Autodesk University 2012

Modeling in Revit Structure:
Tips & Tricks for Downstream Construction Utilization

Jeremiah Bowles – Black & Veatch
Justin Honey – Pittsburg State University

SE3262 The engineer's model in Autodesk Revit Structure software is quite valuable when used in construction. This class explores the avenues for using Revit Structure—from traditional architecture and engineering projects to process plant application. We will provide tips and tricks for working with Revit tools that enable construction, including parts, assemblies, rebar, tilt-up, embeds, structural supports, beam pockets, lift drawings, location, cast-in-place, logistics, bracing, and component connections. We will discuss the value of the engineering model and the potential for contractors to use it in planning, sequencing, animation, location, detailed shop drawings, fabrication, and estimation. Discover how construction engineers can take full advantage of the analysis data to assist in temporary load calculations and how engineering and construction firms can partner with each other for mutual benefit.

Learning Objectives

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

- Understand vital engineering modeling tools that assist in Estimation, Fabrication and Construction Assembly
- Create a competitive advantage and synergy when partnering with engineered models.
- Understand how Construction firms can leverage the Engineers model beyond traditional 4D uses.
- Understand how Engineering & Construction firms can work together for mutual benefit.

About the Speaker

Jeremiah Bowles is National BIM Manager at Black & Veatch Engineering , Autodesk Revit Structure SME and Adjunct Professor at ITT Tech. He has been in the AEC industry since 1992 with a diverse portfolio of experience. As an early adopter of Revit and BIM technologies he has been able to leverage his real world experience to create contextual and applicable learning. He is an innovator in CAD & BIM use and is on the forefront of extending BIM utilization into construction beyond the current methods. He holds a B.A. in Business, previously attended Pittsburg State working for B.S. in Technology in Construction Management and currently attaining a Masters in Construction Management at University of Kansas. Follow me on twitter @therevitcoach or email me @ jeremiah.bowles@therevitcoach.com or LinkedIn @ http://www.linkedin.com/pub/jeremiah-bowles/10/68/519

Justin Honey is Assistant Professor at Pittsburg State University in the College of Construction. With over 20 years in the Construction industry he is an advocate for technology utilization in the field and is able to transform learning opportunities and blend building methodologies and technology. His industry experience and CAD / BIM experience provide relevant context and progressive curriculum. jhoney@pittstate.edu

Table of Contents

Can contractors Benefit from Modeling in Revit

The success in using Revit in the BIM process is not the tool alone, but in the strategies and tactics in how we use the tool. The right tool with the appropriate strategy can go a long way to increasing productivity, ensure accuracy, & improve safety.

Some important QUESTIONS we must ask?

- When Should BIM be used?
- LOD's – What Should Be modeled?
- Where is the balance of Effort / Reward?
- Where is productivity lost?
- Do any synergies exist?
- What are the clients end deliverables?
- Should we re-invent the wheel 3 different times?
- Does the designer / A|E team have all the information?
- Does the Fabricator have all the information?
- What obstacles face our collaborative world of information exchange? <adversarial effect>

Immediate Benefits (a.k.a. Low hanging fruit)

Too much focus in Design & Construction is placed complaining what the technology can't do. Technology Implementation takes a crawl, walk, run, sprint approach. You must usually crawl well before you can walk, walk before you can run, etc.. One should not begin looking into the benefits of BIM in construction without grabbing the low hanging fruit, at least if they are concerned with profits and the key stakeholders.

Visualization

Contractors / Construction Engineers, take a walk around your "Virtual Project". Although you probably think you understand the project after pouring through a set of Construction / Contract documents you haven't seen it until you've seen it in BIM. Sometimes in creating a model from 2D documents you will find excellent insights into your project that were not captured in reading the plans but building the model.

Conflict Avoidance(a.k.a. "Clash Detection")

Although this is an obvious piece, it is important to run a clash in earlier design than at the construction bid. This class was intended to address joint venturing and working together to leverage the A|E model for construction use, still don't forget to do a 3D clash detection. Once mastered you may also look at a 4D and 5D clash?

A|E Design Model	***Constructability Model***
Design Intent	*Means & Methods*
Building state completed	*Materials*
Structural Requirements	*Component Assembly*
Engineering Specifics	*Fabrication / Shop Dwgs*
Loads, connections	*Coordination*
Detail Concepts	*Scheduling*
Min. Component Req'd.	*Logistical Planning*
Proof of Concept	*Firefighting?*

A|E & Contractor synergy (get a ladder attaining the "Not So Low hanging fruit)

The low hanging fruit may provide some immediate BIM success but the proper balance of implementing the next elements can provide greater benefits, increased production probability, and additional success. These next strategies are not easily attainable but with the correct understanding of the BIM Constructability workflow CM / Construction professionals can partner with A|E Firms to create synergy for downstream construction utilization of the model.

There are distinct model differences

The A|E Model is not traditionally sufficient to construct from. There are also other items that may need to be constructed just to build the construction items that will stay in place. Suffice it to say, you will need to create your own model in addition to the A|E. Their model is called the ***Design Intent*** model; your model is called the ***Constructability*** model. This can be a hybrid of architecture and structure elements but will most certainly will be different than the Architects model. This model can utilize Revit Phasing to illustrate the construction phasing / break-out of work or you can embed parameters into the model components to do phasing inside Navisworks. I usually find that both are useful, especially when creating documents illustrating different phases.

Site Coordinates

Can we really say we have a coordinated design if we have no coordinates? Many BIM design packages may omit the critical site information but this is crucial to understanding the project, logistics and in using Revit & Civil 3D well beyond what the A|E team may have done. There are many strategies around using site information including mass cut / fill iterations, egress planning logistics, etc. For this course we will focus on the

4D Clash Detection

Have you ever heard of this? You usually don't hear about it as 4D clash detection but its clash detection while taking into account prefabrication activities not just the built environment.

Strategic Modeling Consideration:

- Does your site have challenging space limitations?
    - Yard placement
    - 4D yard management
    - 4D SWPP Plans
    - Jobsite trailers
    - Hazardous material zones?
    - Do your subs need layout zones?
    - Temporary Power locations with Ratings
    - Benching and Shoring
- Is Safety a consideration in your planning? (IT SHOULD)
    - Safety Considerations?
    - Virtual Hazard Analysis
    - Lock-out Tag-out
    - Confined Spaces considerations
    - Fall protection
    - RE: BIM for Construction Safety: Beyond the Low Hanging Fruit
- Are there other built items that have to be built on site? (Don't forget to estimate these items)
    - Temporary Forms, Walls, openings, shoring, excavation bracing, etc.
    - Bracing (does your bracing interfere with other elements?)
    - Mass Excavation / Shoring / Bracing / Egress / Fall Protection / Temporary walls?
- Do the items modeled include a higher LOD that the A|E wasn't required to model? Can you leverage the A|E model to add the greater level of detail?
    - Ductwork may have been modeled but are flanges, insulation and support structure being evaluated?
    - Piping may have been modeled but did the A|E draw with the correct content? IS there any flanged pipe, support structures required to support the pipe(s) outside of the pipe supports? Will you have to build pipe racks?
    - Rebar is not traditionally drawn, could you have the record engineer model these?

  - Imbed plates (Are these exposed, if not modeled the Architect may not have realized they would be seen)
  - Structural Connections
  - Parts & Assemblies
- Can you place materials on your site before they are fully built?
  - Will you have temporary construction loads?
  - Did the Engineer do loads in Revit?
  - Can you do quick loads to analyze this?
  - Can you quickly get loading values from Revit to evaluate if your temporary construction loads are satisfactory?

5D Clash Detection

Should we be doing this? 5D Clash detection would be detecting elements that may cause the owner issues. This should have been done by the A|E but you will show the value of your services if you address this question.

Considerations:

- If you picked a different manufacture for equipment specified, did you check for required clearances?
- If there are filters or any other elements that require lift equipment, can you get access to these?
- Any other evaluation of commissioned elements?

3D Sections

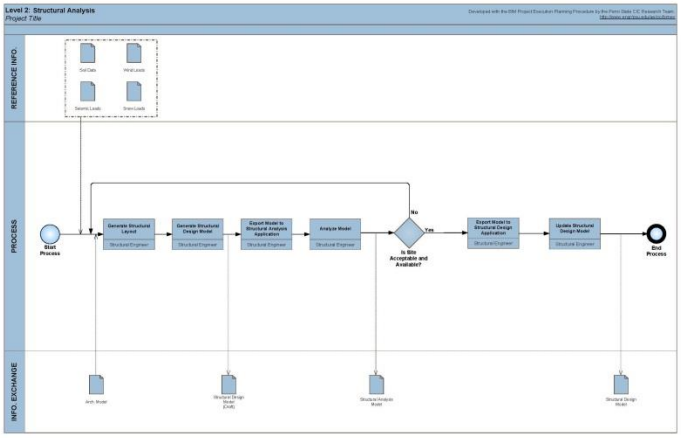
If you received a Revit model you most likely received a model with 2D Details and Sections. You may want to create some 3D sections to illustrate key elements like:

- Elevation Changes
- Identify Assembly order, elements to be constructed first (Create 3D, static isometric to convey assembly order) Validate in 4D with Navisworks.

Integrated Structural Analysis

You may already be doing structural analysis in your office. Are you doing integrated structural analysis. As this course if for both A|E and Construction professionals you will want to consider a few things:

A. What data can I create?
B. Do I have a diagramed workflow of data exchanges?
C. Is this process efficient?
D. What Data can be consumed?
E. Do we understand each other's needs? A|E & Construction

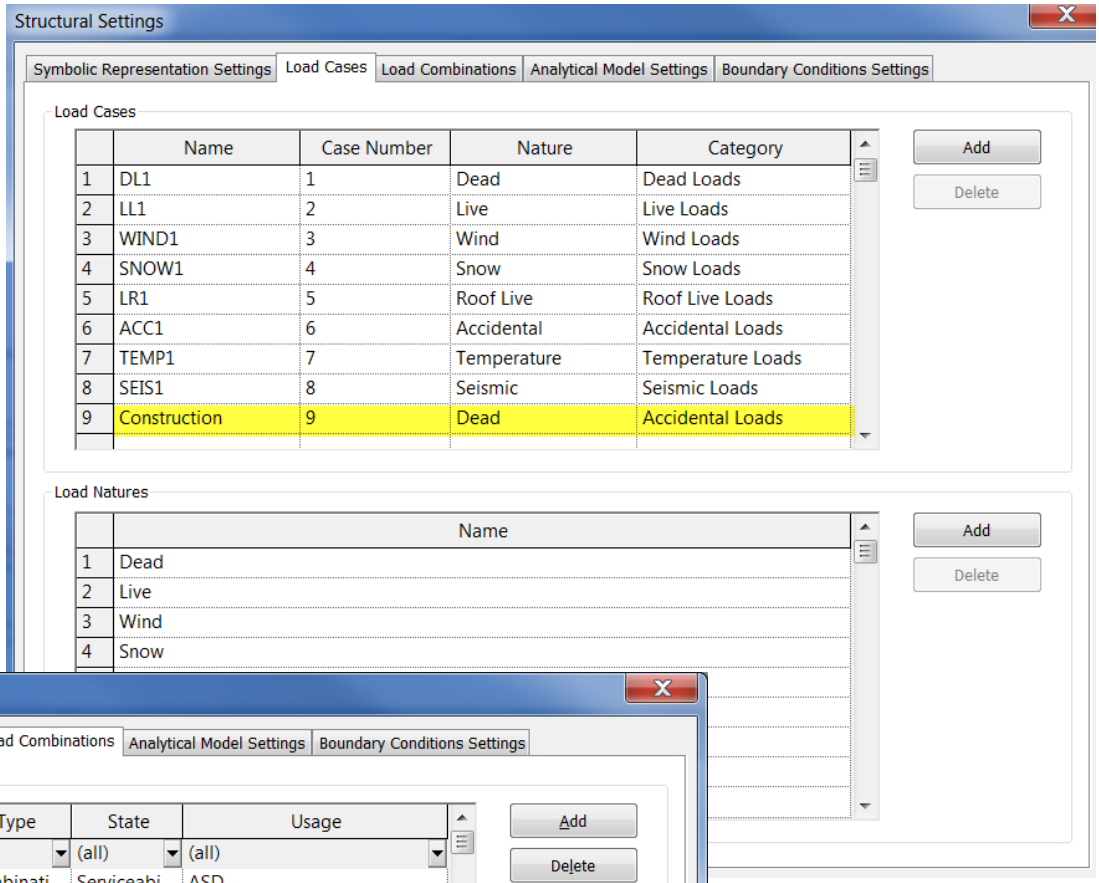


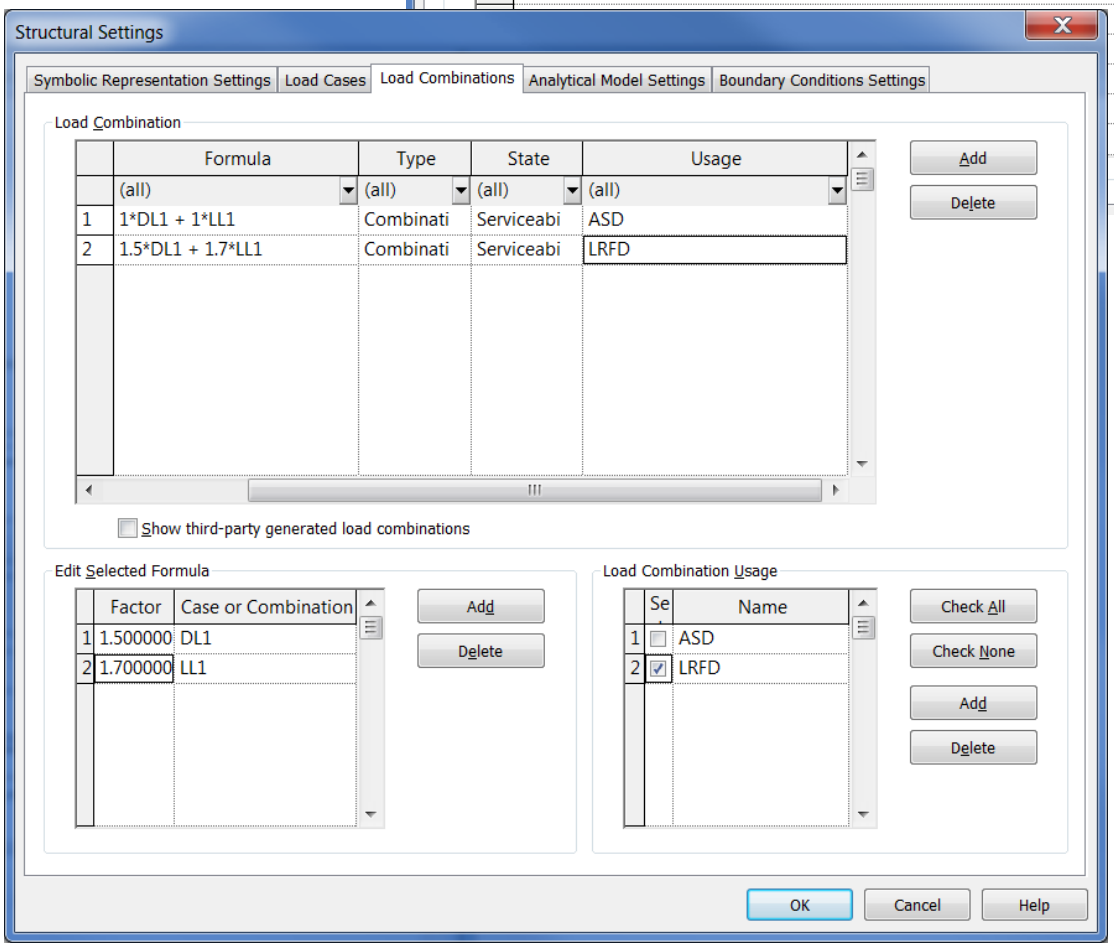
Revit as the Model of Record

Setting & Creating Loads

The most common Load Cases are already established in Revit by Default. You may want to Add Construction Load Cases into your list if you want to extend this for construction use.

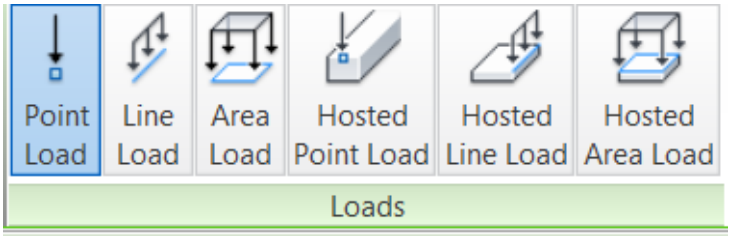
- Create Load Combinations out of Established Load Cases





Placing Loads in Model

Loads can be place on any work plane or level. It is best to place these loads in a floor plan and are placed on your physical model. Ensure that loads are assigned to the analytical model graphically.

