Enclosure Design of Electronics Equipment
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Lecture – 58
Components CAD Physical Models

Please bare with me, allow me to continue from where I had left off yesterday. I had to go back and rework a little on this module which I was trying to show you. So, please have a look at the monitor, see if you remember, I started with something with this little bit of keys.

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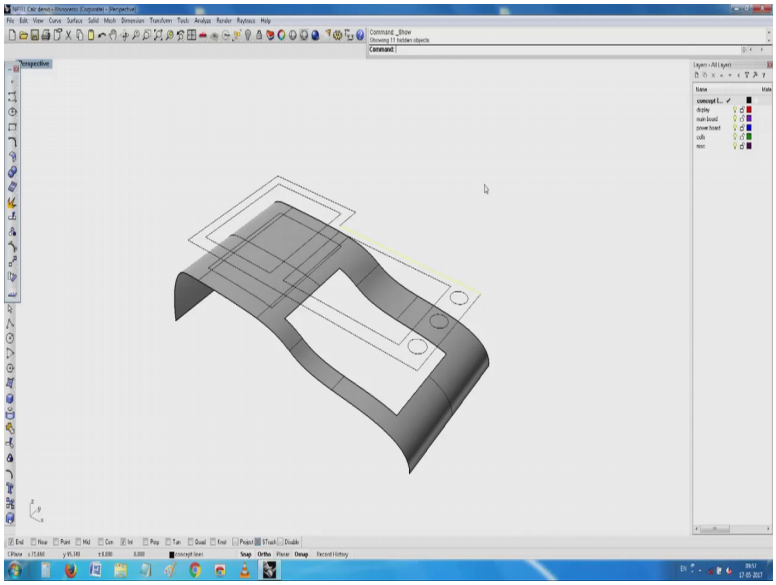

And these things saying can I make sheet metal out of it? Yes and no also; the thing is in general sheet metal, you know behaves slightly different from the way the other things behave. So, what I will do at this point is see if I can now work back and see whether the concept sketches and all these things can be improved upon; if you observe this a little carefully, one of the first things you will notice is I have tried as I have told you earlier, I have tried to start a layout in a plan view and trying to build on various things which I have had outside including all these what you call various types of pictures and hardware items and so on. Today most likely I will be able to show you; how these things will go into an enclosure, you have 2 PCBs, rather 3 PCBs, 1 has a camera.

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And then this is some T I board and this is some other standard thing; how these things will eventually be put into a small enclosure, this is what is the focus of the whole thing which I wanted to do yesterday. So, today, allow me to get back again to this concept of a simple enclosure which I can put it into a PCB can be built around it. So, just let me say; I got carried away a little and then, now I will start fresh here at this point, I will call this a top portion and then I will make one more thing which I will call a bottom portion.

I go back to the concept drawing, go to the top because it is a little easier for me, I have started with a nice simple clean rectangle and I continue to work in the concept layer see in this rectangle, the idea is normally; how are you supposed to put a printed circuit board or various details underneath and then I am not able to work on the fly and make these things demonstrable easily for you. So, instead; what I will do is I will now work with a imaginary; what you call constraint, this is the top and then this let me say; it is a front view. This is where we had started. So, I start with a; this is how my side view is likely to look because of various practical considerations, allow me to play around a little with these things and see I have improved upon the thing which I had started yesterday. So, my side view is likely to look like this.

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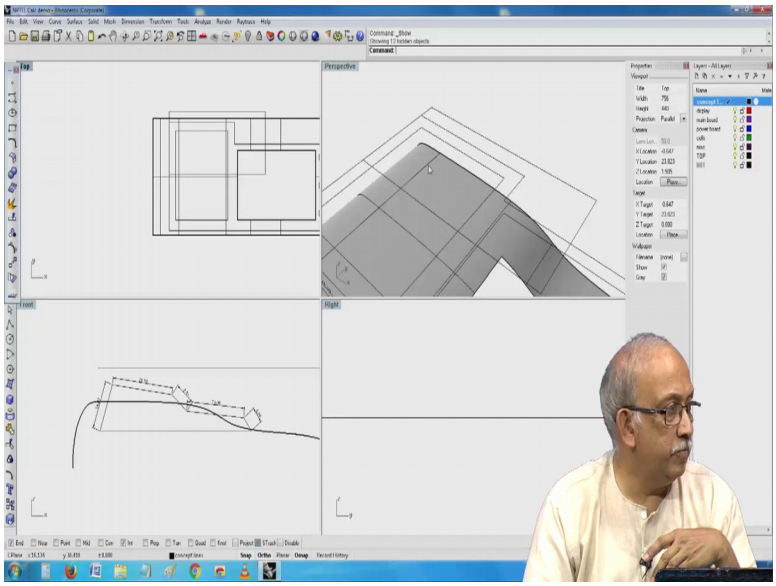

And then I will try to build a small; what you call sheet metal enclosure to seek these things and then see if I can incorporate those devices which I have kept here and then yesterday, I was trying to tell you about in case the dimension does not fit, how to increase or decrease those things and then one more.

I would like to also point out that this is only of the; what you call simpler softwares which we can download off the net and then use it in a trial versions in 25 saves version of it, you see this, I have a profile of this whatever my project is going to look like, this is what I tried to tell you yesterday, saying if I now want to make a sheet metal enclosure, I should develop starting from this long bit of a profile 2 or 3 things; you will notice here. Now if I try to dimension these things. So, kindly what you call just bare with me until things, I have seen this it has come to not. So, what you call integral numbers thing being 2 things are here, if you are working with sheet metal; one is dimensions have to be accurate, then the concept of the bending allowance comes there.

