

Revit Architecture

Student Workbook

Building Information Modeling with Revit Architecture

Autodesk®

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Introduction

This student workbook contains exercises that clarify in a practical way the concepts explained in the *Building Information Modeling with Revit® Architecture Lecture Notes* by Simon Greenwold.

The exercises cover the basic principles of the Revit Architecture technology and the building information modeling (BIM) approach. For more training information, see the official Revit Architecture training manuals and the tutorials available from the Help menu. This workbook explains the different functionalities through various exercises, but the emphasis is on the workflow rather than on the tools themselves.

Because this workbook is a companion to the lecture notes, it is organized roughly to correspond to the organization of that document. The difficulty of the exercises increases as you proceed through the units, so it is recommended that you do them in sequence. However, each exercise has a corresponding starting point Revit Architecture file and can be completed independently of the other exercises. Files representing the ending point of each exercise have also been provided in the *Completed* folder along with the rest of the data sets and can be used to check your work. Because each exercise can stand alone, you can work through them in any manner you see fit. The following table organizes the units to give you an idea where you might find information particular to a given operational task:

Interoperability	Design	Model	Visualization	Documentation
Unit 5: Using Revit with 3ds Max	Unit 6: Design Constraints	Unit 1: Walls, Doors, Windows	Unit 1: Navigation, Working with Views, Camera	Unit 5: Views
Unit 9: Importing SketchUp® Files	Unit 7: Groups	Unit 2: Object Properties	Unit 5: Shade/Shadow	Unit 5: Linework Control
Unit 12: Importing and Exporting DWG Format Files Importing Revit Architecture Files	Unit 9: Massing	Unit 3: More Walls, Doors, Windows	Unit 5: Solar Studies: Creating Sheets	Unit 6: View Templates
Unit 17: External Databases	Unit 9: SketchUp Link	Unit 6: Extruded (with Curve) Roofs	Unit 11: Family Materials	Unit 7: Graphic Overrides
	Unit 12: Site	Unit 8: More Roof Tricks, plus Gutters, Soffits	Unit 18: Color Fills	Unit 14: Drafting/ Linework
	Unit 19: Phasing	Unit 10: Family Components	Unit 5: Using Revit with 3ds Max	Unit 18: Schedules, Legends, and Material Takeoffs
	Unit 20: Design Options	Unit 11: Family Constraints and Advanced Parameters, Nesting Families		
		Unit 16: Formulas in Families		

The workbook is structured in a three-column format, as follows:

The first column contains an explanation of all steps necessary to complete an exercise.

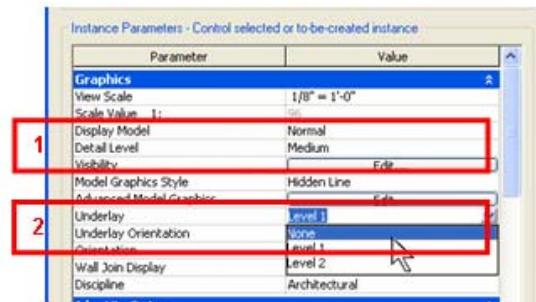
The middle column contains the images that clarify visually the tasks to accomplish.

The third column contains notes on the features and tools that are being used, as well as a few helpful tips.

Add a Floor slab on the newly created Level

10. Open **Floor Plan Level 2**.

11. RMC on the Floor plan **Level 2** in the Project Browser and open the **Properties** window. Change the **Detail Level** from **Coarse** to **Medium**.



12. Change the **Underlay** field to **None**

We have prepared the following data for you:

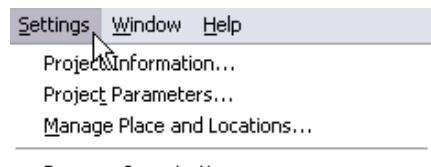
- Workbook (this document).
- Workbook data sets (placed in a folder that contains all necessary files, families, and the template prepared for your use).

Before starting the exercises, change the following settings to simplify use of this workbook and provide faster access to the data sets.

These steps create a library using the Revit Architecture Option settings. A library is a shortcut that appears in any Revit Architecture dialog box that asks you to browse for a file. This includes the Open and Save As commands as well as others.

Create a Library (Shortcut) to the Workbook Files

- 1 Copy the provided *Workbook Data Sets* folder onto your desktop.

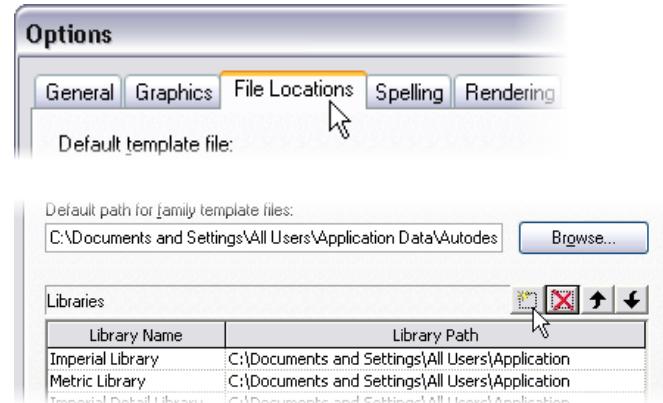


- 2 Start Revit Architecture.

You can copy the data sets from the provided CD or download to any location you choose.

- 3 • On the Settings menu, click **Options**.

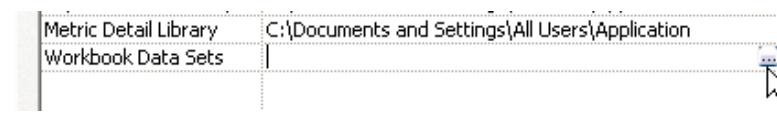
- 4 Click the **File Locations** tab.



- 5 Click the **Add Library** button.

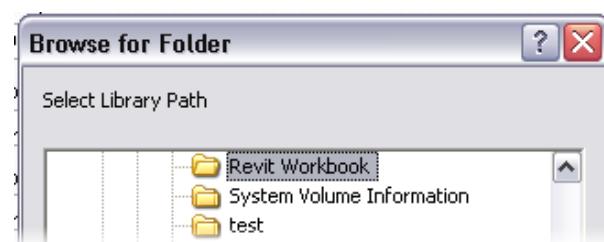


- 6 Click in the New Library name field. Rename the newly created New Library 1 to **Workbook Data Sets**.



- 7 Click in the blank Library Path field next to it.

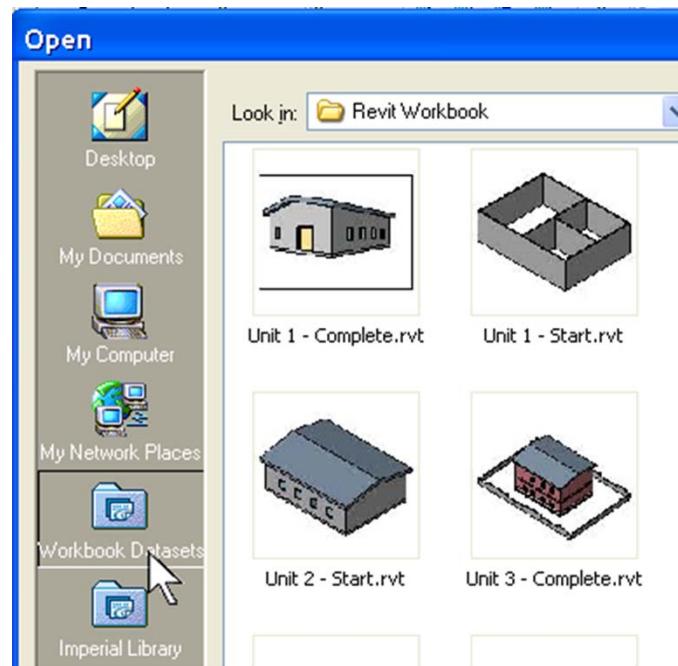
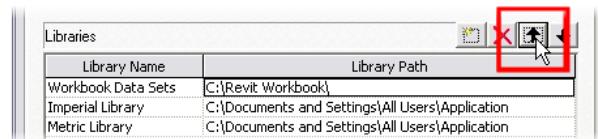
Click the **Browse** icon at the far right of the row.



- 8 Browse to the path where you saved the data sets.

Click OK.

- 9 Click the **Workbook Data Sets** field and, using the upper flash sign , move it up to the first row.



Now each time you go to the File menu to open or save, you see the folder in the browse window on the left so you can access it quickly.

Note: Exercises for some lectures note units are not available here and in some cases have been grouped into a single exercise. The reason lies in the workflow approach that does not meet specific feature training requirements. For more information, see the Autodesk Official Training Courseware and the help file.

We hope you enjoy learning the principles of Revit Architecture and the BIM approach.

Have fun!

Unit 1

Theory: CAD Versus BIM

Revit Architecture: Introduction, Interface, and Sketching

This unit has two exercises. The first is an introduction to the terminology of the Revit Architecture interface, and the second exercise creates a new project, using a template.

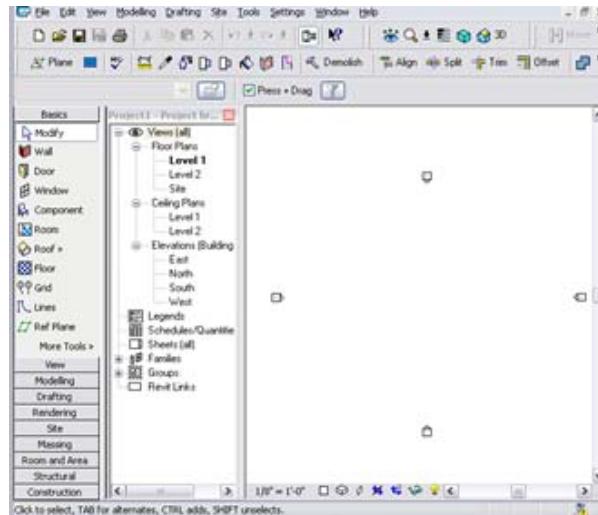
Exercise 1A: Interface and Terminology

This first exercise is for anyone new to the Revit Architecture environment. This is not an exercise as much as an introduction to the locations and terminology of the various Revit Architecture tools and functions that are used throughout the workbook.

Revit Architecture Environment

When you open Revit Architecture, you see a window that looks like the image shown here. When working through the workbook, you are asked to perform functions such as:

- Using the menus.
- Using the design bar tools to add things to the project.
- Using the toolbar tools to modify things with Copy, Move, Align, and Split tools.
- Using the project browser to change views or set views current.



Menu System

The menu system is like most Microsoft® Windows®-compliant software. Click the menu item to view a list.

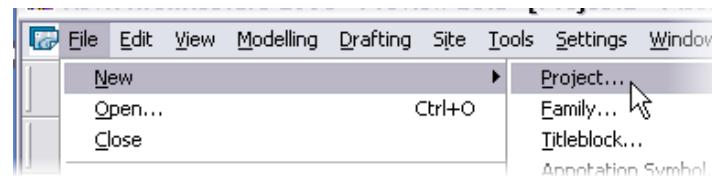
Many of the menu functions have flyout functions as well.

Within the workbook, menu flyouts are indicated with a ">" character.

Example:

On the File menu, click **New > Project**.

This format indicates that you use the menu File to select **New** and then **Project**.



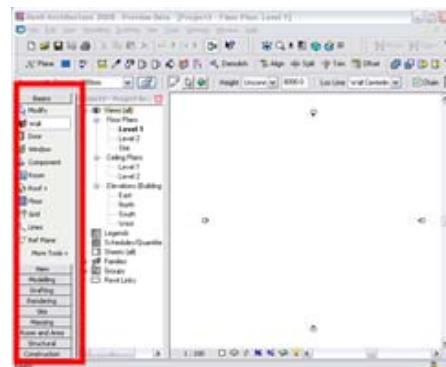
Toolbars

Again, as in most Windows programs, Revit Architecture includes a series of tools on toolbars immediately below the menu system. In Revit Architecture, these toolbars provide access to common functions such as New, Save, and Print as well as modify functions such as Copy, Move, and Trim.



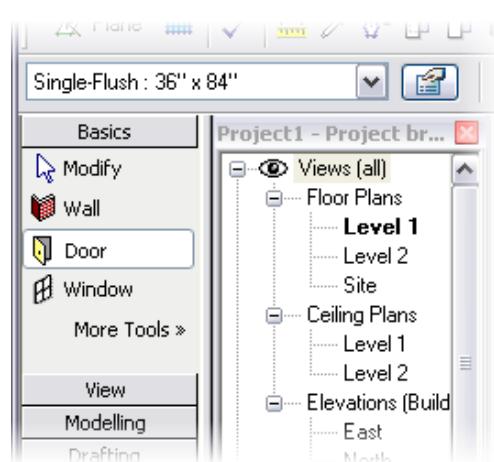
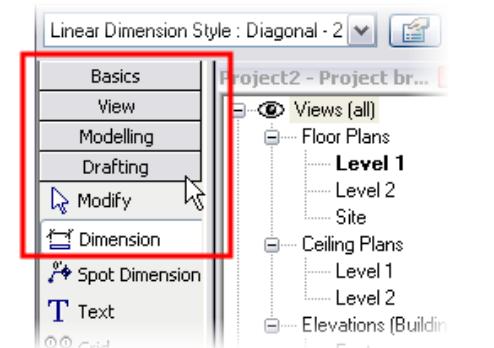
Design Bar

The design bar is the area on the far left of the Revit Architecture drawing window. The design bar contains most of the tools to add components such as walls, doors, windows, desks, and chairs, as well as schedules, tags, and section or elevation marks.



The design bar has many tabs. Each tab (Basics, View, Modeling, and more) appears as a rectangle with the title on it. Each tab contains its own set of tools.

Change to a different tab by left-clicking the tab.



Within the workbook, exercise steps tell you which tab to find the tool on.

Example:

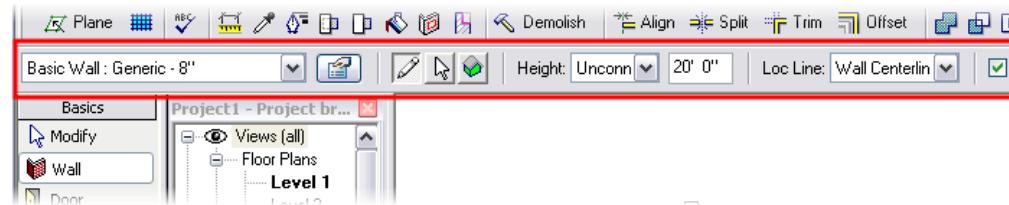
On the Basics design bar, click **Door** and place two doors **Single Flush 36" x 84"**.

Options Bar

The options bar is where you adjust properties of the objects as you are drawing them. You can also use the options bar to modify an object's properties after it is in the project.

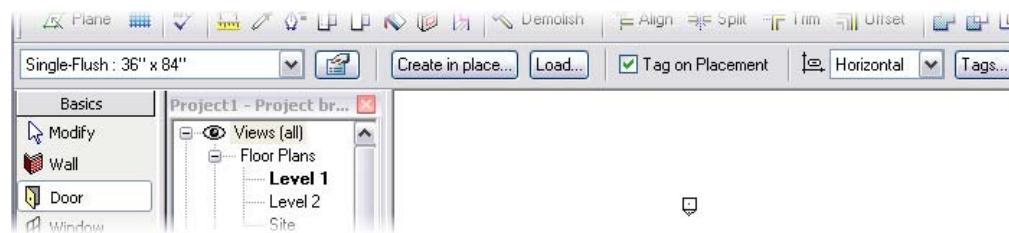
The options bar can be confusing to some new users. Appearing immediately below the toolbar, it may look like just another toolbar.

This image shows the options bar while adding a wall.



The contents of the options bar are fluid. What appears on the options bar is determined by the command/tool you are currently using.

This image shows the options bar with while adding a door.



As you are learning Revit Architecture, pay attention to the options bar. It provides a convenient location to modify the common properties of the tool you are currently using.

Revit Architecture Workflow

This section describes adding objects, using the design bar and the options bar in sequence.

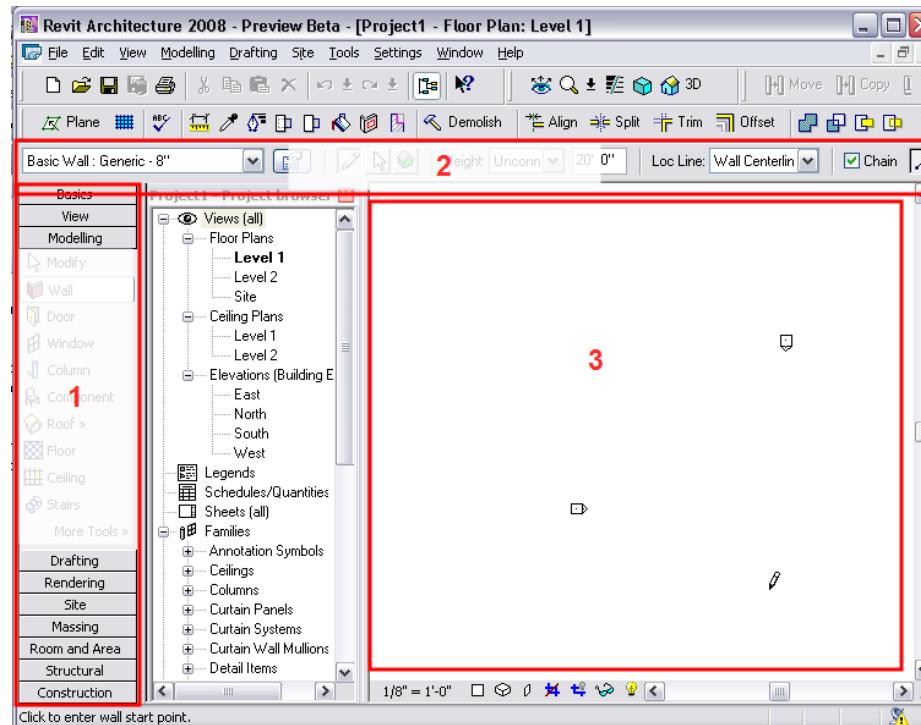
When you add an object to the project, you pick an object to add from one of the design bar tabs (area 1). Before you click in the drawing window, you set the variables in the options bar (area 2). Then proceed to use the tool in the drawing window (area 3).

This is a general rule, and as you become familiar with Revit Architecture, you may find it easier to add the objects directly into the drawing window, skipping the options bar and modifying the elements after. As you are learning, at least look at the variables presented on the options bar as you use the design bar and the toolbar commands.

Status Bar

At the lower-left corner of the screen is a portion of the window that is the status bar. Again, as a new user you may find it beneficial to watch what is happening at this area of the window. The status bar serves two purposes.

The first function is to alert you to what you do next. This works while you are adding objects such as a wall, as well as when you are using the other tools such as Copy, Trim, or Align.

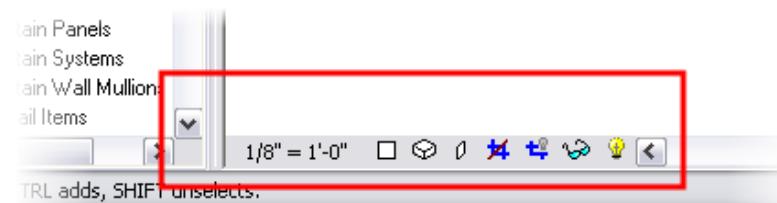


The second function is to alert you to what you are selecting. If you are not in a command and you hover your cursor over an object, the status bar displays what that object is. If you have several objects in the same location, you can use TAB to cycle through the objects at that location.

Workspace View Bar

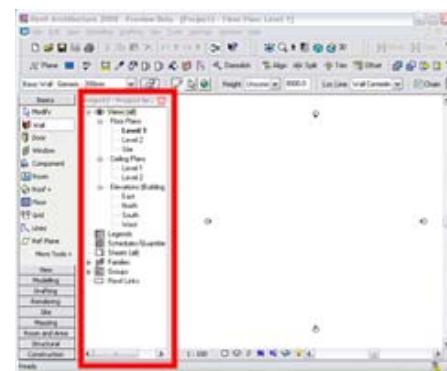
The Drawing View menu is also located near the bottom-left side of the screen just below the drawing area.

The Drawing View menu provides access to some of the view's properties such as intended plotting scale, detail level, and the Hide/Isolate Objects in Current View functions.



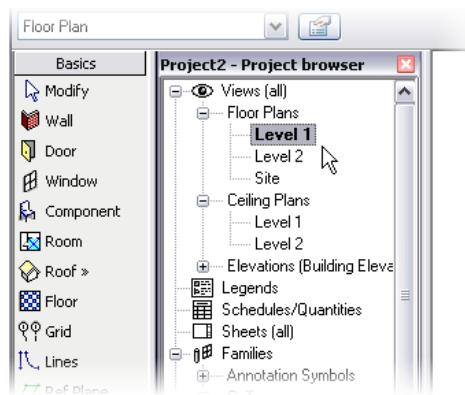
Project Browser

The project browser is located between the design bar and the drawing area.



The project browser is the navigation control of the project. Each view of the project is listed in a tree organization.

You access these views by double-clicking the view name. Below the views are listed the families (building component definitions) that are currently loaded into the project for you to use.



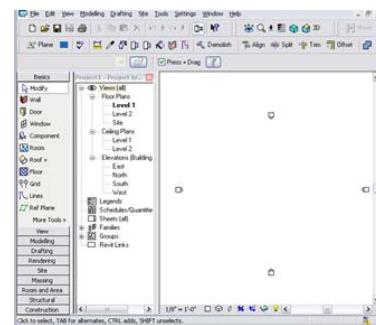
Exercise 1B: Starting a New Project

In this unit you start a new project using the Workbook Imperial template.

Templates are prepared drawing files that contain data according to office or project standards, helping to ensure that all team members who are working on the same project are using the same objects and standards. You can create these templates on your own, according to your office or project requirements.

Create a New Project from the Provided Template

In this exercise you add walls, doors, windows, floor, and roof to create a simple building that you will work on through later units 2–5.



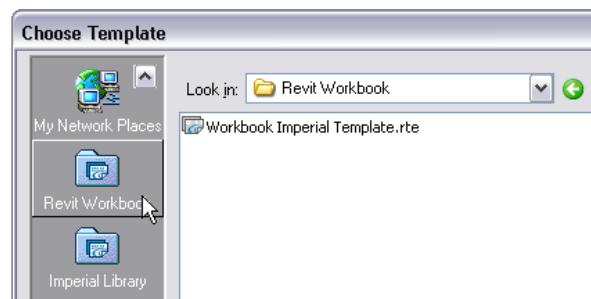
Exercise Start

- On the File menu, click **New > Project**.



Exercise End

- 2 Click the **Browse** button. Select the Revit Workbook library shortcut icon.

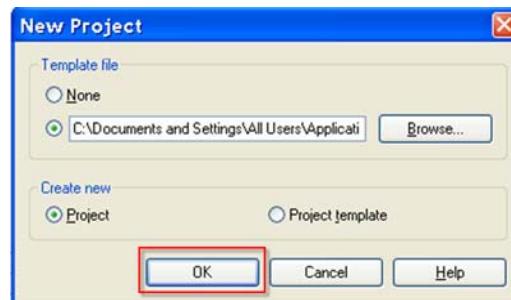


- 3 Select Workbook Imperial Template.rte.

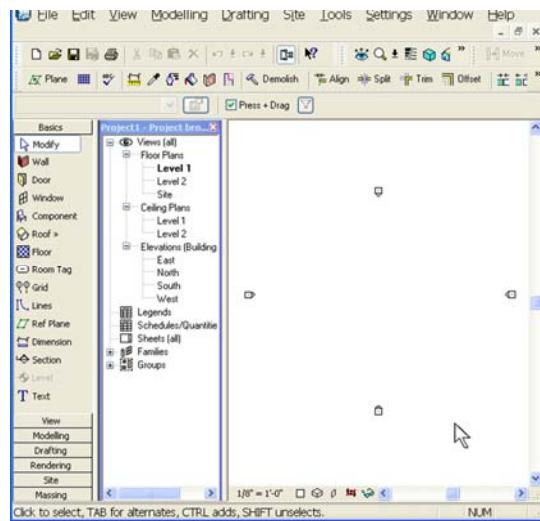
In the default folder are templates for commercial and residential, as well as other specialized templates you can choose to start from. Each of these templates has unique families, views, and possibly sheets already loaded for you to work with.

- 4 Click **Open**.

Click OK.



A new project file is created.



You can set the path to the default template used for all projects on the Settings menu: Options > File Locations > Default template file. This setting determines which template is used when you click the New Project button on the toolbar.

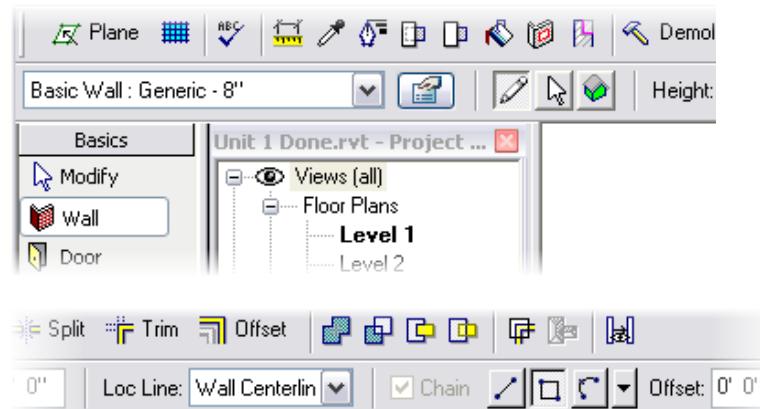
Add Exterior Walls

- 5 On the Basics design bar on the left of your screen, click **Wall**.

On the options bar, set:

- Type = Basic Wall: Generic 8".
- Height = Unconnected 20' 0".
- Shape = Rectangle.

In this section you add four exterior walls and two interior walls.

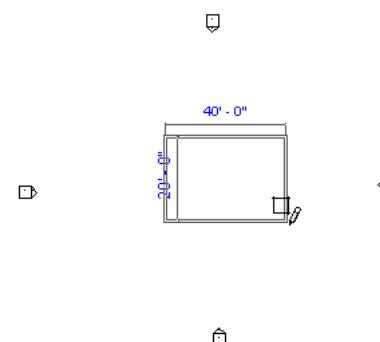


After you select the Wall tool, the options bar displays the different options for drawing the wall segments. Select the rectangular shape to draw the external walls.



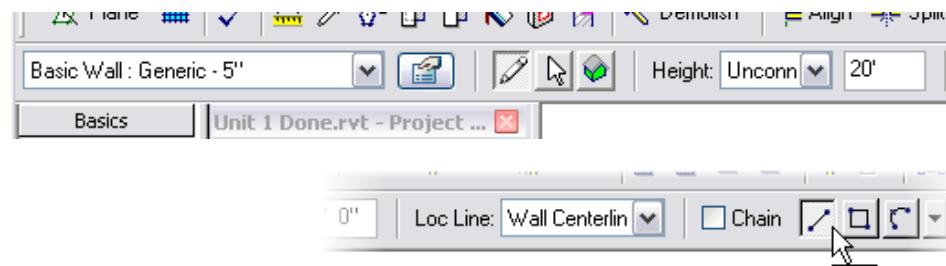
Switch to the linear option to draw the interior walls.

- 6 To draw the four exterior walls, left-click at a point within the four elevation markers in the drawing area. Holding the mouse button, drag your cursor to the lower right and release the mouse button. The rectangle should be about 40' x 30' but does not have to be exact at this point.

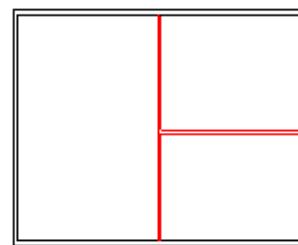


Draw the Interior Walls

- 7 Without exiting the Wall command, on the options bar set:
- Wall Type = Generic- 5".
 - Height = Unconnected 20'.
 - Shape = Line.
 - Clear the Chain check box.



- 8 Draw two interior walls, as shown in the image.



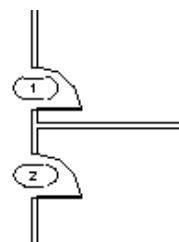
Zooming: Use the mouse wheel to zoom in and out of the drawing window.

Add Doors and Windows

In this section you add doors and windows to the project.

There are some door definitions in the project. You use the Load function to add more definitions.

- 9 On the Basics design bar, click **Door**. Place two doors Single-Flush: 36" x 84", as shown in the image.



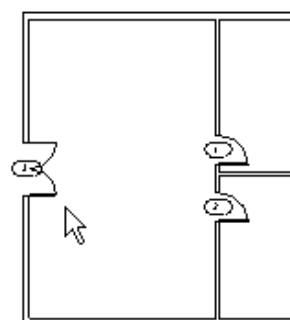
- 10 With the Door tool still active, on the options bar, click **Load...**.



- 11 In the Open dialog box:

- Click the **Imperial Library** shortcut.
- Browse to the **Doors** folder.
- Select the **Double Flush** door type.
- Click **Open**.

- 12 Change the door type on the options bar to Double-Flush: 72" x 84". Position a door on the left wall, as shown in the image.



- 13 Press **ESC** twice to exit the command.

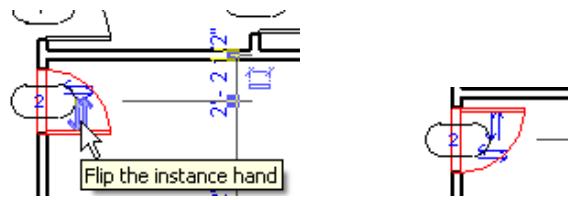
As you add these two doors, press SPACEBAR before you select a point to flip the swing before the door is placed.

Many other door types are installed with the software but not available within the general template you started with. When you load from library, you are bringing in a family of doors and all its types.

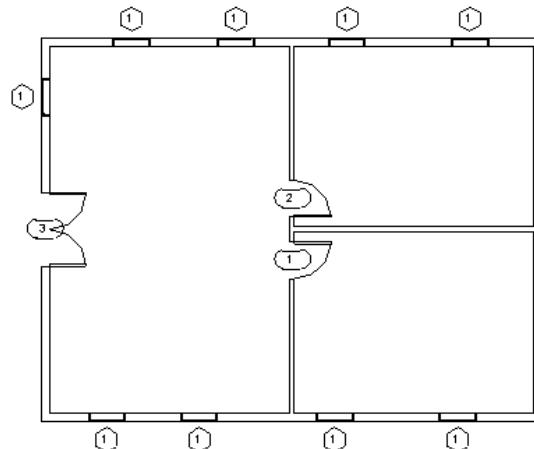
To end a command in Revit Architecture, either press ESC two times, or right-click and then click Cancel two times.

- 14 To change the swing direction of a door:

- Select the door.
- Click the flip arrows that appear.



- 15 On the Basics design bar, click **Windows** and position some windows on the exterior walls.



- 16 On the options bar, select **Fixed: 36" x 48"**.

- 17 Place windows as shown in the image by clicking the exterior walls.

- 18 Right-click anywhere in the drawing window and then click **Cancel** from the popup menu twice to exit the command.

In the next section you add a floor to the project.

When you add floors, you use Sketch mode to draw linework that defines the edges of the floor slab.

The horizontal arrows mirror the door along the wall it is positioned on. Both vertical and horizontal arrow symbols appear in doors, windows, furniture components, and in all families that can be mirrored or reversed without changing their geometry or their function.

Windows and doors are tagged automatically if Tag on Placement is selected on the options bar. To avoid automatic tagging, clear the option.

The tags that appear when placing the components are set on the Settings menu: Annotations > Loaded Tags.

Sketch Mode Introduction

Before you start drawing the floor, read this overview of Sketch mode.

A wall is a linear element that can be defined by two points in the drawing window. Doors and windows have discrete geometry, and this geometry is stored in the family definitions either within the project or outside the project as RFA files that you load as needed.

Some building components such as floors and roofs cannot be stored with predetermined geometry. For these elements, you draw lines to establish the base geometry. Revit Architecture then uses these lines as the base geometry to create the building component.

When you pick a tool from the design bar that depends on a series of sketch lines, the tool starts **Sketch mode**. While you are in Sketch mode, you draw a series of 2D lines.

Tip

TAB to Select Chain of Walls or Lines

To select all the exterior walls or a connected chain of lines in Revit Architecture, you can use the “Hover-TAB-click” method. This method enables you to select the connected (or chained) set of walls with one click rather than clicking each wall separately.

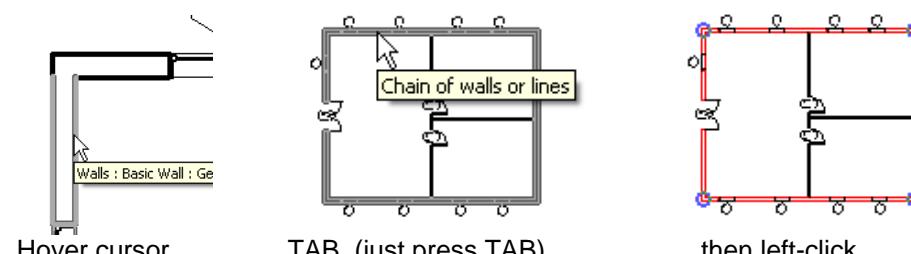
The design bar changes to the Sketch design bar with tools to help you draw the series of 2D sketch lines. When you end Sketch mode, the linework you have drawn is converted to the building component and the design bar returns to its normal state.

You use Sketch mode for many things in Revit Architecture. When creating floors, roofs, railings, stairs, solids, and voids, you use Sketch mode to establish the geometry of the building component.

Sketch mode lines have a few simple rules:

- Sketch lines must not overlap.
- Sketch lines must usually form a continuous shape without breaks or gaps in the linework.
- Sketch lines must not form T intersections.

Each of the different building components that you create with Sketch mode varies slightly in its requirements for its Sketch mode linework.



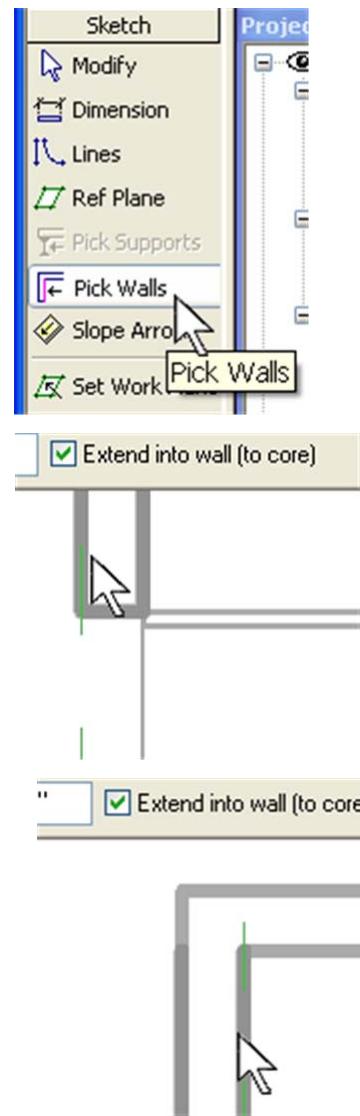
to select all the connected walls or lines.
(note the tab key is just pressed and released, not held down like the shift and ctrl keys)

19

Add a Floor

On the Basics design bar, click **Floor**.

You are now in Sketch mode, and the design bar has changed. The default method for creating floors is by selecting existing walls (Pick Walls).



20

Hover-TAB-click to select all connected walls at once:

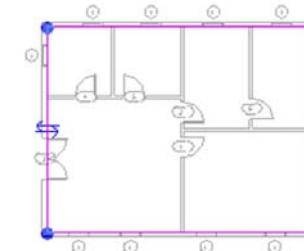
- Place the cursor over the inside edge of one of the exterior walls (without clicking).
- Press **TAB** to highlight all four walls.
- Left-click to select the highlighted walls as the floor boundary. Make sure you click the interior side of the walls.

You can draw the desired shape of your object (floor in this case) using the Lines tool, but often it is much faster and easier to accept the default proposed mode.

The Pick Walls function automatically recognizes the boundary of the connected walls and generates a closed loop of lines that represent the shape of the floor.

The side of the wall your cursor is on when you select a wall determines which side of the wall the sketch line is placed on.

When you use Pick Walls to define your sketch, Revit Architecture snaps either to the exterior/interior faces of the wall or to its structural core layer, as set on the options bar.

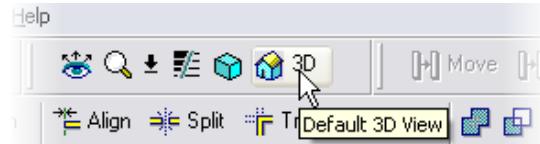


When you click with the mouse button, the software reads the geometry into the command and creates a magenta sketch line at each wall.

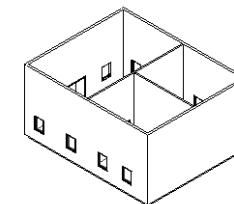
- 21 On the design bar, click **Finish Sketch** to accept the floor sketch.



- 22 Open a 3D view by clicking the 3D view icon on the toolbar.



You can reenter Sketch mode any time after designing the component by selecting the component and clicking the Edit button on the options bar.

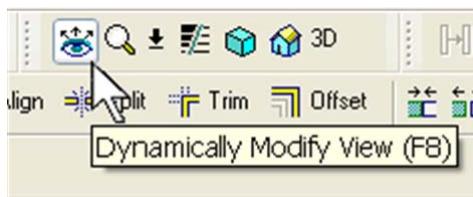


3D View Navigation

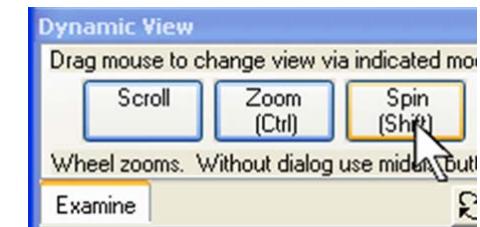
- 23 Rotate the model in the 3D view by pressing **SHIFT** and the middle button of the mouse at the same time, and then move the mouse.



Alternatively, click the icon on the View toolbar to open the Dynamic View dialog box. Then select **Spin** mode.



The cursor changes to the 3D rotate cursor.

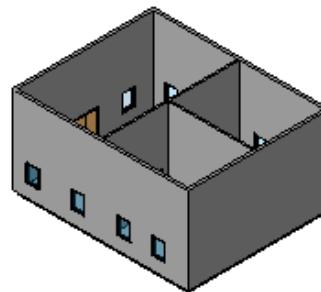


Model Graphic Style

You can use several different methods to change from Shade mode to Wireframe to Hidden mode.

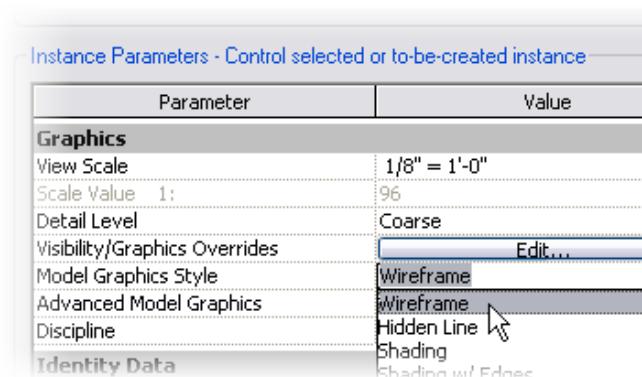
- 24 Model graphic style by keyboard shortcut:

Press the SD keys (in sequence) to activate a shaded view.



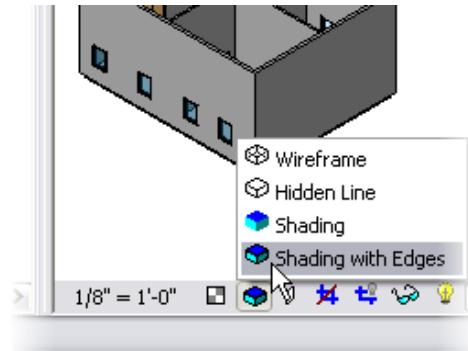
- 25 Model graphic style by view properties:

- Right-click the view. Click **View Properties**.
- In the Properties dialog box, change the Model Graphics Style to **Wireframe**.



- 26 Model graphic style by Workspace View toolbar:

- Click the model graphics tool at the bottom-left of the workspace.
- Click **Shaded with Edges**.



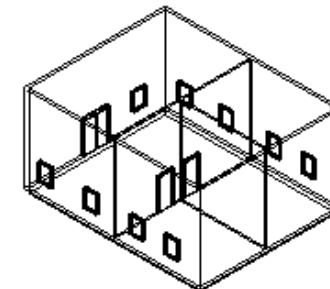
Modify Position of Components with Temporary

The other keyboard shortcuts for graphic style are as follows:

- WF = Wireframe.
- HL = Hidden Line.
- AG = Advanced Model Graphics.

You can customize keyboard shortcuts by editing the *keyboardshortcuts.txt* file in the program folder.

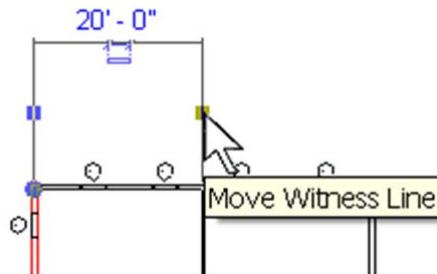
Like any wall or door, the view itself has properties. The properties page of a view controls many aspects of how the model is represented.



Dimensions

- 27 In the project browser, open Floor Plans Level 1 again by double-clicking **Floor Plans: Level 1**.

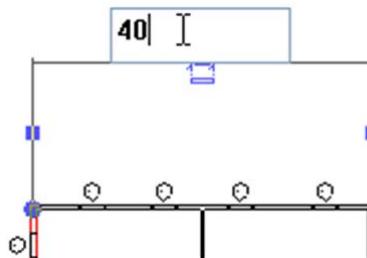
Select the left exterior wall. A temporary dimension appears.



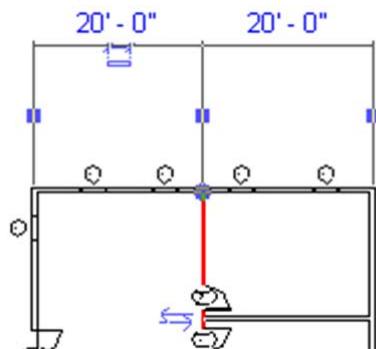
- 28 Drag the square middle grip to the right exterior wall.

- 29 Click the dimension text. Type **40** to change the building width to 40' if it is not already this dimension.

Repeat to make the north-south dimension **30'**.



- 30 Select the interior wall. Use the temporary dimensions to set the interior vertical wall to **20'** from one of the end walls.



The temporary dimension may not have the witness lines in the location you want. Drag the middle square grip on a temporary dimension line to a new location.

Revit Architecture uses real-world units: you can set them to be metric or imperial. You can access the dialog box for setting units by clicking Units on the Settings menu. You can also work in millimeters, centimeters, or meters, found on the same menu.

Notice that you have just defined a new position for the wall, but all other components adjusted accordingly.

Temporary dimensions appear whenever you select a component. Edit these dimensions on the fly by clicking the text and typing the desired value.

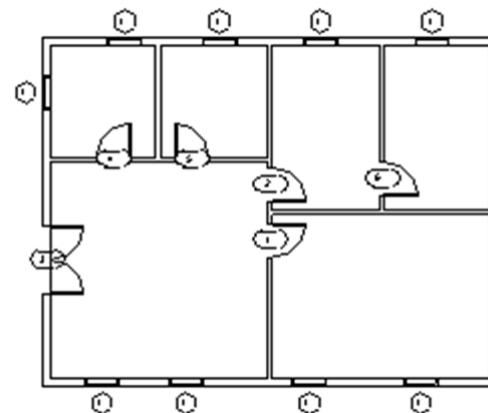
You can transform these dimensions into permanent dimensions by clicking the icon that appears below the dimension line.

- 31 Add walls and doors to create a few more rooms, always using the image as a guide.

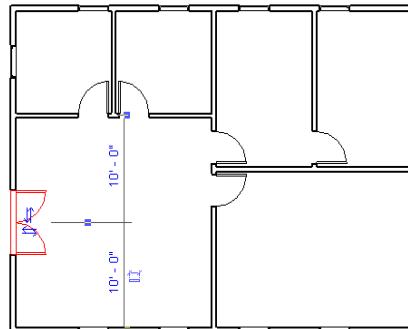
The interior walls are Basic Wall:

- Generic 5" type.
- Unconnected, and 20' tall.

The doors are **Single Flush: 36" x 84"**.



- 32 Select the double-entrance door. Change its position by changing the value of the lower temporary dimension: Type **10** in the dimension text for 10' – 0".



By right-clicking a component, you can use the Create Similar function, which activates insertion mode for the desired component. This command automatically inserts an object of the same type as the one selected.

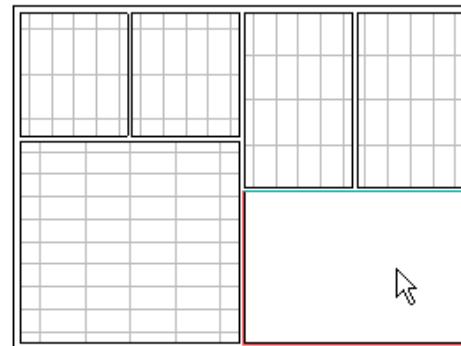
Add Ceilings

- 33 In the project browser, double-click **Ceiling Plans > Level 1**.

34

Add ceilings to the rooms:

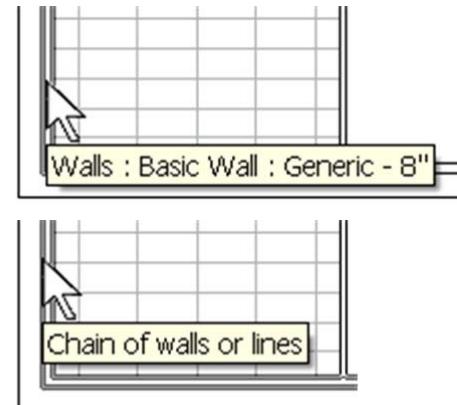
- On the Modeling design bar, click **Ceiling**.
- On the options bar, set ceiling type: **Compound Ceiling: 2' x 4' ACT System**.
- Click once inside each room to automatically generate the ceilings.



Selection Tip

Hold your cursor over the object, and press **TAB**:

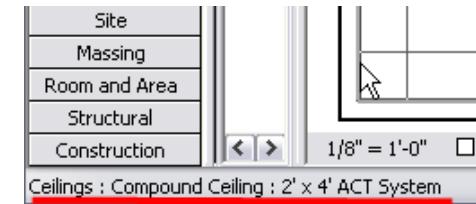
- Sometimes selecting objects that are colinear with other objects can be difficult.
- Hold your cursor over the edge of a ceiling (which is also the same location as a wall).
- Press **TAB** a couple times to cycle through the objects that are at the cursor location.



Add a Roof

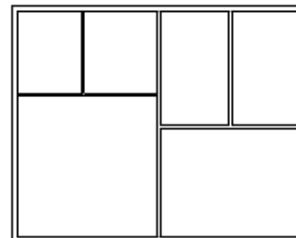
You can create roofs by footprint or by extrusion. This exercise walks you through creating a roof by footprint. A later unit illustrates roof by extrusion.

Although added with just a single click, ceilings, like floors, are also sketch based. The Auto-Generate tool is helpful, but if you need to change the shape, you must select the ceiling and click Edit on the options bar.



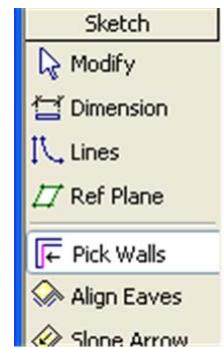
Anything that you select with a left mouse-click is available as a tooltip and at the lower-left corner of the window at the status bar.

- 35 In the project browser, open **Floor Plans > Level 2**.

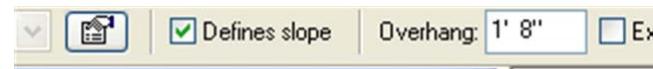


- 36 On the Modeling design bar, click **Roof > By Footprint**.

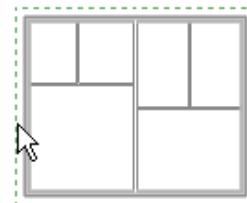
You are in Sketch mode. The default Sketch mode is **Pick Walls**.



- 37 On the options bar, in the Overhang box, type **1' 8"**. Make sure that **Defines Slope** is selected.



- 38 Highlight any exterior wall. Press **TAB** to highlight all four. Click to create the roof footprint.



- 39 On the design bar, click **Finish Roof**.

If the **Pick Walls** option is selected, the roof boundary follows the wall's position. Any further changes to the wall location are automatically propagated on the roof shape.

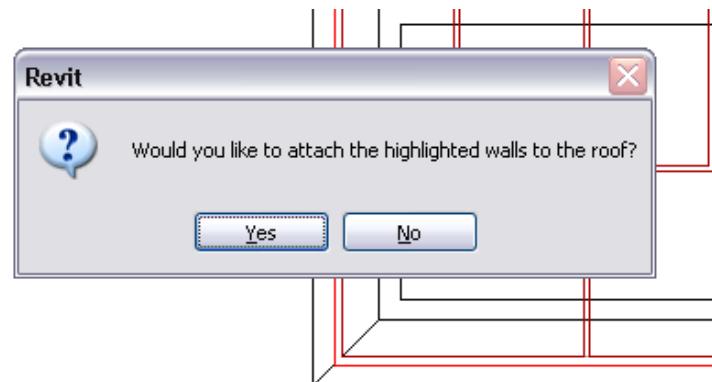
Pick Walls is equivalent to assigning a constraint to maintain design intent or structural sense.

When clicking, make sure your cursor is positioned on the exterior side of the wall or the overhang is on the wrong side.

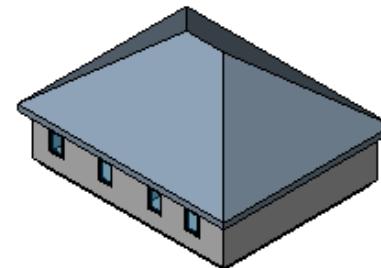
Using **TAB** to select is a convenient way to select chains of components with a single click. It is widely used in Sketch mode.

- 40 A dialog box asks if you want to attach the highlighted walls to the roof. Click **Yes**.

By clicking Yes, you are attaching the walls to the roof and thus defining an explicit relationship: if the roof changes height, the attached walls follow accordingly.



- 41 Open the 3D view by clicking the 3D icon to see the roof.



Make Gable Ends and Adjust Roof Slope

In this section you reenter Sketch mode to modify the slope of the sketch lines.

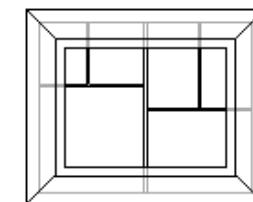
- 42 Go back to floor plan Level 2.

- 43 Select the roof.

On the options bar, click **Edit**.



When you finish the roof, the roof appears to be cut off at the top. The control of the cut plane is set for each view in the view properties. You adjust this setting in the next exercise.



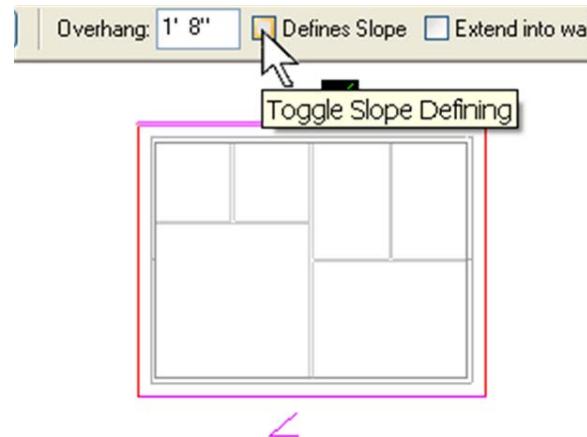
The 3D view category is automatically created once a 3D view is opened. You can customize view grouping so the project browser can display the view groups in many different ways.

- 44 Select the left and right roof footprint lines.

On the options bar, clear **Defines Slope**.

Clearing the Defines Slope check box tells Revit Architecture that this edge of the roof does not slope and is therefore a gable end to the roof.

To select more than a single item, hold down CTRL as you select the objects.



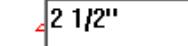
- 45 Select the top magenta line.

Text displaying an angle value appears.



- 46 Click the blue text. Change the value to 2 1/2".

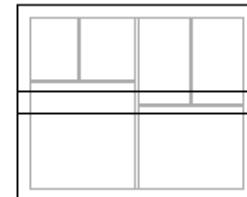
Repeat for the bottom roof sketch line.



Revit Architecture manages the slopes by automatically adjusting most geometrical data. If the eaves are not correct, use the Align Eaves tool to correct the problem. See Unit 8 for more information on the Align Eaves tool.

Hold down SHIFT to remove objects from an existing selection set.

- 47 On the Sketch design bar, click **Finish Roof**.



Sketch lines are displayed in magenta, which you can change to any other color: Settings > Line Styles > Lines (Sketch).

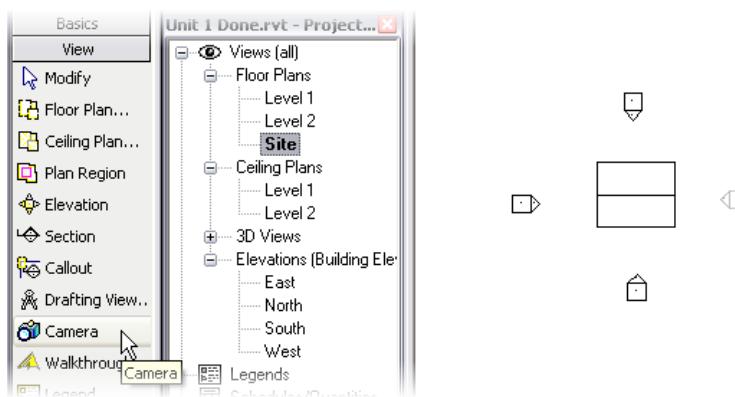
Change the value of the roof slope by selecting the slope-defining line and opening its Properties dialog box, where you find the angle parameter.

While lower in height, the roof is still cut by the view range of level 2.

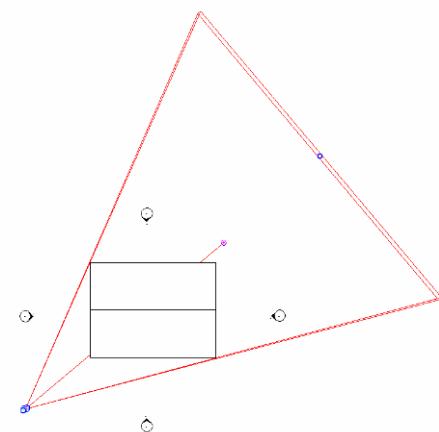
Add a Camera (Perspective View)

- 48 Open **Floor Plan: Site**.

- 49 On the View design bar, click Camera.



- 50 Select a point at the lower left to place the camera.
- 51 Select a point at the upper right to establish the direction the camera is pointing.



- 52 Once you have placed a camera, the building displays in a 3D view (press SD to shade the view).



The camera creates a perspective view that is automatically placed under the 3D group in the project browser.

Once the camera view is generated, the camera itself is no longer displayed in plan view or sections/elevations. To display it, right-click the 3D perspective view in the project browser. Click Show Camera.

An easy way to reposition your camera directly in perspective view is by opening the Dynamically Modify View dialog box and applying the different options available for navigating in the 3D workspace.

Note that you can change or modify elements directly in 3D perspective views only by selecting the component and opening its Properties dialog box.

Unit 2

Theory: Objects

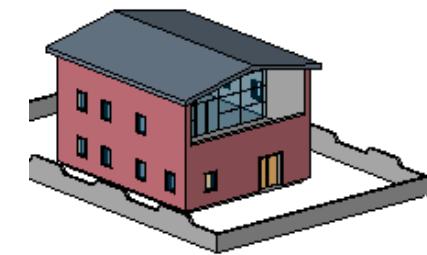
Revit Architecture: Walls, Floors, and Ceilings

This unit covers wall, floor, and ceiling basics.

This exercise adds a level 3 to the project and moves the roof up to the new level. A deck area and curtain wall are added to the second level.



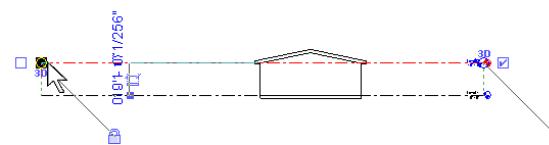
Unit 2 Exercise Start



Unit 2 Exercise Complete

Add a New Level

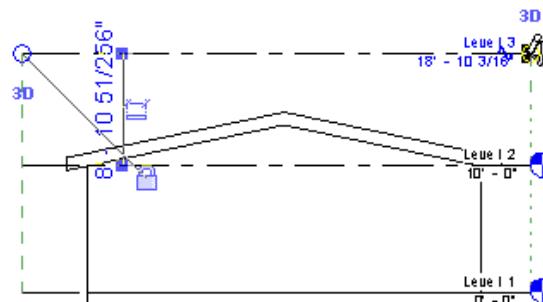
- 1 Open file i_Unit 2 – Start to the 3D view.
- 2 Open Elevation East.
- 3 Adjust the length of the level markers by dragging the ends toward the building:
 - Select a level line.
 - Left-click and drag the open blue circle at the left end of one gridline toward the building.
 - Repeat with the right side.



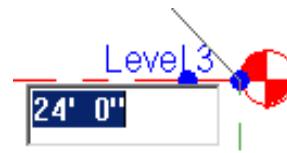
Revit Architecture allows editing and creation of most components in all available views.

4 Add a new level 3 to the project:

- On the Basics design bar, click **Level**.
- Draw a level above Level 2 by drawing a horizontal line from left to right.



5 Click the elevation text of the level mark, and type **24**.

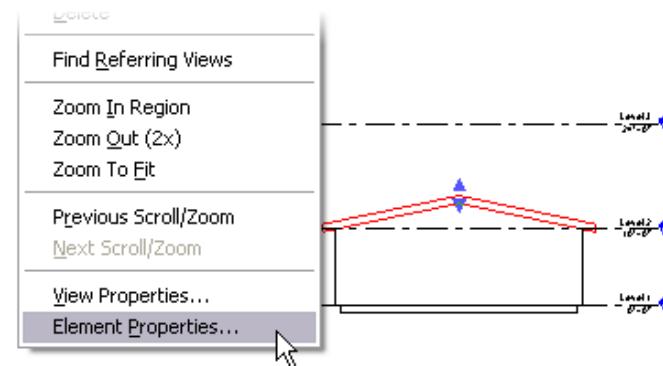


Note how Revit Architecture helps you snap to the beginning and end of the other level lines.

Some annotations allow direct editing of their properties (in this case: level height).

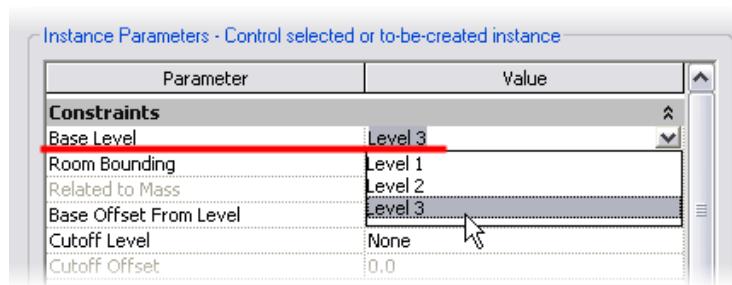
Modify the Roof Position, Changing Its Level from 2 to 3

6 Right-click the roof. Click **Element Properties**.



Levels are managed as any other entity. Levels are a data element in Revit Architecture. Although they look like a standard annotation, they are the basis for vertical control for most components in the building model.

- 7 Change the Roof **Base Level** to **Level 3**.



Change component constraints at any time during the design process.

- 8 Click the OK to return to the drawing window.

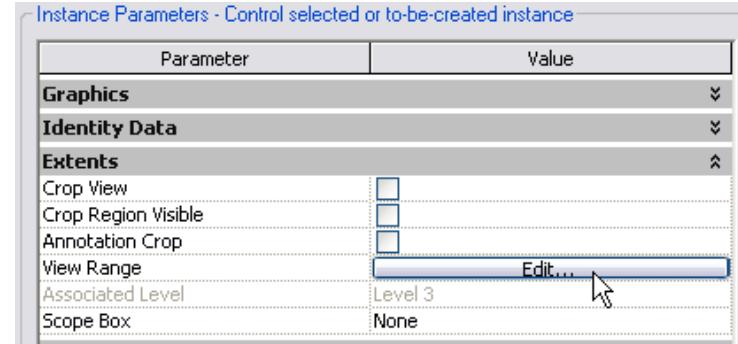
Adjust View Range

Now that the roof is on its final level, you can adjust the view range to show the full height of the roof.

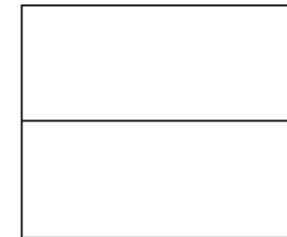
- 9 Open the **Level 3** view.
10 Right-click in the drawing view. Click **View Properties**.



- 11 Click the **View Range Edit** button.

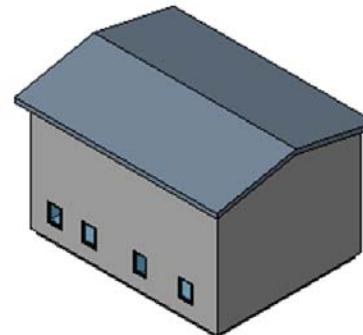


- 12 Change the Top and Cut Plane offsets to **30'**.

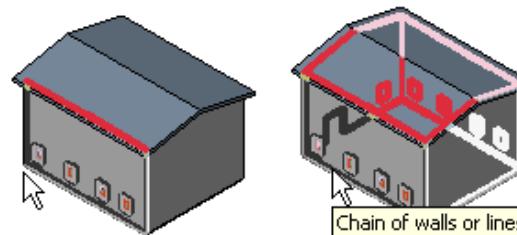


Change Wall Type

- 13 Open the 3D view.



- 14 Select the four exterior walls (hold your cursor over one wall and press **TAB**, and then left-click the chain of walls).

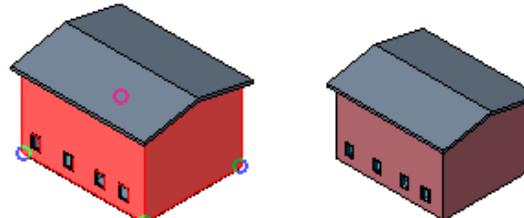


The roof is constrained to the level. As the level moves, the roof moves with it. In addition, because you attached the walls to the roof, the inherent constraint is applied. They then follow the roof up to the third level as well.

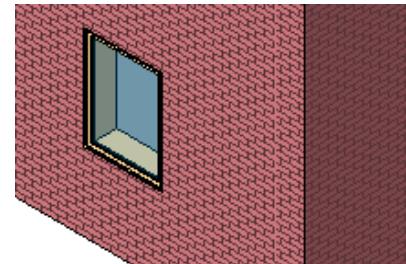
The template contains many different wall types. Walls, roofs, floors, ceilings, stairs, and railings are system families and cannot be loaded from an external file except by using the Transfer Project standards command on the File menu.

Note that you must have at least two projects open in the same session for the tool to be available.

- 15 On the options bar, change the wall type to **Exterior – Brick on Mtl. Stud.**



- 16 Zoom in the 3D view to see the different finish and material of the wall type.



Add a Floor Slab on Level 2

For this floor you extend the floor into the walls to the outside edge of the stud. To do this you need to watch where the cursor is pointing as you are picking in the drawing area.

- 17 Open **Floor Plan Level 2**.

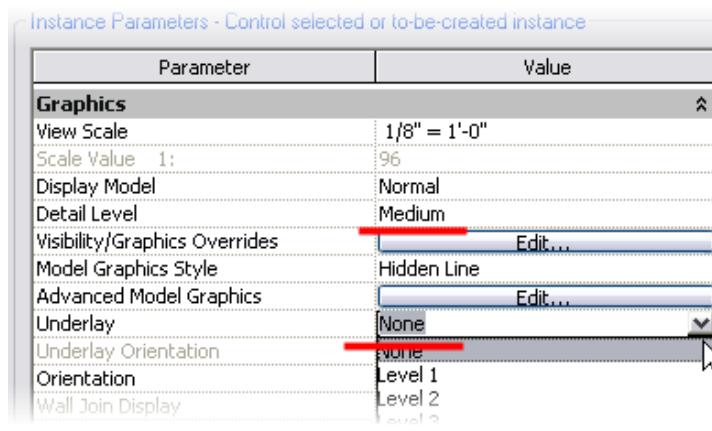


To transfer system families from one project to another, it is generally easier to copy an instance of that object from one project to another. The system family of the instance is then also copied into the target project. Just use CTRL+C to copy and CTRL+V to paste.

The brick hatch appears as you zoom closer into the building. The hatch does not appear in Shading mode, only Shading with Edges.

With the options bar set to “extend into wall (to core)” as you move your cursor pointer over the walls, it highlights either side of the stud rather than the finish face of the walls.

- 18 Change the view detail level and underlay for the second floor view:
- In the project browser, right-click the **Floor Plan Level 2**. Or right-click in the drawing area, and click **View Properties** to open the View Properties dialog box.
 - Change the Detail Level from Coarse to **Medium**.
 - Change the Underlay field to **None**.
 - Click OK to return to the drawing window.



- 19 On the Basics design bar, click Floor.

You are in Sketch mode.



- 20 Verify that Pick Walls is set on the Sketch design bar.

On the options bar, set:

- Offset = **0**.
- Select Extend into Wall (to Core).

Views have many different properties that filter the information of the underlying data model and define how it is displayed.

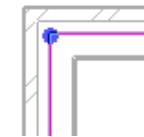
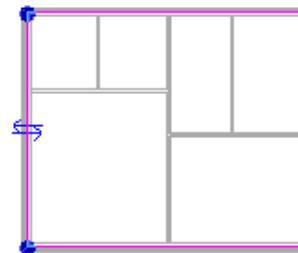
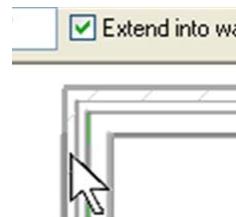
You are setting the detail level to Medium here to allow you to see the stud when you place the floor in the next step.

When clicking the wall-defining line for this floor slab, make sure that:

- The option Extend to Core is selected on the options bar.
- The green lines that appear while highlighting the walls are in the middle of the wall (or slightly off center). This is the exterior face of the core (the stud) of the wall, or if the cursor is inside the building, to the location between the gypsum finish and the stud.

- 21 Hold your cursor over the outside edge of the stud of one exterior wall, and press **TAB**.

Click to select the four exterior walls.



When you created the first floor, Pick Walls created a sketch line either inside or outside the wall. Now that the wall is of a different type (Brick on Stud), the definition has changed. Part of the definition is a core (or structural core). For this wall type the stud has been defined in the core and the brick defined as a finish on the core (outside the core of the wall).

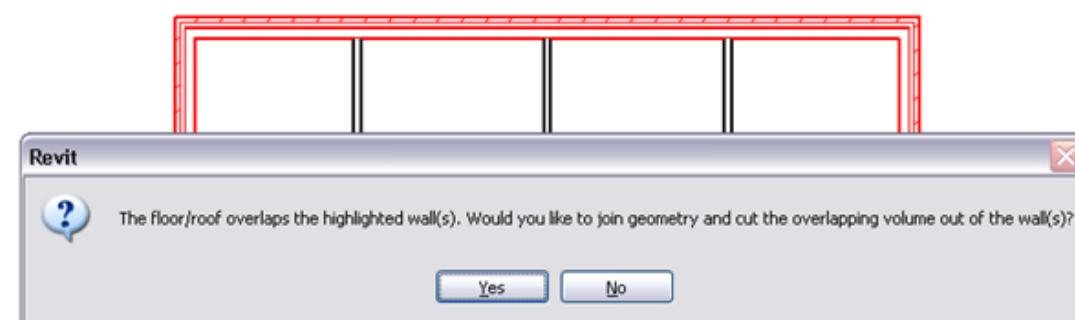
- 22 On the design bar, click **Finish Sketch**.

- 23 In the dialog box that appears when you finish the sketch, click **Yes**.

This prompt is asking if you want to cut the geometry of the floor from the geometry of the wall. Click **Yes**.

This option extends the floor into the wall to create a bearing condition that you see when you start working with the sections.

When you are creating floors, you may also see a similar dialog box. This dialog box appears if you have drawn walls that extend their tops to the level you are drawing your floor on. Because the building you are working on has the walls extending to 20' (created in Unit 1), you should not see this dialog box.

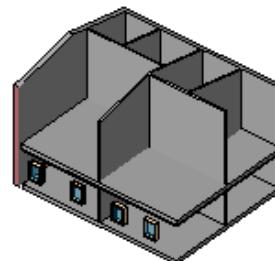


This prompt is asking if you want to establish a relationship between the interior walls and the new floor. Click **Yes**.

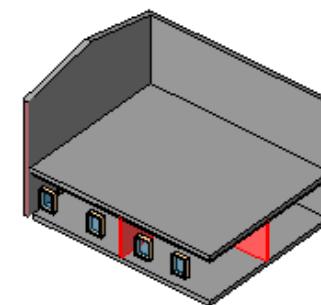
This option cleans up the intersections among walls and the floor.

Constrain Walls to a Different Height

The interior walls were set to the 20'-0" height when they were drawn. When you created the roof, all the walls extended to the underside of the roof. In this section you manually adjust the tops of the interior walls to the underside of the floor you just drew.



Exercise Section Start

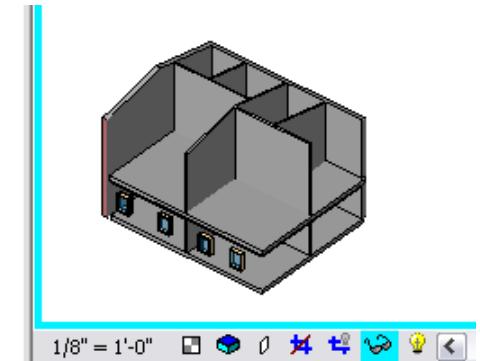
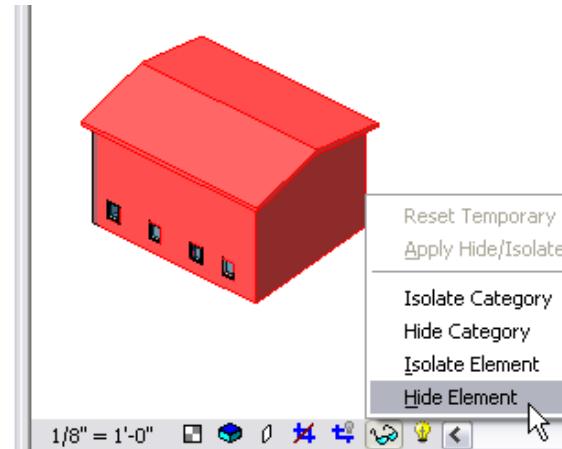


Exercise Section Result

- 24 Hide the outer walls and roof in the 3D view:

- Open the 3D view.
- Select the two visible exterior walls and the roof.
- On the View toolbar, click the **Hide/Isolate** icon.

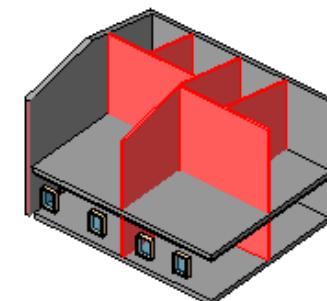
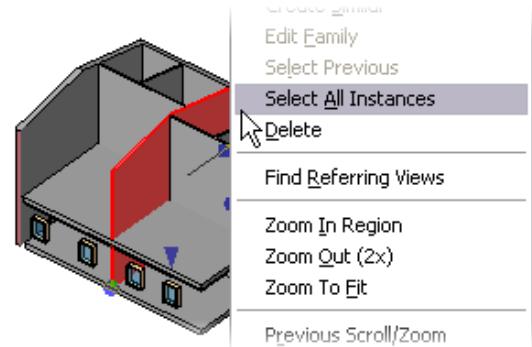
Hide/Isolate is a view-specific tool that is useful when working in a 3D view displaying a lot of data.



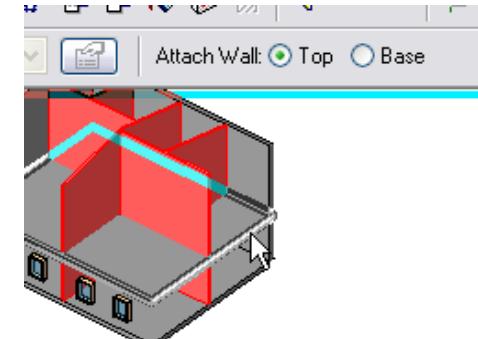
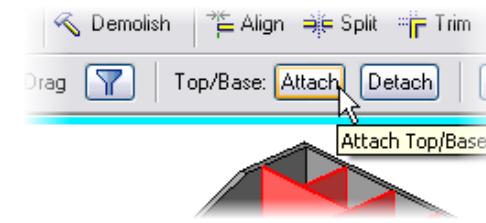
When the tool is active and a component is hidden or isolated, the icon on the View toolbar changes color to indicate that the view contains hidden data.

- 25 Select all the interior walls:

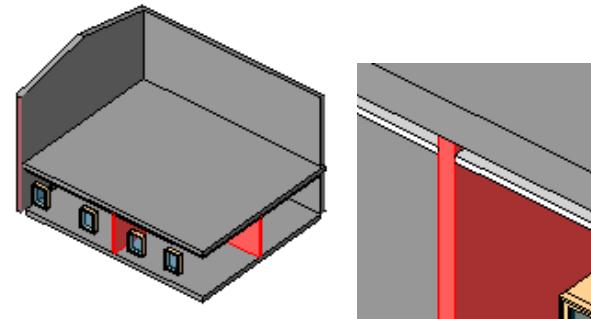
- Right-click one interior wall.
- Click **Select All Instances**.



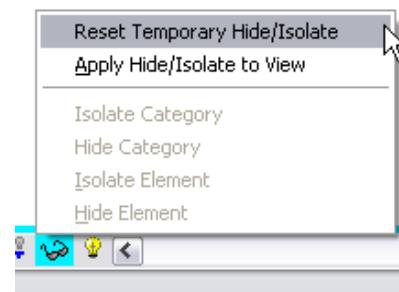
- 26 On the options bar, click **Attach**. Then click the second-level floor.



An explicit relationship between the interior walls and the slab above is established.

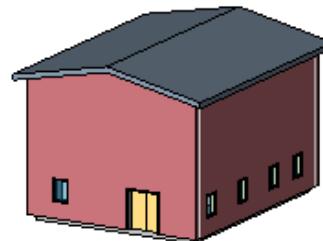


- 27 Click the **Temporary Hide/Isolate** icon on the Workspace View toolbar. Click **Reset Temporary Hide/Isolate**.



Add a Deck and Curtain Wall at the Second Floor West Side

This next section takes you through adjusting the west wall to be a balcony height wall, then adding a curtain wall to the second floor.

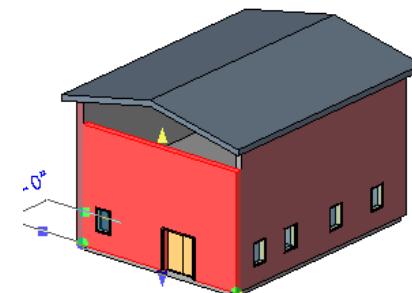
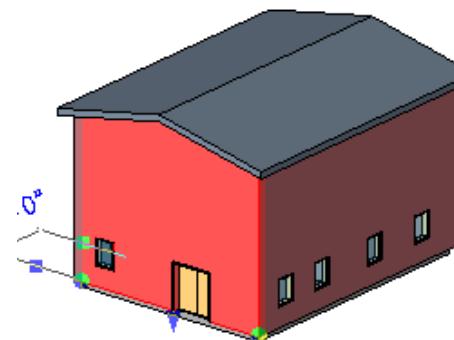


Exercise Section Start



Exercise Section End

- 28 Rotate the 3D view, as shown in images.
- 29 Remove the wall's attachment to the roof:
 - Select the front wall (containing the double door).
 - On the options bar, click **Detach**.
 - Click the roof.



- 30 Move the top of the wall 4' above level 2:
 - Right-click the western wall.
 - Click **Element Properties**.
 - Change the Top Constraint value from Explicit to Level 2 and the Top Offset field to 4'.

Instance Parameters - Control selected or to-be-created instance	
Parameter	Value
Constraints	
Location Line	Wall Centerline
Base Constraint	Level 1
Base Offset	0' 0"
Base is Attached	<input type="checkbox"/>
Base Extension Distance	0' 0"
Top Constraint	Up to level: Level 2
Unconnected Height	10' 0"
Top Offset	4'
Top is Attached	<input type="checkbox"/>

You can remove explicit relationships at any time.

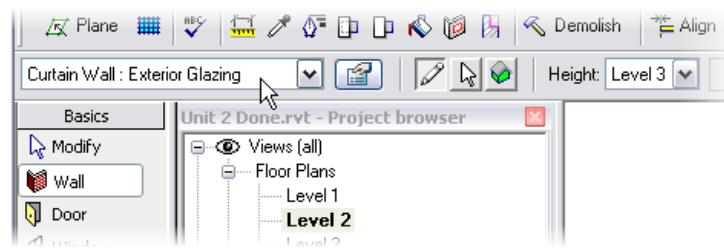
Add a Curtain wall

- 31 Open Floor Plan Level 2.
- 32 On the Basics design bar, click **Wall**.

Change the wall type on the options bar to **Curtain Wall: Exterior Glazing**.

Before you start drawing, set the height to Level 3 on the options bar.

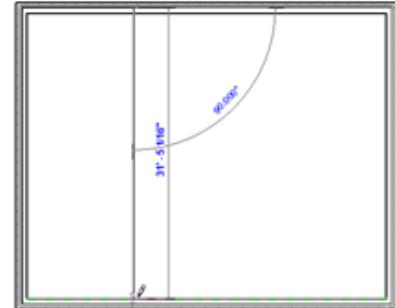
- 33 Draw a vertical wall, as shown in the image.



- 34 Open the 3D view.

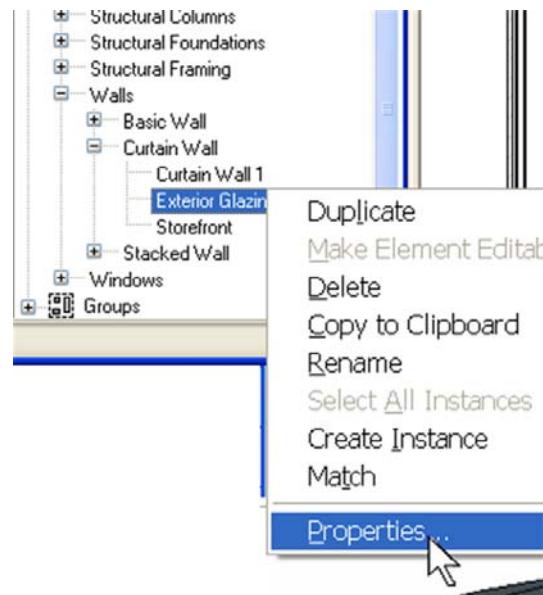
While a curtain wall in architectural terms is a specific term that applies to a glazing system, in Revit Architecture, the curtain wall object is not limited to this strict definition.

You can use Revit Architecture curtain wall objects to define many grid-based construction assemblies, including curtain walls and interior modular partitions.



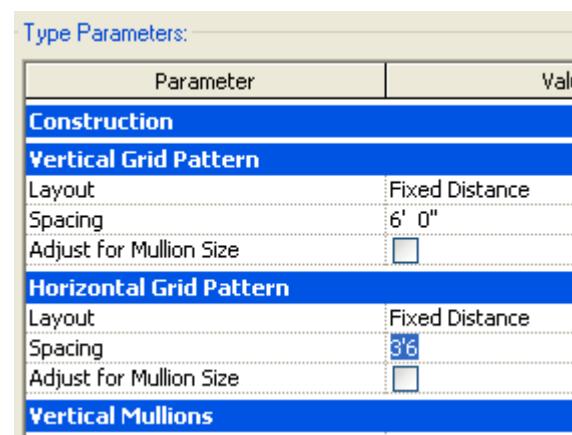
Curtain walls are considered wall families. Most of the Instance parameters are the same as for the basic wall families, but the Type parameters are completely different.

- 35 In the project browser, right-click **Families > Walls > Curtain Wall > Exterior Glazing**. Choose Click Properties.



- 36 Change the pattern to the spacing as shown.
- Vertical Grid: Spacing: 6'-0".
 - Horizontal Grid: Spacing: 3'-6".

Click OK to close the dialog box and see the changes in the model.



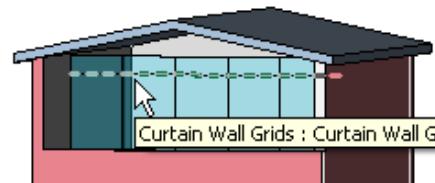
There are many different ways to access a family's Properties dialog box.

The pattern layout properties refer to the curtain gridlines.

The available options allow for flexible editing.

Selecting Curtain Walls

When you are selecting the curtain wall, as you hover your cursor over the curtain wall, you see either the individual grids of the curtain wall highlight or the outer frame. You can perform different functions depending on what you select. In this case you want to select the overall rectangle.

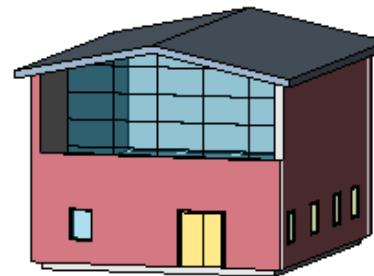


Pointer above grid selects individual gridline.



Pointer over edge selects the curtain wall object.

- 37 Select the curtain wall. On the options bar, click **Attach**. Click the roof.



This curtain wall type contains only the grid divisions. Mullions must be placed after positioning the curtain wall.

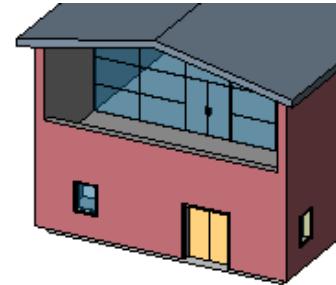
To add mullions, on the Modeling design bar, click **Mullion** and click any curtain grid. But do so after completing the next section of the exercise where you add a door into the curtain wall.

Add a Section

In this part of the exercise you:

- Add a section to the project.
- Add a door to the curtain wall.

A section, like a level, also creates a view that represents the section. In many cases in Revit Architecture, it is convenient to add a section or an elevation specifically to help you see and access for selection the objects you are working on.



Project shown with curtain wall door in place.

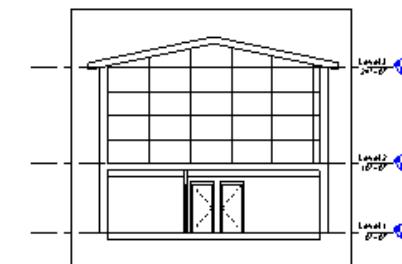
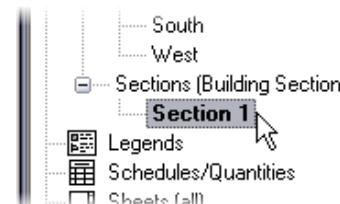
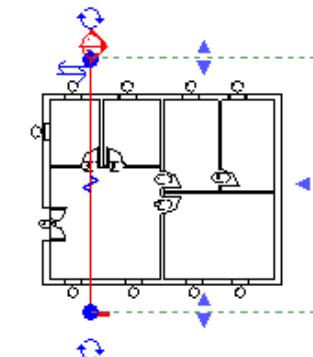
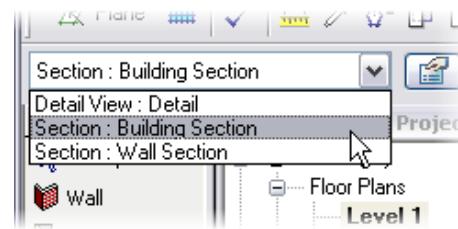
- 38 Open the view Floor Plan > Level 1.

39 Place the section mark:

- On the design bar, click **Section**.
- On the options bar, verify that the type selector is set to **Section: Building Section**.
- Click a point for the section bubble at the top left of the floor plan.
- Click a point for the section tail below the first point.

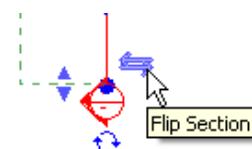
Click a white area of the drawing window to deselect the section mark just drawn.

40 Open the section by double-clicking the Building Section view that was automatically created in the project browser.

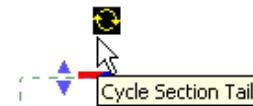


Section Marker Toggles

When you select a section marker, you see blue flip arrows and blue cycle head/tail markers.

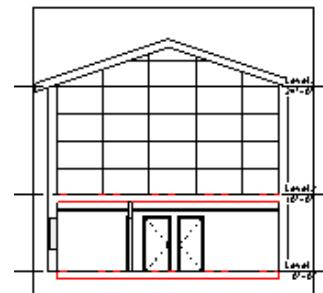


Reverse section views by clicking the arrow symbols that appear next to the section head.



Section heads and tails can be turned on or off and toggled among the available loaded ones by clicking the circular arrow symbols next to the section head and tail.

- 41 Select the floor slabs on Level 1 and Level 2 (use CTRL). On the options bar, verify that their type is **Generic - 12"**.

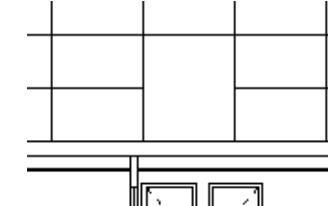
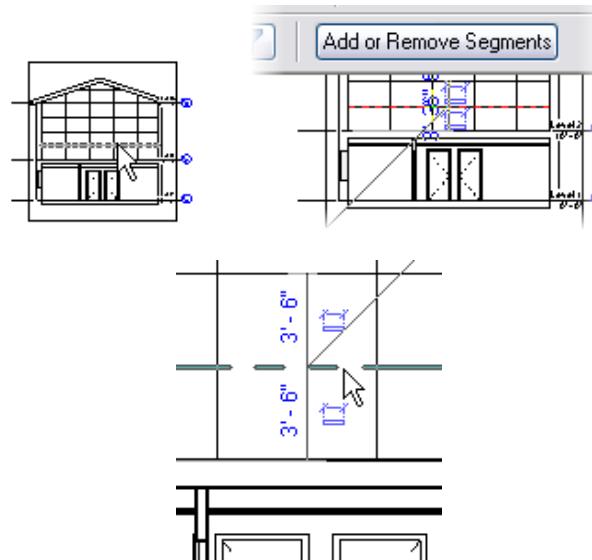


You can switch between section and plan views by double-clicking the blue marker for the level or the section mark. This method works only if the mark is deselected, that is, showing blue rather than red (selected).

Add a Door in the Curtain Wall

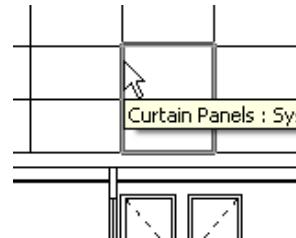
- 42 Remove the segment of the grid where the door will be placed:
- Select the first gridline from the bottom of the curtain wall (use TAB if needed to select).
 - On the options bar, click **Add or Remove Segments**.
 - Click the middle segment to remove it.

