CARL SPALDING: Hi, good afternoon, everyone. So they saved the best to last, it seems. That's us. Thank you for sharing your time with us. My name's Carl, and with me today is Joseph. I won't introduce ourselves too much because you've been reading that for the past 10 minutes.

So we're going have a look at the future of making rebar in Revit. We're going to show some stuff just core to Revit, but also some of the technology that we have that is changing the way people will approach designing rebar in Revit. There's only one exit, that way, health and safety, but if you can monitor your phones and remove ear phones so you're not listening to music whilst we're doing the session, it'll be great. And we hope you enjoy yourself, that's the most important thing.

I'm not going to read all of this to you, but it's just, when you get a copy of the presentation after this, you've got it for your reference. So for us, the key objectives today is for you guys to come away with a much better understanding on how you can create a connected workflow. Obviously, we're focusing on structural. Look at the intelligent data exchange. I say intelligent, it's not just geometry any more. BIM is, the acronym in BIM is information. We want to look at the data as well. It's a very important part of that process. And then look at how we can start to take advantage of building performance information to automate your processes, and then automate, use that to automate the creation of 3D reinforcement and the associated documentation.

And for us, this starts to equal-- and I say starts because we're just beginning down the path of BIM-- starts to equal the future of making rebar in Revit. So before we get started, I'll just, a quick introduction. When I say quick, very quick. So this is probably the most important slide for you. Amar Hanspal said that Autodesk are doing a lot in their technology and their technology is evolving rapidly, but they are reliant on partners like ourselves to deliver what they would call targeted customer solutions for a particular industry. And that's what they rely on, their AEC partners. So Graitec is an AEC partner and that's what we do. So the technology that you're going to see today is relevant to you and that's why you're here.

In addition to that, we do have other strings to what we offer. We do have 30 offices around the world as part of our delivery of a solution to our clients, and we offer the full range of Autodesk technology, so we cover all strings. But today, we're really looking at reinforcement and rebar. So let's set the scene. If you'll just read a few things for me, hopefully we'll,

everyone, a bit fired up.

[MUSIC - "STAR WARS MAIN THEME"]

The saga continues.

Thank you for humoring me. Hopefully we've set the scene. A bit more entertaining, I'm sure you've had a lot of Power Points, didn't want to continue the theme, apart from the next two slides, but hopefully the scene is set. So what we're going to look at are some of the challenges that you guys face in your everyday environments. Just by a show of hands, engineers in the room? Majority. BIM managers? Maybe they're the same. Technicians? OK, we've got a good mix. And others?

OK, so the changes you guys face in your kind of daily embrace of your roles is multiple software solutions and then sharing a load of data digitally, but perhaps not as in an intelligent model that's due just to the formats that are available to you, to share them in. That creates a bit of a disjointed and elongated workflow that's perhaps prone to extended times, that could be eliminated, maybe even errors. And then that breaks that kind of BIM workflow, and probably past experiences are preventing reuse, or at least reengaging and trying again. There's other things, there's crossed issues and situations where you're not really getting paid for some of the work that you're doing, and adding another overhead to that by creating 3D rebar, for example, in a Revit model which is very time consuming. It's just not something that you want to engage with, we've had several conversations along that line.

On the technical side, I'll just break this down from the engineer being FEM side, the analysis and design, and then the technician could be, the engineer, could be a designer could be the GC, is the guy being the-- it could be a specialist detailer doing the documentation side. So again, how we are using BIM centric software, but that's kind of more the generic model, like Revit. It's not really geared up for RC-detailing. It gets disconnected when you start looking at creating the details, it's in a separate software.

Engineering data is passed over in big chunks, lots of reference materials, and so on, it's not really hosted inside the core model. And it's a 2D basis, most guys are doing 2D with that. Does that reflect what you guys are facing at the moment? If I can, just by show of hands, how many guys are doing 3D rebar in Revit? Oh, cool. Others and halves. So some yes, some not

so sure. OK, good, that's a good mix. So that's it in the PowerPoint side. So I'm going to hand over Joseph, and we're going to show you some of the stuff we talked about, address some of those challenges, and just kind of see how to put this into practice for yourselves. I'm going to ask questions along the way, please feel free to engage. This is a two way thing and it's a class for you guys to get out of it as much as you want.

So the first thing we're going to look at is just using some of the technology that we've integrated into Revit. To configure a page.

JOSEPH PAIS: OK, thank you, Carl. So first, I'm Joseph coming from France, maybe you can hear it. So first, I apologize, because there is no way for me to use Imperial units, it's just a nightmare for me. So I will apply US codes, but with metric units.

OK, so as Carl said, the first way to produce rebar in Revit is to use some Rebar configurator. So basically, here we have a building composed with columns, beams, footings, walls. And now what we can do, we take this first level and we can just zoom on footing. So this is related footing. If I want to produce rebar, what can I do? In fact, I can call here a dialog where you see that you have a parametric definition of the 3D rebar in the footing. So here, just entering geometrical parameters for the different type of bars, so you see the reinforcements for the footing, but also for the definition of the supported element, longitudinal and transversal reinforcements. And here, they're both directions. So here, what can I do? I just impose the value here, for example, 15 bars. Here you can set the bar number you want to apply. It's calculated automatically, the spacing. I can impose the hook angles for the bars, a value of the anchorage, and doing this, I'm just defining in the two directions manually, the geometry of the bars.

OK, for the top, I can just put a few bars with a smaller diameter, just for non-cracking conditions, for example. OK, you hit the button and then you get automatically, the 3D rebar cage. OK that's obviously a Revit object, so it's a Revit rebar set with some properties. So you can access the properties either through the property list or coming back to the dialog, selecting the footing, and changing the parameters.