Now, can you incorporate the bending allowance here and make the final drawings has been the thing which I wanted to insist on yesterday, if I go to the other view here, top you have seen this what we want is that outline which I have shown you which high court successfully put it on this and then make into a surface which is easy, you ask me probably it is much much easier than the other things. Now when I go back, I just wanted to show you how to work with this. So, 2 very important or other 2 points to note are this

dimensions should be as per the requirements including; we have a PCB layout here and how those things work on the PCB layout and all that.

Right now in view of the time and all that let me go little fast and second thing is whenever we are working with sheet metal, we need to add the bending allowance and bending allowance again depends on 2 simple factors, one of them is thickness of the material and where the material follows the fabrication, I am sorry, the fabrications just followed to make the bending and this is a little theoretical, a little practical and then they are all you know, it has been tried theory has been applied and then it has been updated and also its so test specimen, we make and all that and something which is quite important to notice is angles are again you have seen this deliberately, oh, it is in a different mode. So, I need to break it and see the internal angle is not 90 it is in fact, a very odd number; some 100 into point something. Similarly here internal angle is something else.

Internal angle is something else again and not a nice convenient integers which we have tried to show you in the earlier lectures and in the workshop itself. Now this is again directly proportional to the angle. So, for 90 degree, normally depending on our materials and all we have some 0.56 millimeters depending on the clamping and the fingers radius and all that. So, if something the angle is what you call; how do you do the bending is less than 90. Let us say the 147 in this case is the amount of bending required that is compared to this straight line is less than 90 in this case. Now the bending allowance you need to add is less.

So, in a flat sheet logically there is no bending allowance. So, it is then when you come to 90 that is the one, it is as you keep increasing the bend that out triangle keeps increasing all the way up to 180, slowly you will notice that the material properties and the way they were; they work change a little. So, it is I would rather say you need to try. So, right now this focus is not on this, it is more about how to make. So, I will just delete all these dimensions and start fresh, how to make the top and bottom covers and the actual formation using this and so on. So, what I will do is in fact, I will remove this top thing only. So, one only useful thing I have this is side view. So, what I need to do at this point is try to join all of them together.

So that I have a nice object here and then just it is a matter of because I am working on the fly see here. So, I have my device which looks a little like that calculator and all those things. So, now, what I will do is I need to decide on how the whole formation is going to be, I said top cover is going to come here then I have a bottom chasse and then I see what best I can do with it. So, I will go a little faster here, looks a little like what I wanted. So, the top looks fine and then it is nothing, but except that it is not a; it is just a collection of lines, their points in space and then whole things have to be joined together now I will see what I can what you call do with it you see here.

This one was if you remember; now I had started with what is called a poly line. So, I have something here which will make; see here I have created 2 surfaces which represent the left and right faces of the object and then one more surface also, I will try to create here, see here, I have the bottom u portion of it. So, for the present, what I will do is I take all these 3 items and then I will go and change the properties here instead of being in the construction line I will make them into the bottom plate.

So, they all come in the bottom if I switch off the bottom they are not visible anymore you have seen this on and off. Now I will do I will try to do the same thing with the top, I will try to continue making a surface, this is a very important surface for me. So, I start with that. Similarly, this is another surface, I start with these 2 things, now when I join these edges, sometimes depending on the type of a program, the precision and the platform on which it works there may be small errors, these errors; they are no problem in a very simple geometric object like this.

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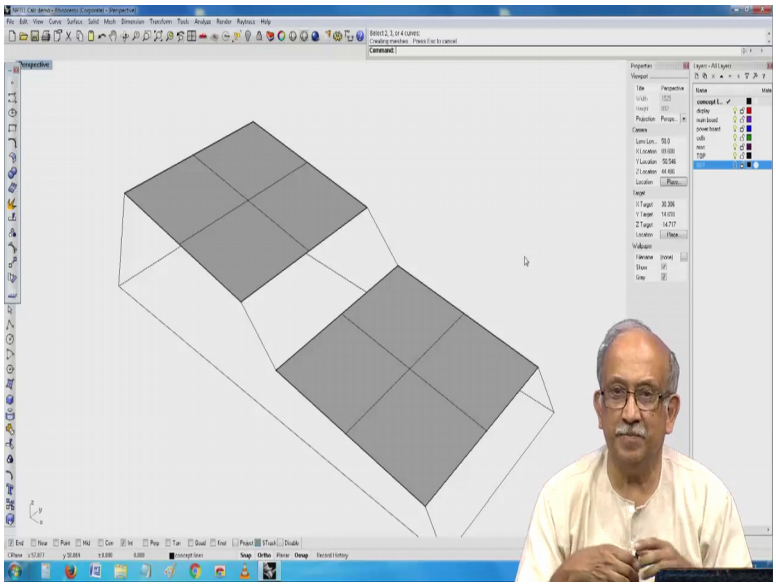

But you have a complicated shape and then when you are trying to print it in 3D, we end up with unstitched or un-welded surfaces these unstitched un-welded surfaces will cause problems. So, to make use of to avoid it, generally this is I have found out there is much better way, already start with things which are known here, if you see; I have a surface edge plus I have the curve also. So, I will stick with the surface edge and then here also I will stick with the other surface edge. Now you see here, this is likely to be a little more true compared to the what you call something which I have started with the lines to continue with it, what I will do is I will go back to the top and then if you remember all these you see here they are still in the construction what you call area. So, I will change them also to the top.

So, now this concept or construct lines I can hide. So, nothing is lost here, I have my essential things which are here. Now this last 2; you see here this and this; I need to attach together in the beginning for the case of convenience, I have shown you saying I have created this using the construction lines here. Now go back on the; what you call and just what I have tried to say a little, I will now delete all these things and see if I use the edges of things which are already created there is a small thing will avoid the error. So, what I will do is I will now try to create the surface using edge curves, I will try to use edge of this.

