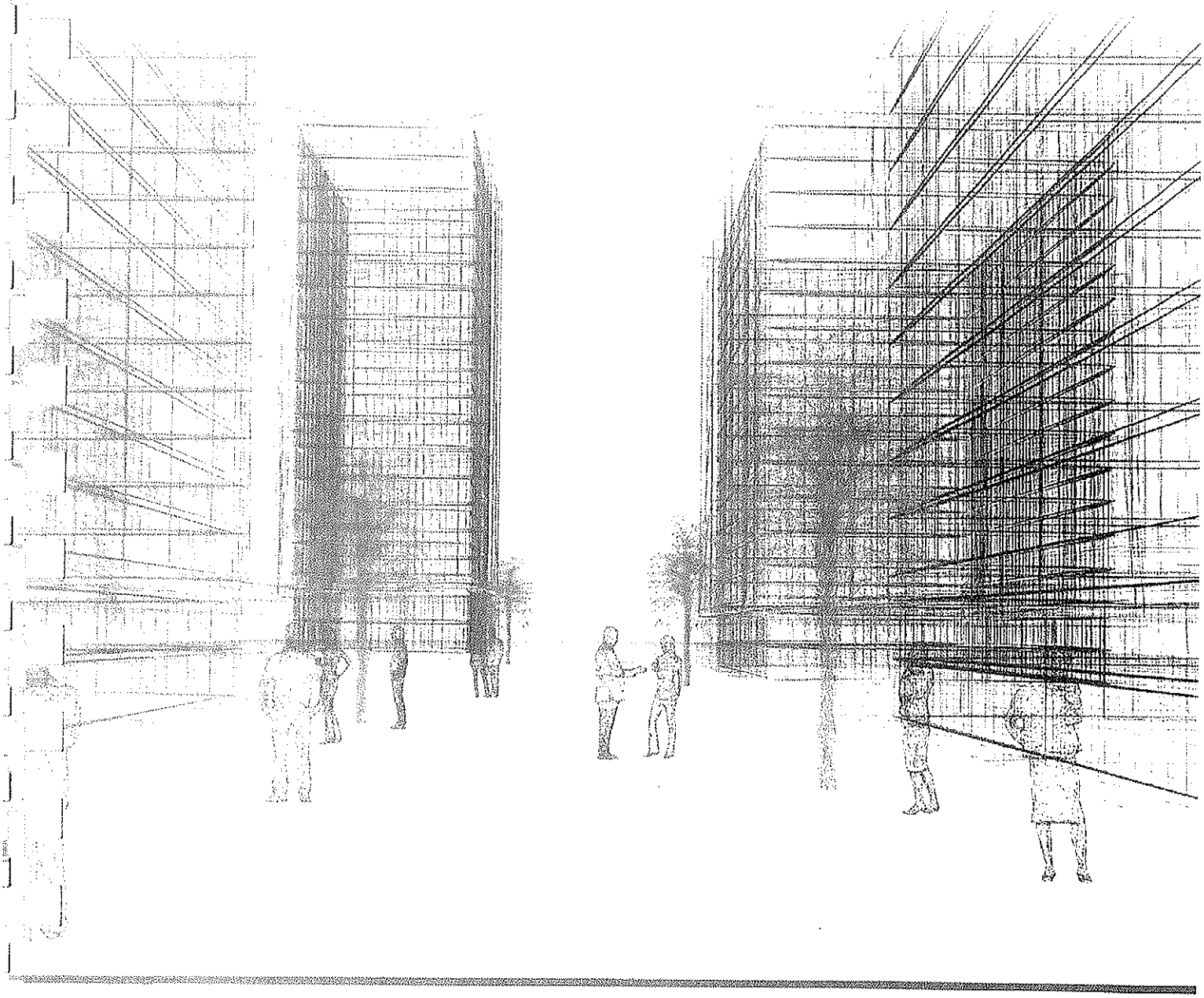

Autodesk® Revit® MEP 2013

Fundamentals

Student Guide - Metric (rev. 1.0)

Autodesk
Official Training Guide

Autodesk® Revit® MEP 2013 Fundamentals

Student Guide - Metric

Revision 1.0
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CONTINUING EDUCATION AIA

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Preface

To take full advantage of Building Information Modeling, the *Autodesk® Revit® MEP 2013 Fundamentals* training guide has been designed to teach the concepts and principles of creating 3D parametric models of MEP system from engineering design through construction documentation. The training guide is intended to introduce students to the software's user interface and the basic HVAC, electrical, and plumbing/piping components that make Revit MEP a powerful and flexible engineering modeling tool. The objective is to familiarize students with the tools necessary to create, document, and print the parametric model. The examples and practices are designed to take the students through the basics of a full Revit MEP project from linking in an architectural model to construction documents.

The main topics covered in the course include:

- Introduction to Revit MEP, its interface, including viewing, drawing, and editing commands.
- Working with linked architectural files.
- Creating and modifying views.
- Understanding Revit MEP systems in general.
- Creating spaces and zones.
- Analyzing heating and cooling loads.
- Working with the HVAC module to add air terminals, mechanical equipment, and create HVAC systems.
- Working with the Piping module to add mechanical equipment as well as creating hydronic piping systems.
- Working with fire protection systems.
- Working with fixtures and piping systems in the Plumbing module.
- Working with components, circuits, cable tray, and conduits in the Electrical module.
- Creating and annotating construction documents.
- Adding tags and creating schedules.
- Detailing in Revit MEP.

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Icon Reference Chart

The following icons are used throughout this training guide to help you to quickly and easily find helpful information.

	Indicates the Learning Objectives that are covered in the current chapter or section of the training guide.
	Indicates items that have been enhanced in the Revit MEP 2013 software.
	Indicates items that are new in the Revit MEP 2013 software.

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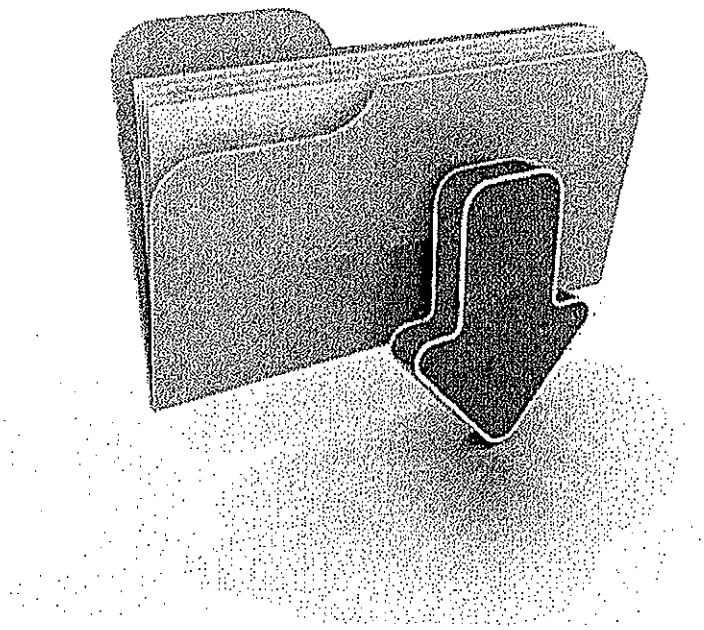

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Setting up the Interface

The Autodesk® Building Design Suite version of the Autodesk® Revit® software is designed to be used with all building disciplines but the interface can be modified to suit each user's need. In this topic you learn how to modify the discipline-specific interface that is used in this training guide.

Discipline Specific Interface

The Autodesk Revit software has three disciplines: Architecture, Structure, and MEP (Mechanical, Electrical, and Plumbing, which is also know as Systems). When using the Autodesk Building Design Suite, all of the tools for these disciplines are installed in one copy of the software. By default, all of the tools, templates, and sample files are available, as shown in Figure 1. Most users only need access to their specific set of tools and the interface can be customized to suit those needs.

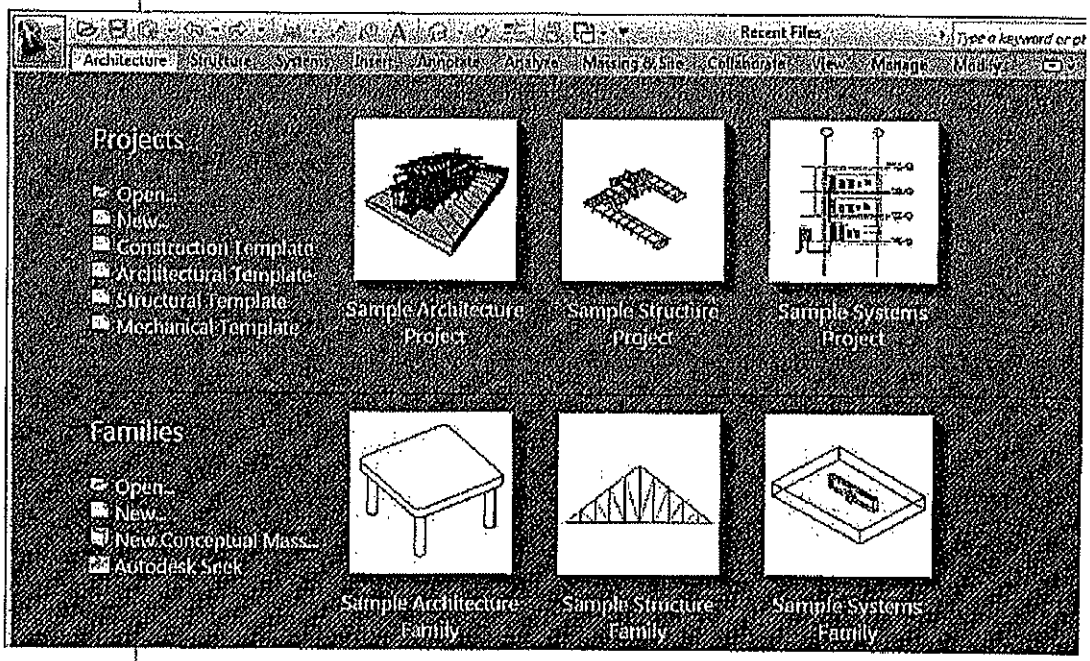

Figure 1

- The following steps describe how to set up the suite-based software to match the layout of the discipline-specific software. If you are using the discipline-specific software you do not need to make any changes.
  - This training guide is based on the Autodesk Revit MEP interface.

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How to:

Setup the Autodesk Revit Interface by Discipline

1. In the upper left corner of the screen, expand (Application Menu) and click Options.
2. In the Options dialog box, in the left pane, select **User Interface**.
3. In the *Configure* area, under *Tools and analyses* (as shown in Figure 2), clear all of options that you do not want to use.

You are not deleting these tools, just removing them from the current user interface.

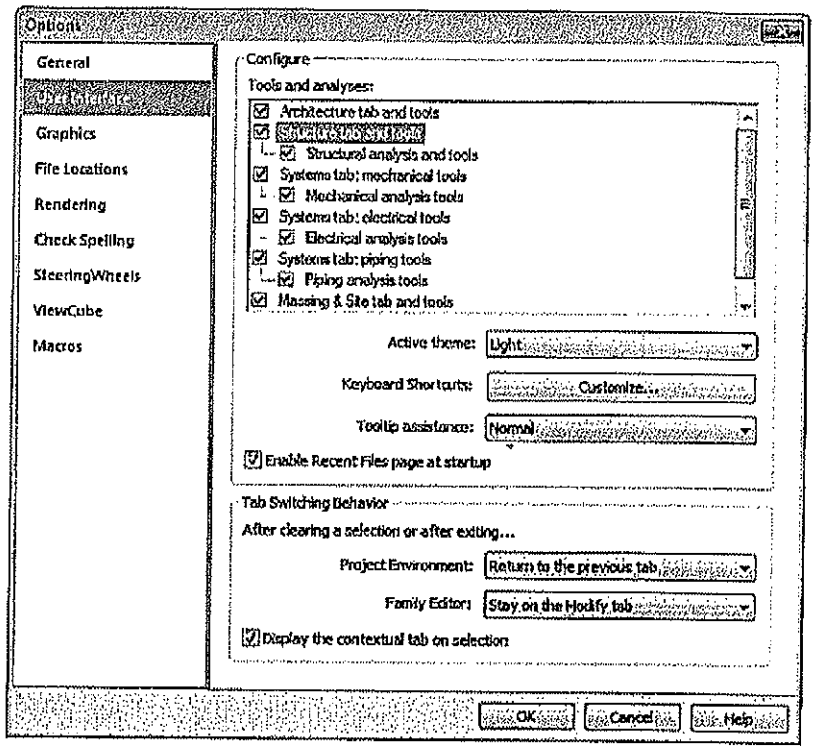

Figure 2

- To match the Autodesk Revit MEP interface, clear only the following option:
  - *Structure* tab and tools
4. You can also specify which templates display when starting a new project. In the left pane, select **File Locations**.

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5. In the right pane (as shown in Figure 3), select and order the templates that you want to display. Typically, these are set up by the company.

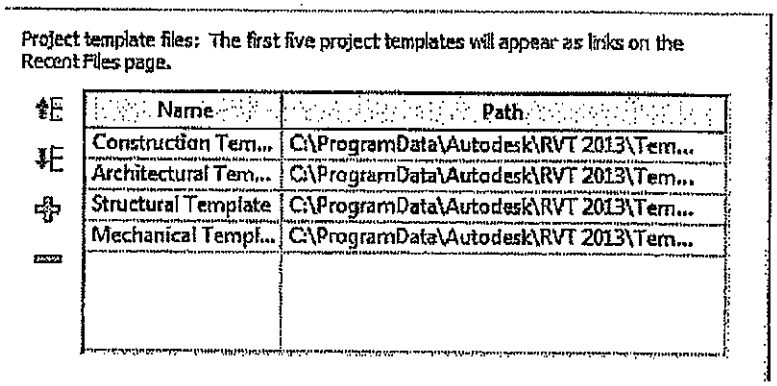

Figure 3

- To match the Autodesk Revit MEP interface, remove the **Construction Template**, **Architectural Template**, and **Structural Template**. Add the **Electrical Template (Electrical-Default.rte)** and **Systems Template (Systems-Default.rte)** found in the RVT 2013>Templates><*appropriate units*> folder.

6. Click OK. The interface and template locations update for this installation of the software.

- You might also need to move the tabs to a different order. To do so, select the tab, hold down <Ctrl> and drag the tab to the new location.
  - To match the Autodesk Revit MEP interface, select the *Systems* tab and drag it to the front of the tabs.

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Chapter 1

Introduction to Autodesk Revit MEP

In this chapter you learn about Building Information Modeling (BIM) and how it is used in Autodesk® Revit® MEP software. You investigate the software interface and terminology, learn how to start projects, and work with the viewing commands including zoom controls, 3D isometric, and perspective views.

This chapter contains the following topics:

- ✓**Building Information Modeling**
- ✓**Overview of the Interface**
- ✓**Standard Terminology**
- ✓**Starting Projects**
- ✓**Viewing Commands**

Learning Objectives

This chapter provides instruction to enable you to do the following:

1.1 Building Information Modeling



Understand the concept of Building Information Modeling and its workflow in relation to the Autodesk Revit software.

1.2 Overview of the Interface



Navigate the graphic user interface.

1.3 Standard Terminology



Use typical terms and concepts found in the software.

1.4 Starting Projects



Start new projects using templates.

1.5 Viewing Commands



Manipulate 2D and 3D views by zooming and panning.



Create 3D Isometric and Perspective views.



Set the Visual Style of a view.

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1.1 Building Information Modeling

Understand the concept of Building Information Modeling and its workflow in relation to the Autodesk Revit software.

Building Information Modeling (BIM) is an approach to the entire building life cycle. The BIM process supports the ability to coordinate, update, and share design data with team members throughout the design, construction, and management phases of a building's life.

The Autodesk® Revit® software is a *Parametric Building Modeler*, and is an important part of the BIM process. *Parametric* means you can establish a relationship between two building elements; when one element changes the other element changes as well. *Building* signifies that this software is designed for working with buildings, as opposed to gears or roads. *Modeler* signifies how a project is built in a single file around the building model (as shown on the left in Figure 1–1). All views, such as plans (as shown on the right in Figure 1–1), elevations, sections, details, schedules, as well as all design sheets printed for construction documents, are automatically generated based on the model.

When a change is made anywhere in the model, all of the views update automatically. For example, if you add an element in a plan view, it displays in the related section view and in schedules (if applicable).

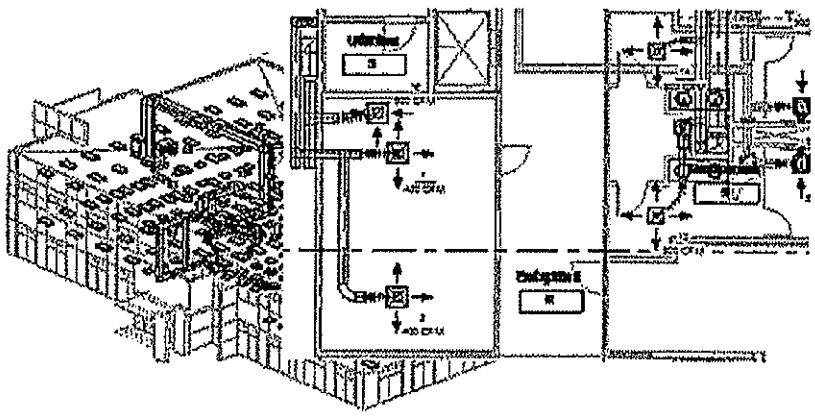

Figure 1–1

- The Autodesk Revit MEP software coordinates with two other packages: Autodesk® Revit® Architecture and Autodesk® Revit® Structure. It also enables you to check for interferences between disciplines.

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Workflow and BIM

BIM has changed the process of how a building is designed. Autodesk Revit software is a true BIM product in that it is much more than a drafting software. By creating complete models and associated views of those models, the software takes much of the tediousness out of producing a building design.

In the traditional design process, plans create the basis for the model, from which you then create sections and elevations, as shown in Figure 1–2. Construction Documents (CDs) can then be created. In this workflow, changes are made at the plan level and then coordinated with other documents in the set.

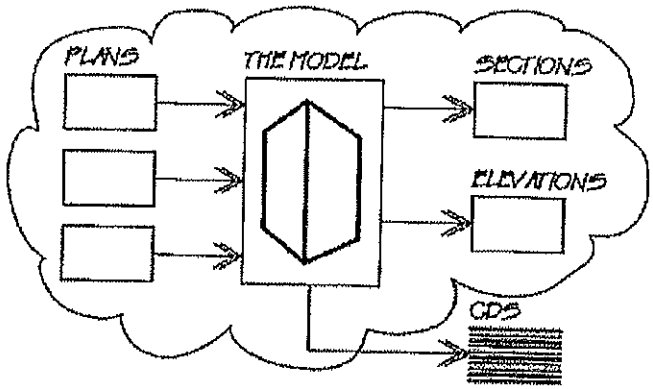

Figure 1–2

In the BIM, the design process revolves around the model, as shown in Figure 1–3. Plans, elevations, and sections are simply 2D versions of the 3D model. Changes made in one view automatically update in all views. Even Construction Documents update automatically with callout tags in sync with the sheet numbers. This is called bidirectional associativity.

The elements you create in the software are "smart" elements that know they are pipes, electrical outlets, and ducts. Because they are intelligent elements, they display properly in plan, elevation, or 3D views. This ensures drawings are coordinated across the project since the same model generates all of the necessary views.

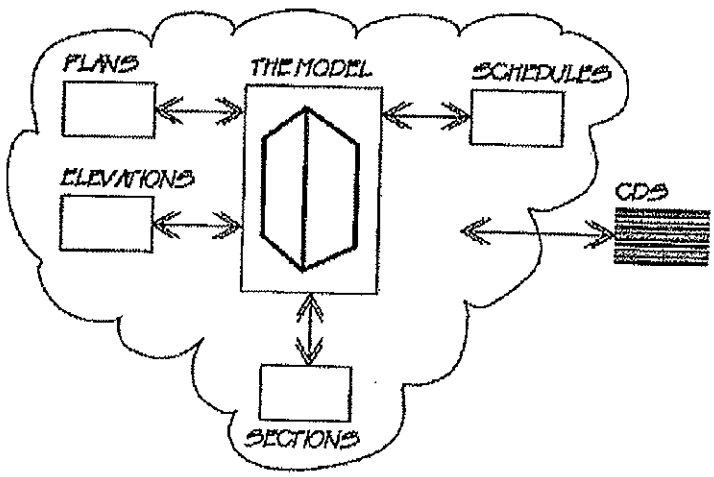

Figure 1–3

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Views and Sheets

In the traditional workflow, the most time-consuming part of the project is the construction documents. With BIM, the base views of those documents (i.e., floor plans, ceiling plans, elevations, sections, and schedules) are produced automatically and update as the model is updated, saving hours of work. The views are then placed on sheets that make up the construction document set.

For example, a floor plan is duplicated to create a Lighting Plan. In the new view, certain categories of elements are turned off (such as grids) and on (such as lighting fixtures). Annotation is added as needed. The plan is then placed on a sheet, as shown in Figure 1–4.

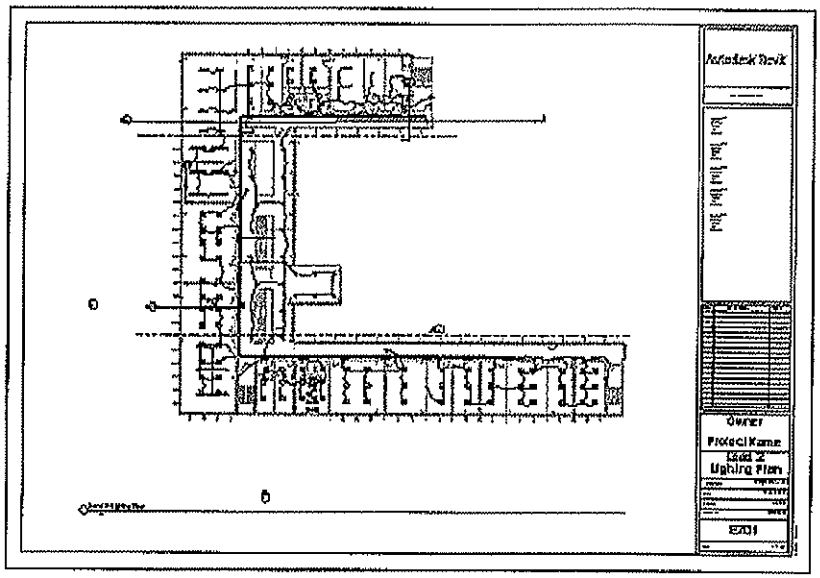

Figure 1–4

- Work can continue on a view and is automatically updated on the sheet.

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1.2 Overview of the Interface

Navigate the graphic user interface.

The Autodesk Revit interface is designed for intuitive and efficient access to commands and views. It includes the Ribbon, Quick Access Toolbar, Application Menu, and Status Bar, which are common to the newer versions of all Autodesk® software. It also includes tools that are specific to the Autodesk Revit software, including the Properties palette, Project Browser and View Control Bar. The interface is shown in .

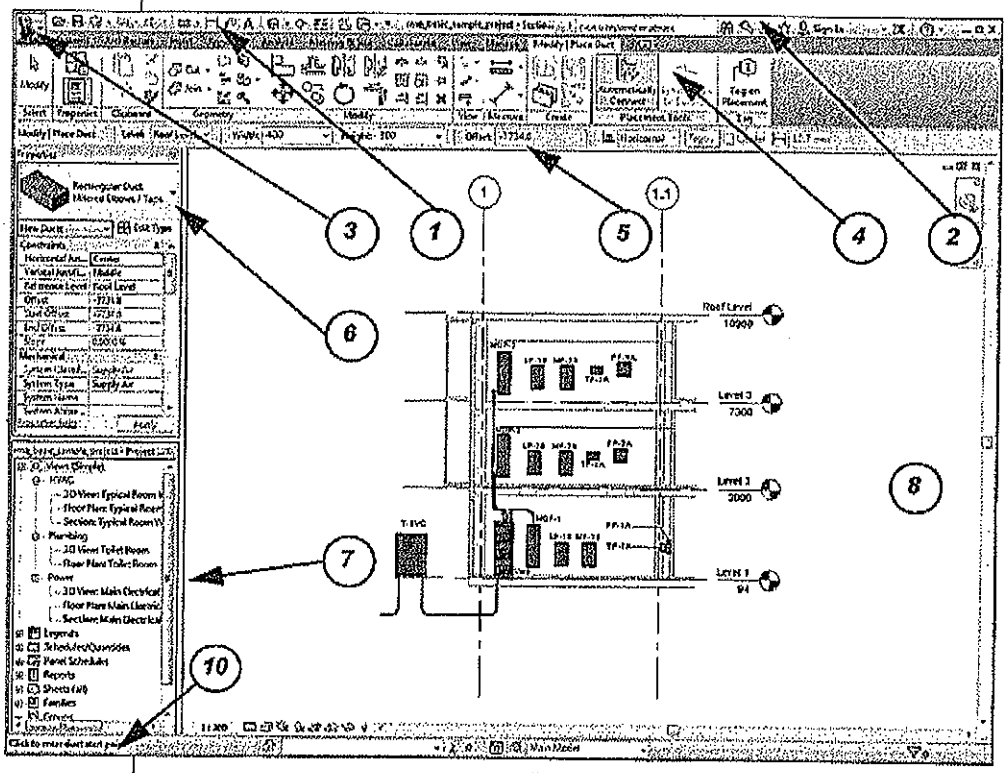

Figure 1–5

1. Quick Access Toolbar
2. InfoCenter
3. Application Menu
4. Ribbon
5. Options Bar
6. Properties Palette
7. Project Browser
8. View Window
9. View Control Bar
10. Status Bar

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1. Quick Access Toolbar

The Quick Access Toolbar provides access to commonly used commands, such as **Open**, **Save**, **Undo** and **Redo**, **Dimension**, and **3D View**, as shown in Figure 1–6.



Figure 1–6

- The Quick Access Toolbar is easily customizable. Select the arrow at the end of the toolbar. You can choose from the list of commands or click **Customize Quick Access Toolbar** to bring up a dialog box where you can modify the location of the tools on the toolbar as shown in Figure 1–7.

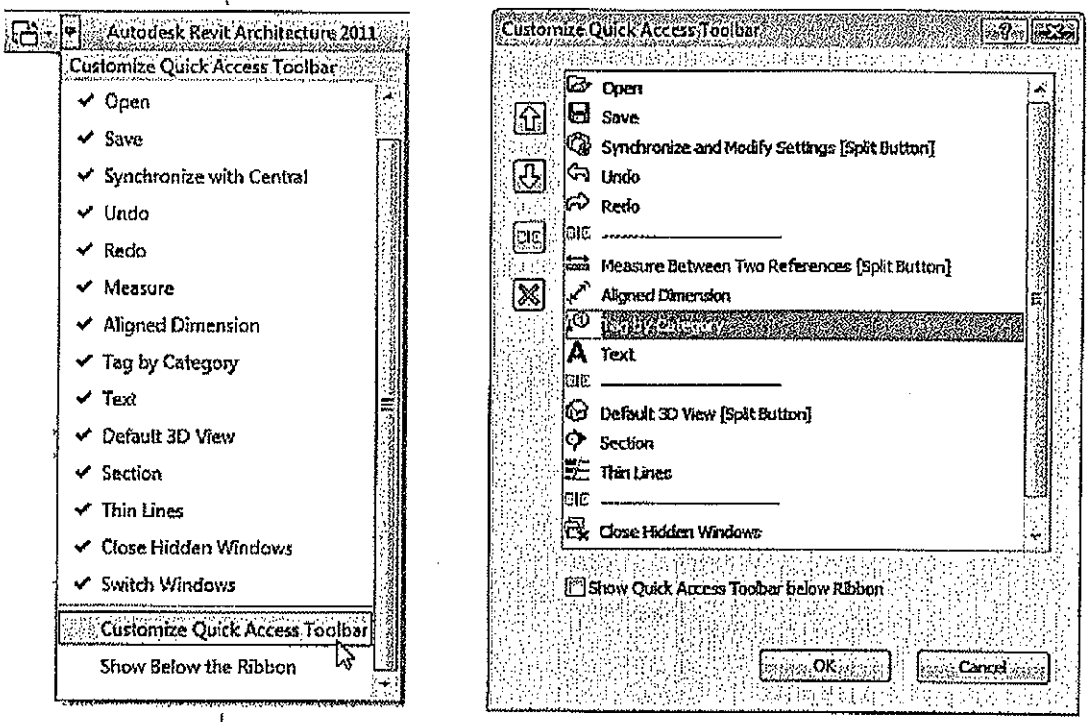

Figure 1–7

- You can also customize it by adding commands from any of the Ribbon tabs. Right-click on the command in the Ribbon and select **Add to Quick Access Toolbar** as shown in Figure 1–8.

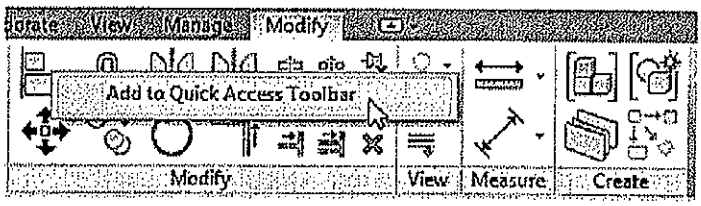

Figure 1–8

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2. InfoCenter

The InfoCenter enables you to quickly search for help on the web, as shown in Figure 1–9. You can specify which Help documents to search, and collapse or expand the *Search* field to save screen space. You can also sign into Autodesk Online to access additional services and use the Autodesk Exchange Apps website.

You can collapse or expand the Search field to save screen space.



Figure 1–9

3. Application Menu

The Application Menu provides access to file commands, settings, and documents, as shown in Figure 1–10. Hover the cursor over a command to see a list of additional tools.

If you click the primary icon rather than the arrow, it starts the default command.

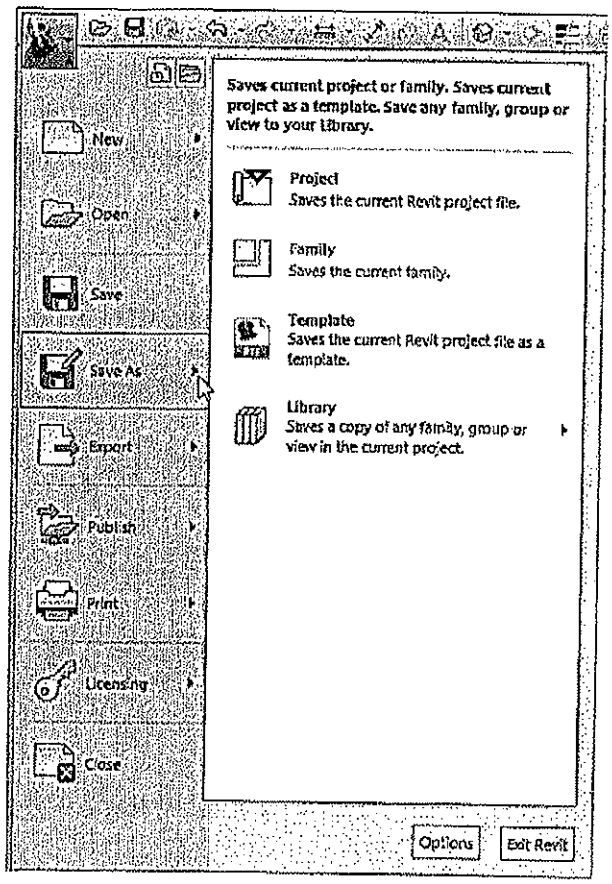

Figure 1–10

- At the bottom of the menu, click Options to open the Options dialog box or click Exit Revit to exit the software.

Recent Drawings

To see a list of recently used documents, in the Application menu, click (Recent Documents). The documents can be reordered, as shown in Figure 1–11.

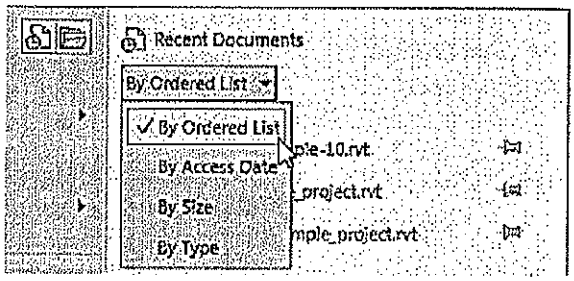

Figure 1–11

- Click (Pin) next to a document name to keep it available, even if more documents are opened than can be displayed. It displays with the push pin tacked in ( ).

Open Drawings

To see a list of open documents and views, click (Open Documents). The list displays the open documents and each view that is open, as shown in Figure 1–12.

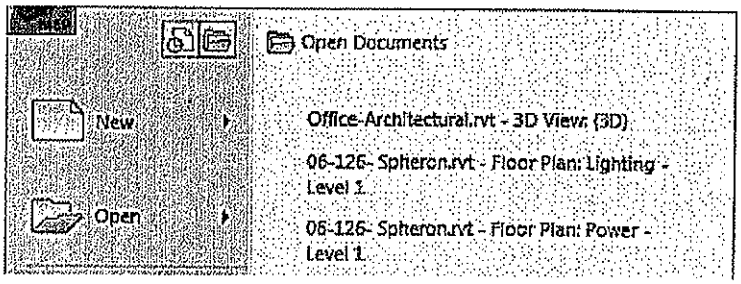

Figure 1–12

- Click (Close) to close the current project.

New in 2013

- When you expand (Open) there is a new option ((Sample Files)) that takes you to a folder containing the sample files supplied with the software.

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4. Ribbon

The Ribbon contains tools in a series of tabs and panels, as shown in Figure 1–13. Selecting a tab displays a group of related panels. The panels contain a variety of tools, grouped by function.

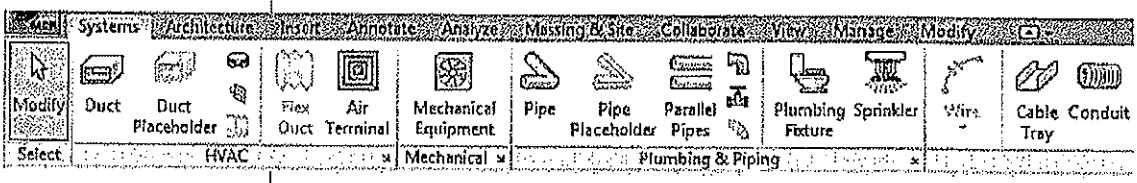

Figure 1–13

When you start a command that creates new elements or you select an element, the Ribbon displays the *Modify* | contextual tab. This contains general editing commands and command specific tools at the end of the tab, as shown in Figure 1–14.

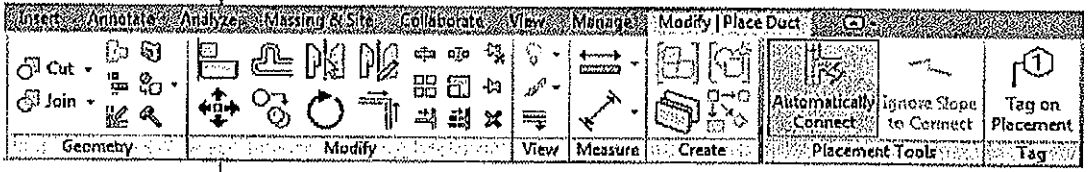

Figure 1–14

- When you hover over a tool on the Ribbon, tooltips display the tool's name and a short description. If you continue hovering over the tool, a graphic (and sometimes a video) displays, as shown in Figure 1–15.

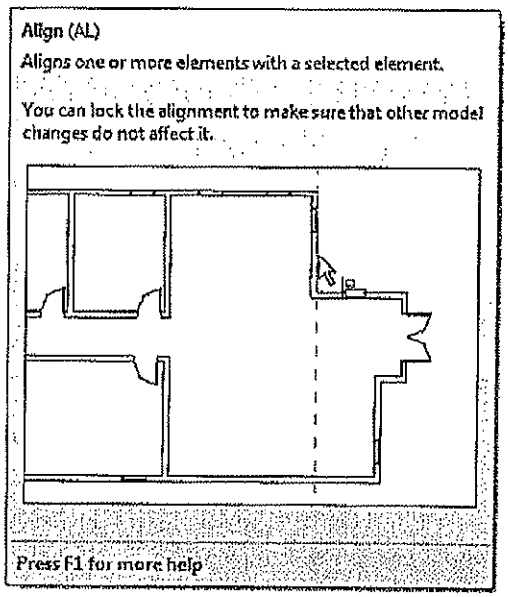

Figure 1–15

- Many commands have shortcut keys. For example, type **AL** for **Align** or **MV** for **Move**. They are listed next to the name of the command in the tooltips. Do not press <Enter> to execute shortcuts.

Enhanced in 2013

- The order in which the Ribbon tabs are displayed can be modified. Select the tab, hold down <Ctrl>, and drag it to a new location. The location is remembered when you restart the software.

- Any panel can be dragged by its title into the drawing area to become a floating panel. Click the **Return Panels to Ribbon** button as shown in to replace the panel.

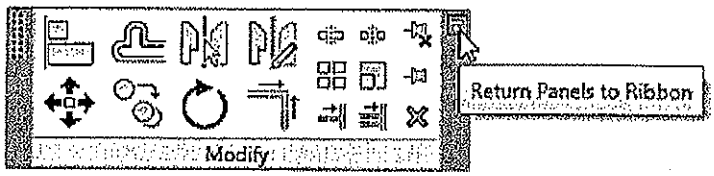

Figure 1–16

Hint: You are always in a command when using the Autodesk Revit software.

When you are finished working with a tool, you typically default back to the **Modify** command. To end a command, use one of the following methods:

- In any Ribbon tab, click (Modify).
- Press <Esc> once or twice to revert to **Modify**.
- Right-click and select **Cancel...**
- Start another command.

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5. Options Bar

The Options Bar displays options that are related to the selected command or element. For example, when the **Rotate** command is active it displays options for rotating the selected elements, as shown at the top of Figure 1–17. When the **Place Dimensions** command is active it displays dimension related options, as shown at the bottom of Figure 1–17.

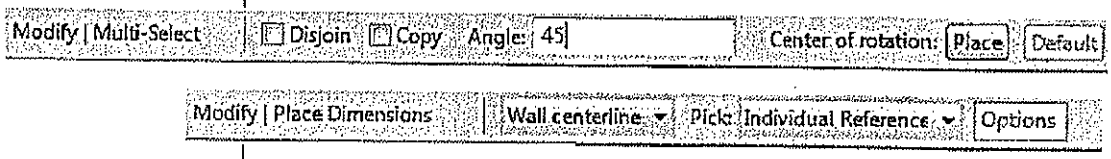

Figure 1–17

6. Properties Palette

The Properties palette is where you can make extensive modifications to views and elements. If nothing is selected and you are not in a command, the Properties palette displays options for the current view, as shown on the left in Figure 1–18. If a command or element is selected, it displays options for the associated element, as shown on the right in Figure 1–18.

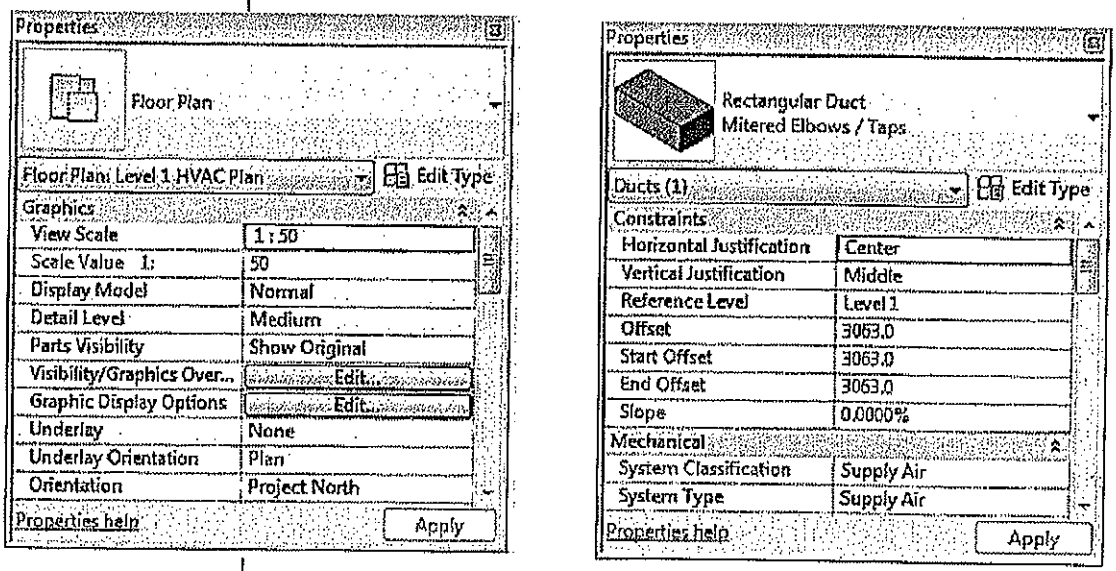

Figure 1–18

- Items that are grayed out are read-only.
- The Properties palette is usually kept open while working on a project to easily permit modifications at any time. It can be placed on a second monitor as well as floated and resized.
- If the Properties palette does not display, in the *Modify* tab> Properties panel, click (Properties) or type **PP**.

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- When multiple elements are selected, you can filter the elements selected in the Properties palette using the drop-down list, as shown in Figure 1–19.

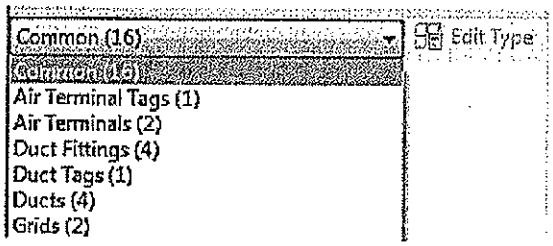

Figure 1–19

- When you start a command or select an element, you can set the element type in the Type Selector as shown in Figure 1–20.

Right-click on the Type Selector to add it to the Quick Access Toolbar and/or to the Ribbon Modify tab.

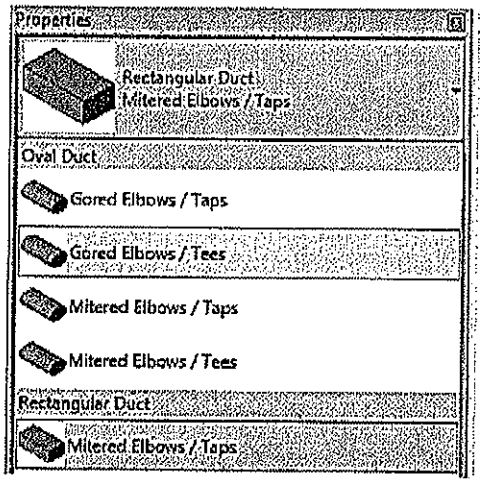

Figure 1–20

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Hint: Type Properties

Type Properties include parameters whose values are common to a specific type within a specific family. For example, as shown in Figure 1–21, the **System Family: Rectangular Duct** includes a *Type:* **Mitered Elbows / Taps**. When a single type of element is selected, click (Edit Type) in Properties to open the Type Properties dialog box.

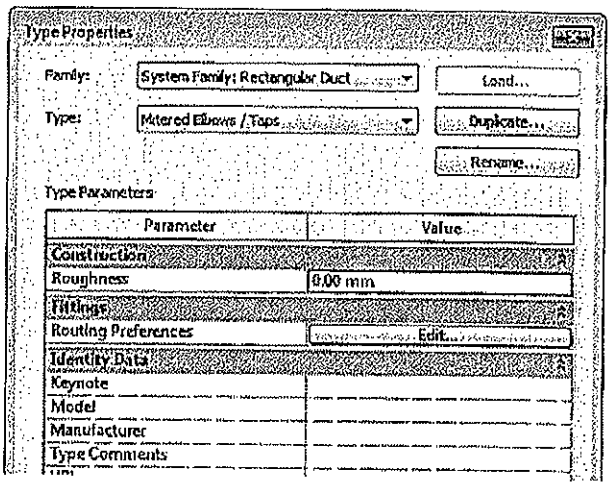

Figure 1–21

7. Project Browser

The Project Browser displays the name of the active project.

The Project Browser lists the views that can be opened in the software as shown in Figure 1–22. This includes all views of the model in which you are working and any additional views that you create, such as floor plans, ceiling plans, 3D views, elevations, sections, etc. It also includes views of schedules, legends, sheets (for plotting), families (such as ducts and lighting fixtures), groups, and Autodesk Revit Links.

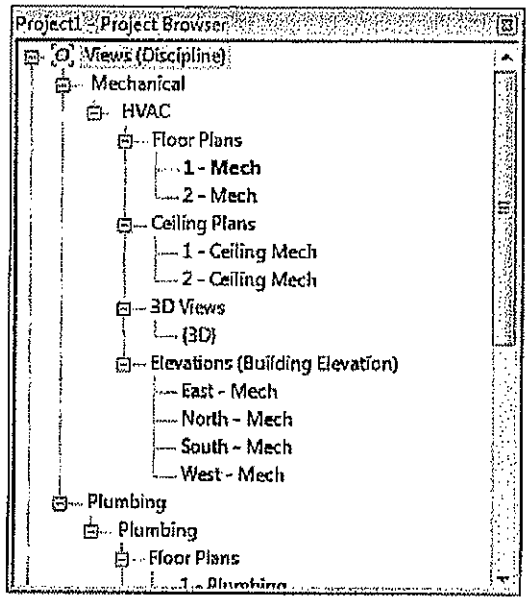

Figure 1–22

- Double-click on an item in the list to open the associated view.
- To see the views associated with a view type, click (Expand) next to the section name. To hide the views in the section, click (Contract).
- Right-click on a view and select **Rename** or press <F2> to rename a view in the Project Browser.
- If you no longer need a view, you can remove it. Right-click on its name in the Project Browser and select **Delete**.
- The Project Browser can be floated, resized, and customized.
- In Autodesk Revit MEP projects, views are typically divided into folders by discipline type. Depending on the type of project in which you are working, several disciplines might be listed with associated sub-categories as shown in Figure 1–22.

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How to:

New in 2013

Search the Project Browser

1. In the Project Browser, right-click on the top level *Views* node as shown in Figure 1–23.

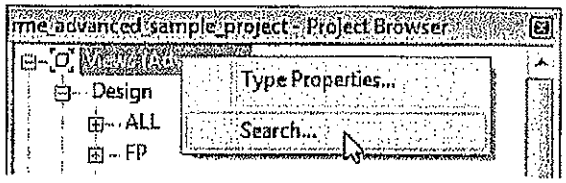

Figure 1–23

2. In the Search in Project Browser dialog box, type the words that you want to find, as shown on the left in Figure 1–24, and click Next.
3. In the Project Browser, the first instance of that search displays as shown on the right in Figure 1–24.

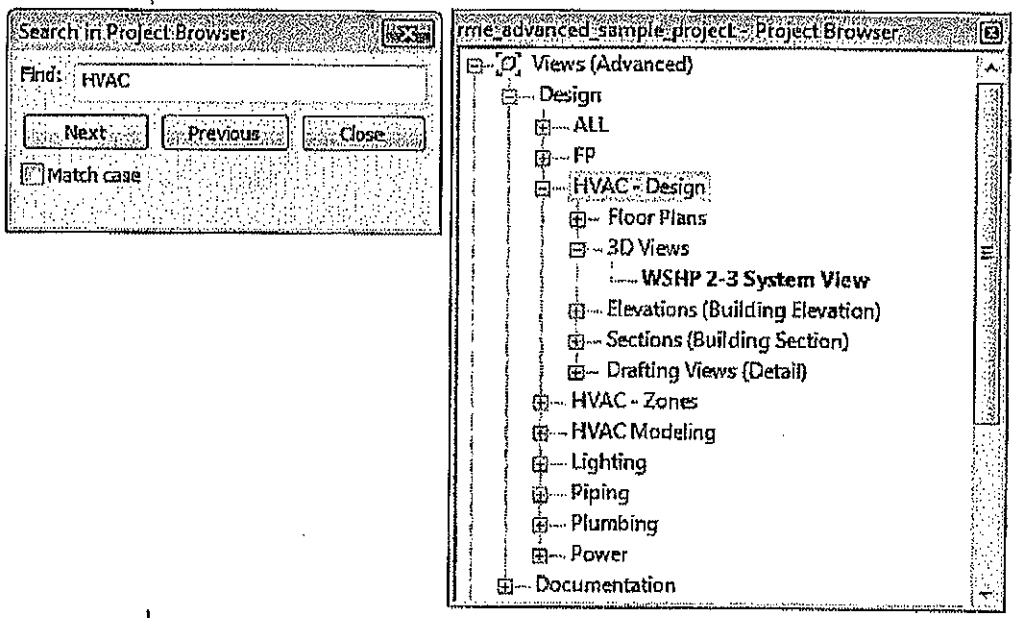

Figure 1–24

4. Continue using Next and Previous to move through the list.
5. Click Close when you are done.

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8. Drawing Area

Each view of a project opens in its own window, as shown in Figure 1–25. Each view displays a Navigation Bar (for quick access to viewing tools) and the View Control Bar.

In 3D views you can also use the ViewCube to rotate the view.

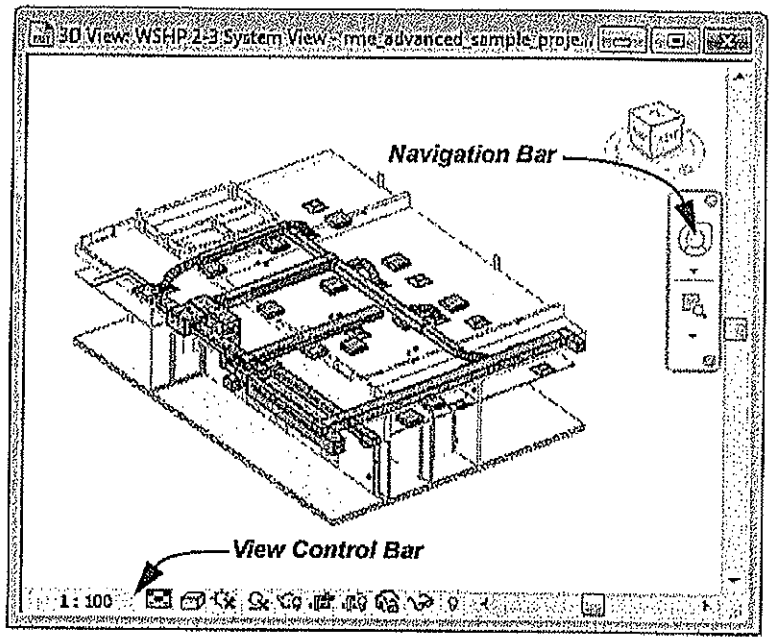

Figure 1–25

- Each view of a project opens in its own window. You can use the Project Browser or press <Ctrl>+<Tab> to cycle through the open views.
- If you have a lot of views open you can choose a view by name. In the Quick Access Toolbar or *View* tab>Windows panel, expand (Switch Windows) and select from the list.
- If you have more than one view open, in the *View* tab> Windows panel, click (Cascade) or (Tile), to arrange them in the selected order on the screen. You can also use the shortcut keys **WC** for **Cascade** and **WT** for **Tile**.

9. View Control Bar

The View Control Bar, as shown in Figure 1–26, displays at the bottom of each view window. It controls aspects of that view, such as the scale and detail level. It also includes tools that display parts of the view and hide or isolate elements in the view.

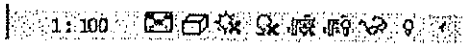

Figure 1–26

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10. Status Bar

The Status Bar provides information about the current process, such as the next step for a command, as shown in Figure 1–27.

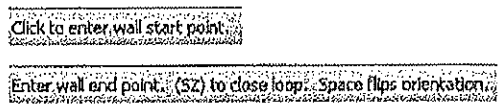

Figure 1–27

- Other options in the Status Bar are related to Worksets and Design Options (advanced tools) as well as selection methods and filters.

Hint: Right-click Menus

Right-click menus help you to work smoothly and efficiently by enabling you to quickly access the required commands. These menus always provide access to basic viewing commands as well as recently used commands, as shown in Figure 1–28. The other options vary depending on the selected element or command that you are using.

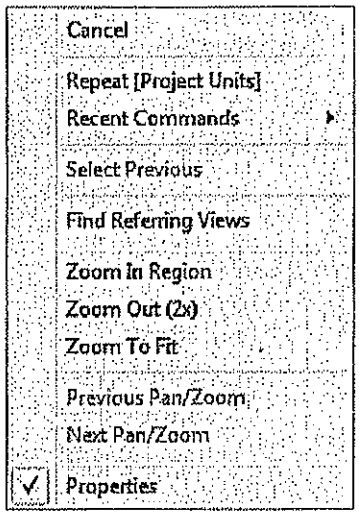

Figure 1–28

1.3 Standard Terminology

Use typical terms and concepts found in the software.

As you start working with BIM based software, you should know the typical terms used to describe items in Autodesk Revit software. There are several types of elements, as shown in , and described in the following table.

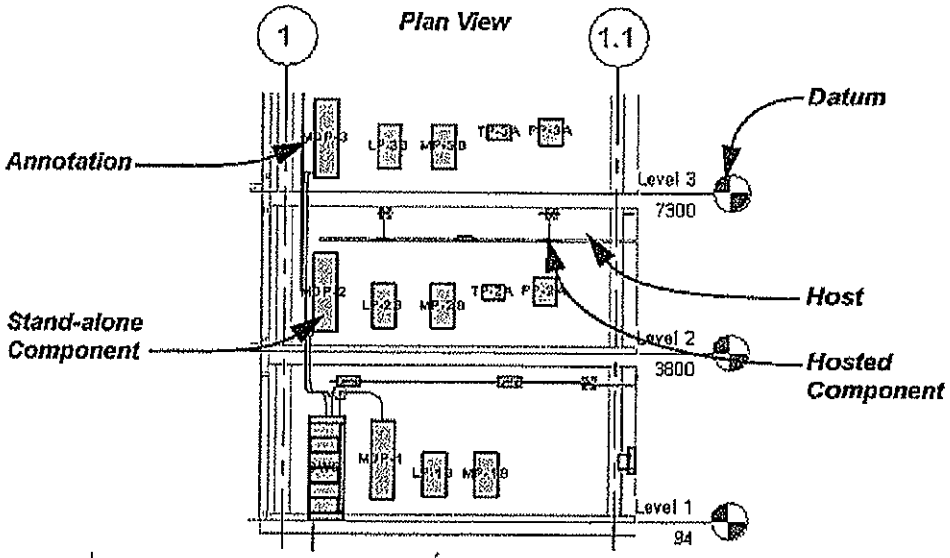

Figure 1–29

Host	*Built-in-place* construction elements (such as floors, walls, roofs, ceilings, stairs, and ramps). They can stand alone in the project.
Components	Elements that need to be attached to host elements (such as plumbing fixtures, diffusers, and electrical receptacles), as well as stand-alone items (such as ducting and equipment).
Views	Enables you to see and manipulate the project. For example, you can view and work in floor plans, ceiling plans, elevations, sections, schedules, and 3D views. You can change a design from any view. All views are stored in the project.
Datum	Elements that define the project context. These include levels for the floors, column grids, and reference planes that help you draw.
Annotation	2D elements that are placed in views to define the information drawn in the project. These include dimensions, text, tags, and symbols. The view scale controls their size.

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Property Types

There are two types of properties for most elements in the software:

- *Instance Properties* are parameters that can be set for the individual element you are drawing or modifying. These display in the Properties palette.
- *Type Properties* control options for all elements of the same type. If you modify these parameters, all elements of the selected type change.

- Instance properties display in the Properties palette, and can be toggled on/off in the *Modify* tab>Properties panel as shown in Figure 1–30, or type the shortcut **PP**.

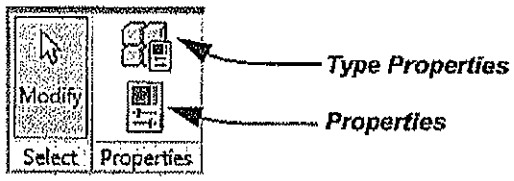

Figure 1–30

- To display the type properties, click (Edit Type) in Properties to open the Type Properties dialog box, as shown in Figure 1–31. Any changes you make in the Type Properties dialog box impacts all instances of the type in the project.

The parameters displayed in the dialog boxes vary according to the type of element selected.

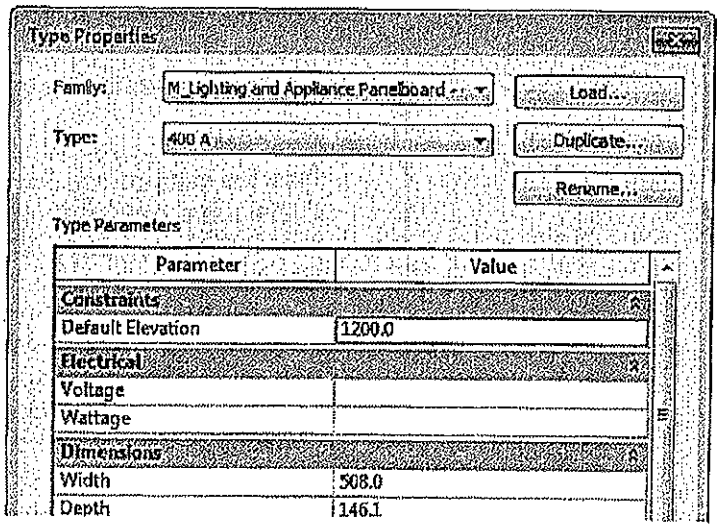

Figure 1–31

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1.4 Starting Projects

Start new projects using templates.

File operations to open existing files, create new files from a template, and save files in Autodesk Revit software follow standard Windows procedures, as shown in the Open dialog box in Figure 1–32.

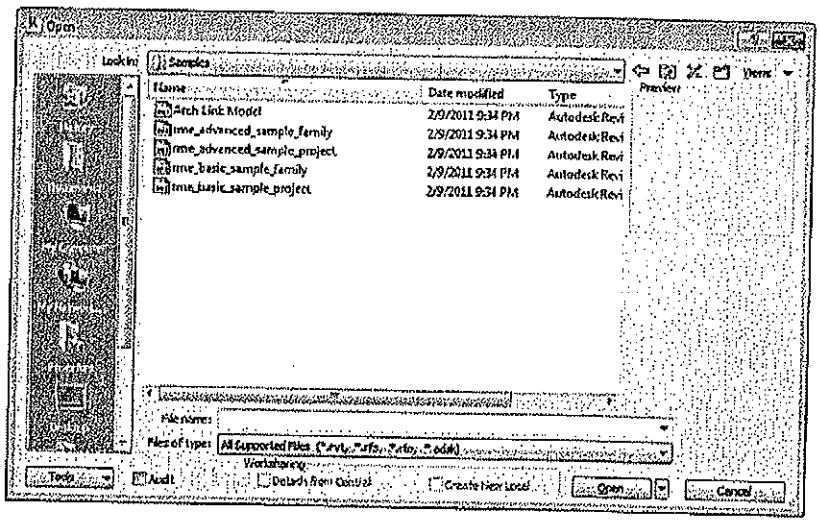

Figure 1–32

There are three main file types:

- **Project files (.rvt):** Your primary drawing files. This is where you do the majority of your work in the building model with views and sheets. They are initially based on template files.
- **Family files (.rfa):** Separate components that can be inserted in a project. For example, the Lighting and Appliance Panelboard electrical equipment family includes a variety of amperages and sizes, and the VAV Unit - Parallel Fan Powered includes a number of sizes and inlet diameters.
- **Template files (.rte):** Designed to hold standard information and settings for creating new project files. The software includes several templates for residential, commercial, and structural projects. You can also create custom templates.
- When you first open the Autodesk Revit software, the Startup Screen opens, displaying lists of recently used project and family files. This screen also displays if you close all projects.

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Hint: Opening Workset-Related Files

Worksets are used when the project becomes large enough for multiple people to work on it at the same time. At this point, the project manager creates a central file with multiple worksets (such as plumbing, ventilation, hydronics, and electrical) that are used by the project team members.

When you open a workset related file it creates a new local file on your computer as shown in Figure 1–33. Do not work in the main central file.

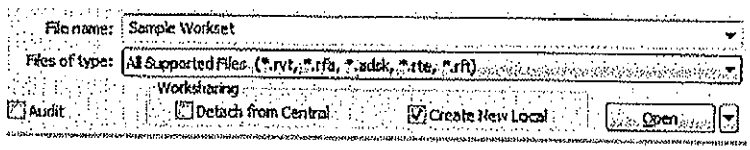

Figure 1–33

Starting New Projects

New projects are based on a template file. The template file includes preset levels, views, and some families, such as wall styles and text styles. Check with your BIM Manager about which template you need to use for your projects. Your company might have more than one based on the types of building you are designing.

How to: **Start a New Project**

1. In the Application Menu, expand (New) and click (Project), as shown in Figure 1–34.

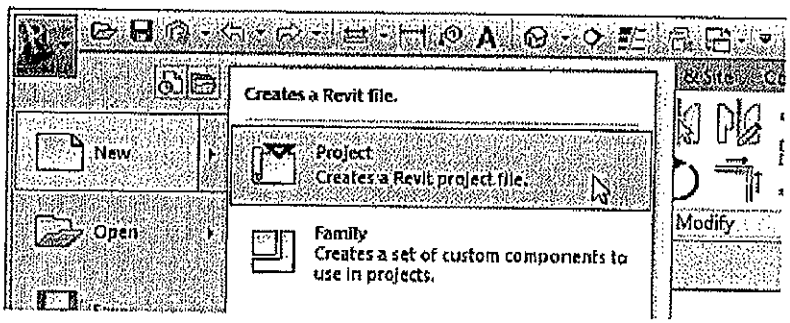

Figure 1–34

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The list of Template files is set in the Options dialog box in the File Locations pane. It might vary depending on the installed product and company standards.

2. In the New Project dialog box, as shown in Figure 1–35, select the template you want to use and click OK.

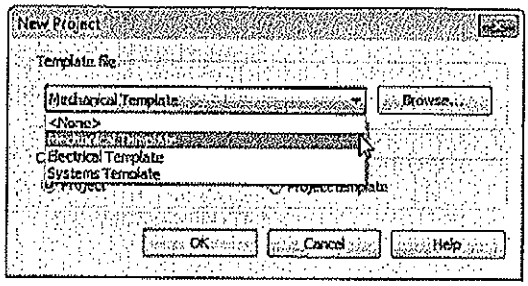

Figure 1–35

- You can select from a list of templates if they have been set up by your BIM Manager.
- You can add (New) to the Quick Access Toolbar. At the end of the Quick Access Toolbar, click (Customize Quick Access Toolbar) and select **New**, as shown in Figure 1–36.

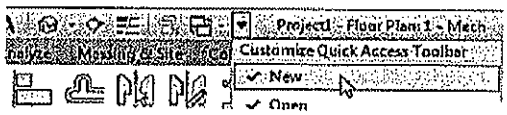

Figure 1–36

Hint: Project Information

Project Information includes *Identity Data, Energy Analysis, and Other* sets of parameters, as shown in Figure 1–37. Some of these are displayed in title block labels (which are updated automatically when the information changes).

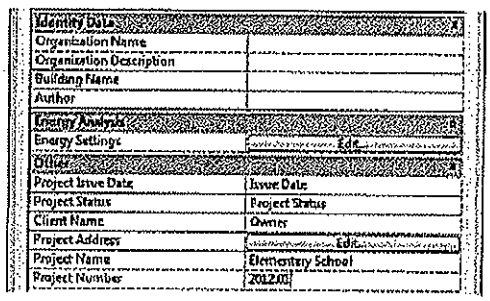

Figure 1–37

- In the *Manage* tab>Settings panel, click (Project Information) to open the dialog box.

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Saving Projects

Saving your project frequently is a good idea. Click (Save) in the Quick Access Toolbar to do this at any time. If the project has not yet been saved, the Save As dialog box opens, where you can specify a file location and name.

- To save an existing project with a new name, in the Application Menu, expand (Save As) and click (Project).
- If you have not saved in a set amount of time, the software opens the Project Not Saved Recently alert box, as shown in Figure 1–38. Select **Save the project**. If you want to set reminder intervals or not save at this time, select the other options.

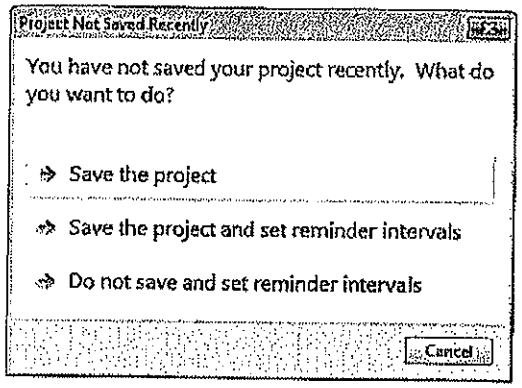

Figure 1–38

- You can set the *Save Reminder interval* to **15** or **30 minutes**, **1**, **2**, or **4 hours**, or to have **No reminders** display. In the Application Menu, click Options to open the Options dialog box. In the left pane, select **General** and set the interval as shown in Figure 1–39.

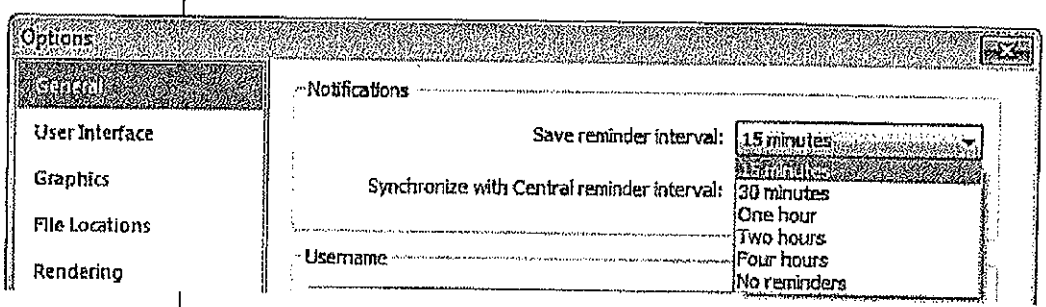

Figure 1–39

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Saving Backup Copies

By default, the software saves a backup copy of a project file when you save the project. Backup copies are numbered incrementally (e.g., **My Project.0001.rvt**, **My Project.0002.rvt**, etc.) and are saved in the same folder as the original file. In the Save As dialog box, click Options... to control how many backup copies are saved. The default number is three backups. If you exceed this number, the software deletes the oldest backup file.

Hint: Saving Workset-Related Projects

If you use worksets in your project, save locally and to the central file. Save the local file frequently just like any other file.

Then, every hour or so, click  (Synchronize Now) in the Quick Access Toolbar to save your changes back to the main file. After you save to central, save the local file again.

If you use  (Synchronize with Central), you can specify that the local file is saved before or after the synchronization.

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1.5 Viewing Commands

- Manipulate 2D and 3D views by zooming and panning.
- Create 3D Isometric and Perspective views.
- Set the Visual Style of a view.

Zoom commands are crucial to working efficiently in most drawing software and Autodesk Revit software is no exception. Once in a view, you can use Zoom controls to navigate within it. You can zoom in and out and pan in any view. There are also special tools for viewing in 3D.

Zooming and Panning

Using Your Mouse to Zoom and Pan

Use your mouse wheel, as shown in Figure 1–40, as the main method of moving around the drawing.

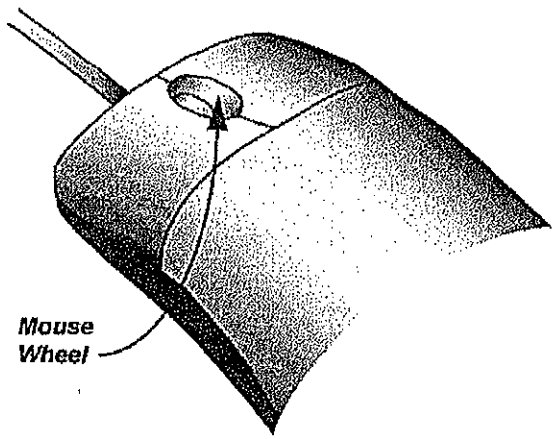

Figure 1–40

- Scroll the wheel on the mouse up to zoom in and down to zoom out.
- Hold down the wheel and move the mouse to pan.

New in 2013

- Double-click the mouse wheel to zoom to the extents of the drawing.
- In a 3D view, hold down <Shift> and the mouse wheel and move the mouse to rotate around the model.

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Zoom Controls

A number of additional zoom methods enable you to control the screen display. **Zoom** and **Pan** can be performed at any time while using other commands.

- You can access the Zoom commands in the Navigation Bar in the upper right corner of the view (as shown in Figure 1–41). You can also access them from most right-click menus and by typing the shortcut commands.

*(2D Wheel) provides cursor-specific access to **Zoom** and **Pan**.*

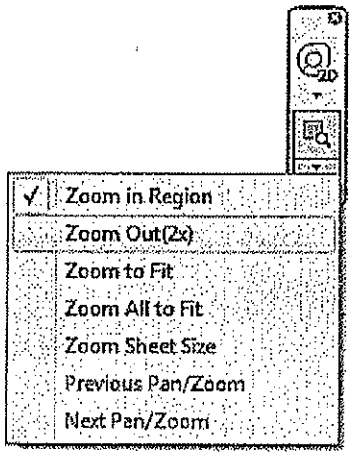

Figure 1–41

Zoom Commands

	Zoom In Region (ZR)	Zooms into a region that you define. Drag the cursor or select two points to define the rectangular area you want to zoom into. This is the default command.
	Zoom Out(2x) (ZO)	Zooms out to half the current magnification around the center of the elements.
	Zoom To Fit (ZF or ZE)	Zooms out so that the entire contents of the project only display on the screen in the current view.
	Zoom All To Fit (ZA)	Zooms out so that the entire contents of the project display on the screen in all open views.
	Zoom Sheet Size (ZS)	Zooms in or out in relation to the sheet size.
	Previous Pan/Zoom (ZP)	Steps back one Zoom command.
	Next Pan/Zoom	Steps forward one Zoom command if you have done a **Previous Pan/Zoom**.

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Viewing in 3D

*There are two types of 3D views: isometric views created by the **3D View** command and perspective views created by the **Camera** command.*

Even if you started a project entirely in plan views, you can quickly create 3D views of the model, as shown in Figure 1–42.

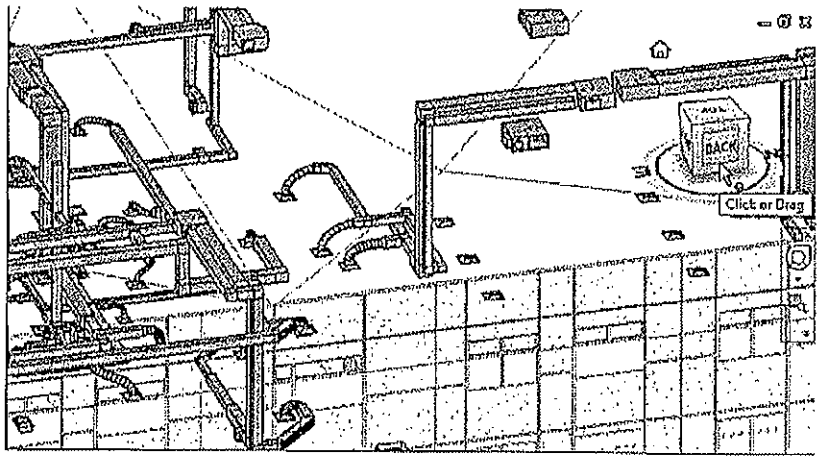

Figure 1–42

Working in 3D views helps you visualize the project and position some of the elements correctly. You can create and modify elements in 3D views just as in plan views.

- Once you have created a 3D view, you can save it and easily return to it.

How to:

Create and Save a 3D Isometric View

1. In the Quick Access Toolbar, click (Default 3D View).The default 3D Southeast isometric view opens, as shown in Figure 1–43.

You can spin the view to a different angle using the mouse wheel or the middle button of a three-button mouse. Hold down <Shift> as you press the wheel or middle button and drag the cursor.

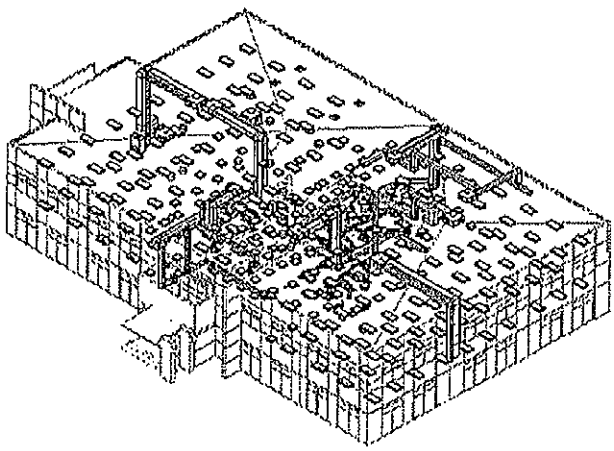

Figure 1–43

2. Modify the view to see the building from other directions.

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You can also rename perspective views.

3. In the Project Browser, right-click on the {3D} view and select **Rename...**
4. Type a new name in the Rename View dialog box, as shown in Figure 1–44, and click OK.

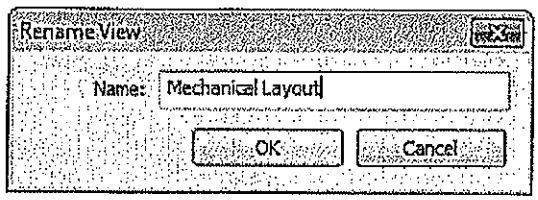

Figure 1–44

- When changes to the default 3D view are saved and you start another default 3D view, it displays the Southeast isometric view once again. If you modified the default 3D view but did not save it to a new name, the **Default 3D View** command opens the view in the last orientation you specified.

How to:

Create a Perspective View

1. Switch to a Floor Plan view.
2. In the Quick Access Toolbar or *View* tab>Create panel, expand (Default 3D View) and click (Camera).
3. Place the camera on the view.
4. Point the camera in the direction in which you want it to shoot by placing the target on the view, as shown in Figure 1–45.

Note the type of plan view in which you are working. Typically, you should create camera views in Coordination plans that display all of the different MEP systems.

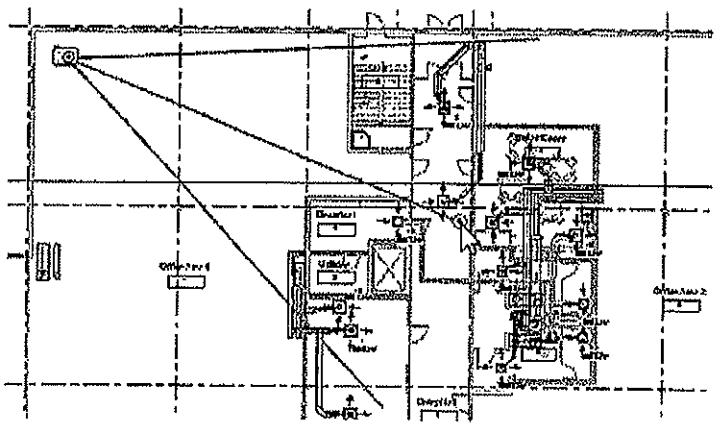

Figure 1–45

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Use the round controls to modify the display size of the view and press <Shift> + mouse wheel to change the view.

A new view is displayed, as shown in Figure 1–46.

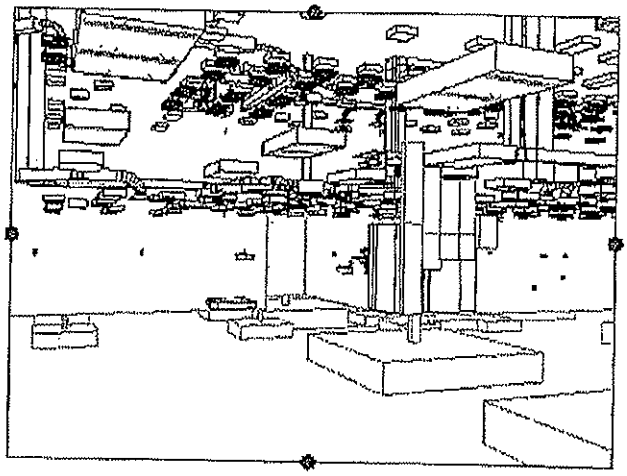

Figure 1–46

Visual Styles

Any view can have a visual style applied. The **Visual Style** options found in the View Control Bar, as shown in Figure 1–47, specify the shading of the building model. These options apply to plan, elevation, section, and 3D views.

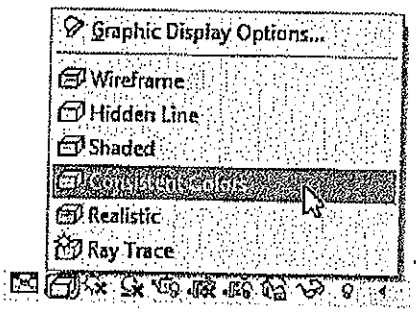

Figure 1–47

- The **Shaded** and **Consistent Colors** visual styles give you a sense of the materials, including transparent glass.
- The **Realistic** visual style displays what you are going to see when you render the view. It takes a lot of computer power to execute this visual style; therefore, it is better to use the other visual styles most of the time as you are working.

New in 2013

- The **Ray Trace** visual style is useful if you have created a 3D view that you want to render. It gradually moves from draft resolution to photorealistic. You can stop the process at any time.

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Hint: Using the ViewCube

The ViewCube provides visual clues as to where you are in a 3D view. It helps you move around the model with quick access to specific views (such as top, front, and right), as well as corner and directional views, as shown in Figure 1–48.

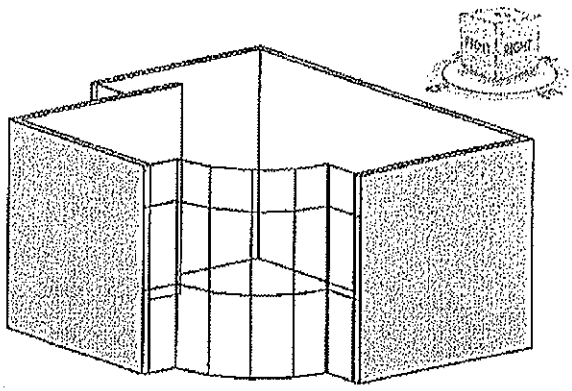

Figure 1–48

Move the cursor over any face of the ViewCube to highlight it. Once a face is highlighted, you can select it to reorient the model. You can also click and drag on the ViewCube to rotate the box, which rotates the model.

- (Home) displays when you roll your cursor over the ViewCube. Click it to return to the view defined as **Home**. To change the Home view, set the view as you want it, right-click on the ViewCube, and select **Set Current View as Home**.
- The ViewCube is available in isometric and perspective views.

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Practice 1a

Open and Review a Project

- Navigate the graphic user interface.
- Manipulate 2D and 3D views by zooming and panning.
- Create 3D Isometric views.
- Set the Visual Style of a view.

Estimated time for completion: 10 minutes

In this practice you will open a project file and display each of the various parts of the Autodesk Revit MEP interface as shown in Figure 1–49. You will open views through the Project Browser, and switch between different views. You will also select elements and display the information about them in the Properties palette. Finally you will create and save 3D views.

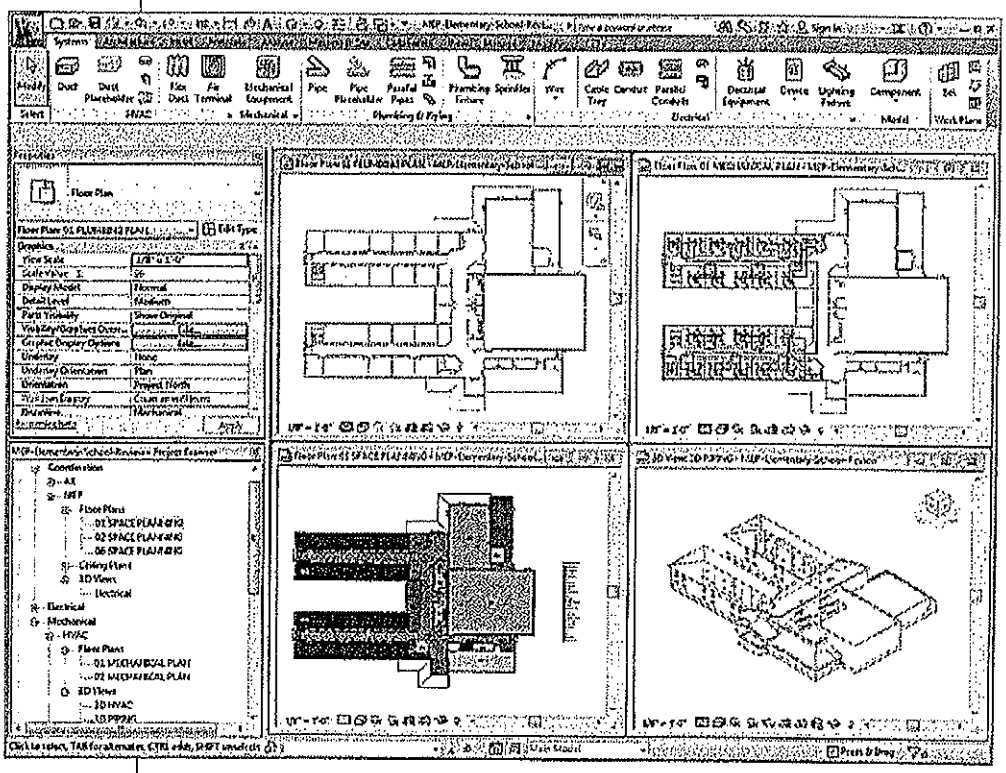

Figure 1–49

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Task 1 - Open an Autodesk Revit MEP project and review it.

1. Open the project **MEP-Elementary-School-Review-M.rvt**, found in the *Chapter 1* folder of your class folder. The project opens in the **3D PIPING** view, as shown in Figure 1–50.

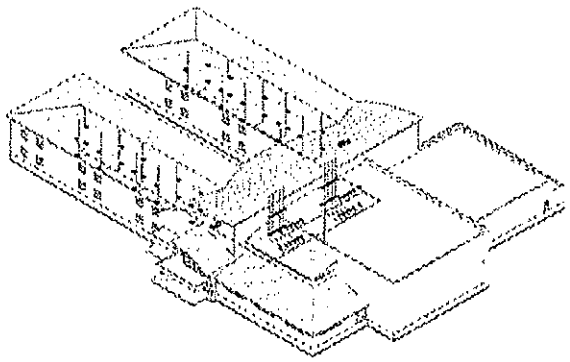

Figure 1–50

2. Close any other open projects and views.
3. In the Project Browser, expand Mechanical>HVAC>*Floor Plans*, as shown in Figure 1–51.

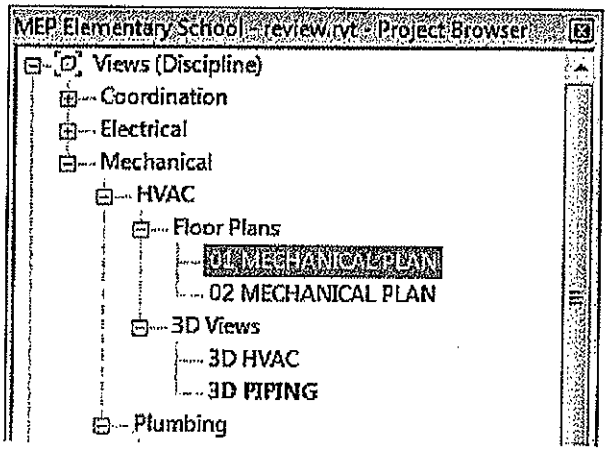

Figure 1–51

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4. Double-click on **01 MECHANICAL PLAN**. The applicable view opens as shown in Figure 1–52.

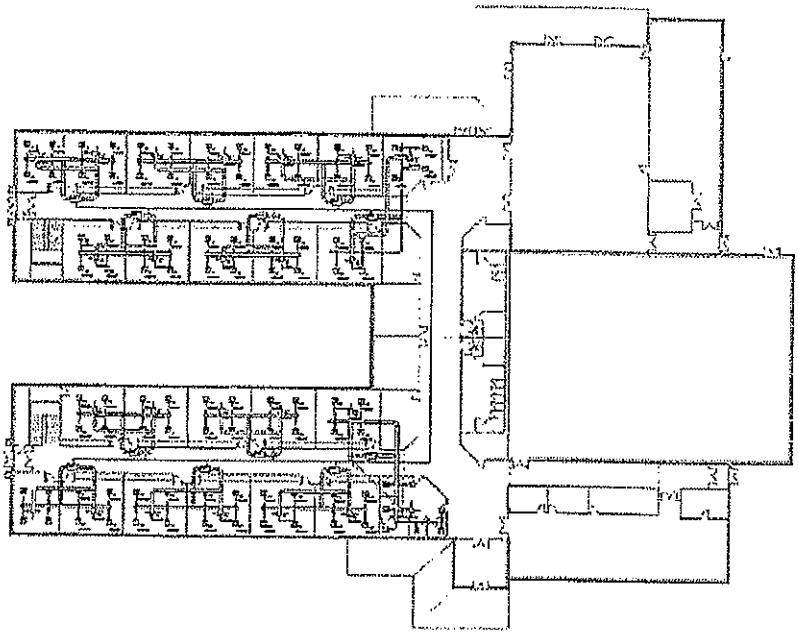

Figure 1–52

5. Use the scroll wheel to zoom and pan around the view.
6. Double-click on the scroll wheel or type **ZF** (Zoom to Fit) to return to the full view.
7. Expand Mechanical>Plumbing>*Floor Plans*. Double-click on the **01 PLUMBING PLAN** view to open it.
8. Expand Coordination>MEP>*Floor Plans*. Double-click on **01 SPACE PLANNING** to open this view.
9. All of the previous views are still open. In the Quick Access Toolbar (or *View* tab>Windows panel), expand (Switch Windows), as shown in Figure 1–53, and select one of the previous views to which to switch.

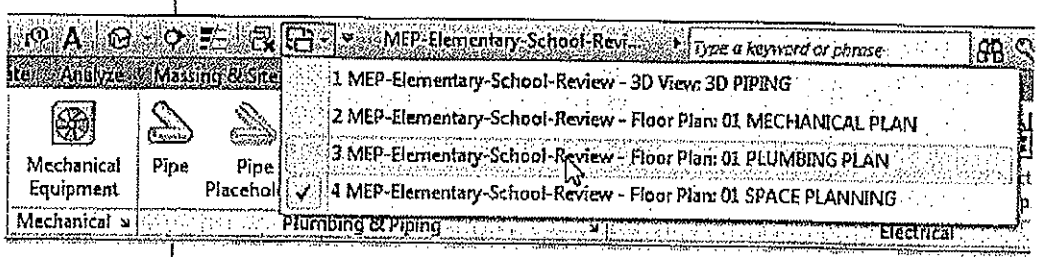

Figure 1–53

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10. In the *View* tab>Windows panel, click (Tile) or type **WT** to display all of the open views on the screen at the same time. Type **ZA** (Zoom All to Fit) to have the model display completely within each view window, as shown in Figure 1–54.

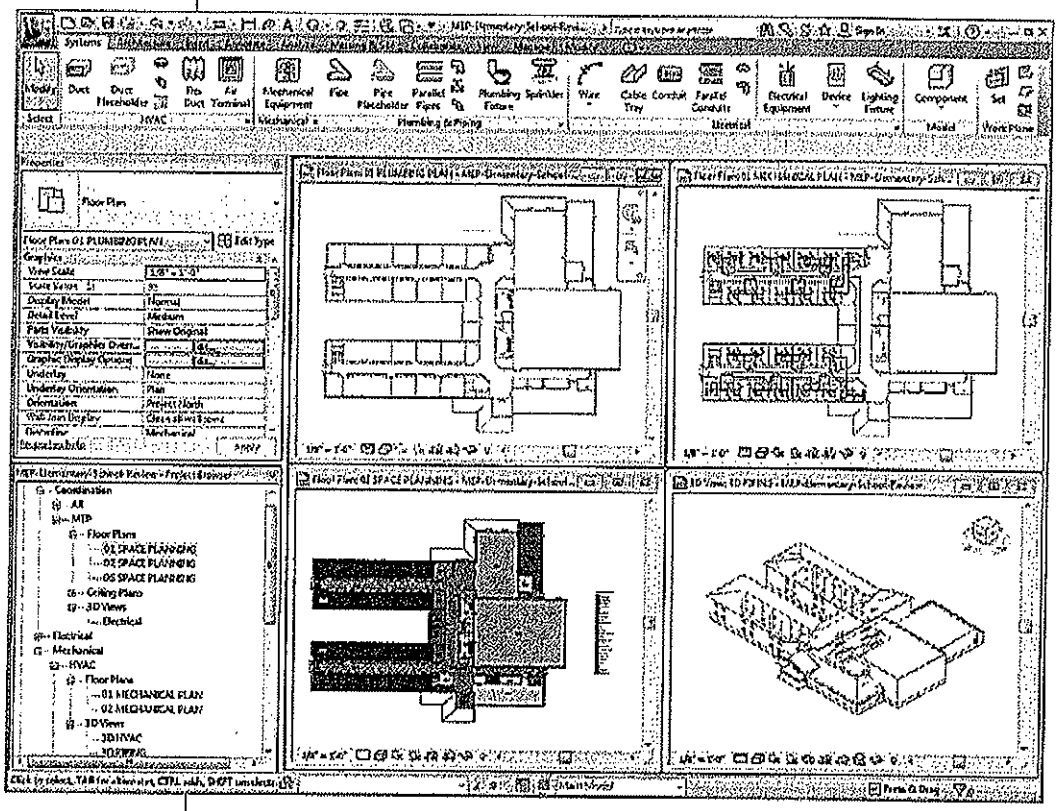

Figure 1–54

11. Click in the open **01 MECHANICAL PLAN** view to make it active.

12. In the upper left corner, click (Maximize), as shown in Figure 1–55, so that this view fills the drawing area. Then use one of the zoom commands so that the model fills the view.

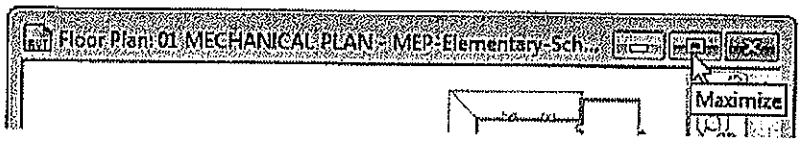

Figure 1–55

13. In the Quick Access Toolbar, click (Close Hidden Windows). Only the current active view is open.

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Task 2 - Display the Element Properties.

1. In the **01 MECHANICAL PLAN** view, hover over a duct without selecting it first. The duct highlights and a tooltip displays as shown in Figure 1–56. Information about the element also displays in the Status Bar but not in Properties.

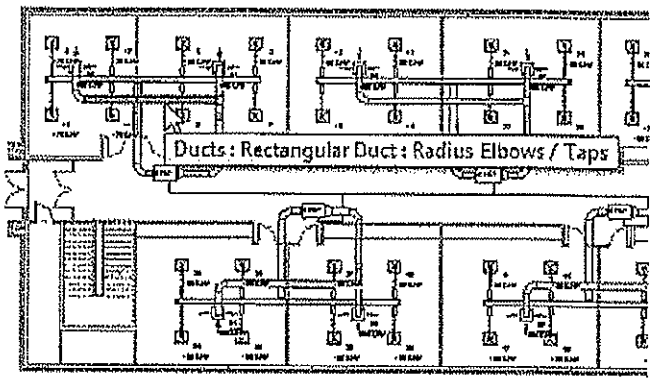

Figure 1–56

2. Click on the duct to select it. The selection color and Ribbon tabs at the top of the screen change. Properties now displays information about this piece of ductwork, as shown in Figure 1–57.

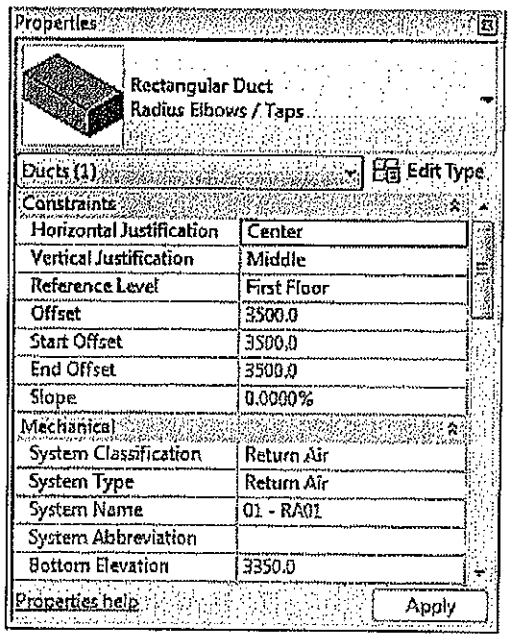

Figure 1–57

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3. Hold down <Ctrl> and in the view, select another, similar Duct element, as shown in Figure 1–58. Properties now displays that two ducts (Ducts(2)) are selected with the same information.

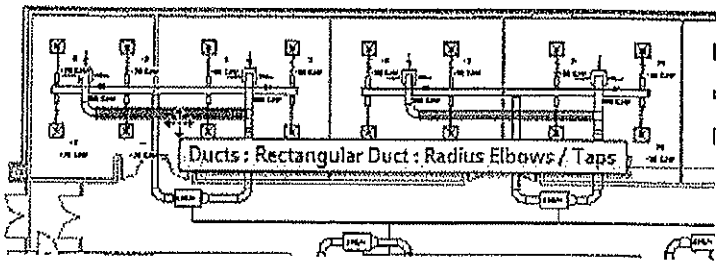

Figure 1–58

4. Hold down <Ctrl> and select an air terminal. Properties now displays Common (3) in the Filter drop-down list, because the three selected elements are not of the same type. Therefore they do not share the same type of properties.

5. In Properties, expand the Filter drop-down list and select **Air Terminals**, as shown in Figure 1–59.

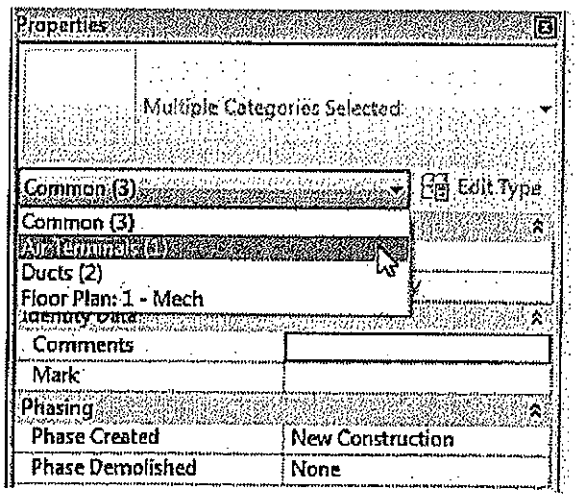

Figure 1–59

6. Only the Air Terminal properties are displayed, but the selection set has not changed. In the view they are all still selected.

7. In *Modify | Multi-Select* tab>Select panel, click (Modify). The selection set is released. You can also press <Esc> twice or click in the drawing window without selecting an element to clear the selected objects.

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Task 3 - Create 3D Views.

1. In the Quick Access Toolbar, click (Default 3D View).
2. A **3D Isometric** view displays, as shown in Figure 1–60.

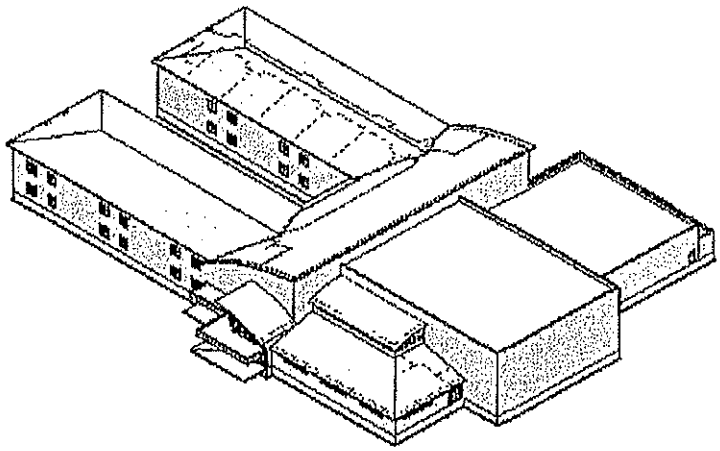

Figure 1–60

3. Press and hold <Shift> and press the middle mouse (scroll) button to orbit the view.
4. In the View Control Panel, select several different Visual Styles to see how they impact the view, as shown in Figure 1–61.

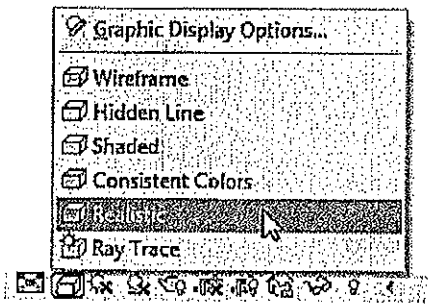

Figure 1–61

5. Select a view and Visual Style that you like. In the Project Browser, in the Coordination>All>*3D Views* area, right-click on {3D} and select **Rename**.
6. Name the view as needed and click OK.

Task 4 - Create a Camera View.

1. Switch back to the **01 Mechanical Plan** view.
2. In the Quick Access Toolbar, expand (Default 3D View) and click (Camera).
3. Place the camera and select a point for the target similar to that shown in Figure 1–62.

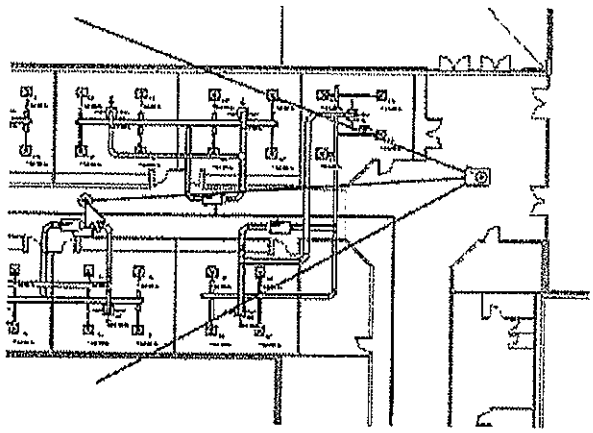

Figure 1–62

4. The new view displays. Use the controls on the outline of the view to resize the view.
5. Click inside the 3D view and use <Shift>+ mouse wheel to rotate around until you get a good view of the ductwork.
6. Set the Visual Style as required.
7. In the Project Browser, expand Mechanical>???>*3D Views* and select the new **3D View 1** as shown in Figure 1–63.

The new view displays in the ??? category because it has not been assigned a Sub-discipline.

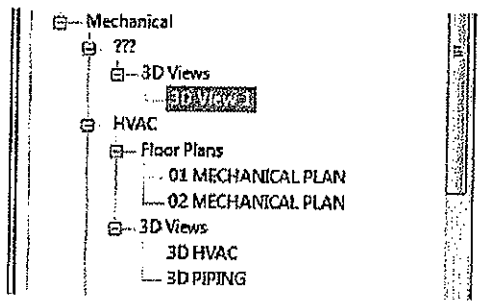

Figure 1–63

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8. In Properties, in the *Graphics* area, expand Sub-Discipline and select **HVAC** as shown in Figure 1–64.

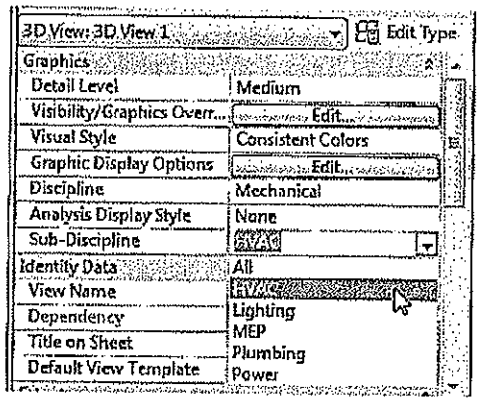

Figure 1–64

9. Click Apply. The view moves to the correct sub-discipline group as shown in Figure 1–65. Rename the view as needed.

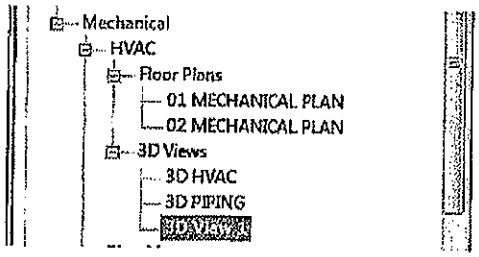

Figure 1–65

10. Save the project.

11. In the Application Menu, click (Close).

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Chapter Review Questions

1. When you create the building elements in the Autodesk Revit software, do you draw in 2D or 3D?
   a. You draw in 2D in all views.
   b. You draw in 2D in plan and elevation views and model in 3D in isometric views.
   c. You model in 3D and the software creates 2D views.
2. How do you create a perspective view?
   a. Create a new Perspective view.
   b. Create a new Camera view.
   c. Create a new Default 3D view and apply a perspective to it.
   d. Create a new elevation view and apply a perspective to it.
3. When you start a command, such as **Duct**, which of the following parts of the User Interfaces change to display related tools? Select all that apply.
   a. Properties
   b. Quick Access Toolbar
   c. Options Bar
   d. Ribbon
4. Levels are considered a:
   a. Host
   b. Component
   c. Annotation
   d. Datum
5. Which of the following elements are typically included in a template file?
   a. Views
   b. Beams
   c. Reinforcement
   d. Slabs

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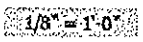
Command Summary

Button	Command	Location
	**3D View**	■ **Quick Access Toolbar** ■ **Ribbon:** *View* tab>Create panel
	**Camera**	■ **Ribbon:** *View* tab>Create panel> 3D View>Camera
	**Consistent Colors**	■ **View Control Bar:** Visual Style> Consistent Colors
	**Hidden Line**	■ **View Control Bar:** Visual Style> Hidden Line ■ **Shortcut:** HL
	**Home**	■ **ViewCube**
	**Modify**	■ **Quick Access Toolbar** ■ **Ribbon:** *<name of contextual>* tab> Select panel ■ **Shortcut:** MD ■ **Contextual Ribbon**
	**New**	■ **Quick Access Toolbar (Optional)** ■ **Application Menu:** New>Project ■ **Shortcut:** <Ctrl>+<N>
	Next Pan/Zoom	■ **Navigation Bar** ■ **Right-click Menu**
	**Open Documents**	■ **Application Menu:** Open Documents
	Previous Pan/Zoom	■ **Navigation Bar** ■ **Shortcut:** ZP
	**Ray Trace**	■ **View Control Bar:** Visual Style> Ray Trace
	**Realistic**	■ **View Control Bar:** Visual Style> Realistic
	**Recent Documents**	■ **Application Menu:** Recent Documents
	**Save**	■ **Quick Access Toolbar** ■ **Application Menu:** Save ■ **Shortcut:** <Ctrl>+<S>
	**Scale**	■ **View Control Bar**
	**Shaded**	■ **View Control Bar:** Visual Style> Shaded ■ **Shortcut:** SD

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	**Synchronize Now/ Synchronize and Modify Settings**	■ **Quick Access Toolbar**
	**Visual Style**	■ **View Control Bar**
	**Wireframe**	■ **View Control Bar:** Visual Style> Wireframe ■ **Shortcut:** WF
	**Zoom All to Fit**	■ **Navigation Bar** ■ **Shortcut:** ZA
	**Zoom In Region**	■ **Navigation Bar** ■ **Shortcut:** ZR
	**Zoom Out 2x**	■ **Navigation Bar** ■ **Shortcut:** ZO
	**Zoom Sheet Size**	■ **Navigation Bar** ■ **Shortcut:** ZS
	**Zoom to Fit**	■ **Navigation Bar** ■ **Shortcut:** ZF or ZE

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Chapter 2

Basic Drawing and Editing Tools

In this chapter you learn how to use the basic drawing and editing tools that apply to almost all types of elements. These tools also include alignment lines, temporary dimensions, snaps, and the Properties palette. You learn how to select elements for editing. You also learn how to move, copy, rotate, mirror, and array elements and how to align elements, split walls, trim, extend, and offset elements.

This chapter contains the following topics:

- ✓**General Drawing Tools**
- ✓**Editing Elements**
- ✓**Basic Modifying Tools**
- ✓**Helpful Editing Tools**

Learning Objectives

This chapter provides instruction to enable you to do the following:

2.1 General Drawing Tools

- Use contextual Ribbon tabs, the Options Bar, and the Properties palette as you draw and modify.
- Draw elements using draw and pick tools.
- Use drawing aids including alignment lines, temporary dimensions, and snaps.

2.2 Editing Elements

- Select elements to modify.
- Modify elements using the Ribbon, Properties, temporary dimensions, and controls.
- Filter selection sets.

2.3 Basic Modifying Tools

- Move and copy elements.
- Rotate elements around the center or an origin.
- Mirror elements by picking an axis or drawing an axis.
- Create Linear and Radial Arrays of elements.

2.4 Helpful Editing Tools

- Align, split, trim, and offset elements by using the modify tools.

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2.1 General Drawing Tools

- Use contextual Ribbon tabs, the Options Bar, and the Properties palette as you draw and modify.
- Draw elements using draw and pick tools.
- Use drawing aids including alignment lines, temporary dimensions, and snaps.

When you start a drawing command, the contextual Ribbon, Options Bar, and Properties palette enable you to set up features for each element you are placing in the drawing. As you are drawing, several features called *drawing aids* display, as shown in Figure 2–1. They help create designs quickly and accurately.

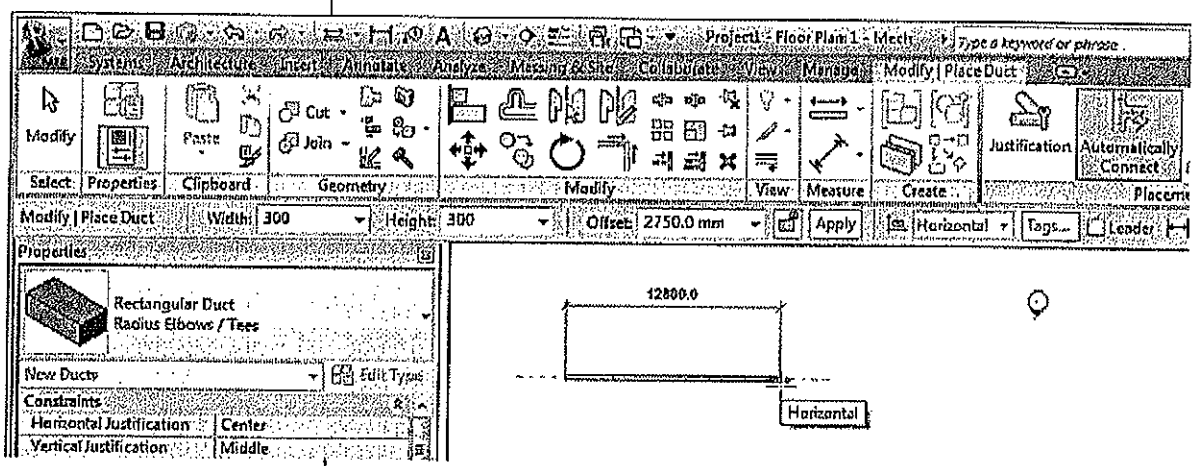

Figure 2–1

The Contextual Ribbon

When you select a command, the Ribbon displays the *Modify* tab with the contextual tools. For example, when you click (Duct), the *Modify | Place Duct* tab opens, as shown in Figure 2–1.

- The Modify tools are always displayed to the left of the Ribbon and the contextual tools to the right with a green panel title.

In the Select panel, click (Modify) to finish the command and return to the main tab at any time.

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The Options Bar

The Options Bar displays the most used options for an element, as shown in Figure 2–2. These options are also typically found in the Properties palette.



Figure 2–2

The Properties Palette

The Properties palette displays the current element type in the Type Selector. You can select other types and modify some of the related parameters for the selected object, as shown in Figure 2–3.

Some of the properties parameters are only available when you are editing an element. They are grayed out when you are creating an element.

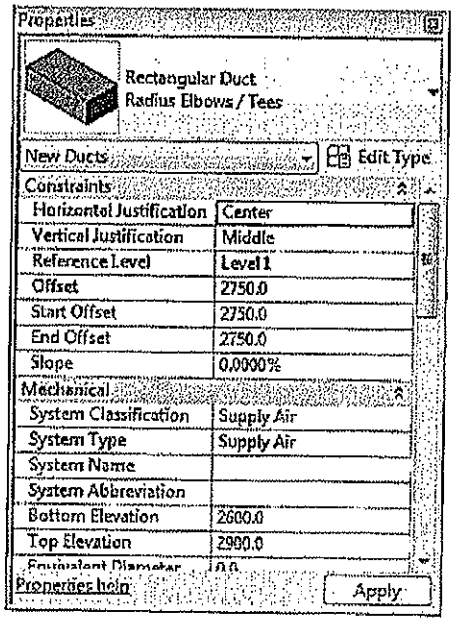

Figure 2–3

- The Properties palette can be floated and moved around the screen. If it is turned off, you can turn it on in the *Modify* tab> Properties panel by clicking (Properties) or by typing **PP**. This is an on/off toggle.

- Changes in the palette do not take effect until you click Apply or move your cursor off the palette. If you click in the window, it applies the change but clears the elements.

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Drawing Aids

As soon as you start drawing in the software, three drawing aids display on the screen: *alignment lines*, *temporary dimensions*, and *snaps*. These are available with most drawing and many modification commands.

Alignment Lines

Dashed *alignment lines* display as soon as you select your first point, as shown in Figure 2–4. They help keep lines horizontal, vertical, or at a specified angle. They also line up with the implied intersections of other elements.

Angles display at 90, 45, 15, 5, and 1 degree increments. The order of the angle list controls the power level of the snap. For example, the 90 degree angle is most likely to display if you are close to horizontal or vertical.

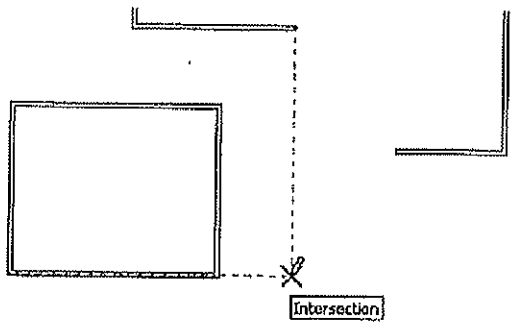

Figure 2–4

- Hold down <Shift> to force the alignments to be orthogonal.

Temporary Dimensions

Along with alignment lines, *temporary dimensions* display as you draw to help place linear elements at the proper length and location, as shown in Figure 2–5.

You can move the cursor to the exact dimension, or place it approximately and then modify the dimension as needed. This enables you to sketch the building and then come back and use the parametric engine to update the model with greater precision.

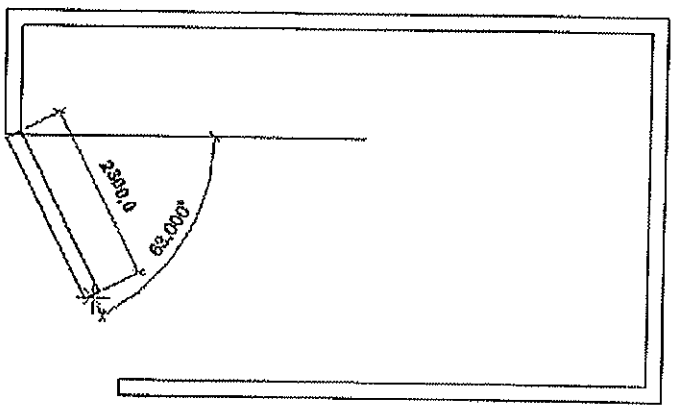

Figure 2–5

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Dimensions are a powerful tool to help create and annotate the model.

- The increments displayed for dimensions change as you zoom in closer to the elements. These *dimension snap* increments are for both linear and angular dimensions, and can be set in the Snaps dialog box.
- For Metric measurements, the Autodesk Revit software understands a default of millimeters. For example, when you type **4**, it assumes 4mm. To indicate meters, type **M** after the distance.
- Temporary dimensions disappear as soon as you finish drawing linear elements. If you want to make them permanent, select the control shown in Figure 2–6.

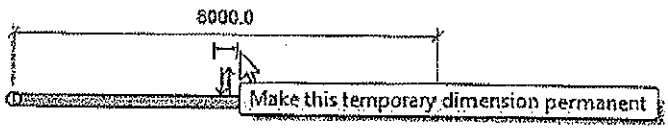

Figure 2–6

- The size of the temporary dimensions, in pixels, can be set in the Options dialog box on the *Graphics* tab.

Snaps

Snaps are key points that help you reference existing elements to exact points when drawing, as shown in Figure 2–7.

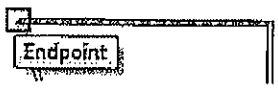

Figure 2–7

They include *Endpoints*, *Midpoints*, *Nearest*, *Work Plane Grid*, *Quadrants*, *Intersections*, *Centers*, *Perpendicular*, *Tangents*, and *Points*. When you move your cursor over an element, the **Snap** symbol displays. Each snap location type displays with a different symbol.

- To modify the snap settings, in the *Manage* tab>Settings panel, click (Snaps). This opens the Snaps dialog box, where you can set which snap points are active, as well as the snap distances (for dimension and angular increments). It also displays the keyboard shortcuts for each snap, which you can use to override the automatic snapping.

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Hint: Temporarily Overriding Snap Settings

You can use the shortcut key combinations (displayed in the Snaps dialog box) or right-click and select **Snap Overrides** to temporarily override snap settings. Temporary overrides affect a singe pick only but can be very helpful when there are nearby snaps other than the one you want.

Reference Planes

As you develop designs in Autodesk® Revit® MEP, there are times when you need additional temporary lines to help you define certain locations. You can draw *reference planes* (the dashed lines) to host the height of sinks or to help you define centerlines and paths for ductwork, as shown in Figure 2–8. You can snap to reference planes and they display in associated views.

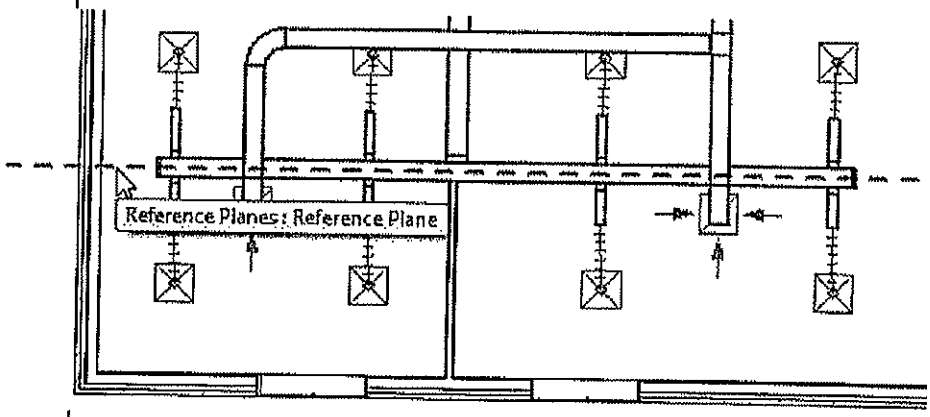

Figure 2–8

How to:

Sketch with Reference Planes

1. In the *Systems* tab>Work Plane panel, click (Ref Plane) or type **RP**.
2. In the *Modify | Place Reference Plane* tab>Draw panel, click (Line) or (Pick Lines).
   - For (Line) select two points that define the reference plane.
   - For (Pick Lines), select any linear element and a reference plane is created that matches the length of that element.
3. Click (Modify) when you have created all of the required reference planes.

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- In the Options Bar, the *Offset* field enables you to enter values to draw the reference plane at a specified distance from the selected points. For example, set *Offset* to **3000** and select the end points of an existing wall to create a reference plane 3000mm away. You can also use *Offset* with **Pick Lines**.
- To change the length of a reference plane, drag the circle at either end.
- You can name reference planes. Select the reference plane and in the *Identity Data* area in Properties, type a name.

Draw Tools

Linear elements include walls, lines, detail lines, and sketches for floors, roofs, stairs, and railings.

The MEP tools (such as ducts, pipes, and conduit), are strictly straight linear elements that are automatically connected with the appropriate elbows or tees. However, if you are working with walls as shown in Figure 2–9, or lines used in details, legends, and schematic drawings, more tools are available. They display in the contextual Ribbon and the tools vary according to the element being drawn.

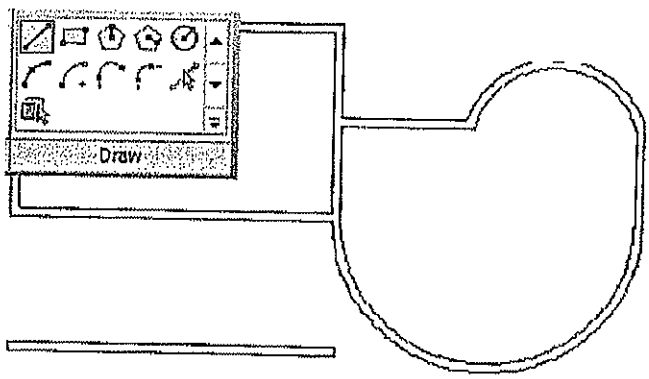

Figure 2–9

- Two styles of tools are available: one where you *draw* the element using a geometric form, and another where you *pick* an existing element (such as a line, face, or wall) as the basis for the new element's geometry.

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Draw Tools

	**Line**	Draws a straight linear element defined by the first and last points. If **Chain** is enabled, you can continue selecting end points for multiple segments.
	**Rectangle**	Draws four linear elements defined from two opposing corner points. You can adjust the dimensions after selecting both points.
	**Inscribed Polygon**	Draws a polygon inscribed in a hypothetical circle with the number of sides specified in the Options Bar.
	**Circumscribed Polygon**	Draws a polygon circumscribed around a hypothetical circle with the number of sides specified in the Options Bar.
	**Circle**	Draws a circular linear element defined by a center point and radius.
	**Start-End-Radius Arc**	Draws a curved linear element defined by a start, end, and radius of the arc. The outside dimension shown is the included angle of the arc. The inside dimension is the radius.
	**Center-ends Arc**	Draws a curved linear element defined by a center, radius, and included angle. The selected point of the radius also defines the start point of the arc.
	**Tangent End Arc**	Draws a curved linear element tangent to another element. Select an end point for the first point, but do not select the intersection of two or more elements. Then select a second point based on the included angle of the arc.
	**Fillet Arc**	Draws a curved linear element defined by two other linear elements and a radius. Because it is difficult to select the correct radius by clicking, this command automatically moves to edit mode. Select the dimension and then modify the radius of the fillet.
	**Spline**	Draws a curved linear element based on selected points. The curve does not actually touch the points (Model and Detail Lines only).
	**Ellipse**	Draws an ellipse from a primary and secondary axis (Model and Detail Lines only).
	**Partial Ellipse**	Draws only one side of the ellipse, like an arc. A partial ellipse also has a primary and secondary axis (Model and Detail Lines only).

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Pick Tools

	Pick Lines	Use this option to select existing linear elements in the project. This is useful when you start the project from an imported 2D drawing.
	Pick Face	Use this option to select the face of a 3D massing element (walls and 3D views only).
	Pick Walls	Use this option to select an existing wall in the project to be the basis for a new sketch line (floors, ceilings, etc.).

Draw Options

When you are in Drawing mode, several options display in the Options Bar, as shown in Figure 2–10.

Other options display according to the type of element you are drawing.

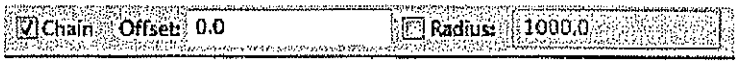

Figure 2–10

- The **Chain** option controls how many segments are drawn in one process. If it is not selected, the **Line** and **Arc** tools only draw one segment at a time. If it is selected, you can continue drawing segments until you select the command again.
- The *Offset* field enables you to enter values to draw the linear elements at a specified distance from the selected points. For example, set *Offset* to **3000** and select the end points of an existing wall to create a new wall 3000mm away.
- When using a radial draw tool, you can select the **Radius** option and add a radius in the edit field.
- To draw angled lines, move your cursor to the desired angle indicated by the temporary dimensions, and type the distance value. The angle increments shown vary depending on how far in or out the view is zoomed.

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2.2 Editing Elements

- Select elements to modify.
- Modify elements using the Ribbon, Properties, temporary dimensions, and controls.
- Filter selection sets.

Building design projects typically involve extensive changes to the positions of equipment, ducting, piping, and other elements. Autodesk® Revit® software was designed to make such changes easy. (Modify) works with all of the different element types.

- When you select an element during an active command, there are a number of ways to change it, as shown in Figure 2–11:
  - Modify commands and element-specific tools display in the contextual tab in the Ribbon.
  - The Properties palette displays the Type Selector and associated parameters.
  - *Temporary dimensions* enable you to change the element's dimensions.
  - *Controls* enable you to drag, flip, lock, and rotate the element.
- When you hover your cursor over an element, a tooltip displays information about it.

The Type Selector can also be found in the Modify tab in the Ribbon or in the Quick Access Toolbar.

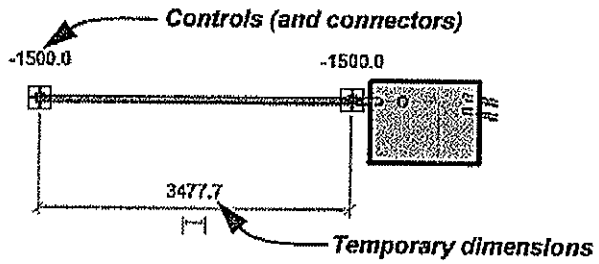

Figure 2–11

- Connectors are frequently linked to controls. Therefore, when the control is moved the connector is as well. Be careful not to disconnect systems when moving these controls.

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- To delete an element, select it and press <Delete>, right-click and select **Delete**, or click (Delete) in the Modify panel.
- When working with temporary dimensions, the default location of the dimension line might not be where you need it. For example, as shown on the left in Figure 2–12, instead of setting the distance of the selected wall from the center of the left wall, you might want to modify the distance from the grid line. Drag the control (also called the witness line) to the grid line, as shown on the right in Figure 2–12.

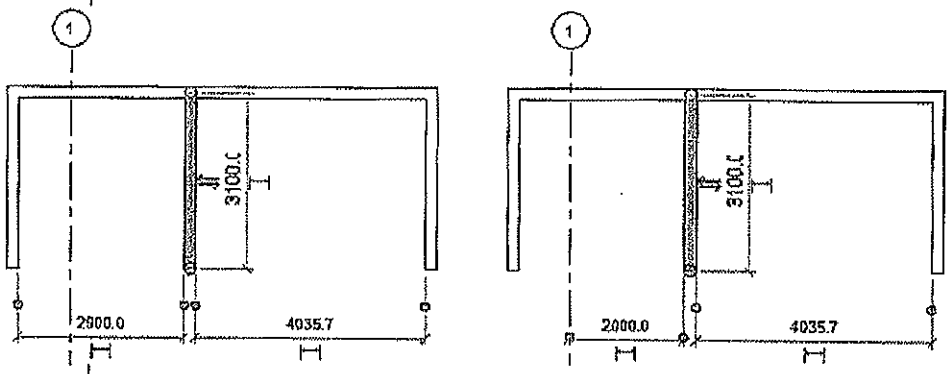

Figure 2–12

- You can click on the square control to move the witness line from one part of the selected wall to another or drag it to a new location.
- The new location of a temporary dimension is remembered as long as you are in the same session of the software.

Hint: Press & Drag

You can move elements by dragging them to a new location. To do this without selecting them first, verify that the **Press & Drag** option is selected in the Status Bar, as shown in Figure 2–13.



Figure 2–13

Selecting Elements

You can select elements in several ways:

- To select a single element, place your cursor on the edge of the element and click to select it.
- To add another element to a selection set, hold down <Ctrl> and select another item.

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- To remove an element from a selection set, hold down <Shift> and select the element.
- If you click and drag the cursor to *window* around elements, you have two selection options, as shown in Figure 2–14. If you drag from left to right, you only select the elements completely inside the window. If you drag from right to left, you select elements both inside and crossing the window.

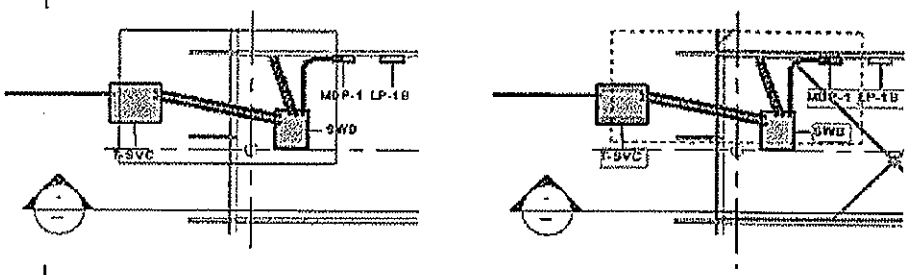

Figure 2–14

- If several elements are on or near each other, press <Tab> to cycle through them before you click. If there are elements that might be linked to each other, such as walls that are connected, pressing <Tab> selects the chain of elements.
- Press <Ctrl>+<Left Arrow> to reselect the previous selection set. You can also right-click in the drawing window with nothing selected and select **Select Previous**.
- To select all elements of a specific type, right-click on an element and select **Select All Instances>Visible in View** or **In Entire Project**, as shown in Figure 2–15.

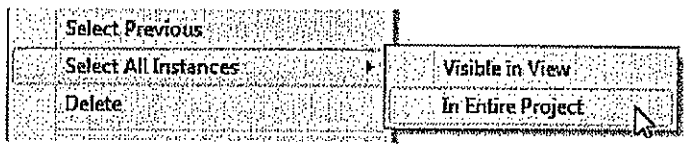

Figure 2–15

Hint: Nudge

Nudge is a feature that is often overlooked. It enables you to move an element in short increments using the arrow keys on the keyboard. The snap increments specified in the Snap dialog box determine the distance that is applied each time the arrow keys are pressed, depending how far in or out you are zoomed. This is very useful with annotation elements.

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Modifying Multiple Elements

When multiple element types are selected, the *Multi-Select* contextual tab opens on the Ribbon, as shown in Figure 2–16. This gives you access to all the Modify tools, as well as the **Filter** command and tools to create and use selection sets.

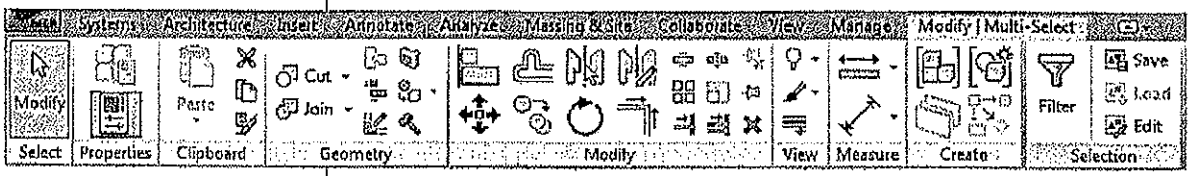

Figure 2–16

- The Properties palette displays tools that are common to all element types if they are available. You can also select just one type and make modifications, as shown in Figure 2–17.

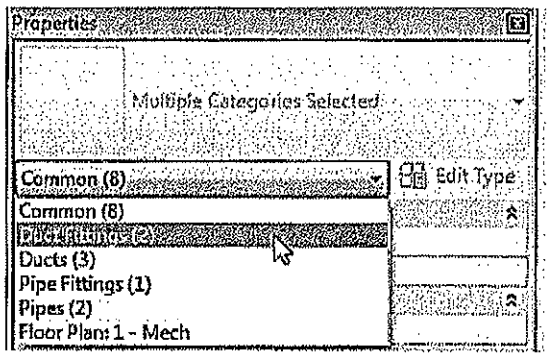

Figure 2–17

Filtering Selection Sets

The **Filter** command enables you to specify the types of elements to select. For example, you might only want to select lighting fixtures, as shown in Figure 2–18.

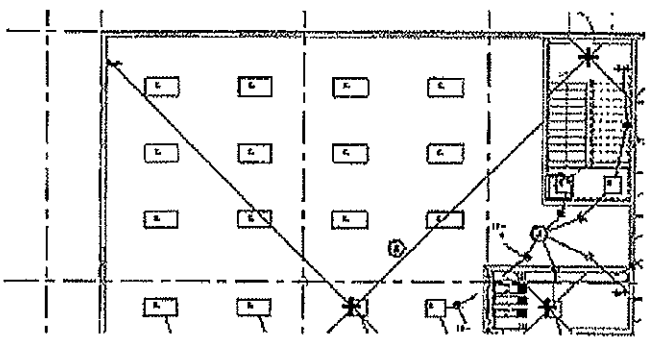

Figure 2–18

How to:

The Filter dialog box displays all types of elements in the original selection.

Filter a Selection Set

1. Select everything in the desired area.
2. Click (Filter) in the *Modify* | *Multi-Select* tab or in the Status Bar. The Filter dialog box opens, as shown in Figure 2–19.

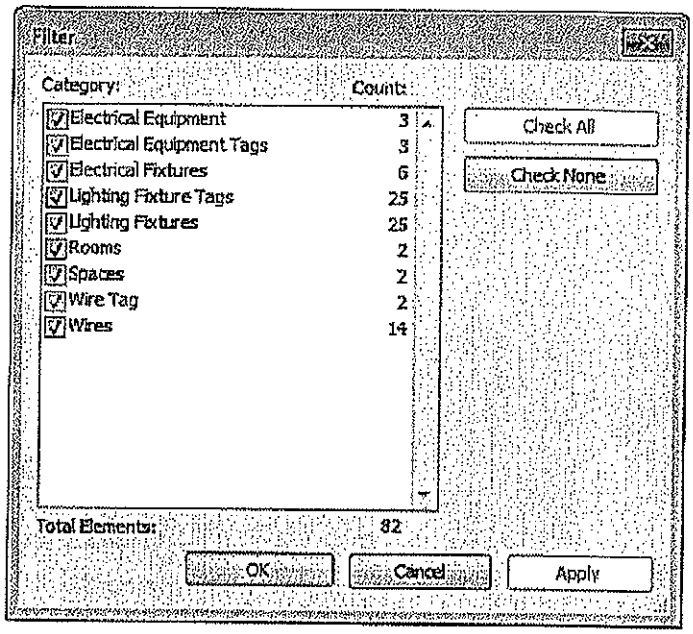

Figure 2–19

3. Click Check None to clear all options and then select the element types you want included in the selection.
4. Click OK. The selection set is now limited to the elements you specified.

- In the Status Bar, (Filter) displays how many elements you selected.

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New
In 2013

Selection sets are a type of filter.

Reusing Selection Sets

When multiple elements types are selected, you can save the selection set for reuse later. For example, you might want to select a system of ductwork and not have to select each element separately. You can create a selection set that you can access quickly, as shown in Figure 2–20. You can also edit selection sets to add or remove elements from the set.

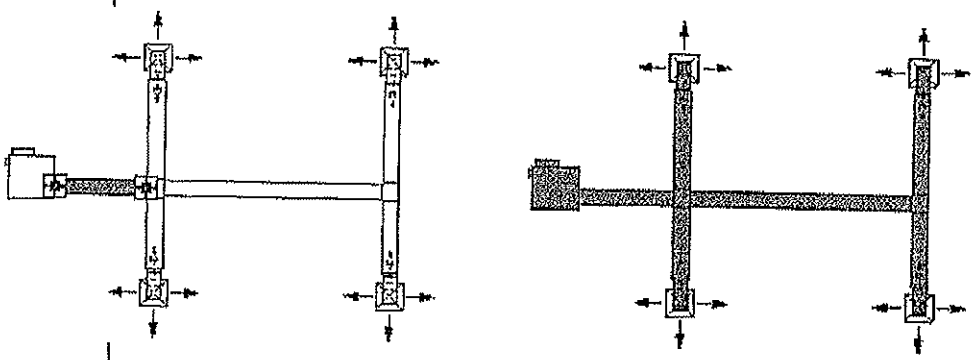

Figure 2–20

How to: **Save Selection Sets**

1. Select the elements you want to include in the selection set.
2. In the *Modify | Multi-Select* tab>Selection panel, click (Save).
3. In the Save Selection dialog box, type a name for the set as shown in Figure 2–21, and click OK.

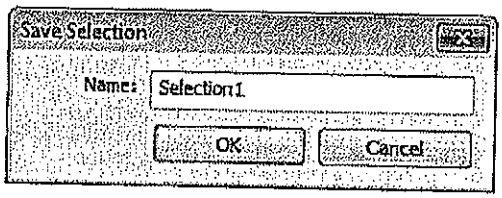

Figure 2–21

How to: **Retrieve Selection Sets**

1. Select the elements that you want to use along with the selection set. In the *Modify | Multi-Select* tab>Selection panel, click (Load).
   Or, without any other selection, in the *Manage* tab>Selection panel, click (Load).

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2. In the Retrieve Filters dialog box, as shown in Figure 2–22, select the set you want to use and click OK.

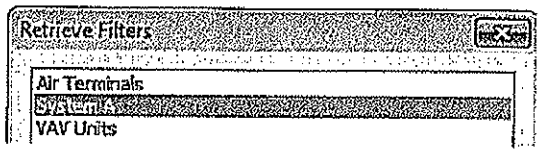

Figure 2–22

3. The elements are selected and you can continue to select other elements or use the selection.

How to:

Edit Selection Sets

1. If elements are selected, in the *Modify | Multi-Select* tab> Selection panel, click (Edit).
   Or, without any selection, in the *Manage* tab>Selection panel click (Edit).

2. In the Filters dialog box, as shown in Figure 2–23, select the set you want to edit and click Edit...

Some filters in this dialog box are not selection sets but apply to categories of elements, such as the various system categories shown in Figure 2–23.

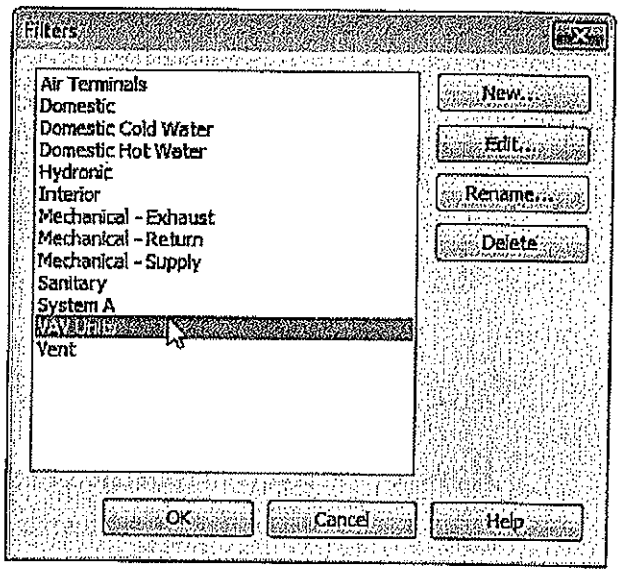

Figure 2–23

- If you want to modify the name of the filter, click Rename...

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3. The selection set elements stay black while the rest of the elements are grayed out. The *Edit Selection Set* tab also displays, as shown in Figure 2–24.

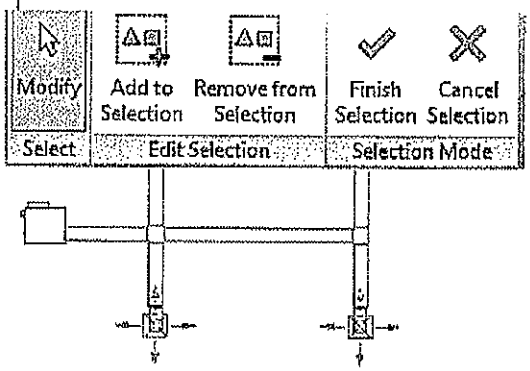

Figure 2–24

4. Use (Add to Selection) to select additional elements for the set and (Remove from Selection) to delete elements from the set.
5. When you are finished editing, click (Finish Selection).
6. In the Filters dialog box, click OK to finish.

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2.3 Basic Modifying Tools

- Move and copy elements.
- Rotate elements around the center or an origin.
- Mirror elements by picking an axis or drawing an axis.
- Create Linear and Radial Arrays of elements.

The Autodesk Revit software contains controls and temporary dimensions that enable you to edit elements. Additional modifying tools can be used with individual elements or any selection of elements. They are found in the *Modify* tab>Modify panel, as shown in Figure 2–25, and in contextual tabs.



Figure 2–25

- The **Move**, **Copy**, **Rotate**, **Mirror**, and **Array** commands are covered in this topic. Other tools are covered later.

You can either select the elements and start the command or start the command, select the elements, and press <Enter> to finish the selection set.

Moving and Copying Elements

The **Move** and **Copy** commands enable you to select the element(s) and move or copy them from one place to another. You can use alignment lines, temporary dimensions, and snaps to help place the elements, as shown in Figure 2–26.

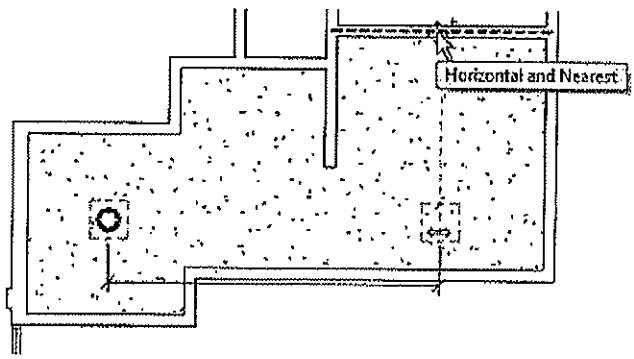

Figure 2–26

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How to:

If you start (Move) and hold down <Ctrl>, the elements are copied.

Move or Copy Elements

1. Select the elements you want to move or copy.
2. In the Modify panel, click (Move) or (Copy). A boundary box displays around the selected elements.
3. Select a move start point on or near the element.
4. Select a second point. Use alignment lines and temporary dimensions to help place the elements.
5. The elements remain highlighted, enabling you to start another command, or press <Esc> to finish.

Move/Copy Elements

The **Move** and **Copy** commands have several options that display in the Options Bar, as shown in .



Figure 2–27

Constrain	Restricts the movement of the cursor to horizontal or vertical, or along the axis of an item that is at an angle. This keeps you from selecting a point at an angle by mistake. **Constrain** is off by default.
Disjoin (Move only)	Breaks any connections between the elements being moved and other elements. If **Disjoin** is on, the elements move separately. If it is off, the connected elements also move or stretch. **Disjoin** is off by default.
Multiple (Copy only)	Enables you to make multiple copies of one selection. **Multiple** is off by default.

- These commands only work within the current view, not between views or projects. To copy between views or projects, use (Copy to Clipboard) and (Paste).

Hint: Pinning Elements

If you do not want elements to be moved, you can (Pin) them in place, as shown in Figure 2–28. They can be copied.

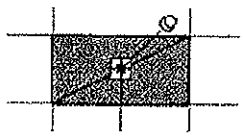

Figure 2–28

Select the element and click (Unpin) to free it.

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Rotating Elements

The **Rotate** command enables you to rotate selected elements around a center point or origin. You can use alignment lines, temporary dimensions, and snaps to help specify the center of rotation and angle. You can also create copies of the element as it is being rotated.

How to:

Rotate Elements

1. Select the element(s) you want to rotate.
2. In the Modify panel, click (Rotate) or type **RO**.
3. The center of rotation is automatically set to the center of the element or group of elements, as shown on the left in Figure 2–29. To change the center of rotation, as shown on the right in Figure 2–29, use one of the following:
   - Drag (Center of Rotation) to a new point.
   - In the Options Bar, next to *Center of rotation*, click Place and use snaps to move it to a new location.
   - Press the <Spacebar> to select the center of rotation and click to move it to a new location.

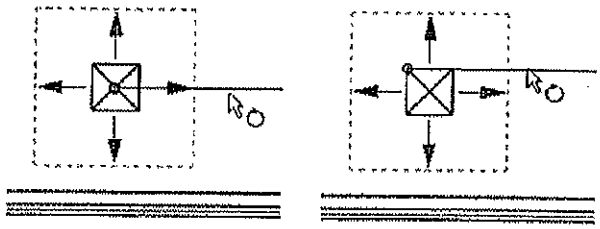

Figure 2–29

   - To start the **Rotate** command with an automatic prompt to select the center of rotation, type **R3**.
4. In the Options Bar, specify if you want to make a Copy (select **Copy** option), type an angle in the *Angle* field, as shown in Figure 2–30, and press <Enter>. You can also specify the angle on screen.

*To specify the angle on screen, select a point for the **rotate start ray**—the reference line for the rotation angle. Then select a second point, using the temporary dimension to help you set the angle.*

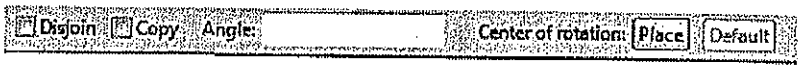

Figure 2–30

5. The rotated element(s) remain highlighted, enabling you to start another command, or press <Esc> to finish.

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- The **Disjoin** option breaks any connections between the elements being rotated and other elements. If **Disjoin** is on (selected), the elements rotate separately. If it is off (cleared), the connected elements also move or stretch. **Disjoin** is off by default.

Mirroring Elements

The **Mirror** command enables you to mirror elements about an axis defined by a selected element or by selected points as shown in Figure 2–31.

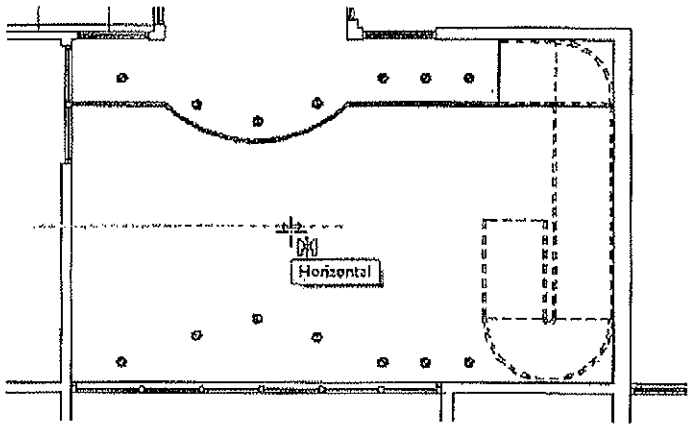

Figure 2–31

How to:

Mirror Elements

1. Select the element(s) to mirror.
2. In the Modify panel, select the method you want to use:
   - Click (Mirror - Pick Axis) or type **MM**. This prompts you to select an element as the **Axis of Reflection** (mirror line).
   - Click (Mirror - Draw Axis) or type **DM**. This prompts you to select two points to define the axis about which the elements mirror.
3. The new mirrored element(s) remain highlighted, enabling you to start another command, or press <Esc> to finish.

- To mirror the elements without keeping the original, clear the **Copy** option in the Options Bar before mirroring.

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Hint: Scale

The Autodesk Revit software is designed with full-size elements. Therefore, not much can be scaled. However, you can use (Scale) in reference planes, images, lines, walls, and imported files from other software. Scaled walls are made longer or shorter, but retain the original width and height.

Creating Linear and Radial Arrays

The Array command creates multiple copies of selected elements in a linear or radial pattern, as shown in Figure 2–32. For example, you can array a row of columns to create a row of evenly spaced columns on a grid, or array a row of air terminals. The arrayed elements can be grouped or placed as separate elements.

- A linear array creates a straight line pattern of elements, while a radial array creates a circular pattern around a center point.

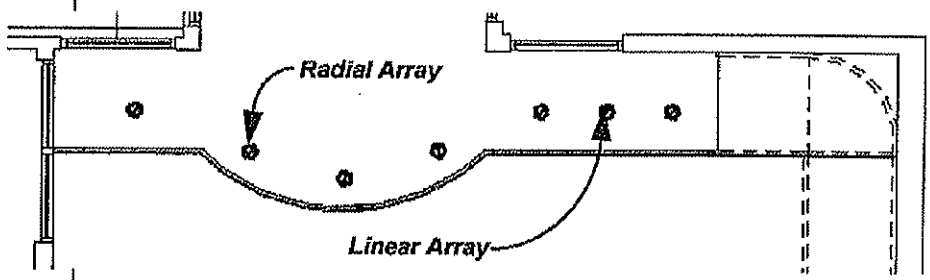

Figure 2–32

How to: **Create a Linear Array**

1. Select the element(s) to array.
2. In the Modify panel, click (Array).
3. In the Options Bar, click (Linear).
4. Specify the other options as needed.
5. Select a start point and an end point to set the spacing and direction of the array. The array is displayed.

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Type a new number or click on the screen to finish the command.

- If you have the **Group and Associate** option toggled on, you are prompted again for the number of items, as shown in Figure 2–33.

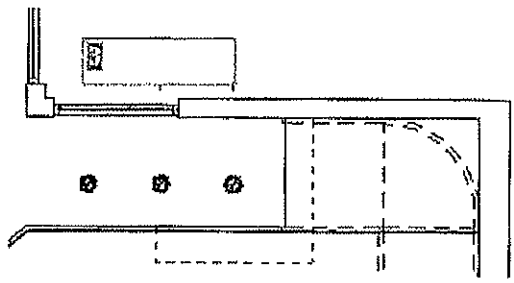

Figure 2–33

- To make a linear array in two directions, you need to array one direction first, select the arrayed elements, and then array them again in the other direction.

Array Options

In the Options Bar, set up the Array options for **Linear Array** (top) or **Radial Array (bottom)**, as shown in Figure 2–34.

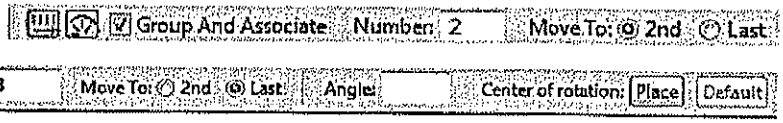

Figure 2–34

Group and Associate	Creates a group element out of all arrayed elements. Groups can be selected by selecting any elements in the group.
Number	Specifies how many instances you want in the array.
Move To:	**2nd** specifies the distance or angle between the center points of the two elements. **Last** specifies the overall distance or angle of the entire array.
Constrain	Restricts the direction of the array to only vertical or horizontal (Linear only).
Angle	Specifies the angle (Radial only).
Center of rotation	Specifies a location for the origin about which the elements rotate (Radial only).

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How to:

Create a Radial Array

1. Select the element(s) to array.
2. In the Modify panel, click (Array).
3. In the Options Bar, click (Radial).
4. Drag the (Center of Rotation) control or use Place to the move the center of rotation to the appropriate location, as shown in Figure 2–35.

*Remember to set the **Center of Rotation** control first, because it is easy to forget to move it before specifying the angle.*

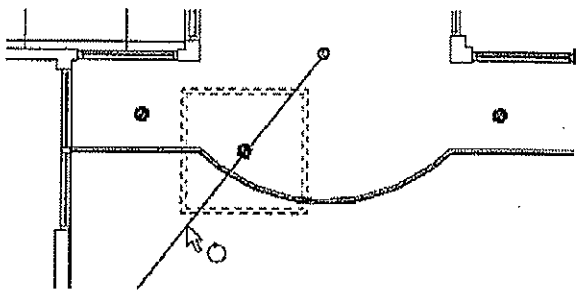

Figure 2–35

5. In the Options Bar, type an angle and press <Enter>, or specify the rotation angle by selecting points on the screen.

Modifying Arrays

When you select an element in an array that is created as a group, the associated shape controls and dimensions display, as shown in Figure 2–36. You can modify the number of instances and for radial arrays you can modify the distance to the center.

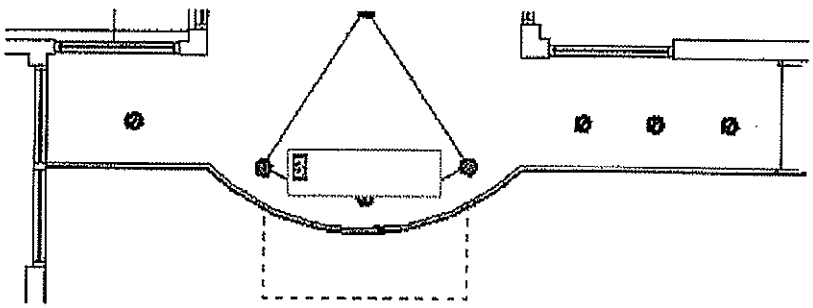

Figure 2–36

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- To remove just the array constraint on the group, select one of the elements in the group and in the *Modify* contextual tab>Group panel, click (Ungroup). This only ungroups the array but not the groups created when the array was created. To ungroup all of the elements, select the elements and use (Filter) to select just groups. Then click (Ungroup).

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2.4 Helpful Editing Tools

Align, split, trim, and offset walls and other elements by using the modify tools.

As you work on a project, some additional tools on the *Modify* tab>Modify panel, as shown in Figure 2–37, can help you with placing, modifying, and constraining elements. **Align**, **Split**, **Trim**, and **Offset** can be used with a variety of elements.

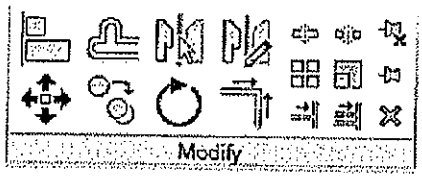

Figure 2–37

Aligning Elements

The **Align** command enables you to line up one element with another. Most Autodesk Revit elements can be aligned. For example, you can line up an air terminal with ceiling grids as shown in Figure 2–38.

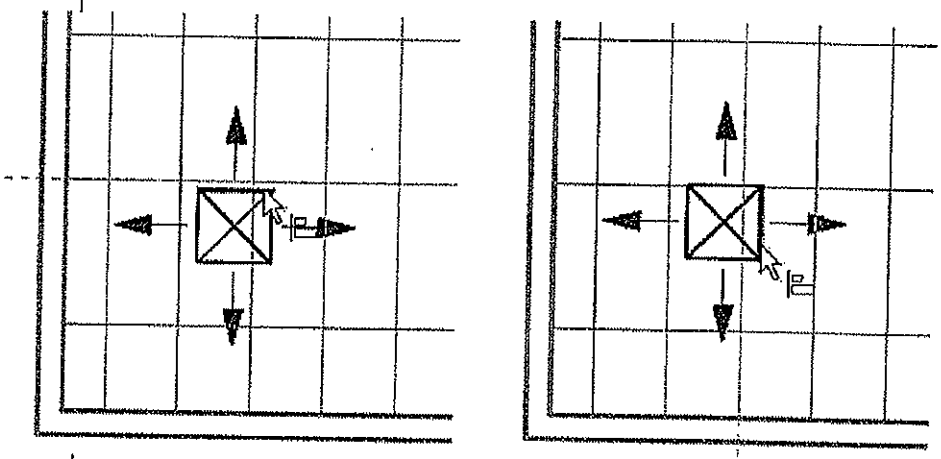

Figure 2–38

How to: **Align Elements**

1. In the *Modify* tab>Modify panel, click (Align) or type the shortcut **AL**.
2. Select a line or point on the element that is going to remain stationary.

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3. Select a line or point on the element to be aligned. The second element moves into alignment with the first one.

- The **Align** command works in both plan and elevation views.
- The **Align** command also works in 3D views. Make sure you select the correct component of the elements to align. Zoom in if needed.
- You can lock alignments so that the elements move together if either one is moved. Once you have created the alignment, a padlock is displayed. Click on the padlock to lock it, as shown in Figure 2–39.

Locking elements enlarges the size of the project file, so use this option carefully.

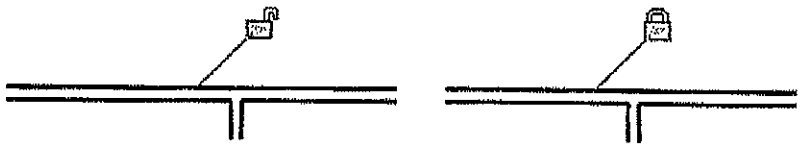

Figure 2–39

- Select the **Multiple Alignment** option to select multiple elements to align with the first element, as shown in Figure 2–40. You can also hold down <Ctrl> to make multiple alignments.
- For walls, you can specify if you want the command to prefer **Wall centerlines**, **Wall faces**, **Center of core**, or **Faces of core**, as shown in Figure 2–40. The core refers to the structural members of a wall as opposed to facing materials, such as sheetrock.

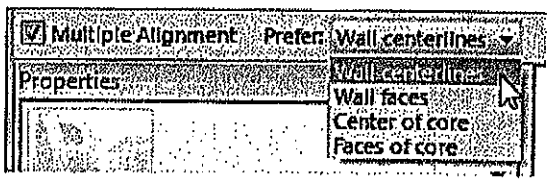

Figure 2–40

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Splitting Linear Elements

The **Split** command enables you to break elements, such as ducting, piping, cable tray and conduit, as well as walls and lines, at a specific point. You can use alignment lines, snaps, and temporary dimensions to help place the split point. After you have split the element, you can use other editing commands to modify it. Splitting duct and pipe provides Autodesk Revit's sizing tools with greater flexibility to reduce size where needed as shown in Figure 2–41.

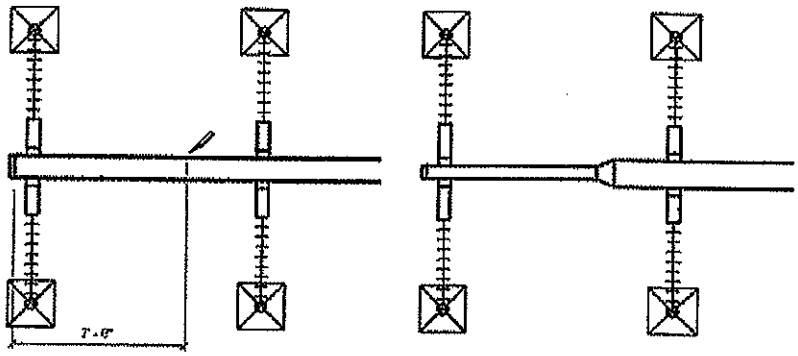

Figure 2–41

- There are two commands: (Split Element) and (Split with Gap).

How to:

Split Linear Elements

1. In the *Modify* tab>Modify panel, click (Split Element) or type the shortcut **SL**.
2. In the Options Bar, select or clear the **Delete Inner Segment** option, as needed.
3. Move the cursor to the point you want to split and select the point.
4. Repeat for any additional split locations.
5. Modify the items that were split, as needed.

*The **Delete Inner Segment** option is used when you select two split points and want the segment between the two split points is automatically removed.*

- (Split with Gap) splits the element at the point you select, as shown in Figure 2–42, but also creates a *Joint Gap* specified in the Options Bar.

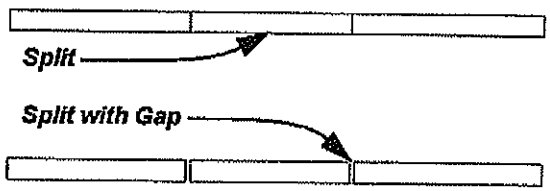

Figure 2–42

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Trimming and Extending

The **Trim** command enables you to either trim or extend walls, lines, beams, and braces. There are three trim methods: **Trim/Extend to Corner**, **Trim/Extend Single Element**, and **Trim/Extend Multiple Elements**.

- When selecting elements to trim, click the part of the element that you want to keep. The opposite part of the line is then trimmed.

How to: Trim/Extend to Corner

1. In the *Modify* tab>Modify panel, click (Trim/Extend to Corner) or type the shortcut **TR**.
2. Select the first wall or line on the side you want to keep.
3. Select the second wall or line on the side you want to keep, as shown in Figure 2–43.

