Physical Modelling for Electronics Enclosures Using Rapid Prototyping

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Lecture - 08
Product Sample Exercise - 1

Hello, let me start. Morning, I did not bring this torch cell, which is what is the basis for the design you are seeing there.

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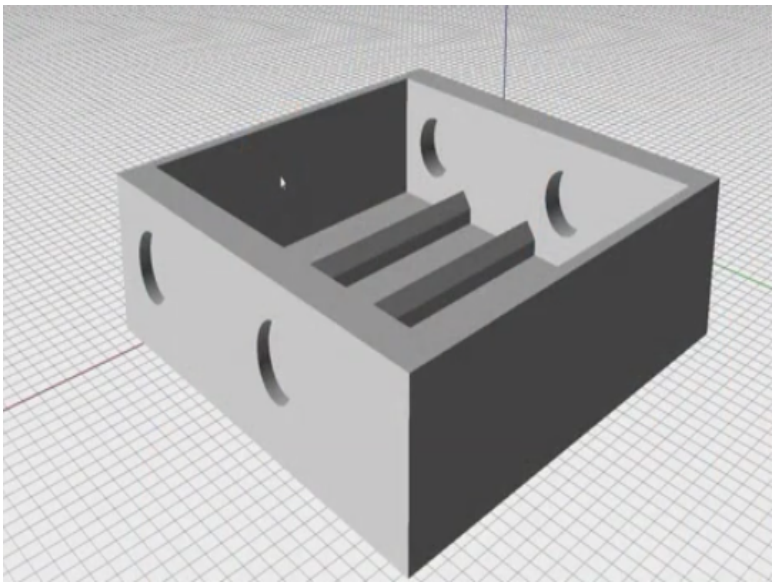

Basis for that design is the torch cell that is here. If you see here, any of these designs is based on a physical reality. Physical reality in this case is diameter, then what you call, the height, and then there is a small knob like thing at the bottom. This is where, what you call, a lot of reality check has to be done. Depending on the devices for which you are designing, you need to take the original.

If you see this cap here, this so called double layered cell was probably around 2 inches at one time and half an inch. So I have 12.7 and 50.8 and so like that. Now you see the small detail at the top is very critical for us to proceed to the next side. So you must have this real thing as from the final batch, which they are going to supply; only issue being is often, there is mild variation from batch to batch and what the manufacturer has contracted in is manual.

So you need to have the original data, which is manual and the actual pieces here. Now please look at my thing there. I will try to make this brief. If you remember, we started here saying I started with a cross section.

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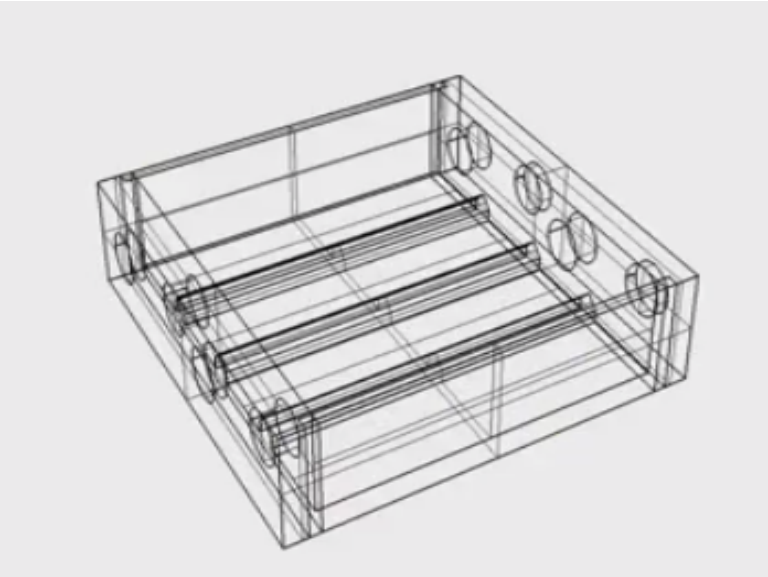

Somewhere here, the original profile of this from left to right is there and then as part of this profile, I have a thickness here. A small ridge like thing here, ridge here and something you will notice is that we have a very different thickness here and different thickness here. So what do we about this thicknesses and how did we come up about it. Now this thing needs something to close itself also on top of it.

