JAKE KOELLIKER: Good afternoon, everyone. Welcome to our class today. We're going to be talking about self-perform concrete and Revit Structure. My name is Jake Koelliker, and I'm a BIM engineer with McCarthy Building Companies in our Phoenix office.

ROBERT FOUT: I'm Robert W. Fout. I'm also a BIM engineer, also working out of the Phoenix office for McCarthy.

JAKE KOELLIKER: Switch it. There it goes. OK.

Today, we're going to be going over a workflow that we've established at our company that helps us change and cater to each individual job, and how those specific jobs, how we can meet those needs. So we'll be going over concrete lift drawings, a workflow of how to establish those with our job site team, and then go over in Revit and show a demonstration of that.

First off, how many of you know what a concrete lift drawing is?

ROBERT FOUT: It looks like we have the majority of the class right now.

JAKE KOELLIKER: And so I'm assuming most of you know what the benefits are. How many of you know what the benefits are of a concrete lift drawing?

ROBERT FOUT: All right, we lost a few, which is what we expected.

JAKE KOELLIKER: And how many of you actually use them on some of your jobs at your companies?

ROBERT FOUT: All right, about the same number in terms of knowing the benefits are using them now. So hopefully, we're all in the right class.

JAKE KOELLIKER: Very good. So like I was saying before, the first portion of our presentation today is going to be going over our workflow that we've established to get things rolling with our job site team. And then after that, set in place the standards and the best practices that we have established based on our experience. And then incorporate that into each job. And then roll out into Revit, creating the model and producing those concrete lift drawings.

So first off we'll go ahead and start talking about our workflow.

ROBERT FOUT: At the beginning of each project for self-perform concrete, we need to provide a concrete lift drawing estimate to the job site. We've created a template to help us in our consistency and our accuracy of that estimate. What we don't want to do is provide a budget for one job, be spot on with that job, and then the next two, we end up going over budget with our concrete lift drawing estimate. So this template, we break down the structure, the level, and the individual pores with the concrete superintendent.

But we also break those numbers down for man hours to model time, annotation time, and administration time. That way, the job site team is actually able to look at detailed information detailing the amount of time that we allot for a typical wall pour, for example, without any embeds versus a deck pour with penetrations and depressions, which are going to allow us to have to put more details, more dimensions, more notes. It just takes more time.

We also provide a disclaimer with each estimate. Because if they see the concrete lift drawing estimate, and they see something that's not provided in there and they want it added, we can. Whether it be planters in the hardscape. It could be cambered notation that we typically don't always provide. Anything like that, we can add. But that disclaimer allows them to know what we have alloted for and all the man hours. We ask that they review this. We get their approval. We move forward.

A concrete lift drawing checklist, at the same time that we find out the job site team in terms of concrete superintendent, foreman, structural engineer, as well as the project manager, we try to get them this list, which is what we call a standard. This list not only has all the information that we want them to provide in the lift drawings, it gives them the chance to add, subtract whatever they want to see for that particular job.

JAKE KOELLIKER: So after we've given them the checklist and the estimate, our basic point with all of this is establishing that communication with the job site team early on. That way, once we've established that, the whole process is open communication. We can talk about anything, talk about problems, get to the point as fast as we can. So once we've given them this information with the checklist and the estimate, we also provide them a BIM execution plan. And we then have a kickoff meeting.

So our BIM execution plan is a contract between us and the job site team, all parties in the job site team relating to BIM. So with this contract, it allows the job site team to know their expectations that they should have for us and the expectations that we have for them.

And there's a specific attachment in that BIM execution plan, attachment number five, which is also provided to you guys in our extra class materials that you can download for your own use. It goes over our whole workflow, our whole process that we do from start to finish. Talking about creating lift drawings, review time, signatures, getting the right people involved. And we'll discuss some of those things a little more in depth later.

But at the kickoff meeting, this is when we open it up. We talk about every situation that's going to be hard or difficult with this project. Some projects can't be based off grid lines because they're more of a radial structure. Some you have a nice square building, so it's a little easier for that.

So at this meeting, we go over those things. We go over budget. We go over the key people who are going to be in contact with us. We try to have one contact on the job site team, so that way, we can just be contacting back and forth with them, and they can funnel that to whoever needs it on the job site.

So the kickoff meeting is very important to start the job off right, to get our workflow established, and to get the right people in the right place. And that is where we can establish, OK, the superintendent, you're in charge of this. This is what he's expecting. So we know what he's expecting to see on drawings. And then we also tell them, talk to them, explain what we expect them to do in the review process, or in providing red lines for us. So the kickoff meeting is essential in setting the stage for the whole project.

Now also at the kickoff meeting, we talk about the schedule. Schedule's very important. From the very beginning, we have to create a drawing list. We create a drawing list based off of the baseline schedule, the project schedule. And we use those dates, the form dates, to then put in place our issue for construction date.

As you can see here, we have the different columns for different dates that we're issuing for construction, issue for review date, and then the actual dates that we get those off and when they were returned. And we also have drawing numbers and the description. It's very important that we establish this early on so that way, when we're going through our drawings and going through the list, the job site team knows exactly where we're going, we know where we're going, and it's easy to have that communication.

