

Lesson 5

Vertical Circulation:

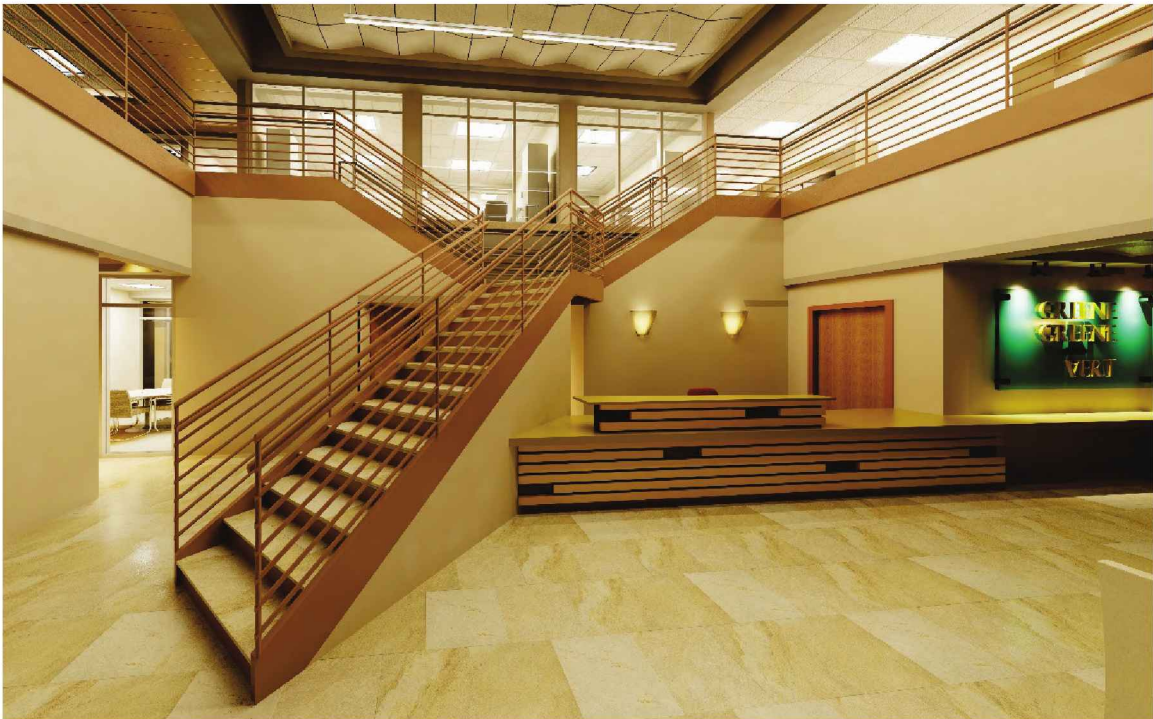
In this chapter Revit's Stair, Railing and Ramp tools will be covered. This can be one of the most challenging features in Revit given the vast variety in the world when it comes to stairs and railings. These tools have some limitations and cannot accommodate all situations. In these cases one might have to use In-Place families and model a highly customized stair and/or railing.

The first few “exercises” will provide a basic introduction to the stair and railing tools in Revit. There are no required steps for the law office project in these sections. However, it is highly recommended that this information be reviewed prior to completing the steps required later in this chapter.

Exercise 4-1:

Introduction to Stairs and Railings

Prior to getting into the details, this first section will provide a broad overview of Stairs and Railings in Revit.



This image is a photorealistic rendering of a stair and railing modeled in Revit. This example is from the author's *Interior Design Using Autodesk Revit* textbook. Notice the railing occurs on both sides of all three “runs” of stairs and along the [second] floor edge.

Basic Stair and Railing Terminology:

First, let's define some terms related to stairs and railings in Revit. These terms generally correspond to real-world architecture/construction terminology. However, the main goal here is to define the terms in the context of Revit.

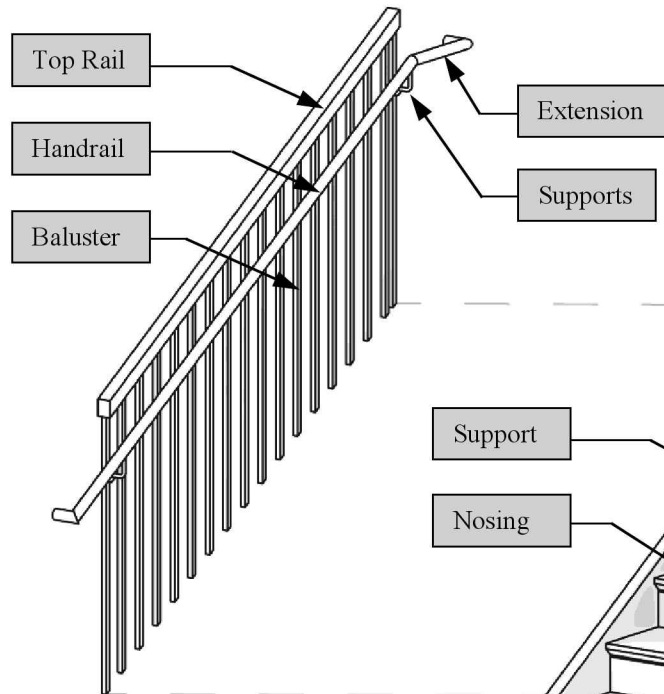


FIGURE 5-1.1a Basic Railing

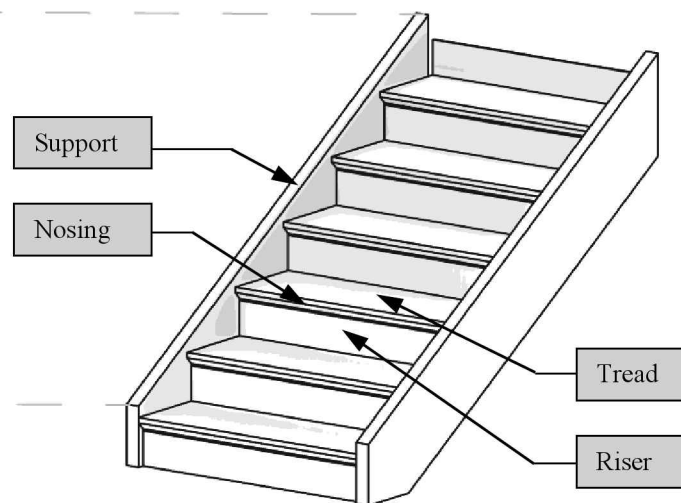


FIGURE 5-1.1b Basic Stair

- **Revit Stair Element**
 - **Run:** a continuous section of stairs, consisting of Risers and Treads, between main floor levels and/or landings.
 - **Tread:** the flat horizontal part you step on.
 - **Riser:** the vertical portion which fills the gap between the treads. Not all stairs have risers.
 - **Nosing:** the outer edge, where the riser and tread come together.
 - **Landing:** intermediate horizontal surface (i.e. floor) between the main floor levels of a building. Building codes require a landing if a stair “run” rises more than a certain distance—which allows someone to have a safe place to rest.
 - **Supports** (aka Stringer): the structural elements supporting the treads and risers. For a commercial project this is typically a steel tube or C-channel. A stair typically has a stringer on each side of the stair. For wider stairs, one or more stringers may be required. They either span between floors (e.g. Level 1 up to Level 2) or may be anchored to an adjacent wall.

- **Cut Marks:** in a 2D plan view, the stair is cut where it intersects the view's cut plane—an angled line is added to graphically cut off the stair. This allows space below the stair to be seen.
- **Stair Path** (Annotation)
 - **Down/Up arrows:** in a 2D plan view, the arrow graphically indicates the direction the stairs ascend or descend. The arrow is typically used in conjunction with text (see next definition).
 - **Down/Up Text:** Text used in conjunction with arrows to make it clear which direction the stairs are going, which would be difficult to determine without looking at other views (e.g. sections) which a printed set of drawings may not contain (e.g. a small remodel project).
 - **FYI:** The Arrow and Text are added automatically to a new stair but can be deleted. Thus the Stair Path tool exists, on the Annotation tab, if they need to be added back to the model.
- **Tread Number** (Annotation): This tool, on the Annotation tab, places a sequence of numbers along a stair “run” indicating the total number of risers or treads.
- Revit Railing Element
 - **Balusters:** vertical elements extending from floor or stair up to “top rail.” For commercial projects, building codes state that a 4” sphere cannot pass through a railing system. **FYI:** Balusters are not needed if glass panels are used.
 - **Handrails:** continuous rounded element, attached to a wall or balusters with a “support,” along a floor edge, a ramp or stair “run” which allows someone to place their hand on to prevent falling.
 - **Guardrail:** A taller railing system, which may include a handrail, to prevent falling from a stair or floor edge. **FYI:** In the USA, when a guardrail is required it must be at least 42 inches tall.
 - **Supports:** bracket used to attach handrail to wall or balusters.
 - **Top Rails:** continuous rail at the top of the railing system—supported by balusters.

Plan View Representation of Stairs:

In Revit plan views, Stairs and their hosted Railings are not shown as true 3D elements being cut by the view's cut plane. Rather, they are a hybrid 2.5D representation which follows traditional architectural graphic standards for floor plans. An example of this can be seen in Figure 5-1.2a. Notice all parts of the stair and railing extend to the Cut Mark. Contrast this with Figure 5-1.2b which is a true 3D view of the same stair; notice the railing is hardly visible and there is no cut mark. The cut plane for both examples is 3'-0" as seen in Figure 5-1.2c.

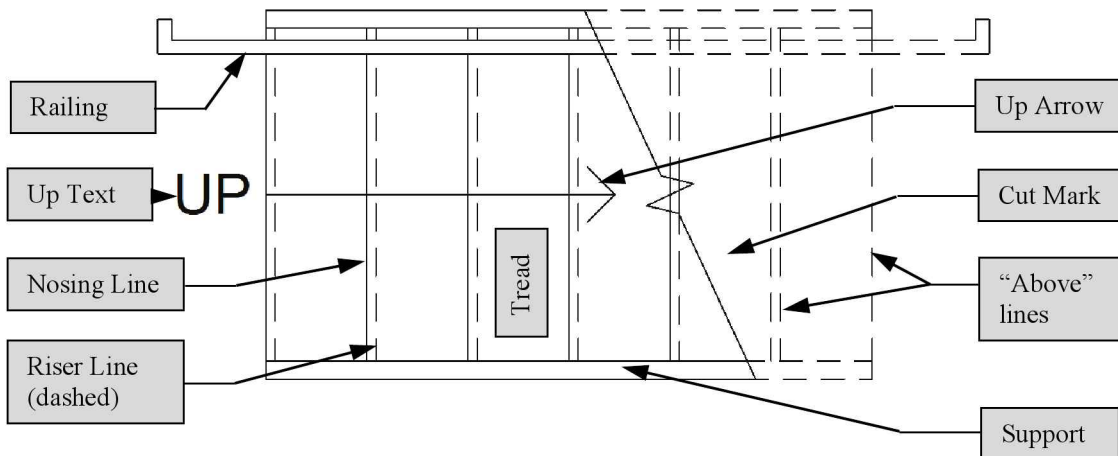


FIGURE 5-1.2a Plan view of a stair and railing – 2.5D representation

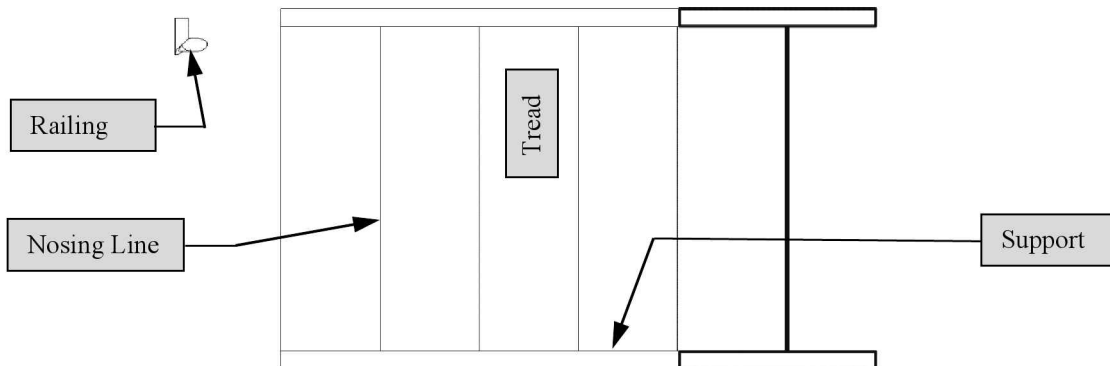


FIGURE 5-1.2b Plan view of a stair and railing – true 3D representation

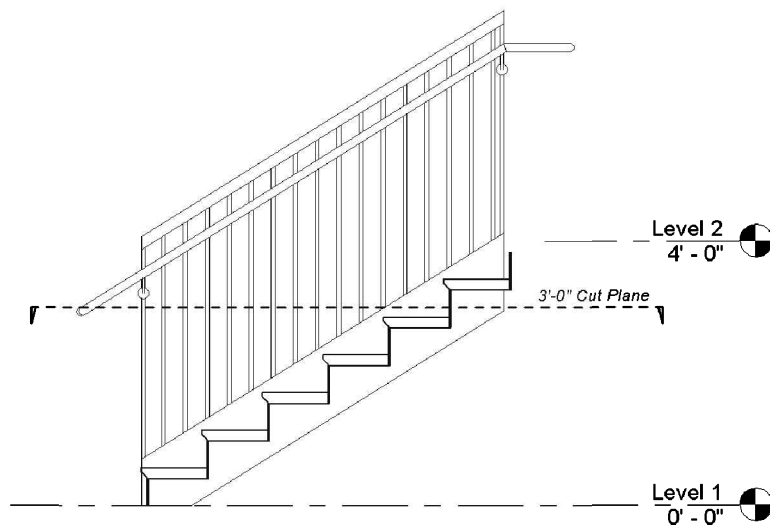


FIGURE 5-1.2c Stair in section with plan view's *cut plane* indicated

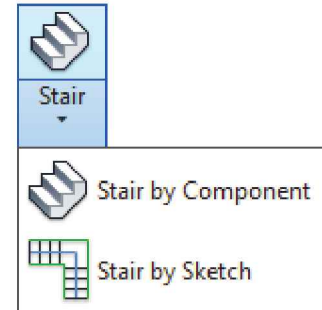
The Stair and Railing tools will be covered in more detail in the following “exercises” in this chapter. But, first, here is a high level introduction to the tools available in Revit...

Stair Tools:

Revit has two main tools one can use to model stairs:

- Stair by Sketch
- Stair by Component

The **Stair by Sketch** used to be the only stair tool in Revit, but it has some limitations—for example, it cannot create a triple switchback stair because the 2D sketch lines cannot be on top of each other while in sketch mode. Thus, in Revit 2013, the **Stair by Component** tool was introduced. This new tool overcame some challenges and introduced new ones. Interestingly, some of the new challenges are overcome by converting the newer *Stair by Component* elements to the older (original) *Stair by Sketch* based elements. As such, both of these tools will be covered in order to fully leverage Revit’s abilities to model and document stairs.



Railing Tools:

Revit has two main tools one can use to model railings:

- Sketch Path
- Place on Host

The **Sketch Path** tool allows a continuous section of railing to be added to the current level. The **Pick Host** command provides a quick way to add railings to a stair or railing, which is handy if they were deleted or not added during the stair/ramp creation.



In addition to these two Railing tools, railings can also be created while creating Stairs and Ramps. While in the Stair or Ramp command, selecting the **Railing** button on the Ribbon lets you specify which railing to use and how to position it (Figure 5-1.3). Revit will add a railing to both sides. Once created, one or both of the railings can be deleted. One tricky thing about the Pick Host tool is it only works if the stair or ramp does not have any railings hosted.

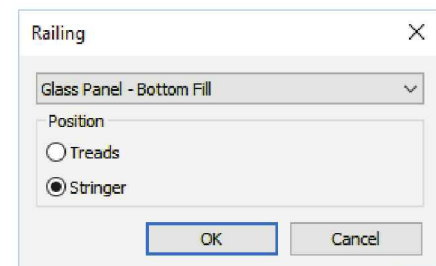


FIGURE 5-1.3
Specify how railing will be created

Sloped Railings Tip: A railing will not slope with a floor if the floor has been made to slope by modifying its sub elements. Instead, use a Slope Arrow in Sketch Mode for the floor.

Basic Stair Types:

Revit has three fundamentally different stair types which are needed to properly model the various types of stairs typically found in construction.

Stair Types:

- Assembled Stair
- Monolithic Stair (aka Cast-In-Place)
- Precast Stair

Assembled Stair

Revit's Assembled Stair represents the most common type of stair in construction: concrete pan and steel riser (Figure 5-1.4). A residential stair constructed of wood can also be accomplished with this option. With this type Revit provides separate settings for the treads, risers and supports.

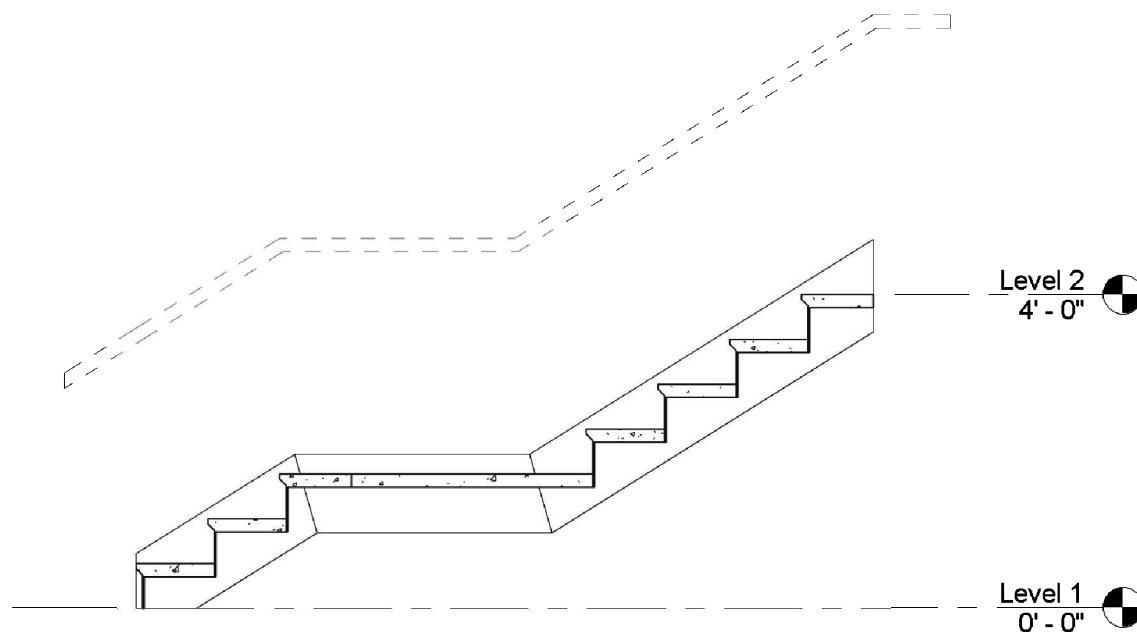


FIGURE 5-1.4 Assembled stair type example

Monolithic Stair (aka Cast-In-Place)

When a stair is constructed with cast-in-place concrete (CIP), the monolithic stair type should be used (Figure 5-1.5). This stair is often used outside the building (site design) or within the building whose primary structure is also CIP concrete. The properties for this type of stair vary a bit from the assembled stair type—for example, the minimum thickness and whether the bottom should slope or step can be specified. Structural designers can also add **Rebar** to this type of element.

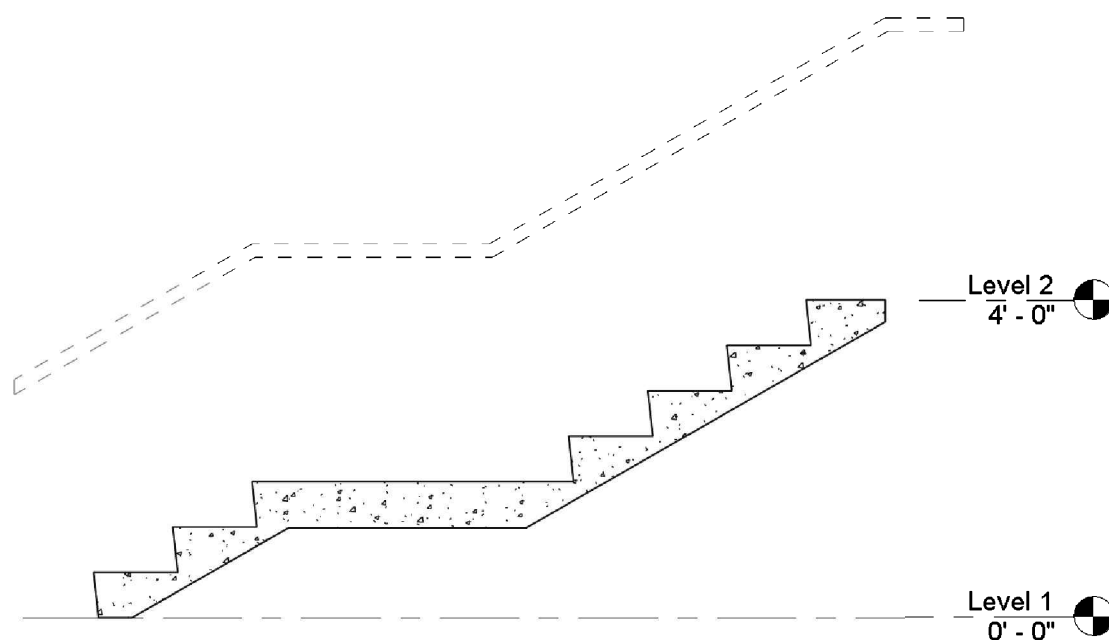


FIGURE 5-1.5 Monolithic stair type example

Precast Stair

When the various parts of a stair are manufactured off-site with concrete and then shipped to the job site, the Precast Stair type can be used to properly represent this special condition (Figure 5-1.6). Notice the special notches which are used to interconnect and support the individual parts. This stair type can also have Rebar added to it. **FYI:** This stair type can only be created using the *Stair by Component* command.

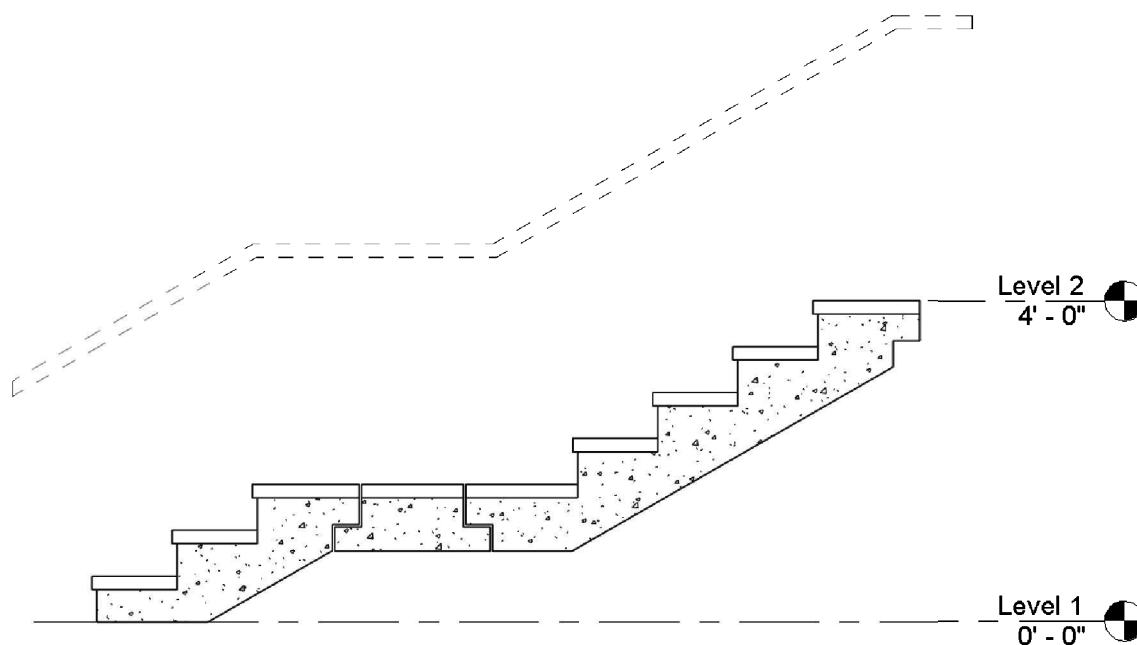


FIGURE 5-1.6 Precast stair type example

Because the parameters vary between stair types, it is often not a simple task to select a stair of one type (e.g. Assembled) and switch it to another (e.g. Monolithic) via the Type Selector. The biggest issue is an assembled stair has the option to end with a riser or a tread, but monolithic and precast stairs can only end with a tread. The stair needs to be modified or recreated from scratch to switch between types.

To see the difference between the **End with Riser** versus **End with Tread** options, compare Figure 5-1.2c, which is set to end with riser, with Figure 5-1.4 set to end with tread. In this example, the “end” is the top and each option is common in construction. The ‘end with riser’ option is used if the stair stops right at the floor edge. The ‘end with tread’ option is used when the stair ends a distance away from the main floor and something similar to a landing is added to fill in the gap.



This image is another view of the stair and railing design shown at the beginning of this section. The railings at the level 2 floor edge are separate elements from the railings hosted to the stair.

Graphic Controls:

There are a number of ways to manage the visibility of Stairs and Railings in Revit. For the most part, these options apply to all stairs and railings regardless of which tool was used to create them.

Object Styles (project wide settings)

The highest level of graphic control in a Revit project is **Manage → Object Styles** (Figure 5-1.7). Here, one can specify the line thickness and color for the various parts of a Stair (same for Railings). For Stairs and Railings, these settings only apply if there are no view specific overrides or filters. *Tip:* Compare the terms listed to the previous images.

Visibility/Graphic Overrides (view specific settings)

The graphics of Stairs/Railings can also be controlled on a view by view basis via the **Visibility/Graphics Overrides** dialog (Figure 5-1.8); while in a view, type **VV**. For example, maybe a Demolition plan or Code plan should show less detail...this can be achieved just in those views.

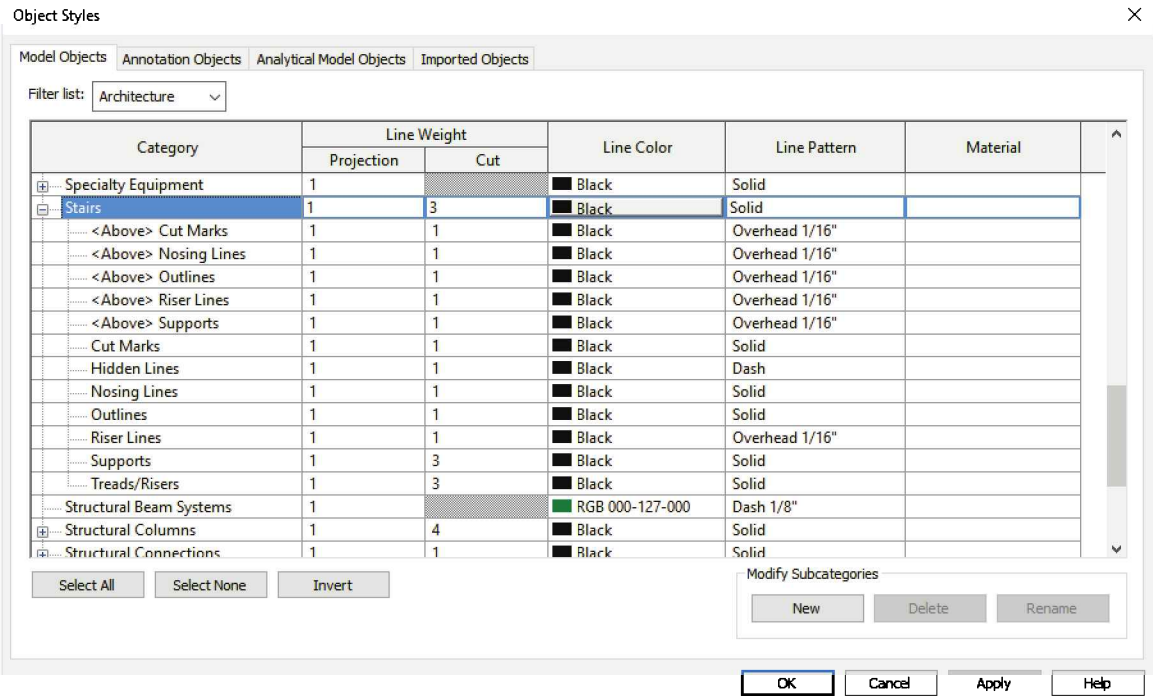


FIGURE 5-1.7 Object Styles dialog – project-wide graphics controls for stairs

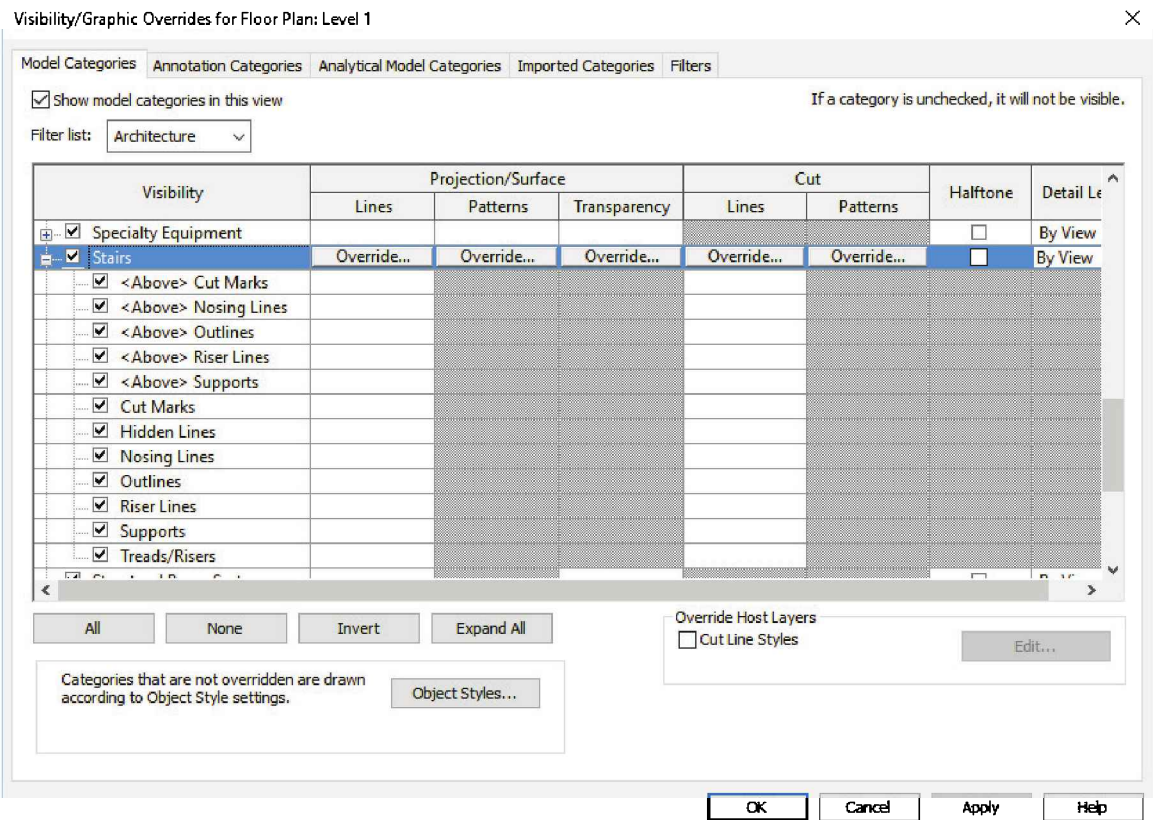


FIGURE 5-1.8 Visibility/Graphic Overrides dialog – view specific graphics controls for stairs

Calculate Tread/Riser Size:

Although Revit automatically calculates the rise and tread dimensions for you, it is still a good idea to understand what is happening.

