Physical Modelling for Electronics Enclosure Using Rapid Prototyping
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Lecture - 07
Sample Product Concept

Hello. Now let me get back to the starting point of actually anyhow these what you call rapid prototyping parts or anything.

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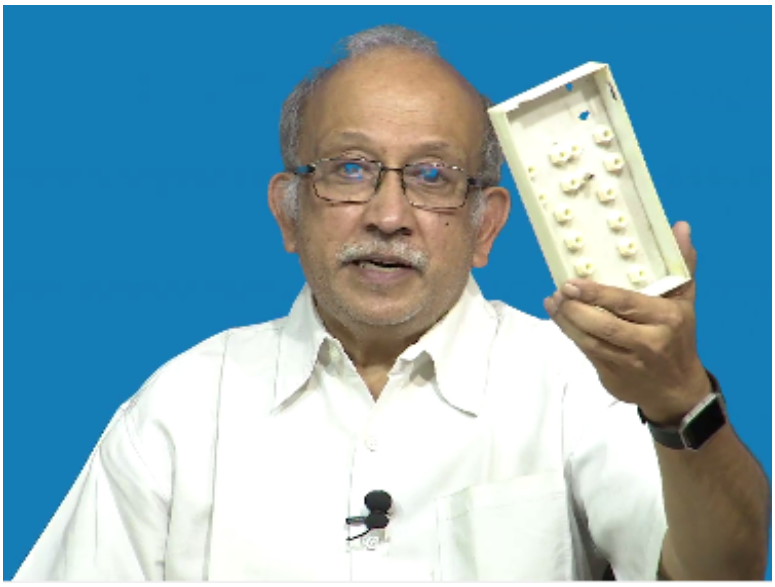

So allow me to show you or refresh you a memory with this. If you remember this is one of our earliest what you call (()) (00:39) rapid prototyping. This part was maybe made around 6 years back. Only problem is we are not very familiar at that time especially with respect to the strength of the particular material. What is the minimum thickness, how to support it and all that? After nearly working on it for 8 or 9 years we are only marginally better. So I will see if I can start with.

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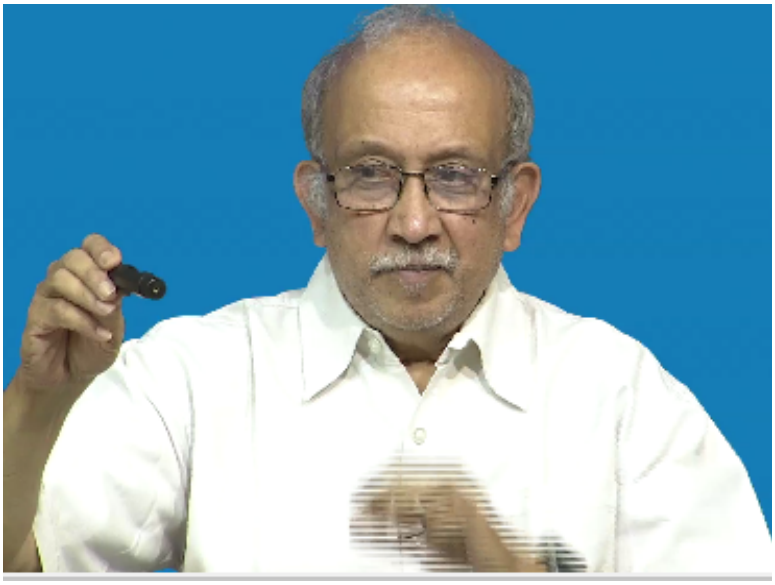

Can we make some small thing like this or equivalent to that? This one is part of some toy laser I am sure what it is. If you press a button here and it was a gunsight or something so it sits on that. This is probably the simplest part where accuracy is not that important and the volumes are very high.

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In contrast mouse like this requires tremendous amount of accuracy.

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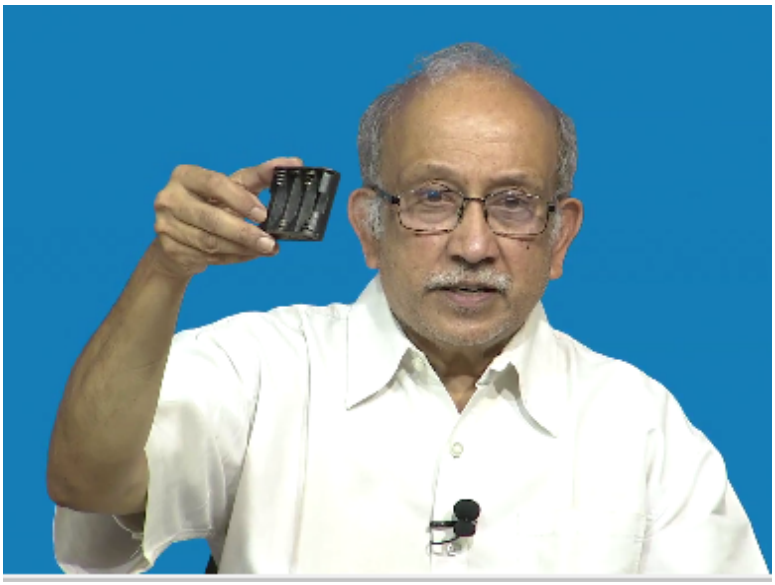

Now I will take something via media this one is a battery holder and ideally meant for such applications.

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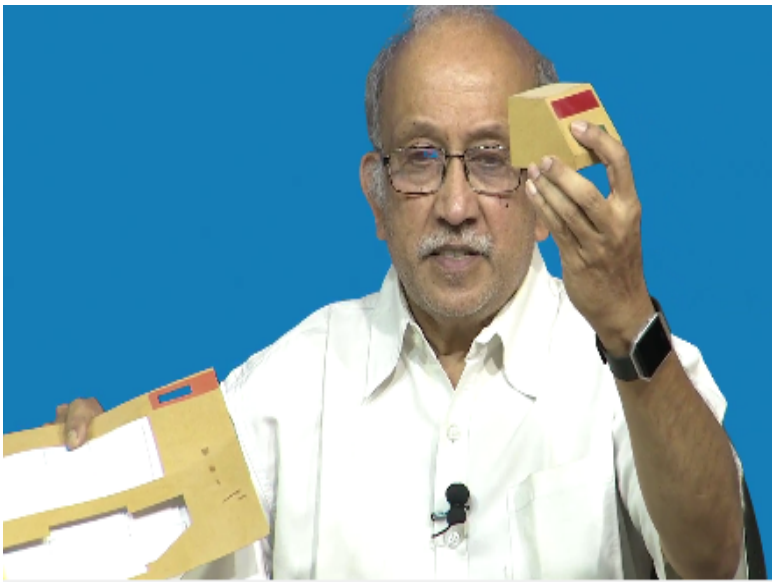

I do not recollect as I have already shown you typically a small product like this. This is a modified might call it a prismatic object and instead of this phase being vertical a certain inclination and then you see there all what you call meant for an exercise so you have a display there then you have 3 buttons and so on.