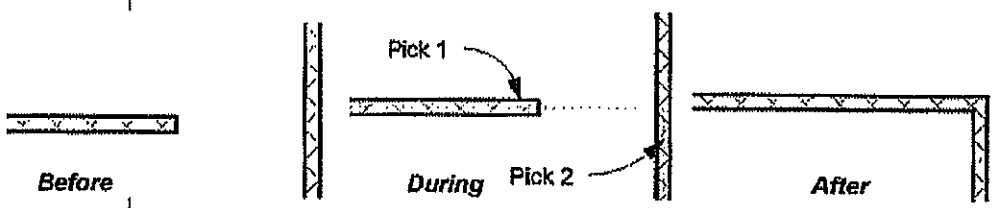

Figure 2–43

How to: Trim/Extend a Single Element

1. In the *Modify* tab>Modify panel, click (Trim/Extend Single Element).
2. Select the cutting or boundary edge.
3. Select the wall or line to be trimmed or extended, as shown in Figure 2–44.

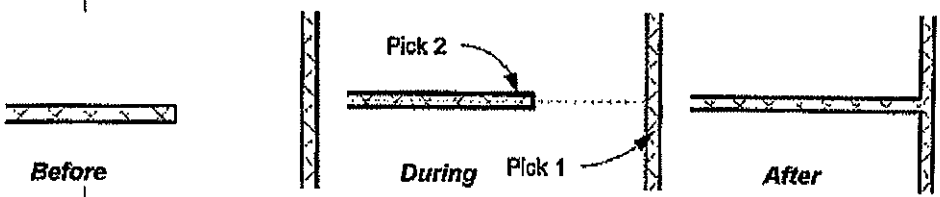

Figure 2–44

How to: Trim/Extend Multiple Elements

1. In the *Modify* tab>Modify panel, click (Trim/Extend Multiple Elements).
2. Select the cutting or boundary edge.

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3. Select the walls or lines that you want to trim or extend. For trimming, select the side you want to keep, as shown in Figure 2–45.

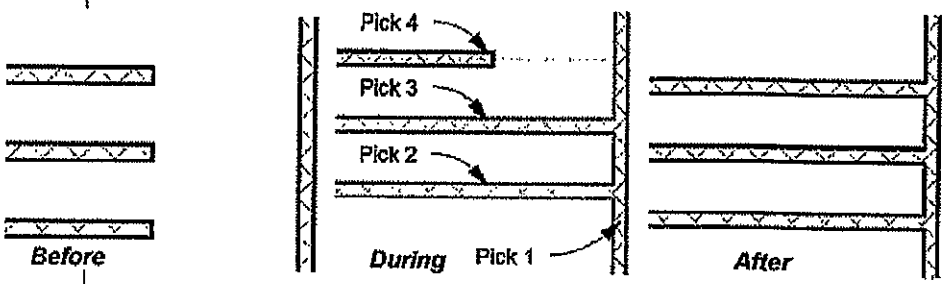

Figure 2–45

- You can click in a blank space to clear the selection and select another cutting edge or boundary.

Offsetting Elements

The **Offset** command is an easy way of creating parallel copies of linear elements at a specified distance, as shown in Figure 2–46. Ducts, Pipes, Cable Tray, and Conduit can all be offset.

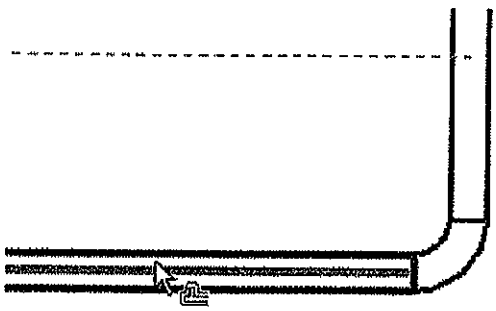

Figure 2–46

The offset distance can be set by typing the distance (**Numerical** method shown in Figure 2–47) or by selecting points on the screen (**Graphical** method).



Figure 2–47

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How to:

*The **Copy** option (on by default) makes a copy of the element being offset. If this option is off, the **Offset** command moves the element.*

Offset using the Numerical Method

1. In the *Modify* tab>Modify panel, click (Offset) or type the shortcut **OF**.
2. In the Options Bar, select the **Numerical** option.
3. In the Options Bar, type the required distance in the *Offset* field.
4. Move the cursor over the element you want to offset. A dashed line previews the offset location. Move the cursor to flip the sides, as needed.
5. Click to create the offset.
6. Repeat steps 4 and 5 to offset other elements by the same distance, or to change the distance for another offset.
7. Press <Esc> or start another command to finish.

- With the **Numerical** option, you can select multiple connected elements for offsetting. Hover your cursor over one and press <Tab> until the required elements are highlighted, as shown in Figure 2–48. Select the elements to offset them. This enables you to offset all of them at once.

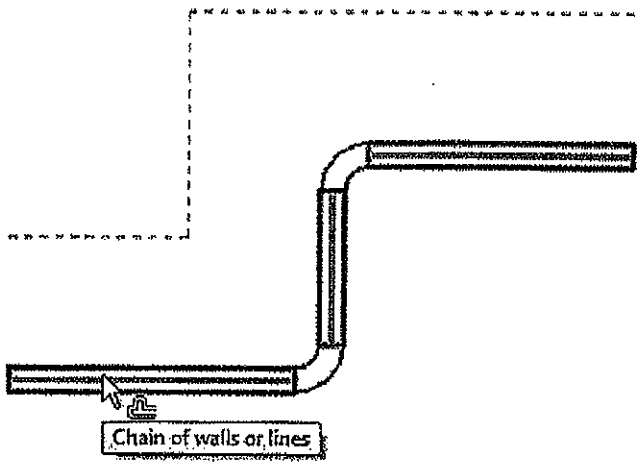

Figure 2–48

How to:

Offset using the Graphical Method

1. Start the **Offset** command.
2. In the Options Bar, select the **Graphical** option.
3. Select the element to offset.
4. Select two points that define the distance of the offset and which side to apply it. You can type an override for the temporary dimension for the second point.

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- When working with MEP elements (such as ducts) the offset element might not automatically connect to other nearby elements, as shown on the left in Figure 2–49. Drag the end of the new element away from the other element and then back again. It should connect as shown on the right in Figure 2–49.

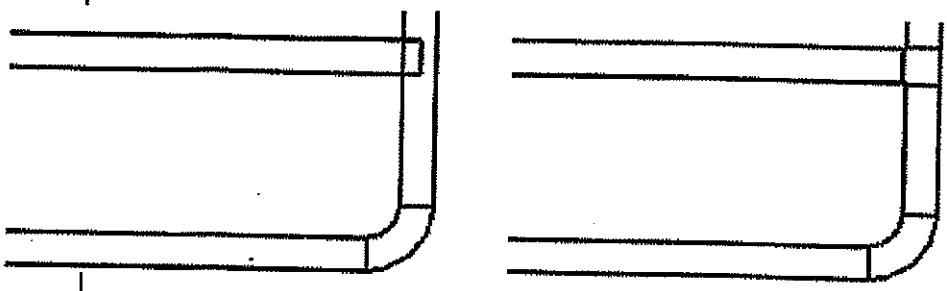

Figure 2–49

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Hiding Elements in Views

As you are working, you can hide individual elements or entire categories of elements to clarify the display. They remain hidden until you display them again.

- Select the element(s) you want to hide, right-click, and select **Hide in view>Elements** or **Category.**
- The **Elements** option hides only the elements you selected, while the **Category** option hides all elements in that category. For example, you can select one grid line and use **Hide in view>Category** to hide all of the grid lines.
- To see the elements or category again, in the View Control Bar, click (Reveal Hidden Elements). The border and any hidden elements are displayed in magenta, while visible elements in the view are grayed out, as shown in Figure 2–50. Select the hidden elements you want to restore, right-click, and select **Unhide in View>Elements** or **Category**, or in the Reveal Hidden Elements contextual panel, click (Unhide Element) or (Unhide Category).

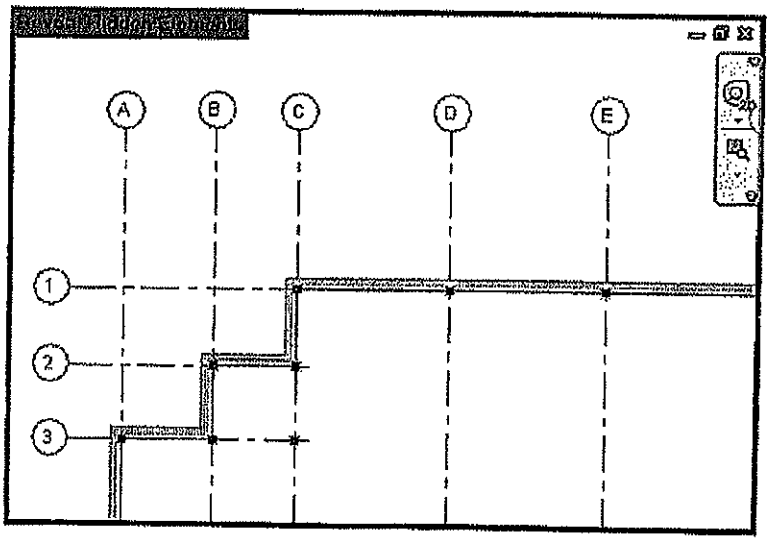

Figure 2–50

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Practice 2a

Estimated time for completion: 10 minutes

Helpful Editing Tools

Use various drawing aids to modify the location of elements.

Copy, move, rotate, and align air terminals to match ceiling grids.

In this practice you will use temporary dimensions, controls, and snaps to modify the location of elements. You will than copy and move elements as well as rotate and align elements. The final version of the project is shown in Figure 2–51.

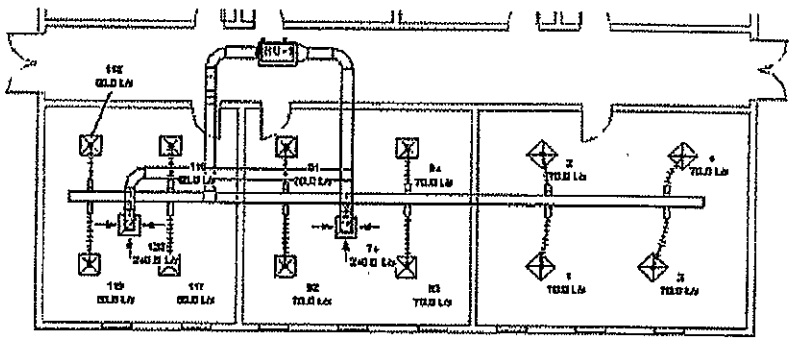

Figure 2–51

Task 1 - Use temporary dimensions and controls to modify elements.

1. Open the project file **Simple-Building-M.rvt**, found in the *Chapter 2* folder of your class folder.
2. Select the **AHU-1** unit in the hall of the building.
3. Zoom in to the connectors/controls. Select the temporary dimension above the unit and change the *distance* to **400mm**, as shown in Figure 2–52.

The temporary dimensions work with the walls in this project because they are part of the project, not linked in.

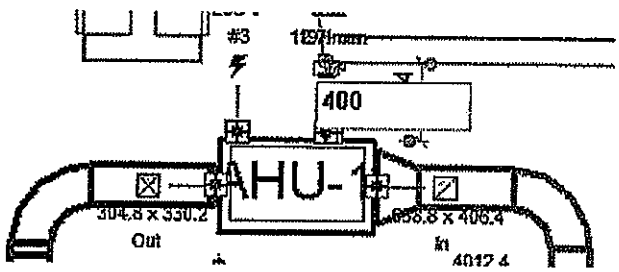

Figure 2–52

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4. The unit moves and the ducts move with it because the connectors control the location of the duct fittings and ducts.
5. Pan over to the lower left room in the building. Select the tag that overlaps the ductwork as shown on the left in Figure 2–53.
6. In the Options Bar, select **Leader**.
7. Use the **Move** control to move the tag outside the room to a position in which it is not overlapping anything as shown on the right in Figure 2–53.

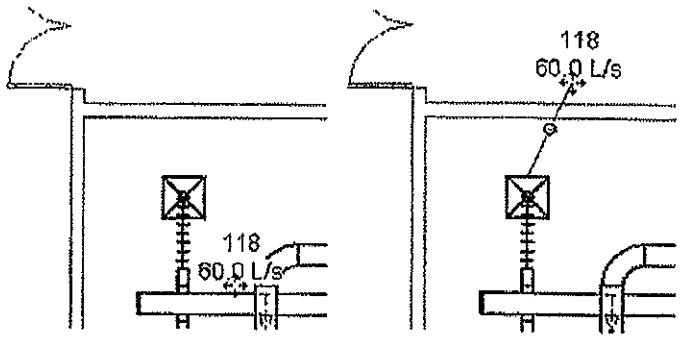

Figure 2–53

8. Zoom out to display the entire building. (Hint: Double-click the mouse wheel.)
9. Select the blue horizontal duct and use the Drag control to lengthen the duct so that it reaches into the room on the far right.
10. Click in empty space to clear the duct selection.
11. The endcap of the duct did not move, as shown in Figure 2–54. Select and drag it to the endpoint of the duct.

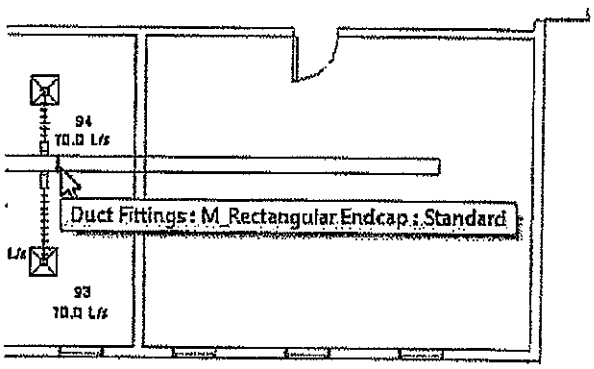

Figure 2–54

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12. Undo the change in duct length.

13. Select the duct endcap.

Because there is only one type of element selected, the specific type of element is displayed in the contextual tab.

14. In the *Modify | Duct Fittings* tab>Modify panel, click (Move).

15. For the base point, select the duct endpoint.

16. Move it into the other room again. This time the endcap moves and the duct, which has a connector to the endcap, resizes as well.

Task 2 - Copy elements.

1. Select the **Air Terminals** and associated ductwork as shown in Figure 2–55.

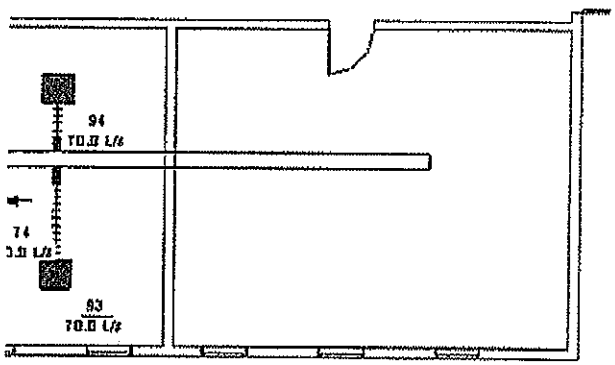

Figure 2–55

Because there is more than one type of element selected the contextual tab displays as Multi-Select.

2. In the *Modify | Multi-Select* tab>Modify panel, click (Copy).

3. In the Options Bar, select the **Multiple** option.

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4. For the base point, select the endpoint of one of the vertical ducts as shown in Figure 2–56.

5. Copy the elements into the last room, as shown in Figure 2–56.

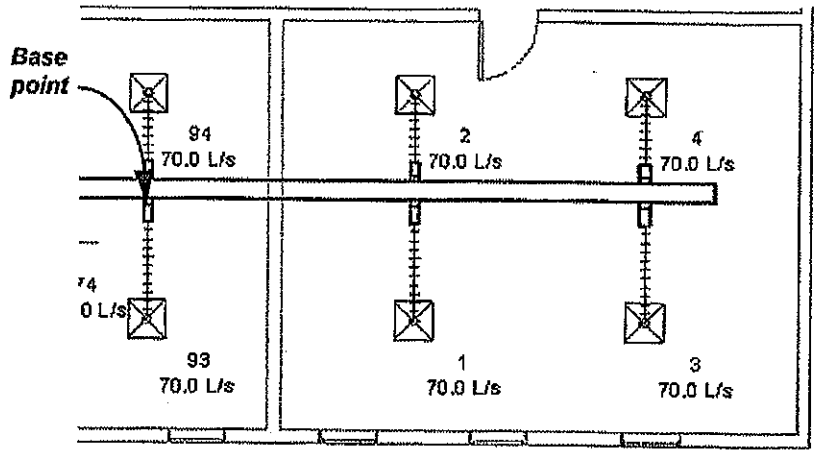

Figure 2–56

6. Press <Esc> twice to end the command.

Task 3 - Align and rotate elements.

1. In the Project Browser, open the view **Mechanical>HVAC> Ceiling Plans: 1- Ceiling Mech.**

2. The air terminal locations do not match the ceiling grids as shown in Figure 2–57.

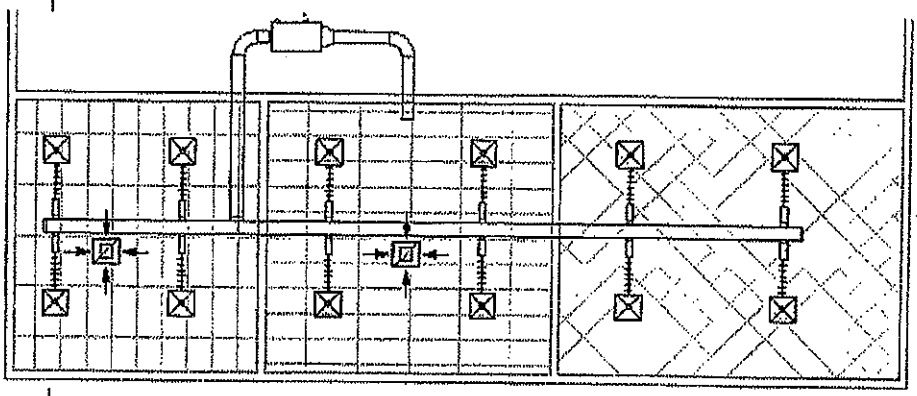

Figure 2–57

3. Zoom in on the room to the left.

4. In the *Modify* tab>Modify panel, click (Align).

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5. Select a vertical grid line and then the edge of the air terminal as shown in Figure 2–58. The air terminal now lines up with the vertical pattern of the ceiling grid.

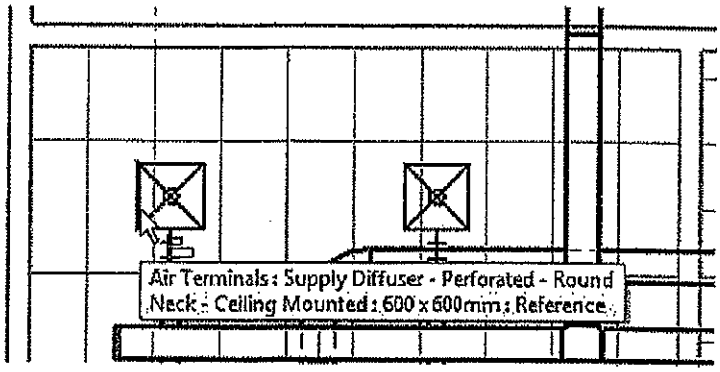

Figure 2–58

6. Repeat the process with the air terminal and the horizontal grid location. Select the edge of the grid line first and then the air terminal.

7. Repeat the process in both rooms so that the air terminals line up with the grids shown in Figure 2–59.

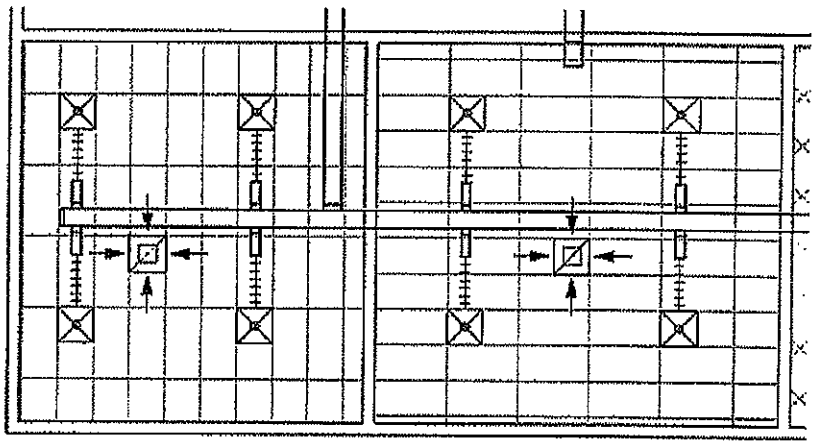

Figure 2–59

8. In the last room the ceiling grid is rotated. In this case you need to rotate the air terminals as well.

9. Select one of the air terminals in the room with the rotated ceiling grid.

10. In the *Modify | Air Terminals* tab>Modify panel, click (Rotate).

11. In the Options Bar, set the *angle* to **45**.

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12. Use the **Align** command to move the air terminal to match the ceiling grid location. First you will select the ceiling grid line and then the edge of the air terminal.

13. The flex duct moves with the air terminal as shown Figure 2–60.

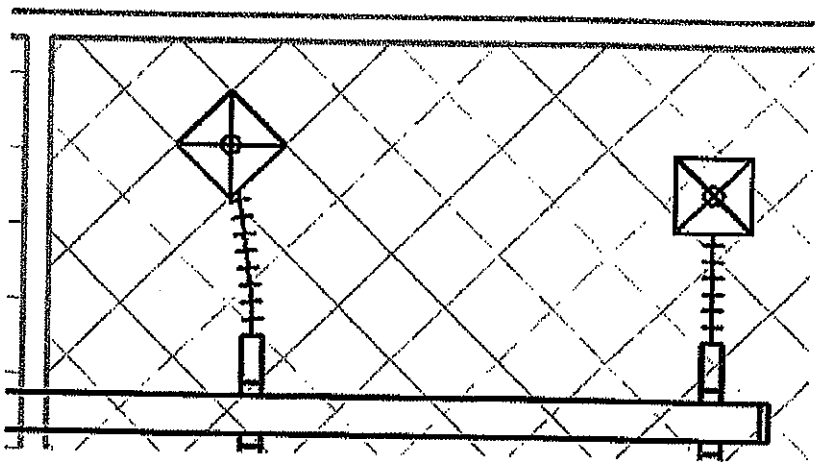

Figure 2–60

14. Without rotating the air terminal, click (Align).

15. Select a grid line close to one of the other air terminals and then select the edge of the air terminal. The air terminal moves to touch the grid line and also rotates to match the angle of the grid line.

16. Finish aligning all of the air terminals in this room. The exact location is up to you.

17. Zoom out to display the entire building.

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18. Switch to the **Mechanical>HVAC>Floor Plans: 1 - Mech** view. The rotated terminals and flex duct display correctly in this view as well, as shown in Figure 2–61.

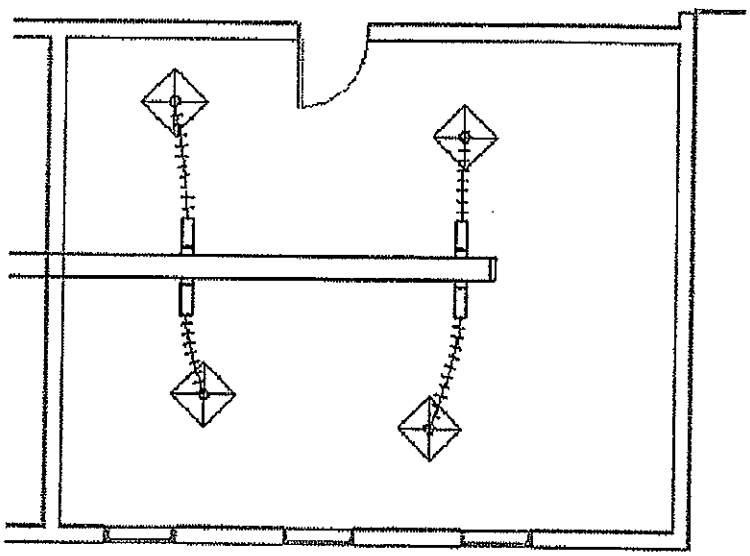

Figure 2–61

19. Zoom out to display the entire building.

20. Save and close the model.

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Chapter Review Questions

1. Which of the following explain alignment lines? Select all that apply.
   a. They help keep the lines horizontal, vertical, or at a specified angle.
   b. They snap to points along a line.
   c. They line up with the implied intersections of walls or other elements.
   d. They are part of temporary dimensions that touch the dimensioned elements.
2. Which editing command would you use to break part of a duct so you can change the duct type?
   a. **Align**
   b. **Split**
   c. **Trim**
   d. **Offset**
3. All of the **Trim** commands can also be used to extend elements.
   a. True
   b. False
4. Which of the following commands enable you to select only Light Fixtures in a view?
   a. Filter
   b. Group
   c. Quick Select
   d. Design Options
5. In the **Mirror** command, how do you remove the original element(s) if you do not want to keep them?
   a. You must delete them separately from the command.
   b. Use the **Demolish** tool.
   c. Clear the **Copy** option in the Options Bar.
   d. Select the **Delete Original** option in the Options Bar.

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Command Summary

Button	Command	Location
	**Add to Selection**	■ **Ribbon:** *Edit Selection Set* tab>Edit Selection panel
	**Align**	■ **Ribbon:** *Modify* tab>Modify Panel ■ **Shortcut:** AL
	**Array**	■ **Ribbon:** *Modify* tab>Modify Panel ■ **Shortcut:** AR
	**Copy**	■ **Ribbon:** *Modify* tab>Modify Panel ■ **Shortcut:** CO
	**Copy to Clipboard**	■ **Ribbon:** *Modify* tab>Clipboard panel> Copy to Clipboard ■ **Shortcut:** <Ctrl>+<C>
	**Delete**	■ **Ribbon:** *Modify* tab>Modify panel> Delete ■ **Shortcut:** DE
	**Edit (Selection)**	■ **Ribbon:** *Modify* | *Multi-Select* tab> Selection panel or *Manage* tab> Selection panel
	**Edit Type/ Type Properties**	■ **Ribbon:** Modify tab>Properties panel> Type Properties ■ **Properties palette:** Edit Type
	**Filter**	■ **Ribbon:** *Modify* | *Multi-Select* tab>Filter panel>Filter ■ **Status Bar**
	**Load (Selection)**	■ **Ribbon:** *Modify* | *Multi-Select* tab> Selection panel or *Manage* tab> Selection panel
	**Mirror - Draw Axis**	■ **Ribbon:** *Modify* tab>Modify Panel ■ **Shortcut:** DM
	**Mirror - Pick Axis**	■ **Ribbon:** *Modify* tab>Modify Panel ■ **Shortcut:** MM
	**Move**	■ **Ribbon:** *Modify* tab>Modify Panel ■ **Shortcut:** MV
	**Offset**	■ **Ribbon:** *Modify* tab>Modify Panel ■ **Shortcut:** OF
	**Pin**	■ **Ribbon:** *Modify* tab>Modify panel>Pin ■ **Shortcut:** PN

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	**Properties**	■ **Ribbon:** *Modify* tab>Element panel> Properties ■ **Shortcut:** PP
	**Ref Plane**	■ **Ribbon:** *Systems* tab>Work Plane Panel ■ **Shortcut:** RP
	**Remove from Selection**	■ **Ribbon:** *Edit Selection Set* tab>Edit Selection panel
	**Rotate**	■ **Ribbon:** *Modify* tab>Modify Panel ■ **Shortcut:** RO
	**Save (Selection)**	■ **Ribbon:** *Modify* | *Multi-Select* tab> Selection panel or *Manage* tab> Selection panel
	**Scale**	■ **Ribbon:** *Modify* tab>Modify Panel ■ **Shortcut:** RE
	**Split Element**	■ **Ribbon:** *Modify* tab>Modify Panel ■ **Shortcut:** SL
	**Split with Gap**	■ **Ribbon:** *Modify* tab>Modify Panel
	**Trim/Extend Multiple Elements**	■ **Ribbon:** *Modify* tab>Modify Panel
	**Trim/Extend Single Element**	■ **Ribbon:** *Modify* tab>Modify Panel
	**Trim/Extend to Corner**	■ **Ribbon:** *Modify* tab>Modify Panel ■ **Shortcut:** TR
	Type Selector	■ **Properties palette** ■ **Ribbon:** *Modify* tab (Optional) ■ **Quick Access Toolbar** (Optional)

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Chapter 3

Starting Autodesk Revit MEP Projects

In this chapter you learn how to link and manage a model created in Autodesk® Revit® Architecture software into an Autodesk® Revit® MEP project, use the Copy/Monitor tools, and run a Coordination Review. You also learn how to add, copy, and monitor levels.

This chapter contains the following topics:

- ✓**Linking in Architectural Projects**
- ✓**Copying and Monitoring Elements**
- ✓**Setting Up Levels**

Learning Objectives

This chapter provides instruction to enable you to do the following:

3.1 Linking in Architectural Projects

- Import and link CAD files into an Autodesk Revit project so that you can build on the information provided.
- Modify imported CAD files by deleting layers.
- Change the Visiblity Graphics of an imported or linked file to make it distinct from the structural elements created in the project.

3.2 Copying and Monitoring Elements

- Copy and monitor elements from a linked architectural model individually and using **Batch Copy**.
- Apply Coordination Settings for Copy/Monitor.
- Run a Coordination Review.

3.3 Setting Up Levels

- Add and modify levels.
- Create Plan views.

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3.1 Linking in Architectural Projects

- Import and link CAD files into an Autodesk Revit project so that you can build on the information provided.
- Modify imported CAD files by deleting layers.
- Change the Visibility Graphics of an imported or linked file to make it distinct from the structural elements created in the project.

When you are working with an architectural firm that uses the Autodesk Revit Architecture software, you can link the architectural model directly into your Autodesk Revit MEP project. A linked model automatically updates if the original file is changed. When the model is linked to the systems project, the architectural elements display in halftone, as shown in Figure 3–1.

The more links that are in a project, the longer it can take to open.

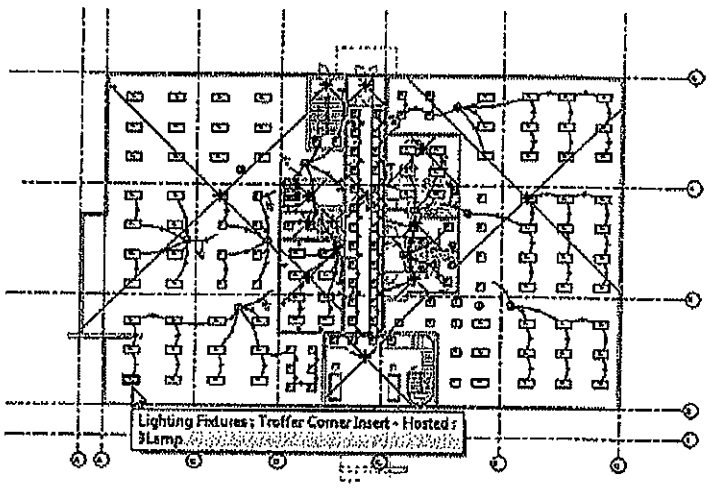

Figure 3–1

- Autodesk® Revit® Structure, Autodesk Revit MEP, and Autodesk Revit Architecture files can be linked to each other as long as they are from the same release cycle.
- You only link a model once but you can place as many copies as needed into the host project. The linked models can be individually moved, rotated, arrayed, and mirrored.

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- Linked models can be constrained to elements in the host project and to each other. You can select references in linked models as a work plane and can schedule elements from the linked model in the host project.
- When you use linked models, clashes between disciplines can be detected and information can be passed between disciplines.
- Elements can be copied and monitored for even better coordination. For example, if the architect has established levels, the engineer can copy the levels into their model. As elements are copied, they are also monitored for changes. If a level is modified, the software provides a report. You then have the option of permitting the software to adjust the host project to coordinate with the change in the architectural model.

How to: **Add a Linked Model to a Host Project**

1. In the *Insert* tab>Link panel, click (Link Revit).
2. In the Import/Link RVT dialog box, select the file that you want to link. Before opening the file, set the *Positioning*, as shown in Figure 3–2.

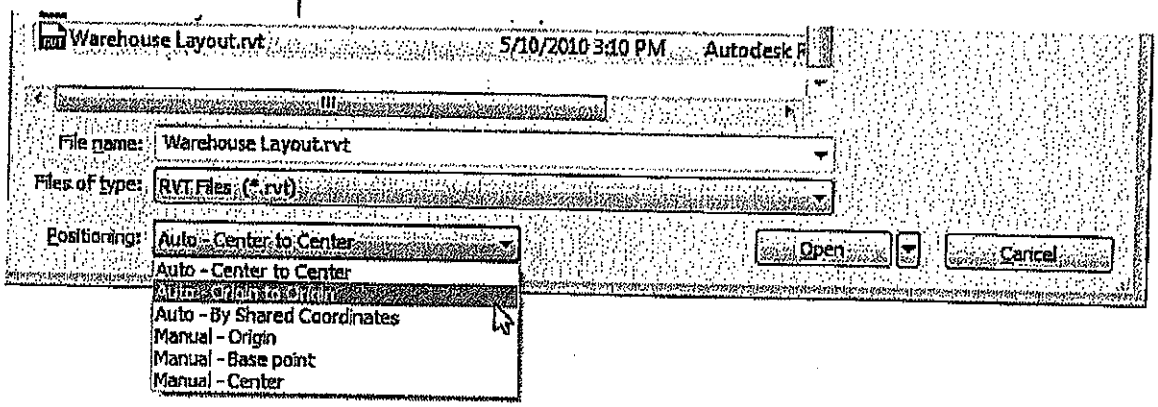

Figure 3–2

3. Click Open.
4. Depending on how you decide to position the file, it is automatically placed in the project or you can manually place it with your cursor.

- Typically, you want to position the link **Auto - Origin to Origin**. If the size of the linked model footprint changes, other options could cause the link to shift location.

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- When you have placed a linked model in a project, you can use the Project Browser, as shown in Figure 3–3, to drag and drop additional copies of the link into the project.



Figure 3–3

- You can also copy (or copy and paste) instances of a linked model. This is typically done when creating a master project with the same building placed in multiple locations, such as a university campus with six identical student residence halls. The new copies are also links. Be patient as links are loading, do not click on the screen or click any buttons.

Managing Links

If the architectural model changes as you are working on the host project, it can be managed in one of two ways. You can reload the model by right-clicking on the Revit Link in the Project Browser and selecting **Reload** or **Reload From...** as shown in Figure 3–4.

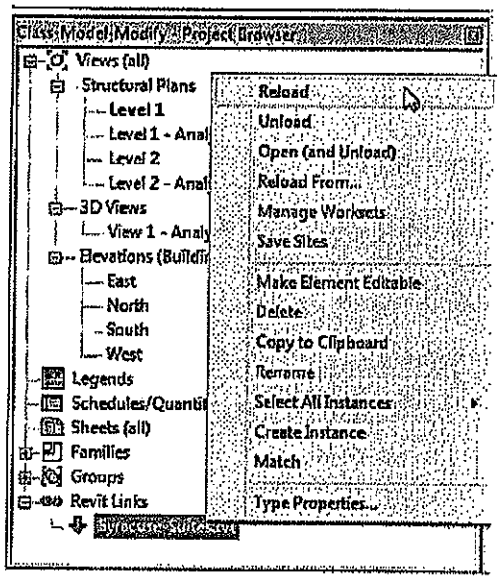

Figure 3–4

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You can also manage the link using the *Revit* tab in the Manage Links dialog box as shown in Figure 3–5.

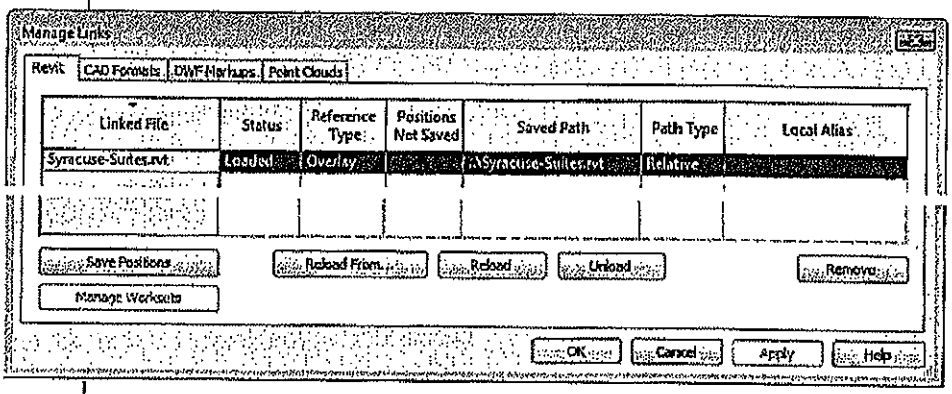

Figure 3–5

- To open the dialog box, in the *Insert* tab>Link panel or *Manage* tab>Manage Project panel, click (Manage Links) or right-click on Revit Links in the Project Browser and select **Manage Links**.

Manage Links Options

- **Status:** Displays the status of the linked model (**Loaded** or **Not Loaded**). This is read-only.
- **Reference Type:** Linked models can be nested in one another. How a linked model responds when the host project is linked into another project depends on the **Reference Type**. If the type is set to **Overlay**, the linked model is not referenced in the new host project. If the type is set to **Attach**, it displays in the new host project.
- **Positions Not Saved:** Works in conjunction with **Save Positions**. It is active if the linked model is part of a shared coordinate environment.
- **Saved Path:** Displays the location of the original linked model.
- **Path Type:** The path type can be set to **Relative** or **Absolute**. Typically, it is set to **Relative** so that if the linked model is moved, the software still searches for it. If it is set to **Absolute** and the original linked model is moved, the software is not able to find it.

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- **Local Alias:** Displays an additional name for models linked to Worksets.
- **Save Positions:** Works with shared coordinate systems to save a linked model to a position in the host project.
- **Reload From:** If the file location has changed, use this option to find the new location.
- **Reload:** Reloads the linked model without needing to close and reopen the project.
- **Unload:** Unloads the linked model so that it is not seen or calculated in the project but is still linked. Use **Reload** to restore it.
- **Remove:** Deletes the link to the model.

Hint: Visibility Graphics and Linked Files

When you open the Visibility/Graphics dialog box (type **VV** or **VG**), you can modify the graphic overrides for Revit links as shown in Figure 3–6.

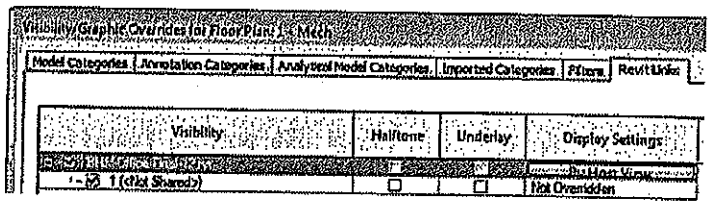

Figure 3–6

The *Display Settings* include:

- **By host view:** The display of the Revit link is based on the view properties of the current view in the host model.
- **By linked view:** The appearance of the Revit link is based on the view properties of the selected linked view and ignores the view properties of the current view.
- **Custom:** You can override all of the graphical elements.

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Practice 3a

Estimated time for completion: 10 minutes

Starting an MEP Project

Create a new project file with Project Information.

Link an Autodesk Revit Architecture model into an Autodesk Revit MEP project.

In this practice you will create a new project file and add Project Information. You will then link in a Autodesk Revit model into it, as shown in Figure 3–7.

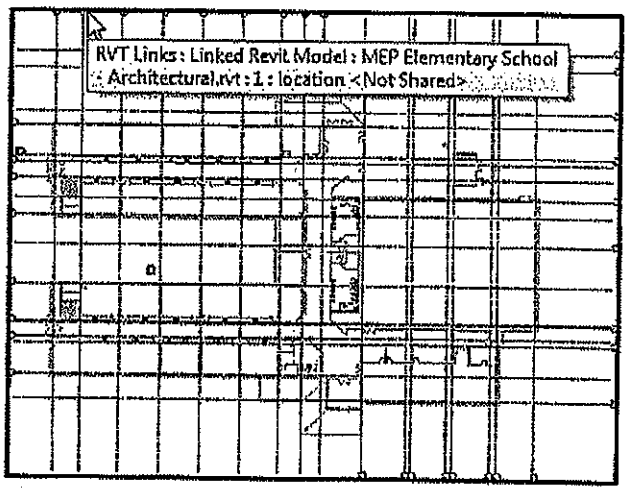

Figure 3–7

Task 1 - Create a new project.

*Click (Customize Quick Access Toolbar) at the end of the Quick Access Toolbar and select **New** if it is not displayed.*

1. In the Quick Access Toolbar or Application Menu, click (New).
2. In the New Project dialog box, select the *Template file:* **Systems Template** and click OK.
3. Save the project as **Elementary-School.rvt** in the *Chapter 3* folder of your class folder.
4. In the *Manage* tab>Settings panel, click (Project Information).

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5. In the Project Properties dialog box, for the *Project Name*, type **Elementary School**, and add a *Project Number*, as shown in Figure 3–8, and click OK.

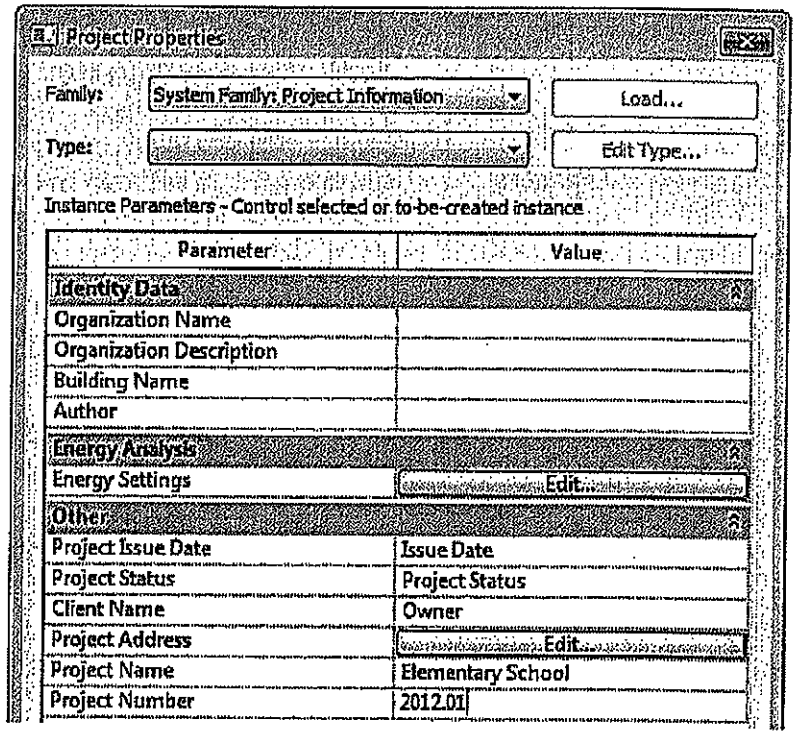

Figure 3–8

6. Save the project.

Task 2 - Link in a architectural model.

1. In the *Insert* tab>Link panel, click (Link Revit).
2. In the Import/Link RVT dialog box, select **MEP-Elementary-School-Architectural-M.rvt** found in the *Chapter 3* folder of your class folder. Set the *Positioning* to **Auto - Origin to Origin** and click Open.

You might need to zoom out slightly to display the entire building in the existing view.

3. The new building displays in the active view and is linked into the new Revit MEP project.
4. Select the linked model. In the *Modify | RVT Links* tab>Modify panel, click (Pin). This keeps the linked model from being moved by accident. Click in empty space to clear the linked model.

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5. Type **VG**. In the Visibility/Graphics Override dialog box, select the *Annotation Categories* tab.

6. Scroll down and clear the check from **Grids**. Click OK to close the dialog box.

7. Select the various views to display the building. Some equipment is already included in the architectural file, such as the lighting fixtures shown in the **1 - Lighting** view shown in Figure 3–9.

If necessary, you can also turn off the grids in any views for clarity.

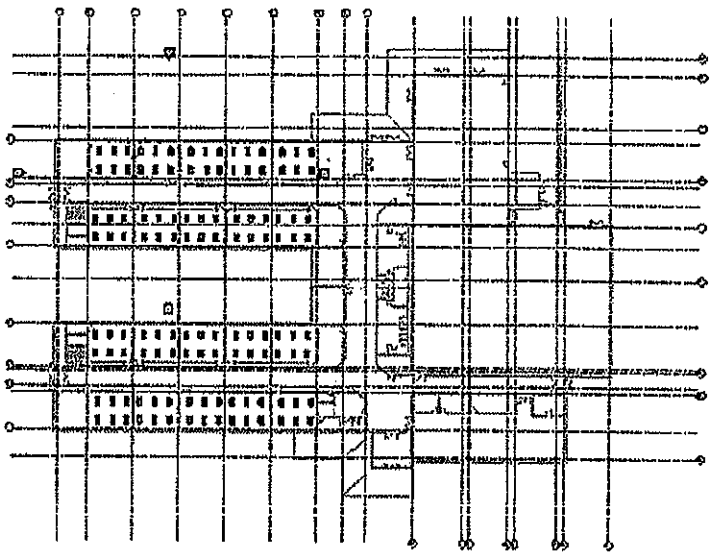

Figure 3–9

8. In the Project Browser, expand the Revit Links node to display the name of the linked model. Right-click on the Revit Links node and select **Manage Links...** or in the *Insert* tab> Link panel, click (Manage Links).

9. In the Manage Links dialog box, the linked model displays as shown in Figure 3–10.

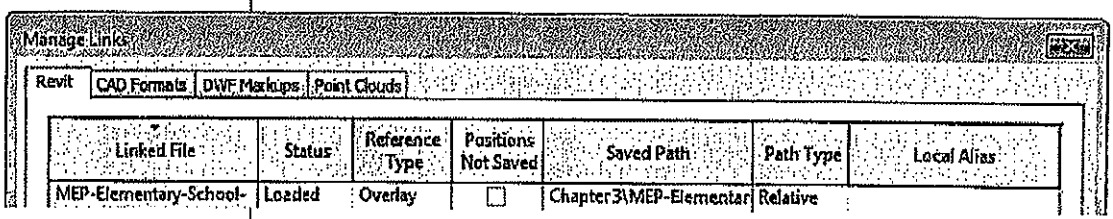

Figure 3–10

10. Close the dialog box and save and close the project.

3.2 Copying and Monitoring Elements

- Copy and monitor elements from a linked architectural model individually and using **Batch Copy**.
- Apply Coordination Settings for Copy/Monitor.
- Run a Coordination Review.

Once a linked architectural model is in place, the next step is to copy elements from the link that you need in the host project. These commonly include lighting fixtures and other electrical devices (as shown in Figure 3–11), plumbing fixtures, mechanical equipment, sprinklers, and levels. A monitoring system keeps track of the copied elements and prompts for updates if something is changed.

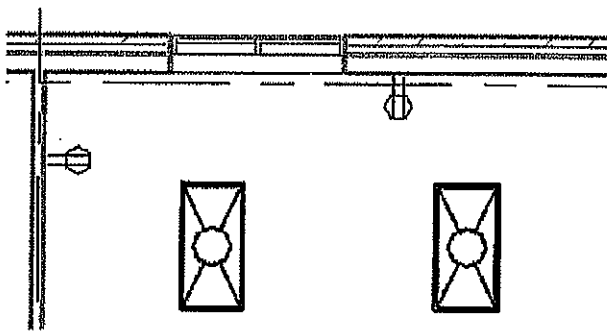

Figure 3–11

- Items that are monitored, display (Monitor) when selected, as shown in Figure 3–12.

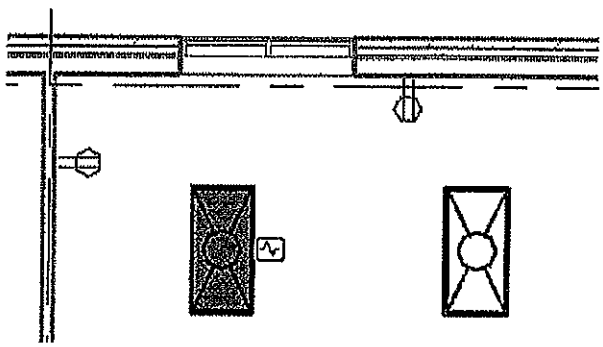

Figure 3–12

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How to:

Typically, Copy and Monitor as explained here is used primarily to monitor levels and grids. Fixtures are more easily copy/monitored using the Coordination Settings and Batch Copy described later in this chapter.

Warnings about duplicated or renamed types might display.

Copy and Monitor from a Linked Model

1. In the *Collaborate* tab>Coordinate panel, expand (Copy/Monitor) and click (Select Link).
2. Hover your cursor over the linked model. A frame displays around the linked model and a tooltip also displays as shown in Figure 3–13. When they are displayed, select the linked model.

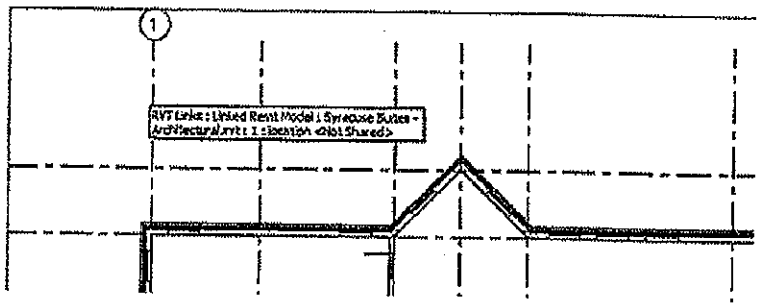

Figure 3–13

3. In the *Copy/Monitor* tab>Tools panel, click (Copy).
4. In the Options Bar, select the **Multiple** option as shown in Figure 3–14.



Figure 3–14

5. Select all of the elements that you want to copy into your model.
6. In the Options Bar, click Finish.
7. Repeat the process with any other elements that you want to copy.
8. Click (Finish) to end the session of Copy/Monitor. The elements are physically copied into your model and (Monitor) displays indicating that the elements are actively monitored as shown in Figure 3–15.

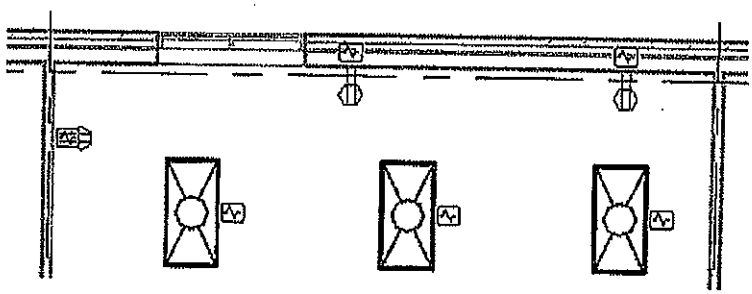

Figure 3–15

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Coordination Settings

There several types of fixtures that can be copied and monitored from linked models including air terminals, lighting fixtures, electrical fixtures, mechanical equipment, and plumbing fixtures. Only Autodesk Revit MEP fixtures in the linked model can be copied and monitored. This does not work with fixtures in the host project.

- If a linked model has nested links you can only copy and monitor fixtures from primary linked model.
- Create the default settings before you start to copy and monitor. This saves you time and reduces errors.

How to:

Define Default Coordination Settings

1. In the *Collaborate* tab>Coordinate panel, expand (Copy/Monitor) and click (Select Link).
2. Select the linked model you want to work with.
3. In the *Copy/Monitor* tab>Tools panel, click (Coordination Settings).
4. In the Coordination Settings dialog box, set the *Behavior* for each category of Revit MEP fixtures, as shown in Figure 3–16 for Air Terminals. In the *Category* area, select the type of fixtures you want to modify. In the *Behavior* area, specify the **Copy behavior** and the **Mapping behavior.**

Coordination Settings are also accessible in the Collaborate tab> Coordinate panel.

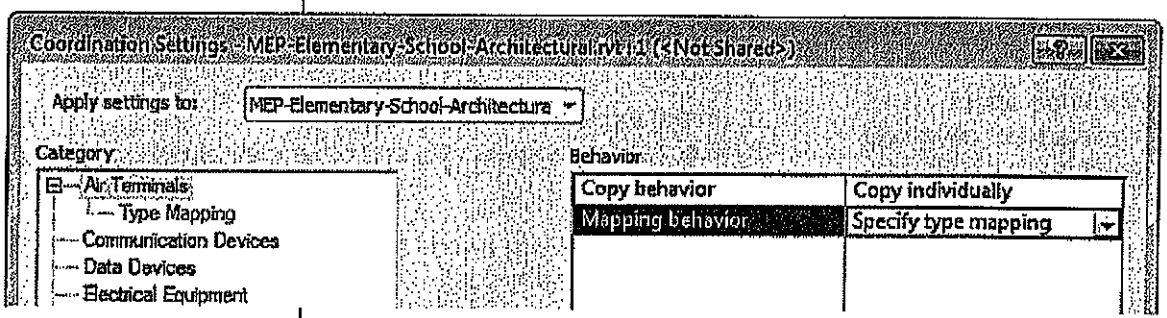

Figure 3–16

- **Copy behavior:** Select **Allow batch copy, Copy individually,** or **Ignore category.** For example, if you only want to work on part of a building, select **Copy individually.** If you are only working on one discipline, set the behavior to **Ignore category** for all of the ones you are not working with.

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- **Mapping behavior:** Select **Copy original** or **Specify type mapping.**

5. If you select **Specify type mapping**, under the Category, select Type Mapping. Then you can set up the coordination between the linked model and the host project as shown in Figure 3–17.

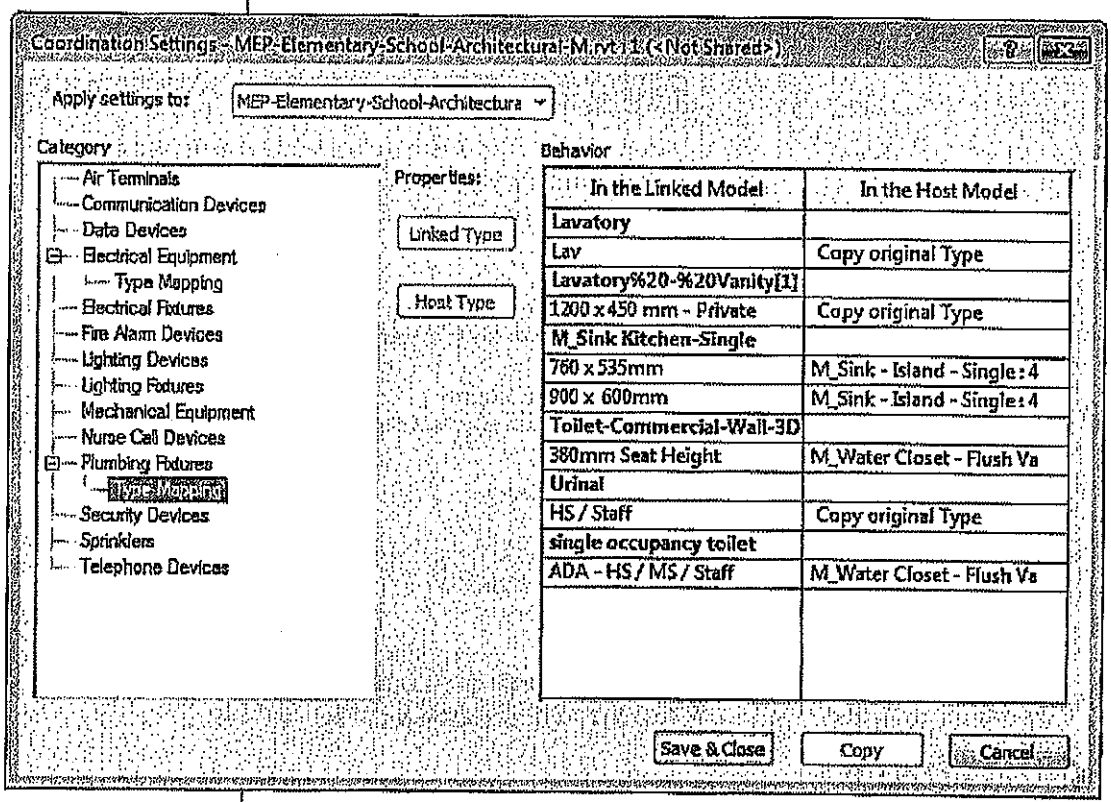

Figure 3–17

6. Click Save & Close.

Batch Copying Fixtures

When working with a project in which the architect has placed most of the fixtures and devices, you can use a batch copying process that saves you the time it would take to select each element.

- It is recommended that you set up the Coordination Settings for the linked model before you start the process. However, you can also do this before copying in the fixtures.
- Levels should be copied first before you copy fixtures into the project.

How to:

Batch Copy Fixtures

1. Start the **Copy/Monitor** process and set the **Coordination Settings** for a selected linked model.
2. In the *Copy/Monitor* tab>Tools panel, click (Batch Copy).
3. In the Fixtures Found dialog box shown in Figure 3–18, select **Specify type mapping behavior and copy fixtures** or **Copy the fixtures.**

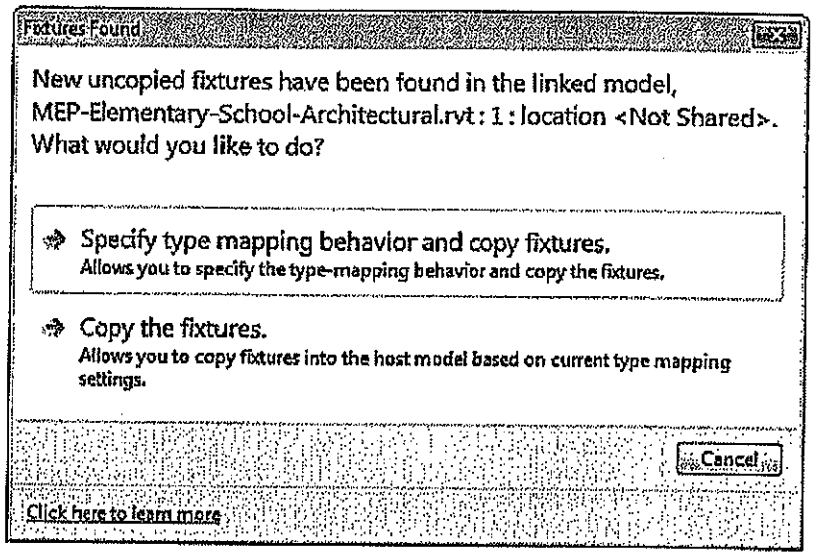

Figure 3–18

4. The elements are copied into the host project and set to be monitored, as shown in Figure 3–19.

If an element of that name already exists in the project, a warning box opens prompting you the copied element has been given a new name.

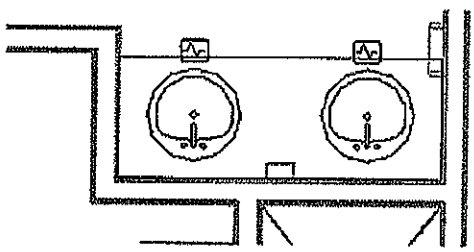

Figure 3–19

- If you have specified **Allow batch copy** for a category and a change is made in the linked model to which elements of that category have been added, you are prompted to specify the type mapping or directly copy the fixtures when the linked model is reloaded or you open the Autodesk Revit MEP file with a linked attachment.

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Hint: Copy/Monitor Options

Copy/Monitor Options are similar to **Coordination Settings**, except that they work with architectural and structural elements, such as Levels, Grids, Columns, Walls, and Floors.

In the *Copy/Monitor* tab>Tools panel, click (Options) to open the Copy/Monitor Options dialog box. Select the tab for the elements you want to set up. You can then specify the parameters as shown in Figure 3–20.

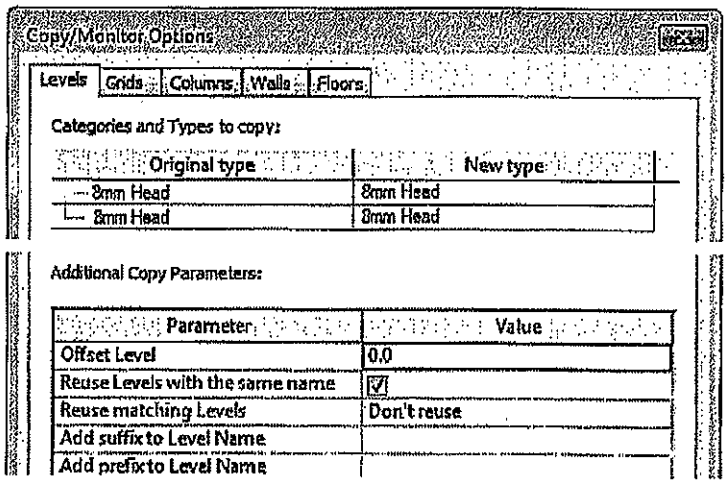

Figure 3–20

Monitoring Elements

Sometimes you need to model elements in the host project and then check them against changes in the architectural model. For example, you might need to add a level for the base of a plenum that you want to be monitored against a ceiling level in the linked model as shown in Figure 3–21.

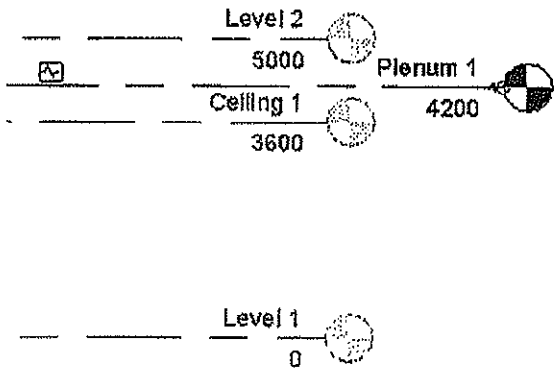

Figure 3–21

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How to:

Monitor Elements

1. In the *Collaborate* tab>Coordinate panel, expand (Copy/Monitor) and click (Select Link) to monitor elements between the MEP project and the linked model. You can also click (Use Current Project) to monitor elements within the MEP project.
2. In the *Copy/Monitor* tab>Tools panel, click (Monitor).
3. Select the first element that you want to monitor. If you are working with a linked model, select the element that is in your host project first. (Hint: the order in which the software requires you to select the elements is displayed in the Status Bar, as shown in Figure 3–22.)



Figure 3–22

4. Select the corresponding element to monitor.
5. The two elements are now monitoring each other. If one is modified, an alert displays indicating the change.
6. Repeat the process for any additional elements.
7. Click (Finish) when you are done.

- The elements do not have to be at the same elevation or location for the software to monitor them.

Working with Monitored Elements

When you have monitored elements in a project, alert boxes display when anything is modified between the host project and the linked model (or within the host project). To display the precise changes, you can run a **Coordination Review**.

- If you open a project with a linked model, which contains elements that have been modified and monitored, the Warning shown in Figure 3–23 displays.

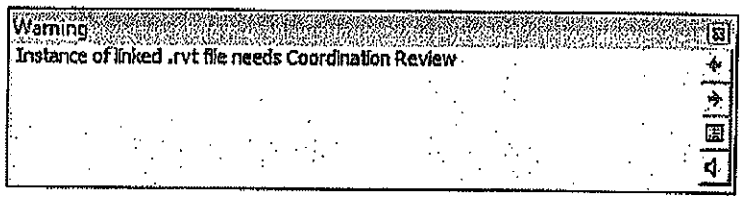

Figure 3–23

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- If you move an element that is copied into the host file, a Warning displays as shown in Figure 3–24. This does not prevent you from making the change but alerts you that this is a monitored element that needs further coordination with other disciplines.

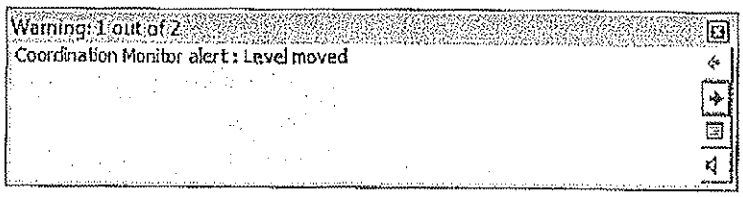

Figure 3–24

- If you no longer want an element to be monitored, select it and in the associated *Modify* tab>Monitor panel, click (Stop Monitoring).

Coordination Review

Monitoring elements identifies changes in the data (such as level names) as well as changes in placement. For example, if you move a plumbing fixture, it prompts a Coordination Monitor alert, as shown in Figure 3–25. To correct or accept these changes you can run a Coordination Review.

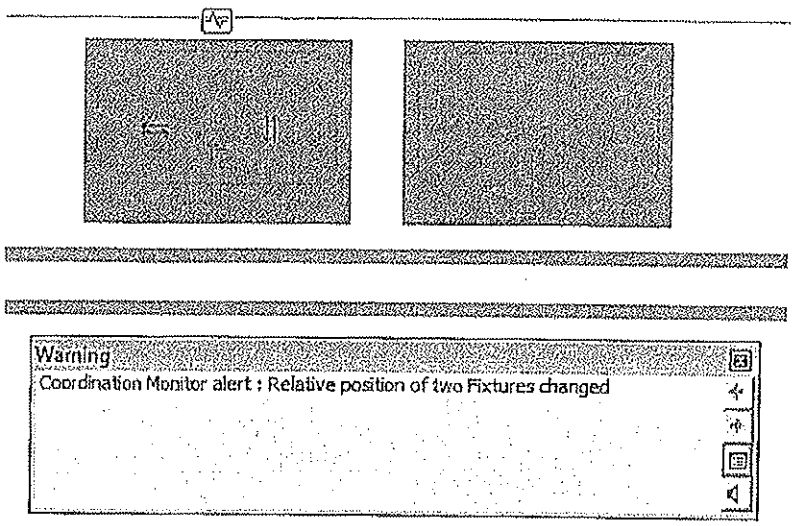

Figure 3–25

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How to:

Run a Coordination Review

1. In the *Collaborate* tab>Coordinate panel, expand (Coordination Review) and click (Use Current Project) or (Select Link). The Coordination Review dialog box lists any conflicts detected as shown in Figure 3–26.

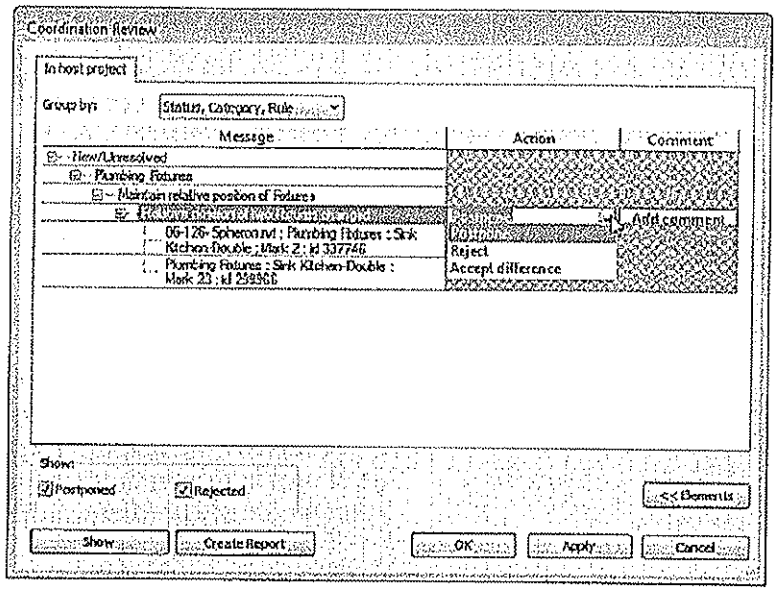

Figure 3–26

- If there are no conflicts the *Message* area is empty.
- You can group the information by **Status**, **Category**, and **Rule** in a variety of different ways in the Group by: drop-down list. This is important if you have many elements to review.
- Beside each conflict is a place for an Action. The Action can be: **Postpone**, **Reject**, **Accept Difference** (as shown in Figure 3–27), or **Rename/Modify/Move** in relationship to the elements involved.

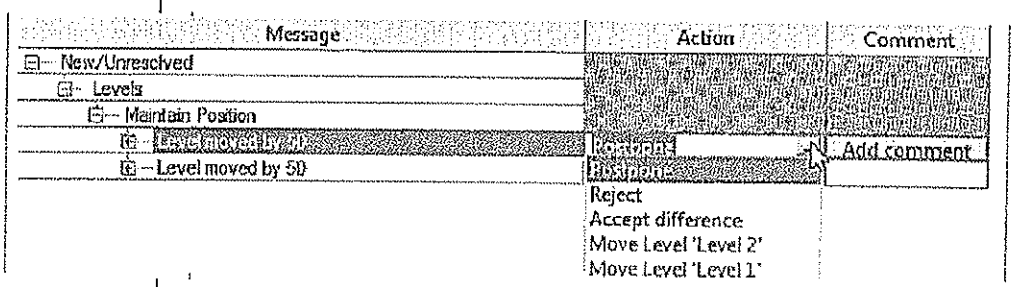

Figure 3–27

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- To add a comment, click Add comment in the column to the right. This enables you to make a note about the change, such as the date of the modification
- You can select the element names or click Show to display any items in conflict where the view changes to center the elements in your screen. Selecting the name does not change the view.
- Click Create Report to create an HTML report that you can share with other users, such as the example shown in Figure 3–28.

Revit Coordination Report

In host project

New/Unresolved	Plumbing Fixtures	Maintain relative position of Fixtures	Relative position of two Fixtures changed	Plumbing Fixtures : Sink_Kitchen-Single[1] : Mark 1 : id 734856 MEP-Elementary-School-Architectural.rvt : Plumbing Fixtures : Sink_Kitchen-Single[1] : Mark 80 : id 329165

Figure 3–28

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3.3 Setting Up Levels

Add and modify levels.

Create Plan views.

Levels define stories and other vertical heights (such as a roof or the top of a parapet), as shown in Figure 3–29. The default templates include two levels, but you can define as many levels in a project as needed. They can go down (for basements) as well as up.

Levels are often the first thing you need to copy and monitor into an Autodesk Revit MEP project from the linked architectural model.

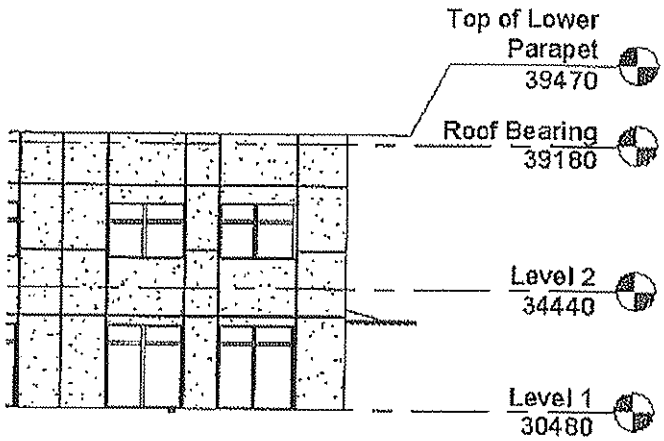

Figure 3–29

- You must be in an elevation or section view to define levels.
- Levels can be drawn or copied and monitored.

How to:

Draw Levels

1. Open an elevation or section view.
2. In the *Architecture* tab>Datum panel, click (Level), or type **LL**.
3. In the Type Selector, select the Level Head type if needed.
4. In the *Modify | Place Level* tab>Draw panel, click either (Pick Lines) to select an element or (Line) to draw a level.
5. Continue adding levels as needed.
6. End the command.

*To end a command, press <Esc>, or right-click and select **Cancel**, or click (Modify) or another command.*

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- Level names are automatically incremented as you place them. You can rename levels in Properties or by double-clicking on the name.

- To use (Pick Lines), in the Options Bar specify an *Offset* and select the level above or below to place the new level, as shown in Figure 3–30.

This is the fastest way of creating multiple levels.

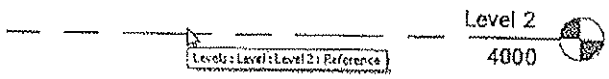

Figure 3–30

- To use (Line), align the cursor with the left end point of the existing level for the level's start point. A temporary dimension displays from that level. Select a point at the desired distance from the existing level or type a value. Drag the level line to the right until it lines up with the bubble on the existing level, and click to set the level end point, as shown in Figure 3–31.

You can draw the level lines from left to right or right to left.

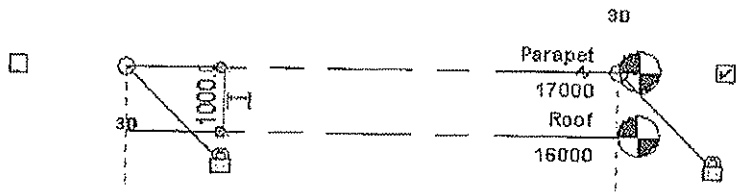

Figure 3–31

- You can also use (Copy) to duplicate level lines. The level names are incremented but no plan view is created.

Creating Plan Views

When you place a level, a Floor Plan and Ceiling Plan view for that level is automatically created if the **Make Plan View** option is selected in the Options Bar, as shown in Figure 3–32.

If you do not want the plan views to be created, clear the option.



Figure 3–32

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- You can identify if a plan view is created for a level, by the color of the level head. Level heads with views are blue, such as Level 1 and Level 2 in Figure 3–33, and level heads without views are black, such as Level 3 in Figure 3–33.

Typically, you do not need to create plan views for levels that specify data.

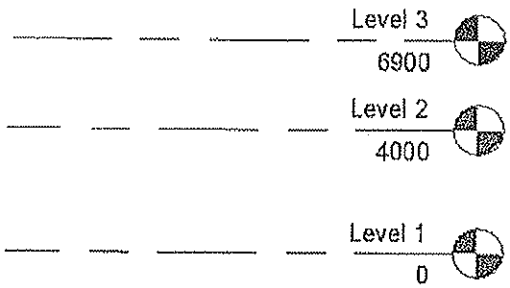

Figure 3–33

- You can add plan views to match levels if they were not already created.

How to: Create Plan Views

1. In the *View* tab>Create panel, expand (Plan Views) and click (Floor Plan) or (Reflected Ceiling Plan).
2. In the New Floor (or Ceiling) Plan dialog box, select the levels for which you want to create plan views, as shown in Figure 3–34.

Hold down <Ctrl> to select more than one level.

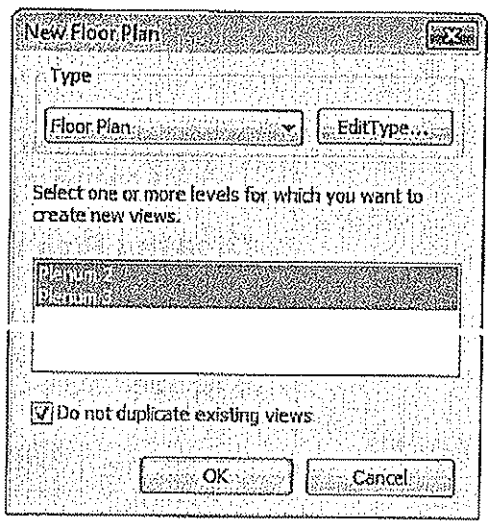

Figure 3–34

3. Click OK.

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Modifying Levels

You can change levels using standard controls, temporary dimensions, and lock tools, as shown in Figure 3–35. You can also make changes to the level name and height by clicking on the information in the level element or in properties.

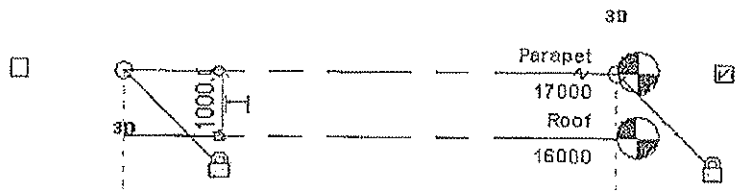

Figure 3–35

Elements, such as walls and columns can be referenced to a level height. Changing that height affects the entire model.

- (Hide / Show Bubble) displays on either end of the level line and toggles the level head symbol and level information on or off.

- 2D 3D (Switch to 3d / 2d extents) controls whether any movement or adjustment to the level line is reflected in other views (3D) or only affects the current view.

- (Create or remove a length or alignment constraint) controls whether the level is locked in alignment with the other levels. If it is locked, the blue dashed alignment line displays. When a level element is stretched, all of the other levels stretch as well. This helps to maintain conventional drafting standards. If it is unlocked, the level stretches independent of the other levels.

- (Modify the level by dragging its model end) at each end of the datum enables you to drag the level head to a new location. The vertical dashed line indicates if the end is locked to other levels.

- The temporary dimensions between the levels can be edited and changed to permanent dimensions. Click (Make this temporary dimension permanent) to keep the dimension visible. You can still modify the increment by selecting the level. The permanent dimension temporarily turns blue, enabling you to edit the value.

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- Click (Add Elbow) to add a jog to the level line as shown in Figure 3–36. Drag the blue sizing handles to new locations as required. This is a view-specific change.

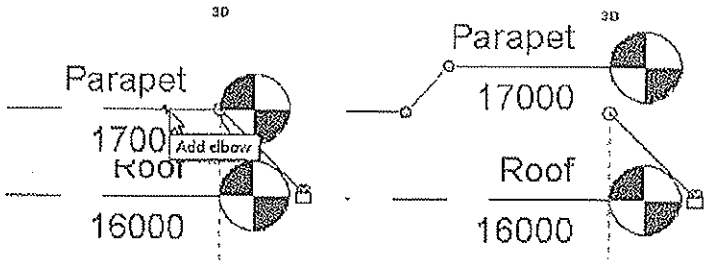

Figure 3–36

Renaming Levels

You can rename a level by double-clicking on the name next to the level head or by selecting the level and modifying the *Name* in Properties.

- If you rename a Level, an alert box opens, prompting you to rename the corresponding views as shown in Figure 3–37. Click Yes. The view is renamed in the Project Browser and all other associated views.

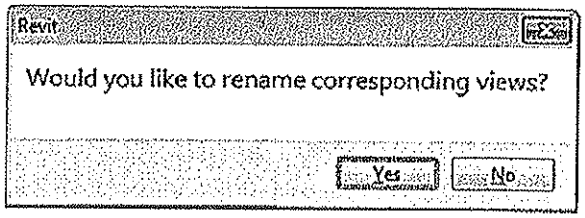

Figure 3–37

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Practice 3b

Linking and Coordinating Projects

- Copy and monitor levels.
- Make changes to monitored levels and use Coordination Review to resolve the changes.
- Use Coordination Settings and Batch Copy to copy and monitor plumbing fixtures.

Estimated time for completion: 20 minutes.

In this practice, you will use **Copy/Monitor** to copy and monitor levels from the architectural file to the Autodesk Revit MEP file, as shown in Figure 3–38. You will make changes to the monitored levels in the linked architectural model and use **Coordination Review** to resolve the changes. You will also copy and monitor MEP plumbing fixtures using **Coordination Settings** and **Batch Copy**.

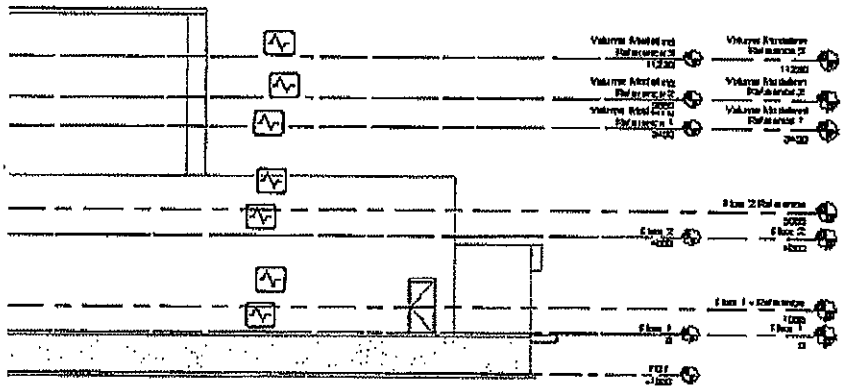

Figure 3–38

Task 1 - Copy and Monitor Levels.

1. Open the project **MEP-Elementary-School-Linking-M.rvt** found in the *Chapter 3* folder of your class folder.
2. Open the **Mechanical>HVAC>Elevations (Building Elevations): East - Mech** view.
3. Type **VG**. In the Visibility/Graphics Override dialog box, in the *Model Categories* tab, turn off **Plumbing Fixtures**. In the *Annotation Categories* tab, turn off **Grids**. Click OK.

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4. There are two levels in the host project, as shown in Figure 3–39.

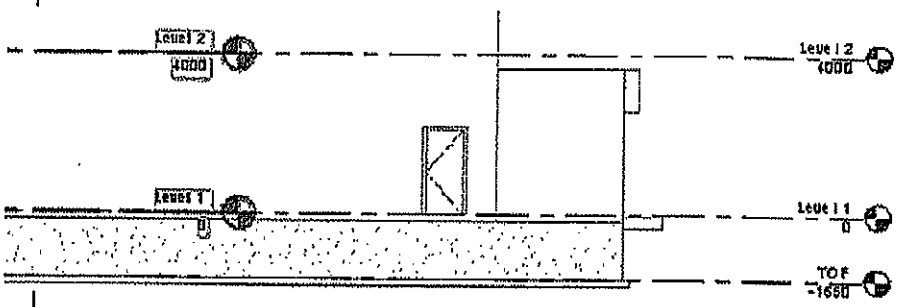

Figure 3–39

5. Click (Modify) and select one of the level bubbles in the host project. Select the control and drag it to the side, as shown in Figure 3–40.

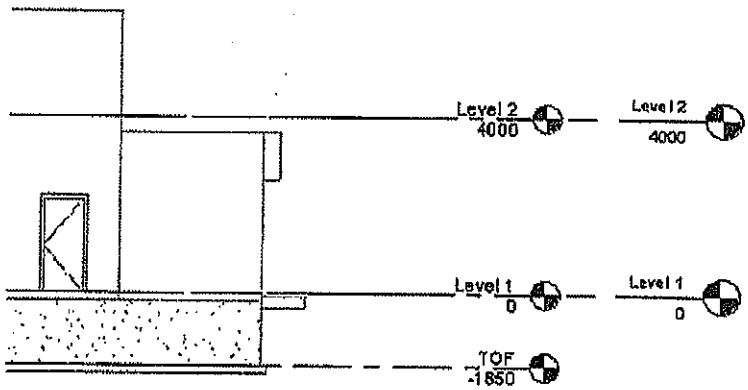

Figure 3–40

6. In the *Collaborate* tab>Coordinate panel, expand (Copy/Monitor) and click (Select Link).
7. Select the linked model.
8. In the *Copy/Monitor* tab>Tools panel, click (Monitor).
9. In the host project, select **Level 1**. In the linked model, select **Level 1**. Repeat for **Level 2**.

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10. In the Copy/Monitor panel, click (Finish). The levels are now monitored as shown in Figure 3–41.

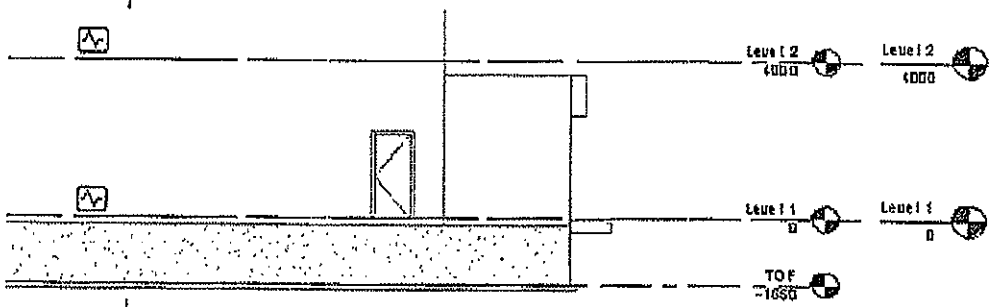

Figure 3–41

11. Select **Level 2**. Change the *height* to **4300mm** (use temporary dimensions or change the number below the level name). A Warning box opens as shown in Figure 3–42.

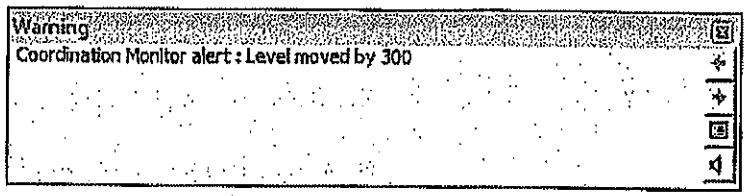

Figure 3–42

12. Close the warning box and undo the level height change.

13. In the *Collaborate* tab>Coordinate panel, expand (Copy/Monitor) and click (Select Link).

14. Select the linked model.

15. In the *Copy/Monitor* tab>Tools panel, click (Copy). Select the top three levels. They are reference levels used to create the heights of spaces.

16. In the Copy/Monitor panel, click (Finish).

17. Drag the level bubbles over so that they are all away from the linked level bubbles.

18. Save the project.

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Task 2 - Add and Monitor Levels.

1. In the *Architecture* tab>Datum panel, click (Level).
2. In the *Modify | Place Level* tab>Draw panel, click (Pick Lines).
3. In the Options Bar, clear **Make Plan View** and set the *Offset* to **1065mm**.
4. Roll your cursor over Level 1 and verify that the alignment line for the offset is above the level as shown in Figure 3–43.

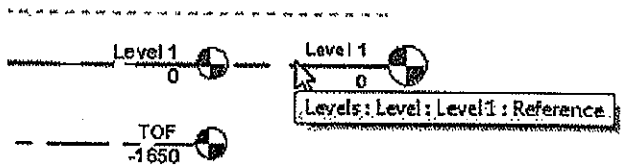

Figure 3–43

5. Click on Level 1 to place the new level.
6. Repeat with Level 2 and then click (Modify) to end the command.
7. Click on the name of new level above Level 1 and change it to **Level 1 - Reference**, as shown in Figure 3–44.

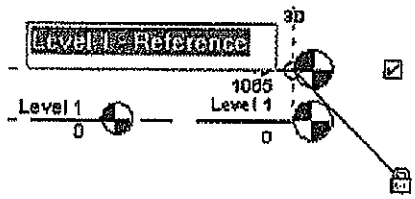

Figure 3–44

8. Repeat with the new level above Level 2 and name it **Level 2 - Reference**.
9. In the *Collaborate* tab>Coordinate panel, expand (Copy/Monitor) and click (Select Link).
10. Select the linked model.
11. In the *Copy/Monitor* tab>Tools panel, click (Monitor).

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12. In the host project, select **Level 1 - Reference**. In the linked model, select **Level 1**. Repeat for **Level 2 - Reference** and **Level 2**.

13. In the Copy/Monitor panel, click (Finish).

14. Save the project.

Task 3 - Copy and Monitor MEP Fixtures.

1. In the Project Browser, open the Mechanical>Plumbing> Floor Plans: **1 - Plumbing** view.
2. Revit MEP Fixtures display darker in this view but are not yet copied into the host project.
3. In the *Collaborate* tab>Coordinate panel, expand (Copy/Monitor) and click (Select Link).
4. Select the linked model.
5. In the *Copy/Monitor* tab>Tools panel, click (Coordination Settings).
6. Select the **Plumbing Fixtures** category and set the *Copy behavior* to **Allow batch copy** and the *Mapping behavior* to **Specify type mapping** as shown in Figure 3–45.

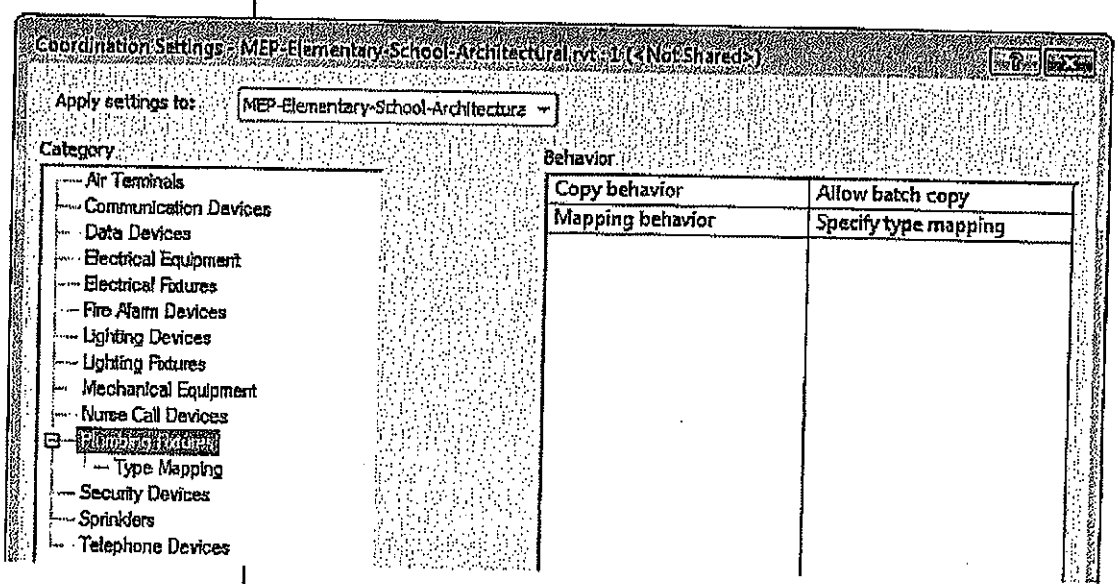

Figure 3–45

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7. In the *Category* area, under the **Plumbing Fixtures** category, select **Type mapping**.

8. In the *Behavior* area, change the *Host Model* type for the Toilets to **M_Water Closet - Flush Valve - Wall Mounted: Public - 1.6 lpf** as shown in Figure 3–46.

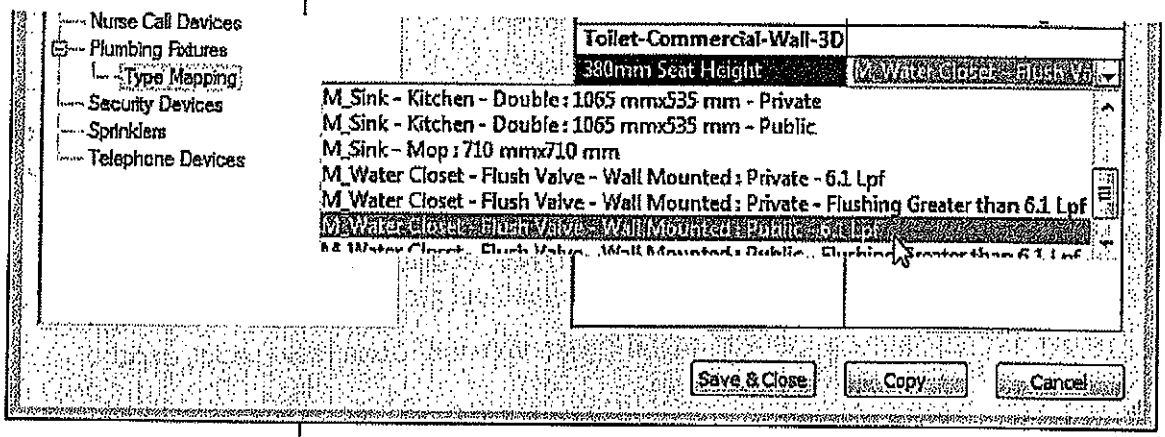

Figure 3–46

9. Click Save & Close.

10. In the *Copy/Monitor* tab>Tools panel, click (Batch Copy).

11. In the Fixtures Found dialog box, select **Copy the fixtures**. Wait while the fixtures are being pasted.

12. In the Copy/Monitor panel, click (Finish).

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13. Zoom in on one of the restrooms. If the Water Closet that was specified in the Type Mapping came in correctly, save and close the project and skip to the next task. If the Water Closet came in as the opposite of the existing, as shown in Figure 3–47, continue with the next step.

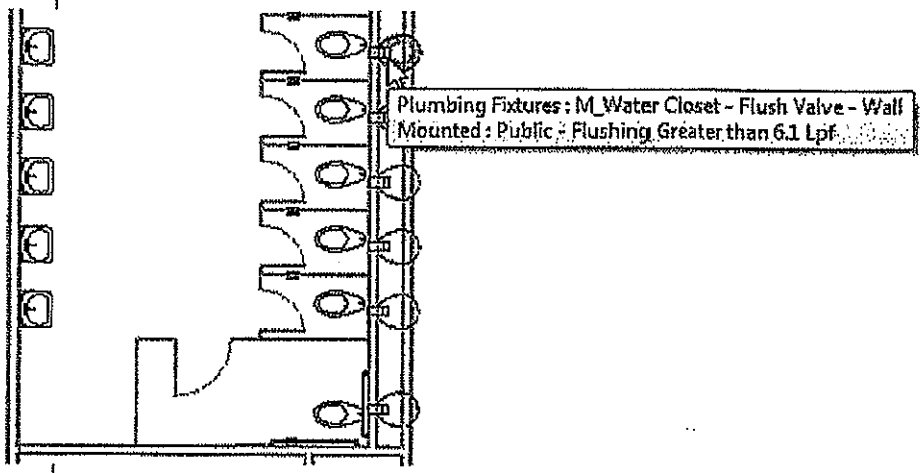

Figure 3–47

14. Select one of the water closets. (Flip Workplane) displays as shown on the left in Figure 3–48. Click on the control. The water closet is placed in the correct direction as shown on the right in Figure 3–48.

Flipping the work plane does not cause a coordination review.

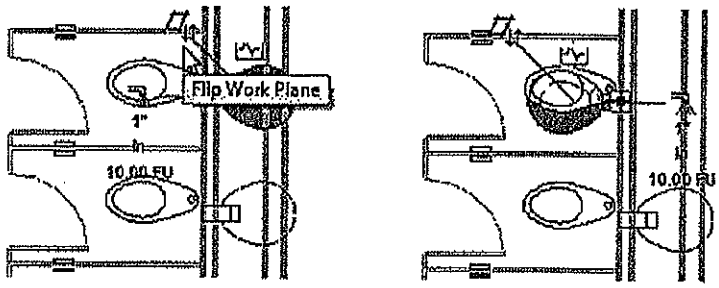

Figure 3–48

15. Repeat this process for each of the water closet fixtures. This must be done one at a time.

16. Double-click the mouse wheel to zoom out to the full view.

17. Save and close the project.

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Task 4 - Coordinate the architectural and MEP models.

1. Open the file **MEP-Elementary-School-Architectural-M.rvt** found in the *Chapter 3* folder of your class folder. This is the file that is linked into the Autodesk Revit MEP project.
2. In the Project Browser, open the Elevations (Building Elevation)>Architectural: **East** view.
3. Zoom in on the Level names to the right of the elevation.
4. Select **Level 1** and change the *name* to **Floor 1** as shown in Figure 3–49.

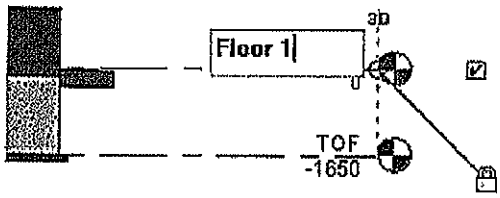

Figure 3–49

5. Repeat with **Level 2** and rename it **Floor 2.**
6. Save and close the project.
7. Reopen **MEP-Elementary-School-Linking-M.rvt.** A Warning box opens, prompting you that the linked model needs a Coordination Review, as shown in Figure 3–50.

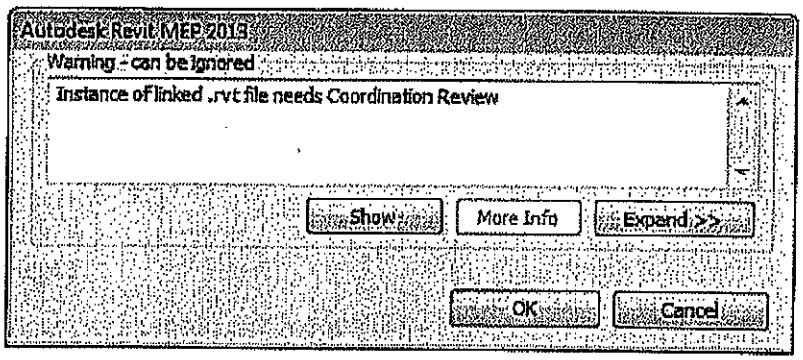

Figure 3–50

8. Click OK.

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9. Open the Mechanical>HVAC>Elevation (Building Elevation): **East - Mech** view and zoom in on the level names. The linked model displays the updated names but the host file has not yet been updated as shown in Figure 3–51.

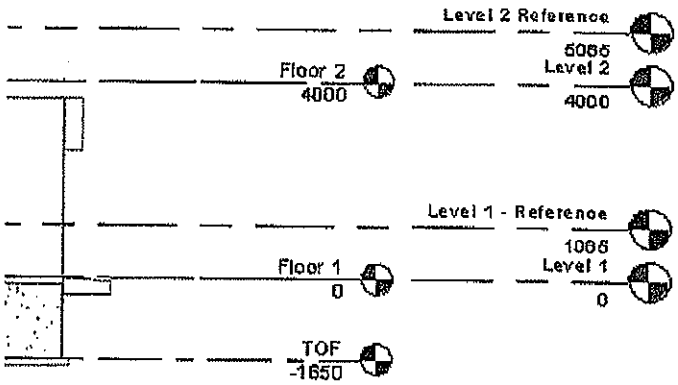

Figure 3–51

10. Select the linked model.

11. In the *Modify | RVT Links* tab>Monitor panel, click (Coordination Review).

12. In the Coordination Review dialog box, expand each of the New/Unresolved>Levels>Maintain Name>*Name changed* categories to display the proposed changes.

13. Select one of the **Name changed** options to display the related levels highlighted in the view as shown in Figure 3–52. In the example, the Autodesk Revit software recognizes the monitoring connection between Level 2 in the host project with Floor 2 in the linked model.

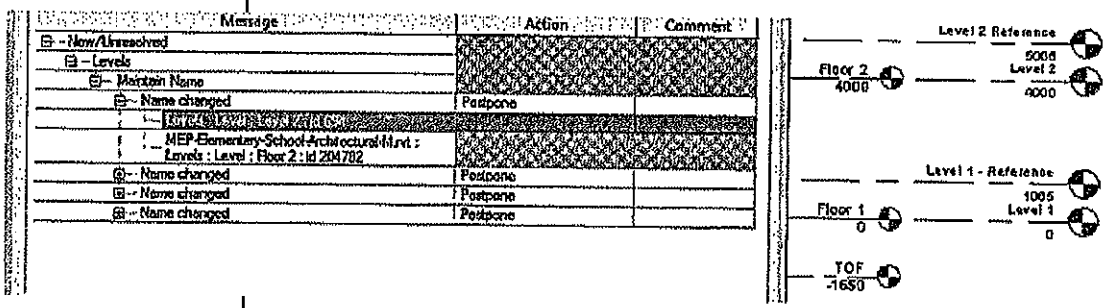

Figure 3–52

14. Next to each *Name changed* message, expand the list in the *Action* column and select **Rename Element** as shown for Level 2 in Figure 3–53.

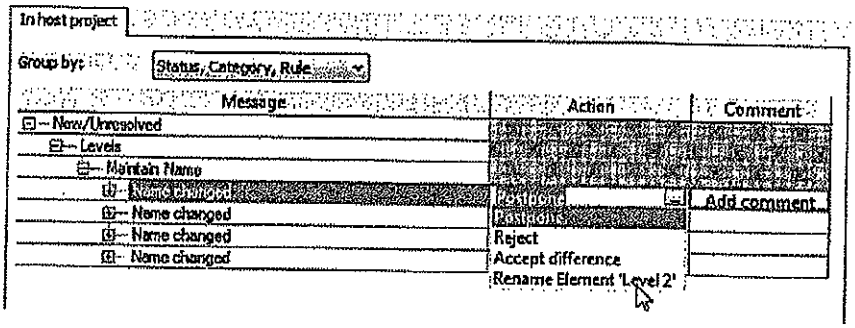

Figure 3–53

15. Click OK.

16. The levels in the host project are renamed as shown in Figure 3–54.

If the second level does not change you might have missed monitoring it earlier in the practice.

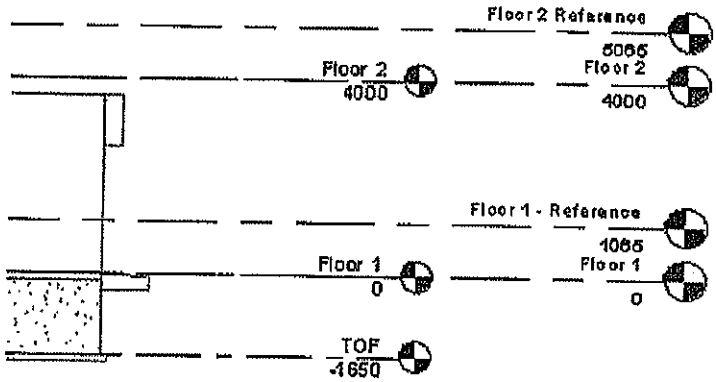

Figure 3–54

17. Save and close the model.

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Chapter Review Questions

1. Which of the following elements can be copied and monitored? Select all that apply.
   a. Plumbing Fixtures
   b. Levels
   c. Ducts
   d. Electrical Devices
2. On which of the following element types can a coordination review with the host project be performed?
   a. CAD link
   b. CAD import
   c. Revit link
   d. Revit import
3. When linking an architectural model into a systems project, which of the positioning methods keeps the model in the same place if the extents of the linked model change in size?
   a. Auto - Center-to-Center
   b. Auto - Origin-to-Origin
   c. Manual - Basepoint
   d. Manual - Center
4. How many times can one project be linked into another project?
   a. Once
   b. It is limited by the size of the link.
   c. As many as you want.
5. How many different levels can you have in a project?
   a. 1.1-10
   b. 10 up and 10 down from Level 1.
   c. As many as there are in the template file.
   d. As many as you want.

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Command Summary

Button	Command	Location
	Coordination Review	■ **Ribbon:** *Collaborate* tab>Coordinate panel
	Copy	■ **Ribbon:** *Copy/Monitor* tab>Tools panel
	Copy/Monitor> Select Link	■ **Ribbon:** *Collaborate* tab>Coordinate panel, expand Copy/Monitor
	Copy/Monitor> Use Current Project	■ **Ribbon:** *Collaborate* tab>Coordinate panel, expand Copy/Monitor
	Level	■ **Ribbon:** *Architecture* tab>Datum panel
	Link Revit	■ **Ribbon:** *Insert* tab>Link panel
	Manage Links	■ **Ribbon:** *Manage* tab>Manage Projects panel or *Insert* tab>Link panel
	Monitor	■ **Ribbon:** *Copy/Monitor* tab>Tools panel
	Options	■ **Ribbon:** *Copy/Monitor* tab>Tools panel

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Chapter 4

Working with Views

In this chapter you learn how to create duplicate views, callout views, elevations, and sections. You also learn how to setup views using underlays and view range as well as by overriding graphics in views. You also learn how to create elevations and sections and work in ceiling plan views.

This chapter contains the following topics:

- ✓**Duplicating Views**
- ✓**Adding Callout Views**
- ✓**Setting the View Display**
- ✓**Creating Elevations**
- ✓**Creating Sections**
- ✓**Working With Ceilings**

Learning Objectives

This chapter provides instruction to enable you to do the following:

4.1 Duplicating Views

- Duplicate views and modify what displays in each view.

4.2 Adding Callout Views

- Create callout views for detailed plans and sections.
- Modify callout views in the main view and in the callout view including setting the Annotation Crop Region.

4.3 Setting the View Display

- Modify the view display so that it displays only what is needed for that view.
- Override graphics in views for elements and categories.

4.4 Creating Elevations

- Add building and interior elevations.

4.5 Creating Sections

- Create building and wall sections.
- Modify section lines including adding a split.

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4.1 Duplicating Views

Duplicate views and modify what displays in each view.

Once you have created a model, you do not have to redraw the elements at different scales or copy them so that they can be used on more than one sheet. Instead, duplicate views and modify them to suit your needs. For example, a view of the coordination plan can be duplicated and modified to create an electrical floor plan at a different scale, as shown in Figure 4–1.

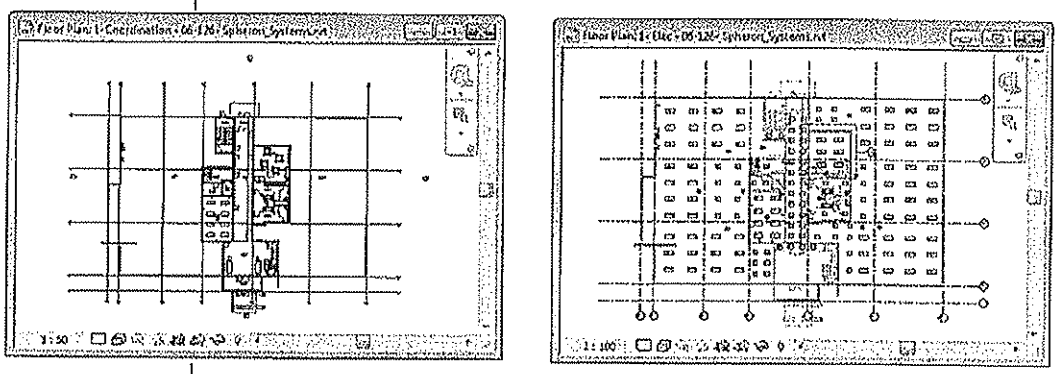

Figure 4–1

How to:

Create Duplicate Views

1. Open the view you want to duplicate.
2. In the *View* tab>Create panel, expand **Duplicate View** and select the type of duplicate view you want to create, as shown in Figure 4–2. This duplicates the active view.

Most types of views can be duplicated.

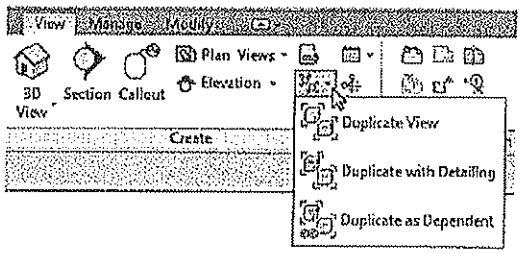

Figure 4–2

- Or, right-click on a view in the Project Browser and select the type of duplicate you want to use, as shown in Figure 4–3.

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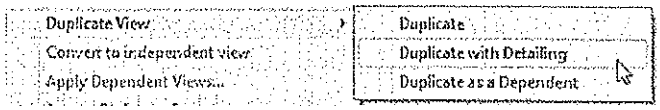

Figure 4–3

Duplication Types

Duplicate creates a copy of the view that only includes the building and datum elements, as shown in Figure 4–4. Annotation and detailing are not copied into the new view. When changes are made to the building model, the elements automatically update in all views. But view-specific changes made to the new view are not reflected in the original view. For example, you can duplicate a plan view that has dimensions and tags to create a plan without any annotation elements.

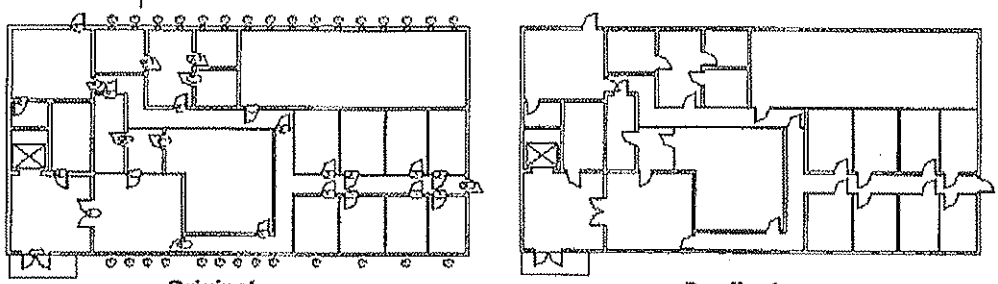

Figure 4–4

Duplicate with Detailing creates a copy of the view and includes all annotation and detail elements (such as tags), as shown in Figure 4–5. Any annotation or view-specific elements created in the new view are not reflected in the original view.

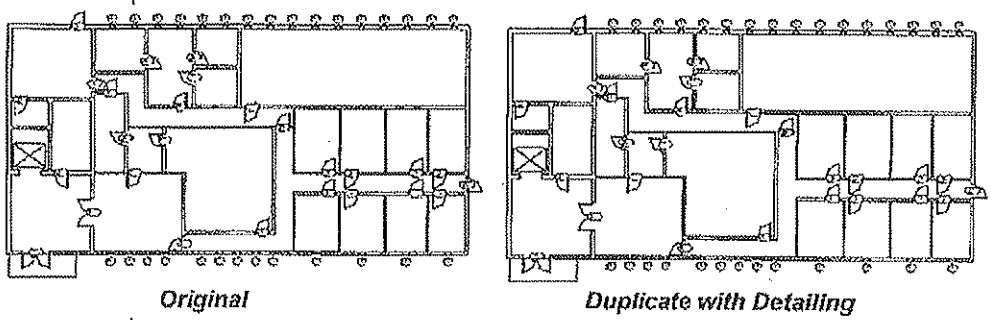

Figure 4–5

Duplicate as a Dependent creates a copy of the view and links it to the original (parent) view. View-specific changes made to the original view are also reflected in the dependent (child) view and vice-versa. Any updates to View Properties, View Display, or Visibility/Graphic Overrides display in both the original and dependent views.

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Hint: Common Uses of Duplicate as a Dependent

Use dependent views when the building model is so large that you need to split the building up on separate sheets, with views that are all at the same scale. Having one overall view with dependent views makes viewing changes (such as the scale or detail level) easier.

Dependent views display in the Project Browser under the top-level view, as shown in Figure 4–6.

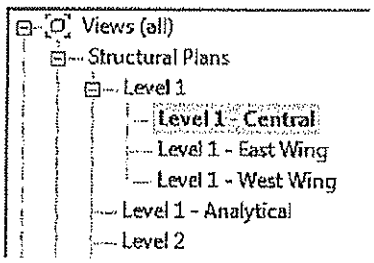

Figure 4–6

- If you need a plan displayed at a smaller scale, create a regular duplicate view, change the scale, and then create dependent views of this new view if needed.
- If you want to separate a dependent view from the original view, right-click on the dependent view and select **Convert to independent view.**

- The building model always updates in every view. Annotation elements (such as door tags, window tags, and dimensions) are view-specific and only update in dependent views.
- You can use View Properties, View Display, and Visibility/Graphic Overrides to make the duplicate view different from the original view.
- If you created levels that did not have views associated with them but now you want to add one, use (Plan Views) in the *View* tab>Create panel to select the level(s).
- Once you create a new view, you probably want to assign a new name to it. Right-click on the new view in the Project Browser and select **Rename**.

*You can also press <F2> to start the **Rename** command.*

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4.2 Adding Callout Views

- Create callout views for detailed plans and sections.
- Modify callout views in the main view and in the callout view including setting the Annotation Crop Region.

Callouts are enlarged plans or detail views. When you place a callout in a view, it automatically creates a new view clipped to the boundary of the callout, as shown in Figure 4–7. If you change the size of the callout box in the original view, it automatically updates the callout view and vice-versa.

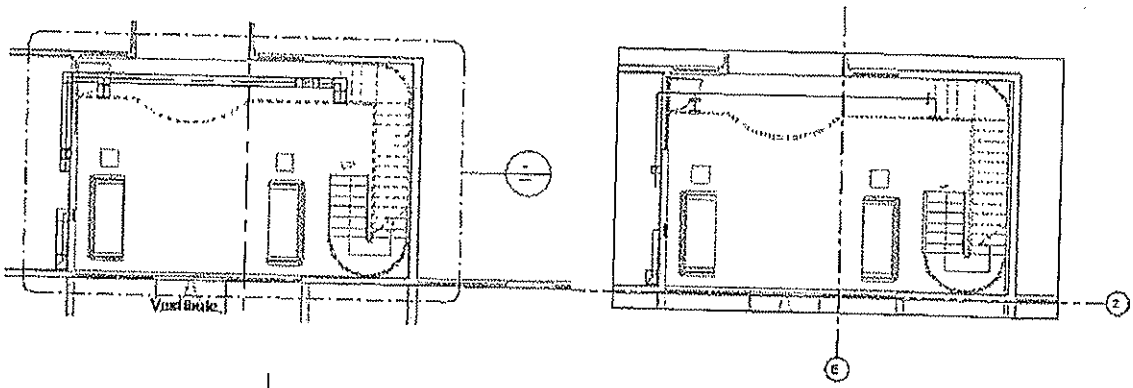

Figure 4–7

How to:

Create a Callout

1. In the *View* tab>Create panel, click (Callout).
2. In the Type Selector, select the type of view you want to create. It can be a matching view type or a Detail view.
3. Select points for two opposite corners to define the callout box around the area you want to detail.
4. Select the callout and use the shape handles to modify the location of the bubble and any other edges that might need changing.
5. In the Project Browser, rename the callout as needed.

- To open the callout view, double-click on its name in the Project Browser or double-click on the callout bubble (make sure it is not selected before you double-click on it).
- The scale of the callout is half the scale of the original. You can change this, if needed, once you open the callout view.

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Modifying Callouts

The callout bubble displays numbers when the view is placed on a sheet.

Modifying Callout Boundaries

In the original view where the callout is created, you can use the shape handles to modify the callout boundary and bubble location, as shown in Figure 4–8. You can also rotate the callout box by dragging (Rotate).

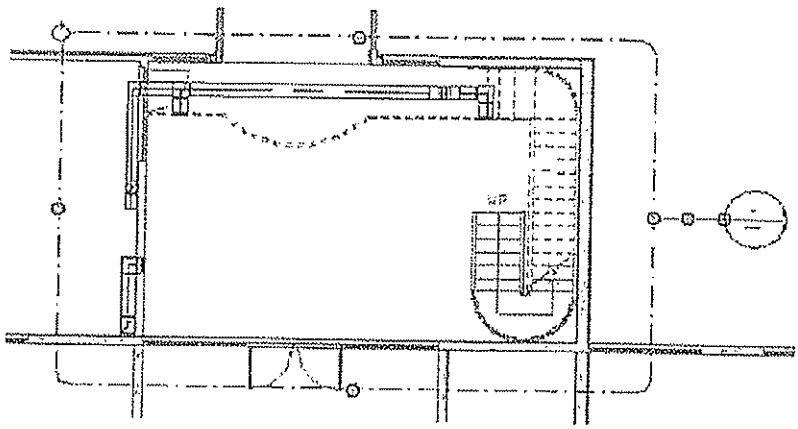

Figure 4–8

Modifying Callout Views

In the callout view, you can modify callouts with controls and view breaks, as shown in Figure 4–9.

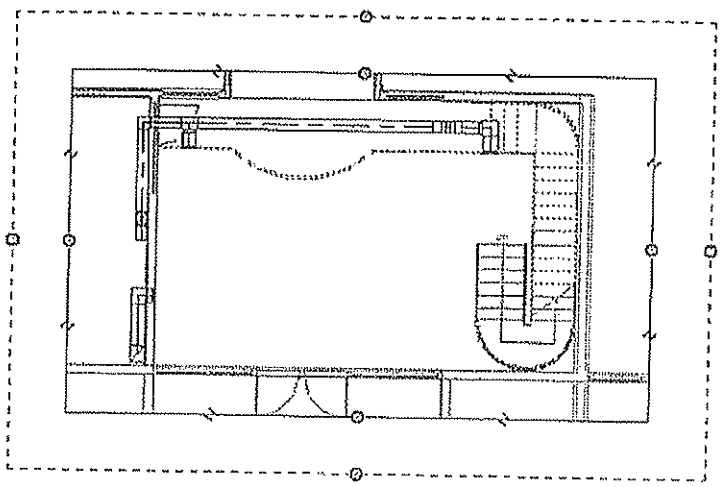

Figure 4–9

- The crop region must be displayed if you want to modify the size of the view. In the View Control Bar, click (Show Crop Region) if it is not visible.

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Breaking the crop region is typically used with sections or details.

- Resize the crop region using (Arrow) on each side of the region.
- If you want to break the crop region, click (Break Line) control to split the view into two regions, horizontally or vertically. Each part of the view can then be modified in size to display what is needed and be moved independently.
- The display in the callout view is controlled by the two crop regions, as shown in Figure 4–10.
  - **Model Crop Region:** Controls which model elements are displayed and how they are cropped.
  - **Annotation Crop Region:** Controls which annotation elements (such as dimensions and tags) are displayed. By default, annotation elements that are cut by the callout box are not displayed in the callout view.
- If the Annotation Crop Region is not displaying, turn it on in the Properties of the view. Scroll down to the *Extents* area and select **Annotation Crop**, as shown in Figure 4–10.

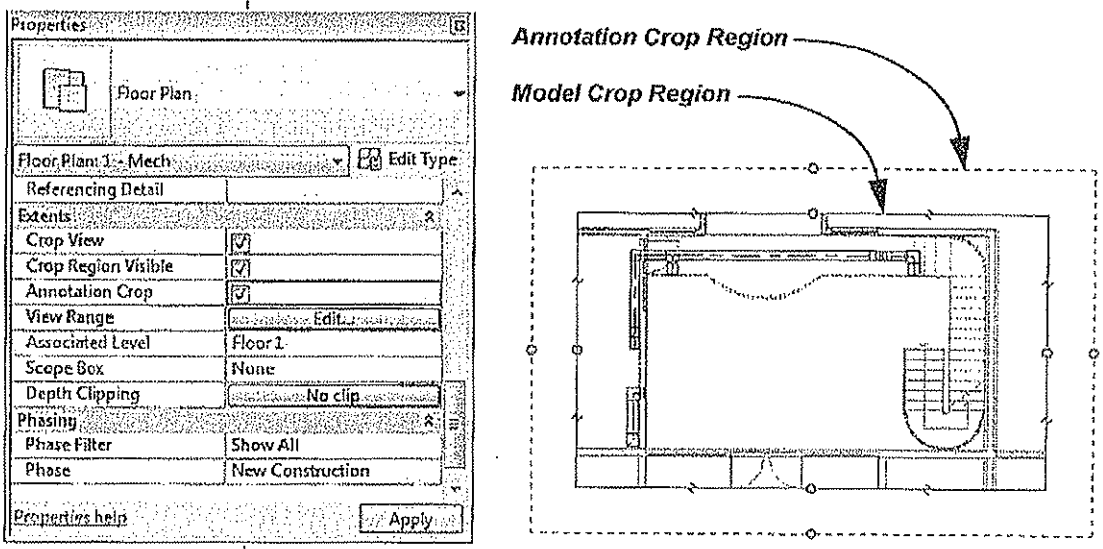

Figure 4–10

- It is a good idea to hide a crop region before placing a view on a sheet. Doing so minimizes the viewport size. In the View Control Bar, click (Hide Crop Region).

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4.3 Setting the View Display

- Modify the view display so that it displays only what is needed for that view.
- Override graphics in views for elements and categories.

Whenever you have not selected any objects, the Properties palette displays the View Properties, as shown in Figure 4–11. Many of these properties (such as the *View Scale*, *Detail Level*, and *Visual Style*) are most often changed in the View Control Bar. Several important modifications to views include setting Underlays, modifying the View Range, and overriding graphics of elements and categories.

The options in View Properties vary according to the type of view. A plan has some different parameters than a 3D view.

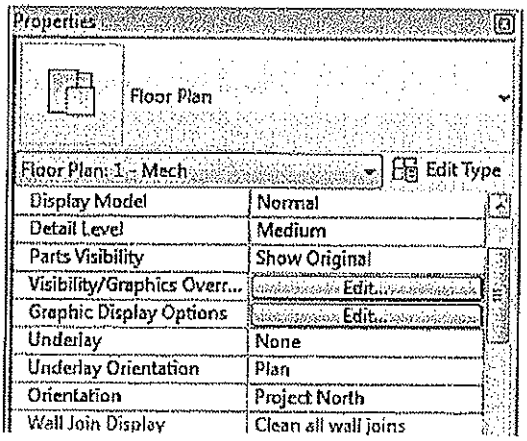

Figure 4–11

Underlays

Setting an *Underlay* (*Graphics* area of Properties) is helpful if you need to see elements on a different level, such as the basement plan shown with an underlay of the first floor plan in Figure 4–12. You can then use the elements to trace over or even copy to the current level of the view.

Underlays are only available in plan views.

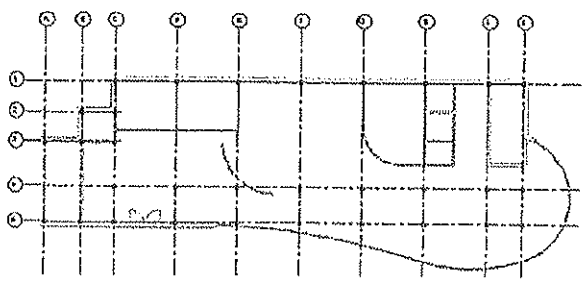

Figure 4–12

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View Range

The View Range sets the locations, in plan views, of cut planes and view depths. For example, when you place foundation walls under walls in a floor plan, the footing is not visible, as shown on the left in Figure 4–13. Modify the *View Range* (which sets the height and depth that you see above and below a level and the cut plane) so the foundations are visible, as shown on the right in Figure 4–13. By default, the software displays only the current level and the associated cut plane.

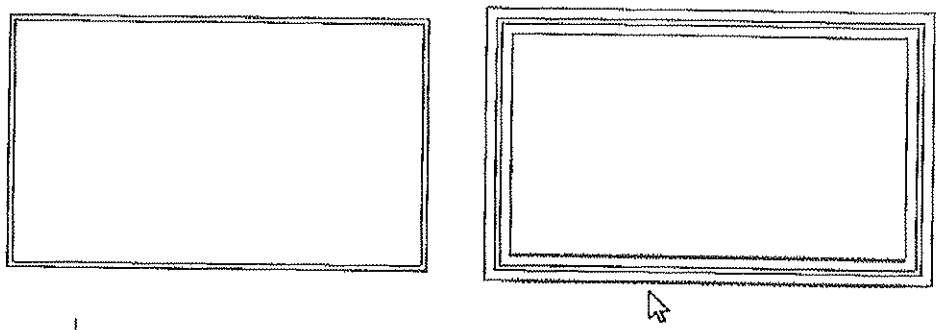

Figure 4–13

How to:

Set the View Range

1. Open the view in which you want to change the View Range.
2. In Properties, scroll down to *View Range* and select **Edit...**
3. In the View Range dialog box, as shown in Figure 4–14, modify the Levels and Offsets for the *Primary Range* and *View Depth.*

If the settings used are not able to be graphically represented, a warning displays stating the inconsistency.

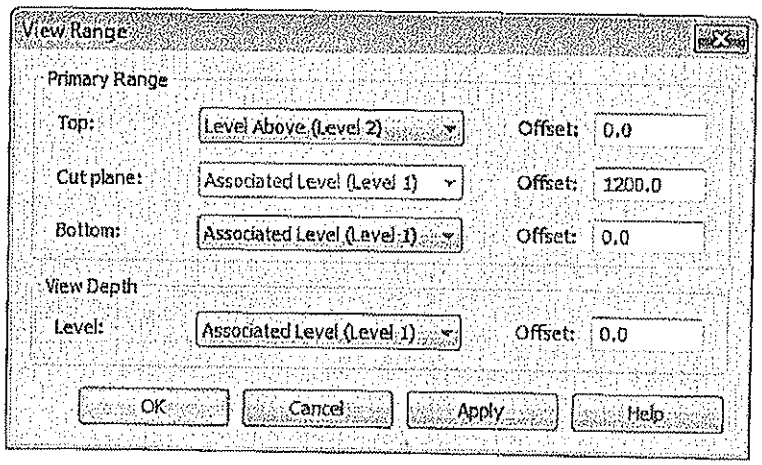

Figure 4–14

4. Click OK.

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Overriding Graphics in a View

If you want to change the way the graphics (such as lineweight, color, or pattern) display for elements or categories, you can override them in a view. For example, you can change the grid category in a Floor Plan to halftone, as shown in Figure 4–15.

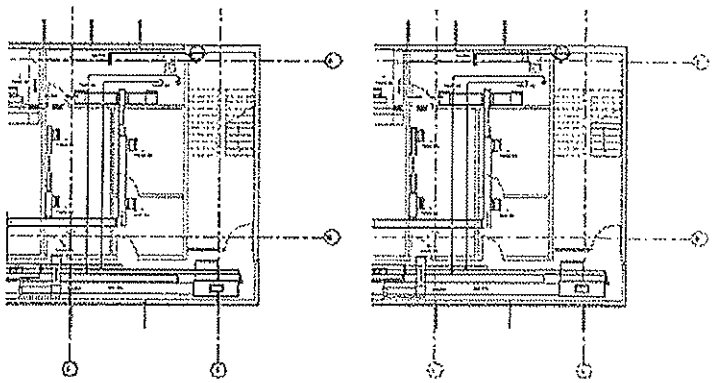

Figure 4–15

How to: **Override Graphics of Individual Elements**

1. Select the element(s) you want to modify.
2. Right-click and select **Override Graphics in View > By Element**. The View-Specific Element Graphics dialog box opens, as shown in Figure 4–16.

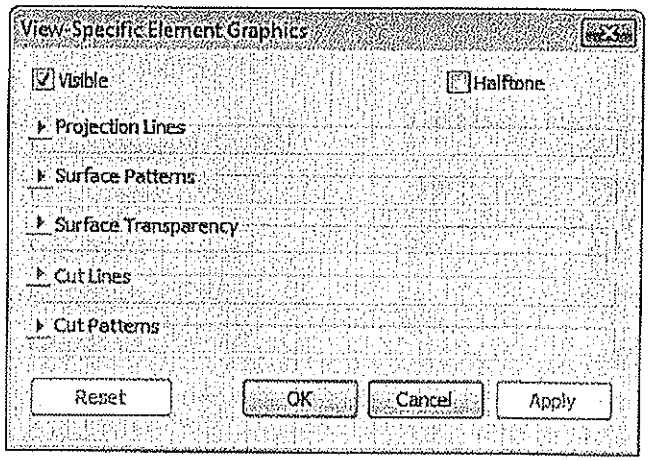

Figure 4–16

3. Select the changes you want to make and click OK.

- The options in the dialog box vary depending on the type of elements selected.
- Clearing the **Visible** option is the same as hiding elements.

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- Projection Lines, Surface Patterns, Cut Lines, and Cut Patterns can change according to options such as *Weight*, *Color*, and *Pattern*, as shown in Figure 4–17.

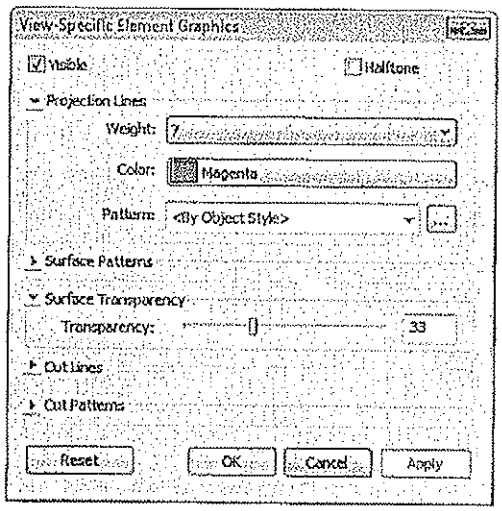

Figure 4–17

Enhanced In 2013

- You can modify the transparency of a surface by moving the Surface Transparency slider bar. For example, the wall shown on the left in Figure 4–18 is set all the way to the right of the bar to make it transparent, while the wall on the right is set at a 33% transparency.

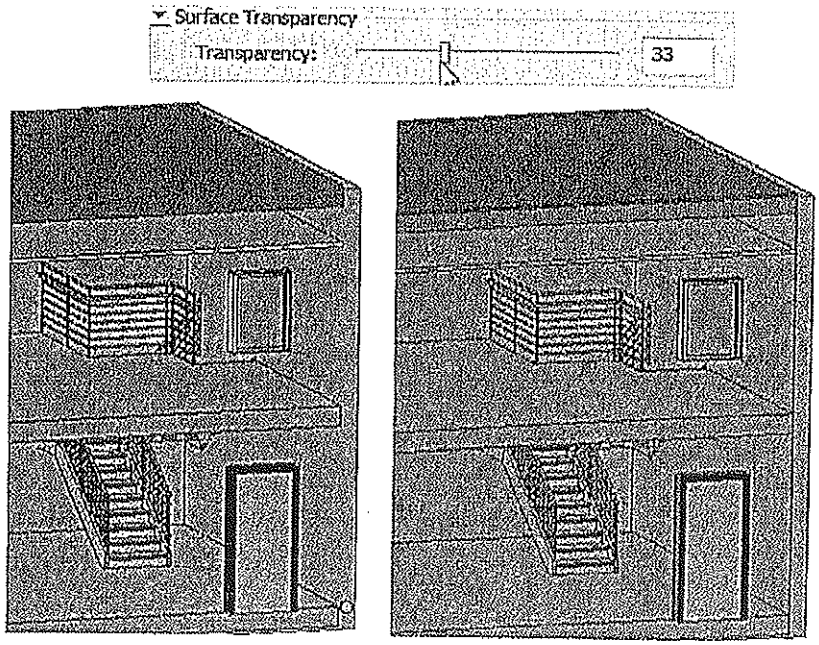

Figure 4–18

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How to:

Override Graphics of Entire Categories

1. Select an element in the category you want to modify.
2. Right-click and select **Override Graphics in View > By Category.**
3. In the View-Specific Category Graphics dialog box, as shown in Figure 4–19, modify the options in the same way you modify the element graphics and click OK.

Enhanced in 2013

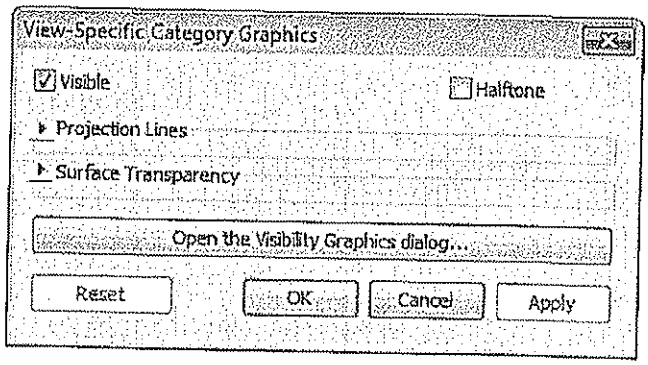

Figure 4–19

- The types of overrides displayed in the dialog box depend on the type of element you selected.
- To have more control over the categories, click Open the Visibility Graphics dialog..., or without opening the View-Specific Category Graphics dialog box, type **VV** or **VG** at the Command Line. The Visibility/Graphic Overrides dialog box opens, as shown in Figure 4–20.

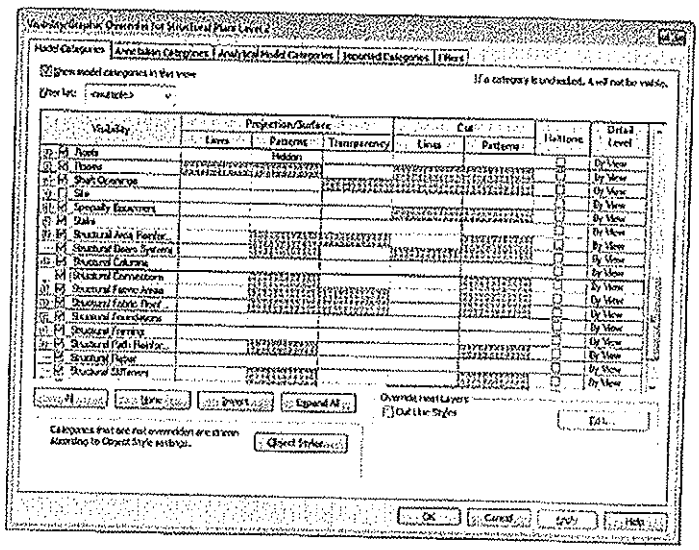

Figure 4–20

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For AutoCAD® users, modifying categories in this dialog box are similar to the concept of modifying layers.

You can use filters to refine the element selection.

- The options in the Visibility/Graphic Overrides dialog box control how every element and sub-element in Autodesk® Revit® software is displayed per view. You can control the *Visibility*, *Projection/Surface Lines*, *Patterns and Transparency*, *Cut Lines* and *Cut Patterns*, as well as set the *Halftone*. You can also override the *Detail Level* from the default **By View** to **Coarse**, **Medium**, or **Fine**.
- The Visibility/Graphic Overrides are divided into the *Model*, *Annotation*, *Analytical Model* and *Imported* categories.
- If you use the right-click menu to open the Visibility/Graphic Overrides dialog box after selecting an element, the selected category is highlighted. You can also make changes to other categories as needed.
- When working with additional information or data (such as *Design Options*, *Linked Files*, or *Worksets*), new tabs are automatically added to the Visibility/Graphic Overrides dialog box.
  - Most elements contain sub-categories that can be modified by expanding the category. *Conduits* consist of **Centerline**, **Drop**, **Rise**, each of which can be customized, as shown in Figure 4–21.

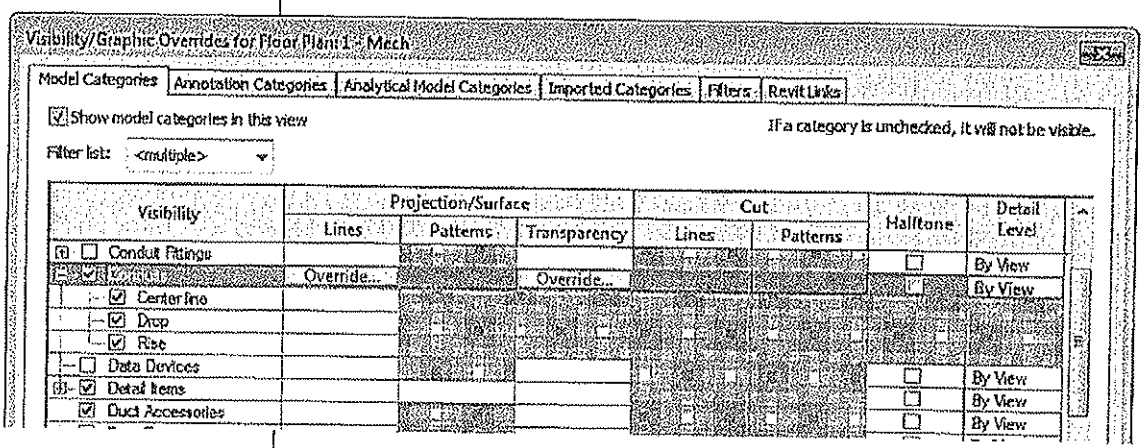

Figure 4–21

New in 2013

- The Filter list enables you to display limited types of elements. You can filter by **Architecture**, **Structure**, **Mechanical**, **Electrical**, or **Piping** and can select one or several.

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Enhanced in 2013

Hint: Applying View Templates

A powerful way to setup views the way you want them to be is to use View Templates. These are often preset by the company BIM Manager so check to see which ones are available.

To apply a View Template, in the Project Browser, right-click on a view and click **Apply View Template Properties**. Then, in the Apply View Template dialog box, select a *Name* from the list, as shown in Figure 4–22, and click OK.

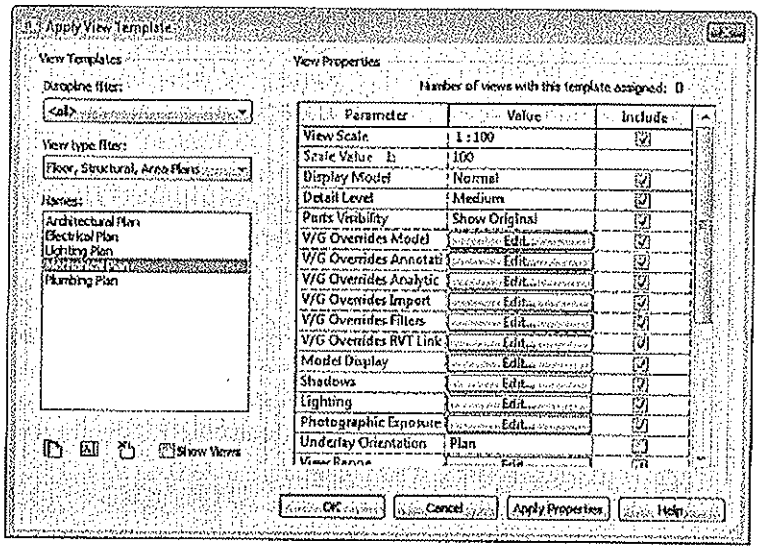

Figure 4–22

- The view takes on the properties described in the View Template.

Type Properties for views can also be set up to apply a specific View Template to new views.

- View Templates can also be preset in the View Properties as shown in Figure 4–23. Using this overrides all changes to categories.

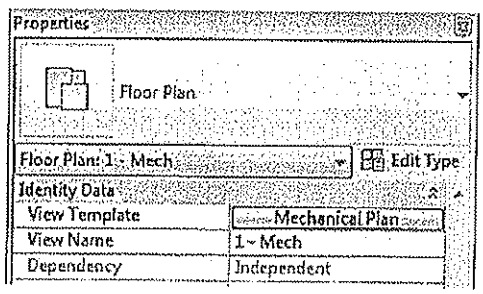

Figure 4–23

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Practice 4a

Estimated time for completion: 15 minutes

Setting Up Duplicate Views and Callouts

- Duplicate and crop views.
- Add a callout view and modify the Visibility/Graphics so that duplicates of the call out display different information.

In this practice you will create duplicate views at different scales with different areas of the project cropped. You will also create callout views and make modifications to the visibility graphics, as shown in Figure 4–24.

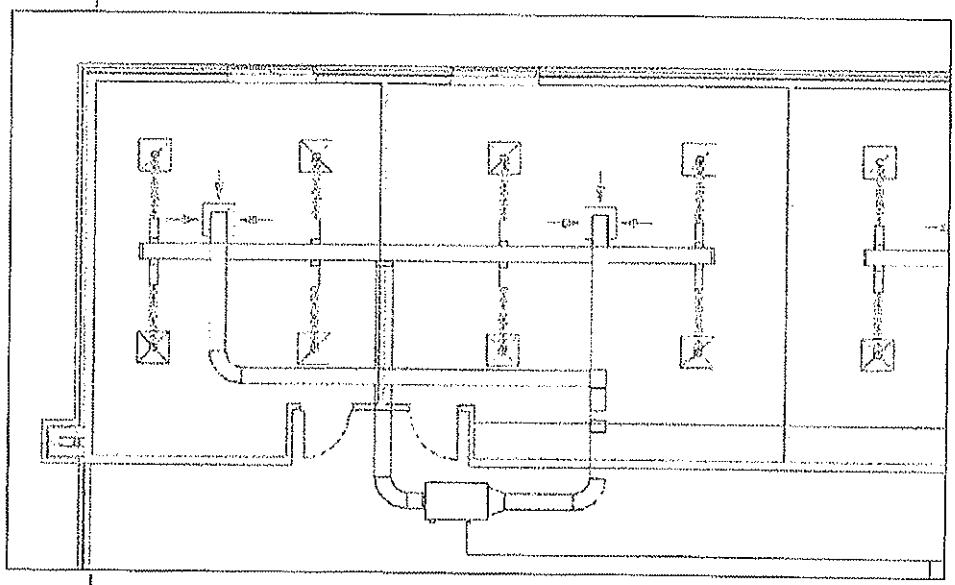

Figure 4–24

Task 1 - Duplicate views.

1. Open the project file **MEP-Elementary-School-Views-M.rvt** found in the *Chapter 4* folder of your class folder.
2. In the Project Browser, open the **Coordination>All>Floor Plans: Level 1** view.
3. In the Project Browser, right-click on the **Level 1** view and select **Duplicate View>Duplicate with Detailing**. A copy of the view is created, which includes the tags displaying the room names.

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4. Right-click on the new view and rename it as **Level 1 - North Wing.**

5. In the View Control Bar, click (Show Crop Region).

6. Zoom out to display the full extents of the crop region and select it, as shown in Figure 4–25.

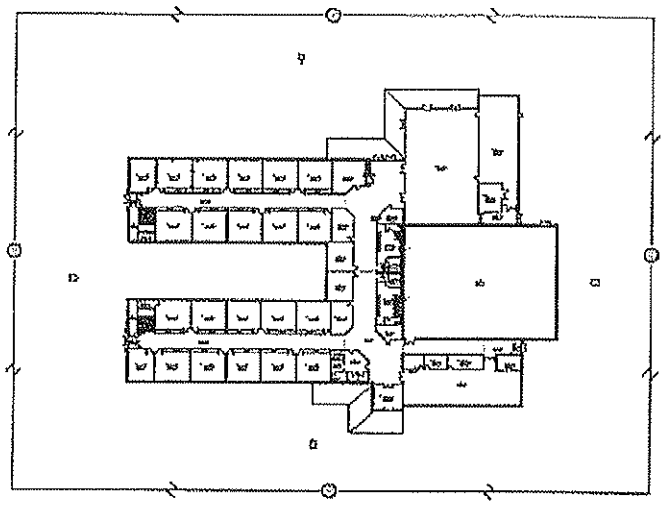

Figure 4–25

7. Change the crop region so that only the upper left wing of the building displays, as shown in Figure 4–26.

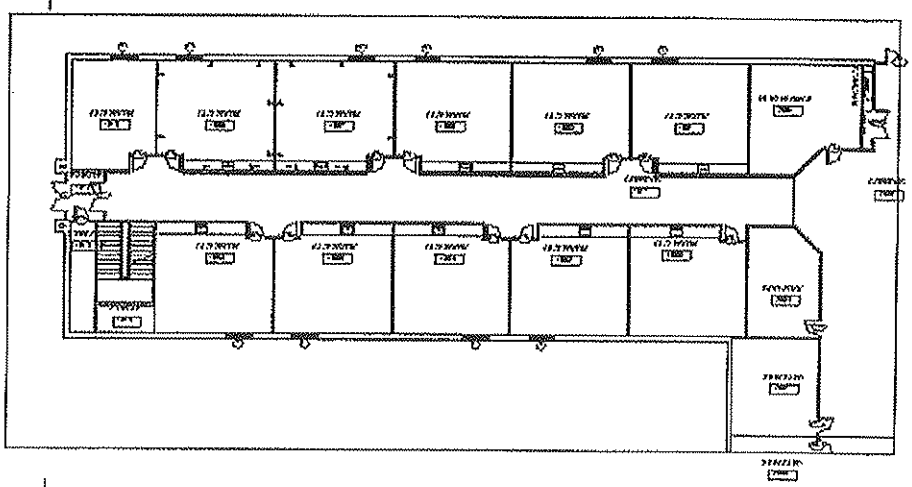

Figure 4–26

8. There are several tags outside the crop region that still display. Select the crop region.

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9. In Properties, scroll down and, in the *Extents* area, select **Annotation Crop** and click Apply.
10. Modify the Annotation Crop region so the room/space tags do not display.
11. In the View Control Bar, click (Hide Crop Region).
12. Open the original **Level 1** view.
13. In the View Control Bar, change the *Scale* to **1:200**. All of the annotations become larger, as they need to plot correctly at this scale.
14. Save the project.

Task 2 - Add callout views.

1. In the Project Browser, collapse the *Coordination* group and expand the Mechanical>HVAC> Floor Plans group. Open the **02 MECHANICAL PLAN** view.
2. In the *View* tab>Create panel, click (Callout).
3. Place a callout around the two classrooms in the north wing of the building, as shown in Figure 4–27. Move the bubble as needed. Click in empty space to clear the selection.

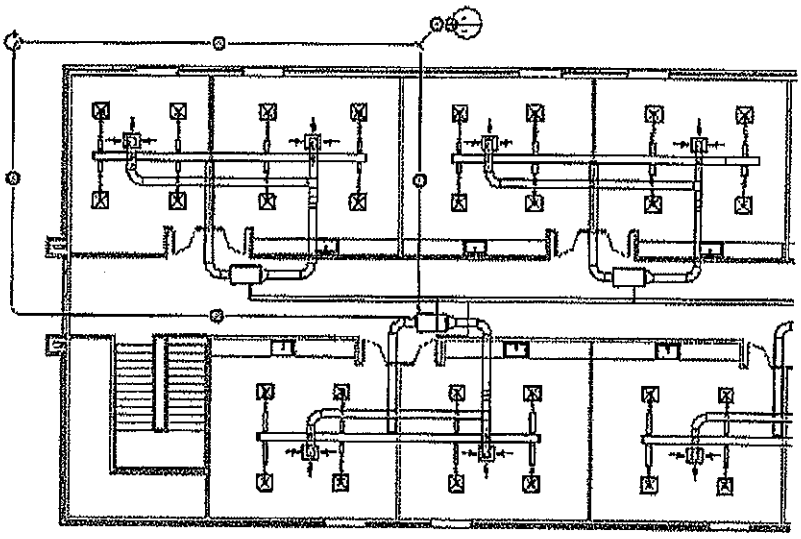

Figure 4–27

4. Double-click on the callout view bubble to open the view.

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5. In the Project Browser, rename the view as **Typical HVAC System - Air Terminals**.
6. Duplicate the callout view and rename it as **Typical HVAC System - Ductwork**.

Task 3 - Hide and override graphics in views.

1. Open the **Typical HVAC System - Air Terminals** view.
2. Close all open views.
3. Select one of the ducts, right-click and select **Hide in View> Elements**. Only the selected duct is turned off.
4. Select another duct, right-click and select **Hide in View> Category**. All of the ducts are turned off.
5. Select at least one of the Duct Fittings and Flex Ducts. Right-click and select **Hide in View>Category**. The rest of the ducts and associated fittings are turned off as shown in Figure 4–28.

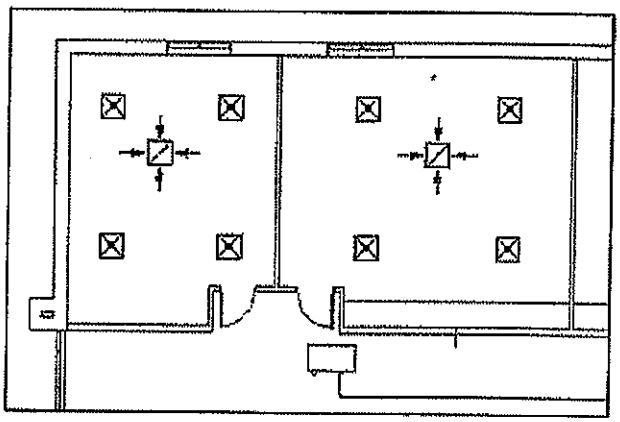

Figure 4–28

6. Open the **Typical HVAC System - Ductwork** view. The ducts still display in this view.
7. Select one of the air terminals. Right-click and select **Override Graphics in View> By Category.**
8. In the Visibility/Graphics Overrides dialog box, *Halftone* column, add a check mark to the **Air Terminals** categories. Click OK to close the dialog box.

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The view should display with all of the air terminals in halftone.

9. In the View Control Bar, change the *Detail Level* to (Medium). The ducts display full size, as shown in Figure 4–29.

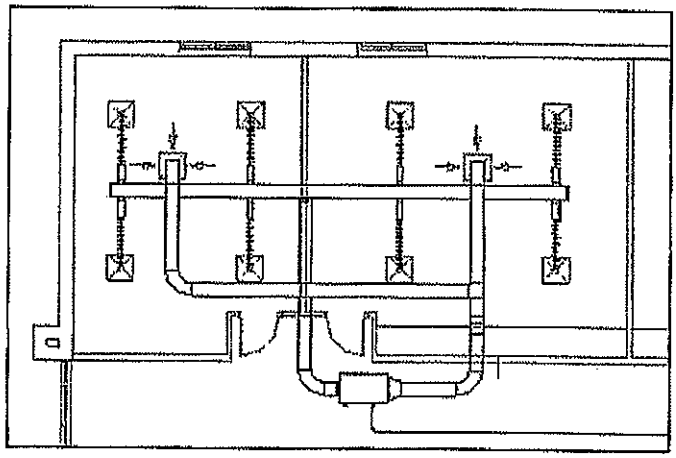

Figure 4–29

10. In the *View* tab>Windows panel, click (Tile). The two views should display. (If there are any other projects open, close them and tile the windows again so that only the two callout views are displayed.)

11. Move one of the air terminals slightly. The ductwork automatically updates as shown in Figure 4–30. What is done in one view replicates in all other related views.

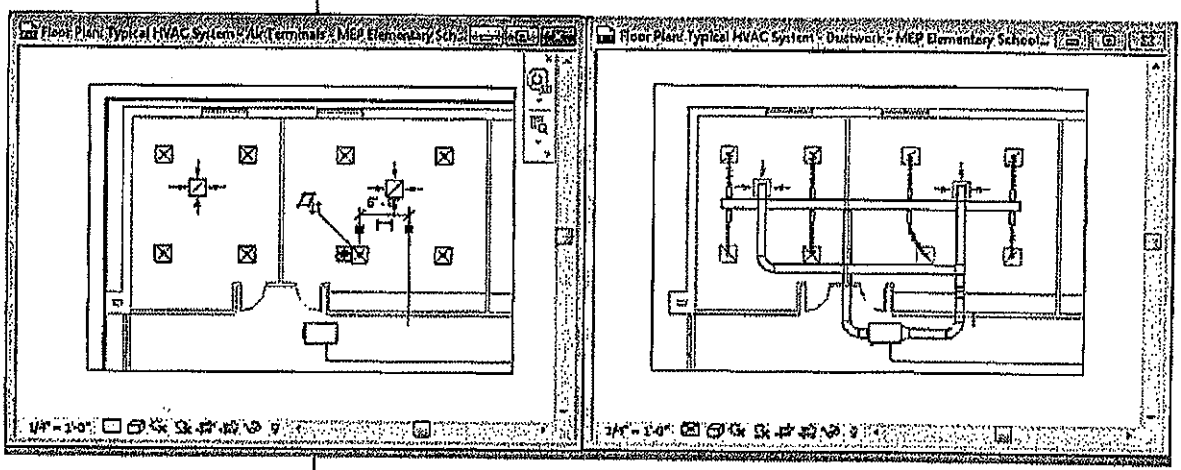

Figure 4–30

12. Save and close the project.

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4.4 Creating Elevations

Add building and interior elevations.

Elevations are *face-on* views of the interiors and exteriors of a building. Four Exterior Elevation views are defined in the default template: **North**, **South**, **East**, and **West**. You can create additional building elevation views at other angles or for Interior Elevation views, such as the elevation shown in Figure 4–31.

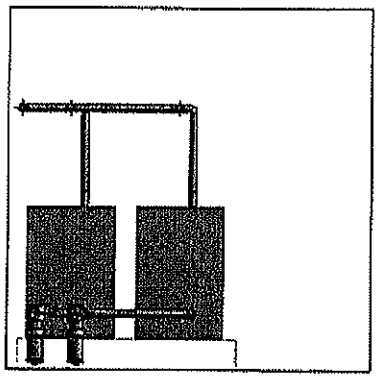

Figure 4–31

- You must be in a plan view to create a new elevation view.

How to: **Create an Elevation**

1. In the *View* tab>Create panel, click (Elevation).
2. Move your cursor near one of the walls that defines the elevation. The marker follows the angle of the wall.
3. Click to place the marker.

- The arrow automatically points towards the nearby walls. To have it point to other elements, place it and use **Rotate** to change its direction.
- The length, width, and height of an interior elevation are defined by the wall(s) at which the elevation marker is pointing.
- To open the elevation view, double-click on the elevation pointer or on its name in the Project Browser. You might have to adjust the crop region in the Elevation view to specify what needs to be seen.

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Modifying the Elevation

- When you add an elevation to a sheet, the detail number is automatically added to the view title.

Select the pointer of the elevation marker (not the circle portion) to display the clip plane, as shown in Figure 4–32. You can adjust the length of the clip planes using the round shape handles and adjust the depth of the elevation using (Control).

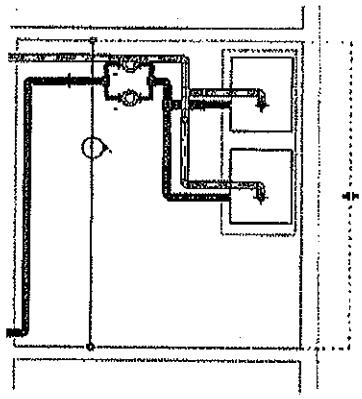

Figure 4–32

To display additional elevations from one marker, place an elevation marker and select the circle portion (not the arrowhead). With the elevation marker selected, place a check mark in the directions that you want to display, as shown in Figure 4–33.

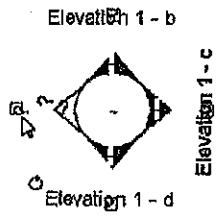

Figure 4–33

Be careful when using Rotate. If it is not exactly perpendicular to the structure, the view is off.

- You can also rotate the marker using (Rotate) (i.e., for a room with angled walls).
- When an elevation marker is deleted, the view is deleted as well.
- When moving an elevation marker, select it using a window so that both the body and the pointer move together.

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4.5 Creating Sections

Create building and wall sections.

Modify section lines including adding a split.

Sections are slices through a model. You can cut a section through a building, as shown in Figure 4–34, or through one wall for a detail. Once you have created a section, you can modify it further in the Section view. Any changes made to the project model are also displayed in the sections.

Sections can be created in plan, elevation, and other section views.

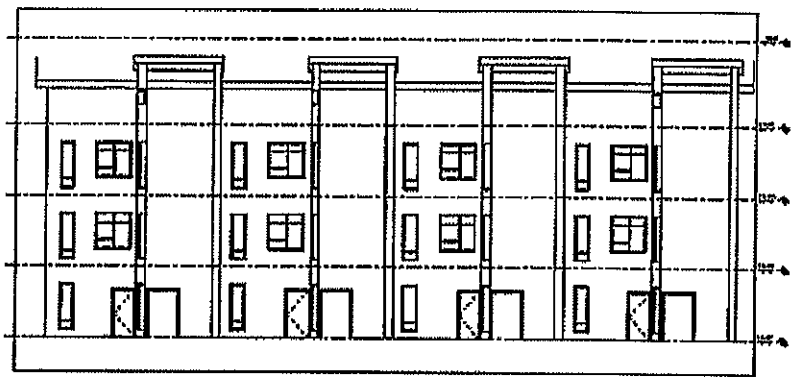

Figure 4–34

How to:

Create a Section

1. In the *View* tab>Create panel or in the Quick Access Toolbar, click (Section).
2. In the Type Selector, select from the types listed.
3. In the view, select a point where you want to locate the section head.
4. Select the other end point where you want to locate the section tail.
5. The shape controls display. You can flip the arrow and change location of the far clip plane, as well as set the location of the section head and tail.

- When you add a section to a sheet, the detail number and sheet number are automatically added to the view title.

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Hint: Using Thin Lines

The Autodesk Revit Structure software automatically applies line weights to views, as shown for a section on the left in Figure 4–35. If a line weight seems heavy or obscures your work on the elements, turn off the line weights. In the Quick Access Toolbar or in the *View* tab>Graphics panel, click (Thin Lines). The lines display with the same weight, as shown on the right in Figure 4–35.

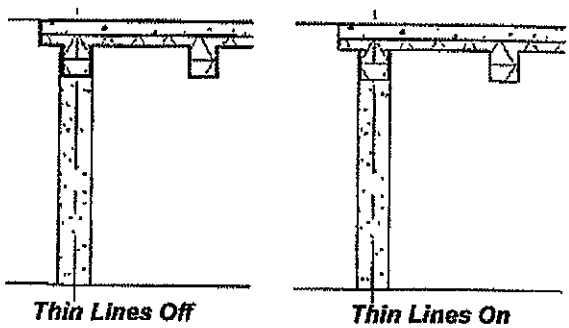

Figure 4–35

Modifying Sections

You can modify a section using shape handles and controls, as shown in Figure 4–36.

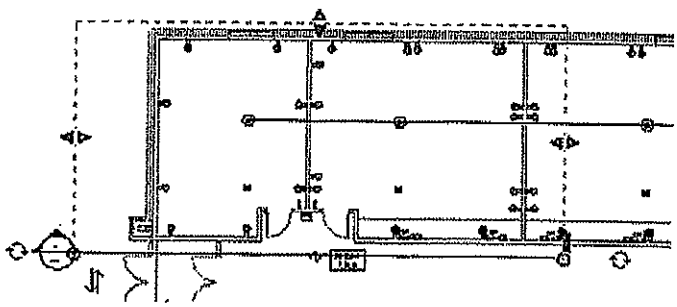

Figure 4–36

- Change the size and location of the cut boundary by dragging (Arrow) on the dashed lines in or out.
- Change the location of the head or tail without changing the cut boundary by dragging the circular handles at either end of the section line.
- Click (Flip) to change the direction of the arrowhead, which also flips the entire section.

