Physical Modelling for Electronics Enclosures Using Rapid Prototyping
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Lecture - 31
Multi Direction Features Contd.

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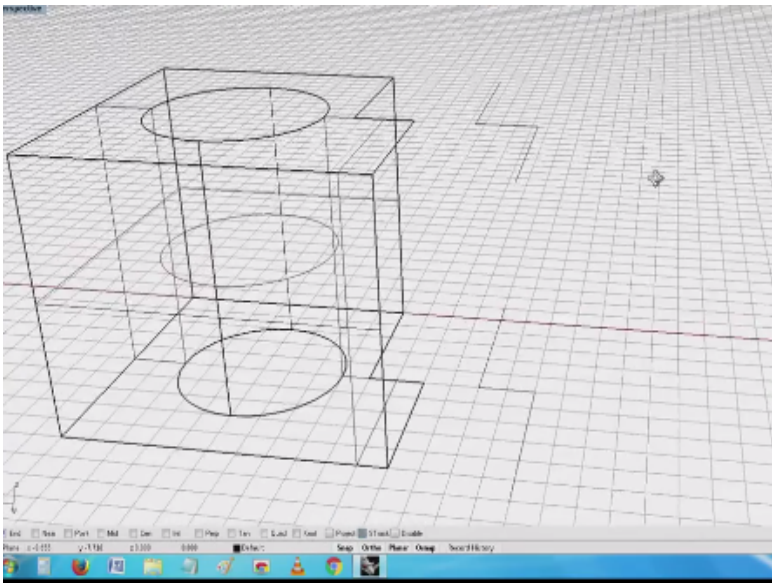

Temporarily let me hide this so that it will not come in the way, you have seen here, I have got one object here, I have got one more object here. So I will try to create a surface using this as the edge curves, I have an edge curve here. I have a reasonably okay thing, small (()) (00:46) here kindly. Just about made it, seen this. I will just give it a, so because this surface is common with the other object.

I have reasonably well made one object I have here. Now if you see because of this orientation this object can be built easily without any other thing. Meanwhile I will unhide the other object, which I have kept there, the same, see there is a small error I will try to correct the error. Thing being it is very much possible for me to, seen this.

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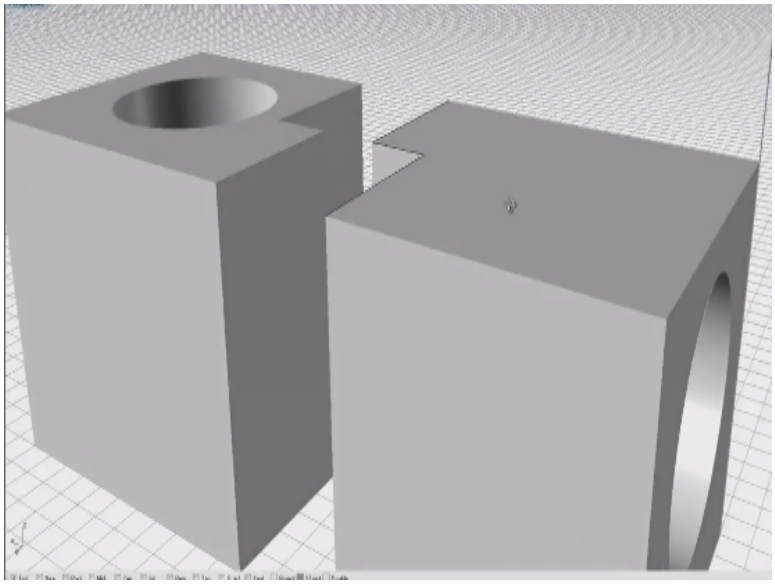

And you have noticed this hole is in the other direction. Now all I need to do is, I need to take this and rotate it, seen this, they look a little like similar except one of them is a through hole, the other is not a through hole, other is a blocked hole. So using this it is possible for me now to, wait, let me, it did not get welded there properly, exactly, no waste of material. Seen here I have a little problem here because of this.

I will end up with a peculiar support required here while this is the route I was able to build here end up with a support problem. As I need to undo it keep it back and rotate it in the other direction. Good, perfect textbook example.

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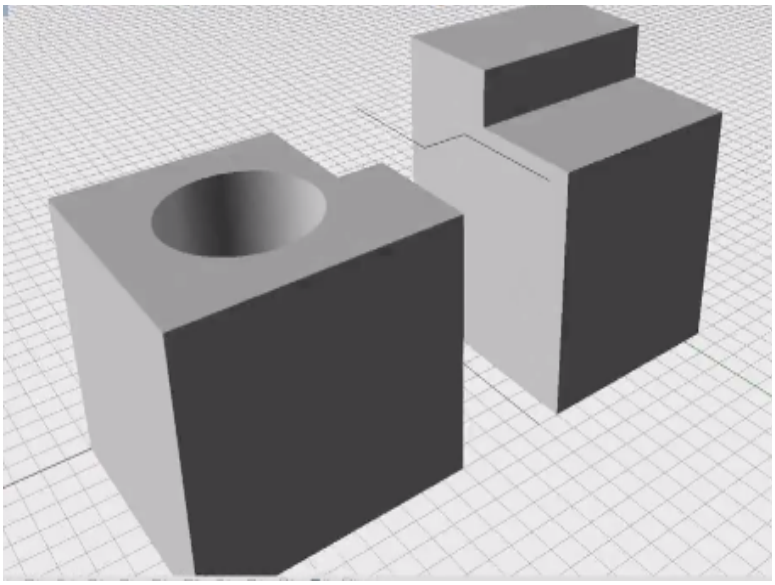

So if you see here building this is easy, it will continue to build like this and now if you see this also while outside it looks like this the hole is at the bottom. So the circular layers will be

continued to be built. This is where I was telling you, you do not need to actually have even 3D printing machine, now you can try your best to what you call create the layers. I will just quickly try to create just 1 or 2 of them.

