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Attention to Detail: Creating Construction Details in Autodesk® Revit® Architecture

Matt Dillon – Enceptia

AB1419 As important as a good model is in a Building Information Modeling (BIM) workflow, equally important is generating a good set of construction documents, complete with detail drawings. This class teaches you how to stop getting lost in superfluous minutiae by taking full advantage of the best parts of your model and adding 2D detail components and linework, combined with display modification techniques, to create your construction details.

Learning Objectives

At the end of this class, you will be able to:

- Explain how to determine what to model and what not to
- Explain what a hybrid detail is
- Modify model geometry to make it usable for construction documents
- Add detail components and line work to finish out the detail

About the Speaker

Having been a registered architect with over 20 years of experience in Autodesk® architectural applications, Matt has worked with AutoCAD® Architecture since its initial release and Revit® Architecture since its purchase by Autodesk. Matt is an Autodesk Certified Instructor at an Autodesk Authorized Training Center. In addition to assisting customers in implementing Autodesk Revit platform products, he has also consulted with Autodesk development staff in product design and usability for AutoCAD Architecture. He co-authored Architectural Desktop 2007—An Advanced Implementation Guide (Second Edition). In 2010, Matt was one of the recipients of Autodesk's "Distinguished Speaker Award" and has consistently been a highly-rated instructor at Autodesk University since he began presenting in 2000.

mattdillon@enceptia.com

Introduction

Much attention is paid in any demonstration or class having to do with Autodesk Revit Architecture on the modeling process. To be sure, this is important; without a model you don't have a project, after all. But equally important is the ability to generate construction documents that go beyond the model. Unfortunately, many firms choose to forego using the detailing and drafting tools in Revit Architecture and choose instead to generate their details in AutoCAD. This is a bad idea for at least two reasons.

1. Generating details in AutoCAD separates the detailing process from the Revit workflow, increasing the opportunity for errors and omissions.

2. Most importantly, generating details in DWG format and then importing/linking those details into the Revit model so that they can be plotted on sheets in the Revit project can affect the model in adverse ways – file size can grow disproportionately to the size of the DWG files being imported, performance suffers, and the project file may become unstable. In general it is not a good idea to have a lot of DWG files, if any, in a Revit project.

Admittedly, the drafting and detailing process in Revit is markedly different than AutoCAD's, and that is probably the main reason that firms tend to adopt it last if at all. However once the tools have been mastered most users report that they are creating details faster and more accurately than they used to in AutoCAD. It just takes a little investment in learning the new tools and processes.

Level of Detail

One of the most common mistakes new users of Revit make is to "over-model" – to put too much detail in the model. This can cause the model to become inordinately large very quickly, and can cause you to spend huge amounts of time on minutiae with little or no payback. It is important to realize when it is not appropriate to model an object and when to simply show certain objects in a detail as 2D geometry instead.

As a general rule of thumb, you can use the scale of your typical floor plans as the first "litmus test" as to whether or not you're going to model something. In a commercial project for example, your floor plan scale is probably around 1/8"=1'-0". Therefore if something would not normally be seen at that scale you should think twice before modeling it. That doesn't mean you would definitely not model it, but you need to weigh the consequences and effort of modeling the object against the benefits and payback. If it is something that might take a long time to model and would only be seen in one or two views then it might be a better idea to show it using 2D detailing tools instead.

The Revit Detailing Process

Creating a hybrid 3D/2D detail (that is, a detail that is based partly on the project's model geometry and partly on 2D detail components and line work) can be broken down into four main phases or steps:

1. **Turn off unwanted geometry.** This does not mean incorrect geometry. In this step you merely use Visibility / Graphics Overrides and other view properties to turn off or crop out parts of the model or project that you don't want to see in the detail.

2. **Suppress or change the display of incorrect model geometry.** There are usually things in a model that, when viewed at a larger scale, are incorrect. In this step you use 2D detailing tools such as masking regions and cut profiles to either suppress them entirely or to modify the way they display themselves in the current view. It is important to note that you are not editing the model, even though at times it may look that way. You are merely changing the way it displays in the view.

3. **Add 2D geometry to complete the detail graphics.** Once the model geometry has been stripped down to just those items that are correct, the rest of the detail can be added using 2D detail lines, detail components and filled regions.

4. **Annotate and dimension the detail.**

A closer look at all four steps follows:

Step 1 - Turn off Unwanted Geometry

Figure 1 shows a Callout that was created from a building section. The detail's intent is to show the connection detail at the wall and floor and it will be plotted at a scale at 1 ½"=1'-0". Obviously the detail in its current form, which is based purely on the model geometry visible in the view, is not suitable for final construction documents.