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- Cycle between a head, tail, or nothing on each end of the section by selecting (Cycle Section Head).
- Create gaps in section lines by clicking (Break), as shown in Figure 4–37. Select it again to restore the full section cut.

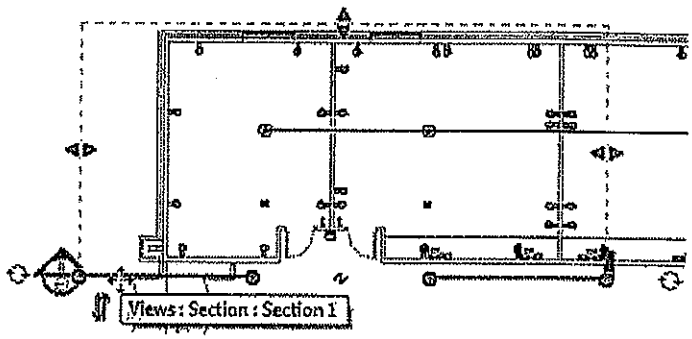

Figure 4–37

How to: **Split a Section Line**

In some cases, you need to create additional offsets in a section line so that it displays the most important information along the cut, as shown in Figure 4–38.

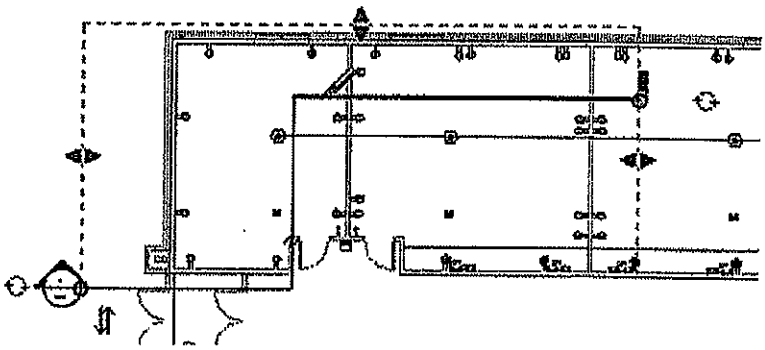

Figure 4–38

1. Select the section line you want to split.
2. In the Section panel, click (Split Segment).
3. Select the point along the line where you want to create the split, as shown in Figure 4–39.

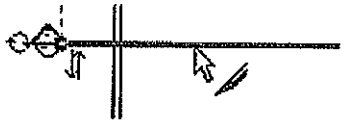

Figure 4–39

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4. Specify the location of the split line, as shown in Figure 4–40.

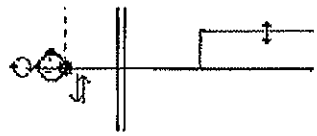

Figure 4–40

- If you need to adjust the location of any segment on the section line, modify it and drag the shape handles along each segment of the line, as shown in Figure 4–41.



Figure 4–41

Hint: 3D Section Views

You can modify a 3D view to display in the section, as shown in Figure 4–42.

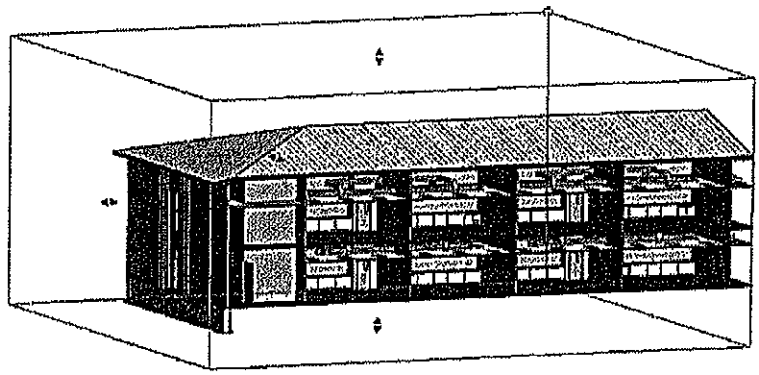

Figure 4–42

1. While in a 3D view and without any elements selected, in Properties, in the *Extents* area, select the **Section Box** parameter.
2. Click Apply, press <Enter>, or click in the view.
3. Select **Section Box** in the 3D view and use the shape handles to modify the plane of the box.

- You can rotate the box to achieve the required cut. Select and drag (Rotate) until it displays the correct cut.

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Practice 4b

Creating Elevations and Sections

Create building and interior elevations and building sections.

Estimated time for completion: 15 minutes

In this practice you will create exterior and interior elevations, as shown in Figure 4–43. You will also add several building sections.

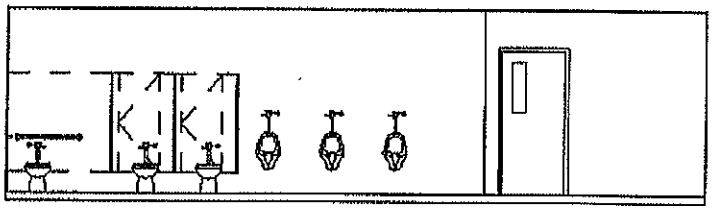

Figure 4–43

Task 1 - Add exterior elevations.

This file is the main architectural project, not an MEP specific project.

1. Open the file **MEP-Elementary-School-Elevations-M.rvt** found in the *Chapter 4* folder of your class folder.
2. Open the **01 FLOOR PLAN - MEP COORDINATION** view.
3. In the *View* tab>Create panel, click (Elevation) and in the Type Selector, select **Elevation: Building Elevation.**
4. Place two elevation markers between the two classroom wings as shown in Figure 4–44.

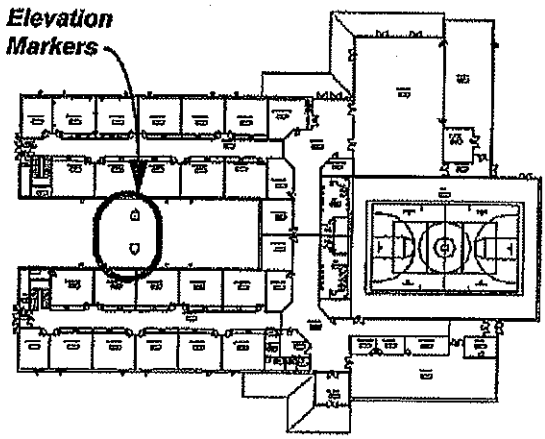

Figure 4–44

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5. Click (Modify).
6. Select the top arrow of the elevation marker.
7. Use the controls to modify the depth of the elevation so that it covers the entire wing as shown in Figure 4–45.

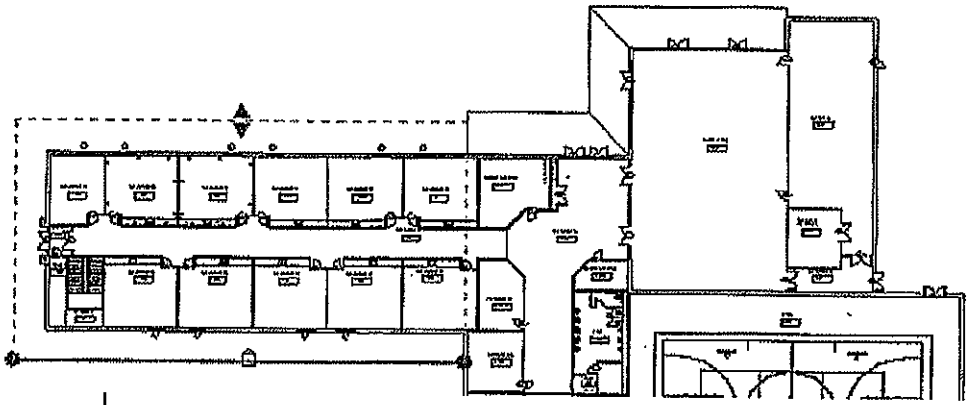

Figure 4–45

8. Repeat for the other direction.
9. To display the view, double-click on the arrow of the elevation marker that points up.
10. In the Project Browser, scroll down to *Elevations (Building Elevation)*.
11. Rename the current view as **North Wing** and rename the other new elevation as **South Wing**.

Task 2 - Add interior elevations.

1. Switch to the **01 FLOOR PLAN - MEP COORDINATION** view.
2. Zoom in on the restrooms near the basketball court.
3. In the *View* tab>Create panel, click (Elevation).
4. In the Type Selector, select **Elevation: Interior Elevation**.
5. Place an elevation facing the wall of sinks in one of the restrooms and then in the other restroom.
6. Click (Modify).

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7. Select the circle part of one of the elevation markers and check the box on the opposite side, as shown in Figure 4–46.

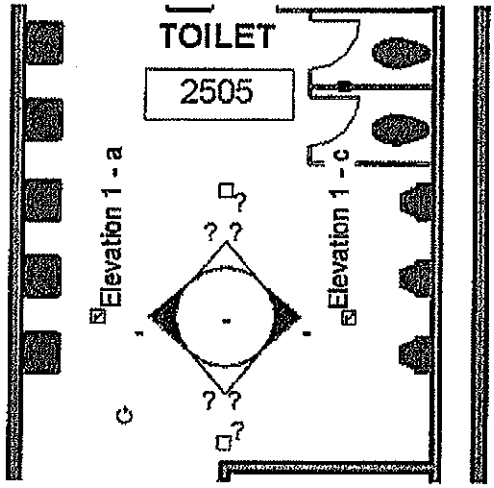

Figure 4–46

8. Repeat for the other restroom.
9. Open one of the elevations, the interior elevation automatically stops at the boundaries of the walls and the level or ceiling above.
10. Select the level and one of the grids (press <Ctrl> to select more than one element) and hide the categories in the view.
11. Save the project.

Task 3 - Add building sections.

1. Switch to the **01 FLOOR PLAN - MEP COORDINATION** view.
2. In the *View* tab>Create panel, click (Section).
3. In the Type Selector, select **Elevation: Building Section.**

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4. Draw several sections through the building, as shown in Figure 4–47.

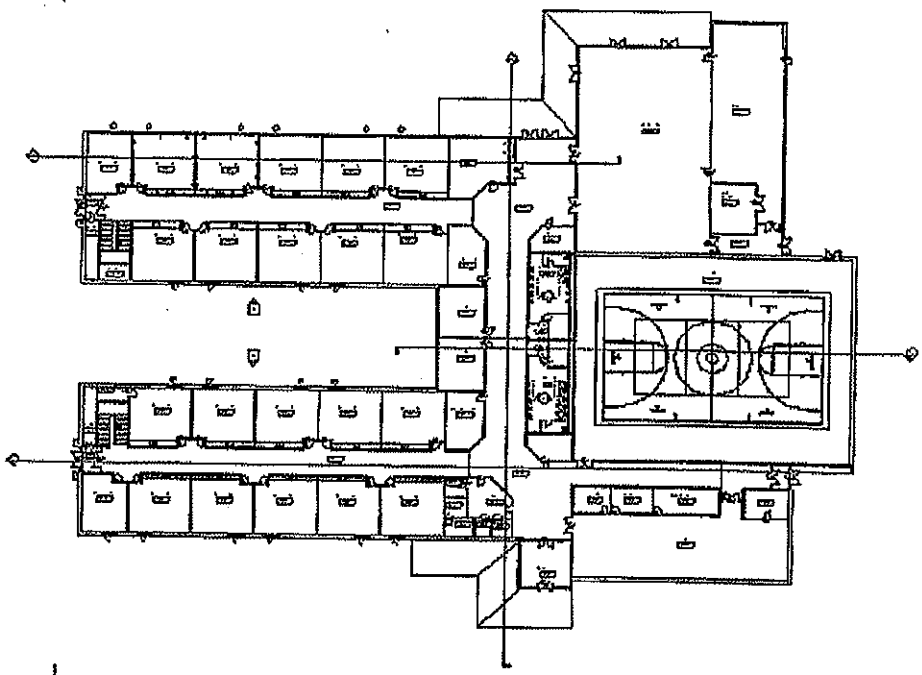

Figure 4–47

5. In the Project Browser, under the *Sections* group, rename the sections as needed.
6. View each of the building sections.
7. Save the project.

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4.6 Working With Ceilings

Create and modify ceilings.

Adding ceilings to Autodesk® Revit® MEP models is a straightforward process. Ceiling grids are typically added to areas bounded by walls and are centered in the space. These are the defaults when you use the **Ceiling** command. However, you can also sketch custom ceilings when needed, such as the diagonally hatched ceiling with a curve as shown in Figure 4–48. The ceiling grid and any fixtures you attach to it display in reflected ceiling plans, as well as in sections and 3D view.

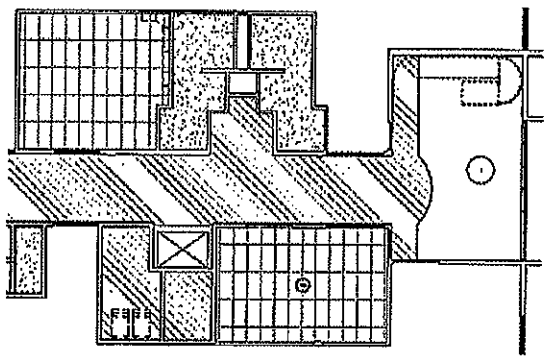

Figure 4–48

How to:

Create a Ceiling

1. Switch to the appropriate Ceiling Plan view.
2. In the *Architecture* tab>Build panel, click (Ceiling).
3. In the Type Selector, select the ceiling type. In Properties set the *Height Offset from Level*.
4. In the *Modify | Place Ceiling* tab>Ceiling panel, verify that (Automatic Ceiling) is selected. Click inside a room to create a ceiling, as shown in Figure 4–49.

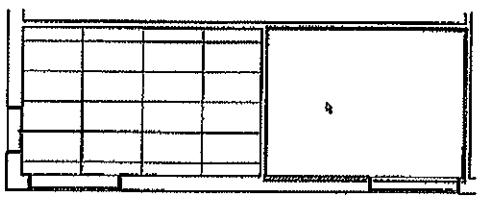

Figure 4–49

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5. Continue adding ceiling grids to other rooms or press <Esc> or click (Modify) to end the command.

- When you start the **Ceiling** command, you are placed in Auto-Ceiling mode. This mode identifies the boundaries of enclosed areas by highlighting them as you hover the cursor over them. When you click, a ceiling is created within that boundary.

Hint: Room Bounding Status

Elements (such as walls, floors, ceilings, and roofs) have a **Room Bounding** parameter that is set in Properties. In most cases, this is turned on by default, as these elements typically define areas and volumes.

The **Automatic Ceiling** tool uses this parameter to identify walls that set the outline of a ceiling. If you turn off this parameter for a wall (such as a partial height wall), the **Automatic Ceiling** tool ignores the wall.

Sketching Ceilings

To include a hole in a ceiling, draw the hole as part of the sketch. The hole must be a closed loop completely inside the ceiling boundary.

You might only want to add a ceiling to part of a room, or have two different ceiling types at separate levels, as shown in Figure 4–50. In these cases, you need to sketch a ceiling.

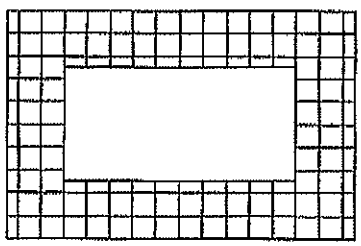

Figure 4–50

How to:

Sketch a Ceiling

1. In the *Architecture* tab>Build panel, click (Ceiling).
2. In the *Modify | Place Ceiling* tab>Ceiling panel, click (Sketch Ceiling).
3. In the Draw panel, click (Line) or (Pick Walls) and define a closed loop for the ceiling boundary, similar to sketching a floor boundary.
4. Click (Finish Edit Mode) to create the ceiling.

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Modifying Ceilings

You can modify the ceiling type and properties, as well as edit the boundary and position the grid lines, as shown in Figure 4–51.

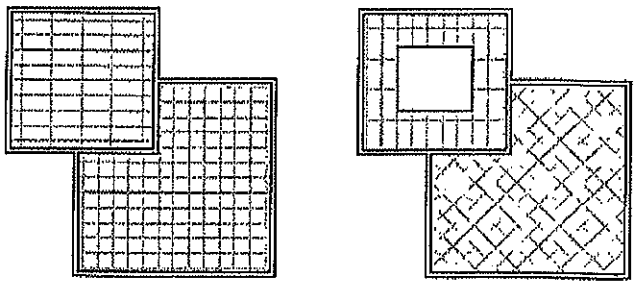

Figure 4–51

How to: **Modify a Ceiling Boundary**

1. Hover your cursor over a grid line or an edge of the ceiling and press <Tab> until the boundary displays. Click to select it.
2. In the *Modify* |*Ceilings* tab>Mode panel, click (Edit Boundary).
3. Modify the boundary as needed by drawing additional lines or using the Modify tools.

How to: **Move a Ceiling Grid**

1. Select a grid line in the ceiling that you want to modify.
2. In the *Modify* | *Ceilings* tab>Modify panel, click (Move).
3. Move the cursor to one side and type a distance, such as **300mm** or **150mm**.

How to: **Rotate a Ceiling Grid**

1. Select a grid line in the ceiling that you want to modify.
2. In the *Modify* | *Ceilings* tab>Modify panel, click (Rotate).
3. In the Options Bar, type an *Angle* or use the (Rotate) control to visually select the angle.
4. The standard 600 x 1200mm ceiling grid style might be oriented horizontally. To make it vertical, select a grid line and use (Rotate) to rotate it 90 degrees.

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Practice 4c

Estimated time for completion: 10 minutes

Working with Ceilings

- Add ceilings using both the automatic and sketched methods.
- Modify the heights of ceilings and the location of ceiling fixtures.

In this practice you will add ceilings to a group of rooms using Automatic Ceiling and Sketch Ceiling. You will modify the height of the ceilings in Properties. Finally, you will move the ceiling fixtures to fit at the correct location on the grids, as shown in Figure 4–52.

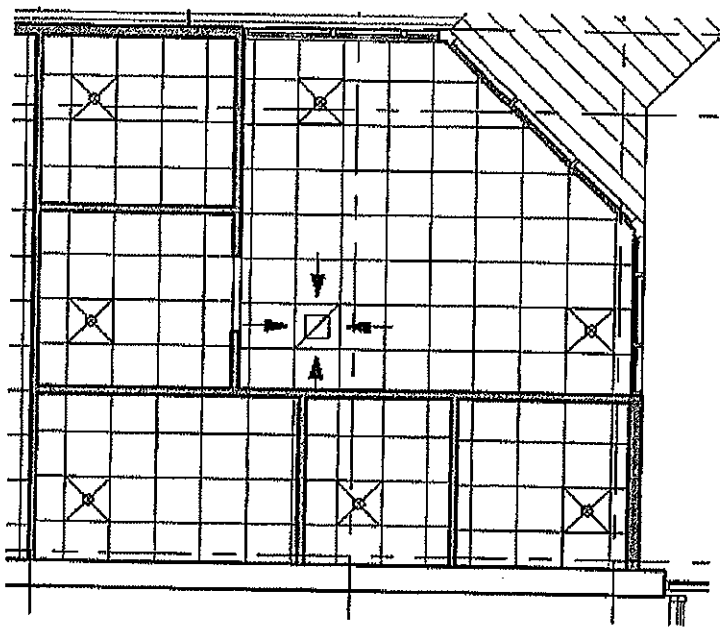

Figure 4–52

Task 1 - Add Ceilings

1. Open the project **MEP-Elementary-School-Ceilings-M.rvt** found in the *Chapter 4* folder of your class folder.
2. In the Project Browser, open the Coordination>All>Ceiling Plans: **Level 1** view.

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Figure 4–53 shows the location in the floor plan view.

3. Zoom in on the Office near the main entrance of the building as shown in Figure 4–53.

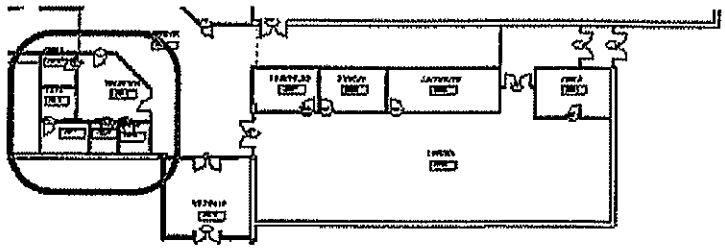

Figure 4–53

4. In the *Architecture* tab>Build panel, click (Ceiling).
5. In the Type Selector, select **Compound Ceiling: 600 x 600mm Grid** and in Properties, set the *Height Offset from Level* to **2440mm**.
6. In the *Modify | Place Ceiling* tab>Ceiling panel, verify that (Automatic Ceiling) is selected.
7. Click inside each of the rooms to place a ceiling.
8. One room is not working correctly as shown in Figure 4–54. In the *Modify | Place Ceiling* tab>Ceiling panel, click (Sketch Ceiling).

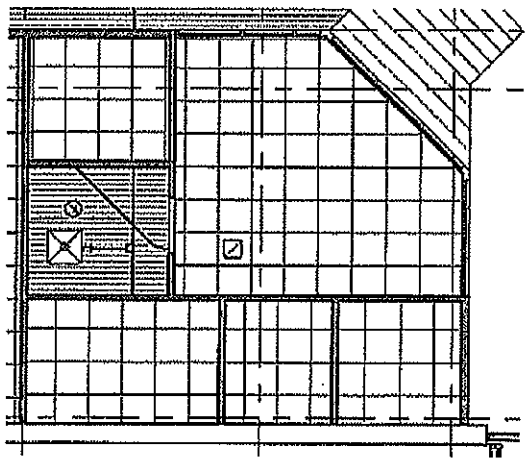

Figure 4–54

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9. In the *Modify | Create Ceiling Boundary* tab>Draw panel use one of the draw tools to create the rectangular boundary as shown in Figure 4–55.

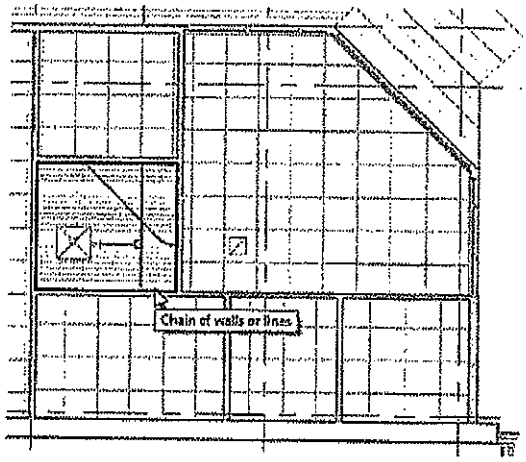

Figure 4–55

10. In the Mode panel, click (Finish Edit Mode).

11. The existing lighting and mechanical fixtures are not displayed because the ceiling is too low. Select one of the ceilings by its boundary or one of the grid lines. In Properties, change the *Height Offset from Level* to **2740mm** as shown in Figure 4–56.

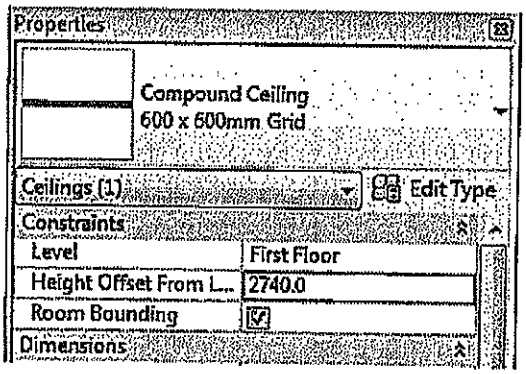

Figure 4–56

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12. Select the rest of the ceilings (hold down <Ctrl> and select one grid line in each room), and change their heights to **2740mm** as well. The fixtures now display but they are not placed on the grids correctly as shown in Figure 4–57.

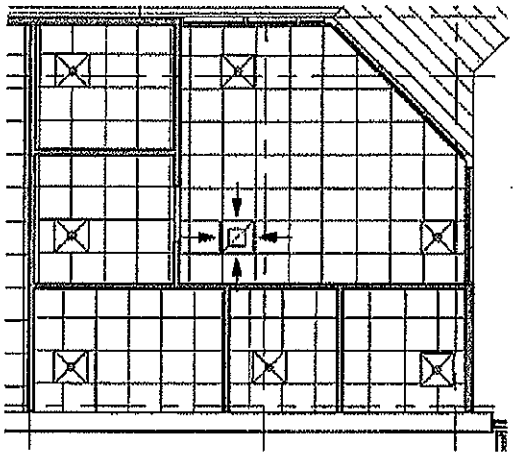

Figure 4–57

13. Use (Align) to reposition the ceiling fixtures so they are in-line with the grid.

14. Save and close the project.

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Chapter Review Questions

1. Which of the following can you use to create a jog in a section line?
   a. **Split Segment** command
   b. **Add Jog** control
   c. **Add Elbow** control
   d. **Split** command
2. You have a plan view with dimension and tags and you want to create a duplicate view that does not need to have the dimensions and tags included. Which **Duplicate View** option would you use?
   a. **Duplicate**
   b. **Duplicate with Detailing**
   c. **Duplicate as a Dependent**
3. You have a plan view with dimension and tags and you want to create a duplicate view which also needs to display the dimensions. Which **Duplicate View** option would you use?
   a. **Duplicate**
   b. **Duplicate with Detailing**
   c. **Duplicate as a Dependent**
4. Where can you turn off the display of annotation objects, such as elevation and section markers?
   a. Options Bar
   b. Dynamically Modify View dialog box
   c. Visibility/Graphics Overrides dialog box
   d. Annotation Properties
5. How do you control the extents of a view?
   a. Modify the Crop Region.
   b. Modify the View Boundary.
   c. Modify the View Extents.
   d. Modify the View Overrides.

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Command Summary

Button	Command	Location
	**Callout**	■ **Ribbon:** *View* tab>Create panel> Callout
	**Ceiling**	■ **Ribbon:** *Architecture* tab>Build panel
	**Crop View**	■ **View Control Bar** ■ **View Properties:** Crop View (check)
	**Do Not Crop View**	■ **View Control Bar** ■ **View Properties:** Crop View (clear)
	**Duplicate Views> Duplicate**	■ **Ribbon:** *View* tab>Create panel> Duplicate View>Duplicate View ■ **Right-click:** (*on a view in the Project Browser*) Duplicate View>Duplicate
	**Duplicate Views> Duplicate with Detailing**	■ **Ribbon:** *View* tab>Create panel> Duplicate View>Duplicate with Detailing ■ **Right-click:** (*on a view in the Project Browser*) Duplicate View>Duplicate with Detailing
	**Duplicate Views> Duplicate as Dependent**	■ **Ribbon:** *View* tab>Create panel> Duplicate View>Duplicate as Dependent ■ **Right-click:** (*on a view in the Project Browser*) Duplicate View>Duplicate as Dependent
	**Elevation**	■ **Ribbon:** *View* tab>Create panel> Elevation
	**Hide Crop Region**	■ **View Control Bar** ■ **View Properties:** Crop Region Visible (clear)
	**Hide in View**	■ **Ribbon:** *Modify* tab>View panel> Hide>Elements *or* By Category ■ **Right-click:** *(when an element is selected)* Hide in View>Elements *or* Category
	**Override Graphics in View**	■ **Ribbon:** *Modify* tab>View panel> Hide>Elements *or* By Category ■ **Right-click:** *(when an element is selected)* Override Graphics in View>By Element *or* By Category ■ **Shortcut:** *(Category only)* VV or VG
	**Reveal Hidden Elements**	■ **View Control Bar**

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	**Show Crop Region**	■ **View Control Bar** ■ **View Properties:** Crop Region Visible (check)
	**Section**	■ **Ribbon:** *View* tab>Create panel> Section ■ **Quick Access Toolbar**
	**Temporary Hide/Isolate**	■ **View Control Bar**

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Chapter 5

Understanding Autodesk Revit MEP Systems

In this chapter you learn about Autodesk® Revit® MEP systems in general, including how to work with components such as air terminals, mechanical equipment, plumbing fixtures, and electrical fixtures. You also get an overview of creating systems and learn about applying graphic overrides to systems and views, connecting the components, and analyzing the systems.

This chapter contains the following topics:

- ✓**About MEP Systems**
- ✓**Working with Components**
- ✓**Creating Systems - Overview**
- ✓**System Graphics**
- ✓**Connecting Components**
- ✓**Analyzing Systems**

Learning Objectives

This chapter provides instruction to enable you to do the following:

5.1 About MEP Systems

- Identify the systems supplied with the Autodesk Revit MEP software and access the system commands.

5.2 Working with Components

- Load and insert components used by the various systems.

5.3 Creating Systems - Overview

- Create systems.
- Use the System Browser to identify and select systems and components of systems.

5.4 System Graphics

- Set up and use duct and piping systems, graphic overrides, and filters.

5.5 Connecting Components

- Connect systems using ducts, pipes, conduit, cable tray, or wiring using manual or automatic tools.

5.6 Analyzing Systems

- Check systems by displaying disconnects and running the **Check Systems** tool.
- Use the System Inspector to display information about the system.
- Automatically size ducts and pipes based on established criteria.

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5.1 About MEP Systems

Identify the systems supplied with the Autodesk Revit MEP software and access the system commands.

Autodesk Revit MEP systems includes duct, piping, and electrical systems that are used in the process of creating and analyzing the various elements. These elements make up the HVAC, piping, fire suppression, plumbing, and electrical layouts in a building.

Frequently these systems overlap. For example, a chilled water air handling unit is connected to supply and return duct systems, hydronic supply, and return systems. It also needs electrical input and therefore is connected to an electrical system (circuit) as well, as shown in Figure 5–1.

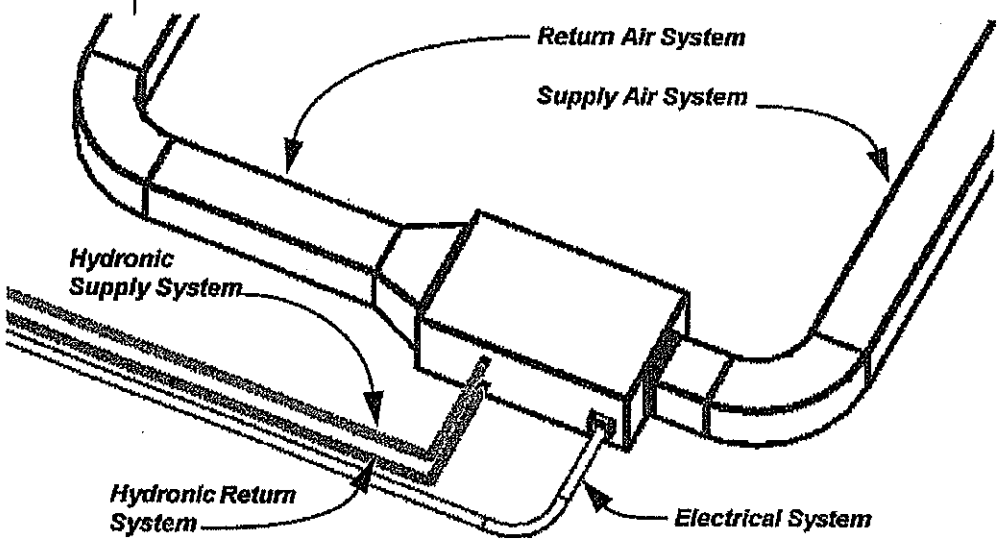

Figure 5–1

While not each of these systems is covered in detail, the process for creating the systems is similar for every instance.

1. Add mechanical or electrical equipment.
2. Add end components such as air terminals, plumbing fixtures, sprinklers, and electrical fixtures and devices.
3. Create the system.
4. Generate the layout of the duct or pipe to connect equipment and fixtures, or model these manually.
5. Analyze the systems using the System Browser. Check Systems tools and the System Inspector.
6. Review and update information in related schedules.

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Accessing MEP System Commands

As you are creating the systems, several similar ribbon tabs hold the commands that you need.

- The system components and connectors (such as ducts and pipes) are found in the *Systems* tab as shown in Figure 5–2.

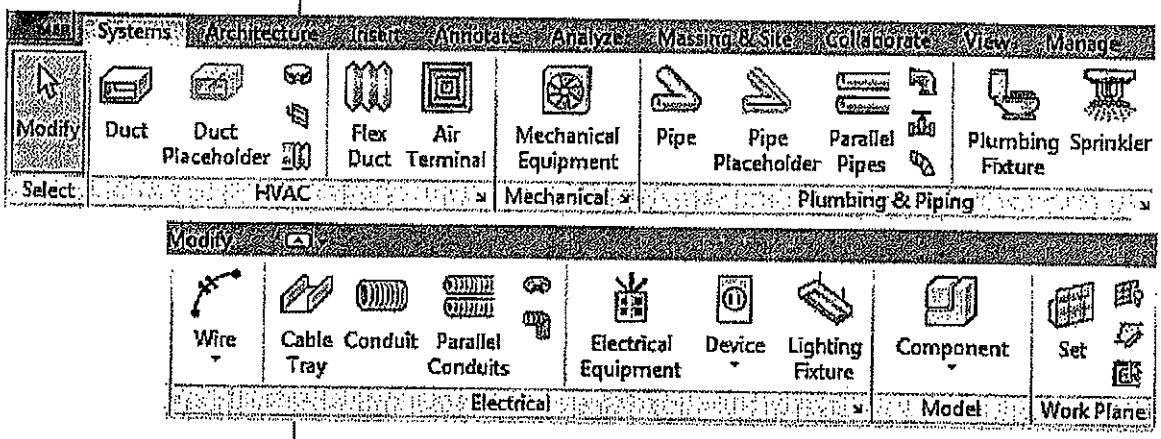

Figure 5–2

- When you select one of the components, a contextual tab displays with the option of creating a system, as shown in Figure 5–3. In this case, the selected mechanical equipment component can be connected to Duct, Power, and Piping Systems.

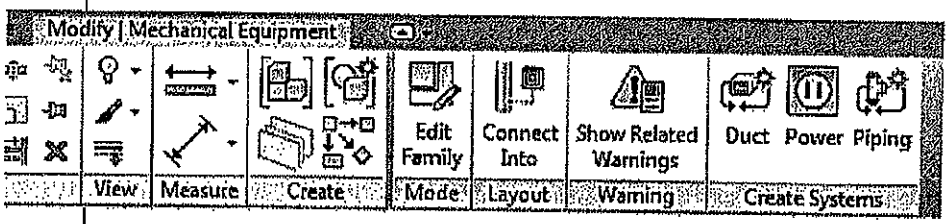

Figure 5–3

- When you have a system in place, a contextual tab with editing options such as adding or removing components displays, as shown in Figure 5–4 for a Duct system.

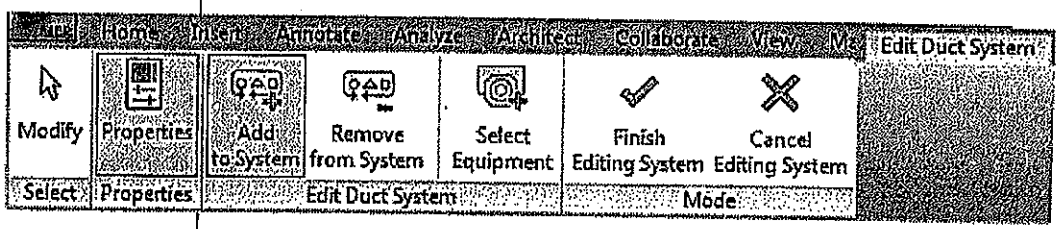

Figure 5–4

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5.2 Working with Components

Load and insert components used by the various systems.

Air terminals, mechanical equipment, plumbing fixtures, sprinklers, as well as electrical equipment, devices, and lighting fixtures are all considered Autodesk Revit MEP components. They are full 3D elements that can be placed at appropriate locations and heights as shown in Figure 5–5. The general methods for inserting and modifying those are the same for all the different types of components.

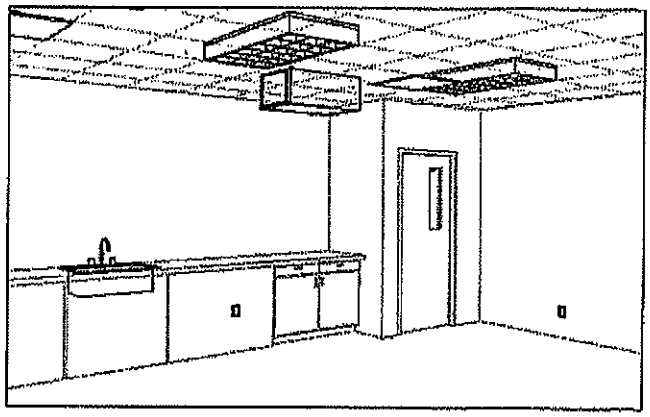

Figure 5–5

How to: **Insert Components**

1. Start the appropriate command.
2. In the Type Selector, select the type/size you want to use, as shown in Figure 5–6.

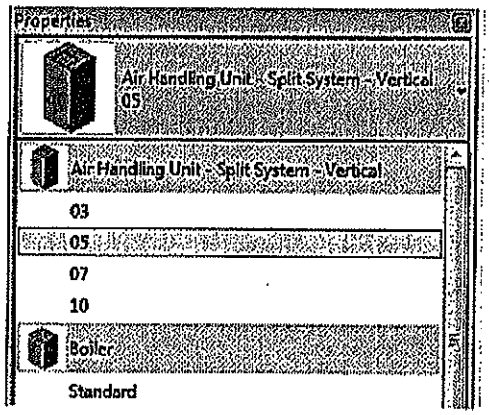

Figure 5–6

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Parameters found in Properties are also included in schedules.

Set the Elevation for components hosted by walls.

3. In the related contextual tab>Tag panel, click (Tag on Placement) to toggle this option on or off.
4. In Properties or in the Options Bar, set appropriate information.
5. Depending on the type of component select the following:
   - If the component can be placed on any surface, set the *Level* and *Offset* in Properties, as shown in Figure 5–7, and then click in the model to place it.

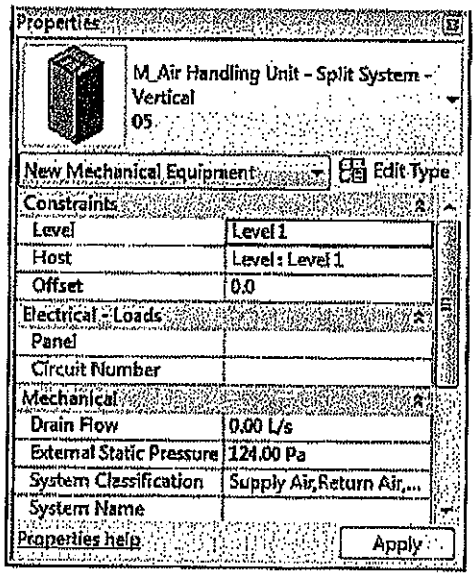

Figure 5–7

   - If the component can be placed on a face, the options display in the related contextual tab>Placement panel, as shown in Figure 5–8.

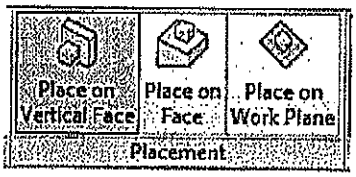

Figure 5–8

	Place on Vertical Face	Places the component on a vertical face, such as a wall.
	Place on Face	Places the component on a defined face, such as the ceiling grid.
	Place on Work Plane	Places the component on a defined plane such as a level or ceiling in a linked architectural model.

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Loading Family Types

If the required components for mechanical or electrical equipment, air terminals, plumbing fixtures, etc., do not exist in your project, you can load the families from the library. A wide variety of families is stored in library folders for Cable Trays, Conduit, Duct, Electrical Components, Fire Protection, Mechanical Components, Pipe, and Plumbing Components, as shown in Figure 5–9.

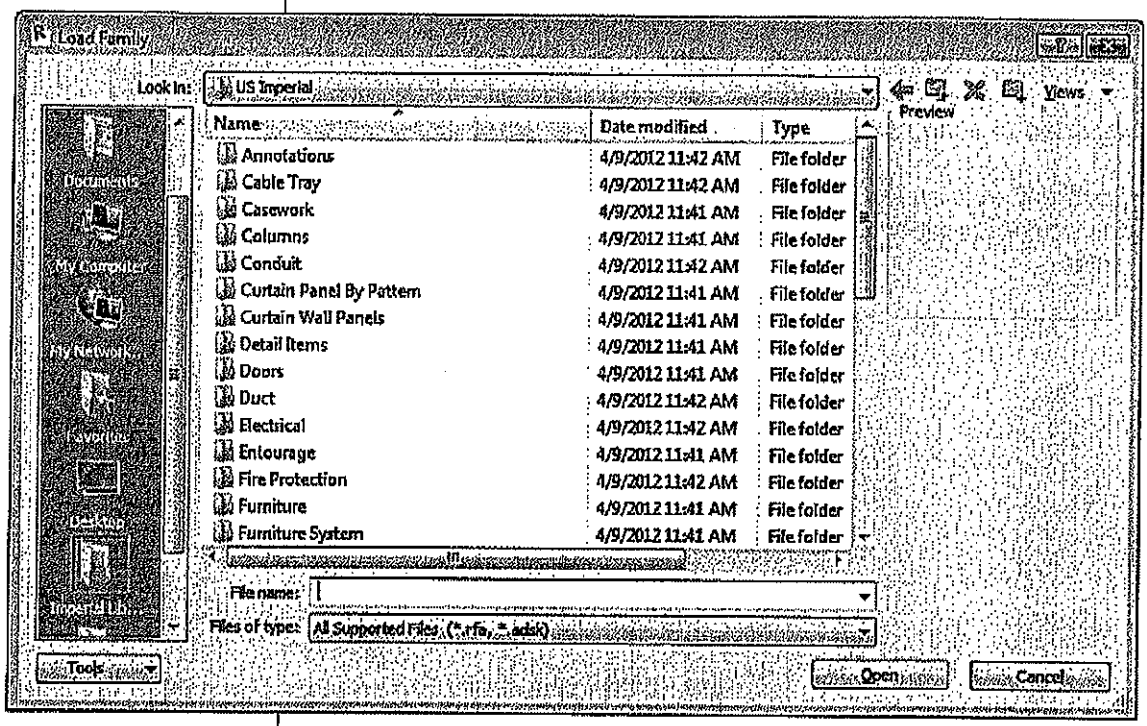

Figure 5–9

How to: Load Family Types

1. If you have started a command such as Air Terminal or Plumbing Fixture, in the *Modify | contextual* tab>Mode panel, click (Load Family). If you have not started a command, in the *Insert* tab>Load from Library panel, click (Load Family).
2. In the Load Family dialog box, navigate to the appropriate folder, select a type and click Open. The component is then available for selection in the Type Selector.

- If a family type or tag for that type has not been loaded, you are prompted to load one.

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Hint: Batch Copying

If you are working with a linked model that has components, such as plumbing fixtures or lighting fixtures, already placed, as shown in Figure 5–10, you can batch copy them into the host project using the appropriate MEP families in their place.

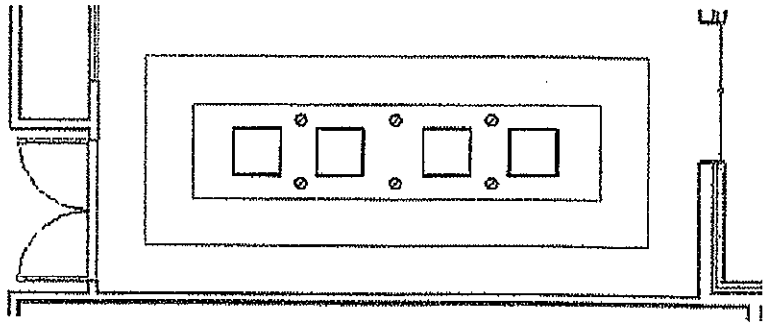

Figure 5–10

After you start the **Copy/Monitor** command, set up the Coordination Settings to enable batch copying as shown in Figure 5–11. Then, in the *Copy/Monitor* tab>Tools panel, click (Batch Copy) to start the command.

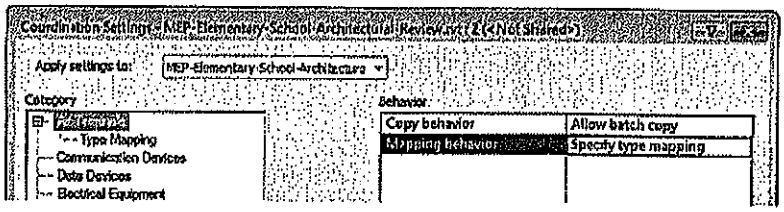

Figure 5–11

5.3 Creating Systems - Overview

- Create systems.
- Use the System Browser to identify and select systems and components of systems.

Some systems, such as sanitary and domestic cold water, do not have equipment.

Systems are made up of components that are of the same type or have connectors to that type of system. Most systems have end components and one piece of source equipment, as shown in Figure 5–12, with a group of supply air terminals and an air handling unit. The general method for creating all different systems is similar. The System Browser helps you identify and evaluate the system components.

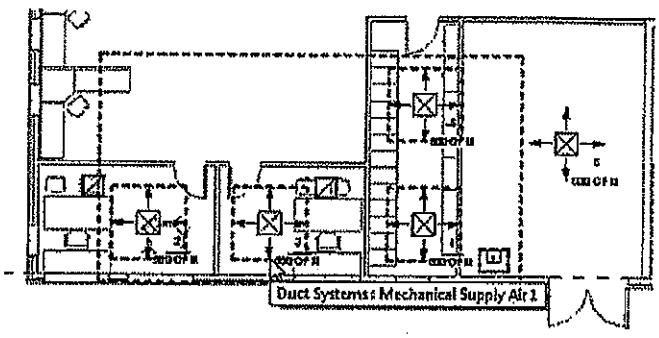

Figure 5–12

- Components can be part of several systems. For example, if an air handling unit is using hot water from a central boiler, then that boiler and all the air handling units receiving water from it would be part of a separate hydronic supply system, as shown in Figure 5–13.

Creating systems correctly is critical for the Autodesk Revit MEP software to understand and calculate flow, pressure, etc.

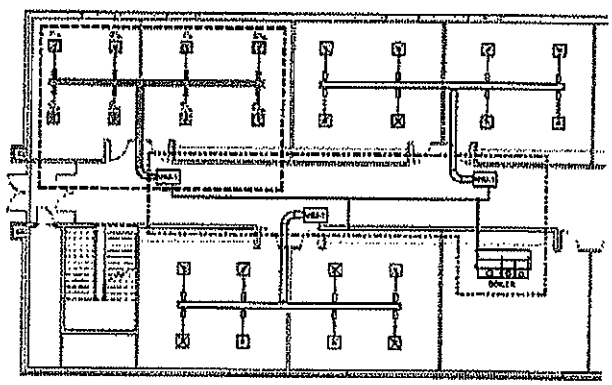

Figure 5–13

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How to:

Create a System

The type of systems available depends on the component you select.

1. Select one or more related components. (For example, you can select supply air terminals but not supply and return air terminals or not supply terminals and a light switch.) Do not select source equipment at this point.
2. In the *Modify | contextual* tab> Create Systems panel, click (Duct), (Power), (Piping), (Data), (Fire Alarm, (Controls) or other system types.
3. For Duct and Piping Systems, you are prompted to select the *System type* and assign a *System name,* as shown in Figure 5–14. Then click OK.

If you know you want to add the source equipment or more components to the system at this time, select ***Open in System Editor.***

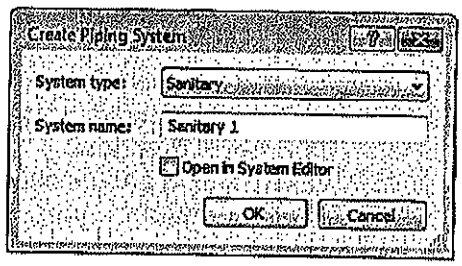

Figure 5–14

4. In the contextual *Modify* tab>System Tools panel, click (Select Equipment) as shown in Figure 5–15, or click (Select Panel).

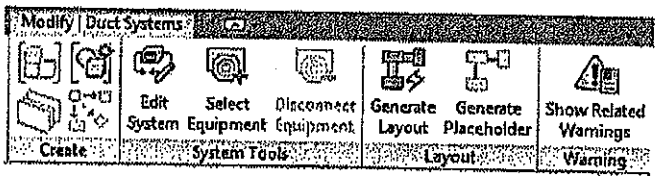

Figure 5–15

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5. If you want to add additional end components (and did not select **Open** in System Editor, for ducts or pipes), in the contextual *Modify* tab>System Tools panel, click the related Edit tool such as (Edit Circuit). The related contextual tab displays, as shown in Figure 5–16.

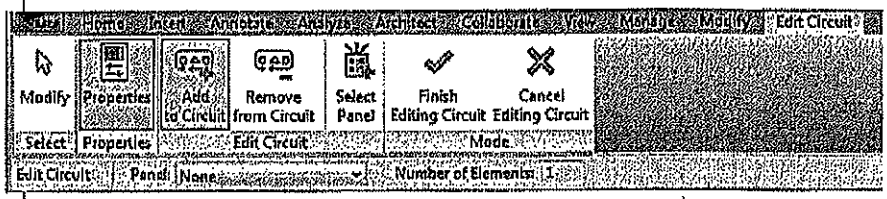

Figure 5–16

- While the icon and name for each system type is different, the processes and locations are still the same.

6. The related **Add to** tool is automatically selected. Click on other components in the model to add them to the system. Remove components from the system using the **Remove from** tool.
7. To add mechanical equipment or an electrical panel to a system, you can use the related **Select** tool or in the Options Bar, select the equipment from a list.
8. When you have completed your selection, click (Finish Editing).

- Whenever you select a component that is assigned to a system, you can return to editing the system by clicking on the contextual tabs, as shown for an air handling unit in Figure 5–17.

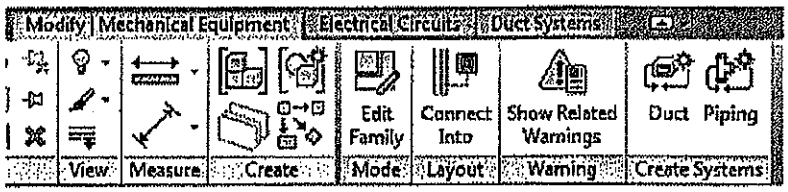

Figure 5–17

- When drawing piping or ductwork, you do not have to create a system or select mechanical equipment first. For example, if you draw ductwork between two Return Air Terminals, all the elements are automatically placed in a new Return Air System.

- You can select a system by hovering over one component and pressing <Tab> until the system highlights.

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Hint: Dealing with Warnings

Warnings might display as you are working or in one of the contextual tabs. These are situations that can be ignored and dealt with at a later time. Click (Show Related Warnings) to open a dialog box displaying messages about what is not working. Often, these are corrected as you continue working in a system and complete the full connection. However, some need to be corrected before the system works as required.

Using the System Browser

The System Browser, as shown in Figure 5–18, is an important part of determining the relationships between components and the systems they are a part of. It also enables you to identify and select the components, especially those not assigned to a system.

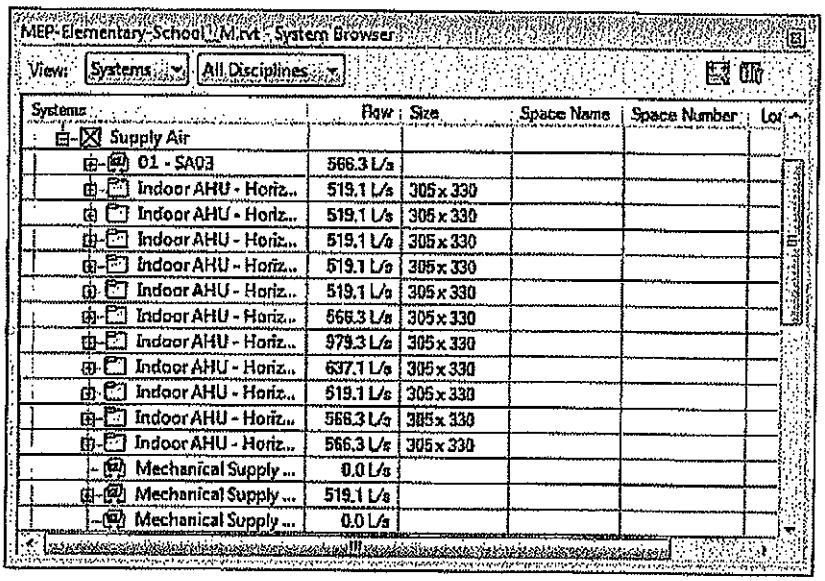

Figure 5–18

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- To display the System Browser, press <F9> or, in the *View* tab>Windows panel, expand (User Interface) and select **System Browser** as shown in Figure 5–19.

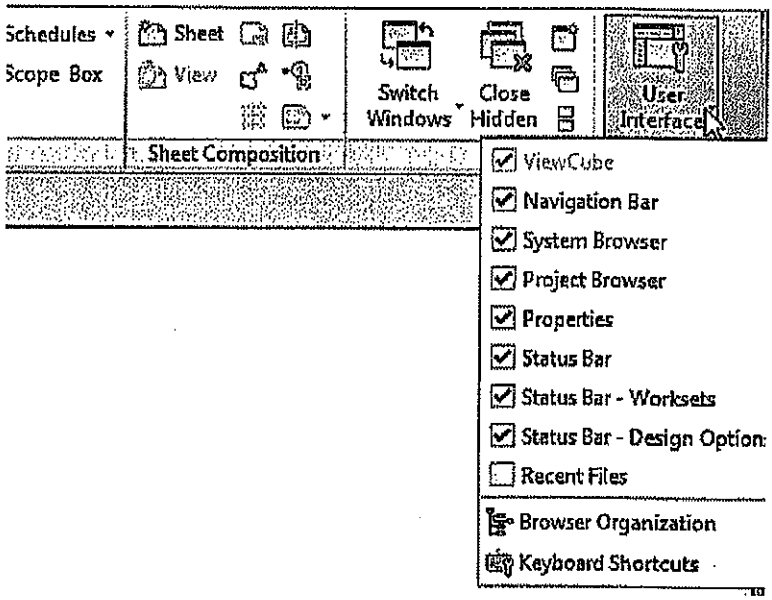

Figure 5–19

- You can float or dock the System Browser to any side of the screen. You can also place it on a second monitor.

- At the top of the System Browser you can select **Systems** or **Zones** (used in HVAC analysis) to display the drop-down list. When working with Systems, select the discipline in which you want to work, as shown in Figure 5–20. Selecting a discipline limits the display of elements to that specific discipline both in the system names and in the *Unassigned* area.

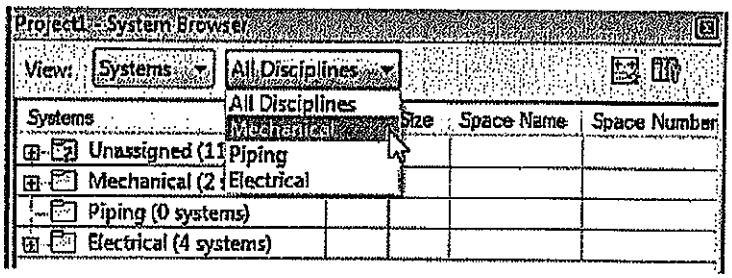

Figure 5–20

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- The System Browser is setup with a multiple level tree structure for clarity. Expand the nodes down to the components level to view all the components found in each system. Components that are not in a system, display in the Unassigned list which is also setup in the tree structure.
- In the System Browser, when you hover the cursor over the system name or select it, or select an individual component, it gets selected in the model as shown in Figure 5–21.

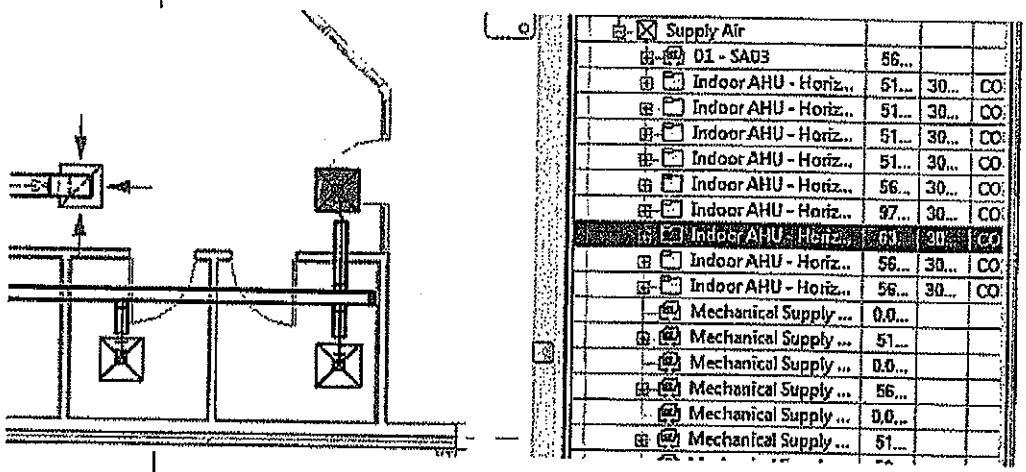

Figure 5–21

- You can select multiple items in the System Browser by holding down <Ctrl> or <Shift> while selecting.
- If you select a component in the model, it is also selected in the System Browser.

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- If you select a component that is referenced to multiple systems, it is highlighted in each of those systems as shown in Figure 5–22.

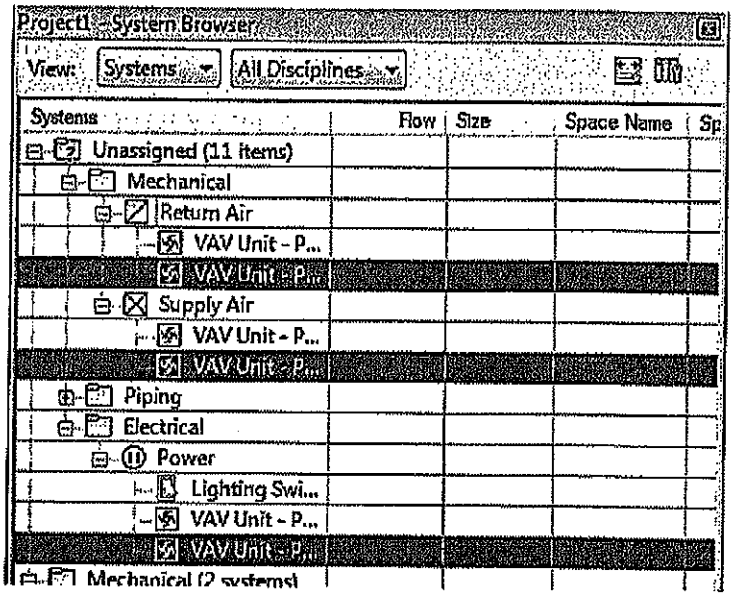

Figure 5–22

- When a component or system is selected in the System Browser, it also displays in Properties where you can modify parameters associated with the items.

- If you want to get a close-up view of a component, select it in the System Browser, right-click and select **Show**. If a view with the component is already open, it zooms into that view. In the Show Element(s) In View dialog box, as shown in Figure 5–23, click Show to search for other views.

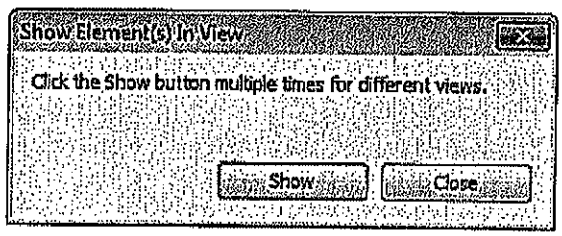

Figure 5–23

- To delete a component through the System Browser, right-click on it and select **Delete**. This deletes it from the project.

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Hint: What is displayed in the System Browser?

Two buttons in the System Browser help display what you need to see. Click (Autofit all Colums) to change the width of the columns so that the contents fit exactly in the column.

Click (Column Settings) to open the Column Settings dialog box, as shown in Figure 5–24, in which you can select the parameters to display for the various system types.

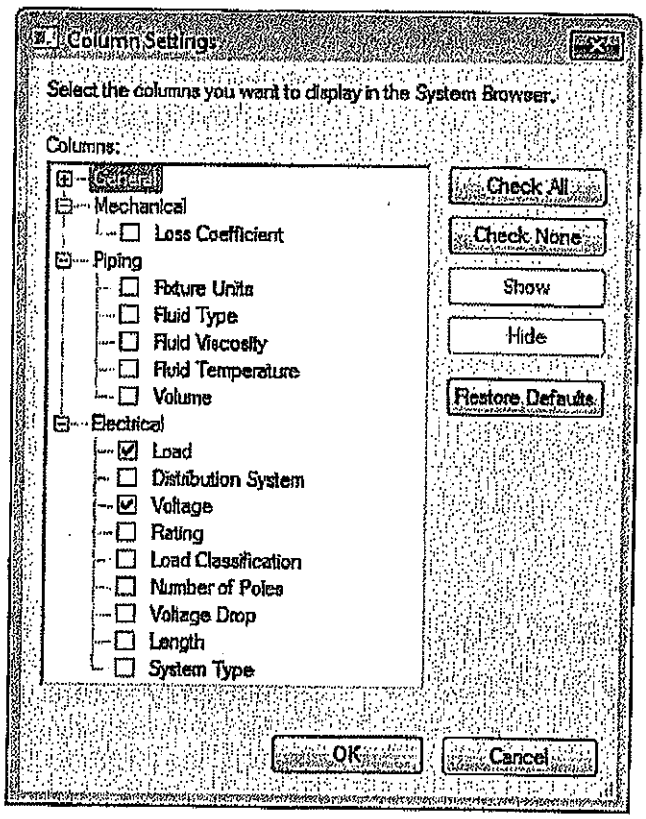

Figure 5–24

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5.4 System Graphics

Set up and use duct and piping systems, graphic overrides, and filters.

When you start working with systems, it helps to have color coding to identify different systems within a discipline. For example, you can have supply ducts display in one color and return ducts display in a different color. These are setup by graphic overrides at the system level. You can also setup filters that help you display only the systems you want to see in a view. For example, in a section view, you might want to display the sanitary piping only and not the hot and cold water piping, as shown in Figure 5–25.

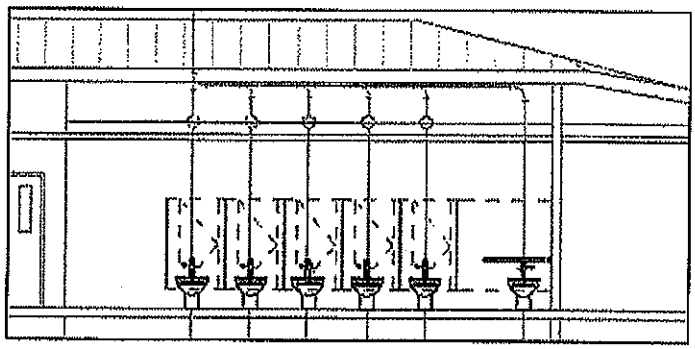

Figure 5–25

Duct and Piping System Graphic Overrides

When you create Duct and Piping Systems, they are automatically assigned specific graphic overrides based on the system family settings. By default, for example, Return Air Systems are magenta and Supply Air Systems are blue. In this example the Hydronic Supply Systems are red, and Hydronic Return Systems are cyan. The colors display in all views including 3D views, as shown in Figure 5–26.

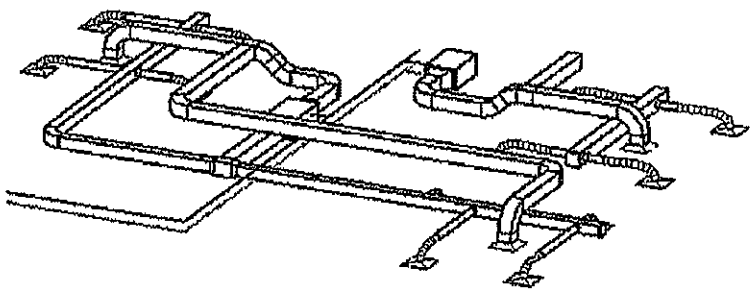

Figure 5–26

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The various Piping Systems, as shown in the Project Browser in Figure 5–27, also have graphic overrides applied.

To create a new system family, in the Project Browser, right-click on an existing type and duplicate it.

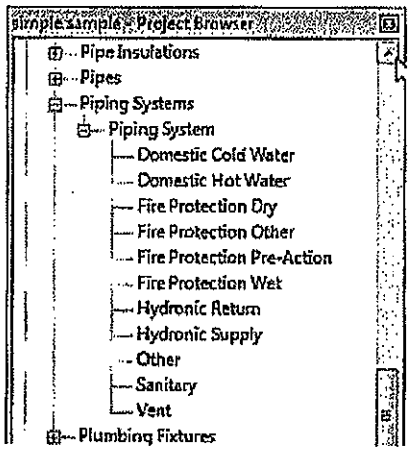

Figure 5–27

Legacy drawings need to be updated.

- These graphic overrides are consistent across a project. They are not view dependent. This is a change from earlier versions of the Autodesk Revit MEP software where the View Filters were applied individually to views.

How to:

Setup System Graphic Overrides

1. In the Project Browser, expand **Families>Piping (or Duct) Systems> Piping (or Duct) System**.
2. Double-click on the one that you want to modify or right-click and select **Type Properties**.
3. In the Type Properties dialog box next to *Graphic Overrides*, click Edit....
4. In the Line Graphics dialog box as shown in Figure 5–28, make changes to the *Weight*, *Color*, and/or *Pattern*.

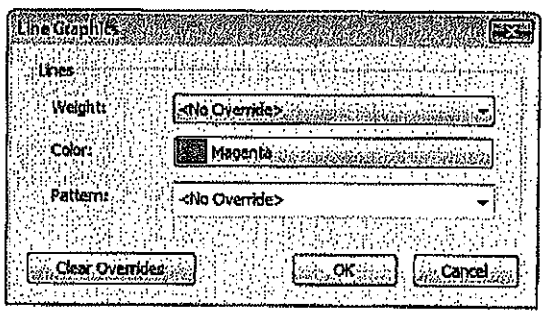

Figure 5–28

5. Click OK twice to apply the changes.

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Using Graphic Override Filters

Any view can be duplicated and then set to display only specific systems in the view by using filters. In the example in Figure 5–29, the view on the left displays all the systems and also extra elements such as data components. The view on the right has graphic overrides that turn off extraneous elements and filters out all systems except duct and hydronic piping.

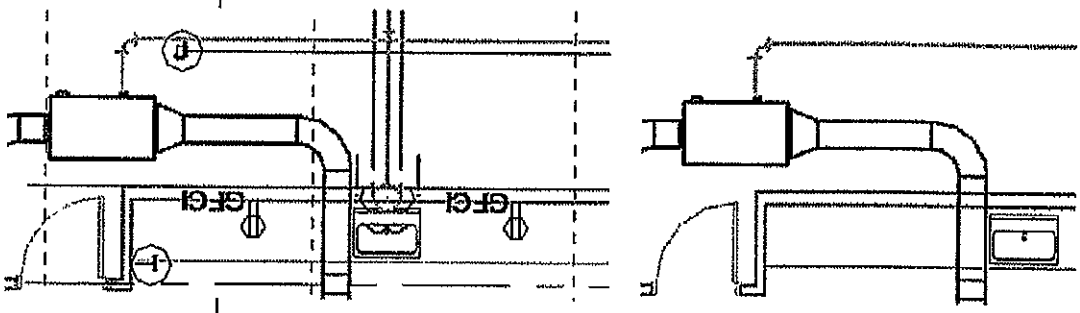

Figure 5–29

- When you create an elevation or section, it uses the basic filters from the original plan view, but some cleanup might be required using Visibility Graphics Overrides.

How to:

Apply a View Filter to Override a View

1. Type **VG** or **VV** to open the Visibility/Graphic Overrides dialog box.
2. In the dialog box, select the *Filters* tab. Some filters might be available.
3. To add a new filter to this view, click Add.
4. In the Add Filters dialog box, as shown in Figure 5–30, select the type of systems you want to modify and click OK.

The list might vary depending on the filters that have been set up in the project.

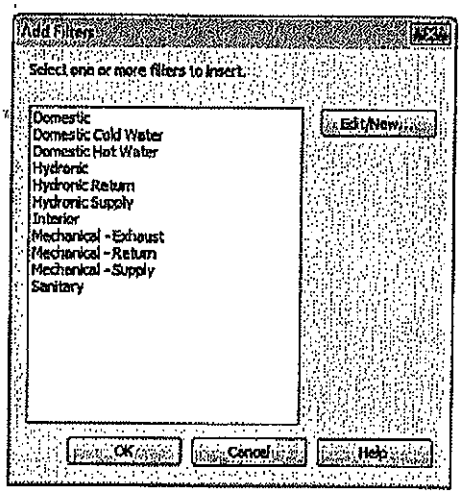

Figure 5–30

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5. In the *Filters* tab, select **Visibility** and any other overrides you might want to use. In the example in Figure 5–31, the Domestic Cold and Hot Water have been turned off while only the Sanitary systems display.

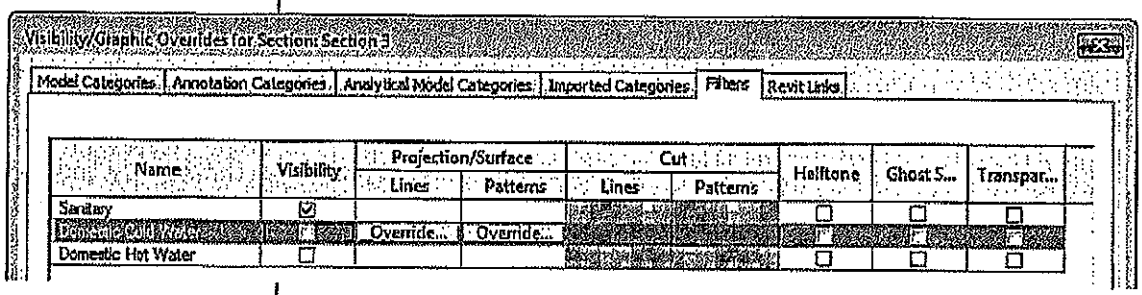

Figure 5–31

6. Click OK to close the dialog box.

- You might also want to turn off other elements, such as levels or grids. You can use the other tabs in the Visibility/Graphics dialog box or use **Hide in View** or **Override Graphics in View**.
- View Filters override system graphics so any colors you set in this dialog box supersede those specified in the System Type.
- If you need to change information about the filter itself click Edit/New... in the Add Filters or Filters dialog box. Then modify the *Categories* or *Filter Rules*. For example, the Mechanical - Exhaust Filter does not include Air Terminals by default so you need to select it as shown in Figure 5–32.

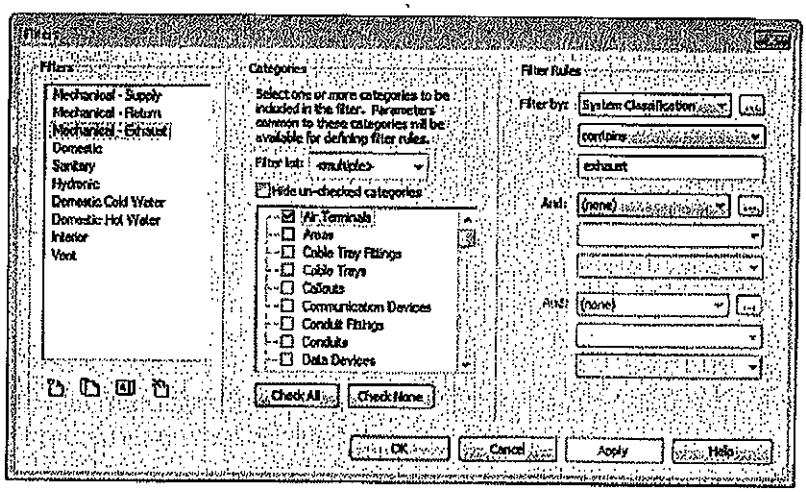

Figure 5–32

5.5 Connecting Components

Connect systems using ducts, pipes, conduit, cable tray, or wiring using manual or automatic tools.

Once you have components in place, you can start connecting them together using elements such as ducts, as shown in Figure 5–33, pipes, cable tray, and conduit. If you have created systems, you can use layout tools to automatically generate duct or pipe layouts to connect all of the components in a system. You can also add duct, pipe, conduit, cable tray, and wiring manually between components as required.

For electrical systems, wiring can also be generated but it is symbolic and annotative.

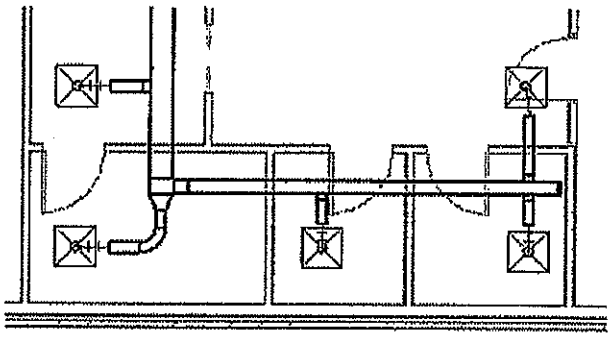

Figure 5–33

- All of the Autodesk Revit MEP system elements have connectors. Using the connectors, as shown in Figure 5–34, you can attach ducts, pipe, etc. to the correct point on the component. Then the software can calculate the height and size of the opening and apply the appropriate fittings.

These connectors might also contain options to create systems, draw ducts and pipes, when you right-click on them.

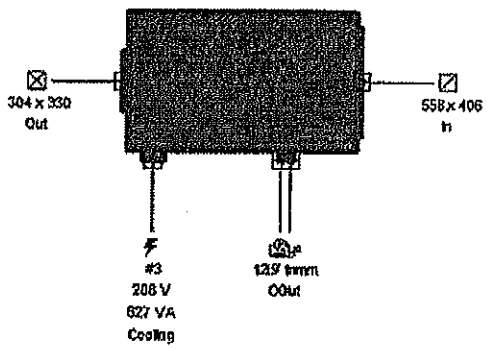

Figure 5–34

- You can connect elements before or after creating systems, but the systems must to be in place to use the automatic layout tools.

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Drawing Connections

For each system type, exact steps for creating these connections are covered later in the material.

There are two different ways of drawing linear connections between components:

1. Select a component, right-click on a connector and start one of the **Draw** commands, as shown for a plumbing fixture in Figure 5–35.

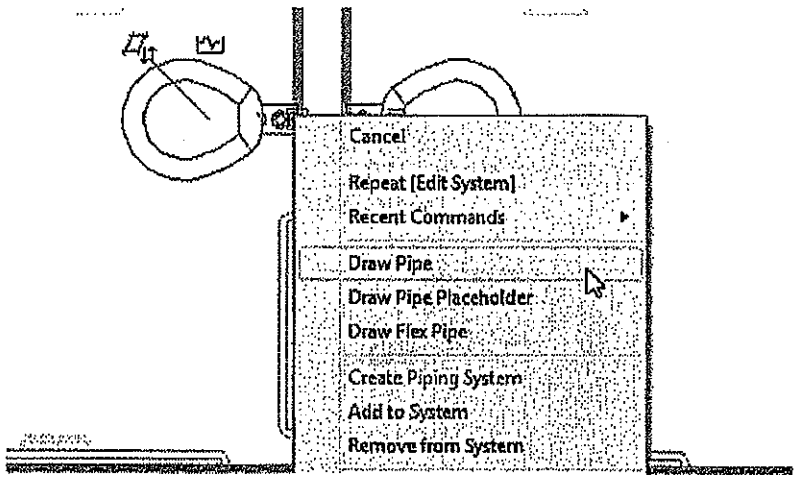

Figure 5–35

2. Start the commands from the *Systems* tab>HVAC, Plumbing & Piping, and Electrical panels as shown in Figure 5–36.

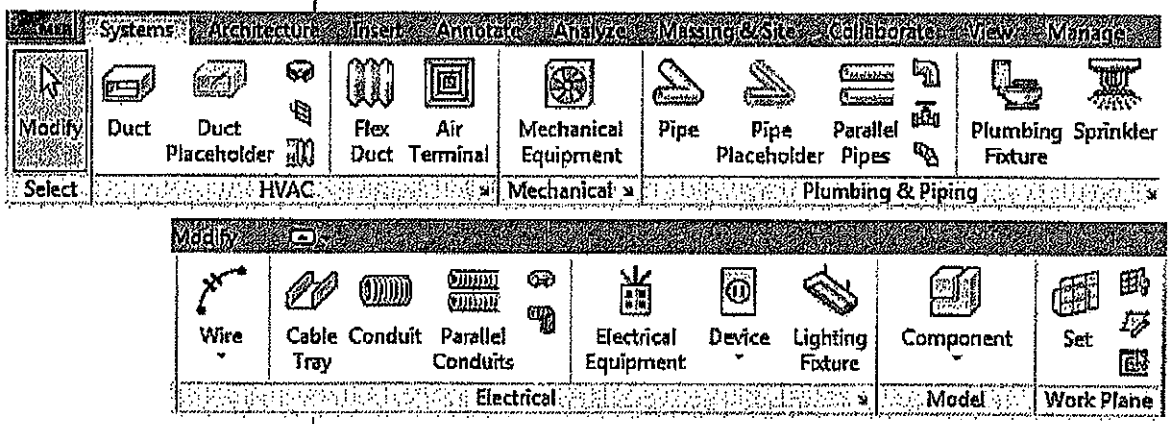

Figure 5–36

Parallel Pipes *and* ***Parallel Conduits*** *are based on existing elements.*

- For HVAC systems use **Duct**, **Duct Placeholder**, and **Flex Duct**.
- For Plumbing, Hydronic Piping, and Fire Suppression systems use **Pipe** and **Pipe Placeholder**.
- For Electrical systems use **Wire**, **Cable Tray**, and **Conduit**.

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- Once you have started one of the drawing commands select the type in the Type Selector and set options such as **Justification, Elevation,** and **Size** in the Placement Tools panel or Options Bar, as shown in Figure 5–37. Other tools are available depending on the type of elements you are working with.

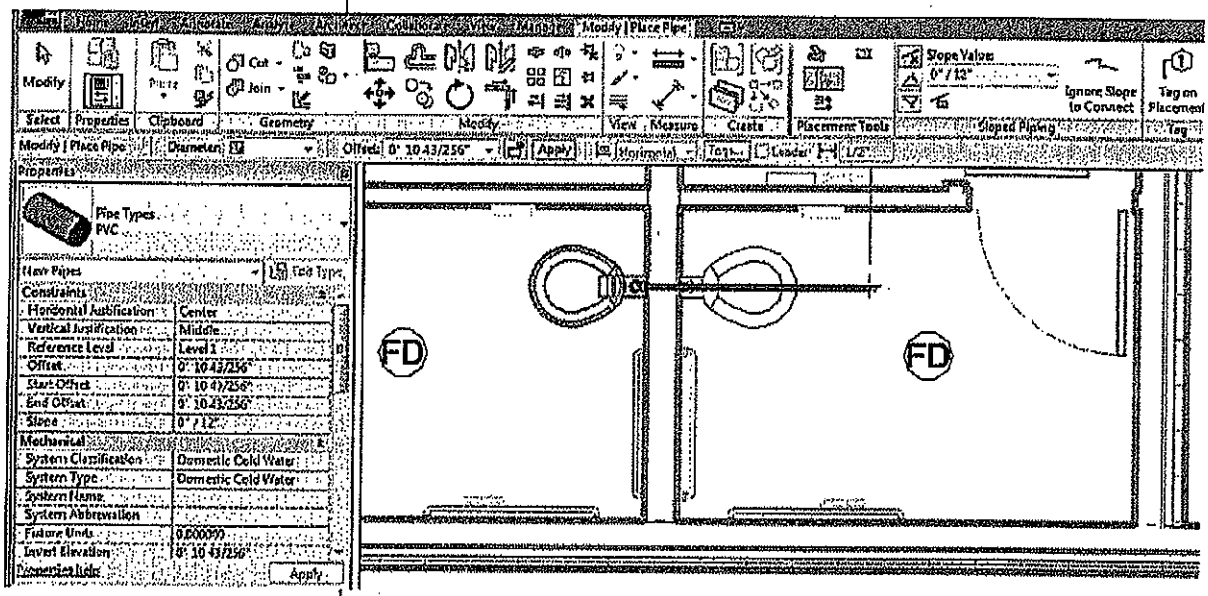

Figure 5–37

- Draw the objects using temporary dimensions and snaps - specifically snapping to the point snap of a connector as shown in Figure 5–38. Fittings are automatically applied.

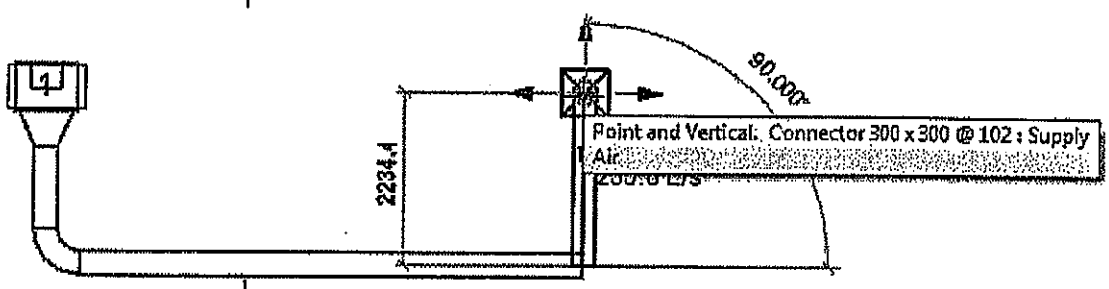

Figure 5–38

- If you started to draw duct or pipe from an element in an existing system and selected an element that has not yet been added to the system, the selected element is automatically added to the existing system.

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Creating Automatic Layouts

After you place components and equipment to create a system, select the system and click (Generate Layout) to work through solution types, as shown in Figure 5–39.

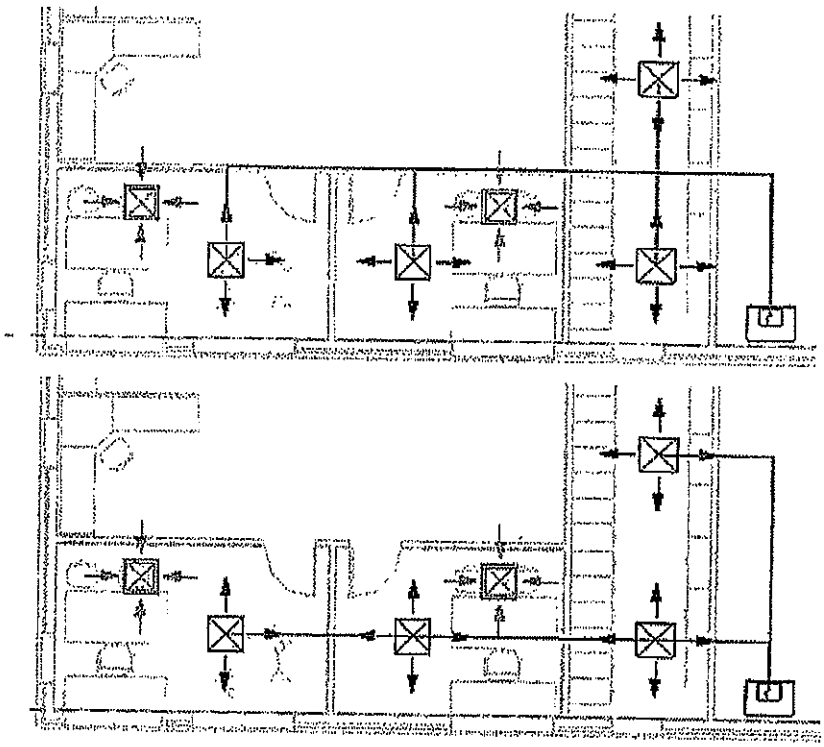

Figure 5–39

- When you have completed the routing, finish the layout and the connecting ducting or piping is automatically created as shown in Figure 5–40.

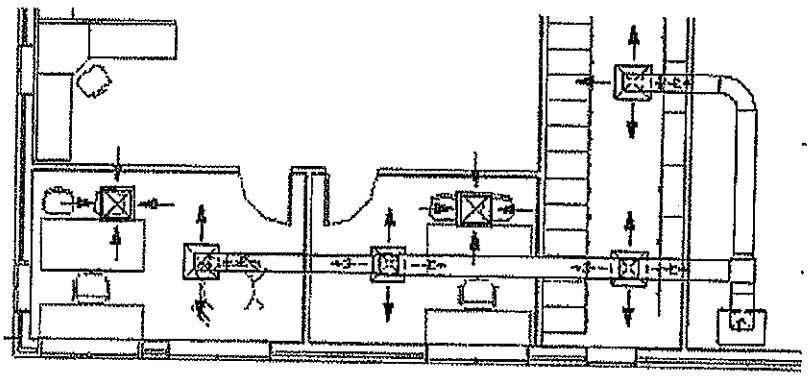

Figure 5–40

- You can use settings to modify the heights and other aspects of the layout.

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5.6 Analyzing Systems

- Check systems by displaying disconnects and running the **Check Systems** tool.
- Use the System Inspector to display information about the system.
- Automatically size ducts and pipes based on established criteria.

The Autodesk Revit MEP software is not only a drawing tool but a full BIM (Building Information Modelling) type of software. Therefore, the elements used in each model are smart elements and can be used to analyze the different types of systems. The tools used by all system types include Show Disconnects and various Check tools. For Duct and Pipe Systems, you can also use the System Inspector and Duct/Pipe Sizing. All elements can be scheduled for analysis or construction documentation.

- For a quick way to test the continuity of a system, hover the cursor over one of the linear connections and press <Tab> until the whole system highlights. For example, in Figure 5–41, one of the ducts is not attached to the fitting and therefore is not highlighted.

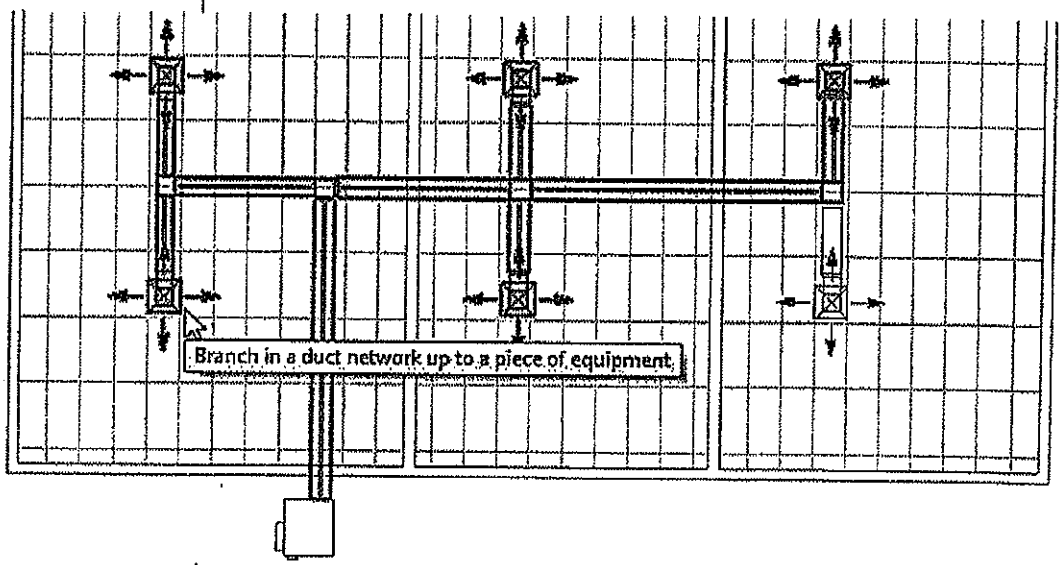

Figure 5–41

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Checking Systems

Duct Systems, Pipe Systems, and Circuits can be analyzed and reviewed for issues. This includes looking for disconnects and checking the various systems. For example, in Figure 5–42, there are open connectors at three different places. Once the tee fitting is changed to an elbow fitting and the flex duct connects the end of the existing duct to the air terminal, the warnings are removed.

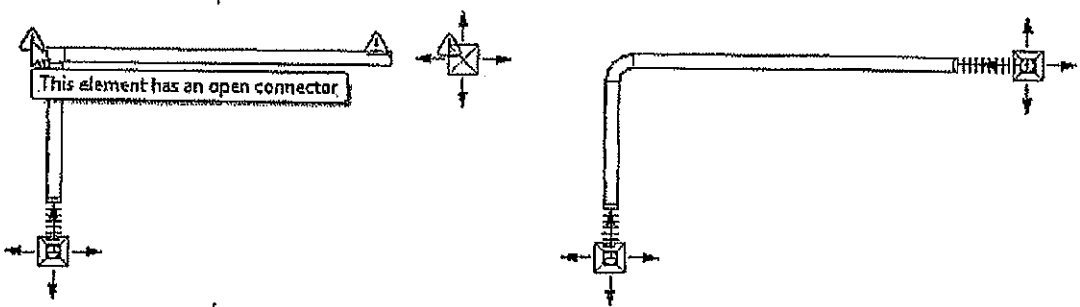

Figure 5–42

How to:

Show Disconnects

1. In the *Analyze* tab>Check Systems panel, click (Show Disconnects).
2. In the Show Disconnects Options dialog box, select the types of systems you want to display as shown in Figure 5–43 and click OK.

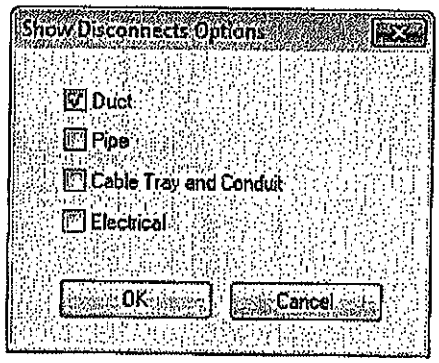

Figure 5–43

3. The disconnects displays (Warning).
   - The disconnects continue to display until you either correct the situation or run **Show Disconnects** again and clear all of the selections.

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4. Roll your cursor over the warning icon to display a tool tip with the warning or click on the icon to open the Warning dialog box, as shown in Figure 5–44.

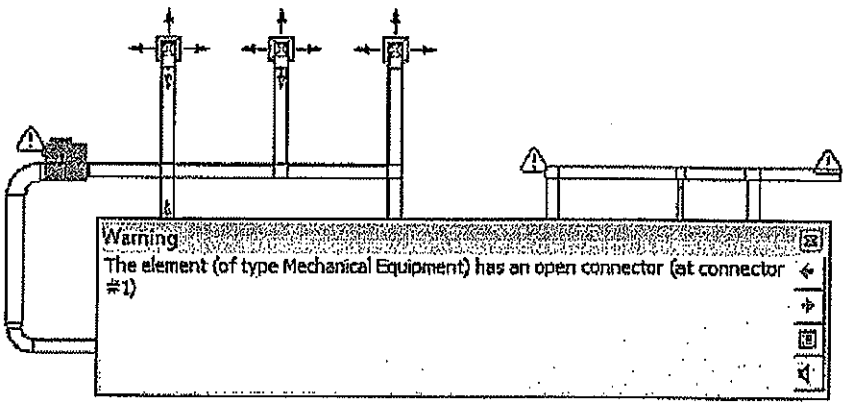

Figure 5–44

How to: **Use the Check Systems Tools**

1. In the *Analyze* tab>Check Systems panel, click (Check Duct Systems), (Check Pipe Systems, or (Check Circuits). These are on/off toggles.
2. (Warning) displays. Click one of the icons to open the Warning alert box as shown in Figure 5–45.

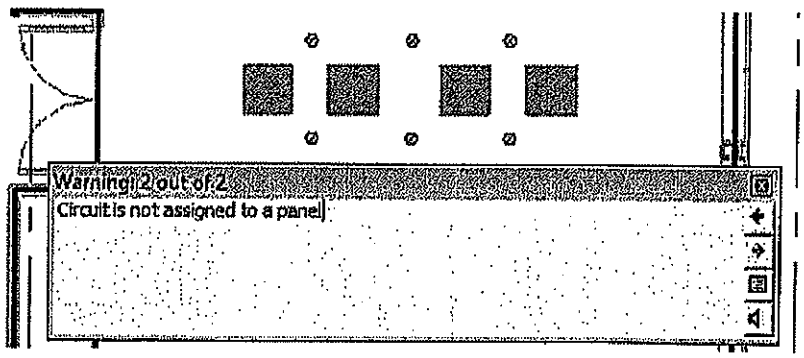

Figure 5–45

- For icons that have more than one warning, in the Warning alert box, click (Next Warning) and (Previous Warning) to search through the list.

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- Click (Expand Warning Dialog) to open the dialog box as shown in Figure 5–46. You can expand each node in the box and select elements to show or delete.

If there are a lot of warnings to review, you can click Export... *and save the HTML report to review separately.*

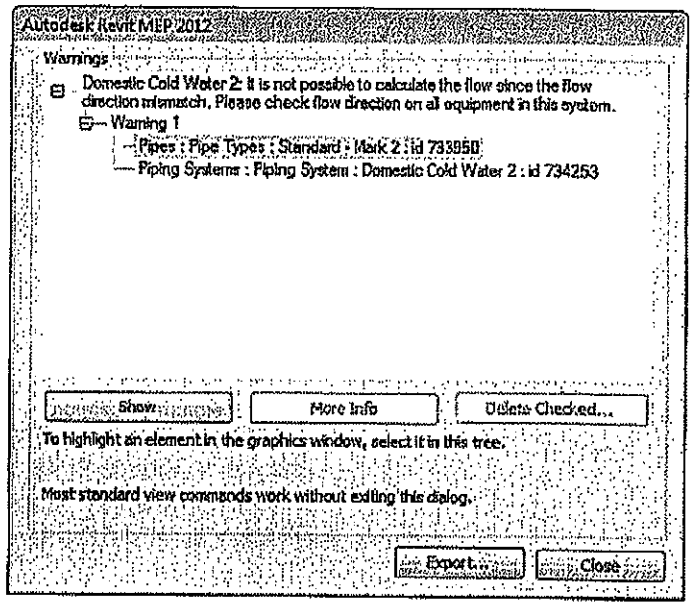

Figure 5–46

System Inspector

The System Inspector provides information such as flow rate, static pressure, and pressure loss at every point in a system, as shown in Figure 5–47 for a Domestic Cold Water system. It also enables you to make changes to components of the system, while you are inspecting.

The System Inspector works with all Duct and Piping Systems except with Fire Suppression Systems.

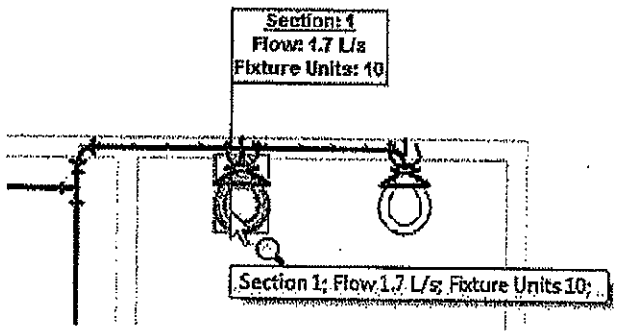

Figure 5–47

- The System Inspector does not display in the Ribbon if an open system is selected.

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How to:

Use the System Inspector

1. Select any part of a system including air terminals, ductwork, piping, mechanical equipment, or plumbing fixtures.
2. In the contextual *Modify* tab>Analysis panel, click (System Inspector) or in the System Browser, right-click on the top level of a system and select **System Inspector.**
3. The floating System Inspector panel displays, as shown in Figure 5–48.



Figure 5–48

4. Click (Inspect). The air flow displays in the system, as shown in Figure 5–49. Move the cursor over a section of system to display information, such as the Flow, Static Pressure, and Pressure Loss for duct systems.

The red path displays the greatest static pressure.

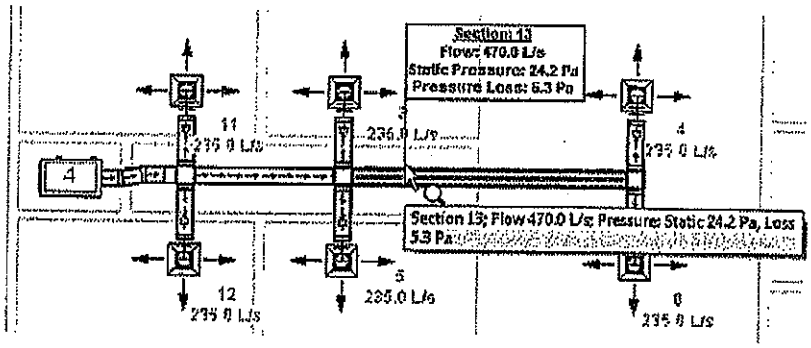

Figure 5–49

5. If you need to change a component of the system, remain in the System Inspector and in the Select panel, click (Modify). Select the component. You can then make changes to it on the screen using controls or in Properties.
6. Click (Inspect) to return to the flow pattern.
7. When you are finished reviewing the system, click (Finish) to apply any changes to the system or (Cancel).

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- If you select a piece of mechanical equipment that is attached to more than one duct-based or pipe-based system, the Select a System dialog box displays as shown in Figure 5–50. Select the system you want to inspect and click OK.

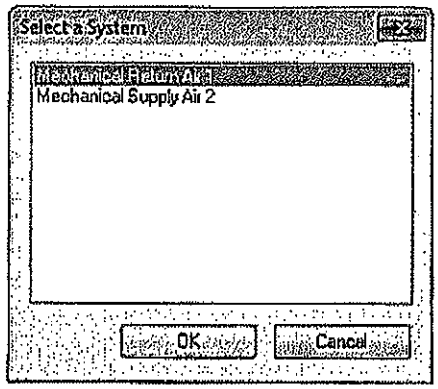

Figure 5–50

New in 2013

- The System Inspector displays in a floating panel by default. You can move it or make it a part of the Ribbon by clicking **Return Panels to Ribbon**, as shown in Figure 5–51.

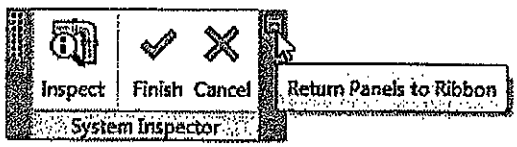

Figure 5–51

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Pressure Loss Reports

New in 2013

Pressure Loss Reports are HTML files (as shown in Figure 5–52), that include all of the data that can be viewed dynamically in the System Inspector. The reports can be set up to export exactly the information you need. They can be created for Duct or Pipe systems. The analysis for each system includes total pressure loss for the system as well as detailed information for various sections of duct or pipe.

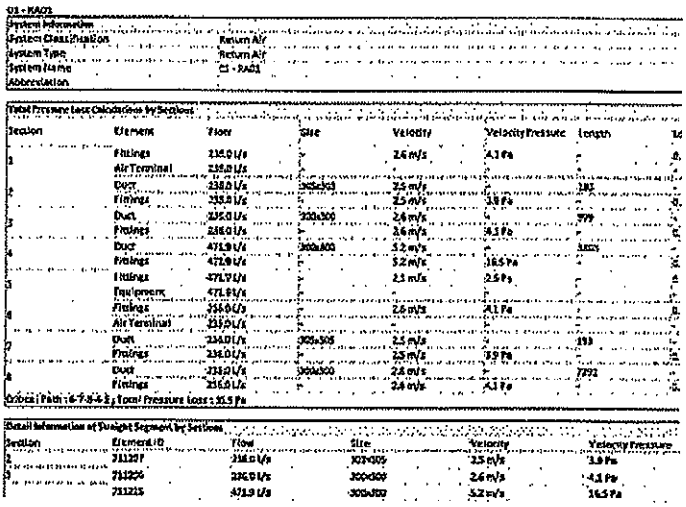

Figure 5–52

How to: Create a Duct/Pipe Pressure Loss Report

1. In the *Analyze* tab>*Reports & Schedules* tab, click (Duct Pressure Loss Report) or (Pipe Pressure Loss Report).
2. In the Duct (Pipe) Pressure Loss Report - System Selector dialog box (shown in Figure 5–53), select the systems that you want to include in the report.

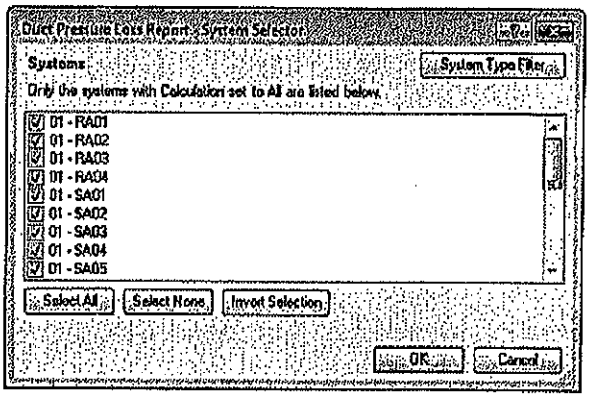

Figure 5–53

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- To limit the systems displayed in the System Selector, click [System Type Filter...] to open the dialog box shown in Figure 5–54. Select the types of systems you want to include in the report and click [OK] to return to the main dialog box.

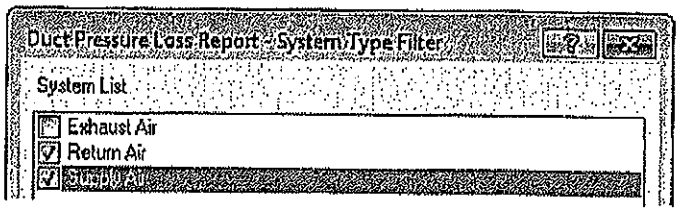

Figure 5–54

- Use [Select All] [Select None] [Invert Selection] to help with the selection as needed.

3. When you have finished selecting the systems to include, click [OK].
4. In the Duct/Pipe Pressure Loss Reports Settings dialog box, specify the type of Report Format and the Reports Fields, as well as other information as shown in Figure 5–55.

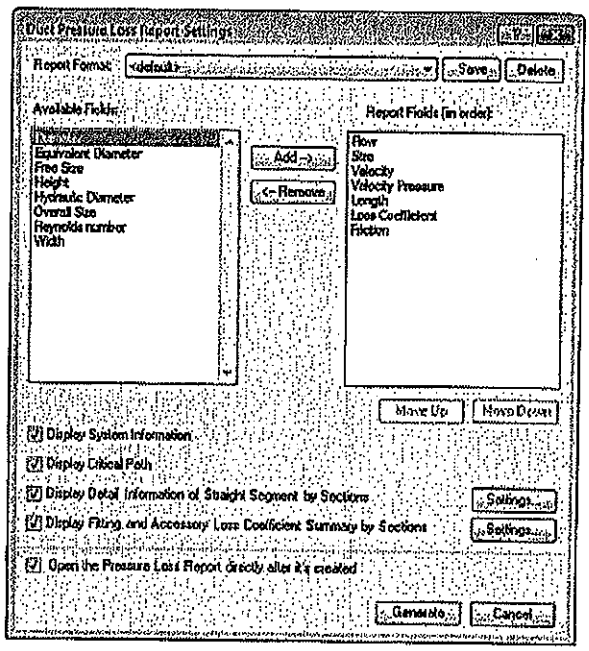

Figure 5–55

5. Click [Generate].

Duct and Pipe Sizing

It is easiest to draw ducts or pipes using the default sizes provided by the opening sizes of the equipment or as preset in the Mechanical Settings. These are often incorrect for the system. The **Duct/Pipe Sizing** tool uses a specified sizing method and constraints to determine the way the pipes or ducts should be sized, as shown in Figure 5–56.

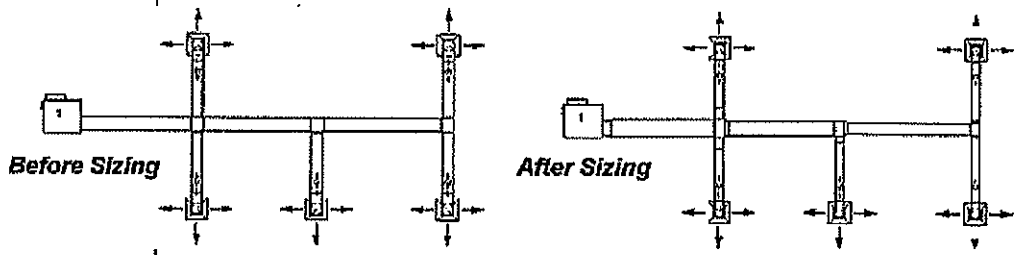

Figure 5–56

How to:

Size Ducts and Pipes

1. Select a duct system.
2. In the *Modify | Multi-Select* tab>Analysis panel, click (Duct/Pipe Sizing).
3. In the Duct Sizing dialog box, set the *Sizing Method* and *Constraints* as required, as shown in Figure 5–57.

The most common method for low pressure duct work is Friction. Ducts should be sized according to company design standards.

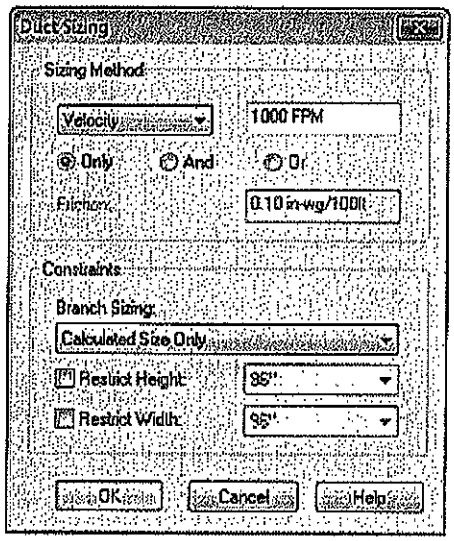

Figure 5–57

4. Click OK.

- If you select only one duct, it analyzes just that one set of connections so select the entire system.

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- Once you make a change to the system, you need to run the software again (as shown in Figure 5–58) where the CFM was changed on two air terminals.

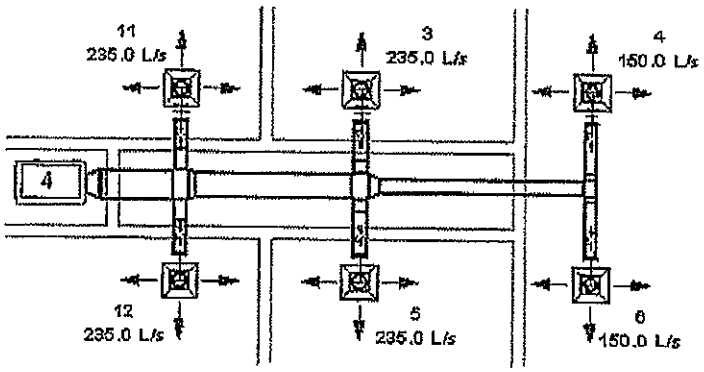
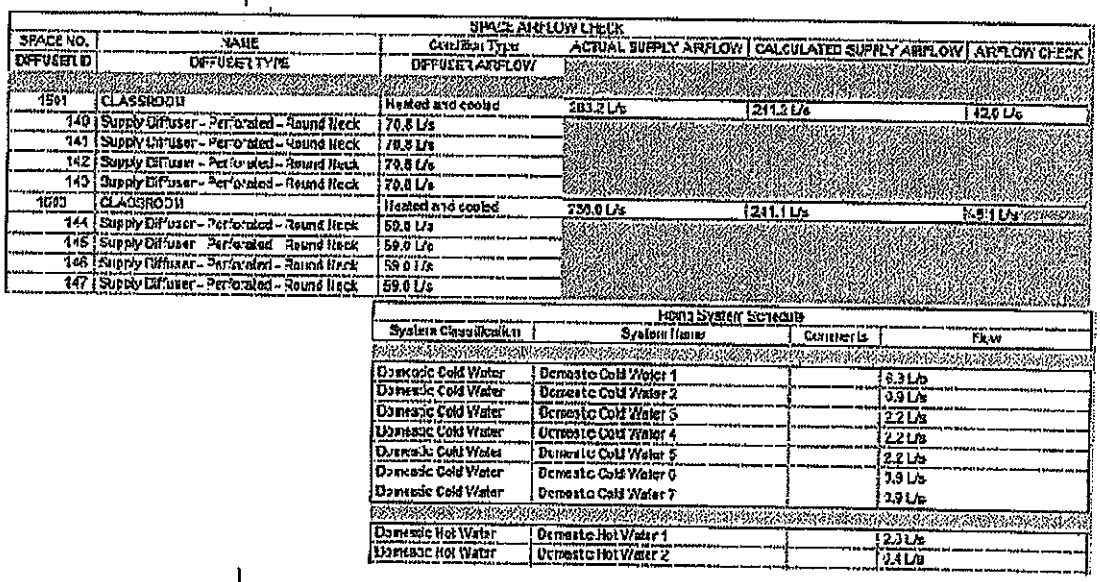


Figure 5–58

Typical Schedules

No schedules come with the default Autodesk Revit MEP templates but many firms create typical ones that can be used in most projects. They are helpful for analyzing the systems by searching for items such as Duct pressure loss and Flow for piping schedules. Two sample schedules are shown in Figure 5–59.



SPACE AIRFLOW CHECK

SPACE NO. / DIFFUSER ID	NAME / DIFFUSER TYPE	Condition Type / DIFFUSER AIRFLOW	ACTUAL SUPPLY AIRFLOW	CALCULATED SUPPLY AIRFLOW	AIRFLOW CHECK
1501	CLASSROOM	Heated and cooled	283.2 L/s	211.2 L/s	42.6 L/s
140	Supply Diffuser - Perforated - Round Neck	70.8 L/s			
141	Supply Diffuser - Perforated - Round Neck	70.8 L/s			
142	Supply Diffuser - Perforated - Round Neck	70.8 L/s			
143	Supply Diffuser - Perforated - Round Neck	70.8 L/s			
1503	CLASSROOM	Heated and cooled	236.0 L/s	241.1 L/s	-5.1 L/s
144	Supply Diffuser - Perforated - Round Neck	59.0 L/s			
145	Supply Diffuser - Perforated - Round Neck	59.0 L/s			
146	Supply Diffuser - Perforated - Round Neck	59.0 L/s			
147	Supply Diffuser - Perforated - Round Neck	59.0 L/s			

Hydronic System Schedule

System Classification	System Name	Comments	Flow
Domestic Cold Water	Domestic Cold Water 1		3.3 L/s
Domestic Cold Water	Domestic Cold Water 2		3.9 L/s
Domestic Cold Water	Domestic Cold Water 3		2.2 L/s
Domestic Cold Water	Domestic Cold Water 4		2.2 L/s
Domestic Cold Water	Domestic Cold Water 5		2.2 L/s
Domestic Cold Water	Domestic Cold Water 6		3.9 L/s
Domestic Cold Water	Domestic Cold Water 7		3.9 L/s
Domestic Hot Water	Domestic Hot Water 1		2.3 L/s
Domestic Hot Water	Domestic Hot Water 2		2.4 L/s

Figure 5–59

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Practice 5a

Viewing and Analyzing Systems

- Review mechanical systems using the System Browser and System Inspector.
- Review plumbing systems in 3D and in plan view.
- Check electrical systems and correct a problem.
- Create an electrical switch system.

Estimated time for completion: 15 minutes

In this practice you will review existing mechanical systems, such as the one shown in Figure 5–60, in the System Browser and System Inspector. You will view plumbing systems in 3D and plan view. You will check electrical circuits, correct a problem, and create an electrical switch system.

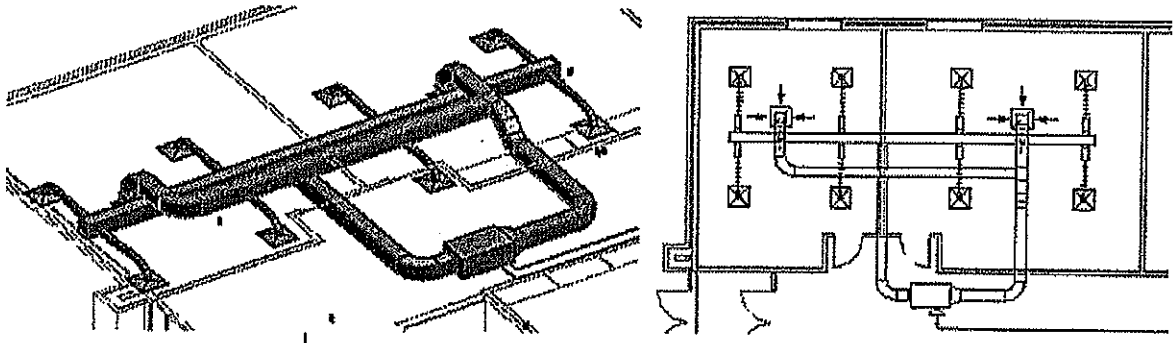

Figure 5–60

Task 1 - Review and Analyze Existing Duct Systems.

1. Open the project file **MEP-Elementary-School-Overview-M.rvt** found in the *Chapter 5* folder of your class folder.
2. In the 3D HVAC view, zoom in and look at the various systems in place. Identify the various systems identified by color.
3. In the Project Browser open Mechanical>HVAC>Floor Plans>**01 MECHANICAL PLAN.**
4. Zoom in and select one of the Supply Air Terminals (Blue).

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5. Inspect the options in the Ribbon tabs, Options Bar, and Properties. They all relate to the Air Terminal.
6. Press <F9> to open the System Browser.
7. In the System Browser, expand the nodes until highlighted Air Terminal displays.
8. In the System Browser, select the associated system as shown in Figure 5–61. The system highlights instead of just the one air terminal. (The system varies according to the air terminal you selected earlier.)

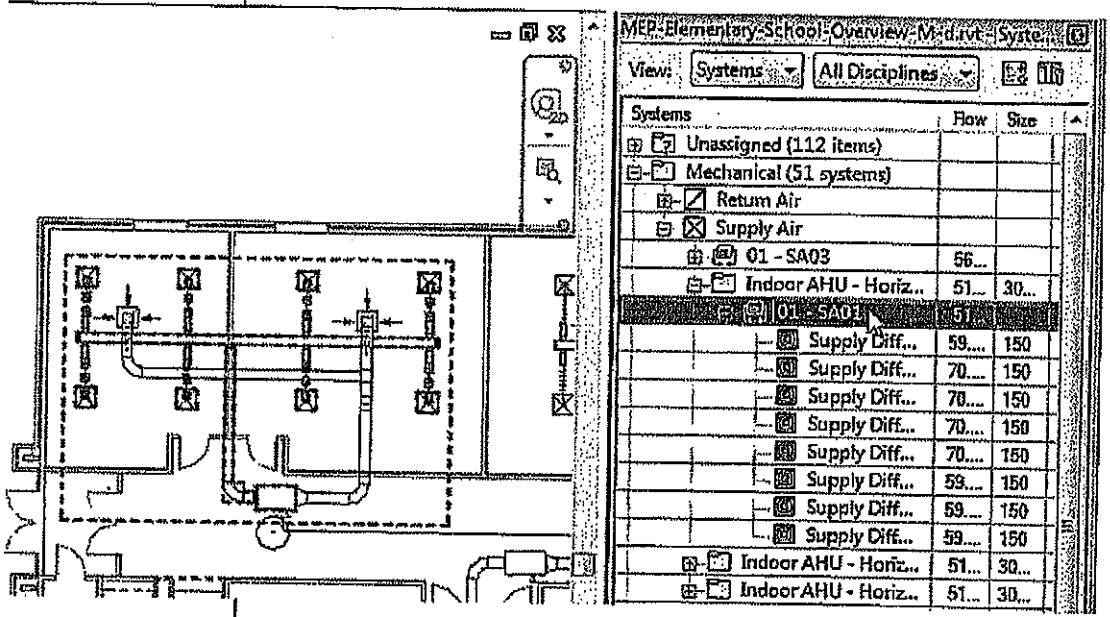

Figure 5–61

9. Right-click on the System Name and select **Inspect**.
10. In the floating System Inspector panel, click (Inspect).

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11. Roll your cursor over parts of the system to view the information, as shown in Figure 5–62.

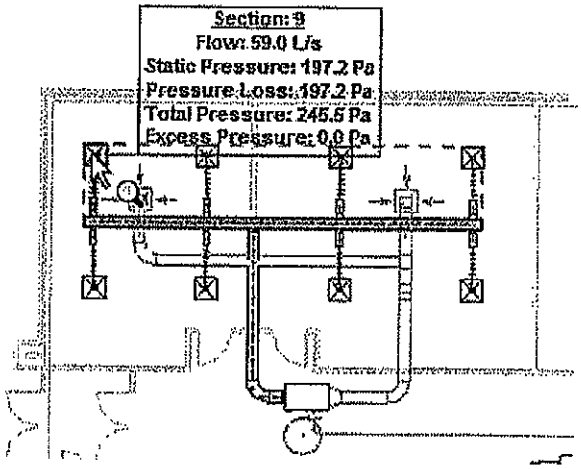

Figure 5–62

12. When you are finished inspecting the system, click (Finish).

Task 2 - View Plumbing Systems.

1. Open the Mechanical>Plumbing>3D Views>**3D PIPING** view.
2. Zoom in and view the various plumbing fixtures and the piping connecting them. This view displays the hot and cold water piping and the sanitary piping.
3. Select the linked architectural model.
4. In the View Control Bar, click (Temporary Hide/Isolate) and select **Hide Element**. This makes the elements easier to view.
5. Zoom in on the restrooms and see how the hot and cold water pipes are above the ceiling while the sanitary pipes on the first floor are below the floor, as shown in Figure 5–63.

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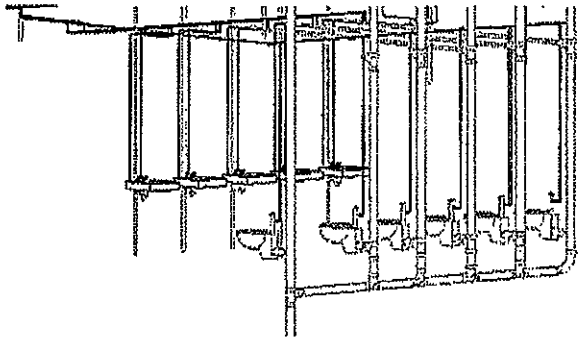

Figure 5–63

6. In the View Control Bar, click (Temporary Hide/Isolate) and select **Reset Temporary Hide/Isolate**.
7. Open the Mechanical>Plumbing>Floor Plans>**01 PLUMBING PLAN**. If you zoom in you can see that the hot and cold water lines display in part at the fixtures.
8. In Properties, edit *View Range*. Change the *Top Offset* to **5000mm**. The full line of the piping now displays as shown in Figure 5–64.

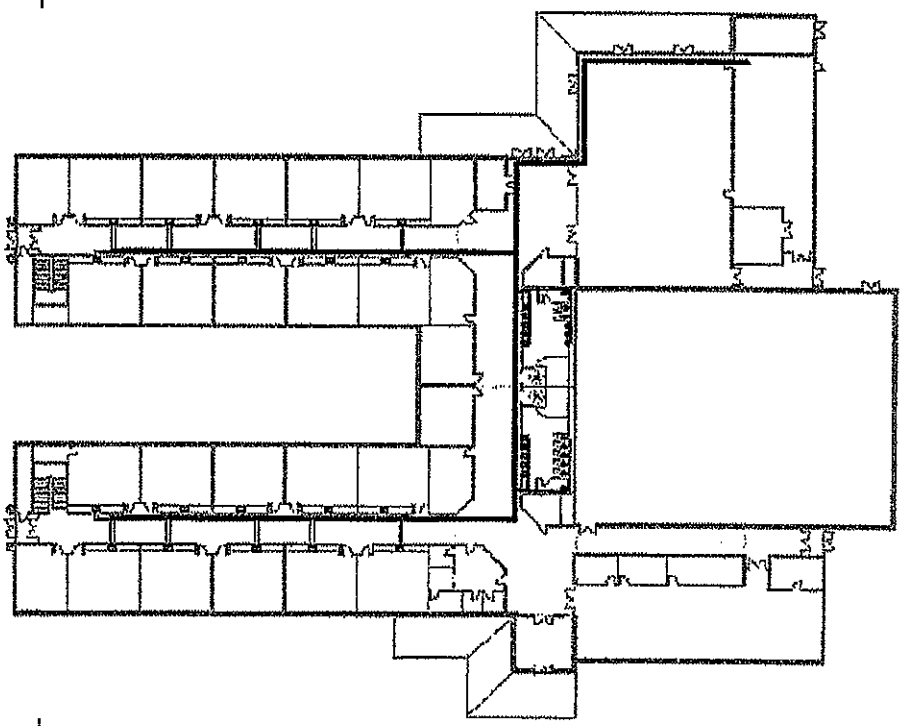

Figure 5–64

9. Select one of the sinks in the classroom wing and identify the systems it is attached to in the System Browser.

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10. Open the **01 SANITARY PLAN**. This plan displays the sanitary piping only.

Task 3 - Check circuits and correct a problem.

1. Open the view Electrical>Lighting>Floor Plans>**01 LIGHTING PLAN.**

2. In the *Analyze* tab>Check Systems panel, click (Check Circuits).

3. A Warning box displays with the message **Circuit is not assigned to a panel**. The elements in the circuit are also highlighted, as shown in Figure 5–65.

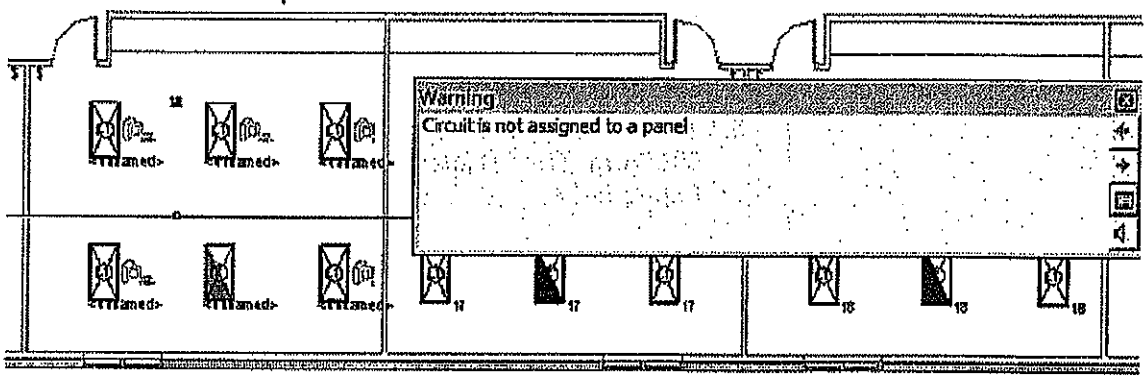

Figure 5–65

4. Hover your cursor over one of the lighting fixtures and press <Tab> to display the circuit. Click to select it.

5. In the *Modify | Electrical Circuits* tab>System Tools panel, click (Select Panel).

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6. Zoom in on the electrical room and select panel **LP1** as shown in Figure 5–66.

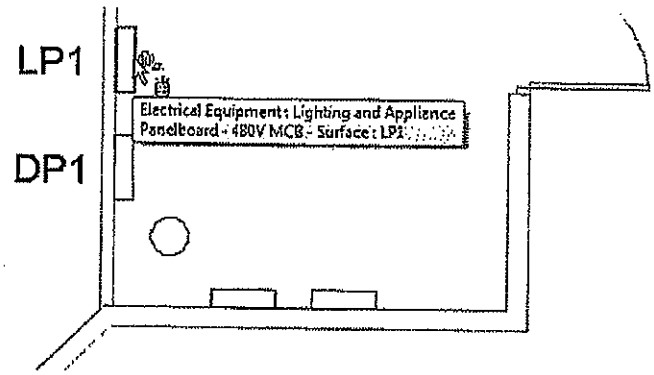

Figure 5–66

7. Zoom out to see the circuit outline including the panel.

8. Click (Modify) to release the selection.

9. Run (Check Circuits) again. This time the software should respond with **No circuit errors found**. Close the dialog box.

Task 4 - Create a Switch System.

1. Continue working in the **01 LIGHTING PLAN** view.
2. Zoom into the room where you added a panel to the system.
3. Select one of the light fixtures.
4. In the Ribbon there are two tabs, one for the selected lighting fixture and the other for the electrical circuit the fixture is attached to.
5. Lighting fixtures can be connected to a Switch system and electrical circuits. In the *Modify | Lighting Fixtures* tab>Create Systems panel, click (Switch).
6. In the *Modify | Switch Systems* tab>System Tools panel, click (Select Switch).

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7. Select the switch near the door in the same room. A line connecting the lighting fixture to the switch displays, as shown in Figure 5–67.

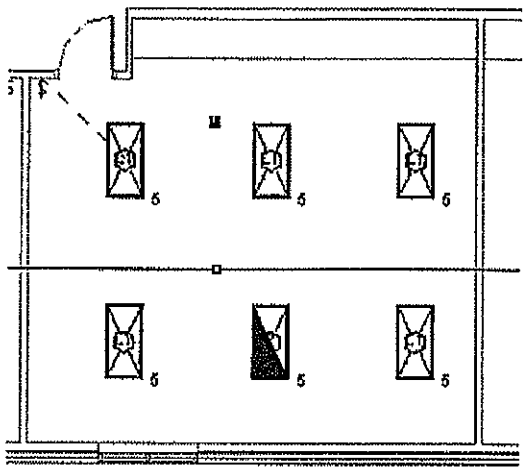

Figure 5–67

8. The new switch system is still selected. In the *Modify | Switch System* tab>System Tools panel, click (Edit Switch System).

9. (Add to System) is automatically selected.

10. Click on the other standard lighting fixtures in the room and then click (Finish Editing System).

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11. Hover over one of the lighting fixtures and <Tab> through the options until the Switch System displays as shown in Figure 5–68.

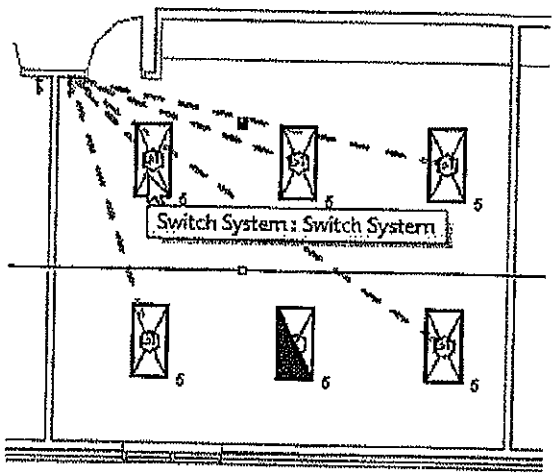

Figure 5–68

12. Move your cursor away from the selection.

13. Save the project.

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Chapter Review Questions

1. Which of the following commands imports a component that you want to use that is not available in your project.
   a. **Load Family**
   b. **Load Equipment**
   c. **Load Component**
   d. **Load Fixture**
2. Which of the following happens when you select a component in the System Browser? Select all that apply.
   a. The component highlights in the current view.
   b. The parameters of the component display in Properties.
   c. If the component has more than one system it also highlights in the other nodes in the System Browser.
   d. The appropriate Ribbon tab displays.
3. When you select a Mechanical Equipment component several icons display. What is the purpose of these icons? Select all that apply.
   a. They are where ducts, pipes, or electrical circuits connect to the equipment.
   b. You can draw ducts, pipes, or circuits from them.
   c. You can use them to drag and align to other features in the project.
   d. They establish the size or power of the connection.
4. An existing system needs to be in place before you can automatically add piping between plumbing fixtures using the **Generate Layout** tool.
   a. True
   b. False
5. When analyzing a project how do you specify that you see places where the ducts or pipes are not closed?
   a. Use **Check Duct/Pipe Systems**.
   b. Use **Show Disconnects**.
   c. Create a Duct/Pressure Loss Report.
   d. Open the Review Warnings dialog box.

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Command Summary

Button	Command	Location
	**Check Duct Systems**	■ **Ribbon:** *Analyze* tab>Check Systems panel
	**Check Circuits**	■ **Ribbon:** *Analyze* tab>Check Systems panel
	**Check Pipe Systems**	■ **Ribbon:** *Analyze* tab>Check Systems panel
	**Duct/Pipe Sizing**	■ **Ribbon:** (*when ducts or pipes are selected*) *Modify* | *varies* tab>Analysis panel
	**Duct Pressure Loss Report**	■ **Ribbon:** *Analyze* tab>Reports & Schedules panel
	**Load Family**	■ **Ribbon:** (*when a command that uses components is selected*) *Modify* | *varies* tab>Mode panel ■ **Ribbon:** *Insert* tab>Load from Library panel
	**Pipe Pressure Loss Report**	■ **Ribbon:** *Analyze* tab>Reports & Schedules panel
	**Show Disconnects**	■ **Ribbon:** *Analyze* tab>Check Systems panel
	**Show related Warning**	■ **Ribbon:** varies according to the element selected
	System Browser	■ **Ribbon:** *View* tab>Window panel, expand  (User Interface) ■ **Shortcut:** <F9>
	**System Inspector**	■ **Ribbon:** (*when a system component is selected*) *Modify* | *varies* tab >Analysis panel ■ **System Browser:** *right-click on a system name*>Inspect

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Chapter 6

Spaces and Zones

In this chapter you learn how to add and modify spaces, use space separations, and place space tags. You also learn about zones and how to work with the System Browser with zones and spaces. Finally, you learn to create color-coded diagrams based on zones.

This chapter contains the following topics:

- ✓**Creating Spaces**
- ✓**Working with Spaces**
- ✓**Creating Zones**
- ✓**Creating Color Schemes**

Learning Objectives

This chapter provides instruction to enable you to do the following:

6.1 Creating Spaces

- Prepare a model so that you can add spaces by setting room bounding status, volume computations, and creating views and view templates.
- Create spaces individually or automatically.
- Add Space Separation lines to further divide spaces.

6.2 Working with Spaces

- Select spaces and modify them graphically and in Properties.
- Set up spaces for specific situations, including shafts, sliver spaces, cavities, and plenums.

6.3 Creating Zones

- Add zones to connect spaces for analysis.
- Use the System Browser with Zones.

6.4 Creating Color Schemes

- Create Color Schemes and Color Fill Legends for spaces and zones.

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6.1 Creating Spaces

- Prepare a model so that you can add spaces by setting room bounding status, volume computations, and creating views and view templates.
- Create spaces individually or automatically.
- Add Space Separation lines to further divide spaces.

The Space element is a critical component in the process of establishing heating and cooling loads. It identifies each room in a building providing area, perimeter, and volume information about each space as well as information used in Electrical, Mechanical, and Energy Analysis, as shown in Figure 6–1.

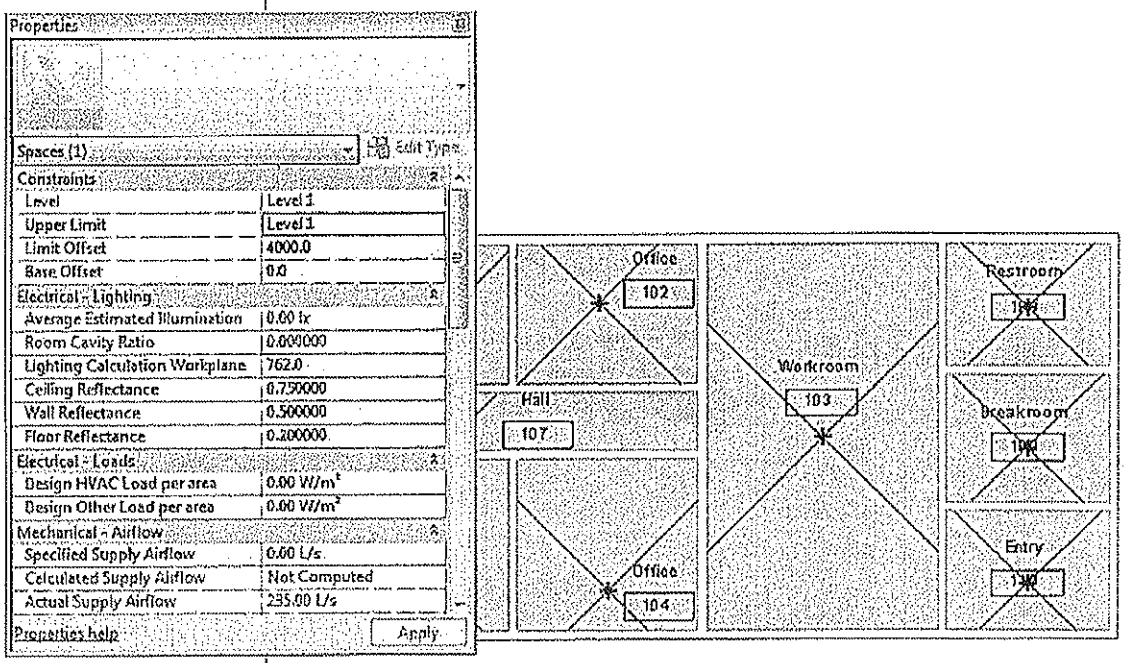

Figure 6–1

- Spaces are similar to Rooms created in Autodesk® Revit® Architecture. However, they contain more information about the volume for heating and cooling loads analysis.
- In Autodesk® Revit® MEP projects, you need to add spaces to shafts, chases, plenums, and other enclosed areas that would not normally be assigned a room by the architect.

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Preparing a Model for Spaces

Before adding spaces to a project it is helpful to set up the room bounding status of linked models and the area and volume computations, and to create views that display the spaces, as shown in Figure 6–2.

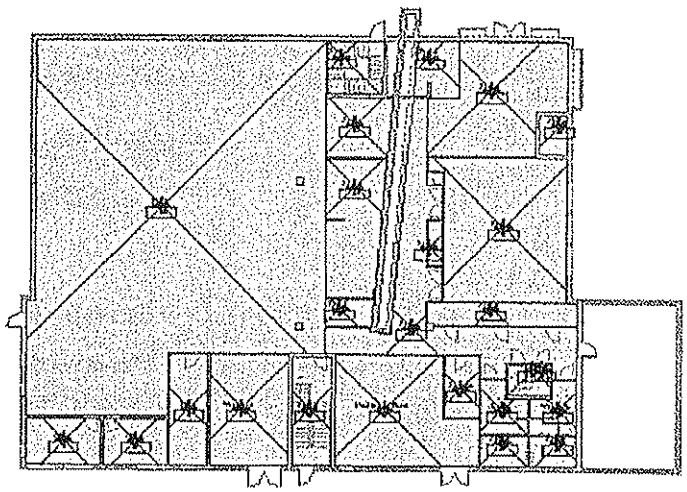

Figure 6–2

Linked Models and Room Bounding Status

Spaces must be created in the host project, not in a linked model. When working with a linked model you first need to set it to **Room Bounding** before using it to create spaces.

- Select the linked model and, in Properties, click (Edit Type). Then, in the Type Properties dialog box, select the value for **Room Bounding** as shown in Figure 6–3.

Room bounding elements, whether in a linked model or the host project include: walls, roofs, floors, ceilings, columns, curtain systems, and room or space separation lines.

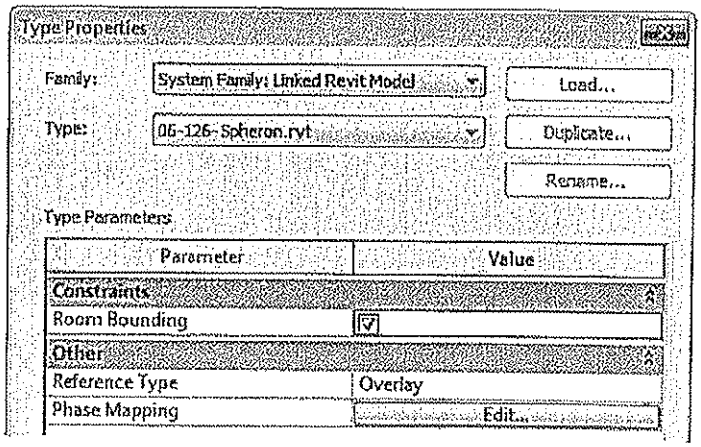

Figure 6–3

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Area and Volume Computations

You can set the way Autodesk Revit MEP calculates volumes and boundary locations. In the *Analyze* tab>Spaces & Zones panel, expand the panel title and click (Area and Volume Computations) to open the Area and Volume Computations dialog box, as shown in Figure 6–4.

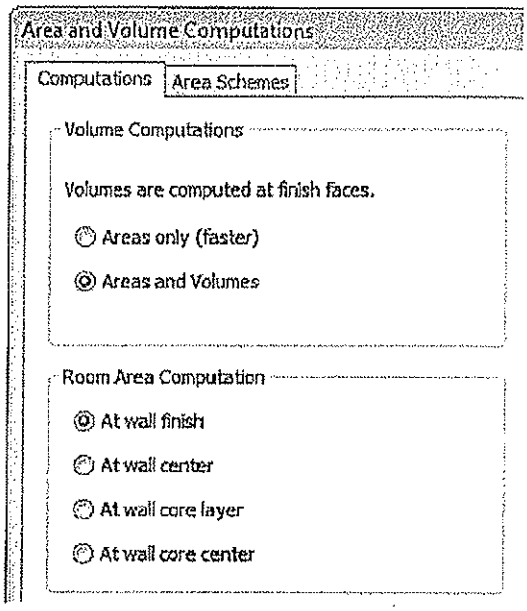

Figure 6–4

- Typically, you have **Areas and Volumes** on when you are working in Autodesk Revit MEP projects. This impacts the spaces that are controlled by bounding elements, such as ceilings and roofs as shown in Figure 6–5.

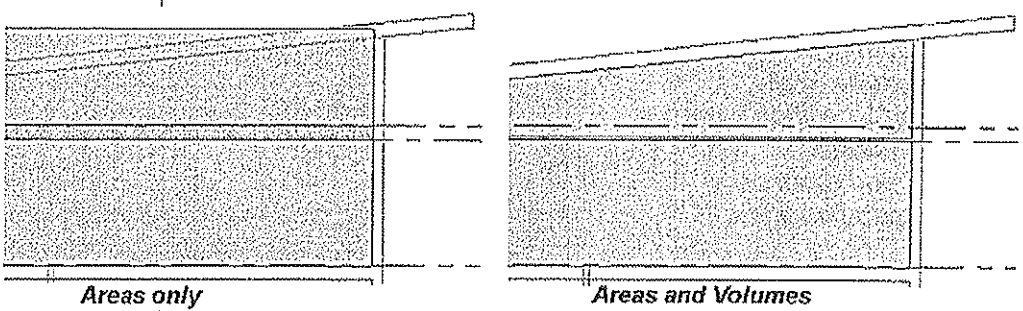

Figure 6–5

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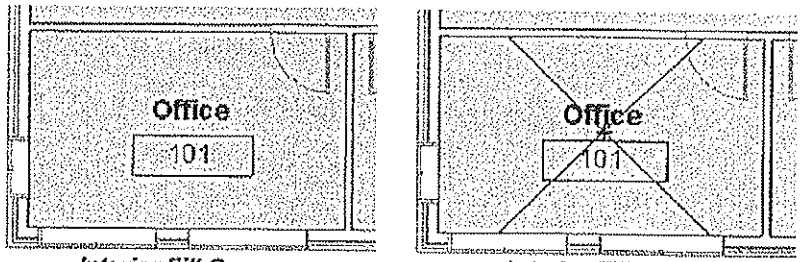
Creating Views for Spaces

By default, spaces only display when you hover your cursor over them or select them. To help you place and view spaces, create a view that displays them and limits the display of other elements. You can set up spaces to display an interior fill and reference lines (as shown in Figure 6–6), in floor plans, and in sections.



Interior Fill On

Interior Fill and Reference Line On

Figure 6–6

How to:

Create a View to display spaces

1. In the Project Browser, right-click on a view similar to the one in which you want to display spaces and select **Duplicate View>Duplicate**. (You do not need to use **Duplicate with Detailing** unless the view you select already has space tags.)
2. Rename the new view.
3. In Properties, assign the *Discipline* (often **Coordination**) and *Sub-Discipline* as needed.
4. Type **VG** to open the Visibility/Graphics Overrides dialog box.
5. In the *Model Categories* tab, expand Spaces and select **Interior** as shown in Figure 6–7. The **Reference** option displays the x lines across the space as shown in Figure 6–6.

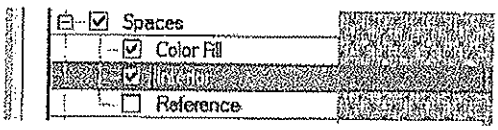


Figure 6–7

6. In the various tabs, turn the other categories on and off as needed. For example, you might want to turn off most MEP elements as well as grids and furniture and, in the *Revit Links* tab, set the linked model to **Halftone**.
7. Click OK.

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View Templates

View templates can be used to quickly apply not only Visibility/ Graphics Overrides, but also any other View Properties including *Discipline* and *View Range*, as shown in Figure 6–8. You can then apply the view template to views.

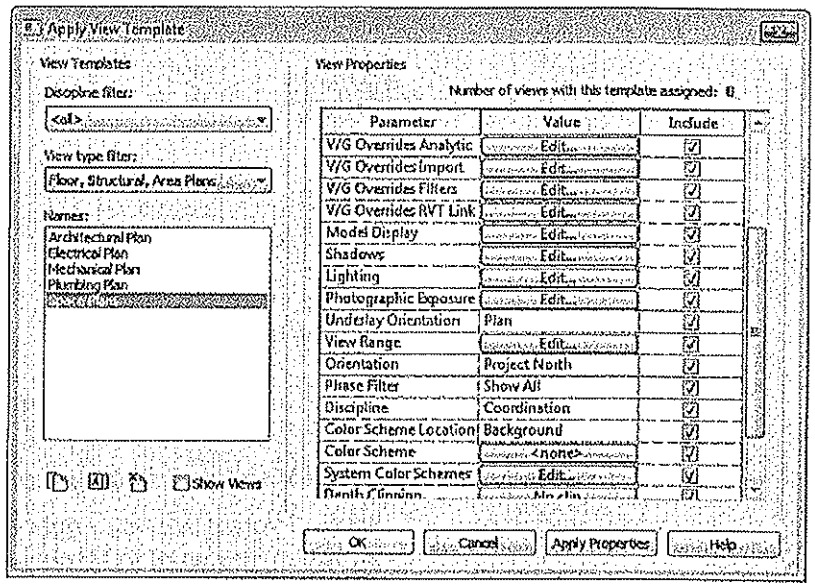

Figure 6–8

- View templates work with all types of model views.

How to: Create and Apply View Templates to Views

1. Setup a view the way you want it.
2. In the Project Browser, right-click on that view and select **Create View Template From View...**
3. In the New View Template dialog box, type a new Name and click OK.
4. To apply a view template to a view, right-click on the view and select **Apply Template Properties.**
5. In the Apply View Template dialog box, select the one you want to use and click OK.

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- To have more control over views, in the Properties of the view, in the *Identity Data* area, you can specify a View Template as shown in Figure 6–9. Doing so limits the changes you can make to the view, such as the Scale, Visibility Graphics Overrides, and View Range.

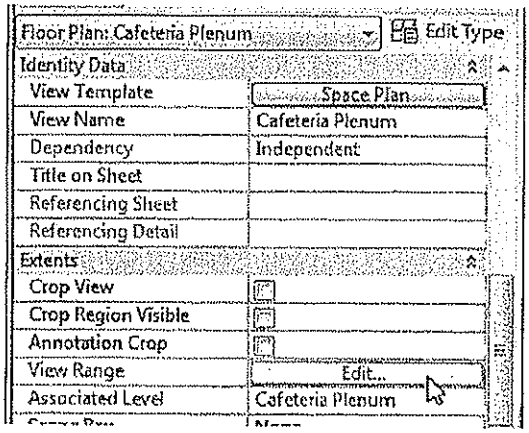

Figure 6–9

Creating Spaces

Once you have set up views for the spaces you can start applying them to the model. You can do this by selecting individual boundaries or automatically filling each space. Spaces can be further divided using Space Separators. You can also tag spaces, which can help with naming and numbering. The space tools are located in the *Analyze* tab>Spaces & Zones panel as shown in Figure 6–10.

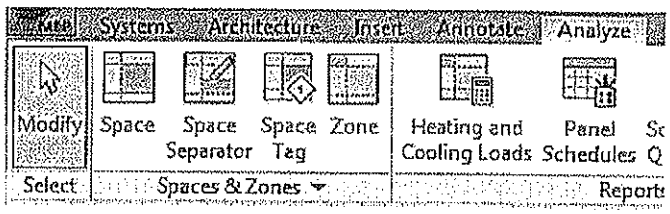

Figure 6–10

How to:

Create Spaces by Selecting Boundaries

1. In the *Analyze* tab>Spaces & Zones panel, click (Space).
2. In the *Modify | Place Space* tab>Tag panel, click (Tag on Placement) if you want to include a tag as you place the space. In the Options Bar, you can set the *Orientation* of the tag and the *Leader*.

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3. In the Options Bar, set the *Upper Limit* and *Offset*, which control the volume calculations, and set the height of the space, as shown in Figure 6–11. If space names were previously created in a schedule, you can select a *Space* name from the drop-down list.



Figure 6–11

- Set the *Upper Limit* to the level above and the *Offset* to **0** if you want elements, such as ceilings, to control the height of the space.

4. Move your cursor into a boundary area and click to place the space. Continue adding spaces, as shown in Figure 6–12.

To see the volume of the spaces as you create them it helps to have a floor plan and a section view tiled.

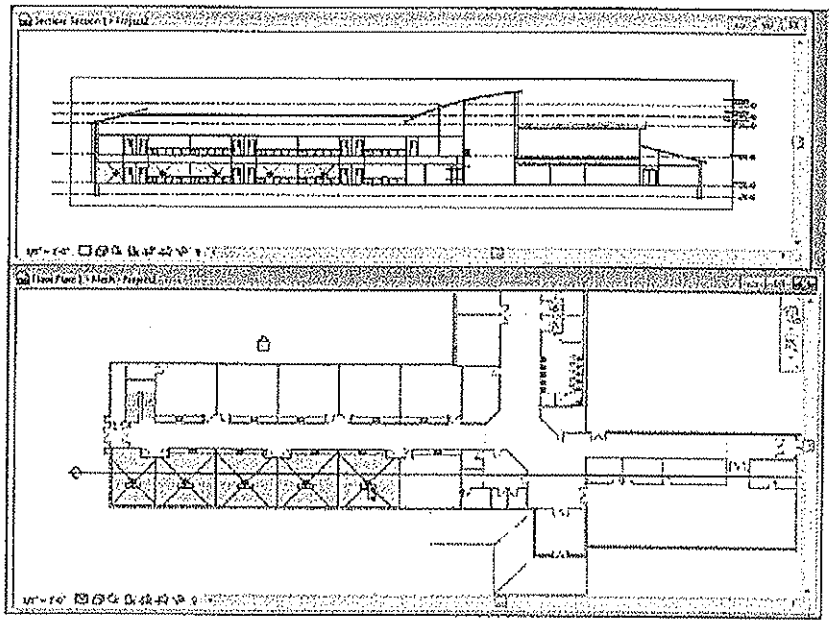

Figure 6–12

5. Click (Modify) or press <Esc> to end the command.

How to: Place Spaces Automatically

1. In the *Analyze* tab>Spaces & Zones panel, click (Space).
2. In the *Modify | Place Space* tab>Spaces panel, click (Place Spaces Automatically).

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3. An alert box opens prompting you about the number of spaces created as shown in Figure 6–13. Click Close.

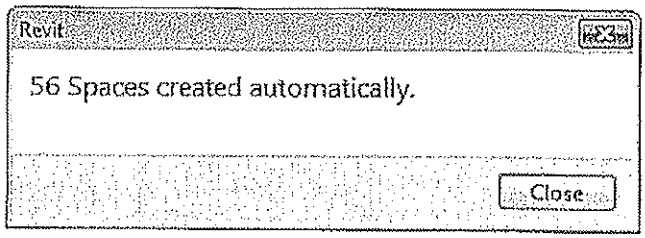

Figure 6–13

4. Spaces are added in each bounded area and a tag is placed if that option is selected in the Ribbon.

Highlight Boundaries does not work with linked files because the entire linked file highlights rather than just the actual space bounding elements.

In the *Modify | Place Space* tab>Spaces panel, click (Highlight Boundaries) to display all of the bounding objects in the project. An alert box opens prompting you that the room bounding elements have been highlighted. When you close the alert box, it turns off the highlighting of the bounding objects.

Space Separation Boundaries

Boundaries for spaces can also be defined by space separation lines. Use these where you might not have a wall to separate the areas, but still want to specify them as different space. For example, in a lobby, there might be an area open to above that does not have a wall that defines the change in space height. Draw a space separation boundary as shown in Figure 6–14.

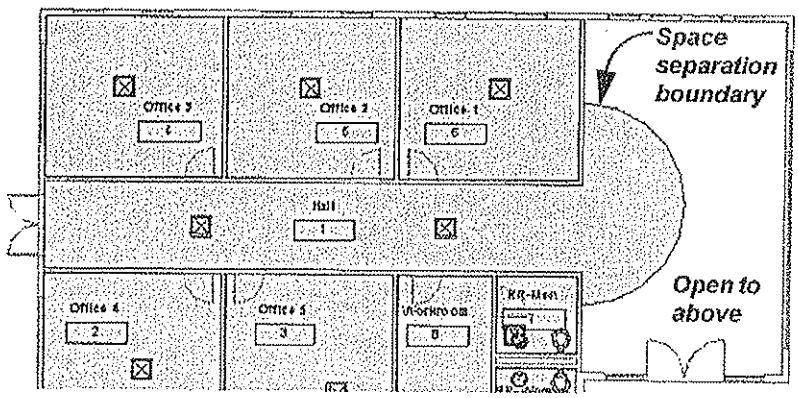

Figure 6–14

How to:

Create Space Separation Boundaries

1. In the *Analyze* tab>Spaces & Zones panel, click (Space Separator).
2. In the *Modify | Place Space Separation* tab>Draw panel, use the sketch tools to draw the edges of the boundary.
3. Click (Modify) or press <Esc> to end the command.
4. Use (Space) to add spaces in the areas bounded by the separation lines.

- You can edit space separation lines by splitting, trimming, etc.

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6.2 Working with Spaces

- Select spaces and modify them graphically and in Properties.
- Set up spaces for specific situations, including shafts, sliver spaces, cavities, and plenums.

As you are working with spaces in an Autodesk Revit MEP project, it is important to place a space in every open area so that the energy analysis is computed correctly. Check the project in plan and in section to find elements, such as shafts and plenum spaces as shown in Figure 6–15. You also need to set up the properties of each space for correct calculation.

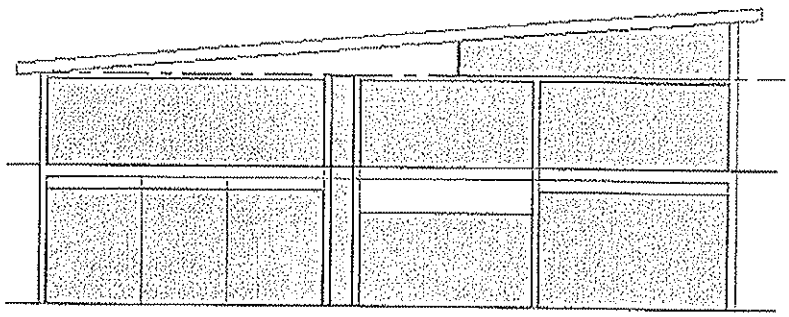

Figure 6–15

- To select a space, hover the cursor over it until you see the crossing line, as shown in Figure 6–16. Select the reference point to pick the space.

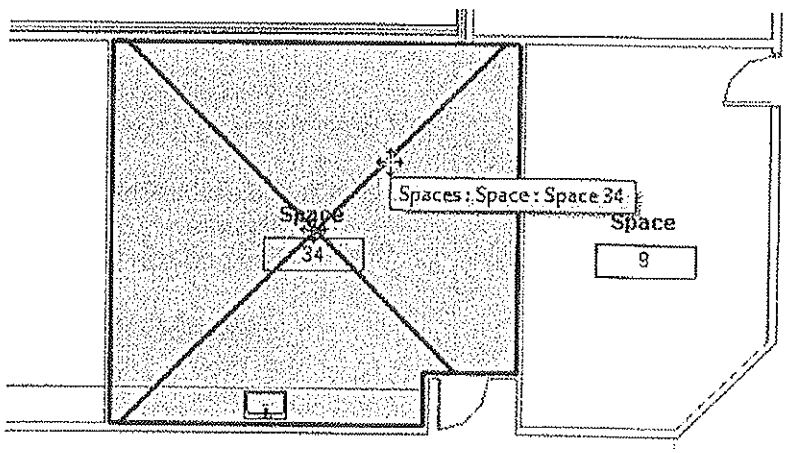

Figure 6–16

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This information is critical to setup before doing Heating and Cooling Loads and using various Energy Analysis tools.

- When a space is selected, you can modify its Properties, as shown in Figure 6–17. These include *Constraints* on the space, including the **Upper Limit** and **Limit Offset**, which display the height of the space, *Electrical-Lighting* and *Loads* information, and *Mechanical Airflow* and *Energy Analysis* features as well as standard *Identity Data* where you set up the *Space Name* and *Space Number*.

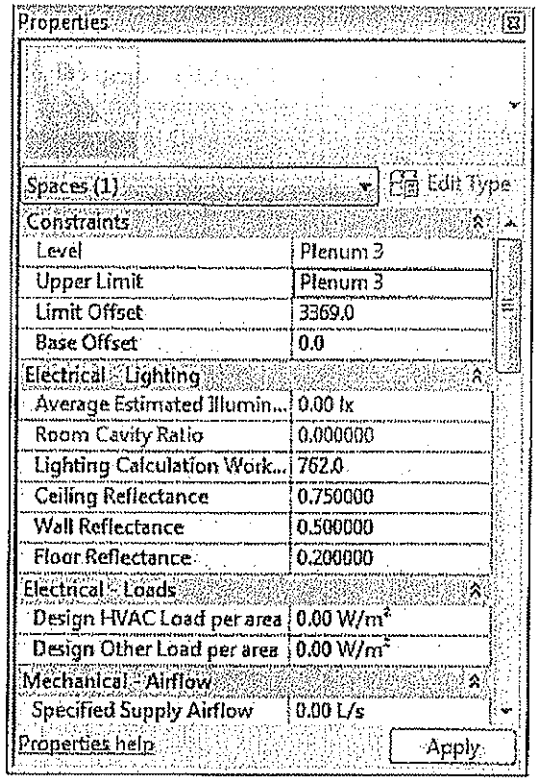

Figure 6–17

- You can select several spaces at once to add the same information to all of them.

- If a linked architectural model includes rooms the associated *Room Name* and *Number* are displayed in the Space Properties and can be set to match as shown in Figure 6–18.

Identity Data	
Number	112
Name	Studio
Room Number	112
Room Name	Studio
Comments	

Figure 6–18

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- Another way to change the space name or number is to select the tag name or number to modify it, as shown in Figure 6–19.

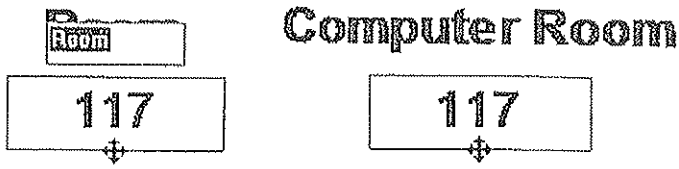

Figure 6–19

- To make a height change visually, open a section and use the controls and temporary dimensions as shown in Figure 6–20.