And then see, I have got a as before a textbook example. I can slice each of these things.

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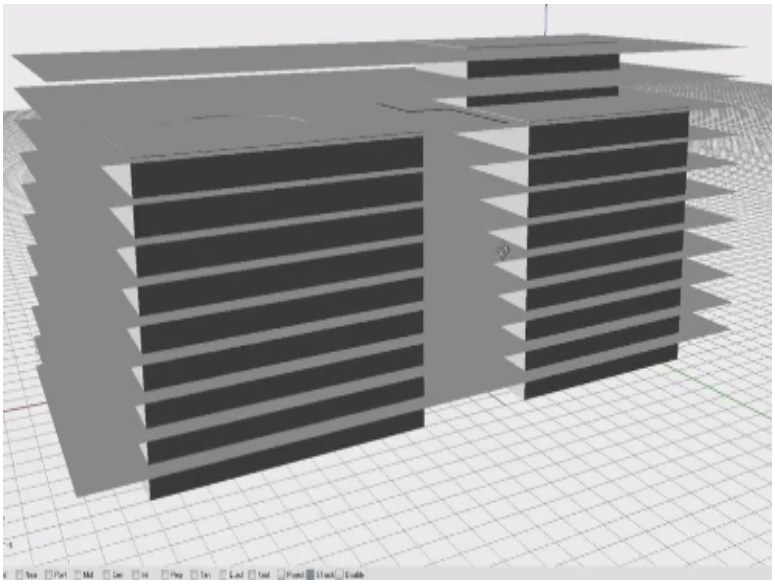

See how the buildup is done and it is a routine thing so instead of my talking I will quickly try to do as best I can do. So as before I need to go for these what do you call split, objects to be split this one and this one, cutting objects, all of them have been split. Total have been made into large number of 39 pieces and like before again there is a peculiarity of this particular machine, the solid, all the planar openings needs to be created.

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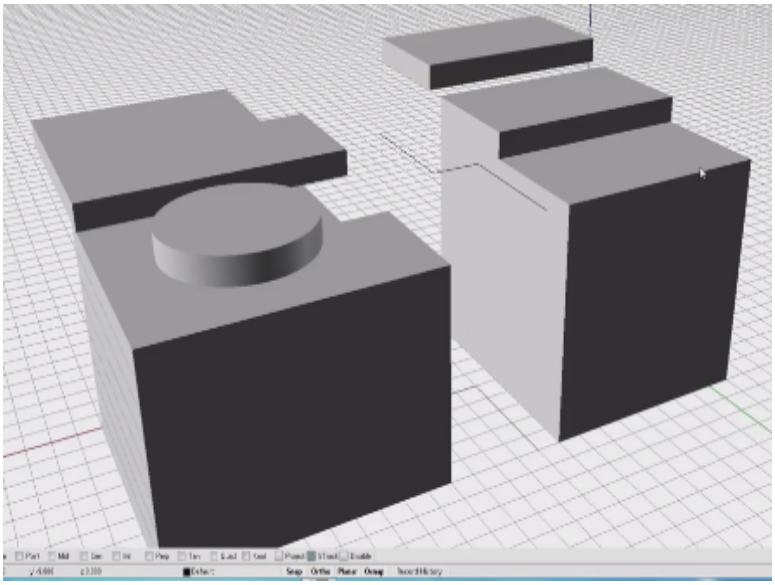

Now if you see here this is the top most layer, seen what it is, there is some issue with the cutting but; however, this is how object will start getting built like this. There was a problem in that cutting and this thing and so on, but the thing is saying what I wanted to actually tell you is that it is very much possible for us to check the orientation of the object and see how putting it in one particular direction it is obvious here, is it not.

So this starts building without any support is required and the top layer it may need a support. So you need to take a call once again because it is circular there is nothing, only that middle layer we may require something. So you now decide where to cut it and how to make join things. Alternatively keeping in principle with the other thing what we are doing if the hole actually intersects the other you understand know.

So I will go back here, it looks like there is a problem of some sorts of, I have this cylinder here so it is possible for me, I can continue to make it into a through hole this direction also. Now cutting such an object will be easy and see here I have a relatively neat object which comes like this except that you will notice here there is a small opening here.

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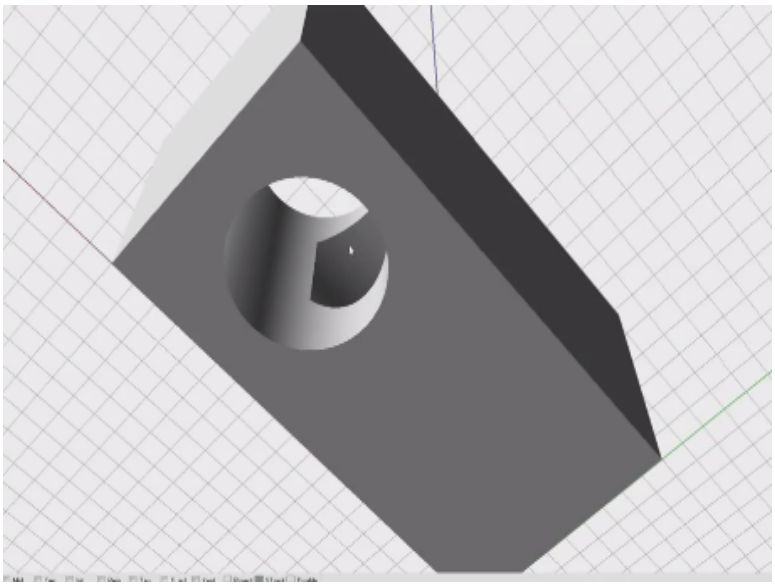

It really functionally it does not matter for me or I can build things around. Now when I cut the thing here carefully, it is possible for me to make it such that it builds perfectly well. So I have the readymade object actually with me. So I will try to show you the object how the original is and eventually after it is all made, both of them have been joint together. So we will have a look at that object as soon as it is over.

