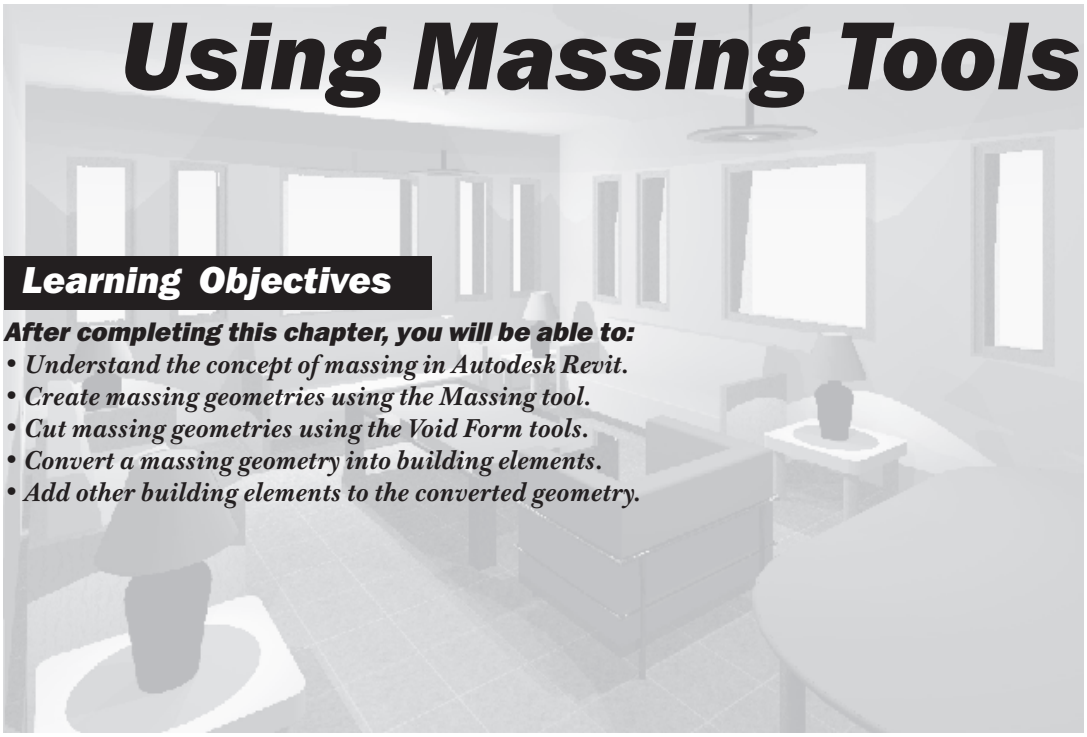
Chapter 9

Using Massing Tools



Learning Objectives

After completing this chapter, you will be able to:

- *Understand the concept of massing in Autodesk Revit.*
- *Create massing geometries using the Massing tool.*
- *Cut massing geometries using the Void Form tools.*
- *Convert a massing geometry into building elements.*
- *Add other building elements to the converted geometry.*

In earlier chapters, you learnt to use various building elements and components to create a building model. These parametrically associated building elements enable you to generate a building model based on specific design requirements, such as wall types, door width, window height and so on. Each of the elements must be assigned specific properties to achieve the desired element parameters. This makes the building model accurate. Needless to say, this is a fairly time consuming procedure. Autodesk Revit Building provides an alternative method of creating the building model using a much simpler method, known as Massing.

UNDERSTANDING THE MASSING CONCEPTS

At the conceptualizing stage of a project, you may want to study it in terms of its building volumes and shapes. You may also want to convey the basic idea of the structure of the building in a three-dimensional form, without putting in a lot of detailing. This can be achieved by using the **Massing** tool.

The **Massing** tool in Autodesk Revit Building not only enables you to conceive and create a variety of building shapes and volumes with relative ease, but it also conveys the potential design in terms of building masses and geometric shapes. You can create and edit geometric shapes and amalgamate them to form the building structure. This process can be compared to the creation of building a model using foam blocks. You have the liberty to add or cut geometric shapes and join different blocks or masses to form an assembly. For example, Figure 9-1 shows a grouping of volumes that can be created to represent the building volume and mass.

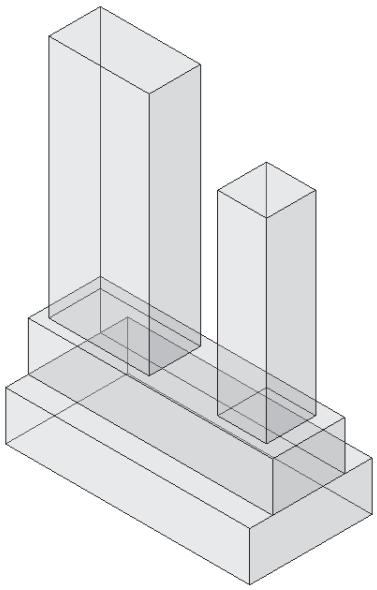


Figure 9-1 *Building blocks created using the massing geometry*

Autodesk Revit Building also empowers you to convert the building mass into building elements. The building blocks can be transformed into an assembly of individual building elements, such as walls, roof, and floor. The transformation, carried out using the tools provided for replacing the massing faces with a predefined wall, roof and floor types, allows you to convert the same

building mass into a building model. You can then develop it into a detailed building model, by incorporating the individual building elements with specified parameters.

Autodesk Revit Building provides the much needed continuity in the design development of a building project, using the same building model, from its conceptualization to completion. It also empowers you to control the visibility of the geometry between the building volumes (massing) and building elements (shell), during the initial stages of the project development. Other project information, such as its total area and so on, can also be extracted from the building massing.

It is, however, important to understand the limitations of the massing tool. It is only meant for conceptual design development, using simple geometric shapes. You can place the predefined massing family elements provided in the additional libraries. Autodesk Revit Building attempts to translate the massing geometry into building elements or shell and so it is not recommended to be used for the development of a detailed geometry, such as columns, cavity walls, footing, and so on.

CREATING THE MASSING GEOMETRY

Autodesk Revit Building provides various massing tools to generate and view the massing geometry. These tools can be accessed from the **Massing** tab in the **Design Bar**, as shown in Figure 9-2. It displays the basic tools used to create the massing geometry. To activate the **Massing** tab, move the cursor over the **Design Bar** and right-click. Select **Massing** from the shortcut menu to display the **Massing** tab.

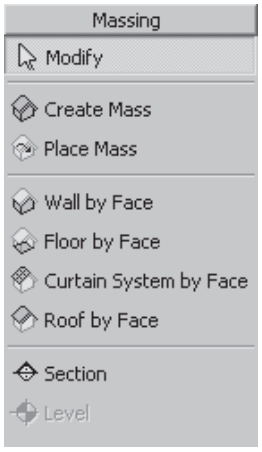


Figure 9-2** The **Massing** tab in the **Design Bar

Autodesk Revit Building Release 9.0 provides you two methods of creating a massing geometry. The first method is to create a mass using the **Create Mass** tool and its associated tools. The second method is to use the **Place Mass** tool to load and place the predefined massing geometry from Autodesk Revit's additional library.

When you create shapes in massing, Autodesk Revit Building simultaneously creates its corresponding building elements. It is, therefore, imperative to consider the associativity of the massing and shell elements. The massing elements may need to be transformed into individual building elements. Therefore, the massing geometry must be created accordingly.

For example, when you create a complex geometric massing shape and convert the faces into building elements, you may find that the certain planes do not acquire the desired building element characteristics. The inclined planes and curved surfaces are converted into in-place roofs.

Using the Create Mass Tool

Menu Bar: Modelling > Massing > Create Mass
Design Bar: Massing > Create Mass

The **Create Mass** tool enables you to create the massing geometry. When you choose this tool, the **Name** edit box is displayed. Enter a name for the massing geometry to be created. You can create a number of solid and void forms in a single massing geometry. The **Design Bar** is replaced by the **Mass** tab, displaying the various massing tools shown in Figure 9-3. You can use the **Model Lines** and **Reference Lines** tools to assist you in creating the massing geometry. The **Place Mass** tool can be used to place the predefined massing family elements.

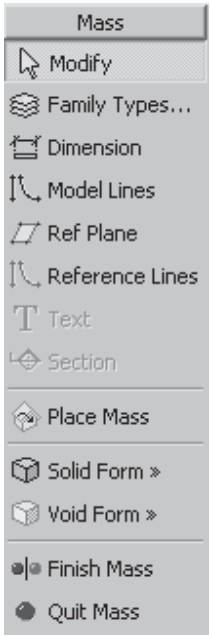


Figure 9-3** The **Mass** tab in the **Design Bar

To create a solid form, choose the **Solid Form** tool. It displays a cascading menu with four tools, **Solid Extrusion**, **Solid Blend**, **Solid Revolve**, and **Solid Sweep**. These are provided to create various solid shapes and profiles. Similarly, the **Void Form** tool can be used to create a void form. This tool also displays a cascading menu with four tools, **Void Extrusion**, **Void Blend**, **Void Revolve**, and **Void Sweep**. Massing geometry can be created using a single or a combination of the **Solid Form** and **Void Form** tools. The usage of these tools for creating simple massing geometries is described next. However, the designer can select the appropriate tool judiciously, depending on the massing geometry to be created.

Creating an Extrusion

Menu Bar: Modelling > Massing > Create Mass > Solid Form > Solid Extrusion
Design Bar: Massing > Create Mass > Solid Form > Solid Extrusion

The **Extrude** tool is used to create a massing geometry, by adding height to a sketched profile. When you choose this tool, Autodesk Revit Building enters the sketch mode and the **Sketch** tab is displayed in the **Design Bar**, as shown in Figure 9-4.

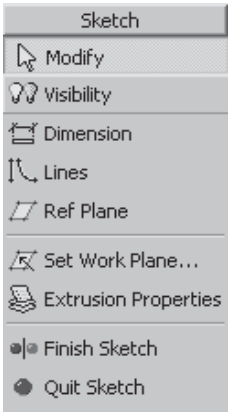


***Figure 9-4** The **Sketch** tab for the **Solid Extrusion** tool*

You first need to define the work plane to sketch the profile. The **Set Work Plane** tool, available in the **Sketch** tab, can be invoked for this purpose. The **Ref Plane** tool can be used to draw reference planes for locating the exact points for sketching the profile. The **Lines** tool is used to sketch the 2D profile to be extruded. On invoking this tool, the sketching options are displayed in the **Options Bar**. You can select the appropriate option(s), depending on the shape of the profile, which must form a closed loop.

The **Extrusion Properties** tool is used to invoke the **Element Properties** dialog box, in which you can specify the start and end levels

of the extrusion and other properties. The **Extrusion Start** instance parameter in the **Element Properties** dialog box indicates the start level of the extrusion from the base level. The **Extrusion End** parameter indicates the top level of the extrusion. The difference between these two parameters is calculated as the depth of the extrusion. You can also enter its value in the **Depth** edit box available in the **Options Bar**. Autodesk Revit Building assumes the depth of the extrusion from the base level.

After sketching the profile, choose the **Finish Sketch** tool to create the extruded massing. The **Quite Sketch** tool is used to discard the sketched profile and return to the **Massing** tab.

For example, to create a high rise building, choose the **Create Mass** tool from the **Massing** tab. Assign a name for the massing geometry in the **Name** edit box. Enter the value of the height of the building in the **Depth** edit box in the **Options Bar**. The **Lines** tool (selected by default) in the **Sketch** tab of the **Design Bar** can be used to sketch the extrusion profile. Various sketching tools available in the **Options Bar** can also be used. You can enable the **Chain** tool to sketch the base profile, if required. Sketch the base of the specified dimension using the temporary dimensions, as shown in Figure 9-5. When the profile is completed, choose **Finish Sketch** to return to the **Mass** tab. You can then use the **Finish Mass** tool from the **Design Bar** to extrude the sketched profile to the specified depth. The created building mass can be viewed in the 3D view, as shown in Figure 9-6.

