



Autodesk® Revit® 2022 MEP Fundamentals

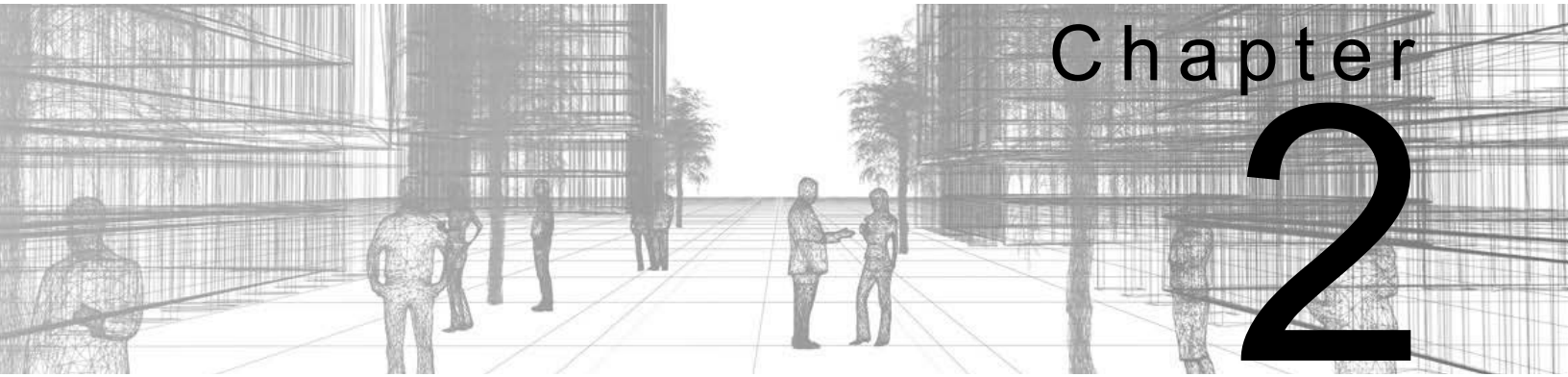
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Chapter 2

Basic Sketching and Modify Tools

Basic sketching, selecting, and modifying tools are the foundation of working with all types of elements in the Autodesk® Revit® software. Using these tools with drawing aids helps you to place and modify elements to create accurate building models.

Learning Objectives in This Chapter

- Sketch linear elements, such as walls, beams, and pipes.
- Ease the placement of elements by incorporating drawing aids, such as alignment lines, temporary dimensions, snaps, and connectors.
- Insert components such as mechanical equipment, plumbing fixtures, and electrical devices.
- Use techniques to select and filter groups of elements.
- Modify elements using a contextual tab, Properties, temporary dimensions, and controls.
- Move, copy, rotate, and mirror elements and create array copies in linear and radial patterns.
- Align, trim, and extend elements with the edges of other elements.
- Split linear elements anywhere along their length.
- Offset elements to create duplicates a specific distance away from the original.

2.1 Using General Sketching Tools

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

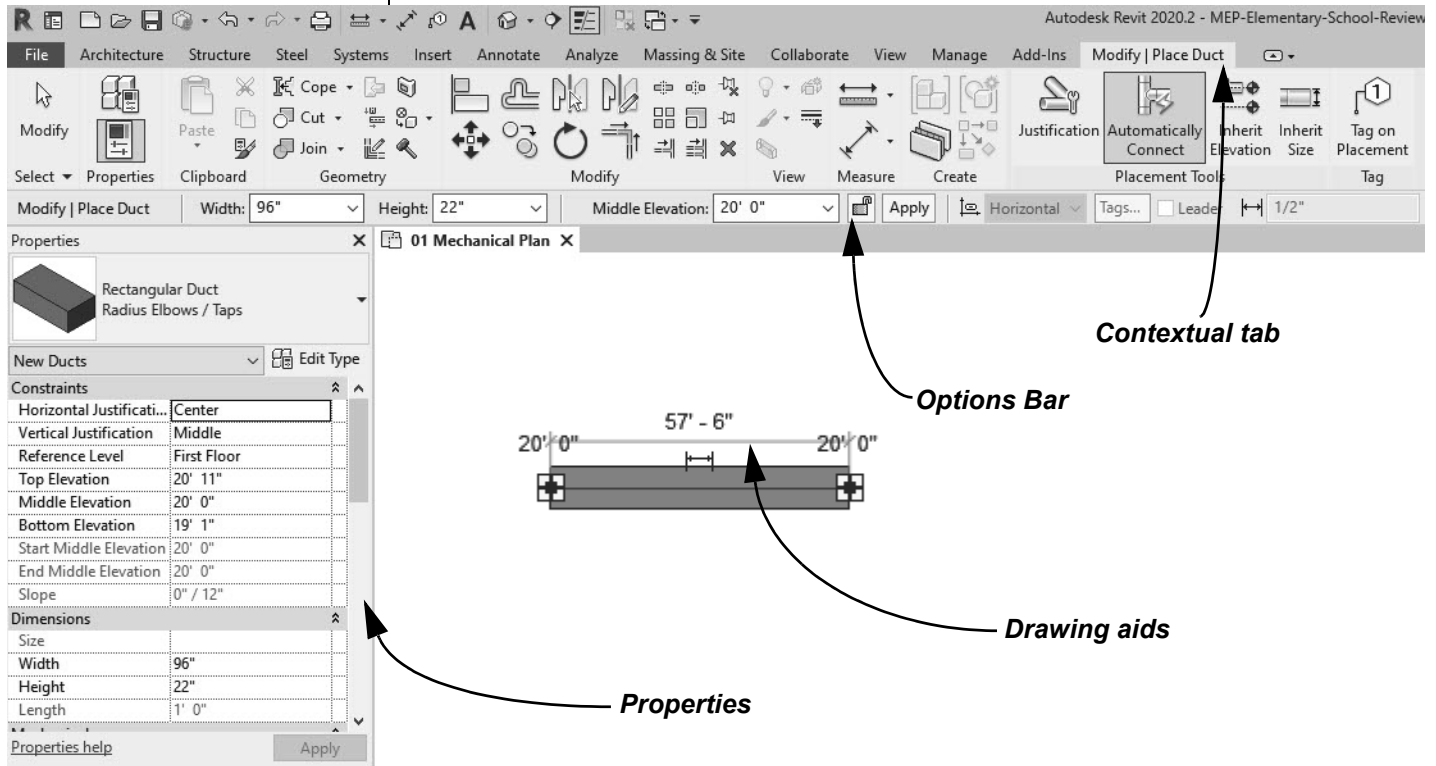


Figure 2–1

- In Autodesk Revit, you are most frequently creating 3D model elements rather than 2D sketches. These tools work with both 3D and 2D elements in the software.

Draw Tools

Many linear elements (such as walls, beams, ducts, pipes, and conduits) are modeled using the tools on the contextual tab on the *Draw* panel. Other elements (such as floors, ceilings, roofs, and slabs) have boundaries that are sketched using many of the same tools. Draw tools are also used when you create details or schematic drawings.

The exact tools vary according to the element being modeled.

You can change from one Draw tool shape to another in the middle of a command.

Different options display according to the type of element that is selected or the command that is active.

Two methods are available:

- *Draw* the element using a geometric form.
- *Pick* an existing element (such as a line, face, or wall) as the basis for the new element's geometry and position.


How To: Create Linear Elements

1. Start the command you want to use.
2. In the contextual tab>Draw panel (shown in Figure 2–2), select a drawing tool.



Figure 2–2

3. Select points to define the elements or watch the Status Bar, in the lower-left corner, for hints on what to do.
4. Finish the command using one of the standard methods:

- Click  (Modify).
- Press <Esc> twice.
- Start another command.

Draw Options













When you are in Drawing mode, several options display in the Options Bar, as shown in Figure 2–3.



Figure 2–3




- **Chain:** Controls how many segments are created in one process. If this option is not selected, the **Line** and **Arc** tools only create one segment at a time. If it is selected, you can continue adding segments until you press <Esc> or select the command again.
- **Offset:** Enables you to enter values so you can create linear elements at a specified distance from the selected points or element.
- **Radius:** Enables you to enter values when using a radial tool or to add a radius to the corners of linear elements as you sketch them.

Draw Tools

	Line	Draws a straight line defined by the first and last points. If Chain is enabled, you can continue selecting end points for multiple segments.
	Rectangle	Draws a rectangle defined by 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 circle defined by a center point and radius.
	Start-End-Radius Arc	Draws a curve 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 curve 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 curve 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 curve defined by two other 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 spline curve based on selected points (sketches, model lines, and detail lines only). The curve does not actually touch the points.
	Ellipse	Draws an ellipse from a primary and secondary axis (walls, sketches, model lines, and detail lines only).
	Partial Ellipse	Draws only one side of the ellipse, like an arc (sketches, model lines, and detail lines only). A partial ellipse also has a primary and secondary axis.

Drawing Aids

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.).

As soon as you start sketching or placing elements, three drawing aids display, as shown in Figure 2-4:

- Alignment line
- Temporary dimensions
- Snaps
- Connectors

These aids are available with most modeling and many modification commands.

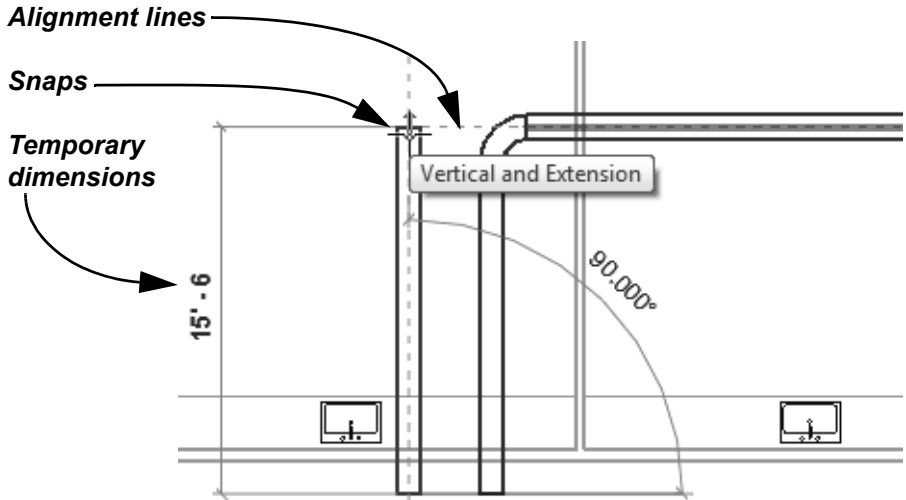


Figure 2-4


Alignment lines display as soon as you select your first point. They help keep lines horizontal, vertical, or at a specified angle. They also line up with the implied intersections of walls and other elements.

- Hold <Shift> to force the alignments to be orthogonal (90° angles only).

Temporary dimensions display to help place elements at the correct length, angle, and location.

- You can type in a value or move the cursor until you see the dimension you want, or you can place the element and then modify the value as needed.
- The length and angle increments shown vary depending on how far in or out the view is zoomed.
- For imperial measurements (feet and inches), the software uses a default of feet. For example, when you type **4** and press <Enter>, it assumes 4'-0". For a distance such as 4'-6", you can type any of the following: **4'-6"**, **4'6**, **4-6**, or **4 6** (the numbers separated by a space). To indicate distances less than one foot, type the inch mark (") after the distance, or enter **0**, a space, and then the distance.

Hint: Temporary Dimensions and Permanent Dimensions

Temporary dimensions disappear as soon as you finish adding elements. If you want to make them permanent, select the dimension symbol () , as shown in Figure 2-5.

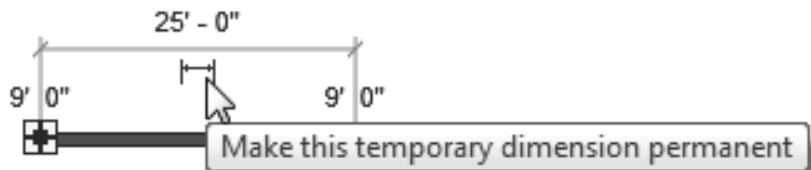


Figure 2-5

Snaps are key points that help you reference existing elements to exact points when modeling, as shown in Figure 2-6.



Figure 2-6

- When you move the cursor over an element, the snap symbol displays. Each snap location type displays with a different symbol.

Connectors work similarly to snaps, but they have more intelligence about the size, system, and flow of items (e.g., ducts, pipes, and electrical connections). For example, connectors automatically add fittings to ducts, such as the elbow, transition, and tee shown in Figure 2-7.

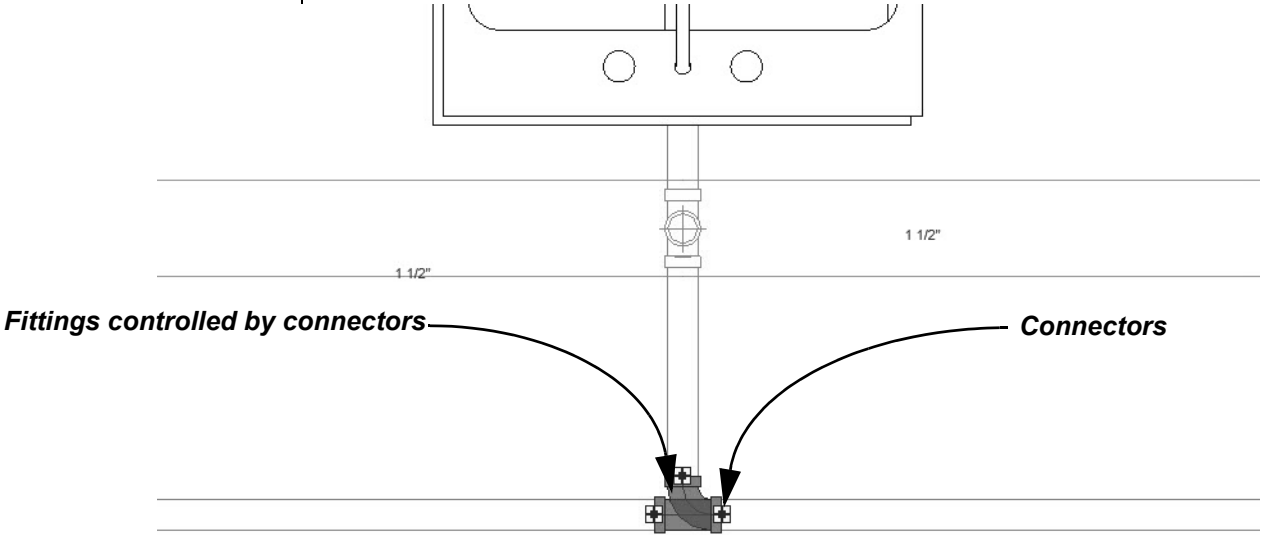



Figure 2-7

Hint: Snap Settings and Overrides

In the *Manage* tab>Settings panel, click  (Snaps) to open the Snaps dialog box, which is shown in Figure 2–8. The Snaps dialog box enables you to set which snap points are active, and set the dimension increments displayed for temporary dimensions (both linear and angular).

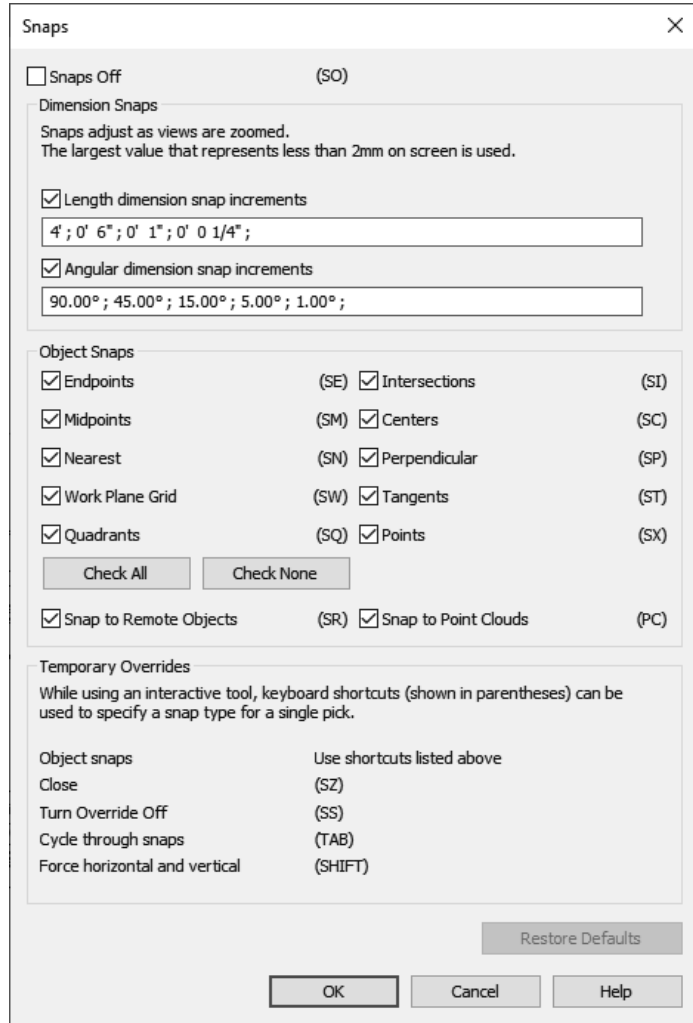



Figure 2–8

- Keyboard shortcuts for each snap can be used to override the automatic snapping. Temporary overrides only affect a single pick, but can be very helpful when there are snaps nearby other than the one you want to use.

Reference Planes

Reference planes do not display in 3D views.

As you develop designs in Revit, there are times when you need lines to help you define certain locations. You can sketch reference planes (displayed as dashed green lines) and snap to them whenever you need to line up elements. For the example shown in Figure 2–9, the lighting fixtures in the reflected ceiling plan are placed using reference planes.

- To insert a reference plane, in the *Architecture*, *Structure*, or *Systems* tab>Work Plane panel, click  (Reference Plane) or type **RP**.

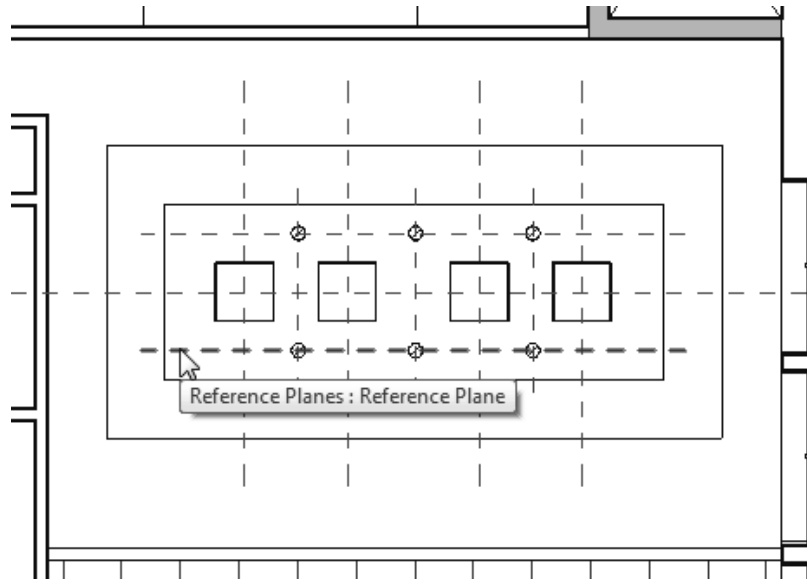


Figure 2–9

- Reference planes display in associated views because they are infinite planes and not just lines.
- You can name reference planes by clicking **<Click to name>** and typing in the text box, as shown in Figure 2–10.

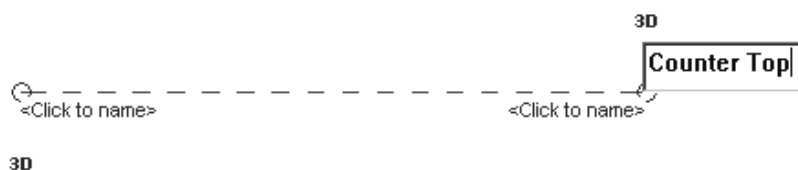
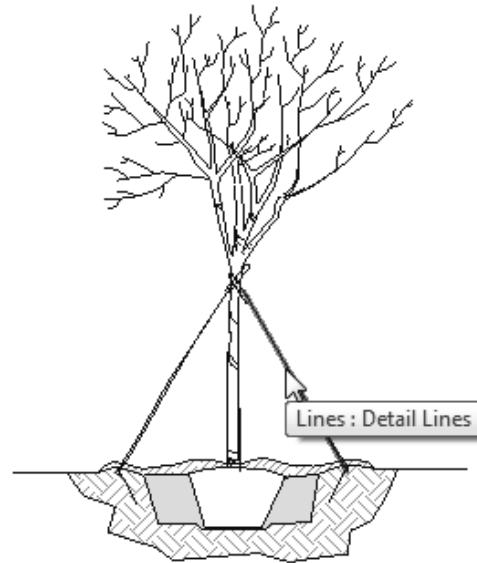




Figure 2–10

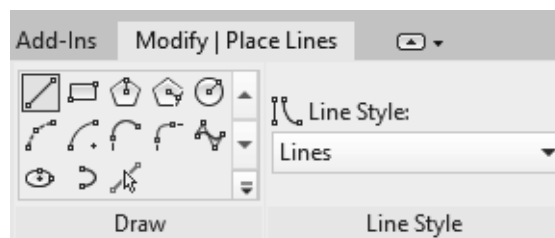
- If you sketch a reference plane in sketch mode (used with floors and similar elements), it does not display once the sketch is finished.
- Reference planes can have different line styles if they have been defined in the project. In Properties, select a style from the Subcategory list.

Hint: Model Line vs. Detail Line

While most of the elements that you create are representations of actual building elements, there are times you may need to add lines to clarify the design intent. These can be either detail lines, as shown in Figure 2–11, or model lines. Detail lines are also useful as references because they are only reflected in the view in which you sketch them.

**Figure 2–11**

- A model line (*Architecture* or *Structure* tab>Model panel>  (Model Line)) functions as a 3D element and displays in all views.
- A detail line (*Annotate* tab>Detail panel>  (Detail Line)) is strictly a 2D element that only displays in the view in which it is drawn.
- In the *Modify* contextual tab, shown in Figure 2–12, select a Line Style and then the Draw tool that you want to use to draw the model or detail line.

**Figure 2–12**

2.2 Inserting Components

Components (also known as families) are full 3D elements that can be placed at appropriate locations and heights, and which interact with the building elements around them. For example, a lighting fixture can be designed to be hosted by a face (such as a wall or ceiling), or to stand alone by itself, as shown in Figure 2–13. The Autodesk Revit software includes both architectural components (such as the lamp and wall sconces in Figure 2–13) and MEP components (such as the downlight fixtures) that include connectors.

*Components are located in family files with the extension .RFA. For example, a component family named **Wall Sconce.rfa** can contain several types and sizes.*

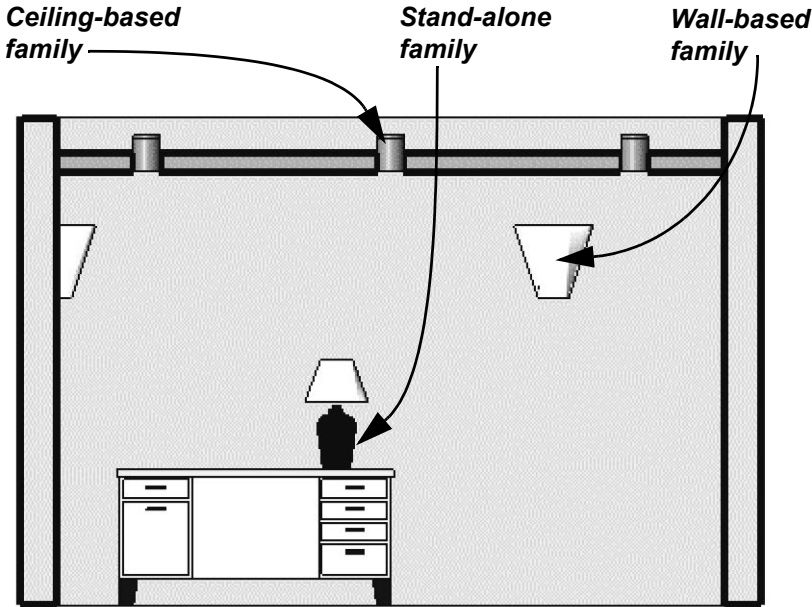











Figure 2–13

Most components are inserted using specific tools, including:

Exact steps for inserting specific components are covered later in this guide.