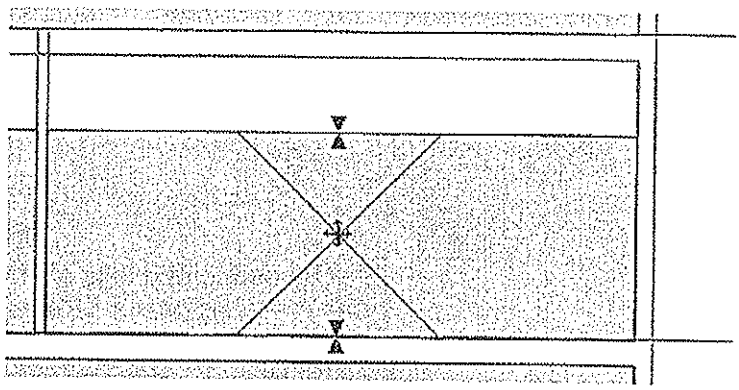

Figure 6–20

- When there are changes in the height of an area the space must be placed at the tallest height as shown on the left in Figure 6–21, where a Plenum level was added. You can then change the *Bottom Offset* in Properties to have the space extend down as shown on the right in Figure 6–21.

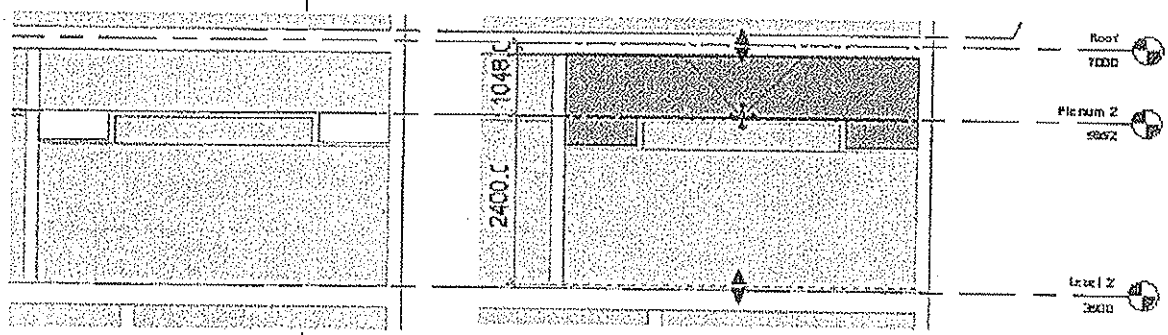

Figure 6–21

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Hint: Adding Space Tags

Not all tags are needed until you set up construction documents, but space tags can help you identify and set up the spaces. You can change the space name and number by clicking on the tag.

Space Tags can be added during or after spaces are added to a project. There are three space tag types: **Space Tag**, **Space Tag With Area**, and **Space Tag With Volume**, as shown in Figure 6–22.

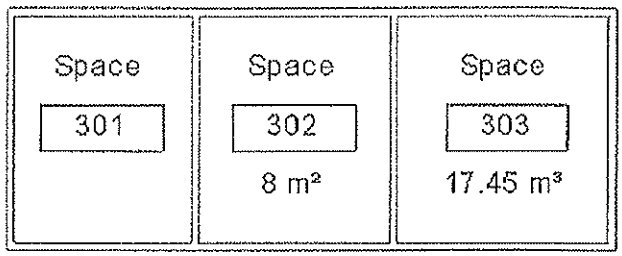

Figure 6–22

If you need to add tags after spaces have been placed, in the *Analyze* tab>Spaces & Zones panel or the *Annotate* tab>Tag panel, click (Space Tag). In the Type Selector, select the tag type and then select the space to tag.

- Spaces can be tagged in plan or section views.
- If you delete a space tag, the space is not deleted.
- If you move a tag outside its space without a leader, it loses the association, as shown in Figure 6–23. You can add a leader or use the alert box buttons to move it back in the space to re-associate it.

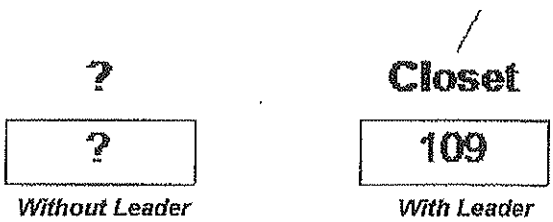

Figure 6–23

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Special Space Situations

There are several situations in which you need to make modifications to spaces or the surrounding bounding areas to have them read correctly when analysis is done. These include shafts, sliver spaces, cavities, and plenum spaces.

Shafts and Interior/Exterior Bounding Elements

It is critical to place a space in every area in a building before you try to analyze the heating and cooling load because any wall that is not bounded by another space is considered an exterior wall. In the example in Figure 6–24, there are several spaces that have not been added, including a shaft, an elevator shaft, and a room. The open spaces are considered exterior rather than interior spaces.

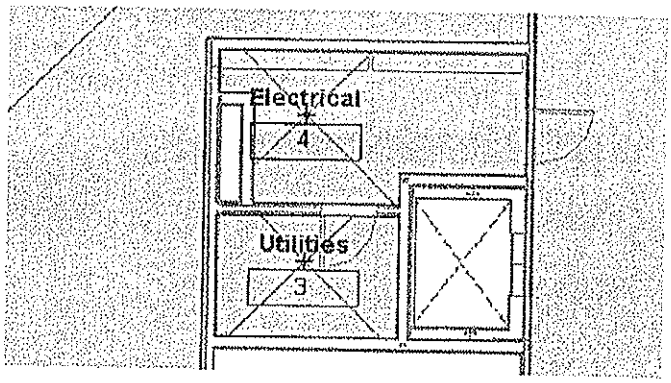

Figure 6–24

- Wall type functions can be specified in the Type Parameters as shown in Figure 6–25. **Interior** and **Core-shaft** *Function* types are considered interior whether they have a space on the other side of the wall or not.

When space boundary objects are contained in linked projects it might be necessary to coordinate these settings with the project Architect or Structural Engineer.

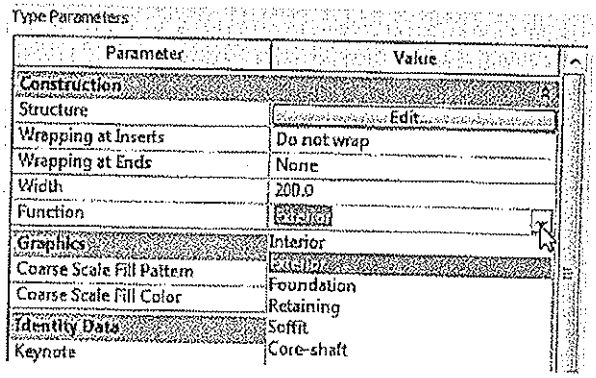

Figure 6–25

- Floor types can also have a *Function* of **Interior** or **Exterior**.

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This is useful when the boundary objects have not been set to define core, soffit, interior, or exterior options.

Sliver Spaces

Sliver spaces are shafts or other thin vertical spaces that have parallel walls with spaces on all sides and meet a Sliver Space Tolerance setup in Energy Settings. You cannot place a space in such areas.

- To define the Sliver Space Tolerance, in the *Manage* tab> Settings panel, click (Project Information) and click Edit... next to the **Energy Settings** parameter.
- Instead of changing the Sliver Space Tolerance, which could cause problems elsewhere in your project, you can clear the Room Bounding status in the wall properties as shown in Figure 6–26. If there is a linked model this must be done directly in the original file.

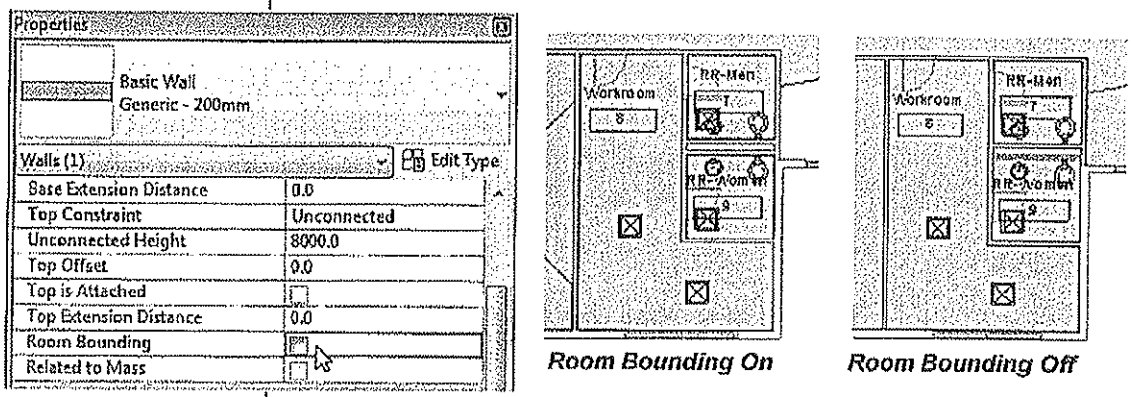

Figure 6–26

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Cavities

Cavities are small areas in which the walls are asymmetrical, such as a curved or triangular space that defines an odd shaped room, as shown in Figure 6–27. Typically, walls that define such spaces only extend to the ceiling or just above the ceiling. If you can add a space, do so. Check the area in section to verify that the entire space has been filled.

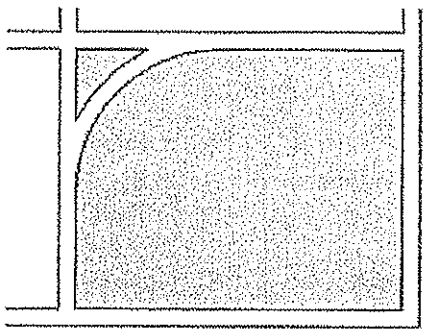

Figure 6–27

Plenum Spaces

Plenum spaces are the areas between ceilings and the floor above, typically where ducts, piping, and electrical lines are run. Plenum areas need to have spaces added to them as shown in Figure 6–28.

In Properties, plenum spaces can have the Plenum box checked, which automatically unchecks and greys out Occupiable *and sets Condition Type to Unconditioned.*

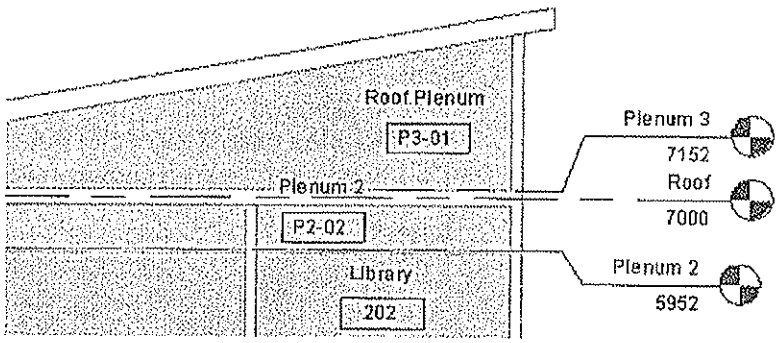

Figure 6–28

How to:

Create Spaces in a Plenum

1. Place spaces in the existing areas.
2. In a plan view, create a section that cuts through the area in which the plenum runs.

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3. In the section, verify that all of the spaces are touching the ceilings, as shown in Figure 6–29. (Typically, set the space **Upper Limit** to the level above to have the space automatically stop at a boundary, such as a ceiling.)

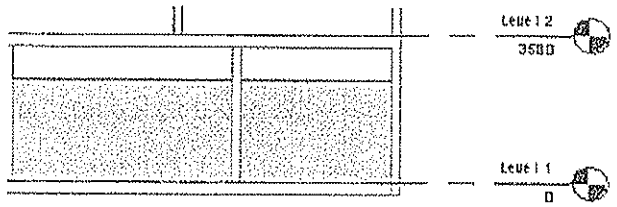

Figure 6–29

4. In the *Architecture* tab>Datum panel, click (Level).
5. In the Type Selector, select **Level: Plenum**.
6. In the Options Bar, select **Make Plan View**.
7. Draw a new level at the height of the ceiling.
8. Rename the level and any associated views with a name that fits the project, such as **Plenum 1** shown in Figure 6–30.

Some templates include the Plenum Level type. However, it is not included in all templates and is not a requirement.

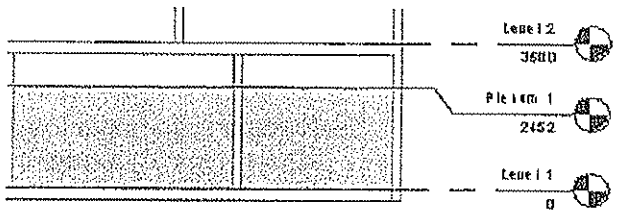

Figure 6–30

9. Open the new floor plan.
10. In Properties, edit the View Range and set the *cut plane offset* to **150mm** (or other value that fits the height of the plenum.)
11. In the plan view, place the spaces. They should fill the plenum area as shown in Figure 6–31.

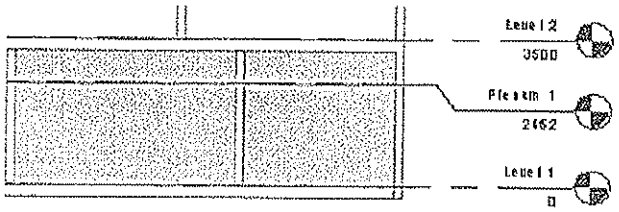

Figure 6–31

12. Repeat as needed for all other plenum areas.

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Practice 6a

Working with Spaces

- Set up views and view templates where you define spaces.
- Add spaces and name them based on existing room names.
- Create plans and sections in the cafeteria and classroom wings in which you can place plenum spaces.
- Investigate and correct problems with overlapping spaces.

Estimated time for completion: 20 minutes

In this practice you will add spaces to a variety of areas, modifying heights and renaming them as needed. You will also create plenum levels and add plenum spaces, as shown in Figure 6–32. You will investigate an overlap of spaces and add space separation lines to correct it.

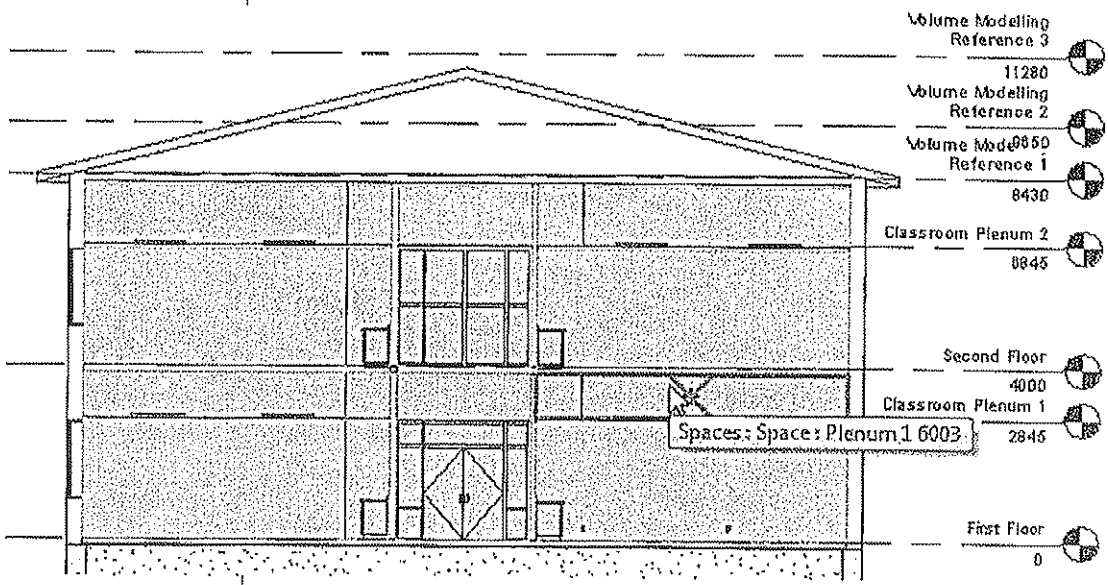

Figure 6–32

Task 1 - Set up a view in which you will define spaces.

1. Open the project **MEP-Elementary-School-Spaces-M.rvt** found in the *Chapter 6* folder of your class folder.
2. In the Project Browser, expand Coordination>All>*Floor Plans*. Select the **First Floor** view, right-click and select **Duplicate View>Duplicate with Detailing**.

*Use **Duplicate with Detailing** so that it includes the existing tags.*

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3. Rename the new view as **01 Space Planning**.
4. No spaces display in this view. Type **VG** to open the Visibility/Graphics dialog box.
5. In the *Model Categories* tab, scroll down and expand **Spaces**. Select **Interior** and click OK.
6. Most of the areas in this building have spaces as shown in Figure 6–33 but several still need to be added for the Gym, Cafeteria, and Kitchen.

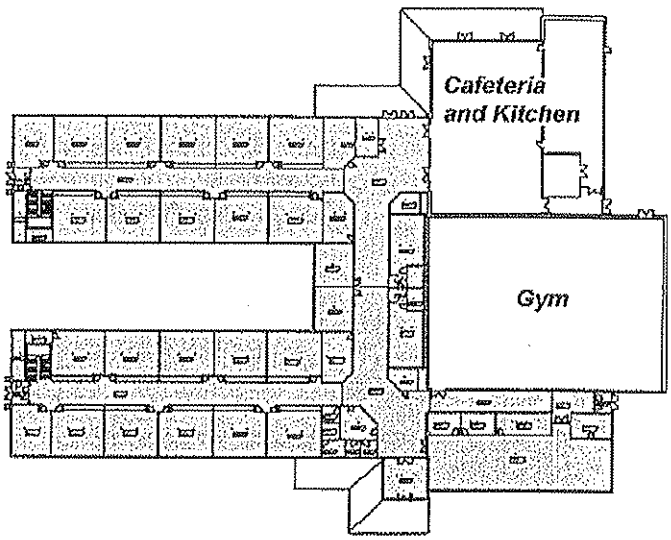

Figure 6–33

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You need to apply these view settings to other views as you work with spaces. Therefore, it is a good idea to create a View template.

7. In the Project Browser, right-click on the **01 Space Planning** view and select **Create View Template from View...**
8. In the New View Template dialog box, type **Space Plan** and click OK.
9. In the View Templates dialog box, click OK. This template can be used again for any other plan views that you create while working with spaces.

Task 2 - Modify and add spaces.

1. Zoom in on the Stairs in the North Classroom wing. There is a Space Separation line across the stairwell as shown in Figure 6–34. It is not needed because the stair is open to the corridor. Delete the line and the related Corridor space fills the stairwell.

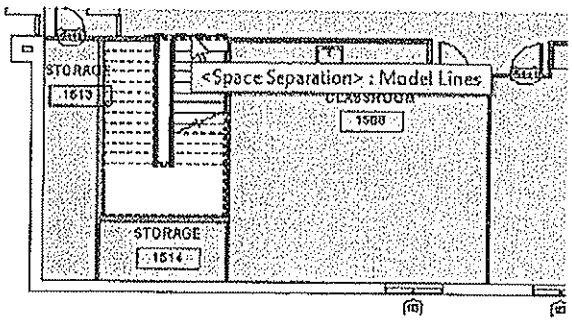

Figure 6–34

2. Zoom into the Cafeteria and Gym areas of the building.
3. In the *Analyze* tab>Spaces & Zones panel, click (Space).
4. In the Options Bar, set the *Upper Limit* to **Second Floor** with no *Limit Offset*.
5. In the *Modify | Place Space* tab>Tag panel, verify that (Tag on Placement) is selected.
6. Click inside the Gym, Cafeteria, and support spaces.
7. Click (Modify) to end the command.

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8. Zoom in to the space tag in the gym. The right name and number are not set even though there is an associated room in the linked model.
9. Select the space (not the tag).
10. In Properties, scroll down to the *Identity Data* area. The *Number* and *Name* for the space do not match the *Room Number* and *Room Name* as shown in Figure 6–35.

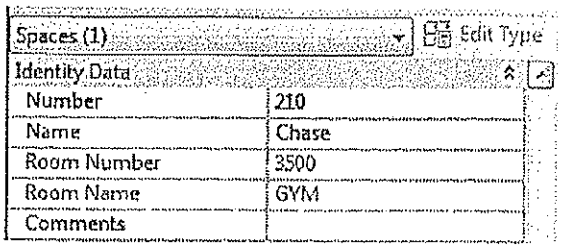

Figure 6–35

11. Change the space name and number to match the room name and number and click Apply.
12. In the view, note that the space tag updated with the new information.
13. Repeat the process with the other new spaces for the Cafeteria (as shown in Figure 6–36), Kitchen, Kitchen Storage, and Corridor.

To make it easier to see the Identity Data area, collapse the other areas. This modification is remembered for spaces as long as you are working in this session of the software.

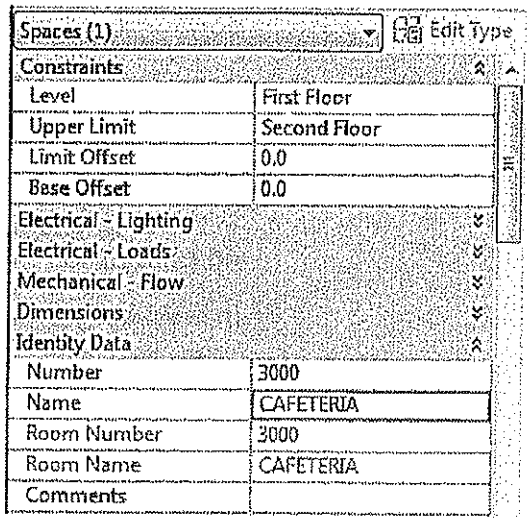

Figure 6–36

14. Save the project.

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Draw the section so it does not display the far wall. This makes it easier to just display the gym and its space.

Task 3 - Verify the heights of spaces.

1. Draw a section across the part of the gym that extends beyond the rest of the building, as shown in Figure 6–37.

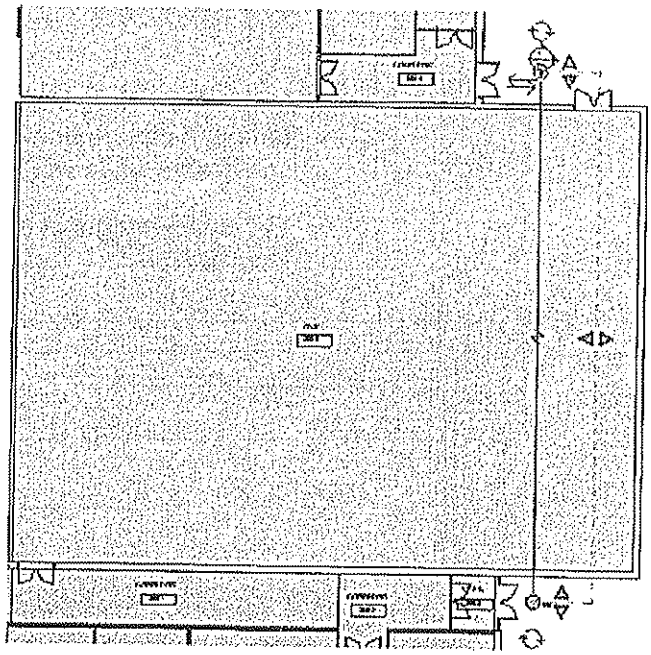

Figure 6–37

2. Click in empty space to clear the selection and then double-click on the arrow of the section marker to open the section.
3. Modify the height of the crop region so the entire gym structure is displayed.
4. In Properties, set the *Discipline* to **Coordination** and the *Sub-Discipline* to **All**.
5. Type **VG**. In the Visibility/Graphics Overrides dialog box, in the *Model Categories* tab, select the **Spaces>Interior** category. In the *Annotation Categories* tab, clear **Grids**.

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6. In the Project Browser, right-click on the new section view (Coordination>MEP>Section (Building Section): **Section 1**) and select **Create View Template from View...**
7. In the New View Template dialog box, type **Space Section** and click OK.
8. In the View Templates dialog box, click OK. This template can be used again for any other section views that you create while working with spaces.
9. The space height in the gym is too low as shown in Figure 6–38.

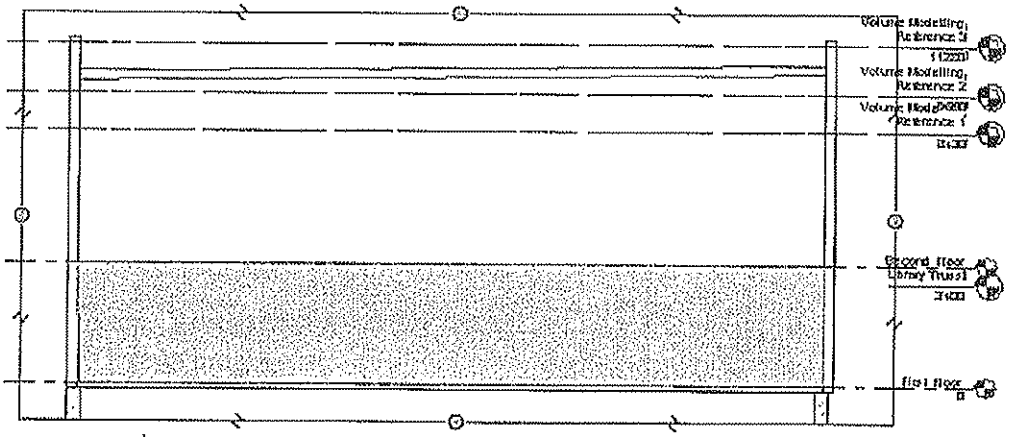

Figure 6–38

10. Select the space. Use the controls to extend the space above the roof of the gym or, in Properties, change the *Upper Limit* to **Volume Modeling Reference 3**.
11. Press <Ctrl>+<Tab> to return to the **First Floor** plan view.
12. Draw a section across the end of the Cafeteria and Kitchen as shown in Figure 6–39.

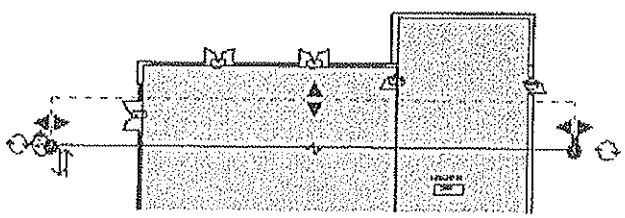

Figure 6–39

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13. Click in empty space to clear the selection and then double-click on the arrow of the section marker to open the section.

14. In Properties, scroll down to the *Identity Data* area and click the button next to *View Template*. In the Apply View Template dialog box, select **Space Section** and click OK. The view inherits the settings of the View Template that you created earlier.

15. The **Library Entrance Reference** level is not needed in this view. Right-click and select **Hide in View>Elements**.

16. You can see that the Kitchen space (to the right in Figure 6–40) fills the height correctly but the Cafeteria (to the left in Figure 6–40) does not. The Kitchen has ceilings that create a boundary to the space that are below Level 2 which was set as the upper limit. Part of the Cafeteria ceiling is above Level 2.

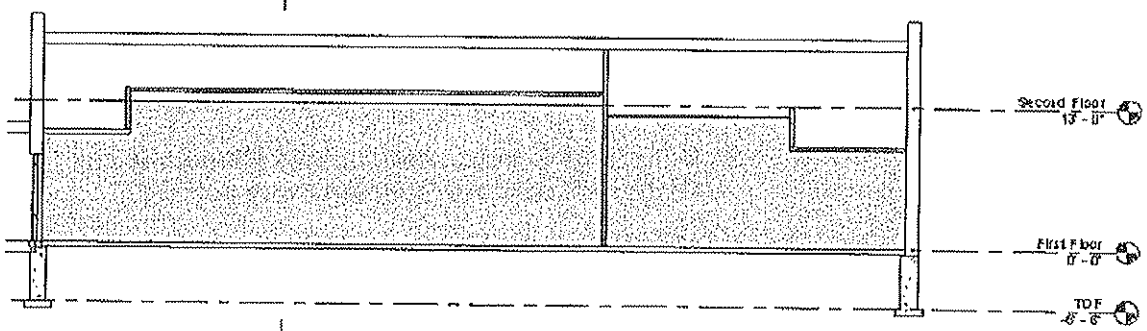

Figure 6–40

- If the windows along the far wall are displayed, in Properties in the *Extents* area, select **Far Clipping** and change the setting to **Clip with line**.

17. Select the Cafeteria space. In Properties, change the *Limit Offset* to **1000mm** as shown in Figure 6–41.

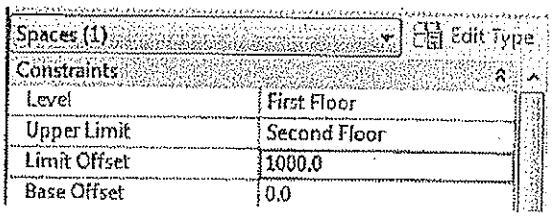

Figure 6–41

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18. The space is now filled in correctly as shown in Figure 6–42.

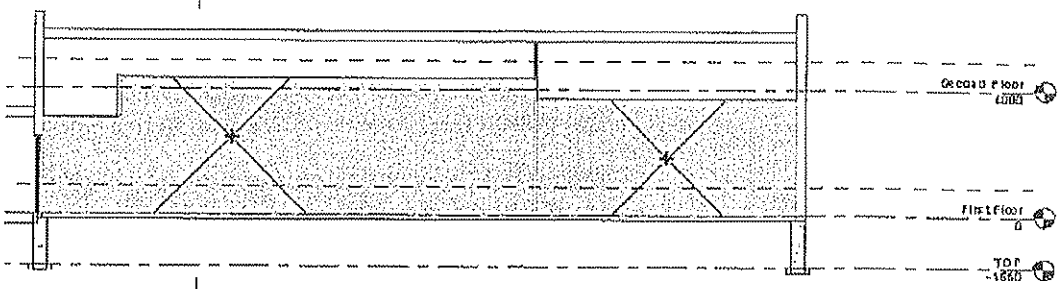

Figure 6–42

19. Save the project.

Task 4 - Add Plenum Spaces.

As you can see in the section of the Cafeteria and Kitchen, there is an open area above the ceilings that also needs a space. To do this you need to add an additional level and its associated plan view.

1. In the *Architecture* tab>Datum panel, click (Level).
2. In the Type Selector, select **Level: Plenum** and, in Properties, clear the **Building Story** option.
3. Draw a level line **4380mm** above the First Floor and rename it as **Cafeteria Plenum** as shown in Figure 6–43. When prompted, rename all of the associated views.

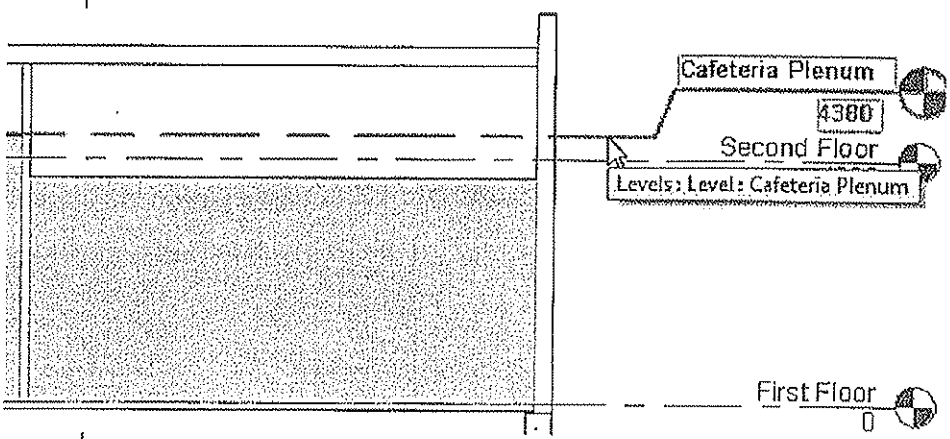

Figure 6–43

4. Double-click on the **Cafeteria Plenum** level head to open the floor plan view.

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5. In Properties, scroll down to the *Identity Data* area and set the *View Template* to **Space Plan** to quickly display the spaces and turn off the grids in the view.

6. Scroll down to the *Extents* area. View Range is grayed out because the View Template is controlling this setting.

7. Click on the View Template again, change the name to <None>, and click OK. The information stored in the view template is still applied but no longer controls the View Range.

8. Edit the View Range of the view and set the *Cut Plane* to **500mm** and the *Bottom* and *View Depth Level* to **Level Below (Second Floor)**.

9. In the *Analyze* tab>Spaces & Zones panel, click (Space).

10. Add spaces to the Cafeteria and Kitchen areas. The Kitchen space fills the entire area, as shown in Figure 6–44, because the base of the space is at the Cafeteria Plenum level, which is above all of the interior walls.

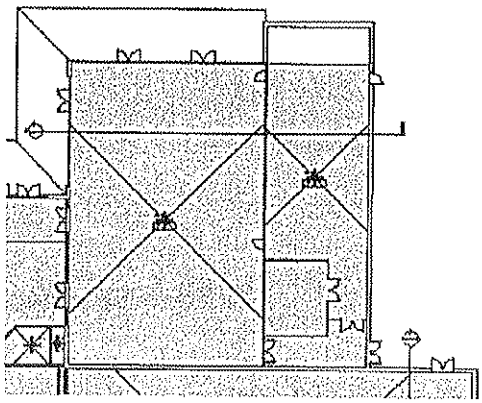

Figure 6–44

11. Change the space name and number over the cafeteria to **Cafeteria Plenum** and **6000**. Change the space name and number over the kitchen to **Kitchen Plenum** and **6001**.

12. Switch to the Cafeteria section. The height of the space is appropriate but the depth of some parts is not as shown in Figure 6–45.

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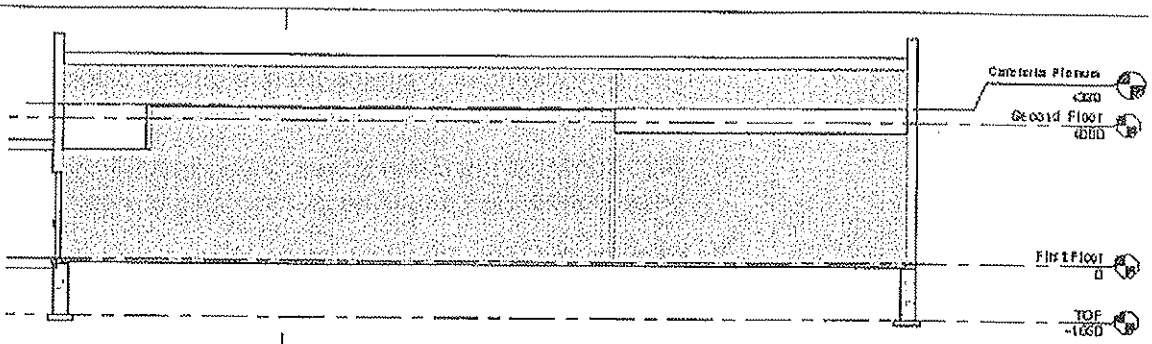

Figure 6–45

13. Select the Cafeteria Plenum space. In Properties, change the *Base Offset* to (negative) **-1000mm**. The space expands down but not all the way. Change the *Base Offset* to (negative) **-1500mm**. The space expands down to fill the plenum area.

14. Select the Kitchen Plenum space. This time use the Drag controls to extend the space below the lowest ceiling. The section should display as shown in Figure 6–46.

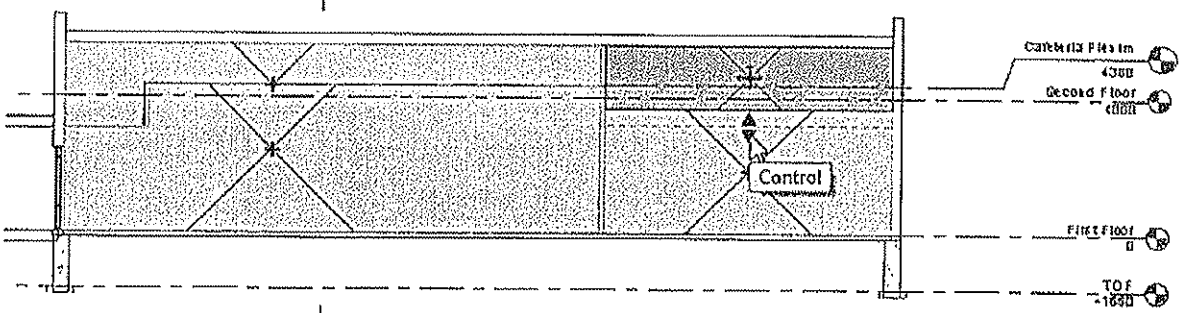

Figure 6–46

15. Save the project.

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Task 5 - Add plenum spaces to the Classroom Wings.

1. Return to the **01 Space Planning** view.
2. Draw a section that cuts across both Classroom Wings as shown in Figure 6–47.

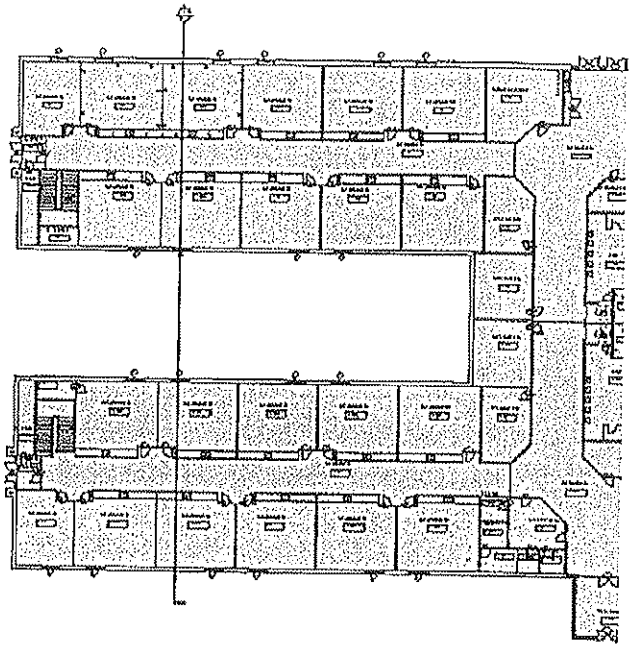

Figure 6–47

3. Verify that the section is pointing to the left.
4. Open the section view and, in Properties, set the *View Template* to **Space Section**.
5. Modify the crop region as needed to see the full height of the building.There are plenum areas to which spaces have not been applied as shown in Figure 6–48.

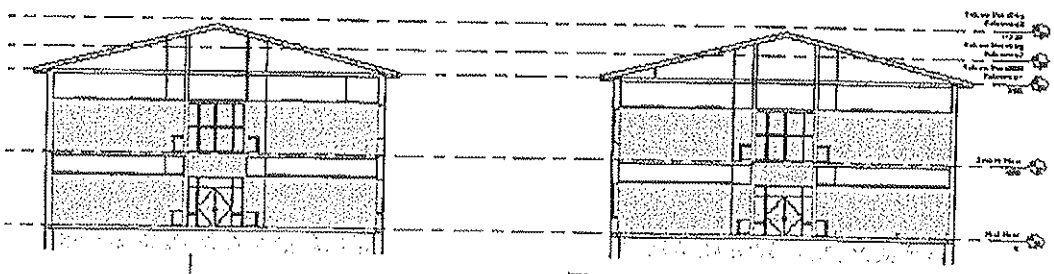

Figure 6–48

6. In the *Architecture* tab>Datum panel, click (Level).

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7. In the Type Selector, select **Level: Plenum** and, in Properties, clear the **Building Story** option.
8. Add two levels at the height of the ceilings on the first and second floors, one at **2845mm** and the other at **6845mm**.
9. Rename them as **Classroom Plenum 1** and **Classroom Plenum 2**, as shown in Figure 6–49. When prompted, rename all of the associated views.

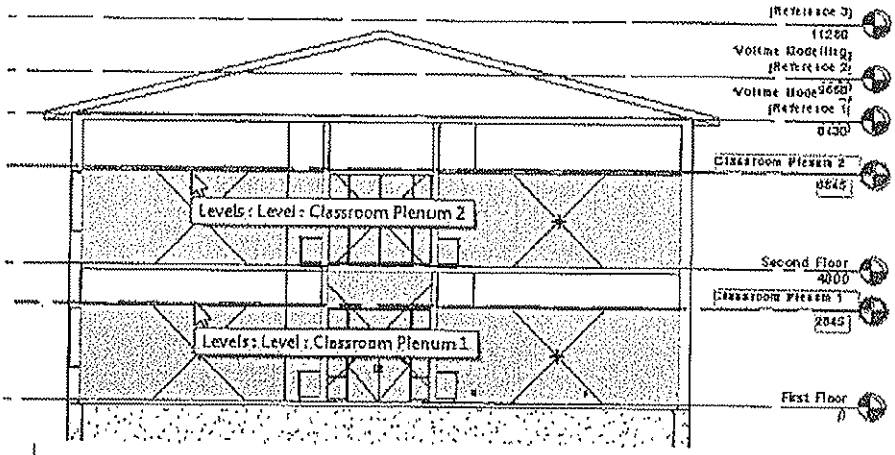

Figure 6–49

10. In the Project Browser, expand the Coordination>HVAC> Floor Plans nodes to display the new Classroom Plenum views.
11. Hold down <Ctrl> and select both of them.
12. Right-click and select **Apply View Template...**
13. In the Apply View Template dialog box, select **Space Plan** and click OK.
14. The plans are now moved to the Coordination>All>Floor Plans node, the grids are turned off and spaces are turned on as specified in the view template
15. Open the **Classroom Plenum 1** view.

If you set the View Template in Properties you cannot change the View Range at this point.

16. In Properties, scroll down to the *Extents* area, and edit the *View Range*. Change the *Cut Plane Offset* to **300mm** and click OK. Some spaces are already expanded through the plenum areas as shown in Figure 6–50.

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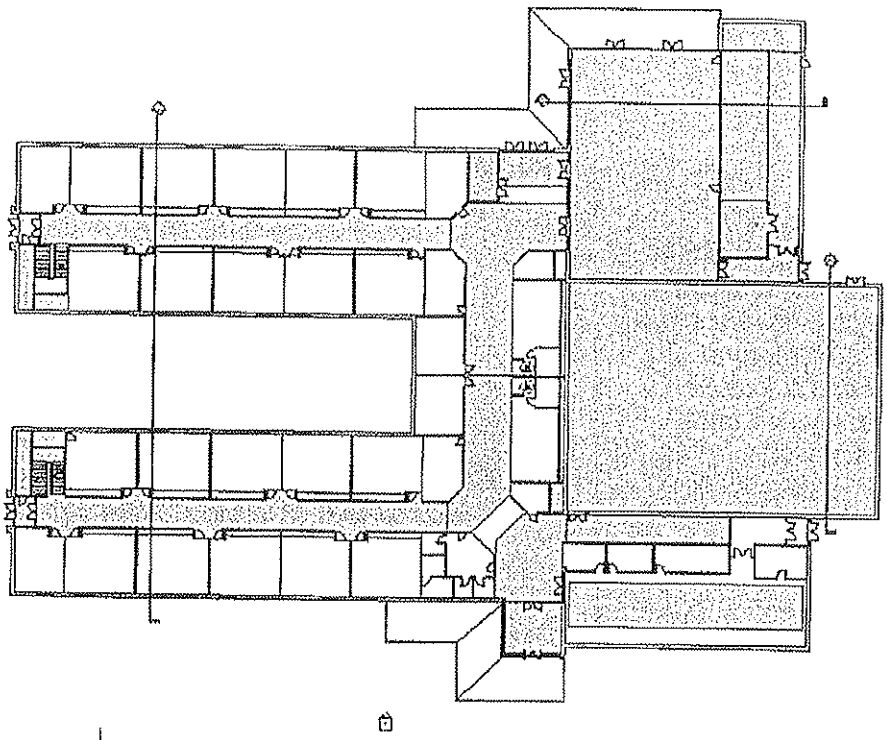

Figure 6–50

17. In the *Analyze* tab>Spaces & Zones panel, click (Space).

18. In Properties, set the *Upper Limit* to **Second Floor** and the *Limit Offset* to **0**. Scroll down to the *Identity Data* area and change the *Name* to **Plenum 1**. Scroll down to *Energy Analysis* and select **Plenum** as shown in Figure 6–51. Doing so means that all of the spaces you place in this command have these properties.

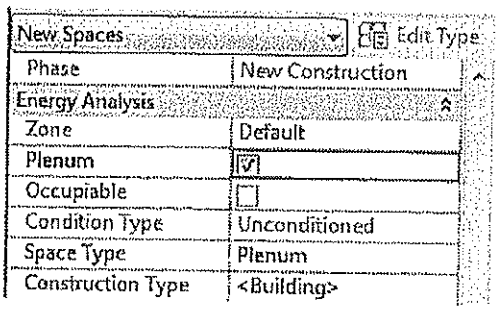

Figure 6–51

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19. Click in all of the open areas. Most fill in without any problem but others cause alerts about overlapping spaces to display. Disregard the alerts and continue placing spaces except in the Library area.

20. When you finish the view should display as shown in Figure 6–52. The areas that are not enclosed are roofs.

You can disregard the Library area at this time as it requires work in the linked architectural model and additional plenum levels for the spaces to work.

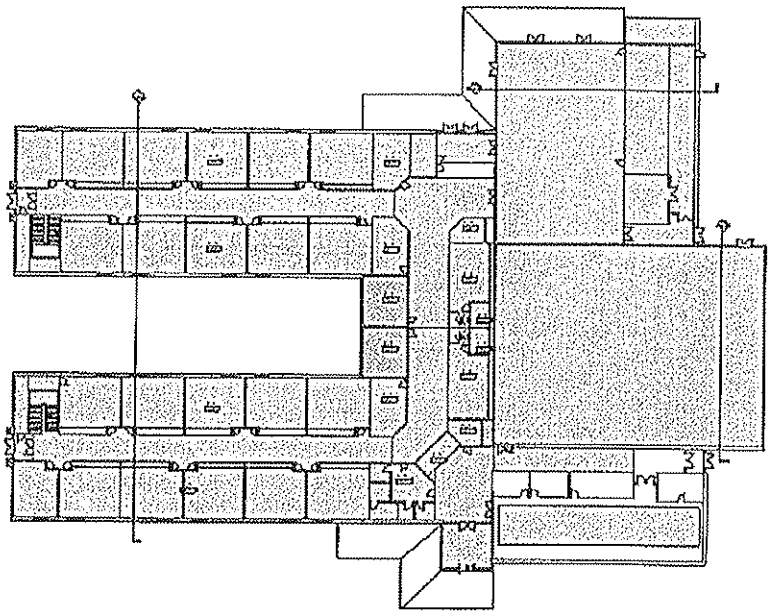

Figure 6–52

21. Zoom in on the Office area near the Front Entrance, as shown in Figure 6–53. There are two issues in this area. There is a small triangular area that does not have a space. Start the **Space** command again and add a space to the area.

Verify the properties of the new space before or after placing it.

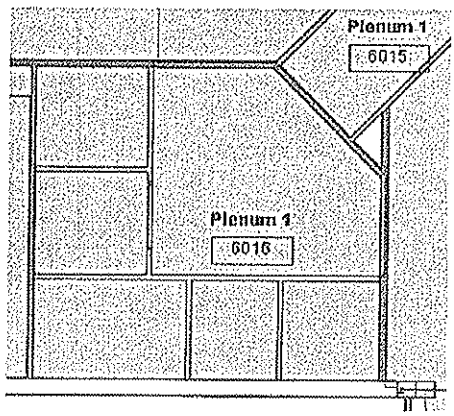

Figure 6–53

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This option displays if there is a problem with the selected space.

22. Select the space in the office.

23. In the *Modify | Spaces* tab>Warnings panel, click (Show Related Warnings).

24. In the dialog box, expand the warnings as shown in Figure 6–54. The issues are with the Copy and Reception spaces on the first floor and the plenum space above.

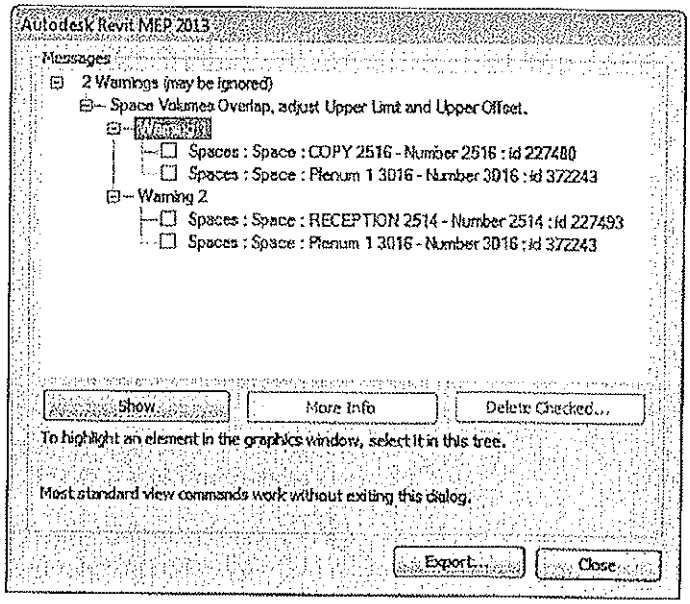

Figure 6–54

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25. In Warning 1, select the Copy space and click Show. Read any alerts and continue. The view zooms in and displays the problems as shown in Figure 6–55.

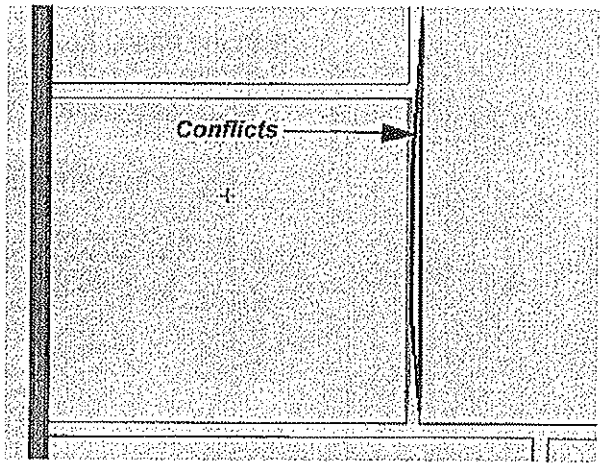

Figure 6–55

26. Close the dialog box.

27. Draw a short section through this area. Open the section and apply the **Space Section** view template to it.

28. When you select the copy space you can see how it extends into the plenum area (as shown in Figure 6–56), but you cannot tell why.

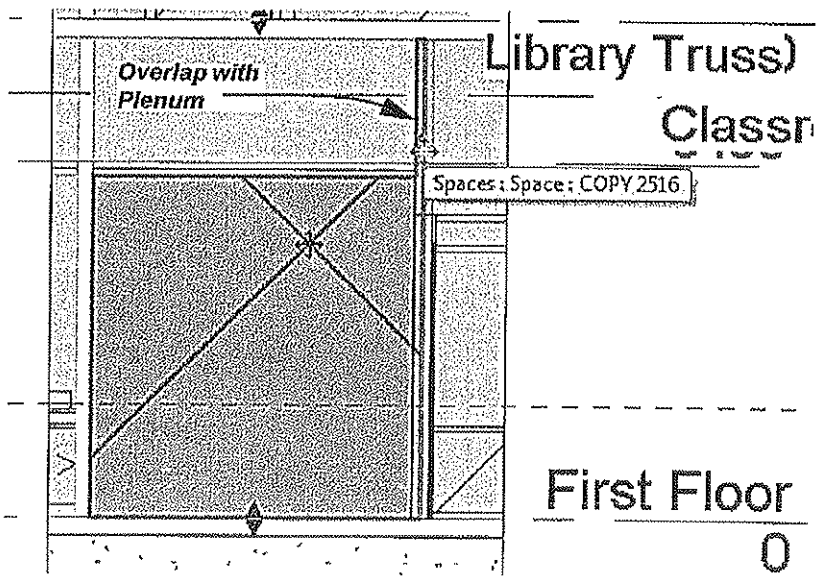

Figure 6–56

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29. Open the **01 Space Planning** view.

30. There is an opening rather than a door between the Copy and Reception areas. This is creating an issue with the wall and therefore with the plenum space. To solve this problem you need to add a Space Separator so that the software treats this opening like any other door.

31. In the *Analyze* tab>Spaces and Zones panel, click (Space Separator).

32. In the Options Bar, clear **Chain** and draw two lines on each side of the framed opening as shown in Figure 6–57.

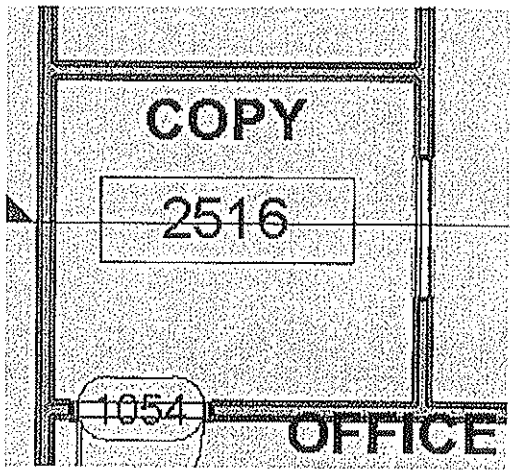

Figure 6–57

33. Select the Copy space again. The Warning no longer displays.

34. Display the related section and the **Classroom Plenum 1** plan view. None of the overlaps exist.

35. Save the project.

Task 6 - Add other spaces (optional).

1. Create a copy of the Coordination>All>Floor Plans>**Second Floor** view and rename it **02 Space Planning** and apply the Space Plan view template to it.

2. Look for areas in which there are no spaces and add any if needed.

3. Open the **Classroom Plenum 2** floor plan view and add plenum spaces.

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4. There are other plenums in the project and spaces with overlaps. If you have time you can investigate the problems and figure out the solutions. Use sections and additional levels as needed to modify the spaces.
5. Save the project.

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6.3 Creating Zones

- Add zones to connect spaces for analysis.
- Use the System Browser with Zones.

The next step in preparing to compute heating and cooling loads is to divide the building into zones, as shown in Figure 6–58. Each zone consists of similar spaces that would be heated and cooled in the same manner.

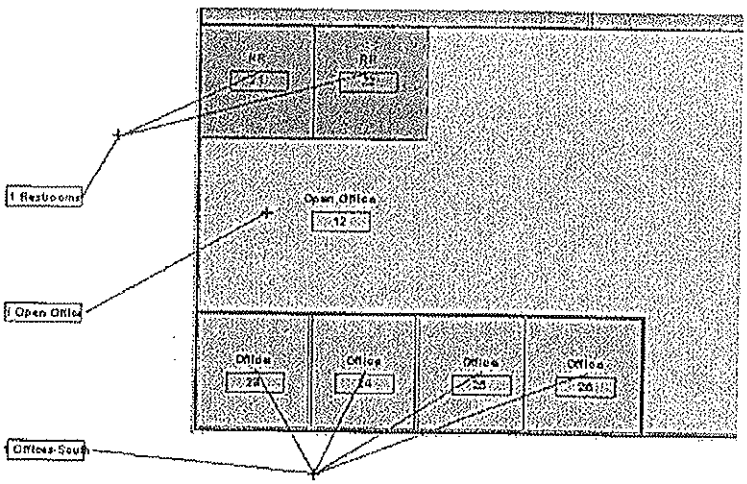

Figure 6–58

- There is always one **Default** zone in a project. All spaces are automatically attached to that zone when they are created.
- While you can add typical zones into a template, you usually add spaces first and then create zones and add spaces to the zones.
- You can create zones in plan and section views.

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How to:

You can set up a view template for zones in the same manner as you set up one for spaces.

Add Zones

1. Open a plan view that contains the spaces you want to work with. (If you have a zone that stretches across two levels, open a section view as well.)
2. For each view, type **VG**. In the Visibility/Graphic Overrides dialog box, expand **HVAC Zones** and select all of the options as shown in Figure 6–59.

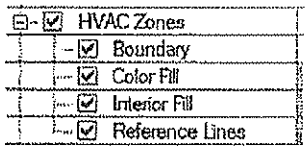

Figure 6–59

3. In the *Analyze* tab>Spaces & Zones panel, click (Zone).
4. In Properties, under *Identity Data*, type a name for the Zone. By default, they are numbered incrementally.
5. In the *Edit Zone* tab, as shown in Figure 6–60, (Add Space) is automatically selected.

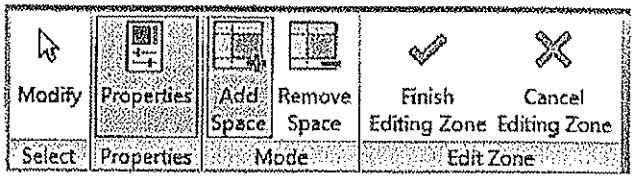

Figure 6–60

6. Select the spaces that you want to add to the zone.
7. Click (Finish Editing Zone).

- Another quick way to add a zone is to select the spaces first and then, in the *Analyze* tab>Spaces & Zones panel, click (Zone). The spaces are automatically added to the zone.
- To edit an existing zone, select one of the zone lines and, in the *Modify* | *HVAC Zones* tab>Zone panel, click (Edit Zone). The *Edit Zone* tab displays in which you can add more spaces.
- Click (Remove Space) to detach a space from the zone or modify the zone properties.

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- Zones do not automatically have a tag placed but it is helpful to display these as you are working, as shown in Figure 6–61. In the *Annotate* tab>Tag panel, click (Tag by Category) and select on the zone(s) that you want to tag.

You can change the name of a zone by selecting the tag and selecting the blue text. If Zone tags are not loaded, you can find them in the Autodesk Revit MEP library in the Annotations> Mechanical folder.

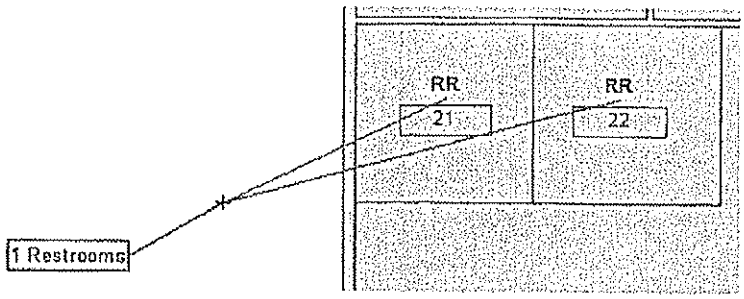

Figure 6–61

Using the System Browser with Zones

The System Browser is a useful tool when working with spaces and zones. When you select a space in the System Browser, it displays in the project and the System Browser, as shown in Figure 6–62. The selected zone or space is automatically made active in the Properties. This enables you to modify names for spaces and zones and assign information such as electrical loads and mechanical airflow.

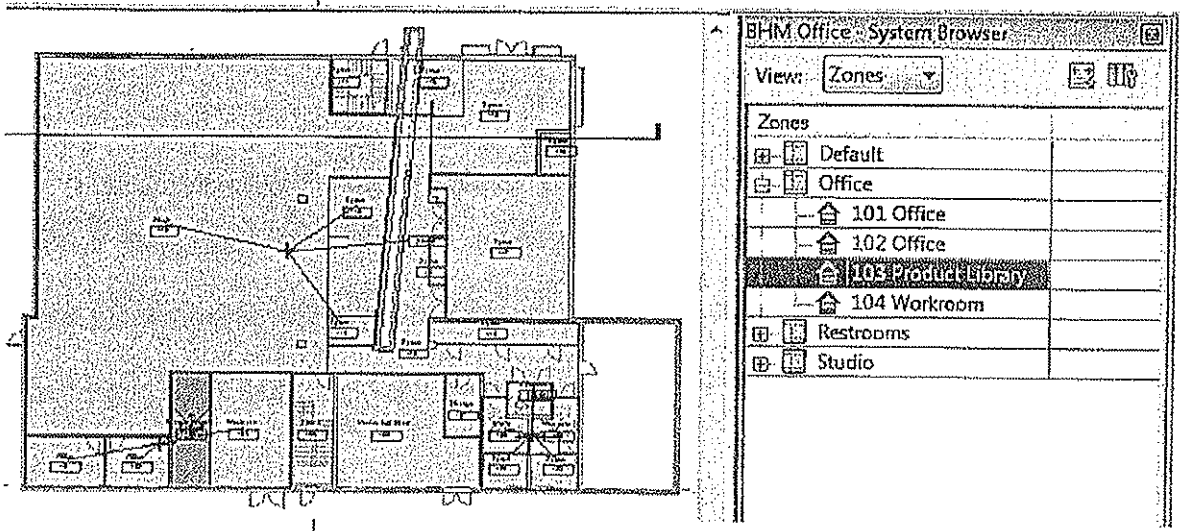

Figure 6–62

- As with other palettes, the System Browser can be floated or docked. If you have dual screens you can move it to the other monitor and can remain open as long as required.

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How to:

Use the System Browser with Zones

1. In the *Analyze* tab>System Browser panel, click (System Browser).
2. If the zones are not displayed, open the View drop-down list and select **Zones** as shown in Figure 6–63.

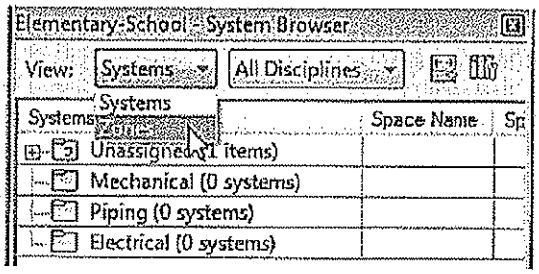

Figure 6–63

3. All of the spaces are listed under the Default zone, as shown in Figure 6–64, until they are added to a specific zone.

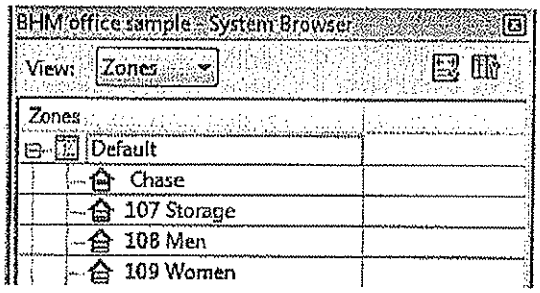

Figure 6–64

- Each space displays an icon showing its status:

  (Occupiable), (Not Occupiable), and (Space not placed).

- As new zones are added the spaces are moved into the new zones.

4. Select a space or zone. It is highlighted in the project and becomes active in the Properties.

- You can select more than one space or zone at a time using <Ctrl> and <Shift>.

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- In the System Browser, if you right-click on a space or zone and select **Show**, the software zooms in on the selected elements. If there is more than one view in which the space can be displayed, the Show Element(s) in View dialog box opens as shown in Figure 6–65.

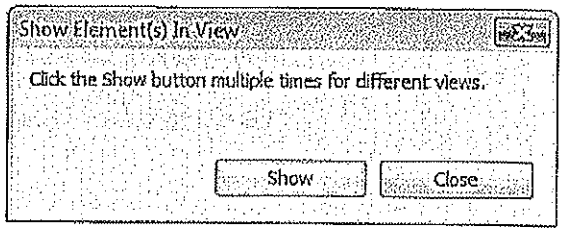

Figure 6–65

- If you place spaces and then delete them, they remain in the project. You can delete them entirely in the System Browser, by right-clicking on the name and selecting **Delete**.
- You can also delete spaces in a space schedule view.

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6.4 Creating Color Schemes

Create Color Schemes and Color Fill Legends for spaces and zones.

When working with Zones and Spaces, it is useful to have a view that displays color coding for individual zones, spaces, or rooms as shown in Figure 6–66. You can include a color fill legend in the same view to clarify the use of the colors.

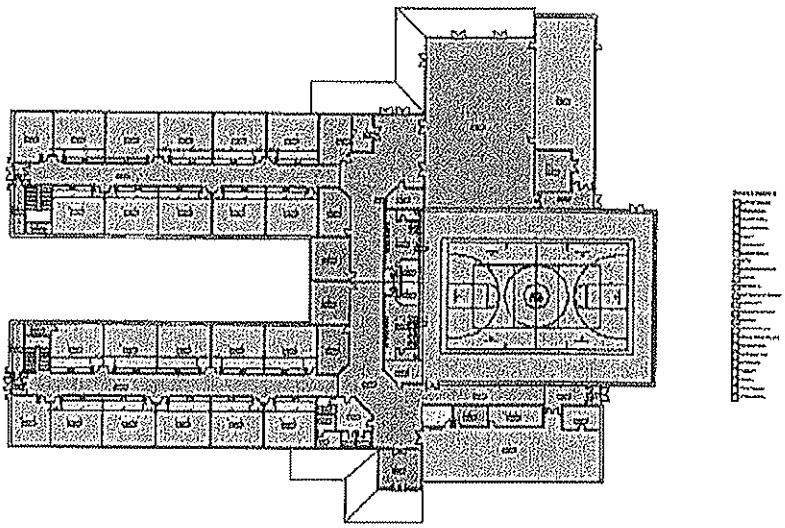

Figure 6–66

- Color schemes are controlled by a view property. Therefore, you should create a view for each color diagram that you want to include.

How to: **Set Up a Color Scheme in a View**

1. Create or duplicate a view that you want to use for the color scheme.
2. In Properties, click the button next to the **Color Scheme** parameter, as shown in Figure 6–67.

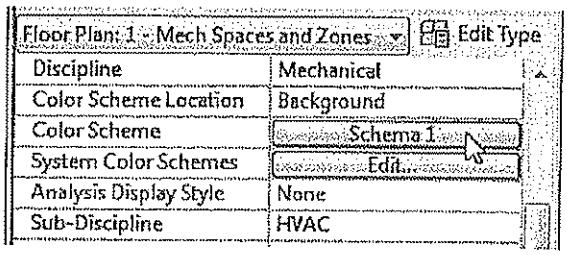

Figure 6–67

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3. In the Edit Color Scheme dialog box, *Schemes* area, select a **Category** as shown in Figure 6–68.

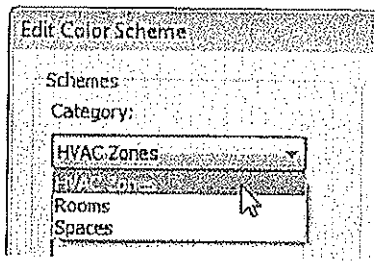


Figure 6–68

4. Select a scheme in the list, such as **Schema 1** as shown in Figure 6–69.

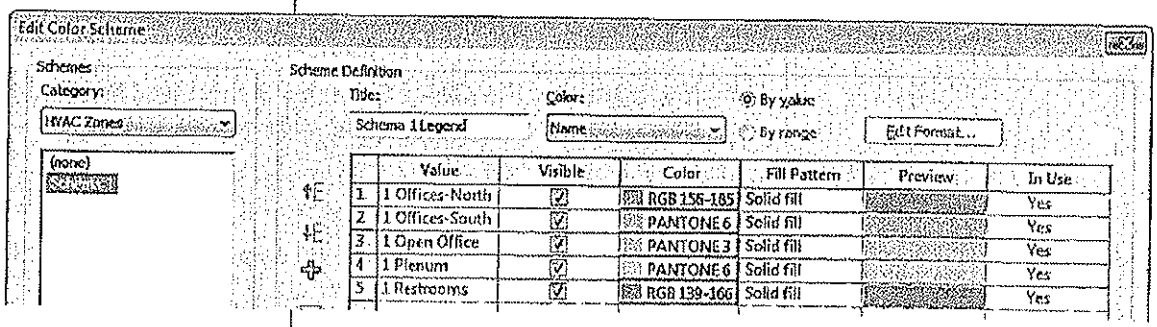
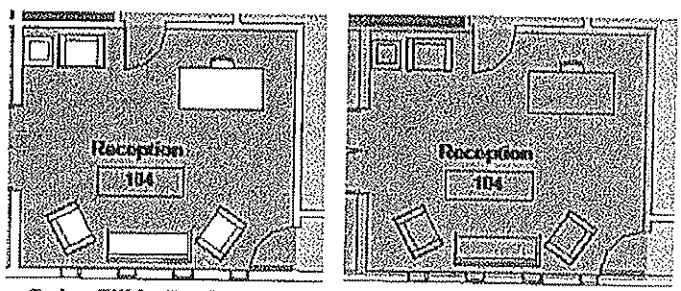


Figure 6–69

5. Click OK. The new color scheme displays in the view.

- The color fill of the scheme can display in the background or foreground of the view, as shown in Figure 6–70. This impacts how components display and whether or not the color fill stops at the walls.

In Properties, set the Color Scheme Location.



Color Fill in Background ***Color Fill in Foreground***

Figure 6–70

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- You can add a legend that matches the Color Scheme, as shown in Figure 6–71. In the *Analyze* tab>Color Fill panel, click (Color Fill Legend) and place the legend where you want it.

Type Properties for the Color Fill Legend control the appearance of the legend, including swatch size and text styles.

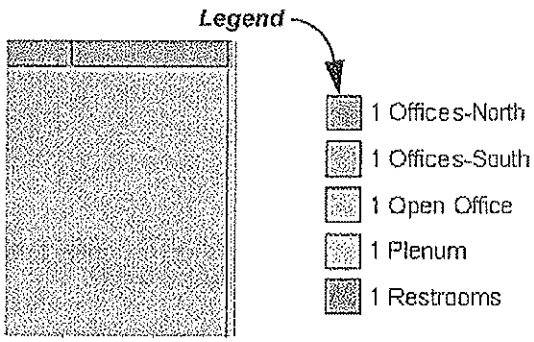

Figure 6–71

- If you change the **Color Scheme** in the View Properties dialog box, it also updates the associated legend.

How to: **Define a Color Scheme**

1. In Properties, click the button next to the **Color Scheme** parameter.
2. In the Edit Color Scheme dialog box, *Schemes* area, select a **Category**.
3. Select an existing scheme and click (Duplicate).
4. In the New color scheme dialog box, enter a new name and click OK. If the Colors Not Preserved warning displays, click OK again.
5. In the Edit Color Scheme dialog box, in the *Scheme Definition* area, type a name for the *Title* of the color scheme. This displays when the legend is placed in the view.
6. In the Color drop-down list, select an option, as shown in Figure 6–72. The available parameters depend on the type of scheme you are creating.

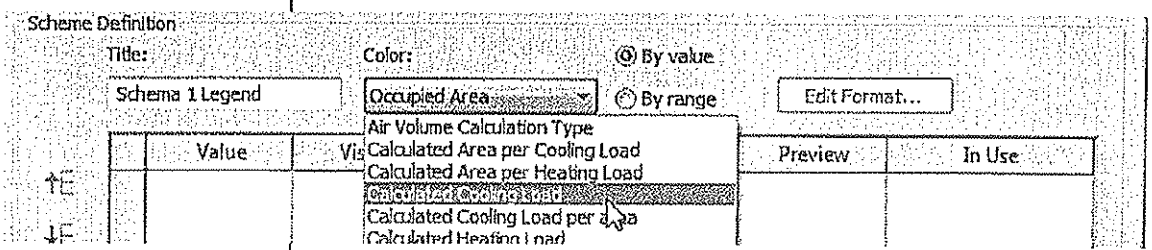

Figure 6–72

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7. Select the **By value** or **By range** options to set how the color scheme displays. Depending on the selection made in the Color drop-down list, **By range** might not be available.
8. If needed, click (Add Value) to add more rows to the scheme, as shown in Figure 6–73. Modify the visibility (*Visible* column), *Color*, and *Fill Pattern* as needed.

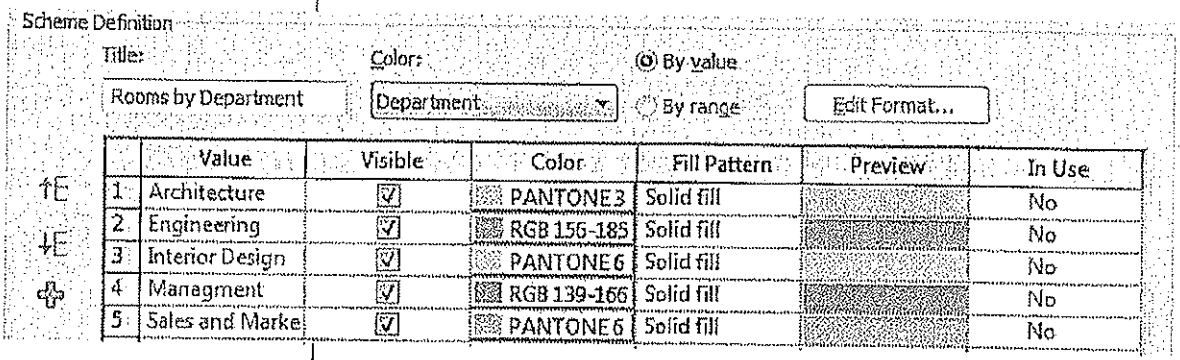

Figure 6–73

9. In the *Options* area, select the **Include elements from linked files** option if you are using linked models.
10. Click OK to end the command.

Color Schemes By Value

If you select the **By value** option, you can modify the visibility, color, and fill pattern of the scheme. The value is assigned by the parameter data in the room or area object.

- Values are automatically updated when you add data to the parameters used in the color scheme. For example, if you create a color by space name and then add another space name in the project, it is also added to the color scheme.
- Click (Move Rows Up) and (Move Rows Down) to change the order of rows in the list.
- To remove a row, select it and click (Remove Value). This is only available if the parameter data is not being used in the room or area elements in the project.

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Color Schemes By Range

If you select the By range option, you can modify the *At Least* variable and the *Caption*, as well as the visibility, color, and fill pattern, as shown in Figure 6–74.

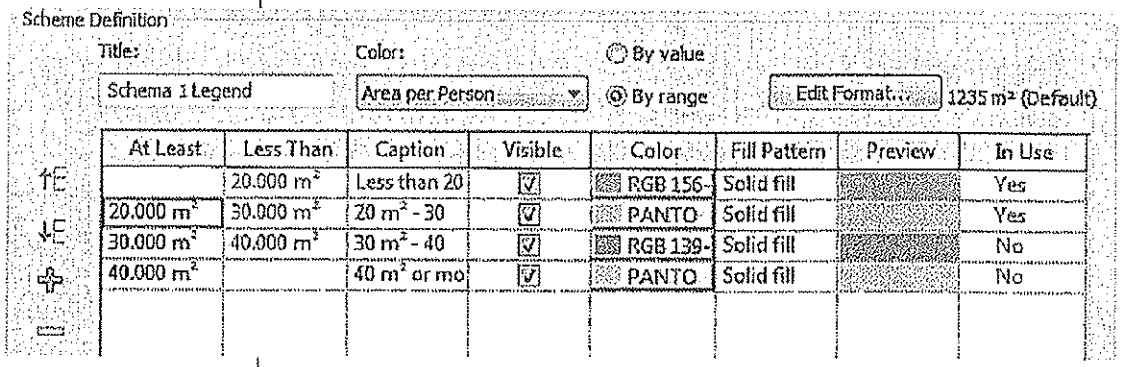

Figure 6–74

- Click Edit Format... to modify the units display format.
- To add rows, select the row above the new row and click (Add Value). The new row increments according to the previous distances set or by double the value of the first row.

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Practice 6b

Estimated time for completion: 15 minutes

Creating Zones

- Create views and add zones to the new views.
- Use the System Browser to identify and modify zone information.
- Create a color scheme showing the zones.

In this practice you will add zones to the project. You will examine the zones and spaces in the System Browser and you set up a view that displays the zone names by color as shown in Figure 6–75 with optional zone tags. (The scale of this view has been changed for clarity.)

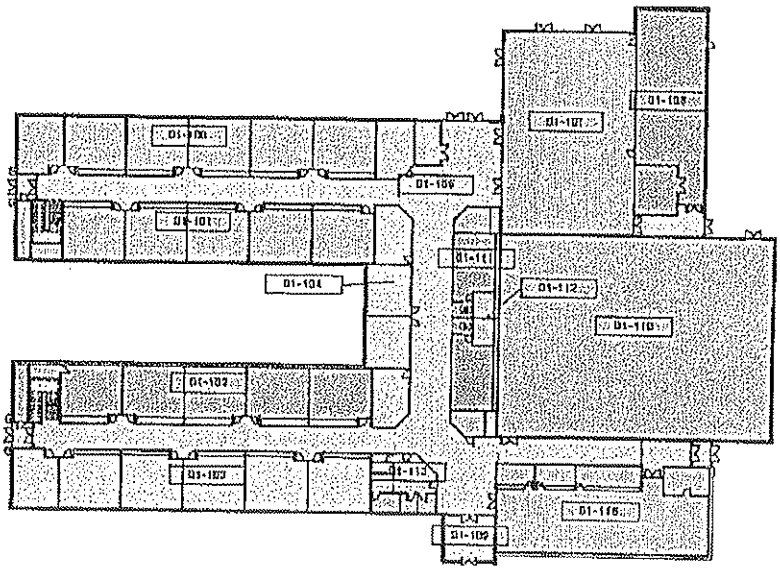

Figure 6–75

Task 1 - Add zones.

1. Open the project file **MEP-Elementary-School-Zones-M.rvt** found in the *Chapter 6* folder of your class folder.
2. In the Project Browser, Coordination>MEP>*Floor Plans* area, right-click on the **01 Space Planning** view and create a **Duplicate with Detailing** view named **01 Zoning**.
3. Repeat the process with **02 Space Planning** and name it **02 Zoning**.

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You can create a view template after modifying the first view and apply it to any other plan views.

4. In each view, open the Visibility/Graphics Overrides dialog box and in the *Model Categories* tab, expand **HVAC Zones** and select **Interior Fill** and **Reference Lines.**
5. Open the **01 Zoning** view.
6. In the *Analyze* tab>Spaces & Zones panel, click (Zone).
7. In the *Edit Zone* tab, verify that (Add Space) is selected.
8. Select the spaces across the top group of Classrooms as shown in Figure 6–76.

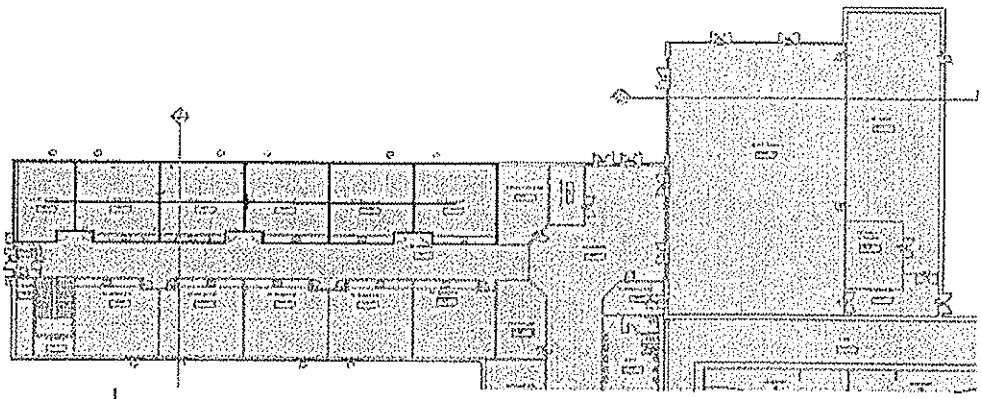

Figure 6–76

9. In Properties, change the *Name* to **01-100**.
10. In the *Edit Zone* tab>Edit Zone panel, click (Finish Editing Zone).
11. Add another zone to the Classrooms and Storage Areas on the other side of the hall as shown in Figure 6–77.

The name of the zone automatically increments as each zone is added.

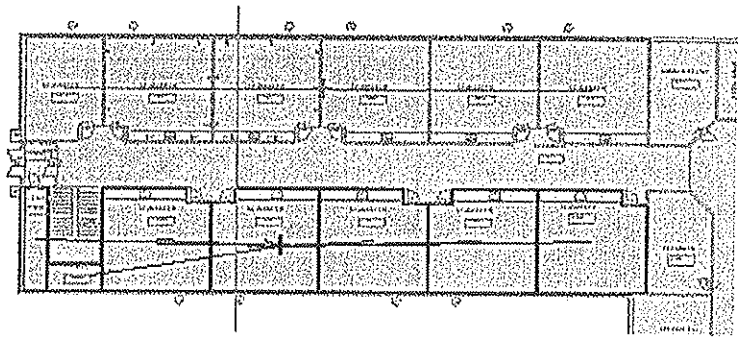

Figure 6–77

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12. Continue adding zones as listed below and shown in Figure 6–78. This figure uses different shades for clarity.

- (1) Two sets of Classroom zones in the South Wing.
- (2) All of the corridors plus the Electrical Room.
- (3) All of the vestibules.
- (4) Nurse's Office, Bookroom, Special Ed rooms, and Workroom.
- (5) Reception, Offices, and Copy Room.
- (6) Library and associated rooms.
- (7) Gym.
- (8) Cafeteria.
- (9) Kitchen and Kitchen Storage.
- (10) Restrooms.
- (11) Housekeeping, Janitor, and associated chases.

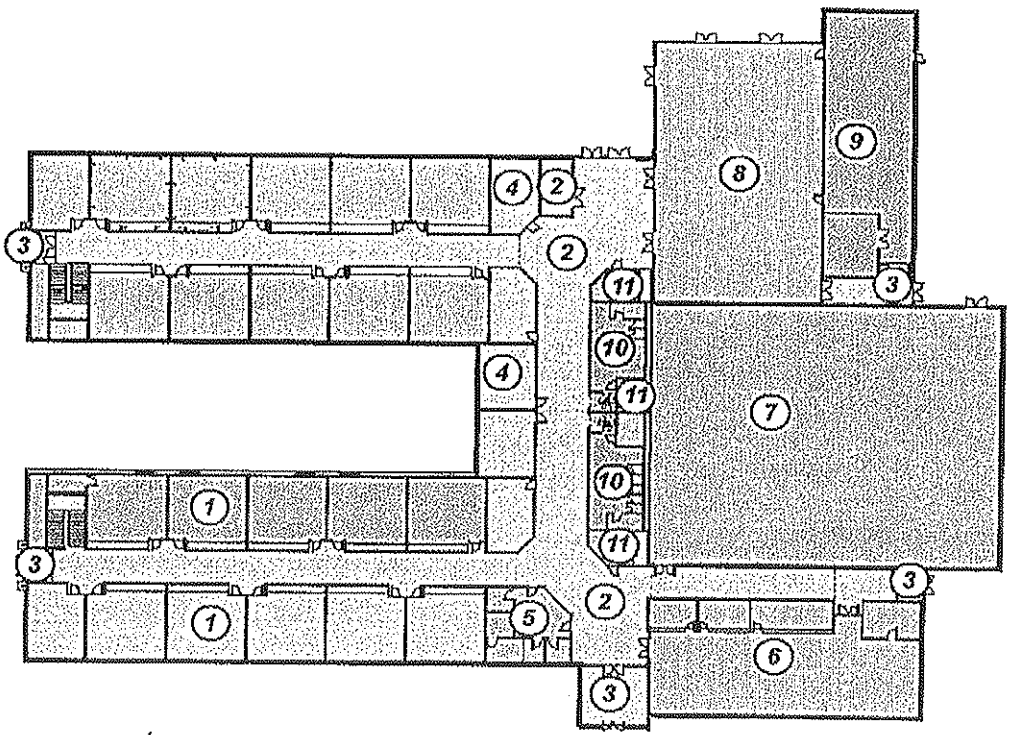

Figure 6–78

13. Optional, add tags to each zone. In the *Annotate* tab>Tags panel, click (Tag by Category), and select each zone to place a tag.

14. Save the project.

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Task 2 - Use the System Browser.

1. Open the System Browser if it is not already open.
2. In the System Browser, set the view so it displays **Zones**. It should display as shown in Figure 6–79.

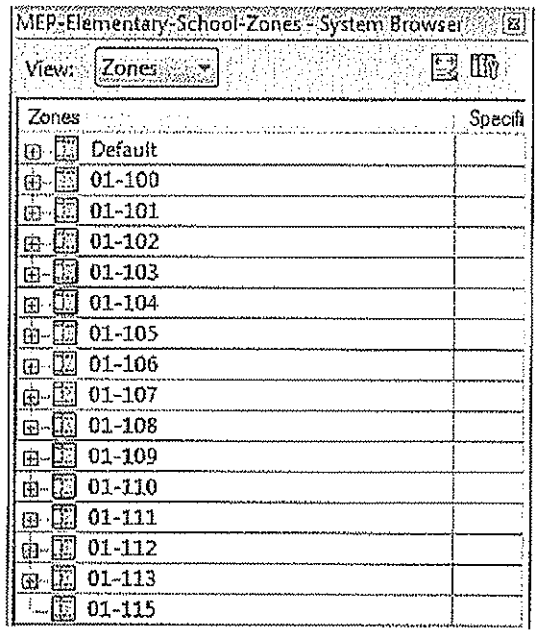

Figure 6–79

3. Expand the various zone names to display the spaces.
4. There are still a lot of spaces in the Default Zone as shown in Figure 6–80. There are two different types of icons for spaces displaying occupied and unoccupied spaces.

Your list might look different than the one shown in Figure 6–80.

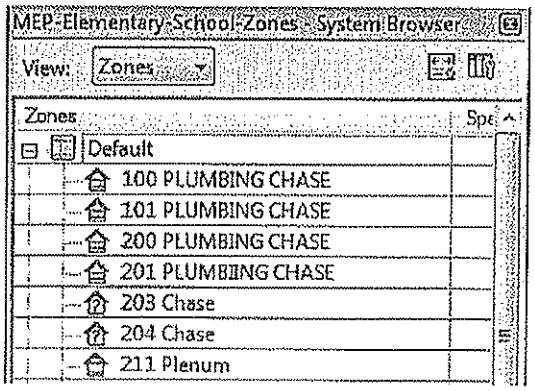

Figure 6–80

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5. Some of the spaces that should be unoccupied, such as the Plumbing Chases shown in Figure 6–80, are not set correctly. In the System Browser, hold down <Ctrl> and select several plumbing chases.

6. In Properties, scroll down to the *Energy Analysis* area and clear **Occupiable**. Repeat this for other chases or plenums that might not be correctly.

7. As you scroll through the spaces, note that some display (Space Not Placed). Right-click on them and click **Delete**.

8. In the System Browser, in the default zone, right-click on one of the plenums and select **Show**. The view changes to display the location of the plenum, such as the one shown in Figure 6–81. In the Show Element(s) in View dialog box, you can click Show to display multiple views. If the alert box prompts you that no other views are open, click OK to search the closed views.

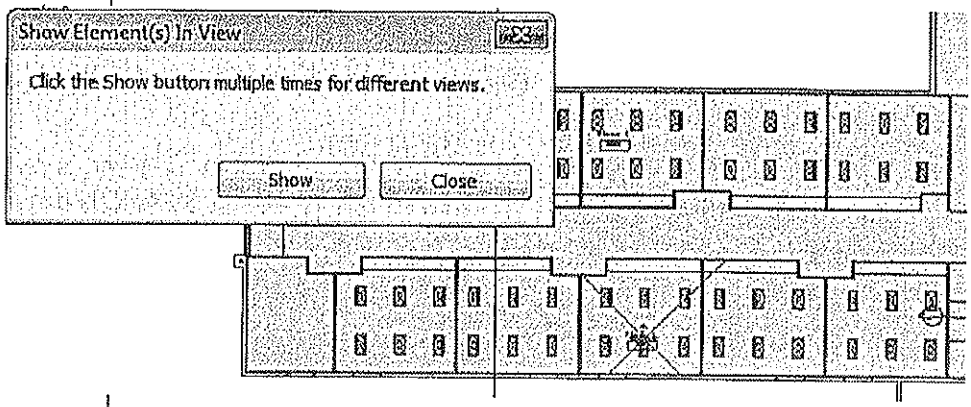

Figure 6–81

9. Save the project.

Task 3 - Add a color scheme.

1. Open the **01 Zoning** view and close any hidden windows.

2. In Properties, in the *Graphics* area, click the button next to *Color Scheme*.

3. In the Edit Color Scheme dialog box, in the *Schemes* area, change the *Category* to **HVAC Zones**.

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4. Select the default **Schema 1**. The Scheme Definition automatically populates by zone name as shown in Figure 6–82.

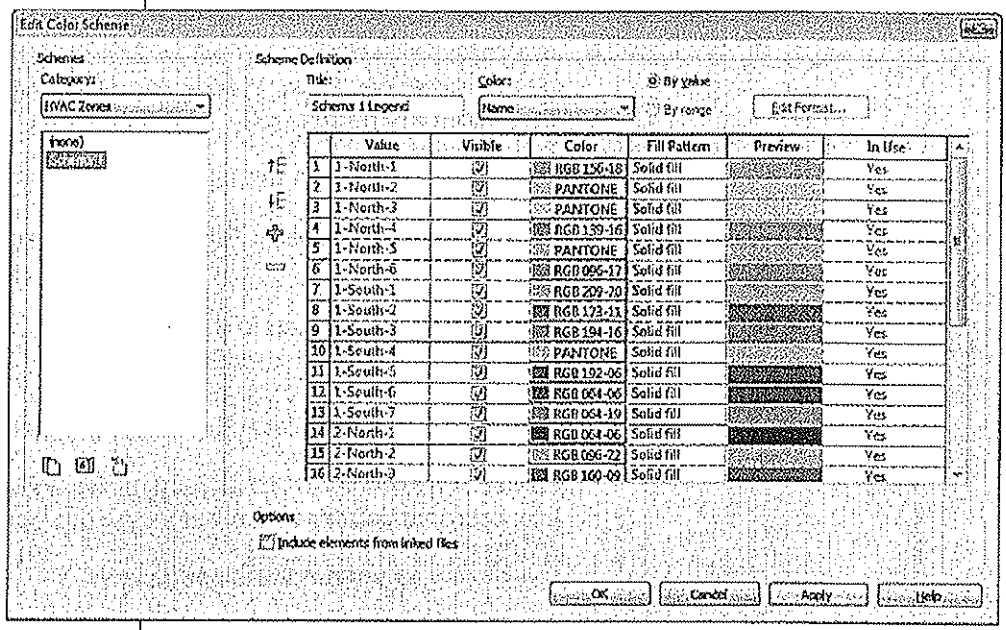

Figure 6–82

5. Change the *Title* of the Scheme to **Zones**.

6. Click OK. The color scheme is applied to the view. The display will be similar to that shown in Figure 6–83.

Your zone colors might vary.

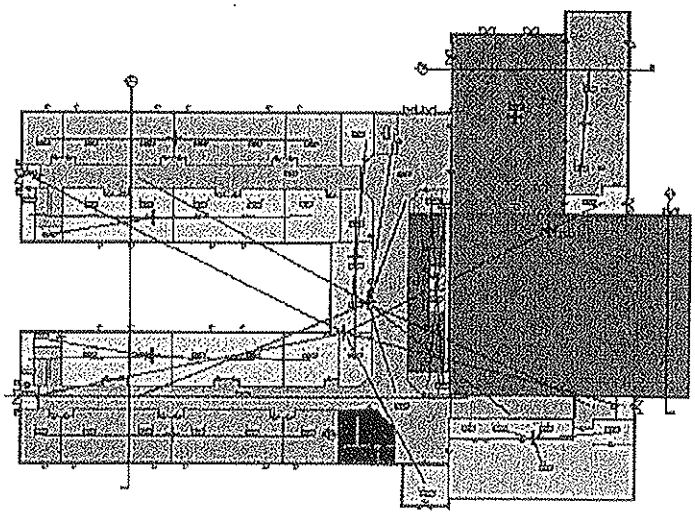

Figure 6–83

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7. In the *Analyze* tab>Color Fill panel, click (Color Fill Legend) and place the legend near the kitchen as shown in Figure 6–84.

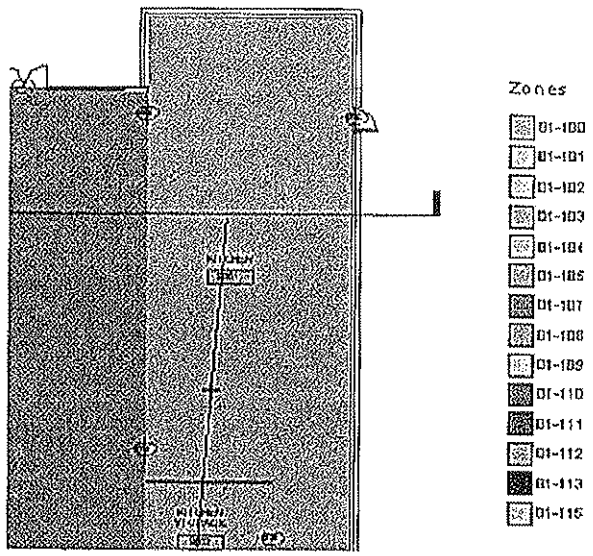

Figure 6–84

8. To turn off the lines that connect the zones, type **VG**. In the Visibility/Graphics dialog box, expand HVAC Zones and clear **Reference Lines**. This can make the color fill easier to read.

9. Open the **02 Zoning** view and add a Color Fill Legend. Because a Color Scheme has not been assigned to the view the Choose Space Type and Color Scheme dialog box opens as shown in Figure 6–85.

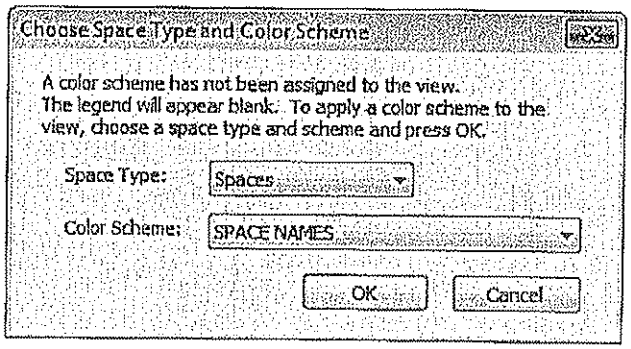

Figure 6–85

10. Set the *Space Type* to **HVAC Zones** and the *Color Scheme* to **Schema1**.

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11. Some of the Zones display because they penetrate the second floor.
12. If the HVAC Zone Reference Lines from the first floor display and make the view difficult to understand, turn them off.
13. Add a zone to the group of classrooms in the North Wing similar to that on the first floor. In Properties, change the name to **02-100**.
14. The zone is automatically filled with color and added to the zone name list as shown in Figure 6–86.

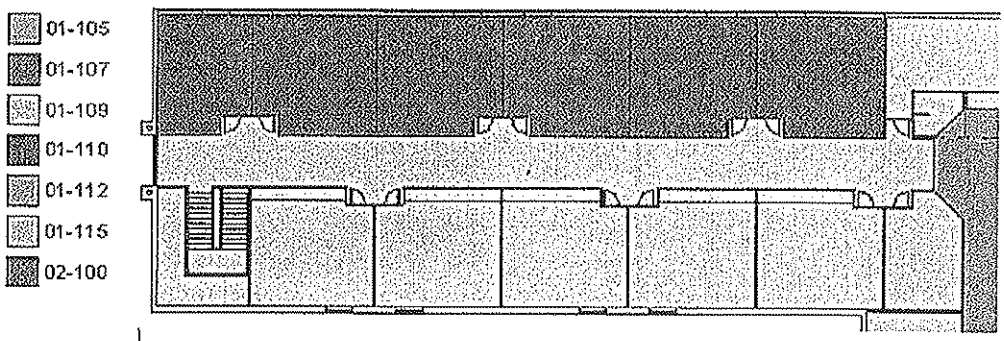

Figure 6–86

15. Continue adding zones to the second floor.
16. If you have time, add other zones including those in the plenums.
17. Save the project.

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Chapter Review Questions

1. Which of the following is true before you run a Heating and Cooling Loads analysis? Spaces need to be created in all rooms...
   a. that have heating and cooling.
   b. established in the architectural drawing.
   c. that span more than one level.
   d. as well as shafts, plenums, and other non-occupied spaces.
2. When you have a space that is not defined entirely by walls, such as a balcony into a 2-story lobby, how do you control the size of the space?
   a. Sketch the boundaries of the space.
   b. Add space separation lines.
   c. Modify the size in Properties.
   d. Change the Room Bounding status of the other walls.
3. If you are not seeing colors for spaces or zones, how do you display them?
   a. Modify the Color Scheme in Visibility/Graphics.
   b. Assign a Color Scheme in Properties.
   c. Toggle on Color Schemes in the View Control Bar.
   d. Add a Color Fill Legend.
4. Zones are made up of spaces that would be heated and cooled in the same manner.
   a. True
   b. False
5. In the System Browser, when a Zone is expanded to display the spaces, what does  mean? The space is...
   a. Occupiable.
   b. Unoccupied.
   c. A plenum.
   d. Not used.

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Command Summary

Button	Command	Location
	**Area and Volume Computations**	■ **Ribbon:** *Analyze* tab>Spaces & Zones panel>expand the panel title
	**Color Fill Legend**	■ **Ribbon:** *Analyze* tab>Color Fill panel
	**Space**	■ **Ribbon:** *Analyze* tab>Spaces & Zones panel
	**Space Separator**	■ **Ribbon:** *Analyze* tab>Spaces & Zones panel
	**Space Tag**	■ **Ribbon:** *Analyze* tab>Spaces & Zones panel or *Annotate* tab>Tag panel
	**System Browser**	■ **Ribbon:** *View* tab>Windows panel, expand User Interface ■ **Shortcut:** Fn9
	**Zone**	■ **Ribbon:** *Analyze* tab>Spaces & Zones panel

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Chapter 7

Performance Analysis

In this chapter you learn how to prepare a project to analyze Heating and Cooling Loads, run the Heading and Cooling Loads tool, and export a project to gbXML for additional energy analysis.

This chapter contains the following topics:

- ✓**Preparing a Project for Energy Analysis**
- ✓**Analyzing the Heating and Cooling Loads**
- ✓**Exporting for Secondary Analysis**

Learning Objectives

This chapter provides instruction to enable you to do the following:

7.1 Preparing a Project for Energy Analysis

- Set up the specifics of the Energy Settings and Building Type Settings for the project.

7.2 Analyzing the Heating and Cooling Loads

- Run a Heating and Cooling Loads analysis.

7.3 Exporting for Secondary Analysis

- Export information contained in a project to gbXML that can be used in other energy analysis software.

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7.1 Preparing a Project for Energy Analysis

Set up the specifics of the Energy Settings and Building Type Settings for the project.

Before adding HVAC systems to a project you need to analyze the heating and cooling loads. To do this you first must have spaces and zones in place. Then you can either use the **Heating and Cooling Loads** tool that comes with the Autodesk® Revit® MEP software, as shown in Figure 7–1, or export the project to gbXML (Green Building XML) which can then be imported into a third-party analysis software.

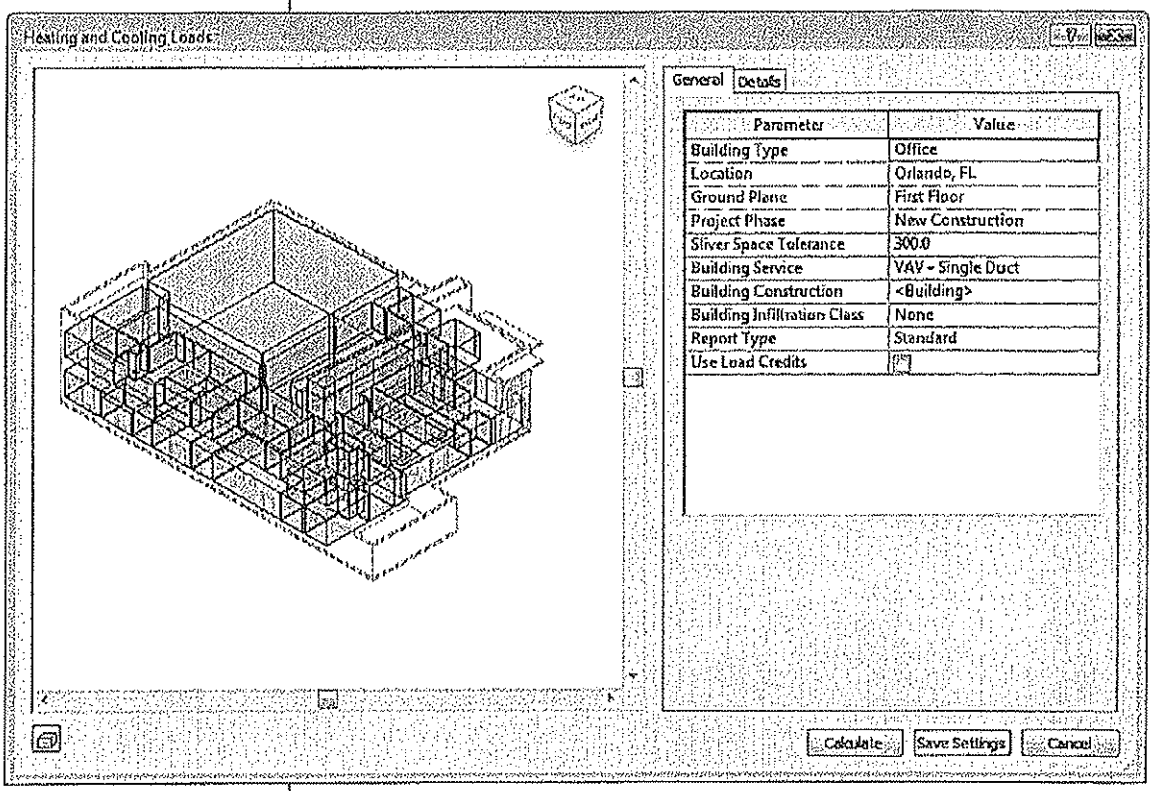

Figure 7–1

- Before running the energy analysis software, verify that all areas in the project are set up with space elements, including unoccupied shafts, plenums, and sliver spaces.
- Add spaces to zones other than the default zone. The default zone is calculated but might not work correctly as spaces in the default zone can be far apart.

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- Sliver spaces do not display in plan views but do display in the analytical model.

New in 2013

- Materials have Thermal Properties, as shown in Figure 7–2, which can be used for analysis in an Autodesk Revit MEP project or when exported to GBxml. These need to be set up in the architectural model.

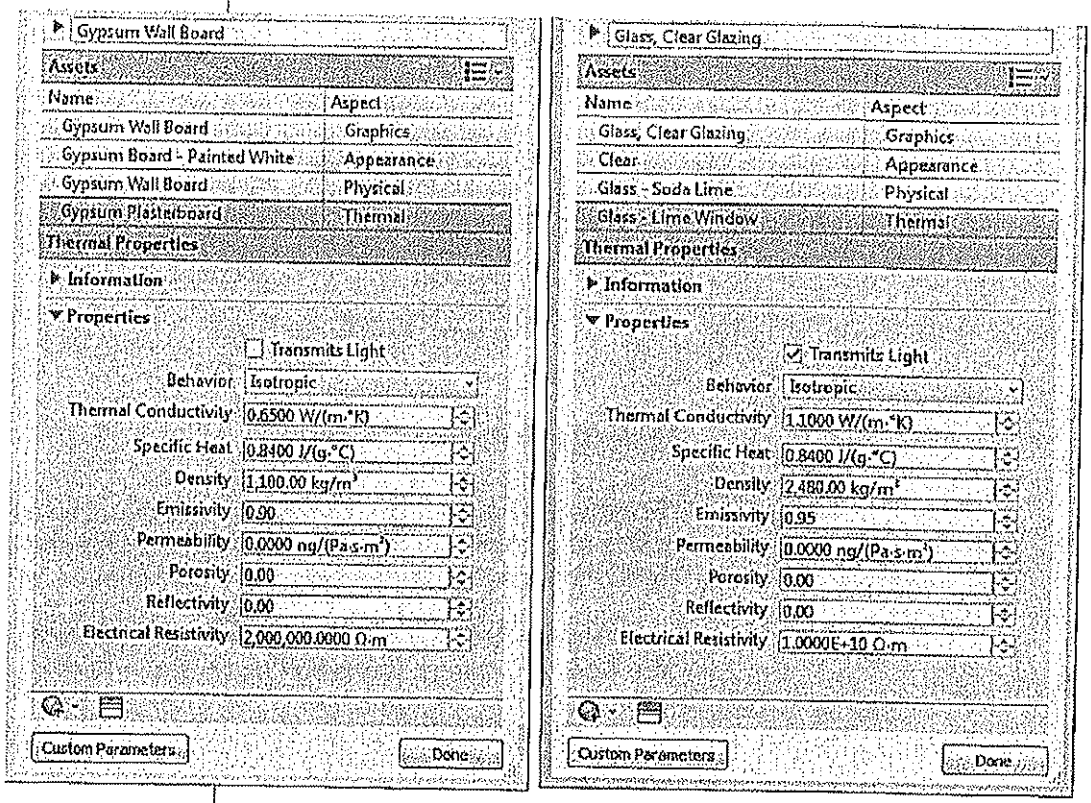

Figure 7–2

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Preparing Energy Analysis

After adding spaces and zones you need to take more steps to prepare the entire project for analysis, including **Energy Analysis Settings** and **Building/Space Type Settings**. These settings can be as detailed as the opening and closing time of a retail building type as shown in Figure 7–3.

Parameter	Value
Energy Analysis	
Area per Person	6.667 m²
Sensible Heat Gain per person	73.27 W
Latent Heat Gain per person	58.61 W
Lighting Load Density	9.69 W/m²
Power Load Density	16.15 W/m²
Plenum Lighting Contribution	20.0000%
Occupancy Schedule	Warehouse Occupancy - 7 A
Lighting Schedule	Retail Lighting - 7 AM to 8 PM
Power Schedule	Retail Lighting - 7 AM to 8 PM
Opening Time	8:00 AM
Closing Time	6:00 PM
Unoccupied Cooling Set Point	27.78 °C

Figure 7–3

Energy Settings

Energy Settings are critical components because a multi-story office in a tropical climate has different heating and cooling requirements than a warehouse in a cold climate. In the *Analyze* tab>Energy Analysis panel, click (Energy Settings) to open the Energy Settings dialog box as shown in Figure 7–4.

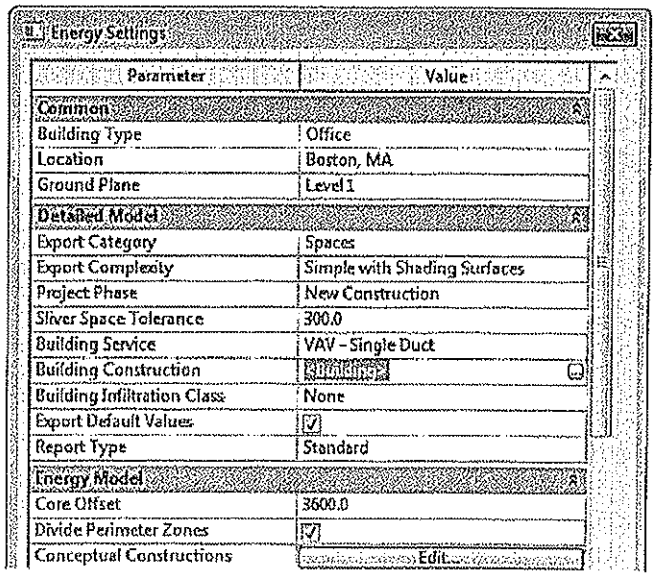

Figure 7–4

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Common Settings

Building Type: Select a building type from a list of types, as shown in Figure 7–5. Additional information about these types can be set in the **Building/Space Type Settings**.

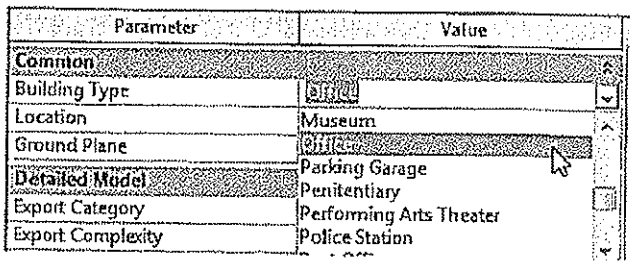

Figure 7–5

Location: Define the location using the **Internet Mapping Service**, as shown in Figure 7–6, or use **Default City List** in which you can select from a list of cities or specify the exact **Latitude** and **Longitude** for the site.

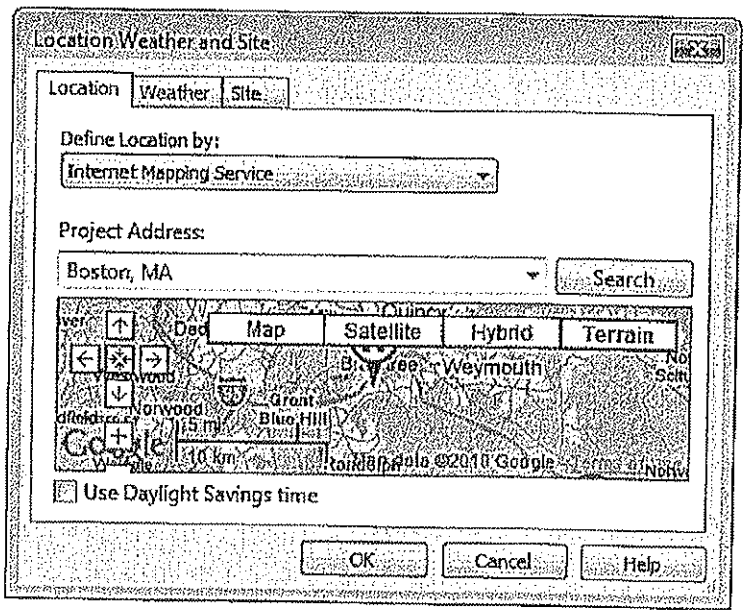

Figure 7–6

- Select the *Weather* tab to set precise information about the Weather. By default, the software automatically selects the closest weather station to your location. You can override the weather settings if needed.

Ground Plane: Specifies the level that is considered the ground plane for the project. All elements below this level are considered underground.

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New In 2013

Detailed Model Settings

Export Category: Select **Spaces** or **Rooms.**

Export Complexity: Specify how much detailed information you need for analysis. When using the analysis tools that come with the software, use **Simple**. **Simple with Shading Surfaces** (shown in Figure 7–7) and **Complex** are only used when you export to gbXML and want to indicate how the building behaves with sun obstructions.

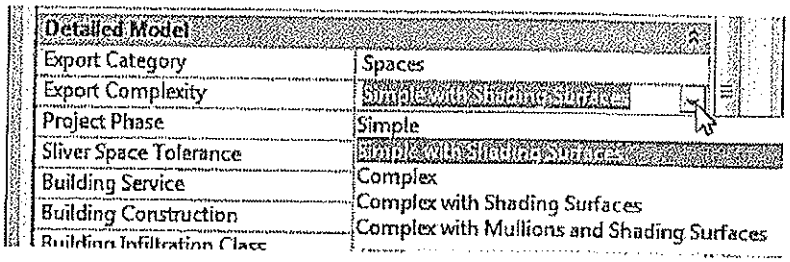

Figure 7–7

Project Phase: Specify the phase the project is in for this analysis. (For renovation and multi-phase projects).

Sliver Space Tolerance: Specify the opening size of shafts, etc. that are considered sliver spaces.

Building Service: Specifies the type of heating and cooling service used in the building as shown in Figure 7–8.

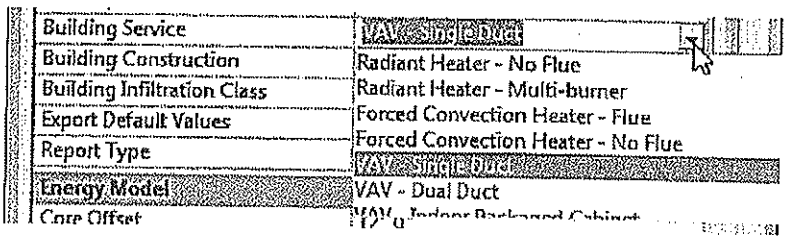

Figure 7–8

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Enhanced in 2013

Building Construction: By default, the materials of model elements provide the properties for analysis but you can add overrides, as shown in Figure 7–9.

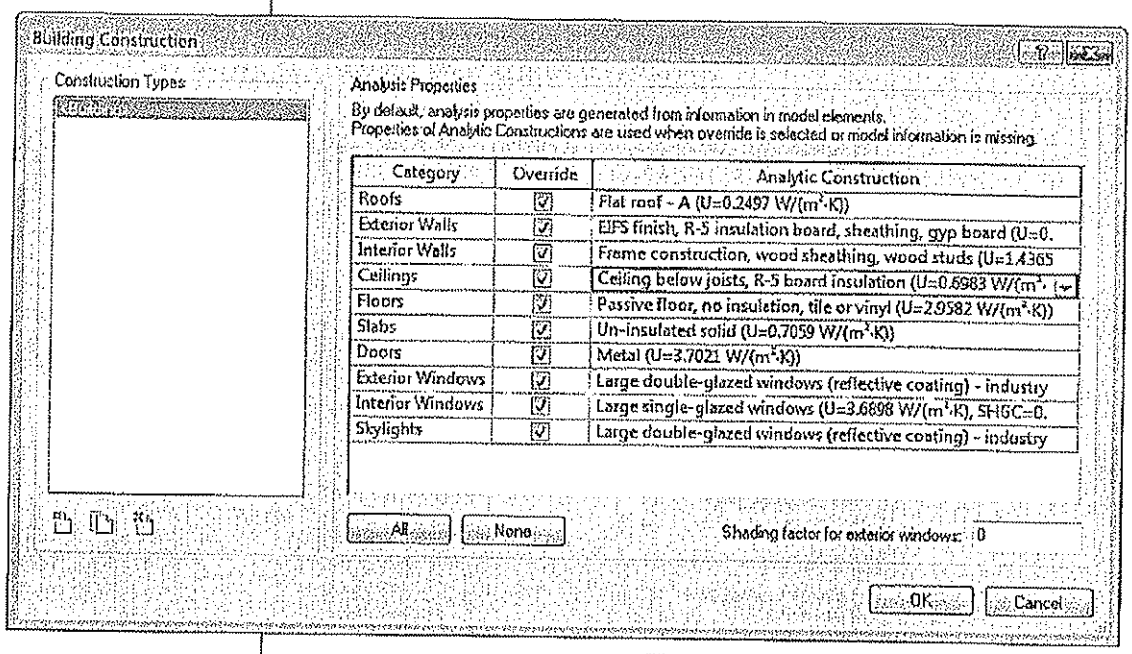

Figure 7–9

Building Infiltration Class: Indicates the amount of outdoor air that leaks into the building envelope. Specify **Loose**, **Medium**, **Tight**, or **None** (information excluded from calculation of loads).

Export Default Values: For gbXML export only. When cleared, only user-specified values are exported. When selected it also includes default values for **People and Electrical Loads**, **Occupancy**, **Lighting**, and **Power Schedules**, and building/space type **Construction Types**.

Report Type: Specifies the amount of information in the heating and cooling loads report. You can select **Simple**, **Standard**, or **Detailed**.

- The Energy Model and Energy Model - Building Services areas are for use when doing an energy analysis of the Conceptual Model, a feature that is available to subscription customers.

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Building Type Settings

When you set energy setting options, the building type is included, such as an office, theater, or warehouse. The settings for building types can be managed in Building/Space and Types Settings dialog box as shown in Figure 7–10.

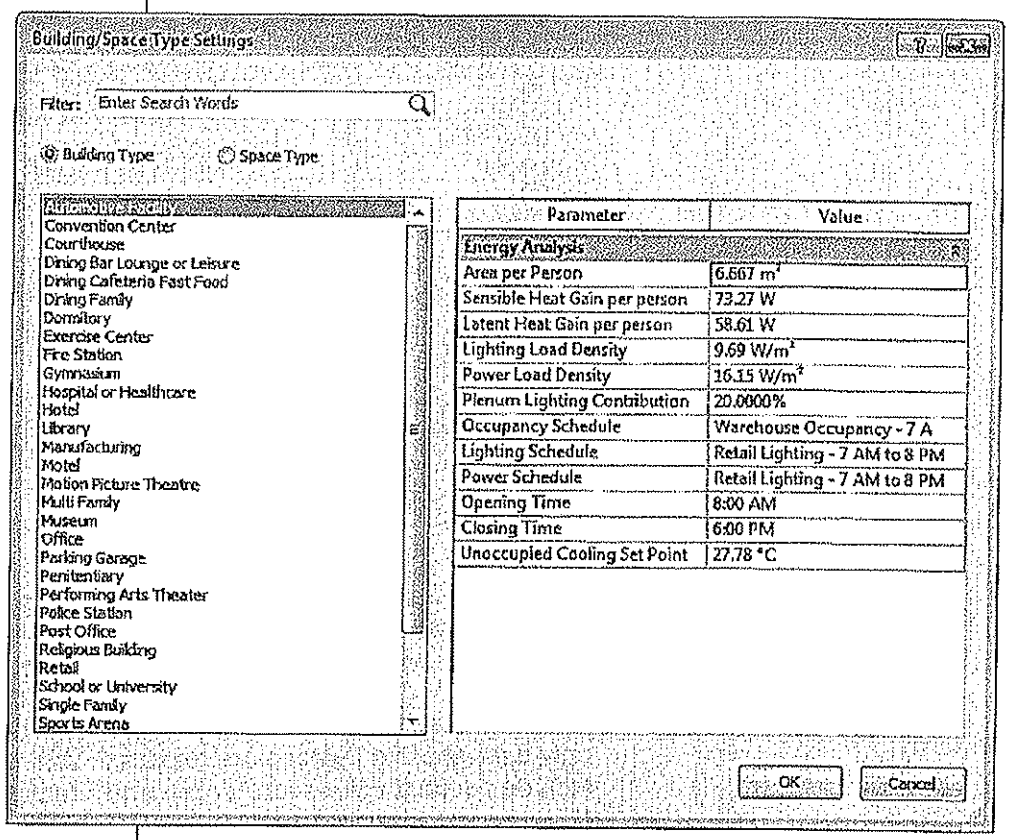

Figure 7–10

- To open the dialog box, in the *Manage* tab>Settings panel, expand (MEP Settings) and click (Building/Space and Type Settings) or in the *Analyze* tab, click in the Reports & Schedules panel title.

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- For each type of building or space you can specify energy analysis information, such as the number of people and expected heat gain per person, as well as the schedules of typical times that the building is occupied as shown for a Warehouse in Figure 7–11.

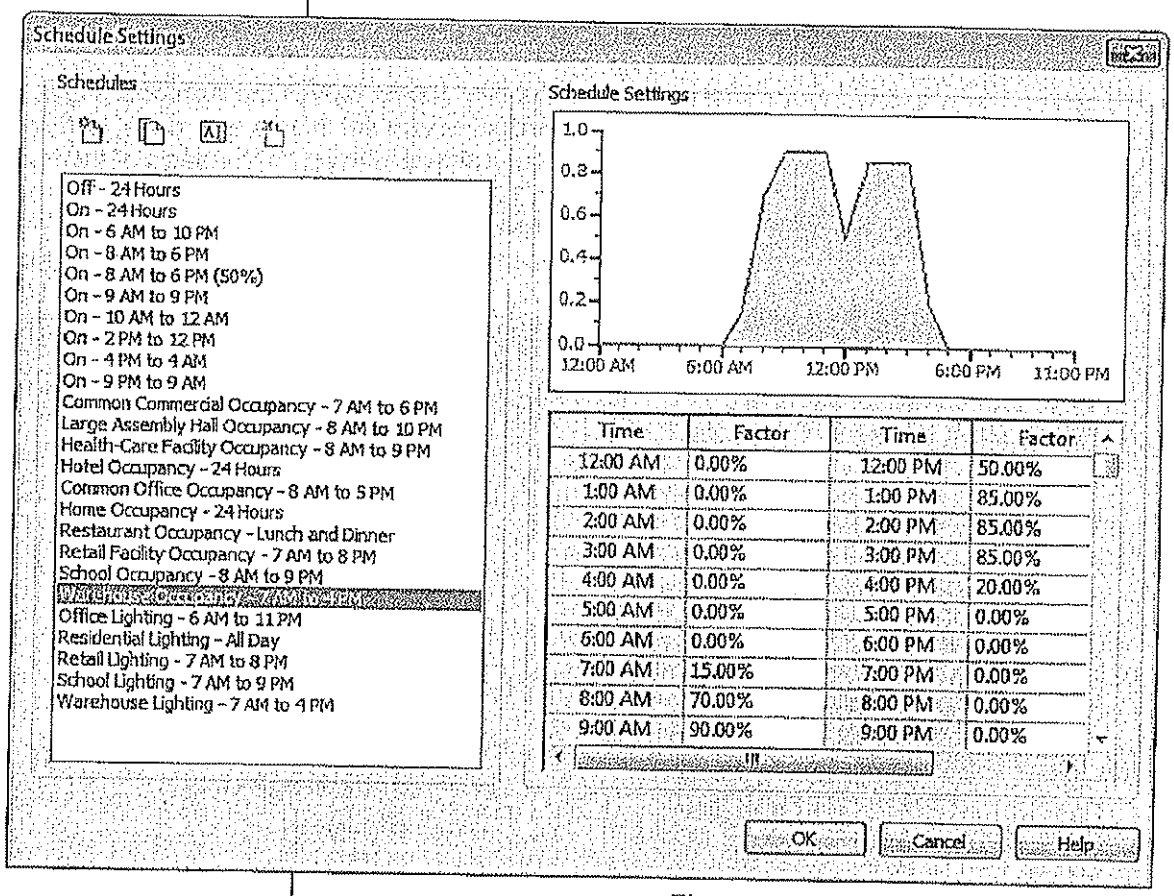

Figure 7–11

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7.2 Analyzing the Heating and Cooling Loads

Run a Heating and Cooling Loads analysis.

Using the power of BIM technology in the Autodesk Revit software, the information you set in spaces, zones, and other energy analysis parameters is used as the basis of the loads analysis for the project. Use the **Heating and Cooling Loads** tool to verify the spaces and zones, as shown in Figure 7–12, and verify the parameters before calculating a Loads Report.

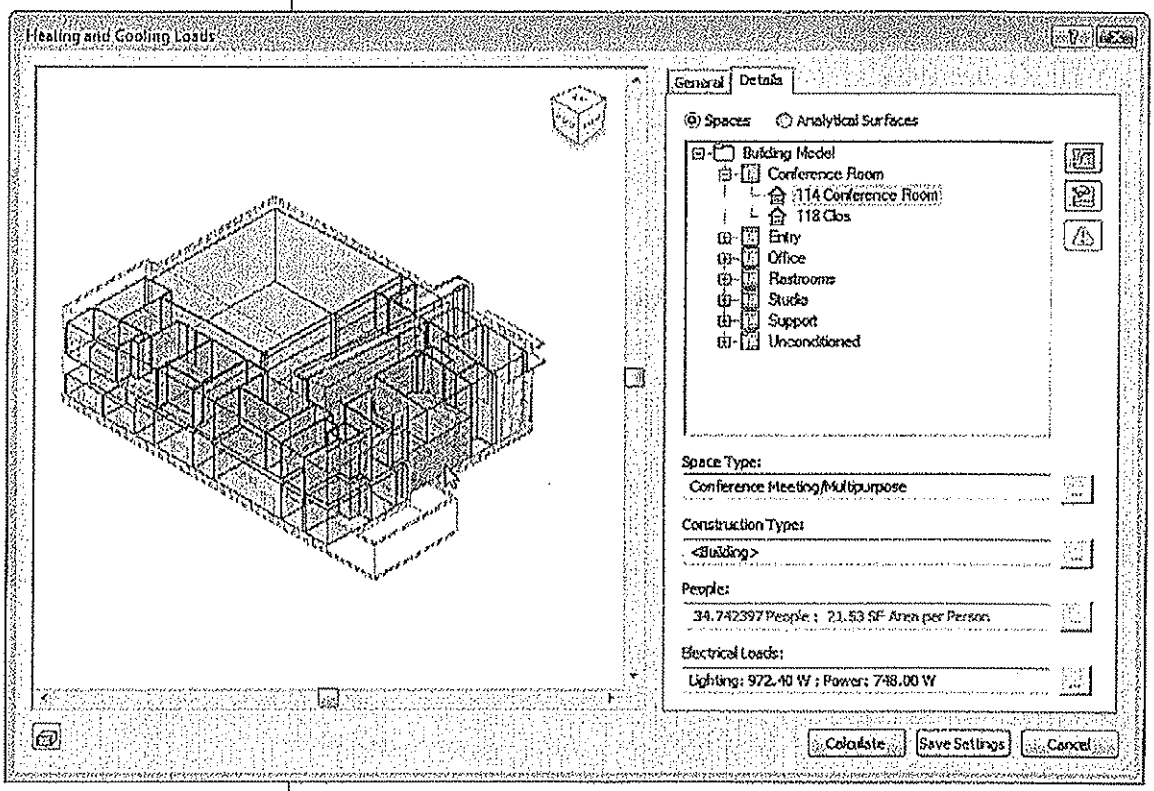

Figure 7–12

How to: Run a Heating and Cooling Loads Analysis

1. In the *Analyze* tab>Reports & Schedules panel, click (Heating and Cooling Loads).
2. The Heating and Cooling Loads dialog box opens as shown in Figure 7–12. It contains a 3D view of the space volumes and displays information in the *General* and *Details* tabs.

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3. In the *General* tab, verify or apply the **Project Information** parameters, as shown in Figure 7–13.

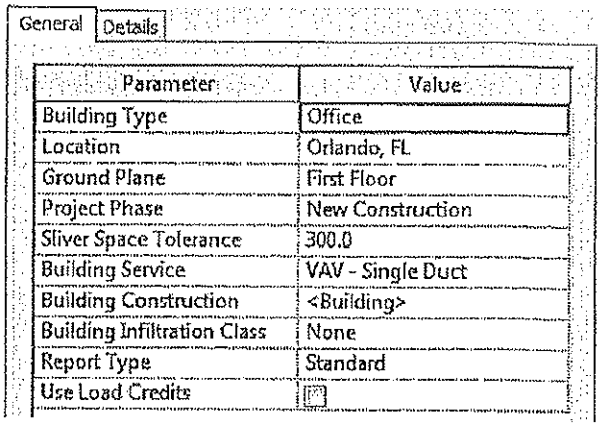

Figure 7–13

4. Select the *Details* tab and expand the levels to display the spaces for each level. Icons next to the space name indicate whether the space has been able to be calculated and if it is occupiable or not, as shown in Figure 7–14.

In this example there are still some spaces left in the Default Zone. You should stop the process and return to the System Browser to establish zones for the spaces and remove extra spaces.

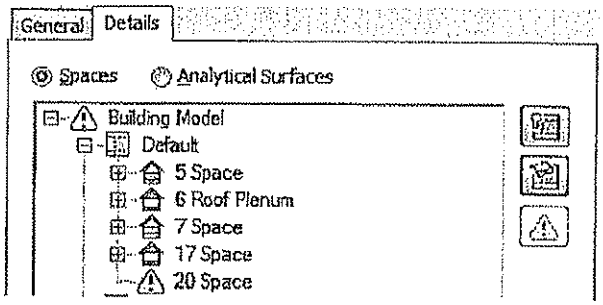

Figure 7–14

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5. To display an error, select the room name and click (Show Related Warnings). The Warning box opens as shown in Figure 7–15, indicating the cause of the warning.

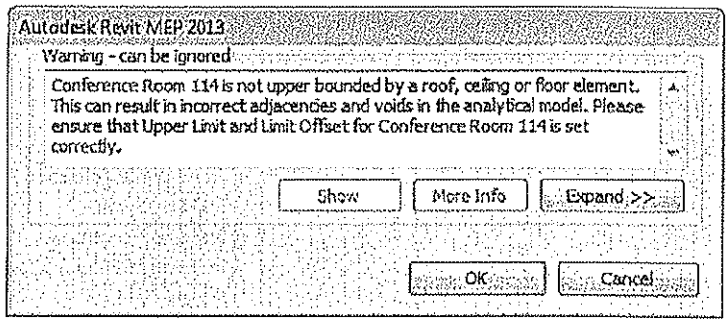

Figure 7–15

6. To display visual information about the space, select the space name and click (Highlight) to highlight the space in the 3D view. You can also click (Isolate) to turn off the display of all of the other spaces in the 3D view.
   - Click the icons again to turn them off.
7. Select **Analytical Surfaces** to display the surface calculation planes, as shown in Figure 7–16.

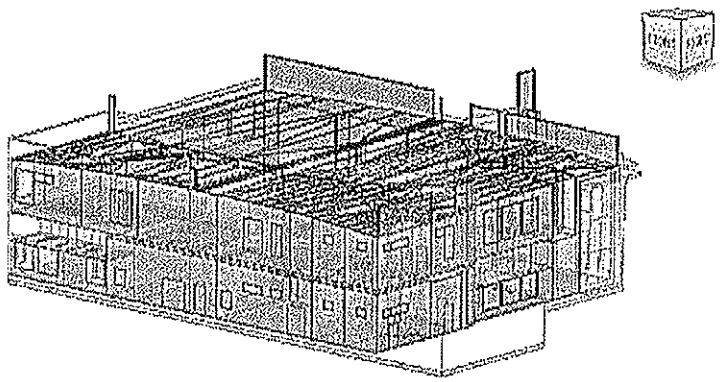

Figure 7–16

   - You can use your mouse or the ViewCube to zoom, pan, and rotate around the model.
8. If you need to make changes to the model, click Save Settings to save any changes you have made and return to the model.

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9. When you are ready to run the report, click Calculate. The Loads Report displays and is also available in the Project Browser. Expand **Reports>Loads Reports** and select the one you need as shown in Figure 7–17.

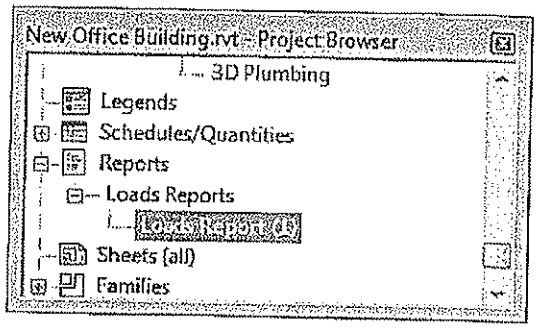

Figure 7–17

- The name of the report can be changed in Properties when the report is selected in the Project Browser.
- The Loads Report (shown in Figure 7–18), includes summaries for the Project, Building, and each Zone.

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Project Summary

Location and Weather	
Project	Project Name
Address	
Calculation Time	Wednesday, June 27, 2012 10:18 AM
Report Type	Standard
Latitude	42.21°
Longitude	-71.03°
Summer Dry Bulb	34 °C
Summer Wet Bulb	25 °C
Winter Dry Bulb	-15 °C
Mean Daily Range	-7 °C

Building Summary

Inputs	
Building Type	Office
Area (m²)	1,358.75
Volume (CF)	213,499.60
Calculated Results	
Peak Cooling Total Load (Btu/h)	323,933.3
Peak Cooling Month and Hour	July 3:00 PM
Peak Cooling Sensible Load (Btu/h)	314,897.6
Peak Cooling Latent Load (Btu/h)	9,035.7
Maximum Cooling Capacity (Btu/h)	325,495.0
Peak Cooling Airflow (CFM)	19,824
Peak Heating Load (Btu/h)	283,513.6
Peak Heating Airflow (CFM)	9,355
Checksums	
Cooling Load Density (Btu/(h·ft²))	22.15
Cooling Flow Density (CFM/SF)	1.01
Cooling Flow / Load (CFM/ton)	549.15
Cooling Area / Load (SF/ton)	541.80
Heating Load Density (Btu/(h·ft²))	19.38
Heating Flow Density (CFM/SF)	0.64

Zone Summary - 3

Inputs	
Area (m²)	170.26
Volume (CF)	18,069.78
Cooling Setpoint	23 °C
Heating Setpoint	21 °C

Figure 7–18

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7.3 Exporting for Secondary Analysis

Export information contained in a project to gbXML that can be used in other energy analysis software.

The process of exporting a file to gbXML is the same as running the internal heating and cooling load analysis, except that you create a gbXML file that can then be imported into another energy analysis software. Numerous types of software do this type of analysis. Most of this third-party software can also analyze shading for the seasons and time of day that impacts energy consumption, as shown in the shadow study in Figure 7–19.

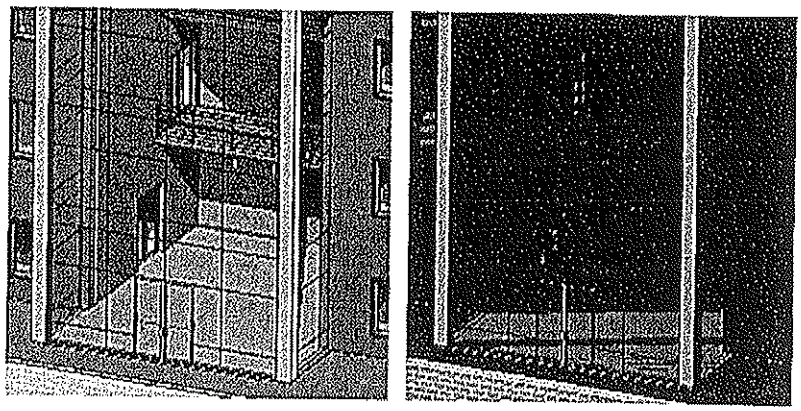

Figure 7–19

- gbXML stands for Green Building Extensible Markup Language. It is a standard used to transfer building information from a BIM model to an engineering analysis tool.
- Engineering analysis tools include HVAC manufacturer software (such as Trane or Carrier), and the United States Department of Energy's simulation tool.

New In 2013

- Subscription- Only Feature. You can enable the energy model directly in the Autodesk Revit MEP software and run energy simulations using Autodesk 360 and Autodesk Green Building Studio. This does not require exporting to gbXML.

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How to: **Export a File to gbXML**

1. In the Application Menu, expand (Export) and click (gbXML).
2. The Export gbXML - Settings dialog box opens as shown in Figure 7–20, displaying a 3D view of the space volumes and information in the *General* and *Details* tabs.

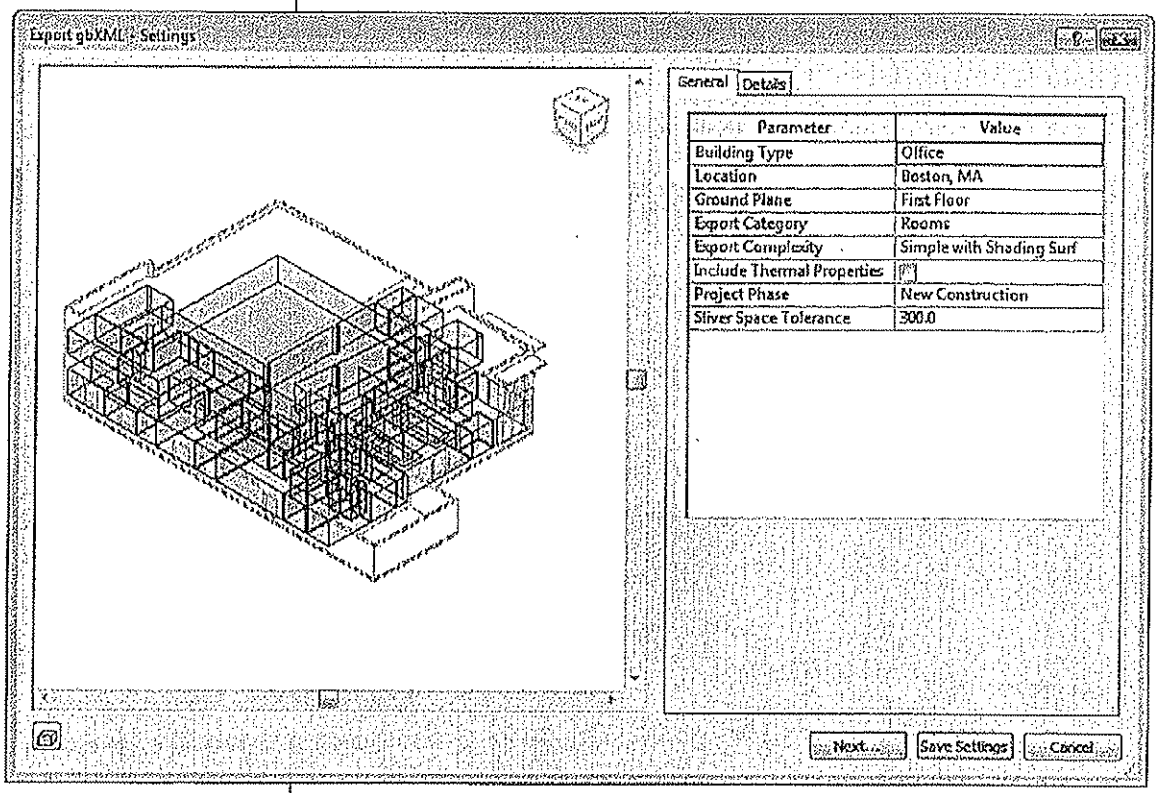

Figure 7–20

3. Review all of the values as you would if you were using the **Heating and Cooling Loads** tool.
4. When you are ready to export, click Next....
5. In the Export gbXML - Save to Target Folder dialog box, select the folder location and name for the file, and click Save.
6. The resulting .XML file can then be imported into an energy analysis software.

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The beginning of the .XML file contains project information about the building, including its location and type, as shown in Figure 7–21. Each room is listed with its name, description, area, volume, and coordinate points.

```
<?xml version="1.0" encoding="UTF-8" ?>
- <gbXML temperatureUnit="C" lengthUnit="Meters" areaUnit="SquareMeters"
    volumeUnit="CubicMeters" useSIUnitsForResults="true"
    xmlns="http://www.gbxml.org/schema" version="0.37">
  - <Campus id="cmps-1">
    - <Location>
        <Name>Boston, MA</Name>
        <Latitude>42.213000</Latitude>
        <Longitude>-71.033000</Longitude>
      </Location>
    - <Building id="bldg-1" buildingType="Office">
```

Figure 7–21

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Practice 7a

Heating and Cooling Analysis

- Prepare a project for energy analysis with Energy Settings.
- Review the details of zones and spaces in the Heating and Coolings Loads dialog box and fix any warnings.
- Calculate the analysis and export the file to gbXML.

Estimated time for completion: 20 minutes

In this practice you will run the Heating and Cooling Loads software and review the details of the zones and spaces in the project. You will identify problems, as shown in Figure 7–22, return to the model to solve them and then rerun the software and calculate the analysis. You will then export the file to gbXML.

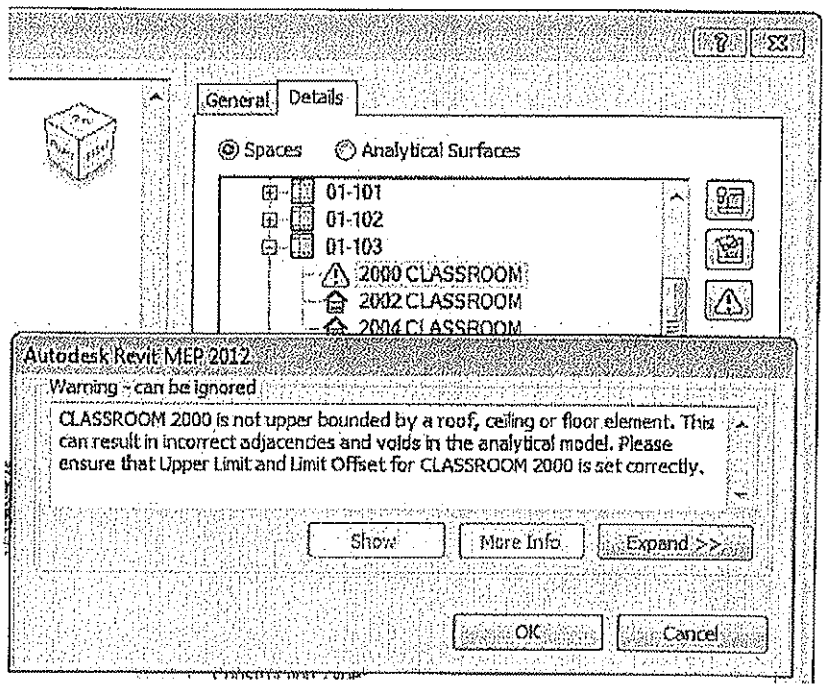

Figure 7–22

Task 1 - Prepare the project for energy analysis.

1. Open the project file **MEP-Elementary-School-Analysis-M** found in the *Chapter 7* folder of your class folder.

2. In the *Analyze* tab>Energy Analysis panel, click (Energy Settings).

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3. In the Energy Settings dialog box, set the following values:
   - *Building Type*: **School or University.**
   - *Location*: your home town
   - *Building Service*: **VAV - Single Duct**
   - *Building Infiltration Class*: **Medium**
4. If time permits, set the *Building Construction* values in the associated dialog box.
5. Close the dialog boxes.

Task 2 - Test the project.

1. In the *Analyze* tab>Reports & Schedules panel, click (Heating and Cooling Loads).
2. The project displays in the Heating and Cooling Loads dialog box with the General information that you set in the Energy Settings as shown in Figure 7–23.

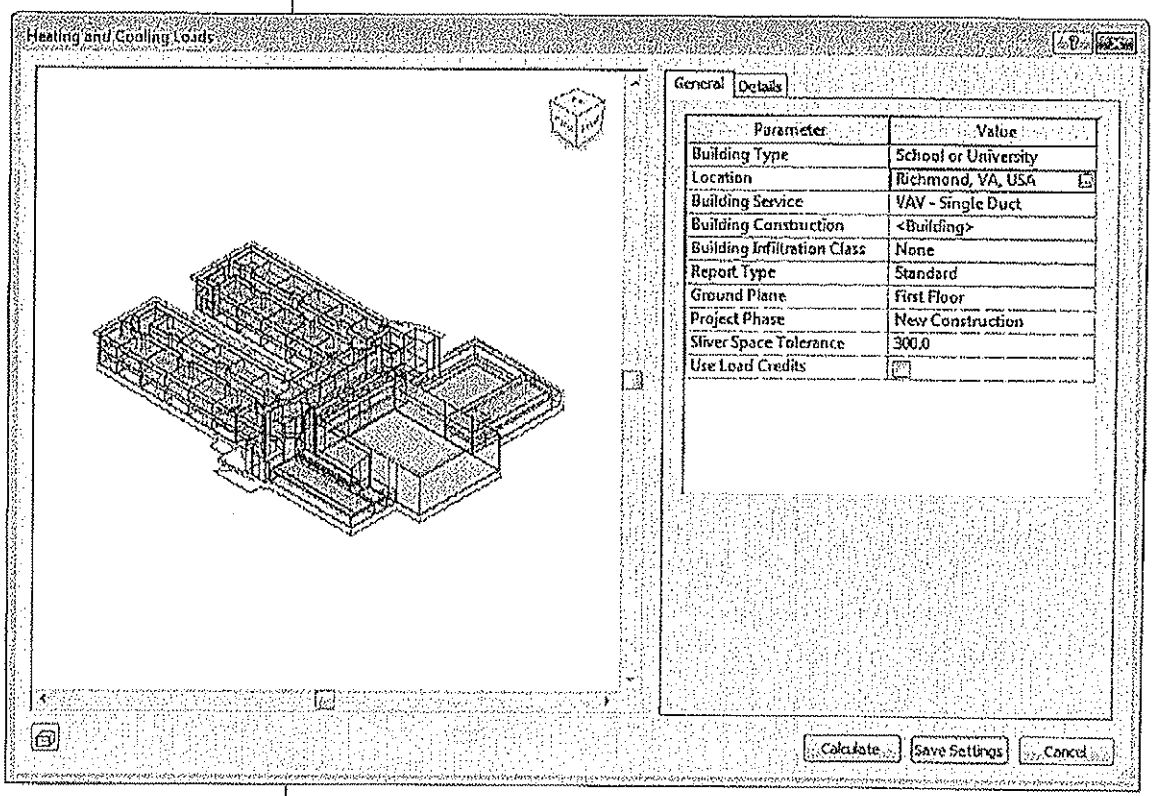

Figure 7–23

3. Select the *Details* tab.

4. Several issues need to be resolved before you can calculate the loads starting with a Warning at the top of the building model as shown in Figure 7–24.

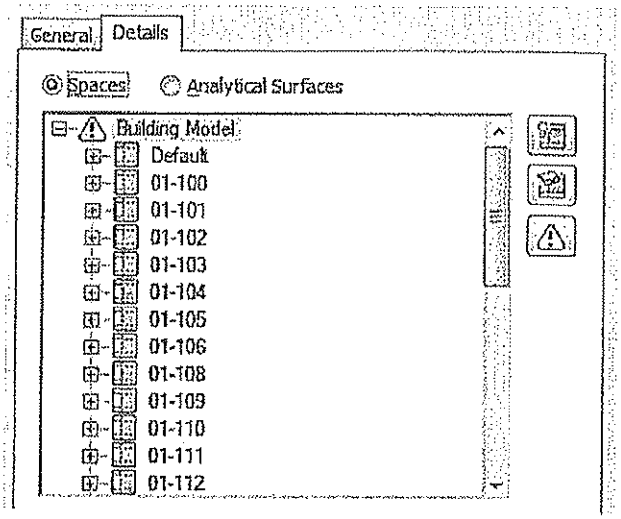

Figure 7–24

5. Click (Show Related Warnings). The Warning indicates that there are undefined spaces in the model. If your company includes a space schedule in your templates you can use it as mentioned in the Warning. You can also delete empty spaces in the Zone view of the System Manager. Click Cancel.

6. Expand the Default Zone. There are several spaces in this zone that need to be modified and moved to other zones, as shown in Figure 7–25.

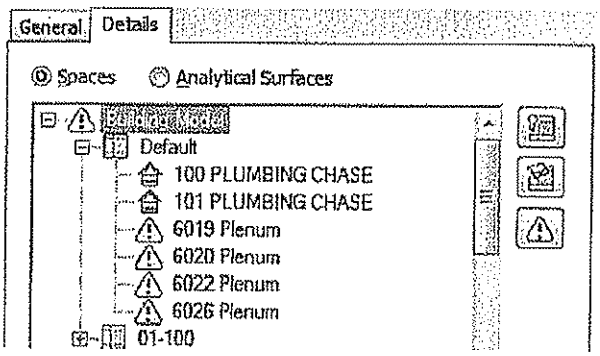

Figure 7–25

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7. Select **100 Plumbing Chase**. The information about the space indicates that there are People and Electrical Loads associated with this space when they should not be, as shown in Figure 7–26. This is also indicated by

   (Occupiable).

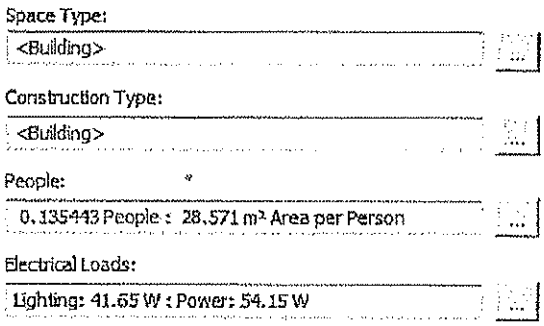

Figure 7–26

8. Use (Highlight) and (Isolate) to identify the plumbing chase locations. For example, you might want to select both chases and isolate them first as shown in Figure 7–27. Then switch to **Highlight** to indicate their location within the building. They are hard to identify because they are very thin.

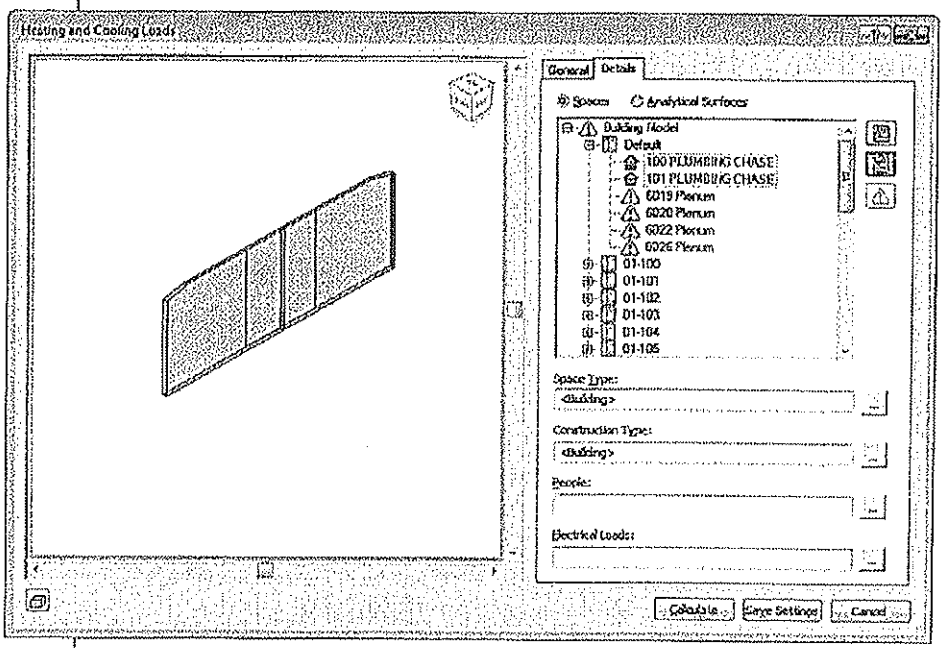

Figure 7–27

9. Turn off **Highlight** and **Isolate**.

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10. Select the four plenum spaces by holding down <Ctrl> as you select.

11. Click (Show Related Warnings). These spaces have not been placed and are ignored in the energy analysis as shown in Figure 7–28.

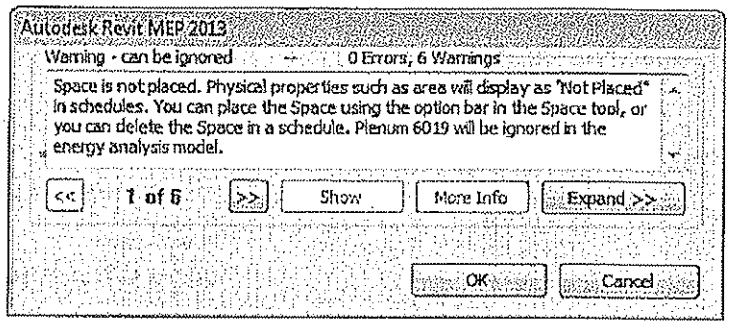

Figure 7–28

12. Scroll down through the zones to check for other problems, such as the one shown in Figure 7–29. Write down this zone and the space number so you can correct it in the model.

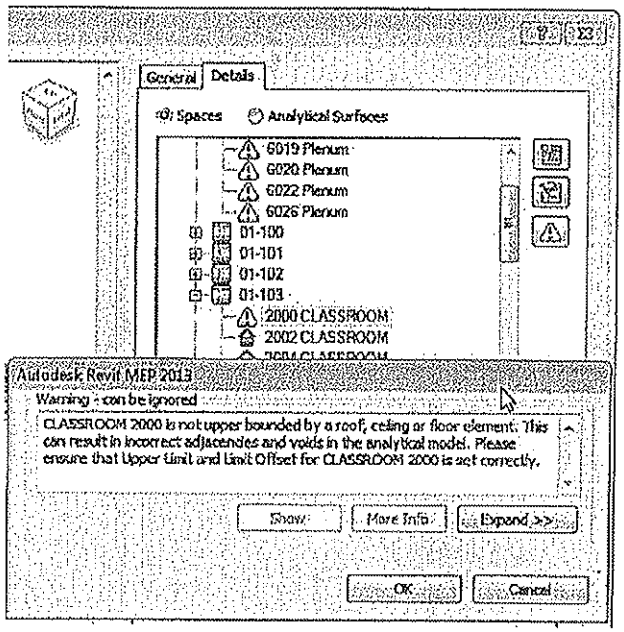

Figure 7–29

13. Click Save Settings to close the Heating and Cooling Loads dialog box and return to the model so that it can be modified.

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Task 3 - Modify the Model.

1. Open the System Browser in the Zones view.
2. Expand the Default zone, select the four unplaced spaces, right-click and select **Delete** as shown in Figure 7–30.

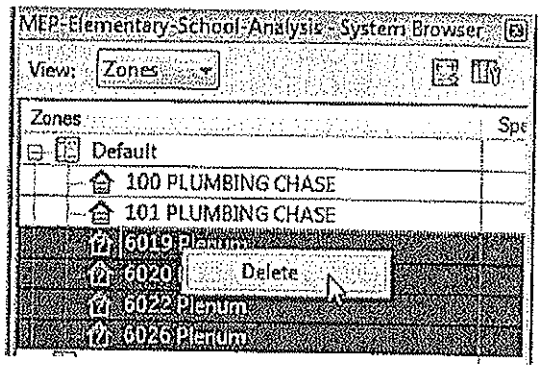

Figure 7–30

3. When prompted to delete the spaces, click OK.
4. In the System Browser, select one of the plumbing chase spaces. If you cannot see where it is in the project, right-click and select **Show**. The view zooms in to the location with the space selected. Click Close.
5. The information about the space also displays in Properties. In Properties, scroll down to the *Energy Analysis* area and clear **Occupiable**. The icon in the System Browser changes as shown in Figure 7–31.

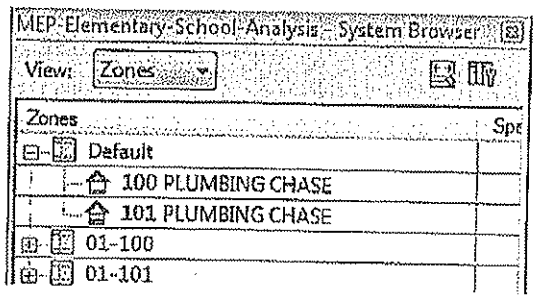

Figure 7–31

6. Select the other plumbing chase and repeat the process.

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7. These two chases need to be added to the same zone as the other chases nearby. Roll your cursor over one of the other chase spaces until the Zone highlights, as shown in Figure 7–32. Select the Zone.

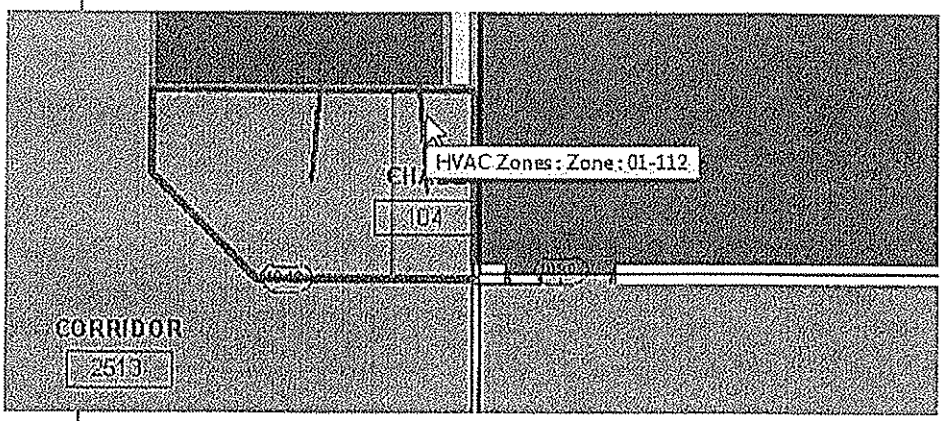

Figure 7–32

8. In the *Modify | HVAC Zones* tab>Zones panel, click (Edit Zone).

9. In the *Edit Zone* tab>Mode panel, click (Add Space).

10. Zoom in as needed and select the two plumbing chase spaces. They should change to the color of the selected zone. Click (Finish Editing Zone).

11. In the System Browser, there should no longer be any spaces in the default zone.

Task 4 - Fix a Space.

1. In the Systems Browser, find the other space (Zone **01-103** Space **2000 Classroom**) that had a problem with HVAC Loads. It does not display any warnings.

2. Right-click on the space and select **Show**. The view zooms in on the space but there are no warnings that anything is wrong.

3. In the View Control Panel, click (Reveal Hidden Elements). (This temporarily displays the section markers which have been hidden in this view.)

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4. Draw a section through the space as shown in Figure 7–33.

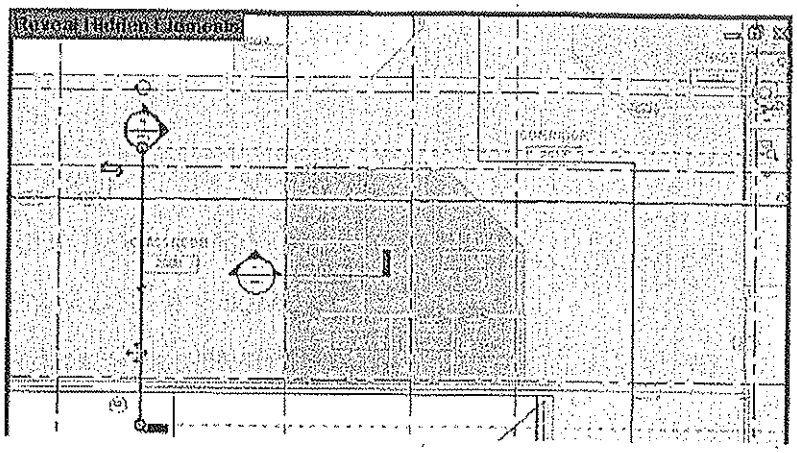

Figure 7–33

5. Double-click on the section arrow to open the section.

6. Modify the crop region of the view and hide categories as needed to clean up the view. Type **VG** and turn on **Spaces> Interior**. The space does not extend up to the ceiling as it should as shown in Figure 7–34.

