Autodesk®

Revit® 2018 Architecture Fundamentals

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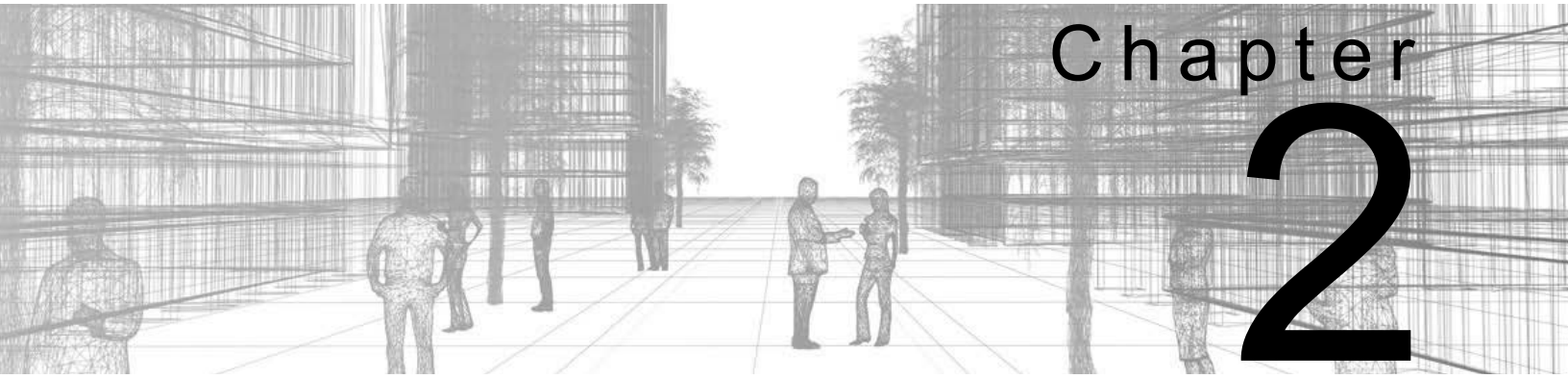


Chapter 2

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, permanent dimensions, and snaps.
- Place Reference Planes as temporary guide lines.
- 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 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.

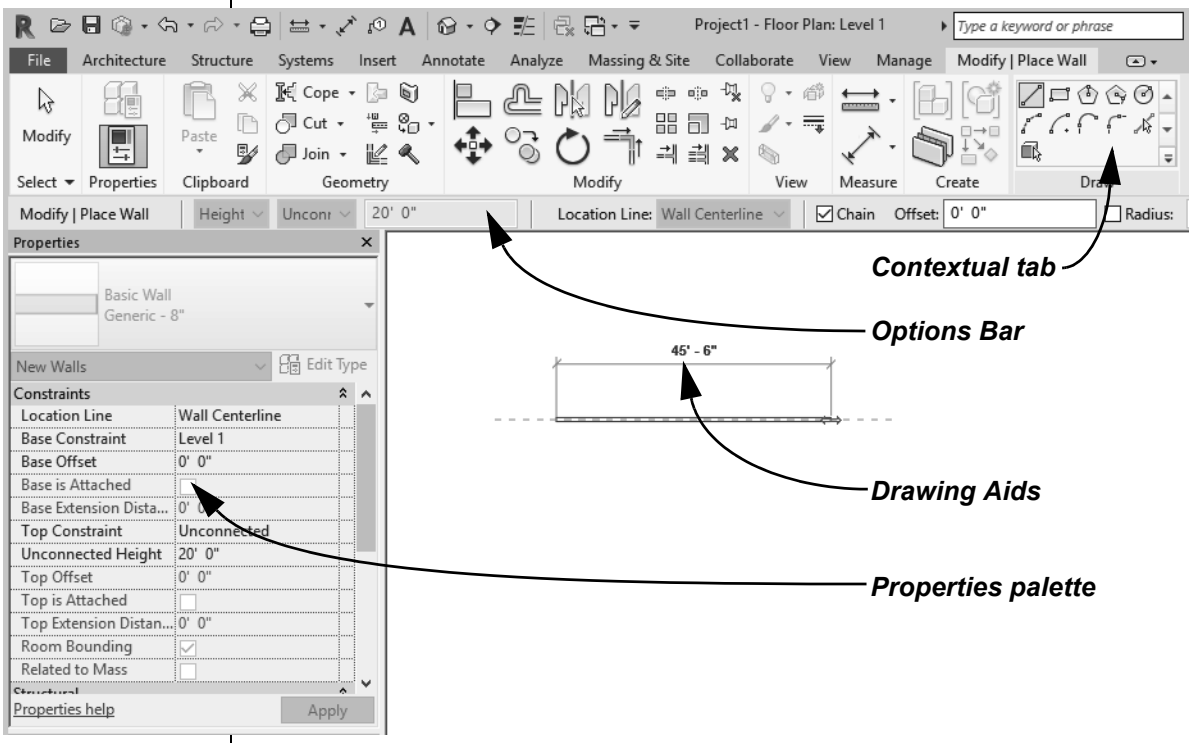


Figure 2–1

- 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, as shown for walls in Figure 2–1. 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.

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, as shown in Figure 2–2, select a drawing tool.
3. Select points to define the elements.

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

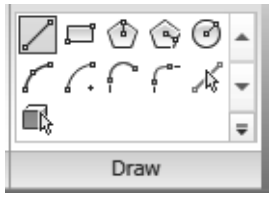


Figure 2–2

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.

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

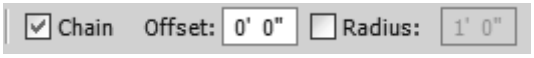


Figure 2–3

- **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. The curve does not actually touch the points (Model and Detail Lines only).
	**Ellipse**	Draws an ellipse from a primary and secondary axis (Model and Detail Lines only).
	**Partial Ellipse**	Draws only one side of the ellipse, like an arc. A partial ellipse also has a primary and secondary axis (Model and Detail Lines only).

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.).

Drawing Aids

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

- Alignment lines
- Temporary dimensions
- Snaps

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

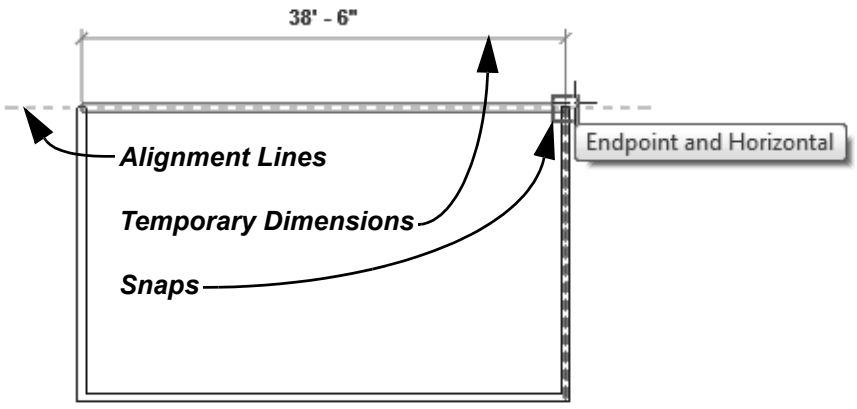


Figure 2–4

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 degree angles only).

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

- You can type in the dimension and then move the cursor until you see the dimension you want, or you can place the element and then modify the dimension as required.
- 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 control shown in Figure 2–5.

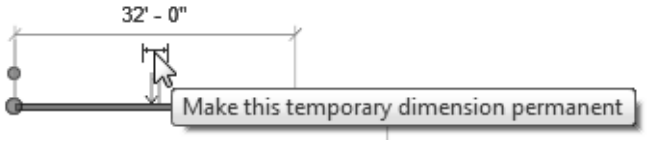


Figure 2–5

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.

Hint: Snap Settings and Overrides

In the *Manage* tab>Settings panel, click (Snaps) to open the Snaps dialog box, which is shown in Figure 2–7. 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).

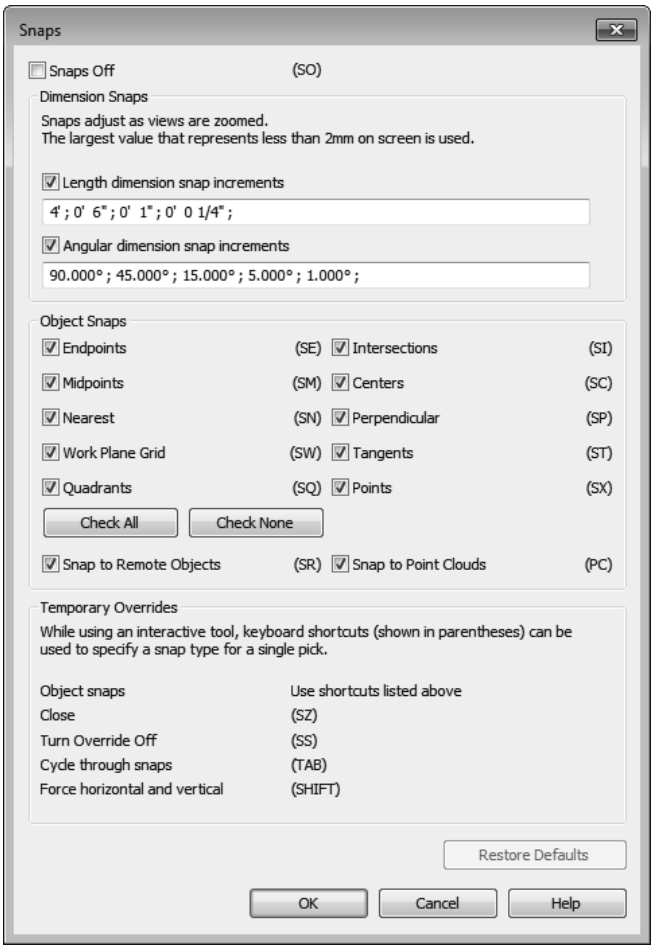


Figure 2–7

- 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.

Using Dimensions as Drawing Aids

Dimensions are a critical part of construction documents that can also help you create the elements in your model. There are a variety of dimension types, but the most useful is **Aligned Dimension** with the *Individual References* option.

How To: Add Aligned Dimensions to Individual References

1. In the Quick Access Toolbar or the *Modify* tab>Measure panel, click (Aligned Dimension), or type **DI**.
2. Select the elements in order.
3. To position the dimension string, click a point at the location where you want it to display, ensuring that the string is not overlapping anything else, as shown in Figure 2–8.

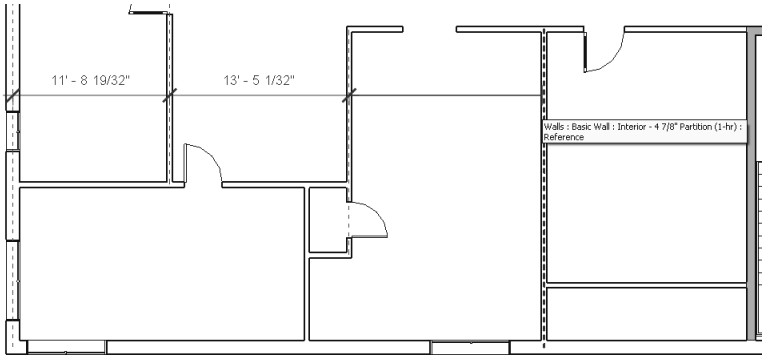


Figure 2–8

Hint: Setting Dimensions Equal

Using dimensions while you are modeling enables you to set a string of dimensions so that they are equal. Doing this updates the model elements, such as the location of windows in a wall, as shown in Figure 2–9.

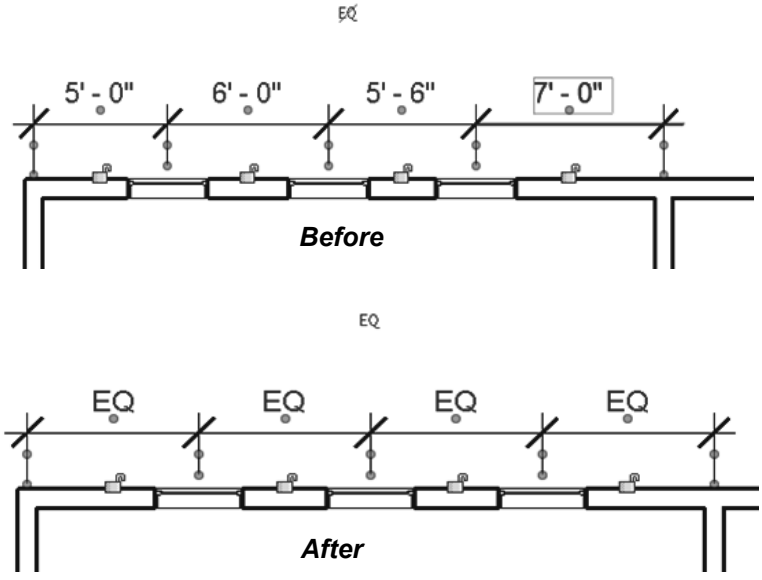


Figure 2–9

Reference Planes

As you develop designs in the Autodesk Revit software, 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 2–10, the lighting fixtures in the reflected ceiling plan are placed using reference planes.

