LUCY KUHNS: Hello. Welcome to-- as someone said, one of the only survey classes at Autodesk University-- and as we start on this realm of building information modeling for infrastructure, we're starting to see some interesting problems. And the problem I'm going to talk about is a construction problem that we'll kick off. And-- anyone here from New York, the New York area? And you know this bridge. If you fly into JFK you probably would see this bridge. And the example that we have here is the classic problem of grid to ground, where we have projections and we have true construction measurement. So that's going to be the problem that we're going to be faced with in the wonderful world of building information modeling for infrastructure.

So at the time, in 1964, this was the largest span of bridge in the world, and the unique problem is that when we design, we design on a piece of paper. So we design a flat and when you actually build this when they built it the 600 a 93 foot towers at the top or actually 1.7 inches further apart than they design. So what do you suppose that did to the steel cable that was stretching between it? Doesn't seem like be a big deal but 1 and 1/2 inches is a big deal to put that extra stress on that cable.

So can we solve that in Civil 3D. We could have solved-- we can solve this problem in Civil 3D. And let's just open up Civil 3D and take a look at this example.

So I have-- and I hope you can see the screen OK. It seems like it's a little bright in here-- here is the project on a grid. And if I zoom in and take a look at-- there is one end, the towers on the west end and the tower on the east end. So just remember those point numbers. The bases are point number 1 and point number 2, and the tops are point 3 and 4.

And so what I want to do is I want to get in and on my analyze tab I just want to do a quick inquiry. And the inquiry type I'm going to do is a point to point inverse. And I want to look at the distance between the bases. And we said it was point number 1 and point number 2. And if I take a look at that, down here at the bottom, we can see that the geodetic distance is greater than the grid distance, which makes sense, because in that part of the projection that's not outside the edge where we have an inverse scale factor.

So I want us to remember this number right here, the grid distance, and I've put it-- it has zeros at the end to make our calculations easier.

So now let's take a look at the top towers and those were towers three-- or points 3 and 4. And when we calculate those, we can see that the difference is 0.1413, and it's also the same distance if we do this geodedically just because we're not going a very, very large measure. So whatever the delta is or the difference, we see that the difference is 0.1413.

So I want to see if what the contractors told me, that this difference was 1 and 5/8 inches, if that's really true. Now, I can use in Civil 3D or in AutoCAD, I'm just going to use the calculator function-- and CAL for the calculator function-- I'm going to take that difference, which was 0.1413 and I'm going to multiply that by number of inches in a foot, right-- because I want to see what's going on here-- and so that's by 12-- oops, not by zero 12-- by 12, and let's look at the result.

So the result is 1.6-- you can see it right here-- 1.7 inches. OK? And 1 and 5/8 is about 1.7 inches. So we used Civil 3D to solve the contractor's problem that they ran into in 1964.

And also, to show that as a function of elevation we are seeing the effects of grid to ground get greater and greater and greater. Now, the reason that this works in Civil 3D is if I go to the settings, and if I look at the settings for my drawing, in the transformation tab I have elected to put on and toggle on to account for sea level factors. So that means it's going to take into consideration the height above sea level. The height above our geoid. So that's how we could use this to solve a problem.

And again, in a nutshell, any kind of projection that we use is a flat projection. However, the geodetic surveying that we do is going to be the more like what we're going to see when we calculate this on earth. So what would happen if our challenge is coming to meet us as we start to see these BIM projects longer and longer and more area and more linear length. And then we have this, our designs traditionally and in InfraWorks for example and in Civil 3D, we're designing on what, a grid or a ground?

We're designing on a grid. This was great for us in the old times when we weren't doing miles and kilometer long projects. The advent with all the new technology in the field of surveying and geodesy allows or is giving us this wealth of information. The advent of GNSS, which the navigation, excuse me, Global Navigation Satellite Systems, and now we have many of these systems, NAVSTAR, GLONASS, GALIEO, and all of you now I'm sure that your serving profession has changed from sites and visual observations to more collecting things RTK and using GPS. Correct? Yes, no, maybe?

So in your work, would you say 80% GPS? More? 100 percent GPS? Less? OK. Who does more traditional or observation type surveying than GPS surveying? Is there anyone here that still does more observational?

AUDIENCE: [INAUDIBLE]

LUCY KUHNS: Construction stuff. That's the answer. And because, when you do construction stuff, the observational is giving you what? It's giving you that true measure. So that's the right answer.

Now what would happen if we turned the clock forward from 1964 to 2001, 2004? And this is the highest bridge in the world, and its height is twice what we saw in the New York bridge, and the length is quite a bit longer. So what if we would have designed this entire thing on a grid? You can imagine what the difference would be when we laid out the construct-- when we ordered up the materials. Hello, give me x kilometers worth of cable. And then when that last cable pull-- oh my goodness, we're this much short.

So this works-- the same thing with pipelines and any kind of very long linear information. So let's take a look at how we can take some of these localized coordinate systems and use them in Civil 3D and then also get them to be used in InfraWorks.

So we have a variety of sources that are typically-- for example, if I had GIS data, if I have shape file data, if I have parceling data, is that grid or ground measure? Yes, it's grid measure. So all the tools that we're using are bringing this all in on a grid. And so we need to have a system that can consume and use all of this grid information. But yet, when I want to build something or yet when I have to comply with an agency that has a special-- and I'm going to call it an assumed coordinate system-- and I don't want to get the syntax between local and assumed-- I want to get this straight.

