DAN MCCLOSKEY: I'm Dan McCloskey. This is Erich Bretz, and today we're going to talk to you guys about creating shop drawings for structural elements within Revit. So hopefully you've read this, but we're going to cover four different sort of sections. And so we're not going to get into the high level of detail about here's how you put rebar in a beam, that kind of thing. But hopefully we'll give you an idea how to do it for each of these four structural elements.

So first we're going to talk about-- one thing we're going to talk about is rebar. Another one is concrete lift drawings. We're also going to talk about precast concrete. And we'll also talk about structural steel and miscellaneous metals.

So first I want to give you a quick background of who we are, and how this came about essentially, but Eric and I, we're from Denver. We used to work for a-- we're on the design side, structural engineers. And the firm that we worked for started offering rebar modeling and shop drawings. In 2010, Eric and I were kind of tasked with leading that transition. One of our competitors at the time had started to offer those services, and so the firm we were with also offered those services.

Eric and I led a team to do that. And it went really well. And we kind of realized hey, there's an opportunity here to kind of take structural engineering, structural design a little bit further, and use the models to take that into fabrication so we started our own company in 2011. And after that branched out into pre-cast concrete, concrete lift drawings, structural steel, amongst other things.

We also do some Navisworks coordinations, virtual mock-up, stuff like that. Really our clients are general contractors and specialty subcontractors at this point. A big thing we do is concrete lift drawings. We're going to talk about that today. We also do some sort of front end work, some sequence animations, and model based estimating, that kind of stuff.

So before we talk about the how, we Wanted to talk about that the who, what, when, and the why is also changing on the structural side. Really what's happening is that EORs, at least in Denver, and it's kind of happening across the country are a little bit too, I think. But in Denver, EOR is just starting to offer shop drawings for the elements that they design. And the big pro to that is to prevent the drop off in data and knowledge from the design team into fabrication and then the construction. Design team knows it best. So to kind of carry that into fabrication and construction really makes sense.

And what that does is that enhances the quality of the final product at the end of the day. And the reason that's been able to happen is mostly because the BIM tools. So structural engineers have been given a set of tools, with Revit getting better, and becoming a true rebar detailing software. Autodesk buying advanced steel and putting that in their package. Other tools for pre-cast, and we'll talk about today too. But all of a sudden, structural engineers have these tools to be able to take their designs and push it further into fabrication and then into construction.

And what that means, though, is that the sort of typical design build is really changing. There's pros and cons to that. The pros are-- there's a lot of pros, but at the end of the day it's about the process, it's more collaborative, it's more communicative. Design and construction are sort of being linked as well as fabrication. And it's really a better process.

But the cons is there is a pretty significant change in risk structure for a lot of this. And that's something to think about. And really some people may disagree, but construction still is somewhat of a slow moving machine. So trying to get a process to change and kind of get mentalities to change is sometimes a little bit difficult, and takes some communication.

Who realizes the benefits? It's different between the different entities. For design teams, if you're structurally EOR, and you're offering detailing services, the advantages is A, you set yourself apart from competitors. But then you are kind of ensuring that your design intent makes it into fabrication and makes it in the construction, kind of opens up the dialogue between the design team and the construction team. It kind of makes them act as one.

For the fabricators and the specialty subs, it kind of gets them a seat at the table. We work for a pre-caster, and when we're modeling for them, they're able to kind of get in the game with the design team and say, hey, we've got a Revit model to share, we'd be involved in these decisions and these coordination meetings and that kind of thing. So it kind of helps the fabricators and the specialty subs get their efficiencies incorporated early.

For the GCs, it gets the whole team kind of acting together and kind of prevents. There's less [? RFI's, ?] there's better communication. There's less drop off of knowledge and data and information. And then, for owners, at the end of the day it's scheduled, it's a better quality product, and hopefully less change orders and less problems in the field.

So concrete lift drawings. What concrete lift drawings are is a set of drawings that a concrete subcontractor or GC that self performs concrete work creates to essentially define every edge of concrete that they're going to pour, and then typically include all of the embeds in that as well. People have been doing this for a long time. But bigger GCs or more sophisticated and subcontractors are starting to do it in Revit. And they're starting to use models and then communication with design teams models to do that, or they hire some of them like us to do it for them.

The benefits of that's really the end of the game or the end of the day, the main benefit is field labor productivity. How do you get the field crew working faster and better, and have them not picking through structural drawings and architectural drawings and trying to figure out issues kind of on the fly. Field labor visualization. It sounds a little bit silly, but just 3-D views of every pore that we give them, that gets you so much by our clients. And their field crews really love to see the complicated stuff.

Sharing a model. So we take our model. And we send it to the GCs And they use that for Navisworks coordination. We will spit out DWGs if needed. So our model becomes kind of the hub for concrete. We send stuff to the rebar fabricator to detail their bar. We send stuff to the former guys. Really we're controlling the concrete geometry. And that's our model is kind of the hub for concrete.

Enhanced coordination. That's a big thing, is kind of figuring it out via the model rather than in the field. So we're taking the structural and architectural models and or drawings, MEP models, we'll pull them all into one place, all the subcontractors models that have embeds, or their shops, and pulling it into one place. Again, the concrete model and having that control everything.

Quantity management. What I'm talking about here is really pretty simple. It's cubic yards of concrete. But it's also embed counts as well for all the different subs, the other specialty subs whose embeds we need to coordinate with the concrete. And then schedule management. We put data in the concrete, and it kind of ties our model to their construction schedule. And that's helpful to our clients.