Reference planes do not display in 3D views.

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

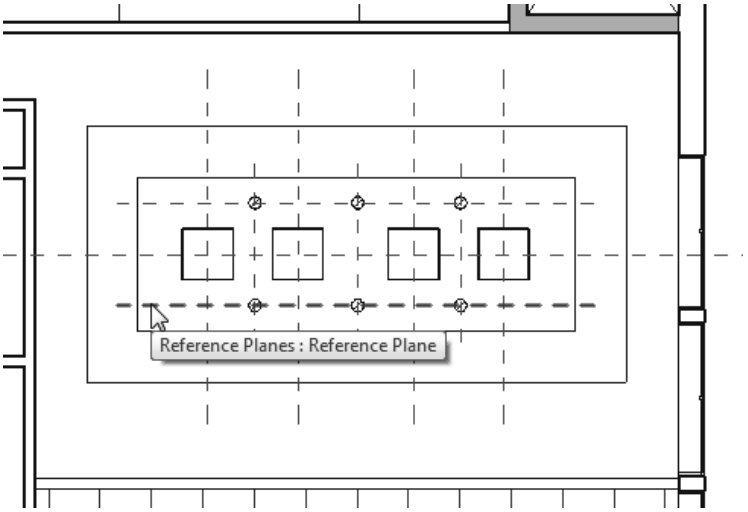


Figure 2–10

- Reference planes display in associated views because they are infinite planes, and not just lines.
- You can name Reference planes by clicking on **<Click to name>** and typing in the text box, as shown in Figure 2–11.

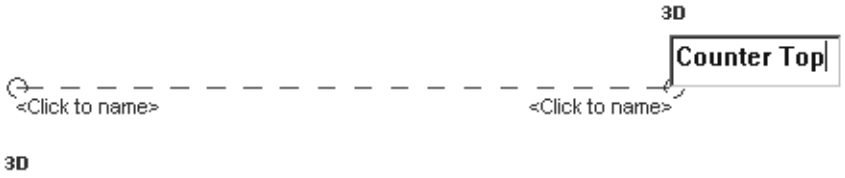


Figure 2–11

- If you sketch a reference pane 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 Lines vs. Detail Lines

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 2–12) or model lines. Detail lines are also useful as references because they are only reflected in the view in which you sketch them.

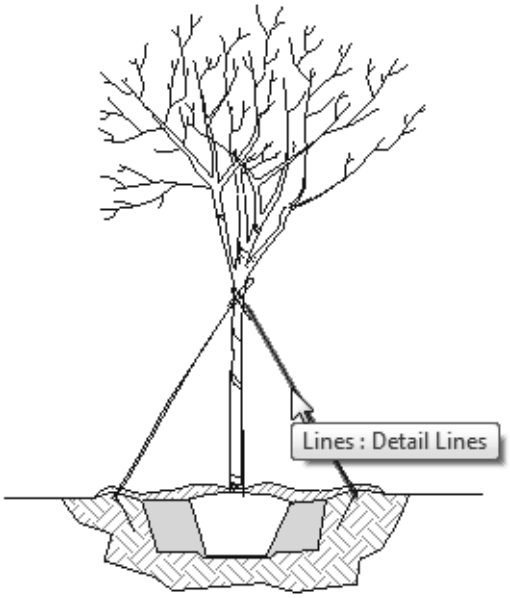


Figure 2–12

- Model Lines (*Architecture* or *Structure* tab>Model panel (Model Line)) function as 3D elements and display in all views.
- Detail Lines (*Annotate* tab>Detail panel> (Detail Lines) are strictly 2D elements that only display in the view in which they are drawn.
- In the *Modify* contextual tab, select a Line Style and then the Draw tool that you want to use to draw the model or detail line.

2.2 Editing Elements

Building design projects typically involve extensive changes to the model. The Autodesk Revit software was designed to make such changes quickly and efficiently. You can change an element using the following methods, as shown in Figure 2–13:

- 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 (not shown) enable you to drag elements to modify their height or length.

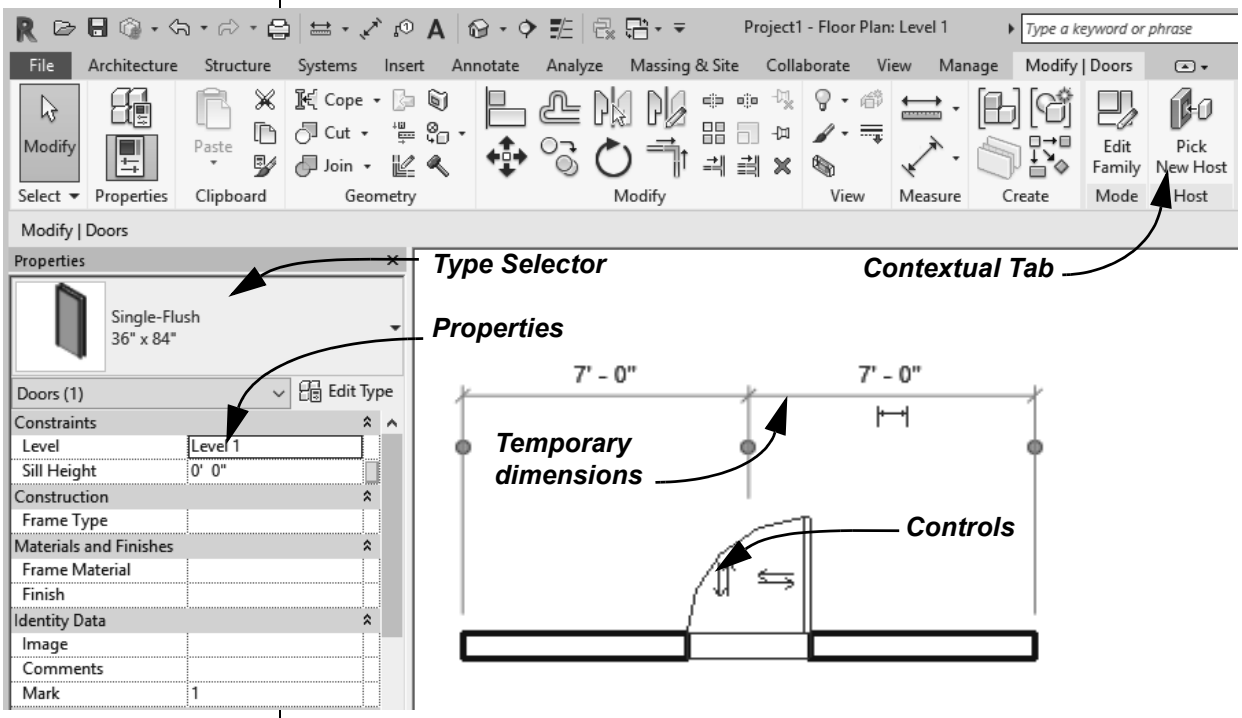


Figure 2–13

- 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 Shape Handles

When you select an element, various controls and shape handles display depending on the element and view. For example, in plan view you can use controls to drag the ends of a wall and change its orientation. You can also drag the wall ends in a 3D view, and you can also use the arrow shape handles to change the height of the wall, as shown in Figure 2–14

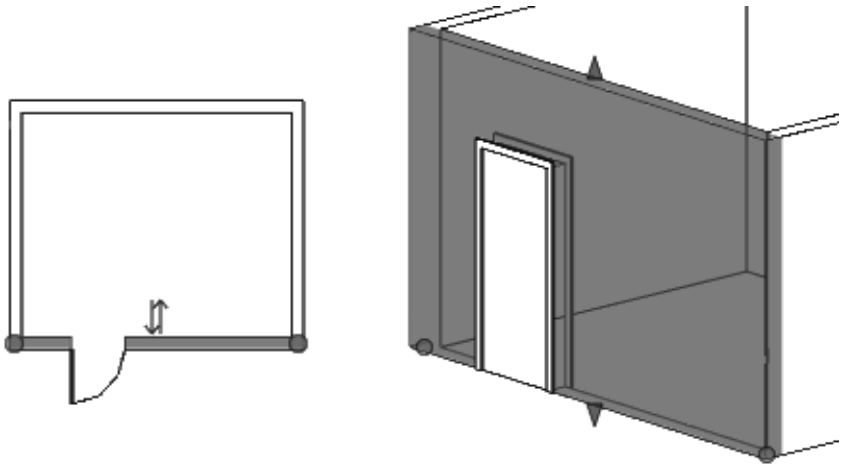


Figure 2–14

- If you hover the cursor over the control or shape handle, a tool tip displays showing its function.

Hint: Editing Temporary Dimensions

Temporary dimensions automatically link to the closest wall. To change this, drag the *Witness Line* control (as shown in Figure 2–15) to connect to a new reference. You can also click on the control to toggle between justifications in the wall.

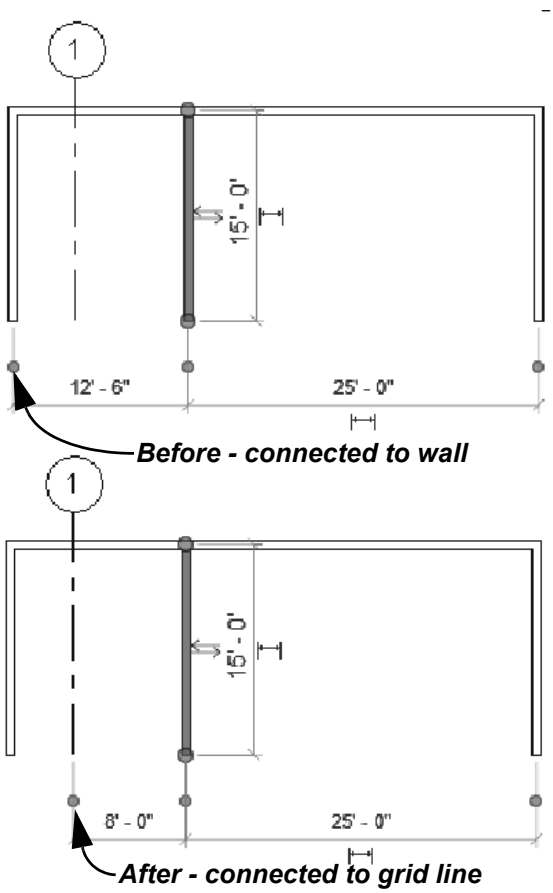
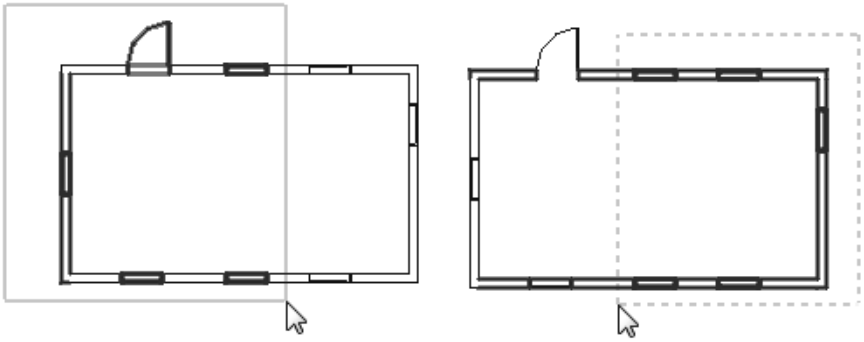


Figure 2–15

- 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

- 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 2–16. 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.



Window: Left to Right ***Crossing: Right to Left***

Figure 2–16

- If several elements are on or near each other, press <Tab> to cycle through them before you click. If there are elements that might be linked to each other, such as walls that are connected, pressing <Tab> selects the chain of elements.
- Press <Ctrl>+<Left Arrow> to reselect the previous selection set. You can also right-click in the 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 2–17.

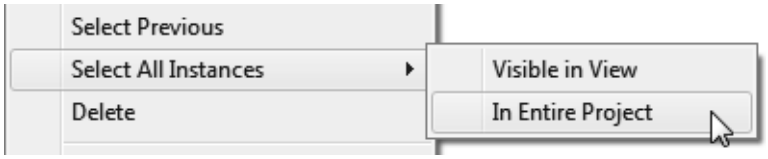


Figure 2–17

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 on the *Modify* tab> Measure panel, as shown in Figure 2–18.

