Physical Models for Electronics Enclosures Using Rapid Prototyping
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Lecture - 14
3D Print Assembly Design

Hello, allow me to continue where I left off. I took a small break and went and collected this convertor.

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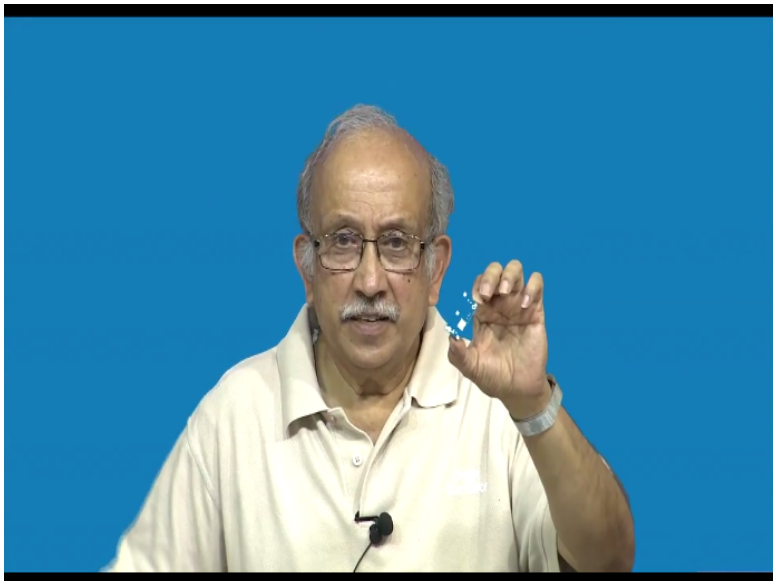

The thing what you see on this converter is it has at the back an area which is exposed. You have seen this know and then is slightly expensive and so we have what you call these capacitors which are mounted almost flush, see in this know there are nothing, there is no projections here. It is slightly different from the convertor what you call the buck converter which I have shown you last time where these two capacitors were lead in whole type.

Here in this case, it is absolutely flush. Now if I were to take something like this and try to make a box which I am showing here, life will be somewhat easy for me.

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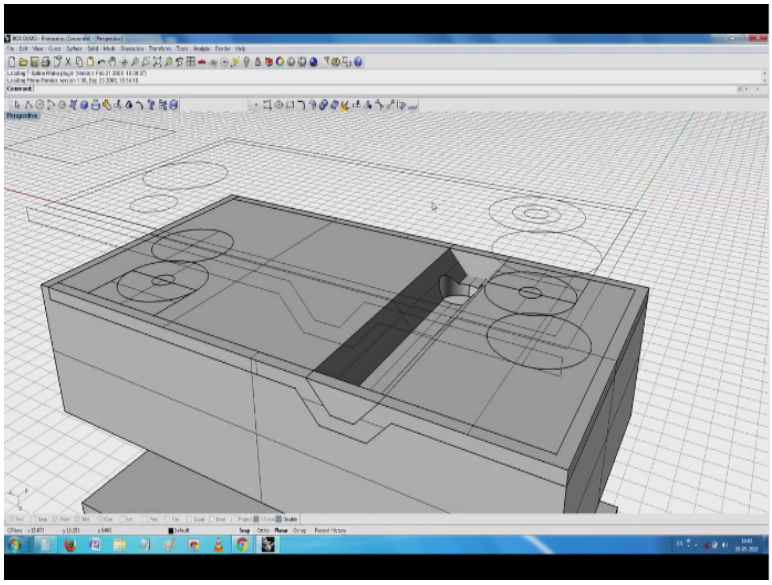

See in this so I will just select all the only 3-dimensional objects and in our case now it is called polysurfaces and then I will hide all the non-polysurface objects know I will hide everything. See here, this is the basic unit which I have got here and this is where I was trying to tell you yesterday, imagine this were made with aluminum and I will also use the same holes which are used for fixing the printed circuit board directly to the base.

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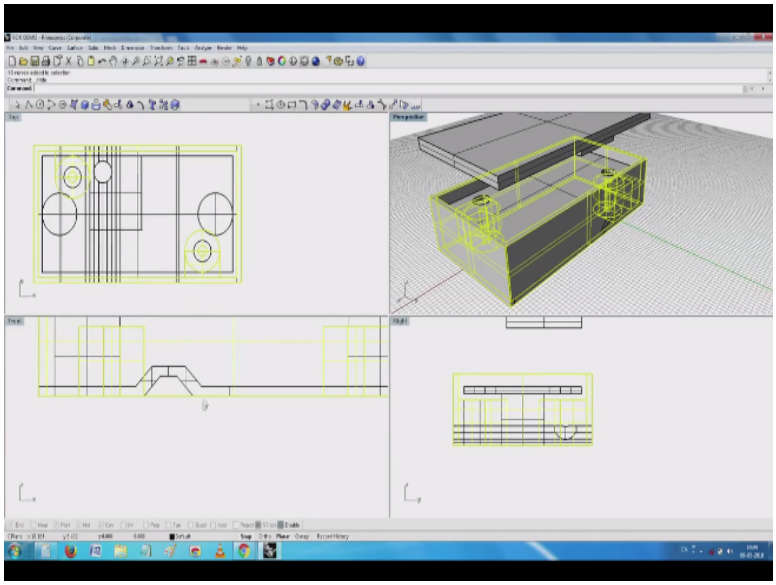

So we have 3 objects here, we have the box okay. One part is the cover, there is the heat sink, that is the enclosure, looks nice.

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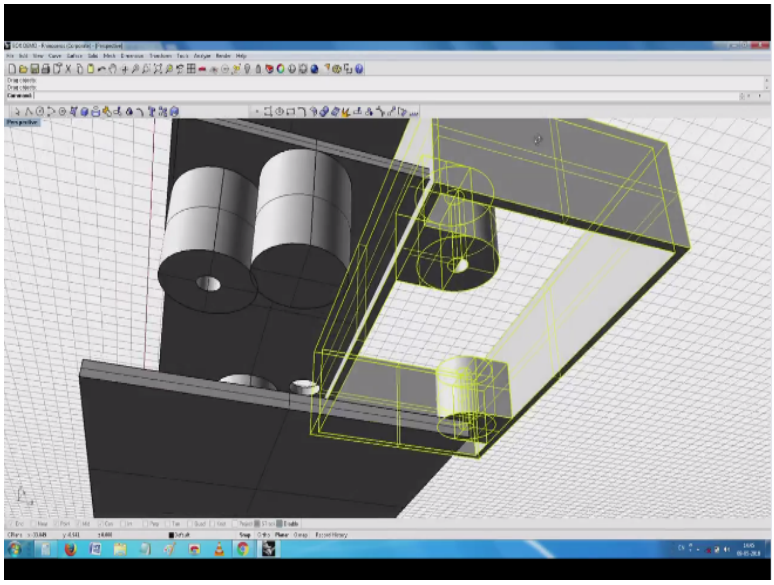

Now if you remember, last time when I left I told you that I will not play around too much with the small box that is projecting and then that how that box is coming and that box is coming what you call interfering with the capacitors here, little close that is because the actual capacitors for the printed circuit board we have are little smaller.

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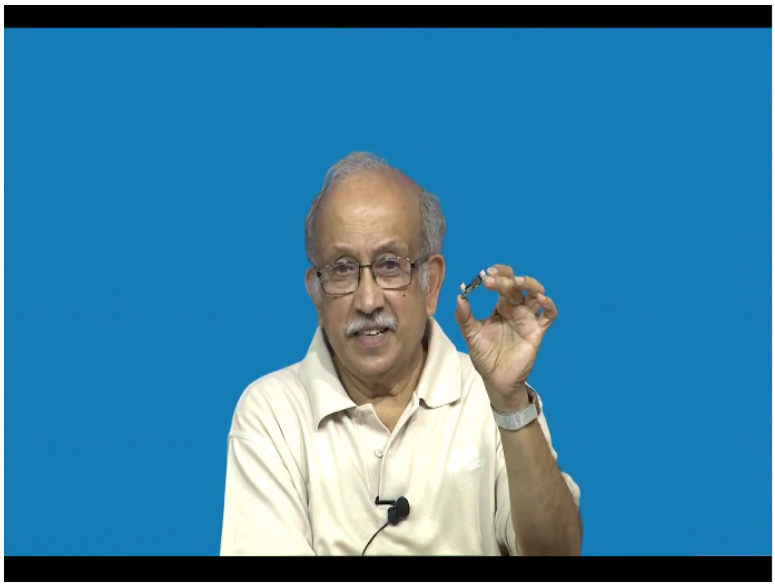

These are little smaller than that, that one knows sits nicely here. So we have the basic things all worked out here. This what I just wanted to say except that if you are part of this solid modeling thing, difference is in the case you want to visualize the product, it will be nice if I have a small radii in the corner. So just to make it a little more what you call presentable, I will now go out, select all this, select the cover, select this, select this or let me start with the this unit itself, I will go here.