 Air terminal	 Electrical Equipment
 Mechanical Equipment	   Devices (Data, Fire Alarm, Switches, etc.)
 Plumbing Fixture	 Lighting Fixtures
 Sprinkler	

- Take time to get to know the components that come with the Autodesk Revit software. Their most critical content are the connectors, as you see in for a piece of mechanical equipment in Figure 2–14.

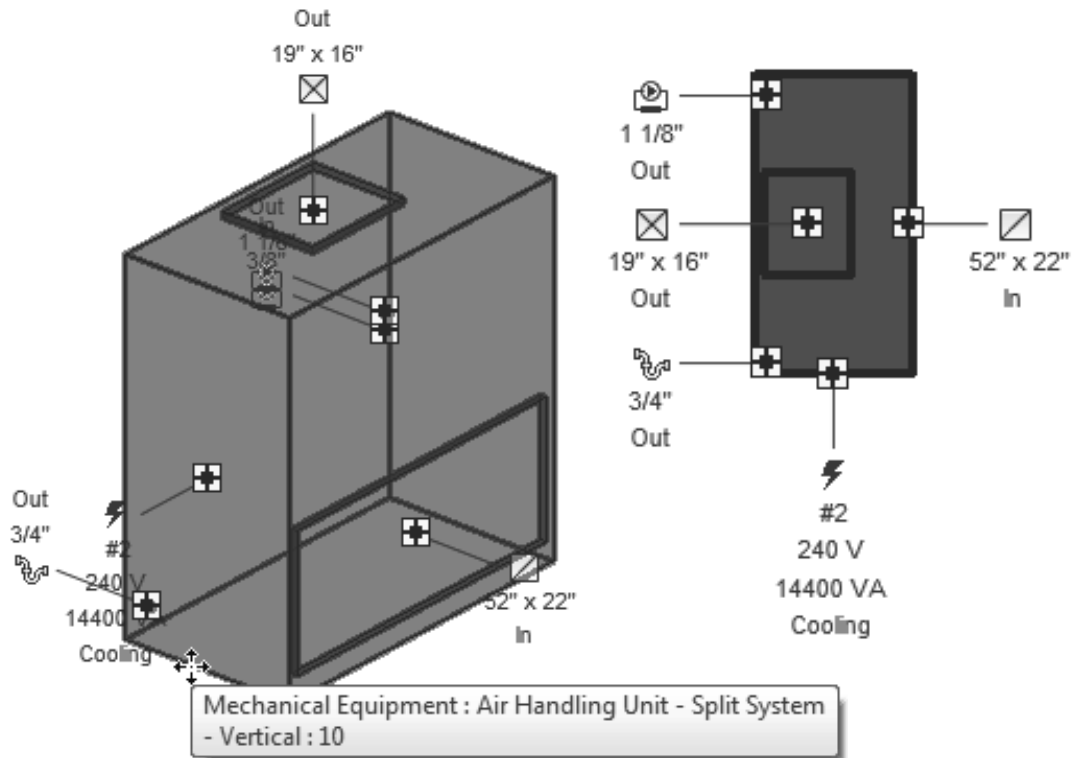



Figure 2–14

- Connectors often contain options to create systems and draw ducts and pipes when you right-click on them.

How To: Insert Components

1. In the *Systems* tab>Model panel, click  (Place a Component), or type **CM**.
2. In the Type Selector, select the type/size you want to use, as shown in Figure 2–15.

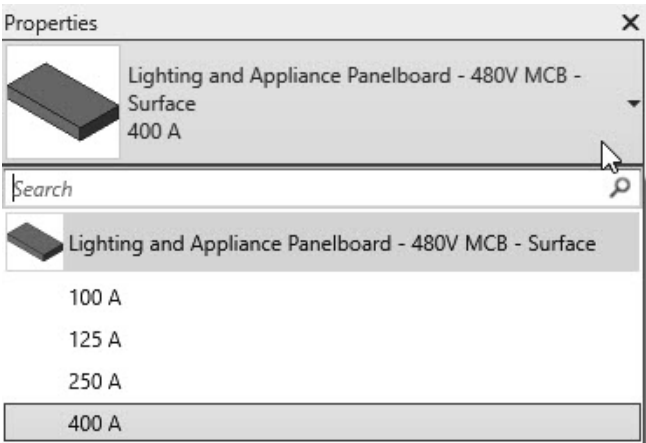



Figure 2-15

3. In the command-specific contextual tab>Tag panel, click  (Tag on Placement) to toggle this option on or off.
4. Proceed as follows, based on the type of component used:

If the component is...	Then...
Not hosted	Set the <i>Level</i> and <i>Offset from Host</i> in Properties, as shown in Figure 2-16.
Wall hosted	Set the <i>Elevation from Level</i> in Properties, as shown in Figure 2-17.
Face hosted	Select the appropriate method in the contextual tab> Placement panel, as shown in Figure 2-18. <ul style="list-style-type: none"> • Vertical Faces include walls and columns. • Faces include ceilings, beams, and roofs. • Work Planes can be set to levels, faces, and named reference planes.

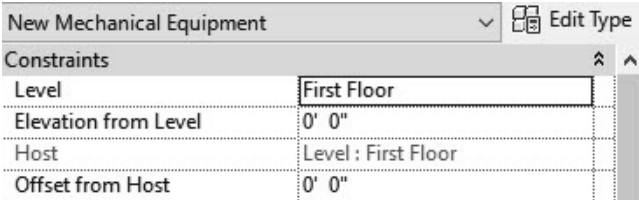


Figure 2-16

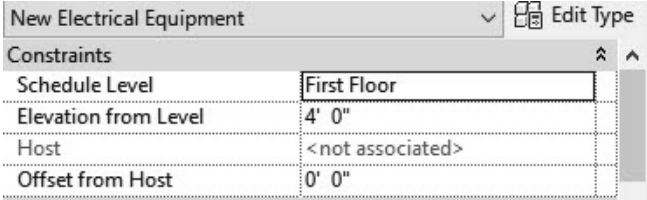


Figure 2-17

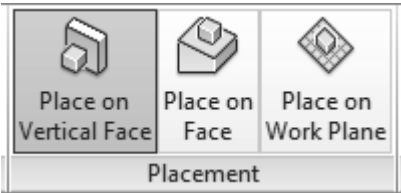


Figure 2-18

5. Place the component in the model.

- Many components can be rotated by pressing <Spacebar> when placing them. This will rotate them in 90° increments, unless your cursor is over an angled wall, reference plane, or grid line.
- In the Options Bar, many components will have an option to **Rotate after placement**, as shown in Figure 2–19. This allows you to rotate the element by any degree immediately after placing the family.



Figure 2–19

- A fast way to add components that match those already in your project is to select one, right-click on it, and select **Create Similar**, as shown in Figure 2–20. This starts the appropriate command with the same type selected.

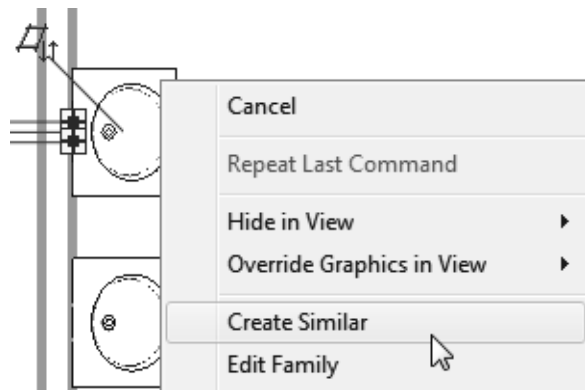



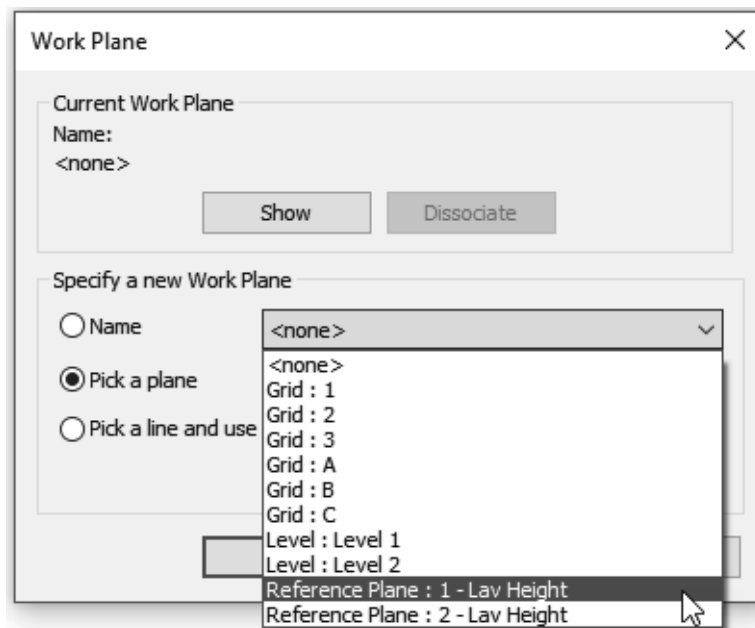
Figure 2–20

Hint: Work Planes

A work plane is the surface you sketch on or extrude from. In a plan view, the work plane is automatically parallel to the level. In an elevation or 3D view, you must specify the work plane before you start sketching.

How To: Select a Work Plane

1. Start a command that requires a work plane or, in the *Systems* tab>Work Plane panel, click  (Set).
2. In the Work Plane dialog box, select one of the following options:
 - **Name:** Select an existing level, grid, or named reference plane (as shown in Figure 2–21) and click **OK**.

**Figure 2–21**

- **Pick a plane:** Click **OK** and select a plane in the view, such as a wall face. Ensure the entire plane is highlighted before you select it.
- **Pick a line and use the work plane it was sketched in:** Click **OK** and select a model line, such as a room separation line.


If you are in a view in which the sketch cannot be created, the Go To View dialog box opens. Select one of the views and click **Open View**.

Loading Components

To optimize project size and improve performance, by default, the Revit project templates are not fully loaded with all Revit families. However, you can load more families with multi-options from the Autodesk Revit Library or the Autodesk website. You can also load your company's custom families or families from other manufacturers that you may have available in your local device.

You can also copy a component to the clipboard in one project and paste it into a different project. The Revit Library has MEP-based components available in the following folders: *Cable Tray, Conduit, Duct, Electrical, Fire Protection, Lighting, Mechanical, Pipe, and Plumbing*.

How To: Load a Family

1. In the related contextual tab > Mode panel or *Insert* tab > Load from Library panel, click  (Load Family).
2. In the Load Family dialog box, locate the folder that contains the family or families you want to load, as shown in Figure 2–22.
 - If the Load Family dialog box does not default to the Revit Library folder, click on **Imperial Library** in the Places panel.

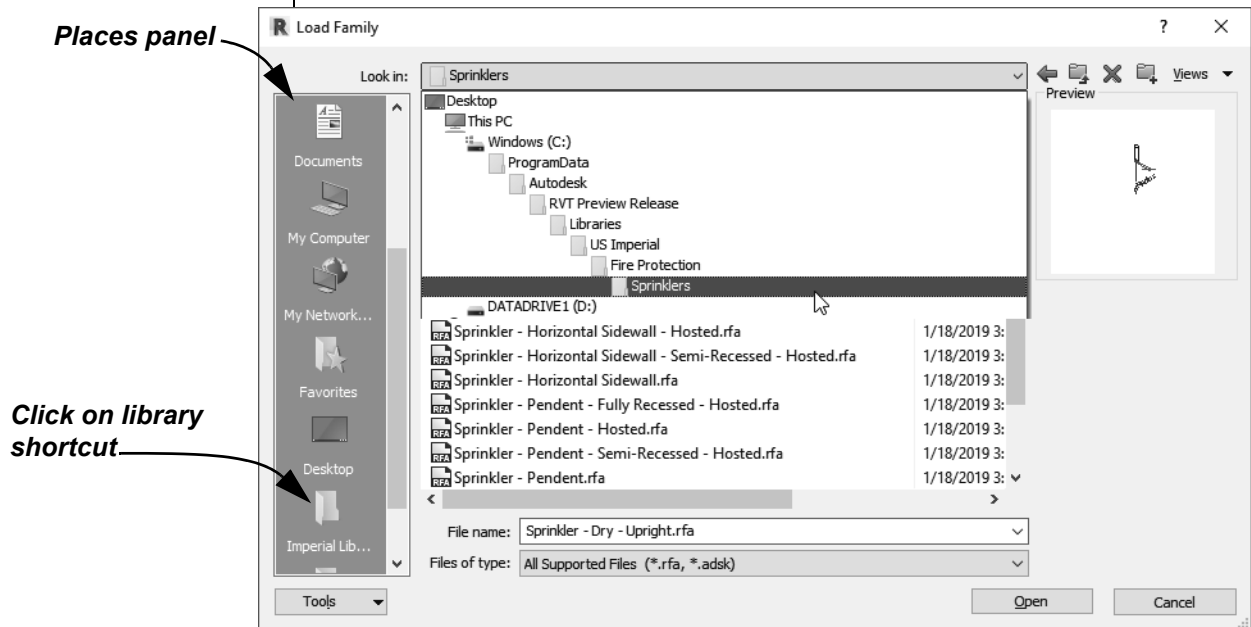



Figure 2–22

3. Select the family or families you want to load. You can hold <Ctrl> to select multiple families.
 - The program remembers the last-used folder.
4. Click **Open**.

How To: Load an Autodesk Family

1. In the *Insert* tab>Load from Library panel, click  (Load Autodesk Family).
2. In the Load Autodesk Family dialog box, filter your search by typing in what kind of family you are looking for, or click on a category in the Browse section, as shown in Figure 2–23.

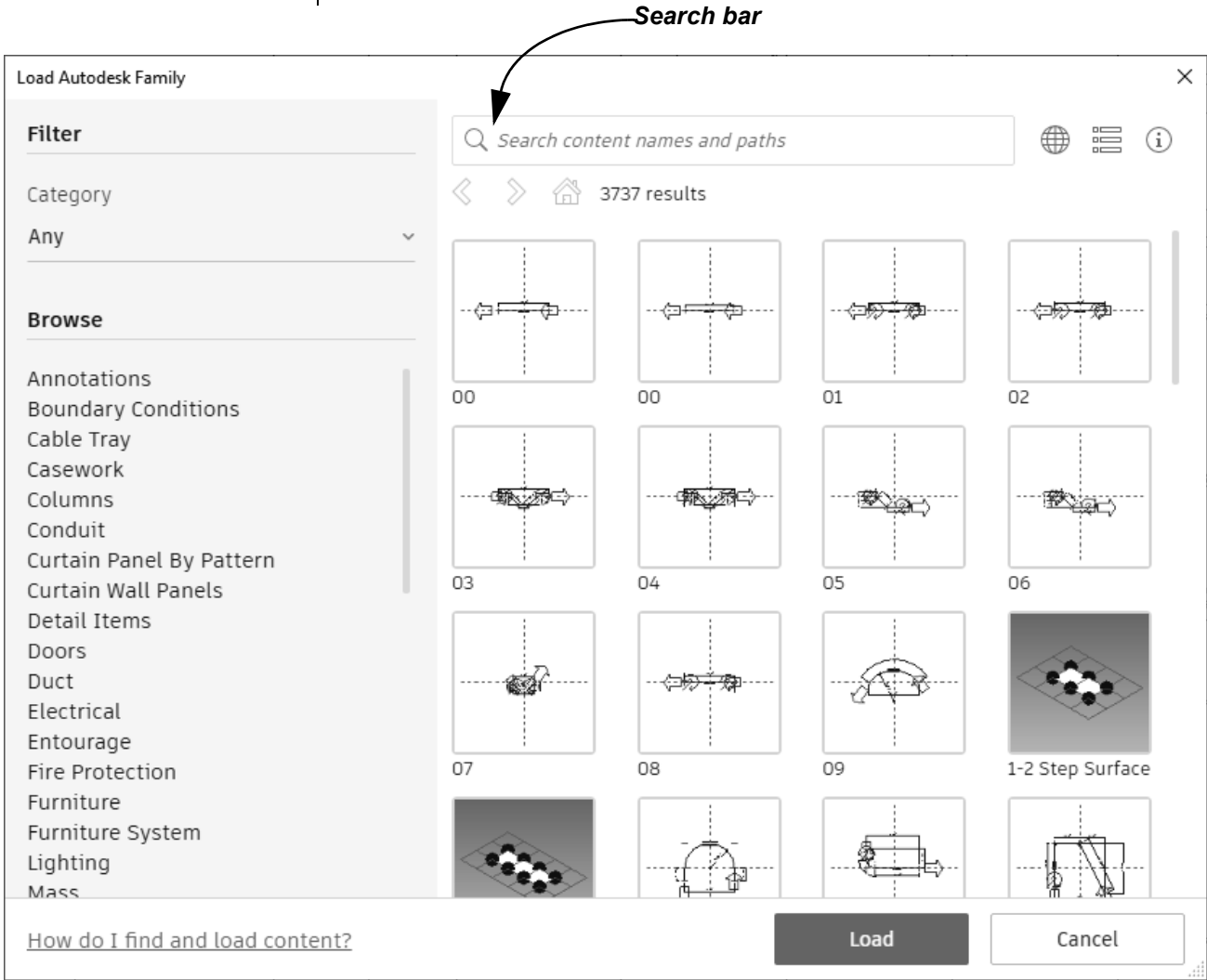


Figure 2–23

3. Click **Load** to load the family into your project.

Purging Unused Components

You can remove unused elements from a project, including individual component types, as shown in Figure 2–24.

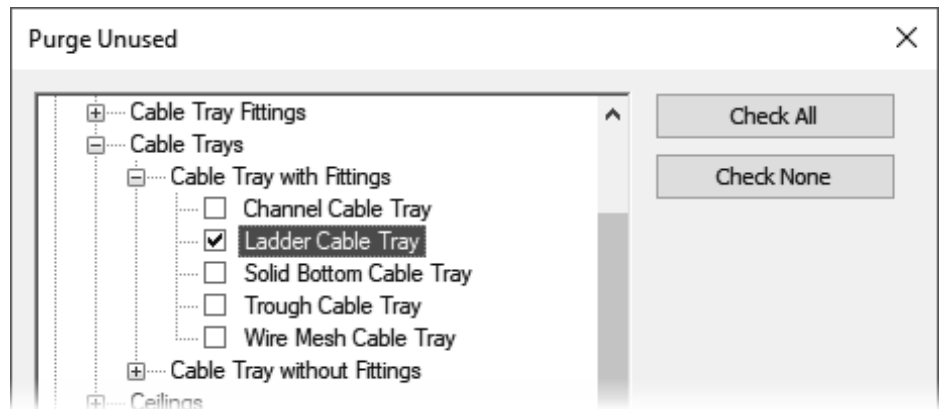



Figure 2–24

- Some elements are nested in other elements and it might require several rounds of purging the project to remove them.

How To: Purge Unused Elements

1. In the *Manage* tab>Settings panel, click  (Purge Unused).
2. In the Purge unused dialog box, click **Check None** and select the elements that you want to purge.
3. Click **OK**.
4. Purging unused components not only helps simplify the component list, but more importantly, reduces the project file size.

Practice 2a

Insert Components - Mechanical

Practice Objectives

- Insert components.
- Use drawing aids.

In this practice, you will insert air terminals and a mechanical equipment fixture, as shown in Figure 2–25. You will use various drawing aids to help you place the fixtures appropriately.

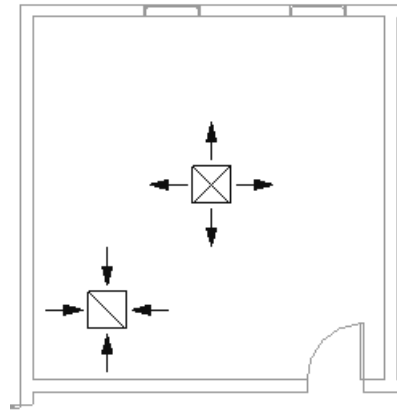



Figure 2–25

1. In the practice files *Working Models>Mechanical* folder, open **Mech-Start.rvt**.
2. In the Project Browser, expand the **Mechanical>HVAC>Floor Plans** node. Double-click on the **1 - Mech** view to open it.
3. In the *Systems* tab>HVAC panel, click  (Air Terminal).
4. In Properties, note that the default in the Type Selector is a **Supply Diffuser** and that the *Level* is **Level 1**.
5. Set the *Offset from Host* to **9'-0"**.

6. Click near the center of the room labeled **Lab 101**, as shown in Figure 2–26.

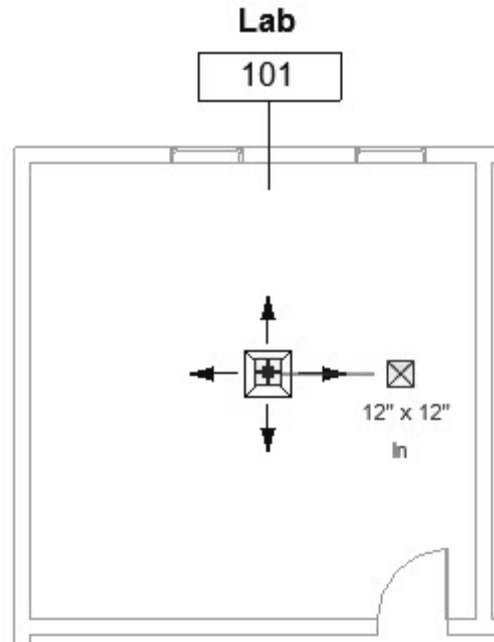




Figure 2–26

7. While still in the Air Terminal command, in the Type Selector, change the *Type* to **Return Diffuser: 24 x 24 Face 12 x 12 Connection** and set the *Offset from Host* to **9'-0"**.
8. Click to place the component in the lower-left corner of **Lab 101**.
9. Click  (Modify).
10. In the *Systems* tab>Mechanical panel, click  (Mechanical Equipment.)
11. In the Type Selector, select **Boiler: Standard**.
12. In the Mech/Elec room, move the cursor near the exterior wall. Note that the interior side of the wall highlights, as shown in Figure 2–27. Press <Spacebar> and the boiler will rotate around the placement point, which is your cursor.

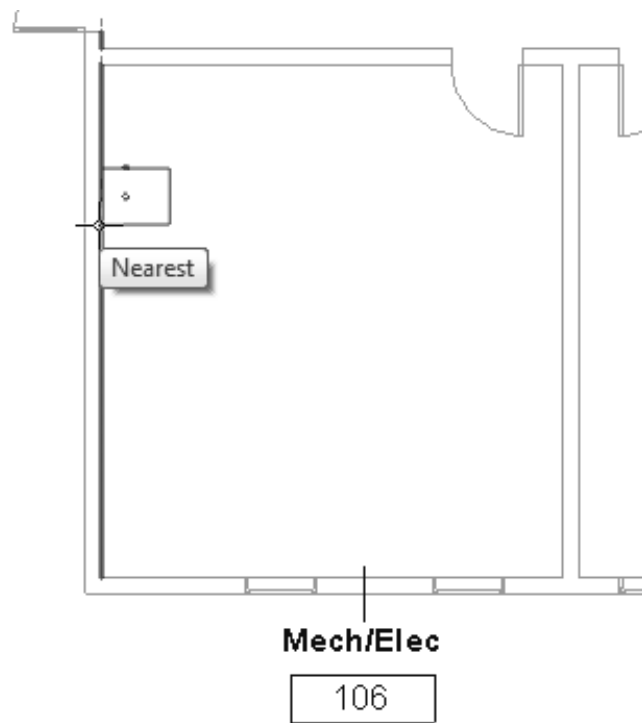



Figure 2–27

13. Click to place the component.
14. Click  (Modify) to end the command.
15. Save and close the project.

Practice 2b

Insert Components - Electrical

Practice Objectives

- Insert components.
- Use drawing aids.
- Select a work plane.