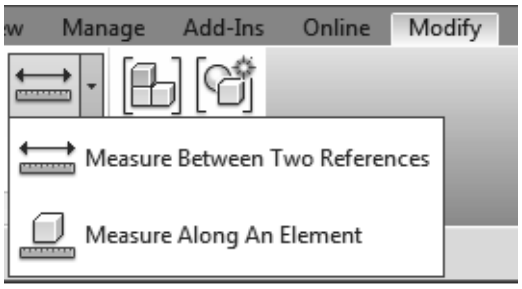


Figure 2–18

- (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 select other elements and then click to measure along all of them, as shown in Figure 2–19.

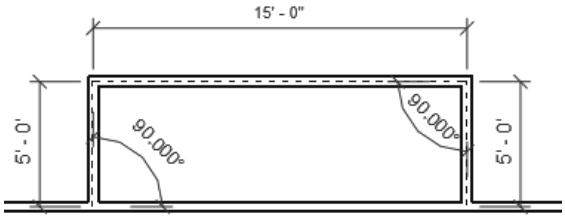


Figure 2–19

- 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 columns, as shown in Figure 2–20.

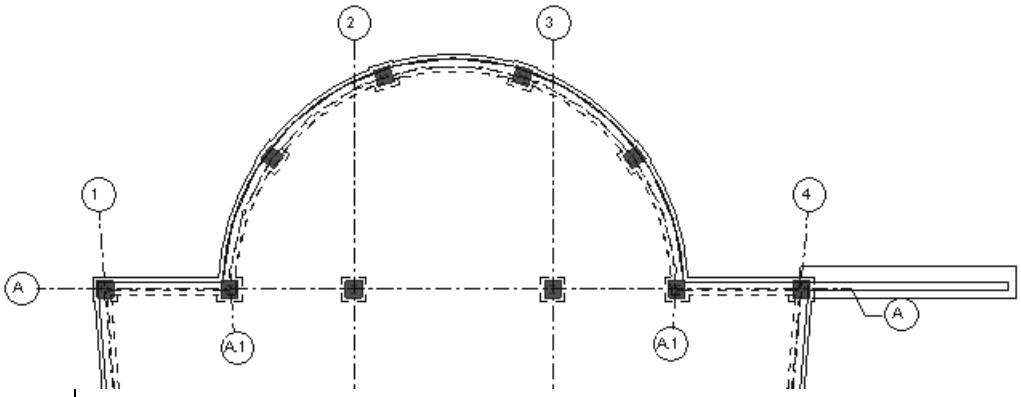


Figure 2–20

How To: Filter a Selection Set

1. Select everything in the required 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 2–21.

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

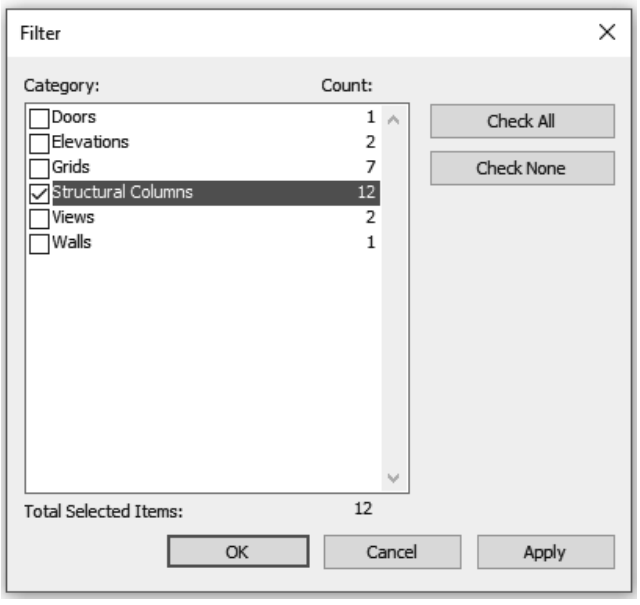


Figure 2–21

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 required.

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 the Properties palette.
- Clicking **Filter** in the Status Bar also opens the Filter dialog box.

Hint: Selection Options

You can control how the software selects specific elements in a project by toggling Selection Options on and off on the Status Bar, as shown in Figure 2–22. Alternatively, in any tab on the ribbon, expand the Select panel's title and select the option.

Figure 2–22

- **Select links:** When toggled on, you can selected linked CAD drawings or Autodesk Revit models. When it is toggled off you cannot select them when using **Modify** or **Move**.
- **Select underlay elements:** When toggled on, you can select underlay elements. When toggled off, you cannot select them when using **Modify** or **Move**.
- **Select pinned elements:** When toggled on, you can selected pinned elements. When toggled off, you cannot select them 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 2a

Estimated time for completion: 10 minutes

Sketch and Edit Elements

Practice Objective

- Use sketch tools and drawing aids.

In this practice you will use the **Wall** command along with sketching tools and drawing aids, such as temporary dimensions and snaps. You will use the **Modify** command and modify the walls using grips, temporary dimensions, the Type Selector, and Properties. You will add a door and modify it using temporary dimensions and controls. The completed model is shown in Figure 2–23.

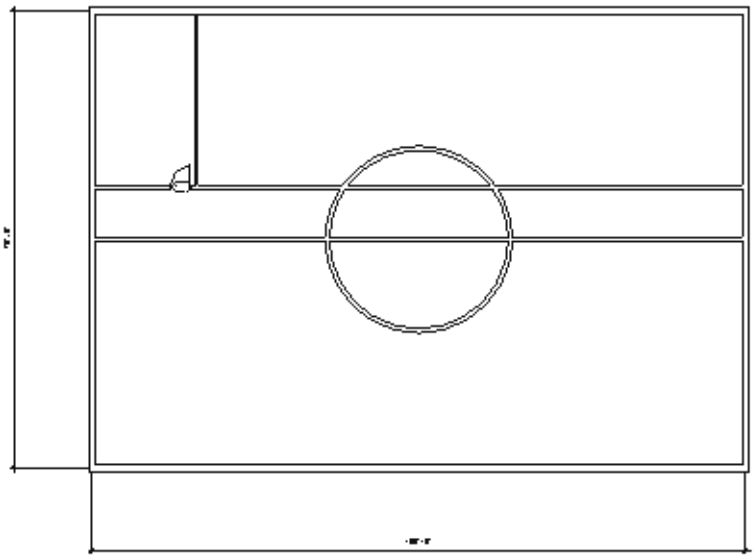


Figure 2–23

Task 1 - Draw and modify walls.

1. In the *File Tab*, click (New)> (Project).
2. In the New Project dialog box, select **Architectural Template** in the Template file drop-down list, and click **OK**.
3. In the Quick Access Toolbar, click (Save). When prompted, name the project **Simple Building.rvt**.
4. In the *Architecture* tab>Build panel, click (Wall).

5. In the *Modify* | *Place Wall* tab>Draw panel, click

   (Rectangle) and sketch a rectangle approximately **100’ x 70’**. You do not have to be precise because you can change the dimensions later.

6. Note that the dimensions are temporary. Select the vertical dimension text and type **70’ 0"**, as shown in Figure 2–24. Press <Enter>.

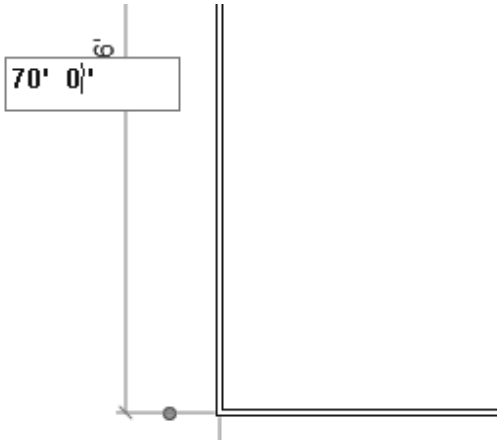


Figure 2–24

7. The dimensions are still displayed as temporary. Click the dimension controls of both the dimensions to make them permanent, as shown in Figure 2–25.

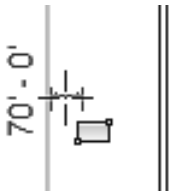


Figure 2–25

   - You will change the horizontal wall dimension using the permanent dimension.

8. In the Select panel, click (Modify). You can also use one of the other methods to switch to **Modify:**

   - Type the shortcut **MD**.
   - Press <Esc> once or twice.

9. Select either vertical wall. The horizontal dimension becomes active (changes to blue). Click the dimension text and type **100’ 0"**, as shown in Figure 2–26.

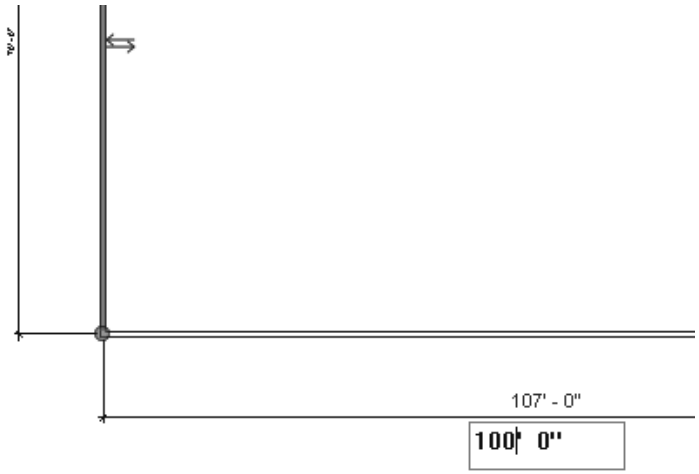


Figure 2–26

10. Click in an empty space to end the selection. You are still in the **Modify** command.

11. In the *Architecture* tab>Build panel, click (Wall). In the Draw panel, verify that (Line) is selected. Sketch a wall horizontally from midpoint to midpoint of the vertical walls.

12. Draw another horizontal wall **8’-0"** above the middle horizontal wall. You can use temporary dimensions or the *Offset* field to do this.

13. Draw a vertical wall exactly **16’-0"** from the left wall, as shown in Figure 2–27.

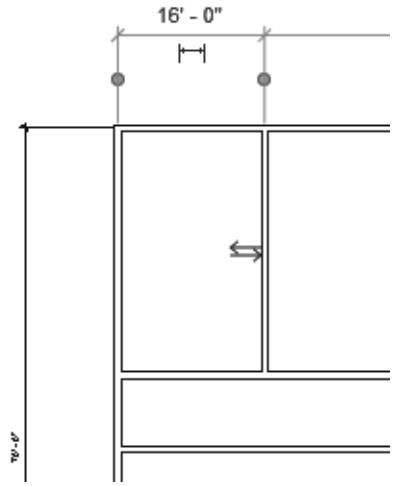


Figure 2–27

14. In the Draw panel, click (Circle) and sketch a **14’-0"** radius circular wall at the midpoint of the lower interior horizontal wall, as shown in Figure 2–28.

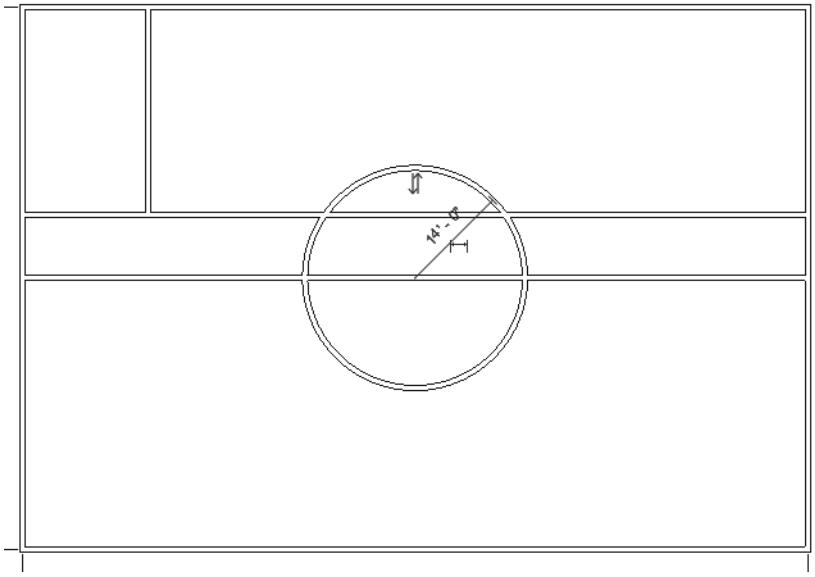


Figure 2–28

15. Click (Modify) to finish the command.

16. Hover the cursor over one of the outside walls, press <Tab> to highlight the chain of outside walls, and click to select the walls.

17. In the Type Selector, select **Basic Wall: Generic-12"**, as shown in Figure 2–29. The thickness of the outside walls change.