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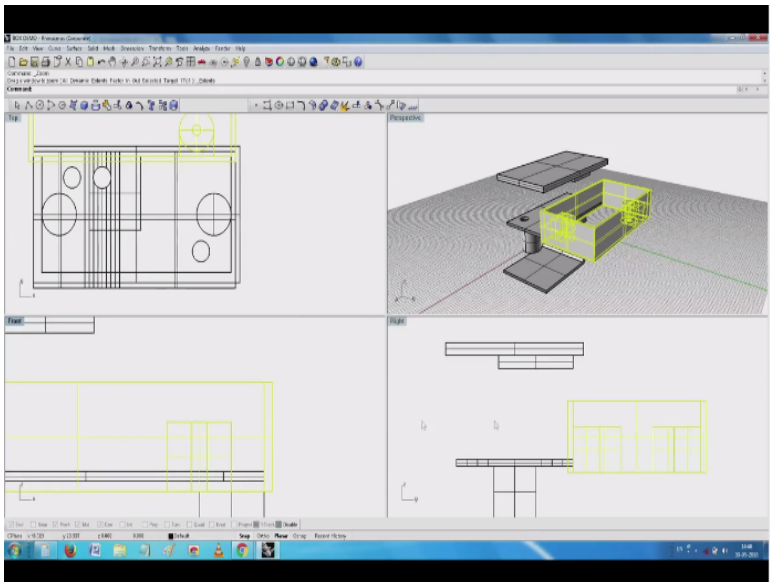

When we try to attempt to render it, see how it looks. Right now, it looks a little harsh.

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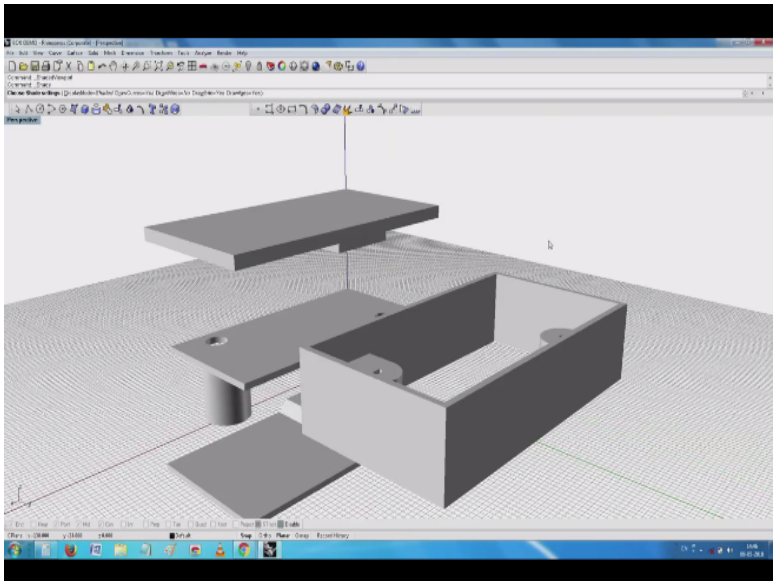

Because the corner what you call highlights are not cord, it looks flattened not that much presentable, it looks a lot more like a 3D object and not a real object. To make it look like a real object, it is very easy. All we have to do is go to this what you call solid command and then we what you call fillet the edges okay. I make a very tiny fillet, a little what you call I will say small minor problem is there, kindly put up with it.

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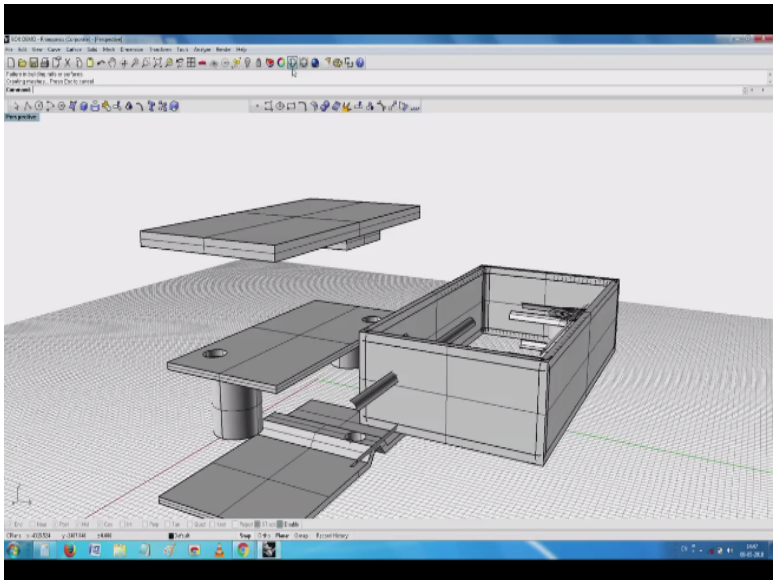

But one thing you will notice that this object know looks see the corners have all been rounded and same anything is happen to the corners here but this is what you call a buck because of various other thing. So I will write now, I will undo it because my interest is not about this how to fillet it, my interest is more about how to make a real life objects.

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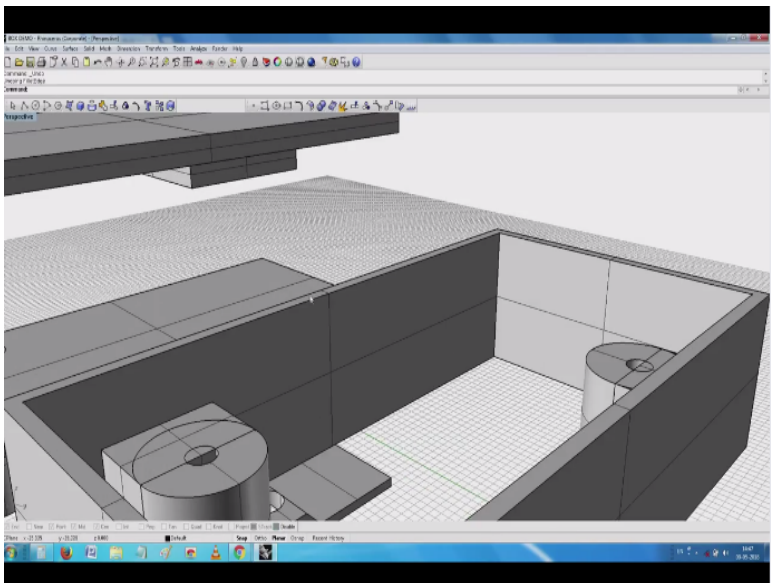

In the case of this rapid prototyping and especially 3D printing very, very difficult to create fillets, fillets create a nuisance because that circular portion does not print well which is different from any other construction and especially different from sheet metal or any what you call wherever some shear is applied or wherever bending is applied and so on. In a way, it is very convenient for us except that when you want to actually make parts like this.

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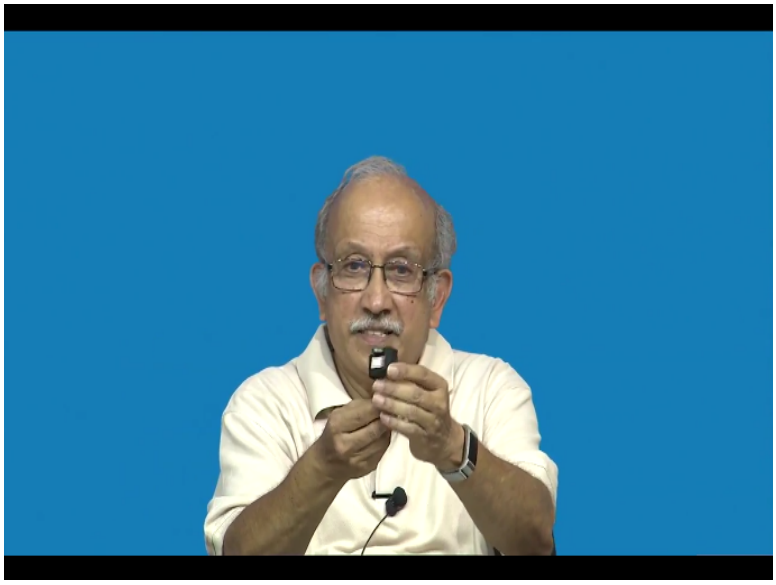

Can you see what it is? This is a small capacitor, probably it is I do not know oh I will see what they have written here, probably it is a paper capacitor which is you know 440 volts, 1.5 microfarad something and something here. Can you see it? For items like this to make the corner sharp and so on is very difficult in injection molding because you cannot make a cavity which is you know automatically have sharp corners, especially this one of this corners know whether you like it or not, it ends up with the built in radius.