In this practice, you will insert lighting fixtures, as shown in Figure 2–28. You will use various drawing aids to help you place the fixtures appropriately.

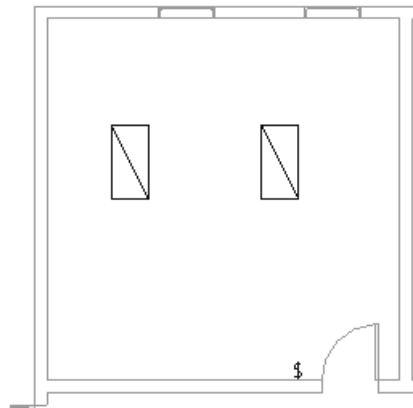




Figure 2–28

1. In the practice files *Working Models>Electrical* folder, open **Elec-Start.rvt**.
2. In the Project Browser, expand the **Electrical>Lighting>Ceiling Plans** node and double-click on **1 - Ceiling Elec** to open the view.
 - Ensure that you are opening the ceiling plan so that the ceiling grids display.
3. In the *Systems* tab>Electrical panel, click  (Lighting Fixture).
4. In the Type Selector, select **Plain recessed Lighting Fixture: 2x4 - 277**.
5. In the *Modify | Place Fixture* tab>Placement panel, click  (Place on Face).

6. In the room **Lab 101**, hover the cursor over the grid. The light fixture snaps to the ceiling grid intersection lines, as shown in Figure 2–29.
7. Press <Spacebar> to rotate the fixture about the placement point, which is your cursor. Click to place two fixtures in the room, as shown in Figure 2–30.

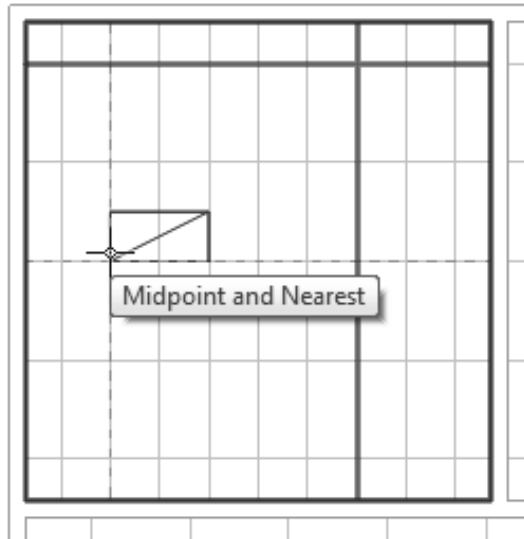


Figure 2–29

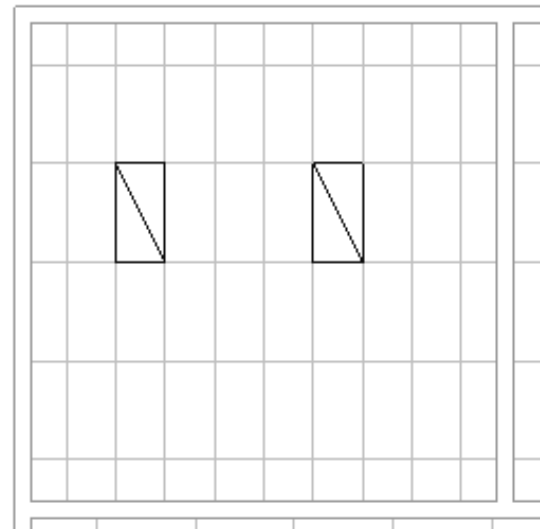



Figure 2–30

8. Open the Electrical>Lighting>Floor Plans>**1 - Lighting** view. The light fixtures display in this view although you are seeing a plan view.
9. In the *Systems* tab>Electrical panel, expand the Device drop-down list and select  (Lighting).
10. In the Type Selector, select **Lighting Switches: Single Pole**.
11. In Properties, note that the *Elevation from Level* is set to **4'-0"**, a standard height for switches.

12. Place the switch next to the door. It displays only as a symbol, as shown in Figure 2–31.

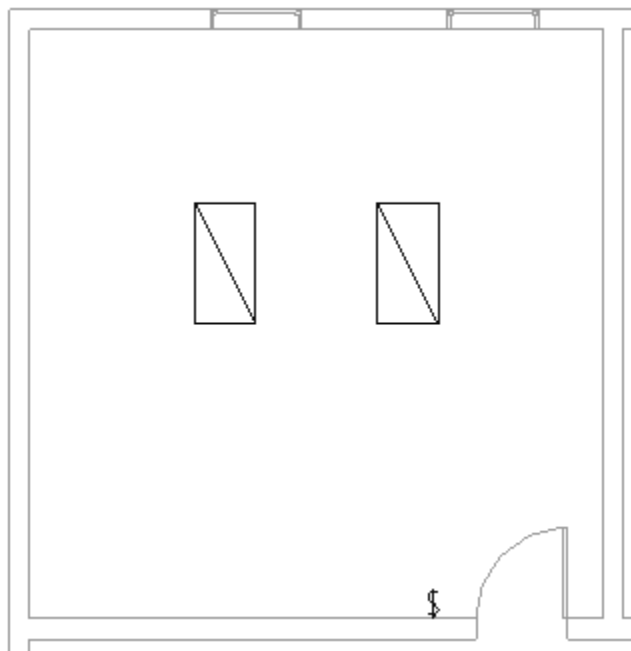



Figure 2–31

13. Click  (Modify) to end the command.
14. Save and close the project.

Practice 2c

Insert Components - Plumbing

Practice Objectives

- Load and insert components.
- Use drawing aids.

In this practice, you will insert plumbing fixtures, as shown in Figure 2–32. You will use drawing aids to help you place the fixtures appropriately.

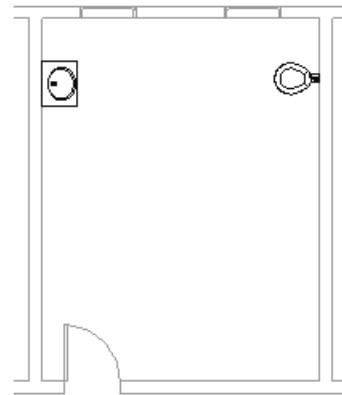



Figure 2–32

1. In the practice files *Working Models>Plumbing* folder, open **Plumb-Start.rvt**.
2. In the Project Browser, expand the **Plumbing>Plumbing>Floor Plans** node and double-click on **1 - Plumbing** to open the view.
3. In the *Systems* tab>Plumbing & Piping panel, click  (Plumbing Fixture).
4. In the Type Selector, select one of the wall-mounted water closets.

5. Click along the wall in the men's restroom to place the fixture, as shown in Figure 2–33.

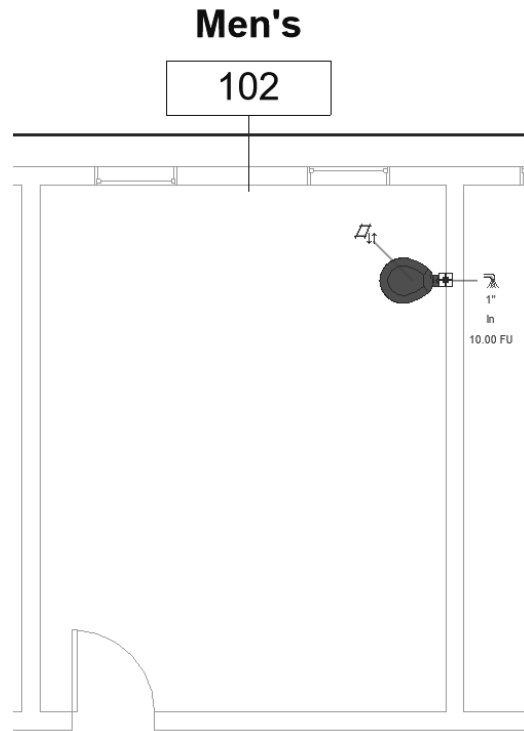



Figure 2–33

6. Return to the Type Selector and review the list. Note that there are sinks, but no lavatories.
7. In the *Modify | Place Plumbing Fixture* tab>Mode panel, click  (Load Family).
8. In the Load Family dialog box, the Autodesk Revit Library automatically displays. Navigate to the *Plumbing> MEP>Fixtures>Lavatories* folder and select **Lavatory - Oval.rfa**, as shown in Figure 2–34.

If the Revit Library folder does not automatically display, refer to the Loading Components section in 2.2 Inserting Components.

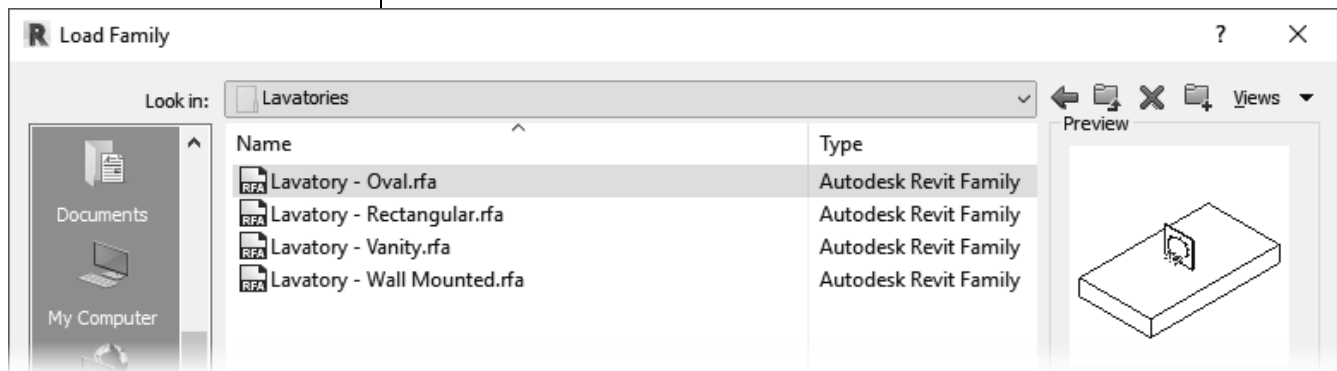



Figure 2–34

9. Click **Open**.
10. In the Type Selector, select **Lavatory - Oval: 25"x 20" - Public**.
11. Place the lavatory against the wall across from the water closet.
12. Click  (Modify) and select the new fixture. Drag it up or down until it meets with the alignment line of the water closet, as shown in Figure 2–35.

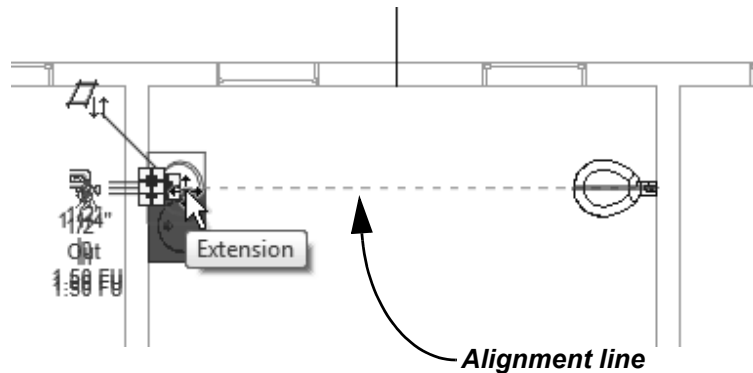


Figure 2–35

13. Click outside the building model in an empty area to release the selection.
14. Save and close the project.

2.3 Selecting and Editing Elements

Building design projects typically involve extensive changes to the model. Revit was designed to make such changes quickly and efficiently. You can change an element using the following methods, as shown in Figure 2–36:

- Type Selector enables you to specify a different type. This is frequently used to change the size and/or style of the elements.
- Properties enables you to modify the information (parameters) associated with the selected elements.
- The contextual tab in the ribbon contains the Modify commands and element-specific tools.
- Temporary dimensions enable you to change the element's dimensions or position.
- Controls enable you to drag, flip, lock, and rotate the element.
- Shape handles enable you to drag elements to modify their height or length.
- Connectors show how related elements attach to each other with intelligence about size, needed fittings, and system information.

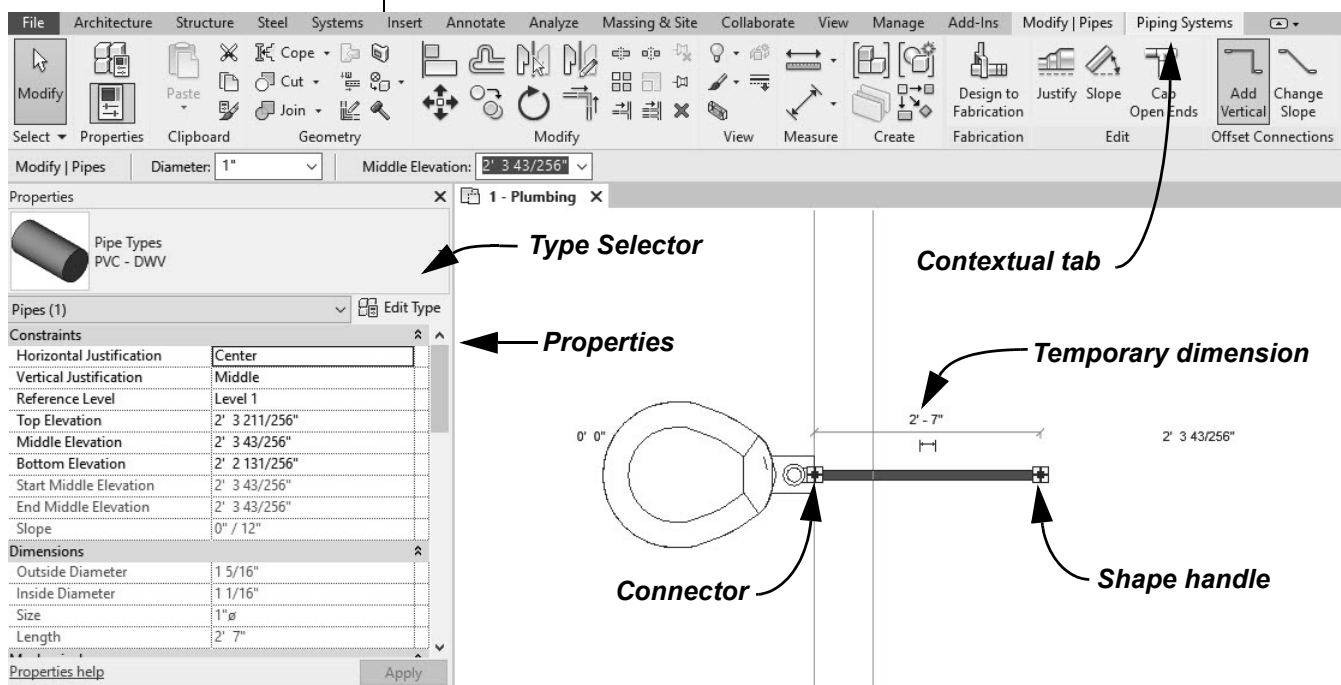



Figure 2–36

- To delete an element, select it and press <Delete>, right-click and select **Delete**, or in the Modify panel, click  (Delete).

Working with Controls and Connectors

When you select an element, various controls and connectors display depending on the element and view. Using controls, you can change an element's length or location, and flip or rotate some elements. MEP connectors also provide information about attachments and enable you to add related elements, as shown for creating pipe from a pipe accessory in Figure 2–37.

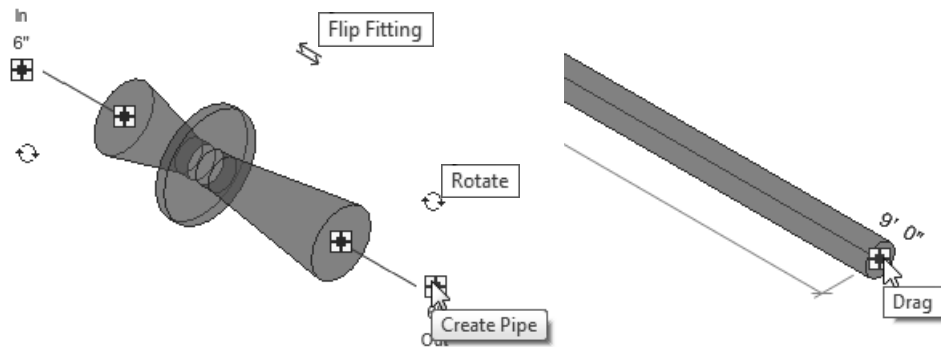


Figure 2–37

- If you hover the cursor over the control or connector, a tooltip displays showing its function.

Hint: Editing Temporary Dimensions

Temporary dimensions automatically link to the closest wall. To change the location, you can drag the *Witness Line* control, as shown in Figure 2–38, to connect to a new reference. You can also click on the control to toggle between justifications in the wall.

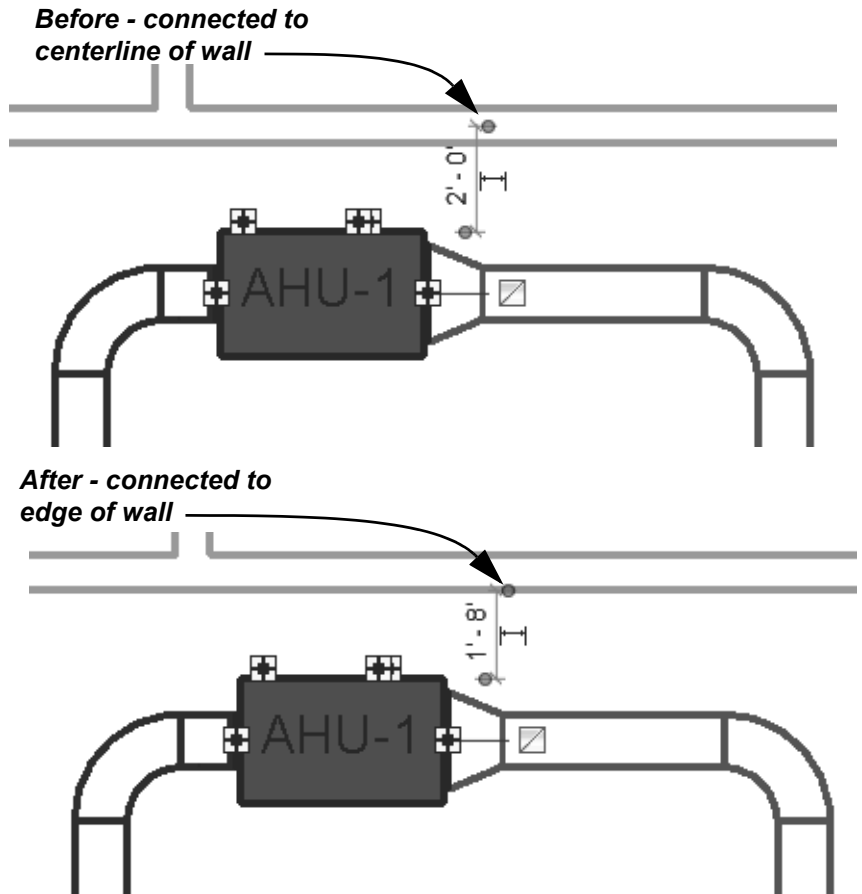


Figure 2–38

- The new location of a temporary dimension for an element is remembered as long as you are in the same session of the software.

Selecting Multiple Elements

You can select more than one element at a time. Once you have selected at least one element, hold <Ctrl> and select another item to add it to a selection set.

- To remove an element from a selection set, hold <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 2–39. 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.

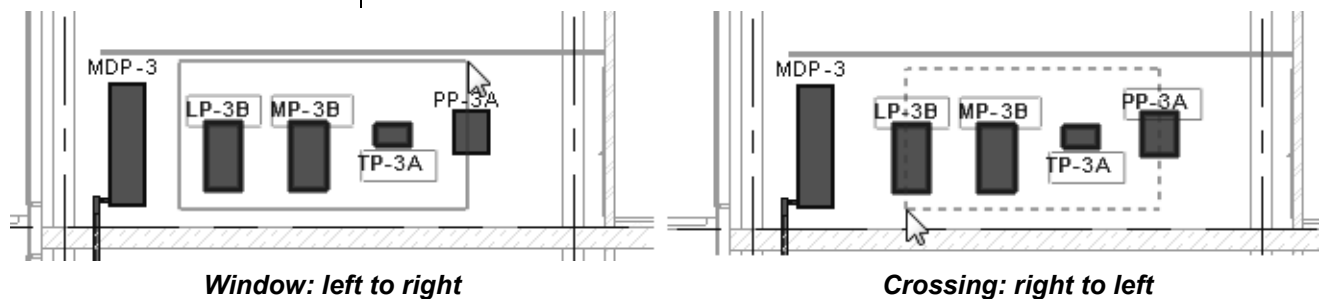


Figure 2–39

- If several elements are on or near each other, hover your cursor over an edge and 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 view 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 2–40. For example, if you select a column of a specific size and use this command, only the columns of the same size are selected.

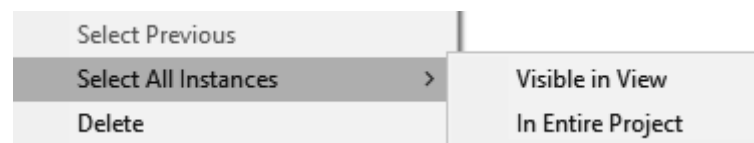


Figure 2–40

- You can save selections and use them again.

Hint: Measuring Tools

When modifying a model, it is useful to know the distance between elements. This can be done with temporary dimensions or, more frequently, by using the measuring tools found in the Quick Access Toolbar or in the *Modify* tab> Measure panel, as shown in Figure 2–41.

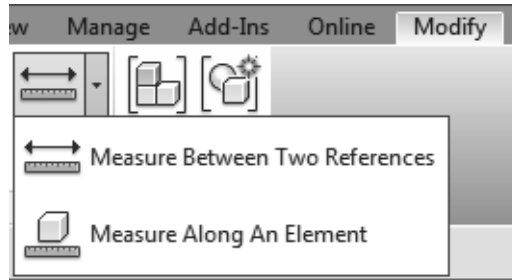




Figure 2–41

-  (Measure Between Two References): Select two elements and the measurement displays.
-  (Measure Along An Element): Select the edge of a linear element and the total length displays. Use <Tab> to highlight other elements and then click to measure along all of them, as shown in Figure 2–42.

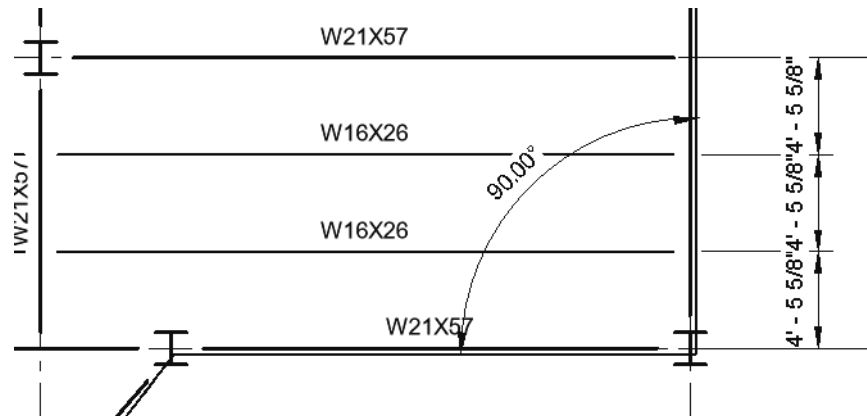


Figure 2–42

- References include any snap point, wall lines, or other parts of elements (such as door center lines).

