**MARCELLO SGAMBELLURI:** Is everyone excited about this class? All right, OK. Well, today we're going to be talking about Dynamo for Contractors: Practical Applications with Dynamo for Revit. I wanted to-- oh well, OK.

No one doesn't know, my name is Marcello Sgambelluri. I'm the BIM director at John Martin and Associates. We're a structural firm in downtown Los Angeles-- been using Dynamo for about two years there. I taught it to myself. It's a very easy program to learn.

Has anyone-- well, my presentations are very informal. So I allow questions and comments throughout the class. I have no problem with that. How many people have seen me speak before? Few, whoa. OK, so you know I'm real energetic, and dynamic, and oh, I'm so passionate. I love this stuff. It's just so genuine. So I'm going to get everyone involved, and we're going to get to know each other as we go through the course.

OK, so, again, if you have any questions, comments, shout them out, right, complaints, whatever. It will be my job to control and-- I'm very approachable. So, after this session I'll be around there for the week. You can approach me, and talk to me, and geek out about whatever you want OK.

All right, OK, so, let's get into it. Let's get to the formalities. Also, today we're going to talk about Dynamo. And the reason I decided to create this class was I taught a class last year called Practical Dynamo. And in that class, I realized that there were a lot of contractors who came up to me and asked me, how could I use this tool. How could I use Dynamo to help me better, more efficient in my office?

So it was a year journey that I went through. It started about mid-December last year where I just interviewed a pile of contractors, and architects, and even engineers on what would be a good fit for examples to teach in a class dealing with Dynamo for contractors and what problems you face in the office. So, it was pretty clear to me that, for the most part, contractors deal with existing data, existing Revit files. So this class is going to be focused about using Revit and how to work with existing Revit files, how to pull the information you need out, and so on, OK.

All right, Dynamo is moving so quickly. There are other add-ins to Dynamo. You can link it with

Navisworks and other things like that. I will not be focusing on that today, OK. I'm only going to be focusing on the interaction between Dynamo and Revit, and no other external program, OK. Though there are a lot of resources out there, which you can link to other external databases, Navisworks being one of them. Because I know a lot of you in here use Navisworks.

So before I continue, let me just get a poll. I need to know who I'm talking to. How many contractors are in the audience today? Oh, cool, about half of you. And then the rest, the other half, or the other 49% are architects? Is that right? Come on now. Where are you? Because I'm-- OK. And then the other 1% is other. I'm saying the numbers because we're getting recorded. So if you have friends who want to see this later that's going to be recorded and it'll be up probably in mid-December, up on the website.

OK, enough formalities, let's get going. Oh, wait. I have another question, Jeez. How many people have actually use-- other than the pre-conference, let's exclude that for the moment-- how many people have used Dynamo where they actually downloaded it and created something within Dynamo before. OK, so that's about 30%. And that's OK. It's not a requirement. I will treat this like an intro class to Dynamo.

I do request that you have Revit experience. And if you don't, I'm not going to go over the Revit basics. So just bear with me on that. All right, so I already went over this, what we're going to do, OK.

Let's talk about the examples we're going to go through. Now, as we go through, I'm going to give you five examples today-- these are not them. But if you want more, there is a handout that has an appendix in it, which has many more examples, ones that didn't make the cut for this class but I was on the edge of, on the cusp of showing.

So there's an appendix in there with about 30 examples or so. But quite honestly, through the course of the year, I have created over 100 Dynamo examples and I whittled it down to these five for this particular class. So I'm glad you're going to go on this journey with me, because I absolutely love it.

Now how many people have downloaded the handout? It's not a test. Downloaded it, OK. And I only get this question every year. The handout is available on the app. It's a PDF format. So, it's available to everyone to download and look at.

And if you haven't downloaded it and looked at it, I also bring hard bind copies of the handout. So I'll pass this around, and you can look at it while I teach the class. I don't have a problem with that, OK. And if that disappears somehow with someone, then I won't be offended. I'll be honored, because I have created something worth stealing.

[LAUGHTER]

All right, so OK, let's just jump right into it. Let's just jump right into it. First example-- are there any questions before we start? OK. So there we go. OK, enough formalities. Excuse me, my mouth's so dry. All right, so let's do it. Oh, I'm so excited. Oh, I have been waiting a whole year to do this, OK. All right, so let's go ahead and start out slow, and we will pick up the pace. Here we go. All right, all right, so let me give you a little intro to each one. I'll keep an eye on the time. We get here at 9:30.

So what we have here is a concrete ramp, OK, like this. So one thing that needs to happen very often is you need to get the area or the surface area of these ramps for your four more calculations or things like that, right. If you're going to four more calculations, then you don't need actually the top surface of this, right. So you're only interested in the sides, and the bottom, and the sum of that, right.

So there's really no good way in Revit to do that right now, especially with a curved ramp or a curved concrete piece. If you have flat planes, you can calculate it by hand, probably could even do it in your head. So I'm going to show you Dynamo, how you can interact with Revit to extract that kind of information. How you can extract geometry out of Revit and then chew on it in Dynamo, all right.

So this is example number one, here we go. So all you need to do is download Dynamo-- dynamoBIM.org-- it's free, completely free. It's an add-on. It's developed by Autodesk. And it takes you 30 seconds to install. So once you do that, it'll end up here on the add-ins.

By the way, how many people would be interested to know how to actually pull the areas off of a solid? Can I get that? Only a few, hmm. OK, how many people would know people who would be interested in pulling the areas off a surface or a solid? All right, cool.

Now the theme I'm running this whole year is being a hero. Did anyone attend my class yesterday morning? Yeah, OK, about 30%. Yeah, you've got to be a Dynamo hero, right. We all geek out about this. We're learning this very powerful advanced, super cutting edge

program that's ridiculously simple to use, so, it's ridiculously simple to teach. If you're not using it and you're not doing some of these particular examples, show someone who does. Because they'll love you for it. And everyone wins, all right.

So, let's do it. So here we go. New-- all you say is New and you get a blank Dynamo canvas like this. And this is where you'd be placing all your nodes. Dynamo's a visual programming language. It's not text-based, which is awesome. That's why it's so ridiculously simple to use. And you just drop down boxes and wires. They're called nodes and wires, I suppose.

All Right so the first thing we want to do in Dynamo is-- OK, so you open up your Revit session, you open up Dynamo. Dynamo will automatically link to your Revit session. So now it says, OK, I understand you want to work with that Revit file. Tell me something to do.

So, in this case, we want to be able to extract that geometry out of Revit and place it in Dynamo. Why do we want to do that? Because Dynamo has the tools to extract those areas. Revit doesn't, all right. OK, so that's why we're using Dynamo.

So what you do is when you want to manipulate anything or build anything inside of Revit from Dynamo or interact with it, you go to the Revit tab, OK. Down here, and then there's a selection right here. Because we're going to be selecting, right. These are pretty clear.

Now what we want to do is-- in this case, there's a lot of ways to select. In this case, we're going to just drop down this node called Select Model Element. And we click on that. And then we click on the actual element itself. Boom. Revit works in element IDs. So this-- see this number, this long number here-- this is the element ID of this particular ramp, all right.

Now the next thing we have to do is turn it into Dynamo geometry. So in order to do that, you have to go over here to Revit, and then Elements, and under Element, Element again. And then since we're interested in the surfaces, we're actually going to use this one called Faces. This is a really nice node where it'll actually extract all the surfaces of the actual solid. It's really cool.

So while we do and we want to float information from one to the other. We just pull out a wire and then drag it together. These are output ports. These are input ports. And when the geometry is placed in Dynamo, it gives you a preview of the actual geometry, which is cool, right. Isn't that what we want? OK, so simple, right. This is Revit geometry. That's Dynamo geometry, OK. No question there? No? OK, let's keep going.

Now we got the faces. Now these are called watch buttons I suppose. It's pulling down all the surfaces. And in Revit-- in Dynamo, they always work with lists when there's more than one item. And the lists are based on programming language so it starts at zero. But, anyway-- so the first question is, what surfaces am I interested in? Well, there are six surfaces, obviously, but which one's the top surface, right?

In Dynamo, you're allowed to pull areas. You're allowed to do sums. But the first question is, which surface is this? Since Dynamo works in this programming language, it's not so easy. It's not so obvious when you first look at it. But it's actually pretty easy once you get into it, OK.

