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Autodesk® Revit® 2023 Architecture Conceptual Design and Visualization

Learning Guide

Imperial Units - 1st Edition

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ASCENT - Center for Technical Knowledge®
Autodesk® Revit® 2023 Architecture
Conceptual Design and Visualization

Imperial Units - 1st Edition

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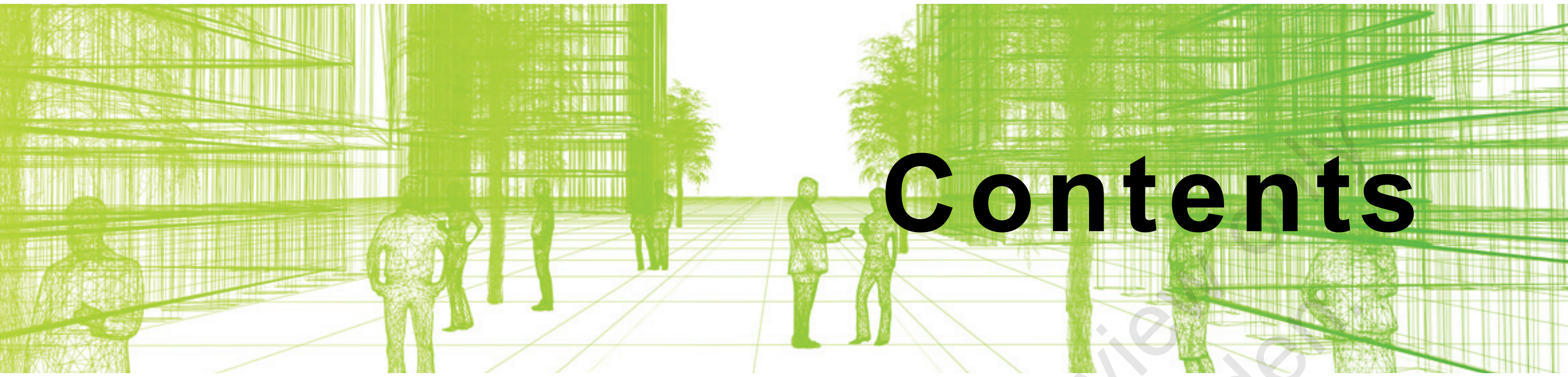

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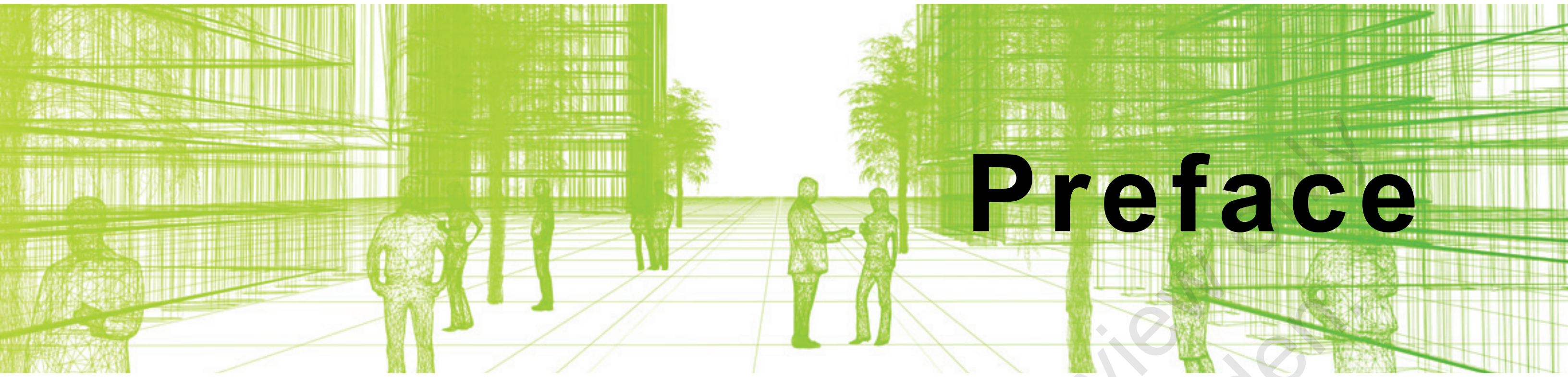


Preface

As architects and designers start a project, they frequently think about the overall massing of a building or the area of the footprint. The Autodesk® Revit® software, using its powerful Building Information Modeling (BIM) engine, includes tools for creating mass elements that can be modified into many shapes. You can then apply walls, roofs, and floors to them to continue designing. You can use space planning tools to set up areas for rooms and colors to mark the different areas. For presentations, you can create, embellish, and render perspective views.

The objective of the *Autodesk® Revit® 2023 Architecture: Conceptual Design and Visualization* guide is to enable users who have worked with the Autodesk Revit software to expand their knowledge in the area of conceptual design, including massing studies, space planning, visualization, and rendering.

Topics Covered

- Create in-place conceptual mass elements.
- Create building elements from massing studies.
- Use rooms and areas for space planning and analysis.
- Create perspectives, sketches, exploded views, and solar studies.
- Render views that include materials, lighting, and enhancements such as people and plants.

Prerequisites

- Access to the 2023 version of the software, to ensure compatibility with this guide. Future software updates that are released by Autodesk may include changes that are not reflected in this guide. The practices and files included with this guide might not be compatible with prior versions (e.g., 2022).
- You should be comfortable with the fundamentals of the Autodesk Revit software, as taught in the *Autodesk Revit: Fundamentals for Architecture* guide. Knowledge of basic techniques is assumed, such as creating walls, roofs, and other objects; copying and moving objects; creating and working with views; etc.
- Collaboration Tools, BIM Management, and Site Planning and Design are taught in additional guides.

Note on Software Setup

This guide assumes a standard installation of the software using the default preferences during installation. Lectures and practices use the standard software templates and default options for the Content Libraries.

Lead Contributor: Cherisse Biddulph

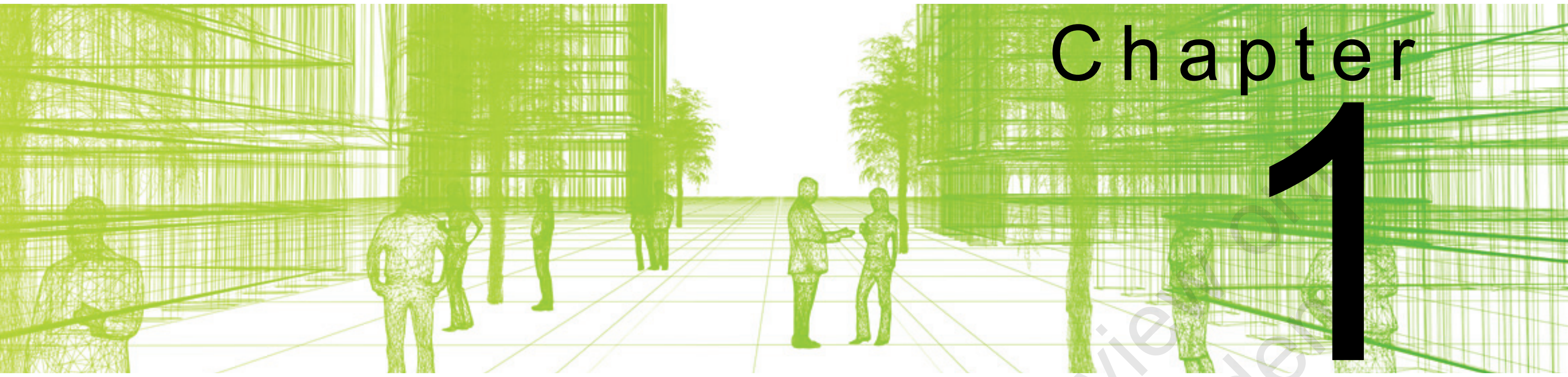
Cherisse is an Autodesk Certified Professional for Revit as well as an Autodesk Certified Instructor. She brings over 19 years of industry, teaching, and technical support experience to her role as a Learning Content Developer with ASCENT. With a passion for design and architecture, she has worked in the industry assisting firms with their Building Information Modeling (BIM) management and software implementation needs as they modernize to a BIM design environment. Although her main devotion is the Revit design product, she is also proficient in AutoCAD, Autodesk BIM 360, and Autodesk Navisworks. Today, Cherisse continues to expand her knowledge in the ever-evolving AEC industry and the software used to support it.

Cherisse Biddulph has been the Lead Contributor for *Autodesk Revit Architecture: Conceptual Design and Visualization* since 2019.

In This Guide

The following highlights the key features of this guide.

Feature	Description
Practice Files	The Practice Files page includes a link to the practice files and instructions on how to download and install them. The practice files are required to complete the practices in this guide.
Chapters	A chapter consists of the following: Learning Objectives, Instructional Content, Practices, Chapter Review Questions, and Command Summary. • **Learning Objectives** define the skills you can acquire by learning the content provided in the chapter. • **Instructional Content**, which begins right after Learning Objectives, refers to the descriptive and procedural information related to various topics. Each main topic introduces a product feature, discusses various aspects of that feature, and provides step-by-step procedures on how to use that feature. Where relevant, examples, figures, helpful hints, and notes are provided. • **Practice** for a topic follows the instructional content. Practices enable you to use the software to perform a hands-on review of a topic. It is required that you download the practice files (using the link found on the Practice Files page) prior to starting the first practice. • **Chapter Review Questions**, located close to the end of a chapter, enable you to test your knowledge of the key concepts discussed in the chapter. • **Command Summary** concludes a chapter. It contains a list of the software commands that are used throughout the chapter and provides information on where the command can be found in the software.
Appendices	Appendices provide additional information to the main course content. It could be in the form of instructional content, practices, tables, projects, or skills assessment.



Chapter 1

Massing Studies

The Autodesk® Revit® software is a powerful tool for creating accurate building models. When you are just beginning a design, however, you do not need to have that level of accuracy and may only want to model general features, such as the overall shape of a building. The massing tools help with this initial modeling stage by enabling you to create and modify simple and complex forms directly in a project.

Learning Objectives in This Chapter

- Place and modify massing elements using existing mass families.
- Create mass forms (and void forms), including extrusions, revolves, sweeps, blends, swept blends, and lofts.
- Modify mass faces, edges, or vertices using the 3D Control feature.
- Edit profiles of mass elements.
- Add edges and profiles to mass elements.
- Divide and pattern the faces of masses.
- Create floors at selected levels in the mass.
- Add walls, roofs, curtain systems, and floors to a mass element using the Model by Face tools.

1.1 Overview of Massing Studies

When you start designing a building, you normally do not know its exact size or the locations of doors and windows. You probably do not even know what type of wall system you want to use. In some cases, you need to establish the relationship of the forms of the new building to those of the existing structures around it first, as shown in Figure 1–1. The focus is the overall shape and footprint of the building, which you develop in a massing study.

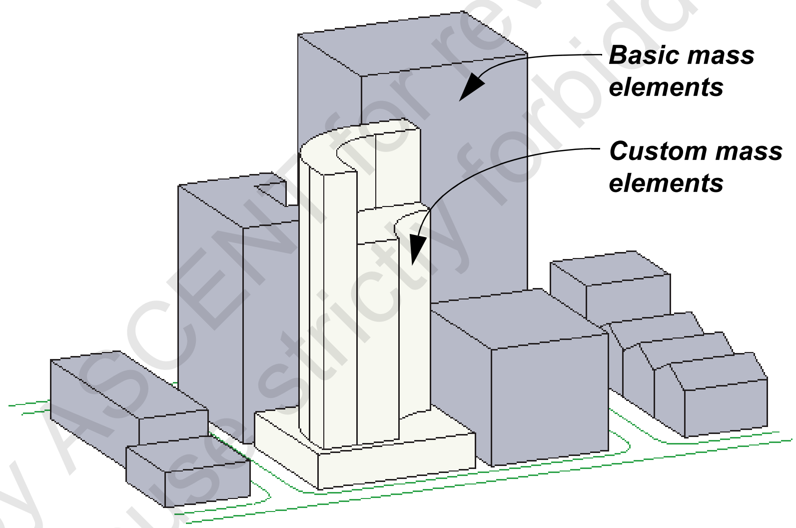


Figure 1–1

- Massing elements are intended for large forms that define the overall shape and size of a building. For smaller elements (e.g., furniture or columns), create or use family elements.

- By default, mass elements do not display in views until the Show Mass mode has been toggled on. In the *Massing & Site* tab>Conceptual Mass panel, select either:

  -  (Show Mass by View Settings): The Mass category must be toggled on in the Visibility/Graphic Overrides dialog box. Use this if you want to print or export the mass elements.

  -  (Show Mass Form and Floors): Overrides the Visibility/Graphic Overrides and toggles on mass elements and mass floors.

- **Show Mass Surface Types** and **Show Mass Zones and Shades** are connected to the subscription based Mass Analysis tools.

Hint: Other Sketching Programs

There are a variety of standalone sketching programs, like Autodesk's FormIt Pro. These offer intuitive sketching and modeling capabilities. The 3D models can be imported into Revit in a variety of ways.

The advantage of creating the massing directly in Revit is that the massing model resides in the same file (or family) as the entire Revit model and is not dependent on external programs.

Premade Mass Elements

Premade mass elements (families) can be inserted into a project using the **Place Mass** command. Revit includes several basic massing elements that work like building blocks to help you create the conceptual design, some of which are shown in Figure 1–2.

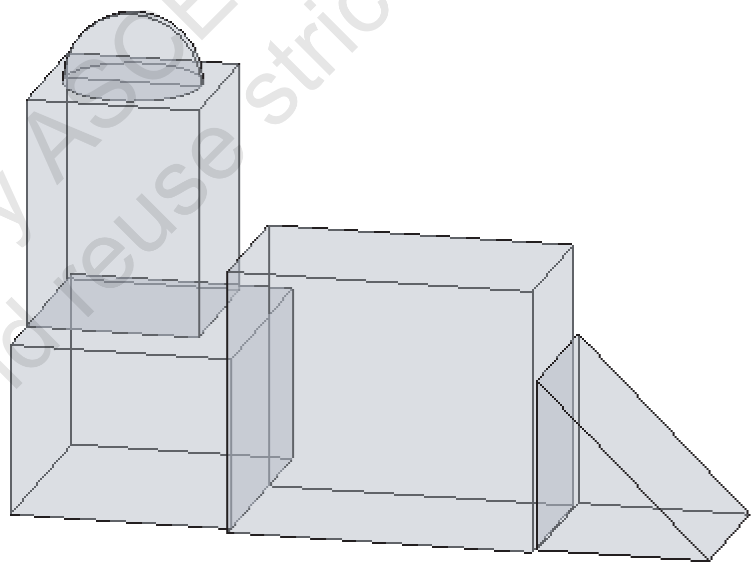


Figure 1–2

Custom Mass Elements

Custom mass elements are created in a project as an **In-Place Mass** or in a separate **Conceptual Mass** family. These families are highly customizable. They are created by drawing profiles, as shown on the left in Figure 1–3, and then applying a form, such as an extrusion (as shown on the right in Figure 1–3) or a loft.

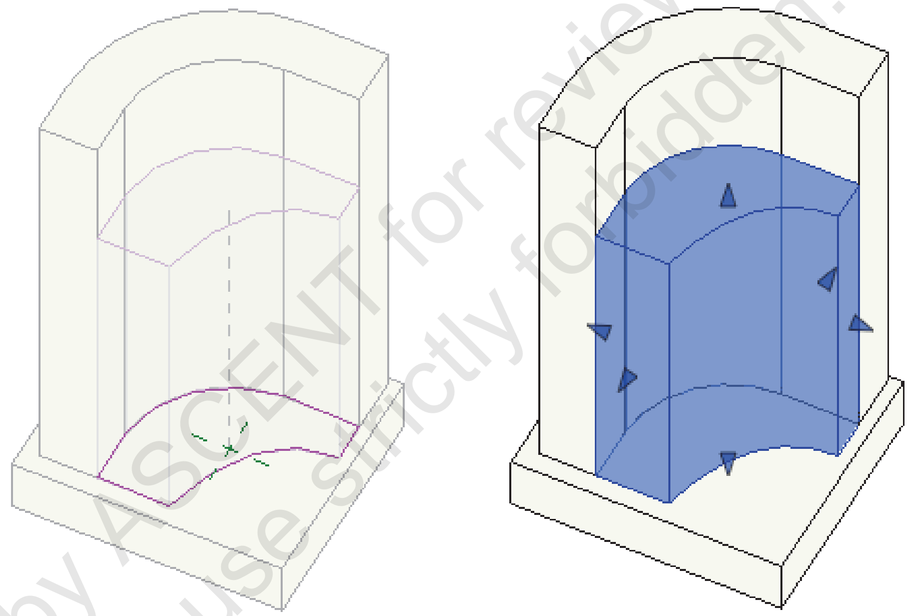


Figure 1–3

Modifying Mass Elements

Premade mass elements can be modified using shape handles in plan, elevation, and section views, as shown in Figure 1–4. Custom mass elements can be modified using shape handles in 3D views and have additional modification options, as shown in Figure 1–5.

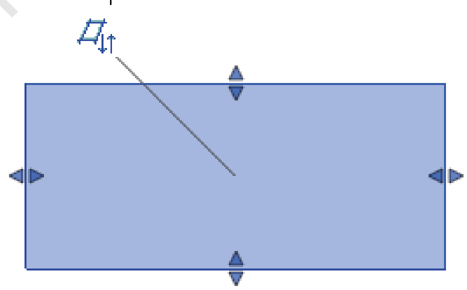


Figure 1–4

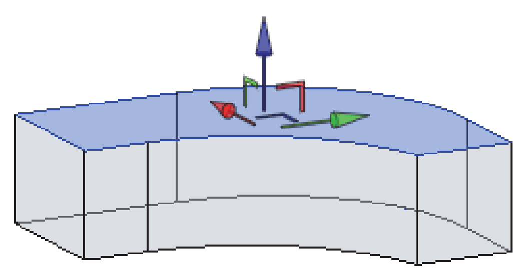


Figure 1–5

Making Buildings from Mass Elements

When you have finished the massing study, you can apply walls, curtain systems, roofs, and floors to the faces of the mass elements (as shown in Figure 1–6), and then proceed to the next step in the design process.