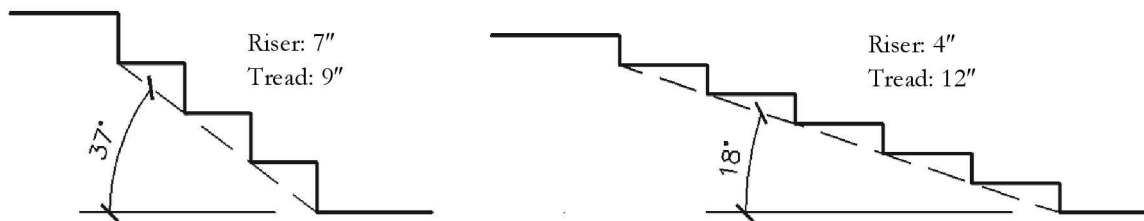
The **riser** is typically calculated to be as large as building codes will allow. Occasionally, a grand stair will have a smaller riser to create a more elegant stair.

Similarly, the **tread** is usually designed to be as small as allowable by building codes. This author worked on the design of a ski chalet where the treads were deeper than required by code for the comfort of those wearing ski boots in the building.

The largest riser and shortest tread creates the steepest stair allowed. This takes up less floor space; see the next image. A stairway that is too steep is uncomfortable and unsafe.

Building codes vary by location; for this exercise, you will use 7" (max.) for the risers and 12" (min.) for the treads (11" tread plus a 1" nosing).

Codes usually require that each tread be the same size in a single run, likewise with risers.



To calculate the number and size of the risers:

Given:

Risers: **7" max.**

Floor to floor height: **13'-4"**.

Calculate the number of risers:

$$13'-4" \text{ divided by } 7" \text{ (or } 160" \text{ divided by } 7") = 22.857$$

Seeing as each riser has to be the same size we will have to round off to a whole number. You cannot round down because that will make the riser larger than the allowed maximum ($13'-4" / 22 = 7.3"$). Therefore, you have to round up to 23. Thus: $13'-4" \text{ divided by } 23 = 6.957$.

So you need **23** risers that are **6 15/16"** each.

Multistory Stairs:

If a stair extends multiple stories (i.e. levels) in a building, Revit has a feature which will support this in some cases (but not all). When a stair is selected, adjusting the parameter **Multistory Top Level** will cause the entire stair (runs, landings and railings) to array vertically. This really only works with straight run or U-shaped stairs (aka switchback stair).

In the image below (Figure 5-1.9), there are triple-run (left) and double-run (right) stairs. As a side note, the triple-run stair might be used to minimize required floor space, but requires enough vertical distance between floors as two runs overlap and can create headroom issues. When the *Multistory Top Level* parameter is adjusted a level two or more levels above, the **double-run will work, but the triple-run will not.**

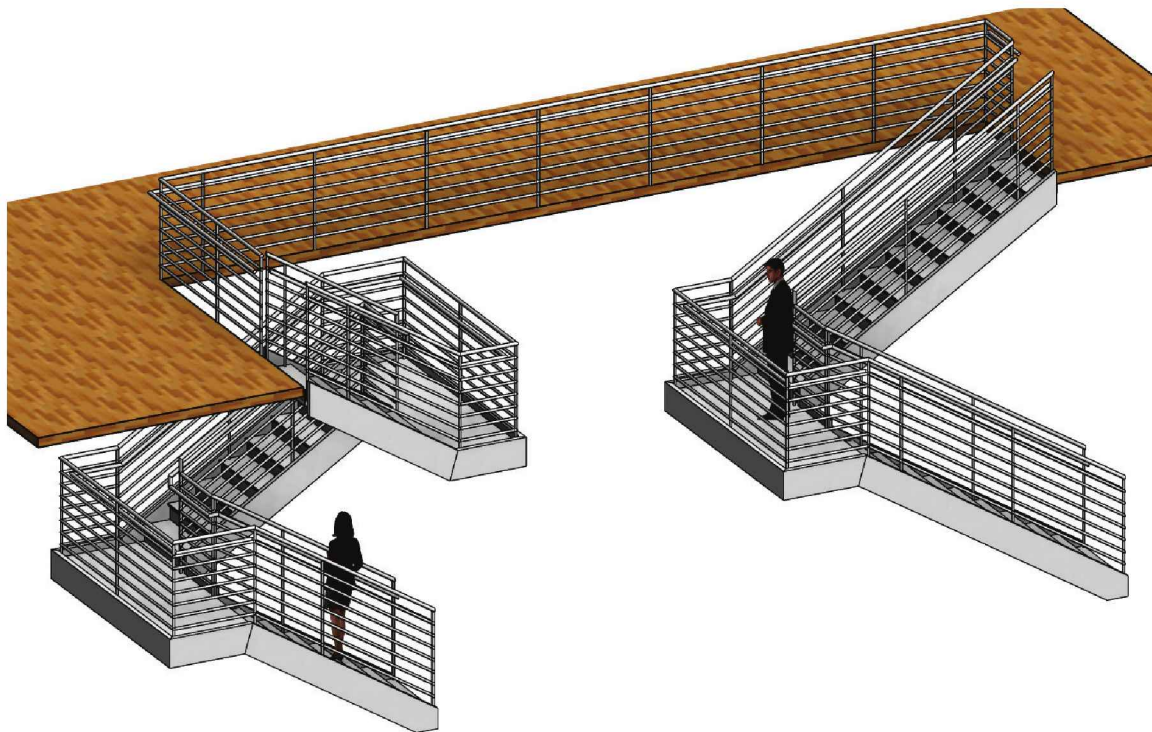


FIGURE 5-1.9 Two stair designs between level 1 and level 2

If the Multistory Top Level parameter is adjusted for both stairs in the example above, we see the result in Figure 5-1.10. Because the stair is arrayed vertically, and the triple-run starts and ends on the same side, we see a major issue. However, the double-run stair works correctly.

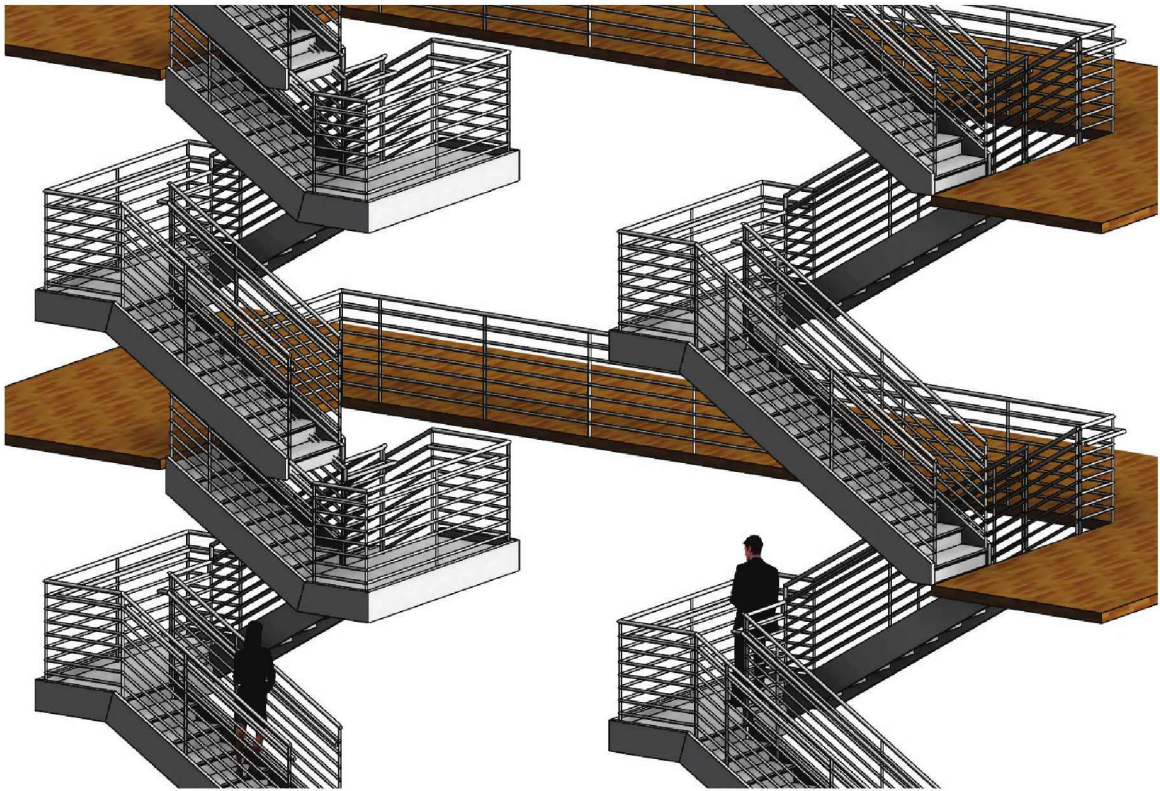


FIGURE 5-1.10 Stairs arrayed vertically using the Multistory Top Level parameter

Keep in mind that the floor-to-floor height must be the same because this feature does not alter the stair at all. Also, only the original, lowest-level stair can be edited.

Conclusion:

This concludes the basic introduction to Stairs and Railings in Revit. The next sections will dive deeper into each of these tools.

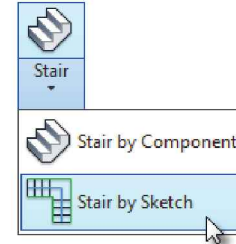
Exercise 5-2:

Stair by Sketch

This section will cover the first of two tools available in Revit for creating stairs. The **Stair by Sketch** option used to be the only way to create stairs in Revit—this is the option we will look at in this section.

Stair Parameters:

First you will review the parameters available in the *Stair Family*. Note that *Stairs*, like *Walls*, are a *System Family* and are only defined within a project or template.



1. From the *Project Browser*, expand the **Families** → **Stairs** → **Stair** (i.e., click the plus signs next to these labels).
2. Right-click on the stair type **Steel Pan Stair**, and select the **Type Properties** option from the pop-up menu.

You should now see the parameters shown in Figure 5-2.1.

Take a couple minutes to see what options are available.

- **Tread:** This defines the minimum dimension of tread in plan view. Unlike Risers, this dimension will not automatically change.
- **Nosing Length:** Treads are typically 12" deep, usually code minimum, and 1" of that depth overlaps the next tread. This overlap is called the nosing.
- **Riser:** This provides Revit with the maximum dimension allowed by code, or, if you want, less. The actual dimension will depend on the floor to floor height as described in the previous section.
- **Stringer Dimensions:** These dimensions usually vary per stair depending on the stair width, run and materials, to name a few variables. A structural engineer would provide this information after designing the stair.
- **Cost:** Estimating placeholder.

Type Properties

Family: System Family: Stair Load...

Type: Steel Pan Stair Duplicate... Rename...

Parameter	Value
Calculation Rules	
Calculation Rules	Edit...
Minimum Tread Depth	0' 11"
Maximum Riser Height	0' 7"
Construction	
Extend Below Base	0' 0"
Monolithic Stairs	☐
Landing Overlap	0' 0"
Underside of Winder	Smooth
Function	Interior
Graphics	
Break Symbol in Plan	☒
Text Size	3/32"
Text Font	Arial
Materials and Finishes	
Tread Material	<By Category>
Riser Material	<By Category>
Stringer Material	<By Category>
Monolithic Material	<By Category>

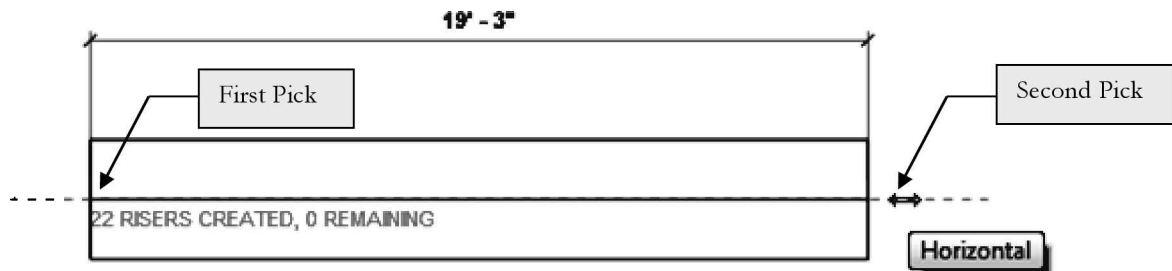
<< Preview OK Cancel Apply

FIGURE 5-2.1 Stair type properties

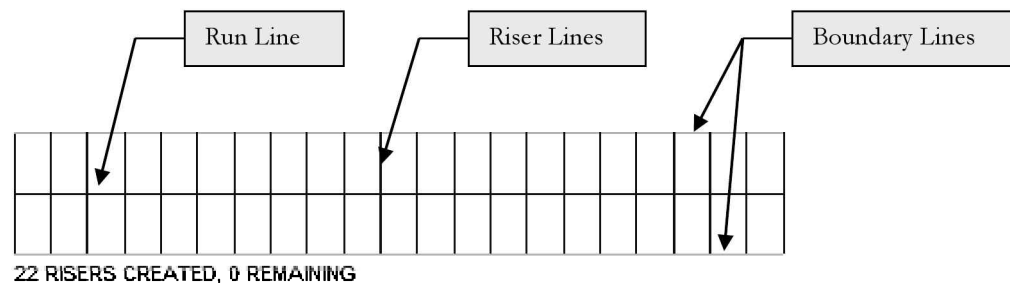
Sketching Stair Layouts:

When the *Stair by Sketch* tool is selected, Revit enters *Create Stairs Sketch* mode. First you set the *Base Level* and *Top Level*; this determines how many treads and risers are created. Next, begin drawing the stair; the first pick is the bottom. The default sketch mode is “Run.” This mode allows you to pick two points and let Revit automatically create the *Riser* and *Boundary* lines. The distance between the points you pick determines how many treads and risers are created. Picking two points far enough apart will create a single run stair that extends from floor to floor.

The following three images show how a simple single-run stair is drawn.



After picking your first point, move your cursor until the on-screen text (near your first pick) says “0 REMAINING,” and then click your second point. Be sure you see the *Horizontal* or *Vertical* alignment line before clicking your second point, if it is to be so aligned.



The *Riser* and *Boundary* lines may be manipulated at this point; e.g., move the boundary line to make the stair wider, or rotate it to make it follow an angled wall, or you can even rotate a single riser, maybe for a stage?



Clicking *Finish Edit Mode* (i.e., green checkmark) creates the stair. Note that a railing is added by default to both sides and the cut symbol is added relative to the view's *Cut Plane* (via *View Range*).

Looking at Figure 5-2.2 you can see how the stair looks in a 3D camera view. Notice the guardrail on each side with a handrail. The two railings are hosted by the *Stair*. This is similar to how a door is hosted by a wall. If the stair is deleted, the railings will be deleted. However, you may delete one, or both, of the railings and the *Stair* will not be affected.

Next you will take a look at how Revit will automatically create a landing when needed.

Landings

Creating an intermediate landing is pretty simple. Your first two picks must fall short of the number of risers needed. Then, you pick the 3rd and 4th points as shown in Figures 5-2.3 and 5-2.4. The first example shows an L Shaped stair, the second a straight stair with an in-line landing. See Figure 5-2.5 on the next page for a 3D view of these completed stairs.

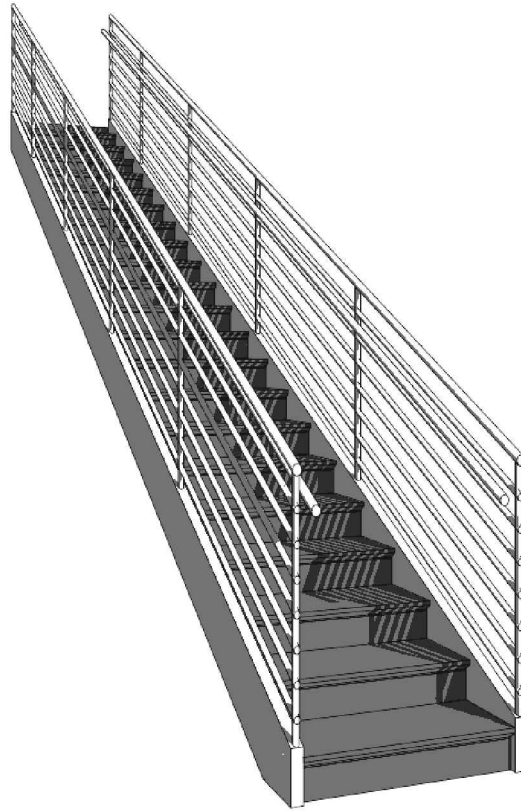


FIGURE 5-2.2 3D view of stair

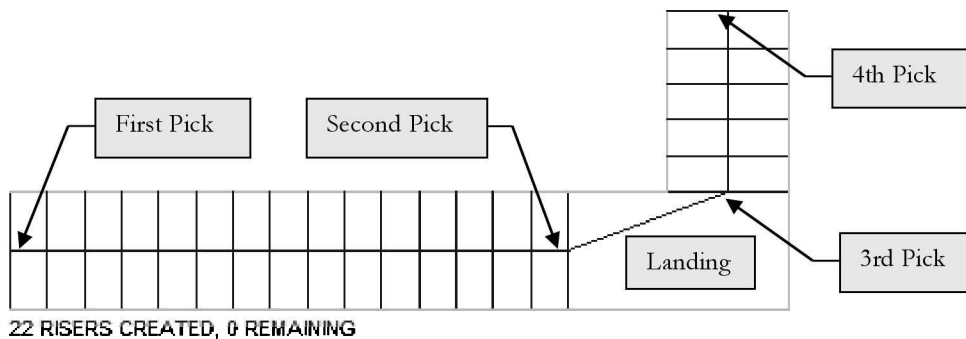


FIGURE 5-2.3 Sketching a stair with a landing – L shaped stair

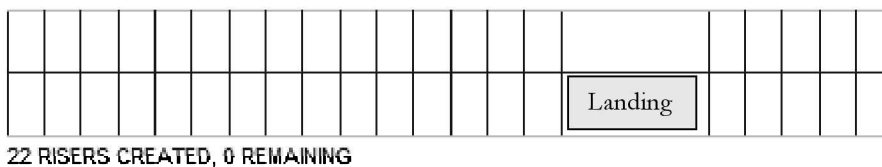


FIGURE 5-2.4 Sketching a stair with a landing – straight run

Variations

Next you will take a look at how the sketch lines can be customized to accommodate unique situations.

First, while in *Sketch* mode, the *Boundary Line* (s) can be rotated as shown in Figure 5-2.6.

The next image, Figure 5-2.7, shows how the *Boundary Line* can be modified to follow multiple angles. While in *Edit* mode, you select the *Boundary* option on the *Ribbon*. You can now sketch new lines and modify existing ones.

Boundary Lines must be continuous and there can only be two total (sides, not lines). Therefore, there are a number of limitations on what can be modeled.

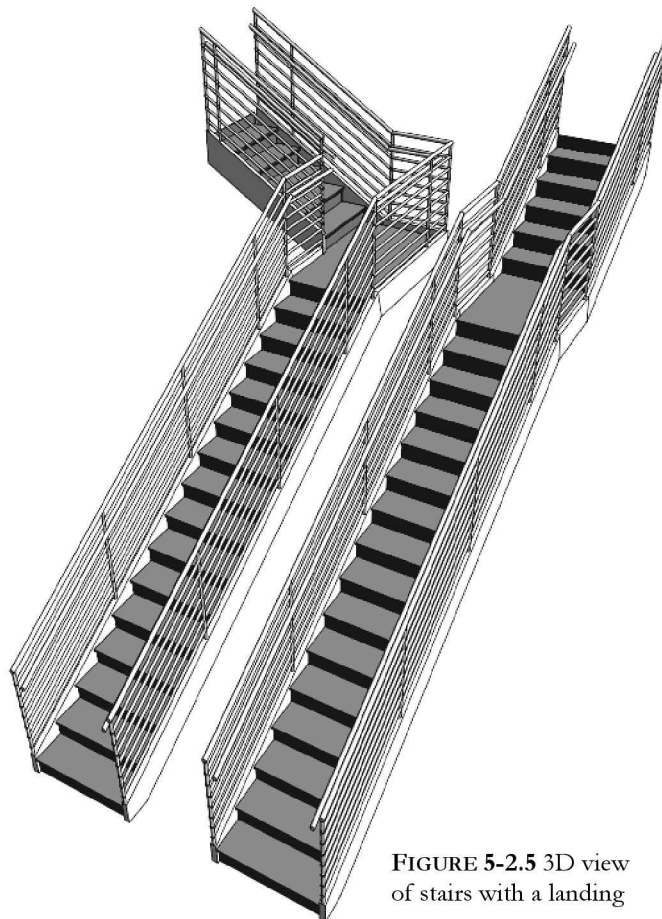


FIGURE 5-2.5 3D view of stairs with a landing

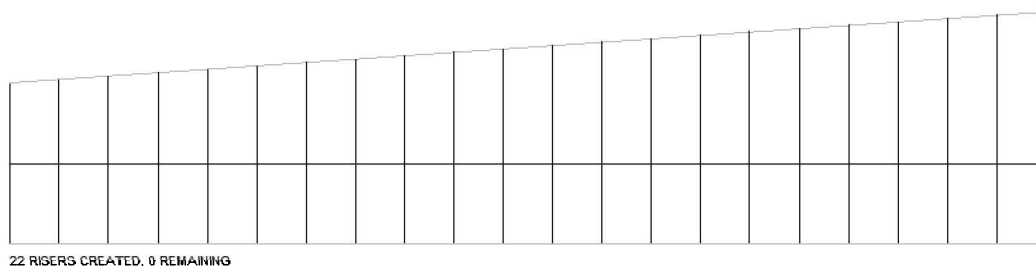


FIGURE 5-2.6 Rotating the boundary line to make one side of stair angled

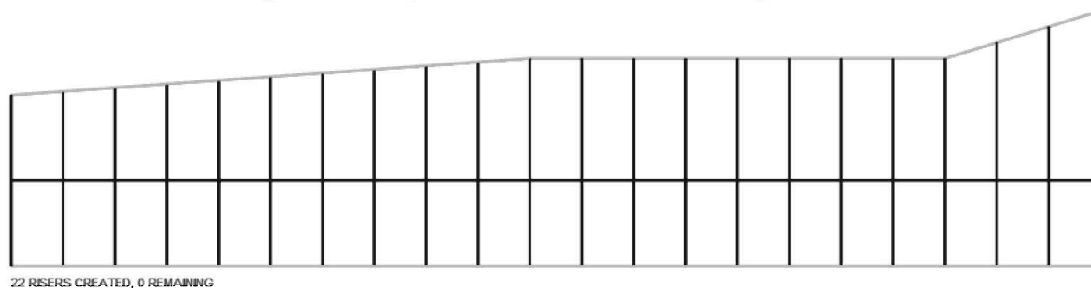


FIGURE 5-2.7 Editing boundary line to make one side of stair follow irregular wall

The *Risers* may also be modified while in *Sketch* mode. First you select the *Riser* option (Figure 5-2.8) and then sketch additional line work, which represents the edge of a tread. An example of this can be seen in Figures 5-2.9a and b. The green boundary line was trimmed back; this causes the stringer to stop short of the last riser. To draw the curved riser line, simply select one of the arc options from the *Ribbon* while the *Riser* draw option is current. Draw the curved line and finish the sketch.

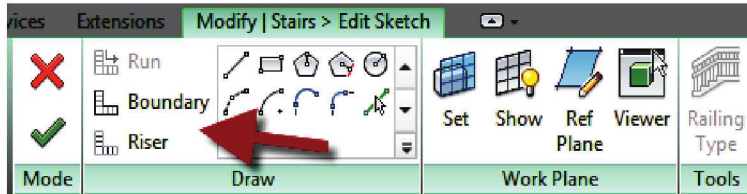


FIGURE 5-2.8 Ribbon options while in *Stair Sketch* mode

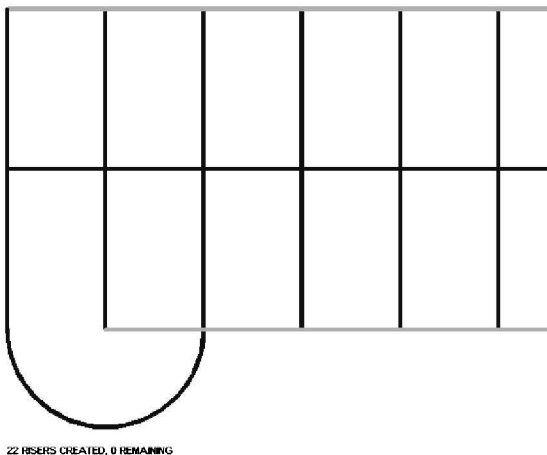


FIGURE 5-2.9a Custom riser modification

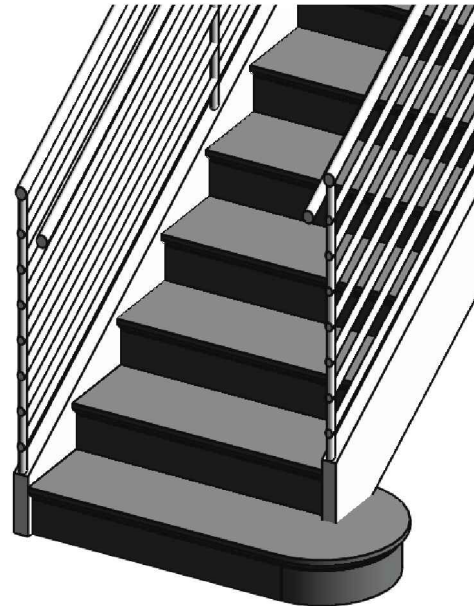


FIGURE 5-2.9b Custom riser in 3D view

Stringer Conditions

Revit offers limited control over the stringer shape. For example, it can only be rectangular shaped – but you can adjust the size. There are other ways of modeling a stringer; you could hide the built-in stringer and add a channel shaped stringer to the railing system's bottom edge, or model it separately.

You can modify the start and end positions of the stringer. This is often required to match the design developed by the structural engineer or stair fabricator. Often, the stringer extends to a beam or floor edge. Here is how that is done...

While in *Sketch* mode, use the **Boundary** option (Figure 5-2.8) to draw a small line past the last *Riser* as shown in Figure 5-2.10. Select this line and set its *Slope* to be **Flat** on the *Options Bar*. You can also adjust the *Height Correction* option to make the top of the stringer align with an adjacent wall base if needed. The final result is shown in the 3D image (Figure 5-2.10).

Another option is to just drag the current *Boundary* edge out past the last *Riser*. This extension can only be sloped as it is a continuation of the main sloped stringer.

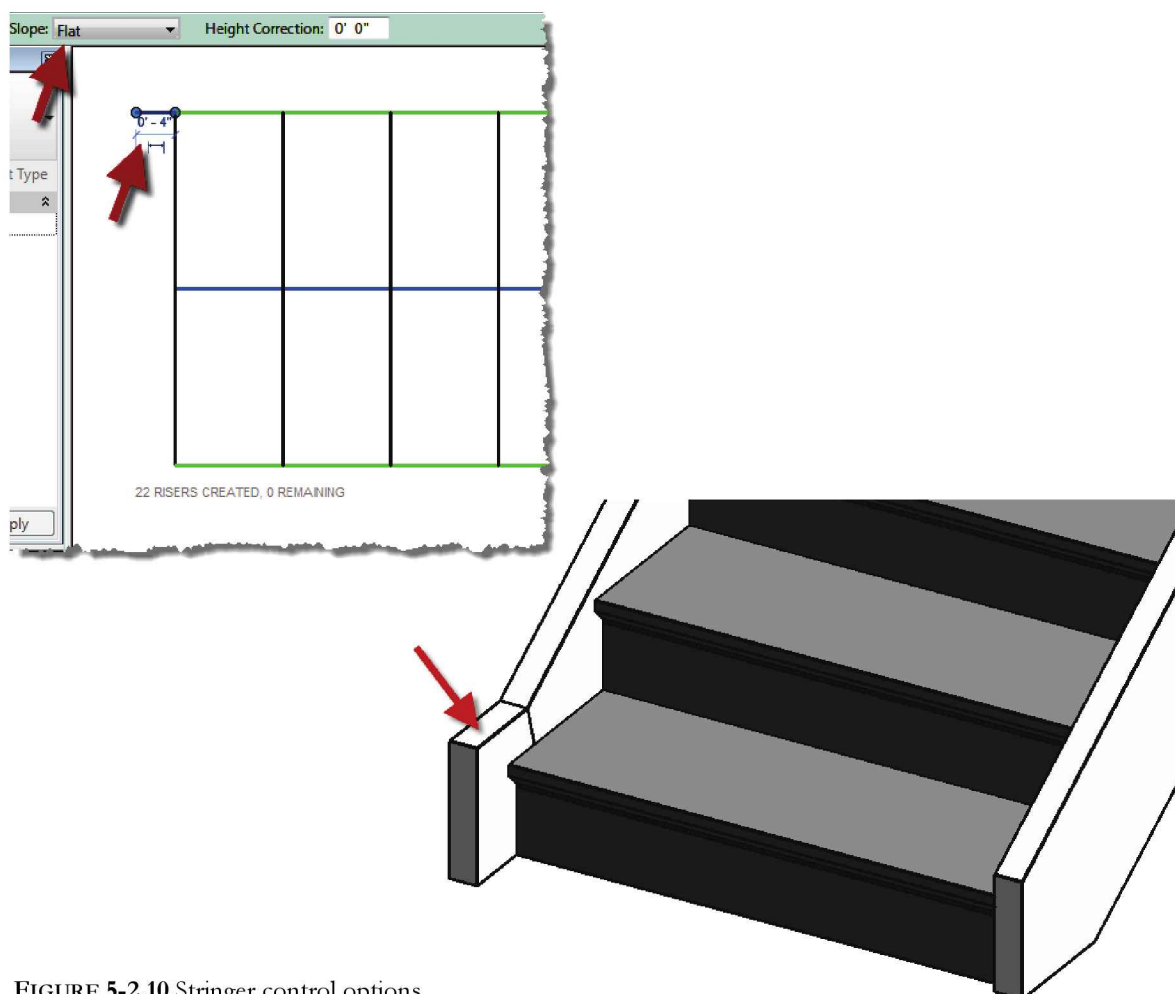


FIGURE 5-2.10 Stringer control options

Stair Width

Keep in mind that the width of the stair is between the two stringers. When laying out a stair, you need to consider the size of the stringer that will appear on each side when the stair is finished (Figure 5-2.11). This is only true when the *Type Properties* has the stringer left and right options set to *Closed*. Otherwise, when set to *Open*, the stringers are below the stair and do not increase the overall width. Figure 5-2.12 shows an example of an *Open* stringer.

