GREG SMITH: OK, well, welcome everybody to Using Revit, and Point Layout and a Robotic Total Station for Construction Layout. Prepare to be razzle dazzled. My name is Greg Smith. This is my colleague, Mark King. Greg "Cool Breeze" Smith. I'm the VDC, west coast director, for Skanska. I support all of our projects with virtual design and construction on the west coast. My esteemed colleague colleague here, Mark, iTravel.com king.

MARK KING: Let's just be clear, he put that up there. I think he's trying to give me a hint that I might be gone too often.

GREG SMITH: The man most most known for taking all of his vacation to travel the world. So Mark, go ahead and introduce yourself.

MARK KING: Yeah. Like Greg said, my name is Mark King. I'm the VDC manager in the Seattle office. So we have a small team up there that I manage, and I get involved in a lot of our projects as well. So you're going to go over the agenda.

GREG SMITH: Yeah, so the agenda. I'm going to talk about point layout out briefly because Mark's going to get into that a little bit more and show you a demo later. I'm going to talk about what is digital layout and how we use it. A little bit of a history of the instrument. And then mark's going to get into how we've implemented it in the Seattle office and also give you an example of point layout.

I'm going to stand over here, if you don't mind. So digital layout using point layout. Points created in a Revit model have spatial intelligence coordinates in relation to the project reference point in Revit. That's a lot to say. Basically, we have our XYZ coordinates within Revit, we're adding a point and that point has XYZ coordinates within that point.

And then the second bullet point, we can extract those points out of the model and import those into our total station. Points can also be embedded in Revit families such as spread footings or anchor bolts. So when we have a point embedded in a family, and we use that family in our model, then we have that point in information in there. One of things I forgot to mention in very beginning, if you guys have questions along the way, let's have more of a dialogue rather than

a set and get. So if you have a question, let's ask it. OK?

So point layout steps. Aligning models. Number one step is aligning models and CAD files. And/or CAD files. God, I'm going to trip over those things all day long. So that's the very important step. Aligning the models to either our survey information or some known points on the site. If we don't do that and we start adding points to the model, then it has no relation to the site. And where to add points? I'm going to get into communication, but we have to have a dialogue with our layout guys on how, or where, to add the points in the model.

OK. And then point numbering, having some standards. Mark will get in more to the point numbering. And then importing and exporting in and out of point layout. So point layout is a plugin that works in Revit. We can add points into our Revit model, we can extract those or export them into a text file that we can load into our total station.

We can also go out, and we can shoot points with our total station, and bring those back in, import those points back into our Revit model, check for accuracy. So you go out to where you've laid out anchor bolts, you shoot those anchor bolt locations, you bring those back into Revit and you see the accuracy of that.

Point Layout real briefly. Up in the upper left hand corner, you can see it's YXZ. That's northing, easting and elevation. And then we have point numbers and a point description. What it's going to look like in your text file is the point numbers, that's the 20,050-- that's the point number. And then that y. The northing, the easting, elevation and a description.

And when we look at the drawing, this one doesn't have the northing, easting and elevation. It only has the elevation as a point number and the description. But we're adding those points to the drawing. And, again, mark is going to get into more detail on that later.

Another use for Point Layout, that we use Point Layout for, is with point clouds from laser scans. You have a Revit object in there, and you have your point cloud, and you can compare the two. So the upper picture there is a shoring wall on a site. And we were really concerned about the innies and outies in that wall,

how plum it was. And then the lower is a concrete slab. We went out and scanned it, brought it into Revit. Within Point Layout, we can see the highs and lows in that slab.

So Digital Layout. What is it? This is a typical drawing that we would give to our field. It has a lot of dimensional information down there, the northings and eastings. We can add points to that, extract those points into that text file and then load them into our total station. Again, you see the point number there. The northing, easting, elevation and a description of the point.

So before we started using Point Layout, our layout guys would sit there with their data collector typing in all those points. And you look at the number of numbers there. Very difficult to type in those without making mistakes. It would take them hours. As a matter of fact, one guy, it was taking him 30 hours a week to type in those numbers manually into the total station. Once we gave him Point Layout, it was taking one to two hours to add those points. So two hours versus 30 hours. He spent a lot more time doing other tasks than entering data.

So benefits. Layout team does not have to manually calculate thousands of points per project. Before mark started the initiative up in Seattle, we had two layout guys. One would crunch numbers during the day, the other guy would check those numbers that night. And then he'd come back in the next day and he'd enter those points into his gun. So no need to manually enter coordinates for every point in a handheld device. And a DXF file can be exported from Revit that shows a view of model and data collector.

And we have total stations for all from several years ago that have a screen that's smaller than your cell phone. So, typically, we wouldn't load a DXF file or any model information in there, we just have the points. Some of the newer data collectors or input devices, some of them are an iPad or iPad like. So they have a much bigger display and they can display that better.