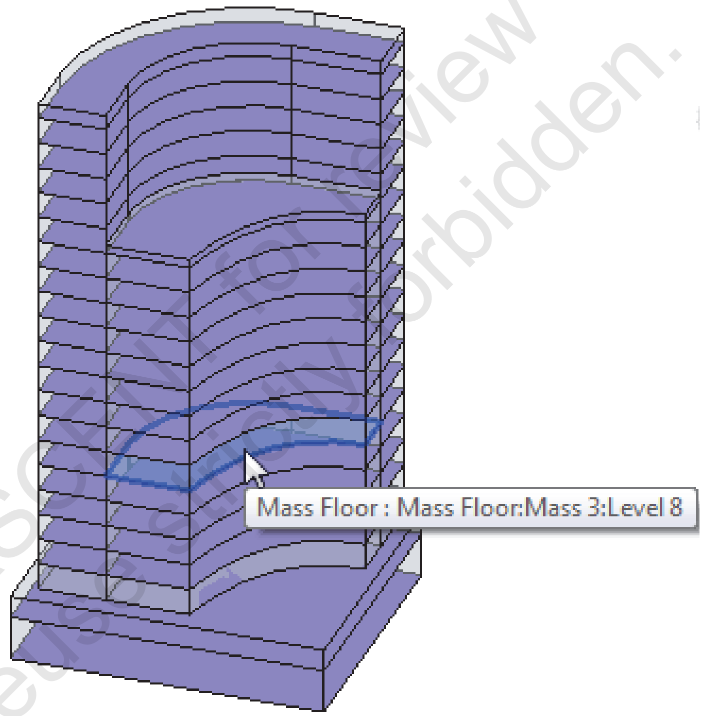


Figure 1–6

1.2 Placing Mass Elements

The most basic building blocks of massing are the mass families included with Revit. These include standard building block shapes, as shown in Figure 1–7, which can be resized using shape handles in plan, elevation, and section views, and in Properties for more precise sizing. These mass families need to be loaded into a project.

If you know you are going to use these families in your massing studies, you might want to preload them into a template.

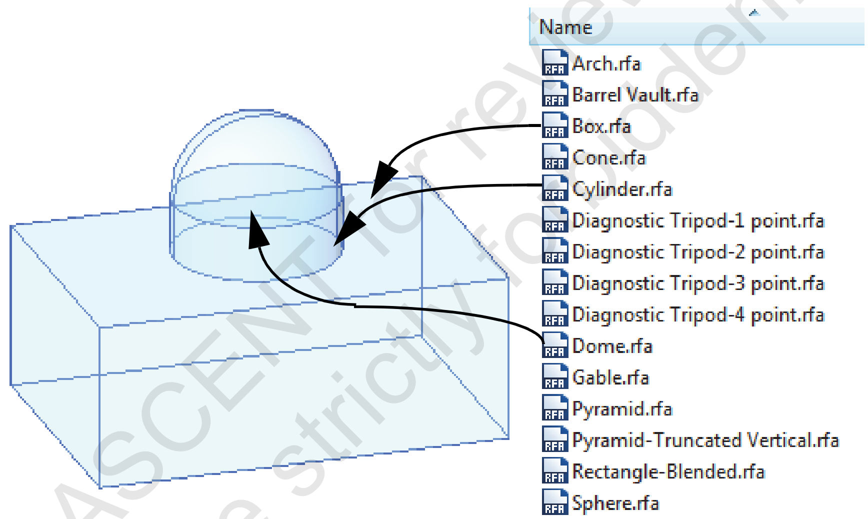


Figure 1–7

- Premade mass families are found in the Revit Library in the *Mass* subfolder.

Hint: Family Library Location

If you do not default to the Revit family folder location, click on the **Imperial Library** folder icon in the Places panel, shown in Figure 1–8 within the Open or Load Family dialog box.

By default, these families do not get downloaded or installed and require a separate installation. For that reason, the families required for the practices in this guide have been included with the guide's practice files.

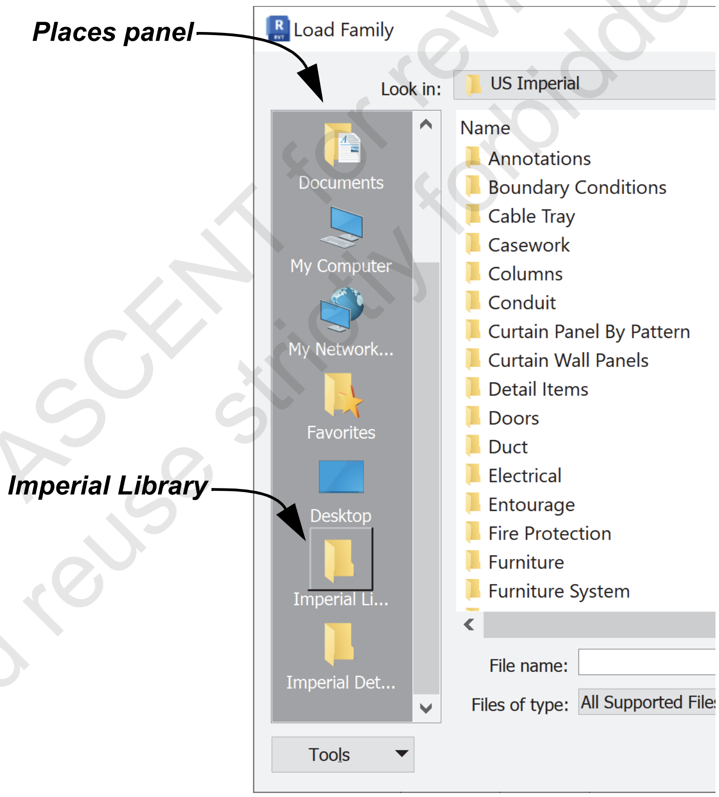


Figure 1–8

How To: Place Massing Elements

1. In the *Massing & Site* tab>Conceptual Mass panel, click  (Place Mass).

- If you have not already toggled on Show Mass mode from the Visibility/Graphic Overrides dialog box, an alert box displays stating the program has toggled it on automatically, as shown in Figure 1–9.

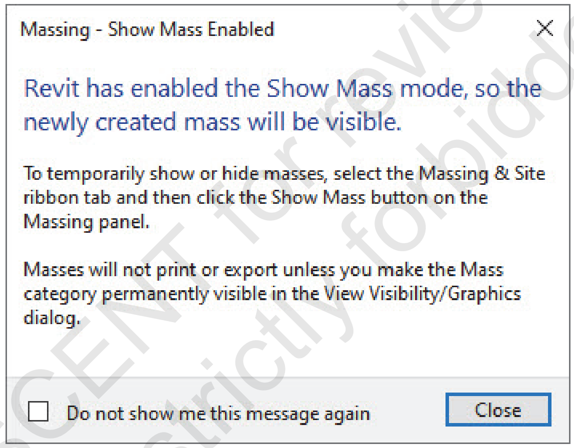


Figure 1–9

- If no mass family is loaded, you are prompted to load a family, as shown in Figure 1–10. Click **Yes** to open up the Load Family dialog box.

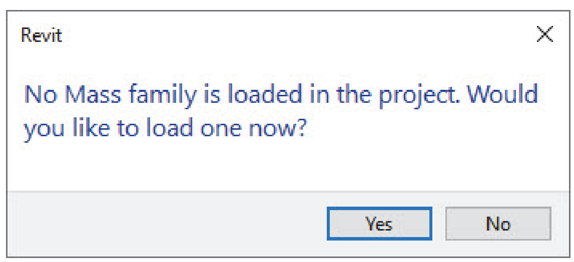


Figure 1–10

2. In the Type Selector, select a mass type, as shown in Figure 1–11.

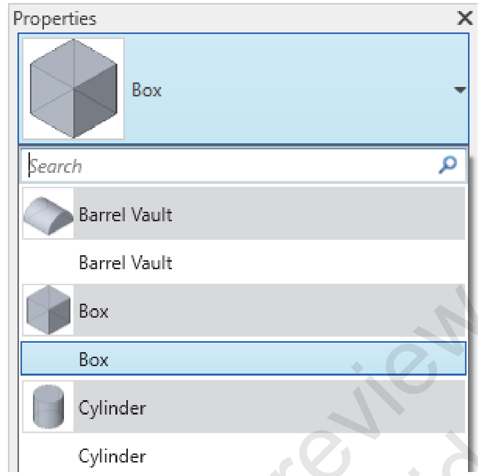


Figure 1–11

*Another element must be in the project for you to be able to use **Place on Face**.*

3. In the *Modify* | *Place Mass* tab>Placement panel, click either (Place on Face) or (Place on Work Plane). Pick a point on the screen to place the mass.
   - To rotate the mass before placing it, press <Spacebar> to rotate it in 90 degree increments.
   - To rotate the mass after you place it, select **Rotate after placement** in the Options Bar.

Modifying Basic Mass Elements

You can use Properties to modify an element's shape, material, and offset from host. You can also use shape handles to change the sizes of mass elements in plans or elevations (but not in 3D views), as shown in Figure 1–12. This method is not very precise but might be all that you need to do at this early stage of the conceptual design. The shape handle in the center flips the work plane.

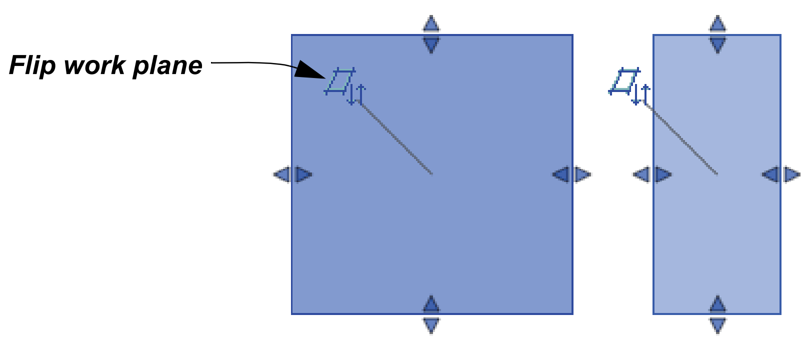


Figure 1–12

- Figure 1–13 shows the Properties for a box mass element. Dimension options vary according to the parameters of the shape.

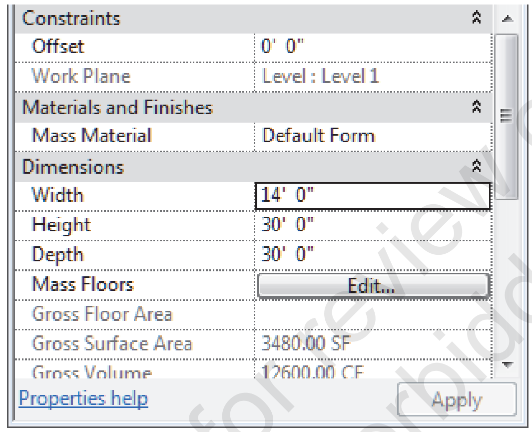


Figure 1–13

- If you want to move an existing mass element to a different work plane, in the *Modify* | *Mass* tab>Work Plane panel, click  (Edit Work Plane). Specify the new work plane in the Work Plane dialog box.

Applying Materials

The material (Default Form) for mass elements is transparent by default. Therefore, all of the edges of the mass are displayed, as shown using a Rectangle-Blended form in Figure 1–14.

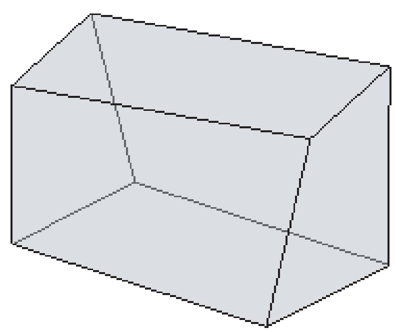


Figure 1–14

- To change the material for the entire mass element, select it and in Properties, change the **Mass Material** parameter (as shown in Figure 1–15) to a different material (as shown in Figure 1–16). This only works for the standard mass elements that are included in the library.

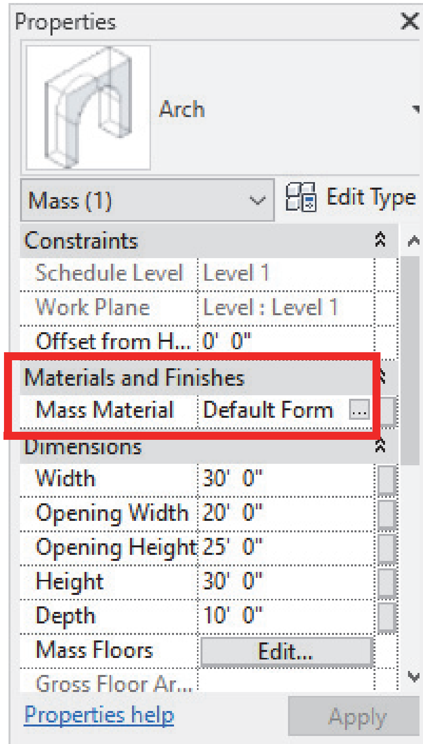


Figure 1–15

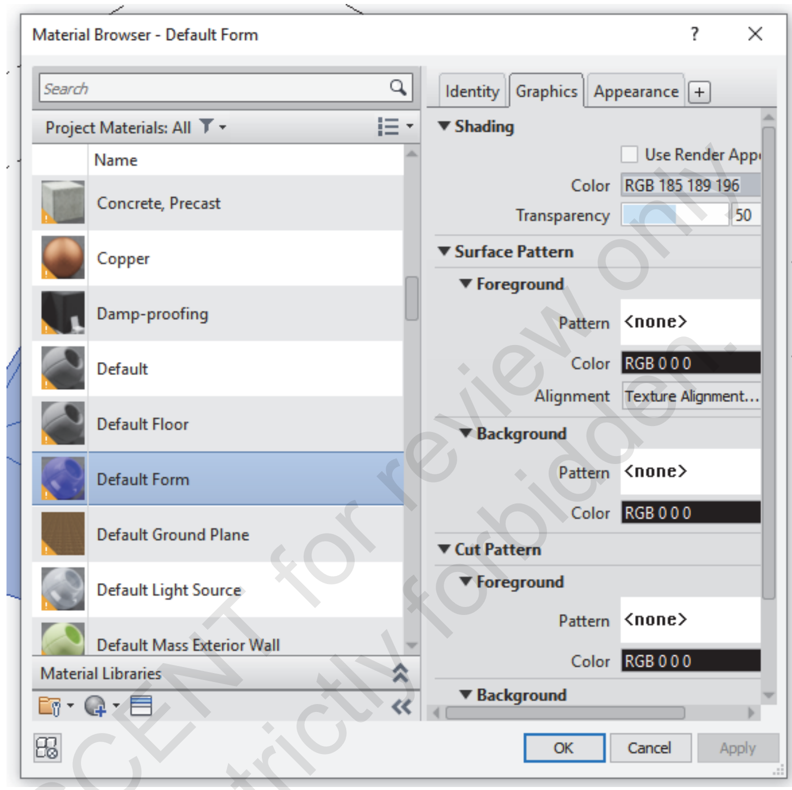


Figure 1–16

Practice 1a

Place Mass Elements

Practice Objective

- Add mass elements using existing mass families.

In this practice, you will use basic shapes from the massing families supplied with the Revit software to model existing buildings around a proposed site, as shown in Figure 1–17. The footprint and height for each mass are included on the toposurface.

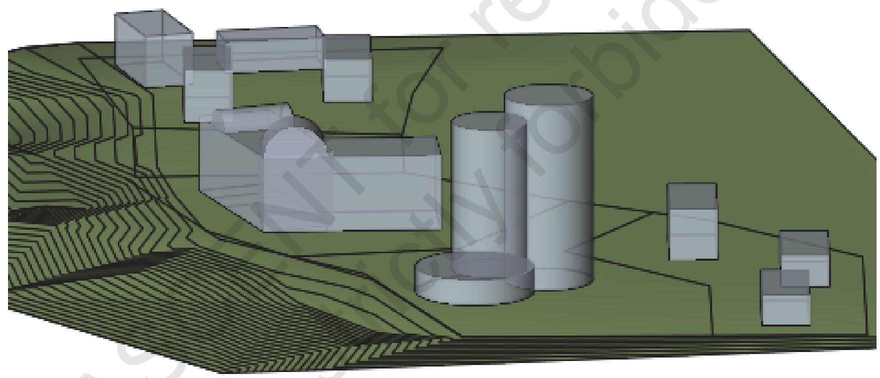


Figure 1–17

Task 1 - Add box mass elements.

1. In the practice files folder, open **Edmon-Towers.rvt**.
2. Open the **Floor Plans: Existing Site** view.
3. In the *Massing & Site* tab>Conceptual Mass panel, expand (Show Mass by View Settings) and click (Show Mass Form and Floors).
4. In the *Massing & Site* tab>Conceptual Mass panel, click (Place Mass). The Box mass element family is already loaded.
5. In the *Modify* | *Place Mass* tab>Placement panel, verify that (Place on Work Plane) is selected and place several box massing elements on the site plan where you see rectangular outlines, as shown in Figure 1–18.

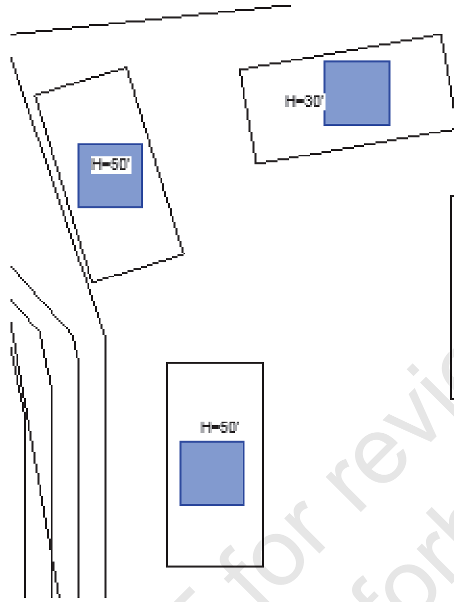


Figure 1–18

6. Click (Modify).
7. Select each box and use shape handles to resize them to fit the outline. For the angled sketches, rotate or align the boxes first. When you drag the shape handles, they automatically snap to nearby elements, as shown in Figure 1–19.
8. Use Properties to set the heights as indicated on the existing site plan, as shown in Figure 1–20.

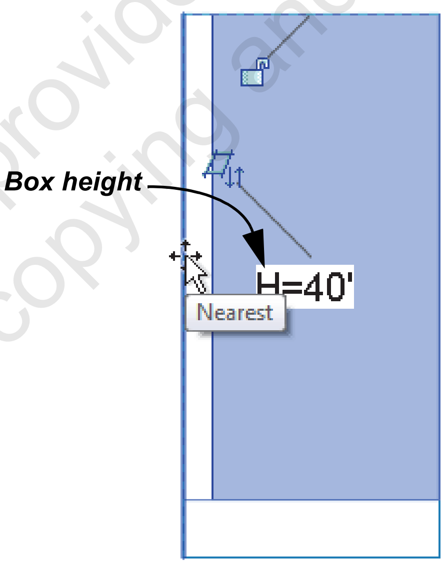


Figure 1–19

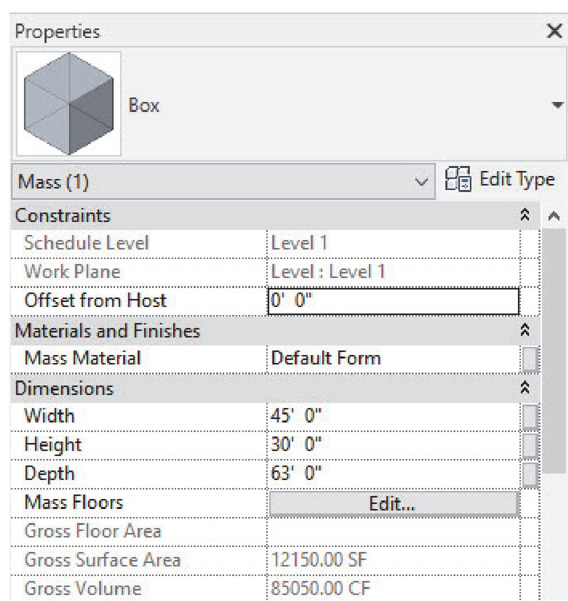


Figure 1–20

9. Repeat the process to add box mass elements to the rectangular sketches in the lower right side of the site.
10. Save the project.

