AUTODESK UNIVERSITY 2014

Mining concrete- how to modify a concrete model for quantification and 4D simulation

Daniel Doherty – Clark Builders

CO4906

This presentation will focus on practices that we at Clark Builders have used successfully when taking quantities from structural concrete design models provided by consultants. By strategically adding custom materials and modifying specific families, we are able to pull not only material volume but also formwork contact area off of models. The presentation will highlight some common practices that can throw off quantities (connections, constraints, joined geometry, and so on), and I will cover some effective practices while auditing models. Additionally, I will demonstrate how to break up the model using the Parts tool to divide the concrete structure into its pour sequences; by adding identifying parameters to that specific geometry, we can utilize search sets to expedite the setup in Navisworks project review software for a 4D simulation downstream.

Learning Objectives

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

- Learn how to quickly modify concrete models to represent actual construction in order to better ensure more accurate information
- Learn how to create and add custom materials into existing families to automate formwork quantity extraction
- Learn how to break up a concrete model to use in Navisworks software 4D simulations
- Discover how custom parameters in Revit software can be capitalized on by Navisworks software search sets

About the Speaker

Daniel is Manager of Virtual Construction at Clark Builders in Edmonton, AB. He has over 10 years experience in the AEC industry starting as a construction laborer. As an Architectural Technologist, he gained experience in the multiple facets of design and construction and played a lead role in the adoption of BIM technology. While at Clark Builders, Daniel earned his bachelor's degree in Technology Management a Certification of Management in BIM (CM BIM) and continues to implement tools, develop processes and advocate VDC technology for a general contractor. Daniel sits on the board of directors of the Alberta center of excellence for BIM (aceBIM), presents at various BIM conferences and continues to look for innovative ways to educate the AEC industry in the benefits of virtual construction.

dan.doherty@clarkbuilders.com

Introduction

From a General Contractors perspective, using concrete design models for quantity takeoffs can be a frustrating and sometimes futile exercise. Design models are seldom built to mimic site construction and more often than not, contain very little relevant embedded information. Moreover, when dealing with typical contractual processes were faced with limited access to information, or the inability to manage what is information is in the models. However, with some simple modification and customization, we can pull valuable information while facilitating downstream Navisworks 4D utility. This type of workflow is useful when given a structural concrete model in the tender process of a design bid build (DBB) project. We must quickly vet information that provides value to our estimating department as well as our operations department.

This handout will take you through the typical steps we follow in order to: audit the model to find obvious errors, pull relevant and useful quantity information and break the model apart for 4D constructability analysis.

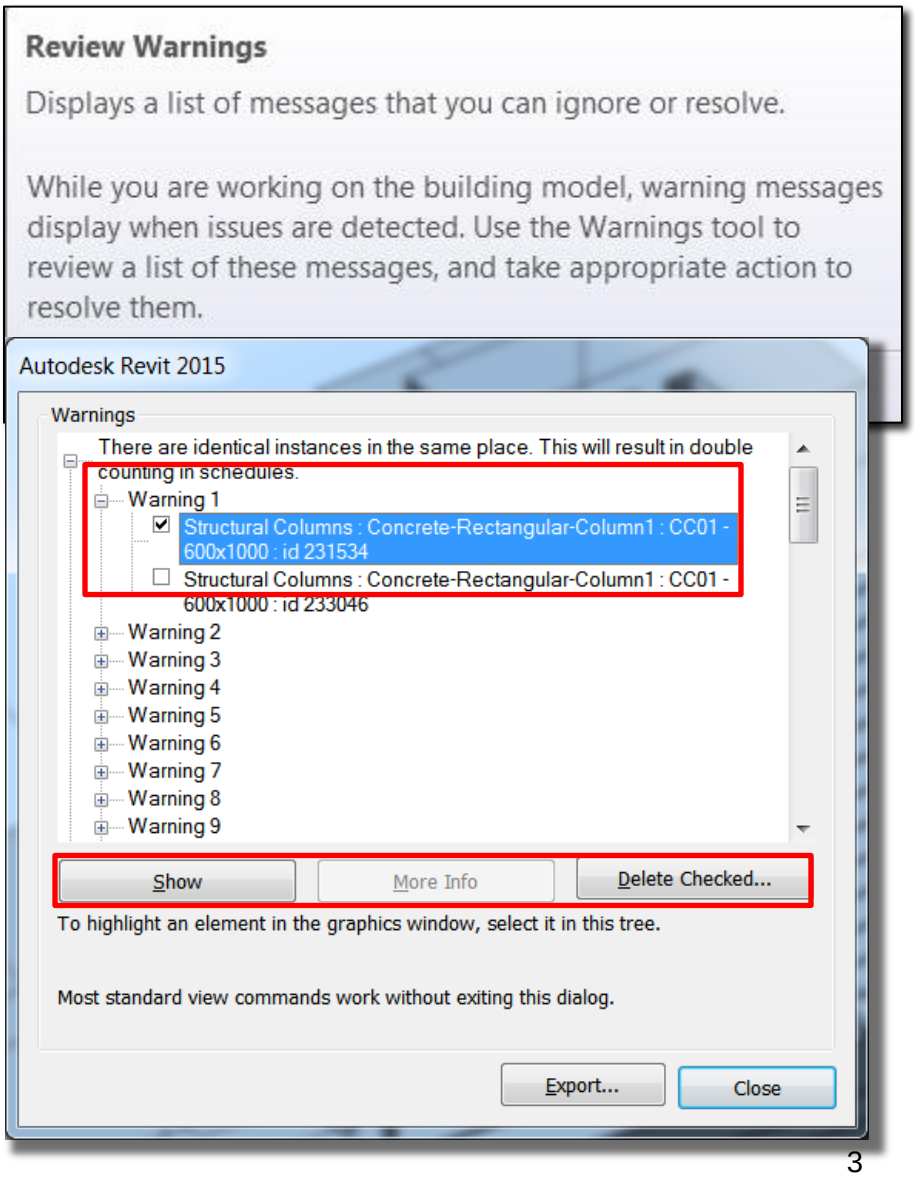
Auditing Geometry

The first thing I do when receiving a consultant concrete model is to examine the geometry and audit the information. Common modeling errors are not considered *errors* at the design stage. In most delivery methods, if the 2D documents produced are graphically correct, the contract is fulfilled and the integrity of the model is of little concern. The level of manipulation the model will need to pull accurate quantity information will vary wildly depending on the consultant team experience, individual work practices and level of collaboration overall. Although this presentation will focus specifically on structural concrete, much of the same auditing fundamentals should be followed if trying to pull quantities from other disciplines.

Review Warnings

Hopefully your model will be built better than the one I used for this example; nevertheless, a good place to start is the review warnings tool. From there you can easily delete duplicated geometry (figure 1) and locate any other errors that will considerably alter quantities in the schedules. Keep in mind that this does not find everything that could effect quantity extraction from the model, but it is a good start.

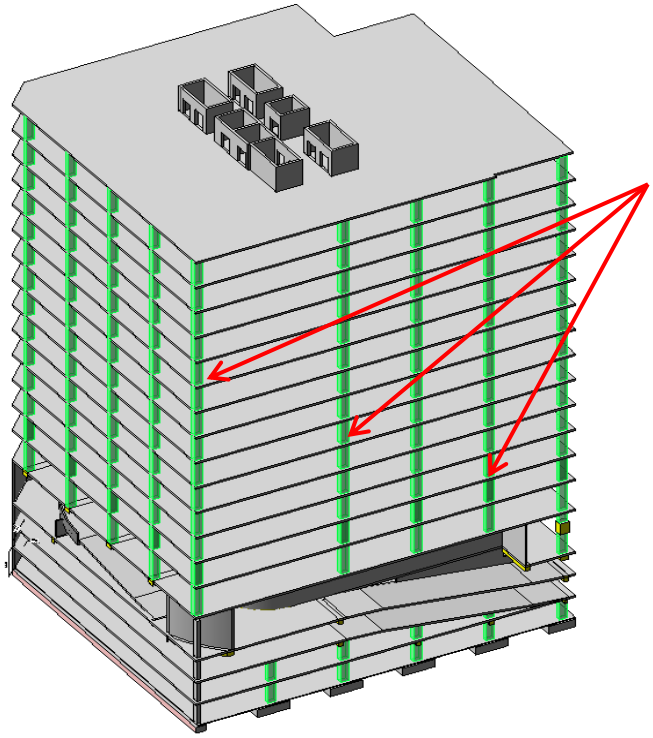
Figure1 – Warnings



Column Constraints

The second thing I look at when opening a concrete model, are the columns. As figure 2 shows, the columns start at the basement level and continue all the way to the top. When this is the case, I have a pretty good idea that the model is going to be in rough shape. Thankfully, there are some easy tools and simple steps that we can take to resolve some of these issues. For this particular problem:

Figure 2 - Incorrect column constraints



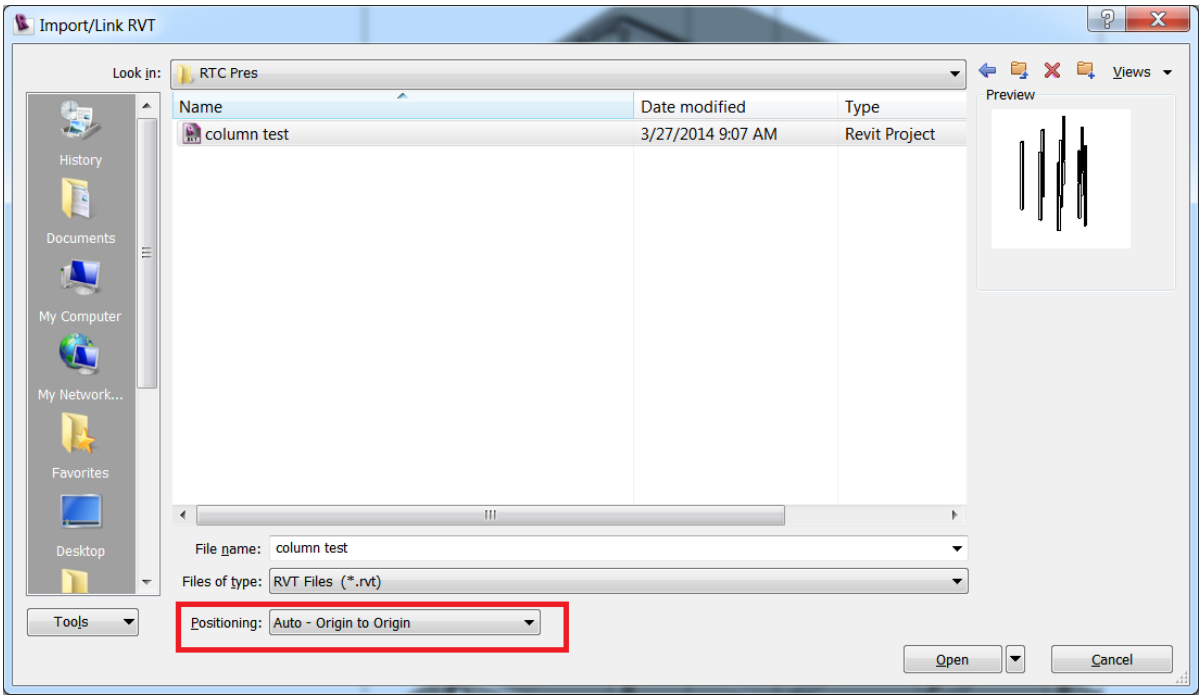
Columns that run the full height of the building show up fine in the 2D views, but will throw off quantities

1. Select and group all the columns you want to split.

2. Find the group you just created in the Project Browser and save it as a separate rvt. file

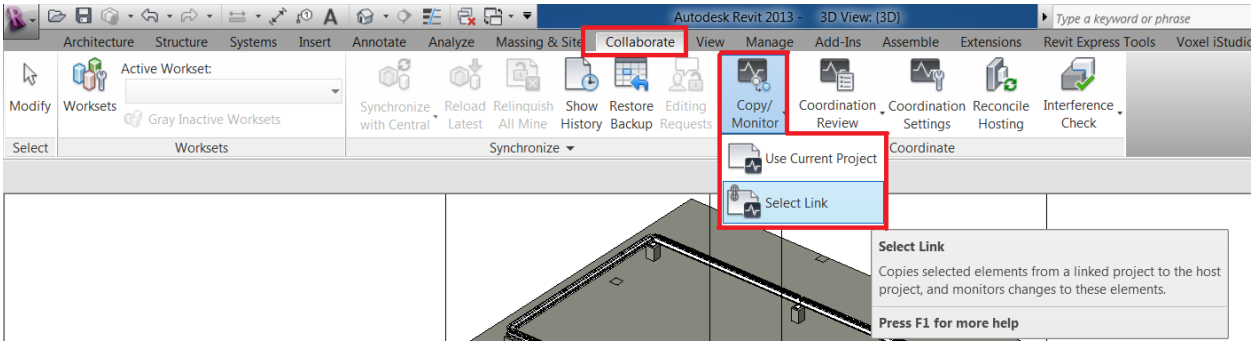
3. Link that rvt. file into your project making sure it's positioning is origin to origin (figure 3.)

