



Autodesk Revit 2008

Raising the Roof: Creating Roofs in Revit

David Cohn

Course Summary:

Roofs are one of the most complex architectural elements to model, but with Revit, you can create just about any type of roof. This class will explore the best methods for creating roofs using all of the tools in Revit. We'll explore complex roofs with varying pitch, offset plate heights, ridge and valley control, dormers, flat roofs, and more. We'll also look at the new variable thickness settings and shape editing tools for slabs, roofs, and floors. Whether you do primarily residential or commercial buildings, you'll learn how to model roofs using Revit.

Instructor:

David has more than 20 years of hands-on experience with AutoCAD as a user, developer, author and consultant. He is an applications engineer with The PPI Group, a contributing editor to Desktop Engineering magazine, the former publisher and editor-in-chief of *CADCAMNet* and *Engineering Automation Report*, the former senior editor of *CADalyst* magazine, and the author of more than a dozen books on AutoCAD. A licensed architect, David was also one of the earliest AutoCAD third-party software developers, creating numerous AutoCAD add-on programs. As an industry consultant, David has worked with many companies including Autodesk. He teaches college-level AutoCAD courses and is always a popular presenter at Autodesk University.



Autodesk User Group International

www.AUGI.com

Introduction

In Revit, roofs are a type of building element, just like walls and floors. You can design any type of roof for a building model using Revit Architecture.

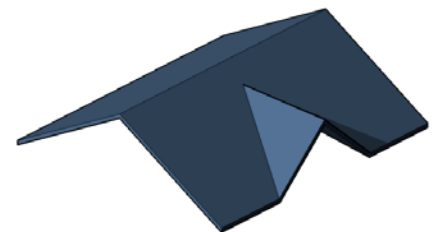
Definition of Roofs

Roofs are building components that represent different types of actual roofs on a building. You can create roofs from footprint outlines, as extrusions, or from mass instances. You can also modify the properties of a roof, including its outline, structural composition, and slope.

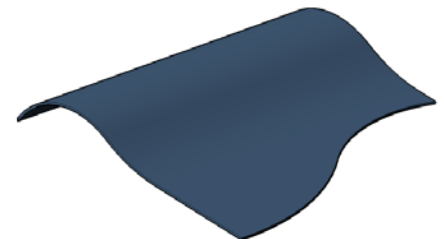
Roofs, like walls and floors, are system components; that is, they are defined within the Revit project file, not as separate Revit family components (.rfa files). That means that if you create a roof system that you subsequently want to use in another project, you must transfer it from one project to another. If it is a roof system that you will use often, you should copy it to a template file so that it is more easily available for use in subsequent projects.

Roof by Footprint

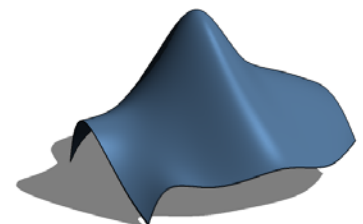
With the roof by footprint method, you specify a 2D sketch of the perimeter of the roof in plan view. You then define the slopes of the roof by identifying the lines in the footprint that are edges of sloping roof planes. The sketch of the footprint must be a closed loop that represents the exterior of the roof. The sketch can also contain other closed loops inside the perimeter that define openings in the roof. The plan level at which you sketch determines the level of the roof.



Roof by Footprint



Roof by Extrusion



Roof from Mass Instance

Roof by Extrusion

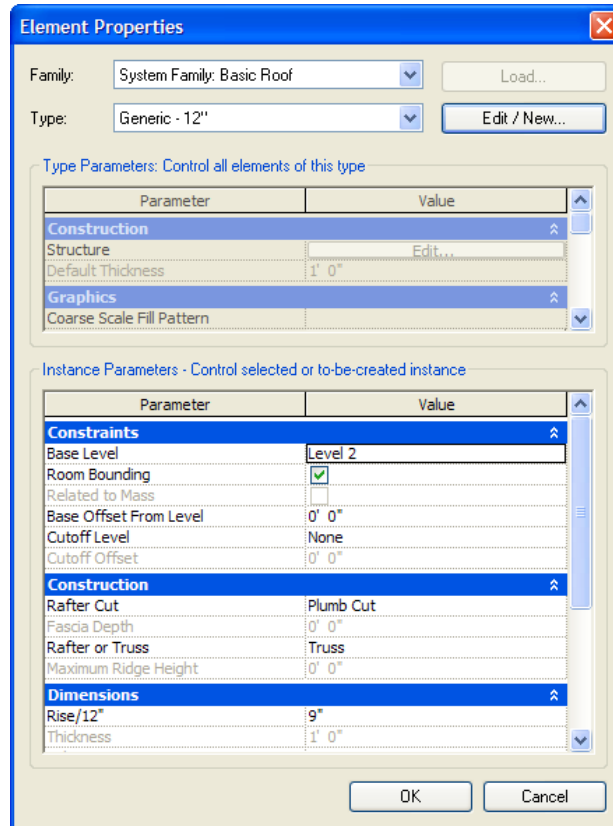
With the Roof by Extrusion method, you sketch the profile of the top of the roof in an elevation or section view, and then extrude the roof. You set the start and end point of the roof to determine the depth of the extrusion. You can use a combination of straight lines and arcs to create the profile. The location of the profile in the elevation view determines the height of the roof. The sketch should be a series of connected lines or arcs that are not closed in a loop. Revit applies the roof structure according to the type of roof.

Roof from Mass Instances

The Roof by Face command lets you create roofs on any non-vertical faces of a mass.

Properties of Roofs

You can modify the properties of roofs just like any other Revit building component. Roof properties are controlled using the Element Properties dialog. This is the same dialog box you use to control the properties of other Revit elements. You can modify properties of an instance or all instances of a roof type such as outline, slope defining edges, slope angle, base level, and structure. You can select a roof or a roof sketch to edit its properties.



A few of the more important controls are described below:

Family – The Family selector drop-down shows the roof categories available. Select from one of the two predefined families:

System Family: Basic Roof – Control settings for typical roof assemblies.

System Family: Sloped Glazing – Control settings for roof assemblies using a system of panels and mullions in a grid pattern.

Type – Select the type of roof from the drop-down. Click Edit/New to modify the selected roof type or define a new roof type.

Structure – Defines the composition of the roof (similar to defining the composition of a wall).

Default Thickness – Indicates the thickness of the roof, which is determined by the cumulative thickness of its layers. This is a read-only property.

Graphics – Determines the fill pattern and color of the fill pattern for the roof in a coarse-scale view.

Identity Data – Enables you to specify additional information such as keynote, model, manufacturer, type comments, URL, description, assembly description, assembly code, type mark, and cost.

Instance Properties – Instance parameters affect only the single instance of the roof. Roof-specific instance properties fall into three areas:

Constraints

Base Level – Sets the level for the footprint or extruded roof.

Room Bounding – This is an on/off checkbox. If selected, the roof is part of a room boundary so that room objects calculate volume to the underside of the roof.

Related to Mass – This read-only value indicates if the element was created from a mass element (roof by face).

Base Offset From Level – Sets the height of the roof above or below the level where it is being sketched (enabled only for roof by footprint).

Cutoff Level – Specifies the level at which the roof should be cut off. Typically, another roof will be created to fill the hole created by cutting off the first roof. This property and the Cutoff Offset apply to the first roof, not the second roof (enabled only for roof by footprint).

Cutoff Offset – The height of the cutoff above or below the level specified by the Cutoff Level (enabled only for roof by footprint).

Extrusion Start – Sets the start point of the extrusion (enabled only for extruded roofs).

Extrusion End – Sets the end point of the extrusion (enabled only for extruded roofs).

Reference Level – The reference level for the roof (enabled only for extruded roofs).