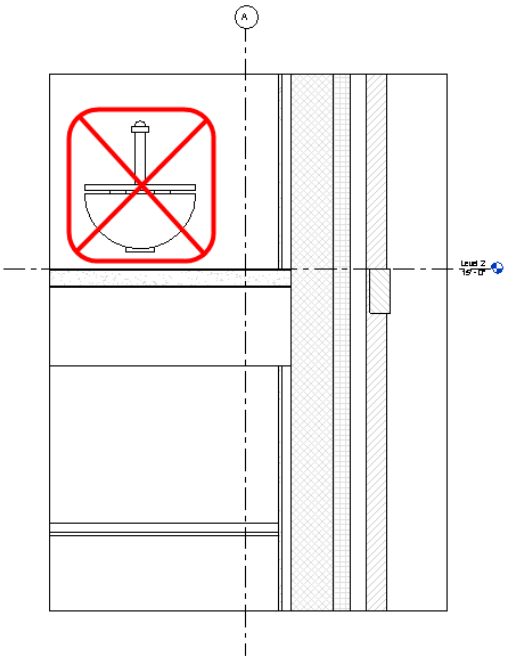


Figure 1. A typical callout view containing only model geometry.

For our example, we'll turn off the level markers. This is easily accomplished in the Visibility / Graphics Overrides of the view. However we also do not want to see the toilet that is shown above the floor in Figure 1. These items are being seen because the depth of the callout is the same depth of the parent section view by default. This can be changed by setting the Far Clip Settings in the Properties palette to "Independent" and making the Far Clip Offset distance significantly smaller (in this case, we'll make it 1'-0"). Figure 2 shows the result of turning off the Grid and Level objects and then modifying the Far Clip settings.

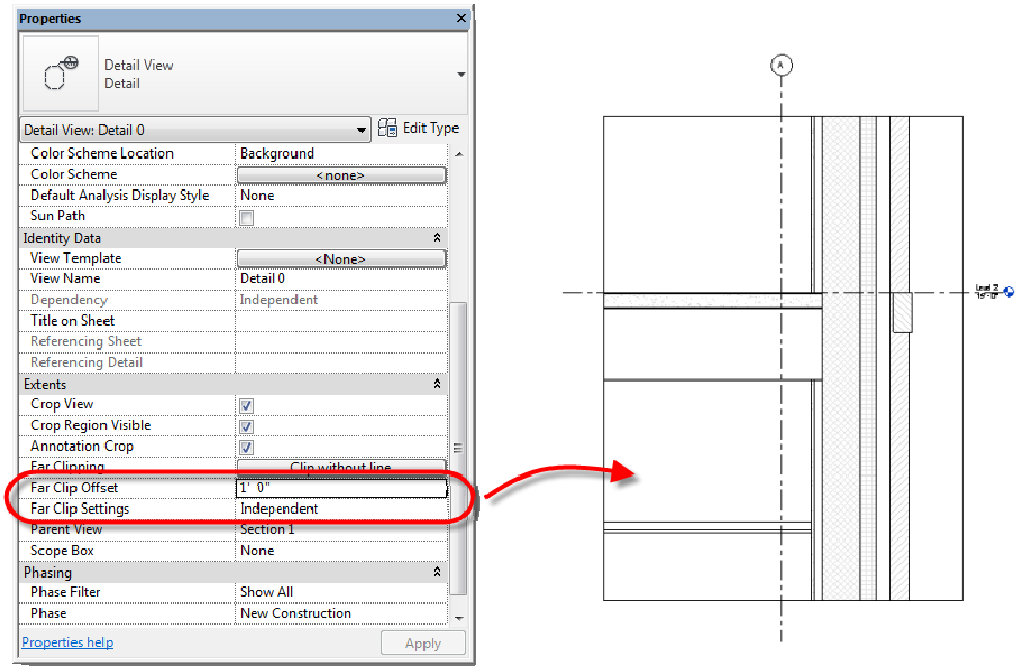


Figure 2. At the end of Step 1, the callout view has been stripped of geometry that, while correct, is neither required nor desired in the detail.

Step 2 - Suppress or Change the Display of Incorrect Model Geometry

There are several things that need to be done during this step to make our callout view more correct at this scale. First, the brick that is currently shown behind the soldier course needs to be suppressed. Additionally, the floor that is currently in use in the model has a layer that represents the space required for a 14K1 steel bar joist. In the detail, however, we need to actually show the joist. Rather than model it, in this example we'll eventually place a 2D detail component that represents the bar joist in elevation in the view to represent it. So for this detail we need to remove the layer of the floor that we'll be replacing. Additionally, we need to show the gypsum wall board and furring strip on the inside of the wall extending just a short distance above the ceiling.

All of the above can be accomplished with a single powerful tool for this type of editing: the "Cut Profile" tool, located on the "View" tab of the ribbon. This tool can be used in any plan or section view and will modify the way the profile of any object that is being cut through displays itself in

the current view. It is important to note again, that while it may appear that you are editing the model, you are not. The Cut Profile tool has two options that will appear on the the Options Bar when it is selected, “Face” and “Boundary between faces”. In both contexts the word “Face” refers to the cross section view of a layer within a wall, floor, roof, ceiling, etc.