Figure 3 - Origin setting



4. Under the collaborate tab, use the Copy/Monitor tool and select the linked file (figure 4)

Figure 4 - copy/monitor



5. Select options, then under the columns tab and check the “Split columns by Levels” box, making sure that your “New type” matches your “Original type” (figure 5)

6. Be sure to select the “multiple” box before using the copy function (figure 6).

Figure 5 - Column settings

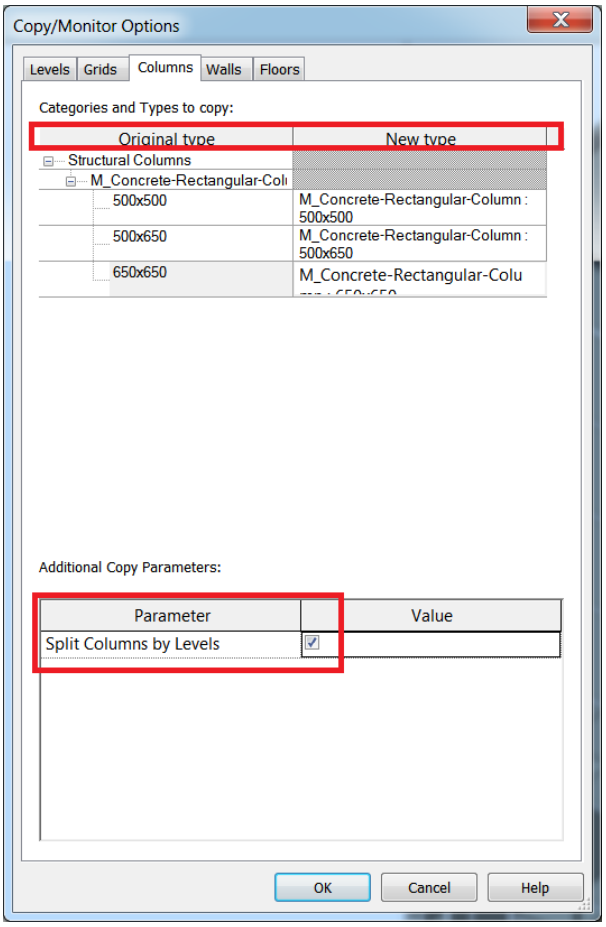
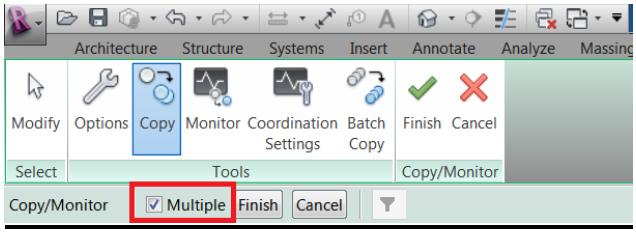


Figure 6 – “multiple” check box



7. Select all the columns and select finish on the options bar by the multiple checkbox, and finish again on the copy/monitor command.

8. Delete the group and unload the linked file.

NOTE: You will have to adjust the column offsets, but this saves a ton of time on large projects.

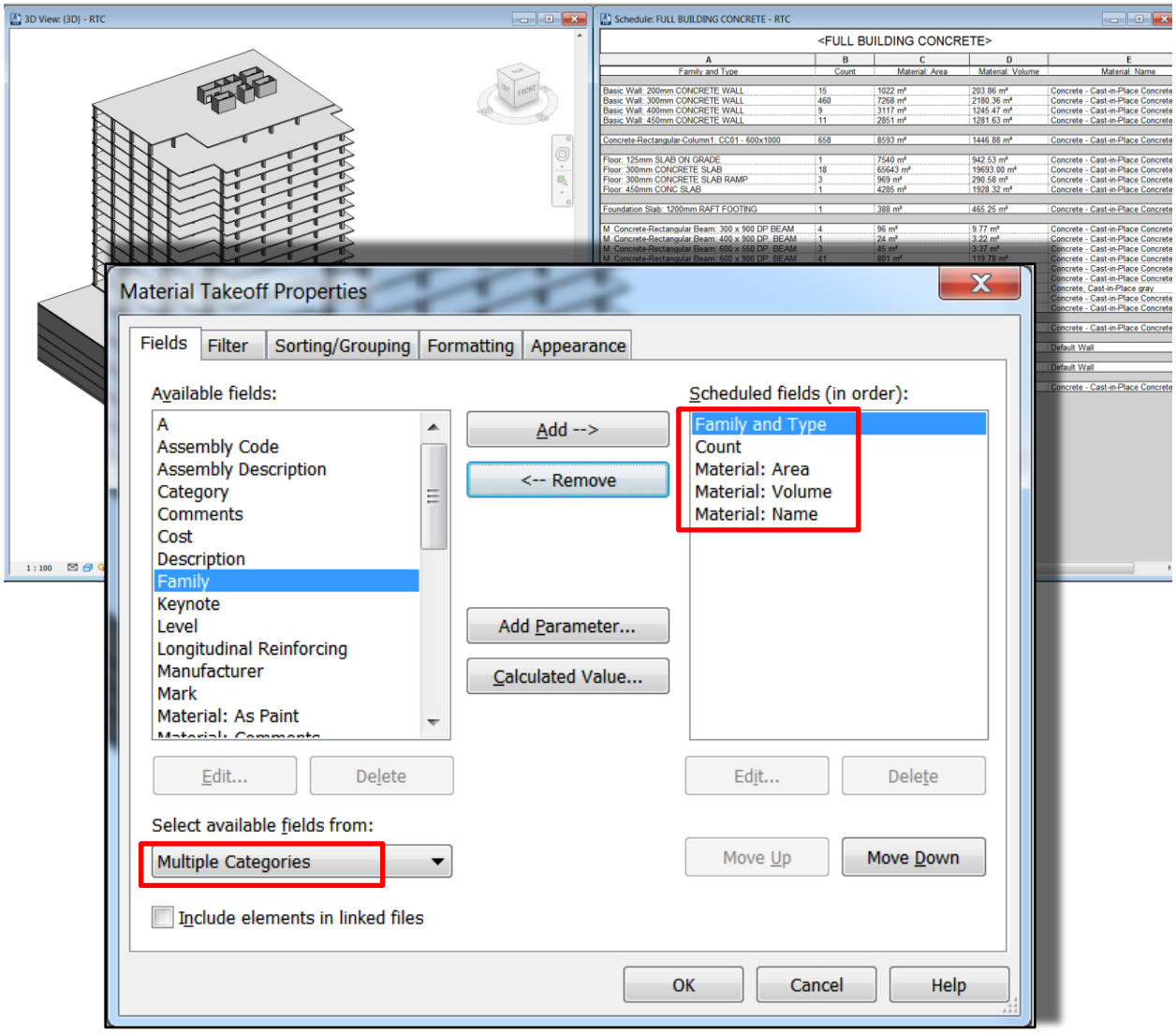
Separating Geometry

Once the concrete columns have been separated by floor, the constraints and geometry must be addressed. I will return to the geometry *problems* later on, because at this point I divide up the model into specific families and start adding color to the different categories for two reasons: first it helps to spot discrepancies in the materials, and second it’s easier to move geometry around into the proper categories. The simplest way to do this is through a **material takeoff schedule**. I start with a multi category material takeoff to get a quick breakdown of the families, geometry and materials I’m dealing with. Figure 7 has the schedule parameters I typically use. I’ll sort by Family and Type and then by Material: Name. From here

you can assign materials to any geometry with missing or incorrect information such as “default wall”.

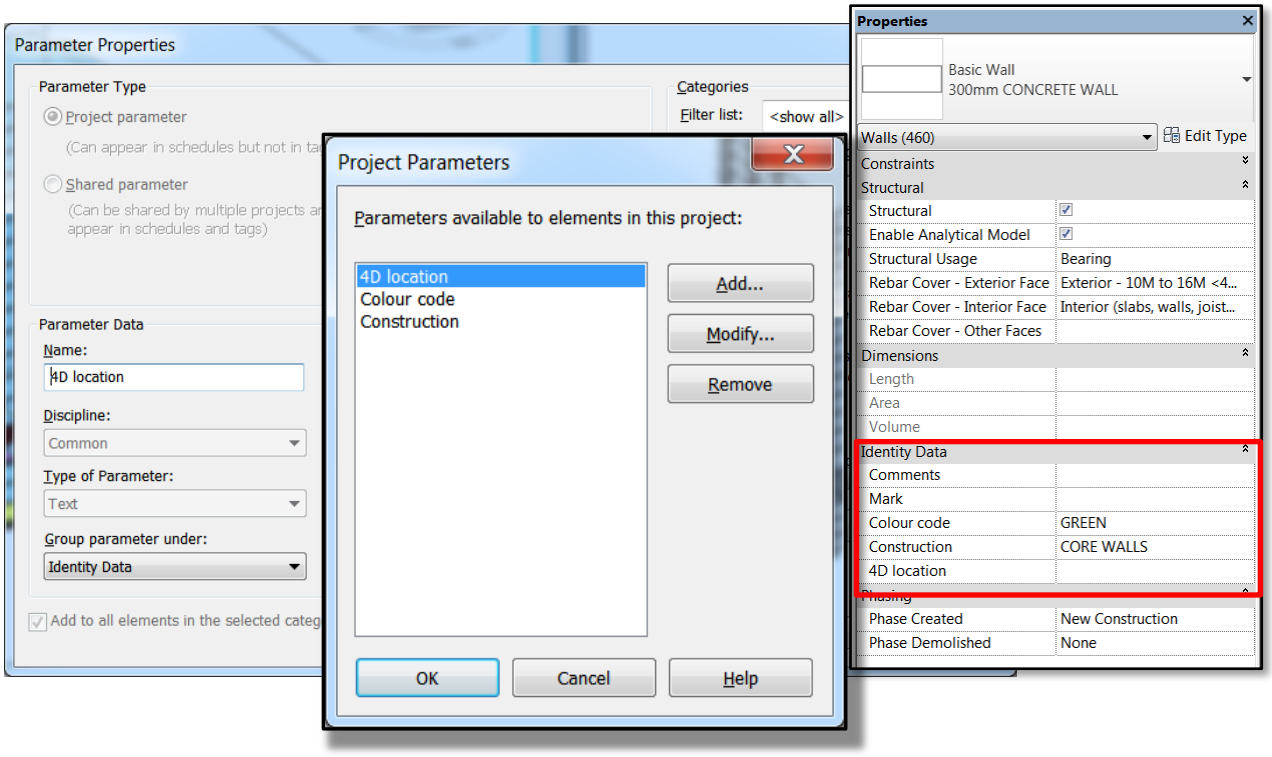
<u>For this exercise, I want to quantify *concrete volume* and *formwork contact area* of: strip footings, pad/raft footings, core walls, one sided foundation walls, columns, slab on grade, suspended slabs, ramp walls and ramp soffit area.</u>

Figure 7 - multi category material takeoff schedule



Depending on how the structural consultant named the different types of families they used, to get accurate numbers you will probably have to add or modify information in order to distinguish between similar geometry. For example, in this model they used the same family: ***Basic Wall: 300mm CONCRETE WALL***, for both core walls and foundation walls. Our estimators need to differentiate between the two, but Revit can't tell the difference. To separate the different geometry into the categories we're looking for, I add an identifier parameter called **Construction** into the project parameters. At the same time I'll add two more custom parameters: ***color code***, to assist downstream users with visual identification, and ***4D location,*** to utilize search sets later on in Navisworks Manage. All three are instance, text parameters and I group them under Identity data, Figure 8.

Figure 8 – custom project parameters



The next steps require some manual manipulation of the model, but most structural elements can be categorized fairly quickly. By isolating the family and type through the material takeoff schedule, one can quickly apply an identifier into the Construction Field we added. Once isolated, I simply override the graphics in a specific 3D view to suit and enter the information into the color code field. I color

the geometry at the same time I'm sorting the categories. This just provides a quick visual reference for me as well as the estimators, figure 9.

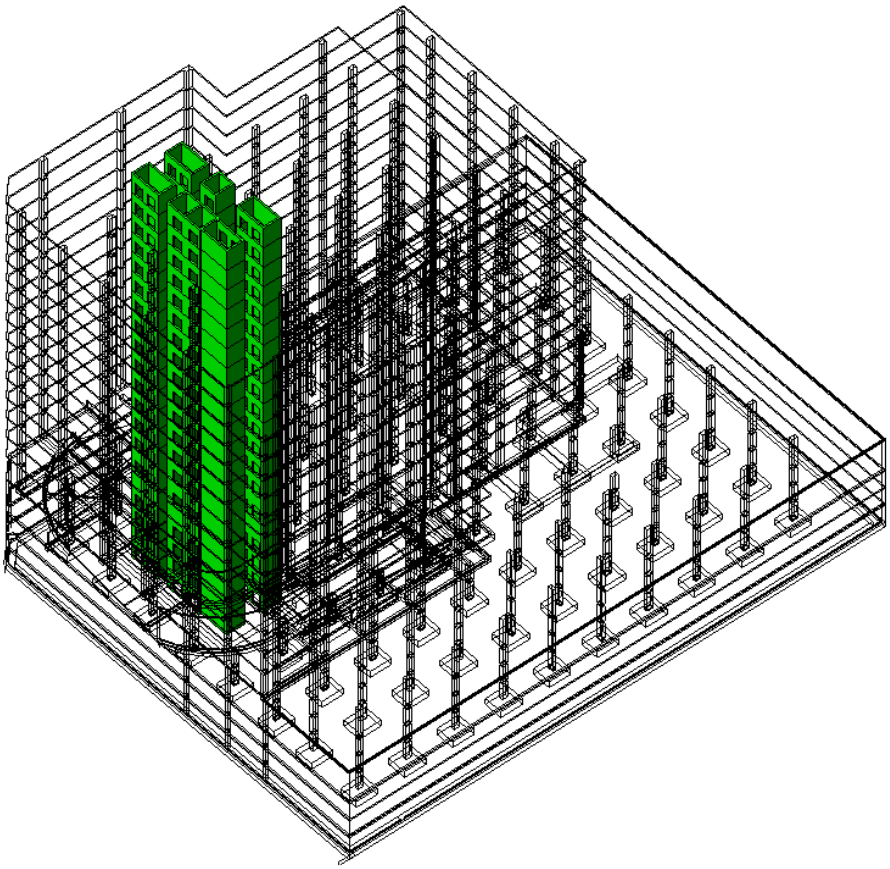
NOTE: Once you start adding identifiers to the geometry, you must add the fields *in the material takeoff to include that parameter or it will not show up on your* schedule.

Figure 9 – Filtered categories

Schedule: CORE WALLS - RTC

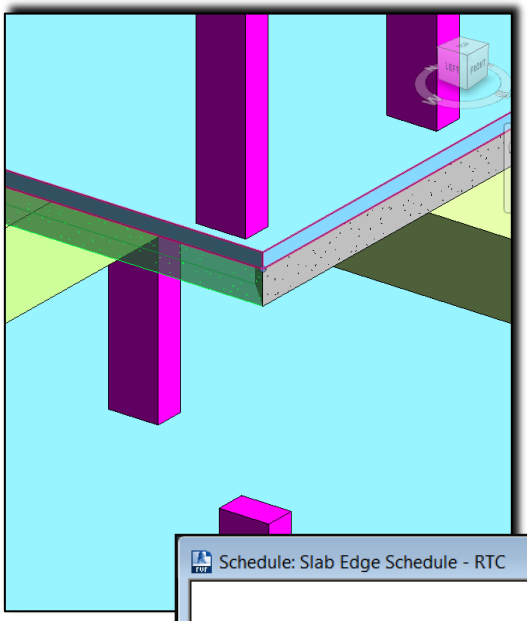
<CORE WALLS>

A	B	C	D	E
Family and Type	Construction	Material: Volume	Material: Name	Colour code
Basic Wall: 300mm CONCRETE WALL	CORE WALLS	2180.36 m³	Concrete - Cast-in-Place Concrete	GREEN



After I have gone through the model and separated the specific elements into the construction categories asked for by estimating, the geometry problems that will skew quantities have to be fixed.