In the case of 3D printing, it is very convenient to DC for us. It is the slightest problem know, without the slightest problem we can print such a small thing. This is now I will just take a small diversion. Now if you see here this part can be one of this parts, so to make it a little more what you say interesting I will try to you know give some you know touch some materials and then try to see what best can be done.

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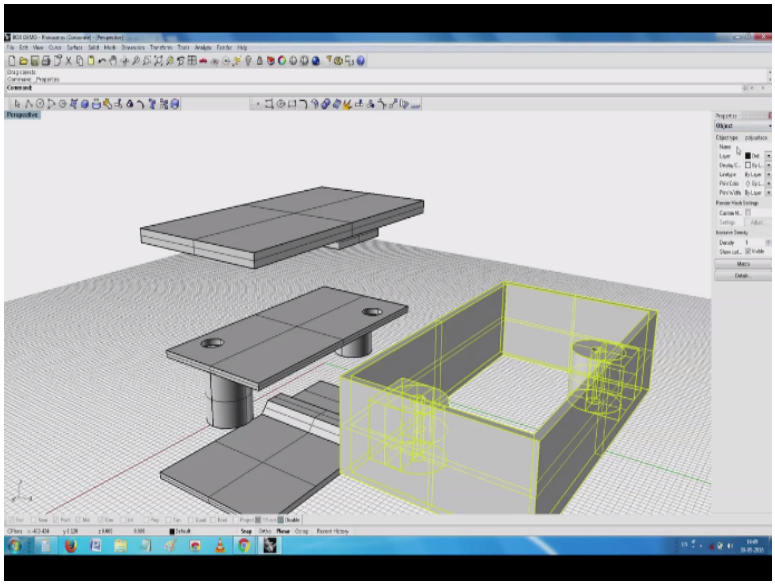

I have given random some blue color to this to identify to the other things and then I will give another color for this maybe green color for that okay and then I give yet some other color for this, just to distinguish these things when they finally get printed. I am sorry when you observe them on the screen here.

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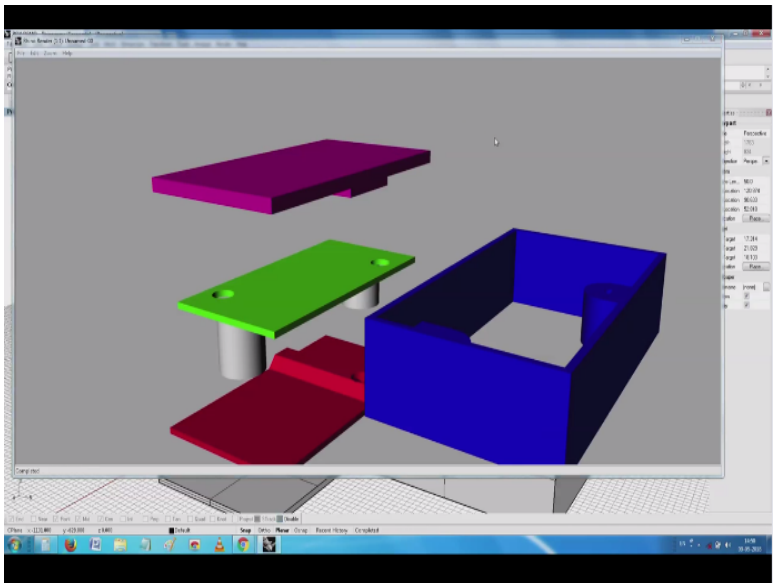

See all the four parts have got different colors now. It is easy for me just now because you know I wanted to be fast and so on, I have chosen green which is the normal color of what you call photoresist which we have here and in this case, it is purple. Then, I have also chosen something else for this. I could have left it grey color which is typically a sheet metal part and then I see here I have 2 mounting holes which are actually matching this.

Printed circuit board, mounting hole and on other side I have a cover which can I can now make this cover as part of this. Then, from the top I introduce the printed circuit board and then we are nicely into a useful product.

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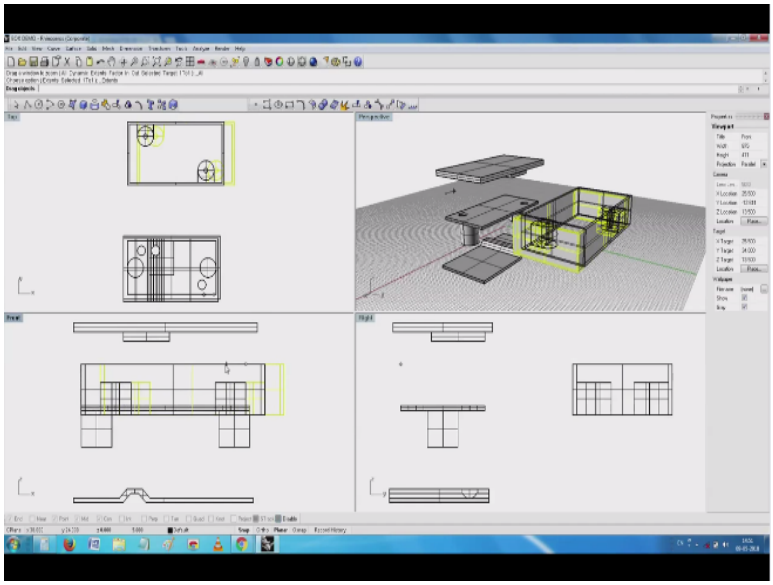

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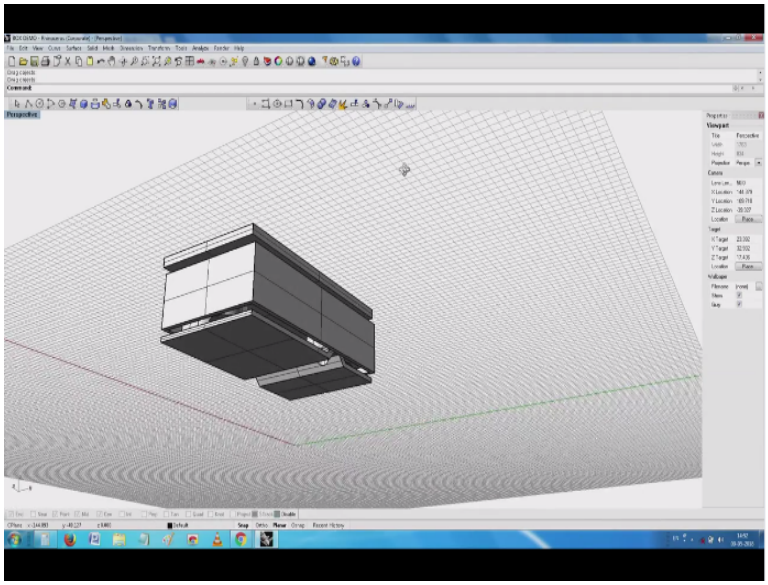

So slowly my intended 3D printed object is getting ready. So it is a question of while one more time know, I will just say whether I can join these 2 things. I will keep only those what you call visible and then try to see what best I can do.

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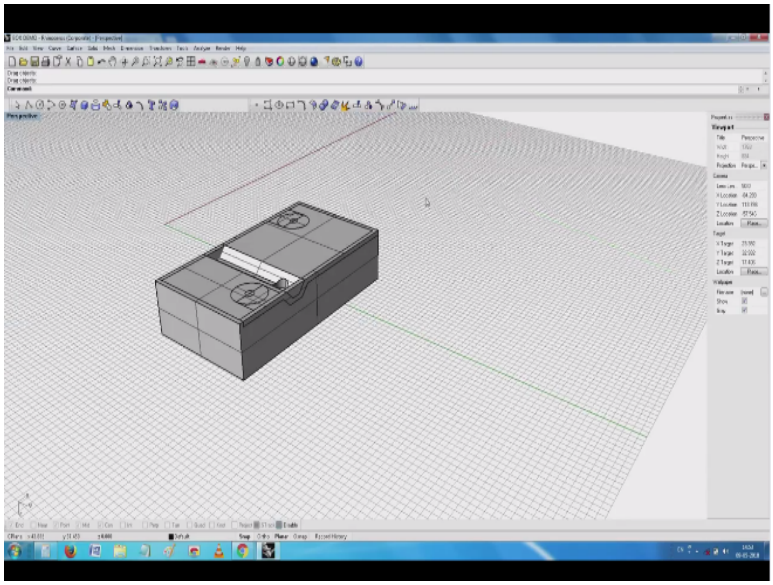

Depending on the various features, I will see whether it is possible for me to Boolean them and make it into a single solid. So I will try to union them. It has failed, do not worry too much about it and it is because some of the you know things maybe open or something like that, they may not be joined together, some issue maybe there. Finally, printing an object like this is not difficult okay.