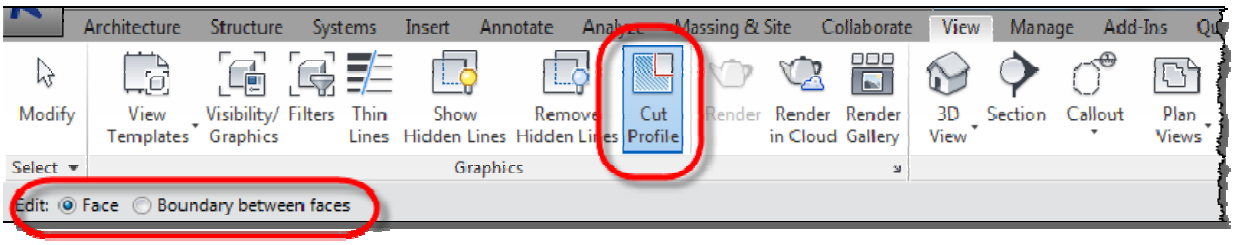


Figure 3. The Cut Profile tool.

In our example, we’ll use the “Boundary between faces” option to quickly edit the brick around the soldier course to make it look correct (see Figure 4).

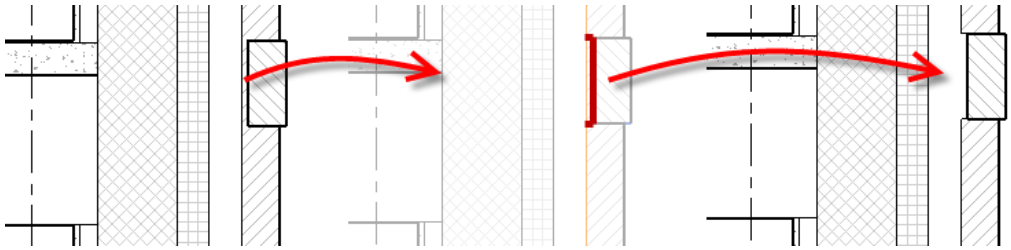


Figure 4. Modifying the brick at the soldier course using the Cut Profile tool.

Using the same tool, we can quickly modify the profiles of the floor and the wall layers using the “Face” option so that the detail at the completion of this step looks like Figure 5.

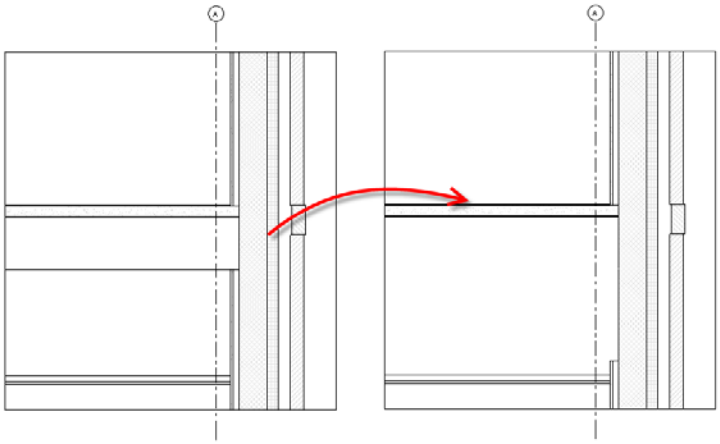


Figure 5. The callout view at the end of Step 2.

Step 3 - Add 2D Geometry to Complete the Detail Graphics

Once the model geometry has been stripped of those parts that are incorrect at this scale it can be "built up" again using 2D geometry and detail components. A large library of pre-made detail components ships with Revit Architecture, and they are also very easy to create from scratch. Figure 6 shows the first detail component to be added into this particular detail, a W10x30 wide flange beam in section view.