Level Offset – Raises or lowers the roof from the reference level (enabled only for extruded roofs).

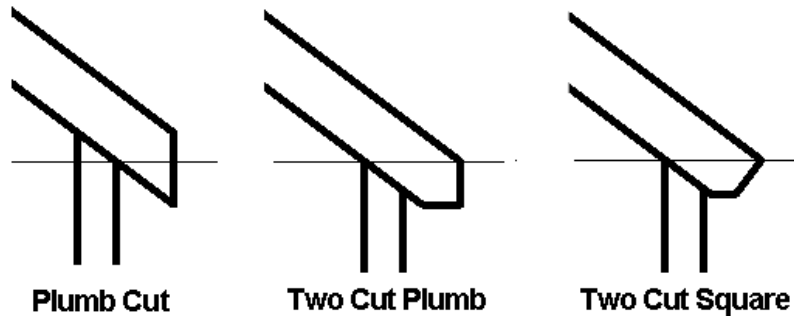
Construction

Rafter Cut – Defines the rafter cut on an eave by selecting from a drop-down:

Plumb Cut – Cuts the roof fascia at a 90-degree vertical.

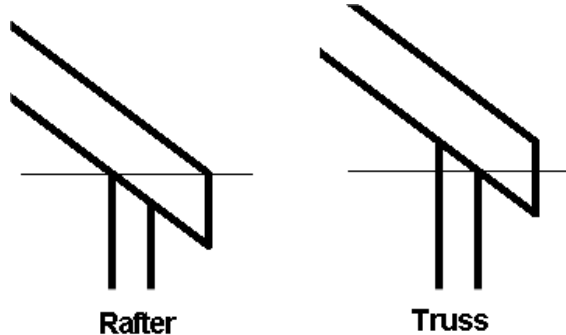
Two Cut Plumb – Cuts the roof fascia 90-degrees vertically and horizontally at the Fascia Depth.

Two Cut Square – Cuts the roof fascia at 90-degrees relative to the face of the roof, and horizontally at the Fascia Depth.



Fascia Depth – The length of the lines defining the fascia.

Rafter or Truss – Select either Rafter or Truss for the roof construction method to control how the roof sits on the walls. If you choose Rafter, the Plate Offset from Base is measured from the inside of the wall. If you choose Truss, the Plate Offset from Base is measured from the outside of the wall (affects only roofs created by footprint).



Maximum Ridge Height – A read-only value that displays the maximum height of the top of the roof above the base level of the building (enabled only for roof by footprint).

Dimensions

Slope – Controls the value of the slope-defining line.

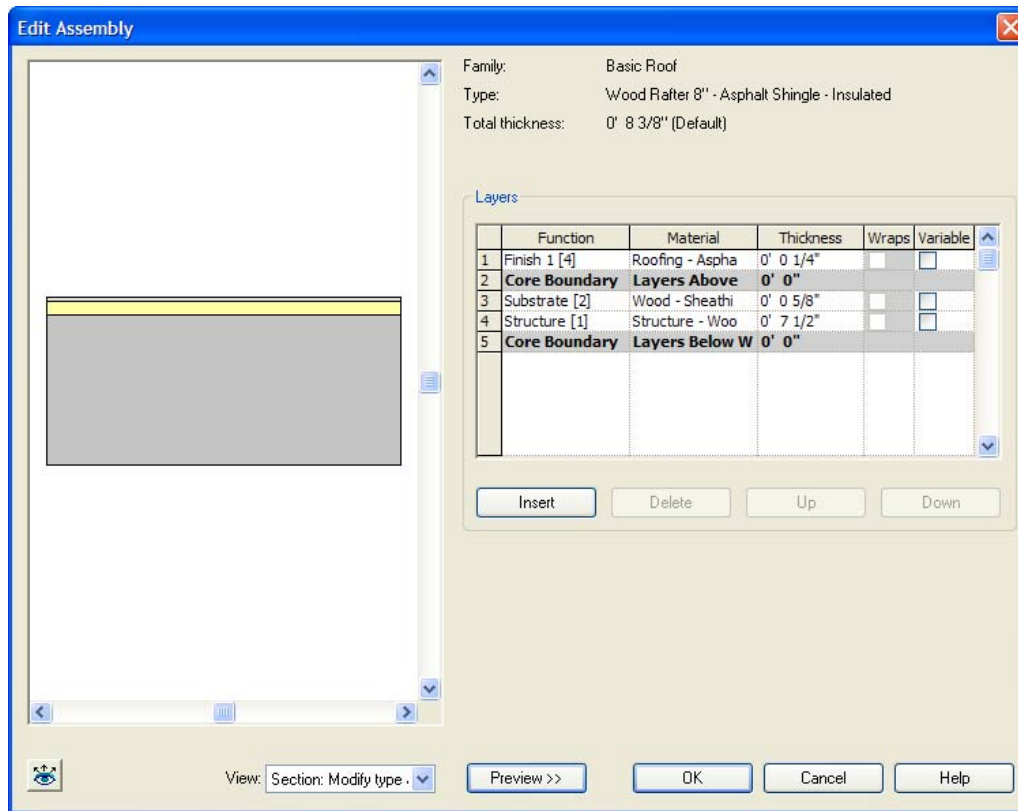
Thickness – Indicates the thickness of the roof (read-only).

Area – Indicates the area of the roof (read-only).

Volume – Indicates the volume of the roof (read-only).

Roof Assemblies

Roof assemblies are defined as a series of parallel layers, similar to the way you define a wall assembly. Like walls, each layer in a roof has a specified function, material, and thickness. Within the Edit Assembly dialog, these layers are bounded by core boundaries on the exterior and interior sides of the roof.



To add a new layer, select a layer by clicking on its number, and then click the Insert button. The new layer will be added above (toward the exterior side) of the layer you selected. You can use the Up or Down buttons to reorder the layers. You then need to specify the following:

Function – Choose from Structure, Substrate, Thermal/Air Layer, Finish 1, Finish 2, or Membrane Layer.

Material – Displays the Materials dialog, which lets you select from among the materials that are supplied with Revit or create a new one. The material controls the appearance for shaded and rendered views as well as the pattern applied to the surface and cut pattern, as well as letting you add physical and identify information.

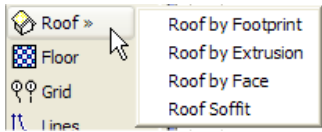
Thickness – You must assign a thickness for each layer you create except for layers whose function is specified as a membrane layer.

Note that any one of the layers you define can have a variable thickness (by selecting the Variable check box), in which case you can later modify the thickness of that layer (for example, to slope an otherwise flat roof by varying the thickness of the roof insulation).

Note also that the two layers called Core Boundary cannot be modified and have no thickness. They are provided as references for dimensions.

Adding a Roof

You use the Roof tool to add a roof to your building. This tool appears on both the Basics and Modeling tabs of the Design bar. When you click on this tool, Revit presents four options:



Roof by Footprint – creates a roof by footprint

Roof by Extrusion – creates a roof by extrusion

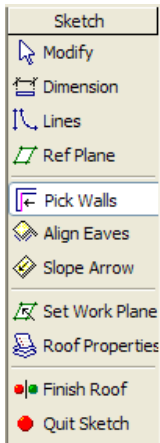
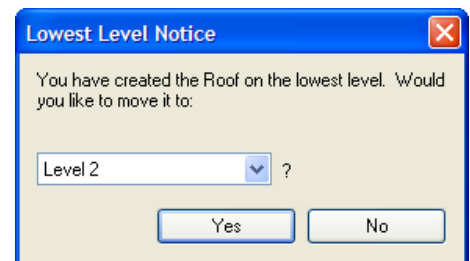
Roof by Face – creates a roof from a mass instance

Roof Soffit – creates a roof soffit

Creating a Roof by Footprint

The roof footprint is a 2D sketch of the perimeter of the roof. The sketch is created on the current plan level. If the current plan level is the lowest level, Revit will ask if you'd like to create the sketch on a different level. You can then select the level from a drop-down list.