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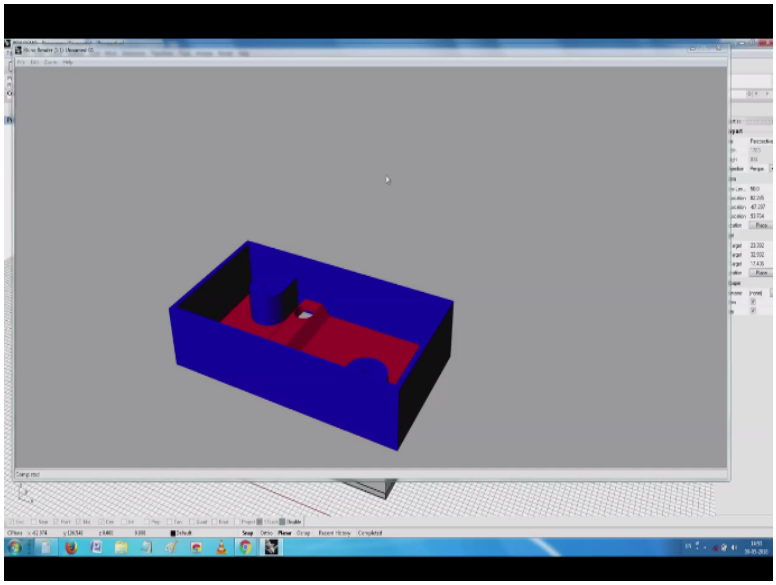

So now again if I give a render, you see I have a cover which is there on all around and then we have a small depression such that this tuning can be done here. We have made something across so that tuning can be done here. In this case, it has been made such at the top surface, top surface is flat.

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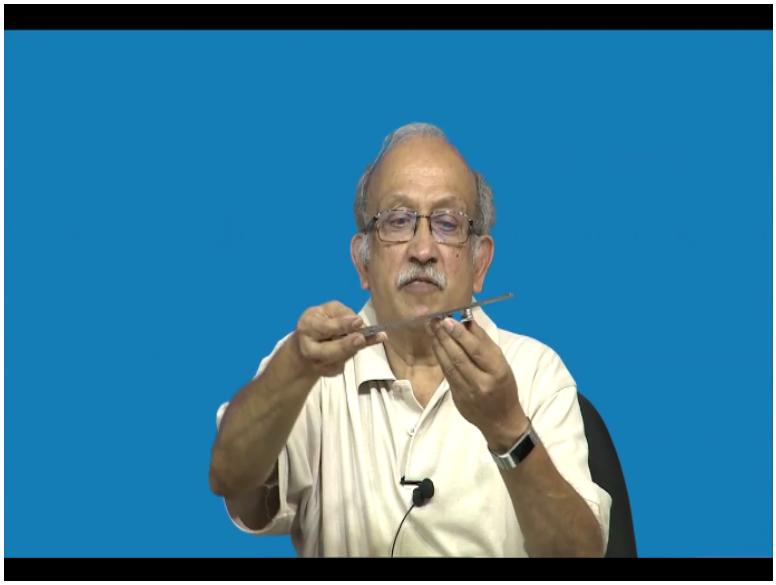

This is the original. In this case, you see top surface is almost flat and if I have thickness if I give a counter sink, nicely that small screw projects out of it. So in this case, we do not need that you know what you call that small kind of thing we have given. Overall, I will have a small box for it. I will show you the soldered one. In this case, we have four wires coming out. So you need to do something about the wires.

What are the wires which we can do and so on? Now this is where our next level of advantage of a 3D printing takes place saying conventionally what would have done, we would have tried to take two wires here to try to do some wires and so on. Looking at this, we notice that there is a lot of extra space here. It is very easy for us to build probably an input and probably an output.

If you want this to run from let us say this is supposed to go and derive a modem or mobile phone. Suppose I need to make a 12 volts to 5 volts mobile phone charge, I have two options, one of them is I can have the wire here which directly can plug in here.

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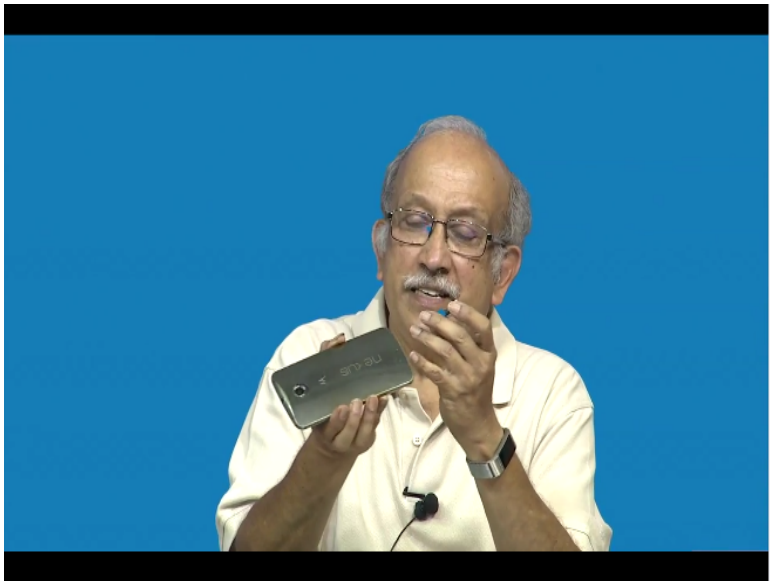

Alternatively, I can have a USB type plug here and if I have a OTG cable on-the-go cable, so it will be possible for me to just plug it in here. See in that know, so now I have a chance for me to if I can see whether we can build a cable with an OTG I mean counter part of the OTG cable here I have it and this other end I can decide what to do. I can leave two wires or I may be give a crocodile clip or I can make it saying it should be part of some other place where I have other voltages available.

So this is where the core is same where you need to produce things outside can be very what do call effectively handled using this thing. Now at the minute I will try to what you call close it and come back to a more interesting thing.

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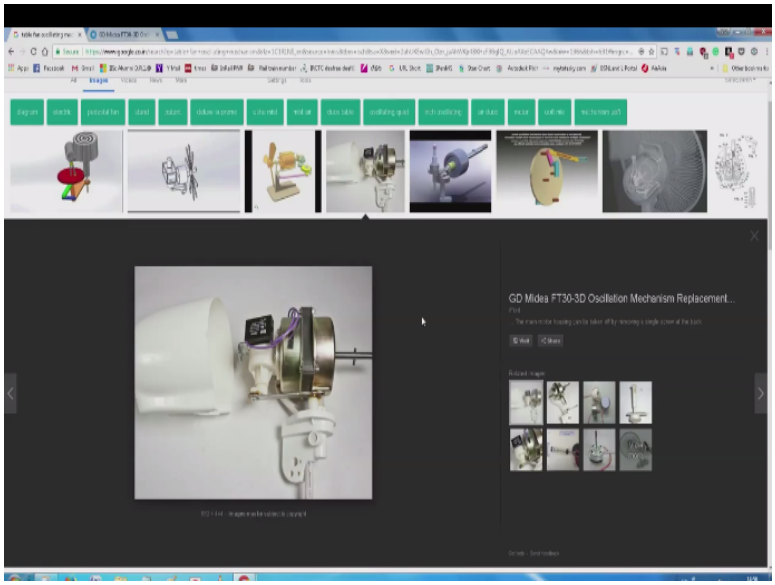

If I you remember last time, I left this. I said rather I promised I will get back to you with a better thing.

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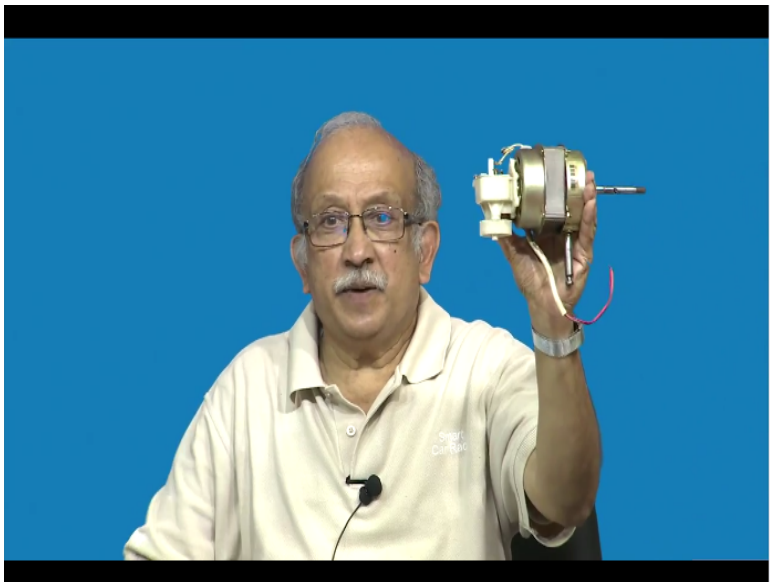

This is part of an oscillating fan. Now you see here, we have a fan which is rated as some 75 watts, so you can convert it you know as to how many watts make the horsepower and based on the how many watts loosely I will take 750 watts make one horsepower. So 75 watts is 110th horsepower. Given the 110th horsepower and given all this mass and all that, I can calculate how much of force is required for it to turn and how much is the reduction that is turned.