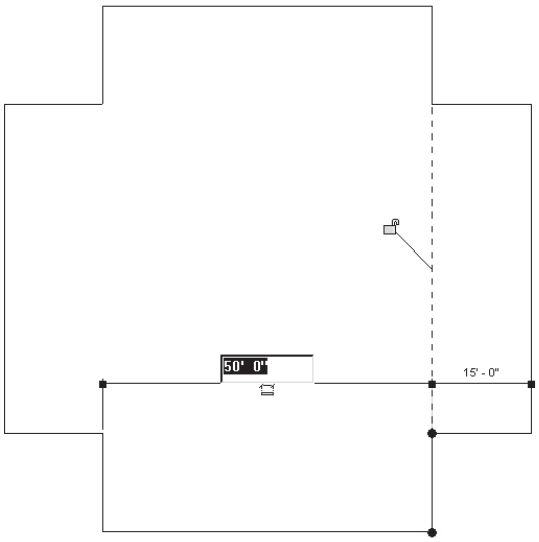


Figure 9-5 *An example of sketching a building profile to be extruded*

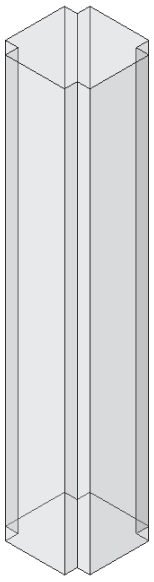
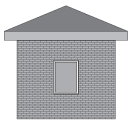
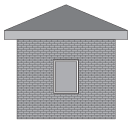


Figure 9-6 *Massing geometry created using the* ***Solid Extrusion*** *tool*



Tip: *The* ***Modify*** *tool, invoked from the* ***Sketch*** *tab is used to select and edit the sketched profile.*



Tip: *The work plane is defined for the purpose of sketching the profile and it need not coincide with the start or end plane. It is also used to set the direction of the extrusion. Autodesk Revit uses the direction vector perpendicular to the work plane as the direction of the extrusion.*

You can also create multiple extrusions by sketching multiple looped profiles and then choosing the ***Finish Sketch*** *tool. Autodesk Revit extrudes all the profiles to the same depth.*

You can also specify negative values for the extrusion depth parameter. The sketched profile is then extruded in the 'negative' direction.

Creating a Revolved Geometry

Menu Bar: Modelling > Massing > Create Mass > Solid Form > Solid Revolve
Design Bar: Massing > Create Mass > Solid Form > Solid Revolve

The **Solid Revolve** tool is used create a solid geometry that is revolved around an axis. This tool can be used to create shapes such as domes, donuts, cylinders, and so on. When you choose this tool, Autodesk Revit Building enters the sketch mode and the **Sketch** tab is displayed in the **Design Bar**, as shown in Figure 9-7.

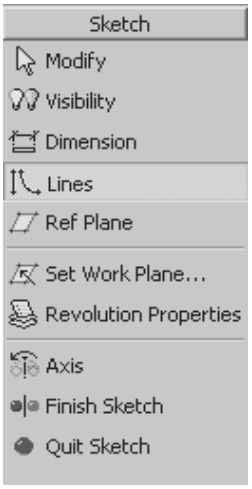


Figure 9-7 *The* ***Sketch*** *tab for the* ***Revolve*** *tool*

Upon choosing the **Set Work Plane** tool, the **Work Plane** dialog box is displayed. You can choose the appropriate option to specify the work plane.

The **Lines** tool is used to sketch the profile to be revolved. The sketched profile must be a single closed loop or multiple closed loops that do not intersect. The **Axis** tool can be invoked to select or create the axis of revolution. The **Options Bar** displays the **Draw** and the **Pick** options. The **Draw** option is used to draw a line that can be used as the axis. Alternatively, use the **Pick** option to pick a line or an edge to define the axis of revolution. After completing the sketch and defining the revolution axis, choose **Finish Sketch** from the **Sketch** tab to generate the revolved geometry.

The **Revolution Properties** tool is used to set the start and end angles of the revolution. The default value for these two parameters is 0 degree and 360 degrees respectively.

For example, to create a dome that has a circular puncture in the centre, you can sketch the profile and define the axis, as shown in Figure 9-8. Before you start the sketch, you need to set the work plane as a plane perpendicular to the horizontal plane. The generated revolved geometry is shown in Figure 9-9. Notice that because the profile does not touch the axis, the cylindrical puncture is generated in the dome.

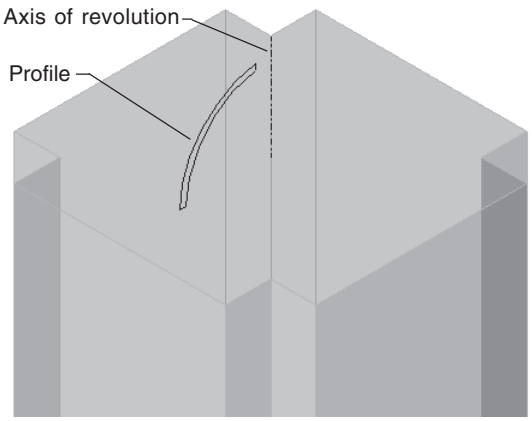


Figure 9-8 *An example of a sketched profile and the defined axis of revolution*

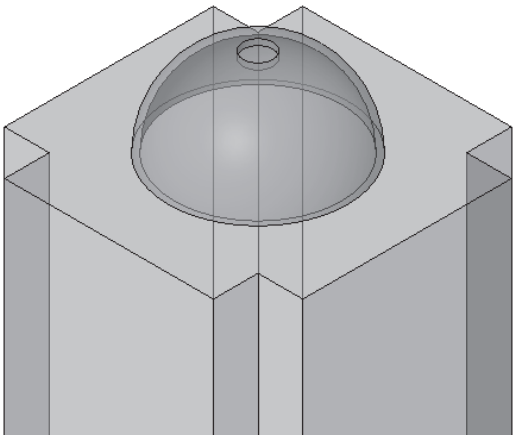


Figure 9-9 *Resulting revolved massing*

Figure 9-10 shows another example of the sketched profile and the defined axis of revolution. You can use the **Revolution Properties** tool to set the **End Angle** parameter to -180 degrees. The resulting massing is shown in Figure 9-11.

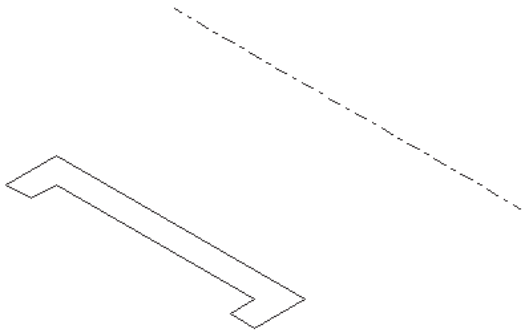


Figure 9-10 *Sketching the profile and then defining the axis of revolution of an arch*

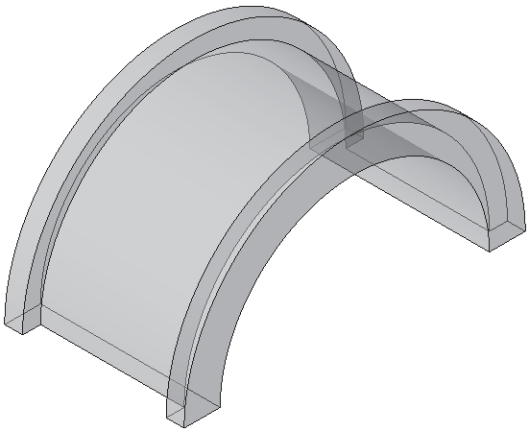
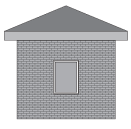


Figure 9-11 *Resulting arched massing shape*



Tip: *In order to create the massing, you may need to view the shape from various directions and work in different work planes, using the* ***Orient*** *and* ***Work Plane*** *tools.*

Creating a Sweep

Menu Bar: Modelling > Massing > Create Mass > Solid Form > Solid Sweep
Design Bar: Massing > Create Mass > Solid Form > Solid Sweep

Solid Sweep

Using the **Solid Sweep** tool, you can create a geometry by sketching a profile and then sketching the 2D path, along which it is sweeped. When you choose this tool, Autodesk Revit Building enters the sketch mode and the **Sketch** tab displays the related tools, as shown in Figure 9-12.

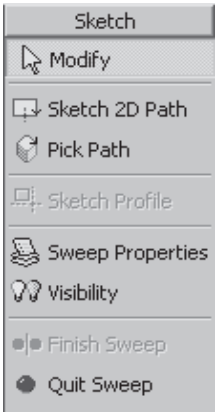


Figure 9-12 *The* ***Sketch*** *tab for the* ***Solid Sweep*** *tool*

The **Sketch 2D Path** tool is used to sketch the path to be used for extrusion. Upon selecting this tool, the sweep sketch tab is replaced by another sketch tab that contains the tools to draw the path. You can use the **Lines** tool and the appropriate sketching tools from the **Options Bar** to sketch the desired shape of the path, which can be open or closed. It can be a combination of lines and curves. After completing the path, choose **Finish Path** from the Sketch tab to return to the original sketch tab.

Alternatively, choose the **Pick Path** tool and select an element to define a path. Choose the **Sketch Profile** tool from the **Sketch** tab. Using various sketching tools, you can then sketch the profile that needs to be extruded. Autodesk Revit Building also provides built-in profiles that can be used in the projects. These are available in the drop-down list in the **Options Bar**, before the tool is selected. You can also choose the **Load profiles** button from the **Options Bar** and access additional profiles in the **Imperial Library > Profiles** folder. After completing the profile, choose the **Finish Sweep** and then the **Finish Mass** options from the **Design Bar** to generate the sweep geometry. Figure 9-13 shows an example of a 2D path with a sketched profile and Figure 9-14 shows the resulting massing shape.

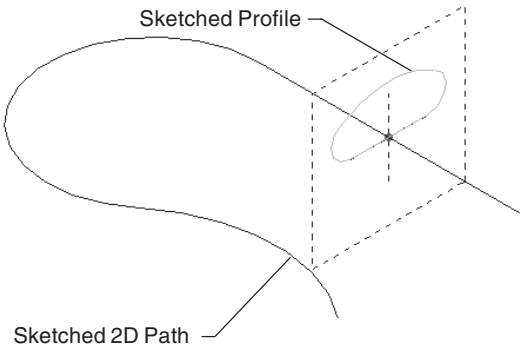


Figure 9-13 *Sketching the profile and the 2D path for creating a sweep*

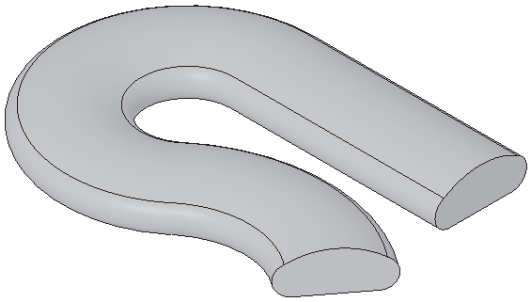


Figure 9-14 *Resulting massing shape*

Creating a Blend

Menu Bar: Modelling > Massing > Create Mass > Solid Form > Solid Blend
Design Bar: Massing > Create Mass > Solid Form > Solid Blend

Solid Blend

Using the **Solid Blend** tool, you can create a massing geometry by blending or linking two profiles. When this tool is chosen, the **Sketch** tab displays the tools to create and edit the blend, as shown in Figure 9-15.

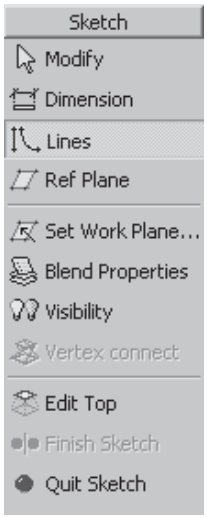


Figure 9-15 *The* ***Sketch*** *tab for the* ***Blend*** *tool*

You can sketch the base profile using the **Lines** tool, after setting the desired work plane. The **Blend Properties** option can be used to set the levels for the **First End** and the **Second End** instance parameters. After completing the base profile, you can choose the **Edit Top** tool to sketch the profile of the top in any work plane. The depth of the blend can be specified in the **Depth** edit box available in the **Options Bar**.

The **Vertex Connect** tool is available only after both the base and top profiles have been sketched. This tool enables you to specify the connectivity between the vertices of their profiles. After completing both the profiles, choose the **Finish Sketch** option from the **Design Bar** to create the blend geometry. Figure 9-16 shows two circular profiles being sketched as the base and the top profiles. The resulting geometry is shown in Figure 9-17.