So the first thing we need to do is extract that out. Excuse me. We're going to sum all of the surfaces, all the areas of all those surfaces and then subtract out the one that's on the top, right. Because what we're interested in, right. So this is how you do it.

The question is, which one is it. Well, Dynamo developers right now are working on labels for surfaces. They have them for nodes. So, there's other ways you can do it, which is pretty cool. So all you have to do then is-- now that we're working with Dynamo geometry, all you have to do is come over here to Geometry, and then Surfaces, and then there's a pile of tools to actually work in surfaces. And one is area.

Now why am I pulling the areas off of this? Because it's going to tell me a lot, OK. Let me expand this so you can see it. Here we go. All right, right there. Now do you see these are the different areas in square footage. Why is it in square footage? Because the base units of the Revit model is in square feet or feet. OK, that's what.

So, at least we can narrow down which two surfaces it is, right? Don't you fuss with that one, or that one, or that one, or that one, right. We're all smart in here. We know it's one of those two. So we could at least narrow it down to that.

So what I'm going to do is I'm going to sum these areas first. And there's really awesome tools in Revit to do that. If you want to just get the sum of all areas, even if you don't want to extract the top, it's so simple.

Watch this. OK, here we go. So all you do is go to Sum. You can type in Sum. It's also in the math menu. You just pull it in there. Boom. Do you see that? It's going to actually sum all the areas of the surfaces, OK. That's pretty useful, right?

Well, we want to take it a little further. We want to subtract out that top surface, but we've got to find out which one it is. Well, I suppose since the top and bottom are the same, it doesn't really matter in this case. But you may have situations where it will matter. So, what you can do is you can extract one of those out and then see if it's the right one by selecting on it.

Do you notice when I select on the note, it actually highlights the preview, right. So we can pull out a surface, one of the surfaces and click on it, and we'll see if we're selecting the top or the bottom and we'll know that's the one.

All right, so, the way to extract information out of a list or the new way of selecting information out of a list is just using simple design scripts. And it's really easy. All you do is set up a variable, x. And then do you notice how these are in square brackets? You just go ahead and set your square brackets and then whatever number you're interested in. I'm going to say three, for now, OK.

And then all you do is you come over here and you can pull out the list here of all the faces and then slide it into there. Now that's going to go ahead and pull out number three. Do you see that? And did you see when I did that, it actually highlighted the top surface and not the bottom? So I know that number three is the top surface, OK.

Now if you have-- just because I get this question-- if you have a six-sided ramp, I suppose [INAUDIBLE]-- then the top is always number 3, OK. But this is just a general purpose thing for you to understand. All right, so then now that I have that, I can actually pull the area again off it, right. Here we go. So now we have the surface, and we have that particular area, right.

OK, what do I do next everyone? Because we're a little quiet. What do I do next? What? What?

| AUDIENCE: | Subtract. |
| --- | --- |

| MARCELLO SGAMBELLURI: | Subtract this from this, right. That's so easy. Watch this. OK, all you do is double-click again and get your little code block. Code block is another word for DesignScript. DesignScript is a scripting language within Dynamo, which is really simple to use. And you can set up equations and variables. It's awesome. |

So all we want to do is just say-- your variable can be anything-- so I'll just say total area minus what? Top area, maybe? Yeah. And then since this code block doesn't know what those values are, it's going to give you input ports to tell you, hey, what are those. So you tell it, hey,

that's my top area and that's my bottom. And then you say, boom, that is my surface area for the sides, the bottoms, and not the top, right. How cool is that? It's easy, right. Yeah?

OK, we're going to get started. How cool is that? It's easy, right.

**AUDIENCE:** Yeah.

**MARCELLO GAMBLER:** Yeah, all right. Cool. You don't use this, find someone who does. Awesome. Oh my goodness, you know what's been happening in the past, I interview those contractors like, oh, I got to take that stuff off my hand. And I host walls to those surfaces. And then I subtract, I'm like, whoa, wait a minute. No, look 1, 2, 3, 4, 5, 6, 7, nodes, right. And you just saved yourself what, a few hours a week. That's a lot, OK.

But let's take it a little further. Now what I wanted to show you was how to actually pull geometry out and then chew on it in Dynamo. There's more things you can do. I won't get into it too much here, because we got more advanced examples. But, for example-- I mean, that's cool. But you may want to know the arc lengths of the edges, right. In case you want to put your plywood on the edges and know how many sheets of plywood you need-- that kind of thing, right.

So there's other information you can yank off of this, which is amazing, especially now that you have that top surface. So, with the top surface, keep an eye on it, which is right here, OK, I'll slide these out of the way. What you can do is you can actually extract the perimeter curves of surfaces.

So, if I go back to Surface here, somewhere, here, and then I go down to Perimeter Curves. See perimeter curves will pull off any perimeter curve around a surface. So I just fire that up, boom, drop it in. Now I got perimeter curves all the way around. Do you see that, which is kind of cool. But, actually I want to know the lengths of each one, right. No problem.

Then you come over here, since you have a curve, you slide up to the Curve menu. Pull that down. And there's a lot of beautiful things in here. We're going to do a lot of them later. And then they have one called, what do you think? Length, oh, yeah. And do you see how simple this is? Pull that over. Ready, here we go. Another one, boom. There we go. There's our length.

Now don't ask me which one's the inside curve and which one's the outside curve, please, OK.

We're all smart here, we know. It's OK. You could ask me. That's OK. All right, so and then you can use your math to divide it up. You can round these-- you could-- I don't know what you could do, like if you got eight foot pieces of plywood, you could-- let me do it.

OK, so someone said, yeah, that's fine. But I need to know how many pieces of plywood along-- OK. OK, I'll show you. So let me show you. So what you can do is you can then say, well, I know that my pieces of plywood are 8 foot long. So I could actually-- I could take that value-- whatever value-- and I can divide it by 8. And then I can feed this in.

And you go, yeah, now I got 0.375 pieces of plywood. Yeah, now-- wait, no. I need to round those all up, because I won't have just 4.25 pieces of plywood. OK, because I got to go to Home Depot and order and buy those, right. OK, fine, so you got to round it up. So all you have to do is you can just type round up. There's a round up one here.

You just fire that in and boom, and then now you've got your pieces of plywood, right. They're like, no, now I need to know how many. Oh, OK. Well, then use the Sum tool, my goodness. There you go, right. Boom. There we go. Oh, I need 12 pieces of plywood. OK, how cool is that? Come on, cool stuff, right? OK.

All right, so you can send this to schedule Excel, take pictures of it, e-mail it to your friends, whatever, right. But at the least-- OK, so I'm not going to go into this too much other than the fact that you can start thinking about how to use these awesome tools to do what you need, OK. Any questions about this before we move on. Oh, wow. OK.

Good. All right, so let's see what we got next in the lineup. Aw, next, next, next, next-- and did you see how once we pulled that out of Revit, we didn't go back. Did you see that? We were just working in Dynamo, and that's OK. Revit's the conduit at which to pull that information out of, which is OK, because we get a lot of existing Revit models or you build a lot of Revit models and you need to deal with that data. All right, cool.

So let's move on to the next one. Was there a question there? Yes, go ahead. I'm listening to you.

**AUDIENCE:** How do you loop throughout those pieces that are in the Revit model so you can find out the number for the whole [INAUDIBLE]?

**MARCELLO SGAMBELLURI:** The question was how-- wait, hold on I'll repeat his question. You mean if you had multiple ramps?

**AUDIENCE:** Yeah.

**MARCELLO SGAMBELLURI:** OK. Question was, what if I have-- I'll change your question a touch-- what if you have multiple ramps? Then what? Well, we'll get into it, but did you see the selection method that I used was just a point and a click. There's other selection methods where you can select all ramps, all concrete elements, the entire project, whatever you want. And then from there you use the same methodology to extract your data. There's a little bit of list management involved when you have multiple elements. And I'll get into that when we talk about fireproofing columns, OK.

So let's talk about the next one, which is DWG files? How many people have to work with DWG files? Anyone? Oh, yeah. OK, watch this. I've never shown this to anyone ever, ever. I'm so excited. Watch this. I was like, all this awesome BIM stuff you keep getting 2D CAD files from your subs, right. Or if your architecture giving-- well, anyway.

[LAUGHTER]

I was about to go there, and I was like, wait a minute, Marcello, don't do that. Don't go there. OK, here we go. Ready? Let's see. I love this crowd. You know what they need to do-- is anyone from Autodesk here? I want to have a review for the audience. You are all going to get 10s. I don't know why it doesn't go the other way. That makes no sense to me.