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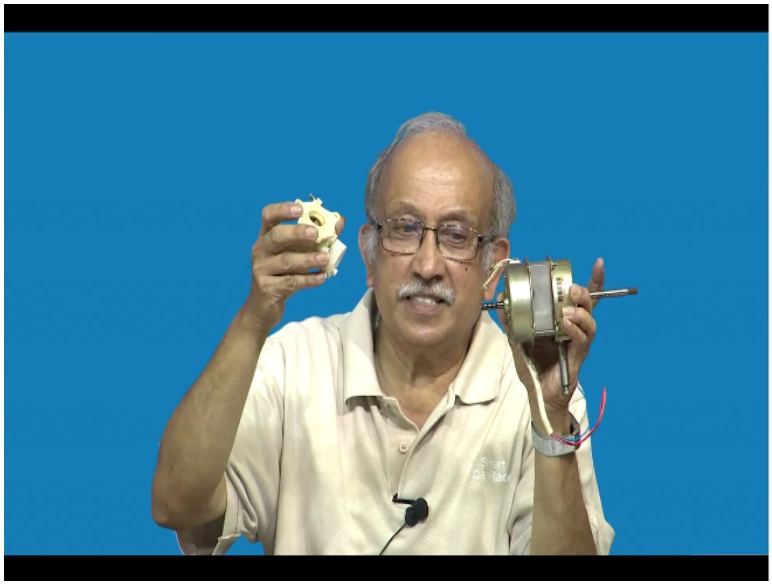

And in this case, you notice from manufacturing the shafted cell comes with the worm at the end of it. Over I do not know maybe almost a century it has become standard to have the

worm build into it. This back portion is changed a lot. Long, long ago they were all made in brass because perhaps that is the easiest thing that was available for watchmakers. Now all things can be conveniently printed on this thing made out of any plastic or typically a simple injection molded plastic.

Now if you remember last time, I showed you that one epicyclic gear train saying if you attach it, we can attach it to the ceiling. Instead in this case, I have a different type of a mechanism. In this case, this is where I thought now I will show you how these things can be put here.

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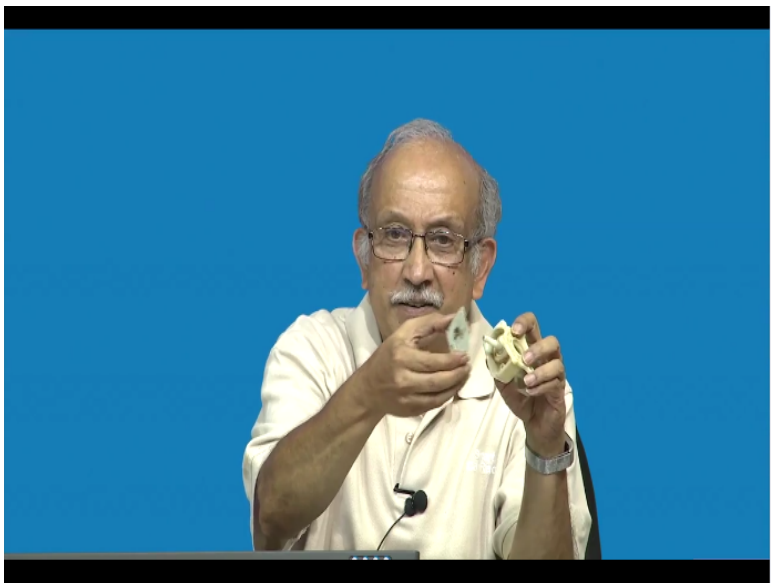

You see here, if I open it here I have several gears and this one of these gears this directly meets with this.

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See here, this gear meets with this, got. Now you see here already, there is a reduction. Generally, there is a reduction may be of the order of 1:10 and so on depending on the pitch. While the speed is reduced, in our case a little desired effect is the torque has improved. Torque has increased tremendously because a big fan know has to rotate. Then, the second resultant thing for that is speed is reduced, torque is increased.

Hence, these parts become very, very critical. Designing these parts know becomes very, very critical, so one increase in torque, reduction in speed. Next level, now next increase in torque and speed has happened here, now you see here. This slowly end up with more and more items which depend a lot on friction and mechanical forces.

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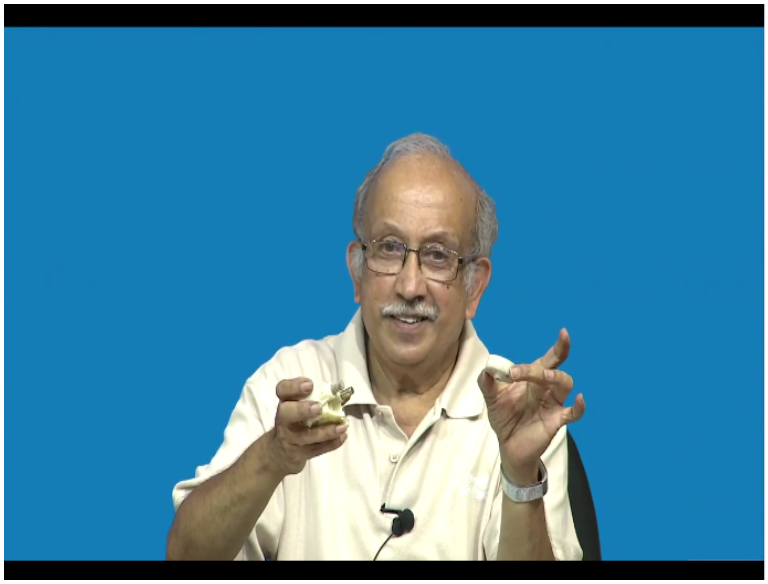

So wherever such things are there, we have no choice but to continue to use metallic objects load bearing. Possibly, if you are thought very carefully, it may have been possible for us to replace it but over the years, they would have found out, now probably this is already a standard item and they have it in large numbers or friction and secondly this tangential force in this know there will always be a little bit of force between these two.

This will lead to a problem, so they have decided to keep things as they are.

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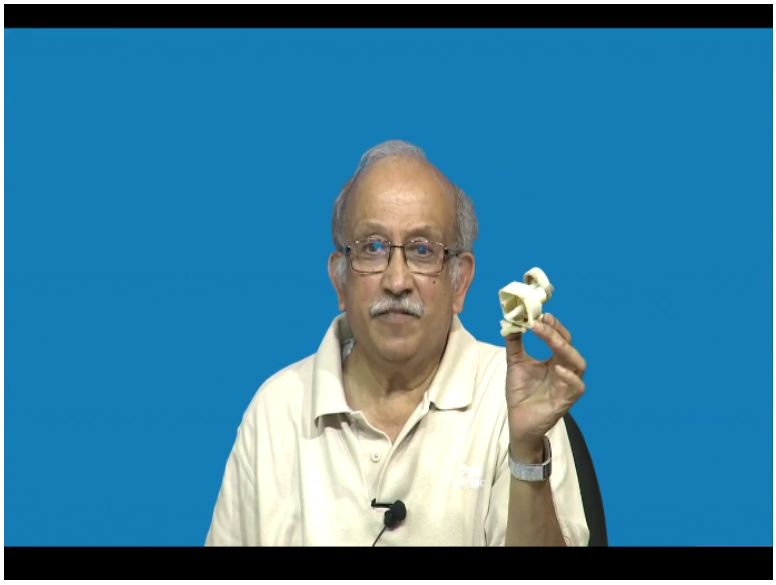

So in this case, this is an ideal candidate for being manufactured in 3D printing. So allow me to show you the same pictures on the screen here which you see here.