Before I go on, I want to see a show of hands. Who is in the room? Contractors? How about those that use Point Layout? Glad. Who does Layout? A couple. All right, good. So you guys are probably all smart than we are. OK. So where to add points? The image on the left is a concrete planter sloping sides. We had a

location for where those embeds were going to be, and all I had to do is add elevation information that the layout guys were going to use.

For that project, typically, it would take him two guys for a week to two weeks to go lay out that site. Because the old school way of doing it is you have a string line from the bottom of the planter up to the top of the planter, and then you're measuring down with the tape measure to lay out those embeds. Using Point Layout and the information, it took one guy about two days to lay everything out.

Here's another example where we have a fairly complex concrete model and we're adding elevation information to certain points on the wall. And then we can extract that so they can layout that in the field as well. Yeah?

AUDIENCE: [INAUDIBLE]

GREG SMITH: On a what?

AUDIENCE: [INAUDIBLE]

GREG SMITH: Well, I mean, this is the Revit model with the annotation in Revit. And then, I mean, we can put it on a sheet in Revit and print it out in 2-D, but it's out of Revit directly. So is the other image as well. And then embeds. We all talk about embeds, we all hear about embeds.

And an embed for us, and we do a lot of self-performed concrete work, it's basically a steel plate with some little bolts on it, that are welded onto it, and then that gets put into the concrete formwork so when we pour the concrete, that embed is there. So we have a steel plate that we can weld something to. The location of those embeds, especially if we have thousands of embeds, before we were using Digital Layout, we would miss those all the time. They still get missed, just not as many.

History of the instruments. And this is one of those input devices there that's more like an iPad, or it is iPad, that's some of the newer devices there. And I'll show you a picture of some of the older devices as well. So some of the definitions of the theodolite is a precision instrument for measuring angles in the horizontal and vertical plane. Measures angles this way, measures angles that way.

Total station is intelligent theodolite except it also has an electronic distance meter built into it. And then a robotic total station is kind of the same thing, except it eliminates the need for a second person. It's self-contained that one person can use it. They set it up, and then they go hold the prismpole, and it communicates electronically with their data collector.

So that's an image of an old theodolite developed in the 1500's, again measures horizontal and vertical angles. There is some math that goes along with that. So some of the smart people in the room might want to take a look at those formulas and decide to use the formulas. I don't want to do that. I'd rather let the computer do it.

Some images of a theodolite. Measures the vertical and horizontal angles electronically. But, again, here you see somebody with a tape measure right there. Right? So they're measuring that distance. This is one of our total stations. It's kind of older school. You can see that screen on there, it's smaller than your cell phone. But it measures distance and angles, records information to a data collector and then the robotic total station allows for a single operator.

So along with Mark and myself, I want to introduce you to another guy at our Portland office named Zeke Gunther. Now, Zeke's a unique character. He's a great guy. He's totally self-contained. You see him there on the left hand side. He does the Revit modeling. Again, we do a lot of self-performed concrete and steel. So he is modeling, in Revit, the concrete stuff that we're going to pour. Then he goes out and he spits out the points to a total station, sets it up, and then he starts laying out the points. And I'm going to introduce you to Zeke through a couple of videos as well.

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So communication is extremely important. You know, it's really easy for me or Mark to sit back in our office and add points to a Revit model. The great thing about Point Layout is you can automatically add thousands of points to a model. That's the great thing about it. The bad thing about Point Layout is you can automatically add thousands of points to a model that the layout guys are not

going to use.

So the first thing we need to do before we start adding points to a model is go have a conversation with who's going to lay out the site and what points they need. So then when we sit down with that Revit model, we can start adding those points to the model in a format that they need. Yeah?

AUDIENCE: [INAUDIBLE]

GREG SMITH: Yeah. And I have another video, Zeke, that I didn't include in this, that's pretty funny. So he gets really close with his prismpole and then he uses a very scientific method of using his boot to kick it into place to get it really close. So you can get really close. And one of the segments coming up kind of talks a little bit about that. I mean, you get really close, but it's not like everything is in that XYZ coordinate to eight decimal places.

AUDIENCE: [INAUDIBLE]

GREG SMITH: Yeah. Absolutely. Yeah. The prismpole has a level on it, so you know when it's level. As a matter of fact, the prismpoles can be really tall. Or you can reduce the height of the prismpole so you're holding it down there. And that's going to give you a more accurate measurement because your prismpole can move a little bit. What's that?

AUDIENCE: [INAUDIBLE]

GREG SMITH: So I'll tell you what Mark and I do. A lot of times we try and use the models from, primarily, structural engineer. Zeke, occasionally he'll do that. But a lot of times he will either take that and change it a little bit, or he'll rebuild it from scratch based on how we're going to pour the concrete.

MARK KING: So the question was, does Zeke use engineering models or does he build the Revit models himself. I think it's a combination of both. A lot of it is, is he depending on that engineer to be correct? Or a lot of times, we get the injury models and we have to add things to it that the engineer didn't have in the mile model. So, usually, it's a combination of both.