In this section you merge two panels in the curtain wall and replace the panel with a door.



The grid is removed from that section of the curtain wall. This is now a solid panel that you can replace with a door.

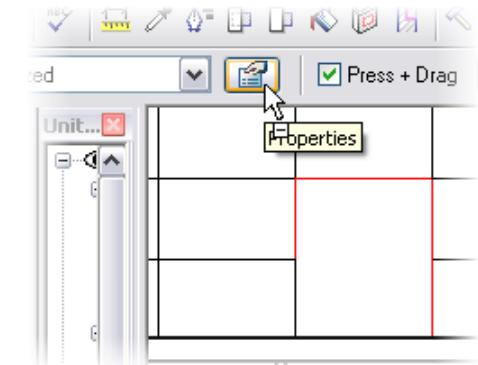
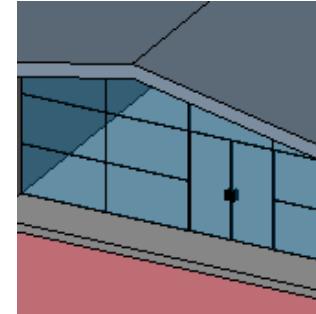
- 43 Using **TAB**, select the new curtain panel that is twice as big as the other ones (position the cursor next to the side of the panel, and press **TAB** until it is highlighted, and then left-click). Open the Properties dialog box by clicking the icon on the options bar.



- 44 Click **Load**, and navigate to Imperial Library > Doors > Curtain Wall Dbl Glass.rfa.



- 45 Click OK to accept and close the Properties dialog box. Open the 3D view to see the change.



Load family components as needed during the design process.

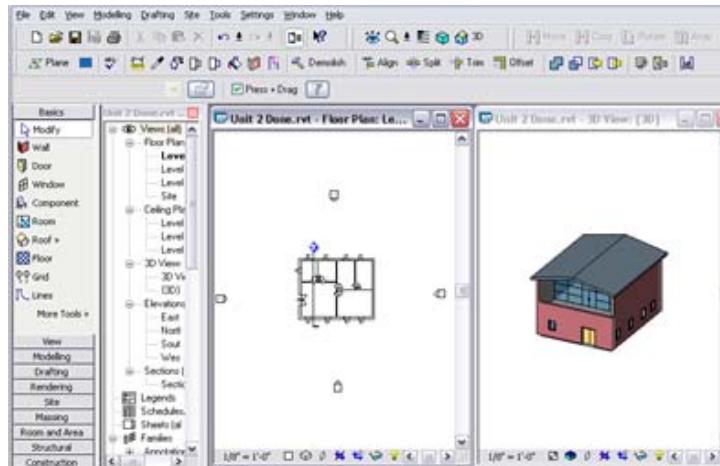
Copy Components from One Level to the Other

- 46 On the Window menu, click **Close Hidden Windows**.

As you work with the different views, they remain open until you close them. Close Hidden Windows enables you to free computer memory by closing those windows that you are not using.

- 47 Open the view **Floor Plan Level 1**.

- 48 On the Window menu, click **Tile**.



Select, Filter, and Copy Components from One Level to the Other

In this section you copy some of the windows from level 1 to level 2. In copying the windows, you use several selection tools.

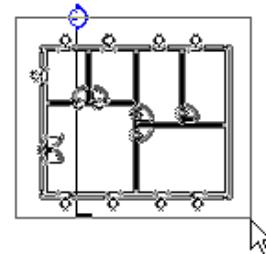
You use the window selection method (picking a point in the screen at left and dragging the pointer right around the objects you want to select).

You then use the filter function to remove everything from the selection set but the windows.

You then selectively remove some windows from the selection set by selecting while holding SHIFT.

- 49 Open Floor Plan Level 1.

- 50 In plan view, draw a selection window around the building.



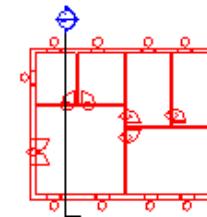
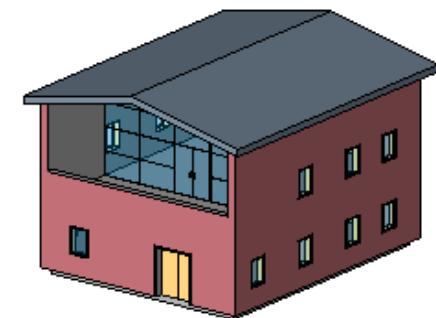
Alternatively, you can press WT on your keyboard to tile the windows.

Tiling windows enables you to work in more than one view at a time.

This tool is particularly useful for selecting objects that may not be available from any one view.

Any windows that you have minimized at the time do not tile.

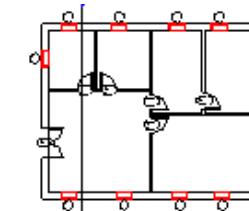
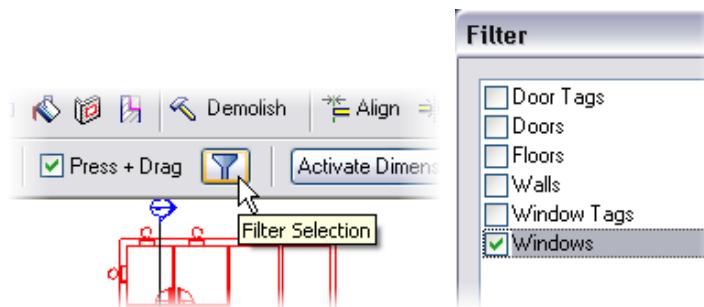
Finally you use Copy and Paste Aligned to copy the windows to level 2.



The selection window selects everything within the box created by the two picks.

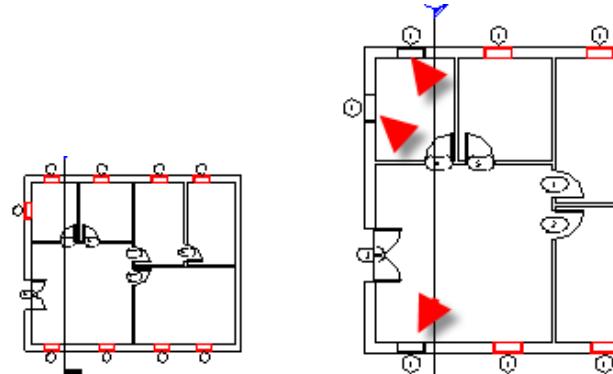
51 Filter out everything but the windows:

- With the building still selected, on the options bar, click the **Filter** tool.
- Select only the **Windows** check box.



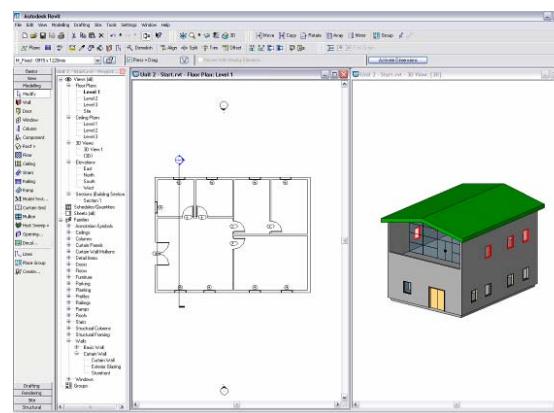
52 Remove the western three windows:

- Press and hold **SHIFT**.
- Click the three windows on the west side of the building to remove them from the selection set.



53 On the Edit menu, click **Copy to Clipboard**.

On the Edit menu, click **Paste Aligned > Select Levels by Name > Level 2**.



The default selection with the cursor movement is as follows:

- Left to right: Include only those objects entirely within selection box.
- Right to left: Include any element that lies within or is crossed by the bounds of the selection box.

When selecting individual components:

- CTRL+click** adds to the selection set.
- SHIFT+click** removes from selection set.

You can use Paste Aligned on multiple levels at the same time by pressing **CTRL** and clicking the level names in the dialog box.

Modify a Wall Profile

In this last section of the exercise you add a small garden wall around the building and modify the profile of the wall to provide a sculpted top.

54 Open Floor Plan: Site.

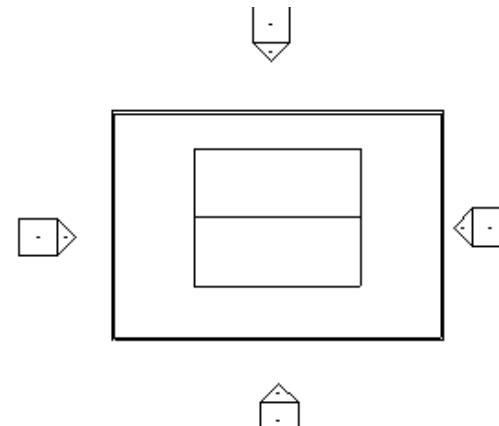
55 Add the site walls:

- On the Basics design bar, click **Wall**.
 - Wall type = Generic 8".
 - Height = Unconnected 4'.
 - Shape = Rectangular.
- Click in the drawing window above and to the left of the building.
- Click in the drawing below and to the right of the building.

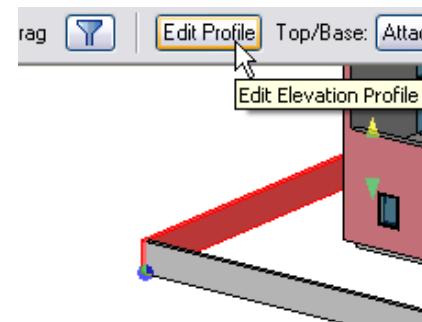
56 Open the 3D view.

57 Select the north wall.

On the options bar, click **Edit Profile** to enter Sketch mode.



Change wall height as well as any other wall property after it has been positioned by opening the Wall Properties dialog box.



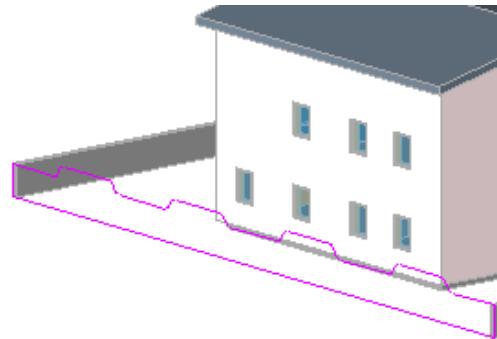
When editing the wall profile, you are in Sketch mode and some specific rules are applied:

- All wall constraints are removed while sketching.
- The line that is constrained (usually the bottom and top lines) displays a lock icon if you select it.

- 58 Select the top sketch line of the wall and delete it.

Create a new top profile for the wall using the Sketch design bar's **Line** tool. Rotate the model for better visibility. Use image as a guide.

Click **Finish Sketch** when done.



- 59 Repeat the process with the south wall.



You can create rectangular openings in curved walls but not edit the profile. To achieve a different profile, you must cut the wall with an in-place family.

Unit 3

Theory: Families and Nested Families

Revit Architecture: Editing Types

Control for how Revit Architecture components are constructed and located in a project occurs at the family, type, or instance level. In general the **family** controls the geometry, the **type** controls the size, and the **instance** controls the location in space. In this unit you work with families and types. You create a new **wall type** and **window type** by duplicating existing types in the project.

There are two kinds of families in Revit Architecture: system families and component families.

System Families

Walls, floors, ceilings, and roofs all are system families. The definition for system families cannot exist outside the project. You create new types of walls by duplicating existing ones in your project and then changing the definition of the copy. In this unit you create a wall type with a sweep for a base and a reveal (cut-out) at the top. You also split the brick, adding a new component to the wall base.

Component Families

As opposed to system families, families such as doors, windows, and furniture can exist outside the project as files with an RFA extension. When you use the Load from Library command, you are loading one of these families. While the type definitions (sizes) are part of the family definition, you can copy and create new types within the project file. In this unit you duplicate an existing window type to create a new size window.

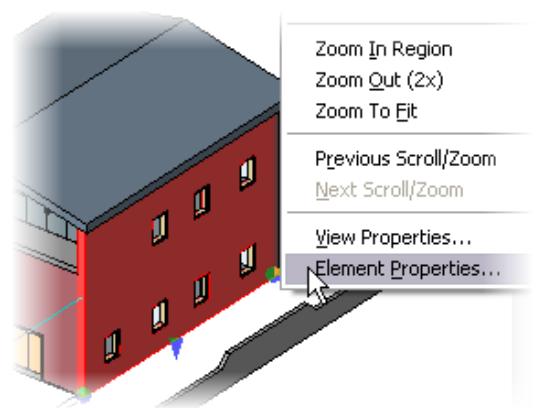
This exercise focuses on how to create types within the project. Nested families and the Family Editor for creating new family RFA files are explained in Units 10 and 11.

Duplicate a Wall Type

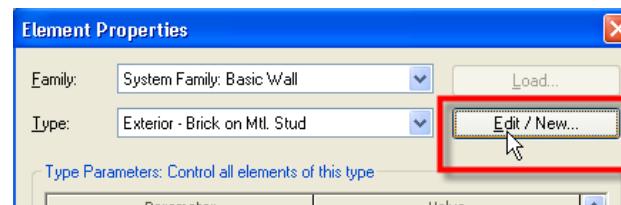
- 1 Open file Unit 3 – Start. Open the 3D view and orient the view as shown.



- 2 Right-click one of the exterior walls.
Click **Element Properties**.



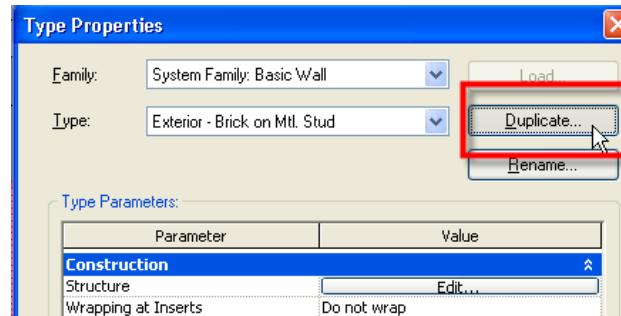
- 3 Click **Edit/New**.



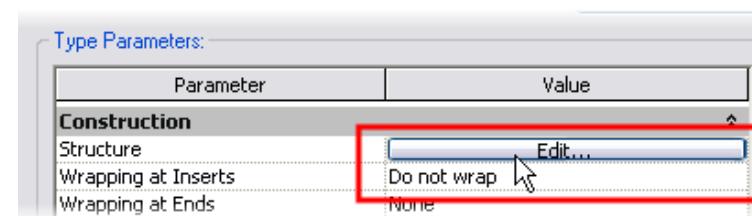
- 4 Click **Duplicate**.

Enter **Exterior - Brick on Mtl. Stud with Base** as the new name for the wall type.

Click OK to return to the Type Properties dialog box.



- 5 Click the **Edit** button next to **Structure**.



To access a component Properties dialog box, select the component and do one of the following:

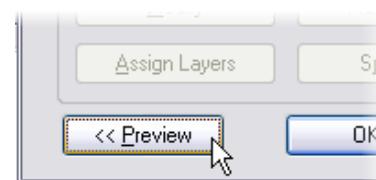
- Right-click the component. Click **Element Properties**.
- On the options bar, click the **Properties** icon.



It's good idea to always duplicate an existing type instead of editing it directly, which would mean that you were actually changing the standard Revit Architecture library. You can easily purge excess types later.

Every wall component has the following properties: layer, function, material, and thickness. Wall components can "wrap" around the wall end or at inserts.

- 6 If you do not currently see a preview at the left side of the Edit Assembly dialog box, click **Preview** in the bottom left of the dialog box.

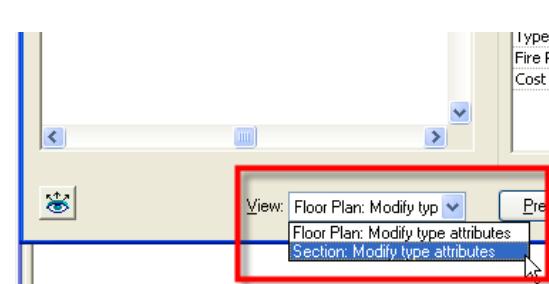


Load and Add a Wall Sweep

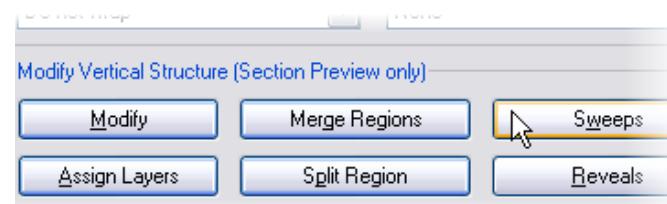
In this section you load and add a wall sweep to the wall.

- 7 Default preview is plan structure.

In the View list located on the left pane, select **Section**.

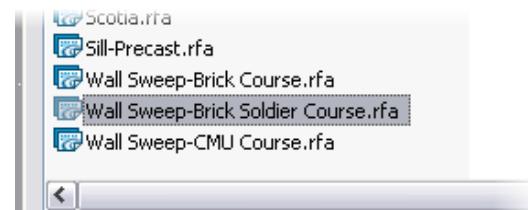


- 8 In the right pane, click **Sweeps**.



- 9 In the Wall Sweeps dialog box, load a new wall style into the project:

- Click **Load Profile**.
- Browse to **Imperial Library > Profiles**.
- Click **Wall Sweep Brick Soldier Course.rfa**.
- Click **Open**.



The preview pane displays the components in the views selectable from the drop-down menu below the preview.

The layer determines how wall components clean up with each other.

The material determines what hatch is shown when the wall is cut in section or plan or viewed in elevation along with the shading and rendering textures. Materials also affect how walls clean up.

Note that the lower part of the structure window becomes active only if you switch the preview to Section.



Sweeps and reveals are profile-based. The Sweep and Reveal dialog boxes allow for direct profile loading.

- 10 In the Wall Sweeps dialog box, click **Add**.

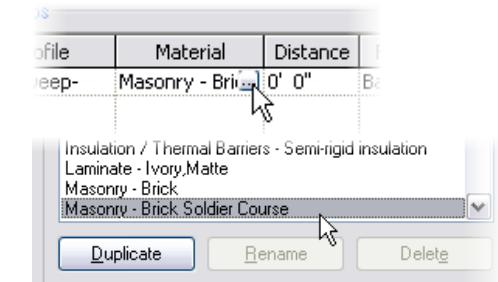
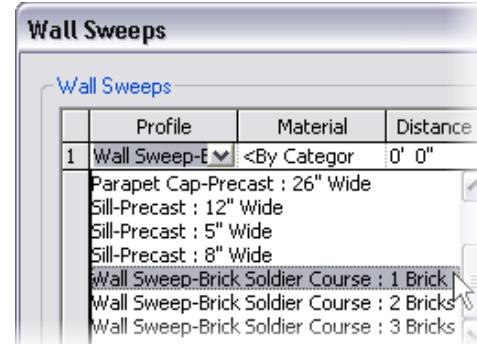


- 11 Use the list to set the profile to the Soldier Course: 1 Brick.

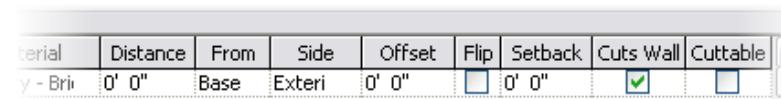
Click the **Material** line.

Click the **Browse** icon.

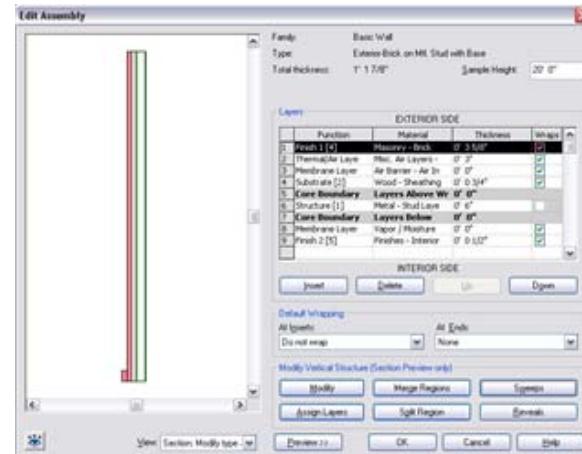
In the material selection page, double-click **Masonry Brick Soldier Course**.



- 12 Verify that the other values default to the values shown.



- 13 Click OK to return to the Edit Assembly dialog box.



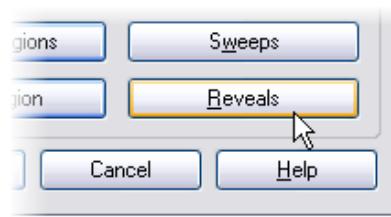
The brick sweep you applied appears at the lower-left corner of the wall.

Add a Reveal

A reveal is like a sweep, but instead of adding to the wall form, it subtracts from it.

The process and dialog boxes are the same. However, the profile already exists in the project because it was loaded into the original template.

- 14 You should still be in the Edit Assembly dialog box. Click **Reveals** to add a reveal.

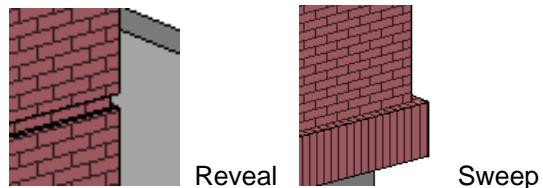


- 15 Click **Add** and set:

- Profile = Reveal - Brick Course: 1 Brick.
- Distance = 10' 6".
- From = Base.
- Exterior.

Reveals							
	Profile	Distance	From	Side	Offset	Flip	Setback
1	Reveal-Brick Course : 1 Brick	10' 6"	Base	Exterior	0' 0"	<input type="checkbox"/>	0' 0"

- 16 Click OK to close each dialog box and return to the drawing window.



You should see that a reveal notches out of a wall, and a sweep adds to the wall.

Sweeps and reveals are profile based. The Sweep and Reveal dialog boxes allow for direct profile loading.

More on Sweeps

Walls cannot have vertical sweeps set in the type, but they can be added manually from Modeling design bar > Host Sweep > Wall Reveal/Wall Sweep. You can also use this tool to create a horizontal instance of sweeps or reveals.

Sweeps and reveals clean up correctly at angles and inserts unless the inserted family contains specific solid elements in the family itself (that is, an exterior or interior door frame) that may interfere with the sweep/reveal.

It is possible to grip-edit sweeps at inserts and corners to redefine them. It is also possible to modify the sweep return around the corner. Select any sweep and check the available options on the options bar.

A profile is an external family that consists of linear geometry. You define a closed line shape (similar to Sketch mode) and save it as a family. Then you load the profile into the project as you would a door or window. However, unlike a door or window family, profiles cannot be used directly in the project but must be assigned to a sweep type definition (applied sweeps, roof slab edges), or directly to the object (wall and railing type definitions).

Split the Brick Layer

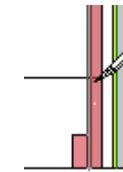
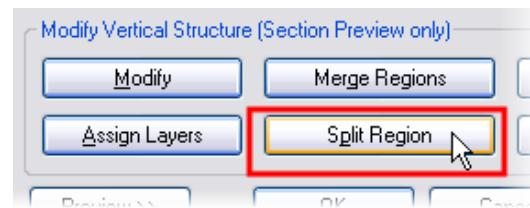
- 17 Return to the Edit Assembly dialog box for the wall you have been working with.

You can split the vertical components of a wall, adding different materials.

Right-click the wall with the reveal and sweep. Click Properties > Edit > New. Click the Structure Edit button.

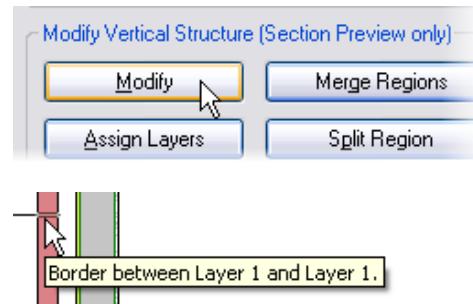
18 Click Split Region.

Hold your cursor over the masonry brick exterior layer on the preview. Click near the bottom of the wall to divide the brick structure into two parts.



19 Click Modify.

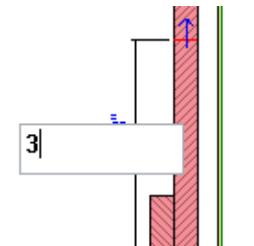
Click the line dividing the two brick regions.



To select this edge, you probably need to use the hover and tab process:

Hold your cursor over the split you made in the brick component. Do not select with the left mouse button yet. Use TAB to cycle through the various faces that you can select. Watch the edges highlight each time you press TAB. As you do this, watch the status bar at the lower-left corner of the application window. The status bar displays a description of what will be selected if you click at that time.

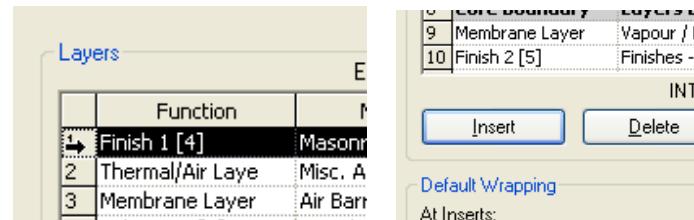
20 With the edge selected, use the temporary dimension to move the line to 3 feet above the bottom of the wall. Click the text of the temporary dimension and type 3 for 3'-0".



Add a New Wall Component

This section leads you through creating a new component with a different material to assign to the piece you just split.

21 Click Layer 1. Click Insert to create a new layer.

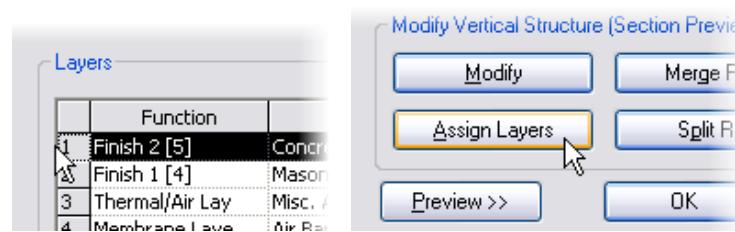


- 22 Change the new component's settings:
- Function: Finish 2 [5].
 - Material: Concrete Cast in Place.
 - Thickness: Do not change.

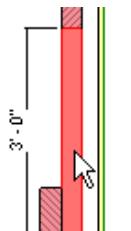
- 23 Make sure the layer row with the new component is selected.

Click Assign Layers.

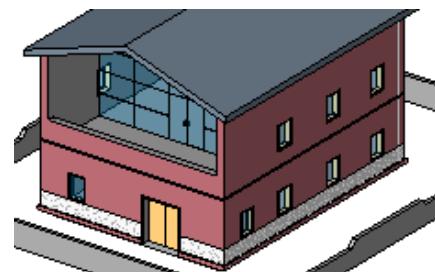
Layers				
EXTERIOR SIDE				
	Function	Material	Thickness	Wraps
1	Finish 2 [5]	Concrete - Cast-in-Place	0' 0"	<input checked="" type="checkbox"/>
2	Finish 1 [4]	Masonry - Brick	Variable	<input checked="" type="checkbox"/>
3	Thermal/Air Lay	Misc. Air Layers -	0' 3"	<input checked="" type="checkbox"/>



- 24 Click the lower part of the exterior brick component in the preview pane to assign the new wall component to it.



- 25 Click OK to close each dialog box and return to the drawing window.
26 Select the remaining three exterior walls, and on the options bar change their type to the new type Exterior - Brick on Mtl. Stud with Base.



Once the regions have been divided, it's not possible to edit the width of the component, as the system sets the default value to "variable thickness" according to how it is used within the wall type. That is, you could assign the same layer material to two different regions, laying on two different components, each with a different width.

You can split wall components into as many regions as you want, but creating complex walls should be done only when the design idea and the construction method are clear. Otherwise, editing the regions can become difficult when there are many of them.

The wall you just modified belongs to a system family. It cannot exist outside the project (RVT file) as a file you can edit. You create new types by duplicating existing types as was done in this exercise.

External (Hosted) Families: When you load from library, you are loading a separate file—a family (RFA) file. These files store the basic geometry and parameters for components such as doors and windows.

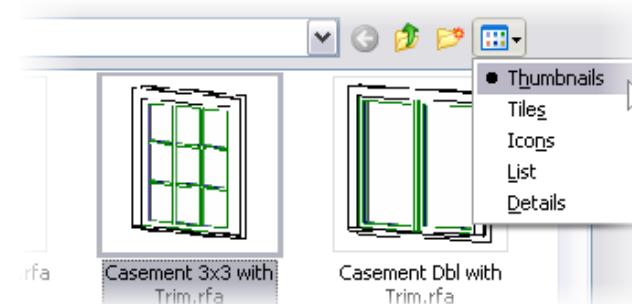
External families are also termed *hosted families*. Although this makes sense for doors and windows that are hosted by a wall, other components may be hosted by different components. For example, ceiling light fixtures must be placed on a ceiling. You cannot create an instance of a ceiling light unless there is a ceiling in the project. In general, all components that you load from the library are hosted at least by the level you place them on.

Load a Window Family

- 27 On the File menu, click **Load from Library > Load Family**. Navigate to the default Imperial Library > Windows folder.

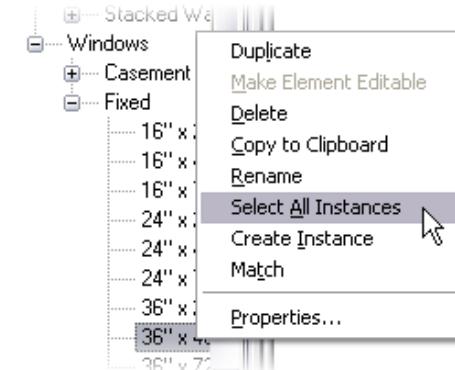
Activate the preview in the browsing window to see previews of the window types.

Select the window family **Casement 3x3 with Trim.rfa**.



This is one of many ways to load families. In Unit 2 you loaded a family directly from the component's Properties dialog box. You see more ways to load families later.

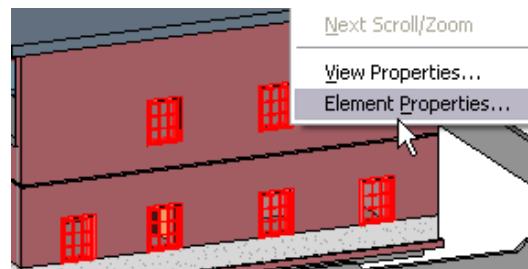
- 28 Change windows from Fixed to Casement family of the same size:
- In the project browser, select **Families > Windows > Fixed**. Right-click **36" x 48"**. Click **Select All Instances**.
 - On the options bar, change the window type to **Casement 3x3 with Trim 36" x 48"**.



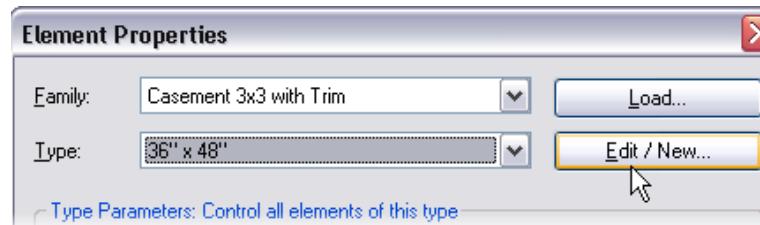
Selecting families from the project browser is a convenient and easy way to create a selection set for a specific family type. Because it is not view specific, it selects all types contained in the model.

You can also select all instances by right-clicking one of the windows in any view and clicking **Select All Instances**.

- 29 Without deselecting the windows, right-click. Click **Element Properties**.



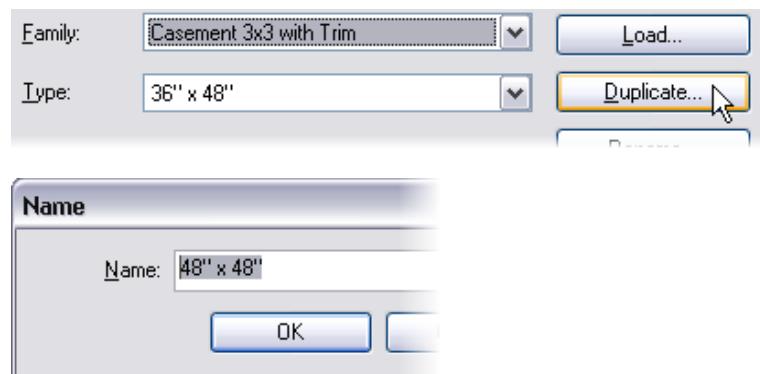
- 30 Click **Edit/New**.



- 31 Click **Duplicate**.

Type **48" x 48"** for the name.

Click OK to return to the Element Properties dialog box.



- 32 Change the Width value to **4'-0"**.

Click OK to close each dialog box and return to the drawing window.

Dimensions	
Height	4' 0"
Default Sill Height	3' 0"
Trim Projection - Ext.	0' 0 1/2"
Trim Projection - Int.	0' 0 3/4"
Trim Width - Exterior	0' 3 1/2"
Trim Width - Interior	0' 3 1/2"
Width	4' 0"
Window Inset	0' 0 3/4"
Bunch Width	

The Edit/New button opens the Element Properties dialog box. You can define Type parameters and Instance parameters during family creation.

Duplicating the window type and modifying the window family do not automatically update the family file (RFA) stored outside the project file. You export the family to your library at the end of this exercise.

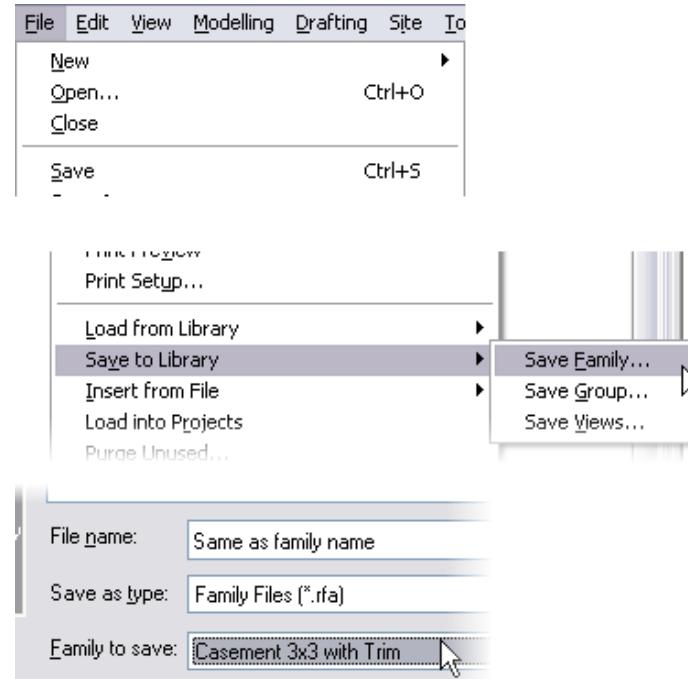
It's a convention to name types using their size so that other people using families can easily trace and understand them. In a team, conventions are a fundamental part of optimizing the design process, making it easier to share the data consistently.

There are many parameters in this dialog box that vary in type: length, material, text, and other component-specific properties. Try changing the materials to see what happens.



Export the Window Family

- 33 On the File menu, click **Save to Library > Save Family**.



Be sure to save in a location that makes sense. It is a good practice to keep your personal libraries separate from the default installed library.

- 34 From the Family to Save list, select the family **Casement 3x3 with Trim**.

If you save your libraries in the same folder as the Revit Architecture libraries, you might lose all of them if you forget to pull them out before upgrading to the next release. So, make it a habit to create your own library folder.

Unit 4

Theory: Parameters

Revit Architecture: Dimensions, Doors, and Windows

In this unit you explore dimensioning of doors and windows.

Dimensions for Locating Objects

When you work with doors, you work with both temporary and permanent dimensions. Temporary dimensions appear anytime a model object is selected in a view. When the object is deselected, the dimension disappears. Permanent dimensions are an annotation placed in the current view. Permanent dimensions are specific to the view and do not show up in other views. Dimensions are much more than instructions to the contractor to build these elements at this location. Dimensions in Revit Architecture are one of the mechanisms for locating objects accurately in the building model.

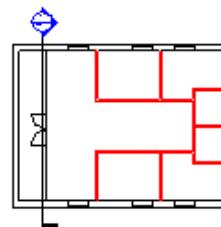
Dimensions for Modifying Subcomponent Locations Within a Family

In the second section of this exercise you work with dimensions within the window family. Many families have parameters that allow control of the relationships and locations of the subcomponent parts. These relationships are often established by family type. Modifying these parameters affects all instances of that type. Also defined by the family are instance parameters. A general rule is that the instance parameters control the location of an object within its host. Each of these parameters is determined by the author of the family. They can differ from family to family, and you quickly become familiar with accessing both the instance parameters and type parameters when working in the Revit Architecture environment.

Add Doors and Locate with Temporary Dimensions

- 1 Open file i_Unit 4 – Start.

- Open Floor Plan Level 2.
- Zoom into the east area of the building.

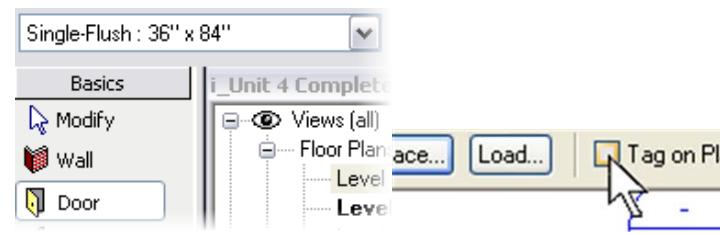


- 2 On the Basics design bar, click **Door**.

On the options bar, select door type:
Single-Flush: 36" x 84".

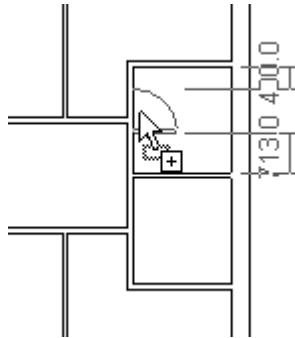
On the options bar, clear the **Tag on**

The highlighted walls have been added for you.

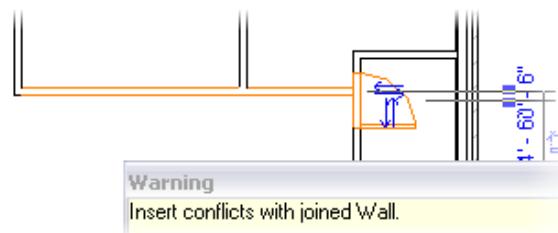


Placement check box.

- 3 Position the cursor over the vertical wall, as shown in the image.

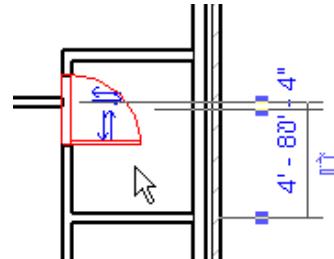


- 4 Click to place the door. Try to place it so that the opening is in front of the perpendicular wall.



- 5 On the Basics design bar, click **Modify**, and select the door.

On the options bar, clear the **Tag on Placement** check box.



The opening side of the door is defined while you position the door by moving the cursor from one side of the wall to the other.



Pressing SPACEBAR while positioning the door changes the swing direction.

A Warning dialog box displays if there is a conflict between the door and the wall.

If you want, you can ignore this warning and resolve the problem later.

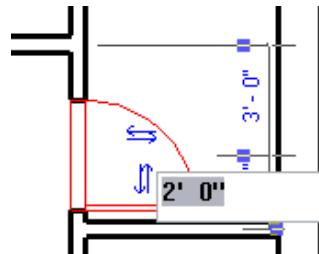
Click the Close (X) button to dismiss the warning, or just proceed to the next door.

When you select a door, two symbols appear. Use them to invert opening side, swing direction, or both.

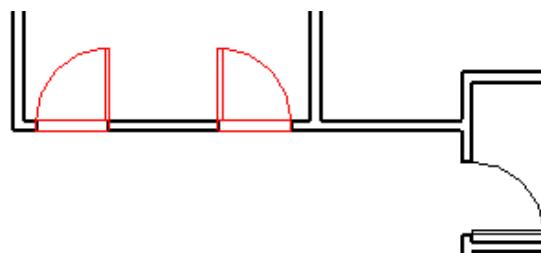
↑ Invert swing.

↔ Invert side.

- 6 Click the text of the dimension that is attached to the horizontal wall in the middle. The value becomes editable. Type **2'** and press **ENTER**.



- 7 Add more doors to the other rooms as shown:
- Type = Single-Flush: 36" x 84".



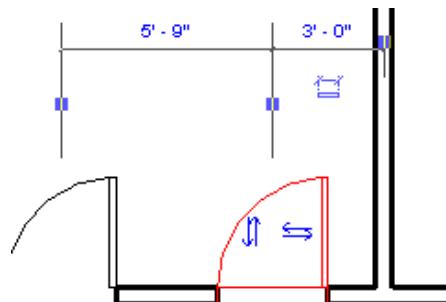
Relocate Witness Lines

You can change where the witness lines of the temporary dimension are located.

You edit temporary dimensions with the control boxes (blue squares) on each witness line. Just click a control box and drag it to a new position or right-click it and then click **Move Witness Line**.

- 8 Select the door on the right side.

Temporary dimensions appear, but you need to adjust their position to help you move the door into the adjacent room.



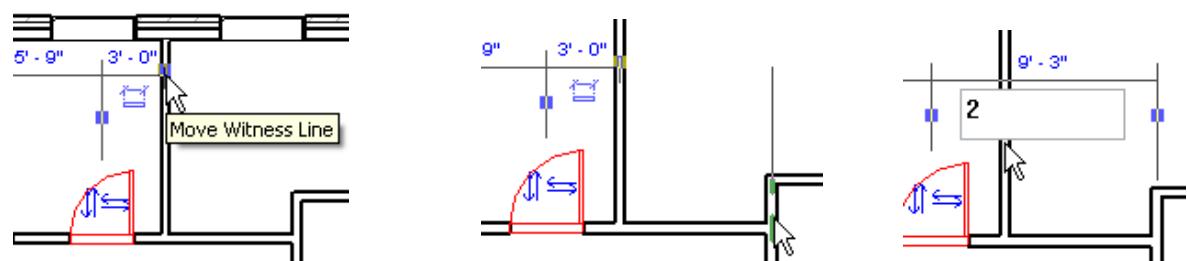
Place doors, as shown in the image. Use temporary dimensions to get an idea of location relative to walls.

Left-clicking a temporary dimension control box toggles the witness line to another point on the object. There is a limited set of points that the witness lines can find with this method.

- 9 Drag the blue square to a new position (face of the far vertical wall) and then release to validate the position, as shown in image.

Click the text of this dimension, and the value becomes editable.

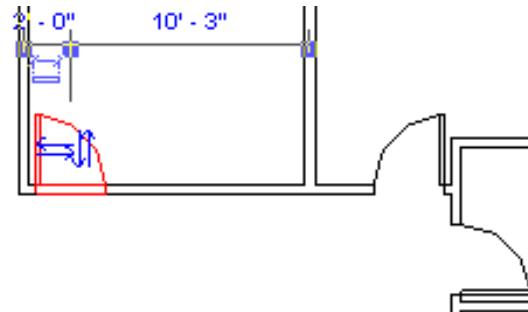
Type **2** and press **ENTER**.



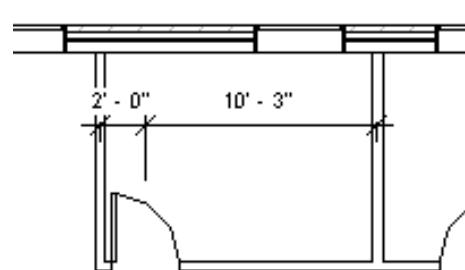
- 10 Select the door on the left side.

Use the temporary dimensions to adjust the position so that the door is placed **2'** from the vertical wall on the left to the center of the door.

Click horizontal control arrows to flip the door.



- 11 With the door still selected, click the symbol. The temporary dimension becomes a permanent dimension.

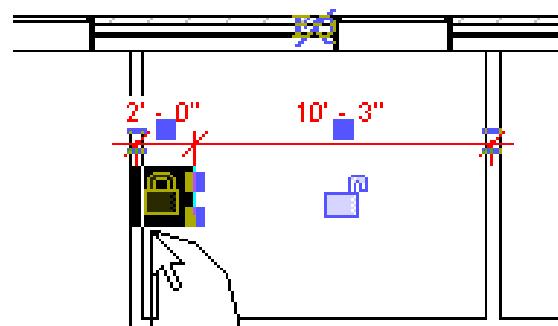


You can use permanent dimensions to annotate your design. They can be useful to place a relationship between components.

- 12 On the design bar, click **Modify**.

Click the permanent dimension that you just placed.

Click the blue lock icon near the dimension line.



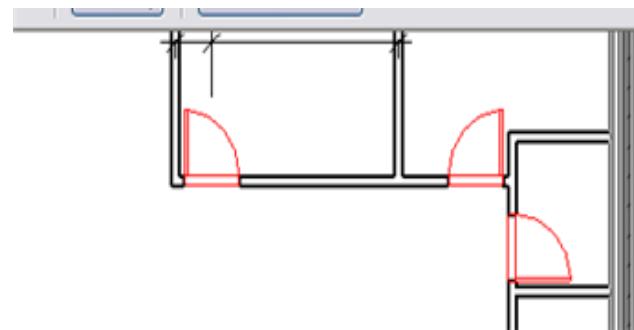
When you click to lock the dimension, you are creating an explicit relationship. If you move the wall, the door retains its position relative to the wall.

If you delete a dimension that establishes a relationship, Revit Architecture displays a warning asking what you want to do. You can delete the dimension and keep the relationship or simply delete the dimension and the relationship.

- 13 On the Basics design bar, click **Modify**.

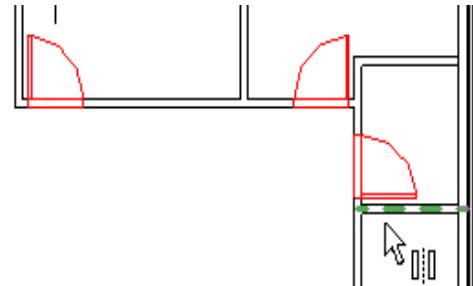
Select the three doors (use CTRL to multiselect).

On the Edit toolbar, click **Mirror**.



- 14 On the options bar, check that **Pick** and **Copy** are selected.

Click the horizontal wall on the right side.



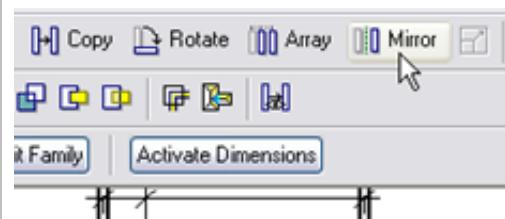
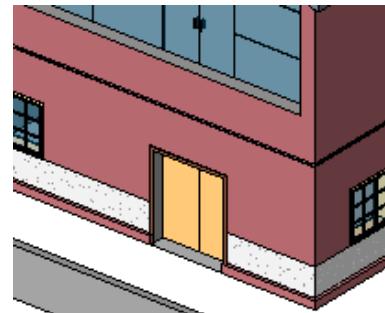
Load a Door Family and Change a Type

- 15 On the File menu, click **Load from Library > Load Family**.

Navigate to the *Doors* folder in the imperial library.

Select **Double-Glass 2.rfa**, and click **Open**.

Open the 3D view and rotate the model so that you can see the double door.



Use the options bar to:

- Draw or select an axis for the mirror.



- Choose if you want to copy the mirrored objects.



The easiest way to rotate the model is by pressing SHIFT and the middle mouse button at the same time.

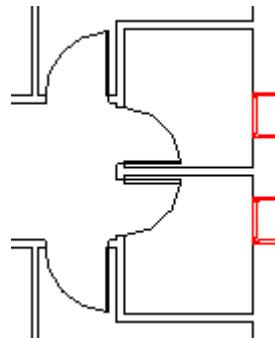
- 16 Select the door. On the options bar, click **Double-Glass 2: 68" x 84"** in the type selector.



Change Type and Instance Parameters

- 17 Add two casement windows to level 2:

- Open Floor Plan Level 2.
- On the Basics design bar, click **Window**. On the options bar, click **Load**.
- Navigate to the *Imperial library Windows* folder, select Casement with Trim.rfa, and click **Open**.
- On the options bar, click **Casement with Trim: 24" x 24"**. Clear the **Tag on Placement** check box.
- Add two windows on the vertical wall (east side) using the image as a guide.

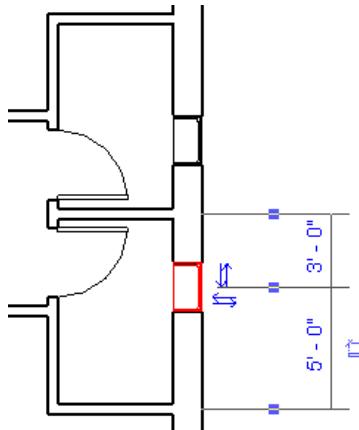


You can load a family in a project in many different ways:

- On the File menu, click Load from Library > Load Family.
- Select the corresponding button on the design bar, and on the options bar, click Load.
- Drag a family from Microsoft® Windows® Explorer and drop it into Revit Architecture.

The casement window is like the casement 3x3 window but without the muntins. Different geometry, different family.

- 18 Using temporary dimensions, adjust the window's position at 3' from the horizontal wall.

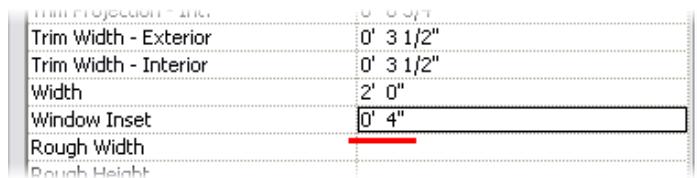


- 19 Zoom in around the windows.

- Select a window, and on the options bar, click **Properties**.
- In the Element Properties dialog box, click **Edit/New**.



- 20 In the Type Parameters dialog box, change the **Window Inset** parameter to 4".



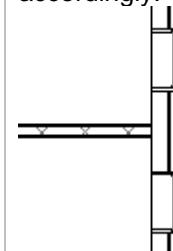
- 21 Click OK in the Type Parameters dialog box.

Click OK in the Element Properties dialog box to accept change and exit.



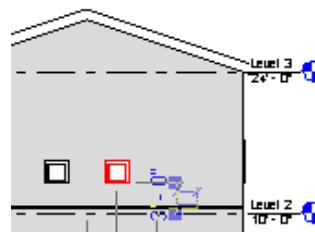
You can right-click to display the shortcut menu and then click **Properties**.

Window Inset is a type parameter. If you modify a type parameter, all the instances in the project that belong to the same type are modified accordingly.

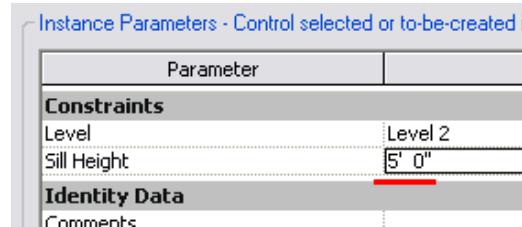


- 22 Go to Elevation East. Select the window on the right.

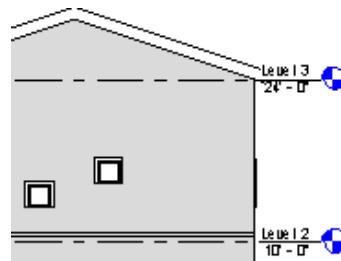
On the options bar, click **Properties**.



- 23 In the Element Properties dialog box, change the Sill Height parameter to 5'.



- 24 Click OK in the Element Properties dialog box.



When you change an instance parameter, only the selected components are modified.

Unit 5

Theory: Representations

Revit Architecture: Views, Visibility, and Sheets

This unit covers the display features and capabilities of Revit Architecture. It also covers some different presentation methods.

This unit includes five exercises:

- Exercise 5A leads you through adding a section and detail callout. This exercise also covers adding views to sheets.
- Exercise 5B adds material to the roof of the building.
- Exercise 5C illustrates some fine-tuning control over the visibility and cleanup of walls in plan view.
- Exercise 5D demonstrates how to create a sun and shadow study for your model.
- Exercise 5E shows you how to import a model created in Revit Architecture to Autodesk® 3ds Max® software for visualization.

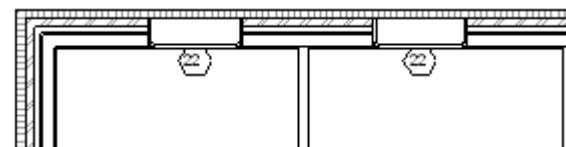
Exercise 5A: Sections, Views, and Sheets

In this exercise you add a section to the building. You then adjust the view properties for the section and add a detail callout to the section view. At the end of the exercise you create a new sheet and composite the views on the sheet.

Add a Section View

- 1 Open file **Unit 5a – Start**.

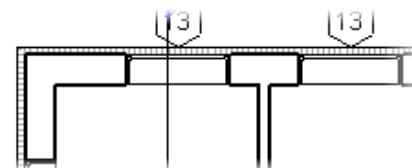
- Open Floor Plan Level 1.
- Zoom into the two first rooms on the left side of the building.



- 2 Right-click in the view.
Click **View Properties**.



- 3 In the Element (view) Properties dialog box, change the detail level parameter to **Medium**.
Click OK.



You don't have to open a view to edit the properties. You can simply right-click a view in the project browser and then click Properties.

Note:

When you set the detail level to medium or fine, the structure is displayed.

4 Open Floor Plans Level 2.

Right-click in the view. Click **View Properties**.

In the Element Properties dialog box, change the **Underlay** parameter to **Level 1**.

Revit Architecture allows three different levels of detail (Fine, Medium, and Coarse). Objects in the project display correctly for each detail level.

The detail level of a view is also available from the Drawing window View toolbar.

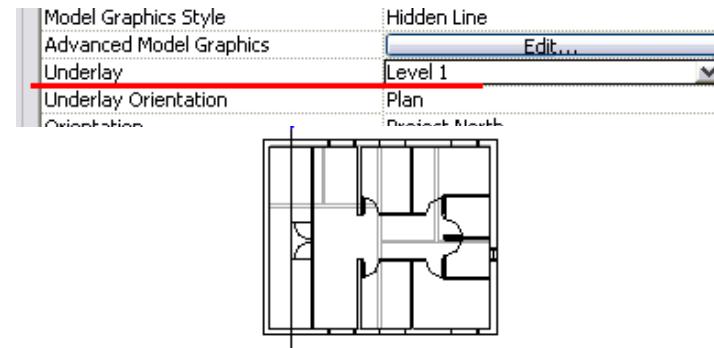
**5 Open Floor Plans Level 1.**

On the Basics design bar, click **Section**.

Select **Type Section: Building Section**.

6 Draw a line from left to right. Use the image as a guide.**Note:**

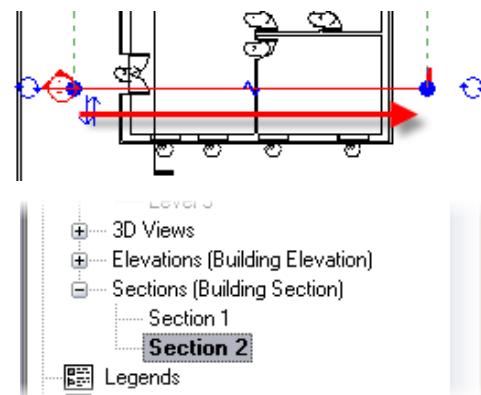
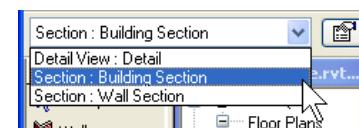
Adding a section mark to the drawing adds a new view in the project. This view is automatically added to the project browser under Sections.



Revit Architecture enables you to choose which view you want to use as an underlay. The view is dimmed, but you can use these elements for alignments or as a reference for new objects.

Any level in the building can be used as an underlay, or simply choose the level below or the level above.

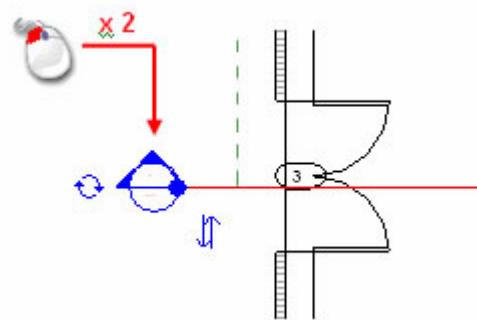
You can choose to view the underlay in plan or reflected plan (ceiling) view.



The direction used to draw the section line defines the direction of the section, but it can be flipped after you place it.

- 7 On the Basics design bar, click **Modify**.

Double-click in the middle of the circle of the section bubble in the project. (The section bubble should be blue when you do this. In other words, it should *not* be selected.)



You can also right-click the section line, and then click Go to View.

Cancel

Flip Section

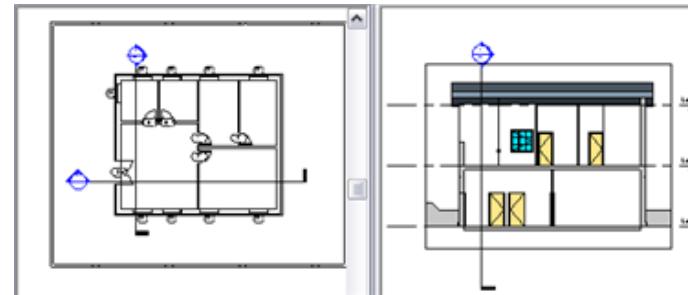
Go to View

Rotate

- 8 Use the window view toolbar to select **Shaded with Edges**.

Press **WT** on the keyboard to tile the windows.

If you have many windows open, either close or minimize any windows you do not want to see, and press **WT** to tile the windows again.



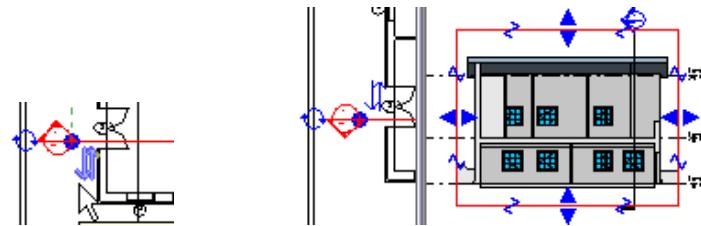
There are four model graphics style modes:

- Shading with Edges
- Shading
- Hidden Lines
- Wireframe

- 9 Make the view **Level 1** current by clicking in the drawing window.

- 10 Select the section line (click the line, not the round head). Some symbols are displayed next to the section line. Click the arrow symbols to flip the section.

Open the section view.

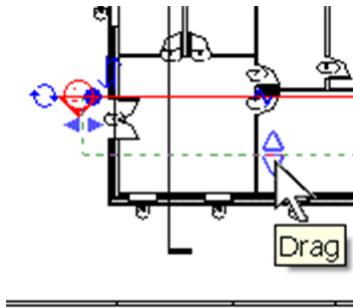


The section view is dynamic. As you flip the section marker, the view changes.

Flip the section. Cycle through different symbols for the section line. Change the symbol at each end of the section line.

- 11 In Floor Plans Level 1 view, select the horizontal section line.

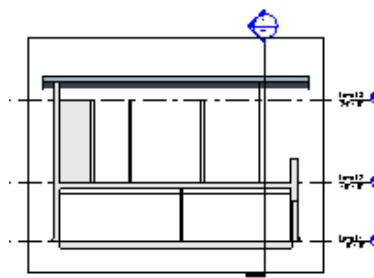
Drag the blue double arrow (in the middle of the green dashed line) so that this point is above the exterior south wall.



When you move this point, you change a view parameter value: Far Clip Offset. You can change it in the view properties by assigning a value in the field.

Extents	
Crop Region	<input checked="" type="checkbox"/>
Crop Region Visible	<input checked="" type="checkbox"/>
Far Clip Active	<input checked="" type="checkbox"/>
Far Clip Offset	1745.2
Scope Box	None

- 12 Make the section view active.



The section view is now cut by the far clipping plane.

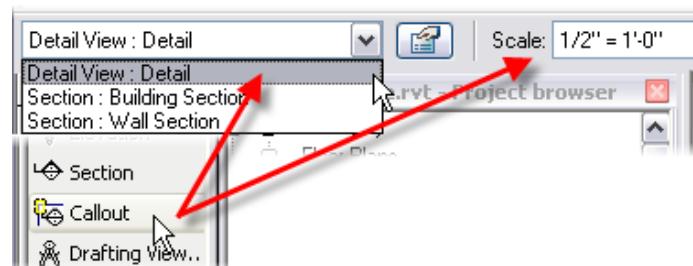
Add a Detail Callout

- 13 On the design bar's **View** tools, click **Callout**.

On the options bar, change Type to **Detail View: Detail**.

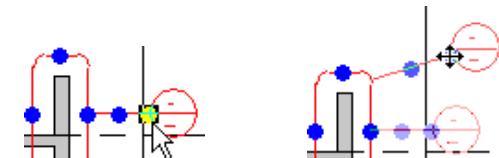
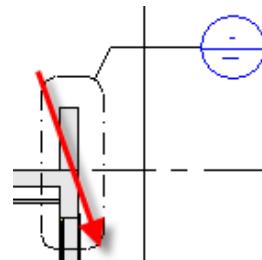
Check that Scale is set to $\frac{1}{2}''=1'-0''$.

A detail callout like a section mark creates its own view in the project browser.



You can modify the scale later in the callout view properties.

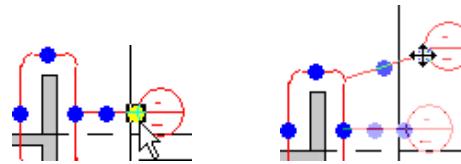
- 14 Draw the detail frame (click and drag) around the intersection between the floor and the exterior wall on the right side of the building, as shown in the image.



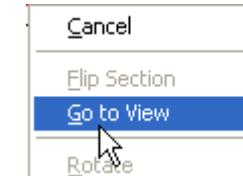
Note:

Adjust the size of the frame and location of the bubble by dragging the blue grips.

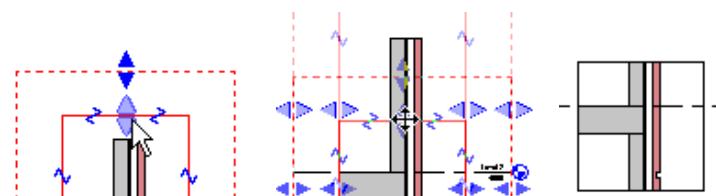
- 15 Double-click the bubble that is attached to the callout frame.



A callout view can be opened like the section view. Right-click the symbol. Click Go to View.



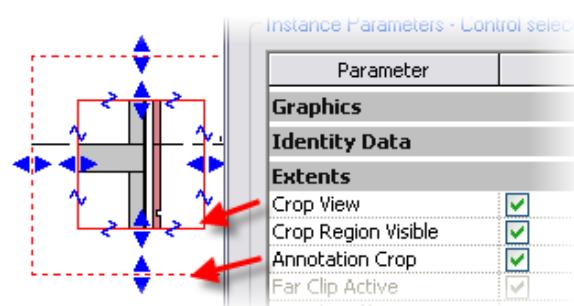
- 16 Select the frame around the view. Use the blue grips to resize the view so that you see only what you want to show in this callout.



For further exploration of detail views, refer to Unit 14.

Note: There are two different crop regions associated with the view.

The **Crop Region** limits the visible extents of elements in the view.

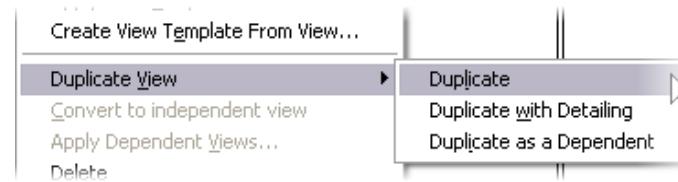


The **Annotation Crop** is used primarily for dependent views and can be turned off for your detail. The width of this crop region affects the extents of the view as it is placed on a sheet.

Duplicate a View

Plan view can only be placed on a single sheet. Often, you need to have multiple views of a plan that present different information for the same floor plan.

- 17 In the project browser, right-click **Floor Plans - Level 1 > Duplicate View > Duplicate**.



Duplicate a view with detailing (Duplicate with Detailing) or without (Duplicate). If you choose Duplicate only, then none of the detail components (those that are view specific, such as dimensions, tags, and annotations) are duplicated.

- 18 In the project browser, right-click **Copy of Level 1**. Click **Rename**.

In the Rename View dialog box, enter a new name for the view: **Level 1 – Area**.

Click OK.

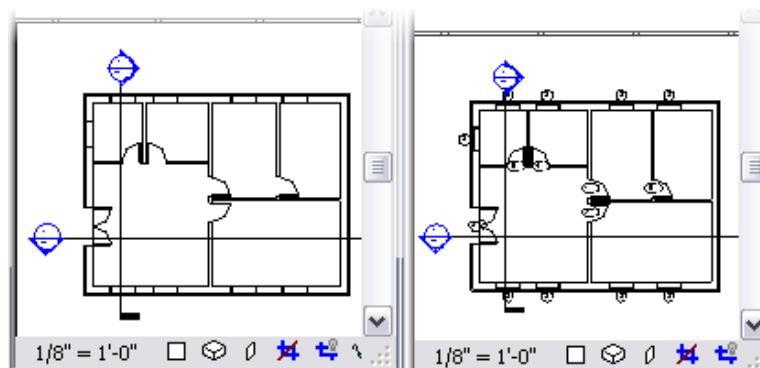


- 19 On the Window menu, click **Close Hidden Windows**.

In the project browser, open **Floor Plans – Level 1**.

On the **Window** menu, click **Tile**.

You can now see the views side by side.



- 20 In any view, move a wall. In all other views, that wall moves accordingly.

Keep in mind that it's the same wall in the same building. When you move that wall in any view, all other views where that wall is visible automatically update.

Even if you copy a view, you can choose to display it with a different scale, different detail level, different shading mode, and so forth.

Work with Shade and Shadow

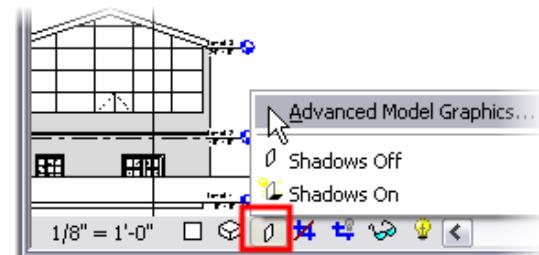
Revit Architecture provides the ability to work with shade and shadow directly in any view.

This is part of the view properties called advanced model graphics.

21 Set the West Elevation current.

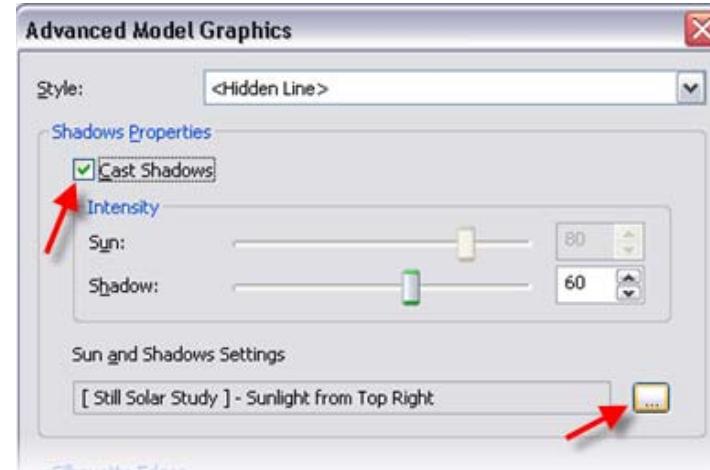
On the Drawing Window View toolbar, click the **Shadow** icon.

Click **Advanced Model Graphics**.

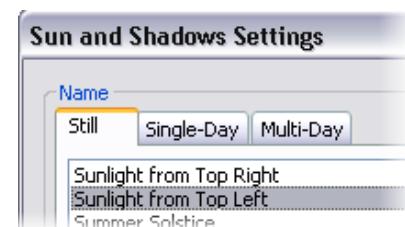


22 In the Advanced Model Graphics dialog box:

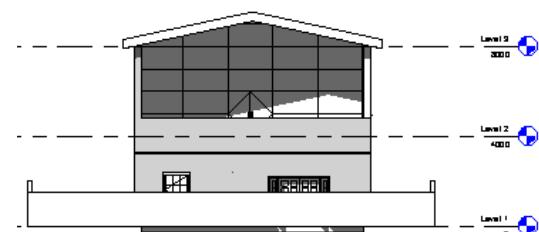
- Select the **Cast Shadows** check box.
- Under Sun and Shadows Settings, click the **Browse (...)** button.



23 Change the preset to **Sunlight from Top Left**.



24 Click OK to close each dialog box and return to the drawing window.



The sunlight from top left is in relationship to the plan view of the building.

The shadow is now generated on the elevation.

If the shadows do not show up immediately, change to a different view and return to this, or press the refresh key (F5).

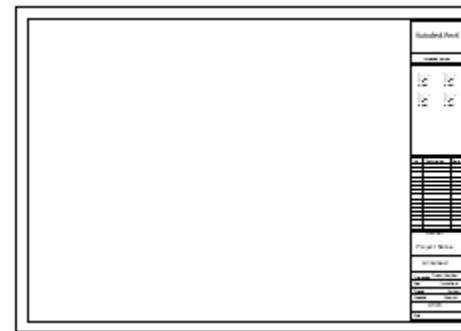
Create Sheets

In Revit Architecture, a sheet is another view of the building model. Sheets are listed in the project browser in their own category directly above the family list.

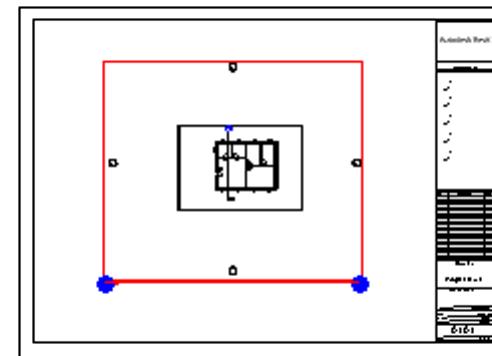
- 25 In the project browser, right-click **Sheet**. Click **New Sheet**.



- 26 In the Select a Titleblock dialog box, click OK (use the default E1 30 x 42 Horizontal title block).



- 27 In the project browser, drag **Floor Plans – Level 1** onto the sheet.



The overall flow is as follows:

- Create a sheet.
- Place any of the views (plans, sections, elevations) on the sheet by dragging it onto the sheet view.
- Adjust the properties of the plan view to meet your presentation needs.

To choose another title block, you have to first load it in your project. To load a title block, click the Load button in the Select a Titleblock dialog box and load a title block RFA file as you would any other type of Revit Architecture family.

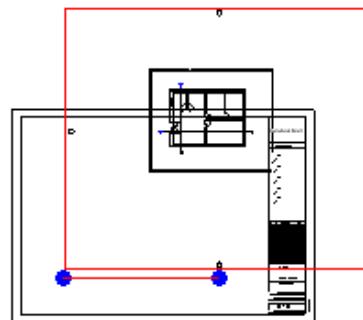
Revit Architecture won't let you place the same view twice on a sheet or the same view on two separate sheets. Instead, you duplicate the view you want to place on two separate sheets.

The crop region determines the size of the view on the sheet. By default, the view is set to the extents of the objects in this view.

- 28 In the project browser, right-click **Floor Plans – Level 1**.

Click **Properties**, and change View Scale Parameter to **1/4" – 1'-0"**.

Click OK.

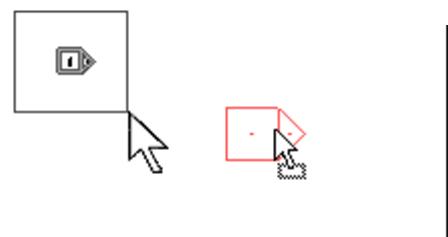


- 29 Open Floor Plans Level 1:

Select the elevation marker by dragging a window selection with the cursor.

Drag the elevation marker away from the surrounding low wall.

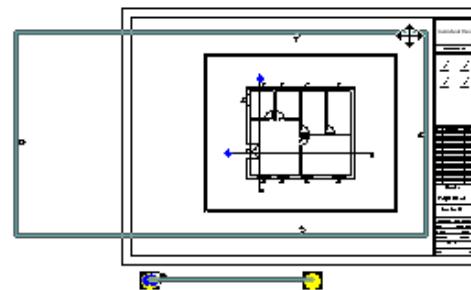
Repeat with the other markers but move them toward the wall.



The view's scale determines how large an area it takes up on the sheet.

- 30 Open the sheet:

- Notice that the size of the view now incorporates the new location of the elevation markers.
- Move the view into the middle of the sheet by left-dragging the view.

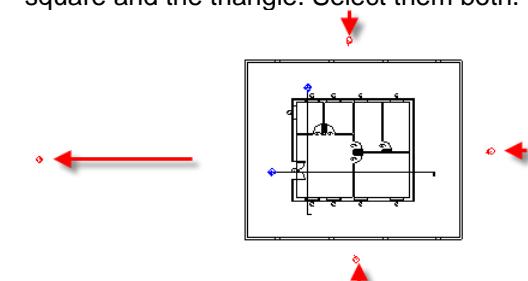


Note that as you hover your cursor over the view on the sheet, you get two different options depending on whether your cursor is over the boundary of the view or the title of the view.

Click the viewport to move the view, activate the view, or resize the title mark.



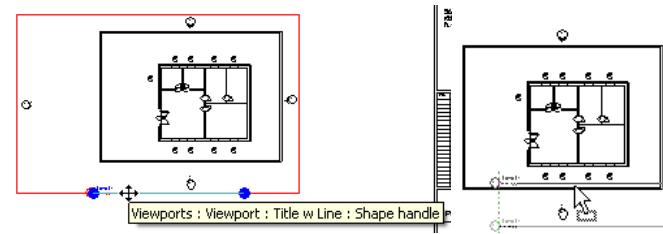
The elevation mark has two pieces: the square and the triangle. Select them both.



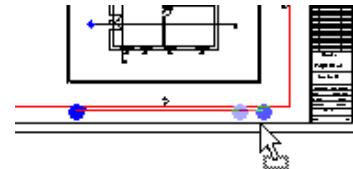
The title of the view also moves with the plan view.

Click the title mark if you want to move the title mark.

- 31 Move the title mark:
- Click the shape handle (the title mark line).
 - Left-drag the line into place on the sheet.



- 32 Adjust the title mark length:
- Click the view border to activate the blue grips.
 - Grip-stretch the right grip to make the title line shorter or longer.



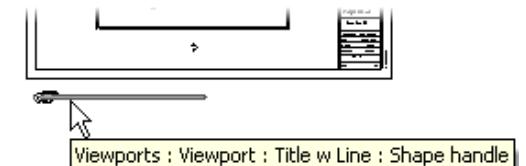
Adjust the Crop Region for the View

- 33 In the project browser, right-click **Floor Plans – Level 1**. Click **Properties**.

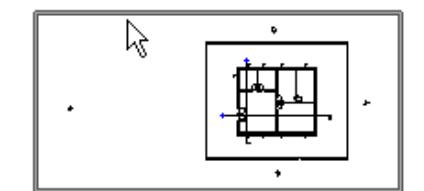
Select the **Crop Region** and **Crop Region Visible** check boxes to turn on the crop region for the view.

Set view **Floor Plan > Level 1** current.

Instance Parameters - Control selected or to-be-created instance	
Parameter	Value
Graphics	
Identity Data	
Extents	
Crop View	<input checked="" type="checkbox"/>
Crop Region Visible	<input checked="" type="checkbox"/>
Annotation Crop	<input type="checkbox"/>

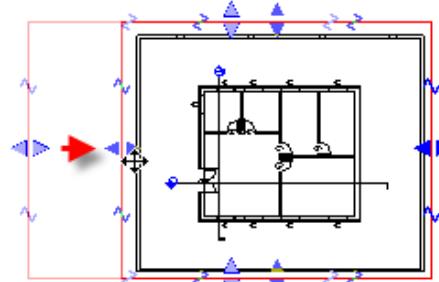


If you cannot get the tooltip to appear with Viewports: Viewport: Viewport 1: Shape Handle, watch the status bar at the lower left for the same information.



The view now has a visible crop region.

- 34 Select the crop region, and drag the blue grips in toward the building.



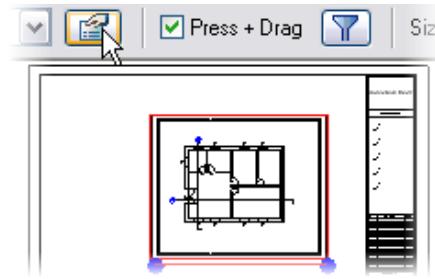
- 35 Open the sheet view.

The drawing sheet now reflects the smaller bounds established by the crop region.

Select the viewport in the sheet.

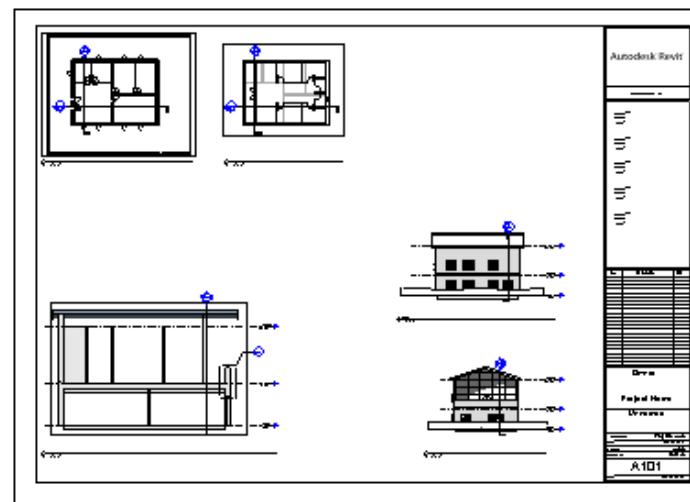
Click the **Properties** button.

Change the scale of the viewport to $1/8'' = 1'-0''$.

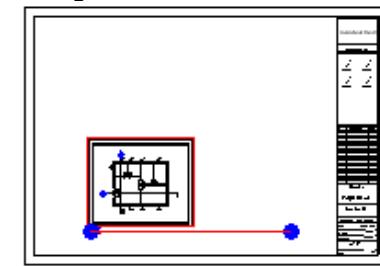


- 36 Complete the sheet:

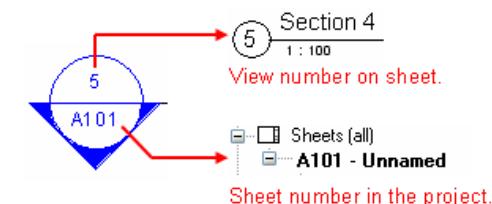
- Move the Level 1 view on the sheet in the upper left and resize the title mark.
- Turn on the crop region for level 2, verify that its scale is $1/8'' = 1'-0''$, and drag it from the project browser onto the sheet to the right of Level 1.
- In the same way, place elevations (west/north) and the Section 2 onto the sheet, adjusting the crop regions and scale as needed to fit.



The properties of the viewport are linked to the properties of the view, in this case, Floor Plan Level 1. When the view scale changes back to $1/8'' = 1'-0''$, the size on the sheet changes.



Take a look at the symbol of the section line.



Revit Architecture recognizes what sheet this section is positioned on and automatically fills in this information in the section bubble.

Place the section on any other sheet, and the bubble updates automatically. Section bubbles are families that you can customize to display other information.

Exercise 5B: Display Control of Materials

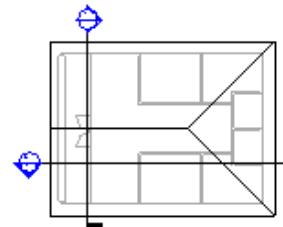
This exercise takes you through creating a material for the roof in the project from the last exercise. In creating the roof, you create a new Revit Architecture Material. Material definitions control the color of the object in Shade mode, the rendered material, what pattern the object displays when cut by a section, as well as what pattern is displayed when the object is seen in a projection.

Create a New Roof Type

- 1 Open i_Unit 5b – Start.

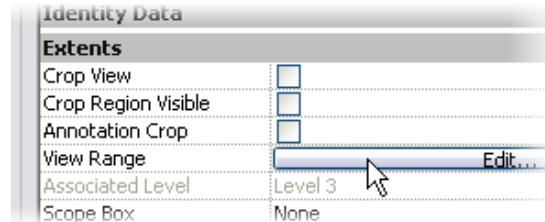
Set Floor Plans: Level 3 view current.

This section of the exercise is long. You duplicate the existing roof type to create a new type and then assign different materials to the layer components of the roof.



- 2 Right-click in the view:

- Click **View Properties**.
- In the view's **Element Properties** dialog box, next to View Range, under Extents, click the **Edit** button.



- 3 Verify that the Top offset is set to 35'. Set Cut Plane Offset to 35'.

Click OK to close each dialog box.



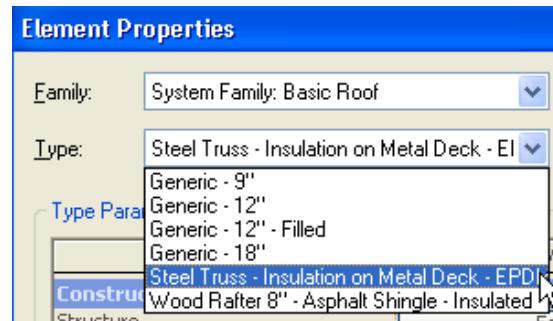
- 4 Click the roof. On the options bar, click the **Properties** button.

You also duplicate a material and create a model pattern and drafting pattern for the roof material you create.

The east side has been returned to a sloped condition for you to better illustrate the behavior of the patterns for the material you define in this exercise.

Setting the cut plane to a high value helps to ensure that if you raise the slope of the roof, it will not be cut in this view. You must keep the top of the primary range above the cut plane.

- 5 In the roof's **Element Properties** dialog box:
- Change the roof type to **Steel Truss – Insulation on Metal Deck EPDM**.
 - Click the **Edit/New** button.

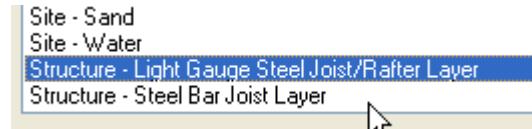


- 6 In the Type Properties dialog box:
- Click **Duplicate**.
 - Name the new roof type **Steel Truss – Insulation on Sheathing with Metal Roof**.
 - Click the Structure's **Edit** button.

- 7 In the Edit Assembly dialog box:
- Click the **Preview** button if you do not see a preview by default (a last-used setting).
 - Click Layer 5's material.
 - Click the **Browse** button that appears.

2	Thermal/Air Lay	Insulation / The	0' 5"
3	Core Boundary	Layers Above	0' 0"
4	Structure [1]	Metal - Deck	0' 0 1/4"
5	Structure [1]	Structure - Stee... l	1' 4"
6	Core Boundary	Layers Below w	0' 0"

- 8 Click the **Light Gauge Steel Joist** material.



- 9 Repeat for Layer 4, changing the material from **Metal – Deck** to **Wood – Sheathing – Plywood**.

Change the thickness of this layer to $\frac{1}{2}$ ".

3	Core Boundary	Layers Above Wrap	0' 0"
4	Structure [1]	Wood - Sheathing - Plywood	0' 0 1/2"
5	Structure [1]	Structure - Light Gauge Steel Jois	1' 4"
6	Core Boundary	Layers Below Wrap	0' 0"

Do not close the Edit Assembly dialog box yet.

Create a New Material and

All materials defined in the project file can be accessed by clicking Materials on the Settings menu. In this example, you

Assign to the Roof Type

In this section you continue editing the assembly but create a new material on the fly.

- 10 Click Layer 1's material.

Click the **Browse** button that appears.

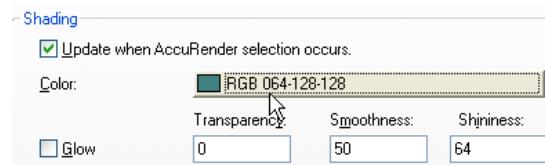
- 11 Click the **Metal Roofing** entry.

Click **Duplicate**.



- 12 Enter **Metal – Roofing Standing Seam** as the name of the new material.

- 13 In the Material dialog box, under Shading, click the **Color** button. Pick a teal green color for the roof.



This color is used in the model only when the view is set to Shading or Shading with Edges.

- 14 There are currently no standing seam materials provided with the software. If you have a JPG, you can create an AccuRender™ material from the image file. Because you are not going to render this building, for this exercise leave this setting as you found it.

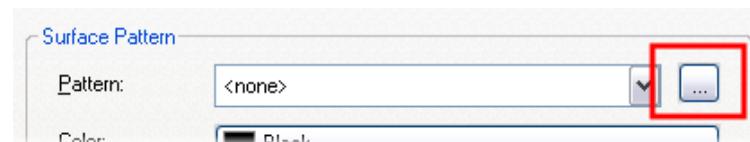


- 15 The Surface Pattern is empty for this material. There is no Standing Seam fill pattern either. You also create these on the fly in the next section.

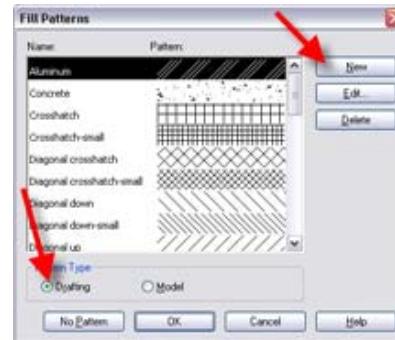
**Create a New Fill Pattern for the Material**

In this section you create a new fill pattern on the fly to use in the material you just created.

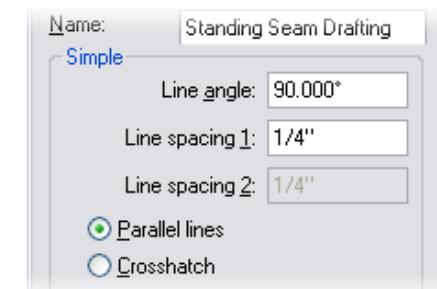
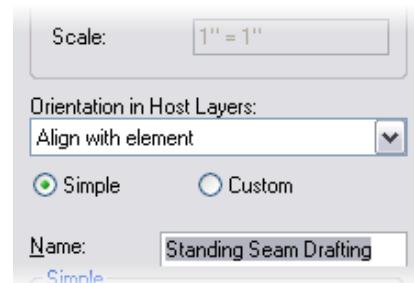
- 16 Click the **Browse** button to the right of the empty Surface Pattern field.



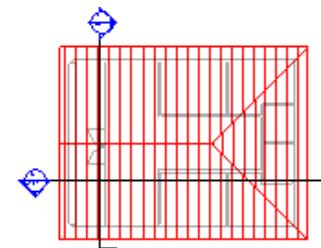
- 17 In the Fill Patterns dialog box:
- Click **Drafting**.
 - Click **New**.



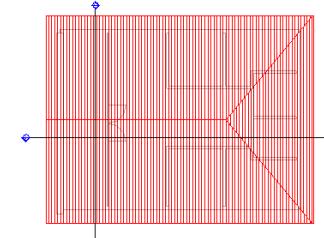
- 18 In the New Pattern Properties dialog box:
- Set Orientation in Host Layers to **Align with Element**.
 - Click **Simple**.
 - Name the pattern **Standing Seam Drafting**.
 - Set the line angle to **90**.
 - Set the line spacing to **1/4"**.
 - Click **Parallel Lines**.