Task 2 - Load and add other mass elements.

1. Click (Place Mass). In the *Place | Mass* tab>Mode panel, click (Load Family).
2. Navigate to the practice files *Families*>*Mass* folder, select **Barrel Vault.rfa** and **Cylinder.rfa**, and click **Open**.
3. In the Type Selector, select **Cylinder**.
4. Click (Place on Work Plane), then to position the Cylinder masses at the center of the existing circles, type **SC** (Snap Center) and select the edge of the circle to place it. Place the Cylinder mass on the three circles.
5. Click (Modify).
6. Change the radius by stretching the grips and heights to match the plan, as shown in Figure 1–21.

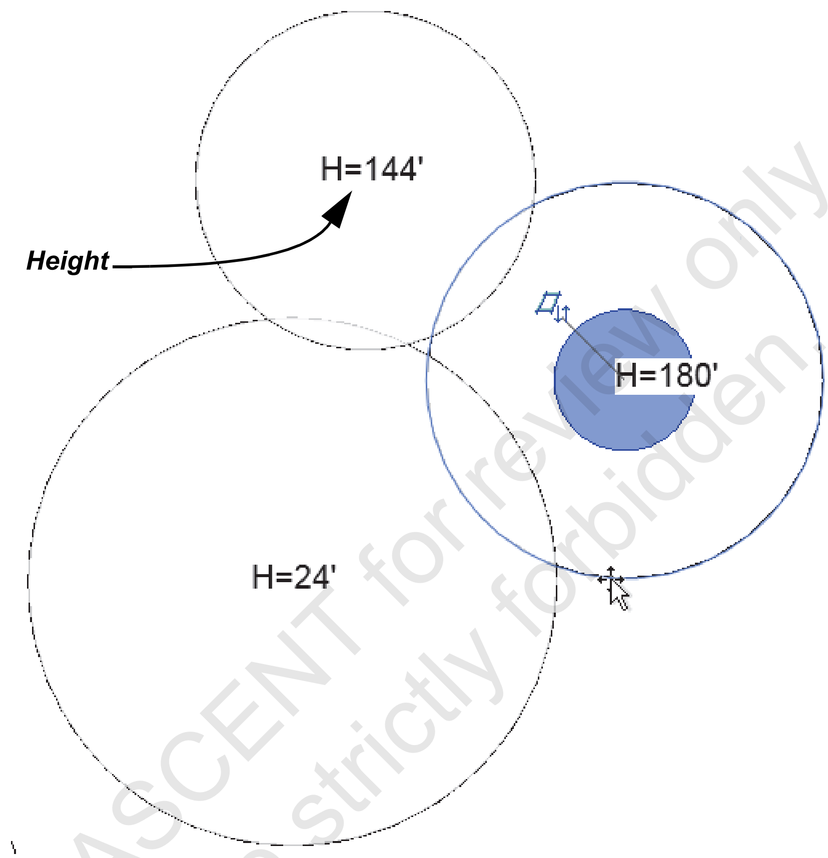


Figure 1–21

If greater accuracy is required, an in-place mass could be created to match the building footprint. For this practice, use two boxes.

7. For the angled building, use two box masses to create the base building, as shown in Figure 1–22. The two masses need to overlap slightly. Set the height of both of them as shown in the plan view.

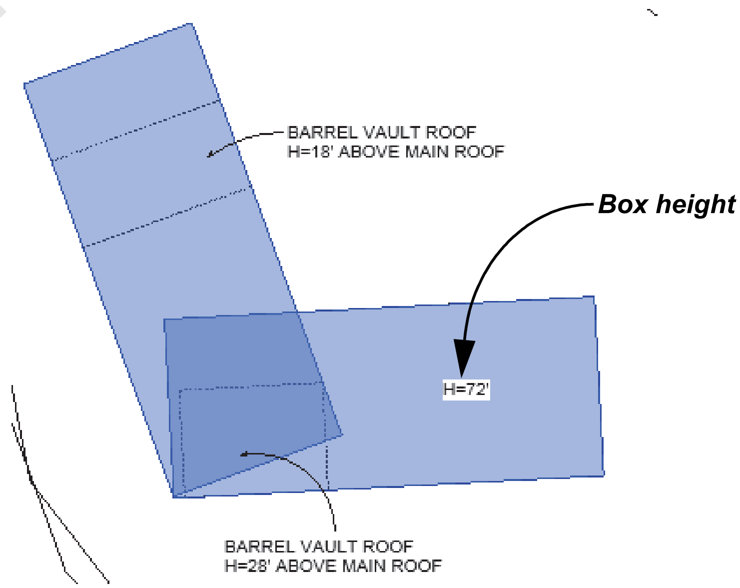


Figure 1–22

8. Add two barrel vault mass elements using (Place on Face) to place them on the top of the box elements.

9. Click (Modify).

10. Align them and then use shape handles to position them, as shown in Figure 1–23.

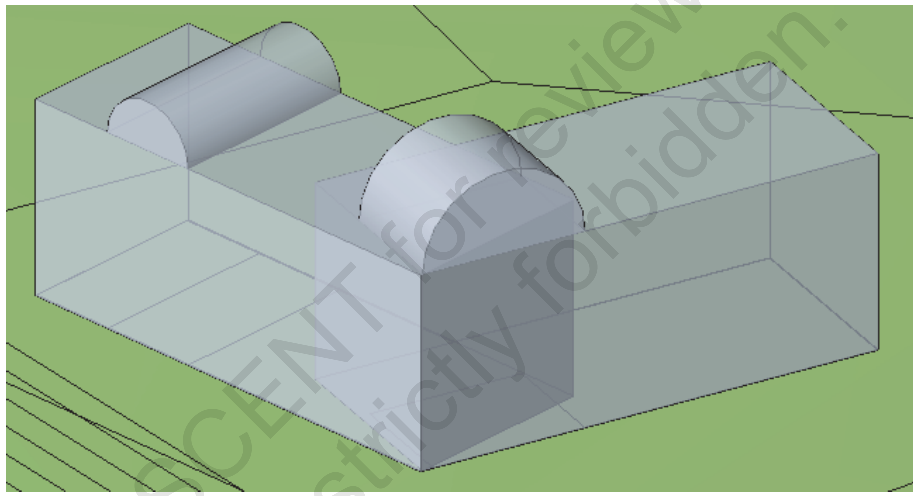


Figure 1–23

11. View the project in 3D.

12. Save the project.

1.3 Creating Conceptual Massing

If you want to use a massing element more than once in a project, you should create a separate mass family.

To create custom massing elements, you need to start with an in-place mass where you can create a 3D form from 2D sketches. Masses can be made up of solid and void forms, as shown in Figure 1–24.

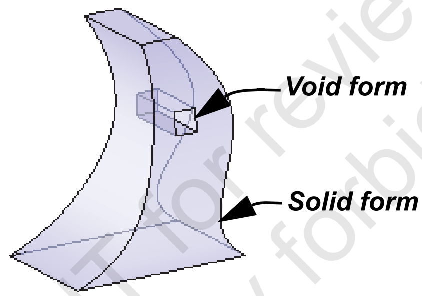


Figure 1–24

Forms are created from a mixture of profiles, paths, and points. For example, one profile becomes an extrusion, as shown in Figure 1–25, while a profile, a point, and a path become a sweep, as shown in Figure 1–26.

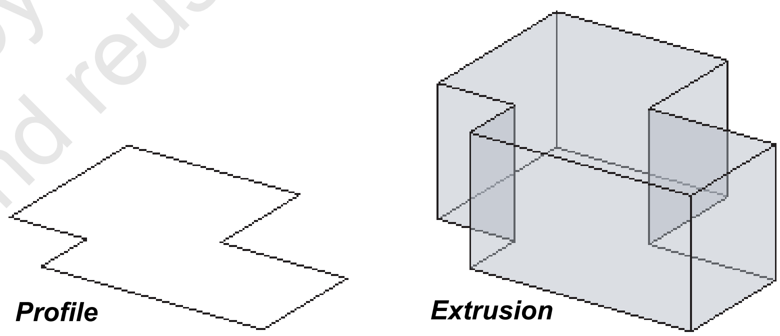


Figure 1–25

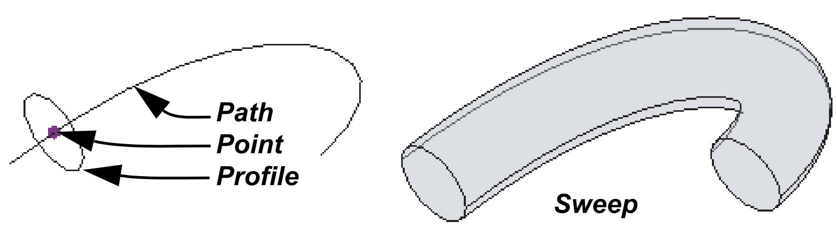


Figure 1–26

How To: Create an In-Place Mass (Overview)

1. In a project, in the *Massing & Site* tab>Conceptual Mass panel, click (In-Place Mass).
2. In the Name dialog box, set a new name for the mass.
3. In the *Create* tab>Draw panel, click (Model) and use the draw tools to sketch the profiles, paths, and points that make up the form.
   - Use (Reference Line) or (Reference Plane) as guidelines to help you draw the sketches.
4. Select the profile as well as any related path or points.
   - For the profile, ensure that you select the chain of lines, as shown in Figure 1–27, instead of individual sketch lines, as shown in Figure 1–28

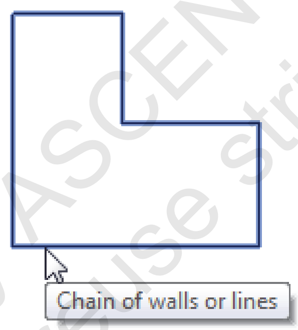


Figure 1–27

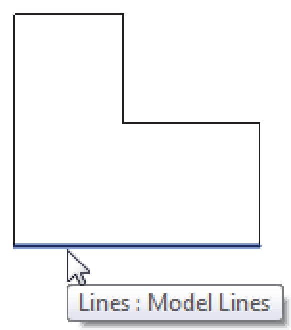


Figure 1–28

5. In the *Modify | Lines* tab>Form panel, expand (Create Form) and select (Solid Form) or (Void Form).
   - A closed profile becomes a solid and an open profile becomes a surface, as shown in Figure 1–29.

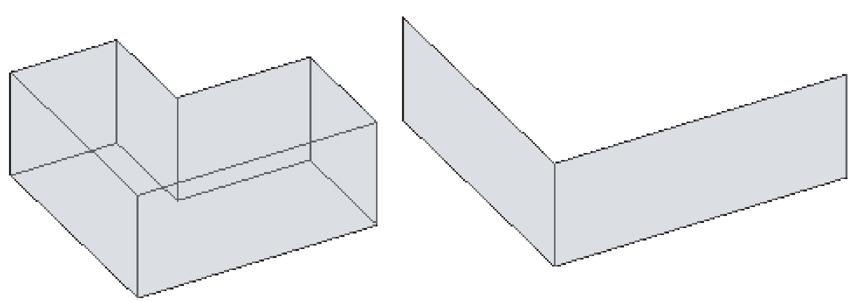


Figure 1–29

6. Click (Finish Mass).

Types of Forms

Six different types of forms can be created, as shown in Figure 1–30.

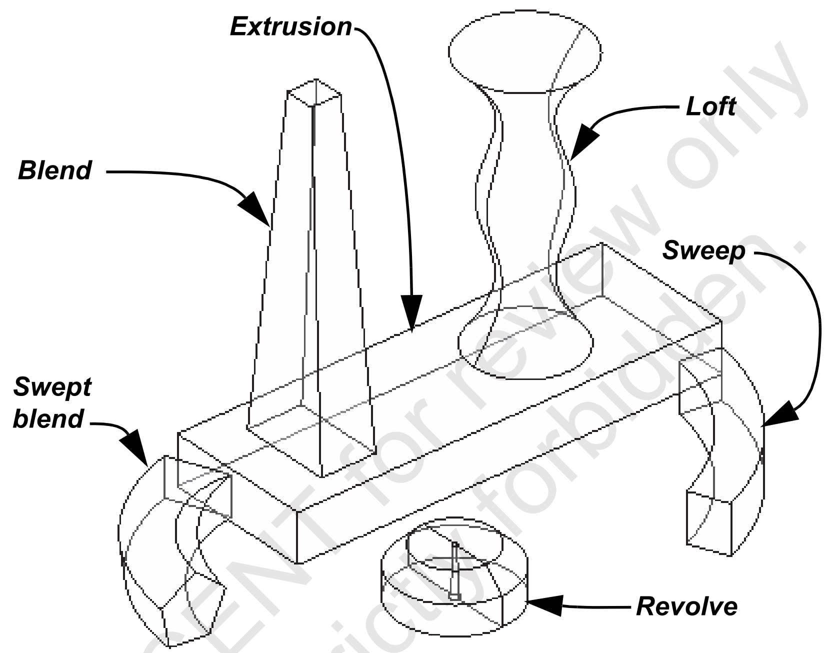


Figure 1–30

Extrusions

An extrusion pushes a single profile in one direction. Although the default extrusion height is preset, you can modify it using the 3D control or temporary dimensions in a 3D view, as shown in Figure 1–31.

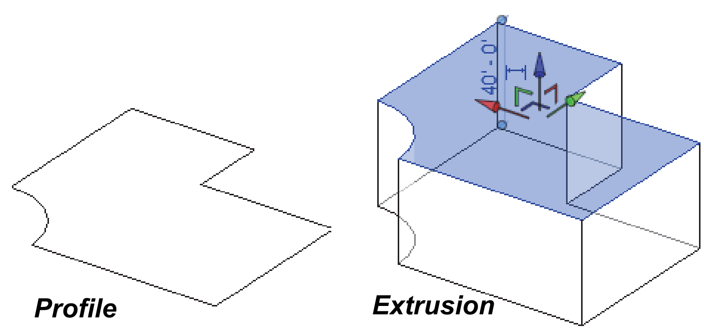


Figure 1–31

- Some profile shapes, such as a circle, have options for the shape of the form. Select the shape from the options displayed on the screen, as shown in Figure 1–32.

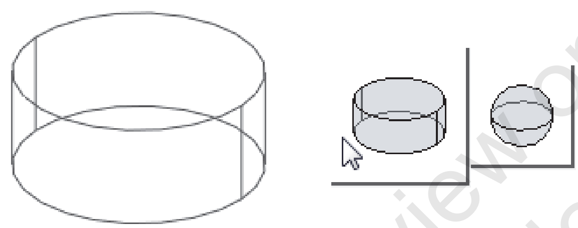


Figure 1–32

Blends

A blend links two profiles together. It is similar to an extrusion but is created when you select two profiles in different planes, as shown in Figure 1–33.

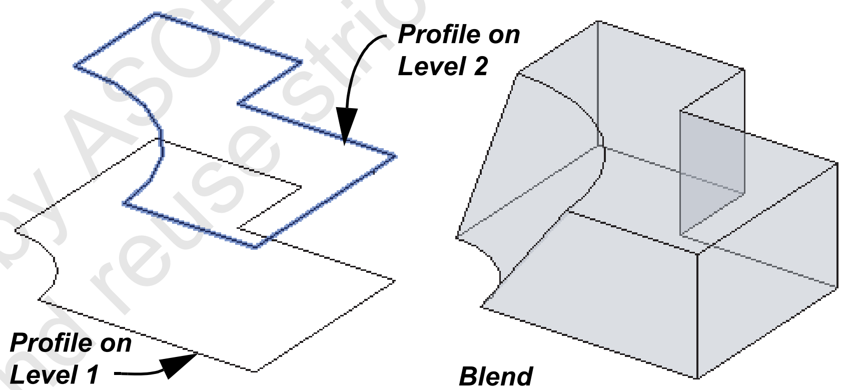


Figure 1–33

Lofts

A loft connects multiple profiles that do not need to be on parallel planes.It is created when you select more than two profiles in different planes, as shown in Figure 1–34.

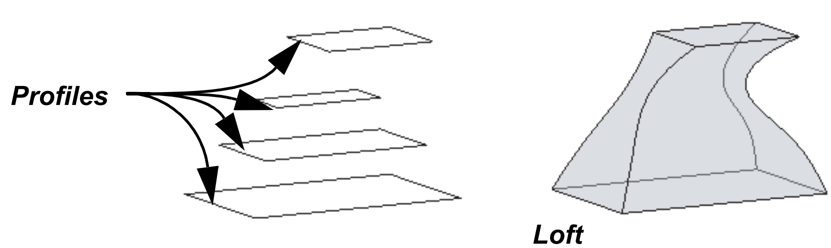


Figure 1–34

Revolves

A revolve rotates a profile about an axis. It is created when you select an axis and a profile that are both in the same plane, as shown in Figure 1–35.

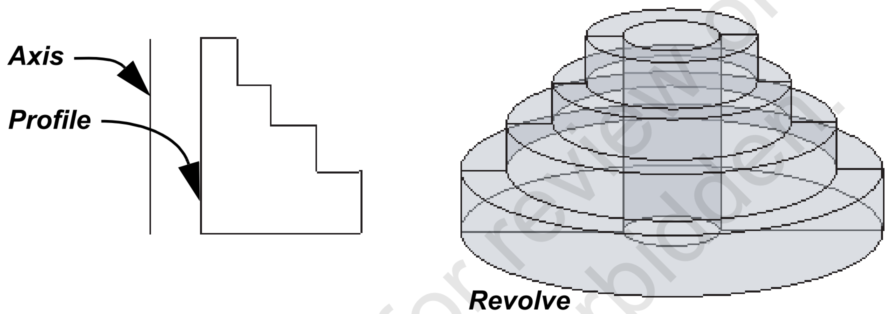


Figure 1–35

- When the axis is away from the profile, a hole is generated in the center of the revolve. To create an entirely closed shape, use a reference line for the axis, as shown in Figure 1–36.
- By default, a full circle form is created. To change this, you can select the start edge of the profile, as shown in Figure 1–36, and use the gold arrows to open it, as shown in Figure 1–37.