And edge of this I have it; similarly I have edge of this, I have edge of this, I have it, this and this, yes, this see I have got most of them covered seen this. Now since I have been playing with the thing as before, now when I switch off the bottom I have this beautiful top which is sitting peacefully. Similarly, I can switch off the other one, I have this bottom if you are working with sheet metal and then if you are a little what you call and careful, you probably need not do the whole exercise which I am about to do, but anyway let me see how I can carry it through. I now work with the top, here comes the interesting thing saying for us to look at something which is coming from the top the side; obviously, has to be like this and then the top has to sit on it. So, that on the top, we do not see anything.

Now, I need to somehow make sure that this overlaps here by the thickness, this is where the big decision; we need to make if you want to protect the or optimize the space inside probably, it is much better, you go and build the surface to the outside, you try your best and see what else we can do with it. Alternatively, if you want to make sure that the external size of this; you know should be let us say its decided sign, you should be coat pocket or something in the external size is restricted, then you build the surfaces toward the inside. It is easy to say, but slightly more; how to tell difficult to implement. So, let me try with bottom plate, once you see here, I have this depending on the type of what you say the facilities that are available and so on.

So, I take this bottom portion and then I see; I have been able to make it into a 1 mm thick something here same thing here and here again, you see, I have what looks very much like a 3D solid just ignore the corners for a little while, it is a maybe mistake which I have done or maybe it is something and so on, right. Now just allow me to ignore the corner, I have a beautiful; what I say nice object here, this is probably the reason; no where you rarely will have those things sloping at the 45, I am sorry, at an angle when another surface has to meet. So, generally now even if it is sloping in the last, they will try to bend it a little and make them like this ones, you make it; there is a good reasonable chance of things meeting here.

So, you see here, we have a little problem because this top version, it does not join easily maybe it makes sense, if I try to extrude in the other direction, shall we have a go at it. Now I will see whether I can make a solid by extruding it down, saved, save is it not, it is a beauty. Now this is where we have small advantage. Now if you see the top cover, its

stop angle like this. So, you need to make a small projection. So, that it goes down here, this is where the genuine solid modeling helps and proper solid things help. Now what I will do is I will just see; I will use the standard union and then see whether all these things join together, very good, everything has joined together, oh, I did not join at all Boolean union failed like that; I do not know why the Boolean union failed, I will try one more time, I will see if all these things will be able to; I had selected the wrong objects. There were that construction surfaces which were sitting there, this is the reason why I said we must have a concept or construction I mean what you call layer in which we work now you see very conveniently.

And very you know nicely I have an object here and then if I try to use the render thing, it even looks nice, can you see back and then I see whether under this render properties, I can reduce the background color, oh, I am not able to; I think I will have to work it outside, otherwise, we end up with yeah you put color, was background little this thing, I will now see, no, leave it, excuse me for the little. I should not be playing around, but I have done it. I will just try to see what best I will do it. I will now go out of this and come to the standard wireframe model. Now you see here, slowly, we will see what is best, I can build up these things in reality, sheet metal is nothing like sharp 90 degree bend, if you are to make it chance or it will crack, otherwise there will be a small definite bend only in a very peculiar condition called the fine blanking.

You can come as close as you can elsewhere in mechanical engineering, if you want to avoid that corner. In fact, go out and make a circular opening and then try to push it inside and all that; we will leave it and now I will see about the; what you call very interesting thing called filleting the corners and then by default it shows 1 mm radius and then I said we are very much familiar with this 0.5. So, you see here, see here nicely, something has been built up, see in this here. Similarly on the outside, see nice cute thing has been built up here. Now if I try to go to the inside and try to do this, see try to do as best as within the; what you call I will say ignorance of my settings and all that just try to do as best as possible, but you will notice still there is something hanging around here which is not what I wanted. There is a small problem with the radius in the corner, have you seen this. So, we need to work on this to make sure that in the end, we do not get any surprises relating to this part.

So, what I will do is I will try to although go back to the very beginning of this is probably where I had started seen this recollect what we did and why we came here. Now I will say whether I can marginally improve on these things which I started which was actually a small problem, I should not have done this without considering that the top, when it comes down better be straight. So, I will try to now work on this; try to delete all these unwanted things and seen here; this is where I had started. Now I will try to go back and see if I try to do something to make sure that the bottom portion needs to be a little straight. So, what I will do is I will do the very obvious and simple thing, try to what you call there is a command called you know make it back into individual entities, then move it a little, maybe about that much and then now try to add a line.

If you see this, this will partly take care of the problem which we had faced there and why I came back here is we will come down to the next position saying while the bottom is convenient to build and we wanted the top to be kept on top of it. So, I will say that several ways, how this can be done. One of the easiest ways will be; obviously, make this whole thing into a single entity called a poly line, I will join all of them, this has become a poly line and now try to offset it to the thickness; what we wanted which is typically I will make it 2 mm, oh, I pressed a wrong key, it shows that see here. Now I need to take that important decision at that points saying which part will pay the top cover, which part will be the bottom cover and then where do I stop. So, I now try to see this is; obviously, not very useful for me. This bottom portion is not useful. So, I will sort of check it by removing it now if I look a little form the side.

See this is how most likely my that object which I was talking about would look like; see here interesting for me. So, all I need to do is if I want to make the top cover, I just I call this tough, this part of it is a top cover as I was telling you earlier and then I now try to transfer all these to the top and this will remain as the now I switch it off this is the bottom and I have the profile and then elsewhere. Now I have shown you how to build that small you know thickness and so on and then added to that here; you here, I have a nice straight portion here, this straight portion will help me build that radius properly in the bottom, well, I will not call it a trial and error, I call it experience, take a little interest in it and then I have told you before; now you have to plan play around and then finally, know, I am sorry, you have to start plan, you have to play around a lot and finally, in the end, now the last execution will be that you make these drawings which work a lot.