So we take the descriptions and the drawing numbers based off of the schedule. That usually

coincides, and we typically have those numbers and those names there. And then we use that later on in our drawing process when we create those concrete lift drawings.

So when we have this all set in place, this is the last thing we need to start establishing that workflow. Then we move into putting in place our standards. So like what we've said before, it's really important that we establish this open communication with this workflow so we have everything set up for the job. Then we move into using our standards, our best practices that we've had that have worked for us on previous jobs. And we continue to adapt, but really, from the experience we've had, those are set in place.

First, Autodesk BIM 360 Glue. This is our collaboration tool that we use. We have all of our subcontractors. We upload to it. All the trades that are going to be involved are uploading to this. And so in our BIM execution plan, we talk about where the project origin is, where everything's established, project base point. That's all set up. So when we use Glue, we're all in the same place. All the trades can coordinate then together.

And we make sure that we have a guy on site who can run this and control this. That way, they know all the clashes that are coming up. They know where we're at. They know the status of the models, when they've recently been changed or updated. And that allows us to keep that open communication. And then allows the job site team to double check anything that we may have missed in our concrete lift drawings, or then check things that maybe we should look out for or see what we're trying to identify in our drawings. Because sometimes, it's easier to see in 3D rather than in 2D.

ROBERT FOUT: So required signatures. As discussed during the kickoff meeting, there's a certain number of individuals that are required to be involved with the review of those drawings. We need three signatures, at least as a minimum, once we get the drawings back from them before we move forward for IFC-- or Issued for Construction. We always require the concrete superintendent. We actually promote the concrete foreman, the structural engineer, as well as the project manager. What this does is it gives us the benefit of having multiple individuals review the drawings and different expertise.

So an example that we came across recently is a project where part of the review team looked at the concrete slab on grade. We had blockouts for concrete columns. They said the individual gave us a directive to take those blockouts out and pour straight up to the concrete column with expansion joints. During the same review from the concrete superintendent, he

realized we have to have those blockouts in there. We're going to be extending our control joints from blockout to blockout. We've got to put them back in.

So if we didn't have that process of multiple individuals looking at that drawing, we would've had much rework. And it just gives an example of why we require three signatures. Once we get them back, it just gives us the directive to move forward, issue that drawing for construction, and basically realize that there shouldn't be any questions when they place that concrete for that pour.

Review time. When we submit the drawings for review, typically, the job site's given three days to review those drawings. Sometimes, it may take five depending on the complexity of the pour or the complexity of the drawing itself. When they issue the drawings back to us with the required signatures, we are given the same amount of time to make the revisions, issue the drawings for construction.

The key with the review time is for you to stay on schedule. If you fall behind in your review time and giving us the drawings-- all our engineers are working at multiple jobs, so we're trying to maintain schedules on multiple jobs. And if you fall behind on your review time, we may not get back to your job in the time that you need to. So not only are we falling behind with your review time, it may affect your entire project schedule. So stay on schedule. That is one of the keys that you have to do in working with the team.

Throughout the whole process, in creating our workflows, we need to continue to promote that the team buys into what concrete lift drawings can do for you and how they can improve your efficiency. From the director to the project manager, superintendents, whoever it is, we need to get their buy-in.

Not long ago, all these same buildings that we're doing now, they were produced without concrete lift drawings. And they were produced well. So we're continuing to try to evolve that workflow. We can help them. We can make things faster, eliminate rework. And that's the process of trying to get things bought in. Even now, our BIM manager continues to try to slot time in with our company training groups, trying to continue to, again, have those teams buy in to what concrete lift drawings can provide.

Once the team is all bought in with our workflows and processes, it's time to move forward for us in creating our concrete lift drawing model. We start with Revit.

JAKE KOELLIKER: So now that we've established our workflow, set the whole job up for success, we've incorporated our standards, we then move to creating the model. We have created a template at our company that we use to start off modeling. It gives us origin, sets up the Project Browser very nicely in Revit, and keeps the annotation consistent. So text sizes, callouts, dimensioning, those things are the same, unless they are changed or the job site team asked us to change them per our kickoff meeting. So with this template that we'll show you when we get into the demonstration, all of that is already there to start. That way, once we start modeling, everything's smooth, easy, good to go.

We also use Collaboration for Revit. This has been a newer tool we've started using that has really helped us to be able to work from any location. All it requires is a good internet connection. It allows us to work on site, at home, in the office, different states, wherever, without any issues of lag time or slowing down because of the central file on the server, it takes forever to push a button and sync.

And I see a lot of you nodding your head. That's days of the past. Those days were horrible. You had to work from the office. But now, with C4R, we're able to work from everywhere. And now that's why we have incorporated that into our process.

ROBERT FOUT: So as you can imagine, in producing a concrete lift drawing model, there's lots of coordination. Obviously, there's structural for us in doing the concrete model, architectural, mechanical, plumbing, steel-- structural steel, that is. You might have elevator shop drawings that you have to deal with. We try to link all these files, whether 2D or 3D, into our one Revit concrete model. Obviously, we could view them all at once, or we can individually look at them within our model.

Then we can also upload the 3D views into BIM 360 Glue as Jacob mentioned. The key, again, for this is keeping your models current. That way, when individuals are looking at it, it's live. They can create clashes. We can address issues long before anybody sees them on the site.