When I say a local coordinate system, and the example I'm going to give you is on British National Grid. And that would be something like a State Plane Coordinate System. I'm going to call that local. It's local because it's localized to a state or a section of the state. It's localized to in an area. And the assumed coordinate system is going to be the one that we are going to customize. So assumed coordinate systems-- we used to do, what, 5,000 5,000, 10,000 10,000, things like that. So that's going to be what I call assumed.

Now, the assumed one we're also going to assume is going to be in ground measure. So that when I buy the cable, I'm going to buy the right length of cable. If I pave the road, I'm going to buy enough asphalt to pave it. All right?

So this requires localized accuracy. And I'm going to point out why this is such a dilemma and why this is going to be a problem, and am I going to solve this problem for you today? No, I'm not. Duncan I'm sorry. We're not going to solve the problem today. We're going to make you aware of the problem, and we have to think how we're going to move information modeling to solve-- the tools that we use to solve this.

I'm going to show you how you can solve it in localized small areas but not for big, big long projects.

Computational values. Precision is going to be compromised in some of our BIM tools. Has anyone ever use Revit? Anyone ever tried to design a Revit building at like UTM coordinates where you got 1 and 1/2 million meters away from the equator-- that will be up here. What happens to your Revit model? It explodes, because Revit is single-precision accuracy and calculation, and we know that our tools, the AutoCAD verticals, are double-precision. So I'm going to show you how we can get around that in one of my examples.

Oh my goodness, here's a process map. Why am I showing you a process map? Because when you get into BIM for information modeling, you have lots of process maps. And this is the documentation that you have to do when you are starting a BIM project. You have things that are overall process maps. And then we start to get into detailed and process maps. And here's a skeleton process map that you can tear out of this PowerPoint and start to use, change it to make your own steps and your own procedures, but those process maps go where?

They're very important because they go in your BIM manual. Your workflow manual and your actual instruction manual. Documentation in an overall BIM project is incredibly important and so I'm surprised if you haven't seen more of these slides the last three days at Autodesk University about process maps.

All right. Let's start with our project. We're going to identify our project and we're going to find the area that we are interested in. So here is a big view of the project, and I'm going to zoom in, and the task at hand is we're going to locate an actual structure at the beginning of this bridge abutment, and we're going to have to locate it in a localized highway agency coordinate system.

So the first thing I'm going to do is identify where I'm going to put my control point. Notice that I use the big maps, so that I can make sure that when I send the surveyors out to put the control, I'm not putting them in the middle of a forest or in the bottom of a gully. All right? So there is my control point. Now, the control point, as use as you can see there, that control point has a northing end easting and a latitude and longitude. This drawing is set up in British National Grid. All right? That's my control point.

Now, when we go to a custom coordinate system, there's usually rules, criteria, how this is calculated. All right? So here's an example with the England Highways Agency on how they want you to convert from a grid coordinate system to their Highway Agency system. So I'm not going to bore you with the details, but I want you to know that there are standard formulas. Or if not, if you're just making up your own custom coordinate system, is it a good idea to write down the process? So that the person that comes after you is not going to be confused, and so that you have ways to validate and get things going.

Now, here's an input here's an interesting thing. The good old AutoCAD block. Now I used to do a lot of surveying in New Mexico, Colorado and Arizona. That's where my license is good. And we, at the advent of this great new information, the GIS information-- New Mexico is one of the first states that flew the entire state and we had sub-meter contour maps for the whole site, which was going to put me out of business because we made a lot of money doing topographic surveys. And now, the flights and the contours and the DEMs now are getting so precise that if I was only doing topographic surveys the old fashioned way I would certainly be out of business.

But these topographic surveys were all done on a grid. So how do you get that from a grid measure to a ground measure? Oh, you just apply the inverse of the scale factor. Oh, what does that do to the elevation? OK? So that's why we have to use an AutoCAD block. So we take the AutoCAD block, you put all of the contour information in an AutoCAD block, and what can you do when you insert a block in the drawing? Scale it by the x, scale it by the z-- excuse me, scale it by the x, scale it by the y. I was just seeing if you were awake.

And what do I do with the z-scale? 1 OK. So now this is going to be a common theme. This is how you're going to take, for example, a Civil 3D corridor model. Now, will Civil 3D objects scale? Can I pick them up, put them in a block, and scale a Civil 3D object? Yes, no, or maybe? No, no, no. You can't. All right. So good. We all passed that quiz.

The thing-- what's the tool that we do with corridors to make them useful outside of Civil 3D?

What is the command? what's the thing that you do?

Louder, louder. You export it, but it's not an export it's a--

AUDIENCE: [INAUDIBLE]

LUCY KUHNS: Yeah. OK. OK. I will buy that. I will buy that. OK. Export to CAD. And even we probably export to solids right? Because we're BIM'y and we know that solids were for BIM. And so export to solids, or export to-- you're absolutely right-- to what? CAD. Because CAD-- and solids are CAD-- can do what? Exactly this. You can scale them, rotate them, and keep the z at the same value. All right?

So that is going to have to be your technique in the short term to take these exotic models and get them into a ground measure. All right? So-- oh, by the way, when you scale, the-- what does CSF mean? That is the Combined Scale Factor and we'll look at what that means right now. So the Combined Scale Factor. We have a scale factor that is the grid to ground, like the New York bridge, the Verrazano bridge, but I also have another scale factor. As I get higher and higher in elevation-- if we get up in elevation that is greater than-- and here I'm showing this in bands-- look, if I'm up to 800 meters I have to apply this secondary scale factor to the horizontal scale factor. All right? As we go up, up, up, up. Does that make sense? All right. So that's what we end up with is a combined scale factor.