So, again coming back to the old approach, now which comes, first you need to be little familiar with the operations that they carry out in the fabrication shop and then try to see the type of representation they would like. So, that you make these drawings. So, that earlier that over the wall or way of saying there are standard way of making something and then eventually it gets made is disturbed now. So, coming back, I will now go a little faster this again I will convert it into a what you call a whole.

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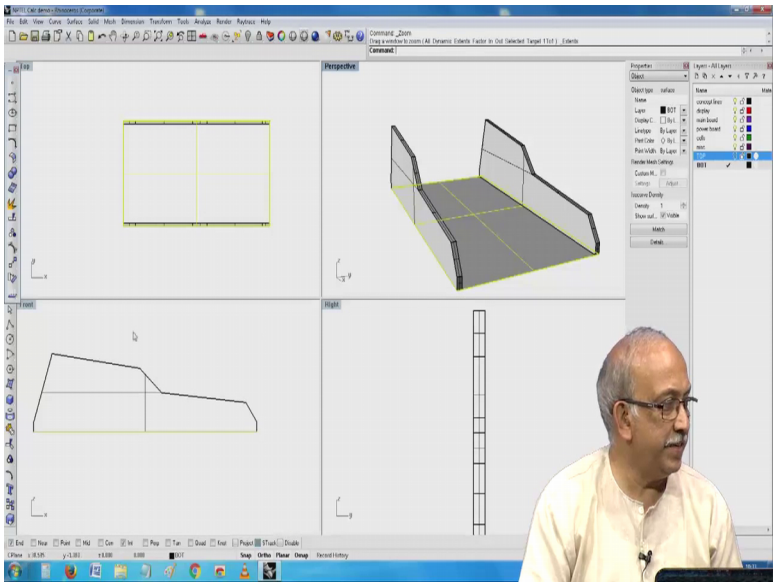

And then try to make a solid out of this, seen this I have a beautiful solid here, I still have the curve there I copy the curve. So, that it looks a little like what I wanted, one more time is this curve to make a solid see here I have using that features which I have built there I have tried to make it now I need to complete the bottom part of it. So, I use 2 of the features which see bottom plate has been attached to this.

Now I will see, if I can extrude it up again and see whether, I am slightly better off definitely I have something here and then I Boolean the whole thing that is make it into a single object, hey, why did it fail, it has finally become a single object seen this. Now I see depending on that various thicknesses and all that I have intentionally chosen 1 mm thick sheet, generally it will be little thinner the top one was 2 mm, but this is only 1 mm to see; how well we can do it. Now I will see whether I can do the; in this solid the filleting, the edge I have a 0.5 plate, there try to do still I have a little problem there maybe see there I have this. Now I will see what to do with the external surface I add

that 1.5 mm thick, oh, sorry I am not able to make out what could be the problem, I will now try maybe 1 mm filleted edge no still fails, I think probably I will have to work out better on this and get back. So, please bare with me and then I will see what best I can do, but meanwhile let me go back and show you.

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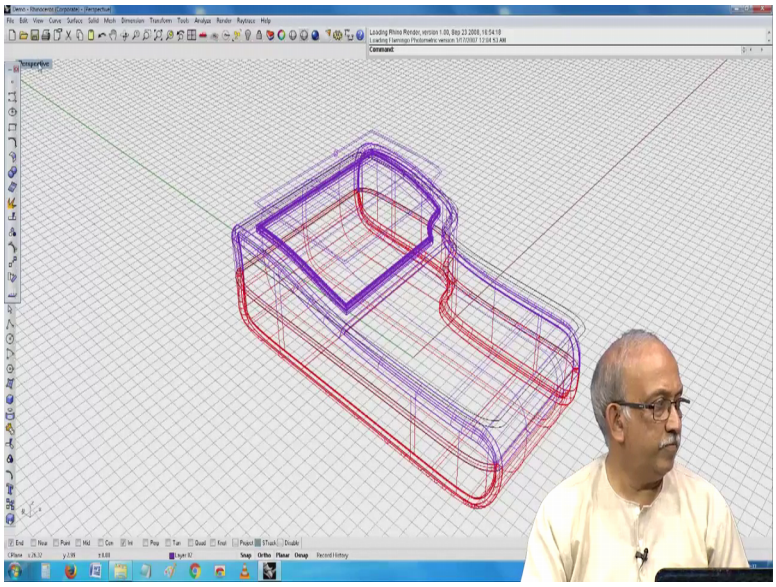

Next what you call level of our working is going to talk about; how to do the organic objects using several shell commands and so on.

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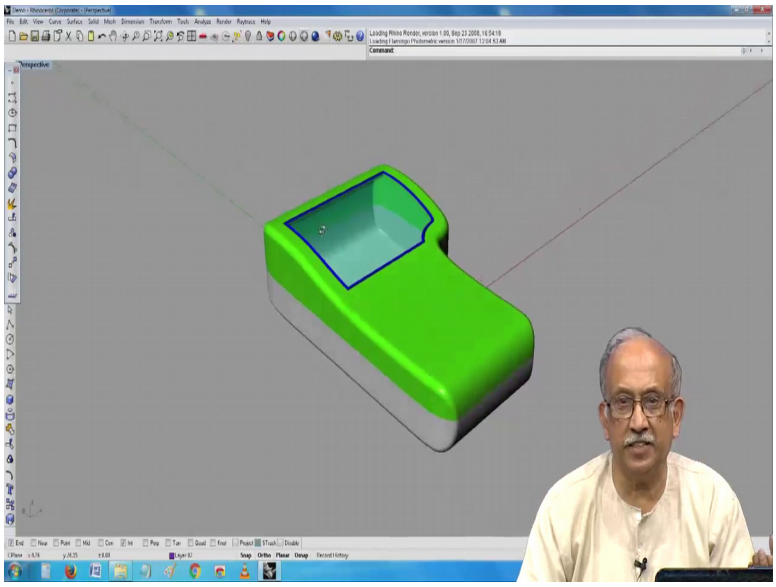