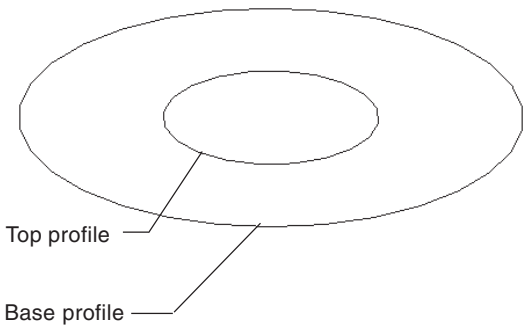


Figure 9-16 *Sketching the base and top profile to create a blend massing*

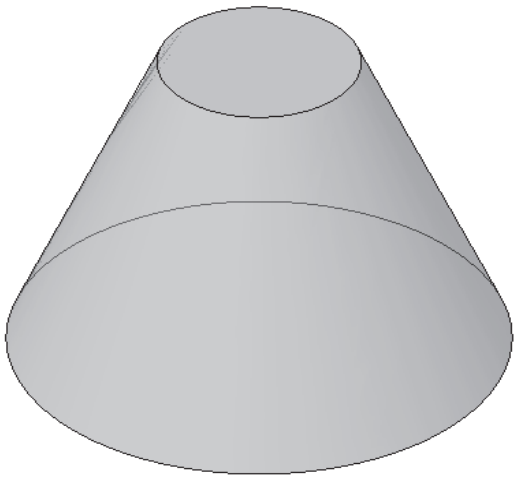
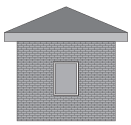


Figure 9-17 *Resulting shape after blending the base and top profiles*



Tip: *For creating a blended massing geometry, you can not sketch more than two closed loops, one for the base and one for the top.*

Editing the Massing Geometry

In Autodesk Revit Building, you can easily edit the massing geometry. It can be edited using the drag controls or by editing the massing parameters.

Resizing the Massing Geometry Using the Drag Controls

Upon selecting the massing geometry, various drag controls are displayed as arrows. You can use the dragging method to drag the desired face. The entire massing is automatically updated, based on the dragged face. For example, Figure 9-18 shows a cuboid with the drag controls displayed on all its eight planes. When you drag the plane of the cuboid using the drag control, Autodesk Revit Building immediately updates the geometry, as shown in Figure 9-19.

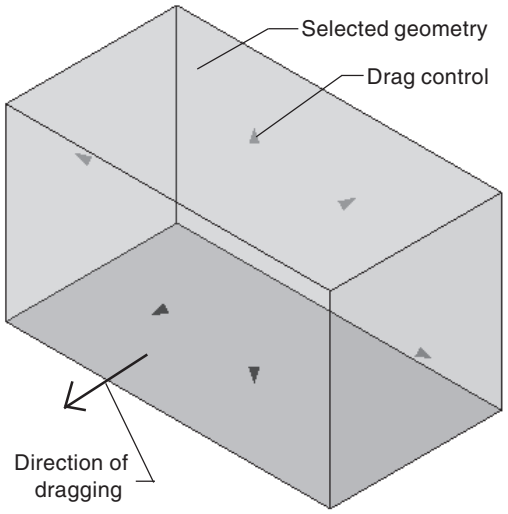


Figure 9-18 *Selected geometry with the displayed drag controls*

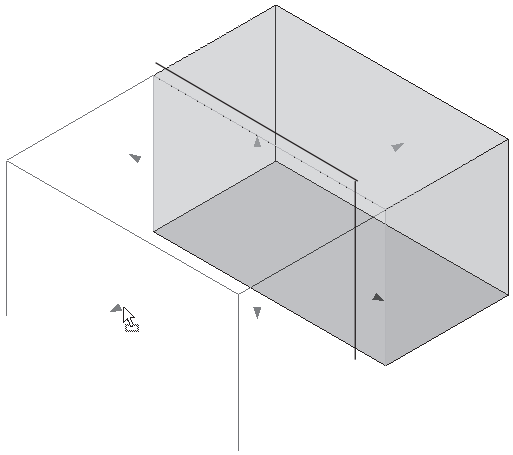


Figure 9-19 *Resizing massing geometry using the drag control*

Editing Geometry Parameters

The parameters of the massing geometry can also be modified by selecting it and choosing the **Edit** button from the **Options Bar**. The mass tab is displayed in the **Design Bar**. Again, select the massing geometry and choose the **Edit** button from the **Options Bar**. The **Sketch** tab is displayed, various creation and editing tools are available in this tab. You can then edit the parameters such as the profile, depth and properties, based on the method used for its creation.

To a certain extent, the massing features can also be modified like other building elements. You can use the editing tools along with the massing tools including, **Mirror**, **Copy**, **Group**, **Array**, and so on.

Creating Cuts in the Massing Geometry

Menu Bar: Modelling > Massing > Create Mass > Void Form
Design Bar: Massing > Create Mass > Void Form

The **Void Form** tool is used to cut a massing geometry by creating a void form, which is cut or subtracted from the massing geometry it intersects. When you choose this tool, a cascading menu is displayed. It displays four tools used to create the void form, **Void Extrusion**, **Void Blend**, **Void Revolve**, and **Void Sweep**. You can select the appropriate tool to generate the shape and volume of the void form. The method of creating the void form using these tools is similar to the respective process described for creating a solid form. The **Void Form** tool can be invoked, after selecting the solid massing geometry and choosing the **Edit** button from the **Options Bar**. When you complete the void form, Autodesk Revit Building automatically cuts its shape and volume from the intersecting massing geometry. Therefore, the **Void Form** option should not be selected directly from the **Design Bar** or menu bar.

For example, Figure 9-20 shows a rectangular profile being sketched using the **Void Form** and the **Void Extrusion** tool. When you choose **Finish Sketch**, the cutting geometry, in this case another cuboid, is generated and automatically cut from the larger massing geometry. Figure 9-21 shows the resulting massing geometry.

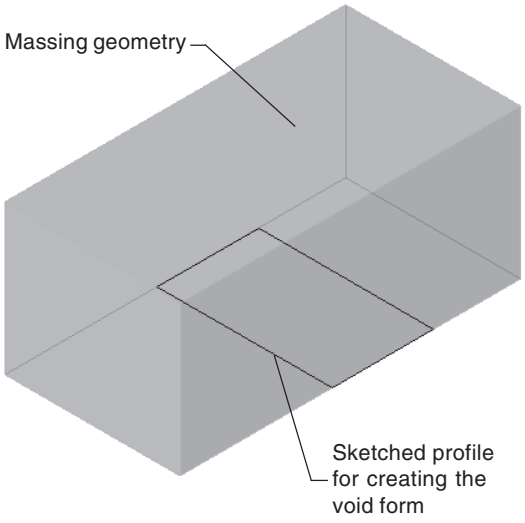


Figure 9-20 *Sketching the profile for creating the void form using the* ***Void Extrusion*** *tool*

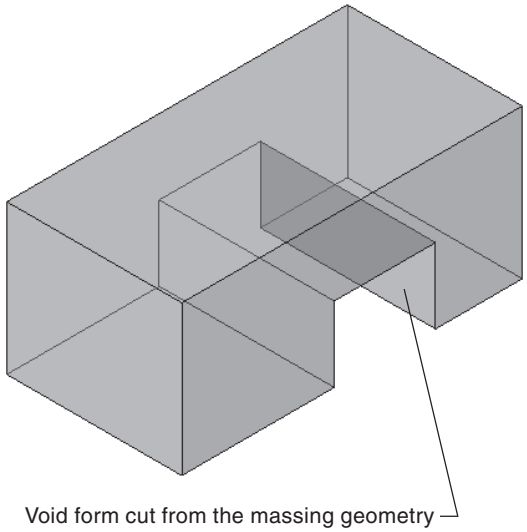


Figure 9-21 *The generated void form and the resulting massing geometry*

Similarly, you can use the **Void Revolve**, **Void Sweep**, and **Void Blend** tools to create the void form. For example, to create a tunnel through a building block, you can use the **Void Sweep** tool to sketch the semicircular profile and specify its path, as shown in Figure 9-22. The resulting void form is cut from the cuboid to create an arched opening through the building block, as shown in Figure 9-23.

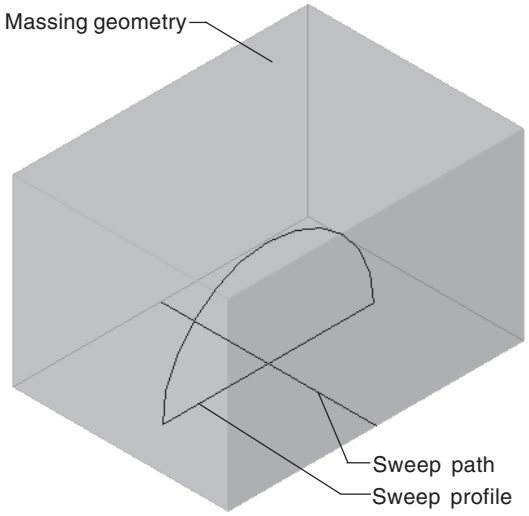


Figure 9-22 *Creating the void form using the* ***Void Sweep*** *tool*

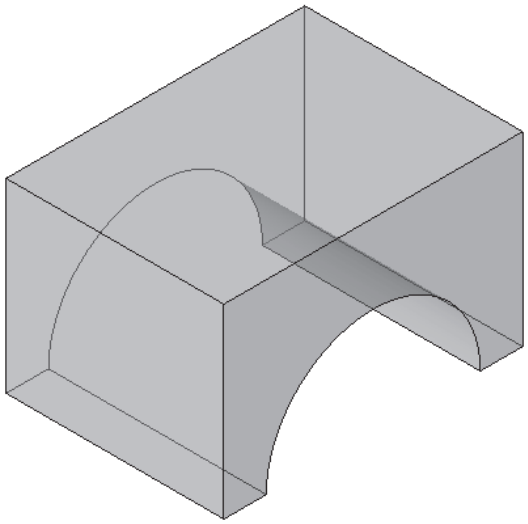


Figure 9-23 *Resulting void form and the cut massing geometry*

You can also use various editing tools, such as **Copy**, **Mirror**, **Array**, and so on, to make multiple copies of the void form profile for a single massing geometry. For example, Figure 9-24 shows a multistorey building block with a semicircular vertical cut as the void form on one of its sides. You can select the 2D profile of the void form and use the **Array** tool with the **Radial** option to create its multiple copies. Autodesk Revit Building automatically creates the arrayed void forms and generates the resulting geometry, as shown in Figure 9-25.

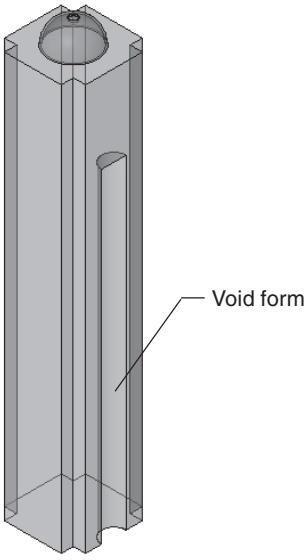


Figure 9-24 *Building mass with a single void form*

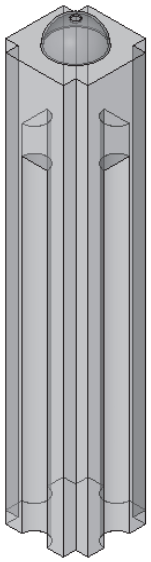
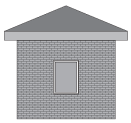


Figure 9-25 *Resulting massing geometry with an array of void forms*

Placing the Massing Geometry

Menu Bar: Modelling > Massing > Place Mass
Design Bar: Massing > Place Mass

Autodesk Revit Building Release 9.0 provides you the option of adding a predefined massing geometry into the project, using the **Place Mass** tool. When you invoke this tool, Autodesk Revit Building displays the loaded massing geometries in the **Type Selector Bar**. You can use the **Load** button available in the **Options Bar** to load additional massing geometries. In case a massing geometry is not loaded into the project file, Autodesk Revit Building displays the message box prompting you to load it. Various predefined massing geometries have been provided in the **Imperial Library > Mass** folder. You can select and load a single or multiple massing geometries from this folder and then select the one from the drop-down list of the **Type Selector Bar**. The selected mass can then be placed in the project by simply clicking at the desired location. Autodesk Revit Building also enables you to edit the predefined geometry. You can select the placed mass and modify its instance and type properties using the **Properties** button.



Tip: *The **Imperial Library > Mass** folder provides simple 3D geometries, such as cuboid, cone, sphere, and so on.*

CREATING BUILDING ELEMENTS FROM THE MASSING GEOMETRY

After generating the shape and volume of the massing forms, you can then convert them into building elements, such as, walls, floors, roofs and curtain systems. You can select the faces of the generated massing geometry and replace them with the desired building element. Various tools are available in the **Massing** tab in the **Design Bar** to carry out the conversion of faces into building elements.