So now that we've got through the initial steps in creating our Revit concrete model, we wanted to walk you through a Revit demonstration showing you the typical workflow of a concrete lift drawing.

JAKE KOELLIKER: So as Robert gets this set up, the project we're going to show you is actually Top Golf, just here a couple blocks away. And so as you'll see on the screen, he'll talk about-- we're going to

do a basement pour, basement wall pour. So you'll see that. And we'll create the drawing with different elevations and different section cuts that you'll be able to see here once he gets it pulled up.

So you can see, this is an isometric view, a 3D view of the structure. We've included the structural steel model in there just so we can have that for reference when we do start producing the drawings. We like to have it in there, as Robert was saying, so we can easily identify where those anchor bolts or where those steel embeds might be.

So once we've established the model, we've modeled everything, got everything set up, then we open up our plan view. As I said before, this is the basement. And we're going to then crop our region. So we zoom into one of the wall pours.

So as you notice, I mean, there's a [? jog ?] here, some pilasters. Those are all things that we need to incorporate into our drawing to make sure the job site team has all the information that they're going to need for this specific pour. That's the critical part.

A lift drawing-- a good lift drawing-- has all the information from architect, engineer, steel subcontractor, the MEP guys, all in one place. So the guys in the field can put it in place, form it up, without having to reference anything else. That's our goal when we're creating these drawings.

So here, something--

AUDIENCE: Do you get your steel from steel fabricators or are you getting [INAUDIBLE]?

JAKE KOELLIKER: Yeah, we had a steel subcontractor. And then he does the model, and he uploads it to Glue.

So as you can see here, we like to color code it per pour. So one pour is the yellow, and these are other pours, future pours or previous pours. And we do that just because it's easier for clarification. So when we quantify it, they can easily see, OK, the yellow is what we're focusing on. This is the portion of the lift drawing. The other portions are just for reference. And we're good to go.

So then we'll create our sheets. As I was talking about before with our drawing schedule, we have our drawing numbers and our drawing names here that correlate with our drawing tracker that we've created. So that way, we have it. The job site team knows these are the

dates. It's all consistent all the way through.

Also, here's the title block where we talked about the signatures. We have concrete sup, concrete GF, PM, concrete structural PE. Whoever's involved in this process, in the review process, whoever we need to sign off on these drawings, those are the people who we want. Their title's there, so they have a place to sign, and so we can make sure all the review process is smooth.

So once we've created the sheet, we then put the view onto the sheet. And as many of you have done concrete lift drawings in your companies, it's simple. But then the annotation starts. The annotation is the critical part. Robert, in his previous life, was an architect. Nothing against architects. Everything is nice and lined up and clean.

That's something that me, being from a construction background, I had to learn. I didn't line everything up. I said, OK, you got the dimension there? You're good. You don't need anything else. Robert along with the rest of our department, has taught us that we need to line it up, make it neat, clean, so it's easy to identify the sizes, dimensions, the callouts. Because some of these drawings can get really busy, really clouded with all the information we need to have there. So the cleaner it is, the neater it is, the better. The job site team likes it a lot better.

So as you can see here, we're showing steel anchor bolts, steel embeds there, and with the pilasters, and dimensioning those. And as you see, I mean, this is an anchor bolt here, and there's an embed here. So to show that in plan, it helps them see, OK, this is the spacing here. We'll add some dimensions. What's the size of that? Then we can start adding other views that will help them see projection depth and locations vertically.

So once we've started doing that, we'll start adding sections and details, and start developing the drawing further. So we've added an isometric view here to identify where these beams come in. That's hard to tell from a plan view. You're not going to be able to see that.

So we provide iso views to see how the pilasters go in with the wall and where of the beams tie in. It's so the job site team can see, OK, I'm going to form it like this. There needs to be a blockout here, here. Everything's good. Otherwise, they could form that without the blockout. So we need to make sure that's called out.

Then we'll provide elevations and make sure that everything's dimensioned that way, so we can see heights, elevations, lengths, and overall quantities, and any embeds that could be on

the wall faces.

Here, as you can see, we've called out the embeds with the embed number, plate size, elevation. And that's all information that we get from the shop drawings. So we're incorporating the information we get from the steel subcontractor into our lift drawings, again, so our superintendent in the field or the guys putting in place, they don't have to reference those shop drawings.

They should reference those when they're reviewing it, definitely. But in the field, when they're actually putting it in place, they have that. They know that information's good. They can collect all those different types of embeds, have them there so they can tie them in with the rebar during the forming process. And everything's good to go.

AUDIENCE: [INAUDIBLE]

JAKE KOELLIKER: Yeah?

AUDIENCE: Is that a tag or is [INAUDIBLE] getting that base plate [INAUDIBLE]?

JAKE KOELLIKER: In this one, we use text. You can use tags. It just depends on how you form your template.

So we're getting in the final stages of this drawing. As we zoom into these elevations, you can see better the projection of the anchor bolts and those embeds. And it's nice to have those multiple views because you can see, OK, this embed is going in behind this anchor bolt. You reference the plan view. You see the distance between them. And then you see that both of them are there. And then it's called out here also. And then all these embeds here are dimensioned nice and neat, nice and clean.