So as far as how to model in Revit to create concrete lift drawings, it's not rocket science. If you're an intermediate Revit user, you probably know the tools. The only specific tools are really parts. But it's really what you model that's a little bit different. So this is a model we did for a client. It's pretty simple. It's just foundation walls as far as the scope. There's not much to it. But the reason they hired us for this one was really architectural and structural coordination.

The big thing here is the brick ledges, slab poured down these little stems and curbs that were quite complicated, and there's some complex curving and stuff like that. But just these little elements that they knew weren't coordinated. So what we do is we start with the structural model. Fortunately we had a good structural model on this one. It gave us a good starting point.

But even with the good structural model, there is a lot of stuff that's not figured out. There's stuff that's not modeled to the level of detail you need, or figured out with architecture. So you can see there the architect had assumed some little wraps for some brick conditions for some kind of pillar type things. Bottoms of walls are wrong. And I think we changed that for some constructability issues that didn't work.

Here there's some blackouts for these beams that ran through. Stuff that a structural engineer, no offense to them, I didn't include it when I was a structural engineer either, but just the level of detail isn't quite as high as what you need for a construction model. But it's a good starting point, essentially.

The next thing when talking about here's what you kind of-- how you break things up. You have to break it up per the actual construction sequence. What you see there is a starter wall, so the structural engineer didn't know that was going to happen, but we break up our model per pore, essentially.

This job's a little bit different, where a client hired us to do the lift drawings on this one, really for the sake of embed coordination. So on this one we modeled the embeds for the stairs, the elevators. It was a steel frame building with pre-cast skin. Some spandrels and stuff at the bottom you see in a second. But there is just a ton of embers in this.

And really on this job we had a high level of detail concrete model-- I just turn it off the 3D grids here-- with a high level of detail concrete model, but it was really the embeds is kind of what drove our client to hire us for this.

And here you can see this is the embeds that we got from the steel fabricators model. We brought it in through IFC. And it's great. We'll take it any time we can. But when we got them, they'd come in as generic model elements. We wanted to assign more data to them. They weren't cutting and hosting to their walls the way we'd like. So we did remodel those embeds, and put our data in, but we use theirs as a background.

And here what you can see, we had a 3-D GWG from the pre-caster. I'm also turning on the steel fabricators model that was brought in through IFC. But what we essentially did here is we kept everybody's models. We got new models all the time. But we were also coordinating that with their shop drawings.

So as some of you on the construction side may know, what you get in models from subs isn't always what you get in their shop drawings. So that was something we had to really pay attention to. And we were essentially modeling of their shop drawings, because that's what controlled. But then QCing off their model is the way we handled that.

So there's just a ton of embeds here. There's steel framing embeds that you can see. We were looking at the pre-cast embeds a second ago. But on this job it essentially comes down to us being the end coordinators for this one. There was some complex geometry, as well. Again, it's these kind of stem wall brick ledge type conditions that are never really totally figured out between architecture and structure.

And speaking of that, this next one I want to show you, when our client gave us a set of drawings and said, hey, we want you to do lift drawings for this one, we looked at it like and were like, hey, it's really just stem walls and spread footings, really no big deal. And then, once we got into it and studied the architectural and structural drawings, we realized why they had us do it.

The geometry is extremely complex as far as all of the pore downs and ledges and stems. And this is a really good example of a set of drawings that looks coordinated between structure and architecture. And so you get into it and realize, holy cow, there's a lot of work that needs to be done here.

What I'm showing now is during construction the design team moved a grid and shifted a wing of the building, and our client had already poured concrete, had already fabricated a bunch of rebar. And the owner said hey, no big deal. We just shifted this little bit. It's not a big add or whatever. And our client said whoa, we've poured some of this. We have the reap some out. We've got to re fabricate some rebar.

And they were having a hard time convincing the owner. So we just took an archive model that we had from before the change, showed them after the change. And we pulled it up in Navisworks for them. And it just-- apparently that's what did it for the client to see holy cow, OK, I get it. That's the change.

So that's modeling. The other big side of lift drawing to think about is annotation. And really the goal of annotating lift drawings is to put all the information for one pore on one sheet, so that the concrete's doesn't have to look anywhere else for any information they need for this pore.

So we color code MEP penetrations. We put in concrete mixed design data. And really the key, though, is taking all of the information from the difference subs, meaning the-- in here you can see we're just got a schedule, where we're counting embeds. And those embed marks do match what's in the steel shops. So we've got the embeds from the steel shops, the embeds from stair shops, it's two different entities in this job. Embeds for the elevator guys. And then we're just referencing everything.

So if you're the guys in the field-- and then really we dimension the crap out of everything. We put spot elevations everywhere. And when we do it, we do it in a way that you want to think about how the guys in the field want to weigh out tape. And so you want to give them every dimension from grid line, from concrete edges, from inside face to outside face, and really everywhere that you can imagine that they might need to measure to or from you want to give them that dimension.

So our client just-- this is a big change for them, and they love having drawings with a ton of information, that makes it really easy for these guys. So this is a job. We're just looking at the stem wall job. This is about as cluttered as a sheet comes. But this is just one pore here. But you can kind of imagine, if you can see how much information is on the sheets, if you were in their shoes and doing this the old way with structural drawings, architectural drawings, anchor bolt drawings, all these different drawings from these different entities and trying to figure this out, it would be-- you'd have a heck of a time trying to build that as efficiently as having this set of drawings.

So we show sections of everything. We elevate every wall. Here we quantified block outs. They had a carpenter off to the corner on the site just building blackouts all day. So they'd take our drawings and know what they need to build for that day or for that pore.

