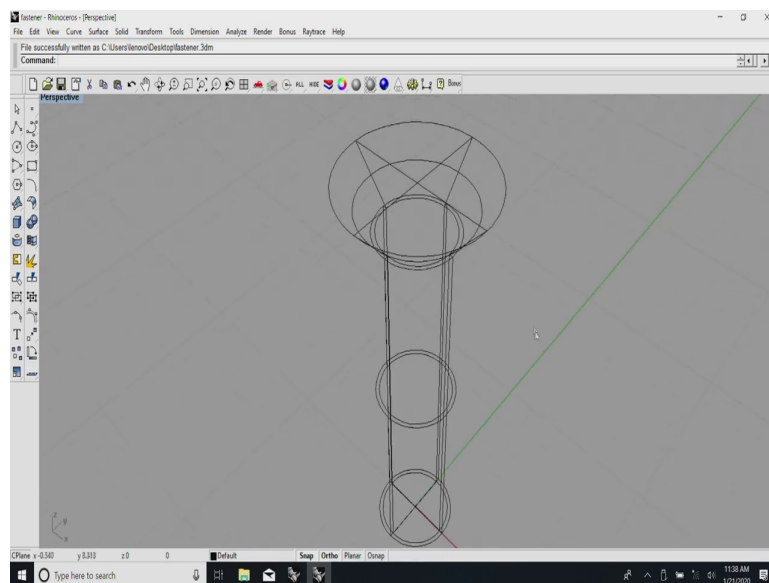


**Electronics Equipment Integration and Prototype Building**  
**Dr. N. V. Chalapathi Rao**  
**Department of Electronic Systems Engineering**  
**Indian Institute of Science, Bengaluru**

**Lecture – 36**  
**Fastener representation, detailing**

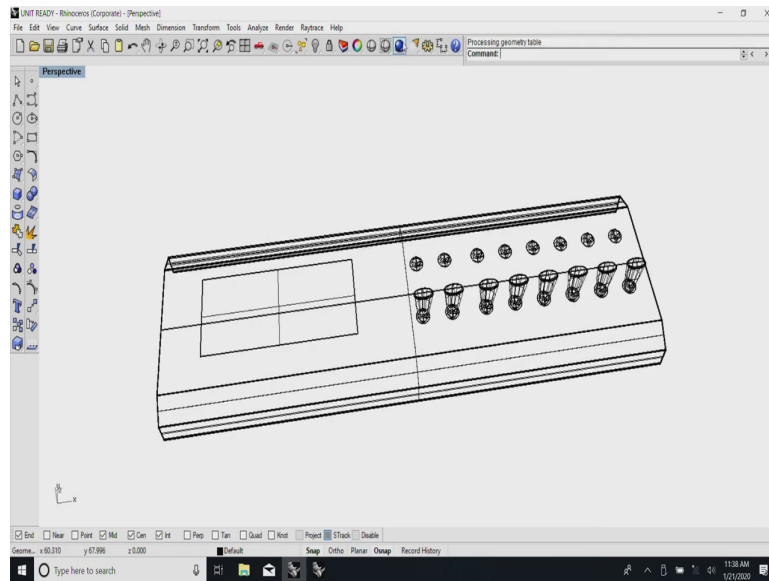
I am continuing on the theme of how to make solid models which are useful for laying out equipment. I have covered a little bit of about how to make a small electro mechanical item.

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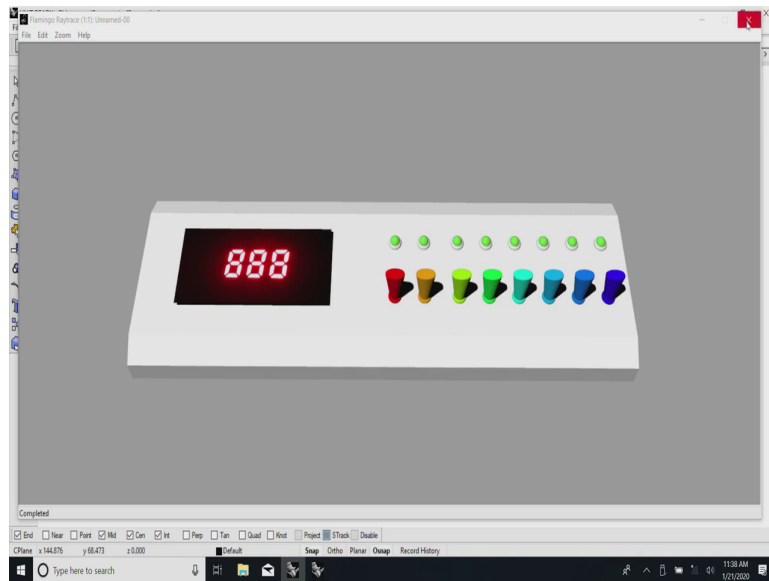
So, typically the simplest thing you can think of is probably in the switch.

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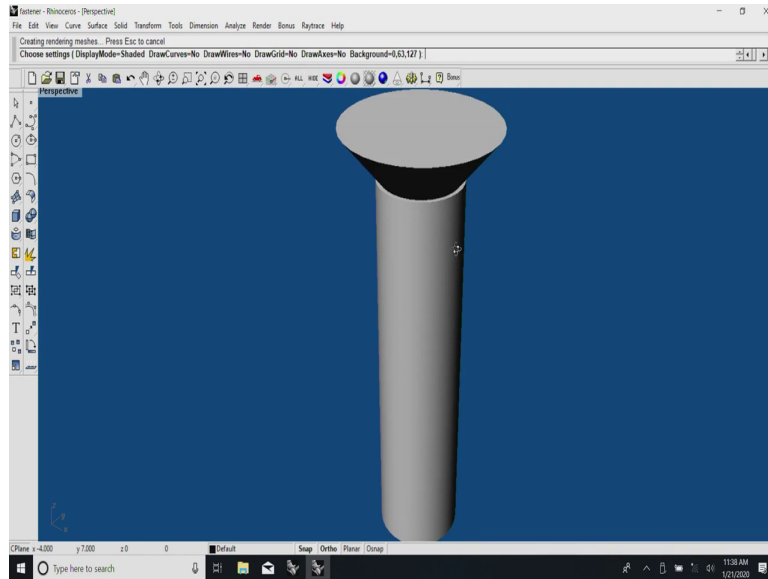


So, if you come to this you remember this and then I also told you if I now make a proper switch and I can make it generic by giving it different colors and so on and then I can reposition it various places.