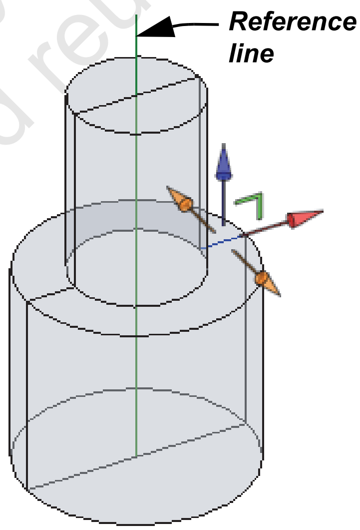


Figure 1–36

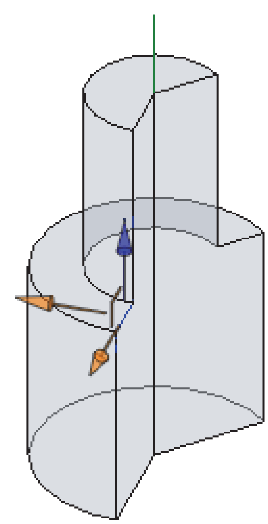


Figure 1–37

- You can also modify the *Start Angle* and *End Angle* in Properties, as shown in Figure 1–38.

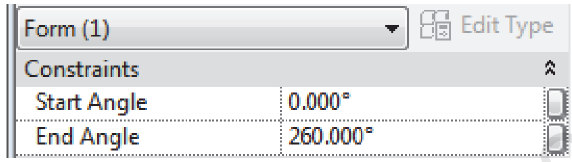


Figure 1–38

Sweeps and Swept Blends

A sweep extends a profile along a path. It is created when you select a path and a profile, as shown in Figure 1–39. The point element defines the location of the profile on the path.

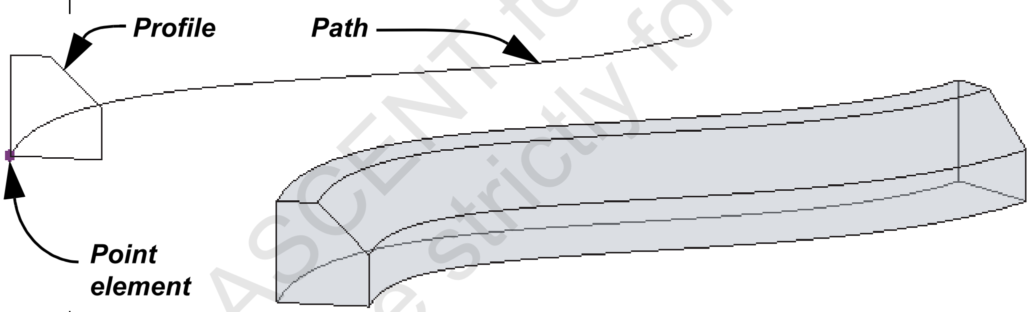


Figure 1–39

A swept blend connects two profiles along a path. It is created when you select a path connecting two profiles in different planes, as shown in Figure 1–40.

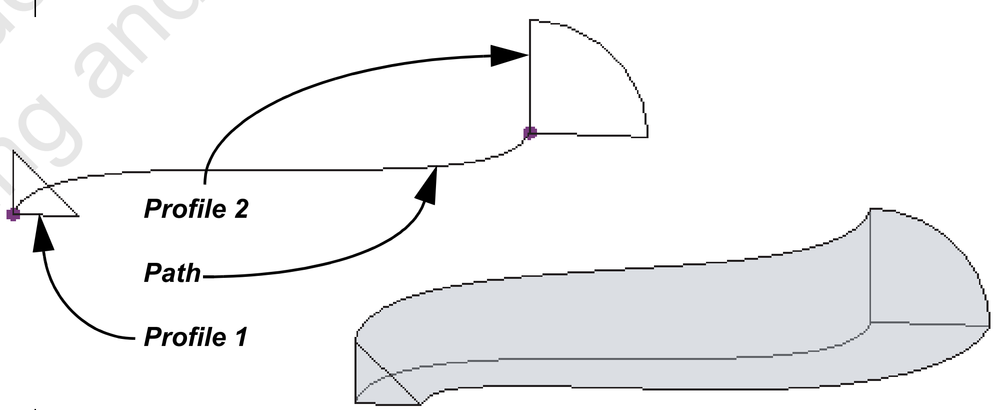


Figure 1–40

How To: Create Sweeps and Swept Blends

1. In the *Modify* | *Place Lines* tab>Draw panel, click (Model).
2. Use the drawing tools to sketch a path for the sweep to follow.
   - A single-segment path can be used with an open or closed profile. A multi-segment path requires a closed profile.
   - A swept blend can only be made from a single-segment path but you can use arcs and splines to create it.
3. In the Draw panel, click (Point Element) and click on the path.
   - For a sweep, place a point at one end of the path.
   - For a swept blend, place a point at each end of the path.
4. Open a 3D view if you are not already in one.
5. Click (Modify) and select the point element. A reference plane perpendicular to the path is displayed. It becomes the work plane on which you can draw the profile for a sweep, as shown in Figure 1–41.

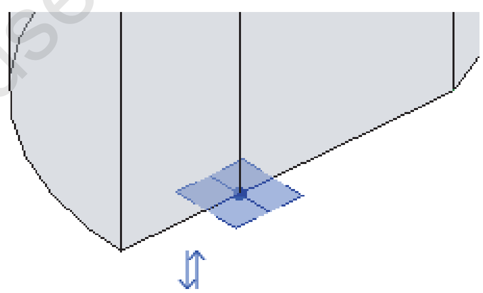


Figure 1–41

6. Use the drawing tools to sketch a profile on the new reference plane.
7. For a swept blend, repeat the process of drawing a profile on the other end of the path.
8. Click (Modify) and select both the path and the profile(s).
9. In the *Modify* | *Multi-select* or *Lines* tab>Form panel, click (Create Form).

Void Forms

The process of creating void forms is essentially the same as the one for creating solid forms. The only difference is that void forms are designed to be inside a solid form so that it has a solid element to cut out, as shown in Figure 1–42.

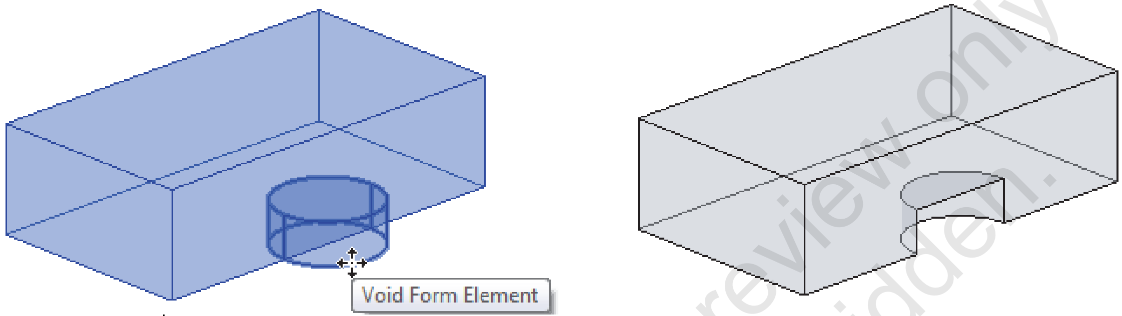


Figure 1–42

You can change a form from solid to void. Select the solid form and in Properties in the *Identity Data* area, change the *Solid/Void* parameter, as shown in Figure 1–43.

This change can only be done to in-place mass forms.

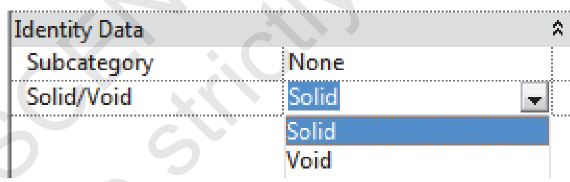
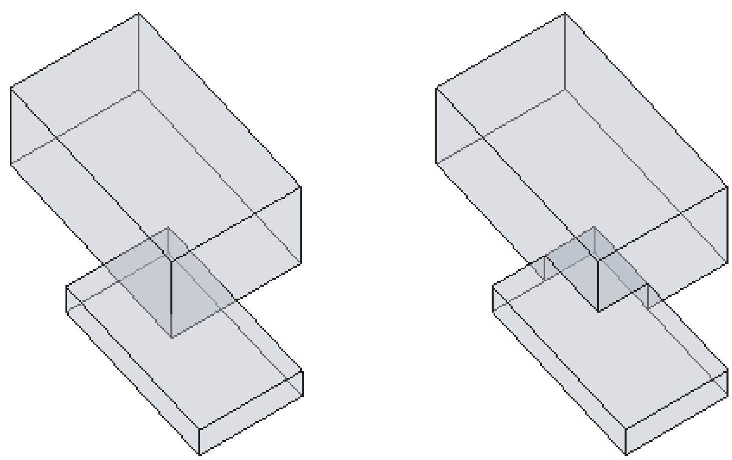


Figure 1–43

Hint: Cutting Solid Forms with Other Solid Forms

If you have two solid forms that overlap, you can use  (Cut Geometry) to cut out one of the forms, as shown in Figure 1–44.



Before cut ***After cut***

Figure 1–44

- The first form selected is cut and the second form selected remains as is.

1.4 Setting the Work Plane

Profiles and paths are the building blocks of the mass form elements. They are sketched on the current work plane which can be a face, as shown in Figure 1–45, or a specified work plane, as shown in Figure 1–46.

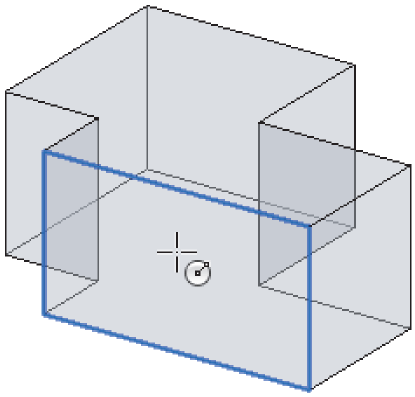


Figure 1–45

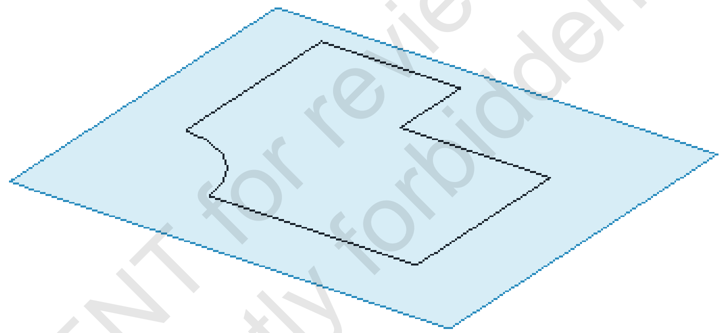


Figure 1–46

- If you are in a plan view, the related level is the active work plane by default.

How To: Establish a Work Plane by Face

1. In the *Create* tab>Draw panel, select a sketching tool.
2. In the *Modify* | *Place Lines* tab>Draw panel, click  (Draw on Face). This is typically selected by default.
3. Hover the cursor over the face of an existing element. It highlights and you can then draw the sketch, as shown in Figure 1–47.

Sketches can be locked to faces.

Press <Tab> to cycle through nearby faces.

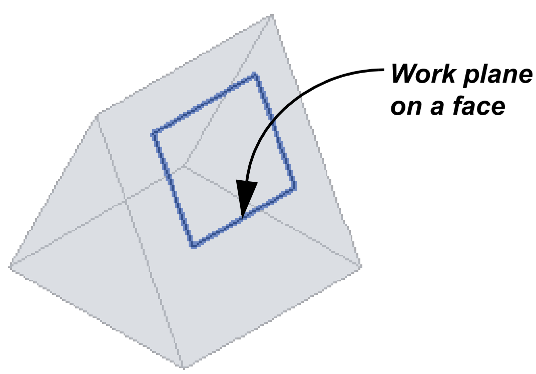


Figure 1–47

4. You can move directly to another face and continue drawing sketches.

How To: Establish a Work Plane by Placement Plane

To display the work plane in a view, in the Work Plane panel, click (Show).

1. In the *Create* tab>Draw panel, select a sketching tool. The active work plane displays with a heavy outline.
2. In the *Modify | Place Lines* tab>Draw panel, click (Draw on Work Plane).
3. In the Options Bar, in the *Placement Plane* drop-down list, select a *Level* or named reference plane, as shown in Figure 1–48.

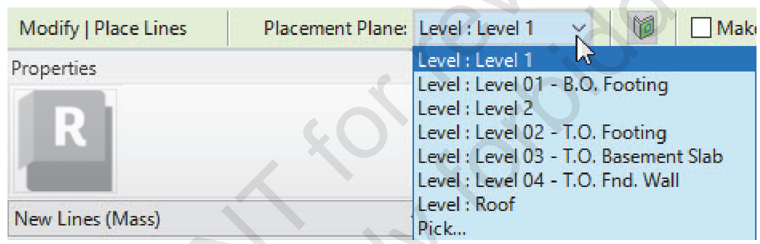


Figure 1–48

- This list varies according to the elements contained in the massing study.

4. Draw the sketch on the plane, as shown in Figure 1–49.

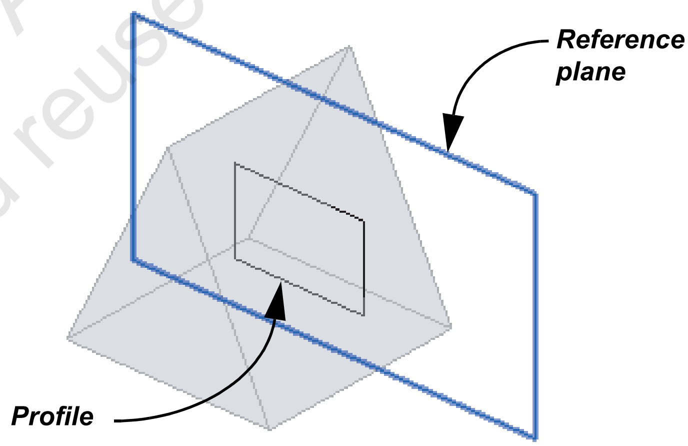


Figure 1–49

- If you have used the **Pick...** option, the selected face becomes the active work plane.

Hint: Naming Reference Planes

You can name reference planes so that they can be specified as a work plane. Select the reference plane and <*Click to name*> or in Properties, set a *Name*, as shown in Figure 1–50.

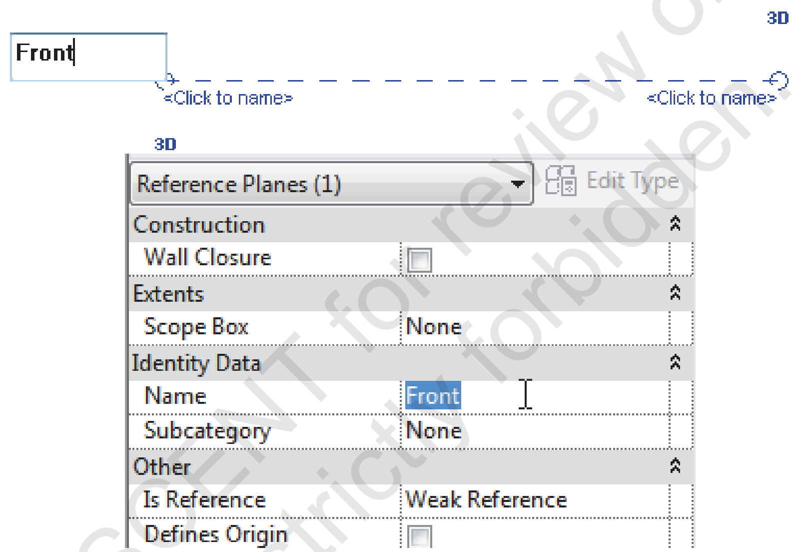


Figure 1–50

How To: Change the Work Plane of a Sketch or Form

1. Select the sketch or form.
2. In the Options Bar, click **Show Host**. The host work plane highlights, as shown in Figure 1–51.
3. In the Host drop-down list, select a new host for the sketch. The sketch moves to the selected plane.

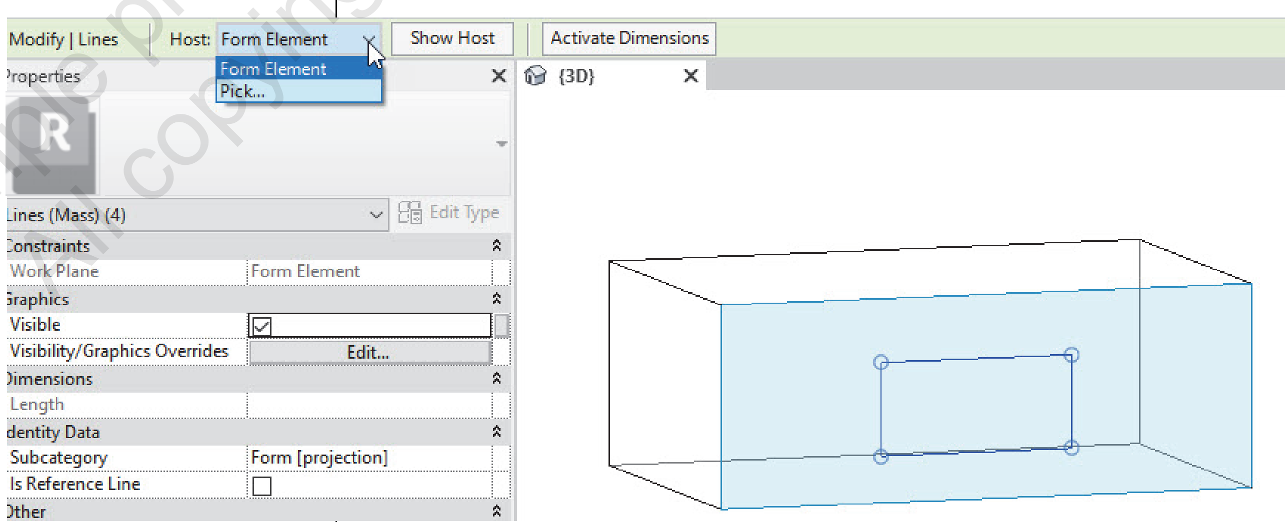


Figure 1–51

Practice 1b Create Mass Forms

Practice Objectives

- Create an extruded mass form.
- Create a lofted mass form.
- Add a swept void form.

In this practice, you will create two towers in a massing study. For one building, you will extrude a mass form using a simple profile. For the other building, you will create a lofted form using a variety of profiles at different levels and then add a void form using a swept profile, as shown in Figure 1–52.