- 19 Click OK to close each dialog box and return to the drawing window.



Drafting patterns change their scale depending on the view scale. Changing the scale of the view to $\frac{1}{2}'' = 1' - 0''$ keeps the plotted distance between the lines consistent at $\frac{1}{4}''$.



Create a Model Fill Pattern and Assign to the Material

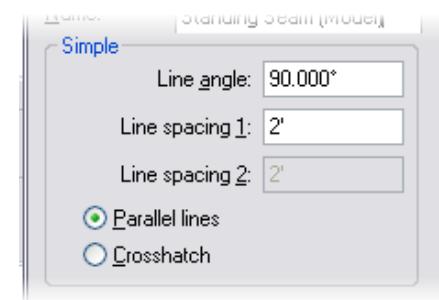
- 20 On the **Settings** menu, click **Fill Patterns**.



- 21 This time click **Model** and then click **New**.

- 22 In the Add Surface Pattern dialog box, set:

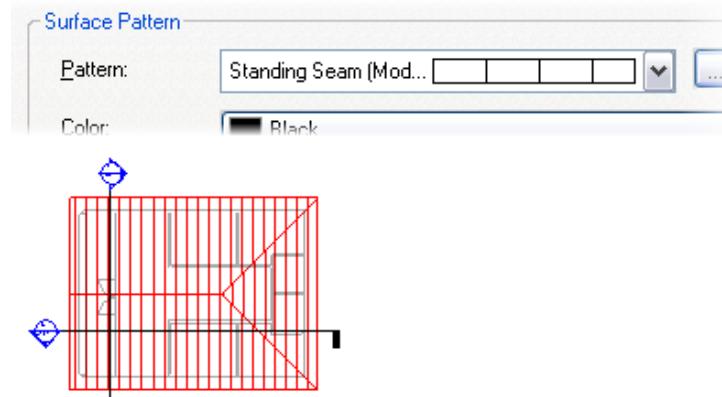
- Type = Simple.
- Name = Standing Seam (Model).
- Line Angle = 90.
- Line Spacing = 2'.
- Click Parallel Lines.



Click OK to close each dialog box.

- 23 On the Settings menu, click **Materials**.

- 24 Select **Standing Seam (Model)** from the material's surface pattern list



Model surface pattern dimensions are set by the fill pattern definition and do not vary by drawing scale.

Exercise 5C: Fine-Tuning Wall Cleanup and Display

This exercise illustrates some of the display and cleanup control you have over walls in your Revit Architecture project.

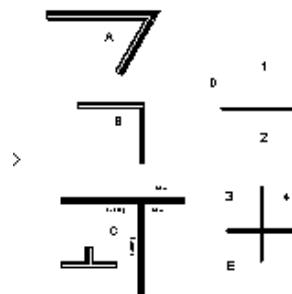
Set Wall Fill for Coarse Level Display



- 1 Open file Unit 5c – Start.

Open Floor Plan Level 1.

Verify that the view's detail level is set to **Coarse**.



- 2 Select any wall.

Open its Properties dialog box.

- 3 Click the **Edit/New** button to access the wall's type properties.

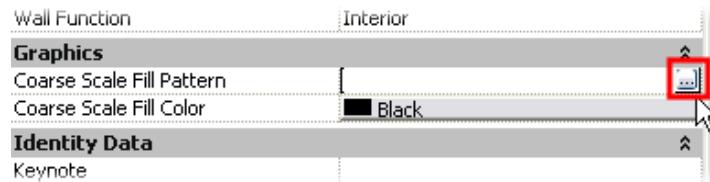
- 4 Verify that Coarse Scale Fill Color is **Black**.



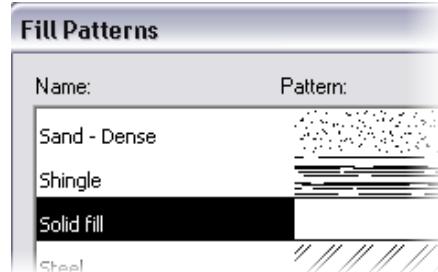
Revit Architecture walls have a separate control for the display detail level **Coarse**. This coarse fill pattern and color allow you to poche the entire width of the wall regardless of the number of components in the wall.

See also the end of this exercise for overriding the fill pattern for all walls.

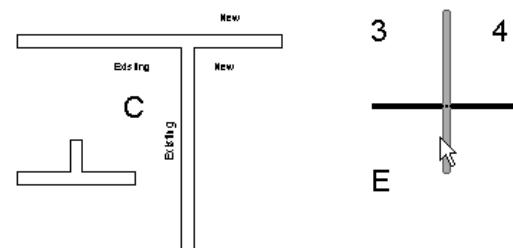
- 5 Click in the Value field of the Coarse Scale Fill Pattern parameter. Click the **Browse** button that appears in the field.



- 6 Select **Solid Fill** for the fill pattern.



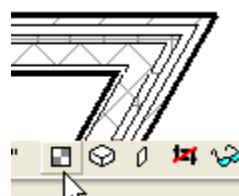
- 7 Click OK to close each dialog box and return to the drawing window.



Because this is a type parameter, you need to repeat this process for all wall types used in the project.

Global Control of Linework Display of the Walls: Object Styles

- 9 Set the View Detail level to **Medium**.



In addition to the coarse display control, Revit Architecture provides the ability to override the system default display of walls for a specific view.

- 10 Click Settings menu > **Object Styles**.

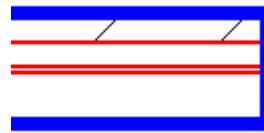
- 11 In the Object Styles dialog box, Model Objects tab, scroll down the list of objects and expand the **Walls** category.



- 12 Change the Walls Cut Line color to **blue** and Common Edges to **red**.

Category	Line Weight		Line Color
	P...	Cut	
Walls	2	5	Blue
Common Edges	2	2	Red
Hidden Lines	2	2	Black
Wall Sweeps - Cornice	1	5	Black
Windows	2	2	Black

- 13 Click OK to return to the drawing window.



Override Linework Display of the Walls: View Visibility/Graphics by Category

- 14 Open the View properties for Floor Plans: Level 1.

Next to Visibility/Graphics Overrides, click the **Edit** button.



The Object Styles dialog box controls the linewidth, color, and linetype. This is also where you can assign materials to objects.

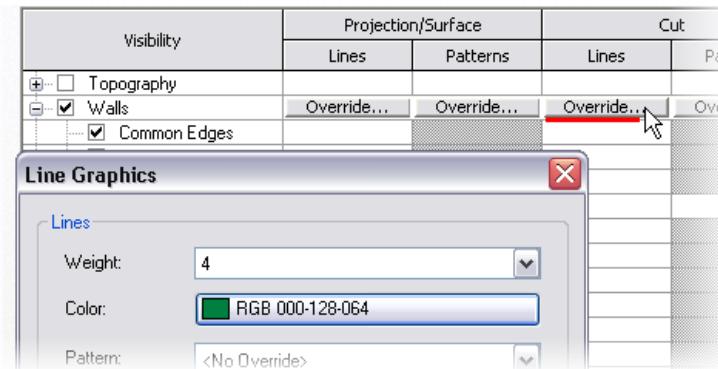
In all cases if the object is set to "By Category" for any of these parameters, these are the values referred to.

Changes you make in the Object Styles dialog box are global and apply to all views.

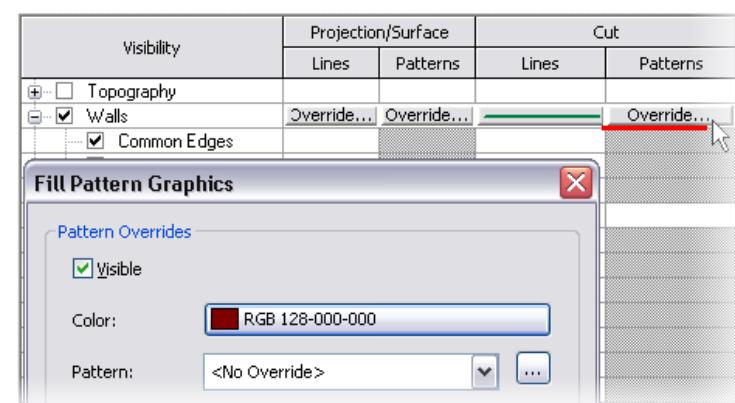
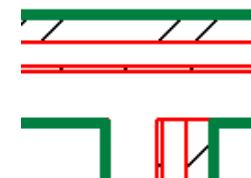
The object styles are now applied to all wall types in the project. The wall's Cut (pen 5 and blue) refers to the outer edge of the wall. The wall's subcategory Common refers to the lines common to the layers in the wall.

The Visibility/Graphics dialog box also has overrides to the wall component display graphics.

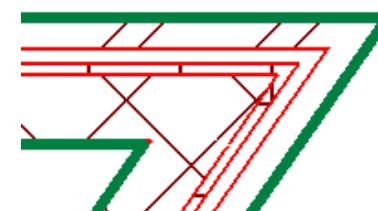
- 15 In the Visibility Graphics Overrides dialog box:
- Scroll down the list to Walls.
 - Click the wall line.
 - Click the **Override** button in the Cut/Lines column.
 - Set the override weight to **4**.
 - Set the override line color to a dark green.
 - Click OK to close each dialog box and return to the drawing window.
- 16 Return to the view's Visibility/Graphics Overrides dialog box.
- On the Model Objects tab, set the Override Model Patterns Cut Pattern Color to dark red.
 - Click OK to return to the drawing window.



These changes are for the current view only.



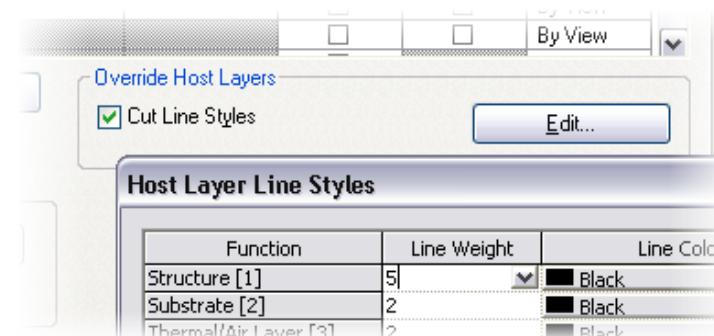
The override applies to all cut patterns for all layers in the wall type.



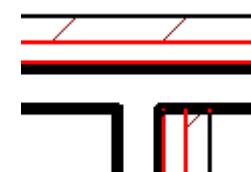
Override Linework Display of the Walls: View Visibility/Graphics and Cut Line Styles

- 17 Return to the view's Visibility/Graphics Overrides dialog box:
- Under Override Host Layers, select the **Cut Line Styles** check box.
 - Click **Edit**.
 - Set Structure[1] to linewidth 5.

Click OK to close each dialog box and return to the drawing window.

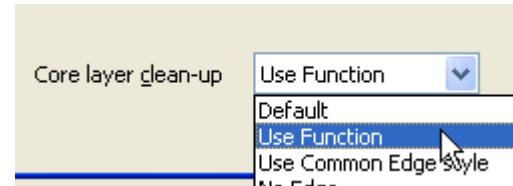


Any layer in the wall type definition assigned to the structure layer now has the wider (pen 5) linewidth assigned to it.

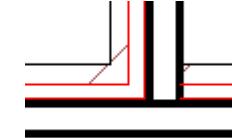


- 18 Return to the view's Visibility/Graphics Overrides dialog box:
- Click the Cut Line Style's Edit button.
 - Set Core Layer Clean-Up to **Use Function**.

Click OK to close each dialog box and return to the drawing window.

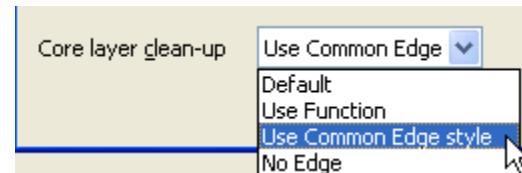


This setting affects only the layers within the core of the wall type's definition.

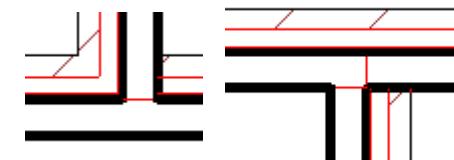


- 19 Return to the view's Visibility/Graphics Override dialog box.
- Click the Cut Line Style's **Edit** button.
 - Set Core Layer Clean-Up to **Use Common Edge Style**.

Click OK to close each dialog box and return to the drawing window.



This setting affects only the layers within the core of the wall type's definition. Joins between individual walls are shown but use the common edge style graphic line.



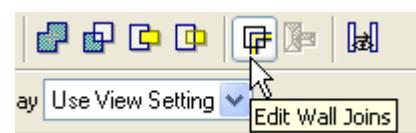
- 20 Repeat the previous step and set Core Layer Clean-Up to **No Edge**.

Wall Cleanup and Joins

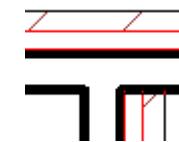
Revit Architecture walls automatically clean up as they are added to the project. This section guides you through control of some special conditions.

- 21 Zoom into Condition A in the project.

On the toolbar, click the **Edit Wall Joins** tool.

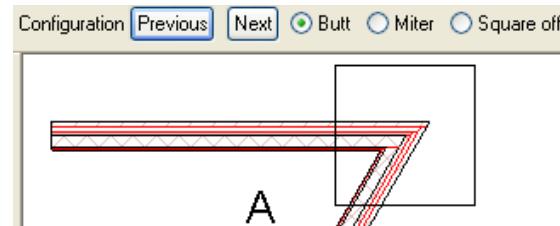


No edges are shown at the core cleanup condition between joins.



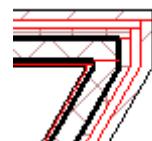
- 22 Hover your cursor over the intersection of the walls until you see a square appear around the intersection.

Click that area.

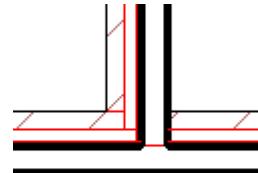


Once you have selected an intersection to edit, the configuration control appears on the options bar. The Next and Previous buttons cycle through various ways you can clean up this intersection.

- 23 Click **Square Off** and then **Next** until you cycle through to the solution shown at right.

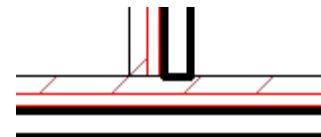
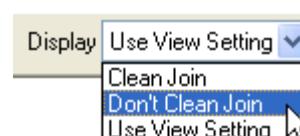


- 24 While still in the Edit Wall Joins mode, click the intersection of the inverted T at Condition C.



This illustrates a condition that might happen when adding a new wall that abuts an existing wall. In this case you do not want the core penetrating through the existing (horizontal) wall.

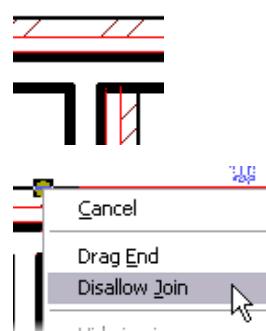
- 25 On the options bar, from the Display list, select **Don't Clean Join**.



The join is disallowed, and the wall does not cut through the existing brick face.

- 26 Click the **Modify** tool to exit the Edit Wall Joins function.

Zoom into the other intersection at Condition C.



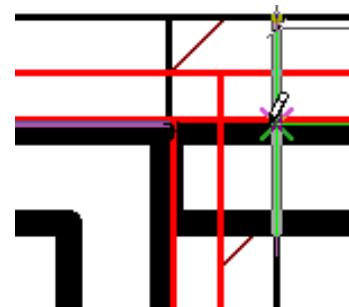
This condition is similar to the last; however, three walls make up the intersection. You cannot disallow all joins because you still want the two existing walls to clean up.

- 27 Click the right wall of the three walls at this intersection.

Right-click the blue end grip of this wall.

Click **Disallow Join**.

- 28 Drag the wall end to the exterior face of the existing brick.



Wrap the End of the Wall

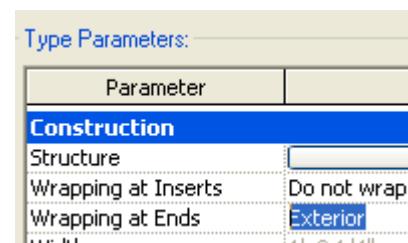
- 29 Zoom into Condition B in the project.

Right-click the wall and open the Element Properties.

Open the Type properties of the horizontal wall by clicking **Edit/New**.

- 30 Change Wrapping at Ends to **Exterior**.

Click OK to close each dialog box and return to the drawing window.



- 31 Return to the type parameters of the wall . Click the **Structure Edit** button.

Clear the **Wraps** column for Thermal Air Layer and Membrane Layer.

Click OK to return to the drawing window.

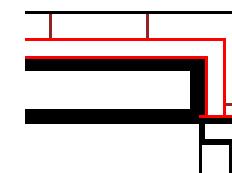
Join Geometry

Join geometry has several uses. In general the join geometry creates a relationship between two objects. In this case the intersection between the walls then cleans up.



In this case, the exterior finish system does not wrap around the end of the wall to provide closure to the curtain wall.

The exterior layers now wrap around the end of the wall.

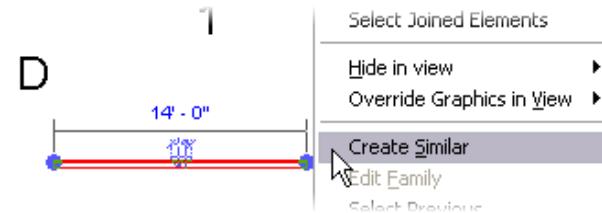


Within the structure of the wall type, you can control which layers wrap.

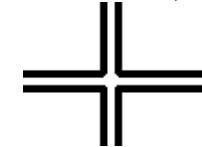


- 32 Right-click the wall at Condition D. Click **Create Similar**.

Draw a vertical wall from the number 1 to 2.

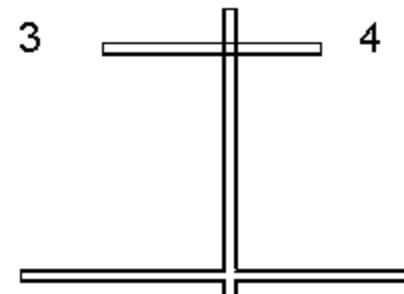


As long as the walls do not cross near the end of a wall, the walls will clean up.



- 33 Right-click the wall at Condition E. Click **Create Similar**.

Draw a vertical wall from the number 3 to 4.

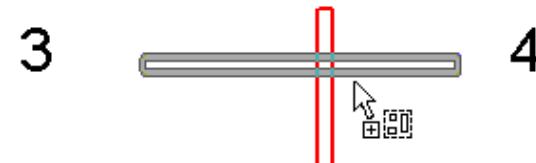


If crossing walls do not clean up, you can use the Join Geometry tool to force the cleanup.

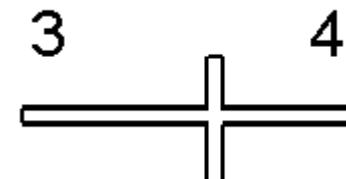
- 34 On the toolbar, click the **Join Geometry** tool.



- 35 Click one of the walls, then the other.



The two walls now clean up with each other.



Override All Walls Fill Patterns

This exercise opened with the coarse fill pattern type property for walls. You also have the ability to override the fill pattern for *all* walls as a view graphics override similar to the linework override earlier in this exercise.

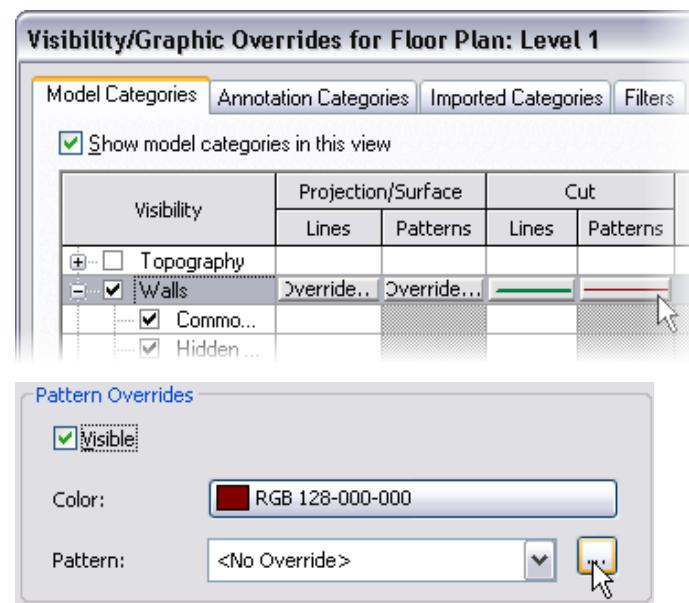
- 36 Type **VG** on the keyboard to open the visibility graphics override for this view.

On the Model Categories tab, scroll down the list and select the **Walls** line to activate it.

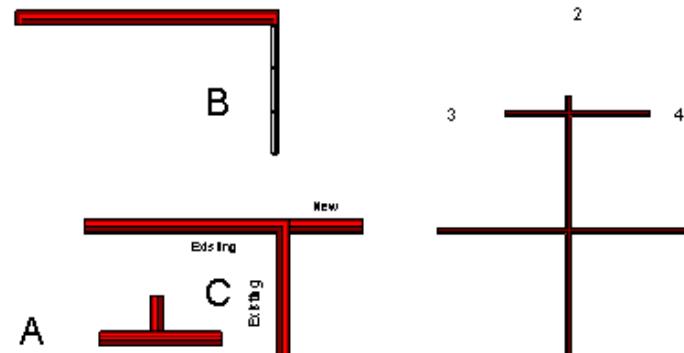
Click in the Override field in the Cut: Patterns column.

- 37 Click the **Browse** button.

Click the **Solid Fill** pattern.



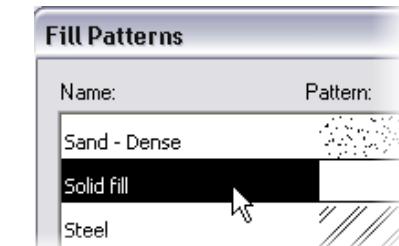
The override is applied to *all* wall types in this view but does not affect other views.



- 38 Save and close the project.

Keyboard shortcuts are just the two keys typed on the keyboard. There is no need to press ENTER after you type the shortcut.

This dialog box is the same as if you had opened the view properties and clicked the Visibility Edit button.



Exercise 5D: Sun and Shadow Studies

This exercise leads you through using the sun and shadow features of Revit Architecture.

Duplicate the 3D View

In this section you create a new 3D view

Duplicating a view is not required for creating a shadow study. However, because many of the settings for the sun studies are view specific, creating a view specifically for the sun study

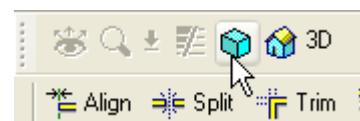
For example, you could have three different 3D views, one with the sun settings for December 21, another for

for the sun studies using the Dynamic View tool.

- 1 Open file Unit 5d – Start.

Verify the 3D Views: {3D} is current.

On the toolbar, click the **Show Mass** tool.

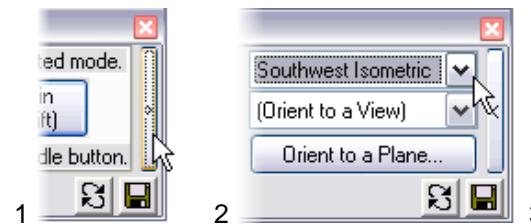


- 2 Click the Dynamically Modify View tool.



- 3 In the Dynamic View dialog box:

- Click the expansion bar at the right of the dialog box.
- Click **Orient to a Direction**, and click **Southwest Isometric**.
- Click the **Save** icon and name the new view **Southwest Isometric Sun Study**.



Set the Sun Study Parameters

The view's advanced model graphics stores the sun and shadow parameters.

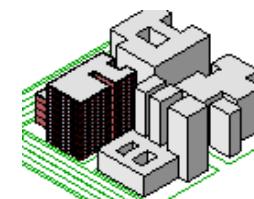
- 4 In the drawing window, click the **Shadows** menu.

Click **Advanced Model Graphics**.

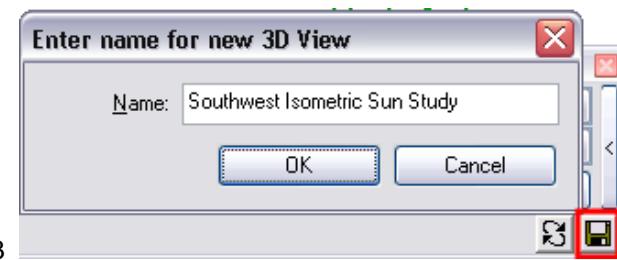


enables you to keep these settings for this view and create other views with different sun settings.

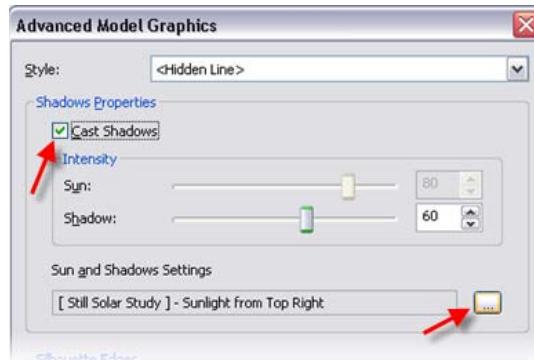
March 21, and a third for June 21.



You can access the advance model graphics either through the view properties or the shortcut menu of the drawing area window as shown here.



- 5 In the Advanced Model Graphics dialog box:
- Select the **Cast Shadows** check box.
 - Click the **Sun and Shadows Settings** button.



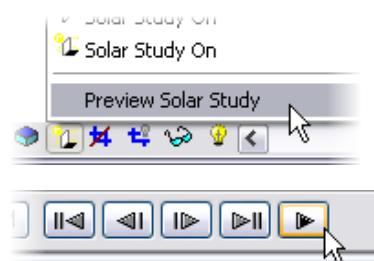
- 6 In the Sun and Shadows Settings dialog box:
- Click the **Single-Day** tab.
 - Click **By Date, Time and Place**. Set the location to your city or enter the values directly with the Azimuth and Altitude settings.
 - If you do not have a toposurface in the model (discussed in Unit 12), verify that the **Ground Plane at Level** check box is selected.



Click OK to close each dialog box and return to the drawing window.

Preview the Sun Study in the View

- 7 On the Shadows shortcut menu in the drawing window, click **Preview Solar Study**.
- 8 On the options bar, click the **Play** button.



The sun study plays through the day, cycling at the interval specified in the sun and shadow settings.



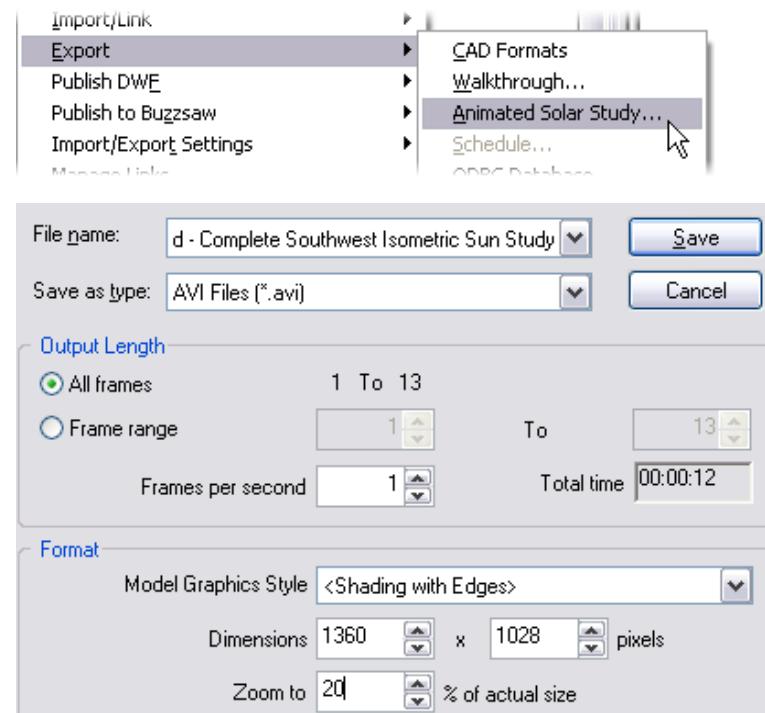
Click the Next Frame button to walk through the study.

Export the Sun Study to an AVI File

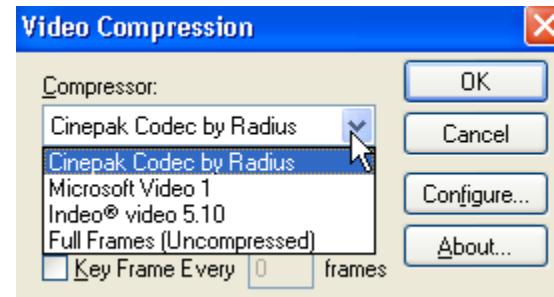
- 9 On the File menu, click **Export > Animated Solar Study.**

With the sun study parameters set and previewed, you are ready to export the sun study to a movie format file.

- 10 In the Save As dialog box, set the following:
- Name the AVI file.
 - Change the frames per second to 1, as you have left the default at 1 frame per hour. Having 15 frames per second would make for a very short AVI file!
 - Adjust the format display mode and dimensions to your preferences.
 - Click **Save.**



- 11 Change the compression codec if you want. Click OK.



The compressors available depend on the software installed on your machine. Full Frames is the most compatible compression method but also produces the largest file.

Exercise 5E: Importing a Revit Architecture Model into Autodesk 3ds Max

The following exercise describes how to import a Revit Architecture model into Autodesk 3ds Max software for visualization. For more detailed exercises on working with 3ds Max, refer to the Autodesk Visualization Supplemental Curriculum.

Set up Your Model for Export

This exercise does not have a starting data set but illustrates the general process of linking a Revit Architecture model into 3ds Max. You can work with your own project or any of the workbook projects. This exercise uses the *i_Settings.rvt* file in the training folder of the Revit Architecture content.

This exercise file has some materials already assigned such as brick and glass. For this example, we have additionally assigned a beige stucco material to the remaining exterior walls.

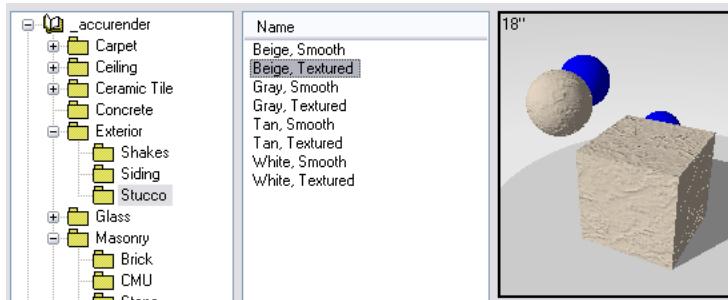
- 1 Before exporting your model, find the appropriate 3D view. Either use the default 3D view, or create your own by placing a camera.
- 2 If you prefer to set up a camera, simply go to a plan view.

On the View design bar, click **Camera**.

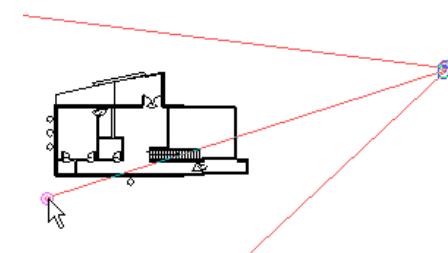
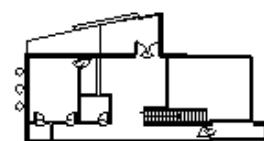
- 3 Click once to place camera.

Click again to establish the view direction.

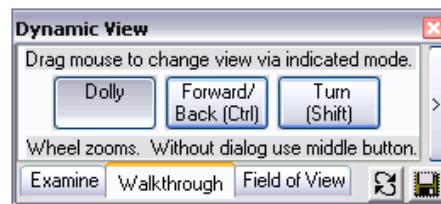
3ds Max cannot import Revit project (RVT) files directly. You can, however, export the model to an AutoCAD® drawing file and then load the file into 3ds Max.



This stucco material has a JPG material map. It is assigned to the wall along the left side of the elevation shown in the Revit Architecture model.



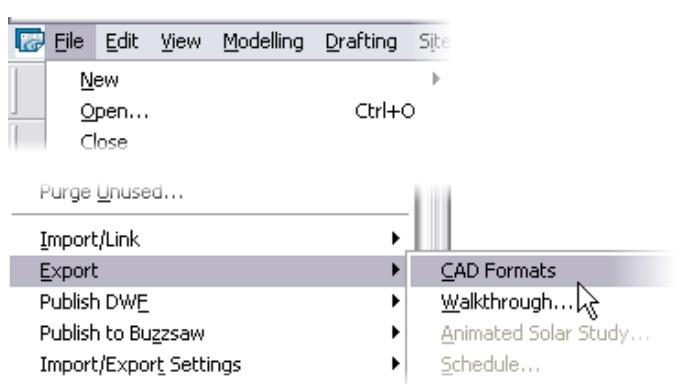
- 4 Use the **Dynamic View** tools to adjust the view to your liking.



With the camera in place, your 3D view is now ready for export to DWG™ format.

Export Your Model

- 5 To export your design to the DWG format, click **File menu > Export > CAD Formats**.

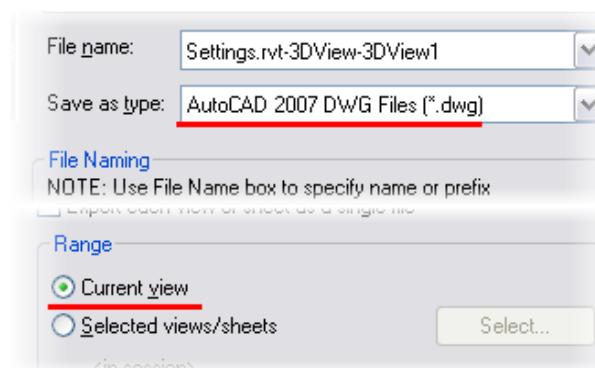


- 6 Verify that Save as Type is set to **AutoCAD DWG 2007** format.

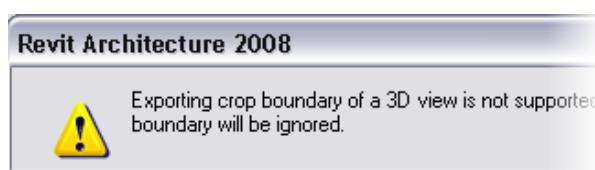
Click **Current View**.

Accept the other default values in this dialog box. Click **Save**.

Choose a location to save your exported model.



- 7 When exporting a camera view, you see an alert indicating that the crop region will not be exported. Click **OK**.



Use a section box on a 3D view to limit the geometry exported to the DWG file.

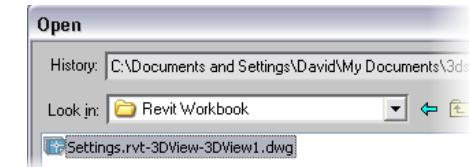
Link Your Model to 3ds Max

- 8 In 3ds Max, click **File** menu > **File Link Manager**.



- 9 In the File Link Manager dialog box, Attach tab, click **File**. Browse to the exported DWG file.

Select the exported DWG file. Click Open to return to the File Link Manager.



- 10 Open the preset to verify that the cameras created in Revit Architecture are also available in 3ds Max.

In the **File Link Manager** dialog box:

- Click **Presets** tab.
- Click the **Revit** preset.
- Click **Modify**.

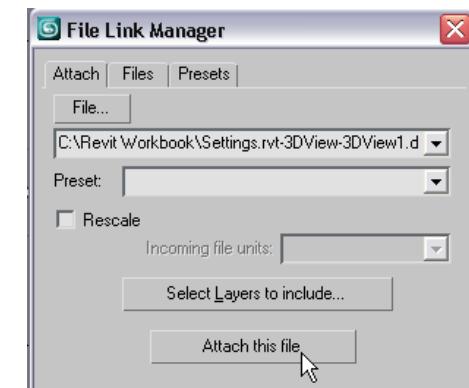
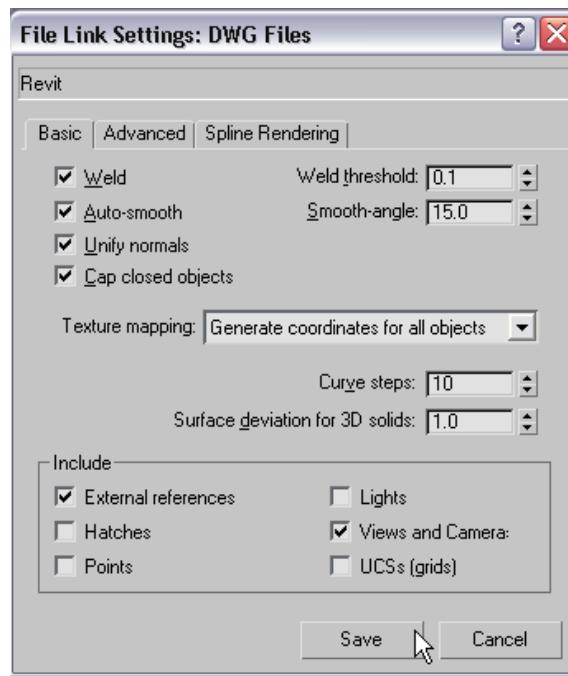


If you do not want to modify the provided Revit preset, copy it and then modify it.

- 11 There are several options on this tab. To ensure that your Revit Architecture cameras are available in 3ds Max, make sure the Views check box is selected.

Save your modifications, and then go back to the Attach tab in the File Link Manager dialog box.

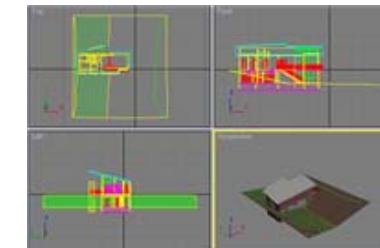
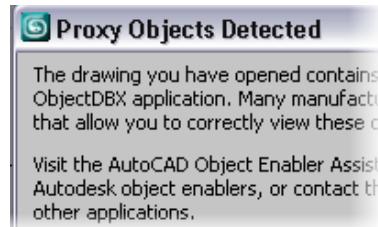
Click Attach This File to load the DWG file into 3ds Max. Then click **Close**.



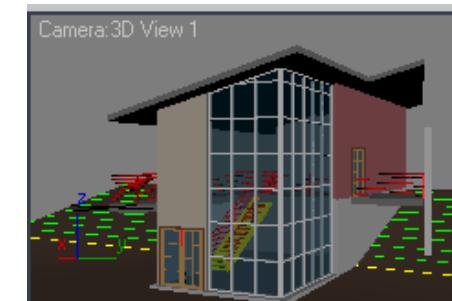
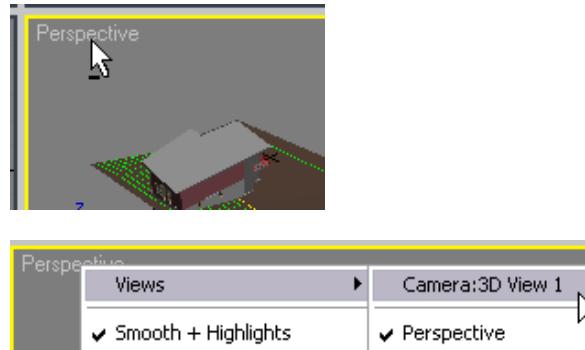
- 12 If you receive a proxy message, click **Yes** to proceed with link.

Your model is now loaded into 3ds Max.

Close the File Link Manager.



- 13 You can change the view to one of the camera views created in Revit Architecture by simply right-clicking the view name in the upper-left corner of the viewport and then clicking Views > Camera: View # (where # represents the number of the Revit Architecture camera).



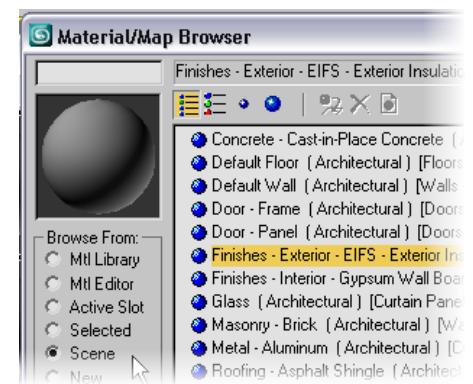
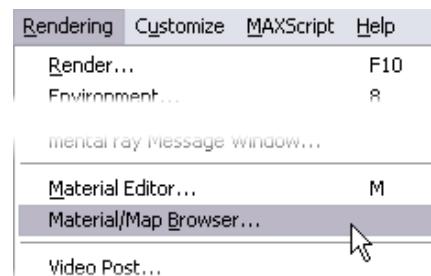
- 14 From this shortcut menu you can select the same camera to modify its location in the other views.



- 15 Finally, the materials that are applied in Revit Architecture are accessible in the 3ds Max environment:

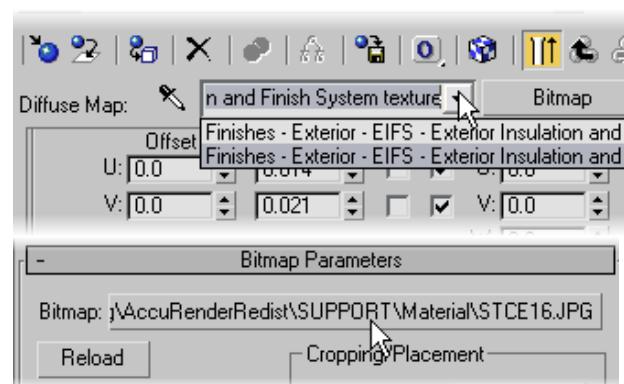
On the Rendering menu, click **Material/Map Browser**.

The materials in the scene are the AccuRender materials read from the original Revit Architecture model. They have maintained the same names.



- 16 When listed in the Material Editor, the materials carry with them bitmaps assigned to them with the Revit Architecture model.

When rendered, the assigned material maps come through without any manipulation in the 3ds Max Material Editor.



Once again, for in-depth coverage of 3ds Max, refer to Autodesk Visualization Curriculum.

Unit 6

Theory: Design Constraints

Revit Architecture: Levels, Reference Planes, and Grids

This unit covers the basics of design constraints. You create gridlines, and then use the array tool to look at the constraint tools it offers. You then add walls, constraining them to the gridlines. In the second part of this unit, you create a roof by extrusion that is constrained to reference planes.

Add a New Level

- 1 On the **File** menu, click **New > Project**.

Click the **Browse** button. Navigate to the folder that contains **Workbook Imperial Template.rte** provided with the data set.

In the project browser, open **Elevations South**.

- 2 On the Basics design bar, click **Level** and click two points below **Level 1**. It does not matter where you click (use the image as a guide).
- 3 With the level still selected, click the text of the dimension of this new level. Change the value to **-2' - 6"**.

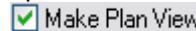
- 4 On the Basics design bar, click **Modify**.

Select the level you've just added.

Drag the blue dot on the left until it is aligned with the existing ones.

Do the same for the blue dot on the right.

Each time you create a level, Revit Architecture automatically creates a view for that level. If you don't want a view for a level, clear the **Make Plan View** check box on the options bar.



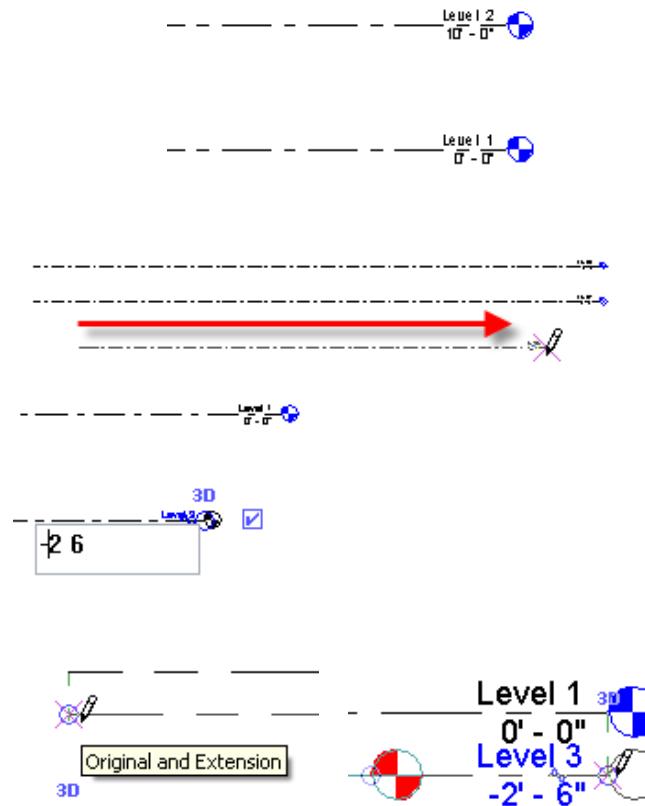
In this case you are going to make the plan view so that you have a view you can work in to modify the foundation later.

Double-click the black triangle on an elevation symbol in the project to automatically open the corresponding elevation.



To place a new level you must be in elevation view or in a section view.

If you know the absolute elevation of a level, you can type it directly by clicking the text that is below the level line while still in the command.

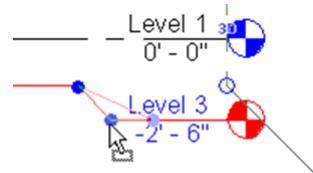


Revit Architecture helps you here: As soon as the points are aligned, Revit Architecture displays a green dashed line along these points. You then see a blue lock icon, which indicates that all the points are locked together. If you move one, all the others follow.

- 5 Click the squiggle grip to offset the mark from Level 1.



- 6 Drag the blue circle grips to adjust the leader away from the mark.



- 7 Click the name of the new level (**Level 3**).

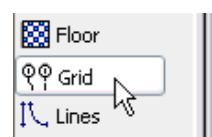
Change this name to **T.O.F.** (Top of Footing).

Revit Architecture asks if you want to rename the corresponding view. Click **Yes**.

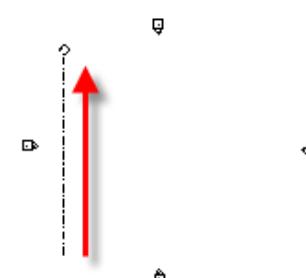
Add Gridlines

- 8 In the project browser, open **Floor Plans Level 1**.

On the **Basics** design bar, click **Grid**.

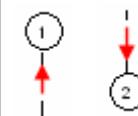


- 9 Click two points to place the first vertical gridline. Pick from bottom to top, or south to north.

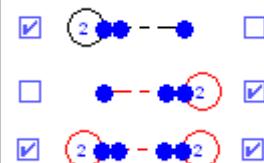


You can choose to rename the level in the project browser by right-clicking this view and then clicking **Rename**.

The direction used to draw the gridline defines the side where the bubble is attached.



If you draw it in the wrong direction, you can use the check box that appears at the end of the gridline when the gridline is selected.



Note: The same concept applies to level

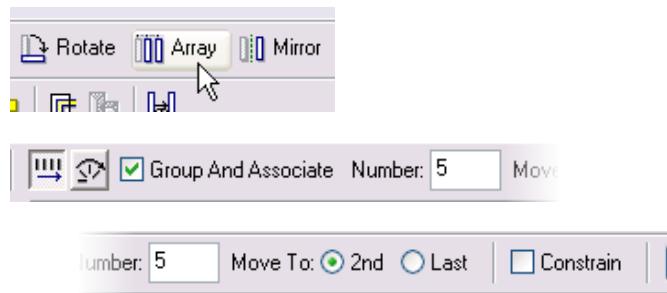
- 10 On the Basics design bar, click **Modify**.
Select the gridline in the project.

On the Edit toolbar, click **Array**.

On the options bar, set the following:

- Select Linear.
- Select Group and Associate.
- In the Number box, type 5.
- Select Move to 2nd.

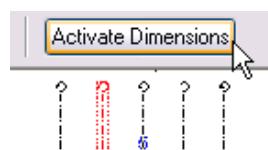
Click anywhere in the drawing window.
Move your cursor to the right, and on the keyboard, type **18** and press **ENTER**.



Adjust Arrayed Elements

- 11 Click gridline 2.

On the options bar, click **Activate Dimensions**.



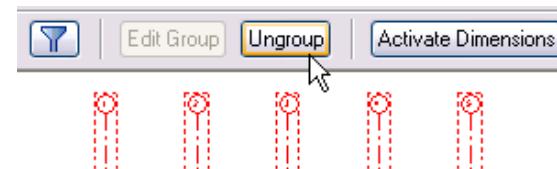
Modifying a dimension between arrayed elements modifies all arrayed elements.

- 12 Click the dimension that appears.

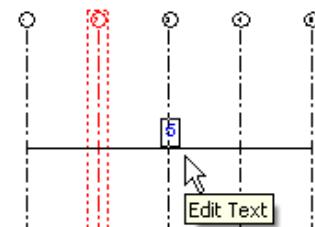
Type **20** for the distance.

- 13 Select all the vertical gridlines.

On the options bar, click **Ungroup**.



markers.



When you've finished the array, you can easily change the number of copies. If necessary, click an element in the array to display the number of copies.



The entire grid system adjusts to the new dimension.

Each gridline can now be moved individually.

Now that you've ungrouped the element, the number of elements in the array can no longer be changed automatically.

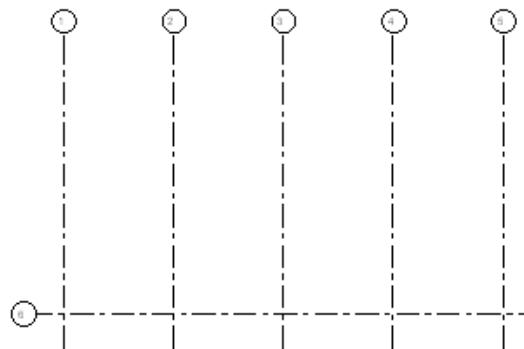
The gridlines adjust as if you had used the Copy tool to create the five gridlines.

Add Horizontal Grids

- 14 On the Basics design bar, click **Grid**.

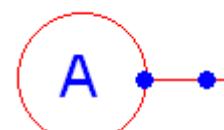
Click two points to place the first horizontal gridline, from right to left.

Press **ESC** twice.



- 15 Zoom around the bubble of the horizontal gridline.

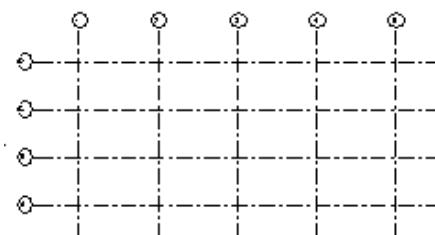
Select the gridline. Click the text in the bubble, change the value to **A**, and press **ENTER**.



- 16 Create an array with this gridline.

Clear **Group and Associate**.

The distance between two lines should be **12'** and the number of copies set to **4**.



Add Foundation Walls Constrained to Grids

- 17 Right-click in the view. Click **View Properties**.

In the Element Properties dialog box, click **Edit** next to View Range.



- 18 From the View Depth list, select **Level Below**.

In the View Range dialog box, click OK.

In the View Properties dialog box, click OK.

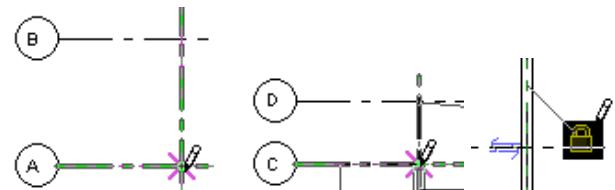
Arrays in Revit Architecture are powerful. You can move one element in the array and all the others move accordingly. Note, however, that this occurs only if you have selected Group and Associate on the options bar before array creation.

The foundation wall is positioned below the current level. If you don't change view depth, you cannot see the new wall that you are going to add.

19 On the Basics design bar, click **Wall**.

On the options bar:

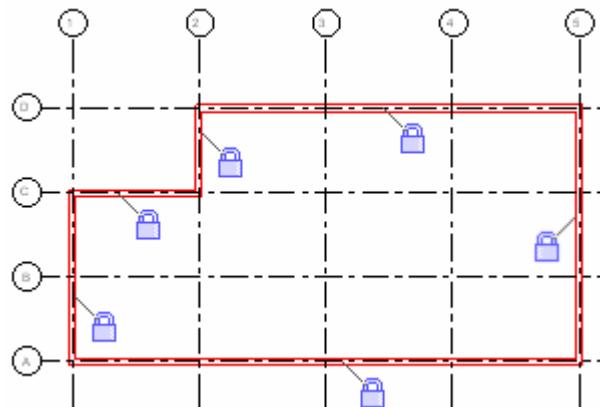
- Set type as Basic Wall: Foundation – 12" Concrete.
- Set Depth to Level T.O.F.
- Check that alignment is set to Wall Centerline.
- Clear Chain.



Draw a first wall from the intersection between lines 1-A and intersection 1-C.

Click the lock icon to lock the wall with the gridline.

20 Using the image as a guide, add five walls. All of them must be locked with the corresponding gridline. Lock each wall section immediately after drawing it.

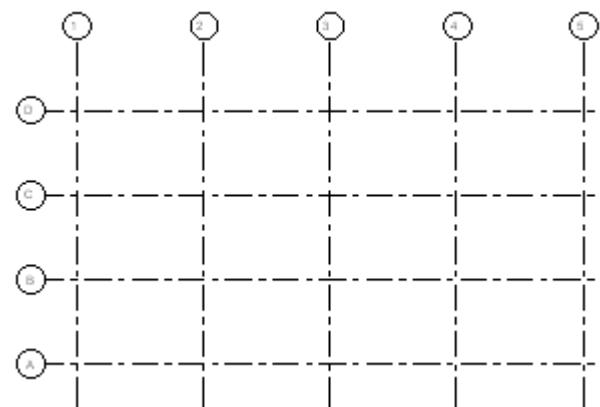


21 Right-click in the view. Click **View Properties**.

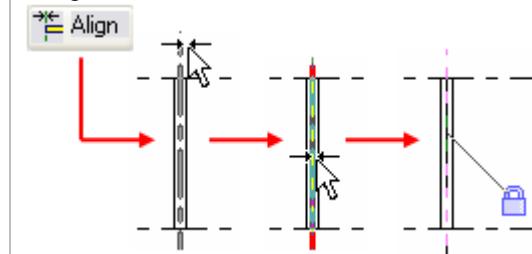
In the Element Properties dialog box, click **Edit** next to View Range.

In the View Depth list, select **Associated Level**.

In the View Range and View Properties dialog boxes, click OK.



If you've used the Chain option, you probably don't see the lock icon. Use the Align tool to lock the relationship between the gridline and the wall.



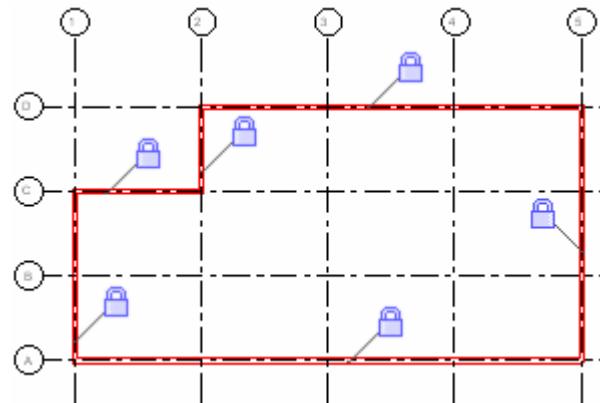
The foundation walls disappear because they are not in the view range.

22 On the Basics design bar, click **Wall**.

On the options bar:

- Set type: Basic Wall: Generic- 8".
- Set Height to Level 2.
- Check that alignment is set to Wall Centerline.
- Clear the Chain check box.

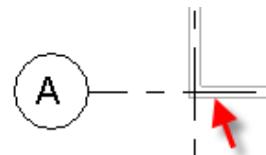
Using the image as a guide, add these walls. All of them must be locked with the corresponding gridline. Lock each wall section immediately after drawing it.



Add Structural Members

Like foundation walls, structural members are often drawn down from the current level to the level below. This setting is similar to Walls on the options bar.

23 Go to Floor Plans Level 2.

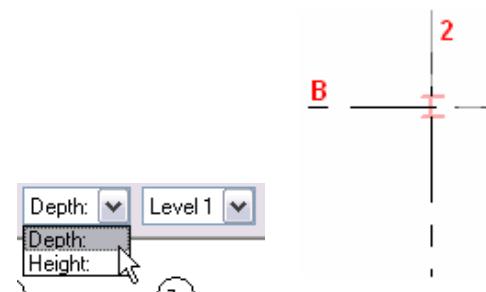


24 On the Structural design bar, click **Structural Column**.

On the options bar, set:

- Type = W-Wide Flange-Column: W10X49.
- Depth = Level 1.

Click the intersection between gridline B and 2.



If you do not see the Structural tab on the design bar, you can add it by right-clicking anywhere on the design bar and then clicking it on the shortcut menu.

You can see the walls below because Level 1 is set as an underlay for the view by default in the workbook template you started with.

Advanced Model Gra	Level 1
Underlay	
Underlay Orientation	Plan
Orientation	Project North

Structural components are automatically locked with gridlines. Click precisely at the intersection. Zoom in if necessary.

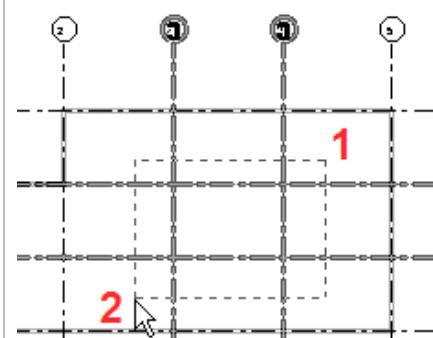
Most structural elements, including the foundation, are drawn extending down. This includes the foundation wall and structural columns.

25 On the options bar, click **Grid Intersection** and do one of the following:

- Hold **CTRL** as you select gridlines B, C, 3, 4.

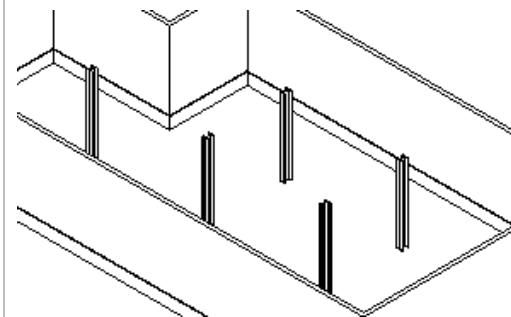
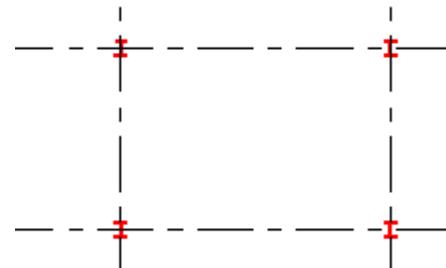
OR

- Select the intersection of these grids with a selection window from right to left across the grids as shown at far right.



26 On the options bar, click **Finish**.

Press **ESC** twice to end the command.



27 Select all the columns in the project. Open their element properties and verify:

- Base Level = Level 1.
- Top Level = Level 2.
- Top Offset = 0.

Click OK.

Parameter	
Constraints	
Base Level	Level 1
Base Offset	0.0
Top Level	Level 2
Top Offset	0.0
Moves With Grids	<input checked="" type="checkbox"/>
Graphics	

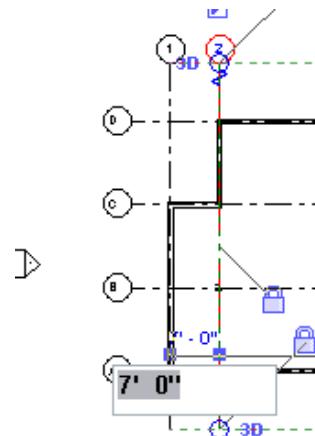
With some walls and columns in the project and locked to the gridlines, you can now adjust the dimensions between the gridlines and all the constrained components update accordingly.

Flex the Building

28 Set current Floor Plans – Level 1.

Move gridline 2 13' left:

- Click the **Modify** tool.
- Click **gridline 2**.
- Click the **Move** tool.
- Click anywhere in the drawing window.
- Move your cursor to the left.
- Type **13** and press **ENTER**.



Because the wall between grids C and D along grid 2 has been locked or constrained to grid 2, it, the foundation wall below this view, and the column along this grid all move with the gridline.

Add an Extruded Roof—Create and Set Work Plane

Unit 1 leads you through creating a simple roof by footprint. When you create a roof by footprint with the Pick Walls option, there is a soft or inherent constraint between the roof and the walls that generated it.

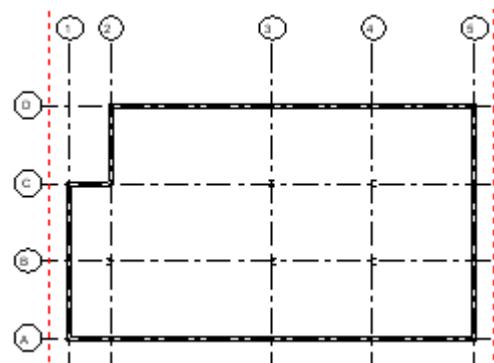
29 Go to Floor Plans Level 1.

On the Basics design bar, click **Reference Plane**.

Add a reference plane on the west and east sides of the building.

Press **ESC** twice.

In this part of the exercise, you create a roof by extrusion. The extrusion roof is a shape generated by lines drawn in a reference plane perpendicular to the normal plan working plane. Once constructed, the extruded roof's start and end points are defined by the location of its reference plane.

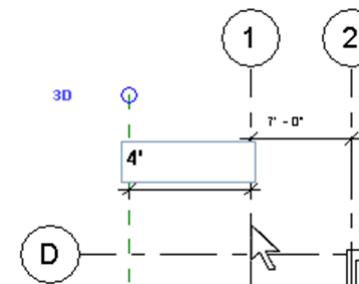


Drawing a reference is like drawing a line: you click two points (start, end).

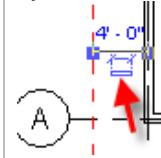
30 Select the reference plane on the west side.

Change the value of the temporary dimension to **4'**.

Convert the temporary dimension to a permanent one.



To convert a temporary dimension to a permanent dimension, simply click the symbol below the dimension line.



- 31 Click the dimension line to select it instead of the column line.

Click the lock icon that appears.

Perform the same operations for the east side.

- 32 Select the west side reference plane.

On the options bar, click **Properties**.

In the Element Properties dialog box, type **Roof Shape** in the Name parameter.

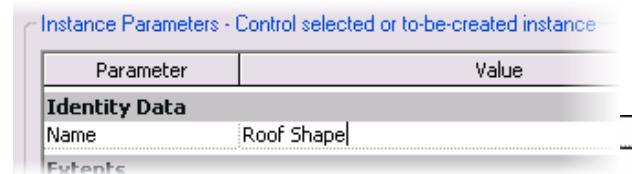
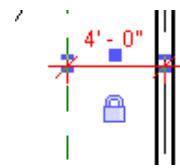
Click OK to return to the drawing window.

Add Roof by Extrusion

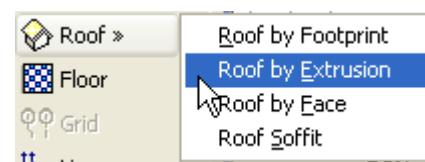
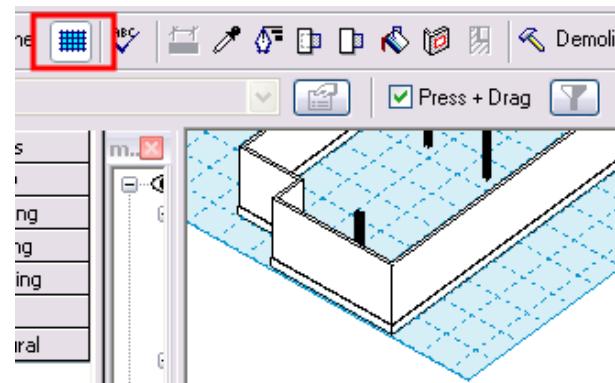
- 33 Open the 3D view.

On the Tools toolbar, click **Work Plane Visibility**.

- 34 On the Basics design bar, click **Roof > Roof by Extrusion**.



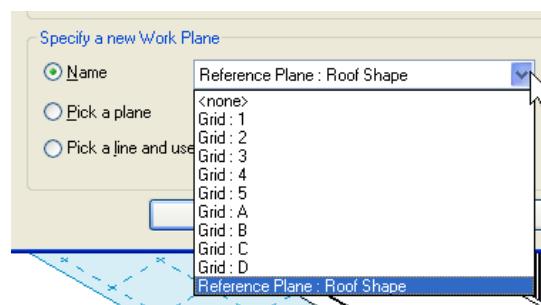
In this section, you use the reference plane as a work plane to draw an extruded roof.



The blue grid is the work plane on which you create the sketch. In most cases Revit Architecture automatically creates a work plane that enables you to sketch. If Revit Architecture can't find a solution, it prompts you to select a suitable work plane.

- 35 In the Work Plane dialog box, select **Roof Shape** from the Name list.

Click OK.



- 36 In the Roof Reference Level and Offset dialog box, click OK to accept Level 2 as a reference level for the roof.

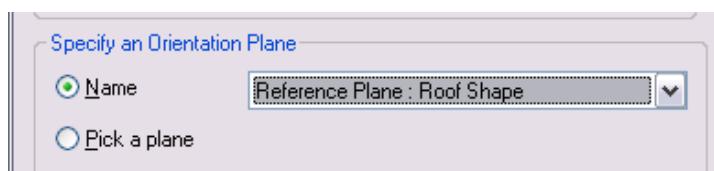
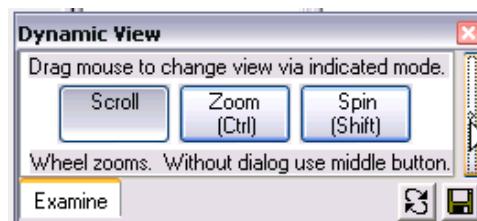
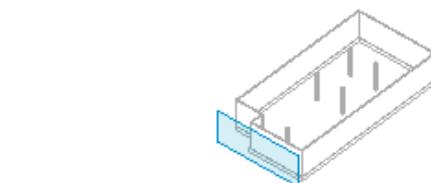


- 37 Open the 3D view.

On the Tools toolbar, click **Work Plane Visibility**.



A note on setting views to work planes:
For this exercise you change the west view in the next step to draw your sketch line.
However, if you do not have quick access to an elevation or section that looks at the work plane, you can use the dynamic view to set the 3D view to the work plane.



- 38 Set the West Elevation current.

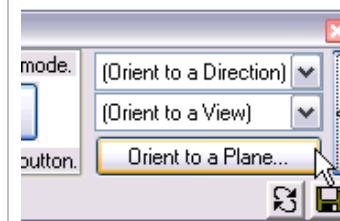
As you can see, if you name a reference plane, it automatically creates a work plane. This is a useful feature.

Work planes can be defined by a face on an object (a wall, for example), a reference plane, or a line.

Notice that each of the gridlines is also automatically considered to be a work plane.

The work plane is aligned with the reference plane placed previously.

To sketch the roof, it is easier to have a point of view perpendicular to the work plane.



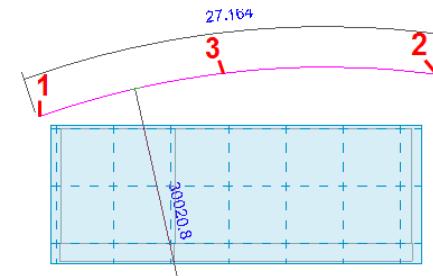
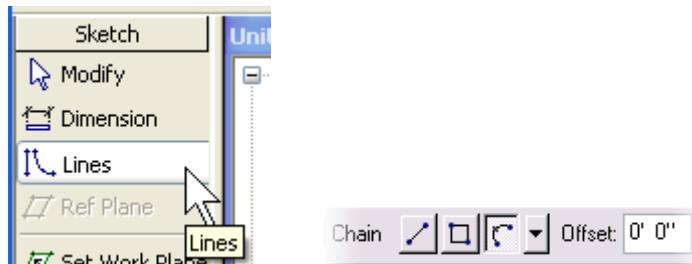
The view orients to the work plane and shows as much of the model as possible. In this case it is backward, so you use the west elevation instead.

- 39 On the design bar click **Lines**.

On the options bar, click **Arc (Passing Through Three Points)**.

Draw an arc using the image as a guide.

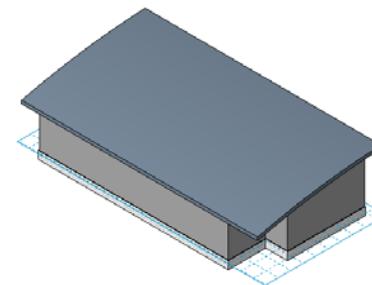
On the design bar, click **Finish Sketch**.



- 40 Set the 3D view current.

On the View menu, click **Orient > Northwest**.

Highlight an exterior wall. Press **TAB**, and click to select the walls.



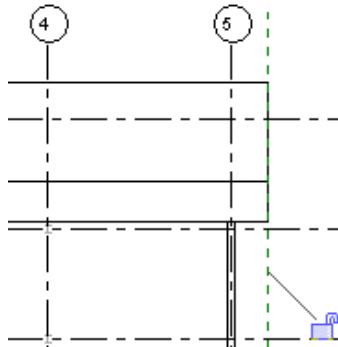
On the options bar, click **Attach** and select the roof.

- 41 Go to Floor Plans Level 2.

On the Tools toolbar, click **Align**.

Click the east reference plane.

Click the edge of the roof.



The roof is cut by the cut plane of the view.

Introduction to View Templates

A view template stores all the parameters of a view. You can create and apply these as needed to quickly adjust the view settings.

- 42 In the project browser, right-click **Floor Plans: Level 2**. Click **Duplicate**.

- 43 You should now be working in a view titled Copy of Level 2.

On the View menu, click **Apply View Template**.

Select Structural Framing Plan from the list. Click **Apply**.

Review the changes in the drawing window, but do not close the dialog box.

Select Site Plan.

Click **Apply**. Review the changes in the drawing window, but do not close the dialog box.

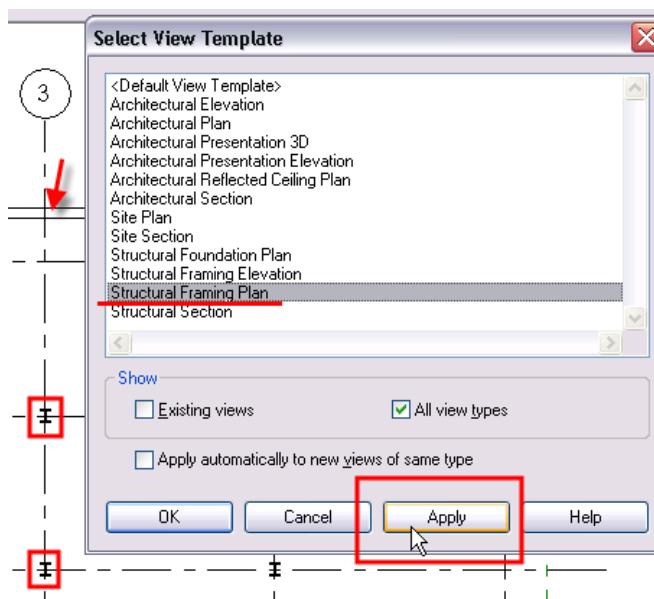
Finally, select Architectural Plan. Click **Apply**. Click OK.

Create a View Template

- 44 Right-click in the view. Click **View Properties**.

In the View Properties dialog box:

- Change the name to **Roof Plan**.
- Next to View Range, click the **Edit** button.



Parameter	Value
Identity Data	
View Name	Roof Plan
Dependency	Independent
Title on Sheet	
Referencing Sheet	
Referencing Detail	
Default View Template	Structural Framing Plan
Extents	
Crop View	<input type="checkbox"/>
Crop Region Visible	<input type="checkbox"/>
Annotation Crop	<input type="checkbox"/>
View Range	<input type="button" value="Edit..."/>
Associated Level	Level 2
Scope Box	None

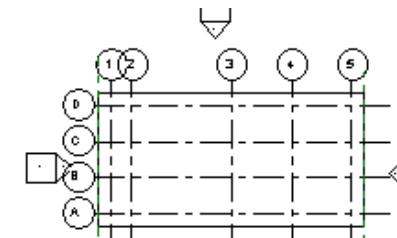
View Range			
Primary Range			
Top:	Associated Level (Level 2)	Offset:	40' 0"
Cut plane:	Associated Level (Level 2)	Offset:	40' 0"
Bottom:	Associated Level (Level 2)	Offset:	0' 0"

- 45 In the View Range dialog box, change the Top and Cut Plane values to **40'**.

Click OK to close each dialog box and return to the drawing window.

The cut plane for a framing plan is much lower, so you see less of the roof.

Also, the columns that were gray now appear solid.



For the site plan, the scale changes as well as the view range, which shows the entire roof.

- 46 On the View menu, click **Create View Template from View**.

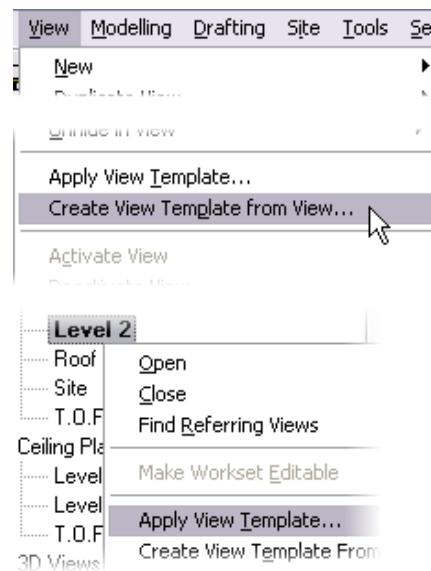
Type **Roof Plan View Template** for the template name.

Click OK to close each dialog box and return to the drawing window.

- 47 Change to the Level 2 view.

In the project browser, right-click Floor Plan Level 2. Click **Apply View Template**.

Select Roof Plan View Template from the list. Click OK.

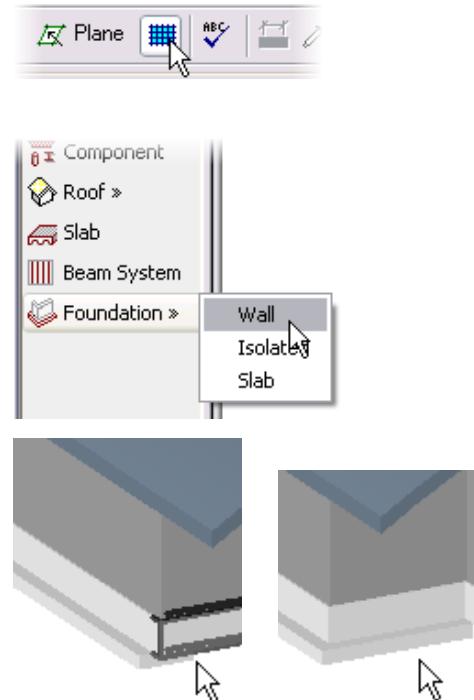


Add a Strip Footing

- 48 Open the 3D view. Rotate the view to see the building in isometric.

Click the **Work Plane Visibility** tool to turn off the grid.

- 49 On the Structural design bar, click **Foundation > Wall**.

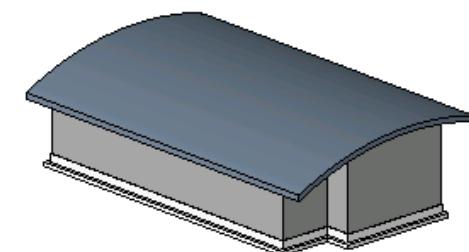


- 50 Click the lower wall to add the continuous footing to the lower stem walls.

The view template you made and its parameters are applied to the Level 2 view as well.

The next unit explores view templates in more depth.

The Continuous Footing tool adds a spread footing at the base of a wall. In this case, you add the continuous footing at the bottom of the lower of the two walls.



Now that your model is filled out, explore the constraints still on the walls and gridlines.

Create more reference planes in a section view that are nonorthogonal to the project. Name the reference planes and set a 3D view to orient to them. With these skew reference planes as the work plane, what objects can you draw? What objects are you prohibited from drawing?

Unit 7

Theory: Design Information Organization

Revit Architecture: Components, Categories, and Subcategories

This unit has four exercises.

- 7A provides a quick overview of the organization and structure of Revit Architecture design objects.
- 7B explores the user-created organizational system of Revit Architecture groups.
- 7C continues the exploration of groups and the ability to convert a group to a linked file or vice versa.
- 7D leads you through breaking a view into two dependent views to place a larger plan onto two sheets.

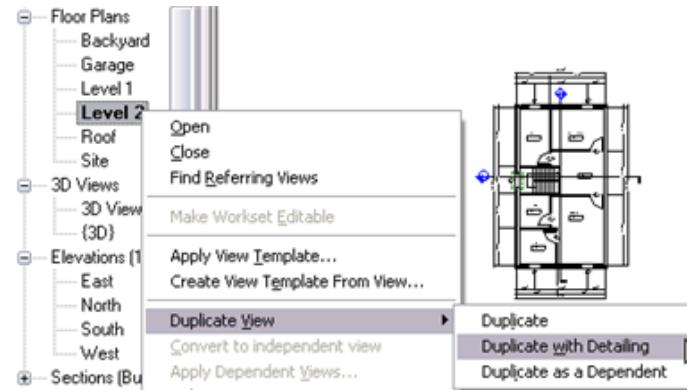
Exercise 7A: View Templates, Categories, and Subcategories

In this exercise you create and apply a view template to explore the categories and subcategories of object styles that are the basis for object organization and structure in Revit Architecture.

Create a New View and Apply a View Template

- 1 Open file i_Unit 7a – Start. The file should open with the Floor Plan Level 2 active.

In the project browser, right-click **Floor Plans: Level 2**. Click **Duplicate View > Duplicate with Detailing**.



- 2 Right-click **Floor Plans: Copy of Level 2**. Click **Rename**.

Rename this to **Level 2 Furniture**.

Tile the Level 2 and Level 2 Furniture

The plan view has a view template assigned to it (1/4" Architectural Plan).

Duplicate with Detailing copies the annotation elements that are placed in that view.

The new view has dimensions, tags, and other annotation copied from the original view.

Although you could use Duplicate rather than Duplicate with Detailing here, you are going to take care of these elements with a view template.

WT is the window tile keyboard shortcut.

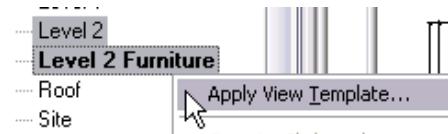
views.

- 3 In the project browser, hold **CTRL** and select both the Level 2 and Level 2 Furniture views.

Right-click. Click **Apply View Template**.

Click the **1/4" Furniture Plan** template.

Click OK.

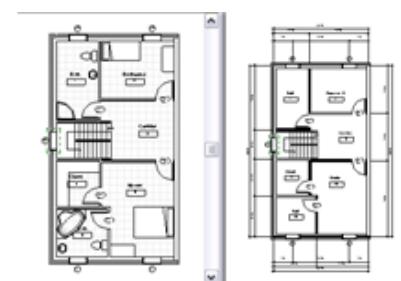


- 4 In the project browser, right-click the Level 2 view.

Click **Apply View Template**.

Click the **1/4" Architectural Plan**.

Click OK.



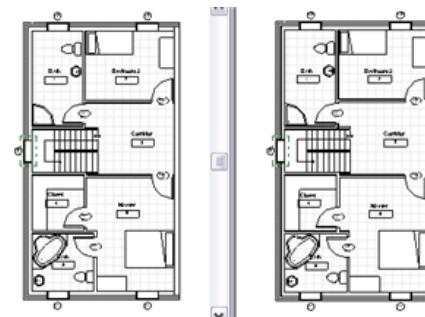
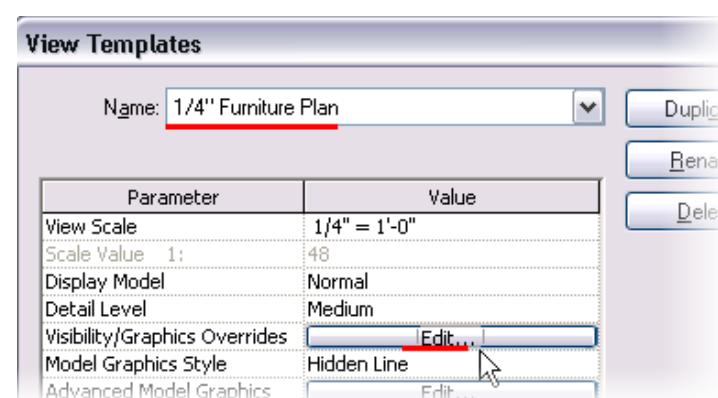
Edit the Furniture Plan View Template

- 5 On the Settings menu, click **View Templates**.

Set the view template to edit to 1/4" Furniture Plan.

Next to Visibility/Graphics Overrides, click **Edit**.

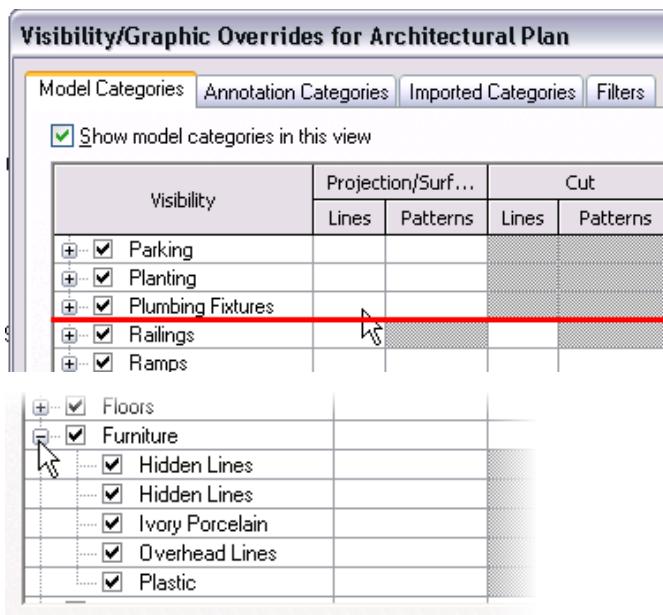
In this section you edit the view template parameters to turn off the window and door tags.



Both views have now been updated with the new set of visibility parameters stored in the view template.

The Level 2 view is returned to its original state.

- 6 On the Model Categories tab, note that Plumbing Fixtures has no overrides in place.



- 7 Expand the Furniture category.

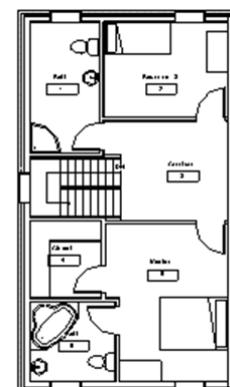
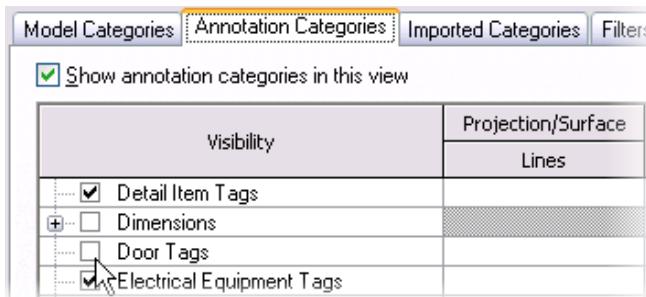
- 8 Click the **Annotation Categories** tab:
- Clear Door Tags.
 - Clear Window Tags.
 - Verify that Elevations and Sections are cleared.

Click OK to close each dialog box and return to the drawing window.

- 9 In the project browser, right-click **Level 2 Furniture**. Click **Apply View Template**.

Select 1/4" Furniture Plan.

The door and window tags have been turned off for this view only.



When there are no overrides in place, a view uses the By Category setting. In such cases the objects look to Settings > Object Styles for display parameters. There are no overrides set for this view template.

These are the subcategories of Furniture. In general, subcategories are established by the families as you load them into the project.

You create a new subcategory later in the exercise.

Clearing these elements tells Revit Architecture not to display them when you apply this view template.

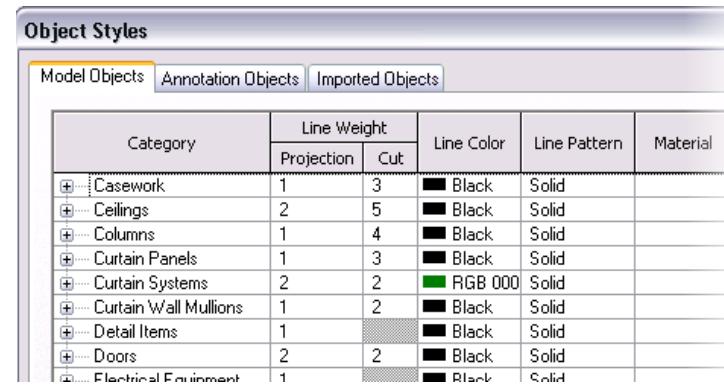
You can save visibility settings in view templates and recall them to be assigned at any point to any view. The visibility settings define what categories and subcategories are visible within a view.

To save the active visibility setting that you define as a view template, on the View menu, click Save as View Template.

To apply a view template, on the View menu, click Apply View Template, or right-click in the project browser and then click Apply View Template.

Change an Object Style Globally

- 10 On the Settings menu, click **Object Styles**.



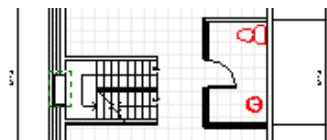
- 11 Scroll down the window to Plumbing Fixtures, and change color to Red.

Click OK.

- 12 Open the Level 1 plan view.

Verify that the plumbing fixtures have assumed the new color settings.

Close the Level 1 plan view.



Create and Assign a Subcategory

- 13 On the Settings menu, click **Object Styles**.

Expand the **Furniture** category.

Floors	2
Furniture	1
Hidden Lines	1
Hidden Lines	1
Ivory Porcelain	1
Overhead Lines	1
Plastic	1
Furniture Systems	1

The object styles control the linework representation for all objects. Changes you make in this dialog box affect all views that do not have an override in place.

Use category/subcategory structure to manipulate the settings for linewidth, line pattern, and material for the objects.

The Object Styles dialog box has three tabs: Model Objects, Annotation Objects, and Imported Objects.

You can control the appearance of model and annotation objects from the first two tabs. On the third tab you can control display settings for imported objects such as DWG format files (line color, weight, style).

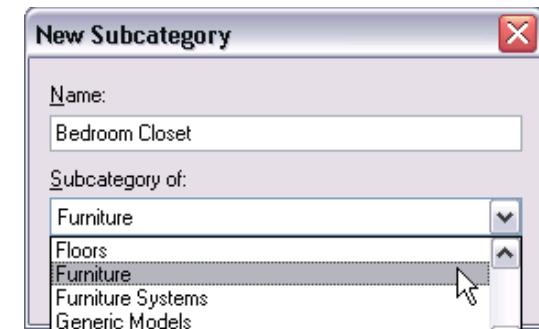
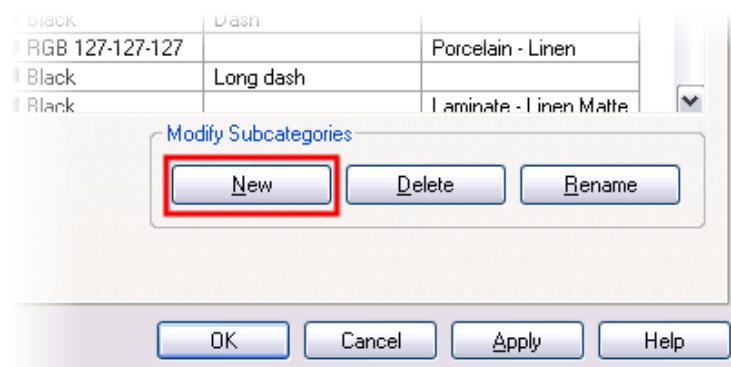
Because styles are not view specific, changing the color of a category affects the display of that category in all views.