So this you can do it also-- for example, I will turn around-- here I have an L-section column here. So you can do the same. You go there. It's the same function. So the software, in fact, is interactive, so it detects the selected elements, so this is a column, and you have a complete dialog to set the rebar of the column. So you see many possibilities, so I will not show

everything. I can just define here the diameters of the bar. So here you have a sketch, so you can define for the a, b, c, d sides of the column, the number of bars. You want to apply, for example, three, three, and two bars on the sides c and d. Also, I can set the transversal reinforcements, so for the element above, for the element below, for the main part of the column, I just had here a rebar set. Just define the spacing value, the number, sorry, the spacing here, the diameter. And here, you see, directly, where the position of stirrups, so here I can say the opposite of the first one, five centimeters from the foot of the column, and you hit, and you get the 3D Rebar inside the column.

So that's the first way you can produce rebar with a kind of rebar generator.

CARL SPALDING: And just to be clear, that's not the future of making rebar in Revit, that's just an easy way to get your rebar done. So it's a byproduct of the technology that we've developed. You can just use it to create reinforcement on the fly. So just to add a point, Joseph is using metric units. In Imperial, of course, that does kind of highlight that you can switch and change to any standard on the fly. It's not a single language and country specific code, it can be changed on the fly.

So next, that's great, so we can see that we can configure reinforcement. Can you guys all see the screen OK? So now that's step one, nice easy one. Second option is it's pre-installed with the country specific settings, preferences, it comes preloaded with those. Of course as you've seen, you can override them you can save them, that's great. So with that in mind, let's go to the next level.

JOSEPH PAIS: Yeah. So the next level is that here, for example, I can select several elements. So one continues being one, is a static beam, a column, the footing. And here, just press the button to get the 3D rebar cages automatically. So now that the software is doing, in fact, is creating the 3D rebar based on reinforcement preferences. So here, I have the Dashboard, I will go back to this one a little bit later on. So here, when you select a column, here you see that you have some reinforcement preferences. So here, the user, of course depending on the code-- so here we start speaking about codes because all the preferences you can define depends on the codes and the countries. So here, I set the system to the United States using the ACI code for the reinforcement options.

So now if I select this column here, you have several reinforcement options where you can define the maximum spacing you want to put in place, the type of hooks, the angle you want to put in place for the longitudinal, for the transversal bars inside the column, the minimum, the

maximum diameters, the way you want to place, to close, the stirrups. And you can do it defined, all those assumptions for each element, for footing here. So you see, you have a different dialogue to define how you want to reinforce the footing. And also the same for the beam.

And here, you will see that you really have the natural rate definition, a lot of possibilities for the reinforcement preferences. You see for the transversal bars, for the longitudinal bars, but not only for the anchorage, the [INAUDIBLE] reinforcement bars you have to put in place, in case of beams with a high value or the support reinforcement, the splice bars of support and so on. So you can define all those preferences. Obviously, it's not a must to define them all the time. So that's very important. You can define a set of templates that can be saved on this that can be reused on different projects. So you can pre-configure the system to apply your preferences, depending on the elements, depending on the project, and so on. So that's very important.

Also, as you can see, it's quite accurate. So here, for example, just to go a bit more into detail, so we see that here, we have quite a lot of clashes between the two beams. So, of course, sometimes when you have small diameters, you don't care about clashes, you manage them on the building side. It's sometimes less costly than managing them at the engineering point of view, but you can also do it here. For example, you can just select the beam, access the assumptions, in here, for example, change directly. So you see that I'm using dialogs coming from our tools. Why? Because it's easier to use. Here, I can just change the top face and the bottom face concrete cover value for the beam, just OK, and then update the 3D rebar cage, and now you see that I'm avoiding those clashes. OK?

It's important also to mention, to see, to keep in mind that everything is linked to Revit. So you see that the fact that I changed the concrete cover by using the dialog created a new cover, concrete cover templates in Revit, so that's important.

CARL SPALDING: So these are all integrated. Everything you're seeing is completely client-side configurable and inside Revit. So these are Revit families, it's Revit tools. And so, obviously, they were introducing some additional parameters that aren't inside Revit, which is why our tools are there, but it's there for you guys to be able to configure. So remember that big document pack that the engineer hands over. So let's assume we've got one of those. And the advantage of what we're showing you and the reason we're showing you all this is because it can be applied in multiple ways, so you don't have to use the high end, complete, connected workflow. And to

be fair, that's not the case. People will work with different partners or different stakeholders and you'll get data in different formats, so we're trying to respect that so you can apply this technology in any way, as you've seen manually in two ways. Now let's have a look at having those codes, and once we've got that engineering data, how we can use that directly in Revit, to start adding a little bit more intelligence to what we were producing.

JOSEPH PAIS: So before going one step forward on the calculation point of view, what we can do also with this technology is that I can select those two elements. So for example here, the footing on the column. And here, ask to get the reinforcement drawings. So here, what's the idea? The idea is that based on Revit templates, I will go a bit more in details in a few minutes. So based on Revit templates, the system is producing all the detail views you need and the drawing sheets. So now it's taking a few seconds, but, honestly, comparing to the time you need to do it by hand, it's much faster. And here, you see that it has created four detailed views for the footing automatically, placing the annotations, the dimensions, and so the section, the other section on the other directions, the supported element. And here, as you can see, the drawing sheet. OK, so here, if I--

CARL SPALDING: We like that, we like that, it's good.

JOSEPH PAIS: So everything is coming from templates, nothing is [INAUDIBLE]. It means that this is a title block, so here, of course, and this is the Graitec A3 metric, which you will never apply in US, of course, you will apply your title block. And what is important is that here, you see that we are providing a rebar schedule more detailed than the one you can use in Revit or you can produce with Revit, for example, including the shapes schemas in the bar schedule, but that's important. Again, we are running on top of Revit, so obviously, I can just decide, to remove this schedule, and here, to produce a schedule from Revit. So I have prepared a schedule. What I just need to do is to assign a-- let me, here, using one of our tools, I will just create out of this element a 3D view. OK, duplicate. It will be easier for me. OK, so I have the 3D view.