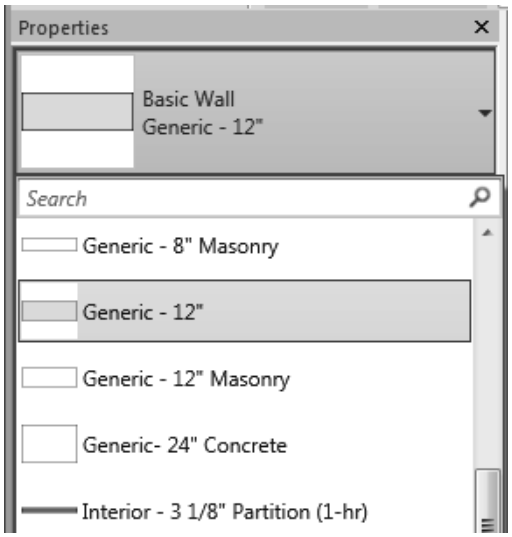


Figure 2–29

18. Click in empty space to release the selection.
19. Select the vertical interior wall. In the Type Selector, change the wall to one of the small interior partition styles.
20. Click in an empty space to release the selection.

Task 2 - Add and modify a door.

1. Zoom in on the room in the upper left corner.
2. In the *Architecture* tab>Build panel, click (Door).
3. In the *Modify* | *Place Door* tab>Tag panel, click (Tag on Placement) if it is not already selected.
4. Place a door anywhere along the wall in the hallway.
5. Click (Modify) to finish the command.
6. Select the door. Use temporary dimensions to move it so that it is **2’-6"** from the right interior vertical wall. If required, use controls to flip the door so that it swings into the room, as shown in Figure 2–30.

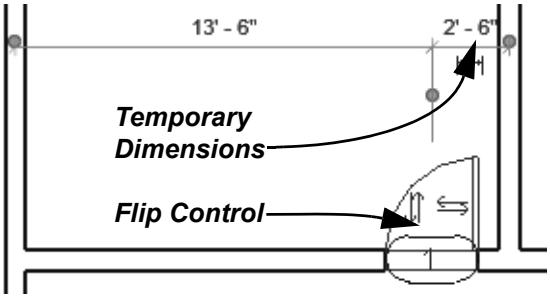


Figure 2–30

7. Type **ZE** to zoom out to the full view.
8. Save the project.

2.3 Working with Basic Modify Tools

The Autodesk Revit software contains controls and temporary dimensions that enable you to edit elements. Additional modifying tools can be used with individual elements or any selection of elements. They are found in the *Modify* tab>Modify panel, as shown in Figure 2–31, and in contextual tabs.

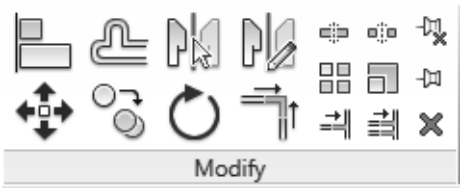


Figure 2–31

- The **Move**, **Copy**, **Rotate**, **Mirror**, and **Array** commands are covered in this topic. Other tools are covered later.
- For most 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 2–32.

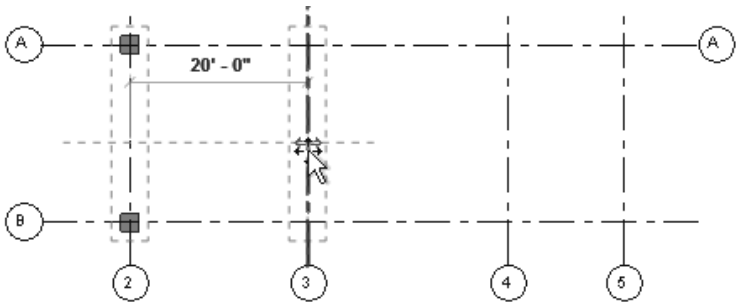


Figure 2–32

Hint: Nudge

Nudge enables you to move an element in short increments. When an element is selected, you can press one of the four arrow keys to move the element in that direction. The distance the element moves depends on how far in or out you are zoomed.

How To: Move or Copy Elements

*You can also use the shortcut for **Move, MV** or for **Copy, CO**.*

1. Select the elements you want to move or copy.
2. In the Modify panel, click (Move) or (Copy). A boundary box displays around the selected elements.
3. Select a move start point on or near the element.
4. Select a second point. Use alignment lines and temporary dimensions to help place the elements.
5. When you are finished, you can start another modify command using the elements that remain selected, or switch back to **Modify** to end the command.

- If you start the **Move** command and hold <Ctrl>, the elements are copied.

Move/Copy Elements Options

The **Move** and **Copy** commands have several options that display in the Options Bar, as shown in Figure 2–33.

Figure 2–33

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

- These commands only work in the current view, not between views or projects. To copy between views or projects, In the *Modify* tab>Clipboard panel use (Copy to Clipboard), (Cut to the Clipboard) and (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 2–34. Select the elements and in the *Modify* tab, in the Modify panel, click (Pin). 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.

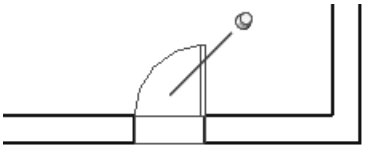


Figure 2–34

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

Rotating Elements

The **Rotate** command enables you to rotate selected elements around a center point or origin, as shown in Figure 2–35. 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.

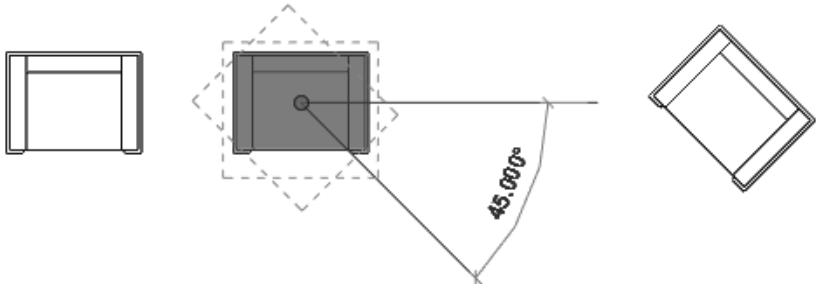


Figure 2–35

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**.

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

3. The center of rotation is automatically set to the center of the element or group of elements, as shown on the left in Figure 2–36. To change the center of rotation, as shown on the right in Figure 2–36, use the following:
   - 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.

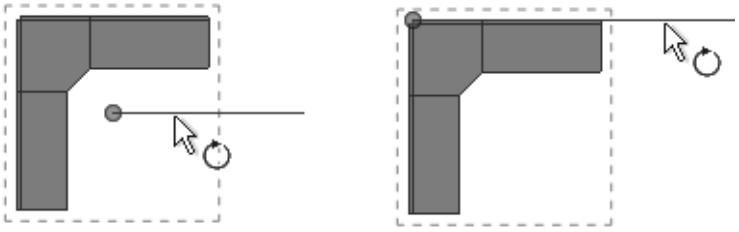


Figure 2–36

4. In the Options Bar, specify if you want to make a Copy (select **Copy**), type an angle in the *Angle* field (as shown in Figure 2–37), and press <Enter>. You can also specify the angle on screen using temporary dimensions.

Figure 2–37

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. If it is off (cleared), the connected elements also move or stretch, as shown in Figure 2–38. **Disjoin** is toggled off by default.

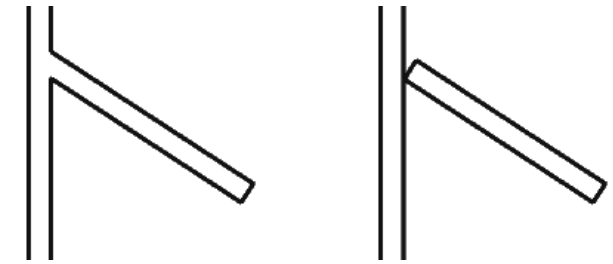


Figure 2–38

Mirroring Elements

The **Mirror** command enables you to mirror elements about an axis defined by a selected element, as shown in Figure 2–39, or by selected points.

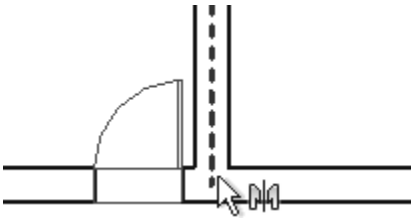


Figure 2–39

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 return to **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.

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.

Creating Linear and Radial Arrays

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

The **Array** command creates multiple copies of selected elements in a linear or radial pattern, as shown in Figure 2–40. For example, you can array a row of columns to create a row of evenly spaced columns on a grid, or array a row of parking spaces. The arrayed elements can be grouped or placed as separate elements.

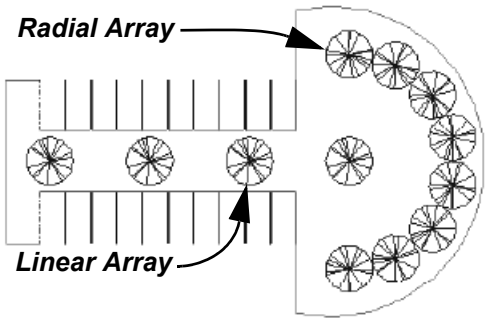


Figure 2–40

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 required.
5. Select a start point and an end point to set the spacing and direction of the array. The array is displayed.
6. If **Group and Associate** is selected, you are prompted again for the number of items, as shown in Figure 2–41. Type a new number or click on the screen to finish the command.

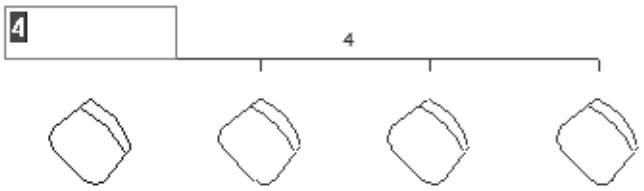


Figure 2–41

- 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 2–42) or **Radial Array** (bottom of Figure 2–42).

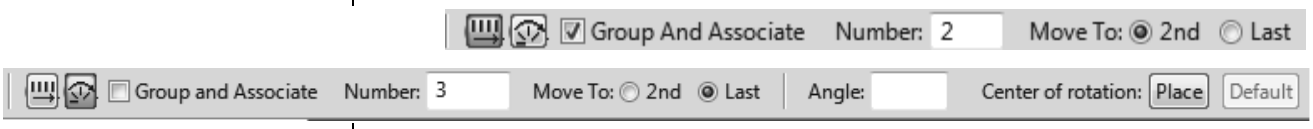


Figure 2–42

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

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 the move the center of rotation to the appropriate location, as shown in Figure 2–43.

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

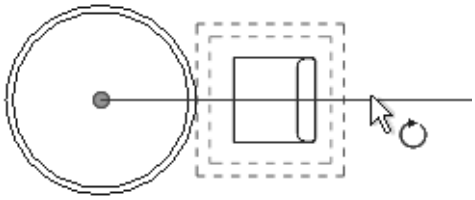


Figure 2–43

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

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 2–44. For radial arrays you can also modify the distance to the center.

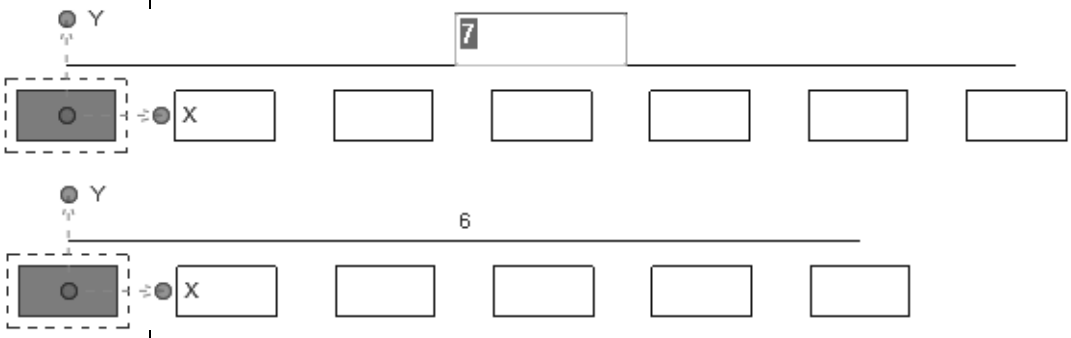


Figure 2–44

- Dashed lines surround the element(s) 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 2–45.

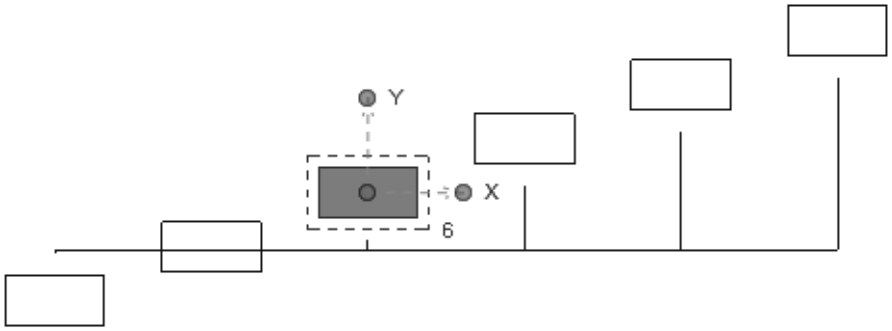


Figure 2–45

- 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**.