The following steps are usually done within the family file as illustrated in Unit 11. However, the same theory applies if you create in-place families as has been done on the closet shelves in this project.

- 14 Add a subcategory by clicking **New**.

Name the new subcategory **Bedroom Closet** as a subcategory of **Furniture**.

Click OK to return to the Object Styles dialog box.



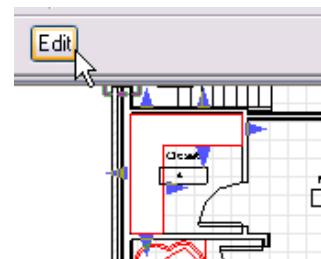
- 15 Change the subcategory color to **orange** by clicking the Line Color column.

		BLACK	Solid
		Black	Solid
		RGB 255-128-000	Solid
		Black	Dash

Assign the Closet Shelf to the New Subcategory

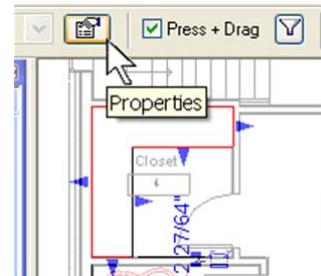
- 16 Select the furniture item inside the closet in the main bedroom (see image). It's an in-place family.

On the options bar, click **Edit**.

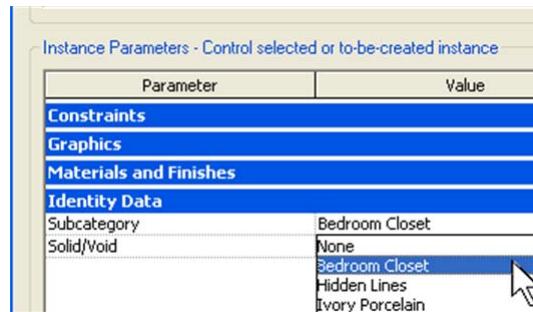


- 17 Again, select the shelf in the closet.

On the options bar, click the **Properties** button.



- 18 Change the subcategory to **Bedroom Closet**.



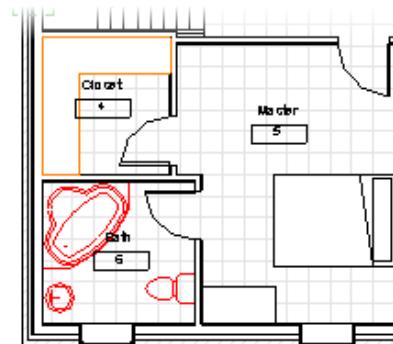
- 19 Right-click the symbolic lines defining the closet. Click **Element Properties**.

Assign the subcategory **Bedroom Closet**.

- 20 Click OK to close window.

On the design bar, click **Finish Family**.

Note the color change of the component.

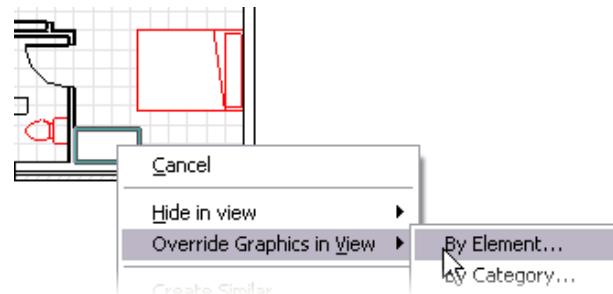


The visibility of the Bedroom Closet subcategory can be switched off even if the rest of the furniture is visible. Open the visibility settings for this view and expand the Furniture category. The Bedroom Closet subcategory is now available as a parameter that you can control by object style for all views, or by visibility graphics for view overrides.

You can override the color of the category or subcategory by opening the visibility settings for the view and setting a view override.

Override by Element

Revit Architecture also provides the ability to override the display of individual elements.

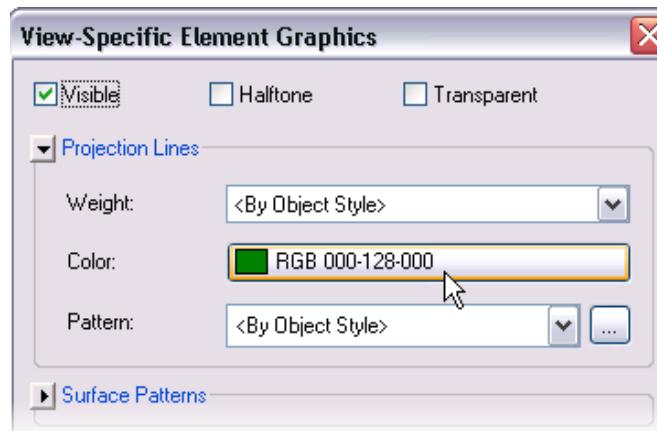


- 21 Right-click the dresser and bed in the master bedroom. Click **Override Graphics in View > By Element**.

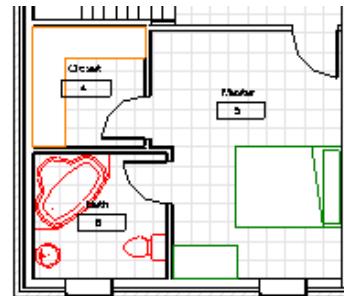
22 Click the Project Lines expansion arrow.

Click the **Color** button.

Change the color to green.



23 Click OK to return to the drawing window.



You have quite a bit of control over how individual objects are displayed. This function enables you to override most of the individual element's visibility properties, including the linewidth, color, and pattern. This function also enables you to override an element's material surface pattern.

View Filters

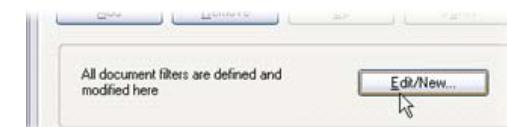
Revit Architecture provides the ability to control items by category, subcategory, and instance. Within a specific view you also have the ability to create filters that give you further control over the display of objects.

24 Open Level 2 Furniture view properties.

Click the **Visibility/Graphic Edit** button to access the overrides for this view.

Click the **Filters** tab.

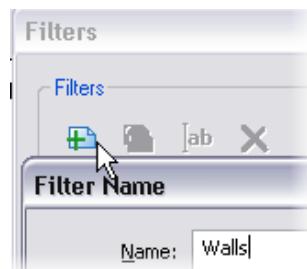
On the lower portion of the Filters tab, click **Edit/New...**.



25 On the Filters tab, click the **New** icon.

Type **Walls** for the filter name.

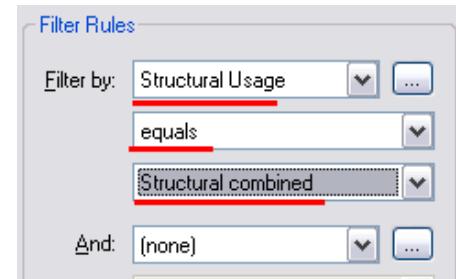
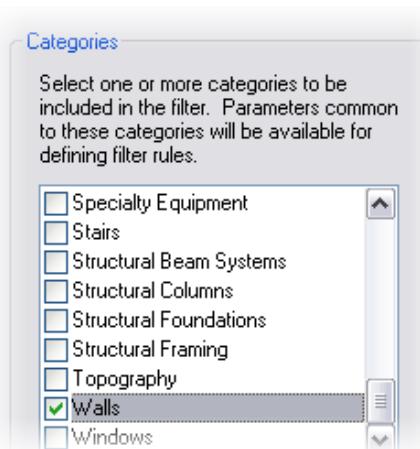
Click OK to return to the Filters tab.



26 On the Filters tab, under Categories, scroll down the list and select **Walls**.

Under Filter Rules, set:

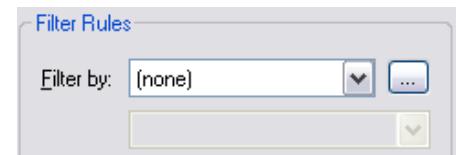
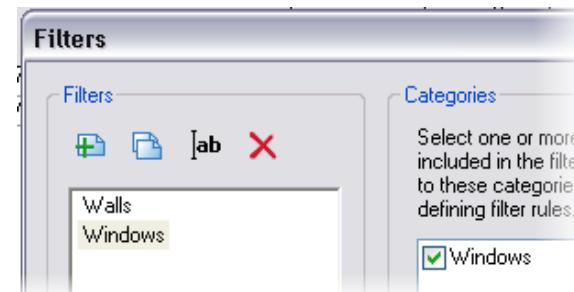
- Filter By = Structural Usage.
- Operator = Equals.
- Structural Combined.
- And = None.



The Filter Rules options enable you to adjust visibility overrides for specific rules.

27 Repeat, adding a filter for Windows. For this filter, leave Filter By to **None**.

Click OK to return to graphic overrides page.



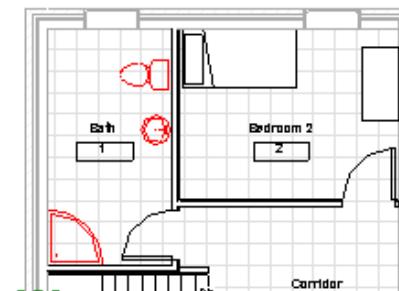
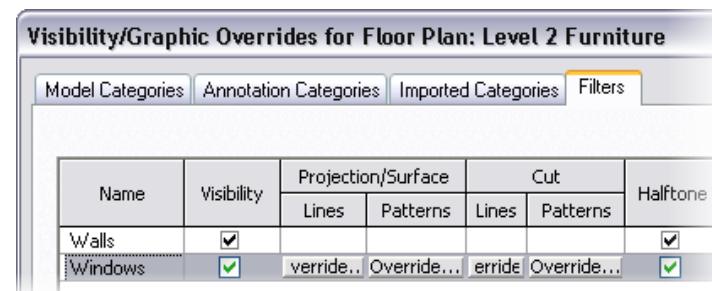
28 On the Visibility Graphic Overrides page, Filter tab, click **Add**.

Click both filters. Click OK.



- 29 Select the **Halftone** check box for each filter.

Click OK to return to the drawing window.



Both of the exterior wall types have the designation Structural Combined and are gray along with all the windows. The interior walls are nonbearing and are not affected by the filter override.

Exercise 7B: Group Basics

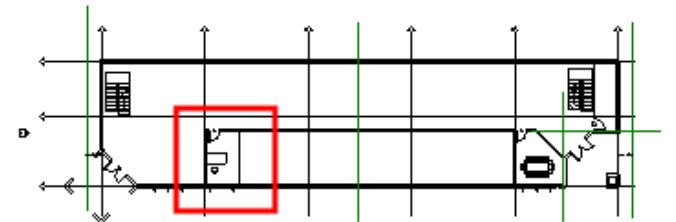
A group is a collection of Revit Architecture objects that behave as one element. Annotation elements and model elements cannot belong in the same group. When you create a group from a collection of objects that contains both model and annotation elements, you create two groups, a model group and an annotation detail group. This exercise explores the basic functionality of groups along with the relationship between the model and annotation groups.

Create a Group

- 1 Open the data set **i_Unit 7b - Start.rvt**.

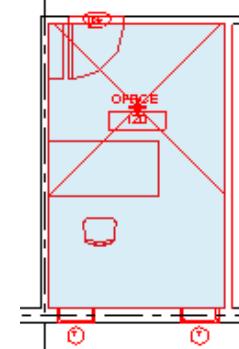
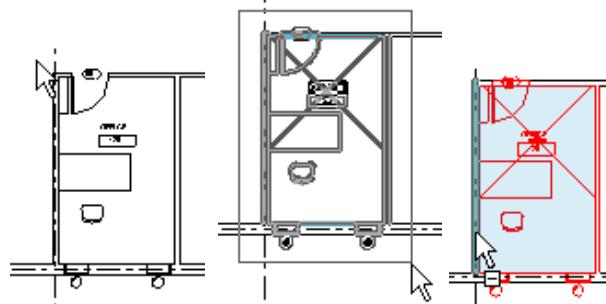
Verify that Floor Plans Level 1 is current.

Zoom into the desk and chair (middle left).



- 2 Select the shelf, door, door tag, windows, window tags, desk, chair, room, room tag, and the right wall of the office:

- Click outside the upper-left corner. Holding the left mouse button, drag the pointer to the outside of the lower-right corner and release.
- Hold **SHIFT** and click the left wall to deselect it.



- 3 On the toolbar, click **Group**.



- 4 In the Create Model Group and Attached Detail Group dialog box, set:

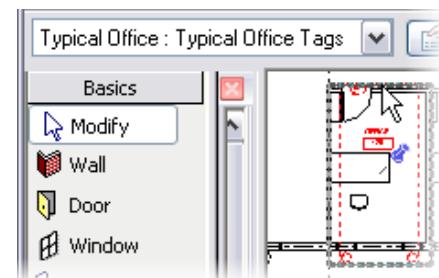
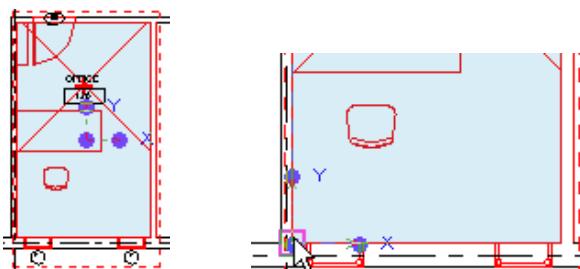
- Model Group Name = Typical Office.
- Attached Detail Group Name = Typical Office Tags.



Click OK to return to the drawing window.

- 5 Note that the group has three grips. The middle grip is the insertion point of the group.

Drag the insertion grip to the lower-left corner of the space.



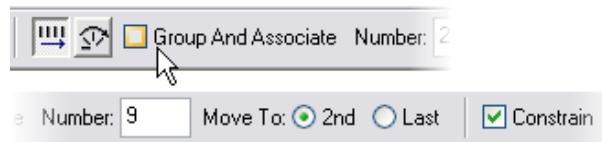
Also note that the tags have been moved to a separate group.

Array Typical Office Model Group

- 6 With the model group still selected, click the **Array** tool.

On the options bar, set:

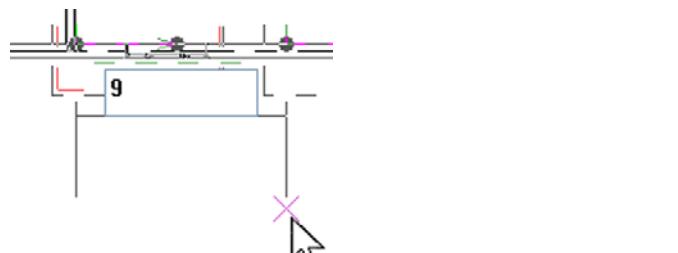
- Array type = Linear.
- Clear Group and Associate.
- Number = 9.
- Move to 2nd.
- Select Constrain.



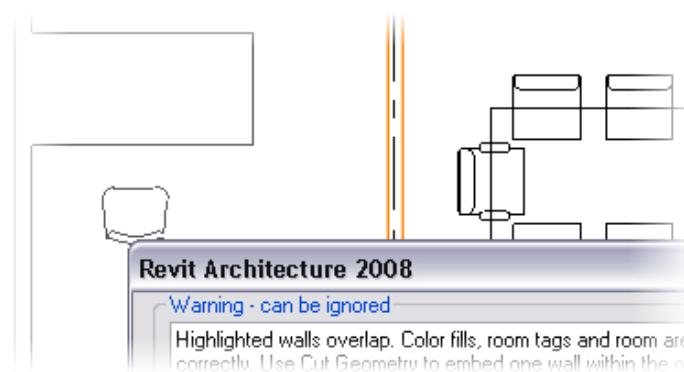
- 7 Click anywhere in the drawing window. Drag to the right.

Type 9 **for 9'**.

Press **ENTER**.



- 8 Click OK in the warning message that appears.



This message tells you that the right wall in the group is lying on top of the left wall of the conference room. This is not an uncommon condition when working with groups. One end or both will be unique conditions.

Furthermore, the warning says that you can hover your cursor over that wall and remove the offending wall from this instance of the group.

- 9 Hover the cursor over the wall between the conference room and the far right office.

Press **TAB**.

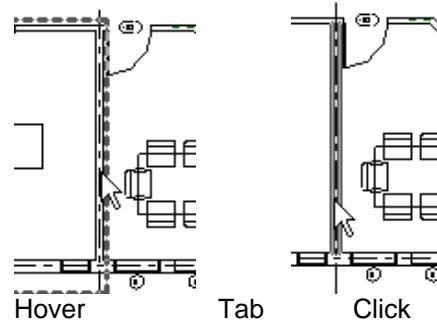
Click the wall that highlights. A blue group icon appears with a leader to the wall.

Click the blue icon to exclude this wall from the group.

Edit the Group

- 10 Click any of the model groups.

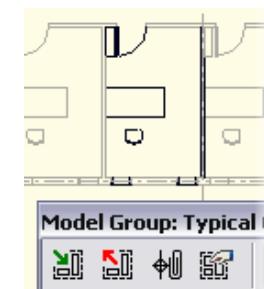
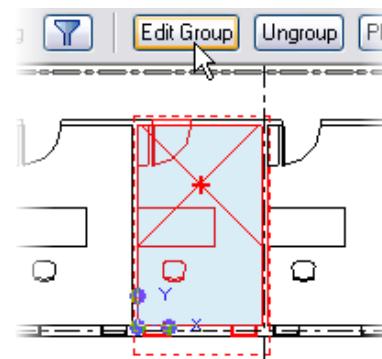
On the options bar, click **Edit Group**.



You can also right-click the wall or blue icon and then click **Exclude** on the shortcut menu.



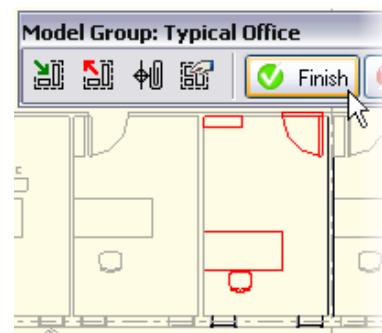
To change a group's definition you enter Edit mode.



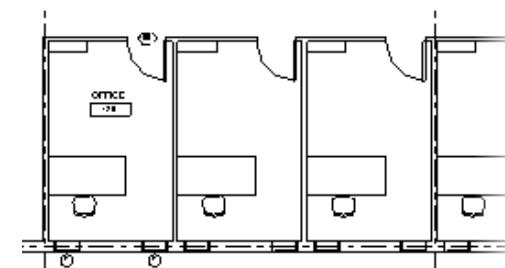
- 11 Move the desk and chair toward the window.

Move the door against the right wall. Rotate the shelf.

On the design bar, click **Finish**.



The group is open for editing. Those objects not in the group are dimmed and not accessible.



The change is propagated throughout each of the offices.

Add Objects to the Group

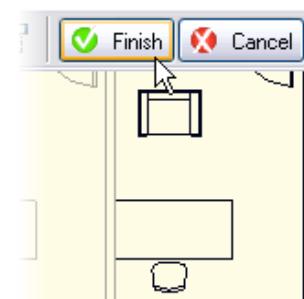
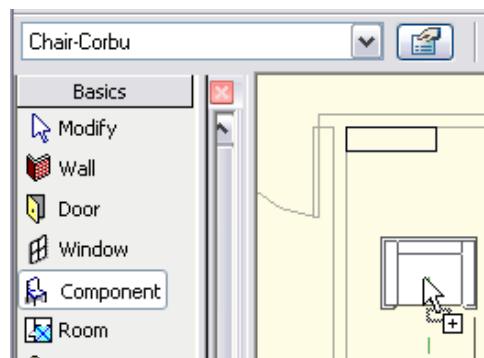
- 12 Click one of the model groups.

On the options bar, click the **Edit** button.

On the Basics design bar, click **Component**.

Add a Chair-Corbu to the office.

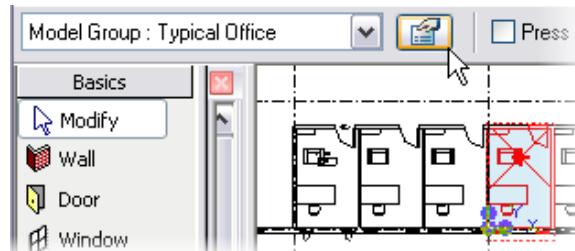
Click **Finish**.



Once a group has been defined in the project, it acts much like any other Revit Architecture object. You can create *types* based on the original.

- 13 Click the fourth model group in the row.

On the options bar, click **Properties**.

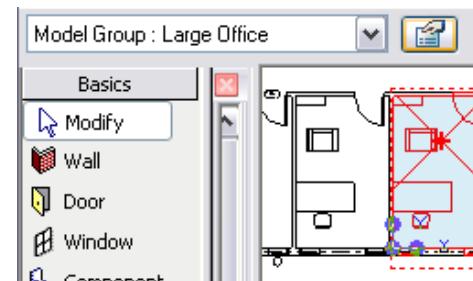


- 14 Click **Edit/New**.

Click **Duplicate**.

Type **Large Office** for the name.

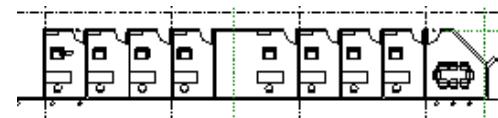
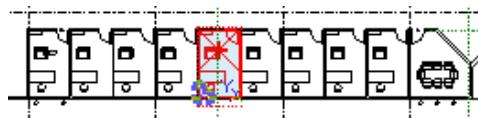
Click OK to close each dialog box and return to the drawing window.



This group now has a different type definition from the other groups.

Modify the New Large Office Group

- 15 Delete the fifth model groups as shown in the image.



- 16 Select the Large Office Group.

On the options bar, click **Edit Group**.



- 17 Change the layout as shown here:

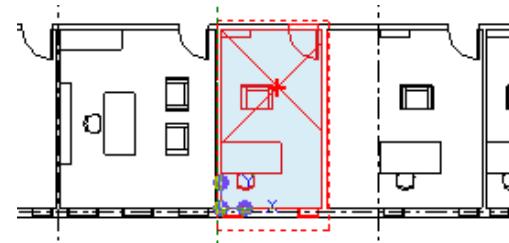
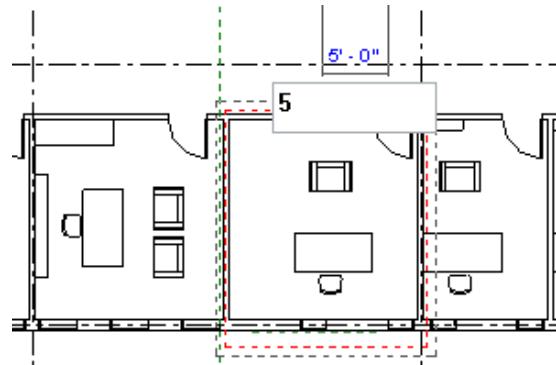
- Move the wall 5' east.
- Move the door.
- Add a credenza to the north wall.
- Move the shelf to the west wall, and change to larger type.
- Rotate the desk and chair.
- Change the windows to 36" x 72", and add a third window, moving as needed to center in space.



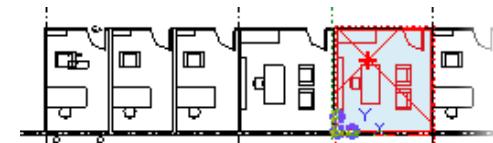
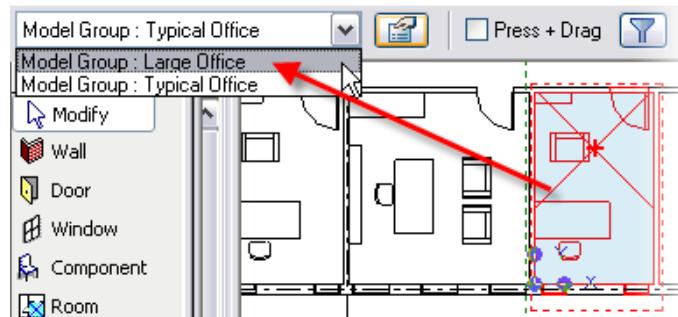
On the Group toolbar, click **Finish**.

Apply Group Type to a Different Group

- 18 Move the fifth model group 5' to the left.



- 19 With this group still selected, use the options bar Type list to change the type of this group to **Large Office**.



Groups can be powerful tools for working with sets of objects in the Revit Architecture environment.

Add Annotation Detail Groups

- 20 Press **CTRL** and click model groups 2, 3, 6, 7, and 8.

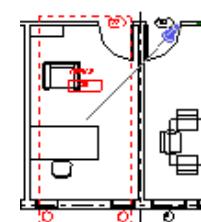
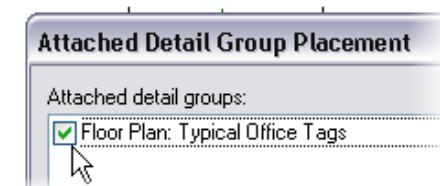
On the options bar, click **Place Detail**.

Under Attached Detail Groups, select the **Floor Plan: Typical Office Tags** check box.

Click OK.

Note: Each group now has an associated annotation group.

The annotation groups are “pinned” to the model group, forcing them to move together.

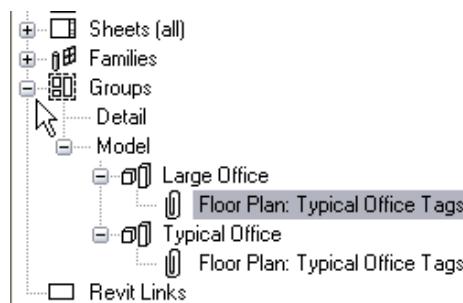


There is only one annotation detail group defined in the project so far, and that group is not appropriate for the Large Office group.

The detail group for the typical office will not work for the large offices because there is a third window now for the Large Office group.

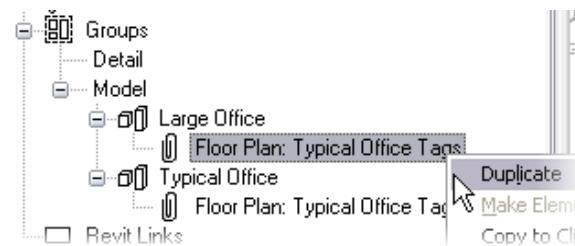
Duplicate Annotation Detail Group for the Large Office

- 21 In the project browser, expand the **Groups** category (at the bottom of the list).



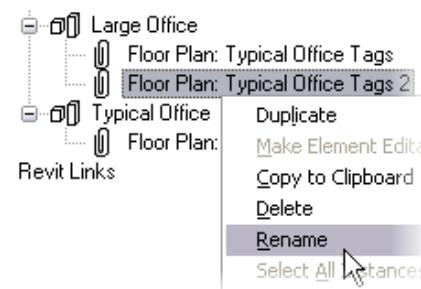
The Groups category in the project browser lists all the group definitions in the project.

- 22 Right-click the Large Office's associated annotation detail group **Floor Plan: Typical Office Tags** group. Click **Duplicate**.



- 23 Right-click the new definition **Typical Office Tags 2**. Click **Rename**.

Enter **Large Office Tags** as the name.



- 24 Click the large office on the left.

On the options bar, click **Place Detail**.

Under Attached Detail Groups, click **Floor Plan: Large Office Tags**.

Click OK.

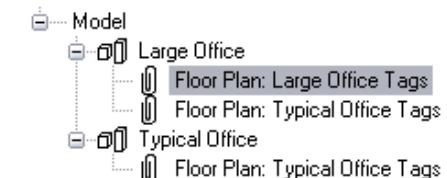
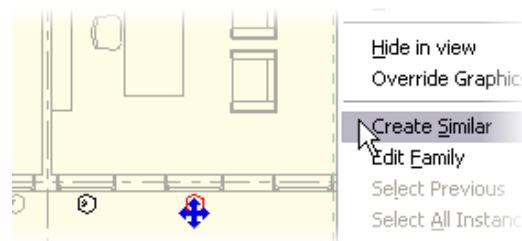


- 25 With the large office tags attached detail group selected, on the Options Bar, click **Edit Group**.

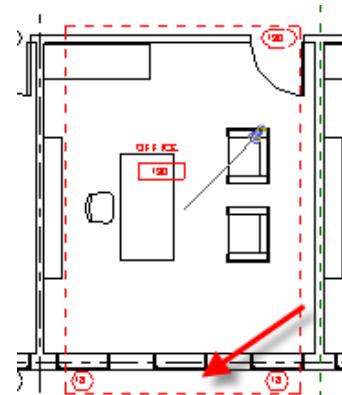
Right-click one of the window tags.

Click **Create Similar**.

On the options bar, clear the **Leader** check box.



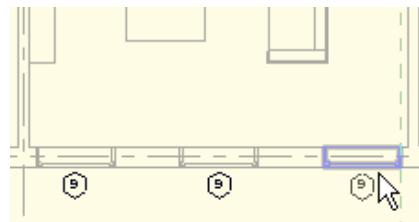
Both of these groups can be applied to the large office model group.



The definition is the same but with a different name. You still need to edit the group and add a new tag for the window.

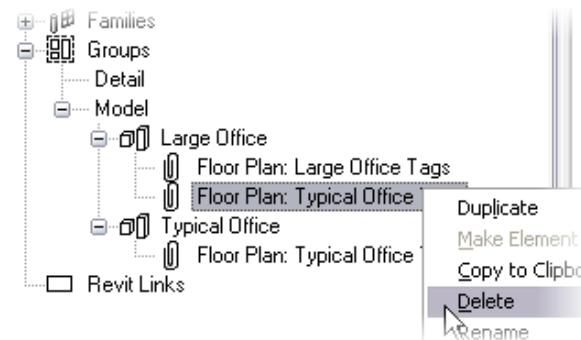
26 Click the untagged window.

On the Attached Group toolbar, click **Finish**.



27 Remove the extraneous attached detail group:

- Right-click the **Typical Office Tags** subgroup of Large Office.
- Click **Delete**.



28 Add the detail group to the second large office:

- Click the large office on the right.
- Click **Place Detail**.
- Click the **Large Office Tags** group.
- Click OK.



29 Save and close the project.

On your own, further explore the use of groups. Create an entry for the building. Can you create groups that you can swap out for one another, showing different solutions to the entry design?

You can insert groups using the design bar > Modeling tab > Model Group tool.

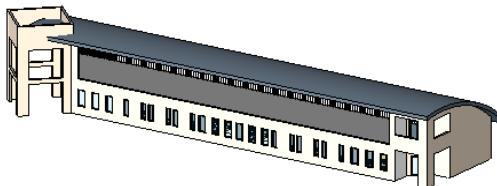
Groups can be exported as Revit Architecture (RVT) files. Linked files can be bound to the current project and then become their own group. The next exercise continues with this data set and explores this process.

Note that only those attached detail groups associated with the model group in the project browser are available to add from this dialog box.

Exercise 7C: Groups and Links

This exercise explores the interaction of groups and linked Revit Architecture files. In this exercise you start with the end point of the last exercise. You make a group out of the string of offices on the south side of the building along with the south wall. Once the larger group has been created, you convert it to a linked Revit Architecture file and copy and paste it to the second floor.

Once the file has been converted to a linked file, you have to close the exercise project to open the newly created/linked Revit Architecture file for editing. After changing some windows in this file, you close it and open the original exercise file and explore the changes.



Exercise Start



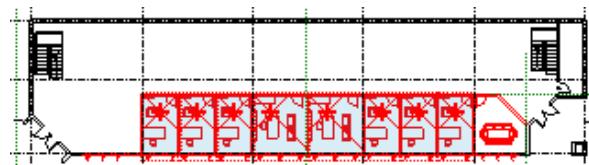
Exercise Complete

Create a Floor Group

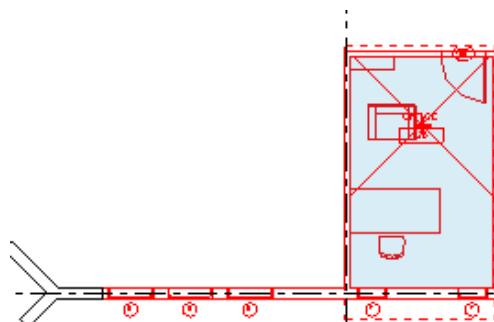
- 1 Open file i_Unit 7c – Start. The file should open with the Floor Plan Level 1 active.



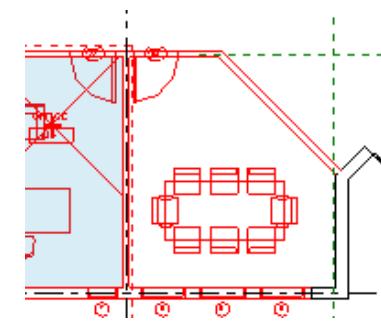
- 2 Drag a selection window from left to right around the interior office groups along with the southern wall and the conference room wall. (Refer to the images to the right and on the next line.)



Note that the south wall has been split to help with this exercise. The images show the left and right conditions as to what should be selected (do not select the small portions at each end of the southern wall).



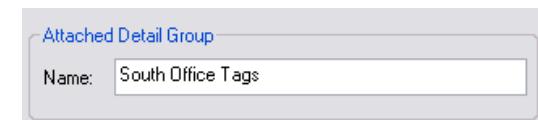
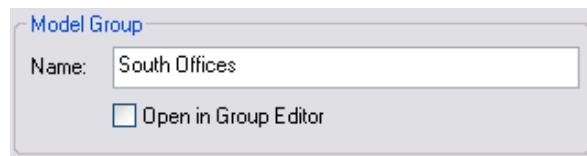
This is the result of the last exercise. The attached detail groups have been ungrouped in preparation for making the group named South Offices that you export to an RVT file.



- 3 On the toolbar, click **Group**.

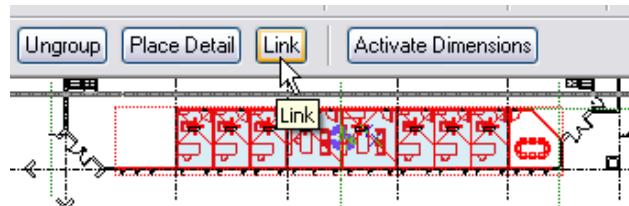


- 4 Name the model group **South Offices** and the attached detail group **South Office Tags**.



- 5 With the group selected, on the options bar, click **Link**.

In the Convert Group to Link dialog box, click **Create New**.



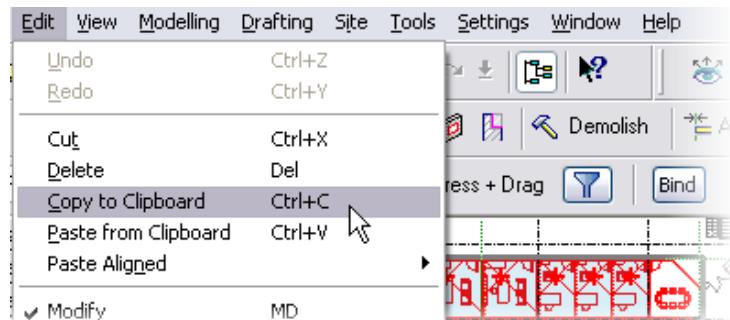
- 6 In the Save Group dialog box:

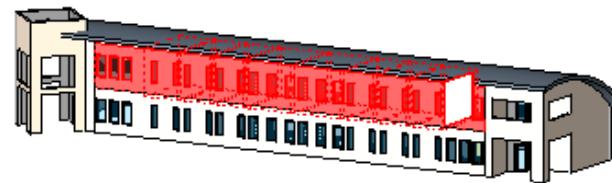
- Browse to where you are keeping your workbook files.
- Leave the file name **Same as Group Name**.
- Verify that **Include Attached Detail Groups as Views** is selected.
- Click **Save**.



- 7 Copy the link to the second level:

- Select South Offices model group.
- On the Edit menu, click **Copy to Clipboard**.
- On the Edit menu, click **Paste Aligned > Select Levels by Name**.
- Click **Level 2**.
- Click OK.





The south wall and all the offices are now copied to the second floor.

Edit the Linked South Offices Project File

8 Save and close your project.

9 Open file South Offices from the location where you just saved it.

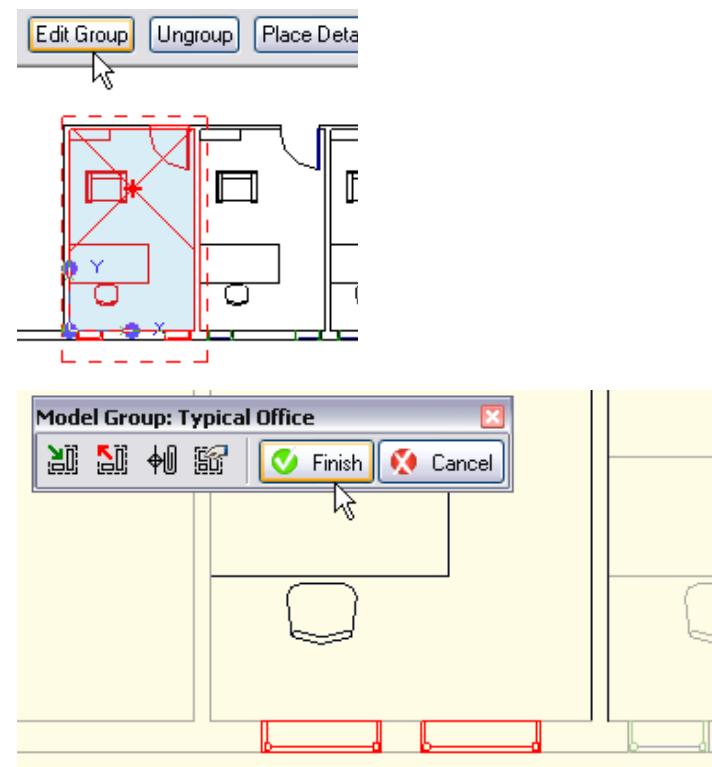
Open the Level 1 floor plan.

Click one of the **Typical** offices.

On the options bar, click **Edit Group**.

10 Change the two windows to 36" x 72" and move them closer together.

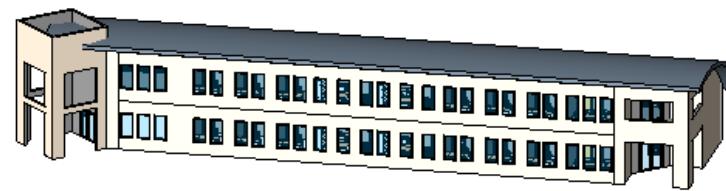
On the Model Group toolbar, click **Finish**.



11 Save and close the South Offices Revit file.

12 Open file i_Unit 7c – Start.

Open the 3D view.



Both instances (first and second floors) are updated with the new definition.

Bind a Linked File

Revit Architecture enables you to work the reverse of the process you just completed. You could design the offices in a different file and then link them into the building shell and bind them.

13 Select both instances of the linked Revit Architecture file.

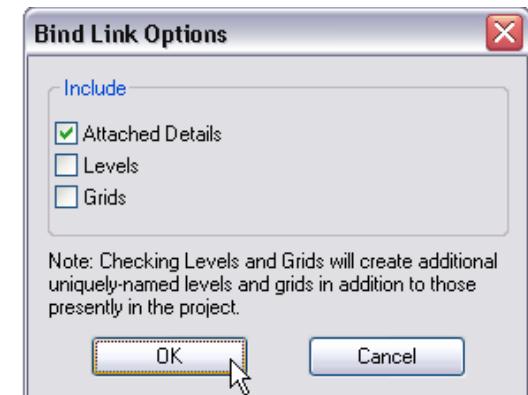
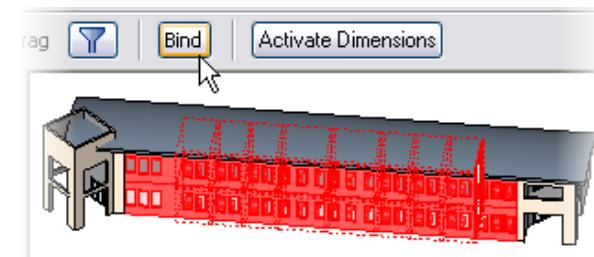
On the options bar, click **Bind**.

Verify that **Attached Details** is selected.

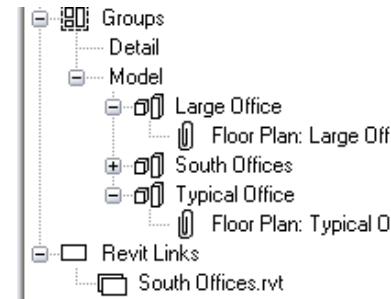
Click OK.

In practice, some cases call for converting a group to a linked file and others call for linking in a separate Revit Architecture project and binding it to use as a group.

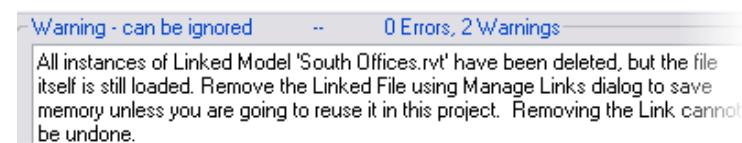
As an exploration, this exercise is a bit cyclical and studies both of these tasks. The remainder of the exercise leads you through binding the linked Revit Architecture file. The action of binding a linked file converts it to groups.



14 Click **Yes** to replace the existing group definitions in this project with those defined in the linked file.



15 Click **Remove Link** in the warning dialog box.



The link is removed.

The file now has been updated with the changes. The southern wall and the offices are now back to being a single group South Offices.



The roof above the entry is completed in Unit 8.

Exercise 7D: Dependent Annotation views

When you are working with a large project, you probably won't be able to place it on a sheet to plot at a scale that shows the annotation. Revit Architecture provides a feature called *dependent views* that enables you to split a view into parts (child views) that you can plot on separate sheets. Any annotation done on any of the sheets appears on all of the related views.

Create Dependent Views

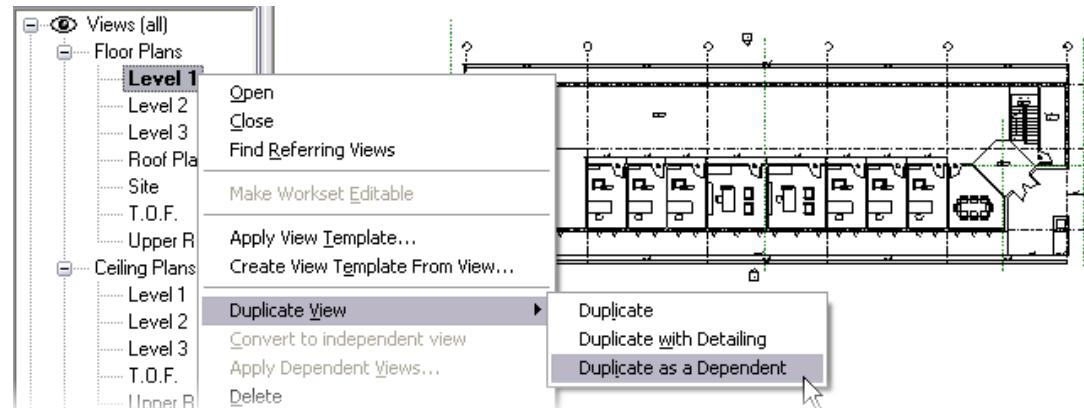
In this section of the exercise you duplicate the level 1 view two times to create a dependent view for the east and west halves of the building.

The starting data set is the end point of the last exercise. Some rooms and dimensions have been added to the end point of the last exercise to help illustrate how annotations behave in dependent views. Two sheets have also been added for you to place the finished views on.

- 1 Open the data set **i_Unit 7d - Start.rvt**.

Verify that Floor Plans Level 1 is current.

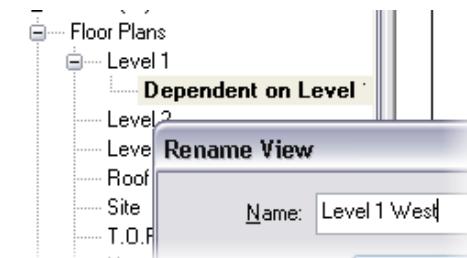
In the project browser, right-click **Level 1**. Click **Duplicate View > Duplicate as a Dependent**.



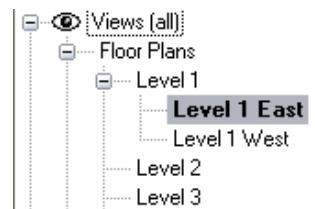
- 2 Right-click **Dependent on Level 1 View**. Click **Rename**.

Type **Level 1 West** for the name.

Click **OK** to return to the drawing window.



- 3 Repeat the same process, adding a dependent Level 1 East.



Add Annotation

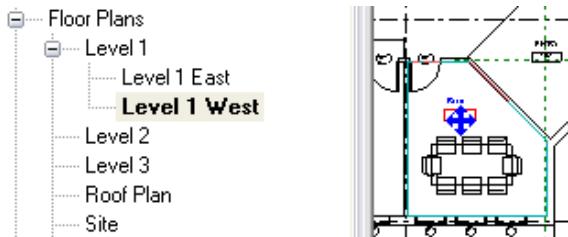
In general, when you add annotation such as tags and dimensions, they are not visible in other views. This is not true

- 4 **Level 1 East** should be the current view from the last step.

Use the Basics design bar **Room** tool to add a room with a tag to the conference room on the far east side.

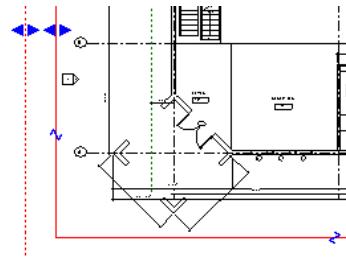


- 5 Set the view Level 1 West current.

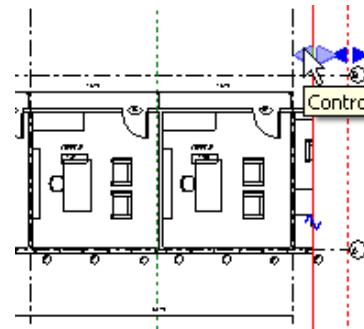


Set the Crop and Annotation Crop Regions

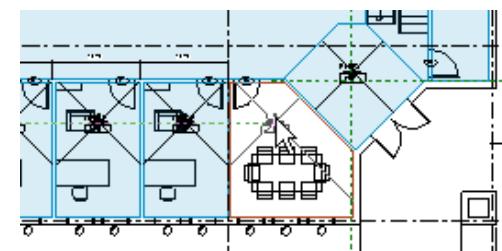
- 6 In the Level 1 West view, click the crop region to display its grips.



- 7 Drag the east side crop region control grip  just east of gridline 4 (just east of the two larger offices).



for dependent views. Annotation added to any of the views is available in the other views.

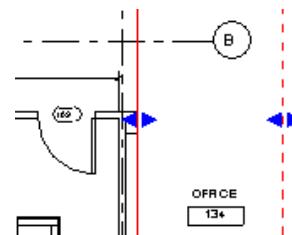


The tag is visible in this view also, as well as the parent view Level 1.

The crop region is the solid line. As you move this, it hides the model object.

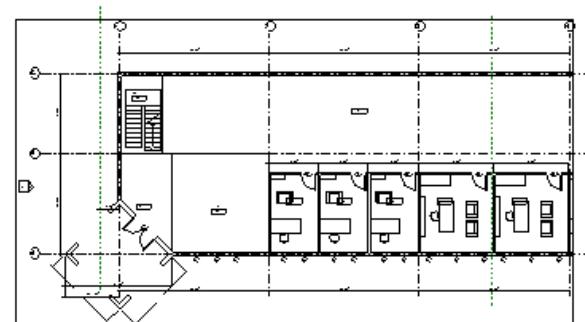
The red dashed line is the annotation crop region, which gives you control over where you choose to stop the visibility of the annotation such as dimensions and tags.

- 8 Drag the annotation crop region to the right past the grid bubble end.

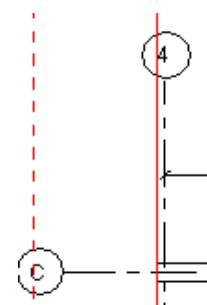
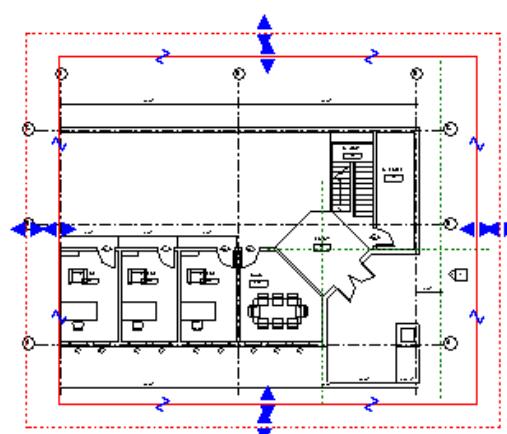


As you manipulate the annotation crop, room tags appear only if the crop region cuts the room and the tag location falls within the annotation crop region boundaries.

- 9 Drag the crop region controls for the north, west, and east sides, moving the crop region boundaries closer to the building.



- 10 Set the Level 1 East view current. Repeat the preceding steps to limit this view to the right two bays of the building.

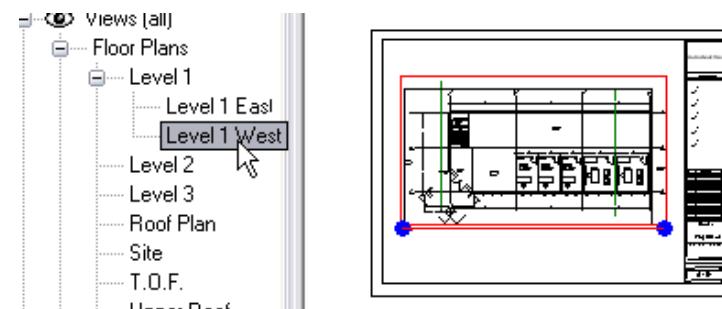


As you do this, notice that if the crop region cuts a dimension string, only full dimensions appear in the view.

Add Views to the Sheets

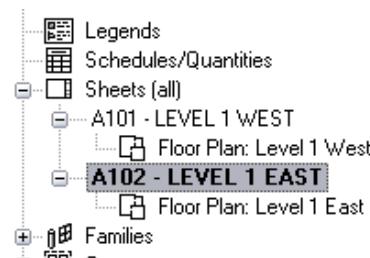
- 11 Open Sheet A101- Level 1 West.

Left-drag from the project browser the dependent view Level 1 West onto this sheet.



See Unit 5 for more detailed information on adding views to sheets.

- 12 Repeat, adding dependent view Level 1 East to sheet A102 Level 1 East.



Create a Match Line

- 13 Set **Level 1 Floor Plan** current.

On the View design bar, click **Matchline**.

Click the **Lines** tool.

Draw a line to one side of gridline 4.

On the design bar, click **Finish Sketch**.

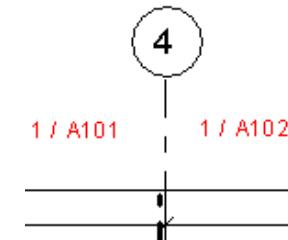
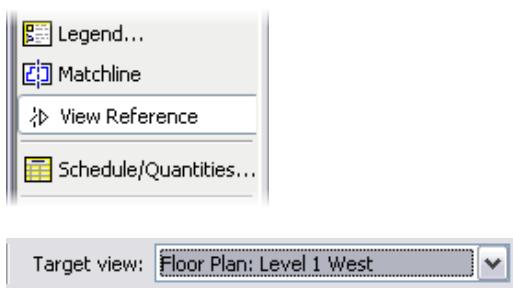
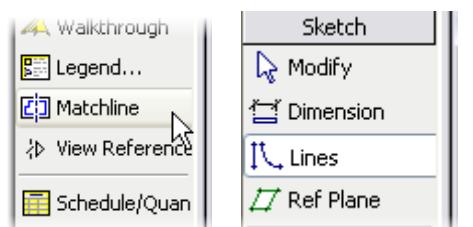
- 14 On the View design bar, click **View Reference**.

On the options bar, set Target View to **Floor Plan: Level 1 West**.

Click the west side of the match line you just created.

Repeat, adding another view reference targeted to Floor Plan: Level 1 East to the right of the match line.

- 15 Save and close the project.



The view references are dynamic and do change their reference if the views are relocated to different sheets.

Unit 8

Theory: Domain-Specific Knowledge

Revit Architecture: Roofs

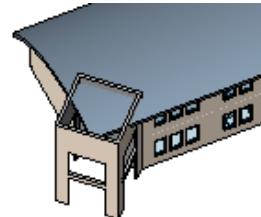
This exercise takes you through adding more detail to the roof and looks at how to put together multiple roofs to achieve different forms.

Clip the Extruded Roof

Any extruded roof (as opposed to a roof by footprint) can be cut using the Cut Plan Profile tool.

- 1 Open the data set **i_Unit 8 – Start.rvt**.

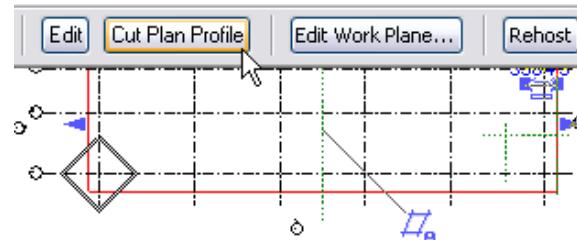
Set the 3D view current.



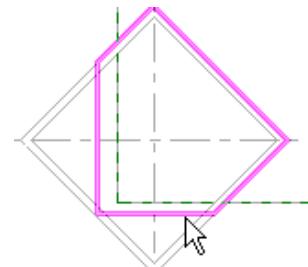
- 2 Set the **Upper Roof Plan** view current.

Click the roof in the plan.

On the options bar, click **Cut Plan Profile**.



- 3 Using the Lines tool, draw sketch lines in a shape that follows the outer edge of the upper walls and passes outside the edge of the roof on the west and south sides.

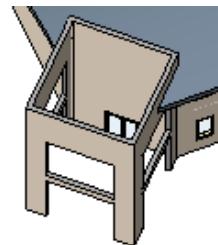


This data set is the same as the building at the end of exercise 7C. The roof is an extruded roof similar to the roof created in Unit 6. Because an extruded roof just passes its form from one plane to another, the extrusion needs to be cut away from the interior of the entry tower.

This initiates Sketch mode. Just draw the shape you want to remove from the extruded roof. This shape must be closed.

Notice that the linework on the south and west sides is outside the roof. Try not to make the lines coincident with the edge of the roof.

- 4 On the design bar, click **Finish Sketch**.



The shape that you sketched is now removed from the extruded roof.

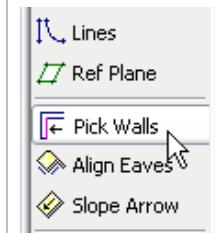
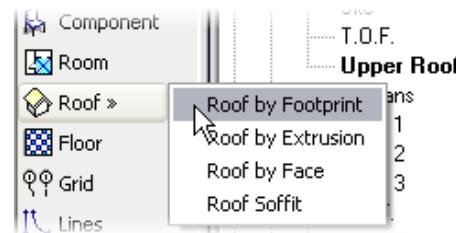
Roof by Footprint: Pick Walls Versus Lines with Offsets

In this section you create an upper roof on the entry walls. Unit 1 explored Roof by Footprint and creating a gabled end. This section explores some of the limitations and workarounds using the roof you create here as a basis for a slightly more complex (to Revit Architecture) roof.

- 5 Set the **Upper Roof** view current.

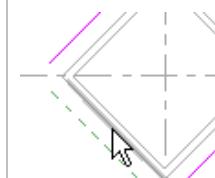
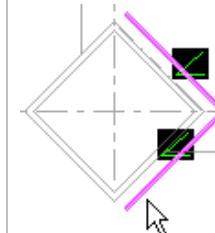
Click **Roof > Roof by Footprint**.

On the Sketch design bar, verify that **Pick Walls** is selected.



- 6 On the options bar, set:

- Defines Slope = selected.
- Overhang = 2'-0".
- Extend to Wall Core = selected.



- 7 On the design bar, click the **Lines** tool.

On the options bar, set:

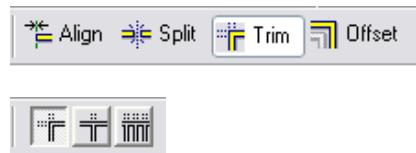
- Draw Method = Pick Lines.
- Defines Slope = selected.
- Offset = 2'-0".



As you click the walls, keep your pointer to the outside of the walls.

Click the remaining two walls on the west side.

- 8 Use the **Trim** tool to clean up the corners of the sketch lines.

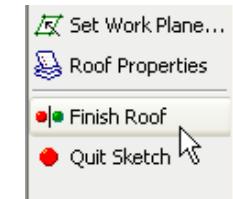


- 9 On the Sketch design bar, click **Roof Properties**:

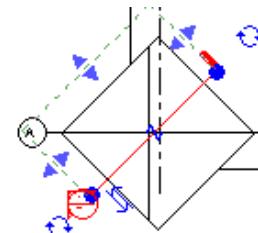


Click OK to return to the drawing window.

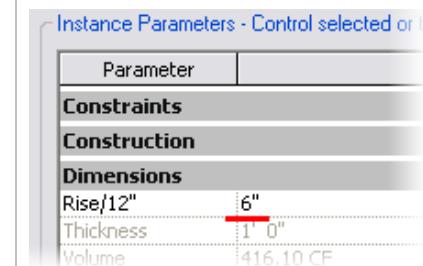
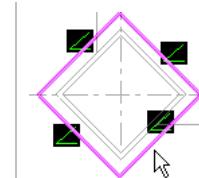
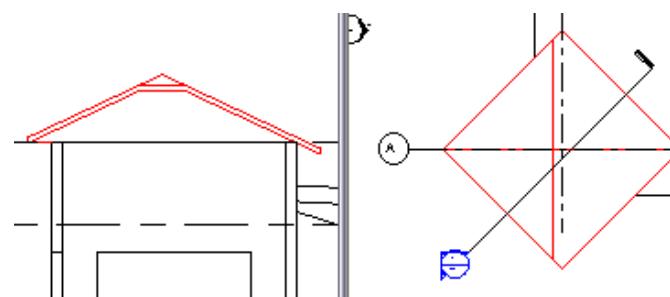
- 10 On the Sketch design bar, click **Finish Roof**.



- 11 Add a section as shown here.



- 12 Open the section view, and tile the two views: Section 1 and Upper Roof.

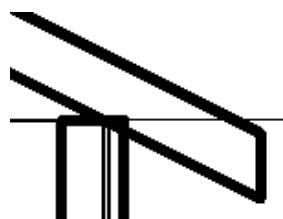


The roof is created, but it is not symmetrical to the entry walls. This is because of the differences in the lines created by picking walls versus using the Lines tool.

The sketch lines drawn with the Lines tool originate at the edge of the roof at the level the roof is constrained to (left side of image).

The sketch lines drawn with the Pick Walls tool establish the fascia edge of the roof below the level by a distance determined by the slope of the roof over the overhang setting, in this case, 4/12 over 2 feet.

- 13 Toggle the section view to Medium Detail.



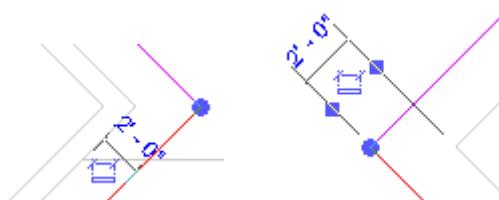
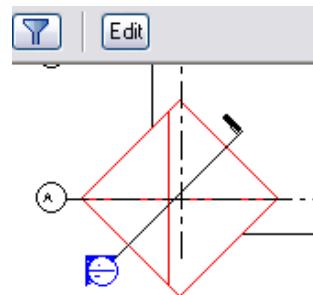
Align Eaves

Align Eaves is a tool available in Sketch mode of a footprint-type roof.

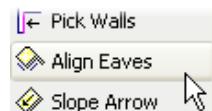
- 14 Set the **Upper Roof** view current.

Click the roof.

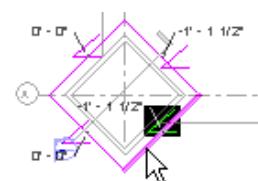
On the options bar, click **Edit**.



- 15 Click each of the lines, and use the temporary dimensions to adjust the distance to the face of the wall to 2'-0".

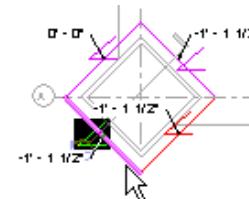


- 16 On the Sketch design bar, click **Align Eaves**.



- 17 Click the eave to align TO (the southeast line).

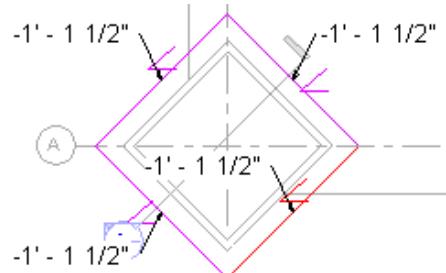
Click the eave to align to that location (the southwest line).



Notice also that the Pick Walls tool had Extend to Core selected. The outside face of the core (the metal studs) of the wall is used, and the overhang of 2' is calculated from this point rather than from the exterior face of the entire wall. As such, the overhang on the picked walls is slightly less than the overhang of the drawn line segments.

- 18 Repeat for the northern lines. All the sketch lines should now be set to the same value.

On the Sketch design bar, click **Finish Roof**.

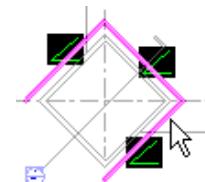


Create Multiple Roofs

You sometimes need to create two or more roofs to complete the shape you are looking for. Any roof with a discontinuity in the form probably needs to be created out of two different roof objects. This section guides you through creating a simple example of such a roof, as shown at right.

- 19 Open the roof sketch for editing:
- Set the Upper Roof view current.
 - Click the roof.
 - On the options bar, click **Edit**.

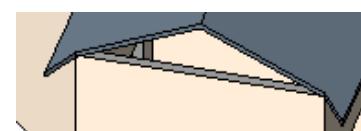
Delete the southwest line.



- 20 On the Sketch design bar, click **Lines**. On the options bar, set:
- Draw Method = Draw.
 - Defines Slope = Cleared.
 - Offset = 0'-0".



Draw the three lines on the west side shown in the image.

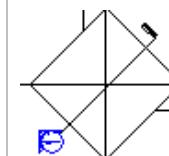


Verify that Defines Slope is *not* selected.

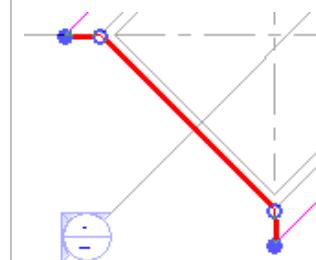
- 21 On the Sketch design bar, click **Finish Roof**.



- 22 Extend the wall to the roof:
- Open a 3D view.
 - Click the southwest wall.



The roof should now be symmetrical to the underlying entry walls.



- On the options bar, click Top/Base Attach.
- Click the roof to attach to.

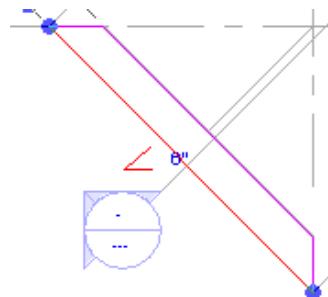
Add the Second Roof to Complete the Form

23 Set the Upper Roof view current.

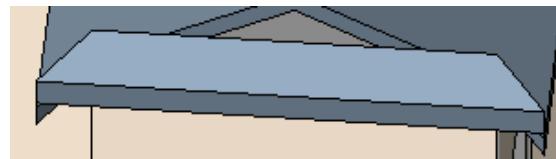
Click **Roof > Roof by Footprint**.

Use the Lines tool to draw the lines shown at right.

Within the properties of the roof, verify that the type is set to Generic 9" and the slope is set to 6" rise/12" run.

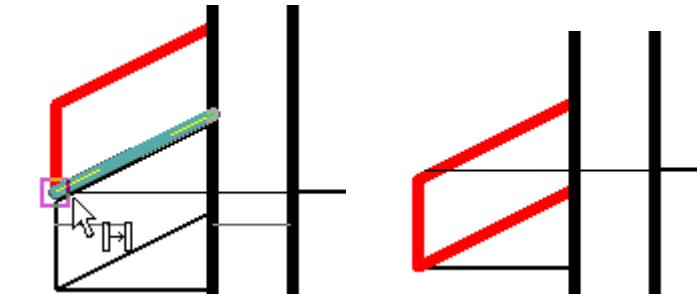


24 On the Sketch design bar, click **Finish Roof**.



25 Open the section view.

Use the Move tool and snaps to move the roof into place, using the roof beyond as the reference.



Add Fascias and Gutters

Revit Architecture provides the ability to sweep a shape around the edge of a roof. This can be any shape stored in a roof sweep type of profile family. One thing to keep in mind about many of the sweeps is that although the shape definition is stored in a family (RFA) file, the definition is buried (or nested) in a system family definition in the project file.

26 Open the 3D view of the project.

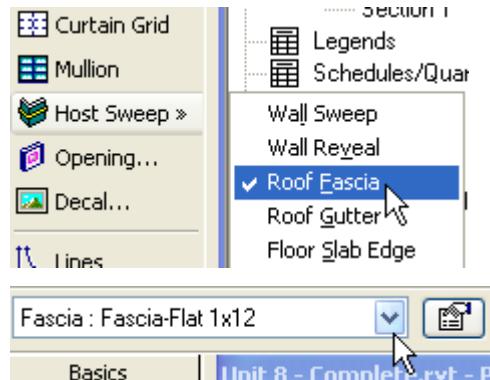
Note that only the outermost line (shown in red) defines a slope. The other three do not.

The roof is finished, but like the first roof in the exercise, the linework is based at the upper roof level rather than the eave of the existing roof.



- 27 On the design bar, click the Modeling tab.

Click Host Sweep > Roof Fascia.



- 28 There is only one type defined in this project.

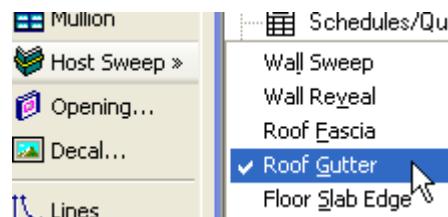
- 29 Click the upper edge of the fascia area of a roof.

Continue clicking edges to add the fascia to each edge of the roof.

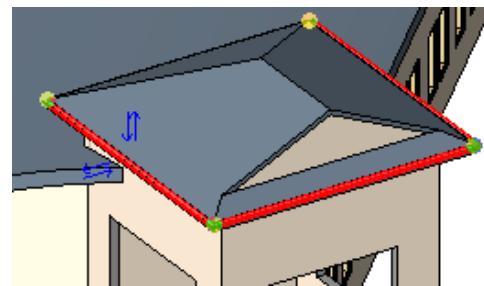


- 30 On the design bar, click the **Modeling** tab.

Click Host Sweep > Roof Gutter.



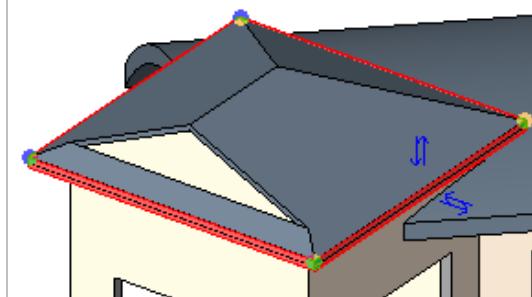
- 31 Click the fascia edge about the entry door.



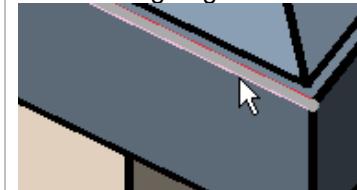
Add Soffits

Creating a soffit in Revit Architecture is much like creating a roof.

Note the fascia is a system family (defined only in the project, not as an RFA file). There are other families you can load and use in the project, but you would need to duplicate this type and assign the loaded profile into the type parameters of the new type.

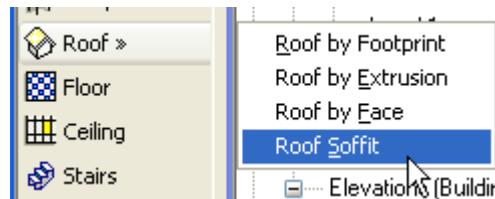


Be careful as you select. Because the inside face of the fascia, the roof, and the outside face of the fascia are all very close together, it is easy to add the gutter to the wrong edge.

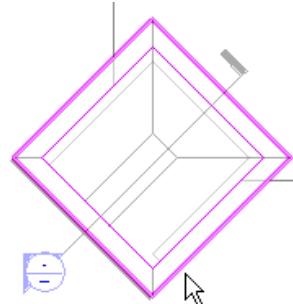


32 Set the Upper Roof level current.

Click **Roof > Roof Soffit**.

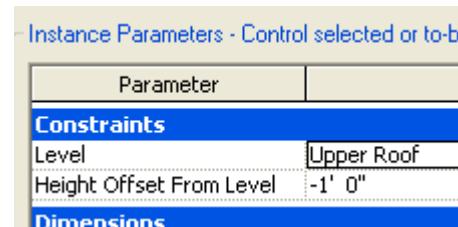


33 Draw two sets of lines, as shown in the illustration.



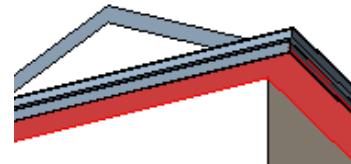
34 On the Sketch design bar, click **Roof Soffit Properties**.

Set the Height Offset from Level to **-1'-0"**.

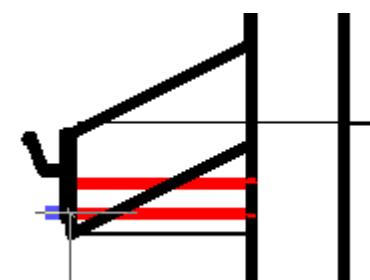


35 On the Sketch design bar, click **Finish Sketch**.

Set the Section 1 view current.

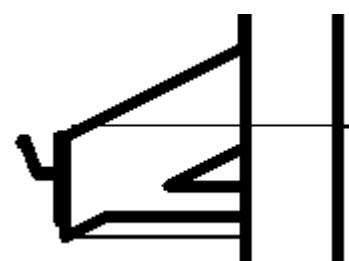


Although there are automatic selection tools that enable you to select roofs and walls, because this is not just a single roof, you may find it easier to draw the lines manually.



36 Click the **Join Geometry** tool.

Click the soffit, and then click the roof.



The two geometries are joined, and the profile line wraps both objects.

Unit 9

Theory: Delaying Specificity

Revit Architecture: Massing

There are two exercises in this unit. This first exercise guides you through the process of adding mass elements to a Revit Architecture project. The second illustrates the software's ability to import SketchUp files and how to use them as mass elements.

Exercise 9A: Mass Components and Building Maker

In this exercise you work with Revit Architecture software's Building Maker. Building Maker is a collection of tools that includes:

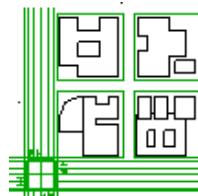
- Mass elements composed of solid forms and void forms.
- Walls, floors, roofs, and curtain systems associated with the mass faces.

The general workflow in this exercise is to create the mass forms, apply the building elements to the faces, modify the forms, and then update the building elements to the new geometry of the changed form.

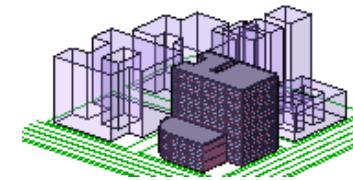
Create a Mass Element

- 1 Open file i_Unit 9a – Start.rvt.

Verify that the view Floor Plans – Site is current.



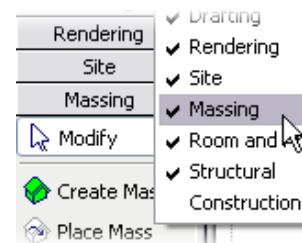
The starting point of this exercise is a project that has some 2D line work in place that you can use as guidelines for creating the massing.



At the end of the exercise you have a model with four building massings, one of which has wall, floors, and a roof associated with it.

- 2 Verify that the Massing design bar is available:

- Right-click the design bar.
- Click **Massing** to show the Massing design bar if it is not already visible.



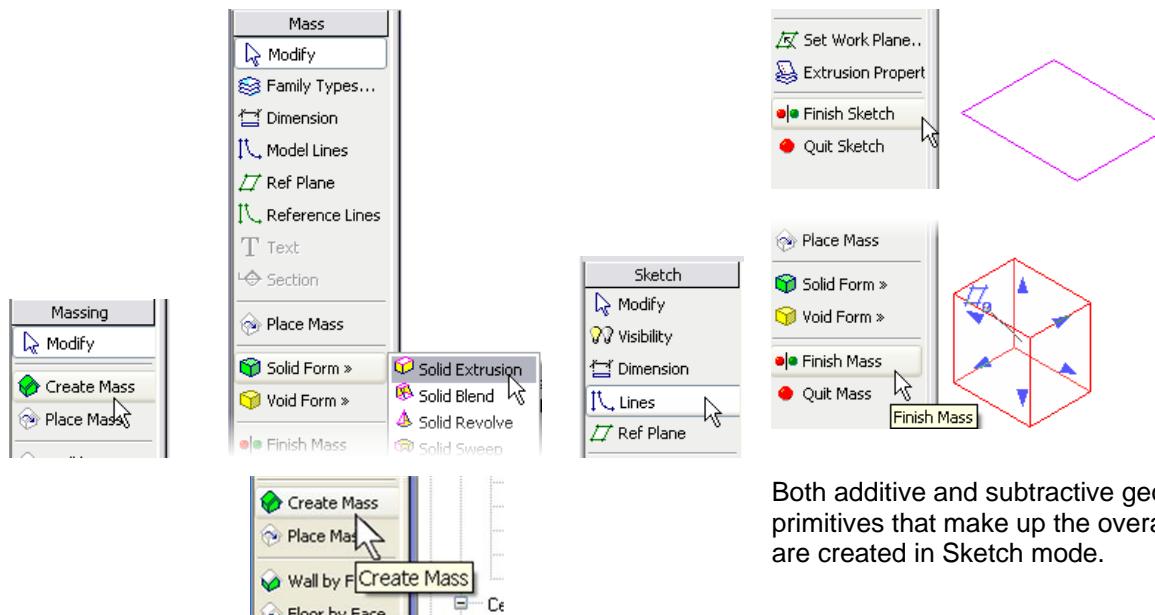
Design bars can be displayed or hidden to optimize screen space.

Massing Notes:

When you create a mass, you enter Sketch mode, but the Sketch mode is more like a family than a roof or floor. Within Sketch mode you create solids and voids by sketching lines.

This is a nested Sketch mode.

As you are working through this exercise, be aware of which level of Sketch mode you are in by keeping an eye on the design bar.



- 3 On the Massing design bar, click **Create Mass**.

- 4 If the Show Massing dialog box appears, click OK.

- 5 Give the massing a name.

Click OK to continue.

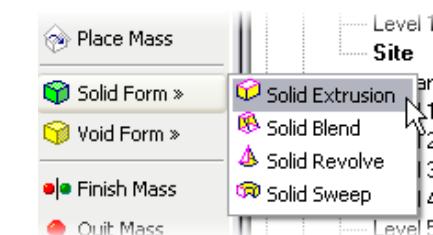
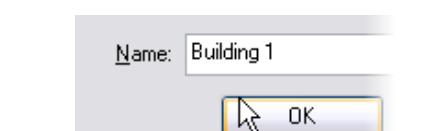
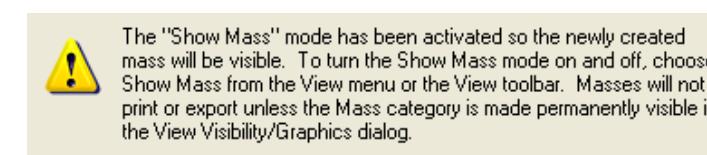
- 6 On the Massing design bar, click **Solid Form > Solid Extrusion**.

- 7 On the design bar, verify that the Lines tool is selected.

On the options bar:

- Enter **70'**.
- Click the pick lines (the **Arrow**)

Both additive and subtractive geometric primitives that make up the overall mass are created in Sketch mode.



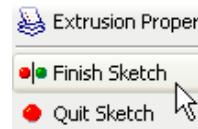
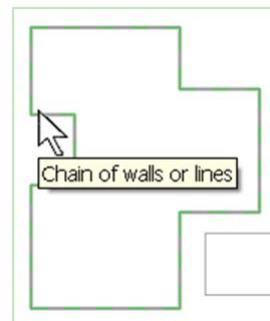
The geometric shapes that make up the final Revit Architecture mass instance can be created in four ways (Extrusion, Blend, Revolve, Sweep) and can be either solid or void. Voids are subtractive forms that cut geometry from solid forms.

Sketch lines can be drawn or selected. When selecting, you can automatically lock the lines to the original drawing by selecting the Lock check box on the options bar.

symbol).

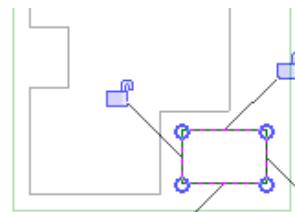
- 8 Zoom into the upper-right building footprint.

Hover the cursor over one of the lines. Press **TAB**, and then click to select all the lines.



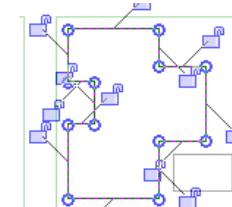
- 9 Click **Finish Sketch** to complete the mass.

- 10 Repeat steps 6–9 to create a mass for the small rectangle to the lower right of the solid you just created.



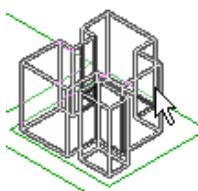
- 11 Click **Finish Mass** to complete the mass.

- 12 Change to the 3D view.



Like selecting a chain of walls, you can click connected lines to generate sketch lines by using TAB.

Quit Sketch discards the lines that were drawn in Sketch mode. Finish Sketch finalizes the solid but does not complete the mass because a single mass can comprise multiple solids and voids.



This is the nested series of Sketch modes that creates a mass object. One mode takes you to the mass creation set of design bar options. When you start a solid or void, you drop down one more level and the design bar changes to a more familiar Sketch mode. You must click Finish Sketch and Finish Mass to complete the command.

You have drawn two shapes in the mass element Sketch mode. These will be two parts on a singular mass element when selected.

Add the Remaining Masses

Return to the site view and repeat the process with all the building footprints in the blocks. The general process is the

The key points for each building have been noted in the next few steps.

- 13 Create Building 2 (northwest corner). This building has a simple open area in the middle.

As you create the mass, create two chains of sketch lines, one for the outer wall and another for the inner courtyard.

- 14 Building 3 at southwest corner:
Make this also as a single extrusion. You develop this building later in the exercise, using the void shape to carve out part of the mass.

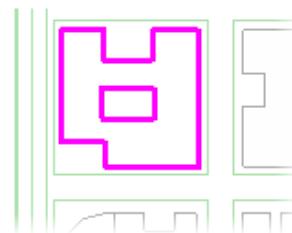
- 15 Building 4 Southeast:
This mass is two levels. To create the two levels with solid elements, you have to create two different solid elements. These can intersect each other.

- 16 Open the 3D view.

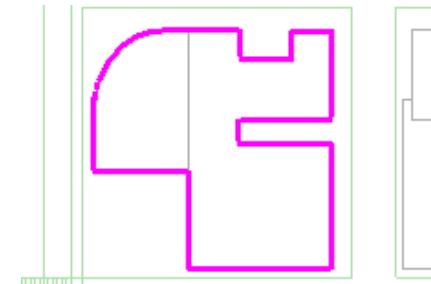
Type **SD** for a shaded view of the massing.

Type **HL** for hidden line view.

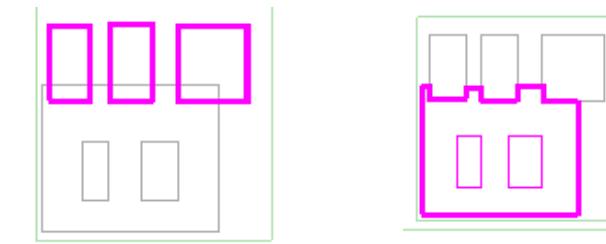
same as for the mass you just created.



This is a single extrusion with a height of 82 feet.



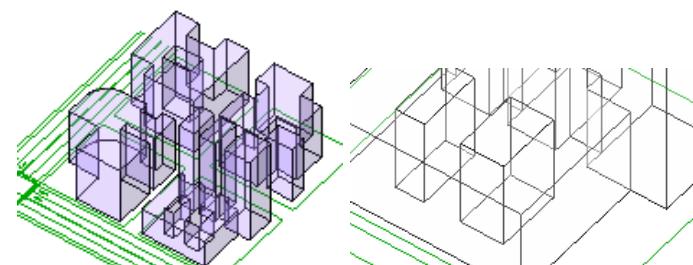
Extrusion Height = 94 feet.



One mass, two extrusions:

Solid extrusion 1 is 106 feet and consists of three separate rectangles for the towers.

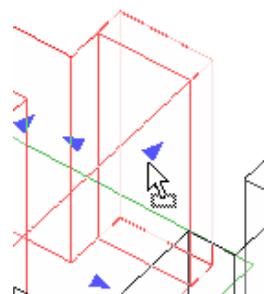
Solid extrusion 2 is 34 feet, cuts around the towers, and has two interior rectangles.



The default material of a mass object is 5 percent transparent.

Hidden line shows the beyond conditions because the material is translucent.

- 17 Resize the northwest mass by dragging the blue grips that appear (one grip for each face).

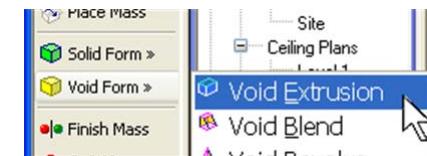
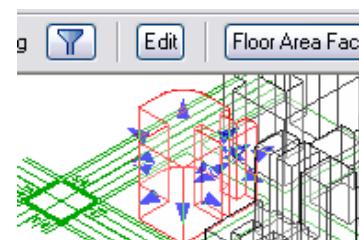


Edit masses directly in any view by dragging the grips.

Edit the Southwest Mass to Add a Void

- 18 Click the southwest massing (Building 3).
On the options bar, click **Edit**.
Click **Void Form > Void Extrusion**.

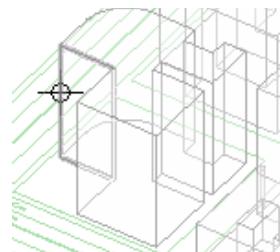
The process of adding a void—or subtractive solid—is the same as that for creating the original solid.



- 19 On the Sketch design bar, click **Set Work Plane**.
In the Work Plane dialog box, click **Pick a Plane**.
Click OK.
20 Click the vertical face of the mass located on the lower-left block.



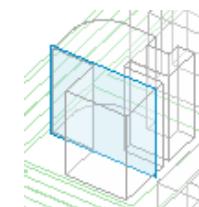
Setting a work plane allows automatic change of the coordinate system in a simple way.
You can select any face, reference plane, or gridline as an active work plane.



- 21 On the design bar, click the **Work Plane Visibility** button to see the active work plane.

In this case, you are selecting a vertical face directly in the 3D view.

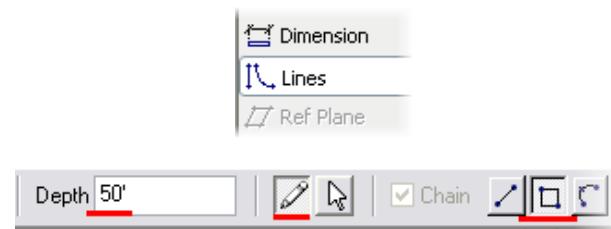
Revit Architecture automatically changes the relative coordinate system to vertical.



22 Click the **Lines** tool.

On the options bar, set:

- Depth = 50'.
- Draw tool.
- Rectangle shape.



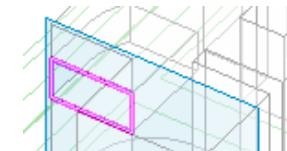
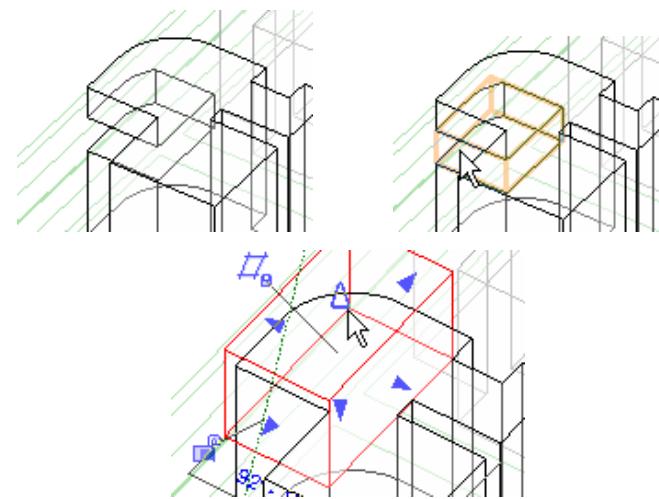
Draw a rectangle on the face of the mass as shown at far right.

Click **Finish Sketch** but do not finish the mass.

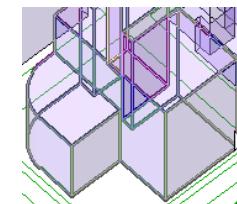
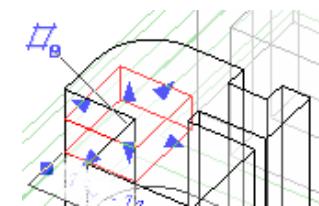
Voids: The void now cuts 50 feet out of the building. Voids are not visible by default but show up as you move the pointer over them and make their control grips available once selected.

23 Drag the shape handle of the void until it snaps to parallel geometry to make the void cut completely through the solid.

Click **Finish Mass** to complete the mass.



In this case, the depth refers to the horizontal plane, as you are drawing on a vertical plane.



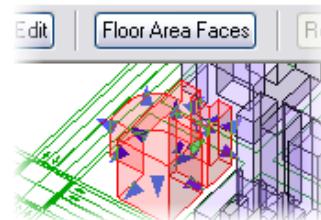
You do not need to be exact with the void. Once you are done with mass Sketch mode, the void disappears.

Add Floor Faces to the Mass

24 Select the southwest massing (the one you have been working with).

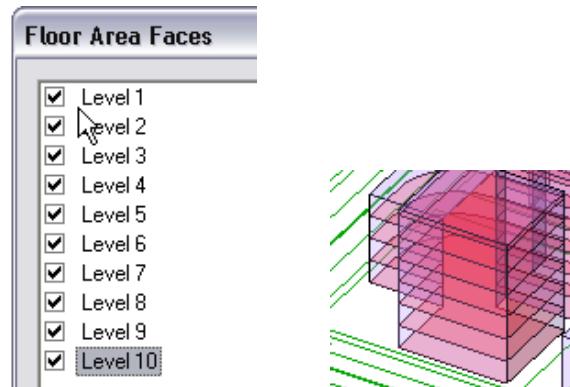
On the options bar, click **Floor Area Faces**.