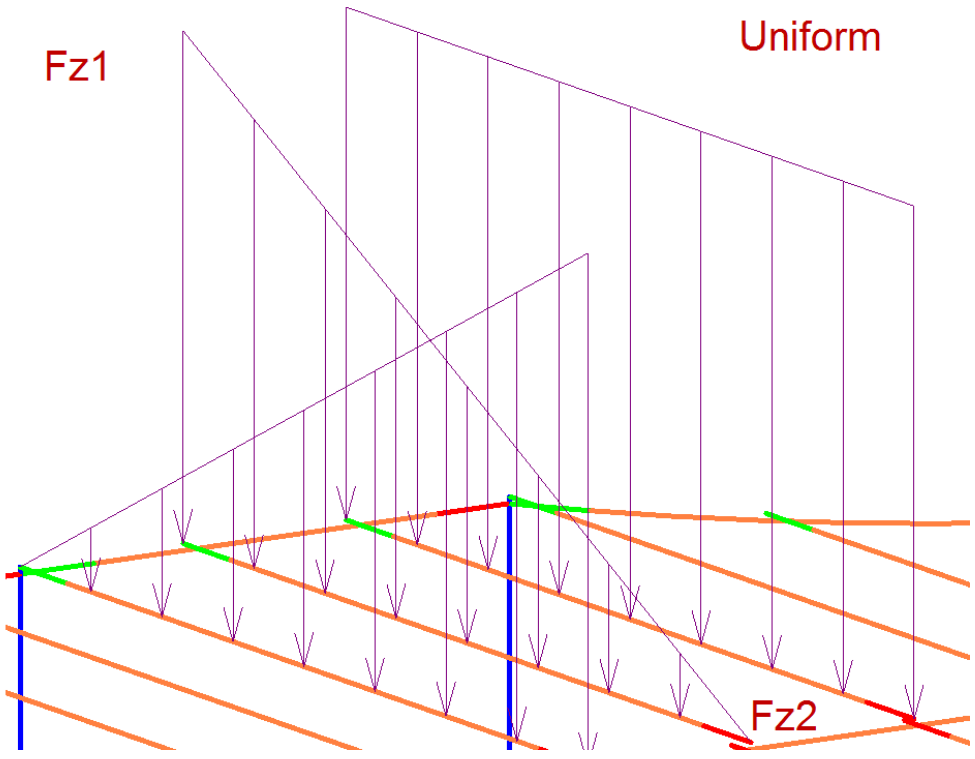


There are 3 Types of loads, each with hosting and free modeling capabilities.

Note with Hosted Area loads you don't have the option to set reference points for multiple forces.

Structural Analysis	
Is Reaction	☐
Load Case	DL1 (1)
Orient to	Workplane
Fx 1	0.000 kip/ft
Fy 1	0.000 kip/ft
Fz 1	-0.500 kip/ft
Fx 2	0.000 kip/ft
Fy 2	0.000 kip/ft
Fz 2	0.000 kip/ft
Mx 1	0.00 kip-ft/ft
My 1	0.00 kip-ft/ft
Mz 1	0.00 kip-ft/ft
Mx 2	0.00 kip-ft/ft
My 2	0.00 kip-ft/ft
Mz 2	0.00 kip-ft/ft
Uniform Load	☑

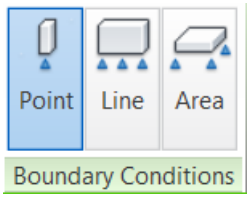
- Area Loads are applied to Walls & Floors
- No hosting allows for specifying workplane, level, irregular surfaces, and to pick supports, this is ideal for placing mechanical equipment or any loads you want supported with specified beams.
- Point Loads can be placed directly on a workplane or hosted to an object (i.e. Beams, etc.)
- Line loads can be drawn on an object or hosted
- Once you are done drawing a load you can select the loads and apply the forces (Fx,Fy,Fz) or Moments (Mx,My,Mz) in the properties palette shown to the Right.
- Deselect *Uniform Load* to adjust start and end forces.
- To draw on a sloped frame see Revit WIKI for detailed instructions.



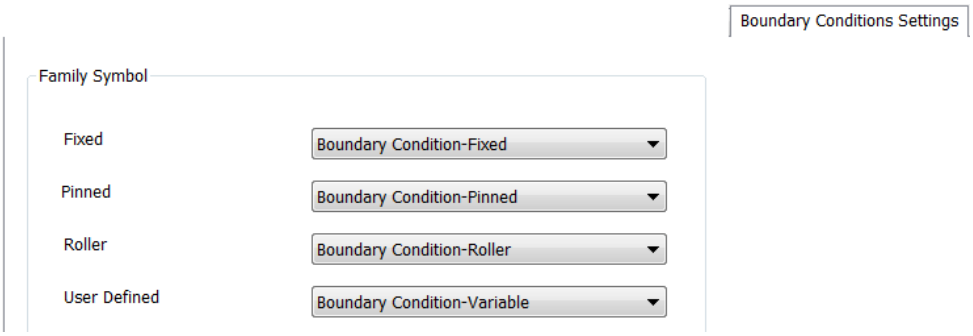
Integrated / Enhanced Documentation

Boundary Condition Settings

Boundary conditions are analytical model elements that define the support conditions of a structural element by its surrounding environment. They communicate the engineering assumptions about support conditions to the analysis software.



- Assign Boundary conditions to Point, Line or Areas.
- Set Boundary Condition Settings Defaults to control Graphics in Structural Settings Tab.



- Default Boundary Conditions are set below:

Point

Fixed

Translation in	State
X-Translation	Fixed
Y-Translation	Fixed
Z-Translation	Fixed
Rotation about	**State**
X-Rotation	Fixed
Y-Rotation	Fixed
Z-Rotation	Fixed

Pinned

Translation in	State
X-Translation	Fixed
Y-Translation	Fixed
Z-Translation	Fixed
Rotation about	**State**
X-Rotation	Released
Y-Rotation	Released
Z-Rotation	Released

Roller

Translation in	State
X-Translation	Released
Y-Translation	Released
Z-Translation	Fixed
Rotation about	**State**
X-Rotation	Released
Y-Rotation	Released
Z-Rotation	Released

Line

Fixed

Translation in	State
X-Translation	Fixed
Y-Translation	Fixed
Z-Translation	Fixed
Rotation about	**State**
X-Rotation	Fixed

Pinned

Translation in	State
X-Translation	Fixed
Y-Translation	Fixed
Z-Translation	Fixed
Rotation about	**State**
X-Rotation	Released

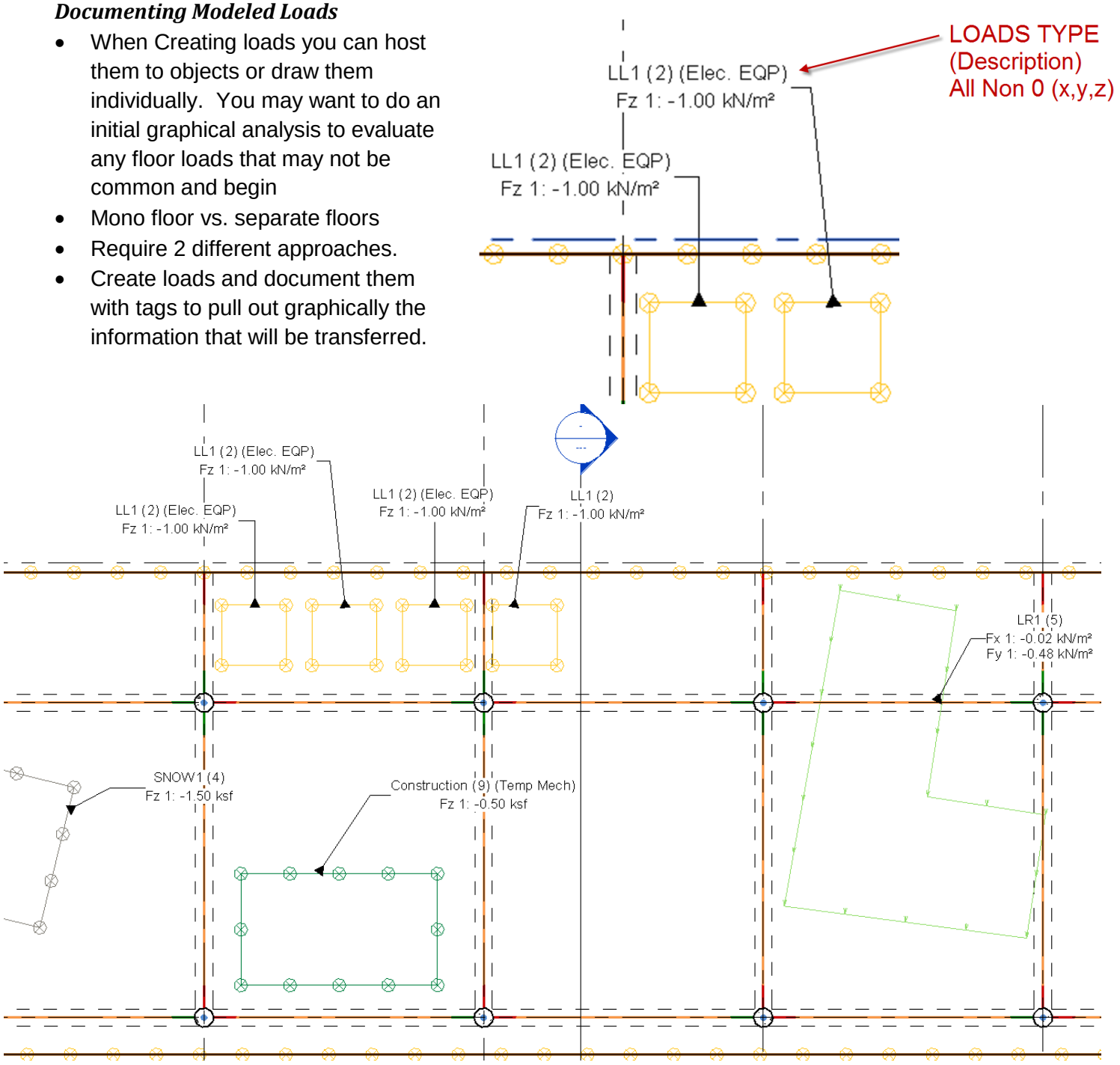
Area

Pinned

Translation in	State
X-Translation	Fixed
Y-Translation	Fixed
Z-Translation	Fixed

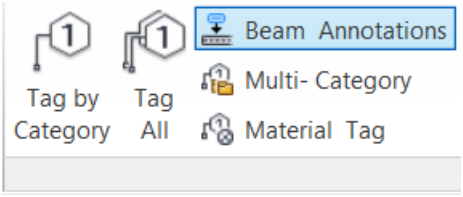
Documenting Modeled Loads

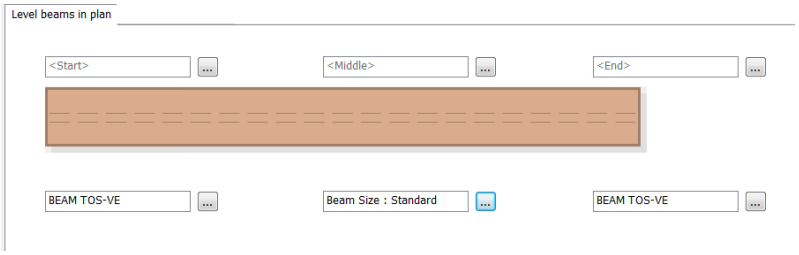
- When Creating loads you can host them to objects or draw them individually. You may want to do an initial graphical analysis to evaluate any floor loads that may not be common and begin
- Mono floor vs. separate floors
- Require 2 different approaches.
- Create loads and document them with tags to pull out graphically the information that will be transferred.

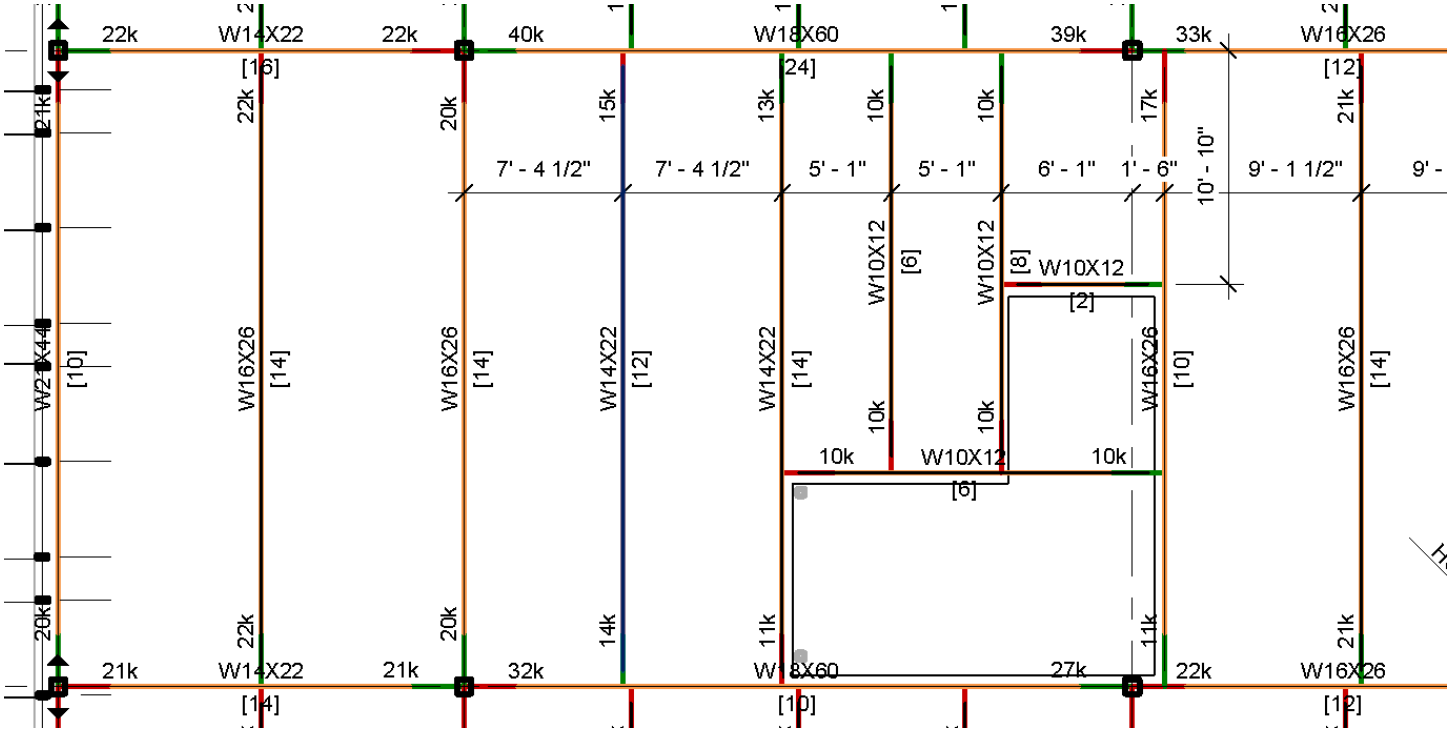


Documenting Beam Reactions

- After analysis has been completed beam reactions and can be Documented using the Beam Annotation Tagging tool. Define Start / End Reactions and Framing Tag's.

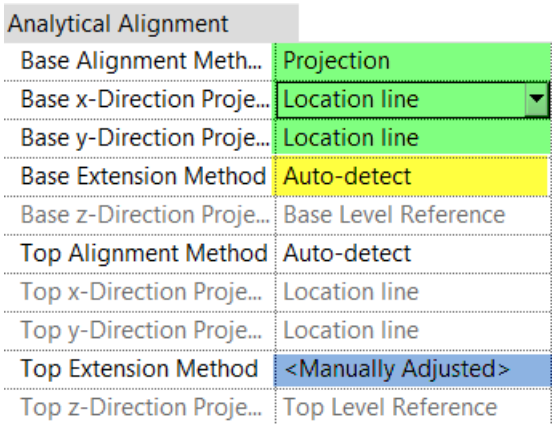






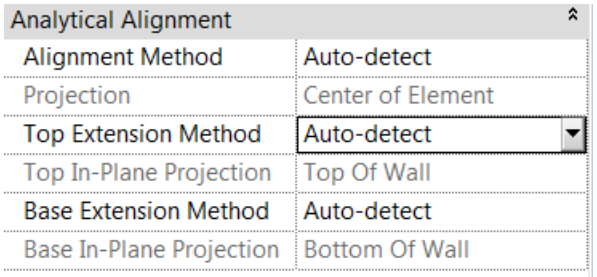
Improve model fidelity before export:
Clean up the model by adjusting the analytical model to avoid warnings & errors and nsure connectivity and analysis fidelity

Review model graphically to see if columns, foundations and footings are aligning up top to bottom. These analytical lines will be what Revit exports to analysis software.