And so here's our typical cover sheet. We just try to quantify data. Again that's just cubic yards of concrete. Any information they need for kind of an overall project viewpoint, we put on this cover sheet. And our clients-- this client in particular-- always puts this drawing's always full size in the job trailer. They use it all the time to talk about it.

On a job, this job in particular, we've got three different colors because there's three different crews. So we color the pores per crew. We show the progression with that. We put some data in there of what crews pouring it when, and then there is actual data that tied to the rebar delivery. That was that last piece of the data there.

Here's another example of us doing that. In this job our client just asked us to tie it to their actual scheduled data and [? naming ?] so we just used Excel, an Excel link, I believe, to push some data in and from their scheduling software. But they used this for planning purposes and just to kind of see the progression. And to us it seems pretty surface, I guess, but for our clients they really appreciate that cover sheet.

The last thing I want to talk about is point data. So that's kind of the next way that we've pushed with lift drawing's, is we use Autodesk Point Layout. And so we very easily put points into our lift drawing models, and we've had some trouble getting traction from our clients. We've got some sort of using it. But we're sending him point data, just the XYZ. I don't know if anyone's used Autodesk Point Layout, but it's very easy in Revit. And it ties directly to the field equipment, the total stations. And they can layout or QC based on the points from our model, which in my mind is awesome and should be used a lot more.

So next on to rebar. So the advantages-- if you're a structural engineer and you're offering or wanting to offer rebar shop drawing services, the huge advantage you can offer schedule. You can offer pre-approved rebars shops where, when you issue issue your CDs, you can be issuing your shop drawings at the same time.

So really what that does is that can cut out about a six week chunk of your schedule versus having to issue CDs that goes to the rebar fabricator. They detail the bar, they create the shop drawings, send it back to the EOR, they review it. You guys know the process, but that's about a six week savings. So if you're the EOR, you could say, hey, we can give you shop drawings that are ready to go approved when we give you CDs. And that's a huge, huge advantage.

For us, being outside consultants, the big savings that we see is material savings. I can talk for about an hour on why. But we see about a 10% to 15% savings in tonnage when we model bar and our clients buy it on a unit cost basis, versus going to a fabricator and getting a lump sum price for rebar.

We've got data to prove it. I can talk to you afterwards about it. But that's a huge, huge savings that we're kind of seeing over and over. Better shop [? seekers ?] easier installation. Again, it's about keeping that field crew moving, no slowdowns, efficient. And when you are doing it in Revit-- when you're doing rebar shops in Revit-- you can do things a lot better, in my opinion, than 2D CAD, and show things in ways that's going to help the guys in the field that are actually using the placing drawings.

Enhanced coordination. We send our models to the GCs. They use it Navisworks coordination. Recently we had a job where, on the core walls, there is a ton of jam reinforcing at the corners. And they pulled at in Navisworks and realized that fire protection had sleeves at every level going through that jam reinforcement. And that was a huge like, oh, wow, good thing we saw this now and had a rebar model, or else nobody would have caught that.

But just using the model to figure that stuff out and looking for areas of high congestion, and saying hey, do we really need to hook every bar here? Can we maybe hook every other bar? Kind of looking for stuff that's going to be field issues that you can see when you're modeling bar, instead of doing it the old way.

So if you're the EOR, the first question you're going to have is do I use my design model and add the rebar to it, or do I use two separate models? We prefer, we advocate for using two separate models. And there's pros and cons to both. I guess the pros are lighter models. Rebar models can get kind of heavy. That job they're is tough to see, but this job had about 2000 tons of rebar that we modeled and Revit. And so that's tens of thousands of sticks of bar. So they can get kind of heavy.

The other pro to having separate models is that your design team can't screw up your rebar, essentially. Someone may tweak a wall or move something, and rebar grows and shifts and tries to be smart in Revit, and that's kind of a QC nightmare. The cons of having two separate models is duplication of work. If the engineer wants to change the beam size or something, you're going to have to do it in two different models, and there's the risk of that not being coordinated.

But regardless of what you do, starting with the design teams the model, is very important from a Rebar Model. You've got a lot figured out already. Take it. Go with it. Don't reinvent the wheel. There's probably more information in the model. In some cases, that might be in your drawings. So use that model

Multiple rebar models, what you're seeing here in this image, the colors really fade out. But what you're seeing is we had four different models for this.

I'd recommend it, again, for file size, and then also for sort of a QC. We had a foundation model where we didn't want to be changing some stuff with some walls and have some foundation bar that we had kind of locked down moved, because bars kind of move on their own in Revit sometimes.

So again, I'm not going to get into like the nitty gritty of here's how you put bar into beams, but we've taught previous classes here on that kind of stuff. So if you want more information, look us up. You'll we'll find some more info. But what I want to talk about today parameters in a Rebar Model. In my opinion, that's one of the most important parts of setting up a Rebar Model in Revit, is how to organize your parameters.

So we'll talk about each of these individually, but when you're getting into Rebar Modeling in Revit, think about what you want to do with this model. Think about how you're going to set up your visibilities and your filters, what you're going to do with your Bend Schedules, your bills of materials, tagging bar, your QC process, and set up your parameters to help you accomplish those goals.

So the first two parameters are really the workhorse of rebar and Revit. And these came about in 2015, and Revit 2015. And really this is what turned Revit into kind of a hack with Rebar Modeling and detailing to a true Rebar Modelin Software. And so the first parameter is partition. And so what that is when you assign a bar to any partition, let's say yo're using letters, we'll call it A, B, C, so on. When you assign a bar to partition A, when you model a four foot long number 6 bar with a standard hook, then it's going to give it bar number 001, let's say.