Figure 10 – Slab edge



NOTE: One thing to remember is that Revit does not schedule slab edge quantities in a material takeoff schedule. This is a limitation that I have been told by Autodesk may be fixed in a later release. Nevertheless, it will yield volumes in a standard schedule.

Schedule: Slab Edge Schedule - RTC

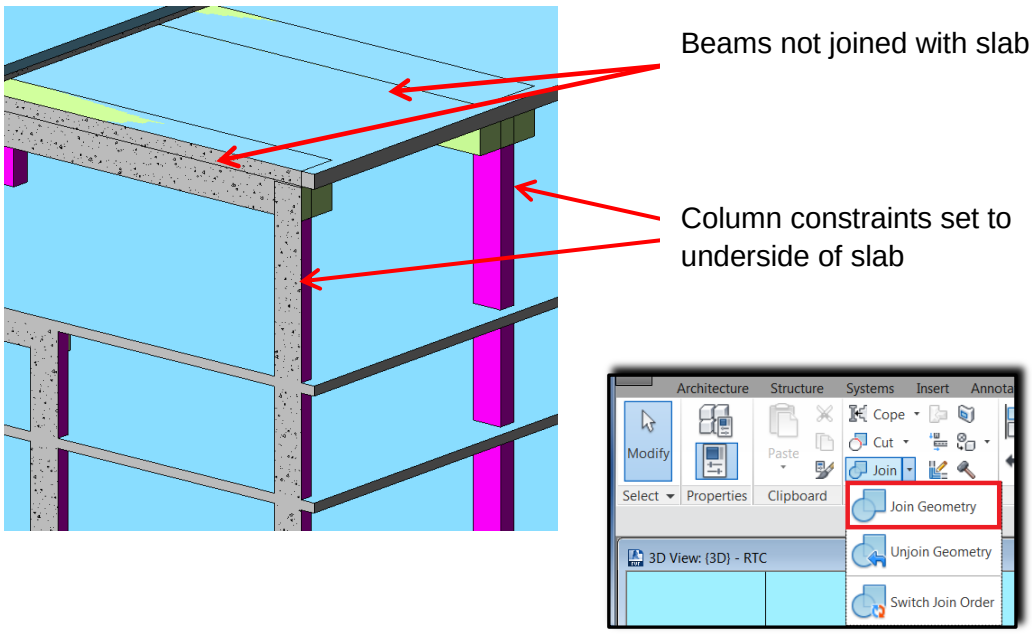
<Slab Edge Schedule>

A	B	C	D	E
Type	Volume	Material	Length	Profile
Slab Edge	15.50 m³	Concrete, Cast-in-Place gray	39730	M_Slab Edge-beam 660 x 600
Slab Edge	11.02 m³	Concrete, Cast-in-Place gray	27833	M_Slab Edge-beam 660 x 600
Slab Edge	21.37 m³	Concrete, Cast-in-Place gray	54257	M_Slab Edge-beam 660 x 600
Slab Edge	13.00 m³	Concrete, Cast-in-Place gray	33117	M_Slab Edge-beam 660 x 600

Fixing Geometry

Even though we have split the columns by floor, we have to fix the column constraints to ensure the quantities are correct. As evident in Figure 11, the columns are not constrained to the bottom of the beams as they will be built; they run through the beam to the underside of the floor. Additionally, the beams are not joined with the slab. Both these conditions will throw of your quantities.

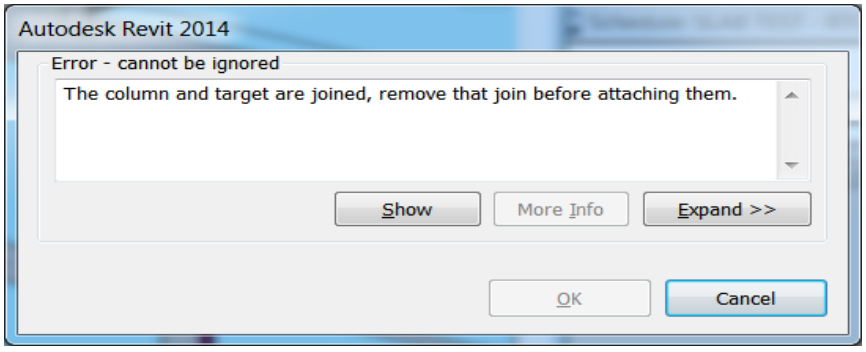
Figure 11 – column and beam geometry



The beam and slab can be fixed quite easily with the **Join Geometry** command; however, it is important to note, while the *Beam* area and volume will adjust accordingly when joined with the slab, the area of the slab will be unaffected in the schedule. To get accurate *slab soffit area* requires the beams to be joined to the slab in a way that takes away from the slab, not the beam. Unfortunately, this does result in a little extra form contact area for the beams. This is covered in the formwork contact area section.

Fixing the column to beam connections is not as straight forward. Revit joins the column to the beam of the same material by default. The **Unjoin Geometry** command does not work in this instance and, if the column runs right through the beam, if you try to **Attach Top/Base** to the beam, you will receive an error as seen in figure 12.

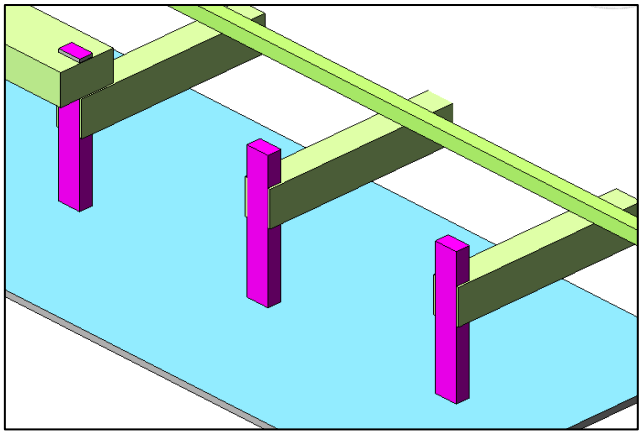
Figure 12 – column attachment error



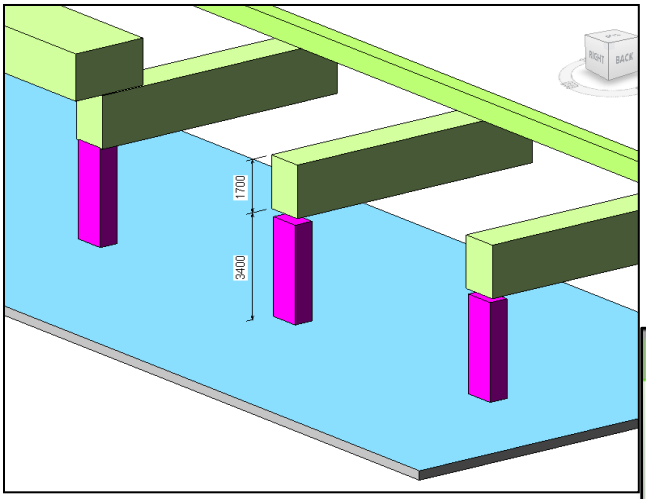
If this happens, you must reset the top constraints of the column to be below the beam, making sure their not touching, and then **Attach Top/Base** to the beam.

In the situation shown below in figure 13, the column is constrained to the floor levels and runs through an intermittent beam. You can split the columns in a section view, or you can model additional ones. However, in order to split columns they must be changed to a slanted style (don't ask *me* why, please direct questions to Autodesk…), so here, I will show the latter solution.

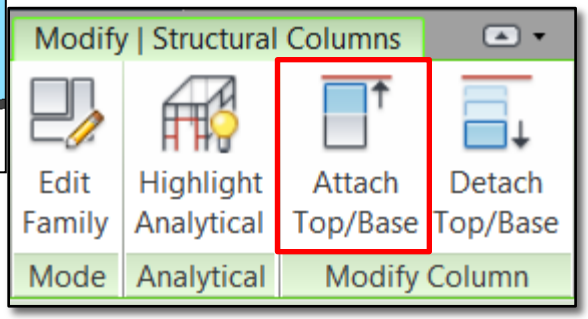
Figure 13 – column and beam geometry

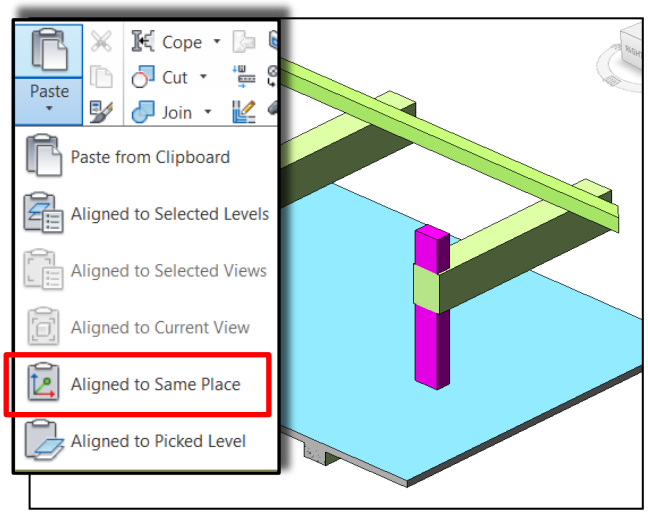


Here, a single beam runs directly through the concrete beams.



Set the top constraint lower than the beam bottom elevation as previously mentioned. Next **Attach Top** of the column to the beam.

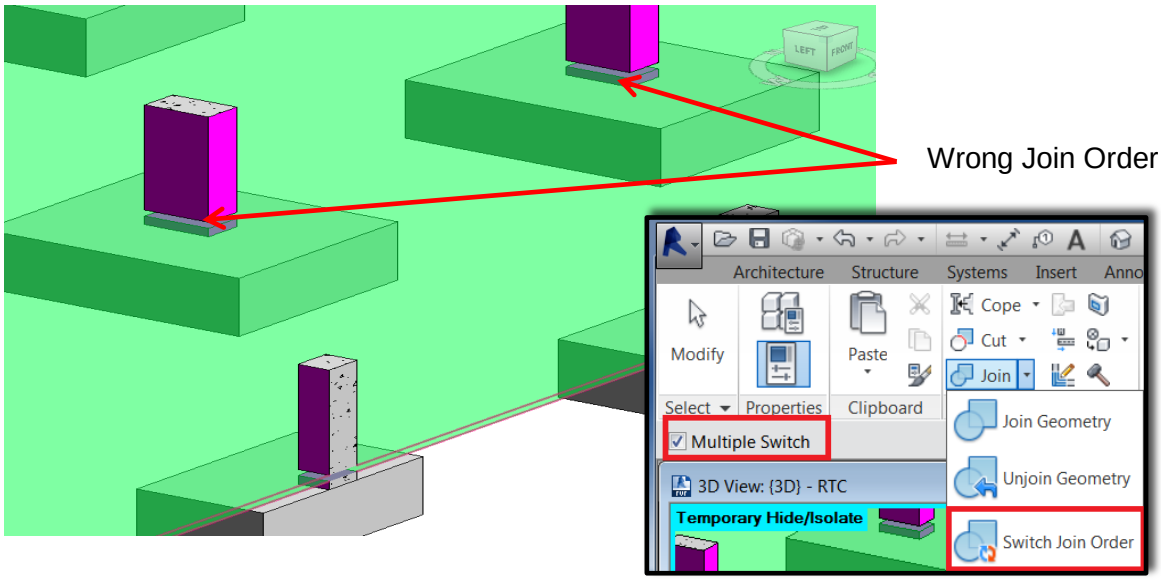




Copy the required columns and paste "**aligned to same place**". From here, you have to reset the bottom offset of the copied columns to match the top of the beam.

Revit joins the same materials automatically, but sometimes certain geometry takes priority over others, when it really shouldn't. For example, the bottom slab on grade is poured after the columns sitting on the pad footings. However, once the floor is modeled it cuts through the columns even though it should be reversed, see figure 14. New in Revit 2014 is **the Switch Join Order tool**. To do multiple objects, select the **Multiple Switch** checkbox in the options bar, select the slab and then every column that needs to be reversed.

Figure 14 – Join Order

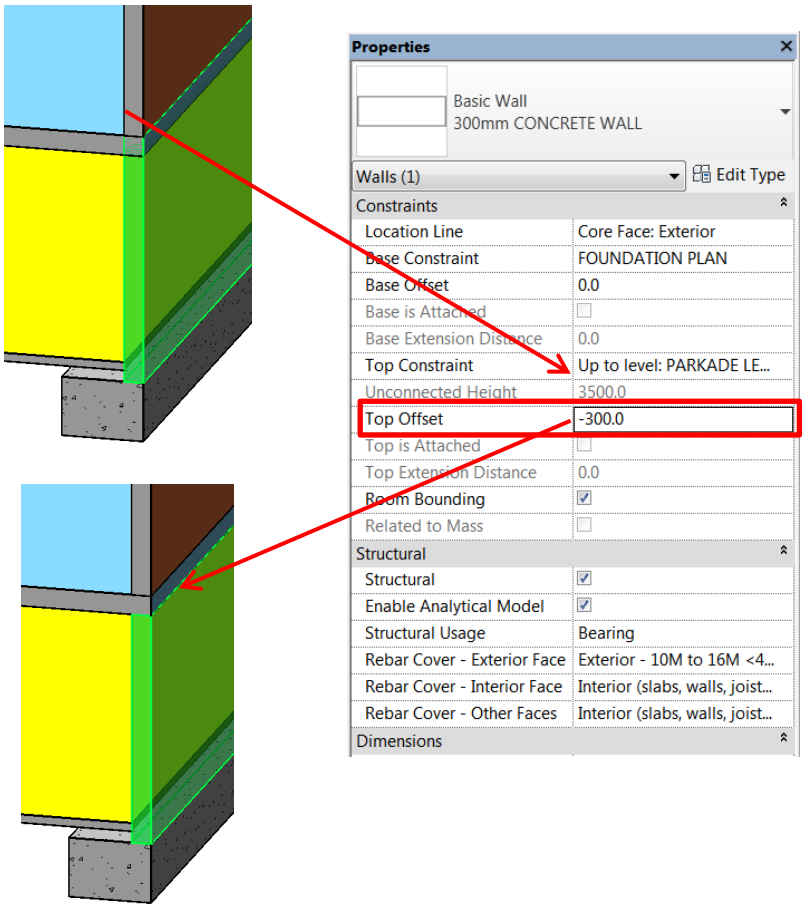


Wall Constraints

Next I examine the wall constraints. This *can* be an easy fix if the wall were modeled properly i.e. separated and constrained at each floor level and were just not offset or attached right. It is as simple as finding out how thick the suspended slab is and using that distance as your top offset in the properties window, or using the attach top/bottom tool, as shown previously in figure 13.