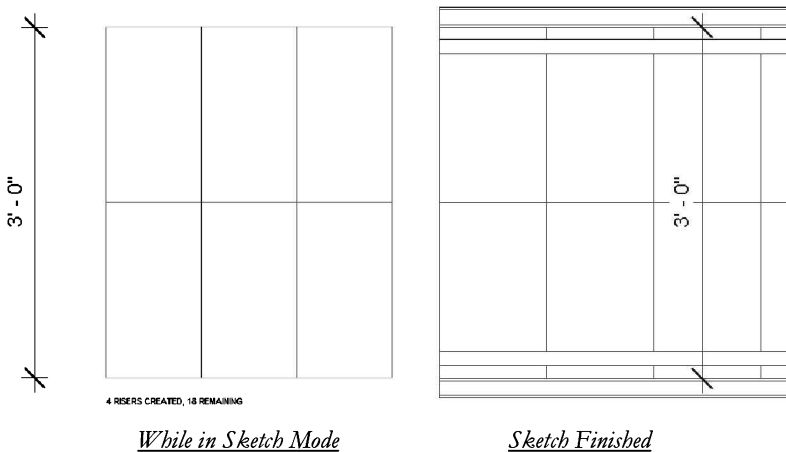


FIGURE 5-2.11 Stair width does not include stringers (when *Stringer* set to closed)

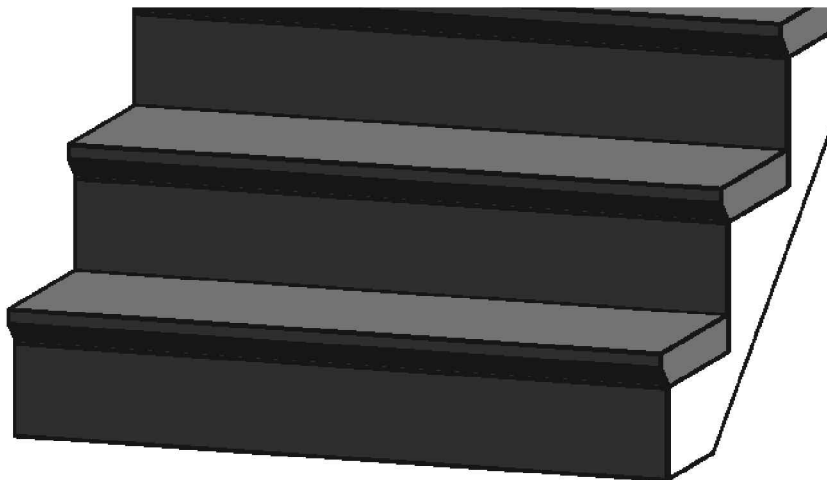


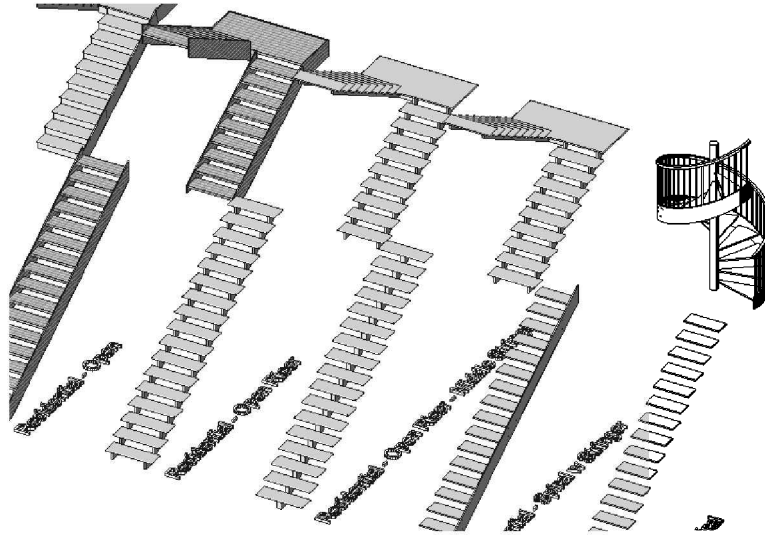
FIGURE 5-2.12 Stair with *Stringer* option set to open

Limitations with Stair by Sketch

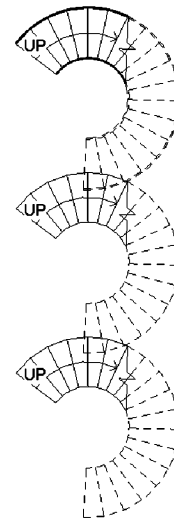
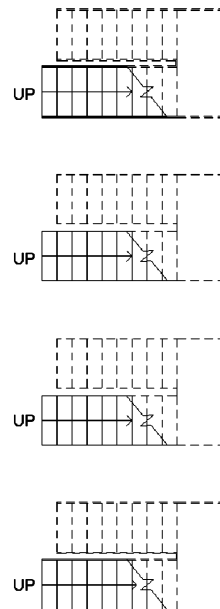
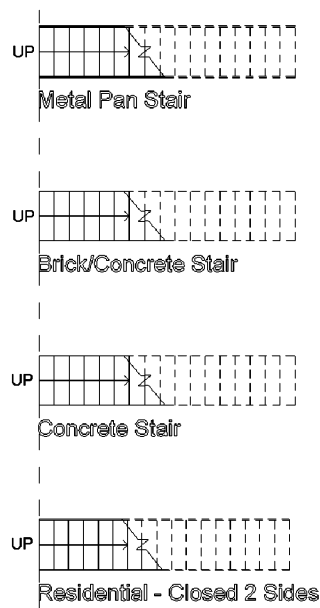
There are a few things which the Stair by Sketch cannot do. One is create a three-run, or double switch-back, stair as the 2D sketch lines cannot overlap. Another is to have a stair split off into two directions from a landing as shown in the rendered images earlier in this chapter. For these reasons and a few others, Autodesk created the Stair by Component tool covered in the next section.

Stair Sample File from Autodesk's Web Site:

Make sure to examine the stair sample file available on Autodesk SEEK. On the Insert tab, in Revit, search for "Revit samples" in the Seek search box and then select the stair option listed in your browser. You can download this file and see examples of several different stair types side-by-side as seen in the images below. You can also select one and view its properties to see how it is done. Additionally, you can Copy/Paste one into your project, select your stair, and then select the newly imported type(s) from the *Type Selector*. The partial view of the sample file, shown below, has open riser, single stringer, no stringer, spiral, etc.



Partial 3D Ortho 1 view



Partial Level 1 Plan view

Exercise 5-3:

Stair by Component

The **Stair by Component** tool was created in Revit to deal with some limitations inherent with the *Stair by Sketch* tool. At first glance, this tool works in a similar way to the *Stair by Sketch* tool; for example, start the command and pick two points to create a single-run stair. The resulting stair, for Steel Pan Stair, even looks exactly the same. However, as we dig deeper we find many differences.

Stair Types:

When the *Stair by Component* command is selected, the **Type Selector** lists three options (Figure 5-3.1); this example is based on the Commercial-default template. At this point it is helpful to compare these three options with their corresponding entries in the **Project Browser** under Families - marked with #1 in Figure 5-3.2. The fourth item marked with #2, “stair,” contains everything related to the older *Stair by Sketch* command. The remaining items are the “components” for this newer stair tool. These components are selected within the properties of the three main options highlighted here.

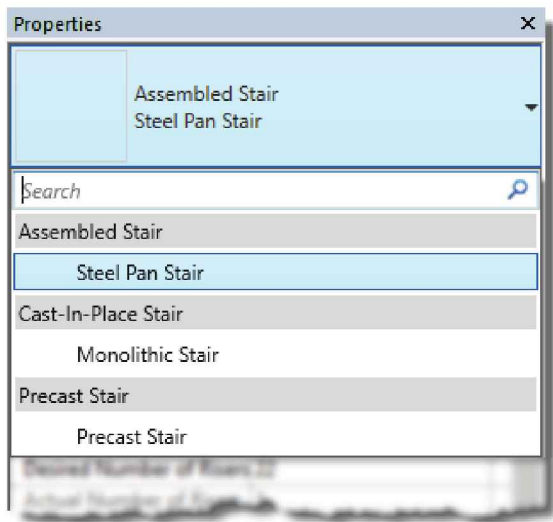


FIGURE 5-3.1 Type Selector;
Stair by Component tool active

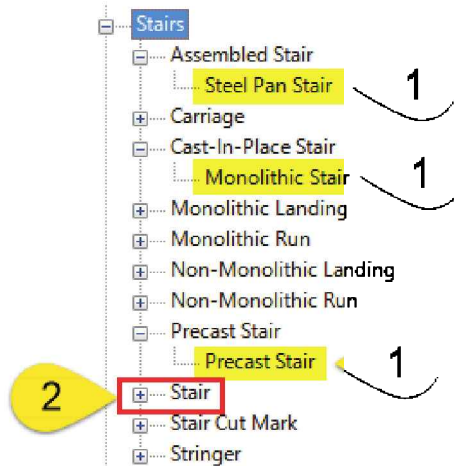


FIGURE 5-3.2 Family\Stairs
in Project Browser

Stair Component Types:

To see how a Stair by Component type, listed above, makes use of the **component types** take a look at the Type Properties for the “Steel Pan Stair” in Figure 5-3.3. The selected component types, which have been highlighted, can each be seen in the Project Browser as shown in Figure 5-3.4, also highlighted.

Unlike the Stair by Sketch, which contains all required properties in one Type Properties dialog (covered in the previous section), the Stair by Component has Type Properties for the entire stair (Steel Pan Stair in this example) and then Type Properties for the various components: Run Type, Landing Type, Supports and Cut Mark Type.

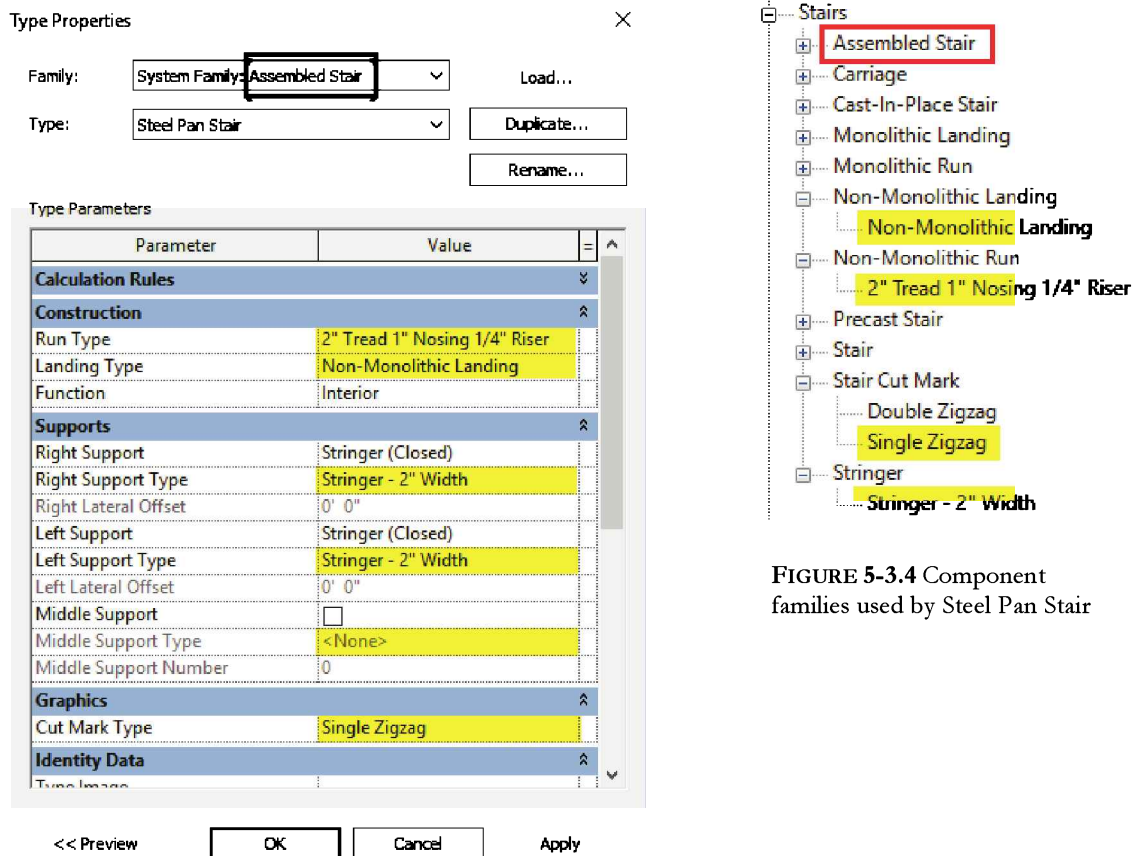


FIGURE 5-3.4 Component families used by Steel Pan Stair

FIGURE 5-3.3 Steel Pan Stair type properties

Supports defined: Both a **Carriage** and a **Stringer** are able to support the stair. In Revit, a carriage is below the riser and treads while a stringer runs alongside them. A *Stair by Component* stair can have three supports, Left, Right and Middle, as seen in Figure 5-3.4. All three supports can be carriage-style but only the Left/Right can be stringers. **FYI:** There is some legacy terminology in Revit that is a bit confusing; a stringer is called “Closed” and a carriage is called “Open.”

Examples of parameters associated with component types can be seen in Figure 5-3.5; here we see the *Run Type* named **2" Tread 1" Nosing 1/4" Riser** and the *Right Support Type* named **Stringer – 2" Width**.

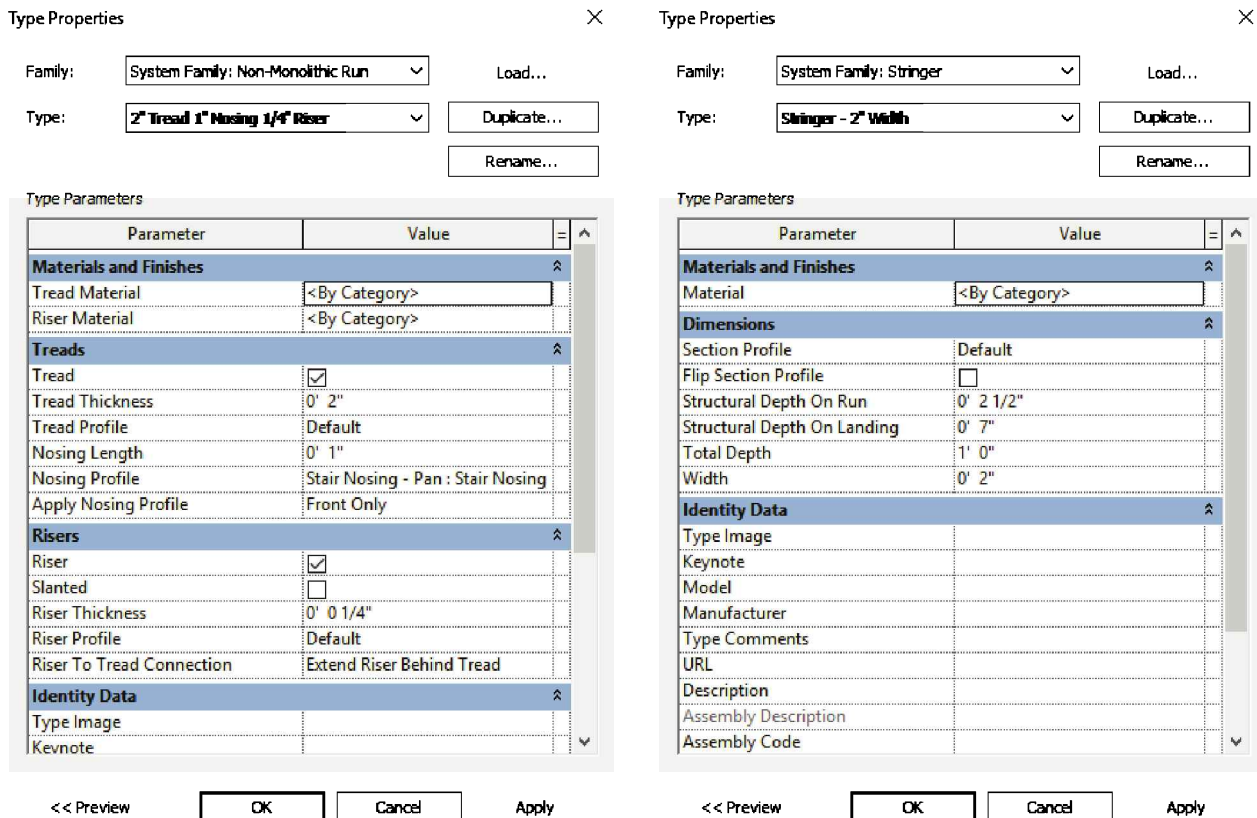


FIGURE 5-3.5 Type properties for two of the stair component types associated with ‘Steel Pan Stair’

Notice in the image above that things like material and tread profile can be selected. This entire **Run Type** can be duplicated and modified when required—for example, a project has a simple utilitarian stair and a more formal open stair. Also notice that a profile can be selected for the supports: **Section Profile**. Thus, we can define a channel-shape which is fairly common in commercial construction. Remember, with the Stair by Sketch, the support can only be rectangular in shape.

All these settings will make more sense once you start using this tool. However, at this point you should have the basic understanding that there are properties for the entire stair system and then separate properties (i.e. types) for the individual components of the stair.

Creating Stairs using Stair by Component:

While creating a stair with Stair by Component, the 3D “components” are created along the way. Using this tool, the individual sketch lines are not seen or editable (e.g., boundary and riser) like they are with the Stair by Sketch tool. This makes it easier to see what the stair will look like before clicking Finish Edit Mode. Also, because there are not sketch lines, it is possible to create a stair with multiple switch backs.

Here are the basic steps for the Stair by Component tool:

- Start at the lowest level
- Select **Stair by Component** tool
- Verify stair style in **Type Selector**
- Verify Base and Top Level settings in **Properties**
- Adjust settings on **Options Bar**
 - Location Line
 - Offset (horizontal)
 - Stair Width
 - Landing creation
 - See Figure 5-3.6 below
- **Pick points** to define one or more runs
- *Optional:* Add **Landing** to top or bottom if needed
 - select *Landing* on Ribbon while in Stair by Component tool
- *Optional:* Select and delete individual **Support** elements
 - For example, if there is a door at an intermediate landing
 - Use the *Support* option to replace if needed

The image below shows the **Options Bar** while the Stair by Component tool is active (Figure 5-3.6). Be sure to select the best option for Location Line. If in a stair shaft, one of the exterior support options is likely the more convenient option. Note that these settings can vary per run within the same stair instance.



FIGURE 5-3.6 Options bar for Stair by Component tool

Picking the points on-screen is similar to the Stair by Sketch tool. Two clicks could create a continuous single-run from floor to floor, or, as seen in the image below, multiple clicks creates multiple runs. All along, Revit indicates how many risers remain before reaching the next level.

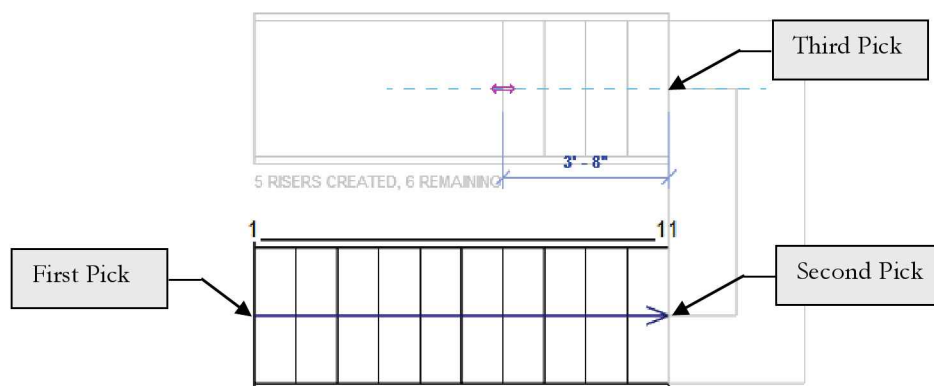


FIGURE 5-3.7 Creating stair with Stair by Component tool

Once the components are created, and while still in the Stair by Component tool, individual components can be selected.

Stair Landings:

In the first image (Figure 5-3.8) the intermediate landing is selected. Notice there are six grips. There is one grip on each side and one grip at each stair run.

The next image (Figure 5-3.9) shows how the landing can be modified when adjusting the grips by clicking and dragging. In this example, the three circled grips were moved to change the size and shape of the intermediate landing.

Landings are only automatically added between runs when **Automatic Landing** is checked on the Options Bar. If additional landing construction is required at the top or bottom of the stair, select the **Landing** option (see Ribbon image below) and then sketch a closed loop which is touching the adjacent stair run.

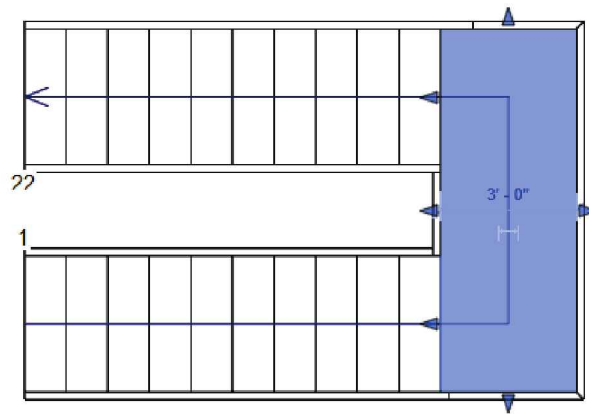
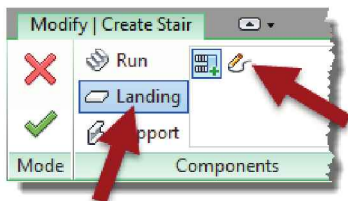


FIGURE 5-3.8 Stair by Component edit mode with landing selected

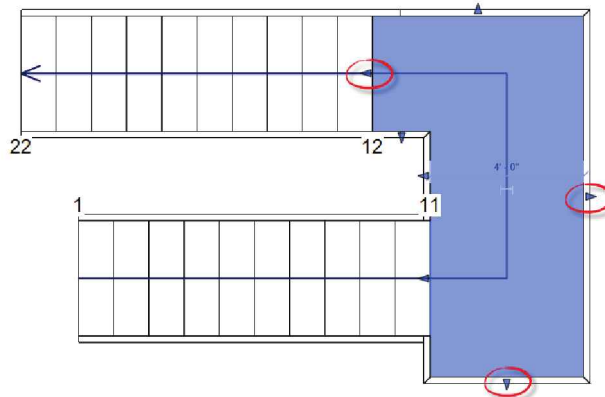


FIGURE 5-3.9 Landing adjusted using grips

The result is a landing with added supports on all three sides as seen in the upper part of Figure 5-3.10. Selecting the end support allows you to delete it. Notice how the side supports adjust from mitered to flush cut in the lower image once the support has been deleted.

When a landing is selected, its **Relative Height** and thickness are listed in the Properties Palette. Adjusting the elevation will automatically adjust the runs, plus the number entered will be changed to the closest riser position. However, the runs are not adjustable if any of them have been converted to a sketch (more on this in a moment).

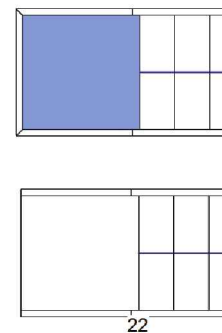
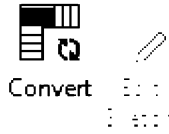


FIGURE 5-3.10 Added landing and support deleted

Non-rectilinear Landings:

The intermediate landings automatically created by Revit can be modified. While in Stair Edit mode, select the landing component as shown in the first image in Figure 5-3.11. Click the **Convert** command on the Ribbon.



At this point, a message appears indicating the conversion is irreversible. Click **Close** to complete the conversion. The landing portion of the stair is now a Sketch-based stair element.

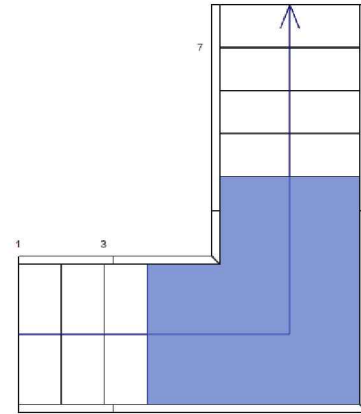
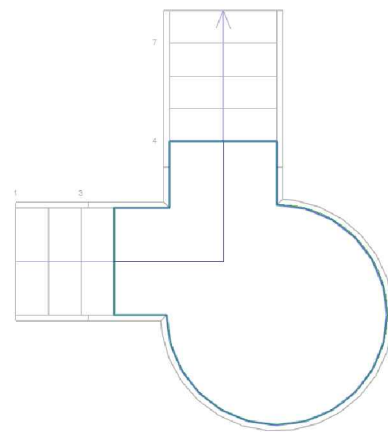
With the landing still selected, click the **Edit Sketch** command on the Ribbon. The lines which define the perimeter of the landing, in plan-view, are now editable. Use **Draw** and **Modify** tools, such as Line, Circle, Arc, Split, Trim, Offset, etc. to adjust the footprint of the landing. An example of a modified landing can be seen in the second image to the right.



When finished editing the landing sketch, click the **green checkmark** to exit sketch mode. If the sketch is not a clean outline with any overlapping or crossing lines Revit will create the landing. Unlike other sketches, like floors, there cannot be multiple closed loops (e.g. in a floor, a loop within a loop would create a hole in the floor). If a sketch error is shown, Revit will highlight the problem area. Simply click Continue and fix the problem.

Click the green checkmark one more time to finish the entire stair instance; Revit will recreate any hosted railings as well. This can be seen in the last image to the right.

If the landing needs to be modified again, select the stair and click Edit Stair and then select the landing component and click Edit Sketch.

*Original Landing**Convert to Sketch and Modify**Custom Landing Result***FIGURE 5-3.11** Custom Stair Landing

Landing Properties:

A landing can have its main properties defined by the Run, which is the default setting, or independently.

Selecting a landing and then looking at its Type Properties we see **Same as Run** is selected (Figure 5-3.12). This tells Revit to inherit several properties from the stair run that the landing is connected to within the *Stair by Component* instance.

TIP: A component within the stair can be selected without entering edit mode. Simply hover your cursor over the component and then tap the **Tab** key and click to select once the component highlights.

When **Same as Run** is unchecked, several properties appear as shown in Figure 5-3.13.

Landing Material:

In addition to controlling the various tread properties, notice that a **material** parameter is also now available when **Same as Run** is unchecked. If the landing requires a different floor finish, uncheck the **Same as Run** option and specify the material using the **Tread Material** parameter.

An example of the nosing and material matching the run can be seen in Figure 5-3.14.

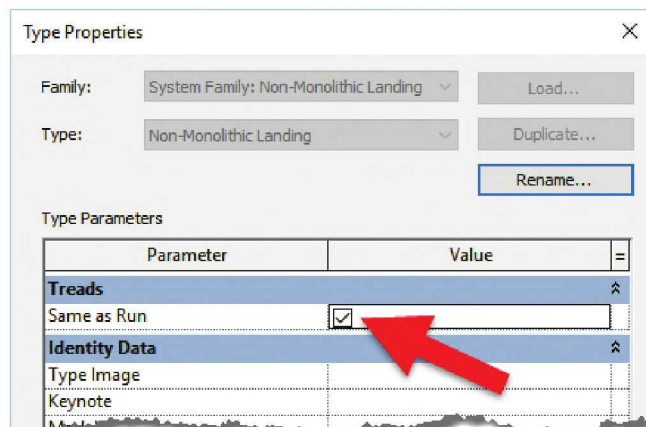


FIGURE 5-3.12 Landing type properties; 'Same as Run' checked

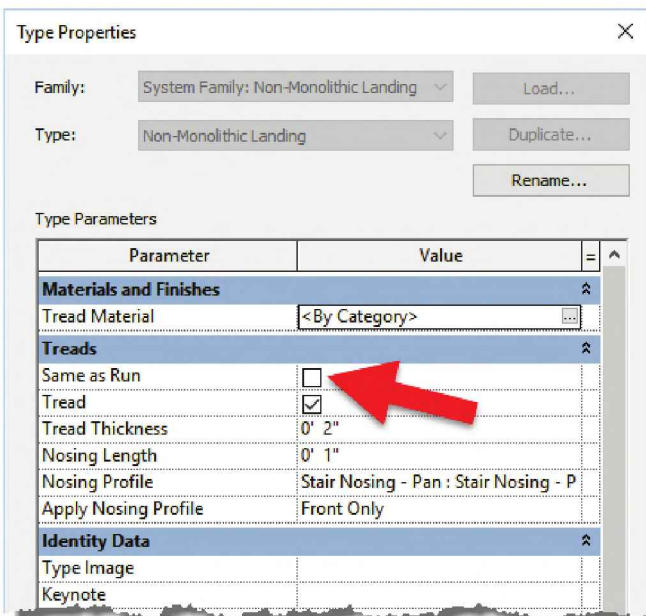


FIGURE 5-3.13 Landing type properties; 'Same as Run' unchecked

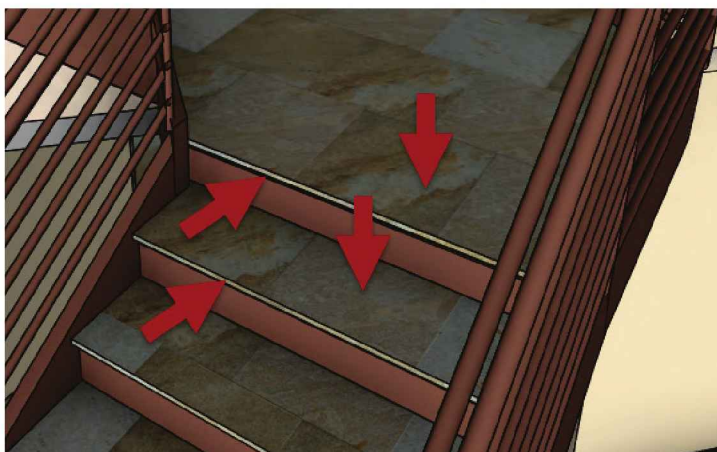


FIGURE 5-3.14 Landing nosing and material example

Stair Supports:

When a support (aka Stringer) is selected, there are three ways in which the end can be cut: Horizontal, Perpendicular and Vertical (Figure 5-3.15). The default is Vertical. This setting is only adjustable at the ends of a top or bottom run. Notice in the image that the setting can vary for each side of the stair.

These options for supports are more limiting than those for the Stair by Sketch tool. Looking back at that section, we see it is possible to control whether the stringer continues to slope or is flat, and its vertical dimension. With the Stair by Component tool we can only extend the stringer if there is a landing to host it.