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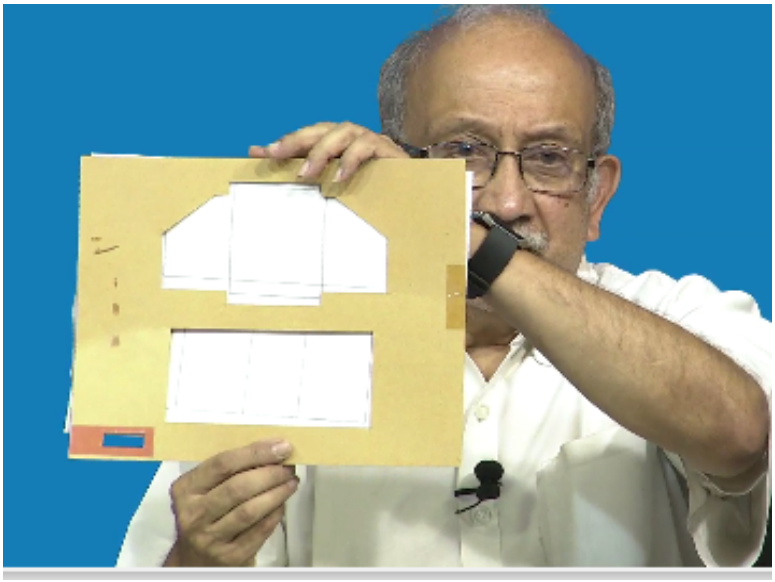

The main feature of it if you see carefully is that the whole thing has been made out of a flat sheet. Their advantage and disadvantage. Advantage you see it is relatively easy to make in sheet metal. Disadvantage you see this is not the ideal product meant for a rapid prototyping applications especially with fused filament depositing modeling that is you have a filament which goes up and so on. So in real life you have several other options.

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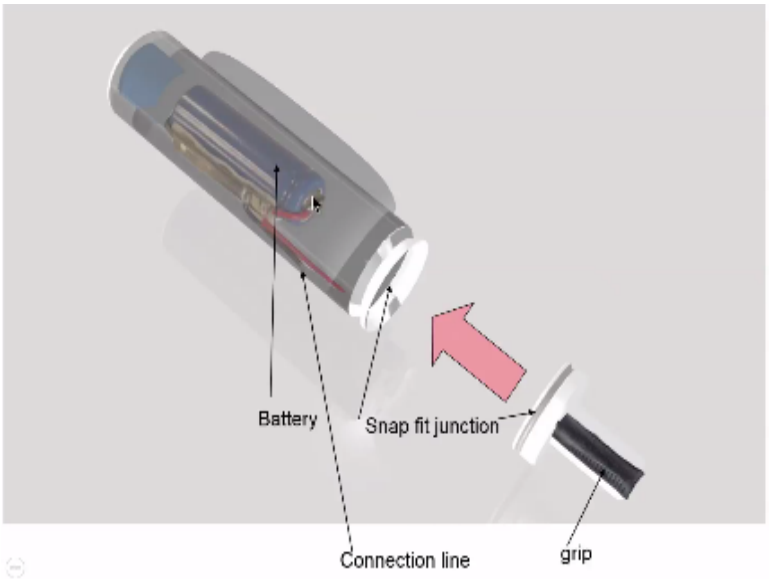

So if you can kindly look at my display here. If you see here my student earlier had made this some lamp. So in this lamp you will notice that there are certain features for example this circular cap and inside can you see there is a what you call is cell. In this case it is directly at (()) (03:24) volts cell commonly we call it a battery because inside it can have more than one cell.

So if you see that what you call toy laser I have shown that had 3 cells all putting together, but right now lithium ion, nickel metal hydride all these things depending on the chemistry it can be a single cell or battery. Now you see here lot of this detail has been carefully worked out.

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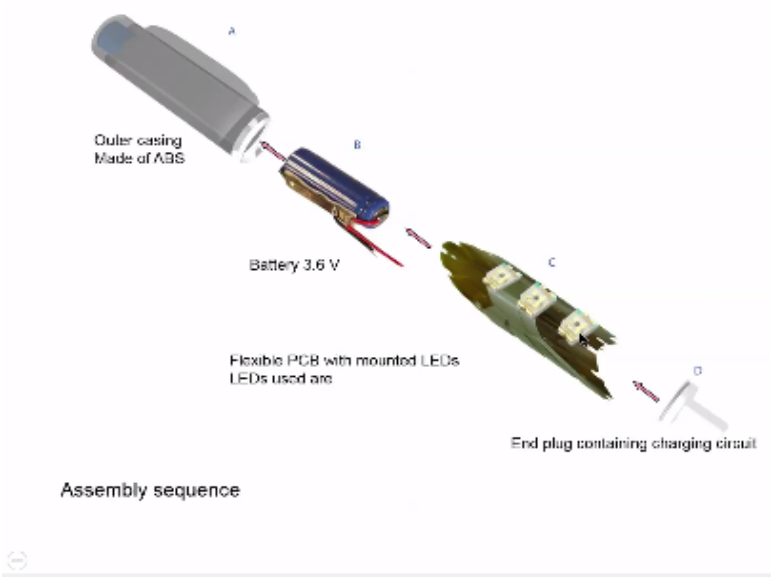

And eventually we may 3.6-volt battery then we have an outer casing of ABS then we have all the what you call necessary electronic insights.

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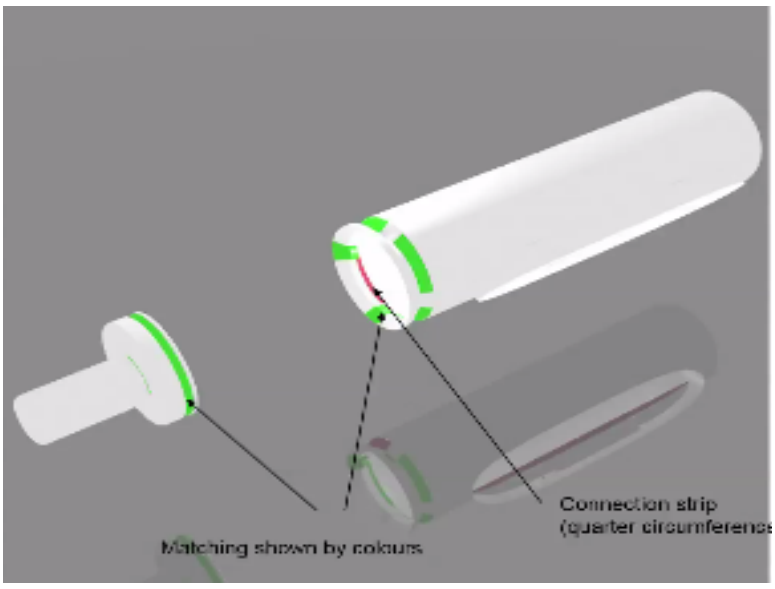

And finally this is the product. I will stop here. Now I will try to get back to how to start actually making a model.

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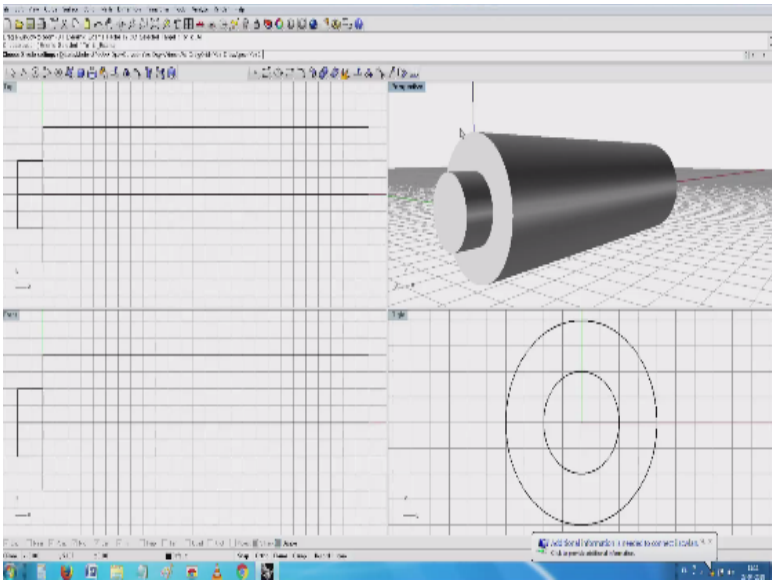

You have a look here one of the first things you will notice is it has been started with very, very basic units. I will say it is meant for a battery holder. On the right side I tried to create a battery.