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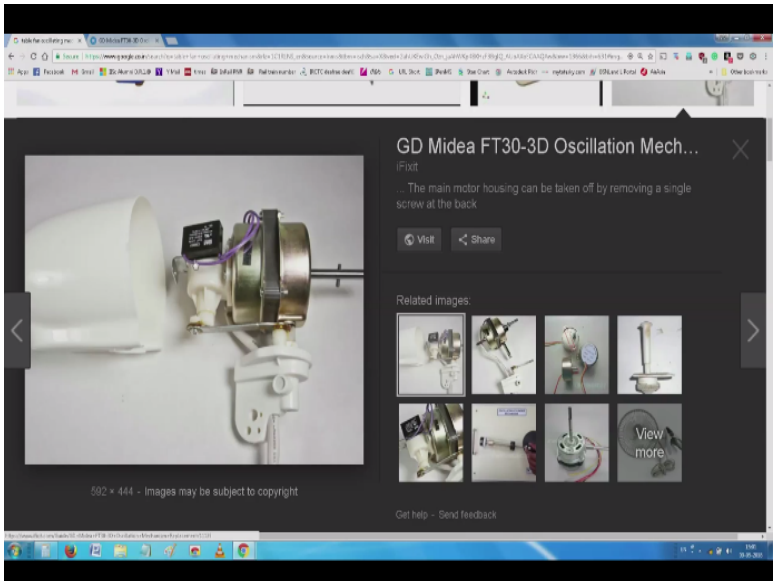

Typically see in this, this is the mechanism which I was trying to show you. So these are reasonably good candidates for us to make I mean take the next level of this thing to this. So right now due to some this thing I will try one more time and see whether any way it is nothing, it just shows all these parts yourself can may be go to the what do you call go to this I mean websites and check for detailing like this.

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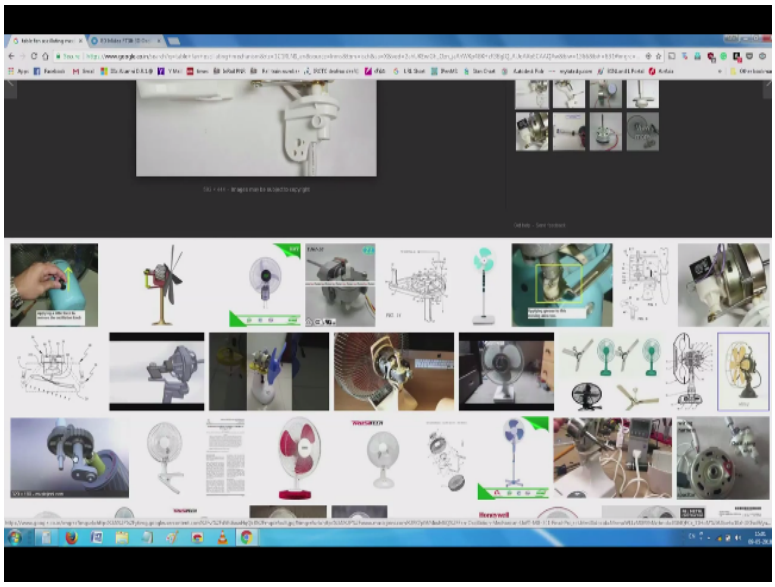

You see here at the bottom, a small detailing which can be done here. Same thing, much more explanatory, explanatory, explanatory I have to go and break a motor to get you this. So I think now you know a little about which are you know parts that we need to deal with it. Now getting back again to this motor, please have a look at this motor.

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You see here, when I want to assemble it to this, when I need to assemble this mechanism to it, one of the first thing is it should have perfect alignment and randomly with the high speed when I try to push it now automatically alignment should take place. So there are 3 fixing screws, metallic again and then these are all bosses now here which will go and sit here like this. These are very, very convenient to do.

And if you have the file with us irrespective of the stack, irrespective of this diameter, irrespective of this is required for a big fan or small fan, we can always modify it and then if you want it to name few hundred or even what you call 1000 numbers printing apart like this makes a lot more sense and right now materials are available which will help us in printing these things without any difficulty.

Here because of various restrictions, there are only hard type of what you call I think probably it is a nylon and it is injection molded and because of this you have radius here and everywhere there is a taper and anything you want to do here know everything has something or the other which is part of some other thing. So we have this and here you come into the next level of choosing fasteners.

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This one is a course which self-taping screw for this plastic thing, plastic items because you are not expected to frequently open it and play around with it, so we have this okay. So again getting back to this design point of view know you should pick on objects which are printable.

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Now if you see the other side, one more small detail I wanted to show you. You see here they have given a small step here and left the remaining material, it is because in the case of injection molding it is very important that overall know total weight should be less and how the flow of material takes places very critically and runs all the drafts and all. In our case, if you see the other this thing, it may or may not be required like this.

In fact, you can have probably a block and then have something along here and it will do equally well. So either you save in this material or you save in the support material or alternatively how you place it on the table and then which was the orientation takes place. Later on, another place know I will try to show you that thing. So right now I will stop here and take you to very small interesting thing.

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Now this is also an interesting thing here. Earlier when these were all made with metal, a separate clamping a device had to be made. Right now, not needed either you modify this part to take the clamp alternatively you modify the capacitor and by itself know it comes with this beautiful thing and then happily we have a nicely built thing.

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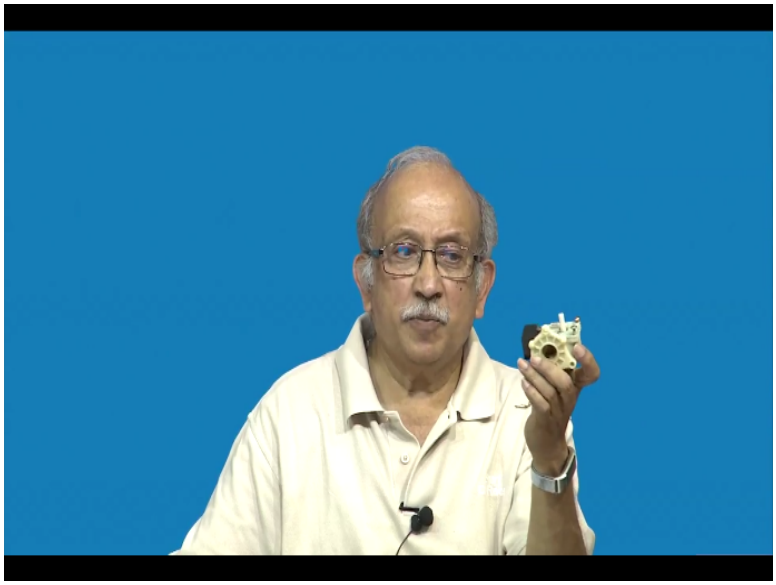

And these days, it is also possible that there are what you call machines where you can stop the process in between and add metallic inserts. Right now, we do not have the facility, so the next may be 10 minutes I will show you, I will take a small diversion and I will show you something else from what you call interesting thing. This is all about how they make cars.

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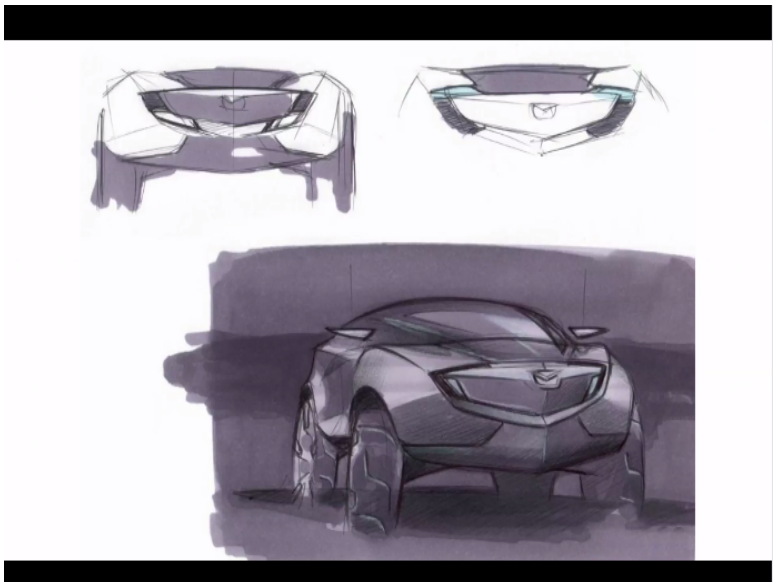

This is taken from their Mazda's website and one car enthusiast shared it with us. I would like to acknowledge saying the starting point of any big thing also is sketching and 3D design. I will go through it very quickly, may be if you are interested know, you can watch again.