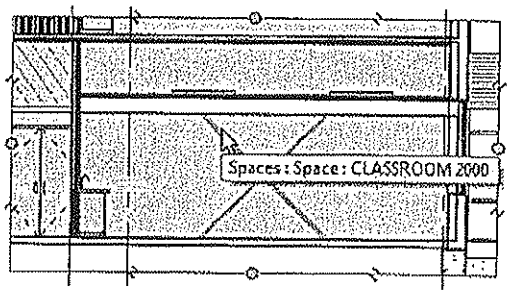

Figure 7–34

7. In the section view, select the space. In Properties, change the *Limit Offset* to **3000mm**. The space now extends up to touch the ceiling as shown in Figure 7–35.

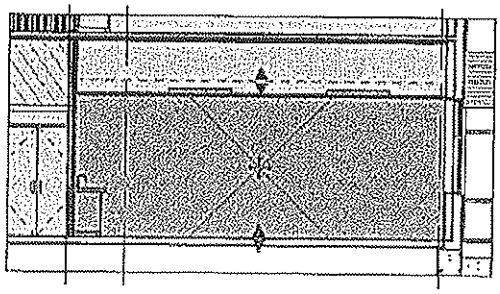

Figure 7–35

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8. Return to the previous plan view. In the View Control Bar, click (Close Reveal Hidden Elements) and zoom out to display the entire plan.

9. Save the project.

Task 5 - Run the Heating and Cooling Loads.

1. In the *Analyze* tab>Reports & Schedules panel, click (Heating and Cooling Loads).

2. In the Heating and Cooling Loads dialog box, in the *Details* tab, expand the zones. The problems have been taken care of as shown in Figure 7–36.

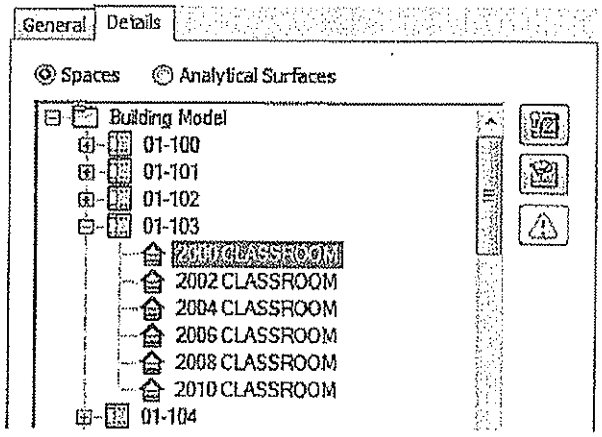

Figure 7–36

3. Click Calculate. The progress displays in the Status bar as shown in Figure 7–37. This takes time.



Figure 7–37

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4. Review the Loads analysis document as shown in part in Figure 7–38.

Project Summary

Location and Weather	
Project	MEP Elementary School
Address	1234 Schoolhouse Road, Richmond VA
Calculation Time	Friday, October 28, 2011 11:34 AM
Report Type	Standard
Latitude	37.53°
Longitude	-77.47°
Summer Dry Bulb	36 °C
Summer Wet Bulb	27 °C
Winter Dry Bulb	-10 °C
Mean Daily Range	-7 °C

Figure 7–38

5. Save the project.

Task 6 - Export the project to gbXML.

1. In the Application Menu, expand (Export) and click (gbXML). A dialog box similar to the Heating and Cooling Loads dialog box opens, as shown in Figure 7–39.

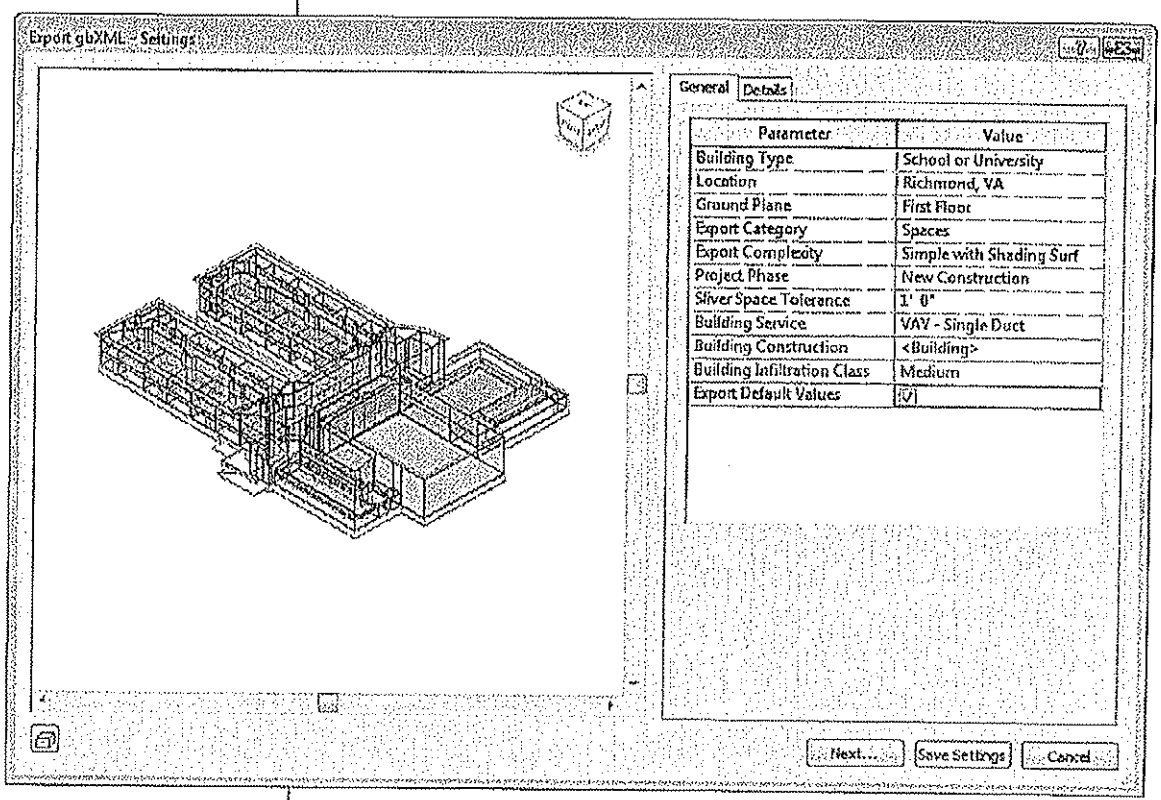

Figure 7–39

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2. Click Next....
3. In the Export gbXML - Save to Target Folder dialog box, specify the class folder as the location for the file and click Save.
4. You can now import the resulting .XML file into an energy analysis software, or view it with Internet Explorer.
5. Save and close the project.

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Chapter Review Questions

1. Which of the following are Energy Settings that impact Energy Analysis? (Select all that apply.)
   a. Geographic location of the building.
   b. Exterior wall construction.
   c. Number of spaces in the model.
   d. Plenum heights.

2. In the System Browser, in the Zones view, displays next to the name of the space. It indicates that the space...
   a. occupancy has not been defined.
   b. does not have an upper boundary.
   c. gas not been placed.
   d. is not part of a zone.

3. When running the Heating and Cooling Loads analysis, the *Details* tab indicates that there are still spaces listed under Default. What needs to be done?
   a. Delete those spaces from the model.
   b. Verify the height of the spaces.
   c. Move the spaces to another zone.
   d. Change the status of the spaces to occupiable.

4. The purpose of exporting a file to gbXML is to import the information into spreadsheet software for manual review of the energy analysis information.
   a. True
   b. False

5. When using the **Heating and Cooling Loads** tool, set the export complexity to...
   a. **Simple**
   b. **Simple with Shading Surfaces**
   c. **Complex**
   d. **Complex with Shading Surfaces**

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6. Before running the energy analysis, all areas in the project need to be set up with... (Select all that apply.)
   a. light fixtures.
   b. spaces.
   c. heating equipment.
   d. sun shade devices.

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Command Summary

Button	Command	Location
	**Export gbXML**	▪ **Application Menu:** expand Export
	**Heating and Cooling Loads**	▪ **Ribbon:** *Analyze* tab>Reports & Schedules panel
	**Energy Settings**	▪ **Ribbon:** *Analyze* tab>Energy Analysis panel

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Chapter 8

HVAC Systems

In this chapter you learn about HVAC Systems including how to add air terminals and mechanical equipment. You also learn to add ductwork manually or automatically and create duct systems.

This chapter contains the following topics:

- ✓About HVAC Systems
- ✓Adding Air Terminals and Mechanical Equipment
- ✓Adding Ductwork
- ✓Creating Duct Systems
- ✓Automatic Ductwork Layouts

Learning Objectives

This chapter provides instruction to enable you to do the following:

8.1 About HVAC Systems

- Understand the steps required for creating an HVAC system.

8.2 Adding Air Terminals and Mechanical Equipment

- Place air terminals on the face of an element, such as a ceiling or wall or on the work plane.
- Copy and rehost air terminals in a ceiling.
- Add Mechanical Equipment in a project.

8.3 Adding Ductwork

- Add ductwork to connect mechanical equipment and air terminals.
- Convert placeholder ducts to standard ducts and rigid ducts to flex ducts.
- Add insulation and lining to ducts.
- Modify duct justifications and work with duct fittings.

8.4 Creating Duct Systems

- Create Duct Systems.

8.5 Automatic Ductwork Layouts

- Set up Mechanical Settings related to ductwork.
- Generate automatic ductwork layouts.

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8.1 About HVAC Systems

Understand the steps required for creating an HVAC system.

HVAC Systems consist of components to provide heating, ventilation, and air conditioning to a building, as shown in Figure 8–1. Autodesk® Revit® MEP software provides tools to help you properly design these systems.

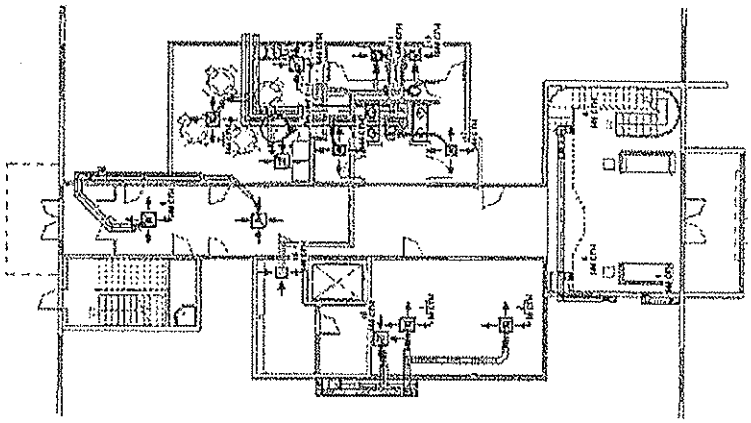

Figure 8–1

There are several steps in the process of creating HVAC systems:

1. Add air terminals and mechanical equipment.
2. Create a supply or return air system.
3. Generate ductwork automatically or add it manually.
4. Check and modify the system.

You can generate or create duct placeholders initially and later on convert those to full duct runs.

- The tools to begin creating and placing HVAC components and systems are located in the Ribbon, in the *Systems* tab> HVAC panel, as shown in Figure 8–2.

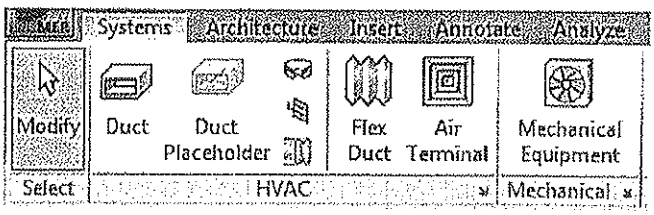

Figure 8–2

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8.2 Adding Air Terminals and Mechanical Equipment

- Place air terminals on the face of an element, such as a ceiling or wall or on the work plane.
- Copy and rehost air terminals in a ceiling.
- Add Mechanical Equipment in a project.

Air Terminals supply air to a building's rooms from its associated air handling unit. It is best practice to begin the HVAC system design by first placing the air terminals and mechanical equipment, and then connecting these pieces with the appropriate duct work. A typical ceiling view with air terminals is shown in Figure 8–3.

Verify the location of the air terminals in a reflected ceiling plan where the architect has setup the ceiling grid.

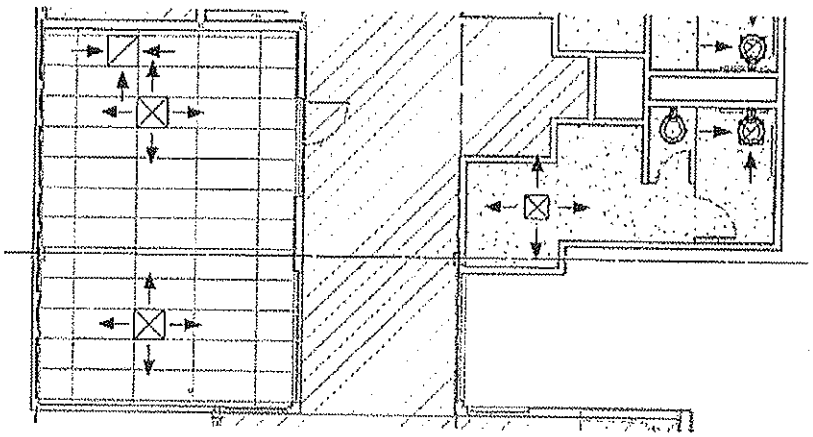

Figure 8–3

Air Terminals

Air terminals can be used in supply, return or exhaust air systems. You can place individual air terminals or batch copy them from a linked file.

- Typically, air terminals are placed on a host, such as a ceiling. Therefore when placing an air terminal, use a reflected ceiling plan view.
- Air terminals display regardless of the cut plane of the view.

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- Air terminals that are hosted by a ceiling in a linked model (as shown in Figure 8–4), move automatically with any changes that the architects make to the ceiling height. This can be an advantage of using hosted fixtures.

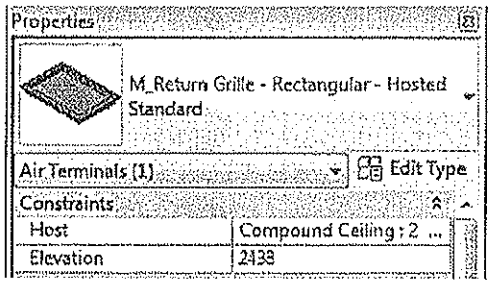

Figure 8–4

- If the architect deletes the ceiling and puts a new one in the linked model, the hosted air terminals are orphaned and do not move with changes in the ceiling height. A warning box opens when you reload the linked model or reopen the MEP project, as shown in Figure 8–5. Use the **Coordination Monitoring** tools to address the issue.

Some firms add reference planes and place the hosted families on them instead of in the ceiling. This gives them control over the height of the families. If the architect moves the ceilings up or down, the engineer adjusts the height of the reference plane to match.

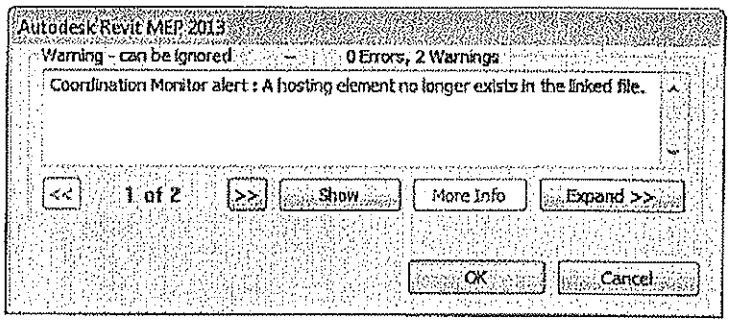

Figure 8–5

- When using a non-hosted air terminal it is placed at a specified height above the level of the current view, as shown in Figure 8–6. It is not modified if the linked architectural model is modified.

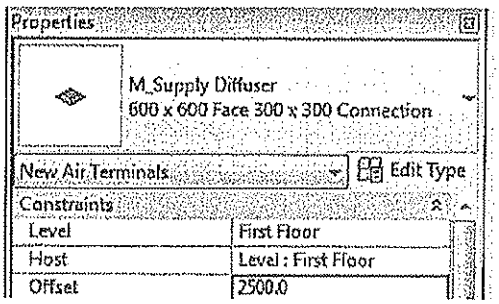

Figure 8–6

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How to:

Place an Air Terminal

1. Open the view where you want to place the air terminals.
2. In the *Systems* tab>HVAC panel, click (Air Terminal) or type **AT**.
3. In the Type Selector, select an air terminal type.
   - If the Air terminal is not hosted, in Properties, set the *Level* and *Offset*.
   - If the air terminal type is hosted, in the *Modify | Place Air Terminal* tab>Placement panel, select the type of placement to a face or a plane.

	Place on Vertical Face	Places air terminal on a vertical face, such as a wall.
	Place on Face	Places the air terminal on a defined face, such as the ceiling grid.
	Place on Work Plane	Places the air terminal on a defined plane such as a level or ceiling in a linked architectural model.

The flow of each air terminal in a Space is summed, so that total air flow in a Space can be easily checked against Specified Airflow and Calculated Airflow in a Schedule.

4. In Properties, set the *Flow* and other parameters.
5. If you want to tag the air terminal, verify that (Tag on Placement) is selected.
6. Place the air terminal in the model by clicking at the desired location in the model view.
7. Continue to place additional air terminals, as shown in Figure 8–7, or click (Modify) to exit the command.

Use other objects in the model, such as the ceiling grid or previously placed air terminals, to line up the air terminal.

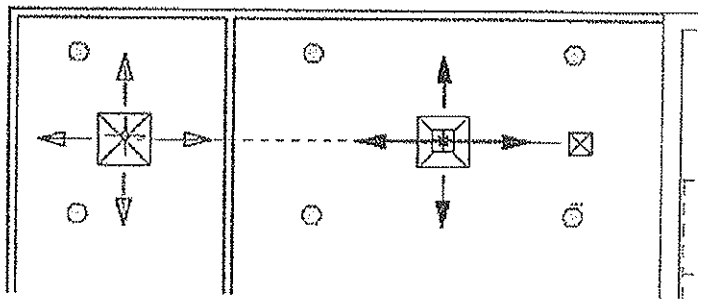

Figure 8–7

- After any air terminal is initially placed, you can modify it in any view and use the standard modify tools to move, align, and rotate it.

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- If the air terminal you want does not exist in your project, you can load one from the Library>*Mechanical>MEP>Air-Side Components>Air Terminals* folder. Some air terminal types prompt you to select sizes as shown in Figure 8–8.

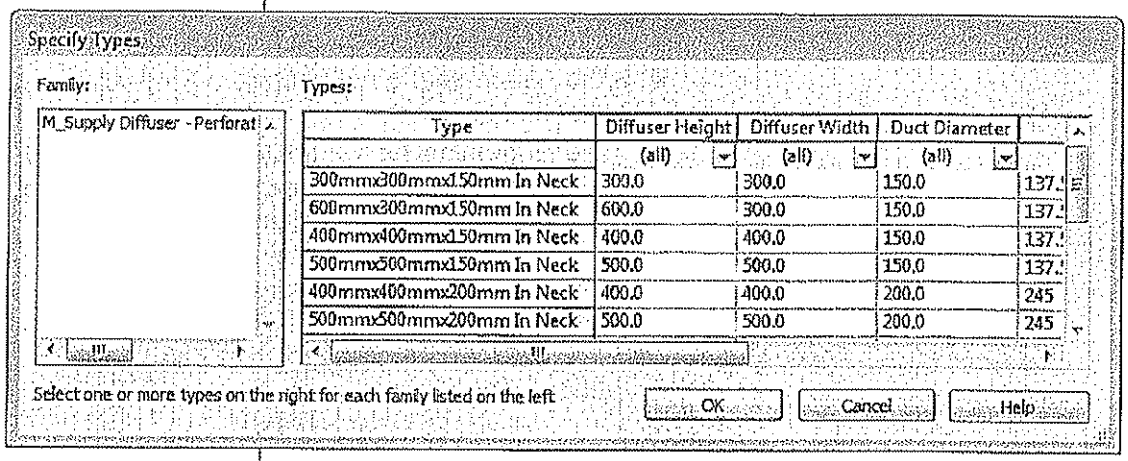

Figure 8–8

- You can modify Air Terminal sizes. In Properties, click (Edit Type) and duplicate it before making changes.

Copying Air Terminals

You can also batch copy fixtures from a linked file into the host file.

If you have air terminals in a project with similar parameters including the type, elevation, and flow, you can place one and then copy it to the other locations.

While working with linked models, if air terminals are copied from one ceiling to other ceilings of the same height, the copied air terminals are hosted by their respective new ceilings. However, if the ceilings are a different height than the ceiling that hosts the original air terminal, the copied fixtures are not associated with the ceiling. They end up at the same elevation as the original air terminal, as shown in Figure 8–9. Therefore, you need to rehost the air terminal.

If the ceilings are in the host project you are not permitted to copy a hosted air terminal from one ceiling to another.

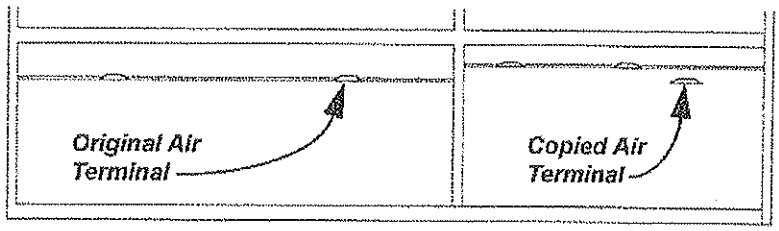

Figure 8–9

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How to:

Rehost an Air Terminal

1. Copy the air terminals as needed.
2. Select the one(s) that need to be rehosted to a different ceiling.
3. In the *Modify | Air Terminals* tab>Work Plane panel, click (Pick New).
4. In the Placement panel, click (Face).
5. Select the ceiling to which you want the air terminal(s) hosted.

- This needs to be done in the reflected ceiling plan view for ceiling hosted fixtures.

New in 2013

- Occasionally, the location of a light fixture or air terminal is such that the software assigns its electrical/mechanical values to the wrong space. This results in faulty heating and cooling load calculations and incorrect space values. To correct this, use a family that has the **Room Calculation Point** turned on. The point is visible in the project when a fixture is selected, as shown in Figure 8–10. However, the point cannot be manipulated and its visibility is only for review purposes.

Not all air terminals or light fixtures have this feature turned on by default. It must be added in the Family Parameters of the component.

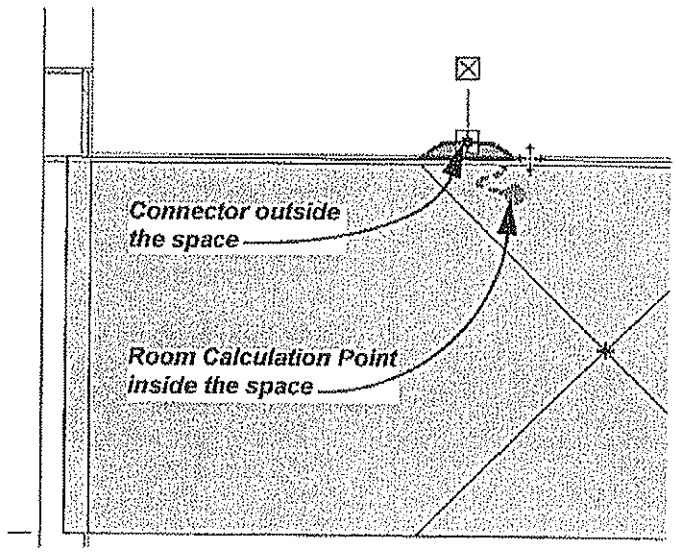

Figure 8–10

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Mechanical Equipment

Mechanical Equipment supplies the air to the air terminals, and is connected to the air terminals via duct work to complete the system. Mechanical Equipment includes various air handling units, such as fan coil units or variable air volume units. Mechanical equipment families have connectors, as shown in Figure 8–11, where the system components connect.

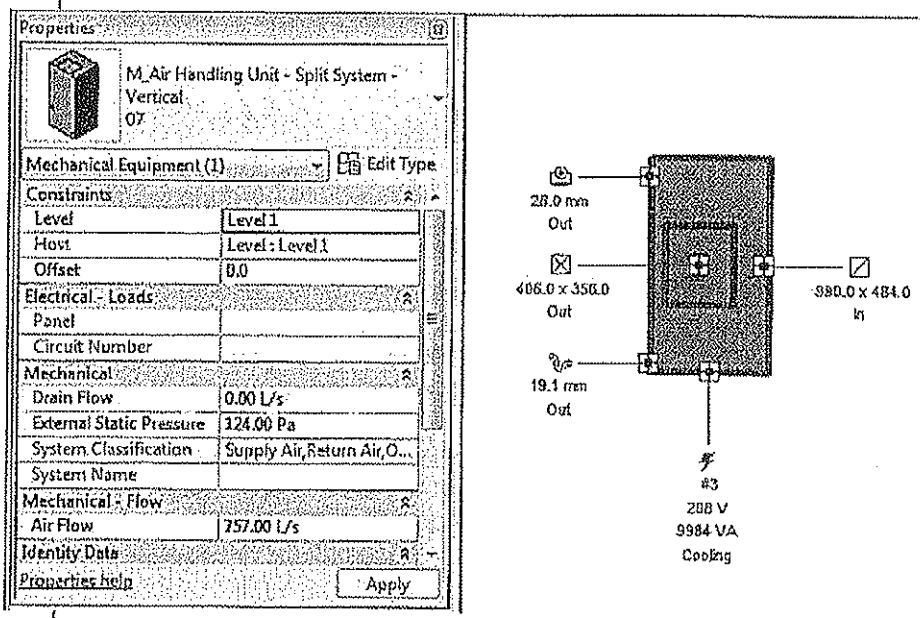

Figure 8–11

- Depending on the component, Mechanical Equipment can be placed in plan, elevation, and 3D views.

How to: Place Mechanical Equipment

1. Open the view where you have to place the mechanical equipment element.
2. In the *Systems* tab>Mechanical panel, click (Mechanical Equipment) or type **ME**.
3. In the Type Selector, select a Mechanical Equipment type. In Properties, set any other values such as the *Level* and *Offset* if it is not hosted.
4. Place the Mechanical Equipment in the model by clicking at the required location in the model view. You can use other objects in the model to line the element up and press the <Spacebar> to rotate it before placing it.
5. Continue to place additional Mechanical Equipment elements, or click (Modify) to exit the command.

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- Additional boilers, radiators, VAV units and more can be loaded from the Library in the *Mechanical>MEP* sub-folders.
- Take time to get to know the types of mechanical equipment that come with the Autodesk Revit MEP software. You can view them in 3D, plan, or elevation/section views. Select them to see the connectors as shown in Figure 8–12.

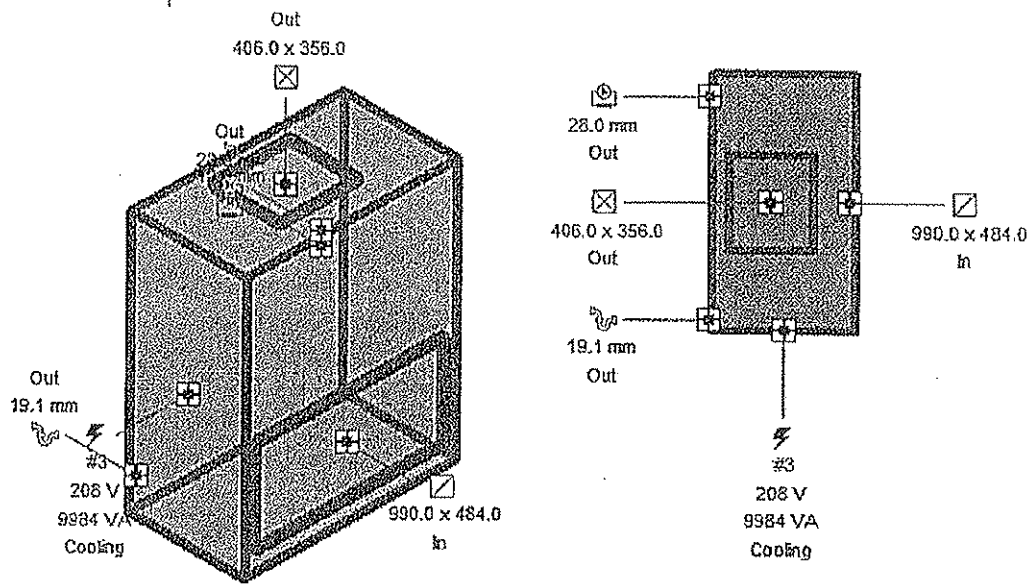

Figure 8–12

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8.3 Adding Ductwork

- Add ductwork to connect mechanical equipment and air terminals.
- Convert placeholder ducts to standard ducts and rigid ducts to flex ducts.
- Add insulation and lining to ducts.
- Modify duct justifications and work with duct fittings.

Duct work connects the mechanical equipment to the air terminals, as shown in Figure 8–13. There are various shapes and sizes that can be used both for regular and flex duct. By using connectors in the equipment and the air terminals you can quickly attach the ducts and have the software automatically calculate any differences in height.

Fittings are automatically added in some cases. You can also modify fittings and add others.

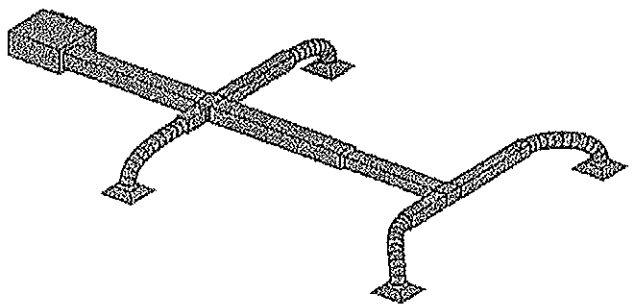

Figure 8–13

- If you need to lay the duct runs but the type and size of ducting has not yet been determined, create Duct Placeholders, as shown in Figure 8–14.

Duct placeholders can be converted to standard ducts at a later stage.

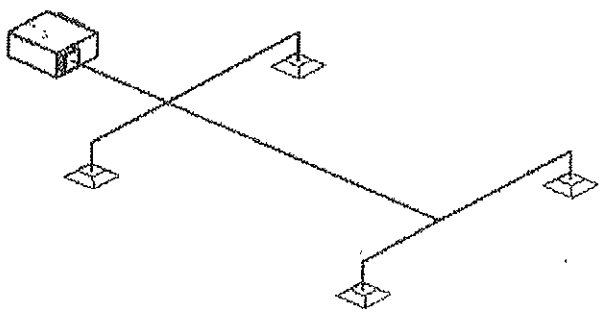

Figure 8–14

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How to:

The duct tools are very similar in creation. The difference is in the actual type of duct or placeholder they create.

Add Ducts

1. Open the view where you want to place the duct. Ducts can be drawn in plan, elevation/section, and 3D views.
2. There are several ways to start the **Duct** command:
   - In the *Systems* tab>HVAC panel, click (Duct), (Duct Placeholder), or (Flex Duct).
   - Type **DT** for Duct or **FD** for Flex Duct.
   - Select the mechanical equipment, air terminal, or an existing duct or fitting to display the connectors. Hover over a **Duct Connector** icon and select **Create Duct,** as shown on the left in Figure 8–15.
   - With the element selected, right-click on a duct connector and select **Draw Duct, Draw Duct Placeholder,** or **Draw Flex Duct** as shown on the right in Figure 8–15.

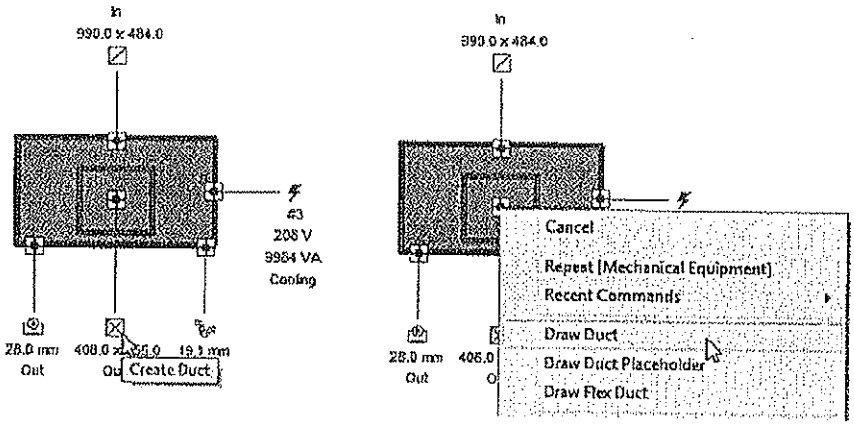

Figure 8–15

3. In the Type Selector, select a duct type as shown in Figure 8–16.

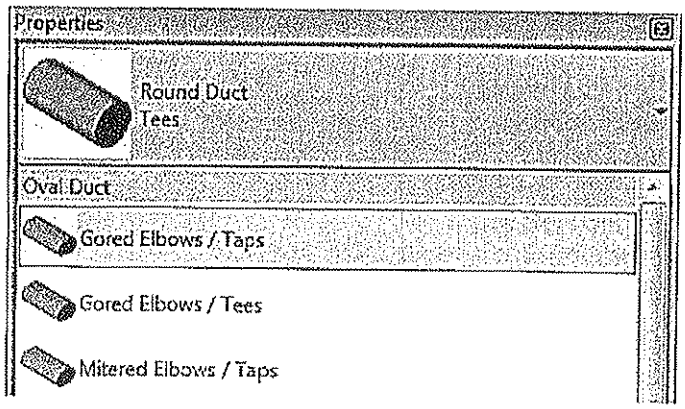

Figure 8–16

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4. If you are drawing ducts without selecting mechanical equipment or air terminals, in Properties, specify the *System Type* as shown in Figure 8–17 before you start drawing the duct.

Drawing from existing connectors automatically applies the System Type.

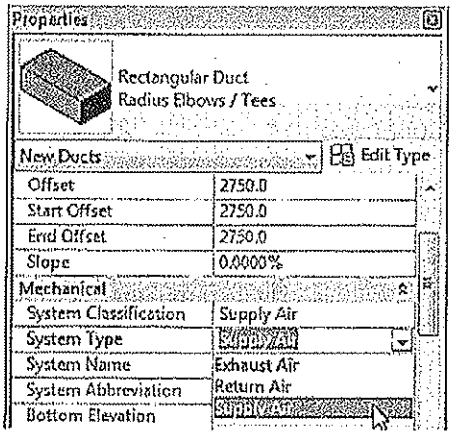

Figure 8–17

5. In the Options Bar set the *Width*, *Height*, and *Offset* for the duct as shown in Figure 8–18. If you started from a connector, the default sizes and offset match the parameters of the selected connector.



Figure 8–18

6. In the *Modify | Place (Flex) Duct (Placeholder)* tab> Placement Tools panel, click (Automatically Connect), if you want a duct to connect to a lower duct and automatically places all the right fittings, as shown on the left in Figure 8–19. Turn it off, if you want to draw a duct that remains at the original elevation, as shown on the right in Figure 8–19.

*Even if **Automatically Connect** is not on, when you snap to a connector any changes in height and size are applied with the appropriate fittings.*

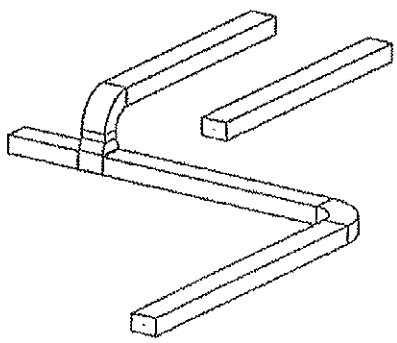

Figure 8–19

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7. Draw the ducts using temporary dimensions, snaps, and alignments to locate each point along the path as shown in Figure 8–20.

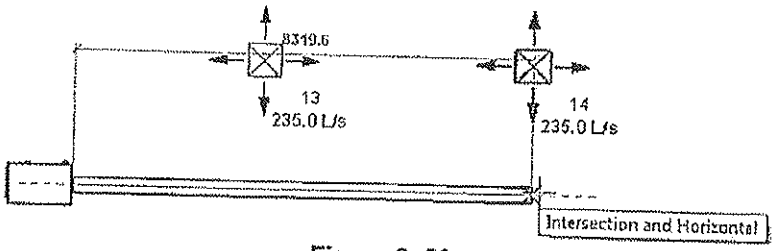

Figure 8–20

- Press <Esc> once to stay in the command but have a new start location. If you select a point along an existing duct it automatically adds a fitting according to the duct type.

If you change the size or shape, the appropriate duct fitting is automatically added.

- When you change direction an elbow or tee is added. The exact fitting depends on the duct type. This is also true if you change the offset off the level as shown in Figure 8–21.

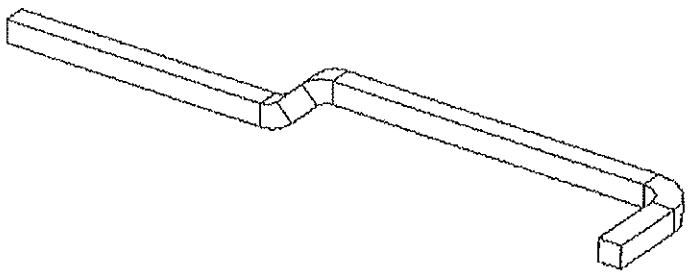

Figure 8–21

- In the example in Figure 8–22, a flex duct is started from the air terminal that is lower than the existing ducts. Make sure you select the point snap on the end of the other duct to create the connection.

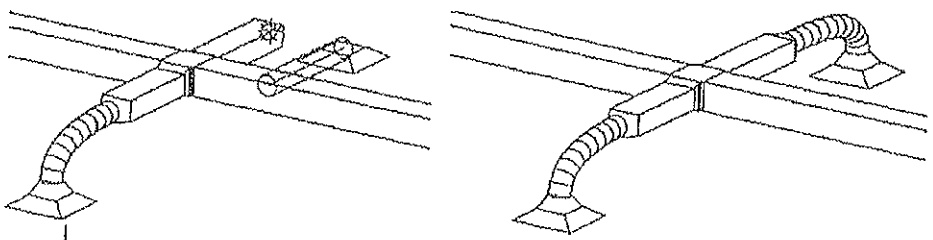

Figure 8–22

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Duct Placement Options

	**Justification**	Opens the Justification Setting dialog box where you can set the default settings for the *Horizontal Justification*, *Horizontal Offset*, and *Vertical Justification*.
	**Inherit Elevation**	An on/off toggle. If the tool is toggled on and you start drawing a duct by snapping to an existing duct, the new duct takes on the elevation of the existing duct regardless of what is specified, as shown in Figure 8–23
	**Inherit Size**	An on/off toggle. If the tool is toggled on and you start drawing a duct by snapping to an existing duct, the new duct takes on the size of the existing duct regardless of what is specified, as shown in Figure 8–23.

You can also press the <Spacebar> to inherit the elevation and the size of the duct you snap to.

Horizontal Duct Offset 3660mm and Size 300x300mm

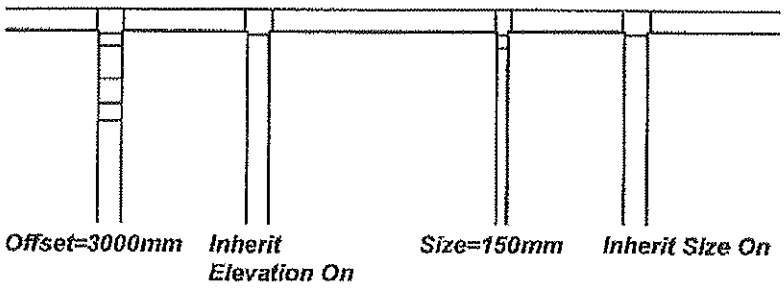

Figure 8–23

New in 2013

- To display centerlines for round ducting, in the Visibility/ Graphics Overrides dialog box, turn on the *Centerline* subcategory for duct and duct fittings, as shown in Figure 8–24.

*Centerlines display in plan and elevation views set to the **Wireframe** or **Hidden Line** visual style.*

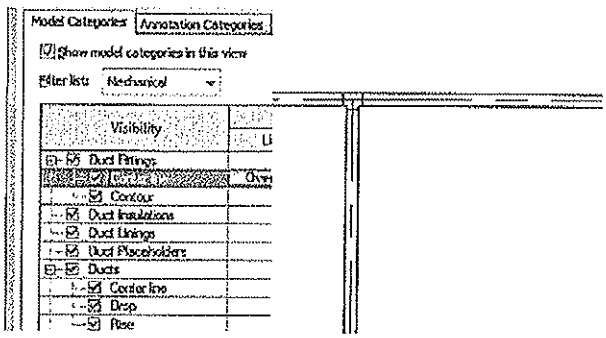

Figure 8–24

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Modifying Ducts

Ducts can be modified using a variety of standard modifying tools and other specialty tools, such as duct sizing, converting duct placeholders to ducts, changing rigid ducts to flexible ducts, adding insulation and lining, and modifying the justification of ducts.

You can modify ducts using universal methods by making changes in Properties, in the Options bar, and by using temporary dimensions, controls, and connectors. Modify tools, such as **Move**, **Rotate**, **Trim/Extend**, and **Align** help you place the ducts at the correct locations.

Often a change using these tools automatically applies the correct fittings. For example, in Figure 8–25 the *Edit End Offset* control was changed from **3630mm** on the left and to **3000mm** on the right and the appropriate duct fittings are automatically placed to facilitate the change in elevation.



Figure 8–25

Converting Ducts and Duct Types

After placing ducts, you can change the type of the entire duct run including fittings. If the definition of a duct type has been changed you can reapply the type to existing duct runs. You can also convert duct placeholders to ducts and rigid duct to flex duct if it is connected to an air terminal.

How to:

Change the Type of Duct Runs

1. Select the duct run and filter out everything except ducts, duct accessories, and duct fittings.
2. In the *Modify | Multi-Select* tab>Edit panel, click (Change Type).
3. In the Type Selector, select a new type of duct run. This changes not only the duct but also any related fittings.

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- In Figure 8–26, the type **Rectangular Duct: Radius Elbows / Tees** was changed to the type **Round Duct: Taps**.

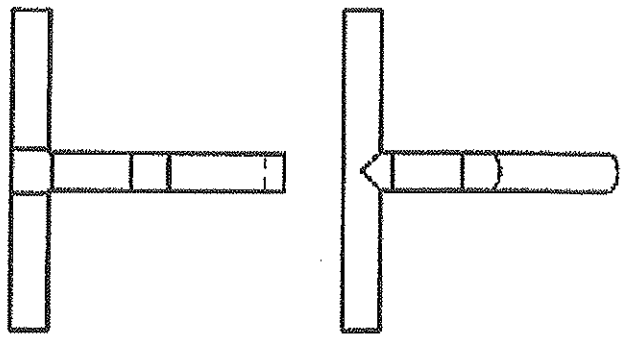

Figure 8–26

How to: **Reapply the Type to Duct Runs**

New In 2013

1. Select a single duct run. You can select different runs, but they must be all of the same duct type and same system. If you select duct runs in different systems, the software prompts you to select one system to which to reapply the type.
2. Filter out everything except ducts, duct fittings, and duct accessories.
3. In the *Modify | Multi-Select* tab>Edit panel, click (Reapply Type).

How to: **Convert Duct Placeholders to Duct**

1. Select the duct placeholder(s).
2. In the *Modify | Duct Placeholders* tab>Edit panel, click (Convert Placeholder).
3. The placeholder(s) is changed into the duct type that has been selected earlier, as shown in Figure 8–27.



Figure 8–27

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How to: **Convert Rigid Duct to Flex Duct**

1. In the *Systems* tab>HVAC panel, click (Convert to Flex Duct) or type **CV**.
2. In the Options Bar set the *Max Length*.
3. Select the air terminal connected to the rigid duct. The duct is converted as shown in Figure 8–28.

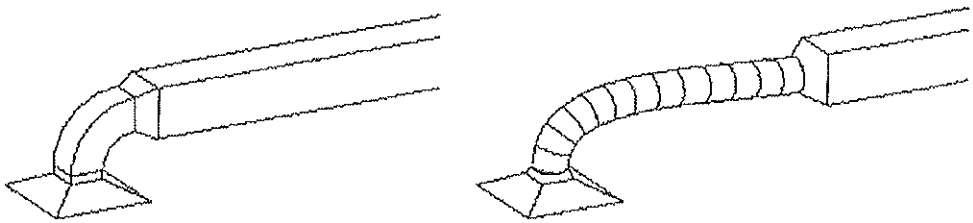

Figure 8–28

- This command only works if the rigid duct is connected to an air terminal.

Adding Insulation and Lining

When you select duct runs, you can add insulation, lining, and specify the type and thickness. This information displays as a thin line outside of the duct for insulation and a dashed line inside the duct for lining, as shown in Figure 8–29.

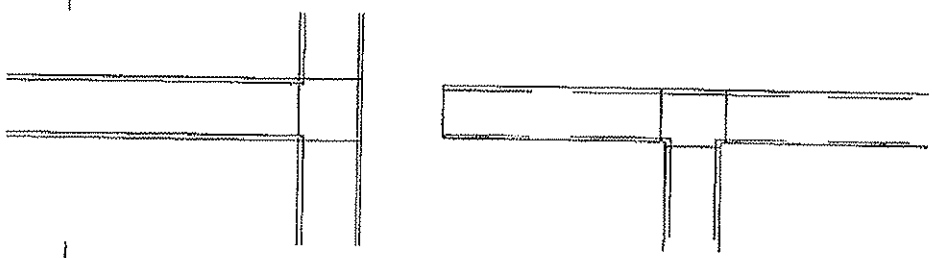

Figure 8–29

How to: **Add Insulation or Lining**

1. Select the duct run that you want to insulate or line. You can select more than one system. Use (Filter) to select only the ducts and duct fittings.
2. In the *Modify | Ducts (or Multi-Select)* tab>Duct Insulation panel, click (Add Insulation) or in the Duct Lining panel click (Add Lining).

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At times line thicknesses make it difficult to see some elements, such as the insulation or lining. To toggle the lineweight on or off, in the Quick Access Toolbar, click (Thin Lines) *or type* ***TL****.*

3. In the associated dialog box, select a *Insulation Type* and set the *Thickness*, as shown for Duct Insulation in Figure 8–30.

   Click OK.

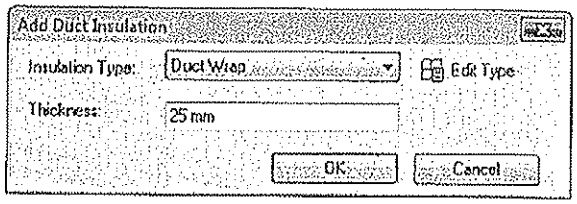

Figure 8–30

- To modify insulation or lining, select the associated ductwork. In the *Modify | Multi-Select* tab>Duct Insulation panel, click (Edit Insulation) or in the Duct Lining panel, click (Edit Lining). Change the type in the Type Selector and/or change the thickness in Properties.

- To remove it, click (Remove Insulation) or (Remove Lining).

Modifying the Justification

If a duct run has different sized duct, you can modify the justification of those ducts, as shown in Figure 8–31.

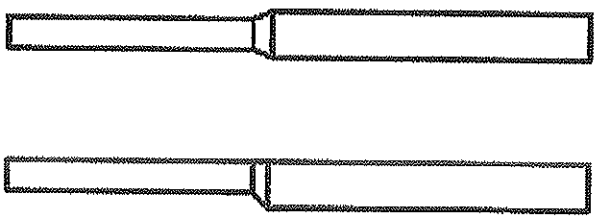

Figure 8–31

How to:

Modify Duct Justifications

1. Select the duct run.
2. In the *Modify | Multi-Select* tab>Edit panel, click (Justify).
3. To specify the point on the duct that you want to justify around, in the *Justification Editor* tab>Justify panel, click (Control Point) to cycle between the end point references.

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- The alignment location displays as an arrow, as shown in Figure 8–32.

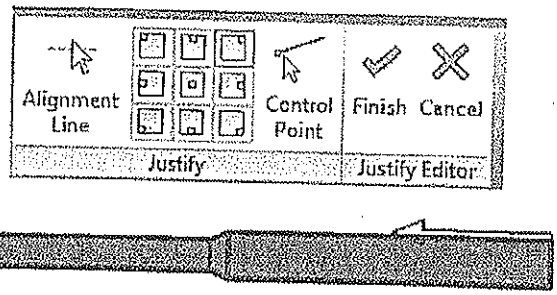

Figure 8–32

4. To indicate the required alignment, either click one of the nine alignment buttons in the Justify panel, or in a 3D view, use (Alignment Line) to select the required dashed line, as shown in Figure 8–33.

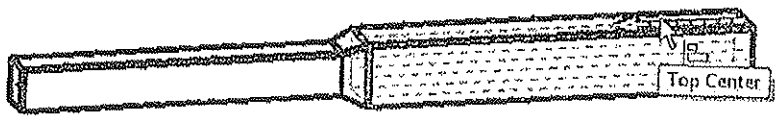

Figure 8–33

Working with Fittings

Many fittings are automatically applied as you create the ductwork. But, there are times when you need to add your own such as the endcap shown in Figure 8–34.

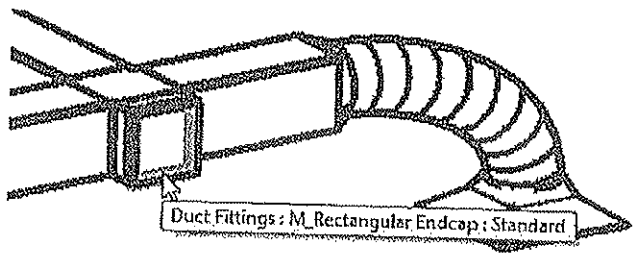

Figure 8–34

How to: Add Duct Fittings

1. In the *Systems* tab>HVAC panel, click (Duct Fitting).
2. In the Type Selector, select the type of fitting you want to use.
3. Move your cursor over the appropriate connector in the ductwork. Only usable locations are highlighted.
4. Click on the location. The duct fitting resizes to fit the duct.

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- (Duct Accessories) is very similar to Duct Fittings. Select the type of accessory, such as a fire damper, filter, or smoke detector and place it at an appropriate connector.
- Additional duct fittings and duct accessories can be loaded from the library.

Modifying Duct Fittings

Duct Fittings, whether added automatically or manually can be modified using the Type Selector, Properties, the Options Bar, and a variety of connectors and controls. For example, an Elbow can be changed to a Tee by clicking a control, as shown in Figure 8–35.

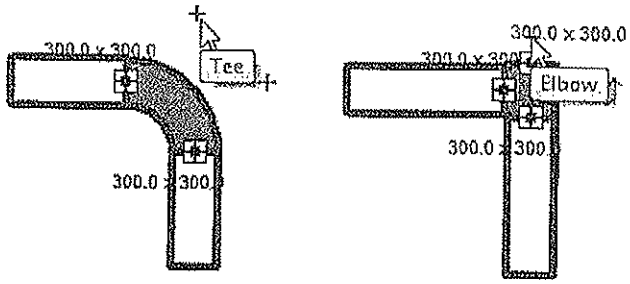

Figure 8–35

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Hint: Creating a 3D Section box

When you are working in a multistory building frequently you need to isolate one part of the building in a 3D view, as shown in Figure 8–36, so you can check for interferences and other problems. You can do this by adding a 3D section box created from a plan, elevation, or other 3D view.

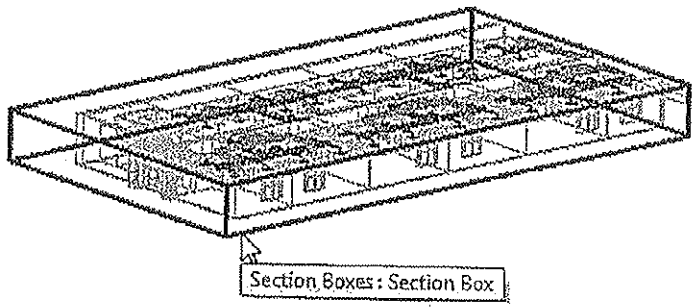

Figure 8–36

Open a 3D view, right-click on the ViewCube and select **Orient to View>Floor Plans>***name of view* as shown in Figure 8–37.

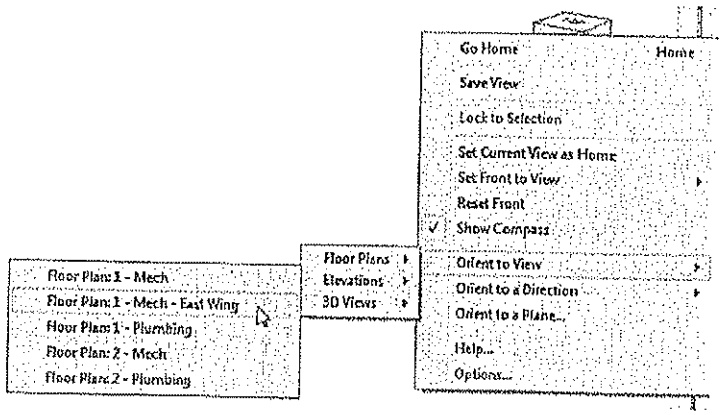

Figure 8–37

The view remains 3D but rotates to the orientation of the selected view. You can then use the ViewCube or mouse to rotate it to an appropriate 3D orientation.

- This works best if you have floor plans with dependent views but also works with callouts of floor plans and elevations. Modify the crop window size if you do not see the model.

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Practice 8a

Adding Air Terminals and Ductwork

- Setup a 3D view of HVAC systems.
- Add air terminals and mechanical equipment.
- Add ductwork connecting the air terminals and equipment.
- Add duct placeholders and convert the placeholders to standard ducting.
- Add duct insulation.

Estimated time for completion: 20 minutes

In this practice you will set up a 3D view of HVAC systems of a specific area of the project. You will add air terminals and mechanical equipment. Then you will add ductwork connecting the mechanical equipment to one of the air terminals and modify and add duct fittings, as shown in Figure 8–38. You will also add duct placeholders, convert the placeholders, and add duct insulation.

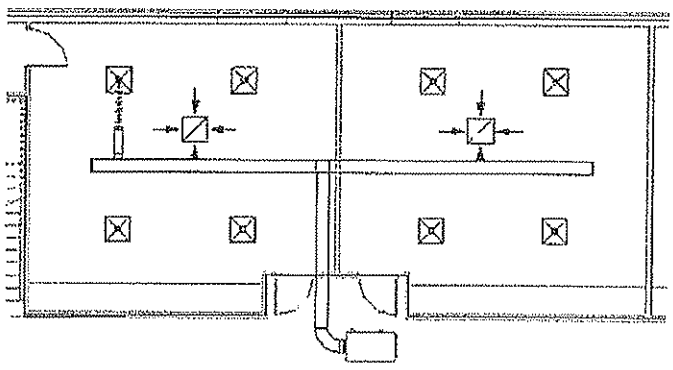

Figure 8–38

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Task 1 - Setup a 3D View of the HVAC System.

1. Open the project file **MEP-Elementary-School-HVAC-M.rvt** found in the *Chapter 8* folder of your class folder.
2. In the Project Browser, expand Mechanical>HVAC>*Floor Plans* and then expand the **01 MECHANICAL PLAN** view to see the dependent views as shown in Figure 8–39.

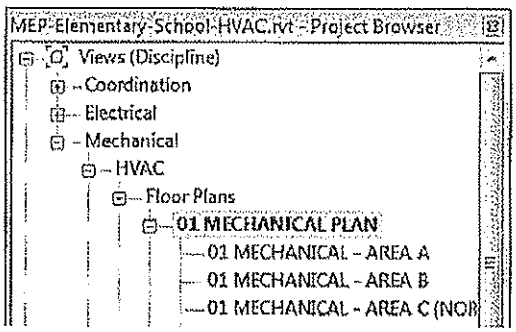

Figure 8–39

3. Open the **01 MECHANICAL - AREA B** view and zoom in on one of the existing systems and review the components of the system.
4. In the Quick Access Toolbar, click (3D View). The entire building displays and you cannot see the HVAC equipment.
5. Right-click on the ViewCube and select **Orient to View> Floor Plans>Floor Plan: 01 MECHANICAL-AREA B.**
6. Rotate the view using the ViewCube to see it in 3D. The box that *cuts* the view is a section box as shown in Figure 8–40.

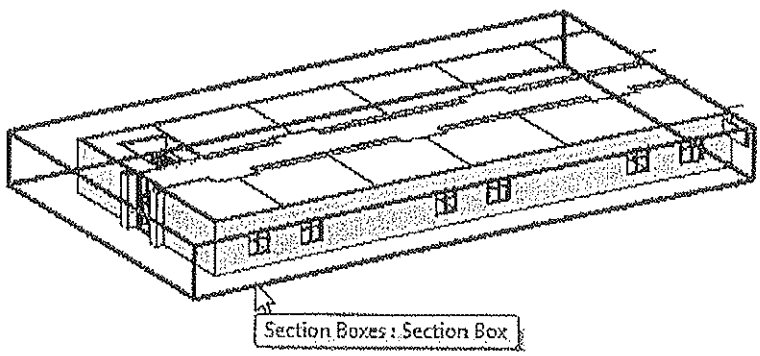

Figure 8–40

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7. In the Project Browser, expand Coordination>All>**3D Views** to display the default **{3D}** view, as shown in Figure 8–41. Right-click on it (or press <F2>) and rename it as **01 MECHANICAL - AREA B 3D**.

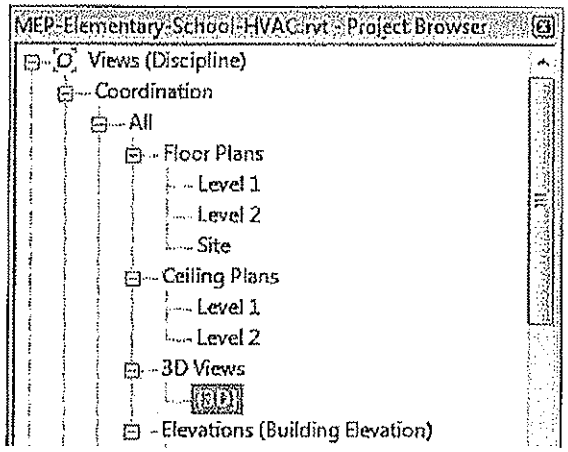

Figure 8–41

8. In Properties, change the *Discipline* to **Mechanical** and the *Sub-Discipline* to **HVAC**.

9. The view moves to Mechanical>HVAC>**3D Views** and the view changes to match the defaults for this type of view as shown in Figure 8–42.

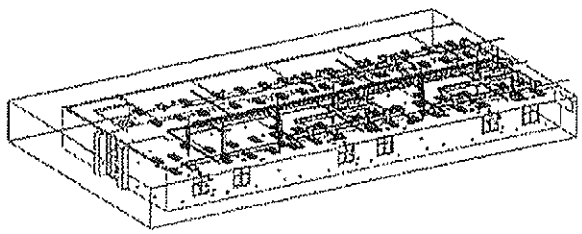

Figure 8–42

10. There is still more information in this view than is needed for the practice including plumbing, electrical, and fire systems. Type **VG**.

11. In the Visibility/Graphics Override dialog box, *Model Categories* tab verify that the *Filter list* is set to **Mechanical**.

12. To select the only elements you want to see, at the bottom of the dialog box, click All. Click in one box to clear all of the categories. Click None to clear all of the categories.

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13. Select the following categories:

- Air Terminals
- Duct Accessories
- Duct Fittings
- Duct Insulations
- Duct Linings
- Duct Placeholders
- Ducts
- Flex Ducts
- Mechanical Equipment

14. Click OK. The HVAC Systems are now easier to view as shown in the close-up view in Figure 8–43.

Use this view as needed to verify and correct any problems as you create additional systems.

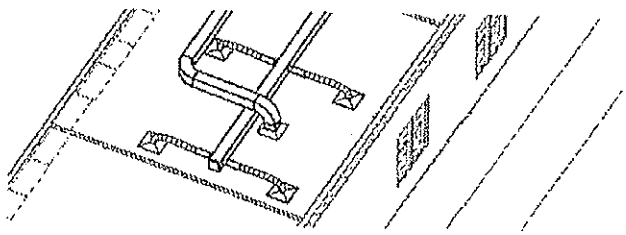

Figure 8–43

Task 2 - Add Air Terminals and Mechanical Equipment.

1. Open the Coordination>MEP>Ceiling Plans>**01 RCP** view. In this view you can see the locations of the ceiling grid and light fixtures provided in the architectural project.
2. Zoom in to the west end of the south wing where there is no HVAC system.
3. In the *Systems* tab>HVAC panel, click (Air Terminal).
4. In the *Modify | Place Air Terminal* tab>Placement panel, click (Place on Face).

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5. In the Type Selector, select **Supply Diffuser - Perforated - Round Neck - Ceiling Mounted: 600x600x150mm Neck** as shown in Figure 8–44.

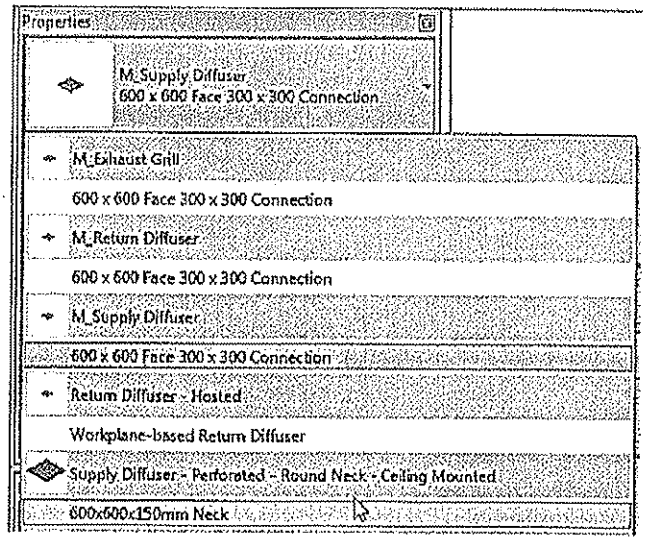

Figure 8–44

6. Move your cursor into the project. As you pass over a ceiling, it highlights. Line the air terminal up with one of the others in the project as shown in Figure 8–45.

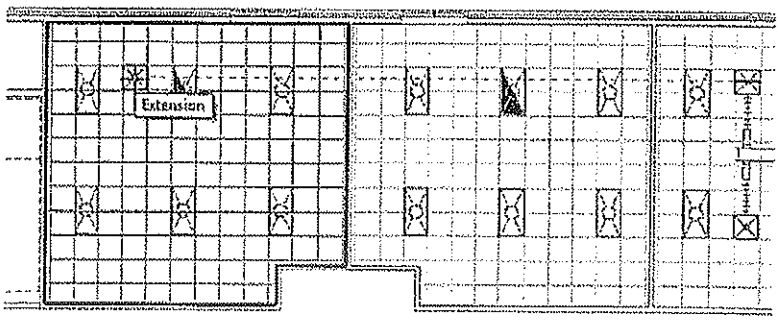

Figure 8–45

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7. Place the rest of the air terminals as shown in Figure 8–46.

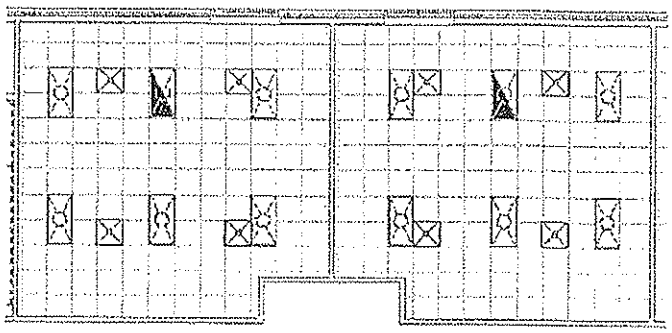

Figure 8–46

8. Select one of the air terminals. In Properties look at the *Elevation*. It is grayed out because the air terminal is attached to the face of the ceiling, which is at 2740mm.

9. Start the Air Terminal command again and select the type **Return Diffuser - Hosted: Workplane-based Return Diffuser.** In Properties, change the *Offset* to **0mm** if it is not already done.

You do not need to change the Elevation as it is set by the face.

10. In the *Modify | Place Air Terminal* tab>Placement panel, click (Place on Face). Add two return diffusers as shown in Figure 8–47.

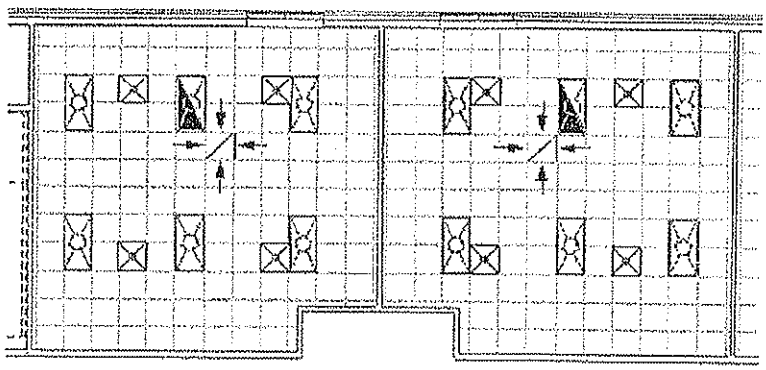

Figure 8–47

11. In the *Systems* tab>Mechanical panel, click (Mechanical Equipment).

12. In the Type Selector, select **Indoor AHU - Horizontal - Chilled Water Coil: Unit Size 24** and set the *offset* to **2820mm**.

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13. Press <Spacebar> to rotate it around until the connectors face the rooms as shown in Figure 8–48. Click to place it and press <Esc> twice to finish.

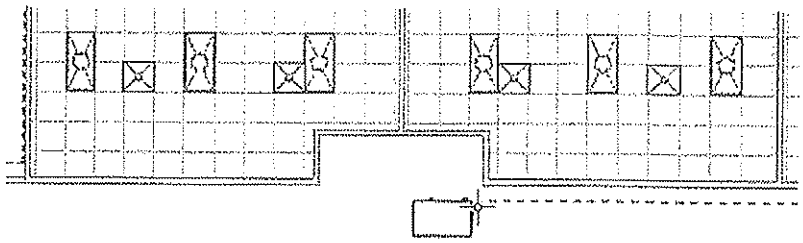

Figure 8–48

14. Save the project.

Task 3 - Add ductwork.

1. Open the Mechanical>HVAC>Floor Plans>01 MECHANICAL PLAN>**01 MECHANICAL - AREA B** view.
2. Select the mechanical equipment and right-click on the left connector and select **Draw Duct**.
3. Start drawing the duct. You can see that the duct is too large and it is a return air duct (magenta) rather than a supply air duct (blue) as shown in Figure 8–49.

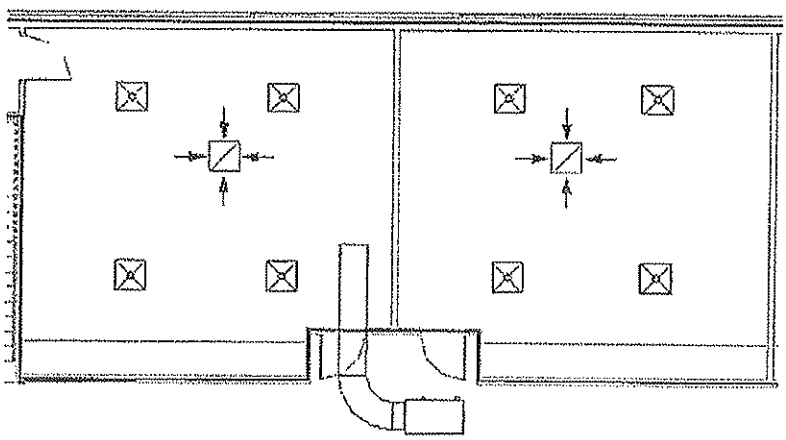

Figure 8–49

4. Undo the duct.
5. Zoom in on the mechanical equipment. In the Quick Access Toolbar, click (Thin Lines) so you can see the physical of the unit.

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6. The unit needs to be mirrored to have the supply air on the left. Select the unit. In the *Modify | Mechanical Equipment* tab>Modify panel, click (Mirror - Draw Axis).
7. In the Options Bar, clear **Copy**.
8. Draw a vertical axis from the midpoint of the unit as shown in Figure 8–50

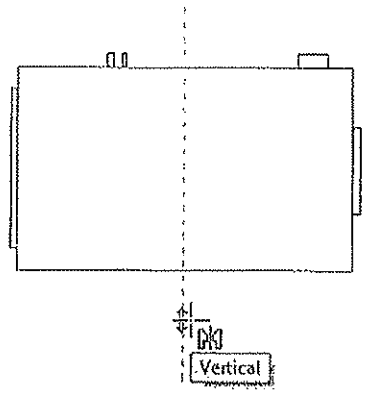

Figure 8–50

9. The unit is flipped over in place. In Properties, verify that the *Offset* is set to **2820mm**. The unit is reversed in place.
10. Right-click on the left connector again and select **Draw Duct**. This time the size of the duct is smaller. The Width and Height default to the size of the opening in the equipment.
11. In the Type Select, ensure that **Rectangular Duct: Radius Elbows / Taps** is selected.
12. In the Options Bar, set the *Width* and the *Height* to **300mm** and the *Offset* to **3050mm**
13. Draw the duct following a path similar to that shown in Figure 8–51. Extend the end of the duct past the air terminals. Press <Esc> twice.

When you type in dimensions for the size of duct you do not need to add the inch mark like you do when drawing dimensions. The Autodesk Revit MEP software knows that duct sizes are in inches.

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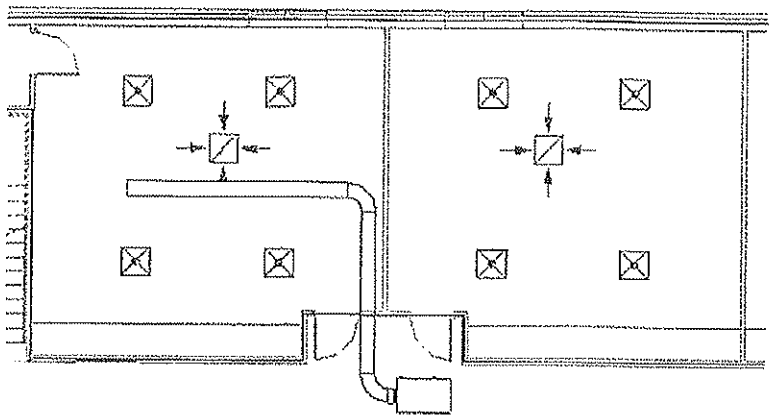

Figure 8–51

14. Select one of the air terminals in the same room as the ductwork. Right-click on the connector and select **Draw Flex Duct**. Connect the flex duct to the rectangular duct as shown in Figure 8–52.

15. Select the new flex duct. In the *Modify | Flex Duct* tab, the Warning panel displays because there is a problem. Click (Show Related Warnings). You should get a warning stating that the flex duct length exceeds the maximum specified length.

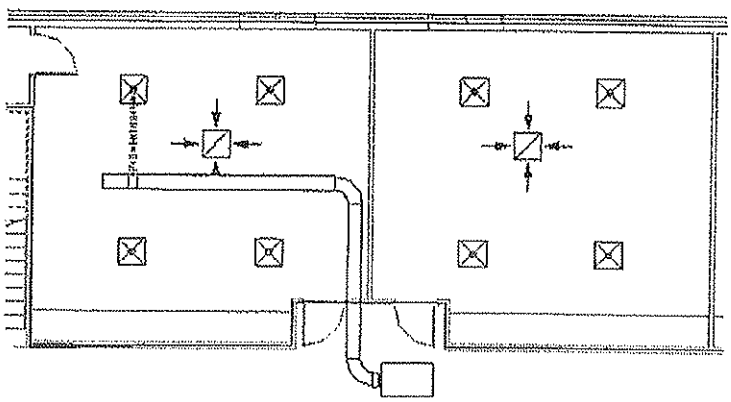

Figure 8–52

16. There needs to be an additional length of rectangular duct extending out toward the air terminal. Undo the flex duct.

17. In the *Systems* tab>HVAC panel, click (Duct).

18. In the Options Bar, set the *Width* and *Height* to **150mm** and the *Offset* to **150mm**.

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19. Draw a short section of duct from the main duct toward the air terminal as shown in Figure 8–53. Use alignment lines to line it up with the center of the air terminal.

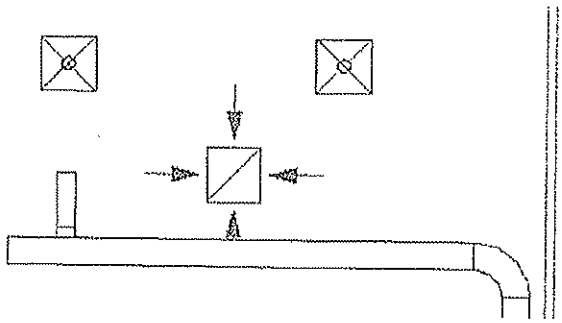

Figure 8–53

20. Repeat the process of selecting the air terminal and drawing flex duct to this new section. Make sure you connect to the *point snap* of the rectangular duct.

21. Select the new flex duct again. This time no warning displays.

Task 4 - Modify and Add Duct Fittings.

1. Zoom in on the rectangular elbow that turns to the left and select it. Click on the Tee control as shown in Figure 8–54.

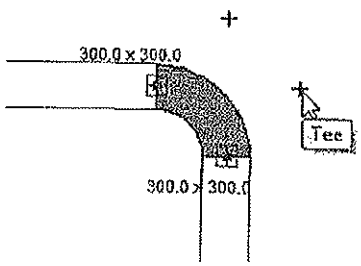

Figure 8–54

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2. Right-click on the new tee and draw a duct to the right, as shown in Figure 8–55. Click (Modify) to end the command.

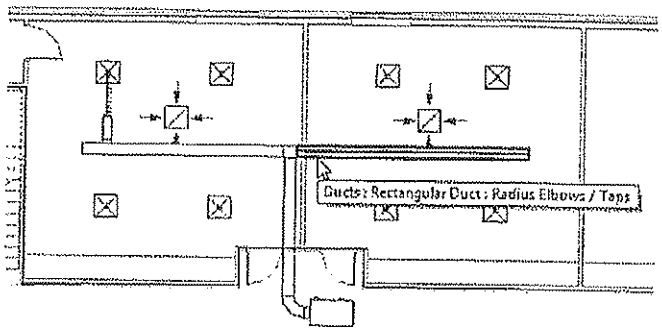

Figure 8–55

3. Open the Mechanical>HVAC>3D Views>**01 MECHANICAL - AREA B 3D** view and review the ductwork you have drawn so far to see the connections as shown in Figure 8–56.

The Visual Style is set to (Shaded).

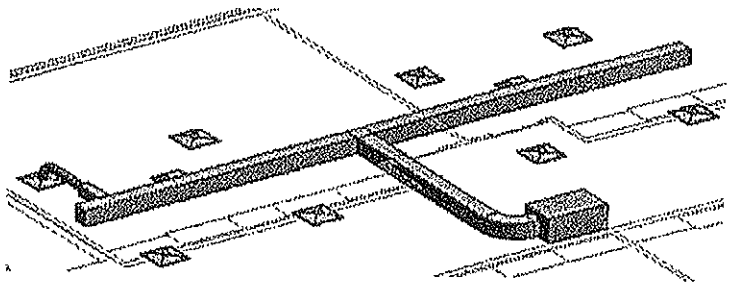

Figure 8–56

4. The end of the horizontal ducts past the air terminals are still open. You can place duct fittings in either the 3D view or the floor plan view. In the *Systems* tab>HVAC panel, click (Duct Fitting).

5. In the Type Selector, select **M_Rectangular Endcap: Standard**.

6. Move your cursor over the open end of the duct. When the opposite end highlights, click to place the endcap. It automatically resizes to fit the duct and is placed on the correct end. Repeat for the other end of the open duct.

7. Save the project.

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Task 6 - Adding Duct Placeholders.

1. Open the dependent view **01 Mechanical - Area A**. In this part of the project, there are air terminals and mechanical equipment in place but not all of the needed ductwork.

2. In the *Systems* tab>HVAC panel, click (Duct Placeholder).

3. In the Type Selector, select **Round Duct: Taps / Short Radius.**

4. In the Options Bar, set the *Diameter* to **200mm** and *Offset* to **3400mm.**

5. Snap to the Point connector for Supply Air in one of the AHU, as shown in Figure 8–57.

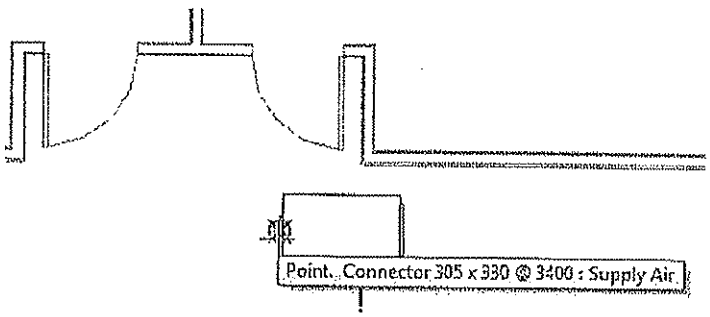

Figure 8–57

6. Draw the duct placeholder using alignment lines to go over the first air terminal and then turn to the upper left air terminal as shown in Figure 8–58.

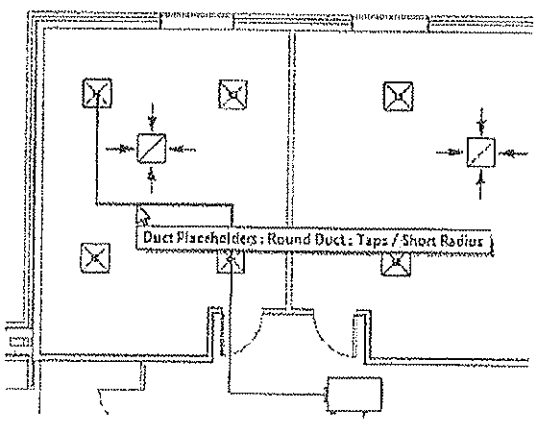

Figure 8–58

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7. Continue adding duct placeholder until the duct runs are similar to Figure 8–59.

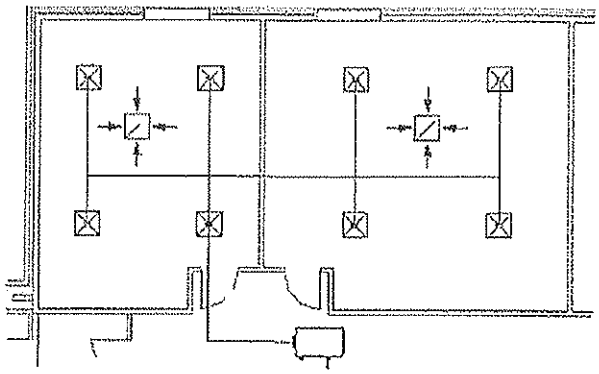

Figure 8–59

This might not be the way you want it, but you are still at the planning stage and it shows you how to draw duct straight up.

8. To create the duct placeholder from the air terminal that is directly under the ductwork, snap to the connector of the air terminal. In the Options Bar, verify that the *Offset* is **3400mm** and click Apply. This draws the duct straight up into the existing duct.

9. Save the project.

Task 6 - Converting Placeholders and Adding Lining

1. Select all of the duct placeholders.

2. In the *Modify | Multi-Select* tab>Edit panel, click (Convert Placeholder). The ducts are placed using the original settings as shown in Figure 8–60.

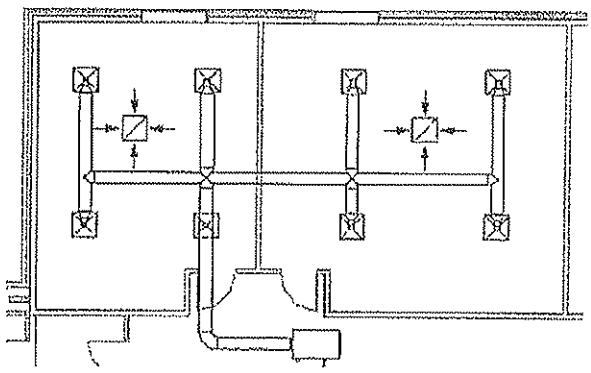

Figure 8–60

3. Select all of the new ducts and fittings.

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4. In the *Modify | Multi-Select* tab>expanded Duct Lining panel, click (Add Lining).
5. In the Add Duct Lining dialog box, set the *Thickness* to **15mm** and click OK.
6. In the Quick Access Toolbar, click (Thin Lines) if needed, so you can zoom in and see the lining applied to the ducts, as shown in Figure 8–61.

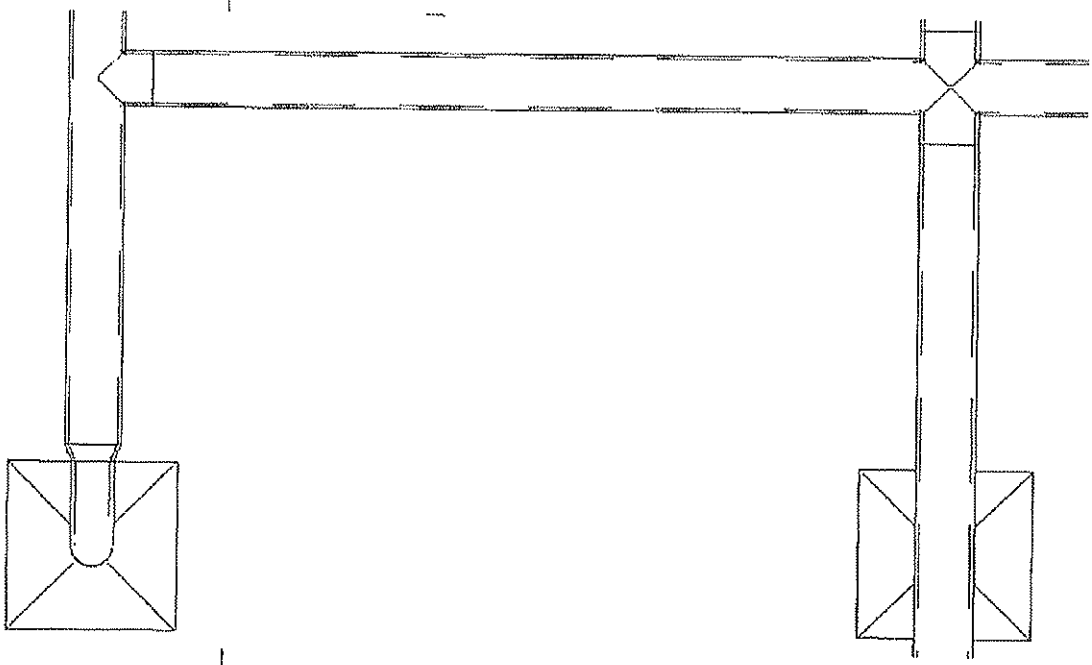

Figure 8–61

7. Save the project.

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8.4 Creating Duct Systems

Create Duct Systems.

Once you have placed the air terminals and mechanical equipment into the model, you need to create the appropriate supply or return air system from these elements. Once the elements are part of a system, you can then add the duct work to connect them together, as shown in Figure 8–62.

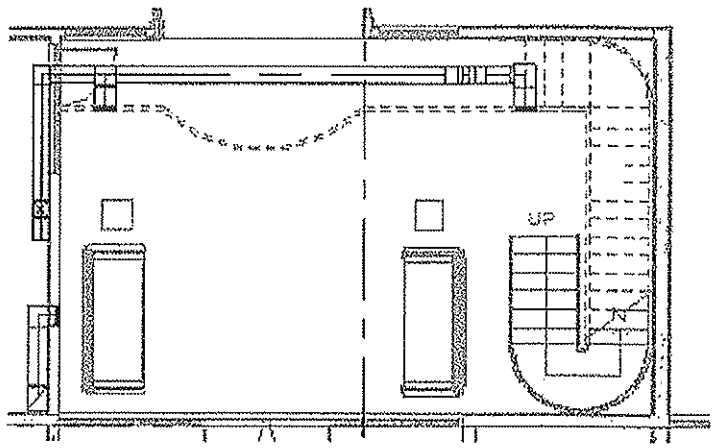

Figure 8–62

- Your model probably contains multiple air systems, including exhaust systems, which function similarly but are not covered in detail.
- You can add ducts before creating air systems but to use the automatic layout tools you need to have a system in place.

How to: **Create a Duct System**

1. Select one or all of air terminals/equipment (end units) that are going to become part of the air system. The air terminals must all be the same type: Supply, Return, or Exhaust.
   - Do not select the source equipment at this time.
2. In the *Modify | Air Terminals* tab>Create Systems panel, click (Duct).

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You can select a type from the System type drop-down list, if you selected mechanical equipment only.

3. In the Create Duct System dialog box, the *System type* is preset if you selected a specific type of air terminal. In the *System name* field, enter a name as shown in Figure 8–63.

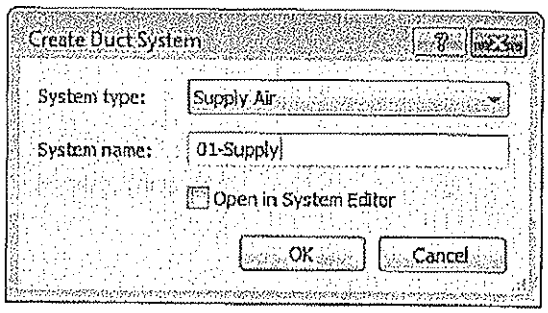

Figure 8–63

- You can also right-click on an air terminal or mechanical equipment connector and select **Create Duct System.**

4. In the *Duct Systems* tab>System Tools panel, as shown in Figure 8–64, click (Select Equipment) to select the air handling equipment for the system.

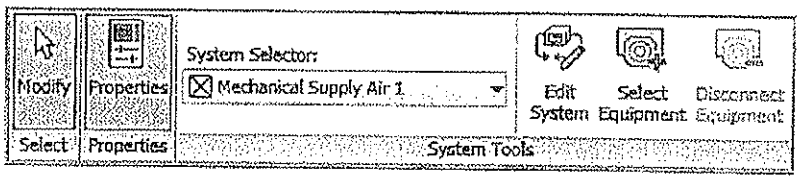

Figure 8–64

5. To add or remove air terminals, click (Edit System).
6. In the *Edit Duct Systems* tab>Edit Duct System panel, click (Add to System) as shown in Figure 8–65. Select any air terminals in the model that are to be part of this air system that were not selected earlier.

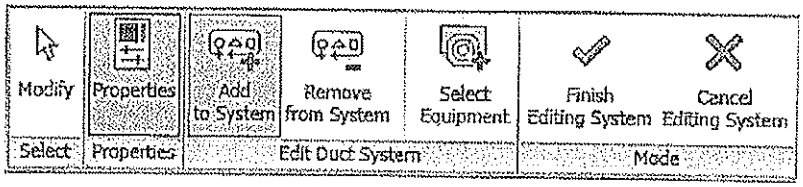

Figure 8–65

- Click (Remove from System) if you need to remove any air terminals.

7. You can select the mechanical equipment for this air system.

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8. In the Options Bar, you can change the *System Name* and select the *System Equipment* as shown in Figure 8–66. You can also set the *System Name* in Properties.



Figure 8–66

9. Click (Finish Editing System) to accept all components and complete the creation of the air system.

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8.5 Automatic Ductwork Layouts

Set up Mechanical Settings related to ductwork.

Generate automatic ductwork layouts.

Once you have created the duct system, you can automatically create the ductwork layout. These tools create various routes for the ductwork as shown in Figure 8–67.

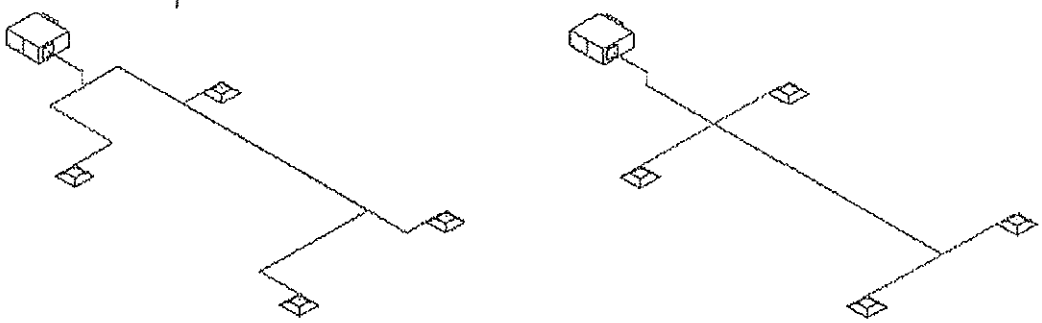

Figure 8–67

Mechanical Settings

Before you add ducts automatically, there are defaults that should be set for each type of system (Supply, Return, and Exhuast Air) that include the *Duct Type* and *Offset.* In the *Systems* tab>Mechanical panel title, click (Mechanical Settings) or type **MS** to open the Mechanical Settings dialog box as shown in Figure 8–68.

*In the dialog box, select Duct Settings> Conversion>**Main** (or **Branch**). On the right side, select the System Type and add the values for the Duct Type and Offset.The Branch option also has the Flex Duct Type and Maximum Flex Duct Length.*

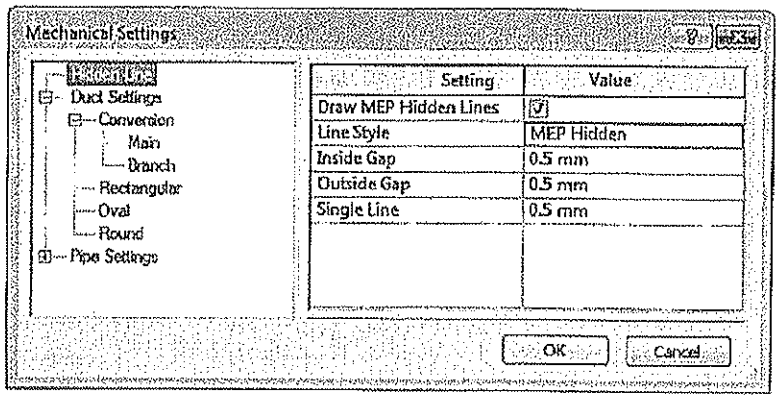

Figure 8–68

- You can also specify the Duct Rise/Drop symbol and establish sizes for Rectangular, Oval, and Round ducts.

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Automatic Ductwork

If you have just one or two air terminals that need to be connected to existing ductwork, you can use the **Connect Into** tool. If you have a more complex duct system then use the **Generate Layout** tool.

How to:

Connect an Air Terminal to existing Ductwork

1. Select the Air Terminal that needs to be connected to existing ducts.
2. In the *Modify* | *Air Terminals* tab>Layout panel, click (Connect Into).
3. Select the duct to connect as shown in Figure 8–69.

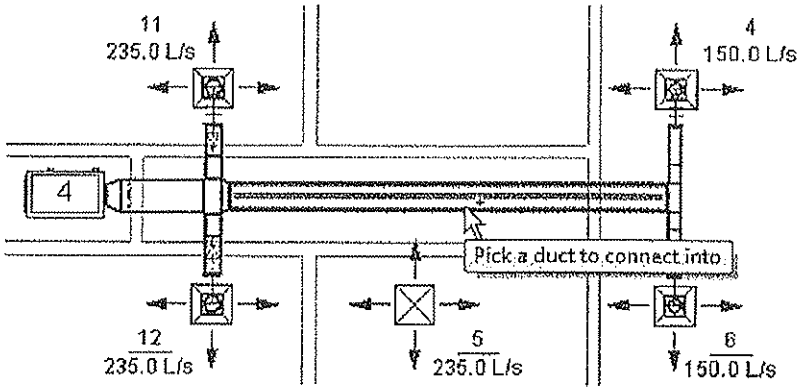

Figure 8–69

- If you select a duct that cannot work with the air terminal, an error is displayed as shown in Figure 8–70. Cancel out and try a different one or add ductwork separately. Most often this happens because the offset between the two is too close for the software to create a ducting based on the duct systems' default fittings.

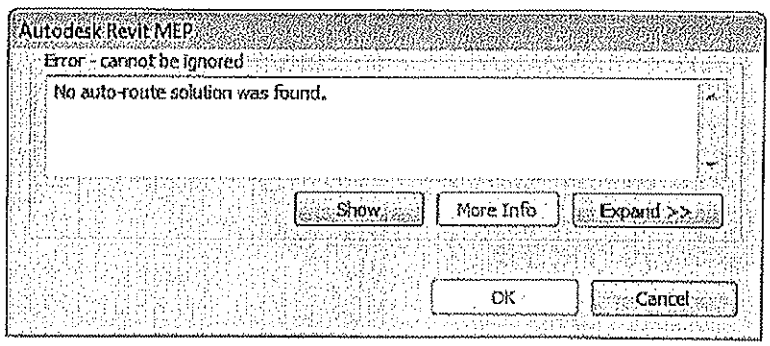

Figure 8–70

- This process automatically connects the air terminal to a system.

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How to:

You can view the solutions in the plan or a 3D view.

Generate an automatic ductwork layout

1. Select one of the air terminals or hover over an air terminal or the mechanical equipment in a system and press <Tab> until you see the outline of the system, as shown in Figure 8–71. Click to select the system.

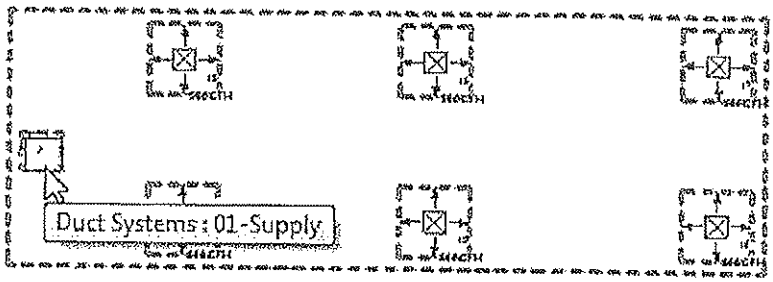

Figure 8–71

2. In the *Modify | Duct Systems* tab>Layout panel, click (Generate Layout).
3. In the Options Bar, click Settings... to open the Duct Conversions Settings dialog box and set the duct types and offsets that apply to this layout. (These settings are specific to this system only. Global settings are defined in Mechanical Settings as previously described.)
4. In the Options Bar, select a *Solution Type*, as shown in Figure 8–72, and click (Next Solution) or (Previous Solution) to cycle through the possible options.

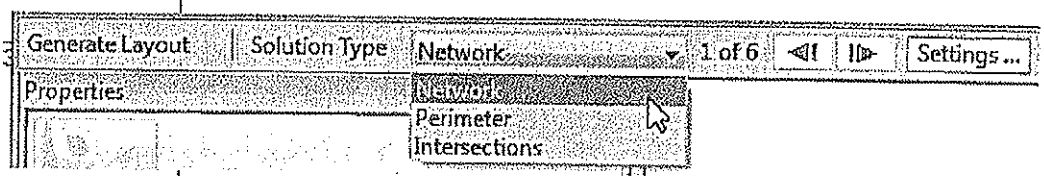

Figure 8–72

Network	Creates a layout with the main segment through the center of a bounding box around the entire system and the branches at 90 degrees from the main branch.
Perimeter	Creates a layout with segments being placed on three of the four sides, and one with segments being placed on all four sides. (The **Inset** value is the offset between the bounding box and components.)
Intersections	Creates a layout with segments extending from each connector of the components. Where they intersect perpendicularly, proposed intersection junctions are created.

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- The blue lines identify the main duct system and green lines identify branch systems.
- Gold lines show a potential open connection that could cause problems when the ductwork is added as shown in Figure 8–73, or other issues related to adequate space to place the required fittings.

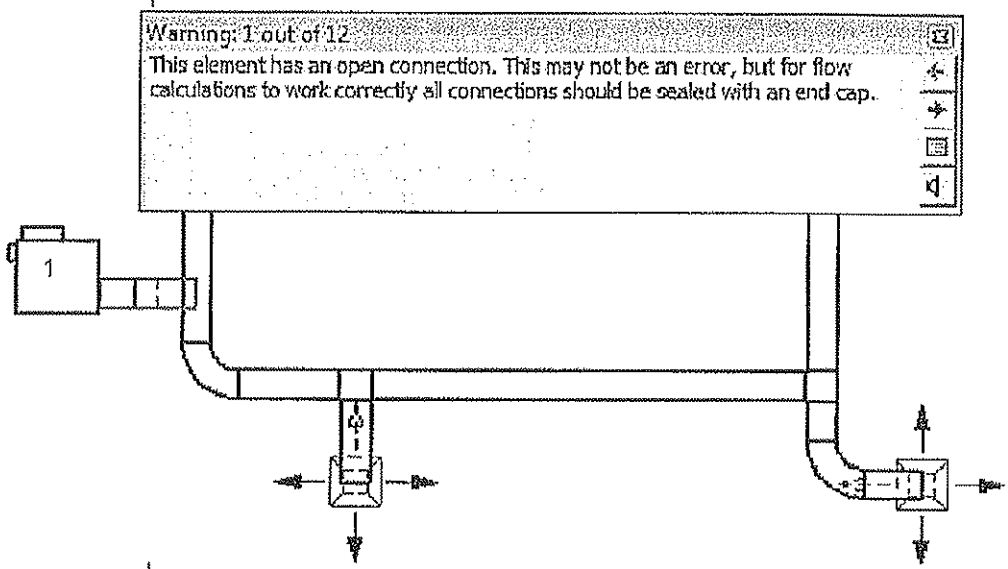

Figure 8–73

5. In the *Generate Layout* tab>Generate Layout panel, click (Finish Layout) when you have a solution that looks best.

- In the Options Bar, clicking Settings... opens the Duct Conversion Settings dialog box, as shown in Figure 8–74. You can modify the settings while selecting solutions to provide the best options. For example, having the *Branch Offset* too low can cause issues if the *Offset* of the Air Terminal value is close. Also, you should specify a flex duct in the Branch if you want air terminals automatically connected that way.

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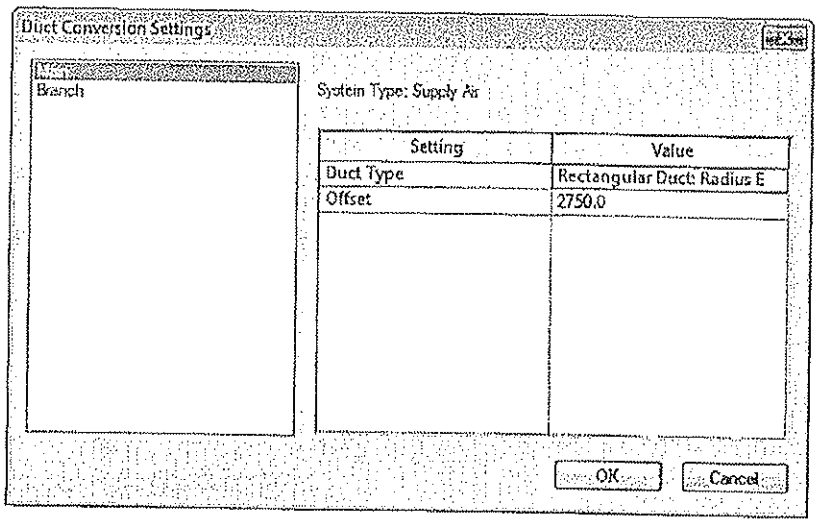

Figure 8–74

How to: Customize the Layout

1. Using (Solutions), select a layout design similar to what you want to use.
2. In the *Generate Layout* tab>Modify Layout panel, click (Edit Layout).
3. Select one of the layout lines. You can use the move control to change the location of the line as shown in Figure 8–75. You can also change the height of the offset by clicking on the number control.

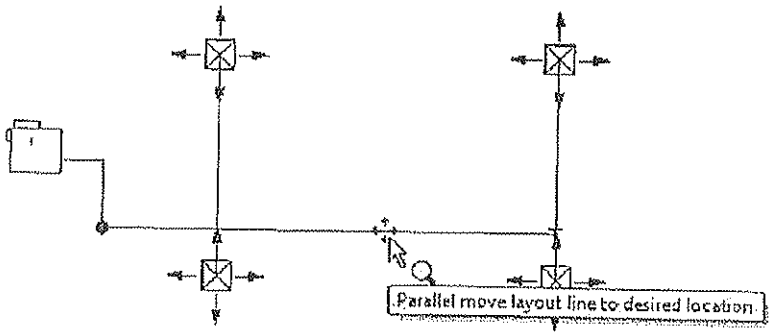

Figure 8–75

4. Click (Solutions) to finish customizing the layout. The Solution Type list now has **Custom** as an additional option to the standard three solution types.
   - The Autodesk Revit software only permits one custom option at a time.

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5. In the *Generate Layout* tab>Generate Layout panel, click (Finish Layout).

- To test the continuity of the system, hover the cursor over one of the ducts and press <Tab> until the whole system highlights. For example, in Figure 8–76, one of the ducts is not attached to the fitting and therefore is not highlighted.

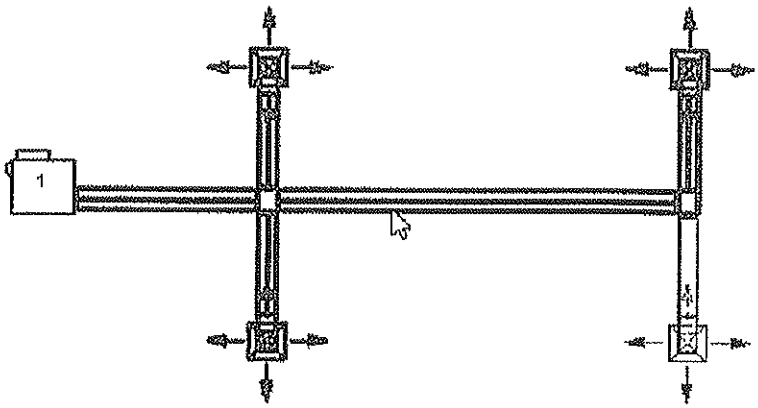

Figure 8–76

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Practice 8b

Adding and Analyzing Duct Systems

- Create ducts using the **Generate Layout** tool with both standard and custom layouts.
- Modify ductwork after it has been placed.
- Check the information using existing schedules.

Estimated time for completion: 20 minutes

In this practice you will create supply ducts using the **Generate Layout** tool, and modify the ductwork in the layout and after it has been placed. You will also create a custom layout for the return ducts and modify the ductwork. The final systems are shown in Figure 8–77. You will then check and modify information in premade schedules.

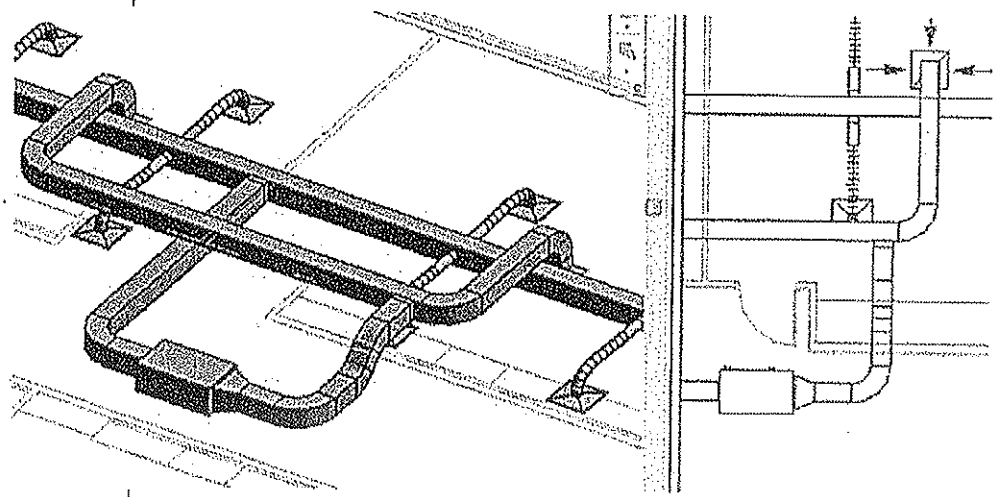

Figure 8–77

Task 1 - Create a Duct System.

1. Open the project file **MEP-Elementary-School-Systems.-Mrvt** found in the *Chapter 8* folder of your class folder.

2. In the *Analyze* tab> System Browser panel, click (System Browser) or press <F9>.

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3. In the System Browser, change the *View* to **Systems** and All Disciplines to **Mechanical**, as shown in Figure 8–78.

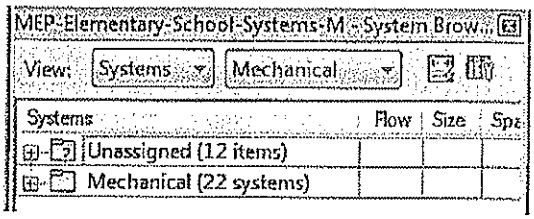

Figure 8–78

4. In the System Browser, expand Unassigned>Mechanical> Supply Air. There are several Air Terminals and an AHU listed, as shown in Figure 8–79.

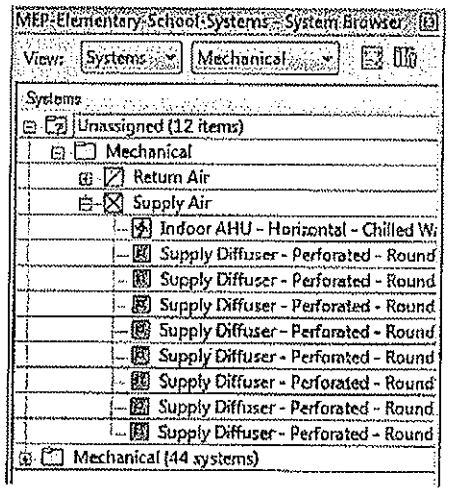

Figure 8–79

5. Select one of the unassigned Supply Diffusers. In the view window find the air terminal that was selected.
6. In the *Modify | Air Terminals* tab>Create Systems panel, click (Duct).
7. In the Create Duct System dialog box, type the name **01 - SA08**, select **Open in System Editor** and click OK.
8. In the *Edit Duct System* tab>Edit Duct System panel, click (Select Equipment) and select the associated AHU unit.

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9. Click (Add to System) and select the other seven air terminals as shown in Figure 8–80.

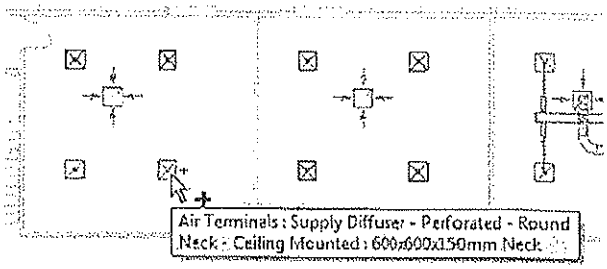

Figure 8–80

10. Click (Finish Editing System).

11. Select one of the air terminals in the new system.

12. In the System Browser, expand the highlighted levels until the new system displays, as shown in Figure 8–81. This would have been very hard to identify without the selection because the system listing is under the AHU unit.

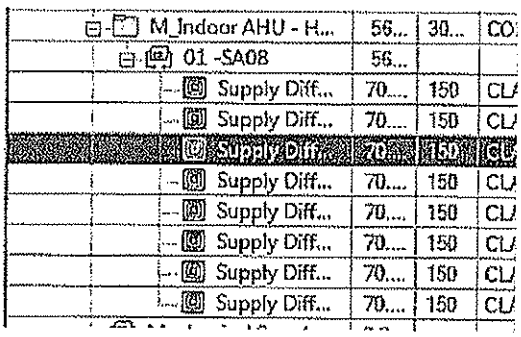

Figure 8–81

13. In the System Browser return to the Unassigned area and expand Mechanical>Return Air. Hold down <Shift> or <Ctrl> and select the two return air terminals. They are also selected in the view window.

14. In the *Modify* | *Multi-Select* tab>Create Systems panel, click (Duct).

15. In the Create Duct System dialog box, set the *System name* as **01 - RA08**. Select **Open in System Editor** and click OK.

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16. In the *Edit Duct System* tab>Edit Duct System panel, click (Select Equipment). Select the **Air Handling Unit**.

17. Click (Finish Editing System).

18. The new system connections display as shown in Figure 8–82.

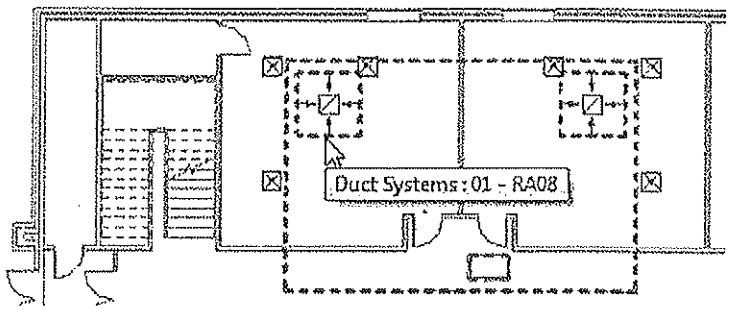

Figure 8–82

19. Click (Modify) twice to release the selection.

20. Close the System Browser and save the project.

Task 2 - Set up the Mechanical Settings.

1. In the *Systems* tab>Mechanical panel title, click (Mechanical Settings).

2. In the Mechanical Settings dialog box expand **Duct Settings>Conversion>Main** and set the following parameters:

   - *System Type*: **Supply Air**
   - *Duct Type - Rectangular Duct*: **Radius Elbows/Taps**
   - *Offset*: **3050mm**

3. Select **Duct Settings>Conversion>Branch** and set the following parameters, as shown in Figure 8–83:

   - *System Type*: **Supply Air**
   - *Duct Type*: **Round Duct: Taps / Short Radius**
   - *Offset*: **3050mm**
   - *Flex Duct*: **Flex Duct Round: Flex - Round**
   - *Maximum Flex Duct Length*: **1800mm**

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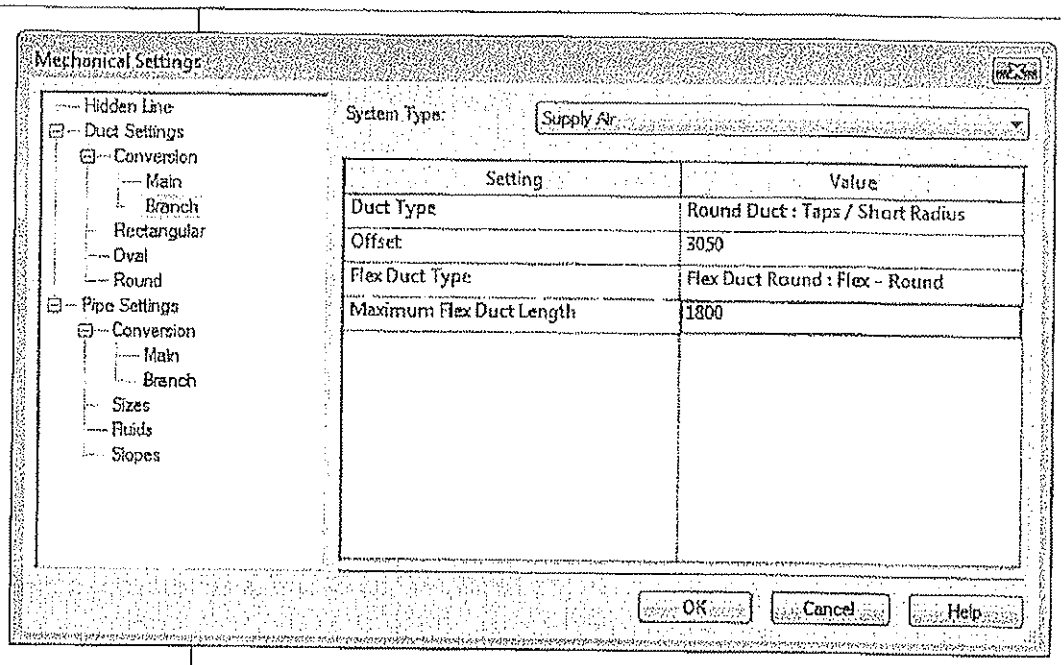

Figure 8–83

4. Change the *System Type* to **Return Air** and set the same parameters as above except set the *Offset* of the *Branch* to **3350mm**.

5. Click OK.

Task 3 - Create an Automatic Ductwork Layout.

You can use WT (Window Tile) if only these two views are open in that Revit MEP session.

1. Open the Mechanical>HVAC>3D Views>**01 MECHANICAL - AREA B 3D** view and resize the views so you can see both the 2D plan and 3D views of the new systems area.

2. Rotate the 3D view to display the existing air terminals.

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3. In the plan, roll your cursor over one of the supply air terminals and press <Tab> until the system displays. Click to select it as shown in Figure 8–84.

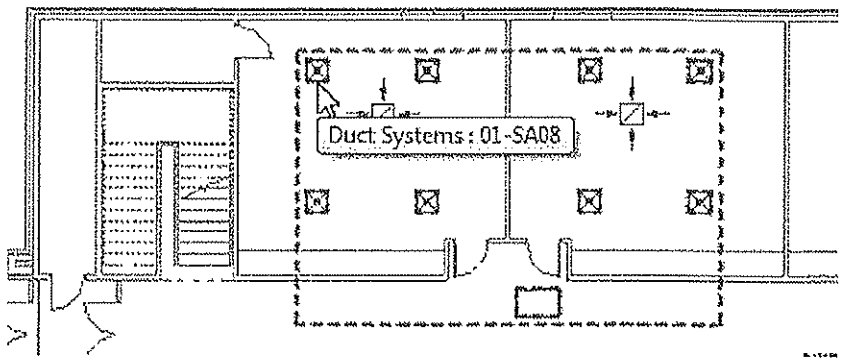

Figure 8–84

4. In the *Modify | Duct Systems* tab>Layout panel, click (Generate Layout).

5. In the *Generate Layout* tab>Modify Layout panel, verify that (Solutions) is selected and the Options Bar displays Solution Types.

6. In the Options Bar, use the arrow buttons and Solution Types to try out several different solutions. End with the solution shown in Figure 8–85 and click (Finish Layout).

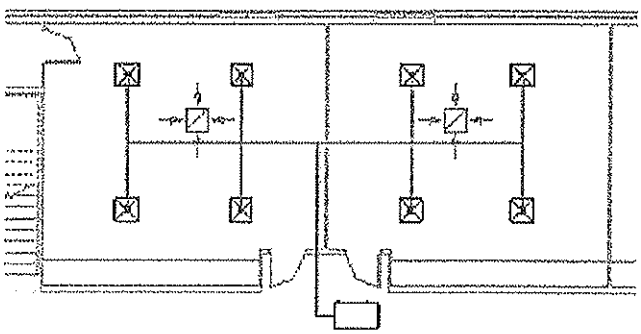

Figure 8–85

7. A Warning displays prompting you that there is an open connection and the horizontal duct is highlighted as shown in Figure 8–86. You can see in the 3D view that it is missing an endcap.

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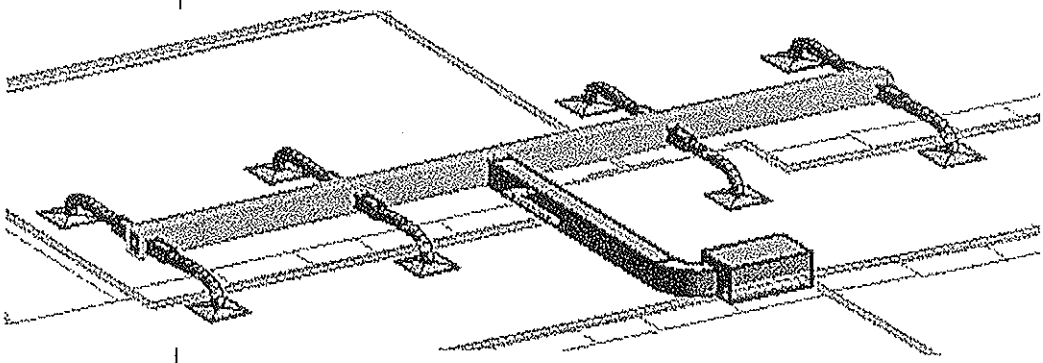

Figure 8–86

8. Click in the 3D view to activate it.

9. In the *Systems* tab>HVAC panel, click (Duct Fitting).

10. In the Type Selector, select **M_Rectangular Endcap: Standard**.

11. Move the cursor over the end of the duct and place the endcap.

12. Rotate the 3D view or move to 2D view to place an endcap on the other end.

13. Save the project.

Task 4 - Create a Custom Ductwork Layout.

1. Continue working with the same two views open.

2. In the 2D view select the Return Air System.

3. In the *Duct Systems* tab>Layout panel, click (Generate Layout).

4. View the various solutions. Most of them have some problem with the layout. When the gold lines display it is a warning that the layout could fail in those areas.

5. In the Options Bar, click Settings....

6. In the Duct Conversion Settings dialog box, select **Main** and change the options as follows:

   - *Duct Type*: **Rectangular Duct: Radius Elbow and Taps**
   - *Offset*: **3500mm**

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7. In the Duct Conversion Settings dialog box, select **Branch** and change the options as follows:
   - *Duct Type*: **Rectangular Duct: Radius Elbow and Taps**
   - *Offset*: **3500mm**
   - *Flex Duct Type*: **None**
8. Click OK. This still didn't correct all the problems but it solved some by changing the heights of the ducts.
9. Cycle through the solutions until you reach one similar to that shown in 3D in Figure 8–87. There are still some problems but they need to be fixed after you create the layout.

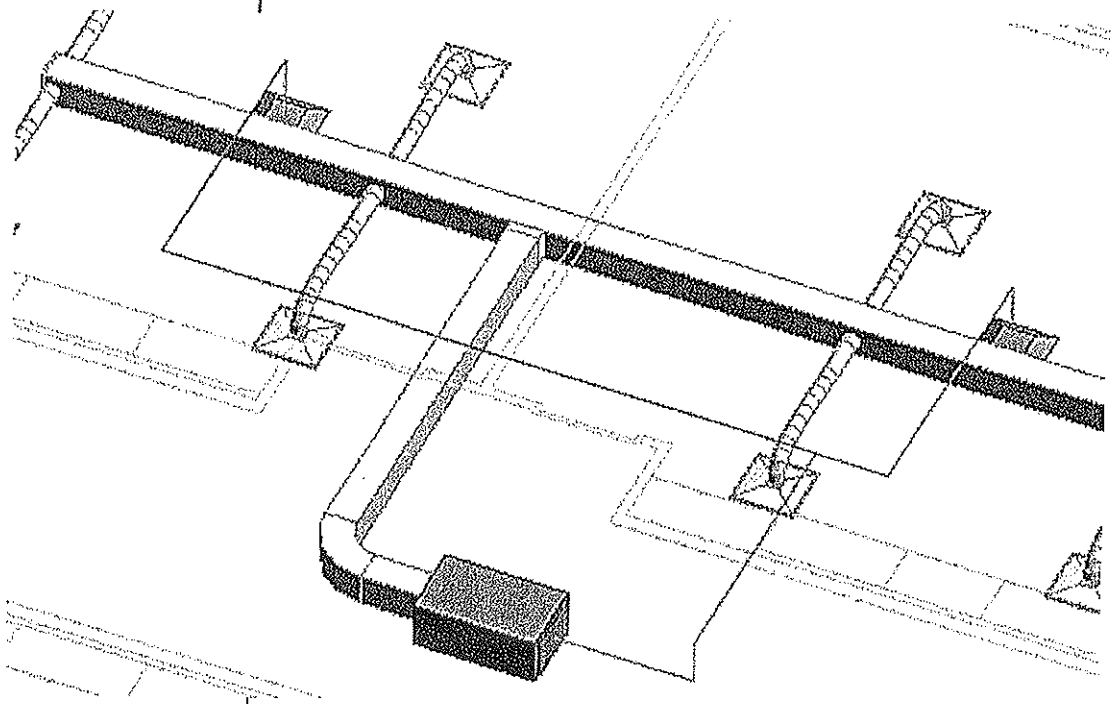

Figure 8–87

10. Click (Finish Layout).

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11. The connections to the return air terminals are working correctly but you need to modify the ducts and connectors to the mechanical equipment as shown in Figure 8–88.

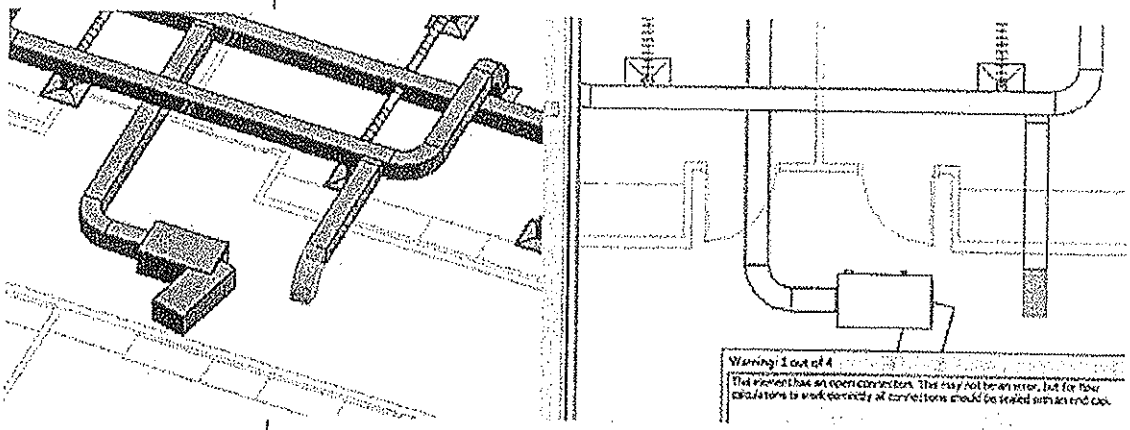

Figure 8–88

- It is possible that another place will be broken. You can still do the following steps but delete elements indicated by the other issues.

12. In the 2D view select and delete the following three items:
    - The duct at an angle from the mechanical equipment
    - The elbow (in gold) at the end of the duct that is not connected
    - The duct attached to the elbow
13. Select the Mechanical Equipment unit, right-click on the Return Air control and select **Draw Duct**.
14. In the Options Bar, set the *Width* and *Height* to **300mm** and the *Offset* to **3050mm** as shown in Figure 8–89.

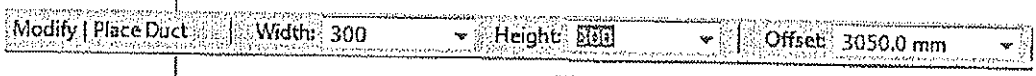

Figure 8–89

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15. Draw the first leg of the duct until it aligns with the intersection of the tee. In the Options Bar, change the *Offset* to **3050mm** and connect the duct to the rectangular takeoff, as shown in Figure 8–90.

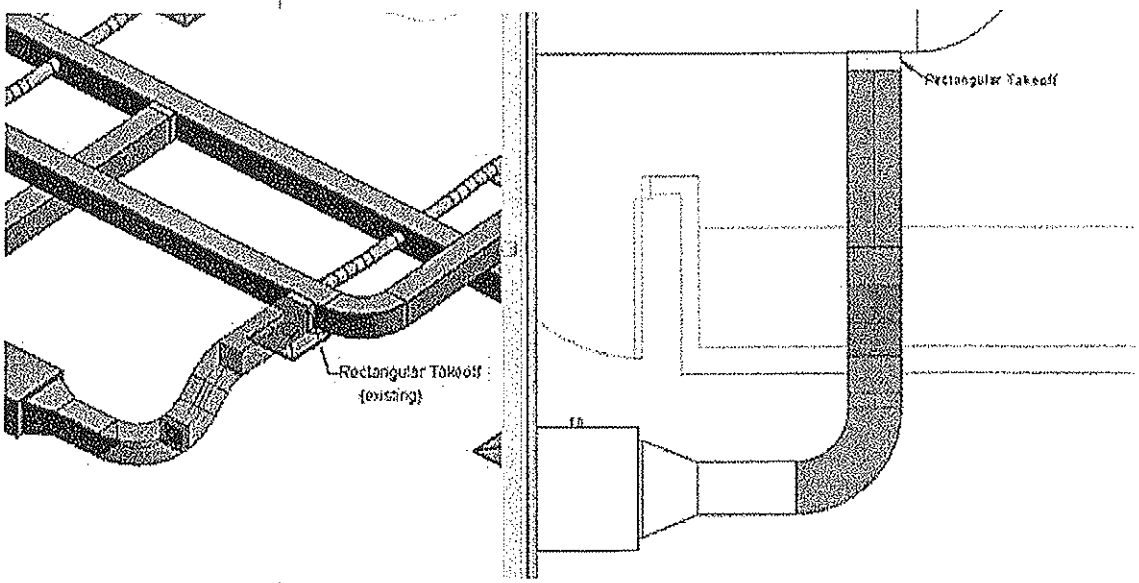

Figure 8–90

16. Save the project.

Task 5 - Work with Schedules.

1. In the **01 MECHANICAL - AREA B** view, roll your cursor over the edge of one of the rooms with air terminals and press <Tab> until you see the room boundary displayed, as shown in Figure 8–91. Click on the room boundary and look at the number and name of the room in Properties.

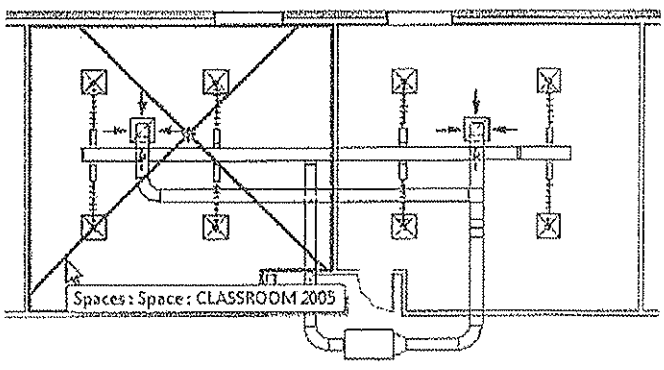

Figure 8–91

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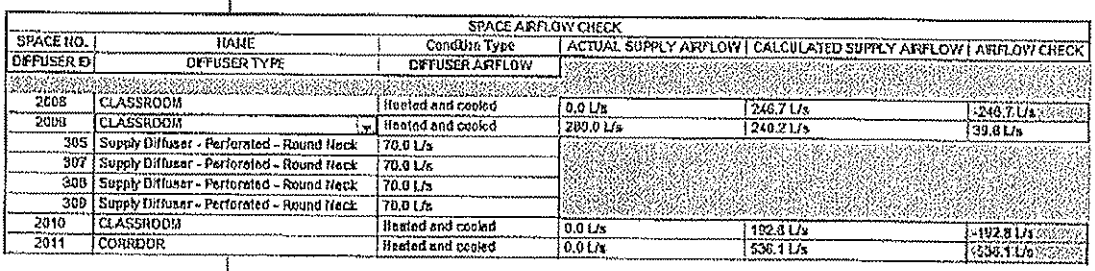
2. Repeat this to find the room number and name for the other room in the system.

3. In the Project Browser, scroll down to the *Schedules* area and open **Space Airflow Check**.

4. Find the two rooms you just selected. (The Room Number and Space Number are the same.)

5. In the schedule, under Diffuser Airflow, change one of the air terminals to **25 L/s**. The Airflow Check displays a negative number because this does not provide enough airflow for the space. Test several options and end with a positive air flow for the room.

6. Scroll down to Space Number **2008** and **2010**. Neither of these spaces have any air terminals and therefore have a negative Airflow Check number, as shown in Figure 8–92.



SPACE AIRFLOW CHECK

SPACE NO.	NAME	CondUse Type	ACTUAL SUPPLY AIRFLOW	CALCULATED SUPPLY AIRFLOW	AIRFLOW CHECK
DIFFUSER ID	DIFFUSER TYPE	DIFFUSER AIRFLOW			
2008	CLASSROOM	Heated and cooled	0.0 L/s	246.7 L/s	-246.7 L/s
2009	CLASSROOM	Heated and cooled	280.0 L/s	240.2 L/s	39.8 L/s
305	Supply Diffuser - Perforated - Round Neck	70.0 L/s			
307	Supply Diffuser - Perforated - Round Neck	70.0 L/s			
308	Supply Diffuser - Perforated - Round Neck	70.0 L/s			
309	Supply Diffuser - Perforated - Round Neck	70.0 L/s			
2010	CLASSROOM	Heated and cooled	0.0 L/s	192.8 L/s	-192.8 L/s
2011	CORRIDOR	Heated and cooled	0.0 L/s	536.1 L/s	-536.1 L/s

Figure 8–92

7. Arrange the view windows so you can see the **Space Airflow Check** schedule and the Coordination>MEP>Ceiling Plans>**01 RCP** view with Space 2008 and 2010 showing in each. (The spaces are in the lower left of the south wing of the school.)

8. Select one of the existing supply air terminals. Right-click and select **Create Similar**. This starts the Air Terminal command and sets the type and Properties to match the original.

9. In the *Modify | Place Component* tab>Placement panel, click (Place on Face).

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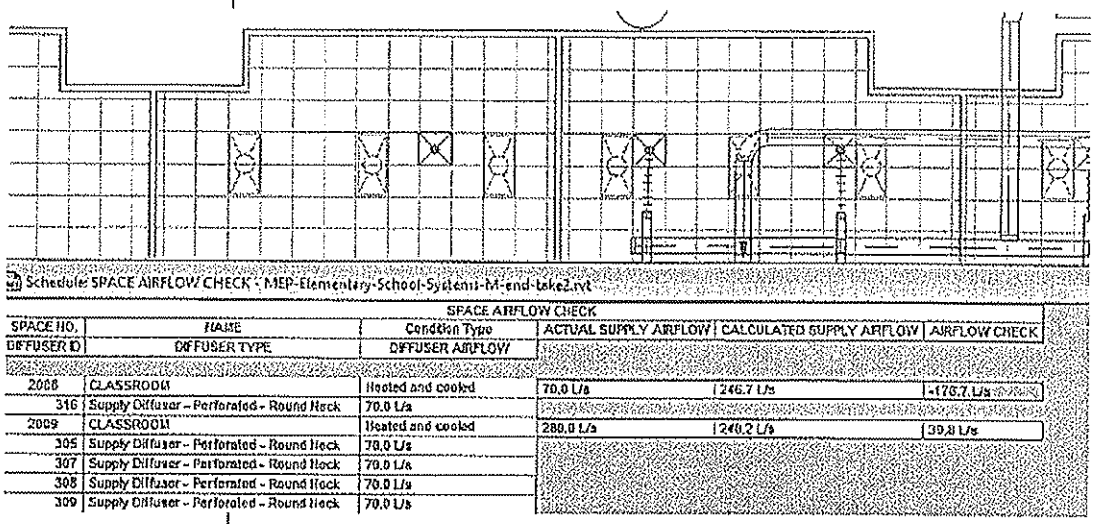
10. Add an air terminal in one of the spaces without air terminals. The schedule automatically updates and includes the flow rate of the air terminal in the Airflow Check as shown in Figure 8–93.



Schedule: SPACE AIRFLOW CHECK - MEP-Elementary-School-Systems-M-end-take2.rvt

SPACE AIRFLOW CHECK

SPACE NO. / DIFFUSER ID	NAME / DIFFUSER TYPE	Condition Type / DIFFUSER AIRFLOW	ACTUAL SUPPLY AIRFLOW	CALCULATED SUPPLY AIRFLOW	AIRFLOW CHECK
2008	CLASSROOM	Heated and cooled	70.0 L/s	246.7 L/s	-176.7 L/s
316	Supply Diffuser - Perforated - Round Neck	70.0 L/s			
2009	CLASSROOM	Heated and cooled	280.0 L/s	240.2 L/s	39.8 L/s
305	Supply Diffuser - Perforated - Round Neck	70.0 L/s			
307	Supply Diffuser - Perforated - Round Neck	70.0 L/s			
308	Supply Diffuser - Perforated - Round Neck	70.0 L/s			
309	Supply Diffuser - Perforated - Round Neck	70.0 L/s			

Figure 8–93

11. Add as many air terminals as needed to have a positive airflow and then repeat the process in the other room.

12. Save the project.

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Chapter Review Questions

1. Where do you specify the *Flow* of an air terminal if it already exists? Select all that apply.
   a. In the Ribbon.
   b. In the Options Bar.
   c. In the Air Flow Dialog Box.
   d. In the Properties.
   e. In the Air Terminal tag.
2. The size of the duct drawn from a control on mechanical equipment must remain the same size as the opening on the equipment.
   a. True
   b. False
3. In which cases can you convert rigid duct to flexible duct?
   a. When the rigid duct is round.
   b. When the air terminal is already connected to a rigid duct.
   c. When creating a system and sizing the ducting.
   d. When the **Allow Conversion** parameter is selected in the rigid duct's instance properties.
4. How do you change an elbow fitting to a tee fitting?
   a. Delete the elbow and place a tee instead.
   b. Select the elbow and use the Type Selector to select a tee fitting instead.
   c. Select the elbow and click + (Plus).
   d. Select the elbow and click the **Convert to Tee** button in the Ribbon.
5. What is needed before you can create an automatic ductwork layout?
   a. A Duct System
   b. Air Terminals
   c. Duct placeholders
   d. All air terminals and equipment placed for the entire project.

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Command Summary

Button	Command	Location
	**Add Insulation**	■ **Ribbon:** (*with Ducts and Duct Fittings selected*) *Modify* | *Multi-Select* tab> Duct Insulation panel
	**Add Lining**	■ **Ribbon:** (*with Ducts and Duct Fittings selected*) *Modify* | *Multi-Select* tab> Duct Lining panel
	**Add to System**	■ **Ribbon:** *Edit Duct System* tab>Edit Duct System panel
	**Air Terminal**	■ **Ribbon:** *Systems* tab>HVAC panel ■ **Shortcut:** AT
	**Change Type**	■ **Ribbon:** (*with Ducts and Duct Fittings selected*) *Modify* | *Multi-Select* tab> Edit panel
	**Convert to Flex Duct**	■ **Ribbon:** *Systems* tab>HVAC panel ■ **Shortcut:** CV
	**Disconnect Equipment**	■ **Ribbon:** *Edit Duct Systems* tab> System Tools panel
	**Duct**	■ **Ribbon:** *Systems* tab>HVAC panel ■ **Shortcut:** DT
	**Duct Accessory**	■ **Ribbon:** *Systems* tab>HVAC panel ■ **Shortcut:** DA
	**Duct Fitting**	■ **Ribbon:** *Systems* tab>HVAC panel ■ **Shortcut:** DF
	**Duct Placeholder**	■ **Ribbon:** *Systems* tab>HVAC panel
	**Duct (System)**	■ **Ribbon:** *Modify* | *contextual* tab> Create Systems panel ■ **Right-click:** Create Duct System
	**Edit Layout**	■ **Ribbon:** *Generate Layout* tab> Modify Layout panel
	**Edit Insulation**	■ **Ribbon:** (*with Ducts and Duct Fittings that have Insulation selected*) *Modify* | *Multi-Select* tab>Duct Insulation panel

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	**Edit Lining**	**Ribbon:** (*with Ducts and Duct Fittings that have Lining selected*) *Modify* | *Multi-Select* tab>Duct Lining panel
	**Edit System**	**Ribbon:** *Duct System* tab>System Tools panel
	**Flex Duct**	**Ribbon:** *Systems* tab>HVAC panel **Shortcut:** FD
	**Generate Layout**	**Ribbon:** *Duct System* tab>Layout panel and *Modify* | *Air Terminals* tab> Layout panel
	**Inherit Elevation**	**Ribbon:** *Modify* | *Place Duct* tab> Placement Tools panel
	**Inherit Size**	**Ribbon:** *Modify* | *Place Duct* tab> Placement Tools panel
	**Justification (Settings)**	**Ribbon:** *Modify* | *Place Duct* tab> Placement Tools panel
	**Justify**	**Ribbon:** (*with Ducts and Duct Fittings selected*) *Modify* | *Multi-Select* tab> Edit panel
	**Load Family**	**Ribbon:** *Modify* | *Place Air Terminal* tab>Mode panel
	**Mechanical Equipment**	**Ribbon:** *Systems* tab>Mechanical panel **Shortcut:** ME
	Mechanical Settings	**Ribbon:** *Systems* tab>HVAC or Mechanical panel title **Shortcut:** MS
	**Pick New (Work Plane)**	**Ribbon:** *Modify* | *Air Terminal* tab> Work Plane panel
	**Remove from System**	**Ribbon:** *Edit Duct System* tab>Edit Duct System panel and *Generate Layout* tab>Modify Layout panel
	**Remove Insulation**	**Ribbon:** (*with Ducts and Duct Fittings that have Insulation selected*) *Modify* | *Multi-Select* tab>Duct Insulation panel
	**Remove Lining**	**Ribbon:** (*with Ducts and Duct Fittings that have Lining selected*) *Modify* | *Multi-Select* tab>Duct Lining panel

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	**Select Equipment**	▪ **Ribbon:** *Duct System* tab>System Tools and *Edit Duct Systems* tab>Edit Duct System panel
	**Solutions**	▪ **Ribbon:** *Generate Layout* tab> Modify Layout panel
	**System Browser**	▪ **Ribbon:** *View* tab>Windows panel, expand User Interface ▪ **Shortcut:** <F9>

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Chapter 9

Hydronic Piping Systems

In this chapter you learn about Hydronic Piping and Fire Protection Systems. You learn to add mechanical equipment, create hydronic systems, and add piping manually or automatically. You also learn how to add wet and dry sprinklers including the associated piping and systems.

This chapter contains the following topics:

- ✓**About Hydronic Piping Systems**
- ✓**Adding Mechanical Equipment**
- ✓**Drawing Piping**
- ✓**Creating Hydronic Systems**
- ✓**Automatic Piping Layouts**
- ✓**Fire Protection Systems**

Learning Objectives

This chapter provides instruction to enable you to do the following:

9.1 About Hydronic Piping Systems

- Understand the process of creating hydronic piping systems.

9.2 Adding Mechanical Equipment

- Place mechanical equipment components for piping systems.

9.3 Drawing Piping

- Draw piping to connect mechanical equipment that uses fluids including parallel pipe runs.
- Modify pipes including converting pipe placeholders to pipes, changing types in pipe runs, adding insulation, and modifying justification.
- Work with pipe fittings and accessories.

9.4 Creating Hydronic Systems

- Create systems of hydronic piping and mechanical equipment.

9.5 Automatic Piping Layouts

- Use the **Generate Layout** tool to add piping to a piping system.

9.6 Fire Protection Systems

- Add systems, sprinklers, and piping for fire protection systems.

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9.1 About Hydronic Piping Systems

Understand the process of creating hydronic piping systems.

Hydronic Piping Systems use hot and cold water to provide heating and air conditioning to a building. They can include boilers that heat water circulated through radiators or large boiler/chiller equipment that sends hot or cold water to air handling units as shown in Figure 9–1. Autodesk® Revit® MEP software provides tools that help you to properly design these systems.

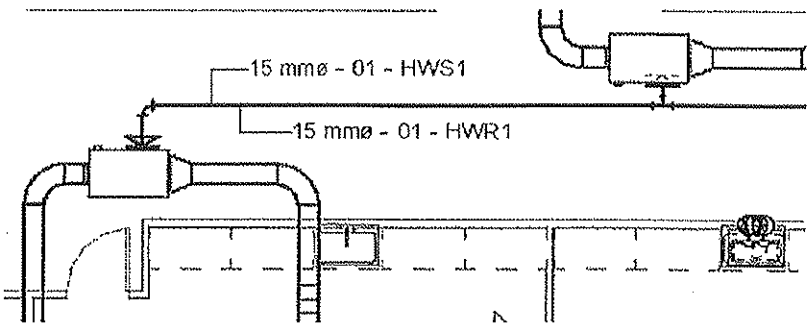

Figure 9–1

There are several steps in the process of creating HVAC systems:

1. Add mechanical equipment (some might already be in place if you are attaching the hydronic piping to air handling units.)
2. Create a supply or return hydronic system.
3. Generate piping automatically or add it manually.
4. Check and modify the system.

- The tools used for creating and placing piping components and systems are located in the *Systems* tab>Plumbing & Piping panel, as shown in Figure 9–2.

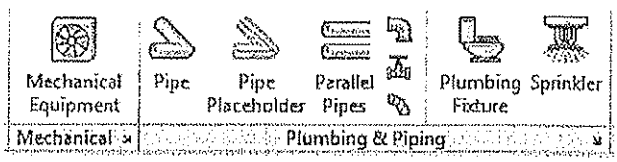

Figure 9–2

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9.2 Adding Mechanical Equipment

Place mechanical equipment components for piping systems.

Boilers and chillers or a combination unit supplies the hot and/or cold water to other equipment in a hydronic system. These are connected through piping to complete the system. Some equipment used with ductwork is also designed to have hydronic piping systems connected to it such as the Air Handling Unit, as shown in Figure 9–3. Blue nodes on a selected piece of equipment represent connection points for system components.

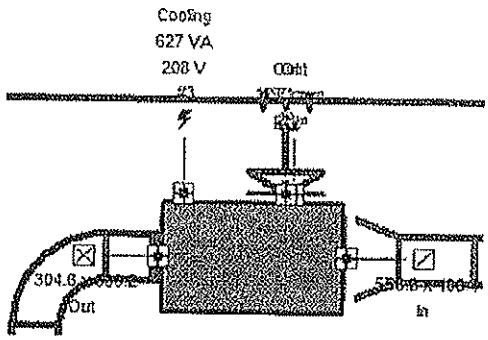

Figure 9–3

- Mechanical Equipment can be placed in any plan view.

How to:

Place Mechanical Equipment

1. Open the view where you want to place the mechanical equipment element.
2. In the *Systems* tab>Mechanical panel, click (Mechanical Equipment) or type **ME**.
3. In the Type Selector, select a Mechanical Equipment type. In Properties, set any other values such as the *Level* and *Offset* if it is not hosted.
4. Place the Mechanical Equipment in the model by clicking at the required location in the model view. You can use other objects in the model to line the element up and press the <Spacebar> to rotate it before placing it.
5. Continue to place additional Mechanical Equipment elements, or click (Modify) to exit the command.

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- Additional boilers, radiators, VAV units and more can be loaded from the Revit MEP Library in the *Mechanical Components* sub-folders.

- Take time to get to know the types of mechanical equipment that come with the software. You can view them in 3D, plan, or elevation/section views. Select them to display the connectors as shown in Figure 9–4.

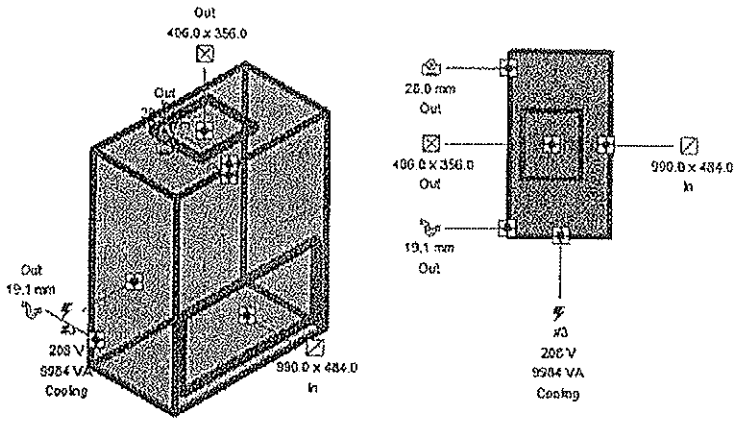

Figure 9–4

Mechanical Settings-Piping

Before you add piping there are defaults that should be set for each type of system (Hydronic Supply, Hydronic Return, and the rest of the types of piping). Similar to the Duct Settings you select the *Pipe Type* and *Offset*. In the *Systems* tab>Plumbing & Piping panel title, click (Mechanical Settings) or type **MS** to open the Mechanical Settings dialog box as shown in Figure 9–5.

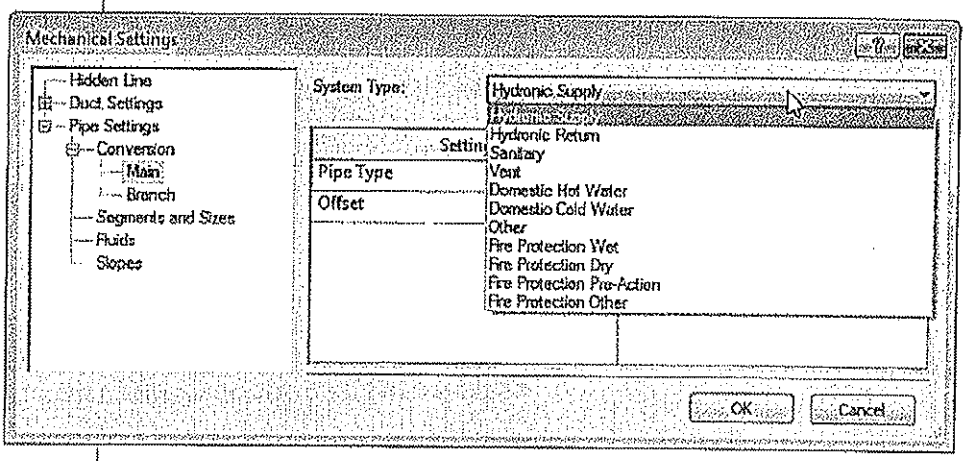

Figure 9–5

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Other options that can be set in this dialog box include the Pipe Rise/Drop Annotation Size and symbols, typical pipe sizes by segment for materials, such as carbon steel, copper, and plastic. You can also set the fluid information where you set the Temperature, Viscosity, and Density of different types of fluids used in the systems as shown in Figure 9–6, and default Slopes for use when you use sloped piping.

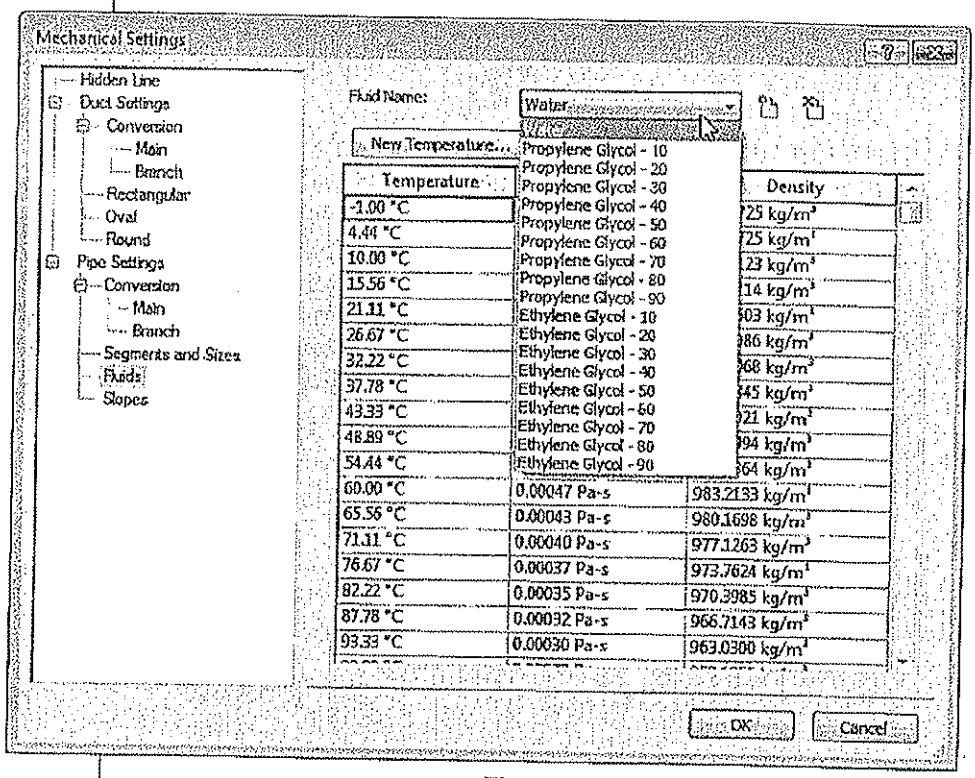

Figure 9–6

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9.3 Drawing Piping

- Draw piping to connect mechanical equipment that uses fluids including parallel pipe runs.
- Modify pipes including converting pipe placeholders to pipes, changing types in pipe runs, adding insulation, and modifying justification.
- Work with pipe fittings and accessories.

Piping connects the mechanical equipment that heats or cools the fluid to the radiators or air handling units that use the fluid. You can view the piping at different detail levels. The Coarse Detail level displays the pipe and ductwork in schematic, as shown on the left in Figure 9–7. The Medium level displays ductwork at full size but piping in schematic. The Fine level displays both ductwork and piping at full size as shown on the right in Figure 9–7.

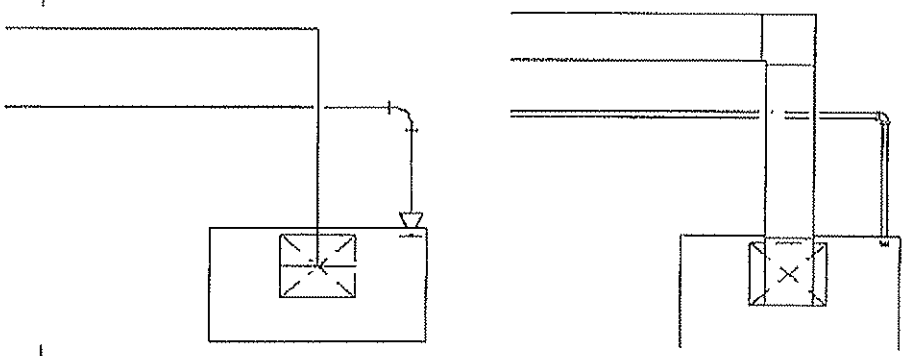

Figure 9–7

- Pipes can be drawn in plan, elevation/section, and 3D views.
- Fittings are automatically added according to the system family that has been defined. You can also modify fittings and add others.
- You can draw Pipe Placeholders early in a project and then convert them to standard pipes as the system is further defined.
- Using (Pipe), (Pipe Placeholder), and (Flex Pipe) are very similar. The tools are present in the *Systems* tab>Plumbing & Piping panel.

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New in 2013

- To display centerlines for piping, in the Visibility/Graphics Overrides dialog box, turn on the *Centerline* subcategory for pipe and pipe fittings. Centerlines display in plan and elevation views set to the **Wireframe** or **Hidden Line** visual style.

How to:

Add Piping

1. Open the view where you want to place the pipes.
2. In the *Systems* tab>Plumbing & Piping panel, click (Pipe), (Pipe Placeholder), or (Flex Pipe). You can also select the mechanical equipment, plumbing equipment, or an existing pipe or fitting to display the connectors. Click on the connector icon to select **Create Pipe**, as shown in Figure 9–8. You can also right-click while hovering over the appropriate connector and select **Draw Pipe**, **Draw Pipe Placeholder**, or **Draw Flex Pipe**.

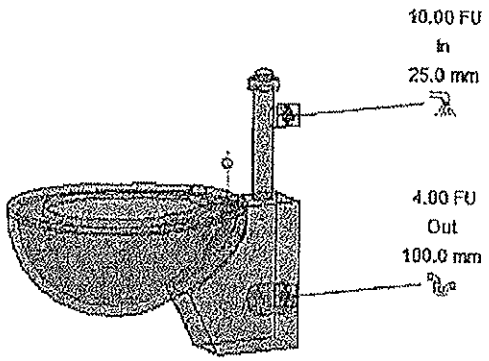

Figure 9–8

3. In the Type Selector, select a pipe type as shown in Figure 9–9.

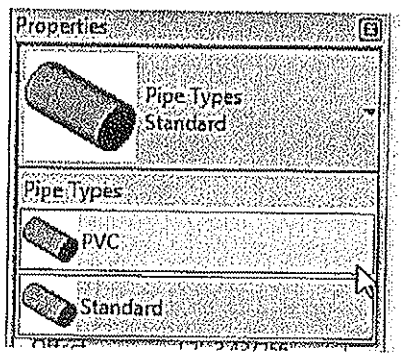

Figure 9–9

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4. In the Options Bar, set the *Diameter* and *Offset*. The default diameter and offset match the parameters of the selected connector if used.
5. In the *Modify | Place (Flex) Pipe (Placeholder)* tab>Sloped Piping panel, set the slope value and direction if needed, as shown in Figure 9–10. (Hydronic piping does not slope very often.)

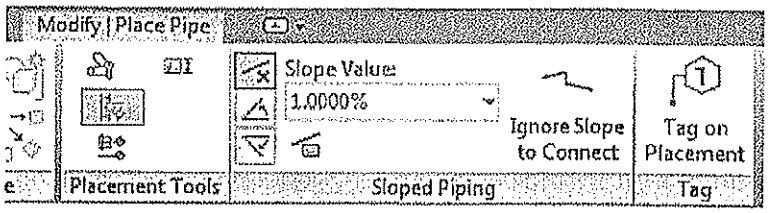

Figure 9–10

6. In the Placement Tools panel, verify that (Automatically Connect) is on.
7. Draw the pipes using temporary dimensions, snaps, and alignments to locate each point along the path as shown in Figure 9–11.

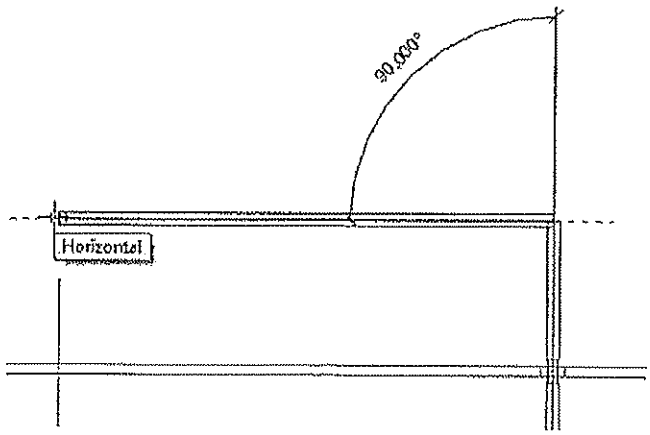

Figure 9–11

- Press <Esc> once to stay in the command but have a new start location. If you select a point along an existing pipe it automatically adds a fitting.

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If you change the size or shape, the appropriate pipe fitting is automatically added

- When you change direction an elbow or tee is added. This is also true if you change the offset of the level as shown in Figure 9–12.

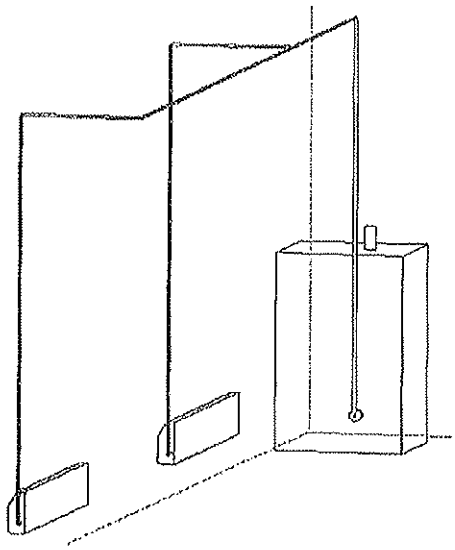

Figure 9–12

Pipe Placement Options

	**Justification Settings**	Opens the Justification Setting dialog box where you can specify the default settings for the *Horizontal Justification, Horizontal Offset,* and *Vertical Justification.*
	**Inherit Elevation**	An on/off toggle. If the tool is toggled on and you start drawing a pipe by snapping to an existing pipe, the new pipe takes on the elevation of the existing pipe regardless of what is specified.
	**Inherit Size**	An on/off toggle. If the tool is toggled on and you start drawing a pipe by snapping to an existing pipe, the new pipe takes on the size of the existing pipe regardless of what is specified.