So you see that I'm using, basically, I'm using tools coming from Graitec, not tools coming from Revit. So here, for example, here I have a tool to manage how to display, just with line or with solids, the rebars. OK, I will just hide this box. OK, and here, for example, what I can do, I can select all those bars. OK, and here, from our tools, I have an option to assign those bars to a sheet. So I will assign those selected bars, 13 bars, to this drawing sheet. OK, it's done. And now, when I'm creating this rebar schedule, I will go to the properties and you see here, we have a parameter called G-sheets Graitec.

So I can filter on this parameter. So this parameter equal to the assigned drawing sheet. Let me just see-- OK, so this parameter is even. So now I have, as you can see, the rebar schedule, and now it's quite easy to just drag and drop this schedule inside the drawing. OK, so maybe I will place it here, just move those two views like that. And you see that, quite fast, you can get your drawing-- again, I have to move a little bit more-- OK, and then you get the drawing, including this time, a rebar schedule.

CARL SPALDING: The key point being it's Revit. You apply this in your workflow as you do at the moment, it's just trying to speed up that process. As you've created a 3D view of the footing, do you just drag that on there as well?

JOSEPH PAIS: Yeah, sure, sure, you can. So yes, of course, you can drag and drop also the 3D view there, change the scale, and get it--

CARL SPALDING: Voila!

JOSEPH PAIS: In the drawing. C'est parfait.

CARL SPALDING: OK, great. So I mentioned earlier about the engineer's document pack with all the loads. Let's go one step further.

JOSEPH PAIS: Yeah, so now I'm coming back here to my model. So here, what I did, I just in fact, produced 3D repackages based on reinforcement preferences, that's it. For the moment, I have no idea if these 3D rebar cage fits with the requirements, fits with the required bearing capacity of the column. So the next step we can do for the future, going step by step to the future of making things, of making rebar, is I select the column and now I want to design this column. So first to design this column, I can access, directly in Revit, to the design assumptions.

OK, so here for example, you can set-- it was user defined, so you can set the concrete class, you can set the grade of the steel from the rebars, so you have all the design assumptions. What I need, also, to design this column is the loads. So here, I can just come here. So in this dialog, I have the possibility to create different load cases, so I create a snow load case, for example. So I have that load, live loads, snow loads. And here, yes I want to apply, I'm just applying manually the loads, coming from--

CARL SPALDING: A spreadsheet.

JOSEPH PAIS: A Spreadsheet or coming from a hand calculation or whatever. So I will handle values, I will just put here, for example, two horizontal values, the same for the live loads, and smaller value for the snow. OK then as soon as I have defined the design assumptions, the reinforcement preferences, I can calculate the column. So here you see that the column is too small, OK. You see, it's just impossible. So what I can do, I can change the section of the column. Then you see that the stirrups are stretched, that's a Revit behavior, but what is more important is that I redo the calculation to get unabated design of the column. That's important. Now I get something much better, obviously. OK, and the column is designed, that's very important. So first, here for example, I can call this function, called diagram, so now it's loading a set of results from the database, and it will display. You see the three interaction curves, and here you have the working ratios. So I can still optimize this column if I want, because here, I see the maximum working ratio is around 50%, so I can optimize. But that's important to keep in mind, that what I'm doing now is using an integrated design inside Revit. Yes, there is a question?

AUDIENCE: [INAUDIBLE]

JOSEPH PAIS: No, no, no, it's an it's an engine developed by [INAUDIBLE]. Yeah.

CARL SPALDING: But installed as part of the BIM design is. No, at this stage we're showing you, everything is just inside Revit. This is, yes?

AUDIENCE: [INAUDIBLE] transport the results to Revit, can you in some way, use the results?

JOSEPH PAIS: Yes, yes, you are doing too fast, that is the next step. But yes, the answer is yes.

CARL SPALDING: I like your train of thought, that's very good. Keep that, keep that, we're going there. We want to build this up.

AUDIENCE: [INAUDIBLE]

JOSEPH PAIS: Sorry? It's because in fact, I imposed a section, and so basically, the building capacity depends on the section of the column that I have imposed, because I didn't run a pre-sizing, and also on your reinforcement assumptions. So you can fine tune playing with those two sets of parameters.

So here, just to see that here you have a detailed reports, including the article from the norm, the formulas and the numerical applications. So that's important to see, that this is a 2D

designed tool running in Revit.

CARL SPALDING: So this engineer's design report to your code, depending on Canadian, American, or European wide, is all, everything show so far is all within Revit. It's all contained within our Revit environment.

JOSEPH PAIS: So just to finish with this part, so you can do the same with beams, columns, footings. So here, for example, for a beam it's the same, you can just go here, just define the load. So you see you have different set of loads, uniform, triangular loads, and so on. So you can just quickly apply the loads on the beam. The same for the light load case. And again, just calculate the beam and get the 3D reinforcement for the beam. OK so that's--

CARL SPALDING: OK, so I like to pause at this point. Yes, so you have a question?

AUDIENCE: I have a question, yeah. [INAUDIBLE]

CARL SPALDING: Sorry, can we cut-- can you cut-- it's still Revit, so we're just creating the reinforcement. So once you have it, you can--

AUDIENCE: [INAUDIBLE]

JOSEPH PAIS: Yeah, yeah. In fact, there are two ways. Some of, for example here, there are some possibilities which are included in our tool. For example, in case of a beam in the reinforcement assumptions, you can say that you want to apply, I don't know if it's your question, to apply splice reinforcements at the edge of the beam. If you do so and you validate, you recalculate the beam.