Floor faces help you visualize flooring in the mass element and are used to place floor objects later in the process.



- 25 Select the check boxes for all the levels.

Click OK to return to the drawing window.



Each level that intersects the massing is a candidate for a floor area face.

The floor faces are drawn at each level.

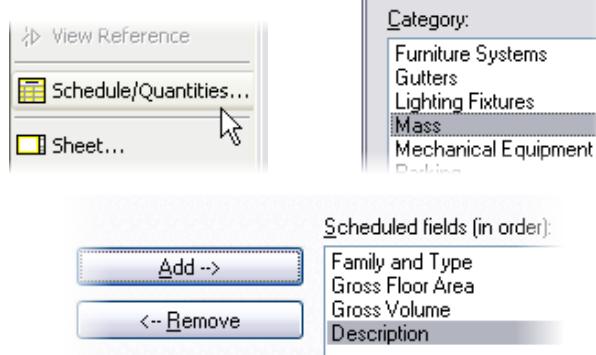
Already at this phase you can get feedback from the building information model such as the total floor area of the floor faces in the design.

Create a Gross Floor Area Schedule

- 26 On the View design bar, click the **Schedule/Quantities** tool.

Select the **Mass** category.

Click OK to continue to the Schedule Properties.



For the schedule to work, the floor areas must first be assigned to the mass object.

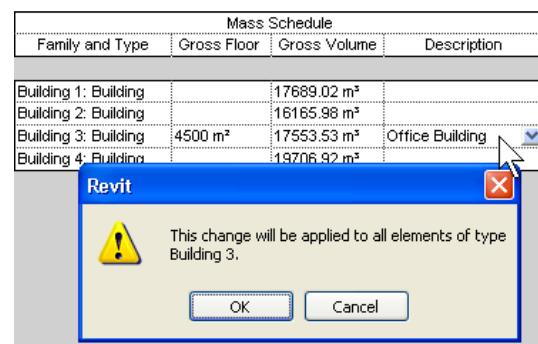
- 27 Add fields:

- Family and Type.
- Gross Floor Area.
- Gross Volume.
- Description.

Click OK.

- 28 Add a description to Building 3—Office Building.

Click OK at the type change prompt.



Mass Schedule			
Family and	Gross Floor	Gross Volume	Description
Building 1:		533128.56	
Building 2:		703259.61	
Building 3:	59082 SF	682342.19	
Building 4:		505516.94	

A gross building volume and floor area schedule can be generated and placed in a sheet.

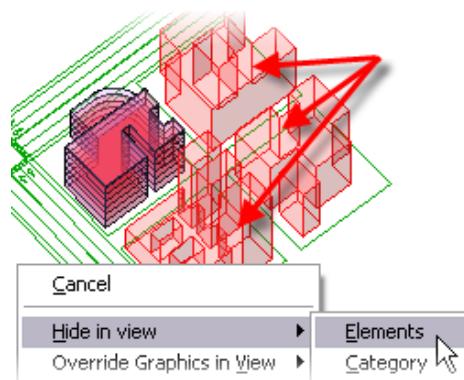
Only the building for which you created the floor faces shows a value in the Gross Floor column of the schedule.

Add the Physical Floor Component

29 Isolate the southwest building:

- Open the 3D view.
- While pressing **CTRL**, click each of the three building masses without floor assignments.
- Right-click. Click Hide in View > Elements.

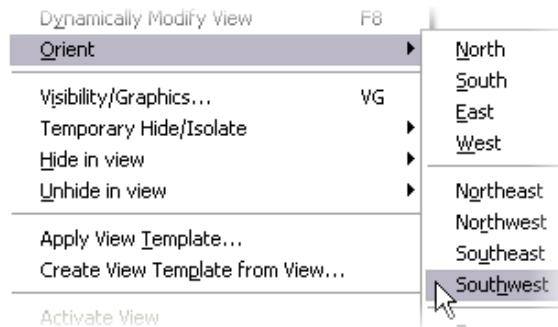
The floor areas created previously are simple vertical divisions of the mass that have no thickness. Use the Floor by Face tool to add floors into the mass.



30 Use the **View** menu to orient the view to the southwest.

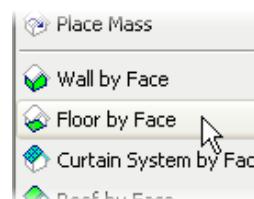
Click the mass.

Use the grips to change the height of the lower wing to just under one of the floor area faces.



Add Floors to the Building

31 On the Massing design bar, click **Floor by Face**.

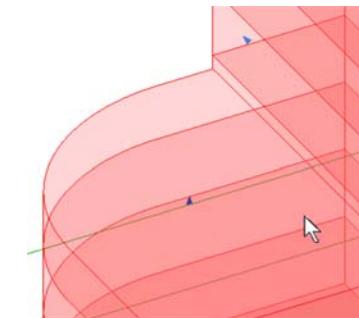
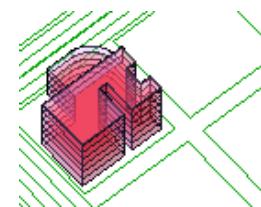


32 On the options bar:

- Set floor type to LW Concrete on Metal Deck.
- Verify that **Select Multiple** is selected.

You cannot use the Floor by Face tool until you have created the **floor faces**.

Use Hide Object/Isolate Object to work on one object in the project.



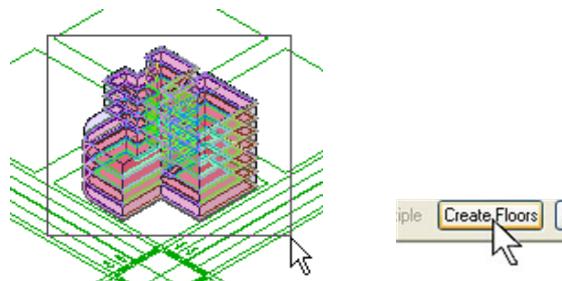
Now that you have created the mass of the building, you can start adding the building elements.

This tool places floor objects at the locations of the floor faces.

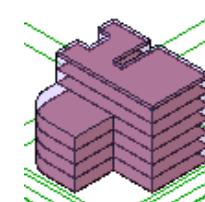


- 33 Drag a selection window around the whole building.

On the options bar, click **Create Floors**.



The floors are automatically generated.



Create Walls

The Wall by Face tool enables you to create walls that are associated with the massing faces in the same way the floors are associated with the floor faces.

- 34 On the **Massing** design bar, click **Wall by Face**.

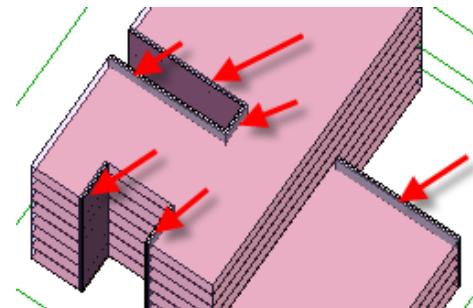


- 35 On the options bar, set:

- Wall Type = Exterior Brick on Mtl. Stud.
- Draw Type = Pick Face (House Icon).
- Height = Automatic.
- Loc Line = Core Face Exterior.



- 36 Click the faces shown at right.



Spin the model to select these faces. Hold down the scroll wheel and move the cursor to spin the model.

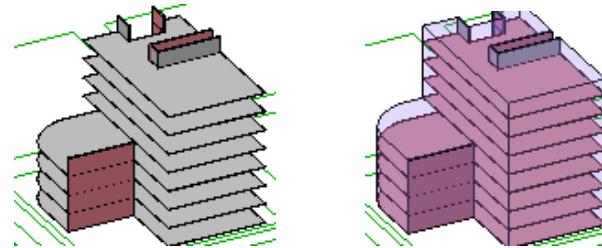
- 37 Click the **Show Mass** tool.

Click the **Show Mass** tool to show the mass again.



This tool enables you to move back and forth between seeing the massing and the floors and walls or just the floors and walls.

When you open a project that has mass objects in it, you may have to toggle the Show Mass tool on to make the masses visible.



Adjust the Building Envelope (Massing)

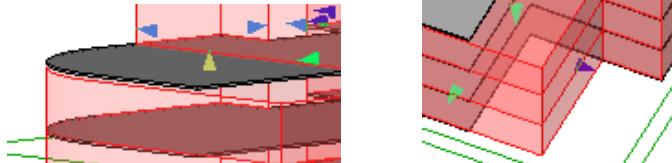
- 38 Click the **Modify** tool.

Select the mass.

Use the triangular face grips to modify the lower wing:

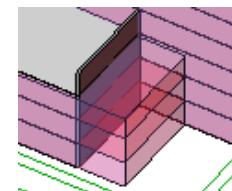
- Top face down one level (just under the floor).
- South face half the distance to the street.

See illustrations at right.



With some walls and floor in place, you now modify the mass using grips. As the mass changes, you need to update the floors and walls to the new massing envelope using the Remake tool.

- 39 Click any white area to deselect the building.



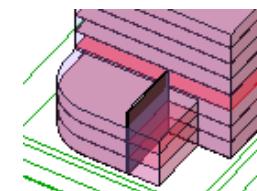
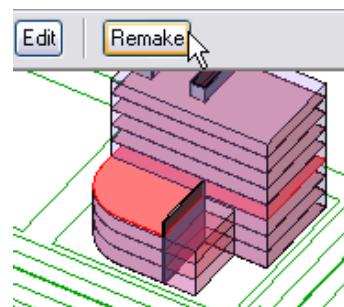
If stray portions of the mass show up as you grip the mass faces, use the **Edit** button to access Sketch mode and adjust the void extrusion to clean up.

The building elements are now out of sync with the mass model.

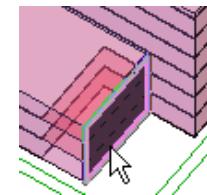
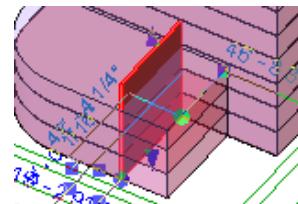
Resynchronize the Building Elements to the New Mass Form

- 40 Select the floor exposed by dropping the top face.

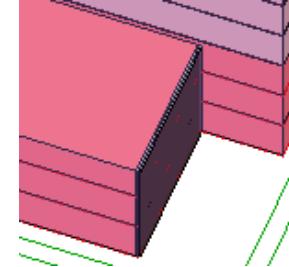
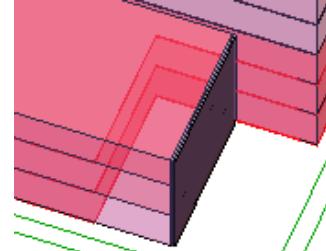
On the options bar, click **Remake**.



- 41 Repeat, selecting the lower wing south wall, and then clicking the **Remake** button.



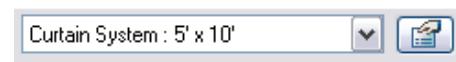
- 42 Repeat to remake the lower floors.



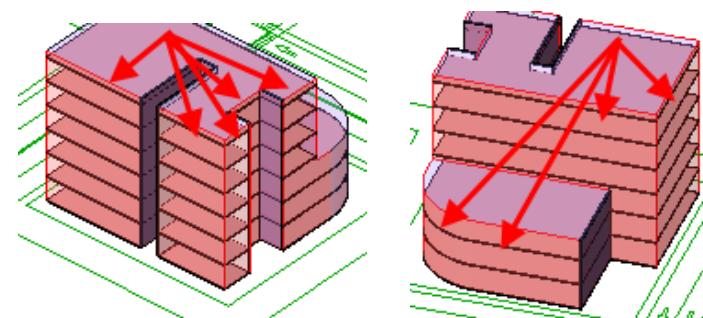
Add Curtain Wall System

- 43 On the Massing tab of the design bar, click **Curtain System by Face**.

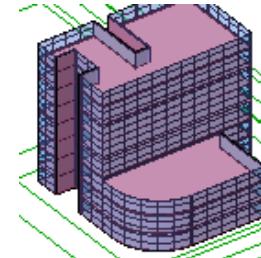
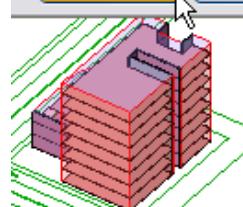
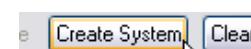
The Curtain System by Face tool enables you to create curtain walls that are associated with the massing.



- 44 Verify that the curtain system type is set to **Curtain System: 5' x 10'**.



- 45 Click the remaining mass faces that are not occupied by the brick wall type.

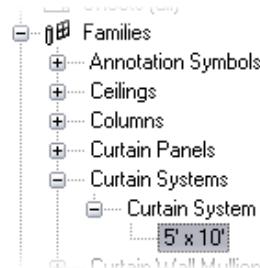


- 46 On the options bar, click **Create System**.

Adjust Curtain Wall System Spacing

- 47 In the project browser, expand **Families > Curtain Systems > Curtain System**.

Right-click the **5' x 10'** type. Click **Properties**.

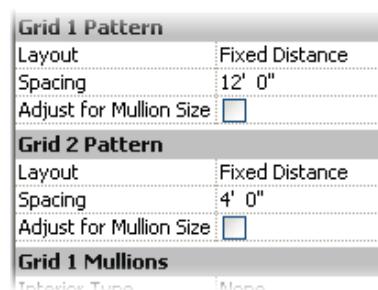


- 48 In the Type Parameters, set the Layout (Grid 1) (vertical spacing of the horizontal grid) to Fixed Distance, and 12' for the spacing.

Set the Layout (Grid 2) to **Fixed Distance** and **4'**.

Click **Rename**. Type **4' x 12'** for the name.

Click OK to return to the drawing window.



This definition can also hold values for the mullion system, but is not used here.



Because you are editing the type, the changes you make apply to all curtain systems in the project.

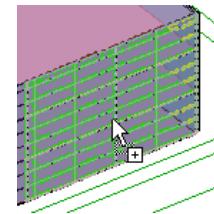
Add Mullions to the Curtain System

- 49 On the **Modeling** design bar, click **Mullion**.

On the options bar, click **All Empty Segments**.



- 50 Click a curtain system face of the model.



- 51 Repeat for the remaining curtain system faces.

Add Roof

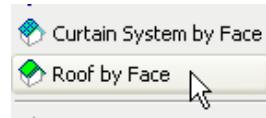
The process of adding a roof is the same as that for adding the walls or floors.



- 52 On the **Massing** design bar, click **Roof by Face**.

On the options bar, set:

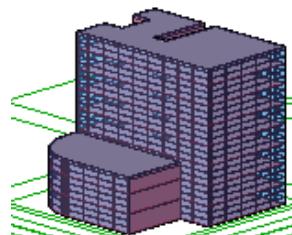
- Roof Type = Steel Truss – Insulation on Metal Deck – EPDM.
- Level = 9.



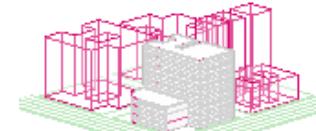
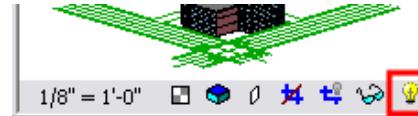
- 53 Select the top face of the mass.

On the options bar, click **Create Roof**.

Repeat, adding a roof at level 3 for the lower wing.



- 54 On the drawing View toolbar, click the **Reveal Hidden Elements** tool.

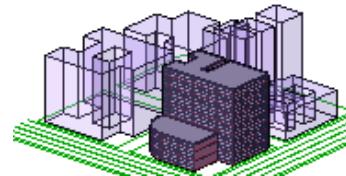
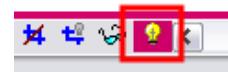


- 55 Select all three hidden mass instances.

On the options bar, click **Unhide Element**.



- 56 Click the **Reveal Hidden Elements** tool to exit Reveal mode.



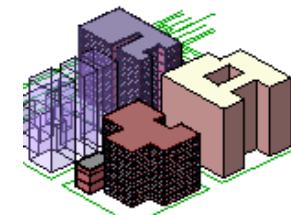
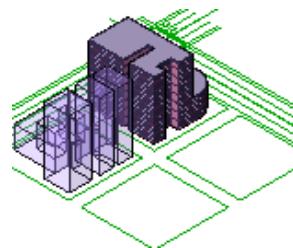
Note that if you come back to this project later, you may have to click the Show Mass tool to see the mass elements. Show Mass is not turned on by default in a new session.

Exercise 9B: Importing SketchUp Files

In this exercise you import a SketchUp file directly into the project as well as import a SketchUp file into a mass family as it is created. Importing the SketchUp file while creating a mass enables you to place walls, floors, and roof as explained in the previous exercise.

Import a SketchUp File

The SketchUp models used in this exercise are provided in the same folder as the other exercise data sets.



This exercise starts with the endpoint of the last exercise, but two of the masses have been deleted to make room for the SketchUp models you will use in the exercise

- 1 Open file **i_Unit 9b – Start.rvt**.

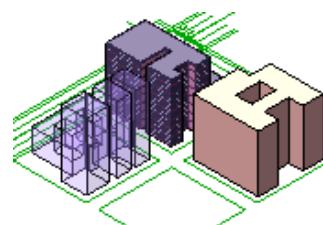
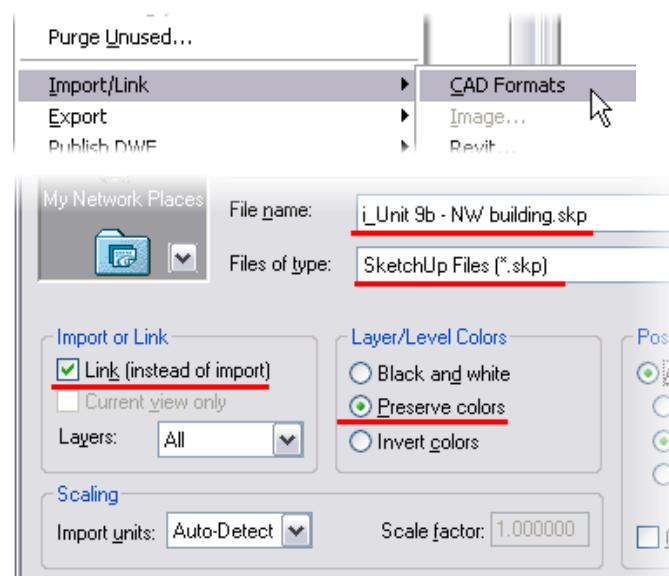
Set the view **3D Views: North East Iso** current.

Click **Show Mass**.

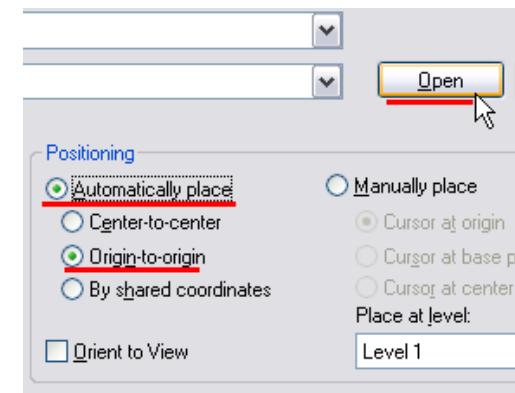
- 2 On the File menu, click **Import/Link > CAD Formats**.

- 3 In the Import/Link dialog box, set:
 - Files of Type = SketchUp.
 - File to Import = **i_Unit 9b – NW building.SKP**.
 - Select Link (Instead of Import).
 - Click Preserve Colors.
 - Automatically Place = Origin to Origin.

Click **Open**.



The exercise ends with two different SketchUp models used in the Revit Architecture project.



The SketchUp model is read into the Revit Architecture project.

Note that this SketchUp file has a brick material applied.

The file you use next does not have any SketchUp materials applied. For this instance you use Revit Architecture functions to apply walls with materials to the linked SketchUp file.

Import a SketchUp Model into an In-Place Mass Family

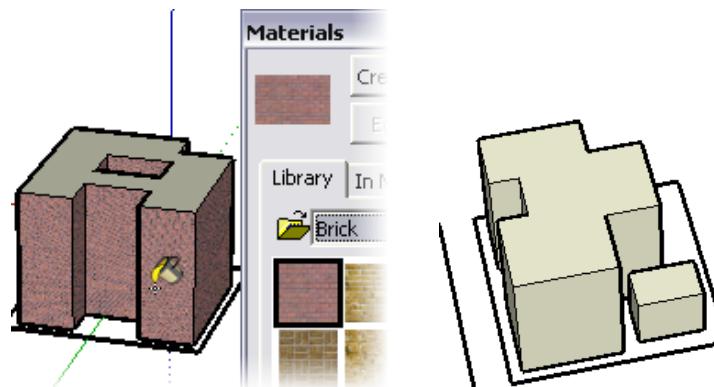
- On the Massing design bar, click **Create Mass** to start the In-Place Mass routine.

Name the new mass **Building 5**.

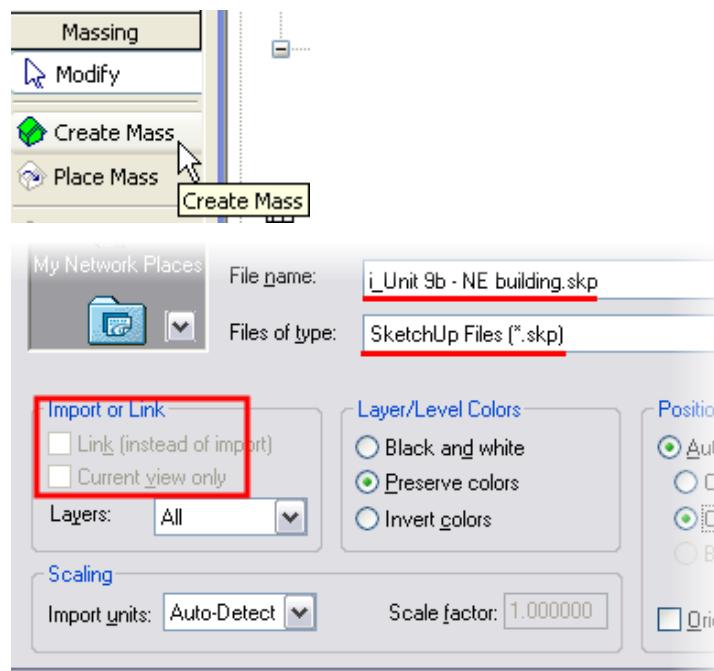
Click OK to return to the drawing window.

- Repeat steps 2 and 3 to import a SketchUp model. In this case you import the SketchUp file *i_Unit 9b - NE building.skp*.

Notice that you cannot link the file when you place the SketchUp file within a mass instance; you can only import it. This means if the SketchUp file changes, these modifications are not passed into the Revit Architecture project.

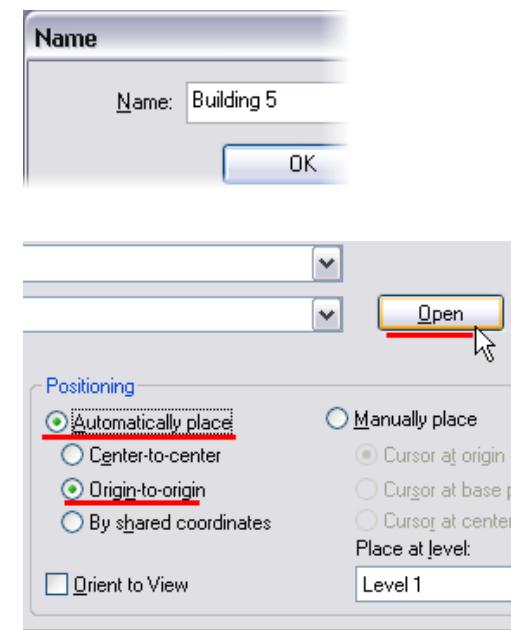


While the SketchUp model is displayed in the Revit Architecture project, it acts as a solid block. You cannot use the Building Maker tools such as Wall by Face. For more flexibility with the SketchUp model, you can import it *into* an in-place mass or a Revit Architecture mass family (RFA) file.

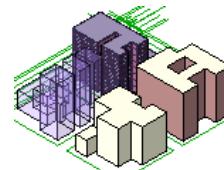


When linked, the SketchUp material color value is approximated in Revit Architecture, but the material detail is not visible.

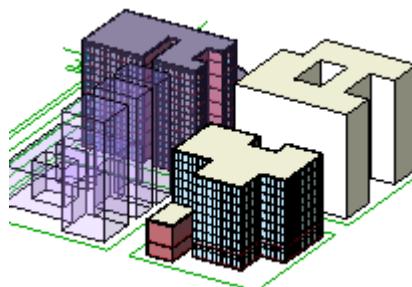
Once the SketchUp file has been nested inside a mass, you can use the Building Maker features as explained in Unit 9, Exercise A.



- 6 On the design bar, click **Finish Mass**.



- 7 Use the Massing design bar tools, Wall by Face, Floor by Face, and Roof by Face, to apply walls, floors, and roof of your choosing.

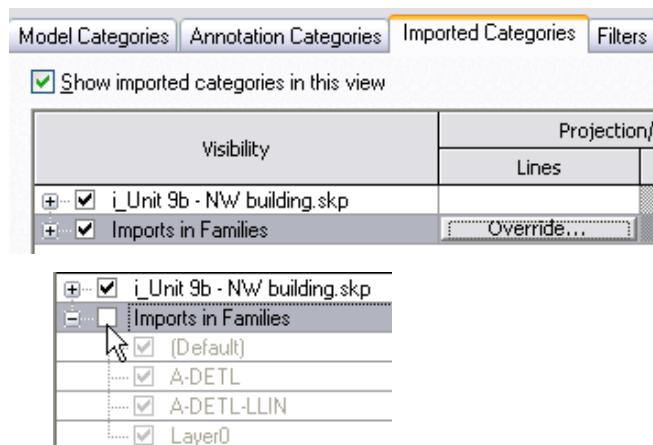


Turn off the SketchUp Model

As for any other imported file, you have control over the visibility of the graphics of the linked file.

- 8 Type **VV** to access the view's graphic overrides.

Click the **Imported Categories** tab.

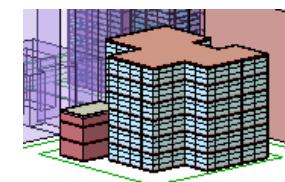


- 9 Clear the **Imports in Families** check box.

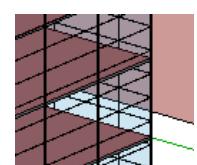
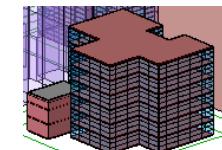
Click OK to return to the drawing window.

The mass is complete and appears to be the same as the SketchUp file linked directly into the project. However, now that it is incorporated into the Revit Architecture mass object, you can use the software's massing tools on it.

If you need assistance with this review, see the previous exercise for step-by-step instructions on applying walls, floors, and roof to faces of the mass (Building Maker functions).

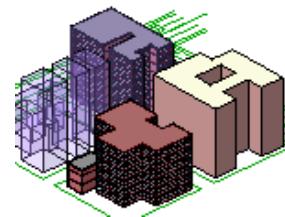


In this dialog box you should see two different lines. The file with the .skp extension is the SketchUp file linked directly into the project. The Imports in Families check box controls the SketchUp file that was imported inside the Revit Architecture mass object.



The SketchUp model within the mass has been turned off.

10 Save the project if you want.



Unit 10

Theory: Component Design

Revit Architecture: Family Editor

This workbook unit is to be used with lecture units 10 and 11. Unit 10 builds a shelf unit as a furniture family using solids. This shelf is the basis for the multiple exercises in Unit 11. This exercise is long, so give yourself enough time to finish it, or save it in a location that you can access later.

This exercise uses dimensions and alignment tools extensively. You should be familiar with these tools before you start this exercise.

Create a Component Family

Component families are those created and stored externally to the project as files with an .rfa extension.

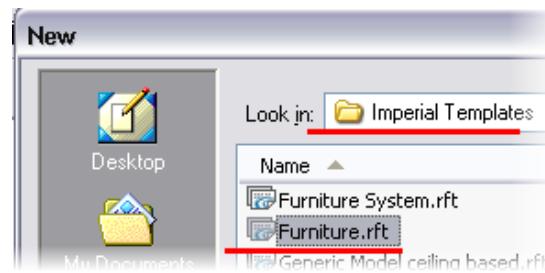


This exercise starts by opening a family template.

By the end of the exercise, you will have completed a shelf family.

- 1 On File menu, click **New > Family**.

In the New dialog box, verify that you are looking in the **Imperial Templates** folder, and open the template called **Furniture.rft**.



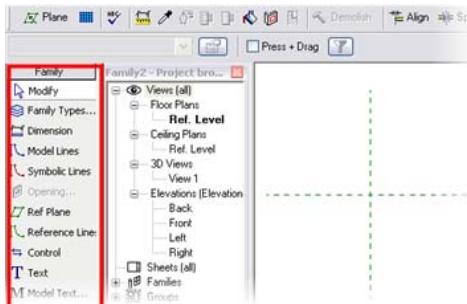
- 2 Save this file:

- On the File menu, click **Save As**.
- Browse to the data set folder that contains the workbook exercise files.
- Open the **Extra RFA Files** folder in this location.
- Save this file as **Unit 10 Shelf Unit**.

Note: The completed RFA files for Units 10 and 11 are in the *Completed Data* folder.

The other shelf units in this folder are starting points for Unit 11 exercises.

Note that the base routing for template search is on the Settings > Options > File Location tab. If you do not have the imperial templates set as default or installed on your computer, you can start with the **Furniture.rft** provided in the *Extra RFA* folder included with the workbook data sets.

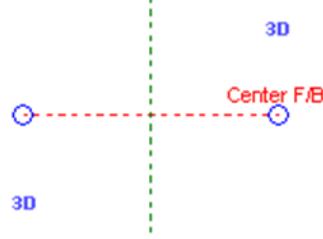


Create Overall Reference Planes

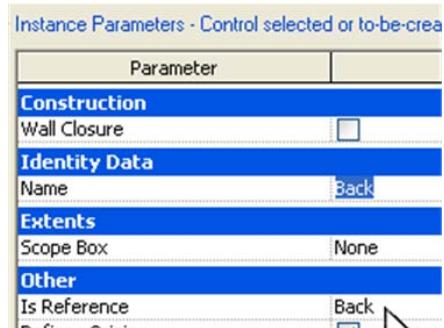
- 3 In the project browser, open **Floor Plans > Ref. Level**.

Right-click the horizontal reference plane. Click **Element Properties**.

When you are working with families, you are creating reference planes. These reference planes are assigned the parameters that drive the geometry.



- 4 In the Properties dialog box:
- Change the name to **Back**.
 - Verify that **Is Reference: Back** is selected.
 - Click OK to exit.



The Family Editor opens. Note that the work environment is similar to Project mode. The design bar provides just one Family bar. The usual bars are not available (Site, Modeling, Structural, and so forth) because they are not used for family creation. The project browser is similar: there are plan views, elevations (which are named differently), and 3D views.

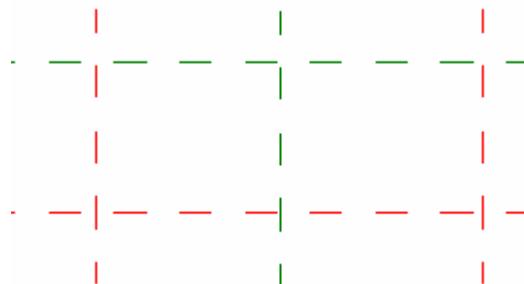
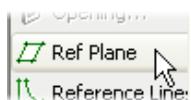
In this view there are two reference planes. The intersection of these two planes represents the insertion point of the family. In this case, this point is the rear (back) and the middle of the piece of furniture. Begin by changing the name of this reference plane.

Reference planes are important in the creation of families. It is on these lines that you base the parameters of your family; they are references for the geometry. Adding reference planes is easy. Simply specify a starting point and a final point (just like drawing a line). The length of the line symbol is not important. If necessary, you can resize it using the grips that appear at its ends when it is selected.

A reference plane displays its name when selected. Naming your reference planes as you add them is a good idea.

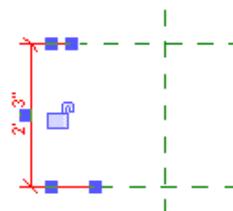
- 5 On the design bar, click **Ref Plane**.

Add three planes, as shown in image (don't worry about the distance between each plane).



- 6 On the design bar, click **Dimension**.

Add a dimension line between the two horizontal reference planes.

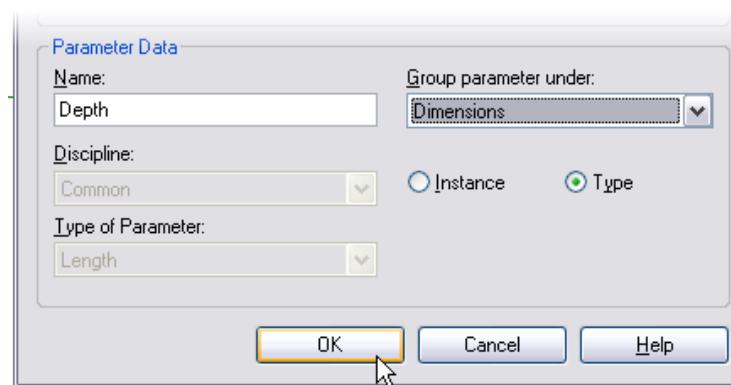


- 7 On the design bar, click **Modify**.
Select the dimension.

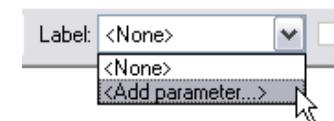
On the options bar, Label list, click **Add Parameter**.

- 8 In the Properties dialog box for the parameter:

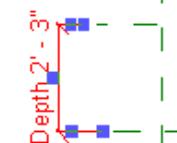
- Enter **Depth** as the name.
- Verify that the **Type** radio button is selected.
- Set the Group Parameter Under option to **Dimensions**.
- Click OK.



You must be able to vary the width and depth of your piece of furniture, so you add two new parameters to your family. To create a parameter you must add a dimension and assign it a label. The depth of the furniture family corresponds to the distance between the two horizontal reference planes; the width corresponds to the distance between the two vertical reference planes (right and left).



The Group Parameter Under setting is an organizational structure for the parameters.

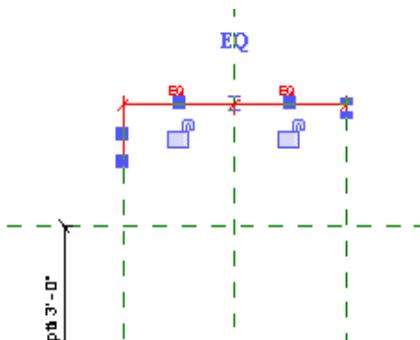


A dimension that is associated with a label (parameter) displays the parameter name in the dimension string.

9 On the design bar, click **Dimension**.

Add a dimension between the three vertical reference planes (click each line and position the dimension line with a left mouse-click).

Click the **EQ** symbol that appears.



10 Repeat the earlier steps to add the width parameter (shown far right).

Add a dimension (between two outside vertical reference planes). Click the dimension.

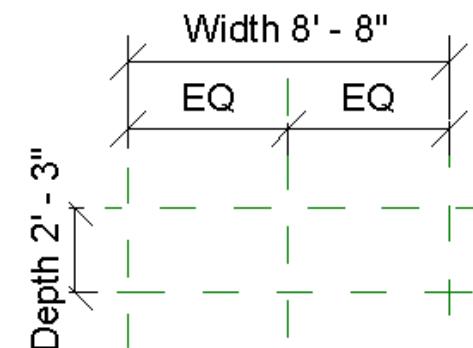
On the options bar click **Add Label**.

Set the label as follows:

- Name = Width.
- Group Parameter Under = Dimensions.
- Type parameter.

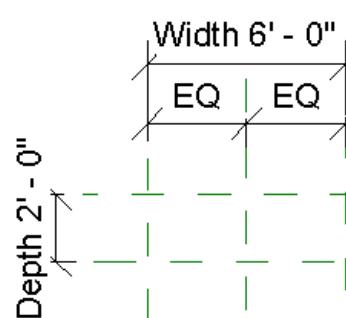
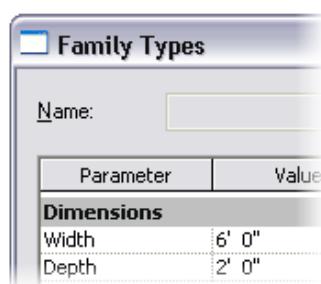


The vertical reference plane between the two other planes is the axis of the furniture. Thus, it must be equidistant between the planes on the right and left. To achieve this and keep it as a constant during the design, you need to add a dimension between the three reference planes and activate the equality constraint (EQ symbol).



11 On the design bar, click **Family Types**.

- Change the Width values to 6'.
- Change the Depth values to 2'.
- Click **Apply**.
- Click **OK**.



During family design, it is important to test the parameters to check that all is working properly. You have just added two parameters in your family. You can test them by changing some of their values. During this test, reposition the reference planes. You should not receive any error message.

This process is referred to as flexing the family parameters.

- 12 Add a reference plane and parameter for height:

- In the project browser, click **Front View**.
- Add a horizontal reference plane.
- Add a dimension between the reference plane on the ground and the one you have just added. Transform this dimension into a parameter named **Height** (also a type parameter in the Dimension group).

Flex the family by changing parameter values in the Family Types dialog box.

Save your project.

Create Side Supports

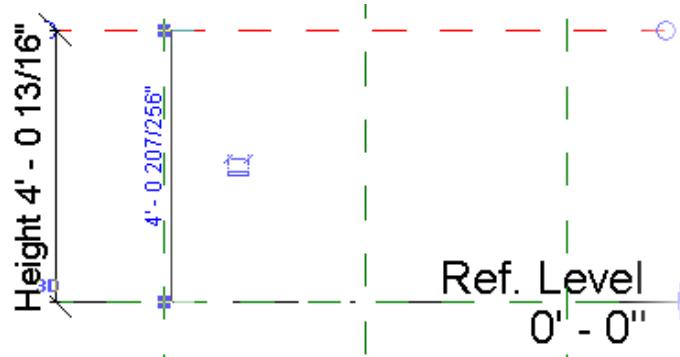
- 13 Activate the **Ref. Level** view.

On the design bar, click **Solid Form > Solid Extrusion**.

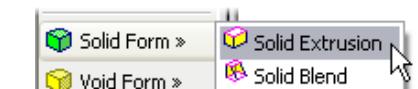
- 14 On the design bar, click the **Lines** button.

On the options bar, click **Rectangle**.

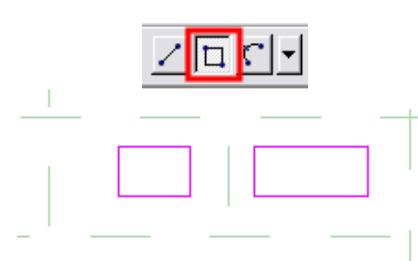
Draw two rectangles, as in the image (the size is not important).



Remember to save your work regularly. You can decide to create a new tree structure of files under the main *Library* folder. It's a good idea to keep your personal libraries separated from the installed library.



Now that the reference planes are in place, you create the side supports with the Solid Extrusion tool.

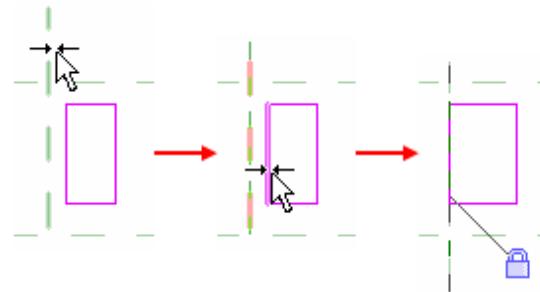


Sketch mode is used for creating forms: the design bar displays the tools available to create the sketch, which must be a closed loop.

- 15 Use the Align tool to lock the left sketch line to the left reference plane, as in the image:

- Click the **Align** tool.
- Click left reference plane.
- Click left line of the left rectangle sketch line.

Lock this alignment by clicking the lock icon to close it.



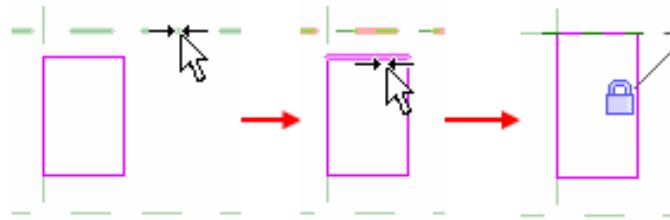
- 16 Repeat the process for the right rectangle, locking the right edge to the right plane.



- 17 Use the Align tool to lock the top sketch lines to the upper reference plane, as in the image.

- Click **Align** tool.
- Click upper reference plane.
- Click top line of the left rectangle sketch line.

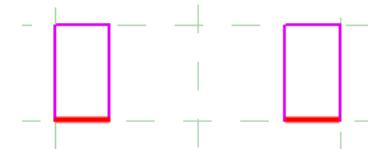
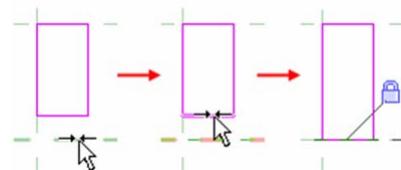
Lock this alignment by clicking the lock icon.



- 18 Repeat the process for the right rectangle's top sketch line.



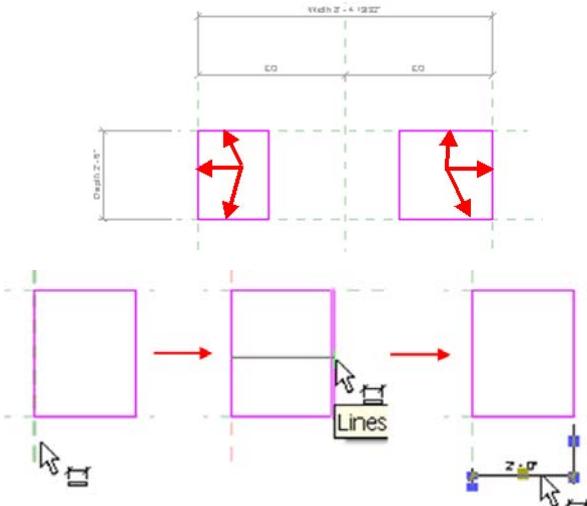
- 19 Repeat this process for the bottom sketch lines, locking them to the lower reference plane.



- 20 On the design bar, click **Dimension**.

Click the left reference plane and then the right line (which is not locked).

Position the dimension.



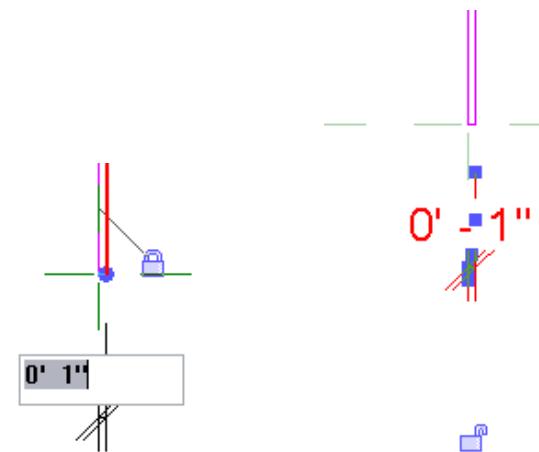
- 21 Click the **Modify** tool.

Select the sketch line on the right side of the rectangle you just dimensioned.

Click the dimension text and change the value to 1".

Lock the dimension:

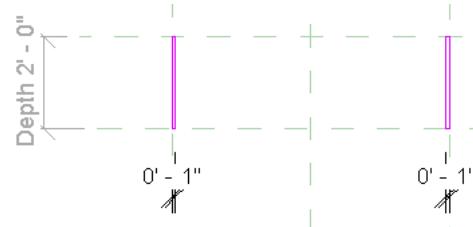
- Click the dimension line to make the dimension's constraint lock appear.
- Click the dimension's lock icon.



- 22 Repeat this process for the sketch on the right side.

Click **Finish Sketch**.

Save the family.



The sketch lines shown here should now be aligned/locked with their respective reference planes.

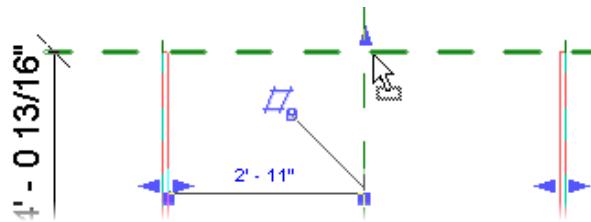
When you dimension a sketch like this, you want to run the dimension to the reference plane rather than the sketch line.

This allows the sketch to flex as you use the dimensioned label parameters to drive the geometry.

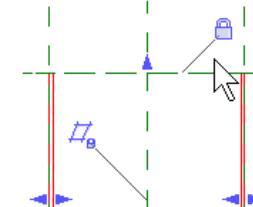
To get the lock to appear, the dimension must be selected, *not* the sketch line.

23 Adjust the heights of the side pieces:

- In the project browser, under Elevations, select **Front** view.
- Select the 3D geometry (the solid extrusions you just drew). Blue grips that can be used for dragging the faces appear.
- Drag the grip that allows changing of the height of the solid element until you reach the top reference plane.
- Click the lock icon to lock the alignment.



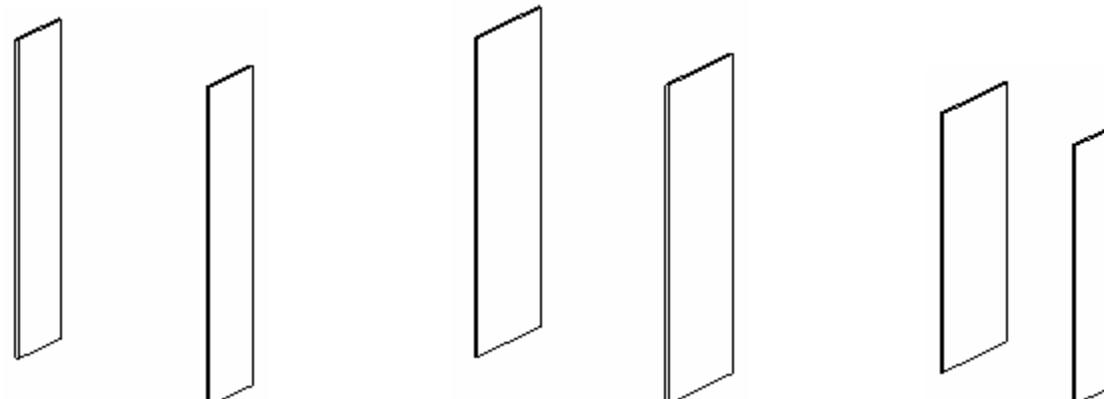
You can also use the Align tool to accomplish this task.



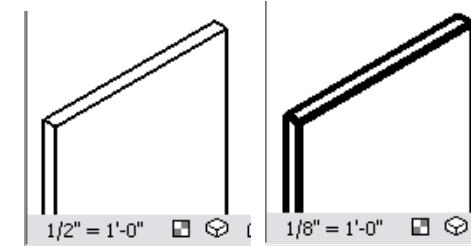
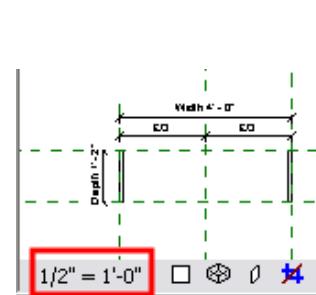
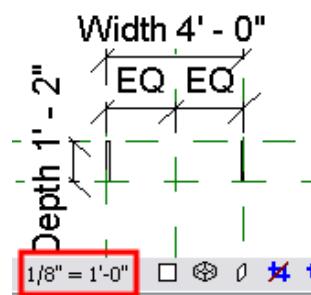
Because you drew two rectangles in Sketch mode, you have only one vertical grip that controls the height of both side frames.

24 The vertical sides are finished. Test your work by varying the parameters of the family (width, height, depth) in the Family Types window and clicking **Apply** (flexing the model). The 3D geometry must update consequently, and no error message should appear.

To clearly see the effect of the parameters, open a 3D view.



Note that as for all Revit Architecture views, a scale is associated with the view. You can use this scale to adjust the size of the text you see in the view as well as the profiling seen in 3D.



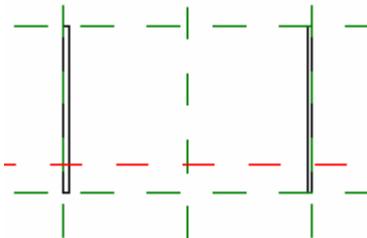
Add Reference planes for Shelves and Base

Like the side supports, you draw the reference planes first and then the solid extrusions for the base trim and shelves.

25 In the project browser, activate the **Ref. Level** view.

-

Add a horizontal reference plane just above the one that defines the depth of the furniture family.



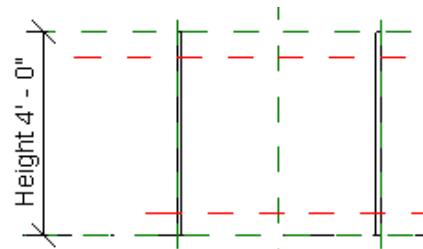
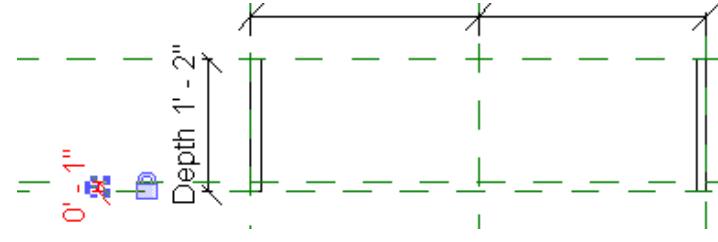
26 Add a new dimension line between the bottom reference plane and the one you just created.

Select the reference plane and change the dimension text to **1"**.

Lock the dimension.

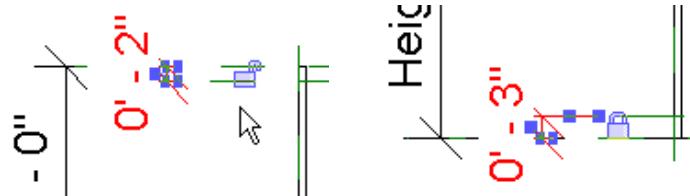
27 Open the **front** view.

Add two horizontal reference planes, as shown in the image.

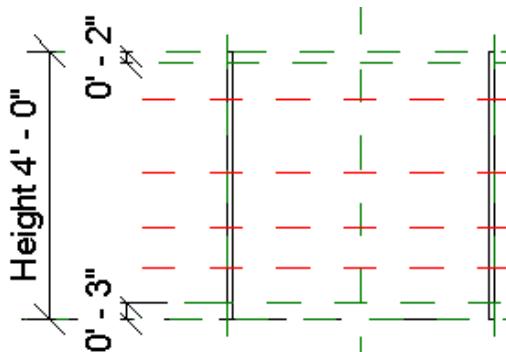


28 Dimension and lock the upper two reference planes to **2"**.

Dimension and lock the lower two reference planes to **3"**.



- 29 Add four more reference planes, as shown in the image.



- 30 Click **Dimension**:

- Click the four reference planes as well as the two created in the previous step.
- Click the EQ symbol.
- Flex the model by changing parameter values.

Save the file.

Add Base Trim

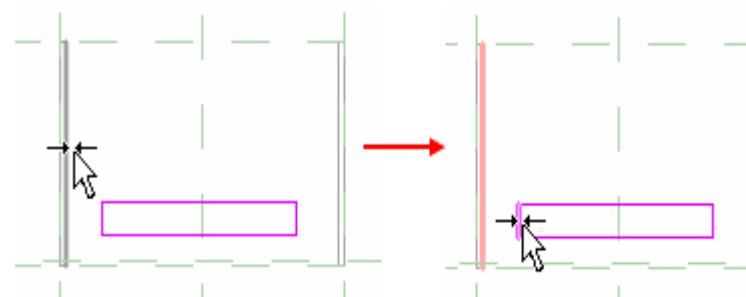
- 31 Open the **Ref. Level** view.

- On the design bar, click Solid Form > Solid Extrusion.
- On the design bar, click **Lines**.
- On the options bar, click the rectangle template.
- Draw a rectangle, as shown in image. The size is not important.



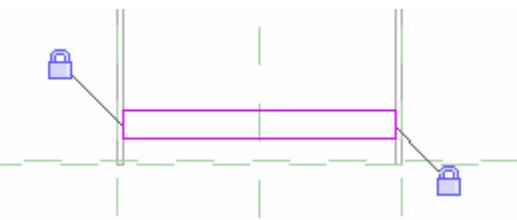
- 32 On the toolbar, click **Align**.

- Click the internal face of the upright, and then click the nearest line of the rectangle.
- Lock this alignment by clicking the lock icon to close it.



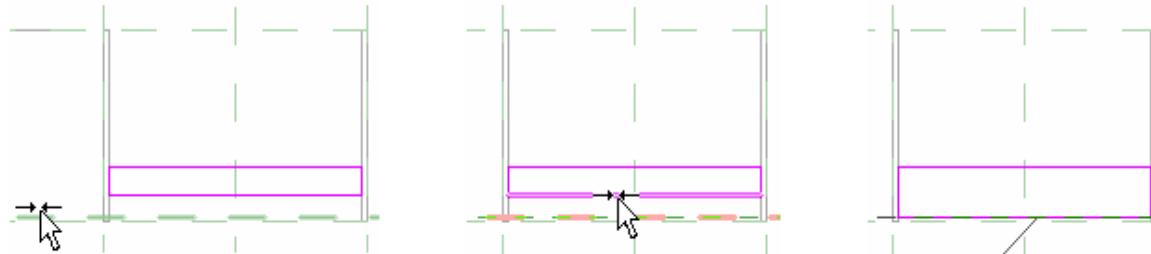
A few words to explain these reference planes: two of them cannot move. They are constrained by locked dimensions (3" and 2"). The other four are spaced regularly because of the dimension line that constrains the distance between them. Thus, if the height of a piece of furniture is modified, the top and bottom parts are fixed, whereas the distance between the four other planes is adjusted to satisfy the equality constraint.

- 33 Repeat the process on the right side.
Lock the alignment.



- 34 With the **Align** tool, click the upper of the two bottom horizontal reference planes and then click the nearest horizontal line of the sketch.

Lock this alignment by clicking the lock icon to close it.

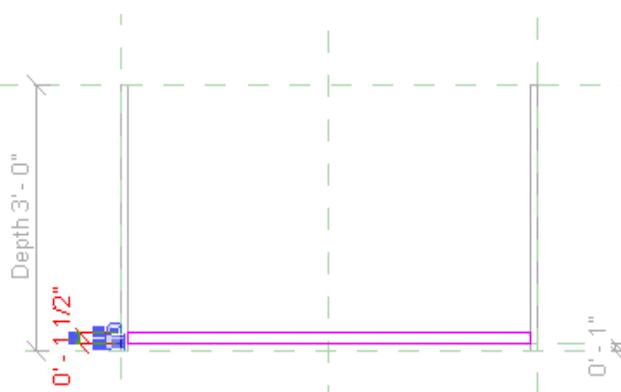


- 35 Add a dimension between the reference plane immediately above the one that defines the depth. Click the line that you did not lock.

Select the line. In the dimension text change the value to **$1\frac{1}{2}$ "**.

Select the dimension and lock it.

Click **Finish Sketch**.

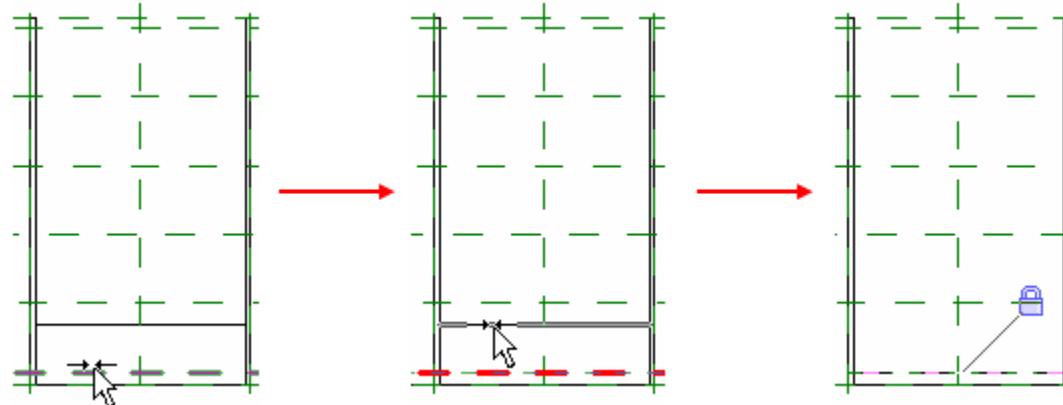


Notice that when you finish the sketch, the dimension disappears.

It is still there when you edit the sketch. This is a useful way to keep your families free from extra dimension clutter but can make it difficult to track when a family gives you overconstraint errors.

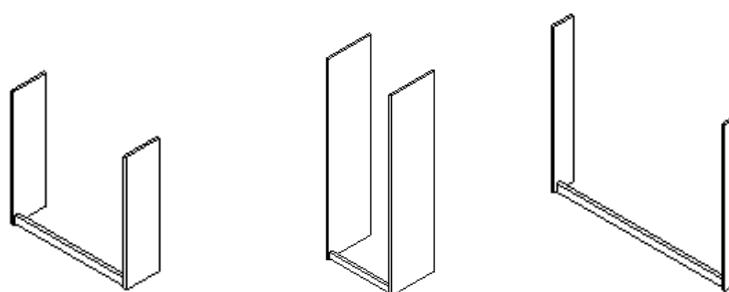
- 36 Open the front view.

- Click Align.
- Click the reference plane that is directly below the top of the solid you just created, and then click the top of the solid.
- Lock the alignment by clicking the lock icon.



37 Flex the model.

Save the family.

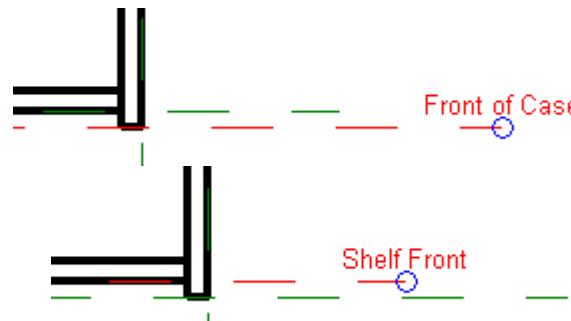


Add Shelves

38 Open Ref. Level.

Rename the horizontal reference planes.

- Right-click the lowest horizontal reference plane. Click **Element Properties**.
- Rename the reference plane to **Front of Case**.
- Repeat, and rename the second reference plane **Shelf Front**.
- Click the top reference plane to verify that it is named **Back**. If not, repeat preceding steps to rename it.



We refer to these reference planes now by these names.

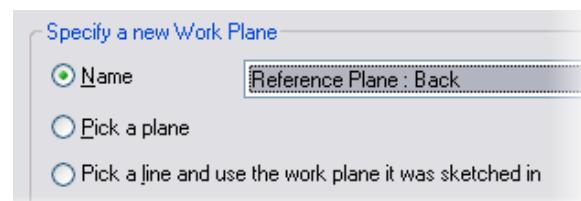
39 Open the **Elevation Front** view.

On the design bar, click **Solid Form > Solid Extrusion**.

On the design bar, click the **Set Work Plane** tool.

Set the work plane **Name to Back**.

Click OK to return to the drawing window.



- 40 On the design bar, click **Extrusion Properties**.

Set the Extrusion End to 4".

Click OK to return to the drawing window.

- 41 On the design bar, click **Lines**.

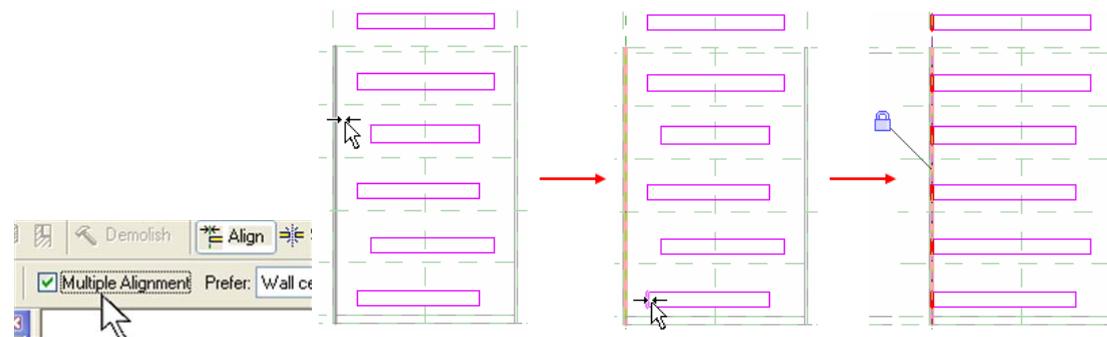
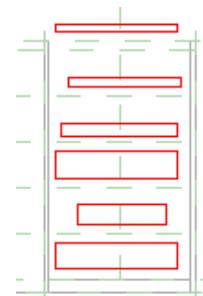
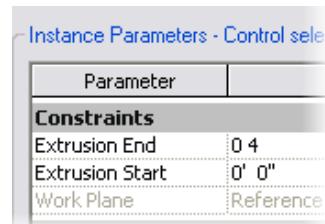
On the options bar, click the rectangle template.

Draw six rectangles, as shown in image. The size is not important.

- 42 Click the **Align** tool. On the options bar, click **Multiple Alignment**.

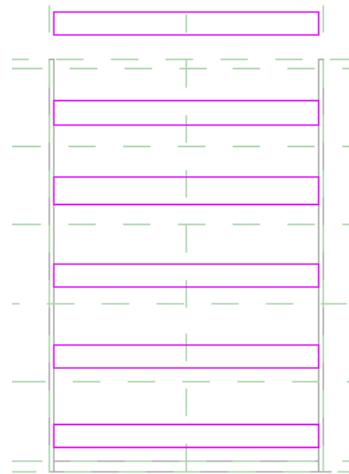
Click the interior face of the left upright. Click the left vertical lines of the rectangles (one at a time).

Lock each alignment. (You must lock each line individually after aligning it.)



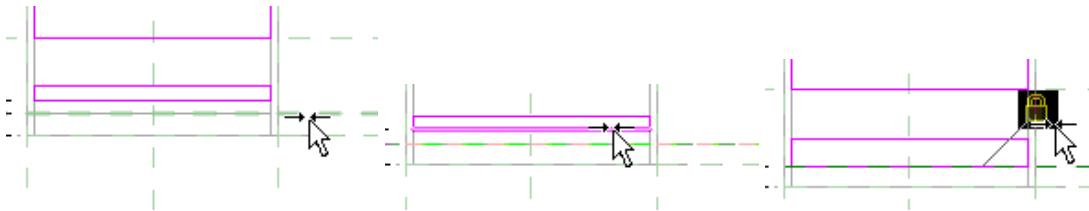
You could set the depth of the shelves to 1 foot (or the numeric depth of your shelf), but doing so would not allow the shelves to flex as you changed the depth of the family. Changing it to 4 inches makes it easier to work within plan view when you align and lock this front edge to a reference plane when you are finished with this sketch.

- 43 Repeat the process for the lines on the right side. Remember to lock the alignments.

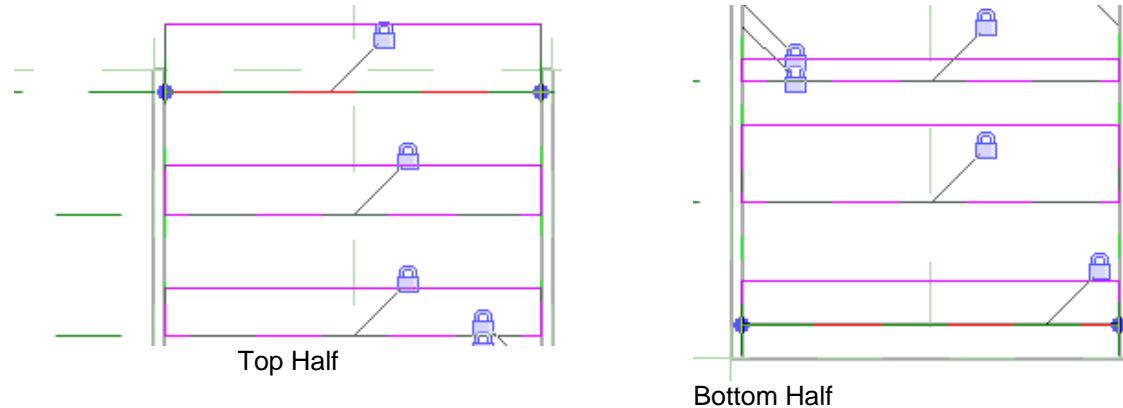


- 44 Click the **Align** tool.

- On the options bar, clear the **Multiple Alignment** option.
- Click the reference plane above ground level and then the bottom horizontal line of the lowest rectangle.
- Lock the alignment.



- 45 Repeat the alignment process with the horizontal reference planes and the bottom lines of the rectangles, as shown in image.



These alignments allow the horizontal racks to remain in contact with the vertical uprights if the furniture family's width is resized. You should now force the horizontal lines of the rectangles; the lines of the bottom of the rectangles must be respectively aligned with the reference planes that are subjected to the equality constraint.

Then you need to place a dimension between each reference plane and the top line of the rectangles. Adjust and lock these dimensions to keep the thickness of the shelves constant.

- 46 Add a dimension between the reference plane and the top line of the rectangle located on the bottom, as shown in image.

- Select the line and change the dimension text to **1"**.
- Lock the dimension.

Repeat the process for all horizontal lines (located on the top of the rectangles). Remember to lock the dimensions.

Click **Finish Sketch**.

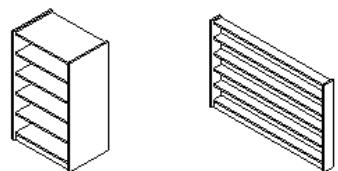
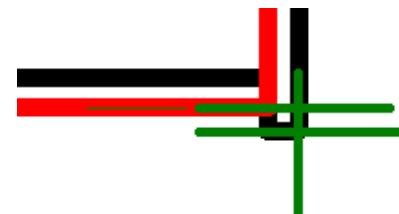
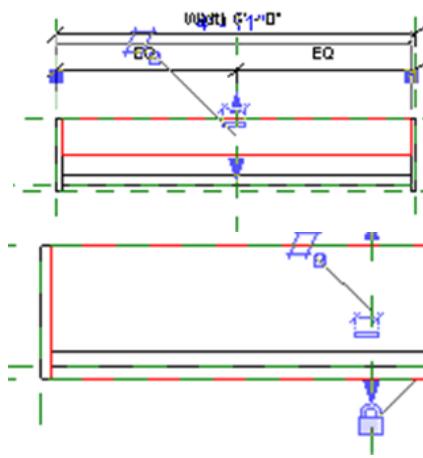
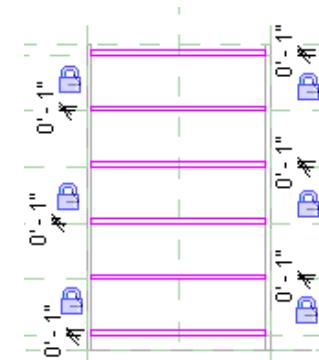
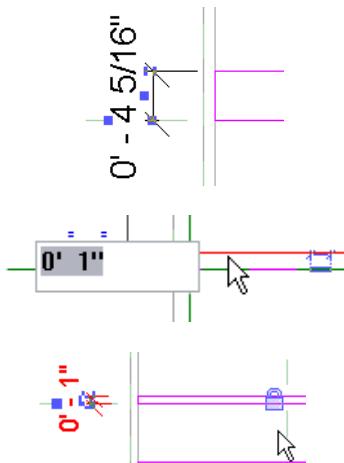
Save the family.

- 47 Align the shelves to the **Shelf Front** reference plane:

- Open Ref. Level.
- Select the 3D geometry, as shown in image. The blue grips appear.
- Drag the lower blue grip to the reference plane Shelf Front, as shown in image.
- Click the lock icon. If the lock icon does not appear, use the Align tool.

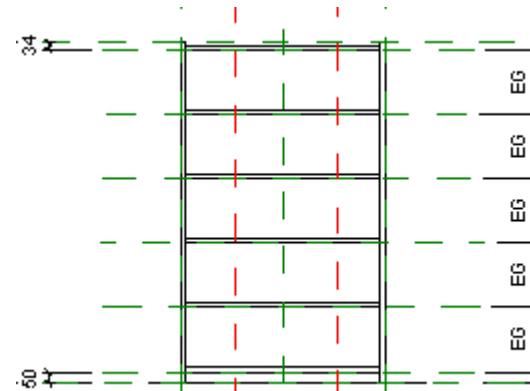
- 48 Flex the model.

Save the family.



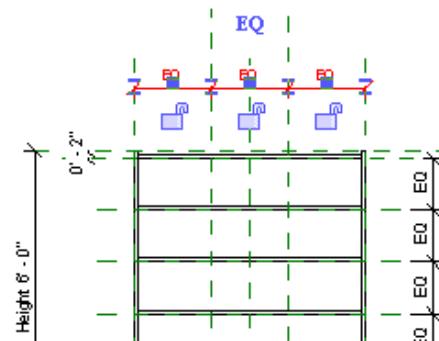
Add Vertical Supports

- 49 In the project browser, open the front view.
Add two vertical reference planes, as shown in image.



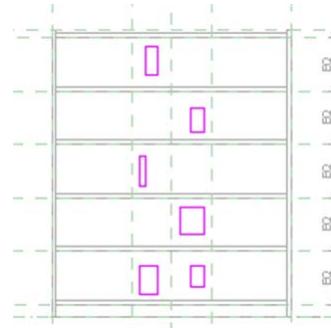
- 50 Add a dimension line between the two reference planes you just added and the external ones, as shown in image.

Click the **EQ** symbol.



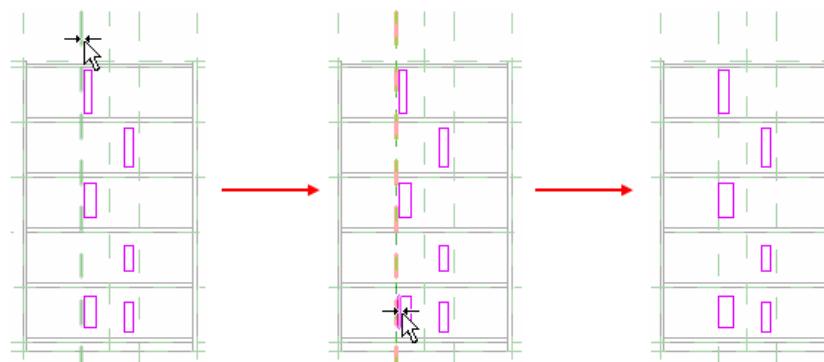
- 51 On the design bar, click **Solid Form > Solid Extrusion**.

- On the design bar, click **Lines**.
- On the options bar, click the rectangle template.
- Draw six rectangles, as shown in image. The size is not important.

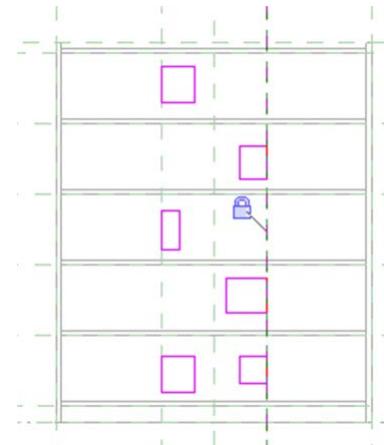


52 On the toolbar, click Align.

- On the options bar, select **Multiple Alignments**.
- Click the left reference plane (see image) and align the three rectangle lines, as shown in image.
- Lock each alignment as you make it.

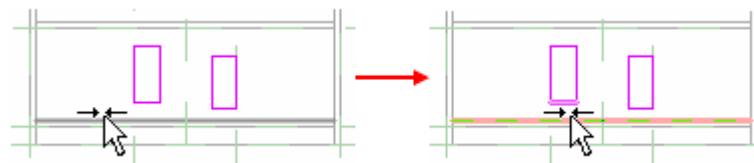


53 Repeat the process with the remaining rectangles and the right reference plane.



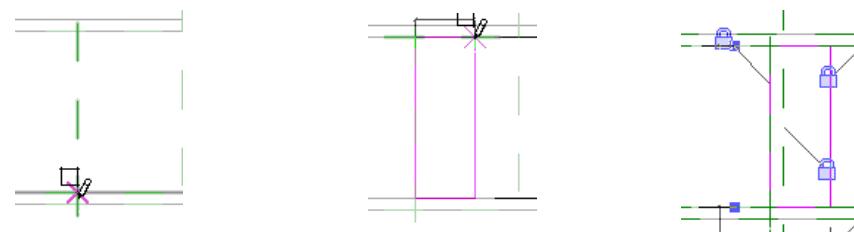
54 Align bottom left support sketch line:

- Click the **Align** tool.
- On the options bar, clear the **Multiple Alignment** option.
- Align the bottom line of the bottom rectangles, as shown in image.
- Lock the alignment.

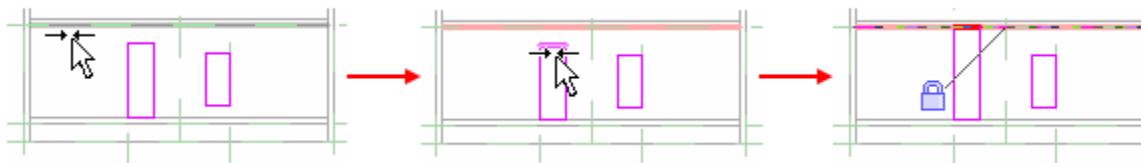


All these alignments are locked to maintain this constraint when you change the value of the width parameter of the furniture family.

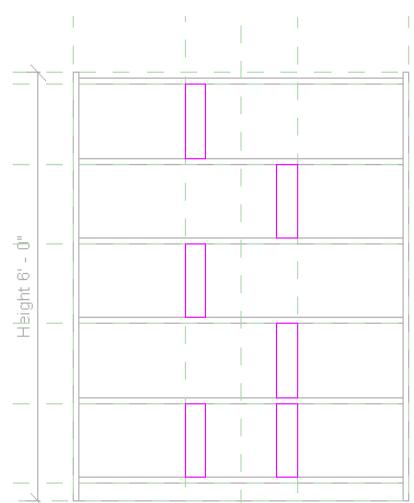
Note that as you draw these rectangles, you can draw on top of the reference planes, and a lock appears. You can lock it at this time for the same effect.



- 55 Repeat the process with the top lines (see image).



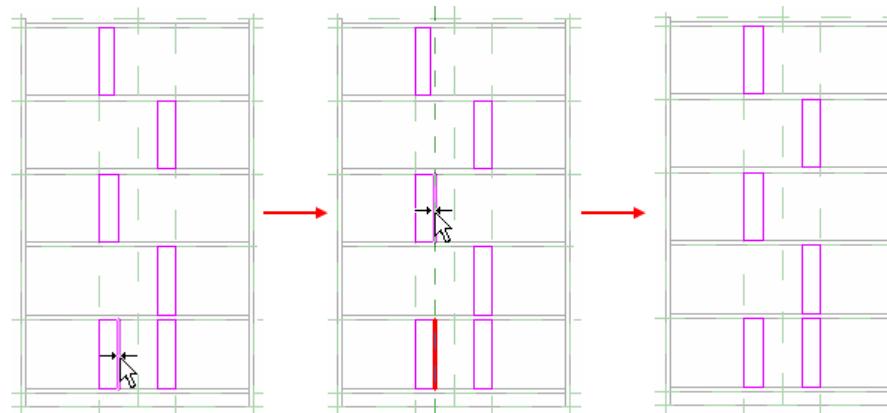
- 56 Repeat the process for all the rectangles.



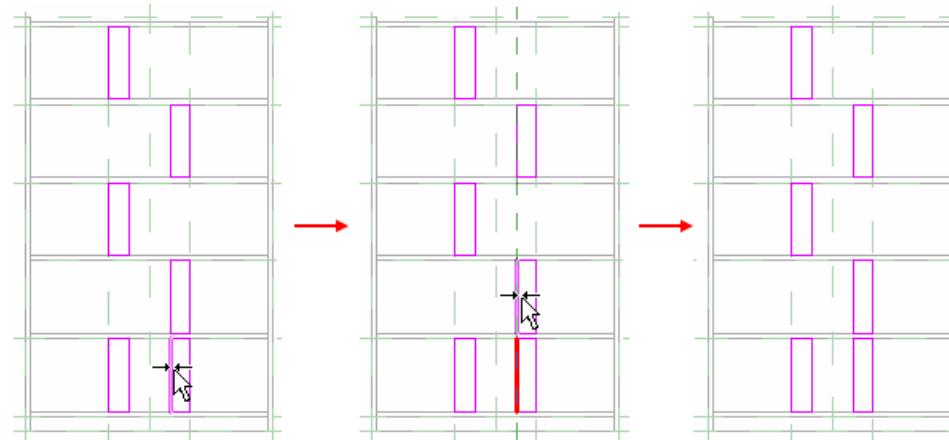
It is now necessary to manage the thickness of vertical separations. You operate in a way identical to the preceding stages, namely, a dimension locked between the reference plane and the unconstrained line of the rectangle. But before that, you align the sides of the rectangles between them (on the left and right).

- 57 Align and lock the vertical supports to each other to establish a single control for the width of many elements:

- On the toolbar, click **Align**.
- On the options bar, click **Multiple Alignment**.
- Click the right vertical line of the bottom-left rectangle, and then click the right vertical lines of the rectangles on top of it (see image).
- Lock each alignment as you make it.



- 58 Repeat the process for the rectangles on the right side.



- 59 Place a dimension line between the vertical lines of the bottom-left rectangle (see image).

Select the line, and in the dimension text change the value to 1".

Select the dimension and lock it.

Repeat the process for the right rectangle.

Click Finish Sketch.

- 60 Open Ref. Level view.

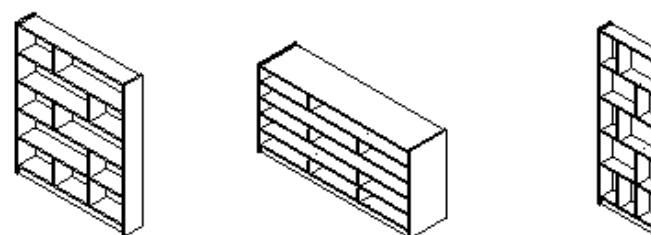
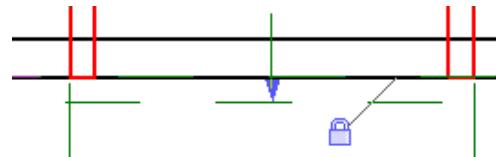
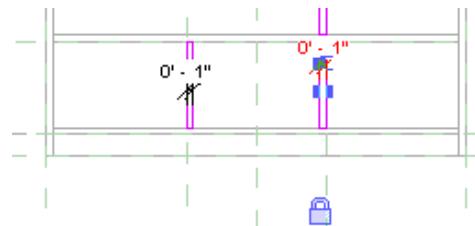
Adjust the vertical supports:
Select the 3D geometry and use the blue grips to align the bottom face, as shown in image.

Lock the alignment.

- 61 Flex the model.

Save the family.

Because the right sides of this set of rectangles are locked together, you need to place only one dimension to control all rectangles in that set.



The shelves are now ready to be used in a project. On your own, start a new project to insert this family.

- On the File menu, click **Load from Library > Load Family**.
- Navigate to where you saved the family and open it.
- On the Basics design bar, click **Component**. You can now place your family.



To test your new family in a project, you load it in a project. You can then insert it from the Component tool. Do not forget that your family is parametric! To find the Width, Height, and Depth parameters, open the Type Properties of the family.

Unit 11

Theory: Propagation of Constraints

Revit Architecture: Alignment, Locking, and Constraints

This unit is to be used with Lecture Units 10 and 11. Unit 11 builds on the family created in Unit 10. This unit has several exercises designed to illustrate various capabilities of the family within Revit Architecture.

Exercise A:

- Add the symbolic line representation to create the coarse, medium, and fine detail views.
- Add a masking element to hide the floor pattern.
- Use in-place family editing from the project environment.

Exercise B: Add a material parameter to control the materials assigned to the shelf unit.

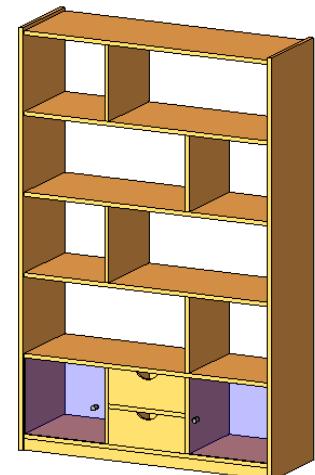
Exercise C: Add a glass door and assign a visibility parameter to control the display of the glass element.

Exercise D: Work with nested families to add a drawer unit to the family, using the parent shelf parameters to drive the geometry of the nested family.

Exercise E: Fine-tune the family, adding control of family elements through the use of subcategories.

In this unit you complete the furniture family created in the previous unit by adding components to it. See image.

The family that you created in the first part of the exercise requires more work so you can use it properly. You need to generate its 2D representation, associate all necessary materials, and define the levels of detail. Later in the exercise, you can experiment with nested families and formulas—an enormously powerful part of the Family Editor.



Exercise 11A: In-Place Family Editing and Symbolic Line Representation

In Unit 10 you worked with the Family Editor. In-place family editing provides access to the family definition directly from the project environment.

Symbolic Lines and View Detail Level

When you create a family, you need to define how that family behaves in different views (plan, section, elevation, 3D). The first important decision is its 2D representations: will the display of the family in plan view simply result from a cut 3D view, or should it be represented with a simple 2D sketch? In this case, it is not generated from the 3D model but is represented with a 2D sketch that you create. After you have defined the way your family (object) is displayed in different views, you need to define its representation in different scales (coarse, medium, fine) for all views. So, this is our objective:

	Coarse	Medium	Fine
Plan View			
Section, Elevation, 3D View	Display representation is generated from the 3D model (Solid Extrusion elements).		

You need to add two new sketch drawings to your family—one for its Coarse-Medium representation and one for the Fine representation. You use the symbolic lines for these sketches. You set the visibility of the objects in the family such that only the sketch lines display in the project and not the 3D elements of the shelf.

Masking Regions

Masking regions are 2D objects such as a fill pattern that allows families to hide floor patterns and color fills when used in a project.

Open the Exercise Project

- 1 Open i_Unit 11a – Start.rvt.

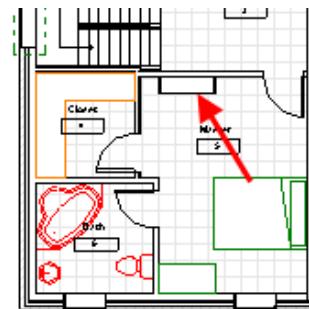
Verify that the current view is **Floor Plans: Level 2 Furniture**.

Zoom into the larger bedroom area.

The shelf created in the last unit has already been placed in this project. In this project the shelf family is simply named **iShelf**.

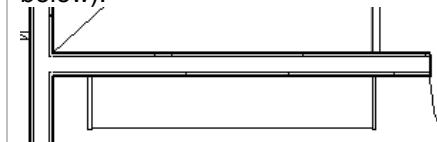
Crop a 3D View

In this exercise you edit the family directly from the project. You access the shelf from the 3D view.



Create a 3D view that has an active section box. Use section boxes to slice away parts of the model to show the interiors.

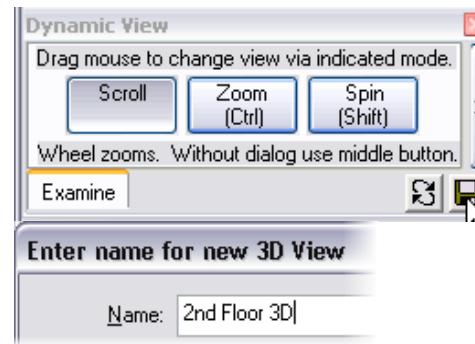
The shelf has no symbolic lines. What is displayed in the drawing window is the solid form elements viewed from above (see note below).



2 Duplicate the 3D view with the Dynamic View tool:

- Set the 3D view current.
- Press F8 to bring up the Dynamic View dialog box.
- Click the disk icon in the Dynamic View dialog box.
- Enter **2nd Floor 3D** for the name.

Click OK.



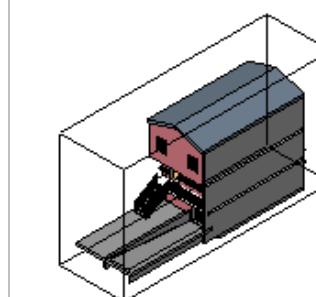
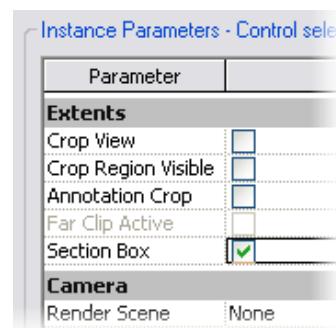
This creates a new view in the project browser under 3D views.

3 Right-click in the drawing window.

Click **View Properties**.

- Select **Section Box** in the view properties.
- Clear Crop View and Crop Region Visible check boxes.

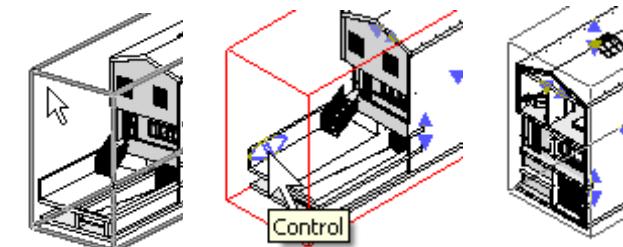
Click OK to return to drawing window.



Turn on Shade mode if you want.

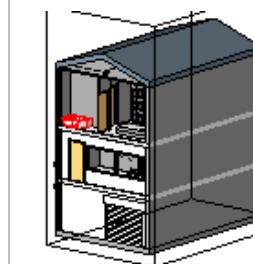
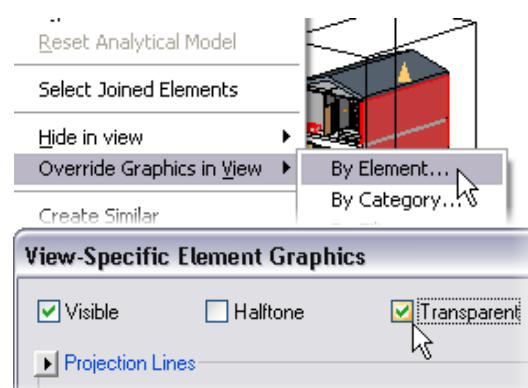
4 Cut the 3D view with the section box:

- Click the section box that appears in the drawing window.
- Use the face grips to cut away the south walls.



5 Apply a transparency override to the east wall:

- Right-click the solid east wall. Click **Override Graphics in View > By Element**.
- In the View-Specific Element Graphics dialog box, select **Transparent**. Click OK.



The wall still exists and is selectable in the view, but is now transparent.

Both the element-level overrides and the section box are convenient ways to illustrate the interior of your design.

Edit the Shelf Family in Place

Any component family within a project can be edited directly from the project.

- Select the shelf unit.

On the options bar, click **Edit Family**.