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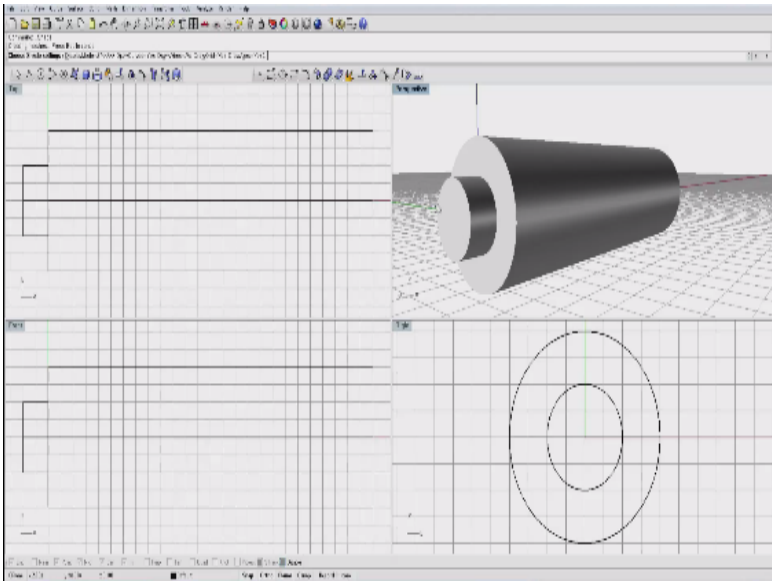

See I will start with a cylinder which typically represents the length of the main cell and then at the end of it we also have a small cap in this. So if you see here this is how probably it is going to look. Now only problem is I mean please put up with it because you need to learn little bit of the solid modeling also. You see here now this thing finally it has moved off. I did not want to move off like this.

When I want to do any orientation or anything it should not move off like that. Logically it should sit back where it was.

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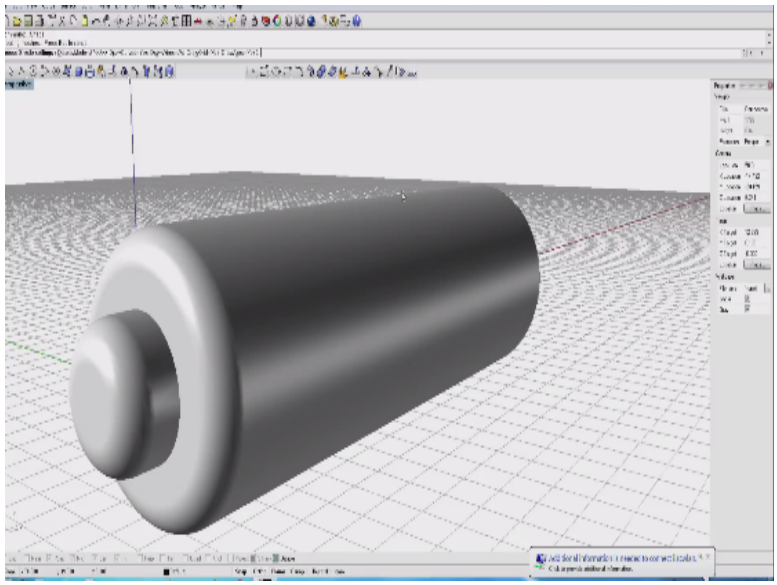

So I go here and by using normal techniques I do what is called a simple union of these 2 objects. I understand in case some of you are very much familiar with these things that we can also join them together or instead of (()) (05:49) them we can what you call attach each one of them together into a group which is called group and ungroup and do it and in some conditions it is valid.

In this case since it is an object which has to be also known it need some important things like (()) (06:04) for here. I will say what I will do with this using this solid (()) (06:10) I will see if I can just filet it you see their done same here. You see now it starts looking a little like that cell which I wanted to make. Right now I have done it just off the curve. I am not taking too many dimensions. I am not doing that associated with it. I just have right now for the first thing.

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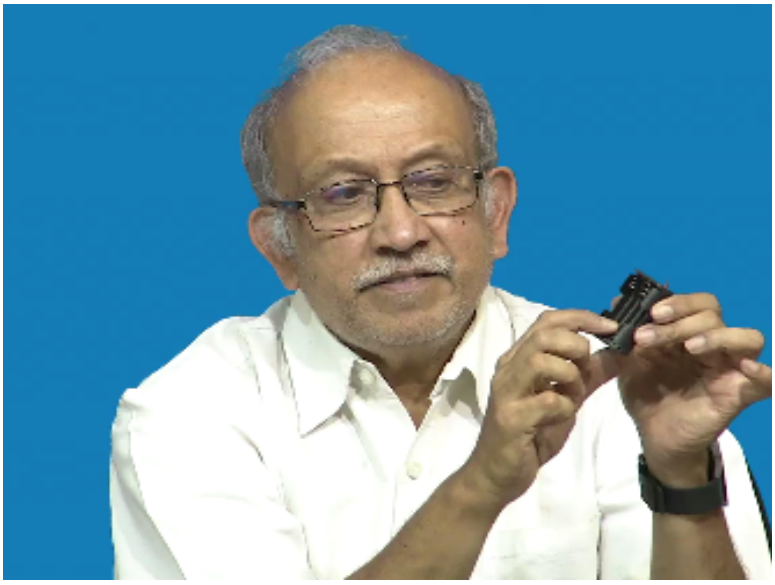

This is not even part of the actual this device what I wanted to make. But I need it a lot so that I should know how to proceed beyond these things you have seen this. Now once more if you see depending on the voltage, depending on the number of what you call contact are required you see here I have 2 contacts and I have something else also at the back here. If I now concentrate on the 2 contact and I want the let us say this is what you call one polarity and all this now we end up with a very peculiar situation.

So I have a top cell and let me say for the moment the top is positive and the bottom is negative. Next tune if I keep next usually it is customer (()) (07:58) us to invert it. If we invert it positive negative, negative to positive and positive will come here. Now comes the third thing. I am sorry positive, negative, positive, negative comes here. If I have to take connections from the top it is easy.

Now let us say I need to add one more to make that 3.6 it ends up on the other side. Now I wanted one more like this. This orientation and where you put the spring contact becomes very, very critical. So in this case our various I do not know practical purposes they have made this. So luckily for me invariably this will be a positive contact negative join to positive again I know negative join to positive it goes like this.

And finally I have can I get both of them on the same side. You see we have a problem here. Again let me trace positive, negative, negative to positive, positive to negative to positive and negative here. Luckily these 2 are on the same side no problem for me, absolutely no problem. So if I have 3 cells I still have a problem. Now what these people have done is they

have done a lot of I will say magic here.

Why this magic has been made is so that in the end this has to become compatible with (()) (09:39) invent which is common with the 9 volts cells. I leave it here at the moment I will just show you how to make this. Further if you see a little bit of detailing here I have 3 partitions here and outside ones. How do I ensure that everything sits properly here and then where is the place for this what you call tensioning spring and so on. I will try to see how best I can build it here.