However, in the model I'm using in my example, the walls were modeled the same way as the columns extending from foundation to main floor. There are a few ways to fix this condition depending on your model. You could easily reset the constraints to attach to the floor above, then copy paste to selected levels. This works fine if there are no door openings or if there is nothing else attached to the wall. If you don't want to lose the openings, you need to **split** the wall. Go to a plan view of the wall and cut a section through it. Use the **split** tool to divide the wall at the desired levels. Next, attach the top of the walls to the proper slabs, figure 15.

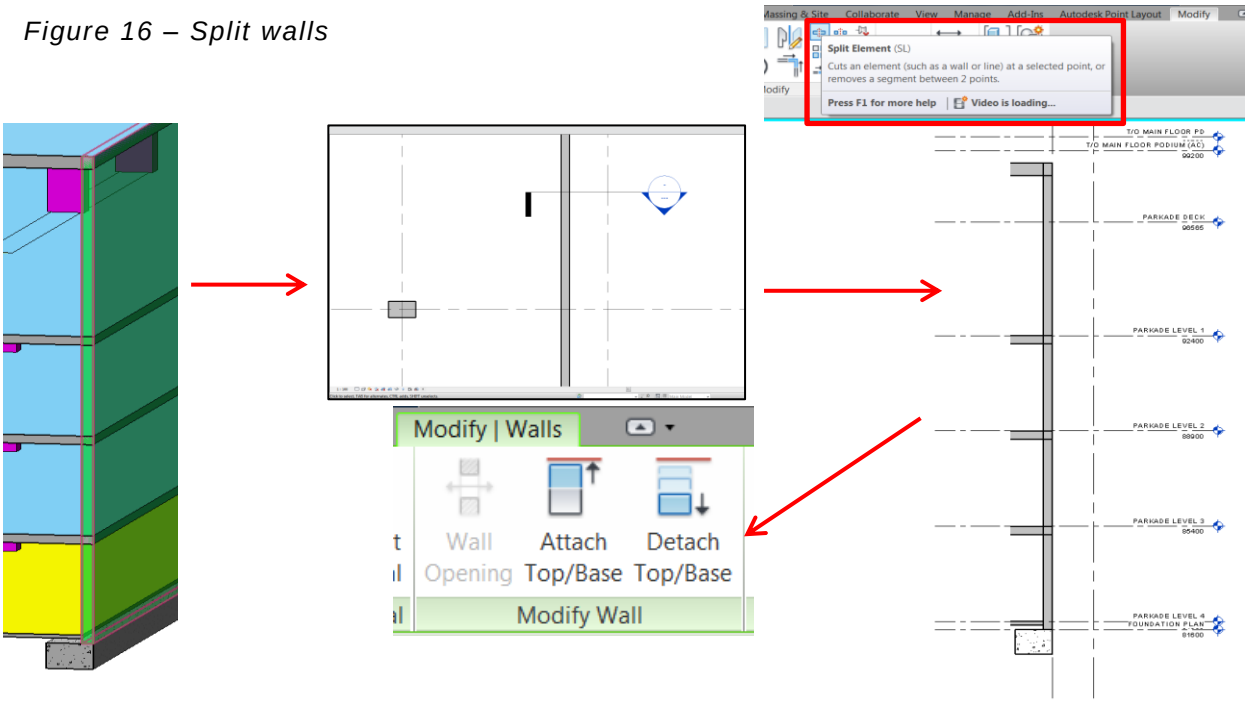
Figure 15 – wall constraints



Top offset or attaching wall can easily fix inaccurate wall constraints

NOTE: The full height wall geometry itself will not throw off your *quantities* substantially, but it will not work properly in your 4D after exported to Navisworks

Figure 16 – Split walls



Form contact area

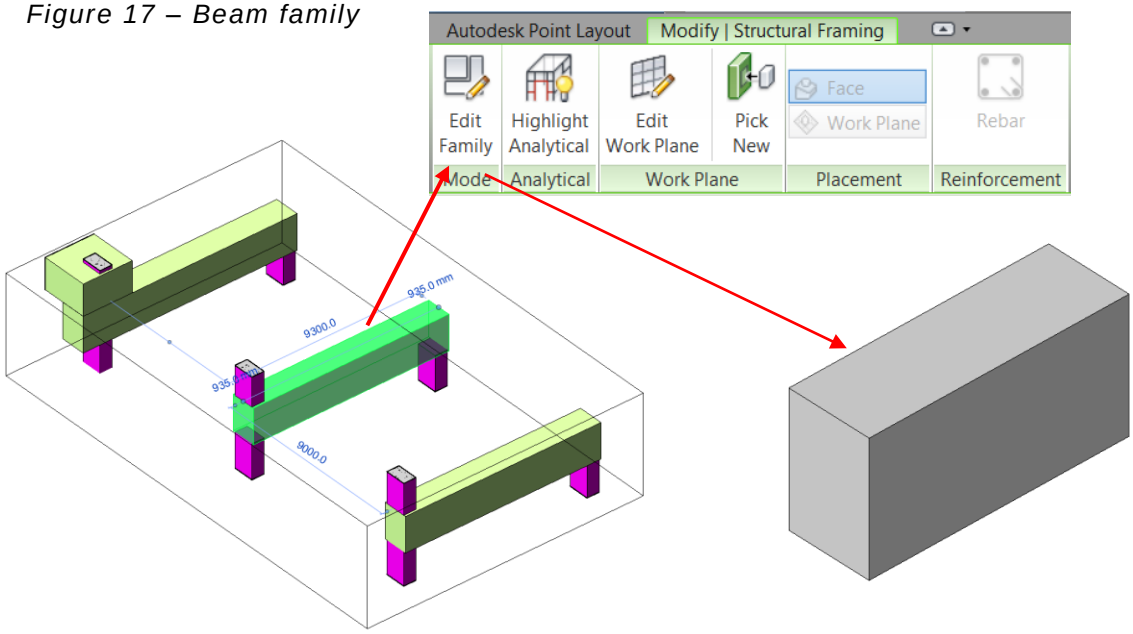
Revit does not have the ability to directly schedule form contact area; however, if we add some supplemental information into the families themselves, we can isolate that information in a schedule. Once the geometry is fixed in the model, you can easily pull accurate information from it.

Beams

By default, Revit will calculate the full surface area of all 6 sides of the beams in a material takeoff schedule. Obviously, there is no formwork needed for the top of the beam because it is poured as part of the slab. We are only after the soffit area of the slab and the sides and soffit of the beams. The slab itself will yield the one sided area like a wall by default because it is a system family; however, the area is correct only if we join the beams to the slab… creatively.

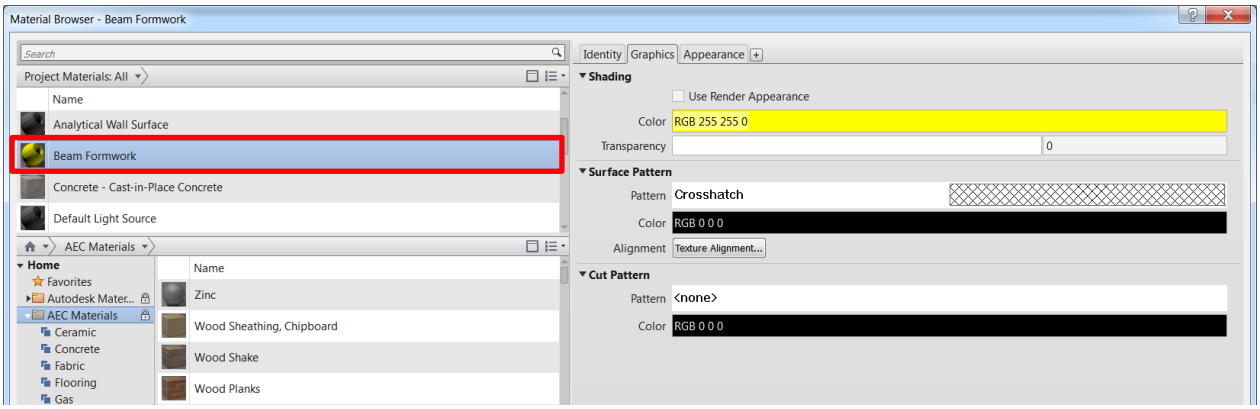
To start, open the beam family to edit as shown in figure 17.

Figure 17 – Beam family



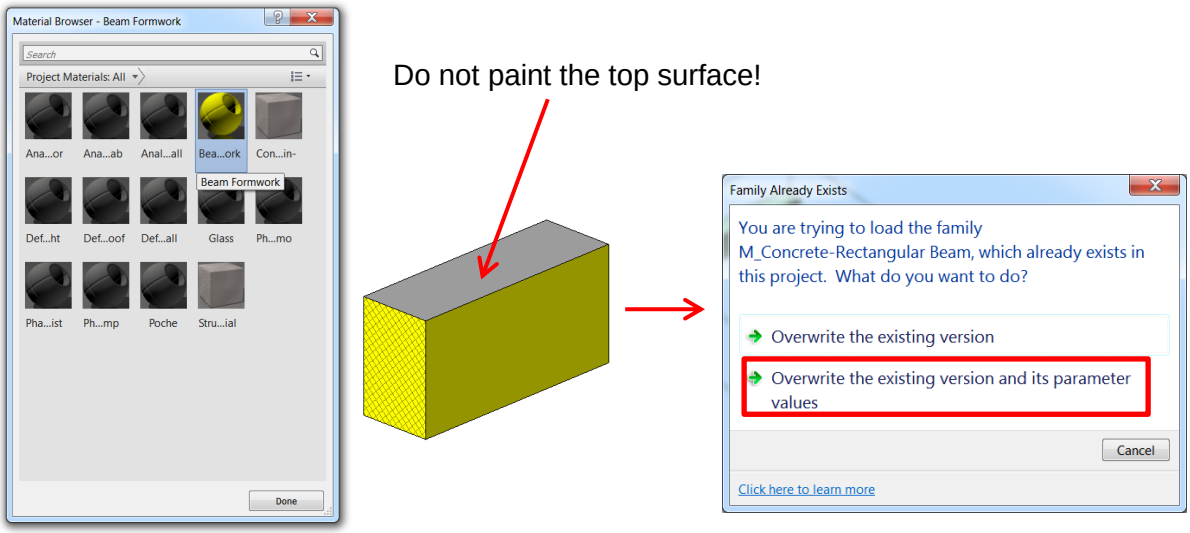
Next, we need to add the material that will represent the formwork we need to quantify. In the material browser, either duplicate an exiting material and rename, or create a new material called “Beam Formwork” and change the graphics to something unique to your project to visually identify as shown in figure 18. **NOTE:** You will have to reset the graphic overrides in your 3D view if you want to see the formwork material.

Figure 18– custom material in beam family



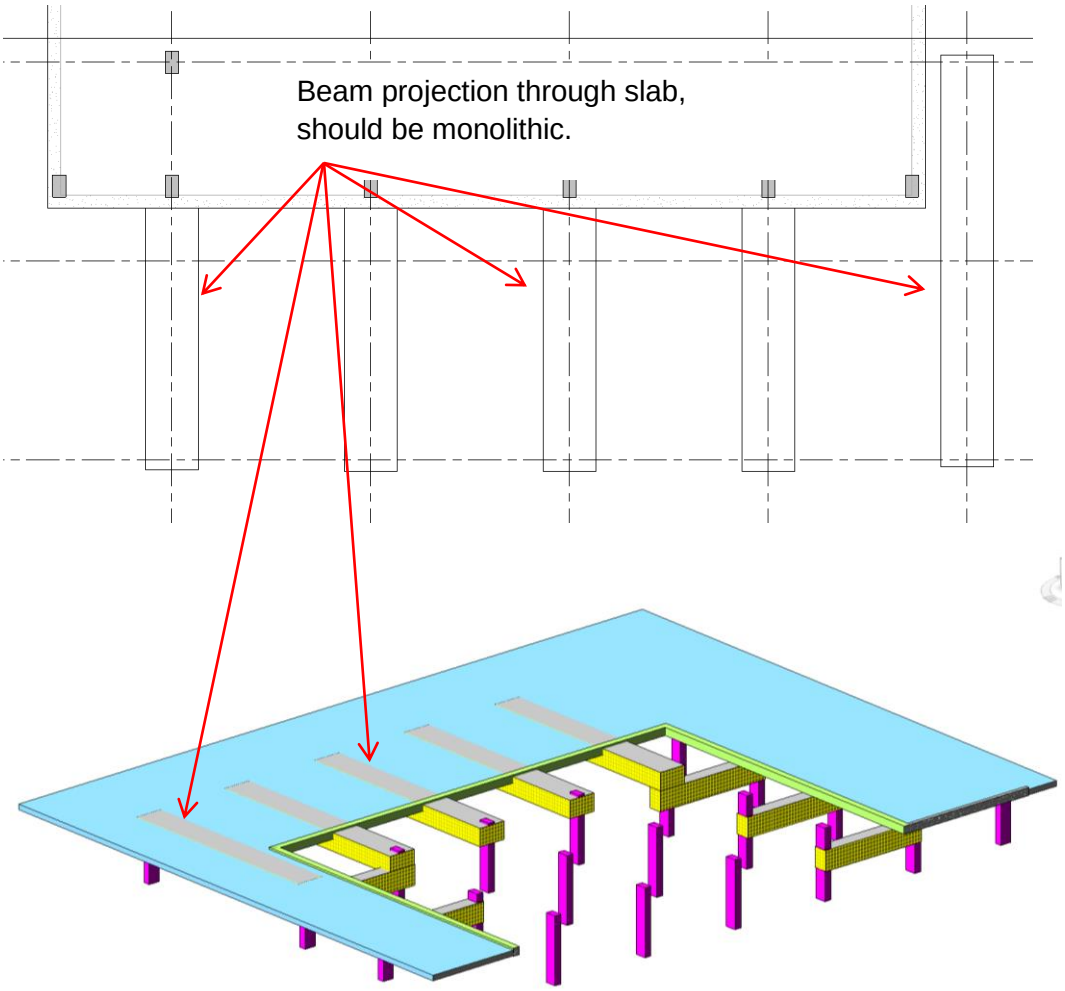
Paint the surfaces of the beam you want to calculate with the new material “beam formwork” making sure not to paint the top of the beam. Load the beam family back into your project and “overwrite existing version and parameter values”. Keep in mind this is not a once size fits all solution and many concrete designs might need a more thorough evaluation, or more than one beam type with different sides painted.