GREG SMITH: And the other thing is, when we get a structural engineers model, the entire slab

is one big piece. And he'll chop it up based on the pores. Any other questions? Setup and layout terminology. Survey points, survey control points, internal control points, resection, accuracy and tolerances. OK, so the survey control points. Survey goes out there and sets survey control points around the site. And the internal control points, based on those survey control points, we'll set up the total station, then we'll go set up internal points where we need them.

And then resection is where we go and we set up the total station just someplace on the site. And then we can triangulate based on those survey control points. And then we can move around with the prismpole and set the points. Accuracy and tolerances. We were kind of talking about this a little bit with the prismpole. Pool When we get models, and a lot of the designers there is zero tolerance. They are, this is 10 feet by 40 feet or something. There's no tolerance built into the Revit models.

But out in the field, you've heard me talk about that, when we get down to the 1/16 of an inch or an eighth of an inch, there's tolerance in the field. So we need to be cognizant of that when we're laying things out or when we're modeling stuff. Questions on any of that?

AUDIENCE: [INAUDIBLE]

GREG SMITH: Yeah. I'll tell you what. One of the things about Zeke, and he and I have talked about it quite a bit. And, again, he's totally self-contained. He'll go out and model something, then go out and lay something out. But it's also kind of a scary thing because it's always better to have somebody back check what you're doing.

[VIDEO PLAYBACK]

- Obviously, your control points, you need to make sure that's going to be a spot that's going to be visible for a while. The other thing is when you do any kind of your grid line offsets or anything, this particular one, it's easier for me get to the inside, but now

that offset is buried under the slab. So it no longer exists.

I had to set this one up when we were working down here because we have this wall that was in the way of me getting to my other control points. So when I had a good set up one day, I came around and shot a couple extra control points that I could come back to. You'll find that, on the job site, you'll need more than just a civil survey, unless it's just a wide open job site. More than likely, you'll need to establish your own control inside the fence.

[END PLAYBACK]

GREG SMITH: OK. So there's also a point map, grid offsets and some of the other tools that get used. And Zeke is going to talk a little bit about grid offsets again on point map. A lot of times, he'll go out there with a drawing. And this one is just hand sketched. But normally, he does a PDF that he uses on a cell phone. He sees the planned view, and he sees where he's going to lay out, and then a point number associated with that. So then he can use that with his list of points in the total station, and go out and lay out the site.

Offsets. And this where I thought you were going with that question a little bit. So an offset. We can set up a point at a grid intersection. But as soon as you pour that footing, that point's gone. So a lot of times, we'll set up a grid offset a foot or two feet off the grid, or off a footing, or off a wall, so we have that point later to use after we built more of the project.

So that's an example of a point that's a grid offset. You can see, it says one foot off the face of column and then the center line of column. OK? So whoever goes out there and sees that point, they can see it's one foot off the face of that column at the centerline of that column.

[VIDEO PLAYBACK]

- This is the mainstream way that the layout used to be done. You'd get a surveyor to come out and put in a wood hub with

the tack in it that would represent a grid line and an offset. And then your carpenters would come in and rebuild this batter board over it, two by four and some stakes. And the nail in the middle would be what's plumbed up over the wooden hub.

And that would set up a theodolite over, and shoot a straight line down the building and have somebody down there marking it with a pencil. Or you would be able to run a string line from one batter board to another once you shot in the theodolite. And then you would work off that grid line to establish where column is, slab edge, footing edge, et cetera.

[END PLAYBACK]

GREG SMITH: So these are some of the other tools, some of the old school tools. You've got a string line, tape measure, a laser level. When you see Zeke out there laying out the side, he's got his vest on and he's got all these other tools in there. Not just his total station, not just his point map. But he'll go out and he'll run a string line between two points.

As a matter of fact, if we have eight columns and a line, he's not going to go shoot a point at eight columns. He's probably going to shoot one at this column. And then maybe two or three columns away and two or three columns away again, and then run a string line between them. Or he can come back with a total station in check. But, again, because of some of the variances, if I shoot one every column, you might be zigzagging when you're going down the line. So shoot them further apart, it's even better.

[VIDEO PLAYBACK]

- Benchmark, or an elevation hub, is something that, usually, we are contractually required to

give for our self-performed and for our sub-contractors. Typically, we don't have to give a lot of them, but I know with our crew in here, having to build to this, I went around and did fairly insignificant scrag mark and a 4 foot offset of finished slab on all the columns and walls around here.

So now it's easier for them to come in. I give them a sheet that says how many inches it is from this mark up to the bottom of the beam or the deck and then come through really easily, tape up, set their deck and beams, and move on.

[END PLAYBACK]

GREG SMITH: So, again, that communication is really important. Going out and talking to the field layout guys, talking with the subcontractors, understanding the site. The other thing is, getting out into the site. Again, we can sit-in our office and we can model away. And still to this day, it amazes me, I can look at the whole building model, or a whole site, on the computer, but until I go out there and I physically see the actual size of what we're building, and some of these huge columns that we're building, or big core, or something, it just does something to your mind when you see what the actual site is, rather than sitting at the office looking at a computer saying, oh yeah, I can visualize this. I can visualize it, but not until you get out and see the size and the scope of it.