Please look at this. I have this box, which is meant for my hearing aid and you see the profile. They have made some small dent, so that a spare battery can be kept there, spare cell can be kept there. Right now, this is meant for a bigger thing, so if I take this it is supposed to go back here and more important is, when you close it, it should close and probably snap. So I have a catch here.

I press the catch and it releases and goes back and you see little more detail about the hinge. Can you see? When I take it out, the hinge is here, it is not here. Hinge is here and then there is a tremendous mechanism is here and it completely it swings itself out of the way. This is where I

feel our wrapper prototyping probably helps. Can you here, there is a small hinge that part of it and you need to develop the whole thing from the various space I have shown you there.

Though the starting point is the same cell, this is the amount of what you call thing, which has gone into place. At this point, allow me to get back to something which is more interesting to hold your interest. How does it build these things? Because everything seems to be critical about how it builds. So for my benefit, look at the cross section.

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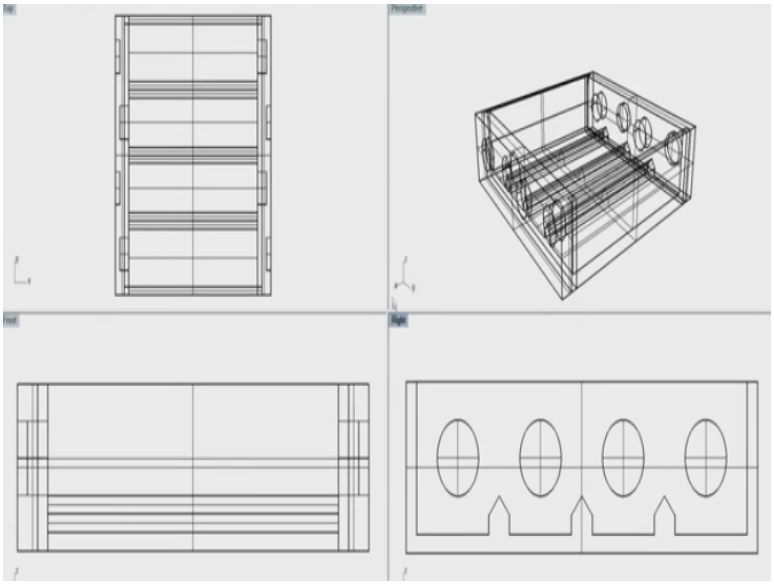

What I am going to do here is right now remove parts of the material coming from top and see, just pay attention and stay with me for a short time. This is how the layup is going to start. For convenience sake, I just removed all the top portion of the material and then by a little bit of interest and little bit of intention and little more by accident, you see that back things have remained as it is.

So as the layup starts, what do you call that nozzle is going to fill material like this slowly depending on the type of algorithm they have, some of them go diagonally like this in one layer, some of them goes straight away like this. So when I undo it, first layup is going to be this much. The bottom portion is being built slowly. So whatever thickness is in this case for convenience and speed, I just removed the top. This is how the layup is going to start.

Now when you go to the next feature, I will just undo it here and then try to show you the next feature. You see here at the top. See what has happened. Thus, small things including that dividers between the cells, then the left and right things and then the front and back there being slowly built up. This is where I wanted to tell you, we have 3 axis, x, y, and z. X and y those things depend tremendously on the basic resolution of it and the nozzle characteristics and so on.

Z is the vertical axis, the slices depending on the complexity of the machine and the build of the machine and so on. They may or may not have the same type of resolution of the other things. So the first one the base has been built. After that, parts of the ribs have been built. Now I will again undo it and show you. If you see a little closer, part of the taper is being built. In this case, I have chosen half the taper. So here slowly that tapered section is being built.

This is one thing, which nowadays very much characteristic of any of these things, which is a layup type of things, which has a distinct physical thickness. In that, it cannot form a smooth plane as we think it has. So you get something which is slightly jagged. Jagged means you have depending on the thickness and the overlap and depending on the rate of heating and rate of cooling and all that.