Filtering Selection Sets

When multiple element categories are selected, the *Multi-Select* contextual tab opens in the ribbon. This gives you access to all of the Modify tools and the **Filter** command. The **Filter** command enables you to specify the types of elements to select. For example, you might only want to select light fixtures, as shown in Figure 2-43.

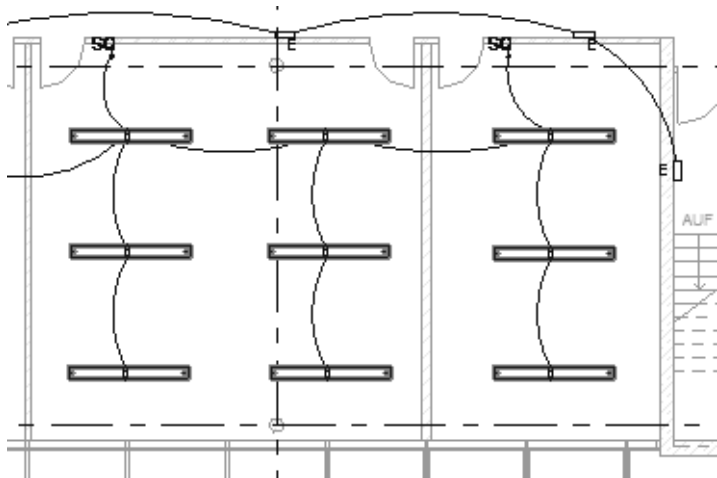



Figure 2-43

How To: Filter a Selection Set

1. Select everything in the area.
2. In the *Modify* | *Multi-Select* tab>Selection panel, or in the

Status Bar, click  (Filter). The Filter dialog box opens, as shown in Figure 2-44.

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

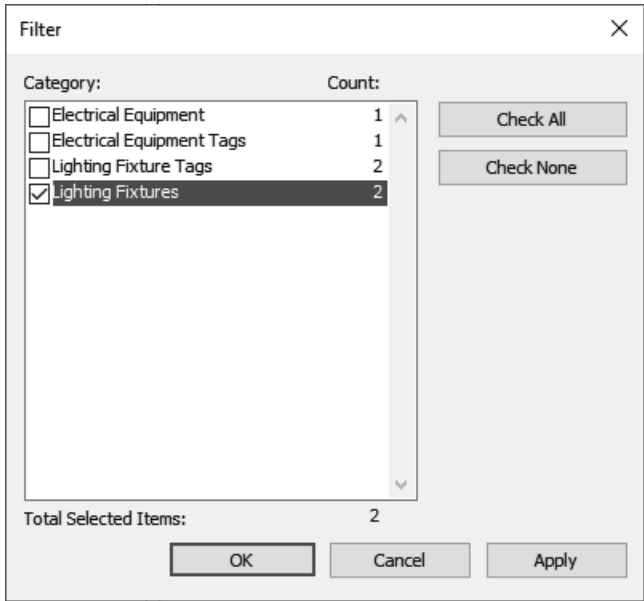
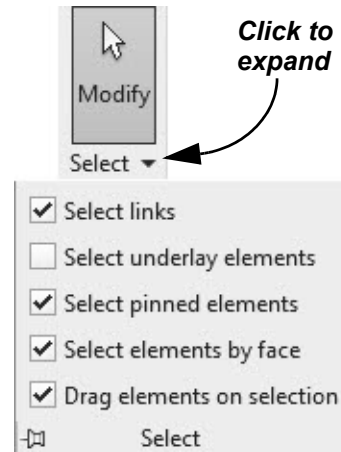







Figure 2-44

3. Click **Check None** to clear all of the options or **Check All** to select all of the options. You can also select or clear individual categories as needed.
 4. Click **OK**. The selection set is now limited to the elements you specified.
- The number of elements selected displays on the right end of the Status Bar and in Properties.

Hint: Selection Options

You can control how the software selects specific elements in a project by toggling selection options on and off in the Status Bar, as shown in Figure 2–45. Alternatively, in any tab on the ribbon that has the Modify command, you can expand the Select panel and select the options shown in Figure 2–46.

**Figure 2–45****Figure 2–46**

-  **Select links:** When toggled on, you can select linked drawings or Autodesk Revit models. When toggled off, you cannot select linked drawings when using **Modify** or **Move**.
-  **Select underlay elements:** When toggled on, you can select underlay elements. When toggled off, you cannot select underlay elements when using **Modify** or **Move**.
-  **Select pinned elements:** When toggled on, you can select pinned elements. When toggled off, you cannot select pinned elements when using **Modify** or **Move**.
-  **Select elements by face:** When toggled on, you can select elements (such as the floors or walls in an elevation) by selecting the interior face or selecting an edge. When toggled off, you can only select elements by selecting an edge.
-  **Drag elements on selection:** When toggled on, you can hover over an element, select it, and drag it to a new location. When toggled off, the crossing or box select mode starts when you press and drag, even if you are on top of an element. Once elements have been selected, they can still be dragged to a new location.

Practice 2d

Select and Edit Elements - Mechanical

Practice Objectives

- Use a variety of selection methods.
- Use Create Similar to add similar elements.
- Use alignment lines to line up elements.
- Modify elements using Properties.
- Become familiar with selecting elements.

In this practice, you will modify the location of an air terminal and use **Create Similar** to add additional components, as shown in Figure 2–47. You will also modify the height of the air terminals in Properties.

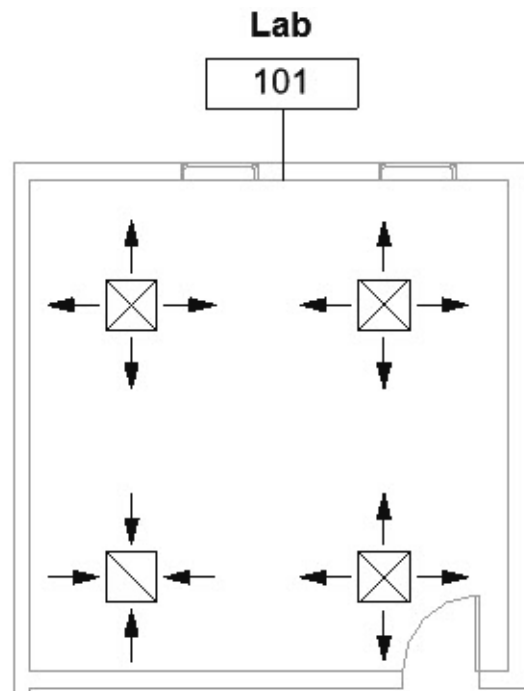
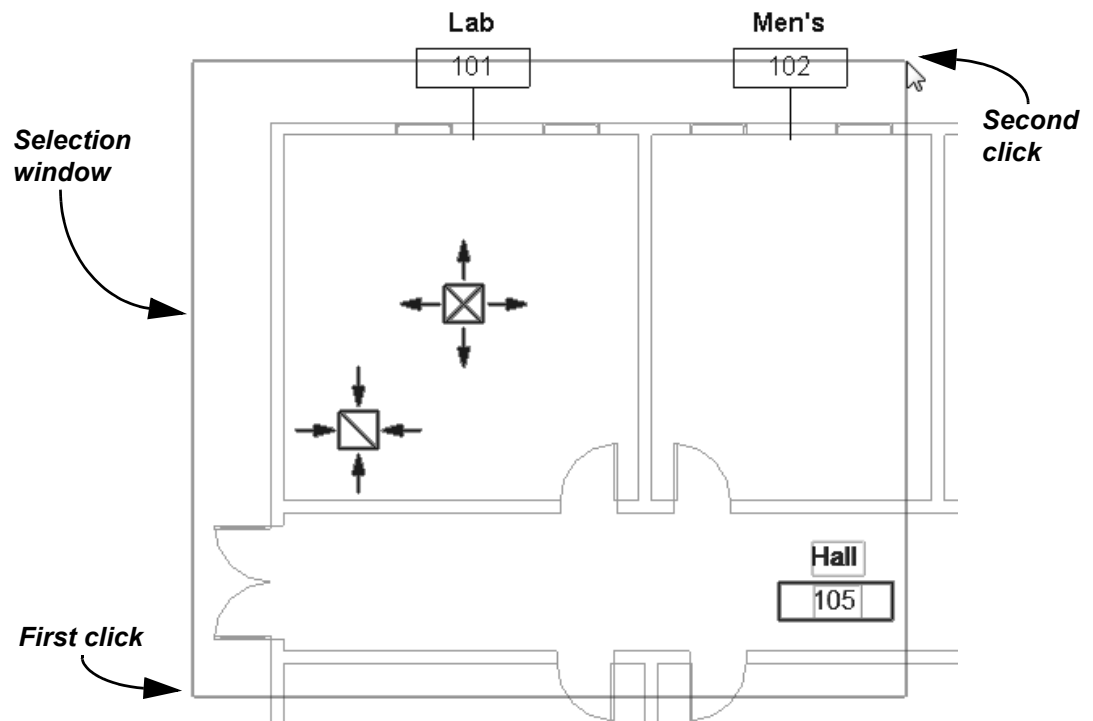


Figure 2–47

- Note: Elements have been modified so that you will have the opportunity to modify their properties.

Task 1 - Use a variety of selection methods.

1. In the practice files *Working Models>Mechanical* folder, open **Mech-Edit.rvt**.
2. Open the Mechanical>HVAC>Floor Plans>**1 - Mech** view.
3. Draw a selection window from left to right around some of the elements so only those completely inside the window are selected. The elements that are selected will highlight in blue, as shown in Figure 2–48.

**Figure 2–48**

4. Click in an empty space in the view to clear the selection.

You can toggle



(Select Links) in the Status Bar to keep the link from being selected.

5. Draw a crossing window (i.e., from right to left) around the same area, as shown in Figure 2–49. Note that any elements that the window touches are included in the selection, including the linked architectural model.

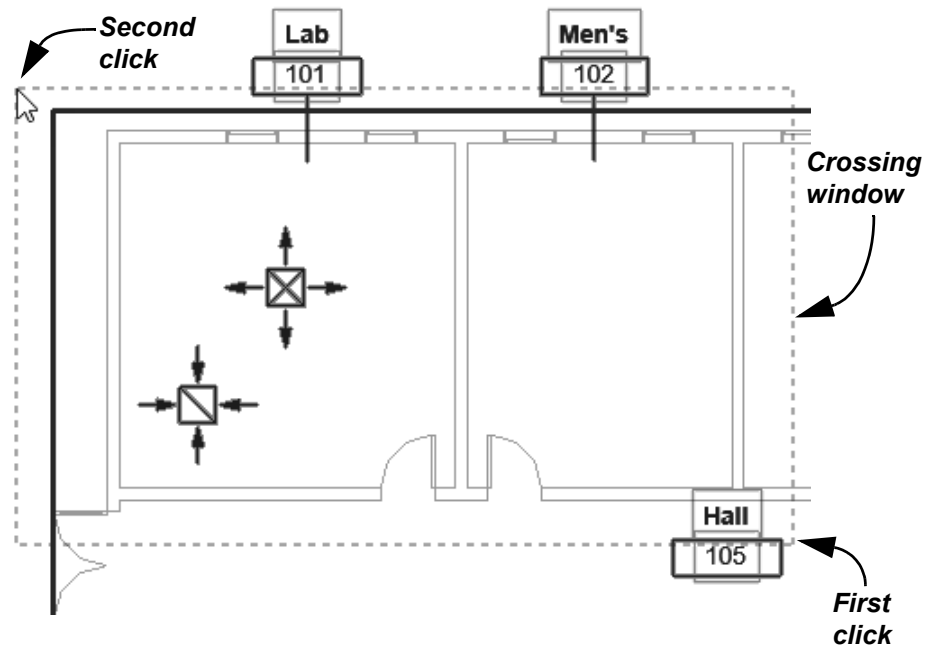




Figure 2–49

6. Hold <Shift> and select the edge of the architectural model. This removes it from the selection.
7. In the Status Bar, note the number of items that are selected and click  (Filter).
8. In the Filter dialog box, view the categories and clear the checkmark from **Air Terminals**.
9. Click **OK**. Only the room tags remain selected.
10. Press <Esc>. The elements are no longer selected.
11. Select one of the room tags. Right-click and select **Select All Instances>Visible in View**. All of the tags are selected.
12. Click  (Modify). The elements are no longer selected.
 - Remember these selection methods as you start working in the projects.

Task 2 - Modify elements using controls and properties.

- 1. Still in the Mechanical>HVAC>Floor Plans>1 - Mech view, select the supply air terminal, then click and drag it to a new location using the alignment line referencing the return air terminal, as shown in Figure 2-50.

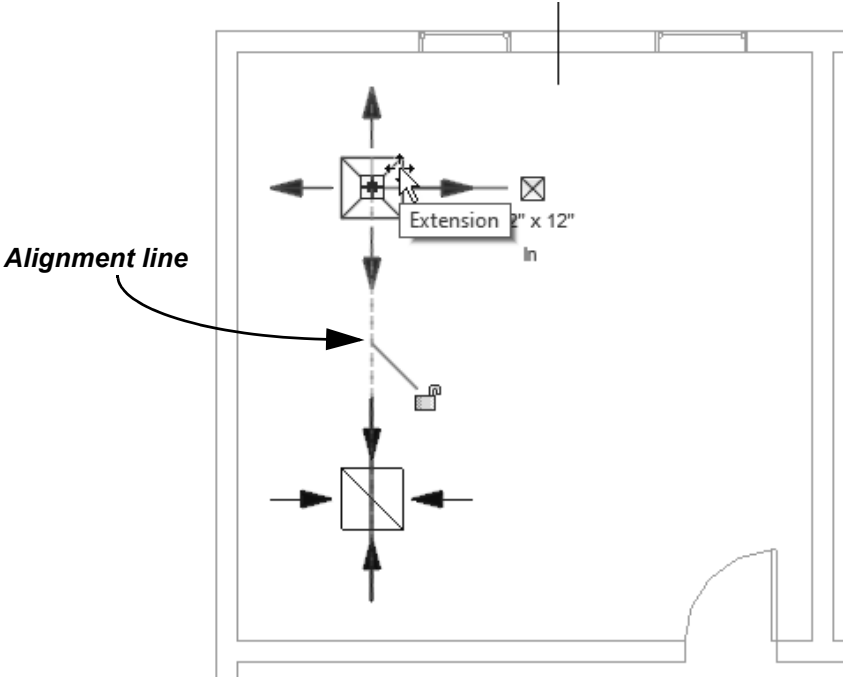


Figure 2-50

- 2. Right-click on the control and look at the variety of options you can use. Figure 2-51 shows a partial menu.

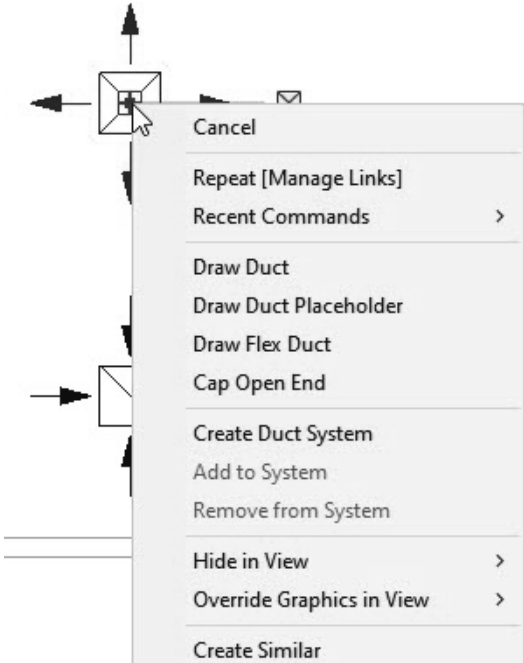


Figure 2-51

3. In the shortcut menu, select **Create Similar**. This starts the **Place Component** command using the same supply diffuser type. Place two more air terminals in the same room, using alignment lines to place them, as shown in Figure 2–52.

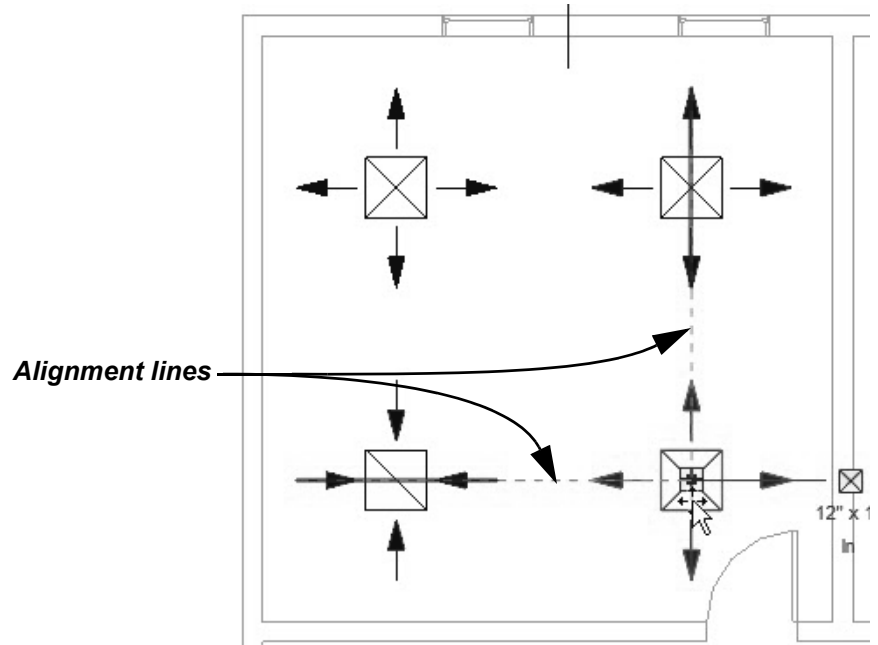



Figure 2–52

4. Click  (Modify) and select all three of the supply air terminals. Note the information in Properties. The *Offset from Host* is set to **0'-0"** above Level 1.
5. Hold <Ctrl> and select the return air terminal. The *Level* and *Offset from Host* are available to change, although two different types of components are selected.
6. Note that similar parameters with different values show as **<varies>** in Properties, as shown on the left in Figure 2–53.

- Change the *Offset from Host* to **8'-0"** and click **Apply**. The offset for all of the air terminals is updated, as shown on the right in Figure 2–53.

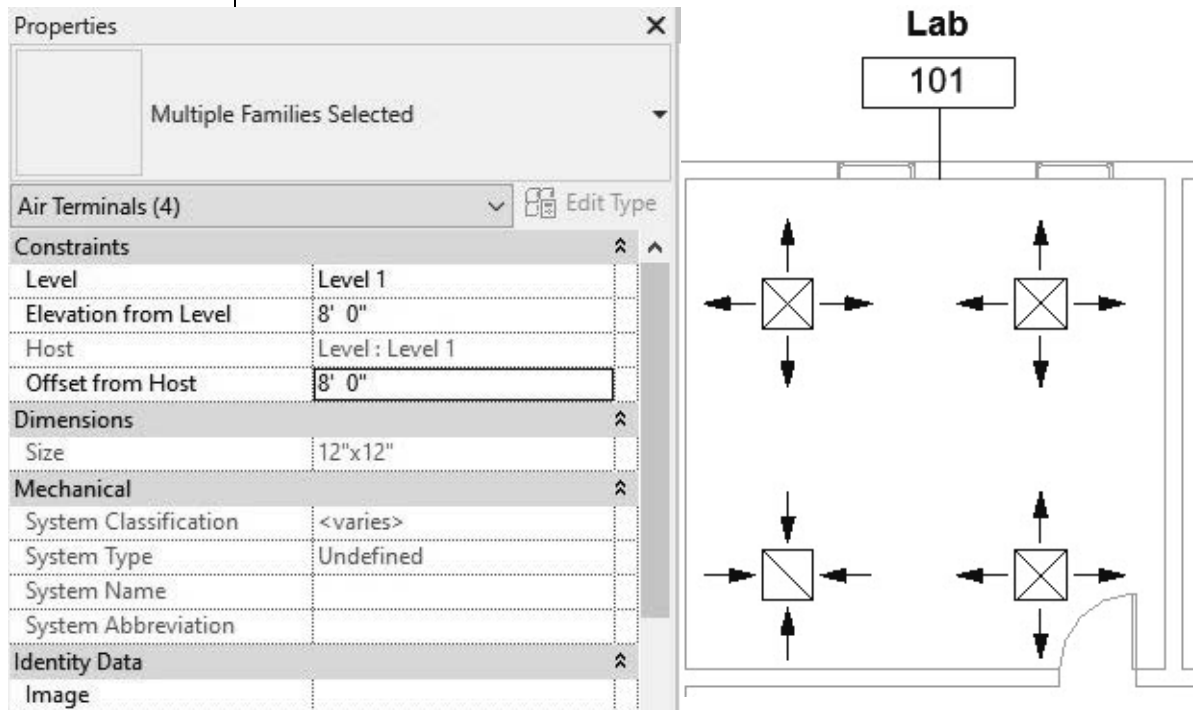


Figure 2–53

- Click in an empty space to clear the selection.
- Save and close the project.

Practice 2e

Select and Edit Elements - Electrical

Practice Objective

- Change an element's type using the Type Selector.
- Use Create Similar to add similar elements.
- Use alignment lines to line up elements.
- Modify elements using Properties.
- Become familiar with selecting elements.

In this practice, you will select lighting fixtures and change their type (as shown in Figure 2–54).

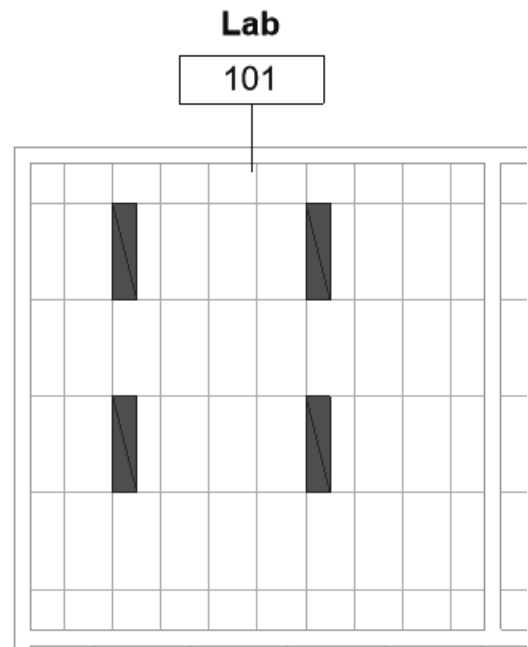
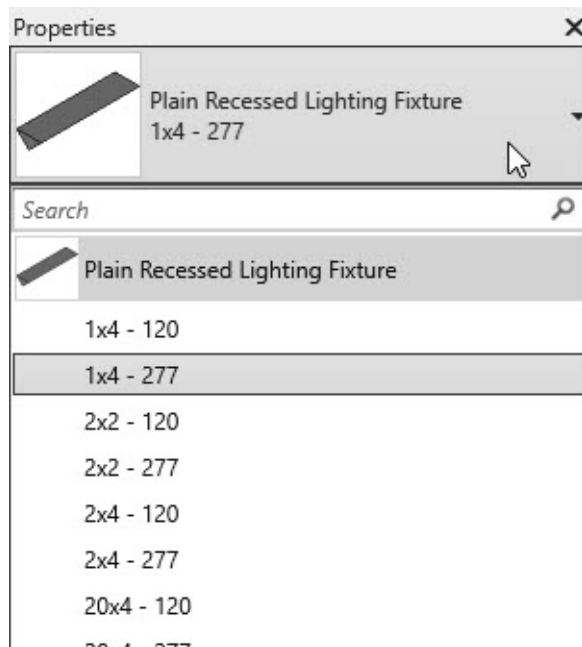


Figure 2–54

Task 1 - Use a variety of selection methods.

1. In the practice files *Working Models>Electrical* folder, open **Elec-Edit.rvt**.
2. In the Project Browser, open the Electrical>Lighting>Floor Plans>**1 - Ceiling Elec** view.
3. Draw a selection window from left to right around some of the elements so only those completely inside the window are selected. The elements that are selected will highlight in blue, as shown in Figure 2–55.