So we have the two scale factors. We multiply them together and that gives us our overall scale factor. Now, you realize if you're at sea level that that first scale-- the height scale factor is going to be 1. That gives us our combined scale factor and we have to do that.

Now, here's some more rules. This is the rule for this particular assumed coordinate system. This is the Highways Agency in England, and this is the rules of how they get their northing in easting. OK? So that's just the procedure for the easting. This is for the northing. So basically what I do is I take the national grid number and I apply the formula.

Now, the cool thing is, in Civil 3D we have the ability to put expressions into labels. So that means that I can make a label that will work in my British National Grid drawing and tell me what the equivalent northing and easting is in the Highways Agency System. Now, when I say Highway Agency System, I want you to think the same as if I said State Plane Coordinate Zone. OK? This is exactly identical to what you can do with the State Plane Coordinate Zone.

So once you have an Expressions for labels are really easy in Civil 3D. Just do your math, put it in parentheses, put the division sign in there, and that's the expression.

So on your settings tab in Civil 3D at the bottom of the collection for your labels, that's where you find the Expressions tab.

So I've created the calculation. I have the Expression for the northing and the easting. Make sure that when you make the Expression that you format the result as what you want it to be. There's distances, there's reels, there's strings-- and this is a coordinate value. Then we can apply this label style to our British National Grid drawing. Why do I want to do this? I want to validate what my future custom coordinate system is going to be.

So once you have that expression in there, look what happens when you design a label style. In the dropdown you can see the custom Expressions that you made. They will automatically show up in that label style, and there is the northing and the easting. And I'm just going to-- how many times have you've forgotten to push the arrow button? OK. If I had a dime for every time I forgot the arrow button we could all go out to dinner and maybe even have lobster.

OK. So now I'm going to update that label style. We'll change it to the style I just made, and we'll see now I have the information not only in my local grid but the assumed grid. This is kind of interesting. When we do an assumed grid, there's a reason that these numbers are off by a magnitude. All right? Do you see that this number here is in the thousands and the number in the top is in the hundred thousands. Why do you suppose we do that?

AUDIENCE: [INAUDIBLE]

LUCY KUHNS: So you know what you-- right, so you don't get confused.

And I can tell you, I came across a coordinate system in Finland and it was like 25 trillion. They put the UTM zone as the prefix in front of these numbers. Oh my goodness. Those numbers are bizarre, and that'll take a hatch pattern and blow it to pieces if you try to draw it in AutoCAD. All right. So we're going to use the MAPCSCREATE command, and we're going to use the information that we just found out and we're going to make a custom coordinate system for our localized point right there. So we have to know what the latitude and the longitude is and we have to know the northing and the easting that we're going to translate this to, and we have to know the scale factor.

So this is just stepping through-- it's a wizard-like thing, and what we're going to do is we're going to take the base, which is the British National Grid so you don't have to worry about defining the datum or the geoid or anything like that. And that's going to-- I'm going to create this new coordinate system based on the British National Grid. You would do it, for example, based on your State Plane Coordinate Zone grid. Make sure you give it a special name and the description-- be pretty good about how you're describing these things.

I forgot to put my name in in who made it. And here is where the goods happened. Here's where we have to look at the information that we just created, and now I take the central meridian-- remember, if it's west, it's negative. OK. Right. Your longitude is negative in the west-- and the latitude-- and then I have to put in the number that I calculated for our assumed coordinate system-- that point. So all I'm doing is taking the latitude and longitude and making it that special point that I did. Now the scale factor.

Now this is the interesting part here. There's that combined scale factor. OK?

So I have a custom coordinate system, and the limits-- I'm going to keep roughly the same latitude and longitude box as the British National Grid-- and that is-- those are the steps. All right?

How many of these custom coordinate systems can you make? As many as you want. And you're going to see that if you do have long alignments, you're going to have to make many of these at the different areas of interest, because this is only good for a small area. We can't do long alignments based on just one coordinate system. All right, I'm going to validate the coordinate system with a good old shape file and probably our Bing maps. So what I'm going to do here is I'm going to drop some shape files in, open up the Map task pane, and we're going to zoom to the extents of that shape file and see what it looks like.

So I have a shapefile that is the center line of that road alignment, and I also have a shapefile that is a couple of control points. And here's the nice thing about shape files is it's tabular data and geographic-- excuse me-- yeah, and data on the screen. And you can hook back and forth.

So now, I'm going to set, in a new drawing, this coordinate system that I just made. All right. Now, when you first make a coordinate system, here's a tip. Shut down Civil 3D and open it up again. If you don't shut it down you won't get the coordinate system. You have to shut it down after you make it and then open it up and it'll be right in the list. All right. So now, I have that new coordinate system, and I'm dragging and dropping the same shape files in. OK? They look OK. But the acid test is putting the Bing maps underneath them. And do the Bing maps work? Let's look at it side by side. Let's see side by side.

So on the left hand side we have our custom coordinate system, and on the right hand side we have the grid. So the British National Grid or for example this could be your assumed coordinate system and the State Plane Coordinate System. All right. So things look good. The points line up. The aerial imagery lines up. So I'm encouraged. I could probably put this in InfraWorks. All right?

So but let's take it a step farther. Let's go into the survey database. Now I love the survey database in Civil 3D. Why? Because it's separate, it sits on the side, and it's protected information. And when I make a survey database-- here I'm setting up where it's being-- the folder, the local folder-- that survey database is intelligent. It knows what coordinate system that the data that you're going to put it in is. So in this particular case, I'm making a brand new survey database. I'm calling it SBA dash 0 0. Now, here's where I tell it to be geospacially aware.

