

AUTODESK **UNIVERSITY** 2015

MSF10435

Goin' Big with Rebar in Revit Structure

Dan McCloskey, P.E.
MB BIM Solutions

Ryon Pax, E.I.T.
MB BIM Solutions

Learning Objectives

- Discover how to manage pours, fabrication, and delivery data, and coordination between CIP concrete entities
- Learn how to use partitions and automatic bar number to develop a quality control system for rebar data
- Discover how rebar data can be exported from the Revit model for direct import into common rebar cutting and bending software
- Discover tips and tricks to take advantage of repetition to efficiently model rebar and create shops for a large rebar job

Description

This class builds on previous Autodesk University classes that taught rebar modeling and shop drawing tools in Revit Structure software. We will expand on this by showing how to manage a large rebar model and shop drawings for large building construction projects in Revit software. Using a 2000-plus ton rebar model for a 1 million square foot mixed-use, mid-rise project as an example, we will discuss how to use the Revit software model and add-ins to manage pours, fabrication data, and coordination between the contractor, rebar fabricator, and installer. We will present techniques that will help you use partitions and bar numbering to manage data in a large rebar model, as well as how to use parameters and filters to control and QC rebar delivery data. We will demonstrate spreadsheet links and add-ins to export rebar fabrication data from the Revit software model to input directly into common rebar cutting and bending software applications. You will also learn tips and tricks to help you take advantage of repetition to efficiently model rebar and annotate shop drawings.

Your AU Experts

Dan McCloskey received his bachelor's degree in civil engineering from the University of Illinois at Champaign-Urbana. After spending 2 years designing bridges for URS Corporation, Dan attended Purdue University where he obtained a master's degree in structural engineering. Dan then moved to Denver, Colorado, where he worked as a structural design engineer and then structural project engineer for S.A. Miro, Inc. During his 5 years with Miro, Dan became an in-house expert in Revit Structure software, and he moved into the role of Building Information Modeling (BIM) manager. In 2011 Dan co-founded MB BIM Solutions as a BIM-focused consultancy that provides construction-level modeling of structural systems and components for its clients. Dan is active in the Denver-area BIM community with Rocky Mountain Building Information Society, has taught several classes at Autodesk University, has been published in AUGIWorld magazine, is a Revit Beta contributor, and is also a Revit Gunslinger participant.

General Model Set-Up

Rebar Model and Design Models as a Single Model or Separate Models

One of the first things to consider, in the case of a structural engineer acting as EOR for a project and simultaneously creating a rebar model and shop drawings, is whether to combine the rebar and design models, or create two separate models. We prefer to have two separate models, which are obviously then linked and copy/monitored. Here are the pros and cons of the separate model approach:

Pros:

- Design modeling vs. construction modeling – different needs and LOD
- File size – these models can get very big, and tougher to work with for the design team
- Possibility of design team inadvertently messing up rebar

Cons:

- Duplication of work, possibility of design model not matching rebar model
- Some data and details will need to be generated twice

It may make sense to combine the design and rebar model for some firms or for specific projects. In this case, using worksets is a good way to separate the rebar from the rest of the model.

Using Design Team Models as a Starting Point for a Rebar Model

If you are detailing rebar on a project in which you are not also the structural engineer, using the structural engineer's Revit model (or even architect's model) is obviously a great starting point for your model. However, because the concrete element geometry controls the rebar geometry in your model (i.e. column dimensions), it is absolutely imperative to thoroughly QC any geometry that you import or copy/monitor into your model. Often, structural Revit models over-simplify concrete geometry for conditions such as brick ledges in foundation walls, caisson lengths, and core wall openings and just refer to the architecture in their details. Because this information needs to be geometrically accurate in a Revit rebar model, it is best to either use the concrete in a linked structural/architectural model as a reference when creating your own concrete model, or very thoroughly QC and tweak any concrete you bring in from a design model.

Multiple Rebar Models?

Another thing to consider is whether or not the project justifies the use of multiple rebar models. This may seem counterintuitive from a workflow, model management, and bar numbering standpoint. However, the bar numbering problem can be easily solved by using partitions that are created to work across different models.

Pros:

- Lighter models
- Avoid unintentional interaction between rebar of different element type, like columns and slabs

Cons:

- If using these models in Navisworks or as linked models, more models to manage
- Need to jump between models to modify different bar in an area where bar from the different models interacts (i.e. core wall dowels and core wall verticals)

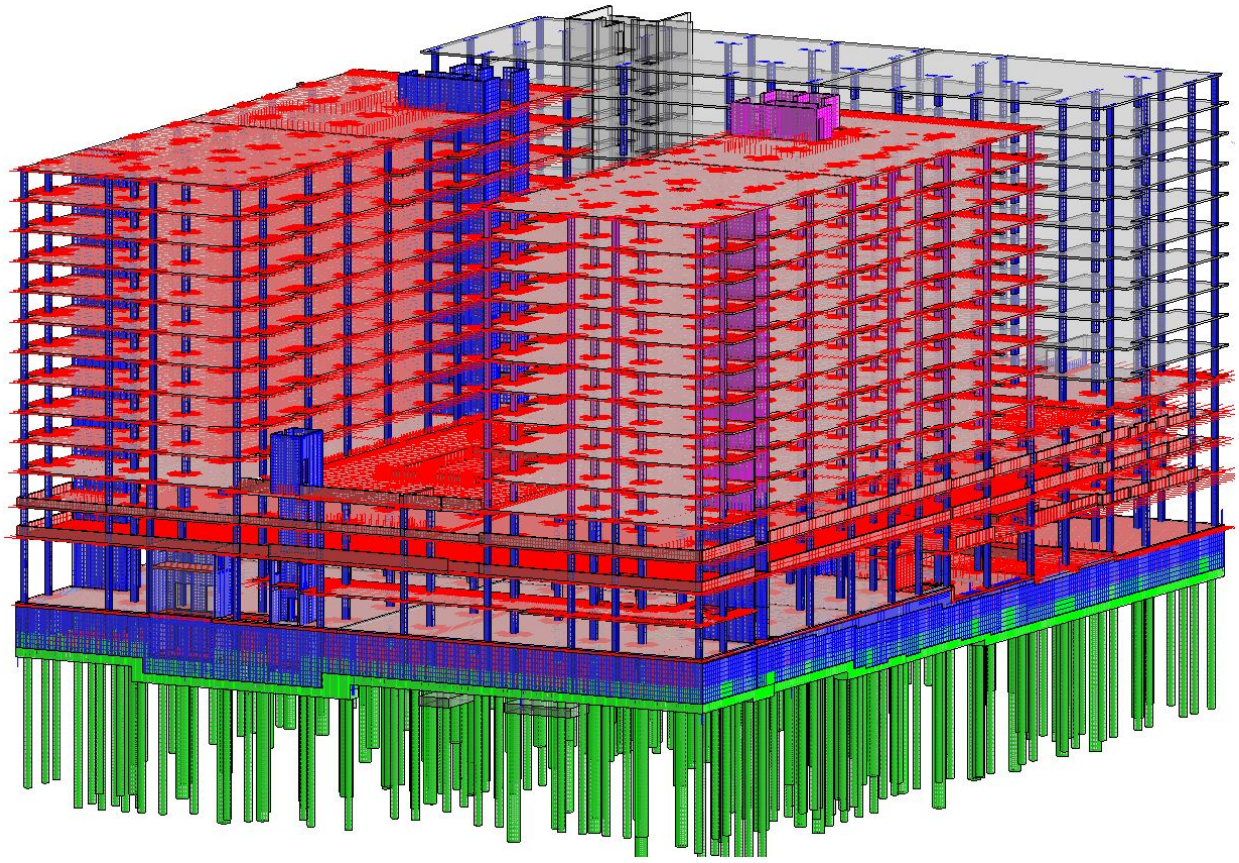


FIGURE 1: FOUR REBAR MODELS LINKED TOGETHER, COLOR-CODED BY MODEL

For the 17W project that we are using as an example in this presentation, we had three main models. Figure 1 shows the foundation model in green, the walls/columns model in blue and the slab in red. The main driving force to our decision to use multiple models was model weight and concern that a user could inadvertently modify rebar in one element by adjusting rebar in another element.