The Design bar changes to display the Sketch tab. You can use the sketch tools to create the perimeter of the roof.



Modify – Used to select objects.

Dimension – Place dimensions for visual measurement or to constrain objects.

Lines – Create 2D lines and curves to define the perimeter of the roof.

Ref Plane – Place a reference plane to aid in creation of the roof.

Pick Walls – Select walls to define the perimeter of the roof.

Align Eaves – Adjust the eave height or overhang distance to make the eave height equal around the perimeter of the roof.

Slope Arrow – Create complex footprint roofs by defining slopes that cannot be created from setting footprint boundary lines as slope-defining.

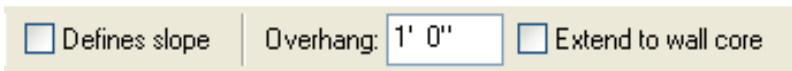
Set Work Plane – Change the plane in which the roof sketch is drawn.

Roof Properties – Display the Element Properties dialog for the roof so you can select the roof type and specify roof parameters.

Finish Roof – Completes the creation of the roof.

Quit Sketch – Exits sketch mode, disregarding any changes made while in sketch mode.

While in sketch mode defining the perimeter of the roof, the Options bar provides additional controls. For example, if you sketch the perimeter using Lines, you can select the type of lines (straight, rectangle, polygon, arc, and so on). If you are defining the roof by picking walls (the default method of creating a roof by footprint), the Options bar provides specific controls.



Defines Slope – This check box toggles the slope-defining property of the sketch line on and off. When selected (on), the sketch line you create will display an adjacent angle symbol and a value specifying the slope. You can change the slope by editing this value. When not selected (off), the perimeter line you sketch will not define a slope. Note that lines representing gable ends do not define a slope.

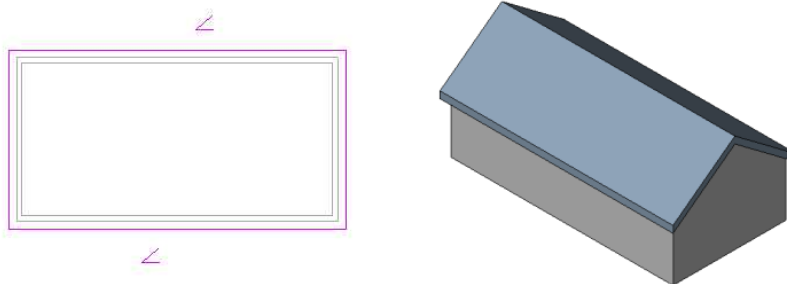
Overhang – When picking walls to define the perimeter, this value lets you specify how far the roof extends beyond the face of the wall.

Extend to Wall Core – When selected, a roof that abuts a wall will extend through any of the wall's layers to its core layer.

Creating a Simple Gable Roof by Footprint

To create a simple gable roof by footprint.

1. Display a plan view.
2. On the Design bar, select Roof > Roof by Footprint.
3. On the Sketch tab of the Design bar, select Lines or Pick Walls to sketch a closed loop for the roof.
4. On the Options bar, set the slope defining lines. (Notice in the illustration below that the end walls do not define a slope.)
5. On the Design bar, click Finish Roof.



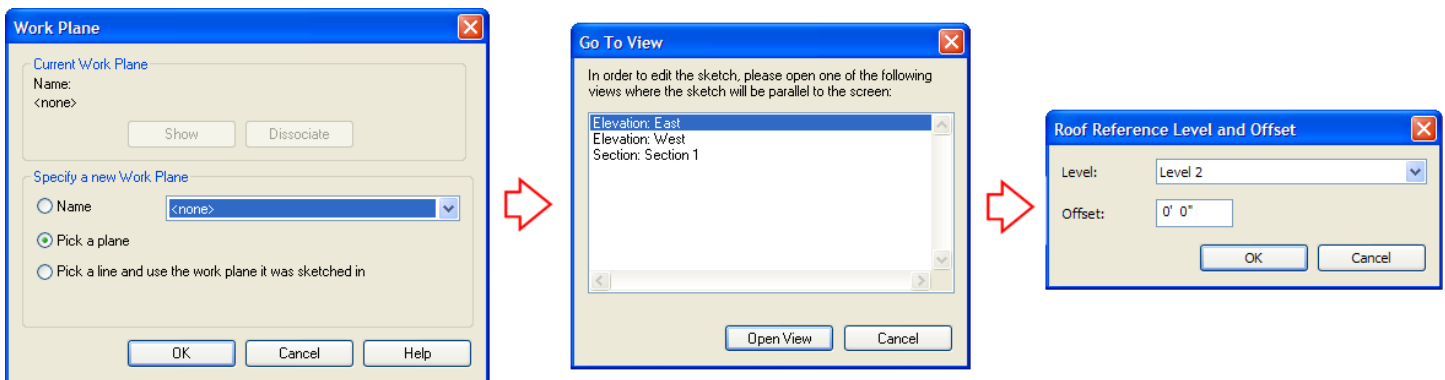
Tip: When picking walls, if you hover over one wall and then press TAB, the entire chain of walls will be highlighted. You can then click once to select all the walls and then use the Modify tool to select edges that are not slope defining.

Note that if the walls you previously created extend above the roof, Revit will ask you if you want to attach the highlighted walls to the roof. If you say Yes, the profile of the walls will be changed to follow the slope of the roof. If the walls end below the roof, you can select the walls and then attach them to the roof.

Creating a Roof by Extrusion

With the Roof by Extrusion method, you sketch the profile of the top of the roof in an elevation or section view, and then extrude the roof. You can use a combination of straight lines and arcs to create the profile. The height of the roof depends on the location where you sketch the profile in the elevation or section view. The sketch must be a series of connected lines or arcs that are not closed in a loop.

When you start the Roof by Extrusion command, Revit displays a Work Plane dialog so you can specify the work plane on which you will sketch the roof profile. It is often helpful to sketch reference planes to guide in the placement of the profile. You can also select the Pick a Plane option and then click to select an existing elevation or section; you can then sketch the profile on that plane. Revit will also ask you to specify the reference level and offset for the roof.



The Design bar changes to display the Sketch tab. You can use the sketch tools to create the profile of the roof. Note that when sketching a profile for a roof by extrusion, the tab does not include the Pick Walls, Align Eaves, or Slope Arrow tools.

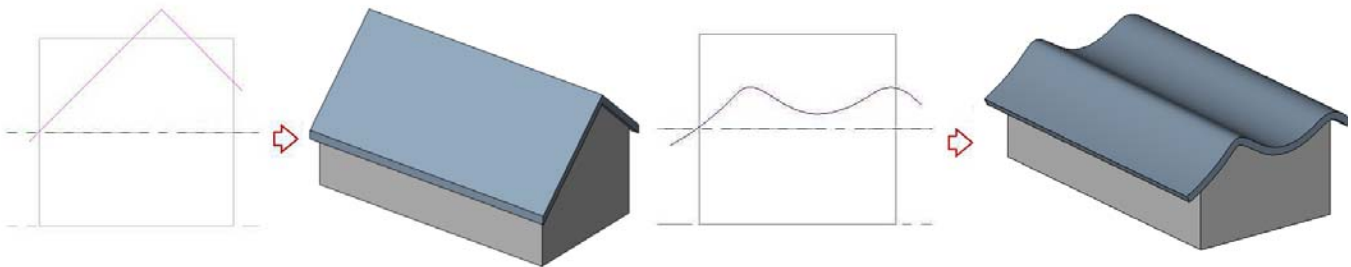
The direction in which the roof profile extrudes is known as the extrusion direction. The extrusion of a roof can extend in either direction along a plane perpendicular to the plane in which the profile is created. You use the Extrusion Start and Extrusion End controls in the Element Properties dialog to control the length of the extrusion. You can extend the extrusion towards or away from the view. Extrusion directions that are up or towards the view are positive, and extrusion directions that are down or away from the view are negative.