I'm going to tell it-- and again, my custom system-- I put it in the group for Great Britain-- when I drop down the list, it's going to be in the list. And there it is. There's the custom coordinate system. So now, that means that the information in my survey database is in that custom coordinate system.

Notice that I'm also-- I'm making some of the settings so that we have more precision because I want you to see these values. Oh, that other stuff about inches mercury and all that, what's that good for? It's only used for least squares adjustment. OK? If you use an equipment setting.

All right. So now I'm going to take the points-- the control points-- out of the drawing, and I'm going to put them in the survey database. All right? So I've grabbed those points, we put them in a network-- a network is just a collection of objects, it's not a true network like I'm going to go around and do am adjustment-- and that's a syntax error I think in our survey database that we call it a network. Because when I do a network I think it's a control network. Right? Try to adjust it and get it right. You know? But it's just a collection of information.

All right. So now those survey points are in the database. Look at the northings and eastings. Those aren't British National Grid. Those are the ones that are in my custom system. All right?

And we can check with our British National Grid and we can see that everything makes sense.

We can check the latitude and longitude, everything looks good, and we've got a nice survey database in our custom coordinate system.

I'm going to show you some more things that we can put in the survey database to do that. And in this one-- I think we're going to push these to the base map.

OK. Here we are, and we're going to push these into our base map that is in the custom system, because I want to show you how we set up two drawings side by side. All right. That's the one in our custom system. So we've got two things going on here. All right. There they are, side by side. We've got the grid and we've got the custom system. And again, just like we saw before, everything works. Our geospatial information is going to work because I'm validating it with the Bing maps.

All right. Now, let's see how this works-- we saw it work with points, now let's see it work with figures. I'm going to take in my survey database, and I'm going to create a figure from an object. Now this object-- I'm going to call it-- it's a parcel, it's a treatment plant parcel. Oh no. I'm going to do the ring road center line. So I'm taking this from a grid measurement, and we're going to put it into the survey database. What's it going to do when it comes out of grid and goes into the survey database?

It's going to transform. So what is the length of that centerline going to do? Is it going to shrink or grow? It's going to grow. OK? All right. So there it is on the grid base, and now I'm opening it up in the customer base and there it is-- works fine. And so we're transforming on the fly.

Now, go I'm going to take a parcel. Why would this be interesting for a parcel? If the length expands, what do you suppose the area of a parcel would do?

AUDIENCE: [INAUDIBLE]

LUCY KUHNS: Yeah. So good question. When you buy a piece of land, which measurement are you buying? Whichever is cheaper. I can show you how you could make that parcel be so big, it will be bigger than your neighbor's parcel.

All right. And again, let's validate it by turning on the Bing maps behind it. So you can see that we've transformed everything on the fly. So far so good. I'll show you the area thing in my Civil 3D. All right. Now let's take this custom work and let's put it into InfraWorks 360. What I want to do is, in my base drawing here-- and this is my custom base map. What we have is I have a block building-- just because I want something to show you to bring into InfraWorks-- so I have a 3D block.

What's one way we can get 3D information out of Civil 3D and into InfraWorks? What's one way?

How do you guys get your 3D information into InfraWorks from Civil? IMX? IFC. I like the word IFC. We could also take the drawing itself, right? OK? I'm going to do map export here. Map export is going to give me the points and the parcel, and I'm going to do an-- I did the IFC on the building. So IFC on the building. Now, here we're going to bring this information in. This is the IFC, the building. Now IFC stands for what? Ian, you can't answer this. And Nate, you can't answer it either. IFC is what?

AUDIENCE: Industry Foundation Class.

LUCY KUHNS: Excellent. Industry Foundation Class. Look what happens here. If I go in my list in InfraWorks, I'm going to go into the Great Britain grouping. And if I look down the list, there it is. There is my custom coordinate system. Now, I'm working on the same machine, right? How does one transfer a coordinate-- oh, and here's the settings in InfraWorks-- when I have a 3D object in InfraWorks, always look at the 3D tab to make sure that it is-- that your object looks like an object. And I turned of the material so we could see-- you can see I like to have just white shape masses, because I don't want to pollute anyone with architectural styles they might not like.

So there is our building that was made in the Highway Agency's coordinate system, and it shows up in InfraWorks. The other thing that I want to bring into InfraWorks is my control points. So on my control points, I'm going to make those points of interest. And again, fill out the information. And we'll use the big 3D teardrop point. And there's my control point. All right? We'll have to-- if we wanted to we could make a nice 3D marker maybe looks like a monument and put it in or something. But those are just the defaults.

And you saw in the beginning, I had like four control points in the background there, and they're all landing in a good location, in a good spot.

So what we did is we took this highly localized information, created a custom transformation, and it shows up well in InfraWorks.

Now, before we jump into how we get Revit into InfraWorks-- is anyone interested in how you get a Revit model in? Why would I include that in a survey class, a Revit model? Anyone ever opened up Revit? There's a project base point and what's the other point in Revit? Survey point. And that's why I get excited. When we see the word survey, we know that that has something to do with us. So we have to show it in a survey class. Right?