This slowly starts building up like this. The bottom first layer was the base. Probably it could be made out of depending on a thickness, suppose it is 1 mm thickness and the resolution is around 0.2 mm, usually they will have 5-6 vertical runs on that to build up that 1 mm and then later on, they will build the ribs. Starting from the ribs onwards, the algorithm which is used for moving it. Algorithm is a very too general and too abstract a way.

The path, which the nozzle takes will be different, advantageous because there is material here. There is no point in that nozzle going everywhere here. So logically probably, the nozzle moves one length and then moves over to that and then moves and so on depending on the manufacturer's capability and so on and the type of, what do you call, the technology at the moment, they will make an optimized way, out of which of building these things.

So no material is deposited here. However, material was there and this next layer, it needs to now followup and getting this corner is a tough job, where the difference between no way it is made at home and the professional things helps. All these professional things, that nozzle, which builds it knows how to move here. It knows how to move here and how to maintain this corner sharpness, but in spite of it occasionally they have chances of things going built properly and improperly, little bit of errors.

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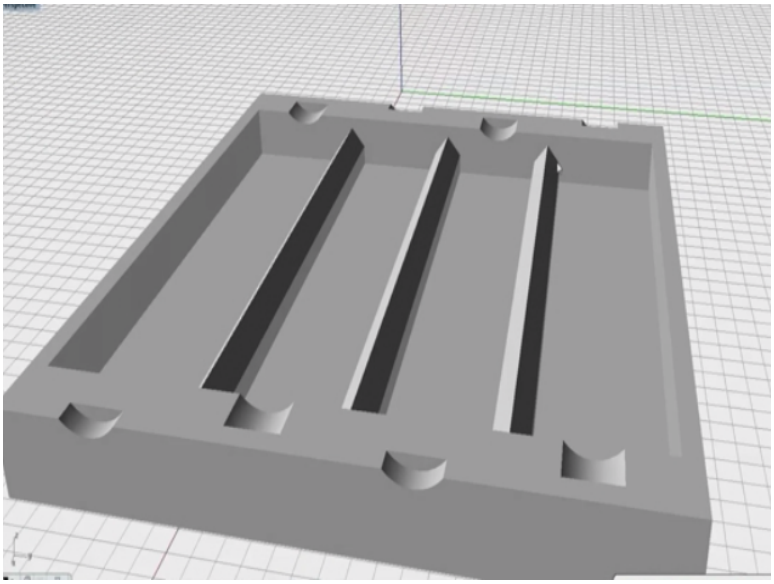

So I have come back here. Now I will move it to the next higher level. Intentionally, I have taken it there, so that we can see a little bit of it and then I will try to remove. See here, for the first time, I notice whatever features we wanted to are being built up gradually. Good point is that the sharp portion has been completed already. The sharp portion here, this is where what you call depending on your application and depending on the sort of hype you have come about.

If somebody says, I can make a knife using rapid prototyping and I can smuggle it and all that, you believe, do not unnecessarily argue with it. It still a lot of it depends on how well that pyramidal that corner has been built. Is it sharp enough? Does it have a gothic arch? Is it straight or does it have the inverse hyperbola type of things and the profile is the one, it makes a lot of difference, which you can do.

Depending on the type of machine and the material you can play with it a lot. In this case only, for a sample I have made. So I have just a triangular thing, but you see here the bud beak. What I feel is equally important thing is you see how well the circular features are being built. It is an advantage and a disadvantage. Advantage being anything you want can be made. Disadvantage being the detail is an important thing.

Maybe in the next class and maybe after demonstration, I would like to show you whenever there is a wide or space, pay attention again, whenever there is a wide or a space, something called support material is built up. The earlier machines, they had a different support material, which is made with polylactic acid. So polylactic acid is something, which has a melting point, which is at least 10 degrees lower than the base material.

So this whole thing is put in a hot water barrel and sometimes left to soak overnight, or sometimes a few hours and afterwards you need to snap off that part of the support material, such that you do not need to have it in the original thing. The new ones are slightly improved on that because printing a support material and again changing all that in spaces like this is a little problem.