Practice 2b

Work with Basic Modify Tools

Practice Objective

- Use basic modify tools such as Move, Copy, Rotate, and Array Elements.

Estimated time for completion: 15 minutes

In this practice you will create a series of offices using the Copy and Mirror commands. You will then array desks around a circular wall, then rotate and array a pair of columns across the front of a simple building, as shown in Figure 2–46.

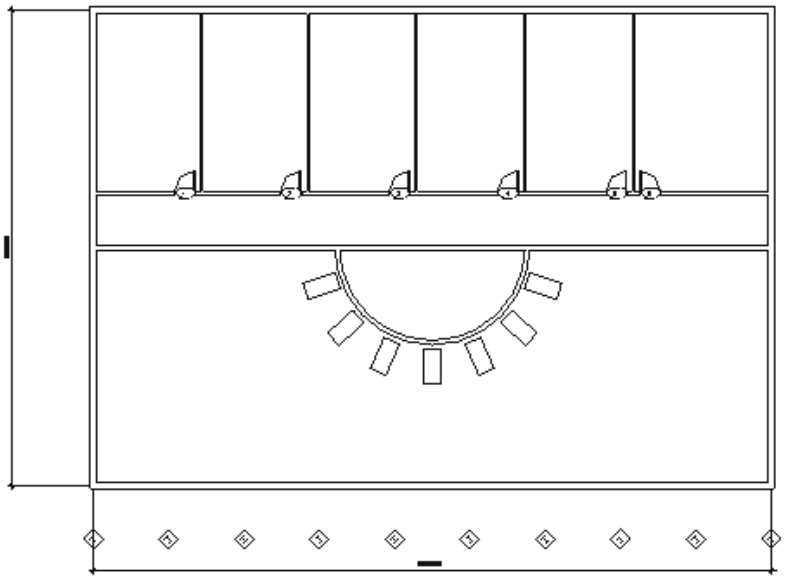


Figure 2–46

Task 1 - Modify walls and doors.

1. Open the project **Simple-Building-1.rvt** from your practice files folder.
2. Select the top arc of the circular wall.

*Remember that you can also press <Delete>, or right-click and select **Delete**.*

3. In the Modify panel, click (Delete). The walls that the circular wall crossed are automatically cleaned up.
4. Select the vertical interior wall, door, and door tag. Hold <Ctrl> to select more than one element, or use a selection window.
5. In the Modify panel, click (Copy).

6. In the Options Bar, select **Constrain** and **Multiple**. The **Constrain** option forces the cursor to move only horizontally or vertically.

7. Select the start point and the end point, as shown in Figure 2–47. The wall, door, and door tag are copied to the right and the door tag displays **2**.

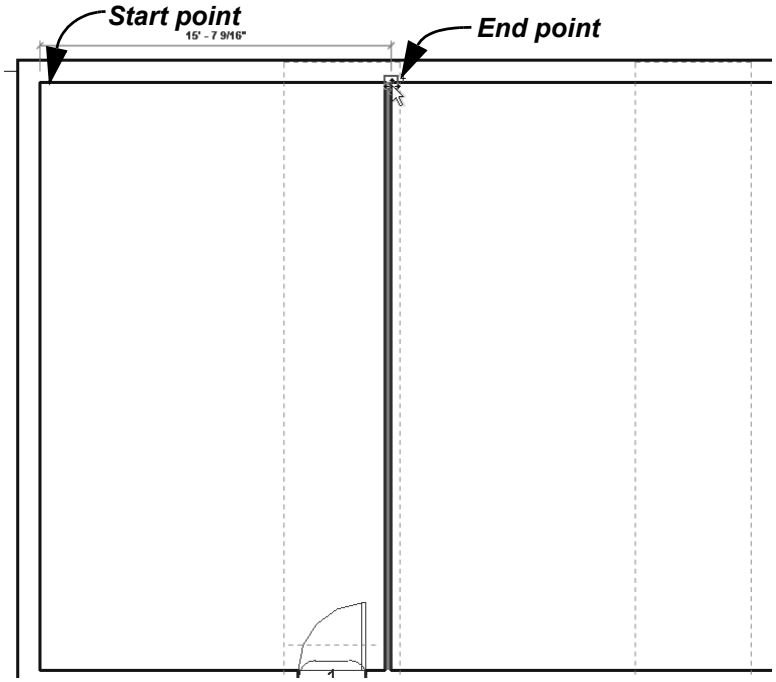


Figure 2–47

8. The new elements are still selected and you can continue to copy them. Use similar start and end points for the additional copies, or type **16** (16'-0") and press <Enter> to set the distance between each copy. The final layout is shown in Figure 2–48.

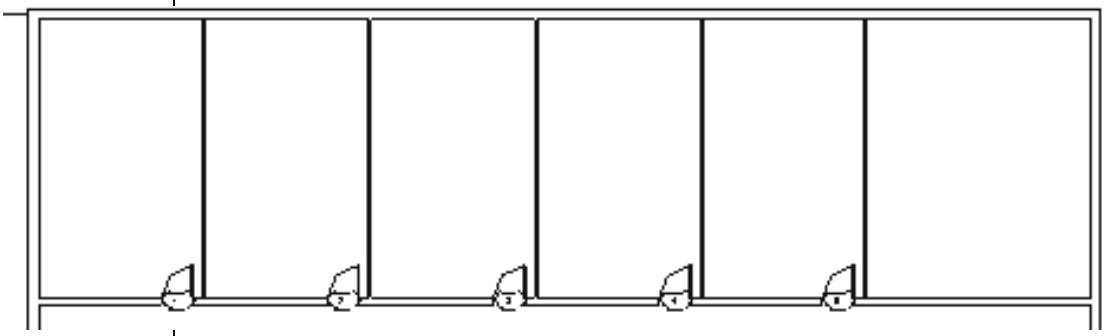


Figure 2–48

9. Click (Modify) to finish the command.

10. Zoom in on the room to the far right.

11. Select door #5 and the associated door tag.

12. In the Modify panel, click (Mirror - Pick Axis). In the Options Bar, ensure that **Copy** is selected.

13. Select the vertical wall between the rooms as the mirror axis. An alignment line displays along the center of the wall. Place the new door, as shown in Figure 2–49.

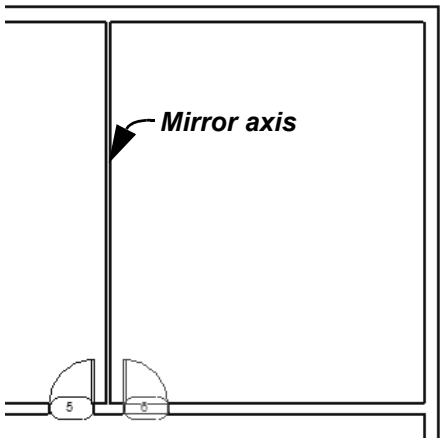


Figure 2–49

14. Click in empty space to release the selection.

Task 2 - Add reference planes and use them to place a component.

1. In the *Architecture* tab>Work plane panel, click (Ref Plane).

2. Draw two reference planes, as shown in Figure 2–50. The vertical one starts at the midpoint of the wall. You can place the horizontal plane anywhere, and then use temporary dimensions to place it more exactly.)

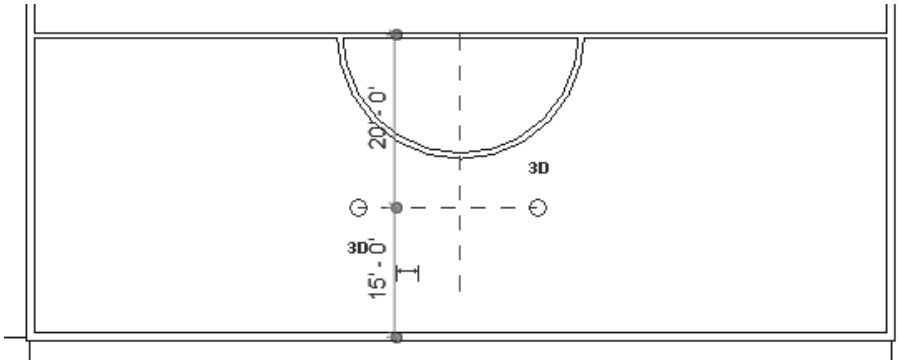


Figure 2–50

3. In the *Architecture* tab>Build panel, click (Component).
4. In the Properties palette, in the Type Selector, verify that **Desk: 60" x 30"** is selected, as shown in Figure 2–51.

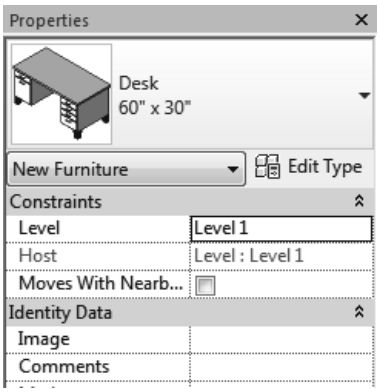


Figure 2–51

5. As you move the cursor you can see that the desk is horizontal. Press <Spacebar> to rotate the desk 90 degrees.
6. Place the desk at the intersection of the two reference planes, as shown in Figure 2–52. Zoom in as required to ensure that you are connected to the reference planes, and not to any other alignment lines.

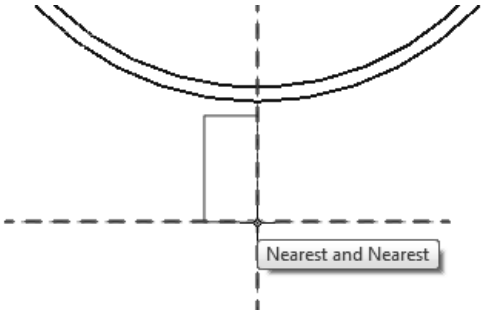


Figure 2–52

7. Click (Modify) and select the desk you just placed.
8. In the Modify panel, click (Move). Select the start point of the move as the vertical alignment line of the desk, and the end point as the vertical reference plane.
9. Save the project.

Task 3 - Create a Radial Array.

1. Select the desk.
2. In the Modify panel, click (Array).
3. In the Options Bar, click (Radial). Clear the **Group and associate** option, set the *Number* field to 15, and set the *Move to:* field to **2nd.**
4. Drag the center of rotation from the center of the desk to the midpoint of the wall, as shown in Figure 2–53.

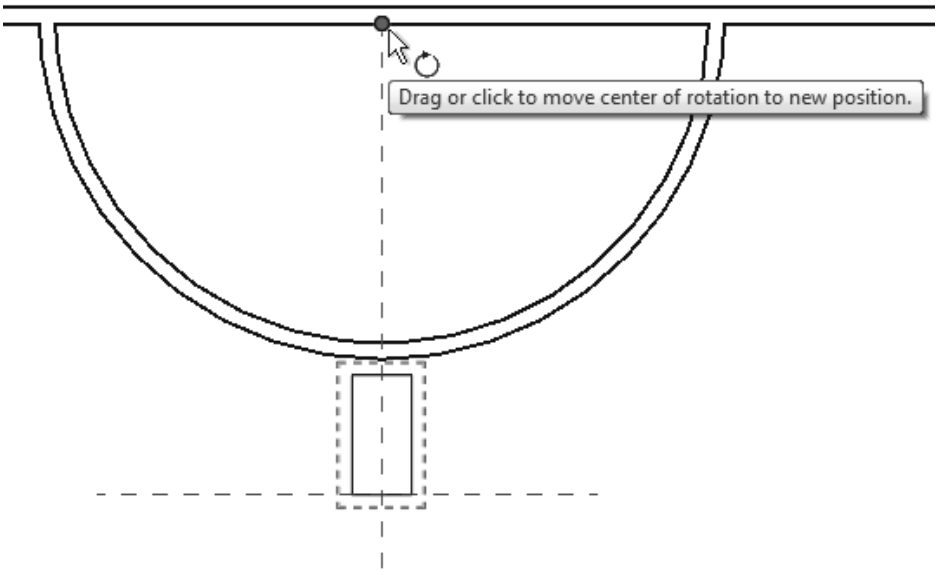


Figure 2–53

5. Return to the Options Bar and set the *Angle* to **360**. Press <Enter>. The array displays as shown in Figure 2–54.

Sometimes it is easier to create more elements then you need, and then delete the ones that are not required, as is done in this example.