But before we do that, I'd like to go to Civil 3D and I'd like to open up these two drawings that we've been talking about. And I'm going to tile these side by side, and we want to look at some things. Now this is different. This is a little bit of a different project than the one that I showed you in the video. This one is live. And I'm showing you-- this is actually the origin of the B16 coordinate system. And we can see that in our-- the National Grid one is here and our assumed one is on the left. And I'm just validating that those origin numbers are correct.

Now, what I've done here, is we have some parcels. And we talked about the parcels and how the parcel areas would be different. So in the survey database, I'm going to open up the survey database that has the parcel in here. And again, this is a different survey database than the one that was in the video. And just to show you, I'm going to look at the survey database settings, and this one now is in National Grid. It's not the custom one. It's in National Grid.

All right? So that means that when I go into this survey database, and if I look at the figures in this survey database and we go to farm plat number one, and if I look at the properties for this, it's giving me the area. Now, because the survey database is in grid, that area is what? In grid. Correct? Because the survey database is in grid. So that is the correct area.

However-- so remember this, 9.11 hectares-- and I'm going to zoom to that in the drawing here. And this is in that local grid drawing. And I'm going to do what everyone tells you not to do. I'm going to explode it. And then I'll get rid of that. So now this is a good old polyline. Oh, did I explode it too much? Oh dear me. Let's back up a little bit. I think I-- there. That's what I want.

All right. So the properties-- and the area-- oh, look at the area. It's quite a bit different isn't it?

Can you see that number? So that's how you can-- that's how you can sell a lot that's bigger than it really is. I could make that lot even bigger by messing with the scale factor couldn't I? So how do you suppose, in all of our agency offices-- do they keep stuff in grid or ground? Yeah, exactly. And that's why we have things like State Plane Coordinates.

So there is the measure. Now, this is interesting because these do-- and I do want to point out-- and this is the dilemma. This is the problem. At our origin you saw that both of those points at the origin were 0 0 points. And the local grid is starting to drift and become different between the real-- these numbers are different because we're drifting away from where we picked that origin, and we're going to start drifting further and further away. You can see the difference in the northing and the easting. We've got like 20 meters on one and we've got four meters on the other one. So we're still close, but it's not good enough for us as surveyors.

However, it's very interesting because we used a geodetic transform, if I turn on the mapping, we're going to see that the mapping looks really well, but it's the data that doesn't fit. And if I go to both of these, we can see that my outline and my farm plat is the correct in either case.

Let's come into this one and do the farm plat. Come on. Light up. There we go. And let's take a look at a different farm plat that is even further away from the origin. And I'm going to zoom to that one. It's further away and I have some local coordinates tied down. And let's go to this one here in this view. And we can see it looks good, but the actual data numbers are not going to be right. And we'll come in here and we'll look at those data numbers and you can see these now are really far off.

So what does that mean in a nutshell? That these custom coordinate systems are what? Highly, highly localized. And the further away you get from that definition point, the worse the data is going to be. And don't be tricked because it looks like it's perfect because of my Bing maps. The data behind it is not quite right.

All right. I'll ask you, which would you rather see, Revit into how we take the survey point and put Revit into InfraWorks, or do you want to see how we take COGO points and put it into InfraWorks?

AUDIENCE: [INAUDIBLE]

LUCY KUHNS: OK. We vote for COGO points and then later if you want to see Revit you can see-- we can see Revit. OK.

We'll fast forward. I got all excited when I saw survey points in Revit. And it is. It's a little bit of a dilemma.

OK. So now I have some COGO points in Civil 3D. This is a tree survey. The tree survey, we're telling it the tree type, oak, elm, and apple, and I'm also giving it a drip diameter. So I have a style and a size. Let's see how we get a style and a size into InfraWorks. And the first thing we need to do with a COGO point to get it into InfraWorks is turn it into a block, because we don't have a easy, easy way to get COGO points into InfraWorks.

Within the default program Civil 3D, there's the easy button that will turn these into blocks. You don't have to do anything exotic except for select the COGO points and find that pulldown. Now I use the map export command. The map export command is going to make what kind of file? You're not allowed to answer Ian. Shape files. OK. Why do we like shape files? They're ubiquitous. They can work in many, many different kinds of softwar. They hold graphic information and attribute information.

So I'm using the map export command, going through, making sure I pick the right things, making sure that I toggle on the attributes, making sure you look at the bottom of the map export dialog box to make sure that 0 are filtered out. I'm also going to add a unique ID just in case. That will be my key ID that I can connect to. And so I have shape files.

So convert COGO points to shape files. Now I'm going to import this into InfraWorks. And in InfraWorks there is my model. And I'm in engineering view. I'm going to go into conceptual view. So the engineering view kind of makes the surface transparent so I can see underneath.

The shape files-- and there's the trees. The new tree's a shape file. And we'll go ahead and bring it-- we'll configure it first. When I configure it, I need to tell it that it is trees. So I'm going to drop down the type-- and it is trees-- and then we're going to start to give it some-- use the attributes that we just exported out. I'll use the point number as the name. And for the external ID, the ID tree. And for the description, we'll use the point block description, which was the COGO point description. Coordinate system is the British National Grid. I'm going to drape the trees on the surface. That way, because my InfraWorks surface, if it changes, I want the trees to be above the ground.

I'm showing you the big data table, and we're looking at where our data is-- description,

description, name, point, so on and so forth. So I've imported the trees. They don't look like apple trees, elm trees, oak trees, and they're all the same size. That's not what I spent all my money to collect. So I want my trees to work, and I want them to be styled the way I collected them. So we're going to use-- we're going to create some styles.