Any questions? Razzle dazzled?

AUDIENCE: I do have a question.

GREG SMITH: Yeah.

AUDIENCE: So he sort of seems like he's a field guy. Did he come up in construction? How did he learn Revit?

GREG SMITH: So he's a carpenter by trade. And he's a field engineer, but he's kind of a BIM VDC guy. He started out with AutoCAD for a long time, and then we switched him over to Revit and got him Point Layout. So yeah he's definitely a field guy.

AUDIENCE: Was he internally trained within Skanska?

GREG SMITH: Internal, yeah.

MARK KING: A lot of it's self-taught, I believe, right? I mean, he sent down for tools and dug into YouTube and Google.

GREG SMITH: And, kind of, our philosophy, especially in the Northwest, where we do a lot of self-performed work, most of the VDC people we have came from the field. It's pretty easy to teach them how to use a computer, it's tough to teach them 20 years of construction experience. So that's not global with everybody within Skanska, but especially the self-performed guys, they have a lot of field knowledge. So I'm going to turn it over to Mark.

MARK KING: Thanks, Greg. All right. So I'm going to take you through the rest of our presentation. Like Greg said earlier, feel free to stop me and ask questions. Let's make the [INAUDIBLE] of the dialogue. I started using Get the Point before Autodesk ever bought it, probably about 2008. And we were really getting in that initiative at the contractor I was at. And then I went away from construction for a few years and I came back in 2014 to work for Skanska.

So this is really one of the first initiatives we started looking at. We had a couple of our VDC guys dabbling in Point Layout in Seattle, but we really didn't have any structure around it. So the first thing we did is we did a survey of the layout team to see what kind of tools they had and what their different skill sets were. And it was kind of shocking. What we found out is-- we only had three-- but they didn't have email, they didn't have laptops. None of them had the same data collectors or robotic stations. Everybody has something different.

So I said, OK, they all work the same, but we need to get some kind of standardization here. So that was the first thing we did. Second thing is, we had to sell this now. It's a pretty easy sell because it's kind of low hanging fruit, right? We've got Revit. We have an enterprise agreement, so we have Autodesk Point

Layout. We do self-perform a lot of our work, which is a great way to make money as a general contractor, but it's also our biggest risk on the project.

So the sell to the management was, we're going to give these guys points right out of the model, the georeference model, so they can go and do this layout, and not have to worry about those errors in math. So we had our first meeting in Q4 2014. It showed management that they're on board. They said, let's go get it. So we started working with closely with the layout guys. Until that point, I'd never met them.

So I went out to a couple of their projects, worked directly with them for a day, or six hours or so, and then went back to the office to show them what we could do. And I had a sample project. And when I showed them this, I think I did it on a grid file, and exported every grid intersection in a matter of a couple of minutes, they just were blown away. They told me, you just saved me 10 days of work. So think about that.

So it was a very easy sell to our management team. The thing we need to do is start getting these guys some training in Revit, get them some laptops, and start standardizing our equipment. So we started working on that and then we did another meeting in Q2 2015 where we brought Zeke up from Portland to talk about his experiences, but we really started diving into the standards. How are we going to name and number points? Where are we going to put points on entities that we want to track? And I'll show you some examples of that later.

So that's really where things started taking off. And it was great. Two of the lay out guys didn't even know each other, so everybody is talking now. We gave them the job of figuring out what you want for prefixes on your points. So for corner footings, or for embed centers, or whatever. So they went off, did that and came back with a list of all those prefixes that we use on all of our projects now.

So in a very short period of time, now, about six months later, we had two major projects starting up-- Alderwood Elementary and Tahoma High School. So we fully implemented Point Layout on both those projects and had a lot of successes. So I'll show you a couple of examples of that shortly. And now, as we are implementing new projects, it's kind of our standard, and especially when we're

self-performing our work. So that's kind of the journey that we took to get where we are now.

So let's talk about standardization. Like I said, it's great to have some point prefixes when you spit these out. But if they're different from job to job, first of all, the layout guys are going to get confused and the VDC guys are going to also get confused. So the guys came back with a complete list. I think we have, like, 120 different prefixes that we use for different entities on the project. And then we also had a numbering strategy. So they knew if it was a 1,000 number, that it was a grid line. Or if it was 3,000, it's a footing. Those aren't perfect, but that's the idea.

The other thing we did is, we went out and we bought two of the Panasonic ToughPads here. The guys really liked this. I don't personally use it, but I know Brett, who is working on Mesa data collector prior to that, he really likes it. He's got Wi-Fi on that now, so he can get his email, he can sync all of our files to this. So I'll talk a little bit more about that shortly.

And then we really had a discussion on, how do we locate points? And so that was a real learning event for me because, not being a layout guy, I'm like, well, I think I'll put the points here. But then they came back to me, and one example is I was putting all my corner footing points at the top of the footings, it seemed to make sense. He says, well, you know, if you put them at the bottom, we not only have the corners, now we have the depth. So it's kind of an aha moment.