Figure 19 – painting formwork



Once you load the beam family back into your project, open the concrete material takeoff we completed earlier, you will now see the “Beam formwork” material quantified as well. It is critical to join the beams geometry with the floor slab as to not duplicate soffit areas. By default, Revit’s join order takes away from the beam, not the slab. In order to get accurate soffit form area, the order must be reversed. In the design stage this is not usual practice because of how the graphics show up in a plan view, shown in figure 20, but in order to get accurate soffit quantities of the suspended slab, this is the easiest way to subtract the beam soffit area from the slab. Regardless, at his point we care about information, not graphics.

Figure 20 – plan view beam graphics



Columns and Pad footings

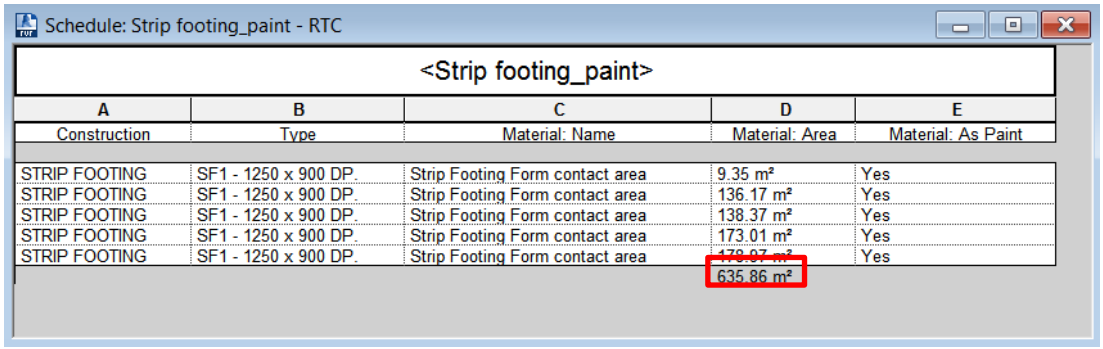
The process is exactly the same for columns and pad footings; edit the family, add a custom material to represent formwork, paint the required sides and reload the family.

Strip Footings

The strip footing is a system family, but Revit quantifies the area of all 6 sides. To calculate your formwork they all must be painted manually within the project environment or, a calculated value within the schedule will yield almost the same value. Follow the same steps as before and create a material called “strip footing formwork” in the project itself and paint the required sides. Conversely, figure 21

shows two different material takeoff schedules, one using a painted surface the other using a calculated value. They are virtually identical.

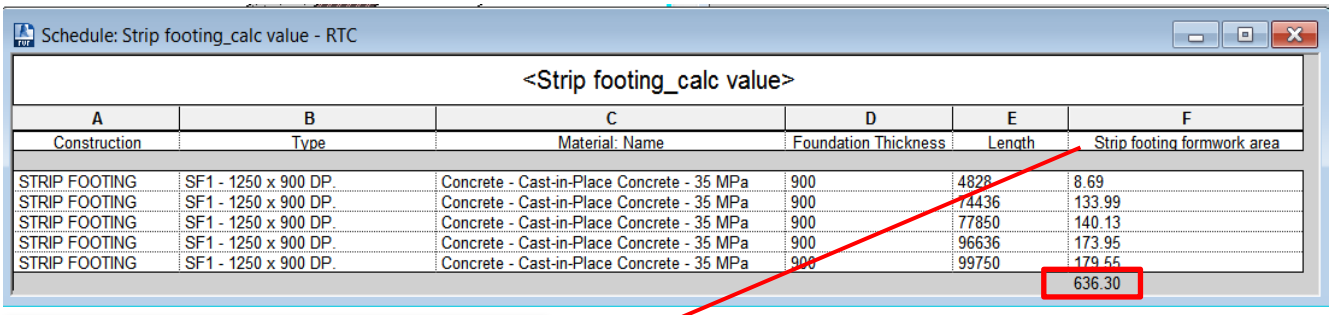
Figure 21 – strip footing formwork comparison



Schedule: Strip footing_paint - RTC

<Strip footing_paint>

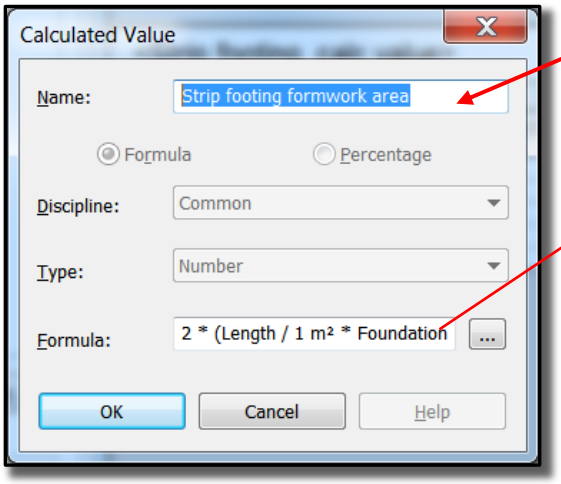
A	B	C	D	E
Construction	Type	Material: Name	Material: Area	Material: As Paint
STRIP FOOTING	SF1 - 1250 x 900 DP.	Strip Footing Form contact area	9.35 m²	Yes
STRIP FOOTING	SF1 - 1250 x 900 DP.	Strip Footing Form contact area	136.17 m²	Yes
STRIP FOOTING	SF1 - 1250 x 900 DP.	Strip Footing Form contact area	138.37 m²	Yes
STRIP FOOTING	SF1 - 1250 x 900 DP.	Strip Footing Form contact area	173.01 m²	Yes
STRIP FOOTING	SF1 - 1250 x 900 DP.	Strip Footing Form contact area	179.07 m²	Yes
			635.86 m²	



Schedule: Strip footing_calc value - RTC

<Strip footing_calc value>

A	B	C	D	E	F
Construction	Type	Material: Name	Foundation Thickness	Length	Strip footing formwork area
STRIP FOOTING	SF1 - 1250 x 900 DP.	Concrete - Cast-in-Place Concrete - 35 MPa	900	4828	8.69
STRIP FOOTING	SF1 - 1250 x 900 DP.	Concrete - Cast-in-Place Concrete - 35 MPa	900	74436	133.99
STRIP FOOTING	SF1 - 1250 x 900 DP.	Concrete - Cast-in-Place Concrete - 35 MPa	900	77850	140.13
STRIP FOOTING	SF1 - 1250 x 900 DP.	Concrete - Cast-in-Place Concrete - 35 MPa	900	96636	173.95
STRIP FOOTING	SF1 - 1250 x 900 DP.	Concrete - Cast-in-Place Concrete - 35 MPa	900	99750	179.55
					636.30



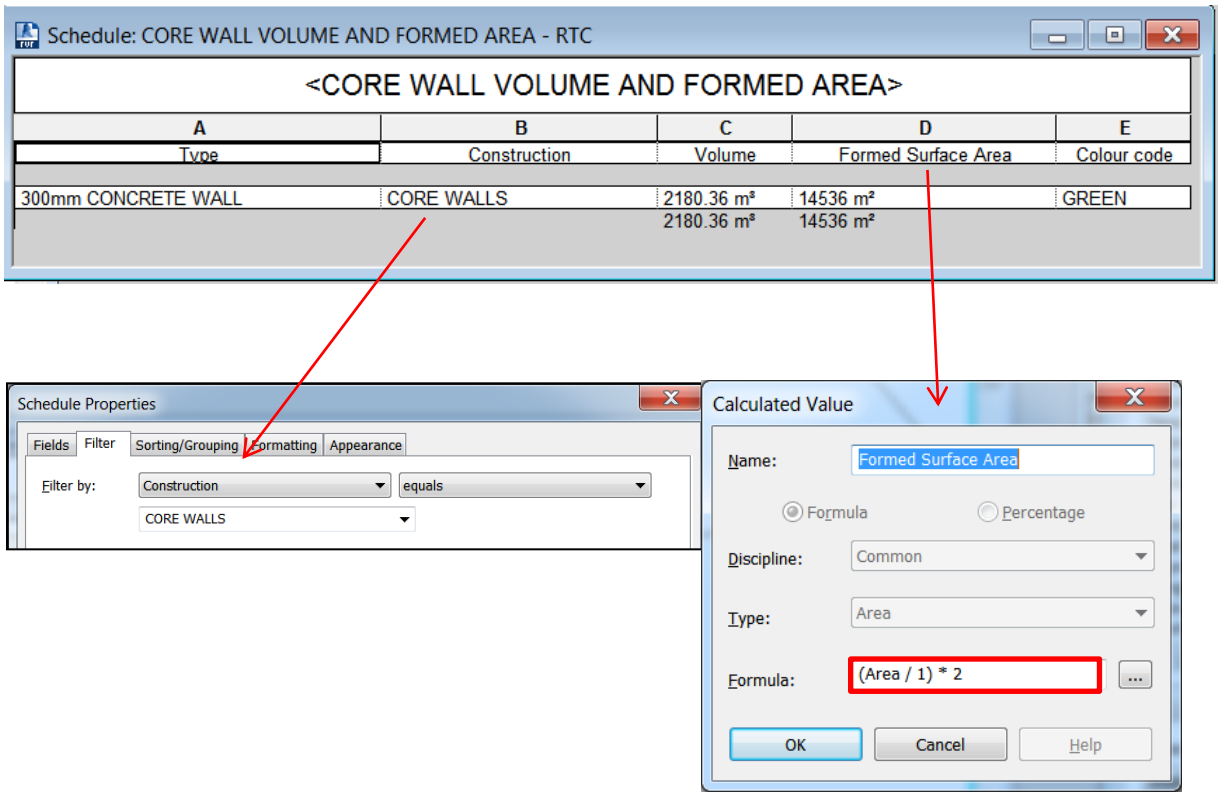
2 * (Length / 1 m² * Foundation Thickness)

Core walls

Because we've already added the Construction parameter as an identifier to specific geometry, isolating the core wall information is as simple as filtering for

that parameter in a wall material takeoff schedule, see figure 22, and the form contact area is a simple calculated value.

Figure 22 – wall material takeoff schedule



One sided foundation walls

Finally… a schedule that needs no modification to yield proper formwork area! As long as we've fixed the geometry, a wall system family automatically schedules one sided area. All you have to do is duplicate the previous core wall material takeoff schedule, change the filter to ONE SIDED FOUNDATION and replace the calculated value with the default "Area" field

Slab on grade

This one is a no brainer. There is no formwork and as long as the geometry was joined properly with the columns running down to the pad footings, the volume will be accurate.

Suspended slabs

Again this one is pretty simple because the Revit default is one sided area. As long as the beams were joined as previously discussed on **page 15** the schedule will yield proper soffit form area as just “Area”.

Ramp walls

Ramp walls should be just walls with a RAMP construction identifier. Duplicate the Core wall Schedule and change the filter. Done.

Ramps

Unless you’re unlucky, the structural consultant should have modeled all ramps as floors and used the “modify sub elements” tool for slopes. If this is the case, you’re golden: Duplicate a floor schedule and change the Construction filter to RAMP.

Unfortunately, Revit does not calculate system family ramp materials in schedules *or* material takeoff schedules. I have not found a workable solution to finding a ramp area, not even the paint on the ramp will show up in a schedule. If anybody has solved this please let me know....

4D scheduling

Once we have quantified the concrete of the model, we like to complete a 4D to visualize how the building will be constructed. This helps our field crew plan site logistics as well as assists our trades in planning the resources they will need. Unfortunately were not done modifying the geometry yet because after sitting down with the project team to come up with a logical sequence, we need to break up the model further into its individual pours.

Parts

The easiest way to break apart concrete for a 4D is using the **parts** tool. Select the slab you want to divide and select parts under the create panel on the modify tab, see figure 23. Be sure to set the work plane to the floor you are working on. Next select the part you just created and pick the divide parts tool. This will open a sketch window where you will be able to either select the intersecting reference planes or grids you wish to divide the slab at or, sketch in the lines where it will be divided (figure 24).