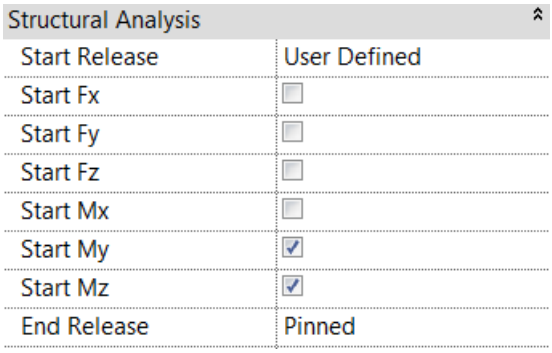
Change the Vertical Analytical Alignment options:

- When a graphical error is noticed select the analytical line and review the Analytical Alignment options in the individual member set-up. Most times it is set to "AutoDetect". You will want to make changes from the three different options <*Manually Adjusted*>, *Auto-detect*, or by *projection* where you can modify the **X & Y** location for *walls / foundations* and **Y & Z** adjustment for *beams & columns*.
- Walls: Alignment Method Auto- detect, Projection (Center of Element, Interior Face, Center of Core, Exterior Face, or Grid Options.)
- Floors: Analyze As (One-Way, Two-Way)



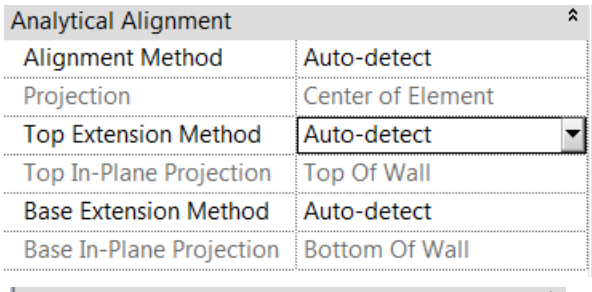
Review Horizontal Analytical Alignment / Settings

- Walls: Alignment Method Auto- detect, Projection (Center of Element, Interior Face, Center of Core, Exterior Face, or Grid Options.)
- Floors: Analyze As (One-Way, Two-Way)

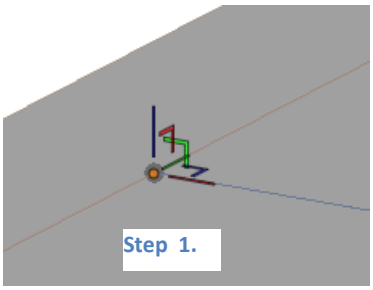


Review Beam Settings (moment, etc.)

- (Manage releases before sending to software)
- Member # (Tracked from Analytical Software)
- Set Releases (Fixed, Pinned, & Bending Moment) Checked = it's pinned in that direction, un-checked = fixed.
- Review *Analytical Model* Options
    - Analyze as (Gravity, Lateral, Hanger)
    - Analytical Links (yes, no, From Column)
        - Note: From Column requires both Beam & Column to be linked.



Adjust Analytical Model (Override)

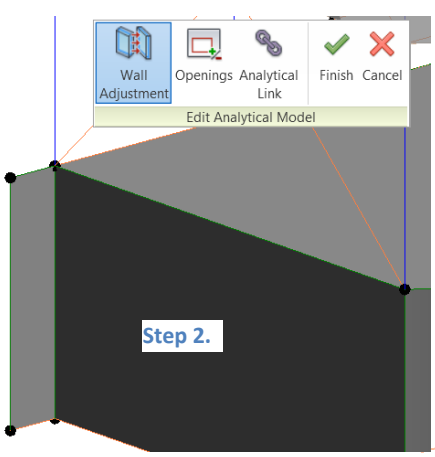


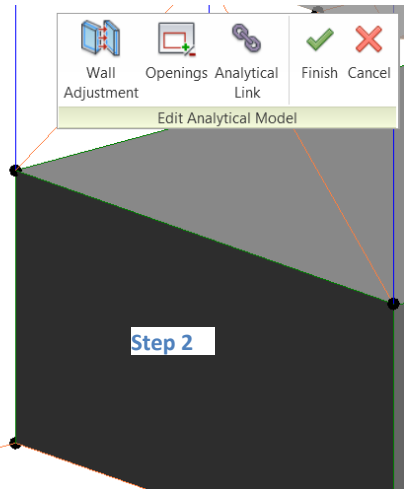
Review for un-supported elements (Elements not correctly connected)

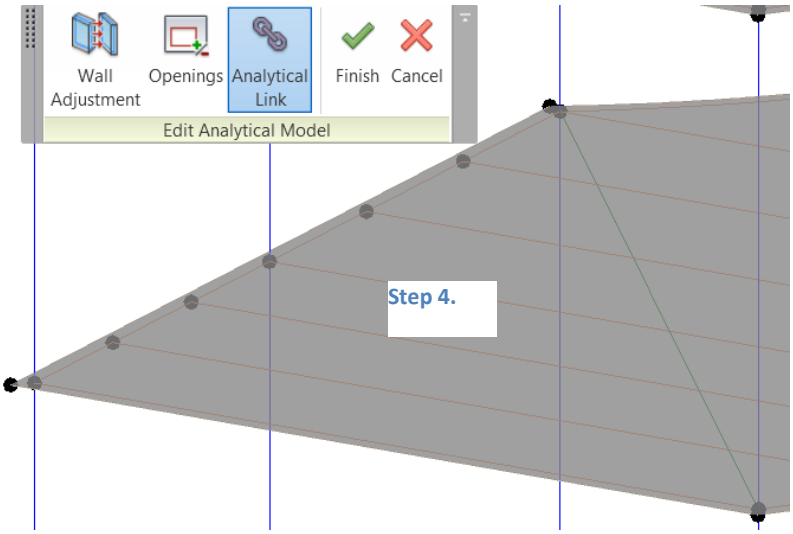
Step 1 Adjust Analytical Properties (previous Step)

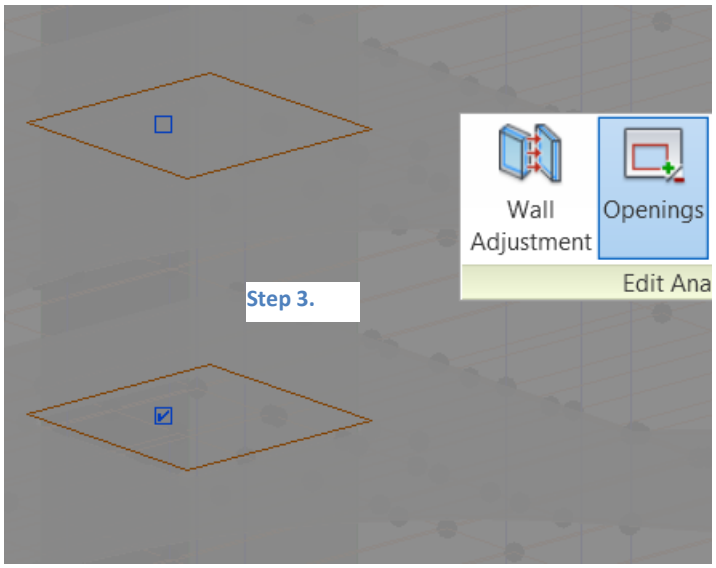
Step 2 Fine tune with Analytical Adjust

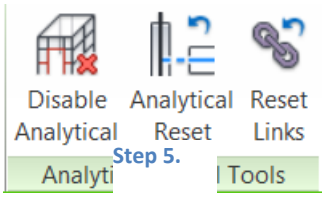
1. Move points with Gizmo adjustment.
- Overrides the analytical location and disconnects it from the location.
- Move nodes together if both selected.
- Use Align, to align node to node.
2. Wall Adjust allows you to override overshoots and missed extensions.
3. Wall Opening Adjustments allow you to toggle on or off to remove openings that may have been placed in your model that are affecting the analytical model.
4. For Creating Rigid diaphragms we can us the analytical links to them together.
5. If you have made mistakes, use analytical reset or Reset Links.





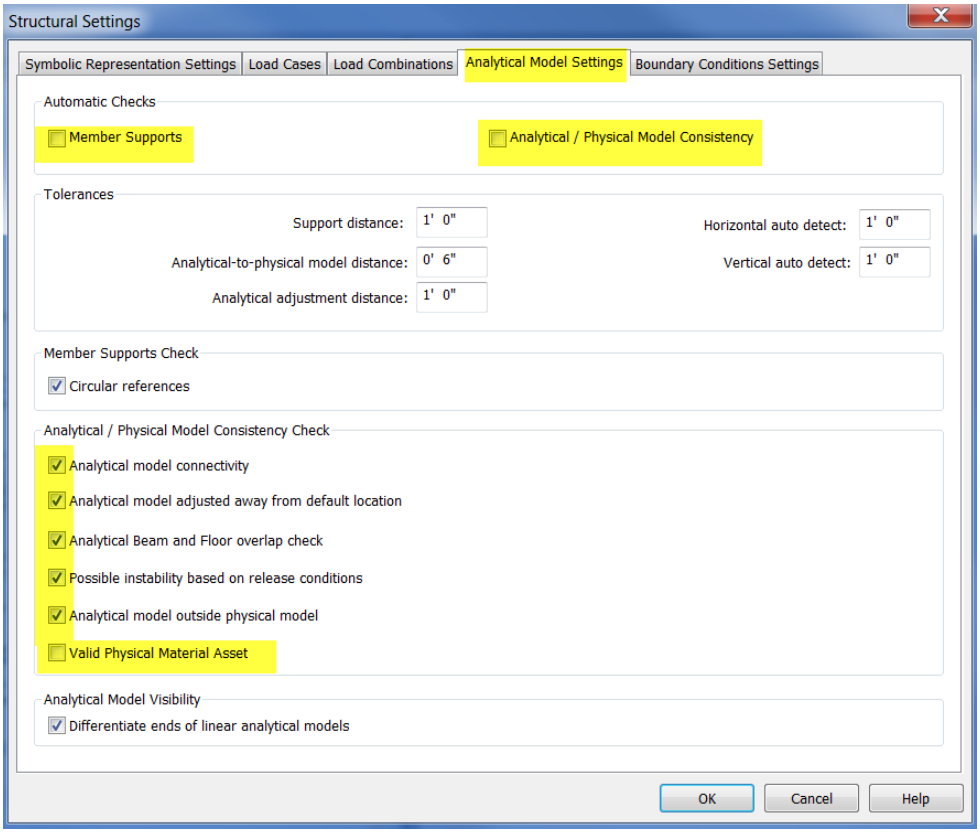


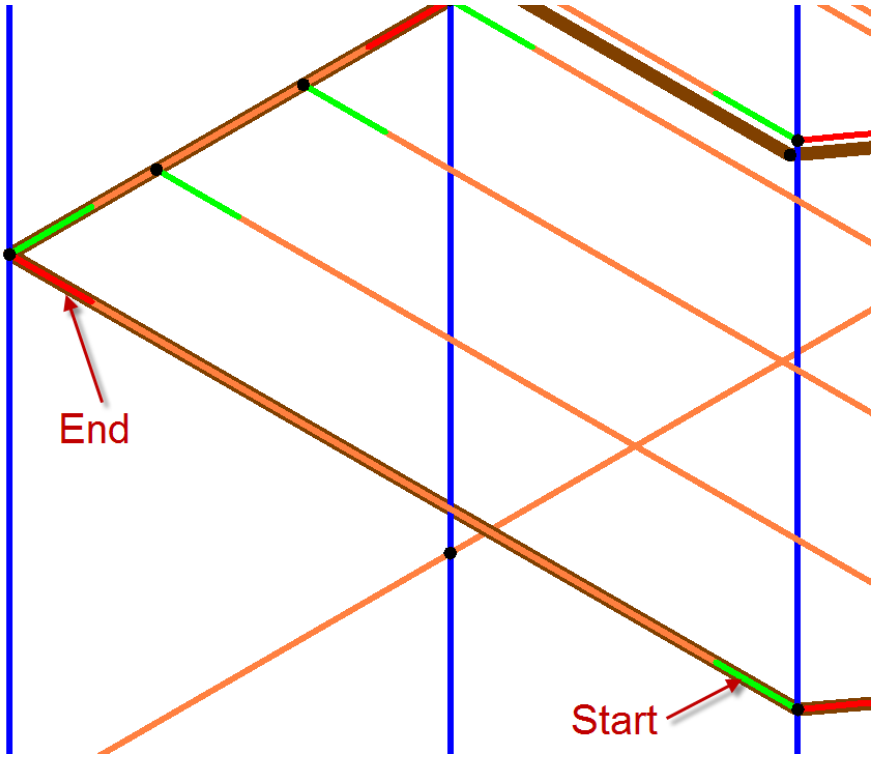




Check Analytical Model Settings

- Automatic Checks: model for Member Supports & Analytical Model Consistency after most settings are established. This will help you avoid the constant checks you will get when you override or modify settings. This can be run at any time.
- Tolerance Checks will assist you in ensuring model fidelity.
- Consistency Checks ensure connectivity, adjustments away from default location, beam / floor overlaps, and instability of release conditions.
- If you are exporting material assets to another program you will also want to check the Physical Material assets.
- Analytical Model Visibility Settings enable start and end conditions to show graphically.
- Establish Modeling Rules (e.g. left to right Start~End Create, Draw Clockwise, etc.)





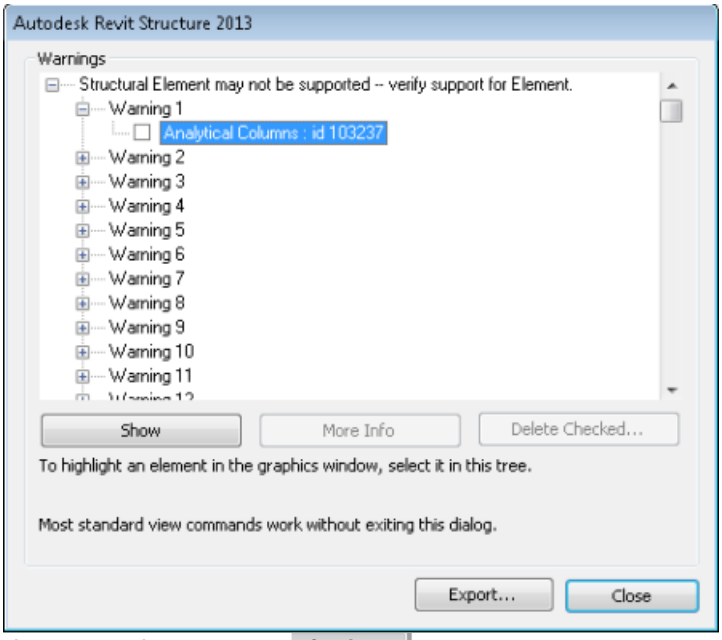
Check Member Supports Tools (Yellow)

Click Analyze tab ➤ Tools panel ➤ Check Supports.

This tool will allow you to review warnings and make changes as appropriate for your design.

Typical Errors are:

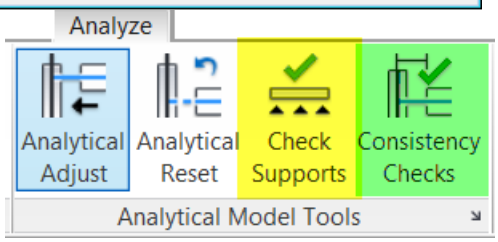
- Unsupported Elements
- Circular Support Chain



Check Analytical / Physical Consistency Tool (Green)

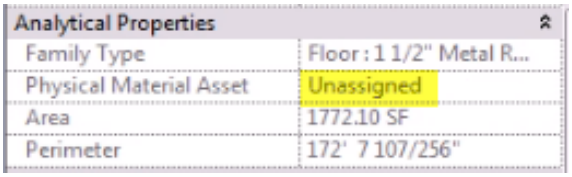
Typical Errors are:

- Analytical Elements without Structural Parameters.
- Possible Model Instability
- Detected Physical Connection between Structural Elements did not detect Analytical Intersection
- Distance between Analytical and Physical Models of structural Elements is beyond tolerance of . . .
- Expand list and fix some of these warnings. Note: Not all warnings are critical and are suitable to export for analysis.