Creating Walls by Selecting Faces

Design Bar: Massing > Wall by Face

The **Wall by Face** tool is used to convert vertical planar or arc faces of a mass into walls. After invoking this tool, select the wall type to be used for conversion from the **Type Selector Bar**. To convert the faces into walls, ensure that the **Pick Faces** option is selected in the **Options Bar**. Appropriate values of the **Level**, **Height**, and **Loc Line**, can be selected from the drop-down list in the **Options Bar**.

To convert the faces into walls, move the cursor over the massing geometry. You will notice that the faces that can be converted are highlighted. Click on the desired face to make the conversion. You can use the TAB key to select all the faces of the massing geometry that can be converted into walls. Figure 9-26 shows the selected faces of a massing geometry and Figure 9-27 shows the created walls.

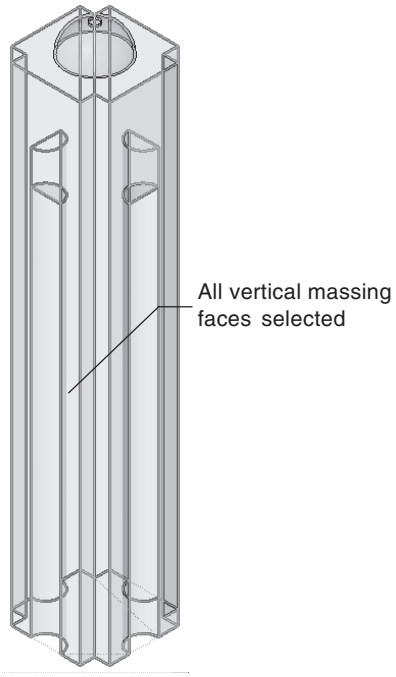


Figure 9-26 *Selected wall faces*

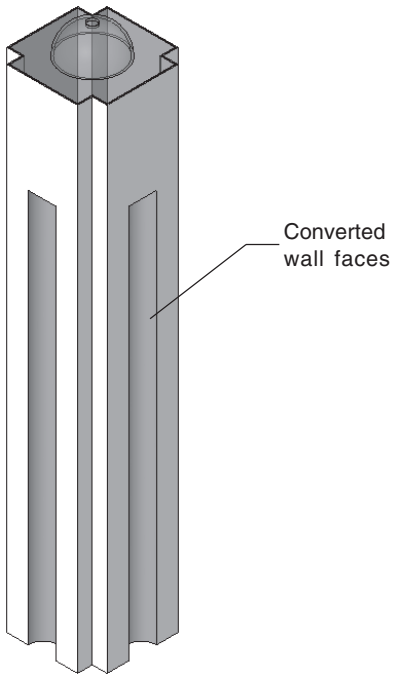


Figure 9-27 *Massing faces converted into walls*

Creating Floors by Selecting Faces

Design Bar: Massing > Floor by Face

In order to create a floor in a massing geometry, you first need to define the floor area faces. This can be done by selecting the mass and choosing the **Floor Area Faces** button available in the **Options Bar**. The **Floor Area Faces** dialog box is displayed. Select the levels, at which the floor area faces are desired and choose the **OK** button. Autodesk Revit Building automatically generates the floor area faces based on the massing geometry and the defined levels.

Next, invoke the **Wall by Face** tool from the **Massing** tab in the **Design Bar**. The floor type can be selected from the **Type Selector Bar**. When you move the cursor over the massing geometry, the floor area faces are highlighted. You can select the **Select Multiple** check box in the **Options Bar** and use the crossing options to create a selection of multiple floor area faces. Choose the **Create Floors** button available in the **Options Bar** to create the floors. Autodesk Revit Building converts all the selected floor area faces into the selected floor type.

Figure 9-28 shows the floor area faces generated for a multistorey building. The created floors are shown in Figure 9-29.

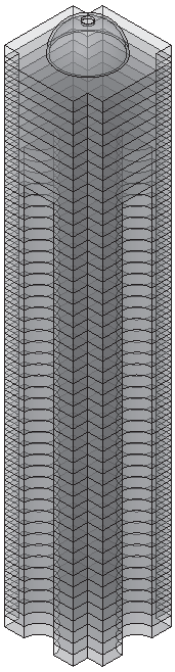


Figure 9-28 *Generated floor area faces*

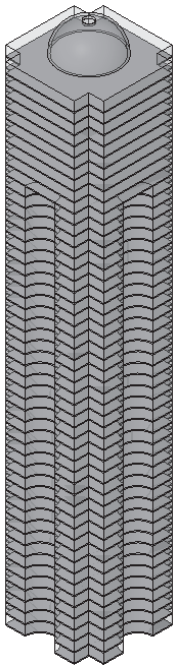


Figure 9-29 *Floor area faces converted into floors*

Creating Roofs by Selecting Faces

Design Bar: Massing > Roof by Face

You can use the **Roof by Face** tool to convert the massing faces into roofs. The faces can be horizontal planes of any shape or those created using the extrusion, revolve, blend, or sweep.

After selecting the **Roof by Face** tool, select the roof type to be used from the **Type Selector Bar**. Move the cursor over the massing geometry and click to select the highlighted face. Choose the **Create Roof** button available in the **Options Bar** to convert it into the roof. Figures 9-30 and 9-31 show an example of the top face of the multistorey building converted into a roof.

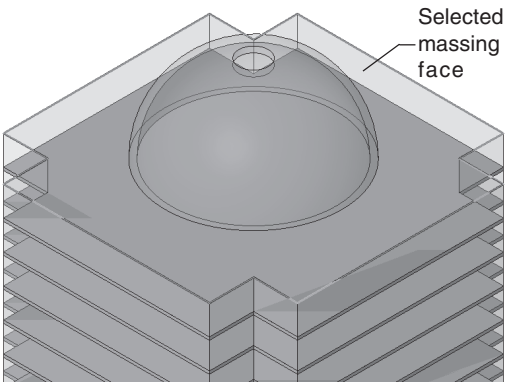


Figure 9-30 *Top faces selected for conversion into a roof*

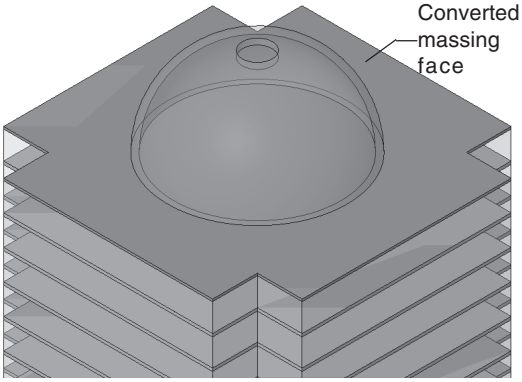


Figure 9-31 *The top face of the massing geometry converted into a roof*

Creating Curtain Systems by Selecting Faces

Menu Bar: Modelling > Curtain System > Curtain System by Face
Design Bar: Massing > Curtain System by Face

Autodesk Revit Building Release 9.0 provides you the **Curtain System by Face** tool to convert planar and non-planar faces into curtain systems. The **Curtain System by Face** tool can also be invoked by choosing **Modelling > Curtain System > Curtain System by Face** from the menu bar. It can also be used to create model curtain system families.

After invoking this tool, select the curtain system type from the **Type Selector Bar**. Use the **Properties** button to modify the properties of the curtain system, before creating it. Move the cursor over the face that needs to be converted into the curtain system and click to select it. Choose the **Create System** button from the **Options Bar** to create the curtain system. Figure 9-32 shows an example of a curtain system dome. You can then add mullions to it curtain system using the **Mullions** tool, as shown in Figure 9-33.

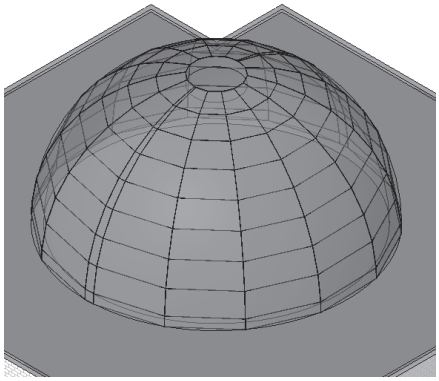


Figure 9-32 *Creating curtain systems using the* ***Curtain System by Face*** *tool*

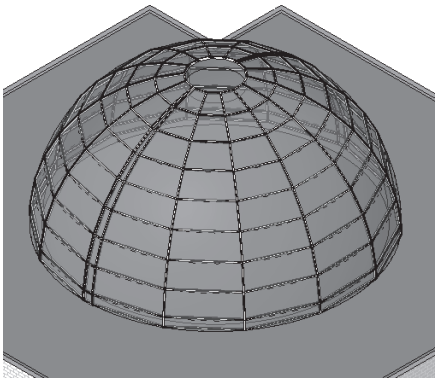


Figure 9-33 *Added mullions to the curtain system*

Figure 9-34 shows other examples of using the **Curtain System by Face** tool to convert non-planar massing faces into curtain systems.

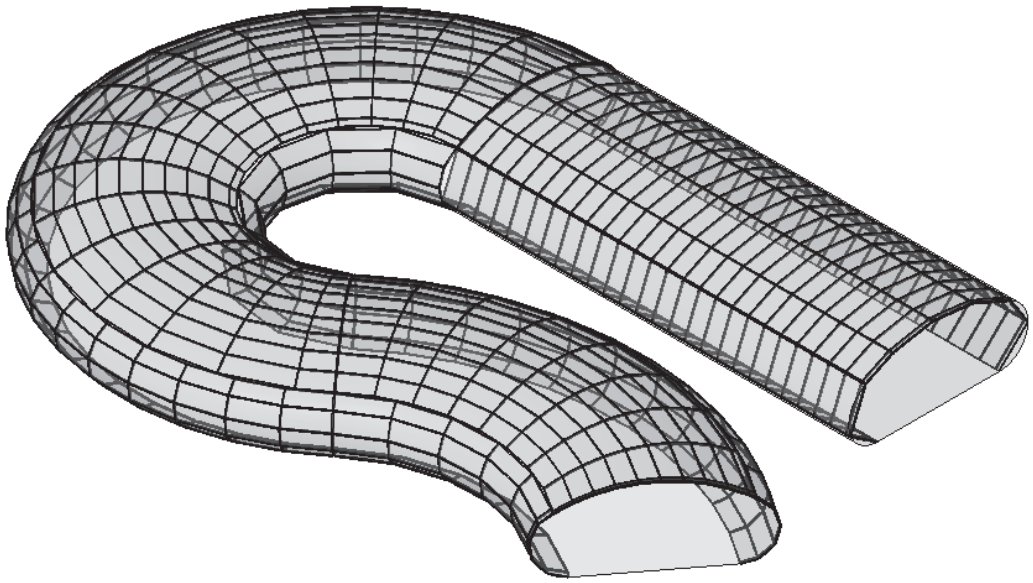


Figure 9-34 *Converting non-planar massing faces into curtain systems with mullions*

Controlling Visibility of the Massing Geometry

Menu Bar:	View > Show Mass
Toolbar:	View > Show Mass

By default, all the massing forms created are not visible in a view. The **Show Mass** tool is used display or hide the massing geometry. However, the use of this tool has a temporary effect on the visibility of the massing forms. When a project file is closed, the show mass settings are not saved with it. Therefore, the next time you open the project file, the massing forms will not be visible.

To display the massing form permanently in a project file, choose **View > Visibility/Graphics** from the menu bar and select the check box for the **Visibility** parameter for the **Mass** model category.

Adding Other Building Elements

After converting the massing geometry to basic building elements, you can add other building elements, such as doors, windows, roofs, and so on, to it. You can also use various editing tools to copy, edit, and delete elements from the building model, just like a model generated using the building elements.

Figure 9-35 shows an example of the building model in the plan view with the modified wall type and added windows. You can then use the editing tools, such as **Mirror**, **Array**, and **Paste**

Aligned to copy elements and create a building model of the desired shape and parameters, as shown in Figure 9-36.