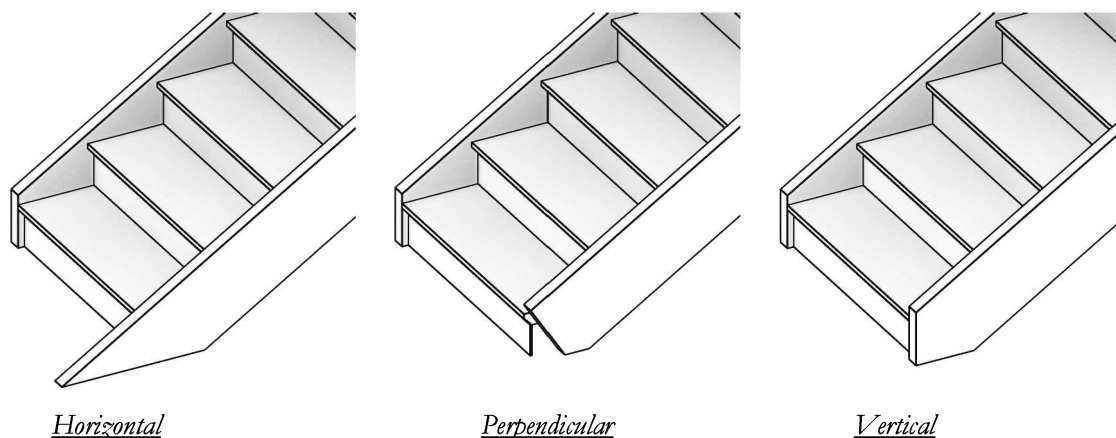


FIGURE 5-3.15 Three options for a support end cut: Horizontal, Perpendicular and Vertical, respectively

Revit generally does a good job at how supports transition. Sometimes there are issues as seen in the example below, on the left. This is not really Revit's fault. The issue is we did not give Revit enough room to make an appropriate transition. Once the landing has been adjusted we see the buildable result on the right. As we will see later, this is true for railings as well.

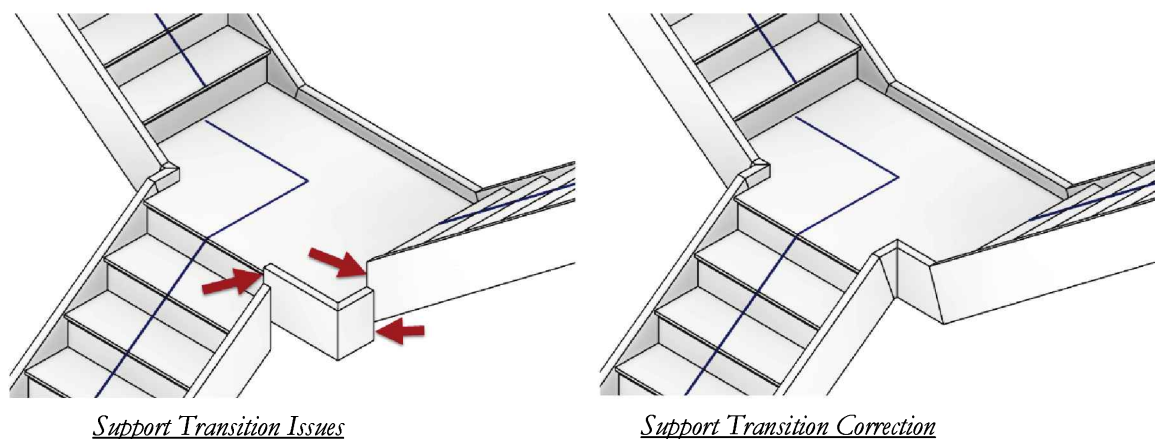


FIGURE 5-3.16 Dealing with supports which do not transition correctly

The example in the previous image (Figure 5-3.16) shows two runs coming off of the same landing, up to the next level. The steps to accomplish this will be covered in the next section on stair runs.

Stair Runs:

When an individual stair run is selected there are a few adjustment options per the grips as seen in Figure 5-3.17.

Dragging the side grips modifies the width of the stair – just for the selected run. Each run can be a different width.

Dragging the top end (or bottom end) grip will depress the number of steps in the selected run. The opposite run will have the same number of steps added (or removed); see Fig. 5-3.18.

A selected run can also be **Nudged** using the Arrow keys. When nudging the stair away from the landing, Revit will automatically extend the landing to meet up with the new stair position.

Additional runs can be modeled within the same stair instance as shown in the previous section. This may be for a grand stair or access to an adjacent roof level. Here is how this is done:

- While in edit mode, select the landing (Fig. 5-3.19)
- Copy the **Relative Height** to the clipboard; highlight and press **CTRL + C**
- Select the **Run** command on the Ribbon (Step #1, Fig. 5-3.20)

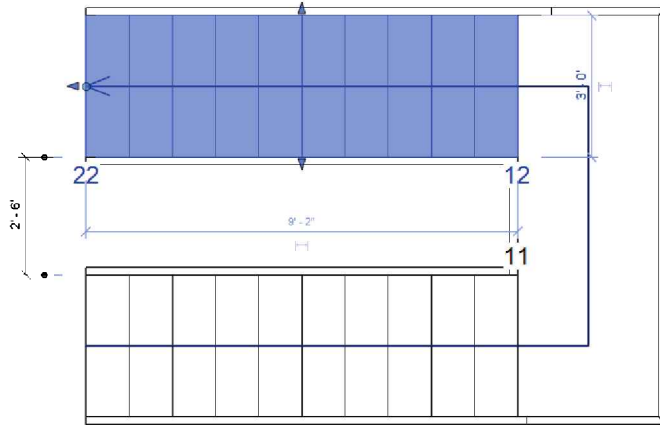


FIGURE 5-3.17 Stair run selected

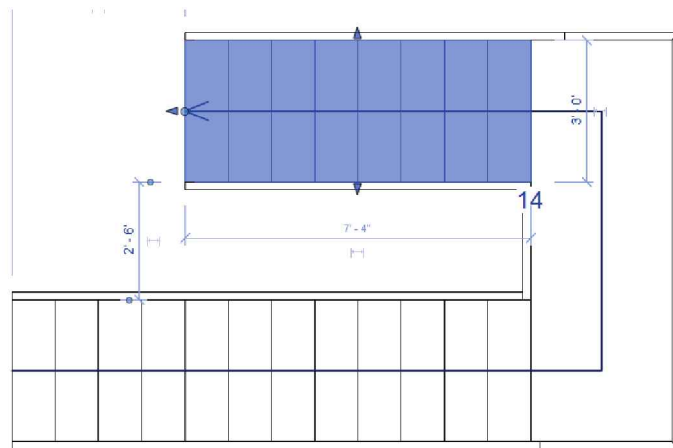


FIGURE 5-3.18 Stair run grip adjusted

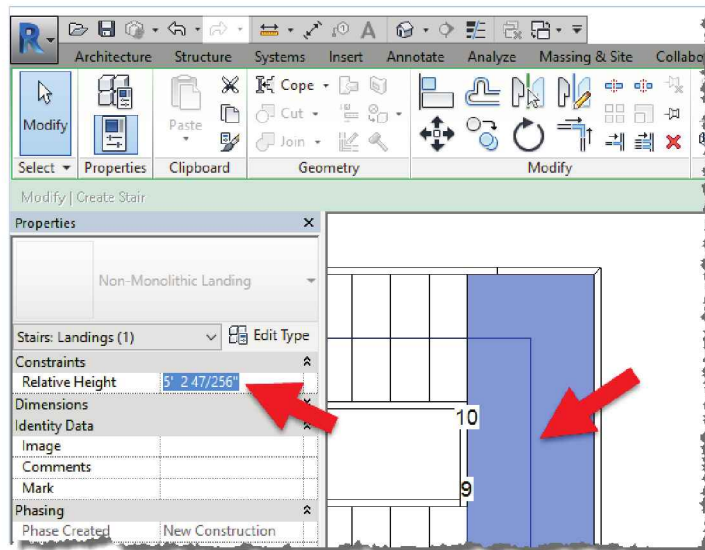


FIGURE 5-3.19 Height listed for selected landing

- Switch the *Properties Palette* drop-down to **Run** (Step #2, Fig. 5-3.20)
- Paste the landing height into **Relative Base Height**; **CTRL + V** (Step #3, Fig. 5-3.20)
- Draw the stair run (Figure 5-3.21)

The result is a new run joined to the landing as seen in the two images that follow. Notice the run arrow is not able to connect multiple stair runs. Thus, make sure to model the desired primary path first. Also, if the secondary stair run needs to be repositioned, it will become un-joined with the landing. However, the landing can be adjusted and once it touches the run it will automatically join with it.

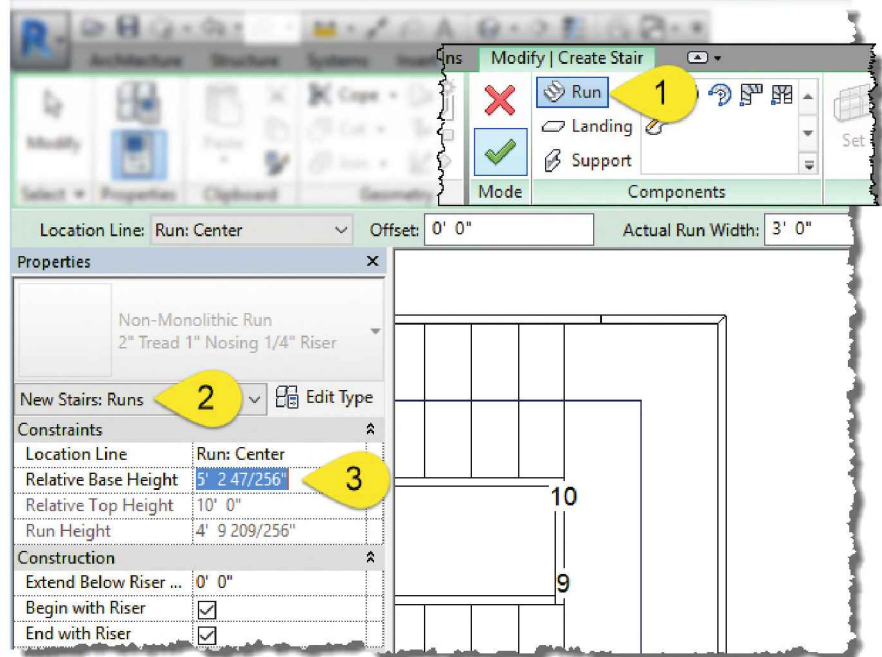


FIGURE 5-3.20 Adding an extra stair run from an intermediate landing

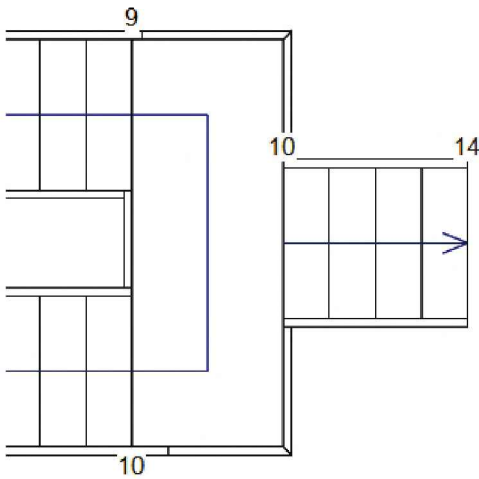


FIGURE 5-3.21 Extra run added to stair

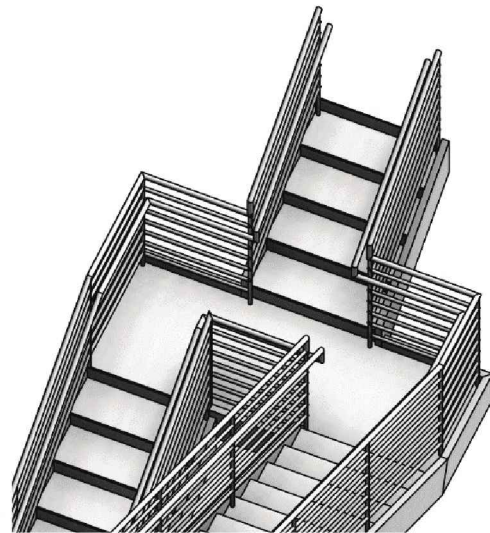


FIGURE 5-3.22 3D view of modified stair

Stair Limitations:

There are a few limitations with *Stair by Component* compared to *Stair by Sketch* when it comes to modeling a stair run or landing. For example, the edge of the stair cannot be angled as shown in the previous section. The bottom tread is not able to be extended out and rounded either.

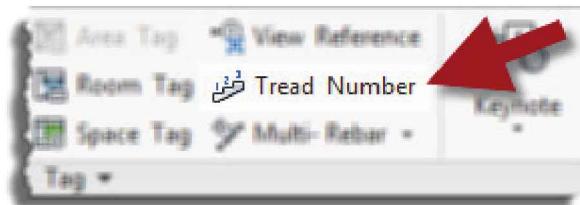
The way to deal with these limitations is to convert the stair component to a sketch-based run or landing. As covered a few pages back for a custom landing, with a stair run selected, while in edit mode, click the **Convert** option on the Ribbon. As the following message indicates, this is irreversible. The main drawbacks are not being able to drag grips to resize the components, but runs and landings still join properly. Thus, the drawbacks are minimal when compared to the need to model the stair correctly. Once a component is converted, select it and click **Edit Sketch** on the Ribbon to modify a run or landing. At this point you are two “edit modes” deep—meaning the green checkmark, for finish, must be clicked twice to fully complete the stair modification.

Stair Annotation:

There are a few annotation tools related to Stair by Component to be aware of.

The **Stair Path** tool, found on the Annotation tab, adds the UP or DN text and an arrow. Keep in mind that every tool on this tab is 2D and view specific. When a stair is initially created, the Stair Path annotation is automatically added to every plan-view.

The Stair Path element can be selected and then repositioned or even deleted in each view. If the annotation is deleted, or a new plan-view is created, use the Stair Path tool to add it to a stair instance.



The visibility of the text and arrows can be controlled separately and per view. Figure 5-3.23 shows the **Visibility/Graphic Overrides** dialog with the Stair Paths category expanded on the Annotation Categories tab.

The text and arrow can be moved separately. The text, “UP” or “DN,” can be moved in any direction. The arrow can only be moved perpendicular to the run of the stair.

The **Tread Number** tool, also found on the Annotation tab, enumerates each tread for a selected run. This tool only works with *Stair by Component* elements; it will not work with a stair created with *Stair by Sketch*. However, if a run is converted to a sketch within a *Stair by Component* stair this command will still work.

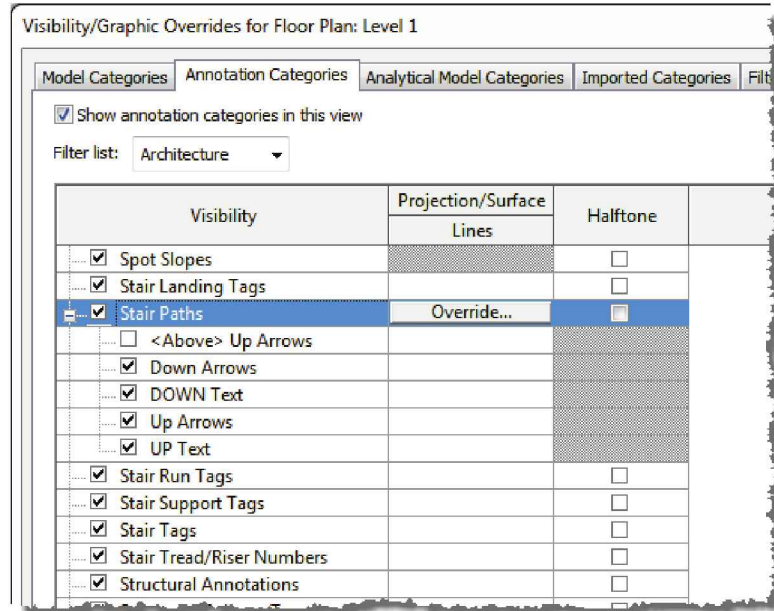
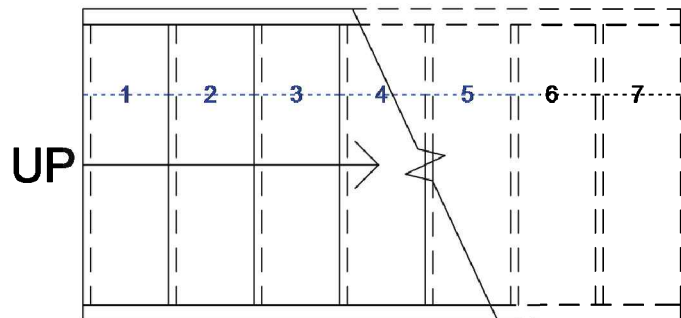


FIGURE 5-3.23 Stair path category

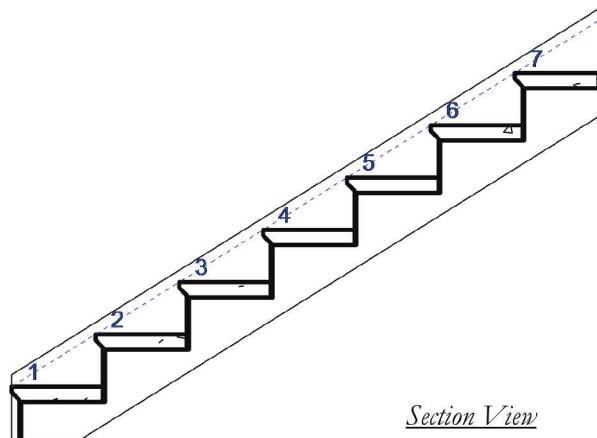
This tool is simple to use. To add tread numbers to a stair, simply start the command and then select a stair run within a plan or section view. Each separate run needs to be selected, even within one Stair by Component instance. The numbers only appear in the current view.



Plan View

An example of the results can be seen in Figure 5-3.24 for both section and plan views.

Once placed, select it to access several formatting options via the Properties Palette. The Tread Number element is selected in Figure 5-3.24; notice the dashed line running through the numbers. When not selected, there is no visible line.



Section View

FIGURE 5-3.24 Tread Number tool results

Warnings:

If a stair has a problem, for example a stair instance does not reach a floor level, the **Show Related Warning** button will appear whenever that stair is selected.

Clicking this button will open a dialog describing the problem as shown in the image below (Figure 5-3.25). This can happen if a stair is created and there are “remaining” risers listed prior to clicking finish. Also, if a stair type is switched from non-monolithic to monolithic this can appear.

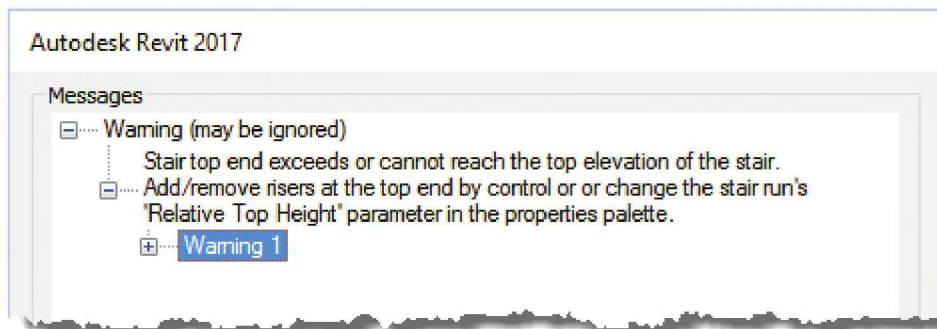
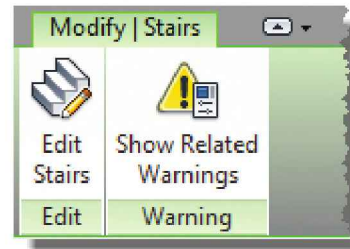


FIGURE 5-3.25 Warning message for selected stair

To see a full list of warnings for the entire model, select **Manage → Warnings** (Figure 5-3.26). This should be done occasionally to ensure there are no major issues with the model. Keeping this list free of major errors can improve the performance of the model as Revit is not constantly checking this situation.

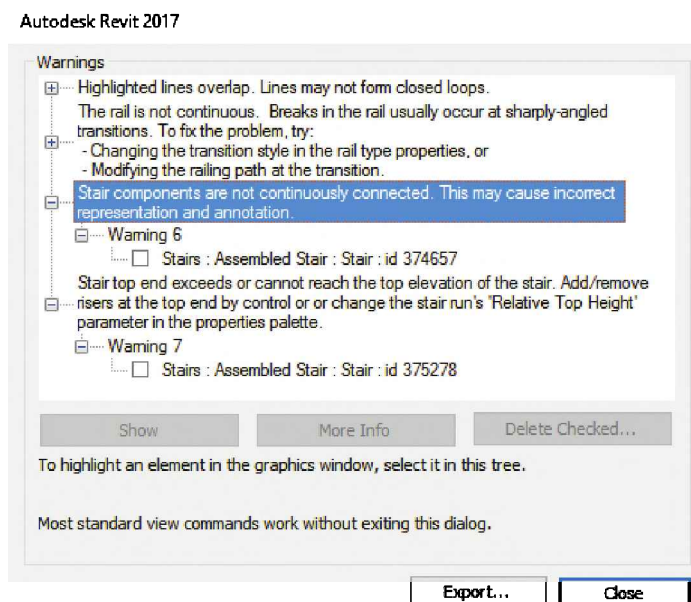
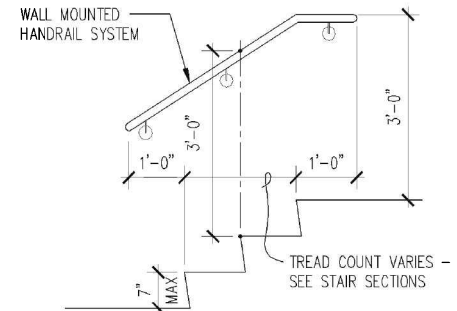


FIGURE 5-3.26 Warnings list for entire project

Exercise 5-4: Introduction to Railings

This “exercise” will provide a basic introduction to the railing tool in Revit. There are no required steps for the law office project in this section. However, it is highly recommended that this information be reviewed prior to completing the steps required later in this chapter.



Railing Types:

When the *Railing* command is selected, the railing Types in the current project are listed in the **Type Selector**. Compare this list to the same items listed in the **Project Browser** under Families\Railings\Railings. The items listed in the Project Browser can be Duplicated or Deleted.

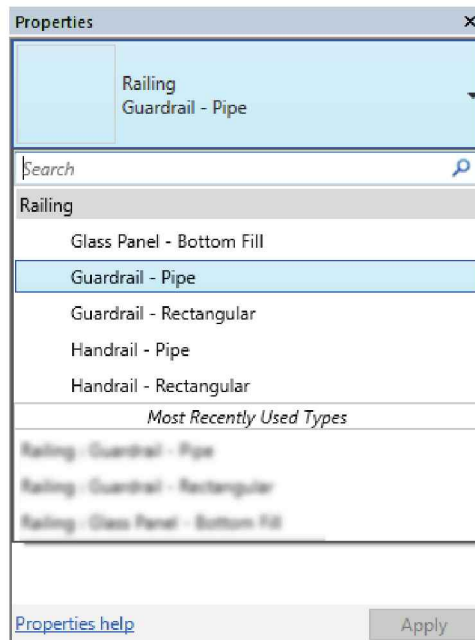


FIGURE 5-4.1 Type Selector;
Railing tool active

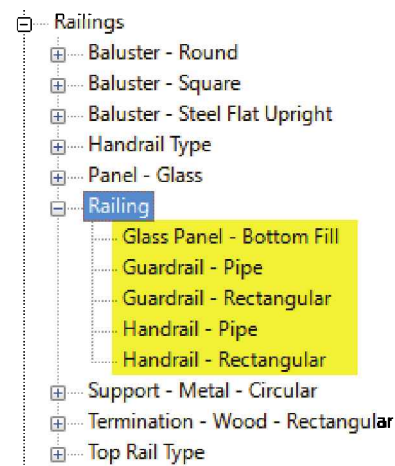


FIGURE 5-4.2 Family\Railing
in Project Browser

Railing Component Types:

Similar to the way Stairs work, Railings have several high-level properties (i.e. Type Properties). These can be seen in Figure 5-4.3. Notice the option to select a Top Rail and Handrail type. Also, there is an option for two handrails on the same railing. This allows a Handrail to be placed on both sides of a railing.

The options available in the Top Rail and Handrail component drop-down lists is based on the Types created in the current project. These options can be seen in the Project Browser as shown in Figure 5-4.4. These Types can be Duplicated or Deleted via the right-click menu.

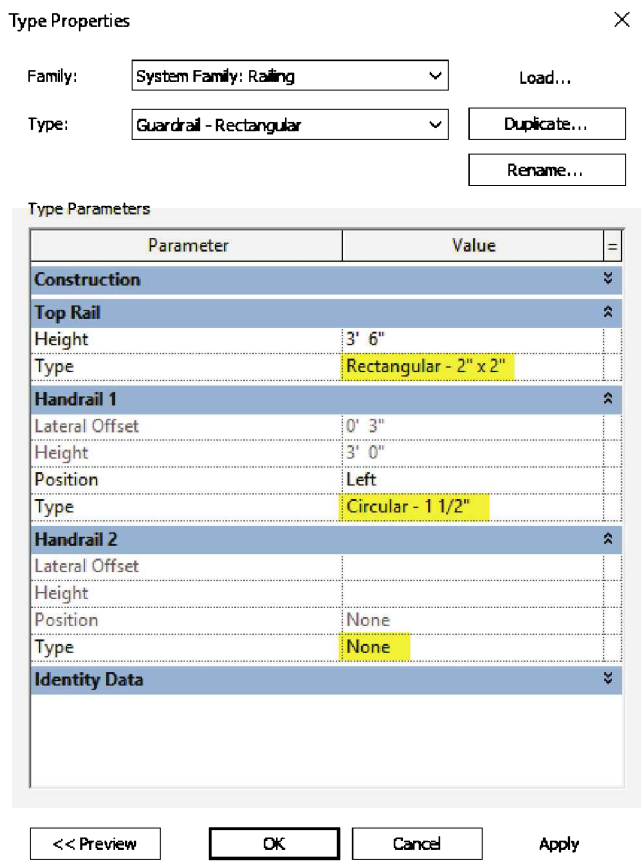


FIGURE 5-4.3 Guardrail – Rectangular railing properties

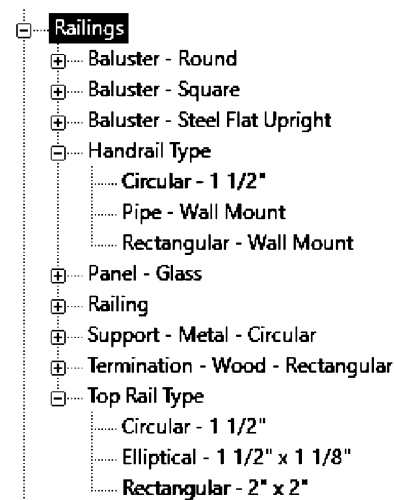


FIGURE 5-4.4 Component families used by railing

Conceptually, take note that a Top Rail and Handrail are more complex than just selecting a profile, as this will help you understand Revit’s internal structure for these element types. The properties associated with the Top Rail and Handrail selected in the previous image can be seen in Figure 5-4.5.

In Revit, a Profile is a simple 2D closed outline—a series of connected lines and/or arcs. An example can be seen in Figure 5-4.7. Similar to other families, profiles can be parameterized. Thus, this simple circle is able to represent multiple diameters. The Project Browser shown in Figure 5-4.6 shows two sizes (i.e. types) for this profile. Just like doors, these types can be duplicated and new sizes created without the need to create a new profile family. However, creating a new profile is easy: **New → Family → Profile.rft** template.

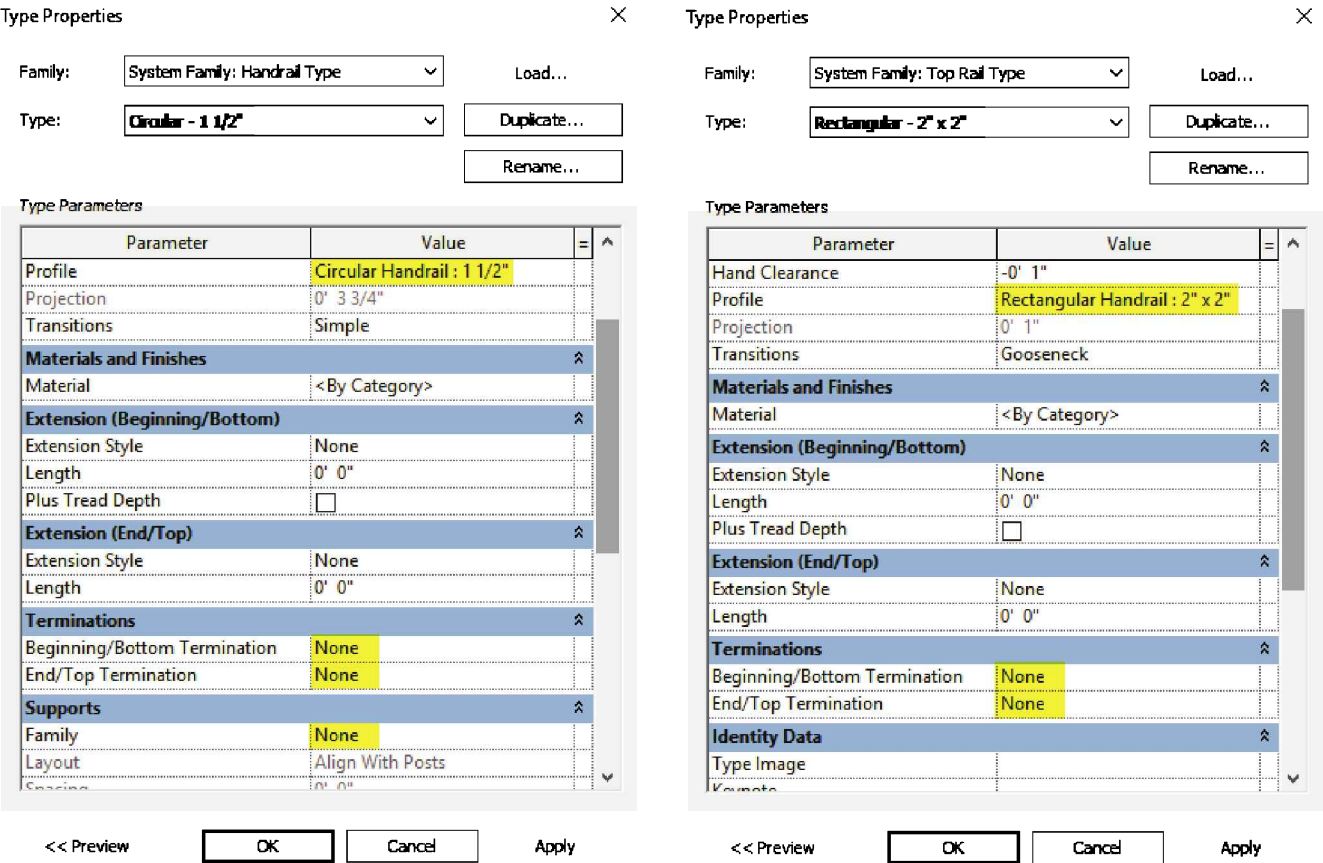


FIGURE 5-4.5 Type properties for two of the railing component types associated with “Guardrail – Rectangular”

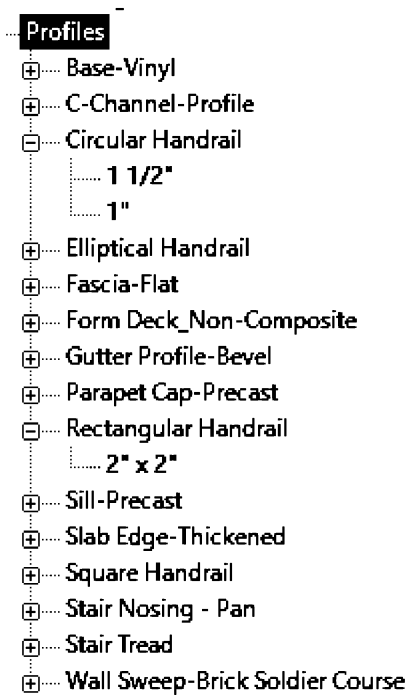


FIGURE 5-4.6 Profiles families used by handrail & top rail types

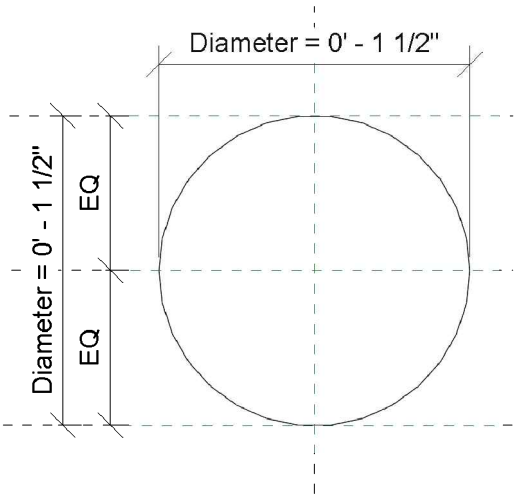


FIGURE 5-4.7 Profiles Circular handrail profile as seen in the family editor

In Figure 5-4.5, notice both Handrails and Top Rails have an option called **Terminations**. Handrails also have an option for **Supports**. In this example they are all set to “None.” Figure 5-4.8 shows that a termination (aka escutcheon) occurs at the end of a Handrail (or Top Rail) and a Support is what holds the Handrail in place. Each of these items are separate families loaded into the current project.