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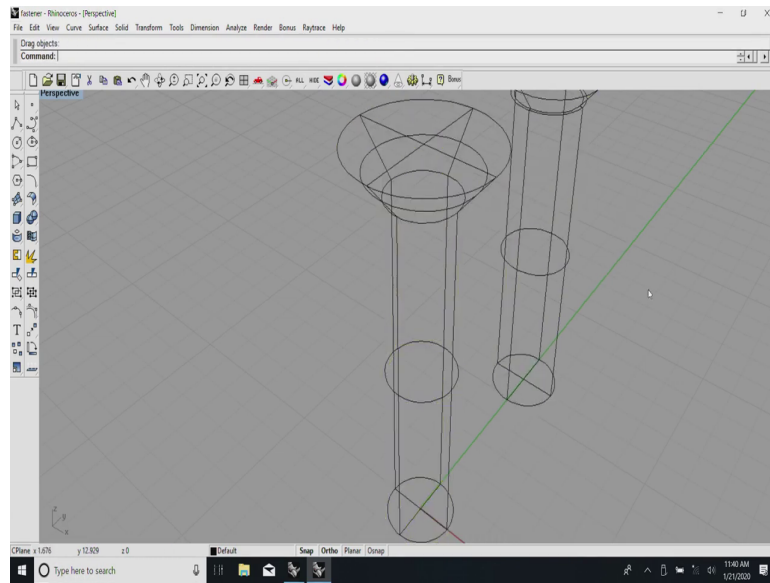
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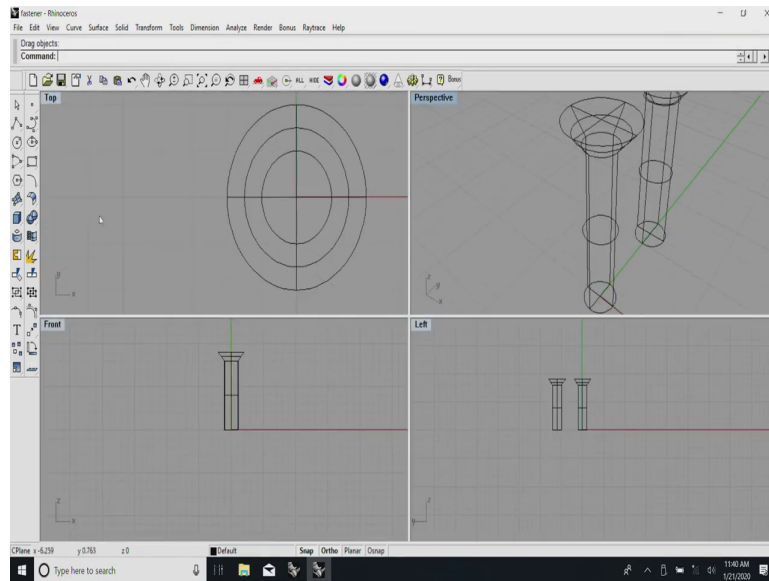
Now, imagine this requires to be having an enclosure at the back. Now, at this point, we definitely require to make fasteners to put it together. So, have made a generic fasteners and previous lecture if you remember I had covered a little about the type of screw heads, the type of various types of other fasteners. I will now just talk about one single item saying how do I attach two simple sheets and try to make several types of openings in them. The basic sheets are there are two sheets put on top of the other and in the case of usually our enclosures usually there will be a small lip at the bottom and something overlapping here and we have fasteners which are fixed there.

And this fasteners which if I remember I told you if you couple it along with the drilling detail a few other issues are involved in it and why do we need to learn because these are the ones that will create surprises. And as a designer if you are familiar with the why this is done its very very easy for you. So, let me start with one of such things here. So, please look at my this thing here. This is as I said it is a very generic fastener. Now I will hide this eh.

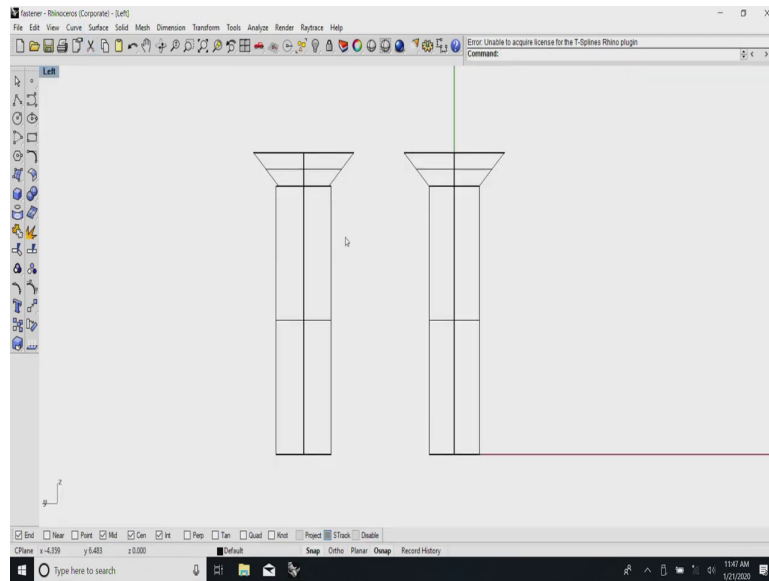
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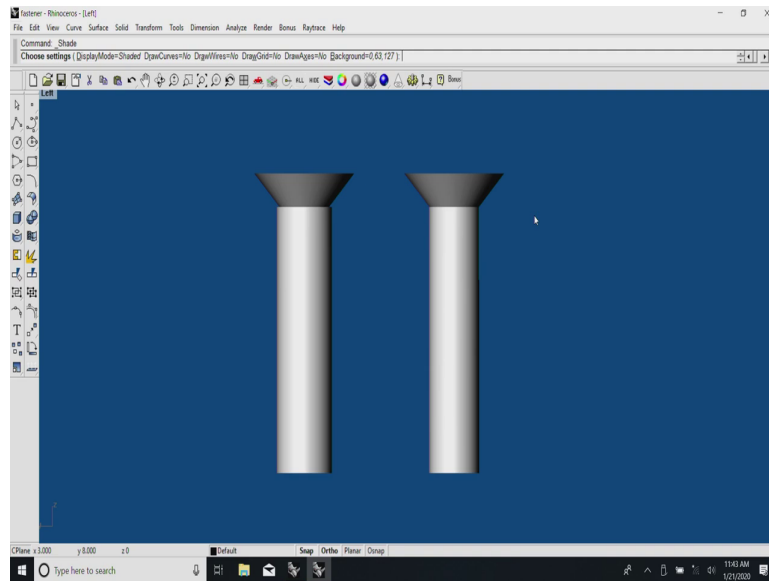


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You see here I have distinctly two objects which I have created. One of these objects is you will see two of them here.

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So, I will just give a both of them they represent two things this one, the right side one is an actual fastener meaning there is a small cylindrical part which is the one that you know passes through something and then the top there is the head portion of it and in the previous lecture I have covered saying there are very large number of these the heads which can be what you call which can be used. So, intentionally this has made such that it is made in a generic portion. I can remove this head and put something else.

So, first time by looking at the catalogue I need to create a cylinder of this specified diameter and I need to create something which is as per the norms that were given. In the case of our metric usually if this is the what you call diameter, this will also be nominally about the same diameter. In this case it this is slightly different I have again and then the most important thing is in the case of this tapered or counters and head the angle and this is very very important.