OK, ready. Here we go. So I want to set this up a touch. And we are 23-- oh, we're good on time. I know we were moving a little slow.

OK, so all I have right now is structural columns inside of a Revit model, OK. Let's say you get an AutoCAD file and you need to extract something. I'm not going to show you how to extract everything, because we'd be here all day. But I'll show you the principles. First thing is, let's say you get an AutoCAD file and you need to extract the grids. And then you need to tell Revit, put grids right back on the top of those DWG grids.

OK, this is how you do it. So with that said, Dynamo does not accept DWGs into its file format. But what you can do is you can put a DWG into Revit, and then use Revit as the conduit at which to access the DWG file. You got it?

OK, cool. So, what we're going to do is we'll go to Level 1 and we'll link a CAD file. See this one Level 2 grid, let's say you get this and you only want the grids. Let's just say you only want the grids, OK. What would you do in the past? Oh, come on now, what would you do in the

past?

**AUDIENCE:** Trace over it.

**MARCELLO SGAMBELLURI:** Click, click, click, click, click, click, click. Trace, trace, trace, trace, trace, right. Yeah, what if you've got thousands of grids, and they're all twisted up, and they're all over the place, right. OK, watch this. This is so cool. Ready, here we go.

**AUDIENCE:** Interns.

**MARCELLO SGAMBELLURI:** Interns.

[LAUGHTER]

**MARCELLO SGAMBELLURI:** Well, inter-- I set myself up for that, because you can shout anything you want. But I'm going to piggyback on that, and say, Dynamo is our new intern, all right. All right. So, here we go. You know I love you, bud. All right, so, here we go, ready. Add in Dynamo-- oh, wait, we've got to do something else first, getting me all excited here.

All right, so we got to clean this up a little. So what you can do is select on this-- and if you only want the grids, then just come over here to Delete Layers and then just leave out the grids, OK. Now, should I say it now? I'll say it now. What if-- did you see how I actually selected it and deleted all layers except the grids?

Now someone's going to ask me what if the grids are not on a separate layer, right. Well, someone asked me this when I was doing my research. And I said, well, where did you get the DWG file. I'm talking to the general contractor. Where did you get the DWG file? From our sub. Oh, OK. So why don't they put the grid on a separate layer so you can isolate it. Because they always work like that. They always put the grid in the bubble and the structural framing on one layer.

And I said, when they-- and I always tell them not to do that. And I say, well, are they working for you at the time when you tell them that and they give you the file? They say, oh, yeah, they were on board. Yeah, yeah. I'm like, well, then you need to tell them to do that, because Dynamo won't solve your management problems all right.

So, if you're going to ask me again what if they're not on separate layers, my answer to you is,

tell them to put it on separate layers, all right. OK, so here we go. So New-- and it's just the same thing. We just-- I'm going to call this-- we just plug and chug. Watch this. Ready? We select the element, Revit. Selection-- select Model Element. OK, I'm moving a little faster, but we're already on board. Select it. Now instead of selecting faces, we could select Curves out of the geometry that we pulled up.

So then we go here to Revit's, and then under Elements we say, Element again. And under Element, we can say Curves. Now do you know what we're doing every time I do this? Last time was faces/surfaces. This times its Curves. These nodes are very powerful, because they reach into whatever you select and they pull out those particular things.

So if this CAD file, for example, had all these crazy surfaces but only had very clean grids, well then if you're pulling out the curves, it doesn't matter what else it has, right. Because it's only extracting the curves, OK. Just like with that ramp, if it had other things in it, you only care about the surfaces, OK.

So anyway, here we go, boom. There they are. I'll tell you what when I saw this, I was like, oh, that is pretty. Look at that, oh my goodness.

OK, one more thing to do is then we need to actually-- OK, you help me out. What do we do next? We need to then? Build what? The grids in--

**AUDIENCE:** Revit.

**MARCELLO SGAMBELLURI:** Revit. So when you need to build something in Revit, you go to the Revit tab. And then you go to Elements, and then you search down. Do you have a grid? Oh, yes, here it is Grid. And then we say, Grid Creation by Line, right. And I'll even hide this for dramatic effect. Oh, I guess it's preview. OK, and it's that simple. See those grids. How cool is that? Yeah?

OK, now you're like, Marcello, the bubbles are on the bottom. I want them at the top. Yeah, OK, I understand. Yes, yes, yes, you could. If you flip the direction of the line, then they'll be at the top or whatever direction you want. I'm not going to get into that, right. You play with that. You geek out about it.

All right, let's do one more, which is also kind of near and dear to my heart. Let's start all over again. All right, so let's say now someone says, OK, those are great. So let's do one more.

Let's say they give you an existing framing plan, right. And you have all these structural

beams, right. What do you do now? Anyone? I mean, what if this is existing? What do you do when you need to draw it in Revit, right? You come over here to your Revit beam tool, and you start, click, click, click, right. Maybe or you have to trace over it, right. Oh, watch this. Oh, this is so cool. Watch this. OK, go back to your Delete Layers. Ready and isolate your beam, Right. OK, so what if the structural beams are not on their own layer, what do you do?

**AUDIENCE:**     [INAUDIBLE].

**MARCELLO**     Yeah, OK. All right, so then same thing. Ready, here we go. Elements, selection, select model
**SGAMBELLURI:**  elements.

OK, and then we need to extract all the curves, right. So we go here to Elements, and then Curve, Element, Curves, right? Are you seeing a pattern here? Right, there are the curves. Aw, pretty. OK. And then now that we've got the curves, what are we going to build? The reason I'm asking you is because this is the thought process you should have. What do you need to get out? I need to get the curves. From where? The DWG file. Well, select the DWG file. Pull out the curves. Now what do you need to do?

**AUDIENCE:**     Make beams.

**MARCELLO**     Make beams in where?
**SGAMBELLURI:**

**AUDIENCE:**     Revit.

**MARCELLO**     No, because it's important. Where, Dynamo or Revit? Revit. So, you go to the Revit tab, and
**SGAMBELLURI:**  then you go to Elements. And then under here you have Revit a Structural Framing by curve. OK, so then all you do here is you feed in the curves, a level, and structural framing. So we're on level 2, so let's feed in the level first. So that's in under Selection Levels.

Now do you see how intuitive this is? This node creates it. It's just telling you, feed me on the input ports what I want-- OK, Curve Level and Structural Framing Type. So, we're on level 2. And then the Structural Framing Type is just the beam. So here's Structural Framing Types selection. Now this is every stru-- it's only one-- there's every structural framing type in your project. This one only has one.

OK, and then you just feed in the curves. And then, oh, yes-- how pretty is that? Oh, yes, right. That is cool. OK, so no more picking. All right, yes, yes.But Marcello, it's only one beam type.

Yes, yes, yes. OK, Yeah, well, then go get the intern and then have them switch out all the beam sizes.

[LAUGHTER]

All right, but do you see what it is? If Dynamo can get you even halfway there, you've already saved so many hours. All right, any questions before I move on to the next one? Working with DWGs. Yes?

**AUDIENCE:** So, in theory, then, you've got a SketchUp model [INAUDIBLE].

**MARCELLO SGAMBELLURI:** Question was-- I got it. I got it. Question was, in theory-- well, I'll form it into a question. Could I, in theory, have a 3D SketchUp model, convert it to a 3D DWG, send it into Revit, and then convert all my three-dimensional geometry into Revit geometry? I got, in my prep for this class, I toyed with the idea of working with 3D DWGs. Because a lot of times you'll get piping or other things that your subs may give you 3D DWGs.

I'm just going to say this is, absolutely possible. The concepts are actually the same. Only it's a little harder to extract center lines. But I have examples in the data set, in the appendix, that tells you if you have solids how to get the center lines of certain things or how to extract the faces of certain things to get you to where you need to be, OK. So, yes?

**AUDIENCE:** Marcello, can I interject? Look at FormIt. FormIt has a SketchUp converter. So, that will solve a lot of it right there.

**MARCELLO SGAMBELLURI:** Oh, so the comment was from Jared, check out FormIt. That may get you halfway there with some conversion things. OK, so cool, check it out.