So I will stop here, you can see the object when I bring it. It is being fired as on end in our case actually one was a screw insert, a metal insert has been placed here other is actually open hole. In this case screw insert was here so that it will go and clamp something and this one is something which is there. It was attached to a quadcopter at the base. In the quadcopter there is a H rail which comes down.

So to attach some experimental load 4 of these have been pushed on to that, then there is that upper load has been attached and the whole thing has been used. So thank you I will continue after the sample, as soon as the sample comes. Let me continue, I did a little bit of homework on that object which I had started yesterday and I think this is it. You see I have a very tiny practically invisible fastener in my hand.

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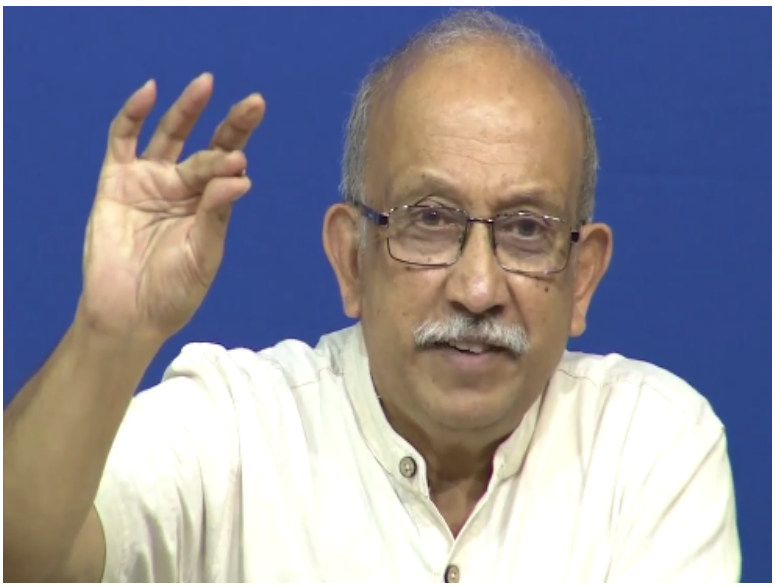

I do not know how to show it okay; it is really this is a 2.5 millimeter clinch nut. Anyway I have got a picture in that okay, one part of it is an hexagon, another part of it is a what you call threaded portion and I will put it and actually probably I need to have a 10x magnifier called a loop. I will put it on the loop and show it to you later. This is the small object. Why I am showing it to you is, kindly if you see here, we have a small issue when it comes to making threaded bores, okay.

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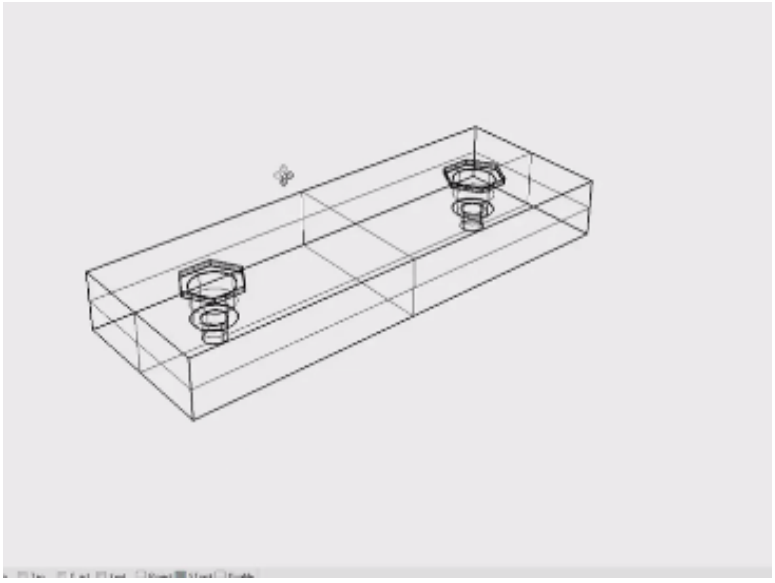

So here is one of those classical objects, so you see here that if I now try to; I think it is clear.

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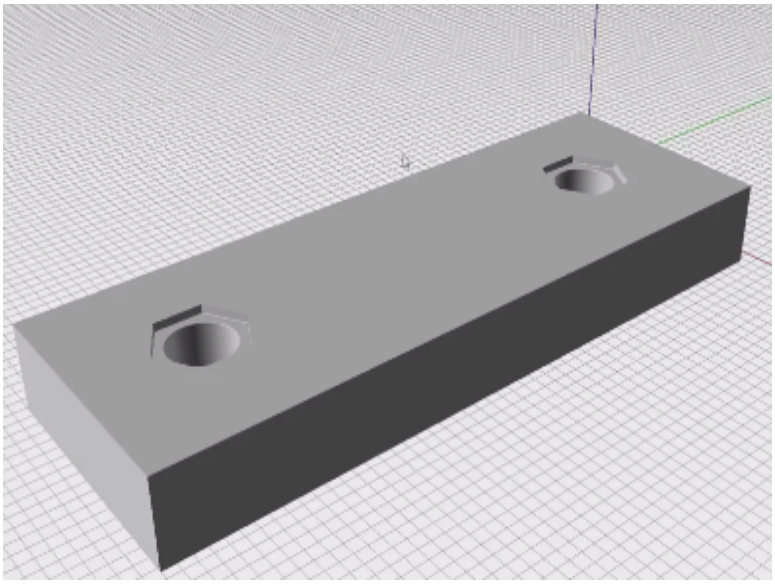

You can even make out what it is, except the dimensions know, right now I have made a dimensionless, on one side we have an opening and one side we have this and then if I now make it by going to the properties make it transparent and then I give a rendering you see, see the object that I have there. I hope it is a little clearer now.