And then we started creating Revit families and embedding these points into those families so that we're not repeating that process every time. So now, when we load that family, it's already in there. Any questions so far?

AUDIENCE: [INAUDIBLE]

MARK KING: I'm sorry, could you repeat that?

AUDIENCE: [INAUDIBLE]

MARK KING: Correct. So his question was about consistency between multiple families. And that's one of the reasons that we're putting it into families. Now, whenever anybody loads it, it's consistently in the same place. So it's also locked to that

point. So this one is locked at the top dead center and face of that. And our footings are locked to the corners and the bottoms.

OK. So I know I saw a lot of hands come up when we asked if you use APL. So there's a lot of standard things that we use it for and we've talked about a few of those. I know MEP guys use it for sleeving and for dropping your hangers, and all that, we use it for embeds, wall framing, structure, grid intersections. And those are kind of the standard things that we all use.

But we started thinking outside the box a little bit. How else can we use this? So we had a few examples. By the way, did I tell you I'm from Seattle? So at Tahoma High School, we had massive site that was nearly a mile from one end to the other. So a huge site. So we said, hey, why don't we use Point Layout for the sports fields. So we did. We laid out the football field, the baseball and softball fields all with Point Layout. And so the guys got there and really easily staked that out.

Safety tie-off's. So we-- I'm sorry, go ahead.

AUDIENCE: Sorry. When you embed your points, [INAUDIBLE], do you re-number or have a sequential number [INAUDIBLE] 1, 2, 3, 4.

MARK KING: Great question. OK. So the question is, do we renumber the points that are embedded in the families? Correct?

AUDIENCE: Yeah. So if you have a family and you have a point on the same interval, now you have thousands of anchor bolts. And, you know, anchor bolt five is here and anchor bolt 20 is over here.

MARK KING: Right. So great question. A short answer is, I don't really care about the numbering, because the system is going to renumber all those for me and make sure I don't have any duplicates. We do a lot of times use the tagging in there. So if we put that anchor bolt in there, we can tag that point. But, essentially, I'm not as worried about the numbers because it's all going to transfer over to the layout guys' system. And so when he's got his DXF file that we've transferred to him, he can go, and he can see where they are right on to the DXF file.

AUDIENCE: [INAUDIBLE]

MARK KING: You know, I'm not sure, yo be honest with you. We do put the prefix in the family. So the point that's in the family will have the prefix in it. So I'll have to check that out though.

AUDIENCE: How are you guys dealing with the state point coordinates, large coordinate systems, in Revit?

MARK KING: So the question is, how are we dealing with coordinates systems in the Revit models? And I don't have one solid answer for you. We've done it a couple, well, three different ways. Number one, we move the model inside of Revit to state plane or world coordinates, and then rotate true North so it comes in correctly.

Another way is we just use what we got from the architect and create a second coordinate system in there. And, basically, that's based off 00 as a grid. Obviously, having it in state plane coordinates is preferable, especially the layout guys, because we have control that is based on real world coordinates. So the way we're doing it on the current project I'm on is we move the model. I mean, move the model-- we told the model it was in a different place. That's probably a better description.

AUDIENCE: So you're incorporating the survey control points into the model beforehand. Because most of you get a model, it's just stuck down at 00 [INAUDIBLE].

MARK KING: Correct. Yeah. So in this particular case, the model we got was started back in about 2007, it was a project that kept getting pushed back, and the architect was just learning Revit. So they didn't have any system. They didn't have a zero-- they had no control. So once we got that, we established the coordinates there so that we could use Point Layout. So it's worked out good. I wouldn't say it was perfect. Because you have to play with that true north, because they gave us a grid intersection at diagonal corners of the building. So if you only go out three decimal points on the true north, you've got to play with it a little bit. Great question.

GREG SMITH: I've got another question here.

MARK KING: Go ahead.

AUDIENCE: [INAUDIBLE]

MARK KING: So a lot of our projects, we are required to have a licensed survey or come out and establish control, especially when we're working for University of Washington, which, we've got four projects going with them right now. So they will come out and establish control. And, I don't want to say they go away, but unless we need something else from them, that's all we get from them. And then our layout guys take it from there.

GREG SMITH: And just to pile on a little bit, we use surveyors all the time for layout as well, not just our own internal guys it. It depends on the project, and depends on the amount of risk, and things like that.

MARK KING: Correct. Yeah. Yeah, thanks.

GREG SMITH: It's all of the above.

MARK KING: So, again, going through some of the things that we're using at Point Layout that are kind of nonstandard. But a lot of times, we'll drop safety tie-offs through our decks, or cast them in our decks. So we can put those in the model and our layout guys can go and shoot it up on the ceiling, or on the roof, or on the deck, if it's a metal deck. Same with roof anchors.

Site features. I think Greg used the same image, so I'm a little embarrassed to recycle it. But we have a lot of things on the site that we can lay out, like curbs, sidewalks, walls, feature steps. I actually used Poing Layout to do some RADIUS features steps last year. And I'm particularly proud of this one. So the superintendent says, hey, can you give me a line where the waterproofers need to go. Because they had to backfill this in a couple of days and they needed to get up there.