So, we have a top cover here and then as I said we played around with this and all that it is very much possible for us to create this objects without too much of a problem and then attach all the various devices and all which we have inside, I have a little problem with the trying to show you with the what you call resources, I have on my desktop, it seems to work well, here I am not able to show you; how well it is and the issue being that it is possible for us to work with the starting point that is what you call; we have a constructioner concept lines and then try to create a solid using various digital sculpting techniques and then try to make parts out of it. The beauty is now if you have to take a part like this, you can very easily create if you were to mount a display or a printed circuit board or anything, you can now attach small buses which nicely go and sit on top of this which have that screw which if you remember, I took it from here you remember this small screw which I got from.

So, we see here that things which have been created elsewhere I can export them import them there and only once in my; what you call professional career, probably I need to make these things, hope, I think I need to introduced them later on, yeah. Now I cannot get it here, it is very easy for us to actually get them online. So, this is like when you make the Fasciner; obviously, the Fasciner also requires the other part of it, it usually 3 or 4 of them; 1 of them is the device usually which will loosely say screw and screws also. So, many variants are there, one of them is pitch and all that; another is the type of it we want. So, if you want the head to be flesh and all that there is some detail about it, saying it could be conical or in cases like this we try to generally make them such that use a cheese head screw.

Because conical screws have some issues about alignment and so on and then for that we need called a counter bore all that detail if you carry, we can always carry it and put it in this and then complete your job in a very simple and convenient way and then this can eventually be passed onto rapid prototyping condition.

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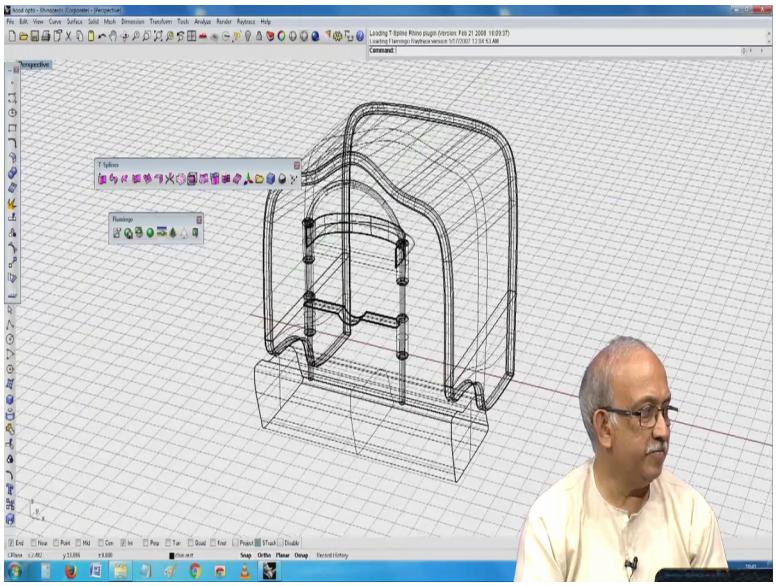

I would know if it looks obvious you know; what it could be, this actually was made as a optical or something made for an ophthalmology thing. So, if I hide this small wood you will notice that you would have seen this, this is a chin rest here you have a chin rest.

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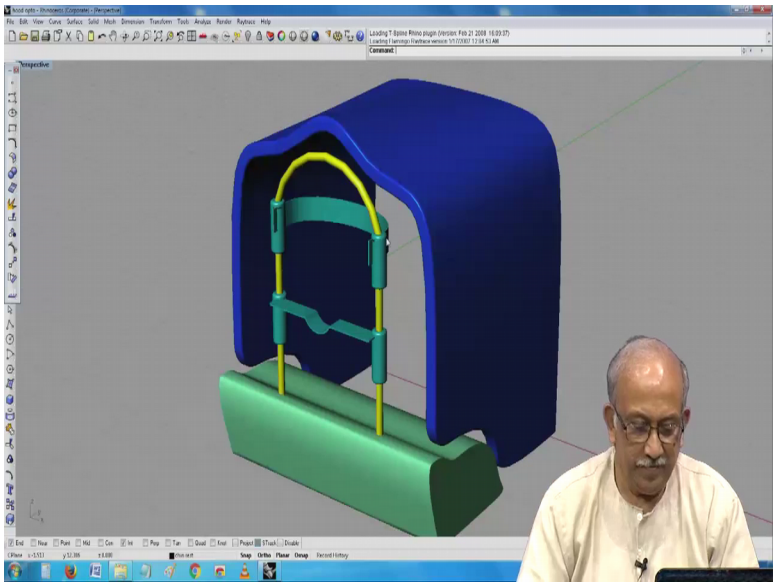

And then here, you have a; what you call a hard device to see that you know your eye is in the plane in which the sensor can focus it. So, this whole thing is a little mechanical and little electronic about it and part of this for example, this chin rest and all have an

approved from various safety standards and all that are available on the in the shops, it is only for us to make sure that we fit all the other things.