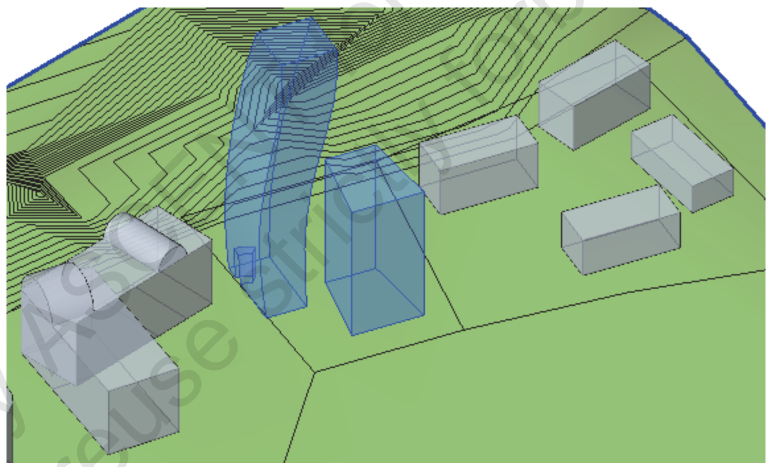


Figure 1–52

Task 1 - Create an extruded in-place mass.

1. In the practice files folder, open **Edmon-Towers-New.rvt**.
2. Open the **Floor Plans: New Site** view. This view displays the new site area, as shown in Figure 1–53.

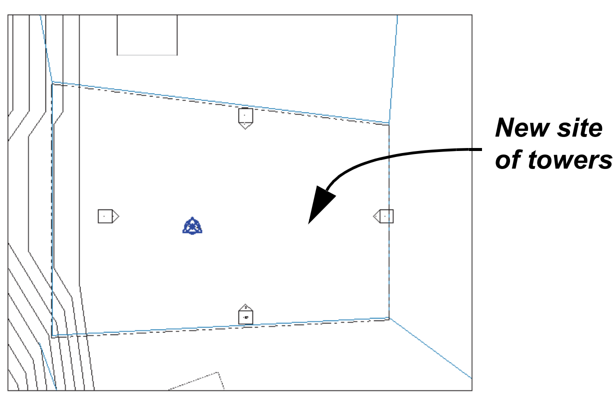


Figure 1–53

3. In the *Massing & Site* tab>Conceptual Mass panel, click (In-Place Mass).
4. The Massing - Show Mass Enabled dialog box, shown in Figure 1–54, displays. Read it and click **Close** to continue with creating a mass.

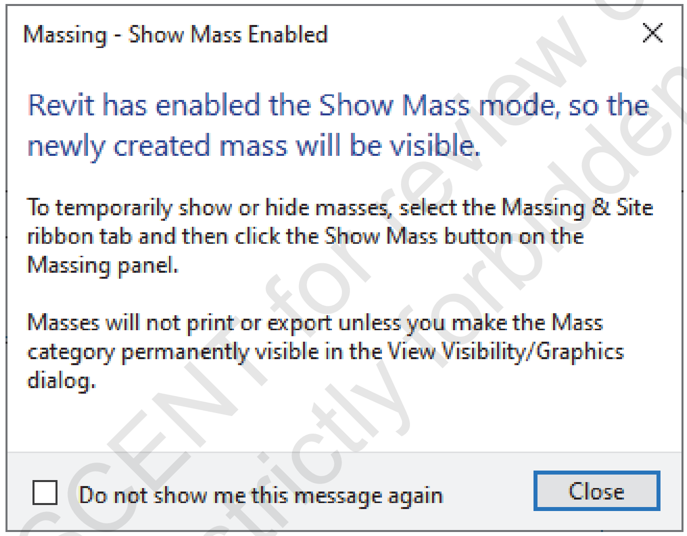


Figure 1–54

5. In the Name dialog box, enter **Tower-1** and click **OK**.

Add reference planes first, if needed.

6. In the *Create* tab>Draw panel, click (Model) and then click (Line).
7. In the northwest quadrant of the new site, draw a trapezoid shape that is roughly **80' x 60'**, as shown in Figure 1–55.

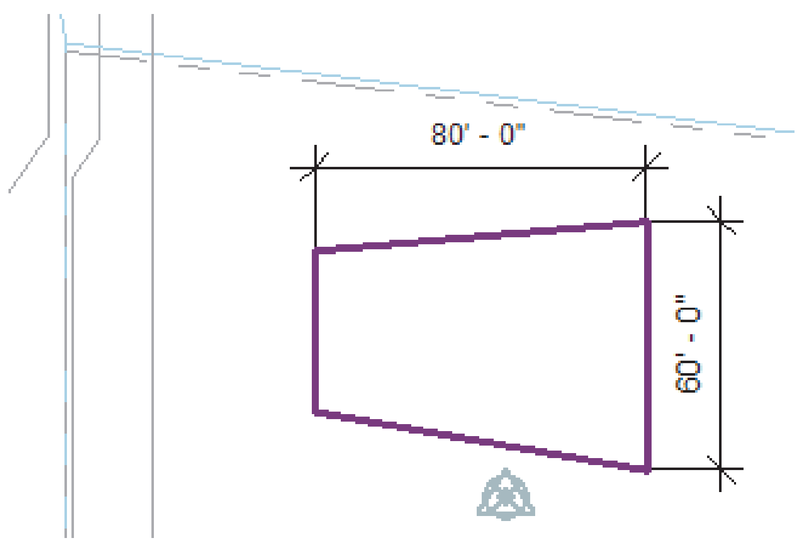


Figure 1–55

8. Open the default 3D view.
9. Select the lines. In the *Modify | Lines* tab>Form panel, click (Create Form). Revit extrudes the profile to create a solid form.
10. In the 3D view, select the blue temporary dimension and change it to **140'**.
11. In the *Modify* tab>In-Place Editor panel, click (Finish Mass).

Task 2 - Create levels.

1. Open the **Elevations (Building Elevation): East** view and zoom in to see the level markers.
2. Set the *elevation* of **Level 2** to **18'**.
3. Set the *name* of the existing **Roof** level to **Level 3**, and its *elevation* to **30'**. Click **Yes** when prompted to rename any corresponding views.
4. Select the newly named **Level 3**.
5. In the *Modify* | *Levels* tab>Modify panel, click (Array). In the Options Bar, set the following, as shown in Figure 1–56:
   - Clear the **Group and Associate** option
   - *Number*: **30**
   - *Move To*: **2nd**

Figure 1–56

6. Create an array of **30 levels**, **12'-0"** apart.
7. Click (Modify) and type **ZE** to zoom out to the extents of the view.

Task 3 - Create a lofted in-place mass.

1. Return to a 3D view.
2. Create a new in-place mass named **Tower-2**.

3. In the *Create* tab>Draw panel, click (Model) and then click (Rectangle).
4. In the Draw panel, click (Draw on Work Plane).
5. In the Options Bar, verify that *Placement Plane* is set to **Level: Level 1**.
6. Draw a **40' x 80'** rectangle south of the **Tower-1**.
7. In the Options Bar, change *Placement Plane* to **Level: Level 10**.
8. Draw another rectangle. Line up at least one of the sides with the rectangle that was drawn at Level 1. Note that when you hover the cursor over the lines on the active work plane, they highlight.
9. Repeat the process at **Level 20** and **Level 30**, varying the size at each level.
10. Click (Modify) and select the four rectangles.
11. In the *Modify | Lines* tab>Form panel, click (Create Form). The new tower displays as shown in Figure 1–57. Your design will vary according to the profiles you drew.

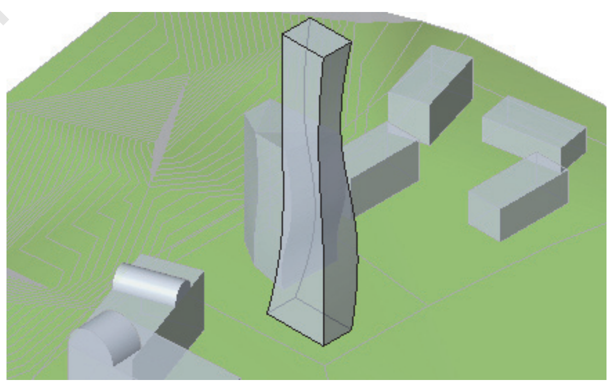


Figure 1–57

12. In a plan view, move one or both of the new massing forms so they do not overlap, if needed.
13. Do not save the project yet because you want to remain in the same in-place mass element.

Task 4 - Add a void form.

1. In a 3D view, zoom in to the base of the new tower.
2. Click (Model) and then select one of the arc drawing tools. In the Options Bar, set the *Placement Plane* to **Level: Level 1**.
3. Draw an arc, as shown in Figure 1–58. This is the path for a sweep. It needs to start outside the existing mass to create the expected void form.

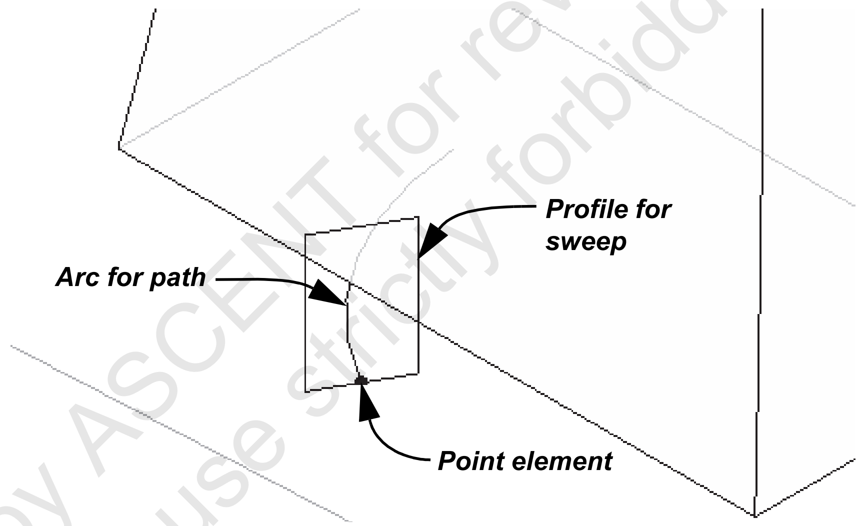


Figure 1–58

4. In the Draw panel, click (Point Element).
5. Add a point at one end of the arc if you want to draw a sweep, and at both ends of the arc if you want to draw a swept blend.
6. Click (Modify) and select the point element.
7. Draw the profile for the sweep.
8. Repeat the process with the other point element if you are creating a swept blend.
9. Click (Modify) and select the path and profile(s).

10. In the Form panel, expand (Create Form) and click (Void Form).

    The new void form is cut out of the existing solid form, as shown in Figure 1–59.

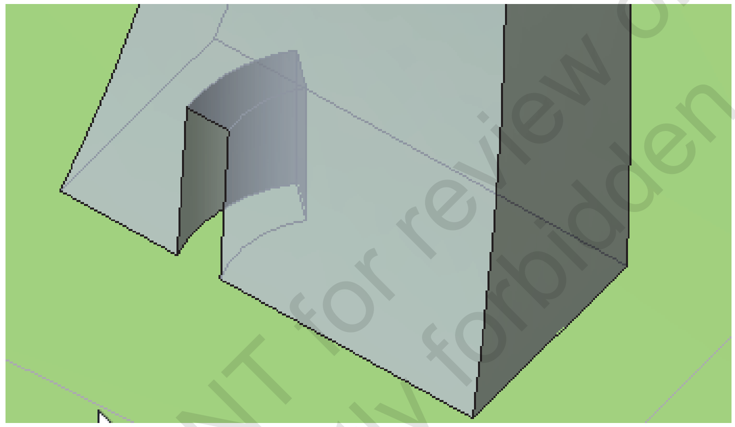


Figure 1–59

11. Click (Finish Mass).
12. Zoom out to see the entire site with the new towers.
13. Save and close the project.

1.5 Dynamic Editing for Conceptual Massing

When a completed in-place mass element is selected, you can modify the length of its faces by dragging the controls, as shown in Figure 1–60. However, for more precise modification, you can edit the mass in-place, as shown in Figure 1–61.

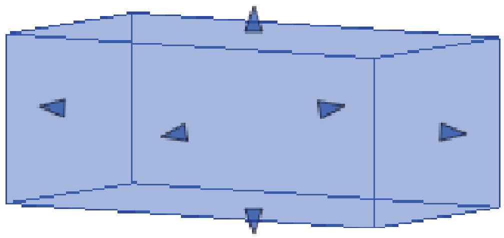


Figure 1–60

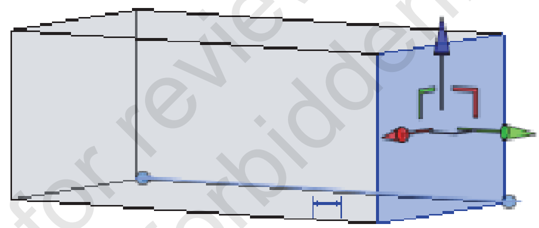


Figure 1–61

Double-click on an in-place mass, or select it and in the *Modify | Mass* tab>Model panel, click  (Edit In-Place). In the Edit In-Place mode, you have direct access to the surface, edges, and vertices of a solid or void form, as shown in Figure 1–62. You can quickly and easily manipulate these sub-elements and create new edges and profiles.

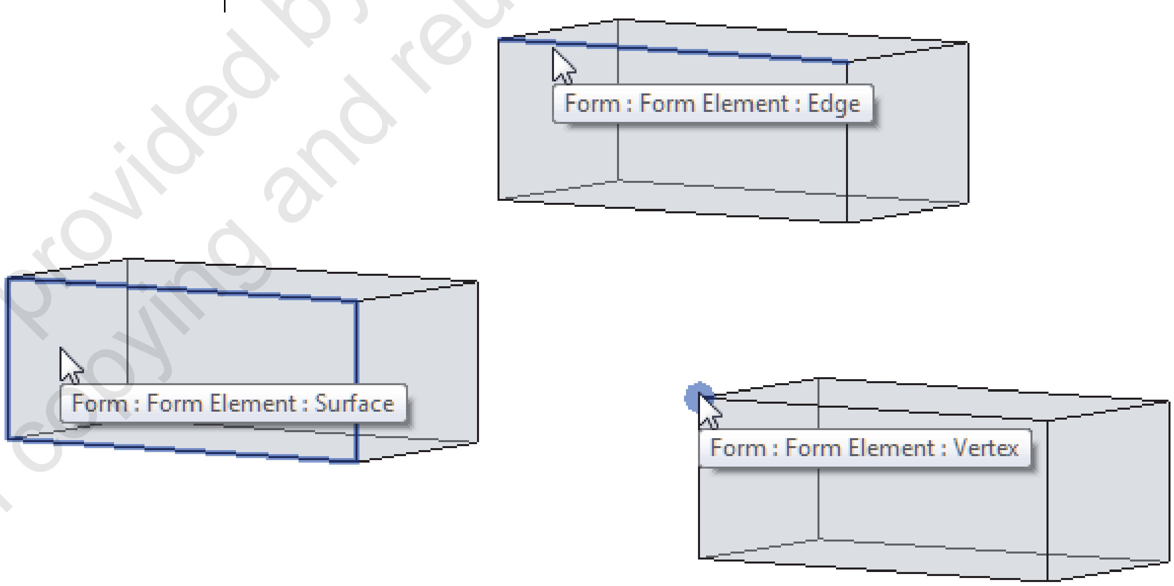


Figure 1–62

- Press <Tab> to cycle between sub-elements to select the right one.
- Predefined masses that you load from the Revit library do not have dynamic editing capabilities.

Using the 3D Control

When a face, edge, or vertex is selected, the 3D control is displayed.

- To move a selected sub-element directly along an axis, select one of the arrows and drag it in the appropriate direction, as shown in Figure 1–63.
- To move a selected sub-element along a plane (as shown in Figure 1–64), click and drag the plane indicator.

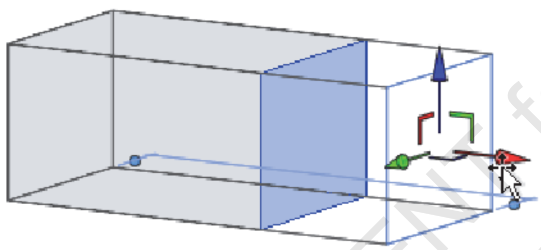


Figure 1–63

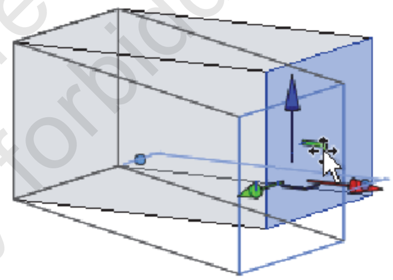


Figure 1–64

Other Modification Options

- You can use (Move) and (Rotate) when you select a face, an edge, or a vertex. In the example shown in Figure 1–65, the face has been rotated.

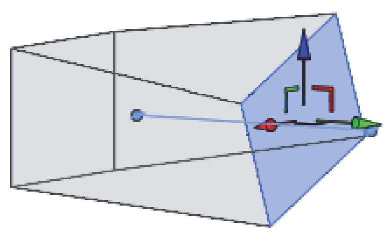


Figure 1–65

- To remove a face, an edge, or a vertex, select it and click (Delete), or press <Delete>. In the example shown in Figure 1–66, a vertex has been selected and deleted.

Figure 1–66

- You can lock a mass element so that the profiles in a form work together rather than separately. Select at least one part of the form and, in the *Modify* | *Form* tab>Form Element panel, click (Lock Profiles).
- When you select an edge and the form is not locked, only the selected edge moves, as shown in Figure 1–67. If you lock the form and move the same edge, the entire form based on that profile moves, as shown in Figure 1–68.

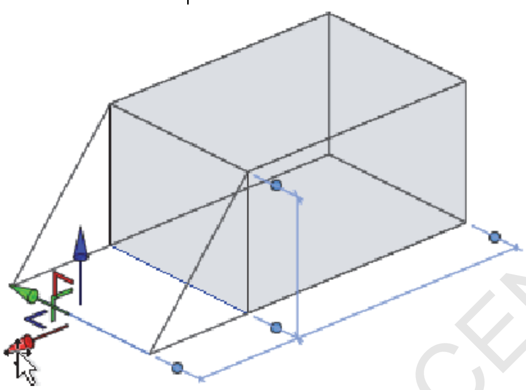


Figure 1–67

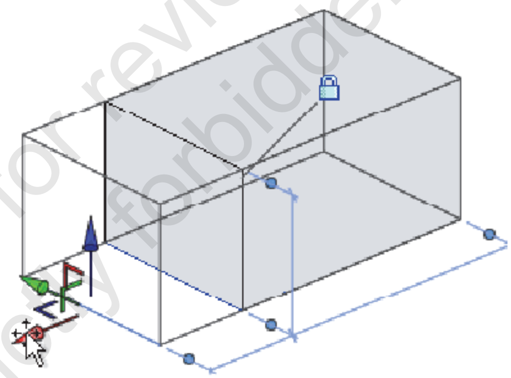


Figure 1–68

- To return the form to its component parts, select the mass element, and in the *Modify* | *Form* tab>Form Element panel, click (Dissolve). Once you have done this, remake the entire form again.