So I brought out the tempo drawings and kind of marked it out along there. And then I gave the layout guy the points along the wall where that needed to go. So, kind of thinking out the box a little bit there. And then again feature stairs.

So a few tips and tricks. I'm sure a lot of you probably know more than me about Autodesk at this point. But we talked about embedding points in families and

locking those. So work with your layout teams and develop those standards for the naming and numbering conventions. And it's really important that you guys are all on the same page.

And Greg, you know, was hammering on communication. I can't-- I mean, I echo that because-- like on the Burke Museum project I'm working on now, literally the layout guy and I are talking three, four times a day. A lot of times he says, hey, can you give me points for this. Or he'll call me from the, I'll be on the trail he'll call me from the site, and I'll run him out some points so he can get them in his data collector.

OK, so this is something that came from the layout team when we first started using this on the first project. We gave them all the grid intersections, and of course, they're just all numbered with a prefix. And he says, you know, that really doesn't help me-- because at the time he still had one of the little pads-- He said, I really like the grid intersections to be the point numbers. So of course, when you use the automated system for grid intersections it comes out and it puts the grid intersection in the descriptions column. So I used a-- I'm not an Excel expert by any means-- but I use this command here to split that description column right after the end and intersection. And then I copy and paste them into the point numbers. So, just a little tip there. So afterwards it looked like this. So now when he pulls that up on his pad, he sees right away the grid intersections. And before he was having to swipe over quite a ways on his pad to see those.

Some of you may not agree with all these. But one of the ways I do it is-- like on the Burke Museum-- when I go to do it and extract all the points, or export all the points, I go and I do the entire project. I don't bother messing around with filtering things out, it's just easier for me. It's not a massive project. So I'll export everything and overwrite the CSV file. And I go in and I format that. And then I copy it into-- like if I have six different elements that I'm tracking, I'll copy it six different times. Because-- at least our layout guys want to see individual files.

And then we Leverage Box. So we have Box Enterprise agreement. So I put all of those CSV files in a BOX sync folder for him. And I give him the heads up, you know, Brad, I just updated the files. And so the next time he's in the office he'll sync those back up to his pad.

And communicate. Communicate, communicate. One of the things-- Greg mentioned grid offsets. And so that's one of the things that Brett and I talk about first on that project. He's like, where do you want to see those points that aren't directly at a grid intersection? So he said well let's get a two foot off-set. off this grid, this grid, this grid, this grid. And so we were able to put those points in there for him.

So we talked a lot about the benefits. You know, we're saving hundreds of hours on a project for these guys to go through and page through drawings and do all this math. So I mean, that's the real low hanging fruit. And, you know, I put a question mark after eliminating human error. Yes, if everything is right, if your model is right, it's georeferenced properly, you can eliminate that error. But you still have to go through the process and make sure that you're doing things correctly, or you can get too dependent on the technology. So you have to be a little bit careful there.

Some of the challenges that we've had. Ensuring that they have the latest point file. And that, again, goes back to communication. You guys know on a construction site things are fluid. I'm doing, you know, all the detailing for the concrete, something changes, we re-export. If I don't tell our layout guy that I've got a new file for him, you know, he's going to have the wrong points. So you got to always be talking to him about that.

And one of the things that we struggle with at Skanska is, there is a philosophy, I guess, to bring your layout guy on just in time. So like, OK, we need to start laying out tomorrow, let's bring Brett out this site. And what happens there is, he has no ramp-up time now. He doesn't know the project. He's been working on another project for the last three months. So it's something that we're struggling with and trying to convince the people that schedule his time and pay him that, yeah, let's give him a week. I mean, minimum a week on the project to learn the project. That gives him and I time to coordinate and decide how we want to do this job, not just a last minute scramble, which it usually ends up becoming.

Right. So, yeah, Zeke?

AUDIENCE: [INAUDIBLE]

MARK KING: Yeah, so that's a good case where he is on the project beforehand. So Zeke's out of Portland. I'm out of Seattle. I think there's-- a slightly, a little bit different philosophy there, I'm not sure.

But the other problem is, we only have three guys to cover the entire Seattle area. So that is one of the limiting factors. But if we could get those guys on a little earlier, we would definitely be more prepared and I think more productive as we go through the layout process.

OK I'm going to give you-- somebody said it'd be a really great idea do a live demo. Was that you? So, any questions before I get into that? Yeah.

AUDIENCE: [INAUDIBLE]

MARK KING: I've got terrible hearing, I'm sorry.

AUDIENCE: How do you handle the changes? So let's say they're pouring the concrete but the [INAUDIBLE] has changed for the upteenth time. And they're out there laying points [INAUDIBLE]

[LAUGHTER]

MARK KING: Right, and that never happens.