**AUDIENCE:** Why is it curve and not line?

**MARCELLO SGAMBELLURI:** Ah, why is it curve and not line? Because Dynamo works in programming language and curve is al-- curved means any linear element, OK. So, it could be straight. It could have some kind of bulge to it. Just, curve is curve. Curve, it means any linear element, all right.

OK cool. Let's move on to the next one. We're losing some people, but I think, that's OK for them.

**AUDIENCE:** Grid was by line.

| | |
|---|---|
| **MARCELLO SGAMBELLURI:** | I'm sorry? |
| **AUDIENCE:** | Grid was by line. |
| **MARCELLO SGAMBELLURI:** | Oh, that's why you asked. That's why you asked. Why is structural beam not by line then. Was that your question then, sort of? OK. OK, the comment was when we built the grid, it had an input port of line. It said line. And the beam said curve. Well, that's because in that particular node for the grid, you can only feed in a straight linear line. Though you could make curved grids, but that's a different node. |

But for structural beams, it'll take any linear element. So you can actually have a lot of fun with that. All right, so let's go ahead and start our project. I'm going to move to the next segment, which is fireproofing. OK.

The reason I decided to put this in is because, first of all, it has always been an issue that within Revit you're not allowed to place fireproofing on structural steel elements. Has anyone had that issue, or ever asked anyone to do that, or how to do it themselves? OK. As architects, you ask the structural engineer to do it, right. And then they do it right away. Is that correct? Is that right?

Right now the only method to really do that well in Revit is to actually edit a structural family, structural beam, or calm family and place solids around it to mimic it within the family. That's OK in certain situations. But if you're getting external files from people, you don't want to be opening it up and editing families. That may not be the workflow you want.

So, I'm going to show you how to actually place fireproofing around structural columns for pipes. But there's the example in appendix how to do it for a wide flanges as well. OK, and it's really simple. OK, and then what's really cool is you send-- you build it in Dynamo, you send it back to Revit, and then they're separate elements. They're separate-- the fireproofing is separate elements. So you can bring it into Navisworks as separate elements. It's a lot easier to control.

All right, so one more thing, too, I have to mention-- I really had a problem with the fact that like MEP piping-- when you look at it, right, it actually already has that love in it, right. Can't you take MEP piping and put on insulation around it, right. And, how fair is that? Come on, right, do you see that? That's not very fair. OK, so we're going to give the pipes, the structural pipes,

the love they need.

All right, so this is how you do it. It's really easy, and it's based on that first example. OK, here we go. So all you want to do is extract the side faces of the pipe, and then thicken them. Easy, right? Easy. Watch this. So, we're all geometry face extraction experts in Dynamo. So I'm going to go through that rather quickly.

OK, so this may help answer your question there. What if you have multiple elements? We have multiple pipes. If you have multiple pipes, you can do selection by other methods. In this case, we're going to do to by family type, OK. And then this family is called HSS12. We're using imperial units today. It's HSS12 by-- when you pull this family type node, it will tell you every single family inside your project, which is cool. I mean that's just a powerful node in and of itself, right.

So, anyway it's right here. See? OK, so that's the family types, kind of got a long name. And then that's just the type. You have to pick all the instances of it. So, you say All Elements of Family Type. OK, that should say all instances of family type, but anyway. I going to put a watch node on here. We run into that language issue sometimes.

All right, here we go. So then that pulls out all the pipes, OK. I got them all right there, OK. All right, cool. Now what we need to do is we need to-- just like the ramp-- we need to-- anyone help me. What do we need to do next? What?

AUDIENCE:     Extract.

MARCELLO
SGAMBELLURI:     What? Extract the services, yes. I heard that. Cool. So all you do is come to Revit, and Elements, and then go back to Element, and then go back to Faces, right. Then wire that up. And now you've got all the faces. It's taking awhile because there's a lot of columns. Do you see them all? You see them all down there? Cool, right.

So here's all the faces. Now this is one thing you need to-- well, OK, let's take one step further. You're like, which face is it of these-- one through six? I don't know. So let's go ahead and put our-- go ahead and grab our extra support here, which is we can actually extract the areas. Remember that? That gives a good tell tale sign of what is what.

So we go over here to surface, and then we go down here to area, right. There it is. OK, cool. And we feed that in right here. And there we go, here like this. Cool. See. So now, I know we're working with lists within lists. I know the people on the other side can't see that. Let me

make this a little bigger.

All right, so this represents all the areas of every single pipe. OK so it would be these two, right, that are the outside faces. Now why are two, because Revit when it builds solids it always builds-- especially when they're circular-- it builds them into halves. That's just the way it is. So we just have to deal with it.

But anyway, it's this one. It's these two, OK. So all we need to do is extract these two areas out of every single occurrence of the lists, and then we can then thicken them. But I'm going to show you a trick of how to do that. Because you're going to be working with data extraction all the time. And when you're dealing with one element, like the ramp, it's a little easier. When you dealing with multiple items, it's a little more difficult.

So what this is saying is this item in the first list represents one pipe column that has all these areas. This one is another instance of a pipe column with all those areas, right. So it makes no sense just to pull one out or two. You've got to do it for every single one. So this is something that you'll need to get familiar with. It's called List Management and List Manipulation. And it's something that's extremely important, but it's not that hard to learn. And I think this example can really, really illustrate that.

OK, so what we do is we have to extract these items out of a list. So there's something in the list thing called Get Item At Index, OK. So all you have to do is send in the index, OK. In this case, we want one and two. So we have to make a list. So if you want to make a list in Dynamo, it's really easy. You just take a code block here and put it in curly braces. Anything in curly braces becomes a list. So, in this case, we want one and two. Got it? That creates a list.

So if you just want to create a list that just has one and two in it, you do it like that. These could be variables, as well. That's going to be our index, all right. Now, this one-- bear with me here-- this one we cant' just feed in this, because it's then going to-- do you see if we fed this in, it would pull this and this, which would make no sense, right. We need to tell it do it for every single list.

So in order to do that, we have something called a List Map. OK, don't let this scare you-- List Map. But what I want you to do when you get back to your office, is tell everyone that you know how to use list maps, right. And, by the way-- well, let me get finished here first, OK. This is really cool. OK, so what you do is you feed in-- so let me move these areas because we

know we have-- feed in the list like this. OK, now what you do when you want to map things over a number of other items is you leave one blank. And then it says it becomes a single function object. And this is asking for a single function object. I know this is all programming languages, but just bear with me.

We feed this in and then the List Map will then take care of it. So now the List Map will say, OK on item 1, I'm pulling out one and two, item 2 I'm pulling out one and two. You see that? Very powerful. OK, very powerful. So, not that hard right? So that's that. Cool, huh.

It was something I'm going to say, which is Dynamo is the wave of the future. It really is. This is awesome stuff. When you teach your friends and your colleagues this, like I said, you're going to be the Dynamo hero. So you're in your office, you're already awesome, right. But when you know Dynamo, you're super cool, right. Now you walk up to those-- now List Maps and Code Blocks separate the OK Dynamo users from the awesome Dynamo users, all right.

So you walk into an office and you say, Yeah, you know Dynamo? I know Dynamo, too. Yeah, do you know List Maps and Code Blocks? I know List Maps and Code Blocks. Let me show you, right. So, it's just that extra level of knowledge you have to really get that data out, all right. So what I want everyone to do is on Monday go back to your office, open up this example, drop down all these nodes, and the List Map, and hit Save. And then put it on your resume that you're a Dynamo user, and you can use List Maps and Code Blocks because it's the wave of the future, all right. Really important.

OK, so now all we need do is thicken those surfaces. So here we go. So we go to Surface and then we go to Thicken. Where's Thicken? Thick, thick, thick. Thicken, here we go. Thicken, that's it, right. Does everyone understand why we need to thicken it? Because that would then be the--

AUDIENCE:    Fireproofing.

MARCELLO        Yeah, fireproofing. Yes. OK, so we feed in the surfaces and the thickness. Now since we're in
SGAMBELLURI:  feet, let's say we want 2 inches then we do have to convert it-- we have to convert it to feet if we're thinking inches. So suppose that would be, what? One sixth. I know it's kind of funny. It'd be 2/12 2/12, one sixth, right? Is that 0.1666? Yeah, cool. OK, and that's the thickness and-- let's do this. We'll zoom into one of these and then we'll feed that in. Boom. Come on now. Aw, look at that. Isn't that pretty? Oh, that's pretty, isn't it.