OK, and here you see that the main bars are stopping at the face of the-- I can zoom a little bit more. The main bars are stopping at the face of the column and then you have splice bars. After for the KZs, which are not handled by the module itself, the tool you have in Revit, everything produced is Revit objects, and you can do whatever you want in Revit, using the Revit functionalities.

CARL SPALDING: Including when we created the column, we expanded the column, made it bigger. That just added another family type to that family, so it's instant. It's a much quicker way of creating families. OK, at this point, you see some good uses for the tool without even looking at the design and the documentation side is pretty cool.

One of the best uses I've seen so far is to use the preferences. Just calculate the entire concrete frame and use it for estimating, without any design parameters, anything. Just to get a real quick fa-- honestly, it took about three minutes for an entire multistory building, very high, it was 17 stories, and got the entire concrete reinforcement for that, so hopefully you can find ways to apply it in you-- so the next step is to look at the analysis side. So again, who's using the analytical model in Revit? Who doesn't know there's an analytical model in Revit? We had a few discussions.

So the thing is, Revit is not a calculation tool, we get that. It's not a running FEM analysis, but what it does have is it has an analytical model. And an analytical model allows us to store engineering data, and it allows us to communicate with engineering software, with FEM software. So not only is it able to do the geometry, it can transfer results packages as well. So if create a load, a load case inside Revit, it will transfer that to your FEM software and it can get that back and it can store the results. So it understands, it speaks the language of engineering, if I can be so simple in the terms. So it understands it, it just, it's not a calculation tool. But it will host all the data, it will store it, and more importantly, it will allow you to use that data in a more intuitive way, and to reuse that data instead of putting in an engineering report. So we--

AUDIENCE: [INAUDIBLE]

CARL SPALDING: We're looking at the concrete frame at the moment, so just the concrete frame.

AUDIENCE: What happens if the column is slanted? [INAUDIBLE]

CARL SPALDING: It's a column, it will work. Yeah.

AUDIENCE: It will work?

CARL SPALDING: Yeah, yeah.

AUDIENCE: But if it's only the frames, then you can [INAUDIBLE]

JOSEPH PAIS: Yeah, but not exactly, you will see why. First, here, the difference is that you have the module inside Revit, and that's very important. We will show you in a minute, speaking about a beam workflow, because when you design an object, the 3D rebar cage, that's something, all the design assumptions, that's something else. If you design a column, you design a beam, you need to get all those design assumptions in Revit, because then imagine what's happening if

you place an opening in the beam. If you want to redesign the beam, either you export it again, you do again a calculation, you import back. Why? You can stay in Revit, you have all the design assumptions, you can just push the button and the system is able to update the reinforcement cage of the beam, including the opening.

CARL SPALDING: Can we show that later?

JOSEPH PAIS: Yeah, we can show--

CARL SPALDING: OK, we'll show you that later. OK, so talking about the analytical model. So there is, like I said, there is an analytical modeling in Revit, but we just need to be aware of what it does and maybe think about how it's created. Because it's, the behavior of the analytical model is slightly different to the geometric model, its counterpart.

JOSEPH PAIS: So for example here, just an example to show you what you can get, you remember here I showed you an L column, an L-section column. And if I display, maybe I can, yes. So here, if I display the analytical model, you see that for this L-section column, we have an issue with the analytical axis, which is, by default, not well placed or not placed as I expected.

CARL SPALDING: It's in the middle of the-- it's in the center of the--

JOSEPH PAIS: So for example, we can see better if I take this view from the analytical model, and here you see I have an issue. So here, first, what is important to know, maybe some of you know that here for example, I can first check the consistency of the model. And here display the details, here you see that I have two awnings with a column and an isolated footings, and the analogical axes are not connected. So first, what I can do, I can select this. Or maybe I will do it from this view, it's better to see what's happening.

So I will select this column, go to the analytical definition of this member, and instead of using or applying the automatic detection of the alignment provided by Revit, I will project the axis. And here, you see that I have some grids on my model. So here I have the grid x five, on the vertical direction it's the A, so I will project the x of this column on those two axes. So here you have the y, z local axis of the column, so I do it for the top and I do it also for the bottom extremity, or the second extremity of the column.

OK, so [INAUDIBLE] this done, so here we see what's happening. And if we are back to the 3D model, you see that now everything is well connected. Of course everything is connected according some tolerances that you can set in the definition of the analytical model in Revit. So

that's the key to handle or to be able to apply a connected workflow. It's the key to be able to manage the analytical model within Revit, because then when you go and come back in Revit, your analytical definition is there.

Also what is important in this model is that I also apply loads. So here I will just switch on the floors and the loads. OK so you can see that this model has already some loads applied, and the loads, of course, are created in load cases. OK. So now as soon as my analytical model is well-defined, I will use a tool which is called beam connect, which will allow me to send this Revit model to a FEM system called advanced design. The link, I will not go in all the details, but here you have different assumptions. So the paths of the families, here you have the possibility to export only the elements having an analytical definition or export all, so that's important to manage the model you will get in the FEM system. And here, you see that you have options to synchronize back the FEM results in Revit. So that, I will do right now.

So first I will use this icon to use the flash links, so both Revit and advanced design I installed on the same computer. So I push the button, so here I just have a log file explaining me, OK, or defining the name of the file, how much elements I have exported, and so on, so you can keep track of what you are doing. And you get the model in advanced design. So here, this dialog is important. Why? Because the issue is that your Revit model may be done with, of course, Revit users families.

CARL SPALDING: Your own families.