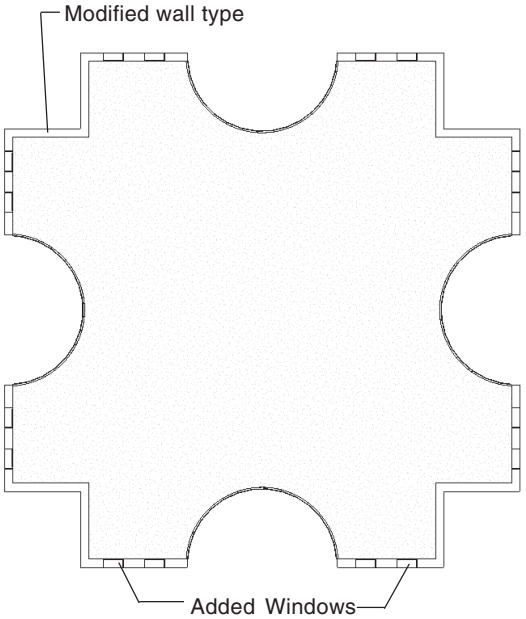


Figure 9-35 *Plan view showing the modified wall type and added windows*

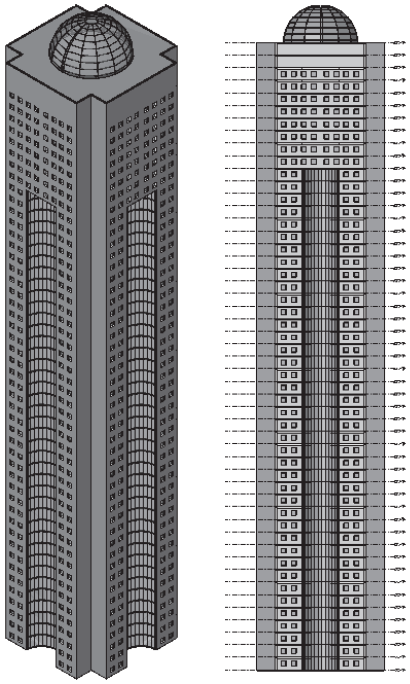
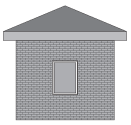


Figure 9-36 *An example of a multistorey building with building components*

Like other building models, you can also create standard building views of the converted massing model. Autodesk Revit Building also provides the facility to extract the areas and other statistical figures of the created massing geometry.



Tip: *With the power of the **Massing** tool, Autodesk Revit enables you to create a variety of shapes and volumes. Based on the desired geometry, you can use a combination of tools to create it. The massing geometry can also be used to generate rendered views of the concceptual building volumes. This can prove to be an effective tool in communicating the design intent to the entire project team, before starting the detailed project plans.*

Tutorial 1 Office Building 2

Create the massing geometry for a five story office building based on the shape shown in Figure 9-37. It consists of a 50'0" X 50'0" central hall that is 60'0" high. It has a 30'0" diameter cylindrical atrium with a hemispherical dome at the top level. The central hall is flanked by the right and left wings that are 40'0" high. The entrance area is 30'0" high Use the dimensions of the building given in the floor plan, shown in Figure 9-38 and the elevation, as shown in Figure 9-39. The dimensions and text have been given for reference and are not to be created. After creating the massing, convert it into building elements with the parameters given next.

(Expected time: 45 min)

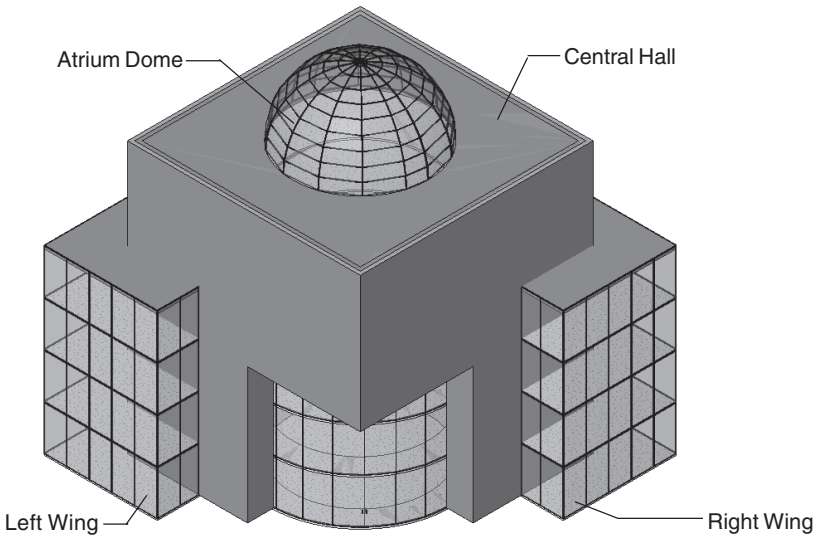


Figure 9-37 *3D sketch view of the office building*

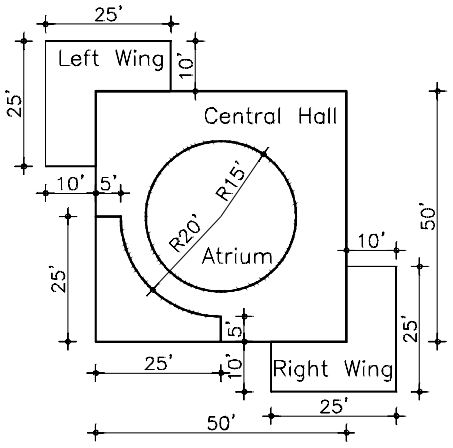


Figure 9-38 *Sketch plan for the office building*

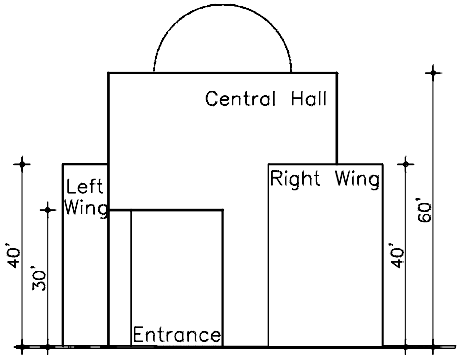


Figure 9-39 *Elevation for the office building*

1. Project parameters:
   Template File- **default.rte**, file name to be assigned- **Office-2.rvt**
   Floor to floor height of the building - 10'0"

2. Building Element types for the converted shell elements:
   Floor: **Floor : LW Concrete on Metal Deck**
   Walls: Central Hall- **Basic Wall: Exterior - Brick on CMU**
   Left Wing, Right Wing and Entrance- **Curtain Wall: Exterior Glazing**
   (Spacing 5'0" horizontal, 10'0" vertical)
   Flat Roof: **Roof : Generic 9"**
   Curtain system for dome: Spacing 2'6" horizontal, 5'0" vertical; Mullion type

   The following steps are required to completing this tutorial:

a. Open a new project file, using the default template file.
b. Add levels using the **Level** tool.
c. Create the massing geometry using the **Solid Form** and **Solid Extrusion** tools, refer to Figures 9-40 through 9-43.
d. Cut the geometry based on the sketch plan to create the atrium and the entrance, using the **Void Form** and **Void Extrusion** tool, refer to Figures 9-44 through 9-46.
e. Use the **Solid Form** and **Solid Revolve** tools to generate the atrium dome, refer to Figures 9-47 through 9-49.
f. Convert the massing geometry into the specified building elements, refer to Figures 9-50 through 9-54.

Opening the Project File and Adding Levels

You can first open a new project file using the **New** tool. As the building is five story high, you will create four additional levels and rename them according to the floor levels.

1. Choose **File > New > Project** from the menu bar. The **New Project** dialog box is displayed.

2. Ensure that the **default.rte** file is the selected template file.

3. Choose the **OK** button to close the **New Project** dialog box. The new project file is opened in the drawing window.

4. In the **Project Browser**, double-click on **South** in the **Elevations (Building Elevations)** head to display the corresponding view.

5. Choose **Drafting > Level** from the menu bar to invoke the **Level** tool.

6. Add four levels above level 2 at an elevation of 10'0" each.
   (For more information on adding levels, see Chapter 5 - Adding Levels)

7. Rename the levels as follows:
   Level 1- First Floor
   Level 2- Second Floor

Level 3- Third Floor
Level 4- Fourth Floor
Level 5- Fifth Floor
Level 6- Roof Floor
While renaming, choose the **Yes** button in the **Revit** conformation box to rename the corresponding views.

Creating the Massing Geometry

You can now start creating the massing geometry using the **Solid Form** tool. The central hall and the two wings can be generated using the **Solid Extrude** tool.

Note

The massing geometry can be created using various methods and tools. You must choose the tool that is the most appropriate to generate the specific geometry. The steps given below describe a general procedure to create massing. The steps and methods may vary, based on the design intent.

1. Ensure that the **Massing** tab is available in the **Design Bar**. If it is not available, then right-click over the **Design Bar** and select **Massing** to display the **Massing** tab.

2. Double-click on **First Floor** under the **Floor Plans** head in the **Project Browser** to display the corresponding plan.

3. Choose **Create Mass** from the **Massing** tab.

4. In the **Name** dialog box, enter the name **Central Hall**, as shown in Figure 9-40, and choose the **OK** button.

Figure 9-40 *Naming the massing geometry*

5. Choose the **Solid Form > Solid Extrusion** tool from the **Mass** tab in the **Design Bar**.

6. In the **Options Bar**, enter the value **60'0"** in the **Depth** edit box.

7. Select the **Rectangle** sketching tool from the **Options Bar**.

8. Move the cursor in the area between the four elevation tags and sketch a square with 50'0" side.

9. Choose **Finish Sketch** from the **Design Bar**.

10. Choose **Finish Mass** from the **Design Bar** to create the central hall massing

    Similarly, create the left and right wing of the building using the **Solid Extrude** tool. You can sketch the profile in the first floor plan view and extrude it to the height of 40'0", as specified in the sketch plan.

11. Choose **Create Mass** from the **Design Bar**.

12. In the **Name** dialog box, enter the name **Wings** and choose the **OK** button.

13. Choose the **Solid Form > Solid Extrusion** tool from the **Mass** tab in the **Design Bar**.

14. In the **Options Bar**, enter the value **40'0"** in the **Depth** edit box.

15. Select the **Chain** check box in the **Options Bar**.

16. Ensure that the **Lines** tool is invoked in the **Design Bar**.

17. Move the cursor near the lower right corner of the square and sketch the profile shown in Figure 9-41, based on the dimensions given in the sketch plan.

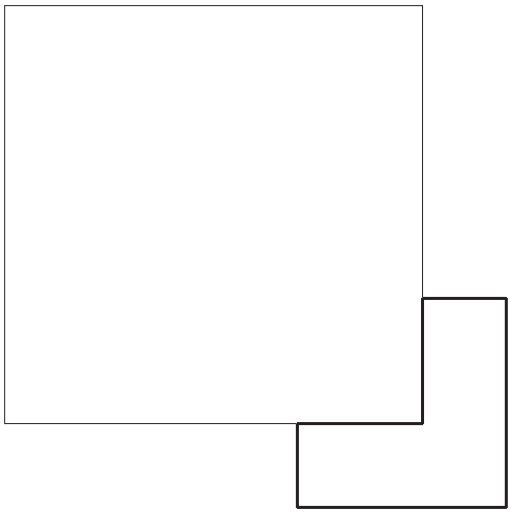


Figure 9-41 *Sketched profile for the right wing*

18. Choose **Modify** from the **Sketch** tab.

19. Select the sketch profile.

20. Choose **Edit > Mirror** from the menu bar to invoke the **Mirror** tool.

21. Select the **Draw** option from the **Options Bar**.

22. Draw a line from the top right corner to the bottom left corner of the central square to define the mirror line. The profile is mirrored to the diagonally opposite corner of the square, as shown in Figure 9-42.

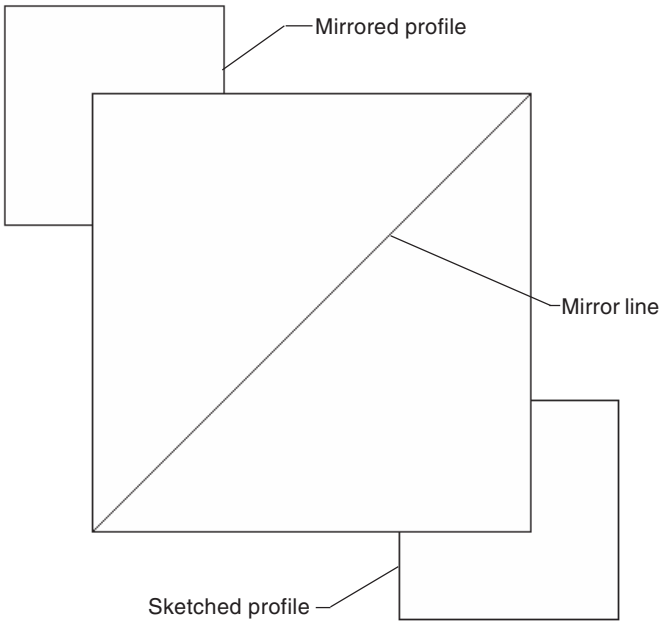


Figure 9-42 *Creating a mirror copy of the sketched profile*

23. Choose **Finish Sketch** from the **Sketch** tab.

24. Choose the **Finish Mass** from the **Design Bar**. The two sketched profiles are extruded by a depth of 40'0".

25. Choose the **Default 3D View** tool from the **View** toolbar and then choose **View > Orient > Northeas**t from the menu bar to display the created massing geometry in 3D, as shown in Figure 9-43.