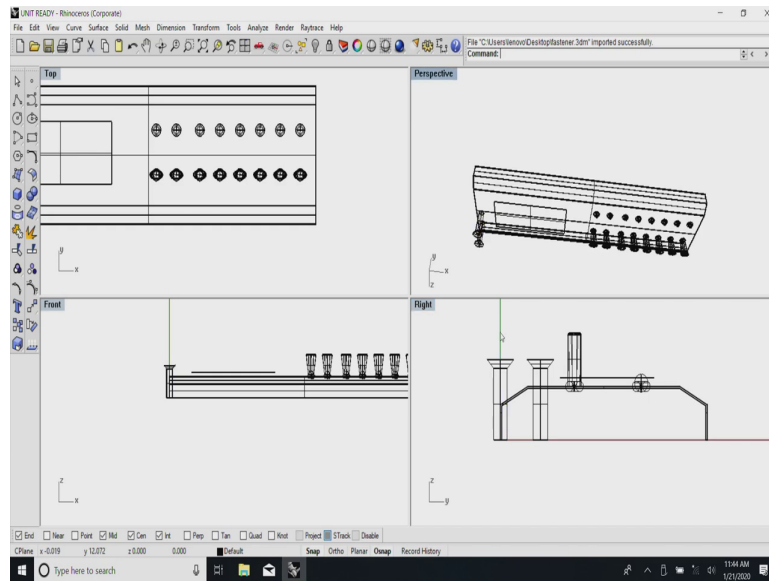


Here in the case of our professional thing you will come to other important thing. One of the important things being that most drill bits are not 90 degrees depending on the way the machining operation are done, they vary between 110 to 115 degrees depending on the basic material and so on.

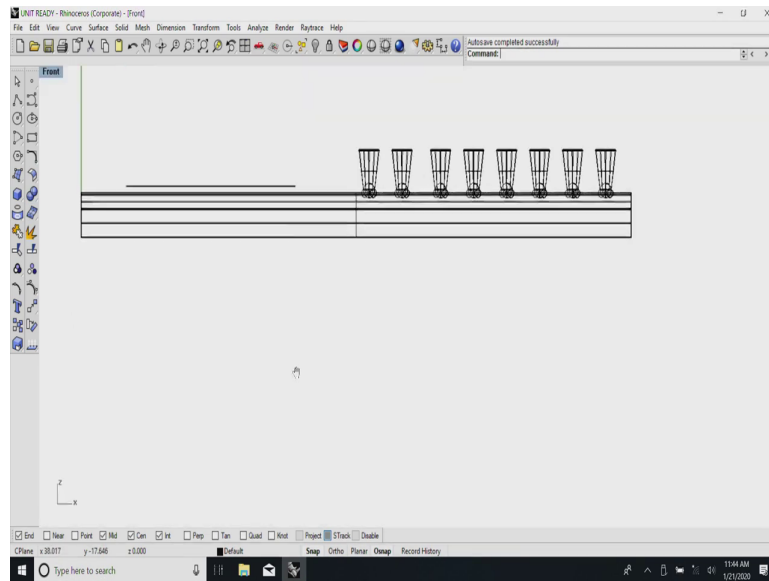
So, you once you specify that this has to be 90 degrees, the process planner will know that all the countersunk they have to make things properly. And one more thing I also have told you about saying the problem with counter sunk is it locates itself almost absolutely.

So, having two counter sunk fasteners and having two fixed nuts usually there is no adjustment possible and even a small variation typically in the sheet metal it is up to outer of 0.2 0.3 mm variation is likely to clear a serious issue. So, in all those cases wherever it is permissible they will not use a countersunk fastener. However, if you want to use a countersunk fastener I will show you how the thing is done and all that in another thing. Now, let me get back to I will now save this yes and now go back to this you will see here.

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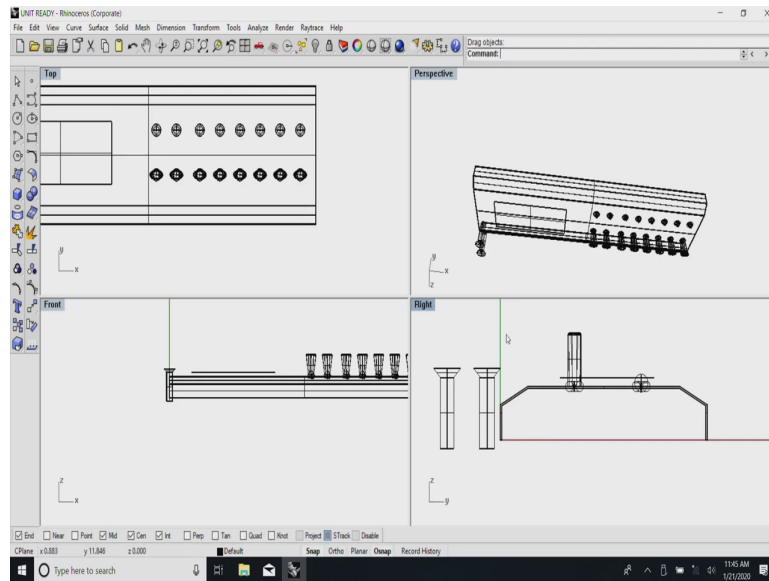


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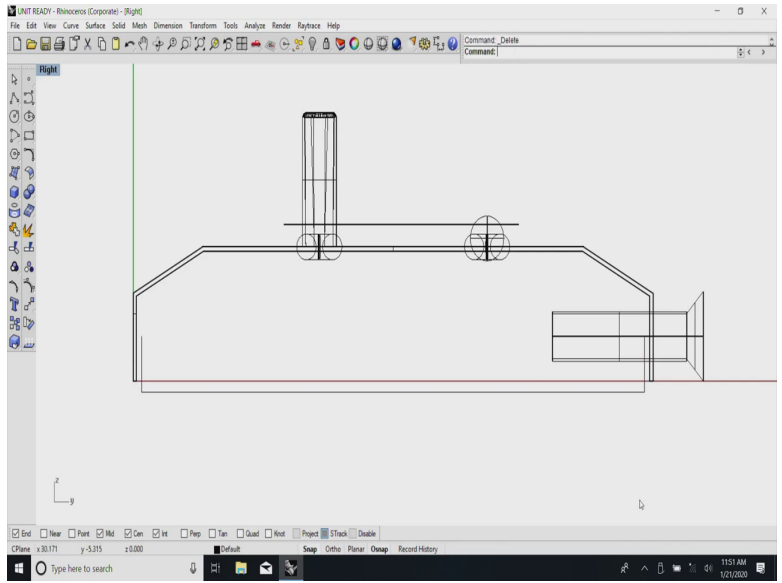


Now, if I want to let us say fix it somewhere all I need to do is import that piece saying there is an input provision here and see where is it sitting? At this point I can now do various operations like move this both of them out here and orient them properly.