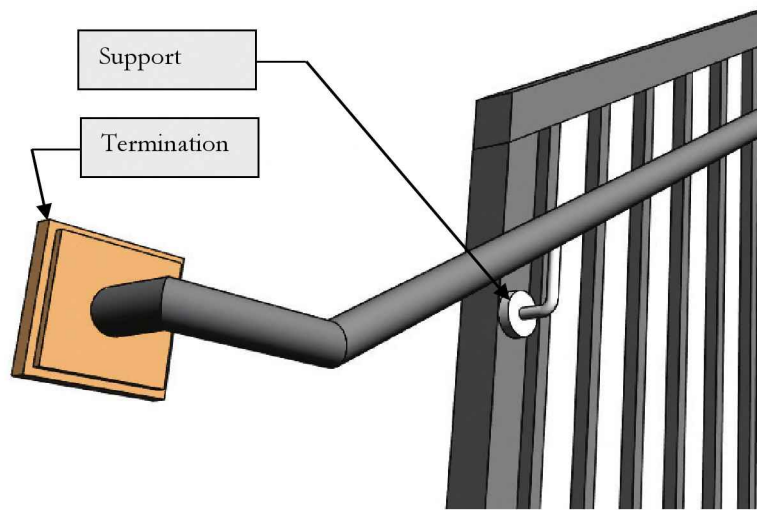
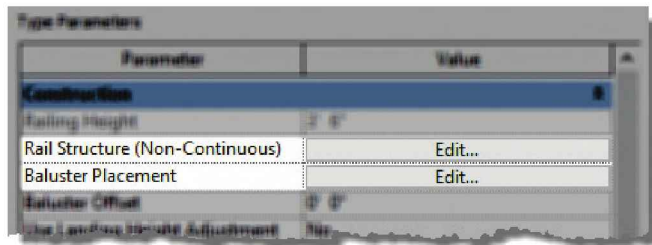


FIGURE 5-4.8 Termination and Supports example

Now that the various components and nested families in a railing have been covered we need to back up to the beginning and look at how the rest of the railing is defined. This is the pattern, either horizontal, vertical or both, that fills that area from the stair/floor up to the Top Rail. You are about to see two of the most complex dialogs in Revit! We will compare the settings between the two guardrail types Pipe and Rectangular to help understand how the various options and settings work.



Rail Structure (Non-Continuous):

When a railing has horizontal/parallel rails, in addition to the Top Rail and Handrail, they are defined in the **Edit Rails (Non-Continuous)** dialog shown in Figure 5-4.10. To access this dialog, select a railing, click Edit Type, and then click Edit next to Rail Structure (Non-Continuous).

Looking at Figure 5-4.9 we notice the “Pipe” railing only has vertical elements. Thus, the Edit Rails dialog is empty. Contrast this with the “Rectangular” railing type which is mainly composed of horizontal/parallel rails.

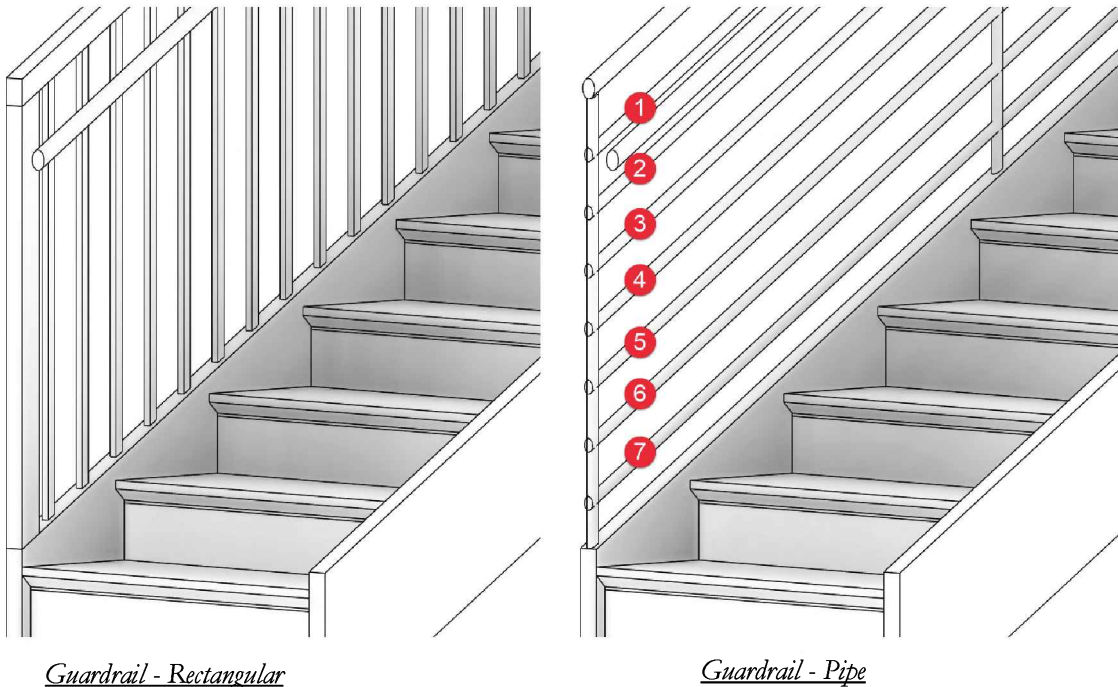


FIGURE 5-4.9 Graphically comparing two railing types found in the Commercial-Default project template

Edit Rails (Non-Continuous) ×

Family: Railing
Type: Guardrail - Pipe

Rails

	Name	Height	Offset	Profile	Material
1	Rail 1	3' 0"	0' 0"	Circular Handrail : 1"	<By Category>
2	Rail 2	2' 7"	0' 0"	Circular Handrail : 1"	<By Category>
3	Rail 3	2' 2"	0' 0"	Circular Handrail : 1"	<By Category>
4	Rail 4	1' 9"	0' 0"	Circular Handrail : 1"	<By Category>
5	Rail 5	1' 4"	0' 0"	Circular Handrail : 1"	<By Category>
6	Rail 6	0' 11"	0' 0"	Circular Handrail : 1"	<By Category>
7	Rail 7	0' 6"	0' 0"	Circular Handrail : 1"	<By Category>

Insert Duplicate Delete Up Down

<< Preview OK Cancel Apply Help

FIGURE 5-4.10 Defining horizontal elements within a railing

The numbers added to the “Rectangular” railing example, in Figure 5-4.9, correspond to the numbered rows in Figure 5-4.10. Notice each row has five settings as defined below.

Name

Each row can be named to help keep things organized. Each row must have a unique name. These named rows appear in the Edit Baluster Placement dialog covered in the next section.

Height

The Height of the rail is from the floor/landing or the front edge of the tread as shown in Figure 5-4.11. Compare the dimensions shown in this image to those listed in the Edit Rails dialog (Figure 5-4.10). Note that the height is to the top of the rail in each case. Dimensions from the tread edge and to the top of the Top Rail and Handrail relate to how building codes define stair, guardrail and handrail requirements.

Offset

This allows each rail to be offset horizontally from the main railing if needed. In previous versions of Revit this is how a handrail was defined. There are many creative ways this option can be used. Keep in mind there are two other “offset” options for a railing; the instance parameter *Tread/Stringer Offset* and the type parameter *Baluster Offset*.

Profile

This defines the shape continuously extruded along the handrail. Speaking of continuously, it is unclear why the dialog says “Non-Continuous”! Load and/or create additional Profiles in the current project for more options. Note that this could include something that looks like a stair stringer to maintain a consistent look when the railing at a stair transitions to a railing at an open floor edge (Figure 5-4.12).

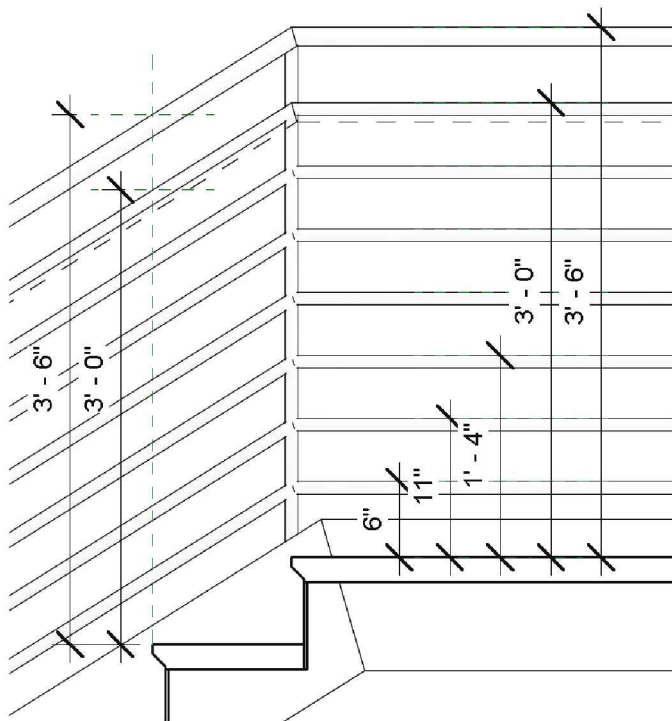


FIGURE 5-4.11 Railing rail dimensions

Material

This defines the material applied to the shape created by the extruded profile.



FIGURE 5-4.12 Railing with stringer

In the Edit Rails dialog, new rows can be inserted, and current rows can be duplicated or deleted. The order of the rows does not matter as the Height parameter dictates its position, but having them in the same relative order is helpful—thus the Up and Down buttons. Finally, expanding the preview option allows you to see the results without closing the dialog or clicking apply. However, clicking Apply will update the model without the need to close the dialog. This shows the changes in your model rather than a generic sample preview.

Baluster Placement:

Where the *Rail Structure* dialog defines all the horizontal/parallel elements (except for top and handrail) the **Edit Baluster Placement** dialog defines all the vertical elements within a railing system. This dialog, as seen in Figure 5-4.13, has two main sections: **Main Pattern** and **Posts** as pointed out.

Family: Railing Type: Guardrail - Pipe

Main pattern

	Name	Baluster Family	Base	Base offset	Top	Top offset	Dist. from previous	Offset
1	Pattern start	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	Regular baluster	Baluster - Round : 1"	Host	0' 0"	Top Rail Element	0' 0"	4' 0"	0' 0"
3	Pattern end	N/A	N/A	N/A	N/A	N/A	0' 0"	N/A

Break Pattern at: Each Segment End Angle: 0.000° Pattern Length: 4' 0"

Justify: Beginning Excess Length Fill: None Spacing: 0' 0"

☐ Use Baluster Per Tread On Stairs Balusters Per Tread: 1 Baluster Family: Baluster - Round : 1"

Posts

	Name	Baluster Family	Base	Base offset	Top	Top offset	Space	Offset
1	Start Post	Baluster - Round : 1"	Host	0' 0"	Top Rail Element	0' 0"	0' 0 1/2"	0' 0"
2	Corner Post	Baluster - Round : 1"	Host	0' 0"	Top Rail Element	0' 0"	0' 0"	0' 0"
3	End Post	Baluster - Round : 1"	Host	0' 0"	Top Rail Element	0' 0"	-0' 0 1/2"	0' 0"

Corner Posts At: Each Segment End Angle: 0.000°

<< Preview OK Cancel Apply Help

FIGURE 5-4.13 Edit Baluster Placement dialog; Guardrail – Pipe (4'-0" main pattern spacing)

Main Pattern

In the example above, for Guardrail – Pipe, there is not a “main pattern” per se. This is because the “main pattern” is defined by horizontal/parallel bars. Thus, in this example the Main Pattern is the “structural” supports for the railing system which are spaced 4'-0" (note the highlighted value in Figure 5-4.13). **FYI:** The 1" diameter pipe at 4'-0" on center may or may not be adequate to develop the code required lateral resistance at the top edge of the railing.

Comparing the two guardrail examples (Figure 5-4.9) we see the “Pipe” type has the “main pattern” spaced at **4'-0"** (Figure 5-4.13) whereas the “Rectangular” option spacing is only **4"** (Figure 5-4.14).

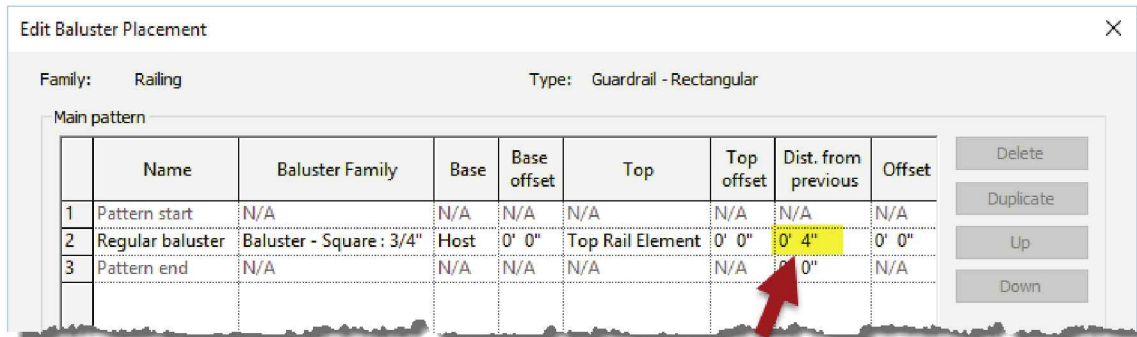


FIGURE 5-4.14 Edit Baluster Placement dialog; Guardrail – Rectangular (4" main pattern spacing)

Main Pattern settings per row:

- **Name**
User defined name for each baluster in the main pattern. This is mainly to help keep things organized.
- **Baluster Family**
This drop-down lists all the baluster families (post or panel) loaded in the current project. Note that *None* is also an option.
- **Base**
Select where the bottom of the baluster is placed. Built-in options are *Host* and *Top Rail Element*. Also, all the named rails (from the Edit Rails dialog) appear here as well.
FYI: The host can be a stair, floor or ramp.
- **Base Offset**
Use this setting to move the baluster vertically relative to the selected *Base*. The value can be positive (for up) and negative (for down).
- **Top**
Similar to the *Base* settings, the *Top* setting specifies the position of the top of the baluster. The height of the baluster can vary depending on the context, e.g. hosted on a stair (sloped) versus hosted on a floor (flat).
- **Top Offset**
Use this setting to move the baluster vertically relative to the selected *Top*. The value can be positive (for up) and negative (for down).
- **Dist. From previous**
Determines the spacing between the balusters.
- **Offset**
Horizontally offset the baluster relative to the sketched path. The value can be positive and negative.

Both of these examples are simple and easy to understand. The example shown below depicts a more complex baluster pattern. Note that the Base and Top options selected relate to named rows in the Edit Rails dialog. This entire “main pattern” is repeated along the railing length. Note the **Justify** and **Excess Length Fill** settings as well.

Edit Baluster Placement

Family: Railing

Type: Deco Type

Main pattern

	Name	Baluster Family	Base	Base offset	Top	Top offset	Dist. from previous	Offset
1	Pattern start	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	major	Baluster - Square3 : 1"	Host	0' 0"	Rail 1	0' 0"	0' 3"	0' 0"
3	minor 1	Baluster - Square3 : 3/4"	Inside bot	0' 0"	inside top	0' 0"	0' 7"	0' 0"
4	minor 2	Baluster - Square3 : 3/4"	Inside bot	0' 0"	inside top	0' 0"	0' 7"	0' 0"
5	minor 3	Baluster - Square3 : 3/4"	Inside bot	0' 0"	inside top	0' 0"	0' 7"	0' 0"
6	major	Baluster - Square3 : 1"	Host	0' 0"	Rail 1	0' 0"	0' 7"	0' 0"
7	Pattern end	N/A	N/A	N/A	N/A	N/A	0' 3"	N/A

Break Pattern at:

Angles Greater Than

 Angle: 0.000° Pattern Length: 2' 10"

Justify:

Spread Pattern To Fit

 Excess Length Fill : Truncate Pattern Spacing: 0' 0"

☐ Use Baluster Per Tread On Stairs Balusters Per Tread: 2

Posts

	Name	Baluster Family	Base	Base offset	Top
1	Start Post	Post - Newel : 6 1/4"	Host	-0' 8"	Rail 3
2	Corner Post	Post - Newel : 6 1/4"	Host	-0' 8"	Rail 3
3	End Post	Post - Newel : 6 1/4"	Host	-0' 8"	Rail 3

Corner Posts At:

Angles Greater Than

 Angle: 0.000°

<< Preview

Delete

Duplicate

Up

Down

FIGURE 5-4.15 Example of a more complex baluster pattern

Another variation on **baluster placement** is to place them **per tread** as shown in the example below Figure 5-4.16. In this residential-type application there are two balusters per tread. Notice the more elaborate newel post family selected as a starting post.

☒ Use Baluster Per Tread On Stairs Balusters Per Tread: 2

Posts

	Name	Baluster Family	Base	Base offset	Top	Top offset	Spa
1	Start Post	Post - Newel : 4 1/4"	Host	-0' 6"	Rail 1	0' 0"	-0' 1"
2	Corner Po	None	Host	0' 0"	Rail 1	0' 0"	0' 0"
3	End Post	Post - Newel : 4 1/4"	Host	-0' 2 1/4"	Rail 1	0' 0"	0' 4"

Corner Posts At:

Each Segment End

 Angle: 0.000°

<< Preview

OK

Cancel

FIGURE 5-4.16 Baluster per tread

5-43

A **baluster family** is unique in that its top and bottom must be able to slope, at stairs, or be flat at a floor or landing. An example of the Baluster – Square family can be seen in the image below—shown in the family editor (Figure 5-4.17). Notice the **Top Cut Angle** and **Bottom Cut Angle** parameters. All of the required parameters are provided in the **Baluster – Post** family template file. If a new baluster family needs to be created, either copy (the RFA file) or start from the provided template.

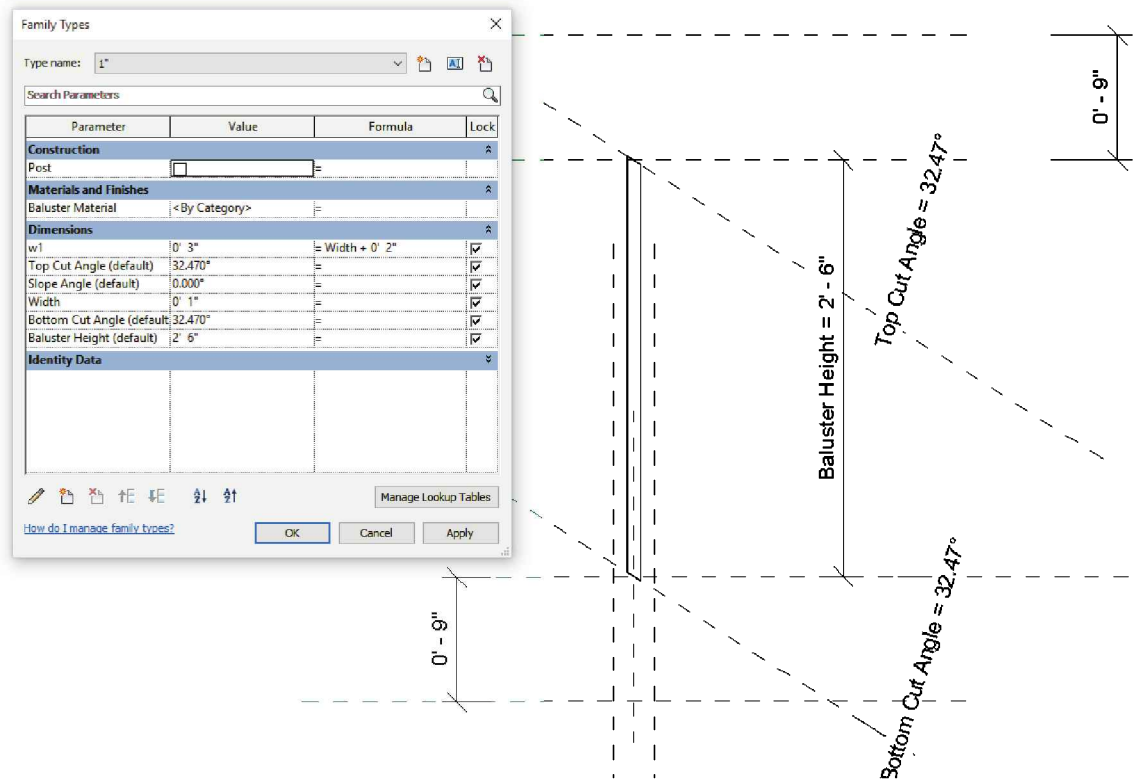


FIGURE 5-4.17 Baluster example in the family editor

For more information on Stairs and Railings in Revit:

- Visit the Autodesk Help website
- Visit revitforum.org, augi.com or forums.autodesk.com
- Check out Tim Waldock's in-depth posts on Revit's stairs and railings on his blog RevitCat: <http://revitcat.blogspot.com.au/2014/02/revit-stairs-railings-index-page.html>

Posts

The Posts section is more straightforward.

	Name	Baluster Family	Base	Base offset	Top	Top offset	Space	Offset
1	Start Post	Baluster - Round : 1"	Host	0' 0"	Top Rail Element	0' 0"	0' 0 1/2"	0' 0"
2	Corner Post	Baluster - Round : 1"	Host	0' 0"	Top Rail Element	0' 0"	0' 0"	0' 0"
3	End Post	Baluster - Round : 1"	Host	0' 0"	Top Rail Element	0' 0"	-0' 0 1/2"	0' 0"

Corner Posts At: Each Segment End Angle: 0.000°

FIGURE 5-4.18 Posts section of Edit Baluster Placement dialog

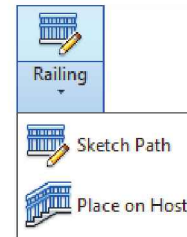
Posts settings per row:

- Name**
 There are only three built-in options named First, Corner and End.
- Baluster Family**
 This drop-down lists all the baluster families (post or panel) loaded in the current project. Note that *None* and *Default* are also options.
- Base**
 Select where the bottom of the post is placed. Built-in options are *Host* and *Top Rail Element*. Also, all the named rails (from the Edit Rails dialog) appear here as well.
FYI: The host can be a stair, floor or ramp.
- Base Offset**
 Use this setting to move the post vertically relative to the selected *Base*. The value can be positive (for up) and negative (for down).
- Top**
 Similar to the *Base* settings, the *Top* setting specifies the position of the top of the post. The height of the post can vary depending on the context; e.g. hosted on a stair (sloped) versus hosted on a floor (flat).
- Top Offset**
 Use this setting to move the post vertically relative to the selected *Top*. The value can be positive (for up) and negative (for down).
- Space**
 Reposition the post along the length of the railing, if needed. One example might be to align the edge of the post with the vertical cut edge of the stringer below.
- Offset**
 Horizontally offset the post relative to the sketched path. The value can be positive and negative.

Railing Tools:

There are two main ways a railing can be added to a Revit project:

- In conjunction with the **Stair** or **Ramp** tools
- Separately, using the **Railing** commands
 - a. Sketch Path
 - b. Place on Host



Railing Placed with Stair Tool:

When a new project is created using one of the default Revit templates, and a stair (or Ramp) is created, a railing is automatically placed on both sides. The image below (Figure 5-4.19) shows what the default results look like in a 3D view. These two railings are hosted by the stair and will update if the stair is modified. There are a number of things we can change to convey the design intent when needed.

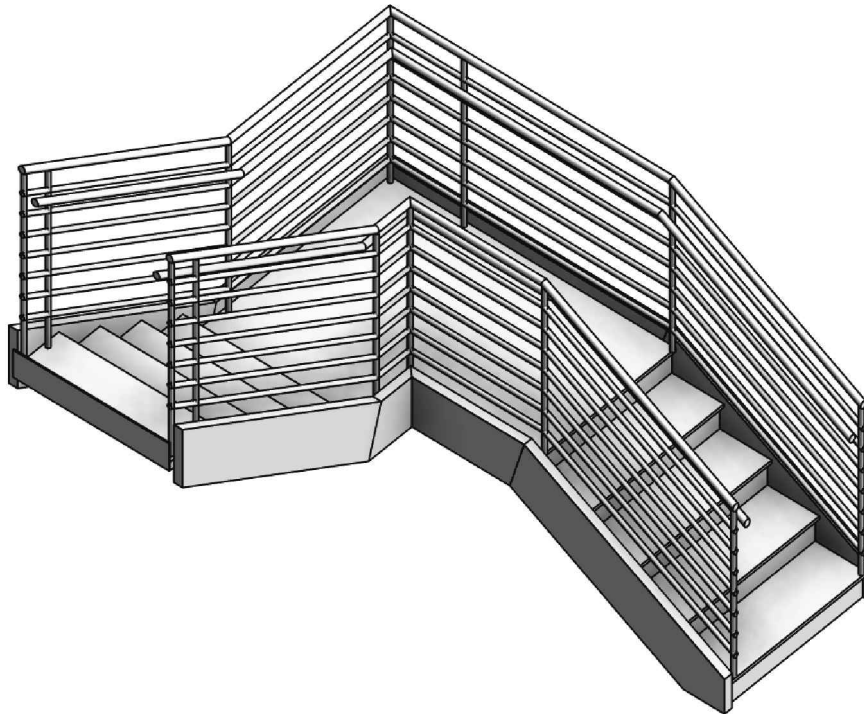


FIGURE 5-4.19 Default railing created with a new stair

If all railings have been deleted, use the **Railing → Place on Host** tool to quickly recreate the railings hosted by the stair. This tool only works if all railings have been deleted from the stair.

There are two settings related to railings we can adjust prior to creating the Stair (or Ramp). While creating the stair, click the **Railing** button on the Ribbon. This opens the Railing dialog shown in Figure 5-4.2. Here the railings type can be changed and its position relative to the stringer and treads. Note that both of these settings can be changed later.



Railing

Given the railing is hosted by the stair there are only a few things that can be done to modify the path.

The railing system can be continued at the top or bottom (or both) of the stair as shown in the image below (Figure 5-4.21).

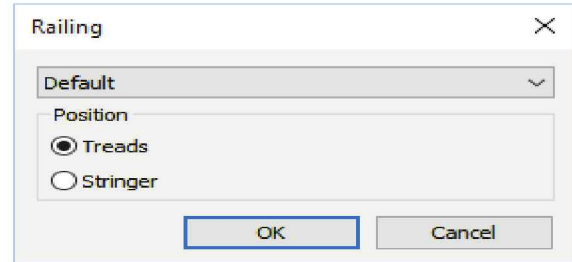


FIGURE 5-4.20 Railing options within stair tool

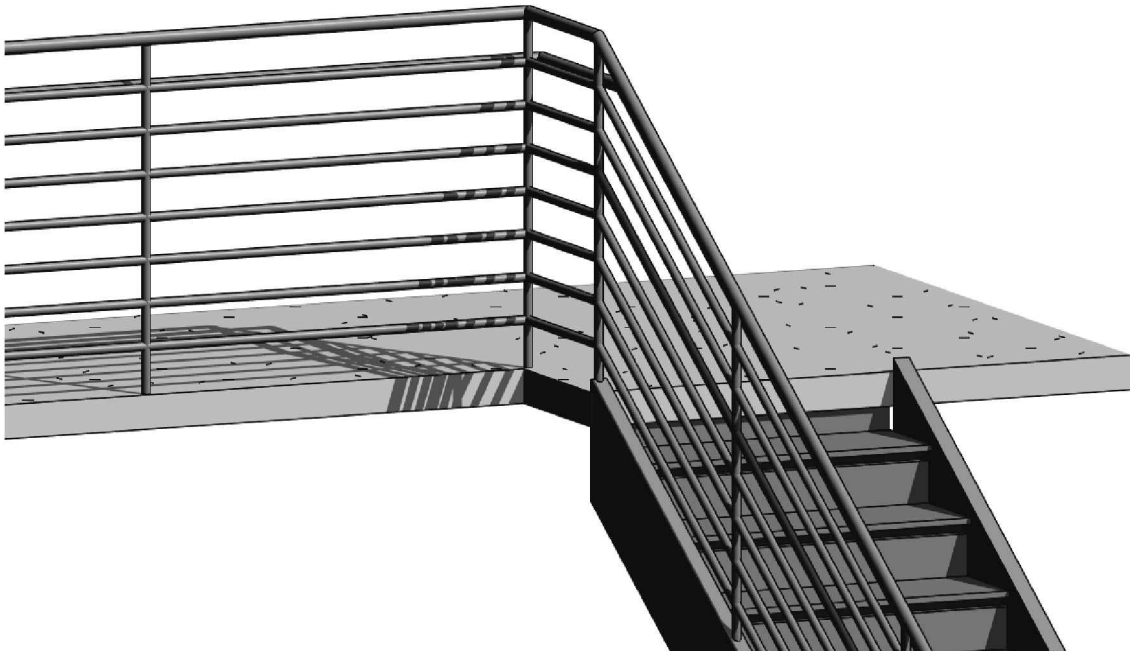
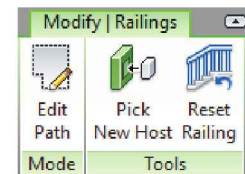


FIGURE 5-4.21 Extending railing at top of stair – along open floor edge

To do this (after the stair and railings are created):

- Start at the top or bottom level of the stair (or 3D view)
- Select the railing
- Click **Edit Path** on the *Ribbon*
- Select one of the **Draw** options (i.e. Line, Arc) from the *Ribbon*
- **Sketch** lines from the end of the stair hosted railing
- **Select** the newly sketched line (one at a time)
- Set the **Slope** option to **Flat** on the *Options Bar*
- See Figure 5-4.22



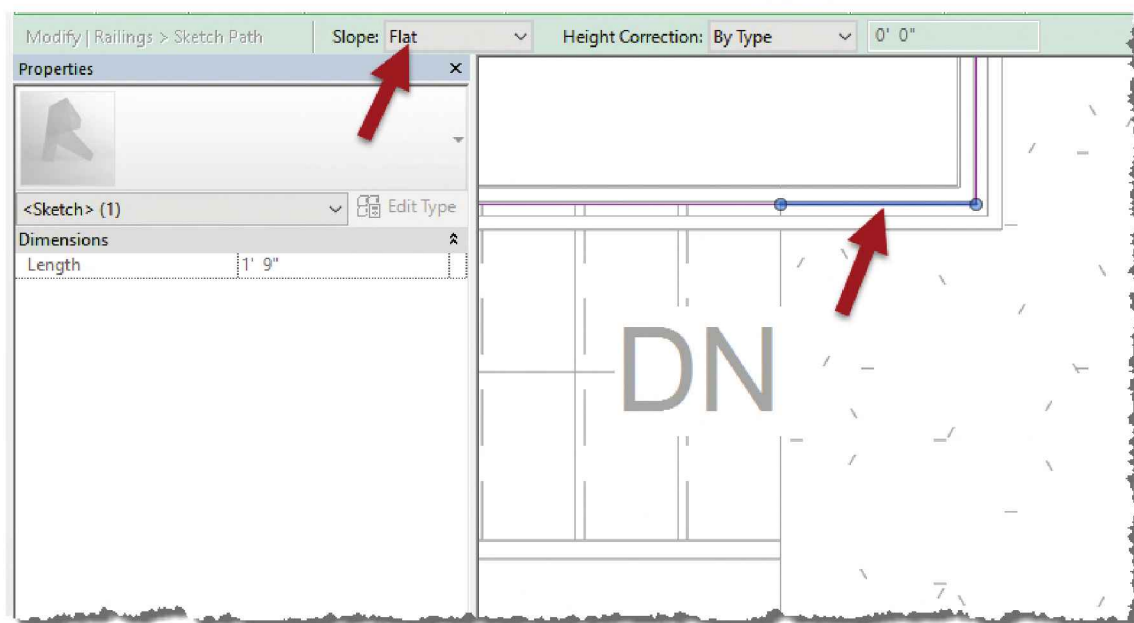
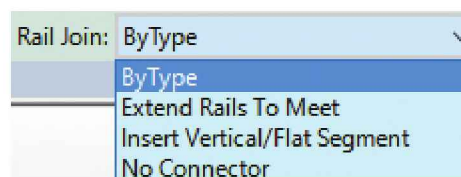


FIGURE 5-4.22 Extending railing at top of stair – along open floor edge

If the railing changes at the floor edge, for example the handrail stops or a stringer needs to be added to the railings as in Figure 5-4.12, then a separate railing element needs to be added—not part of the stair hosted railing. The trick in this case is adjusting the sketch lines so there is not odd overlap or gaps between the two railings.