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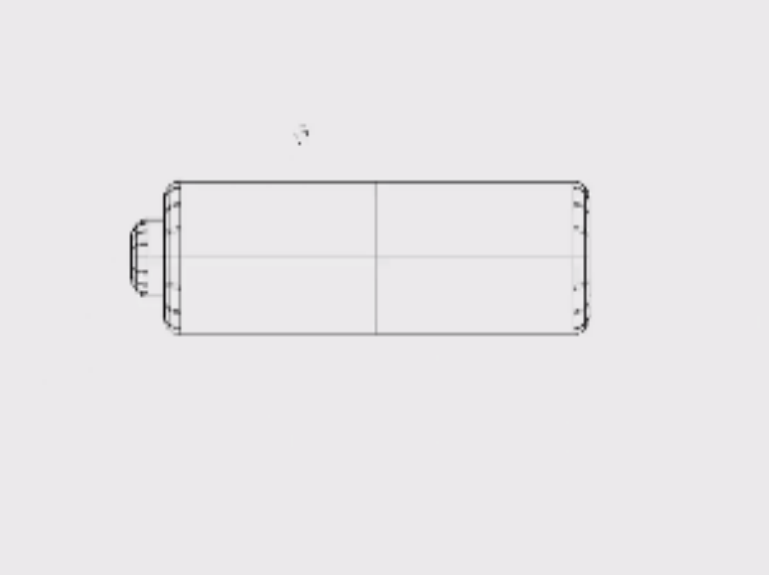

See here now I have one cell in place. This is where the advantage of using CAD will come.

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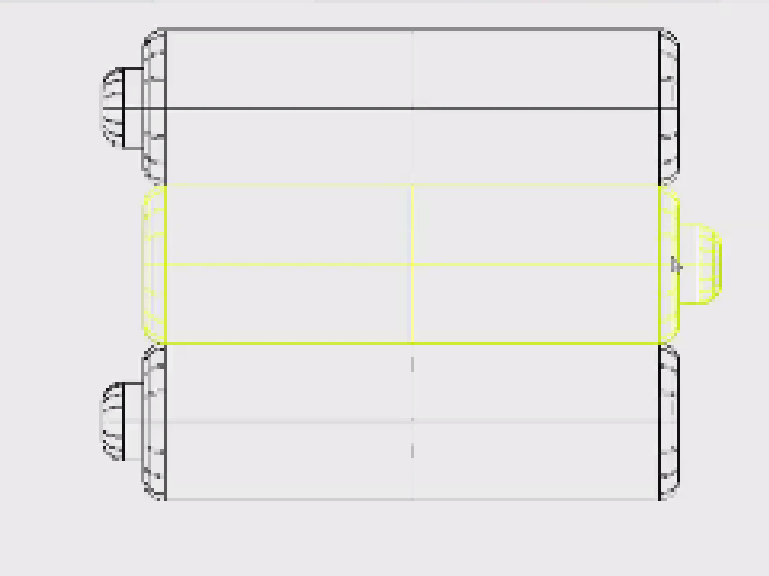

So what I will do I will copy one with the other.

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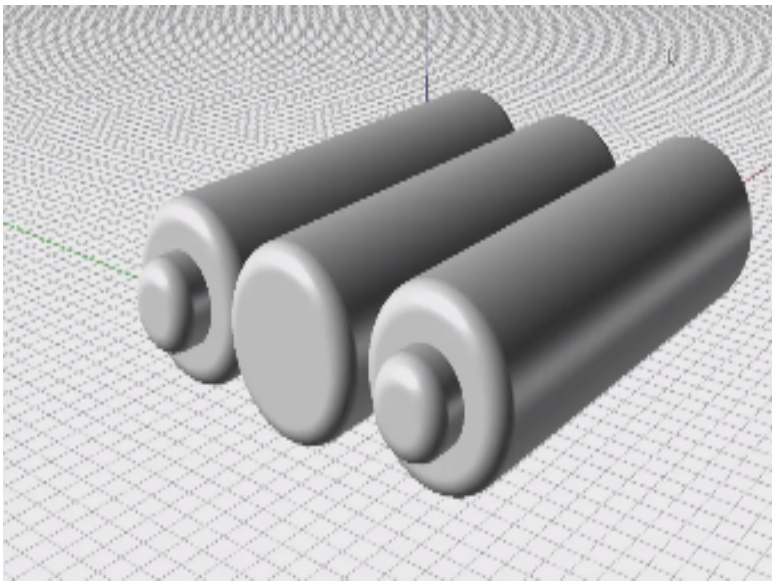

Now if I look at in the other view without too much effort. You have seen I have created 3 cells and where the connection is easy relatively easy, but then we come to the other problem saying both the positives have ended up here. Now how to deal with it that is where the thing comes here.

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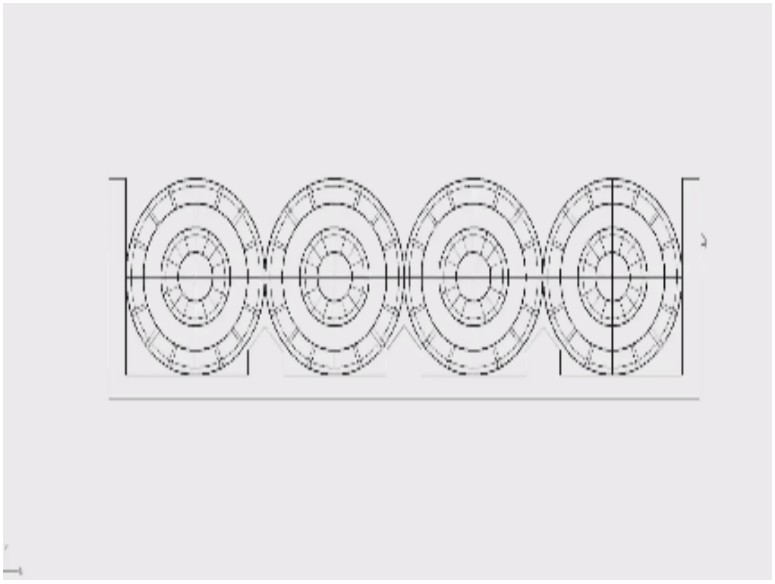

But right now to just what you call move on with it I will see how best we can make things here. I have all the cells in one place Now I need to start building the cover as I would like on the little similar to what I have seen. Now this is where how to collect these samples and take it from various things will come.

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You see here tremendous detailing is there meaning these 2 points I have curved things and little springy also. See this little springy curved and the center these 2 portions are just straight with a small what you call a wedge like thing and why it is anything it is about how well the thing like this can be introduced inside. Earlier what people used to do is try to make a mock-up using what you call polystyrene or even acrylic parts assembled together and tried, but right now thanks to rapid prototyping.

We can still afford to do a few mistakes one or two small mistakes. So one of the things you will notice here is whatever that partition I want to make and how much gap I can say. Right now I have a beautiful place here where I can start. See 2 small rather 3 small some structures have been created here. There is a little advantage and disadvantage. Advantage is without too much of effort I could just trace something on the screen and creates these objects.

Now we will come to the next what you call important thing saying can we create a simple base using these objects here that is a starting point for convenience. I have created a section which is about 1 mm wide it is more a matter of convenience nothing to do with other thing. Now you will see how I will try to attach these things to that. I will use a command right now this is not a command in how to create these things.

As I have explained to you earlier you see here all of these have been attached together like this and now I will go for the next this thing. Having created this what, you call tray like thing which forms part of the base here you have seen this it forms part of the base here base that you see here. This is a cross-section which I have created right now. So instead of these

things with all the slope and all that to make it a little faster.

I have just created something which is straight and these also have created something which is straight. Now what I will do I will hide these what you call cylindrical batteries here attach all these thing together by a command called join.