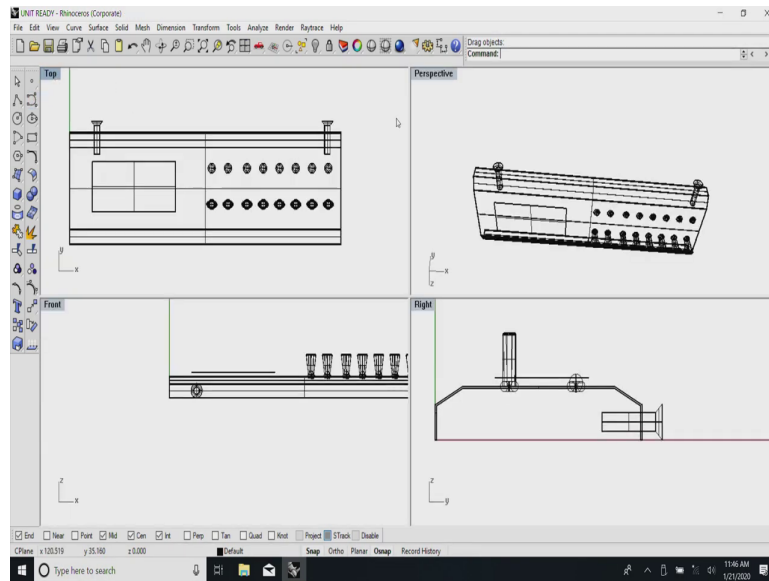
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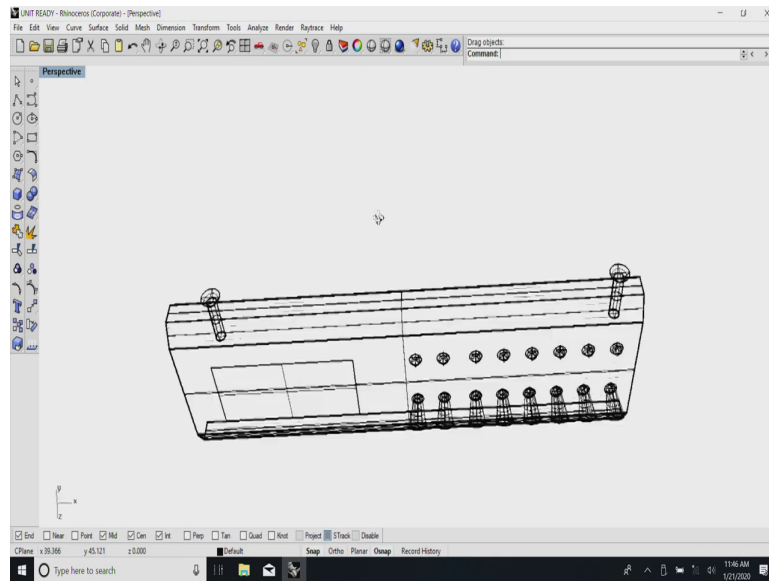


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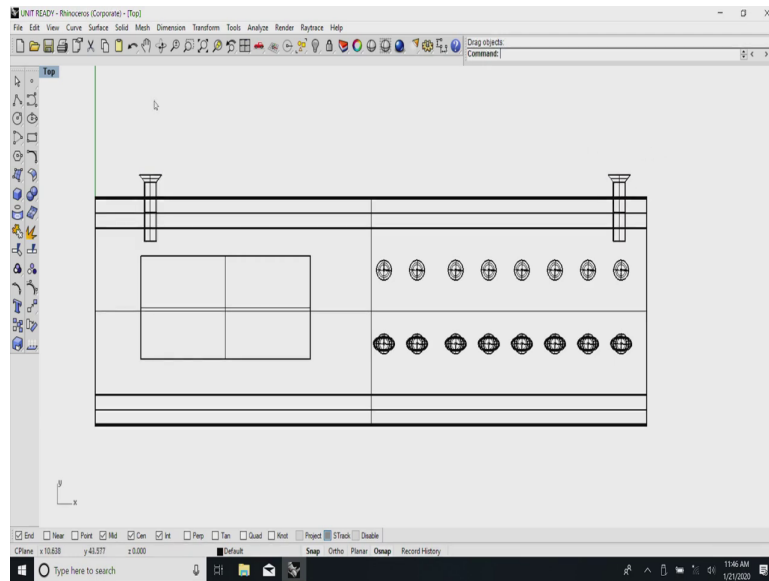
See here, we have I have created something which is at one level quite useful. Let us say it needs to be fixed to another chassis.

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Now, comes the interesting point in this. I will just make it in what you call little faster. It is customary to have the minimum amount of fastener.

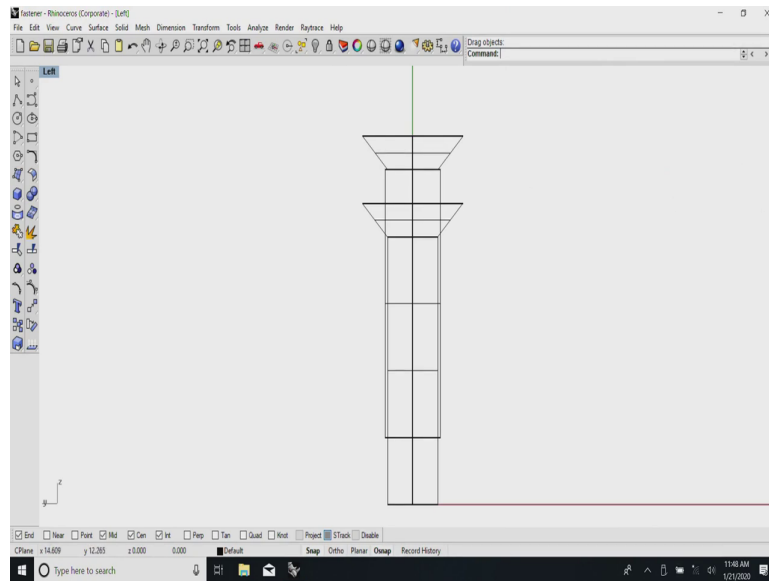
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So, I keep one here keep one here. Now comes the small I will say trick or whatever it is. You will notice that I have two perfect solids and if you examine the solid again, I will just open it on the other side again I go here and open this separately.



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One of the things you will notice is there are two portions in this you will notice that this one is a little bigger than the other one, the inside one is a little bigger than the other one the outside cylinder represents the hole that we need to drill.

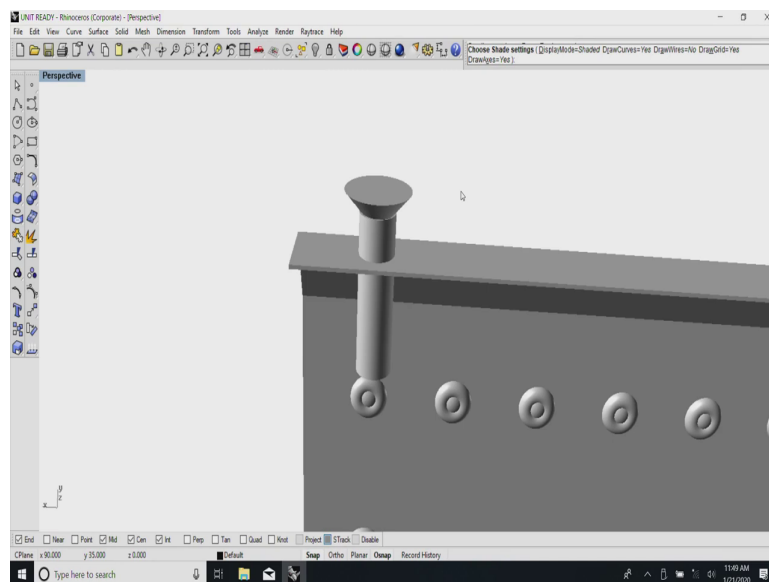
So, while making this fastener in this case know just to show you I have just like that I have made something bigger, but we need to make a particular thing depending on the size of hole I have told you. In the case two items have to be located it is customary for us to make one of the items I mean one of the fixing holes a little small. So, in the case of m 3 customarily 3.2 mm is used, the other is made a little bigger.