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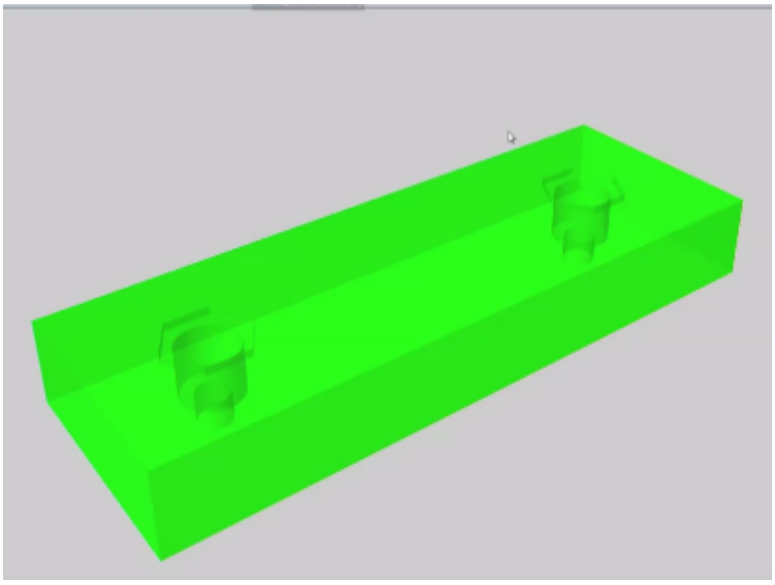

What we have there in fact is a, it is just what do you call just for the purposes of illustration, I have created a solid in which there is a provision for putting a threaded insert. In all other places see if it were aluminium, we try to, if it is very, very small we put a riveting nut or something. It is a sheet metal on one side. We have a riveted nut, or if it is a casting we use something called a helicoil insert.

I will just see if the internet is still working on the other monitor. You see in the case of aluminum it does not hold threads well and even though you can tap it once most aluminum, most alloys and all have a tendency to lose the threads after little while. So what is done is something called a helicoil is inserted into it.

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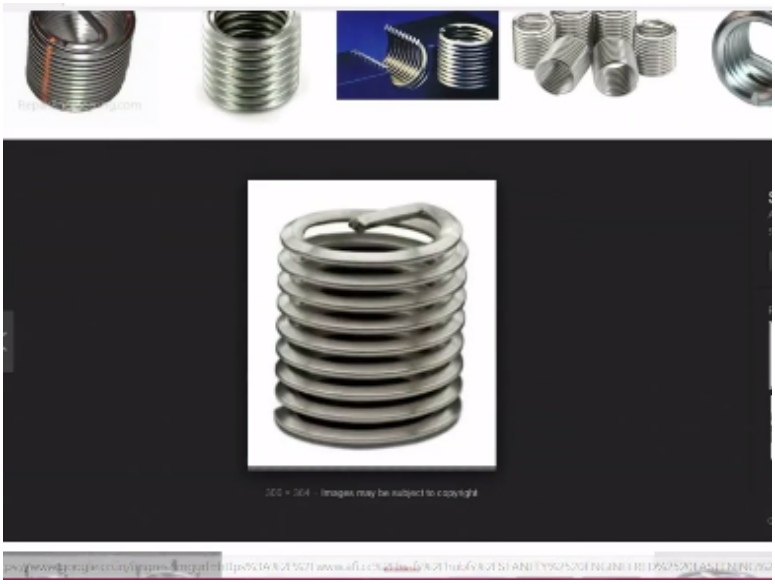

You have seen this; it is called a helicoil. It is nothing, it is a coil which you know it comes with it is own tool which you know come in there is a tap set.

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You tap it to the next over size then you insert one of these things. While it works well we have still a little problem when it comes to, can we use it in plastic.

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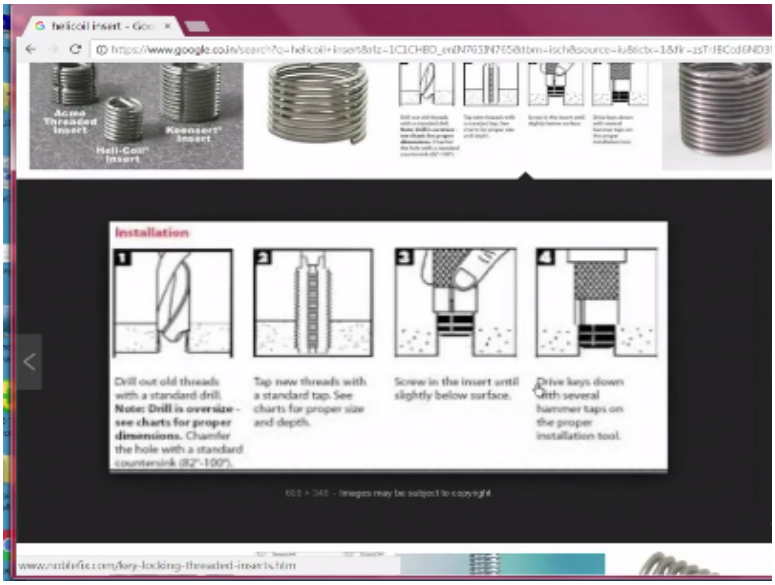

You have seen this know this is typically the way these helicoil stuff works. So you have a hole then you have a special what you call this thing here, then you have a device know which inserts the proper installation and so on. So this is standard practise when it comes to making this you know things in this. There is a good view about it here because often it is used more as a how to tell, is a repair but the reality is more than repair. It makes cents when we actually insert it like this.