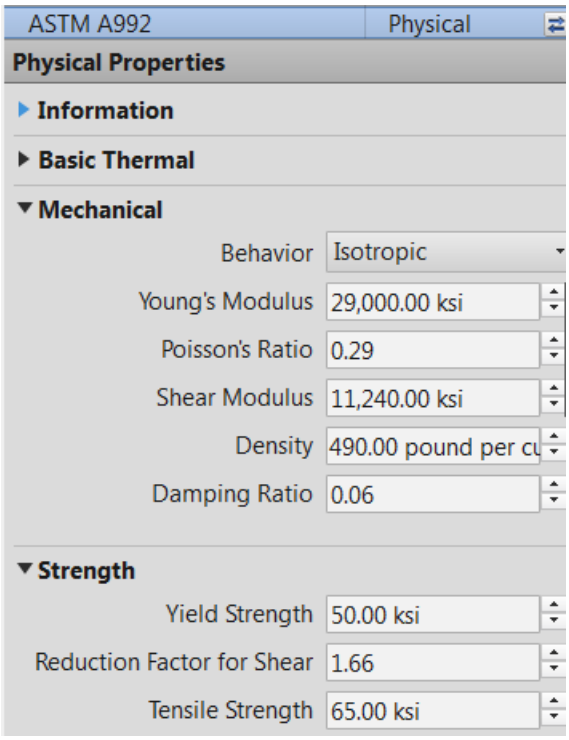


Check Structural Model Assets

- Consistency checks materials properties will flag if unassigned.
- Check if Physical properties are assigned.

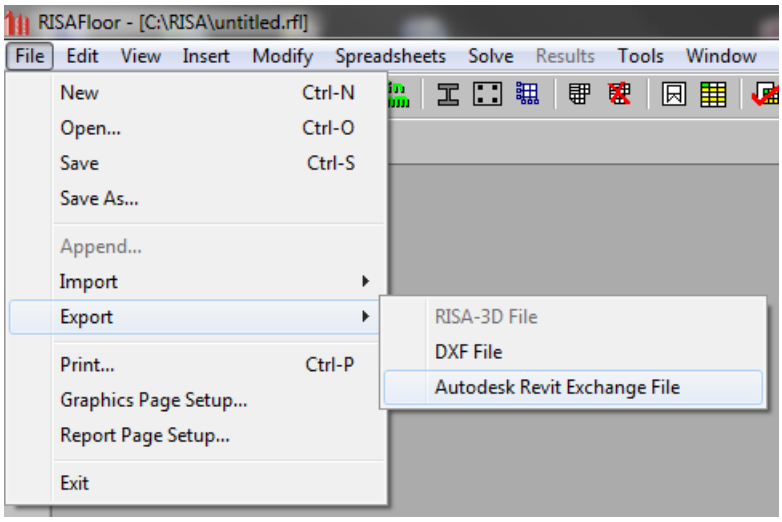


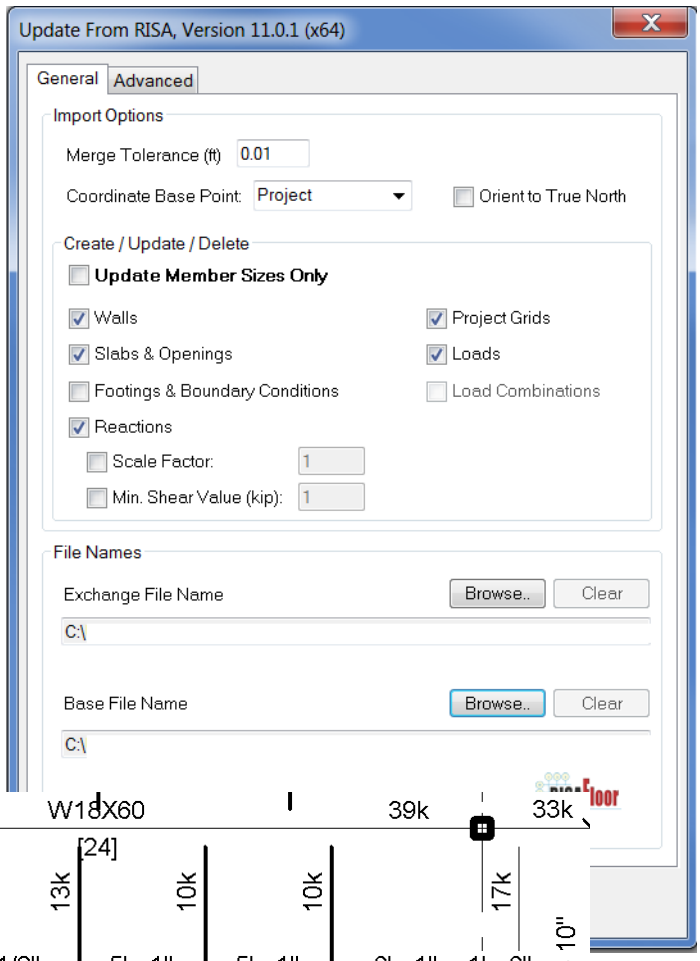
- Review Material Assets(2013 improved feature)
- Material assets can track into analysis software. These come in from the material assets assigned to Beams, Columns, walls, and other structural materials and be passed into analysis software.
  - Mechanical
  - Strength Assets
- Note: No materials will be transferred to analysis software if these are not placed. Many new industry tools are being developed to capture these properties for FEA Analysis.



Import Changes from Analysis Software

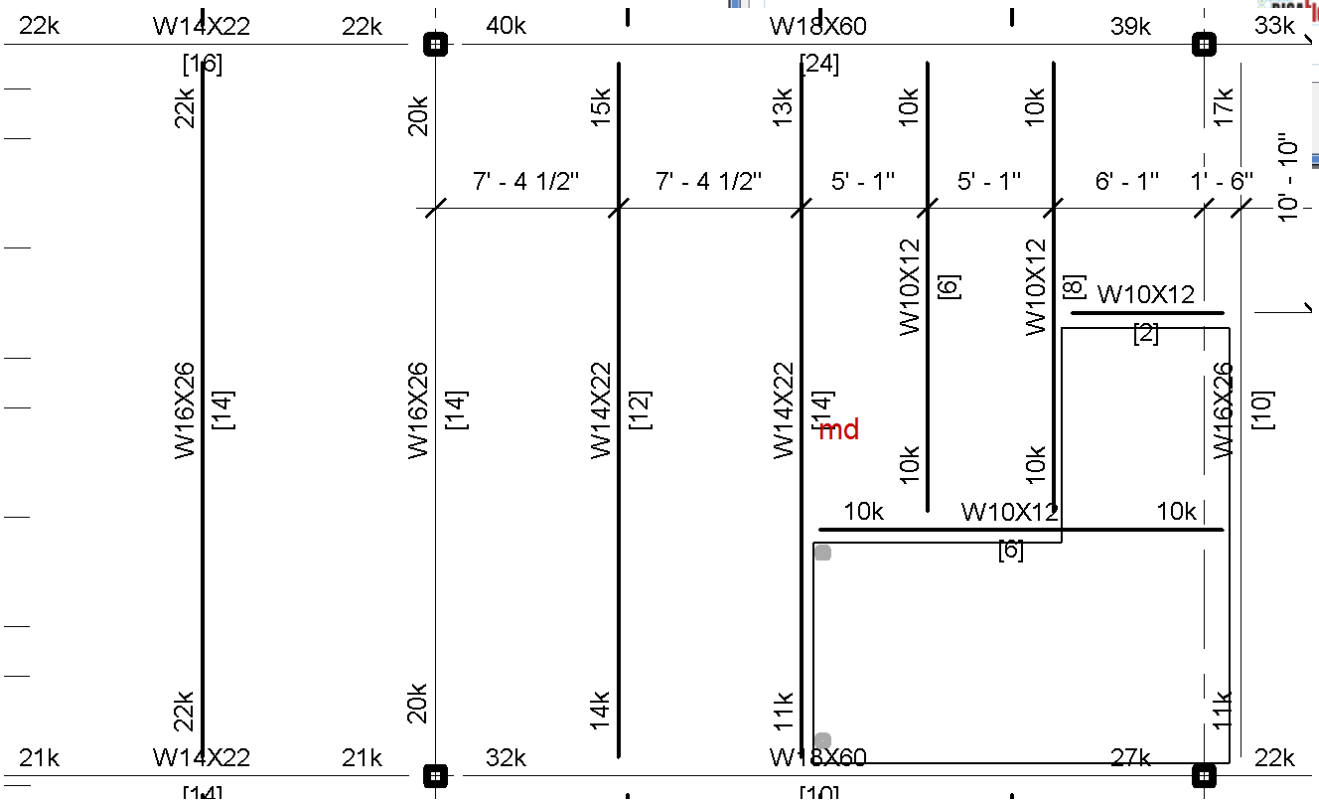
Import Changes / Reactions from Analysis Software

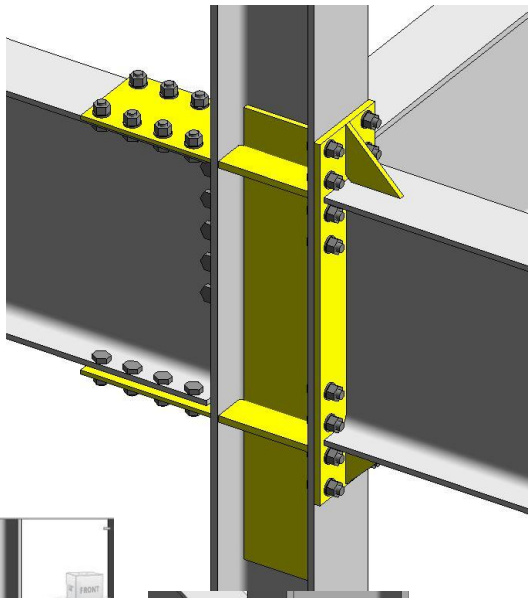




Document Captured Data

- Start / End Reactions
- Number of Studs
- Camber





Moving Beyond the Detailing Mentality:

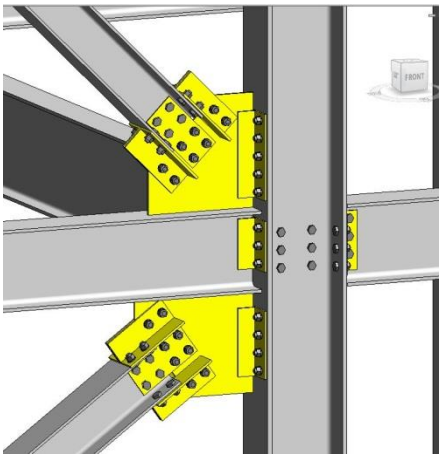
Assimilate Data for Connections

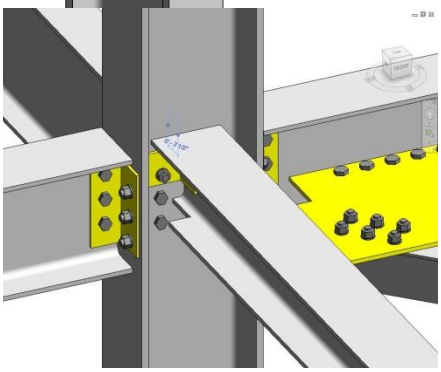
SDS/2 Connect can Read Member end and moment loads from store n Revit Structure from:

- CSC's Fastrack Building Designer
- Risa-3D or Ram

Functionality

- More than placeholder geometry for Clash Detection
- Member loads stored in Revit can be consumed.
- Input Loads or auto-set
- Tagging of many family elements



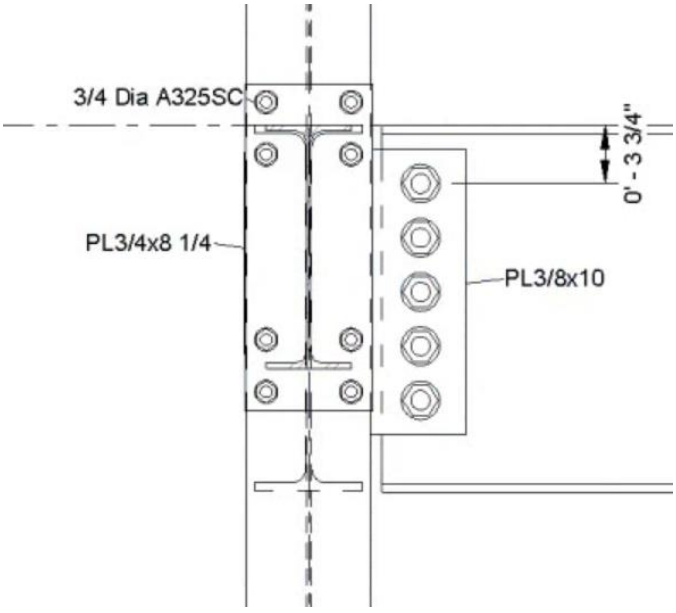


Dynamic change management

- Bolt Diameters
- Plate thickness
- Weld design
- # of Bolts

Greater User Control

- Safety connections
- Attachment methods
- Near side/Far side attachment
- Other variations on the connection



Expanded Design Calculation for Member [257546]'s Left End

Beam web shear (2) Ref: J4-2(a):

Yield stress, $F_y = 50$ ksi
Web thickness, $t_w = 0.305$ in
Full section depth, $d = 13.7$ in
Web area, $A_w = (d)(t_w)$
$= (13.7)(0.305)$
$= 4.1785 \text{ in}^2$
$\Omega = 1.5$
Allowable shear stress, $\frac{F_v}{\Omega} = \frac{(0.6)(F_y)}{\Omega}$
$= \frac{(0.6)(50)}{1.5}$
$= 20$ ksi
Shear capacity $= \left(\frac{F_v}{\Omega}\right)(A_w)$
$= (20)(4.1785)$
$= 83.57$ kips
$83.6 \text{ kips} \geq 34.9 \text{ kips}$ **o.k.**

Bolt bearing on web (110) Ref: J3.10:

Tensile strength, $F_u = 65$ ksi
Plate thickness, $t_{pl} = 0.305$ in
Vertical bolt spacing, $s = 3$ in
Vertical edge distance, $L_{ev} = 0$ in

Data Transfer to Fabricator

Do you have a data transfer plan? After learning and understanding the tools you can put together a data transfer plan to outline the LOD requirements, required data fields, and proposed value added workflow.

Data Export Fidelity

- Exports the model to SDS/2 Detailing
- Several options to provide fullest control of export
- Populate a new structure
- Update an existing model
- Import connections from detailer
- Load Calculations

Notice:

- Shear loads for beams are the only load that Revit Structure stores currently
- SDS/2 Connect will only manage major structural connections. Embed Plates and Base Plates will need to be done in Revit
- SDS/2 Connect was designed to provide optimized data to fabricators using SDS/2 Manufacturing Software and provide an improved workflow and communication plan for A|E and Fabricator.