To create a roof by extrusion.

1. On the Design bar, select Roof > Roof by Extrusion.
2. In the Work Plane dialog, select an option for specifying the work plane and then go to the appropriate view.
3. In the Roof Reference Level and Offset dialog, select the reference level for the roof. The default level is the highest level in the project. If desired, set a value to offset (raise or lower) the roof from the reference level, and then click OK.

4. Sketch the profile of the roof.
5. On the Design bar, click Finish Sketch.

You can use a roof by extrusion to quickly create a roof with different eave heights (such as a Salt Box) or a roof with a complex profile.

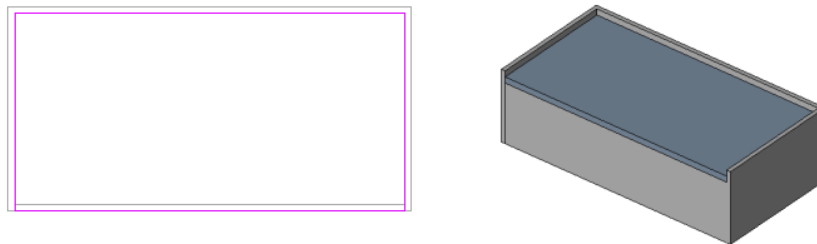


Roof Examples

Now that you know the basics for creating roofs by footprint and by extrusion, let's look at how you can create a variety of roofs.

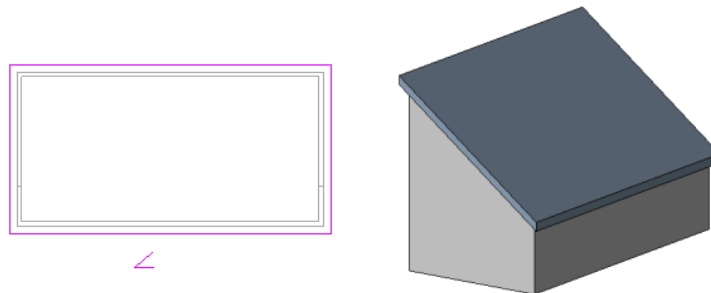
Flat Roof

A flat roof is simply a roof in which none of the edges define a slope. Specify an overhang distance to extend the roof beyond the walls or define the profile along the inside of the wall to create a roof behind a parapet.



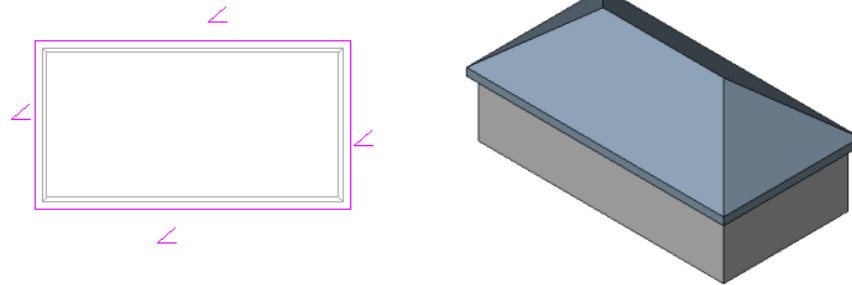
Shed Roof

To create a shed roof, only the edge at the low eave line is slope defining.



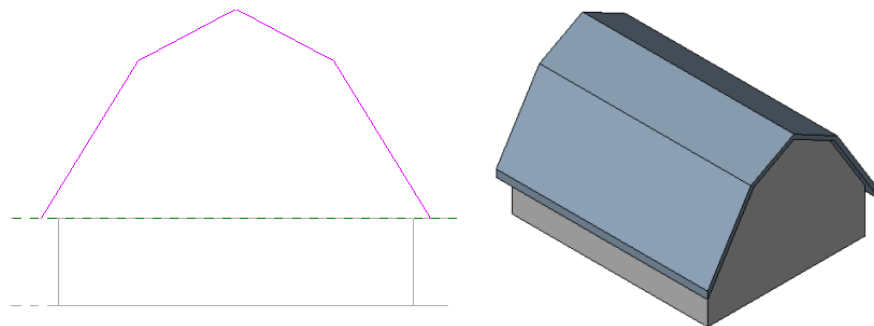
Hipped

To create various types of hipped roofs, all four edges are slope defining. You can vary the slope to create different types of hips.



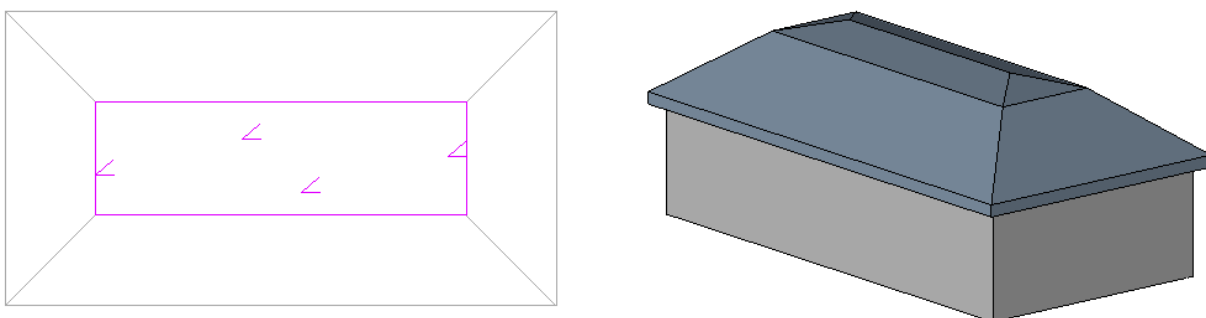
Gambrel



A gambrel roof consists of two roofs, a lower portion with a steep slope angle and an upper portion with a shallower slope angle, but with gable ends. Creating it as an extrusion works better because the roof maintains a consistent fascia along the gable end.



Mansard

A Mansard roof is generally constructed as two roofs, the first steeply sloped and the second either flat or sloping at a much shallower angle. This type of roof can be created using two separate roofs, the first ending at a cutoff level and the second filling the opening in the first.

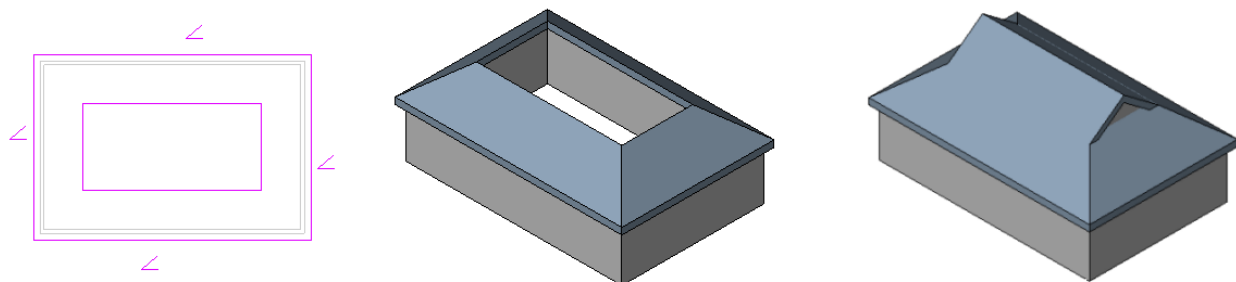



1. On the Design bar, select Roof > Roof by Footprint.
2. Create the footprint for the lower roof.
3. In the Element Properties dialog, under Constraints, select the level for the Cutoff Level.
4. Click OK to complete the lower roof.
5. Make the level used for the cutoff level the current level.
6. On the Design bar, select Roof > Roof by Footprint.
7. On the Sketch tab of the Design bar, click Lines.
8. On the Options bar, click  and then select Defines slope.
9. Select the four edges of the roof cutoff.
10. On the Sketch tab of the Design bar, click Modify.
11. Select one of the roof cutoff lines, press TAB, and select the remaining three lines.
12. On the Options bar, click .
13. In the Element Properties dialog, under Dimensions, enter the shallower rise, and click OK.
14. On the Sketch tab of the Design bar, click Finish Roof.