OK, so, wait. Hold your applause, let's get it into Revit. All right, cool. Watch this. So we've got the Thicken services. It's only previewing it in Revit. So in order to get it into Revit, there's this new cool thing-- and put this on your resume, too. It's called Direct Shape. I mean this node is so new it's hot off the press. It only came within the last three weeks. This Direct Shape-- I know it's got a funny name-- tells if you build anything in Dynamo, you can get it back into Revit into any category, OK.

So let's go ahead and feed in our geometry, and then it's asking for a category. Now for category, that's up to you. In this case, you can type in category here and you'll get a pull down list. This is entirely up to you. There's no fireproofing category in Revit, is there? Not that I'm aware of.

**AUDIENCE:** No.

**MARCELLO SGAMBELLURI:** No, OK. So I don't know what structural connections or whatever you want. Have yourself an academic-- at the office, have yourself an academic, fireproofing category discussion. And then when you're done with it-- select it in the category and wire it up like that.

**AUDIENCE:** Is [INAUDIBLE] new place [INAUDIBLE]?

**MARCELLO SGAMBELLURI:** Oh, I'll get to that in a second. [INAUDIBLE]. We're going to see this happen. There we go. Oh, yes, OK. So I'm going to-- it runs a preview on there, so it's a little hard to see. But let me filter out the structural columns and then we'll select it again. Oh, why is it-- OK, I'll save that and I'll close that. And now look what we got? Oh, look at that fireproofing. Isn't that pretty. Whoops, now that's cool, right. Look at that. That's awesome, huh? Yeah, that's awesome, right. OK, cool.

So it's really simple. Just grab your faces, Thicken, Direct Shape, send it out, figure out your category, boom. That sends into Navisworks in their separate pieces and it's beautiful thing. You can do your class detection, right. And if that pipe happens to clip that fireproofing right, then in the field you just shave off the fireproofing, right? Just have that pipe go through-- don't tell anyone. Hopefully, you don't do that. Yes?

**AUDIENCE:** Can Dynamo select elements from linked Revit files?

**MARCELLO SGAMBELLURI:** Good question. Question was, could Dynamo select elements from linked files? And the answer is, absolutely it can. It's not-- so half of these columns could come from a linked file, OK. It's only requires two more nodes to extract the data. And, there's a package out there

called Archi-Lab that has a pile of nodes to extract information from linked files. So the answer is, absolutely yes. And I use it all the time. Yes?

**AUDIENCE:** With the Direct Shape thing going back into SketchUp, did you use just element.geometry than Direct Shape [INAUDIBLE]?

**MARCELLO SGAMBELLURI:** OK, I'll rephrase your question. But you said back to SketchUp, did you mean back to Revit?

**AUDIENCE:** No, back to the SketchUp question. Could you isolate the framing layer, element.geometry, hit and then Direct Shape and then--

**MARCELLO SGAMBELLURI:** OK, the question was about the Direct Shape node. It's a very powerful node that you have to be very careful with. So this gentleman already is coming up with a workflow for this gal, which is awesome. Make sure you collaborate amongst each other and geek out amongst each other, too, because you can solve each other's problems.

But I'll just mention that real quick. The gentleman said could you bring in 3D data into SketchUp, and then you do it into Revit, and then you bring it into Dynamo as 3D solids, and then you send that to Direct Shape back into Revit into their specific categories. Yes, that's absolutely possible. Yes.

I haven't vetted the Direct Shape node a whole lot, because it's so new. But I encourage everyone to try it. It's a beautiful thing. In fact, I won't have time to go over it, but you could create roads in Revit. You can create roads in Dynamo. And then you can actually Direct Shape those roads back into the road category. Right, anyone see the road category in Revit? Like what is? You can actually make use of it.

[LAUGHTER]

All right, any questions before I move on? Yes?

**AUDIENCE:** Yeah, so the elements that you're creating-- the elements in Dynamo, are those linked, forever linked, to the Dynamo file? So if you could be with with your Dynamo file, it would also be--

**MARCELLO SGAMBELLURI:** OK the question was if you delete the Dynamo file, would the Revit, in this case, fireproofing elements be deleted? The answer is no. You opened Revit. You opened Dynamo. You did all your geometry with Dynamo. You then took Direct Shape and sent it back. OK, they are now

forever Revit elements. So if you close Dynamo, or save it, or delete Dynamo. They will still be there.

Now what happens though is you could open Dynamo again. You just save it. It's called a DY infill. It's called a graph, OK. You could change say-- so then you open up this file. You open that same Dynamo file, right. You could then decide the fireproofing's not two inches, it's an inch and a half. Then, Dynamo will say, I'll make that change. And it'll automatically update the fireproofing thickness, OK.

It's a one-to-one, but it's a one-to-one with some management, OK.

**AUDIENCE:** Does the category node pick up subcategories as well?

**MARCELLO SGAMBELLURI:** Does the category node pick up subcategories as well? The answer is yes. I see a question there. Let me--I know we're--

**AUDIENCE:** Can you group that statement as a couple nodes?

**MARCELLO SGAMBELLURI:** Question was, could you group all those nodes we just made, and make it into one custom node and call it, awesome fireproofing node? Absolutely, yes. And you could share it around. Yes, absolutely. I'm not going into custom nodes, because that's out of the scope of this class. But, yes, absolutely. Yes, you let yourself-- in fact, we're going to use a custom node coming up, OK, when we split slabs.

How we doing on time? OK, we got 40-- we got 38 minutes. Let's split slabs. OK, so let's go ahead and go New, Open. All right so I see everyone texting. Is everyone tweeting this class? It's OK, you can multitask in here. I don't mind.

**AUDIENCE:** We're writing our review.

**MARCELLO SGAMBELLURI:** Oh, awesome.

**AUDIENCE:** [INAUDIBLE].

**MARCELLO SGAMBELLURI:** OK, oh, Jeez. That's not right. This must have been--

**AUDIENCE:** What if you remove the naked element that was used to create the fireproofing? Let's say, I

change the column sizes. Is it still tied to the native element?

**MARCELLO SGAMBELLURI:** Don't worry. I'm listening to you. The question was-- that just wasn't right. The question was, is it forever tied to the native element if you delete the column.

**AUDIENCE:** Or if you update the column?

**MARCELLO SGAMBELLURI:** If you update the column-- if you change the size of the column, would the fireproofing change? The answer is, absolutely. Because think about what we did. We selected all the columns. We extracted all their geometry. Dynamo's reading its geometry, which are the faces, right? And it's got them all. It's keeping track of it.

If you were to lengthen the column, or delete a column, or whatever you did to the column, that it's got in its grips, it will see those changes, pull the new geometry, then thicken that new geometry. So the answer is, yes. It would change.

**AUDIENCE:** The question was more even if you open up the Dynamo file, [INAUDIBLE]?

**MARCELLO SGAMBELLURI:** The question was, would you need to open the Dynamo file to make that happen? OK, these are good questions. The answer is yes. But think about what you did. You used Dynamo to build the fireproofing, because Revit didn't have the capability to build the fireproofing. So if you want to make a change to a column in Revit and you want to change the fireproofing, the only application out there right now that you know of to change the fireproofing is Dynamo. So you would have to open Dynamo, run the script again, and then it would automatically change the fireproofing. Does that makes sense? OK?

**AUDIENCE:** Can you run Dynamo [INAUDIBLE]?

**MARCELLO SGAMBELLURI:** Could you run Dyna-- boy, you got-- OK. There's a lot of what ifs in here, and I love it. And we're going to geek out about it. I got to move on. But the what ifs-- I love what ifs. Let's talk after about the what ifs, because I love what ifs. And I will spend all day on what ifs if-- but you understand. Yes, I like that. And I did say any comment and question. But let's-- the what ifs-- I want to talk about it, but just not right here. But good question. Those are kind of question-- I will answer some questions to help everyone, but that one's a little more specific that not everyone in here would need to know.

All right, so let's go ahead and talk about something awesome. And I did make a custom node for this. So, when I was talking to with contractors one thing they do is they create lift drawings

and pour drawings. And what they do is they'll have structural slabs or slab on grade. And what they'll do is they'll make a pour joint plans, or cold joint plans, like this with model lines. And then they will then have to break up each individual slab based on where the model lines are, OK.

So I came up with a script that will actually divide this up for you, OK. So let me just show it to you, real quick. This is a custom node like the awesome fireproofing node I talked about. This one's called the awesome pour joint split slab node. All right, so here we go. The new-- let's see, I have to-- I think I got to open it. Data set, slab break, start. Oh, OK, it's already got some info in there.