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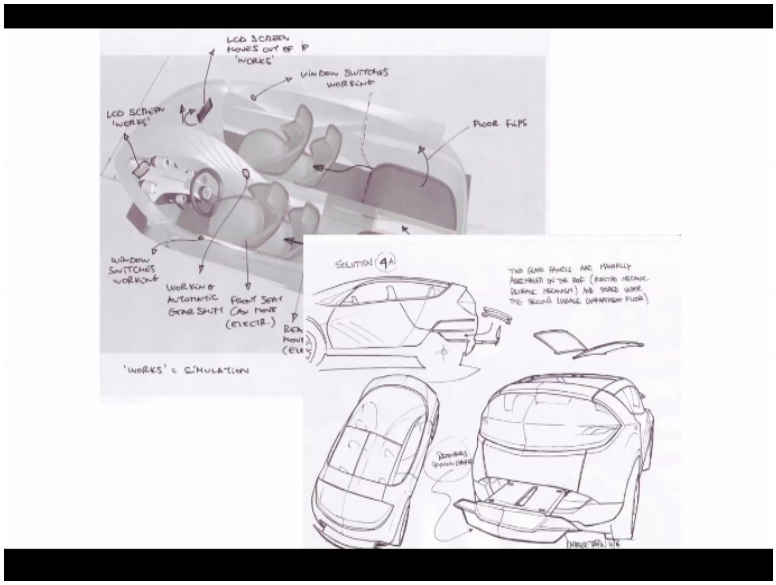

So obviously starting point is where somebody sits very carefully and where is about the product? Can you see here? These are concept sketches.

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And there is something else here. I am not at all sure what it is but there is a theme that is copied here. There is a theme, this may be related to the gear shift lever or it may be related to the external mirror or it may be anything but what it is trying to explain is that there is a theme about it and in this case in fact it is a small thing saying it is a 3D screen. Let us see

here at the bottom, here you can see that it could be part of the speedometer or it could be part of entertainment system or anything.

These small details can easily be printed in 3D. Earlier, it was not possible, somebody had to do. This is about I think 15 or 20 years old presentation from them.

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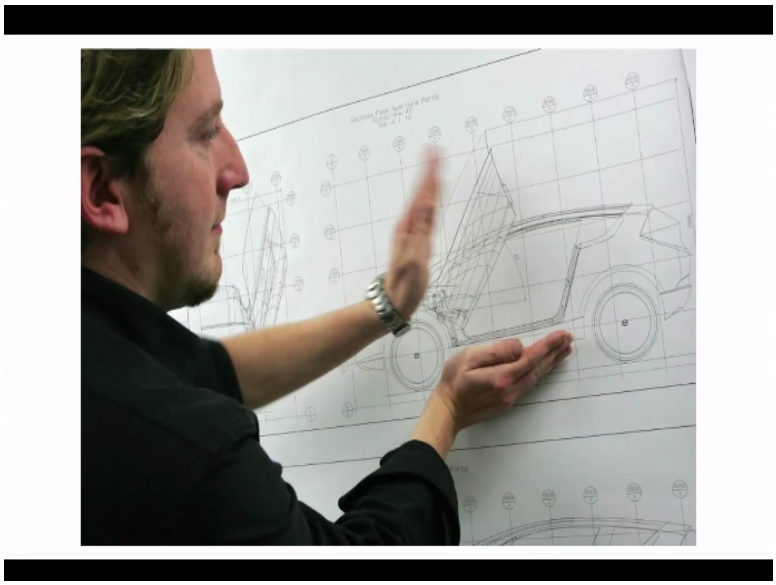

You see here, how to open a door.

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And somebody is you know showing all the various details, hand details.

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And somebody is working about all these things. Advantage there is if you were to make a proper model like this, probably a scale printing can be done. So you have 1:8, 1:16 scale model things are available, it is possible for us to make a scale model print, so that you can show others saying how the whole object is going to take place.

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Designer and these are the people who work on the interiors.

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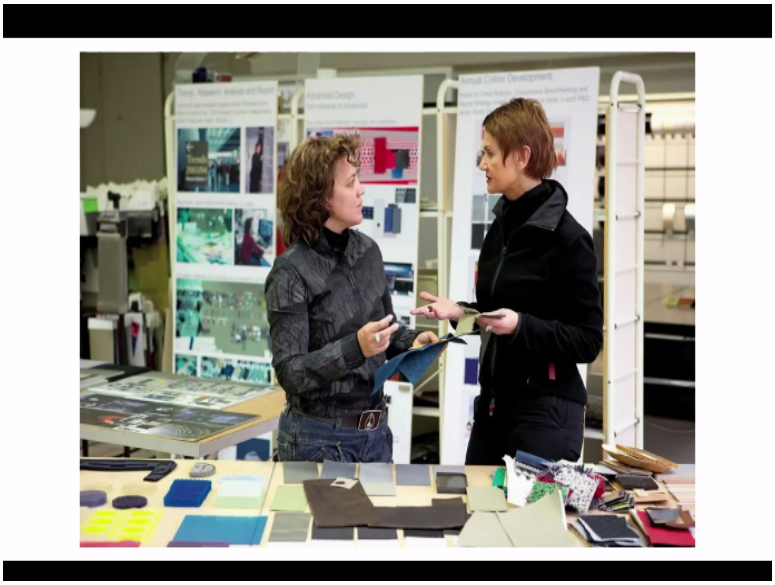

So you see here at the base, all the various type of materials which are required for the upholstery, interiors, everything are there and all of these things can now happily be printed on a scale model.

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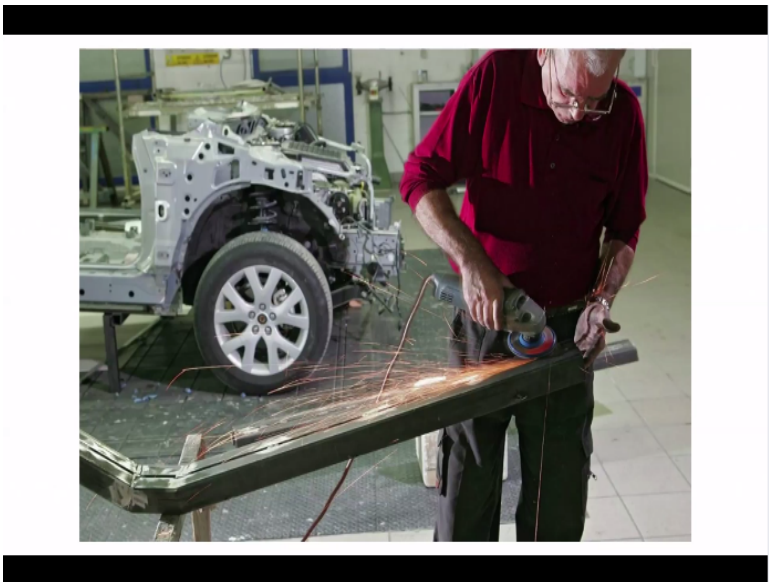

This is slightly different. They are trying to make a working demonstrable model so that it can be shown at an air show. So they have taken a previous platform and then trying their best to attach all these things.

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And then you see here, they have tried to make a door and then inside the whole thing is filled with polyurethane rigid foam structures inside and the later on they will cut it and you see here we have something else here on the top here. I am not very sure to be what it is, it could be a digital sculpting device or it could be what you call coordinate checking machine and so on.

So with this, it is very much possible for us to get the desired shape and whatever we want to do. These are all thick urethane foam here, you see here urethane foam here and can you see what is going on in the back there. Somebody has taken all these pipes and they have made a seat and the seat is being covered with some what you call vinyl so that it looks natural and they are trying to probably built I am not sure that the front or back of the object.

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Slowly it is getting up, so obviously this is the front, this part of it is bonnet, you see here something is already sitting on this. So I am not sure whether it is actually a fiber glass device or it is what you call sheet metal or anything but what is really is it is a mockup and almost near working mockup.

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Next picture will show you, you see here you see in the front we have the concept and at the back you can see that already know slowly the concept is getting shape in 1:1 full size. Now people tell me and then occasionally I have seen on the internet, full-fledged printing can be done on large objects also.

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See all the people are happily sitting here. So what you have seen there is probably a fiber glass mold, you see here this is the fiber glass mold at the back, is one side that is the other

side and then the whole thing has been built out of it. So this is the design team and god is in the details.

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See this, it is getting ready. Life is so easy, is it not and so interesting also.

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And somebody is working on the finishing of it saying how do you paint it, where will the gap sucker and then where do you catch the highlights and how do you make it look as authentic as possible.

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And this is a paint shop, so after glowing and doing everything you see here something else has been done here to make the bonnet look real. They are building up on that.