JOSEPH PAIS: Your own families. And here, for example, the software is telling me, OK, I don't know this section. So you have two ways. Either you can map this section just for the current project or for all your upcoming projects, so that's very important. You can map it, you can map the section to steel sections from the library, to a parametric section. So that's very important. So behind, we have a mapping database, and this mapping database is enriched while you are working with the system. Because for the first project, you will maybe 10, 20 sections. The second project, again, 20 more sections, and so on and so on. And each time, you are enriching, if you want, that's an option as you can see, you're enriching the mapping database. So the next time, the system will not ask you anymore because the mapping is done.

Another option is that, OK, I don't want to map a specific section for this project, so I just create a new cross-section with the corresponding parameters, and we have the same behavior for the unknown materials. OK so it's done. So you see that you can see the model.

Here we see the column, so we see the different levels. What is important is that we get from Revit the levels, here. So that's important, for example, I don't know, to isolate a part of the building. Also we can see that the elements are coming with the exact offset from Revit. You can-- and here, you have many possibilities. Either you can cancel the offset or you can just say, OK, I will select my beams, for example, all the beams. And you can say, OK, I the offset, I just uncheck it for the FEM calculation. So it means that on the visual point of view, on the display point of view it's the same model, but on the FEM calculation, you do not take into account the offset, which will create additional forces on the members.

OK, now I have also the loads. So here I have the loads so I can display on the loads. You see that I have loads coming from the Revit model, OK. Here are the load KZs you can see here on the left in the project browser, and I can, for example, I will apply an additional load here on the roof, so it's now load here. So you can see I created the load. I can do maybe another, some few other modifications. Here I have two columns, with bigger dimensions than the other one above and below. Makes no sense. So what I will do, I will select both of them and just change the section. OK, it's done.

Before going to do the calculation, what is important also is that we get the entire analytical definition of the model. For example this beam, if I go and check the boundary conditions on the elements, you can see that here you have the six degrees of freedom defined in the local axis of the beam, and the two rotations, the two bending rotations are released. And why? Because in my Revit model, if I come back in the Revit, if I select this beam, I have the same definition. OK?

Well I have my model. So what-- OK, just what I am missing, I just need to apply the self weight on the load case. It's done, and I can run the calculation. So here, my purpose is not to make a demo of the FEM system, it's just to explain you the link. So the calculation is done.

CARL SPALDING: Show you the link live, so it's a real working model.

JOSEPH PAIS: OK so the model is calculated. And now I will export back this model to Revit. So first I just need to check to be sure that, OK, the export of the elements on loads is on. And then from here, I will export. So I will create a file. OK, let me put it on my working folder, I will call it back to Revit. OK, I trade the file, and now if I'm coming back to Revit, here I have an option to synchronize the model and not overwrite, of course. So I will synchronize. So here what we have done with the tool is that we have created a dialog where the user can see what he can

and what he wants to synchronize. So it's not something, OK, I synchronize, everything is a abated because then you have no control of what's happening.

So here you see the modification. So I see two columns having a different section in the initial Revit model or in the current Revit model and in advanced design. You can decide, line by line, to accept or to ignore or to keep the modifications. So here, for example, I will select the two lines and accept the modification, and here you see in green, it's the new created element, so I have a new load. It's the road I created, so I accept it. I have to select the line. OK, and then I apply the changes.

So here, what the system is doing, in fact, is updating the geometry of the Revit model. Because I changed two columns, I created a new load on the roof. And it's also, that's why it's taking a little bit of time, is importing the FEM results. So now, first we can see that on the top, on the roof, I have the load on the snow load case, here, and the value. Sorry for the kilonewtons and you don't per square meter, I don't know how much in kp's per inch.

CARL SPALDING: You a room full of engineers that could tell you.

JOSEPH PAIS: Yeah. And if I'm coming back to the 3D, you see that the two columns have been changed. OK, now what's the purpose? In fact, now, if I'm going to the analyzer, here you see that you can install in Revit the structural analyze tool kit. So the people who asked me a question about [INAUDIBLE], I think you are using this tool.

And here you have a results manager there you can see a results package coming from advanced design. So it's now on, just it did it in life. And, of course, you can explore those results. And, for example, you can display the actions for the dead load one. OK you can-- and you see that, in fact, the values that are here, if I'm coming back to advanced design where I can just isolate the support, you will see that, of course, you get the same values. So here for example, I will display the values on support. And the values you can see here, are the ones you have in Revit. OK. So now--

CARL SPALDING: So that results package is good to keep track and history of the changes of the model as well in, and all the iterations that have taken place.

JOSEPH PAIS: Yeah. So here, for example, of course after you can get your old bending moments, actual force, shear values on all the frames or columns and the beams.

CARL SPALDING: So Revit does understand engineering. It doesn't-- yes, please?

AUDIENCE: One question. Let's say that we're reinforcing all the columns in one floor. Is there an easy way to control which columns has been reinforced by the calculation [INAUDIBLE], and which column--

JOSEPH PAIS: Yeah, yeah, yeah. At any time, you can just select some elements and go here, to design statues. And here you see which one are calculated, which one are calculated with arrows, which one are calculated with warnings, and which ones are not calculated. So at any time, you can call this dashboard and have access to your statues in real time. And here, even more, if you click there, you have access to the main results, the working ratios, the warnings-- so here, for example, the warning is that on my foundation, the concrete cover value is too small.

AUDIENCE: And is there any way to [INAUDIBLE] is there any way to keep track of the changes and add comments, and so on?

JOSEPH PAIS: No, the only possibility, in this case, is to create a report having the warnings and to save the file. Because as soon as you do a design, it's overwrite the previous one.

AUDIENCE: [INAUDIBLE]

JOSEPH PAIS: Yeah. Yeah, yeah. This is the last current statues.