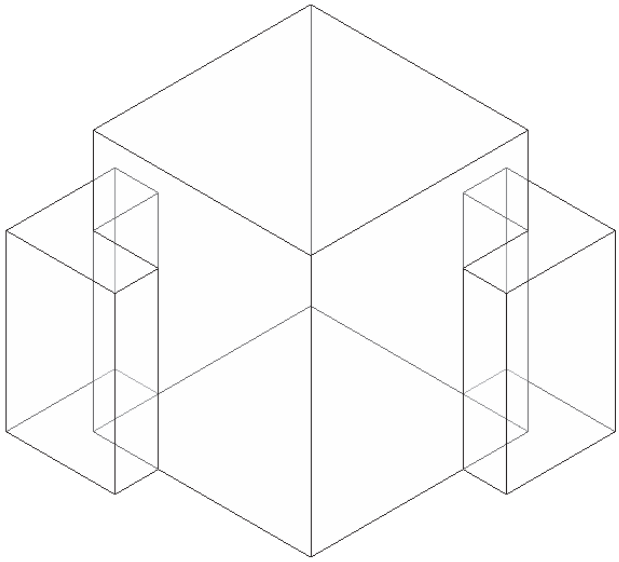


Figure 9-43 *3D view of the massing geometry*

Cutting the Massing Geometry

After creating the desired building block, you can now cut them to create the atrium and the entrance. The **Void Form** and the **Void Extrusion** tool can be used to create the desired void geometry.

1. Select the central hall massing cuboid.

2. Choose the **Edit** button from the **Options Bar**.

3. Double-click on **First Floor** under the **Floor Plans** head in the **Project Browser** to display the first floor plan view.

4. Choose **Void Form > Void Extrusion** from the **Mass** tab in the **Design Bar**.

5. Choose the **Circle** sketching tool from the **Options Bar** by clicking on the down arrow button.

6. In the **Depth** edit box, enter the value **60'0"**.

7. Move the cursor near the center of the square. Use reference planes to locate the center and click to specify it.

8. Move the cursor to the right and enter the value **15'0"** to create a circle of 30'0" diameter.

9. Choose **Finish Sketch** from the **Design Bar** to create the cutting geometry.

The next step is to create the cutting geometry for the entrance

10. Choose **Void Form > Void Extrusion** from the **Mass** tab in the **Design Bar**.

11. Enter the value **30'0"** in the **Depth** edit box.

12. Select the **Arc from center and end points** sketching option from the **Options Bar**.

13. In the drawing window, use the **Ref Plane** tool from the **Design Bar** to locate and select the center of the atrium circle as the center of the entrance arc.

14. Move the cursor horizontally toward the left and enter the value 20'0" to specify the radius.

15. Move the cursor anti-clockwise to create a quarter arc, as shown in Figure 9-44.

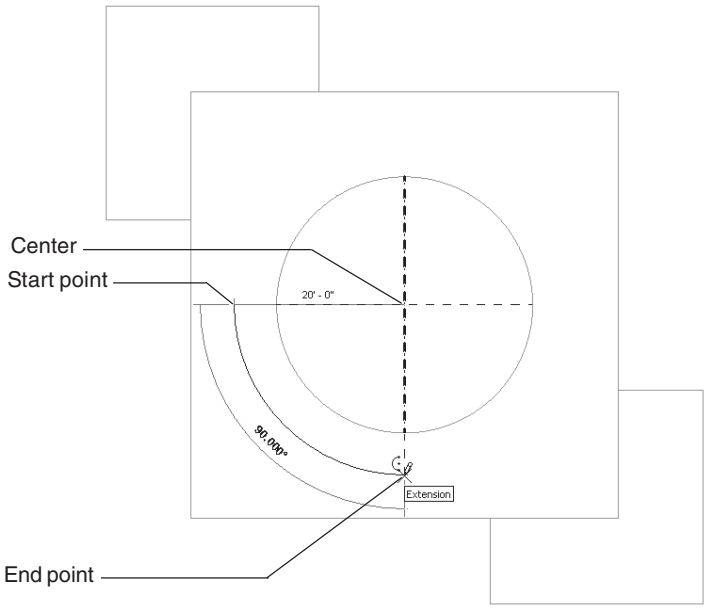


Figure 9-44 *Sketching the cutting geometry*

16. Choose the **Line** sketching option and ensure that the **Chain** option is selected.

17. Sketch the profile of the cutting geometry as shown in Figure 9-45.

18. Choose **Finish Sketch** from the **Sketch** tab.

19. Choose **Finish Mass** from the **Mass** tab in the **Design Bar**.

20. Choose the **Default 3D View** button from the **Views** toolbar and then choose **View > Orient > Southwest** from the menu bar to view the resulting massing, as shown in Figure 9-46.

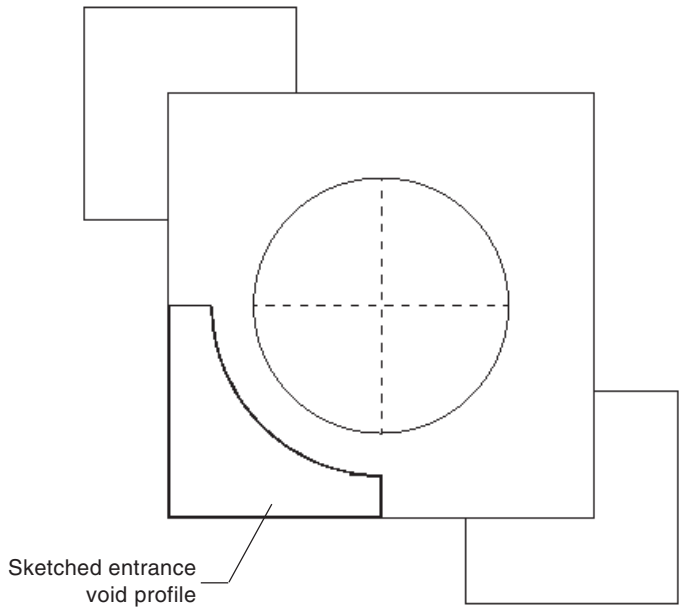


Figure 9-45 *Sketching the cutting geometry*

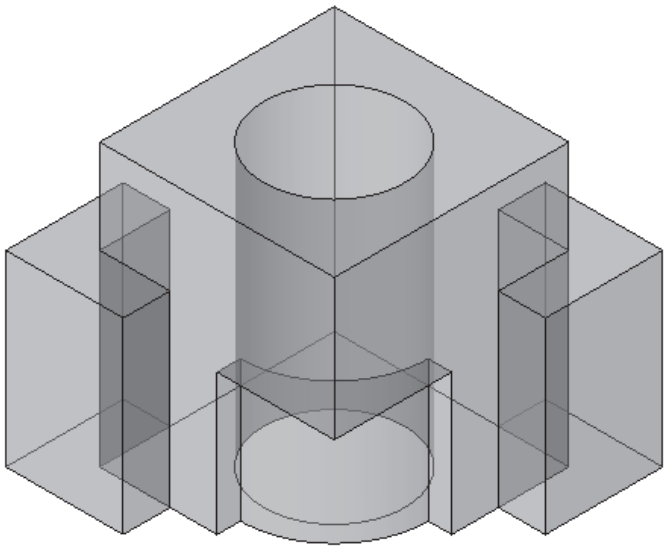


Figure 9-46 *3-D shaded view of the cut massing geometry*

Creating the Atrium Dome

The atrium dome can be added using the **Solid Revolve** tool. It is a hemispherical dome, having radius of 20'0", same as the radius of the atrium.

1. Choose **Create Mass** from the **Massing** tab of the **Design Bar**.
2. Enter the name **Dome** in the **Name** edit box and choose the **OK** button.
3. Choose **Solid Form > Solid Revolve** from the **Mass** tab in the **Design Bar**.
4. Choose **Set Work Plane** from the **Design Bar**.
5. In the **Work Plane** dialog box, select the **Pick a plane** radio button and choose the **OK** button.
6. Select the right side entrance wall as the work plane, refer to Figure 9-47.
7. Choose the **Lines** tool from the **Design Bar**.
8. Sketch the first line from the edge of the circle to the center of the dome and the second line from the center vertically upward with 15'0" length, as shown in Figure 9-47.

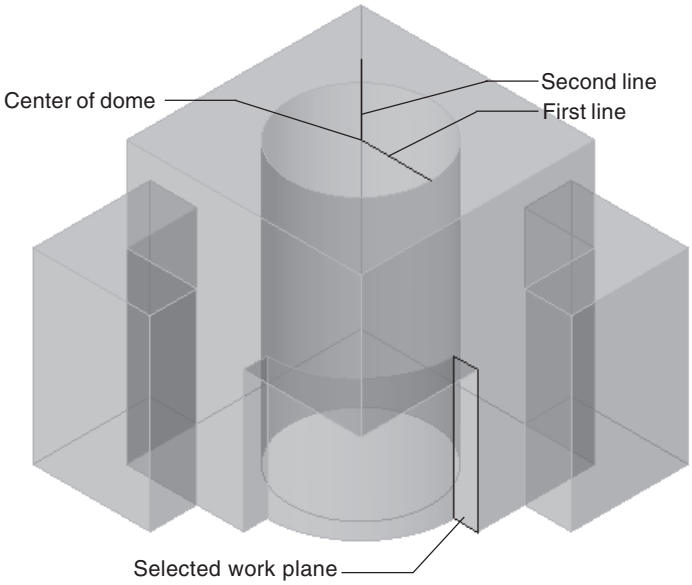


Figure 9-47 *Sketching the dome geometry*

9. Choose the **Arc from center and end points** sketching option from the **Options Bar**.
10. Using the centre of the atrium roof as the center of the curve, sketch a quarter arc.
11. Choose **Axis** tool from the **Sketch** tab.

12. From the center of the dome, sketch a line vertically upward, as shown in Figure 9-48, to define the axis of revolution.

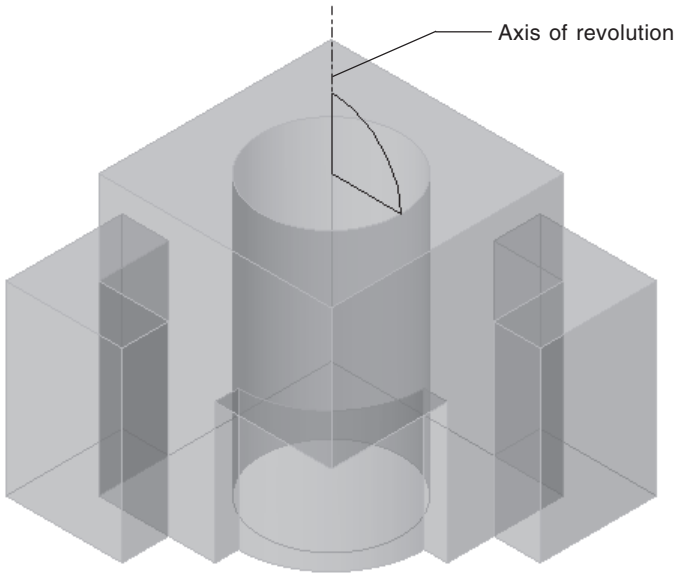


Figure 9-48 *Sketching the axis of revolution for the dome*

13. Choose **Finish Sketch** from the **Sketch** tab to create the dome geometry.

14. Choose **Finish Mass** from the **Sketch** tab to complete the dome, as shown in Figure 9-49.

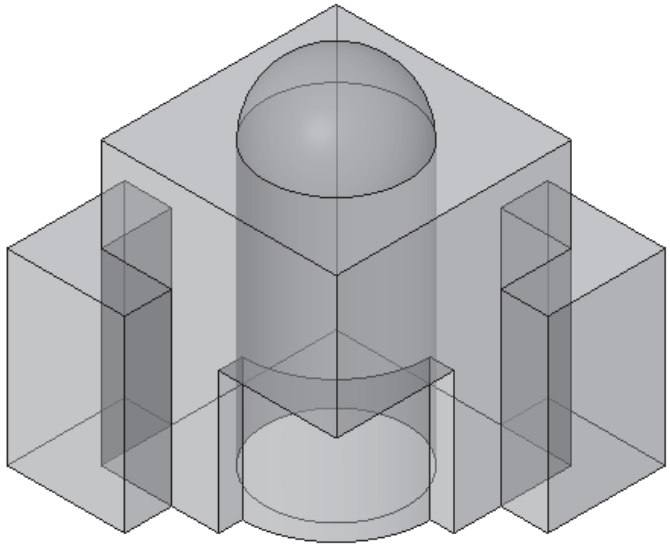


Figure 9-49 *3D shaded view of the created dome mass*

Converting the Massing Geometry into Building Elements

You can now convert the massing geometry into building elements using the **Floor by Face**, **Wall by Face**, and the **Roof by Face** tools. In order to create floors, you must first create different floor area faces.