And that's all catered to what the job site wants to see. Some of our teams, they want to see different dimension, just to the center line continuously. Others want to have bigger text size. Others want smaller. Others want to cram all they can into one sheet so they don't have to carry a bunch of sheets out in the field. Some don't care. They want to see huge views, so they have 18 pages out in the field just so they have all the information. Yeah?

AUDIENCE: What's your sheet size?

JAKE KOELLIKER: Sheet size? 11 by 17. Yeah?

AUDIENCE: Is that model [INAUDIBLE] those anchor bolts, or are they [INAUDIBLE]

JAKE KOELLIKER: You can. If you want to show them in isometric views, or you can just put them in detail. Just whatever the job site wants to see. Sometimes they like to see it in 3D so they can say, OK, this is how it's going to look. Other times, they don't really care. Just as long as they can see it in one view or another.

So as you see here at the bottom, we also incorporate the details from the actual contract drawings. This is something that we haven't always done. But it's something that we have started doing because superintendents in the field, they want to see this rebar here. They want to see the clearance. They want to see all these notes.

And so instead of us having to model some of this, which we can also do, we clip these details. So then they have exactly what it says in the contract drawings shown there, how it's going to tie together with the slab, with the footing, and the wall, and the different reinforcement, and the spacing. They have that all there in one place. Now if it's a more complicated area and it doesn't fit the typical detail, then we'll definitely provide them a section of our model so they can see, OK, this is how it's really tying in, or this is how the turndown is going to tie into the footing, or something like that.

So really, again, goes back to the kickoff meeting. You talk to your job site team and you really establish the workflow. You establish what they want to see. And this process, again, is something that can evolve throughout the project. You may provide them a drawing with something they said originally, and then they say they don't want to see it that way. They want to see it a different way. So really, it's just figuring out with your job site team exactly what they want to see.

So you see here, that's another reason why we clip these. Because you can see all this steel here, how this embed is here with the angle. That's not something we typically show. So there's an angle here, for the slab or deck there. And so it's really important that we provide these. And it really helps them out, because they can see exactly how it was intended to be put in and put in place in the field.

So again, we quantify it with our quantities so they know exactly how much concrete is needed

for that pour. And this whole process can vary for a wall, slab, deck, whatever it may be. So now we're going to go back to our presentation, our slides.

So that's why it is important to establish that workflow originally. Establish the whole process upfront. Put a lot of work in, so then this whole process is smooth. These guys know what's happening. They're bought in. They see how easy it is, how great it is to have all this information in one place. So that way, when they do get these in the field, it's smooth. There aren't any problems. We've fixed everything that needed to be fixed previously. And we're on our way.

ROBERT FOUT: So now that we've walked you through a typical workflow for a concrete lift drawing, I can tell you this. With every project, project schedule, or project team, those are going to dictate and vary per job. So you're going to have specific workflows that you're going to have to create in your lift drawings for each of those jobs. So we've selected several projects that we've worked on recently to highlight some of these workflows that we've had to implement in our lift drawings.

The Banner Estrella Medical Center. It's in southwest Phoenix. We had a patient tower addition, concrete deck with Cunningham beams. Lots of post-tension-- or PT-- cables. Lots of steel reinforcing. Many steel embeds, specifically on the perimeter. We had multiple embeds lined right next to each other for different types of exterior skin.

So what the job site team wanted to do is, at the edge or bulkhead of each pour, the subsequent pour, they wanted a 12-foot look-ahead. So within that 12 feet, we showed them the steel embeds. That way, during the forming, they could locate the steel embeds, not have the clashes actually during the pour of the placement, and eliminate any issues.

So this drawing here is showing just one of the 12-foot look-aheads. We showed them the center lines of the steel embeds. And we did this for each level for each of the pours. Obviously, the last pour wouldn't have one, a 12-foot look-ahead. But that's what we provided for them on this project.

The images here, you can see all the red beam, the PT cable, lots of steel reinforcing. There's embeds here. And again, on the edges, we had many more steel embeds. The skin was just a lot of things going on. And we had to move some things around. We had Nelson studs projecting into depressions. They were so far in that they were extending out into the floors of the shower rooms. So it's all coordination that we had to incorporate into this structure.

JAKE KOELLIKER: Next, we want to talk about Presbyterian Rust Medical Center in Albuquerque. This was also an expansion, and an additional tower and treatment center. And the tricky part with this was the foundations. The foundations were something that I had never seen before. They had six-sided pier caps, sloped grade beams, among other things.

So as you can see here, a drawing like that can get pretty messy. It can get pretty clouded. But if you keep it neat like we talked about, you can still get the information required. So what we had to do with the job site team is sit down and talk about, hey, what information needs to be there? How do you want to show that information? And how can we make this simpler?

So what we ended up doing was shrinking the pours, or cutting them in half, or providing different parts on different sheets, so we could then blow up those views and enlarge the dimensions, call out elevations at the starting and finishing point of the sloped grade beams. And we resulted in this. And as you can imagine, all this foundation has a lot of rebar. So it's very critical that we were able to put all this in place very accurately with all the clearance issues and everything like that.