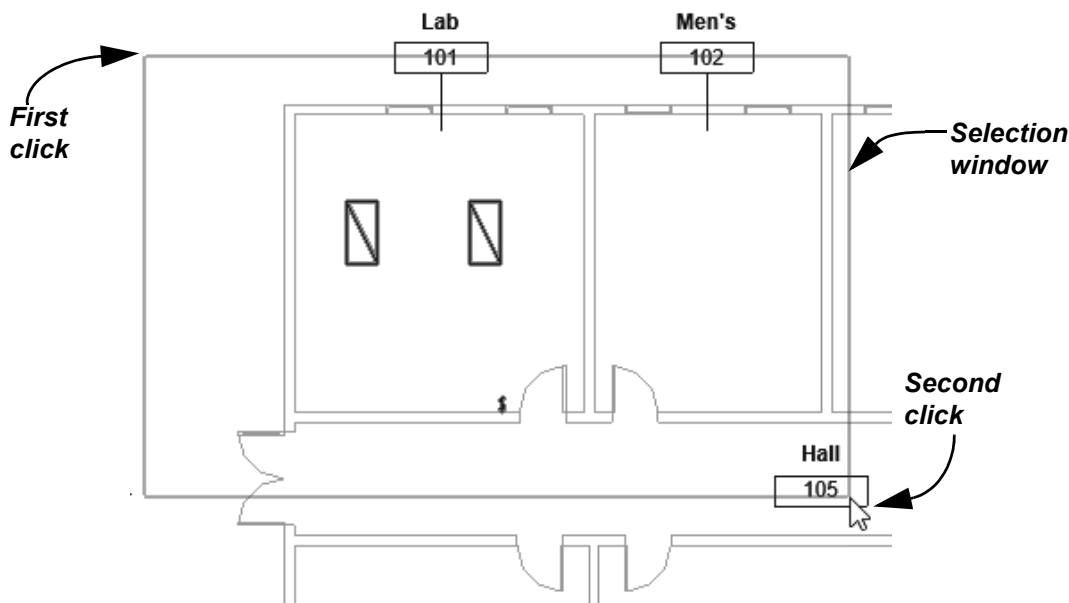



Figure 2-55

- 4. Click in an empty space in the view to clear the selection.
- 5. Draw a crossing window (i.e., from right to left) around the same area, as shown in Figure 2-56. Note that any elements that the window touches are included in the selection, including the linked architectural model.

You can toggle

 (Select Links) in the Status Bar to keep the link from being selected.

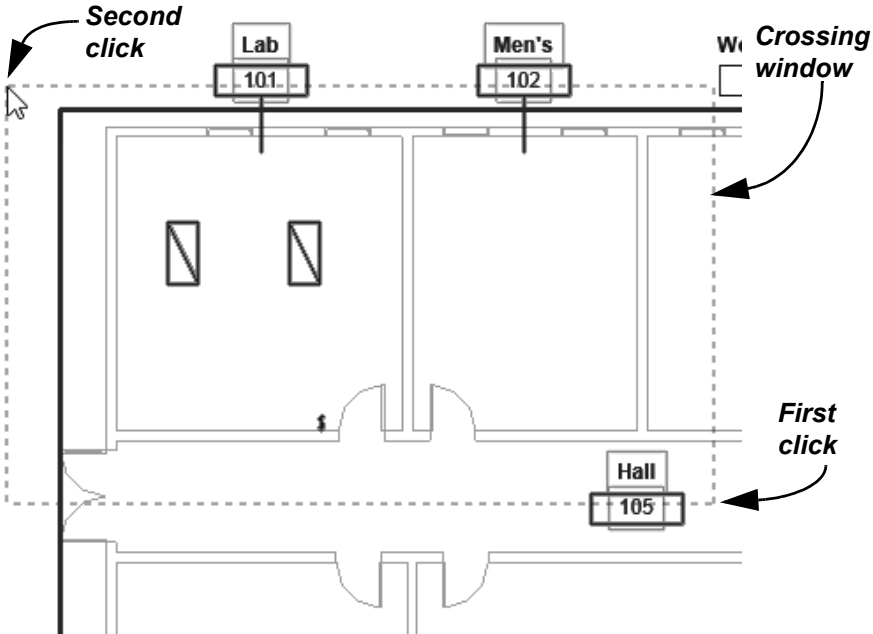




Figure 2-56

- 6. Hold <Shift> and select the edge of the architectural model. This removes it from the selection.

7. In the Status Bar, note the number of items that are selected and click  (Filter).
 8. In the Filter dialog box, view the categories and clear the checkmark from **Lighting Fixtures**.
 9. Click **OK**. Only the room tags remain selected.
 10. Press <Esc>. The elements are no longer selected.
 11. Select one of the room tags. Right-click and select **Select All Instances>Visible in View**. All of the tags are selected.
 12. Click  (Modify). The elements are no longer selected.
- Remember these selection methods as you start working in the projects.

Task 2 - Modify elements using controls and properties.

1. Select one of the lighting fixtures in Lab 101.
2. Right-click on the control and look at the variety of options you can use. Figure 2–57 shows a partial menu.

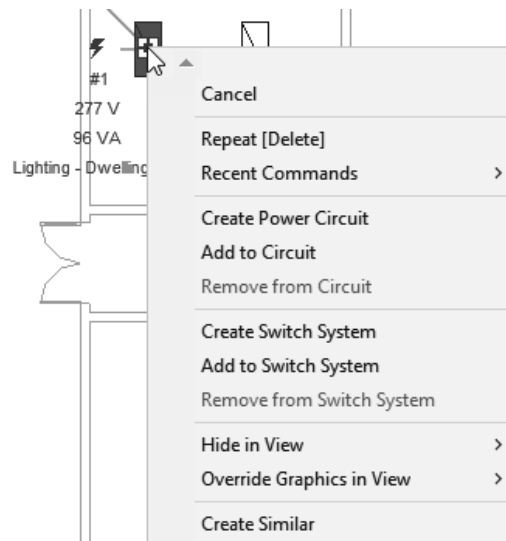


Figure 2–57

3. In the shortcut menu, select **Create Similar**. This starts the **Place Component** command using the same lighting fixture type.

4. In the *Modify | Place Fixture* tab>Placement panel, click



(Place on Face). Place two more lighting fixtures in the same room, using the ceiling grid to place them below the existing lighting fixtures, as shown in Figure 2–58.

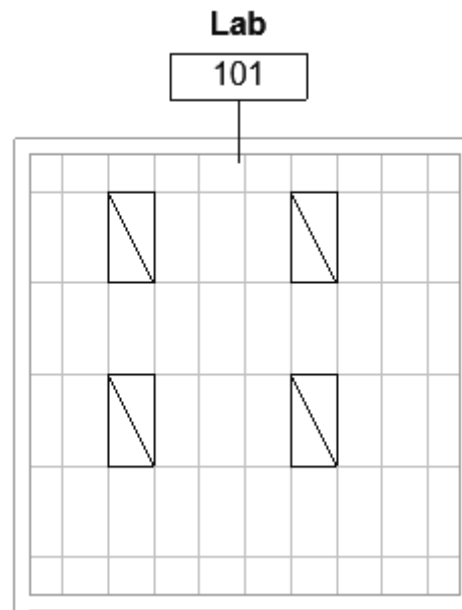


Figure 2–58

5. In the Project Browser, open the Electrical>Lighting>Floor Plans>**1 - Lighting** view.
6. Select one of the light fixtures. The connectors and controls are displayed.
7. Hold <Ctrl> and select the other fixtures. The connectors no longer display, but you can still modify the fixture type.

- In the Type Selector, change the type to **Plain Recessed Lighting Fixture: 1x4 - 277**. Both fixtures change, as shown in Figure 2–59.

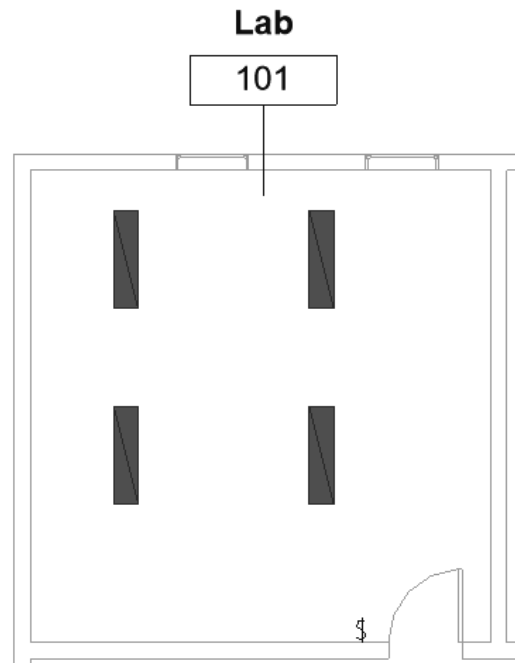


Figure 2–59

- Click in an empty space to clear the selection.
- Save and close the project.

Practice 2f

Select and Edit Elements - Plumbing

Practice Objective

- Modify an element's properties.
- Use Create Similar to add more elements.
- Become familiar with selecting elements.

In this practice, you will modify the height of the lavatory and water closet in Properties (as shown in Figure 2–63).

Task 1 - Use a variety of selection methods.

1. In the practice files *Working Models>Plumbing* folder, open **Plumb-Edit.rvt**.
2. In the Project Browser, open the Plumbing>Plumbing>Floor Plans>**1 - Plumbing** view.
3. Draw a selection window from left to right around some of the elements so only those completely inside the window are selected. The elements that are selected will highlight in blue, as shown in Figure 2–60.

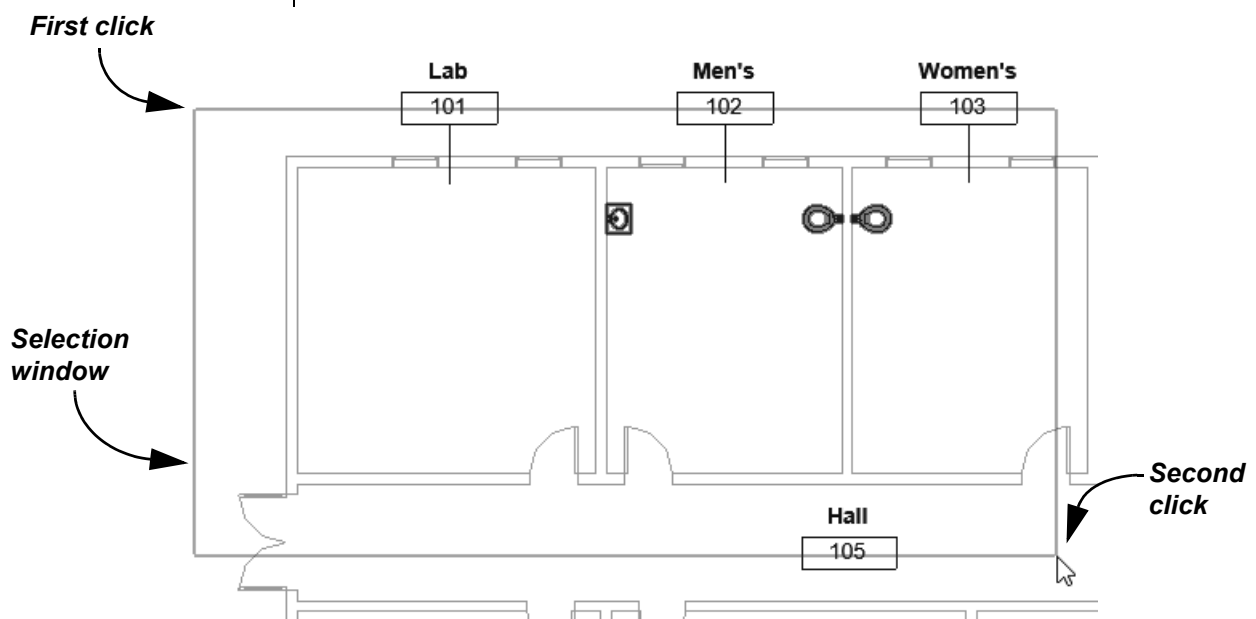


Figure 2–60

You can toggle



(Select Links) in the Status Bar to keep the link from being selected.

4. Click in an empty space in the view to clear the selection.
5. Draw a crossing window (i.e., from right to left) around the same area, as shown in Figure 2–61. Note that any elements that the window touches are included in the selection, including the linked architectural model.

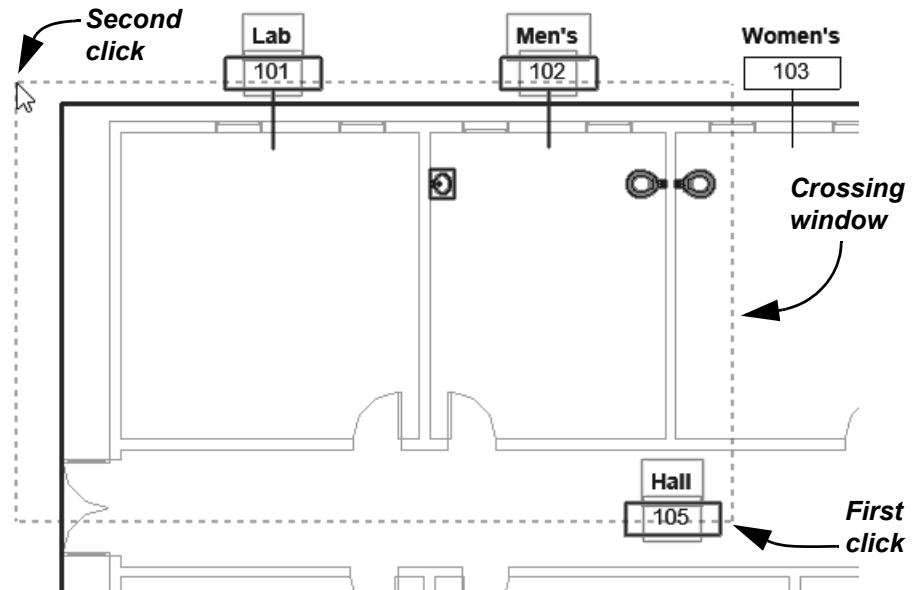


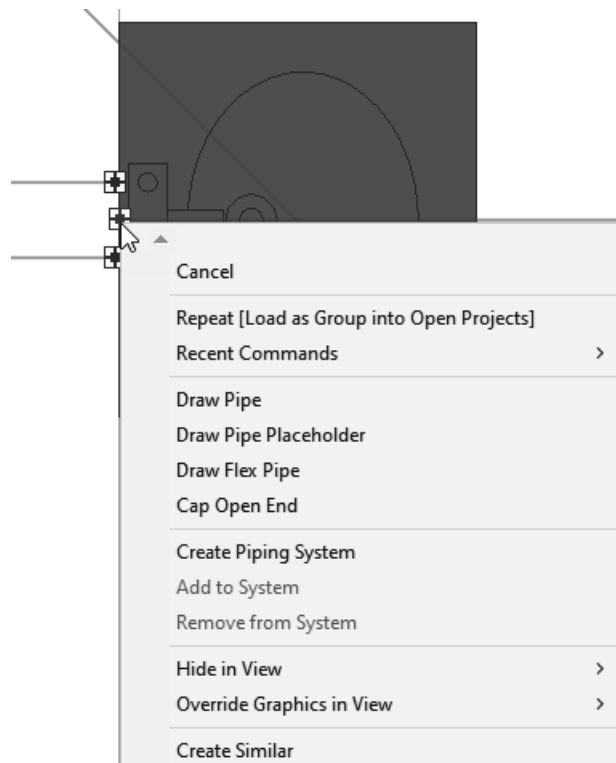



Figure 2–61

6. Hold <Shift> and select the edge of the architectural model. This removes it from the selection.
 7. In the Status Bar, note the number of items that are selected and click  (Filter).
 8. In the Filter dialog box, view the categories and clear the checkmark from **Plumbing Fixtures**.
 9. Click **OK**. Only the room tags remain selected.
 10. Press <Esc>. The elements are no longer selected.
 11. Select one of the room tags. Right-click and select **Select All Instances>Visible in View**. All of the tags are selected.
 12. Click  (Modify). The elements are no longer selected.
- Remember these selection methods as you start working in the projects.

Task 2 - Modify elements using controls and properties.

1. Select one of the lavatories in room 102.
2. Right-click on the control and look at the variety of options you can use. Figure 2–62 shows a partial menu.

**Figure 2–62**

3. In the shortcut menu, select **Create Similar**. This starts the **Place Component** command using the same lavatory type. Place more lavatories (sinks) along the wall.
4. Click  (Modify) to end the command.

5. Select all of the lavatories and, in Properties, set the *Elevation from Level* to **2'-10"**, as shown in Figure 2–63.

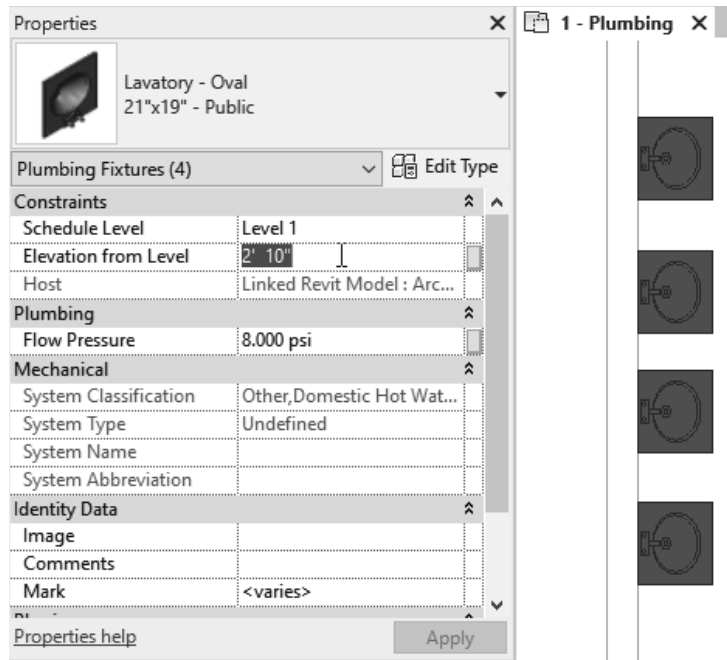



Figure 2–63

6. Select the two water closets (toilets) and set the *Elevation from Level* to **16"** (make sure to include the inches symbol).
Note: This will automatically change to **1'-4"** in Properties.
7. Click  (Modify) to end the command.
8. Save and close the project.

2.4 Working with Basic Modify Tools

The basic modifying tools, **Move**, **Copy**, **Rotate**, **Mirror**, and **Array**, can be used with individual elements or any selection of elements. They are found in the Modify panel (shown in Figure 2–64), in the *Modify* tab, and in contextual tabs.

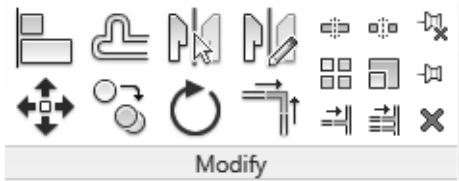


Figure 2–64

- For these modify commands, you can either select the elements and start the command, or start the command, select the elements, and press <Enter> to finish the selection and move to the next step in the command.

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 2–65.

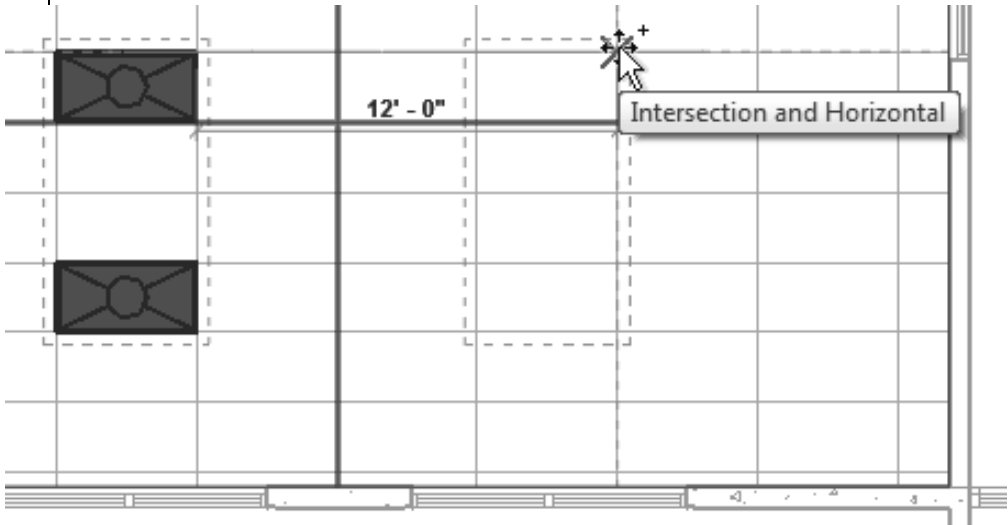





Figure 2–65

How To: Move or Copy Elements

1. Select the elements you want to move or copy.
 2. In the Modify panel, click  (Move) or  (Copy). Alternatively, you can type **MV** for **Move** and **CO** for **Copy**. A boundary box displays around the selected elements.
 3. Select a start point on or near the element.
 4. Select a second point. Use alignment lines and temporary dimensions to help place the elements.
 5. When you are finished, you can start another modify command using the elements that remain selected, or click  (Modify) to end the command.
- You can drag elements to new locations without starting the **Move** command. Holding <Ctrl> and dragging copies the element. This is quick, but not very precise.

Move/Copy Elements Options

The **Move** and **Copy** commands have several options that display in the Options Bar, as shown in Figure 2–66.

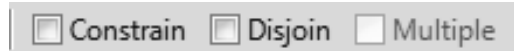






Figure 2–66

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.

- These commands only work in the current view, not between views or projects. To copy between views or projects, in the *Modify* tab>Clipboard panel, click  (Copy to Clipboard),  (Cut to the Clipboard) or  (Paste from Clipboard).

Hint: Pinning Elements

If you do not want elements to be moved, you can pin them in place, as shown in Figure 2–67. Select the elements and in the

Modify tab>Modify panel, click  (Pin) or type the shortcut **PN**. Pinned elements can be copied, but not moved. If you try to delete a pinned element, a warning dialog displays reminding you that you must unpin the element before the command can be started.

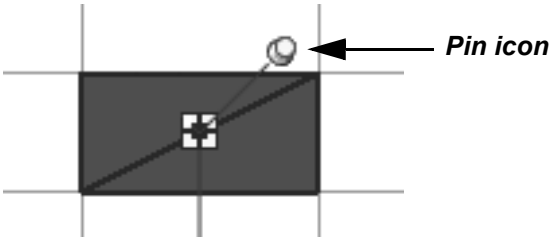



Figure 2–67

Select the element and click  (Unpin) or type the shortcut **UP** to unpin the element.

Rotating Elements

The **Rotate** command enables you to rotate selected elements around a center point or origin, as shown in Figure 2–68. You can use alignment lines, temporary dimensions, and snaps to help specify the center of rotation and the angle. You can also create copies of the element as it is being rotated.

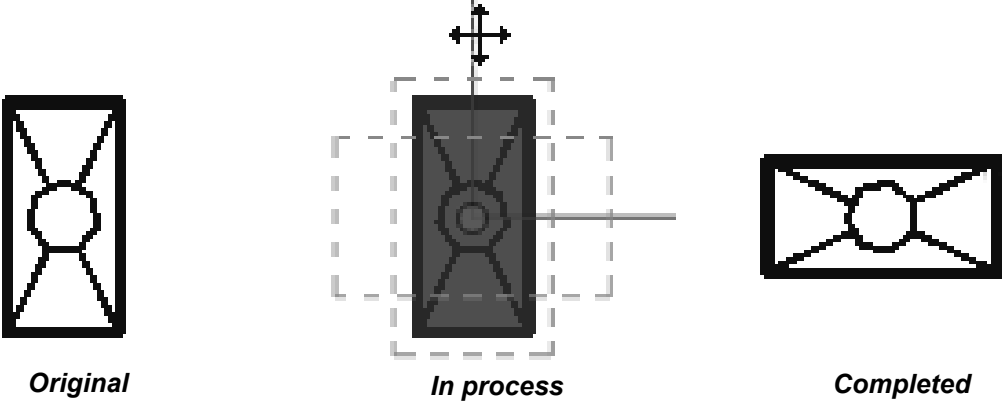




Figure 2–68

How To: Rotate Elements

1. Select the element(s) you want to rotate.
2. In the Modify panel, click  (Rotate) or type the shortcut **RO**.
3. The center of rotation is automatically set to the center of the element or group of elements, as shown in Figure 2–69. To change the center of rotation, as shown in Figure 2–70, use the following:

To start the **Rotate** command with a prompt to select the center of rotation, select the elements first and type **R3**.