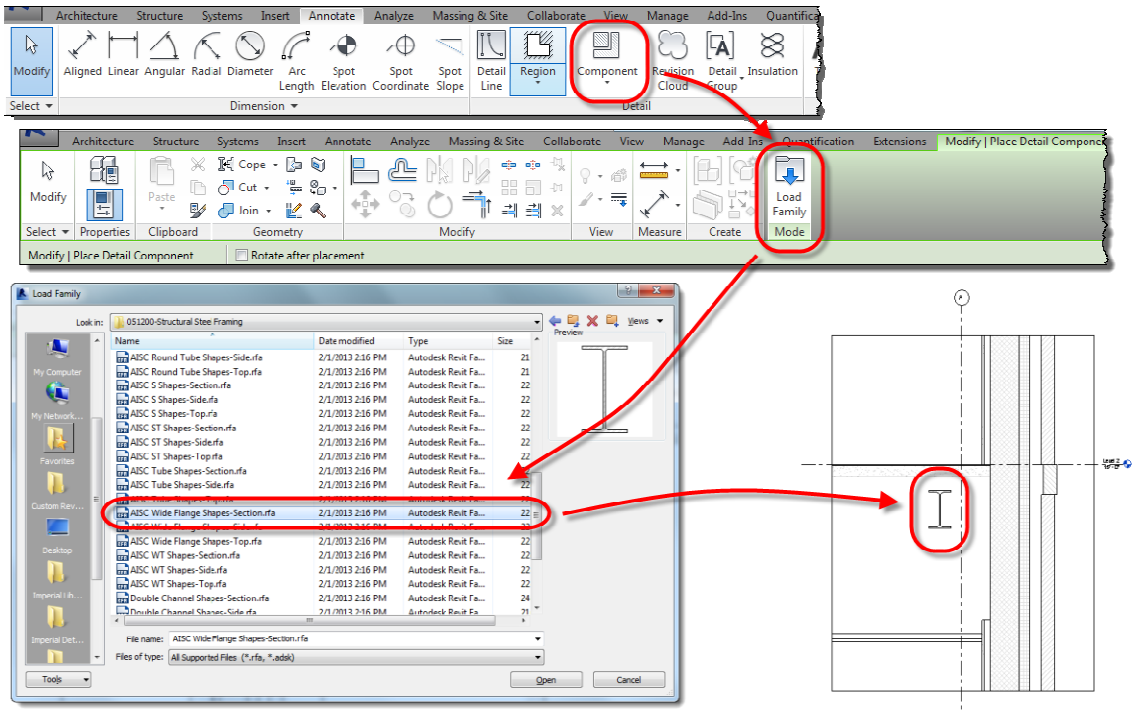


Figure 6 A Wide Flange beam detail component added to the view.

> ***Note*** *– you can use the Align tool and dimensional constraints to lock detail geometry to model geometry. In the example above, the wide flange shape has not been placed in final position yet, however in Figure 8 it has been positioned relative to the bar joist and the column grid line, then locked to both so that if modifications are made to the model that would affect it, it will move as well.*

To take care of the CMU layer in the wall, we need to bring in a detail component that shows a more accurate representation of an 8" x 8" x 16" CMU. Again, this can be found in the standard library of detail components under the "Masonry" section. However instead of simply inserting a single CMU component and then copying it or arraying it to create the rest of the courses, it can be made part of a Repeating Detail. These special types of system families allow you to quickly lay out an array of detail components that need to be spaced evenly, such as masonry, brick, etc. The dialog box in Figure 7 shows the settings for the CMU repeating detail. Note that detail components, when placed on top of model components, will mask the model geometry behind them.

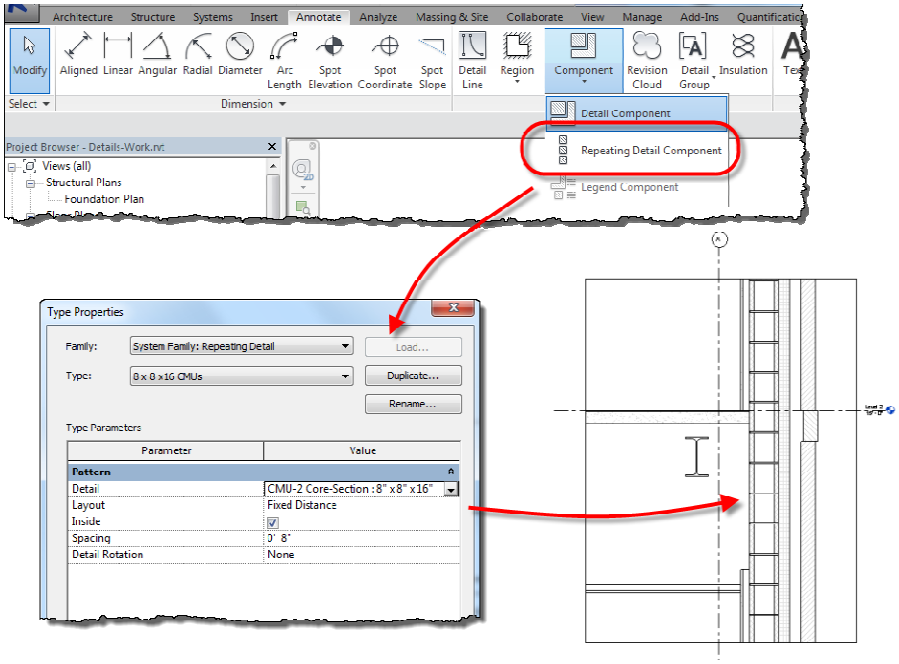


Figure 7. Using a Repeating Detail to create several courses of CMU.

To finish this step, additional repeating detail components combined with “single” detail components can be used. Additionally, you can draw 2D linework with Detail Lines if necessary. Figure 8 shows the detail at the completion of Step 3. The brick mortar joints were added as a repeating detail component as was the roof deck. Both of these components use an embedded masking region to suppress the model geometry behind them. All of the geometry in the detail has been constrained to the model geometry, primarily using the Align tool. That way, if the ceiling moves, the ceiling tiles and grid components will move as well (the model ceiling has been turned off and replaced with detail components). The decking, bar joist and the wide flange shape will move if the model floor moves, and the wide flange shape, the bar joist, the decking, the CMU and the brick mortar joints are all constrained to the wall.