So here are some pictures of how these six-sided pier caps-- you can see it better up here, it's blown up-- how everything ties into it. And see how it slopes here? I mean, it was very, very technical, very difficult. And so an effective lift drawing made it a smooth process for these guys to put it in place, form it up, place the rebar cages, and have everything smooth. So it really is a good example of how these concrete lift drawings can help them in the field. And every one of these guys that was involved in the drawing process and the review process is now bought in.

ROBERT FOUT: The Arizona Fallen Firefighter Memorial in downtown Phoenix. Recently completed. It's a cast-in-place concrete structure all based upon a central radius point. We had to give them radius dimensions for the entire site plan. We also had to incorporate section cuts throughout the lineal walls and the radiused walls because of all the slopes that were incorporated. So they were between 30 and 60 inches that we had to create all these cuts.

So the key on those drawings and annotation were the spot elevations at each of the points on those angled slopes. Revit couldn't even really keep up with all the numbers because of how it had to be modeled. So basically, I had to clarify everything was within 1/16 to 1/8, because it just wouldn't round correctly. You see a dimension on one side. That would give you the total dimension. And then you'd add them all up, and it was off by 1/16, probably. Not everywhere,

but on several locations. But the key for us was giving them those spot elevations to finish this project.

Next images. Here you can see the steel at the slope. How the guys on site were working trowels trying to get that slope down as best they could. Because of the formwork, they were laying down flat on their bellies in certain points of the radius wall, trying to, again, get that slope. It was all granite, if I didn't mention that before.

And in total, the project turned out really nice. The dedication was pretty impressive. And it worked out all right. And the PM basically said, we couldn't have done it without those lift drawings. And that's what we're trying to help out with for each and every project.

JAKE KOELLIKER: Next is the Odysea Aquarium. As I talked about before, a building on a radius, this is it. All these radius walls, concrete tanks, columns rotated at different angles. We had a grid system set up, but you couldn't pull measurements off the grid system. So what we had to do was incorporate Autodesk Point Layout. Now after we model it, we provide the job site team with the APL files. And they could use their data collection to lay out the structure.

So you can see here, this is a shark tank. You see how it's on a radius? And there's three other tanks connected to it along the other side. So if we're off by a couple degrees on that rotation, then that affects the rest of the tanks. So we had to be spot on with these coordinates that we provided. Everything had to match up.

And it was difficult for us at first because we couldn't take those dimensions. So we had to work with the job site team to establish this workflow so they could use the robotic total station in the field with Autodesk Point Layout and lay everything out. And they're still currently working on it. And they're still laying things out. Laying footings, columns, all the tanks. Everything had to be laid out with APL.

So you can see here, this is some of the formwork going up for that same shark tank. And you see here, it's called a biofilter, for the filtration process of the water. But it's here, spacing, and this other tank over here, it's all in a circle around this side. So again, if one side's off by a tiny bit, all of that gets affected. And then you start having a lot of issues.

So with the Town of Gilbert Parking Garage, we also used Autodesk Point Layout. After this was all done, we came back and we found some ponding, some sitting water. So we went back, made sure all the clearances, everything was put in place per the specifications from the

engineer. And then we used APL to create-- here's them pouring some of those decks. We used APL to create a contour map.

So as you can see here, this is the original drain line that they put in per those specifications from the engineer. However, because they were so minimal, we had all this sitting water in this area. So using APL after the fact, we were able to go back, create this map, and show them where the actual sitting water was so they could then put in a new drainage system that allowed them to get rid of that water.

So again, even at the end of the project, there are still some things that we need to adapt for. And all these different things, there's things that come up on every job. Every job is unique. That's why it's so important to get everything established from the very beginning with our job site team. Make sure we're on the same page, communicating, from our kickoff meeting to the end. We're establishing that workflow, setting up that communication, incorporating our standards so everything flows together. So then we can get through all the challenges that come up and have everything run smoothly, or get through those things as quickly and as efficiently as possible.

So we want to remind you guys to give us feedback, provide AU feedback of this session. And then we know you guys chose to come here instead of going to all the other classes you could have gone to. We thank you for that. But you can watch these other sessions online. They are being recorded. And now we want to turn it over to Robert to direct any questions that you guys might have.

ROBERT FOUT: So before you have any questions, I wanted to mention that our intent was to try to give you everything that you saw today either in the class handout and/or the class materials. If you can't find that information there, go ahead and contact us and we'll try to help you out.

AUDIENCE: When you guys go to generate your models, are you guys basically starting from scratch? Or are you taking existing architectural models that you're given from, you know, an architect or something like that and then removing information to simplify to create your life drawings?

ROBERT FOUT: So the question is-- if you didn't hear it, although this is a small room-- do we use the models that we've been given from either the architect or the structural engineer? Typically, we do receive models from those individuals or companies. But we usually start from scratch.

We've looked at some structural models that we think look really good. When you get down to

the tolerances that we're looking for, they don't align. So we typically start from scratch. Yes, there are a lot of job site teams that question that because they see it in our budget. But for us to get it right and for us to help them out, we're going to have to start from scratch. We use those as a reference more than anything. Yes, sir?

AUDIENCE: When you color code your drawings, are you using filters or phases? What are you using to color code the pours?