But just to show you how a style works instantly, I took all the trees and I made them one type of tree, and I gave them a big enough size so that we can see. So at least it looks a little better. But still, I have more valuable data that I need to harness. And in order to harness this-- let's just jump right into InfraWorks. I think I've got this InfraWorks project-- oh, do I not have-- let's launch InfraWorks and let's get this one going.

Nate, if you'd like to come up.

We have a treat. At the end of the class if you want to stick around at the end of the class, Nate's going to show you how to get control points into Recap, survey control into Recap. And I'm going to launch InfraWorks. And how big are InfraWorks files? What's the name of the file that InfraWorks makes? SQLite file. They small?

I think they're pretty big. Yeah. I think they're pretty big. So here is-- oh, let me open this one.

And it's opening the model. I'm sorry I didn't have this open earlier. I should have had this all up and ready for you. It's taking a minute to open. The reason I want to open this for you is I want to show you how we can configure-- and we're going to use string length, string catonization, and substring, and I'm going to look at that description, and I'm going to pull the pieces out of that description. So I'm going to pull out the number for the diameter-- the drip diameter-- and I'm going to use that to help me size the tree, and then I'm going to use the name of the tree and rip that out.

So here we are. Oh, I have some bookmarks. Let's see if they work. Oh, yeah. Oh, there's a bookmark. Woo. Oh there it is. Woo, had me scared. And again I like to use white for my buildings. I'm going to open up the data sources, and let's take a look at the tree data sources. So here's my tree data source.

Now if you look at the-- let me-- OK, there we go. If we look at the trees that I have here-- well those don't look like apple and elm trees, but at least they're different. OK?

So those are style rules, and if I go to my style rules department here, and go down to trees, I have some style rules that have been made for the trees. So in this particular case, I'm taking-- and I've created expressions-- and I'll show you how I did those-- so that I can look and make all the elm trees look like elm trees, the apple trees look like apple trees, and the oak trees look like oak trees. And I'm going to run those rules. And when I run the rules, we can see that they change.

And I'm also showing a size on that. So how did we do that? So if I look at this and double click in here, I'm going to get into the rule editor. And in the rule editor, I'm going to go into the Expression and I'm going to edit that Expression. Now this Expression boxes are not very well documented are they? They're really not. And so what we have to do is, if I select a property here-- so in this case if I look at the description, I want to look at the description that I have and you can see, it's pretty easy. I have the size element as the first two characters in the description. And then I have what the tree is as the last part.

So the description that I'm going to do-- and I'm going to jump down here to actually to this different one. Because this one I'm using a comparison property. So if I look at the functions or operators, and look at comparison, there is one called In. Now, if you hover over these, here's the secret. You hover over these and it tells you what they do. So I literally said that the description, In, has got to be equal to-- and I literally put a list of all of the-- in this case the elm trees.

So I have the 10 foot diameter elm tree-- drip diameter. In this four-- what happens if I had a hundred of these? That would be a pretty long list wouldn't it? So let's look at a different way that we can easily parse out these and-- I'm going to do OK here and let's look at this one. I'm going to use a different type of expression, and this expression-- I am going to use a text function. And in the text function I am going to use a text function that says, if in the description-- and the thing is the-- it's checking the string, it's checking the integer. Forgot the word integer.

It's checking the integer placement in the string. And the way this works is, if you have a string, which is text, and the string is looking for the placement of the word elm. And it will say, oh, it's seven places down. Or if I don't have elm in the string, what's the answer going to be? Zero. Yeah, null or zero. So all I have to do is say, hey, look for elm anywhere. And it's going to be, if elm is anywhere in that string it's going to be greater than what? Zero.

So that means I could parse out hundreds of these trees just by using that string comparative command. So that's what we've done. And I've done that with the apple, the oak, and such, to show you that that is a very efficient way to do that. So that's two of the style rules. And after we commit those we have the size rule.

Now, I have the sizing in place right now. But before we had the size in place, all those trees were what? The very same size. So when I go to configure my trees, this is where we get into scaling. And this is where we can add the scaling factors for our trees. Do I not have those in here? OK. The scale factor on our trees-- again, we can come in-- though I don't have that one ready here. Oh, interesting. I should import it again. There we go. OK, there's my rule style. OK.

I'll bring it up. I've got it on the PowerPoint. The expression that you put in-- and again, it's very similar-- I'm going to take the first three characters and that's going to be-- it's a string, and I know that I don't have any drip diameters that are greater than 99. That would be a pretty big tree. And because it's in the first part of my string, I'm going to pull out the first three characters and-- can I use a string as a scale factor? No, I have to convert it to what? I have to convert it to a real number.

So when we use those expressions, we do have to make sure that they are scaling parameters for that. And that's how you get COGO points into InfraWorks and style them. Yes, question?

AUDIENCE: How do you what scale to apply to the symbol if you don't know the size of the original symbol--

LUCY KUHNS: The question is, how do you know to scale the size of the symbol? What I did is I inserted these particular trees at a scale of 1. And I literally did the distance from point to point and found out how tall they were. And then in this particular case I had to divide by 8. So I have no idea. I think it's-- whoever made the trees in the-- I have a feeling because dividing by 8-- I don't know. They're not all the same. You saw when I put the palm trees in that they totally were not the same. So it just depends on the symbol.

AUDIENCE: [INAUDIBLE]

LUCY KUHNS: Well, you can make your own. Remember how do we-- how do we do it in Civil 3D? We make a unit block. Right? OK.