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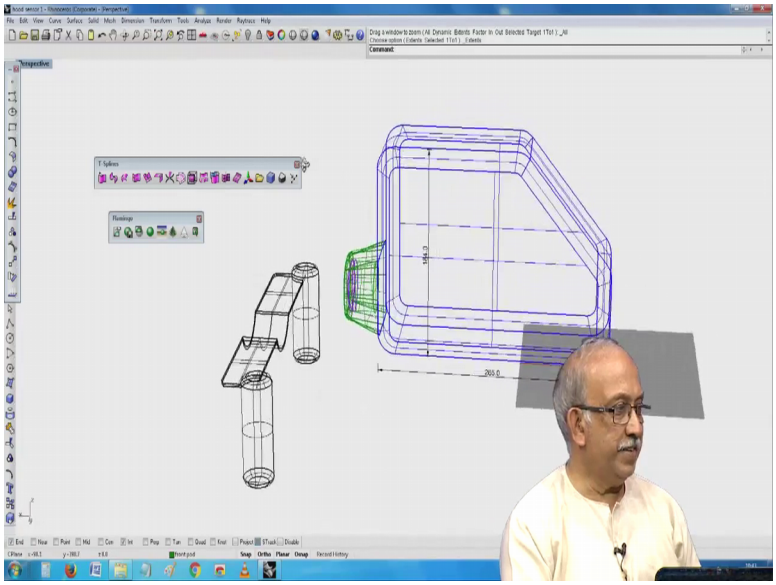

This is made with a special material. It is a type of a firm core stuff, you see here; the core of it here is this whole thing was conceived built and this of course, the prototype, the advanced version of it is in production, see here I have a lens here, you can see; there is a lens here.

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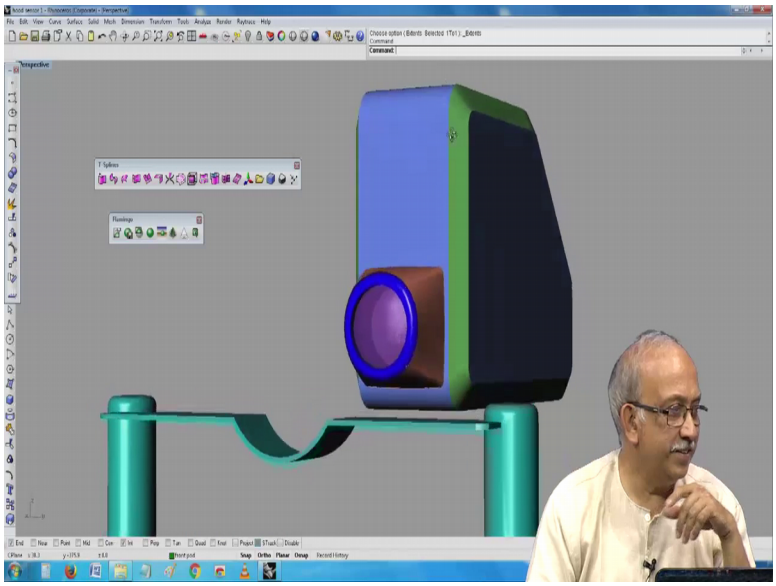

And then there is something else here and for convenience I have shown it here actually this will be a little over and that whole thing will be higher. So, that it will be I and then you have a left and right motion and typically these things; this is a combination of this alignment and mechanical, there is a combination of a optical devices inside and their sensors and their something which stores and in this case. Now probably it transmits retina pictures directly to a remote doctor, it does not have any visible wires or anything.

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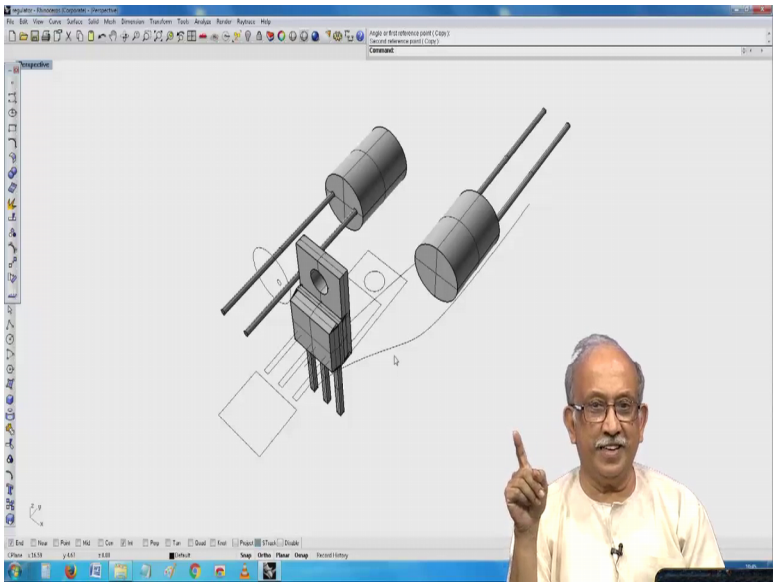

So, part of it is in production I thought you will probably appreciate that all these things invariably depend on remember this which I was trying to showed you earlier, the 3 pin regulator typically your 7805 or 7905 or 7906 and these are all some; I will say some components loosely, I will use the word components why I thought, I will show you here is you need to build up a library of these devices.

And now, we have this; let us say, we need to put this on a heat sink for convenience it is shown flat, but a real heat sink will probably have them like this. Now 2 other things you will notice; one of them is as I have told you earlier certain hardware and certain things which are more related to the packaging have to be fixed of front. So, one of them is the is heat dissipaters, you will end up with this, if you put them somewhere in the middle of the printed circuit board and you want to push them to one corner, we end up with a very peculiar issue instead from the bread board which I have showed, you have a display, you have this and you have also these serious mass of an heat generating elements not all

of the things have become very small and all reality is still there is you know power being dissipated, there is what you call you need to do something about it, I will just see what best I can show you with this, but then you see at the back this whole thing has been constructed using the outline that has been given in the catalog. So, I will just keep this alone on remove all other things see.