When two sketch segments are selected, the Options Bar changes to show the **Rail Join** options. This can be changed if the transition between rails does not look as desired. This is similar to the **Edit Joins** tool on the Ribbon while in sketch mode.



Railing → Sketch Path Tool:

When a railing needs to be created apart from a stair or ramp, use the **Railing → Sketch Path** tool. When this command is selected, you simply sketch a path for the railing system to follow. If the railing has a Handrail, the side it is placed on is determined by which direction the sketch is created. While in sketch mode, click the **Preview** option to see the railing as it is to be sketched (similar to how Stair by Component works).

A sketched railing can be hosted to a floor—even a sloped floor. While in sketch mode, select the **Pick New Host** option on the Ribbon and then select the floor. The default host for a sketched railing is the level associated with the current plan-view.



The next two topics, **Handrails** and **Top Rails**, are relatively new features associated with a Railing type in Revit. Prior to Revit 2013, these elements were defined within the Edit Rails dialog. Now they are their own sub-element and can be selected separately from the main railing in the model (tapping the Tab key may be required). It is helpful to know this in case you are working in older project files—even if they have been upgraded. These old format railings do not allow the handrail or top rail to be selected.

Handrail:

A Handrail, in Revit, is a component used within the Railing type. It cannot be used on its own. Keep in mind that any changes made to a Handrail type will change it wherever it is used. It is easy to edit a Handrail type while working in the context of a specific railing type, not realizing the same Handrail type is used in another railing type. In some cases, the Handrail type needs to be duplicated so changes do not affect other railing types.

Here are the main options related to a handrail type:

- Profile
- Material
- Extension (top and bottom)
- Terminations
- Supports (including spacing)

A few of these options have been adjusted to produce the results shown in the image below (Figure 5-4.23). The steps required to accomplish this will be covered next.

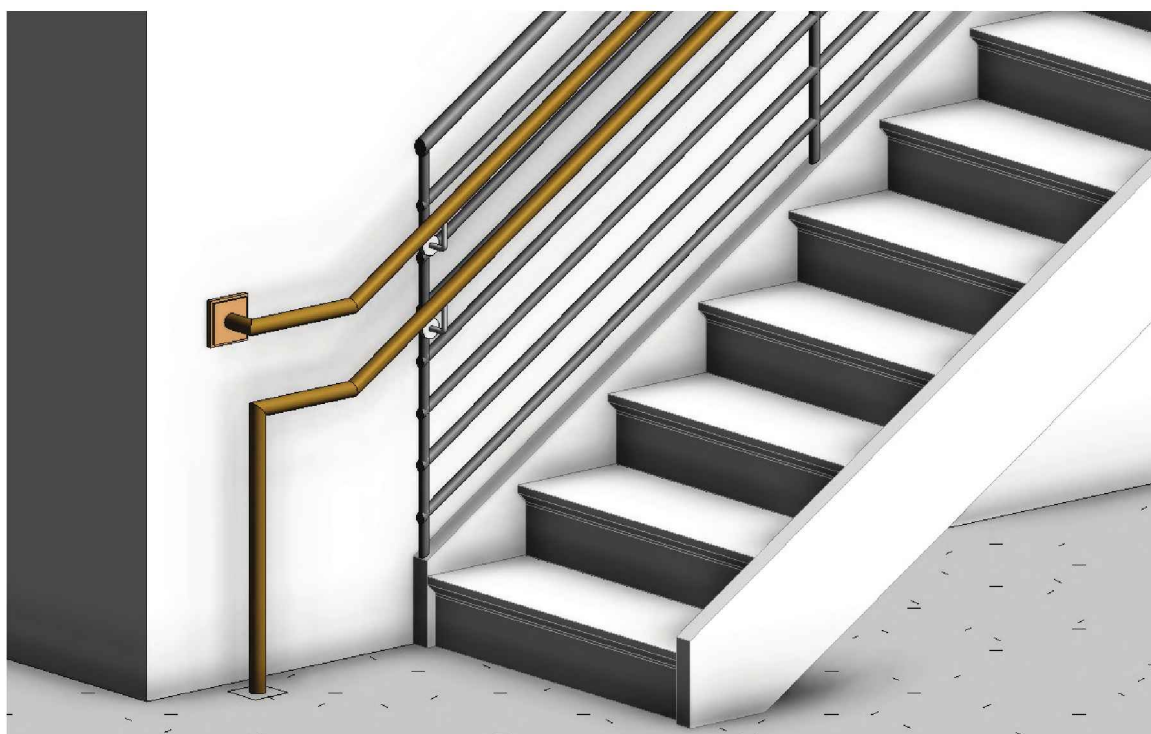


FIGURE 5-4.23 Handrail with several parameter adjustments

Railing Type Settings:

First, we notice the Railing type is where the Handrail is specified (Figure 5-4.24). In this case, two railing types are used, one for **Handrail 1** and one for **Handrail 2**. Creating multiple Handrail types is required if you want to have a different profile or position them at a different height as shown in this example.

For a center railing on a wide stair, Handrail 1 and 2 might be the same type but with different positions (one Left and one Right). This would place a handrail, at the same height, on both sides of the railing.

In this case, for two railing heights, the **Position** is the same.

This double-handrail example is not uncommon in elementary-grade schools. The normal higher rail is for adults and the lower for students.

Creating a duplicate handrail is accomplished by **right-clicking** on a handrail type in the Project Browser and selecting **Duplicate** (Figure 5-4.25). Once a new type is created, the various properties covered on the next few pages can be adjusted as required.

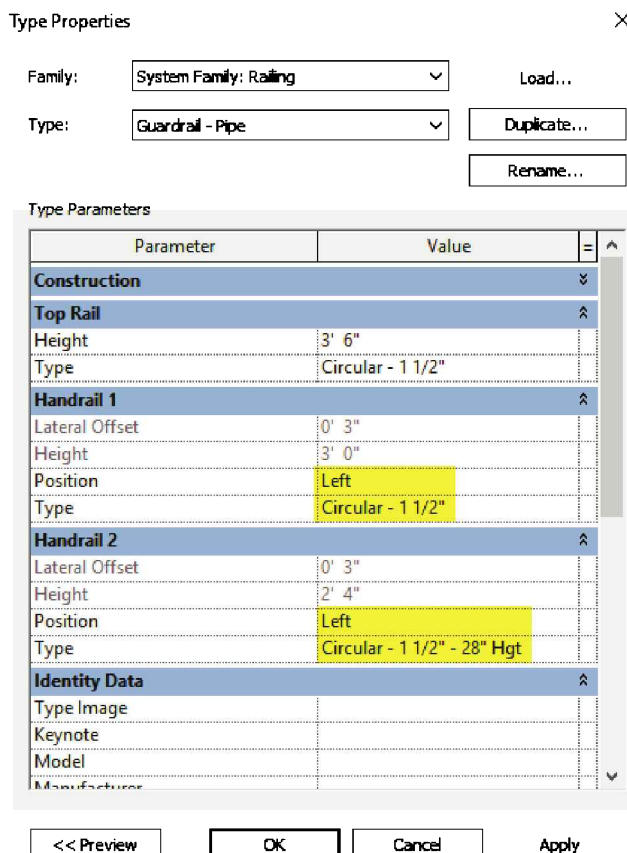


FIGURE 5-4.24 Handrail type and position

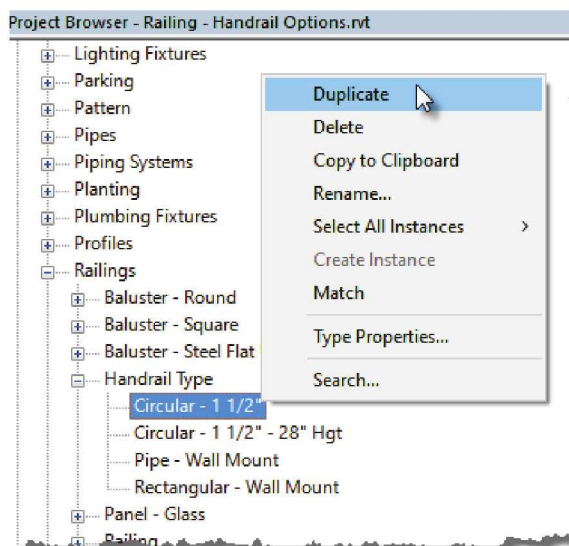


FIGURE 5-4.25 Duplicating a handrail type

Handrail 1 Properties:

The upper handrail, which is the default handrail as seen in Figure 5-4.9, has been modified per the following (see Figure 5-4.26).

- **Material:** Set to Wood
- **Extension Style:** Set to Wall (other options are None, Floor, Post). Default setting is None. This setting makes the handrail automatically return to the wall.
- **Length** (Bottom Extension): 1'-0". This will extend the length of the handrail from its default end, which aligns with the first riser. This is typically required to make the handrail comply with building codes.
- **Plus Tread Depth** (Bottom Extension): Checked. This makes the handrail continue along the slope the length of one tread. Checking this option makes the flat portion, controlled by the previous "Length" parameter, the correct height off the floor.

Type Properties

Family: System Family: Handrail Type Load...

Type: Circular - 1 1/2" Duplicate... Rename...

Type Parameters

Parameter	Value
Transitions	Simple
Materials and Finishes	
Material	Wood
Extension (Beginning/Bottom)	
Extension Style	Wall
Length	1' 0"
Plus Tread Depth	☒
Extension (End/Top)	
Extension Style	None
Length	4' 0"
Terminations	
Beginning/Bottom Termination	Termination - Wood - Rectangular
End/Top Termination	None
Supports	
Family	Support - Metal - Circular
Layout	Align With Posts
Spacing	0' 0"
Justification	Begin

<< Preview OK Cancel Apply

FIGURE 5-4.26 Upper handrail settings (i.e., Handrail 1)

- **Bottom Termination:** Termination – Wood – Rectangular. Places a family at the end of the handrail.
- **Family** (Supports): Support – Metal – Circular. Select the desired family for the handrail support.
- **Layout:** Align with Posts. Determines how the supports are placed/spaced. Other options are Fixed Distance, Fixed Number, Maximum Spacing and Minimum Spacing. Some of these options activate subsequent parameters such as Spacing and Justification.

The families listed for Terminations and Supports are created with a special subcategory designation Railing\Terminations and Railing\Supports.

Handrail 2 Properties:

The **lower handrail** is a duplicate of the previous handrail. Just the variations will be highlighted here (see Figure 5-4.27).

- **Height:** 2'-4"
- **Extension Style:**
Set to Floor

The extension might more realistically just be set to wall like the upper handrail. However, this example helps to depict the options.

Type Properties

Family: System Family: Handrail Type Load...

Type: Circular - 1 1/2" - 28" Hgt Duplicate...

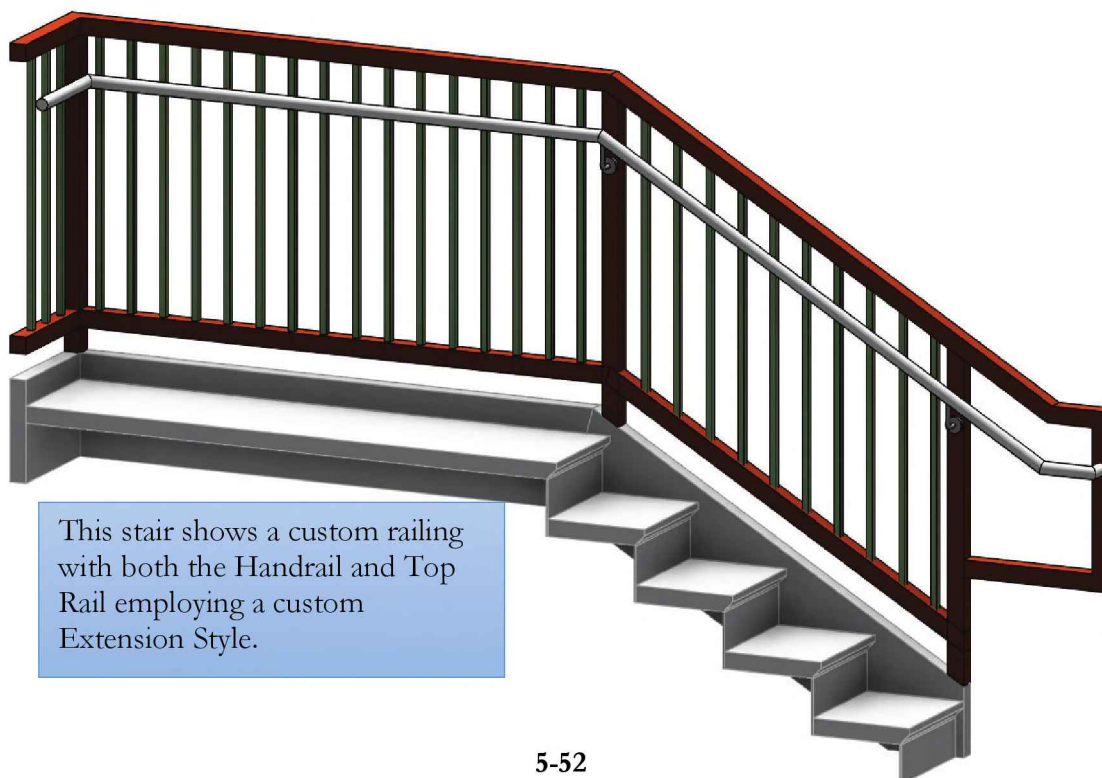
Rename...

Type Parameters

Parameter	Value
Fillet Radius	0' 0"
Hand Clearance	0' 2 1/4"
Height	2' 4"
Profile	Circular Handrail : 1 1/2"
Projection	0' 3 3/4"
Transitions	Simple
Materials and Finishes	
Material	Wood
Extension (Beginning/Bottom)	
Extension Style	Floor
Length	1' 0"
Plus Tread Depth	☒
Extension (End/Top)	
Extension Style	None
Length	0' 0"
Terminations	
Beginning/Bottom Termination	Termination - Wood - Rectangular
End/Top Termination	None
Supports	
Family	Support - Metal - Circular
Layout	Align With Posts
Spacing	0' 0"
Justification	Center

<< Preview OK Cancel Apply

FIGURE 5-4.27 Lower handrail settings (i.e., Handrail 2)



Top Rail:

The Top Rail is defined via a Railing's *Type Properties* as shown in Figure 5-4.28. Additional Top Rail types can be created by duplicating types listed in the *Project Browser*; **Families** → **Railings** – **Top Rail Type**. This is also where the height is defined.

The Top Rail has settings similar to the Handrail but can be adjusted separately from the Handrail. In the image below the Top Rail's **Extension Style** is set to **Post**. It can also be set to Wall, Floor or None just like the Handrail (Fig. 5-4.29).

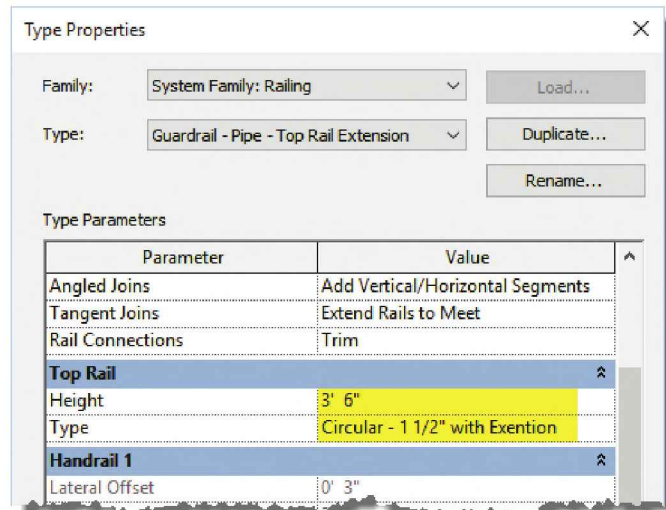


FIGURE 5-4.28 Top Rail defined in railing's type properties

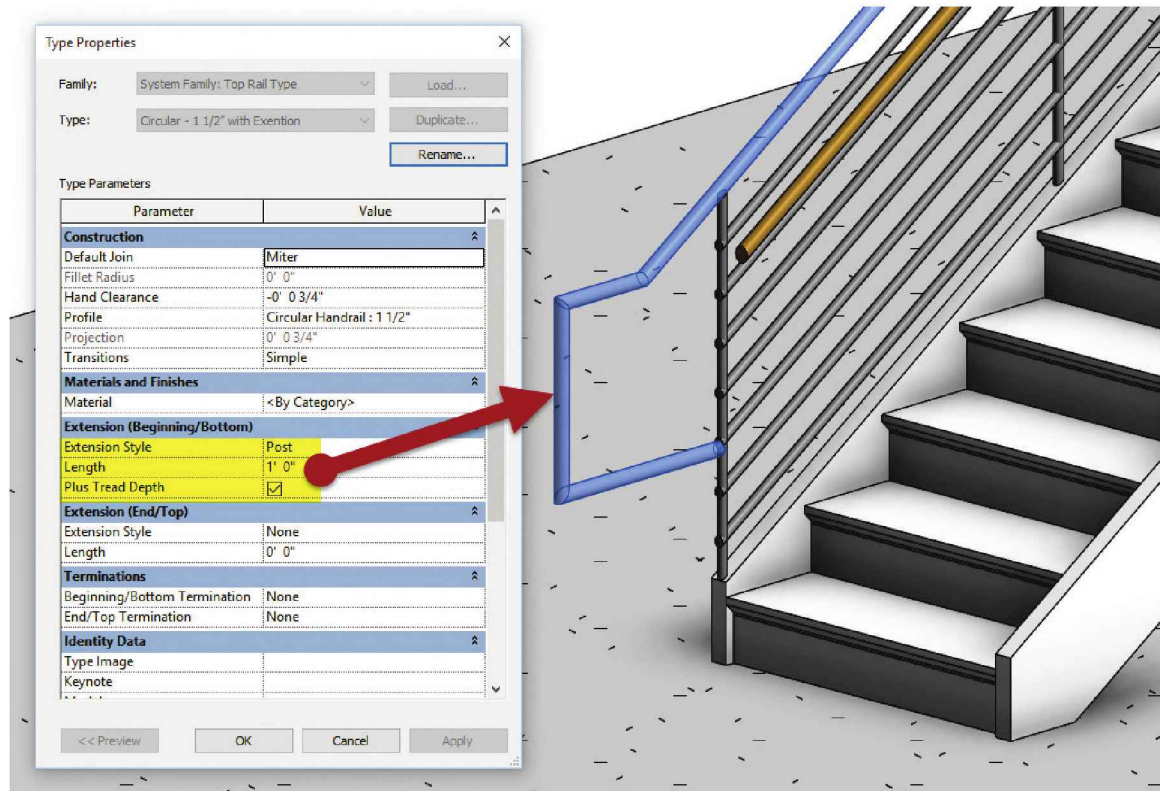


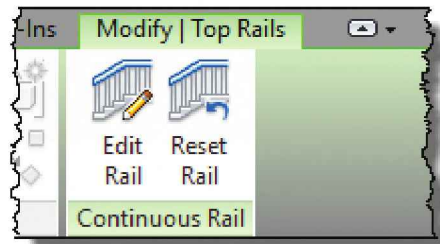
FIGURE 5-4.29 Top Rail extension style set to 'Post'

Remember that changes made to the Top Rail properties will affect all Railing types which use it. Notice the Top Rail type selected in Figure 5-4.28 is different than the Top Rail type specified in Figure 5-4.24 (also compare Top Rail pictures in the Handrail section).

Edit Rail (Top Rail or Handrail):

When a Handrail or Top Rail is selected, an option to edit the path of the railing appears on the Ribbon. This option only allows editing the path in a vertical plane aligned with the railing.

The Handrail or Top Rail can be selected by hovering the cursor over the Top Rail, being careful not to move the mouse, and then tapping the Tab key and clicking to select once highlighted. Once selected, the rail will be a transparent blue.



FYI: Stairs upgraded from older Revit project or template files (anything prior to Revit 2013) do not have the Top Rail and Handrail options. Those elements were defined in the Edit Rail structure dialog. Thus, they are not selectable elements within the railing. In this case, the railing would need to be deleted and recreated.

When the Extension Style options, Wall, Floor, Post and None, do not cover what you want, use the **Edit Rail** option. Clicking this from an elevation, section or 3D view allows a custom path to be defined.

The image to the right, Figure 5-4.30, shows the Top Rail path being modified. Notice the geometry appears as each line is sketched.

The custom result can be seen in Figure 5-4.31.

Unfortunately, at this time the railing cannot change planes/direction—to wrap around a column for example.

Selecting the Top Rail and clicking Reset Rail on the Ribbon will undo any changes.

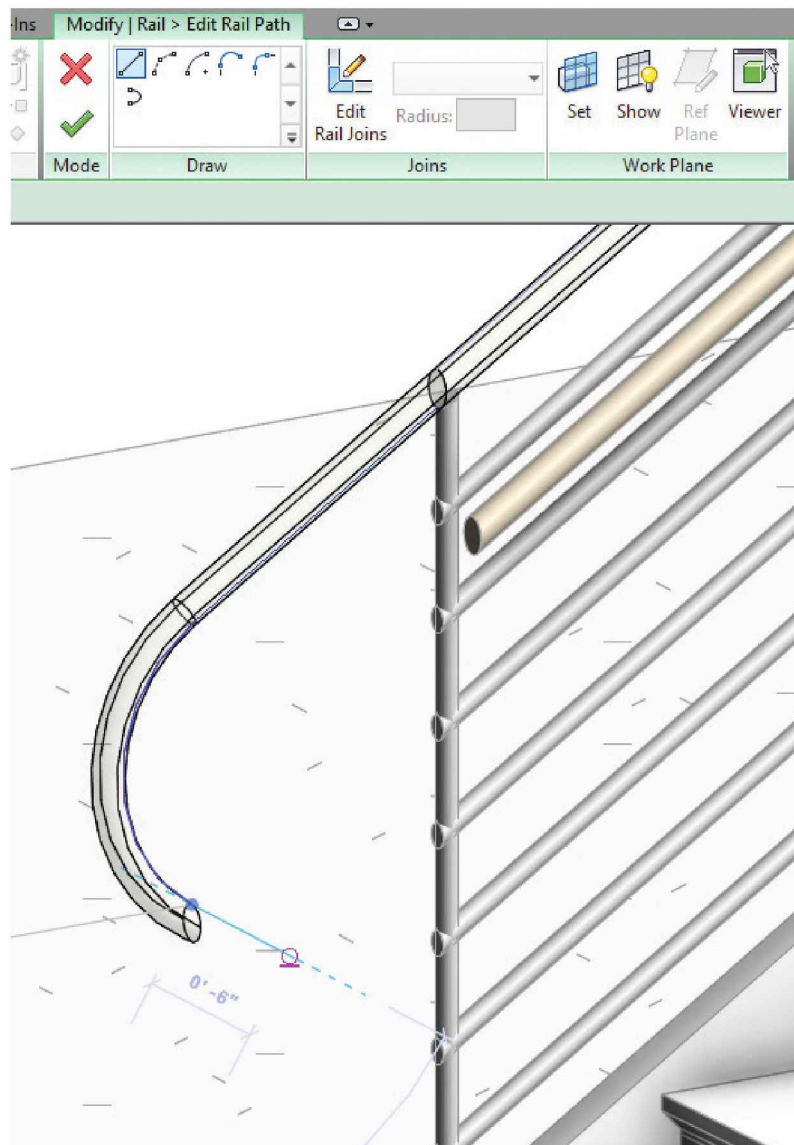


FIGURE 5-4.30 Editing the Top Rail path

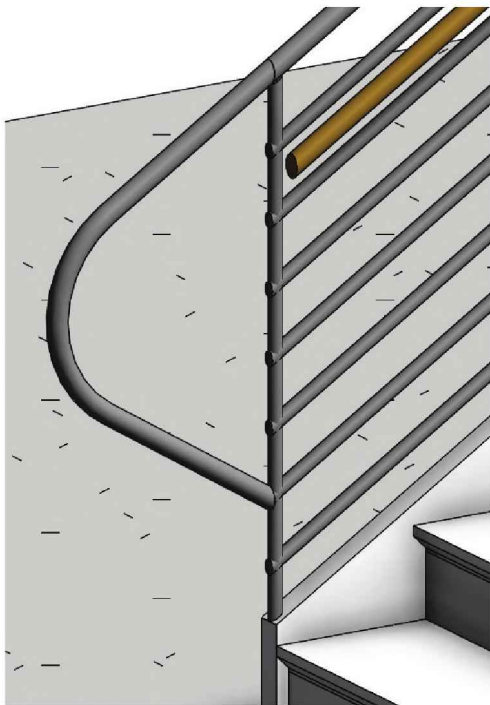


FIGURE 5-4.31 Custom Top Rail defined



FIGURE 5-4.32 Handrail only with supports at 6'-0" O.C. max.

Handrail Only:

A railing or guardrail is not required when a stair, or ramp, is against a wall (Figure 5-4.32). In this case we just need a handrail without a railing. Unfortunately this is not directly possible as there is no Handrail tool, just the Railing tool. Here is how this can be accomplished...

The first step is to **Duplicate** a railing—Guardrail – Rectangular is a good option as it requires fewer changes. In the new railing's Type Properties, set the **Top Rail Type** to **None** (Fig. 5-4.33). Next, click Edit for **Rail Structure** and Delete all rows. Finally, click Edit for **Baluster Placement** and set everything, Main pattern and posts, to **None** (Fig. 5-4.34).

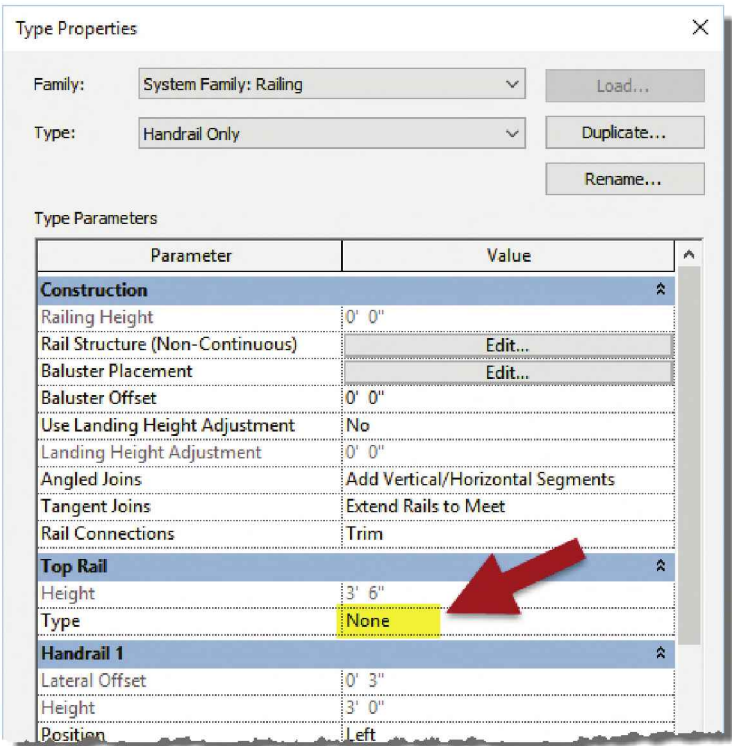


FIGURE 5-4.33 Omitting the Top Rail from a railing

Edit Baluster Placement X

Family: **Railing** Type: **Handrail Only**

Main pattern

	Name	Baluster Family	Base	Base offset	Top	Top offset	Dist. from previous	Offset
1	Pattern start	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	Regular bal	None	Host	0' 0"	Host	0' 0"	4' 0"	0' 0"
3	Pattern end	N/A	N/A	N/A	N/A	N/A	0' 0"	N/A

Break Pattern at: **Each Segment End** Angle: **0.000°** Pattern Length: **4' 0"**

Justify: **Beginning** Excess Length Fill: **None** Spacing: **0' 0"**

☐ Use Baluster Per Tread On Stairs Balusters Per Tread: **1** Baluster Family: **Baluster - Round : 1"**

Posts

	Name	Baluster Family	Base	Base offset	Top	Top offset	Space	Offset
1	Start Post	None	Host	0' 0"		0' 0"	0' 0 1/2"	0' 0"
2	Corner Po	None	Host	0' 0"		0' 0"	0' 0"	0' 0"
3	End Post	None	Host	0' 0"		0' 0"	-0' 0 1/2"	0' 0"

Corner Posts At: **Never** Angle: **0.000°**

<< Preview OK Cancel Apply Help

FIGURE 5-4.34 Omitting Balusters from a railing

Handrail Supports

Within the Handrail **Type** supports can be selected (Figure 5-4.35). The **Family** drop-down is based on special families currently loaded in the project file. The **Layout** option selected determines which of the remaining parameters are editable. In this example, Maximum Spacing causes the Spacing parameter to be active, but Justification and Number are inactive (i.e. greyed out).