Hint: Use X-Ray to Display a Form's Geometric Framework

Vertices, profiles, and paths do not automatically display while editing forms. In X-Ray mode, the surfaces of a form are transparent and all of the key geometric datums display, as shown in Figure 1–69.

- To enable X-Ray mode, first select a form. Note that you might need to hover the cursor over the edge and press <Tab> until a form has been highlighted. With the form selected, in the *Modify* | *Form* tab>Form Element panel, click  (X-Ray).

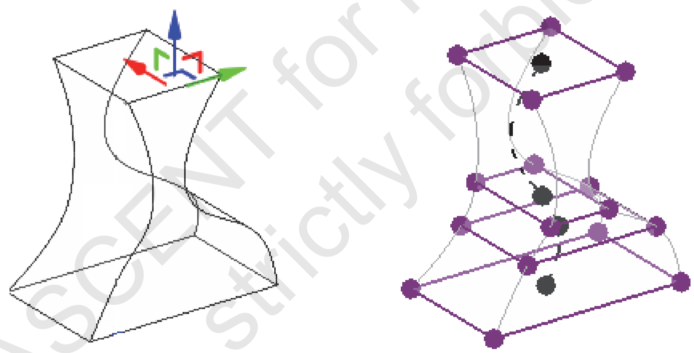


Figure 1–69

- To toggle off X-Ray mode, select the form again and click  (X-Ray).
- Only one form can have X-Ray mode on at a time.

1.6 Working with Profiles and Edges

While a lot can be done to manipulate mass elements using the dynamic editing tools, there are some additional commands where you can do more precise and complex editing, as shown in Figure 1–70. These include editing and adding a profile, adding edges, dividing surfaces, and splitting faces.

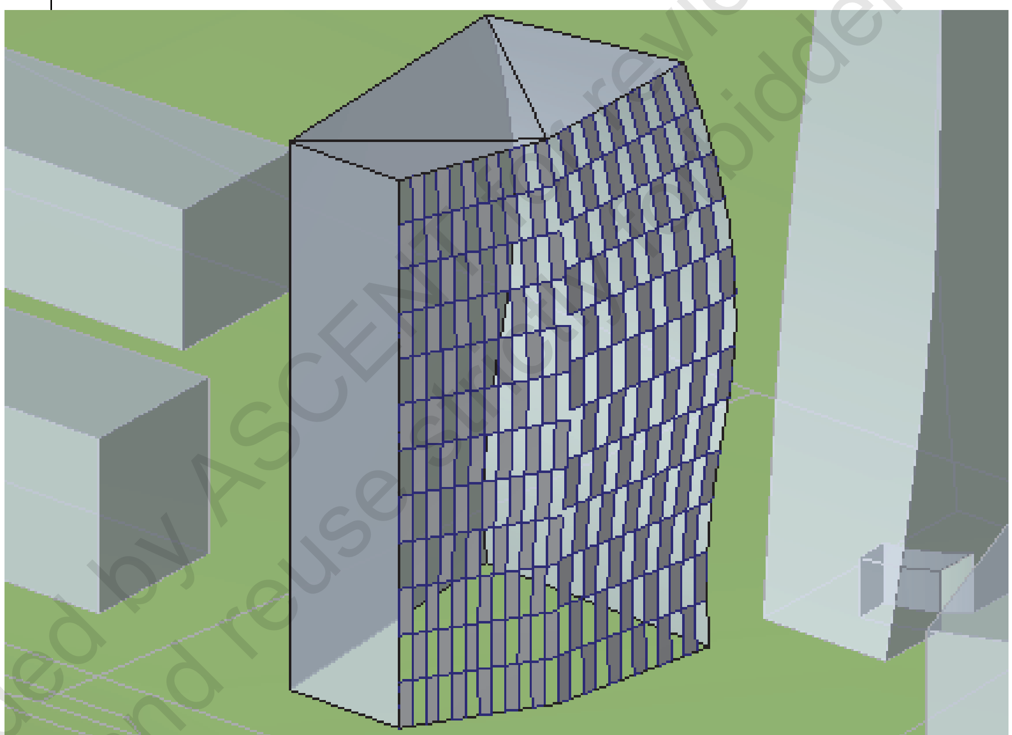


Figure 1–70

Editing Profiles

Form profiles are the basic shape that make up a form's geometry. While in Edit mode, you can edit the profile or path of a swept form, depending on which edge you selected before starting the editing process. For example, you can edit the profile of the bottom outline of an extruded form, as shown in Figure 1–71.

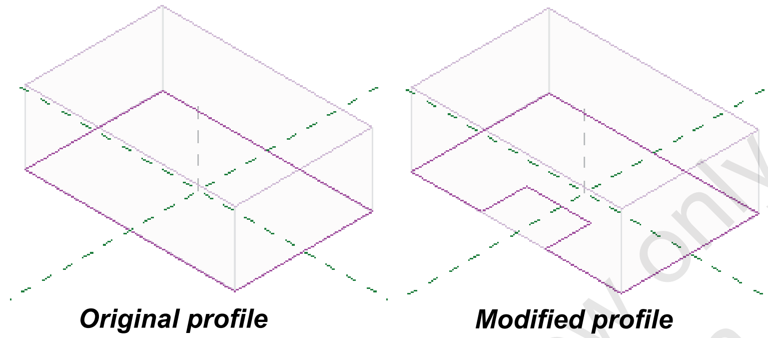


Figure 1–71

How To: Edit Profiles

1. Double-click on the form to enter Edit mode or select the form and in the *Modify |Mass* tab>Model panel, click (Edit In-Place).
2. Select the form or any part of the form and in the *Modify | Form* tab>Mode panel, click (Edit Profile).
3. Pick any profile or path to edit.
4. Sketch mode opens with the profile or path highlighted in magenta. Using the **Draw** and **Modify** tools, make changes.
5. Click (Finish Edit Mode).
6. The selected profile or path is modified.
7. Click (Finish Mass).

Adding Edges and Profiles

You can also add edges and profiles to existing forms and then modify the resulting edges, faces, and vertices. An edge can be added to the sides of a form, while a profile can be added along the path of the profile, as shown in Figure 1–72.

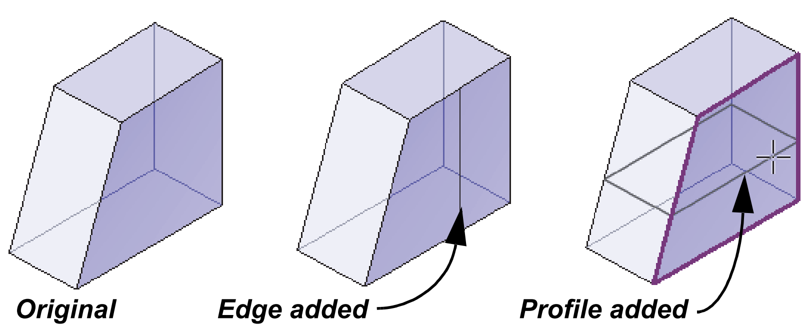


Figure 1–72

Once the edge or profile is placed, you can use the 3D control to create new shapes, as shown in Figure 1–73.

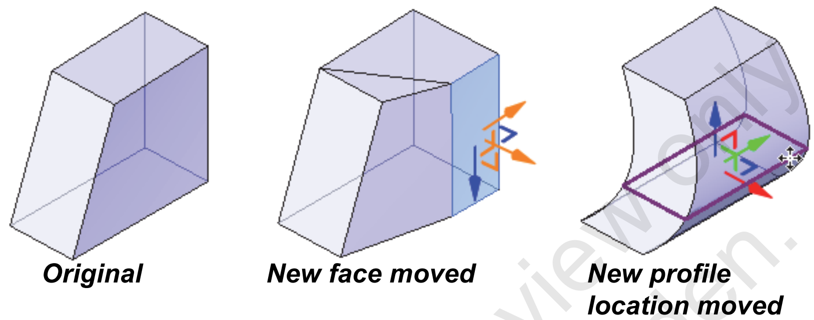


Figure 1–73

- If you cannot add an edge to a face, displays, as shown in Figure 1–74.

You cannot add an edge to the face that is parallel to the sweep path.

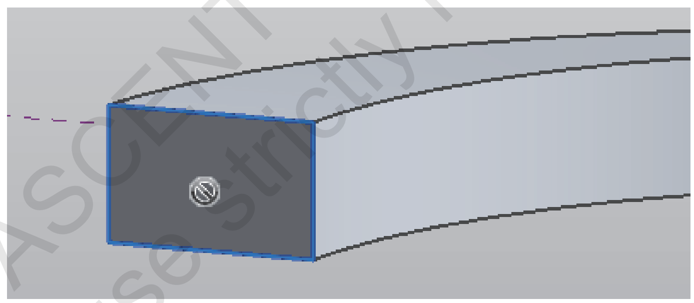


Figure 1–74

How To: Add an Edge

1. While in Edit mode, select anywhere on the form.
2. In the *Modify | Form* tab>Form Element panel, click (Add Edge) or right-click and select **Add Edge**.
3. Hover the cursor over a face. A new edge that reflects the geometry displays, as shown in Figure 1–75. Alternately, pick two points at the vertices or edges of a face, as shown in Figure 1–76.

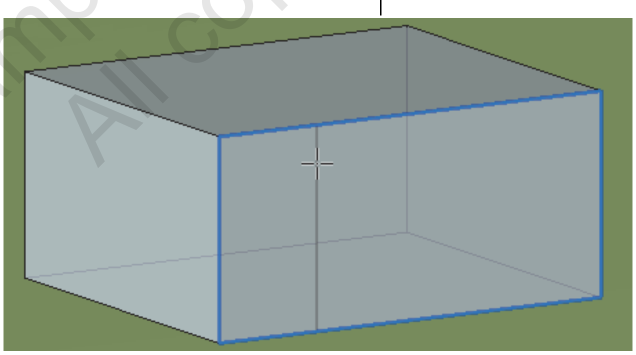


Figure 1–75

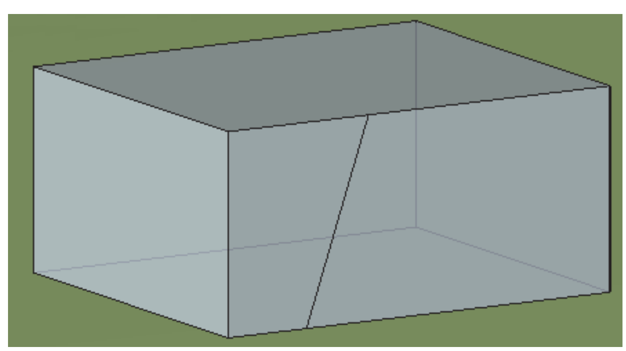


Figure 1–76

How To: Add a Profile

1. While in Edit mode, select anywhere on the form.
2. In the *Modify* | *Form* tab>Form Element panel, click (Add Profile) or right-click and select **Add Profile**.
3. A new profile displays on the selected form when the cursor is moved onto and follows it.
   - The profile automatically adjusts its shape to match the exterior of the form wherever the cursor is located, as shown in Figure 1–77.

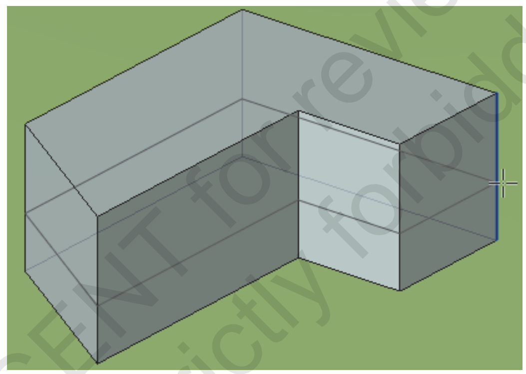


Figure 1–77

4. Click to place the new profile.

Modifying the Faces of Mass Elements

Mass faces can be modified to show patterns and materials. You can apply a pattern similar to creating a curtain wall layout using the **Divide Surface** option, as shown on the top of the mass element in Figure 1–78. You can also split a face into separate surfaces so you can apply different materials to each part, as shown on the base of the mass element in Figure 1–78.

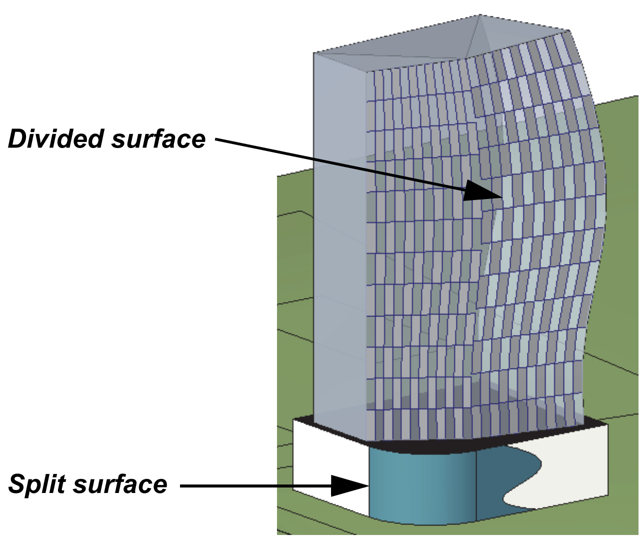


Figure 1–78

How To: Divide and Pattern a Mass Face

1. Double-click on the form to enter Edit mode or select the form and in the *Modify* |*Mass* tab>Model panel, click (Edit In-Place).
2. Select the face of a mass element.
3. In the *Modify* | *Form* tab>Divide panel, click (Divide Surface).
4. The surface is divided using a basic U-V Grid, as shown in Figure 1–79.

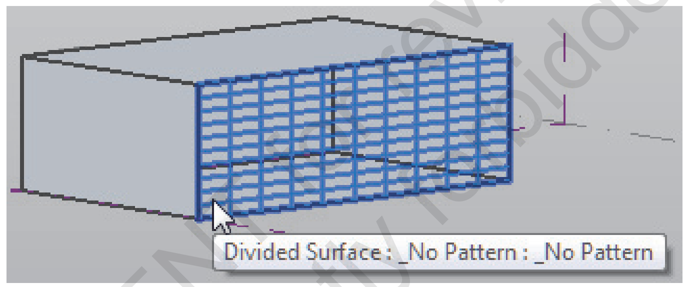


Figure 1–79

5. In the Type Selector, select a pattern from the patterns available, as shown in Figure 1–80.
6. In the Options Bar or Properties (as shown in Figure 1–81), modify the U-V Grid layout.

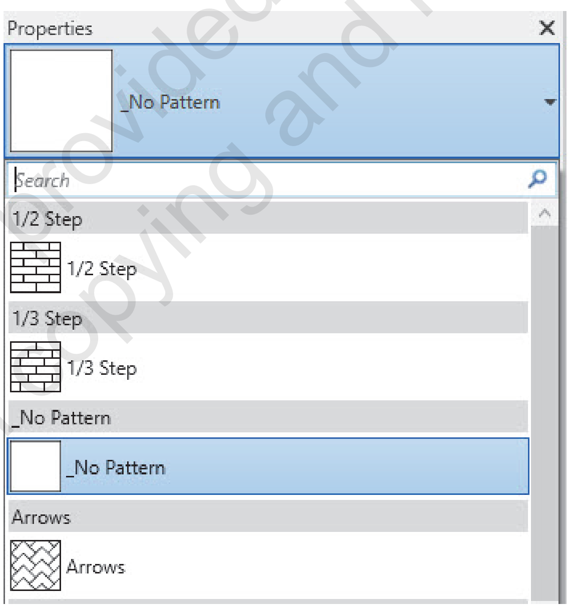


Figure 1–80

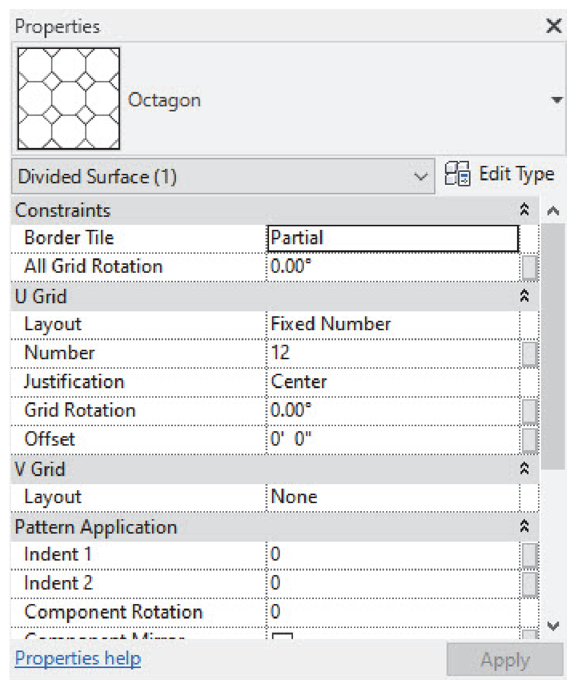


Figure 1–81

7. In the *Modify | Divide Surface* tab>contextual panels (shown in Figure 1–82), you can further modify and display the patterns.

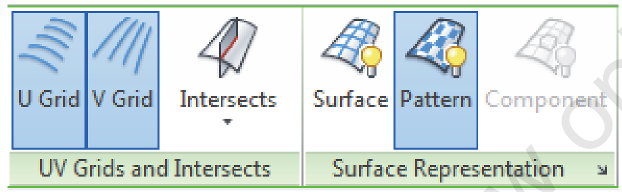


Figure 1–82

How To: Split Mass Faces

1. In the *Modify* tab>Geometry panel, click (Split Face).
2. Select the face of the mass element you want to modify.
3. In the *Modify* tab>Draw panel, use the sketch tools to create a sketch as required, to define the split (as shown in Figure 1–83).