The next four footlong number 6 bar that you model with the standard hook, it's also going to recognize that and give it that same bar number. So you stretch one of those instances to an eight foot long bar. That's now bar 002. So It's the workhorse of automatically numbering bar in Revit. And it's a really, really key tool.

You can kind of split up your parameters in ways that make sense for your workflow, whether it's by level. We use it by element type so that, you know, caissons are A, peer caps are B, foundation walls are C, so on. So when a bar comes out to site and it's tagged, the installers know, they learn what those marks are. And when they see a type K bar, they know that's column bar, when they see a type O, they know it's slab bar. So that's how we use our parameter system.

Next one is pores. So we assign pores not only to rebar, but all cast in place. We assign to views. We assign it pretty much to everything, and we use pore heavily to turn bar and elements on and off and to change visibilities. Let's talk about that a little bit more in a second.

But the next parameter is delivery. So this is really our kind of building material controlling parameter. So the delivery, if that parameter has not been assigned in our model, we have not yet created a bill of material for it. Once it is assigned, it's given a truck number, a date, or whatever, and then we have different views, QC views, to know this bar has been sent to site, this bar hasn't.

For instance, like with a big deja vu, we were just looking at the caisson, there are like 20 different deliveries for that. So we could color code those based on that parameter, and our client knew which bar went to which delivery, essentially.

Bar comments is our catch all parameter. We talked about it when we talked about tags. But but this is kind of our parameter that we add inside face or outside face, or form saver, or CM [? Tao, ?] or-- there's a whole list of them there. But really it's our catchall parameter that we use for a ton of different filtering and QC processes.

User bar quantity is kind of an odd one that I wanted to mention. When you model, let's say, a circular column, if you want 16 bars in there in Revit by itself right now, there's not a great way to put in bars, and for it to know there's 16 of them. It's different if you have a wall and you could say, I want 16 along this line or whatever. But so we use user bar quantities for any-- it's really for caissons and columns when we have to sort of manually override a quantity that we want to tag.

Epoxy coated and GR75. I want to mention this one because it's an anomaly, where instead of using a parameter we actually use bar of different type. And because, in my opinion, if this one gets screwed up, you've got big problems, in general, especially the GR75. So we actually make a different type of bar so that no one can mess up that parameter, and it automatically comes through on all schedules, on all tags, on everything you're always seeing if it's a Epoxy or if it's GR75.

So I talked about partitions and bar numbering. And when you combine those, you can kind of see it's a little bit small. But if you see our bar mark, what our bar mark is it's just the bar size, the partition and the automatic bar number. So based on that partition, based on that, that's all the data that goes into our bar mark. And then that gets used in tags, in the bills of materials, in the Bend Schedules, and so on. But like I said, it's very powerful, and that's really what made Revit a true rebar [INAUDIBLE] piece of software.

Sheets, Filters, View Templates. So we use a combination of the different parameters, whether it's pore, or there are bar comments, or if you're on a slab plan and you want your bottom bar to show up dashed, you know. If bar comments contains B or bottom, show it dashed. If you want to-- on a Bend Schedule, if you want to turn off all bar except what's shown in that pore, pore has to equal this. Or if you want to turn off on a slab plant or column bar, if partition contains K, turn it off. So really using those to kind of change the visibilities, and turn bar on and off and make bar look different in different views.

Bend schedules and bills of materials. Bills materials, delivery equals whatever. That's what kind of drives that. And then tags. People can get carried away with tags and parameters in Revit. And that's why I wanted to go through parameters. It's easy to add more and more parameters and make your rebars system more and more complex. But I'd highly recommend just keeping it simple, keeping the amount of parameters you have to a minimum and having your tags to a minimum, and putting not as much parameters, and not get too carried away with your tags.

So we use the typical information that you would need in a bar, and then we use bar comments to add that extra bit of information that you want to come in to a tag. QC

Views and QC schedules. Again, you know, I've talked about delivery QC. But if I want to look at a slab plan and just look at top bars over columns, I can turn off all bar except bar comments contains uppercase T or whatever it is. On our QC process, we heavily used our parameters to look at certain bar and make sure it's there. If I wan to check all see CM [? udall's ?] or whatever it is, we're using that bar comments parameter.

Next. So there's kind of two different philosophies, at least for a couple of engineering firms in Denver that offer this service, of whether to send bill of material data to the fabricator in PDF form, or to send them actual data. There's pros and cons. The ones that want to send them in PDF want to say hey, this is lockdowns PDF, wash my hands off this. I send you this and then it's not my problem.

But the way we'd like to do is we'd like to send actual data, and the reason for that is is because you get much less resistance from fabricators, because they don't want to-- sometimes they may not like this process. But if you send them actual data, you're turning them into a commodity. You're saying hey, all you have to do is feed this in, and then you bend, cut, ship bar, and that's it.

So what you can see here is a Revit schedule, and then we just export that out, run a macro and convert it to Soule. one of the big fabricators in Denver uses Soule, a cutting and bending software. And so we send them to this Excel file on the bottom. It's in their format. They literally don't have to do anything except send put it into their system. So that's Soule.

aSa is the other big cutting and bending software and material management for a rebar fabricator. They've actually developed a plug-in for Revit. And we've used it, and it works really well. And that's kind of the next step, is taking that data directly from Revit into fabrication. And aSa has made that pretty seamless.

So real quickly, I'm not going to talk about the nitty gritty of modeling, but I do want to talk about assemblies. We used to use model groups a bit. We don't really use those anymore. But assemblies is pretty key in rebar. And when you think about assemblies in Revit, you think about automattic sheet creation and view creation. We don't really use that, being US based rebar modelers, we don't really use those tools for assemblies. But we do use them to schedule things.