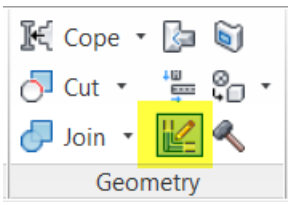
General Model Management Tips:

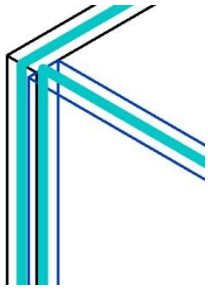
- Use Schedules To review elements settings w/ Split Screen.
- Break down the model to smaller sizes when review using
    - 3D Sections
    - Default 3D View leveraging Sections
- View templates
- Filters

Construction Modeling "Parts "

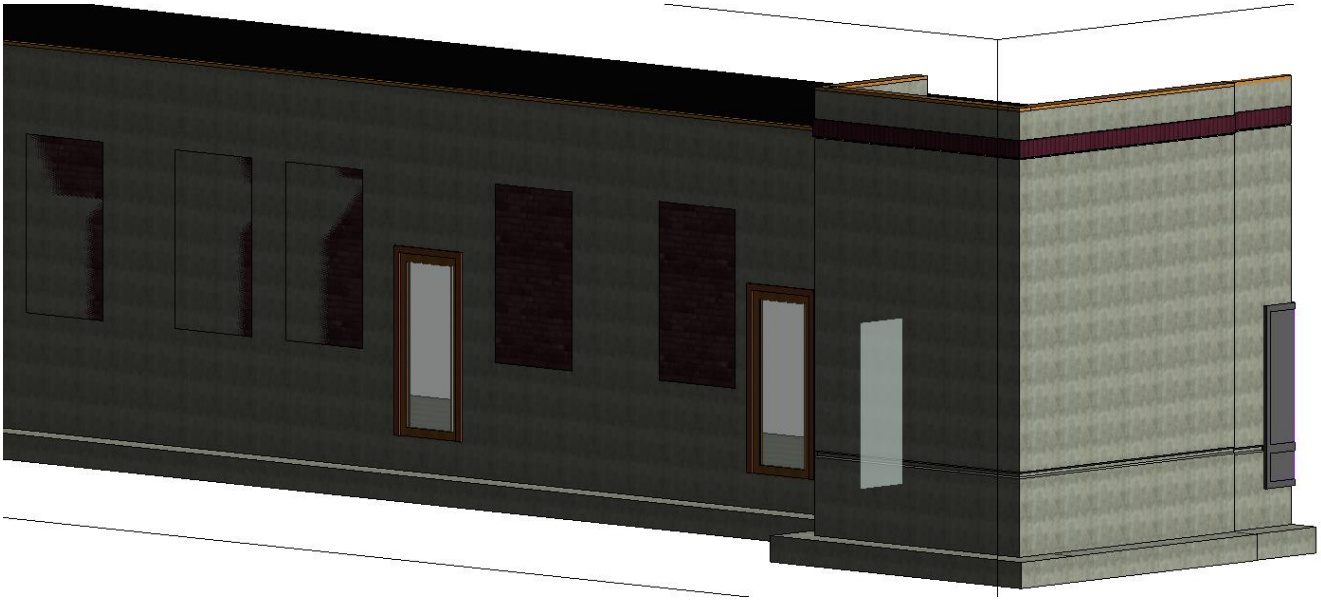
Clean up your models:

- Before you begin breaking up your model with parts you will want to make sure your wall clean-ups are done before hand. If you are using the model for analysis, ensure that the walls are all "joining" Occasionally Architects or engineers will select disallow join, this will also make the analytical lines not join.

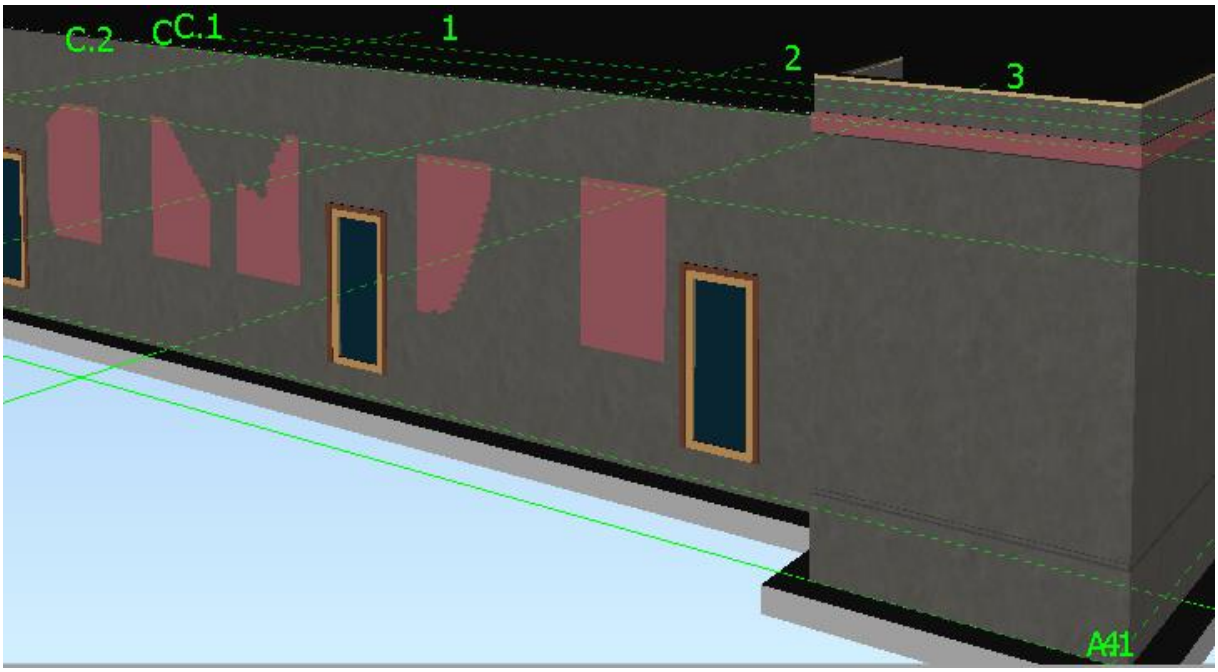




- *Horizontal Wall Sweeps* do not break with parts unless imbed into walls where they will divide.
- *Embed Brick Walls* must be joined to void out existing walls.

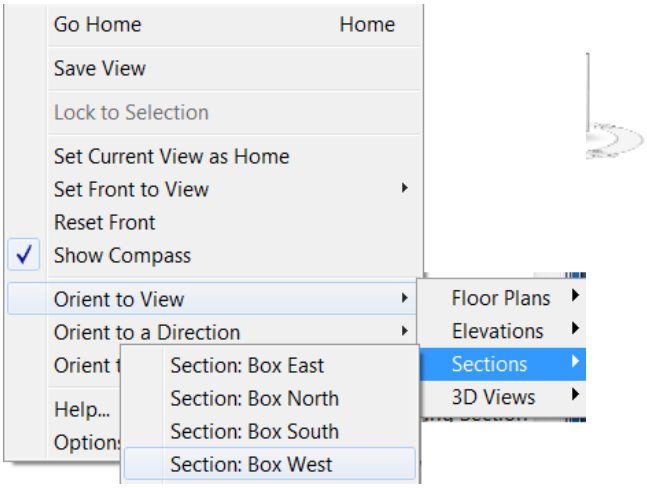


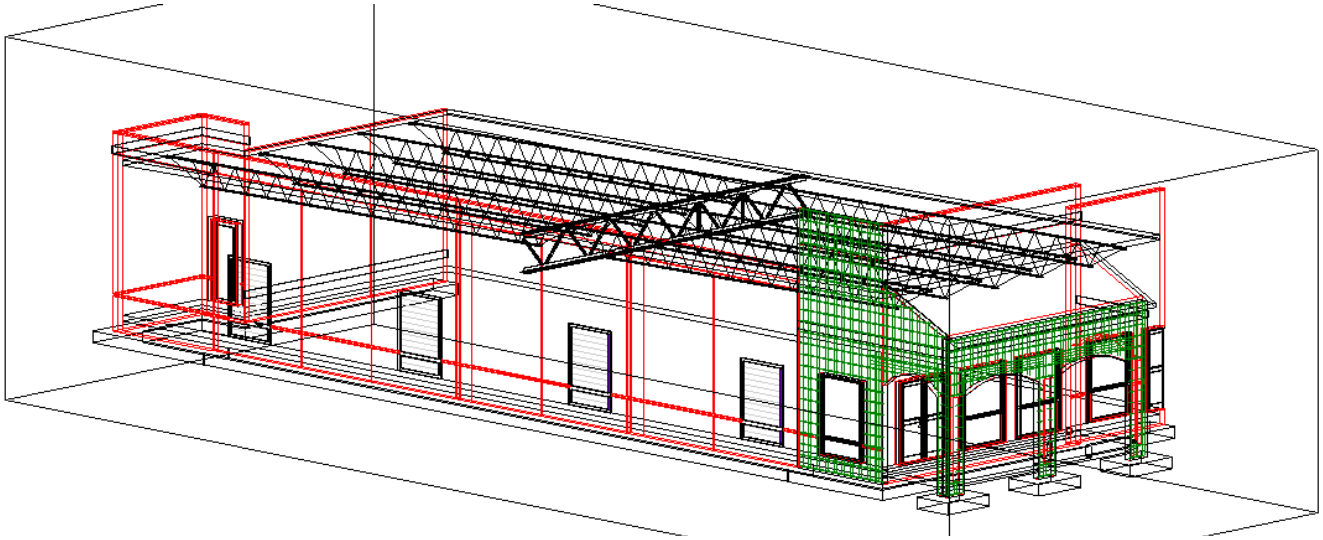
- *Parts Don't show properly in Revit & Navisworks when embeds not joined.*



Break up project into smaller view or sections that are easier to manage.

- Use *section boxes* of specific regions (Focus areas) or potential zones of work. Use your Default {3D} view and use the View cube to navigate to specific Section Boxes. *Right click* on section box and select Orient to view and find pre-defined views to orient to. (e.g. Box East, Box North…)
- Dependent Views with "Match Lines" are good to break up project.

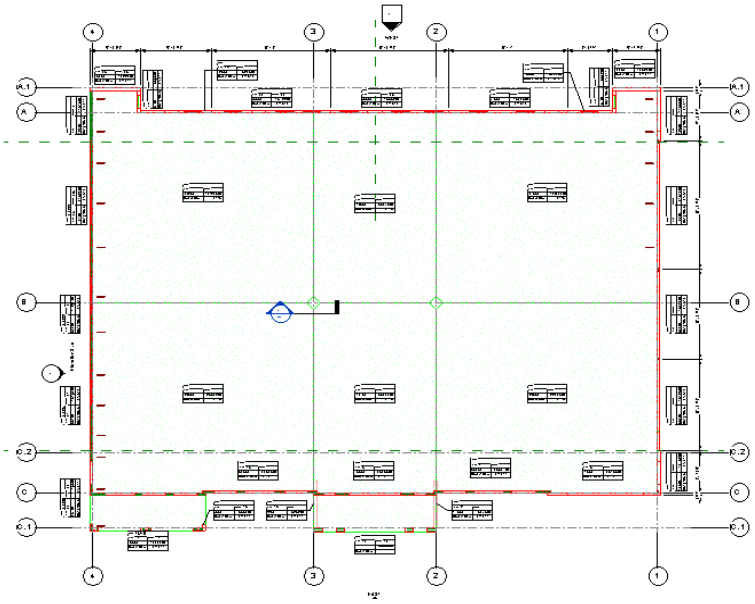




Intelligent Tag's & Planning Views

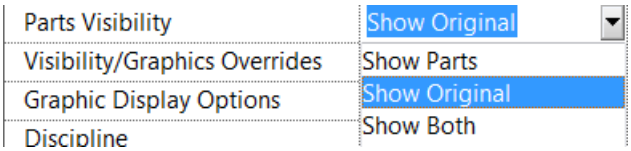
Planning data can be captured in parts and assemblies. <u>These parameters can be consumed into Navisworks intelligently.</u>

Phase: TU19	
Part#: 19	Asmbly: 19
166 SF	100.02 CF
Conc. Tilt-up	0' - 7 1/4"



Create Different Part Views

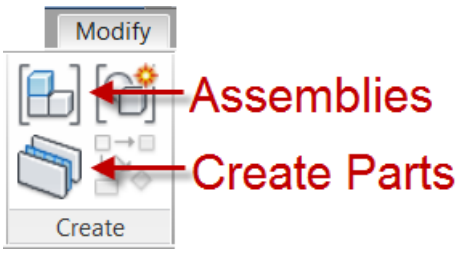
Views have 3 view options:



- Show Parts *(Only parts will only show after you have enabled them and wall/floor/roof will disappear after you have removed them)*
- Show Original – only shows walls.
- Show Both (Recommend Differing Colors)

Set up a generic parts *view template* enabling your graphical overrides for parts to include:

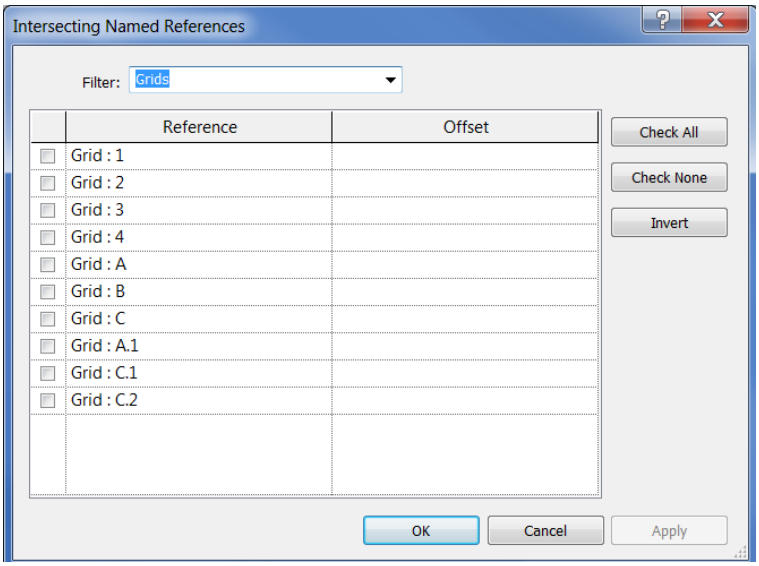
- Color filters for walls, floor & roofs.
- Line overrides, etc. to differentiate what is a part and what is not.



Creating Parts

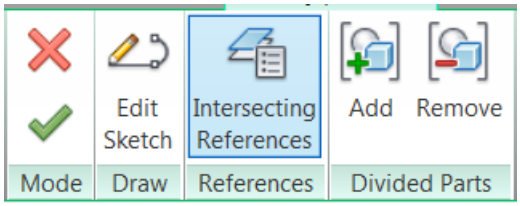
Select Designers wall and Select Create parts.

- Select wall / floor / roof - > Create part
- Or Select Create parts - > Select Multiple
- Parts with like materials join.

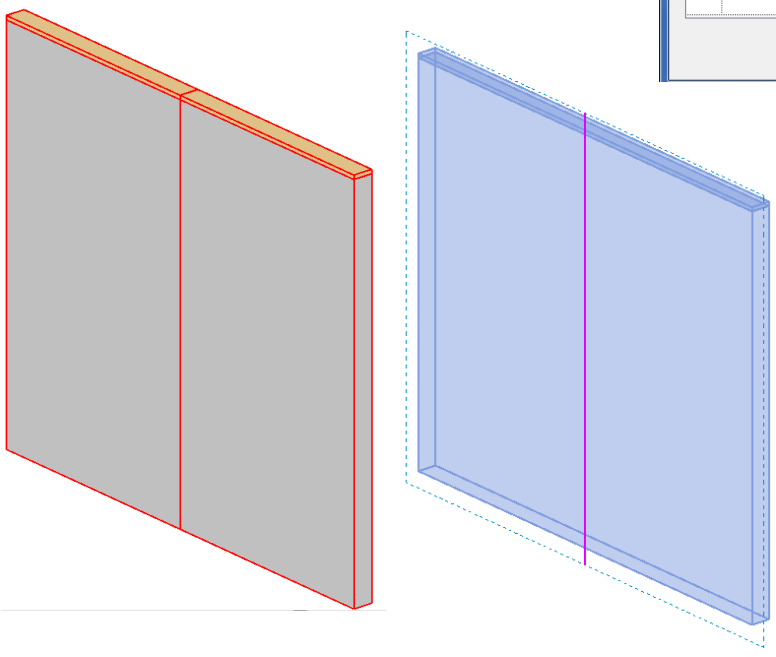


Divide Parts

- Use intersecting References



- Sketch Divisions (Extend Beyond Reference offset lines to break embedded profiles)



Modify Parts

- Enable Shape Handles
  - Per material Layers

Identity Data	
Comments	
Mark	
Show Shape Handles	☑
Original Category	Walls
Original Family	Basic Wall
Original Type	Exterior - Brick on CMU