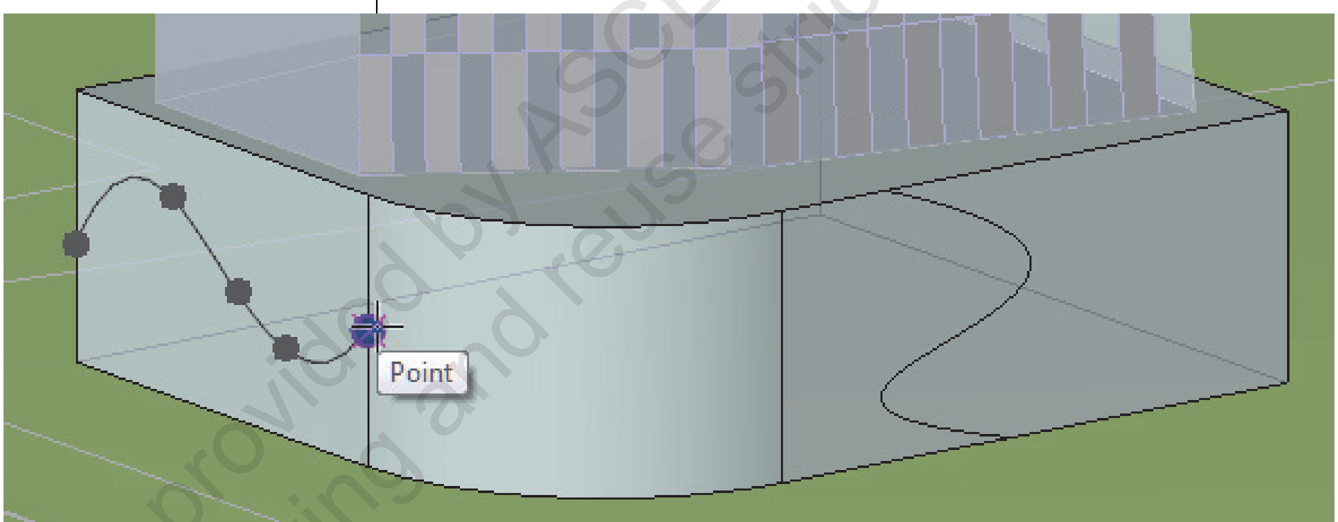


Figure 1–83

- Splitting faces does not create an additional face but you can modify the material in each area.
- The sketch that defines the split must be a closed shape completely inside the face or an open shape that touches the face edges.
- You can split the face of an in-place mass either directly on the face (without entering the mass) or in the In-Place Edit mode.

How To: Add Materials to Individual Mass Faces

1. In the *Modify* tab>Geometry panel, click (Paint).
2. Select a material in the Material Browser, as shown on the left in Figure 1–84.
   - Use the search at the top of the dialog box to narrow down your search for materials.
3. Select the face(s) of the mass that you want to paint, as shown on the right in Figure 1–84.

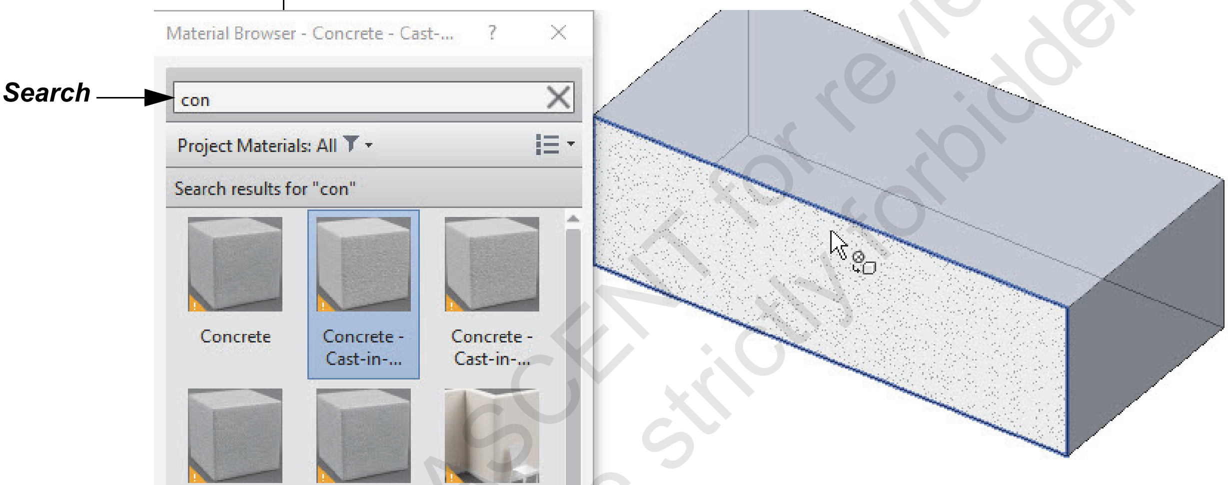


Figure 1–84

- Some material patterns display as shaded when you zoom out. Zoom in to display the pattern. Other material patterns only display when you are in the (Realistic) visual styles.
- To change the material applied to a face, in the *Modify* tab> Geometry panel, expand (Paint) and click (Remove Paint). Select the face(s) from which you want to remove the material.
- Older versions of materials may need to be updated with appearance assets. All legacy materials still work but they may not be as complex and nuanced when rendering.

Practice 1c

Modify In-Place Masses

Practice Objectives

- Modify mass elements.
- Add new profiles and edges.
- Modify faces by dividing or splitting them.

In this practice, you will manipulate the vertices, faces, and edges of an extruded in-place mass element using the 3D control. You will also add profiles and an edge. An example of a possible outcome is shown in Figure 1–85. Additionally, you will divide a face, apply a pattern, split another face, and then paint them with a material.

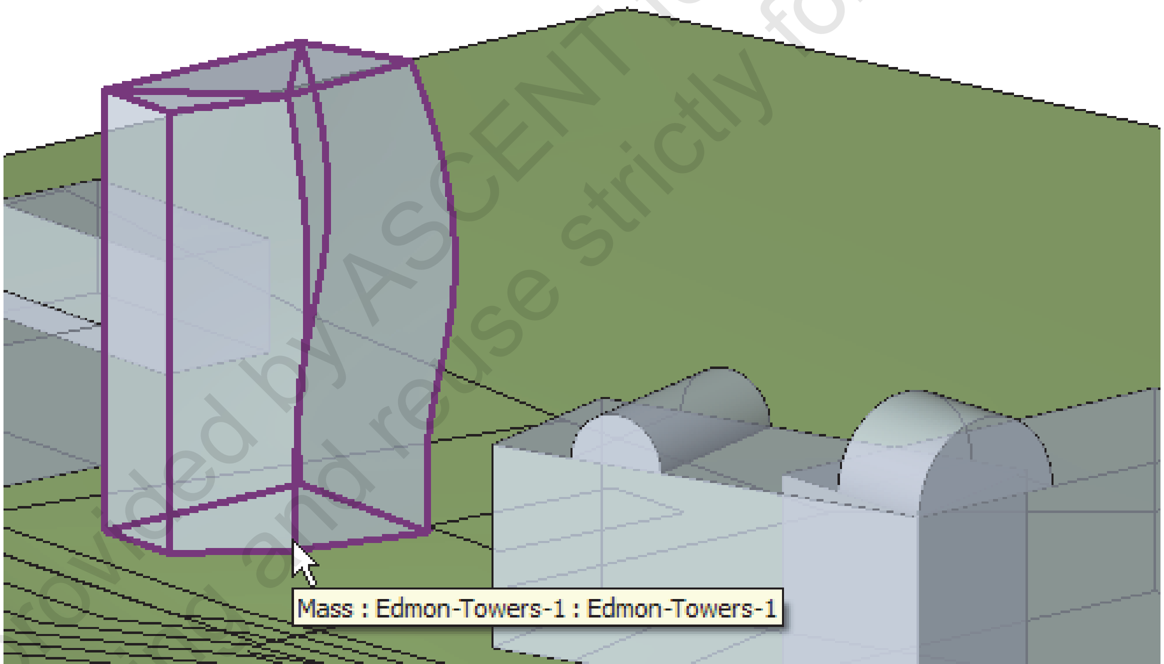


Figure 1–85

Task 1 - Modify an in-place mass.

1. In the practice files folder, open **Edmon-Towers-Modify.rvt**.
2. Select the tall mass **Tower-2** and, from the View Control Bar, temporarily hide the element.
3. Orient the 3D view so you can see the **Tower-1** extruded mass element.

4. Click on the mass element and modify it slightly using the controls, as shown in Figure 1–86. You can make minor modifications to an in-place mass without editing the entire mass form.

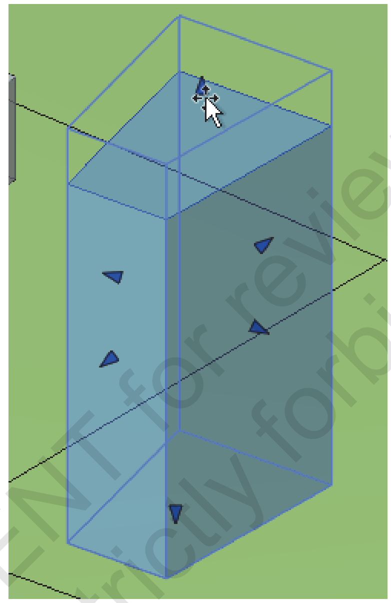


Figure 1–86

5. With the mass still selected, in the *Modify* | *Mass* tab>Model panel, click  (Edit In-Place).
6. Select one of the edges and modify it slightly using the 3D control, similar to that shown in Figure 1–87.

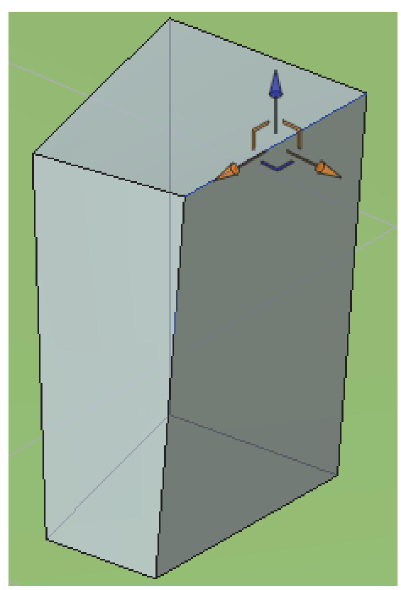


Figure 1–87

Task 2 - Add and modify profiles and an edge.

1. Select an edge in the form. (It does not matter which edge.)
2. In the *Modify* | *Form* tab>Form Element panel, click (X-Ray).
3. In the Form Element panel, click (Add Profile).
4. Add a profile about one quarter of the way up the form.
5. Repeat this process to add two more profiles, so that the form is divided into four sections, as shown in Figure 1–88. Hint: Press <Enter> to restart the **Add Profile** command again.

Do not worry about placing the profiles exactly. Their locations can be adjusted later.

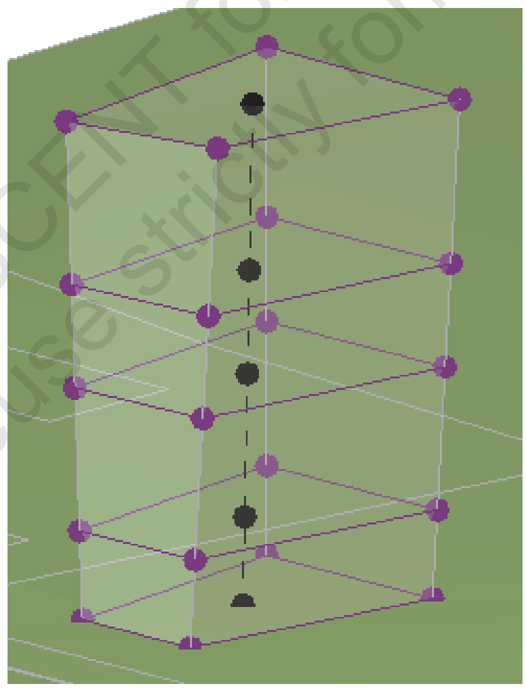


Figure 1–88

6. Use (Add Edge) to add an edge to one side of the building.
7. Click (Modify) to exit the **Add Edge** command.
8. Select the new face and move it out sightly using the 3D control.
9. Manipulate the various vertices and edges to reshape the mass.
10. Toggle off X-ray mode.

Task 3 - Divide and pattern surfaces.

Use <Tab> to select the face.

1. Select one of the mass faces.
2. In the *Modify | Form* tab>Divide panel, click (Divide Surface).
3. In Properties, in the Type Selector, select a pattern.
4. Modify the pattern properties using tools in the ribbon and Options Bar.
5. (Optional) Select a different face and in the *Modify | Form* tab>Geometry panel, use (Split Face) and (Paint) to apply materials.
6. Click (Finish Mass).
7. Save and close the project.

1.7 Moving from Massing to Building

When you have established a massing study, you can start the design development with walls, etc., you do not have to start over. Instead, you can use tools in Revit to create walls, floors, roofs, and curtain systems from the faces of the masses in the project as shown in Figure 1–89.

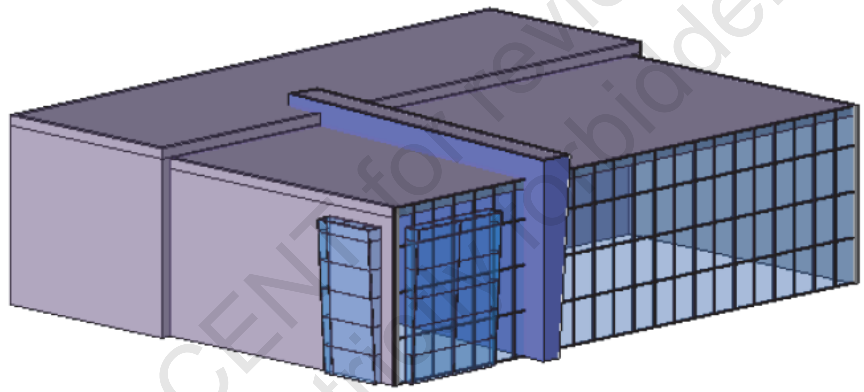


Figure 1–89

- You can add a slope to a wall style from the wall's Properties, but you can also do this with mass elements by creating the shape you want and applying the material or wall style to the mass.
- You can add walls, floors, roofs, and curtain systems to the faces of mass elements using the **Wall**, **Roof**, and **Floor** commands in the *Architecture* tab>Build panel. For example, when you start the **Wall** command, you can click  (Pick Faces) as the drawing method, as shown in Figure 1–90.

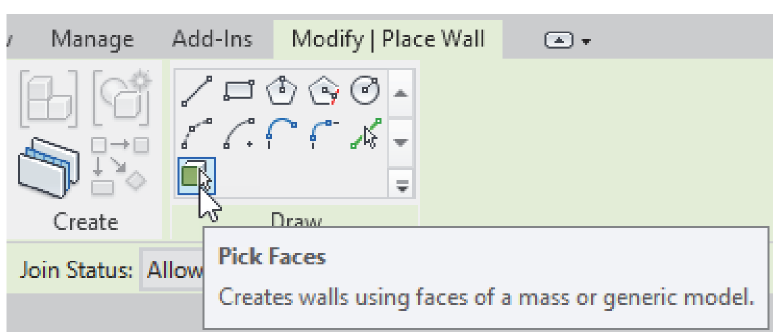


Figure 1–90

- You can also use the specific commands found in the *Massing & Site* tab>Model by Face panel, as shown in Figure 1–91.

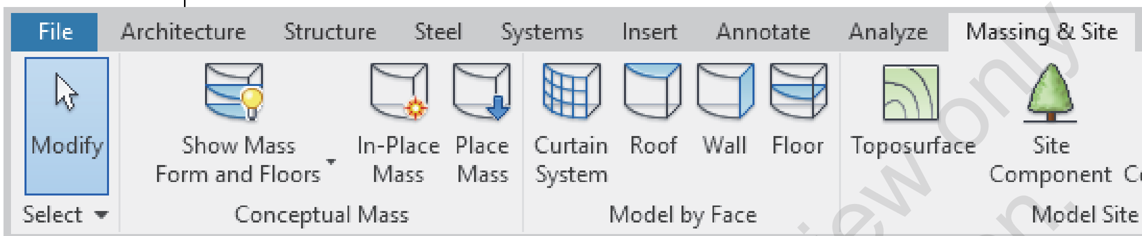


Figure 1–91

How To: Use the Model by Face Tools

1. Open a view where the mass faces display and where you want to apply the building elements. This can be done in either a 3D or elevation view.
2. In the *Massing & Site* tab>Model by Face panel, click (Curtain System), (Roof), (Wall), or (Floor).
3. In the Type Selector, select an element type.
4. Select the faces you want to turn into elements.
5. In the contextual tab>Multiple Selection panel, click the related **Create** command.

Wall by Face Options

Location Line is grayed out if a curtain wall style is selected.

- Ensure that the *Location Line value* is set to **Finished Face: Exterior**. This keeps the walls on the inside of the mass.
- You can create walls on sloped faces using this tool.

Curtain Systems Options

A Curtain System is a type of curtain wall that is typically on a curved or angled face.

- In the *Modify | Place Curtain System by Face* tab>Multiple Selection panel, verify that (Select Multiple) is highlighted if you are planning to select more than one face for a curtain system at a time.

Roof by Face Options

- In the *Modify | Place Roof by Face* tab, hover over the surface so the entire face highlights, then click to place.
- In Properties, set the Constraints *Picked Faces Location* to **Faces at Bottom of the Roof**.
- From the *Modify | Place Roof by Face* tab>Multiple Selection panel, click (Create Roof) to place your roof.
- After you have created a roof by face, you can use shape handles to modify the overhang of the roof, as shown in Figure 1–92.

The overhang distance is remembered if you change the mass.

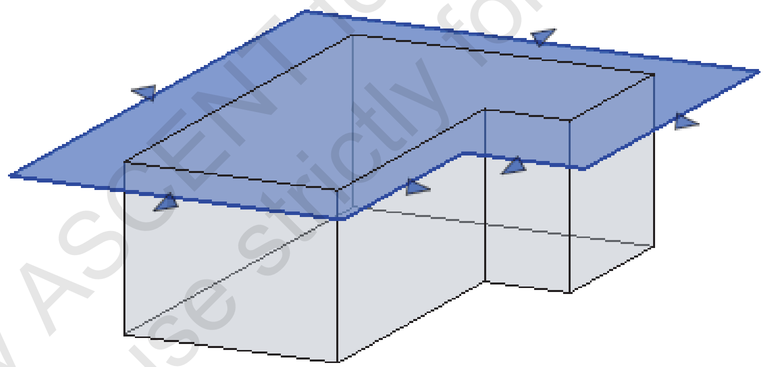


Figure 1–92

Creating Floors from Mass Elements

To create floors in a massing study, you must first create mass floors. These are the basis for creating floors and also help track the floor area of the building. Once you have the mass floors in a project, you can click (Floor by Face) to add the floor elements on the faces.

How To: Create Mass Floors

1. Select a mass.
2. In the *Modify | Mass* tab>Model panel, click (Mass Floors).

3. In the Mass Floors dialog box, select the levels where you want floor area faces to be located, as shown in Figure 1–93, and click **OK**.

If you have a lot of levels to select, hold <Ctrl> or <Shift> to select multiple levels.

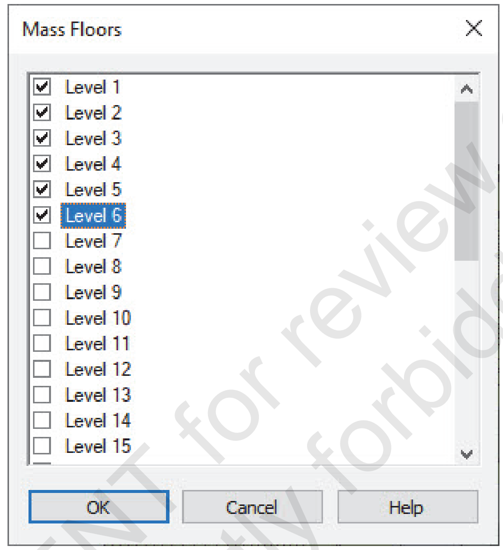


Figure 1–93

The mass floors display in the massing study, as shown in Figure 1–94.