Note that because of the way Revit creates the cutoff, you will probably need to cut a section through the roof and then use the Move tool to adjust the starting height of the upper roof so that it matches the ending height of the lower roof.

Hip Gable, Dutch Gable, Bonnet

This type of roof is also created by constructing two roofs, a hip and a gable. In this case, rather than using a cutoff level, we'll create it by sketching the perimeter of the first roof (the hip roof) and then sketch another closed perimeter inside the other. This second perimeter will form a hole in the hip roof and will then be used to draw the sketch for the gable roof.



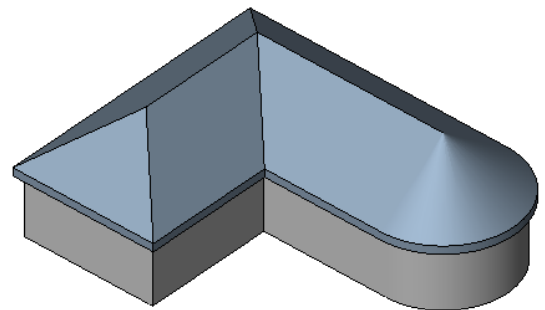
1. On the Design bar, select Roof > Roof by Footprint.
2. Create the footprint for the lower hip roof.
3. On the Sketch tab of the Design bar, click Lines.
4. On the Options bar, click , clear the Defines Slope check box, and set the Offset distance.

5. Click on the walls to create a closed loop inside the first roof perimeter.
6. Click Finish Roof and view the roof in 3D.
7. On the Design bar, select Roof > Roof by Footprint.
8. On the Sketch tab of the Design bar, click Lines.
9. On the Options bar, click  and then select the edges of the opening in the hip roof. The long edges define the slope (and in this case have the same slope as the hip roof) and the short edges do not define the slope (so that they create gable ends).
10. Click Finish Roof.
11. Create a section through the roof and then use the Move tool to align the two roofs.
12. On the Tools toolbar, click  (Join Geometry) and then click one roof and then the other to eliminate the joint between the two roofs.

When creating this type of roof, you'll also want to add walls to fill in the open end of the gable and attach the wall to the upper gable and lower hip roof.


Complex Roofs

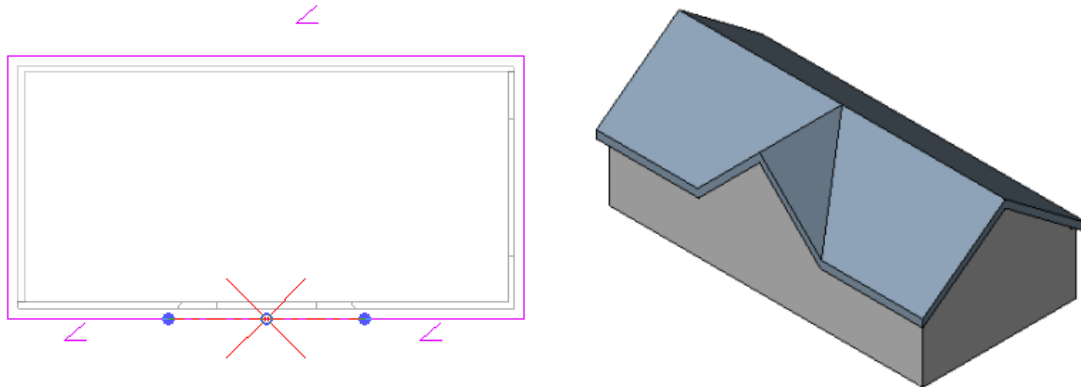
Revit will automatically create complex roofs that follow the shape of the roof footprint. For example, Revit will automatically create valleys for roofs that follow L-shaped footprints or create conical roofs when following an arc footprint.



Roof Slope Arrow

The Slope Arrow command provides an alternative way to create complex footprint roofs by defining slopes that cannot be easily created from setting footprint boundary lines as slope-defining. For example, you can use the following method to create an eyebrow dormer.

1. Create the gable roof.
2. Select the roof and then on the Options bar, click Edit.
3. Use the Split tool to split the profile edge into three sections.
4. Select the middle section and clear the Defines Slope check box.
5. On the Sketch tab of the Design bar, click Slope Arrow.
6. On the Options bar, verify  is selected.
7. Sketch a slope arrow from one of the split points to the midpoint of the middle section.
8. Repeat steps 5 – 7 to add the second slope arrow from the other split point back to the midpoint of the middle section.
9. On the Sketch tab of the Design bar, click Finish Roof.

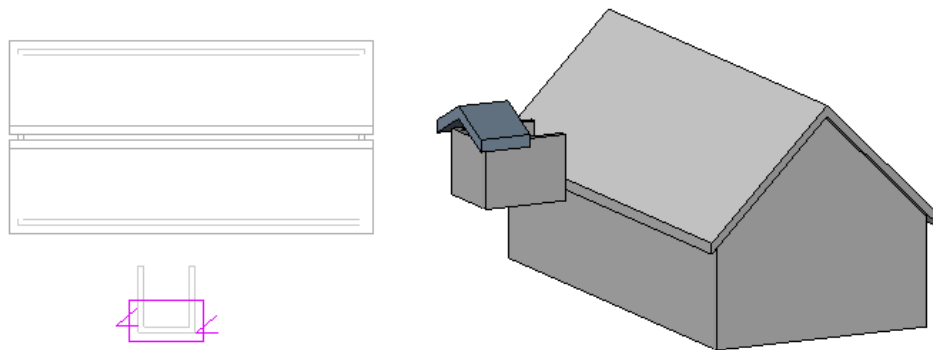


Adding a Dormer to a Roof

Creating a dormer in an existing roof presents another special situation. But while this may initially appear daunting, the following method greatly simplifies its creation. After creating the main roof:

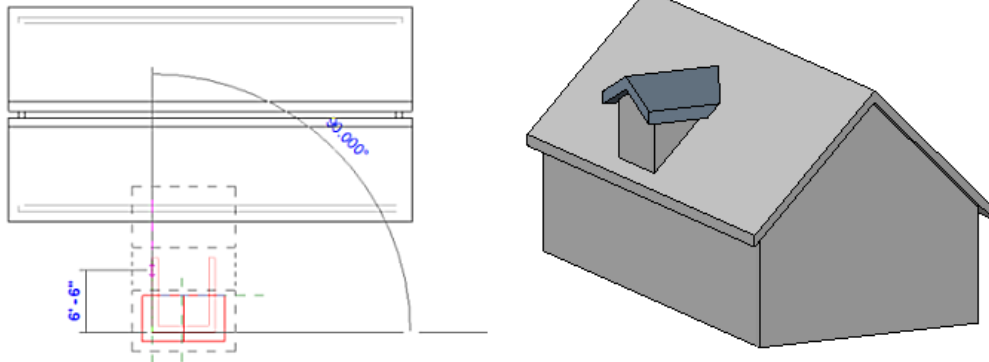
1. In any elevation view, add a new level that represents the top of the dormer walls.
2. Make the Roof level the current view.
3. Draw three walls out in front of the main roof to form the dormer walls. Set the top of these walls to the Dormer level you created in step 1.
4. Open the Dormer level view.
5. Add a roof by footprint to the dormer walls. Make sure that the Defines Slope check box is selected for the sides of the roof, but not the front.
6. Use the Lines tool to sketch a line 2 or 3 feet back from the front edge of the dormer roof. (Don't draw this line all the way back to the end of the dormer side walls.) Use the Trim tool to trim the side lines back to the rear lines.
7. Set the slope for the dormer roof, and then click Finish Roof.