Figure 23 – parts tool

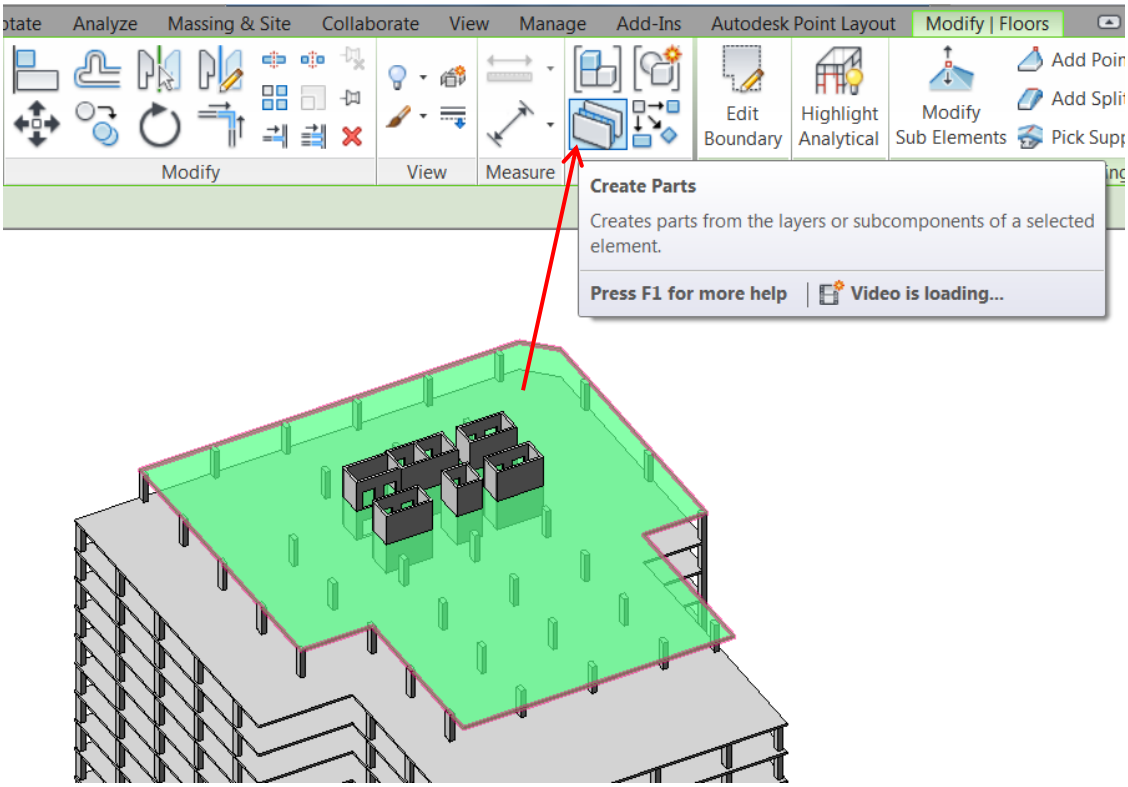
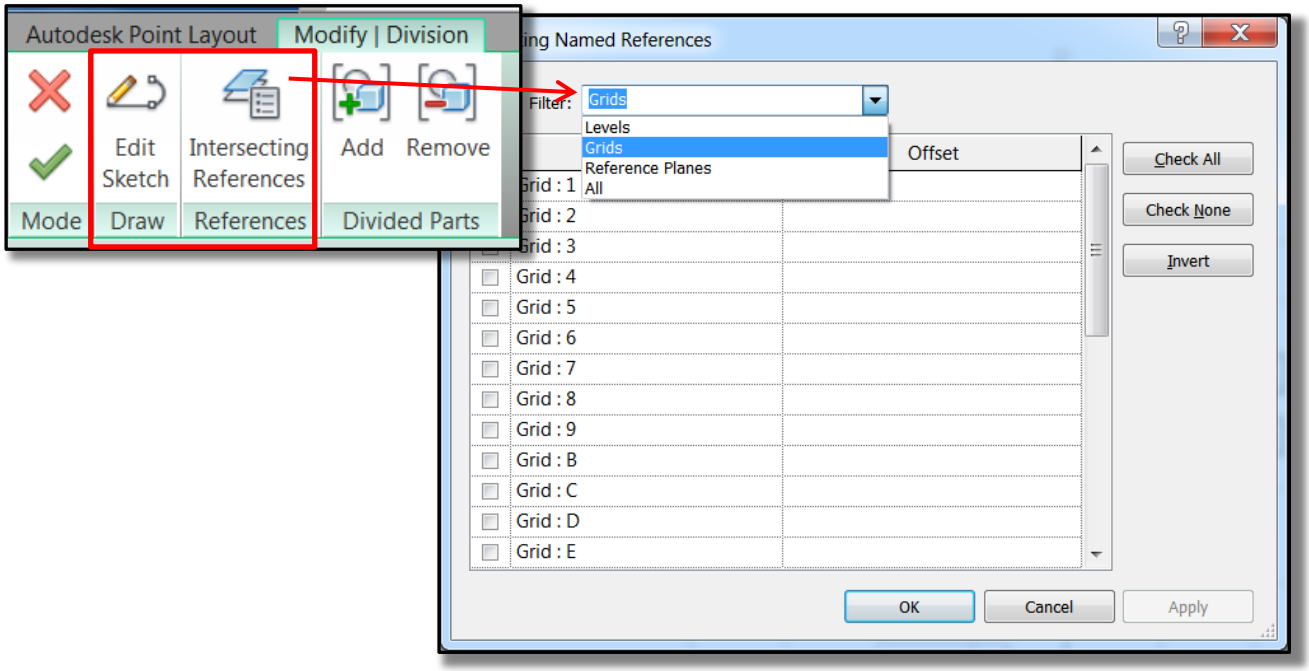


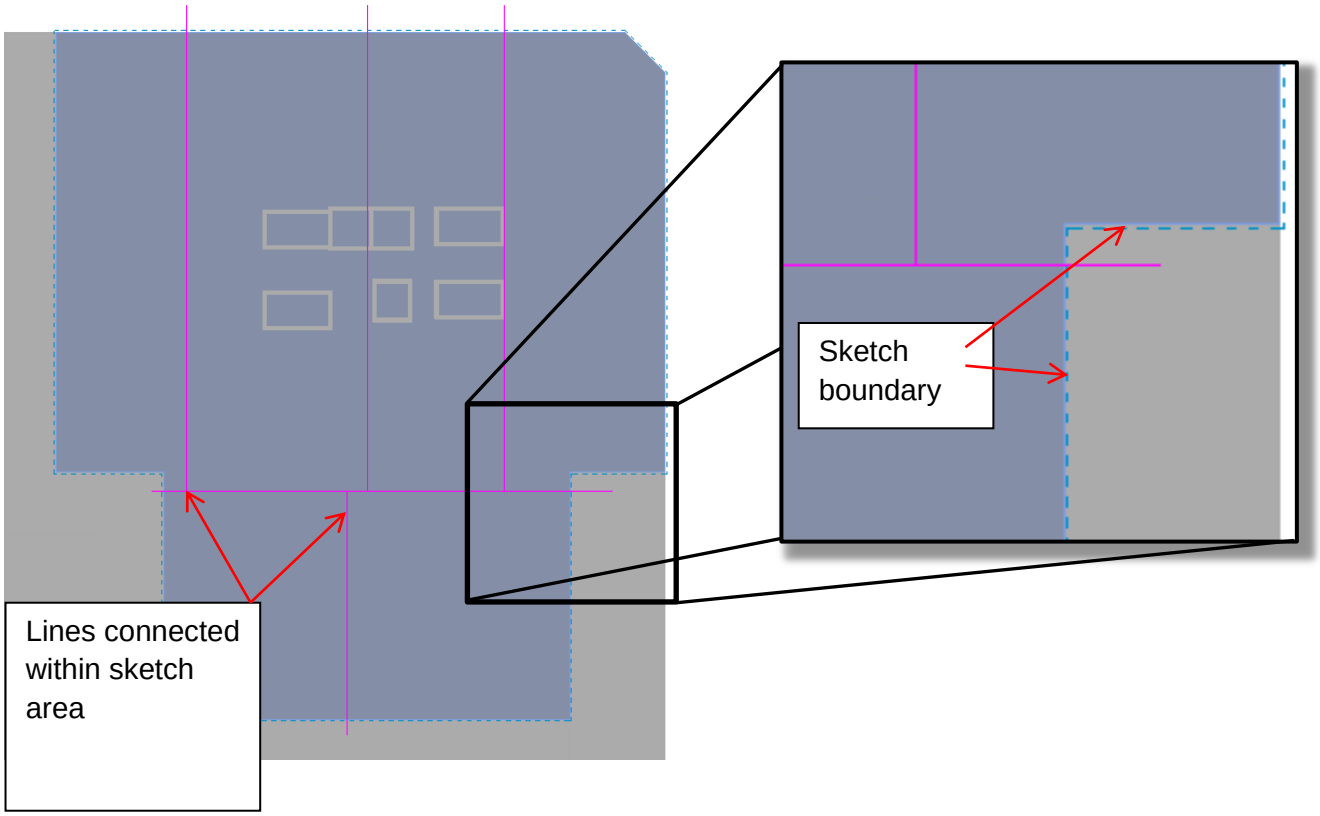
Figure 24 – sketch or reference



Typically the slab pours will be off the grid lines, so we will **Edit Sketch** where we want to divide the slab because it is faster than adding the reference planes first.

Unlike sketching for other Revit applications i.e. floor, roof, when dividing a part, you do not need to have the lines in closed loops. As shown in figure 25, the lines must be connected within the sketch area, and run outside the sketch boundary.

Figure 25 – sketch option

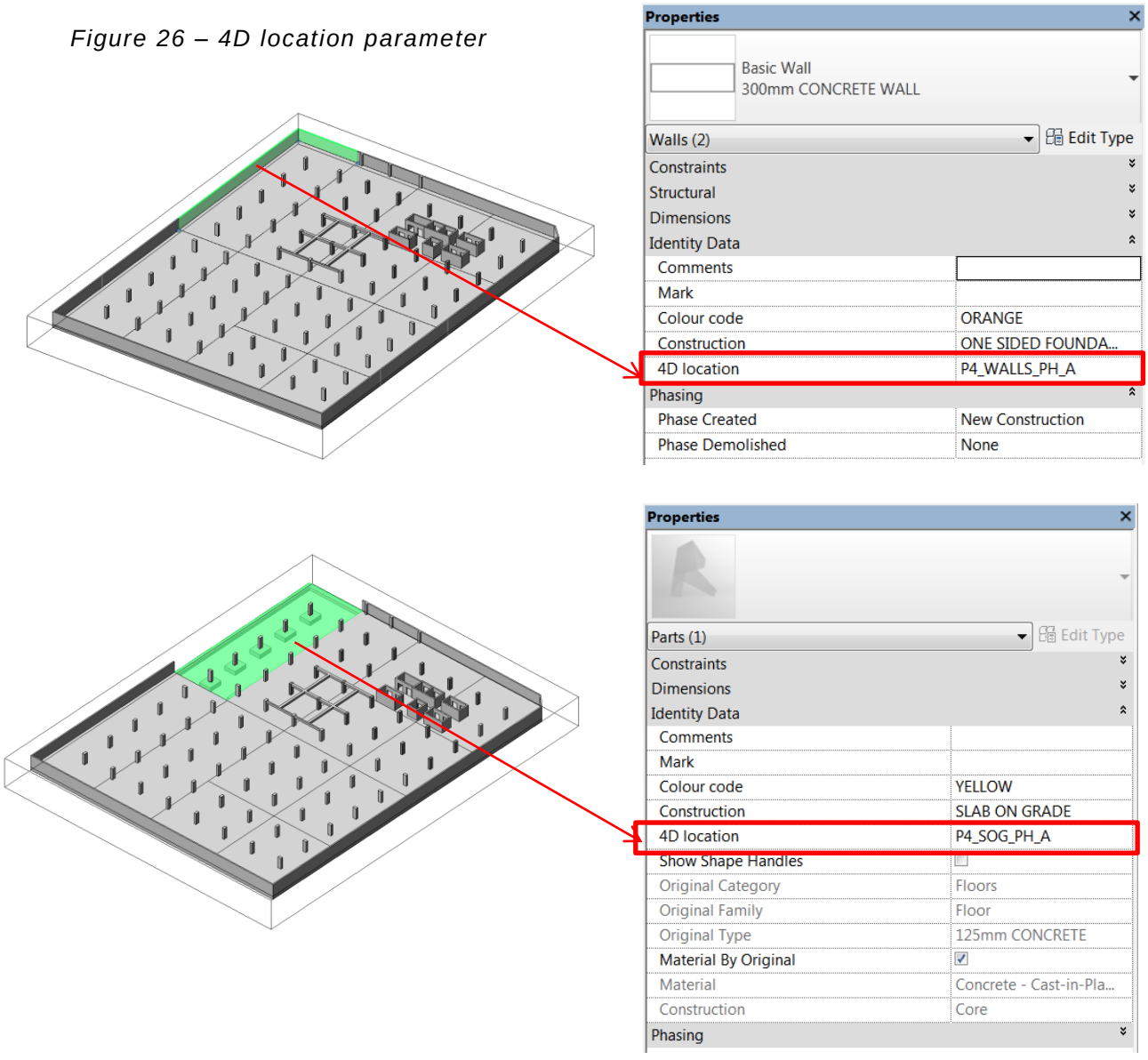


Once you have the proper pours isolated, finish the sketch and finish the division. If the slab division is typical for every floor, you can easily copy paste the sketch lines from floor to floor once within the sketch window. If the walls of your building need to be divided, you can use the split tool in any plan, section or 3D view. The columns have already been separated by level, the beams should be poured as is and you will notice the strip footing splits with the wall it is hosted to; although, the full strip footing will most likely be poured first.

Search sets

The original slab will still visible in the 3D view as well as in all plan views by default. You will need to turn off floors in the visibility graphics before you export to Navisworks from a 3D view, but before we export, we will add an identifier to the geometry to simplify the process of isolating elements for selection sets. This is where the 4D project parameter we added earlier comes in to play, see figure 26. I like to use a section box in a 3D view to isolate floors as I move up the building. I hide the elements after I've applied the identifier so as to not accidently pick unwanted geometry.