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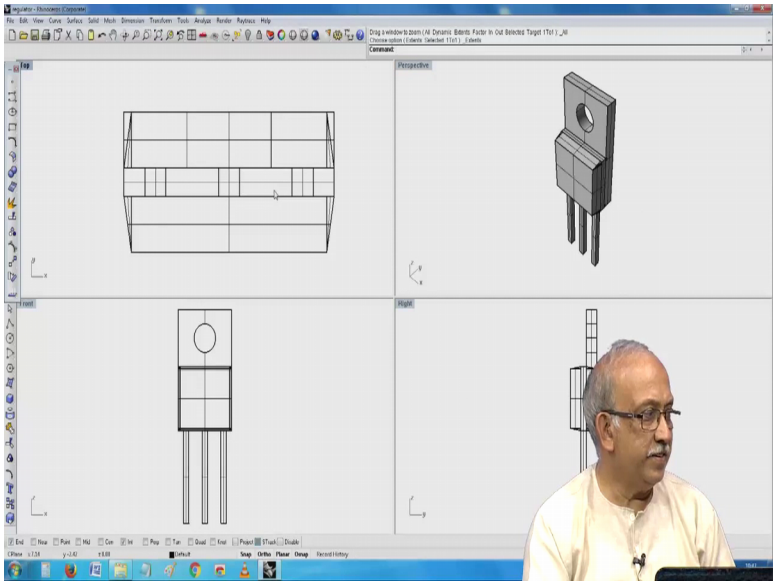

See I have 4 of these devices, do not ask me why, they are now; it is for me to pass on this information to the; what you call designer. Again to avoid that word pass on because it looks like over the wall work with the electronic design people to see, how best we can make a; what you call heat sink and so on. So, if I now go to this plan view, here very easy for me to make see here this is intentional see I have something which is repetitive. So, it is possible for me now to split this object.

See this, I have got one of those fins separately. Now it is possible for me out of convenience say I just copy and paste them, you see here, part of my heat sink is slowly getting ready, this is where cad business helps, if I have some idea, how I would like to make these; what you call various hardware now you see all I need to do is see if I can this looks a little like a symmetrical object.

See in this; I have a nice device which is a heat spreader. So, I will now complete this thing with; so, here what looks like a cute heat sink is steady that is a small error there, but right.

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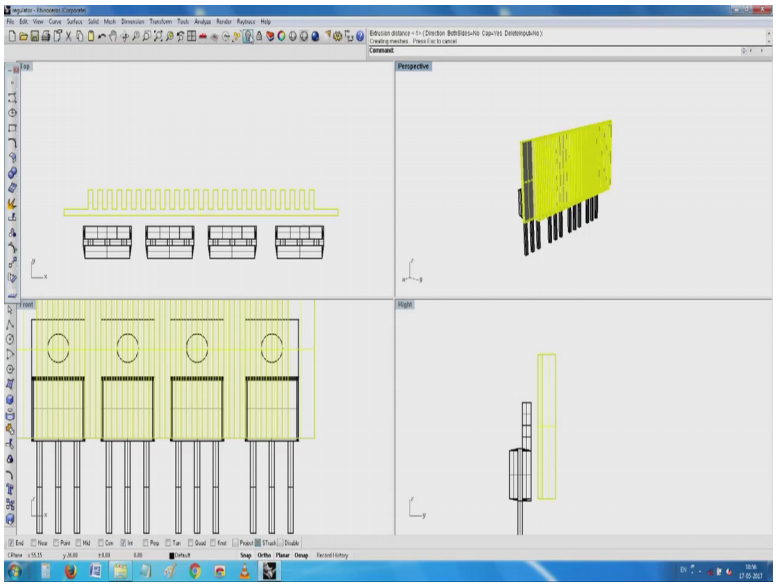

Now, I will ignore it because of this small joining because I have put the mirroring now thing is this whole thing. Now it is very easy for me to you have seen this. Now I have got a relatively nice a cute object it slightly. Now the symmetry has been lost, but kindly yeah, I could retain the symmetry.

Now the moment I have this, it is easy; very easy for me to go ahead and another view something here which I am proud of it without too much of a do I could demonstrate for you. Now the other thing only comes is mounting hardware and all has not been shown yet, it is very easy for me, now if I go back to the original this thing; some of them are only mounted directly by a clip, some of them have an opening and you need to assemble it, I have seen even some occasions where it has been; what you call assemble with a top and now I have this; what you call a beautiful heat sink assembly and then it is very easy for me to now construct what you call an enclosure or something and then trying to see how I can make an opening.

In this case, it is very easy for me, I need to make one more block do a; what you call 3D Boolean operation on a solid remove some material and then push it on top of it. Once I do it I have the mechanical parts of it is ready, one of them I have a heat bridge then I have this heat spreader outside, we can do whatever we want with it. Occasionally they are also wanted inside and in case you need to have what you call first air cooling and all that all the hardware is available now at this point allow me to sort of you know come to

a simple conclusion saying a conclusion is you must do it yourself unless you try it as you said all this know, I have a slightly bigger machine and which now we able to do a little faster on this small laptop here I am not able to its not able to handle this things otherwise if you build this large set of things

For example, if you see here the small series pass regulator or it could be any of those things there are standard packages for which detail is available. Secondly, related to that I have you know made that small fin and all at the back here these are almost generic and you can build a library of these things. So, all known heat sinks and all you can make a library about it and if you want any modification on that. So, if I show you I will see if I can show you here do we really need something sticking out here like this or would you need something little extra here. Now it is, then how do I mount these things have a heat sink, how do I go about mounting this heat sink, you have seen here, it looks a little what you call monotonous and so on very easy all I have to make is, I have to make for openings here. So, that it is can be mounted on a; what you call on an enclosure and if I want to mount those devices, here I have to make small openings, I have to now make a pitch such that that opening exactly comes here.