All right so what it has here is just this slab break at model lines. If you want to ever investigate a custom node-- there's not a whole, I mean there is a few nodes in here-- but it's easy to understand. And they're all custom nodes. There's nothing that was coded with the API to do some special to do this. But I just figure I don't have time in class to go through every single node.

Anyway, you just understand-- what you do is you select the slab. OK so you drop down this custom node. And it's right here in the built-in. And it's here in the data set. It would be right there. Oh no, actually it's somewhere in here. OK, anyway it's in here. And then it's called break, OK. So then all you do is feed in the original slab. You draw some model lines. And I think your model lines could be crazy too. I don't know.

Let's try this-- like something like that maybe even. Or if you have triangulated pieces around columns, right, for those little [INAUDIBLE]. OK, and then you feed in the floor type, which whatever floor type you want the new ones to be-- I don't know, whatever maybe we're on slab on grade. I don't like that fact-- oh, I guess we're in manual, OK. And then you run it, should be it.

Cool, did you see what happened? Look now they're individual slabs. Even they've even got that little corner piece, yeah. Isn't that awesome? Cool, huh. That's all I want to show. But, yeah, you just do that one boom, boom. And then away you go. Could this help you guys? I know they do a lot of self-performing concrete. And other contractors-- who does self-performing concrete? Oh, my goodness look at that. OK, how many people know someone who does self-performing concrete? OK, tell them. All right, any questions about this? Pretty simple, right? Yes?

| | |
|---|---|
| **AUDIENCE:** | I got copies on my job, so could we get a CAD file from him and do this? |
| **MARCELLO SGAMBELLURI:** | Oh, could you get a CAD file from him and do this? Absolutely, you can get a CAD file from him and do this. So the workflow would be, if you get a CAD file from your concrete sub an AutoCAD file, and you tell them to put the pour joint lines on a separate layer, then all you have to do is extract those curves in Dynamo. Then Dynamo has a node called Create model lines. Then you feed the model lines, boom. It will then drop, if they happen to do this like this then it would drop it right on, right. And then away you go. OK. Yeah, good. Yes? |
| **AUDIENCE:** | [INAUDIBLE]. |
| **MARCELLO SGAMBELLURI:** | I'm sorry? |
| **AUDIENCE:** | Do you lose any hosted objects? |
| **MARCELLO SGAMBELLURI:** | Do you lose any hosted objects onto the slab? The answer is yes, because they are new slabs. But that's a bit more in the weeds, because you would lose hosted elements anyway even if you were creating each one of these from scratch. But, yes, it does lose the host. |
| **AUDIENCE:** | One more question, [INAUDIBLE]. |
| **MARCELLO SGAMBELLURI:** | Yeah, I'm listening to you. |
| **AUDIENCE:** | Can we add like Core 1, Core 2, Core 3, [INAUDIBLE]? |
| **MARCELLO SGAMBELLURI:** | What do you mean? |
| **AUDIENCE:** | Can we just add information about each core? |
| **MARCELLO SGAMBELLURI:** | Absolutely. Now, what I'm not really getting into is how to assign particular parameters into each family. But you certainly could do that. You could feed numbers or whatever you want into each one of these if you wanted to. Yeah, absolutely. Let's talk more later about how that could benefit you. But everyone gets the idea of the coolness of this, OK. |
| | Because I have 30 minutes left, let's move into the next example, which is MEP piping and topography. Because I want to make sure I get through it. I have an example on how to auto- |

dimension to slab edges. And if we have time, we'll get to that. If not, then look at it in the handout. It's awesome. So let's go ahead and move into this one, which is how to topo and piping. OK, cool.

All right, so how's everyone doing? Is everyone kind of thinking about Dynamo? How it can help in your office? Right, is that--

[AUDIENCE SIGHS]

**MARCELLO SGAMBELLURI:** Oh, that just took the wind out of my sails. No, I'm just kidding. Aw, we'll deal with that, whatever. Ha, ha, ha, another crash. Do I send the report?

[LAUGHTER]

OK, while this fires up, is everyone starting to get a feel for Dynamo and figuring out how you can use it in your office, right? It's awesome, isn't it?

**AUDIENCE:** Yeah.

**MARCELLO SGAMBELLURI:** Yeah, OK, cool. And is everyone think it's easy?

**AUDIENCE:** Yeah.

**MARCELLO SGAMBELLURI:** Yeah, is everyone a programmer when you use it?

**AUDIENCE:** Yes.

**MARCELLO SGAMBELLURI:** Yes, you are, absolutely. OK, so let's try that again. I don't know what happened. I want to close this. That was a little funny. I got some backup examples in case we can't get this file open, but it's worked before. OK, cool. All right. I got to set you up for this one. Let's do this, let's go to the site plan.

All right, so here's the situation-- we've got topography and we have a 2D line. This 2D line right here that says, existing utility pipe. OK, do you see this? That doesn't do us a whole lot of good when it's a 2D line. A lot of times we actually want to model this so it's actually follows the slope of the topography, right. So if they told us this is a existing utility line, existing utility pipe minus 6 foot from surface, right. You're like, aw, that's an awesome note. But when I look at

this thing in 3D, it's not in 3D. Wait, where did you get this? You got this from your sub. Oh, boy, right. Now I got to take it upon myself to model it. But that's OK, I'm going to show you how to do that, right.

So you could get this from a CAD file. And a lot of times I have seen existing utility information from existing AutoCAD files. But now you know how to extract that information from an AutoCAD file, right? OK, make sure you tell them to get it on a separate layer. And then away you go. So this one just happens to be a model line that's dashed so I don't have to go through how you bring it in with the [INAUDIBLE].

So how many people have had to work with topography in the past? OK, and how many people absolutely love it? OK, yeah, it's a little clunky. I talked about this yesterday in my class that topography is a little difficult to deal with. So I thought it would be important to introduce you to some concepts to work with typography, and how to make elements follow it. In this case, something that's near and dear to everyone's hearts, I know we've got some MEPs in here and contractors, and even structural, is how do you make MEP pipes follow typography?

In the end, these will be MEP pipes. All right, how do you slope a pipe right now with MEP? Anyone have to model MEP pipes? OK, how do you slope it right now? You gotta click on the edge and pull it, and pull it. OK, guess what Dynamo does? It builds MEP pipes. So we're going to use Dynamo, get a guide for it to place on, and then we'll placed MEP pipes on. Everyone ready?

So I'm going to move a little faster now, because there's going to be a lot of geometry manipulation to run intersects and things like that. If I lose you-- well. I won't lose you-- but just bear with me, because we're going to move a little faster. OK, I've got 27 minutes. Any questions before I start? Any questions so far, before I start? All right, cool.

OK, so let's realize that right now that that model line is 2D and that topo surface is 3D. And probably that line was to avoid these trees, I suppose. But anyway, let's get moving.

So open up Dynamo. What we're going to do-- the logic here, in order to get something to follow topography, we need to be able to project that two-dimensional line onto the topography, OK. And with piping you typically want to break it up, I don't know, what 12 feet, six feet. I don't-- whatever it is. Let's just use an increment of six feet.

OK, so we're going to take that 2D line, we're going to break it up into individual six foot

pieces. We're then going to bring it up through the topography. We're going to run intersections to get points on the surface. We'll drop that down a few feet, maybe five feet or six feet. Then we'll lay the piping on it. OK, so that's the plan. So let's do it. And part of this was inspiration from someone I talked to in here, a few people I've talked to in here, as well as some of the research I've been doing through the air.

So here we go, let's do it. So the first thing we got to do is we've got to pull this topo into Revit. So what we do is we say, New, and we say Revit, and we say selection, select Model Element. OK, here we go, boom. We can get like this, all right.

Next thing we need to do is we need to pull all that geometry over into Revit. So there's a custom node out there called Topo to poly surface, I believe. Here we go. That will actually pull all the topo surfaces over to-- it'll take all of this mesh and move it into Dynamo as poly surfaces. Why do we want to change it to poly surfaces? Because poly surfaces is the only things-- we can interact and we can't intersect in Dynamo with meshes. It's just a limitation that I don't think the developers are really going to ever get to. But, it's not a problem, because we just convert it to topo, excuse me, to poly surfaces.