Coordination with Other CIP Trades

Rebar Modeling/Detailing Kick-off Meeting

Before starting on a rebar model, we recommend meeting with the fabricator, installer, and GC (or concrete sub) to kick off the project and address the following questions. This will help you avoid re-work due to mis-communication.

Coordination with Other Trades:

- Size of wall/slab penetrations to be included in the model.
- Lift drawings created from the rebar model?
- Anticipated formwork/rebar conflicts

Sequencing Questions:

- Pour break and wall control joint locations.
    - Cut horizontals in field at horizontal control joints?
- Material staging capabilities and rebar delivery/grouping.
- Anticipated formwork/rebar conflicts

Fabrication Questions:

- What is the desired format for Bills of Materials? Using Soule, ASA, or other bending/cutting software?
- What is max bar length for each size bar?
    - OK to exceed this at caissons?
- Standard CRSI bar bend types, or other fabricator-specific bar shapes?

Installation Questions:

- What method should we use to prevent racking in the drilled pier cages? (#4 wrapper bar, 'X' bracing, substitute in larger ties, ?)
- Provide sample shops to show what your rod-busters are used to seeing.
- Bar marking and bar numbering preferences.
- How to handle caisson overrun/underruns.
- Stability ties at column tops?
- Any two-story cages at columns or core walls?
- Wall corner preferred details.
- Anticipate formsaver locations vs. extending bars through bulkheads.
- Preferred mat slab standees.
- Who is providing chairs/bolsters/standees/wall spreaders?

Pour Break Determinations

A big (and somewhat avoidable) cause of re-work in modeling rebar in Revit is changes in pour sequence and pour breaks. Pour break locations and sequence often set bar lengths, splice locations, and accessories (such as formsavers). By coordinating with the concrete subcontractor, GC, and also PT supplier (for slabs) before you start modeling, you can save a lot of headache and re-work. We have found that it is beneficial to us and the other CIP entities if we use our model to create color-coded pour break views that can then be used by the other entities as planning tools. As described in more detail later in this presentation, we use a custom 'Pour' parameter that is assigned to all CIP elements, parts, rebar, and even views.

Using 'Parts' in Revit is an effective tool to break concrete into pours without using separate model elements. We assign our 'Pour' parameter to Parts, and it is also important to note that Parts can host rebar.

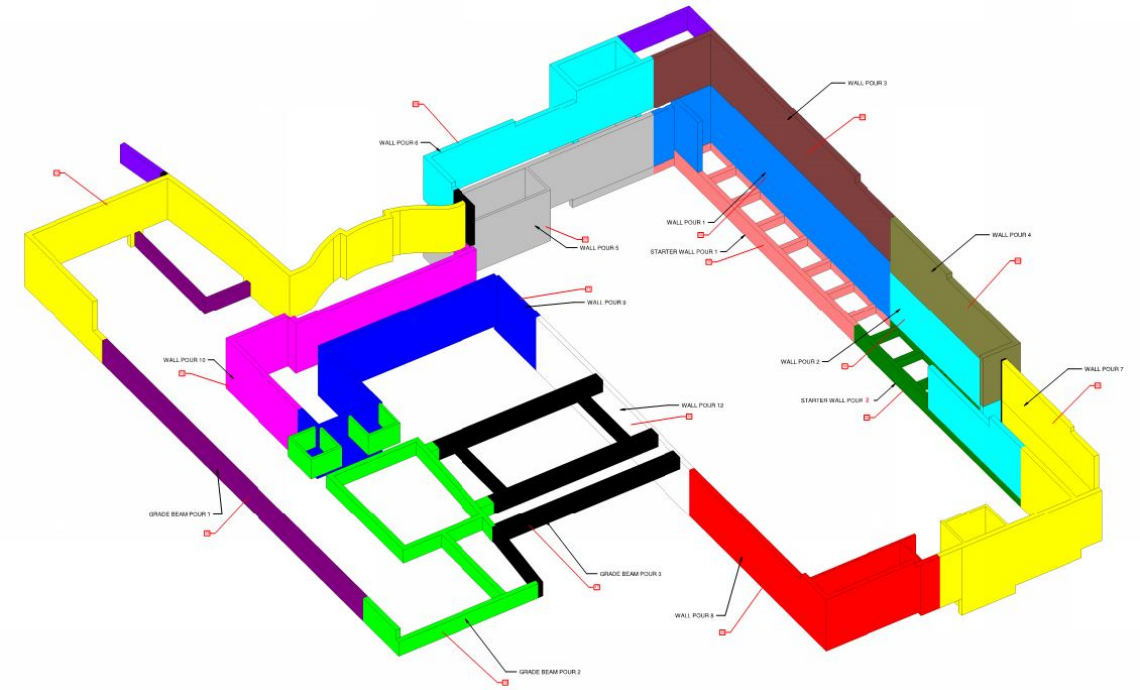


FIGURE 2: COLOR-CODED POUR BREAK VISUALIZATION USING FILTERS WITH POUR PARAMETERS

Another important note about managing pour breaks in Revit is that you should be careful with bar constraints. Rebar constraints that are set to faces of parts, slabs, walls will cause bar to shift and adjust when pour break locations are changed. Because much of the rebar in Revit will be copied and modified from other CIP elements in your model, it can be difficult to constantly pay attention to the constraints that are defining your rebar geometry. When shifting pour breaks, it is wise to try to find rebar that is using these breaks as a face.

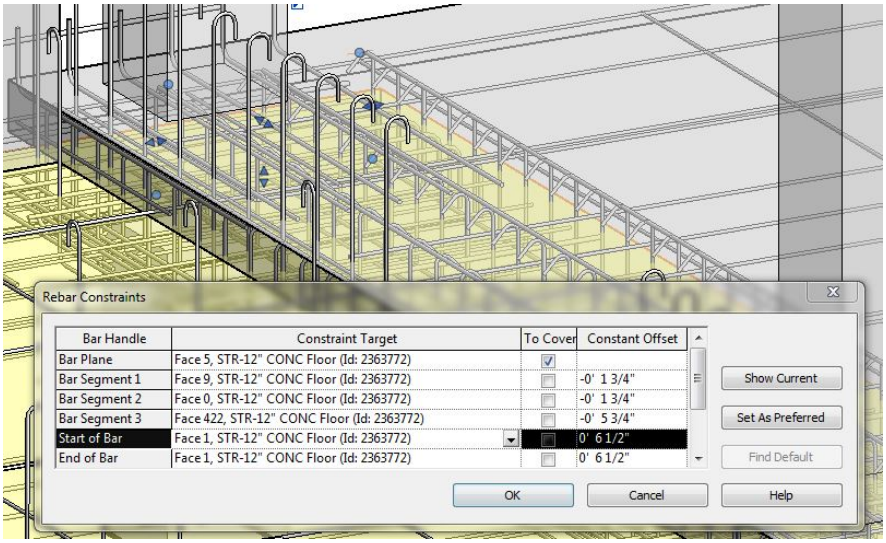


FIGURE 3: REBAR CONSTRAINTS DIALOGUE BOX

Share Your Model! (Or at Least DWG's)

We have found that it is beneficial to both us and the rest of the CIP team when we (our model) become the 'hub' for concrete geometry and coordination of CIP elements and entities. We share our models with the rest of the team, encourage the GC to pull our model into Navisworks MEP coordination, and always offer to send our model (and/or DWG's) to other entities that are also dependent on the concrete geometry.