ROBERT FOUT: So the question is, when we color code, are we using phases or filters? Go ahead, Jake.

JAKE KOELLIKER: Typically, we just change those settings in the view. You can use the phases to change the color throughout the entire project, and that is something we've done on other jobs. It's just a matter of what the job site wants to see. If they want to see their whole model with the different colors set up like that, or if they just want to see it in that view.

ROBERT FOUT: Yes, sir?

AUDIENCE: How are you keeping those 11 by 17 drawings updated? You know, if something changes in your coordination meeting, it seems that the architect may [INAUDIBLE]-- do you get information so you have all the plans [INAUDIBLE]?

ROBERT FOUT: Right. So once we issue the drawing for construction, if there's a change-- and I don't know if it was mentioned previously-- we try to get our dates aligned up with the project schedule. So we want to give them that IFC drawing a week prior to the forming if not two weeks. So obviously, there may be some changes. An RFI comes through, an ASI is issued. We would create delta drawings. Obviously, we don't want them walking around with an IFR drawing, the Issued for Review drawing. They've got to be walking around with an IFC drawing.

And if by chance we do have to issue a delta, we do that. That way the dates are the key. And we just keep updating those, whether we're using-- well, obviously, we try to use BIM 360 Glue in terms of clashes. But we create a cloud-based NAS or put them on Box, and everybody's able to look at the updated drawings. Did that answer your question?

AUDIENCE: Yeah.

ROBERT FOUT: Yes, ma'am?

AUDIENCE: Are BIM engineers [INAUDIBLE] office-based or site-based?

ROBERT FOUT: Out of Phoenix, we're typically office-based. I worked on Banner Estrella Medical Center, and there were three different structures going on. And I was working on all of them at one time. So I was on site three to four days a week. But that's atypical. We have lots of jobs. As I mentioned, all of our engineers are working on multiple projects, whether it be Texas, New Mexico, Colorado, obviously Phoenix. So we are office-based.

We try to get out to the job sites as often as we can. Budget constraints limit that a little bit, as well as we're going to be much more efficient in the office. You get to the job site and they're going to bombard you with questions, what they want to see next time, or can you fix this real fast. Your whole day goes by and all you've done is to answer questions for them.

AUDIENCE: Can I [INAUDIBLE]?

ROBERT FOUT: Sure.

AUDIENCE: Newer engineers, they're typically spending a lot more time on the job site. Because there's a lot of [INAUDIBLE] a lot of educating that needs to happen when we first get on. More senior engineers like Robert, they can spend a little bit more time in the office and be a lot more productive in the office because they understand the projects a little bit better.

ROBERT FOUT: Yes, sir?

AUDIENCE: Do you guys own your own formwork for the concrete, for self-perform concrete?

AUDIENCE: It depends on the-- I'm sorry.

ROBERT FOUT: That's our BIM manager, by the way. Depends on the project and/or the job. McCarthy does have quite a bit of formwork that we can use. But depending on the job and the project schedule, they may use Atlas. They may bring in something else that's already manufactured and ready to go. It just depends on, again, the numbers, the superintendent, the project schedule. So they can try to get them from what we call the yard or the warehouse.

AUDIENCE: I asked that because I was wondering if you guys modeled your own formwork with the lift drawings.

ROBERT FOUT: That would be only specific to the job. We typically do not put the formwork in the drawings right now. But we can if needed. Another example would be rebar. We don't typically put in rebar all the time, but we can if necessary.

JAKE KOELLIKER: For that formwork, though, we do add surface areas and wall surface areas and things like that, just so they can have that extra double check. You know, they can check also.

ROBERT FOUT: Yes, ma'am?

AUDIENCE: Is Revit the only software you're using? [INAUDIBLE]?

ROBERT FOUT: Revit is our primary lift drawing software. Obviously, we bring in 2D and 3D in AutoCAD. But we work and produce our lift drawings out of Revit, yes. Yes, sir?

AUDIENCE: If you [INAUDIBLE] rebar, would you do that in Revit also?

ROBERT FOUT: Yes. He asked, if we do model rebar, is it going to be in Revit? And that is correct. Yes, sir?

AUDIENCE: Are you finding that you're only using wall and floor components, or are you using any specific families or construction parts to do the [INAUDIBLE]?

ROBERT FOUT: So the question is, are we using floors and walls versus families? We try to use as many families as we can. There is quite a bit of models in place, just due to, again, the project. You want to expand on that, Jake?

JAKE KOELLIKER: Yeah, It just depends on the project. I mean, there's some families that we have set up that are easy to use. Some, as we were talking about Odysea, that's a whole brand new project. So I mean, we can develop those families, or we can just do a quick model in place for one specific thing. So again, project-to-project basis.

ROBERT FOUT: Yes, sir?

AUDIENCE: I got a question about Autodesk Point Layout that you mentioned. There's two parts to it. One, in the situation you described, did you essentially survey it and then bring the points into Revit?

JAKE KOELLIKER: Yeah.

AUDIENCE: And then number two, did you guys ever go the other way? Did you ever lay out all the points for all of your embeds in your Revit model and then use APL to bring that on the site, essentially? Shoot all those points [INAUDIBLE]?