You can also press the <Spacebar> to inherit the elevation and the size of the pipe you snap to.

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Creating Parallel Pipes

The **Parallel Pipes** tool facilitates the creation of piping runs parallel to an existing run, as shown in Figure 9–13. This saves time because only one run needs to be laid out, and the tool generates the parallel runs for you.

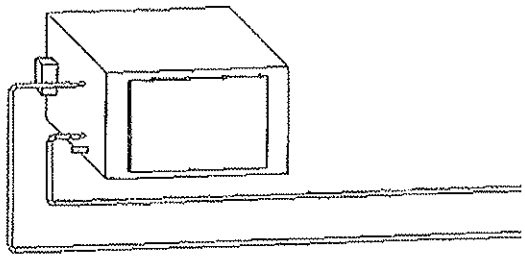

Figure 9–13

- Parallel pipe can be created in plan, section, elevation, and 3D views.

How to: **Create Parallel Pipe Runs**

1. Create the initial single run of pipe as required.
2. In the *Systems* tab>Plumbing & Piping panel, click (Parallel Pipes).
3. In the *Modify | Place Parallel Pipes* tab>Parallel Pipes panel, set the options, as shown in Figure 9–14.

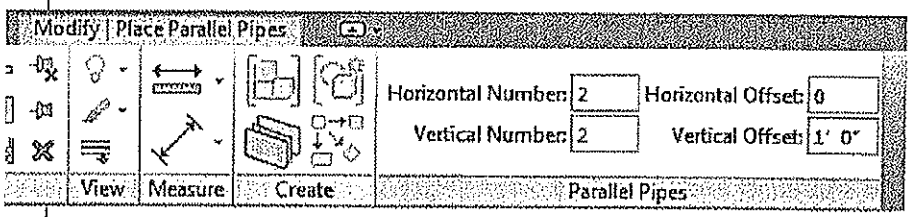

Figure 9–14

4. Hover the cursor over the existing piping, as shown in Figure 9–15, and press <Tab> to select the existing run.

If you do not press <Tab>, parallel pipes are only created for the single piece of existing pipe.

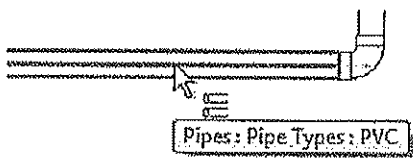

Figure 9–15

5. When the preview displays as required, click to create the parallel runs. The preview varies depending on which side of the existing run you hover the cursor.

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Parallel Pipe Creation Options

Horizontal Number	The total number of parallel pipe runs, in the horizontal direction.
Horizontal Offset	The distance between parallel pipe runs, in the horizontal direction.
Vertical Number	The total number of parallel pipe runs, in the vertical direction.
Vertical Offset	The distance between parallel pipe runs, in the vertical direction.

- In section and elevation views, Horizontal refers to parallel to the view (visually up, down, left, or right from the original conduit). Vertical creates parallel conduit runs perpendicular to the view, in the direction of the user.

Modifying Pipes

Pipes can be modified using a variety of standard modifying tools and specialty tools such as pipe sizings, converting pipe placeholders to pipes, adding insulation, and modifying the justification of pipes.

You can modify pipes using universal methods by making changes in Properties, in the Options Bar, and by using temporary dimensions, controls, and connectors. Modify tools, such as **Move**, **Rotate**, **Trim/Extend**, and **Align** help you place the pipes in the correct locations.

How to:

Convert Pipe Placeholders to Pipes

1. Select the pipe placeholder(s).
2. In the *Modify | Pipe Placeholders* tab>Edit panel, click (Convert Placeholder).
3. The placeholder(s) is changed into the pipe type selected earlier, as shown in Figure 9–16.

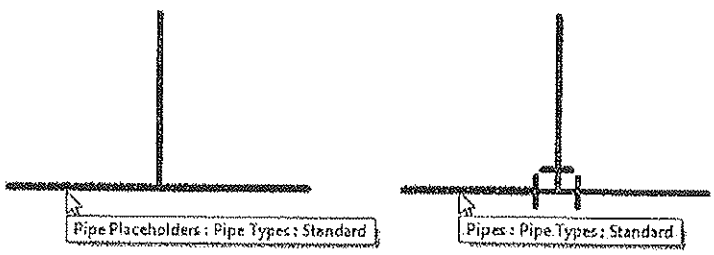

Figure 9–16

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How to:

Change the Type of Pipe Runs

1. Select the pipe run. You can select runs in different systems. Verify that you filter out everything except pipes, pipe fittings, and pipe accessories.
2. In the *Modify | Multi-Select* tab>Edit panel, click (Change Type).
3. In the Type Selector, select a new type of pipe run. This changes the pipe and any related fittings, as shown in Figure 9–17, where the type **Pipe Types: Standard** was changed to the type **Pipe Types: PVC**.



Figure 9–17

How to:

It is sometimes necessary to change the definition of a pipe type after having already created a pipe of that type. This tool enables the user to reapply the type with its new definition to the existing pipe.

Reapply the Type to Pipe Runs

1. Select the pipe run. You can select different runs, but they must be all of the same type of pipe. If you select pipe in different systems, the Autodesk Revit software prompts you to select one system to which to reapply the type. Verify that you filter out everything except pipes, pipe fittings, and pipe accessories.
2. In the *Modify | Multi-Select* tab>Edit panel, click (Reapply Type).

Adding Insulation

When you select pipe runs, you can add insulation by specifying the type and thickness. This information displays as a thin line outside of the pipe, as shown in Figure 9–18.

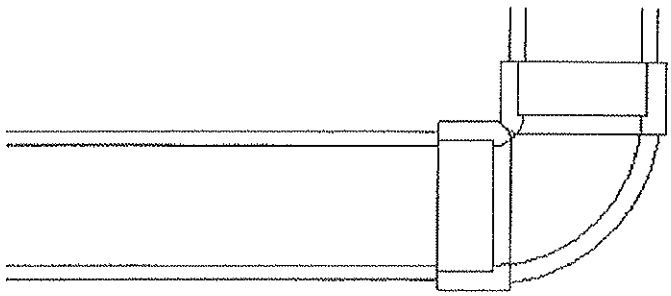

Figure 9–18

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How to:

Add Insulation

1. Select the pipe run that you want to insulate. You can select more than one system. Use (Filter) to select only the pipes and pipe fittings.
2. In the *Modify | Multi-Select* tab>Pipe Insulation panel, click (Add Insulation).
3. In the associated dialog box, select an *Insulation Type* and set the *Thickness*, as shown for Pipe Insulation in Figure 9–19, and click OK.

Sometimes the line thicknesses make it difficult to see some elements such as the insulation or lining. To toggle on or off the lineweight, in the Quick Access Toolbar, click (Thin Lines) or type ***TL****.*

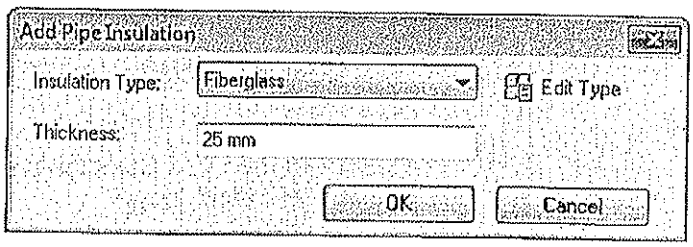

Figure 9–19

- To modify insulation, select the associated piping. In the *Modify | Multi-Select* tab>Pipe Insulation panel, click (Edit Insulation) and change the type in the Type Selector.

- To remove it, click (Remove Insulation).

Modifying the Justification

If a pipe run has different sized pipes, you can modify the justification of those pipes, as shown in Figure 9–20. The process is the same as modifying duct justifications (Refer to HVAC Systems for more information).

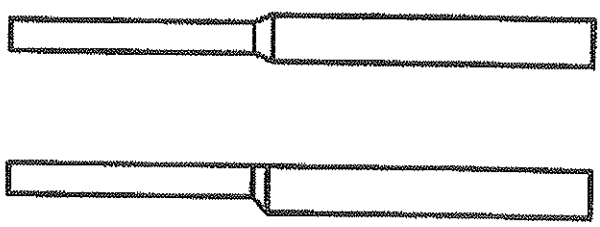

Figure 9–20

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Working with Fittings and Accessories

Many fittings are automatically applied as you create the piping. There are times when you need to add your own or add accessories such as the flow meter, as shown in Figure 9–21.

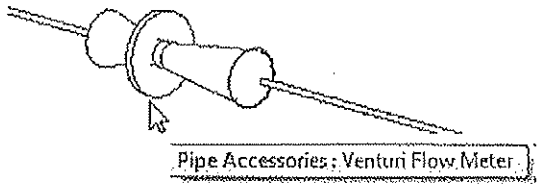

Figure 9–21

How to: **Add Pipe Fittings or Accessories**

1. In the *Systems* tab>Plumbing & Piping panel, click (Pipe Fitting) or (Pipe Accessory).
2. In the Type Selector, select the type of fitting or accessory you want to use.
3. Move your cursor over the appropriate connector in the piping. Only the usable location highlights.
4. Click on the location.

- Additional pipe fittings and pipe accessories can be loaded from the *Pipe* folder of the Imperial Library.

Modifying Pipe Fittings

Pipe Fittings, whether added automatically or manually can be modified using the Type Selector, Properties, the Options Bar, and a variety of connectors and controls. For example, an Elbow can be changed to a Tee by clicking a control as shown in Figure 9–22.

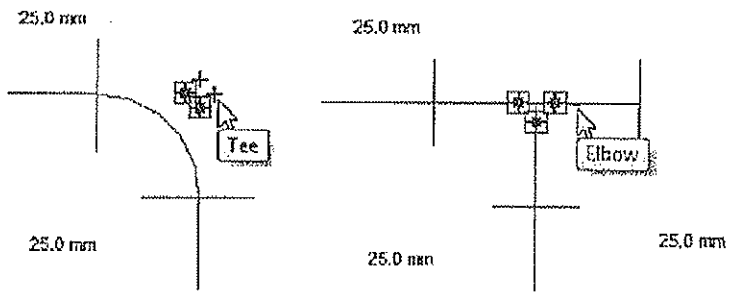

Figure 9–22

- When you trim pipes that intersect, the appropriate fitting is automatically added as part of the **Trim** command.

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9.4 Creating Hydronic Systems

Create systems of hydronic piping and mechanical equipment.

Once you have placed mechanical equipment into the model, you need to create the appropriate supply or return hydronic system, as shown in Figure 9–23, from these elements. Once the elements are part of a system, you can then add the piping to connect them together.

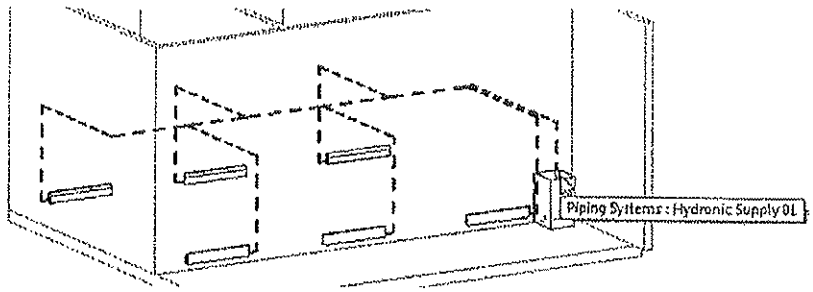

Figure 9–23

- You can add piping before creating hydronic systems, but to use the automatic layout tools you need to have system in place.

How to:

Create Hydronic Systems

1. Select one or more end unit components that are going to make up the system. Do not include the main equipment that is serving these end units.
2. In the *Modify | Mechanical Equipment* tab>Create Systems panel, click (Piping).
3. In the Create Piping System dialog box, the *System type* is preset if you selected a specific connector on the mechanical equipment. Set a *System name*, as shown in Figure 9–24.

*You can also right-click on the pipe connector of the equipment and select **Create Piping System**.*

*You can also right-click on a mechanical equipment connector and select **Create Piping System**.*

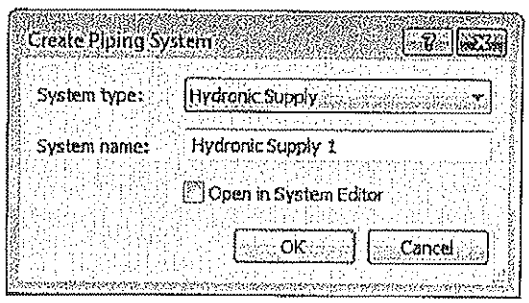

Figure 9–24

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9.5 Automatic Piping Layouts

Use the **Generate Layout** tool to add piping to a piping system.

Once you have created the piping system, you can automatically create the piping layout. These tools create various routes for the piping that you can choose from as shown in Figure 9–29

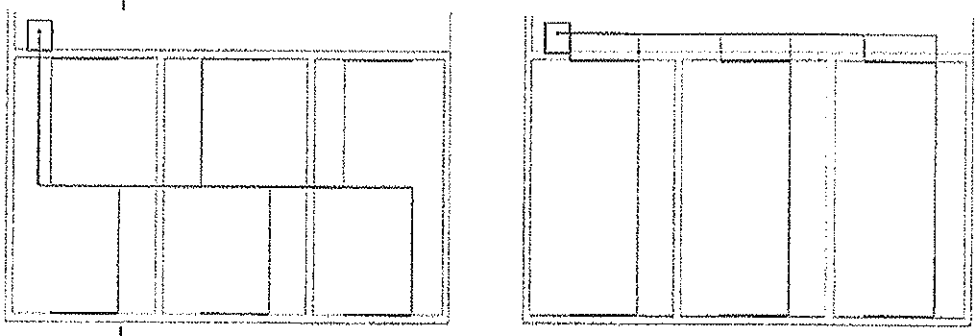

Figure 9–29

If you have just one or two pieces of mechanical equipment that need to be connected to existing piping you can use the **Connect Into** tool. If you have a more complex piping system then use the **Generate Layout** tool.

How to: **Connect to existing Hydronic System**

1. Select the equipment that needs to be connected to existing pipes.
2. In the *Modify | Mechanical Equipment* tab>Layout panel, click (Connect Into).
3. In the Select Connector dialog box, select the type as shown in Figure 9–30. Click OK.

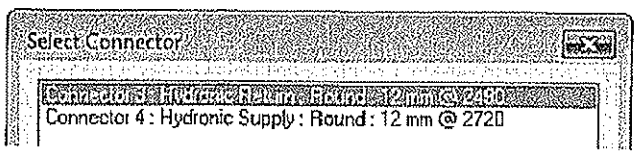

Figure 9–30

4. Select the pipe to connect into.

- This process automatically connects any equipment to a system

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How to:

You can view the solutions in the plan or a 3D view.

Generate an automatic piping layout

1. Hover over the hydronic supply or hydronic return outlet in the mechanical equipment and press <Tab> until you see the outline of the system. Click to select the system as shown in Figure 9–31.

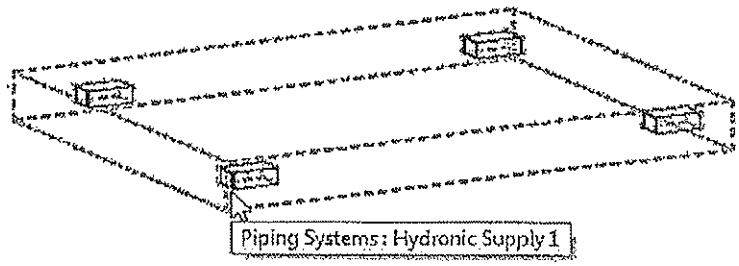

Figure 9–31

2. In the *Piping Systems* tab>Layout panel, click (Generate Layout).
3. If you are working with a partial system and need to specify a connection point, in the *Generate Layout* tab>Modify Layout panel, click (Place Base) and place the base in the project. The **Modify Base** command is activated. Set the *Offset* and *Shape*. Also set the *Diameter* of the connection.

   When you are finished, click (Solutions) to return to the layout tool.
4. In the Options Bar, select a *Solution Type,* as shown in Figure 9–32, and click (Next Solution) or (Previous Solution) to cycle through the possible options.

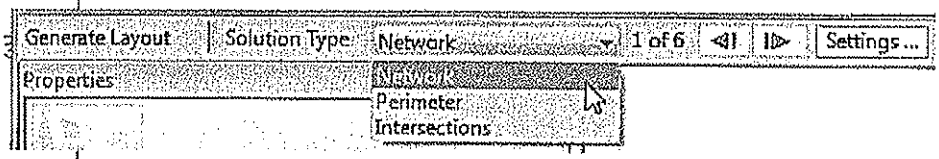

Figure 9–32

Network	Up to six potential solutions, creates a bounding box around entire system, with the main segment through the center of this bounding box, and the branches at 90 degrees off the main branch.
Perimeter	Up to five potential solutions, creates a bounding box around entire system, with segments being placed on three of the four sides, and one with segments being placed on all four sides. (The Inset value determines the offset distance between the bounding box and the components.)

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Intersections	Up to eight potential solutions, segments extend from each connector of the components, and where they intersect perpendicularly, proposed intersection junctions are created.

- The blue lines identify the main piping system and green lines identify branch systems.
- Gold lines display a potential open connection that could cause problems when the piping is added.

5. In the *Generate Layout* tab>Generate Layout panel, click (Finish Layout) when you have found the solution that looks best.

- Settings... in the Options Bar opens the Pipe Conversion Settings dialog box, as shown in Figure 9–33. You can modify this while selecting solutions to provide the best options.

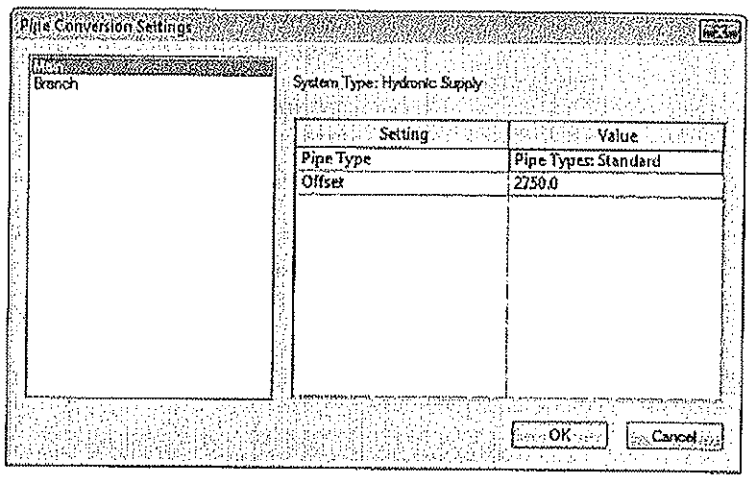

Figure 9–33

How to: Customize the Layout

1. Click (Solutions) and select a layout design similar to what you want to use.
2. In the *Generate Layout* tab>Modify Layout panel, click (Edit Layout).

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3. Select one of the layout lines. You can use the move control to change the location of the line as shown in Figure 9–34. You can also change the height of the offset by clicking on the number control.

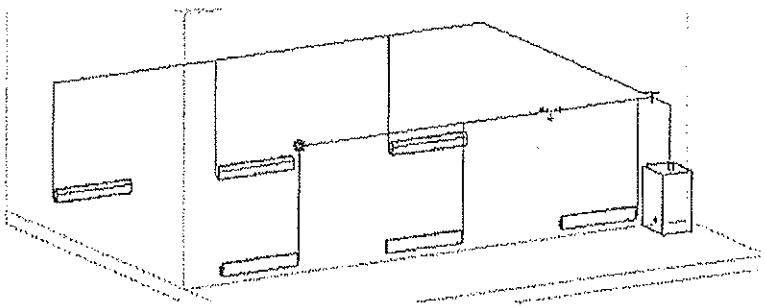

Figure 9–34

Revit only permits one custom option at a time.

4. Click (Solutions) to finish customizing the layout. The Solution Type list now has **Custom** as an additional option to the standard three solution types.
5. Click (Finish Layout).

Adding a Base to a Layout

This tool is not available for systems in which the source equipment is already specified.

While working in the **Generate Layouts** tool you can add a **Base** (a point of connection to the main system), in cases where the source equipment has not yet been placed or where it is located on a different level of the building. The base can be either rectangular or circular as shown in Figure 9–35. The elevation of the base is set in the Options Bar.

*Add the base before you cycle through the Solution Types when using the **Layout** tool, as it changes the options.*

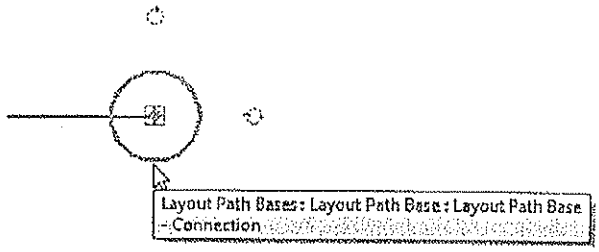

Figure 9–35

- Once the automatic/custom layout is completed, check through the entire system to verify. Make sure you include checking slopes if they are used.

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- To test the continuity of the system, hover the cursor over one of the pipes and press <Tab> until the whole system highlights. One of the pipes is not attached to the fitting and therefore is not highlighted, as shown in Figure 9–36.

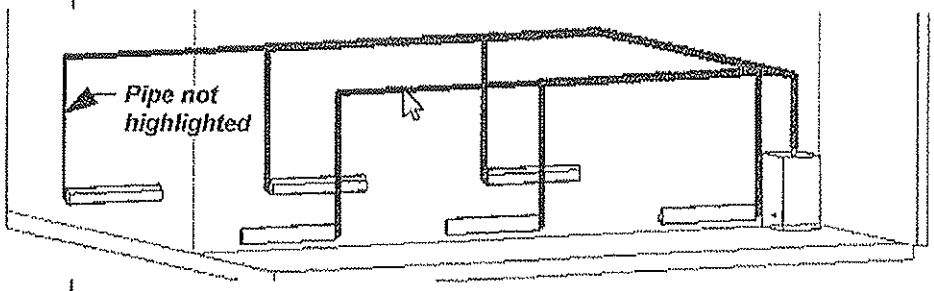

Figure 9–36

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Practice 9a

Working with Hydronic Systems

- Create Hydronic systems.
- Add pipes, connecting air handling units in the systems and use the **Parallel Pipes** tool to create a set of pipes on the existing pipes.
- Clean up connections between the air handling units and the new pipes and at intersections between pipes.

Estimated time for completion: 25 minutes

In this practice you will create Hydronic Supply and Return Systems and then add pipes to connect the Air Handling Units in each system. You will use the **Parallel Pipes** tool to create a set of pipes on top of existing pipes. Finally, you will verify all of the connections and system types for the piping. One of the AHU with piping is shown in Figure 9–37.

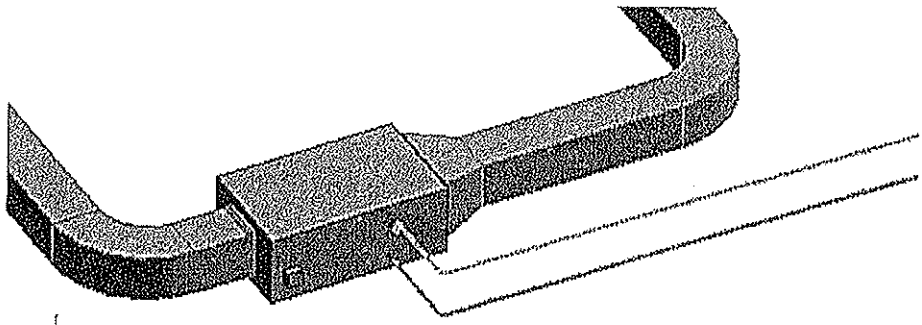

Figure 9–37

Task 1 - Create Hydronic Systems.

1. Open the project file **MEP-Elementary-School-Piping-M.rvt** found in the *Chapter 9* folder of your class folder.
2. In the **01 MECHANICAL PLAN** floor plan view, zoom into the north wing.
3. Select all of the Air Handling Units (AHU) in this wing.
4. In the *Modify | Mechanical Equipment* tab>Create Systems panel, click (Piping).
5. In the Create Piping System dialog box, set the *System type* as **Hydronic Return** and *System name* as **01 - HWR1**. Click OK.

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6. Click anywhere in empty space to clear the selection.
7. Repeat the process and create a Hydronic Supply System using the same Air Handling Units. Name this system **01 - HWS1**.
8. If you have time create a Hydronic Return System and a Hydronic Supply System for the Air Handling Units in the south wing. Name the systems **01 - HWR2** and **01 - HWS2**.
9. Save the project.

Task 2 - Draw Hydronic Return Pipes.

1. In the north wing, zoom in on the far left AHU and select it. Click on the Hydronic Return control that displays **Create Pipe**, as shown in Figure 9–38.

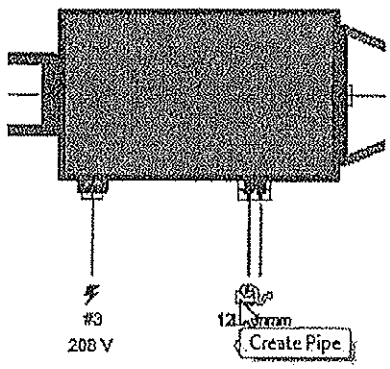

Figure 9–38

2. In the Select Connector dialog box, select **Connector 3: Hydronic Return** and click OK.
3. In the Type Selector, select **Pipe Types: Copper**.
   - The software might prompt you to reselect the connector after changing the Pipe Type.
4. Toggle (Tag on Placement) off, because the tags obscure the smaller pipe segments.
5. Draw the first pipe segment **600mm** into the hall. Then draw the next pipe segment all the way down the hall until it reaches into the main hall, zooming out as required.
6. Press <Esc> twice to finish the command.

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7. Zoom back into the second AHU. Start a pipe from the Hydronic Return control on the back of the AHU. Before drawing the pipe in the Options Bar, change the *Offset* to **2850mm.** This is needed for the pipe go below the return duct. Draw the pipe as shown in Figure 9–39. When you select the intersection of the main horizontal pipe, the program automatically creates the fittings needed to return the pipe to the correct height.

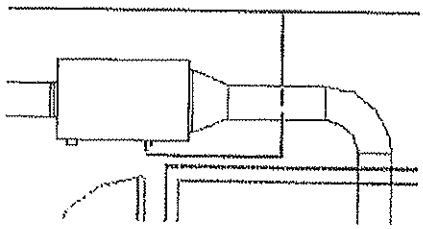

Figure 9–39

8. Repeat the process from each AHU in the wing. You can use (Connect Into) for any of the pipes that come directly off the unit to the main pipe. You need to draw the pipes for the ones that come off the back of the AHU.
9. Save the project.

Task 3 - Draw Hydronic Supply Pipes using the Parallel Pipes tool.

1. Open the Mechanical>3D Views>**AREA A 3D** view. In this view you can see the duct systems and the Hydronic Return System you created earlier.
2. Select the linked project and temporarily hide it. This makes it easier to select the piping and AHU equipment.
3. In the *Systems* tab>Plumbing & Piping panel, click (Parallel Pipes.

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4. In the *Modify | Place Parallel Pipes* tab> Parallel Pipes panel, set the *Horizontal Number* to **1**, the *Vertical Number* to **2**, the *Horizontal Offset* and *Vertical Offset* to **300mm**, as shown in Figure 9–40.

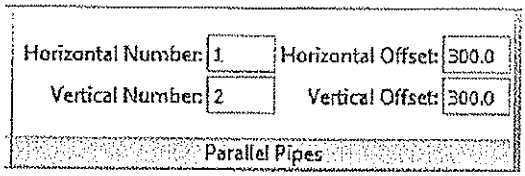

Figure 9–40

5. Hover over a pipe and press <Tab> to see if you can select pipe runs (not all of them work). Click on each of the existing pipes or pipe runs. Concentrate first on the north side of the hallway as there are additional issues with connecting the pipes on the south side because of the ductwork.

6. Click (Modify) to finish the command.

Task 4 - Clean up connections.

1. Zoom in on the AHU at the upper left of the hall. The piping is not attached as shown in Figure 9–41.

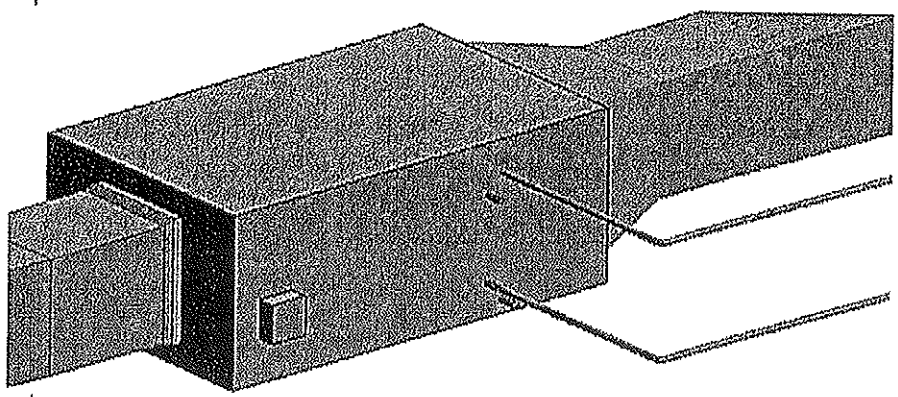

Figure 9–41

2. Select the pipe and use the connector on the end closest to the AHU, to drag the end of the pipe to the snap point of the connector on the AHU, as shown in Figure 9–42.

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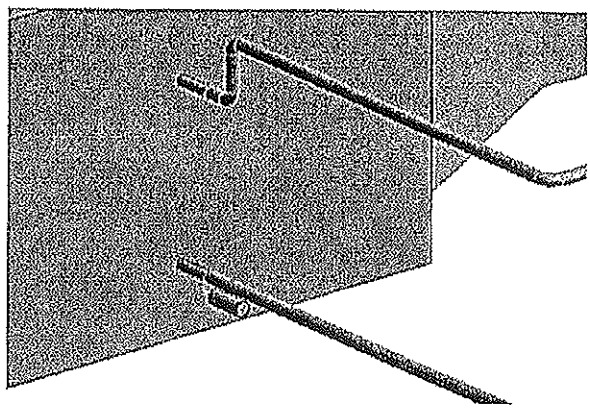

Figure 9–42

3. Another issue that you can see is the color of the pipes. They match the existing pipe system type.
4. Select one of the new pipes connected to the supply system.
5. In Properties, in the *Mechanical Section*, change the *System Type* to **Hydronic Supply**.
6. Click out in space and note that the pipes connected to the supply system have now updated.
7. Pan down to the next AHU on the north side of the hallway.
8. Repeat the process of dragging the connector on the pipe to the connector on the AHU and changing the System Type. This time the pipes connected beyond this point do not change.
9. Zoom in on the T intersection as shown in Figure 9–43. Fittings are missing at this point because you could not select a pipe run but only a pipe.

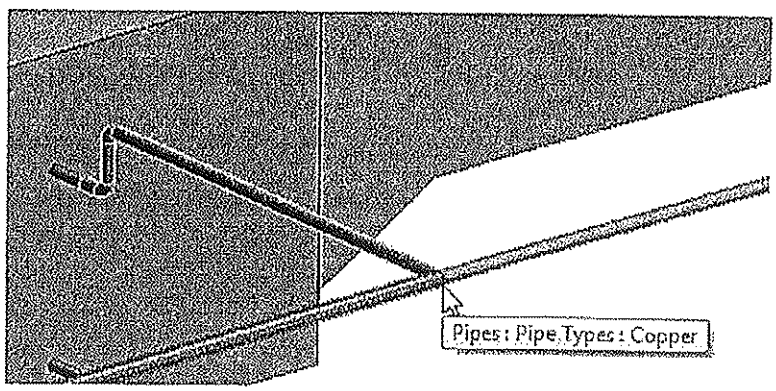

Figure 9–43

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10. Using the connectors, drag the three pipes away from each other, as shown on the left in Figure 9–44. Then drag the two pipes together to touch at connectors. It joins the two pipes together, as shown on the right in Figure 9–44.

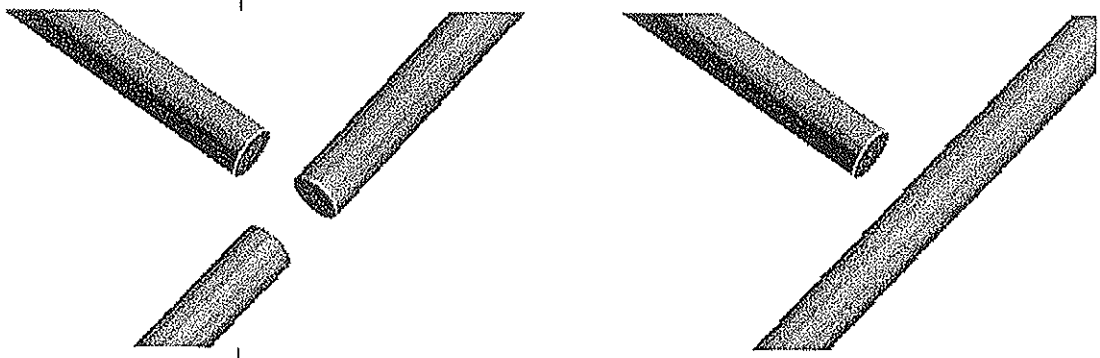

Figure 9–44

11. Finally, drag the vertical pipe to where it intersects with the horizontal pipe. The Tee fitting is automatically applied as shown in Figure 9–45.

Alternately, use *(Trim/Extend to Corner) and select the two colinear pipes to join them into one. Then use* *(Trim/Extend Single Element) to force the software to add a Tee fitting where the vertical pipe meets the main run.*

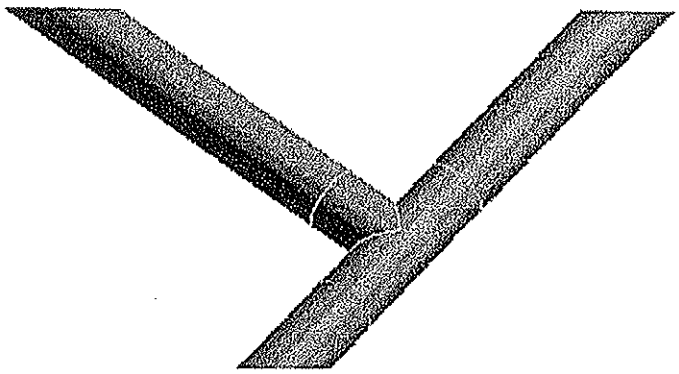

Figure 9–45

12. Continue working down the hall attaching the supply piping correctly to the AHU units. Modify any connections and System Types as needed.

13. If you have time, work on the piping from the AHU units on the south side of the hallway. You need to make adjustments so the pipes do not go through the ductwork.

14. Save the project.

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9.6 Fire Protection Systems

Add systems, sprinklers, and piping for fire protection systems.

Fire Protection Systems work in much the same way as Hydronic Piping Systems. You place sprinkler heads where they are needed, create a system, and add piping through manual or automatic layout tools as shown in Figure 9–46. Schedules of Fire Protection Systems can be created in a company template. This automatically compiles the total number of sprinkler heads in a project.

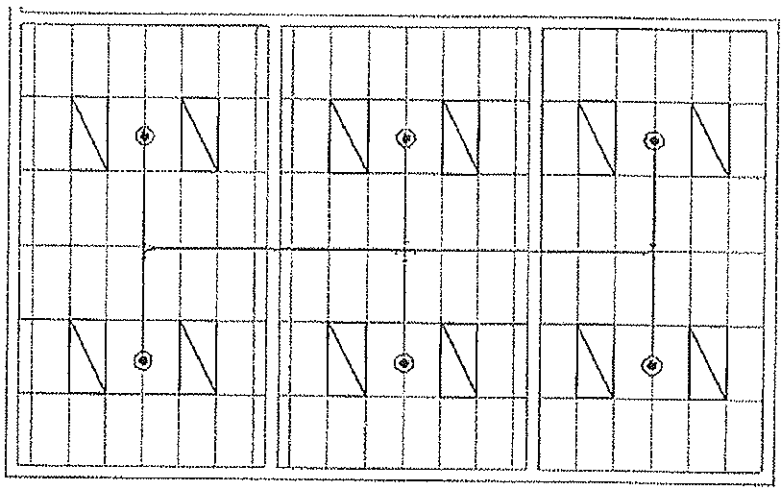

Figure 9–46

- Sprinkler types include wet and dry. All sprinklers in a system must be of the same type.
- To insert sprinklers, in the *Systems* tab>Plumbing & Piping panel, click (Sprinkler) or type SK.
- You can load sprinklers from the *Fire Protection/Sprinklers* folder of the Library.
- Hosted sprinklers need to be placed on ceilings. Therefore, it is best to use a reflected ceiling plan when adding them.

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Practice 9b

Working with Fire Protection Systems

- Create a Ceiling Plan view.
- Add two different types of sprinklers and create fire protection systems using the sprinkler types.
- Add piping to the systems using the Layout tools.

Estimated time for completion: 20 minutes

In this practice you will create a fire protection ceiling plan view, add both wet and dry sprinklers, as shown in Figure 9–47. You will also create fire protection systems and add piping.

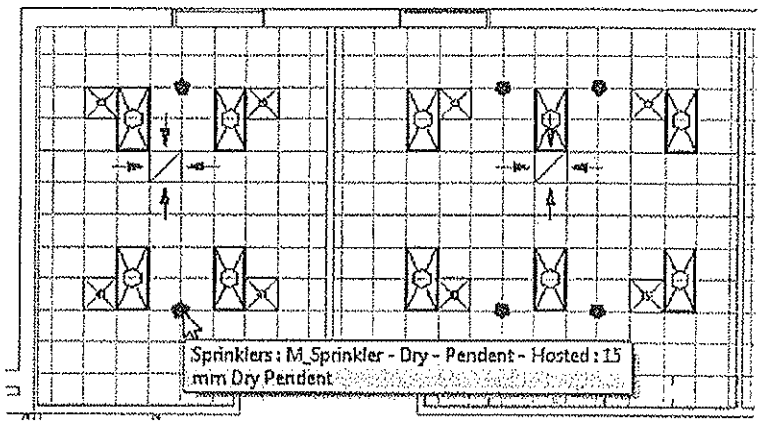

Figure 9–47

Task 1 - Prepare a Fire Protection Ceiling Plan View.

1. Open the project file **MEP-Elementary-School-Fire-M.rvt** found in the *Chapter 9* folder of your class folder.
2. Open the view Coordination>MEP>Ceiling Plans>**01 ELECTRICAL RCP**.
3. In the Project Browser, right-click on the same view and select **Duplicate View>Duplicate**.
4. Rename the new view as **01 FIRE PROTECTION**.

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5. This view displays the light fixtures but you also need to know the location of air terminals so that you can place the sprinklers appropriately. You also need to have the piping turned on so that you can add the appropriate piping to the fire protection system.

6. Type **VG** to open the Visibility/Graphic Overrides dialog box. In the *Model Categories* tab turn on **Air Terminals**, **Pipe Fittings**, and **Pipes**.

7. In the *Filters* tab, clear **Hydronic Supply** and **Hydronic Return** as shown in Figure 9–48, and click OK. The pipes in these systems would display if you do not turn them off by the filters.

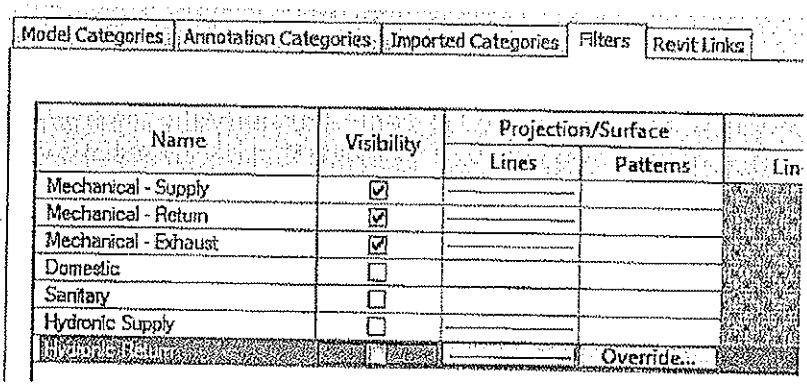

Figure 9–48

8. Save the project.

Task 2 - Add Sprinklers.

1. Zoom in on a few of the classrooms in the north wing.

2. In the *Systems* tab>Plumbing & Piping panel, click (Sprinkler) or type **SK**.

3. An alert box displays with a message that no sprinkler families are loaded. Click Yes to load the sprinklers from the Library.

4. In the Load Family dialog box, open the *Fire Protection>Sprinklers* folder and select **Sprinkler - Dry - Pendent - Hosted.rfa** and **Sprinkler - Pendent.rfa**. Click Open to load them.

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5. In the *Modify | Place Sprinkler* tab>Placement panel, click (Place on Face).
6. In the Type Selector, select **Sprinkler - Dry - Pendent - Hosted: 15mm Dry Pendent.**
7. Move the cursor over the hallway. A ⊘ symbol displays because there is no ceiling in this area.
8. Move the cursor into one of the classrooms where there is a ceiling. Note that you can now place the hosted sprinkler type in the ceiling.

Hint: Placing a sprinkler at the center

To place a sprinkler at the center of a ceiling tile, you can draw a Detail Line from corner to corner as shown in Figure 9–49. In the *Annotate* tab>Detail panel, click (Detail Line). Draw the line and place the sprinkler at the **midpoint snap** of that line. Erase the detail line when you are finished. Once one sprinkler is centered, use the **Copy** command to position other sprinklers in the project.

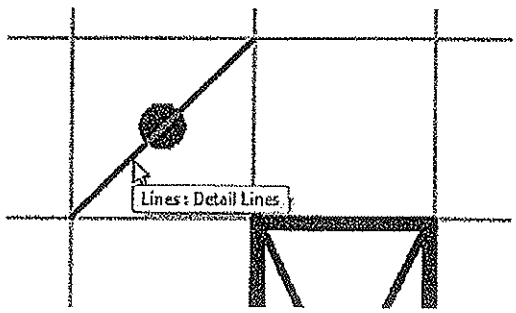

Figure 9–49

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9. Add sprinklers in two classrooms similar to that shown in Figure 9–50.

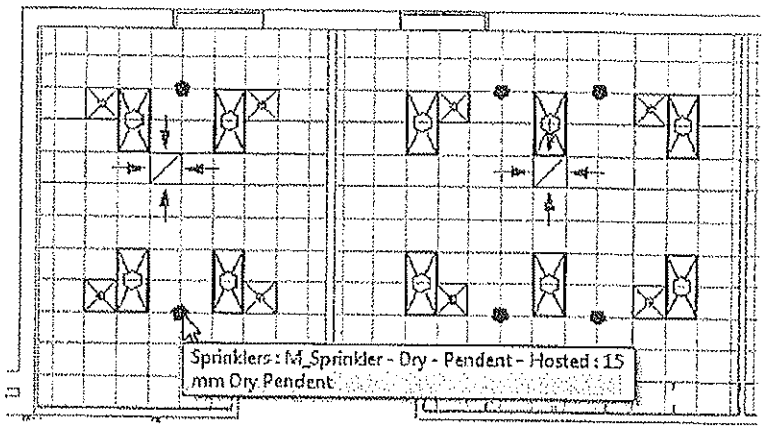

Figure 9–50

10. In the Type Selector, select **Sprinkler - Pendent: 15mm Pendent**. This is a non-hosted sprinkler so you can place it in the hall where there is no ceiling.

11. In Properties, set the *Offset* to **2750mm**.

12. Place sprinklers down the hall at a spacing of **1825mm** off the vestibule door and then **4270mm** on center, as shown in Figure 9–51. You can place the first one and then array the rest or use temporary dimensions to place them.

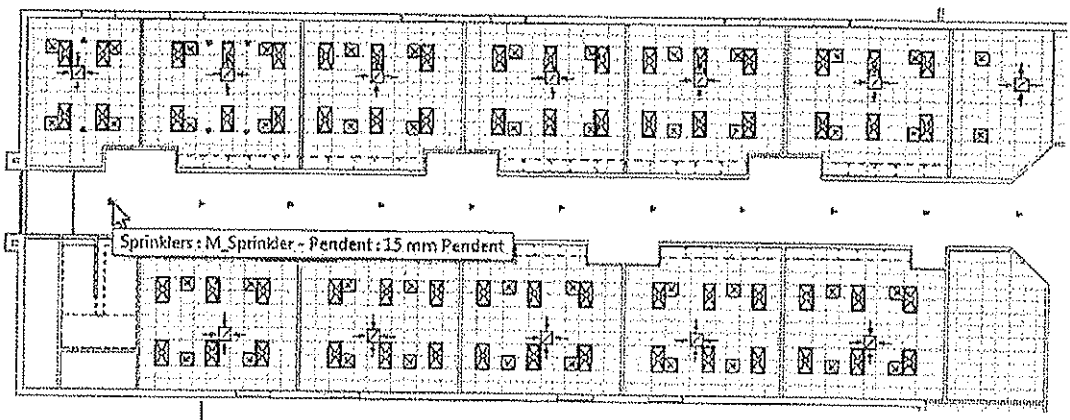

Figure 9–51

13. Save the project.

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Task 3 - Creating Fire Protection Systems.

1. If you created an array of sprinklers down the hall you need to ungroup them before being able to use the individual controls. Select one of the array group and, in the *Modify | Model Groups* tab>Group panel, click (Ungroup). The sprinklers are now independent of each other.
2. Select one of the sprinklers in the hall.
3. In the *Modify | Sprinklers* tab>Create Systems panel, click (Piping).
4. In Properties, set the *System Name* to **01 - FPW1.**
5. In the *Piping Systems* tab>System Tools panel, click (Edit System).
6. Verify that (Add to System) is selected and select the rest of the hall sprinklers. You can select them by drawing a window around them.
7. Click on one of the classroom sprinklers. A warning displays as shown in Figure 9-52. You cannot add this sprinkler to the Wet System because it belongs in a Dry System.

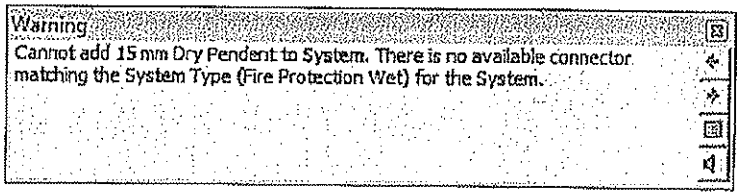

Figure 9-52

8. Click (Finish Editing System).
9. Select one of the classroom sprinklers again.
10. In the *Modify | Sprinklers* tab>Create Systems panel, click (Piping). The Autodesk Revit MEP software knows that this sprinkler needs to be part of a dry system.
11. Add the dry type sprinklers together in a system.
12. Save the project.

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Task 4 - Add Piping for Fire Protection Systems.

1. Hover the cursor over one of the sprinklers in the hall and press <Tab> until the sprinkler system is selected.
2. In the *Modify | Piping* tab>Layout panel, click (Generate Layout).
3. In the Options Bar, click Settings....
4. In the Pipe Conversion Settings dialog box, set the *Offset* for both Main and Branch to **3000mm** as shown in Figure 9–53. Verify that the *Pipe Type* is set to **Copper** and click OK.

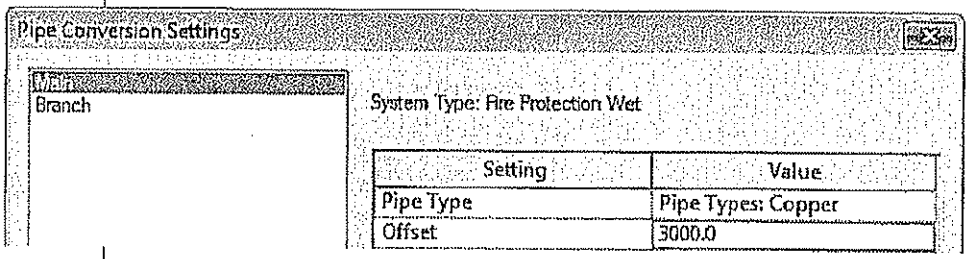

Figure 9–53

5. In the Options Bar view the solutions available in the Network type. There are only two.
6. In the *Generate Layout* tab>Modify Layout panel, click (Place Base).
7. Put the base at the right end of the string of sprinklers in the hall.
8. In the Options Bar, set the *Offset* to **3000mm**.
9. Click (Solutions) to return to the automatic layout tool.
10. Review the Solution Types for the Network, more options are now available.

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11. Select the *Solution Type* **Network 5 of 5.** The pipe runs down the length of the hall directly on top of the sprinklers with the main branch ending at the base, as shown in Figure 9–54.

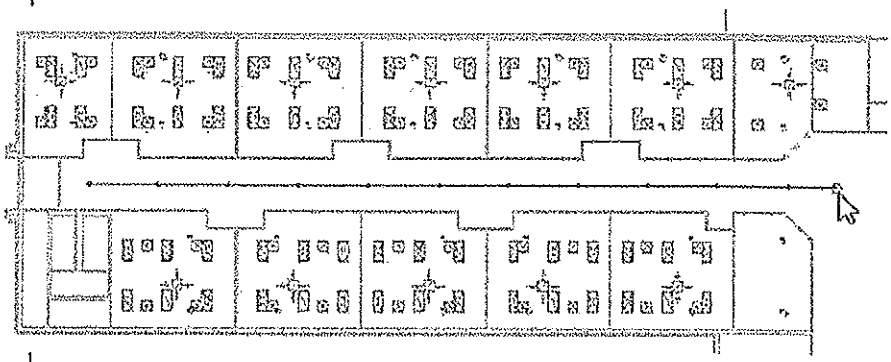

Figure 9–54

12. Click (Finish Layout).
13. Cancel the alert box. The open connection is at the base.
14. If you have time, add piping to the classroom sprinklers. You can draw them using connectors, the **Pipe** command, or with an automatic or custom layout.
15. Save the project.

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Chapter Review Questions

1. Some equipment used with ductwork is also designed to have hydronic piping systems connected to it.
   a. True
   b. False
2. How do you change an elbow fitting into a tee fitting?
   a. Delete the elbow fitting and place a tee fitting.
   b. Select the elbow fitting and click + (Plus).
   c. Draw a new pipe in the elbow and it automatically becomes a tee fitting.
   d. Select the elbow fitting and click the **Fitting Conversion** button in the Ribbon.
3. What is needed before you can create an automatic piping layout?
   a. A piping system.
   b. The piping layout plugin.
   c. All sprinklers laid out throughout the building.
   d. Nothing. The Autodesk Revit software automatically starts laying out pipe as soon as you add mechanical components that have piping.
4. Which of the following can you do when modifying pipe? Select all that apply.
   a. Change Type
   b. Reapply Type
   c. Add Insulation
   d. Edit Lining
   e. Modify Justification
   f. Modify Material
   g. Change Offset
5. What are the two types of fire protection systems that can be created and how are they distinguished?
   a. Wet and Dry
   b. Upright and Pendant
   c. Hosted and Unhosted

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Command Summary

Button	Command	Location
	**Add Insulation**	▪ **Ribbon:** (*with one or more Pipes selected*) *Modify* | *Pipe* tab>Edit panel or (*with Pipes and Pipe Fittings selected*) *Modify* | *Multi-Select* tab> Edit panel
	**Add to System**	▪ **Ribbon:** *Edit Piping System* tab>Edit Piping System panel
	**Change Type**	▪ **Ribbon:** (*with one or more Pipes selected*) *Modify* | *Pipe* tab>Edit panel or (*with Pipes and Pipe Fittings selected*) *Modify* | *Multi-Select* tab> Edit panel
	**Convert Placeholder**	▪ **Ribbon:** *Modify* | *Pipe Placeholders* tab>Edit panel
	**Disconnect Equipment**	▪ **Ribbon:** *Edit Piping System* tab>Edit Piping System panel
	**Edit Insulation**	▪ **Ribbon:** (*with one or more Pipes selected*) *Modify* | *Pipe* tab>Edit panel or (*with Pipes and Pipe Fittings selected*) *Modify* | *Multi-Select* tab> Edit panel
	**Edit Layout**	▪ **Ribbon:** *Generate Layout* tab>Modify Layout panel
	**Edit System (Piping)**	▪ **Ribbon:** *Piping Systems* tab>System Tools panel
	**Flex Pipe**	▪ **Ribbon:** *Systems* tab>Plumbing & Piping panel ▪ **Shortcut:** FP
	**Generate Layout**	▪ **Ribbon:** *Piping Systems* tab>Layout panel
	**Inherit Elevation**	▪ **Ribbon:** *Modify* | *Place Pipe* tab> Placement Tools panel
	**Inherit Size**	▪ **Ribbon:** *Modify* | *Place Pipe* tab> Placement Tools panel

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	**Justification (Settings)**	▪ **Ribbon:** *Modify* | *Place Pipe* tab> Placement Tools panel
	**Justify**	▪ **Ribbon:** (*with one or more Pipes selected*) *Modify* | *Pipe* tab>Edit panel or (*with Pipes and Pipe Fittings selected*) *Modify* | *Multi-Select* tab> Edit panel
	**Mechanical Equipment**	▪ **Ribbon:** *Systems* tab>Mechanical panel ▪ **Shortcut:** ME
	Mechanical Settings	▪ **Ribbon:** *Systems* tab>Plumbing & Piping panel or Mechanical panel title ▪ **Shortcut:** MS
	**Pipe**	▪ **Ribbon:** *Systems* tab>Plumbing & Piping panel ▪ **Shortcut:** PI
	**Pipe Accessory**	▪ **Ribbon:** *Systems* tab>Plumbing & Piping panel ▪ **Shortcut:** PA
	**Pipe Fitting**	▪ **Ribbon:** *Systems* tab>Plumbing & Piping panel ▪ **Shortcut:** PF
	**Pipe Placeholder**	▪ **Ribbon:** *Systems* tab>Plumbing & Piping panel
	**Piping (System)**	▪ **Ribbon:** (*with appropriate mechanical equipment selected*) *Modify* | *Mechanical Equipment* tab>Create Systems panel ▪ **Right-click:** Create Piping System
	**Place Base**	▪ **Ribbon:** *Generate Layout* tab>Modify Layout panel
	**Remove Insulation**	▪ **Ribbon:** (*with one or more Pipes selected*) *Modify* | *Pipe* tab>Edit panel or (*with Pipes and Pipe Fittings selected*) *Modify* | *Multi-Select* tab> Edit panel
	**Remove Base**	▪ **Ribbon:** *Generate Layout* tab>Modify Layout panel
	**Remove from System**	▪ **Ribbon:** *Edit Piping System* tab>Edit Pipe System panel ▪ **Ribbon:** *Generate Layout* tab>Modify Layout panel

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	**Select Equipment**	▪ **Ribbon:** *Piping Systems* tab>System Tools panel ▪ **Ribbon:** *Edit Piping System* tab>Edit Piping System panel
	**Solutions**	▪ **Ribbon:** *Generate Layout* tab>Modify Layout panel
	**Sprinkler**	▪ **Ribbon:** *Systems* tab>Plumbing & Piping panel ▪ **Shortcut:** SK

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Chapter 10

Plumbing Systems

In this chapter you learn about plumbing systems, how to add plumbing fixtures, and draw piping for the fixtures. You learn to create sanitary, domestic hot water and domestic cold water systems. You also review how to use the **Layout** tool with plumbing systems and analyze the systems.

This chapter contains the following topics:

- ✓**About Plumbing Systems**
- ✓**Adding Plumbing Fixtures**
- ✓**Drawing Piping for Plumbing Systems**
- ✓**Working with Plumbing Systems**

Learning Objectives

This chapter provides instruction to enable you to do the following:

10.1 About Plumbing Systems



Set up views to help you create plumbing systems.

10.2 Adding Plumbing Fixtures



Add plumbing fixtures to a project.



Use Named Reference Planes to help you set the right Placement plane for fixtures.

10.3 Drawing Piping for Plumbing Systems



Draw and modify piping between plumbing fixtures.



Add and modify pipe fittings and accessories.

10.4 Working with Plumbing Systems



Create plumbing systems for domestic hot and cold water and sanitary piping.

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10.1 About Plumbing Systems

Set up views to help you create plumbing systems.

Plumbing Systems include sanitary and domestic hot and cold water. The pipes in a system connect plumbing fixtures together and indicate how the system is laid out. You can draw the pipes directly from the connectors in the fixtures and then create the systems or start with a system and use the automatic layout tools. In either case you need to review the system to verify that the fittings match the direction of the slope as shown in Figure 10–1.

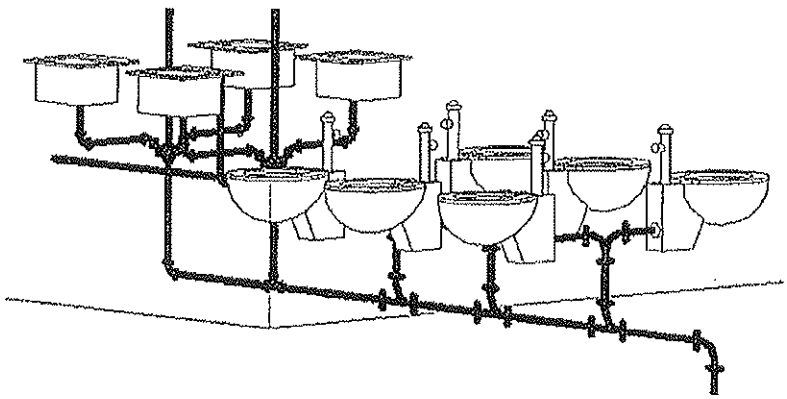

Figure 10–1

There are several steps in creating Plumbing systems:

1. Add plumbing fixtures, such as water closets and lavatories.
2. Create a sanitary or domestic hot or cold water system.
3. Generate piping automatically or add it manually.
4. Check and modify the system.

- The tools to begin creating and placing plumbing fixtures and systems are located in the *Systems* tab>Plumbing & Piping panel, as shown in Figure 10–2.

*You can add **Pipe Placeholders** and **Flex Pipes** using the same methods as placing Pipe.*

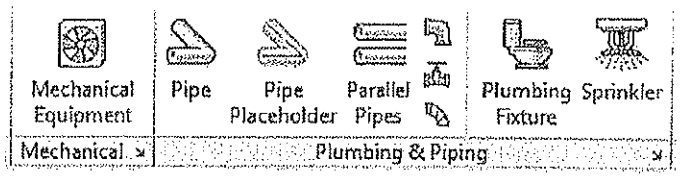

Figure 10–2

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Modifying Views for Plumbing

Several modifications to views can help you as you create the plumbing systems in a project. These include the View Range where you setup a way to see below the floor in a view, setting the Detail Level to see either schematic or full size views of the piping, using Interior Elevations, Sections, and 3D views to help you as you create the systems. You can also use view filters, as shown in Figure 10–3, to see only the types of systems that are needed at the time.

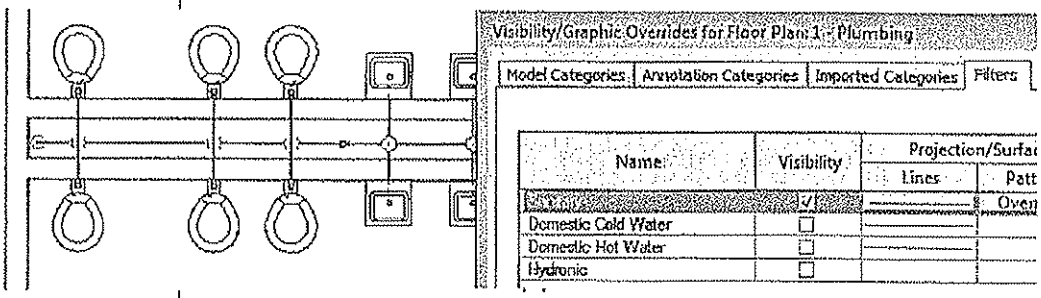

Figure 10–3

Setting View Range

To see plumbing that is below the floor in a plan view you need to modify the View Range. With no elements selected, in Properties, scroll down to *View Range* and click Edit... . In the View Range dialog box, in the *Primary Range* area, change the *Bottom Offset* and in the *View Depth* area, change the *Level Offset* to a depth that displays the plumbing but does not display too much of other elements below, as shown in Figure 10–4.

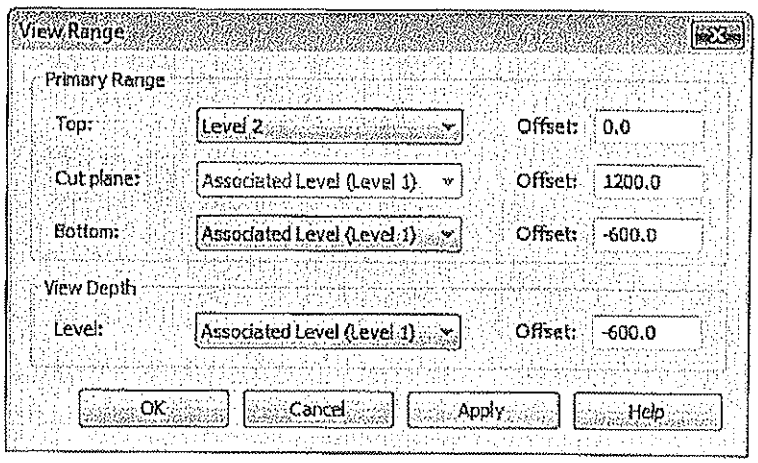

Figure 10–4

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Setting the Detail Level

The Coarse and Medium Detail Levels display plumbing piping in schematic while the Fine Detail Level displays the piping at full scale as shown in Figure 10–5. Set the Detail Level on the View Control Bar.

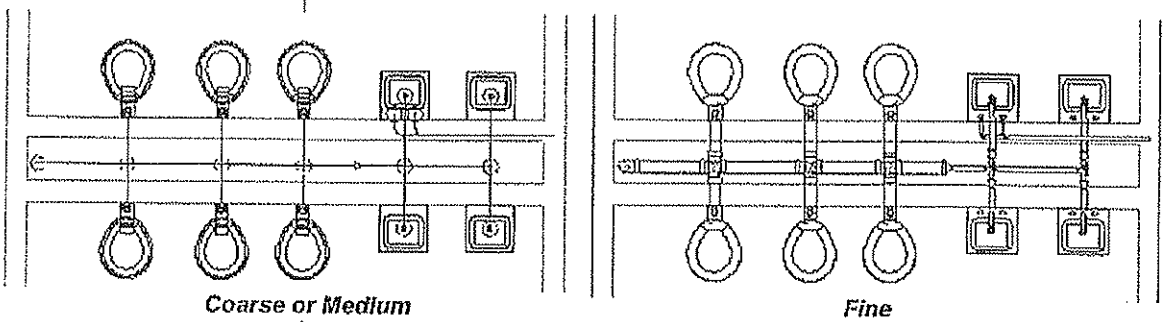

Figure 10–5

Using Interior Elevations, Sections and 3D Views

As you are constructing the plumbing system it is important to work in several views. For example, you might need to create an interior elevation to verify the height of the plumbing fixtures off the floor or a section to make sure that the proper fitting is in place as shown in Figure 10–6.

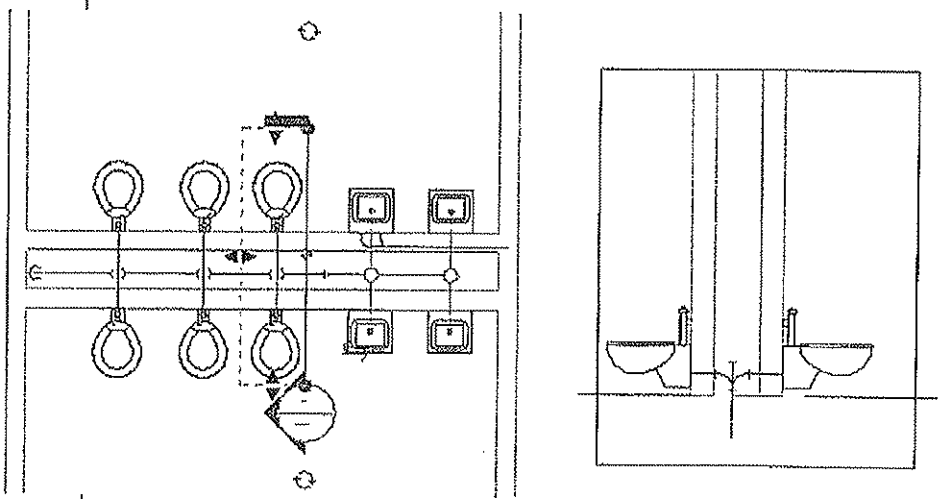

Figure 10–6

- Type **WT** to tile two or more open windows. Before tiling, use (Close Hidden Windows) to close the other views that you do not want tiled.

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View Filters

Using View Filters (type **VG** and select the *Filters* tab), to select the type(s) of systems you want to see in a view, as shown in Figure 10–7.

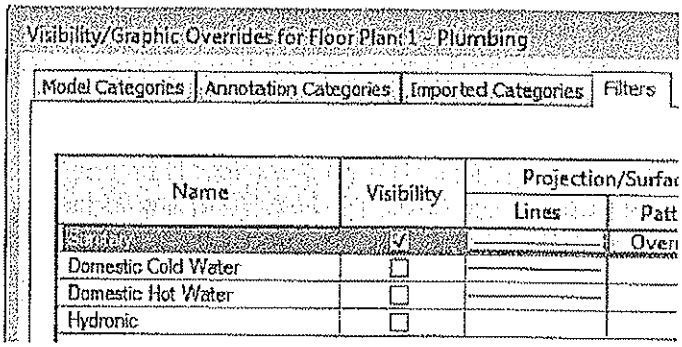

Figure 10–7

- If the view filters you want are not present in a view, click Add and select from the filters listed.
- You can add or change the color for a system in the *Lines* column.
- View Filter colors override the System colors established in the Type Properties of the system. View Filter settings and colors are view specific.

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10.2 Adding Plumbing Fixtures

- Add plumbing fixtures to a project.
- Use Named Reference Planes to help you set the right Placement plane for fixtures.

Plumbing fixtures include water closets, sinks, and lavatories as shown in Figure 10–8. They also include bathtubs, drains, drinking fountains and many more. Depending on the type of fixture, there are connectors for sanitary and domestic hot and cold water pipes.

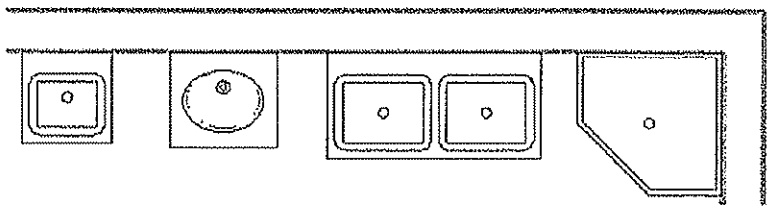

Figure 10–8

How to: **Place Plumbing Fixtures**

1. Open the view where you want to place the fixtures.
2. In the *Systems* tab>Plumbing & Piping panel, click (Plumbing Fixture) or type **PX**.
3. In the Type Selector, select a Plumbing Fixture type. In Properties, set any other values such as the *Level* if it is not hosted.
4. In the *Modify | Place Plumbing Fixture* tab>Placement panel select the type of placement for the specific fixture. The default is (Place on Vertical Face), as shown in Figure 10–9. This works for wall hosted fixtures but you need to use other options for floor or non-hosted fixtures.

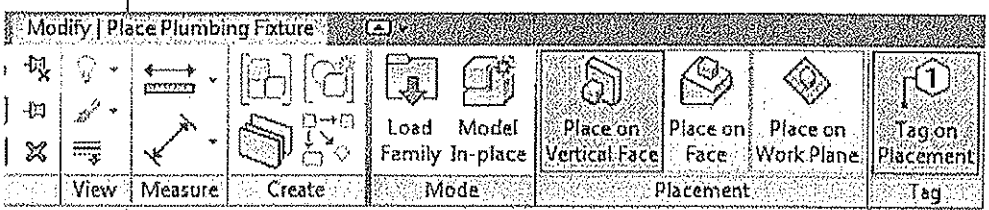

Figure 10–9

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5. Place the fixture in the model by clicking at the required location in the model view. Many fixtures are wall based so you need to select a wall to place them. Press <Spacebar> to rotate the fixture before placing it.
6. Continue to place additional fixtures, or click (Modify) to exit the command.

- Additional plumbing fixtures can be loaded from the Autodesk® Revit® MEP Library in the *Plumbing>MEP> Fixtures* sub-folders.
- To place plumbing equipment, such as Hot Water Heaters, use (Mechanical Equipment).

Reference Planes

Depending on the type of fixture, you need to place it on a face or a work plane. Faces include walls, ceilings, floors, and counter tops. Use this when you have a face-based component. But, frequently you place fixtures on a workplane. You can specify the *Placement Plane* as shown in Figure 10–10. This can include named reference planes.

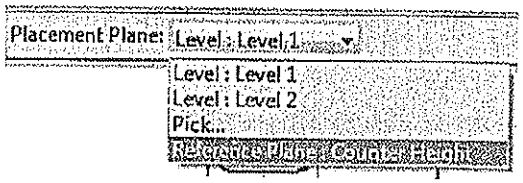

Figure 10–10

How to:

Create a Named Reference Plane

1. Open the view where you want to place the reference plane. For example, to specify a counter height reference you need to be in a section or elevation view.
2. In the *Systems* tab>Work Plane panel, click (Ref Plane).
3. In the *Modify | Place Reference Plane* tab>Draw panel, click (Line) or (Pick Lines).
4. Draw the reference plane.
5. Click (Modify) and select the new reference plane.

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6. In Properties, enter a name for ref. The name also displays when the ref plane is selected, as shown in Figure 10–11.

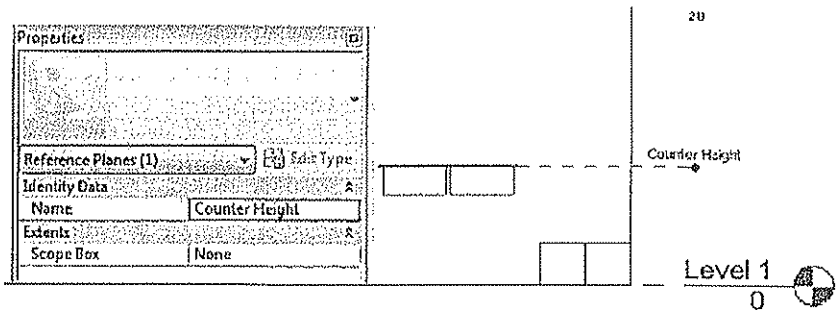

Figure 10–11

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10.3 Drawing Piping for Plumbing Systems

- Draw and modify piping between plumbing fixtures.
- Add and modify pipe fittings and accessories.

Piping for plumbing systems is added in the same manner as all other piping. In this case, you work from the plumbing fixtures, as shown in Figure 10–12, instead of mechanical equipment. It is very important to get the direction of flow and slope correct with sanitary systems. There are also fittings that are not applied automatically that need to be added.

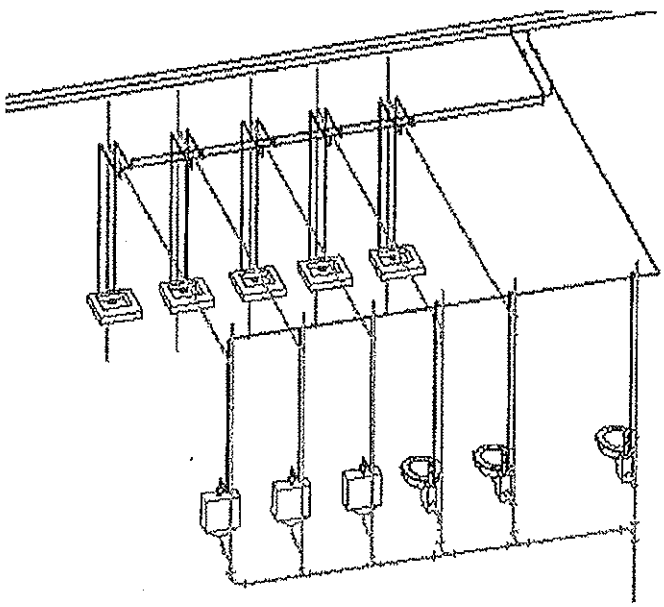

Figure 10–12

How to:

Add Piping for Plumbing

1. There are several ways to start the process of adding piping:
   - In the *Systems* tab>Plumbing & Piping panel, click (Pipe), (Pipe Placeholder), or (Flex Pipe).

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- Select a plumbing fixture, existing pipe or pipe fitting to display the connectors. Click on one of the connector icons as shown in Figure 10–13.

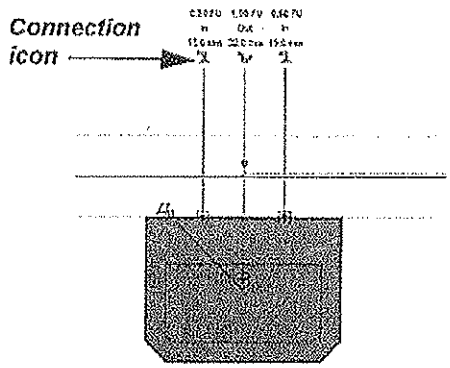

Figure 10–13

- Select a plumbing fixture, existing pipe, or pipe fitting and right-click while hovering over the appropriate connector and select **Draw Pipe, Draw Pipe Placeholder,** or **Draw Flex Pipe.**

2. In the Type Selector, select a pipe type as shown in Figure 10–14.

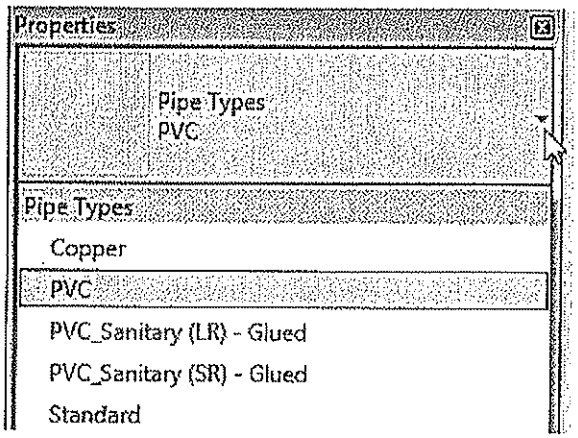

Figure 10–14

3. If not using a connector to start the command, in the Options Bar, set the *Diameter* and *Offset*. In the Placement Tools panel, you can use (Inherit Elevation) and (Inherit Size) to set the elevation or size to match a selected pipe.
   - If starting the command from a connector, the default diameter and offset for the new pipe match the parameters of the selected connector.

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Connecting the new pipe to the end of an existing pipe at a different offset, is not affected by the Automatically Connect toggle.

4. In the *Modify | Place (Flex) Pipe (Placeholder)* tab> Placement Tools panel, use (Automatically Connect) if you want the pipe you are drawing to connect to the middle of an existing pipe which is at a different offset.
5. Draw the pipes using temporary dimensions, snaps, and alignments to locate each point along the path.
6. Press <Esc> once to stay in the command but have a new start location.
7. Press <Esc> twice or click (Modify) to complete the command.

- When drawing pipes with a slope, it helps to identify the direction that *drains to daylight* (the point in the system where it attaches to the exterior drainage pipes). Then, start drawing the pipes from the top most fixture in the system as shown in Figure 10–15.

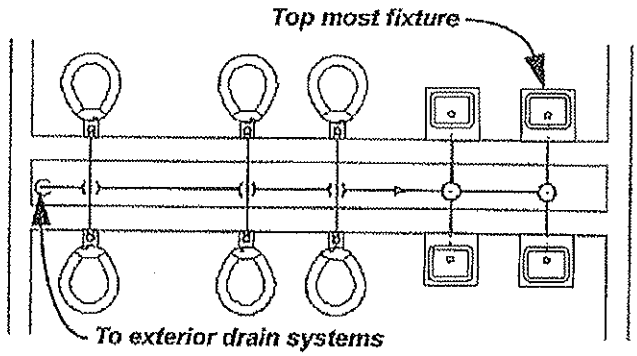

Figure 10–15

- As you are drawing pipes with slopes, you can set the information in the *Modify | Place Pipe* tab>Sloped Piping panel as shown in Figure 10–16. You can change the direction of the slope, the slope value, and turn the slope off or specify that it be ignored when connecting.

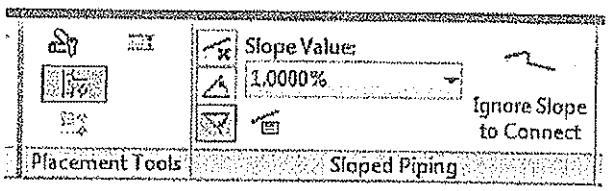

Figure 10–16

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- Turn on the Slope Tooltip to see the exact information of the offsets and slope as you draw, as shown in Figure 10–17.

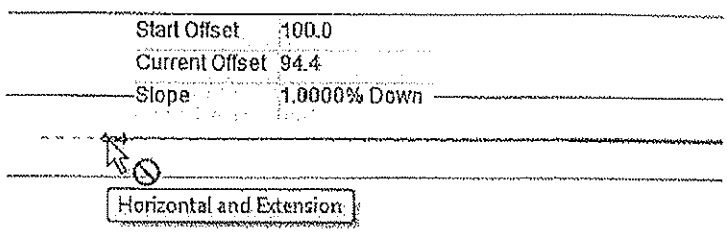

Figure 10–17

- Another way to draw pipe from a plumbing fixture is using the **Connect Into** tool. It can be used to create piping to connect the plumbing fixture into a main pipe. Select a plumbing fixture which has unconnected connections. In the *Modify | Plumbing Fixtures* tab>Layout panel, click (Connect Into) and then select the pipe you want to connect the fixture into.

Pipe Types and Settings

- You can create additional pipe types. Pipes are a system family therefore you need to duplicate an existing family in the Type Properties, as shown in Figure 10–18. The default Standard pipe is Copper. Typically projects also include PVC piping and its related fittings.

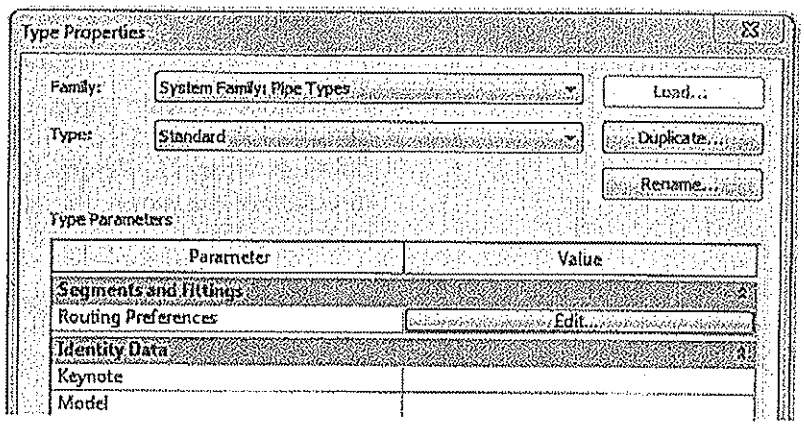

Figure 10–18

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Routing Preferences

New in 2013

The Routing Preferences dialog box (shown in Figure 10–19), enables you to specify the kind of pipe and pipe fittings to use. You can have a simple pipe type with one kind of pipe segment used for all sizes and one family for each kind of pipe fitting. Alternatively, you can set up the pipe type so that as the pipe size increases, different pipe and different fittings are used. Use (Add Row) and (Remove Row) to create or remove rows, and the arrows to re-order items.

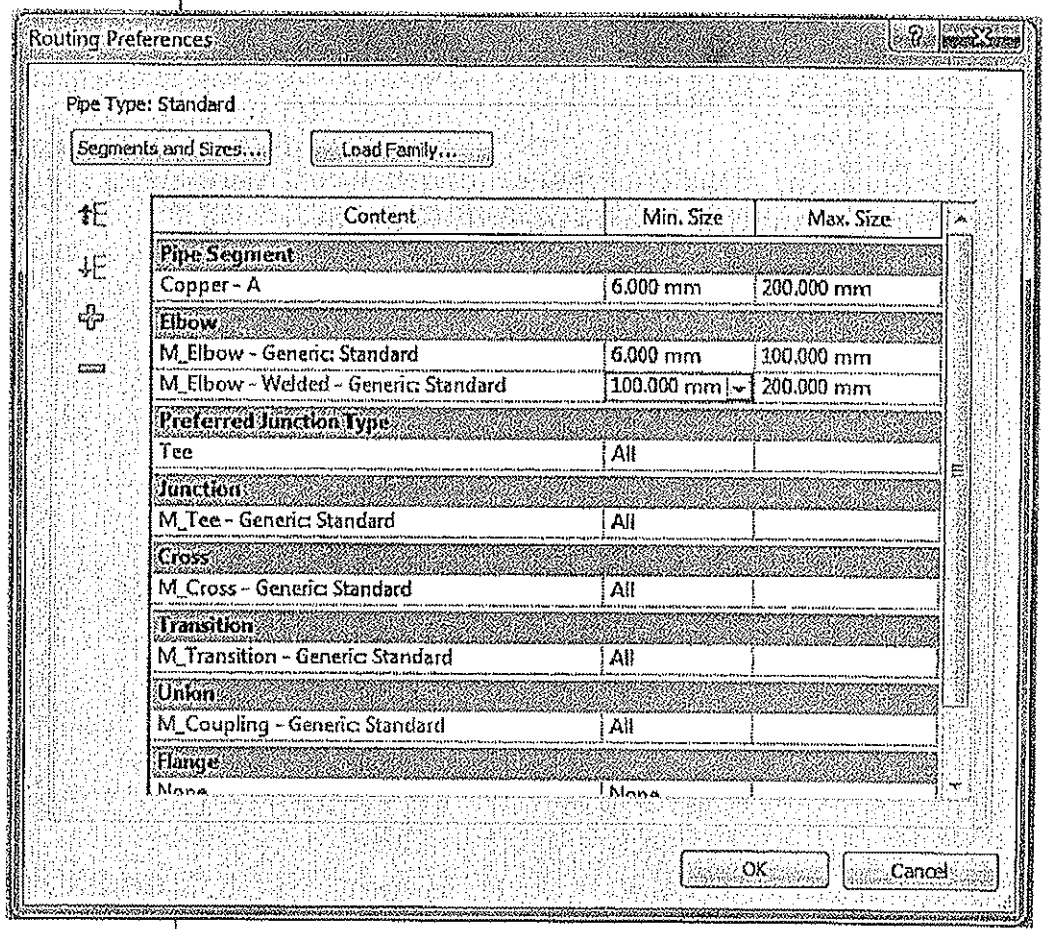

Figure 10–19

- Segments and Sizes... enables you to create named segments with corresponding standard pipe sizes.
- Load Family... enables you to load additional pipe fittings as needed.

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Mechanical Settings

The Mechanical settings for plumbing pipes are similar to other piping systems. In the *Systems* tab>Plumbing & Piping panel title, click ↘ (Mechanical Settings) or type **MS** to open the Mechanical Settings dialog box.

In this dialog box, you can set general pipe settings, such as annotation, conversion settings for automatic pipe layouts, manage segments and sizes (as shown in Figure 10–20), manage fluid types, and set standard slope values.

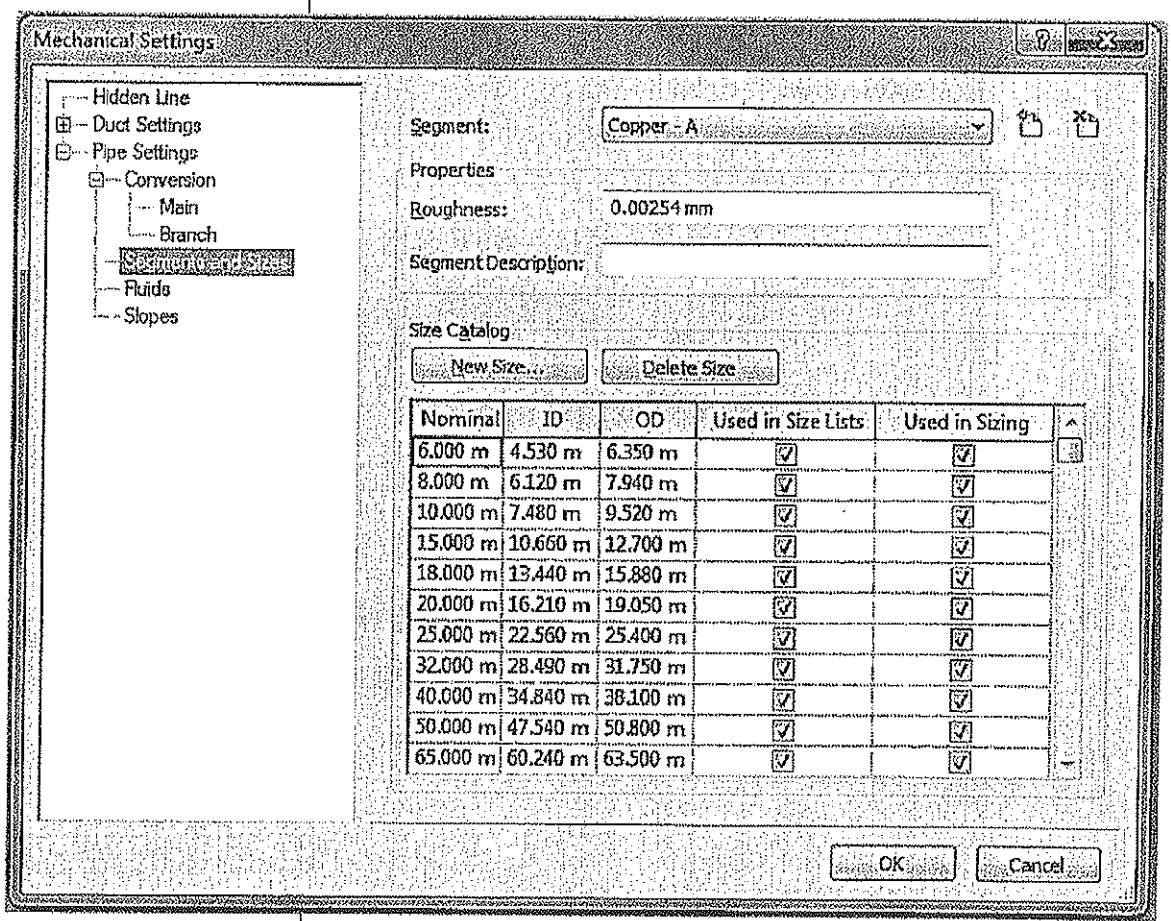

Figure 10–20

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Modifying Plumbing Pipes

To change the slope of a pipe, select it and modify the slope using the *Edit Slope* control as shown in Figure 10–21. You can also click (Slope) to open the Slope Editor. The controls are available in plan or section/elevation views.

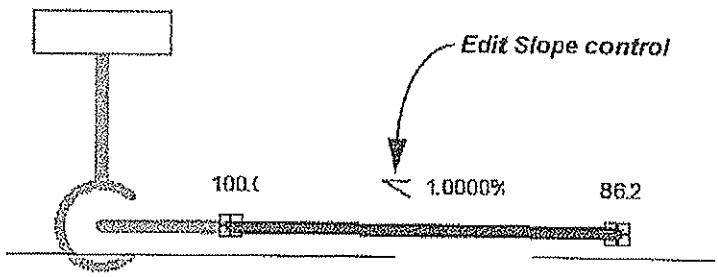

Figure 10–21

- You can change the size of the pipe in the Options Bar or Properties. The offset of the pipe ends can be changed using Properties or the *Edit Start/End Offset* controls.

Plumbing Pipe Fittings and Accessories

One of the challenges about working with plumbing is specifying the correct pipe fitting or accessory and verifying that it is working as expected. For example, if a fitting is facing the wrong direction, you can use (Flip) to switch it, as shown in Figure 10–22.

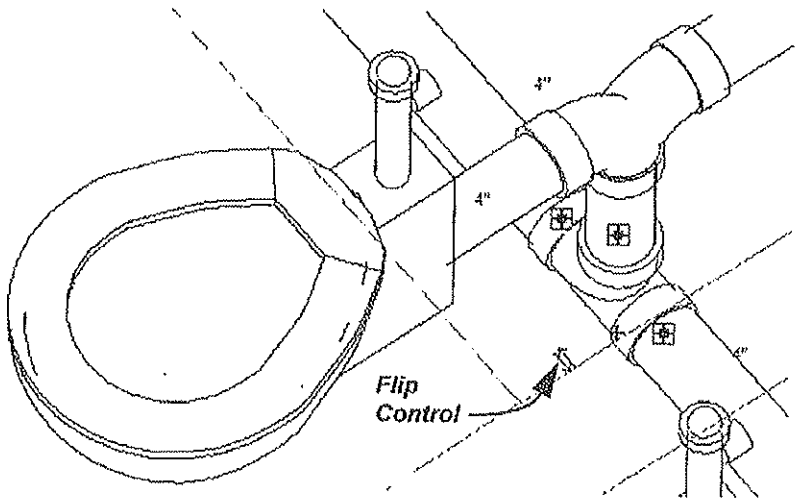

Figure 10–22

- Check various views to verify that you have correctly attached the plumbing fittings to the pipes.

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- Some pipe fittings are specified in the Routing Preferences in the Type Properties of the pipe but others have to be added separately. Accessories are always added later.
- Pipe fittings can be loaded from the Library in the *Pipes> Fittings* sub-folder. Select the folder for the type of pipe you are using, such as **PVC**, as shown in Figure 10–23. Pipe accessories are in the *Pipes>Accessories* sub-folder.

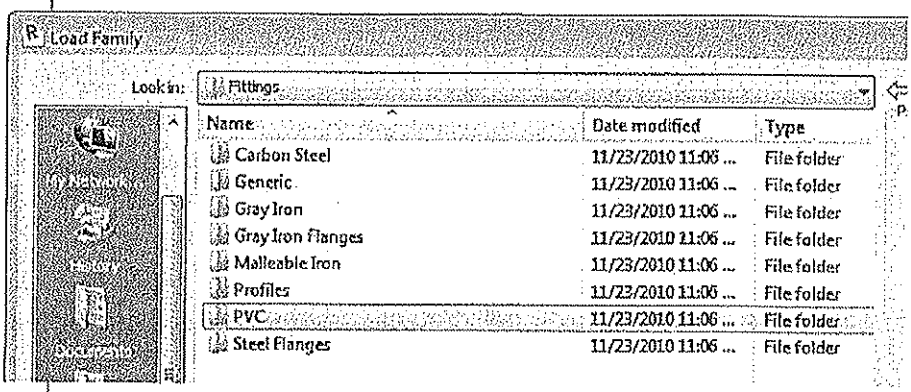

Figure 10–23

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10.4 Working with Plumbing Systems

Create plumbing systems for domestic hot and cold water and sanitary piping.

Similar to all other systems, once you have placed plumbing fixtures into the model, you need to create the appropriate sanitary systems, as shown in Figure 10–24, and domestic hot and cold water systems. The processes and tools to create automatic layouts and to analyze them are similar to other systems.

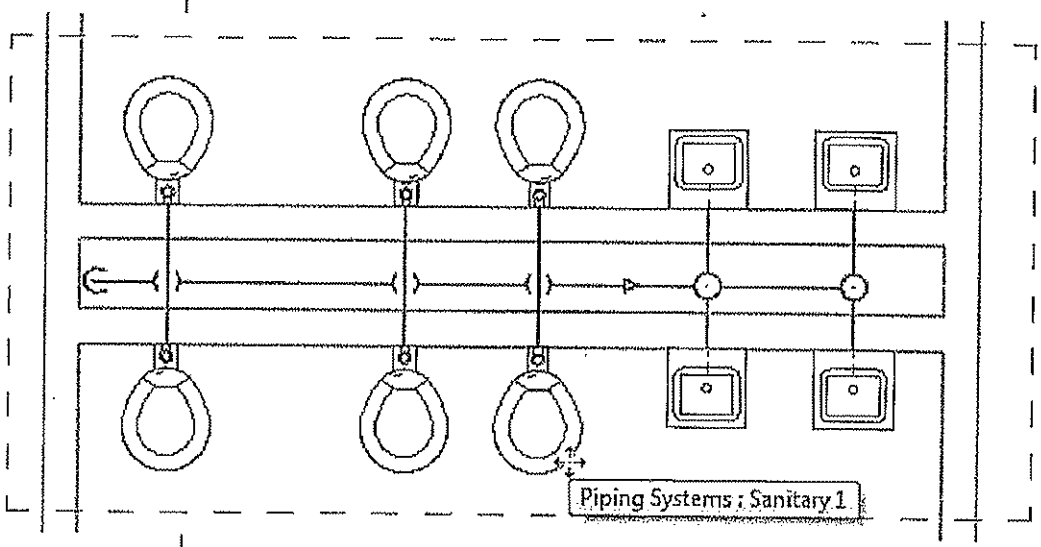

Figure 10–24

How to:

Create Plumbing Systems

1. Select one or all of the plumbing fixtures that are going to become part of the system.
2. In the *Modify | Plumbing Fixtures* tab>Create Systems panel, click (Piping). You can also right-click on the connector of the fixture and select **Create Piping System.**
3. In the Create Piping System dialog box, select the *System type* and assign a *System name.*
4. In the *Piping Systems* tab>System Tools panel, click (Edit System) to add or remove fixtures.

*Selecting **Open in System Editor** is another way of opening the System Editor.*

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5. In the *Edit Piping Systems* tab>Edit Piping System panel:
   - Click (Add to System) and select any fixtures that are to be part of this system that were not selected earlier.
   - Click (Remove from System) if you want to remove any fixtures.
   - Click (Select Equipment) and select any equipment such as a hot water heater.
6. Click (Finish Editing System) to accept all components and complete the creation of the system.

Automatic Layouts

The process of creating automatic piping layouts for plumbing systems is the same as for other piping systems. You can use (Generate Layout) to work through potential solutions for the system, although in most cases it is easier to draw plumbing piping directly. However, if the fixtures are in a row along a wall the automatic layout can work well.

- Use (Place Base) to add a point of connection to the main system if you are working in a sub-system, as shown in Figure 10–25.

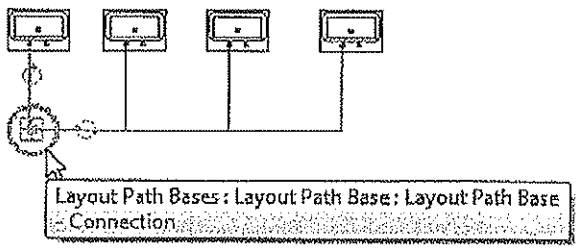

Figure 10–25

- Using **Place Base** is useful for systems such as Sanitary Piping, which are not connected to the equipment, but should have pipe routed in the right direction, which is later connected to the sanitary mains.
- Set up a slope in the Options Bar before selecting a layout.
- When the automatic/custom layout is completed, it is important to go back and check through the entire system to verify the layout. Make sure you include checking slopes and fitting directions.

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Pipe Sizing

It is easiest to draw pipe using the default sizes provided by the opening sizes of the equipment or as preset in the Mechanical Settings. These sizes are often incorrect for the system. The Duct/Pipe Sizing dialog box enables you to specify a sizing method and constraints to determine the way the pipes should be sized, as shown in Figure 10–26.

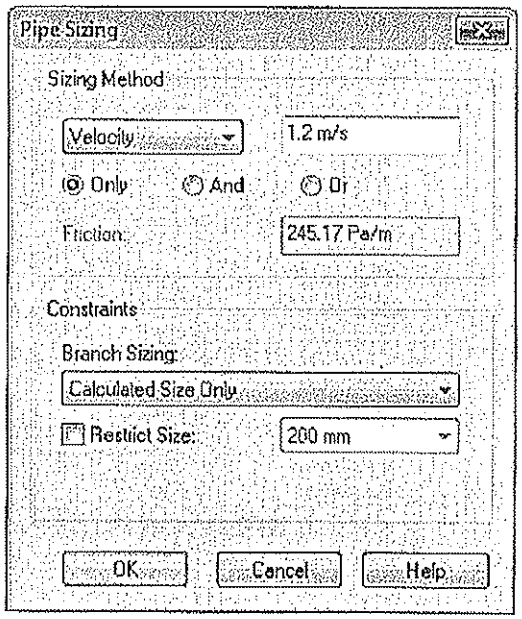

Figure 10–26

- Select a run of piping, in the *Modify | Multi-Select* tab> Analysis panel, click (Duct/Pipe Sizing).
- Plumbing systems are sized using fixture units, the rate of flow within a pipe. As applicable, plumbing fixtures have Waste Fixture Units, Hot Water Fixture Units, and Cold Water Fixture Units assigned to them. All of the connected fixture units in a system are used to size each run of the plumbing line.
- Pipe Sizing cannot be used to size sanitary systems.
- If you add fixtures to the system or change the fixture units of fixtures already included in the system, run the software again as it could impact the pipe sizes.

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Plumbing Schedules

No schedules come with the default templates provided by Autodesk® Revit® MEP software, but many firms create typical ones that can be used in most projects. They are helpful for analyzing the systems (such as, displaying the flow rate, keeping track of the systems, etc.) as shown in Figure 10–27.

Piping System Schedule

stem Classification	System Name	Comments	Flow
estic Cold Water	Domestic Cold Water 1		6.3 L/s
estic Cold Water	Domestic Cold Water 2		0.9 L/s
estic Cold Water	Domestic Cold Water 3		2.2 L/s
estic Cold Water	Domestic Cold Water 4		2.2 L/s
estic Cold Water	Domestic Cold Water 5		2.2 L/s
estic Cold Water	Domestic Cold Water 6		0.9 L/s
estic Cold Water	Domestic Cold Water 7		0.9 L/s
estic Hot Water	Domestic Hot Water 1		2.0 L/s
estic Hot Water	Domestic Hot Water 2		0.4 L/s
estic Hot Water	Domestic Hot Water 3		0.4 L/s
estic Hot Water	Domestic Hot Water 4		0.4 L/s
estic Hot Water	Domestic Hot Water 5		0.4 L/s
onic Return	01 - HWR1		1.2 L/s
onic Return	01 - HWR2		1.2 L/s
onic Supply	01 - HWS1		1.2 L/s
onic Supply	01 - HWS2		1.2 L/s
tary	Sanitary 1		Not Computed
tary	Sanitary 2		Not Computed
tary	Sanitary 3		Not Computed
tary	Sanitary 4		Not Computed
tary	Sanitary 5		Not Computed

Figure 10–27

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Practice 10a

Working with Plumbing Systems

- Set up and review plumbing related views.
- Add Plumbing fixtures.
- Add Domestic Hot and Cold Water piping as well as sanitary piping.
- Create and review plumbing systems.

Estimated time for completion: 25 minutes

In this practice you will set up and review several plumbing related views including plans, sections, and 3D views. You will add plumbing fixtures to a restroom and add piping including sanitary lines, as shown in Figure 10–28. You will then review and add fixtures to a system.

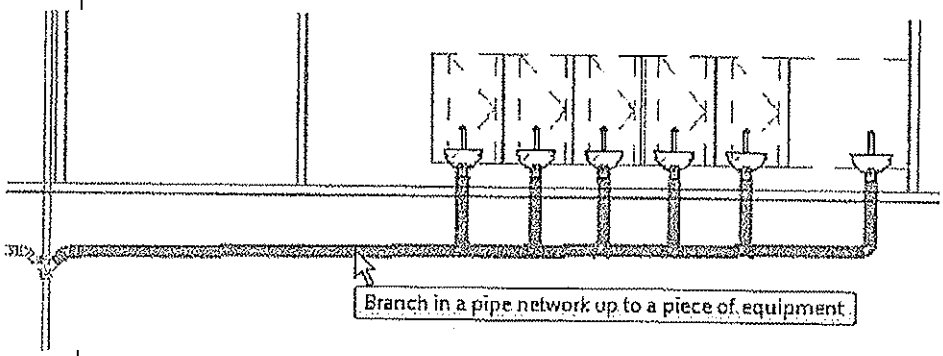

Figure 10–28

Task 1 - Set up and review plumbing related views.

1. Open the project **MEP-Elementary-School-Plumbing-M.rvt** found in the *Chapter 10* folder in your class folder.

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2. In the Project Browser, open Mechanical>Plumbing>Floor Plans>**01 Plumbing Plan** view. Zoom in on the lower left corner of the South Wing. Note the piping coming from the sinks in each classroom, as shown in Figure 10–29.

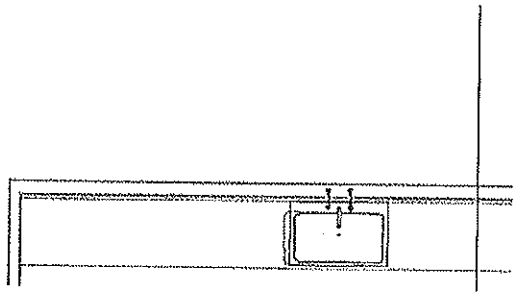

Figure 10–29

3. Double-click on the arrow of the section. The piping goes up into the plenum over the ceiling on the second floor, as shown in Figure 10–30.

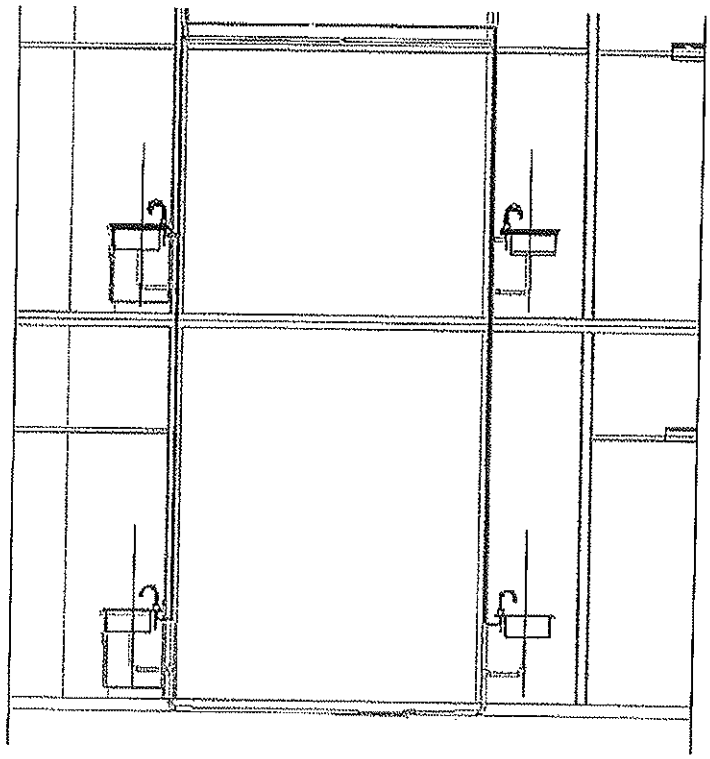

Figure 10–30

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4. Open the **02 Plumbing Plan** view. Note the pipes that cross the ceiling as shown in Figure 10–31.

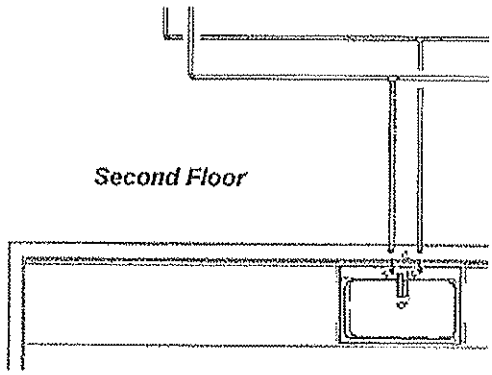

Figure 10–31

5. Check the sanitary views associated with plumbing. System Type graphic overrides and View Filters are used to color the pipes in the systems as well as turn them off and on.

6. Return to the **3D Plumbing** view. Review the existing piping in 3D and note the men's restrooms, as shown in Figure 10–32. The women's restroom, which you will be creating, is similar.

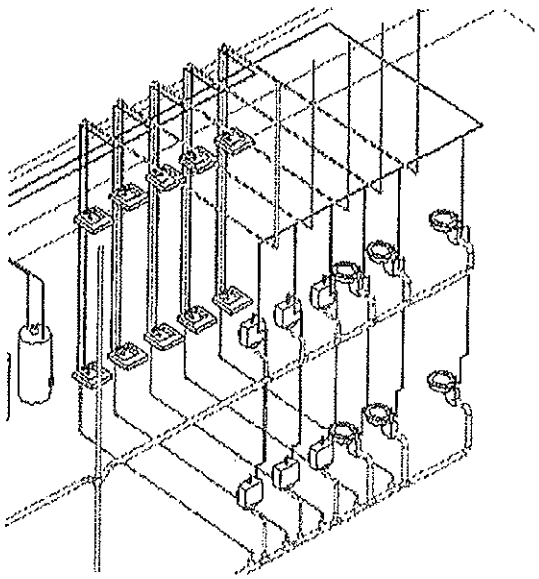

Figure 10–32

7. Save the project.

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The fixtures in the women's restroom on the first floor need to be lined up exactly with the fixtures on the one above so that the pipes work correctly. To facilitate this, you need to draw reference planes.

Task 2 - Add Plumbing Fixtures.

1. Open the **02 Plumbing Plan** floor plan view and zoom in on the women's restroom.
2. In the *Systems* tab>Work Plane panel, click (Reference Plane).
3. Using the alignment line of the toilet, draw a short reference plane across the WC as shown in Figure 10–33.

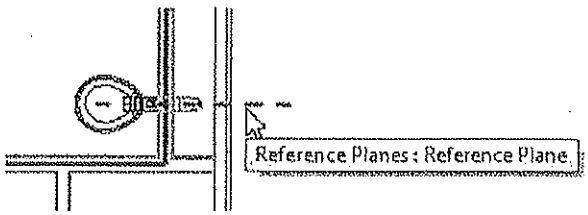

Figure 10–33

4. Repeat the process for each WC and separately for each sink.
5. Open the **01 Plumbing Plan** floor plan view and zoom in on the women's restroom.
6. Select one of the section lines. In the View Control Bar, click (Temporary Hide/Isolate)>**Hide Category**. This temporarily removes the section lines while you are adding the fixtures. You can easily access them again when required.
7. Draw a vertical reference plane on the inside face of each vertical wall in the restroom. Draw from the bottom up on the WC side and the top down on the lavatory side. This helps place the fixtures because they are hosted fixtures and rotate to the direction of the reference planes.
8. Name the vertical reference planes **Lavatory Wall** and **WC Wall**. They can be used later to set the work plane if needed.

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9. The reference planes display as shown in Figure 10–34.

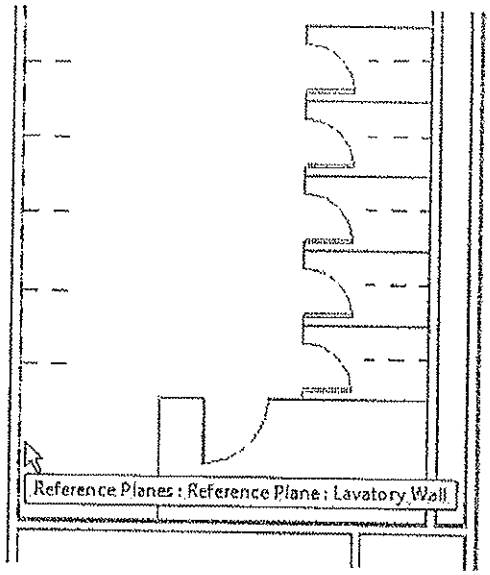

Figure 10–34

10. In the *Systems* tab>Plumbing & Piping panel, click (Plumbing Fixture).

11. In the Type Selector, select **M_Water Closet - Flush Valve - Wall Mounted: Public - 6.1 Lpf.**

12. Turn off **Tag on Placement**.

13. This is a wall mounted fixture. Click (Place on Vertical Face) and place one of the fixtures in the restroom at the intersection of the wall and the reference plane as shown in Figure 10–35.

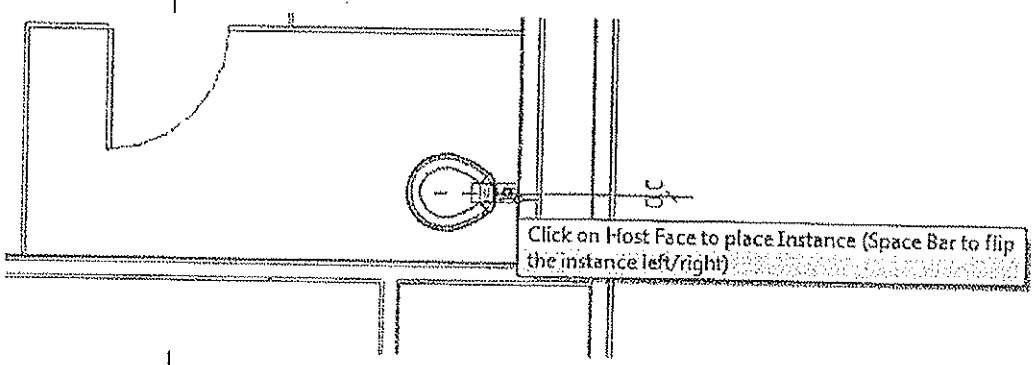

Figure 10–35

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14. Copy the fixture to the other stalls using the reference plane as the move start and end points.

15. Click (Plumbing Fixture) to start the command again.

16. In the Type Selector, select **M_Lavatory Rectangular: 560mmx560mm - Public.**

If the lavatory faces out of the room, delete the vertical reference plane and draw it from top to bottom.

17. Place five (5) lavatories at the reference plane locations across from the toilets.

18. The final layout is shown in Figure 10–36.

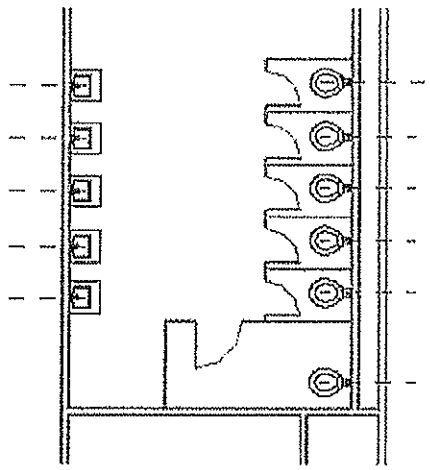

Figure 10–36

19. Save the project.

Task 3 - Add Domestic Hot and Cold Water piping.

1. In the women's restroom, select the bottom lavatory.
2. Right-click on the Hot Water Control and verify that the **Create Piping System** displays in the menu. (Do not create a system at this time.)
3. Select **Draw Pipe**.
4. In the Type Selector, select **Pipe Types: Copper**.
5. In the *Modify | Place Pipe* tab>Placement Tools panel, verify that (Automatically Connect) is toggled on.
6. Draw the pipe out of the back of the lavatory about **75mm** into the wall.

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7. Repeat with the cold water pipe.

8. Reset **Temporary Hide/Isolate** so that the sections that were hidden are displayed. Create a new section facing the back of the lavatories. Limit the depth so that only the lavatories are displayed as shown in Figure 10–37.

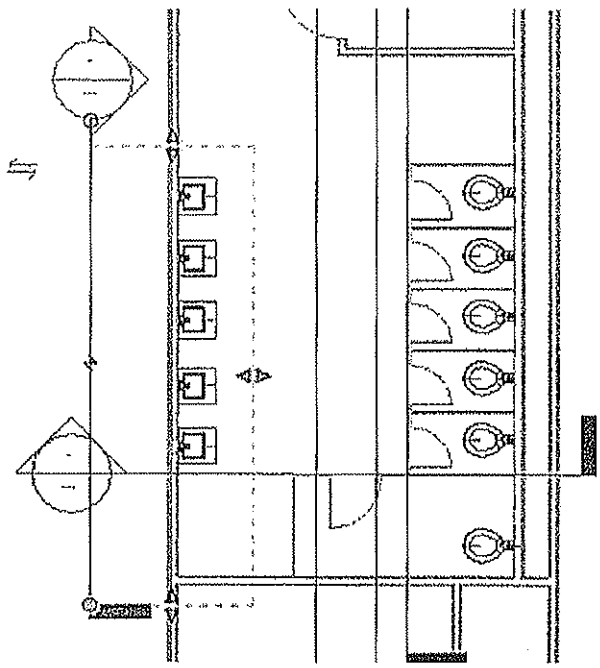

Figure 10–37

9. Open the section. To make things easier to see, temporarily hide everything but the pipes and lavatories.

10. Zoom in on the lavatory above the one to which you just added pipes. The pipes have an elbow fitting as shown in Figure 10–38.

*If the pipes display as a single line, change the Detail Level to **Fine**.*

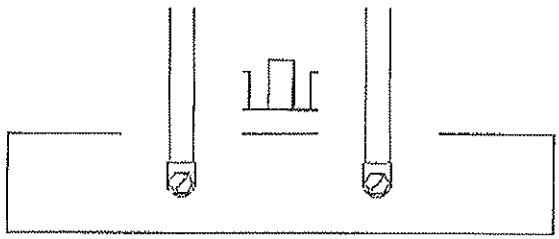

Figure 10–38

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If you have not temporarily hidden the linked architectural file do so now because you cannot easily select the plumbing elements through it.

11. Select the elbow (not the pipe). Note the options that are available on the elbow to create a tee. Click the Tee plus sign as shown in Figure 10–39.

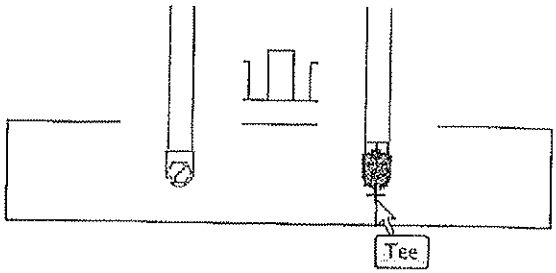

Figure 10–39

12. Repeat with the cold water pipe. After doing so, both pipe fittings should now be open at the bottom as shown in Figure 10–40.

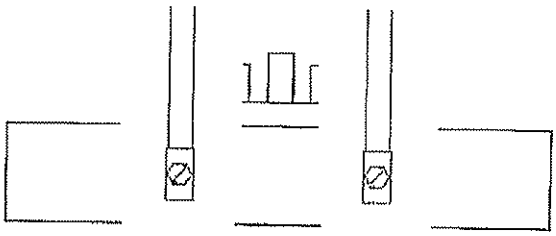

Figure 10–40

13. Zoom out to display the upper and lower lavatories.

14. In the *Systems* tab>Work Plane Panel, click (Set).

15. In the Work Plane dialog box, select the *Name* **Reference Plane : Lavatory Wall**. This enables you to draw the pipes vertically along this plane.

16. Draw pipes from the newly opened Tee to the pipes that come out of the back of the lower lavatory. An elbow fitting is automatically applied. The pipes should display as shown in Figure 10–41.

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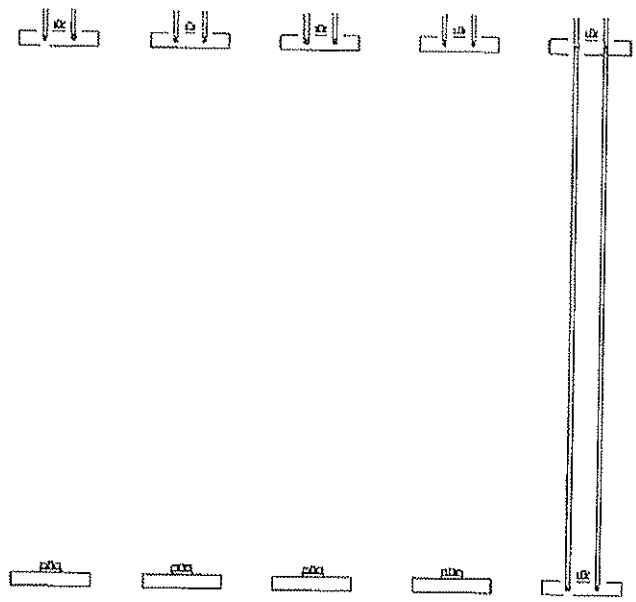

Figure 10–41

17. At this point you can repeat the process for each of the lavatories. This is most likely to work right away and not leave you with any disconnects. Alternatively, you can copy the pipes to the other lavatories.

Task 4 - Copying Pipes and Fixing Disconnects.

1. Still working in the section view, zoom in on the top lavatories and use the controls to open the elbows to tee pipe fittings on each of the lavatories.
2. Select the vertical pipes that you just created along with the pipes and fittings attached to the lower lavatory. Do not select the open tee on the upper lavatory.
3. In the *Modify | Multi-Select* tab>Modify panel, click (Copy).
4. In the Options Bar, select **Multiple**.
5. As the move start point, select a point on the lavatory.
6. As the move end point, select the same point on the next lavatory and repeat until all of the lavatories have pipes as shown in Figure 10–42.

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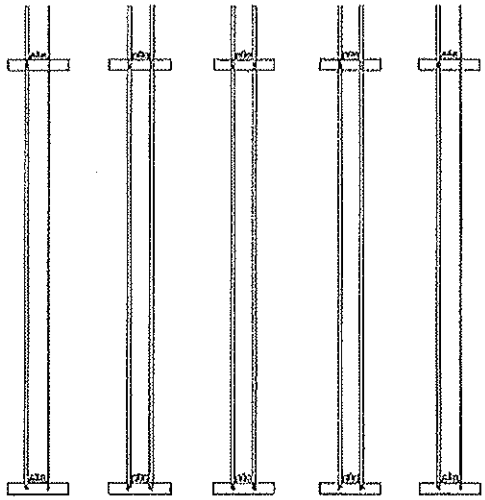

Figure 10–42

7. Everything should look connected, but most likely they are not.
8. Return to the **01 Plumbing Plan** view.
9. In the *Analyze* tab>Check Systems panel, click (Show Disconnects).
10. In the Show Disconnects Options dialog box, select **Pipe** (as shown in Figure 10–43), and click OK.

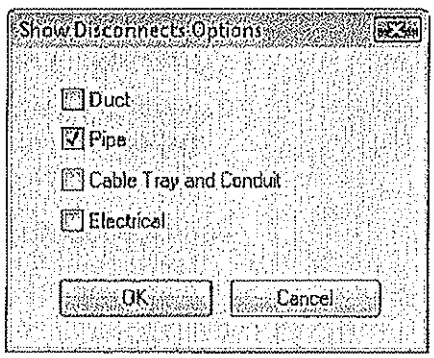

Figure 10–43

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11. Each lavatory displays a number of disconnects as shown in Figure 10–44.

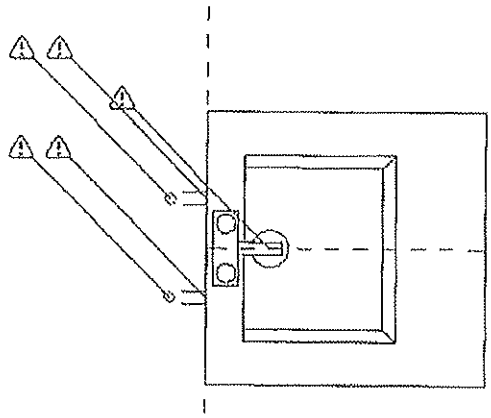

Figure 10–44

*To help discover the problems, tile the section view that you created and the **01 Plumbing Plan** view. When you test the connections the pipe referenced in the disconnect warning highlights.*

12. In the floor plan view, select one of the disconnect warning icons. The pipe highlights in both views and a Warning box opens displaying the issue, as shown in Figure 10–45.

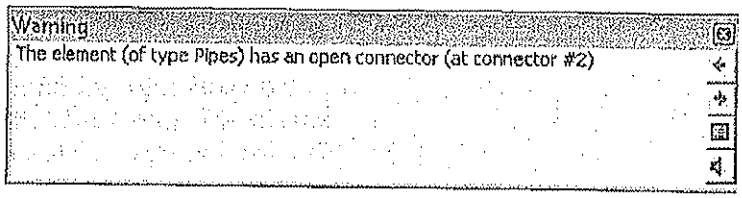

Figure 10–45

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13. To solve the first floor open connector problem, select the pipe that touches the lavatory. Click and drag the control until it displays the point connector as shown in Figure 10–46. When you release the mouse button, the pipe connects to the lavatory and the disconnect warning disappears.

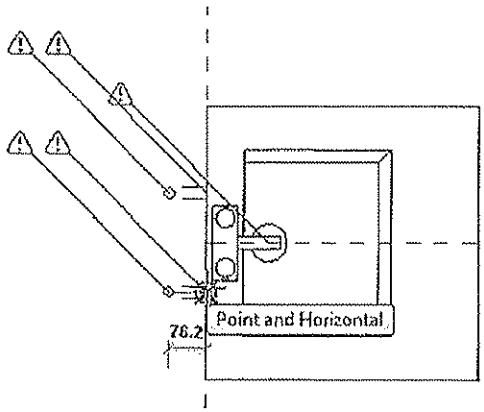

Figure 10–46

14. Repeat with the other open pipes that connect to the first floor lavatories. The open connector that points to the center of the lavatory is for the sanitary line that has not yet been added.

15. In the section view, connect the copied pipe to the tee as shown in Figure 10–47. If the floor plan is still open, note that the disconnect warning disappears as you do each one.

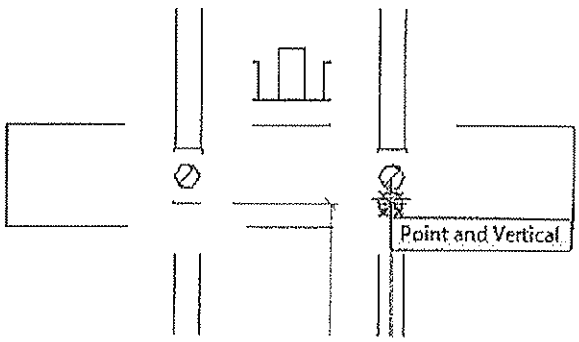

Figure 10–47

16. In the *Analyze* tab>Check Systems panel, click (Show Disconnects).

17. In the Show Disconnects Options dialog box, clear **Pipe** and click OK.

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18. Open the **3D PIPING - First Floor** view to review the piping that you just placed.

Task 5 - Add Pipe Accessories.

1. Open the **02 Plumbing Plan** view.
2. Zoom in on the short pipe extension that goes nowhere at the end of the women's lavatories. (This would be tied into the main cold water line.) Use the Drag control to lengthen it.
3. In the *Systems* tab>Plumbing & Piping panel, click (Pipe Accessory).
4. In the *Modify | Place Pipe Accessory* tab>Mode panel, click (Load Family).
5. In the Load Family dialog box, drill down to the Pipe>Valves> *Ball Valves* folder and select **M_Ball Valve - 50-150mm.rfa**.
6. In the Type Selector, select **M_Ball Valve - 50-150: 50mm**.
7. Place the valves as shown in Figure 10–48. Use the (Rotate) control to modify the location of the handle.

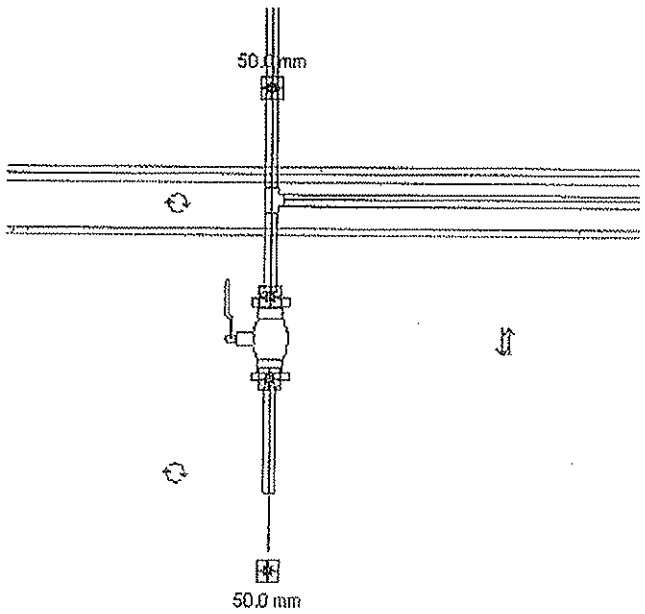

Figure 10–48

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8. If you have time, route the cold water lines to the water closets. Refer to the men's restroom for routing details. Use the **WC Wall** reference plane to set the Work Plane so that you can draw the pipes to go around the sanitary line.
9. Save the project.

Task 6 - Add Sanitary Piping.

1. Open the **01 Sanitary Plan** view.
2. In the Quick Access Toolbar, click (Close Hidden Windows).
3. Open the Mechanical>Plumbing>Sections (Building Sections)>**Plumbing Section - WC - Sanitary** view and zoom in on the second floor women's restroom.
4. Set the *Detail Level* to **Fine** if needed.
5. Review the existing layout and direction of slope, as shown in Figure 10–49.

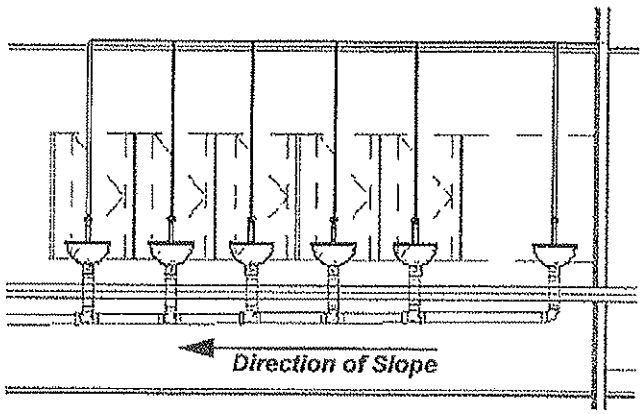

Figure 10–49

Verify that no other projects are open before you try to tile the two views.

6. Type **WT** to tile the section and plan view. Zoom in to the women's restroom in both views as needed to display the Wye pipe fitting below the first floor.

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7. The Wye fitting has several other fittings applied as well. Select the reducer fitting, right-click on the outside control and select **Draw Pipe** as shown in Figure 10–50.

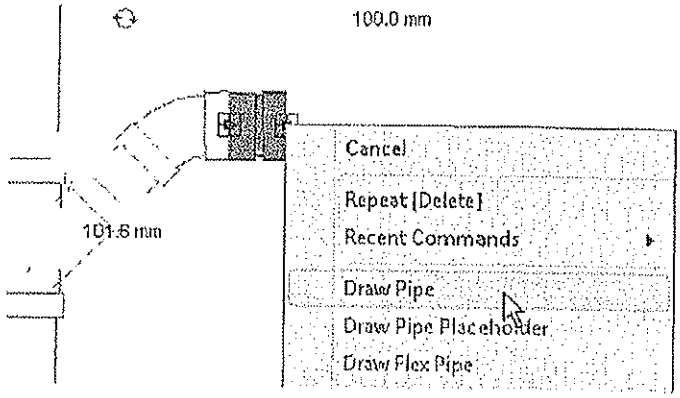

Figure 10–50

8. In the *Modify | Place Pipe* tab>Sloped Piping panel, click (Slope Up) and set the Slope value to 1.000%.

9. When the pipe intersects with the last water closet, draw the pipe up and select the Sanitary connector as shown in Figure 10–51.

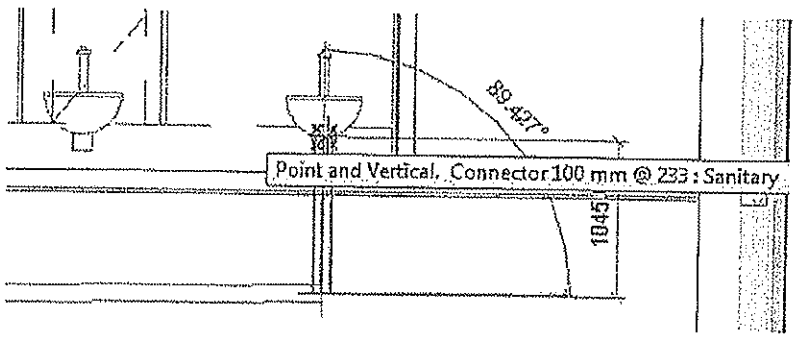

Figure 10–51

10. In either view, select one of the other water closets.

11. In the *Modify | Plumbing Fixtures* tab>Layout panel, click (Connect Into). If you did not have time to connect the cold water supply to these water closets, the Select Connector dialog box opens. Select the Sanitary connector for this and each of the other connections and click OK.

12. Select the sloped pipe.

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13. Continue connecting the water closets to the sloped pipe as shown in Figure 10–52.

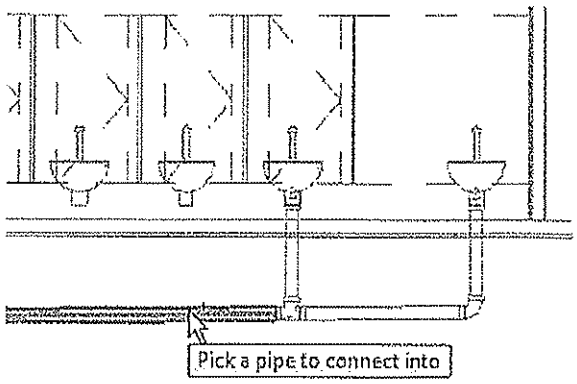

Figure 10–52

14. If you have time, route the sanitary lines to the lavatories. Refer to the men's restroom for routing details.

15. Save the project.

Task 7 - Create and review systems.

1. Make the **01 Sanitary Plan** view active and expand it to fill the screen.
2. Press <F9> to open the System Browser.
3. Zoom out to display the water closets and lavatories.
4. Select one of the water closets that you just added to the view.
5. In the System Browser, expand Unassigned>Piping> Domestic Cold Water to highlight the water closet. When you added piping, the water closets were automatically added to a Sanitary System, but are required to be attached to a Domestic Cold Water System.
6. There is only one Domestic Cold Water System in the project. Therefore, instead of creating a new system, you need to add the water closets to the existing system.
7. Right-click on the cold water connection and select **Add to System**.

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8. Hover over one of the lavatories. The system you are adding to displays as shown in Figure 10–53. Select the lavatory.

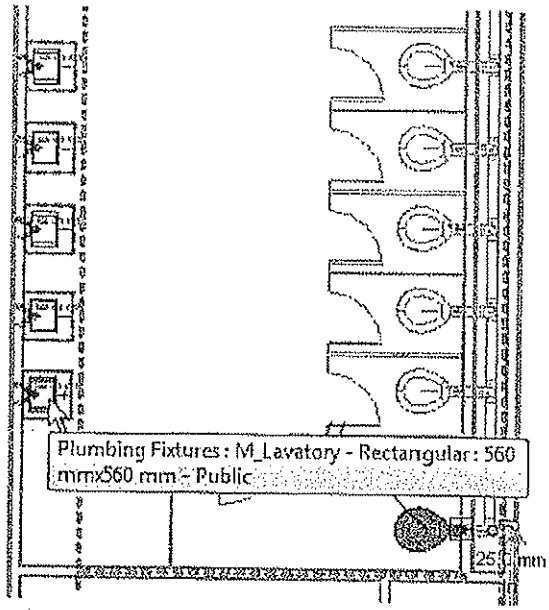

Figure 10–53

9. A Warning box opens as shown in Figure 10–54 and the other water closets highlight. Because the first water closet was attached to the others they are all added to the same system.

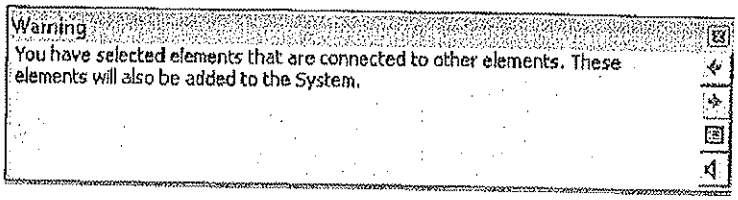

Figure 10–54

10. Save the project.

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Chapter Review Questions

1. You are creating a view to place plumbing pipes below a floor. Which View Property needs to be set so you can see them?
   a. Underfloor View Control
   b. Visibility/Graphics Overrides
   c. View Discipline
   d. View Range

2. After tying in piping to a sloped sanitary pipe, the automatically placed fittings are facing the wrong direction, as shown in Figure 10–55. To fix this, select the fitting and...
   a. click the **Flip** arrow.
   b. place its opposite type.
   c. use **Rotate**.
   d. click the **AutoSlope** icon in the Ribbon.

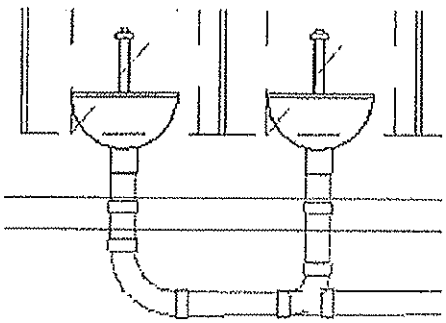

Figure 10–55

3. When you are placing a plumbing fixture, which placement option do you need to use?
   a. **Place on Vertical Face**
   b. **Place on Face**
   c. **Place on Work Plane**

4. How do you specify the direction in which a pipe slopes as you are creating it?
   a. Set the slope in the Options Bar.
   b. Set the slope in the Ribbon.
   c. Create it flat and slope it later.
   d. Draw the pipe in a section view to ensure that it slopes correctly.

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Command Summary

Button	Command	Location
	**Check Pipe Systems**	■ **Ribbon:** *Analyze* tab>Check Systems panel
	**Duct/Pipe Sizing**	■ **Ribbon:** (*when piping in a system is selected*) *Modify | Multi-Select* tab> Analysis panel
	**Edit Layout**	■ **Ribbon:** *Generate Layout* tab>Modify Layout panel
	**Edit System**	■ **Ribbon:** *Pipe Systems* tab>System Tools panel
	**Flex Pipe**	■ **Ribbon:** *Systems* tab>Plumbing & Piping panel ■ **Shortcut:** FP
	**Generate Layout**	■ **Ribbon:** *Pipe Systems* tab>Layout panel
	**Justify**	■ **Ribbon:** (*when piping in a system is selected*) *Modify | Multi-Select* tab> Edit panel
	**Mechanical Settings**	■ **Ribbon:** *Systems* tab>Plumbing & Piping panel or Mechanical panel title ■ **Shortcut:** MS
	**Pipe**	■ **Ribbon:** *Systems* tab>Plumbing & Piping panel ■ **Shortcut:** PI
	**Pipe Accessory**	■ **Ribbon:** *Systems* tab>Plumbing & Piping panel ■ **Shortcut:** PA
	**Pipe Fitting**	■ **Ribbon:** *Systems* tab>Plumbing & Piping panel ■ **Shortcut:** PF
	**Pipe Placeholder**	■ **Ribbon:** *Systems* tab>Plumbing & Piping panel
	**Piping (System)**	■ **Ribbon:** (*with appropriate plumbing selected*) *Modify | Plumbing Fixture* tab>Create Systems panel ■ **Right-click:** Create Piping System

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	**Plumbing Fixture**	■ **Ribbon:** *Systems* tab>Plumbing & Piping panel ■ **Shortcut:** PX
	**Slope**	■ **Ribbon:** (*when piping in a system is selected*) *Modify* | *Multi-Select* tab> Edit panel
	**Solutions**	■ **Ribbon:** *Generate Layout* tab>Modify Layout panel

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Chapter 11

Electrical Systems

In this chapter you learn about various types of electrical systems, how to place types of electrical components, and create electrical circuits. You also learn how to add cable trays, conduit, and associated fittings. You also create and modify Panel Schedules.

This chapter contains the following topics:

- ✓**About Electrical Systems**
- ✓**Placing Electrical Components**
- ✓**Creating Electrical Circuits**
- ✓**Cable Trays and Conduit**
- ✓**Electrical Panel Schedules**

Learning Objectives

This chapter provides instruction to enable you to do the following:

11.1 About Electrical Systems



Prepare to create electrical systems.

11.2 Placing Electrical Components



Place electrical equipment, devices, and lighting fixtures.

11.3 Creating Electrical Circuits



Create Power Circuits, Switch Systems, and other circuit systems.

11.4 Cable Trays and Conduit



Add cable trays and conduit, including parallel conduit runs and fittings.



Modify Cable trays and conduit, including changing types and justification.

11.5 Electrical Panel Schedules



Create and modify electrical panel schedules.

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11.1 About Electrical Systems

Prepare to create electrical systems.

Electrical systems in Autodesk® Revit® MEP software are circuits consisting of devices, lighting fixtures, and other electrical equipment. They are elements in a project and are added to the model using the tools in the Ribbon. There can be different types of electrical plan views based on the type of information required. A typical electrical view plan might display power, systems, or lighting layouts as shown in Figure 11–1.

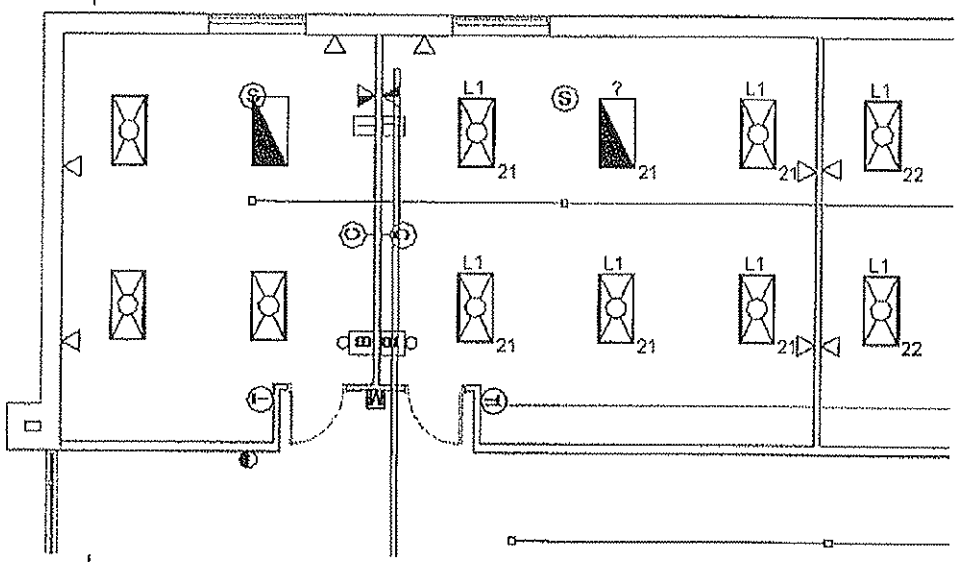

Figure 11–1

There are several steps in the process of creating an Electrical system:

1. Place electrical equipment such as distribution panels.
2. Define the Distribution System in the Properties of the electrical equipment.
3. Place electrical devices, such as receptacles. Each device represents an electrical load in the system.
4. Select an electrical device or lighting fixture, and create a power circuit for it and similar devices in the same room or area of the building.
5. Assign circuits to electrical equipment (e.g. Panel).

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The tools for creating and placing Electrical components and circuits are located in the *Systems* tab>Electrical panel, as shown in Figure 11–2.

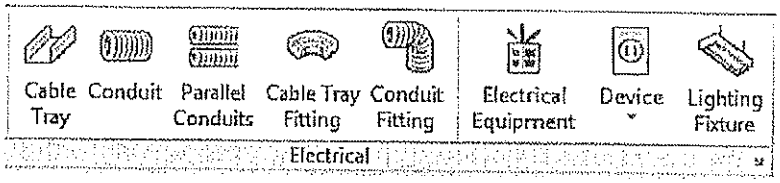

Figure 11–2

When placing Electrical elements in a view, use Properties to set specific information about the element, as shown in Figure 11–3.

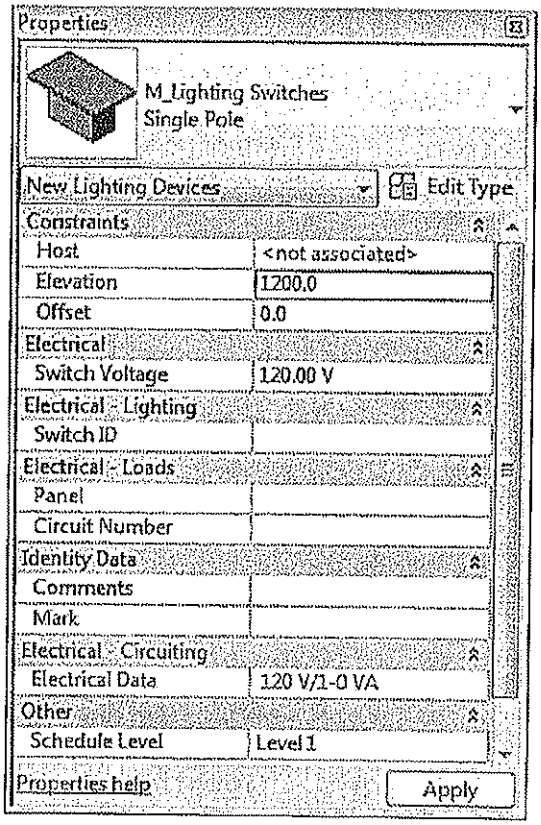

Figure 11–3

In the Type Selector, select a specific family element type. In Properties, other options depend on the type of Electrical element you are placing, and can include offset value, voltage, loads, etc. In the Ribbon, in the Placement panel, you can find options for the face or plane used for placement.

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Electrical Settings

Electrical settings contain many parameters used for various electrical component placement and system/circuit creation. They include wiring parameters, voltage definitions, distribution systems, cable tray and conduit settings, load calculation settings, and circuit naming settings.

In *Manage* tab>Settings panel, expand MEP Settings and click (Electrical Settings), or in the *Systems* tab>Electrical panel, click (Electrical Settings), to open the Electrical Settings dialog box, as shown in Figure 11–4.

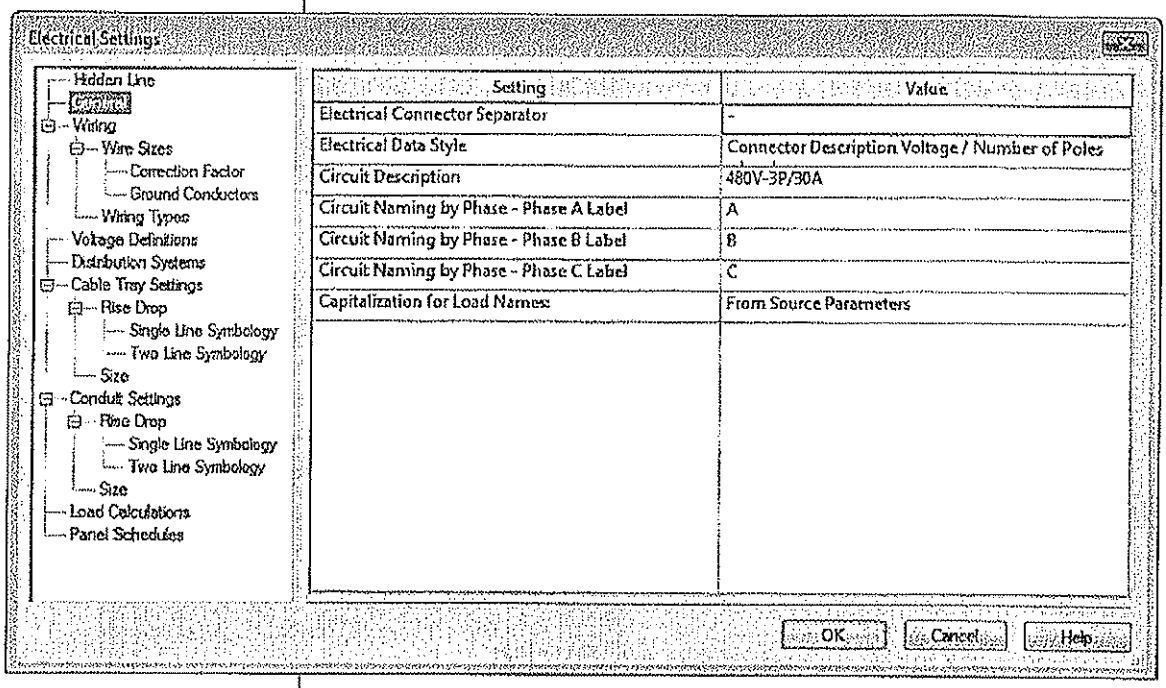

Figure 11–4

The different categories in the left pane have their own specific settings that are available when the category is selected.

Hidden Line	Settings for cable tray and conduit hidden line styles and gaps.
General	Parameters and formats for symbols and styles for various electrical component values, including phase naming.
Wiring	■ Determines how wires and wire sizes are displayed and calculated. ■ Includes type of wires available based on material, temperature, and insulation ratings. ■ Specifies which wire types can be used in a project.

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Voltage Definitions	Lists the ranges of voltages that can be assigned to the Distribution Systems.
Distributions Systems	Defines available distribution systems.
Cable Tray Settings	▪ Specifies annotative scaling for cable tray fittings and rise/drop symbology. ▪ Specifies cable tray sizes available in a project.
Conduit Settings	▪ Specifies annotative scaling for conduit fittings, size prefix and suffix, and rise/drop symbology. ▪ Specifies conduit sizes available in a project.
Load Calculations	Specifies whether to enable load calculations for loads in spaces, and defines Load Classifications and Demand Factors.
Panel Schedules	Specifies settings for spares and spaces, and for merging multi-poled circuits

- Load Classifications are assigned to Device Connectors, and Demand Factors are assigned to Load Classifications.

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11.2 Placing Electrical Components

Place electrical equipment, devices, and lighting fixtures.

There are many different types of electrical components that can be added to a model, as shown in Figure 11–5. Components consist of panels, transformers, switches, receptacles, various communication and safety devices, and lighting fixtures. There are different commands for different types of electrical components.

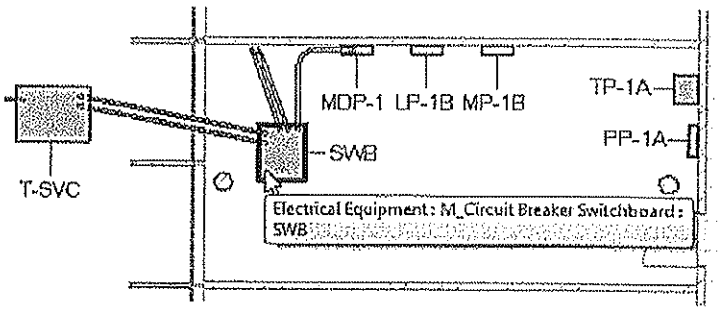

Figure 11–5

- Electrical Components can be placed in any view, including plan, elevation, and 3D.

Electrical Equipment

Electrical equipment includes panels and transformers, which can be placed either as hosted or unhosted components. Panels are typically hosted onto a wall, surface or flush mount, as shown in Figure 11–6, and a transformer could be placed anywhere including ceiling hung. Other electrical equipment includes motor control centers, switchboards, and generators.

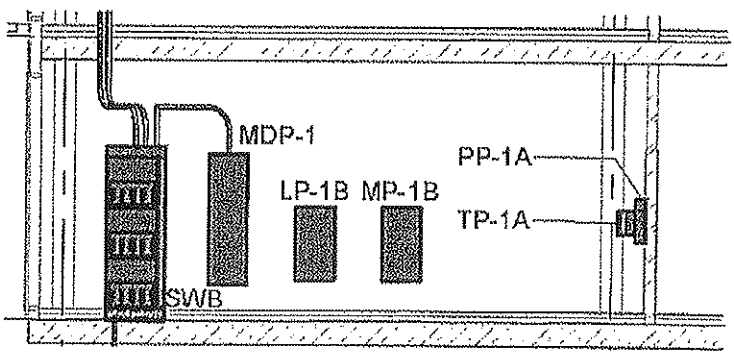

Figure 11–6

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How to:

Place Electrical Equipment:

1. Open the view where you want to place the electrical equipment.
2. In the *Systems* tab>Electrical panel, click (Electrical Equipment).
3. In Type Selector, select a panel board or other piece of equipment and then set the required value or option.
4. In the *Modify | Place Equipment* tab>Tag panel, click (Tag on Placement) to select or clear, as required. If you have selected Tag on Placement, set the parameters for the tags in the Options Bar.

Automatically placing the tags is typically recommended.

5. In the *Modify | Place Equipment* tab>Placement panel, click (Place on Vertical Face), (Place on Face), or (Place on Work Plane).
   - Some equipment does not display the Placement panel. It is placed on the current level with an offset as required.
6. Click on the required location in the model view. Use alignment lines, temporary dimensions, and snaps to aid you in placing the components.
7. Continue to place additional electrical equipment, or click (Modify) to exit the command.

- After placing a piece of electrical equipment, you can move it to a different location by clicking and dragging it to the new location. Click (Modify) to exit its selection.

Electrical Devices

Electrical devices include a variety of types of devices, including receptacles, switches, telephone/communication/data terminal devices, junction boxes, nurse call devices, wall speakers, starters, smoke detector, and fire alarm manual pull stations, as shown in Figure 11–7. These devices are typically hosted components, as they are usually placed on a wall.

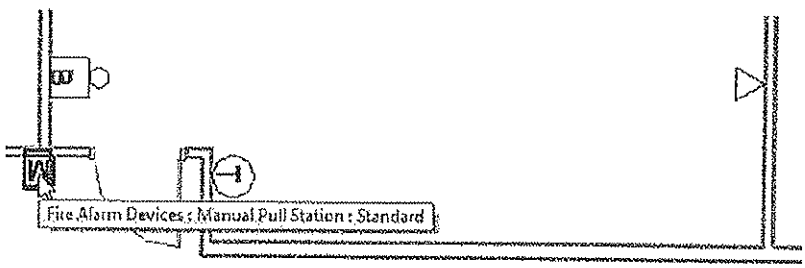

Figure 11–7

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How to:

Place Electrical Devices:

1. Open the view where you want to place the electrical device.
2. In the *Systems* tab>Electrical panel, expand (Device), as shown in Figure 11–8, and click the appropriate command.

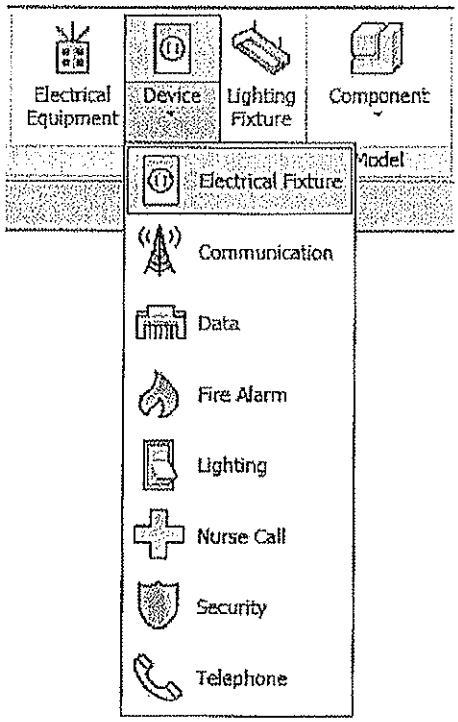

Figure 11–8

3. In Type Selector, select a specific component to insert. In Properties, set any other available required values/options.
4. In the *Modify | Place Devices* tab>Tag panel, click or clear (Tag on Placement) as required. If you have selected Tag on Placement, set the parameters for the tags in the Options Bar.
5. In the *Modify | Place Devices* tab>Placement panel, click (Place on Vertical Face), (Place on Face), or (Place on Work Plane).
6. Click on the required location in the model view. Use alignment lines, temporary dimensions, and snaps to aid you in placing the components.
7. Continue to place additional devices, or click (Modify) to exit the command.

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Hint: Placing Devices Directly Beside or Above Each Other

Electrical device families are model families with an embedded annotation family. This is so that the actual device box displays in sections and 3D views and a symbol displays in plan view, as shown in Figure 11–9.

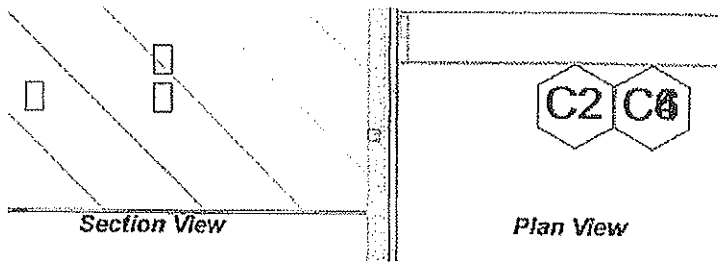

Figure 11–9

Some families do not work well if two devices need to be placed directly next to or above each other. For example, in Figure 11–10, devices that are placed correctly in a section view result in overlapping, illegible symbols in plan. Moving the symbol in the plan view also moves the device in the model.

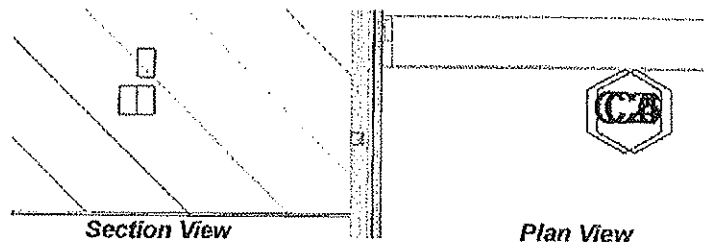

Figure 11–10

Many offices create custom device families, which include offset parameters so that the annotation family can move separately from the model family as shown in Figure 11–11.

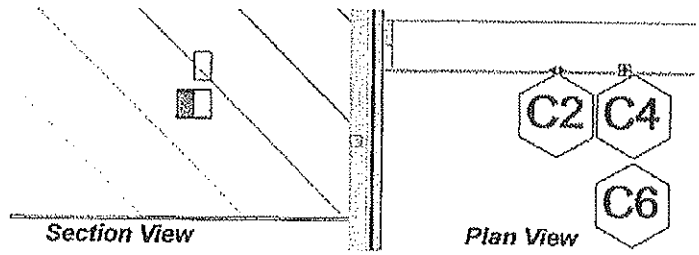

Figure 11–11

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Lighting Fixtures

Most lighting fixtures, as shown in Figure 11–12, are hosted components, and are therefore placed on a ceiling or on a wall.

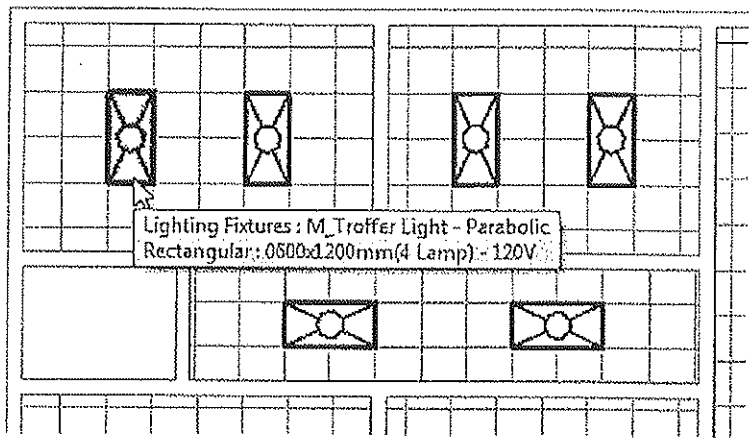

Figure 11–12

- Lighting fixtures can also be copied and monitored from a linked architectural file.

How to:

Place Lighting Fixtures:

1. Open the view where you want to place the lighting fixture.
2. In the *Systems* tab>Electrical panel, click (Lighting Fixture).
3. In Type Selector, select a specific component to insert and, in Properties, set any other available required values/options.
4. In the *Modify | Place Fixture* tab>Tag panel, click (Tag on Placement) to select or clear. If you have selected Tag on Placement, set the parameters for the tags in the Options Bar.
5. In the *Modify | Place Fixture* tab>Placement panel, click (Place on Vertical Face), (Place on Face), or (Place on Work Plane).
6. Click on the required location in the model view. Use alignment lines, temporary dimensions, and snaps to aid you in placing the components.
7. Continue to place additional devices, or click (Modify) to exit the command.