Coordinate Rebar Delivery Data with Concrete Sub AND Fabricator

Use the Revit rebar model as a tool to communicate rebar delivery, shipping, and staging information. As described in more detail below, we use a 'Delivery' custom parameter that is assigned to rebar in our Revit models. This is the parameter that we use to control bundles or trucks of rebar that can be used for either delivery or site logistics (staging). Our BOM's are created by filtering only bar that has a specific 'delivery' data, and we create PDF BOM's and bar list data for cutting/bending/shipping based on this parameter.

We have had different clients want BOM's and bar data broken out in different ways on different projects. For some projects with plenty of room on the site for material staging, they have wanted bar data in a way that optimizes shipping (roughly 20 tons/truck). On other projects, such as the 17W project, the client wanted bar lists broken out by very specific elements to enable just-in-time material delivery. For instances like this, the 'Delivery' parameter can be used to create a filters (and assign colors to these filters) to create a Delivery data QC views from the Revit rebar model. This makes it clear what bar is being sent with each delivery.

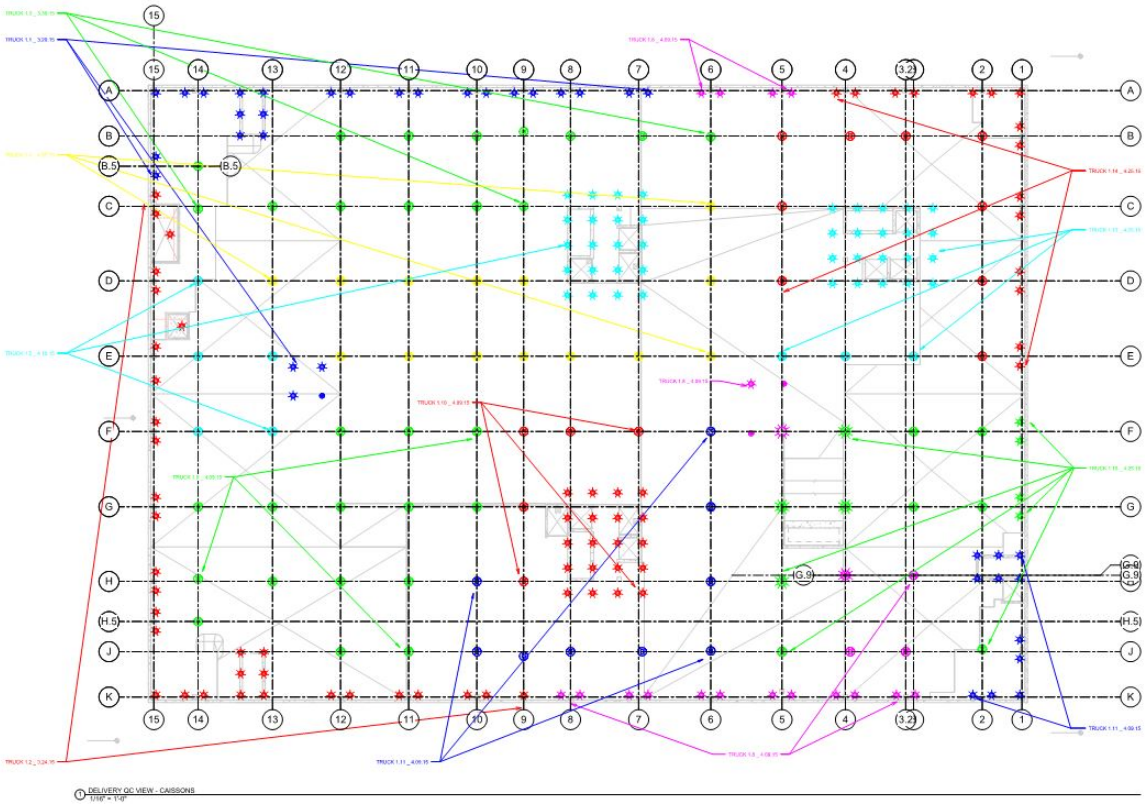


FIGURE 4: CAISSON DELIVERY DATA QC VIEW

Rebar Parameter Management

Purpose of and Goals for Parameters in Rebar Models

When setting up and managing parameters in a large Revit rebar model, it is a good idea to take a step back and think about how to best organize these parameters. The goal should be to use the fewest number of parameters possible, and have those parameters be used across a multitude of tools and processes:

- Sheet / view visibilities / filters
- Bend schedules and bills of material (BOM's)
- Tags
- Assemblies
- QC
- Bar marking and numbering

Parameters Used

We use the following parameters for the following purposes. We try to minimize the number of parameters to keep the system simple for users, but also flexible across our processes:

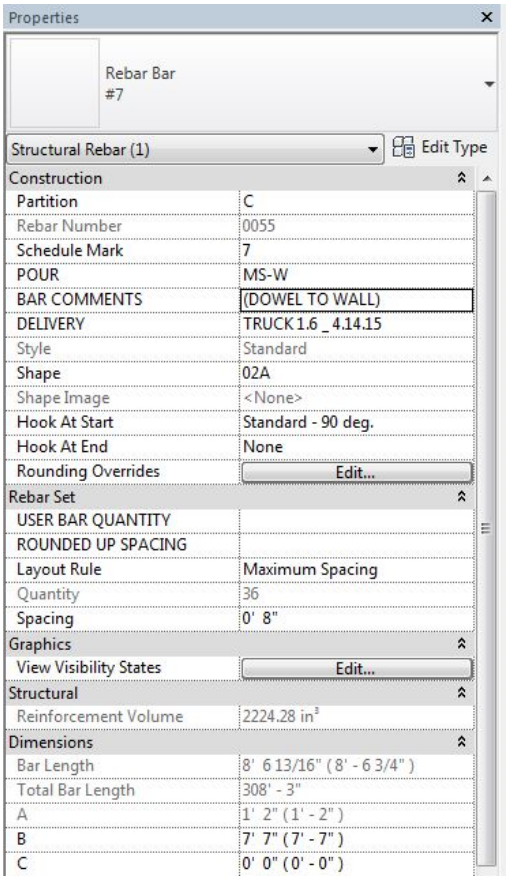


FIGURE 5: REBAR INSTANCE PARAMETERS

Partition:

This is the parameter from which automatic bar numbering in Revit is set. For each partition, Revit will find identical rebar and assign the same rebar number. Therefore, this parameter is extremely important in managing and defining your bar marking and numbering system. Possible uses of the partition parameter are to organize the rebar numbering scheme in your model by construction sequencing and phasing (pours), host element types, location within a host (i.e. top and bottom bar), or location in the model. For 17W and on most jobs, we use the partition to signify the element type from which the rebar is hosted (i.e. caisson, mat slabs, columns, walls, slabs, etc.), and poured as one. This way, a typical 4L0254 slab edge rebar ('candy-cane' bar) at Level 5 has the same bar mark as the identical bar at Level 11, even though they are in different pours. Then our client can steal bars from different deliveries as needed, and their rod-busters are placing consistent bar marks on repetitive jobs. Another thing we do with our partitions is to use an 'S' suffix for straight bar of the same element type, since straight bar doesn't typically have a bar mark. For example, all slab rebar has partition 'L' or 'LS'. This allows us to filter straight bar out of bend schedule, have different tags for straight or bent bar, and use partition filters that use '***contains*** L'. This also helps us to easily QC the partition within the data.

Rebar Number:

As mentioned above, the rebar number is defined automatically per partition. This is really the workhorse in automatic bar numbering, and was a very powerful, game-changing addition to rebar in Revit when it was introduced.