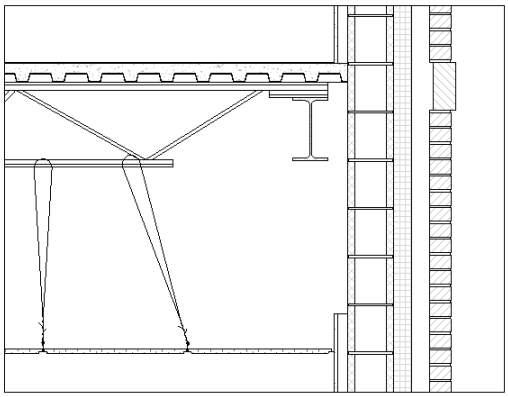


Figure 8. The detail at the completion of Step 3.

Step 4 – Annotate and Dimension the Detail

This is the easiest step; the dimension and text tools are simple and easy to use. However you may decide to use the Keynotes capability of Revit instead.

Keynotes

While using keynotes in Revit is also quite easy, there is a bit of setup involved and some understanding of various options and controls is important.

Associating a Keynote File

Before you can use the keynoting feature in Revit you must first associate your project with a keynote table.

To associate a keynote table, select the “Keynoting Settings” tool from the “Annotate” tab of the ribbon. (Note that it is actually located on the drop down portion of the Tags panel). The first item in the dialog is the path to your keynote table (see Figure 9). Note that in the example shown it is currently reflecting the default keynote table, which should be located in your Imperial or Metric Library. This is a simple text file which can be edited or created from scratch, as we will see later.

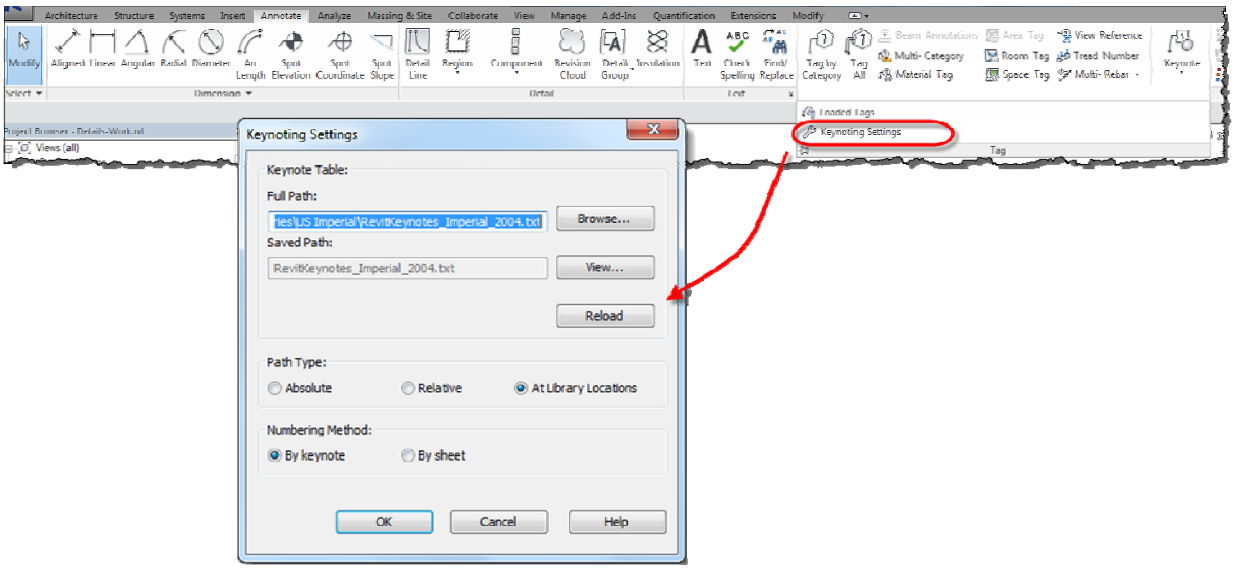


Figure 9. The Keynotes Settings dialog.

Note the other settings in the keynote table. Most importantly we will discuss the difference between the numbering methods “By sheet” and “By keynote” later.

Assigning Keynotes to Types and Materials

Once you’ve associated the keynote table to your project or template you can begin to assign keynotes to element types and material definitions. On the left side of Figure 10 the Type

Properties of the "Exterior - Brick on CMU" wall type include a Keynote assignment, selected from the keynote file shown on the right side of Figure 10.