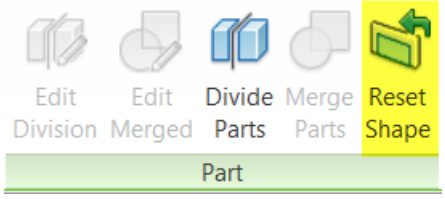
- Override Part Materials

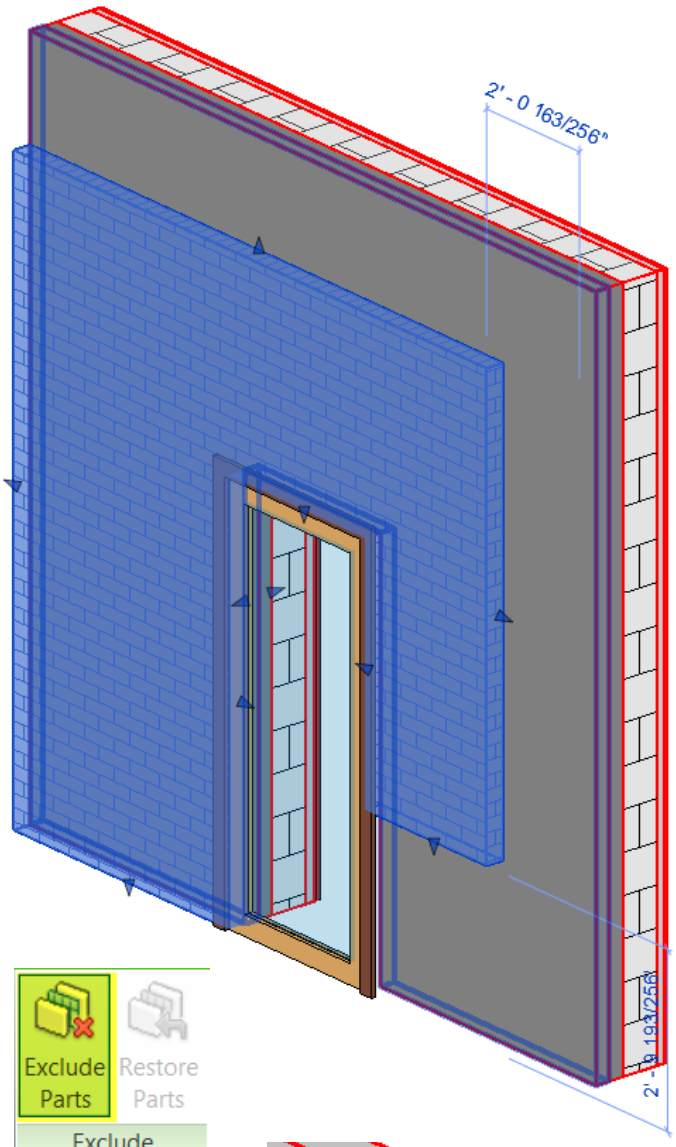
Material By Original	☑
Material	Brick, Common
Construction	Finish

- Override Phases Created / Demolished

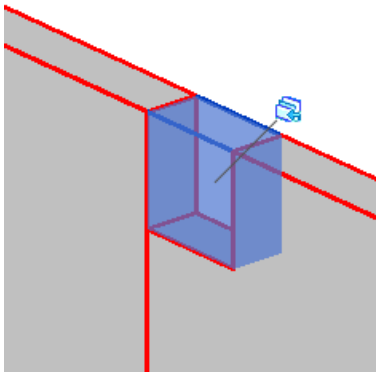
Phasing	
Phase Created	New Construction
Phase Demolished	None
Phase Created By Original	☑
Phase Demolished By Ori...	☑

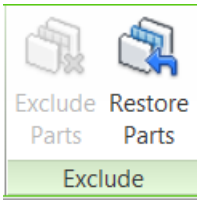
- Use Drag Handles to adjust to conditions fitting appropriate means and methods.
- Reset Shape if you want to revert to the original material.

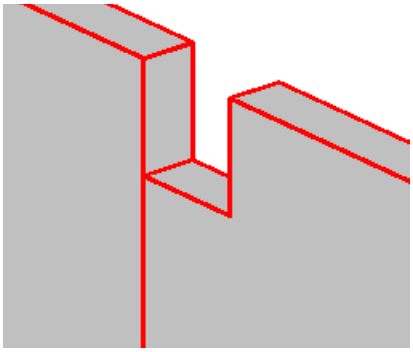




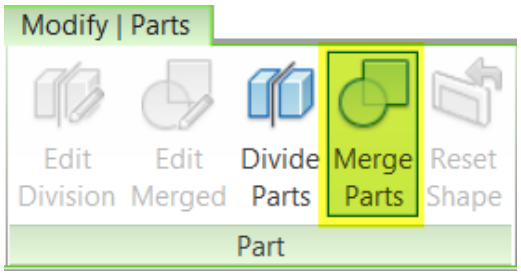
- Exclude Parts
- Restore Parts

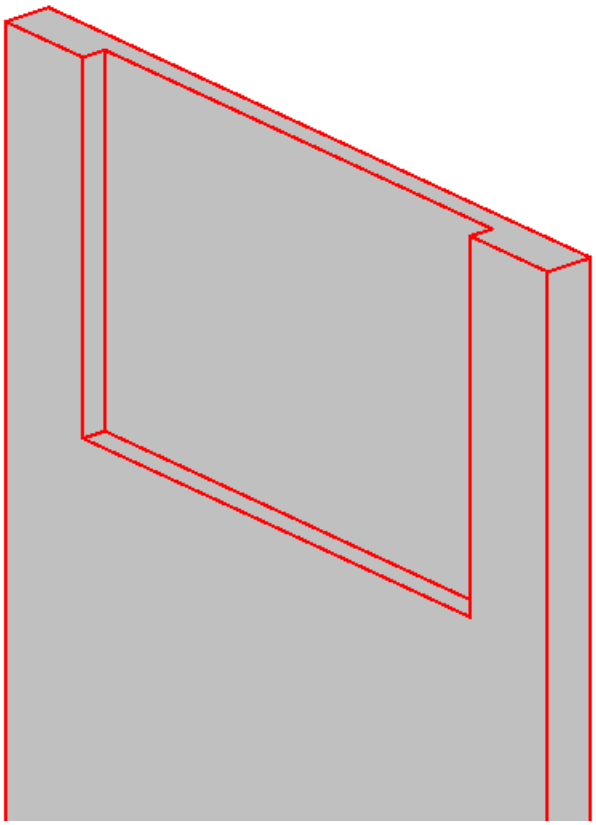






- Merge Parts – Like type materials can be Merged,
  - Merged parts will be included in one material Estimate. (like materials)
  - Join walls included in one pour together.



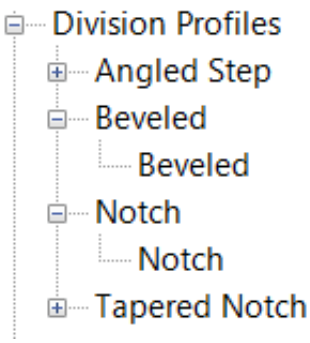


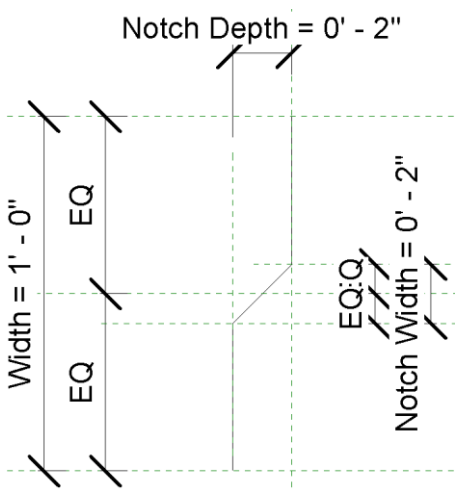
- Notes:
  - Wall Reveals Will divide with Parts
  - Wall Sweeps (not hosted) will not divide or be turned into parts. They can however be included in wall assemblies. Suggest hosting horizontal profiles in wall or redraw.

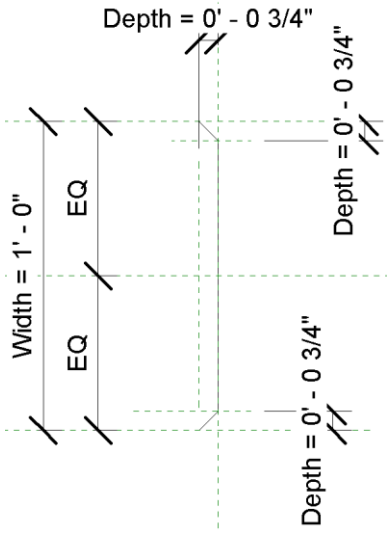
Define Division Profiles

- Modify/Create Division -> Properties -> Set division properties
- Set Divider Gap
- Set Split Profile Types
- Define Edge Match (Complimentary, Mirrored, & Rotated.
- Check Profile Along Flip
- Profile Offsets (+ or -)
- New Profile Type (Division Profiles)

Constraints	
Divider gap	0' 0"
Dimensions	
Split Profile Type	Beveled : Beveled
Edge Match	Mirrored
Profile Along Flip	☐
Profile Offset	0' 0"



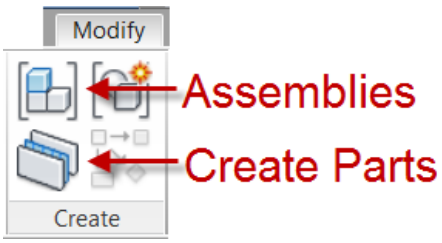


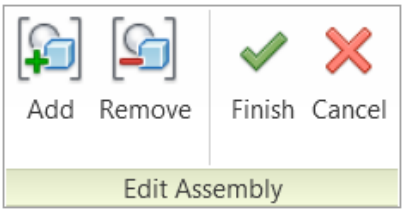


Create Assemblies

Multiple elements combined that maintain independent views, schedules, tags and can & filters.

- Combine several objects into assemblies
- Manipulate elements as a single unit
- Each assembly is a separate assembly type
- Place instances of assemblies
- Changes are tracked as the model changes
- Assemblies consume parts, parameters, and associate to parts.
- Collect and pass data into NavisWorks for Simulation.



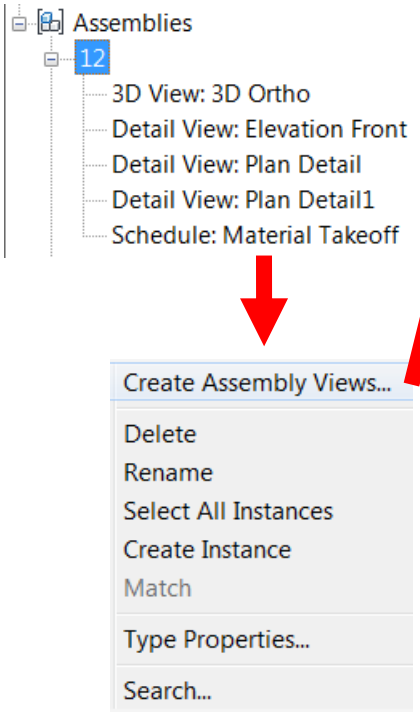


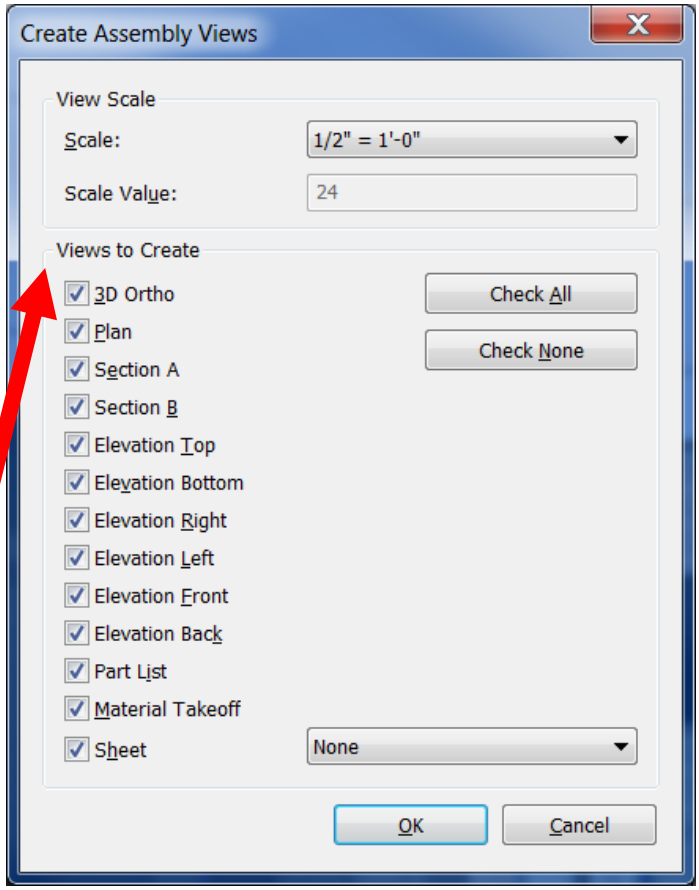
Using Assemblies

- Separate editable, tagged, schedules, and filtered
- Generate sheet and assembly views
- Shop Drawings, clarity drawings, slab plans, form layouts.
- Grouping like type objects

Creating Assembly Views

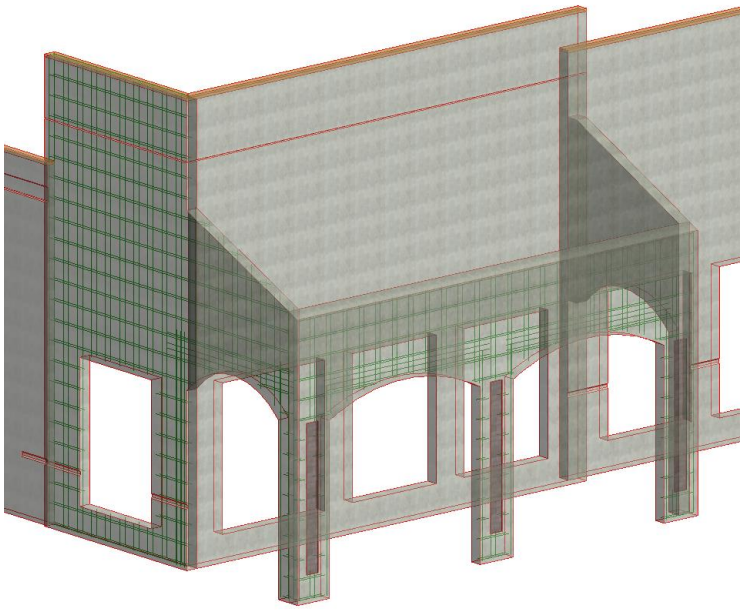
- Select Assembly in Browser and
- Views area automatically created
- Automatic Materials Take-off



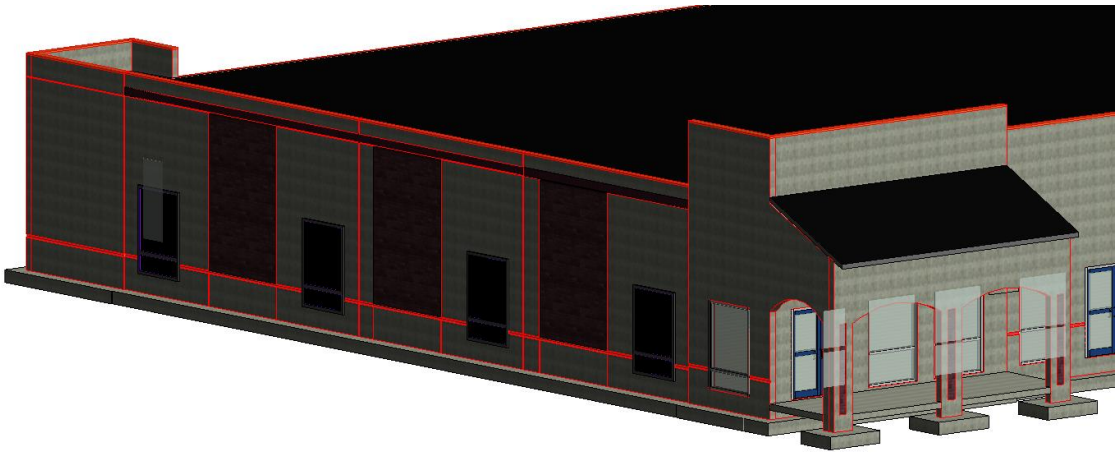


Wall / Rebar Settings

Description	Setting
1 - Tilt-1 1/2" Exterior	0' 1 1/2"
1 - Tilt-3/4" Interior	0' 0 3/4"
2 - Parts offset	0' 2 3/8"



- Define Cover settings for whole wall.
- Draw specialty rebar first then add whole rebar next.
- Cover settings will only apply to parts, when defining boundary, use offset and lock it to the edge of the part.
- Rebar will accommodate openings for doors etc. but does not consider the profile edits unless you incorporate these into your wall. These are associative but not identical giving the designer better coverage.
- Rebar is not dynamically tied to your wall, if you edit the profile or top / bottom, it will not follow these edits. Use pick lines with lock for better success.
- If your wall has an exterior finish (brick, airspace, etc. You may want use the Additional (Exterior / Interior) Cover offsets <instance based>
- Thin set brick walls must join geometry to concrete walls to void out material. Walls will be separate parts.
- Create a View with Parts & Rebar only to facilitate Adding to Assembly views.