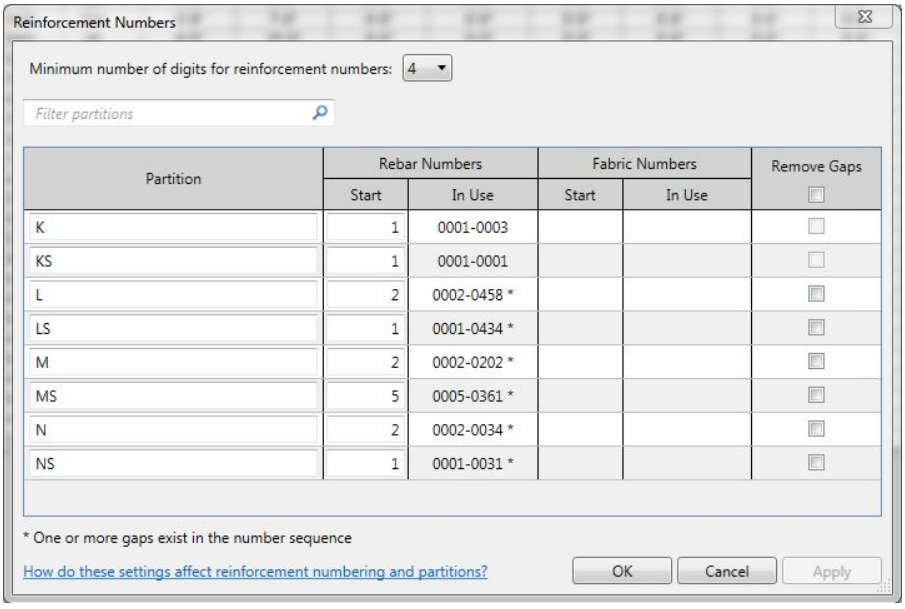


FIGURE 6: PARTITIONS AND REBAR NUMBERS

Pour:

We assign the 'Pour' parameter to all CIP elements, parts, and sometimes views. This is used across rebar bend schedules, BOM's, view filters, and view templates.

Delivery:

As discussed above, this is assigned to rebar and is used in BOM's, view filters, and delivery QC views.

Bar Comments:

This is our 'catch-all' parameter that we use for a whole slew of view filters, tags, and QC applications. We try to use keywords in the bar comments such as 'DOWEL', 'TOP' (or 'T'), E.F., FS, TH, etc. This can be thought of as any extra information that you would like to automatically show up in a live tag, or information that you would like to use to search the model. For example, if you want to find all field bent bar in a model, you can set up a filter for which Bar Comment does not contain 'FIELD BEND', and turn that bar off. This is also used for graphic purposes, such as making all bar that has bar comments = (B) turn dashed on slab rebar plans.

<BAR COMMENTS>					
A	B	C	D	E	F
GRADE	BAR COMMENTS	R	J	O	Est. Tons
60		0'-0"		0'-0"	62.90
60		0'-0"	0'-0"	0'-0"	0.58
60	(2@8'-0") (B)	0'-0"	0'-0"	0'-0"	1.28
75	(ADD'L)(T)	0'-0"	0'-0"	0'-0"	0.45
75	(ADD'L)(T)(CNTR'D ON GRID)	0'-0"	0'-0"	0'-0"	0.13
	(B)	0'-0"	0'-0"	0'-0"	241.51
75	(B) (ADD'L) (CENTER OVER SPA	0'-0"	0'-0"	0'-0"	0.99
60	(B) (ADD)	0'-0"	0'-0"	0'-0"	0.78
75	(B) (CENTER OVER SPAN)	0'-0"	0'-0"	0'-0"	1.43
60	(B) (EA. SLAB)	0'-0"	0'-0"	0'-0"	0.07
60	(B) (FIELD BEND)	0'-0"	0'-0"	0'-0"	0.05
60	(B) (TYP.)	0'-0"	0'-0"	0'-0"	0.69
60	(B) COL. DOWELS	0'-0"	0'-0"	0'-0"	0.13
60	(B)(FIELD BEND)	0'-0"	0'-0"	0'-0"	0.15
60	(B)(POUR JOINT)	0'-0"	0'-0"	0'-0"	0.91
60	(B)(TH)	0'-0"	0'-0"	0'-0"	0.01
60	(BOT MAT)	0'-0"	0'-0"	0'-0"	146.90
60	(COL. BOTT)	0'-0"	0'-0"	0'-0"	34.91
60	(CURB TOP)	0'-0"	0'-0"	0'-0"	0.71
60	(DOWEL E.F.)	0'-0"	0'-5"	0'-0"	0.86
60	(DOWEL TO BEAM)	0'-0"	0'-0"	0'-0"	0.00
60	(DOWEL TO CMU)	0'-0"		0'-0"	3.88
60	(DOWEL TO COLUMN)	0'-0"	0'-0"	0'-0"	0.21
60	(DOWEL TO KNEEWALL)	0'-0"	0'-4"	0'-0"	1.03
60	(DOWEL TO RAMP SLAB)	0'-0"	0'-0"	0'-0"	0.06
60	(DOWEL TO SLAB)	0'-0"	0'-0"	0'-0"	0.02
60	(DOWEL)	0'-0"		0'-0"	0.56
60	(DROP CAP)	0'-0"	0'-0"	0'-0"	0.16
60	(DWL)	0'-0"	0'-0"	0'-0"	7.26
60	(DWL)(B)	0'-0"	0'-0"	0'-0"	2.31
60	(DWL)(T)	0'-0"	0'-0"	0'-0"	2.23
60	(EACH FACE)	0'-0"	0'-0"	0'-0"	3.00
60	(EACH FACE)(HORIZ.)	0'-0"	0'-0"	0'-0"	0.65
60	(EACH FACE)(VERT.)	0'-0"	0'-0"	0'-0"	0.53
60	(HORIZ.)	0'-0"	0'-0"	0'-0"	4.52
60	(I.F.)	0'-0"	0'-0"	0'-0"	0.01
60	(M)	0'-0"	0'-0"	0'-0"	1.01
60	(O.F.)	0'-0"	0'-0"	0'-0"	0.01
60	(SIDE) (E.F.)	0'-0"	0'-0"	0'-0"	0.49
60	(SIDE) (E.F.) (CENTER OVER SPA	0'-0"	0'-0"	0'-0"	0.16
60	(SUPPORT BARS)	0'-0"	0'-0"	0'-0"	30.45
60	(T&B)	0'-0"	0'-0"	0'-0"	0.02
	(T)	0'-0"	0'-0"	0'-0"	187.32
	(T) (ADD'L)	0'-0"	0'-0"	0'-0"	0.76
60	(T) (FIELD BEND)	0'-0"	0'-0"	0'-0"	0.10
60	(T) (TYP.)	0'-0"	0'-0"	0'-0"	0.91
60	(T)(EA. SLAB)	0'-0"	0'-0"	0'-0"	0.05
60	(T)(EACH FACE)	0'-0"	0'-0"	0'-0"	0.04
60	(T)(FIELD BEND)	0'-0"	0'-0"	0'-0"	0.10
60	(T.O.W.)	0'-0"	0'-0"	0'-0"	2.59
60	(TH)	0'-0"	0'-0"	0'-0"	0.05

FIGURE 7: BAR COMMENT EXAMPLES

User Bar Quantity:

This is assigned to rebar and is used as a work-around. We recommend using this as little as possible. Our main use case for this is for column vertical bar. We typically model column vertical bar as a rebar set on each face of the column, but Revit will only automatically report

the rebar quantity for each set. This is how we tell the rebar that is has '**16** - #9 VERT.', with the 16 being the value that is set in the user bar quantity.

Epoxy Coated and GR75 Rebar:

The way we denote epoxy-coated and grade 75 rebar in our models is somewhat of an anomaly. We have different bar types in our model for each of these. For example, we have a '#4' bar and also a '#E4' (epoxy) bar, and we have a '#9' and also a '#9 Gr 75' bar. We do this because it is so critical that they not get mixed up, and by using a different rebar type, this data will always show up in tags, schedules, BOM data, and never have the potential of getting missed. Of course, this also allows us to easily set up filters and QC views that reference this data.