JAKE For the actual embeds?

KOELLIKER:

AUDIENCE: The embeds, I'm sorry.

JAKE KOELLIKER: Yeah, we do on some jobs. Just again, job to job. But yeah, that's something that we have found that has been very helpful in certain instances. But again, not in every job.

AUDIENCE: Is it efficient? Does it slow guys down or does it speed them up?

AUDIENCE: Depends on the application, though, doesn't it?

Yeah.

AUDIENCE: We've had jobs where you have [INAUDIBLE] layout of 35 embeds. You've got a guy on a gun that has a laser point to where the layout point is. And you're dealing with radial dimensions and stuff like that. So you can just tick, next, tick, next, tick, next. But then again, you have some where you're [INAUDIBLE] grid, and you're just working off of your formwork, where it's just easier to use a tape.

JAKE KOELLIKER: Yeah, exactly.

AUDIENCE: [INAUDIBLE]

AUDIENCE: Yeah, the [INAUDIBLE] it's got radial stuff everywhere. We use it all the time, and it's fantastic. So it's changing a lot of CSV files and then trying to make sure that you have-- usually check back and forth between you and your layout [INAUDIBLE].

JAKE KOELLIKER: Yeah, definitely. I would definitely say, on the more radial projects, it'd probably be a lot easier then, because you can't really pull dimensions. But on a more rectangular project, dimensions are probably going to work faster.

AUDIENCE: OK.

JAKE KOELLIKER: Go on. Go ahead.

AUDIENCE: Do you have any metrics on safety, quality, time savings, or anything like that for the process you do?

JAKE KOELLIKER: Do you want to take that?

ROBERT FOUT: We've been working on that corporate-wide. I wouldn't say that we specifically have any formulas right now. With each and every lift drawing, our objective is to basically give them on the job site the lift drawing that's going to tell them everything, every aspect of the placing of concrete for that pour, and make it as efficient for them as possible.

And we recently had a meeting in Newport. And that was the discussion. How does this correlate with the amount of time saved, safety, et cetera? And we're still working on that formula and trying to figure out those exact numbers and be able to back up what we're providing for them.

AUDIENCE: [INAUDIBLE]

ROBERT FOUT: OK. Yes, sir?

AUDIENCE: Yeah, in your signature area of your title block, you showed a spot where the structural engineer of record. Do you get a lot of kickback on that when you're signing off on your drawings?

ROBERT FOUT: That's not the structural en-- that's the structural PE. So the project engineer from McCarthy, our job site. So yeah, that would be a-- the only signature we're going to see from them is on the drawings, so. Yes, sir?

AUDIENCE: So is there [INAUDIBLE]

ROBERT FOUT: Yeah, within each lift drawing, we're giving them a quantity through Revit.

AUDIENCE: OK.

ROBERT FOUT: The job site team uses that as a reference. But they obviously have to do their own calcs and account for, you know, spillage, et cetera. So we do give them that quantity by using phases. I don't know if that answers your question.

AUDIENCE: No, I'm asking, what about the actual pour? [INAUDIBLE] the actual pour?

ROBERT FOUT: We do not. By the time it gets poured, usually the only information we have is, how close were we? Did we miss something? Typically, we're doing OK. And it happened on, again, myself at

Banner Estrella. I think the pour was probably 25 yards over. I, of course, overheard it and started looking at my drawings. And it was just a matter of they had calculated it wrong. So maybe somebody got a new car port, I don't know. Yes, sir?

AUDIENCE: All right. I don't know if I'm [INAUDIBLE] but did you guys ever try Tekla instead of Revit?

ROBERT FOUT: Go ahead.

JAKE KOELLIKER: We have started looking into that.

AUDIENCE: Oh, so you're not actually going to Tekla from Revit?

JAKE KOELLIKER: Oh, the actual-- with switching models and using that?

AUDIENCE: Using new software, yeah.

JAKE KOELLIKER: We've researched it. From what I've found-- and it could be preference-- I prefer Revit just because of the ease of use in certain aspects. There are some tools in Tekla that are great. Like the forming stuff, that stuff is really useful. And so it's just a matter of give and take, I guess, preference.

AUDIENCE: And then when you [INAUDIBLE] Autodesk Point Layout, why not do a building survey [INAUDIBLE] or anything like that? Is there a reason why you [INAUDIBLE] layout?

JAKE KOELLIKER: I don't think there's a specific reason. I think that's just what was available to us at the time, and we just ran with it, incorporated that.

AUDIENCE: Are you guys using [INAUDIBLE]? Both?

JAKE KOELLIKER: Both, yeah.

AUDIENCE: But what are the APO usages? Again, it goes down in cost, also, right? [INAUDIBLE] have any tools available, so we're just [INAUDIBLE].

ROBERT FOUT: Anybody else? Yes, sir?

AUDIENCE: I notice when you budget the job, you excluded any RFIs, ASIs, essentially any changes, and

you're sending that to the project team. Do you charge the project team then for model updates for RFIs? ASIs make sense, for any owner [INAUDIBLE] changes or [INAUDIBLE] changes. Where do you draw the line for what you're charging the project more for, in regard to changes?