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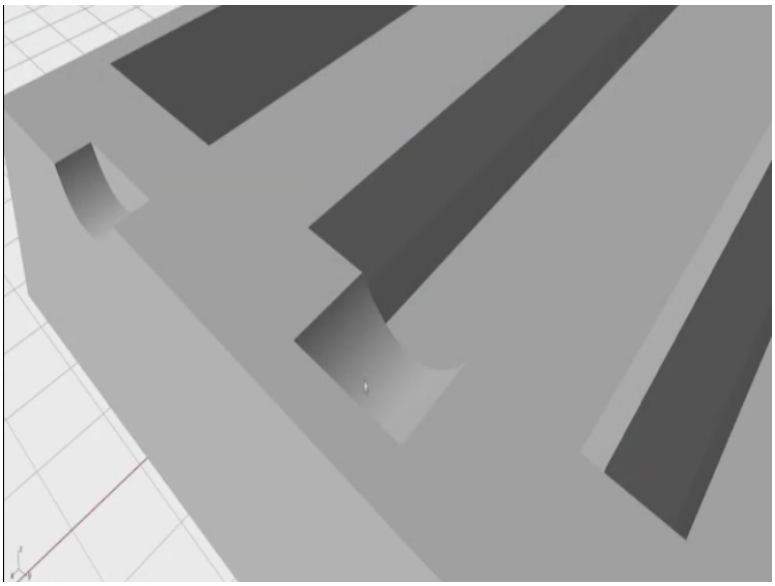

You see here, if you see the space here, you have to now fill a support material and try to fill it, life is not that easy. So depending on the machine you want to use and depending on the facilities, you may have to modify the undercuts and these things. Now I will go back here again.

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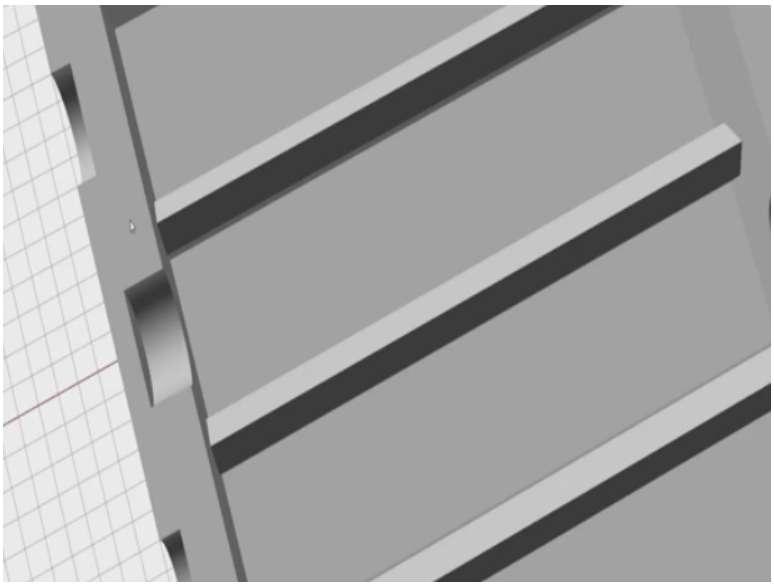

Now I will raise it to the next higher level. Right now, it is here. Part of the thing has been built, if you remember. That is approximately half the diameter of the circular spaces, which I wanted to include. See here several features we are able to notice. One of the features you are able to notice is that as the things build up at this point this angle is almost 90 degrees and if you see the cross section here, small details are features here, which you can either improve, make use of it.

Try to do whatever you want. In this case, I want to have an electrical connection in it, which is not visible outside. Understand, now I need one electrical continuity typically I am having a spring here and then if you have a simple contact here and if I want to join it here, it is possible for me to add certain of these things at this point. So in the original model, if I now create a space in which an electrical wire can be installed, it is possible for me to at least in some of the machines to stop the machine and add the inserts as I like.

In case, that is not possible, we can probably make a through hole here and then try to do whatever operations we want to do. We have got this point, at this point, in case I want to join anything, make a wire, make anything or in some places, I have even seen concealed printed

wire boards installed into these things, which is not possible in a conventional injection moulding machine for the rate at which you are able to do this.