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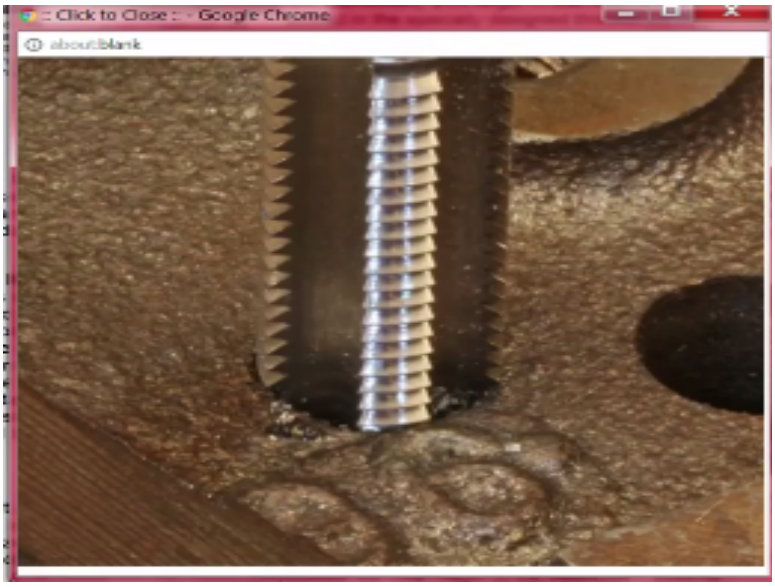

You see this, now attempts have been made to see whether we can extend this to plastic parts and what I can say is no it is, I mean, maybe some plastics can take it, it is not ready plus you can always put a metal insert and mould it around in the plastic. If you remember the first 2 samples I had shown you a box in which I will see if it is still there or, it is still there.

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You see here this is the type of an insert I am talking about, but then you see this is our early stages, it is all crude and finally this insert know did not actually sit well. So it did not serve our purpose. This must have been around 3 or 4 years old. I think, yeah, in fact 4 years old. Various attempts have been made to see if you can improve these things, whether this type of inserts and all can be improved on it.

These are early these things so we have taken this proportions from injection moulded parts both plastic as well as nonferrous alloy casting. So the detail does not look nice. In contrast if you now kindly look at this monitor, back at the monitor you will see that what we have done here is not the best. So various ranges of you know this helicoils and bushes, these are freely available for metallic objects.

Now when you want to use moulded nut inserts for plastic see here we have so many of these devices which are available here, can you see something here about this.

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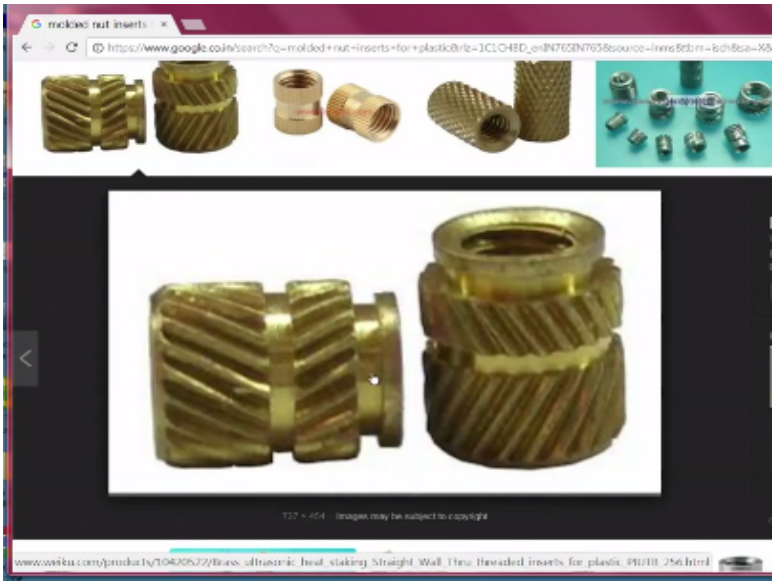

It looks a little like a gear wheel actually. Essential things what you need to notice is that a type of knurling like object has been created here. It is not actually a cross knurling, but then the advantage being about any of these things are it does not easily come out of the, it does not easily get ejected out of the what do you call the part. These are the most common thing which are used in normal injection moulded plastic.

You see there that one had that knurling, but you know it looks like a Herringbone gear this one has straight knurling and it has a small step inside. So maybe it is patent. Maybe it is there and then you see here this could be a very common thing which even you can make. That is take any long hexagonal tube or I mean sorry nut this thing, they are all usually available up to 50 to 60-millimeter-long and then part it and then afterward cut a groove, you have an object that can be easily used in injection moulding.

But now can we use that in our rapid prototyping, we have a little problem there. Problem meaning, how do we lay it up finally. Laying up is not easy. Is it not, in fact you have so many of these options. It is not at all easy, in fact everything you want you know self-locking, anything you want is probably already available there. Seen this all the proportions are given, dimensions are given.

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All the various item, this is the one that I have picked and shown you, seen is the one with the hexagonal thing, this one is coarse knurling on it. You have seen this, it is very tiny, inside the thread could be I mean the smallest thread will be around 2 millimeter even I have seen 1.6 and 1.5, then you have going all the way up to about 4-5 millimeter. Can we use it in our rapid prototyping? No.

Because we still have an issue of as we build layers the in case we put these insert there, it will get into the way from the nozzle and if you try to push the nozzle I mean push the insert after it is made, chances are it would not go well. So it does not sit well because the material know is not a free flowing material like either fully moulded plastic especially glass filled nylon or aluminium.

So we have to look into some work around. So kindly if you see my that working computer. You see here what we have done. What has been done here is the object has been, oh I will not save it, problem, what has been done is we have created a structure which will help us very easily in creating a what do you call one object in which we push that nutsert, nutsert part of it has an hexagonal projection after that there is a straight bore.