ROBERT FOUT: The idea that we would have to ask them for a revised budget would be if we go above and beyond our original estimate. Obviously, we're trying to come in lower than our original estimate. So RFIs, hopefully, they're not going to create that issue where we're going well over budget. And I don't even know if I've been on a job where we had to ask because of an RFI. I'm sure it's happened.

But again, we put enough fluff in our number that we know-- you know, administration time takes a lot more time than you'd think, with all the conference calls, meetings, just sending emails, sending them the lift drawings, whatever it is. So we try to create that estimate to give us enough room.

AUDIENCE: [INAUDIBLE]

ROBERT FOUT: Yes, sir?

AUDIENCE: Another thing you didn't see in that drawings record-- there's a few more protocols [INAUDIBLE] you didn't see in that drawings record, and that's more internal use for us. We track all the revisions and all the changes coming from the field or from the design team, whatever it's generated by. Or even if it's something that maybe we goofed on. We track all sorts of quality issues against us. So we use that tracker as a tool to track all the changes and all the hours due to changes to provide that maybe as a justification if the product teams are asking, why did we go over budget? [INAUDIBLE] the job, we've added 40-something hours with the changes. That equates to this, which we'll watch however much we went over budget on your project.

ROBERT FOUT: Yeah, the example we gave is what we would provide to the job site team. We're not going to give them all the formulas that we look at internally. So the example we gave was something that we'd give the job site with basically dates and maybe man hours. Yes, sir?

AUDIENCE: So as for the embeds in [INAUDIBLE], do you ever get Tekla models from your [INAUDIBLE] and use the imported [INAUDIBLE] so that you can tag directly off of their steel model? And then [INAUDIBLE] and stuff like that on your drawing?

JAKE KOELLIKER: Yeah, typically, we use IFC files for that, then have them export as an IFC.

AUDIENCE: [INAUDIBLE] or just [INAUDIBLE]?

JAKE KOELLIKER: We import an IFC and we have that there. And then we break it up and we have that callout. If not, we just typically use a DWG for that, and then reference the IFC.

AUDIENCE: [INAUDIBLE] manual tags.

JAKE KOELLIKER: Yeah.

ROBERT FOUT: Yes, sir?

AUDIENCE: Do you guys ever do QA/QC checks for your as-builts compared to your lift drawings to make sure everything's installed properly and nothing's missed?

ROBERT FOUT: So the extent of that would be an example that I had on the job where the actual pour went different than our lift drawing. So we create another drawing. We add a delta to it. So it's actually an as-built. What we don't want to do is go back to a project, look at the drawing, and realize, OK, this isn't actually what happened. So that is our back check on those drawings. We want to know that our historical data is correct and what is existing out on the project.

I guess, in terms of a QA/QC with the job site, we don't specifically do that. We try to stay in constant communication. So there's not really the issue to have a so-called discussion at the end. Yes, sir?

AUDIENCE: How do you deal with internal liability? If you're modeling something, if you create that model, then you have the design drawings, and there's a discrepancy between the two, It sounds like you guys are running at full force with your own model. So how do you internally take responsibility for differences between the model that you produced and the [INAUDIBLE]?

ROBERT FOUT: So we're in contact with the job site team. So if we run across issues within the documents, we get with them, and they need to contact the design team. So again, that constant communication. We're trying to eliminate any clashes. We just recently had it where the structural model did not line up with the architectural model. And we were getting ready to roll with lift drawings and with pouring concrete.

Because the architect had dimensioned to the half-inch, it was creating all kinds of trouble. So we had a conference call, and my guess is that the individual was the director. And he basically said-- he didn't realize his team had dimensioned to that nearest half-inch. He told us the directive was, you've got to use the structural model right now, because they just don't align up with the grids. So we went up from the basement up using that structural model. Later on, we had issues at the decks because they still didn't line up exactly. Again, we're trying to stay in contact with the job site team.

AUDIENCE: How [INAUDIBLE] from the architects and engineers who [INAUDIBLE].

ROBERT FOUT: Yes, sir.

AUDIENCE: I'm just wondering, how do you get your formwork quantities? How do you get those?

ROBERT FOUT: Formwork quantities?

AUDIENCE: Yes.

JAKE KOELLIKER: So we provide surface area. In Revit, there are some add-ins that you can download and get the surface areas of those. And then the job site team is also doing a double check on that. So collaborating together to get those quantities.

ROBERT FOUT: Our job site teams do a complete formwork study. And the Odysea manual was-- was it too thick? Two manuals this thick on just straight formwork. So they're doing that before we even get rolling.

AUDIENCE: What's the name of the add-in you were referring to?

JAKE KOELLIKER: Sorry?

AUDIENCE: You said there are add-ins for the surface area.

JAKE KOELLIKER: Oh, one of the add-ins we use, I think it's called Sophistic, something like that. Sophistic.

ROBERT FOUT: Yes, sir?

AUDIENCE: For your APL, do you add the points into the families themselves, or do you add them

individually later in the model?

JAKE KOELLIKER: We usually typically add them later in the model. There are instances, like for solar, for when you're laying out piles, that you can just place that in the family because you're doing thousands of piles, where it does become more beneficial to do it that way.

ROBERT FOUT: Any more questions? All right. Again, we thank you for joining us.