At this point, you should have a dormer constructed out in space with a short portion of roof over the front edge.

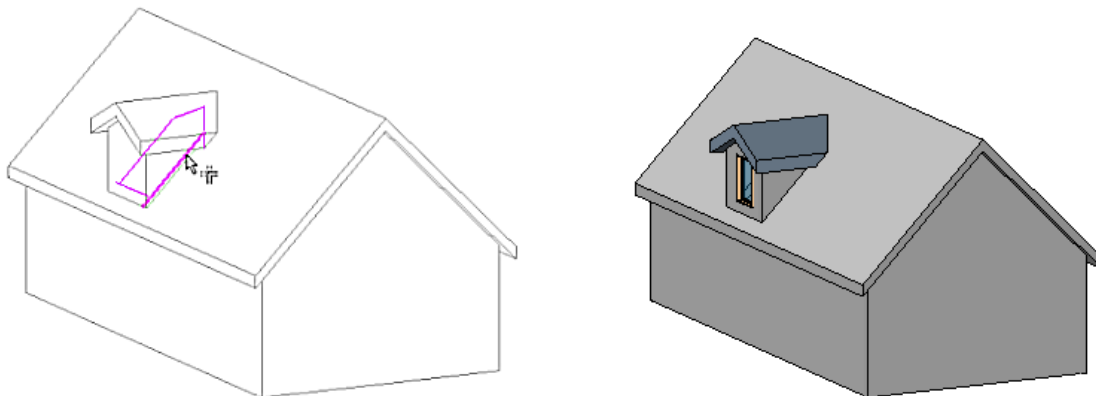


8. In the Dormer Level view, move the dormer over the main roof. (Be sure to select all of the dormer walls and its roof. You can snap the face of the front dormer wall to the face of the wall below.)
9. Switch to a 3D view and then use the Join Roofs tool to trim the dormer roof to the main roof. (Note that you are able to select the back edge of the dormer because it is not hidden under the main roof.)
10. Attach the top of the dormer walls to the dormer roof and the bottom of the dormer walls to the main roof.

The dormer looks complete, but in reality there is one more thing we need to do. We need to cut an opening in the main roof.



11. On the Modeling tab of the Design bar, click Opening > Dormer Opening.
12. Select the Main roof as the roof to be cut by the dormer opening.
13. Pick the dormer roof and then the dormer walls to define the boundary for the opening. Be sure to select the inside faces of the dormer walls. Use the trim command to clean up the boundary. (You may need to zoom in and change the Model Graphics Style so you can see what you're doing.)
14. Click Finish Boundary.



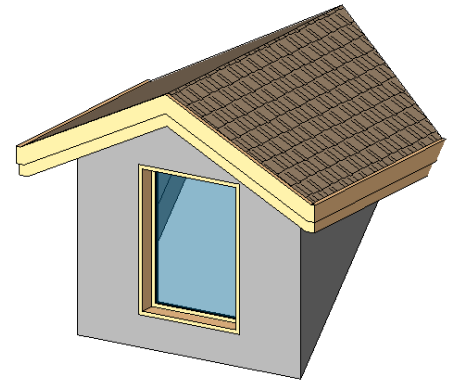
Creating Fascias, Roof Soffits, and Gutters

Revit provides specific tools for adding fascias, soffits, and gutters to your model.

Fascias

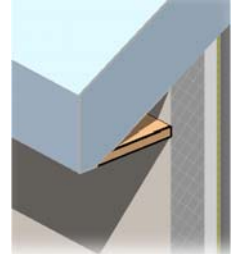
You can add fascias to edges of roofs, soffits, and other fascias. You can also add fascias to model lines. Fascias are added as host sweeps. To add a fascia:

1. On the Modeling tab of the Design bar, click Host Sweep > Roof Fascia.
2. Select the desired fascia profile from the Type Selector. (Note that you will need to load the profile from the Profile > Roofs library before starting the command.)
3. Highlight the edges of roofs, soffits, and other fascias, or model lines, and click to place the fascia.



As you click edges, Revit treats this as one continuous fascia. If the fascia segments meet at corners, they miter. To start another fascia, on the Options bar, click Start Next, and then click on a new edge. This creates a different fascia, which does not miter with other existing fascias even if they meet at the corners.

After creating a fascia, you can use other tools to resize it, flip the fascia, remove segments, change mitering options, and change the horizontal and vertical offsets.



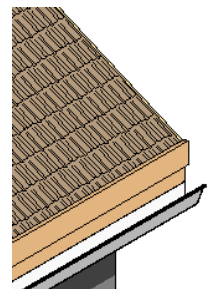
Soffits

You can add roof soffits to your model using the Roof Soffit tool. There are many different styles of soffits, so the method you use can vary widely. In general, the soffit is created as a roof object and is bounded by a closed loop. You can then use the Join Geometry tool to join the soffit and the roof. Depending on the construction of the roof and soffit, you may also need to add trim to close spaces at the ends of soffits.

Gutters

You can add gutters to the edges of roofs, soffits, and fascias. You can also add gutters to model lines. Like fascias, gutters are added as host sweeps. To add a roof gutter:

1. On the Modeling tab of the Design bar, click Host Sweep > Roof Gutter.
2. Select the desired gutter profile from the Type Selector. (Note that you will need to load the profile from the Profile > Roofs library before starting the command.)
3. Highlight the horizontal edges of roofs, soffits, fascias, or model lines, and click to place the gutter.



As you click edges, Revit treats this as one continuous gutter. To start a new gutter, click Start New, and then click on a new edge.

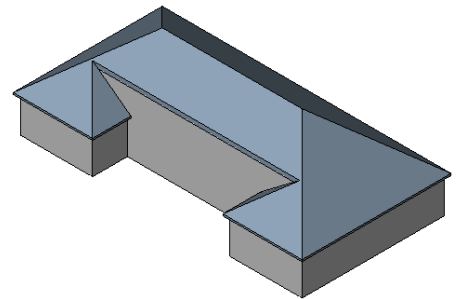
After creating a gutter, you can use other tools to resize it, flip the gutter, add or remove segments, and change the horizontal and vertical offsets.

More Complex Roof Examples

Of course, there are all manner of other complex roof types that we haven't covered. But with some thought, you can probably model any of them in Revit.

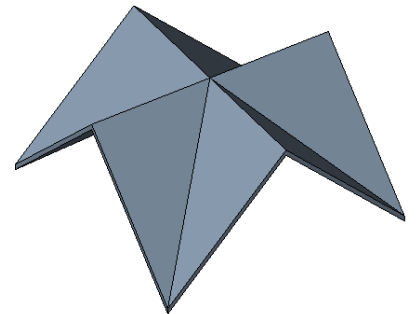
Roof with Intersecting Slope Lines at Different Heights

You can create a roof with intersecting slope lines at different heights by creating two roofs, one starting at the lowest level with a specified cutoff level, and the second starting at the cutoff level, with a footprint matching the opening in the first roof. Then you can use the Join Geometry tool to join the two roofs into one.