So, one of the simple ways is to measure this; if I measure this you see that it typically a 1 mm opening. So, if I have some screw which typically has about those proportions. So, if I take an M 3 screw, M 3 screw typically if you take the pitch and all those things you need to drill I think; 2.5 millimeter hole. So, it is possible for me to make an opening here, a little bit of that tapping touches this and then I make a screw and then on this, this point here depending on if the screw were to be bigger and if I wanted here I can probably make a opening here, I will just again once again on the fly, I will try to say what best I can make here, you see here I have this small which in this case maybe I should call it a tool which I can make the necessary openings on this here.

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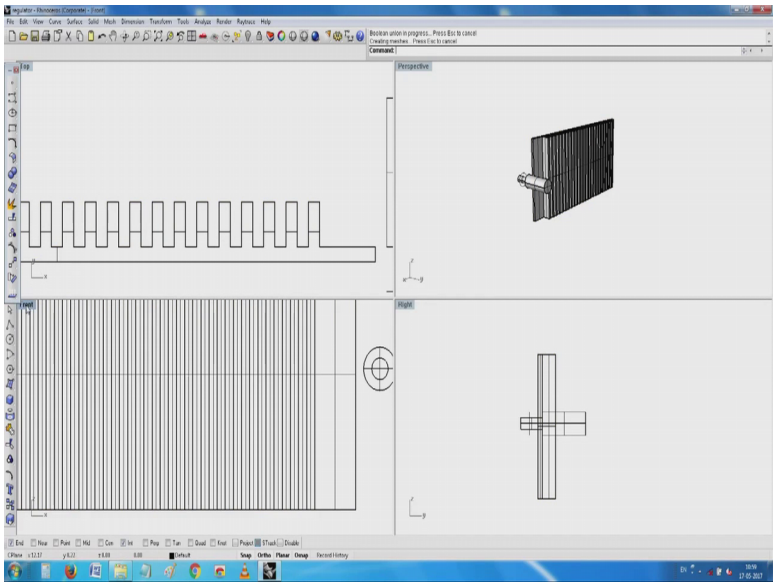

There is no rule saying they need to symmetric or asymmetric all I need to do is if I want them symmetric and then depending where I want them, I have start with something here and then I try to mirror this object, see here I need up with 2 of these things, see I have placed for 4 of these fascining devices part of it is for some reason, I can explain to later. I have openings in here which the devices need to be mounted or in this case if you are talking about those transistor like devices maybe I will concentrate on that I will remove this I will go here I copy more and more of them logically I should have aligned them with the transistors they are at the back.

So, I go about doing the Boolean difference, select this first set and select each of these and you see I hope it will work miraculously the way oh no bad luck oh for some reason the Boolean I think my sequence of operations are wrong, if I do it its possible for me to now make this whole thing with all the openings and all in that place now, but this is actually a part of solid modeling and then I need to do it in a different way, I will try to work on it I do not know why it refuses to yeah, oh, I got it, it is ended up with a peculiar opening which has probably cause the problem see here that is a problem. So, the thing is if you now try to you know extend this and so on that was not a properly completed solid which created the problem here I will see very quickly. So, that I will see if this behaves slightly better with may this time my what you call apologies I think it is not able to calculate the apologies I will leave it I will come back and work with it. So, I will stop

here, I just wanted to show you that starting from the outside concept and the space and then going to the inside, how we can get back to the proper thing.

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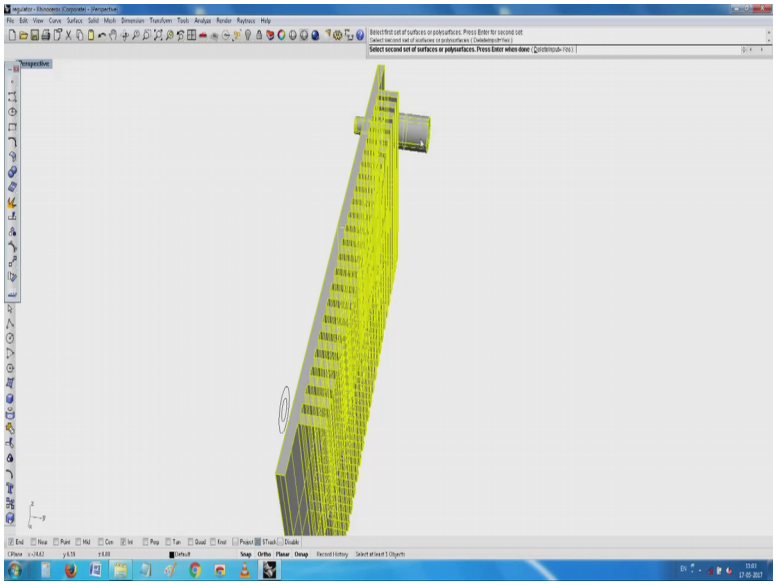

And eventually you will have products which have all the mechanical hardware related to, if you remember the basic displays, the connectors and so on and then also some things related to the heat dissipating components and so on. This is a limitation of this package and the machine, what we have here; it is easy for us to make these things. So, next time when I; when we meet next, I will try to make it, but the focus being that you must have a plan in mind, how you want to proceed with it and then preferably all the dimensions everything have to be marked and you should have the things either written down or in case, you are more familiar with these packages you can have these things here and then you will have lot of peace of mind that is all I can say, I think, I will stop here. So, thank you until we come back here.

Thank you.