Customer again 3.5 is used. So, in one corner if it fixed making all the dimensions from there will be convenient and usually it fits well. Now comes the whole thing saying in the case of our manufacturing can we have so many types of openings that are required that is where it is a

question of what you call your practice. Me being trained under an old doi (Refer Time: 08:57) system, I am all for being perfect. I am all for making 3.2 holes in every corner and having 3.5 mm holes elsewhere.

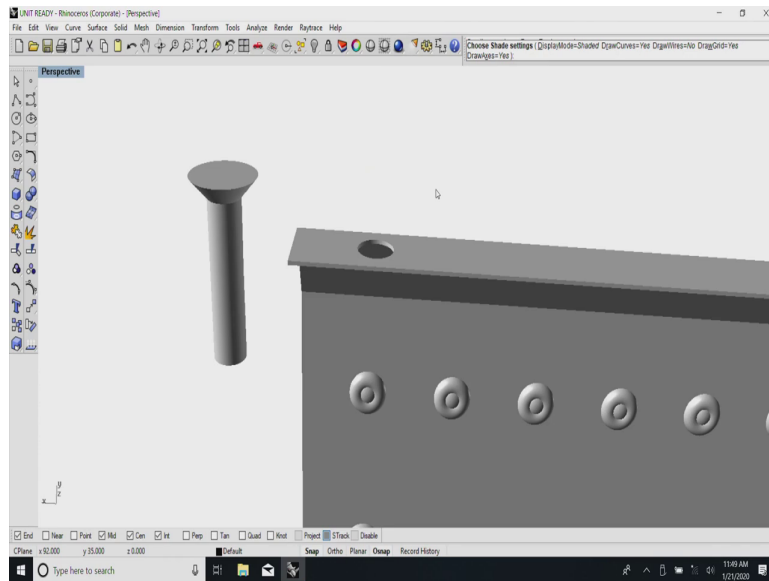
But its been off let it is being very you know sort of common that generally they will probably make all 3 and a half 3.5 millimeter of holes and generally something else somewhere else will locate all these things firmly. So, I will just show you the saying this outer one this one represents the hole and this one represents the what you call the actual fastener. So, at this point I will close this drawing and open this back right.

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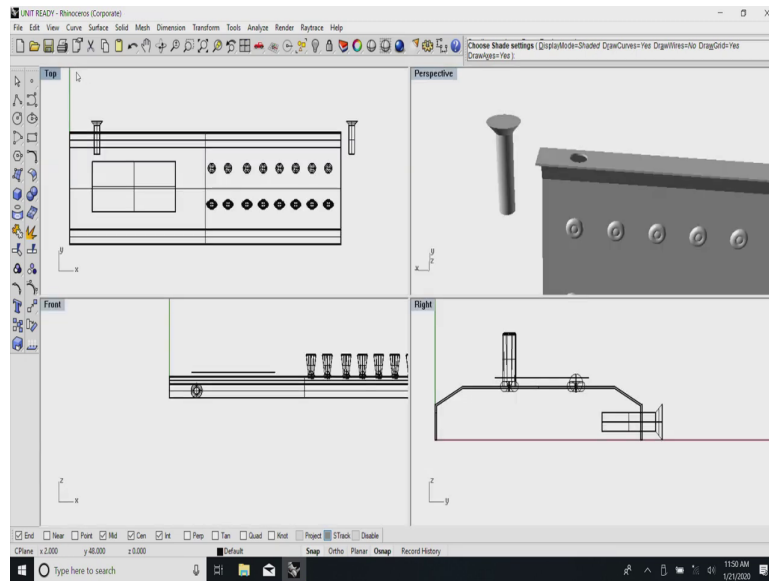
Now, if you see if I rotate it on the other side, first thing you will notice it is just a sheet. Now comes the important point. Now what I do is I take the outermost in the sheet.

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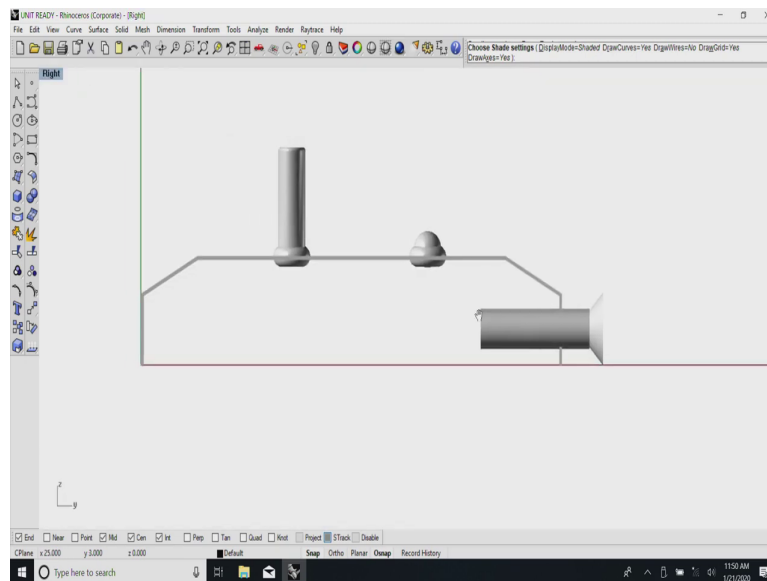


I have an opening, you have seen here thrilled. I am thrilled at least extremely thrilled.

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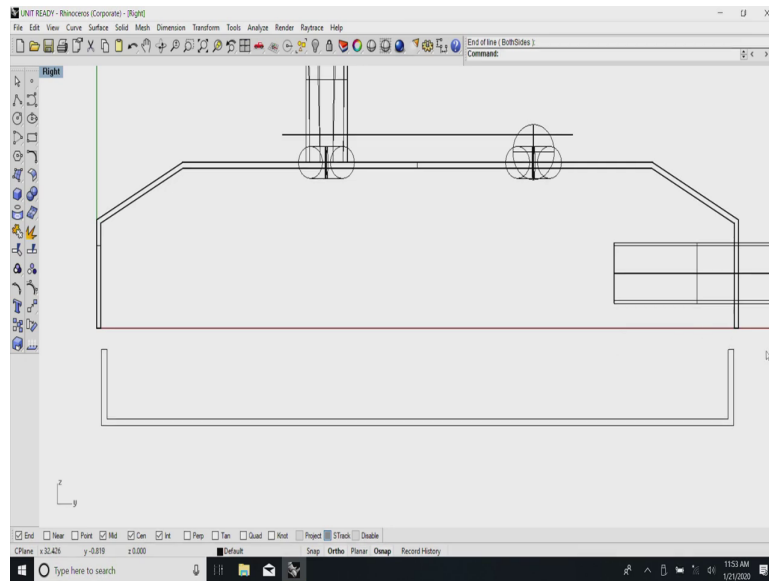
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Now comes the point if let us say I had made a nice unit including what you call a bottom cover and all that this fastener I can just introduce it do the Boolean operation and I have the nice set ready for me to get everything ready. Just to make it a little more interesting, I will now see if I can create they I have a line which I expect which sits here. Can you see?