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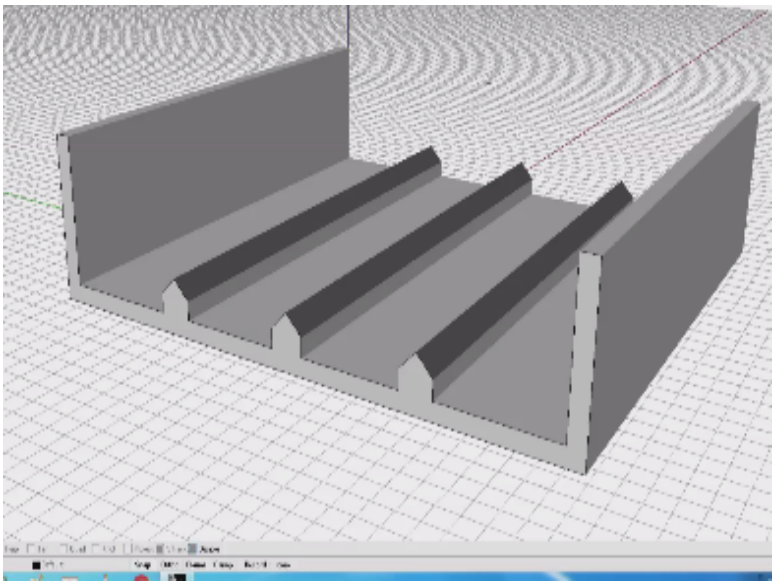

See I have got a single line which looks like this in a way I am little happy now. Let me look at it in the other view you have seen this and all I need to do now is go to something which creates solid here. Already part of my box is ready. You will notice that so far it was just about creating a box as I now know a big deal about it. I have started with these what you call cells which I manage to hide.

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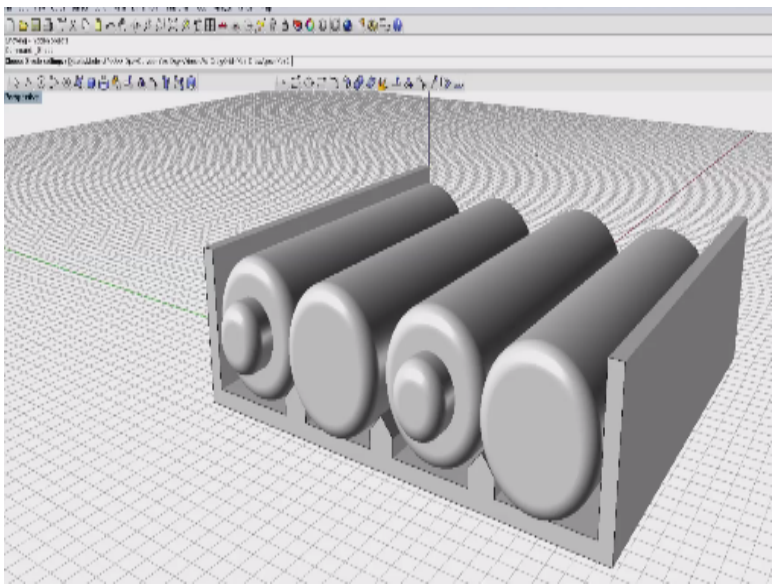

Now I will try to unhide the cells which are there. Now I need to think about how well do they sit together and do I need anything more and one thing why I have stopped here is. Now we have several options and how to lay up this device. One of the things you will notice is this is vertical and relatively tall. Will it be strong enough that is where we started in the beginning.

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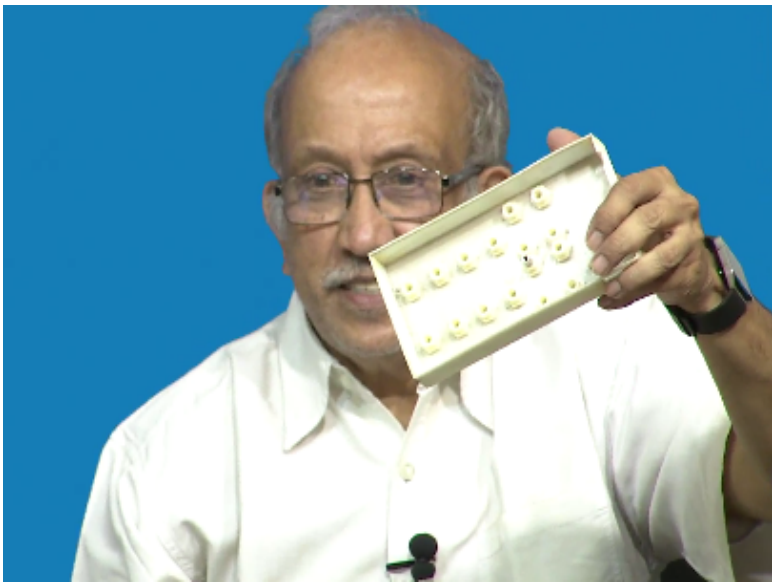

So if we can kindly have a look at my box here. We started like this and then we thought going by the manufacturers specifications we thought this is okay I mean because he said something about 1 mm, 2 mm and all that then we discovered that is not that okay as we think it is. You see it has developed holes because we have to be little more careful about the number we choose at the algorithm the machine itself follows inside.

And while that was clear we overestimated the support required for putting the small. We have what you call thread insert into this too much dust here old 5 or 6 years. Now this is where you probably require little bit of tips and tricks and then somebody else also working with it.

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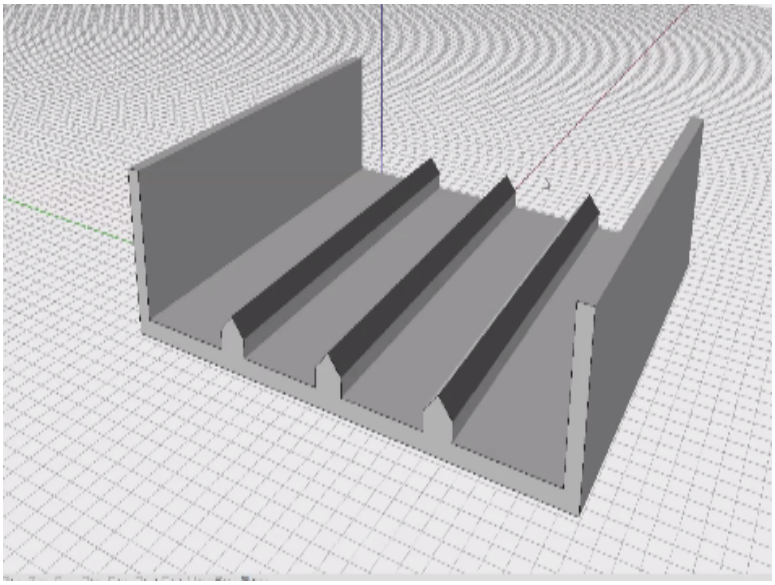

Now going back to this now we have decided is this optimum making things like this or we have a little advantage and disadvantage.

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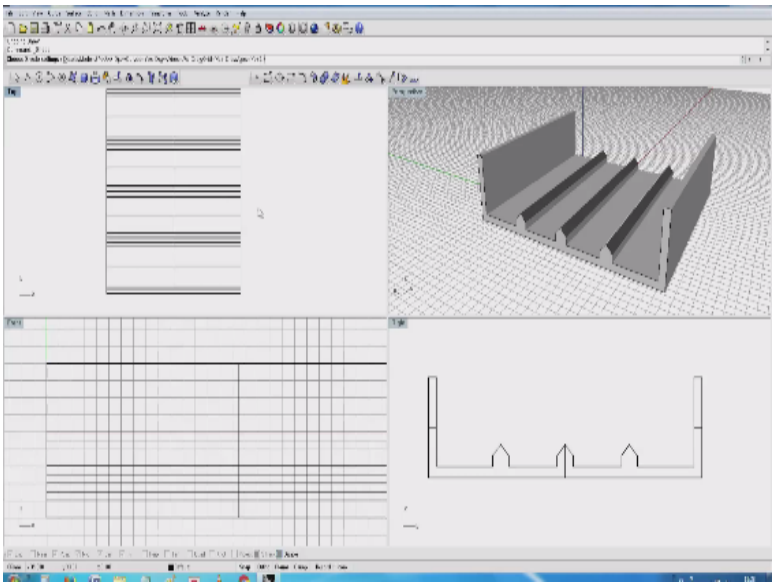

So if you see here if you see this view.