1. Ensure that the **Modify** tool is invoked in the **Design Bar**.

2. Select the Central Hall and Wings massing geometry by holding the CTRL key.

3. From the **Options Bar**, choose the **Floor Area Faces** button.

4. In the **Floor Area Faces** dialog box, select the check boxes for all the floors and choose the **OK** button. The floor area faces are created for the selected floors.

5. Choose the **Floor by Face** tool from the **Design Bar**.

6. Select **Floor: LW Concrete on Metal Deck** from the **Type Selector Bar**.

7. Using the crossing, select all the floor faces. Choose the **Create Floors** button from the **Options Bar**. Choose **View > Shading with Edges** from the menu bar. Autodesk Revit Building creates the floors at the floor area faces, as shown in Figure 9-50.

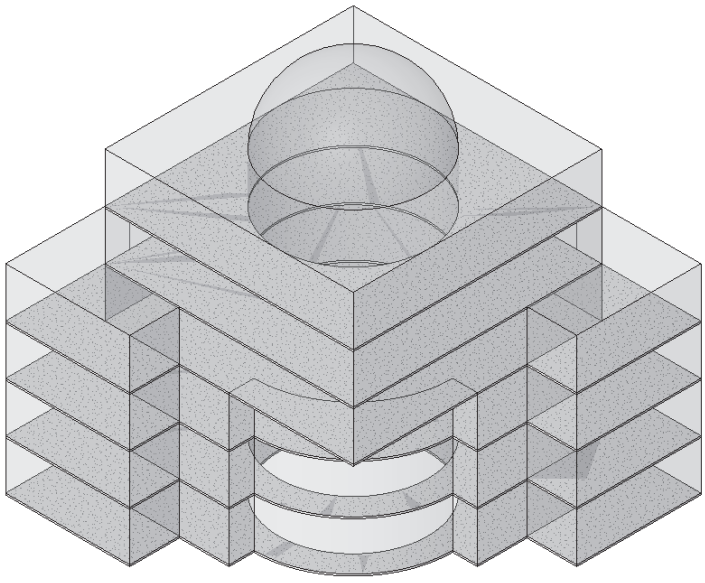


Figure 9-50 *Converted floor area faces into floors*

8. Choose **Wall by Face** from the **Design Bar**.

9. In the **Type Selector Bar**, select the wall type **Basic Wall : Exterior - Brick on CMU**.

10. Move the cursor over the central hall massing geometry and when an exterior wall is highlighted, click to convert the wall face into the selected wall type.

11. Similarly, highlight and click on the other exterior walls of the central hall, including the two side walls of the entrance. The resulting 3D view is shown in Figure 9-51.

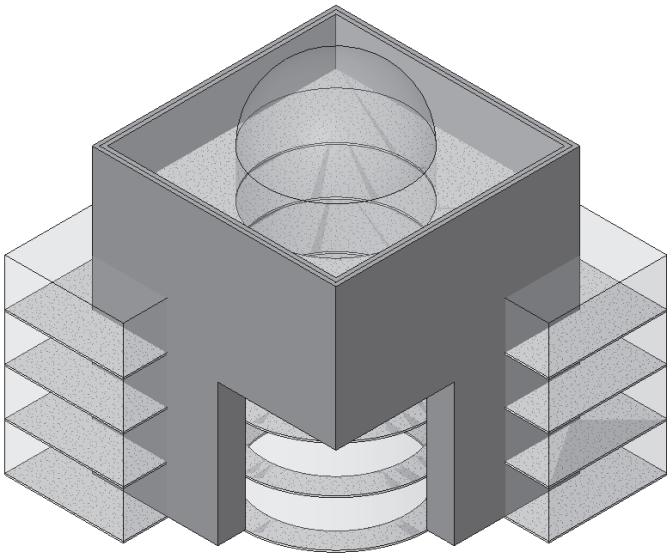


Figure 9-51 *Converting massing into walls*

12. Select the wall type **Curtain Wall : Exterior Glazing** from the **Type Selector Bar**.

13. Choose the **Properties** button.

14. In the **Element Properties** dialog box, choose the **Edit/New** button.

15. In the **Type Properties** dialog box, enter the values 5'0" and 10'0" for **Spacing (Grid 1)** and **Spacing (Grid 2)** type parameters respectively. Choose the **OK** button to close the dialog box.

16. Choose the **OK** button to close the **Element Properties** dialog box and return to the drawing window.

17. Highlight and click on the exterior walls of the right and left wings to convert them into the selected exterior glazing walls.

18. Similarly, convert the curved entrance wall into the exterior glazing wall type. The 3D view will now appear similar to the illustration shown in Figure 9-52.

19. Choose **Roof by Face** from the **Design Bar**.

20. From the **Type Selector Bar**, select the specified roof type **Basic Roof : Generic - 9"**.

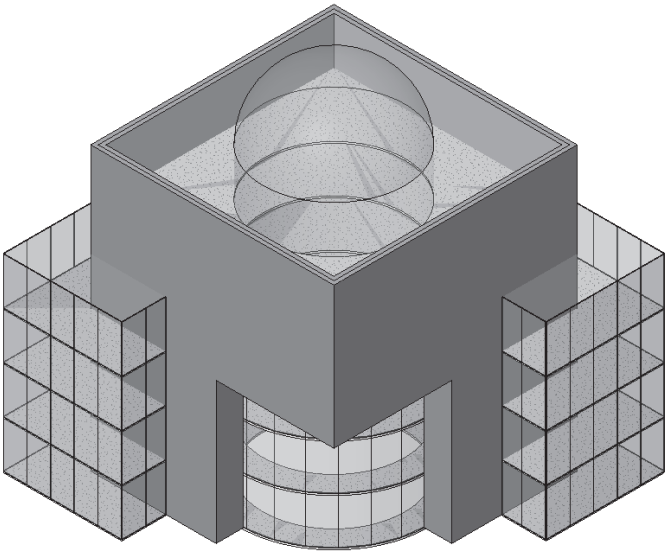


Figure 9-52 *Converting massing into walls*

21. Highlight the roof face of the central hall and click when it is highlighted.

22. Choose the **Create Roof** button from the **Options Bar** to create the roof.

23. Similarly, create the roof of the same type for the two wings. After the roofs are created, the 3D view will appear similar to the Figure 9-53.

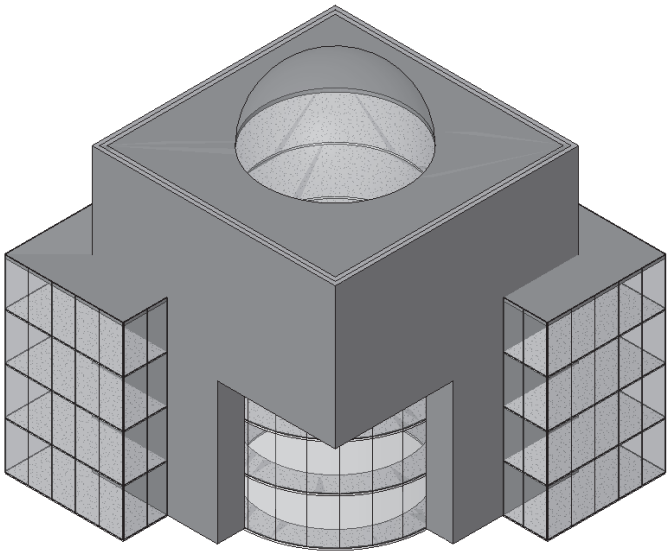


Figure 9-53 *Converting massing into roofs*

Next, you will create the dome curtain wall system.

24. Choose the **Curtain System by Face** tool from the **Design Bar**.

25. Choose the **Properties** button.

26. Choose the **Edit/New** button to display the **Type Properties** dialog box.

27. Choose the **Duplicate** button.

28. In the **Name** edit box of the **Name** dialog box, enter the name **2'6"X5'0"** and choose the **OK** button.

29. Enter the values **5'0"** and **2'6"** for the **Spacing (Grid 1)** and **Spacing (Grid 2)** type parameters, respectively.

30. Return to the drawing window by choosing the **OK** button in the **Type Properties** and **Element Properties** dialog boxes.

31. Select both faces of the dome.

32. Choose the **Create System** button in the **Options Bar**. The curved surfaces of the dome are converted into curtain systems.

34. Load the curtain wall double glass door from the **Imperial Library > Doors** folder. Select and replace the two curtain grids in the center of the entrance with the loaded door.

33. Choose **Modelling > Mullion** from the menu bar.

34. From the **Type Selector Bar**, select the mullion type **Rectangular Mullion : 1" Square**.

35. Select the **All Empty Segments** radio button from the **Options Bar**.

36. Add mullions to all the curtain systems in the project, including the exterior wing walls, the curved entrance wall, and the dome. Use the **Grid Line Segment** option to add grids, if required.

    The completed 3D view of the project will appear similar to the view shown in Figure 9-54.

37. Choose **File > Save** from the menu bar and save the project file as Office-2.rvt.

38. Choose **File > Close** from the menu bar to close the Autodesk Revit Building session.

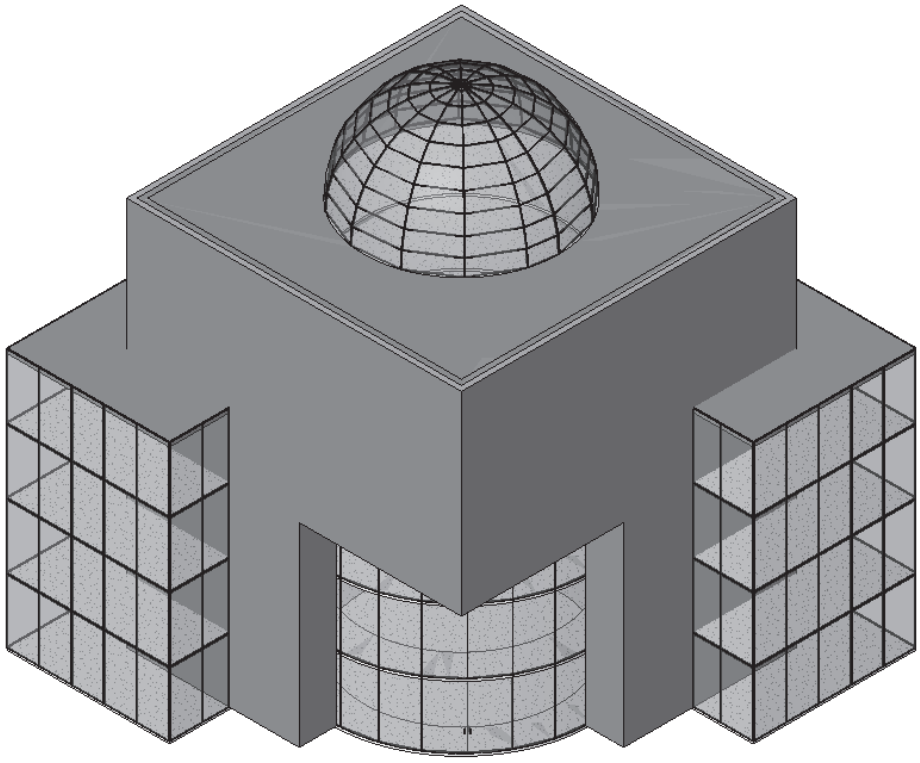


Figure 9-54 *Added roof and curtain systems*

Self-Evaluation Test

Answer the following questions and then compare your answers with those given at the end of the chapter.