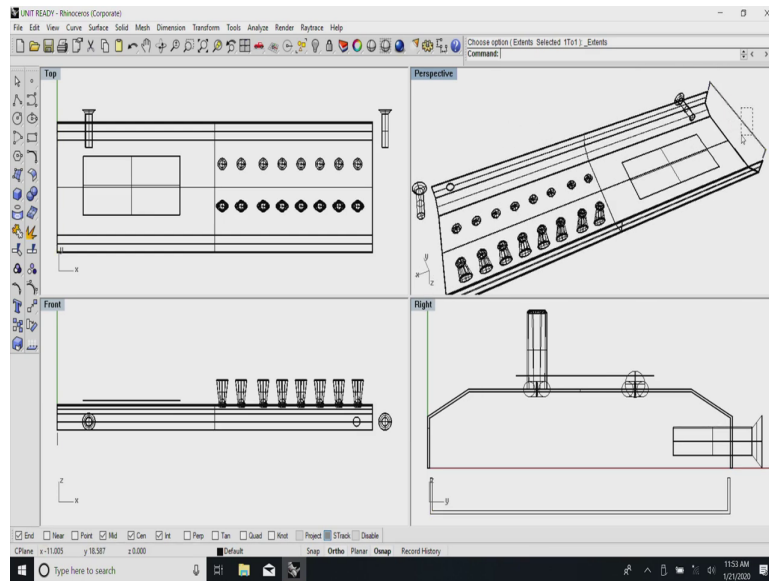
Now, comes another thing, how do I once again we get back to those fits by which saying when two covers need to fit how well will they fit. In that case it is a very loose assembly fit, meaning there must be a gap; typically, at least excess of 0.5 millimeter allowance is required. This 0.5 millimeter allowance takes care of or the small inaccuracies that are likely to spring in the case of manufacture. So, I have here the old, I tried just to make things easy for you to understand. You have seen this? I will delete this.

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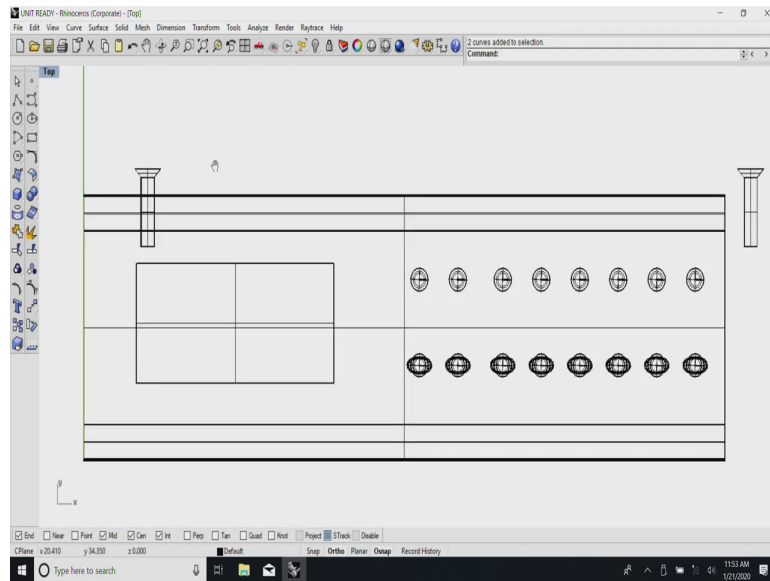
Now, I have this construction line which you see here. I have a chassis which is it strong and I have all the necessary things defined. You see this? This has been worked back from the front panel which we have started with saying typically this type of dimensions we require and this could be the chassis which I am talking about.

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So, what I do is I weld all these things together and see where it is sitting actually. See, this thing is here.

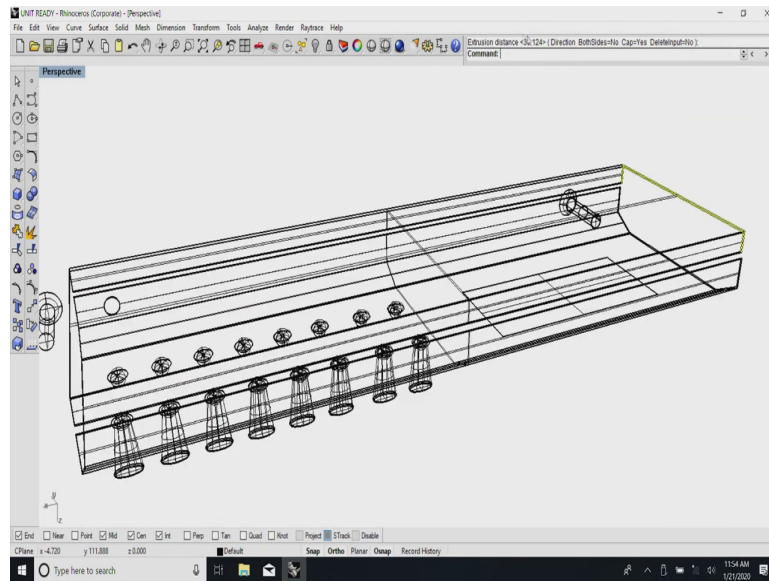
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Now, I try to extend it to cover make a solid out of it.

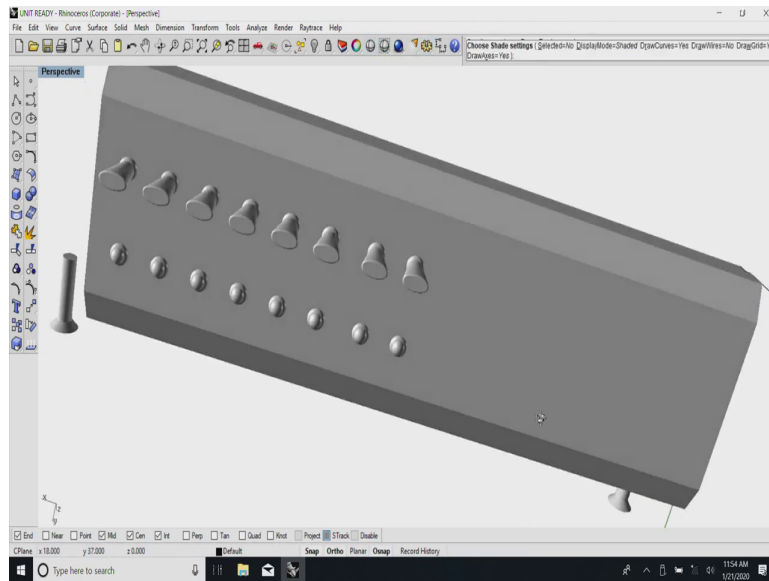


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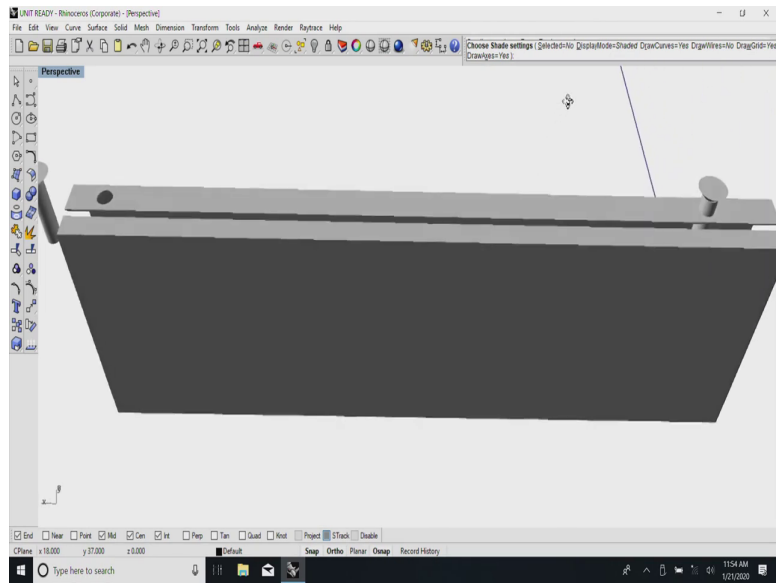


Now, you will notice in this drawing, I have this nice inside cover also ready. You have seen this? I have the inside cover ready in this.