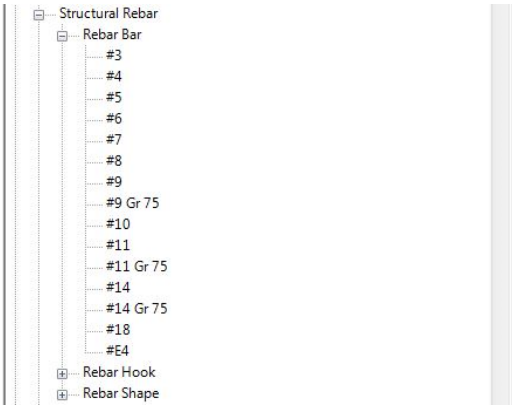


FIGURE 8: REBAR TYPES WITH GR75 AND EPOXY

Use of Parameters Across Model Management

The parameters described above are used across the following tools and processes:

Bar Marking and Numbering:

As described above, automatic bar marking and numbering is accomplished by a combination of the Partition and Rebar Number parameters. Our bar marks are simply a combination of the bar size (which is just a type parameter for each rebar size), partition, and rebar number.

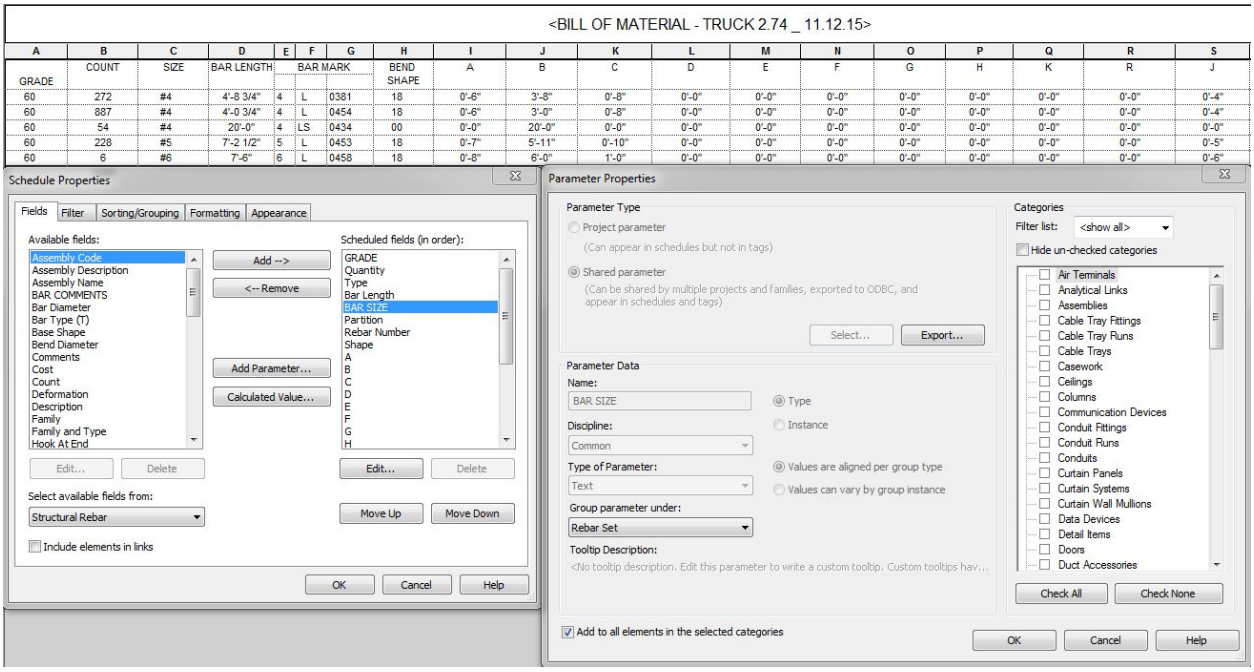


FIGURE 9: BAR MARKING BY PARAMETERS

Sheets / Filters / View Templates and Visibilities:

As described above, the Partition and Pour parameters essentially work together to define what type of element the rebar is hosted by, and when this is poured. This is important for view visibilities and view templates, which are controlled extensively by filters. For example, you usually don't want your rebar shops to show concrete elements that will not be formed at the time of rebar placement. For something like slab rebar shops, you probably won't want to see column rebar, so you can easily use a filter to turn off the partition that contains all column rebar.

Bend Schedules and BOM's:

BOM's are filtered down to only a specific 'Delivery' data input, but bend schedules use a combination of parameters to filter the bar data down to only what we want to see on a specific sheet. We use Partition, Pour, and Grade to filter down our bend schedules to only show the rebar that appears on specific sheets.

Tags:

We have found it best to keep our tagging scheme as simple as possible, and not let users create new tags for any new use case they come across. Our tags only contain bar quantity, 'type name' (bar size), bar length (for straight bar) or bar mark for bent bar, spacing, and bar comments. We do have different tags for where the 'break' is shown in the tag, and for bent bar vs. straight bar.

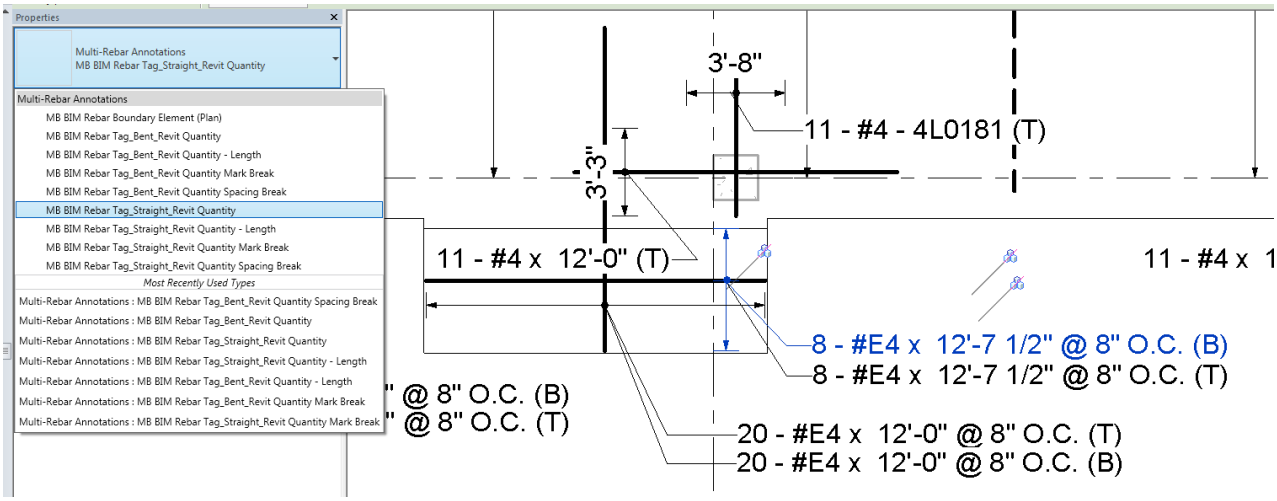


FIGURE 10: REBAR TAG OPTIONS

QC Views and QC Schedules:
The use of the parameters described above in QC view and QC schedules is endless. We use a variety of filters to isolate only certain properties of bar (such as its placement in a slab, its size, grade, etc.), and then often assign color to those filters to make the QC process of a model with tens of thousands of pieces or rebar much more manageable.

Quality Control of Model and Shop Drawings

Creating QC Checklist for Model and Shops for Each Element Type

We have created a QC checklist for each type of CIP element that we use before we send out any shops. In addition to anything that would be typically checked in a 2D rebar shop drawing process, there are Revit-specific items that we check for. For something like columns, we check that the actual number of vertical bars matches the user quantity. For core walls, when bars have two mats of bar we only tag on mat. Therefore, we much check that each mat of bar matches with its sister. Again, using view filters that reference and control rebar data is a great way to handle this.