And then this is the where the screw goes inside. The advantage being when you try to build it in this form, if you try to build it like this anyway is possible. You can for example build like this because bottom most layer will be what do you call, it will be flat, you have seen this. This will be the bottom most layer, it will be flat and as it goes up it keeps building everything and finally that last layer will be a simple hexagonal layer.

Where it is easy, it is obvious, in fact I can cut it and show you but right now I think let us leave it there, you have seen this know this is the bottom most layer then the layers will build up here finally you have the hexagonal layer. After the whole thing is build up now if we take this small tiny you know hexagonal insert and push it from the top and for safety sake probably even put a little bit if super glue on this all around.

And why is it tiny because it is a 2.5 you know millimeter insert. It is very, very small. So after the whole thing is made instead of going about it you know, you will just find one small hexagonal opening, you just push it into the hexagonal opening and thing sit neatly well and for the purposes of our manufacturing you see here we can make something neatly sit here and the top layer can be covered with a vinyl or a sticker which can be contained the graphics which is required for it.

So any equipment invariably will have known if you control then if you displace the control does something to the display and then several terminations and several cautionary nodes and all. All of them can be made on to a vinyl sticker and after inserting it into the what do you call that base after putting just for safety sake you put a little bit of super glue and then you can stick another layer on it.

I am a little phoneky and what do you call (()) (26:32) person so what we insist is we also take usually a strong polycarbonate sheet which is probably around 1 millimeter coated with some adhesive. In our case we generally use chloroform because I mean we have access to it and I mean safety precautions then after that full sheet is stuck on it after putting the inserts in it. Once you put the insert and put the full sheet on top of it and you allow it to harden or anything.

It is practically safe especially by mistake if somebody pushes it in this direction if something is pushed in this direction know, that insert will come away, but this is exactly how the insert is used generally. So it can be for example, this whole thing can be built on a transparent this thing or we add a LED window on to it where displays and all can be done. So it is nice, all I can say is an extremely you know beautiful and convenient this thing.

I will just to show I mean while it is a little gimmicky, kindly I mean put up with me I will just try to make. See here, I have a nice convenient object since it catches the highlights you know what the object is going to look like and small I mean just kindly bear with me for a while, if I delete all these faces I have a wire frame like thing which in general shows you how the object is going to look.

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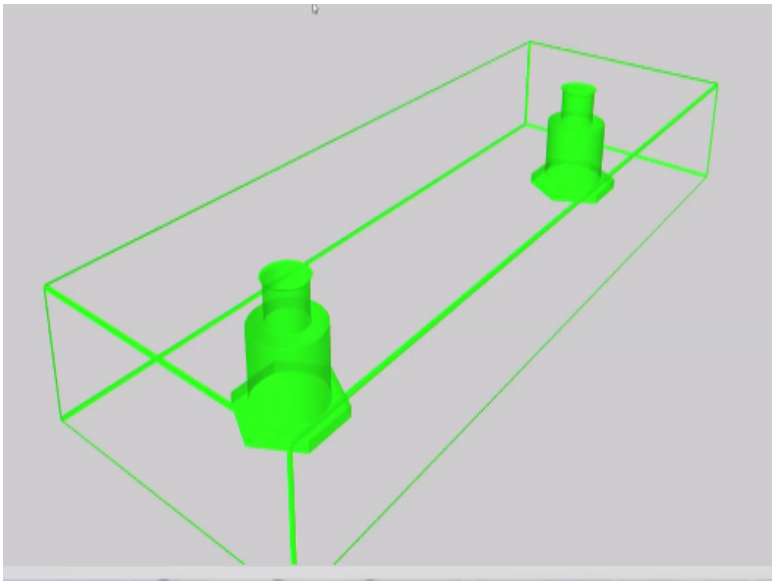

See this know, they are the edges of it and inside we have that small depression which approximates to the nutsert that I am going to push inside or the clinch nut which I am going to push inside and after putting the clinch in it I will have a surface you know which is again, I said 0.8 or 1 millimeter polycarbonate which is generally hard and depending on whether we have a what you call one adhesive which melts and sticks to that.

Now I have a beautiful object which is very functional plus I can play around, make it into any shape I like and it is a build and you know we can clean it. I just wanted as part of the fastening mechanism I wanted to show you this.

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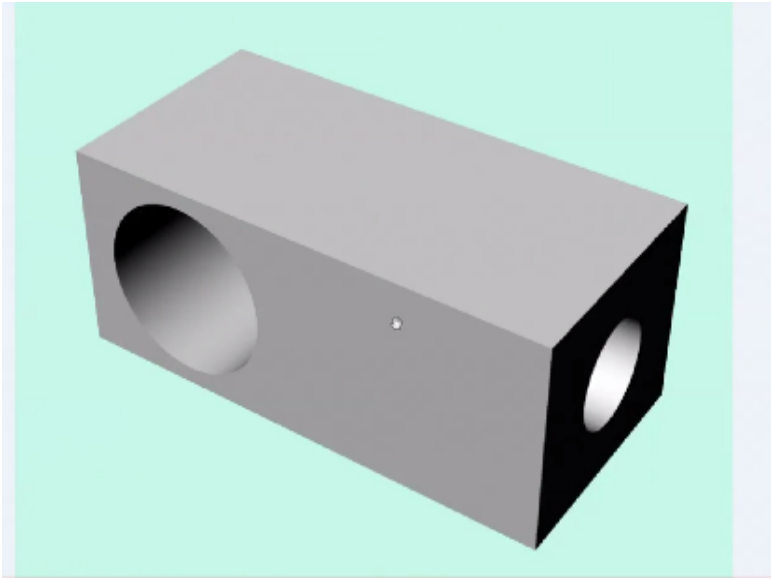

This is the object which I was trying to create yesterday. If you see this object one of the thing it has bores which is orthogonal to each other and just for convenience, I have put it in the axis intersect otherwise there is no necessity for the axis to intersect also. This is only for the in the case of illustration. Unless you have this radius, the highlights are not caught, unless you have the highlights you cannot give a proper thing.