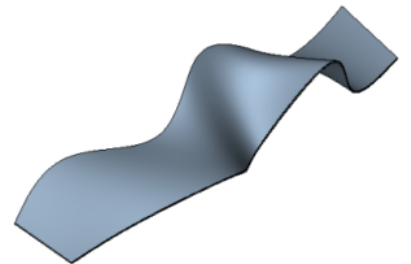
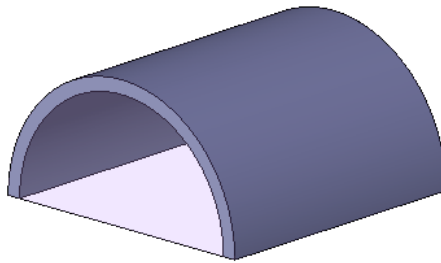
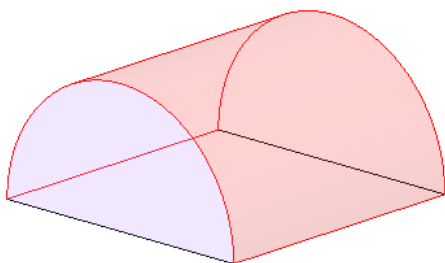
Four Sided Gable Roof

You can create a four-sided gable roof by first defining a square roof footprint with all four sides non-slope-defining. Split each side in half and then use the Slope Arrow command to add identical slopes from each corner to the split point on each side.



Creating Roofs from Mass Instances

By using the Roof by Face command, you can create roofs on any non-vertical faces of a mass. The Roof by Face command is available on the Massing tab of the Design bar or from the Roof command menu on the Modeling tab of the Design bar.



You can also create roofs on NURBS surfaces in generic model or mass families. When you are creating a generic model or mass family, you can import a DWG or SAT file containing NURBS surfaces. After saving the family, use the Roof by Face command to place a roof on the NURBS surface.

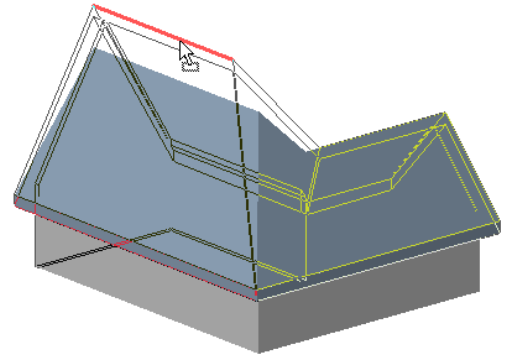
Note that roofs created using the Roof by Face command do not automatically update if you change the mass face. To update the roof, select the roof and then click the Remake button on the options bar. You can also select the roof and then use shape handles to drag the side surfaces.

Modifying a Roof

Even after you create a roof, there are various ways that it can be modified. For example, you can change the roof type by selecting the roof and then changing its properties using the Element Properties dialog.

To edit a roof sketch, select the roof and then on the Options bar, click Edit to display the roof sketch. You can then make the necessary changes and click Finish Sketch.

You can resize roofs that were created by footprint or by face using shape handles in elevation or 3D views.



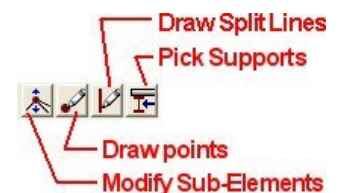
Warped Slabs

One feature that seems to have gone relatively unnoticed in Revit 2008 is the ability to model slabs with multiple slopes, or what Autodesk refers to as “warped slabs.” This is a feature that was specifically highlighted in the roll-out of Revit Structure 2008, but is actually a core component of the entire Revit 2008 family.

You could create sloped slabs in previous versions of Revit, but they could only slope uniformly. It was therefore very difficult to create a warped roof deck typically created in a “flat” roof situation where the structural joists are set at different angles to facilitate roof drainage. The following methods work just as well for roofs, floors, or slabs.

After creating a slab, if you subsequently select that slab, Revit displays four new tools on the Options bar.

Note that these tools will not display unless the slab is initially flat and horizontal with straight-edge boundaries. In addition, the roofs cannot be attached to another roof and the roof cannot be a glazed (curtain) roof.



Modify Sub-Elements – allows direct editing of element geometry using selection and modification points (vertices) and edges.

Draw Points – allows you to create new points on the top face of the slab.

Draw Split Lines – allows sketching directly on the top face of the slab.

Pick Supports – lets you pick linear beams and walls to create new split edges on the top face of the element, matching the slope to that of the underlying support.

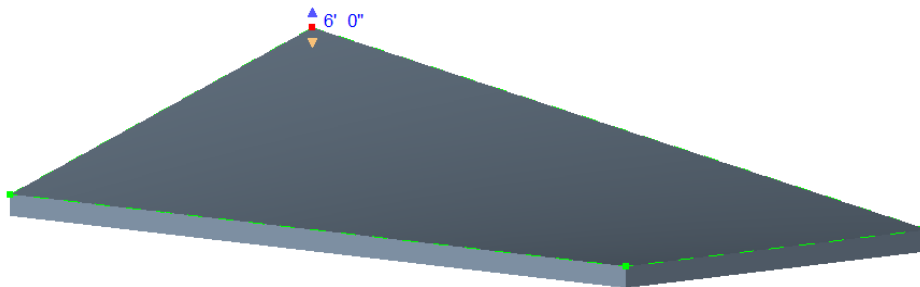
After modifying a slab using any of these shape modifiers, Revit displays a Reset Shape button adjacent to the four shape editing tools. If you click this button, Revit resets the geometry back to its original unmodified state.

In addition to these four new tools, slabs also have a new parameter enabling users to create material layers with variable thickness. When this parameter is active, the non-variable layers will maintain their specified thickness while the variable layer will adjust its thickness based on the slope. This is a great way to create a roof with tapered insulation board, for example.

Using the Modify Sub-Elements Tool

To modify a roof using the Modify Sub-Elements tool:

1. Select the slab, roof, or floor you want to modify.
2. On the Options bar, click the Modify Sub-Elements tool.
3. Click to select a vertex or edge, after which you can do one of the following:
 - Drag the blue arrows to move the point vertically.
 - Drag the red square to move the point horizontally.
 - Click the text control to enter a precise height for the selected point or edge.
 - Enter a precise height in the Elevation edit box on the Options bar.



Note that the value of the height represents the offset from the original top face of the slab. For an edge, the entire edge is moved to the specified height.

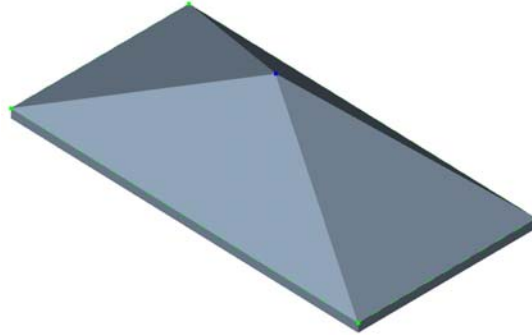
Using the Draw Points Tool

To modify a roof using the Draw Points tool:

1. Select the slab, roof, or floor you want to modify.
2. On the Options bar, click the Draw Points tool.
3. Click on the face or edges of the slab, roof, or floor to add points that define a slope.

Note that when you select the Draw Points tool in step 2, the Options bar displays an Elevation text box. The value in this box determines the elevation of the point you are about to add. When the adjacent Relative check box is selected, the elevation is measured relative to the surface on which

you are adding the point. When this check box is cleared, the elevation represents the actual project elevation and points will be added at this specific elevation.