1. The **Solid Extrusion** tool creates the massing perpendicular to the sketched profile. (T/F)

2. Using the **Solid Blend** tool, you can link two profiles at different levels. (T/F)

3. You cannot specify a negative value in the **Depth** edit box. (T/F)

4. A massing geometry, once created, cannot be resized. (T/F)

5. When you use the **Void Form** tool, the generated massing geometry is cut from the intersecting massing geometry (T/F).

6. The _____ tool is used to add massing by sketching a profile and defining an axis.

7. The _____ tool is used to specify the connection of vertices, while using the **Solid Blend** tool.

8. Using the _____ tool, you can display or hide the massing geometry.

9. The start and end point of a solid extrusion can be specified in the _____ dialog box.

10. To modify a created massing geometry, you can select it and choose the _____ button from the **Options Bar** to modify its profile and properties.

Review Questions

Answer the following questions.

1. The drag controls can be used to resize the massing geometry. (T/F)

2. You can use the editing tools, such as **Move**, **Mirror**, **Copy**, and so on, while sketching the massing geometry. (T/F)

3. The **Solid Blend** tool extrudes a profile, along a defined path. (T/F)

4. You can extrude multiple closed profiles using the **Solid Extrude** tool. (T/F)

5. The **Work Plane** tool can be used to define the plane, in which the profile is to be sketched (T/F).

6. You can load additional profiles, while using the **Solid Sweep** tool. (T/F)

7. Once the massing geometry is converted into building elements, it cannot be viewed as a massing geometry. (T/F)

8. Which of the following parameters can be used to specify the top of the extrusion level from the base level in the **Element Properties** dialog box?

   a) **Level** b) **Extrusion End**
   c) **Depth** d) **Extrusion Start**

9. Which of the following tools is used to create a curved tube?

   a) **Solid Blend** b) **Solid Revolve**
   c) **Solid Extrude** d) **Solid Sweep**

10. Which of the following tools can be used to create a sphere?

    a) **Solid Sweep** b) **Solid Revolve**
    c) **Solid Extrude** d) **Solid Blend**

Exercises

Exercise 1 Office Towers

Create the massing geometry for a office building that consists of two identical 400'0" high towers with a connecting passage at 200'0" height. Each tower has a 50'0" X 50'0" base with an offset of 5'0" at 200'0" and 300'0" levels. There are two masts on each tower with a base radius of 2'6 " and the top radius of 0'6" The connecting passage is 150'0" long and has a width and height of 25'0" with a vault roof. The plan view of the building is shown in Figure 9-55. The 3D view and the elevation is shown in Figure 9-56 and 9-57 respectively. The dimensions and text have been given for reference and are not to be created. Assume missing dimensions proportionate to the building design. After creating the massing, convert it into building elements with the parameters given next.

(Expected time: 45 min)

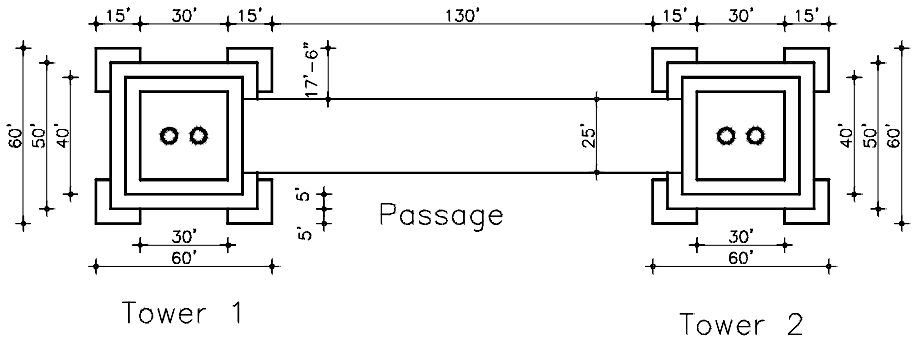


Figure 9-55 *Sketch plan for the multistorey office building*

1. Project File Parameters:
   Template File- **default.rte,**
   File Name to be assigned- **Office Towers.rvt**

2. Building Element types for the converted shell elements:
   Floor: **Floor : LW Concrete on Metal Deck**
   Walls: Towers- **Curtain Wall: Exterior Glazing**
   (horizontal and vertical spacing- 10'0")
   Connecting Passage- **Curtain Wall: Curtain Wall 1**
   Roof: **Basic Roof : Generic 9"**

   After completion, the building model will appear similar to the illustration shown in Figure 9-58.

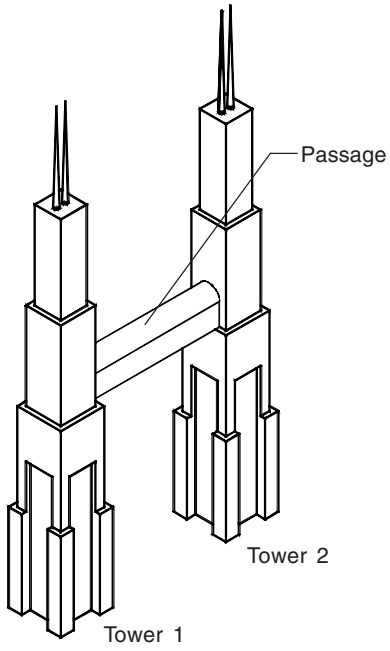


Figure 9-56 *3D view of the building*

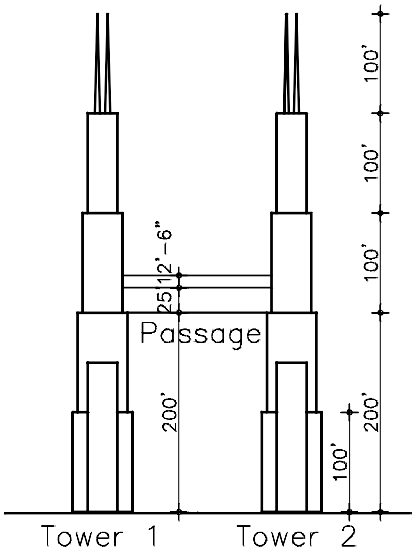


Figure 9-57 *Elevation view of the building*

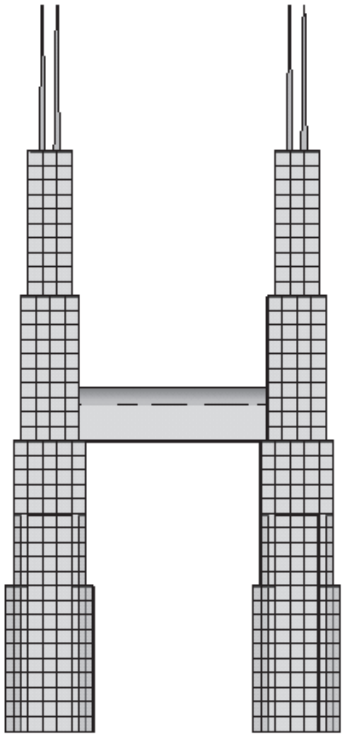


Figure 9-58 *Elevation view of the completed building*

Exercise 2 Stadium

Create the massing geometry for a stadium. Its plan view is shown in Figure 9-59. It consists of the field area and the stands. The lower tier in the stands has 3'0" as the tread width and 1'0" as the riser. The upper tier has 3'0" as the tread width and 1'6" as the riser. The cross-section view of the stands is shown in Figure 9-60. The dimensions and text have been given for reference and are not to be created. Assume the missing dimensions proportionate to the sketch plan. Use the following building parameters. **(Expected time: 30 min)**

1. Project File Parameters:
   Template File- **default.rte,**
   File Name to be assigned- **Stadium.rvt**

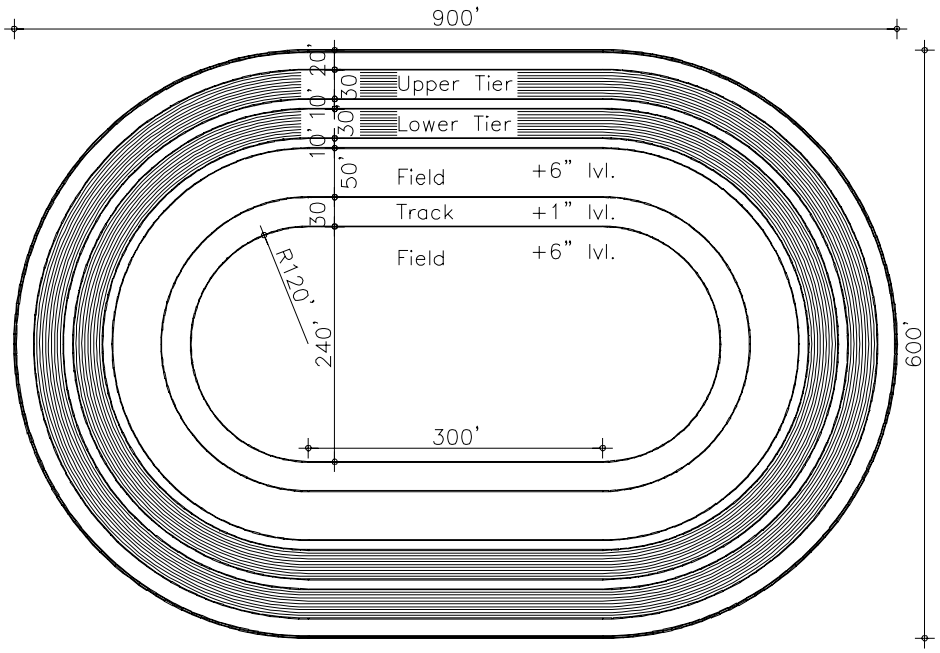


Figure 9-59 *Sketch plan for the stadium project*

After completion, the building model appears similar to the illustration shown in Figure 9-61.

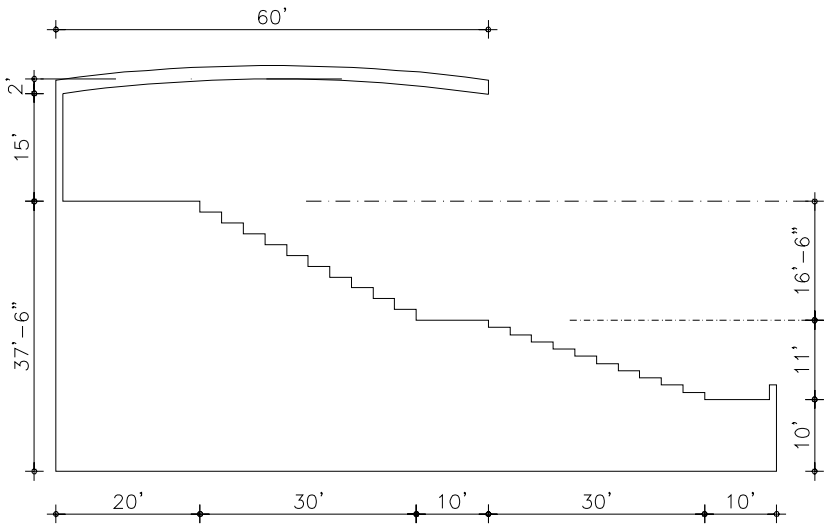


Figure 9-60 *Cross-section view of the stands*

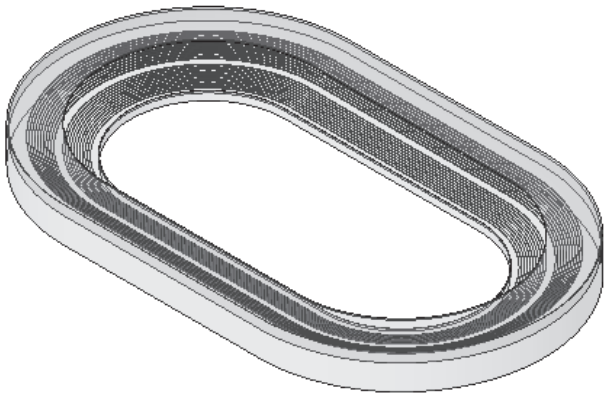


Figure 9-61 *3-dimensional view of the stadium*

Answers to Self-Evaluation Test

1. T, **2.** T, **3.** F, **4.** F, **5.** T, **6. Solid Revolve**, **7. Vertex Connect**, **8. Show Mass**, **9. Element Properties**, **10. Edit**