Click **Yes** to open the family for editing.



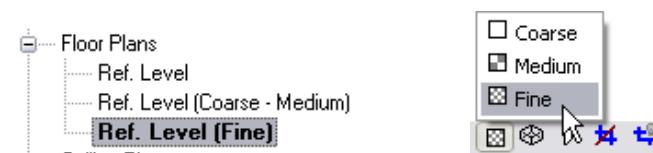
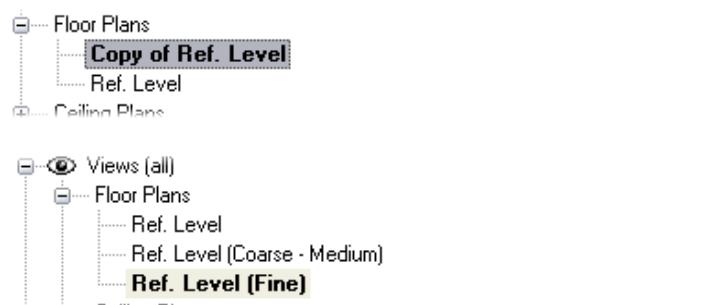
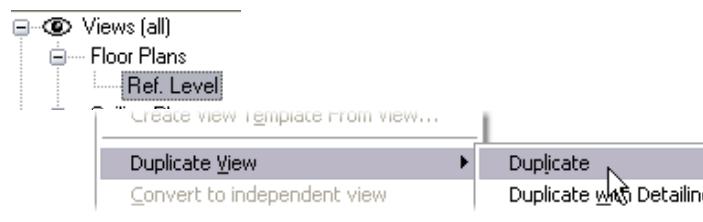
When you use edit in place like this, you are editing the project's definition of the family, not the definition in the external RFA file.

- In the project browser, under Floor Plans, activate the **Ref. Level** view.

Right-click **Ref. Level**. Click **Duplicate**.

Right-click the new **Copy of Ref. Level**. Click **Rename**, and change the name to **Ref. Level (Coarse - Medium)**.

Click OK.



- Set view **Ref. Level (Fine)** current.

Use the Drawing window view toolbar to set the detail level to **Fine**.

Using the same method, assure that **Ref. Level (Coarse - Medium)** has **Coarse** set as view detail level in its properties.

You make only one for both Coarse and Medium because the 2D geometry is the same for both of these representations.



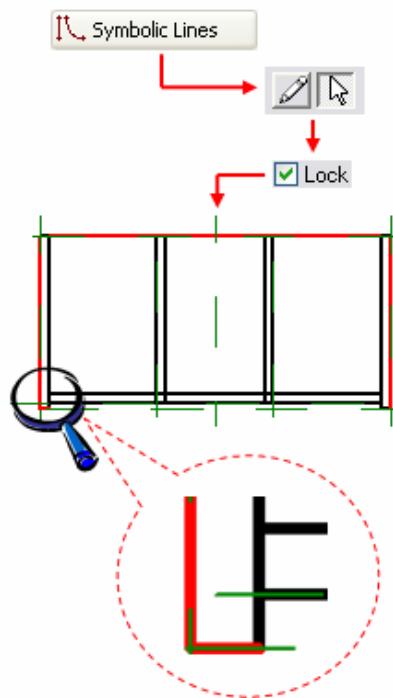
- 10 Set view **Ref. Level (Coarse - Medium)** current.

On the design bar, click **Symbolic Lines**.

On the options bar:

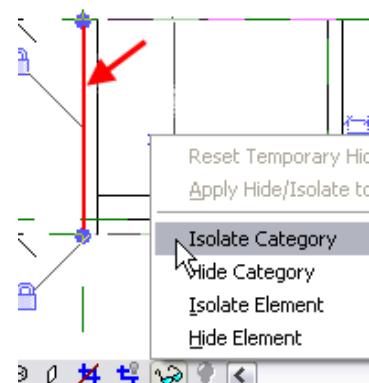
- Click the **Arrow** button (Select).
- Select the **Lock** check box.

Click the four lines shown in the image to create symbolic lines that are anchored and locked to the geometry of the shelf.



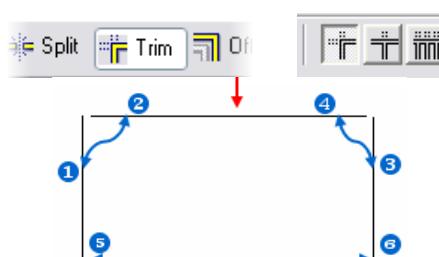
- 11 Hide the vertical supports and reference planes:

- Click the **Modify** tool, and select a symbolic line that you just created.
- From the Drawing window view toolbar, select the **Hide/Isolate** icon.
- Click Isolate Category.



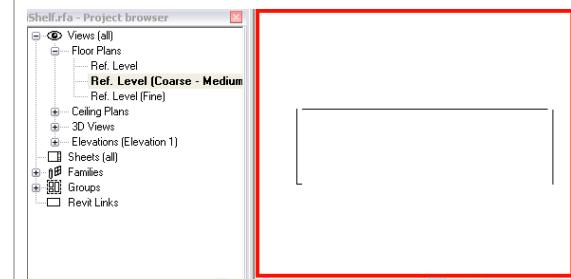
- 12 Clean up the lines:

- On the Tools toolbar, click **Trim**.
- Verify that the options bar's mode is set to **Trim/Extend to Corner**.
- Trim the lines to close the rectangle.



Selecting the Lock check box means that the selected lines automatically lock to the geometry from which they have been generated.

You need to trim the symbolic lines you have just created. But because there is a lot of overlapping geometry, this can be a tedious task. To simplify it, Revit Architecture offers a temporary Hide/Isolate option to hide all 3D geometry, as well as the reference plane. You then have a pure 2D sketch drawing on which it is much easier to work.



The view is now in Isolate mode and shows only the symbolic lines.



Adjust Visibility Settings

You have just finished defining the 2D sketch for the Coarse - Medium level of detail. What remains is to tell Revit Architecture which lines should *not* be associated to the Fine level of detail.

- 13 On the design bar, click **Modify**. Select the line that represents the front of the furniture.

On the options bar, click **Visibility**.

In the Family Element Visibility Settings dialog box, clear the **Fine** check box. Thus the selected line is invisible in views set to this level of detail.

Click **OK**.

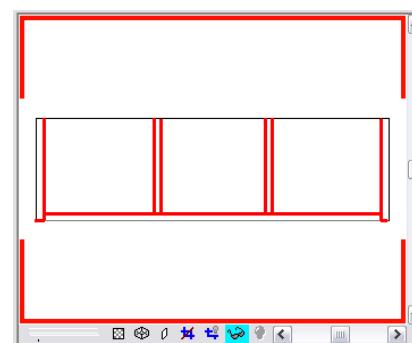
- 14 Activate the **Ref. Level (Fine)** view.

Right-click in the drawing window. Click **Zoom Fit**.



- 15 Use the same methods to create the linework for the fine detail level:

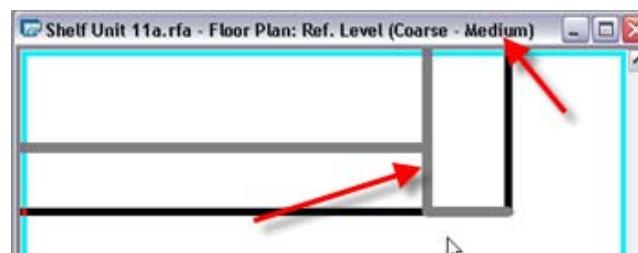
- Hide the Reference Plane category
- Use Symbolic Lines – Pick Lines – Lock.
- Hide the solid geometry category.
- Set the visibility of the new lines to **Fine Only**.
- Click **OK** in the warning that highlighted lines overlap.



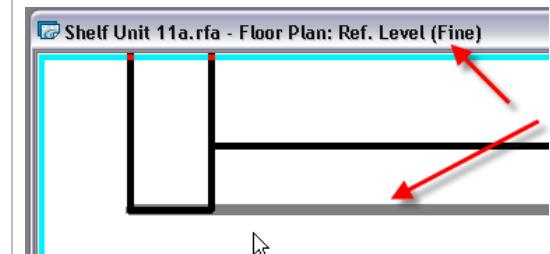
Remember to use the Symbolic Lines Pick tool with the lock so the symbolic lines are related to the solid geometry. The solid geometry is driven by the family type parameters. If you just hide everything and draw the lines, they do not flex with the model.

- 16 Tile the screen so you have both views next to each other.

Use Window > Close Hidden Windows before you use Window > Tile. This keeps all the windows you have open (which is often quite a few) from cluttering up the view.



Note that even though the detail level is set to medium for the view, the symbolic lines that you set to not show in coarse or fine detail appear but are gray rather than black.



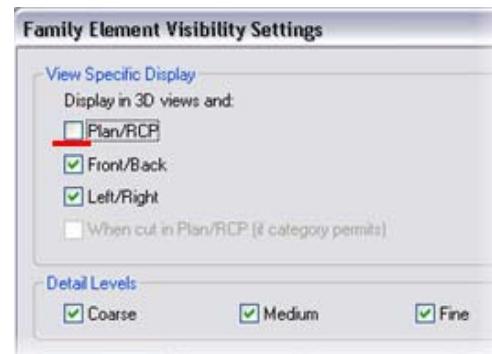
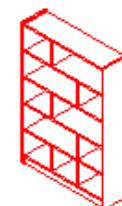
You see this behavior on all components within the family file. They do not disappear, but are gray instead of black. Once the file is loaded into the project, the lines behave as directed.

Flex the Family

- 17 On the design bar, click **Family Types**. Modify the Width or Depth parameter. Note that the 2D geometry follows the change and updates automatically.



- 18 Turn off the 3D solids in plan view:
- Activate the 3D view, and select the entire geometry.
 - On the options bar, click **Visibility** and clear the **Plan/RCP** check box.
 - Click OK.



Reload the Family into the Project

- 19 On the design bar, click **Load into Projects**.

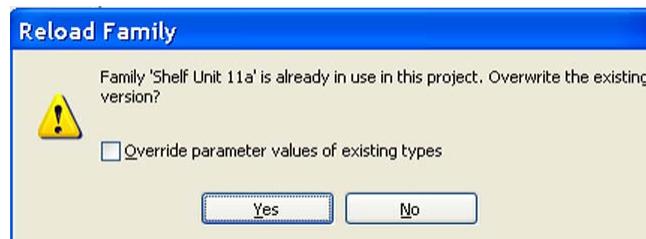


In Plan/RCP views you are going to use the 2D geometry you just created as representations. For all other ways, the representation is generated from the 3D model and in all levels of detail.

This loads the family into any projects you have open.

If you have more than one project open, you are prompted to select which project to load it into (check *i_Unit 11a – Start.rvt*). If you have only one project open, it loads automatically without this prompt.

- 20 Click **Yes** to overwrite the existing version.



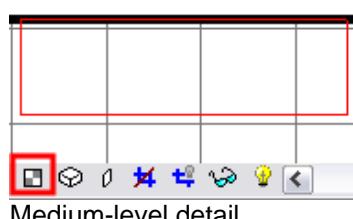
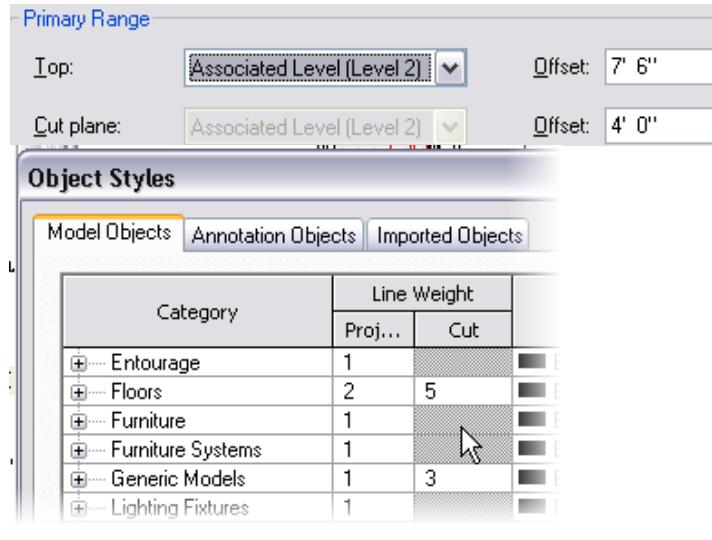
- 21 Save the project.

Note that each plan view has a cut plane. The default value for the cut plane is 4'-0".

Some families do not respect this cut plane when seen in plan view and display as though you were looking at them from the top. Likewise, when cut with a section mark, they display an end view rather than a section.

You can see which categories of model objects show correctly in plan and section by reviewing the categories in the Settings > Object Styles dialog box.

- 22 In the plan view **Level 2 Furniture**, toggle the view detail level between coarse, medium, and fine.



Medium-level detail

Because you have turned off the visibility in plan view of the solid extrusions of the family, the floor shows through the family.

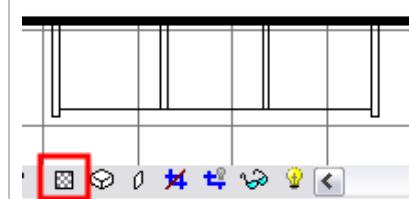
- 23 In the project file, click the shelf.

On the options bar, click **Edit Family**.

At this point your work has been transferred into the current project.

You do not need to save the family you are working on, but you do need to save the project file.

The Furniture Category has no Cut representation. Other family types such as generic models can be cut by a views cut plane or section clipping plane. The symbolic lines you have created in this family are now used as the default representation of the top view of the family.



Fine-level detail

In this section you add a masking region to hide the floor below the shelf.

Because the family is already open, it becomes the active file.

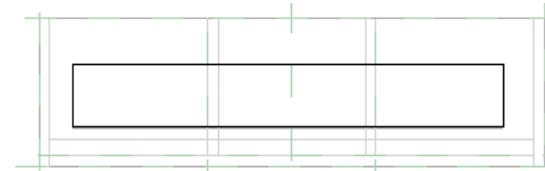
24 Set the plan view **Ref. Level** current.

On the design bar, click **Masking Region**.



25 Use the Lines tool and rectangle shape to draw a rectangle within the shelf area.

On the design bar, click **Finish Sketch**.



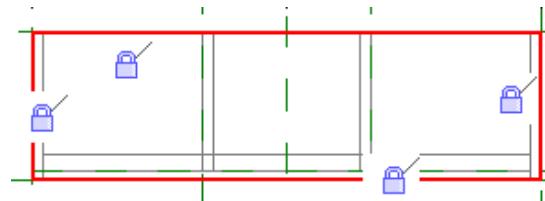
26 Click the region.

On the options bar, click **Visibility**.



Under Detail Levels, clear the **Fine** check box.

27 Select the masking region and use the blue grip or Align tool to associate and lock the edges of the region to the reference planes of the family, as shown.



28 Set the plan view **Ref. Level (Fine)** current.

On the design bar, click **Masking Region**.



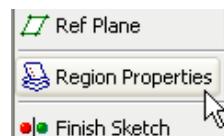
Use the **Lines** tool pick and lock options to follow the outline of the fine symbolic lines.



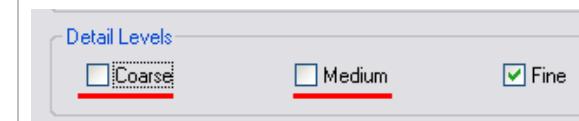
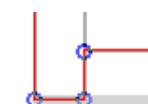
Use the **Trim** tool to clean up the linework to match the images.

29 On the design bar, click **Region Properties**.

Next to **Visibility/Graphics Override**, click the **Edit** button.



Under Detail Levels, clear the



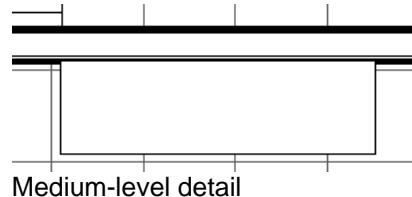
Coarse and **Medium** check boxes.



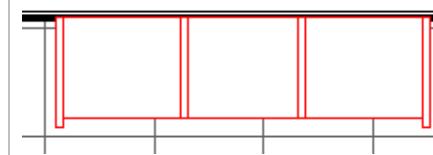
Click OK to return to the drawing window.

30 On the design bar, click **Finish Sketch**.

31 Load the family into a project. Toggle the view detail level between coarse, medium, and fine.

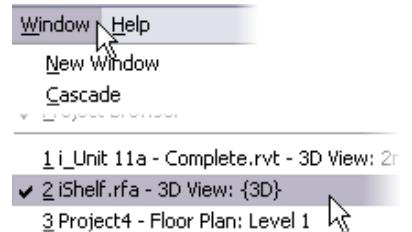


Medium-level detail



Fine-level detail

32 Use the Window menu to change back to the shelf family.



On the File menu, click **Close** to close the family file.

You do not need to save changes. They are already transferred to the project.

33 Save the project if you want.

The remaining exercises in the unit work directly on the shelf family. You can use the family you developed here, or start with the RFA files provided with the exercise data sets.

Exercise 11B: Material Parameters

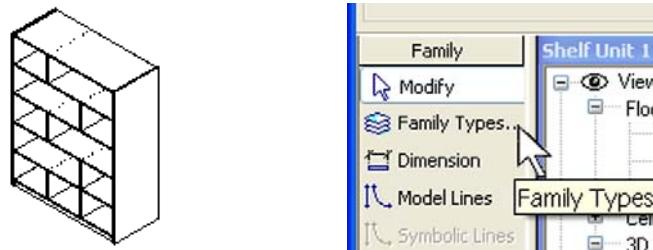
In this exercise you add materials to the shelf.

Although you could assign material directly to the solid extrusions as part of their properties, this definition would be static, lacking the ability to control the materials in the project. Revit Architecture provides a parameter type that enables you to apply materials once the object is in a project. This can be either a type or an instance parameter.

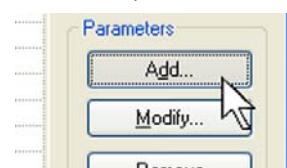
Create New Material Parameters

- 1 Open workbook data sets **m_Unit 11b Shelf -Start.rfa**.

On the design bar, click **Family Types**.



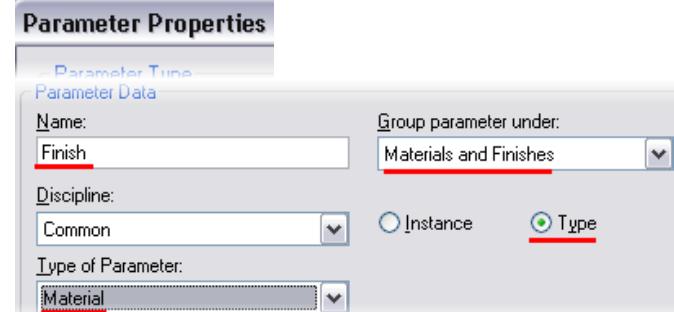
- 2 In the Family Types dialog box, under Parameters, click **Add...**



- 3 In the **Parameter Properties** dialog box, set the following:

- Name = Finish.
- Groups Parameter Under = Materials and Finishes.
- Type = Material.
- Type radio button.

Click OK.



- 4 View the new parameter in the Family Types dialog box.

Click OK to return to the drawing window.

Parameter	Value
Materials and Finishes	
Finish	<By Category>
Dimensions	

The finish parameter is now part of the family definition. At this point it is not assigned to any particular element.

Associate the Family Parameter to the Properties of the 3D

This is a family file in the same folder as the other exercise data files, though it is a family RFA file rather than a project RVT file.

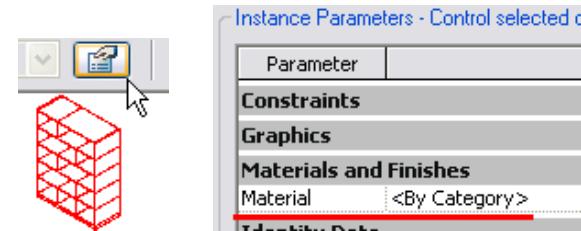
For the moment, your family is fully parametric in respect to its dimensions, but you next add a new type of parameter that allows the user to parametrically change the material associated with the furniture as well. For now, you create just one material parameter to apply to the entire 3D geometry.

If you did not make the finish parameter, then you would not have access to this control once the family was in a project. Only those parameters appearing in the Family Types dialog box are open for editing in a project.

You need to assign this parameter to the solid extrusions.

Geometry

- 5 Select all 3D geometry, and click Properties.

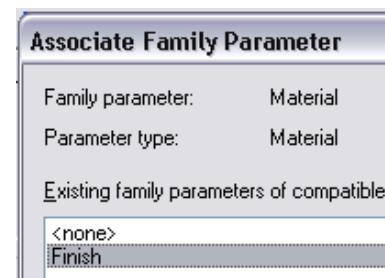


- 6 In the Element Properties dialog box, click the button to the right of Material.



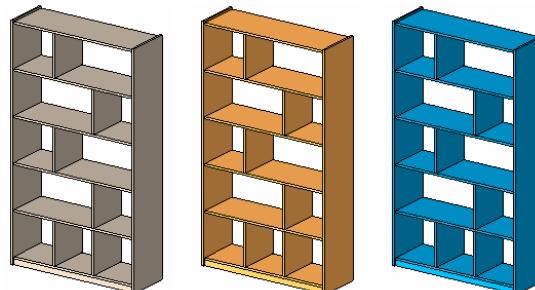
- 7 In the Associate Family Parameter dialog box, select the **Finish** parameter.

Click OK to close each dialog box.



- 8 On the File menu, click **Save**.

Close the family.



The material parameter is a hard-coded property of a solid extrusion. You need to assign to this property the *family* parameter **Finish** that you just created.

If you want, you could create a new material within the Family Editor and associate it as default material of the family. All materials created in the family are going to be automatically created in every project where this family is loaded. If an existing material has the same name, the family material is overwritten. That is why it is advisable to give your materials specific names.

On your own, start a new project and load your family. Insert a few instances of this family in the project and try changing the parameters. Note that all modifications are propagated in all instances of this family. This is because you have defined all family parameters as Type parameters.

Exercise 11C: Visibility Parameters

In this exercise you add glass doors to the shelf unit. You have now worked with two types of parameters. In this exercise you create two glass doors for the shelf unit. You create a new parameter in the family that is a Yes/No parameter type. Yes/No parameters have several uses. In this exercise you assign the Yes/No parameter to the visibility of the glass doors. This enables you to turn them off in a project if you do not want to see them. They are still defined in the family but are not visible.

	Parameter Type	Name	Assigned To	Controls
Exercise 10	Length	Width, Depth, Height	Dimension	Geometry
Exercise 11B	Material	Finish	Solid extrusion properties	Material assigned to the solid
Exercise 11C	Yes/No	Glass Door	Solid extrusion properties	Visibility toggle for element

This exercise continues from the last exercise. If you worked through Exercise 11B, and were successful in both applying materials and manipulating the dimensions parameters, you can continue working on your family in this exercise.

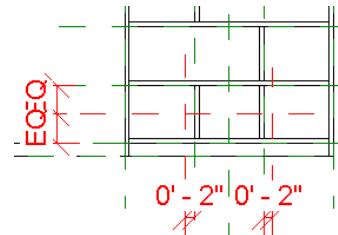
In this exercise you add and constrain new references as well as create solid extrusions and voids. Go back to Unit 10 if you need to review these tasks.

Create Reference Planes for the Door Pulls

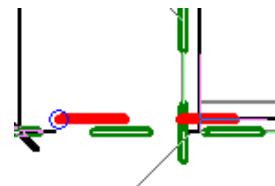
- 1 Open Workbook data sets **i_Unit 11c Shelf - Start.rfa**.

Activate the **front** view.

Add the reference planes and dimensions shown in the image.



- 2 Activate the **Ref. Level (Fine)** view.



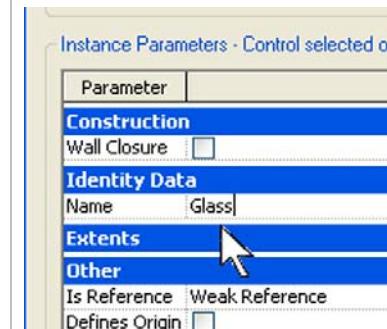
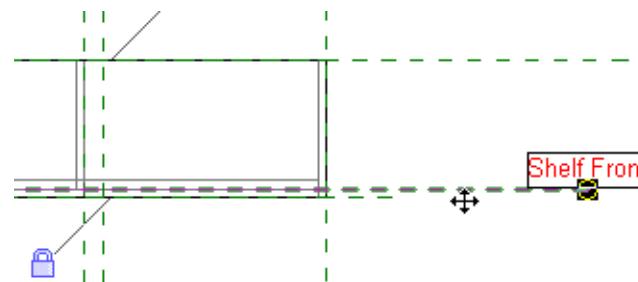
Families recognize logical conditions like Yes/No. You use that to control the visibility of the glass doors within the shelf unit. The next task is to create the geometry of the glass doors.

These reference planes are used to locate the glass door handles later in the exercise.

To facilitate the creation of the glass doors, name one of the reference planes. The effect is to create a work plane on which you can trace your sketch of the doors. Just imagine you are inserting a sheet of paper on which you are simply drawing a sketch.

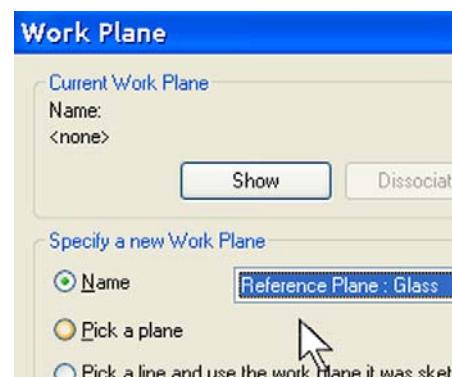
3 Name a working reference level:

- Activate the **Ref. Level**.
- Select the horizontal reference plane that is second from the bottom.
- On the options bar, click **Properties**.
- In the Properties dialog box, change the name to **Glass**.
- Click OK.



4 Start the glass solid extrusion and set the Glass reference plane as the active work plane:

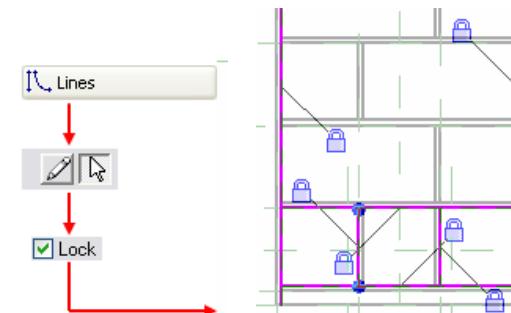
- Activate the **front** view.
- On the design bar, click Solid Form > Solid Extrusion.
- On the design bar, click **Set Work Plane**.
- In the Work Plane dialog box, select **Glass** from the **Name** list.
- Click OK.



5 On the design bar, click **Lines**.

On the options bar, click **Select** and select the **Lock** check box.

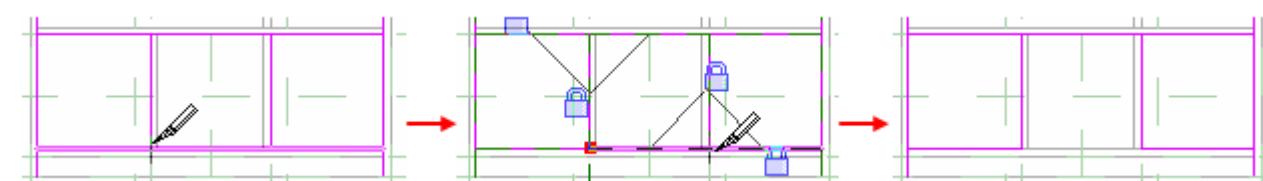
Click the lines that form the first shelf, as shown.



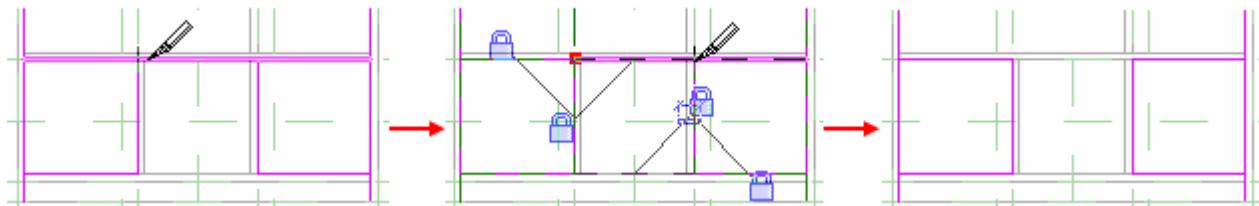
For a sketch to be valid for an extrusion, it should not have T intersections and its lines must be in a closed loop. Since this is not the case for your sketch, you need to fix it.

6 On the Tools toolbar, click the **Split** tool.

On the options bar, click **Delete Inner Segment**. Click the bottom line at the intersection of the two middle vertical lines.

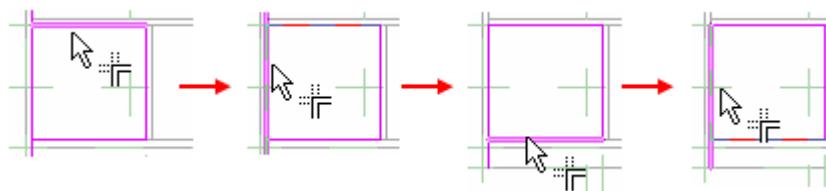


7 Repeat for the line above.

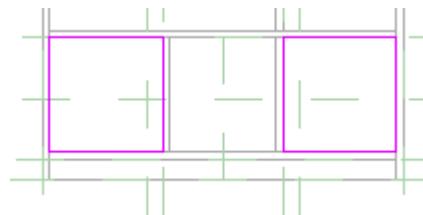


8 Click **Trim**.

Set the trim mode to **Trim/Extend to Corner**.

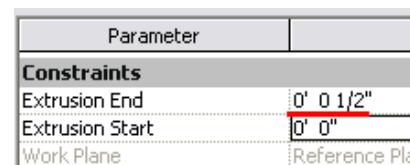


9 Repeat for the other side.



10 Set glass thickness and visibility:

- On the design bar, click **Extrusion Properties**.
- Set **1/2"** for the Extrusion End (glass starts on the interior side of the furniture).
- Click the **Edit** button next to Visibility.
- Clear the **Plan/RCP** check box, as well as **Front/Back** (doors are *not* displayed in the plan or elevation view).
- Click OK to return to the Element Properties dialog box.

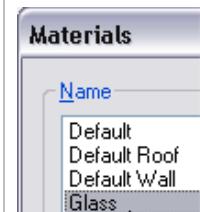


The value positive or negative when drawing an extrusion from a reference plane depends on the direction you first drew the reference plane (right to left or left to right).

If you get it wrong here, you can always change it after you are finished with the sketch, by looking at the extrusion properties.

11 Assign material to the solid extrusion:

- Next to Material, click the <By Category> box, and click the box that appears inside it.
- In the Materials dialog box, select **Glass**.
- Click OK to close each dialog box.



When you assign a material in this way, the material is static. You cannot assign a different material to the element placed in a project.

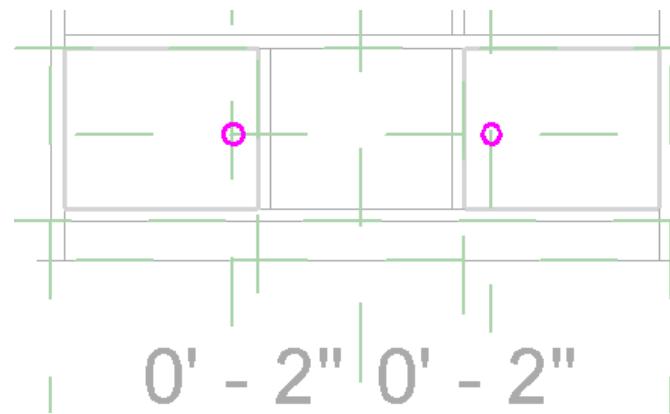
12 On the design bar, click **Finish Sketch**.

Save the file (File > Save).

Create Pulls for the Glass Doors

13 Create the solid form sketch lines:

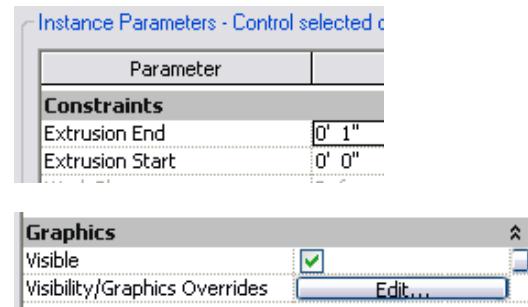
- Click Solid Form > Solid Extrusion.
- On the design bar, click **Set Work Plane**. In the dialog box make sure that the active work plane is set to **Glass**.
- Select **Lines**, and on the options bar, click the **circular** shape. Activate the Radius and set it to **3/4"**.
- Add two circles, as shown on the right. Note that the center of insertion is the intersection point of the reference planes.



14 Set extrusion thickness and visibility:

- On the design bar, click **Extrusion Properties**.
- Set 1" as the extrusion end.
- Click the **Edit** button next to **Visibility** and clear **Plan/RCP**.
- Under Detail Levels, select only **Fine** (knobs are visible only in a Fine level of detail).

Click OK to close each dialog box.

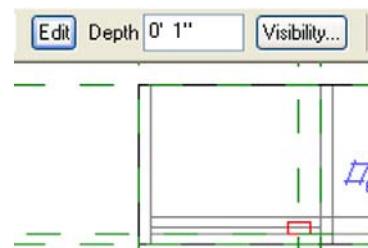


15 Finish the solid form:

On the design bar, click **Finish Sketch**.

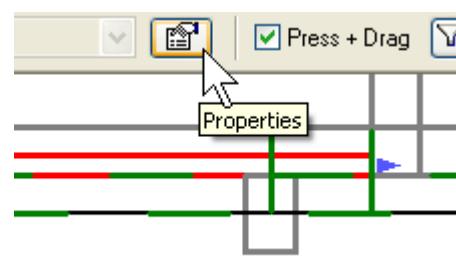
16 Reverse the extrusion:

- Set Floor Plans: Ref. Level current.
- Select **Pulls**.
- On the options bar, set Depth = **-0 1"** (negative).

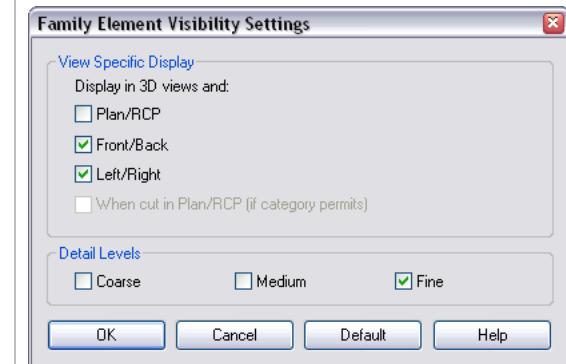


Depending on the direction you originally drew the reference plane Glass, your glass or pulls may be extruded to the wrong side. If so:

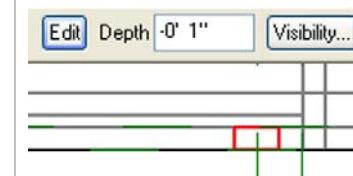
- Select inverted element.
- On the options bar, click **Properties**.
- Set Depth** = (Change the value from negative to positive or vice versa).
- Click OK.

17 On the File menu, click **Save** (make it a habit to save your work often).

Flex your family to test it.



Thus you are exiting Sketch mode, and you have finished creating the 3D object

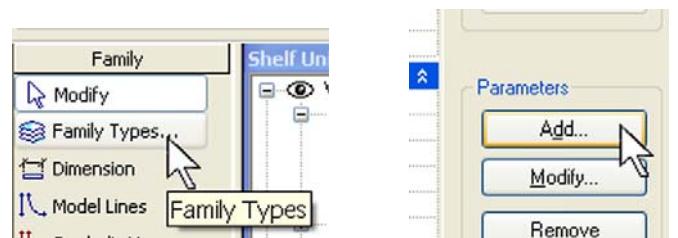


Assumptions about the start and end of the extrusions were opposite because the reference plane was drawn from left to right. A negative value extrudes toward the viewer, and a positive value extrudes away.

Create a Display Control Yes/No Parameter

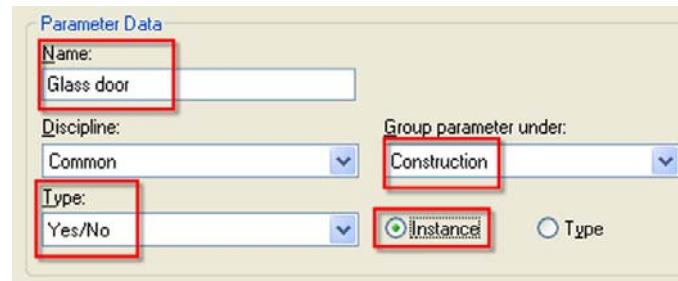
- 18 On the design bar, click **Family Types**.

In the dialog box, under Parameters, click **Add**.



- 19 In the Parameter Properties dialog box, set the following:

- Under Name, enter **Glass Door**.
- Group Parameter Under: **Construction**.
- Under Type, select **Yes/No**.
- Click **Instance** (parameter can vary from one piece of furniture to another).



Click OK to return to the Family Types dialog box.

- 20 Verify that the parameter now exists as a family parameter.

Click OK to return to the drawing window.

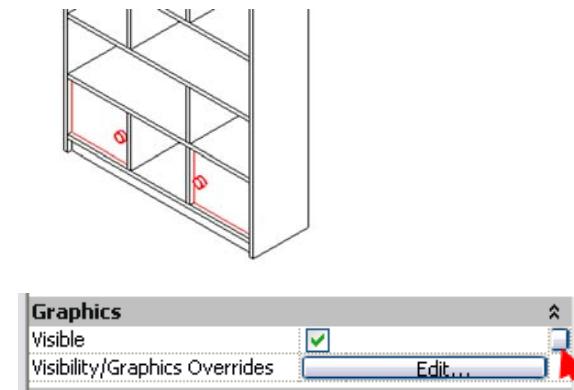


In this section you create an instance Yes/No parameter and assign the glass door and the pulls to this parameter, enabling you to turn off these elements per instance when loaded into a project.

The glass door parameter appears, ready to be assigned to the visibility of an element.

A checked box means show element, and a cleared box means hide.

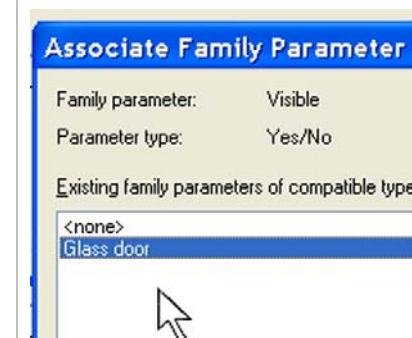
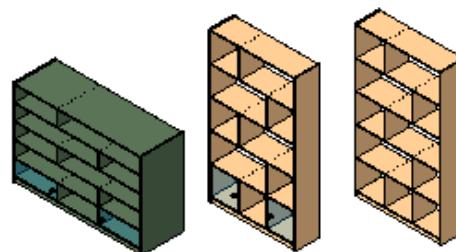
- 21 Assign the glass door visibility parameter to the doors and pulls:
- Select the glass doors and pulls, and click **Properties**.
 - In the Element Properties dialog box, click the gray button at the right end of the **Visibility/Graphics Overrides** line. This button enables you to link one parameter to one property.
 - In the Associate Family Parameter dialog box, select **Glass Door**.



Click OK to close each dialog box.

- 22 Save your work again.

To verify functioning of this parameter, load the family in a project.



Start a new project, load your family, insert a few instances of the family in the project, and try modifying the parameters. The new, added parameter lets you control visibility of the glass doors and the doorknobs per instance. Try changing to different levels of detail in 3D view. The doors and knobs should display only in a Fine level of detail. Try also changing the level of detail in plan view. There, regardless of the level of detail, the doors and knobs should *not* display.

Exercise 11D: Nested Families

In this exercise you add drawers to the shelf unit. To create the drawers you first create a new furniture family and build a single drawer in it. You load this drawer family into the shelf unit family, “nesting” the drawer family in the shelf unit file.

To finalize your family, you add two drawers in the opening between the glass doors. Instead of modeling it in the shelf unit family, you create a new family for the drawer and then insert it in this one as a nested family. The width of this interior space is determined by the overall width of the family type—or the width parameter. You create formula-type parameters that are based on the depth, width, and height parameters of the shelves and pass these parameters through to the nested drawer family.

However, first things first: let's create the drawer family.

Note that the description for creating the drawer is less detailed than the previous one. If necessary, refer to the initial creation of the shelf unit to review the processes.

Roughly, this exercise breaks down into the following sections:

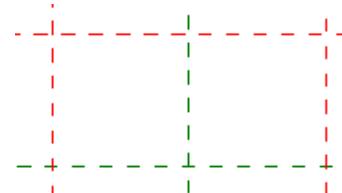
- Create a drawer family. This is a new family that you create.
- Create a drawer shelf. This takes place in the shelf unit family and is a review of the Unit 10 exercise.
- Create drawer parameters in shelf unit family. These drive the geometry of the nested drawer family.
- Create formulas for the drawer parameters within the shelf unit family. The formulas perform arithmetic operations on other family parameters.
- Load, place, and position a drawer. You can load families to use inside other families as components.
- Link parameters from the shelf unit family to the drawer family.

Create a Drawer Family

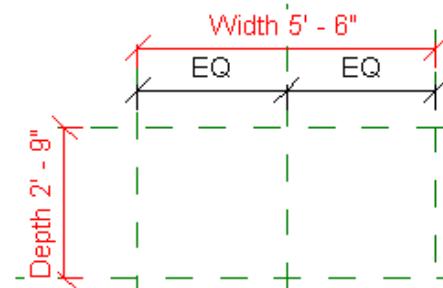
- 1 On the File menu, click **New > Family**.
Select the **Furniture.rft** family template.

Click **Open**.

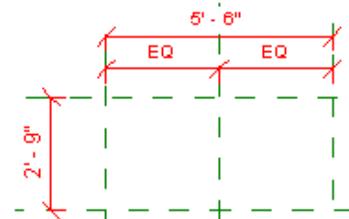
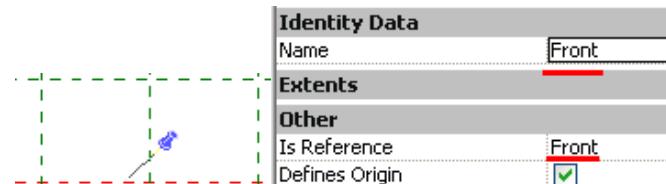
- 2 Add plan reference planes, and dimension:
 - Activate the **Ref. Level** view (project browser, Floor Plans).
 - Add three reference planes, as shown.
 - Add dimensions, as shown.



- 3 Convert the dimensions to labels (type parameters), as shown.



- 4 Select the lower horizontal reference plane, and in its properties select:
 - Name = Front.
 - Is Reference = Front.



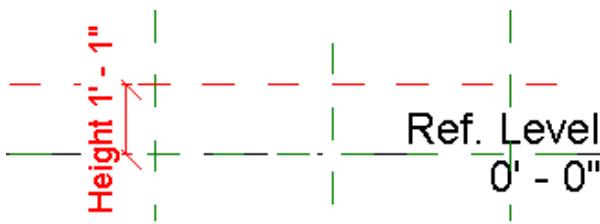
For equating parameters to dimensions see Unit 10.

5 Activate the front view:

- Add another reference plane above the existing one.
- Add a dimension between the two horizontal reference planes.

Associate the dimension with a new parameter **Height**:

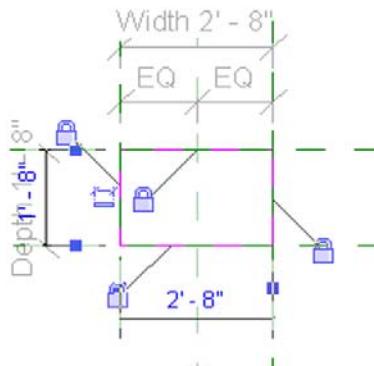
- Group = Dimensions.
- Type parameter.



6 Activate the **Ref. Level** view.

Add a solid form using the extrusion method:

- Draw with the rectangle sketching tool.
- Lock all sides to the reference planes.



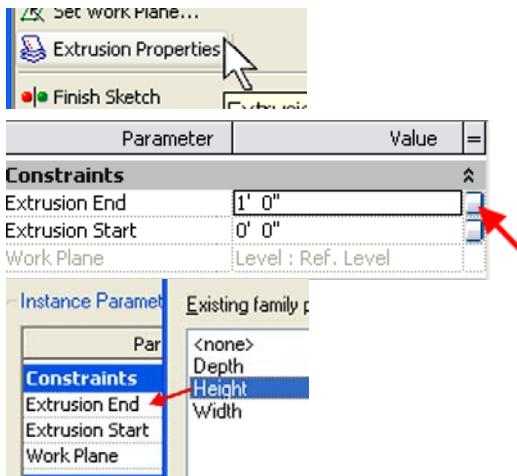
At this stage do *not* click Finish Sketch.

7 On the design bar, click **Extrusion Properties**.

8 In the Element Properties dialog box, click the gray rectangle on the **Extrusion End** line.

Select the **Height** parameter.

Click OK to close each dialog box.



9 Click **Finish Sketch**.

Note that as you hold the cursor over an intersection of two reference planes, one or both of the reference planes are highlighted. If only one reference plane is highlighted, move the cursor slightly until both reference planes are highlighted. Then click the intersection. If you do this with both corners of the rectangle, the locks automatically appear.

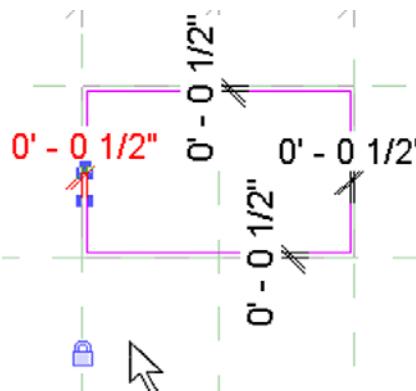
You have just constrained the depth of the solid to the family's height parameter.

Constraints	
Extrusion End	1' 1"
Extrusion Start	0' 0"

The extrusion end (depth) is now dimmed because it is being driven by the height parameter. There is an equal (=) symbol here to let you know this has been assigned to a different parameter.

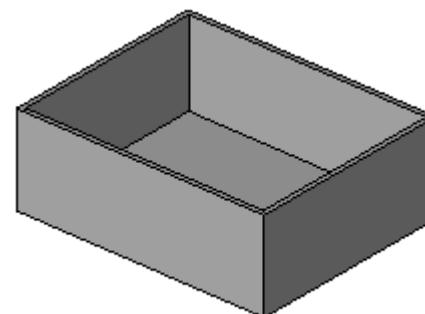
- 10 Create a void to cut away the inside of the box:
- On the design bar, click **Void Form > Void Extrusion**.
 - Draw a rectangle on the interior side of the existing solid.
 - Using the **Dimension** tool, lock the edges of the void to the reference planes (fix the distance to **1/2"**).

At this stage do *not* click Finish Sketch.



- 11 Just as in the previous case, in the Extrusion Properties dialog box, associate the extrusion end to the height parameter and set the extrusion start to **1/2"**.

This is the thickness of the bottom of your drawer. You can see this better in the front or 3D view.



Finish the sketch.

- 12 Create a void for the pull:
- Activate the front view.
 - On the design bar, click **Void Form > Void Extrusion**.
 - Add a new sketch. This time it is a circle cutting out the opening spot for the drawer. Draw the circle as shown on the right.

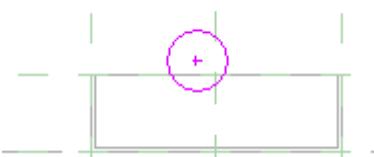
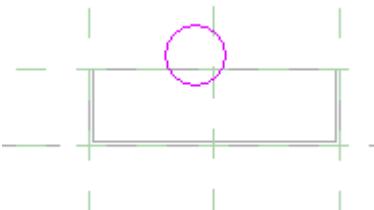
Don't click Finish Sketch yet.

- 13 Click the **Modify** tool.

Right-click the circle. Click **Element Properties**.

Select the **Center Mark Visible** option.

Click OK.

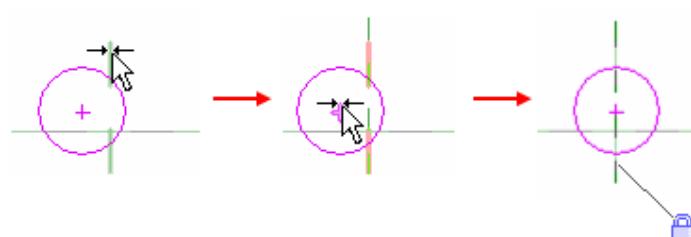


It is a good practice to dimension to the reference plane rather than the geometry of the previous solid form.

You need to assure that this sketch remains aligned to the axis of the drawer width and that its vertical position doesn't change either. To facilitate aligning a circle, it is recommended that you activate the **Center Mark Visible** option and use it as a reference point for constraining.

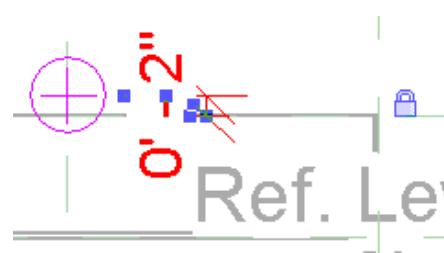
Note the cross in the middle of the circle. It is from this point that you define constraints to the reference planes.

- 14 Using the **Align** tool, align and lock the circle to the central reference plane.



- 15 Add a dimension between the reference plane that defines the height of the drawer and the center of the circle.

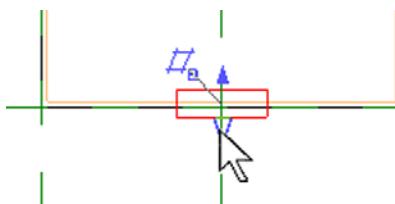
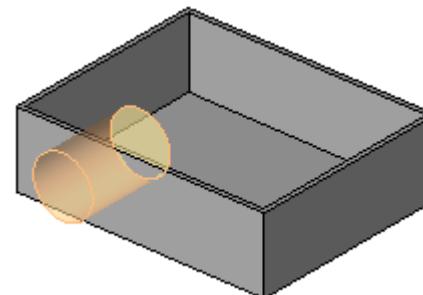
Set the distance to **2"** and lock it.



- 16 In the Extrusion Properties dialog box, set the Extrusion Start to 0.

Click OK.

Click **Finish Sketch**.

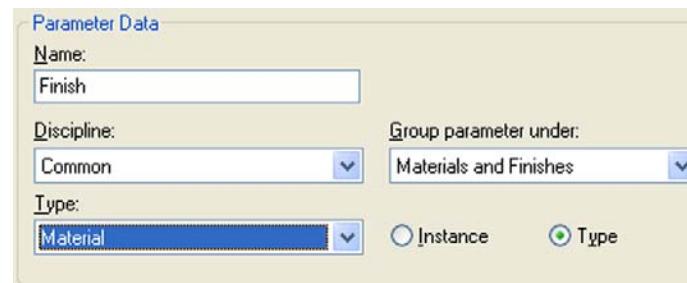


- 17 Open the **Ref. Level** view and select the void. Select the upper blue point and start sliding it toward the interior of the drawer. Lock that position. Lock the bottom triangular grip to the front face of the drawer.

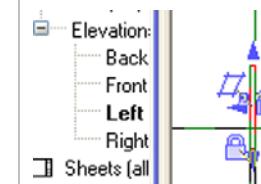
- 18 Finally, in the Family Types Dialog box, add a new Material parameter. Name it Finish. Associate the entire 3D geometry to it.

Flex the model to test the work you have done. Try out different values for width, height, depth, and so forth.

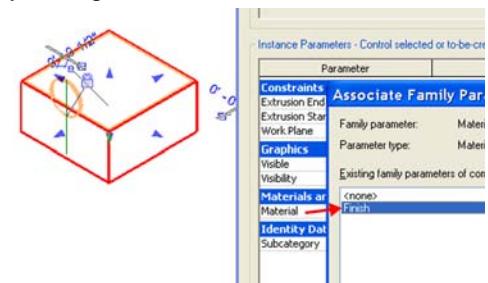
On the File menu, click **Save As**, and save the family as *Drawer.rfa*. Close this file.



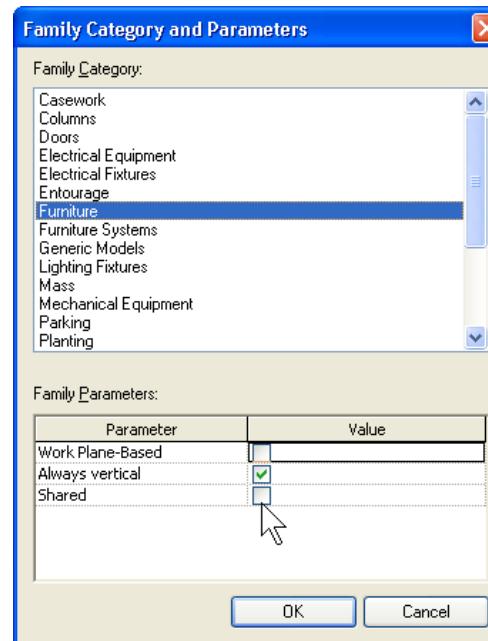
The extrusion is heading the wrong direction. You need to fix that problem.



If you have difficulty doing this in plan view, try the right or left.



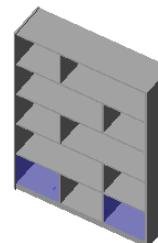
Note that a nested family can also be a shared family. Make a shared family by clicking Family Categories and Parameters on the Settings menu.



The drawer family is now ready to be inserted in the furniture family, but you need to make a few adjustments to the shelf. You are missing a small shelf that is positioned between the two drawers when placed in the opening.

Create Drawer Shelf in Shelf Unit Family

- 19 Open workbook data set **i_Unit 11 d Shelf – Start.rfa**.



There are no parameters in the big family that define the width, depth, and height of the drawer.

You can resolve the first problem using the same techniques you used to create the shelf unit as well as the drawer. The second problem requires formulas to help calculate the values of the drawer parameters.

By selecting the Shared box, you change the behavior of the nested family when it is loaded into a project. When a nested family is shared:

- You can load the family directly into a project to update all families that have that nested family.
- You can schedule the nested family even though it resides within a different family.

You create three new parameters:

- $\text{Drawer Width} = (\text{total width} / 3) - (\text{2} \times \text{thickness of the separation panel})$
- $\text{Drawer Height} = (((\text{total height} - 5") / 5) / 2) - 1 \times \text{shelf thickness}$
- $\text{Drawer Depth} = \text{total depth} - 1"$

The Unit 11D Shelf – Start.rfa is the end product of Exercise 11C. Use this as a starting point, or continue with a shelf unit you have tested in a project.

Now add the separation shelf between the two drawers. To review how to do that, see Unit 10.

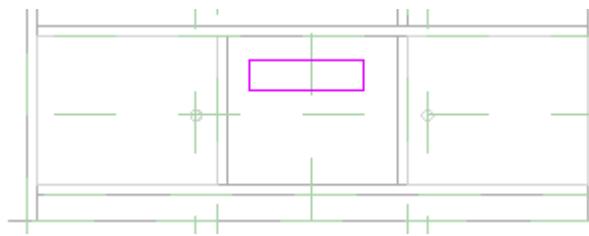
20 Activate the front view.

On the design bar, click **Solid Form > Solid Extrusion**.

Double-check that the active work plane is set to **Back**.

Add a rectangular sketch in the upper part of the empty middle shelf, as shown in the drawing on the right.

21 Align the sketch and lock, as shown.



22 Add a dimension for the shelf thickness.

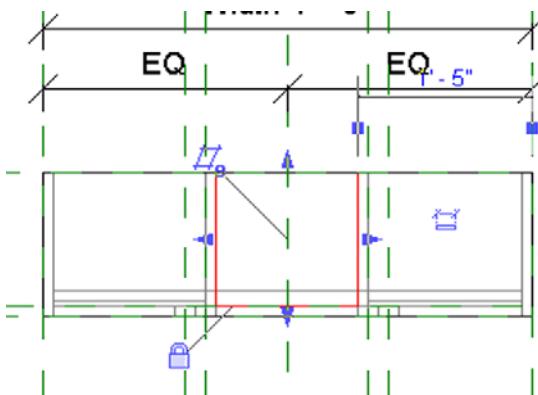
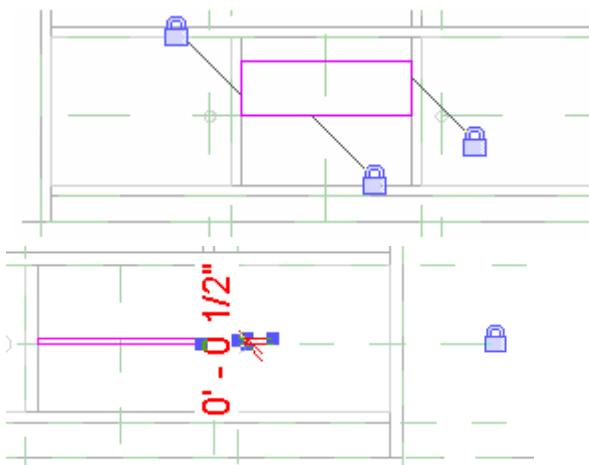
Select the dimension chain, set it to $1/2"$, and confirm.

Lock this dimension.

Click **Finish Sketch**.

23 Open the **Ref. Level (Coarse – Medium)**, select the 3D geometry, and using the blue arrow in the front, align it to the second reference plane from the bottom (see image).

Lock it to that position.



- 24 In the Properties dialog box for this geometry:
- Associate the family parameter **Finish** to element parameter **Material**.
 - Click the **Edit** button next to Visibility/Graphics Overrides, and clear Plan/RCP.

Click OK to close each dialog box and return to the drawing window.

Create Drawer Parameters in Shelf Unit Family

- 25 On the design bar, click **Family Types**.

Under Parameters, click **Add** and set the following:

- Name = Drawer Width.
- Group Parameter Under = Dimensions.
- Type = Length.
- Click Type.

Click OK to return to the Family Types dialog box.

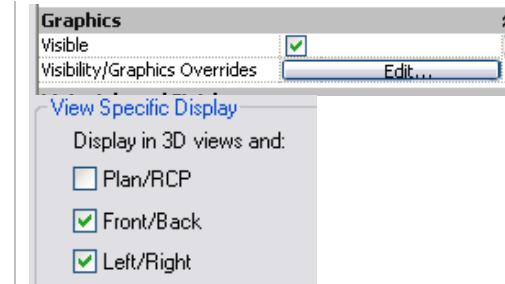
- 26 Under Parameters, click **Add** and set the following Drawer Height parameter:

- Name = Drawer Height.
- Group Parameter Under = Dimensions.
- Type = Length.
- Click Type.

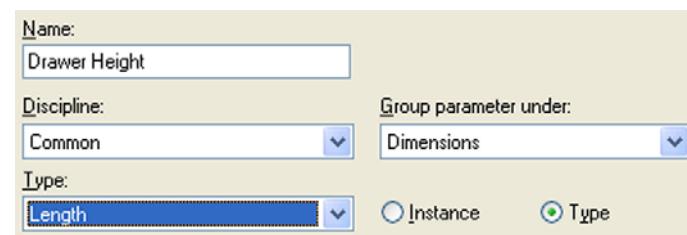
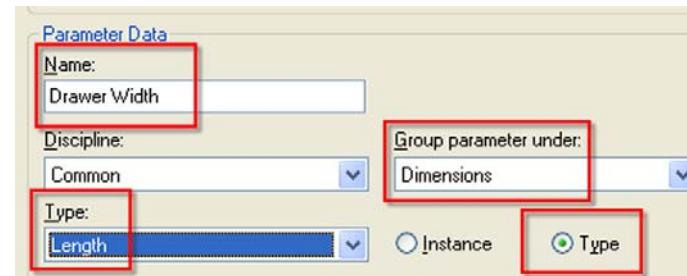
Click **OK** to return to the Family Types dialog box.

- 27 Under Parameters, click **Add** and set the following Drawer Depth parameters:

- Name = Drawer Depth.
- Group Parameter Under = Dimensions.
- Type = Length.
- Click Type.



Everything is ready to embrace the new nested family. The next step is to load the family you want to nest and correctly link its parameters to the parameters of the shelf unit.



Click OK to return to the Family Types dialog box.

- 28 Verify the parameters in the Family Types dialog box.

Click OK to return to the drawing window.

Dimensions		
Width	4' 0"	=
Height	6' 0"	=
Drawer Width	0' 0"	=
Drawer Height	0' 0"	=
Drawer Depth	0' 0"	=
Depth	1' 2"	=

Identity Data		
---------------	--	--

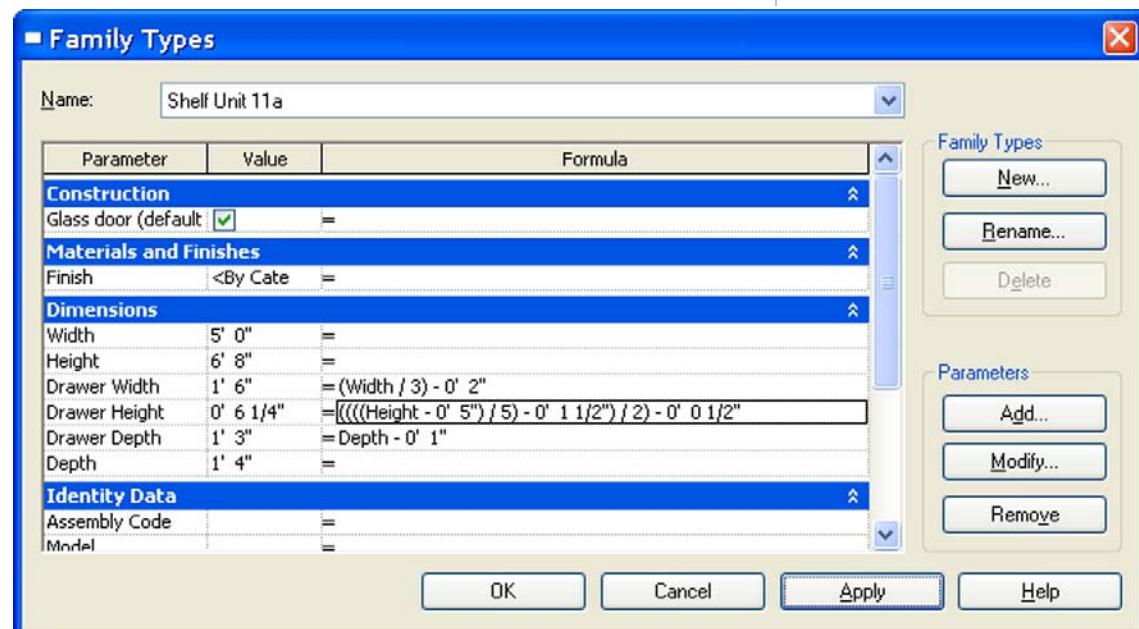
The parameters have been created and are available for use.

Create Formulas for the Drawer Parameters

- 29 Now, in the Family Types dialog box, in the lines of Drawer Depth, Drawer Height, and Drawer Width, enter the formulas as shown in the image.

For Revit Architecture to process the formulas you have just entered, it is necessary to respect case (for Revit Architecture, width isn't the same as Width). The unit of measure is automatically added when you confirm your formula, so it's not necessary to enter it.

Click OK to confirm all.



Note that you can click Apply to test your formulas as you create them.

- 30 Click OK to return to the drawing window.

Save the family.

Load, Place, and Position a Drawer

Type the formula, and click Apply. If everything is correct, the calculated width shows up in the Value column. Revit Architecture alerts you to any errors.

Change the base values such as width and height, keeping an eye on the resultant drawer width and drawer height.

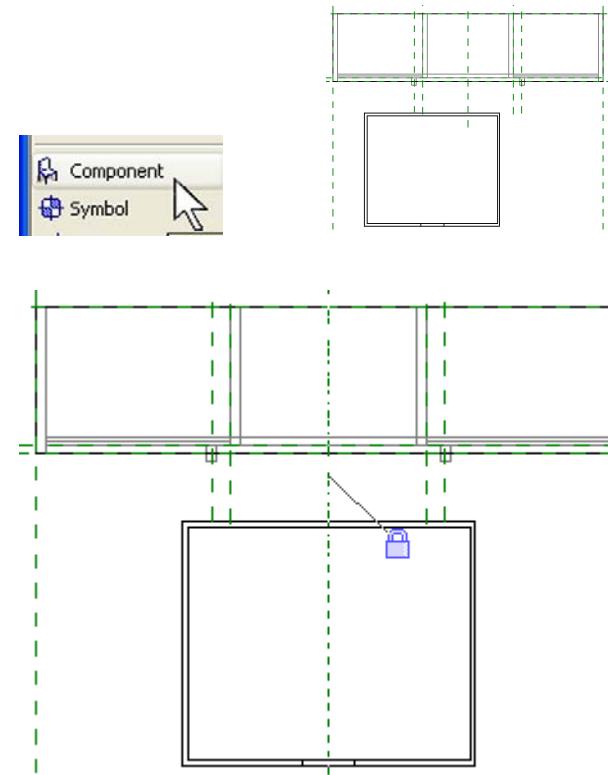
In this section you nest the drawer family into the shelf unit family.

31 Load the drawer family into the shelf family:

- On the File menu, click **Load from Library/Load Family**.
- Browse to find the drawer family (you have to remember where you saved it).
- Click **Open**.

32 Place an instance of the drawer in the shelf unit family file:

- Set the Ref. Level view current.
- On the design bar, click **Component**.
- Click anywhere in the drawing area to insert one instance of the drawer family in the shelf unit.



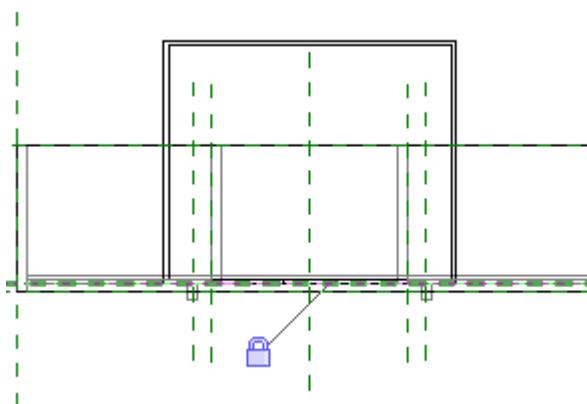
33 Using the **Align** tool, do the following:

- Click the center reference plane.
- Click the axis of the drawer and lock this alignment.

When you place the cursor in Align mode over the axis of the drawer, Revit Architecture displays a thick black line indicating the reference plane of the drawer family.

- 34 Align the front of the drawer to the second reference plane from the bottom (see image).

Lock this alignment as well.

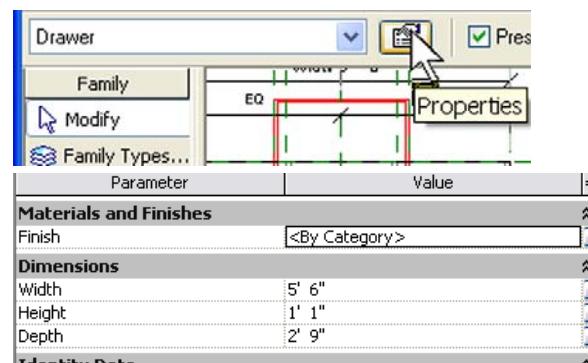


Link Parameters from the Shelf Unit Family to the Drawer Family

- 35 On the design bar, click **Modify** and select the drawer.

On the options bar, click **Properties**.

- 36 In the Element Properties dialog box, click **Edit/New** to view the type properties of the element and thus the drawer parameters.



For a perfect match of the drawer family in the shelf unit, you need to link the parameters of both families.

The element properties are the same properties you would expect to see if you loaded this family into a project.

- 37 Click the small gray box in the Depth line.

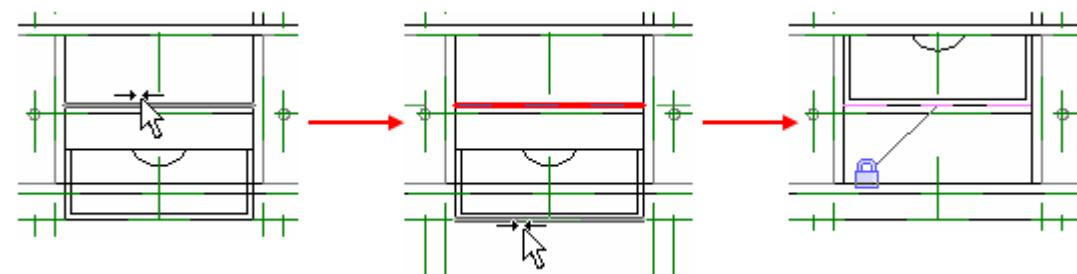
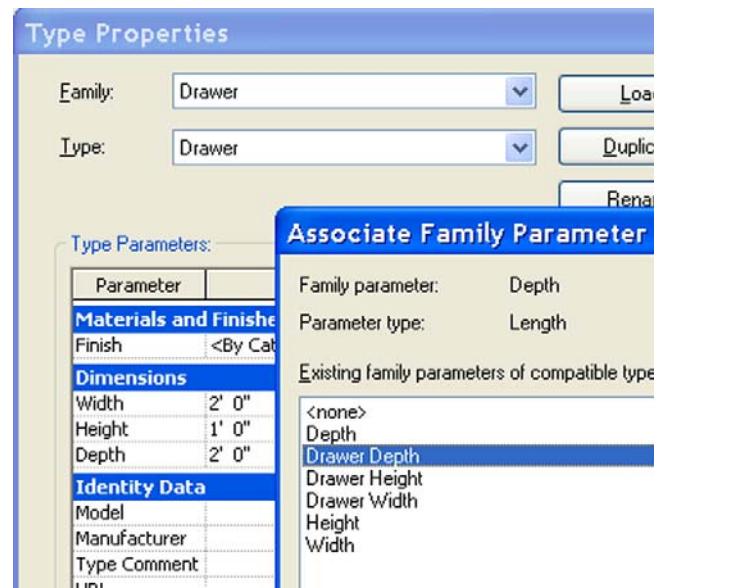
In the Associate Family Parameter dialog box select **Drawer Depth**.

Click OK.

Repeat for all three parameters and associate them as follows:

- Width = Drawer Width.
- Height = Drawer Height.
- Finish = Finish.

Click OK to close each dialog box.



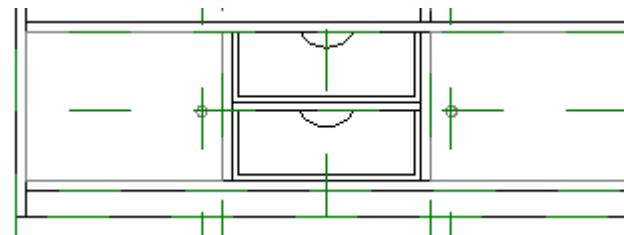
- 38 Activate the front view. Using the **Align** tool, align and lock the drawer in the upper empty space.

If you have trouble selecting the lower line of the drawer, just position your cursor near that line and press **TAB** until that line is activated, and then click to select it. (TAB is a great help whenever you have overlapping geometry.)

- 39 Switch to the **Ref. Level** view and repeat the same method to insert, align, and lock the second drawer.

Switch to the front view, and repeat, aligning and locking the second drawer vertically.

Test the family by flexing the model.



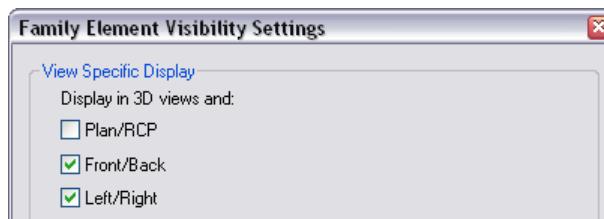
Use the small gray boxes at the far right end of the width, depth, height, and finish parameters to make the link between the parameters.

Because all drawer parameters are type parameters, you do not need to repeat the same for the second drawer. The new drawer instance automatically inherits the instance properties of the existing one. All you need to do is align it in plan view and in elevation.

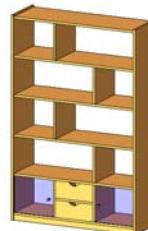
- 40 Select both drawers. On the options bar, click **Visibility**.

Clear **Plan/RCP**.

Click OK.



- 41 Save your file.



If you are daring, try copying the drawer in elevation instead of reinserting it in plan view. Can you get all the alignments in this front view?

You are almost finished with your family. But before you use it in a project, you might want to add subcategories. With subcategories, you can control the entire display of the family in all views (line thickness, line color, line style, material, and so forth).

Exercise 11E: Subcategories and Families

The family category was defined when you selected the template to make it with. You can change this template later, but it is *not* advisable to do so. Always make sure to select the correct template when you create a new family. Next, you set new subcategories within your family.

Create Subcategories of the Furniture Category

This exercise builds on work performed in previous exercises. If you have not completed the previous exercises, but want to work through this exercise on subcategories and families, then open workbook data set [i_Unit 11e Shelf – Start](#).

- 1 On the Settings menu, click **Object Styles**.

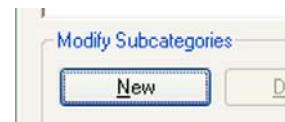
Scroll down to the Furniture category. By default there are two predefined subcategories: Hidden Lines and Overhead Lines. You need three new subcategories:

- Glass
- Shelf
- Accessories

Object Styles					
Category	Line Weight		Line Color	Line Pattern	Material
	Projection	Cut			
Furniture	1		■ Black	Solid	
Hidden Lines	1		■ Black	Dash	
Overhead Lines	1		■ Black	Long dash	

2 Click **New**.

- Enter **Shelf** for Name.
- Under Subcategory Of, select **Furniture**.



New Subcategory

Name:
Shelf
Subcategory of:
Furniture

Click OK.

3 Repeat the operation for Glass and Accessories.

	Furniture	1	Black	Solid
	Accessories	1	Black	Solid
	Glass	1	Black	Solid
	Hidden Lines	1	Black	Dash
	Overhead Lines	1	Black	Long Dash
	Shelf	1	Black	Solid

- For each subcategory, you can set whatever line thickness, color, or material you want. The material is assigned to the family subcategories only if under the Finish parameter the value is set to <By Category>. Here, you simply change the color of one of the subcategories.

4 In the Object Styles dialog box, in the Shelf line, click the **Line Color** button.

Select any color from the Color dialog box.

Click OK.

Category	Line Weight		Line Color
	Projection	Cut	
Furniture	1	Black	Black
Accessories	1	Black	Black
Glass	1	Black	Black
Hidden Lines	1	Black	Black
Overhead Lines	1	Black	Black
Shelf	1	Black	Blue

5 To see just the symbolic lines, activate the **Ref. Level (Fine)** view. Using the Hide/Isolate tool, hide:

- Reference planes.
- 3D geometry.
- Nested families.

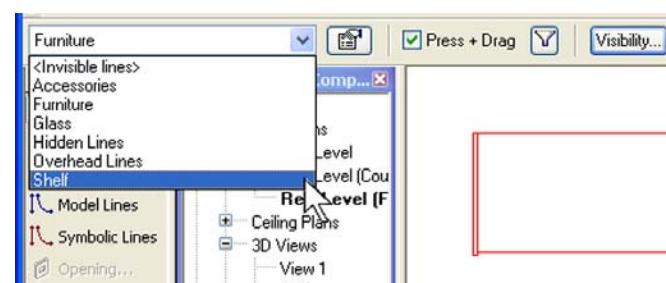
Select all these lines.

On the options bar, use the Type list to change the lines to **Shelf**.

Assign Subcategories to Mask Objects

6 Set the **Ref. Level (Fine)** view current.

Hover your cursor over the edge of the



The masking objects within the family cannot be directly assigned a category in this manner, but must be assigned a subcategory in Edit mode.



shelf.

Press **TAB** until you see masking object appear in the tooltip or at the status bar.

Left-click to select the masking region.

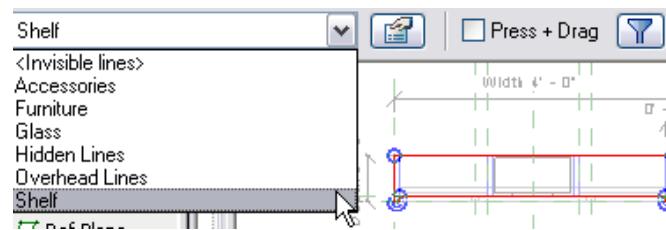
- 7 On the options bar, click the **Edit** button.

Select all the linework. Use the Type list to change the subcategory of these lines to Shelf.

Click **Finish Sketch**.

Repeat for the Coarse detail masking region.

Assign Subcategories to Solid Extrusions



In principle, you can use the same method for both 2D and 3D, though the process is a bit different. For example, when you select a 3D solid, you cannot select the subcategory from the options bar Type list. Instead you must open the element properties for each solid and assign the subcategory there.

- 8 In a 3D view, select the glass doors.

On the options bar, click **Properties**.

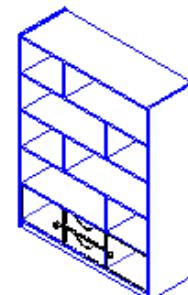
Under Identity Data, set the Subcategory to **Glass**.

Identity Data	
Subcategory	Glass
Solid/Void	Solid

Click OK to close each dialog box and return to the drawing window.

- 9 Repeat, assigning the following elements to their associated subcategories.

- For all vertical separations, horizontal shelves, and the plinth, associate the Shelf subcategory.
- For the doorknobs, click Accessories.

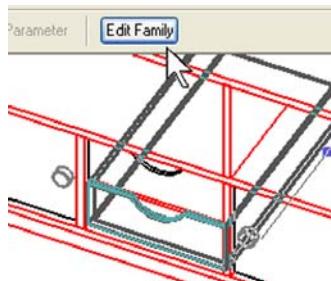


Save the family.

Use In-Place Family Editing to Modify the Drawer Family

- 10 Select a drawer, and on the options bar, click **Edit Family**.

Click **Yes** to open the family for editing.

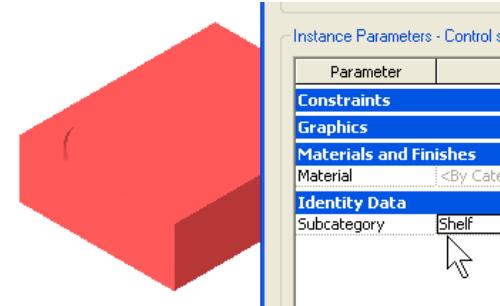


- 11 On the Settings menu, click **Object Styles**.

Create a new subcategory **Shelf**.

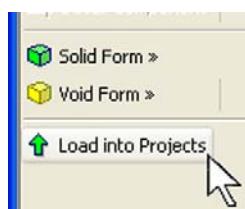
Model Objects		Annotation Objects	Imported Objects
Category	Line Wt	Projection	
Furniture	1	1	<By Category>
Shelf	1		

- 12 Associate the entire geometry to this subcategory.



- 13 On the design bar, click **Load into Projects**:

- Check the current shelf family you are working on.
- Click OK.
- Select Override Parameter Values of Existing Types.
- Click **Yes** to overwrite.



Follow the same process you used in an earlier exercise to access the drawer family and modify the shelf in the project file.

As for the drawers, if you have tried associating a subcategory to them, you may notice that there is no subcategory parameter in their properties. The reason is that the drawers are nested families. So, go back to the drawer family to do this.

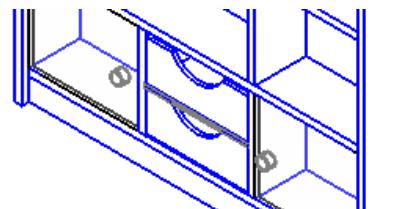
In the next step you create a subcategory in the drawer family called Shelf (same as the subcategory in the family file). All geometry uses the existing shelf definition once it is loaded back into the family file.

Alternatively, you could create a subcategory called Bin. In this case, when loaded into the shelf family, it would bring this subcategory with it and you would then have direct control over this subcategory in the shelf unit family file. Likewise, when you load the shelf unit into a project, it brings all the subcategories, including Bin. You would then have access to this subcategory in the project file.



- 14 Close the **Drawer** family.
Click **No** at the Save Changes prompt.
- 15 You should now be back at the shelf unit family.
Save the family.

You can save the changes if you want. If you do so, the software tries to locate where the original drawer family file came from when it was loaded into the family.



Create Types

The family is finished and is fully parametric. What you still can do is create types. In other words, you can preset different types of this family with predefined parameters such as width, depth, height, and material.

- 16 On the design bar, click **Family Types** and then click **New**.

As a name for the new type, enter **3'w x 5'h x 14"d with Doors**.

Click OK.



- 17 Change the corresponding values in the **Family Types** dialog box.

Repeat, creating a new type **4'w x 6'h x 2'd Without Doors** and adjust the parameters to:

- Width (4').
- Height (6').
- Depth (2').
- Clear the Glass Door check box.

Click OK.

On the File menu, click **Save**.

Parameter	Value	=
Construction		
Glass Door	<input checked="" type="checkbox"/>	=
Materials and Finishes		
Dimensions		
Width	3' 0"	=
Height	5' 0"	=
Drawer Width	0' 10"	= (Width / 3) - 0' 5"
Drawer Height	0' 4 1/4"	= (((Height - 0' 5")
Drawer Depth	1' 1"	= Depth - 0' 1"
Depth	1' 2"	=

You do not need to save because the changes have already been loaded into the shelf unit family.

The drawers assume the properties of the shelf subcategory defined in the shelf unit family.

With types predefined, the shelf unit can automatically be inserted in various standard sizes or materials, enabling users to simply select the type from a list. Should the type not be found on that list, the user can always create it on the fly. This section shows how to do that.

Name:	4'w x 6'h x 2'd Without Doors	
Construction		
Glass Door	<input type="checkbox"/>	
Materials and Finishes		
Dimensions		
Width	4' 0"	=
Height	6' 0"	=
Drawer Width	1' 2"	= (Width / 3) - 0' 2"
Drawer Height	0' 5 11/2"	= (((Height - 0' 5")
Drawer Depth	1' 11"	= Depth - 0' 1"
Depth	2' 0"	=

18 Start a new project or open an existing one. Load the new shelf unit family and insert a few instances of it in the project. Note that in the unit's Properties dialog box under Type, you see two different predefined types of this family.

19 Within a project file, change both the instance parameters (Glass Door) as well as the type parameters (width, height, and so forth). Remember that you do not see the door pulls unless the view is set to Fine.

20 Activate **Level 1** plan view.

Right-click inside the drawing window. Click **View Properties**.

Click the **Visibility/Graphics Override Edit** button.

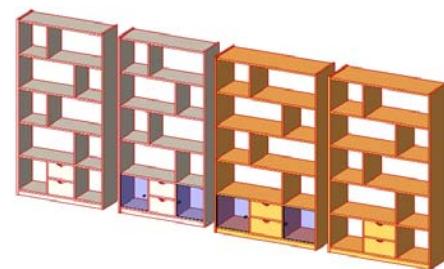
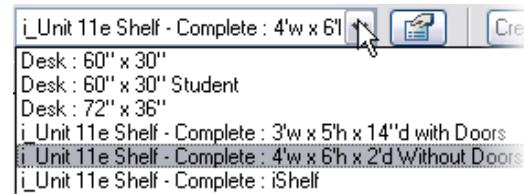
Expand the **Furniture** category.

21 Click the empty box in the Projection Surface – Lines column in the Shelf line to override.

Change the Line Color and the Line Pattern.

Click OK.

22 Make sure the changes you have just made are propagated correctly.



Category	Visibility	Projection	
		By Category	Override...
<input checked="" type="checkbox"/> Floors		By Category	
<input checked="" type="checkbox"/> Furniture		By Category	Override...
<input checked="" type="checkbox"/> Accessories		By Category	
<input checked="" type="checkbox"/> Glass		By Category	
<input checked="" type="checkbox"/> Hidden Lines		By Category	
<input checked="" type="checkbox"/> Overhead Lines		By Category	
<input checked="" type="checkbox"/> Shelf		By Category	
<input checked="" type="checkbox"/> Furniture Systems		By Category	
<input checked="" type="checkbox"/> Generic Models		By Category	
<input checked="" type="checkbox"/> Lighting Fixtures		By Category	
<input checked="" type="checkbox"/> Lines		By Category	

Category	Visibility	Projection/Surface	
		By Category	Lines
<input checked="" type="checkbox"/> Furniture			
<input checked="" type="checkbox"/> Accessories			
<input checked="" type="checkbox"/> Glass			
<input checked="" type="checkbox"/> Hidden Lines			
<input checked="" type="checkbox"/> Shelf			
<input checked="" type="checkbox"/> Furniture Systems			



The family name is displayed along with the type name. The family in this case is the name of the RFA file you have been working in.

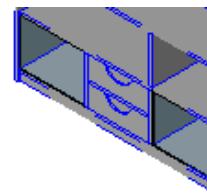
	Furniture	1	Black	Solid
Accessories	1	Black	Solid	
Glass	1	Black	Solid	
Hidden Lines	1	Black	Dash	
Overhead Lines	1	Black	Long dash	
Shelf	1	Blue	Dash	

	Furniture	1	Black	Solid
Accessories	1	Black	Solid	
Glass	1	Black	Solid	
Hidden Lines	1	Black	Dash	
Overhead Lines	1	Black	Long dash	
Shelf	1	Blue	Dash	

23 Activate the **3D** view.

In the View Properties dialog box, click **Visibility/Graphic Overrides**.

- Expand the **Furniture** category.
- Clear Accessories.
- Click OK.



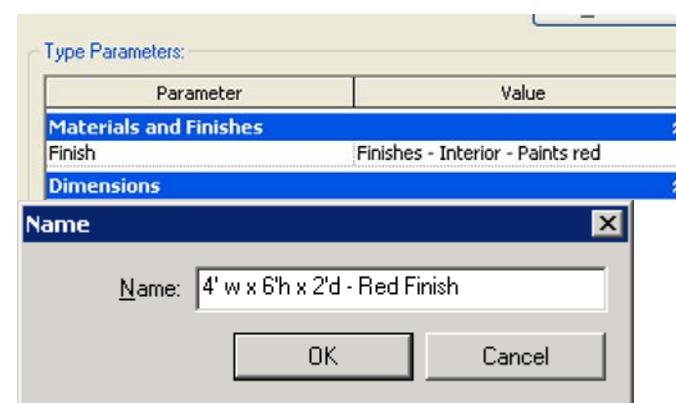
24 Select any instance of the shelf unit:

- Go to its **Properties** dialog box.
- Click Edit/New.
- In the dialog box that opens, select **Duplicate**.
- Revit Architecture prompts you to enter a new name: you are about to create a new type of this family.
- Name this new type **4'w x 6'h x 2'd – Red Finish**.

Click OK to close each dialog box.

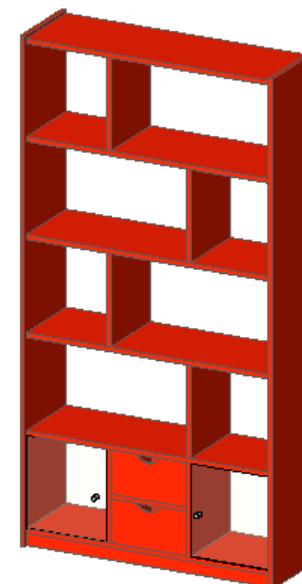
As a challenge, create a red paint material and apply it to the shelf.