CARL SPALDING: So now we have the results in Revit, what's the next step? The rebar? We did rebar already, Didn't we? It's to use that data that's just been imported and use it to calculate, automatically, the required reinforcement.

JOSEPH PAIS: So to answer the question someone placed about if I can use the results coming from robots, I say the answer is yes. Why? Because here, what's important to understand is that here it can be a result's package from robot, it can be a results package from any FEM system, which is able to store FEM results within Revit. OK? So as soon as you have such a FEM system and you are storing the FEM results there in a Revit results package, then in our tools, you can just say that you want to import a set of results. So here, you go to this dialogue, you say, I want to send results from Revits. It's not written import FEM results from advanced design. OK, so it's from Revit. You can select the package in case of a Revit model having different packages because you did several iterations, for example. You can select the one you want to apply. It's telling me that it will overwrite all the loads I eventually define [INTERPOSING VOICES]. So

now it's doing it. And now the difference is that if I'm selecting a footing, and going to the loads definition, you have everything. OK so this works if you store FEM results from robots. It's the same. The system is loading the REM results from Revit.

AUDIENCE: [INAUDIBLE]

CARL SPALDING: Not yet. At the moment, we are looking at the concrete frames. So we don't want to do everything for you.

JOSEPH PAIS: The next step?

CARL SPALDING: No, the next stage is to expand it from there.

JOSEPH PAIS: The next step we are working on now is the shear walls. So soon, I think Spring next year, we will have the shear wall module also running in Revit.

CARL SPALDING: With the exact same principle.

JOSEPH PAIS: So now, what's the, the idea is that now as soon as you have--

CARL SPALDING: Hang on a second. Yes, you have a question?

JOSEPH PAIS: Ask again, excuse me.

AUDIENCE: [INAUDIBLE]

JOSEPH PAIS: Sorry--

CARL SPALDING: The increased size of the file.

JOSEPH PAIS: That's a good question.

CARL SPALDING: Because it's storing it in the database, so it's--

JOSEPH PAIS: At the end of the class, I will tell you if you want, because my initial Revit file is around 11 mega. If you want, just remind me the question at the end of the class and we will [INAUDIBLE] the size of the file, yes, no problem.

CARL SPALDING: So we have the results.

JOSEPH PAIS: So we have the results, yeah. So now what's interesting is that you can select several

elements, like that, and run the calculation. Of course you have to check the design assumptions and so on, which can be done on a multiple selection. You hit the calculate button and you let the system work and design the elements, one by one.

CARL SPALDING: If you don't select anything, it will do the whole model. Obviously, we are very conscious of your time, so we'll do a few elements.

JOSEPH PAIS: So here it's taking a bit more time on the footings because you have the sliding verifications, the [INAUDIBLE] verifications in addition to the design of the footing itself. It will be faster from the columns. And you can do it also from the beams. OK, again you see you have a dashboard of the elements, and you can see what's happening and why you have errors or warnings during the design. And again, everything can be-- OK, maybe let me just uncheck this option-- everything can be changed real time. For example, here, this footing makes not so much sense. Maybe what I can do, I will just, let me just increase the thickness. By the way, I can increase the size of the footing, the height of the footing. OK, don't pay attention to the rebar for the moment, I have to update it. You see that automatically created a new type in the corresponding family in Revit. So that's a way also to create a new type, it's faster than duplicate it, rename it and so on.

And now I can go to the reinforcement assumptions, say that I want to use the closed stirrups instead of single bars. I can't set here the diameter I want, and I can recalculate the footing. OK, and again you have access to everything I said just before, so I can then come back and change the parametric definition of the footing. The only difference is that here, you see that I have a theoretical reinforcement values here.

CARL SPALDING: Over here.

JOSEPH PAIS: So if I do a change and I reduce the number of bars immediately, the system is telling me that in red, the value is in red because it's below the requiring value coming from the design. OK. So that's how you can apply the beam designers in Revit. So you see that for the moment, I'm using the system fully in Revit.

CARL SPALDING: So we may need to interrogate a single element, for example, or maybe there's, you're nearly at the stage of handover and there is a change that needs to be done. So maybe if we take a single element and you need to get that re-checked by the engineer and it's currently sitting in Revit, there a way to do that. So our technology is multi-platform, so it will work, as you've seen, in Revit. It'll also works as a standalone, so you can take a single element, same as the

engineer. He can load it single environment and perform some calculations in that. Equally, it will run in our own software, but we'll show you that in a minute. So you can take a single environment, a single element, and work independently, sharing that load, if you like, between the engineer and technician. And you can have, it supports multi-users as well. So you can have multiple people connected to the Revit. There's only one of Joseph, but if there's more of us, you can have and it will support a multi-user workflow as well.

JOSEPH PAIS: So here, what we call the beam designers, it's the name of those modules, here, for example, I can run the beam design on modules dedicated to reinforce concrete beams. So what's this model? It's a single 2D module where you can define the geometry of the beam, apply the loads, run the calculation, get the design, get the rebar cage. So it can be used as a single tool.

Now here what I want to show you is that I'm working in Revit. I want to send this beam to a colleague that will do the design using the tool. So it means outside Revit. So I select the beam. I export the beam, I give the name to the file. Let's call it beam, to use the mark, 79. OK and I'm going to the module, the standalone module, and I'm opening the file I just created. So I get the beam with the geometry and I can change this geometry. Now I am in my design tool and I'm doing my job.

So I know that I want, for example, to have an opening, I want to edit the pressure on the beam, so I can decide to increase, for example, the height of the section for the first span, the second span also. I will create an opening. So on the span one, I will have a [INAUDIBLE] opening. I give the position, I set the position of the opening. 25. I set the dimensions also. OK, I see the opening here. And on the second span, just going to illustrate, I will create-- not on this one, on the second span. No, this one, yes. I will create the pressure. OK.