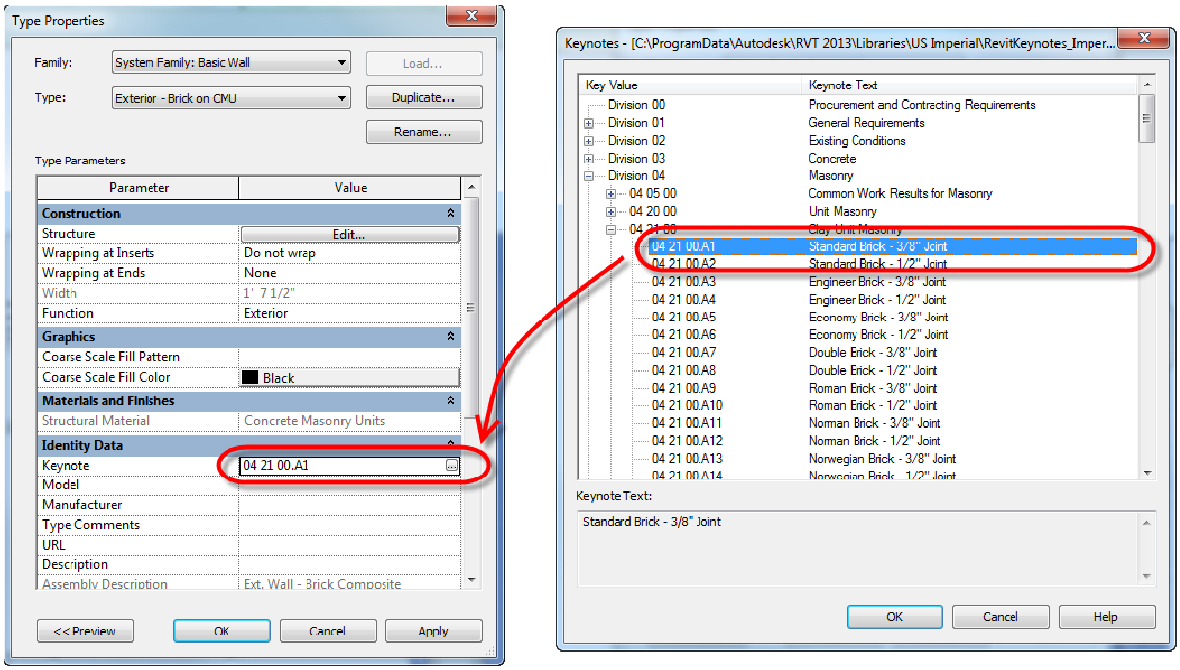


Figure 10. The Material Definitions dialog and the Type Properties dialog.

Keynotes can also be assigned to Detail Component Family Types in the same fashion. To assign a keynote to a Material Definition, click on the material in the Material Browser, shown in Figure 11 and click on the “Identity” tab on the right side. Scroll to the "Revit Annotation Information" section and assign the Keynote as shown in Figure 11.

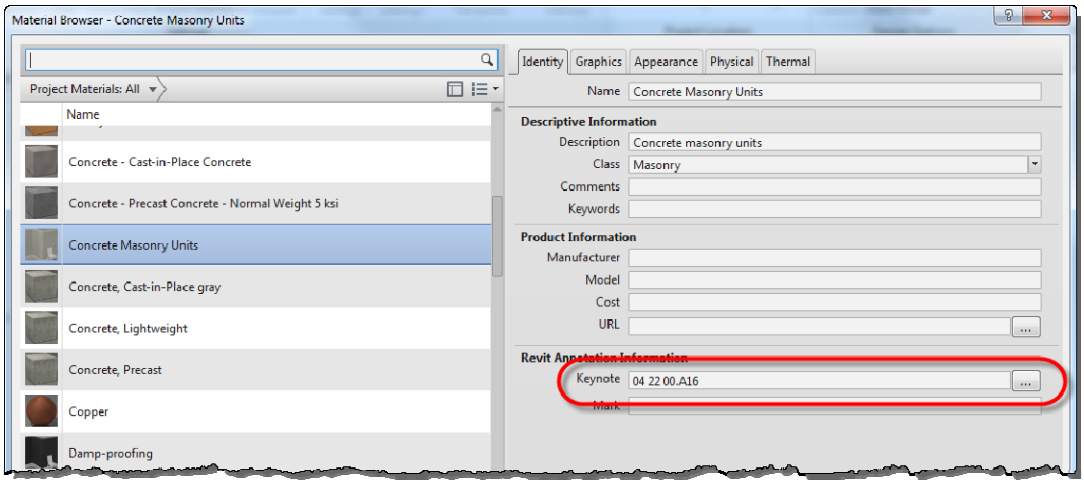


Figure 11. Assigning a keynote to a Material Definition.

Once you've associated a keynote table to your project and you've assigned keynotes to your materials and type definitions, the hard part is done.

Using Keynotes

To use keynotes, go to the "Annotate" tab of the ribbon and select the "Keynote" tool. You have three options:

- *Element:* Pick an element and the keynote assigned to the type definition will be used.
- *Material:* Pick an element that has materials assigned to its components and the keynote assigned to the material definition will be used.
- *User:* Pick any element. Whether or not it already has a keynote assigned to it you will be taken to the keynote table to select any other keynote that you prefer to use.

If you select an element or material that has no keynote assigned to it yet, you'll also be sent to the keynote table to select a note. Once selected, that keynote will then be assigned to the element or material that you selected for future picks. If you accidentally select the wrong keynote during this process you need to edit the type (or material definition) properties and change the keynote assignment there.