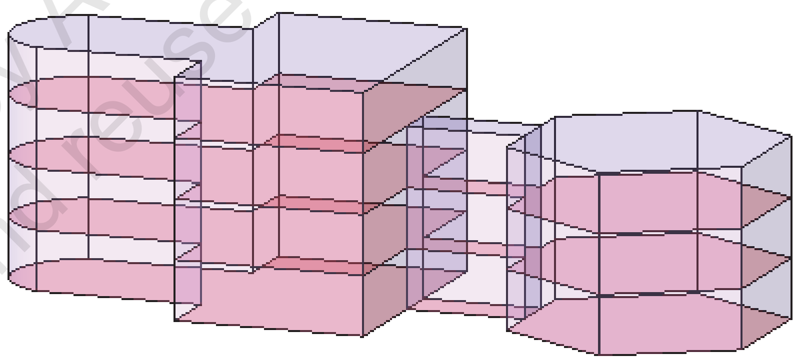
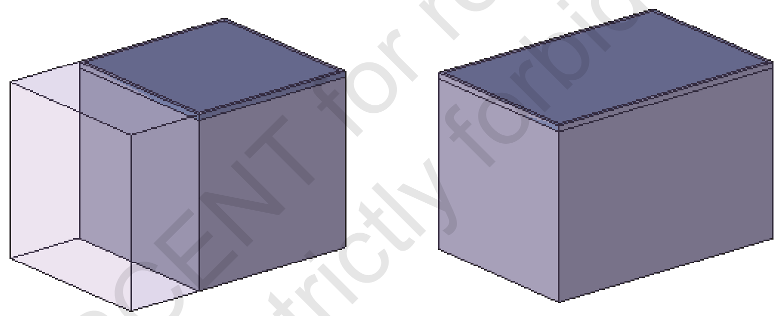


Figure 1–94

- Mass floors keep track of the area, exterior surface area, volume, and perimeter of each floor. This information can be used in schedules and tags.

Hint: Updating Elements Connected to Mass Elements

Elements applied to mass elements, such as walls, floors, roofs, and curtain systems do not automatically update when the massing element changes as shown on the left in Figure 1–95. Select the mass element and in the *Modify* | *Mass* tab>Model panel, click (Related Hosts). Then in the *Modify* | *Multi-Select* tab>Model by Face panel, click (Update to Face). The elements update, as shown on the right in Figure 1–95.



Mass modified ***Walls and roof remade***

Figure 1–95

- If you only want to update one element (such as a roof), select the element that is hosted by the mass and in the *Modify* | *<element type>* tab>Model by Face panel, click (Update to Face). Note that the icon varies according to the element type selected.

Practice 1d Move from Massing to Building

Practice Objectives

- Add mass floors.
- Use existing schedules to track the coverage of the site and the gross area of the mass, while making changes to one of the towers.
- Add walls, floors, roofs, and curtain systems to the finished mass towers.

In this practice, you will add mass floors to specified levels and investigate the site coverage and building volume, as shown in Figure 1–96. You will also add walls, floors, curtain systems, and roofs to the faces of the conceptual mass elements.

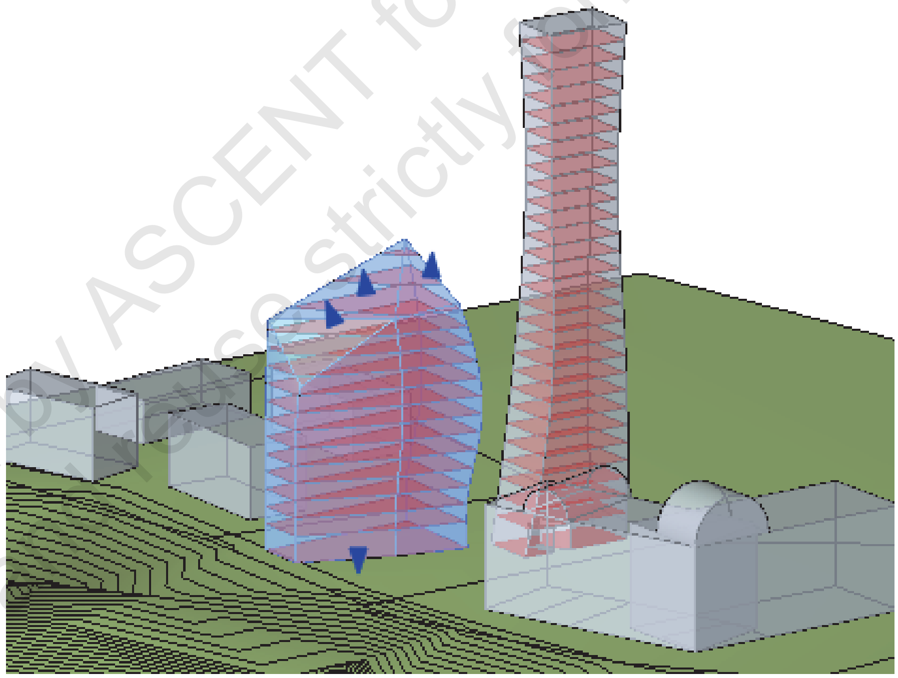
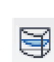


Figure 1–96

Task 1 - Add massing floors.

1. In the practice files folder, open **Edmon-Towers-Building.rvt**.
2. Select the two curved masses included in the project.
3. In the *Modify* | *Mass* tab>Model panel, click  (Mass Floors).

4. Select all of the levels in the Mass Floors dialog box and click **OK**. The new mass floors display as shown in Figure 1–97. Hint: Use <Shift> to select all the levels, then check one check box to check them all.

Some levels are higher than the current height of the masses. By selecting them now, they will automatically be applied when the height of the masses is changed.

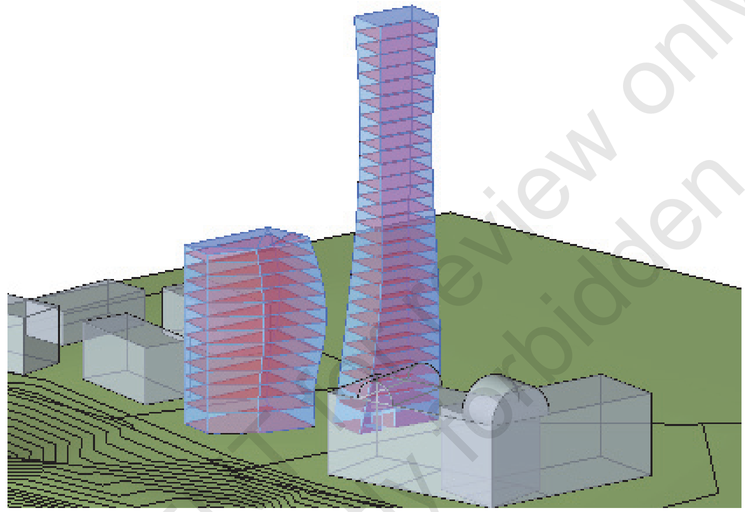


Figure 1–97

Task 2 - Track site coverage and gross area using schedules.

1. If necessary, close any other projects and in the Quick Access Toolbar, click (Close Hidden) to close any windows that do no need to be open.
2. Open the following four views on your screen:
   - *3D Views:* **Site View**
   - *Floor Plans:* **New Site**
   - *Schedules/Quantities:* **Building Volume Schedule**
   - *Schedules/Quantities:* **Coverage of Site**

- The **Coverage of Site** schedule enables you to track how much of the site the proposed building covers. It lists the actual and maximum footprints in both square feet and percentage. You can enter the actual site area in the *Parcel* column, and the amount of the site that the building is permitted to cover in the *Max Footprint (%)* column. The Revit software does the rest.

- **Building Volume Schedule** displays the Total Floor Area and Total Floor Volume at the bottom of the schedule. If the zoning restrictions or program requirements limit the overall floor area of the building, the schedule tracks this for you.

3. Return to the 3D Site View and type **WT** (Window Tile) so that all four views display.

4. Type **ZA** (Zoom All) to display the entire 3D view and the New Site plan.

5. Click in the **New Site** view and select the Property Line, as shown in Figure 1–98.

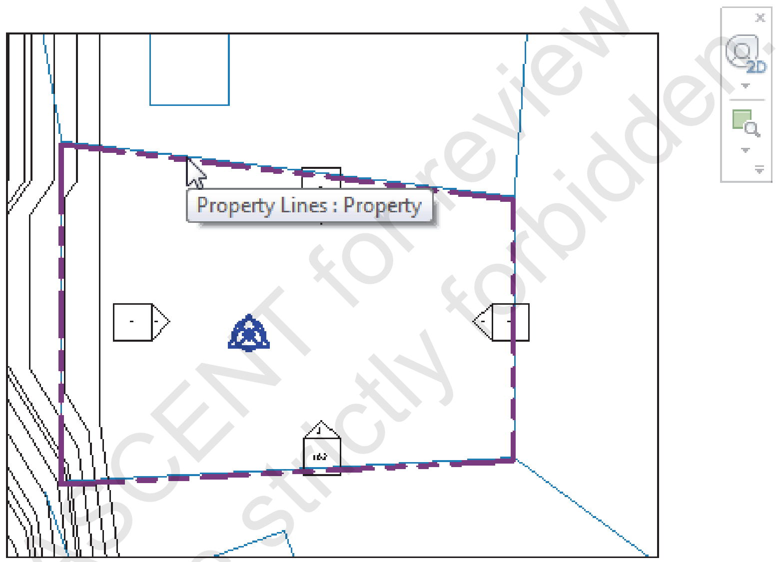


Figure 1–98

6. In Properties, the *Area* is **43,298.77 SF**. This is the size you use for the *Parcel* column.

7. In the **Coverage of Site** schedule, enter **43299** in the *Parcel* cell and **20** in the *Max Footprint (%)* cell, as shown in Figure 1–99.

<Coverage of Site>				
A	B	C	D	E
Parcel	Actual Footprint	Max Footprint	Current Footprint (%)	Max Footprint (%)
43,299 SF	8,263 SF	8,660	19.1	20

Figure 1–99

8. Based on initial numbers in the **Coverage of Site** schedule, both towers are within the *Max Footprint*.

9. In the 3D Site View, select one of the tower masses. Use the shape handles to change the height and shape of the mass. Watch the schedules to ensure that the *Current Footprint* value remains below 20% and the **Building Volume schedule** *Floor Area* total remains below **160,000 SF**.

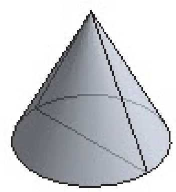
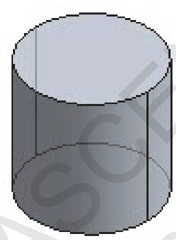
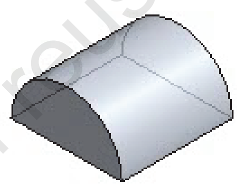
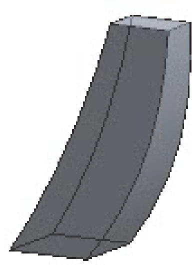
10. If you have time, you can also modify the masses using **Edit In-Place**.

11. Save the project.

Task 3 - Add walls, floors, roofs, and curtain systems.

1. Expand the 3D Site View by selecting it and typing **TW**.
2. Zoom in on one of the mass elements.
3. In the *Massing & Site* tab>Model by Face panel, click (Floor).
4. Select the floors and click (Create Floor).
5. Repeat the process with walls, roofs, and curtain systems. Hint: hide the mass to make this process easier.
6. Save and close the project.

Chapter Review Questions

1. Mass elements display by default in a view.
   a. True
   b. False
2. Which of the following elements was NOT created using the basic family types that come with the Revit software?
   a. 
   b. 
   c. 
   d. 
3. What element(s) need to be placed first to create a blended sweep form?
   a. Two profiles on different work planes.
   b. A profile on an extrusion.
   c. More than two profiles on different levels.
   d. Two or more existing forms.

4. How do you cut a portion out of a conceptual mass element, as shown in Figure 1–100?

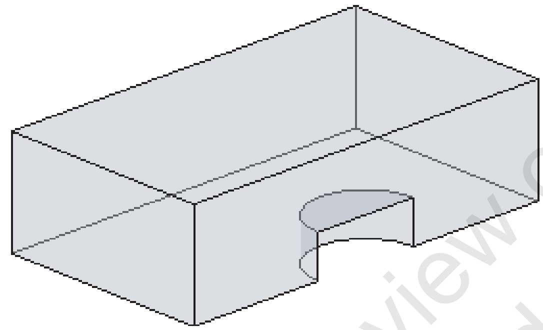


Figure 1–100

   a. Select the form and click  (Edit Profile).
   b. Create a void form in the mass element.
   c. Create another mass element and use  (Cut Geometry).
   d. Edit the form and add another profile to it.

5. Which of the mass form types is created from three or more profiles?
   a. Sweep
   b. Swept Blend
   c. Loft
   d. Extrusion

6. The start of a mass form is a sketch. How do you place a sketch on another form, as shown in Figure 1–101?

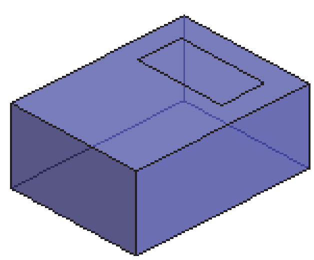


Figure 1–101

   a. Select the **Draw** tool that you want to use, then use the **Draw on Face** tool.
   b. Select the **Draw** tool that you want to use, then use the **Draw on Work Plane** tool.
   c. Select the **Draw** tool that you want to use, then set the *Placement Plane* to a **Level**.

7. How do you move a sketch from one plane to another plane, as shown in Figure 1–102?

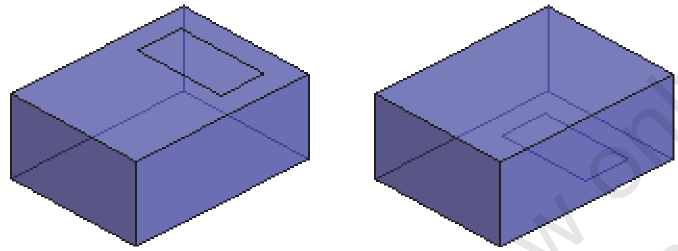


Figure 1–102

   a. Change the *Placement Plane*.
   b. Use the **Move** command.
   c. Change the *Host*.
   d. Use the **Align** command.

8. What must be in place before you can add a floor to a mass element, as shown in Figure 1–103?

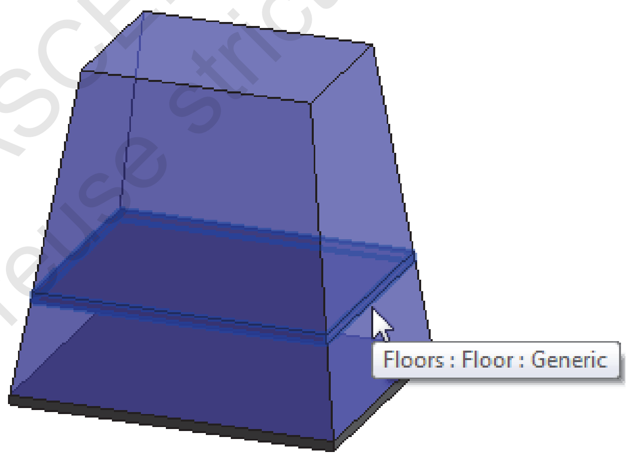


Figure 1–103

   a. Additional mass elements at each floor.
   b. Sketches for each floor.
   c. An additional floor parameter in Properties.
   d. Mass floor elements at each floor.

Command Summary

Button	Command	Location
	Cut Geometry	• **Ribbon:** *Modify* tab>Geometry panel
	Edit In-Place	• **Ribbon:** *Modify* | *Mass* tab>Model panel
	Edit Work Plane	• **Ribbon:** *Modify* | *Mass* tab>Work Plane panel
	In-Place Mass	• **Ribbon:** *Massing & Site* tab>Conceptual Mass panel
	Load Family	• **Ribbon:** *Modify* | *Place Mass* tab>Mode panel
	Paint	• **Ribbon:** *Modify* tab>Geometry panel
	Place Mass	• **Ribbon:** *Massing & Site* tab>Conceptual Mass panel
	Place on Face	• **Ribbon:** *Modify* | *Place Mass* tab>Placement panel
	Place on Work Plane	• **Ribbon:** *Modify* | *Place Mass* tab>Placement panel
	Show Mass by Form and Floors	• **Ribbon:** *Massing & Site* tab>Conceptual Mass panel>expand Show Mass
	Show Mass by View Settings	• **Ribbon:** *Massing & Site* tab>Conceptual Mass panel>expand Show Mass
Conceptual Mass Environment		
	Add Edge	• **Ribbon:** *Modify* | *Form* tab>Form Element panel • **Right-click:** Add Edge
	Add Profile	• **Ribbon:** *Modify* | *Form* tab>Form Element panel • **Right-click:** Add Profile
	Create Form	• **Ribbon:** *Modify* | *Place Lines* tab>Form panel
	Divide Surface	• **Ribbon:** *Modify* | *Form* tab>Divide panel
	Draw on Face	• **Ribbon:** *Modify* | *Place Lines* tab>Draw panel
	Draw on Work Plane	• **Ribbon:** *Modify* | *Place Lines* tab>Draw panel
	Point Element	• **Ribbon:** *Modify* | *Place Lines* tab>Draw panel
	Model Line	• **Ribbon:** *Modify* | *Form* tab>Draw panel

	Reference Line	• **Ribbon:** *Modify* | *Form* tab>Draw panel
	Reference Plane	• **Ribbon:** *Modify* | *Form* tab>Draw panel
	X-Ray	• **Ribbon:** *Modify* | *Form* tab>Form Element panel • **Right-click:** X-Ray
	Void Form	• **Ribbon:** *Modify* | *Lines* tab>Form panel>expand Create Form
From Massing to Building		
	Create Roof	• **Ribbon:** *Modify* | *Place Roof by Face* tab>Multiple Selection panel
	Curtain System (by Face)	• **Ribbon:** *Massing & Site* tab>Model by Face panel
	Floor (by Face)	• **Ribbon:** *Massing & Site* tab>Model by Face panel
	Mass Floors	• **Ribbon:** *Modify* | *Mass* tab>Model panel
	Related Hosts	• **Ribbon:** *Modify* | *Mass* tab>Model panel
	Roof (by Face)	• **Ribbon:** *Massing & Site* tab>Model by Face panel
	Wall (by Face)	• **Ribbon:** *Massing & Site* tab>Model by Face panel
	Update to Face	• **Ribbon:** *Modify* | *Multi-Select* tab> Model by Face panel