So like, for a column, for example, our installers or the installers we work with just want to see tables with data. So one model bar [? in a ?] column wrap it up in assembly. Then the great part is you get to copy it all over the place and quantify it, and you get to have everything wrapped up. And so we do that for columns, caissons, and sometimes for grade beams we use assemblies. Erich's going to talk a bit about assemblies in terms of pre-cast and steel. It's quite a bit different how we used it there.

Lastly, I want to talk about the new tools in 2017. One is reinforcement connectors. So they added couplers and form savers. They're pretty slick. They attached a bar. They know a shortened bar, kind of a cool little tool. Honestly we haven't used it yet on a real job, but it's a cool tool. Variable Rebar Distribution for like a tapered beam. That is a really useful tool.

Previously, for those stirrups we'd have to manually increase the size of the stirrup as the beam depth goes. Now sets will automatically do that.

Lastly, the Rebar Constraints Enhancements. Working with rebar and Revit was previously somewhat difficult as far as constraints. You know, a bar want to snap to the corner of a stirrup or face of concrete, and you didn't always know what it was using. And so Revit kind of change the interface where you can now see what's constraining that bar, the distance from that face that's constraining it, and then you can graphically edit it. So that's a big, big enhancement, from my perspective, because it kind of helps with the actual bar modeling.

ERICH BRETZ: All right, guys, so I'm going to talk about pre-cast concrete shop drawings and steel shop drawings. Before we go too far, like Dan mentioned a second ago, the whole key to the process for both of those shop drawings is the use of assemblies. Structural steel and precast are a little different than rebar and concrete line drawings in that both of those require piece drawings.

And whenever you think of piece drawings, I assume that most of you know what piece drawings actually are, we're talking about an individual view of a beam, for example. And it shows all the cuts and the plates and the bills or material that are required for that beam. Rebar is different in that when we send data to the fabricator, the fabricator really just needs a picture of the bend diagram, and then the data that goes along with that that tells them how long each bend is for that piece.

And concrete. When we define edges, frankly, the edges give the guys in the field enough information to be able to build that piece of concrete. So pre-cast and steel are a little different in that we need actual piece drawings. So like I said, it's like [? to ?] [? go, ?] whenever you think of piece strings, think of assemblies.

Another word that you'll hear a lot is main parts when you talk about structural steel. And then in pre-cast concrete sometimes they're called shop tickets. Really all of them mean the exact same thing. It's just a piece drawing, main part, shop ticket.

As far as structural steel goes, really, really for all of these structural materials that we're talking about, the main thing that we're really taking a shot at is the lead time. It's-- I don't know of a project that I've worked on where the structure hasn't been on the critical path. You know, when you think about it, as soon as the structure is built, and you have a platform that others can work on, you get things closed in, it unlocks a ton of other work that other subs can kind of come in and start doing their work on. So what we're trying to do is we're just trying to reduce that long lead time that comes along with all these materials.

Now, all that being said, structural steel is really a very complex and difficult thing for a non detailer to sort of pick up and learn how to detail. So our recommendation, frankly, isn't to-- is not to use Revit to do standard structural steel shop drawings. It really just isn't the right tool for the job. But there are some special situations in which I think that Revit can be used appropriately.

However, that being said, the models that you guys are building in Revit are totally very useful, with Autodesk's acquisition of Advance Steel, and improved links between Revit and Advance Steel, and then even further the new connection modules that were added in Revit 2017, all those things go from your Revit models directly into Advance Steel, and they are very usable. The interface is great. And there's substantial value to that, for both you and the fabricator.

That functionality actually allows you around the model, so you can get something back from a fabricator that's using Adavanced Steel too. So there's a ton of value there, even if you're not actually preparing steel shop drawings in Revit.

So that brings us to the detriments, really, of-- really the purpose here is to explain why Revit isn't actually the correct tool to be doing steel shop drawings. The biggest one is the automation of tasks. The creation of single part files, main parts, you know, the actual piece drawings, the automatic dimensioning of every little cut, every explicit dimension that needs to be applied to it. Those sorts of things aren't possible in Revit, but they are possible and very easy to do in actual steel fabrication software.

The next is no CNC output. Sophisticated fabricators nowadays aren't, frankly, using a lot of shop drawings. And so they were just taking CNC data, feeding and into their machinery, and then out pops a fully fabricated beam. And Revit just isn't capable of producing that.

Further, as you guys know, Revit is really a tool for designers primarily. And modeling complex connections and complex forms is as much trickier in Revit than it is an actual steel fabrication software. Things like stairs, for example, are tough to do to fabrication model on Revit. Again, this really isn't the right tool.

And single parts. In terms of what a single part is, you can think of any little plates as being a single part. A fabricator needs to know, let's say, that they're fabbing a steel beam that has a series of shear tabs on it. The fabricator needs to know the explicit details for that little shear tab. How do I cut the tab? What size holes are in it? Where are those holes go?

And the drawing for that little shear tab, although EORs never actually see them, and frankly, general contractors never see them, they exist behind the scenes, and are used internally by a fabricator to fully fab the main parts or the pieces of the shop tickets. So in Revit there's no great way to isolate one little piece and turn that into and fully document that piece.

And then, finally, this is going to tie the previous two concepts together. If we're talking about using assemblies for your main parts, the new steel connections that Revit has and in Revit 2017 are not capable of going into assemblies. It's a bit of a weird concept-- and we'll talk more about those actual steel connections in a second-- but the new steel connections allow you to basically connect any two [? augment ?] with standard connections, we'll say a shear tab connection, for example.