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Working with Lighting Fixtures

- Hosted fixtures have an **Elevation** parameter. For example, if the fixture is being placed on a vertical face (e.g., a sconce on a wall), this value can be set to control the height above the level.
- If the fixture is being placed on a face, such as a ceiling, the **Elevation** parameter is automatically determined by the height of the light fixture, which in this case is the same as the ceiling height.
- Some fixtures have an additional **Offset** parameter. This enables you to specify that the fixture be offset from the host, such as a fluorescent fixture, which hangs below the ceiling. In this case, adjust the elevation value to reflect the new elevation of the fixture, as shown in Figure 11–13.

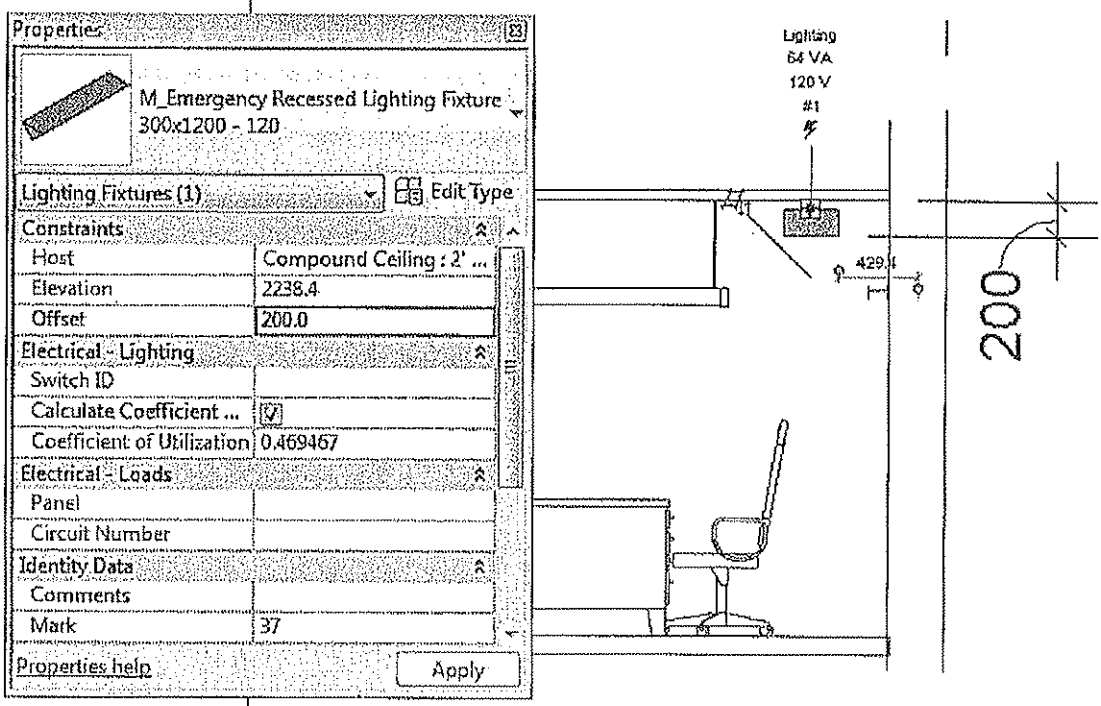

Figure 11–13

- Light fixtures that are hosted by a ceiling in a linked model move automatically with any changes that the architects make to the ceiling height. This can be an advantage of using hosted fixtures.

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Some firms add reference planes and place the hosted families on them instead of in the ceiling. This gives them control over the height of the families. If the architect moves the ceilings up or down, the engineer adjusts the height of the reference plane to match.

- If the architect deletes the ceiling and puts a new one in the linked model, the hosted lighting fixtures are orphaned and do not move with changes in the ceiling height. A warning box opens when you reload the linked model or reopen the MEP project, as shown in Figure 11–14. Use the **Coordination Monitoring** tools to address the issue.

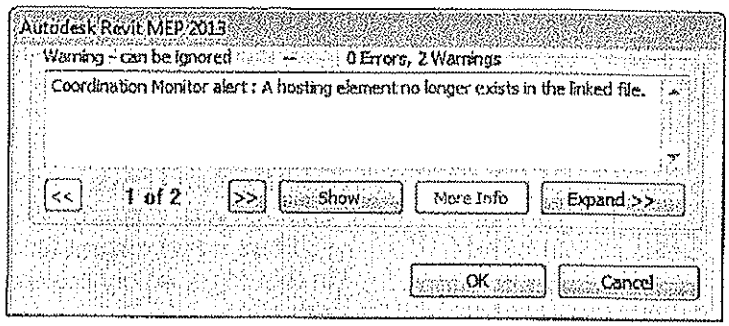

Figure 11–14

- Architectural light fixtures cut holes in the architectural ceiling. If the electrical engineer needs to put fixtures in a different place, they usually turn off the visibility of the linked architectural light fixtures first. This results in holes in the ceiling, as shown in Figure 11–15. To correct this issue, the engineer needs to request that the architect move the architectural lighting fixtures to the final, agreed on location.

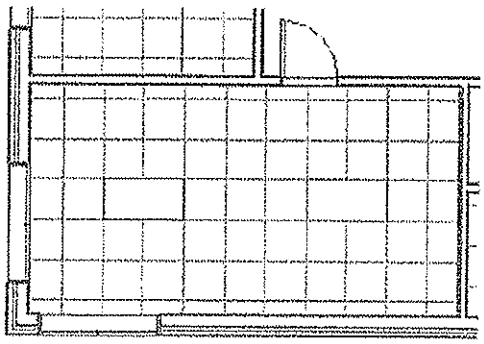

Figure 11–15

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11.3 Creating Electrical Circuits

Create Power Circuits, Switch Systems, and other circuit systems.

Once you have placed the electrical equipment, devices, and lighting fixtures into the model, you need to create the electrical system (circuit) from these components. Circuits connect the similar electrical components to form the electrical system, as shown in Figure 11–16. Once the electrical system is created, you can then add, remove, or modify any of the components. You can also add wiring, but it is not necessary.

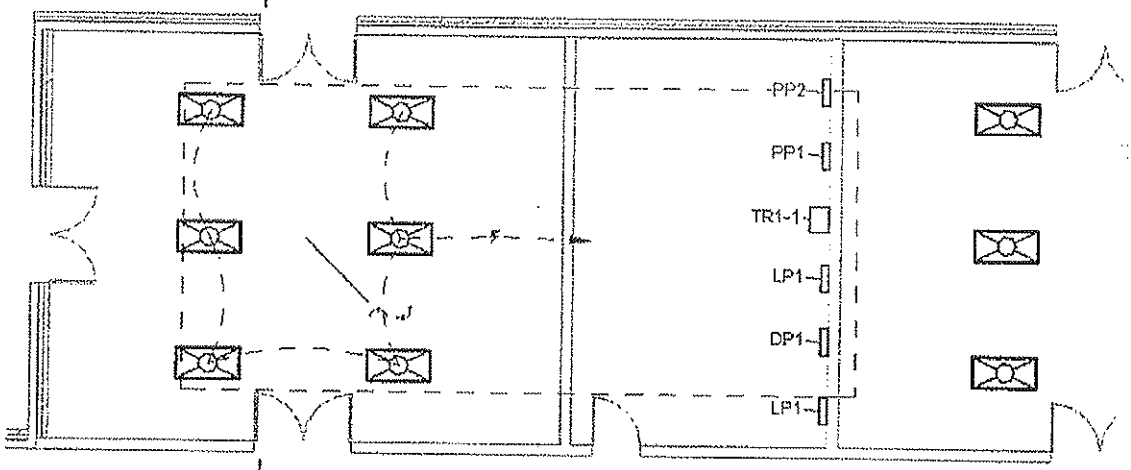

Figure 11–16

- Wiring is typically added to display exposed wires, or other wires that might be necessary for modifications.
- Components that are to be connected in a circuit must be of compatible voltage and distribution system.
- There are two types of systems that circuits can be created for. **Power** circuits (which includes lighting and power distribution) and **signals** and **communications** (data, telephone, fire alarm, nurse call, security, and controls).
- Your model probably contains multiple electrical systems.

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Creating Power Circuits

When creating a power circuit, select a component that is to be part of the power circuit. In the Ribbon, use the *Modify* contextual tab to create systems. Power systems connect compatible electrical devices and lighting fixtures, and connects them in a circuit to an electrical equipment panel, as shown in Figure 11–17.

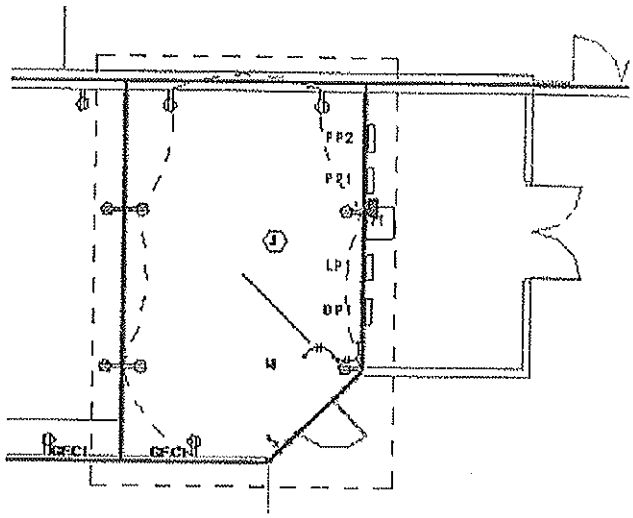

Figure 11–17

How to:

Create a Power Circuit

1. Select at least one of the components (electrical device or lighting fixture) that is to be part of the power circuit.
2. In the *Modify | Electrical Fixtures, Lighting Devices, or Lighting Fixtures* tab>Create Systems panel, click (Power).
3. In the *Electrical Circuits* tab>System Tools panel, click (Select Panel) if you need to add the electrical equipment panel. Select an available panel in the model or in the Options Bar. Verify that the panel has a Distribution System specified.
4. In the *Electrical Circuits* tab>System Tools panel, click (Edit Circuit).
5. In the *Edit Circuit* tab>Edit Circuit panel, click either (Add to Circuit) or (Remove from Circuit). Select additional components in the model to add them to the same circuit.
6. Click (Finish Editing Circuit).

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- If a component has more than one electrical connector, a Select Connector dialog box opens, as shown in Figure 11–18. Select the connector for which you want to make a circuit and click OK.

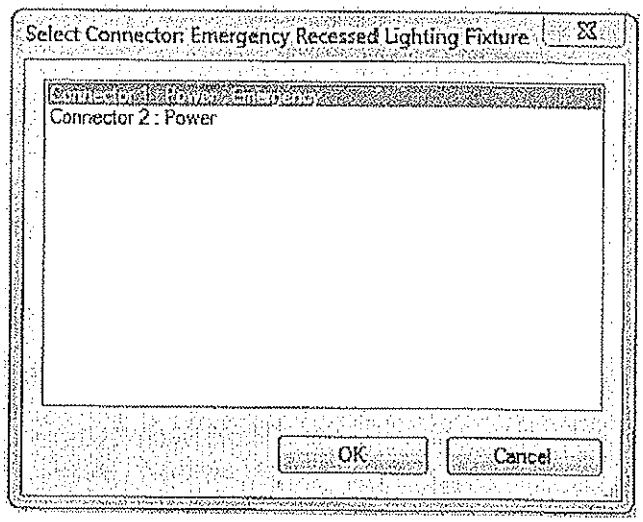

Figure 11–18

Create a Switch System

The S-1 and S-2 notations reference the system names, while the two notations reference the circuit.

In addition to power systems, lighting fixtures also have switch systems. Switch systems enable you to indicate which lights are linked to which switch, as shown in Figure 11–19. This is especially useful for those cases where there are multiple lights on the same circuit but controlled by different switches.

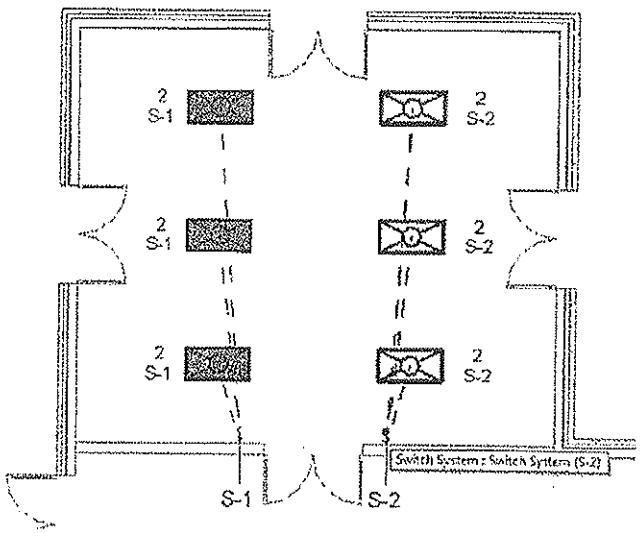

Figure 11–19

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How to:

How to create a switch system

1. Select at least one of the lighting fixtures that is to be part of the switch system.
2. In the *Modify | Lighting Fixture* tab>Create Systems panel, click (Switch).
3. In the *Modify | Switch System* tab>System Tools panel, click (Edit Switch System).
4. In the *Edit Switch System* tab>Edit Switch System panel, (Add to System) is selected by default. In the view, select any other lighting fixtures which are to be part of this switch system.
5. In the Edit Switch System panel, click (Select Switch).
6. Click (Finish Editing System).

- The Switch System is currently only able to have one switch per switch system.

Create Other Circuits

Besides Power circuits, there are other types of circuits that can be created. They are all similar and include data, as shown in Figure 11–20, telephone, fire alarm, communication, nurse call, security, and control systems. When creating these types of circuits, start by selecting a component that is to be part of it. These systems connect compatible devices, and connect them in a circuit to a similar panel.

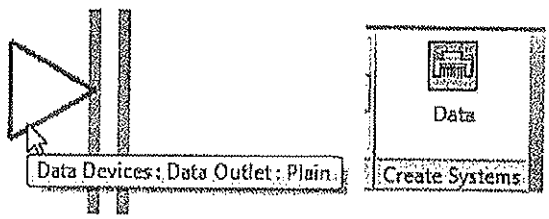

Figure 11–20

- The process for creating any type of circuit is the same. Select at least one of the components that is to be part of the circuit (such as an ethernet data connector device) and then, in the *Modify | (varies)* tab>Create Systems panel, click the appropriate system type, such as (Data).

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Practice 11a

Inserting Electrical Components and Creating Circuits

- Add Lighting fixtures and electrical equipment.
- Create electrical circuits for standard and emergency lighting.
- Display wire connections in a circuit.

Estimated time for completion: 20 minutes

In this practice you will insert lighting fixtures and add two electrical panels, one for standard lights and the other for emergency lights. You will connect light fixtures together in a power circuit, create an emergency power circuit, add light fixtures, and move those, as shown in Figure 11–21. You will also add a transformer and connect panels to it. Finally, you will display wire connections in a circuit.

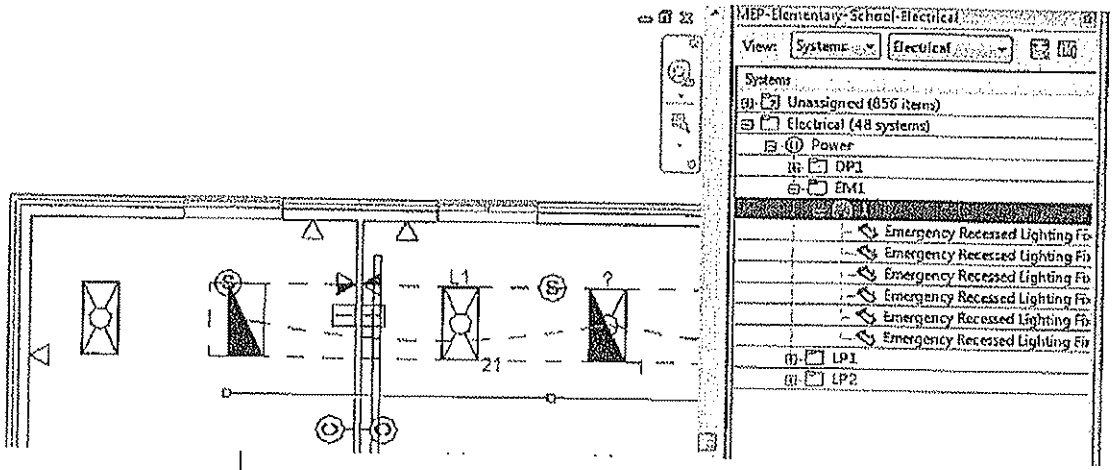

Figure 11–21

Task 1 - Add Lighting Fixtures.

1. Open the project **MEP-Elementary-School-Electrical-M.rvt** found in the *Chapter 11* folder of your class folder.
2. Open the Coordination>MEP>Ceiling Plans>**02 ELECTRICAL RCP** view and zoom to the upper left room.
3. In *Systems* tab>Electrical panel, click (Lighting Fixture).

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4. In Type Selector, select **M_Troffer Light - Parabolic Rectangular: 0600x1200mm(2 Lamp) - 277V.**

5. In the *Modify | Place Fixture* tab>Placement panel, click (Place on Face).

6. Place three of these lighting fixtures in the upper left room. Then change the type to **M_Emergency Recessed Lighting Fixture: 600x1200 - 277** and place one of these lighting fixtures as shown in Figure 11–22.

Press the <Spacebar> to rotate the fixtures.

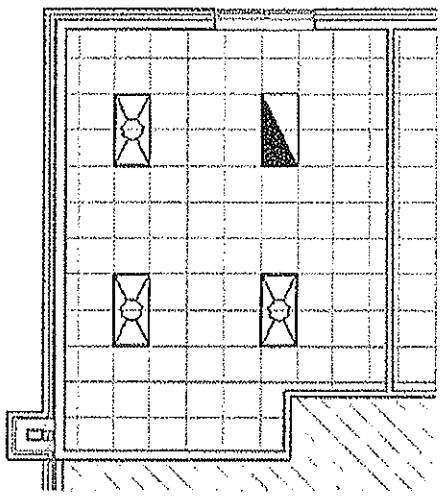

Figure 11–22

7. Click (Modify) to exit the command.

Task 2 - Add Electrical Equipment.

1. In the Project Browser, open the Electrical>Power>Floor Plans>**01 ELECTRICAL ROOM** view.

2. In *Systems* tab>Electrical panel, click (Electrical Equipment).

3. In the *Modify | Place Equipment* > Tag panel, verify that (Tag on Placement) is selected.

4. In Type Selector, select **Lighting and Appliance Panelboard - 480V MCB - Surface: 125 A.**

5. Place one panelboard on the bottom wall of the utility room.

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6. Click (Modify) and select the newly added panel in the active view.

7. In Properties, in the *General* area, set *Panel Name* to **LP2**, as shown in Figure 11–23.

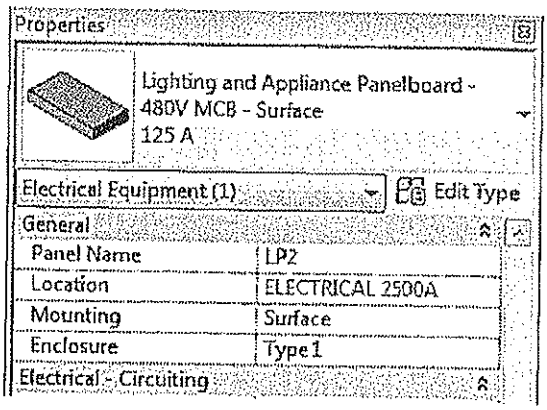

Figure 11–23

8. In Properties, in the *Electrical - Circuiting* area, expand the *Distribution System* list and select the **480/277 Wye** system.

9. Click (Modify) to release the selection.

10. Start the **Electrical Equipment** command again. In the Type Selector, select **Lighting and Appliance Panelboard - 480V MCB - Surface: 400 A**. Place the panel beside the other one you just added.

11. In Properties, in *General* area, set the *Panel Name* to **EM1** and in the *Electrical - Circuiting* area set the *Distribution System* to **480/277 Wye**.

12. Select the tags for the LP2 and EM1 panels and move them above the panels, as shown in Figure 11–24.

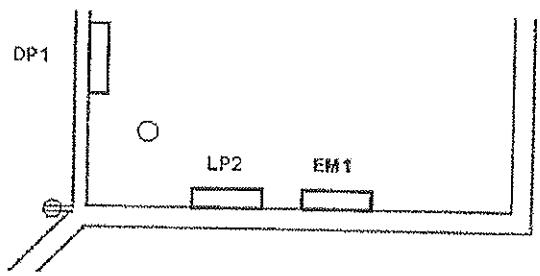

Figure 11–24

13. Save the project.

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Task 3 - Create an Electrical Circuit System.

1. Open the Electrical>Lighting>Floor Plans> **02 LIGHTING PLAN** view and zoom to the upper left room.
2. Select the upper left light and in the *Modify | Lighting Fixtures* tab>Create Systems panel, click (Power).
3. In the *Electrical Circuits* tab>System Tools panel, click (Edit Circuit).
4. In the *Edit Circuit* tab>Edit Circuit panel, verify that (Add to Circuit) is selected. Select the other two standard lights in the room but not the emergency light, as shown in Figure 11–25.

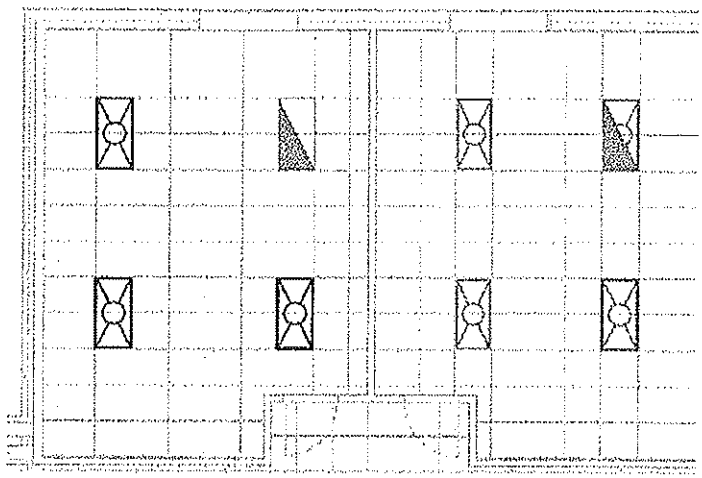

Figure 11–25

5. Select the emergency light. In the Select Connector dialog box, select **Connector 2: Power** and click OK.
6. In the Options Bar, expand the *Panel* list, and select **LP2**.
7. Click (Finish Editing Circuit) to complete the creation of the Power Circuit.
8. Open the Systems Browser if it is not already open.
9. Select one of the Troffer light fixtures which you just circuited.

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10. In the Systems Browser, expand the highlighted nodes to display the selected light fixtures, as shown in Figure 11–26. Only one light is highlighted in the project.

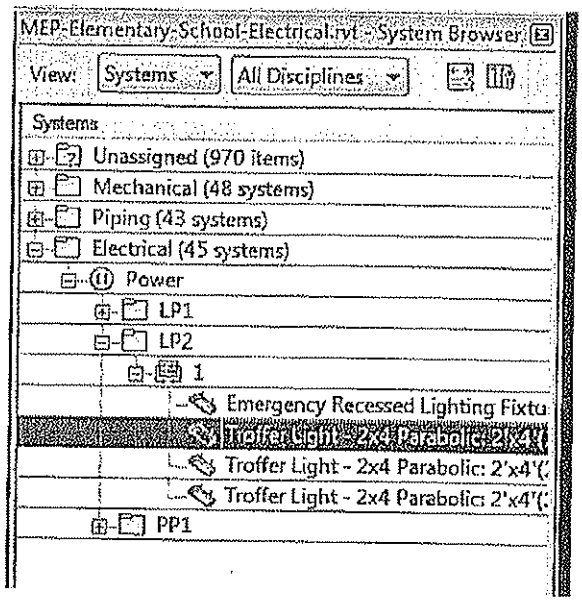

Figure 11–26

11. In the Systems Browser, select the related circuit **1**. The selection in the view changes to display the circuit outline, as shown in Figure 11–27.

The extents box surrounds the system and has connecting arcs to each fixture in this circuit.

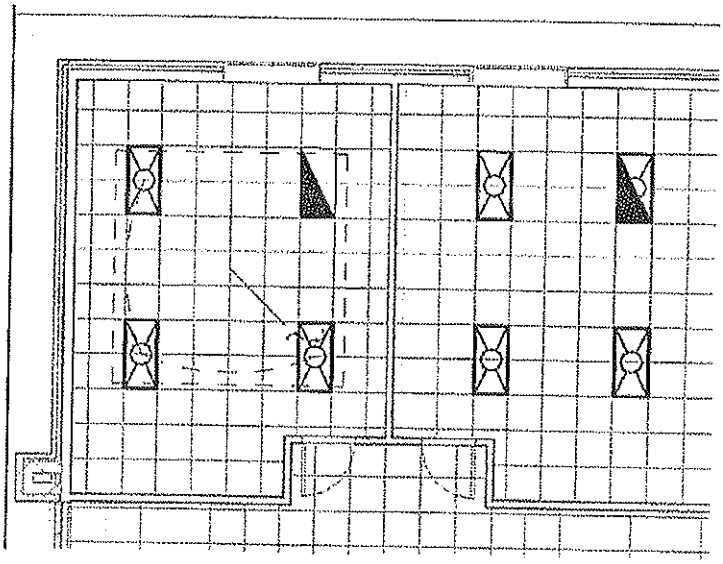

Figure 11–27

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12. In Properties, note the circuit properties. In the *Electrical - Loads* area, the *Circuit Number* should be set to **1** as it is the first circuit added to this panel. This field is non-editable.

13. Clear the selection.

14. Select the **Emergency Recessed Lighting Fixture**. In the Systems Browser, note that the Unassigned node highlights as well. This is because the fixture has two connectors, and you have only circuited one of them. This will be resolved in the next task.

15. Save the project

Task 4 - Add and Move Emergency Lighting Fixtures to an Emergency Circuit and Panel.

1. Continue working in the **02 LIGHTING PLAN** view.
2. Select the emergency lighting fixture added earlier.
3. In the *Modify* | *Lighting Fixtures* tab>Create Systems panel, click (Power).

Because there is now only one uncircuited connector on this fixture, the Select Connector dialog box does not open.

4. In the *Modify* | *Electrical Circuits* tab>Systems Tools panel, click (Edit Circuit).
5. In the Options Bar, select the *Panel* **EM1**.
6. In the Edit Circuit tab>Edit Circuit panel, verify that (Add to Circuit) is selected. Click on the emergency lighting fixture in the room to the right and select the emergency connector.
7. A warning displays that the fixture was part of another circuit, but has been moved to this circuit, as shown in Figure 11–28.

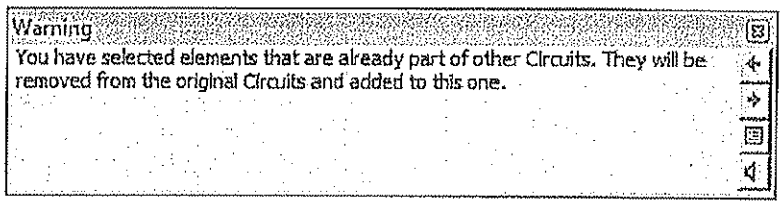

Figure 11–28

8. Click (Finish Editing Circuit).

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The system number varies based on the light fixture you selected.

9. Select one of the other emergency lighting fixtures. In the System Browser, expand the highlighted nodes as shown in Figure 11–29, and note that it is connected with the rest of the classroom circuit.

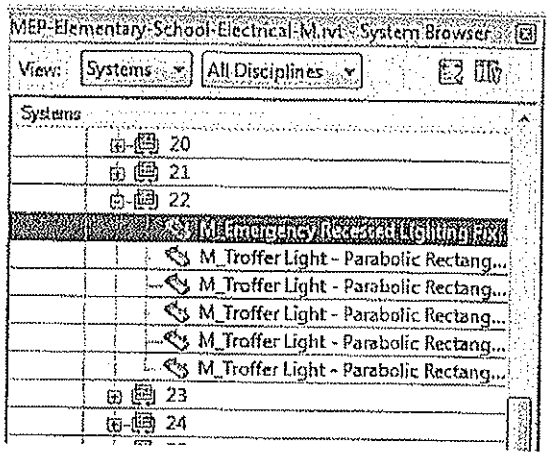

Figure 11–29

10. In the System Browser, select the related circuit number.
11. In the *Modify | Electrical Circuits* tab>System Tools panel, click (Edit Circuit).
12. In the *Edit Circuit* tab>Edit Circuit panel, click (Remove from Circuit).
13. Select the emergency fixture. The fixture is grayed out in the system as shown in Figure 11–30

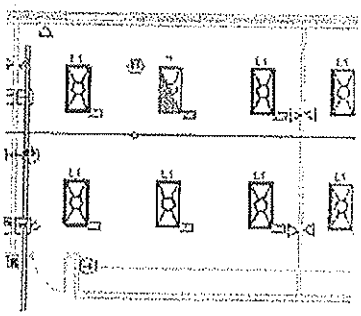

Figure 11–30

14. Click (Finish Editing Circuit) and the fixture is removed from the circuit in the System Browser.

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15. Add this fixture and others in nearby classrooms to the first emergency circuit. When you select other fixtures that have not been first removed, the Warning displays but can be ignored.

16. Save the project.

Task 5 - Add a Step Down Transformer.

1. Open the **01 ELECTRICAL ROOM** view.

2. In the *Systems* tab>Electrical panel, click (Electrical Equipment).

3. In the Type Selector, select **M_Dry Type Transformer - 480-208Y120 - NEMA Type 3R: 15 kVA**.

4. Place the transformer between PP1 and LP1, as shown in Figure 11–31.

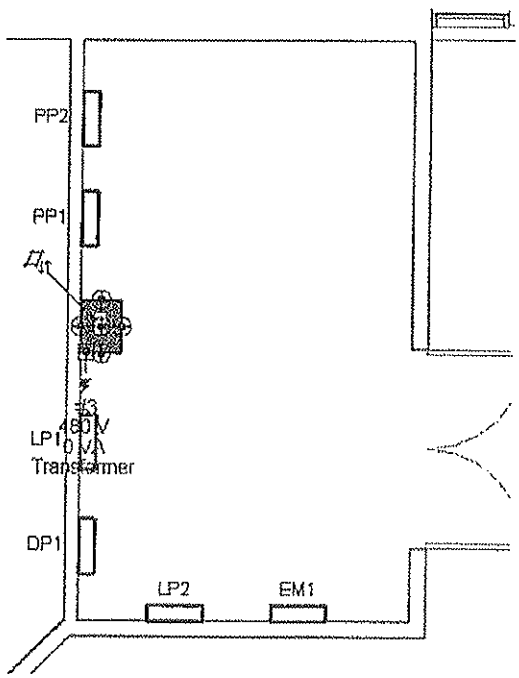

Figure 11–31

5. In Properties, in the *General* area, set the *Panel Name* to **TR1-1**.

6. In the *Electrical - Loads* area, set the *Secondary Distribution System* to **120/208 Wye**.

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The transformer has a primary and secondary distribution system; both are set as properties of the transformer.

7. In the *Electrical - Circuiting* area, set the *Distribution System* to **480/277 Wye**.
8. Click (Modify) and select the panel **PP1**.
9. In the *Modify | Electrical Equipment* tab> Create Systems panel, click (Power).
10. In the *Modify | Electrical Circuits* tab>System Tools panel, click (Select Panel).
11. In the Options Bar, in the *Panel* list select **TR1-1**. The load from panel PP-1 is now assigned to the transformer TR1-1
12. Click (Modify) and select **TR1-1**.
13. Create a Power System and select the panel **DP1**.
14. Click in the empty space to release the selection.
15. Save the project.

Task 6 - Show wire connections in a circuit.

1. Open the Electrical>Lighting> Floor Plans> **01 LIGHTING PLAN** view.
2. Zoom into the area near the electrical room but the nearby classroom should also be visible.
3. Hover your cursor over one of the lights in the classroom and press < Tab> to highlight the circuit. Click to select it as shown in Figure 11–32.

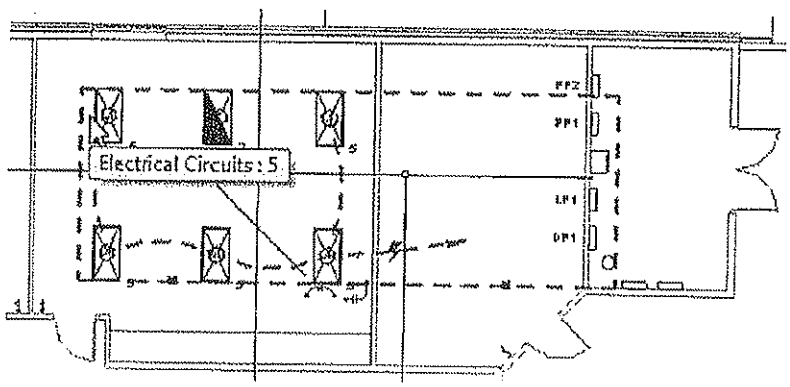

Figure 11–32

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4. In the *Modify | Electrical Circuits* tab>Convert to Wire panel, click (Arc Wire) or click on the Generate arc type wiring control in the drawing, as shown in Figure 11–33.

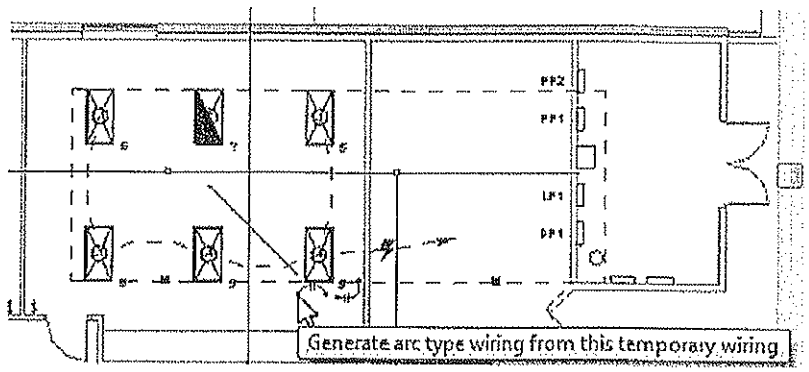

Figure 11–33

5. Wire displaying schematic routing of the circuit is automatically drawn. Adjust the wire arcs manually by pulling the blue control grips, as shown in Figure 11–34.

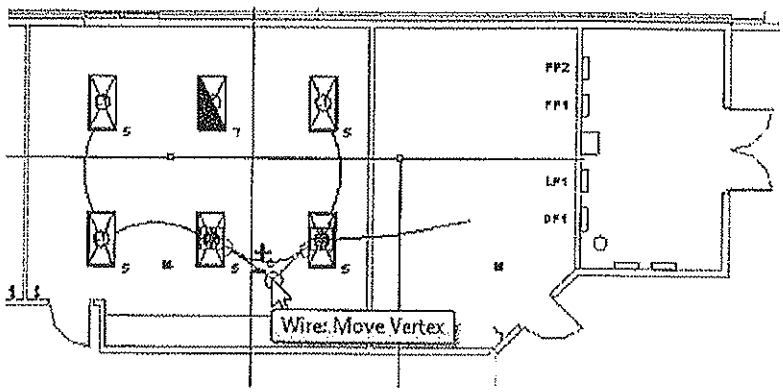

Figure 11–34

The fixture that remains in place is in the linked file.

6. Move a fixture and observe that the wire stays connected adjusting to the new fixture location. Wires are view specific.
7. If you have time you can also create a Switch System for the room.
8. Save the project.

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11.4 Cable Trays and Conduit

Add cable trays and conduit, including parallel conduit runs and fittings.

Modify Cable trays and conduit, including changing types and justification.

In real buildings, cable tray and conduit, as shown in Figure 11–35, hold electrical wiring either for power or data. In Revit MEP software, Cable Trays and Conduits do not correspond to any wiring. As such, they are coordination objects only and are not necessary when creating an electrical system.

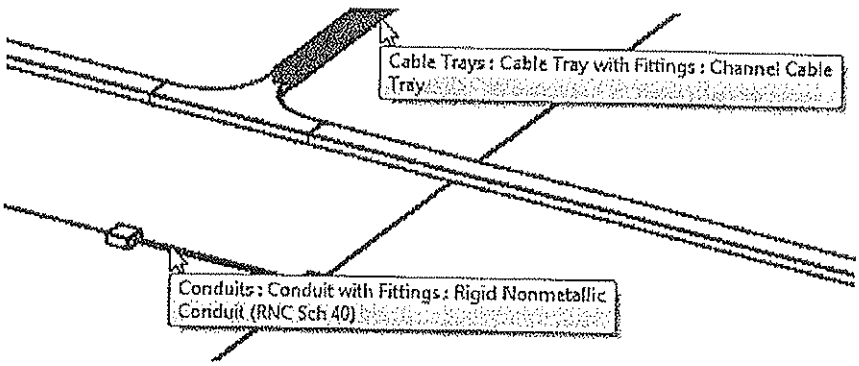

Figure 11–35

- The commands to create and place cable trays, conduits, and their appropriate fittings, are located in the *Systems* tab>Electrical panel, as shown in Figure 11–36.

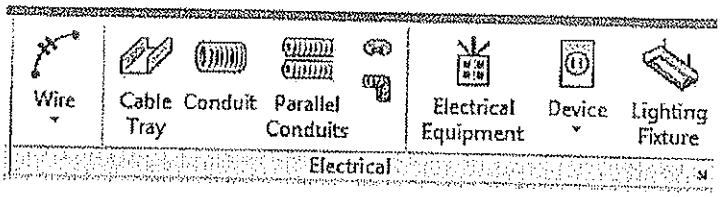

Figure 11–36

- Cable trays, conduits, and fittings can be placed in any view, including plan, elevation, and 3D.

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How to: **Add Cable Tray or Conduit**

1. Open the view where you want to place the cable tray or conduit.
2. In the *Systems* tab>Electrical panel, click (Cable Tray) or (Conduit).
3. In Type Selector, select a type to insert. You can select a type that includes fittings, or a type that does not include fittings.
4. In the Options Bar, for Cable Tray, set the *Width*, *Height*, *Offset* and *Bend Radius*, as shown in Figure 11–37.

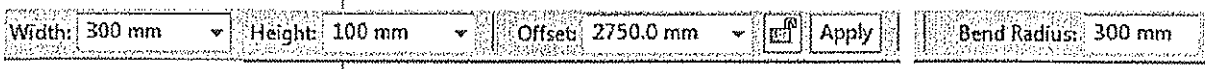

Figure 11–37

For Conduit, set the *Diameter*, *Offset*, and *Bend Radius* values as shown in Figure 11–38.

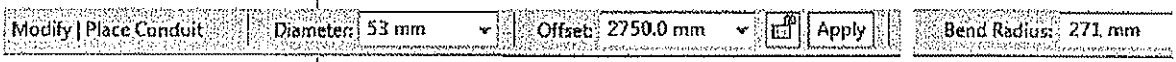

Figure 11–38

- Using (Lock/unlock Specified Elevation) enables the locked segment elevations to maintain their current elevation. However, they cannot connect to segments on different elevations.
- To draw a vertical segment, specify a new *Offset* value in the Options Bar.

5. In the Ribbon, adjust (Tag on Placement) to required setting (selected to automatically tag the equipment is typically recommended). If required, in the Options Bar include a leader and its length.
6. Set the appropriate Placement Tools.
7. In the drawing, click at the required location to begin the cable tray or conduit run.
8. Move to a second location and click to place the other end point of the cable tray or conduit. Continue to click at other points to create additional cable tray segments starting from the last end point. Fittings are automatically added where needed.
9. Click (Modify) to end and exit the command.

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When you snap to a connector, if ***Automatically Connect*** *is not on, any changes in height and size are applied with the appropriate fittings.*

- In the *Modify | Place Cable Tray (Conduit)* tab> Placement Tools panel, click (Automatically Connect) if you want a cable tray or conduit to connect to a lower segment and put in all the right fittings as shown in the background in Figure 11–39. Turn it off if you want to draw a tray that remains at the original elevation as shown in the foreground in Figure 11–39.

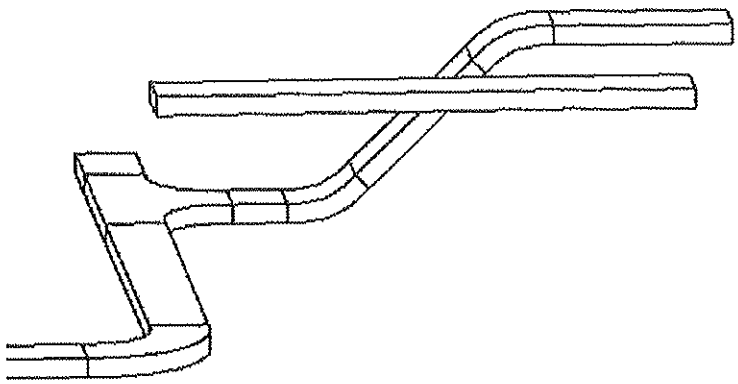

Figure 11–39

- To connect a conduit to a cable tray, start the conduit segment on a cable tray, regardless of elevation.

- For conduit, the **Placement Tools** option, (Ignore Slope to Connect) draws conduit directly from a higher point to a lower point without any fittings, as shown on the right in Figure 11–40. If the option is off, then the conduit does not slope but bends down at the point of connection, as shown on the left in Figure 11–40.

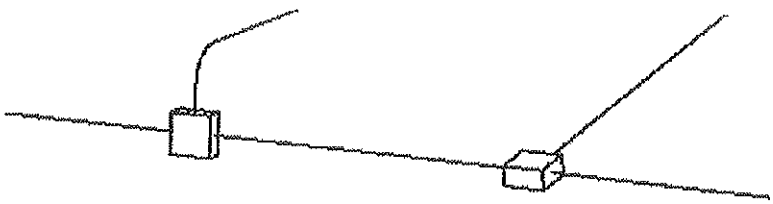

Figure 11–40

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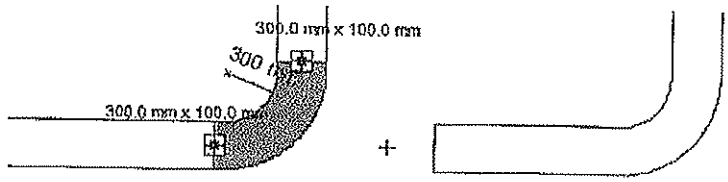
Cable Tray and Conduit With and Without Fittings

The process of placing cable tray and conduit is the same whether you select a type with fittings (separate elbows and tees) or a type without fittings (in the field the elements are bent to create curves and blends). In both cases, the software adds fitting components, but the one with fittings includes options to create tees and crosses, as shown on the left in Figure 11–41. The type without fittings does not, as shown on the right in Figure 11–41.



Cable Tray with Fittings + *Cable Tray without Fittings*

Figure 11–41

- The without fittings type also displays as a continuous element without lines between the straight segments and the fittings. It can use the special Conduit Runs or Cable Tray Runs schedules to schedule each run for a real-life length of conduit that is going to be used at the site.

Cable Tray and Conduit Placement Options

	**Justification Settings**	Opens the Justification Setting dialog box where you can specify the default settings for the **Horizontal Justification**, **Horizontal Offset**, and **Vertical Justification**.
	**Inherit Elevation**	An on/off toggle. If the tool is toggled on and you start drawing a cable tray/conduit by snapping to an existing element, the new cable tray/conduit takes on the elevation of the existing one regardless of what is specified, as shown in Figure 11–42.
	**Inherit Size**	An on/off toggle. If the tool is toggled on and you start drawing a cable tray/conduit by snapping to an existing element, the new cable tray/conduit takes on the size of the existing one regardless of what is specified, as shown in Figure 11–42.

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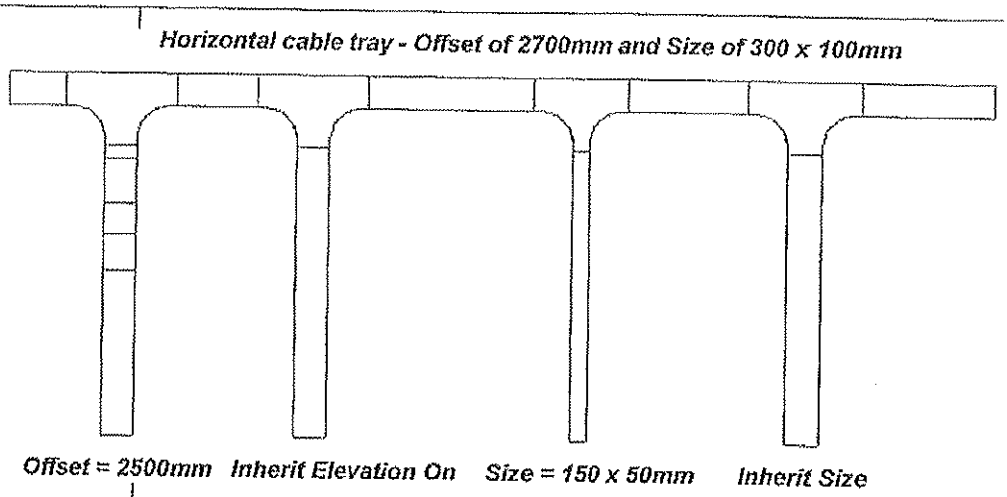

Figure 11–42

Creating Parallel Conduit Runs

The **Parallel Conduits** tool facilitates the creation of conduit runs parallel to an existing run, as shown in Figure 11–43. This saves time because only one run needs to be laid out, and the tool generates the parallel runs for you.

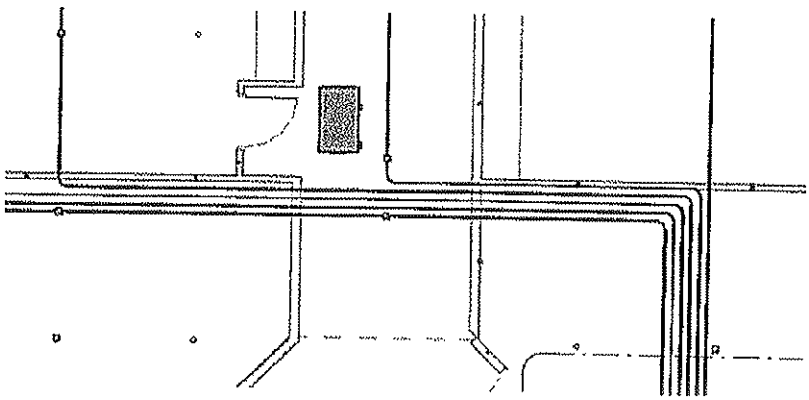

Figure 11–43

- Parallel conduit can be created in plan, section, elevation, and 3D views.

How to:

Create Parallel Conduit Runs

1. Create the initial single run of conduit as required.
2. In the *Systems* tab>Electrical panel, click (Parallel Conduits).
3. In the *Modify | Place Parallel Conduits* tab>Parallel Conduits panel, set the options as required (see below).
4. Hover the cursor over the existing conduit and press <Tab> to select the existing run.

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- If you do not press <Tab>, the parallel conduit is only created for the single piece of existing conduit.

5. When the preview displays as required, click to create the parallel runs.

   - The preview and resulting parallel conduit varies depending on which side of the existing run you hover the cursor.

Parallel Conduit Creation Options

	Bend Radius	Parallel runs use the same bend radius as the original.
	Concentric Bend Radius	The bend radius of the parallel runs varies in order to remain concentric to the original run. This option results in concentric bend radii only when used with parallel conduit types without fittings. For conduit types with fittings, it gives the same result as the Same Bend Radius option.
	Horizontal Number	The total number of parallel conduit runs in the horizontal direction.
	Horizontal Offset	The distance between parallel conduit runs in the horizontal direction.
	Vertical Number	The total number of parallel conduit runs in the vertical direction.
	Vertical Offset	The distance between parallel conduit runs in the vertical direction.

- In section and elevation views, horizontal refers to parallel to the view (visually up, down, left or right from the original conduit). Vertical creates parallel conduit runs perpendicular to the view, in the direction of the user.

Modifying Cable Tray and Conduit

Cable tray and conduit can be modified using a variety of standard modifying tools as well as changing type, modifying the justification and, in the case of conduit, ignoring slope to connect.

You can modify cable tray and conduit using universal methods by making changes in Properties, in the Options bar, and by using temporary dimensions, controls, and connectors. Modify tools, such as **Move**, **Rotate**, **Trim/Extend**, and **Align** enable you to place the elements in the correct locations.

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Often a change using these tools automatically applies the correct fittings. For example, in Figure 11–44, the *Edit End Offset* control is changed from **2750mm** on the left to **2500mm** on the right and the appropriate cable tray fittings are automatically placed to facilitate the change in elevation.

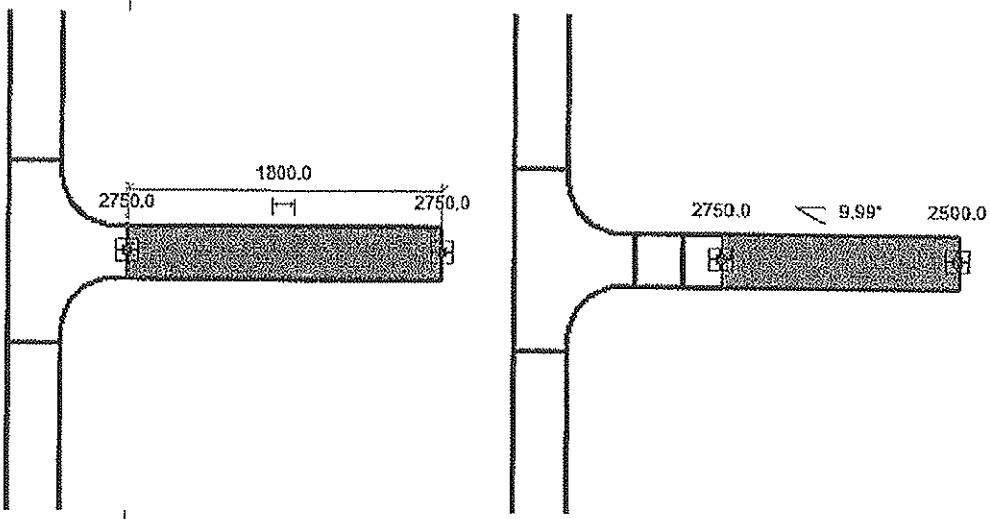

Figure 11–44

How to:

Change the Type of Cable Tray and Conduit Runs

1. Select the cable tray or conduit run. Ensure that you filter out everything except related elements and fittings.
2. In the *Modify* | *Multi-Select* tab>Edit panel, click (Change Type).
3. In the Type Selector, select a new type of conduit or cable tray. This changes the cable tray or conduit and also any related fittings. For example, as shown in Figure 11–45, a solid bottom cable tray is changed to a ladder cable tray.

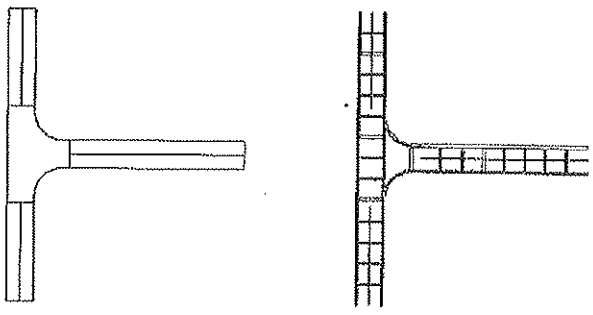

Figure 11–45

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Modifying the Justification

If a cable tray or conduit run has different sizes along its run, you can modify the justification of the cable tray or conduit, as shown in Figure 11–46.

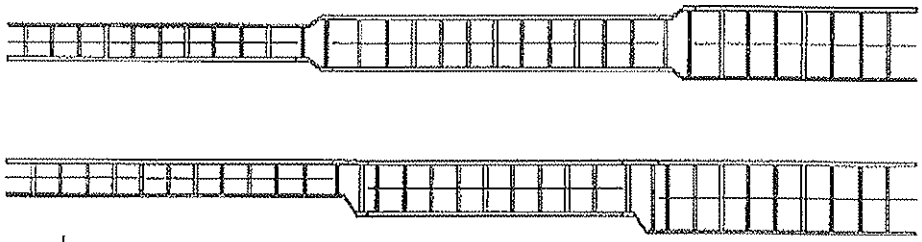
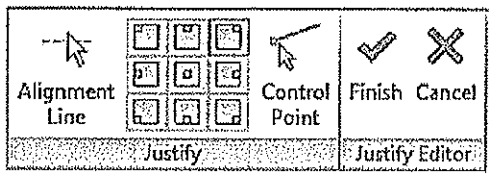


Figure 11–46

- While you can justify conduit, it is not typically required.

How to: **Modify Cable Tray Justifications**

1. Select the cable tray run.
2. In the *Modify | Multi-Select* tab>Edit Panel, click (Justify).
3. To specify the point on the cable tray you want to justify around, in the *Justification Editor* tab>Justify panel, click (Control Point) to cycle between the end point references. The alignment location displays as an arrow, as shown in Figure 11–47.



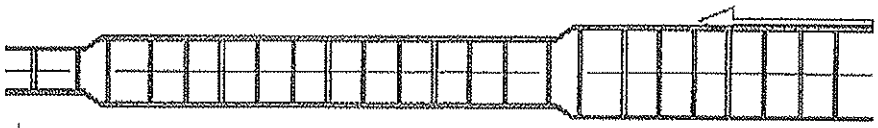


Figure 11–47

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4. To indicate the required alignment, either click one of the nine alignment buttons in the Justify panel, or in a 3D view, use (Alignment Line) to select the required dashed line, as shown in Figure 11–48.

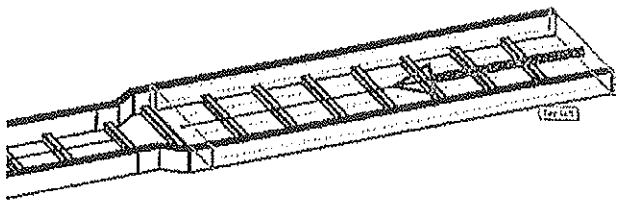

Figure 11–48

5. In the Justification Editor, click (Finish).

Adding Fittings

Revit MEP software automatically adds fittings to cable tray and conduit segments during their creation. It is also possible to manually add cable tray and conduit fittings to any existing segment or segment run. You can also use the controls on the fittings to modify the type, as shown in Figure 11–49.

Only Cable Tray and Conduit types with fittings display + to turn elbows into tees and tees into crosses.

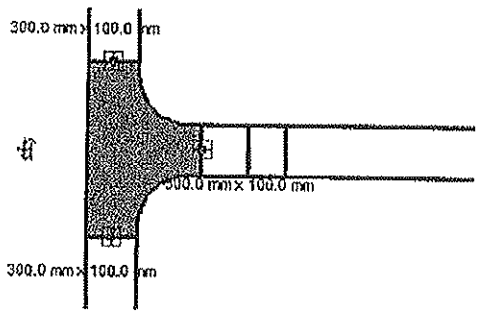

Figure 11–49

How to:

Manually add a Cable Tray or Conduit Fitting to a plan view

1. Open the view in which you are going to place the fitting.
2. In the *Systems* tab>Electrical panel, click either (Cable Tray Fitting) or (Conduit Fitting).
3. In the Type Selector, select the appropriate type you want to place.
4. In Properties, verify that the *Level* and *Offset* values are set as required.
5. Click in the view where you want to place the fitting.
6. Click (Modify) to end and exit the command.

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11.5 Electrical Panel Schedules

Create and modify electrical panel schedules.

Panel schedules are used to concisely present information about panels and the components connected to them through their corresponding circuits. They also list the load values of these circuits, as shown in Figure 11–50. The Autodesk Revit MEP software can create these panel schedules and automatically update them as the panels circuits change.

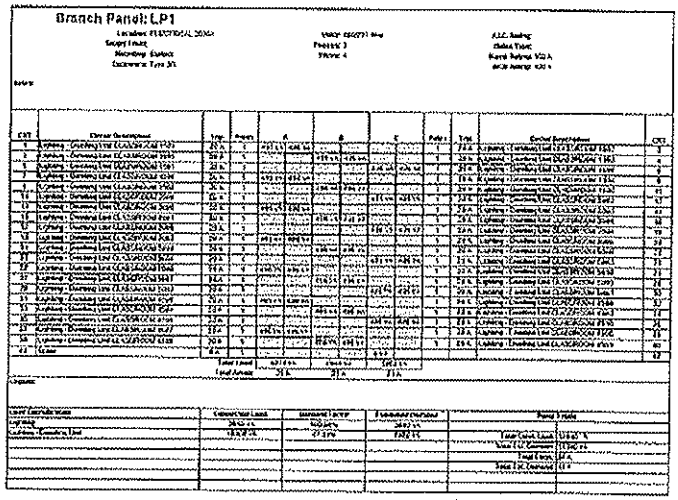

Figure 11–50

Create Panel Schedules

Panel schedules can be created for each panel in the model, and it can be created anytime before or after circuits are created for the panel. Once created, panel schedules are listed automatically in the Project Browser, in the **Panel Schedule** node, as shown in Figure 11–51.

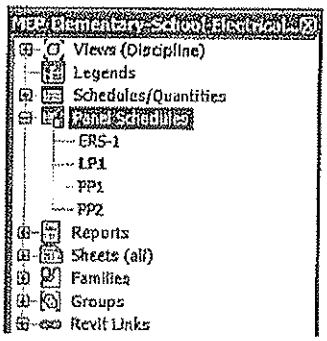

Figure 11–51

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How to:

Create a panel schedule

1. In a drawing view, select the panel that you want to create the panel for.
2. In the *Modify | Electrical Equipment* tab>Electrical panel, expand (Create Panel Schedule) and click (Use Default Template) to use the default panel template.
   - You can also click (Choose a Template) to select a pre-existing template to use.
3. A new panel schedule is created. Its view opens, and is listed in the Project Browser.

Modifying Panel Schedules

After a panel schedule has been created, its circuits can be modified. The circuits can be rearranged, locked, grouped, or renamed. Loads can be balanced across phases, and spares can be added.

How to:

Modify a panel schedule

1. In the panel schedule view, select the particular circuit(s) or empty slot(s) that you want to modify.
2. In the *Modify Panel Schedule* tab, click the particular command that you want to conduct.

The various commands function as follows:

Icon	Command	Function
	Rebalance Loads	Rearranges the panels circuits to redistribute the loads evenly across each phase.
	Move Up, Down, Across	Moves the selected circuit up, down, or across on the circuit panel.
	Assign/Remove Spare/Space	Assigns a slot as either a spare or a space (and are automatically locked), or Removes a spare or space from a slot.
	Lock/Unlock	Locks or unlocks circuits, spares, or spaces in a specific slot location.
	Group/Ungroup	Groups single-pole circuits/spares together to act as a multi-pole circuit (or ungroups them).

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Practice 11b

Adding Conduit and Panel Schedules

Add conduit to a lighting plan.

View and create panel schedules.

Estimated time for completion: 15 minutes

In this practice you will add conduit and a fitting to a project, as shown in Figure 11–52.You will also view an existing electrical panel schedule and create a new one.

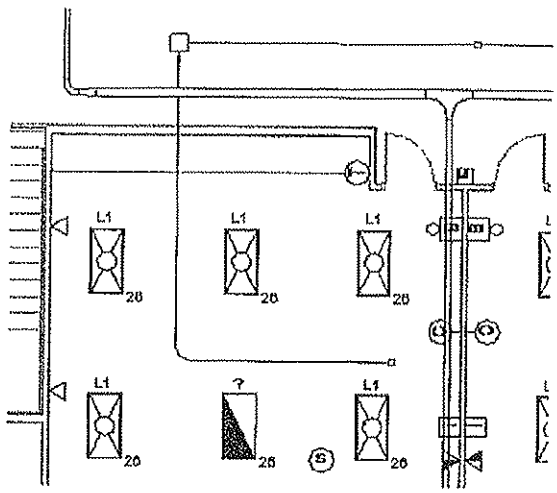

Figure 11–52

Task 1 - Add Conduit.

1. Open the project **MEP-Elementary-School-Electrical-Conduit-M.rvt** found in the *Chapter 11* folder of your class folder.
2. Activate the view **02 LIGHTING PLAN**, in Electrical> Lighting>*Floor Plans*, and zoom to the bottom left classroom in the north wing.
3. In the *Systems* tab>Electrical panel, click (Conduit).
4. In the Type Selector, select **Conduit with Fittings - Rigid Nonmetallic Conduit (RNC Sch 40)**.

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5. In Properties, set the *Reference Level* to **Level 2**, set the *Offset* to **2900mm**, and click Apply.

6. Start the first point of the conduit segment at the conduit junction box above the room, as shown in Figure 11–53.

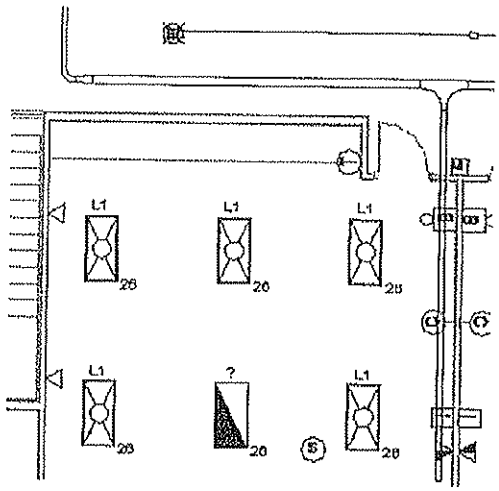

Figure 11–53

7. For the second point, move the cursor straight down and select between the lights, as shown in Figure 11–54.

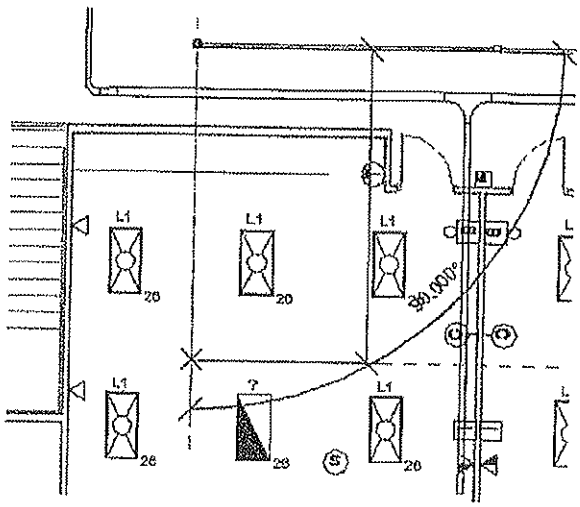

Figure 11–54

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The bend fittings are created automatically.

8. Move the cursor straight to the right and select point just before the wall, as shown in Figure 11–55.

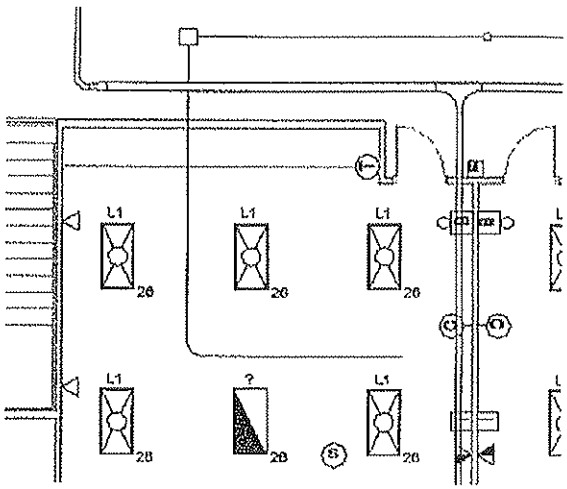

Figure 11–55

9. Click (Modify) to end and exit the command.

10. In the *Systems* tab>Electrical panel, click (Conduit Fitting).

11. In the Type Selector, select **M_Conduit Junction Box - Cross - Aluminum - Standard**. Set *Level* to **Level 2** and *Offset* to **2900mm** Click Apply.

12. Place the junction box at the end of the conduit segment you just created.

13. Click (Modify) to end and exit the command.

14. Save the project.

Task 2 - Viewing and Creating Panel Schedules.

1. In the Project Browser, expand the **Panel Schedules** node and double-click on the LP1 panel schedule to open it.

2. Select circuit **39**, and note its description **Lighting - Dwelling Unit CLASSROOM 4502**.

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3. In the *Modify Panel Schedule* tab>Circuits panel, click (Move Across). It switches place with circuit **40** on the right (**Lighting - Dwelling Unit CLASSROOM 4501**).
4. Continue to move it up, down, or across, and then **Lock** it and try to move others near it. The locked one will not move.
5. Select an empty circuit in the panel schedule.
6. Click (Assign Spare) and a Spare is inserted into that circuit. Note that it is automatically **Locked**, but you can unlock it and move it if required.
7. Close Panel Schedule **LP1**.
8. In the **01 POWER PLAN** view, select the electrical panel **LP2**.
9. In the *Modify | Electrical Equipment* tab>Electrical panel, expand (Create Panel Schedules) and click (Use Default Template).
10. The Panel Schedule **LP2** is created and automatically opened, as shown in Figure 11–56. It is also listed in the Panel Schedules node in the Project Browser. Examine the values in the schedule.

Branch Panel: LP2

Location: ELECTRICAL_2500A
Supply From:
Mounting: Surface
Enclosure: Type 1

Volts: 480/277 Wye
Phases: 3
Wires: 4

A.I.C. Rating:
Mains Type:
Mains Rating: 100 A
MCB Rating: 125 A

Notes:

CKT	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	CKT
1	Lighting - Dwelling Unit CLASSROOM 5010	20 A	1	240 VA									2
3													4
5													6
7													8
9													10

Figure 11–56

11. Save the project.

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Chapter Review Questions

1. Which of the following is NOT a type of Electrical System that can be created in the Autodesk Revit MEP software?
   a. Power
   b. Communications
   c. Low Voltage
   d. Lighting
2. Which of the following are types of electrical components that can be added to a project? Select all that apply.
   a. Electrical equipment
   b. Cable tray
   c. Lighting fixtures
   d. Electrical Devices
3. To change the type of a cable tray or conduit run you must...
   a. Redraw the run using the correct type.
   b. Select one element in the run and change it in the Type Selector.
   c. Select all of the elements in the run and change it in the Type Selector.
   d. Select all of the elements in the run and use **Change Type**.
4. Once a circuit has been added to a panel schedule, can it be modified?
   a. Yes
   b. No
5. How do you move a spare circuit in a panel schedule?
   a. Select it and use the **Move** tool in the *Modify* tab.
   b. Select it and use **Move Up**, **Move Down**, or **Move Across**.
   c. Unlock it and use the **Move** tools in the Circuits panel.
   d. Move the circuit in the plan view. The panel schedule updates accordingly.

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Command Summary

Button	Command	Location
	Add to Circuit	**Ribbon:** *Edit Circuit* tab>Edit Circuit panel
	Automatically Connect	**Ribbon:** *Modify* | *Place Cable Tray* or *Place Conduit* tab>Placement Tools panel
	Cable Tray	**Ribbon:** *Systems* tab>Electrical panel
	Cable Tray Fitting	**Ribbon:** *Systems* tab>Electrical panel
	Conduit	**Ribbon:** *Systems* tab>Electrical panel
	Conduit Fitting	**Ribbon:** *Systems* tab>Electrical panel
	Create Panel Schedule	**Ribbon:** *Modify* | *Electrical Equipment* tab>Electrical panel
Multiple buttons	Device	**Ribbon:** *Systems* tab>Electrical panel
	Edit Circuit	**Ribbon:** *Modify* | *Electrical Circuits* tab>System Tools panel
	Electrical Equipment	**Ribbon:** *Systems* tab>Electrical panel
	Ignore Slope to Connect (Conduit only)	**Ribbon:** *Modify* | *Place Conduit* tab> Placement Tools panel
	Inherit Elevation	**Ribbon:** *Modify* | *Place Cable Tray* or *Place Conduit* tab>Placement Tools panel
	Inherit Size	**Ribbon:** *Modify* | *Place Cable Tray* or *Place Conduit* tab>Placement Tools panel
	Justification	**Ribbon:** *Modify* | *Place Cable Tray* or *Place Conduit* tab>Placement Tools panel
	Lighting Fixture	**Ribbon:** *Systems* tab>Electrical panel

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	**Parallel Conduits**	▪ **Ribbon:** *Systems* tab>Electrical panel
	**Power**	▪ **Ribbon:** *Modify | Lighting Fixtures* tab or *Modify Electrical Equipment* tab> Create Systems panel
	**Remove from Circuit**	▪ **Ribbon:** *Edit Circuit* tab>Edit Circuit panel
	**Select Panel**	▪ **Ribbon:** *Modify | Electrical Circuits* tab>System Tools panel

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Chapter 12

Creating Construction Documents

In this chapter you learn how to setup construction documents by creating sheets with title blocks and adding views on the sheets. You also learn about printing the sheets.

This chapter contains the following topics:

- ✓**Setting Up Sheets**
- ✓**Placing and Modifying Views on Sheets**
- ✓**Adding Revisions**
- ✓**Printing Sheets**

Learning Objectives

This chapter provides instruction to enable you to do the following:

12.1 Setting Up Sheets

- Add sheets to the project.
- Fill in title block information.

12.2 Placing and Modifying Views on Sheets

- Place views on sheets including using Guide Grids to help place the views.
- Modify views on sheets including moving views and view titles, removing views, and resizing views
- Activate views on sheets so you can make minor changes to them.

12.3 Adding Revisions

- Set up revision schedules and place revision clouds and tags on a sheet.

12.4 Printing Sheets

- Print sheets using the default Print dialog box.

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12.1 Setting Up Sheets

- Add sheets to the project.
- Fill in title block information.

While you are working on a project, you should also be thinking about the working drawings that are needed to document it—that is, the printouts with details and annotation to guide construction. Any view, such as a floor plan, section, callout, or schedule, can be placed on a sheet. You can specify the scale for each view and add annotations and other detailing to the views or sheets, as shown in Figure 12–1.

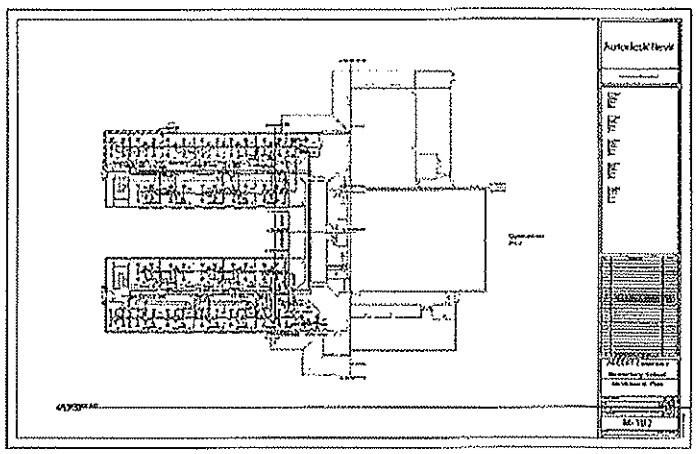

Figure 12–1

How to:

Set Up Sheets

1. In the Project Browser, right-click on the *Sheets* area header and select **New Sheet...** or in the *View* tab>Sheet Composition panel, click (Sheet).
2. In the New Sheet dialog box, select a title block from the list as shown in Figure 12–2.

Click Load... *to load a sheet from the Library.*

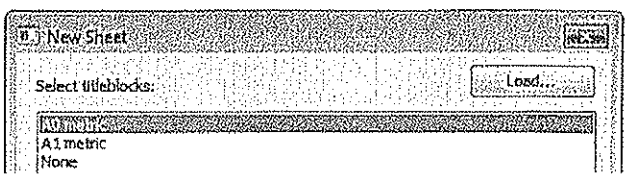

Figure 12–2

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- If you have a preset list of placeholder sheets, you can select the one you want to use from the list, as shown in Figure 12–3.

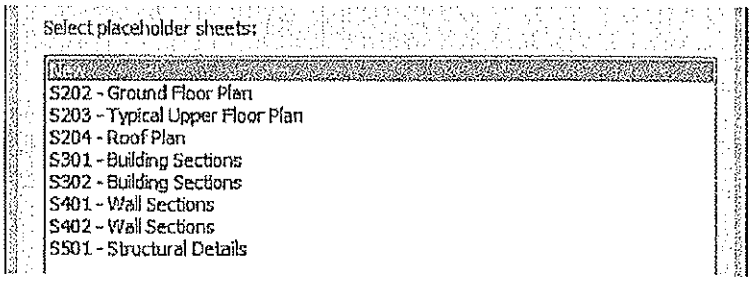

Figure 12–3

3. Click OK. A new sheet is created using the preferred title block.
4. Fill out the information in the title block as needed.
5. Add views to the sheet by dragging and dropping them from the Project Browser onto the sheet.
6. Add any general notes or additional annotation to the sheet.

- Once created, sheets are listed in the *Sheets (all)* area of the Project Browser.

- When you create sheets, the next sheet is incremented numerically.

- When you change the Sheet Name and/or Number in the title block, it automatically changes the name and number of the sheet in the Project Browser.

- Company templates can be created with standard sheets set up with the company (or project) title block with related views already placed on the sheet.

- You can also create placeholder sheets in a Sheet List schedule. A typical use of placeholder sheets in an architectural firm is to include the sheet names and numbers of the consultants' sheets. This way they are listed in the sheet list even if they are not part of the architect's project and are not to be plotted by the architect.

- The plot stamp on the side of the sheet automatically updates according to the current date and time. The format of the display uses the regional settings of your computer.

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- You can create your own title block using a template from Autodesk® Revit® software (**Application Menu>New>Title Block**). Select the size you want to work with and then add lines, text, labels, and imported files as needed to create the title block.

Sheet (Title Block) Properties

A new sheet includes a title block. You can change the information in the title block by selecting any blue label you want to edit (Project Name, Project Number, etc.), as shown in Figure 12–4.

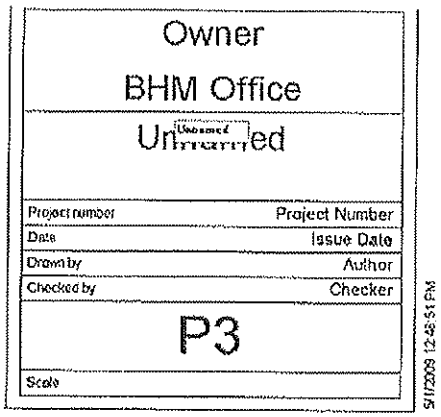

Figure 12–4

- You can also change the title block information that is sheet specific in Properties, as shown in Figure 12–5.

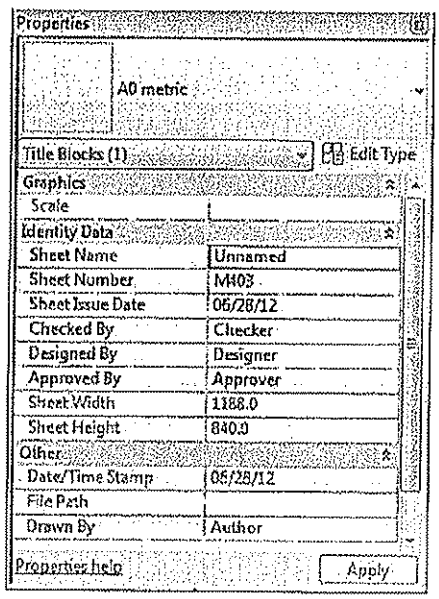

Figure 12–5

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- To set properties that apply to all sheets, enter the Project Properties. In the *Manage* tab>Settings panel, click (Project Information). In the Project Properties dialog box, as shown in Figure 12–6, add the **Project Name**, **Client**, and other project based information.

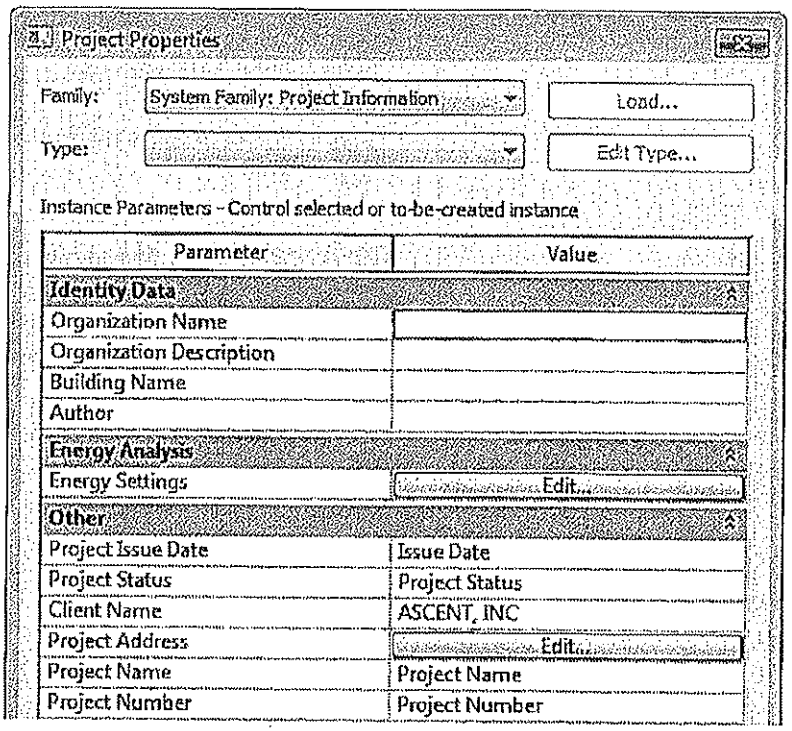

Figure 12–6

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12.2 Placing and Modifying Views on Sheets

- Place views on sheets including using Guide Grids to help place the views.
- Modify views on sheets including moving views and view titles, removing views, and resizing views
- Activate views on sheets so you can make minor changes to them.

The process of adding views to a sheet is simple. Drag and drop a view from the Project Browser onto the sheet. The new view on the sheet is displayed at the scale specified in the original view. The view title displays the name, number, and scale of the view, as shown in Figure 12–7.

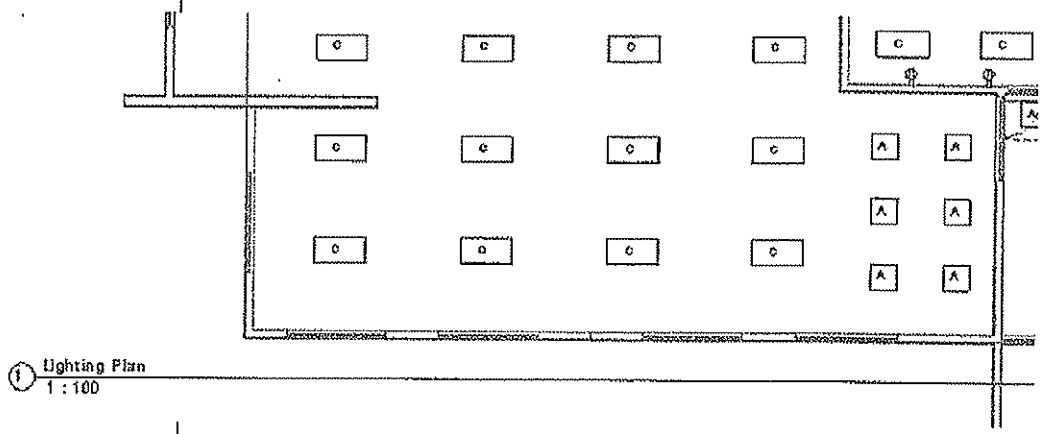

Figure 12–7

How to:

Alignment lines from existing views display to help you place additional views.

Place Views on Sheets

1. Set up the view as you want it to display on the sheet, including the scale and visibility of elements.
2. Create or open the sheet where you want to place the view.
3. Select the view in the Project Browser, and drag and drop it onto the sheet.
4. The center of the view is attached to your cursor. Position the view as needed, and click to place it on the sheet.

- You cannot place a view more than once on your sheets. However, you can duplicate the view and place the copy on a sheet.

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- Views on a sheet are associative. They automatically update to reflect changes to the project.
- Each view on a sheet is listed under the sheet name in the Project Browser, as shown in Figure 12–8.

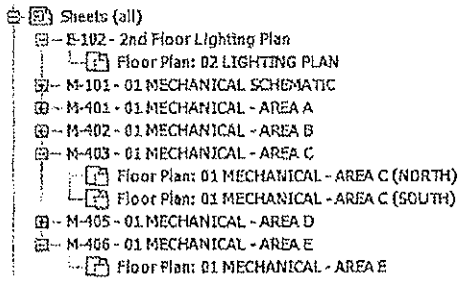

Figure 12–8

- Alternatively, you can place a view by clicking (Place View) in the Sheet Composition panel and then selecting the view from the list in the Views dialog box, as shown in Figure 12–9.

This method lists only those views which have not yet been placed on a sheet.

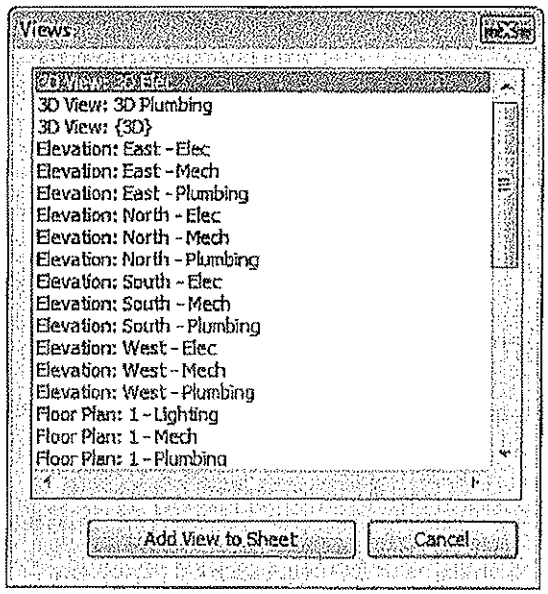

Figure 12–9

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- You can change the title of a view on a sheet without changing its name in the Project Browser. In Properties, in the *Identity Data* area, type a new title for the **Title on Sheet** parameter, as shown in Figure 12–10.

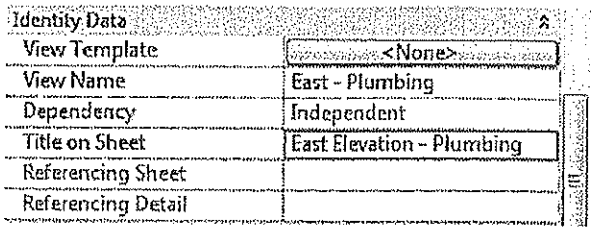

Figure 12–10

Working with Guide Grids

You can use a guide grid to help you place views on a sheet, as shown in Figure 12–11. Guide grids can be set up per sheet. You can also create different types with various grid spacings.

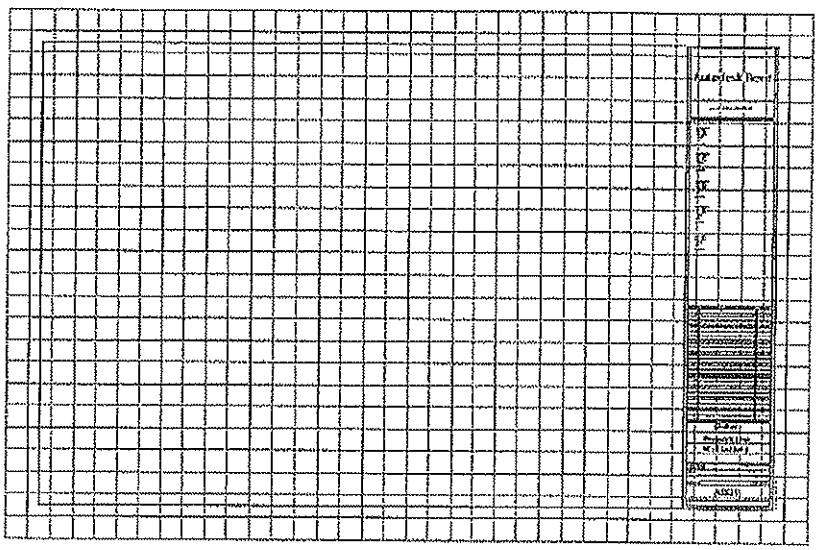

Figure 12–11

- You can move guide grids and resize them using controls.
- Views are positioned based on levels, grids, and reference planes within the view. In some cases, such as details and legends, you need to add reference planes to have elements to select.

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How to:

Add A Guide Grid

1. When a sheet is open, in the *View* tab>Sheet Composition panel, click (Guide Grid).
2. In the Assign Guide Grid dialog box, select from existing guide grids, as shown in Figure 12–12, or create a new one and give it a name.

Enhanced in 2013

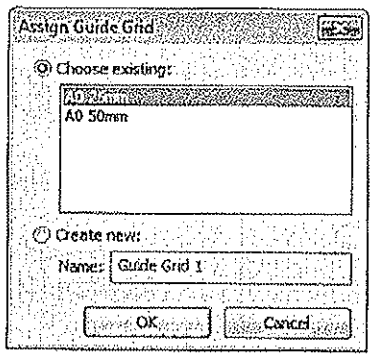

Figure 12–12

3. The guide grid displays using the specified sizing.

How to:

Modify Guide Grid sizing

1. If you create a new guide grid, update it to the correct size in Properties. Select the edge of the guide grid.
2. In Properties, set the *Guide Spacing*, as shown in Figure 12–13.

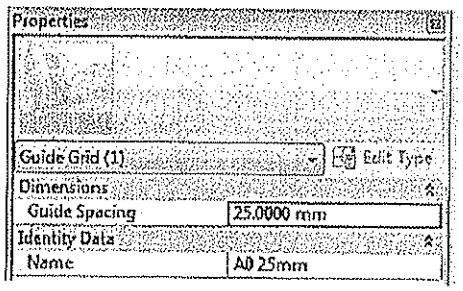

Figure 12–13

How to:

Similar views on other sheets would typically be positioned using the same Guide Grid intersection.

Position a View using the Guide Grid

1. Open a sheet and select the view that you want to position.
2. In the *Modify* tab>Modify panel, click (Move).
3. Select a snap point along or an intersection of two of the following elements: levels, grids, and reference planes. You cannot snap to other elements while on a sheet.

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4. Select the required intersection of the Guide Grid to position the view precisely.

Modifying Views on Sheets

Views can be modified in several ways. You can move, delete, and rotate (90 degrees) views on a sheet. The view title can also be moved independently of the view. When you change any of the view properties of a view, they automatically update on the sheet.

- To display a specific portion of a model, use a callout view or modify the crop region in the view.

Moving Views and View Titles

*You can also use the **Move** command or the arrow keys on the keyboard to move a view.*

- To move a view on a sheet, click the view and drag it to a new location. The view title moves with the view.
- To move only the view title, select the view title directly and drag it to the new location.
- To modify the length of the line under the title name, select the viewport and drag the controls, as shown in Figure 12–14.

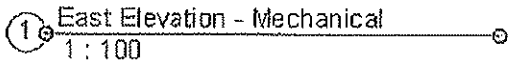

Figure 12–14

Deleting Views

- To remove a view from a sheet, select it and press <Delete>. Alternatively, select the view name under the sheet in the Project Browser, right-click, and select **Remove From Sheet**.

Rotating Views

- If you are creating a vertical sheet, you can rotate the view on the sheet by 90 degrees. Select the view and set the direction of rotation in the Rotation on Sheet drop-down list in the Options Bar, as shown in Figure 12–15.

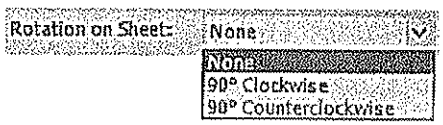

Figure 12–15

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- If a view needs to be rotated to an angle other than 90 degrees, do this before you place it on a sheet. Turn on the crop region in the view and then select the view. In the Modify panel, click (Rotate) and change the rotation. The crop region remains as is, but the elements in the view rotate.

Resizing Views on Sheets

Each view displays the extents of the model or the elements contained in the crop region. If the view does not fit on a sheet, as shown in Figure 12–16, you might need to crop the view or move the elevation markers closer to the building.

If the extents of the view change dramatically based on a scale change or a crop region, it might be easier to delete the view on the sheet and drag it over again, rather than reworking the location of the view and title on the sheet.

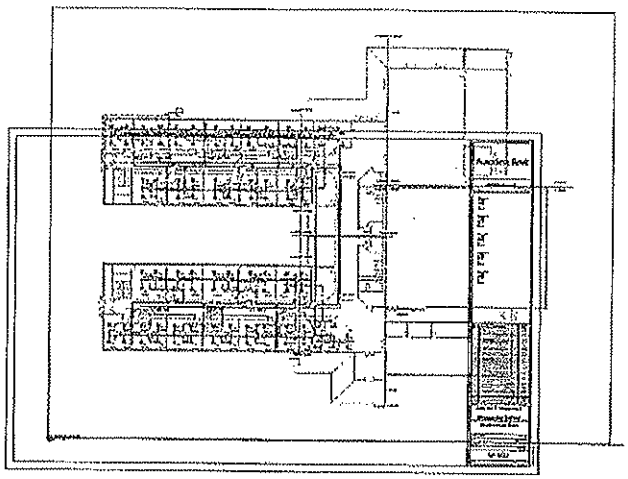

Figure 12–16

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Working Inside Views

Only use this method for small changes. Significant changes should be made directly in the view.

If you need to make small changes to a view while working on a sheet, you can work "through" the viewport on the model itself by activating a view. To activate a view, select it and in the *Modify | Viewports* tab>Viewport panel, click (Activate View). You can also right-click on the viewport and select **Activate View**. Only elements within the viewport are available for modification. The rest of the sheet is grayed out, as shown in Figure 12–17.

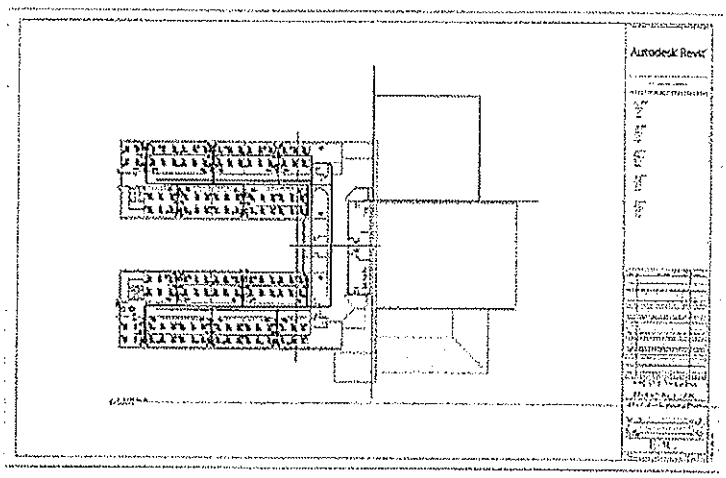

Figure 12–17

- To return to the sheet, right-click and select **Deactivate View**. Alternatively, switch to the *View* tab>Sheet Composition panel, expand (Viewports), and click (Deactivate View).
- Changes you make to elements when a view is activated also display in the original view.

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Hint: Add an Image to a Sheet

Company logos are usually displayed in titleblocks to identify the design team and consultants on the project. In most cases, the logos are added directly to the titleblock family.

1. Open a titleblock. (A titleblock is a family file and has an RFA extension.)
2. In the *Insert* tab>Import panel, click (Image).
3. In the Import Image dialog box, select and open the image file. Cross-hatching lines with grips at the ends display, indicating the extents of the image as shown in Figure 12–18.



Figure 12–18

4. Place the image where you want it to be located within the titleblock.
5. The image is displayed. Pick one of the grips and extend it to modify the size of the image.

- In Properties, you can adjust the height and width and also set the *Draw Layer* to either **Background** or **Foreground**, as shown in Figure 12–19.

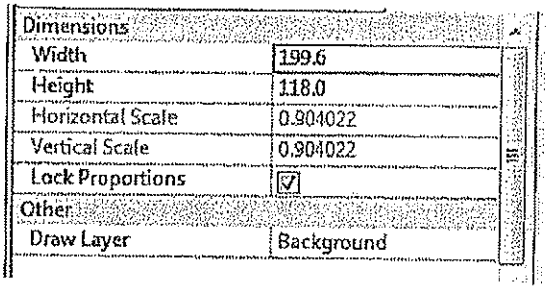

Figure 12–19

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12.3 Adding Revisions

Set up revision schedules and place revision clouds and tags on a sheet.

In the Autodesk Revit software, revisions are more than just a cloud and a triangle. They are a traceable entity and can be organized on a per-sheet basis. There are two steps to creating revisions: setting up the revision list and adding the revision cloud and tag associated with each revision in the schedule. The revisions are automatically added to the revision schedule on the sheet as shown in Figure 12–20.

*You can track revisions on a sheet-by-sheet basis or project wide using the options in the Numbering area in the dialog box. If it is **Per Project**, the revision displays in the schedule on the sheet, even if a revision cloud has not been added to the sheet.*

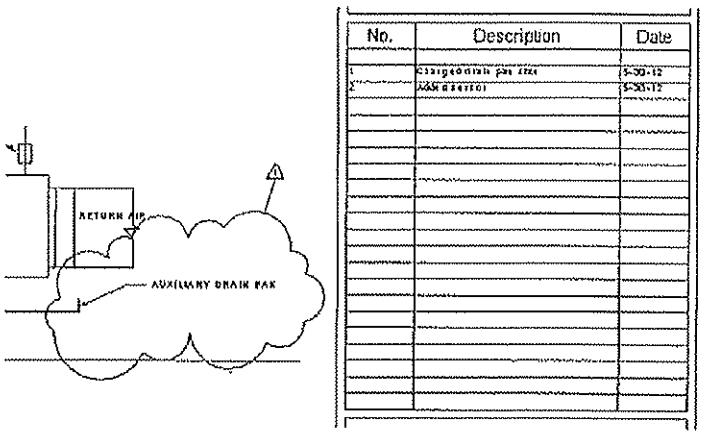

Figure 12–20

How to: Add Revisions to the List and to a Sheet

1. In the *View* tab>Sheet Composition panel, click (Revisions).
2. In the Sheet Issues/Revisions dialog box, click Add.
3. A new revision is added to the list, as shown in Figure 12–21. Modify the Date and Description as needed.

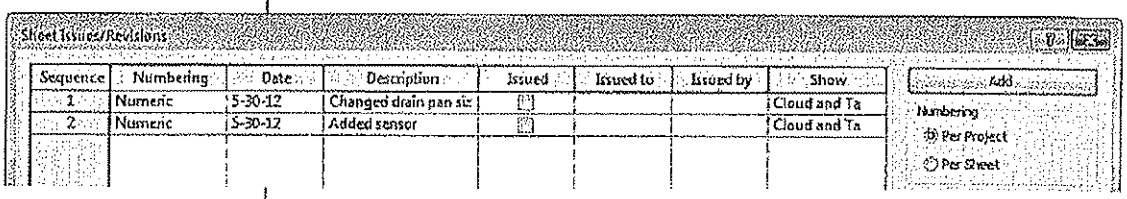

Figure 12–21

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The Sheet Issues/Revisions dialog box includes the following:

Numbering	Set the numbering to **Numeric**, **Alphabetic**, or **None**. **Numeric** is commonly used but the Autodesk Revit software offers some flexibility.
Date	Enter the date of the revision.
Description	Enter a brief description.
Issued	Select the checkbox if this revision has been submitted. If selected, new revision clouds cannot be drawn using this revision number.
Issued To	Enter the agency to which you are submitting.
Issued By	Enter the agency submitting the revisions (usually the designer).
Show	Select **Cloud and Tag**, **Tag only**, or **None** to display on the sheets.

4. Click OK.
5. Open the Sheet in which you want to add the revision.
6. In the *Annotate* tab>Detail panel, click (Revision Cloud).
7. Pick points clockwise around the area in which you want to place the cloud. When you click near the original point it closes automatically.
   - You can place more than one revision cloud in each sketch session but they are considered one dimension cloud.
8. In Properties, set the Revision that matches this cloud as shown in Figure 12–22.

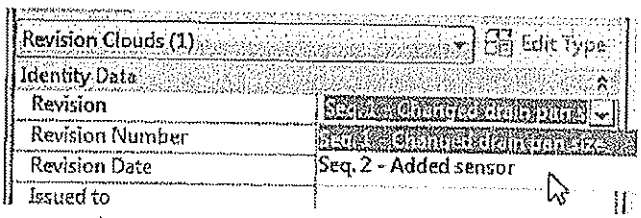

Figure 12–22

9. In the *Modify | Create Revision Cloud Sketch* tab>Mode panel, click (Finish Edit Mode).
10. In the *Annotate* tab>Tag panel, click (Tag by Category).
11. Select the revision cloud and place the tag.
12. The revision schedule for the sheet is populated.

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Practice 12a

Creating Construction Documents

Create Sheets.

Add views to the sheets.

In this practice you will add new sheets to the project. You will fill in title block information. You will then add views to sheets, such as the Lighting Plan sheet shown in Figure 12–23. Complete as many sheets as you have time for in class.

Estimated time for completion: 20 minutes

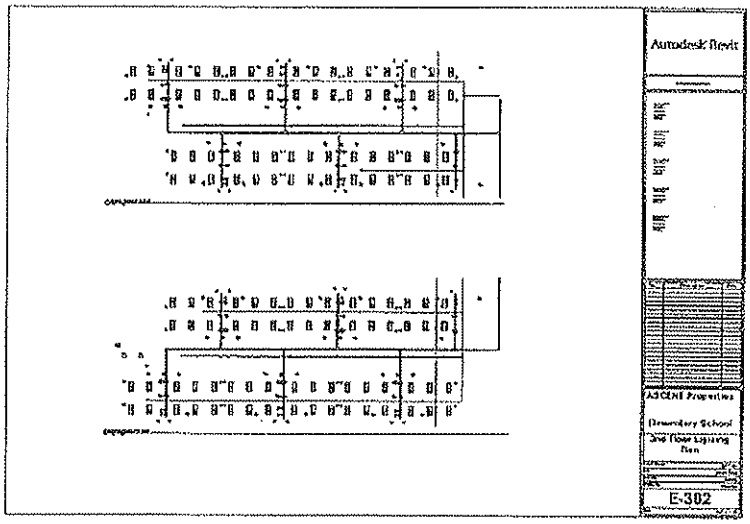

Figure 12–23

Task 1 - Create sheets.

1. Open the project **MEP-Elementary-School-Documents-M.rvt** found in the *Chapter 12* folder of your class folder.

2. In the *View* tab>Sheet Composition panel, click (Sheet).

3. In the New Sheet dialog box, select **A0 metric** and click OK.

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4. Zoom in on the lower right corner of the title block and fill out the labels, as follows (these labels are used across the entire sheet set and do not need to be entered on each sheet), (select the specific label in the titleblock until the edit box appears):

   - *Owner*: **ASCENT Properties**
   - *Project Name*: **Elementary School**
   - *Project Number*: **2013.01**

5. Continue filling out the title block, as shown in Figure 12–24. Note that changing the sheet number and sheet name also changes the name in the Project Browser. Certain labels can be entered on a per sheet basis, such as the *Sheet Name*, *Sheet Number*, *Drawn by*, and *Checked by*. Leave the *Issue Date* as is.

*The Scale is automatically entered when a view is inserted onto a sheet. If a sheet has multiple scales, the scale reads **As Indicated**.*

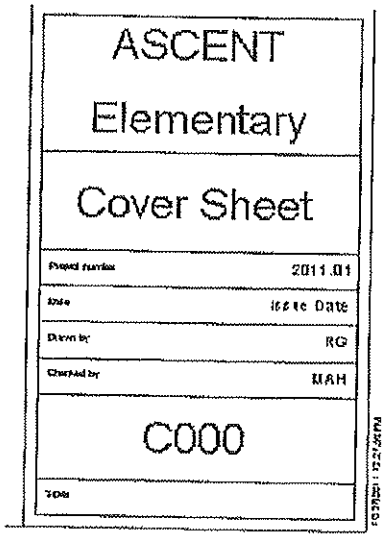

Figure 12–24

6. Click (Sheet) and using the **A0 metric** titleblock, create the following sheets:

   - E-302 - 2nd Floor Lighting Plan
   - E-303 - Power Panel Plan Detail
   - P-509 - Plumbing/Piping 3D

7. Click (Sheet) again. This time, select one or two of the placeholder sheets and click OK.

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8. Look at the Project Browser in the *Sheets (all)* area. These sheets, as well as the other sheets you created and the M-# sheets that were already created for you are displayed.

Task 2 - Set up and add views to sheets.

1. Using **Duplicate as Dependent**, create two copies of the **02 LIGHTING PLAN** floor plan view. Name them **2nd Floor Lighting Plan North** and **2nd Floor Lighting Plan South.**

2. Open the new views and do the following:

   - Hide the linked in Autodesk Revit MEP building model.
   - Turn on the crop region and make sure it is very close to the North (and South respectively) lighting sections.
   - Turn the crop region off.

The crop region defines the extent of the view on the sheet.

3. Open the **E-302 - 2nd Floor Lighting Plan** sheet and drag and drop the **2nd Floor Lighting Plan North** and **South** views you just created onto it.

4. Open the **E-303 - Power Panel Plan Detail** sheet and drag and drop the **Power Panel Callout** view onto it.

5. Repeat the process of adding views and schedules to sheets using the views and schedules you have available.

   - Modify crop regions and hide unnecessary elements in the views. Turn off crop regions after you have modified them.
   - Verify the scale of a view in Properties before placing it on a sheet.
   - Use alignment lines to help place multiple views on one sheet.
   - Change the view title if necessary to more accurately describe what is on the sheet.
   - To make minor changes to a view once it is on a sheet, right-click on the view and select **Activate View**. To return to the sheet, right-click on the view and select **Deactivate View**.

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Your numbers might not exactly match the numbers in the example.

6. Switch to the **01 POWER PLAN** view. Zoom in on the callout marker by the power panels. Notice that it has now been automatically assigned a detail and sheet number, as shown in Figure 12–25.

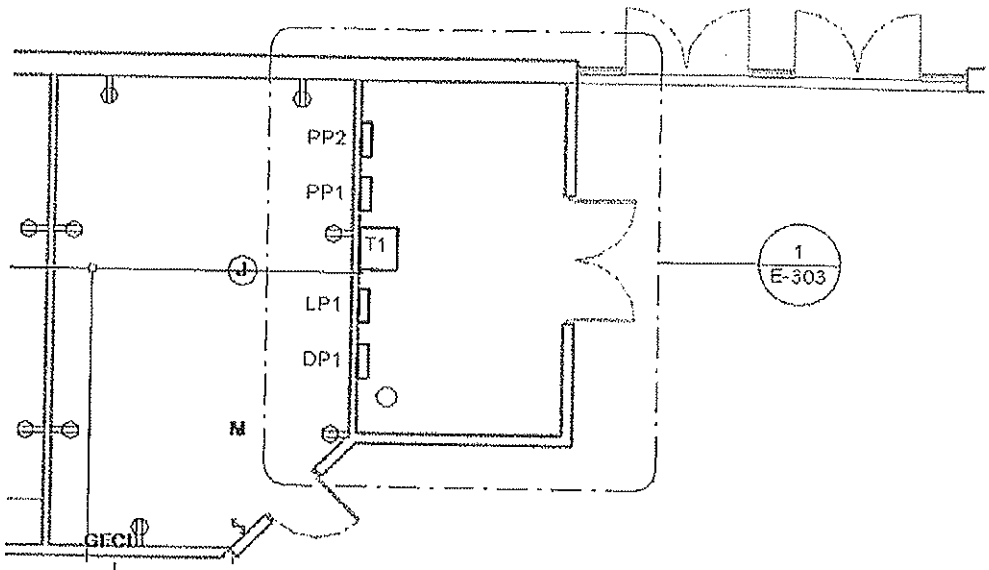

Figure 12–25

7. Save the project.

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12.4 Printing Sheets

Print sheets using the default Print dialog box.

With the **Print** command, you can print individual sheets or a list of selected sheets. You can also print an individual view or a portion of a view for check prints or presentations. The Print dialog box is shown in Figure 12–26.

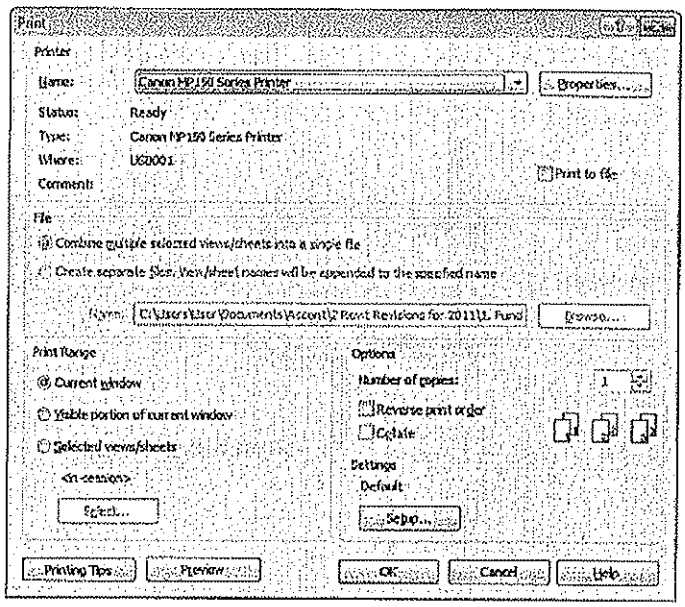

Figure 12–26

How to: **Print Sheets**

1. In the Application Menu, click (Print).
2. Set the options in the Print dialog box as needed. In the *Printer* area, verify the printer's *Name* and *Properties* first.
3. Click OK.

Printing Options

The Print dialog box is divided into the following areas: *Printer*, *File*, *Print Range*, *Options*, and *Settings*. Modify them as needed to produce the plot you want.

- Printing Tips opens Autodesk WikiHelp online where you can find help for troubleshooting printing issues.

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- Preview... opens a preview of the print output so that you can see what is going to be printed.

Printer

Select from the list of available printers, as shown in Figure 12–27. Click Properties... to adjust the properties of the selected printer. The options vary according to the printer. Select the **Print to file** option to print to a file rather than directly to a printer. You can create .PLT or .PRN files.

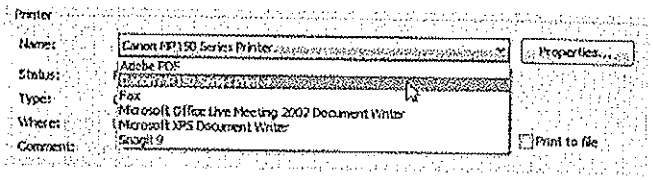

Figure 12–27

File

The *File* area is only available if the **Print to file** option has been selected in the *Printer* area. You can create one file or multiple files depending on the type of printer you are using, as shown in Figure 12–28.

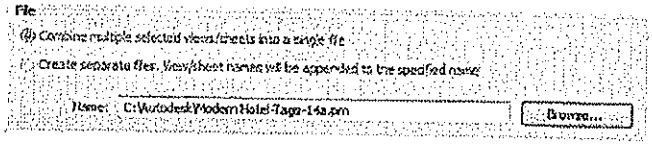

Figure 12–28

Options

If your printer supports multiple copies, you can specify the number in the *Options* area, as shown in Figure 12–29. You can also reverse the print order or collate your prints. These options are also available in the printer properties.

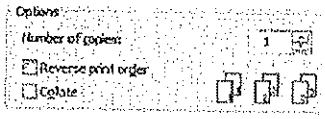

Figure 12–29

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Print Range

The *Print Range* area, as shown in Figure 12–30, enables you to print individual views/sheets or sets of views/sheets. The **Current window** option prints the entire current sheet or view you have open. The **Visible portion of current window** option prints only what is displayed in the current sheet or view.

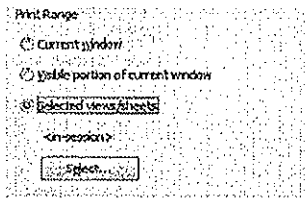

Figure 12–30

To print multiple sheets, select the **Selected views/sheets** option and click Select... to open the View/Sheet Set dialog box. Select each view or sheet to be included in the print set. You can save these sets by name so that you can more easily print the same group again.

Settings

Click Setup... to open the Print Setup dialog box, as shown in Figure 12–31. Here, you can specify the *Orientation* and *Zoom* settings, among others. You can also save these settings by name.

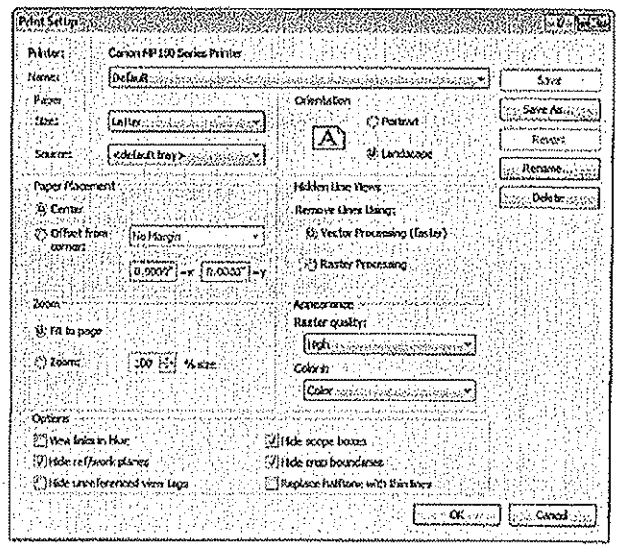

Figure 12–31

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Chapter Review Questions

1. How do you specify the size of a sheet?
   a. Set the size in the Options Bar.
   b. The size of the view(s) controls the size of the sheet.
   c. The size of title block controls the size of the sheet.
   d. Draw Detail lines on the sheet to specify the size.
2. Which of the following methods enables you to change labels in a titleblock, such as the Project Number or Drawn by information? Select all that apply.
   a. Select the titleblock and then select the label.
   b. Modify the sheet specific labels in Properties.
   c. Right-click in the Project Browser.
   d. Modify the overall project labels in Project Information.
3. How do you make changes to a view on a sheet?
   a. You cannot make changes on a sheet. Return to the view.
   b. Right-click on the view and select **Activate View**.
   c. Click the **Edit** button in the Ribbon when you are in a sheet.
   d. Right-click on the Sheet name in the Project Browser and select **Edit**.
4. What do you need to do if the size of a view is too large or too small for a sheet?
   a. Scale the view to fit on the sheet.
   b. Resize the view to fit on the sheet.
   c. Change the View Scale. It automatically updates on the sheet.
   d. Change the size of the titleblock.
5. How do you add views to a sheet?
   a. Import the view onto the sheet.
   b. Use the **Component** command to place the view on the sheet.
   c. Drag and drop the view from Project Browser onto sheet.
   d. Use the **Drafting View** command to create the view on the sheet.

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Command Summary

Button	Command	Location
	**Activate View**	■ **Ribbon:** (*select the view*) *Modify* | *Viewports* tab>Viewport panel> Activate View ■ **Right-click:** (*on view*) Activate View
	**Deactivate View**	■ **Ribbon:** *View* tab>Sheet Composition panel>expand Viewports>Deactivate View ■ **Right-click:** (*on view*) Deactivate View
	**Guide Grid**	■ **Ribbon:** *View* tab>Sheet Composition panel>Guide Grid ■ **Properties:** when a sheet is selected
	**Sheet**	■ **Ribbon:** *View* tab>Sheet Composition panel>Sheet ■ **Project Browser:** (*right-click on the Sheets node and select* ***New Sheet***)
	**View**	■ **Ribbon:** *View* tab>Sheet Composition panel>View

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Chapter 13

Annotating Construction Documents

In this chapter you learn how to add dimensions and work with text. You also create detail lines, add symbols, and legends using various annotation tools.

This chapter contains the following topics:

- ✓**Working with Dimensions**
- ✓**Working with Text**
- ✓**Detail Lines and Symbols**
- ✓**Creating Legends**

Learning Objectives

This chapter provides instruction to enable you to do the following:

13.1 Working with Dimensions

- Add a string of dimensions to walls and other elements and also add dimensions to entire walls as well as their related elements.
- Add other dimensions such as angular, radial, diameter, and arc length.
- Modify dimensions including the text and setting equal constraints.

13.2 Working with Text

- Add text with or without leaders.
- Create text types using different fonts and sizes.

13.3 Detail Lines and Symbols

- Draw detail lines to display non-model elements.
- Add 2D annotation symbols to specific views.

13.4 Creating Legends

- Create a legend view.
- Add legend components, symbols, detail lines, and text to the view.

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13.1 Working with Dimensions

- Add a string of dimensions to walls and other elements and also add dimensions to entire walls as well as their related elements.
- Add other dimensions such as angular, radial, diameter, and arc length.
- Modify dimensions including the text and setting equal constraints.

You can create permanent dimensions using aligned, linear, angular, radial, and arc length dimensions. These can be individual or a string of dimensions, as shown in Figure 13–1.

With aligned dimensions you can locate ducts, pipes, and other mechanical or electrical objects, based on walls, grid lines, or intersecting walls.

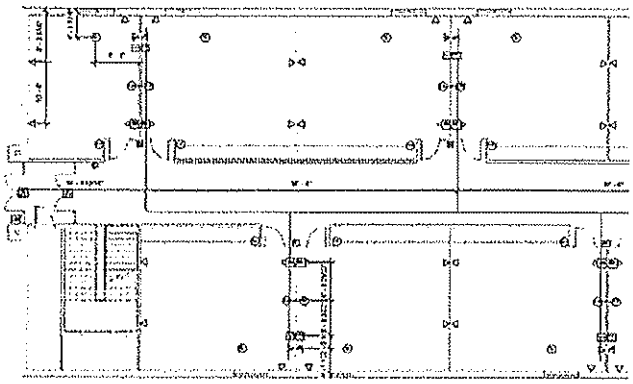

Figure 13–1

- Dimensions referencing model elements must be drawn on a model in an active view. You can dimension on sheets, but only to items drawn directly on the sheets.
- You can use permanent dimensions to modify elements. First, select the element being dimensioned and then edit the dimension value, as you would with temporary dimensions.
- Dimensions are available in the *Annotate* tab>Dimension panel and *Modify* tab>Measure panel. When you start the command, you can switch to other types in the *Modify | Place Dimensions* tab>Dimensions panel, as shown in Figure 13–2.

(Aligned) is also found in the Quick Access Toolbar.

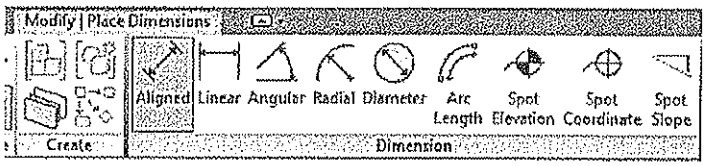

Figure 13–2

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- The default template includes several dimension styles for each type of dimension. It also includes different styles with different leaders when you pull the text away from the dimension line. You can also create your own dimension styles with different text sizes, fonts, and arrowheads, including loop leaders, as shown in Figure 13–3.

Enhanced in 2013

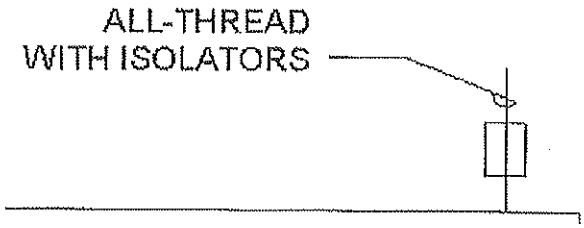

Figure 13–3

How to:

Add Dimensions for a Series of Elements

1. In the Quick Access Toolbar or *Annotate* tab>Dimensions panel, click (Aligned) or type **DI**.
2. In the Type Selector, select the dimension type you want to use.
3. In the Options Bar, set *Pick* to **Individual References**.
4. If you are dimensioning walls, select from the drop-down list to define how the dimensions work with walls: **Wall centerlines**, **Wall faces**, **Center of core**, or **Faces of core**. This can be changed as you add dimensions.
5. Move your cursor over the first element you want to dimension. When it highlights, select the element. A ghost image of the dimension line displays.
6. Select the next element to dimension, as shown in Figure 13–4.

When placing dimensions to and from Autodesk® Revit® MEP components, you can select from their edges or centers.

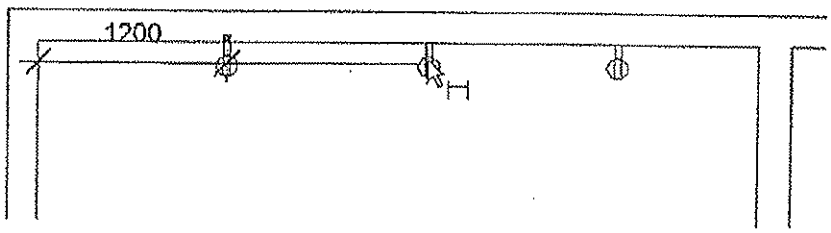

Figure 13–4

7. Continue selecting elements to dimension in a continuous line, as needed.

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8. After the last element to be dimensioned has been selected, move the cursor to a location for the dimension string, as shown in Figure 13–5. Click in an empty space to place it.

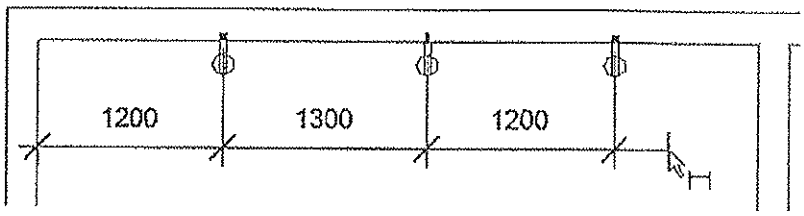

Figure 13–5

How to:

*When the **Dimension** command is active, the dimension methods are also accessible in the Modify | Place Dimensions tab>Dimension panel.*

Add Other Types of Dimensions

1. In the *Annotate* tab>Dimension panel, select a dimension method.

	Aligned	Most commonly used dimension type. Select individual elements or entire walls to dimension.
	Linear	Used when you need to specify certain points on elements.
	Angular	Used to dimension the angle between two elements.
	Radial	Used to dimension the radius of circular elements.
	Diameter	Used to dimension the diameter of circular elements.
	Arc Length	Used to dimension the length of the arc of circular elements.

2. In the Type Selector, select the dimension type.
3. Follow the prompts for the selected method.

New in 2013

Modifying Dimensions

Dimensions automatically update when you move the dimensioned elements. You can also modify the dimensions using various controls and constraints. While the dimension text is automatically updated you can still edit the dimension text, replace, or add to the dimension. There are also constraints for locking the dimension in place and to make dimensions equal.

When the **Modify** command is active and you select a dimension or dimension string, you can change several aspects of the dimension, as shown in Figure 13–6.

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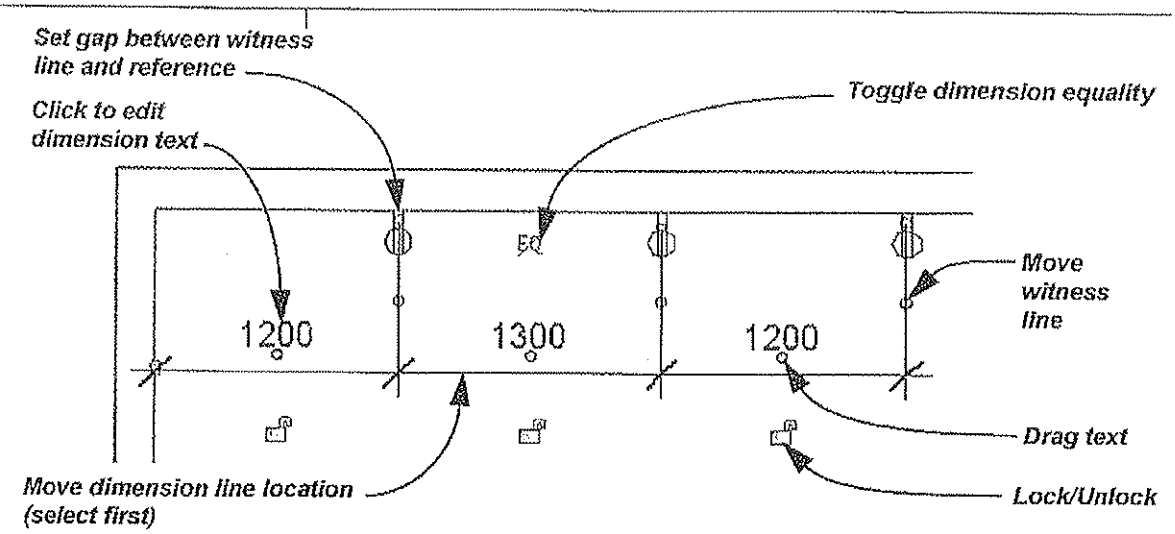

Figure 13–6

Modifying the Dimension Element

- To move the dimension text, select the **Drag text** control under the text and drag it to a new location. It automatically creates a leader from the dimension line if you drag it away. The style of the leader (arc or line) depends on the dimension style.
- To move the dimension line (the line parallel to the element being dimensioned), hover your cursor over the line until you see (Move). Drag the line to a new location.
- To change the gap between the witness line and the element being dimensioned, drag the gap control at the end of the witness line.

Modifying the Witness Lines

- To move the witness line (the line perpendicular to the element being dimensioned) to a different element or face of a wall, use the **Move Witness Line** control in the middle of the witness line. Click repeatedly to cycle through the various options. You can also drag this control to move the witness line to a different element, or right-click on the control and select **Move Witness Line**.

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- To add a witness line to a string of dimensions, select the dimension and, in the *Modify | Dimensions* tab>Witness Lines panel, click (Edit Witness Lines). Select the element(s) you want to add to the dimension. Click in space to finish.

- To delete a witness line, move your cursor over the control in the middle of the witness line, right-click, and select **Delete Witness Line**. Alternatively, you can drag the control to another existing witness line.

New in 2013

- To delete one dimension in a string and break the string into two separate dimensions, select the string, hover over the dimension you want to delete, and press <Tab>. When it highlights, select it (as shown on top in Figure 13–7), and press <Delete>. The selected dimension is deleted and the dimension string is separated into two elements, as shown on the bottom in Figure 13–7.

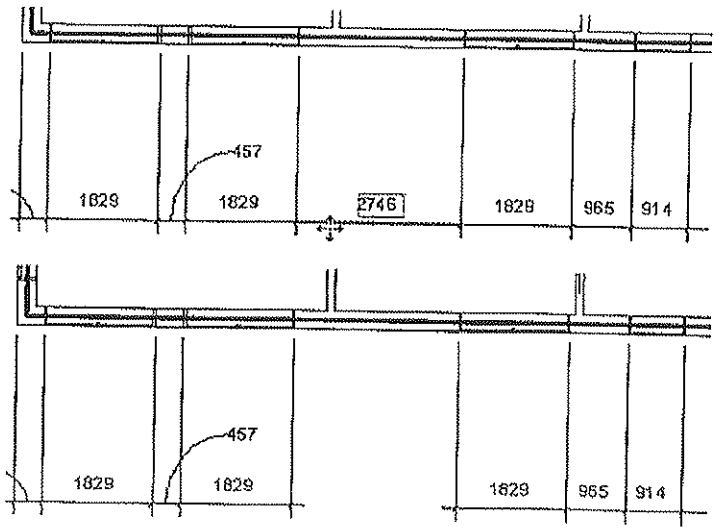

Figure 13–7

Modifying Dimension Text

The dimension text can be changed to a different value, though typically it is not recommended. Because Autodesk® Revit® software is parametric, changing the dimension text without actually changing the elements dimensioned, can cause problems throughout the project especially if you use the project model to estimate materials or work with other disciplines. You can append the text, as shown in Figure 13–8, with prefixes and suffixes which is very useful in renovation projects.

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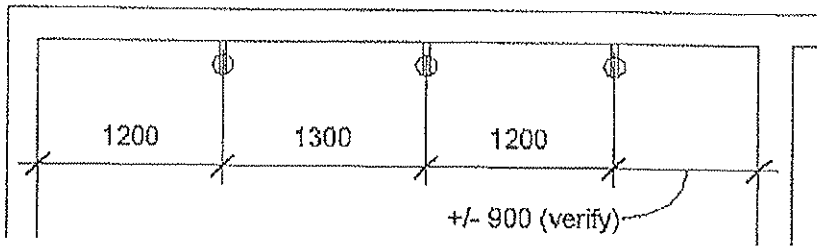

Figure 13–8

Double-click on the dimension text to open the Dimension Text dialog box, as shown in Figure 13–9, and make modifications as required.

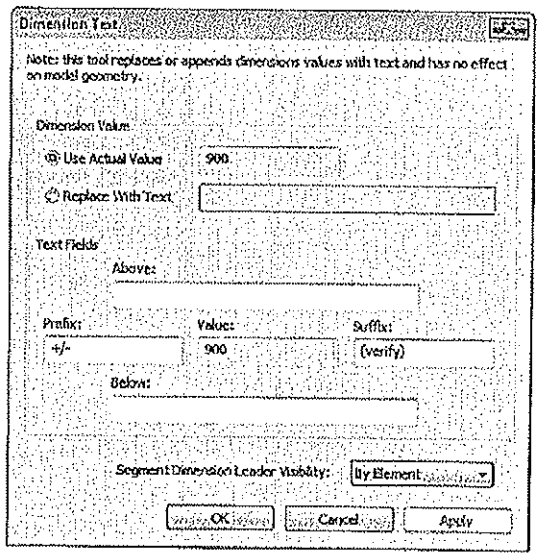

Figure 13–9

Setting Constraints

The two types of constraints that work with dimensions are locks and equal settings, as shown in Figure 13–10.

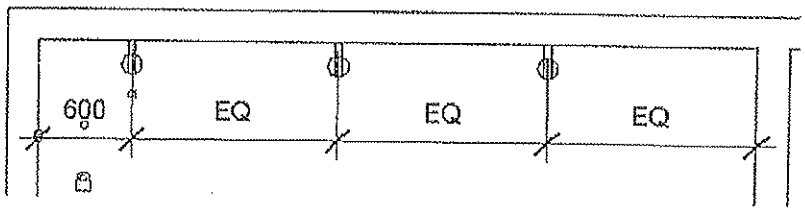

Figure 13–10

- When you lock a dimension, the value is set and you cannot make a change between it and the referenced elements. If it is unlocked, you can move it and change its value.

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- For a string of dimensions, select the EQ symbol to constrain the elements to be at an equal distance apart. This actually moves the elements that are dimensioned.

Enhanced in 2013

- The equality text display can be changed in Properties, as shown in Figure 13–11. The style for each of the display types is set in the dimension type.

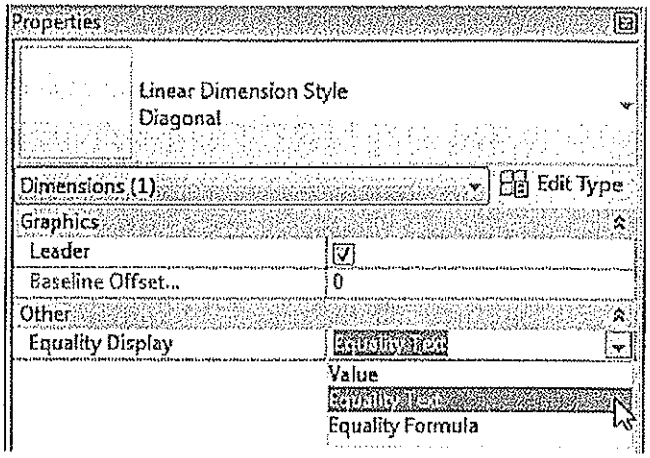

Figure 13–11

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13.2 Working with Text

- Add text with or without leaders.
- Create text types using different fonts and sizes.

The **Text** command enables you to add notes to views or sheets, as shown in Figure 13–12. This command creates text with or without leaders.

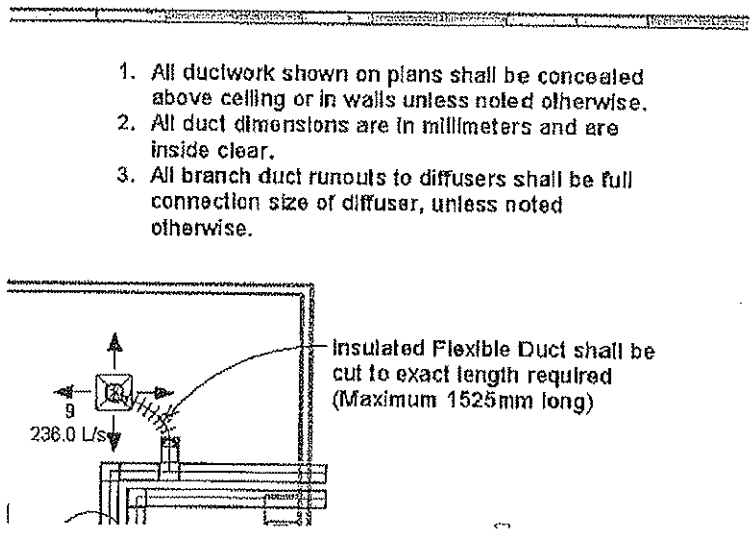

Figure 13–12

The text height is automatically set by the text type in conjunction with the scale of the view, as shown in Figure 13–13, using the same size text type at two different scales. Text types display at the specified height, both in the views and on the sheet.

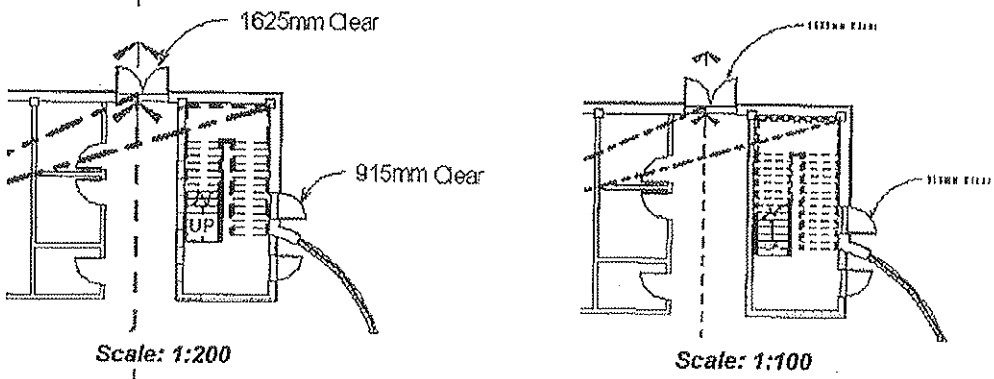

Figure 13–13

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How to:

Add Text

1. In the *Annotate* tab>Text panel, click (Text).
2. In the Type Selector, select a text type.
3. In the *Modify | Place Text* tab>Format panel, select the method that you want to use: (No Leader), (One Segment), (Two Segments), or (Curved).
4. In the Format panel, set the justification for the text and leader, as shown in Figure 13–14.

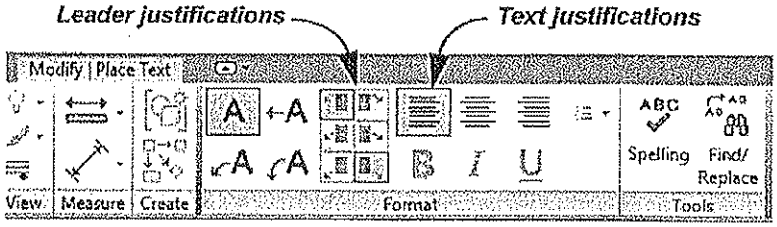

Figure 13–14

5. Select the location for the leader and text.
   - If the **No leader** option is selected, select the start point for the text and begin typing.
   - If using a leader, the first point places the arrow and you then select points for the leader. The text starts at the last leader point.
   - To set a word wrapping distance, click and drag to set the start and end points of the text.
6. Type the required text. In the Format panel (as shown in Figure 13–15) you can apply bold, italic, or underlined formatting to the text, and set a paragraph format.

*The **Bold**, **Italic**, and **Underline** options only apply to that instance of text. If you want a specific type of text to have this formatting, create a new text type and then select the new type in Properties.*

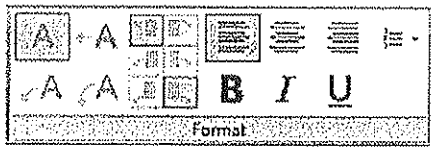

Figure 13–15

7. Click outside the text box to complete the text element.
   - Pressing <Enter> after a line of text does not end the command. It starts a new line of text in the same text window.
8. Click in a new location to start another text element.
9. Press <Esc>, click (Modify), or start another command to finish.

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- Use the controls shown in Figure 13–16 to position, rotate, or edit the text as needed.

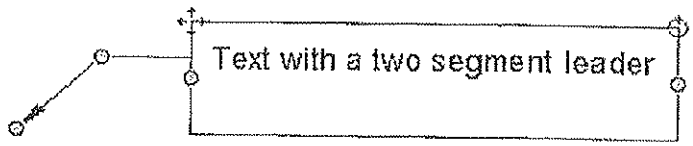

Figure 13–16

- You can add leaders to text when it is selected. Click the related icon in the Format panel, as shown in Figure 13–17. Use the grips to move the leader once it is placed.

More than one leader can be applied to each side.

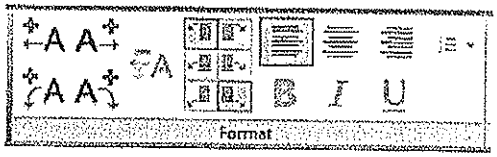

Figure 13–17

- Several text types are included in the default template. These can be set and changed in the Type Selector. You can also create your own text types.

- When placing text, alignment lines help you align the text with other text elements based on the justification of the original text.

Setting the Paragraph Format

While entering text, you can create individual lines of text using the paragraph formats. Change the text format option before you type the line of text as shown in Figure 13–18. When you press <Enter> to start the next line, it continues to use the new format.

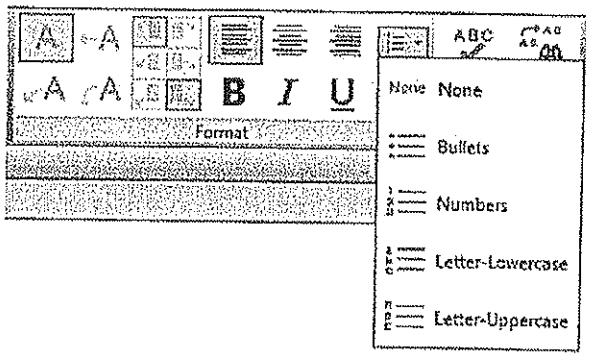

Figure 13–18

- To change a line that has already been typed, click anywhere on the line of text and change the paragraph format.

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- You can also select several lines of text by dragging the cursor to highlight them. You can then change their paragraph format.

Spell Checking

The Spelling dialog box displays any misspelled words in context and provides several options for changing them, as shown in Figure 13–19.

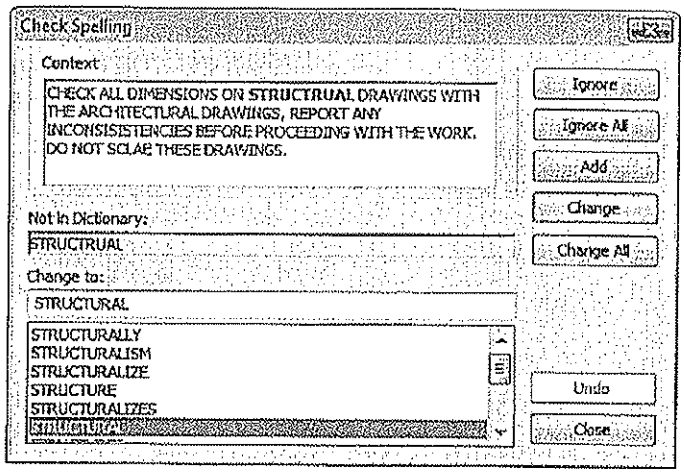

Figure 13–19

- To spell check all of the text in a view, in the *Annotate* tab> Text panel, click (Spelling) or press <F7>. As with other spell checkers, you can **Ignore, Add**, or **Change** the word.
- You can also check the spelling in the selected text. With text selected, in the *Modify | Text Notes* tab>Tools panel, click (Spelling).

Creating Text Types

If you need new text types with a different text size or font (such as for a title or hand-lettering), you can create new ones, as shown in Figure 13–20. It is recommended that you create these in a project template so that they are available in future projects.

General Notes

1. This project consists of furnishing and installing...

Figure 13–20

- You can copy and paste text types from one project to another or use **Transfer Project Standards.**

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How to:

Create Text Types

1. In the *Annotate* tab>Text panel title, click (Text Types).
   - You can also create Text Types by starting the **Text** command or selecting an existing text element, and then, in Properties, clicking (Edit Type).
2. In the Type Properties dialog box, click Duplicate...
3. In the Name dialog box, type a new name and click OK.
4. Modify the text parameters as needed. The parameters are shown in Figure 13–21.

Parameter	Value
Graphics	
Color	Black
Line Weight	1
Background	Opaque
Show Border	
Leader/Border Offset	2.0000 mm
Leader Arrowhead	Arrow 30 Degree
Text	
Text Font	Arial
Text Size	3.0000 mm
Tab Size	6.0000 mm
Bold	
Italic	
Underline	
Width Factor	1.000000

Figure 13–21

   - In the *Graphics* area, click in the cell next to the **Color** parameter and select a color for the text in the Color dialog box. Typically, this remains black if you are creating working drawings. However, if you want to add color to a presentation, you can use the full range of True colors and Pantone colors.
   - The **Background** parameter can be set to **Opaque** or **Transparent**. An opaque background includes a masking region that hides lines or elements beneath the text.
   - In the *Text* area, the **Width Factor** parameter controls the width of the lettering, but does not affect the height. A width factor greater than 1 spreads the text out and a width factor less than 1 compresses it.
5. Click OK to close the Type Properties dialog box.

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13.3 Detail Lines and Symbols

- Draw detail lines to display non-model elements.
- Add 2D annotation symbols to specific views.

While annotating views for construction documents, you might need to add lines and symbols to clarify the design intent or display information, such as the furthest distance from a water closet/urinal to a sink, as shown in Figure 13–22.

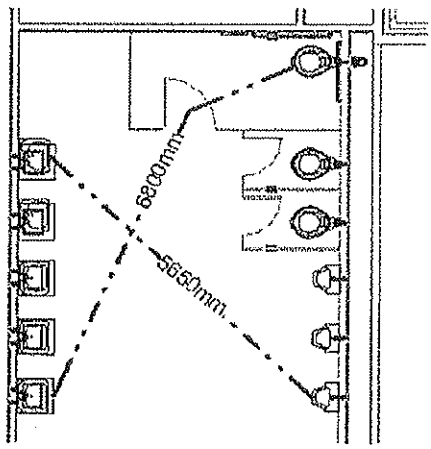

Figure 13–22

- Detail lines and symbols are view-specific, which means that they only display in the view in which they were created.

How to: **Draw Detail Lines**

1. In the *Annotation* tab>Detail panel, click (Detail Line).
2. In the *Modify | Place Detail Lines* tab>Line Style panel, select the type of line you want to use, as shown in Figure 13–23.

You can select from a variety of line styles including thin, medium, and wide lines, center lines, and demolition, hidden, and overhead lines. You can also create your own line styles.

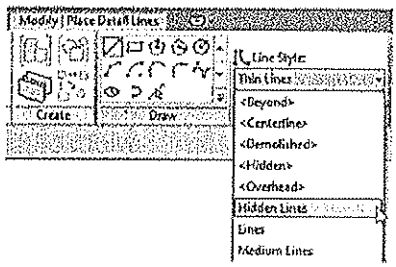

Figure 13–23

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3. Use the tools in the Draw panel to create the detail lines.

Using Symbols

Many of the annotations used in architectural drawings are frequently repeated. Several of them have been saved as symbols in the software, such as the North Arrow, Center Line, and Graphic Scale annotations. The Autodesk Revit MEP software also includes some symbols that can be loaded from the library, such as the Sprinkler symbols shown in Figure 13–24. You could use these simple symbols to indicate roughly where the sprinklers are located if you are using a separate sprinkler consultant.

Symbols are 2D elements that only display in one view, while components can be in 3D and display in many views.

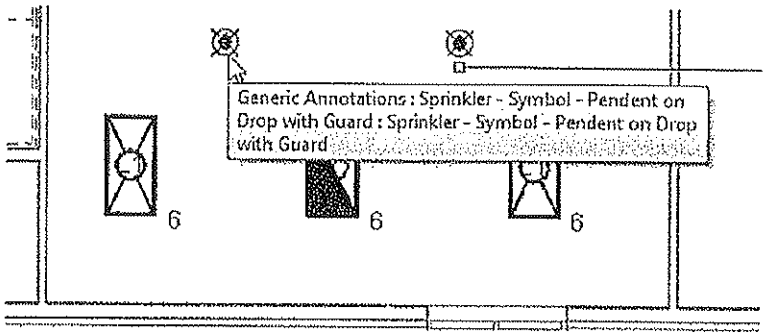

Figure 13–24

- Symbols are 2D elements that only display in one view, while components can be in 3D and display in many views.
- You can also create or load custom annotation symbols.

How to: Place a Symbol

1. In the *Annotation* tab>Symbol panel, click (Symbol).
2. In the Type Selector, select the symbol you want to use.
3. In the *Modify | Place Symbol* tab>Mode panel, click (Load Family) if you want to load other symbols.
4. In the Options Bar, as shown in Figure 13–25, set the *Number of Leaders* and select the **Rotate after placement** option if you want to rotate the symbol as you insert it.

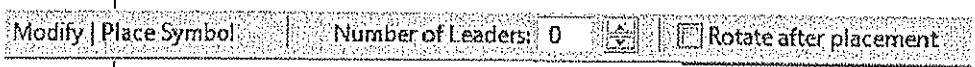

Figure 13–25

5. Place the symbol in the view. Rotate it if you selected the **Rotate after placement** option. If you specified leaders, use the controls to move them into place.

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13.4 Creating Legends

- Create a legend view.
- Add legend components, symbols, detail lines, and text to the view.

A legend view is used to create a list of elements that, while corresponding to the model, should not be considered part of the digital building model. Legends can include a list of all of the symbols you use in your drawings, such as electrical switches (as shown in Figure 13–26), as well as a list of materials, or items to remain or to be removed from a remodel.

Legends are not part of the parametric model but a representation used in annotating the document set.

Electrical Legend	
	Dimmer Switch
	3-Way Switch
	Key Operated Switch
	Manual Pull Fire Alarm

Figure 13–26

A legend view can also be placed on multiple sheets. This is useful when you need to set up the sheets because the software does not permit you to add a regular view to more than one sheet. For example, if you add the **Plumbing>Floor Plans: Level 1** view to sheet **P-101**, you cannot add it to any other sheet, because the software now considers that view to be placed. If you are creating a key plan that needs to be placed on multiple sheets you can create a key plans legend.

- When you add legend components to a legend view, the options are available in the Options Bar and not in the Type Selector.

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How to:

Create a Legend View

1. In the *View* tab>Create panel, expand (Legends) and click (Legend). or in the Project Browser, right-click on the Legends node and select **New Legend...**
2. In the New Legend View dialog box, set the *Name* and *Scale*, as shown in Figure 13–27.

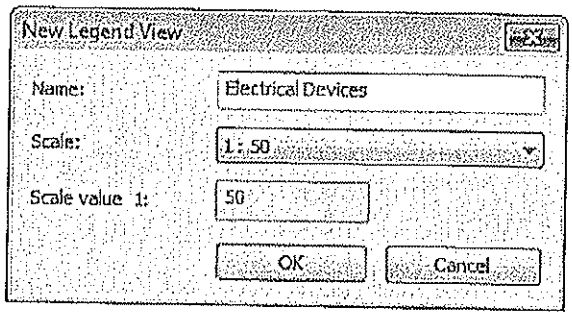

Figure 13–27

3. Click OK. A blank view opens.
4. In the *Annotate* tab>Detail panel, expand (Component) and click (Legend Component).
5. In the Options Bar, select a *Family:* to add to the view and select the *View* type, as shown in Figure 13–28.

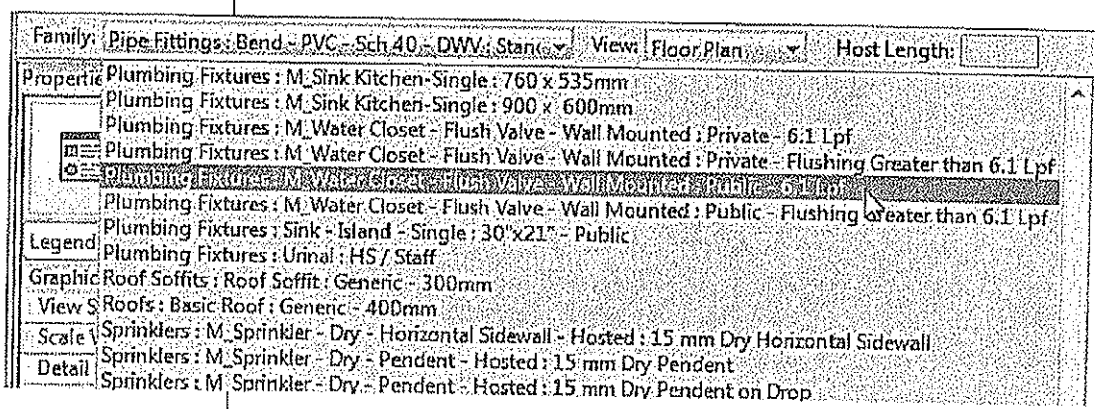

Figure 13–28

   - The list of Families is limited to the ones that are loaded into the project, whether or not they have been used.
6. Place the component anywhere in the view.
   - Legend components are not counted in schedules and material takeoffs.

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7. Add Symbols, such as those shown in Figure 13–29, Text, and Detail Lines to complete the legend.



Figure 13–29

- You can import an existing legend from CAD but it is recommended to do a comparative check of the symbols in your model against the symbols in the imported CAD legend.

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Practice 13a

Annotating Construction Documents

- Add dimensions to a floor plan.
- Add detail lines and text in a callout view.
- Create a plumbing legend.

Estimated time for completion: 20 minutes

In this practice you will add dimensions to the duct branches, and then modify those dimensions, as shown in Figure 13–30. You will also add detail lines and text as well as symbols and legends.

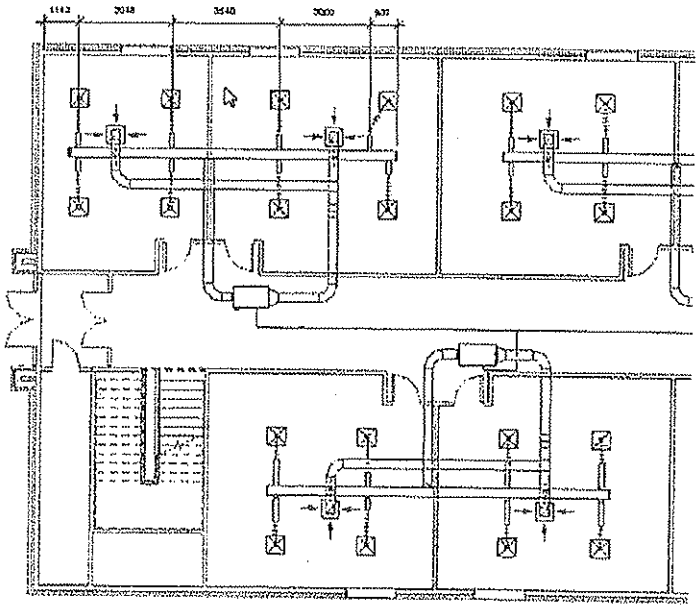

Figure 13–30

Task 1 - Add and Modify duct branch spacing Dimensions.

1. Open the project **MEP-Elementary-School-Annotation-M.rvt** found in the *Chapter 13* folder of your class folder.
2. In the Project Browser, expand Mechanical/HVAC/Floor Plans and open the **01 MECHANICAL PLAN** floor plan view.

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3. In the *Annotate* tab>Dimension panel, click (Aligned).

4. Dimension the first four duct branches on the top side of the North wing, starting from the left side wall, as shown in Figure 13–31. Verify that the **Wall centerlines** is set in the Options Bar. Click (Modify) to finish.

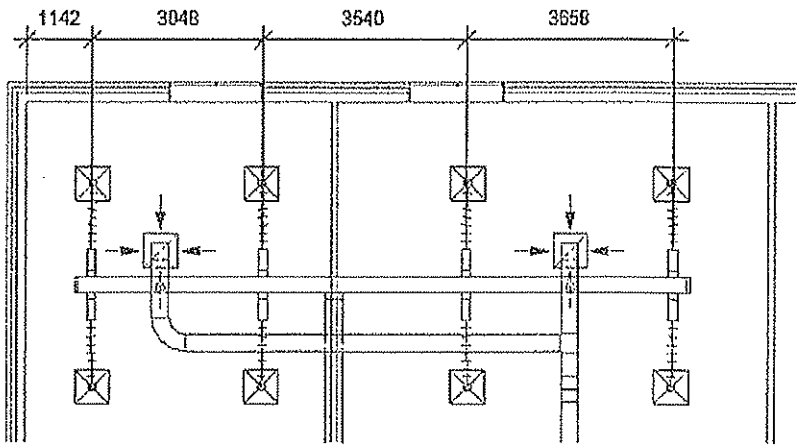

Figure 13–31

5. Select the far right duct branch that you dimensioned. Its dimension to the next duct branch on its left is part of the selection, and is blue.

6. Select the dimension and change its value from **3658mm** to **3000mm**. The duct branch and the flex ductwork move accordingly, but the air terminal maintains its original position, as shown in Figure 13–32. Click (Modify) to finish.

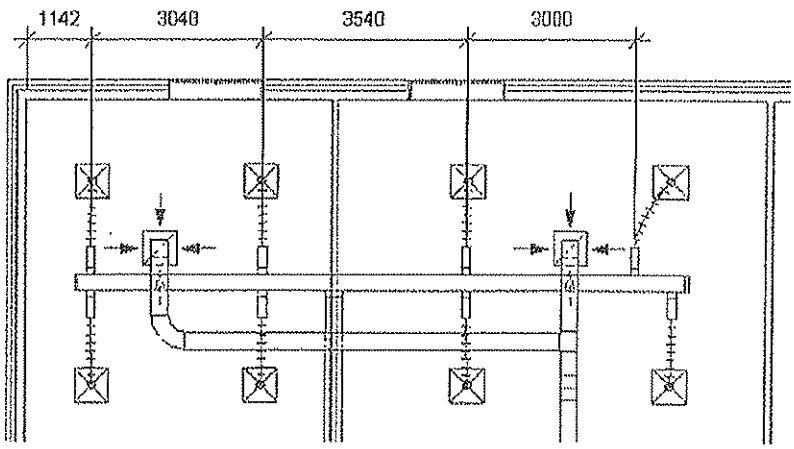

Figure 13–32

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7. Select the dimension line. In the *Modify | Dimensions* tab> Witness Lines panel, click (Edit Witness Lines).

8. Select the end of the main duct to add a fifth dimension to the string of dimensions, as shown in Figure 13–33. Click anywhere in the empty space away from any objects to finish the command. Click (Modify) to finish.

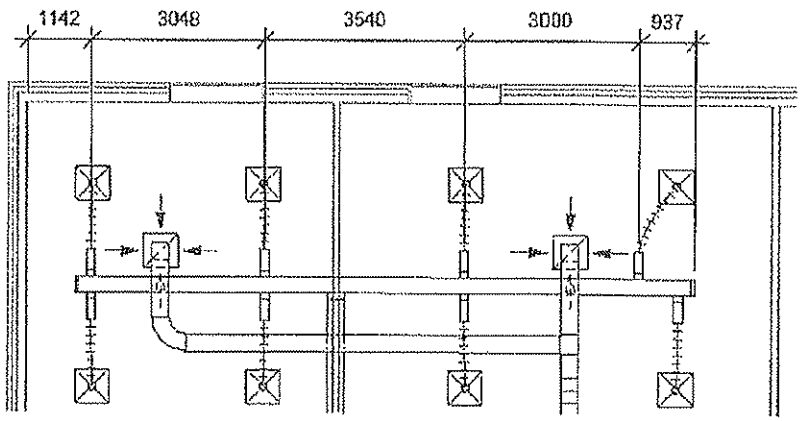

Figure 13–33

9. Save the project.

Task 2 - Add Detail Lines and Text.

1. Open the **MEP-Elementary-School-Annotation.rvt** found in the *Chapter 13* folder of your class folder, if not already open.

2. Open the **01 POWER PLAN** floor plan view, and zoom in on the Electrical Distribution Room in the upper right corner.

3. In the *Annotate* tab>Detail panel, click (Detail Line).

4. In the *Modify | Place Detail Lines* tab>Line Style panel, set the *Line Style* to **MEP Hidden**.

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5. Draw a rectangle from the upper left corner of the room to the lower right corner of the room, approximately **4500mm x 1800mm**, as shown in Figure 13–34. Click (Modify) to finish.

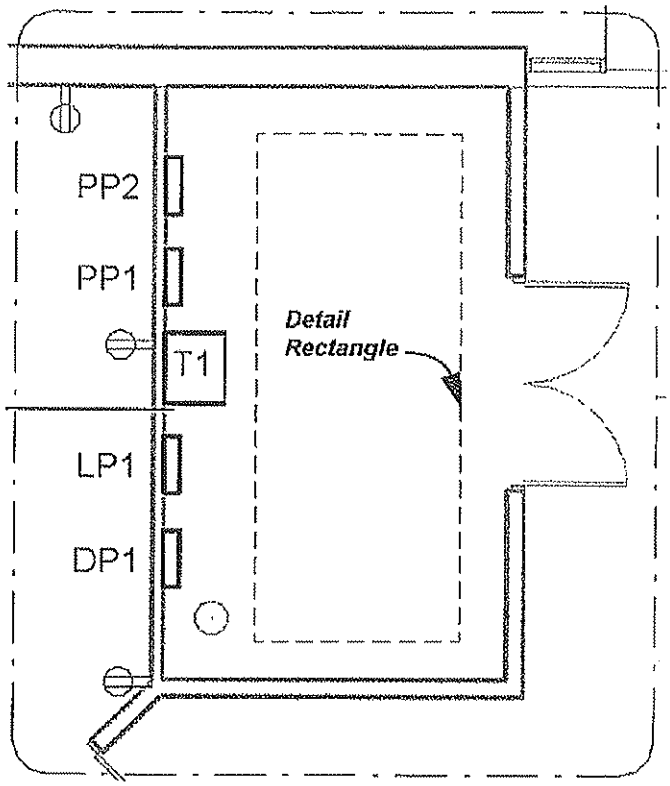

Figure 13–34

6. In the *Annotate* tab>Text panel, click (Text).
7. In the Type Selector, select **Text: 3.5mm Arial**.
8. In Properties, click Edit Type. In the Type Properties dialog box, click Duplicate... Type **4mm Arial - Red** for the name and click OK.
9. Set the following properties:
   - *Color*: **Red**
   - *Text Font*: **Arial**
   - *Text Size*: **4mm**
   - Select the **Italic** option

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10. Click OK to save and close the Type Properties dialog box.

11. Add text using the **4mm Arial - Red** text type, to the inside of the Detail rectangle you drew, as shown in Figure 13–35.

    Click (Modify) to finish.

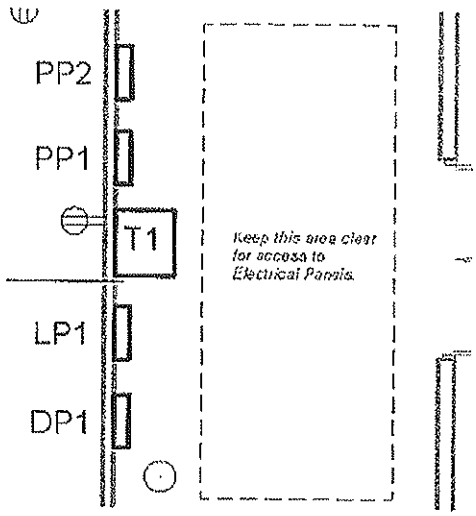

Figure 13–35

Task 3 - Add a Symbol.