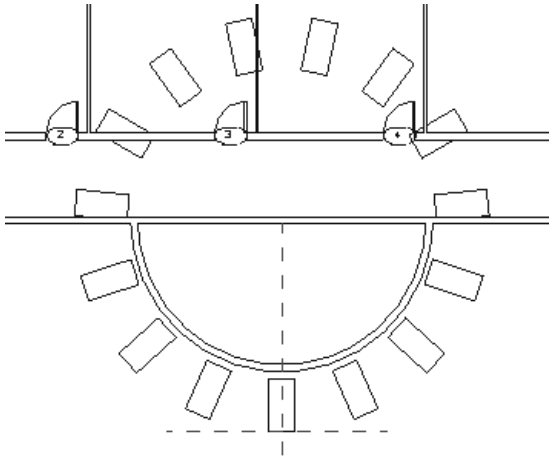


Figure 2–54

6. Delete all of the desks that are outside of the room that has the original desk.
7. Zoom out to display the entire view.

Task 4 - Place columns in appropriate locations.

1. Two columns (one architectural and one structural) have been added to the project. Select the square architectural column and drag it over so that it lines up with the wall, as shown in Figure 2–55. Use the temporary dimension to set the distance off the wall.
2. Place the structural column at the center of the architectural column using the **Midpoint and Extension** snaps, as shown in Figure 2–56.

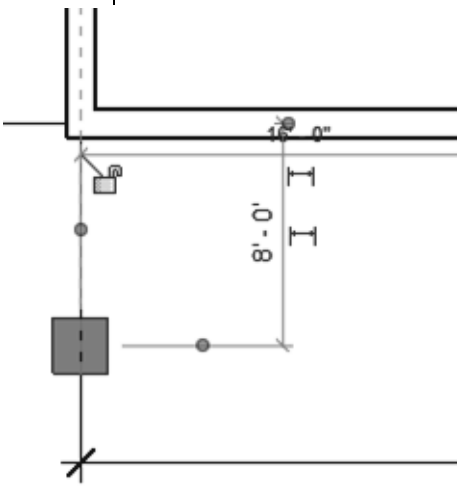


Figure 2–55

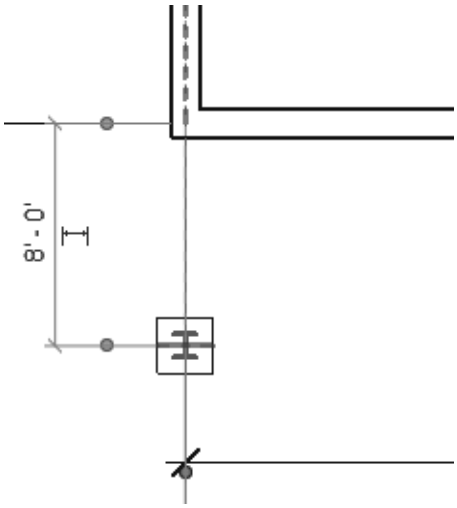


Figure 2–56

3. Save the project.

Task 5 - Rotate and Array the columns.

1. Click (Modify) and select the two columns.
2. In the *Modify* | *Multi-Select* tab>Modify panel, click (Rotate).
3. For the start ray, click horizontally, as shown on the left in Figure 2–57.
4. Move the ray line until you see the temporary dimension **45.000**, as shown on the right in Figure 2–57.

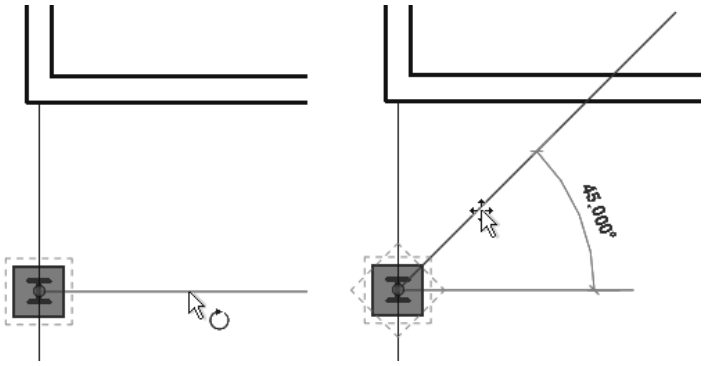


Figure 2–57

5. With the two columns still selected, in the *Modify* | *Multi-Select* tab>Modify panel, click (Array).

6. In the Options Bar, click (Linear), clear **Group and Associate**, set the *Number* to **10**, and set *Move To:* to **Last**.

7. For the start point, click the midpoint of the columns. For the endpoint of the array, select the **Horizontal and Extension** of the center of the far right wall as shown in Figure 2–58.

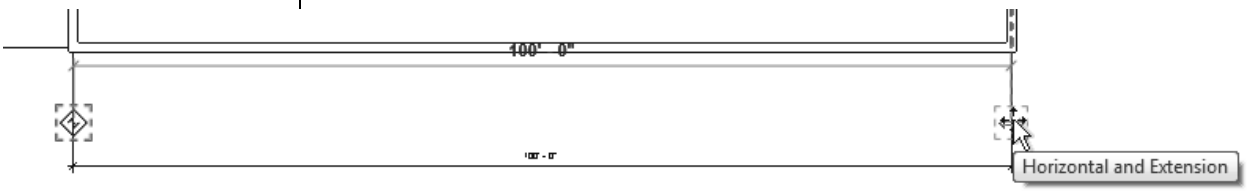


Figure 2–58

8. Zoom out to display the entire building.

9. The columns are arrayed evenly across the front of the building as shown in Figure 2–59.

Figure 2–59

10. Save the project.

2.4 Working with Additional Modify Tools

As you work on a project, some additional tools on the *Modify* tab>Modify panel, as shown in Figure 2–60, 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.

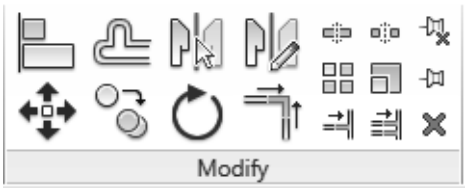


Figure 2–60

Aligning Elements

The **Align** command enables you to line up one element with another, as shown in Figure 2–61. 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.

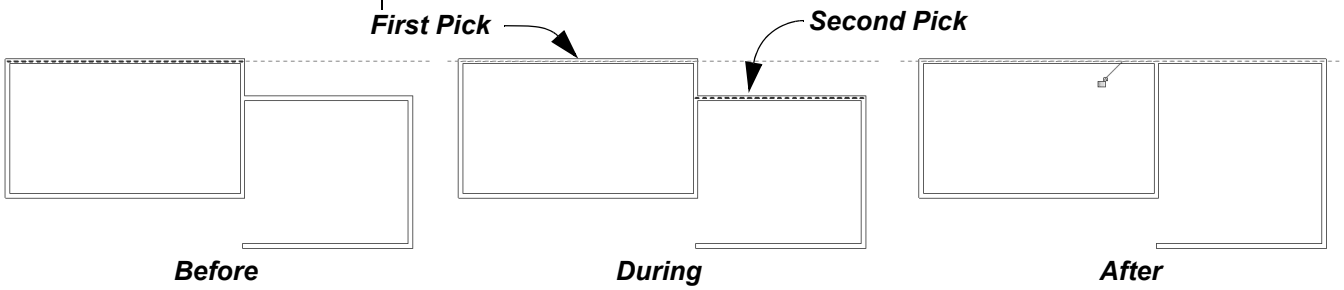


Figure 2–61

How To: Align Elements

1. In the *Modify* tab>Modify panel, click (Align).
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.
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 2–62.

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

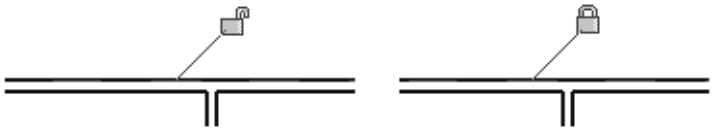


Figure 2–62

- Select **Multiple Alignment** to select multiple elements to align with the first element. You can also hold <Ctrl> to make multiple alignments.

- For walls, you can specify if you want the command to prefer **Wall centerlines**, **Wall faces**, **Center of core**, or **Faces of core**, as shown in Figure 2–63. The core refers to the structural members of a wall as opposed to facing materials, such as sheet rock.

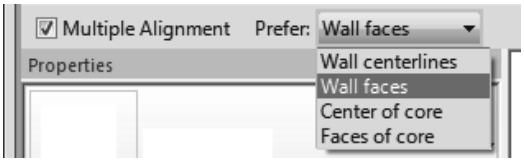


Figure 2–63

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 2–64.

You can split walls in plan, elevation or 3D views.

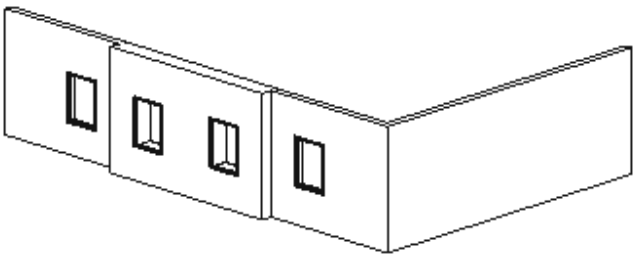


Figure 2–64

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 required.

- 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 2–65), but also creates a *Joint Gap* specified in the Options Bar.

This command is typically used with structural precast slabs.

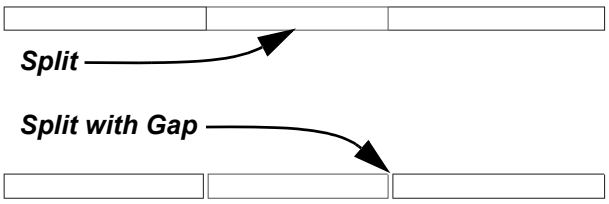


Figure 2–65

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 2–66.

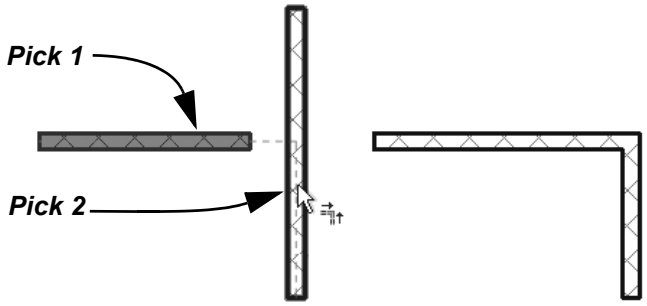


Figure 2–66

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 2–67.

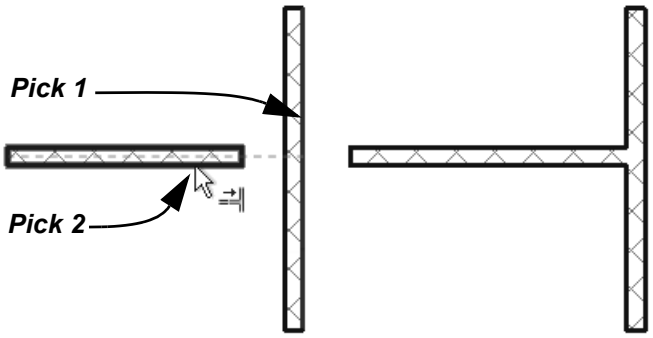


Figure 2–67

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 2–68. For trimming, select the side you want to keep.

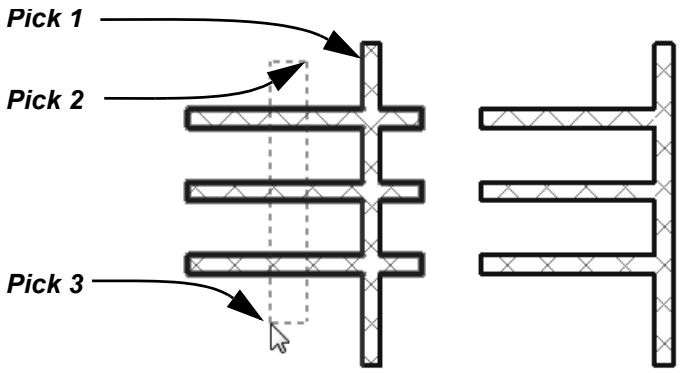


Figure 2–68

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

Offsetting Elements

The **Offset** command is an easy way of creating parallel copies of linear elements at a specified distance, as shown in Figure 2–69. Walls, beams, braces, and lines are among the elements that can be offset.