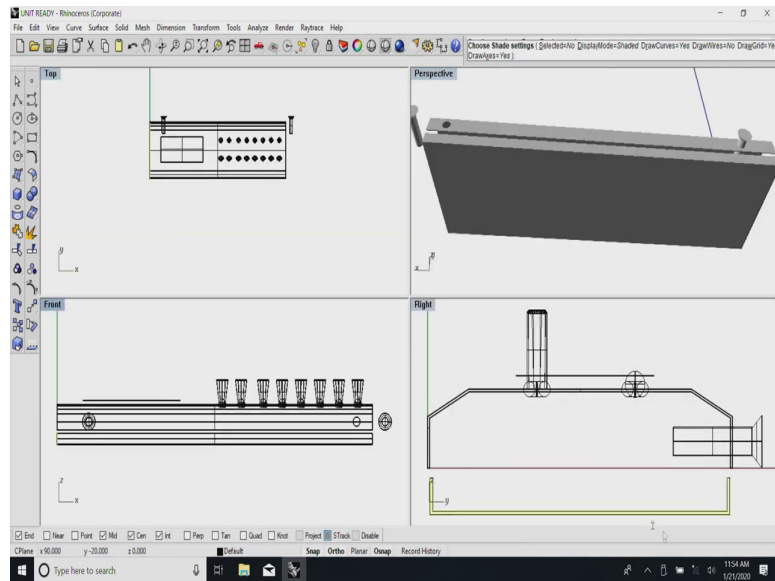
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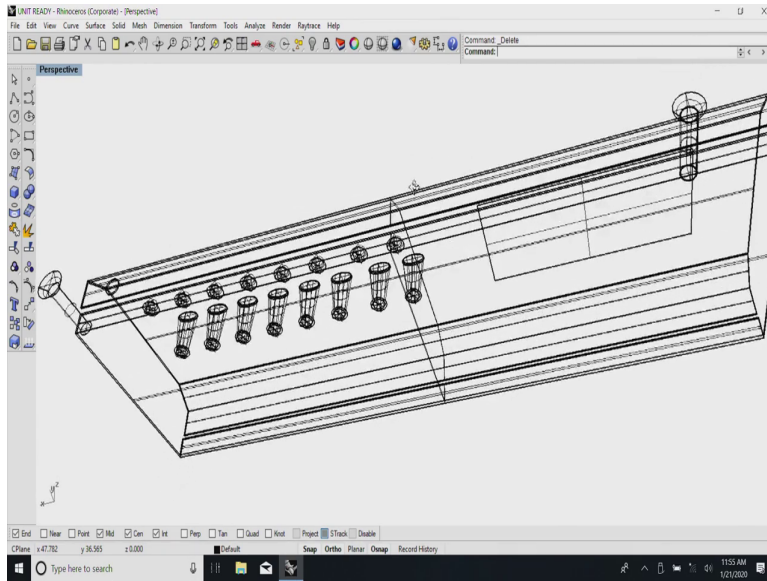
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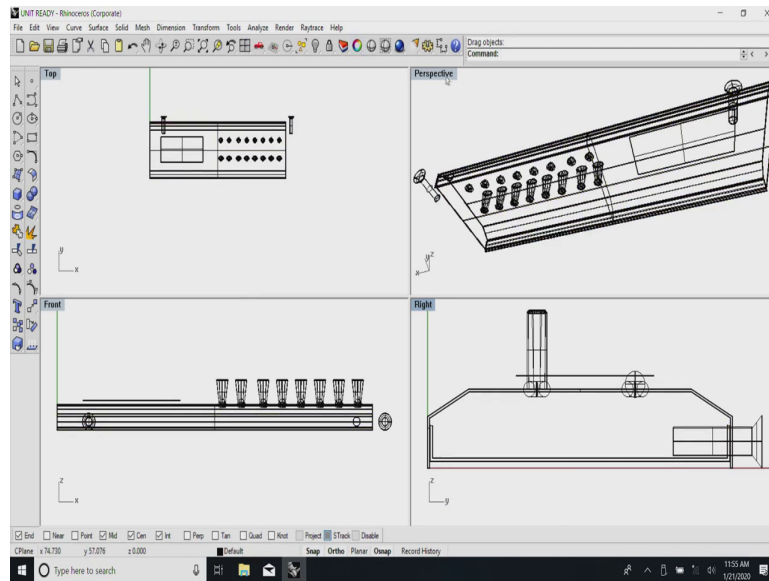


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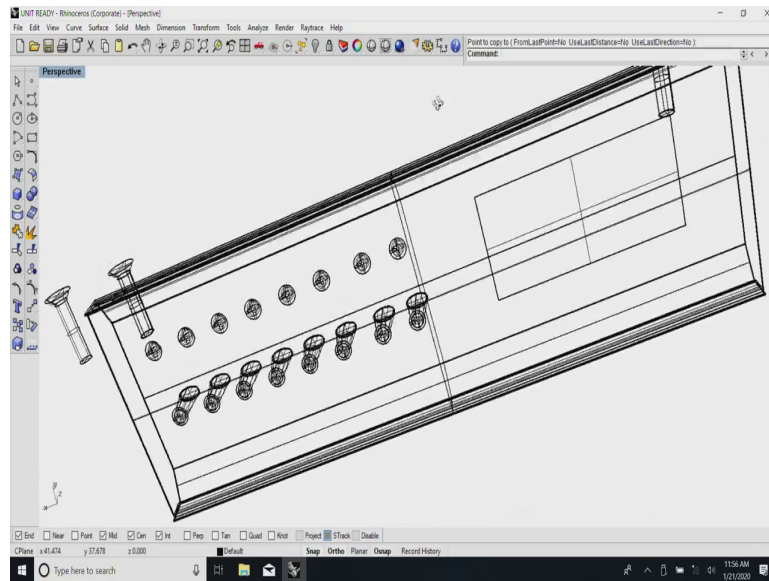
So, to continue with the earlier my assertion, if I carefully look at this drawing, I have this has been created using several surfaces.