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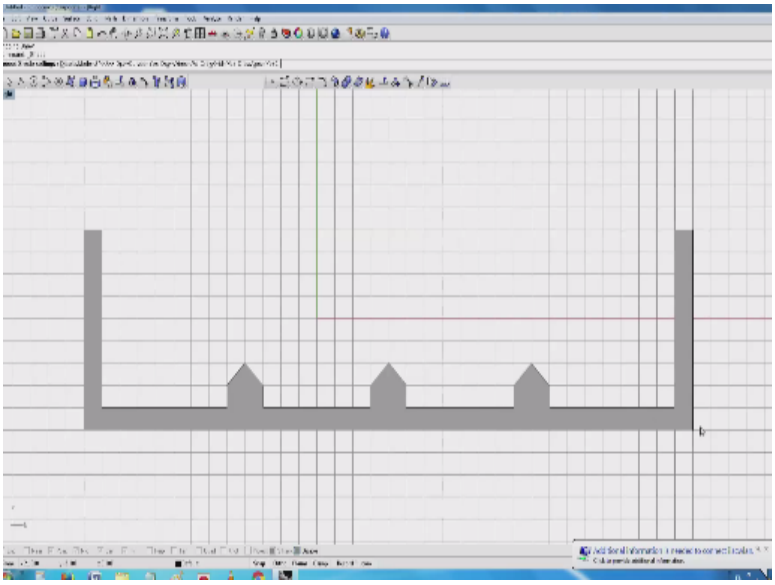

The machine is going to build the things like this vertically. First layer will start here something will move like this after coming here something the algorithm that decides whether it should move backwards and forwards or what to do and then how do we build up these things. This is where the total amount of material we need to save is important. So if you put it in this condition it will behave in one way.

You put upside down it will behave in one way and will it be stiff enough and what about this profile is this sufficient for us. Can it really be a triangle in reality it will never be a triangle. You cannot make an inclined surface if you put it like this because it depends on the layer thickness the issue here is the layer thickness not the XY resolution of the movement. XY resolution is one thing layer thickness is something else and again in layer thickness the way it handles layer is one more thickness.

So it is very easy for me to complete this job here which is where actually our main problem starts. It is easy for me to create an end gap at this point and in fact probably the easiest of all these things. What I do is I try to create a surface a plane corner to corner.

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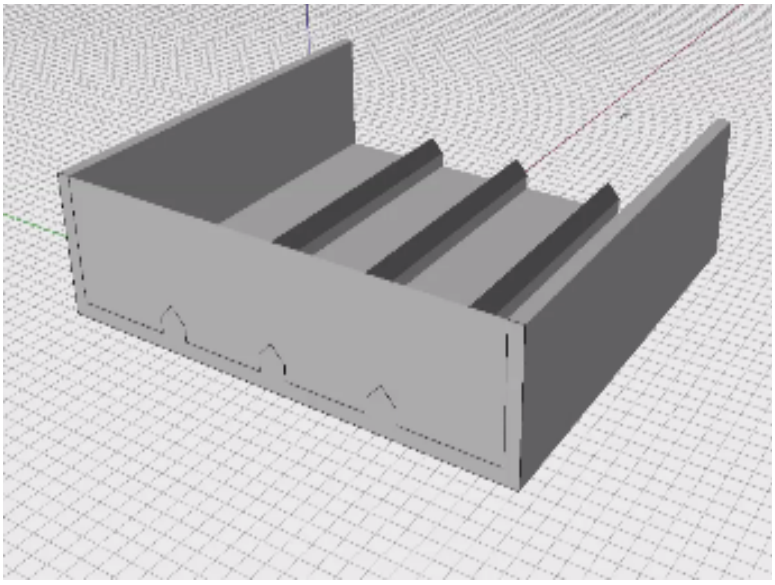

So I have a end cap already. Unlike in regular what you call sheet metal or other plastic construction we need not worry too much about whether it overlaps there. So I will just move out a little and then you see here this seems to be.

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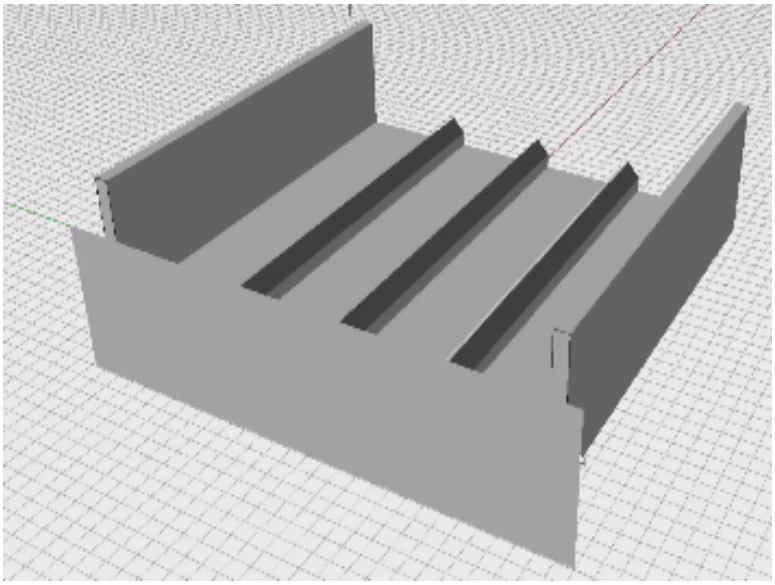

I have 2 options I can make it sit within these thickness from here to here or I can make it sit over the thickness here depending on your method of assembly, method of how you wanted or anything all of these are possible. And finally the ultimate we now need to give a thickness to this. I will just give randomly I will go here and then I will try to give a thickness. Well it is easy as that.

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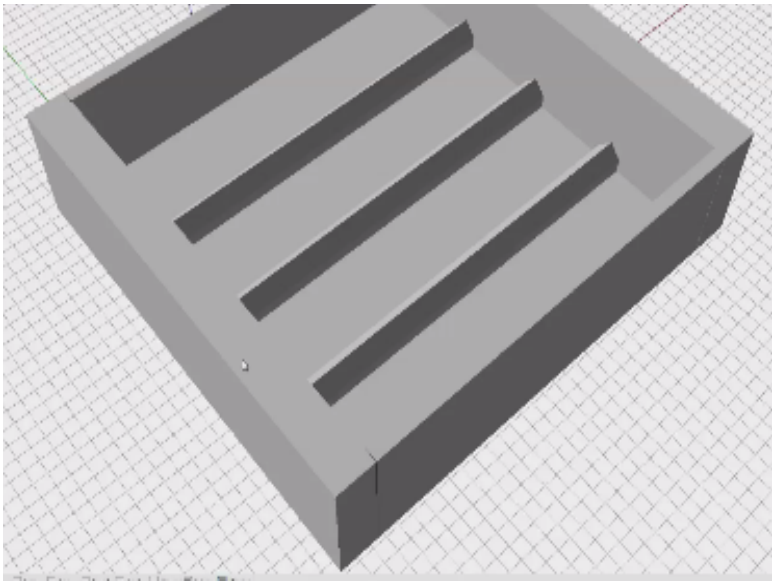

I have created a tray like thing. I have added end caps now you will notice that these end caps I think by some lucky accident they appear to be little thicker than the other things. Why do I need them thicker? because I need to add all these details which are there here. See I have 2 contacts here then I have springs here. So those things are very easy for me to create I will go to the side view here and then I will try to create a small circle.

See I have those peculiar things small knobs or contacts stuck here inside like this.