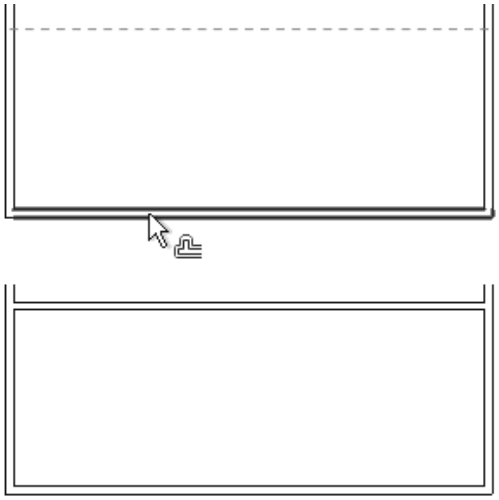


Figure 2–69

- If you offset a wall that has a door or window embedded in it, the elements are copied with the offset wall.

The offset distance can be set by typing the distance (**Numerical** method shown in Figure 2–70) or by selecting points on the screen (**Graphical** method).

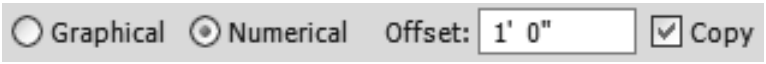


Figure 2–70

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.*

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 required.
5. Click to create the offset.
6. Repeat Steps 4 and 5 to offset other elements by the same distance, or to change the distance for another offset.

- 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. Select the element to offset all of the elements at the same time.

How To: Offset using the Graphical Method

1. Start the **Offset** command.
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.

- Most linear elements connected at a corner automatically trim or extend to meet at the offset distance, as shown in Figure 2–71.

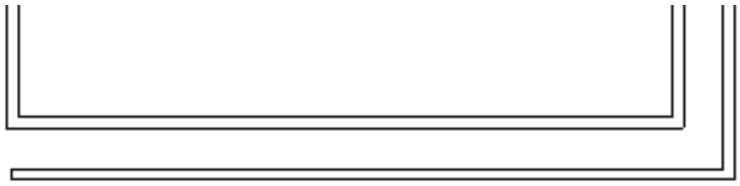


Figure 2–71

Practice 2c

Work with Additional Modify Tools

Estimated time for completion: 10 minutes

Practice Objective

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

In this practice you will split a wall into three parts and delete the middle portion. You will offset walls and then trim or extend them to form new rooms. You will then align the new walls to match existing walls.as shown in Figure 2–72.

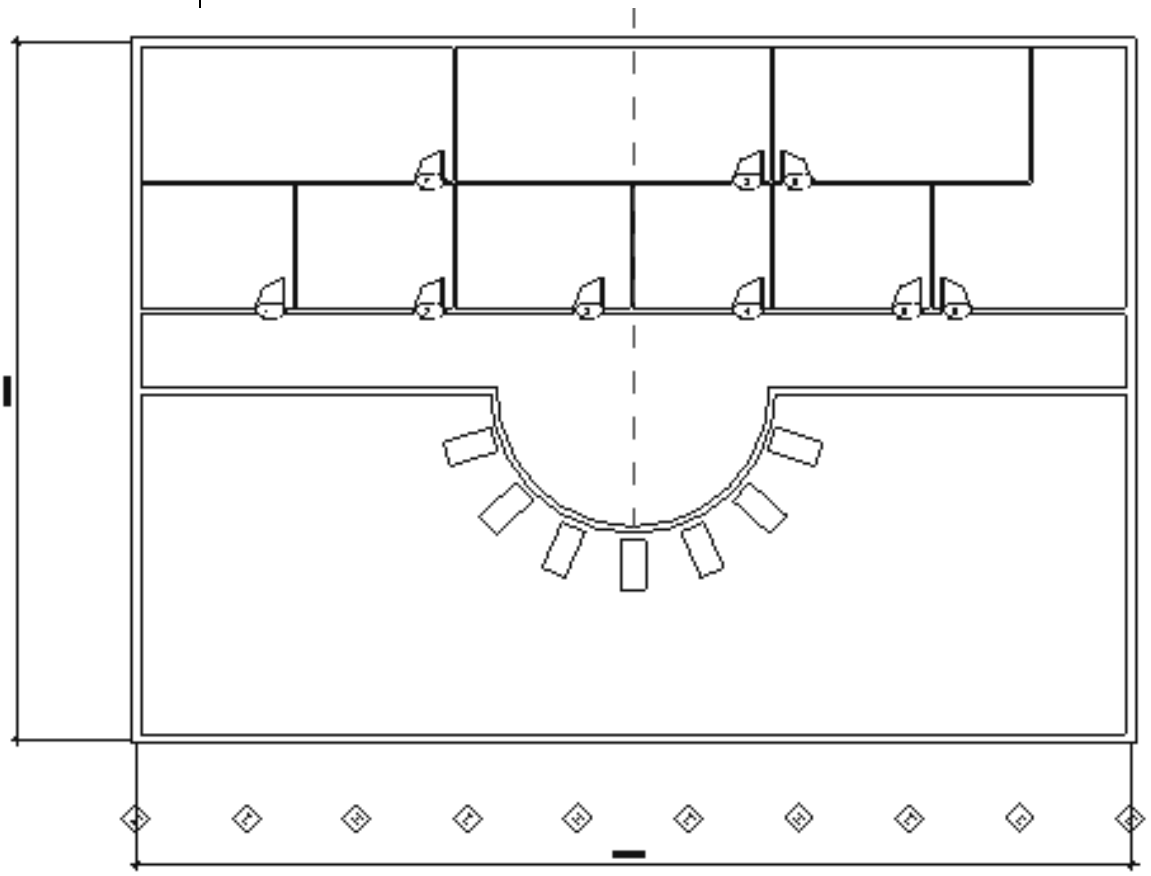


Figure 2–72

Task 1 - Split and Remove Walls

1. Open the project **Simple-Building-2.rvt** from the practice files folder.

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

3. In the Options Bar, select **Delete Inner Segment**.
4. Click on the horizontal wall where it intersects with the curved wall at both ends. The wall segment between these points is removed, as shown in Figure 2–73.

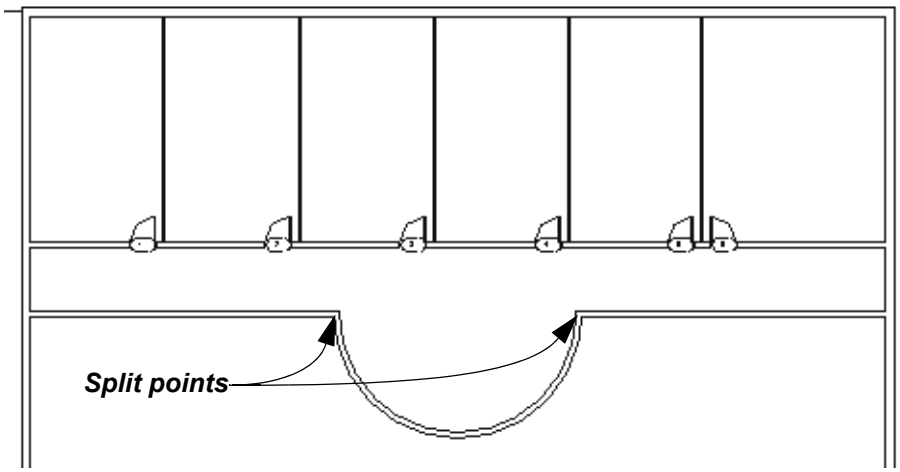


Figure 2–73

5. Click (Modify) to finish.

Task 2 - Offset and Trim Walls

1. In the *Modify* tab>Modify panel click (Offset).
2. In the Options Bar set the *Offset* to **14'-0"** and ensure that **Copy** is selected.
3. Select the top horizontal wall while ensuring that the dashed alignment line displays inside the building, as shown in Figure 2–74.

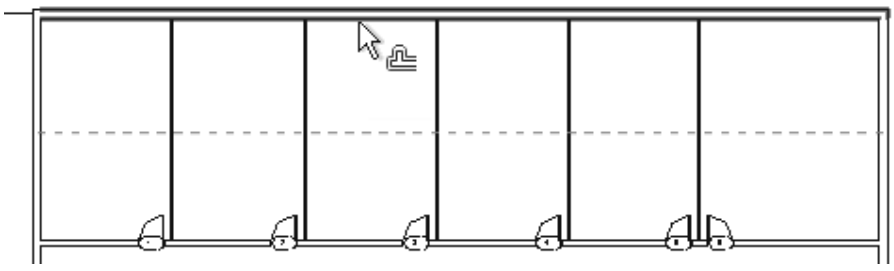


Figure 2–74

4. With **Offset** still active, change the *Offset* to **10'-0"** and offset the last vertical interior wall to the right, as shown in Figure 2–75.

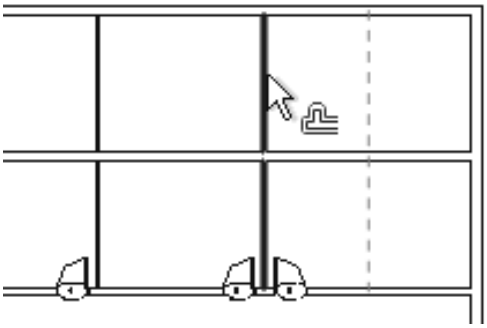


Figure 2–75

5. Click (Modify) and select the new horizontal wall that was created from the exterior wall. Change the wall to **Basic Wall: Interior - 3 1/8" Partition (1-hr).** The layout of the new walls should display as shown in Figure 2–76.

The vertical wall does not need to be changed because it was offset from an interior wall.

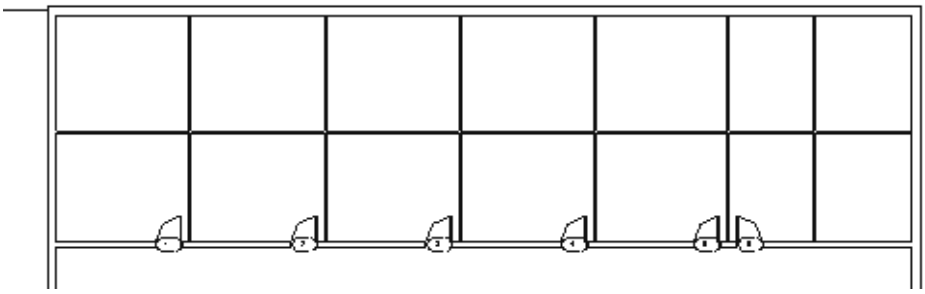


Figure 2–76

6. In the *Modify* tab>Modify panel, click (Trim/Extend Multiple Elements).
7. Select the new horizontal wall as the element to trim against.
8. Select every other wall BELOW the new wall. (Remember, you select the elements that you want to keep.) The walls should display as shown in Figure 2–77.

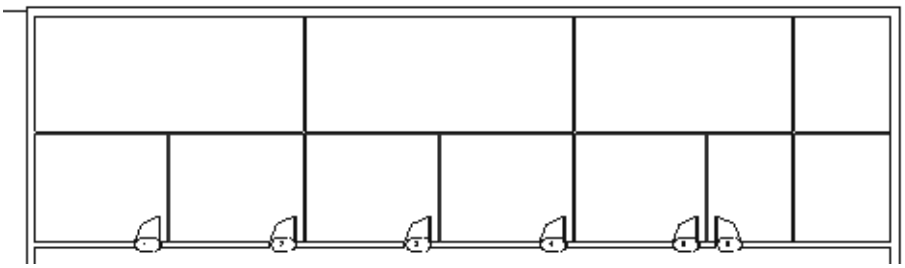


Figure 2–77

9. In the *Modify* tab>Modify panel click (Trim/Extend to Corner) and select the two walls to trim as shown in Figure 2–78.

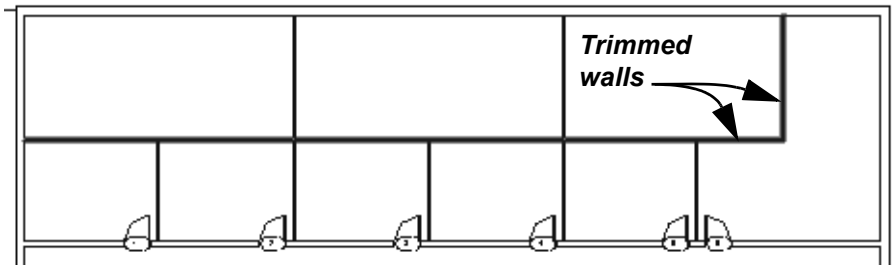


Figure 2–78

10. Add doors into the new rooms.
11. Save the project.

Task 3 - Align Walls.

1. Select the vertical reference plane and use the control to drag the top end so it extends beyond the outer wall, as shown in Figure 2–79.