- Drag the  (Center of Rotation) control 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 <Spacebar> to select the center of rotation and click to move it to a new location.

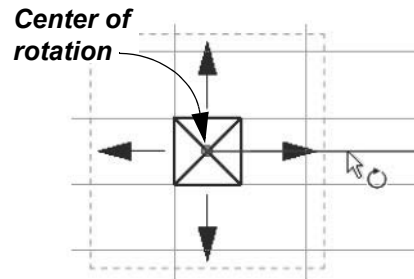


Figure 2–69

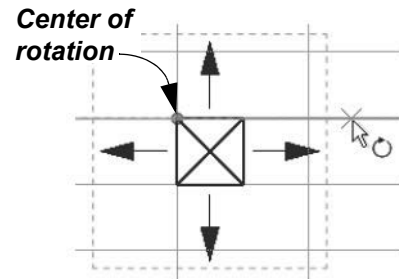



Figure 2–70

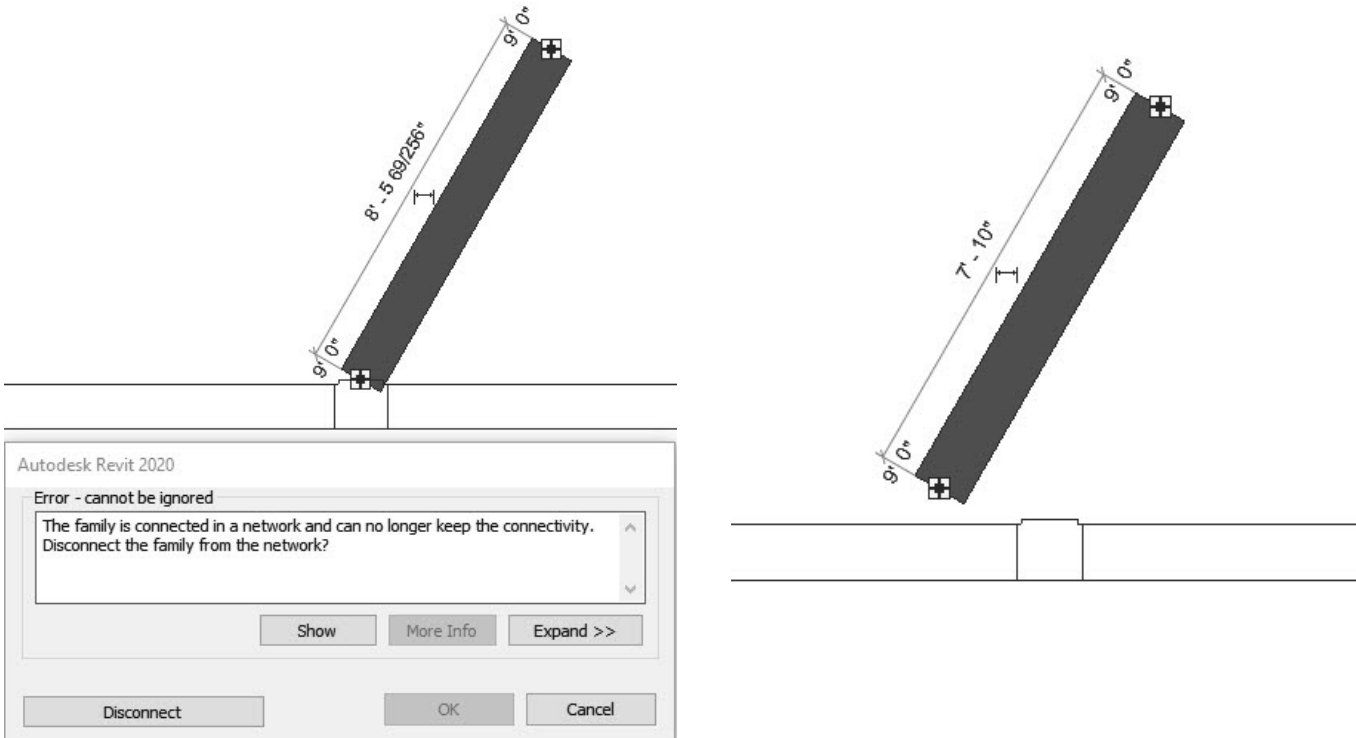
4. In the Options Bar, specify if you want to make a copy (select **Copy**), type an angle in the *Angle* field (shown in Figure 2–71), and press <Enter>. You can also specify the angle on screen using temporary dimensions.



Figure 2–71

5. The rotated element(s) remain highlighted, enabling you to start another command using the same selection, or click  (Modify) to finish.

- The **Disjoin** option breaks any connections between the elements being rotated and other elements. If **Disjoin** is on (selected), the elements rotate separately; however, with MEP elements, the connection to the system will be broken. If it is off (cleared), the connected elements also move or stretch, as shown for a wall in Figure 2–72. **Disjoin** is toggled off by default.



Disjoin on

Disjoin off

Figure 2–72

- Rotating connected MEP elements can easily cause connection and system problems.

Mirroring Elements

The **Mirror** command enables you to mirror elements about an axis defined by a selected element, as shown in Figure 2–73, or by selected points.

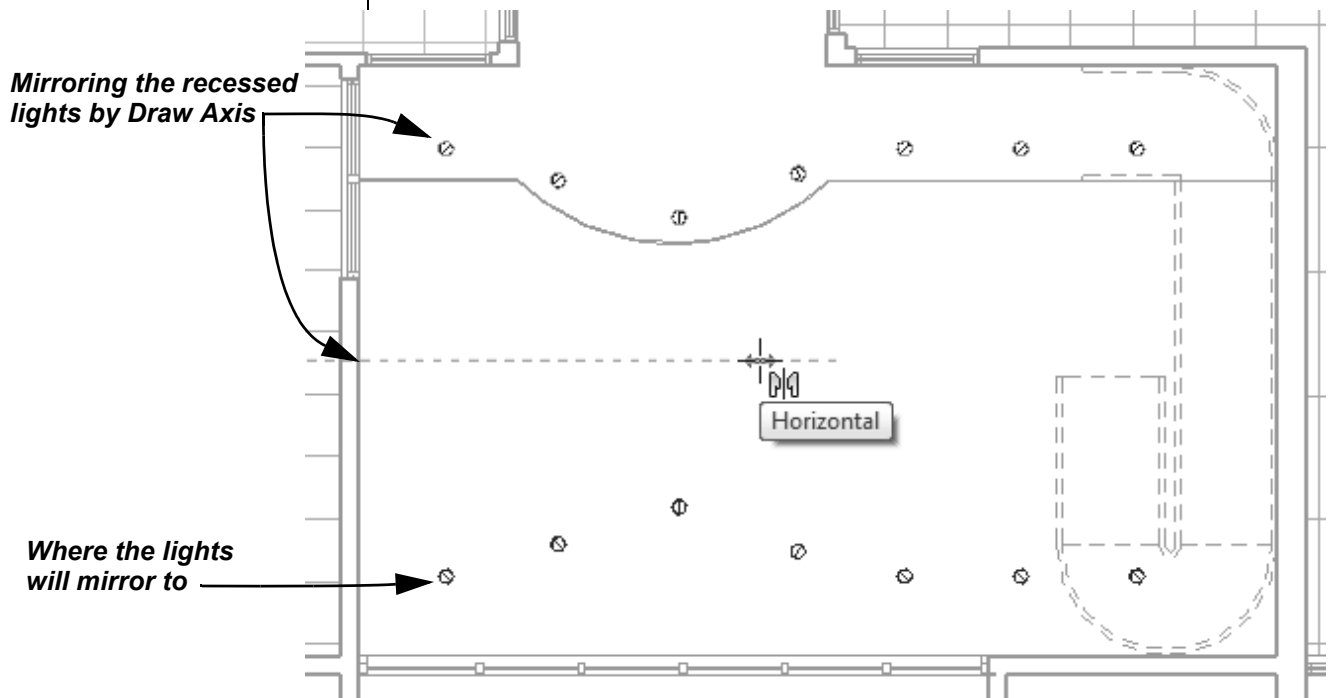





Figure 2–73


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 the shortcut **MM**. This prompts you to select an element as the **Axis of Reflection** (mirror line).
 - Click  (Mirror - Draw Axis) or type the shortcut **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 click  (Modify) to finish.
 - By default, the original elements that were mirrored remain. To delete the original elements, clear the **Copy** option in the Options Bar.

Creating Linear and Radial Arrays

Hint: Scale

The Autodesk Revit software is designed with full-size elements. Therefore, not much should be scaled. For example, scaling a wall increases its length but does not impact the width, which is set by the wall type. However, you can use

 (Scale) in reference planes, images, and imported files from other programs.

The **Array** command creates multiple copies of selected elements in a linear or radial pattern, as shown in Figure 2–74. For example, you can array a row of columns to create a row of evenly spaced columns on a grid line, or array a row of parking spaces. 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.

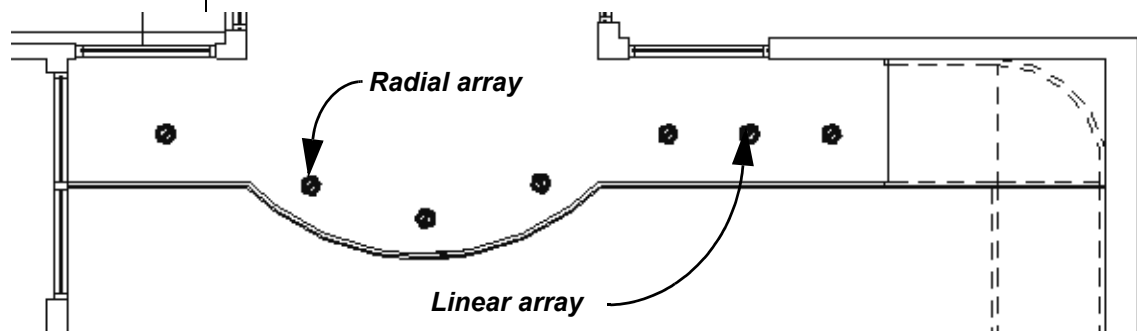




Figure 2–74

How To: Create a Linear Array

1. Select the element(s) to array.
2. In the Modify panel, click  (Array) or type the shortcut **AR**.
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.

- If **Group And Associate** is selected, you are prompted again for the number of items, as shown in Figure 2–75. Type a new number or click on the screen to finish the command.

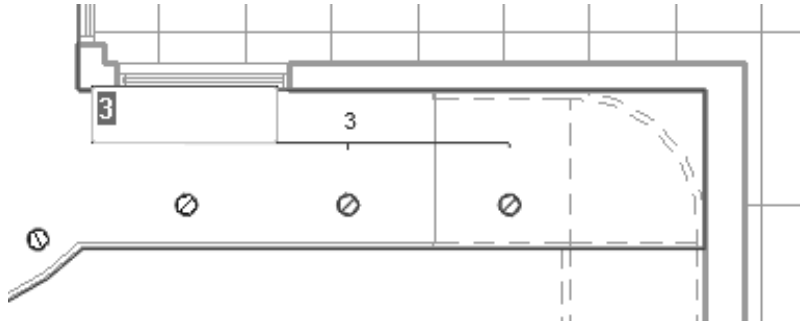


Figure 2–75

- 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 of Figure 2–76) or **Radial Array** (bottom of Figure 2–76).

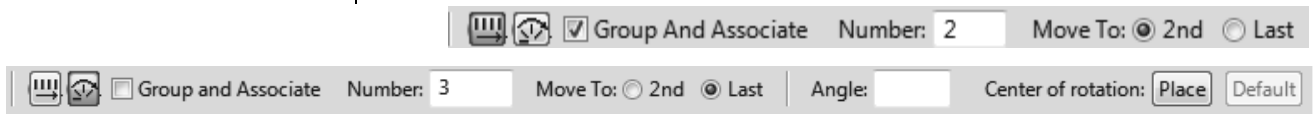





Figure 2–76

Group And Associate	Creates an array group element out of all arrayed elements. The group 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).

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  (Center of Rotation) or use **Place** to move the center of rotation to the appropriate location, as shown in Figure 2-77.

*Remember to set the **Center of Rotation** control first, before specifying the angle.*

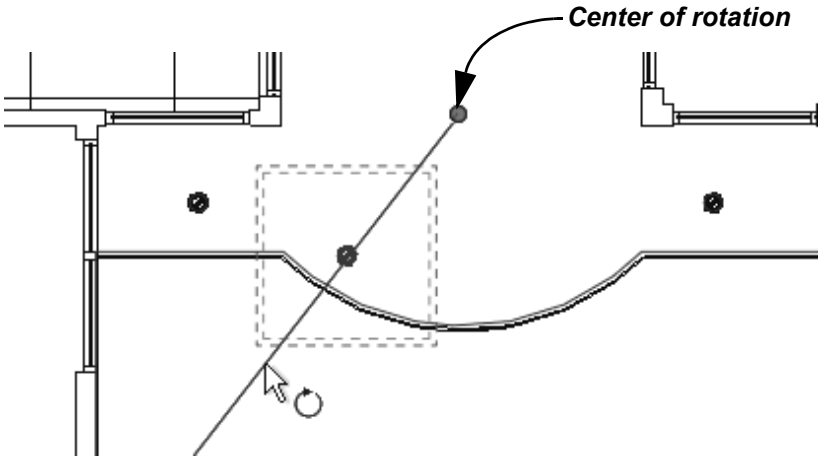


Figure 2-77

5. In the Options Bar, type an angle and press <Enter>, or specify the rotation angle by selecting points on the screen.
6. Specify the other options as needed.

Modifying Array Groups

When you select an element in an array that has been grouped, you can change the number of instances in the array, as shown in Figure 2-78. For radial arrays, you can also modify the distance to the center.

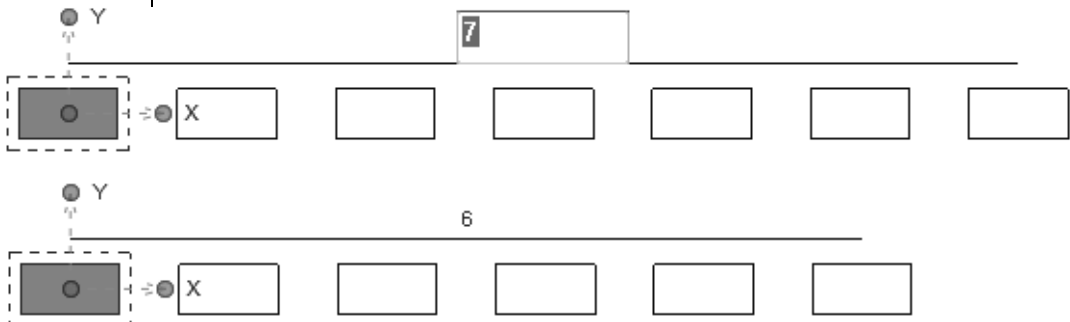


Figure 2-78

- Dashed lines surround the elements in a group, and the XY control lets you move the origin point of the group.

If you move one of the elements in the array group, the other elements move in response based on the distance and/or angle, as shown in Figure 2–79.

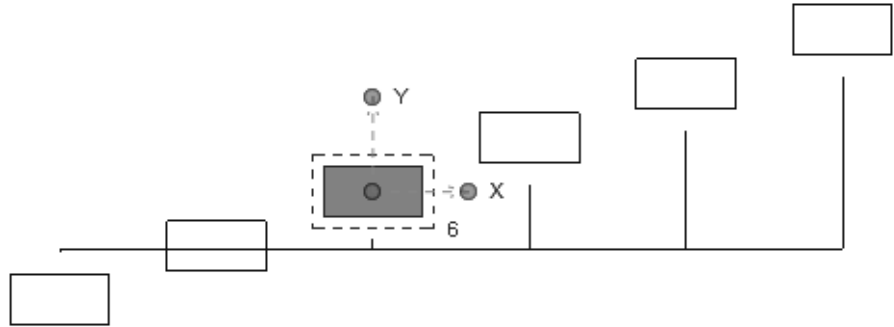





Figure 2–79

- To remove the array constraint on the group, select all of the elements in the array group and, in the *Modify* contextual tab>Group panel, click  (Ungroup).
- If you select an individual element in an array and click  (Ungroup), the element you selected is removed from the array, while the rest of the elements remain in the array group.
- You can use  (Filter) to ensure that you are selecting only **Model Groups**.
- When using an array with MEP objects, you will need to ungroup the objects in order to see the connectors.

Practice 2g


Work with Basic Modify Tools - Mechanical

Practice Objective

- Use the Move and Copy basic modify tools.

In this practice, you will copy air terminals to several rooms and move some so they fit the room logically.

This exercise only covers the Move and Copy tools. For practice using other basic modify tools, you can complete the exercises for the other disciplines.

- For practice using the Copy and Rotate tools, complete *Practice 2h Work with Basic Modify Tools - Electrical*.
 - For practice using the Rotate, Mirror, and Array tools, complete *Practice 2i Work with Basic Modify Tools - Plumbing*.
1. In the practice files *Working Models>Mechanical* folder, open **Mech-Modify.rvt**.
 2. Open the Mechanical>HVAC>Floor Plans>**1 - Mech** view.
 3. Select the four air terminals.
 4. In the *Modify | Air Terminals* tab>Modify panel, click  (Copy).
 5. In the Options Bar, verify that **Multiple** is checked and uncheck **Constraint**.

6. Select the upper-left corners of the following rooms, as shown in Figure 2–80:

- *First point:* **Lab 101**
- *Second point:* **Lab 104**
- *Third point:* **Lab 107**

(You may need to uncheck **Constraint** from the Options Bar for the third point.)

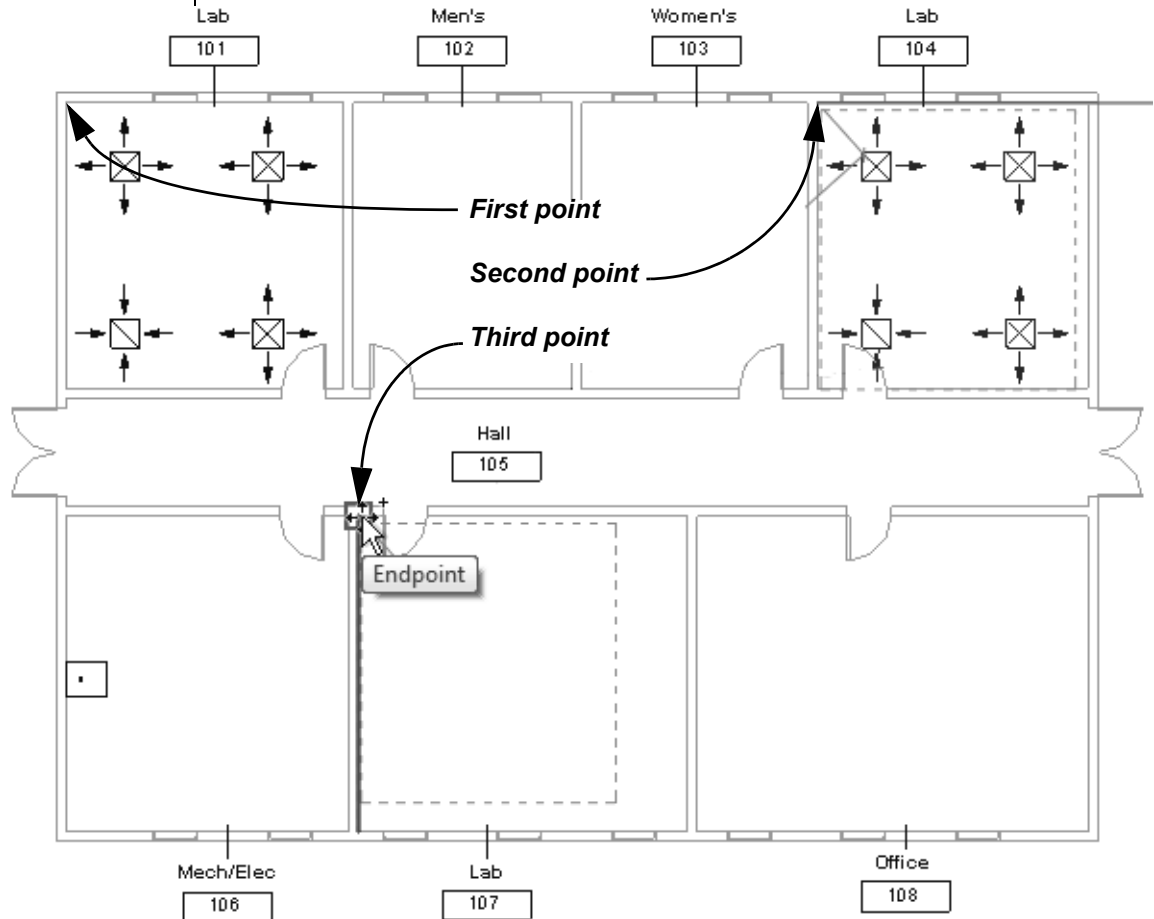




Figure 2–80

7. The air terminals are copied into each room.
8. Click  (Modify).
9. You need to adjust the placement of the air terminals in Lab 107 since the room is the larger than Lab 101. In the *Modify* tab>Modify panel, click  (Move).
10. As there is no current selection, you need to select the elements to move. In **Lab 107**, select the two air terminals on the right and then press <Enter>.

11. Select a base point on one of the air terminals and then use temporary dimensions to move the air terminals **4'-0"** to the right, as shown in Figure 2-81.

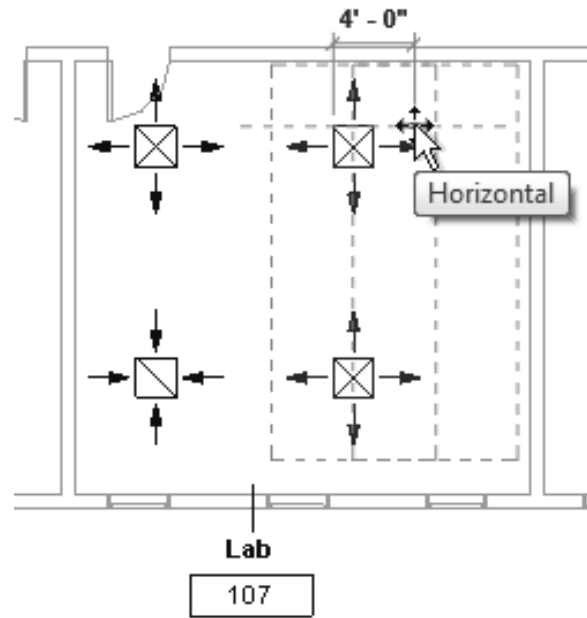



Figure 2-81

12. Click  (Modify) to end the command.
13. Save and close the project.

Practice 2h

Work with Basic Modify Tools - Electrical

Practice Objective

- Use the Copy and Rotate basic modify tools.

In this practice, you will rotate lighting fixtures to fit an angled ceiling grid, as shown in Figure 2–82.