Here we go, OK. Cool, we are on our way. See that? We're on our way, all right. Next thing we need to do is we need to grab all those lines. And I'm going to be a little more loose about it. So I need to grab these lines and bring them into Revit. Let me just select them, again, one off with this Select Model Element. Although you could use Category Model Elements, but I'm just doing it with Revit. Let's see, Selection, Select Model Elements.

OK, bear with me, sometimes with live demos we have to-- you just got to sit back and watch I know me do it. All right so we got that. We got that. We got the lines. Cool, now let's extract the lines. So we go here to Revit, we go to Elements. And we go element, again. And then we go Curves, right, see the theme? Right, common theme here, isn't it?

OK, so I'm going to make this bigger so everyone can see. Because now we're going to be working in here for a while. And we go like that, and now we've got the curves. Do you see them in there, right? Cool.

Let's go ahead and divide that up. Now, here's a cool way to divide it up. Let's go ahead and pull the length, because we're interested in how long it is. So let's go ahead and pull the length and then we'll divide it up into six foot segments. So here we go. We go to Geometry, Curve, and then Curve. We see length here somewhere, length, right? See all the-- I, basically, set

you up for the whole day to go through this example, because now you're familiar with these concepts, because we've got curve length now, right?

So here's all the length of the curve. OK, next thing is-- let me zoom in from under here. OK, the next thing is we actually want to place points along this curve. And then we'll extrude them up like lines and then do the intersection. Because the intersection of lines and surfaces equals, anyone? Intersection of a line and a surface would equal what? What do you think?

**AUDIENCE:** A point.

**MARCELLO SGAMBELLURI:** A point, yes. OK, cool. So we go-- we've got to divide this up. So, there's a thing in here called Point at Distance, OK. OK, point at distance. All right, so we need the curves and we need the distance. So if I just feed this in right now, it's just going to put-- oh, thank you, thank you, thank you, thank you everyone. OK, cool.

If I just put this, it's a zero. So I just don't want it at zero. I want it at zero, six feet, 12 feet, right. So what I do is I go here and I make a range number. So instead of just typing zero, right, curly brackets, zero comma, six comma, 12 comma, right. You'd be there forever. There's a syntax in here, which can make you equate this easy.

So you go, zero. You put two periods to do a range, and then the next number is the one you want to end with, which would be the length we just yanked out. So I'll just say length, OK. Right here, and then the step. And, in this case, maybe six feet.

So I'll feed that in and now it's going to do all the lengths and I can feed that into here. I think I have to lace this longest. There we go, cool. Lacing is something that just tells it-- it's kind of like List Map-- it just tells it apply what you're doing over each list, OK. So here we go. So now we got the spacings, OK. Cool, now let's take these points, which is curve point at distance. Let's extrude them up. There's no real good way to extrude something in Dynamo. Where'd it go? Here? So there's something called translate. If you want to translate energy-- we call it move-- but in Dynamo language, it's called translate, all right.

So if you want to move something in Dynamo, it's actually-- no, it's not even-- it's copy. If you want to copy, move something in Dynamo, it's called translate. So what we do is we want to take these points and translate them high and then put lines between so we have our lines. So all we do here is go to-- let's see, we go to Geometry. And then under there we have Translate, Direction, and Distance. You see This Oh, no, no Translate XYZ. That's even

better. Then we don't have to deal with vectors. OK. Cool.

So we want to feed in the geometry, which is our points and then we want to move it up in the z direction a certain value, 120 feet, maybe. That's going to clear our topo. OK, here we go. And then it should give us-- cool. See the points on the top and bottom, right. Now let's put lines between them and do our intersect. OK, everyone's still with me? Sort of, good, cool. At least in concept you're with me, awesome.

OK, now the next thing we need to do is build lines between them. So, it's easy to build lines. All you do is come over here to Line by start and end point. OK, see that start and end point line? OK, so we feed in a start and end point, which is pretty easy, which if you remember-- see this one is the points at the bottom and this one's the point at the top. Everyone with me?

So we just feed that into start and feed that into end. There you go. Cool, huh. Pretty coo, right. OK, I better save this in case I crash. Let's see here, hold on a minute. OK, let's call it-- all right, so-- just so we-- OK. And then all we need to do now is do an intersection. And then we'll get the-- OK, so here we go. Intersection, geometry, geometry, geometry, intersects right there. All right, OK, bear with me.

So the intersection would be between these lines and what else?

AUDIENCE:     Topography.

MARCELLO       Yeah, the topo, which is way over here. Where'd you-- there we go, right there, OK. And like
SGAMBELLURI:   that-- now that's going to chew a while. I have no idea why creating points intersections take
               so long, but it does. But once you do it, and you keep re-running Dynamo, it doesn't keep
               calculating this. It's just the nature of the intersect command. For some reason, surfaces and
               surfaces intersecting to make lines don't take so long.

               But I'll take any questions while we watch this chew. Anyone? No one? No one?

AUDIENCE:     Where do you get the custom nodes?

MARCELLO       Where do you get the custom nodes? I have created all the custom modes that are in our data
SGAMBELLURI:   set. But they're in the data set. And everyone asks me where do you get the data set? The
               data set-- you can access it through the website, not the app. So just navigate to the class
               through the website and all of that's there, including the handout, the big version of the
               handout, the big 510 page PDF. I don't like the fact that this is still chewing. OK, oh, there we

go, yes.

**AUDIENCE:** Can we talk for a second about packages?

**MARCELLO SGAMBELLURI:** I'm sorry?

**AUDIENCE:** Can we talk about downloading packages?

**MARCELLO SGAMBELLURI:** I could talk about downloading packages for a second, yes. If you find that want to do something in Dynamo and it's not in the out-of-the-box nodes. There's a package manager here where you can actually search for packages. There's some famous ones out there like Clockwork, SteamWorks, and there's a lot of others. Packages are custom nodes that people have created like me and others who just uploaded to the internet so everyone could share it. My custom nodes are not on the internet, only because, at this time, I just wanted it for everyone here in the data set. But you could certainly share them around, if you wish.

All right, so now we got all the points here, right. OK so let me start turning things off so we can see what's going on. Because these have served their purpose. Is there anything else I want need to turn off? So when you want to turn off a preview, you just right-click and say, turn off preview. See like this, right-click, right-click. OK, see cool, huh.

So if anything else, at least we have points that follow topo, right? I mean come on, how cool is that at least? Come on, how cool is that, at least, right? So, if you want you can actually put fence posts along there, whatever you want. But we're taking it a bit further. We're actually going to put MEP piping between each point.

So what we need to do is maybe I should switch to manual. OK, and what we need to do now is offset these. Because that note said existing utility what, minus six feet. So now does anyone remember the node to move something?

**AUDIENCE:** Translate.

**MARCELLO SGAMBELLURI:** Translate, yeah. So here we go. See say, I've got to translate those-- I got to move those points. Yeah, translate, cool. Yeah, so you've got to-- it's right under here under Geometry and Translate. And if you can't find it, just type it here, translate, and it will find it.

OK, so now, in this case, we want to feed in these points. And I better flatten this list. By the

way, when you do operations, upon operations, upon operations, in Revit, in Dynamo, it starts to nest lists, within lists, within lists, within lists, within lists. And a lot of times you don't want to have to dig down five levels deep to get information out. In this case, all we want are those points, so we can do something called flatten.

It's like in Word when you have Roman numeral one, a, little one, little a, one, right? If you want to, just do an indent and move them all back to Roman numeral one. It's the same thing, OK. So you're moving from a sub-list into just one big list. So it's called flatten. And you will be using this all the time in your Dynamo lives. It's just called flatten, OK.

So here it is. Flatten-- I think I have to run that. There we go. OK. So here's all our points. So it tidied it up. Why am I not looking at-- why am I not seeing the preview? Oh, there we go. Oh, because this is on. You've just got to constantly check. If you're working with geometry, you want to select on these to make sure that you're selecting what you need to select and that you're doing the right thing.

OK, anyway, so here we've got all our points flattened, feed this in here, and then our translate would then be what? What I say?

AUDIENCE:    Six.

MARCELLO        Minus six, yeah, minus six. OK, cool, huh? So easy to move translate things around in
SGAMBELLURI:    Dynamo. I'm going to hit run again. And then there they are. Cool, now we have points that are offset. And even if you weren't going to put piping on there, I mean, that's just huge to have points that are offset from the surface, right? What if you had tree roots or something like that, right?