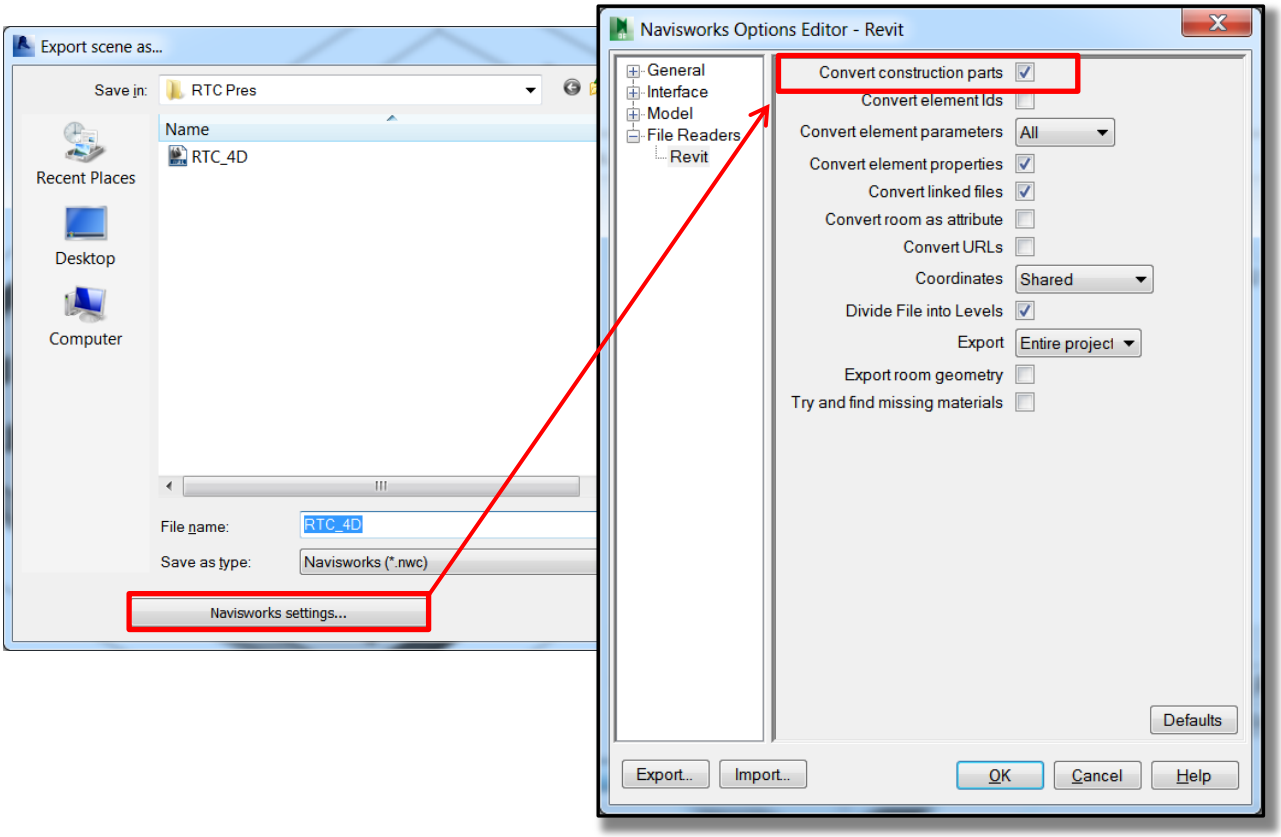
Figure 26 – 4D location parameter



This is a tedious job, but once you have added identifying 4D location parameters to all the geometry, open up a full 3D view, and export the project out as a NWC. file.

NOTE: You will want to check the Navisworks settings, shown in figure 27, and make sure “convert construction parts” is checked *before* you export the file.

Figure 27 – Navisworks settings

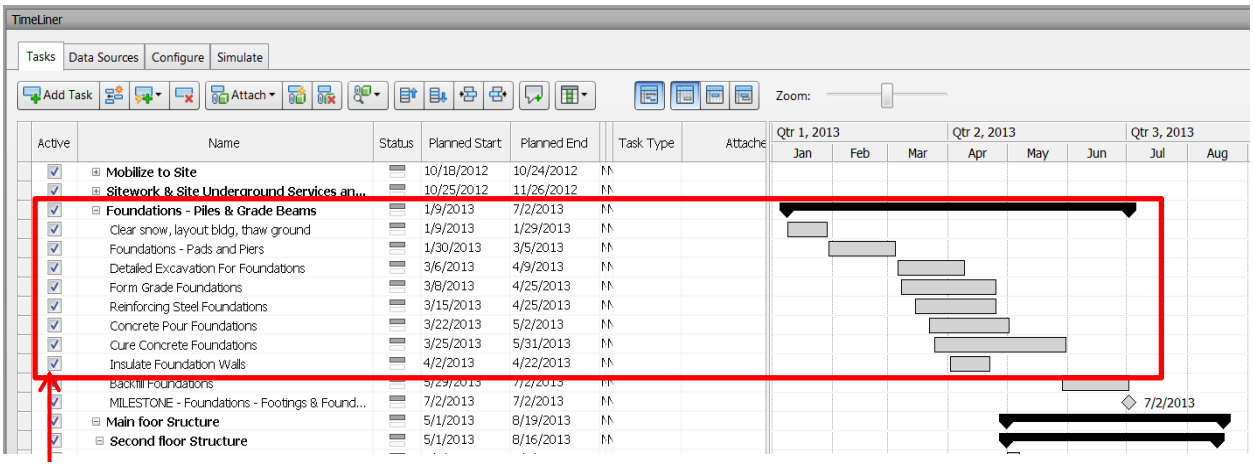


Navisworks TimeLiner

If you are importing an existing Microsoft Project schedule to populate your task list, you can use the 4D location parameter as a search set to help isolate geometry. Most likely, there will be no way to reconcile the task names and geometry from the model because they will be defined separately from the Project Managers schedule as well as interspersed with other tasks other than concrete, see figure 28.

For a 4D limited to concrete, you will most likely manually create your task list; regardless, if you do have a suitable MS Project schedule to work from, you still need to attach the geometry to the tasks.

Figure 28 – Imported schedule from MS Project

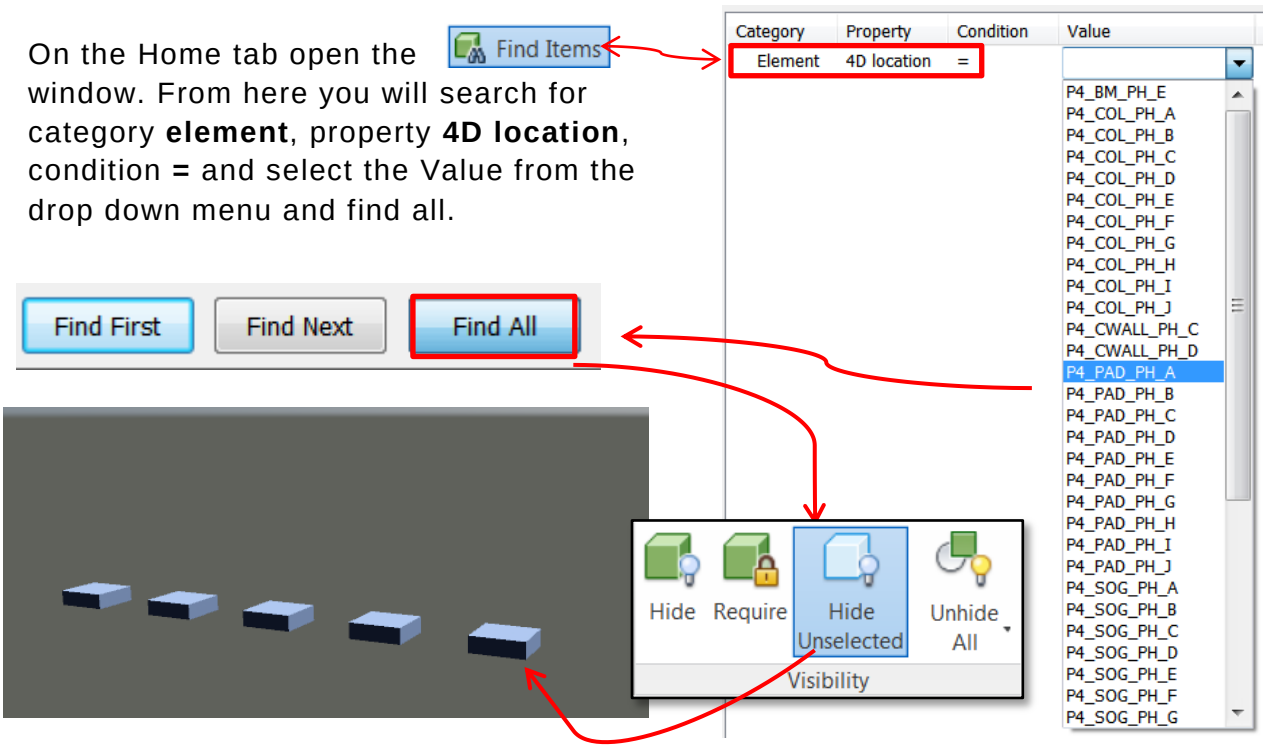


Random named tasks associated with Concrete, no pour phases

To achieve this you *could* manually pick what you need and save selection sets, but we have gone thorough the trouble of adding identifiers in Revit so we can utilize the search sets functionality within Navisworks, figure 29.

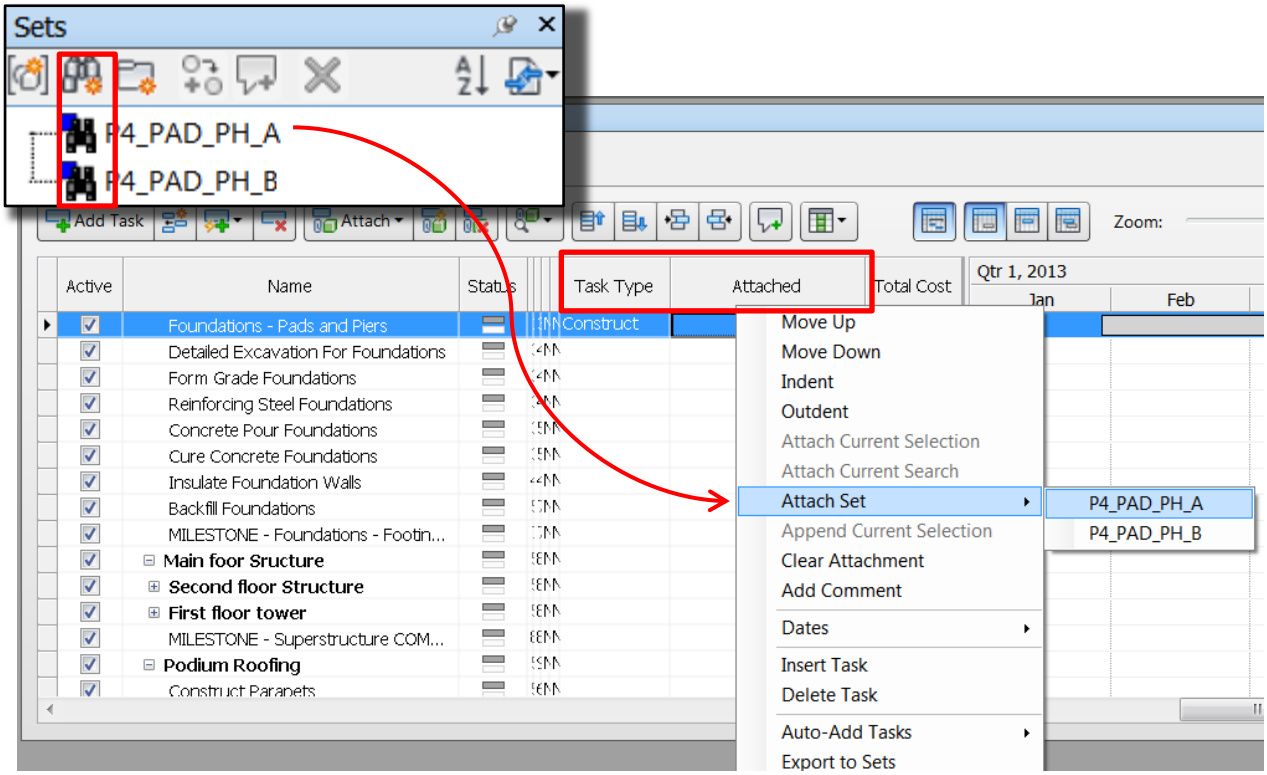
Figure 29 – search set tool

On the Home tab open the window. From here you will search for category **element**, property **4D location**, condition **=** and select the Value from the drop down menu and find all.



To double check the right elements have been selected, press the **Hide Unselected** button on the visibility window. You will want to save the selection as a search set, not a selection set, figure 30. For the reason that if, (and when) the PM changes his mind on sequence, when the geometry is changed within Revit, as long as the 4D location parameter is filled in properly, it will automatically populate the sets once refreshed in Navisworks.

Figure 30 – save selection as search set

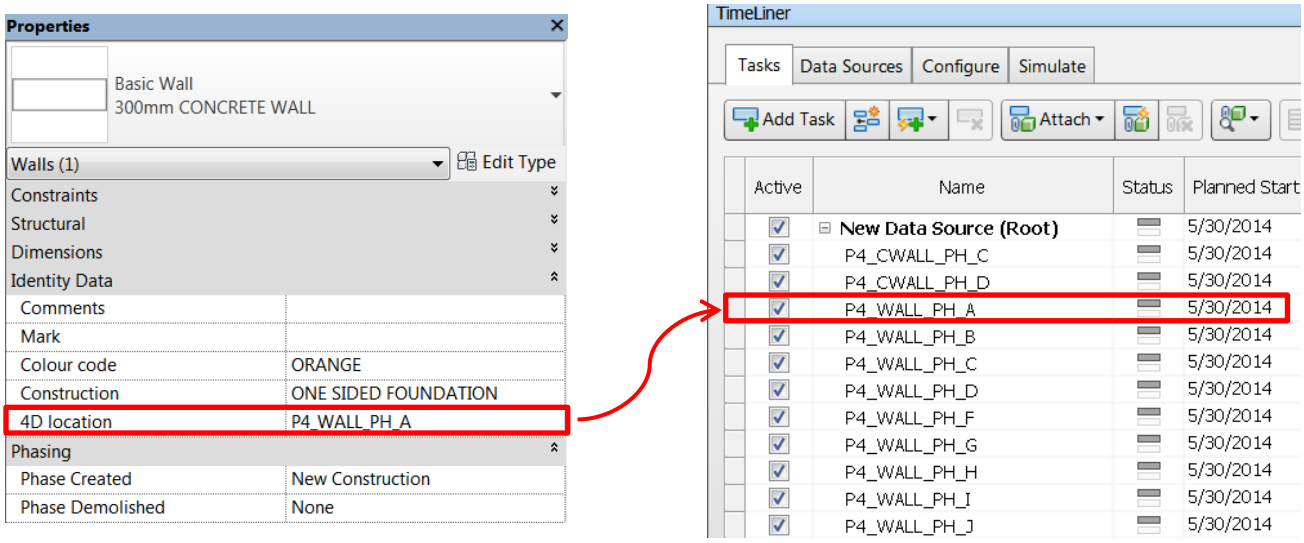


From the “sets” window, you can drag the selection directly into the cell in the “attached” column of the task you wish to populate or, add them by right clicking within the cell. Be sure to set the “Task Type” to construct as well.