Referring back to the keynotes settings dialog box shown in Figure 9 again, note that you can choose to use "By sheet " or "By keynote" when you place keynotes. The difference between these is simple but significant. "By sheet" refers to a system where each keynote is assigned a number that is unique on a particular sheet, however the same keynote could be a different number on a different sheet. Typically the numbers will simply be "1", "2", etc. "By keynote" is a system where the actual keynote number specified in the keynote table will be used, and will be consistent for a given keynote across all sheets. The terms "By sheet" and "By keynote" refer to the US National CAD Standard "Sheet Keynotes" and "Reference Keynotes", respectively. Figure 12 shows a detail annotated with the "By keynote" (reference keynotes) option on the left and with the "By sheet" (sheet keynotes) option on the right.

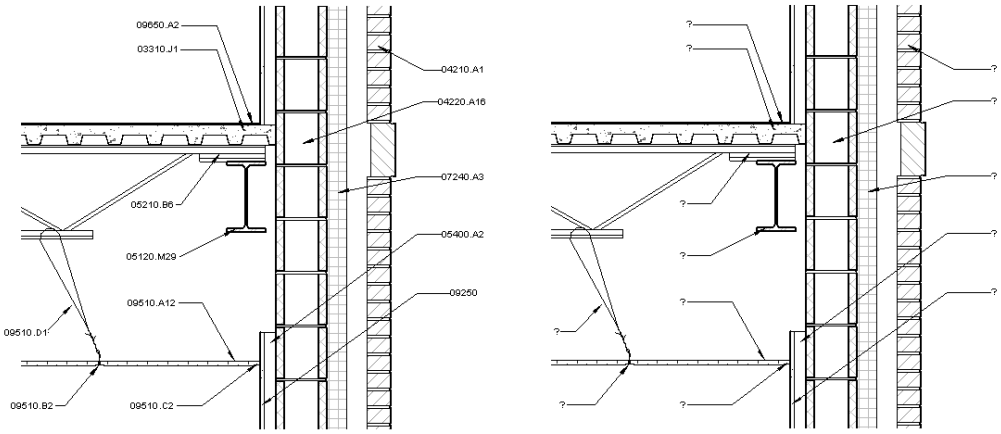


Figure 12. A detail annotated with the "By keynote" and "By sheet" options.

Note that with the sheet keynotes, the actual keynote number is not assigned; instead there is a simple "?" placeholder. The number will be assigned when the detail is actually placed on a sheet. You can actually switch an entire project's details from the reference keynotes option to the sheet keynotes option by simply switching the choice in the Keynotes Settings dialog. All existing keynotes in your project will update immediately to the new system.

Keynotes are essentially nothing more than tags. You can choose to use a tag definition that displays the keynote number, or you can choose to use one that displays the keynote text itself. Therefore, even if you don't use keynoting as an annotation method, you can still use this feature in Revit to standardize and automate your text annotation.

Creating Keynote Legends

Keynote legends are similar to schedule views. To create a Keynote Legend, Select "Legends", then "Keynote Legend" from the "View" ribbon. Once the legend is created, you'll see it listed in the Project Browser under "Legends".

Viewing the properties of the keynote legend, you'll see, in fact, that it has the same structure as a Revit schedule with one critical exception. On the "Filter" tab there will be an option at the bottom to allow you to filter keynotes by sheet, as in Figure 13.

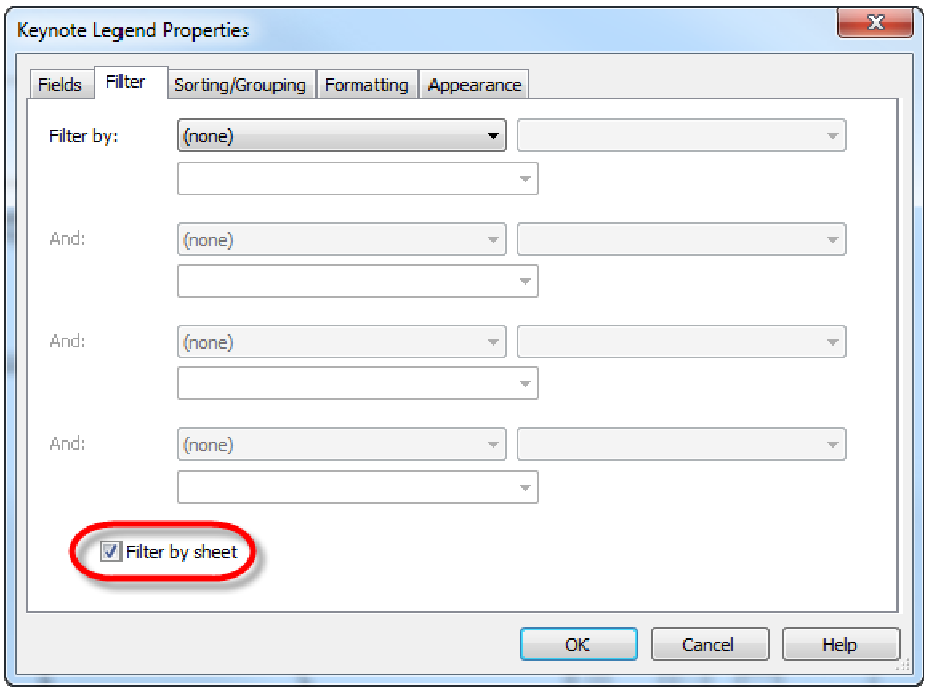


Figure 13. Filtering keynotes by sheet.