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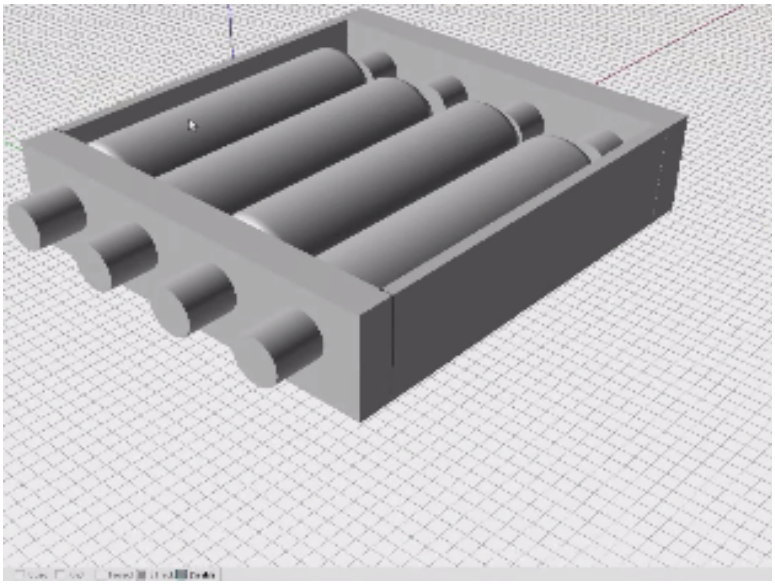

So in this case they are on the inside in this case they are on the outside just to illustrate some point and if you were to follow that old thing which I was telling you earlier. Now you see I have intentionally staggered them.

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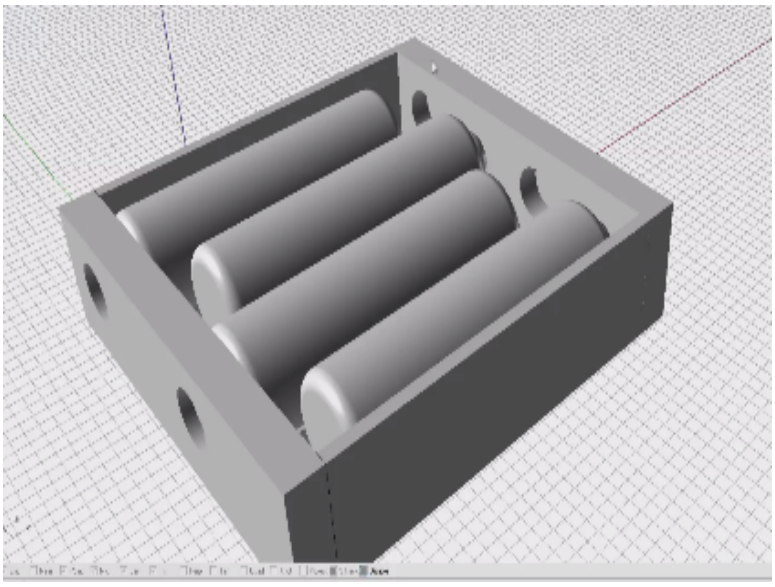

Now I will try to do the Boolean operation one more time and then you will probably now understand why. See here dent has been created on the outside. You have seen this. These 2 represents dents that have been created on the outside where the connections have to come. Now for this sorry some bump because of the what I call (()) (28:17) software problem I will try one more time. This has come out better.

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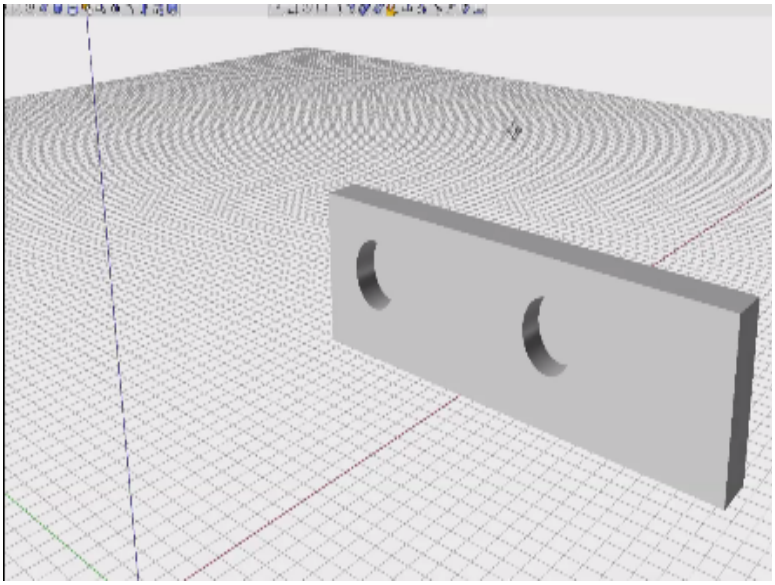

If you see these 2 of these have been the indent has been made inside the other two indents have been made outside. So this was what you call intention for me in creating this thing here.

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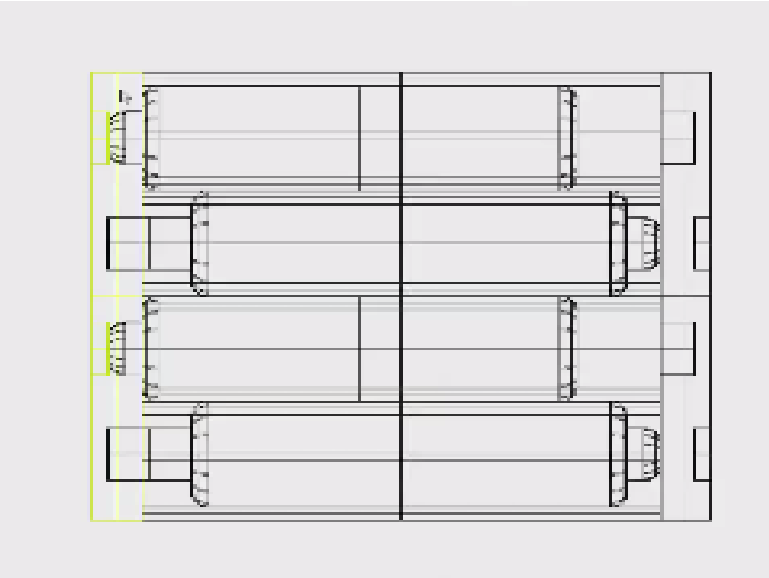

This is where a little more what you call thought has to be created and what we want to do. Now if I want to put all of them back again here you see here this is where the advantage for me lies. Since there is a spring here and you can have an effort to have contact this goes forward. These 2 needs to be moved to the other side. Contact here spring there at the back. I am luckier this time.

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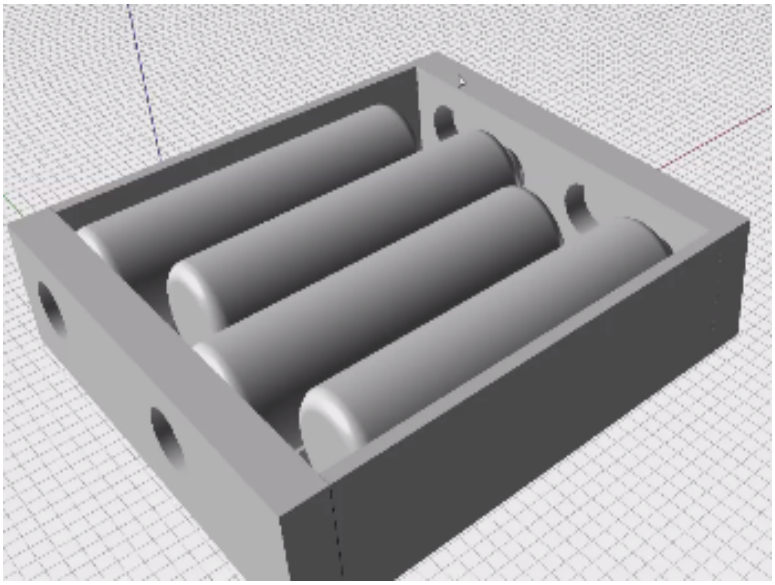

My object is practically ready. Like you I am also very eager to get it printed, but suddenly I noticed that the detail is not really, really this thing. This is far more detailed than that what you call relatively simplistic thing which I have created there that only had some indents here, some indents here and something up closed here some little partition here. So this is already available in the market highly evolved and suitable for injection moulding.