But when you do that, for some reason, right now, the actual shear tab is not capable of going into an assembly. So from a piece drawing standpoint, it kind of makes that unusable, the connection module. We understand from Autodesk that those things are going to be resolved in future releases, but for right now it just isn't possible.

Now, along those same lines the connection module. This is great. This is new in Revit 2017. And basically what it lets you do is it allows you to load any very standard connections into your Revit model, and then connect any two elements with them. In terms of standard connections, there's probably about 20 of them or so. The interface for it looks exactly like it does in Advance Steal.

The downside is that there's not as many connections as there are in Advance Steal. Advance Steal maybe has 20 or 30 additional standard connections. But the standard things that you would expect in any job, shear tabs, base plates, those sorts of things, all included and they all work great.

In terms of how to use them, there's two things that you have to do. One of them that's very critical that took me about a half hour to figure out what was going on, and it is that there are new libraries that are shipped with Revit 2017. There are two versions of each structural framing element family, and each structural column family, steel columns, steel beam family.

They are hidden in a new directory called AISC 14.1. So if you're looking at any steel beam or steel column, and you want to know hey, are my families capable of accepting steel connections? The answer lies in this, and it's all washed out. But it just-- there's a new parameter in the AISC 14.1 families that's called section [? K name. ?] If that parameter exists, you're good to go. So what this means then is that it's unlikely that you're able to take an old project and put dropped connections into it, unless you've updated the families.

For a run through, one common error that we kind of come across a lot, and perhaps it's instructive to hear how it is that this works in Advance Steel to sort of see why it's happening, one thing that we commonly see is that sometimes Revit gets a little confused in terms of which element is supporting which.

When you invoke these commands in Advance Steel, there's a certain order that you have to pick. Typically it's picked the supporting element first, and then Revit says, OK, I'm a girder. And then you pick the secondary element, and that says OK, I'm the one that supported. So Revit-- the actual functionality just requires that you select two pieces, so it [INAUDIBLE] connect them.

Every now and again, it gets jammed up, and it gets confused about which one is which. Really, the resolution for it is very simple. At every connection you get a dot at the node, and then a dot on each element. It's just a matter of switching the elements. But if you don't know what you're doing, then it can be pretty aggravating just these little dots here.

Finally I wanted to reiterate that these connections are all exportable out to Advance Steel and the full connection module functionality still exists in Advance Steel and, again, they can be round-tripped back into your model. So with the addition of this steel connection module, your structural models have dramatically increased in value per share.

In terms of, again, kind of going back to why it is that it's not a great idea for structural engineers to be creating steel shop drawings, the first one is really the most critical. Whether they'll admit it or not, I don't think a lot of structural engineers have a good respect for the amount of precision that's required to create steel shop drawings.

For example, an eighth of an inch bust on a structural steel shop drawing doesn't seem like a lot, but that's-- it's a complete fiasco for the guys in the field. It turns a bolted a connection into a welded the connection just like that. And so that kind of eye towards precision is absolutely critical.

Next, knowledge of fabrication techniques is really critical as well. The best example of what I can think of there is just that, whenever I would picture a standard steel beam shot drawing, I think it's probably a lot like what a lot of you would picture, where every single dimension cut bolt is very, very explicitly defined. And that all makes sense. I think we can all respect that.

But if you are, on the other hand, detailing a stair, for example, it's the exact opposite. A fabricator that we work with says that they want as little dimension as possible. They want to know the critical dimensions, the rise and the run, and then they want their guys to figure it out in the shop beyond that. And there's tons of things like that-- I guess what I'm trying to do is trying to show you that it's not really as easy as you might think that it would be.

And then, finally, a relationship with a fabricator and erector. We all make mistakes. You're going to make mistakes in your structural steel shop drawings. And having a good relationship with a fabricator and erector, in which they aren't going to come shaking their finger at you every time that there's a mistake is absolutely critical, or else you'll be sunk on your first job.

Now, like I said a second ago, there is a very good option. If you do have-- maybe you hire a steel detailer on staff, or you have somebody that's learning, or that you have a relationship with a fabricator that's going to essentially mentor you to provide these types of services, great. Great tool to do that is Advanced Steel.

Advance Steel is great because it is an actual true steel fabrication, steel shop drawing type piece of software. And it has the capability that you would typically expect out of such a piece of software. it automates a lot of the tasks that you would find very tedious, like dimensioning automatic creation of piece drawings, automatic drawing creation. It allows you to put in custom connections, of course, it allows CNC outputs. And then it allows it's very flexible, it allows you to do very complex shapes and forms. So I highly recommend using Advance Steel.

The only caveat here is that Advance Steel is AutoCAD based. So there's a little bit of a learning curve in terms of learning a new sort of system in addition to all of the actual fabrication specific stuff that you would need to learn to be able to do that.

And then, Dan talked a second ago and mentioned that the goal here really isn't to sort of fill you in on exactly how to do still shop drawings. I think one thing that is within the reach of a structural engineer is the detailing of miscellaneous metals. So when I think miscellaneous metals, I think of loose angles, lintels, maybe miscellaneous minor site structures or canopies around a site that aren't really part of the primary structure for a building. In my mind, Revit can be used for that. The risk for those types of things is fairly low. And you can create those types of shop drawings. I like to mention we're not going to go into the exact details of how to do that, but the structure for doing that involves parameters.