Create QC Views Using Filters and Colors

We also set up specific rebar QC views in our Revit model that are then used across various projects. These views have filters set up that hide or isolate certain bar characteristics, or assign different color to different bar properties. Examples of QC views are those for:

- Bar size
- Top / Bottom / Bot Mat / CMU Dowels
- IF / OF / EF

For example, the image below is of a slab rebar QC bar. This has different linestyles for the different type of bottom bar (additional vs. standard mat of #4's @ 48" OC), and has colors assigned to the top bars at the columns that represent the support bar, and the matching bottom bars, since these bars are not being tagged in the placing drawings and are only referenced in a typical detail.

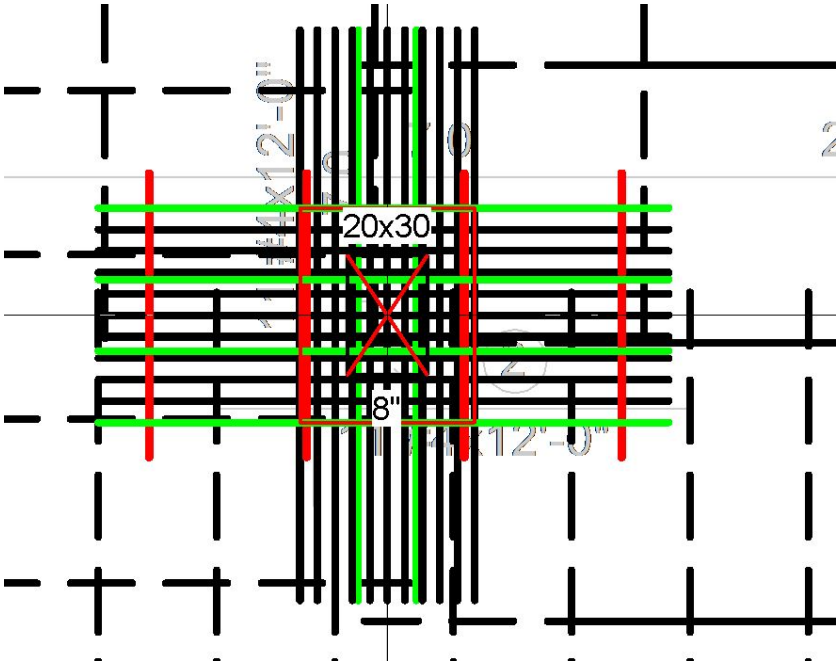


FIGURE 11: SLAB TOP BAR QC VIEW

Delivery Data

Even if your Revit rebar model and shops drawing are 100% correct, a potential problem is that you either miss bar that needs to be send with a bar list, or put bar on a bar list that has already been sent on a previous list. We use the 'Delivery' parameter and a few different filters to avoid these types of problems. Simply by using a 'delivery data exists' and a 'delivery data does not exist' filter and toggling these on and off, you can quickly QC bar that has been sent or needs to be sent.

Isolate Bar Types or Specific Accessories

We commonly use QC views to isolate certain types of bars, and to perform visual QC of those bars. For example, we set up filters that isolate column coupled bar, bars with formsavers, and threaded bar. By isolating these in a view, it is easy to quickly tell if a bar with a formsaver doesn't have a sister threaded bar adjacent to it.

Epoxy-Coated and Grade 75 Bar

Again, big problems arise if bar uncoated bar is shown where it should be epoxy-coated, and Grade 60 bar is used where it should have been Grade 75 bar. We set up QC views that filter by these bar properties so that we can do a quick visual check to make sure bar doesn't have the wrong assignment.

Exporting Data From Revit for Bar Bending and Cutting Software Import

Why to Export and Manage Data

The first job we worked on in which we modeled rebar in Revit, there was a handful of mis-fabricated rebar (and this hasn't happened since). In that project, we sent PDF BOM's to the rebar fabricator, who

then took those bar lists and manually input it into their cutting/bending software input spreadsheets. On that project, we traced the problem back to human (fat-finger) error of data entry by the rebar fabricator's staff. Since that job, we have handled all of the bar data management digitally by exporting data from schedules in Revit, converting the data to the format needed by the cutting/bending software, and handling all of the data for the fabricator. This is preferred by the rebar fabricator because it limits their liability on a project in which they are not detailing the rebar. It is also the method that we prefer, because we take pride in having all of the rebar correct, and want to essentially send the bar directly from our model to the job site.

Revit Export for Soule Import

The rebar cutting/bending software that we are most familiar with is Soule and we aren't aware of any direct links at this point between Revit and Soule. We have done numerous jobs with a rebar fabricator in Denver who uses Soule, and have nailed down an efficient process where we give them direct import data. The process is as follows:

- Get standard input spreadsheet from fabricator
- Set up BOM schedule in Revit that mimics this
- Export CSV from Revit
- Import CSV into Excel – make sure to watch out for anything with potential leading zeros and make sure this is set to 'text'
- Manually convert the data format
    - Use a series of 'find/replace' to replace '- with – (i.e. 4'-0" becomes 4-0"), replace ¼ with .1, replace 0'-0" with (nothing)
    - Combine the rebar size, partition, and automatic bar number into a single bar mark
- Better yet, create a macro that will do the grunt work for you
- Copy/paste values to Soule, 'values only'
- Double-check segment value to ensure they match fabricator standards

<BILL OF MATERIAL - TRUCK 2.33 _ 10.7.15>

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
GRADE	COUNT	SIZE	BAR LENGTH	BAR MARK			BEND SHAPE	A	B	C	D	E	F	G	H	K	R	J	O	Est. Tons
60	8	#4	2'-0"	4	L	0049	D	0'-0"	0'-0"	0'-0"	2'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.01
60	96	#4	4'-6 3/4"	4	L	0179	02A	0'-8"	4'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.15
60	39	#4	6'-6 3/4"	4	L	0181	02A	0'-8"	6'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.09
60	6	#4	7'-6 3/4"	4	L	0428	02A	0'-8"	7'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.02
60	146	#4	10'-0"	4	LS	0002	00	0'-0"	10'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.49
60	202	#4	12'-0"	4	LS	0005	00	0'-0"	12'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.81
60	148	#4	4'-0"	4	LS	0010	00	0'-0"	4'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.20
60	16	#4	6'-0"	4	LS	0014	00	0'-0"	6'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.03
60	173	#4	30'-0"	4	LS	0075	00	0'-0"	30'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	1.73
60	45	#4	11'-0"	4	LS	0092	00	0'-0"	11'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.17
60	286	#4	23'-0"	4	LS	0142	00	0'-0"	23'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	2.20
60	15	#4	7'-0"	4	LS	0318	00	0'-0"	7'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.04
60	16	#5	9'-0"	5	LS	0102	00	0'-0"	9'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.08
60	8	#5	9'-8"	5	LS	0366	00	0'-0"	9'-8"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.04
60	8	#5	10'-10"	5	LS	0368	00	0'-0"	10'-10"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.05
60	80	#6	6'-0"	6	LS	0006	00	0'-0"	6'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.36
60	46	#E4	4'-6 3/4"	4	L	0441	02A	0'-8"	4'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.07
60	6	#E4	4'-10 3/4"	4	L	0442	17A	0'-0"	1'-0"	4'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.01
60	16	#E4	16'-2 1/2"	4	LS	0402	00	0'-0"	16'-2 1/2"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.09
60	3	#E4	4'-0"	4	LS	0403	00	0'-0"	4'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.00
60	6	#E4	11'-7 1/2"	4	LS	0404	00	0'-0"	11'-7 1/2"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.02
60	6	#E4	12'-5 1/2"	4	LS	0405	00	0'-0"	12'-5 1/2"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.02
60	146	#E4	12'-0"	4	LS	0409	00	0'-0"	12'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.59
60	16	#E4	12'-7 1/2"	4	LS	0415	00	0'-0"	12'-7 1/2"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.07
60	16	#E4	17'-2 1/2"	4	LS	0416	00	0'-0"	17'-2 1/2"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0'-0"	0.09
	1553																			7.40