But these are not convenient to build as such, because it generally knows you try to avoid all the fill-its and build a beautiful thing which otherwise is not possible.

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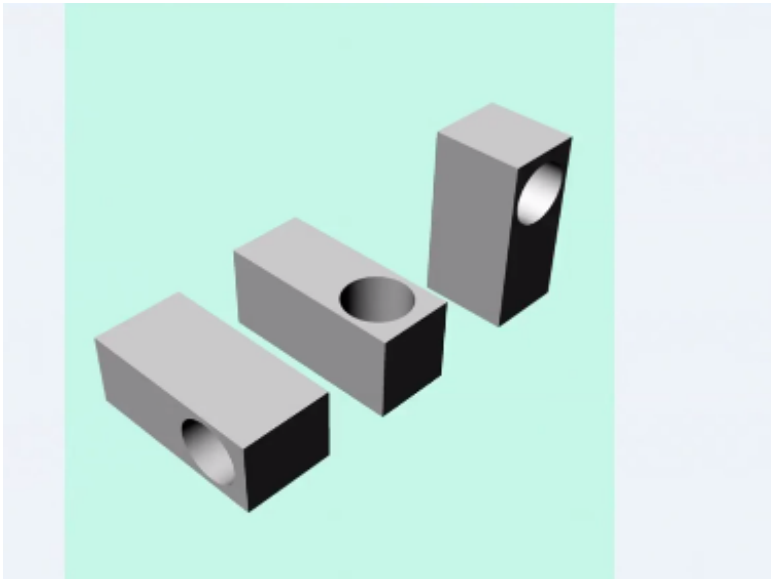

Now let us, we need to build this in our normal 3D printing machine. So if you are to make it such that this wire, this line, I mean the axis of this circular feature, cylindrical feature is normal to the surface meaning it is kept parallel, building here will be easy, absolutely no

problem at all. If it were a full solid is probably the easiest way to build. Now comes the thing other side I have a bore there, which I have shown you.

If you remember here, if you kindly remember the previous thing you know, you see here I have a bore here. Now if I keep it flat and try to build as the software know checks first and then a little bit of a build material or support material is built here. Same thing here. Here supports material is accumulated. So I have rotated it 90 degrees you know along this axis and you see what will happen.

Now the proper way is probably to build it in this direction, looks okay know, but again we have a problem while we have solved the problem with the bottom bore this filling up is required. So is there way of getting over it what has been suggested is you cut it into 2 parts.

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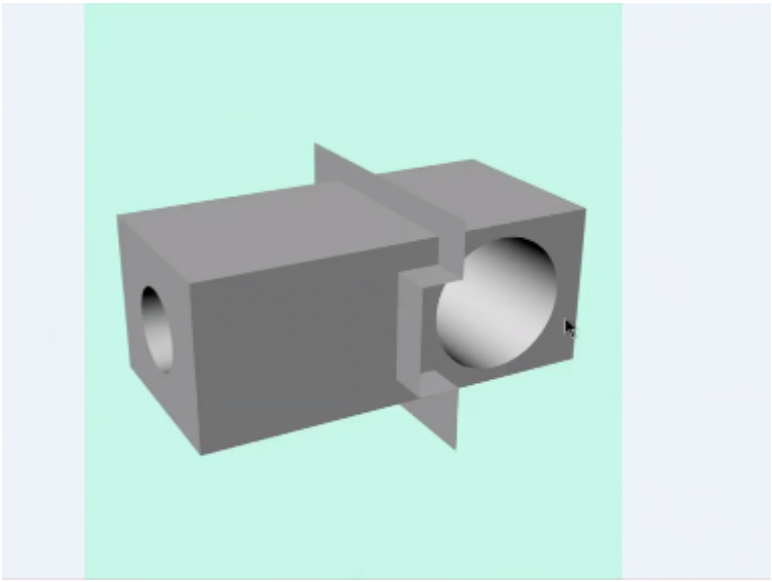

This is what I was trying to tell you yesterday or I will say previous session, I would not say yesterday. Now you see here I have made I had section like thing such that I now split the object into 2 parts. After splitting it this part can be made to build with this face down. This part will be made to build with this face down. So we have no necessity for any build material to be coming inside.

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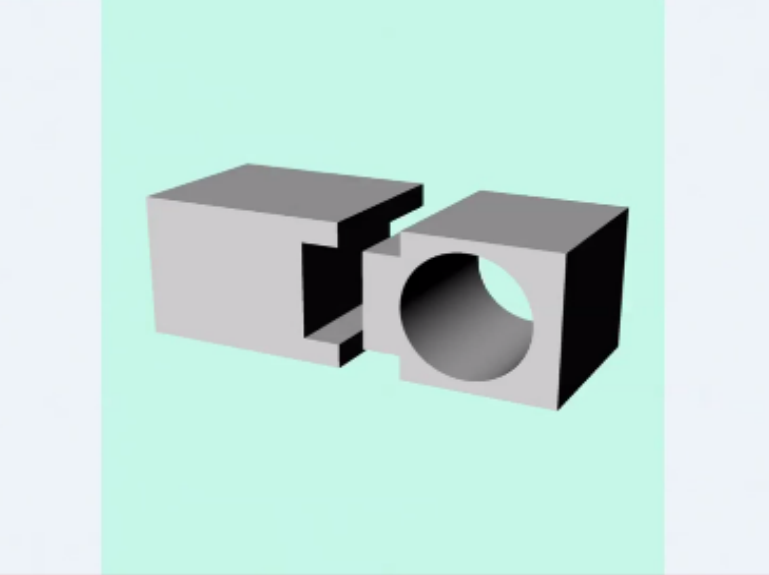

So if you see here it has been cut in this place and we have this like this. Easy is it not. So I had made a small error which I will correct it towards the end. Now it is very easy after having split it into 2 parts and why do we need this very funny thing we need it because alignment is critical. Sometimes there is a, I mean some alignment, especially the outer surface is critical.