These are three parameters that you'll need to be able to incorporate, to be able to use Revit to make miscellaneous metal shop drawings. And I want to talk about them specifically now because pre-cast concrete shop drawings use these parameters and more. And they're used in exactly the same manner. So when we talk about these in pre-cast concrete shop drawings, those same concepts apply directly to structural steel

OK. Pre-cast concrete shop drawings. So again, the big benefit here is the reduced lead time. It's obviously a massive problem for pre-cast concrete as well. The other inefficiencies that we're attacking when we're doing pre-cast concrete shop drawings is just the structure that we kind of have now.

I don't know that I've ever been part of a pre-cast job in which you have an engineer of record that's working independently and laying out the framing on their own, presumably getting a little bit of input from a pre-caster who may or may not be engaged in the project yet. And they lay out the framing as best they see fit. And then the design is complete. Pre-caster gets drawings. They get wiped out and precaster goes and relays out all the framing. So all of that effort that was done by the structural engineer was entirely wasted.

So that really sort of speaks to the next two items there, that you actually have the most knowledgeable entity performing the modeling tasks. And that's really the critical part here. And obviously, the elimination of the duplication of effort that we just talked about a minute ago that is so incredibly inefficient.

In terms of class detection with the actual framing, in situations in which the pre-caster isn't brought on early, or even when they are, if they're required to produce 3-D models, typically those things are done in AutoCAD, and they're done sort of in parallel to the drawings that the pre-caster is using for their erection and peace during creation. So they sort of maintain a shadow model of their actual drawings, because AutoCAD isn't a true BIM piece of software, that there's no connection between different sets of drawings.

So if there clash detection being performed, then it's being performed on a Revit model that is part of-- that is eventually getting fed into fabrication and so forth. So there's a continuity of data there. And then, finally, improved accuracy that comes along with all BIM projects as well.

Like I said it's like going to go, assemblies, the heart of this whole implementation is the use of assemblies. The big picture is just that assemblies allow you to independently tag scheduled filter on elements that are put into an assembly. In terms of-- so now that you have an assembly, let's say you have an assembly of a double T, and all of the plates that go into that double T. And you're ready to create your piece drawing for that double T.

The elements that go into that piece drawing are the actual assembly views, the plans, the elevations and sections, which are great. The schedules, however, that come out of assemblies are not great. The primary problem there is that they simply don't allow a great deal of flexibility in terms of the data that they're showing. So we actually don't use the assembly schedules. We use regular Revit schedules instead of parameters that allow you to filter based on what assembly they're in.

And then Legends. I think you guys are probably all familiar with Legends. We just use that to reduce the amount of typing that we do and sort of impose some uniformity on our projects.

So we'll talk about the parameters. Pardon me. And this kind of gives you a picture for how it is that the whole sort of system works. The first one there is the piece control number. So this is just a unique number for each individual piece on the project. We use this primarily for tagging and for piece tracking. So if you have two double Ts that are sitting right next to each other, each of those double Ts would have a unique number. It would say number 500 and 501.

The next one, the Assembly Mark Number, this is also used for tagging and filtering. The difference here is that each unique piece gets an Assembly Mark Number. So the same two double T's, number 500 and 501 that we just talked about a second ago. Those two double Ts would have the same Assembly Mark Number, we'll say F5 or whatever. So that number does not need to be unique.

Plate Host simply tells you what double T you're in. Let's say we're looking at double T F5, and it has 20 rebars that are cast inside of it. Each of those rebars would have a Plate Host parameters set to F5. And that allows us to work around the Revit assembly schedules and use the actual Revit schedules so we can filter on that data, the plate host.

Plate categories simply tells the plate what it's used for. Precasters have several different shops. They have a steel shop, they have erection shops, and they have rebar shops. The

Plate Category simply divides each piece that gets cast into each framing element into one of those three categories, so that data goes to the appropriate person when the T is being fabricated.

Piece Design Type is really just a number that's corresponding to the actual engineering design of the piece. Assembly Weight is just the weight of the piece. And then we have a series of parameters that sort of allow us to filter views and piece drawings and that sort of thing.

Schedules. We use schedules extensively. I hope that you've gotten the feeling from Dan and the things that I've said as well that we do not fake in anything. All of our data is clean. And and we rely on the integrity of our schedules. So in terms of what we actually use schedules for, the piece drawing data, this is the example I just talked about, where we have standard plates, standard rebar and erection material.

That sends the data to the appropriate party at the precaster. We also use schedules for material and resource planning. If a precaster wants to know how much concrete am I going to need on this date, how many standard plates am I going to need, it sort of helps them plan out activities in their shops.

We also use them for quality control and quality assurance. We obviously, since we're living in this data, we need to make sure that the data is good. We have various schedules that are set up that allow us to check to make sure that everything is working as it should be. And then, finally, product tracking, as a means to sort of plan out our work and facilitate the desired workflow from the precaster, we-- each piece gets a piece of data that just says, hey, if I've been reinforced, have I been annotated? Have I been checked? Have I been submitted, fabricated, installed? Where am I at in this whole sort of process? And that kind of lets us know where we're going there.

Next, the use of Legends. You know this is really very simple, nothing really spectacular here. We just try to look for things that we're constantly typing over and over, and minimize the amount of typing and retyping that we have to do. So we make use of schedules a lot.

In terms of typical piece details, you can imagine that if you've got 100 double Ts on a project, and they all have the same strand drape pattern, for example, it makes much more sense for you to dump that information and draw that detail in a Legend, and then simply apply that legend to each of your double Ts. So that's really the primary use, or where we really cut down on our time the most.

We also create master detail sheets. So if we're talking about all the walls in the project, and we create a series of details-- maybe there's 60 or 70 details for all the walls-- and we put them all on these five sheets. And then, as we create the piece drawings for each of those walls, we simply take out the details that aren't used.