Turning this option on will allow you to have all of your keynotes in one keynote legend. However you can use the legend on multiple sheets. For each sheet that you place it on, only those keynotes that appear on the sheet will be shown in the legend. If you are using sheet

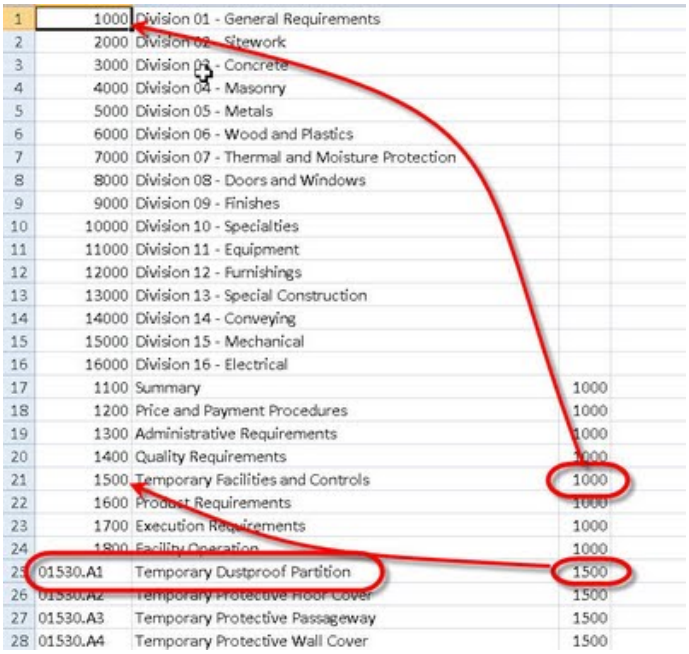
keynotes, the keynote number will be blank in the legend view, since each one can vary from sheet to sheet, but when the legend is placed on the various sheets the numbers for those sheets will be assigned.

The critical thing to make Keynoting move fluidly and quickly is to take the time to assign keynotes to all of your component family types and system family types, as well as your material definitions. This means that you will probably also need to either edit the default keynote table or create a new one.

Customizing a Keynote File

Although keynote files are nothing more than simple text (.txt) files, the best tool to use to create or edit them is actually a spreadsheet editor such as Microsoft Excel. The formatting is a bit confusing in the raw text form, but much more readable in spreadsheet form. When you open the file in Excel (we'll use the default Imperial keynote table as an example), make sure to set the file type in the File Open dialog to "all" so that you can see .txt files. After selecting the file, choose the "Delimited" option in the Text Import Wizard, and select "Next". In the next screen, select "Tab" as the delimiter; you should see a preview of the file in the same dialog box.

Once the file is opened in Excel, you should notice that there are three columns. The first column is the actual keynote number for each note (or the section header for a group of keynotes). The second column is the keynote itself or the header text. The third column is a reference section – it is the section number that the keynote in that row falls under. This is how the keynote file can appear to "cascade" in the keynote dialog box. Looking at Figure 14, let's examine this a bit closer.



1	1000	Division 01 - General Requirements	
2	2000	Division 02 - Sitework	
3	3000	Division 03 - Concrete	
4	4000	Division 04 - Masonry	
5	5000	Division 05 - Metals	
6	6000	Division 06 - Wood and Plastics	
7	7000	Division 07 - Thermal and Moisture Protection	
8	8000	Division 08 - Doors and Windows	
9	9000	Division 09 - Finishes	
10	10000	Division 10 - Specialties	
11	11000	Division 11 - Equipment	
12	12000	Division 12 - Furnishings	
13	13000	Division 13 - Special Construction	
14	14000	Division 14 - Conveying	
15	15000	Division 15 - Mechanical	
16	16000	Division 16 - Electrical	
17	1100	Summary	1000
18	1200	Price and Payment Procedures	1000
19	1300	Administrative Requirements	1000
20	1400	Quality Requirements	1000
21	1500	Temporary Facilities and Controls	1000
22	1600	Product Requirements	1000
23	1700	Execution Requirements	1000
24	1800	Facility Operation	1000
25	01530.A1	Temporary Dustproof Partition	1500
26	01530.A2	Temporary Protective Roof Cover	1500
27	01530.A3	Temporary Protective Passageway	1500
28	01530.A4	Temporary Protective Wall Cover	1500

Figure 14. A partial view of the default Imperial keynote text file

Notice the entry for “01530.A1”. The keynote text for that entry will be “Temporary Dustproof Partition”. It will fall under the section 1500 – “Temporary Facilities and Controls” – note the reference to section 1500 in the far right column for the keynote. Section 1500 will, in turn, fall underneath Section 1000, “Division 01 – General Requirements”, because its far right column includes a reference to that section. Rows that do not include a reference in the far right column will be considered top-level headers.

After editing the file, make sure you save it back to .txt format, not .xls, and you’re ready to go!