The automatically placed supports do not always land in the ideal position. Fortunately they can be repositioned and even deleted individually. To modify a support it

Type Properties X

Family: **System Family: Handrail Type** Load...

Type: **Circular - 1 1/2" - Supports 6' Max Spaci** Duplicate... Rename...

Type Parameters

Parameter	Value
Beginning/Bottom Termination	Termination - Wood - Rectangular
End/Top Termination	None
Supports	
Family	Support - Metal - Circular
Layout	Maximum Spacing
Spacing	6' 0"
Justification	Begin
Number	0
Identity Data	
Type Image	

FIGURE 5-4.35 Handrail support settings

must be selected. To select a Support, hover the cursor over a support (don't move it) and then tap (not press) the Tab key until the Support highlights—and then click to select it. Select the pin icon to unpin that instance (Figure 5-4.36). It can now be moved or deleted as needed.

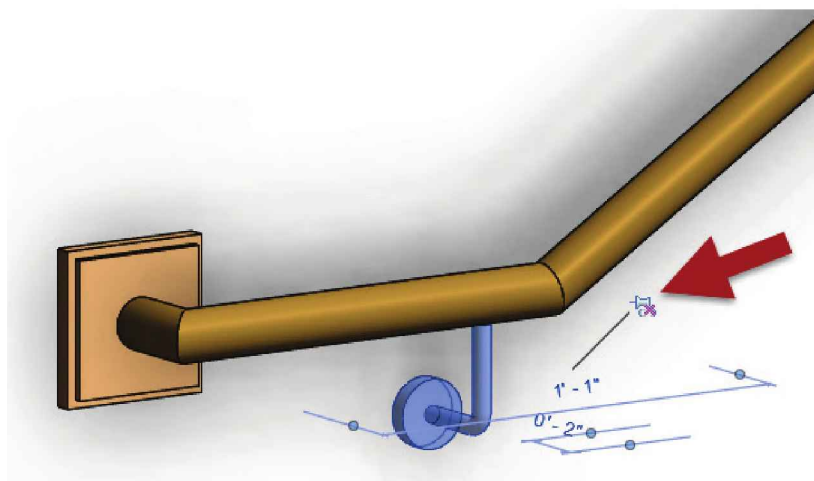
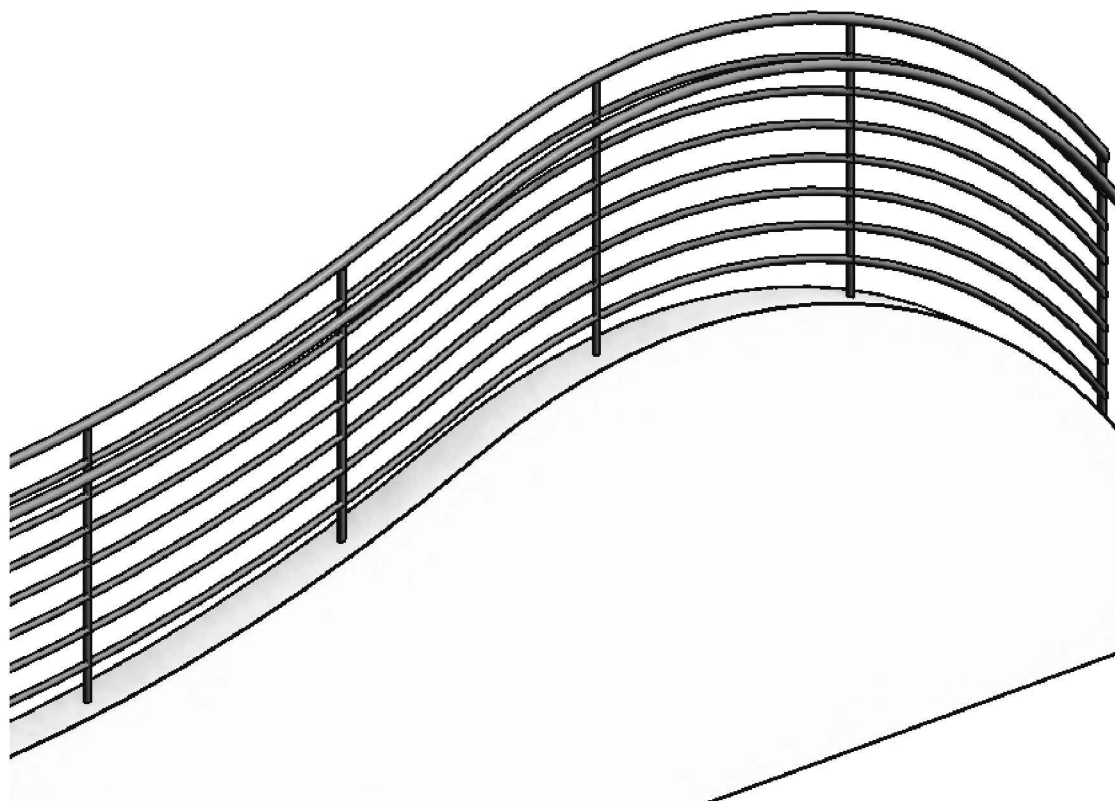


FIGURE 5-4.36 Support selected and un-pinned

Newer Hosting Opportunities:

Revit now has the ability to host railings to floors with modified points and, as shown below, the top of walls—even when they have modified with Edit Profile.



Sample Railing File:

Make sure to examine the railing sample file available on Revit's online content library (seek.autodesk.com – search for “Revit samples” and select the railing option). You can download this file, open it, select a railing and view its properties to see how it works.

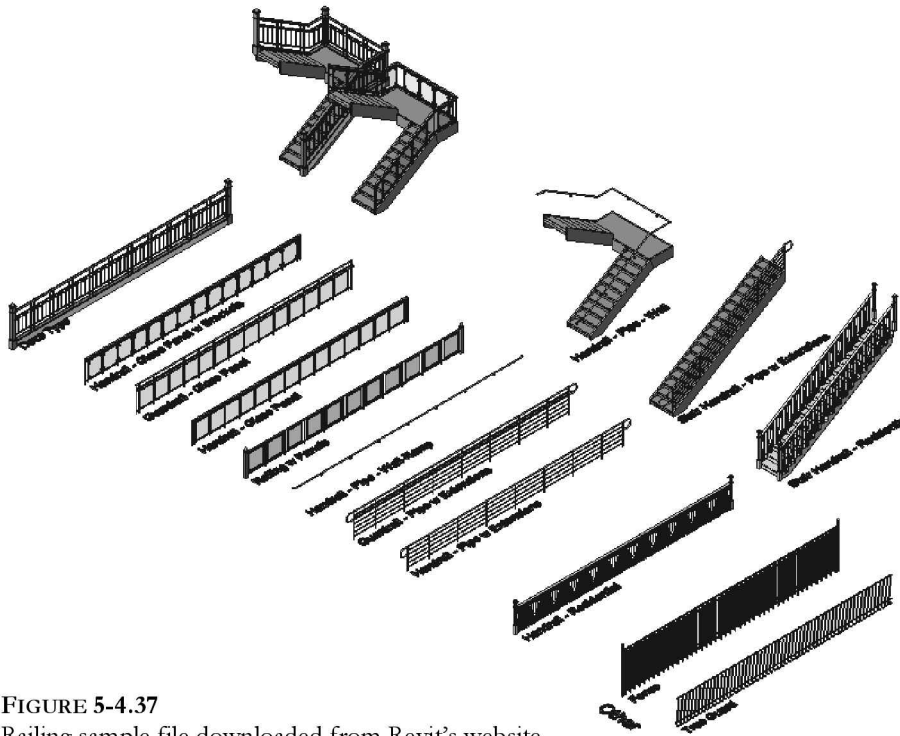
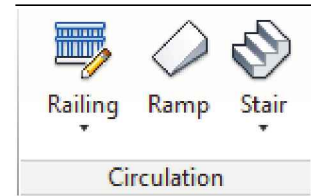


FIGURE 5-4.37
Railing sample file downloaded from Revit's website

Exercise 5-5:

Ramps and Sloped Floors

When two floors do not align vertically, or accessibility is required, a ramp must be provided. There are two main ways to model this in Revit. One is with the Ramp tool and the other is with the Floor tool. **For the most part the Ramp tool should never be used.** Rather, the Floor tool should be preferred as it generally works better as we shall see here.



The Ramp Tool:

First we will review how the ramp tool works and then talk about its limitations.

The ramp tool is closely related to the original *Stair by Sketch* tool in how it works. Starting at the lower level in a plan-view, when the Ramp tool is started, Sketch mode is entered and the **Run** option is selected on the Ribbon. First, verify the **Base Level** and **Top Level** properties are set correctly—this determines the required horizontal distance. Picking points on the screen will define the center of the ramp (Figure 5-5.1). Based on the **Ramp Max Slope** setting (via Edit Type) the required length, in plan, is listed. **Landings** are automatically added between gaps as shown in the two images below (Figure 5-5.1 and 5-5.2). The sketch lines can be modified if needed. For example, maybe one side of the ramp runs along an angled or curved wall.

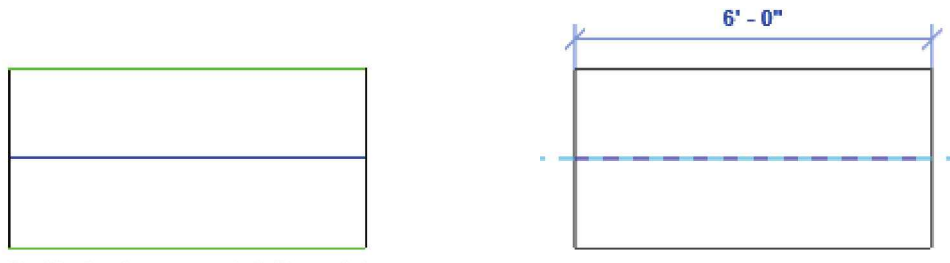


FIGURE 5-5.1 Ramp sketch mode; indicates length required based on vertical distance

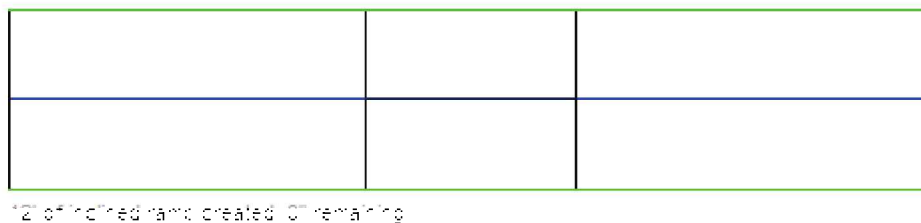


FIGURE 5-5.2 Ramp sketch mode; sketch complete with landing

Once the sketch is complete and the Finish (green check mark) is selected, the ramp is created as seen in Figure 5-5.3. By default this will include a railing on each side of the ramp.

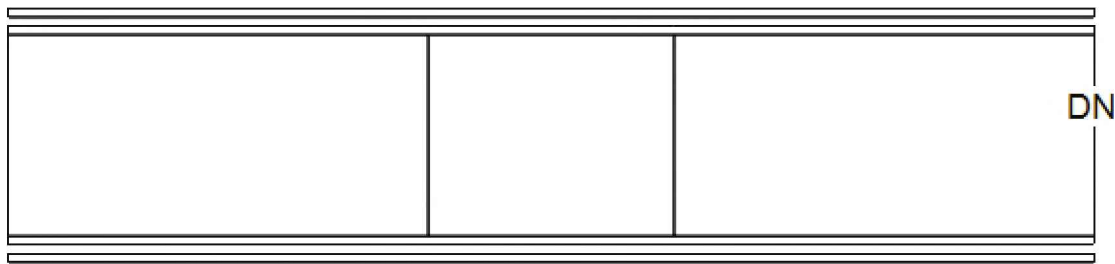


FIGURE 5-5.3 Ramp created including railings on each side

Looking at the ramp in 3D we notice the handrail is on the wrong side and the posts are half on, and half off, the ramp (Figure 5-5.4). Selecting the railings in plan (one at a time) and then clicking the **flip control-arrows** will move the handrail to the correct side. Also, with the railing selected, the **Tread/Stringer Offset** will reposition the railing.

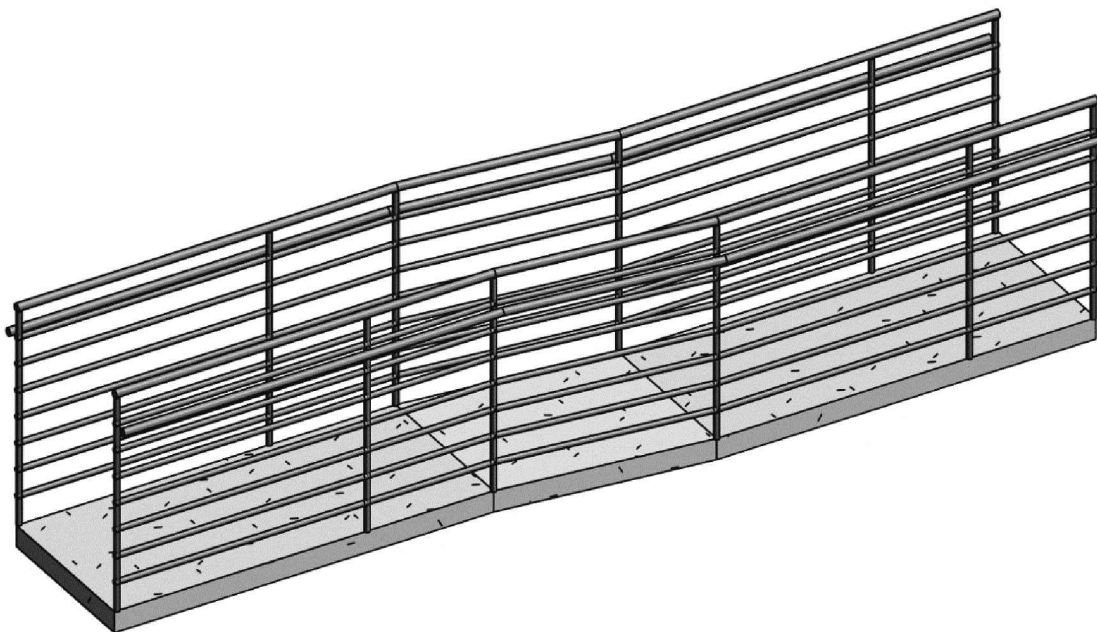


FIGURE 5-5.4 3D view of ramp

Most of the Instance (left) and Type (right) properties shown in Figure 5-5.5 are pretty straightforward. By default Revit set the **Base Level** to match the level the current plan-view is based on and the **Top Level** to the next Level above. This usually works as a Level should generally be created for any surface you can walk on in a building. In this example, the Top Level was changed to match the Base Level and the Top Offset was modified to define the total vertical distance.

The Type property **Shape** determines the shape (or profile) of the ramp in section as seen in Figure 5-5.6, set to **Thick**, and Figure 5-5.7 set to **Solid**. Also notice the Ramp Max Slope (1/x) setting. This defines the horizontal distance required for every 1” of vertical rise. This is typically set based on building code and accessibility code requirements.

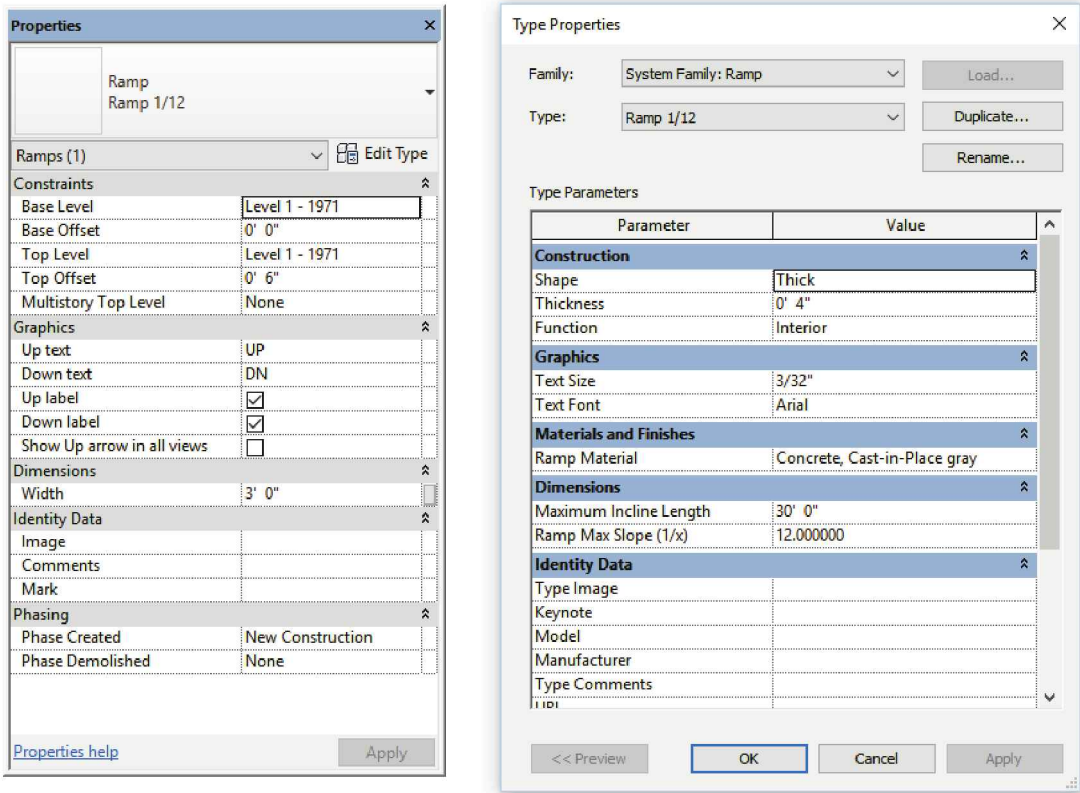


FIGURE 5-5.5 Ramp instance (left) and Type (right) properties

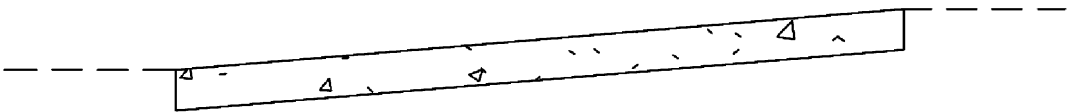


FIGURE 5-5.6 Ramp section with Shape properties set to Thick

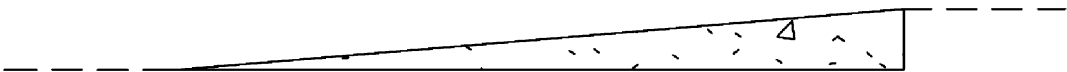


FIGURE 5-5.7 Ramp section with Shape properties set to Solid

Now that the basics of the Ramp tool have been covered we will look at the limitations. The Ramp tool does not allow “Layers” of construction like the Floor tool does. Notice in Figure 5-5.5 that there is just one simple **Thick** property to define the thickness of the ramp. Thus, the ramp cannot look correct in both plan (Figure 5-5.8) and section (Figure 5-5.9), as there is only one material parameter for ramps. Another limitation is that the **Spot Elevation** and **Spot Slope** annotation tools do not work on a Ramp element.

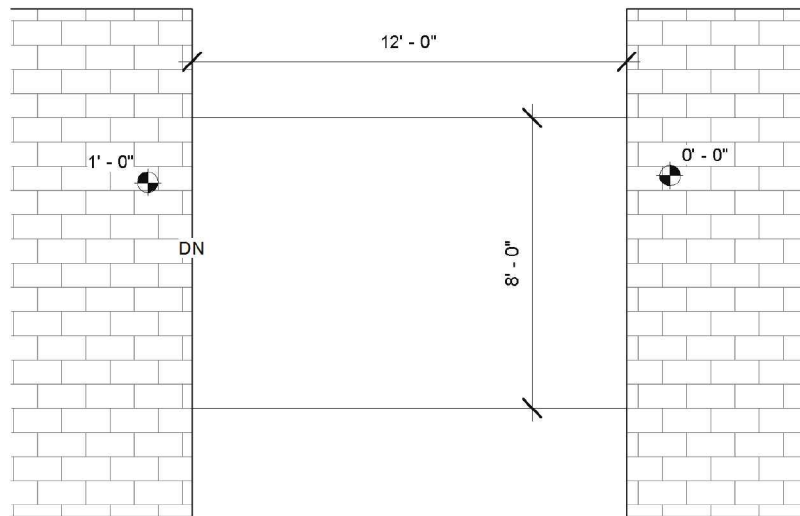


FIGURE 5-5.8 Ramp added between two floors – no floor finish or slope arrow

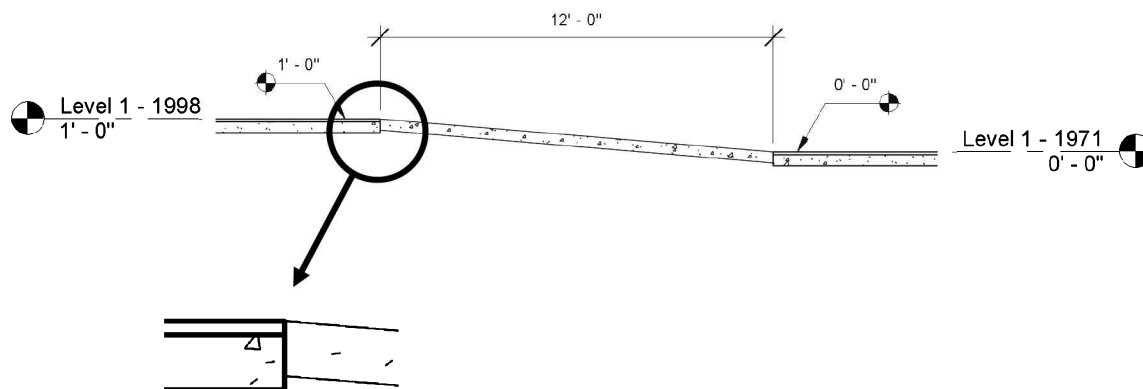


FIGURE 5-5.9 Ramp shown in section next to a concrete floor with a tile finish

The **Paint** tool can be used to apply a different material to the surface of the ramp, but the section and details still would not look correct. A Ramp cannot be joined to the adjacent floor construction as highlighted in the image above.

Sloped Floor:

An alternative to using the Ramp tool is to use the Floor tool and adjust it to slope.

First we will look at the results of creating the same “ramp” as in the previous example. This Floor element can have multiple “Layers” of construction, including a separate surface finish. Additionally, we can apply a Spot Elevation and/or Spot Slope annotation as desired. The plan-view below has a Spot Slope element applied to indicate the slope and direction (Figure 5-5.10).

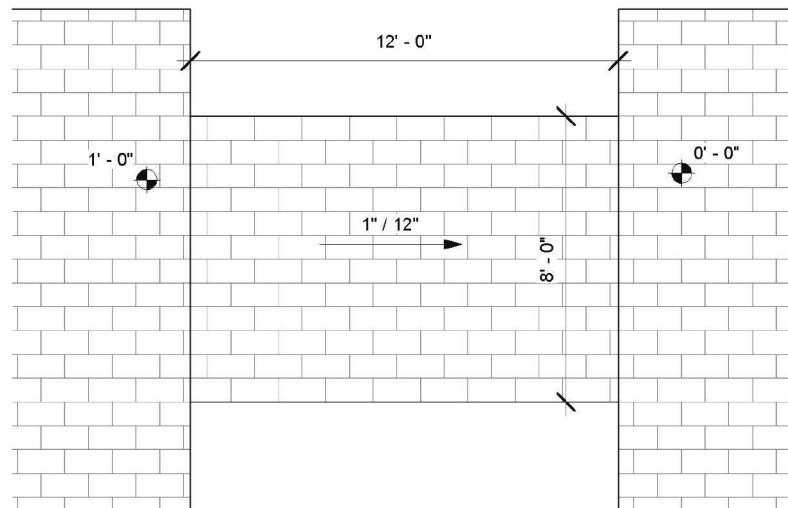


FIGURE 5-5.10 Sloped floor element added between two floors

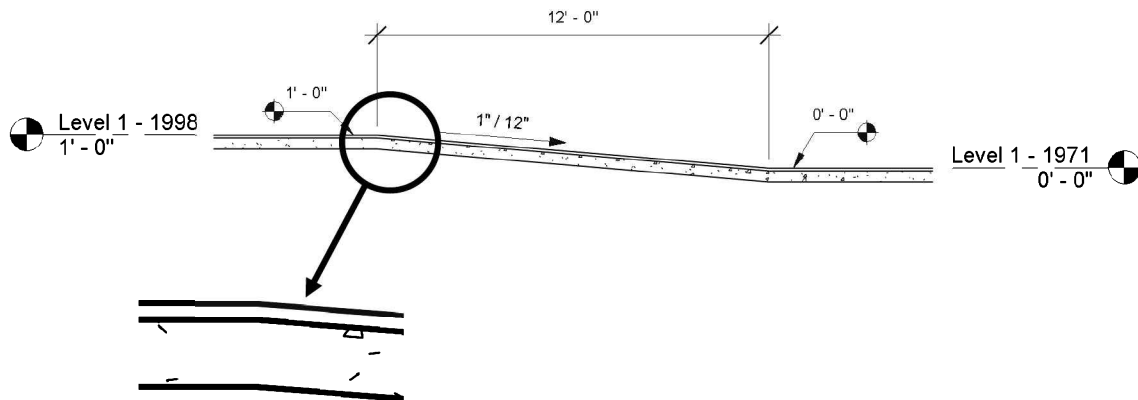


FIGURE 5-5.11 Sloped floor shown in section – joined to adjacent flat floor

As seen in the section above, the sloped floor joins nicely with the adjacent flat floor elements to create a continuous monolithic look that is common in this situation (Figure 5-5.11). Note that the Join command is used to achieve this look.

The only limitation to using a Floor rather than a Ramp element is a Railing cannot be added automatically. However, a Railing can be manually added and hosted to the floor.

Given the two examples, Ramp vs. Floor, it is generally preferred to use a Floor rather than a Ramp. Now we will look at how to create a sloped floor.

There are four ways to make a floor slope:

- Sketch line **defines slope**
- Sketch line **defines constant height** (preferred for existing conditions)
- **Slope Arrow** in sketch mode
- **Shape Editing** (generally avoid for simple ramps)

A sketch line, when selected, can be set to **Defines Slope** on the Options Bar (Figure 5-5.12). For a ramp, only one edge needs to be set to Defines Slope. Once Defines Slope is selected, the Slope parameter may be modified; e.g. 1”/12”.

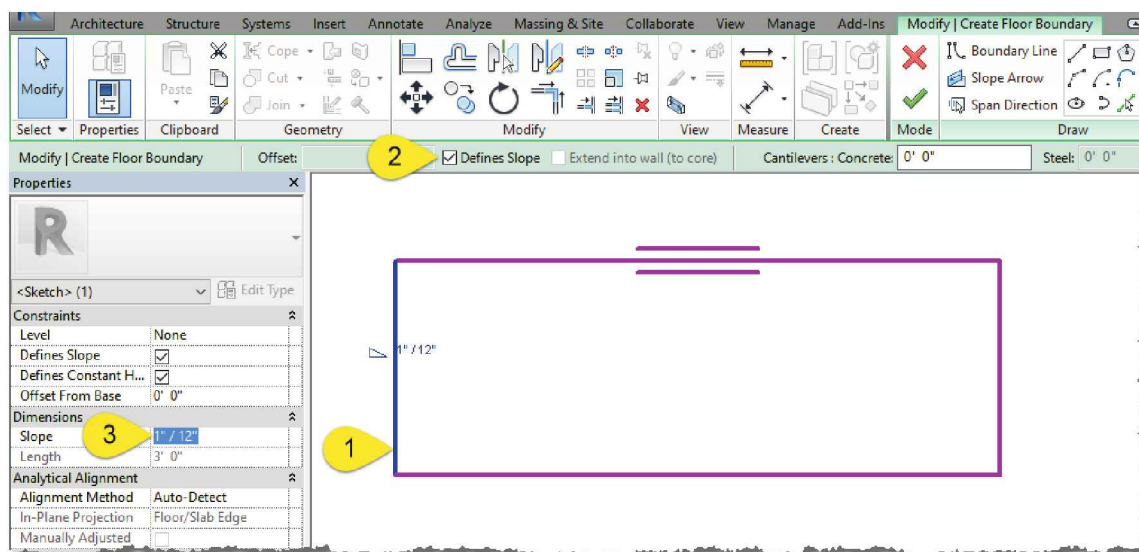


FIGURE 5-5.12 Using Defines Slope in floor sketch

When a sketch line is selected, while in sketch mode, there is a parameter called **Defines Constant Height** (Figure 5-5.13). Checking this box allows the **Offset From Base** to be modified. This value sets the specific height of that edit of the floor relative to the selected Level. This is helpful when documenting existing conditions and the slope is not known or not perfectly constructed per the original construction documents.

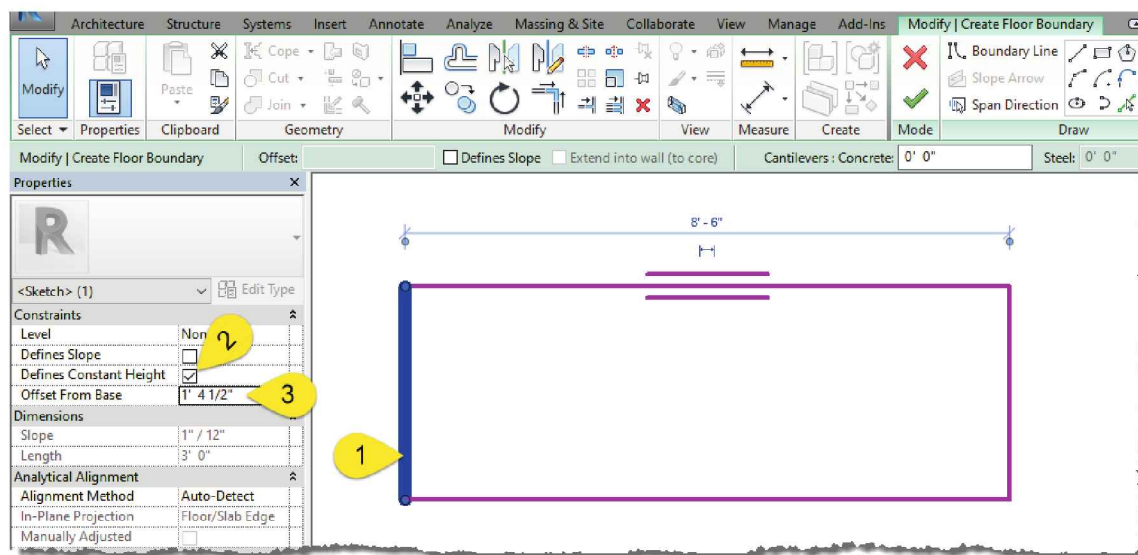


FIGURE 5-5.13 Using Defines Constant Height in floor sketch

The **Slope Arrow** option is easy to use while in sketch mode; simply select the Slope Arrow option on the Ribbon and point to point to define the direction the floor should slope (Figure 5-5.14). With the Slope Arrow selected, the Properties Palette lists the slope related settings. Changing **Specify** to “Slope” allows the Slope parameter to be set; e.g. 1”/12”.