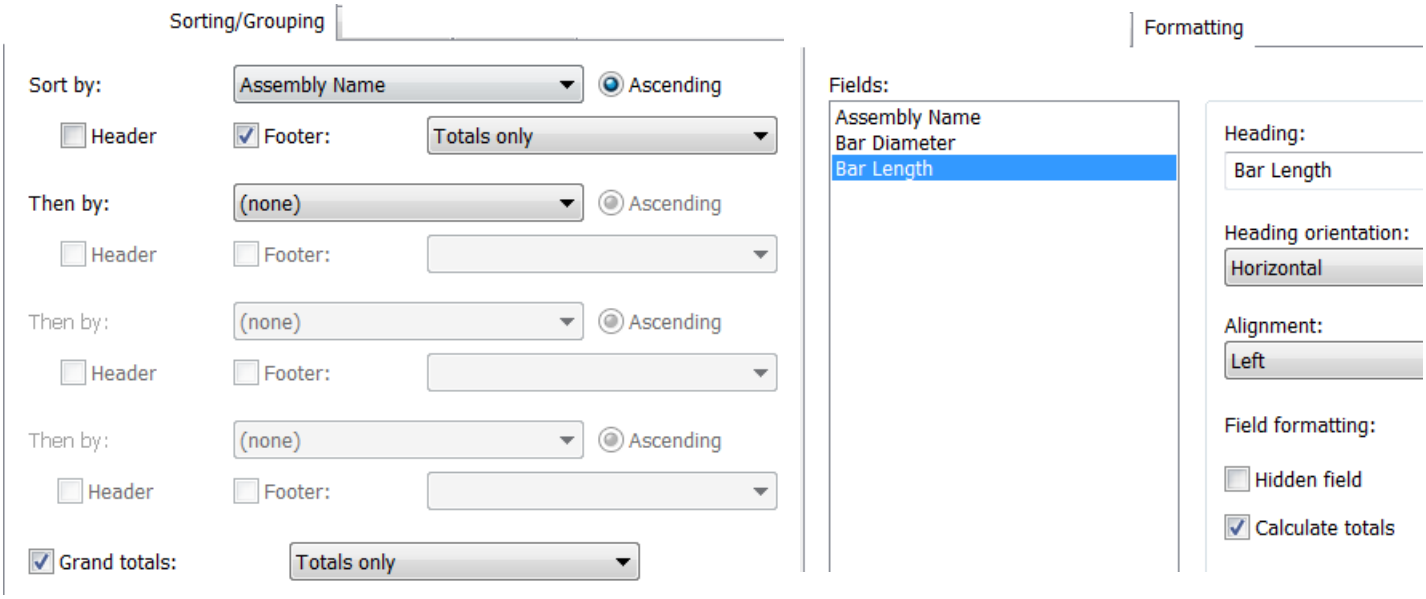
Schedules

Rebar Schedules

- Not Included in Assembly Views (Separate)
- Rebar schedules itemize every instance.
- For QTO itemize by assembly name to estimate bar size length per assembly.
- Sort by Assembly Name, provide totals by footer and give grand totals per Settings below.
- All fields requiring tot als select calculate totals during formatting.

Rebar Schedule

Assembly Name	Bar Diameter	Bar Length
12	0' - 0 1/2"	416' - 4 1/4"
		416' - 4 1/4"
19	0' - 0 1/2"	464' - 3 1/8"
		464' - 3 1/8"
20	0' - 0 1/2"	516' - 0 1/4"
		516' - 0 1/4"
21	0' - 0 1/2"	74' - 6 1/4"
		74' - 6 1/4"
		1471' - 1 3/4"



Scheduling Parts

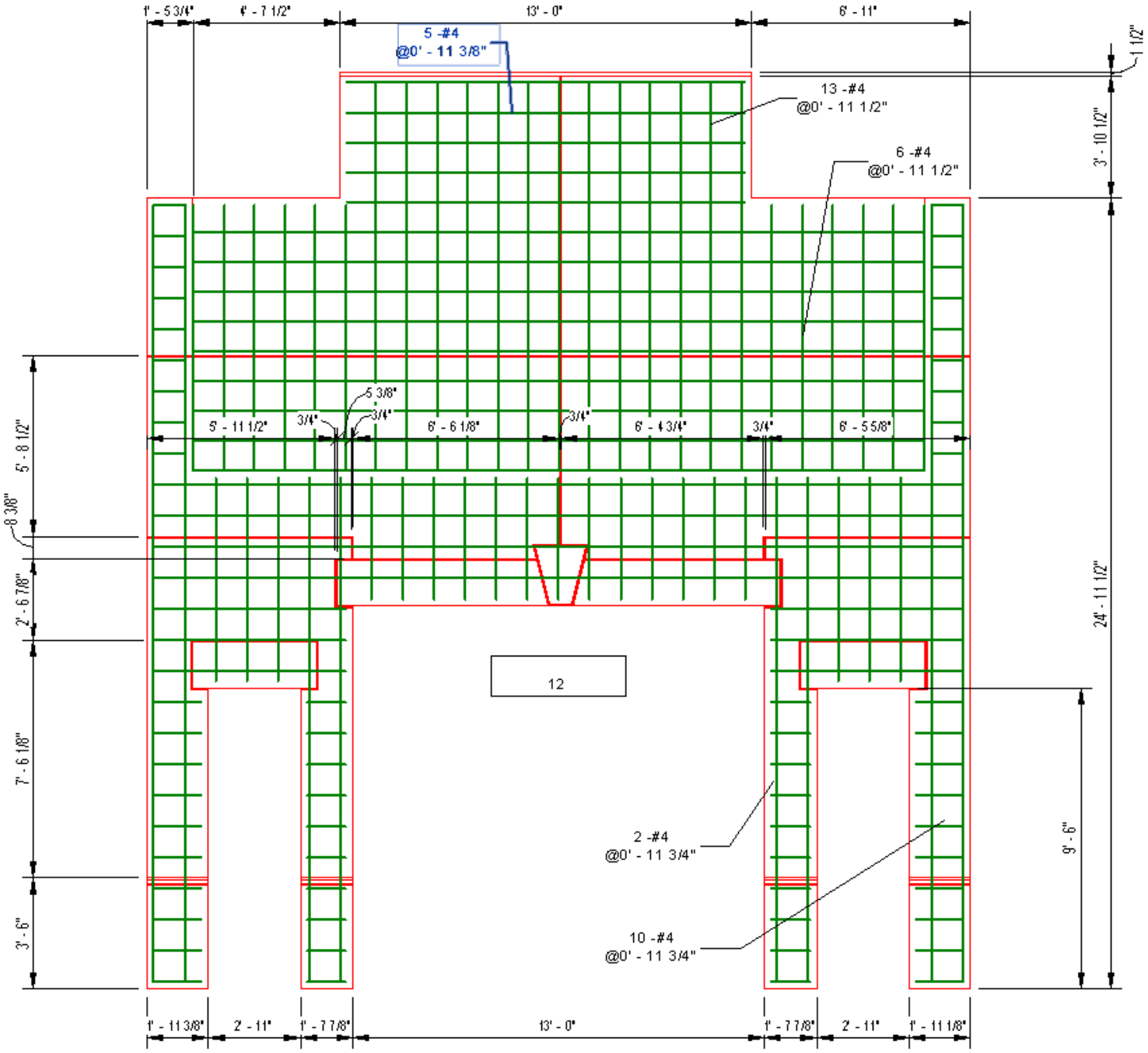
- Create Schedules for Parts
- Associate with Assembly Name
- Sort by Material to break up into different materials.

Wall Parts

Assembly Name	Mark	Panel#	Area
Air			
			132 SF
Brick, Common			
19			5 SF
19			5 SF
19			5 SF
			81 SF
Concrete Masonry Units			
			132 SF
Concrete, Cast-in-Place gray			
	22		327 SF
023	23		471 SF
21	21		332 SF
20			237 SF
17	17		403 SF
19	19		159 SF
18			56 SF
			173 SF
			332 SF

Documenting / Tagging Assemblies

- Tag Rebar Segments / Spacing.
- Document Rebar layout, openings, and reveals from *Assembly Views.*



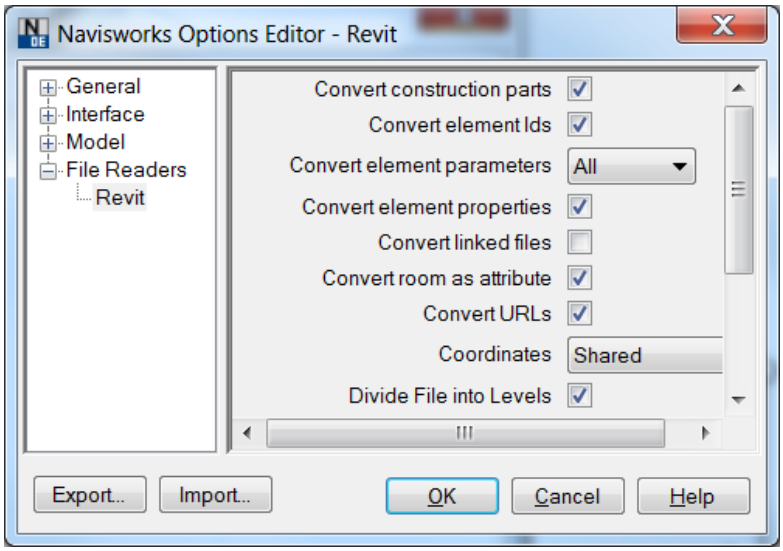
Additional Assembly Workflow Ideas

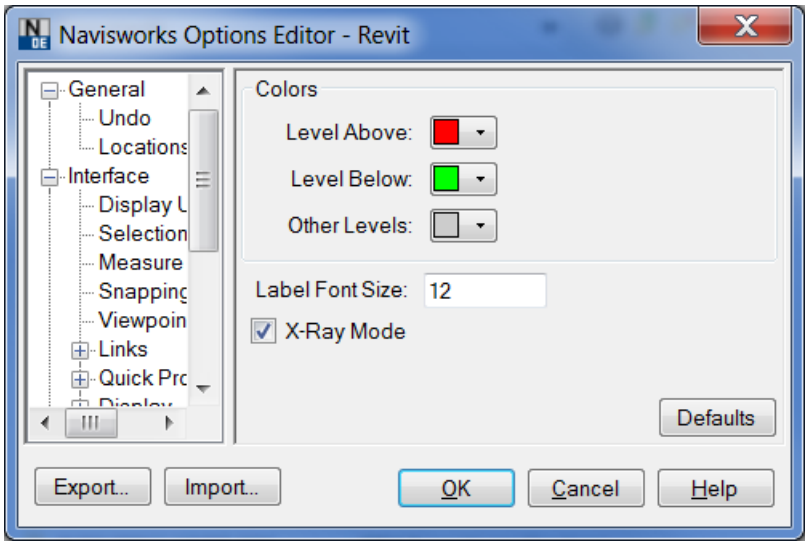
- Place & locate structural embeds plates from beams, joists, and braces into assemblies.
- Place & locate beam pockets into assemblies.
- Place and locate lift plates / devices for tilt-up and pre-cast walls into assemblies
- Locate & Place Bracing into assembles.
- Take all assembly components and add custom simulation parameter to consume in NavisWorks.

Consuming Revit Data to Automate Navisworks

Setting Export Settings for Navisworks

- Select
  - Convert Construction Parts
  - Convert element Id's
  - Convert element properties (all)
  - Convert element properties
  - Coordinates (if defined select)
  - Divide File into Levels
  - Note: Create Export View
- Grid settings

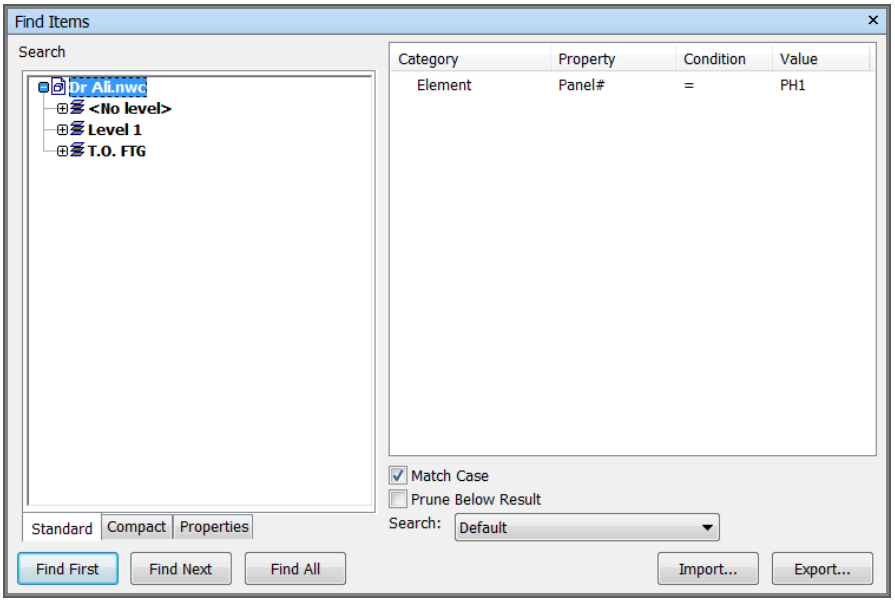




Establish Default Search Sets

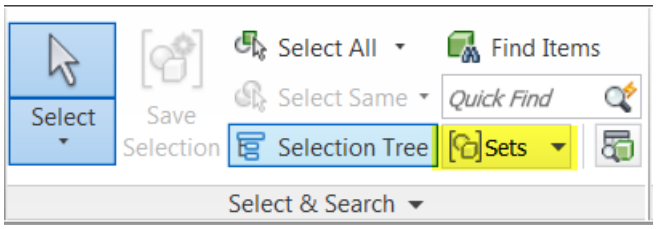
Use parameter based search sets to filter and consume Revit data to avoid manual set-up.

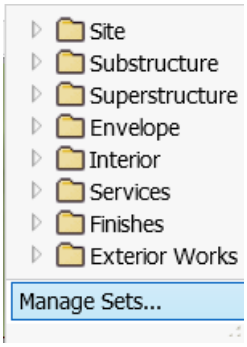
- Material Search
- Phase Code Search
- Misc. Filters

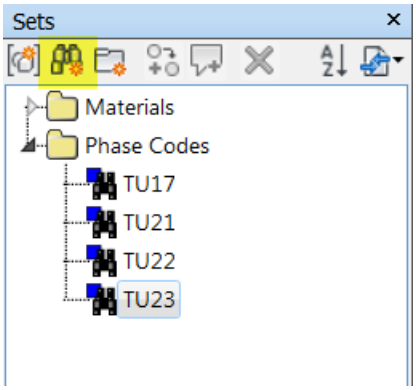


Workflow (Parametric Search)

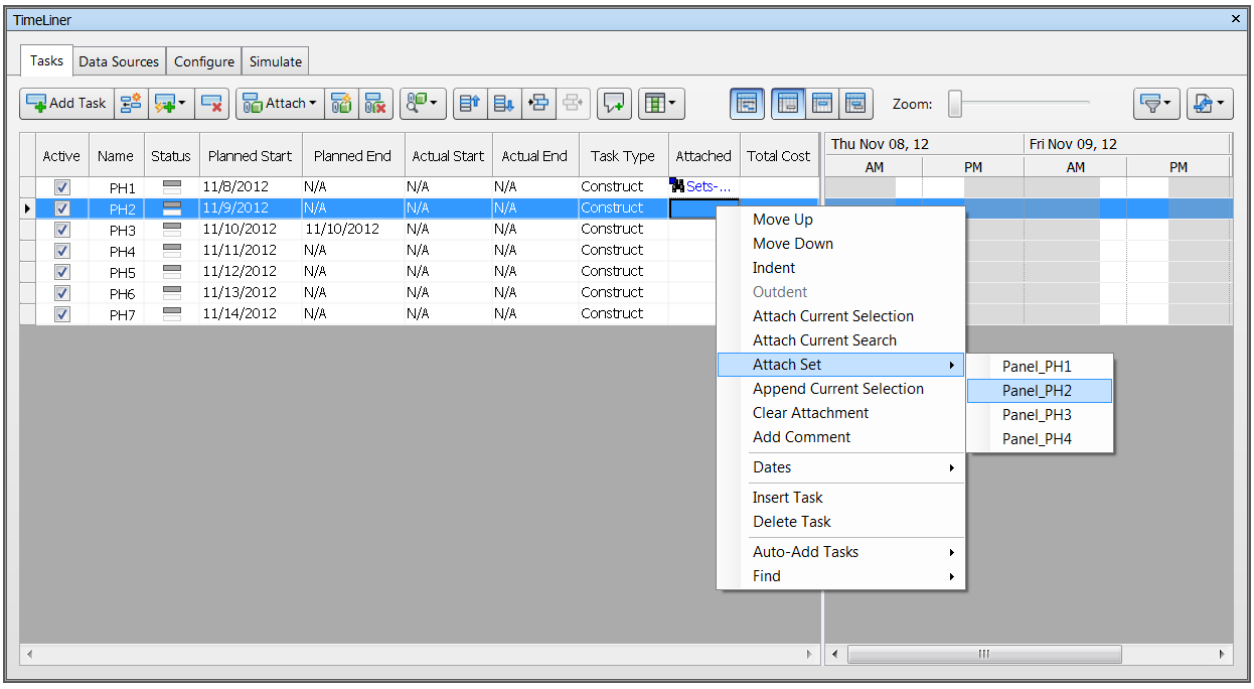
1. Use *find items* tool to search for Revit Parameters for category select <*Element*>, Property <*Parameter name*>, condition <=>, Value (select desired value)
2. Select find all (to verify selection.
3. Open Sets - > Manage Sets
4. Select Save Search to save a search set. Note Do no Save a selection set as changes in Revit will not be reflected.