FIGURE 12: BOM IN REVIT SCHEDULE

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1																								
2					ll items under this section are to be copied into Soule under order input----------																			
3																								
4																								
5																								
6	Placing Instructions	Grade	Unit	Qty	Item	Typ	Total	Part	Tot Lgt	Cut Lgt	Mark	Bend	A	B	C	D	E	F	G	H	K	R	J	O
7	**L5 Slab Pour 1**	60			1		8	4	2-0	2-0	4L0049	D				2-0								
8	**7.40 tons**	|			2		96	4	4-6.3	4-6.3	4L0179	02	0-8	4-0										
9		|			3		39	4	6-6.3	6-6.3	4L0181	02	0-8	6-0										
10		|			4		6	4	7-6.3	7-6.3	4L0428	02	0-8	7-0										
11		|			5		146	4	10-0	10-0				10-0										
12		|			6		202	4	12-0	12-0				12-0										
13		|			7		148	4	4-0	4-0				4-0										
14		|			8		16	4	6-0	6-0				6-0										
15		|			9		173	4	30-0	30-0				30-0										
16		|			10		45	4	11-0	11-0				11-0										
17		|			11		286	4	23-0	23-0				23-0										
18		|			12		15	4	7-0	7-0				7-0										
19		|			13		16	5	9-0	9-0				9-0										
20		|			14		8	5	9-8	9-8				9-8										
21		|			15		8	5	10-10	10-10				10-10										
22		|			16		80	6	6-0	6-0				6-0										

FIGURE 13: SAME BOM CONVERTED TO SOULE INPUT SPREADSHEET

Revit Export for aSa Import

Another common rebar bending/cutting software is aSa. They are working with Autodesk to create a link between Revit and their software to automatically send bar data from Revit to aSa without having to create BOM's natively in Revit and then export and convert that data. This link is currently in beta testing, and we have had a chance to get in there and give it a shot. It seems to work pretty well and has the potential to save us the time and potential human error of converting the bar from Revit ourselves. The highlights of this link are as follows:

- This is a tool to select all bar in any view, sheet, or by selection, and automatically create a BOM and data file to export for direct import to aSa software.
- It also has a tool to convert an aSa file to a Soule file. This will allow the aSa tool to be used on a job like 17W in which the rebar fabricator uses Soule.

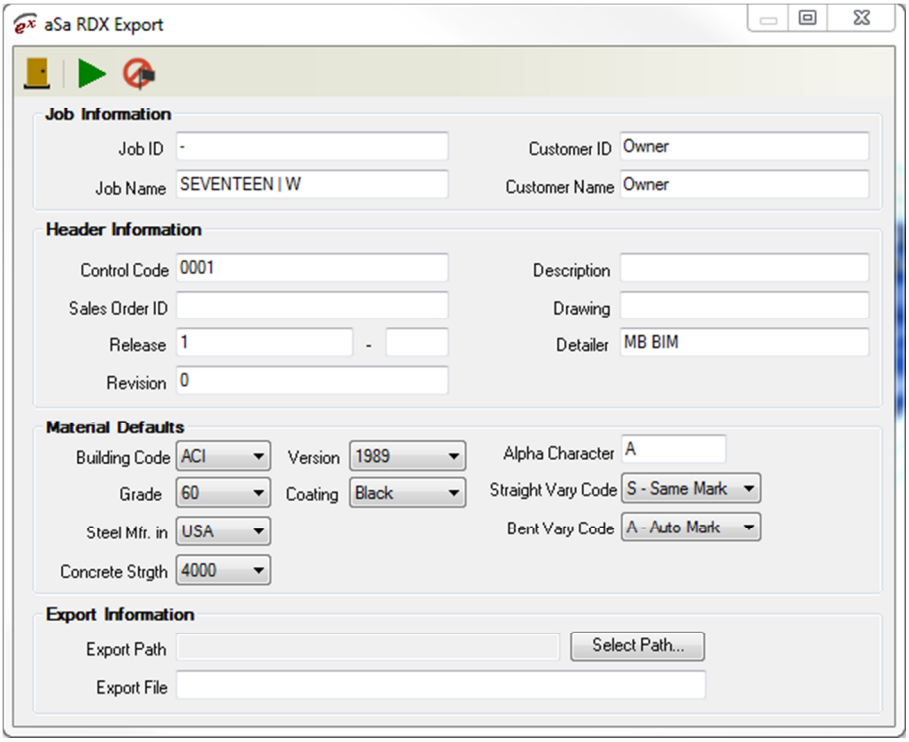


FIGURE 14: ASA RDX EXPORT TOOL IN REVIT

Rebar Modeling and Annotation Efficiencies in Revit

Do You Really Need to Model THAT?

As BIM-nerds, most of us have the tendency to over-model. Unfortunately rebar modeling exposes these tendencies and can very quickly lead to blown rebar modeling and detailing budgets. It is imperative to talk to the installer, and see if there are any elements that they would prefer to just have stock bar shipped and cut in the field. On 17W, examples of these types of cases were SOG, topping slab bar, small concrete curbs, knee walls that jogged and stepped all over, and a uniform mat of #4 bottom slab bar. Also, don't bother starting and stopping bar at small wall and slab openings, this will be field cut and shifted anyway. However, bar in elements such as columns, wall horizontals, grade beams, beams, etc., need to be modeling correctly - especially anything with a hook on its end.

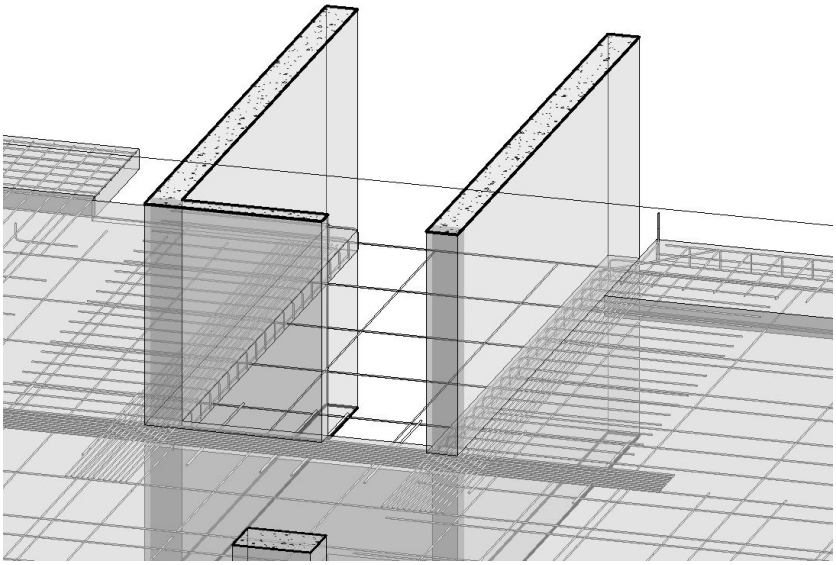


FIGURE 15: BOTTOM MAT REBAR EXTENDING THROUGH SLAB OPENING

Model Groups

At 17W, we used these at tower crane blockouts, beam stirrups at varying-depth beams (to lock these in place so Revit wouldn't auto-correct based on cover), and caissons. This was nice at the caissons because unlike assemblies, Revit would not try to make a new group if everything was the same but it was at a different elevation. We typically ungroup after model is set – you can't select a whole window of rebar and set parameters (such as delivery) when it is in a group. We essentially use groups as a temporary modeling tool.