1. Zoom out to fit.

2. In the *Annotate* tab>Symbol panel, click (Symbol).

3. In the *Modify | Place Symbol* tab>Mode panel, click (Load Family).

4. In the *Imperial Library/Annotations* folder, select the **M_North Arrow 1.rfa** symbol and click Open.

5. Insert a North Arrow near the bottom left of the model. Click (Modify) to finish.

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Chapter Review Questions

1. When a duct is moved, how do you update the dimension?
   a. Edit the dimension and move it over.
   b. Select the dimension and then click the **Update** button in the Options Bar.
   c. The dimension automatically updates.
   d. Delete the existing dimension and add a new one.
2. How do you create new text styles?
   a. Using the **Text Styles** command.
   b. Duplicate an existing type.
   c. They must be included in a template.
   d. Using the **Format Styles** command.
3. When you edit text, how many leaders can be added?
   a. One
   b. One on each end of the text.
   c. As many as you want on each end of the text.
4. Which of the following are examples of Symbols? Select all that apply.
   a. North Arrow
   b. Duct Placeholder
   c. Electrical Device
   d. Graphic Scale
5. When creating a Legend, which of the following elements cannot be added?
   a. Legend Component
   b. Tags
   c. Duct System
   d. Symbol

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Command Summary

Button	Command	Location
	**Aligned (Dimension)**	■ **Ribbon:** *Annotate* tab>Dimension panel>Aligned ■ **Quick Access Toolbar** ■ **Shortcut:** DI
	**Angular (Dimension)**	■ **Ribbon:** *Annotate* tab>Dimension panel>Angular
	**Arc Length (Dimension)**	■ **Ribbon:** *Annotate* tab>Dimension panel>Arc Length
	**Legend**	■ **Ribbon:** *View* tab>Create panel, expand Legends ■ **Project Browser:** (*right-click on Legends node*) New Legend
	**Linear (Dimension)**	■ **Ribbon:** *Annotate* tab>Dimension panel>Linear
	**Radial (Dimension)**	■ **Ribbon:** *Annotate* tab>Dimension panel>Radial
	**Text**	■ **Ribbon:** *Annotate* tab>Text panel> Text ■ **Shortcut:** TX

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Chapter 14

Tags and Schedules

In this chapter you learn how to add tags to individual and multiple elements. You review schedules, how they update, and how to modify them in the schedule view and on a sheet. You also learn to create schedules.

This chapter contains the following topics:

- ✓**Adding Tags**
- ✓**Working with Schedules**
- ✓**Creating Schedules**

Learning Objectives

This chapter provides instruction to enable you to do the following:

14.1 Adding Tags

- Add tags in 2D and 3D views individually or to all of the elements at the same time.
- Load tags that are needed for projects.

14.2 Working with Schedules

- Open schedules and modify schedule cells that are not filled out automatically.
- Add schedules to sheets and modify them so that they fit.
- Import schedule styles from other projects and export schedule information to a spreadsheet.

14.3 Creating Schedules

- Create Building Component Schedules, such as air terminal, lighting fixture, or plumbing fixture schedules.
- Save schedules for use in another project.

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14.1 Adding Tags

- Add tags in 2D and 3D views individually or to all of the elements at the same time.
- Load tags that are needed for projects.

Tags are used to identify elements in plan views, as shown in Figure 14–1, as well as section and elevation views. Tags come in automatically with most mechanical and electrical components, if you use the **Tag on Placement** option when inserting or drawing them. The information that tags display is taken from the elements that are being tagged.

There are tags for many elements, including ducting and piping, mechanical and electrical equipment, electrical devices, and lighting fixtures. These tags are stored in the Annotations folder in the Library.

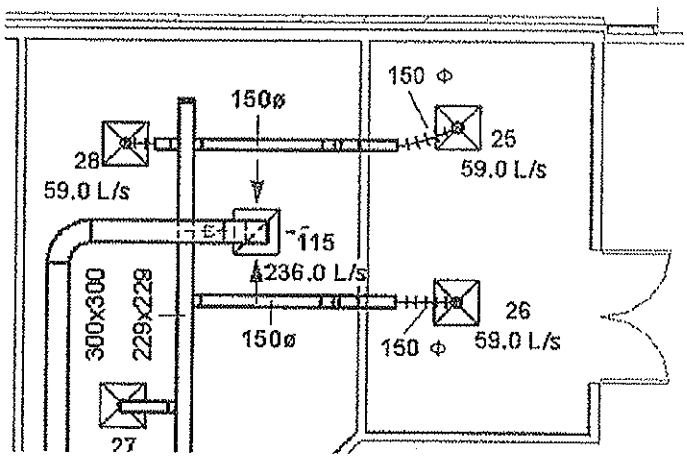

Figure 14–1

You can place three types of tags, as follows:

- **(Tag by Category):** Tags according to the category of the element. It places duct tags on ducts and lighting fixture tags on lighting fixtures.
- **(Multi-Category):** Tags elements belonging to multiple categories. The tags display information from parameters that they have in common.
- **(Material):** Tags that display the type of material. They are primarily used for architectural details.

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How to:

Spaces must be tagged using (Space Tag).

Add Tags

1. In the *Annotate* tab>Tag panel, click (Tag by Category), (Multi-Category), or (Material) depending on the type of tag you want to place.
2. In the Options Bar, set the options as required, as shown in Figure 14–2.

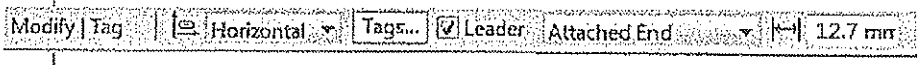

Figure 14–2

3. Select the element you want to tag. The appropriate tag is applied for the category of element selected. If the tag is not loaded, you are prompted to load it from the Library.

Tag Options

You can set tag options for leaders and tag rotation, as shown in Figure 14–3. You can also press the <Spacebar> to toggle the orientation while placing the tag or when modifying it.

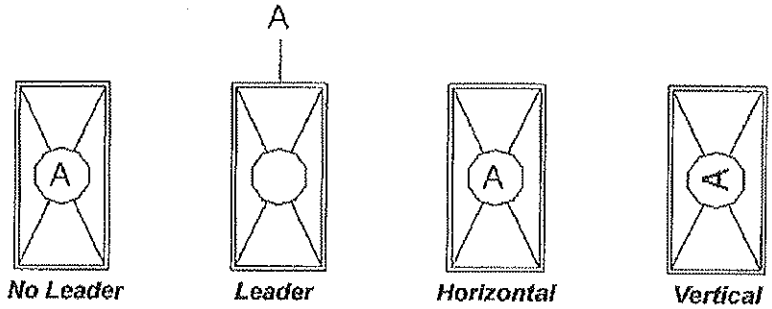

Figure 14–3

- Leaders can have an **Attached End** or a **Free End**, as shown in Figure 14–4. The attached end must be connected to the element being tagged. A free end has an additional drag control where the leader touches the element.

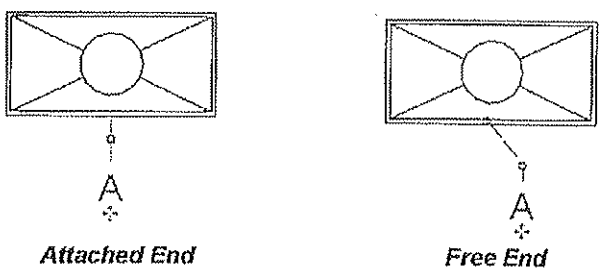

Figure 14–4

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- The **Length** option specifies the length of the leader in plotting units. It is grayed out if the **Leader** option is not selected or if a **Free End** leader is defined.
- If a tag is not loaded a warning box opens as shown in Figure 14–5. Click Yes to open the Load Family dialog box in which you can select the appropriate tag.

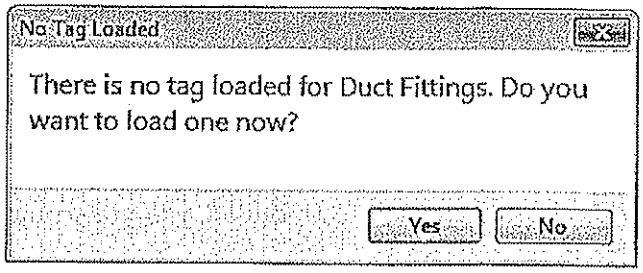

Figure 14–5

- To load tags, you can click Tags... in the Options Bar when a Tag command is active, or, in the *Annotate* tab, expand the Tag panel and click (Loaded Tags). This opens the Tags dialog box, which displays the tags that have been loaded and load additional tags, as shown in Figure 14–6. Most tags are stored in the *Annotations* folder in the Library.

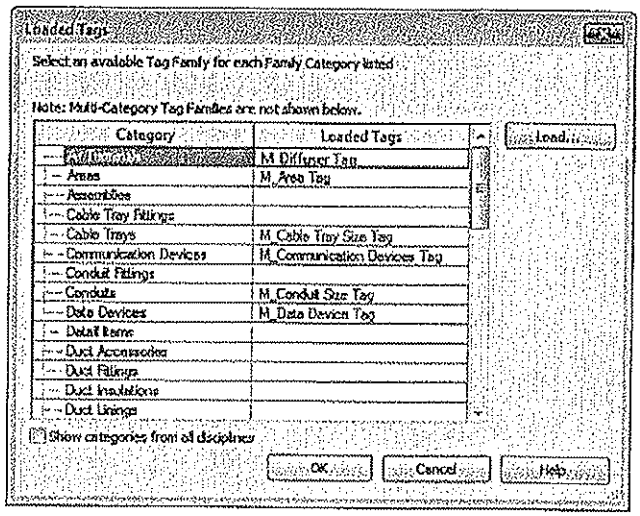

Figure 14–6

Tagging in 3D Views

You can add tags (and some dimensions) to 3D views, as shown in Figure 14–7, as long as the views are locked first. You can only add tags in isometric views.

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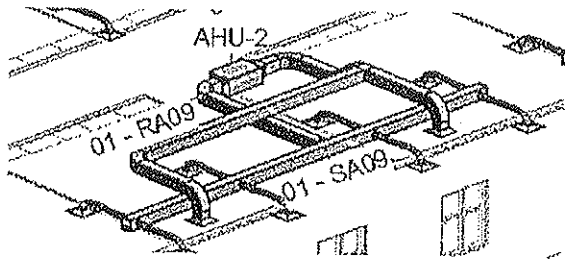

Figure 14–7

How to:

Lock a 3D View

1. Open a 3D view and set it up as you want it to display.
2. In the View Control Bar, expand (Unlocked 3D View) and click (Save Orientation and Lock View).

- If you are using the default 3D view and it has not been saved, you are prompted to name and save the view first.
- You can modify the orientation of the view, expand (Locked 3D View) and click (Unlock View). This also removes any tags you have applied.
- To return to the previous locked view, expand (Unlocked 3D View) and click (Restore Orientation and Lock View).

Tagging Multiple Elements

If you have not tagged various elements on placement, you can tag them in a view using the **Tag All Not Tagged** command. For example, when you cut a section, tags do not automatically display. Therefore, you can use it to add the tags as shown in Figure 14–8. Alternatively, if you copied ducting layouts in a plan view, you can tag all of the new elements at the same time.

*If other Autodesk® Revit® files are linked to the current project, you can also include elements from the linked file when you use the **Tag All Not Tagged** command.*

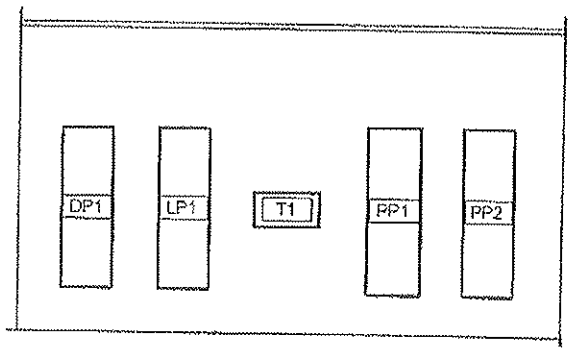

Figure 14–8

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Add Multiple Tags

*To only tag some elements, select them before starting this command and, in the dialog box, select the **Only selected objects in the current view** option.*

Click Apply to stay in the dialog box and continue applying to other categories. Click OK to apply the tags and close the dialog box.

1. In the *Annotate* tab>Tag panel, click (Tag All).
2. Select one or more categories that you want to tag, as shown in Figure 14–9. You can select more than one category by holding down <Shift> or <Ctrl>. Set the *Leader* and *Orientation* as required.

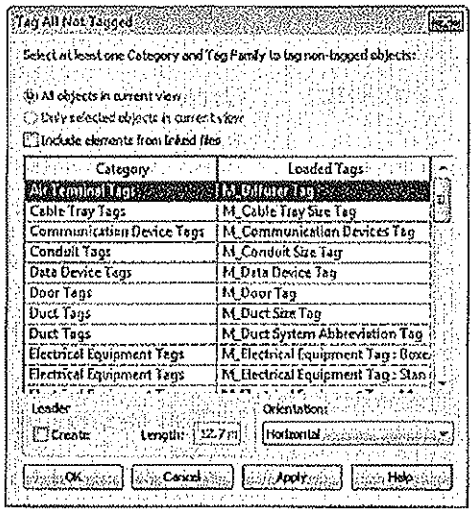

Figure 14–9

Instance vs.Type Based Tags

Autodesk Revit MEP components have instance properties and type properties. For example, the typical air terminal tag includes two instance properties: an individual mark in a numbered sequence, and with a flow value for each instance, as shown in Figure 14–10. However, the tag for light fixtures is displaying the type mark, which is a type property. Changing this information in one tag changes it for all instances of that type.

Tags can display whatever information you need them to display, from instance and/or type properties.

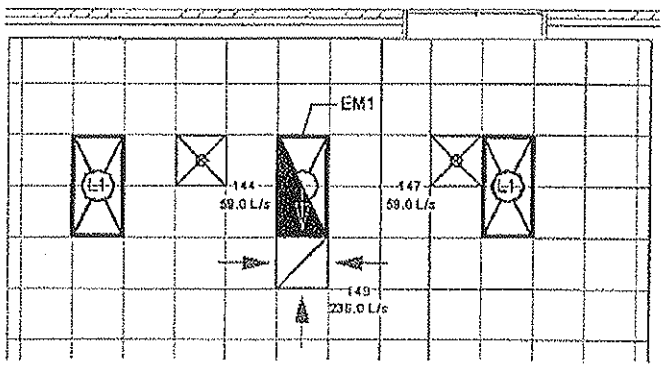

Figure 14–10

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- In Properties or the Options Bar, change the *Leader* and *Orientation* of any type of tag.

- To modify the number of an instance tag (such as the number of an air terminal or an air handling unit), click directly on the number in the tag and modify it. Alternatively, you can select the element (not the tag) and in Properties, in the *Identity Data* area, modify the *Mark* as shown in Figure 14–11. Only that one instance updates.

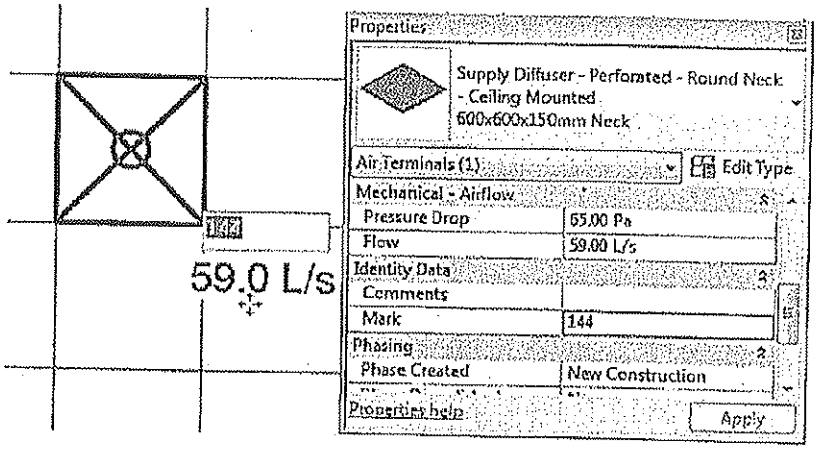

Figure 14–11

- To modify the number of a type tag (commonly used with light fixtures), you can either click directly on the number in the tag and modify it, or select the element and, in Properties, click (Edit Type). In the Type Properties dialog box, in the *Identity Data* area, modify the *Type Mark*, as shown in Figure 14–12. All instances of this element then update.

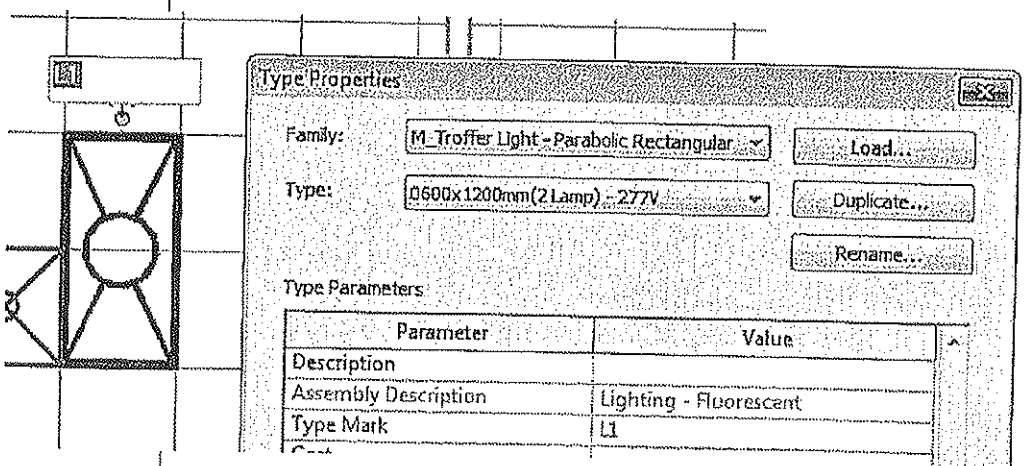

Figure 14–12

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- Many tags that reference a type mark come in empty, as shown in Figure 14–13. The pump on the left has a type mark value preset and the tag displays P-1. The pump on the right does not have a value for type mark and its tag is blank. You can select the empty tag, select the question mark, and type a number. This changes the type mark value for all instances of this type of pump in the project.

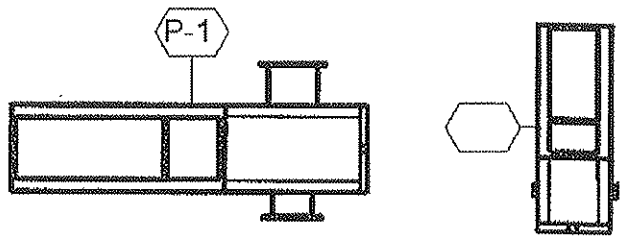

Figure 14–13

- The values for **Mark** and **Type Mark** can be letters or numbers, or a combination of the two.
- Tags that reference information other than instance or type marks, might have more stringent format requirements. For example, a tag that displays air flow in CFM requires a numerical value. Additionally, some tags (such as system tags) cannot be changed by clicking on the tag.
- When you change a number for a type tag (such as a lighting fixture type mark), an alert box opens, warning you that changing a type parameter affects other elements. If you want this tag to modify all other elements of this type, click Yes.

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Practice 14a

Adding Tags

- Add tags to lighting fixtures and conduits in a floor plan.
- Add duct, pipe, and air terminal tags in a separate floor plan.

Estimated time for completion: 15 minutes

In this practice, you will add lighting fixture tags and conduit tags to a floor plan. You will then add duct, pipe, and air terminal tags to another floor plan, as shown in Figure 14–14.

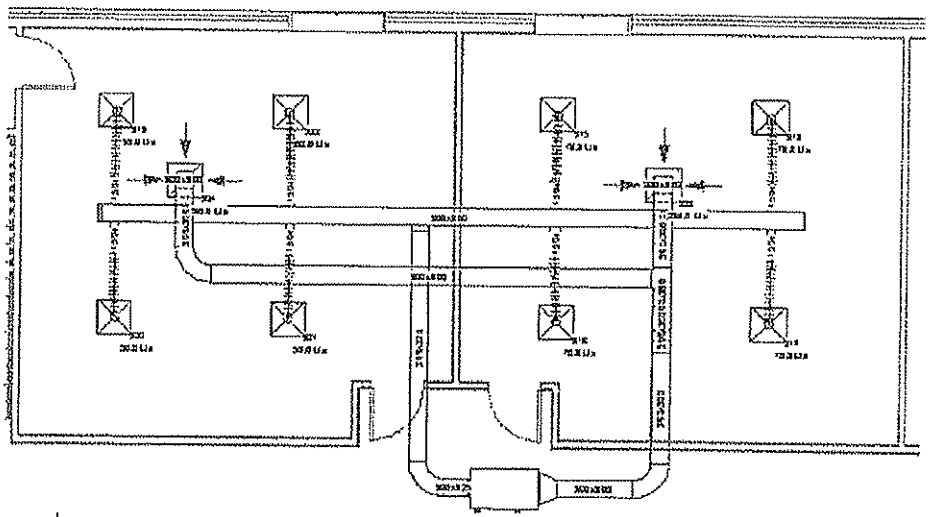

Figure 14–14

Task 1 - Add tags to a floor plan.

1. Open the project file **MEP-Elementary-School-Tags.rvt** found in the *Chapter 14* folder of your class folder.
2. Open the **02 LIGHTING PLAN** floor plan view.
3. Zoom into the classroom at the far upper left corner of the building.
4. In the *Annotate* tab>Tag panel, click (Tag by Category).
5. In the Options Bar, clear **Leader** so that leaders are not displayed.

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6. Tag the three light fixtures with the Type Mark tag that loads automatically, as shown in Figure 14–15.

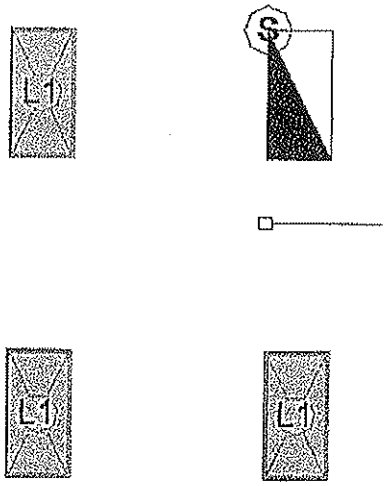

Figure 14–15

7. Click (Modify) and draw a selection box around all four fixtures. Use (Filter) to isolate only the Light Fixture Tags, as shown in Figure 14–16.

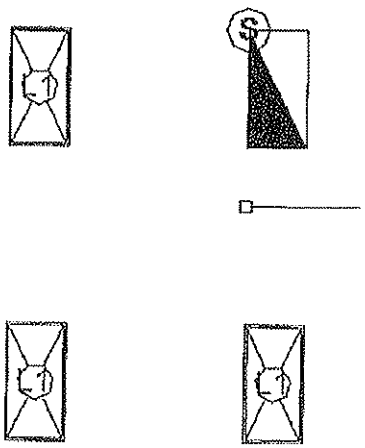

Figure 14–16

8. In the Type Selector, change the existing tag type to **M_Lighting Fixture Circuit Tag: Standard**. The tag information changes from displaying the lighting fixture number to displaying the circuit number.

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The Autodesk Revit MEP software displays alignment lines when you are lined up with other tags.

9. While the tags are still selected drag them off the fixture and place them in line with tags in the adjacent room, as shown in Figure 14–17.

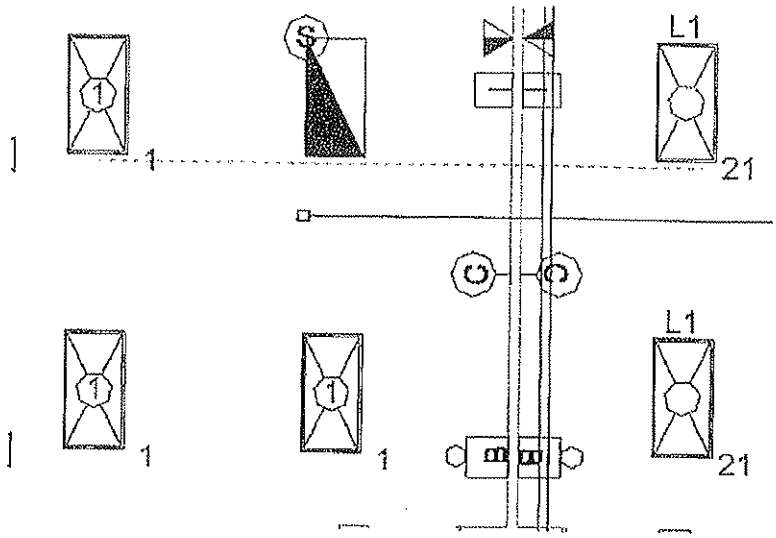

Figure 14–17

10. Using (Tag by Category), tag all four light fixtures in this room. Move the four tags to the top of the light fixtures to match Type Mark tags on the adjacent fixtures.

11. The tag for the emergency recessed lighting fixture has a question mark, as shown in Figure 14–18. This means that the information it is designed to display has not been specified.

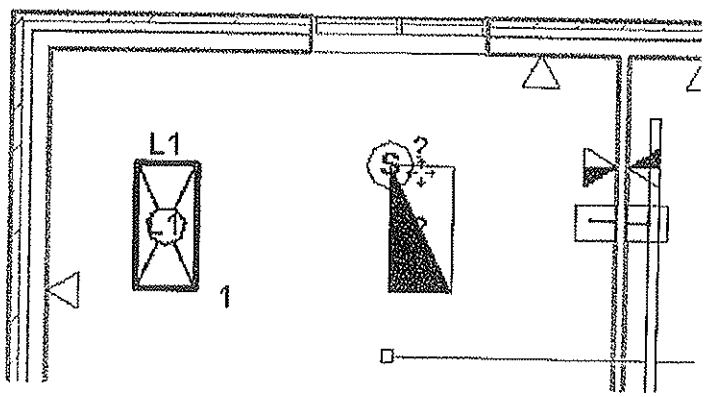

Figure 14–18

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12. Select the emergency recessed lighting fixture. In Properties, click (Edit Type).
13. In the Type Properties dialog box, in the *Identity Data* area, set *Type Mark* to **E1** and click OK. The tag updates to display this information.
14. Select the three regular light fixtures.
15. In the Type Selector, select **Troffer Light - 2x4 Parabolic: 2'x4'(4 Lamp)-277V**. The tags update and display a different type mark, as shown in Figure 14–19.

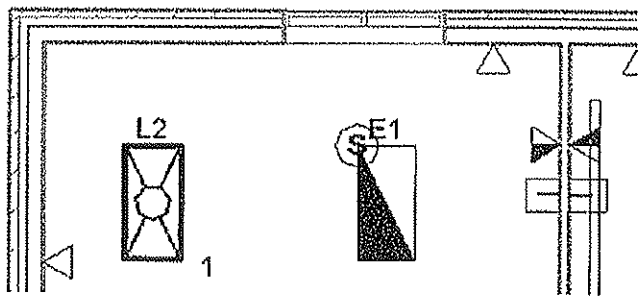

Figure 14–19

Task 2 - Load a Tag and Use a Leader.

1. Using (Tag by Category), click on the conduit that runs horizontally along the classrooms.
2. An alert box displays, warning you that no tag is loaded for Conduits. Click Yes to load one now.
3. In the Load Family dialog box, navigate to the *Annotations>Electrical>Conduit* folder and select **Conduit Size Tag.rfa**. Click Open.
4. The **Tag by Category** tool is still running.
5. In the Options Bar, select **Leader** and in the drop-down list select **Free End**.

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6. Click on the conduit to tag it and locate the leader as shown in Figure 14–20

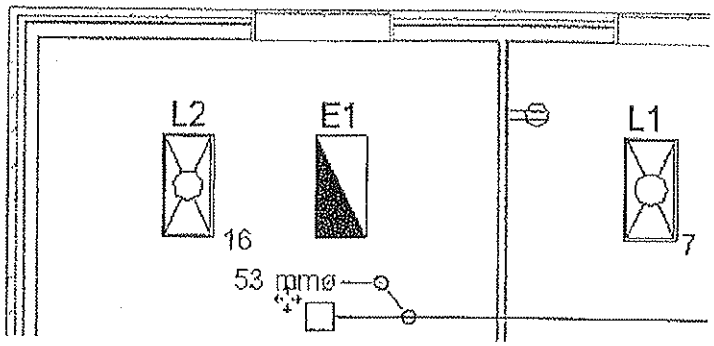

Figure 14–20

7. Click (Modify) to exit the command.

Task 3 - Tag All not Tagged.

1. Open the **01 MECHANICAL - AREA A** floor plan view. Note that there are tags on the ducting and the air terminals.
2. Open the **01 MECHANICAL - AREA B** floor plan view. This view is missing its tags.
3. In the *Annotate* tab>Tag panel, click (Tag All).
4. In the Tag All Not Tagged dialog box, select the following (hold down <Ctrl> to select more than one):
   - Air Terminal Tags: **M_Diffuser Tag**
   - Duct Tags: **M_Duct Size Tag**
   - Pipe Tags: **M_Pipe Size Tag**
5. Verify that the **Leader** is cleared and click OK.
6. If a warning box displays about Elements Have Hidden Tags, click OK.

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7. All the air terminals, pipes and ducts are now tagged in this view, as shown in part in Figure 14–21

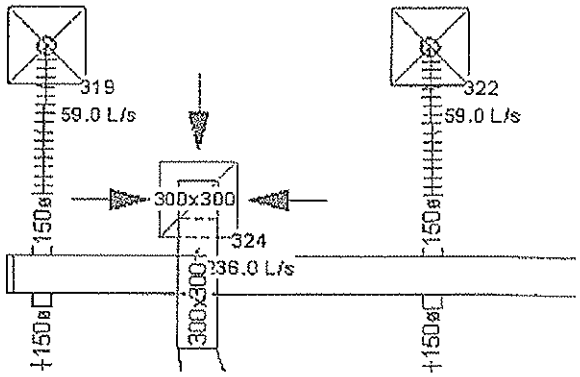

Figure 14–21

8. Save the project.

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14.2 Working with Schedules

- Open schedules and modify schedule cells that are not filled out automatically.
- Add schedules to sheets and modify them so that they fit.
- Import schedule styles from other projects and export schedule information to a spreadsheet.

Schedules extract information from a project and display it in table form. They gather property information from doors, windows, walls, rooms, and other elements. Each schedule is stored as a separate view and can be placed on sheets, as shown in Figure 14–22. Any changes you make to the project that affect the schedules are automatically updated in both views and sheets.

Schedules are typically included in project templates. Ask your BIM Manager for more information about your company's schedules.

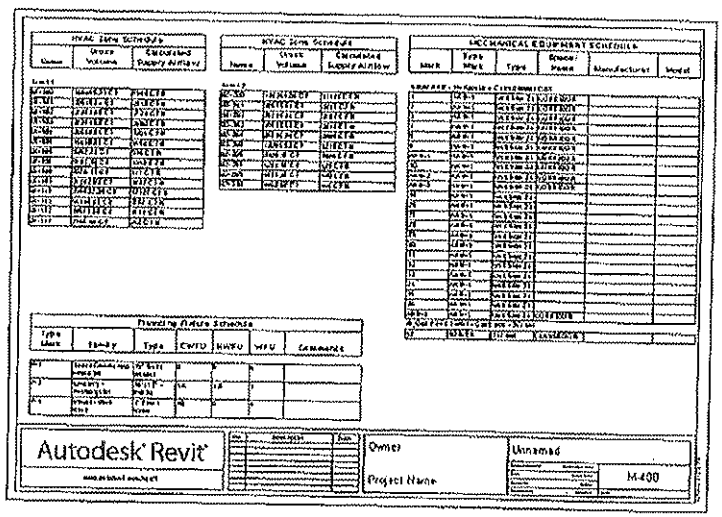

Figure 14–22

How to:

Work with Schedules

1. In the Project Browser, expand the *Schedules/Quantities* area, as shown in Figure 14–23, and double-click on the schedule you want to open.

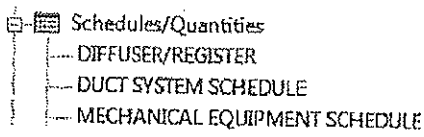

Figure 14–23

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2. Schedules are automatically filled out with the information stored in the property parameters of related elements that are added to the model.
3. Fill out additional information in either the schedule or Properties. Some information is per instance and some is by type.
4. Drag and drop the schedule onto a sheet.

Modifying Schedules

When you make changes to scheduled elements (such as changing the size of a door or adding a fire rating in the Type Properties), the schedule automatically updates. You can also change information in the cells of the schedule table, which automatically updates the elements in the project.

How to: **Modify Schedule Cells**

1. Open the schedule view.
2. Select the cell you want to change. Some cells have drop-down lists, as shown in Figure 14–24. Others have edit fields and some have a drop-down list with the option of typing a new value instead of selecting from the list.

SPACE SCHEDULE

Number	Name	Actual Supply Airflow	Calculated Supply Airflow	Airflow Check	Upper Limit	Volume
1507	CLASSROOM	236.0 L/s	241.1 L/s	-5.1 L/s	Second Fl	141.34 m³
1508	CLASSROOM	283.2 L/s	245.8 L/s	37.4 L/s	Second Fl	140.77 m³
1509	CLASSROOM	283.2 L/s	241.2 L/s	42.0 L/s	Second Fl	141.37 m³
1510	CLASSROOM	236.0 L/s	186.7 L/s	49.3 L/s	Second Fl	100.19 m³
1511	CORRIDOR	0.0 L/s	538.8 L/s	-538.8 L/s	Second Fl	674.06 m³
1512	VESTIBULE	0.0 L/s	27.9 L/s	-27.9 L/s	Second Fl	26.59 m³
1513	STORAGE	0.0 L/s	55.4 L/s	-55.4 L/s	Second Fl	44.22 m³
1514	JANITOR	0.0 L/s	26.0 L/s	-26.0 L/s	Second Fl	24.36 m³
2000	LIBRARY	283.2 L/s	246.7 L/s	36.5 L/s	Second Fl	141.37 m³
2001	NURSES OFFICE	283.2 L/s	233.3 L/s	49.9 L/s	Second Fl	140.77 m³
2002	OFFICE	283.2 L/s	246.7 L/s	36.5 L/s	Second Fl	141.34 m³
2003	PERIODICALS	283.2 L/s	240.3 L/s	42.9 L/s	Second Fl	140.80 m³
2004	PLUMBING CHASE	283.2 L/s	246.7 L/s	36.5 L/s	Second Fl	141.37 m³
2005	RECEPTION	236.0 L/s	240.2 L/s	-4.2 L/s	Second Fl	140.77 m³
2006	CLASSROOM	283.2 L/s	246.7 L/s	36.5 L/s	Second Fl	141.34 m³
2007	CLASSROOM	283.2 L/s	240.3 L/s	42.9 L/s	Second Fl	140.80 m³
2008	CLASSROOM	283.2 L/s	246.7 L/s	36.5 L/s	Second Fl	141.37 m³

Figure 14–24

3. Add the new information. The change is reflected in the schedule, on the sheet, and in the elements of the project.

- If you change an Instance Property, it only applies to that instance.

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- If you change a Type Property in the schedule, it applies to all elements of that type. An alert box opens as shown in Figure 14–25. Changing the schedule updates all related elements.

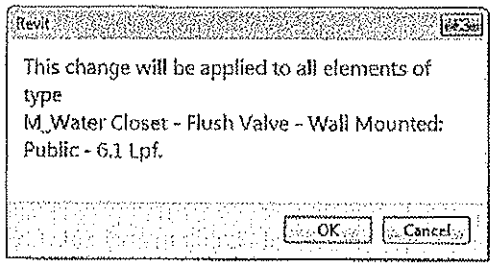

Figure 14–25

- When you select an element in a schedule, in the *Modify Schedule/Quantities* tab>Element panel, you can click (Highlight in Model), as shown in Figure 14–26.

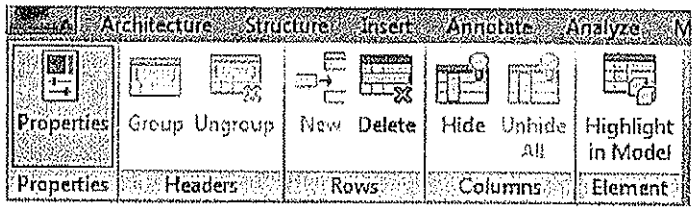

Figure 14–26

- This opens a close-up view of the element with the Show Element(s) in View dialog box, as shown in Figure 14–27. Click Show to display more views of the element. Click Close to finish the command.

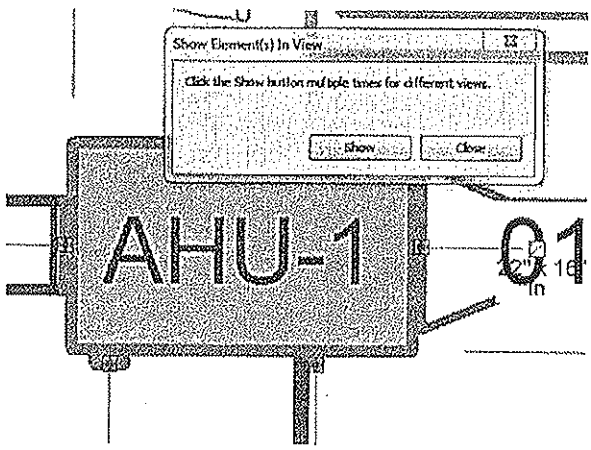

Figure 14–27

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Modifying a Schedule on a Sheet

Once you have placed a schedule on a sheet, you can manipulate it to fit the information into the available space. Select the schedule to display the controls that enable you to modify it, as shown in Figure 14–28.

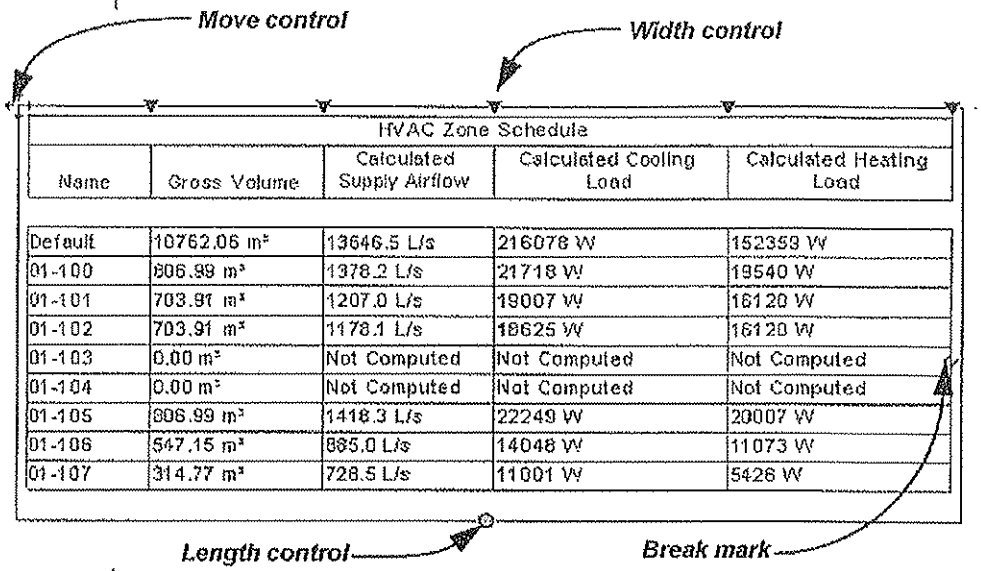

Figure 14–28

- The blue triangles modify the width of each column.
- The break mark splits the schedule into two parts.
- In each part of a split schedule, additional blue controls display. The arrows at the top left of each part enable you to drag that portion of the schedule. The bottom circle on the first schedule enables you to modify the length of the schedule, which automatically impacts the other part(s) of the split.
- To unsplit a schedule, click (Move) in the top left of the part that you want to unsplit and drag it back to the original column.

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Importing and Exporting Schedules

Schedules are views and can be copied into your project from other projects. Only the formatting information is copied; the information about individually scheduled items is not included. That information is automatically added by the project the schedule is copied into. You can also export the schedule information to be used in spreadsheets.

How to:

Import Schedules

1. In the *Insert* tab>Import panel, expand (Insert From File) and click (Insert Views From File).
2. In the Open dialog box, locate the project file containing the schedule you want to use.
3. Select the schedules you want to import, as shown in Figure 14–29.

If the referenced project contains many types of views, change Views: to ***Show schedules and reports only.***

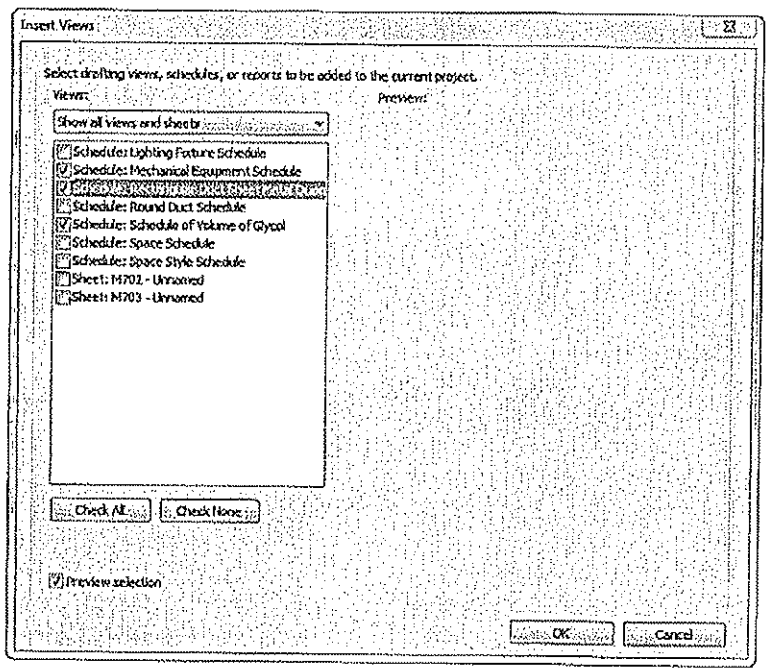

Figure 14–29

4. Click OK.

How to:

Export Schedule Information

1. Switch to the schedule view that you want to export.
2. In the Application Menu, click (Export)> (Reports)> (Schedule).
3. Select a location and name for the text file in the Export Schedule dialog box and click Save.
4. In the Export Schedule dialog box, set the options in the *Schedule appearance* and *Output options* areas that best suit your spreadsheet software, as shown in Figure 14–30.

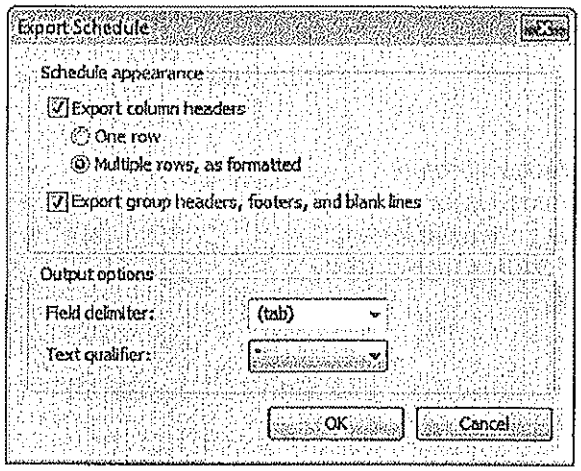

Figure 14–30

5. Click OK. A new text file is created that you can open in a spreadsheet, as shown in Figure 14–31.

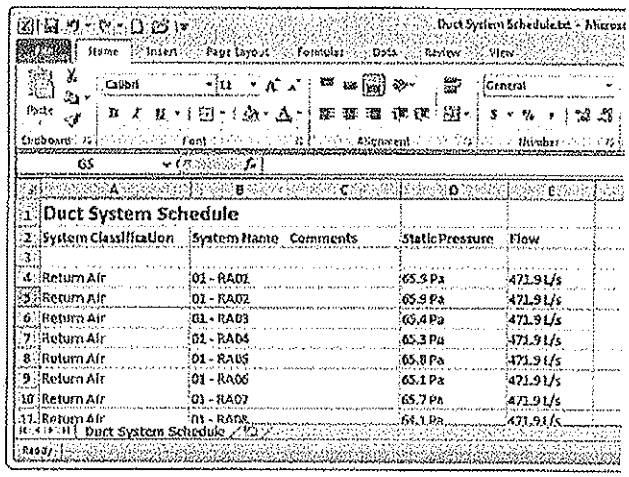

Figure 14–31

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14.3 Creating Schedules

- Create Building Component Schedules, such as air terminal, lighting fixture, or plumbing fixture schedules.
- Save schedules for use in another project.

Schedules can be created at any point in a project or included in template files. Each schedule is a separate view and can be inserted on a sheet, as shown in Figure 14–32.

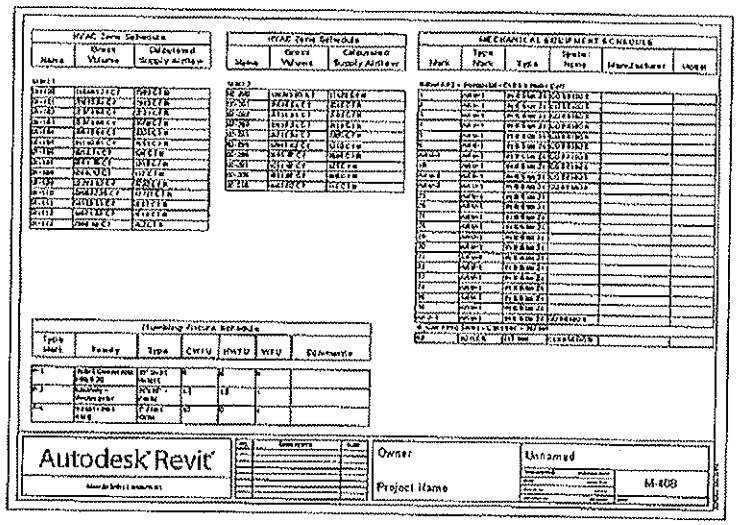

Figure 14–32

You can create the following types of schedules:

	Schedule/ Quantities	A schedule can be created for each element type used in a project with its associated properties.
	Material Takeoff	The schedule gathers information about the materials in a project and can be used to do takeoffs.
	Sheet List	The schedule gathers information about a sheet, including who has designed and checked the sheet.
	Note Block	The schedule keeps count of the symbols used in the project.
	View List	The schedule keeps count of all of the views in the project, including their scale, phase, and use on sheets.

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Building Component Schedules

A Building Component schedule is a table view of element type and instance information. You can specify the fields you want to include in the schedule. They include all parameters found in the type of element you are scheduling. For example, in the air terminal schedule (shown in Figure 14–33), parameters include automatic information (such as **Flow**), and assigned information (such as **Type Mark**, **Manufacturer**, and **Model**).

Air Terminal Schedule

Type Mark	Family	Type	Flow	Manufacturer	Model
SD-1	Supply Diffuser - Sidewall	600x300mm	236.0 L/s	Price	1234
SD-1	Supply Diffuser - Sidewall	600x300mm	236.0 L/s	Price	1234
SD-1	Supply Diffuser - Sidewall	600x300mm	236.0 L/s	Price	1234
SD-1	Supply Diffuser - Sidewall	600x300mm	236.0 L/s	Price	1234
SD-2	Supply Diffuser - Perforated - Round Neck -	600x600x150mm Neck	70.8 L/s	Hanes	5678
SD-2	Supply Diffuser - Perforated - Round Neck -	600x600x150mm Neck	70.8 L/s	Hanes	5678
SD-2	Supply Diffuser - Perforated - Round Neck -	600x600x150mm Neck	70.8 L/s	Hanes	5678
SD-2	Supply Diffuser - Perforated - Round Neck -	600x600x150mm Neck	70.8 L/s	Hanes	5678
SD-2	Supply Diffuser - Perforated - Round Neck -	600x600x150mm Neck	59.0 L/s	Hanes	5678
SD-2	Supply Diffuser - Perforated - Round Neck -	600x600x150mm Neck	59.0 L/s	Hanes	5678

Figure 14–33

How to: Create a Building Component Schedule

1. In the *View* tab>Create panel, expand (Schedules) and click (Schedule/Quantities) or in the Project Browser, right-click on the Schedule/Quantities node and select **New Schedule/Quantities**.
2. In the New Schedule dialog box, select the type of schedule you want to create (e.g., Mechanical Equipment or Fire Alarm Devices) from the *Category* list, as shown in Figure 14–34.

Use the Filter list at the top of the dialog box to determine the disciplines for which you want to display categories.

Key schedules are primarily used in architectural design and documentation.

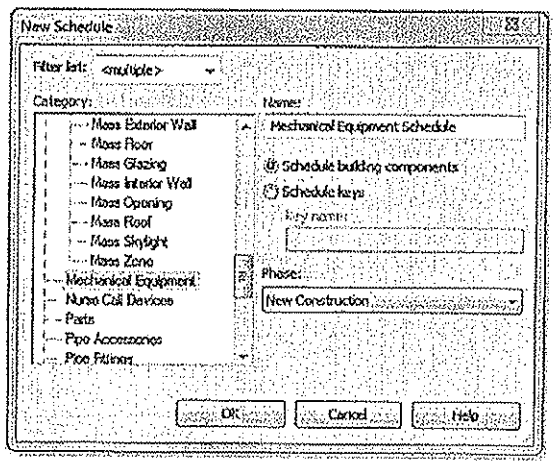

Figure 14–34

3. Type a new *Name*, if the default does not suit.

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4. Select the **Schedule building components** (for a standard schedule) or **Schedule keys** option.
5. Specify the *Phase* as needed.
6. Click OK.
7. Fill out the information in the Schedule Properties dialog box. This includes the information in the *Fields*, *Filter*, *Sorting/Grouping*, *Formatting*, and *Appearance* tabs.
8. Once you have entering the schedule properties, click OK. A schedule report is created in its own view.

Schedule Properties – Fields Tab

In the *Fields* tab, you can select from a list of available fields and organize them in the order you want them to display in the schedule, as shown in Figure 14–35.

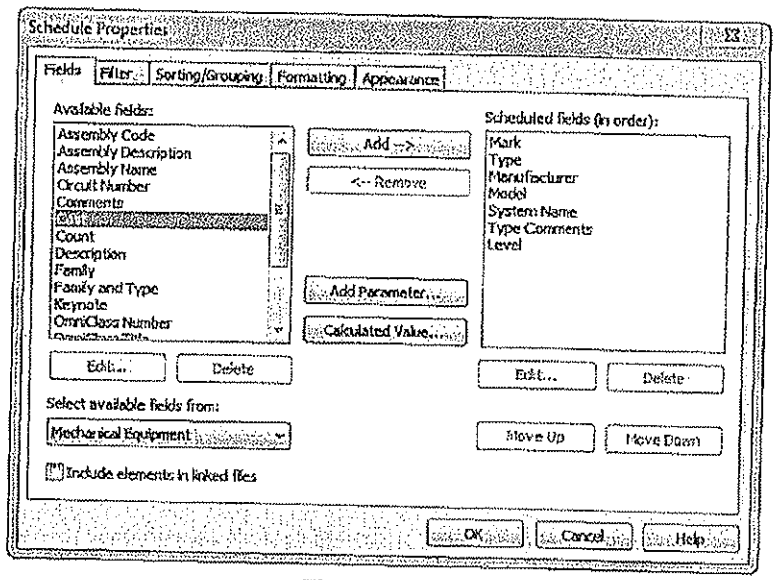

Figure 14–35

How to:

You can also double-click on a field to move it from the Available Fields to the Scheduled Fields list.

Fill out the Fields Tab

1. In the *Available fields* list, select one or more fields you want to add to the schedule and click Add -->. The field(s) are placed in the *Scheduled fields (in order)* list.
2. Continue adding fields as needed. If you add one you did not want to use, select it in the *Scheduled fields* list and click <-- Remove to move it back to the *Available fields* list.

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3. Use Move Up and Move Down to change the order of the scheduled fields.

Other Fields Tab Options

Select available fields from	Enables you to select additional category fields for the specified schedule. The available list of additional fields depends on the original category of the schedule. Typically, they include room and space information.
Include elements in linked files	Includes elements that are in files linked to the current Autodesk Revit MEP project, so that their elements can be included in the schedule.
Add Parameter...	Adds a new field according to your specification. New fields can be created as instance or type parameters.
Calculated Value...	Enables you to create a field that performs a calculation based on other fields.
Edit...	Enables you to edit custom fields. This is grayed out if you select a standard field.
Delete	Deletes selected custom fields. This is grayed out if you select a standard field.

Schedule Properties – Filter Tab

In the *Filter* tab, you can set up filters so that only elements meeting specific criteria are included in the schedule. For example, you might only want to display information for one level, as shown in Figure 14–36. You can create filters for up to four values. All values must be satisfied for the elements to display.

You must include the parameter you want to filter by as a field, but you can have it hidden in the schedule when it is finished.

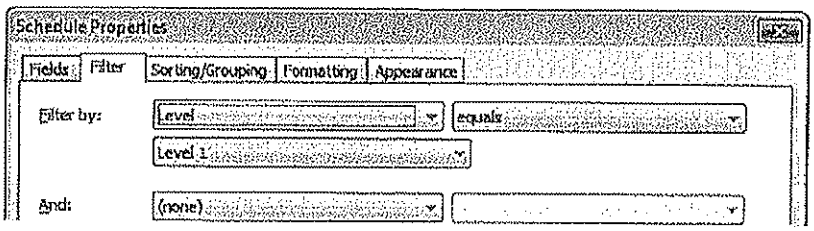

Figure 14–36

Filter by	Specifies the field to filter. Not all fields are available to be filtered.
Condition	Specifies the condition that must be met. This includes options such as **equal**, **not equal**, **greater than**, and **less than**.

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Value	Specifies the value of the element to be filtered. You can select from a drop-down list of appropriate values. For example, if you set *Filter By* to **Level**, it displays the list of levels in the project.

Schedule Properties – Sorting/Grouping Tab

In the *Sorting/Grouping* tab, you can set how you want the information to be sorted, as shown in Figure 14–37. For example, you can sort by type and then mark (number).

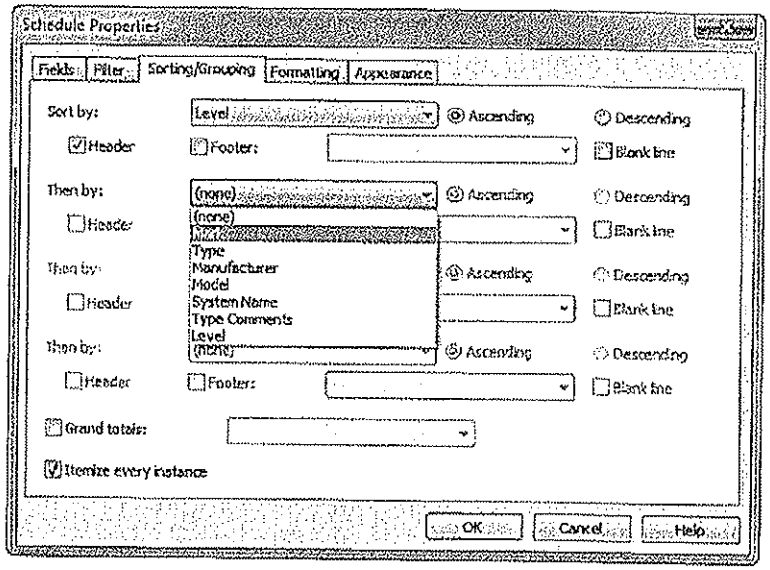

Figure 14–37

Sort by	Enables you to select the field(s) you want to sort by. You can select up to four levels of sorting.
Ascending/ Descending	Sorts fields in **Ascending** or **Descending** order.
Header/Footer	Enables you to group similar information and separate it by a **Header** with a title and/or a **Footer** with quantity information.
Blank line	Adds a blank line between groups.
Grand totals	Selects which totals to display for the entire schedule.
Itemize every instance	If selected, displays each instance of the element in the schedule. If not selected, displays only one instance of each type, as shown in Figure 14–38.

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Air Terminal Schedule					
Type Mark	Family	Type	Flow	Manufacturer	Model
RD-1	Return Diffuser - Hosted	Workplane-based Ret	236.0 L/s	Hanes	9101
SD-1	Supply Diffuser - Sidewall	600x300mm	236.0 L/s	Price	1234
SD-2	Supply Diffuser - Perforated - Round Neck -	600x600x150mm Neck		Hanes	5678

Figure 14–38

Schedule Properties – Formatting Tab

In the *Formatting* tab, you can control how the headers of each field display, as shown in Figure 14–39.

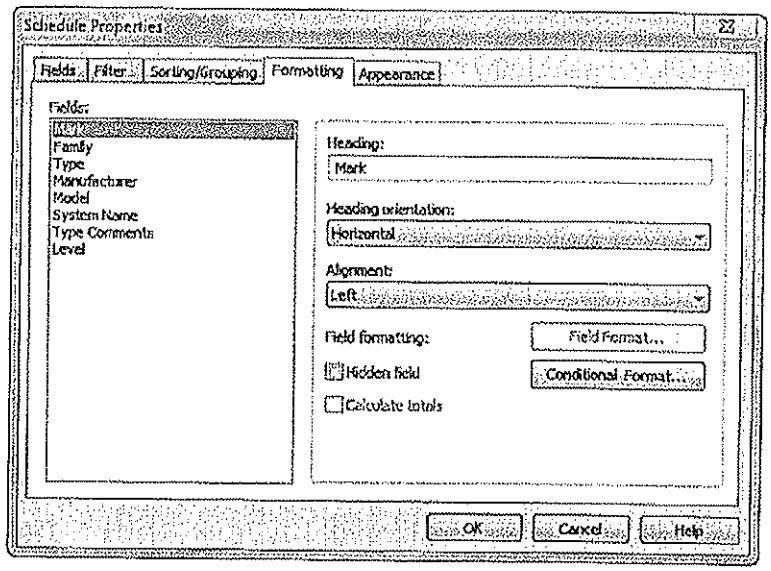

Figure 14–39

Fields	Enables you to select the field for which you want to modify the formatting.
Heading	Enables you to change the heading of the field if you want it to be different from the field name. For example, you might want to replace **Mark** (a generic name) with the more specific **Pump Number** in a pump schedule.
Heading orientation	Enables you to set the heading on sheets to **Horizontal** or **Vertical**. This does not impact the schedule view.
Alignment	Aligns the text in rows under the heading to be **Left**, **Right**, or **Center**.
Field formatting	Sets the units format for the length, area, volume, angle, or number field. By default, this is set to use the project settings.
Calculate totals	Displays the subtotals of numerical columns in a group.

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Hidden field	Enables you to hide a field. For example, you might want to use a field for sorting purposes, but not have it display in the schedule. You can also modify this option in the schedule view through the right-click menu.

Schedule Properties – Appearance Tab

In the *Appearance* tab, you can set the text style and grid options for a schedule, as shown in Figure 14–40.

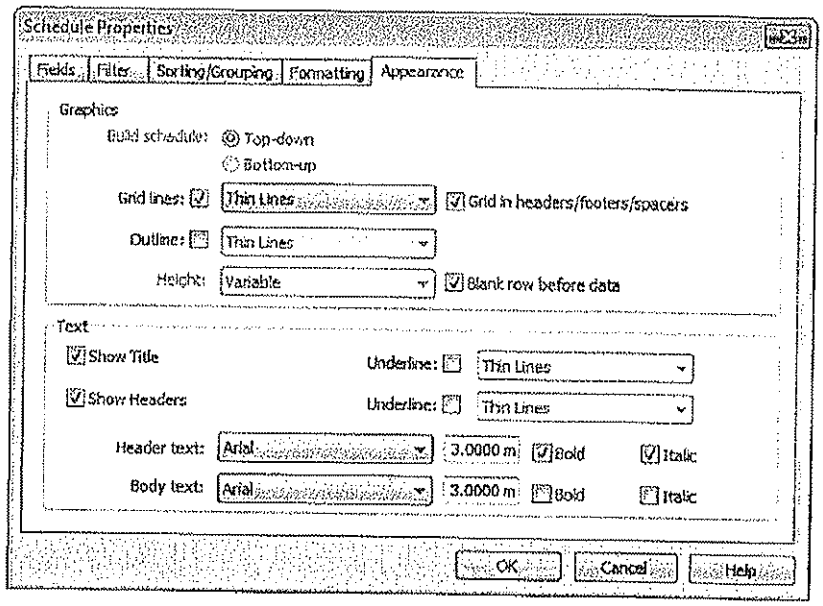

Figure 14–40

Grid lines	Displays lines between each instance listed and around the outside of the schedule. Select the style of lines from the drop-down list; this controls all lines for the schedule, unless modified.
Grid in headers/footers/ spacers	Extends the vertical grid lines between the columns.
Outline	Specify a different line type for the outline of the schedule.
Blank row before data	Select this option if you want a blank row to be displayed before the data begins in the schedule.
Show Title/Show Headers	Select these options to include the text in the schedule. You can also specify a different *Underline* for the title and column headers.
Header text	Select the font, font size, and bold or italic attributes for both the title and column headers.

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Body text	Select the font, font size, and bold or italic attributes for the body text.

Reusing Schedules

Schedule views can be saved to be used in other projects. For example, if you create a new air terminal schedule that is not in your template and you want to use it in your next project, you can save the structure of the schedule to a new file and then insert it into your template or another project.

How to: **Save a Schedule to a File**

1. In the Project Browser, right-click on the schedule you want to save and select **Save to New File...**
2. In the Save As dialog box, type a file name and select a location.
3. Click Save.

How to: **Insert a Schedule from Another Project**

The selected file can be any Autodesk Revit project, not just one where you saved a schedule to a file.

1. In the *Insert* tab>Import panel, expand (Insert from File) and click (Insert Views from File).
2. In the Open dialog box, select the project you want to use.
3. In the Insert Views dialog box, set the *Views:* to **Show schedules and reports only** and select the schedule(s) you want to import into the current project, as shown in Figure 14–41.

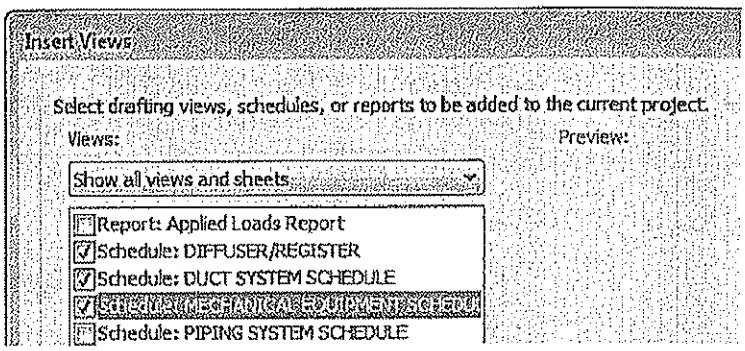

Figure 14–41

4. Click OK to finish.

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Practice 14b

Air Terminal Schedule

- Create an Air Terminal Schedule.
- Add information directly to the schedule and modify the element so the schedule also updates.
- Add a schedule to a sheet.

Estimated time for completion: 10 minutes

In this practice you will create an Air Terminal Schedule by selecting fields, sorting the fields including a count, and setup the formatting and appearance of the schedule. You will edit the schedule, add information directly into the schedule, and add the schedule to a sheet. You will also make a change to the Type Properties of an Air Terminal which then updates in the schedule, as shown in Figure 14–42.

Air Terminal Schedule

Mark	Family	Type	Flow	Manufacturer	Model	Count
RD-1	Return Diffuser - Hosted	Workplane-based Return Diffuser	230.0 L/s			48
SD-1	Supply Diffuser - Sidewall	600x300mm	230.0 L/s			4
SD-2	Supply Diffuser - Perforated - Round Neck - Ceiling Mounted	600x600x150mm Neck				104
Grand total						248

Figure 14–42

- This is an HVAC-oriented practice but the same methods can be used for other items, such as plumbing fixtures, sprinklers, and lighting fixtures.

Task 1 - Create an Air Terminal Schedule.

1. Open the project file **MEP-Elementary-School-Schedules-M.rvt**, found in the *Chapter 14* folder of your class folder.

2. In the *View* tab>Create panel, expand (Schedules) and click (Schedule/Quantities) or in the Project Browser, right-click on the Schedule/Quantities node and select **New Schedule/Quantities**.

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3. In the New Schedule dialog box, select **Air Terminals** from the Category list and click OK.
4. In the Schedule Properties dialog box, *Fields* tab, scroll down in the Available fields: list and select **Type Mark**.
5. Click Add--> or double-click on the name to add this field to the *Scheduled fields (in order):* list.
6. Continue adding the fields shown in Figure 14–43 in this order.

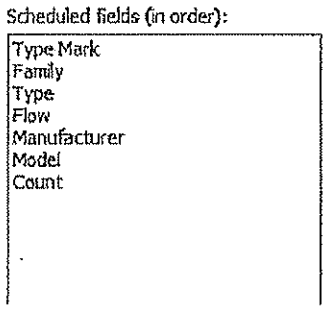

Figure 14–43

- If you have added a field which you do not require, select it in the Scheduled fields (in order): list and then click <-- Remove.
- If you have the right fields but they are in the wrong order, use Move Up and Move Down to reorder them.

7. Continue working in the Schedule Properties dialog box. Click on the *Sorting/Grouping* tab.
8. In the Sort by: drop-down list, select **Type Mark** as shown in Figure 14–44.

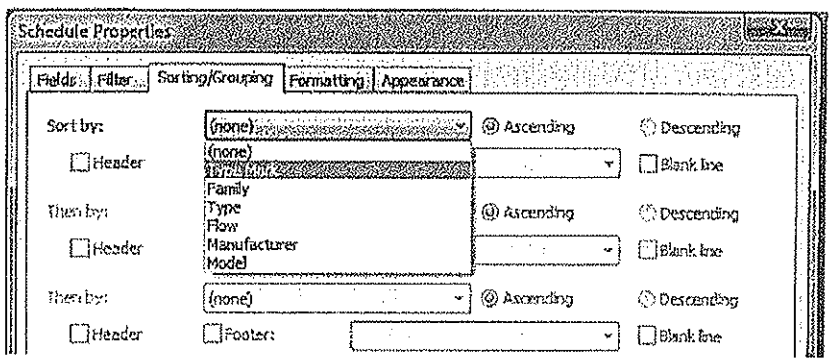

Figure 14–44

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9. Select **Grand totals:** and then **Title and totals** from the drop-down list.
10. Clear **Itemize every instance.**
11. Click on the *Formatting* tab.
12. With **Type Mark** selected in the *Fields:* list, change the *Heading* to **Mark.**
13. With **Count** selected in the *Fields:* list, select **Calculate totals.**
14. Click on the *Appearance* tab.
15. Change the height of the *Header text* to **4mm** and select **Bold**, as shown in Figure 14–45.

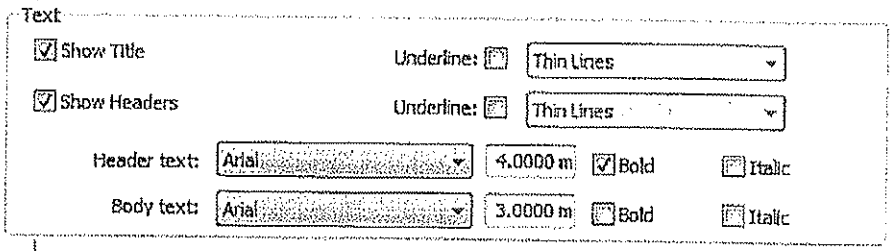

Figure 14–45

16. Click OK. The new schedule should display as shown in Figure 14–46.

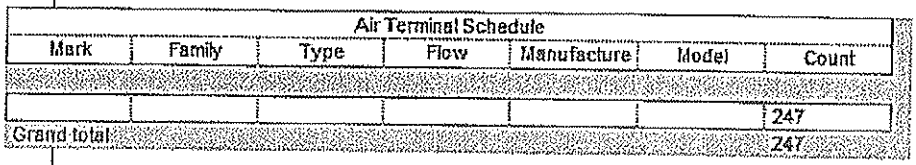

Figure 14–46

- There is one row which is entirely blank except for the *Count* column. At this point none of the air terminals have a Type Mark assigned. Therefore, the Autodesk Revit MEP software groups them into one row.

17. Save the project.

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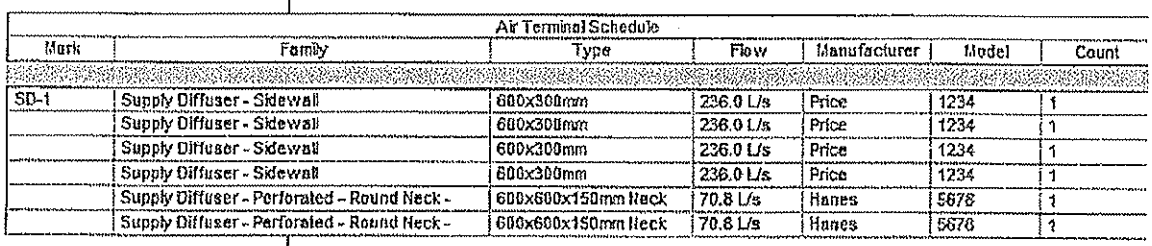
Task 2 - Edit the Schedule and enter data directly into the schedule.

1. In Properties, beside *Sorting/Grouping*, click Edit... . The Schedule Properties dialog box opens again with the *Sorting/Grouping* tab active.
2. Select the box next to **Itemize every instance** and click OK.
   - You will turn this off again later. Right now every air terminal should display so that you can assign Type Marks in the schedule.
3. Click in the first cell in the *Mark* column and type **SD-1**, as shown in Figure 14–47.



Air Terminal Schedule

Mark	Family	Type	Flow	Manufacturer	Model	Count
SD-1	Supply Diffuser - Sidewall	600x300mm	236.0 L/s	Price	1234	1
	Supply Diffuser - Sidewall	600x300mm	236.0 L/s	Price	1234	1
	Supply Diffuser - Sidewall	600x300mm	236.0 L/s	Price	1234	1
	Supply Diffuser - Sidewall	600x300mm	236.0 L/s	Price	1234	1
	Supply Diffuser - Perforated - Round Neck -	600x600x150mm Neck	70.8 L/s	Hanes	5678	1
	Supply Diffuser - Perforated - Round Neck -	600x600x150mm Neck	70.8 L/s	Hanes	5678	1

Figure 14–47

4. A Warning box opens indicating that the change will apply to all elements of the same type, as shown in Figure 14–48. Click OK.

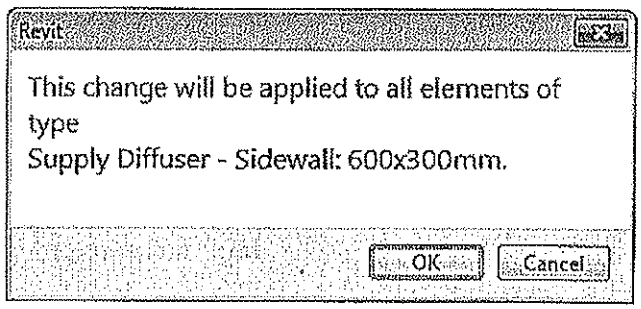


Figure 14–48

5. The list is in order as all the items that have a SD-1 type mark move to the bottom of the list.
6. Repeat with the second Supply Diffuser setting the type as **SD-2**.

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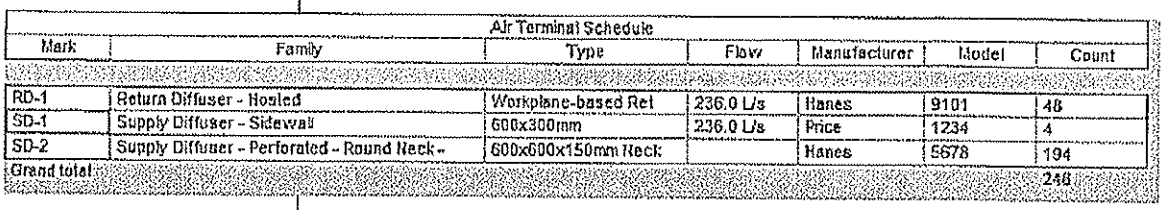
7. Click in the first cell in the *Mark* column and type **RD-1**.

8. Click OK to the warning. The Air Terminals are now all assigned a Type Mark.

9. In Properties, next to *Sorting/Grouping* click Edit... . In the *Sorting/Grouping* area, clear **Itemize every instance** and click OK .

10. The schedule displays correctly, as shown in Figure 14–49.



Air Terminal Schedule

Mark	Family	Type	Flow	Manufacturer	Model	Count
RD-1	Return Diffuser - Hosted	Workplane-based Ret	236.0 L/s	Hanes	9101	48
SD-1	Supply Diffuser - Sidewall	600x300mm	236.0 L/s	Price	1234	4
SD-2	Supply Diffuser - Perforated - Round Neck -	600x600x150mm Neck		Hanes	5678	194
Grand total:						246

Figure 14–49

Task 3 - Adding the schedule to a sheet.

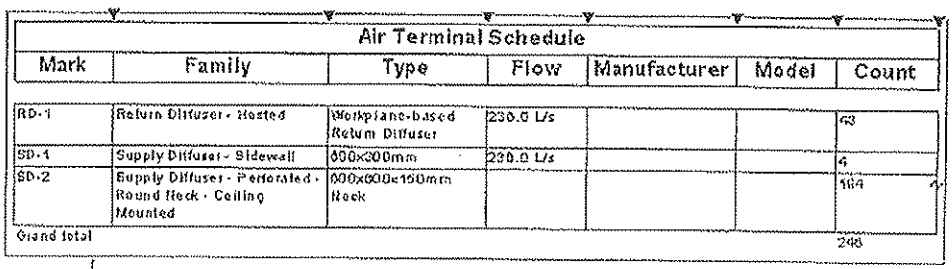
1. In the Project Browser, right-click on *Sheets (all)* node and select **New Sheet**.

2. In the New Sheets dialog box, click OK to create a sheet using the default title block. The new sheet opens.

3. In the Project Browser, expand the Schedules/Quantities node.

4. Locate the **Air Terminal Schedule** and drag and drop it onto the sheet.

5. Zoom in on the schedule. Use the grips to adjust the column sizes, as shown in Figure 14–50.



Air Terminal Schedule

Mark	Family	Type	Flow	Manufacturer	Model	Count
RD-1	Return Diffuser - Hosted	Workplane-based Return Diffuser	236.0 L/s			48
SD-1	Supply Diffuser - Sidewall	600x300mm	236.0 L/s			4
SD-2	Supply Diffuser - Perforated - Round Neck - Ceiling Mounted	600x600x150mm Neck				194
Grand total						246

Figure 14–50

6. Save the project.

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Task 4 - Input parameter values in the air terminal family.

1. Open the **01 MECHANICAL PLAN - AREA A** floor plan view.
2. Select an existing air terminal.
3. In Properties, click (Edit Type).
4. In the Type Properties dialog box, in the *Identity Data* area, next to **Manufacturer** parameter, enter the name of a company which manufactures air terminals. Enter a model number for the value of the **Model** parameter.
5. Click OK.
6. Press <Ctrl> + <Tab> to switch back to the open schedule which is now updated to display this information for that type of air terminal, as shown in Figure 14–51.

Air Terminal Schedule

Mark	Family	Type	Flow	Manufacturer	Model	Count
RD-1	Return Diffuser - Hosted	Workplane-based Return Diffuser	236.0 L/s			48
SD-1	Supply Diffuser - Sidewall	600x300mm	236.0 L/s			4
SD-2	Supply Diffuser - Perforated - Round Neck - Ceiling Mounted	600x600x150mm Neck		Price	1234	194
Grand total						246

Figure 14–51

7. Save the project.

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Practice 14c

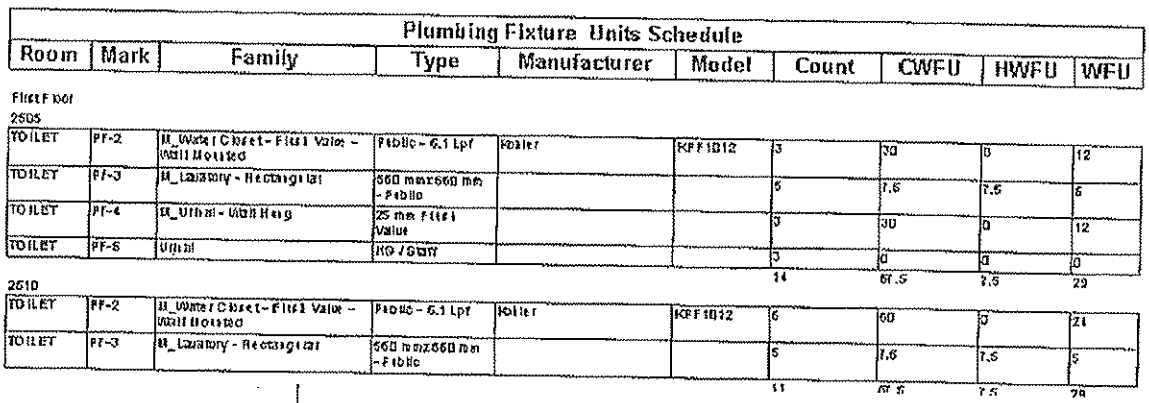
Estimated time for completion: 20 minutes

Plumbing Fixture Units Schedule

Create and modify a schedule for specific plumbing fixtures.

Add the schedule to a sheet.

In this practice you will create a plumbing fixture units schedule starting with a base set of fields and some sorting and grouping and formatting. You will then modify the schedule to add filtering and additional sorting and formatting to get the required information. Finally, you will place the schedule on a sheet, as shown in Figure 14–52, and update some of the type properties of a plumbing fixture and verify that it displays in the schedule.



Plumbing Fixture Units Schedule

Room	Mark	Family	Type	Manufacturer	Model	Count	CWFU	HWFU	WFU
First Floor									
2505									
TOILET	PF-2	M_Water Closet-Flush Valve - Wall Mounted	Public - 6.1 Lpf	Kohler	K-FF1812	3	30	0	12
TOILET	PF-3	M_Lavatory - Rectangular	560 mm x 560 mm - Public			5	7.5	7.5	5
TOILET	PF-4	M_Urinal - Wall Hung	25 mm Flush Valve			3	30	0	12
TOILET	PF-5	Urinal	HO / SWW			3	0	0	0
						14	67.5	7.5	29
2510									
TOILET	PF-2	M_Water Closet-Flush Valve - Wall Mounted	Public - 6.1 Lpf	Kohler	K-FF1812	6	60	0	24
TOILET	PF-3	M_Lavatory - Rectangular	560 mm x 560 mm - Public			5	7.5	7.5	5
						11	67.5	7.5	29

Figure 14–52

Task 1 - Create a plumbing fixture units schedule

1. Open the project file **MEP-Elementary-School-Schedules.rvt-M**, found in the *Chapter 14* folder of your class folder.

2. In the *View* tab>Create Panel, expand (Schedules) and click (Schedule/Quantities) or in the Project Browser, right-click on the *Schedule/Quantities* node and select **New Schedule/Quantities**.

3. In the New Schedule dialog box, in the Category: list, select **Plumbing Fixtures** and click OK.

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4. In the Schedule Properties dialog box, in the *Fields* tab, expand the Available fields: list and select **Type Mark**.

5. Click Add --> or double-click on the name to add this field to the Scheduled fields (in order): list.

6. Continue adding the fields shown in Figure 14–53.

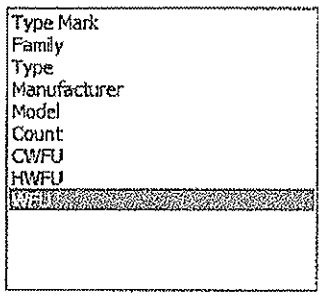

Figure 14–53

- If you have added a field that you do not need, select it in the Scheduled fields (in order): list and click <-- Remove.
- If you have the correct fields but they are in the wrong order, use Move Up and Move Down to reorder them.

7. Stay in the *Fields* tab, expand the Select available fields from: drop-down list, and select **Space**. The Available fields: list changes to display fields from the spaces.

8. Add the following fields: **Space: Level**, **Space: Number**, and **Space: Name** and use Move Up to reorder the list as shown in Figure 14–54.

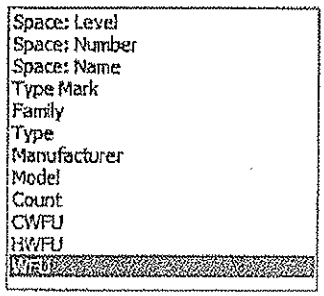

Figure 14–54

9. Continue working in the Schedule Properties dialog box. Select the *Sorting/Grouping* tab.

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10. In the Sort by: drop-down list, select **Space: Level** as shown in Figure 14–55.

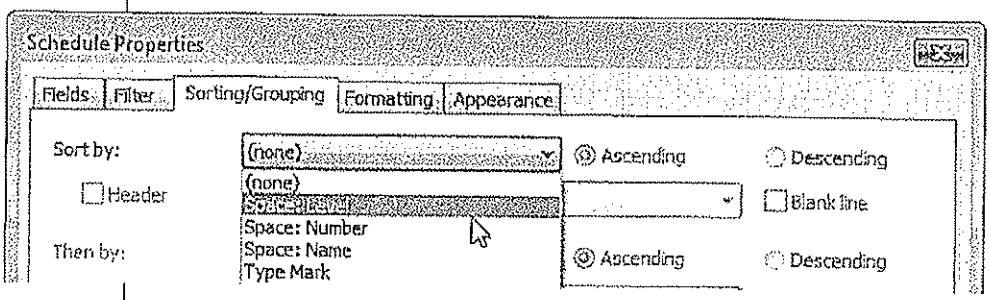

Figure 14–55

11. Set the next two *Sort by* fields to **Space: Number** and **Type Mark.**, select **Grand totals:**, select **Title and totals** from the drop-down list and clear **Itemize every instance**, as shown in Figure 14–56.

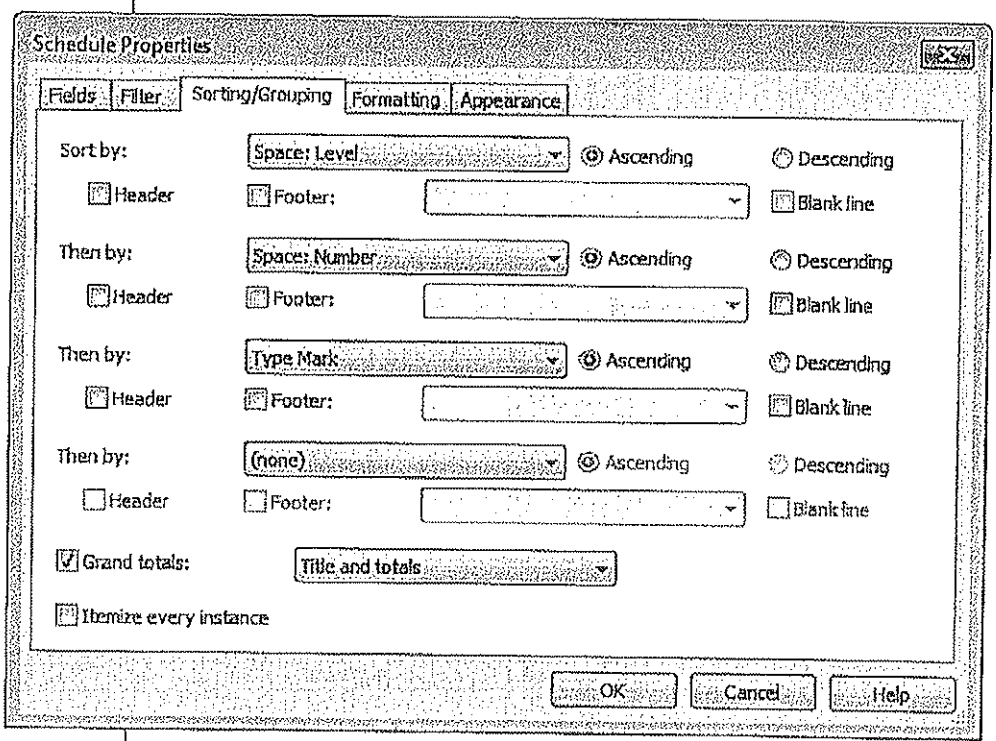

Figure 14–56

12. Select the *Formatting* tab.

13. In the *Fields:* list, select **Type Mark** and change the *Heading* to **Mark.**

14. In the *Fields:* list, select **Count** and select **Calculate totals.**

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15. Select the *Appearance* tab.

16. Change the height of the *Header text* to **6mm** and select **Bold**, and change the height of the Body text to **4mm**, as shown in Figure 14–57.

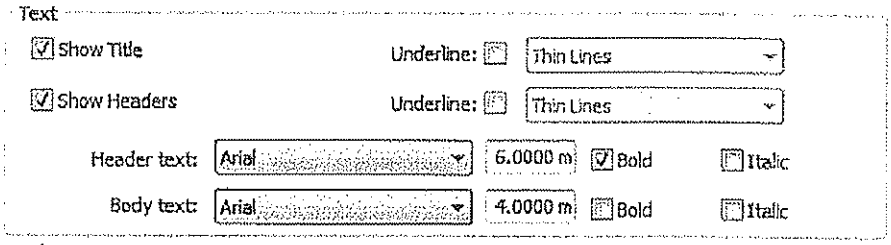

Figure 14–57

17. Click OK. The new schedule should display as shown in Figure 14–58.

- There are multiple rows listing one sink per classroom, and then one row for each of the four main washrooms. At this point a Type Mark has not been assigned to any of the plumbing fixtures. Therefore, the software groups them based on the space in which they are located.

Schedule: Plumbing Fixture Schedule - MEP-Elementary-School-Schedules-M

Plumbing Fixture Schedule

Space: Level	Space: Numb	Space: Name	Mark	Family	Type	Manufacture	Model	Count
First Floor	2005	CLASSROO		M_Sink Kit	760 x 535			1
First Floor	2006	CLASSROO		M_Sink Kit	760 x 535			1
First Floor	2007	CLASSROO		M_Sink Kit	760 x 535			1
First Floor	2008	CLASSROO		M_Sink Kit	760 x 535			1
First Floor	2009	CLASSROO		M_Sink Kit	760 x 535			1
First Floor	2505	TOILET						14
First Floor	2510	TOILET						11
Second Floo	4001	TOILET						2
Second Floo	4005	TOILET						14
Second Floo	4010	TOILET						11
Second Floo	4014	TOILET						3
Second Floo	4500	CLASSROO		M_Sink Kit	760 x 535			1

Figure 14–58

18. Save the project.

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Task 2 - Edit the schedule and enter data directly into the schedule.

1. In Properties, next to *Sorting/Grouping*, click Edit....
2. In the Schedule Properties dialog box, select **Itemize every instance**, and click OK.
   - You will turn this off again later. Currently, every plumbing fixture should display so that you can assign Type Marks in the schedule.
3. Select the first cell in the *Mark* column and type **PF-1**, as shown in Figure 14–59.

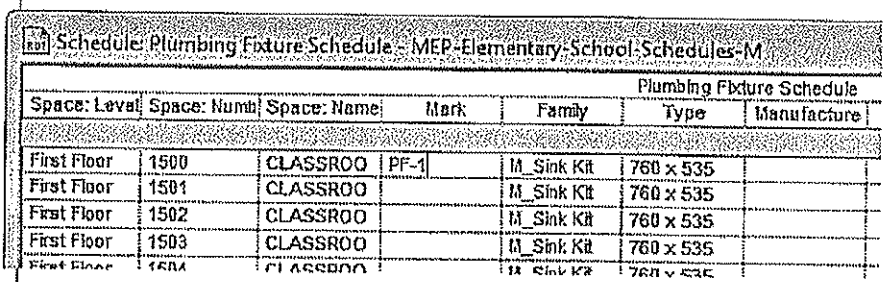

Figure 14–59

4. A Warning box opens indicating that the change will apply to all elements of the same type, as shown in Figure 14–60. Click OK.

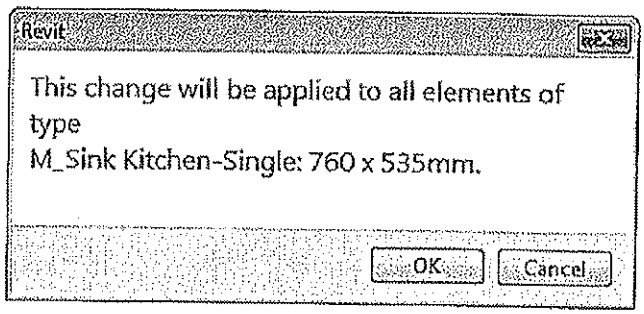

Figure 14–60

5. Because this schedule focuses on the washroom fixtures, you do not want to include the classroom sinks. To remove them you will use a filter. In Properties, next to *Filters*, click Edit....

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6. Expand the first Filter by: drop-down list and select **Type Mark**. Expand the Condition drop-down list and select **'does not equal'**, and expand the Value drop-down list and select **PF-1** as shown in Figure 14–61.

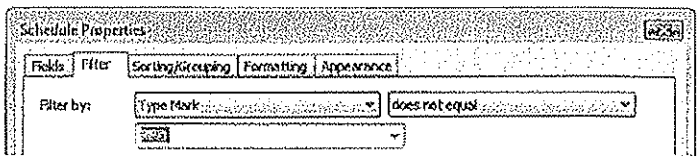

Figure 14–61

7. Click OK. The list is filtered and is significantly shorter.

8. Add Type Marks, starting with **PF-2**, to the remaining fixtures. The schedule reorders as the Type Marks are applied. Click OK in the Warning box.

9. In Properties, next to *Sorting/Grouping*, click Edit....

10. In the Schedule Properties dialog box, in the *Sorting/Grouping* tab, (as shown in Figure 14–62), set the options as follows:

   - Set *Space: Level* to **Header**.
   - Set *Space: Number* to **Header** and **Footer**.
   - In the expanded drop-down list, select **Totals only**.
   - Clear the **Grand totals** and **Itemize every instance** options.

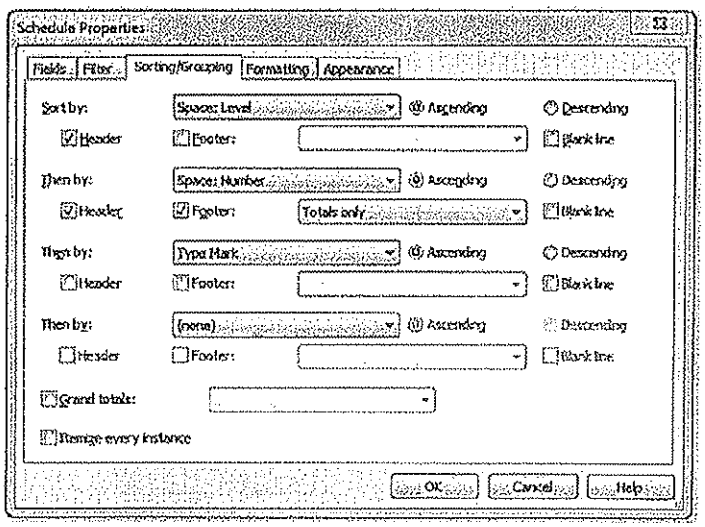

Figure 14–62

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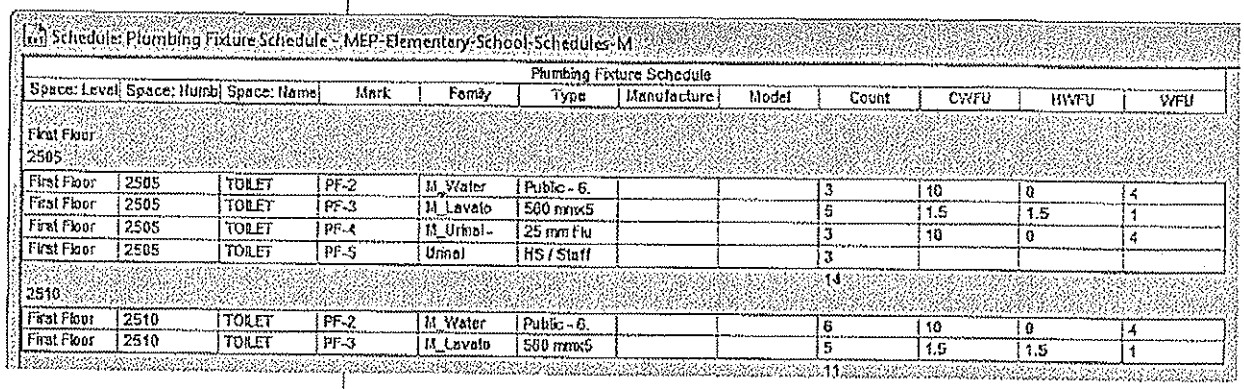
11. Click OK. The schedule displays as shown in part in Figure 14–63.



Schedule: Plumbing Fixture Schedule - MEP-Elementary-School-Schedules-M

Plumbing Fixture Schedule

Space: Level	Space: Numb	Space: Name	Mark	Family	Type	Manufacture	Model	Count	CWFU	HWFU	WFU
First Floor											
2505											
First Floor	2505	TOILET	PF-2	M_Water	Public - 6.			3	10	0	4
First Floor	2505	TOILET	PF-3	M_Lavato	560 mmx5			5	1.5	1.5	1
First Floor	2505	TOILET	PF-4	M_Urinal -	25 mm Flu			3	10	0	4
First Floor	2505	TOILET	PF-5	Urinal	HS / Staff			3			
								14			
2510											
First Floor	2510	TOILET	PF-2	M_Water	Public - 6.			6	10	0	4
First Floor	2510	TOILET	PF-3	M_Lavato	560 mmx5			5	1.5	1.5	1
								11			

Figure 14–63

12. Because **Space: Level** and **Space: Number** have been set with headers, it is not necessary to have the entire column repeating. Select one of the cells that displays **First Floor**, right-click and select **Hide Column(s)**. Repeat this for the *Space: Number* column.

13. The *Fixture Unit* columns (*CWFU*, *HWFU*, and *WFU*) are not displaying overall totals nor by fixture totals. They are only indicating the individual fixture units of that type of fixture.

14. In Properties, next to *Formatting*, click Edit... . For each of the fixture unit fields (*CWFU*, *HWFU*, and *WFU*), select the field and then select **Calculate totals**. With **Space: Name** selected in the Fields: list, change the *Heading* to **Room**.

15. Click OK.

16. Finally, in the schedule itself, click in the title area and change the name to **Plumbing Fixture Units Schedule**.

17. Save the project.

Task 3 - Adding the schedule to a sheet.

1. In the Project Browser, right-click on Sheets (all) node and select **New Sheet**.

2. In the New Sheets dialog box, click OK to create a sheet using the default title block. The new sheet opens.

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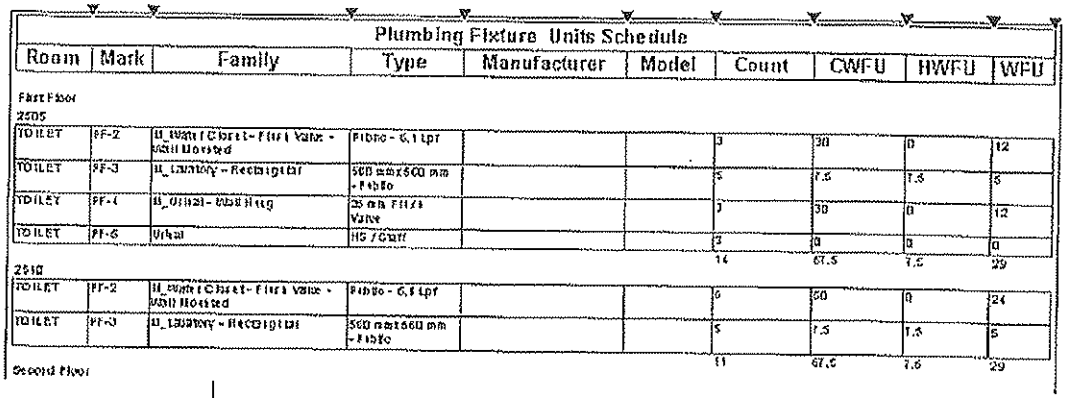
3. In the Project Browser, expand the Schedules/Quantities node.
4. Locate the **Plumbing Fixture Units Schedule** and drag and drop it onto the sheet.
5. Zoom in on the schedule. Use the grips to adjust the column sizes, as shown in Figure 14–64.



Plumbing Fixture Units Schedule

Room	Mark	Family	Type	Manufacturer	Model	Count	CWFU	HWFU	WFU
First Floor									
2505									
TOILET	PF-2	W_Wall Closet - Flush Valve - Wall Mounted	Fixture - 6.1 lpf			3	30	0	12
TOILET	PF-3	W_Lavatory - Rectangular	508 mm x 508 mm - Fixture			5	7.5	7.5	5
TOILET	PF-4	W_Urinal - Wall Hung	25 mm Flush Valve			3	30	0	12
TOILET	PF-6	Urinal	HS 7 Gallon			3	0	0	0
						14	67.5	7.5	29
2510									
TOILET	PF-2	W_Wall Closet - Flush Valve - Wall Mounted	Fixture - 6.1 lpf			6	60	0	24
TOILET	PF-3	W_Lavatory - Rectangular	508 mm x 508 mm - Fixture			5	7.5	7.5	5
						11	67.5	7.5	29
Second Floor									

Figure 14–64

6. Save the project.

Task 4 - Input parameter values in the plumbing fixtures family.

1. Open the Mechanical>Plumbing>Floor Plans>**01 Sanitary Plan** view.
2. Zoom in on the restrooms and select an existing toilet. (The ones in the current project are under the ones in the linked model.)
3. In Properties, click (Edit Type).
4. In the Type Properties dialog box, in the *Identity Data* area, next to **Manufacturer** parameter, enter the name of a company that manufactures plumbing fixtures. Enter a model number for the value of the **Model** parameter.
5. Click OK.

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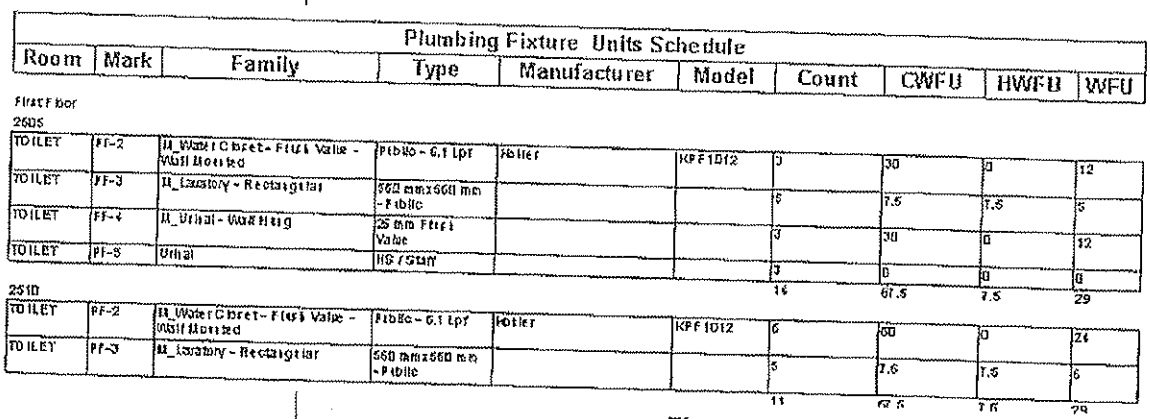
6. Press <Ctrl>+<Tab> to switch back to the open schedule, which is now updated to display this information for that type of plumbing fixture, as shown in Figure 14–65.



Plumbing Fixture Units Schedule

Room	Mark	Family	Type	Manufacturer	Model	Count	CWFU	HWFU	WFU
First Floor									
2605									
TOILET	PF-2	M_Water Closet- Flush Valve - Wall Hanged	Public - 6.1 Lpf	Roller	KPF1012	3	30	0	12
TOILET	PF-3	M_Lavatory - Rectangular	560 mm x 560 mm - Public			6	7.5	7.5	6
TOILET	PF-4	M_Urinal - Washing	25 mm Flush Valve			3	30	0	12
TOILET	PF-5	Urinal	HS / Staff			3	0	0	0
						15	67.5	7.5	29
2510									
TOILET	PF-2	M_Water Closet- Flush Valve - Wall Hanged	Public - 6.1 Lpf	Roller	KPF1012	6	60	0	24
TOILET	PF-3	M_Lavatory - Rectangular	560 mm x 560 mm - Public			5	7.5	7.5	5
						11	67.5	7.5	29

Figure 14–65

7. Save the project.

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Practice 14d

Estimated time for completion: 15 minutes

Average Estimated Illumination Schedule

In this practice you will create a space schedule that displays the average estimated illumination for each space and place the schedule on a sheet, You will edit the schedule and use formatting to set up a conditional formula that indicates where there is no or not enough illumination as shown in Figure 14–66.

Space Illumination Schedule			
Level	Number	Name	Average Estimated Illumination
Level 1			
Level 1	100	PLUMBING CHASE	0 lx
Level 1	101	PLUMBING CHASE	0 lx
Level 1	1500	CLASSROOM	416 lx
Level 1	1501	CLASSROOM	416 lx
Level 1	1502	CLASSROOM	417 lx
Level 1	1503	CLASSROOM	416 lx
Level 1	1504	CLASSROOM	417 lx
Level 1	1505	CLASSROOM	416 lx
Level 1	1506	CLASSROOM	417 lx
Level 1	1507	CLASSROOM	416 lx
Level 1	1508	CLASSROOM	417 lx
Level 1	1509	CLASSROOM	416 lx
Level 1	1510	CLASSROOM	374 lx
Level 1	1511	CORRIDOR	0 lx
Level 1	1512	VESTIBULE	0 lx
Level 1	1513	STORAGE	0 lx
Level 1	1514	STORAGE	0 lx
Level 1	2000	CLASSROOM	416 lx

Figure 14–66

Task 1 - Create an Average Estimated Illumination schedule

1. Open the project file **MEP-Elementary-School-Schedules-M.rvt**, found in the *Chapter 14* folder of your class folder.

2. In the *View* tab>Create Panel, expand (Schedules) and click (Schedule/Quantities) or in the Project Browser, right-click on the Schedule/Quantities node and select **New Schedule/Quantities**.

3. In the New Schedule dialog box, set the *Filter list* to **Electrical**. In the Category: list, select **Spaces** and change the name of the schedule to **Space Illumination Schedule**. Click OK.

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4. In the Schedule Properties dialog box, in the *Fields* tab, in the Available fields: list, select **Level**.

5. Click Add --> or double-click on the name to add this field to the Scheduled fields (in order): list.

6. Continue adding the fields shown in Figure 14–67.

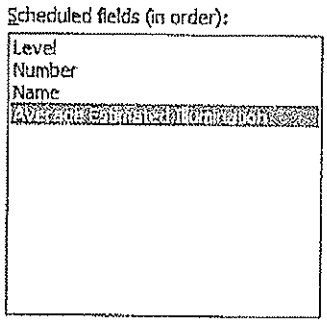

Figure 14–67

- If you have added a field that you do not need, select it in the Scheduled fields (in order): list and click <-- Remove.
- If you have the correct fields but they are in the wrong order, use Move Up and Move Down to reorder them.

7. Continue working in the Schedule Properties dialog box. Select the *Sorting/Grouping* tab.

8. In the Sort by: drop-down list, select **Level** and select **Header**. Set the next *Sort by* field to Number, as shown in Figure 14–68.

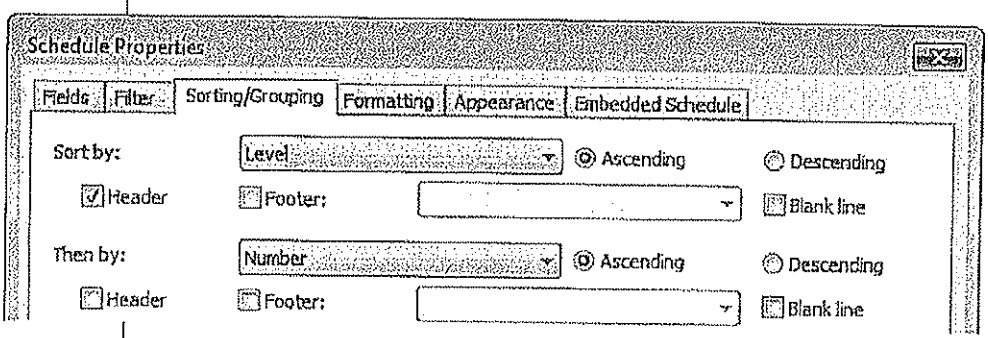

Figure 14–68

9. Select the *Appearance* tab.

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10. Change the height of the *Header text* to **6mm** and select **Bold**, and the *Body text* to **4mm**, as shown in Figure 14–69.

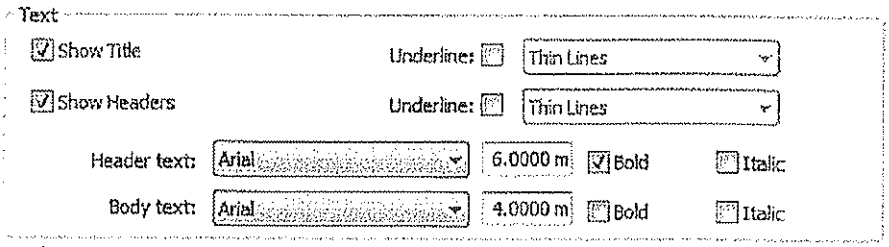

Figure 14–69

11. Click OK. The new schedule should display as shown in part in Figure 14–70. Expand the columns to display the full names.

Space Illumination Schedule			
Level	Number	Name	Average Esti
Level 1			
Level 1	100	PLUMBIN	0 lx
Level 1	101	PLUMBIN	0 lx
Level 1	1500	CLASSR	416 lx
Level 1	1501	CLASSR	416 lx
Level 1	1502	CLASSR	417 lx

Figure 14–70

12. Save the project.

Task 2 - Adding the schedule to a sheet.

1. In the Project Browser, right-click on the Sheets (all) node and select **New Sheet.**
2. In the New Sheets dialog box, click OK to create a sheet using the default titleblock. The new sheet opens.
3. In the Project Browser, expand the Schedules/Quantities node.
4. Locate the **Space Illumination Schedule** and drag and drop it onto the sheet.

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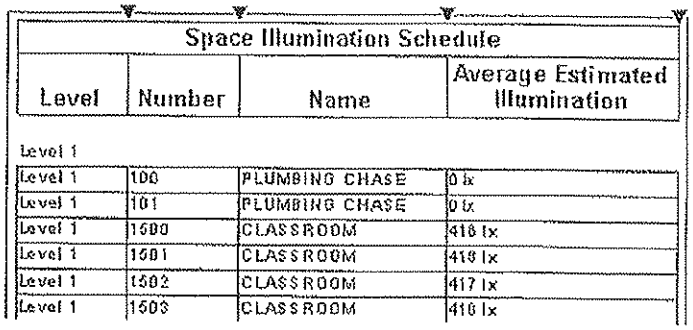
5. Zoom in on the schedule. Use the grips to adjust the column sizes, as shown in Figure 14–71.



Space Illumination Schedule			
Level	Number	Name	Average Estimated Illumination
Level 1			
Level 1	100	PLUMBING CHASE	0 lx
Level 1	101	PLUMBING CHASE	0 lx
Level 1	1500	CLASSROOM	416 lx
Level 1	1501	CLASSROOM	419 lx
Level 1	1502	CLASSROOM	417 lx
Level 1	1503	CLASSROOM	416 lx

Figure 14–71

6. Save the project.

Task 3 - Edit the Schedule to Provide Visual Feedback

1. Switch back to the **Space Illumination Schedule** view.
2. In Properties, next to the *Formatting* tab, click Edit....
3. In the *Fields* list, select **Average Estimated Illumination**.
4. Click Conditional Format....
5. In the Conditional Formatting dialog box, set *Test*: to **Not Between**, and *Value* to **350 lx** and **450 lx**, as shown in Figure 14–72.

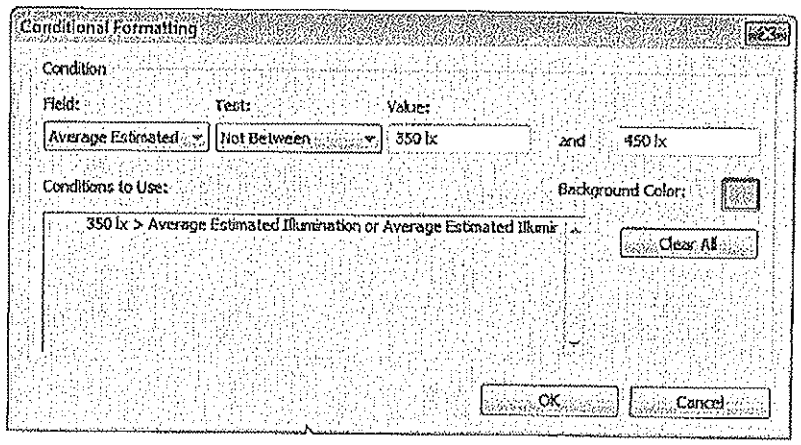


Figure 14–72

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6. Set the background color to the color of your choice and click OK twice to return to the schedule.

7. Switch back to the schedule on the sheet. The conditional formatting does not display as shown in Figure 14–73.

Space Illumination Schedule			
Level	Number	Name	Average Estimated Illumination
Level 1			
Level 1	100	PLUMBING CHASE	0 lx
Level 1	101	PLUMBING CHASE	0 lx
Level 1	1600	CLASSROOM	416 lx
Level 1	1601	CLASSROOM	416 lx
Level 1	1602	CLASSROOM	417 lx
Level 1	1603	CLASSROOM	416 lx
Level 1	1604	CLASSROOM	417 lx
Level 1	1605	CLASSROOM	416 lx
Level 1	1606	CLASSROOM	417 lx

Figure 14–73

8. Save the project.

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Chapter Review Questions

1. Which of the following elements cannot be tagged using **Tag by Category**?
   a. Ducts
   b. Plumbing Fixtures
   c. Spaces
   d. Zones

2. What happens when you delete an air terminal in an Autodesk Revit model?
   a. You must delete the air terminal on the drawing sheet.
   b. You must delete the air terminal from the schedule.
   c. The air terminal is removed from the view but not the schedule.
   d. The air terminal is removed from the sheet and the schedule.

3. In a schedule, if you change type information (such as a **Type Mark**) all instances of that type update with the new information.
   a. True
   b. False

4. When creating a schedule, you want to display the count and type but you do not want to display every instance of the type listed. In which tab do you set this information?
   a. *Filter*
   b. *Sorting/Grouping*
   c. *Formatting*
   d. *Appearance*

5. Which of the following commands enables you to reuse a schedule from another project?
   a. **Schedules>Schedule/Quantities**
   b. **Insert from File>Insert Views from File**
   c. **Insert from File>Insert 2D Elements from File**
   d. **Import Reports>Schedule**

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Command Summary

Button	Command	Location
	**Material Tag**	▪ **Ribbon:** *Annotate* tab>Tag panel> Material tag
	**Multi-Category**	▪ **Ribbon:** *Annotate* tab>Tag panel> Multi-Category
	**Schedule/ Quantities**	▪ **Ribbon:** *View* tab>Create panel> expand Schedules ▪ **Project Browser:** (*right-click on Schedule/Quantities node and select* ***New Schedule/Quantities***)
	**Tag All Not Tagged**	▪ **Ribbon:** *Annotate* tab>Tag panel> Tag All
	**Tag by Category**	▪ **Ribbon:** *Annotate* tab>Tag panel> Tag by Category ▪ **Shortcut:** TG

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Chapter 15

Detailing

In this chapter you learn how to create detail views, import CAD details, use the Detailing tools (including detail lines and detail components), annotate details, and create patterning using Filled Region.

This chapter contains the following topics:

- ✓**Setting Up Detail Views**
- ✓**Creating Details**
- ✓**Patterning**

Learning Objectives

This chapter provides instruction to enable you to do the following:

15.1 Setting Up Detail Views

- Create 2D drafting views where you can draw details of parts of the building to fit together.
- Link callout views to drafting views so that they are referenced correctly in the construction documents.
- Save drafting views to use them in other projects.

15.2 Creating Details

- Add detail lines, detail components, and repeating details to a drafting view to create a 2D building detail.
- Add text, dimensions, symbols, and detail tags to annotate a 2D building detail.

15.3 Patterning

- Add filled regions to pattern or hatch parts of a detail.
- Create a custom filled region pattern type to use in the detail.

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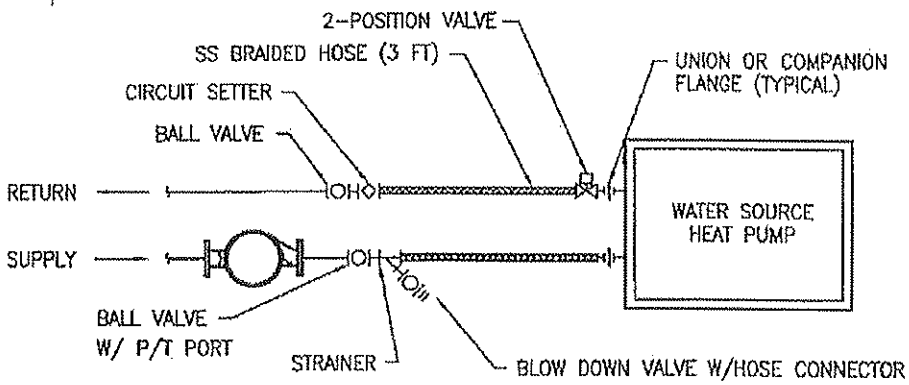
15.1 Setting Up Detail Views

- Create 2D drafting views where you can draw details of parts of the building to fit together.
- Link callout views to drafting views so that they are referenced correctly in the construction documents.
- Save drafting views to use them in other projects.

Most of the work you do in the Autodesk® Revit® software is exclusively with *smart* elements that interconnect and work together in the model. However, the software does not automatically display how elements should be built to fit together. For this, you need to create detail drawings, as shown in Figure 15–1. There are a variety of tools to help you create details, including drafting views, detail lines, special components, and filled regions.



WATER SOURCE HEAT PUMP

PIPING DETAIL

Figure 15–1

- You can use detailing tools (such as detail lines, components, and filled regions) directly in a specially created *Drafting View*, or you can work in a callout from a plan, elevation, or section view.

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How to:

Create a Drafting View

1. In the *View* tab>Create panel, click (Drafting View).
2. In the New Drafting View dialog box, enter a *Name* and set a *Scale*, as shown in Figure 15–2.

*If you set the Scale to **Custom**, you can type the Scale value. Otherwise, the Scale automatically controls the Scale value.*

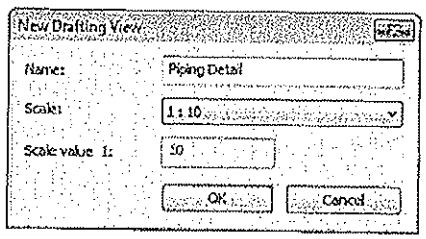

Figure 15–2

3. Click OK. A blank view is created with space in which you can draw.
4. Add detail lines, components, text, and dimensions as needed.

Hint: Importing Details from Other CAD Software

In many cases, you might already have a set of standard details that have been used in various projects. You can reuse them in Autodesk Revit software, even if they were created in other software, such as AutoCAD®. Import the detail into a new project, clean it up, and save it as a view before bringing it into your project.

1. Create a drafting view and make it active.
2. In the *Insert* tab>Import panel, click (Import CAD).
3. In the Import CAD dialog box, select the file to import. Most of the default values are what you need. You might want to change the *Layer/Level colors* to **Black and White**.
4. Click Open.

- If you want to modify the detail, select the imported data. In the *Modify* | *<file name* >tab>Import Instance panel, expand (Explode) and click (Partial Explode) or (Full Explode).
- Use (Delete Layers) before you explode an imported detail. A full explode increases the file size.
- Modify the detail using tools in the Modify panel. Change all the text and line styles to Autodesk Revit specific elements.

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Connecting a Callout to a Drafting View

Once you have created a drafting view, you can link it to a callout in another view, as shown in Figure 15–3. For example, in a section view, you might want to use a callout that references a detail. You can reference drafting views, sections, elevations, and callouts.

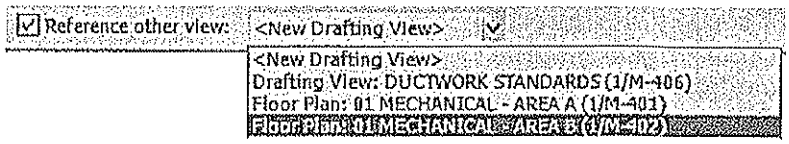

Figure 15–3

How to:

Connect a Callout to a Drafting View

1. Open the view in which you want to place the callout.
2. In the *View* tab>Create panel, click (Callout).
3. In the Options Bar, select **Reference other view**. In the drop-down list, select **<New Drafting View>** or an existing drafting view.
4. Draw the callout box around the required area and move the bubble as needed.

- When you place the associated drafting view on a sheet, the section bubble in this view updates with the required information.
- In the drop-down list, the information in parentheses displays the detail number and sheet where a callout is placed. If information does not display after the name, the existing view has not yet been placed on a sheet.
- If you select **<New Drafting View>** from the drop-down list, a new view is created in the *Drafting Views (Detail)* area in the Project Browser, and named **Callout of <*View Name*>**. You can rename it as needed. The new view does not include any model elements.
- Sections can also be referenced to drafting views.

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Saving a Drafting View

When you create a drafting view and add detail components to it, you might want to save it to use it again in another project. This enables you to create a library of standard details that can be loaded into a project and modified to suit its particular requirements.

Drafting views can be saved in two ways: save an individual drafting view to a new file or save all the drafting views as a group into one new file.

How to:

Save One Drafting View to a File

1. In the Project Browser, right-click on the drafting view that you want to save and select **Save to New File**, as shown in Figure 15–4.

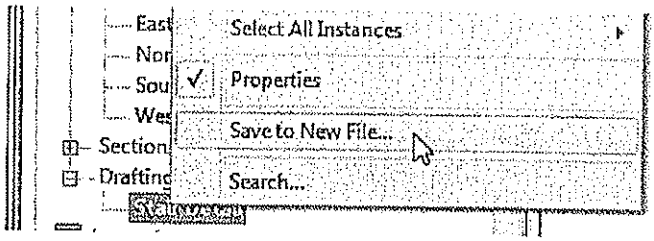

Figure 15–4

2. In the Save As dialog box, specify a name and location for the file and click Save.

How to:

You can save sheets, drafting views, model views (floor plans), schedules, and reports.

Save a Group of Drafting Views to a File

1. In the Application Menu, expand (Save As), expand (Library), and click (View).
2. In the Save Views dialog box, in the *Views:* pane, expand the list and select **Show drafting views only**.
3. Select the drafting views you want to save, as shown in Figure 15–5.

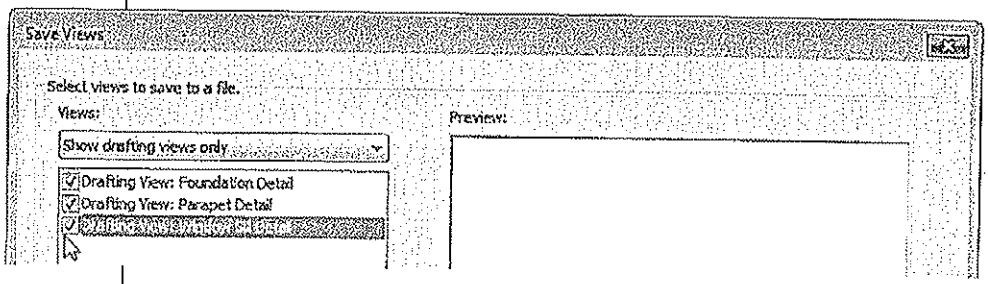

Figure 15–5

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4. Click OK.
5. In the Save As dialog box, specify a name and location for the file and click Save.

How to: **Use a Saved Drafting View in Another Project**

1. Open the project to which you want to add the drafting view.
2. In the *Insert* tab>Import panel, expand (Insert from File) and click (Insert Views from File).
3. In the Open dialog box, select the project in which you saved the detail and click Open.
4. In the Insert Views dialog box, limit the types of views to **Show drafting views only**, as shown in Figure 15–6.

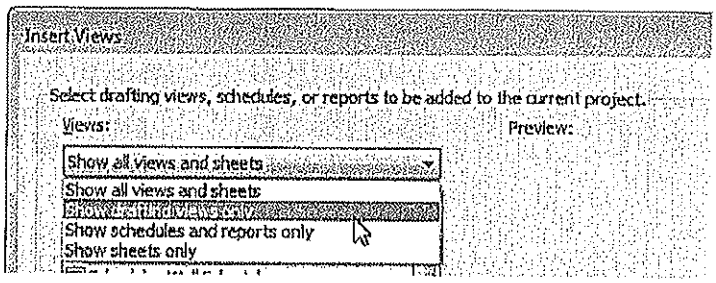

Figure 15–6

5. Select the view(s) that you want to insert and click OK.

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15.2 Creating Details

Add detail lines, detail components, and repeating details to a drafting view to create a 2D building detail.

Add text, dimensions, symbols, and detail tags to annotate a 2D building detail.

Details, such as the heat pump detail shown in Figure 15–7 , normally require additional elements that are not displayed in the Autodesk Revit model. These include elements such as a floor drain section, flashing, electrical panels, and moldings. They can be drawn in a 2D drafting view or on top of a model view. You can add detail lines and components as well as annotations including symbols, text, and dimensions to the view.

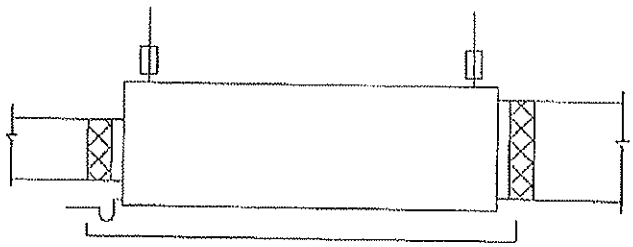

Figure 15–7

Detail Lines

Detail Lines are line elements that only display in one view.

How to:

Add Detail Lines

1. Open a drafting view or a model view to which you want to add 2D detail information.
2. In the *Annotate* tab>Detail panel, click (Detail Line).
3. In the *Modify | Place Detail Lines* tab>Line Style panel, select the detail line type that you want to use.
4. In the Draw panel, select sketching tools and create the detail lines.

- You can select from a variety of line types supplied with the software, including thin, medium, and wide lines, and dashed styles for center lines, demolition, hidden, and overhead lines.

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Detail Components

Detail components are 2D elements made of detail lines and fill patterns that have been grouped together. They are often parametric. You can use them in conjunction with other sketches and annotations to quickly create a detail.

The Autodesk Revit Detail Library contains components, such as slab edge conditions, rebar shapes, steel connections, and stiffeners. The Library contains over 500 2D detail components organized by CSI format, as shown in Figure 15–8.

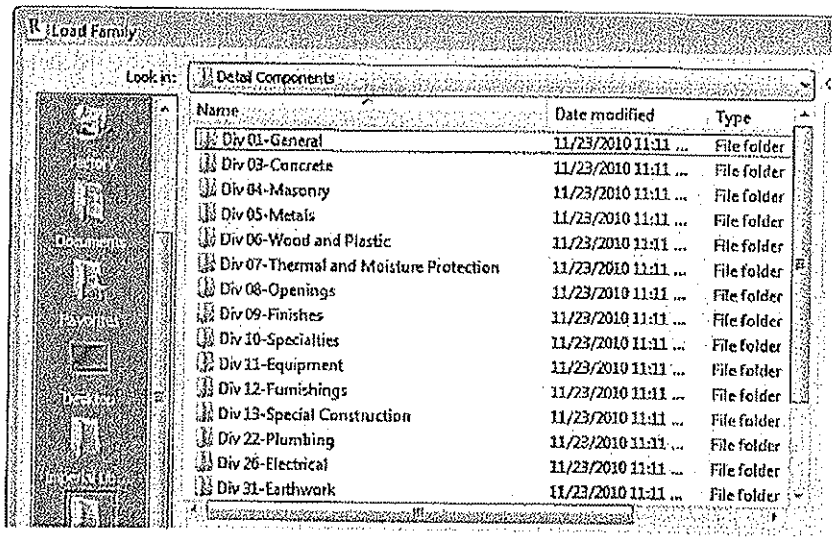

Figure 15–8

- Additional components can be created through Families.

How to: Add a Detail Component

1. In the *Annotate* tab>Detail panel, expand (Component) and click (Detail Component).
2. In the Type Selector, select the detail component type. You can load additional types from the Library.
3. Many detail components can be rotated as you insert them by pressing <Spacebar>. If the components do not rotate by this method, in the Options Bar, select the **Rotate after placement** option, as shown in Figure 15–9.

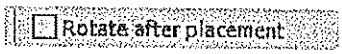

Figure 15–9

4. Place the component in the drawing. Rotate it by pressing the <Spacebar> or using the prompts if you selected **Rotate after placement**.

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Hint: Working with the Draw Order of Details

When you select detail elements in a view, the *Modify | Detail Items* tab displays. In the Arrange panel, you can change the draw order of the elements. You can bring elements in front of other elements or place them behind elements, as shown in Figure 15–10.

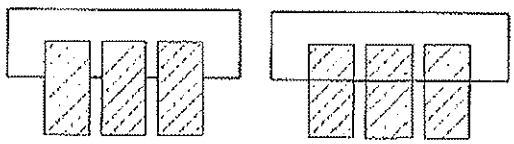

Figure 15–10

(Bring to Front): Places the element in front of all other elements.

(Send to Back): Places the element behind all other elements.

(Bring Forward): Moves the element one step to the front.

(Send Backward): Moves the element one step to the back.

- The **Arrange** tools only affect detail elements, because the location of model elements is determined by their actual location in the building.

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Repeating Detail Components

Details are often repeated, such as a brick or concrete block. Instead of having to insert a component multiple times, you can use (Repeating Detail Component) and draw a string of components, as shown in Figure 15–11. One repeating detail is included with the standard template. You can also create custom details.

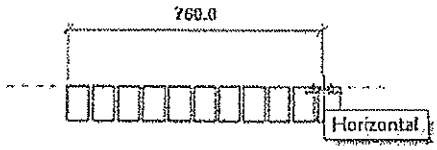

Figure 15–11

How to: **Insert a Repeating Detail**

1. In the *Annotate* tab>Detail panel, expand (Component) and click (Repeating Detail Component).
2. In the Type Selector, select the detail that you want to use.
3. In the Draw panel, click (Line) or (Pick Lines). You can create details at a specified distance from the selected points or line. In the Options Bar, type a value for the *Offset*.
   - If you click (Line), select two points on the screen and the components repeat.
   - If you click (Pick Lines), select a line that exists in the view.
4. The components repeat as needed to fit the length of the line, as shown in Figure 15–12. You can lock the components to the line.



Figure 15–12

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Annotating Details

After you have drawn components and lines of details, add annotations to the drawing. You can place text notes, dimensions, symbols, detail tags, and patterning, as shown in Figure 15–13.

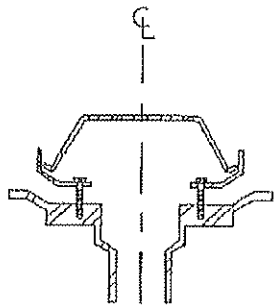

Figure 15–13

Hint: Adding Break Lines

A break line is a component, not a symbol. It is located in the *Detail Components>Div 01-General* folder and is inserted using (Detail Component). A break line consists of a rectangular area (shown highlighted in Figure 15–14) and is used to block out elements behind the area. You can modify the size of the area that is covered and change the size of the cut line using controls.

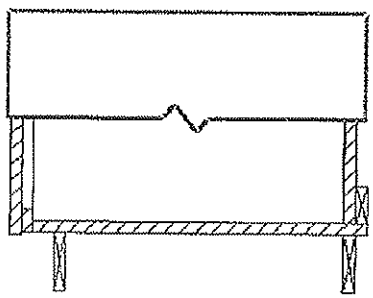

Figure 15–14

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Adding Detail Tags

You can tag detail items, such as components, using (Tag By Category). This is another way of annotating your details instead of using text and leaders. When you modify the tag name, you actually change the *Type Mark* that is set in the Type Parameters for that detail, as shown in Figure 15–15. Therefore, if you have more than one copy of the component in your drawing, you do not have to rename it each time you place its tag.

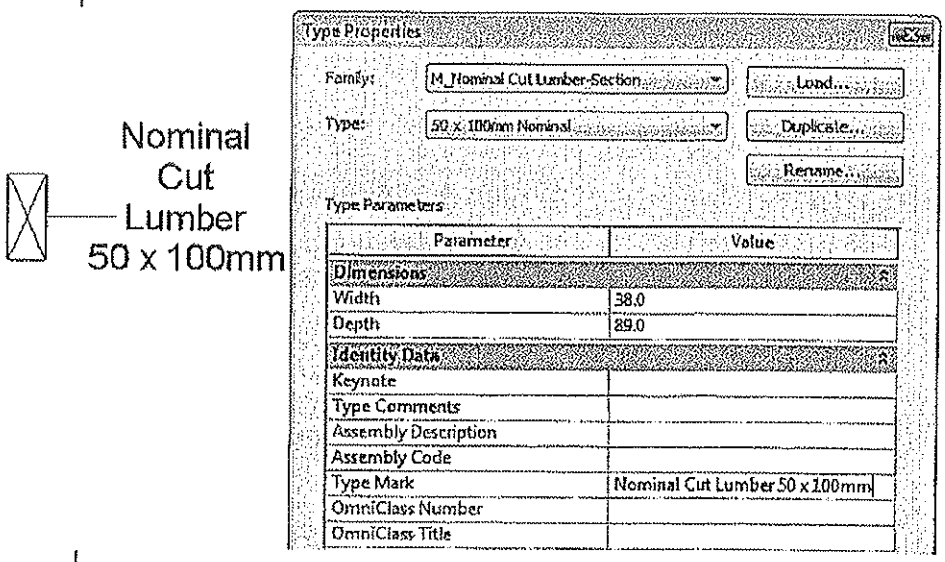

Figure 15–15

- The **Detail Item Tag.rfa** tag is located in the *Annotations* folder in the Library.

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- When you modify a Type Mark for a detail, an alert box opens prompting you that you are changing a type parameter rather than an instance parameter of the element.

Hint: Multiple Dimension Options

If you are creating details that display one element with multiple dimension values, as shown in Figure 15–16, you can easily modify the dimension text.

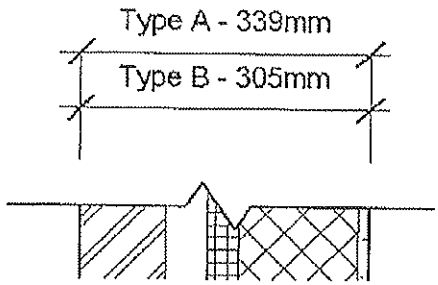

Figure 15–16

Select the dimension and then the dimension text. The Dimension Text dialog box opens. You can replace the text, as shown in Figure 15–17, or add text fields above or below, as well as a prefix or suffix.

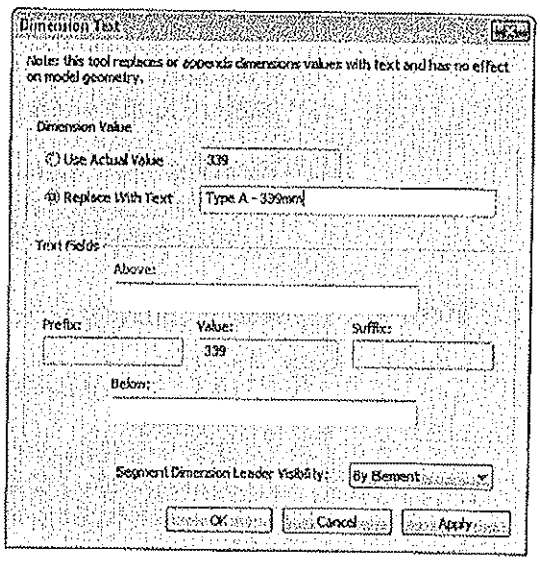

Figure 15–17

15.3 Patterning

Add filled regions to pattern or hatch parts of a detail.

Create a custom filled region pattern type to use in the detail.

The Autodesk Revit software includes patterning (or hatching) which displays in multi-layer components, such as walls, floors, and ceilings when the *Detail Level* of a view is set to **Medium** or **Fine**. To add patterns manually for details, you create filled regions, as shown in Figure 15–18.

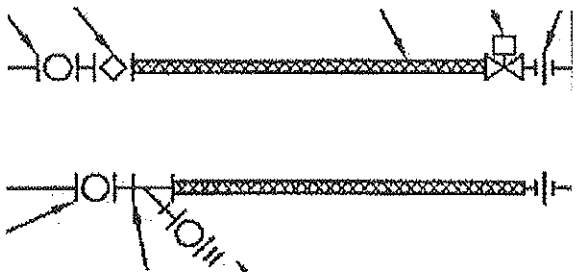

Figure 15–18

The patterns used in details are *drafting patterns*. They are scaled to the view scale and update if you modify it. You can also add full-size *model patterns*, such as a Flemish Bond brick pattern, to the surface of some elements.

- Fill patterns can be applied to all surfaces in a model. If the surface is warped, the patterns display as planar surfaces to keep the visual integrity of the geometry.

How to: **Add a Filled Region**

1. In the *Annotate* tab>Detail panel, expand (Region) and click (Filled Region).
2. In the *Modify | Create Filled Region Boundary* tab>Line Style panel, select the line type for the outside edge of the boundary.
3. In the Draw panel, click (Line) or (Pick Lines) and outline the region (it must be a closed area).
4. Click (Finish Edit Mode).

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5. In the Type Selector, select the fill type, as shown in Figure 15–19.

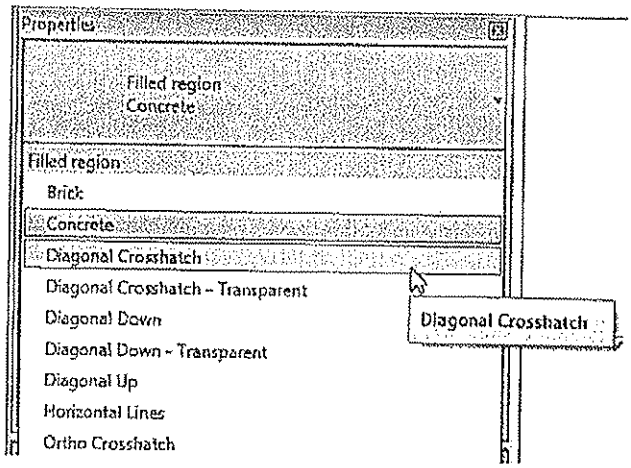

Figure 15–19

6. Click in empty space to clear the elements.

- You can modify a region after it is added by selecting and changing the fill type in the Type Selector, by using the grips to adjust the boundary, or by editing the sketch.

How to: **Create a Filled Region Pattern Type**

1. Select an existing region or click (Filled Region).
2. In Properties, click (Edit Type).
3. In the Type Properties dialog box, click Duplicate... and name the new pattern.
4. Set the *Fill Pattern*, *Background*, *Line Weight*, and *Color*, as shown in Figure 15–20.

Graphics	
Fill Pattern	Concrete [Drafting]
Background	Opaque
Line Weight	1
Color	Black

Figure 15–20

5. Click OK.

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- You can select from two types of *Fill Patterns:* **Drafting**, as shown in Figure 15–21, and **Model**. Drafting fill patterns scale to the view scale factor. Model fill patterns display full scale on the model and are not impacted by the view scale factor.

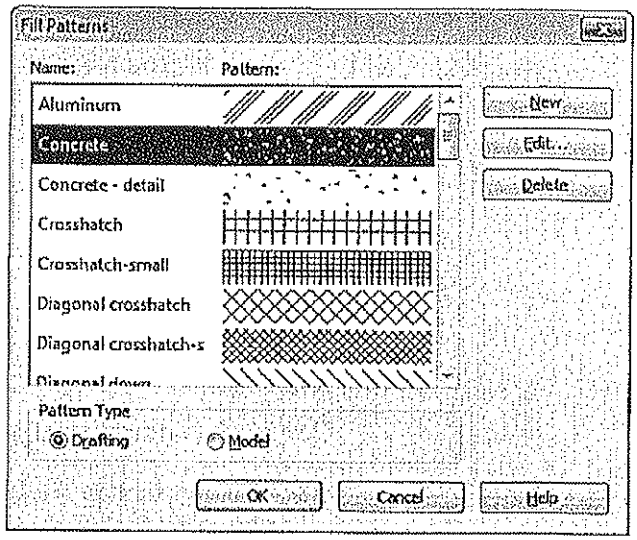

Figure 15–21

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Practice 15a

Estimated time for completion: 15 minutes

Detailing

Create a detail starting with an existing detail created in different software.

Add detail components, filled region, and text to the detail.

In this practice you will create a detail based on an existing detail created in the AutoCAD® software, modifying the imported elements to Autodesk Revit MEP standard elements. You will create leaders and patterning and save it as a separate view. You will then bring the view into the main project, add a detail component and another text note and place the new view on a sheet, as shown in Figure 15–22.

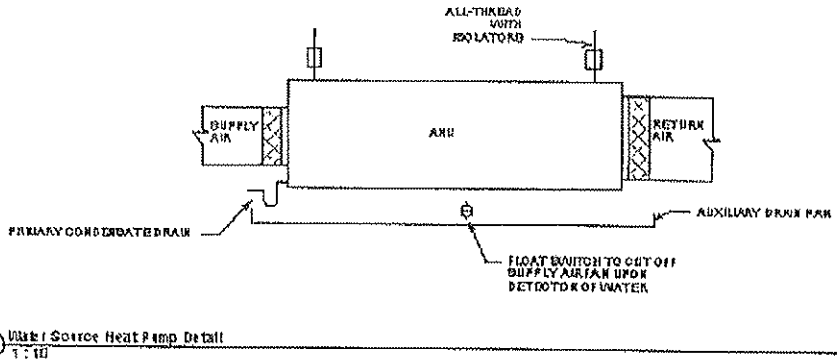

Figure 15–22

Task 1 - Create a detail based on an AutoCAD drawing.

1. Start a new project based on the **Systems-Defualt_Metric.rte** template.
2. In the *View* tab>Create panel, click (Drafting View).
3. In the New Drafting View dialog box, set the name and scale to the following:
   - *Name*: **Water Source Heat Pump Detail**
   - *Scale*: **1 : 10**
4. In the *Insert* tab>Import panel, click (Import CAD).

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5. In the Import CAD Formats dialog box, select the AutoCAD drawing **WS-Heat-Pump-Detail.dwg** found in *Chapter 15* folder of your class folder. Change the *Colors* to **Black and White**, as shown in Figure 15–23 and click Open.

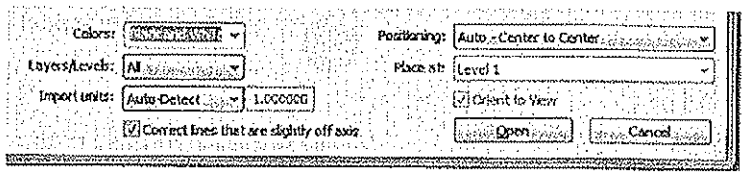

Figure 15–23

6. Zoom in and select the detail. It is one element, as shown in Figure 15–24.

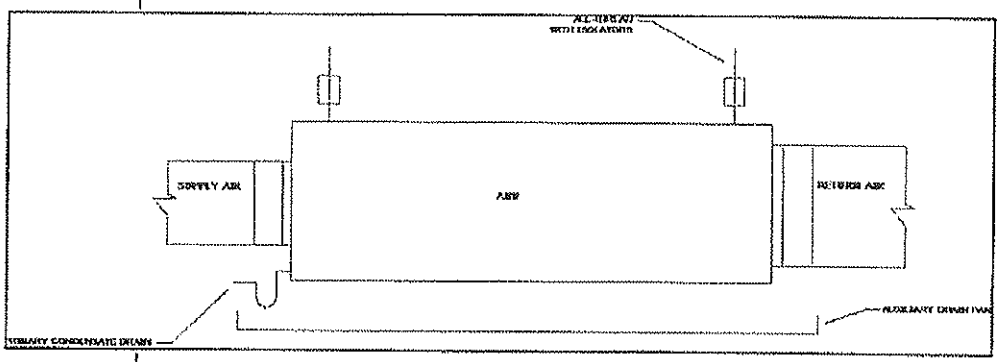

Figure 15–24

7. In the *Modify | WS-Heat-Pump-Detail.dwg* tab>Import Instance panel, expand (Explode) and click (Full Explode). You are now able to edit individual sections of the imported detail.

8. Select all of the text, as shown in Figure 15–25.

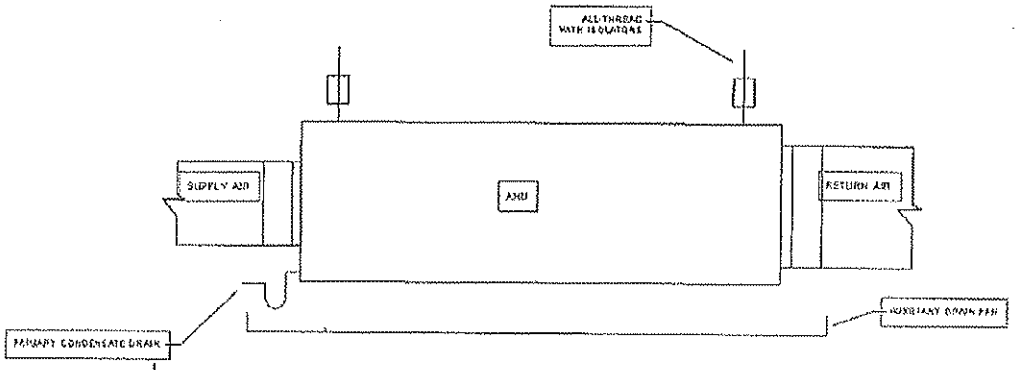

Figure 15–25

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*These are the lines referenced to the AutoCAD layer **0**.*

9. In the Type Selector, select **Text: 2.5mm Arial.**

10. Click (Modify) and select the entire detail.

11. In the *Modify | Multi-Select* tab>Filter panel, click (Filter).

12. In the Filter dialog box, click Check None and then select **Lines (0)**. Click OK.

13. In the *Modify | Lines* tab>Line Style panel, change the *Line Style* to **Thin Lines.**

14. Click (Modify) to clear the selection.

15. Save the project.

Task 2 - Modify text and leaders.

1. Delete the individual leader elements that were part of the exploded imported file. Each one is made up of separate elements.

2. Select a text element. In the *Modify | Text Notes* tab>Format panel, click either (Add Left Side Straight Leader) or (Add Right Side Straight Leader). Modify the leader to point to the correct element, as shown in Figure 15–26.

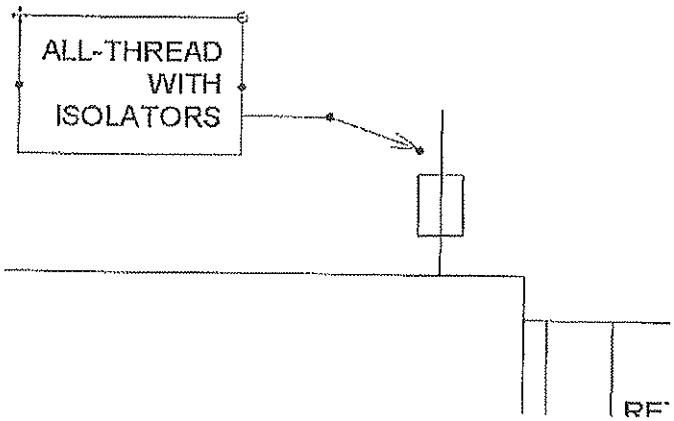

Figure 15–26

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3. Repeat the process of adding leaders to the text, pointing to the appropriate parts of the detail, as shown in Figure 15–27.

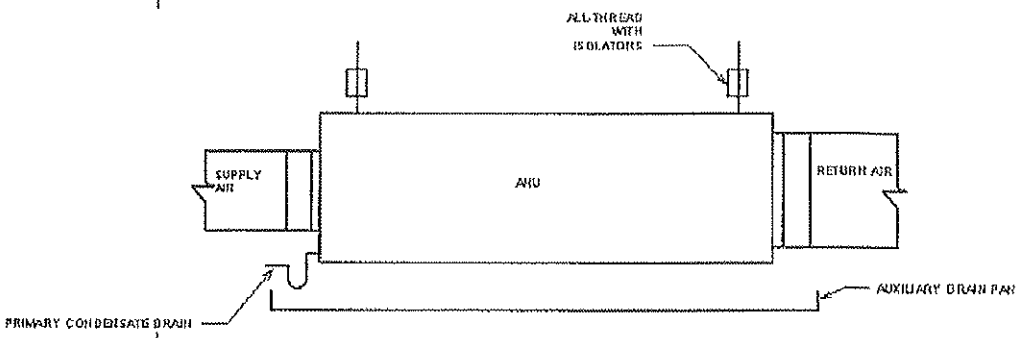

Figure 15–27

Task 3 - Add filled regions.

1. In the *Annotate* tab>Detail panel, expand (Region) and click (Filled Region).
2. In the *Modify | Create Filled Region Boundary* tab>Line Style panel, set the line style to **<Invisible lines>**. The boundary does not need to display in this case.
3. In the *Modify | Create Filled Region Boundary* tab>Draw panel, click (Rectangle). Using snap points, add a rectangle around each of the two sides, as indicated by the dashed areas shown in Figure 15–28. You can do both areas in one sketch.

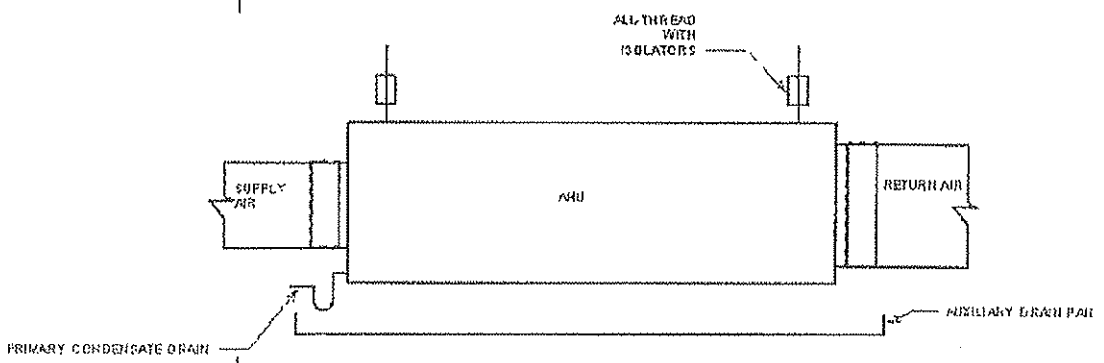

Figure 15–28

4. Click (Finish Edit Mode).

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5. In the Type Selector, select **Filled Region: Diagonal Crosshatch**.
6. Click in empty space to complete the process.
7. The crosshatch is too large for the areas. Select the Filled Region boundary. In Properties, click Edit Type.
8. In the Type Properties dialog box, next to Fill Pattern, click to open the dialog box.
9. In the Fill Patterns dialog box, verify that Diagonal crosshatch is selected and click Edit....
10. In the Modify Pattern Properties dialog box, change *Line spacing 1* and *2* to **2mm** as shown in Figure 15–29.

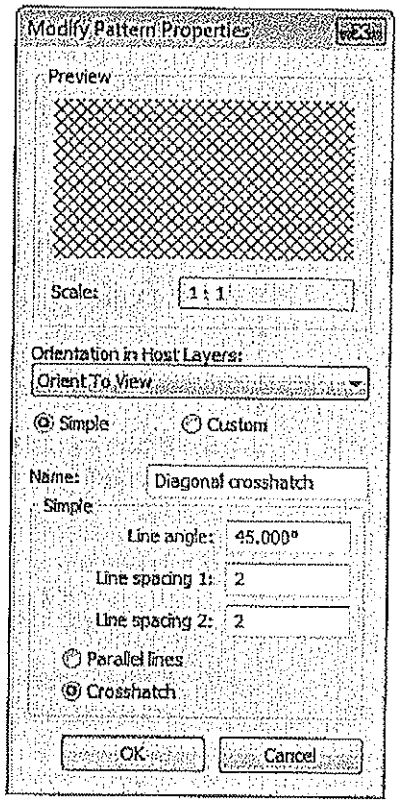

Figure 15–29

11. Close all of the dialog boxes. The filled region updates.
12. The detail view now consists of only Autodesk Revit MEP elements and is safe to use in another project. Save the project.

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Task 4 - Create a View and Import it in to a Project.

1. In the Application Menu, expand (Save As), click (Library), and click (View).
2. In the Saved Views dialog box select the **Drafting View: Water Source Heat Pump Detail**, as shown in Figure 15–30 and click OK.

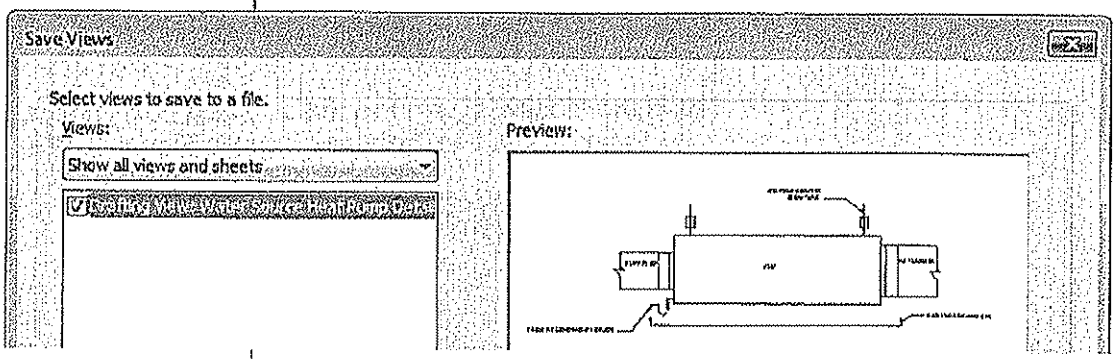

Figure 15–30

3. In the Save As dialog box, navigate to the *Chapter 15* folder of your class folder and click Save.
4. Close the project where you imported the AutoCAD drawing and do not save it.
5. Open the **MEP-Elementary-School-Detailing-M.rvt** project found in the *Chapter 15* folder of your class folder.
6. In the *Insert* tab>Import panel, expand (Insert from File) and click (Insert Views from File).
7. In the Open dialog box navigate to the *Chapter 15* folder of your class folder where you saved the view. Select the view you created, **Water Source Heat Pump Detail.rvt**, and click Open.
8. In the Insert Views dialog box only this view is available. Click OK.
9. Accept any warnings that might display about duplicate types. They do not impact the project.

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Task 5 - Add a detail component and notes.

1. In the *Annotate* tab>Detail panel, expand as required and click (Detail Component).
2. In the *Modify | Place Detail Component* tab>Mode panel, click (Load Family).
3. In the Load Family dialog box navigate to the *Chapter 13* folder of your class folder. Select **Float Switch.rfa** and click Open.
4. Place the detail component in the drain plan at the center of the AHU as shown in Figure 15–31.

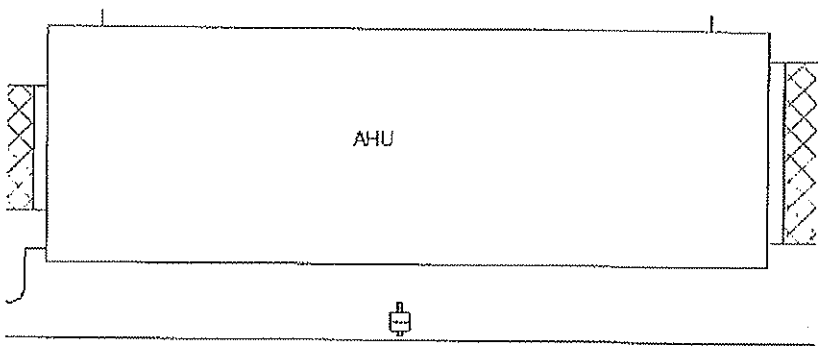

Figure 15–31

5. In the *Annotate* tab>Text panel, click (Text).
6. In the *Modify | Place Text* tab>Format panel, click (Two Segments).
7. In the Type Selector, select **Text: 2.5mm Arial.**
8. Add the note as shown in Figure 15–32.

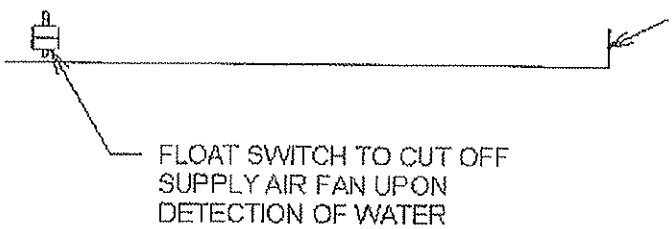

Figure 15–32

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9. In the *View* tab>Sheet Composition panel, click (Sheet).

10. In the New Sheet dialog box click OK.

11. Select the titleblock on the sheet, select the sheet name, and name it **Details.**

12. In the Project Browser, expand *Mechanical>???>Drafting Views (Detail)* and drag and drop the **Water Source Heat Pump Detail** view to the sheet.

13. Save the project.

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Chapter Review Questions

1. Which of the following are ways in which you can create a detail? Select all that apply.
   a. Make a callout of a section and draw over it.
   b. Draw all the elements from scratch.
   c. Import a CAD detail and modify or draw over it.
   d. Insert an existing drafting view from another file.
2. In which type of view can you NOT add detail lines?
   a. Plans
   b. Elevations
   c. 3D views
   d. Legends
3. A symbol is an element that...
   a. Changes in size according to the view scale.
   b. Stays the same no matter what the view scale is.
4. When you draw detail lines they are:
   a. Always the same width.
   b. Vary in width according to the view.
   c. Display in all views associated with the detail.
   d. Only display in the view in which they were created.
5. Which command do you use to add a pattern (such as concrete or brick) to part of a detail?
   a. **Region**
   b. **Filled Region**
   c. **Masking Region**
   d. **Pattern Region**

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Command Summary

Button	Command	Location
	**Add Right Side Straight Leader (and similar)**	■ **Ribbon:** *Modify* | *Text Notes* tab> Leader panel
	**Bring Forward**	■ **Ribbon:** *Modify* | *Detail Items (Detail Lines)* tab>Arrange panel
	**Bring to Front**	■ **Ribbon:** *Modify* | *Detail Items (Detail Lines)* tab>Arrange panel
	**Component: Detail Component**	■ **Ribbon:** *Annotate* tab>Detail panel> expand Component
	**Component: Repeating Detail Component**	■ **Ribbon:** *Annotate* tab>Detail panel> expand Component
	**Delete Layers**	■ **Ribbon:** *Modify* | *<imported file name>* tab>Import Instance panel
	**Detail Line**	■ **Ribbon:** *Annotate* tab>Detail panel
	**Drafting View**	■ **Ribbon:** *View* tab>Create panel
	**Explode: Full Explode**	■ **Ribbon:** *Modify* | *<imported file name>* tab>Import Instance panel>expand Explode
	**Explode: Partial Explode**	■ **Ribbon:** *Modify* | *<imported file name>* tab>Import Instance panel>expand Explode
	**Filled Region**	■ **Ribbon:** *Annotate* tab>Detail panel
	**Import CAD**	■ **Ribbon:** *Insert* tab>Import panel
	**Insert Views from File**	■ **Ribbon:** *Insert* tab>Import panel> expand Insert from File
	**Link CAD**	■ **Ribbon:** *Insert* tab>Link panel
	**Send Backward**	■ **Ribbon:** *Modify* | *Detail Items (Detail Lines)* tab>Arrange panel
	**Send to Back**	■ **Ribbon:** *Modify* | *Detail Items (Detail Lines)* tab>Arrange panel
	**Symbol**	■ **Ribbon:** *Annotate* tab>Symbol panel

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