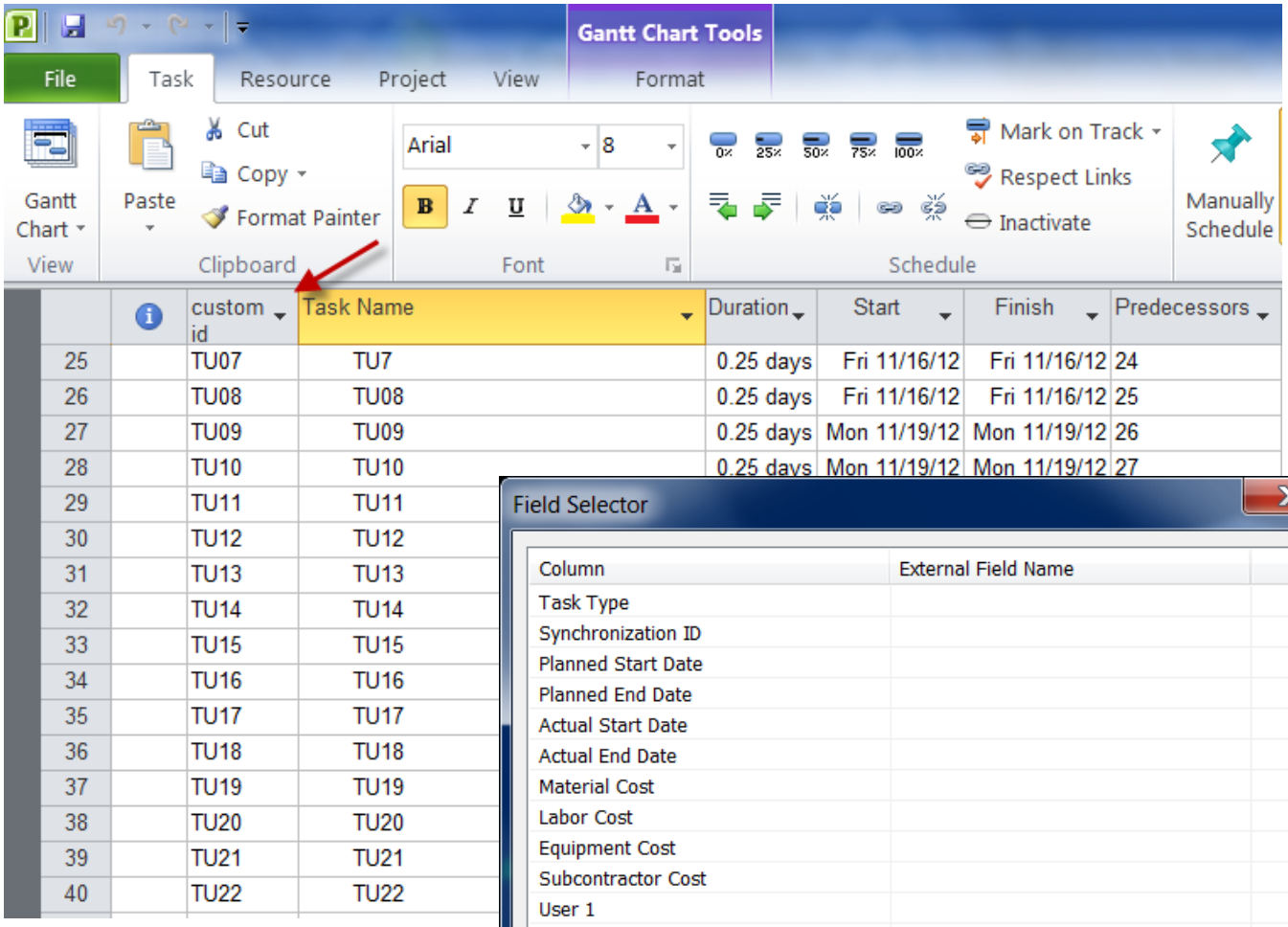
5. Attach Search Set to Phases



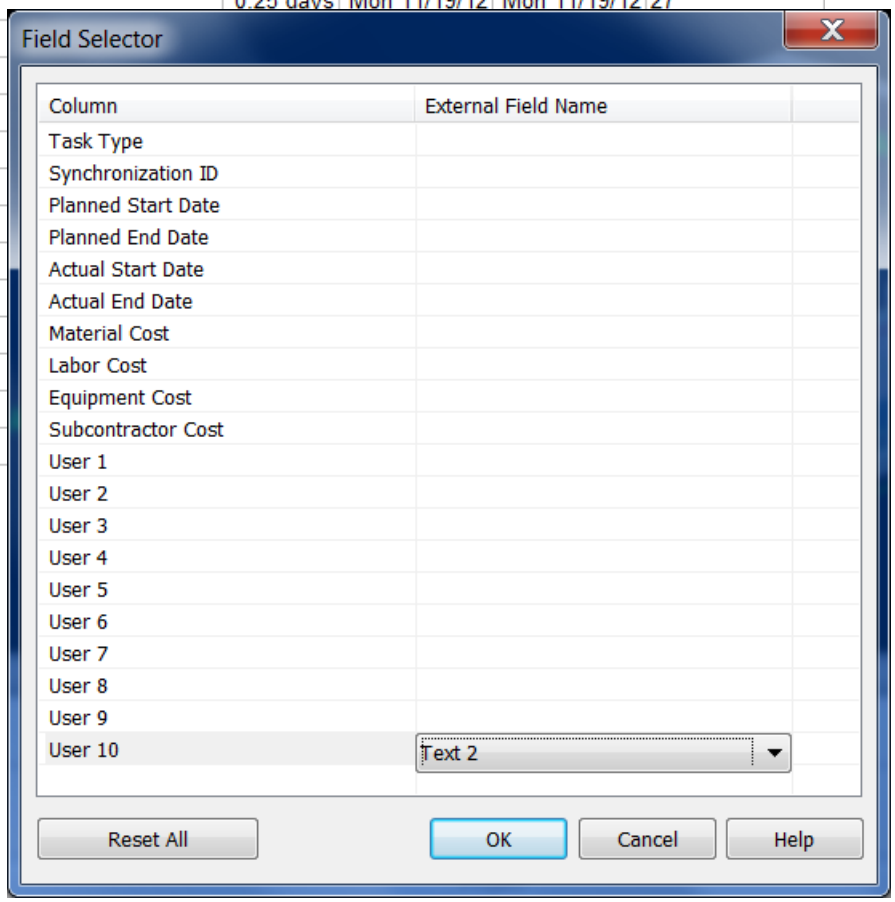
Automating Simulation Selections

With the proper planning there can be synergy between Project Schedule and Shop Drawings / Revit Drawings. Depending on the planning software you can create a unique custom variable that can be also identified in Revit to map to the project schedule then automated through the Rules editor in Navisworks.

Create a custom Phase ID field in your project in whichever planning software you prefer.

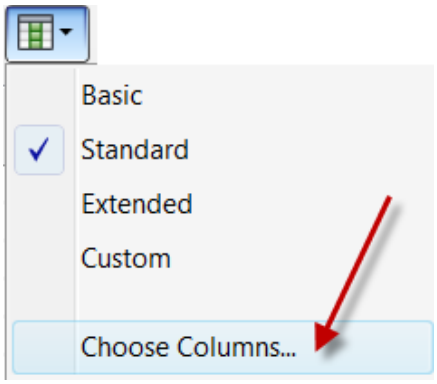


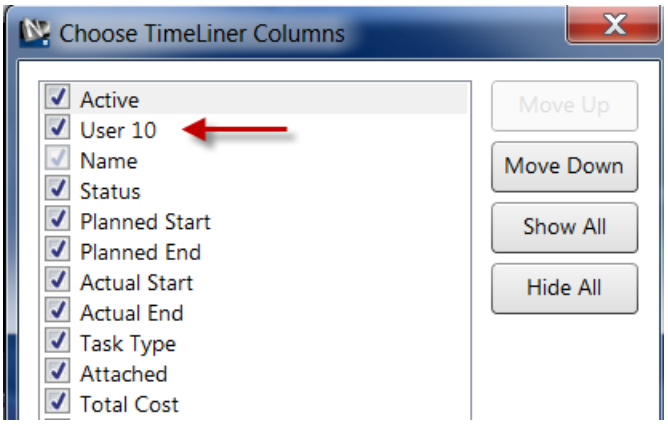
	custom id	Task Name	Duration	Start	Finish	Predecessors
25	TU07	TU7	0.25 days	Fri 11/16/12	Fri 11/16/12	24
26	TU08	TU08	0.25 days	Fri 11/16/12	Fri 11/16/12	25
27	TU09	TU09	0.25 days	Mon 11/19/12	Mon 11/19/12	26
28	TU10	TU10	0.25 days	Mon 11/19/12	Mon 11/19/12	27
29	TU11	TU11				
30	TU12	TU12				
31	TU13	TU13				
32	TU14	TU14				
33	TU15	TU15				
34	TU16	TU16				
35	TU17	TU17				
36	TU18	TU18				
37	TU19	TU19				
38	TU20	TU20				
39	TU21	TU21				
40	TU22	TU22				

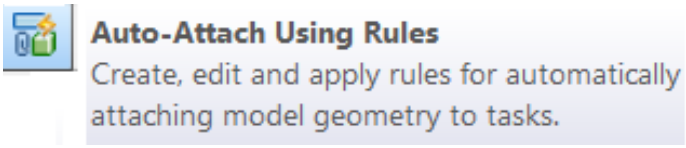


Insert Parameter in Navisworks and move to front. First add project from schedule and select the preferred *User Column* for the Phase ID and map it to the *External Field Name*.(note: this may have been renamed in the planning software), you may need to find this through trial and error if you can't open the project planning software.

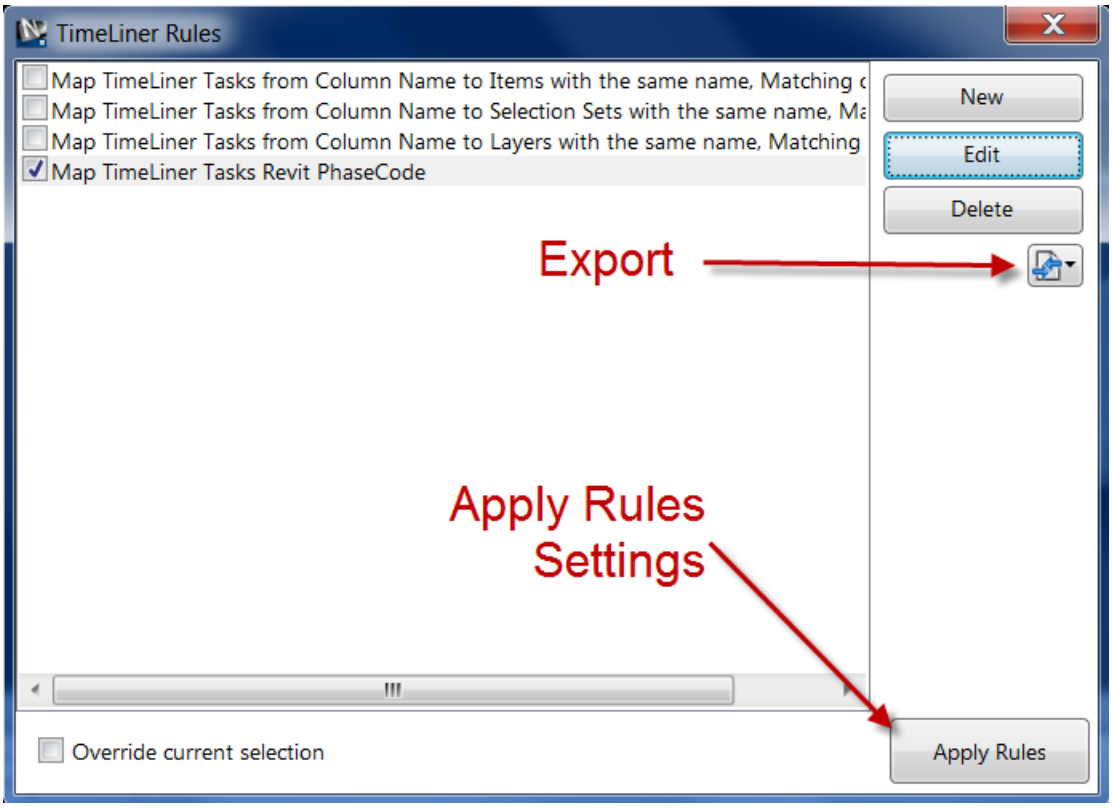
Choose Column for which you want to map the specific parameter. This tool is found on the timeliner task bar. This may automatically be added or may need to be added to existing projects.

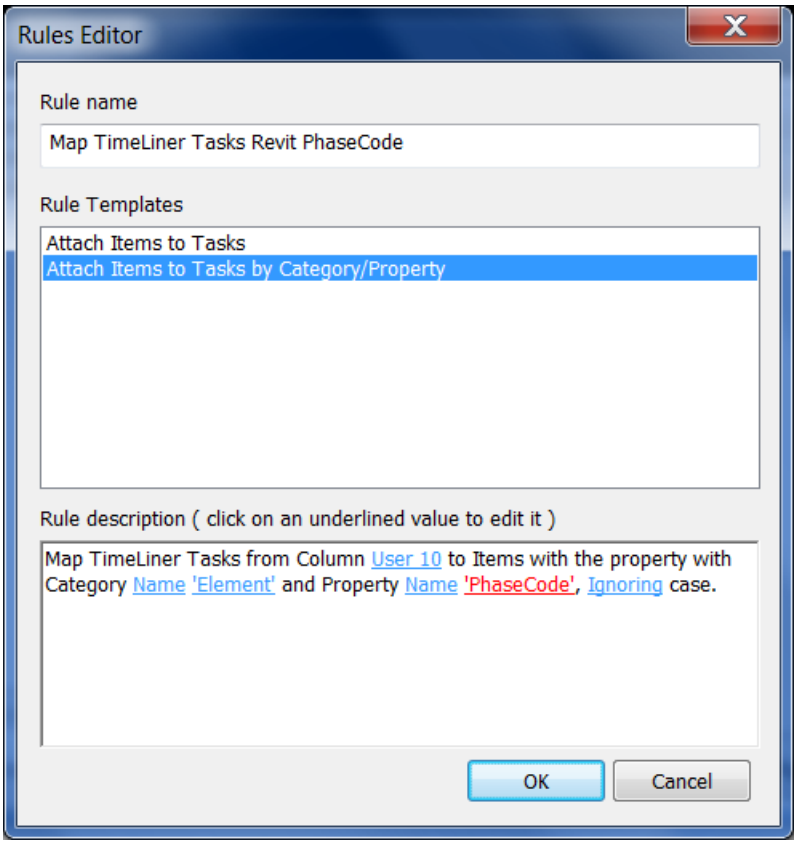






Auto-Attach Using Rules will enable you to map the elements via parameter vs. creating individual search / selection sets. You will want to give it a name different than the other Auto-Attach rules.





Use the Attach Items to task by Category / Property. You can select the Navisworks *Column* to map with specific properties (similar to find items with search Name) This will automate the selection of items that have the previously identified parameters for PhaseCode in Revit. Once created *apply rule* settings. You may want to export these settings for future use or standardization in your organization.

Verify your Project Schedule to ensure that there are explicit selections and don't forget to make sure your task types are selected (i.e. Construct, Demolish, etc.)

Animate areas of greatest concern

Many times animations can be a very trick and complicated avenue for simulation. Even though clients enjoy a good dog and pony show, it is important to demonstrate / animate areas of the greatest concern. This may be simulation of egress, 4D clashing, complicated areas, stacking / demolishing sequences, temporary construction etc. Logistical issues are not always shown in plans but should be not only demonstrated but somehow documented. Navisworks can communicate these weekly elements without the need of plans. Animations can be added to the construction schedule and are not always found on the schedule task bar, remember to add these to your schedule in these complicated areas or egress studies.