If you are creating your Navisworks TimeLiner tasks manually, you will want to be specific and methodical in naming the geometry in Revit because we are going to utilize the “auto attach using rules” feature in Navisworks to expedite our 4D,

without using search sets. For this to work, the "4D location" identifier must match the task name exactly, figure 31.

Figure 31 – Matching parameter fields



There are a number of different ways to populate your tasks with the same name as your 4D location parameter. For example, you can manually enter the tasks or, create a schedule in Revit and copy paste the fields into Navisworks.

However, without any external add on tools, the fastest way I have found is to:

1. Create a multi-category schedule with only the field being "4D location".
2. Next, export the schedule out as a "report". This will create a txt. file that can be imported into excel.
3. Open excel and import the data "From Text" that you just created.
4. Open a new MS project. Simply copy the column from excel with the 4D location parameter and "paste special > text data" into the MS Project "Task name" column, and save. It is probably easier to enter the duration information within MS Project, but, you could do it Navisworks while you can visualize the geometry.

Regardless, once in Navisworks TimeLiner, open the "Data Sources" tab and the MS Project 

file you just created; next, right click on the data source and "Rebuild Task Hierarchy". See figure 32.

Figure 32 – Revit Schedule to TimeLiner Tasks

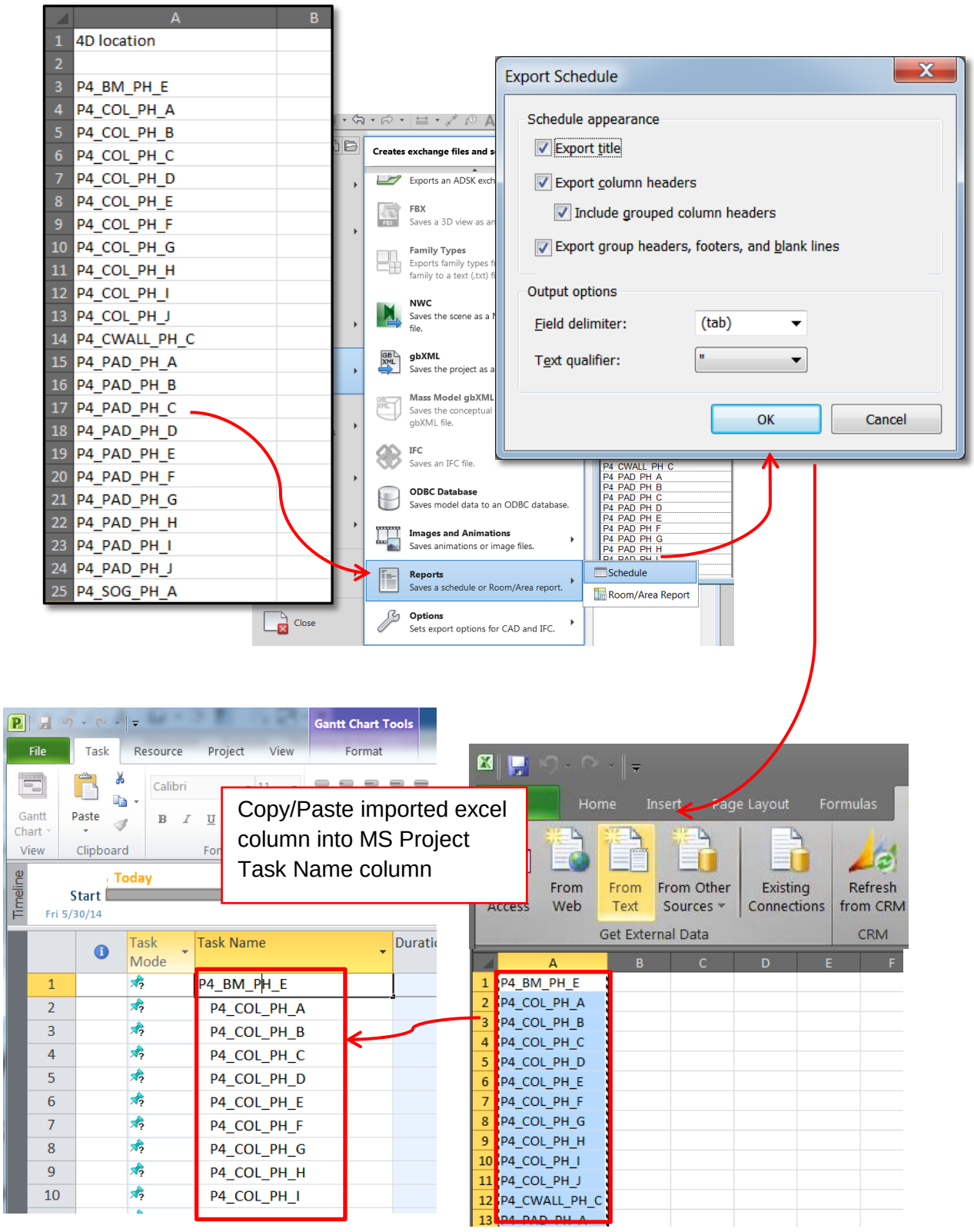
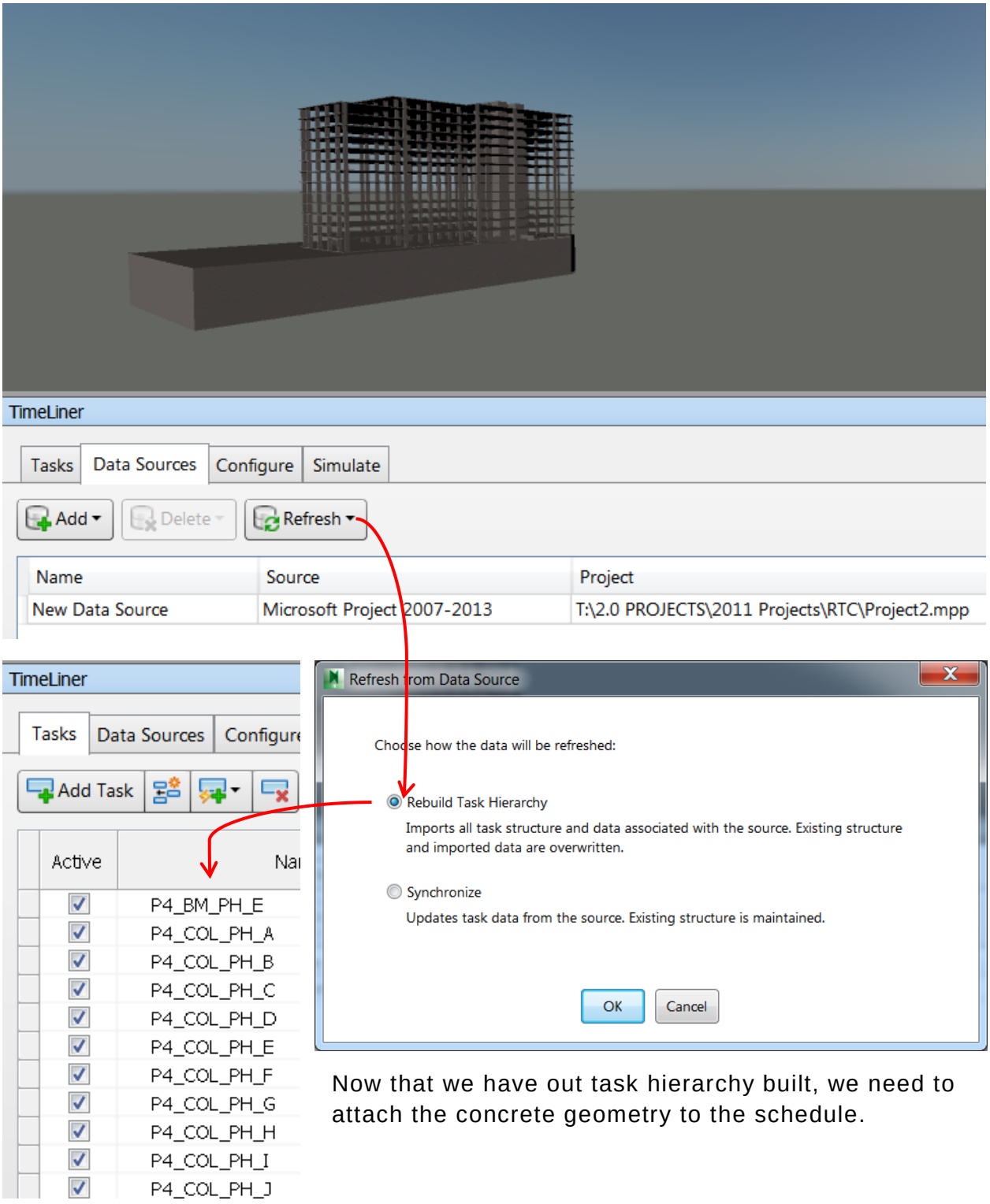


Figure 32 continued. – Revit Schedule to TimeLiner Tasks



Now that we have out task hierarchy built, we need to attach the concrete geometry to the schedule.

Auto Attach Using Rules

Click on the "Auto Attach Using Rules" button on the Tasks tab within TimeLiner. This will open the TimeLiner Rules window. For simplicity, we're going to edit the last in the list of the default rules. Click on the last rule and click the Edit button, figure 33.

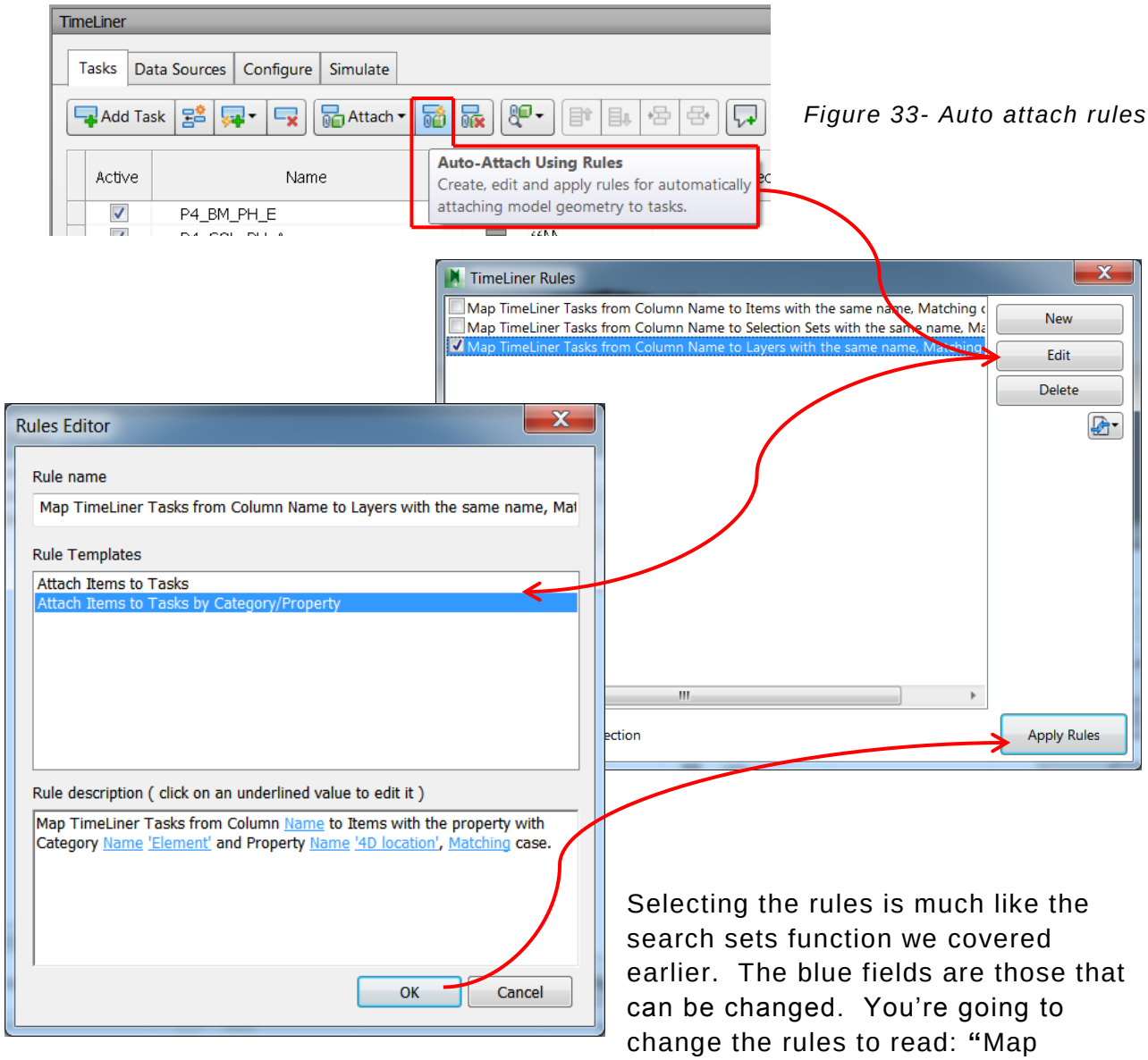


Figure 33- Auto attach rules

Selecting the rules is much like the search sets function we covered earlier. The blue fields are those that can be changed. You're going to change the rules to read: **"**Map TimeLiner Tasks from Column **Name** to Items with the property with Category **Name "Element"** and Property **Name '4D location, Matching** case**"**. And "Apply rules".

The 4D location parameter that we entered in Revit automatically attaches itself to the tasks of the same name. The only drawback is the attached selection reads “Explicit Selection” in the cell. This just means that there is no selection or search set defined first. For a quick and dirty 4D, I think we can live with that. If you have to modify the geometry in Revit, refresh the exported model and rerun the rules to revise the 4D.

Once the geometry in attached to the schedule you can play with the durations to nail down your construction logic.

Closing thoughts

This lecture was intended to teach certain workflows and techniques that could be useful in your workplace. If your project has a BIM component in the contract you can most likely solve a lot of the geometry problems during the usual collaboration and coordination stages. In a typical Design-Bid-Build contract you don’t have that luxury and you must quickly vet information from what you are given. Some concrete models are far more complicated, requiring multiple custom families and materials to incorporate every condition. Moreover, I did not include other BIM estimating tools, such as Innovaya, that will help fill in the information blanks that the estimators will most likely need i.e. productivity, labor etc. Consider this an introduction to mining quantity data from BIMs. Hope it helps, and good luck!