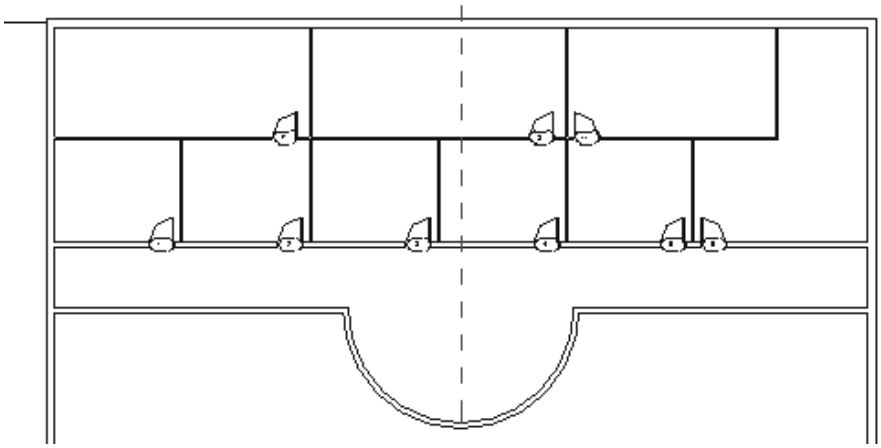


Figure 2–79

2. In the *Modify* tab>Modify panel, click (Align).
3. Select the reference plane, and then the wall to the left. The wall should line up with the reference plane.
4. 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 object.
   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. When you are modeling (not editing) a linear element, how do you edit the temporary dimension, as that shown in Figure 2–80?

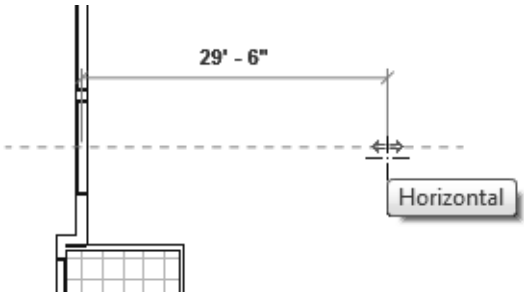


Figure 2–80

   a. Select the temporary dimension and enter a new value.
   b. Type a new value and press <Enter>.
   c. Type a new value in the Distance/Length box in the Options Bar and press <Enter>.
3. How do you select all door types, but no other elements in a view?
   a. In the Project Browser, select the *Door* category.
   b. Select one door, right-click and select **Select All Instances>Visible in View**.
   c. Select all of the objects in the view and use (Filter) to clear the other categories.
   d. Select one door, and click (Select Multiple) in the ribbon.

4. What are the two methods for starting (Move) or (Copy)?
   a. Start the command first and then select the objects, or select the objects and then start the command.
   b. Start the command from the *Modify* tab, or select the object and then select **Move** or **Copy** from the shortcut menu.
   c. Start the command from the *Modify* tab, or select the objects and select **Auto-Move**.
   d. Use the **Move/Copy** command or **Cut/Copy** and **Paste** using the Clipboard.
5. Where do you change the wall type for a selected wall, as shown in Figure 2–81?

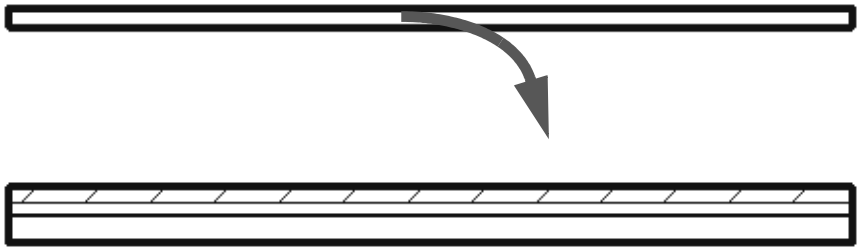


Figure 2–81

   a. In the *Modify* | *Walls* tab>Properties panel, click (Type Properties) and select a new wall type in the dialog box.
   b. In the Options Bar, click **Change Element Type**.
   c. Select the dynamic control next to the selected wall 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 as shown in Figure 2–82? (Select all that apply.)

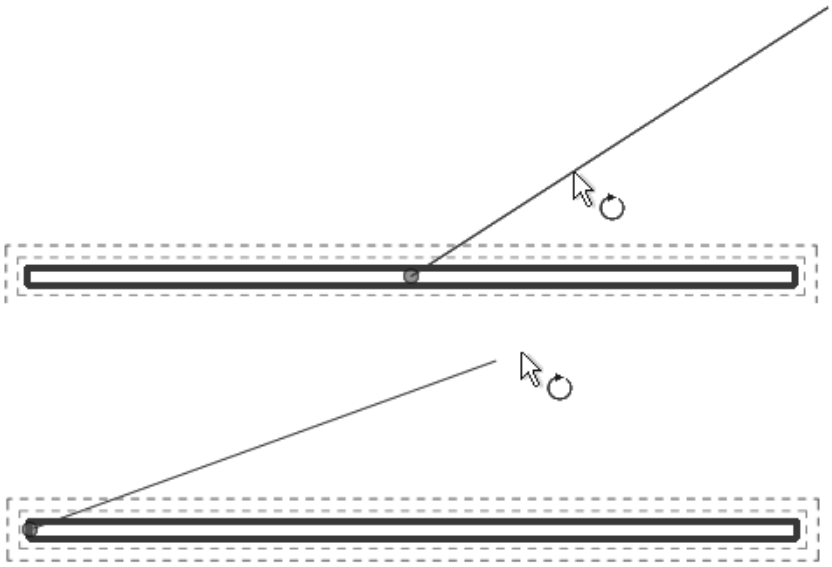


Figure 2–82

   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 remove part of a wall?

   a. (Split Element)
   b. (Wall Joins)
   c. (Cut Geometry)
   d. (Demolish)

8. Which of the following are ways in which you can create additional parallel walls, as shown in Figure 2–83? (Select all that apply.)

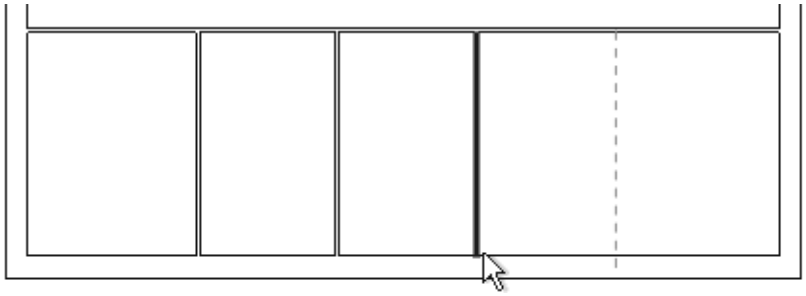


Figure 2–83

   a. Select an existing wall, right-click and select **Create Offset**.

   b. Use the **Offset** tool in the *Modify* tab.

   c. Select an existing wall, hold <Ctrl> and drag the wall to a new location.

   d. Use the **Wall** tool and set an offset in the Options Bar.

9. Which command do you use if you want two walls that are not touching to come together, as shown in Figure 2–84?

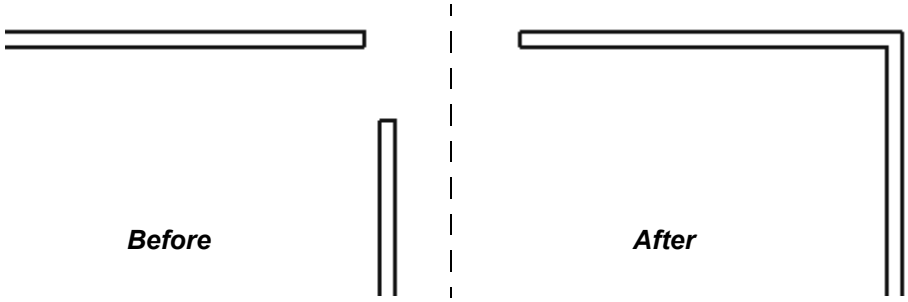


Figure 2–84

   a.  (Edit Wall Joins)

   b.  (Trim/Extend to Corner)

   c.  (Join Geometry)

   d.  (Edit Profile)

Command Summary

Button	Command	Location
Draw Tools		
	**Center-ends Arc**	• **Ribbon:** *Modify* | *(various linear elements)* tab>Draw panel
	**Circle**	• **Ribbon:** *Modify* | *(various linear elements)* tab>Draw panel
	**Circumscribed Polygon**	• **Ribbon:** *Modify* | *(various linear elements)* tab>Draw panel
	**Ellipse**	• **Ribbon:** *Modify* | *Place Lines, Place Detail Lines, and various boundary sketches*>Draw panel
	**Ellipse Arc**	• **Ribbon:** *Modify* | *Place Lines, Place Detail Lines, and various boundary sketches*>Draw panel
	**Fillet Arc**	• **Ribbon:** *Modify* | *(various linear elements)* tab>Draw panel
	**Inscribed Polygon**	• **Ribbon:** *Modify* | *(various linear elements)* tab>Draw panel
	**Line**	• **Ribbon:** *Modify* | *(various linear elements)* tab>Draw panel
	**Pick Faces**	• **Ribbon:** *Modify* | *Place Wall*> Draw panel
	**Pick Lines**	• **Ribbon:** *Modify* | *(various linear elements)* tab>Draw panel
	**Pick Walls**	• **Ribbon:** *Modify* | *(various boundary sketches)*>Draw panel
	**Rectangle**	• **Ribbon:** *Modify* | *(various linear elements)* tab>Draw panel
	**Spline**	• **Ribbon:** *Modify* | *Place Lines, Place Detail Lines, and various boundary sketches*>Draw panel
	**Start-End-Radius Arc**	• **Ribbon:** *Modify* | *(various linear elements)* tab>Draw panel
	**Tangent End Arc**	• **Ribbon:** *Modify* | *(various linear elements)* tab>Draw panel
Modify Tools		
	**Align**	• **Ribbon:** *Modify* tab>Modify panel • **Shortcut:** AL
	**Array**	• **Ribbon:** *Modify* tab>Modify panel • **Shortcut:** AR
	**Copy**	• **Ribbon:** *Modify* tab>Modify panel • **Shortcut:** CO

	**Copy to Clipboard**	• **Ribbon:** *Modify* tab>Clipboard panel • **Shortcut:** <Ctrl>+<C>
	**Delete**	• **Ribbon:** *Modify* tab>Modify panel • **Shortcut:** DE
	**Mirror - Draw Axis**	• **Ribbon:** *Modify* tab>Modify panel • **Shortcut:** DM
	**Mirror - Pick Axis**	• **Ribbon:** *Modify* tab>Modify panel • **Shortcut:** MM
	**Move**	• **Ribbon:** *Modify* tab>Modify panel • **Shortcut:** MV
	**Offset**	• **Ribbon:** *Modify* tab>Modify panel • **Shortcut:** OF
	**Paste**	• **Ribbon:** *Modify* tab>Clipboard panel • **Shortcut:** <Ctrl>+<V>
	**Pin**	• **Ribbon:** *Modify* tab>Modify panel • **Shortcut:** PN
	**Rotate**	• **Ribbon:** *Modify* tab>Modify panel • **Shortcut:** RO
	**Scale**	• **Ribbon:** *Modify* tab>Modify panel • **Shortcut:** RE
	**Split Element**	• **Ribbon:** *Modify* tab>Modify panel • **Shortcut:** SL
	**Split with Gap**	• **Ribbon:** *Modify* tab>Modify panel
	**Trim/Extend Multiple Elements**	• **Ribbon:** *Modify* tab>Modify panel
	**Trim/Extend Single Element**	• **Ribbon:** *Modify* tab>Modify panel
	**Trim/Extend to Corner**	• **Ribbon:** *Modify* tab>Modify panel • **Shortcut:** TR
	**Unpin**	• **Ribbon:** *Modify* tab>Modify panel • **Shortcut:** UP
Select Tools		
	**Drag elements on selection**	• **Ribbon:** All tabs>Expanded Select panel • **Status Bar**
	**Filter**	• **Ribbon:** *Modify* | *Multi-Select* tab> Filter panel • **Status Bar**
	**Select Elements By Face**	• **Ribbon:** All tabs>Expanded Select panel • **Status Bar**

	**Select Links**	• **Ribbon:** All tabs>Expanded Select panel • **Status Bar**
	**Select Pinned Elements**	• **Ribbon:** All tabs>Expanded Select panel • **Status Bar**
	**Select Underlay Elements**	• **Ribbon:** All tabs>Expanded Select panel • **Status Bar**
Additional Tools		
	**Aligned Dimension**	• **Ribbon:** *Modify* tab>Measure panel • Quick Access Toolbar
	**Detail Line**	• **Ribbon:** *Annotate* tab>Detail panel • **Shortcut:** DL
	**Model Line**	• **Ribbon:** *Architectural* tab>Model panel • **Shortcut:** LI
	**Reference Plane**	• **Ribbon:** *Architecture/Structure/ Systems* tab> Work Plane panel