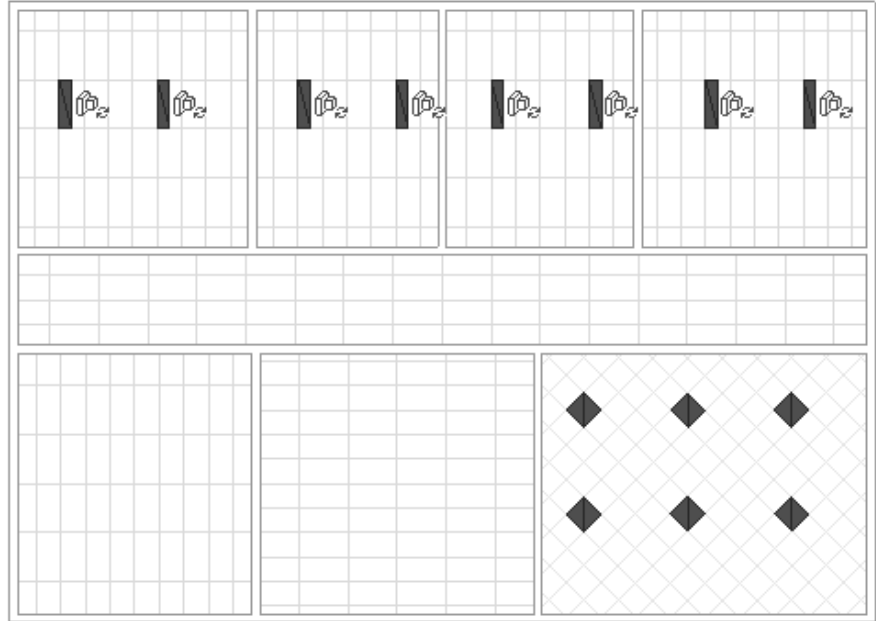
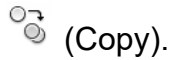


Figure 2–82

This exercise only covers the Copy and Rotate tools. For practice using other basic modify tools, you can complete the exercises for the other disciplines.

- For practice using the Move and Copy tools, complete *Practice 2g Work with Basic Modify Tools - Mechanical*.
 - For practice using the Rotate, Mirror, and Array tools, complete *Practice 2i Work with Basic Modify Tools - Plumbing*.
1. In the practice files *Working Models>Electrical* folder, open **Elec-Modify.rvt**.
 2. Open the Electrical>Lighting>Ceiling Plans>**1 - Ceiling Elec** view.
 3. Select the lighting fixtures.

4. In the *Modify | Lighting Fixtures* tab>Modify panel, click



(Copy).

5. In the Options Bar, verify that **Multiple** is checked and uncheck **Constraint**.
6. Using the ceiling grids, select inside the other rooms on the same side of the hall to copy the lighting fixtures into them in approximately the same position, as shown in Figure 2–83.

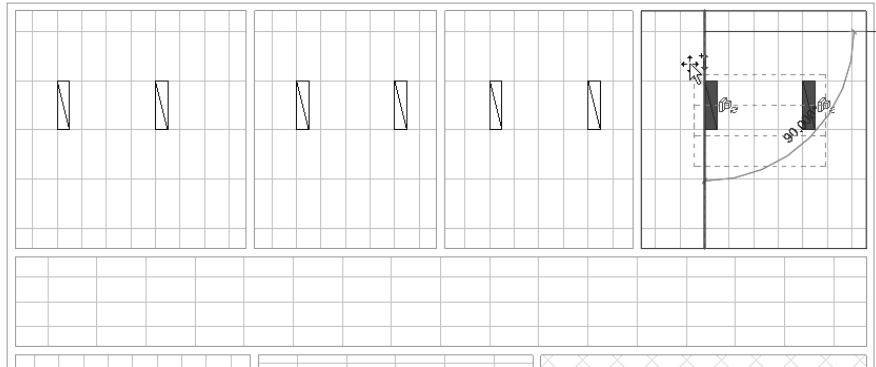




Figure 2–83

7. Press <Esc> twice.
8. Add a **Plain Recessed Lighting Fixture: 2x2 - 277** type lighting fixture to the room with the 45 degree ceiling. (Remember to use **Place on Face**.)
9. Click  (Modify) and select the new square lighting fixture.
10. In the *Modify | Lighting Fixtures* tab>Modify panel, click  (Rotate).
11. In the Options Bar, verify that **Disjoin** is unchecked.

12. Drag the center of rotation control over to the corner of the light, as shown in Figure 2–84.
13. For the rotation's first pick, click when the cursor displays a horizontal line. For the second pick, click on the nearby 45-degree angled line, as shown in Figure 2–85. The fixture now fits in the grid.

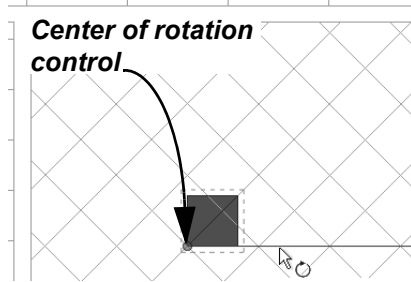


Figure 2–84

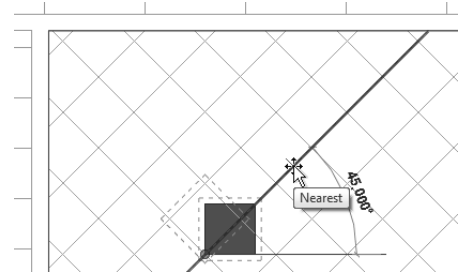



Figure 2–85

14. Copy the fixture to additional places in the room.
15. Click  (Modify) to end the command.
16. Save and close the project.

Practice 2i

Work with Basic Modify Tools - Plumbing

Practice Objective


- Use the Rotate, Mirror, and Array basic modify tools.

In this practice, you will array plumbing fixtures in a restroom and then mirror them to the other restroom.

This exercise only covers the Rotate, Mirror, and Array tools. For practice using other basic modify tools, you can complete the exercises for the other disciplines.

- For practice using the Move and Copy tools, complete *Practice 2g Work with Basic Modify Tools - Mechanical*.
- For practice using the Copy and Rotate tools, complete *Practice 2h Work with Basic Modify Tools - Electrical*.

Note: The model used for this practice has been modified from the last plumbing practice.

1. In the practice files *Working Models>Plumbing* folder, open **Plumb-Modify.rvt**.
2. Open the Plumbing>Floor Plans>**1 - Plumbing** view.
3. Select the water closet (toilet) and lavatory (sink).
4. In the *Modify | Plumbing Fixtures* tab>Modify panel, click  (Array).
5. In the Options Bar, verify that **Group and Associate** is checked, *Number* is set to **2**, and *Move to* is set to **2nd**.

6. Pick the lavatory as the first point and pick a second point **3'-0"** below. You are prompted for the number of elements, as shown in Figure 2–86.
7. Change the array number to **4** and press <Enter>. The additional fixtures are placed, as shown in Figure 2–87.

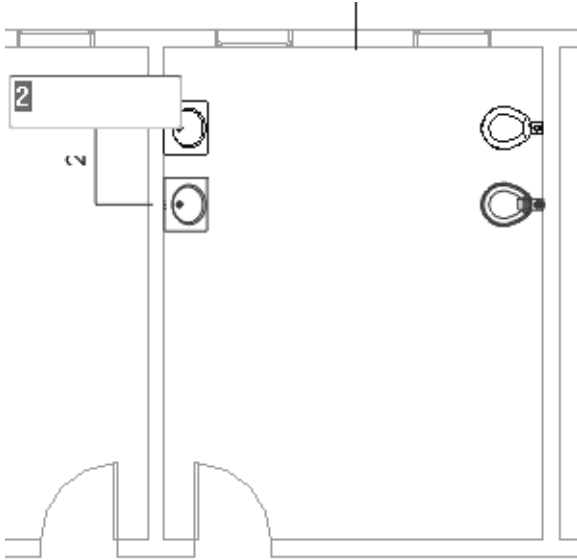


Figure 2–86

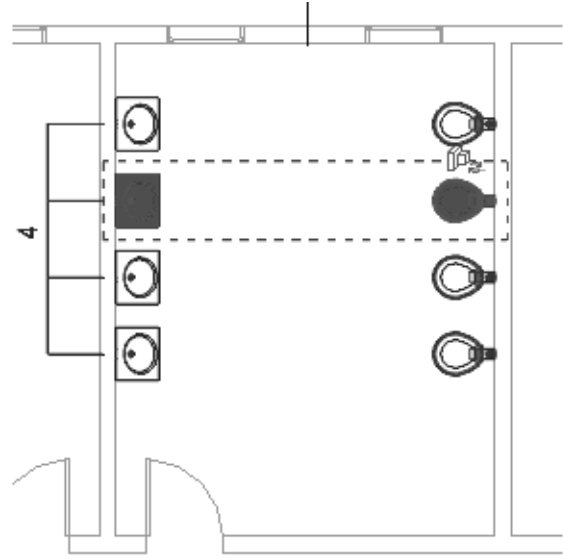






Figure 2–87

8. Click  (Modify) and select all of the fixtures. They are grouped together.
9. In the *Modify | Model Groups* tab>Group panel, click  (Ungroup). Each element can now be moved separately.
10. Click  (Modify) and select all the water closets.
11. In the *Modify | Plumbing Fixtures* tab>Modify panel, click  (Mirror - Pick Axis). In the Options Bar, verify that **Copy** is selected.
12. Hover the cursor on the wall between rooms 102 and 103. The center of the wall should highlight; if not, use <Tab> to cycle through the wall's faces. Select the center of the wall, as shown in Figure 2–88.

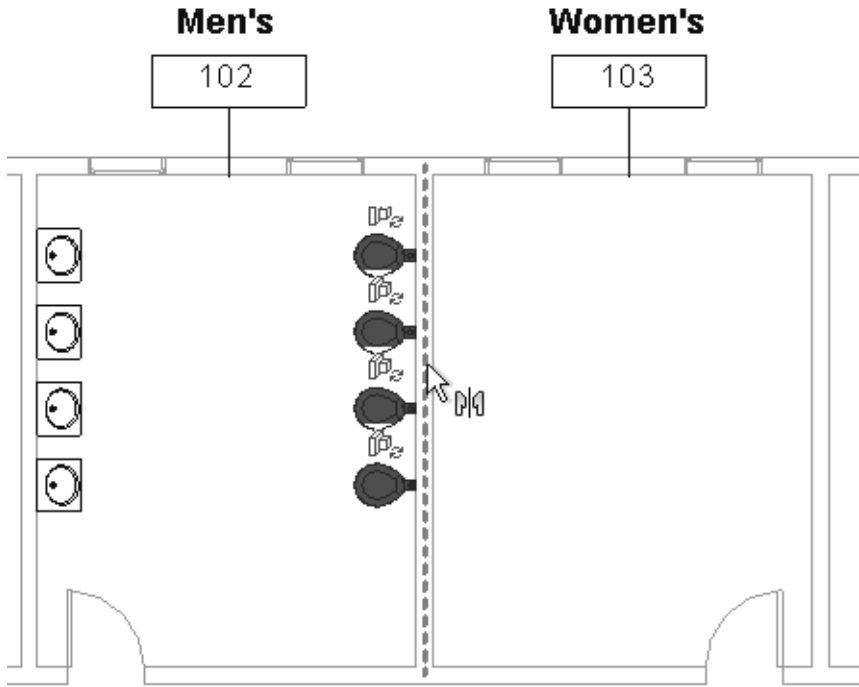



Figure 2-88

Note that mirroring the lavatories reverses the hot and cold water connectors.

- 13. Click in an empty area in the view to clear the selection.
- 14. Select one of the lavatories, right-click, and select **Create Similar**.
- 15. Place the lavatory across from the water closet in the Women's room.
- 16. Click  (Modify). Zoom in to the Women's restroom and select and drag the lavatory into place so it aligns with the water closet, as shown in Figure 2-89.

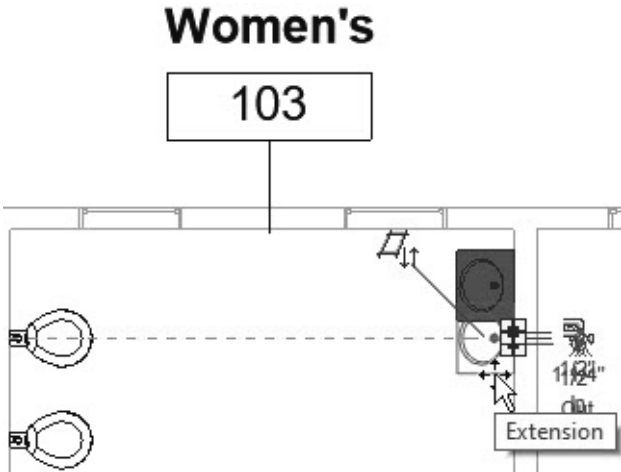



Figure 2-89

17. With the lavatory still selected, start the **Array** command.
18. In the Options Bar, clear the **Group and Associate** option and set the *Number* to **4**. Verify that *Move to* is set to **2nd**.
19. Click a base point on the lavatory's upper left corner, then click a second point **3'-0"** below it. Four lavatories are now placed, which do not need to be ungrouped.
20. Select two of the water closets in Room 102. In the Type selector, change the type to **Urinal - Wall Hung: 3/4" Flush Valve**.
21. Click  (Modify) to end the command.
22. Save and close the project.

2.5 Working with Additional Modify Tools

As you work on a project, some additional tools found in the *Modify* tab>Modify panel (shown in Figure 2–90) can help you with placing, modifying, and constraining elements. **Align** can be used with a variety of elements, while **Split Element**, **Trim/Extend**, and **Offset** can only be used with linear elements.

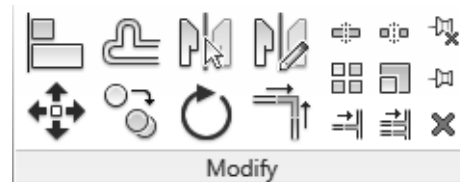


Figure 2–90

Aligning Elements

The **Align** command enables you to line up one element with another, as shown in Figure 2–91. Most Autodesk Revit elements can be aligned. For example, you can line up the tops of windows with the top of a door or line up furniture with a wall.

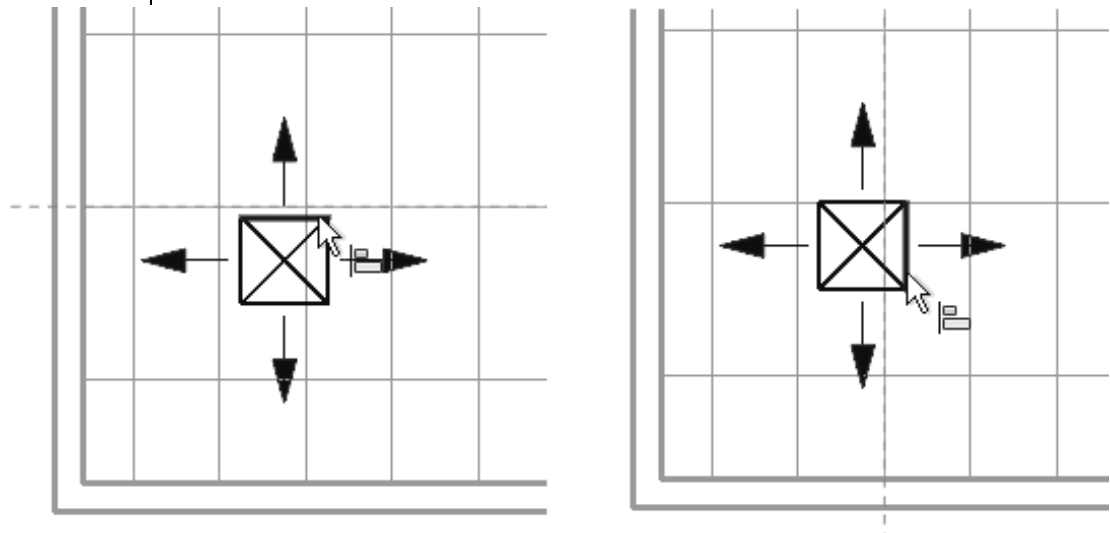



Figure 2–91

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. For walls, press <Tab> to select the correct wall face.

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

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 all model views, including parallel and perspective 3D views.
 - 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 2–92.

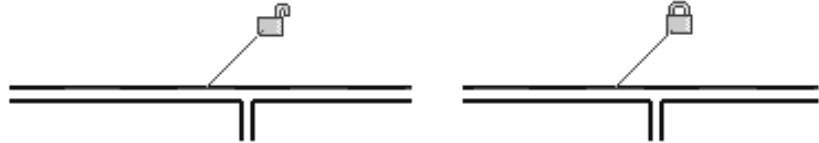


Figure 2–92

- In the Options Bar, select **Multiple Alignment** to select multiple elements to align with the first element. You can also hold <Ctrl> to select multiple elements to align.
- 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 2–93. The core refers to the structural members of a wall as opposed to facing materials, such as sheet rock.

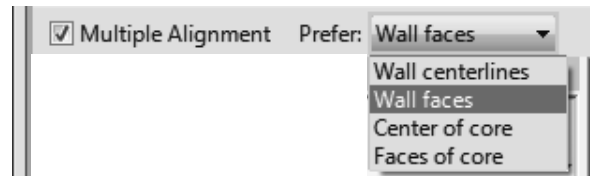


Figure 2–93

Splitting Linear Elements

The **Split Element** command enables you to break a linear element at a specific point. You can use alignment lines, snaps, and temporary dimensions to help place the split point. After you have split the linear element, you can use other editing commands to modify the two parts, or change the type of one part, as shown with walls in Figure 2–94. You can split walls in plan, elevation, or 3D views.

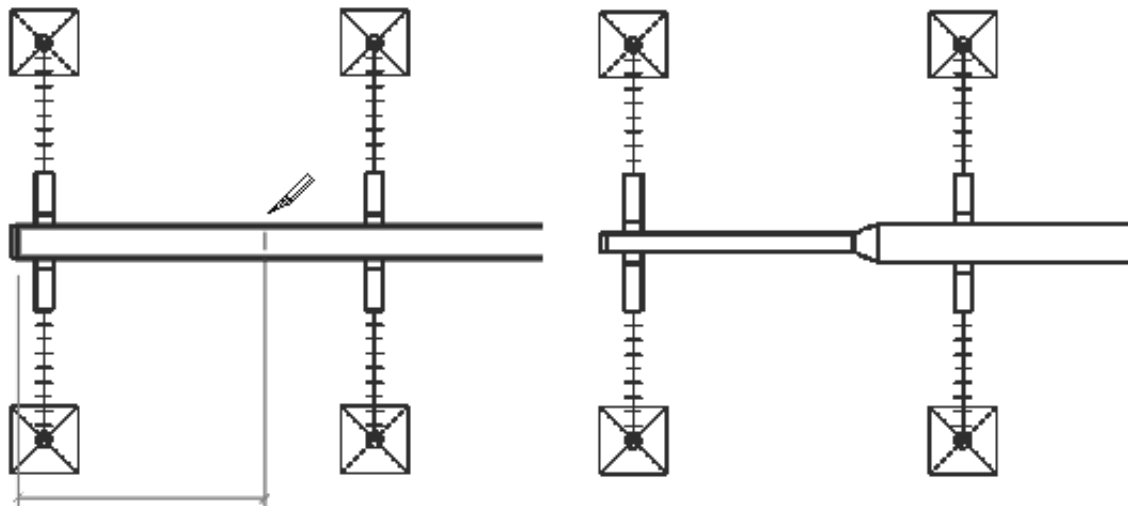




Figure 2-94

- The **Split with Gap** command only works when splitting walls.

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.
 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 elements that were split, as needed.
- The **Delete Inner Segment** option is used when you select two split points along a linear element. When the option is selected, the segment between the two split points is automatically removed.
 - An additional option,  (Split with Gap), splits the linear element at the point you select, as shown in Figure 2-95, but also creates a *Joint Gap* that is specified in the Options Bar.

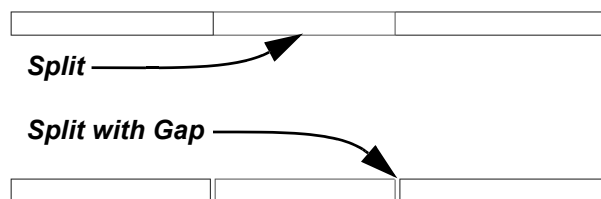



Figure 2-95

Trimming and Extending

There are three trim/extend methods that you can use with linear elements: **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 linear element on the side you want to keep.
3. Select the second linear element on the side you want to keep, as shown in Figure 2–96.

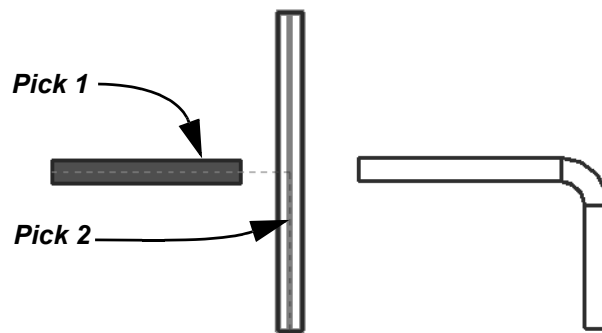



Figure 2–96

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 linear element to be trimmed or extended, as shown in Figure 2–97.

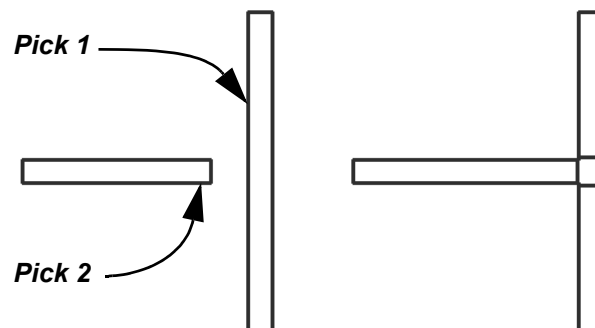



Figure 2–97

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.
3. Select the linear elements that you want to trim or extend by selecting one at a time, or by using a crossing window (as shown in Figure 2–98). For trimming, select the side you want to keep.

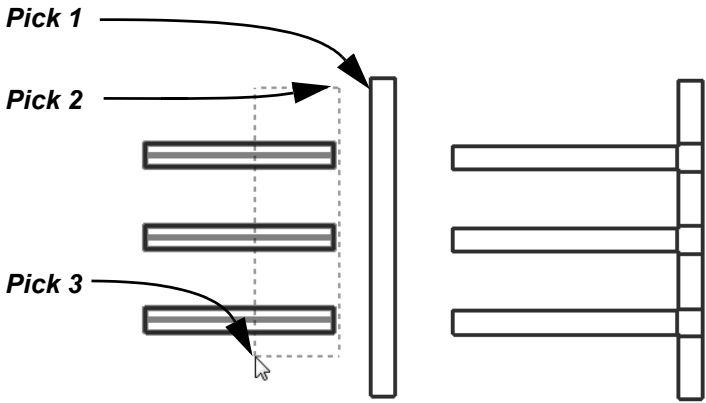


Figure 2–98

- You can click in an empty space in the view 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 2–99. MEP elements can be offset, but you should typically use other tools to create parallel elements, such as ducts, pipes, and conduits.

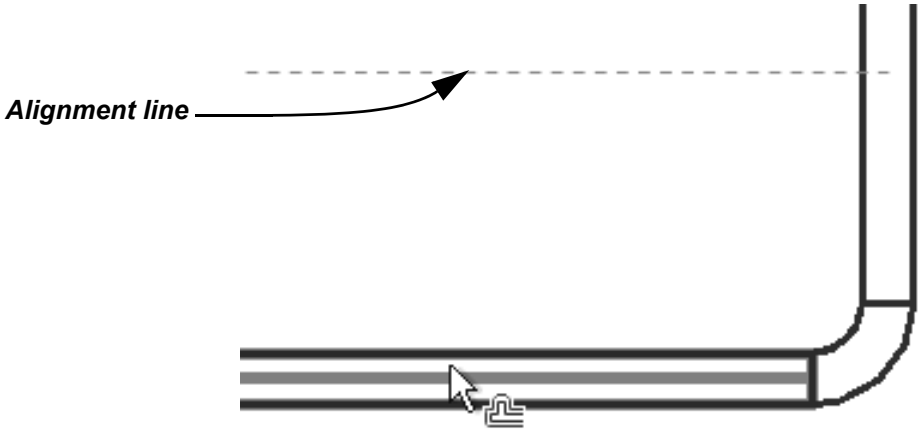


Figure 2–99

The offset distance can be set by typing the distance (**Numerical method**), as shown in Figure 2–100, or by selecting points on the screen (**Graphical method**).