So we may send the precaster a series of wall views and then detail sheets that only have one or two details per sheet, but it's just a way to sort of streamline that whole process. More paper, but substantially less work.

Rebar Venn diagrams. These are going to be the same on every job. Piece finished legends are something else that will be the same on every job. You can see some of these over here, here is a piece finished legend.

We also-- things like and end 1 and end 2. You can imagine on every piece you're going to have to retype that. So instead of doing that, we just make those into legends. We also typically make view titles into legends as well. Despite the fact that you can actually have Revit generate those, there is a substantial amount of typing just to type out DT elevation or whatever. And so really try to minimize that amount of typing.

Finally, I'll talk really quickly about third party tools. There's two that are kind of on the market. There's a handful of these. But these are two that we've looked into, EdgeForRevit and AGA-CAD. We are using EdgeForRevit; we're not using the AGA-CAD tools.

The primary difference here is that the EdgeForRevit tools are really sort of a total pre-cast sort of delivery system in a sense, so it comes pre-canned with parameters, schedules. It's almost like a template, if you will. It's a really good starting point for creating pre-cast shop drawing. AGA-CAD tools, they do offer some great audio dimensioning tools, things like that. But we don't currently use those.

One tool I guess I can tell you about the both of them do have that really is the most critical part of this whole system is they have a tool that automatically creates assemblies. What it does is that you--

PRESENTER: Smart walls.

ERICH BRETZ: I'm sorry?

PRESENTER: It's called smart walls.

ERICH BRETZ: Smart?

PRESENTER: Walls.

ERICH BRETZ: Oh, Yeah. Yeah. So basically, it just performs clash detection on any geometry. So you would pick a double T, the tool performs clash detection on that double T, it assumes that anything that that geometry conflicts with is being cast into that double T, and it dumps that into the assembly. And that's a huge timesaver as far as creating pre-cast shops goes. And that's available in both of those tools there.

DAN MCCLOSKEY: So please remember to fill out your survey. Hopefully this was informative, or useful to you guys. And if not, let us know. And then we're running pretty short on time, but we've got time for some questions. Does anyone have any questions?

AUDIENCE: [INAUDIBLE].

PRESENTER: They want you to repeat the question.

DAN MCCLOSKEY: So, so the question-- the question was-- they asked that we repeat the question for the recording-- the question was, if someone changes the geometry of a cast and place elements in a rebar job, how do you track those changes? Because it is--

PRESENTER: [INAUDIBLE] .

DAN MCCLOSKEY: That's very true. So we use a lot of pinning. So we a lot of pinning for concrete elements. Unfortunately, rebar does not pin very well. There is an add in for Rebar called SOFiSTiK. This year, SOFiSTiK just came out with a tool that is called Freeze Rebar. It takes rebar out of that and puts it-- out of the host-- puts it in a container.

We haven't used it yet, but we're really looking forward to it. But I'd look into that. And then what we've done in the past is you just have to be really careful. You have to kind of keep an eye on-- you have a lot of QC views set up to know what changes have a lot of schedule set up. So then do a change track between those schedules to see if [? bar ?] is extended or whatever. But the answer is there's not a great way except, there's a new add on that helps with that.

AUDIENCE: [INAUDIBLE].

DAN MCCLOSKEY: Yeah, that would be very interesting.

AUDIENCE: [INAUDIBLE] .

DAN MCCLOSKEY: Yeah. I think that would be useful. Other questions?

AUDIENCE: [INAUDIBLE] . Thank you. Can you speak for a minute on your [INAUDIBLE] or talk about [INAUDIBLE] concrete [? cast ?] and plates for walls. Are you guys advocating parts? Or are you advocating [? war ?] profiles? Are you hosting the flowers? And how do you-- can you share some pros and cons about the workflow you've established?

[INAUDIBLE].

ERICH BRETZ: --what you end up with. Let's say you're working on a parking garage and you've got a lot of sloping and [? warping, ?] and you maybe copy [INAUDIBLE].

DAN MCCLOSKEY: I would advocate not kind of working around the parametric nature of Revit. Other questions?

AUDIENCE: When you [INAUDIBLE].

DAN MCCLOSKEY: So the question was when you detail rebar on a wall, when you add a joint, your rebar will get out of whack essentially. And that's a real problem. So the question is how do you approach this?

I would look up-- we did a rebar class last year. We talked about kicking off a rebar job. One of the first things you have to do when you're looking at modeling rebar is drill on the contractor for the pore breaks. Try to get pore breaks determined as early as possible. You can use parts to do that. But really the pore planning to avoid a lot of rework in Rebar Modeling, the pore planning is key.

So try-- and kind of red light and green light. Don't go model some area. Don't add the bar until you've talked to the contractor. And the grade beams, where are we breaking these pores? How are we going to splice these? Are you using form savers? Are you using bulkheads? Extending [? bar ?] through bulkheads. But trying to figure out the pore planning and installing preferences before you actually start modeling bar would be my suggestion.

ERICH BRETZ: We also have some clients that frankly don't give us pore breaks for stuff like that. And that stuff is just figured out by them in the field, whether it is, as Dan said, poking bar out of bulkheads. Or I don't know, maybe sometimes a field [? cut ?] or whatever. But for whatever reason, maybe it's time, maybe it's scheduled, or whatever, maybe they don't know actually how it's going to go. They don't know where the pore breaks are going to be. So in the absence of them, we just detail assuming they just aren't there at all.

DAN MCCLOSKEY: But communication is key, like anything. Other questions?

ERICH BRETZ: Great. Well, thanks--

[INTERPOSING VOICES]

DAN MCCLOSKEY: Thanks for your time.