When you want to build it up for the rapid prototyping some of these things are not so easy to do including this curved surface, but that curved surface is required for it to be held in place. So how do you go about it. This is where that element of product designs also is required. Now I will just try to quickly see what best I can do because I think you need to go back and try it yourself. I have my object ready already to be printed.

Very advantage of any of these solid modeling is after looking at it and in fact if it is very first time you can go ahead and print it, but I see that it needs tremendous amount of refinement especially with respect to the other metallic things which have to go into the product. So even routine thing like this.

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For example, this has some slider like thing here something else here and as I switch here. You have seen here I have switched off. These things you can both integrate as well as take it from what you call this thing here. Now you see here the cells to be pushed inside lot of detailing has gone. This is a toy this whole thing probably would have been produced I expect some 20 cents.

It is cheap by our standard you know it comes to maybe 20 cents is one what you call 1/5 of 60 is around 10 rupees. This whole thing has been including probably what you call all the electronics inside and all for about 10 rupees. This is where it is possible for you to optimize by going back to the model there.

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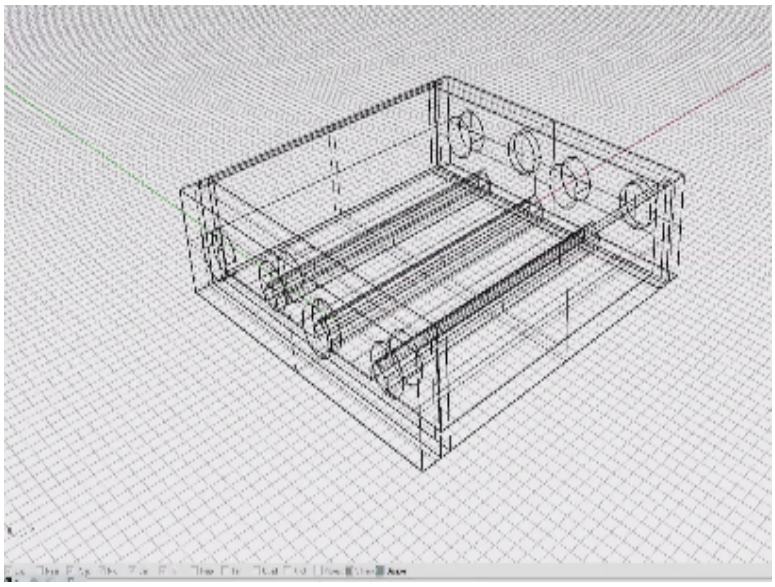

I will just now see one small very minor thing I will see if I can make the thing improving and then I will try to just make it simple and fast lucky again.

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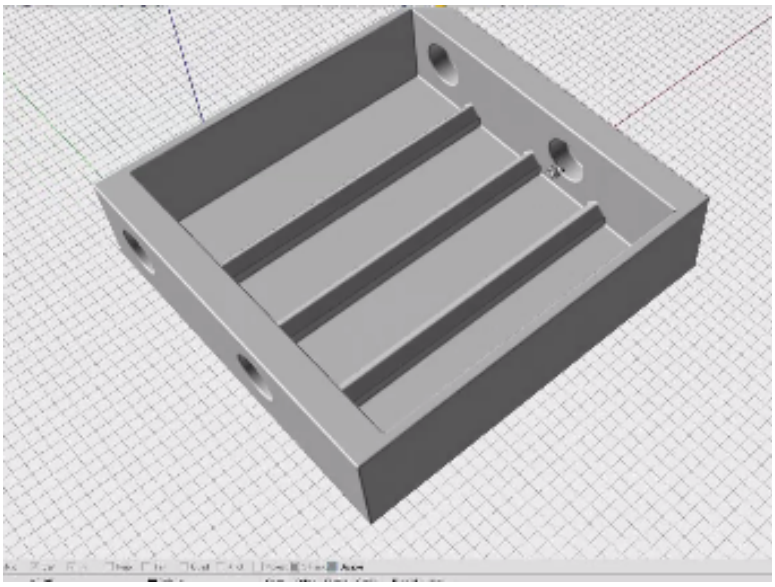

All the sharp corners have been removed. See here and this actually starts looking little more like the models real life things here you see the corner and you see here what happens to the corner. Now comes this is where (()) (35:16) and various other things will come. Once again I will notice this phase is thin looks fragile, but serves the purpose. This intentionally has been made 3 times as thick because this is where the force of all the electrical contacts and all come.

This is incidental just to see that it does not roll about and to minimize the material we can do whatever we want. Other options are also there you need to make it like this or can you give

some curved what you call half circular things by which it can sit inside and finally is it possible for us to make like before 2 halves. Luckily for us in the case of rapid prototyping optimizing by making 2 identical halves and joining together does not arise here.

It is a question of can we open it load our items and push it inside which was not possible earlier which is very much possible now for us. So at this point, I will stop here and see whether see here we have options right now it is by default it is moving at a particular speed. So after you become a little more what you call it is very much possible for you to play around and see everything that is possible.

We like to keep it like this. This is where the difference between injection moulding and our thing come here. Whenever there is a change in cross-section injection moulding has a chance of shrinkages occurring on the other surface.

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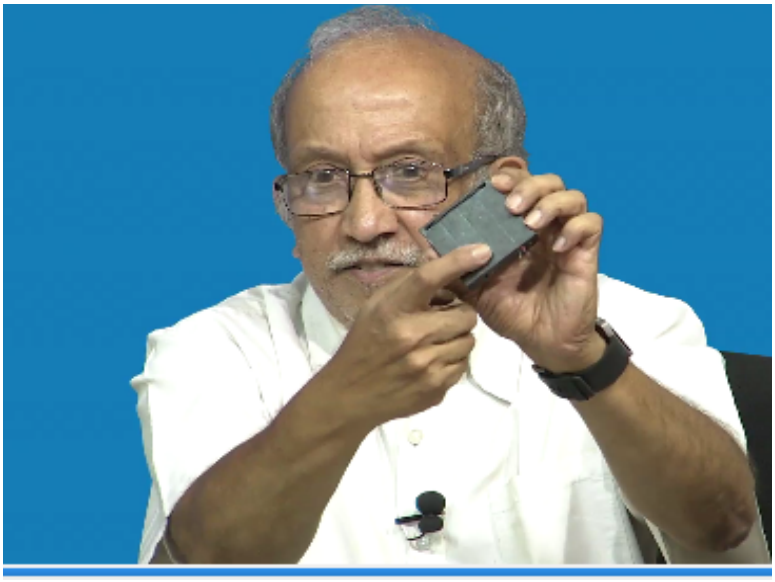

Right now I will see as best I can tilt it towards it. Can you see at this point now you can see some grooves like this thing here 1 grooves, 2 grooves, 3 grooves. These grooves typically are the result of change of cross-sections here. We did not worry about it in rapid prototyping. The other phase because it starts by laying up will look absolutely as clear as possible and in fact we can add any other texture preferably with some dents and all that.

So permit me to stop here so far now what we have come I will continue with this in the next half an hour. So thank you.