Also what's important is that I can change. All the time, you will need to change the assumptions. For example, here I will set the concrete class, I will change the grade, for example, and you run the calculation. So here the calcul-- the beam is designed, but I see that there are things not so good. I have here three layers with a small one, so here I will just go to the bar settings and say that, for example, I want just two layers. I recalculate the beam. OK, it's better.

Now you see what I have done. I have done my job. I have changed the section. I add an opening, I just add the pressure. I changed some design assumptions and so on and so on.

Now I'm saving the file, I'm closing the module, and here I will import back the file. So here is what's very important, according to the question you just placed a few minutes ago, in fact now the system is importing. So in a few seconds, we will see the 3D rebar cage directly in Revit. OK, that's something, but in a beam workflow, it's not the most important, because the most important is the fact that in Revit, I have the 3D rebar cage and all the design assumptions. So it means that I know how the engineer got these 3D rebar cage in the design mode. And now if I want to move for any reason, if I have to move the opening, the opening is not at one point, it's not at 1.5, 2 meters, but 1.5-- sorry, I'm in millimeters. 1500. You see, so it moved. And now I can recalculate the beam.

So that's very important. We cannot speak about connected beam workflow if you are not--

CARL SPALDING: If you're crazy and--

JOSEPH PAIS: --if you are not consolidating all the data in Revit. So that's the purpose. The purpose is, at the point, to store all the engineering data within the Revit model.

CARL SPALDING: Someone has a question?

AUDIENCE: [INAUDIBLE]

CARL SPALDING: A design report?

AUDIENCE: [INAUDIBLE]

JOSEPH PAIS: Yes.

CARL SPALDING: So again, depending on the country settings that you've applied, you will get a variety of templates available. So they're already pre-configured, but you can customize them, put your logos on, create different content for each of them, different chapters for each of your design reports. And the same with all the other templates, as well. The report can be created just as a preview or it can be created as a PDF. Sorry, yes, you have a question?

AUDIENCE: [INAUDIBLE]

CARL SPALDING: No. Updates. We'll show you that in a--

JOSEPH PAIS: Yeah.

CARL SPALDING: So the American design report is quite, quite a lot more content than the European one, so it

takes it slightly longer.

JOSEPH PAIS: OK, it was open sorry. So here,

CARL SPALDING: You can just make it a bit wider.

JOSEPH PAIS: You see that, so here you have, really, all the details. So you see you have 22 pages just for this single beam, with all the combinations, the diagrams. And here, you see that you have, for example, for the [INAUDIBLE] checks, if I zoom in a little bit, you see you have all the values, the combinations, and the detailed hand calculations. Honestly, if you do it by hand, you will do the same job. You see, even maybe less. But you have all the formulas, all the numerical applications. So you have no doubts, you see exactly from where are coming the results, how the module design and the beam. And that's very important, for an engineer to be able to trust the system.

OK, so another question. Why is it to get the drawing? So yes, you can, for example, you can select it. So how do we produce the drawings? In fact, here you can create some templates. So basically, here, for the, of course, we produce with the system, we produce a set of templates. But it's a Revit file, because our templates, it's not maybe the one you expect, so a Revit template is a Revit file where you placed the views you want to generate, the annotations, so you can use [INAUDIBLE], because we provide the [INAUDIBLE] families for [INAUDIBLE]. But you can use your own ones. [INAUDIBLE], you can see that here you can also [INAUDIBLE].

JOSEPH PAIS: Yes, is it on? I don't know. Yeah, OK. So you have also templates for title blocks, for bar schedules, so you have different bar schedules proposed, and then you select the element and you create the drawings. So here it takes a few seconds to create the required detailed views, and then the drawing sheet after depends on the country. It's true that in France, we produce a lot of single drawing sheets per element. You have, also, here the possibility to select, I don't know, tens of columns, and to place all those columns in a single a0, a0, I'm not sure it's a-- yes, it's yes, in US, it's maybe not a0, it's something else, but on a big paper scale, let's say, you can place several elements in the same drawing, of course.

And here, you see that you have the drawing within Revit. Here we see that it's maybe not perfect. So you are in Revit, so you can go to the view. For example, you can select the tag and move it here, for example, like that. Also what can be interesting in this beam, I mean, for example, here are two different types of stirrups, two different size of stirrups. We have a tool

here, which give you the possibility to create automatically bending details. So you can select this rebar set, select this one, and call the function bending detail. So it's creating a bending detail. OK, I have to change the crop area, like that. OK, and you see that you have the bending details automatically produced. And obviously if you change the element, the bending details are automatically updated. Yeah?

AUDIENCE: Is it possible to customize the tags so that--

JOSEPH PAIS: Yes, yes.

AUDIENCE: [INAUDIBLE]

JOSEPH PAIS: Yes, you can customize everything. Even more if you are already using Revit for rebar, you can apply your own tags. That's very important. Yes, yes, yes. Yeah, yeah, it's a must.

AUDIENCE: In Sweden, we do it in another way.

JOSEPH PAIS: Yeah, yeah, yeah, for sure, for sure.

CARL SPALDING: And there are, I think, 18 different standards that are installed with the software for detailing. OK. Should we have a look at what happens when we do changes?

JOSEPH PAIS: Yes, we saw already, if you move, if you change a section, you have to recalculate the element. If you move an opening, you recalculate the element and so on. Everything is updated. Maybe what I can show you also is the fact that we saw that on the possible workflow, you can use the standalone module and get back, consolidate back, all the data within Revit. There is something else you can do, also. Quickly, is the fact, that is to, for example, here. I can, in advance design, so in the FEM software, you can-- OK, let me check a column that is not, which is not reinforced yet, for example, this one. OK, so for example, I will calculate this column.