All right. I'm going to throw it out to you. Revit into InfraWorks or ReCap and control points. You get to vote. OK. This is a real surveying group. I'm going to throw the Revit thing out. I just got excited because there was a survey point in Revit. So I'm-- oh do they only have them? No, here, take a real one. OK. Are you ready?

I'm going to introduce you to my esteemed colleague. Nate can I work for Autodesk, and we're in premium support. And we have the great opportunity to work with some of our larger-- we call them enterprise customers-- but you're all important enterprise customers. But we get the good problems. And Nate and I get to look at these problems. We get to talk to the developers. We get to make defects. We get to work with the great guys here in consulting. We have Autodesk Consulting in the second row here. And they've come up with some great tools and great solutions. And Nate is our ReCap expert. He's also an InfraWorks expert. And he's going to show this new ability to bring survey control into ReCap. ReCap does point clouds. So Nate Moore, it's all yours. And I'm going to sneak behind you and sit down. I'm going to give you the mic.

NATE MOORE: Thank you. [INAUDIBLE]

OK. How's that? How about that? All right. So-- Yeah, like Lucy said, I'm Nate and I'll just give you a quick-- because I think we're at time about right? Or am I wrong? Is it 2:30? OK. I'm Sorry. No, I'm not going to kick you out early. I was coming in from another class on a different schedule. So yeah, in InfraWorks-- sorry, in ReCap you've got this option to assign-- I mean hopefully your scan comes in without the need to go ahead and do the additional points step of adding all this in. When you're lucky, right?

Because it's a little bit hidden. There's two ways to get to it inside ReCap. So what I've already done here is gone through this process of adding in all the different files. And in this case, I only brought in the two, just so we have nice simple process to run through. But you've got this-- Auto Register is great. It'll go through, it'll do a great job of finding those common features between your different scans and bringing it all in. But you do have, just above it there, you can see the manual registration option. And you can either do that here or you can go through here and here you're able to identify those common areas.

Just so that you see the whole manual process-- let me do that and it takes it just a minute to bring stuff up there. And the other thing that's really good about this is this lets you bring in on top of your structured scans-- you know your already structured pieces, other unstructured bits-- so this is where you would do, for example, registering together all of your nice terrestrial scans with maybe a scan-- not even a scan-- maybe a project that you did in ReCap Photo. So when you've gone through the photogrammetric route and you need to tie everything together. So this is how you can do that and get it all into one common coordinate system.

So let's see where are we-- I'm just going to go for a new-- let's see-- registration group. And if we wait a moment-- there we go. So this is just the two different scans. You can see it's already-- it wants me to just ignore the whole thing. It's ready to just merge the two together. And what is cool there is, it gives you a little bit of a preview of how that fit would be. So if you have-- I mean this is simple because it's just the two scans-- but if you have a lot more, it will give you the same approximate layout. So if you're doing this with like internal stuff, you can see if the geometry fits or not or if you've got some weird skewed angles. Things like that.

But in this case, just to show you that manual process, we can just pick a couple common points here. And there's not a-- it's kind of hard to work with the dry leaves. They're not ideal. But luckily we've got this lonely bench out here and a few other things like this. And you do need to be pretty careful about picking those common points correctly. But once you get in there-- if it will let me-- no. It's a real demo.

There we go. There's one. And then you just need to get that into another one here. And I'm on the second one over there. So that is where it falls apart a little bit with the leaves in the background. And it's just not going to let me. All right. Well, so I'll clear that one out and then try something up a little closer. It might just be that it didn't like the resolution of that. So let's see. And of course, there's a third scan in the set that I didn't bring in to keep it simple and it's not going to cooperate as a result.

But anyway, here's the same rock and I'll pick this upper corner of it. There we go. And see, at this point you've got this little icon that comes up a little hidden below there. And this is where you can manually key in your what you've got. So we have the XYZ option there, or the make serve point. And you also can-- if I can find it-- go here. And this is where it gets a little bit more interesting. So I unfortunately I'm not that well prepared. I don't have a txt file to show you here. But it lets you just use your txt and then you pull your values from there. So you don't even have to do the keying in. You just need to know where your control is, go pick it up in two, three, four scans.

And once you've got everything pulled together that way, you just pop it in and off you go. So that's how you get your real control into these unregistered, unreferenced scans. So you can just have your own individual z sorry xyz for each of those and off you go. As long as you know where that all is and have that text file ready to go, you'll be on track. So that's my bit. And remember, you can use it to tie together all those different kinds of scans.

LUCY KUHNS: Exactly. So thanks Nate for coming it at the last minute. How many of you are using point clouds-- point cloud data? And so what, would you say 70% of the people?

NATE MOORE: Yeah, I'd say so.

LUCY KUHNS: Who's using drones? Wow.

NATE MOORE: Cool.

LUCY KUHNS: Wow. That's a lot.

NATE MOORE: On the drone note, it's ReCap Photo and flavor in the cloud has been evolving pretty quickly. But now they've taken out your geotags from the image headers and you immediately get back your geoTIFF and a DEM that fits that and you can bring all stuff straight into Map Civil and [INAUDIBLE] all those other things. In addition to the unregistered point cloud that you get out of it. So you've got really nice options in there. And there's more coming. Even the option to be able to go a step further and be able to pull up the geotags and then refine-- oops, sorry-- with the-- [INAUDIBLE]

I think when you're setting up the project is when you can define your coordinate system and your units. But if you don't do it during that initial setup, you're going to have a hard time.

AUDIENCE: [INAUDIBLE]

NATE MOORE: Well, this came up with some of the project managers yesterday, and basically they-- behind the scenes it's always going to be in metric. So I think that's why it's always defaulting on you back to metric.