[LAUGHTER]

Again it's a communication thing. I mean, I don't-- there's no silver bullet there. It's, you know. The project I'm on right now is fairly small. There's only a few of us in the office, but, like a project engineer who's in charge that scope will come to me and say, hey, you know, we had to move this or this wall is changing or we have a different set up here. So it's really about communication.

AUDIENCE: A 2D CAD plan, with a cloud around it would probably work best for them, so they know which area to focus in on? Maybe even identify the numbers of the points so they can go back [INAUDIBLE]

MARK KING: Right. Yeah. And then, we work so closely, Brett, the layout guy that's out there,

and myself, that we would have that conversation the second it came up. But we use BOX and Bluebeam for all of our mark-ups. So our live set of drawing is on Bluebeam. So that would be marked-up on that with an RFI.

OK, thank you for a question. Anything else?

AUDIENCE: [INAUDIBLE] it's like, one or two light fixtures that have moved, they can actually do a manual point movement inside of the [INAUDIBLE]

AUDIENCE: I didn't know that, OK.

AUDIENCE: [INAUDIBLE]

MARK KING: Yeah, that's a great point. So his point was that the layout guys, inside of their system, can actually move the points as well. And we did a lot out at Tacoma High School when things were changing.

AUDIENCE: Could you just reiterate the process of control, and sharing control, with your sub-contractors? I know we didn't dive too deep into that, but, starting on the same point kind of thing.

MARK KING: Right.

AUDIENCE: And the risk of that kind of process?

MARK KING: Yeah, so neither of us are surveyors.

GREG SMITH: Yeah but, I mean, it is not just in layout. It's in coordination, too. I mean, it seems like it's CAD 101, but we have that challenge on so many projects. Any time I start a coordination project, I take the architect's model and I export the grids and maybe some of the building outline for some context, into a CAD format. And I give that to everybody on the team. I post it to BOX or someplace that everybody can get it. And I say, that's your location and space. So on the layout it would be the same thing. I mean, you know, but like I mentioned at the beginning. Georeferencing those models is like, the critical step. And then sharing that information with the subcontractors.

It sounds like, you've done a lot of layout?

AUDIENCE: Yeah.

GREG SMITH: So how do you take care of that with the subcontractors?

AUDIENCE: It's a constant battle. There's no real good way of taking care of it because if [INAUDIBLE] 2 million feet away from zero, so if they build their model in a true georeferenced location, [INAUDIBLE]. It just blows it all to pieces. So, there's no real good way that we know to deal with it. That's why I was curious how you guys were handling it.

GREG SMITH: Yeah. I mean, other than communication and making sure people have the same information, same file, you know.

AUDIENCE: A lot of times we deal with, like, truncated coordinate systems. So, you know. [INAUDIBLE]. And just deal with like, a 5,000/5,000 range that's referenced correctly. But your zero is now at the big portion of the coordinate system. That's kind of the deal with a lot of it, too.

GREG SMITH: You know, Jennifer, you were you were-- dang it. I knew I was going to trip on that again. You're mentioning a project that might be off by 6 or 7 inches or something. We had a building that we placed 12 feet off.

[LAUGHTER]

And it wasn't actually us, it was a surveyor, but.

AUDIENCE: I would say it's a subcontractor we work closely with. [INAUDIBLE] Get those control points inside a building. And so, it really-- it doesn't matter which way you building is oriented in space. It really doesn't. As long as you have those control points. [INAUDIBLE] But a machine, [INAUDIBLE] computer, once you find out where it's at. [INAUDIBLE]

MARK KING: And so, one other point to answer your question is, the last, I think five, projects we've started using a little bit of a different process. And we talk about trade coordination. And so we're creating all these georeferenced files for our subcontractors. So, Brad is actually on the Burke Museum. So that's all on BOX. And available to them. So when they download that, we just say, OK you're going to model per this CAD file. So we give them a CAD file that's already

georeferenced, that's at the correct elevation, and then they go from there.

AUDIENCE: I've got a question. So, typically we do [INAUDIBLE]. That's where you know where your pipe is. [INAUDIBLE] So I guess, when you're using this to shoot your hangers and your straps in all of your locations, how are adding the points? Are you adding them [INAUDIBLE] or are you bringing them back to AutoCAD 3D? You're the one making the points, right?

AUDIENCE: [INAUDIBLE]

MARK KING: I'm going to get the demo here and then--

GREG SMITH: Point Layout works. Go ahead, Mark. But Point Layout works, with Navisworks too. I've never used Navisworks, I don't know if you guys have. Anybody use Point Layout in Navisworks? Oh, you have? Does it work pretty good?

AUDIENCE: [INAUDIBLE]

MARK KING: OK. So it sounds like a lot of people are fairly well-versed. So maybe this is a little elementary for some of you. But this is just a portion of the model that we're working with out at Burke Museum. And zoom in here. And see that, this is just one of our footing families. And if we go and we take a look at that. You can see that the points are in there. I know I told you I put them on the bottom, but I haven't got to it yet.

[LAUGHTER]

I just got that suggestion a couple of weeks ago. So it's locked to the corner. So when we bring that into our model, no matter how we flex that and tell it what size, it's always locked to the corners there.