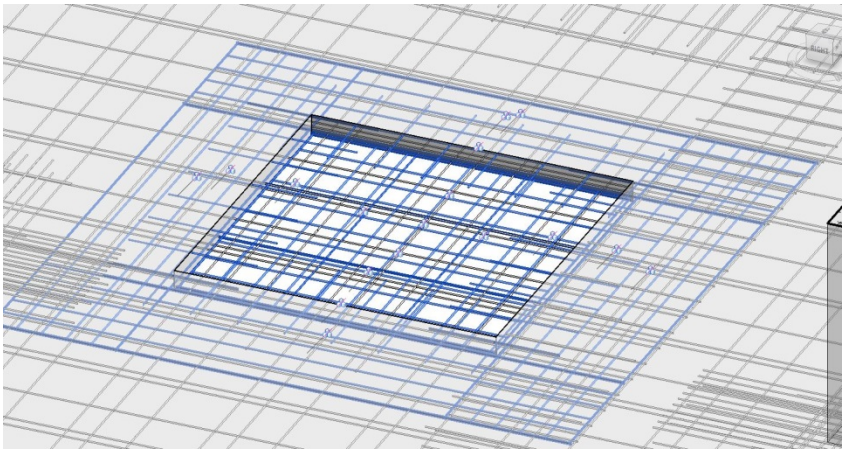
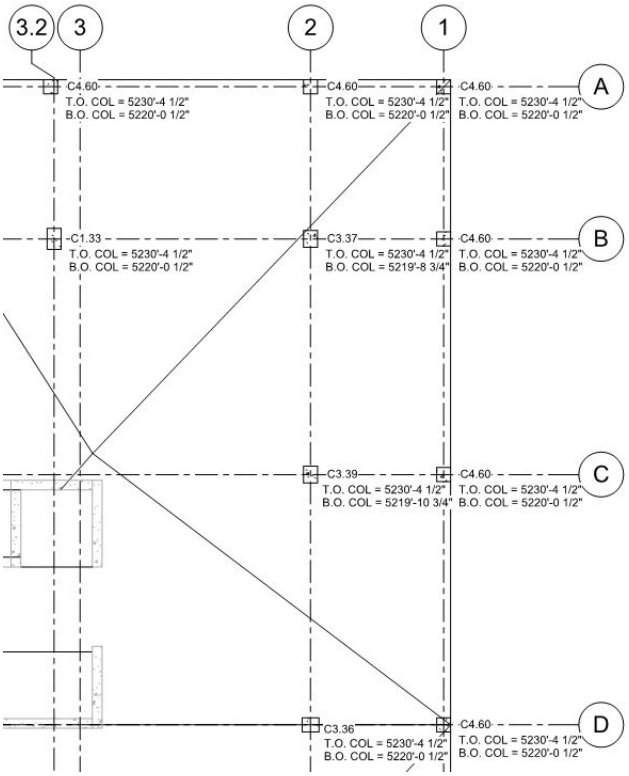


FIGURE 16: TOWER CRANE BLOCKOUT REBAR

Assemblies

Assemblies are a very powerful tool for rebar in Revit. For 17W, the main use case for assemblies was columns. We did not take advantage of automatic view and sheet creation for assemblies because of the style in which the client wanted to see the shops, but in some cases this makes sense. Note that 'Smart Assemblies' is a really cool Revit add-in that automatically creates assembly views and sheets

based on view and sheet templates, and is great for jobs with lots of assemblies and repetition. We used these primarily for copying and repetition in conjunction with scheduling, so that we could easily schedule the rebar with the column. We had to hide quantities in sets (or have a separate schedule for ties), and we had to use 'User Bar Quantity' for columns – this is on the Revit wish-list.



COLUMN REINF. SCHEDULE - SEG 2, LEVEL 03

TIES PER COLUMN	VERTS PER COLUMN	BAR SIZE	BAR MARK	STRAIGHT BAR LENGTH	BAR USE	SPACING
C1.33						
	6	#11 Gr 75	11 G 0434		VERT	
	6	#11 Gr 75	11 G 0435		VERT	
5		#4	4 G 0006		TIES	16"
5		#4	4 G 0011		TIES	16"
5		#4	4 G 0013		TIES	16"
C1.36						
	6	#11 Gr 75	11 G 0398		VERT	
	6	#11 Gr 75	11 G 0419		VERT	
5		#4	4 G 0006		TIES	16"
5		#4	4 G 0011		TIES	16"
5		#4	4 G 0013		TIES	16"
C1C.13						
	6	#11 Gr 75	- - -	9'-9 3/4"	VERT	
	6	#11 Gr 75	11 G 0358		VERT	
8		#4	4 G 0013		TIES	16"
8		#4	4 G 0355		TIES	16"
	6	#10	- - -	9'-0"	DWL	
C2.23						
	4	#10	- - -	9'-8"	VERT	
	4	#10	10 G 0420		VERT	
7		#3	3 G 0005		TIES	20"
7		#3	3 G 0037		TIES	20"
	6	#9	- - -	8'-0"	DWL	
C2B.5						
	10	#10	- - -	9'-4"	VERT	
	2	#10	10 G 0302		VERT	
6		#3	3 G 0369		TIES	20"
6		#3	3 G 0370		TIES	20"
6		#3	3 G 0459		TIES	20"
	7	#9	- - -	8'-0"	DWL	
C3.36						
	6	#10	10 G 0302		VERT	
7		#3	3 G 0005		TIES	20"
7		#3	3 G 0037		TIES	20"
C3.37						
	6	#10	10 G 0303		VERT	
7		#3	3 G 0005		TIES	20"
7		#3	3 G 0037		TIES	20"
C3.39						
	6	#10	10 G 0107		VERT	
7		#3	3 G 0005		TIES	20"
7		#3	3 G 0037		TIES	20"
C4.60						
	4	#9	9 G 0297		VERT	
7		#3	3 G 0004		TIES	18"

FIGURE 17: COLUMN ASSEMBLY SCHEDULE

Create One Schedule, BOM, View Template, and Re-Use

Think through this first, make sure you have come up with your parameter organization and uses, and set this up correctly the first time. You don't want to have to change something in 50 different schedules. Think about using a Dynamo routine to automate the duplicating and editing of these.

Use a Simple Tagging Scheme

Make use of multi-rebar annotation. Set up a simple scheme in which the user only has a few choices, but it handles all situations. Don't tag element that are the same over and over, like bottom bar at columns and slab top bar supports at columns that can be handled with a plan note or typical detail.

Use Drafting Views and Legends Instead of Live Sections

Call out all rebar in plans and elevations, use drafting view and sections with general information that shows things like cover, corner conditions, etc. Use drafting views when you need to cut sections on plan (and duplicate these views when needed on numerous sheets, and use legends when it is a typical detail (so you can use on multiple sheets).

Create Detail Group Templates to Help with Column Top Bar Placement
We had numerous different column sizes and different slab thicknesses, and these dimensions determined the column strip extent for the column top bar. We used detail groups that were laid out based on the different conditions, then placed these over the columns and stretched or shrank the bar extents to snap to these lines.

Mirror/Copy and Re-Locate Project Tools for Mirrored Geometry
We were able to mirror all slab bar (and annotation!) from one Tower to the other with very little re-work and cleanup. For a use case like slab, where most everything is shown in a single plan view, mirroring within the same model works very well. For walls and columns, this was a bit trickier because of all of the various elevations views and tags that needed to be mirrored for the walls. For this scenario, we decided to make a copy of the walls/columns model, mirror the entire project (under 'Position – Mirror Project'), and then rename grids. By doing this, all of our views, annotation, and even sheets were already set up for us!

Add-Ins for Modeling and Detailing Efficiencies
We use a few tools in SOFiSTiK's rebar add-in. We don't really use their full suite, as it seems a bit more geared towards European standards and markets. However, there are some great tools we do use such as the automatic splicing tool and the split sets tool.

Autodesk Revit Rebar Extensions
We use this as a tool to model the rebar in the first column, caisson, pier cap (and sometimes mat slab) in a Revit rebar model. It is a good tool for a starting point, but after the first one is modeled, it is more efficient to copy the rebar cage to a similar element and modify it from there.