So it is possible for me to stop and then put what you call grove like thing, build it up with material, but you have to be very, very careful because not all machine inside does not send if I put something here. So I need to be very, very careful. I will give you a secret way of more in what you call, more nice story to tell and very rarely we have been actually successful in making it like this. Now I will continue with the building and see.

You will notice now slowly that hole, the circular feature is getting completed rather it is being closed. Now at this point, where only your experience will teach you how far you are nearer the intended object and then what you need to do with it, do I need a space here, do we need a hole here and can we make any of the openings later. Can we have a second operation. If you want to have a second operation, it is very much possible for you to make a small dimple or a small opening here.

So that it is possible for you to enlarge it. The marking is already there. You can use probably a drill bit or a hand thing and including depending on the taps you have, can we tap a hole. In earlier things, it was not easy to build such things like what you call threaded fasteners. Right now, depending on the granularity and all the threaded fasteners that can be built, alternately if you have taps, which have course pitch, it is possible to leave a pilot hole and continue the taping later.

I want you to have a look at how this is and so far we have come. You have seen that I started with a base by which only the base portion of it has been built. After that, these ridges in 2 or 3 steps, these ridges have been built. Now I have shown you where to stop in the middle. Now I am showing you where it is around 45 degrees, that whole thing is covered in this using this. Now I will again go back again and do the bullion I have done and then see next level.

Now I go to the next level. If you see here now, practically most of it is ready with a little bit of material left here. So because we were in the learning phase earlier, we will not stop the machine,

but carefully observe whether this portion has been bridged or not, because we have found out especially when support material is there and all that, we had a little bit of problem with this bridging and very rarely a perfectly circular openings were possible to be done.

So we will usually compensate it by having something which is maybe 0.3 mm opening smaller and then after that use a plug with emery. As you have seen this emery, which is used for painting 0 emery and then try to smoothen it. Put it inside and try to smoothen it after the operation is over. So we used to observe this carefully and it is easy for us now I will continue with this. I will go back again, remove this top portion completely.

Now you see, this is the full thing as has been built, is enough, is it not? So this is the first starting thing, which we have started with now. I would like to come to saying what if I wanted a cap to be built on this. I need a cap and it should be snap fit or I should have a snap or a catch, similar to what you have on this various types, in this I have a latch here, can we do it. Because it was a starting point, I did not go further. Now I will do one thing.

For me to make things easy, I will just create a cutting plane for this object. Some of the advanced modelers, you can directly go for examples solid and solid works, I love to do this. In this case, this is the more than primitive free of the net type of it. Here, what I do, I will do a bullion difference from this object.

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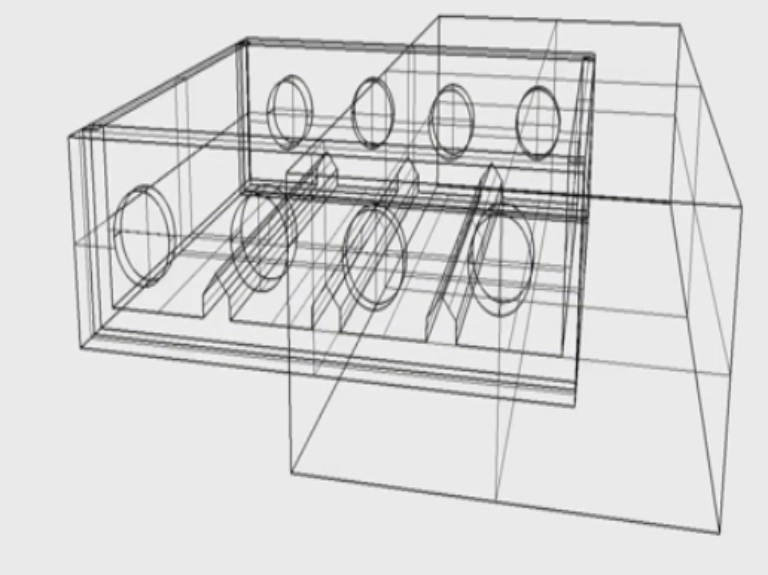

Yeah, got it finally. This incidentally is the cross section of the object. If I want to now create a cap for it; they were easy for me. All I need to do is.