OK so, we'll go to export. Like I said, I prefer just to export everything at once. It's just, for a smaller project, it's easier for me. And that way I know I'm catching all the changes that's happened. So looking at some of the settings here. Greg mentioned earlier. So we work with northing and easting so it's YXZ, which when I first started working on it was really backwards to me. We work in decimal feet, obviously.

I don't do many DXF files except for the grid views. So when we export the grids I definitely do that and give it to the guys. And then if they come back and they say, hey, can you give me a DXF of something else that's specific I I'll go and do that. But it's kind of like, if-- only when they ask for it. We're going to check for duplicate points. We're going to do it in a CSV file, comma delimited. And then we're going to use internal coordinates. And you can see some pretty funky numbers there. Those are, I mean, those are world coordinates.

And then we're going to export the name. And that should go to the right spot. Say OK. So no duplicates. So like I said, I already had a file there. I don't keep multiple files because I don't want to have to manage that, you know. I don't want to use the wrong one. So I overwrite the files. I have 511 files.

And look at that. So, there is that file.

So now you can see the different prefixes that were pulled out of that. So what I do with this, generally, is I-- first thing is I get rid of that. And then I take these and format the cells to be a number with three decimal places.

So now it's formatted the way I want it. Like I said, I've got several different element types in this file now. So I'll go and I'll save this over five, six times whatever it takes to break up those into individual files.

Yeah?

AUDIENCE: Is Point Layout, is that an add-on program?

GREG SMITH: It's a plug-in for Revit from Autodesk.

AUDIENCE: And then, are the points themselves, are they entities?

MARK KING: They're families, yes.

GREG SMITH: Yes?

AUDIENCE: Are you setting up the survey point to read the millions of decimal places? Or [INAUDIBLE]

GREG SMITH: We can set it up either way. We can set up like, at a zero, zero or we can set it up

based on the survey points. And that's what we're talking about as far as putting the model in a location in space that's coordinated with the survey, or just using the architect's model and having an internal control system of how we're going to do that. But the best way is to georeference the model with the survey information, so it's located in space in Revit in the correct location.

AUDIENCE: Do you have any issues with the fact that when it's georeferenced from the survey that it's millions of square feet or millions of feet off zero?

GREG SMITH: Millions of what?

AUDIENCE: Well the suvey points are typically, like, 1 million a hundred thousand something or other. Revit doesn't necessarily like things very far off zero, so, is Revit the issue sometimes?

MARK KING: I moved that control point in the--

AUDIENCE: [INAUDIBLE]

MARK KING: We moved that project base point to that grid. So it doesn't know that the project is a million miles away.

AUDIENCE: So you still-- your survey point is at zero, zero, but your project point would be at the, a lot closer.

MARK KING: Yeah. Yeah. So we've got a couple minutes left. I'm going to go ahead and show you an example of importing files. So this is an elevator pit. After we poured that, the superintendent asked our layout guy to go shoot the corners of that to see where it ended up. Again, it's a similar process. We go to import. This is a file that he created. Actually, he gave me a text file, I created a CSV out of that. And so there's the points. Again, it's YXZ for the northing, easting, decimal feet.

We're going to call these as built point zone. And use the same coordinate system. And if everything works right, oh. No, I'm going to say these are walls and-- Who said live demos never work? So, there's the four points that he shot. So you can see it's-- in construction world that's pretty close.

[LAUGHTER]

I think one of them was like an inch and an eighth off. The rest of them were within-- OK, five minutes left. That's the extent of my demo. So any other questions or comments? This might be a good time, if you have better ways of doing this, to talk about it.

GREG SMITH: Yeah, please share. Go ahead.

AUDIENCE: Did you put [INAUDIBLE]

MARK KING: Yes. The question was, did we put the survey control points in the file? And yes, we did. We also, one other interesting thing about this is, we had the layout guy shoot buildings that were across the street. So we had corners of the buildings to make sure that our crane was missing them. Just another way to use it, yeah.

[INAUDIBLE]

AUDIENCE: I work for a [INAUDIBLE] In one of the instances recently, where in our, the way we're writing our contracts now, we do a lot of multi-family housing with podium and wood construction. And after you go up so high, you know, you have to move everything up. [INAUDIBLE] Can't physically see things on the ground. You have to move things up. There's a disconnect between the speed that we're finding the self-performing concrete guys can lay out and pour slabs versus the wood framing. And so we're-- it's just kind of common, in general, that when we write contracts now, we're asking that the concrete guys take on the layout of both the concrete and the framing.

MARK KING: Oh, OK.

GREG SMITH: So we've got a very similar project right now. It's all concrete but it's a hotel. It's like 30 or 40 stories. And that's actually a situation where we brought in the surveyor to do all of the layout because our guys-- you're right. You know, down here they're pretty good. But as we started going vertical like that, they can lose control, so.

MARK KING: Yeah that's a good point. That's one of the cases where we would have a professional surveyor out there. All right, all done. Thank you everyone for coming.

[APPLAUSE]