In this illustration, I simply warped the roof up to a central point by adding a new point in the center of the roof. The elevation of this point is above the elevation at which the roof was originally created.

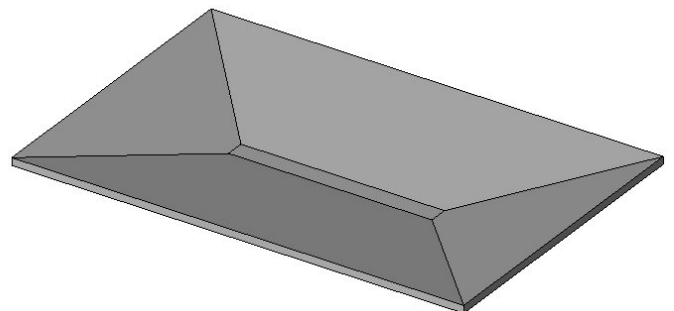
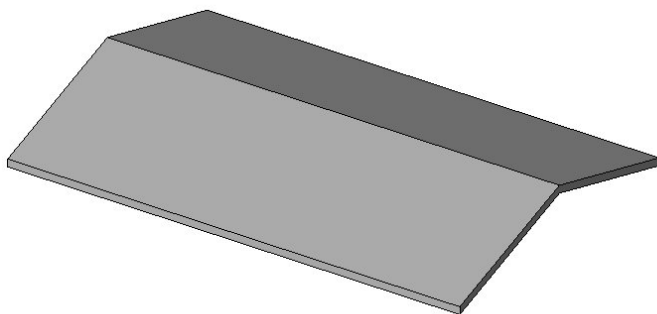
Using the Draw Split Lines Tool

When you add new points, Revit automatically splits the slab into smaller sub-regions. You can use the Draw Split Lines tool to manually split an existing face of a slab into smaller sub-regions. You can then alter the elevation of the vertices and/or edges of that sub-region to warp the slab.

To modify a roof using the Draw Split Lines tool:

1. Select the slab, roof, or floor you want to modify.
2. On the Options bar, click the Draw Split Lines tool.
3. Select a vertex, edge, face, or point anywhere on the slab to start the split line.
4. Select another vertex, edge, face, or point anywhere on the slab to end the split line.

Note that the startpoints and endpoints of the split line can be anywhere on the face of the slab. If your cursor is over a vertex or edge, Revit will snap to 3D vertices and edges and present standard snap controls and temporary dimensions along the edge.



In the illustrations above, I first added a single split line across the entire slab on the left and then used the Modify Sub-Elements tool to raise the elevation of that split line. To create the slab on the

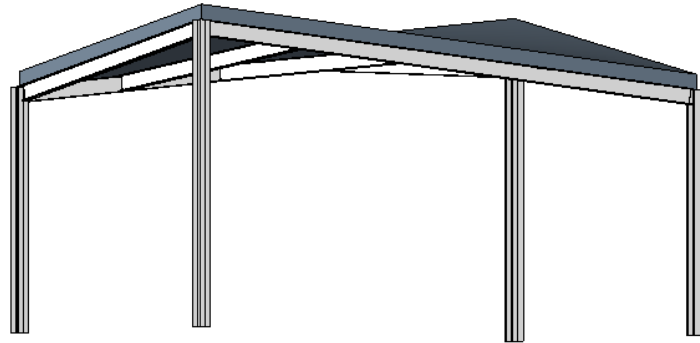
right, I first added four new split lines (using the Chain option when drawing the split lines) and then used the Modify Sub-Elements tool to lower the elevation of the new split lines to create the trench drain.

Using the Pick Supports Tool

The Pick Supports tool provides a special case. When you have already created the supporting structure, you can create a flat roof slab and then use the Pick Supports tool to warp the slab so that it matches the supporting structure.

To modify a roof using the Pick Supports tool:

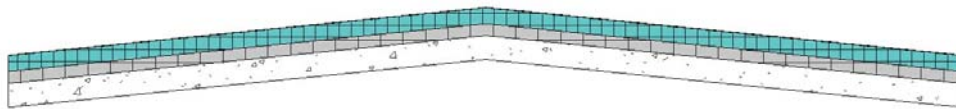
1. Select the slab, roof, or floor you want to modify.
2. On the Options bar, click the Pick Supports tool.
3. Select an existing beam.



A new split edge is created using the endpoint elevations from the picked reference. The elevations are moved up from the bottom face to the top face of the slab or roof using the slab or roof thickness.

Modifying the Variable Thickness of a Roof

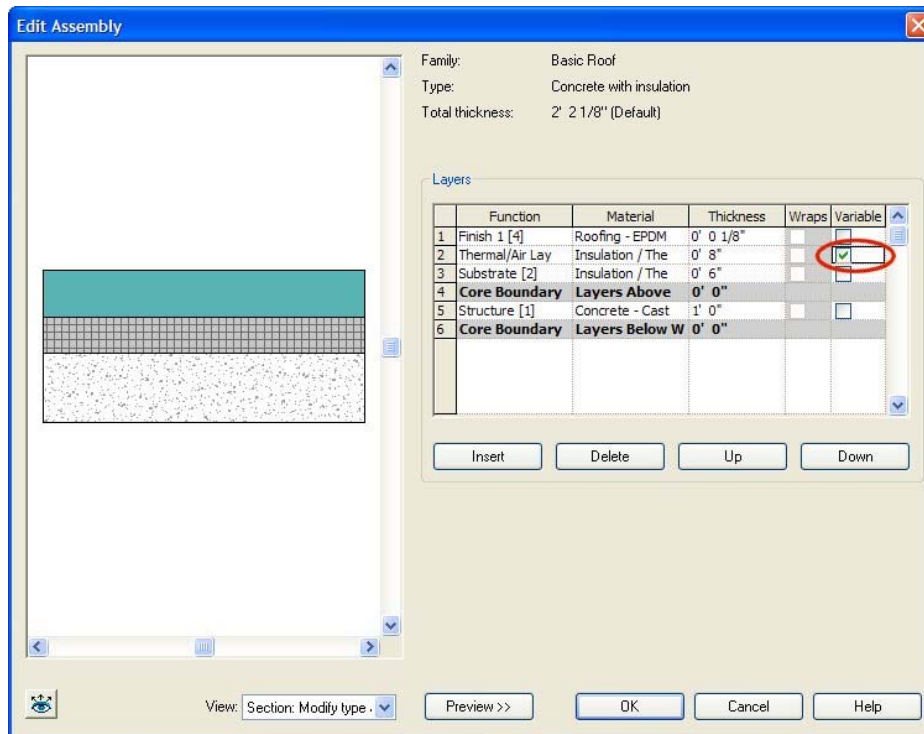
Note that in all of the previous examples, the overall thickness of the slab remains constant and the slab is simply warped to take on the new slope.



That isn't always what you are trying to achieve. Sometimes, such as the case of tapered insulation on an otherwise flat roof, you want to keep the actual structure flat and simply create a layer within the roof assembly that has a variable thickness, to represent the tapered insulation. You can accomplish this by creating a variable thickness slab.

Any one layer within the structure of the slab, roof, or floor can have a variable thickness. To modify the structure of a layer to make it a variable layer:

1. Select the slab, roof, or floor to modify.
2. Display its Element Properties dialog.
3. Click the Edit/New button.
4. In the Type Properties dialog, click the Edit button in the Structure property.
5. In the Edit Assembly dialog, select the check box in the Variable column for the layer you want to have a variable thickness.



6. Click OK until all of the dialog boxes are closed.

You can then select the slab, roof, or floor and use the Modify Sub-Elements tool to make the desired changes to the slab. Only the thickness of the variable layer will change.