So, in fact, within advance design, so the beam designers can't say that they are multi-platform. It means that I can use the same design module within the FEM system. So you see that I'm still in advanced design in the FEM system. I have the column, I can calculate the column. Again the process is the same, I can change the design assumption, I can change everything. And then if I close it, I'm going fast now because it's just showing you the workflow. I can select this column and import the file. Where is my folder. OK, sorry.

CARL SPALDING: [INAUDIBLE] said very quickly.

JOSEPH PAIS: No, no, I just need to find out where I saved my file. OK, it's in Documents, OK. So I will go in Documents. So I will import. So it's in the Documents folder, where is my documents. Ah, concrete building, yes, is there. OK. So this is my column here. And then you get it in Revit. So you see, you can apply the design where you want, when you want, and at any time, consolidate everything in Revit. OK?

CARL SPALDING: OK, so let's, hopefully this is not a bad thing, let's introduce the MEP consultant into the room. And we get a host of elements and we have to coordinate that, and they've, thankfully, gone through all of your beams. So how do we, how do we manage that, and let's have a look at--

JOSEPH PAIS: OK, so here, what I did, I prepared a separated file when I created some MEP elements. Not myself, someone else. So I will load, I will load the file. So I will link this Revit file to my current project. OK, and here, I have-- OK, so I will just hide those bars. OK. So here we have a model with different MEP elements with ducts. So here, first what I can do, I can call a function from our tools, which allow me to create the MEP openings. So here is detecting all the ducts from my model, so I see here the different dimensions. The type of the structural elements, where the ducts are going through. And here I can set an offset, so I can this the full value is too big, so let me just change it. So I define the offset around the ducts. OK, just one. I apply.

OK and now you see that it has created all the openings on the beams. So that's the propose here. The propose is to show the interaction between the MEP and the structure. And now, for example, maybe to better see if I unloaded the MEP file, you see that we have all the openings on the beams. And now the idea is that thanks to the beam designers, I can select an opening, a beam, sorry. A beam having an opening, and then you can calculate and reinforce the beam, considering the opening.

CARL SPALDING: Let's have a small round of just only one.

JOSEPH PAIS: Thank you. OK I think I am late.

CARL SPALDING: Yeah, I think. So maybe just to say a few words about the next, if you do have your own Revit families, you can map. As Joseph said earlier, we do have a mapping database, so once you've mapped them once, they're mapped. So you can continue to use your own families. We do provide the families as well, naturally, because Revit doesn't come with enough families for this particular stuff. So maybe if I take the this and we do a seamless transition again.

So I can't do two things at once, talk and do this. OK, come alive. It's gone to sleep. Hello. Maybe we should have left it on your-- Ah! Dang it! This was to wake you up again. So OK, be prepared for the next clip, they're not really coming for you, but be prepared.

[MUSIC - "STAR WARS MAIN THEME"]

These guys aren't really the bad guys that you saw earlier. In reality, the kittens are [INAUDIBLE]. There's no-- we don't know too much about this next one, [INAUDIBLE] but I say nothing on that one, [INAUDIBLE] is improving himself here. Terminators aren't coming, don't worry. They're not coming for you, either. As we kind of set the scene earlier, the real threat is the guy sitting next to you, or the lady sitting next to you. That's the real threat, it's the guys who are adopting this technology. And going back to what I said earlier about cost, I had an interesting discussion with an engineer who said that they weren't really prepared to do the rebar in Revit because it took them so long. I said what, seconds? You know, it is changing, as we said earlier on the stage, changing the way you work and changing the way you think. The technology is there, it's just waiting for you guys to adopt.

So if I can give you kind of three takeaways, it is trying to just, if you've tried it before and you didn't have a good experience, try it again. Speak to your software vendor about just connecting your Revit software with your FEM software. It's definitely the way forward. You need to get a connected BIM workflow in order to be part of Episode II, level BIM II. Harness the power of BIM. We're beginning to do that, so Graitec is working very closely with [INAUDIBLE] of us, we're trying to use the data that you provide to automate downstream processes. At some stage in the future, and we saw it with Norconsult, they were no drawings. It went from model to site and fabricate it. There was no documentation, no paper trail created. So it's happening.

And then, take advantage of solutions that are designed for you by companies who work for you. So BIM designers, this is being recorded, so we'll make sure I share it with everyone who's attended. But we do have the little stick of power, I call it. Little USB stick, so please feel free to come forward. Has anyone scanned these codes, QR codes? If you've seen that with the 360. It's something you get out of Revit for free, so I'd say just use it, just have a look at it. Scan the code, you get a full 3D model. So if you want to scan that, whilst it's up, with your QR scanner on your phone, do that. And you can see a complete 3D model with reinforcement and so on. And we'll share additional ones as well.

So before you go.

JOSEPH PAIS: They are scanning.

CARL SPALDING: Scanning, OK, I'll wait. I'm a patient fellow. But we do have USB keys up here. So on this USB key is the software, it's in a zip file, just unzip the file. There's some videos and so on, show you how to do it. There's the class handouts as well. Not the presentations, because we were fine tuning those till the last minute. But there's everything you need on here. And once this is online, I'll definitely share it with everyone.

Did you get it, did you see it? If you went to the AEC stand, you can get the little Google cardboards, they've got little lenses in them and you can see the whole thing in 3D. And watch this space, if you've done some of the VR stuff, it's quite cool. This is free, straight out Revit, you're just rendering it as a stereo panorama, and you end up with that, with any of your Revit projects. So, oh yeah, please. You know what to do. We're the last class, so hopefully it was good. Did you find it useful, learn some stuff? It was good? OK, great. Well please come up here and get a memory stick from us. Thank you for sharing your last moments with us. We appreciate it very, very much. Thank you. Thank you very much.