So you see from both directions you can see this is the easiest way to build the object and you see here underneath there is a bore and there is something here. This is the, while it looks convenient actually on further examination I had found out that this bore should have been through, then only it makes sense. Now building these layers will build up automatically building here also I will build.

But to support this top most structure again here will be a support thing required like this. So what to do this has been added here, can you see here a small cut has been given and this has been added here, so that it would not slide off. So now going back to the, see one sits over the other like this.

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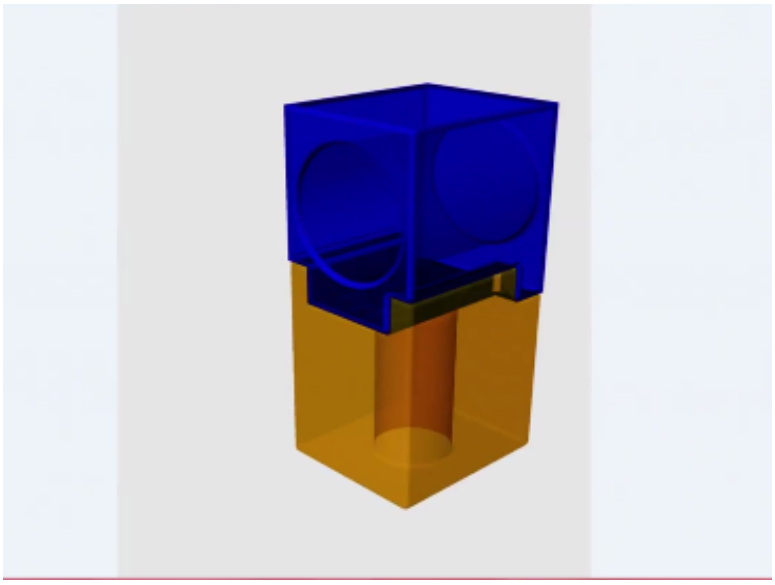

Looks a little like a washing machine is not it. Unless you get into this level of detail it is difficult for job to be successfully integrated. Now you see here if you see carefully I have this bore logically this bore should have come out of here because functionally it will not make any difference. Now for location, left and right this is located. Front and back if I push it, it is located.

And depending on the type of material either I can use super glue or I can use any of the solvents. So often chloroform works best in this. So with this now very conveniently I have objects which are created and which I was looking for. Now if you see you have the bottom it looks like this. This step and then you see this here, we started here. Now let me go back, see here this is the object which I was trying to build actually, see in this.

I started here can you see now, the small mistake I had done was in trying to cut it at a wrong point. So all it would have been you know required was for me to what do you call. We just cut this, I will show you here, which I wanted to do, but I was not able to open both at the same time. See here the bore should have been through like what I have shown here.

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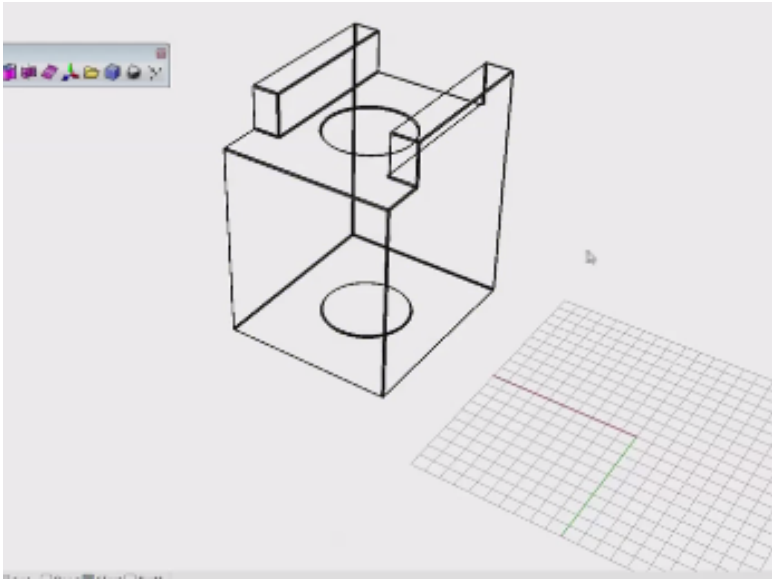

For the purposes of convenience, I have you know hidden all the faces so that you can see the object what it is. Now if I make the bore through this and also make the steps building it will be very, very easy. The easiest object probably knows. One of the easiest object that have been built would have been this. So I just wanted to show you this as what you call way of whenever there are bores which are in the opposite directions or orthogonal directions you need to split the object into parts.

And when splitting also location is very critical. So I have a nice very convenient thing here and I will say it works extremely well. I think that is sufficient. Now what you will notice in this particular case is that several issues are there. First of all, again I was telling you about how to make the build layers. To make build layers you have to take the object and try to slice it. If you have any what do you call 3D modeling software typically solid edge or solid works and so many on the thing or in this case, we have been using McNeel Rhino trial version.

And we have a student licence on that based on that we have been using it and thing is you need to think ahead to see if the object has been built properly. So while it is at this point it is correct now what will happen in case there is one more what you call opening which comes in the other direction. I have one here, two I have managed. Now imagine I have one more which is coming in this direction, what to do now.

So if the job permits it is always possible for us to break it up into small parts alternatively put up with it. I have no choice, just put up with it. So when you put up with it you lose a

little bit of the both the support material and build material, but; however, in principle it is possible to do it. There the rule being actually why I have made this is if the diameter to length is the issue. Typically, flat circular ring like things are there is no problem about the material.

So I have a neat ring image you have this like our bangle or any these things, when it is round if you make it flat you can build it and even if you have to make it here little bit of this material built up you can push it out.