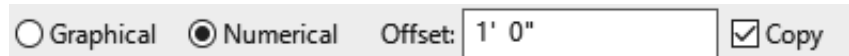



Figure 2–100

How To: Offset Using the Numerical Method

The **Copy** option (which is on by default) makes a copy of the element being offset. If this option is not selected, the **Offset** command moves the element the set offset distance.

The offset is from centerline to centerline of elements, such as ducts or pipes.

Most linear elements connected at a corner automatically trim or extend to meet at the offset distance.

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.
- With the **Numerical** option, you can select multiple connected linear elements for offsetting. Hover the cursor over an element and press <Tab> until the other related elements are highlighted, as shown in Figure 2–101. Select the element to offset all of the elements at the same time.

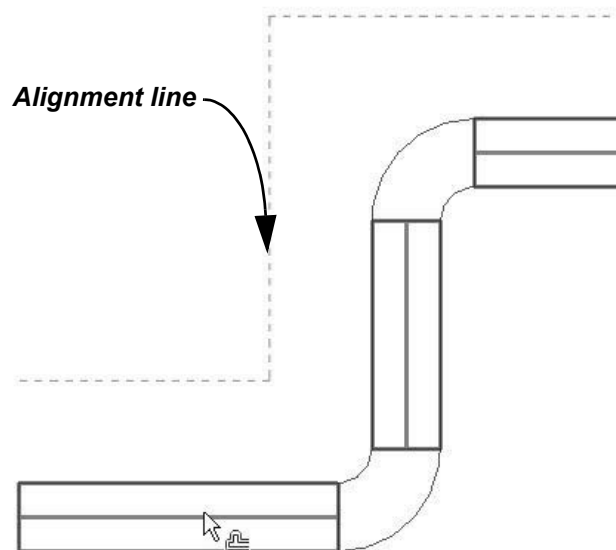




Figure 2–101

How To: Offset Using the Graphical Method

1. In the *Modify* tab>Modify panel, click  (Offset) or type the shortcut **OF**.
2. In the Options Bar, select **Graphical**.
3. Select the linear 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 in the temporary dimension for the second point.

Hint: Using Thin Lines

The software automatically applies line weights to views, as shown for a section on the left in Figure 2–102. If a line weight seems heavy or obscures your work on the elements, toggle off the line weights. In the Quick Access Toolbar or in the *View*

tab>Graphics panel, click  (Thin Lines) or type **TL**. The lines display with the same weight, as shown on the right in Figure 2–102.

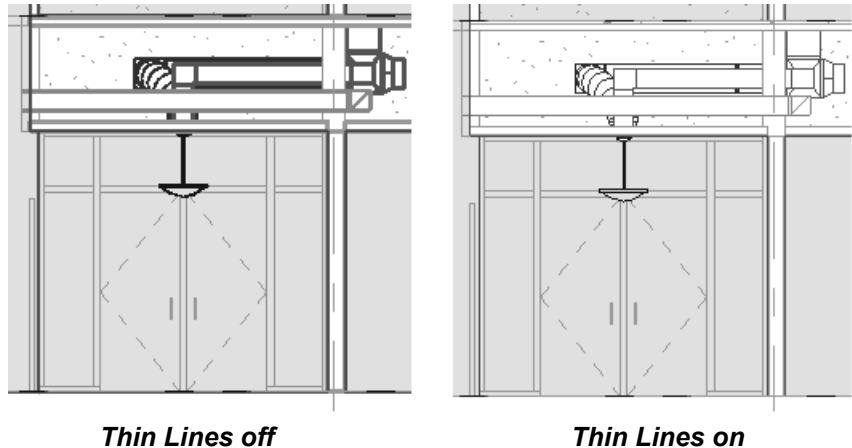


Figure 2–102

- The **Thin Line** setting is remembered until you change it, even if you shut down and restart the software.

Practice 2j

Work with Additional Modify Tools - All Disciplines




Practice Objective

- Use Align, Split, Offset, and Trim/Extend.

In this practice, you will discover and delete excess piping and clean it up with modify tools. You will align air terminals to ceiling grids. Finally you will offset cable trays and use trim/extend commands to link them. You will also split and resize part of the tray.

- Additional linear elements, including pipes and cable trays, have been added to this practice.

Task 1 - Clean up excess piping.

1. In the practice files *Working Models>General* folder, open **Gen-Align.rvt**.
2. Open the Plumbing>Plumbing>3D Views>**3D Plumbing** view. Zoom in on the **Tee - Generic** connection between the water heater and the pipe in the hall.
3. In the View Control Bar, change the *Detail Level* to  (Fine) and the *Visual Style* to  (Shaded) to help display the pipes more clearly.
4. If required, in the Quick Access Toolbar, click  (Thin Lines) to see the piping better.
5. Delete the highlighted pipe, tee, and transition connectors between the pipes, as shown in Figure 2–103.

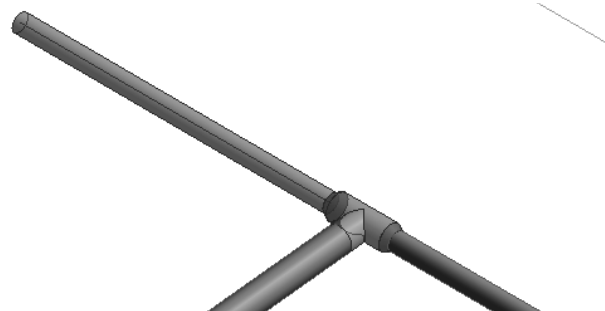



Figure 2–103

6. You need to connect the two pipes, as shown in

Figure 2–104. In the *Modify* tab>Modify panel, click  (Trim/Extend to Corner).

7. Select the smaller 1/2" pipe first and the 3/4" pipe second.

- This is so the elbow connector uses the size of the larger pipe, as shown in Figure 2–105.

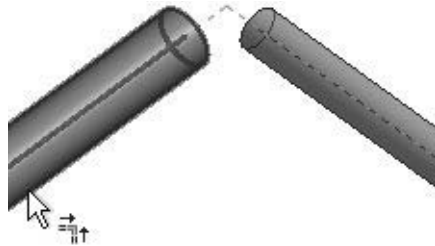



Figure 2–104



Figure 2–105

8. Click  (Modify).

9. Type **ZF** to zoom the model to fit the view.

10. Save the project.

Task 2 - Align air terminals to ceiling grids.

1. Open the Mechanical>HVAC>Ceiling Plans>**1-Ceiling Mech** view.

2. Zoom in on Lab 101.

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

4. Select a vertical grid line and then the side of the air terminal, as shown in Figure 2–106.

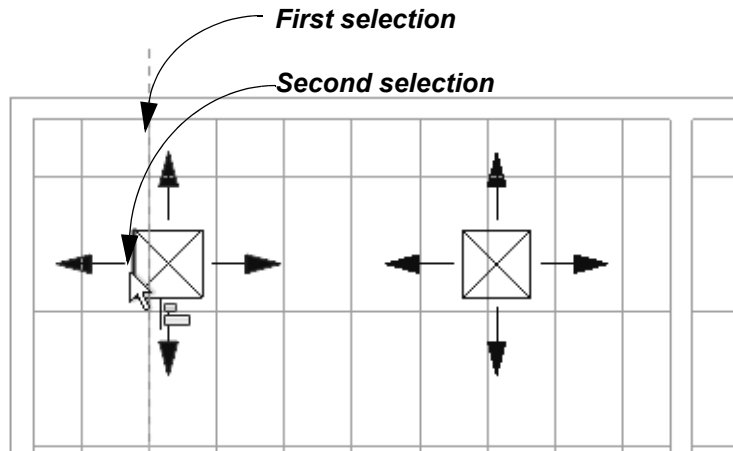


Figure 2–106

5. While still in the **Align** command, in the Options Bar, select **Multiple Alignment**.
6. Without stopping, select the following items in the order listed, as shown in Figure 2–107:
 - Horizontal grid line
 - Horizontal edge of the first air terminal
 - Horizontal edge of the 2nd air terminal

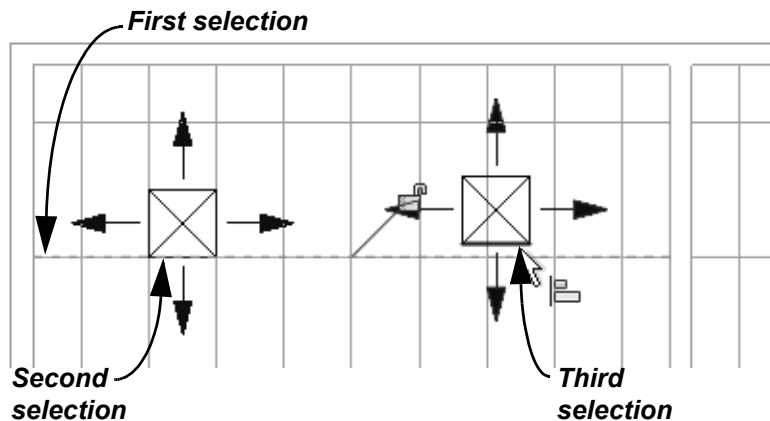


Figure 2–107

7. Click in an empty area in the view. This keeps you in the command but releases the alignment line.

8. Align the other air terminals to the ceiling grid, as shown in Figure 2–108.

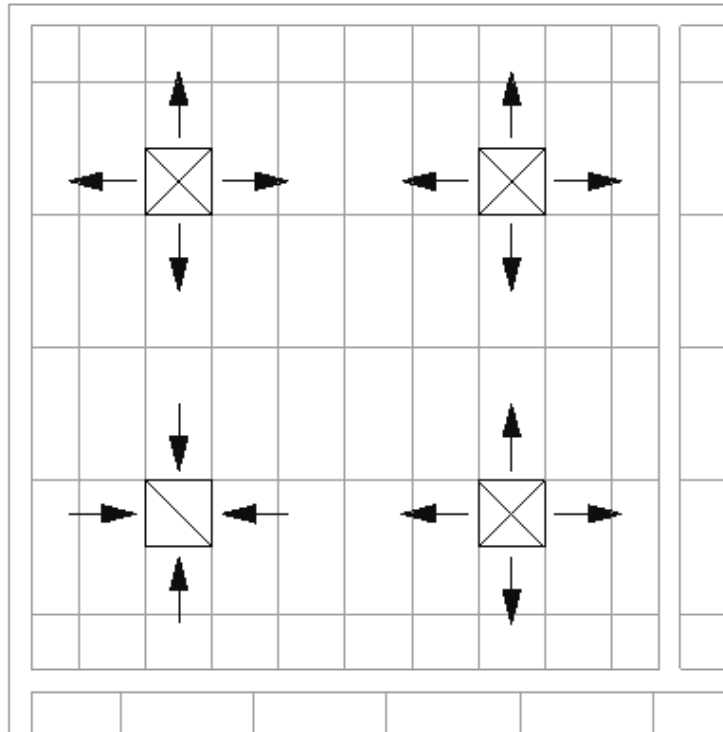



Figure 2–108

9. Use the **Align** tool with or without the multiple alignment (see which works the best for you) to move the air terminals in the other lab rooms.
10. Zoom to fit the view and then save the project.

Task 3 - Offset, trim, and split cable trays.

1. Open the Electrical>Power>Floor Plans>1 - **Power** view. Zoom all if needed.
2. In the *Modify* tab>Modify panel, click  (Offset).
3. In the Options Bar, select **Numerical**, set the *Offset* to **15'-0"**, and ensure that **Copy** is selected.

4. Hover the cursor over the vertical cable tray and ensure that the alignment line is to the right, as shown in Figure 2–109. Click to create the copy.

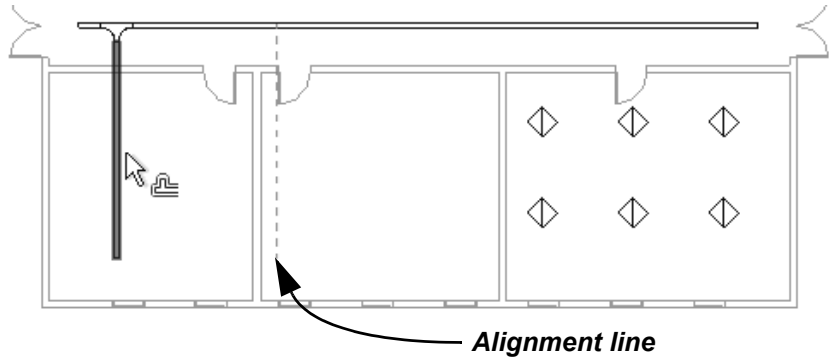


Figure 2–109

5. Select the cable tray in the Mech/Elec 106 room (ensuring that the offset is to the right) and continue until there are five total runs, as shown in Figure 2–110.

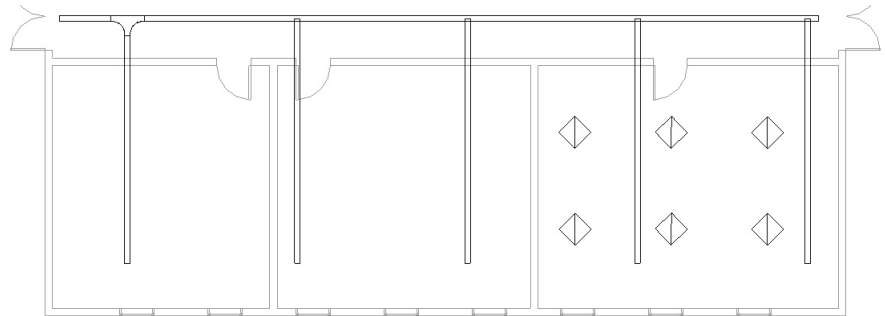




Figure 2–110

6. Click  (Modify).
7. In the *Modify* tab>Modify panel, click  (Trim/Extend Multiple Elements).
8. Select the cable tray running down the hall and then draw a crossing window from right to left, as shown in Figure 2–111.

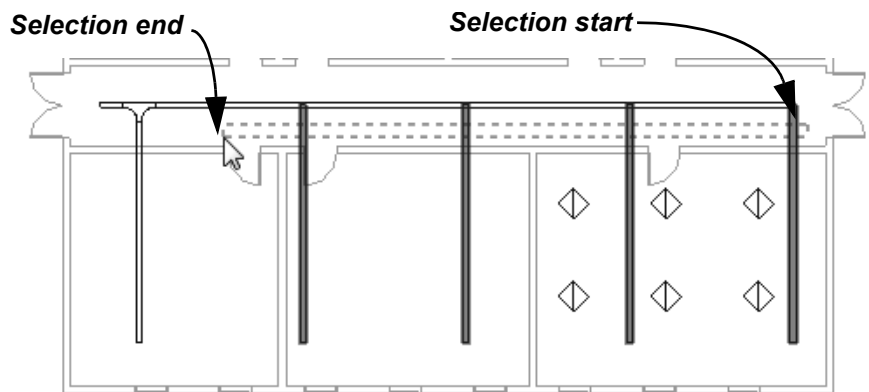



Figure 2–111

9. The cable trays are extended and fittings applied, as shown in Figure 2–112. The last cable tray does not clean up, use the  (Trim/Extend to Corner) command to finish it.

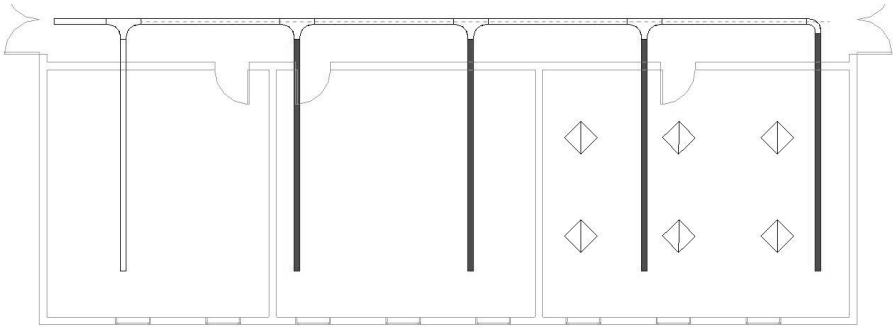



Figure 2–112

10. Click  (Modify).

11. In the *Modify* tab>Modify panel, click  (Split Element).

12. On the cable tray in the Mech/Elec 106 room, select the point on the vertical cable tray shown in Figure 2–113. The cable tray is split and a fitting is applied.

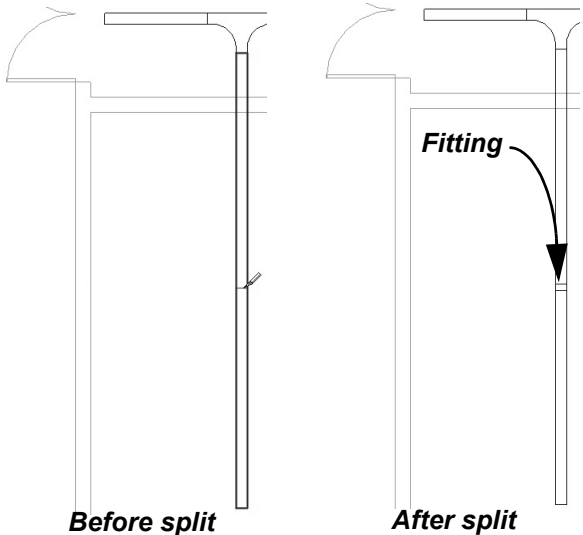


Figure 2–113




13. Click  (Modify) and select the lower part of the tray. In the Options Bar, change the *Width* to **4"**. The size changes and the fitting is applied, as shown in Figure 2–114.









Figure 2–114



















- Note: You will learn how to justify cable trays in *Section 10.5 Adding Cable Trays and Conduit*.
14. Save and close the project.




















Chapter Review Questions









1. What is the purpose of an alignment line?
 - a. Displays when the new element you are placing or modeling is aligned with the grid system.
 - b. Indicates that the new element you are placing or modeling is aligned with an existing element.
 - c. Displays when the new element you are placing or modeling is aligned with a selected tracking point.
 - d. Indicates that the new element is aligned with true north rather than project north.
2. Which of the following commands imports a component that is not available in your project?
 - a. **Load Family**
 - b. **Load Equipment**
 - c. **Load Component**
 - d. **Load Fixture**
3. How do you select all lighting fixture of various sizes, but no other elements in a view?
 - a. In the Project Browser, select the *Lighting Fixtures* category.
 - b. Select one lighting fixture, right-click, and select **Select All Instances>Visible in View**.
 - c. Select all of the elements in the view and use  (Filter) to clear the other categories.
 - d. Select one lighting fixture and click  (Select Multiple) in the ribbon.
4. What are the two methods for starting commands such as **Move, Copy, Rotate, Mirror, and Array**?
 - a. Start the command from the *Modify* tab and select the element.
 - b. Select the element, then start the command from the *Modify* tab.
 - c. Select the element, right-click, and select the command from the list.

5. Where do you change the type for a selected plumbing fixture?
 - a. In the *Modify | Plumbing Fixtures* tab>Properties panel, click  (Type Properties) and select a new type in the dialog box.
 - b. In the Options Bar, click **Change Element Type**.
 - c. Select the dynamic control next to the selected plumbing fixture and select a new type in the drop-down list.
 - d. In Properties, select a new type in the Type Selector drop-down list.
6. Both **Rotate** and **Array with Radial** have a center of rotation that defaults to the center of the element or group of elements you have selected. How do you move the center of rotation to another point? (Select all that apply.)
 - a. Select the center of rotation and drag it to a new location.
 - b. In the Options Bar, click **Place** and select the new point.
 - c. In the *Modify* tab>Placement panel, click  (Center) and select the new point.
 - d. Right-click and select **Snap Overrides>Centers** and select the new point.
7. Which command would you use to break part of a duct so that you can change the duct type?
 - a.  (Align)
 - b.  (Split)
 - c.  (Trim)
 - d.  (Offset)

Command Summary

Button	Command	Location
Draw Tools		
	Center-ends Arc	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> (various linear elements) tab>Draw panel
	Circle	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> (various linear elements) tab>Draw panel
	Circumscribed Polygon	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> (various linear elements) tab>Draw panel
	Ellipse	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> <i>Place Lines, Place Detail Lines, and various boundary sketches</i> tab>Draw panel
	Ellipse Arc	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> <i>Place Lines, Place Detail Lines, and various boundary sketches</i> tab>Draw panel
	Fillet Arc	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> (various linear elements) tab>Draw panel
	Inscribed Polygon	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> (various linear elements) tab>Draw panel
	Line	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> (various linear elements) tab>Draw panel
	Pick Faces	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> <i>Place Wall</i> tab> Draw panel
	Pick Lines	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> (various linear elements) tab>Draw panel
	Pick Walls	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> (various boundary sketches) tab>Draw panel
	Rectangle	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> (various linear elements) tab>Draw panel
	Spline	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> <i>Place Lines, Place Detail Lines, and various boundary sketches</i> tab>Draw panel
	Start-End-Radius Arc	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> (various linear elements) tab>Draw panel
	Tangent End Arc	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> (various linear elements) tab>Draw panel
Modify Tools		
	Align	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Modify panel • Shortcut: AL
	Array	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Modify panel • Shortcut: AR
	Copy	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Modify panel • Shortcut: CO

	Copy to Clipboard	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Clipboard panel • Shortcut: <Ctrl>+<C>
	Delete	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Modify panel • Shortcut: DE
	Mirror - Draw Axis	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Modify panel • Shortcut: DM
	Mirror - Pick Axis	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Modify panel • Shortcut: MM
	Move	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Modify panel • Shortcut: MV
	Offset	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Modify panel • Shortcut: OF
	Paste	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Clipboard panel • Shortcut: <Ctrl>+<V>
	Pin	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Modify panel • Shortcut: PN
	Rotate	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Modify panel • Shortcut: RO, R3
	Scale	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Modify panel • Shortcut: RE
	Split Element	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Modify panel • Shortcut: SL
	Split with Gap	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Modify panel
	Trim/Extend Multiple Elements	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Modify panel
	Trim/Extend Single Element	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Modify panel
	Trim/Extend to Corner	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Modify panel • Shortcut: TR
	Unpin	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Modify panel • Shortcut: UP
Select Tools		
	Drag elements on selection	<ul style="list-style-type: none"> • Ribbon: All tabs>expanded Select panel • Status Bar
	Filter	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> <i>Multi-Select</i> tab>Filter panel • Status Bar
	Select Elements By Face	<ul style="list-style-type: none"> • Ribbon: All tabs>expanded Select panel • Status Bar

	Select Links	<ul style="list-style-type: none"> • Ribbon: All tabs>expanded Select panel • Status Bar
	Select Pinned Elements	<ul style="list-style-type: none"> • Ribbon: All tabs>expanded Select panel • Status Bar
	Select Underlay Elements	<ul style="list-style-type: none"> • Ribbon: All tabs>expanded Select panel • Status Bar
Additional Tools		
	Aligned Dimension	<ul style="list-style-type: none"> • Ribbon: <i>Modify</i> tab>Measure panel • Quick Access Toolbar
	Component	<ul style="list-style-type: none"> • Ribbon: <i>Architecture/Structure/Systems</i> tab • Shortcut: CM
	Detail Line	<ul style="list-style-type: none"> • Ribbon: <i>Annotate</i> tab>Detail panel • Shortcut: DL
	Model Line	<ul style="list-style-type: none"> • Ribbon: <i>Architecture</i> tab>Model panel • Shortcut: LI
	Reference Plane	<ul style="list-style-type: none"> • Ribbon: <i>Architecture/Structure/Systems</i> tab>Work Plane panel