You have just created a new type of this family.



Again, thanks to the subcategories, you can have an instance of this family in which the doorknobs are simply turned off and thus invisible.

If you do not see the accessories in the view, remember these are set to view detail level Fine.



You can create as many types of a family as you want and use them in any project.

Unit 12

Theory: Interdependencies

Revit Architecture: Site

This unit explains the Revit Architecture Site features and workflow as well as linking files and AutoCAD drawings. This unit has five exercises:

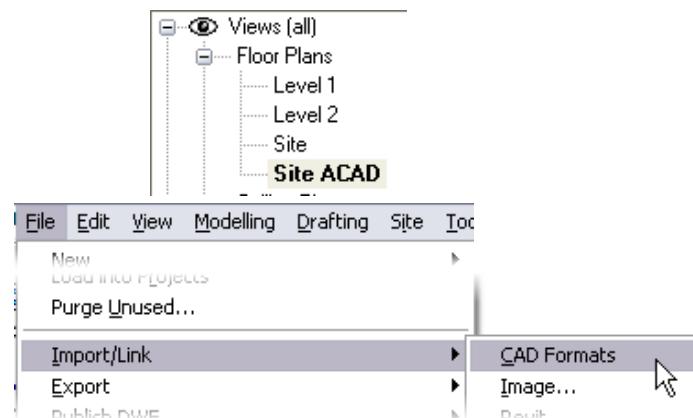
- 12A takes you through the process of importing an AutoCAD drawing.
- 12B illustrates how to link a Revit Architecture project into a current project.
- 12C works with the site tools to develop the model.
- 12D exports a view and sheet into AutoCAD DWG format.

Exercise 12A: Importing AutoCAD Drawings

In this exercise you start with the workbook template and import an AutoCAD drawing to use as a basis for the site work in the rest of this unit. This AutoCAD site drawing has polylines at elevation. In a later exercise you convert this geometry to a Revit Architecture toposurface.

Import an AutoCAD Drawing

- 1 Start a new project with the **workbook template**.
Refer to Unit 1 if you need help creating a project from the workbook template.
- 2 On the File menu, click **Save As** and save your project as **Unit 12.rvt** in the **Workbook data sets** folder.
 - The exercises in Unit 12 build on this project. If you want to work through the exercises using this file, save it. Otherwise the starting point of each exercise has been provided for you, and you can use these files instead.
- 3 Set the **Site** view current.
Duplicate the **Site** view and rename the view **Site ACAD**.
You later use overrides to manipulate the drawing's visibility in these views.
Right-click in the project browser to duplicate and rename the view.
- 4 On the File menu, click **Import/Link > CAD Formats**.



- 5 Browse to and click the drawing file **Import Site Plan.dwg** in the *Workbook* folder.

Match the settings in the Import dialog box to the settings shown at right:

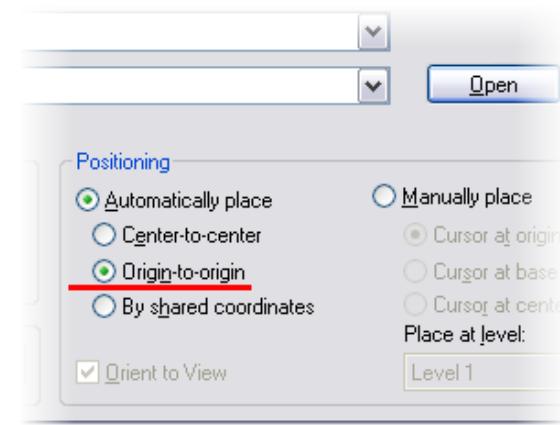
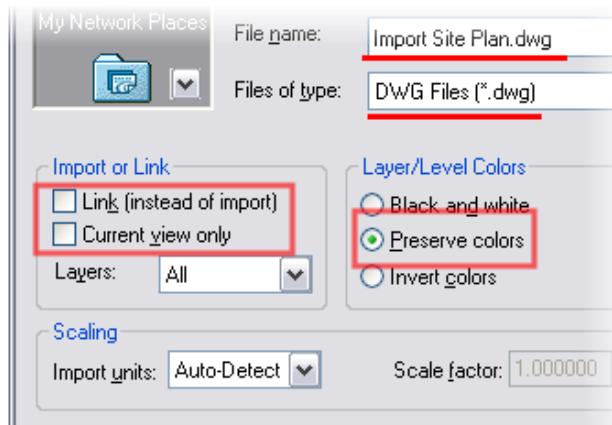
- Clear Link (Instead of Import).
- Clear Current View Only.
- Click Preserve Colors.
- Automatically Place: Origin-to-Origin.

Click **Open** to proceed with the import.

Notes on the Import/Link Dialog box:

Link Instead of Import: This option maintains a live link to the drawing. If the drawing changes, you can reload the drawing with the changes into the Revit Architecture project.

- 6 Right-click in the drawing area. Click **Zoom to Fit**.



Current View Only: It is a good idea to link drawings to a specific view. This approach cuts down on the amount of information that must be regenerated as you switch from view to view.

For this exercise you import the DWG file into all views and use view control to turn the DWG file off in selected views.

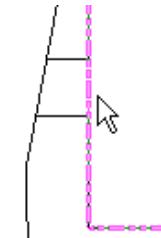


Control Drawing Layer by Query

- 7 Click the imported DWG file in the drawing window.

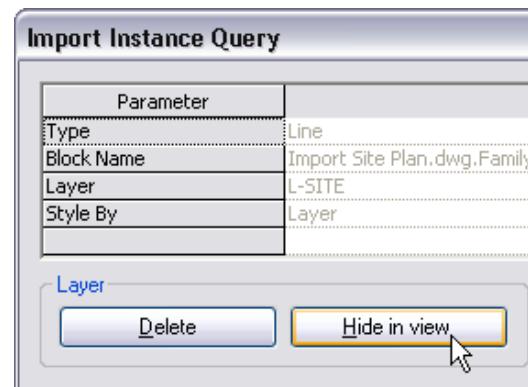
On the options bar, click **Query**.

Click one of the magenta lines in the drawing.



- 8 In the Import Instance Query dialog box, review the information about the line you just selected.

Click **Hide in View**.



Layer Control of Drawing Instance: Visibility Graphics Override by View

- 9 With the **Site ACAD** view current, type **VG** to access the view's visibility graphics override.

- 10 Click the **Imported Categories** tab.

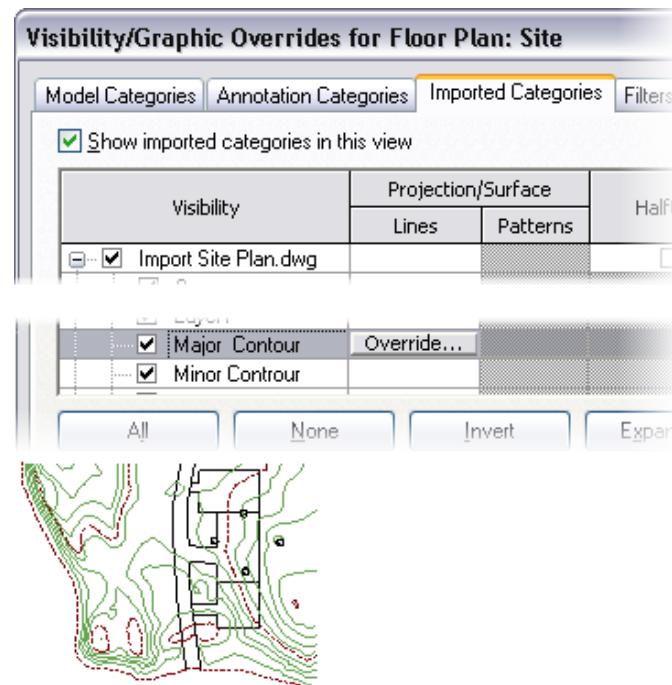
Expand the **Import Site Plan.dwg**.

Click the line style for Major Contour to access the override for this layer in the drawing instance.

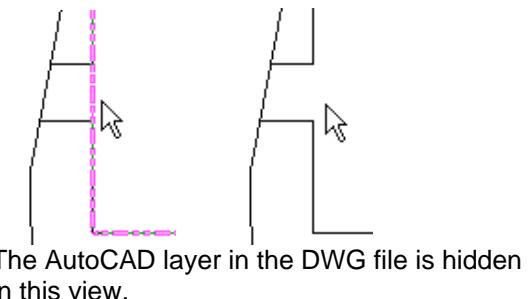
Set the line color to a purple or dark red and the line pattern to Long Dash.

Click OK to close each dialog box and return to the drawing window.

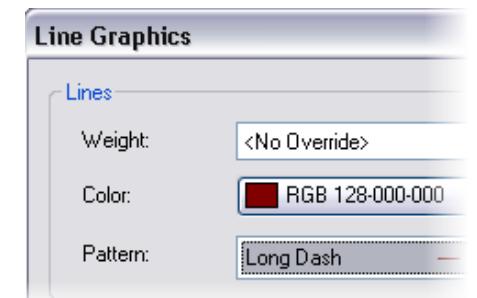
In addition to the on-off control afforded by the query tool, you have complete control over the linework in the drawing instance through the visibility graphics override of the view.



Turn off Visibility with Graphic Overrides



The Query dialog box is a convenient way to find out information about the object you have selected in the imported drawing.



The drawing instance now has overrides for this specific view.

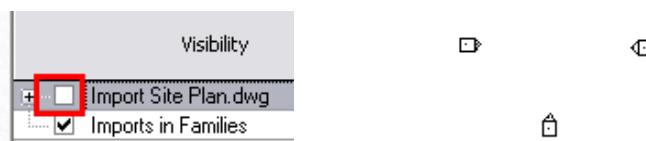
- 11 Set the Floor Plans – **Site** view current.



- 12 With the **Site** view current, type **VG** to access the view's visibility graphics override.

In the Imported Categories section, under Visibility, clear the **Import Site Plan** check box.

Click OK to return to the drawing window.



- 13 Save your project if you are continuing, or close it if you want to use the file provided for the next exercise.

The overrides set in the Site ACAD view are not applied to any other views.

The drawing instance is turned off for this view. You use these two views in the following exercises.

Exercise 12B: Importing Revit Architecture Projects

In this exercise you continue from exercise 12A, but import a Revit Architecture project with a building in it. You then look at some of the display controls you have over the linked Revit Architecture file.

If you completed the last exercise, you can continue to work in that file. If you choose to work in the provided project file, note that for consistency the AutoCAD drawing has been inserted rather than linked.

Link a Revit Architecture Project into the Current Project

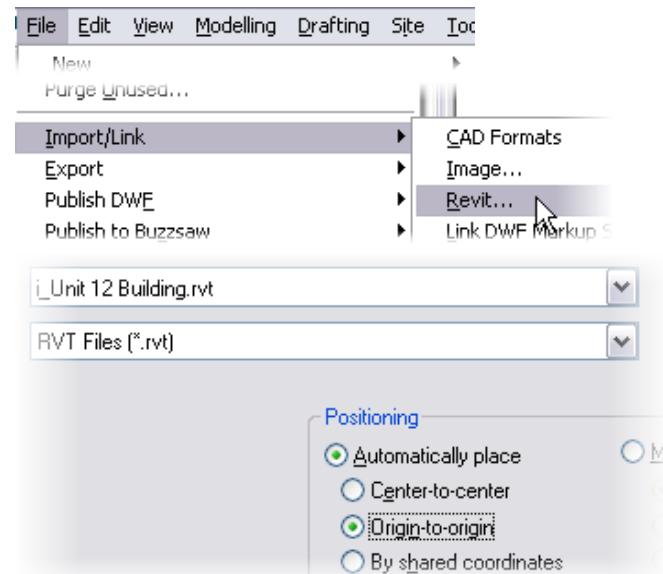
- 1 Open file **i_Unit 12b – Start**. You should be in Site ACAD view.
- 2 On the File menu, click **Import/Link > Revit**.

Browse to the workbook's data set folder. Click **i_Unit 12 Building.rvt**.

- 3 In the Open dialog box, set:
 - Under Positioning, click **Automatically Place** and Origin-to-Origin.
 - Click **Open**.

Revit Architecture files may be linked to one another. As the linked Revit Architecture file changes, it can be reloaded to update the current project with the new information. Also like the linked DWG file, you have control over how the linked Revit Architecture file is displayed in the current view.

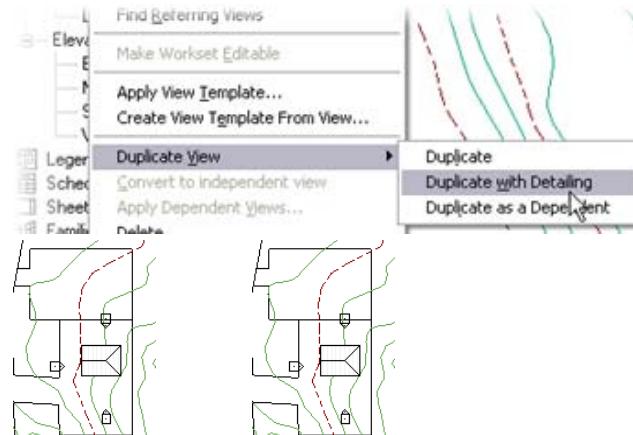
Revit Architecture files import only as a linked file. Once they are in the project, however, you can bind them. Once a linked Revit Architecture file is bound, it becomes a model group in the current file.



Control Linked Project Display By View

You have several levels of control over the display of the linked Revit Architecture file. You can view the linked file with the default visibility of the view or the default settings of a view within the linked file, or override any of the linked constituent parts.

- 4 Duplicate with detailing the **Site ACAD** view. Rename the new view **Site-Concept**.



- 5 Tile the **Site ACAD** and **Site-Concept** views.

- 6 Set the Site-Concept view current.

Type **VG** to access the view's visibility graphics override.

- 7 Click the **Revit Links** tab.

Click the plus (+) sign to the left of *i_Unit 12 Building.rvt*.

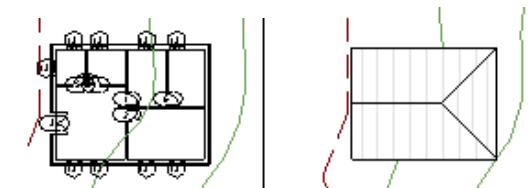
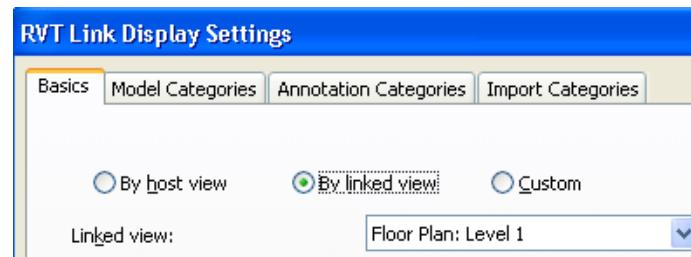
In the Display Settings column, click **By Host View** to override the default display settings.

- 8 In the RVT link Display Settings, click the **Basics** tab. Click **By Linked View** and set the linked view to Floor Plan: Level 1.

Click OK to close each dialog box and return to the drawing window.

Visibility	Halftone	Display Settings
<input checked="" type="checkbox"/> <i>i_Unit 12 Building.rvt</i>	<input type="checkbox"/>	Rv Host View
<input checked="" type="checkbox"/> 1 (<Not Shared>)	<input type="checkbox"/>	Not Overridden

If you have more than one instance of the linked file in your project, each instance is listed in this tree. You control the display of each instance independently.



The linked file now uses the current display settings stored by the linked file rather than the host file's current view settings.

Visibility	Halft...	Display Settings
<i>i Unit 12 Building.rvt</i>	<input type="checkbox"/>	Rv Linked View



Customize Linked Project's Display by Object

- 9 With the Site-Concept view current, repeat steps 6 and 7 to return to the RVT Link Display settings.

- 10 In the RVT Link Display Settings dialog box:

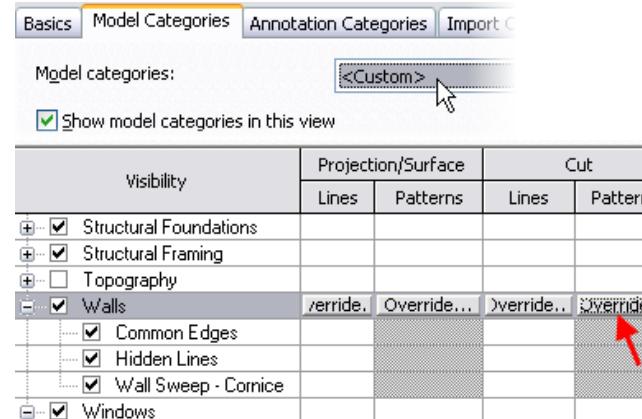
- Click the **Basics** tab.
- Click **Custom**.
- Verify that the Linked View is set to **Floor Plan: Level 1**.
- Change the Detail Level to **Coarse**.



- 11 Click the **Model Categories** tab:

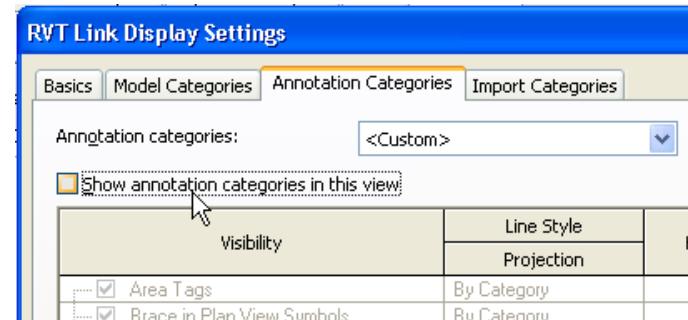
- In the Model Categories list, select **<Custom>**.
- Click the **Walls** line.
- Click the Cut Patterns Override button.
- Assign **Solid Fill** to this override.

Do not close the dialog boxes yet.

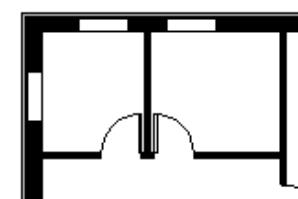


- 12 Click the **Annotation Categories** tab:

- In the Annotation Categories list, select **<Custom>**.
- Clear the Show Annotation Categories in This View check box.

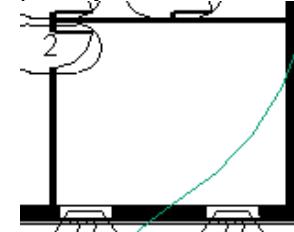


- 13 Click OK to close each dialog box and to return to the drawing window.



Setting the linked view's override to Custom opens up all of the override values in the list below it. These settings allow a general level of control based on settings in the host or the linked file. In addition to this control you also have access to the object categories in the linked project.

If you click OK to return to the drawing at this point, you would see the following:



All of the walls regardless of their type now display as a solid fill. But the door and window tags are still visible because they are part of the display of Floor Plan Level 1 in the linked drawing.

All of the view visibility controls common to a view can also be applied to a linked Revit Architecture project.

Exercise 12C: Site Tools

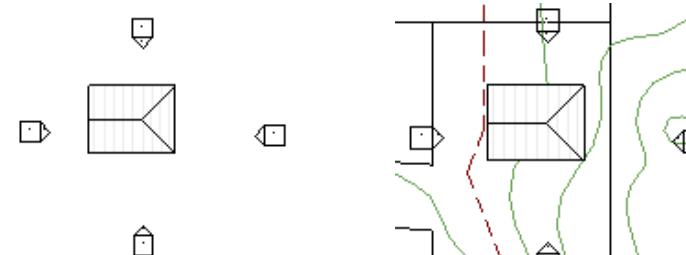
In this exercise you create a site toposurface based on the geometry of the imported AutoCAD site file. You then develop the site using the Revit Architecture site tools.

Create a Toposurface

- 1 Open file **i_Unit 12c – Start**.

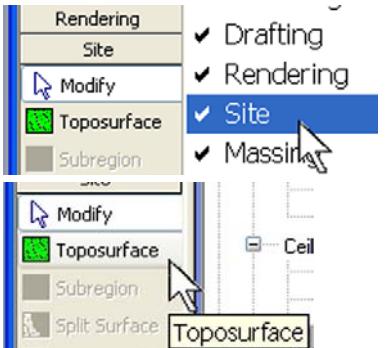
Verify that the **Site ACAD** view is current.

Open the **Site** views. Tile the views using the **WT** keyboard shortcut.



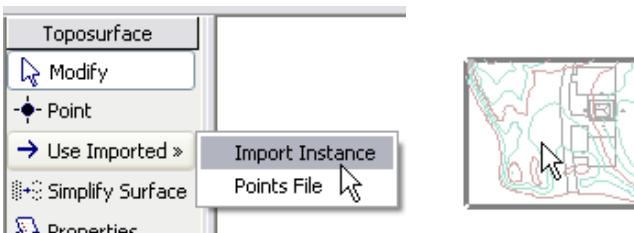
Note on linked file paths: The Revit Architecture model is a linked file, **i_Unit12 building.rvt**.

- 2 Right-click the design bar. Click **Site** to activate the Site design bar if it's not already visible.

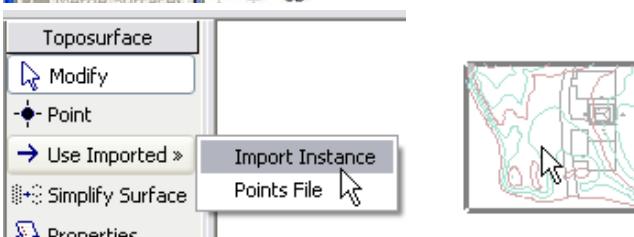


- 3 Set the Floor Plans **Site ACAD** view current.

On the design bar, click **Toposurface** to enter Toposurface Sketch mode.

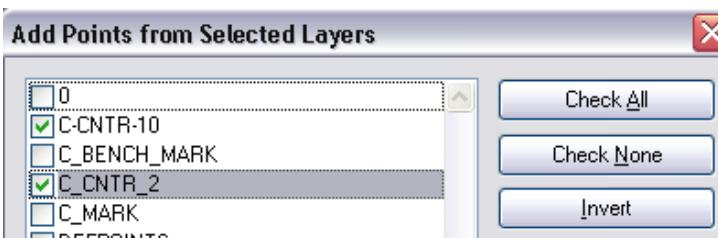


- 4 On the design bar, click **Use Imported > Import Instance**. Click the imported DWG file instance in the drawing window.



- 5 In the Add Points from Selected Layers dialog box:

- Click **Check None** to clear all the layers.
- Click to select only the layers **C-CNTR-2** and **C-CNTR-10**.
- Click OK.

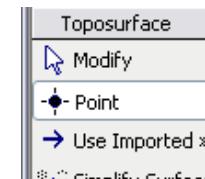


The site file has an imported DWG instance. The DWG data consists of 2D polylines on different heights.

In exercise 12A, you turned off the visibility of the drawing in the site.

Here you create a toposurface that shows the site grading in 3D, section, and elevation.

If you open the file and the building is not there, on the File menu, click Manage Links. On the Revit tab, select the file and browse to find this file.



You can create toposurfaces directly by clicking the Point command and positioning points (the height can be set on the options bar) in the workspace.

Once the DWG instance is selected, Revit Architecture recognizes the layers contained within it and lets you pick which ones you want to use to create the surface.



The contours of the DWG file are converted to the points that the Revit Architecture

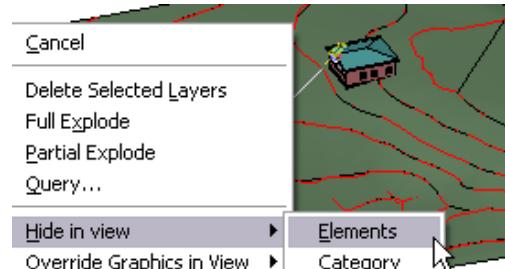
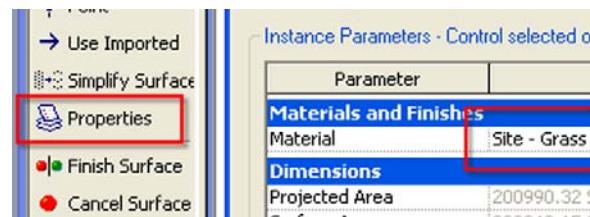
- 6 On the design bar, click **Properties**. Change the surface material to **Site – Grass**.

Click OK.

On the design bar, click **Finish Surface**.

- 7 Open a 3D view.

Right-click the linked DWG file (click one of the colored topography lines). Click **Hide in View > Elements**.



Create a Pad

- 8 Set the Site ACAD view current.

Set the view display mode to **Wireframe**.



- 9 Open the **Visibility/Graphic Overrides** settings for the view:

- Click the Imported Categories tab.
- Turn off visibility for all the DWG layers except **Site Layout**.

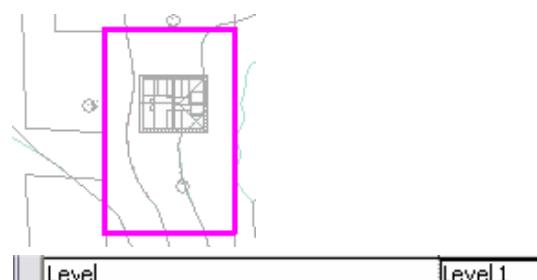
Click OK to close the Visibility Graphics dialog box.

Visibility	Projection/Surface	
	Lines	Patterns
<input checked="" type="checkbox"/> Import Site Plan.dwg		
<input type="checkbox"/> 0		
<input type="checkbox"/> C-CNTR-10		
<input type="checkbox"/> C_BENCH_MARK		
<input type="checkbox"/> C_CNTR_2		
<input type="checkbox"/> C_MARK		
<input type="checkbox"/> DEFPOINTS		
<input type="checkbox"/> L-SITE		
<input checked="" type="checkbox"/> SITE_LAYOUT		

Click OK to close the View Properties dialog box.

- 10 On the Site design bar, click **Pad** to enter into Sketch mode.

Use the **Lines** tool to draw a rectangle around the parking area, as shown in the image.



- 11 On the design bar, click **Pad**

toposurface uses.

You can change the surface material later by opening its Properties dialog box.

Note that the building is sunk inside the topographic surface. The DWG file is also visible in this view.

You can change this property at any time.

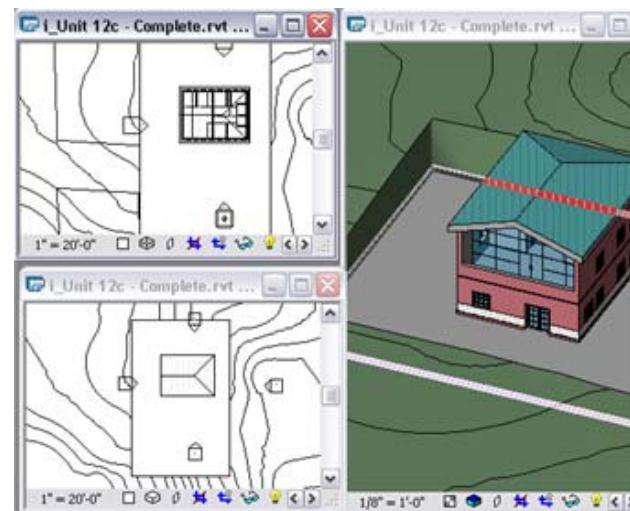
Properties.

Change the Pad Level to Level 1.

12 Click **Finish Sketch**.

13 Open the 3D view to see the pad.

Tile windows (on the **Window** menu, click **Tile**).



The building pad is well below the average grade of the topography.

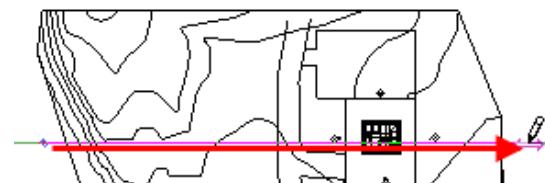
In the next part of the exercise, you create a section view of the site and adjust both the height of the pad and the height of the linked building relative to the topography.

Add a Site Section

14 Set the Site ACAD view current.

On the Basics design bar, click the **Section** tool.

Click a point to the left of the building and a second point to the right of the building to place the section mark.



15 Open the new section view.

Click the crop region to activate the grips.

Drag the control grips to adjust the view to see the full building.



16 As you did in step 7, click the imported DWG file instance and hide it using the shortcut menu.

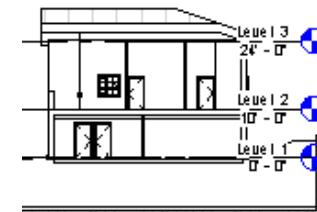
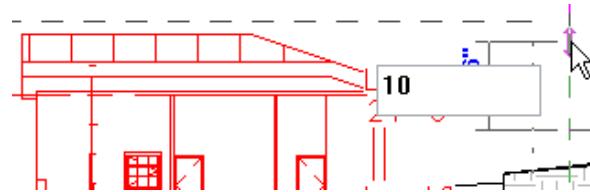


Once again the imported DWG file is visible.

You can turn off the imported DWG file.

- 17 Move the linked Revit Architecture building vertically up 10 feet in the section view:

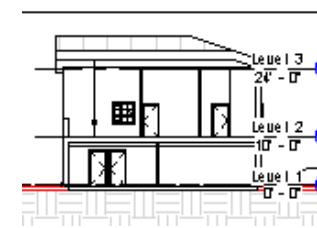
- Click the linked Revit Architecture building.
- Click the **Move** tool.
- On the options bar, click **Constrain**.
- Click anywhere in the drawing window.
- Move the pointer up.
- Type **10** and press **ENTER**.



The building has now moved relative to the site.

- 18 Adjust the height of the pad:

- Click the pad in section view.
- Open its element properties.
- Set the Height offset from Level to **10'**.
- Click OK to return to the drawing window.

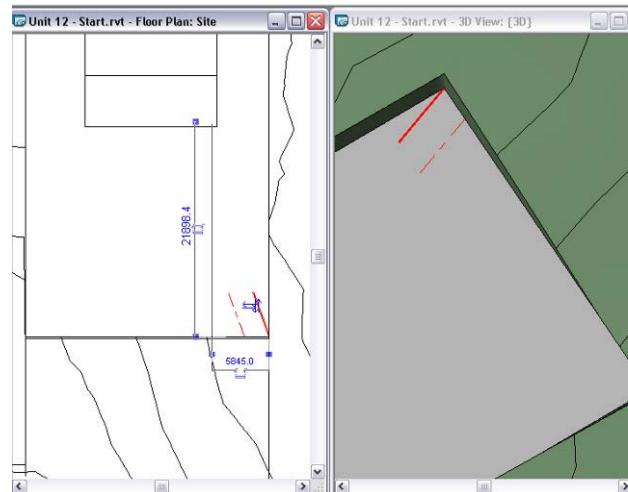


Add Site Components

- 19 Set the Floor Plans: Site Plan current.

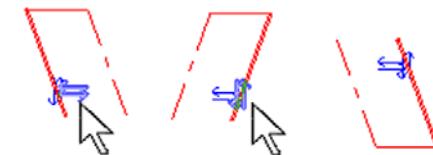
- 20 On the design bar, click **Parking Component**, and add a 9' x 18' - 70 deg, as shown in image.

Use **SPACEBAR** to rotate the element before you click to place it in the project or after an instance has been placed.



Parking components, as site components, automatically recognize the height of their host during positioning.

Use the blue arrows to flip the parking space.



- 21 Select the parking component and array eight instances of it to the left (west).

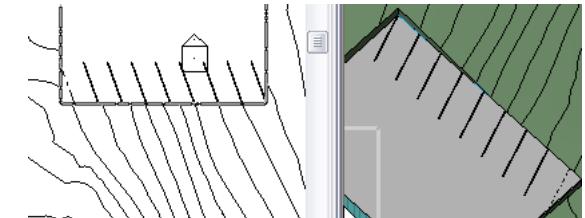
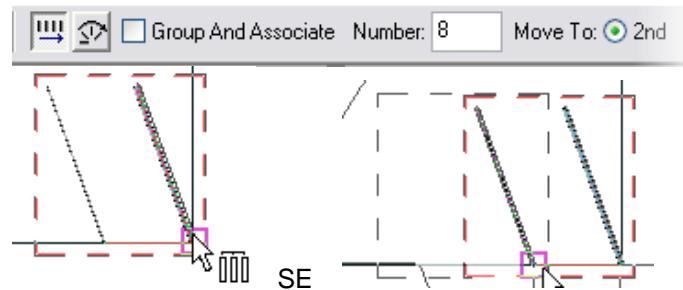
Click the parking stall. Click the **Array** tool.

On the options bar:

- Clear Group and Associate.
- Number = 8.
- Move To = 2nd.

Click the right endpoint of the parking stall.

Type **SE** to get the endpoint snap override.



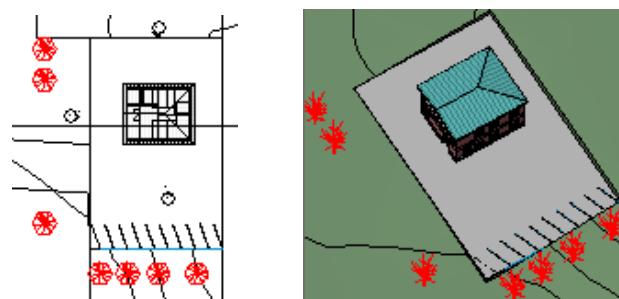
Parametric arrays are helpful when positioning this kind of component.

Click the left endpoint of the stall.

- 22 On the Site design bar, click **Site Component**.

Set the Type to **Quercus Velutina -27'** and add a few tree components, as shown in image.

The symbol used for plans, elevations, sections, and normal 3D is a simple stick symbol. When rendered in AccuRender, the trees show foliage.

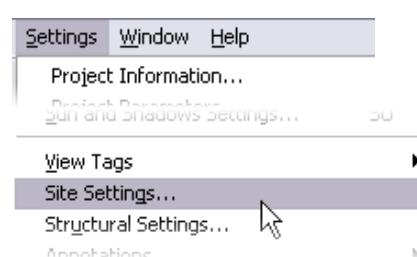


Trees are specific site components that have their own editor and can be customized, though Revit Architecture comes with an extensive tree library.

To navigate through the library, create a new planting family and open the Family Types dialog box. Clicking the Plant Name parameter opens an AccuRender dialog box with the tree library.

Change the Site Settings

- 23 Maximize the site view. On the **Settings** menu, click **Site Settings**.

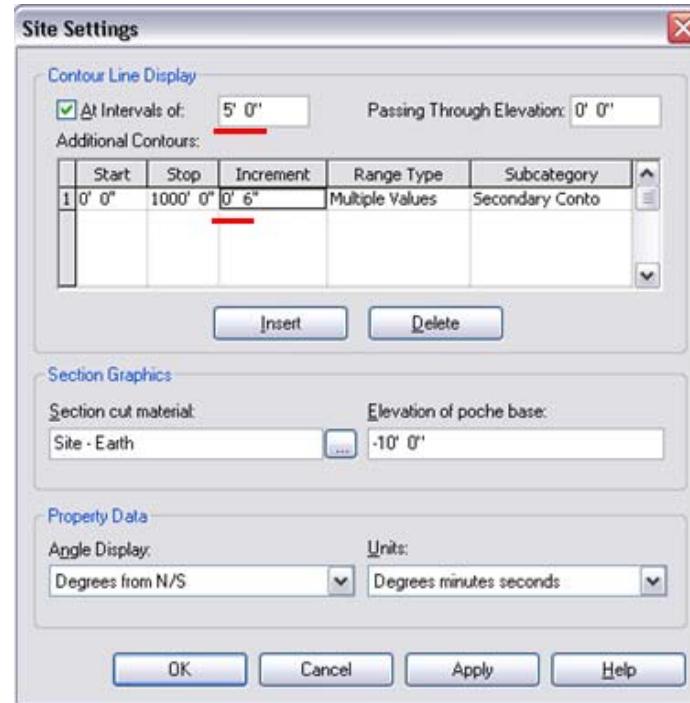


- 24 The default settings are to show contours every 10 feet as primary contours, and every foot as secondary contours.

Change the primary contour interval to 5'.

Change the secondary contours to **6"**.

Click OK.



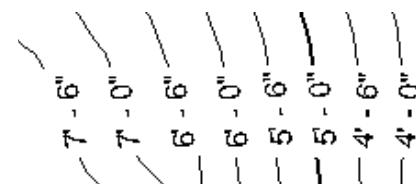
Add Contour Labels

- 25 Set the **Site** view current

On the design bar, click **Label Contours**.

Draw a straight horizontal line, approximately as shown in image.

- 26 Zoom in to see the labels.



The diagram consists of two side-by-side cross-sections of soil. Each section features a wavy, horizontal line representing the soil surface. A small, simple house icon is positioned at the top of each wavy line. The left section's soil layer is depicted as a solid, dark grey band, while the right section's soil layer is shown with vertical hatching, suggesting a different texture or composition.

You can add more contours with the Insert button and assign the new contours with the Subcategory list.

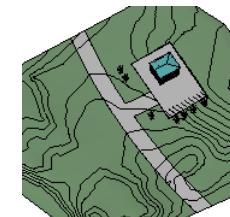
The Cut material defines what type of hatching the toposurface has.

The poche base elevation setting in the bottom left defines how thick the surface displays in section views.

If you zoom in the finished drawing, you see that primary and secondary contours display with different lineweights, which are set in the Object Styles dialog box under the Topography category.

You can draw the contour label line in any direction.

- 27 Save the project if you are continuing to the next exercise.
- On your own, explore the Split Surface and Subregion tools.

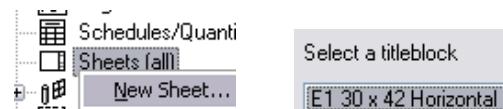


Exercise 12D: Exporting AutoCAD Drawings

In this exercise you export the site model and a sheet for use with AutoCAD software.

Place Views on Sheet

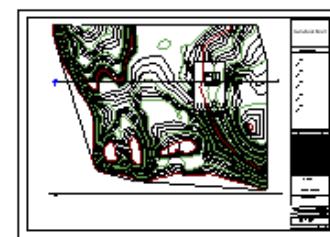
- 1 Open file **i_Unit 12d – Start**. You should be in site view.



- 2 In the project browser, right-click the **Sheets (All)** category. Click **New Sheet**.

Click OK to accept the E1 30 x 42 title block.

- 3 Left-drag Site Concept view, and drop it onto the sheet view.

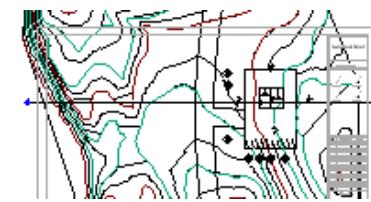
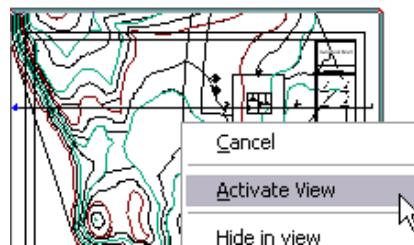


Any view without an active crop region defaults to the model extents when placed on a sheet.

Work with Views on Sheets

In this section you activate the view on the sheet. Activating a view opens the view up for editing as if you had made that view current with the project browser.

- 4 Right-click the site plan. Click **Activate View**.

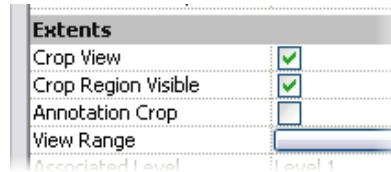


When you activate the view, the other views are dimmed.

- 5 Right-click in the drawing window. Click **View Properties**.

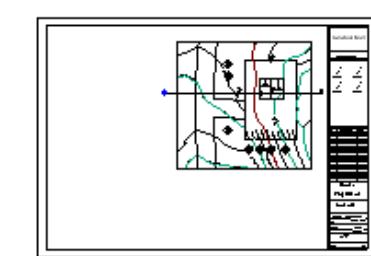
Select the **Crop Region Visible** check box.

Click OK to return to the drawing window.



- 6 Click the crop region, and drag the double blue arrows back into a reasonable location around the information in the view.

When you are finished, right-click anywhere in the drawing window. Click **Deactivate View**.

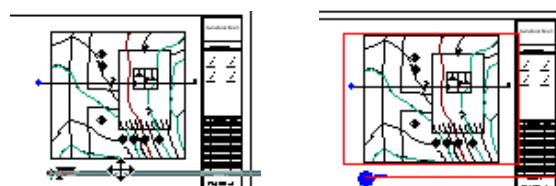


The sheet view is returned to its normal state, but the view title line is not automatically updated.

- 7 Click the title line and drag it into location.

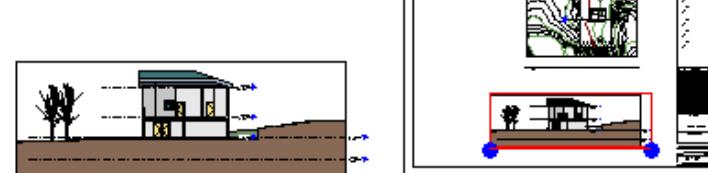
Click the view's crop region.

Grip the title line ends into place.



- 8 Prepare and add Section 1 view to the sheet:

- Open **Section 1** view.
- Change the scale to **1/8" = 1'-0"**.
- Drag the crop regions in as shown.
- Change to **Shading** mode.
- Drag the view onto the sheet.

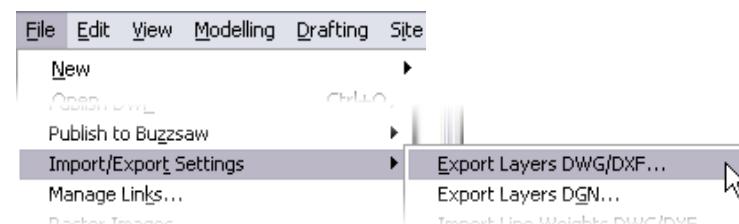


The sheet is now ready to export to AutoCAD software.

Export a Sheet to AutoCAD Drawing Format

- 9 On the File menu, click **Import/Export Settings > Export Layers DWG/DXF**.

Before you export to AutoCAD, verify that the export settings are correct.



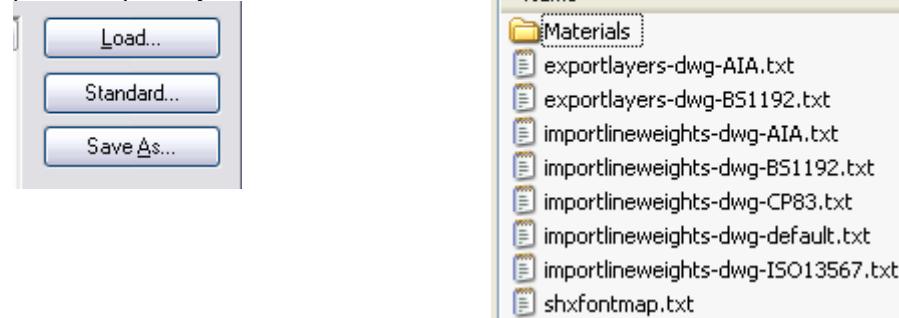
- 10 Make changes as needed to the export settings.

Export Layers: C:\Program Files\Revit Architecture 2008\Data\exportlayers.dwg-AIA.txt

Category	Projection		Cut	
	Layer name	Color ID	Layer name	Color ID
Cut Pattern	A-ROOF-PATT	8	A-ROOF-PATT	8
Fascias	A-ROOF-OTLN	4	A-ROOF-OTLN	4
Finish 1 [4]	{A-ROOF}	4	{A-ROOF}	4
Finish 2 [5]	{A-ROOF}	4	{A-ROOF}	4
Gutters	A-ROOF-OTLN	4	A-ROOF-OTLN	4
Hidden Lines	{A-ROOF}	4	{A-ROOF}	4

Category	Projection		Cut	
	Layer name	Color ID	Layer name	Color ID
Cut Pattern	A-ROOF-PATT	8	A-ROOF-PATT	8
Fascias	A-ROOF-OTLN	4	A-ROOF-OTLN	4
Finish 1 [4]	{A-ROOF}	4	{A-ROOF}	4
Finish 2 [5]	{A-ROOF}	4	{A-ROOF}	4
Gutters	A-ROOF-OTLN	4	A-ROOF-OTLN	4

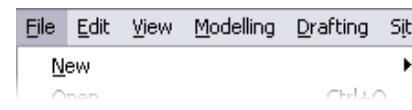
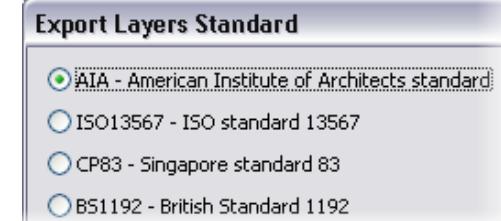
Note that by clicking the **Load** button, you have access to several different preset export layer files.



- 11 Click OK to return to the drawing window.
12 On the File menu, click **Export > CAD Formats**.

Each Revit Architecture object is assigned a layer and color ID for instances where the object is cut (such as a wall in plan view) or used as projection (a wall in elevation). The layer names are created automatically in the new drawing file. The color IDs are the standard AutoCAD ACI colors that are assigned to the layers as they are created.

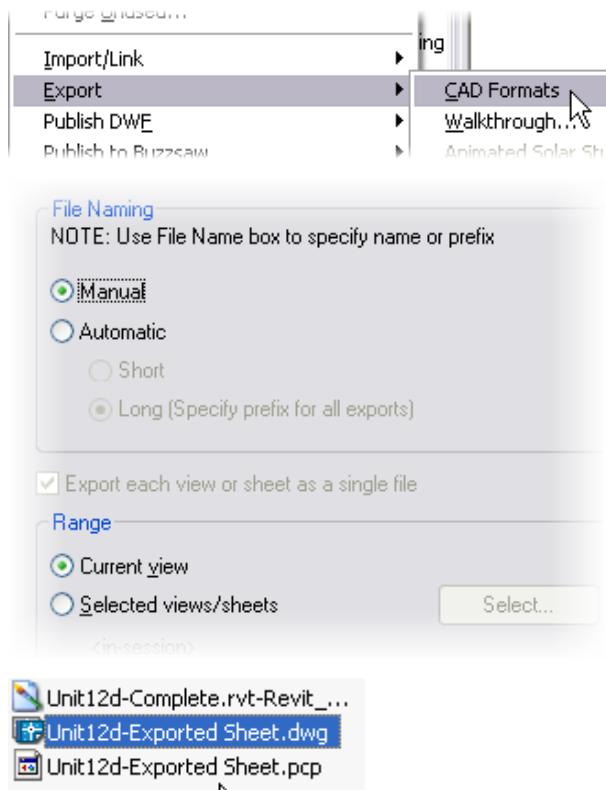
The Standard button enables you to change the standards also.



13

In the Export dialog box:

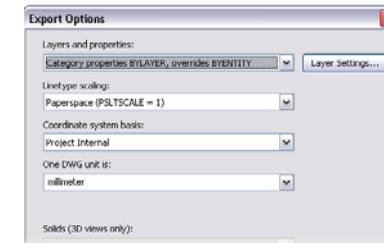
- Under File Naming, click **Manual**.
- Type a file name for the drawing.
- Verify that **AutoCAD** is the format to save to.



14

Click **Save** to create the new drawing file.

You can use the export range to export multiple views and sheets. If you do this, then the Manual button is not selected.



You can fine-tune the export to DWG by clicking the Options button.

The new drawing is created along with a PCP file for the pen settings that AutoCAD can use to plot this file.

Unit 14

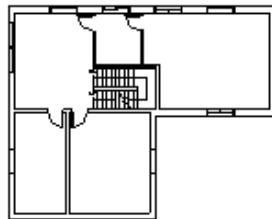
Theory: Detail

Revit Architecture: Drafting and Linework

This unit explains how to create a detail using Revit Architecture.

- 1 Open the file i_Unit 14 – Start.rvt in the *Training Files* directory.

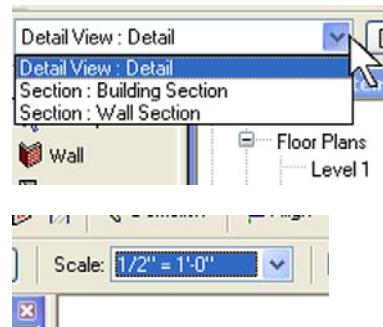
Verify that the view Floor Plans: Level 2 is current.



- 2 On the Basics design bar, click **Section**.

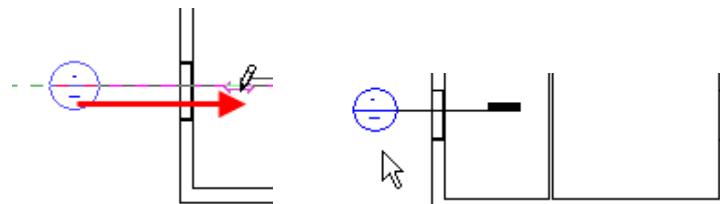
On the options bar, set:

- Section Type = Detail View.
- Scale = $1/2'' = 1'-0''$.



- 3 Draw a section mark over the window, as shown in image.

Open the section by deselecting the mark and double-clicking the detail bubble, or use the project browser.



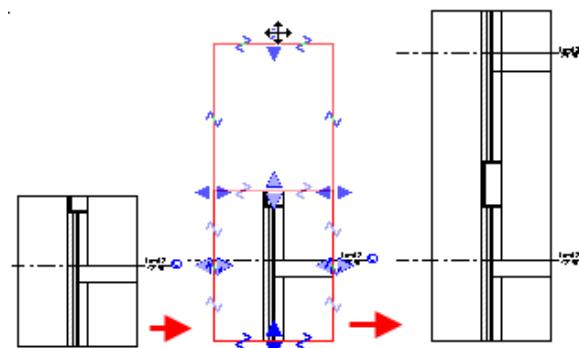
You can create as many section types as you want by duplicating them.

In the project browser, details (including sections) appear under the category called **Detail Views**, while other section types have their own category.

The scale affects the detail level of the new view. Normally, all views $1\frac{1}{2}'' = 1'-0''$ and bigger have detail level set to **Fine**, but it is possible to change the settings by clicking **Detail Level** on the **Settings** menu.



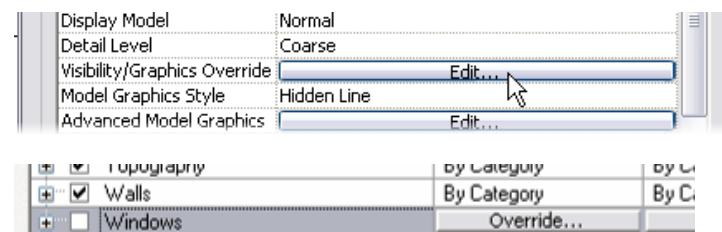
- 4 Click the crop region. Use the grips to resize the detail to show the floor above.



You may need to resize section views, or maybe even turn off the crop region if it disturbs your drawing: Right-click in the drawing window, click **View Properties**, and clear **Crop Region Visible**.

- 5 Right-click in the section detail view. Click **View Properties**.

- Click the Visibility/Graphics Override **Edit** button.
- Under Model Categories, turn off visibility of windows.
- Click OK to exit the dialog box.
- Click OK again to close view properties.



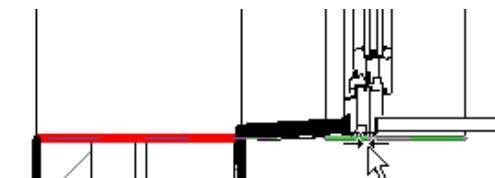
The keyboard shortcut for displaying the visibility settings for the view is VV. It provides a quick way to jump directly to the dialog box.

- 6 On the File menu, click **Load from Library > Load Family**. Navigate to the folder where you placed the workbook data set files. Open the *Extra RFA Files* folder and select the file called **Window Section.rfa**. This detail component was generated from a DWG file.



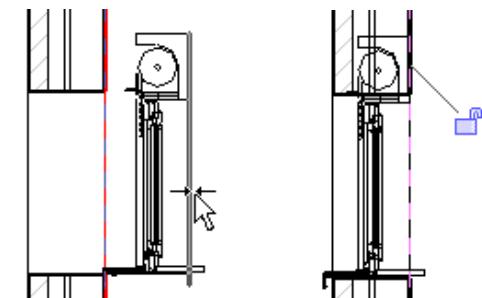
Detail components can be created by drawing directly or by importing a DWG, DXF™, or DGN file if you already have the detail in one of these file formats.

- 7 On the Drafting design bar, click **Detail Component**. The loaded Window section detail component should be ready for placement on the drawing.



While using the Align tool, use TAB to cycle through the align target locations to select the wall sill if it does not select automatically.

Annotations and detail components are view specific: they are visible only in the view in which they are added.



- 8 Place the window detail component to the right of the window.

Use the **Align** tool to align it to the sill.

Use the **Align** tool to align it with the wall finish.

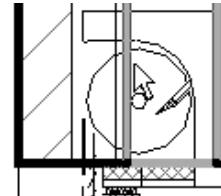
Edit Cut Profile

- 9 On the toolbar click the **Edit Cut Profile** icon. On the options bar, verify that **Edit Face** is selected.



Edit: Face Boundary between faces

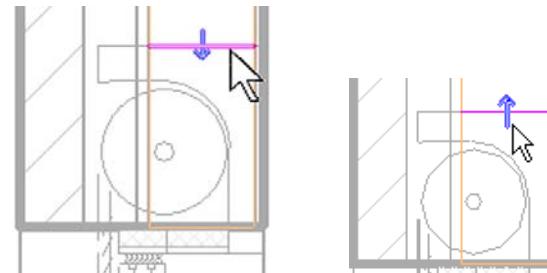
- 10 Click the hatch or boundary of the subcomponent you want to modify.



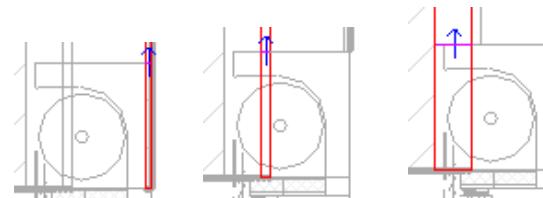
- 11 Use the **Lines** tool to draw a new profile where you want the subcomponent to be cut.

Click the blue arrow toward the side you want to keep.

Click **Finish Sketch**.

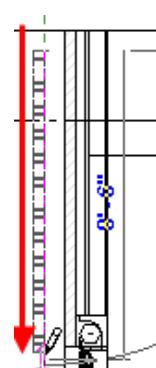


- 12 Repeat for the other three components in the wall that interfere with the shade roller mechanism.

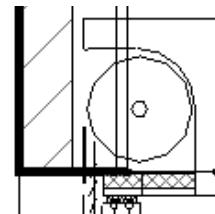


- 13 On the Drafting design bar, click **Repeating Detail**. Change the options bar Type selector to **Repeating Detail: Brick**.

- Click near the upper floor.
- Click near the top of the window.
- Click the **Modify** tool.



This takes you into Sketch mode, where you draw the linework for the new cut profile of the component.



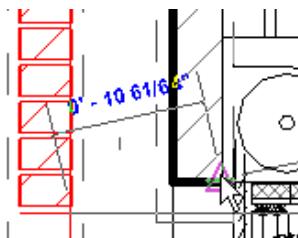
You must repeat the process with each of the components in the wall.

The profile of each material must be edited separately because the tool works on one boundary or wall layer at a time.

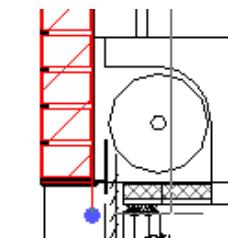
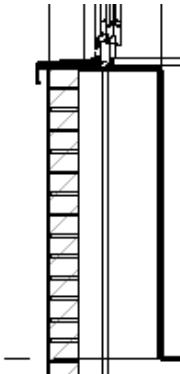
Use detail components in arrays to create a repeating detail. A simple example is a series of bricks in section view. There are various ways to assemble the detail component in a repeating detail.

14 Select the new brick detail.

- Click the **Move** tool.
- Select the bottom corner end point.
- Move the brick detail into place.



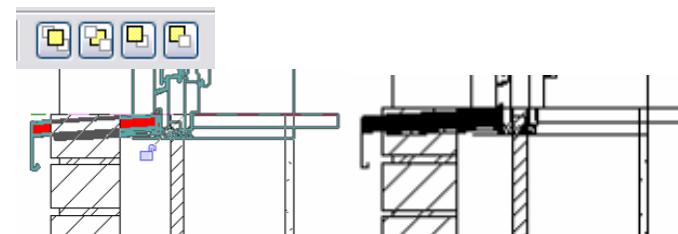
15 Add another Brick – Section repeating detail below the window.



Note that this brick detail component contains an invisible line that defines the width of the mortar. You could add a hatch in the detail component so it displays the mortar in the repeating detail.

16 If the brick repeating detail is in front of the window detail, select the former.

On the options bar, click the **Bring to Front** icon.

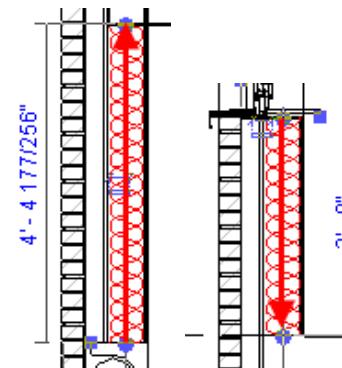


It is possible to define the order of their appearance by using the toolbar displayed on the left. This toolbar appears on the options bar when a detail component is selected.

17 On the Drafting design bar, click **Insulation**.

On the options bar, set the size to $5\frac{1}{2}''$.

Draw the insulation in the exterior wall, as shown in image, both above and below the window detail.



Change the insulation width after designing it by right-clicking and then clicking Properties > Width Field, or by simply changing the Width value on the options bar.

18 Save and close your project.

Unit 16

Theory: Is Architecture Engineering?

Revit Architecture: Formulas

This exercise starts with a data set that is a window family. Families are created using family template files that contain different parameters according to the category. In this window family a crown subcategory was added in the Object Styles dialog box (Settings menu, Object Styles command). The window family is already complete; you add some formulas to control the geometry and visibility of some of the solid elements that compose the window family. In particular, you create the following:

- Formulas that control the relative height of the frames (and the glass), depending on the sill thickness.
- A formula that controls visibility of the crown, to be displayed only if the window width is equal to or larger than 5 feet.

Parameter values should always be changed in the Family Types window to verify whether the model flexes correctly.

In Unit 11 you added formula parameters to control the width of the drawer of the shelf unit. You also added a visibility parameter to control the visibility of the glass doors. In this exercise you combine these types of parameters to create formulas and tie the display of the crown or lintel of the window to the result of the formula.

This exercise assumes you have worked through the exercises in Units 10 and 11. If you have questions about terminology or processes, you can go back to those exercises for review.

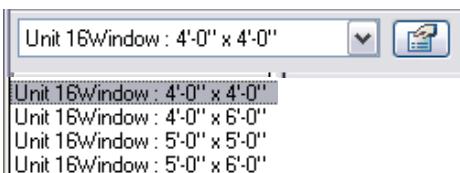
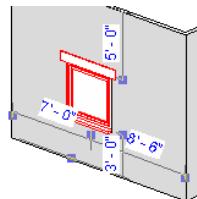
Explore the Window Family in the Project

In this section you explore the existing parameters set up in the window family.

- 1 Open file i_Unit 16 – Start.

Activate 3D Views:(3D).

Click the window in the view.



- 2 Note that there are already a few types defined with the family. Select them from the list. Return to the type named 4'-0" x 4'-0".



- 3 Open the type parameters for the 4' – 0" x 4' – 0" window type.

Change the sill thickness to 4", and click **Apply**. Do not close the Type



The window family is already complete, but you add formulas to control the geometry and visibility of some of the solid elements that compose the window family.

In particular, you create formulas that control the relative height of the frames (and the glass), depending on the sill thickness and whether it is visible.

Another formula controls visibility of the crown, to be displayed only if the window width is equal to or larger than 5 feet.

As you flex the types in the project, note that for the different heights the relationship between the sill and the window frame remains constant.

Note that when you do this, the H parameter changes as well. The current definition of the H parameter is a formula: height (of the window opening) less the sill thickness. The relationship between the

Properties dialog box yet.

- 4 In the Type Properties for the window, clear **Sill Visible**.

Click OK to return to the drawing window.

Edit the Window Family

- 5 Click the window.

On the options bar, click **Edit Family**.

Click **Yes** to edit the family.

Formulate the H Parameter

- 6 The H parameter was specifically created and assigned to the frame height. To see how it is defined:

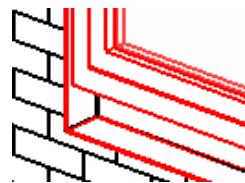
- Select the outer frame.
- On the options bar, click **Edit Sweep**.
- On the design bar, click **Sketch 2D Path**.
- Go to the exterior elevation view.

On the design bar, click **Quit Path**

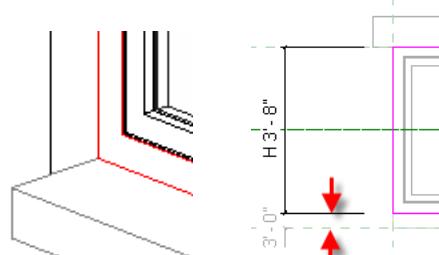
On the design bar, click **Quit Sweep** to return to the standard family editor window.

- 7 In the Family Types Properties dialog box, click the H parameter row. Under the Formulas column, write the IF formula: if (Sill Visible, Height - Sill Thickness, Height).

Other	
Sill Width	0' 6"
Sill Visible	<input checked="" type="checkbox"/>
Sill Thickness	0' 4"
H	3' 8"
Default Sill Hei	3' 0"



In this section, you add a formula to control the relative frame height according to the sill visibility.



Note the gap from the bottom of the sketch line to the opening in the wall to allow for the sill.

Other	
Sill Width	0' 6" =
Sill Visible	<input checked="" type="checkbox"/> =
Sill Thickness	0' 2" =
H	5' 10" = if (Sill Visible, Height - Sill Thickness, Height)
Default Sill Height	3' 0" =

The formula syntax is:

IF (<condition>, <result-if-true>, <result-if-false>)

Because Sill Visible is a Yes/No parameter, you only need to type the condition by itself.

Formulas and parameters are case sensitive.

sill and the window frame is constant.

The window has a gap where the sill is still taken into consideration but is not displayed.

If you see a parameter in a family definition that is not immediately evident when the family is opened, there is a good chance that it is nested into the Sketch mode of a solid element of the family.

To put this into English:

If the sill is visible (condition is true), then Height - Sill Thickness (raise the frame for the sill).

If the sill is not visible (condition false), then use the value held by the height parameter as the height of the window, filling in the space that would otherwise be occupied by the sill.

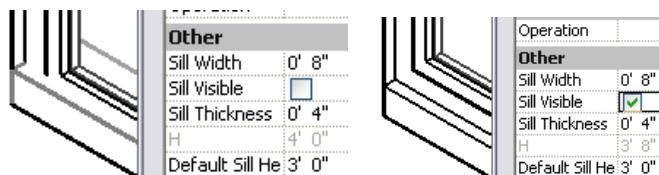
Always flex your family from the Family

- 8 Click **Apply**. Change the Sill Thickness

parameter to different values. Click **Apply** each time you change the value. Note how the height of the window frame now changes correctly.

- Clear the **Sill Visible** check box.

Click **Apply**. Note how the frame resizes accordingly to fit precisely in the opening.



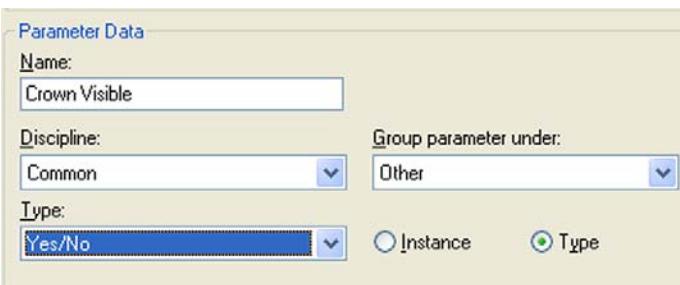
Create a Crown Visibility Parameter

- You next create a visibility parameter to control the crown visibility. Click the **Add** button under the Parameters category in the Family Types dialog box.

- Create a new Yes/No parameter called **Crown Visible** (see image on the right).

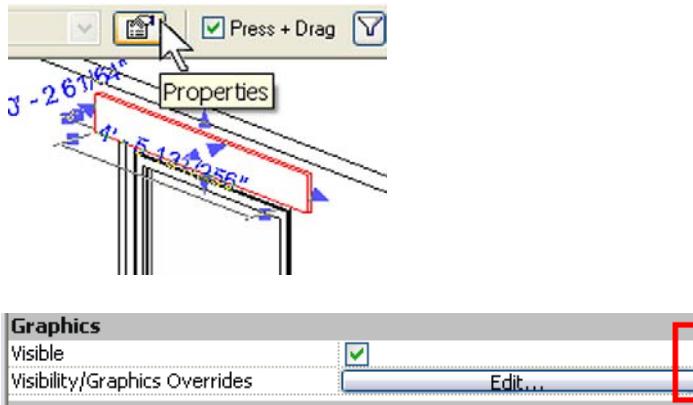
Click OK to return to the Family Types dialog box.

Click OK again.



- Select the solid that acts as the crown.

Open its Properties dialog box by right-clicking and then clicking Properties, or by clicking the Properties icon on the options bar.



- Click the gray icon at the right end of the Visible row.

Types dialog box to check if the model responds correctly.

Note that the sill is still visible in the model but is dimmed. In the Family Editor even if visibility of a specific component is turned off, you still see it for editing purposes. In the normal project environment, the sill would not be visible.

If the window width is greater than a specified width, show the Crown/Header. If it is less than the specified width, do not show it.

Refer to Units 10 and 11 for basics on creating new parameters if you have difficulty with this.

Clicking the button enables you to assign control of that element parameter to an equivalent family parameter that can then be either used in formulas or changed directly in the project.

- 14 Assign it the Crown Visible parameter, which you created in the previous step.

Click OK to close each dialog box.

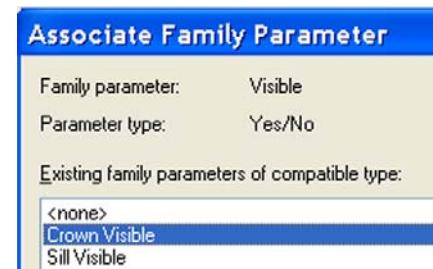
- 15 Open the Family Types dialog box.

Under the Crown Visible parameter row, enter the formula:

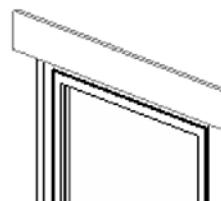
$\text{or}(\text{Width} > 5', \text{Width} = 5')$

- 16 Change the window type from the active one to **4' x 4'**. Note the changes in the crown visibility.

Click OK.



Parameter	Value	Formula
Sill Width	0' 8"	=
Sill Visible	<input checked="" type="checkbox"/>	=
Sill Thickness	0' 2"	=
H	4' 10"	=if(Sill Visible, Height - Sill Thickness, Height)
Default Sill Height	3' 0"	=
Crown Visible	<input checked="" type="checkbox"/>	= $\text{or}(\text{Width} > 5', \text{Width} = 5')$

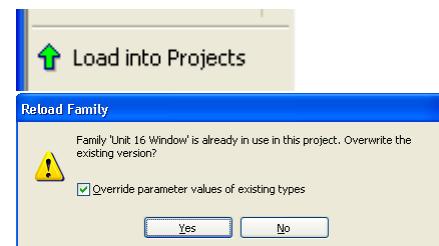


Load the Window Family into Project

- 17 On the design bar, click **Load into Projects**.

Select the **Override Parameter Values of Existing Types** check box.

Click **Yes**.



Flex the Family in the Project

The family parameters displayed are only those of the same type: length parameter if you are setting a distance, yes/no if you are selecting a visibility parameter, material if you are assigning a material parameter, and so on.

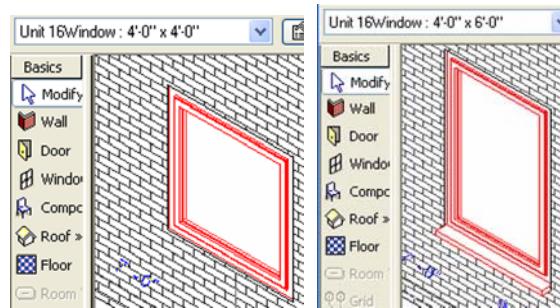
Formulas are case sensitive.

It's a good idea to type the unit suffix in formulas directly to avoid confusion.

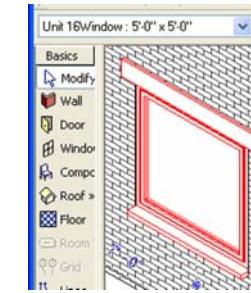
If you have more than one project open, click the i_Unit 16 project you started the exercise with. Click OK.

- 18 Turn off the sill in the window's type properties.

Change the window to different types.



- 19 Use the Window menu to change back to the window family.
20 Close without saving the family.
21 Save the workbook unit exercise RVT file if you want.



The frame now fills in the full height when the sill is turned off.

The family is already loaded into the project. You can save it as a different family or just close it without saving.

Unit 17

Theory: Databases

Revit Architecture: Databases

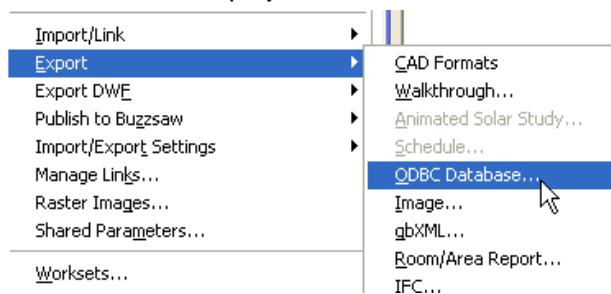
In this exercise you export a Revit Architecture project to an ODBC-compliant database.

Export a Database

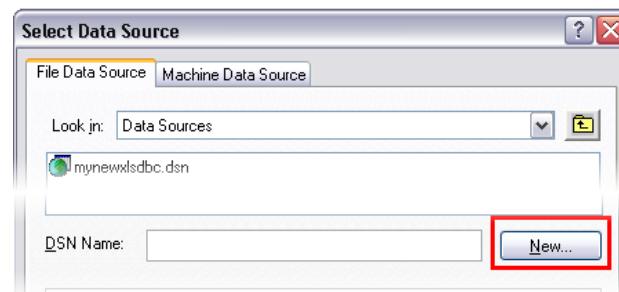
- 1 Open a project. If you are not working on your own project, open one of the projects provided with the workbook.

On the **File** menu, click **Export > ODBC Database**.

There is no data set provided for this exercise. You can start with one of your own projects or any of the workbook data set project files.



- 2 In the Select Data Source dialog box, click **New**.



- 3 Click the **Microsoft Access Driver**.

Click **Next**.



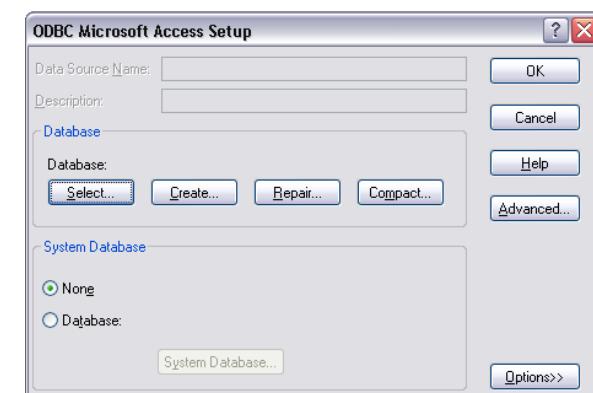
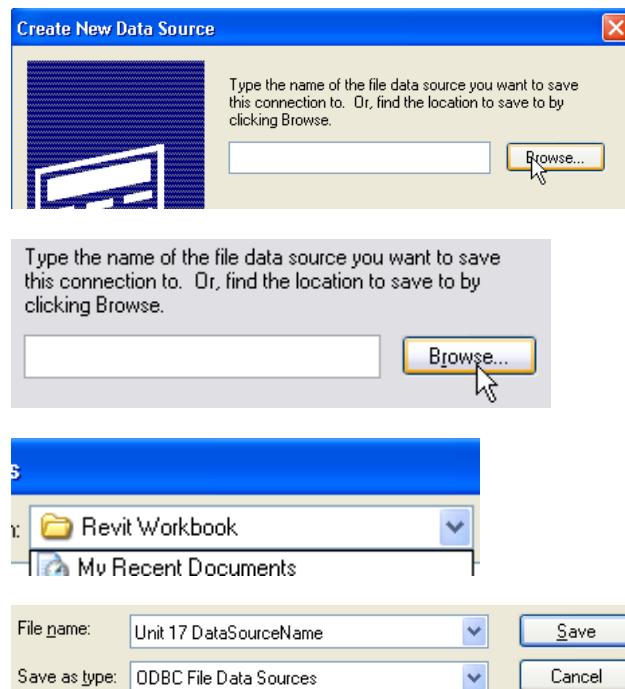
You can export any Revit Architecture project file to an ODBC-compliant database for interaction with other software programs.

ODBC is an acronym for Open Database Connectivity. The purpose is to create a database that any database management system can use. Part of an ODBC-compliant database is a data source name file. This file is like a translator to the database and provides a link between the database and the software used to interpret the data.

In this exercise you create both a Microsoft® Access database (MDB) file and the data source name file.

- 4 In the Create New Data Source dialog box:

- Click **Browse**.
- Browse to the workbook's data set folder.
- Name the file.
- Click **Save**.
- Click **Next**.
- Click **Finish**.



You should now be looking at the ODBC Microsoft Access Setup dialog box.

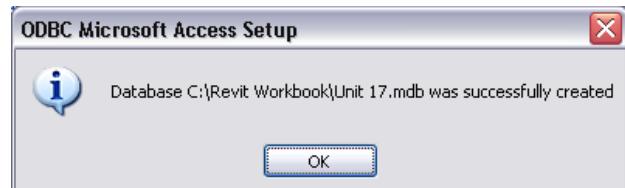
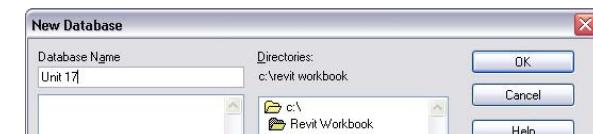
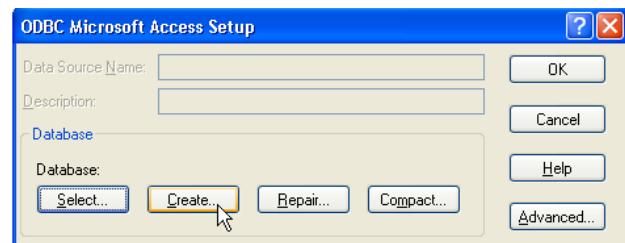
- 5 In the ODBC Microsoft Access Setup dialog box, click **Create**.

Enter a name for the database.

Verify the location where you want to create the database.

Click OK.

- 6 Click OK again.

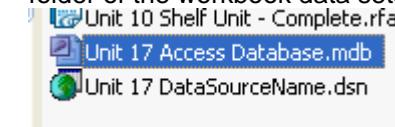


- 7 Click OK again.

8 Click OK again.



The database has been created in the folder you specified. This sample is provided in the *Completed* folder of the workbook data sets.



9 Click OK again.



Unit 18

Theory: Schedules, Tables, and Legends

Revit Architecture: Tags, Schedules and Legends

Schedules are just another view of the building model, but instead of representing the data in a graphical format, the information in the building database is presented in tabular format. The seven exercises in this unit cover the scheduling capabilities of Revit Architecture. Each covers a different aspect of schedules in the Revit Architecture environment.

- Exercise 18A: Door schedules.
- Exercise 18B: Room objects schedule and tags.
- Exercise 18C: Calculated values in a room schedule.
- Exercise 18D: Room finish keys.
- Exercise 18E: Color fill legends.
- Exercise 18F: Symbol legends.
- Exercise 18G: Material takeoff schedules.

Exercise 18A: Door Schedules

In this exercise you create a door schedule, modify its properties, and place it on a sheet.

Create a Schedule

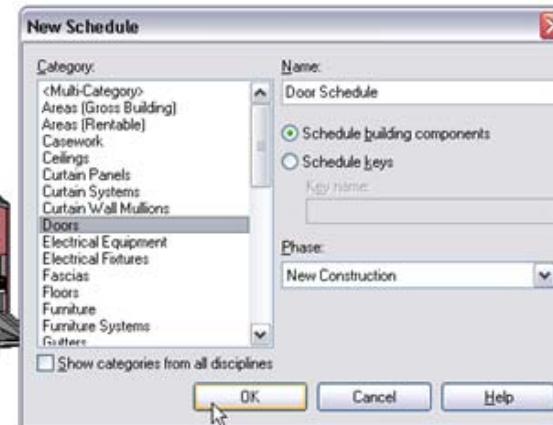
- 1 On the **File** menu, click **Open**.

Browse to find the **file i_Unit 18a – Start** delivered with the workbook and open it.

On the View design bar, click **Schedule/Quantity**.

In the New Schedule dialog box, Category list, select **Doors**.

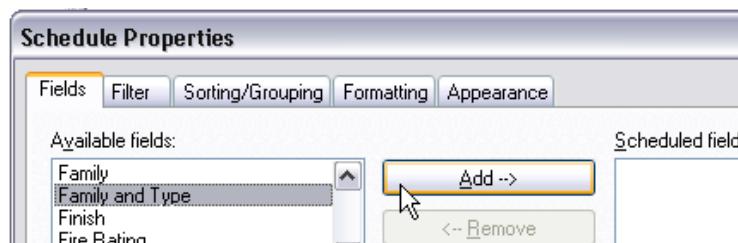
Click OK to proceed to defining the schedule properties.



The file opens with a 3D view of the building. The active view doesn't have an effect on the creation of the schedule table. You can make a schedule table of any object in the model. There are two ways to make a schedule table: using either the **Schedule** button on the View design bar or the View menu, **New > Schedule Table** command.

- 2 In the Schedule Properties dialog box under Available Fields, click **Family and Type**.

Click **Add**.



- 3 The Family and Type field is now moved to the right, under Scheduled Fields. This is now one of the columns in the schedule.

Repeat for two other fields: **Width** and **Height**.



- 4 Click OK to close the Schedule dialog box.

The schedule table is displayed in table form.

Door Schedule		
Family and Type	Width	Height
Single-Flush: 36" x 84"	3' - 0"	7' - 0"
Single-Flush: 36" x 84"	3' - 0"	7' - 0"
Overhead-Rolling: 8' x 6'-6"	8' - 0"	6' - 6"
Single-Flush: 32" x 84"	2' - 8"	7' - 0"
Single-Flush: 32" x 84"	2' - 8"	7' - 0"
Single-Flush: 34" x 84"	2' - 10"	7' - 0"

Every line in the schedule table represents a door within the project. You might think this is an odd way to represent a door, but Revit Architecture can represent an object in a textual manner, showing all important information about that object.

- 5 Right-click the schedule table. Click **View Properties**.



- 6 In the Element Properties dialog box, click the **Edit** button next to **Sorting/Grouping**.

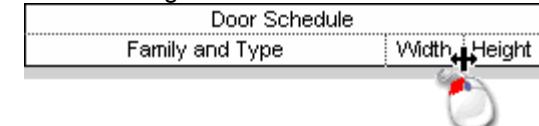


The Available Fields list contains all information that can be extracted from the door object.

On the right is an empty list in which you add the information that you want to see displayed in the schedule table.

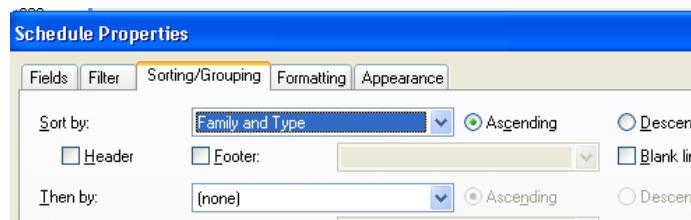
The order of the fields that you have selected determines the order of the columns in the schedule table. You can easily modify this order using the Move Up and Move Down buttons.

You can change the appearance of your schedule table by adjusting the width of the columns. The principle is simple: select the separation line between two columns in the title and drag it to the desired width.



- 7 In the Schedule Properties dialog box, under Sort By, select **Family and Type**.

Click OK to close each dialog box.

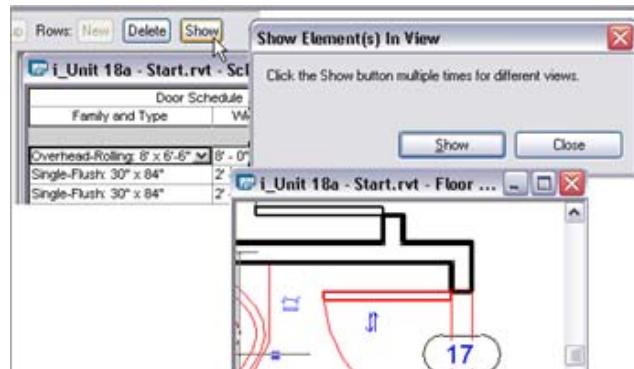


Before you continue working on your door schedule, you need to analyze the possibilities that Revit Architecture proposes at this stage. Let's look at the options bar.

- 8 Click in any schedule table field.

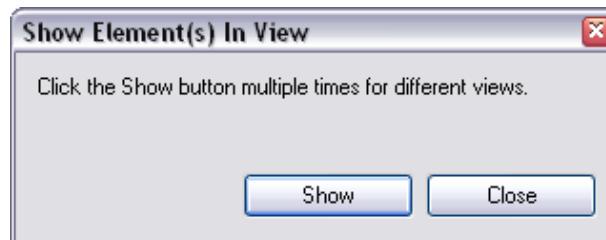
Click **Show**.

Revit Architecture opens a view in which you can see a graphical representation of the selected door.



- 9 Click **Show** several times.

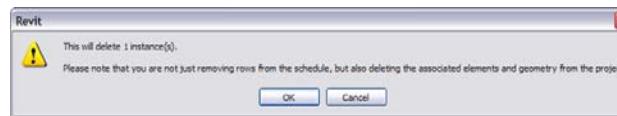
Click **Yes** in the search prompt.



- 10 Click again in any schedule table field.

On the options bar, click **Delete**.

Read the message. Click **Cancel**.



The schedule table displays correctly according to the sorting criteria you have defined. Revit Architecture allows four levels of sorting.

You can achieve the same by right-clicking the schedule field, and then clicking **Show**.

Revit Architecture enables you to search for other views in which this door is displayed. To do that, click **Show**. Should you not want to continue, simply click **Close**.

Revit Architecture double-checks that you really want to delete that instance so you have a final choice of accepting (OK) or cancelling.

Again, you can find the same command by right-clicking and using the shortcut menu.



Finally, you can change the family and type simply by clicking the Family and Type field. This field contains a pull-down list from which you can select the desired door family or type.

Overhead-Rolling: 8' x 6'-6"	8' - 0"	6' - 6"
Single-Flush: 30" x 84"	2' - 6"	7' - 0"
Single-Flush: 30" x 84"	2' - 6"	7' - 0"
Bifold-2 Panel: 30" x 80"	2' - 8"	7' - 0"
Bifold-2 Panel: 30" x 84"	2' - 8"	7' - 0"
Bifold-2 Panel: 32" x 84"	3' - 10"	7' - 0"
Bifold-2 Panel: 36" x 80"	2' - 10"	7' - 0"
Bifold-2 Panel: 36" x 84"	3' - 0"	7' - 0"
Overhead-Rolling: 8' x 6'-6"	3' - 0"	7' - 0"
Single-Flush: 30" x 80"	3' - 0"	7' - 0"

It is important to understand that no matter what changes you undertake in the schedule table, they are populated everywhere in the project.

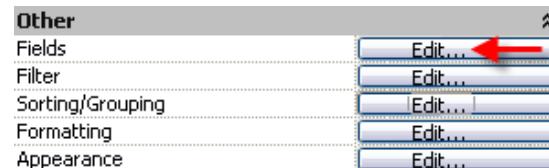
The opposite works as well. If, for example, you delete or add a door in the project, the door is automatically deleted or added in the schedule table. In the Revit Architecture model, the schedule tables are always directionally synchronized with the project.

Note that schedule table cells are editable. You can change any value in the schedule table (for example, the width of the door). You should be careful doing this, however, because the door width is a type parameter. This changes the width of all instances of this type in the project.

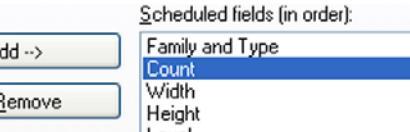
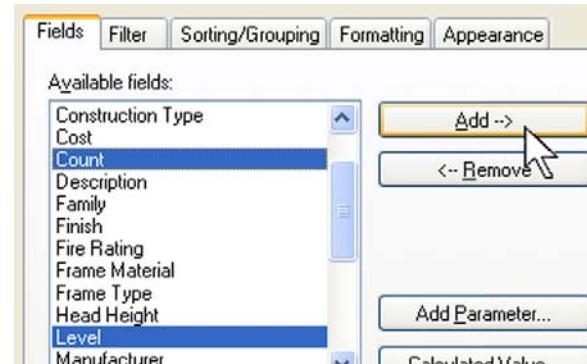
Add Counts and Totals to Schedule

- 11 Right-click the schedule table. Click **View Properties**.

In the Element Properties dialog box, next to Fields, click **Edit**.



- 12 Add the fields **Count** and **Level**. Reorganize them as shown in the image using the Move Up and Move Down buttons.



You have now set all necessary fields. Next is to sort your schedule table to make it more usable. Revit Architecture enables you to sort with four different criteria simultaneously. Here, you want to sort by level and then by family and type.

- 13 Click the **Sorting/Grouping** tab.



- 14 Set the following:

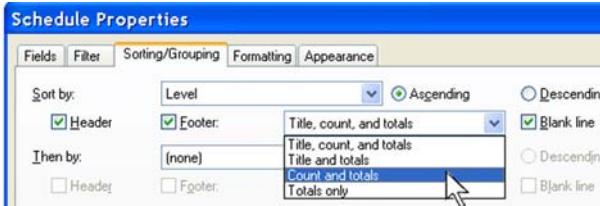
- In the Sort By field, select Level.
- Select the Header and Footer check boxes.
- In the list next to Footer, select Count and Totals.
- Select the Blank Line check box.

Do not close this dialog box.

- 15 In the Then By field, select **Family and Type**.

Select the **Header** and **Blank Line** check boxes.

Click OK to close each dialog box.

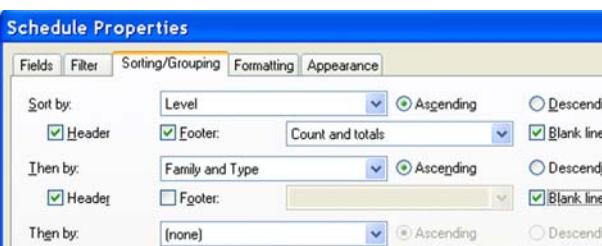


Hide Columns in the Schedule

- 16 Right-click the schedule table.

Click **View Properties**.

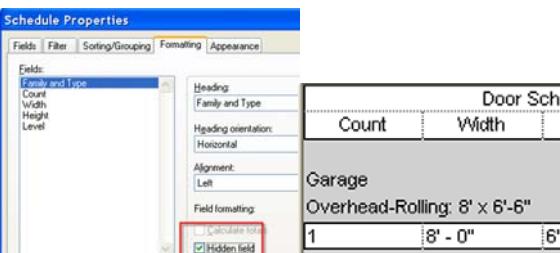
In the Element Properties dialog box, Formatting field, click **Edit**.