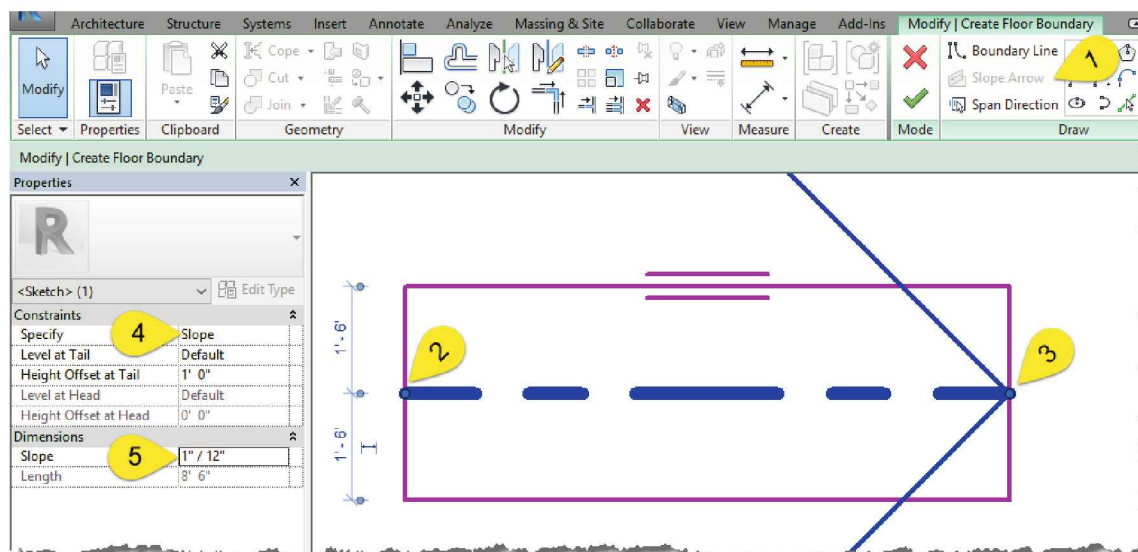


FIGURE 5-5.14 Using Slope Arrow in floor sketch

The **Shape Editing** feature is a little too complicated and should be avoided unless the surface warps or the bottom of the ramp needs to be flat. This feature is more for sloping a slab or roof around a floor/roof drain. To use this option, select the completed floor (not in sketch mode) and click the **Modify Sub Elements** tool on the Ribbon (Figure 5-5.15). Select one of the corner grips and then edit its offset value that appears next to the grip. Edit the grip for the other side of the ramp. Press Esc to finish the command.

If the bottom of the ramp needs to be flat, select the floor, go to Edit Type and then Edit Structure. Check the **Varies** option for each layer to have a flat bottom (Figure 5-5.16). The result can be seen in Figure 5-5.16. Note that the **Varies** setting will only affect floor instances that have their sub elements modified.

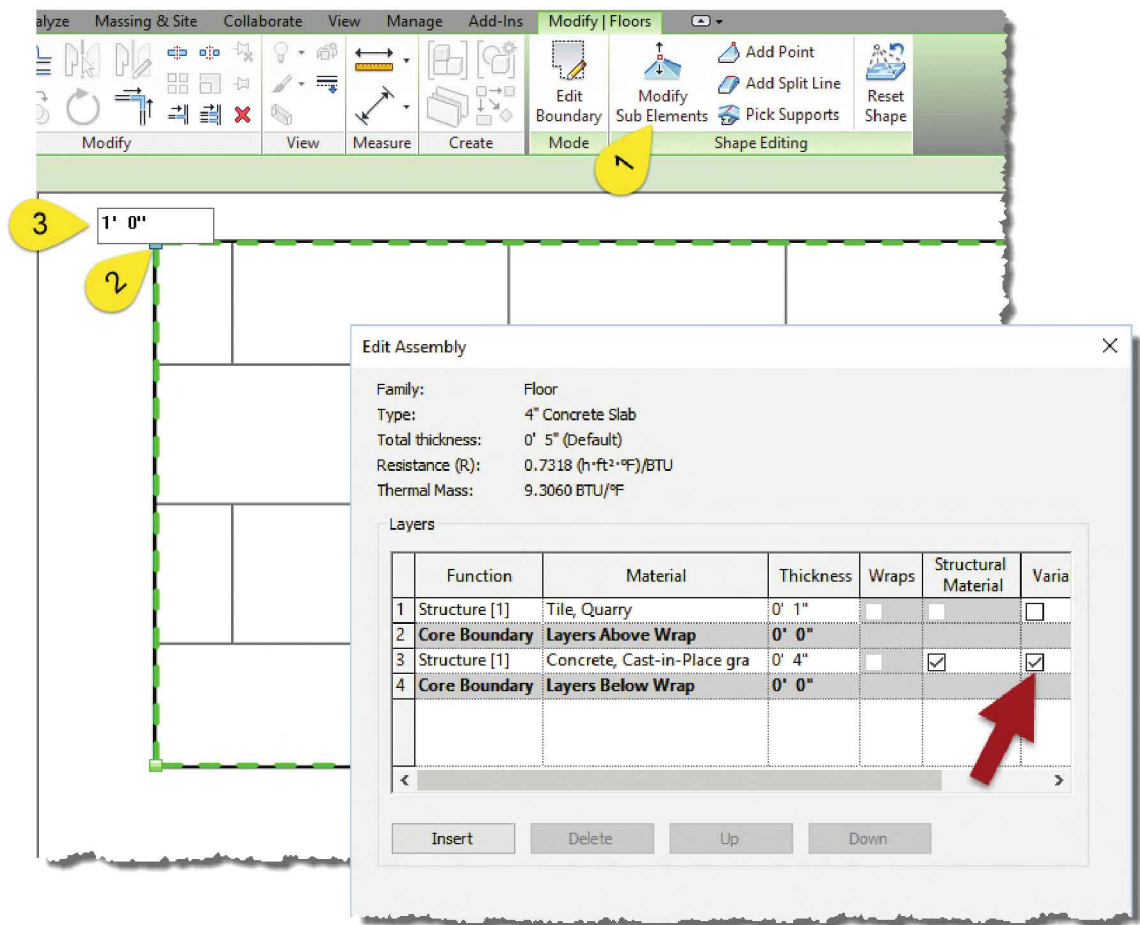


FIGURE 5-5.15 Modifying a floors sub elements & floor structure dialog

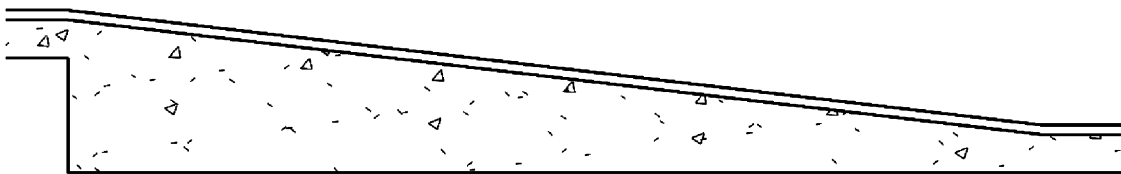


FIGURE 5-5.16 Floor with flat bottom

Exercise 5-6:

Elevators

Commercial buildings with more than one story often have an elevator for convenience and to comply with accessibility codes. This section will take a look at how they can be modeled within Revit.

Shaft Walls:

First, an elevator is contained within a vertical shaft defined by four walls as seen in the image to the right (Figure 5-6.1). These walls are modeled using **Revit's wall tool**. These walls should be modeled as they will be built. In this example the masonry walls are bearing walls (i.e. they are structural and will support the floors and roof) so a single wall extends from the footing to the roof. If they walls are built on each floor, then separate walls should be created at each level. Also, if different finishes are required at each floor, then separate walls are added adjacent to the shaft walls.

The dimensions of the shaft are defined by the elevator manufacturer. The width and depth are derived from the “car” size and required tracks/rails. The height can vary depending on the type of elevator—this often includes a pit (an area below the lowest stop) and an overrun (space above the highest stop).

Shaft Openings:

It is important that the hole in the floor align vertically. The best way to ensure this is to use the **Shaft Opening tool**. This tool is a vertical extrusion which cuts each floor it comes in contact with. This is preferred over editing the sketch of each floor to define the opening—which would potentially be wrong at one or more floors. Depending on building construction, this shaft is either on the inside or the outside of the shaft walls. If inside, the floors will extend into the shaft walls.

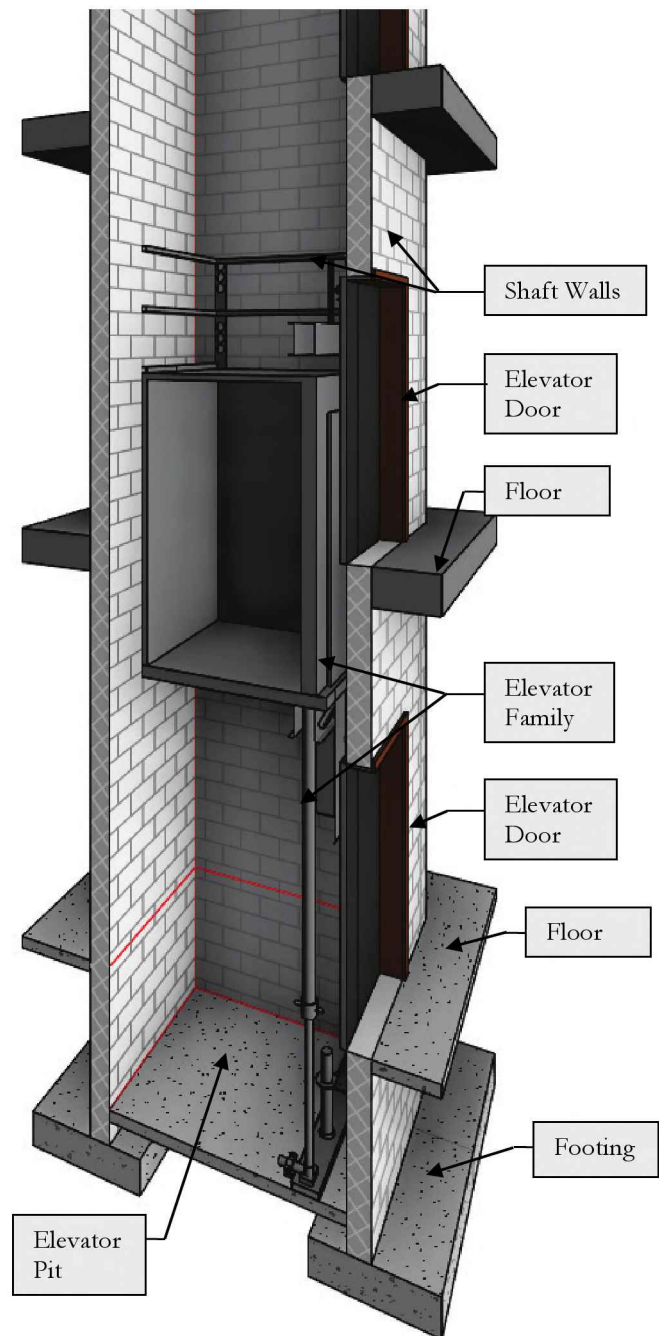


FIGURE 5-6.1 Elevator shaft cut away view

Elevator Family:

The installed version of Revit does not come with any sample elevator content (except in the Metric Library folder). Using Autodesk SEEK, from the Insert tab on the Ribbon, and searching for “elevator” will present several options. Some are very **generic** as seen in the image below (Figure 5-6.2), while others are very **detailed** as in the manufacture example on the previous page.

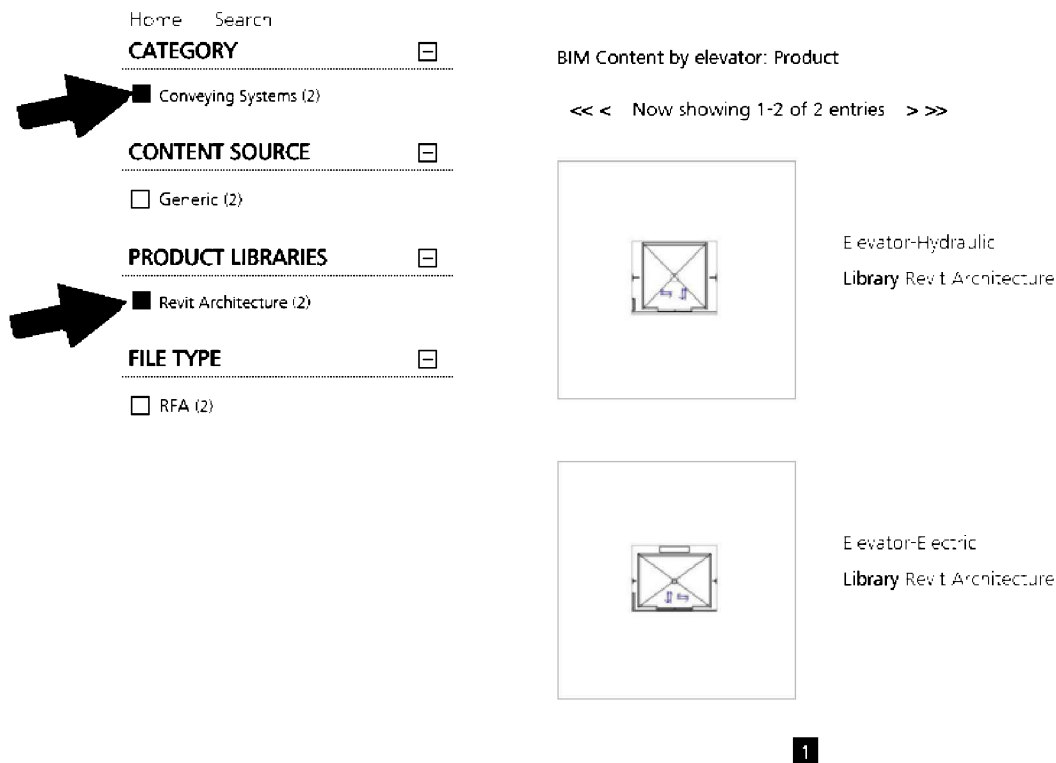


FIGURE 5-6.2 Generic elevator content on Autodesk SEEK site

The value in manufacture content is that it is the correct size and often has helpful features—for example, the family used on the previous page includes a box which defines the required shaft size, including pit depth and overrun. However, in the floor plan-views it does not follow the standard architectural graphics conventions for an elevator (whereas the generic one shown above does).

Another option is to create custom content. It is generic and parametric so it looks correct in plans and sections and is manually adjustable based on the elevator selected. There is a good example of a custom elevator family, including call buttons and indicator lights, in a thread at this location: <http://www.revitforum.org/architecture-general-revit-questions/12415-elevators-what-do-you-do.html>.

Yet another option is **DigiPara Elevatorarchitect**, which is a free Revit add-in. This tool includes several elevator manufacturers such as ThyssenKrupp, OTIS, KONE, Schindler and more. URL: <http://www.digipara.com/>

Elevator Doors:

Elevators have several sets of doors. One set is associated with the elevator car while the rest are located on each floor the elevator stops at. The car door is represented in the elevator family. The doors at each floor are separate families individually placed at each floor. Searching Autodesk SEEK for “elevator door” will result in two generic families (Figure 5-6.3) which are part of the Specialty Equipment category (not Doors, so they will not show up in the door schedule).

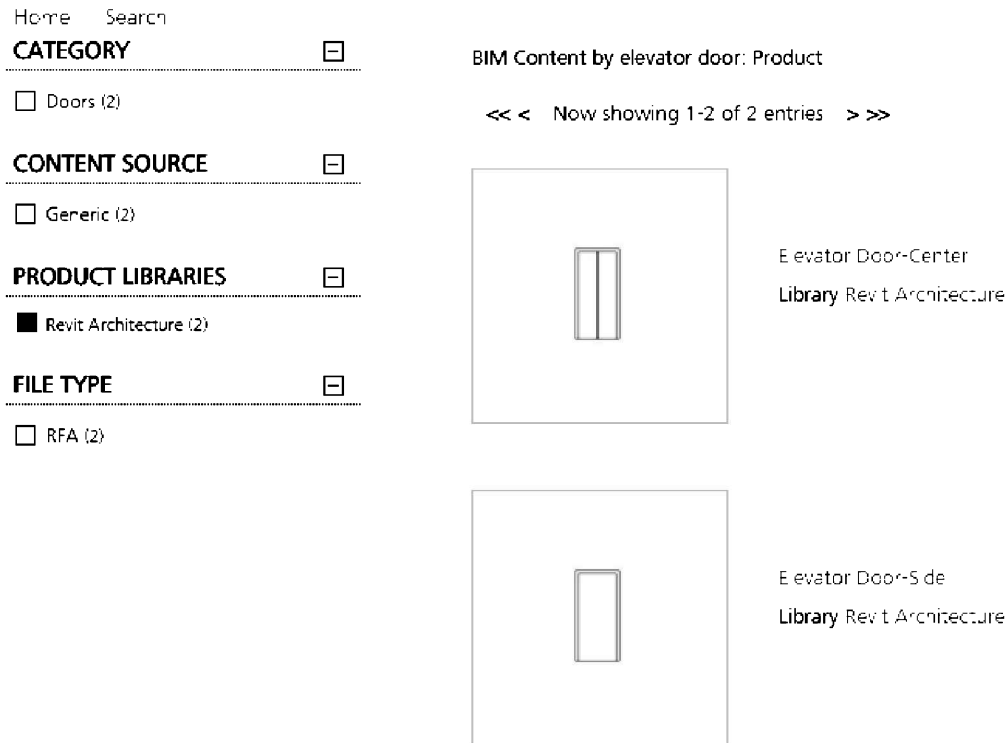


FIGURE 5-6.3 Generic elevator door content on Autodesk SEEK site

Having separate elevator door families at each level will accommodate the various finishes at each level. **TIP:** when using multiple walls to represent the shaft wall and floor-specific finishes, use the join tool on those walls. This will cause the door family to cut through all walls.

Elevator Misc:

Elevators usually require an Elevator Equipment Room. This would be sized and positioned per the manufacturer’s literature. If the elevator has a pit, it most likely requires a “pit ladder” for maintenance personnel to access the pit (this may have to be a custom family if one cannot be found).

Exercise 5-6:

Adding Utilitarian Stairs and Railings

In this exercise you will create a utilitarian stair in a stair shaft; this is a stair required for egress, with simple materials, and not intended to be primary circulation.

The Utilitarian Stair:

The back stair is required for egress and is often referred to as a utilitarian stair due to the simple and durable finishes.

Utilitarian stairs are not readily visible and are primarily meant for emergency egress; their existence is primarily dictated by code. They certainly may be used as a means of vertical circulation within the building.

The finishes and light fixtures are simple, often painted CMU walls and surface mounted lights.

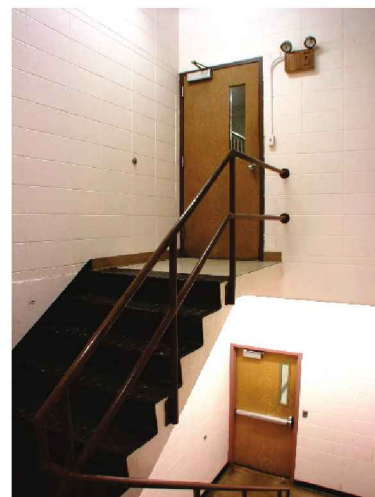
In stairs, building codes often require a gate at the ground level and at the upper level, if the stair continues to the roof. The reason for this is to help guide people in an emergency. Each floor in the utilitarian stair shaft looks the same, so it would be easy for a person, especially in a panicked state, to pass the ground level exit and continue down one or two more floors to the basement, extending their time in a dangerous situation. If the stair is used for normal, day-to-day, vertical circulation, some building officials will allow the gate to be placed on a magnetic hold-open which allows the gate to close in the event of a fire alarm system activation.

Most commercial codes also require that a sphere 4" or larger not be able to pass through the guardrail. This has a large impact on design but creates a safe environment for the users; looking at the photo to the right, it is not difficult to see how older codes allowed for unsafe designs!



Utilitarian Stair Example

Durable, average cost stair with simple design



Next you will add stairs to your East and West stair shafts. Revit provides a powerful *Stair* tool that allows you to design stairs quickly with various constraints predefined (i.e., 7" maximum riser).

Type Parameters:

Before you draw the stair it will be helpful to review the options available in the stair family.

- 1. Open ex5-3.rvt and Save As **ex5-7.rvt**.
- 2. From the *Project Browser*, expand the Families → Stairs → Stair (i.e., click the plus sign next to these labels).
- 3. Right-click on the stair type **7" max riser 11" tread**, and select the **Type Properties** option from the pop-up menu.

You should now see the options shown in Figure 5-7.1.

Take a couple minutes to see what options are available. You will quickly review a few below.

- Tread: depth of tread in the plan view.
- Nosing Length (Depth): Treads are typically 12" deep (usually code min.) and 1" of that depth overlaps the next tread. This overlap is called the nosing.
- Riser: This provides Revit with the maximum dimension allowed (by code, or if you want it, less). The actual dimension will depend on the floor-to-floor height.
- Stringer dimensions: These dimensions usually vary per stair depending on the stair width, run and materials, to name a few. A structural engineer would provide this information after designing the stair.
- Cost: Estimating placeholder.

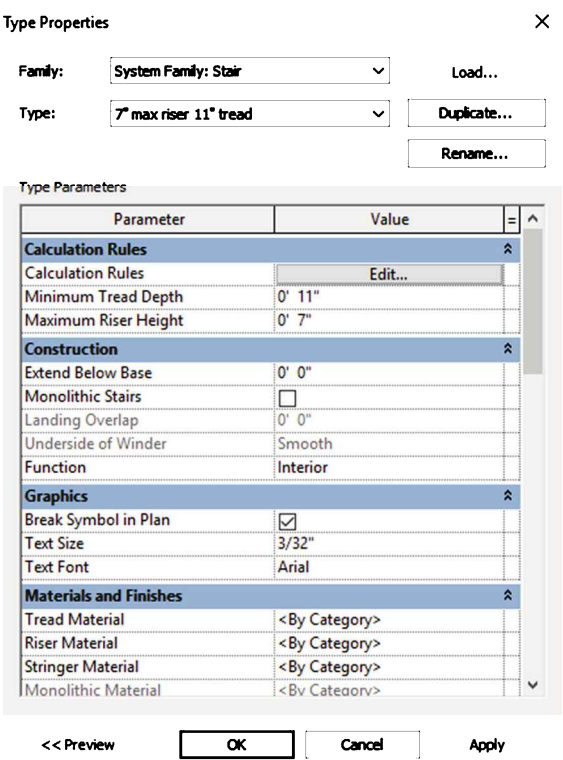


FIGURE 5-7.1 Stair type properties

Drawing the Stairs in Plan:

You will be drawing a standard switch-back stair. At first, when using Revit to draw stairs, it may be helpful to figure out the number of risers and landings. That information will be helpful when drawing the stair. As you become more familiar with the *Stair* tool you will not need to do those calculations to draw a stair. Dividing the floor-to-floor height of 12'-0" by 7" we get 20.57. Obviously you cannot have a fraction of a riser so you need to round up to 21 (rounding down would make the riser higher than 7"). Therefore, 12'-0" divided by 21 equals 6.86". Thus you have 21 risers that are 6.86" high. Additionally, most codes would require a landing in a stair rising 12'-0".

4. Make sure you are in the **Level 1** floor plan view.
5. **Zoom in** to the West stair shaft.
6. Click on the **Architecture** tab on the *Ribbon*.
7. Select the **Stairs** tool (circulation panel).
8. On the *Options Bar*, set the *Location Line* to **Exterior Support: Right**.
9. Also on the *Options Bar*, set the *Actual Run Width* to **3'-6"**.



Stairs

Location Line: Exterior Support: Right Offset: 0' 0" Actual Run Width: 3' 6" ☒ Automatic Landing

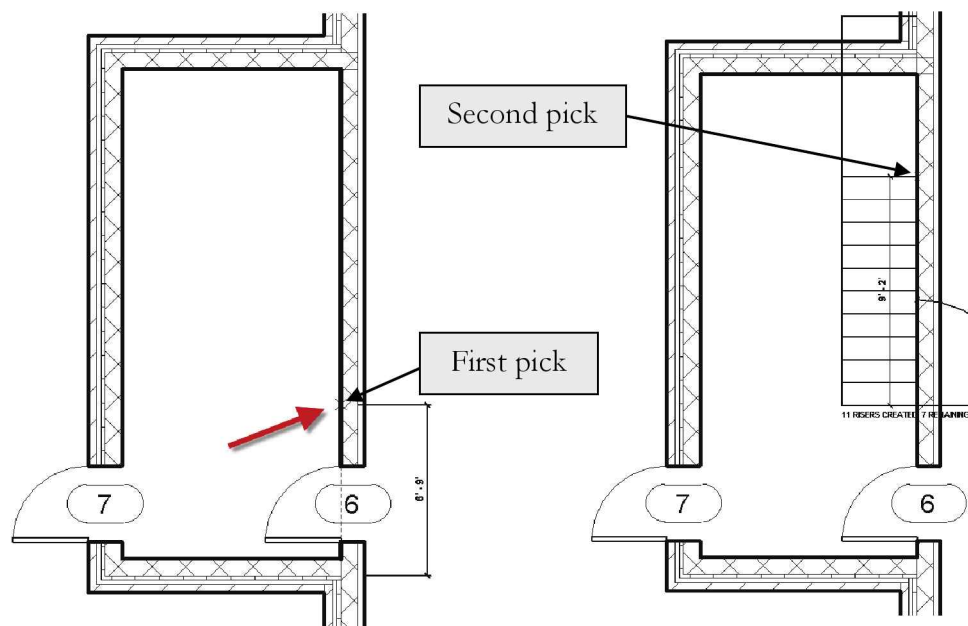
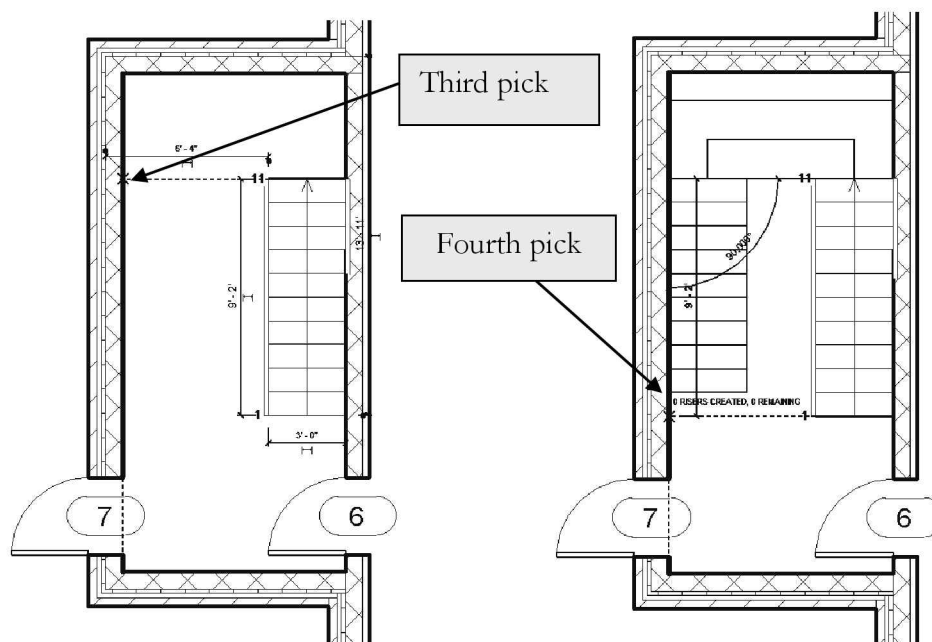
10. Position the cursor approximately as shown in **Figure 5-4.3**; you are selecting the start point for the first step. Make sure you are snapping to the wall with *nearest*.
11. Pick the remaining points as shown in Figures 5-7.4, 5-7.5 and 5-7.6.
12. Hold the **Ctrl** key and then select the two runs of stairs (but not the landing or railings).
13. Click the **green check mark** to finish the stairs (Figure 5-7.2).



FIGURE 5-7.2 Stair Contextual Tab

14. Switch to **Level 2** and repeat the previous steps to add stairs from Level 2 up to Level 3.

Notice as you draw the stairs, Revit will display the number of risers drawn and the number of risers remaining to be drawn to reach the next level. If you click *Finish Stairs* before drawing all the required risers, Revit will display an error message. You can leave the problem to be resolved later.

FIGURE 5-7.3 1st pickFIGURE 5-7.4 2nd pickFIGURE 5-7.5 3rd pickFIGURE 5-7.6 4th pick

FYT: Revit has drawn the intermediate landings between levels. However, the landings at the main floor levels have not been created but could be using the Landing option within the Stair tool. Some projects extend the primary floor structure into the stair shaft to act as the landing for that level and also support the stair. In a later lesson you will draw a floor system that extends into the stair shaft.

15. Repeat these steps for the East stair shaft.
16. **Add doors** to the second and third floors for both the East and West stair shafts (interior doors only!).
17. **Save** your project.

The final stairs still need some work, but with just a few steps you have a nice placeholder. Using the information presented earlier in this chapter, the stair can be further developed as the design progresses. Revit will add railings to both sides of the stair by default (this can be turned off on the *Ribbon* while in the Stair tool). The railings are separate elements which are hosted to the stair, much like a door is hosted to a wall. You can select a railing and delete it without deleting the stair. But if the stair gets deleted, the railings must go.

Self-Exam:

The following questions can be used as a way to check your knowledge of this lesson. The answers can be found at the bottom of this page.

1. Stair landings are added automatically. (T/F)
2. A stair sample file can be downloaded from Autodesk SEEK. (T/F)
3. Stairs and railings are shown as true 3D objects in plan views. (T/F)
4. A stair's railing cannot be deleted. (T/F)
5. Stair types are listed in the *Project Browser* under *Families*. (T/F)

Review Questions:

The following questions may be assigned by your instructor as a way to assess your knowledge of this section. Your instructor has the answers to the review questions.

1. Handrail supports can be moved or deleted. (T/F)
2. The riser is typically calculated to be as large as the building codes will allow. (T/F)
3. Stairs have multiple sub-categories which can be used to control stair visibility. (T/F)
4. To change a stair, select it and then click _____ on the *Ribbon*.
5. A railing extending past the end of a stair run must always slope. (T/F)
6. To extend the stair's stringer you draw _____ lines.
7. Posts, within a railing instance, can be unpinned and repositioned. (T/F)
8. After starting the *Stair* tool, the first thing you need to do is set the _____ level and the _____ level.
9. Railings can be modified to be shorter than the length of the stair. (T/F)
10. The riser height is based on the floor to floor height. (T/F)

SELF-EXAM ANSWERS:

1 – T, 2 – T, 3 – F, 4 – F, 5 – T