AUDIENCE: So there's no way to force it?

LUCY KUHNS: Well, you just need to change Ken and work in metric. Come on. Colorado needs to get with it.

AUDIENCE: It's just the display though.

LUCY KUHNS: It is just the display.

NATE MOORE: Yeah, exactly. How any inches in a mile?

AUDIENCE: I have one question regarding [INAUDIBLE] systems in ReCap, and like when you made you custom coordinate system in Civil, and it was already [INAUDIBLE]. That's not going to [INAUDIBLE] in ReCap. It uses a different library for the coordinate systems. Is there anything in the works to sort of unify that?

NATE MOORE: Well, sometimes it will use the same library. It depends a little bit on versions. But sometimes it gets locked in. Like if you have ReCap, the most recent one, it doesn't go back and read. Say you are on [INAUDIBLE] Civil, it doesn't necessarily read your 2016 custom coordinate systems.

AUDIENCE: OK. Because like I've noticed that it doesn't have all the same definitions that Civil has. We're in Minnesota. Minnesota has a county coordinate system because we like to be different. Wisconsin does that as well. And those definitions are not in. So I just assumed it's using an entirely different library than Civil or some of those other applications.

NATE MOORE: It should be. You know there's those goespatial coordinate system folders, and it should always be pointed back to the current one. But yes--

LUCY KUHNS: But there are. Yeah it's confused.

NATE MOORE: But definitely the place to define is still in Civil or Map, and then it should pick that up. But at different times there have been open defects for that.

AUDIENCE: But I'm just wondering why [INAUDIBLE].

LUCY KUHNS: Call support.

AUDIENCE: [INAUDIBLE]

NATE MOORE: I can try. I really don't do much [INAUDIBLE] anymore.

AUDIENCE: I think it has to do with the coordinate system itself. It blows it out of the water. It really does. It does weird stuff. I always leave that blank until I--

NATE MOORE: Well, that's the thing. If you don't touch it and you know what it is. Then it's going to be OK as long as you define it.

AUDIENCE: Oh yeah. A coordinate's a coordinate whether you're a state plane or whatever. It's all based on 0 0.

LUCY KUHNS: Yeah, and Nate's going to be-- Nate and I'll be here after the class if you have more specific questions on ReCap our InfraWorks of Civil 3D. Stick around, because in case we have some questions.

NATE MOORE: I don't want you to trip on me or anything.

LUCY KUHNS: How many of you have seen the instructors trip on this? So I just want to show you that in the PowerPoint that you can download after this class, here's the instructions for how I did the string parsing to get the size. And here's just a little video on how you get the size on this in InfraWorks. So we can make all of our trees the right instance of size.

And actually we don't need the-- there, that's more important. OK. This is ToFloat. This is how you turn it from a string into a real number. OK? So just a couple of little tips for you so as you venture into InfraWorks that you won't be afraid of doing the expressions. And understand that there is not a lot of documentation on the expressions. But just hover over-- expand the list, hover over them, and it does give you some pretty good information. All right. So since no one wants to see the Revit thing--

I don't want to hold you hostage, because it is, it's the end of the day. And I will actually-- I will say goodbye, and if you do want to stick around I'll do the quick-- I think it takes like five minutes to show the Revit survey base point. And I have to look back through my slide deck to see where that started. And I think it started-- oh it's even-- it's right there. It's only two-- have we got it? OK.

Hey, thank you all. Enjoy the rest of Autodesk University.

[APPLAUSE]

Thank you. So this survey point and the base point, they can be either far away or on the corner of an object, and we just need to know where these values get put into InfraWorks when we configure a Revit object for use in InfraWorks. So we have the project base point, and that is where the rotation for the build-- because architects like to work like this, and surveyors, we know the building is like this-- so architects are going to have-- and they also work on a very flat levels and grids, so nothing does this-- and this survey point is the benchmark that we can tie to in the real world.

That's going to be something that we can tie to in our custom coordinate system or in a local coordinate system. The north rotation is going to be given on the survey point, but it's held on the project point if that makes sense. All right. Let's just look at how this is going to work.

The project point is what we put in in the main category when we configure. Now there's something that you might see is very odd in this. Look at the coordinate system at the very top. What units am I in? International feet. When we bring the Revit files-- this is a bug. It has to be xy international feet. No matter if you're in meters or what.

Now, if you're bringing an IFC in it understands, and you have to match meters to meters and feet to feet. But when you're bringing in a Revit model, this is a little bit of a bug. So here. This is all you need to know, that in this column right here, this is where you put the northings in the eastings in of the project point. And this is where you put the northing and the easting in for the survey point. The offset to the survey point.

If you do that you're going to have success every time in bringing the Revit model in. Now, who's brought a Revit model in and it looks like this? OK. There's two of us in the room that have raised our hands. This, if you haven't had the pleasure of working with Revit models, you will undoubtedly see this problem. Revit sometimes, when you're dealing with these very, very large co-ordinate systems, it's the problem with hatch patterns kind of being torn apart because of the large, large corporate values.

Revit sometimes the models don't stick together when we're dealing with large coordinate values, and that's why we have to have a survey point in there. And the numbers that I'm showing you here are very small, but they can be very, very large indeed on that. So that's it for how you get Revit in. That's just the little cheat sheet. OK?

All right. And with that, Nate and I are here if you'd like to ask any questions. And thank you so much. And I think this is probably we've got one more class for Autodesk University and then we have the party. Hope to see you all there. And thank you very much.