OK, so let's go ahead and move one step further. Let's go ahead and I'm going to bring in a very pretty node, one that I have created. A gentleman in my office helped me create it, too. It's a special mode called pipe. You have to load in a DLL. This one's a little bit special, meaning it's an add-in within Revit. You can do this, and you can create custom nodes.

OK, so right now, out of the box Dynamo does not create MEP piping. Is that clear? But, this will create MEP piping, OK? Awesome. OK, so let's do it. I know there's a lot of inputs, but this is the way MEP piping is. It wants to see a rep system family, a pipe type, a level, and a first and second point.

OK, so let's get through this really quick. Let's go ahead and select these. So a system type--

what you need to do-- a pipe system type. What we've got to do is-- we'll get through it, don't worry-- selection, and then we go through Element Types. Now we pick Element Types, because Element Types are actually system family types. MEP piping are what? What kind of family-- system or a Loadable? System, yeah, why is That I have no idea. But it's a system family.

So we typed in pipe here. We filtered down to pipe system, that's one. We need another one called pipe type, I believe. Pipe Type, OK, there we go. And if you're not that familiar with-- I'm not going to go over MEP piping. But, if you're not that familiar with MEP piping, get familiar with MEP piping, OK. Because it's something you need to communicate with your engineers, if you're contractors. Or if you're MEP, or if your architecture, you've got to talk to-- or even if you're structural.

All right, so then all we need to do is select all those elements of type. OK, so we're just basically pulling these all out. I know it's a little mundane, but this is the only way to really do it. OK, so let me put a watch node on here, on each one of these. OK, so all we're doing is pulling out these different pipe types. One there, one there-- OK, let's take a peek.

Empty list? Oh, oh, oh, pipe system types, I think. Pipe, that's not good. Did we see a system-- here, oh, whew. Oh, OK, good. Oh, boy, that was close. All right, so then all we need to do is choose one of these. I mean, if you're intimately familiar with pipe fai-- you could pick the one you want. But I'm just going to pick the first one out of each list.

OK, does anyone remember how to extract information from each list? You just do-- do you remember? You just use the brace, hard braces. So we'll do this again. And since they're in separate code blocks, you can make the same variable. So we're just pulling out one from each. So that's going to be that one. I'll copy. That one's going to be that one. OK. And we're going to hit run again. It should have them. Cool, cool.

OK, and then we got a level we need to feed in. I think we can just put in Level 1 here. OK, so we got Level. We got System Type. We've got Pipe Type. First and second point-- OK, let's talk about this. First and second point, where are you? Here, you come on over here. Now these are the points that actually represent all the points, right.

Now, if you have a series of points and you want to then place something and make it first and second, first and second, you don't have to make a whole other list. All you have to do is take

this one, drop the first point out of the list. And then on the other list, drop the last point on the list. And that becomes your start and end. Does that make any sense? Sort of? OK, it will when I show you.

All right, so there are some tools in Revit to actually drop the front and the back. We want to drop one on one and two on the other just to make a start and a end. OK, so this is how we do it. Under list, core list, there's something called let's see-- it's called yeah, drop items, list drop. Do you see drop items? There it is-- removes an amount of items from the start of the list. If the list is negative value, items are removed from the end of the list.

Cool, so we're going to pull this in. And we're going to move it from a negative one, because we want one off the back end, like that. And then to do the front, there's actually one here called first item. Oh, no, no, no let's see, it's called rest of items, yeah, yeah, yeah. Where's rest of items? Here, rest of items, removes the first item from the given list, cool. So there we go.

All right, I'll hit run. Uh-oh, what happened? Oh, you know what there is a-- let's try that again, real quick. Rest of items, let's see if we get it. Oh, it's still doing it? You know what? It might be a bug here when I use those. But let's-- OK, I've had that happen to me once before and I was praying it didn't happen to me in this class. But it did. So anyway, let's just back up a little.

So you understand? All we need to do is feed those points in now, right. Everyone with me? OK, so we do that. We do that, all right. And then we feed it into here, right. This is everything we just were at. Right? OK, OK.

You know what it is? I noticed that if I keep hitting manual run a lot over, and over, and over again, sometimes when you extract information there's a little bug there. So I think that's already reported.

Anyway, OK, let's give this a try. Ready? Here we go, so 3D, all right. Let's move it up there and there. OK, let's hope this works. All right, there we go. Zoom in, and then we'll hit run. Now it's got to run through that intersection, too, right. But anyway-- why this chews, are there going to be any questions while we do that? Any questions on this?

AUDIENCE: Can you export a flattened list to a .csv file?

MARCELLO
SGAMBELLURI: Can you export a flattened list to a-- to, yes, you could. To a c-- what file?

| | |
|---|---|
| **AUDIENCE:** | .csv file. |
| **MARCELLO SGAMBELLURI:** | Yes, absolutely. You can even export a list file to a .txt file, as well. |
| **AUDIENCE:** | So is that when you brought that mark into Dynamo, did it bring it from the state coordinates that you had set up in Revit? Because if you had a [INAUDIBLE]. |
| **MARCELLO SGAMBELLURI:** | Wait, I didn't hear the question. Try it again. |
| **AUDIENCE:** | So, when you brought the topography into Dynamo, did it bring it in from your base point? |
| **MARCELLO SGAMBELLURI:** | Oh, OK. The question was, when you brought in the topography in from Revit did it bring it in from the base point. The answer is yes, it brought it in from the base point. When Dynamo links to Revit, it pulls the information-- |

Oh, man, did that just work. Sorry, I'll get back to you in a second. Hold on, holy smokes. Did that just work? Oh my goodness, do we have pipes here? We do have pipes. Yes, OK. So, I will close that. And then let's-- those pipes are tiny, right. So let's make them a little bigger.

Oh my gosh, I am geeking out so hard this worked. Oh, yes. OK, so that's kind of-- we're in-- let's make them thick so you can see them.

Look at that. We got pipes. Oh my gosh, look at that. Uh-oh, wait a minute. We got to go find [INAUDIBLE]. Now we got pipes, MEP pipes, that follow topo. How awesome is that? Oh my goodness, Isn't that awesome? And these are MEP pipes. Holy smokes, I love it. Oh, man.

OK, now I'm ready. So let me just-- it's something you need to be conscious of when you transfer geometry back and forth between Revit and Dynamo. Dynamo talks with Revit. It's very good about knowing where it's at relative to the project. But, for the most part, information coming out of Revit into Dynamo is based on the real ward coordinates, project base point of Revit.

If you're bringing information from other sources, it needs to be relative to project base point within Revit. So if you had a survey crew out there turning angles and getting these existing locations of these pipes, right, in plan, right, and you brought that data into Revit, you need to make sure it's based on your project base point, OK.

Now if it's not, I know project base point sometimes with Revit are a little hard. And your survey crews are out there turning angles and making it relative-- a base point or an origin based on the manhole cover out on the street or something right. What you can do is you could then take a point and place that point inside of Revit, which would represent the manhole cover.

You can extract that XYZ data, and then when you bring that data in just convert it all to let Excel do the math for you, and it will come right in the right spot. Dynamo could do all those conversions for you, but, in my opinion, if you re going to do a lot of data crunching, and you're already using Excel, for example, then why not just do it in Excel and then bring in the clean version into Dynamo.

Dynamo can import and export to Excel. I wasn't going to get into that, because it would have opened up-- it's all documented across the internet. That's one main reason why people use it, OK, so let me check the time. How we doing? Oh, we got four minutes left.

OK are there any other questions? Yes? Yes?

**AUDIENCE:** What is the connection between the geometry that you created in Revit using demo broken so that you've been updating your Revit script again? Will it alter the geometry?

**MARCELLO SGAMBELLURI:** OK, the question was, and I don't have time to do it, but-- for example, if this geometry were to change, right, if these were to all to change, somehow, like that, right, and you would have run the script again, it would automatically update those piping locations.

OK, I know-- wait, hold on-- I'm going to-- people are leaving, so I'm just going to-- let me hold on. I'll take questions in a second. But I want to end the class, officially. But then I will answer questions afterwards. You an come see me, OK.

So I want to thank everyone for coming. You're all awesome. You're an awesome audience. I absolutely love it. I geek out about this stuff. And I'm really proud that you're here. I consider you all my Dynamo heroes now. And I want you to go out there and do awesome stuff OK. Thanks, everyone.