- 17 Verify that **Family and Type** is selected.

At the bottom of the dialog box, select the **Hidden Field** check box.

Click OK to close each dialog box.



On the Sorting/Grouping tab you find the criteria set previously. You need to change them. You want to sort this time by level and then family and type. Because there are two criteria for sorting, use the header and footer to provide additional structure to the schedule.

As a result of the criteria you defined, you find doubling parameters. For example, you can see the Header Single Flush in every row of the door, but it's the same for the level as well. This isn't a problem, because Revit Architecture enables you to hide fields you don't want to be visible.

As you can see, the Family and Type field is not displayed. However, notice that the schedule table displays every instance of your doors, but you need to know the total number of doors of the same type. So, you need to fix that final problem.

- 18 Right-click anywhere over the schedule table again.

Click View Properties.

In the **Element Properties** dialog box, next to **Sorting/Grouping**, click the **Edit** button.

Clear the **Itemize Every Instance** check box.

Click OK to close each dialog box.

Duplicate the View



For the moment, you can consider your schedule table ready. However, you haven't yet learned about schedule filters. The filters enable you to filter through the data in the schedule tables. As for sorting/grouping, there are four levels of filtering. You can filter only fields that are already present on the Fields tab.

Should you need it, you can also display the total number of doors in your building. To make that visible, you need to select the Grand Totals check box on the Sorting/Grouping tab.

- 19 In the project browser, right-click **Door Schedule**.

Click Duplicate View > Duplicate.



- 20 In the project browser, right-click **Copy of Door Schedule**. Click Rename.

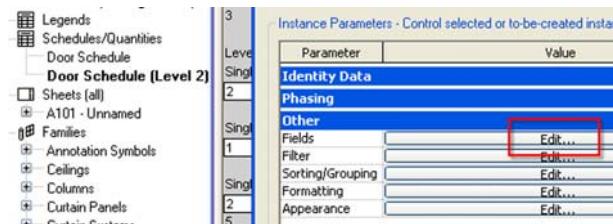
Change the name to **Door Schedule Level 2**.



Click OK.

- 21 Right-click the **Door Schedule (Level 2)** schedule table. Click **View Properties**.

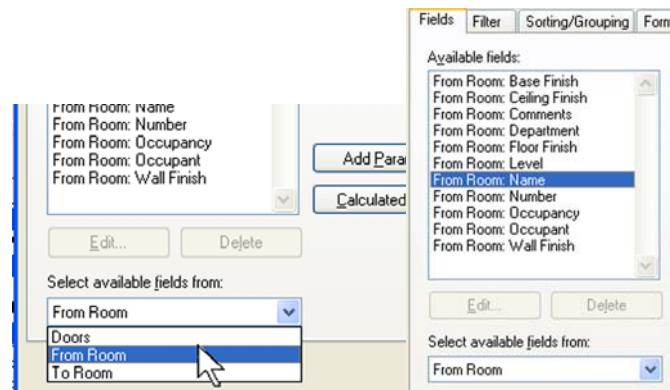
In the Element Properties dialog box, next to **Fields**, click the **Edit** button.



Next, you duplicate the schedule table view and apply a filter to the duplicated view. The goal is to have a schedule table that shows only the doors on Level 2. You reuse the schedule table in the second part of the exercise (Create a Room Schedule Table).

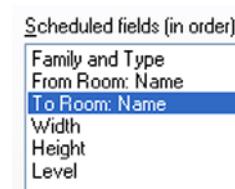
22

- In the Schedule Table Properties dialog box, perform the following:
- Using the Remove button, delete the Count field.
 - From the Select Available Fields From list, select From Room.
 - Under Available Fields, select From Room Name.
 - Click Add.
 - Repeat to add To Room: Name.



23

- Again, arrange the list of fields as shown on the right, using the **Move Up** and **Move Down** buttons.



24

- In the Schedule Properties dialog box, click the **Filter** tab.
- In the Filter By list, select Level.
 - In the next field, select Equals.
 - In the next field below Filter By, select Level 2.



25

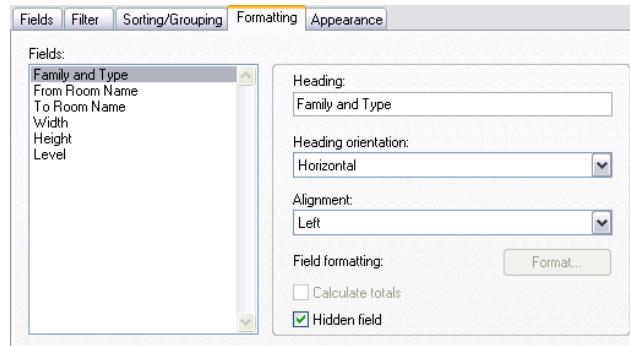
- Click the **Sorting/Grouping** tab:
- Change Sort By back to Family and Type.
 - Verify that Header, Footer, and Count and Totals, and Blank Line are selected.
 - Verify that the Then By sorting line is set to None.
 - Select the Grand Totals check box. Select Count and Totals.
 - Select the Itemize Every Instance check box.



You can just as easily insert or delete fields from the schedule table by double-clicking the desired field.

- 26 Click the **Formatting** tab.

Verify that **Family and Type** is the active field. Select the **Hidden Field** check box.



- 27 Click OK to close each dialog box.

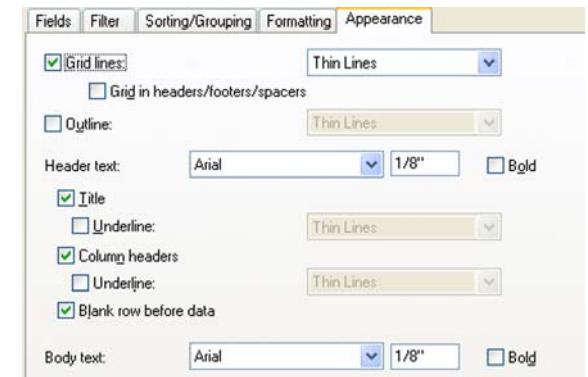
Door Schedule - Level 2				
From Room Name	To Room Name	Width	Height	Level
Single-Flush: 30" x 84"				
Master	Bath	2'- 6"	7'- 0"	Level 2
Master	Closet	2'- 6"	7'- 0"	Level 2
2				
Single-Flush: 32" x 84"				
Corridor	Bath	2'- 8"	7'- 0"	Level 2
1				
Single-Flush: 34" x 84"				
Corridor	Bedroom 2	2'- 10"	7'- 0"	Level 2
Corridor	Master	2'- 10"	7'- 0"	Level 2

Add Door Schedule to a Sheet

Certain parameters of the schedule tables are visible only when a schedule table has been placed on a sheet. That's the case with the parameters on the Appearance tab of the schedule table properties.

You are now going to study the placement possibilities of a schedule table on a sheet. For that purpose you use the entire schedule table of all doors in this building.

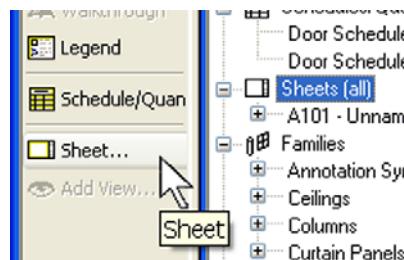
Here, the schedule table displays the criteria you just defined.



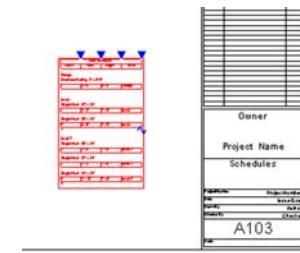
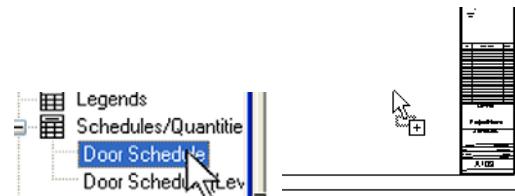
28

In the project browser:

- Click the plus (+) sign to expand **Sheets (All)**.
- Select the sheet **A110 – Schedules** and open it by double-clicking.



29

From the project browser, drag the **Door Schedule** table to the sheet you just opened.

30

Click the schedule. You see a series of controls. Each of the blue grips does something different.

▼ Allows dimensioning of the column width (select, hold, move, and release at the desired position). Note that when you change the width of a column on one part of the split table, it changes in all other parts.

▲ Allows horizontal splitting of the table. Click the symbol and it's done. To reunite the split parts, select the one part and move it over the other. Revit Architecture automatically reconnects the parts.

◆ Allows moving of the table (click, hold, move, release).

● Allows you to change the height of a split part of a table (click, hold, move, release). The allowed moves are up and down. Obviously, changing the height of one schedule part means changing the height of the other. Try it out!

31

Save and close the project.

Exercise 18B: Room Objects, Schedules and Tags

In this exercise you work with the room schedule and tags.

The last exercise did not address the issue of tags. To work with or create a door schedule, all you need are the doors in a project. The tags just present information already associated with the door or in the schedule. The same is true for room schedules. A room does not appear in a schedule unless you place a room object.

This exercise uses the same data set as the previous exercise but does not build on the information created in that exercise.

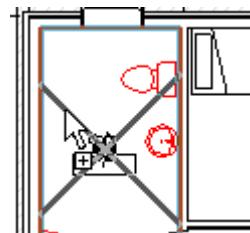
Adjust Room Properties

- 1 On the File menu, click **Open > Browse**. Find the file **i_Unit 18b – Start** delivered with the workbook. Open the file.

In the project browser, select **Level 2**.



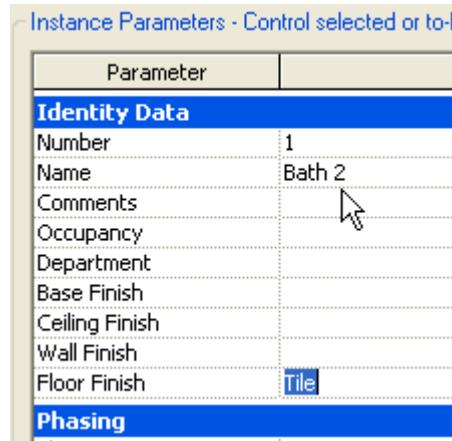
- 2 Hover your cursor near the room tag at the upper-left corner of the building.



The “X” is the room object in Revit Architecture. The room object contains the information for the room schedule about that space in the building.

- 3 Click the room object. Open its properties dialog box:
- Change the name to **Bath 2**.
 - Add **Tile** as the floor finish.

Click OK to return to the drawing window.



Just as for a door or window, the values here can be reported in a schedule.

Create a Duplicate View of the Second Floor

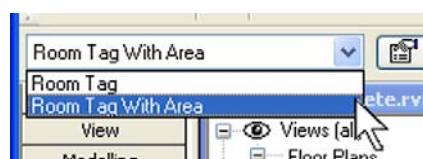
- 4 Duplicate the view of level 2:
- Right-click the Level 2 view. Click Duplicate.
 - Right-click the created Copy of Level 2 view. Click Rename.
 - Change the name to Level 2- Room Areas.
 - Click OK.



When creating a schedule view, you may find it useful to duplicate the plan view in question so you have one plan view free of tags and colors, or to use a different type of tag.

The duplicated view automatically becomes the active view.

- 5 On the design bar, Drafting tab, click **Room Tag**.

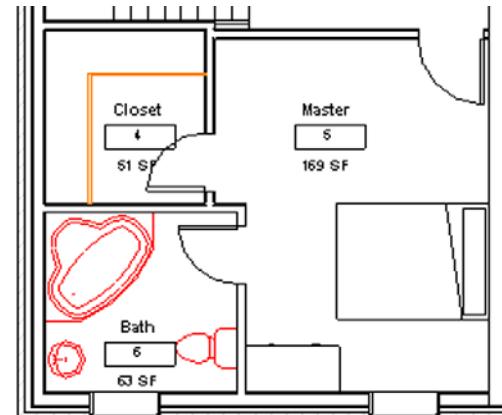
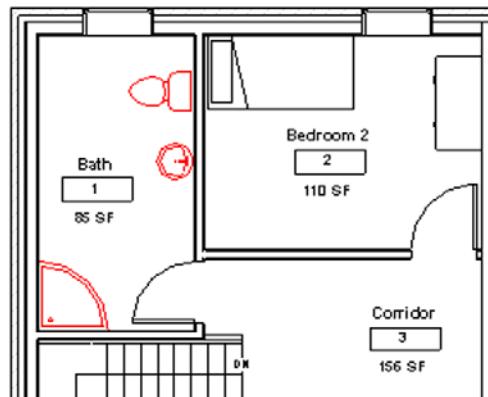


- 6 Set the Room Tag type to **Room Tag with Area**.

Note that the rooms recognize their name, even though this view has no tags. The information displayed by the tag is stored by the room object. This enables you to make multiple views of the same level but use different tagging and annotation styles.

This is an annotation type. Like windows and doors, annotation such as text and tags are also based on family and type. Room Tag with Area is an external family file that you can load and use in any project.

- 7 Start clicking in each room on this floor. Don't worry about the name or number of the rooms you are tagging at the moment. Tag the rooms as shown in the illustrations at right.



Create a Room Schedule

Revit Architecture also allows modification of the names of the rooms from within the schedule table itself. For this, however, you need to have created the room schedule—something you have not yet done. Although the room names appear in your door schedule table, you cannot modify them from here.

When the room schedule is created before the actual room and with the condition that the room names exist in that table, you can select that room as it is inserted using the options bar.

The most effective solution is to select the room tag itself and change its properties on the fly: click the room tag text, and the text becomes an editable zone. Type the desired text and press ENTER, or simply click anywhere in the workspace with the left mouse button.

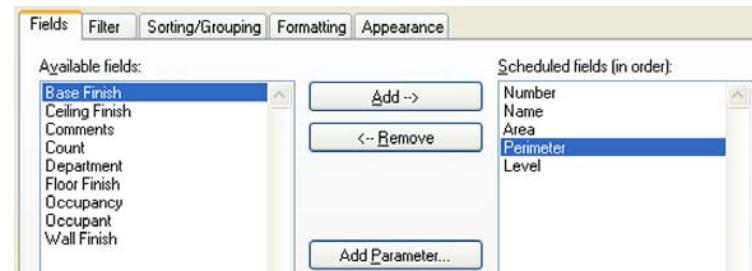
- 8 On the design bar, View tab, click **Schedule/Quantities**.

Select **Rooms** as a category.

Click OK.

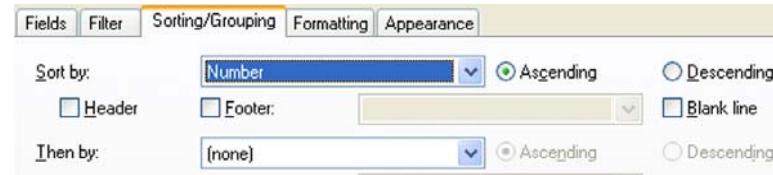


- 9 In the Schedule Table Properties dialog box, add the fields **Number**, **Name**, **Area**, **Perimeter**, and **Level**.



- 10 Click the **Sorting/Grouping** tab.

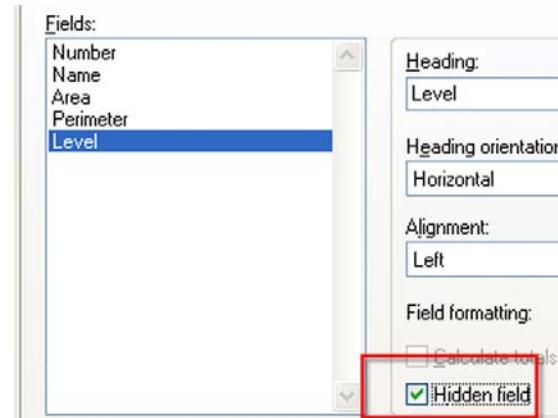
Next to Sort By, select **Number**.



- 11 Click the **Formatting** tab.

Select **Level**.

Select the **Hidden Field** check box.



- 12 Select **Area**. Click **Field Format**.

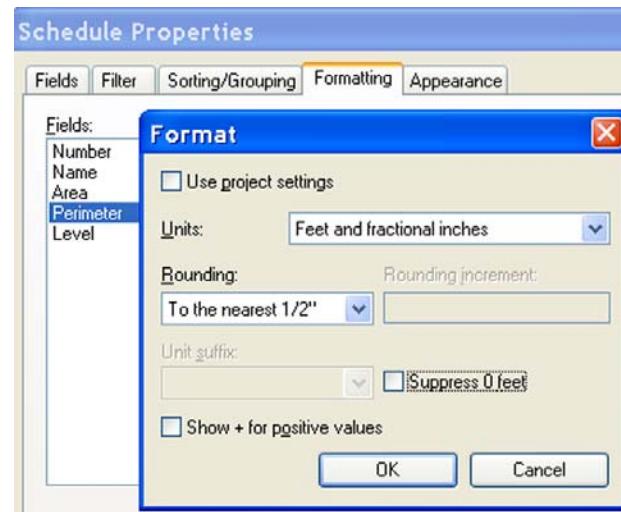
Clear the **Use Project Settings** check box.

Set **Square Feet** for Units, **1 Decimal Place** for rounding, and **SF** for Unit Suffix.



- 13 Repeat for the Perimeter field (set units **Feet and Fractional Inches**, rounding nearest to 1/2").

Click OK to create the schedule.



Put Rooms and Tagging Together with the Room Schedule

In this section you open the first floor plan and tile the views before you add the rooms to the first floor.

- 14 Close Hidden Windows.

Tile the Room Schedule and Floor Plans: Level 1.

Room Schedule			
Number	Name	Area	Perimeter
1	Bath 2	85.5 SF	38' - 10 1/2"
2	Bedroom 2	110.3 SF	42' - 4 1/2"
3	Corridor	155.8 SF	57' - 0 1/2"
4	Closet	51.0 SF	28' - 7"
5	Master	168.8 SF	54' - 0 1/2"
6	Bath	63.4 SF	31' - 10 1/2"

Room Schedule			
Number	Name	Area	Perimeter
1	Bath 2	85.5 SF	38' - 10 1/2"
2	Bedroom 2	110.3 SF	42' - 4 1/2"
3	Corridor	155.8 SF	57' - 0 1/2"
4	Closet	51.0 SF	28' - 7"
5	Master	168.8 SF	54' - 0 1/2"
6	Bath	63.4 SF	31' - 10 1/2"

Notice how even though there are rooms on Level 1, they do not show up in the schedule because no rooms have been placed on this level.

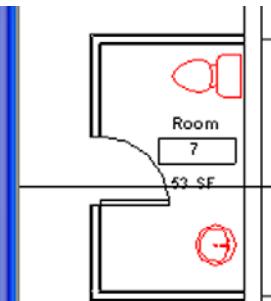
Also even though you duplicated Level 2, only one row shows up in the schedule for each room.

You also use the area separation lines to define rooms not enclosed by walls.



- 15 Use the **Room** tool on the Basics tab of the design bar to add a room and tag to the powder room at the middle right of the plan.

Room Schedule			
Number	Name	Area	Perimeter
1	Bath	85.5 SF	38' - 10 1/2"
2	Bedroom 2	110.3 SF	42' - 4 1/2"
3	Corridor	155.8 SF	57' - 0 1/2"
4	Closet	51.0 SF	28' - 7"
5	Master	168.8 SF	54' - 0 1/2"
6	Bath	63.4 SF	31' - 10 1/2"
7	Room	53.5 SF	30' - 4"



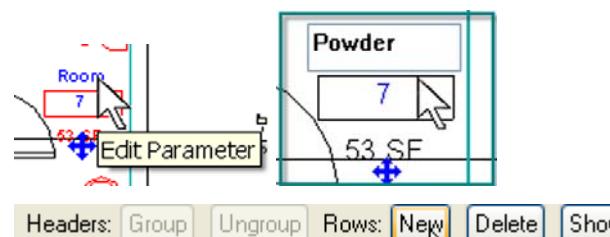
A room is added to the schedule, and a tag is added to the room.

The room appears in the schedule with its area and perimeter.

- 16 Click the **Modify** tool.

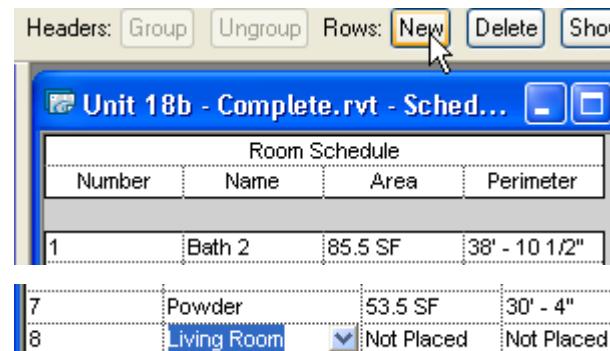
Click in the **Tag Room Name** field.

Set the room name to **Powder**.



- 17 Make the schedule the current view.

Click **Rows: New**.

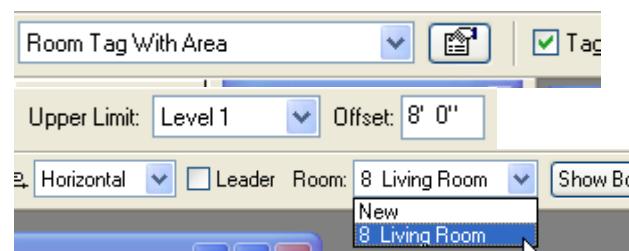


- 18 In the schedule, type **Living Room** for the new room name.

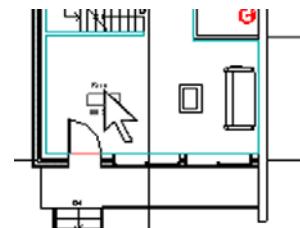
- 19 Click the **Room** tool.

On the options bar, set the following:

- Tag Type = Room Tag with Area.
- Upper Limit = Level 1.
- Offset = 8'-0".
- Room = 8 Living Room.



- 20 Use the **Room** tool to add a room and tag to the living room.



5	Master	168
6	Bath	63
7	Powder	53

You can modify either the tag or the schedule.

Because this room does not exist as a room object in the project yet, the area and perimeter cannot be calculated.

The room you added to the room schedule is available as a room to add.

Before you place the tag, the assumed perimeter is highlighted.

- 21 In the schedule, on the last line change the name from Living Room to **Living**.

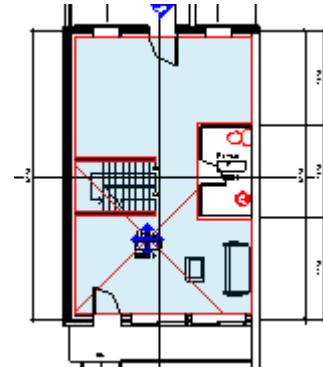


Living

8

500 SF

The tag updated.



The living room extends through the entire floor where there are no room bounding elements to constrain it. Room bounding elements can be columns, curtain walls, walls, or room separation lines.

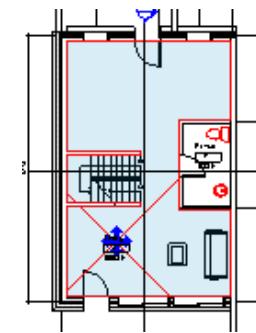
Separate Rooms

In this section you add room separation lines between the stair and living room areas. These lines enable rooms to exist side by side when there is no wall between the rooms.

- 22 Tile both the room schedule and the view Level 1.

Click the Living room in the schedule.

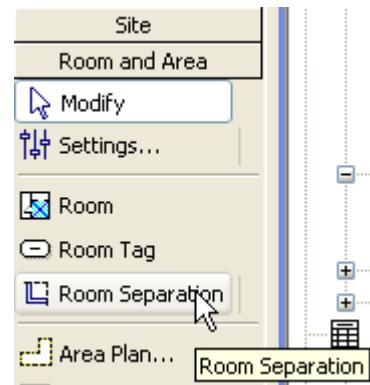
On the options bar, click **Show**.



The plan view zooms to the room selected in the schedule. This shows the living room extending into the stair area.

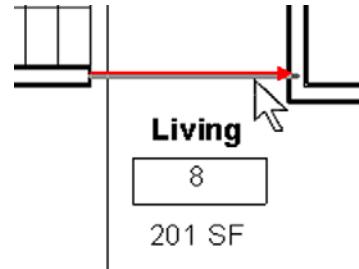
- 23 On the design bar, click the **Room and Area** tab.

Click **Room Separation**.

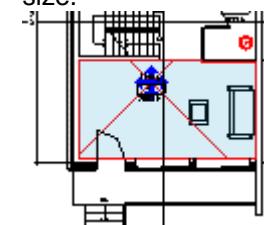


- 24 Click the wall at the bottom of the stairs.

Click the wall at the powder room.

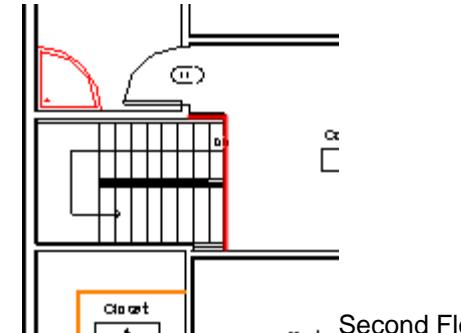
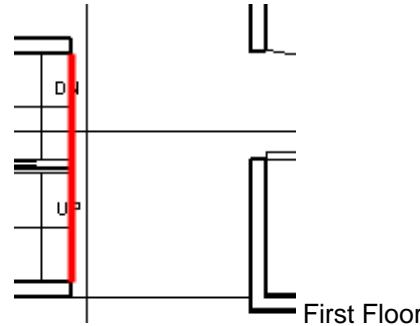


The tag is now associated with the area of the living room up to the room separation line. The tag updates to show the smaller size.



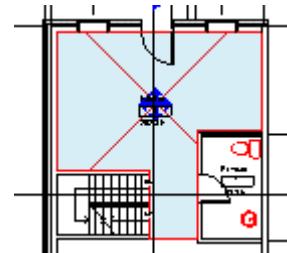
- 25 Add two more room separation lines to separate the stair.

Add this to both the first and second floors.



- 26 Add a room to the north side of Level 1.

Name it **Kitchen**.



Add a Multifloor-Spanning Room

Stairs and how their areas are calculated vary from region to region. Often stairs, atriums, or other spaces that span multiple floors are only calculated once. To do this, the room must have parameters that tell it to extend up to these upper levels.

- 27 Activate the Level 1 plan.

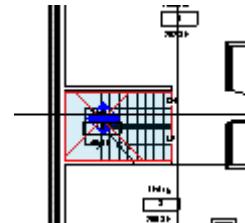
- 28 Click the **Room** tool.

Set the Upper limit to **Level 2** with Offset of **8'**.



- 29 Add this room to the stairs area on Level 1.

Click the **Modify** tool. Rename this room **Stair**.



- 30 Activate the **Level 2 – Room Areas** view, and tag the stair.



The tag takes on the value of the space you just added because the volume of the space extends up 8 feet past the second-floor level.

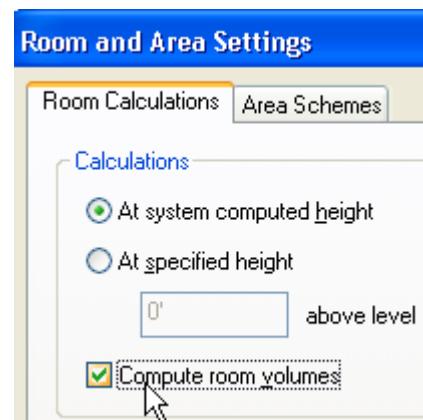
Add a Volume Column to the Room Schedule

If you turn on volume in the room and area settings, you can then add the volume column to the room schedule.

- 31 On the design bar, click the **Room and Area > Settings**.



- 32 Select the **Compute Room Volumes** check box.

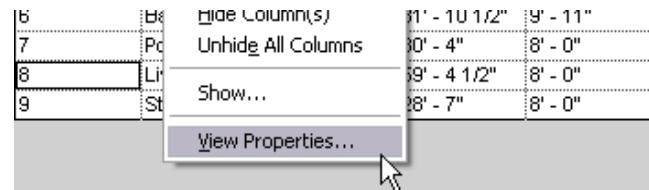


This dialog box also gives you control over how the room areas are calculated.

Boundary Location

- At wall finish
- At wall center
- At wall core layer
- At wall core center

- 33 Set the Room Schedule current, and open its view properties.



- 34 Edit the fields to add **Volume** to the schedule.

Scheduled fields (in order):

- Number
- Name
- Area
- Perimeter
- Level
- Volume**

- 35 Click OK to return to the schedule.

Room Schedule				
Number	Name	Area	Perimeter	Volume
1	Bath 2	85.5 SF	38' - 10 1/2"	847.42 CF
2	Bedroom 2	110.3 SF	42' - 4 1/2"	1093.70 CF
3	Corridor	104.5 SF	43' - 1 1/2"	1035.85 CF
4	Closet	51.0 SF	28' - 7"	506.18 CF
5	Master	168.8 SF	54' - 0 1/2"	1673.84 CF
6	Bath	63.4 SF	31' - 10 1/2"	629.10 CF
7	Powder	53.5 SF	30' - 4"	427.66 CF
8	Living	199.9 SF	59' - 4 1/2"	1598.93 CF
9	Kitchen	252.0 SF	76' - 8 1/2"	2016.09 CF
10	Stair	48.6 SF	28' - 7"	850.13 CF

The schedule now reports volume for each of the rooms in the project.

Exercise 18C: Calculated Values for Rooms

In this exercise you duplicate the schedule created in the last exercise to create another in which you directly read the total area of each room as well as the percentage of that room type according to the total area of the building.

Create a Calculated Values Table for the Second Level

- 1 Open data set i_Unit 18c – Start.rvt. Verify that the Room Schedule is the current view.

In the project browser, duplicate the Room Schedule.

Rename it

Room Schedule (Level2 – Surfaces).

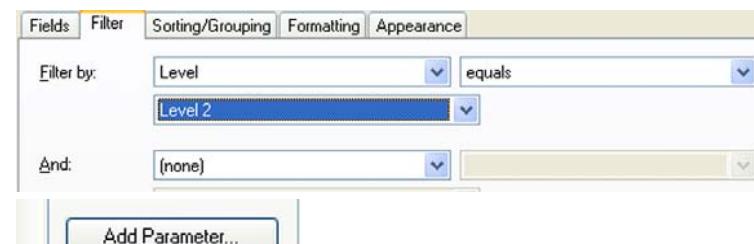
- 2 Right-click the new schedule. Click **Properties**.

Click the **Edit** button next to Fields.

- 3 Click the **Edit** button next to the Filter.

Add a new filter condition under Filter By: Level equals Level 2.

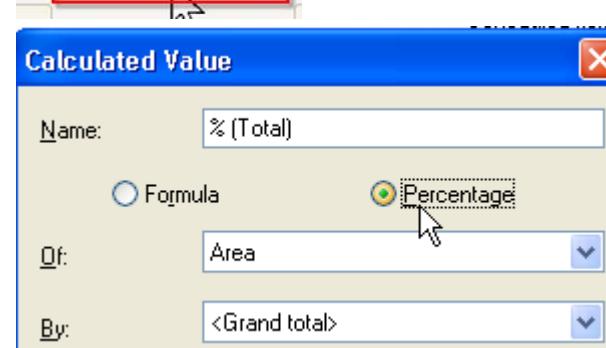
- 4 On the Fields tab, select Number and click **Calculated Value**.



- 5 In the Calculated Value dialog box, set the following:

- Next to Name, enter % (Total).
- Click Percentage.
- Next to Of, select Area.
- Next to By, select Grand Total.

Click OK.

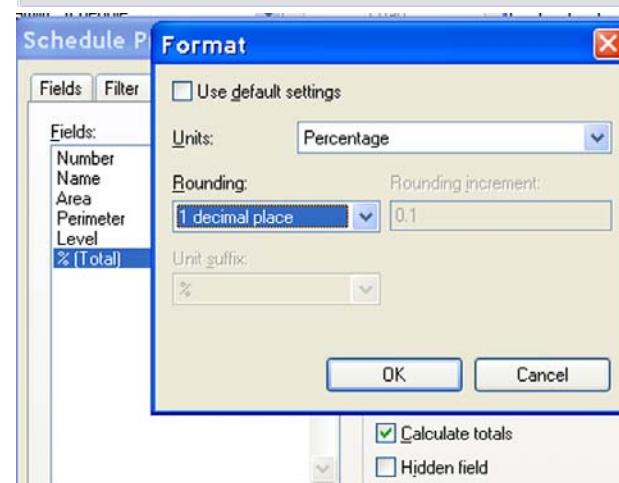


All these commands are also available when you right-click the schedule in the project browser.

- 6 Click the **Sorting/Grouping** tab.
- Change the sorting condition to **Name**.
 - Select **Header** and **Footer** (keep Title, Count, and Totals).
 - Select Blank Line.
 - Select **Grand Total** (keep Title, Count, and Totals).
 - Clear Itemize Every Instance.



- 7 Click the **Formatting** tab:
- Select the calculated field that you created previously (%Total).
 - Select Calculate Totals.
 - Click **Format**.
 - Next to Units, select **Percentage**, Rounding **1 Decimal Place**.



Click OK to return to the schedule.

- 8 Save the project.

Number	Name	Area	Perimeter	Volume	% (Total)
Bath					
6	Bath	63.4 SF	31' - 10 1/2"	629.10 CF	10.9%
	Bath: 1				10.9%
Bath 2					
1	Bath 2	85.5 SF	38' - 10 1/2"	847.42 CF	14.6%
	Bath 2: 1				14.6%
Bedroom 2					
2	Bedroom 2	110.3 SF	42' - 4 1/2"	1093.70 CF	18.9%
	Bedroom 2: 1				18.9%
Closet					
4	Closet	51.0 SF	28' - 7"	506.18 CF	8.7%
	Closet: 1				8.7%
Corridor					
3	Corridor	104.5 SF	43' - 1 1/2"	1035.85 CF	17.9%
	Corridor: 1				17.9%
Master					
5	Master	168.8 SF	54' - 0 1/2"	1673.84 CF	28.9%
	Master: 1				28.9%

Exercise 18D: Room Schedule Keys

In this exercise you add room finish keys to the schedule.

To finish your room schedule table, you are going to create a schedule key. The idea is to be able to associate to each room a finish for the walls, floor, and ceilings. Instead of tediously copying and pasting these values to each room, you prepare a new schedule in which all those finishes are listed and then link it to your room schedule.

Add Room Finish Keys to Schedule

- 1 On the File menu, click **Open > Browse**. Find the file **i_Unit 18d – Start.rvt** delivered with the workbook. Open the file.

- 2 On the Views design bar, click **Schedule/Quantities**.

From the Category list, select **Rooms**.

Click **Schedule Keys**.

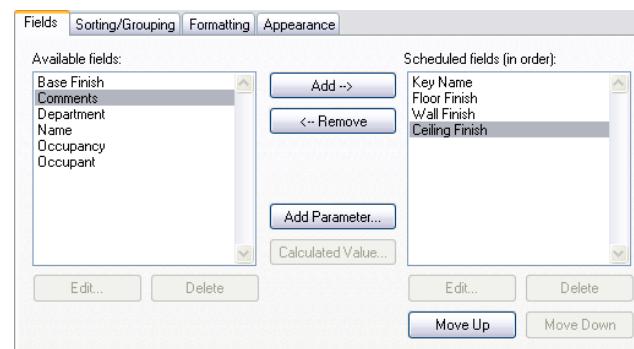
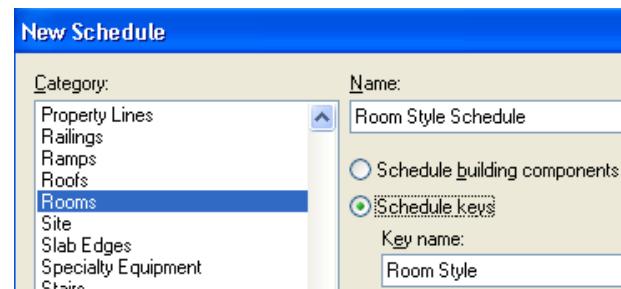
You can change the name of the schedule if you want to.

Click OK to open the Schedule Properties dialog box.

- 3 On the Available Fields list, select:

- Floor Finish.
- Wall Finish.
- Ceiling Finish.

Either select each field by clicking the **Add** button each time, or select them all by holding **CTRL** and add them all at once.



- 4 Click OK.

Room Style Schedule			
Key Name	Floor Finish	Wall Finish	Ceiling Finish

- 5 Click in the schedule view.

On the options bar, click **New**.

Room Style Schedule			
Key Name	Floor Finish	Wall Finish	Ceiling Finish
1			
Room Style Schedule			
Key Name	Floor Finish	Wall Finish	Ceiling Finish
1	Tile	Wallpaper	White Paint
2	Wood	White Paint	White Paint
3	Tile	Tile	White Paint

In principle you should now fill out all the information you have about all possible finishes. The first column is automatically generated as a numeric column in which the number increments with every line added. You can change the numbers, but you cannot duplicate numbers.

The Key Name field is automatically generated. It is this field that creates the link between the two schedules. So, do not delete it!

The schedule key table is usually empty when created. Your next task is to fill it with all the necessary information.

Next, you link this schedule to the room schedule so that you can use these values within it.

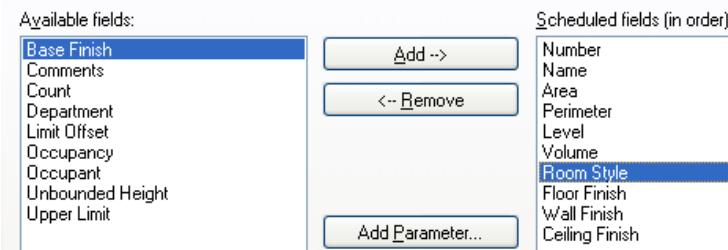
- 6 In the project browser, right-click the room schedule. Click **Properties**.

Click the **Edit** button next to Fields.

Under Fields, you can now add the following fields:

- Room Style.
- Floor Finish.
- Wall Finish.
- Ceiling Finish.

Click OK.



- 7 The principle is simple: you click the Room Style fields and select the key corresponding to the finishes in that room. The Floor Finish, Wall Finish, and Ceiling Finish columns are automatically filled.

Room Schedule									
Number	Name	Area	Perimeter	Volume	Room Style	Floor Finish	Wall Finish	Ceiling Finish	
1	Bath 2	85.5 SF	38' - 10 1/2"	847.42 CF	3	Tile	Tile	White Paint	
2	Bedroom 2	110.3 SF	42' - 4 1/2"	1093.70 CF	2	Wood	White Paint	White Paint	
3	Corridor	104.5 SF	43' - 1 1/2"	1035.85 CF	3	Tile	Tile	White Paint	
4	Closet	51.0 SF	28' - 7"	506.18 CF	(none)				
5	Master	168.8 SF	54' - 0 1/2"	1673.84 CF	(none)				
6	Bath	63.4 SF	31' - 10 1/2"	629.10 CF	1				
7	Powder	53.5 SF	30' - 4"	427.66 CF	2				
8	Living	199.9 SF	59' - 4 1/2"	1598.93 CF	3				

Exercise 18E: Color Scheme

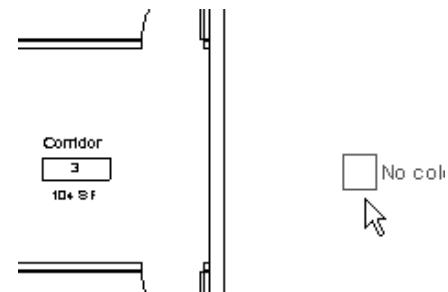
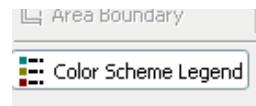
In this exercise you create a color scheme to give a visual indicator to the information held in the room objects.

Add a Color Scheme Legend

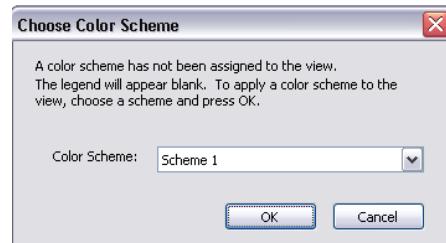
- 1 On the File menu, click **Open > Browse**. Find the file **i_Unit 18e – Start.rvt** delivered with the workbook. Open the file.

- 2 In the project browser, activate **Level 2 - Room Areas**.

On the Room and Area tab, click **Color Scheme Legend**. Click in the drawing window to place the legend next to the floor plan.



- 3 Click OK in the information dialog box that appears.



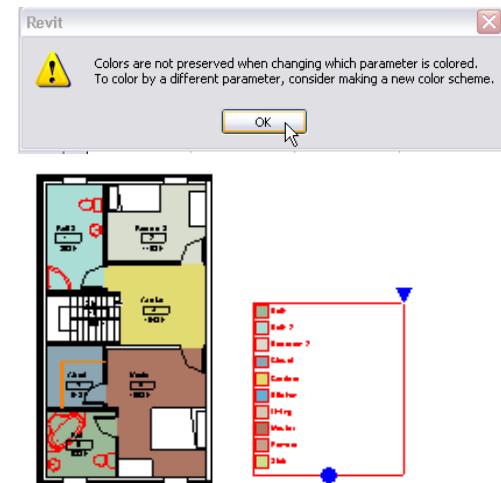
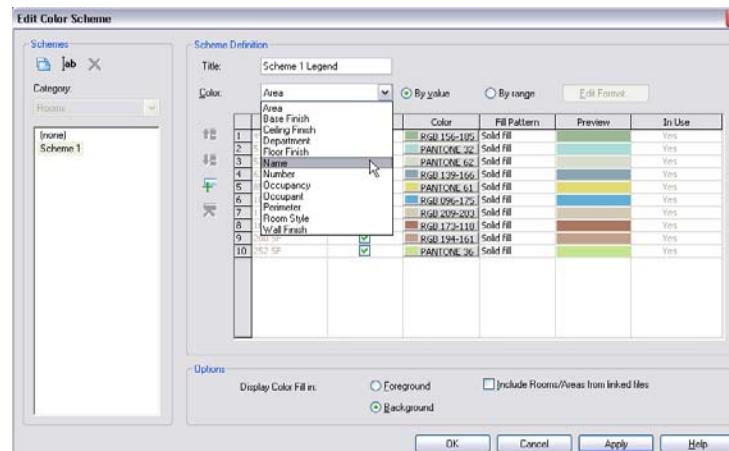
- 4 Select the Color Fill object.

On the options bar click **Edit Color Scheme**.



- 5 Change the Color value to **Name**. Colors are automatically assigned to each room name in the view.

Click OK in the warning dialog box.



6 Select the legend.



7 With the color scheme selected, on the options bar, click **Edit Color Scheme**.

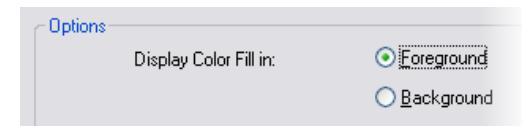
In the Edit Color Scheme dialog box, change **Display Color Fill In** to **Foreground**.

Click OK to return to the drawing window.

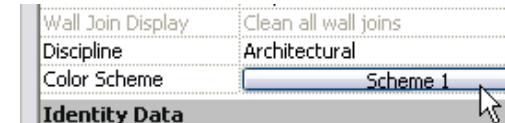


▼ Allows dimensioning of the width of the legend. If the legend has more than one column, you can change their widths independently.

● Allows dimensioning of the height of the legend. Should the height you are setting not be sufficient for the entire legend, Revit Architecture automatically splits the legend in various columns.



View Properties now holds the color scheme for the view. You can assign color scheme definitions here.



Exercise 18F: Legends

In this exercise you create a window legend. A legend is a chart of symbols in the project. You can create legends for any Revit Architecture objects, such as walls, windows, and furniture.

The exercise uses the same data set as the previous exercise but does not build on the information created in that exercise.

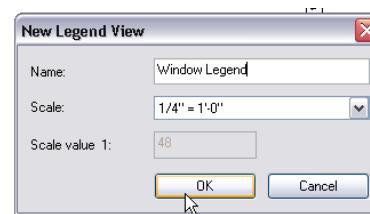
Create a Legend

- 1 On the File menu, click **Open > Browse**. Find the file **i_Unit 18f – Start** delivered with the workbook. Open the file.



- 2 On the design bar, click **Views**. Click **Legend**.

Rename the legend **Window Legend**.

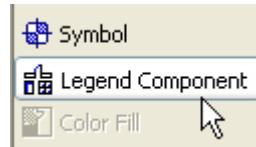


- 3 Click the design bar **Modeling** tab.



- 4 On the design bar, click **Drafting**.

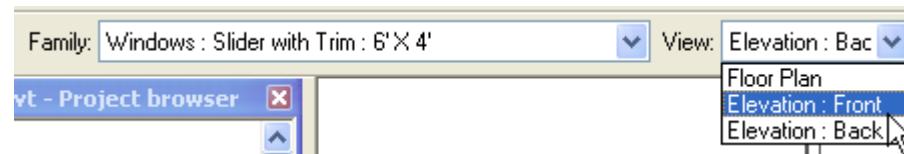
Click **Legend Component**.



This creates and opens a new view. The new view is created in its own category in the project browser. The legend view appears blank with no views of the building model. Think of a legend as a piece of paper on which you place symbols that represent the objects in the building model.

Notice that all the tools are unavailable. There is a special tool you use to add the objects in symbol mode to the legend.

- 5 Use the options bar list to select the following:
- Family = Windows: Slider with Trim 6' X 4'.
 - View = Elevation: Front.

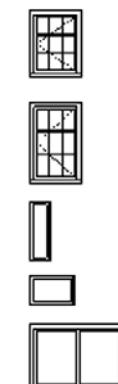


- 6 Click in the legend to place the window.

The symbol of the window is shown in the legend.

- 7 Repeat, adding the window types shown here.

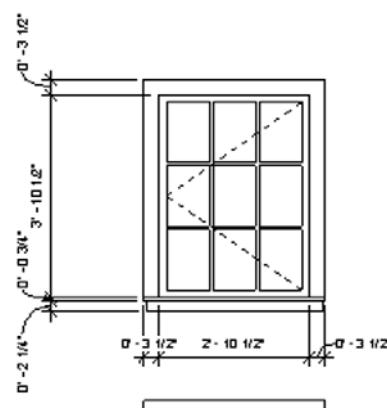
Casement 3x3 with Trim: 36" x 48"
Casement 3x3 with Trim: 36" x 60"
Fixed: 16" x 48"
Fixed: 36" x 24"
Slider with Trim: 6' X 4'



- 8 Change the scale of the legend to 1/2" = 1'-0".

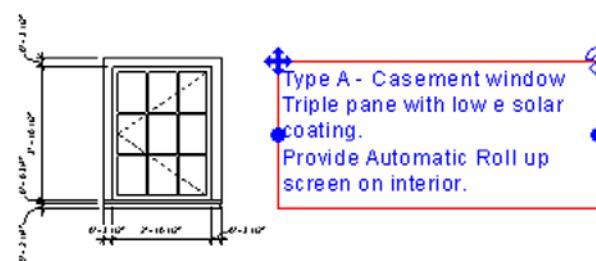


- 9 On the Basics design bar, use the **Dimension** tool to dimension the windows.



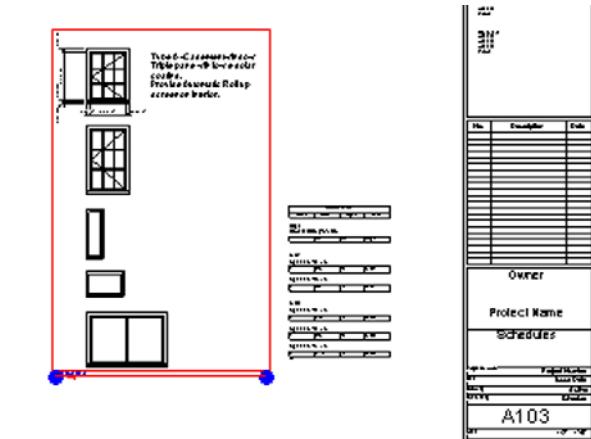
Because this is a window *type*, the window legend is a convenient location to place common information about this window that occurs in multiple locations in the project.

- 10 On the Basics design bar, use the **Text** tool to add notes to the legend.



- 11 Open the schedules sheet.

Drag the legend onto it from the project browser.



- 12 Save and close the project.

Exercise 18G: Material Takeoffs

A material takeoff is just a specialized form of a schedule. This exercise leads you through creating a material takeoff view for the walls.

The exercise uses the same data set as the previous exercise but does not build on the information created in that exercise.

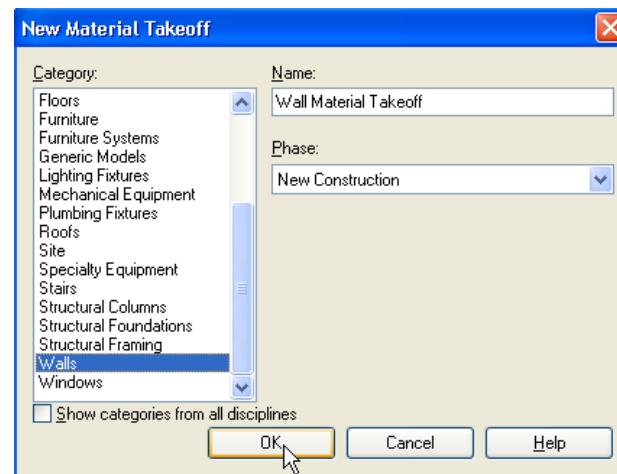
Create a Material Takeoff List

- 1 On the File menu, click **Open > Browse**. Find the file i_Unit 18g – Start delivered with the workbook. Open the file.

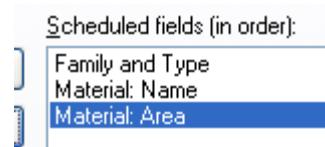
- 2 On the **View** menu, click **New > Material Takeoff**.



- 3 In the New Material Takeoff dialog box:
- Under Category, select **Walls**.
 - Click OK.



- 4 On the Field tab, add the fields shown in the illustration at right.
Click the **Filter** tab.



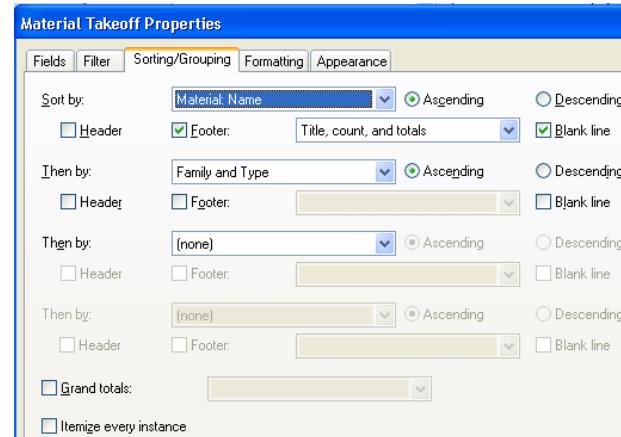
5 Leave Filter By set to **None**.

Click the **Sorting/Grouping** tab.



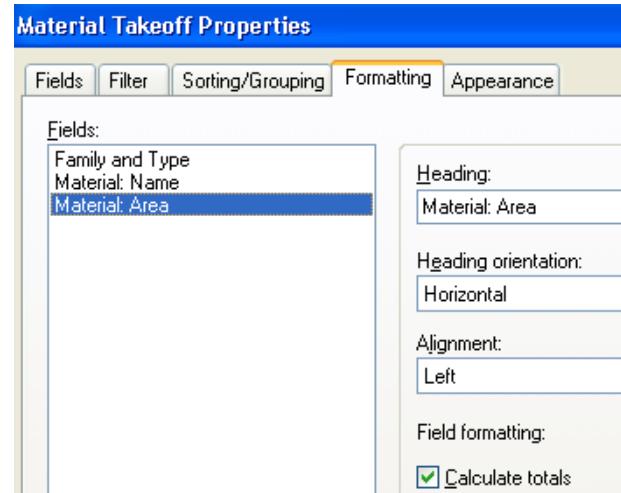
6 On the Sorting/Grouping tab:

- Set Sort By to **Material Name**.
- Select the **Footer** check box, and set to **Title, Count, and Totals**.
- Select **Blank Line** for the sort criteria.
- Clear the Itemize Every Instance check box.



7 On the Formatting tab:

- Select Material: Area.
- Select the **Calculate Totals** check box.



8 Click OK.

Wall Material Takeoff		
Family and Type	Material Name	Material Area
Basic Wall: Exterior - Brick on Mtl. Stud	Air Barrier - Air Infiltration Barrier	1923 SF
Air Barrier - Air Infiltration Barrier: 5		1923 SF
Basic Wall: Generic - 6"	Default Wall	203 SF
Basic Wall: Generic - 8"	Default Wall	1082 SF
Default Wall: 6		1284 SF
Basic Wall: Exterior - Brick on Mtl. Stud	Finishes - Interior - Gypsum Wall Board	1904 SF
Basic Wall: Interior - 4 7/8" Partition (1-hr)	Finishes - Interior - Gypsum Wall Board	2263 SF
Finishes - Interior - Gypsum Wall Board: 18		4167 SF
Basic Wall: Exterior - Brick on Mtl. Stud	Masonry - Brick	1873 SF
Masonry - Brick: 5		1873 SF
Basic Wall: Exterior - Brick on Mtl. Stud	Metal - Stud Layer	1910 SF
Basic Wall: Interior - 4 7/8" Partition (1-hr)	Metal - Stud Layer	1131 SF
Metal - Stud Layer: 18		3041 SF
Basic Wall: Exterior - Brick on Mtl. Stud	Misc. Air Layers - Air Space	1882 SF
Misc. Air Layers - Air Space: 5		1882 SF
Basic Wall: Exterior - Brick on Mtl. Stud	Vapor / Moisture Barriers - Vapor Retarder	1923 SF
Vapor / Moisture Barriers - Vapor Retarder: 5		1923 SF
Basic Wall: Exterior - Brick on Mtl. Stud	Wood - Sheathing - plywood	1882 SF
Wood - Sheathing - plywood: 5		1882 SF

The materials schedule is now part of the project. On your own, add the cost field and add a calculated parameter that multiplies the area field times the cost field.

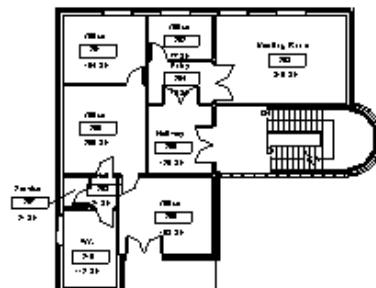
Unit 19

Theory: Time

Revit Architecture: Phasing

This unit explains how the time parameter is managed in Revit Architecture.

- 1 Open file i_Unit 19 – Start.



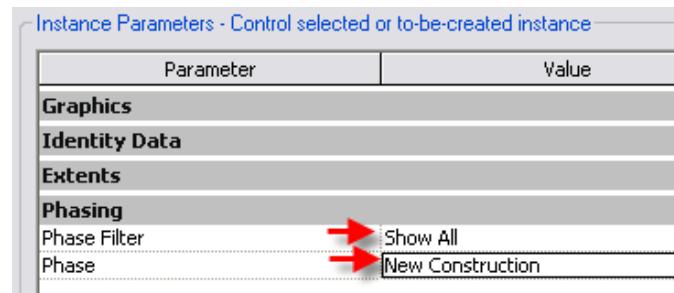
- 2 In the project browser, right-click **Floor Plan Level 2**. Click **Duplicate**.

Rename the new view **Level 2 – Demolition**.



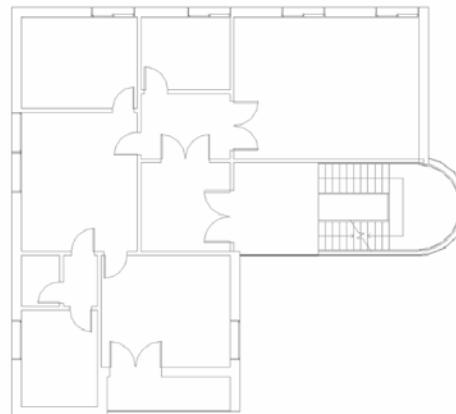
- 3 In the Level 2 Demolition plan, open the view properties and change:

- Phase to New Construction.
- Phase Filter to **Show All**.



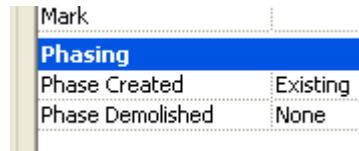
To open View Properties you can right-click the view in the project browser and then click Properties, or right-click anywhere in the view and click View Properties on the shortcut menu.

- 4 Click OK to return to the drawing window.



- 5 Click one of the walls in the plan. Open its properties.

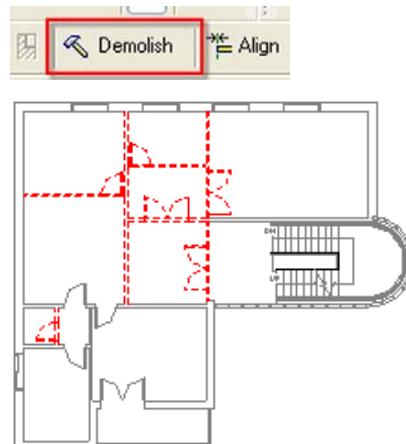
Verify that Phase Created is set to **Existing** and Phase Demolished is set to **None**.



Demolish Walls and Doors

- 6 On the toolbar, click **Demolish**. Click the walls in the middle of the building (see image).

Also click the wall dividing the bathroom area on the bottom left (see image).



Note how the appearance of the existing components changes when the phase of the view is changed.

The first thing you should notice is that views have a parameter called *phase*.

Depending on the value of this parameter, all components created (or demolished) in this view, have their Created Phase set as the one the view belongs to. In this case, the walls and doors you demolish were created in the Existing Phase and are demolished in the New Construction Phase.

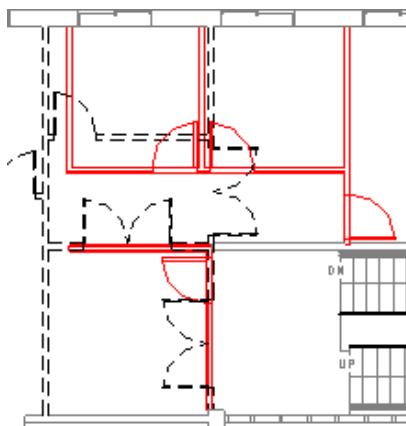
For every object in the building model there is also a phasing property. For each object, Revit Architecture tracks the phase created and the phase demolished. As noted earlier, the phase created is read from the phase property of the view in which it is created.

When you demolish a component, its display changes according to the phase filter assigned to the view.

Phase filters are found in the view properties.

The override of the display of the components is defined in the phase settings: Settings > Phases > Graphic Overrides tab.

- 7 Add new walls and doors as shown in image. You don't need to be exact about positioning the components, but you should design a plan that makes sense.



As you add the walls, verify that the height is set to Level 3.

- 8 In the project browser, duplicate the Level 2 Demolitions plan view.
Rename it to **Level 2 – Complete**.

- 9 Open the view properties.

Change the Phase Filter parameter to **Show Complete**.

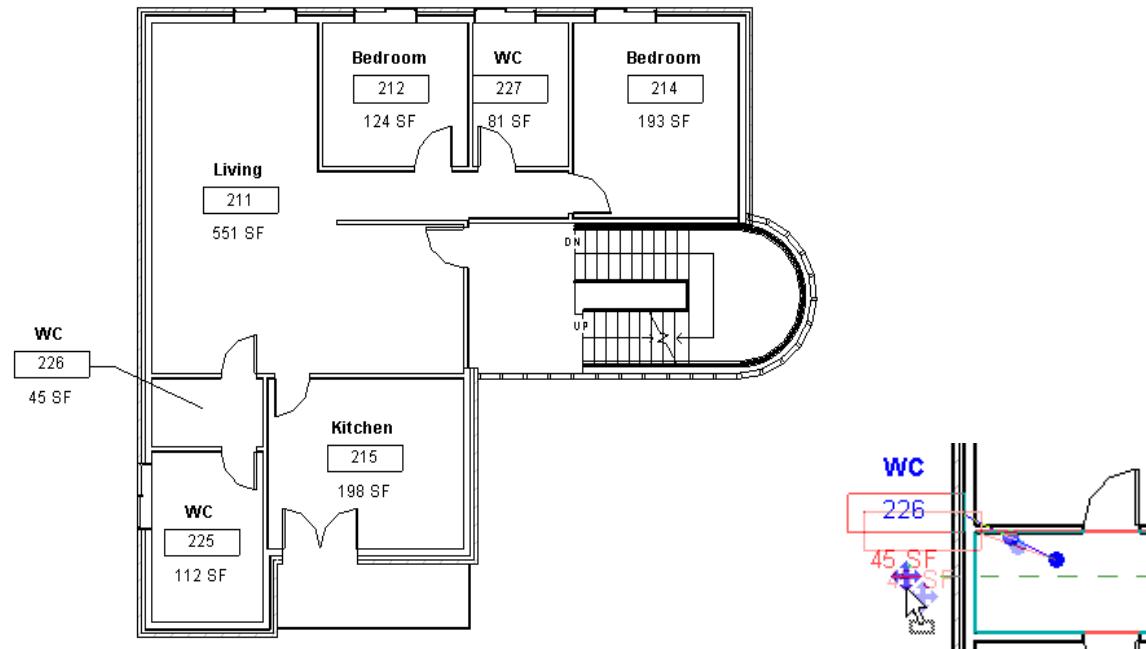
Click OK to exit the dialog box.



- 10 On the Room and Area design bar, click **Room**. Create (and rename) the rooms as shown in the image.

For the WC to the left of the kitchen:
Select the tag.

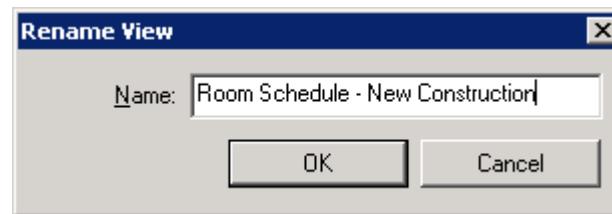
On the options bar, select **Leader**.
Click the drag symbol under the tag number.
Drag tag to the desired position.



Create Schedules for the Phases

- 11 In the project browser, under Schedules/Quantities, right-click the Schedule table Room Schedule – Existing. Click **Duplicate**.

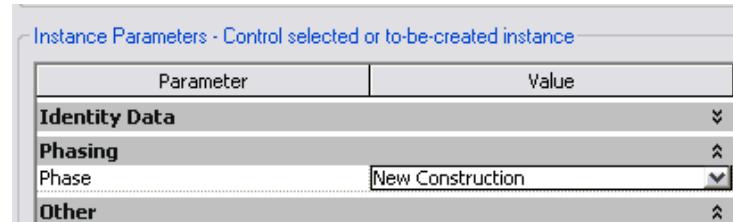
Rename it to **Room Schedule – New Construction**.



- 12 In the project browser, right-click the new schedule. Click **Properties**.

- 13 Change the Phase parameter to **New Construction**.

Click OK to close the window.

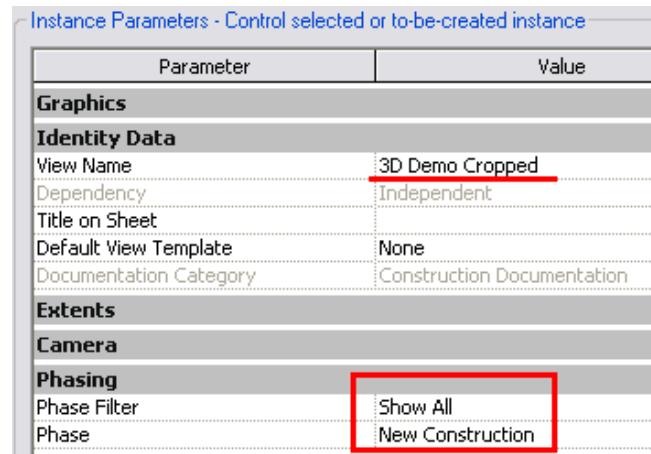


The schedule filters to the rooms created in the new construction.

- 14 In the project browser duplicate the 3D view: 3D Existing Cropped and rename the new view **3D Demo Cropped**.

Open the new 3D view properties and change the Phase to **New Construction**.

Click OK.



- 15 Duplicate this 3D view. Name the new view **3D Complete Cropped**.

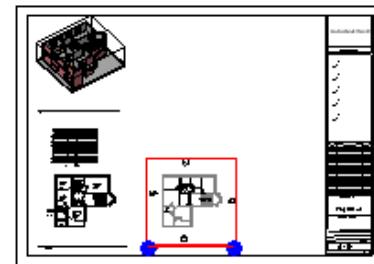
Open the new view's properties. Change the Phase filter to **Show Complete**, and Phase to **New Construction**.

Click OK.



- 16 Set the existing sheet A101 Unnamed current.

Drag the view Level 2 Demolition on the sheet. Position it in the middle, as shown in image.



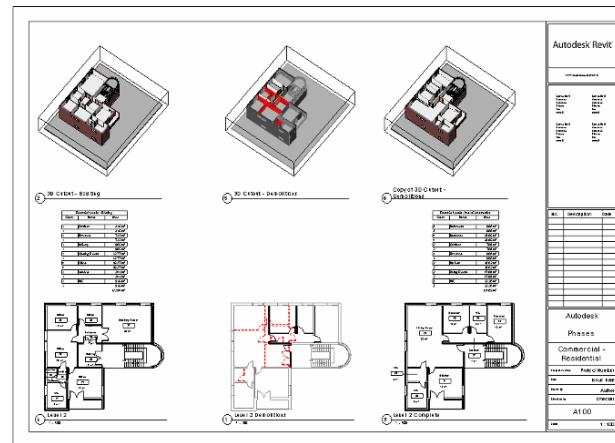
This sheet already has the original views placed on it:

- 3D Existing Cropped.
- Existing Room Schedule.
- Level 2 (Floor Plan).

- 17 Drag onto the sheet the following views:

- Level 2 – Complete.
- 3D Demolition Cropped.
- 3D Complete Cropped.
- Room Schedule – New Construction.

Position them as shown in image.



The sheet is complete.

Save your file if you want to keep it for reference. This data set looks like the data set for Unit 20. However the file **i_Unit 20 – Start.rvt** has added Design Options in place that are used in the exercise steps.

Unit 20

Theory: Variation

Revit Architecture: Options

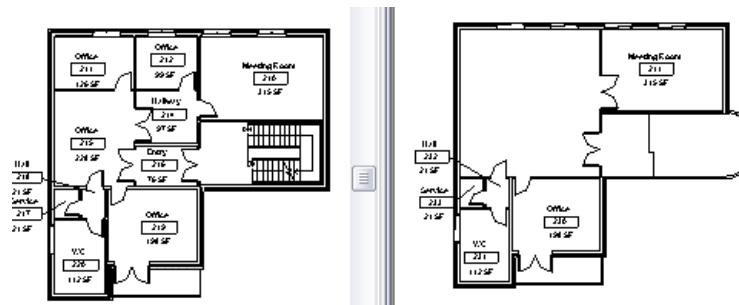
This unit guides you through the powerful Design Options feature. You start using a file that already contains a couple of design options.

Review Design Options

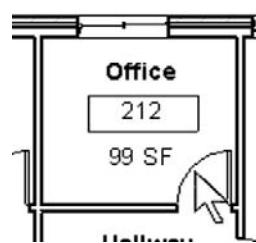
- 1 Open file i_Unit 20 – Start. This file contains an option set with two different design options.

Open Floor Plan views:
Level 2 – Option 1 and **Level 2 Option 2**.

Tile windows to display both options.



- 2 In Plan: Level 2 – Option 1, try to click the door of Office 212.



Note how tiling windows lets you visualize both—or more—options in different views.

Both views represent the second floor of the building. All components are held in the building model. However, the interior walls of the floor, along with the stair and east wall, are held in Design Options.

When the project contains Design Options, the options bar displays a check box to allow selection of components that are part of the option set:



This is just a check to keep you from inadvertently changing objects that are in a Design Option.

View the Options

- 3 Right-click the toolbar, and verify that the Design Options toolbar is selected.



- 4 Click the Design Options tool.

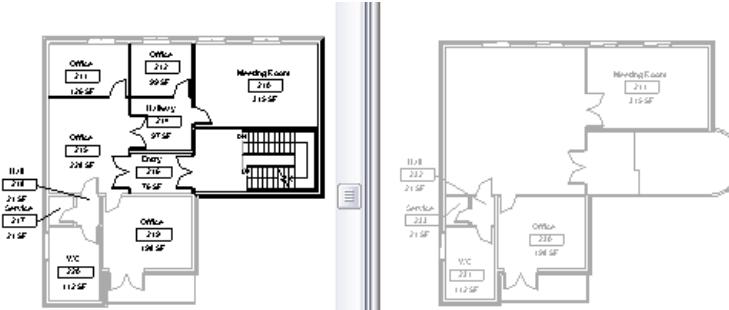
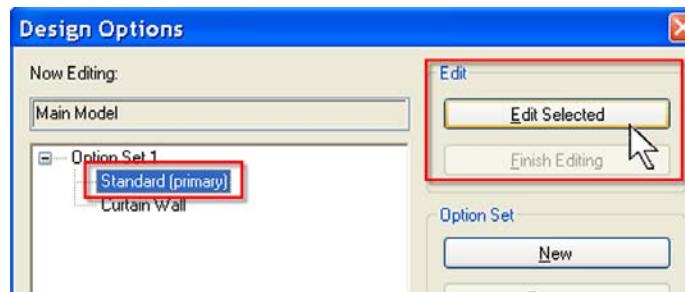


In this file you have only one option set, but you can have as many as you want. Normally, an option set is a specific part of a building where you want to try different design alternatives. An option set can contain as many options as you want.

- 5 In the Design Options dialog box, select **Option Set 1 – Standard**, and click **Edit Selected**.

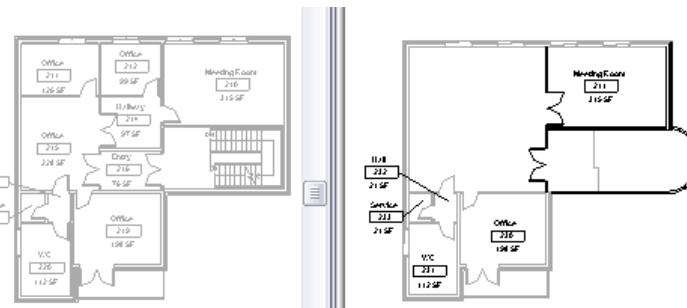
Do not close the Design Options dialog box yet.

When you edit an option, all components that are not part of the option are dimmed.



- 6 In the Design Options dialog box:

- Click Finish Editing.
- Click Curtain Wall.
- Click Edit Selected.
- Click **Close**.
-
-

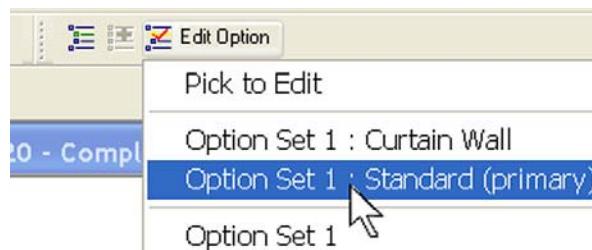


- 7 Click **Edit Option** to end editing the curtain wall option.



Copy Elements Between Options

You can copy and paste elements from one Design Option to another.



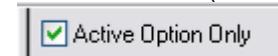
The Now Editing window displays the active edited option.

With two options as in this case, you have three sets of objects:

- Those in the main model.
- Those in sets unique to each of the options.

When you are editing an option, you can see and refer to objects in the main model, but by default you cannot edit them.

The options bar displays a check box that allows selection of components that belong to the main model (not to an option set).



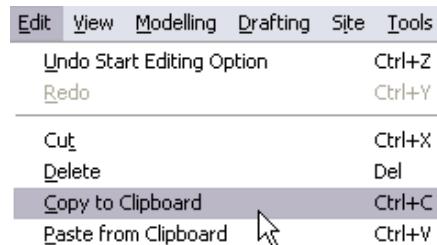
You return to standard Edit mode with neither option open.

This shortcut bypasses the Design Options dialog box.

This tool is cyclical. If you click it again, you exit Edit mode (don't do this yet).

- 9 Select the stairway on the east end of the building.

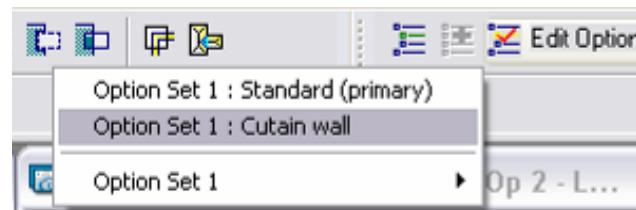
On the Edit menu, click **Copy to Clipboard**.



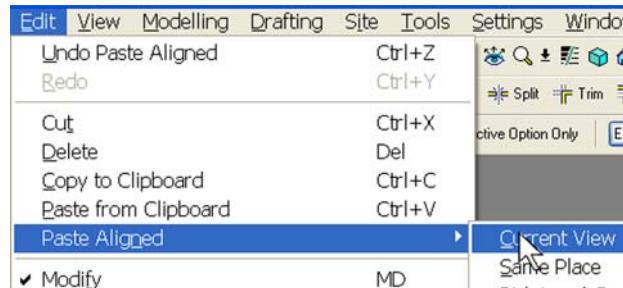
- 10 On the Design Options toolbar, click **Edit Option** to finish editing the option.



- 11 Click **Edit Option** again. From the list, select **Option Set 1: Curtain Wall**.

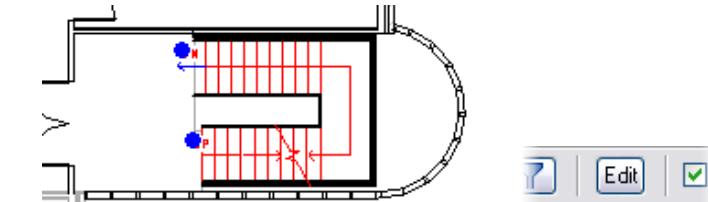


- 12 On the Edit menu, click **Paste Aligned > Current View**.

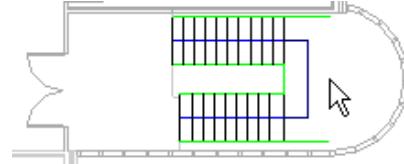


- 13 In the Level 2 Option 2 window, select the stair.

On the options bar, click **Edit**.



- 14 Delete the boundary on the right edge of the landing.



Copy to Clipboard and Paste Aligned (Same Place) constitute an easy way to replicate a situation among different options.

You can also duplicate an option within an option set by selecting it in the Design Options dialog box and clicking Duplicate.

The Design Options toolbar allows for quick selection of the available Design Options.



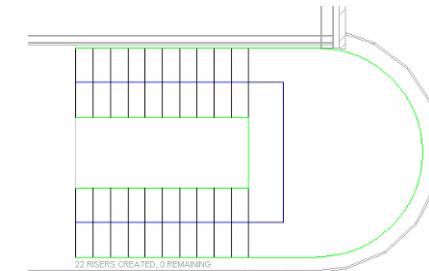
The stair now is part of this option.

When editing stairs, you enter Sketch mode.

- 15 Click the boundary tool on the design bar.

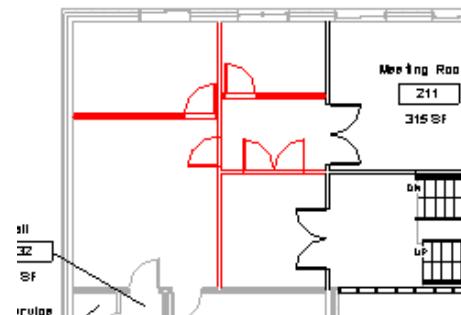
On the options bar:

- Click **Draw**.
- On the options bar, set the template to the **Arc** tool.
- Redraw the landing boundary with the arc by clicking the endpoint of the lines on either side of the staircase until you see the desired arc.



Click **Finish Sketch**.

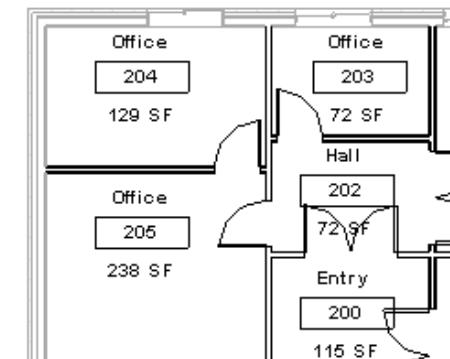
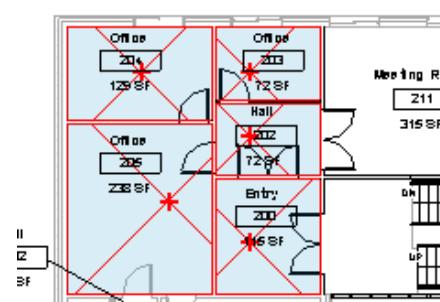
- 16 Add walls and doors to complete the design, as shown in image.



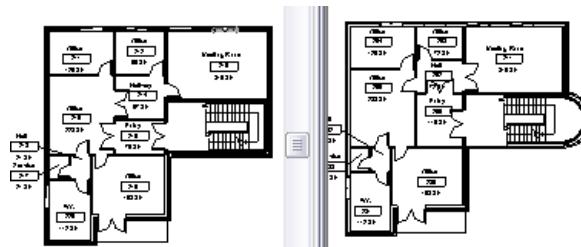
- 17 On the Basics design bar, click **Room**.

Click in all the empty rooms in the option. After placing the tags, rename the rooms as shown in image.

Make sure you are still editing the option before adding the rooms if you want the rooms to be part of the option.



- 18 On the Design Options toolbar, click **Edit Option** to finish editing the option.



Assign an Option to a View

You have been working in two views that are both views of the second level.

- 19 Open 3D View – Option 1.

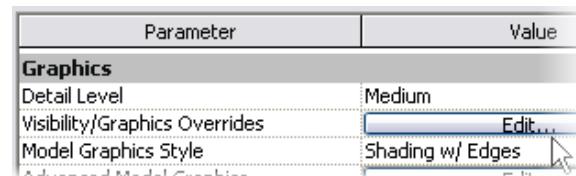


- 20 In the project browser, right-click the 3D view 1. Click **Duplicate**.

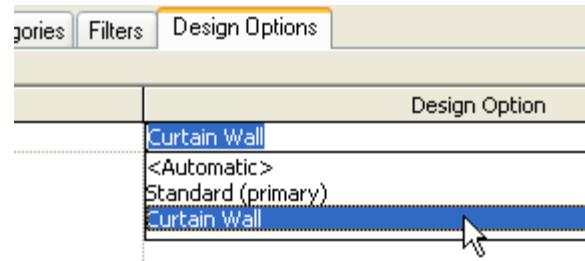
Rename Copy of 3D View 1 to **3D View - Option 2**.

- 21 Open the View Properties dialog box by right-clicking the view in the project browser and clicking **Properties**.

Click the **Edit** button next to the Visibility/Graphics Overrides parameter.



- 22 On the Design Options tab, select Curtain Wall from the list under Option Set 1.



The two plan options are now complete.

The only difference between these is a setting in the view properties assigning one option or the other.

By default, a view shows the option marked primary, in this case the standard option.

When there are design options in the project file, Revit Architecture adds a new tab in the visibility settings of the views.

You can display any option in any desired view: plans, elevations, sections, and so forth.

The list displays the available options for the option set.

When the value is set to Automatic, the view displays the primary option but switches to show the one you are modifying when in Edit mode.

- 23 Click OK to close each dialog box and see the changes.



Assign an Option to a Schedule

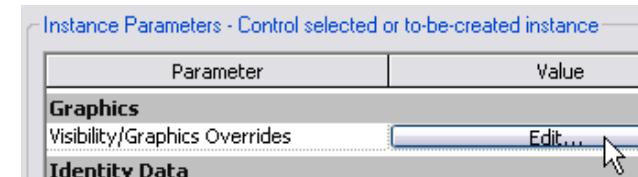
- 24 Create a duplicate schedule for the option:

- In the project browser, duplicate the **Schedules/Quantities: Room Schedule**.
- Rename the new schedule view Room Schedule – Curtain Wall Option.



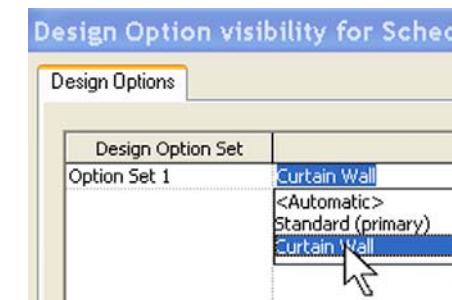
- 25 Assign the option to the new schedule view:

- Right-click the **Room Schedule – Curtain Wall** option. Click **Properties**.
- Click the **Visibility/Graphics Overrides** **Edit** button.
- On the list, select **Curtain Wall**.
- Click OK.



Although access to this parameter is a bit different for the schedule than for the 3D view, the theory is the same. A schedule is just a text view of the building model.

Schedules are views as plans and sections. They can display the desired design option to evaluate the different quantities or costs according to the option displayed.



Room Schedule - Curtain Wall Option			Room Schedule		
Name	Count	Area	Name	Count	Area
Entry	1	115 SF	Entry	1	76 SF
1	1	115 SF	1	1	76 SF
Hall	2	94 SF	Hall	1	21 SF
2	2	94 SF	1	1	21 SF
Meeting Room	1	315 SF	Hallway	1	97 SF
1	1	315 SF	1	1	97 SF
Office	4	638 SF	Meeting Room	1	315 SF
4	4	638 SF	1	1	315 SF
Service	1	21 SF	Office	4	651 SF
1	1	21 SF	4	4	651 SF
WC	1	112 SF	Service	1	21 SF
1	1	112 SF	1	1	21 SF
		10 1296 SF	WC	1	112 SF
			1	1	112 SF
			10	10	1295 SF

You now have two different room schedules. The rooms unique to each option are listed along with those that are common to both options such as the meeting room, WC, and Service.

Place Views of the Options on a

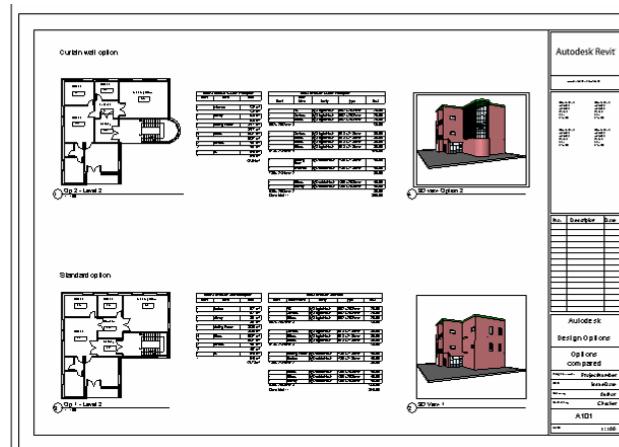
Sheet

26 In the project browser, double-click the sheet A101 – Options Compared.

27 In the project browser, drag **Floor Plan – Level 2 Option 2** onto the sheet as shown in the image.

Place the following views on the sheet, as shown in the image:

- 3D view Option 2.
- Door Schedule Curtain Wall Option.
- Room Schedule – Curtain Wall Option.



You have to turn on the crop region of the 3D view Option 2 and adjust the boundaries of the crop region to fit on the sheet.

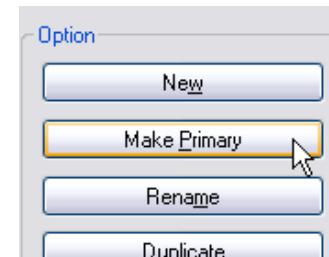
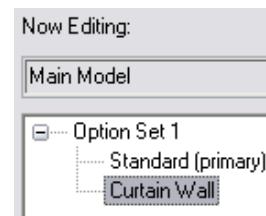
Optional Exercise: Change Primary Option and Accept Primary

Because the following steps delete the nonprimary elements and views, save your project if you want to keep your progress to this point.

28 Open Floor Plan **Level 2 – Option 2**.

29 On the Design Options toolbar, click **Design Options**.

30 Select the **Curtain Wall** option. Click **Make Primary**.



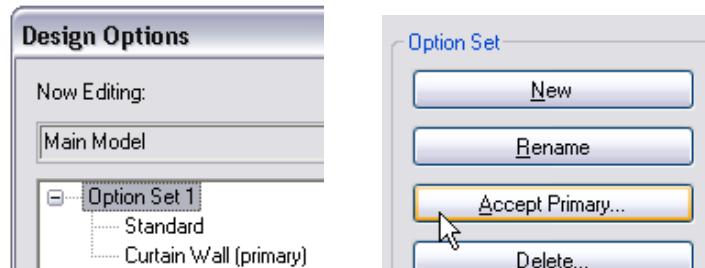
This deletes any items you have in the nonprimary option and deletes any views set to the nonprimary option.

A warning may appear when accepting the primary option, depending on how walls are joined.

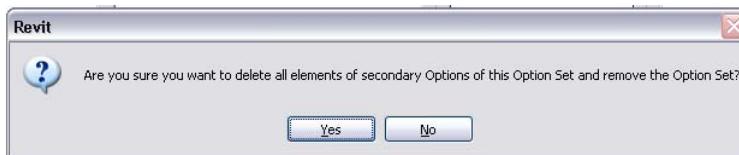
You can normally ignore these warnings and proceed with the next step.

31 Select **Option Set 1**.

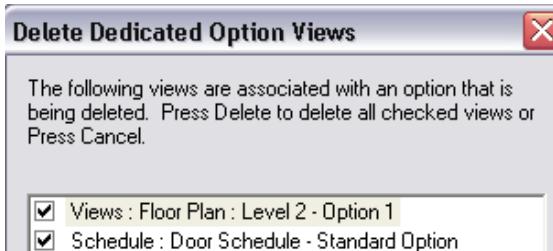
Click **Accept Primary**.



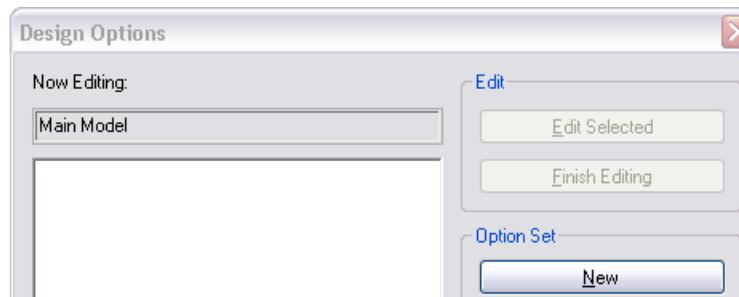
32 Click **Yes** when the dialog box opens.



33 Click **Delete** in the dialog box.



34 The Design Options dialog box is now empty.



Because you are finished with the options process, accepting the primary option deletes all the elements that are stored in Option Set 1: Standard option.

Because you are deleting all the objects that are shown in these views, deleting the views makes sense.

The other views, such as 3D View 1, as well as the schedules, are set to display, which automatically displays the primary option. These views are *not* deleted when you accept the primary option.

After you click the Accept Primary button, all options disappear and the components in the primary option become part of the main model.

Note that the sheet now displays the same information twice and the views display the same model.