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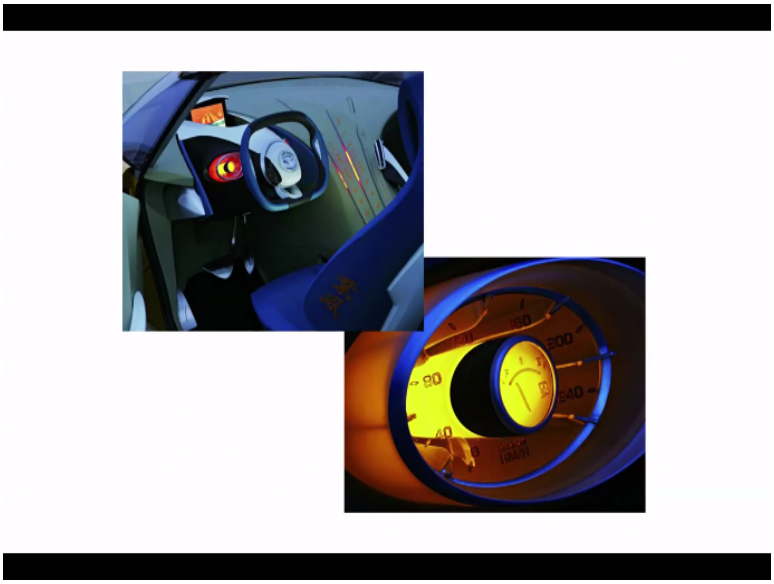

This is a little difficult, I am not able to at the minute tell whether it is only a mockup or it is actually a implemented piece, whether to see here each one of these elements can easily be simulated including all, see here, what you see here inside is the instrument cluster and in the instrument cluster they have very important things, outside you have something or these numbers look threatening.

There is 150 kilometers per hour to 100 and so on and there is a beautiful steering wheel also and at the back this is the LCD screen which was there in the earlier picture.

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People are sitting there and that is real, you have seen this know. This is the real this thing and it is a very peculiarly integrated headrest.

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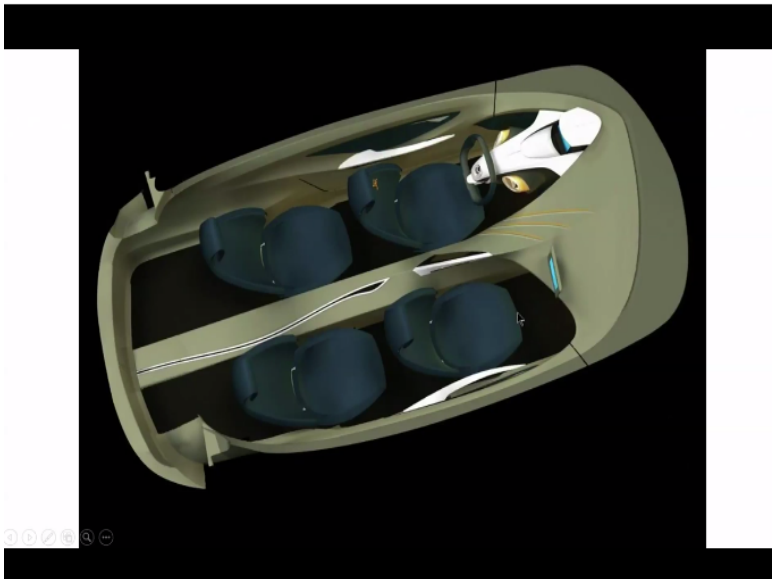

If you remember that LED screen know this LED screen is for the passenger here.

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Now it becomes a little tricky. I am not able to make out, it is just a rendering or it is what you call actual model. I think you will be very easily because of this strong contrast in the way this what you call shadows make out, it is obviously a rendering and the next picture will show you.

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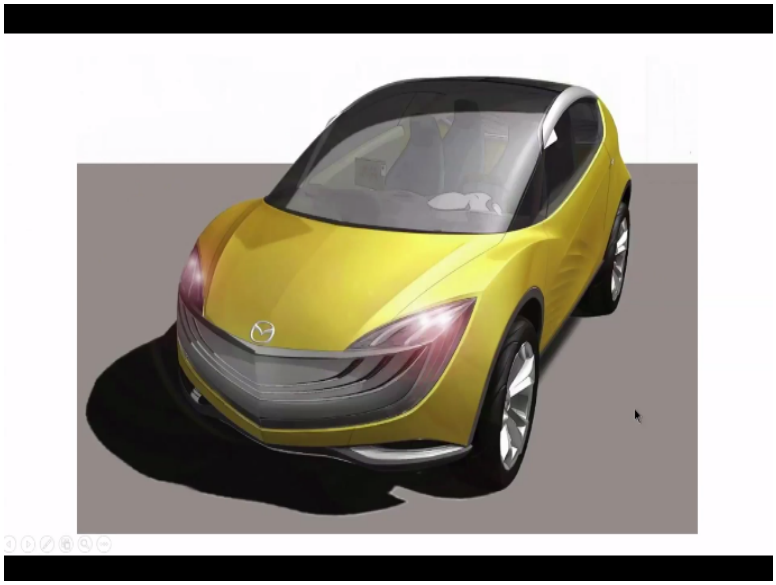

Because it is being a 3D, the movement you make a 3D model lighting and adjusting things are relatively easy, what just gives away our thing is probably last minute know they had to make this and this does not look very, very authentic.

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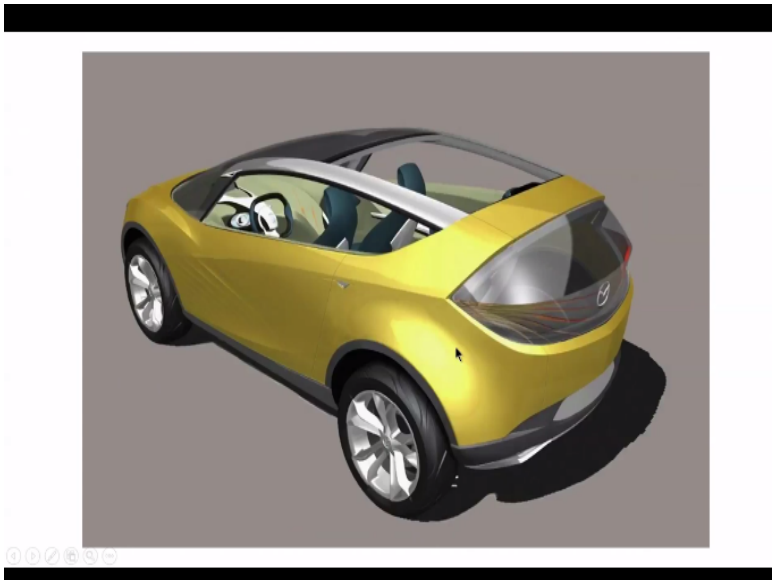

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Better same 3D rendering.

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Now we come to a little thing, is this real or is this virtual? The magic is it looks like it is a mockup which is real. It is not a virtual model; it is a real model. So it can be lucked around and you know they have taken this and also presented it at the show.

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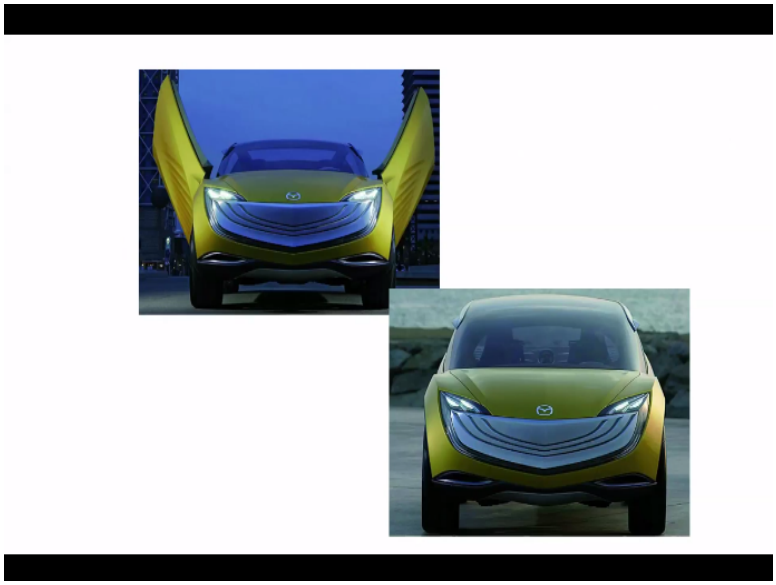

So there was a grand entry on the stage when it is presented at the what you call auto shows but to get it this why I have shown you is saying modeling is very, very critical and the more detail you built up know the better things are. So I will stop here, will meet again in the next this thing and why I showed you this is, it is now possible to print even these large things in 3D printing.

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So thank you and this is actually a real mockup, probably it is stored and kept there, it may not be moving but it is kept there.

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And this is what is you know got ready at the what you call on their premises. The only small thing is the way the wheels are rotating most likely the wheel rotation is done in probably Photoshop. So I will stop here. Thank you, will meet again. Thank you.