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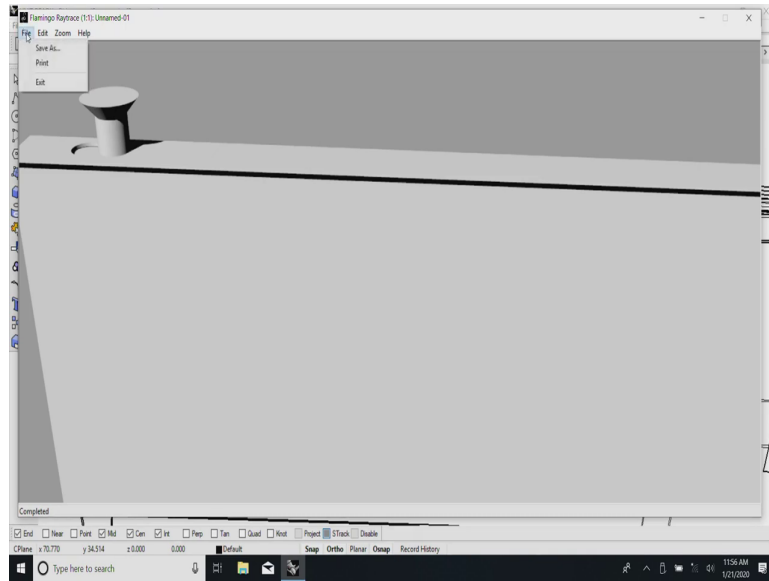
All I need to do is because of some technicality which I will try to explain to you later all the surfaces need to be group together, moved inside and one more time we try to operate this Boolean which I was explaining to you earlier.

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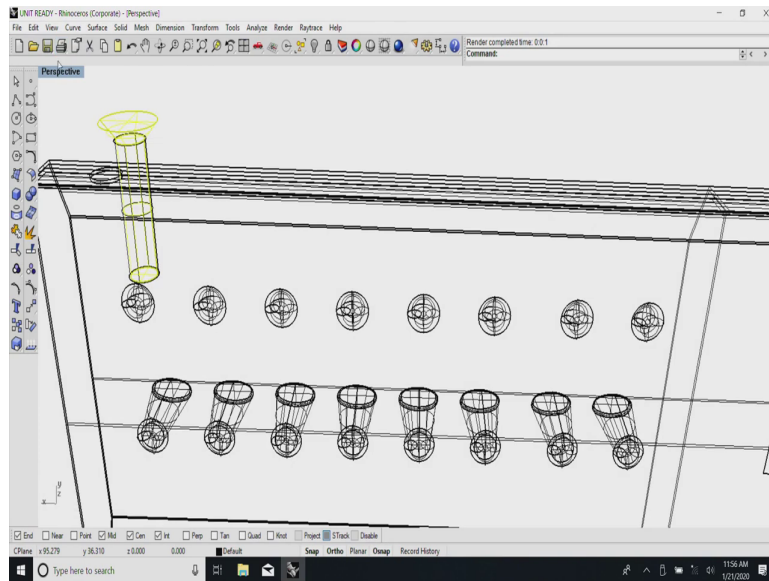
Say now that fastener detail which I tried to create earlier has now been you see here the hole was drilled earlier this is where I feel not about I feel the reality is that if you use this method of trying to create these various things, it is very much possible for you now to align items and have various types of these features ready for us.

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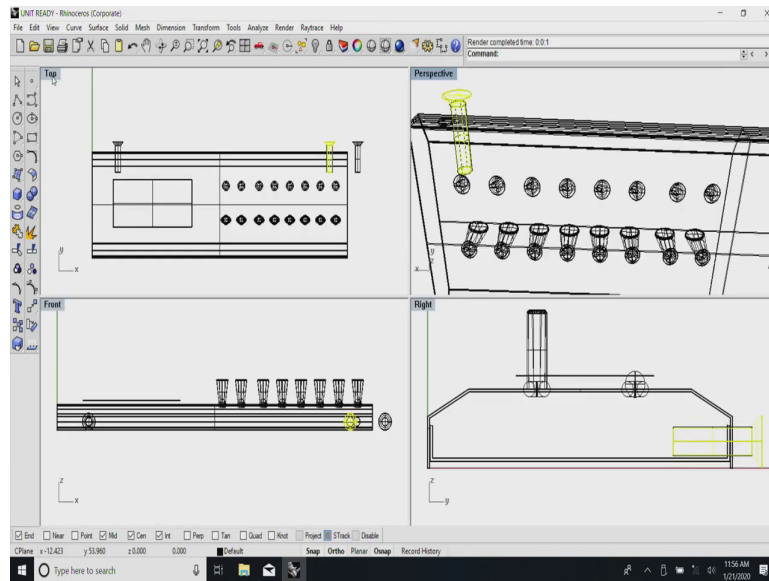




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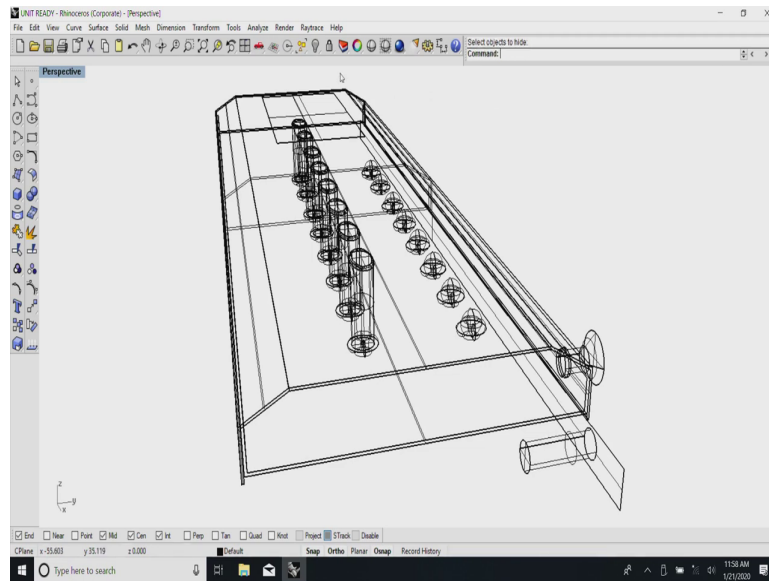


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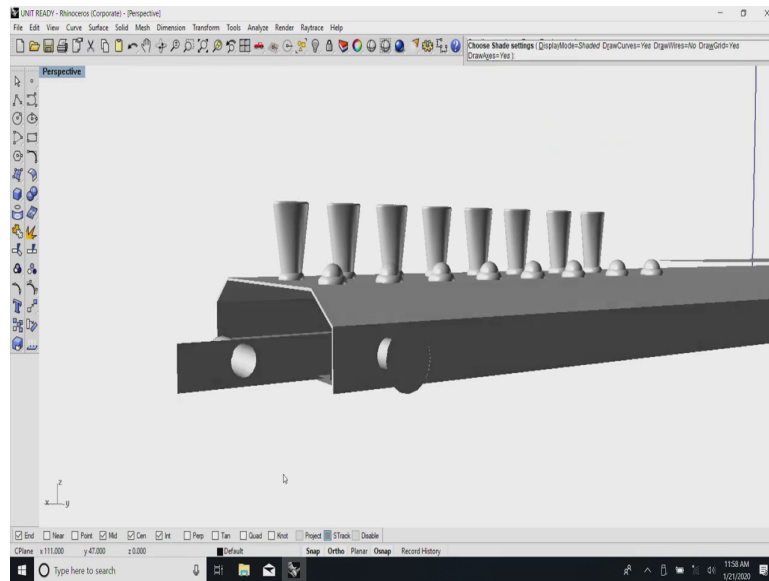
Can you see here? Now, I will try to do the same operation which I have done earlier except inside. You see this the outside one which I am interested in, inside one can be hidden actually.

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Now, I try to do the same all the necessary details which were kept below can seen here.

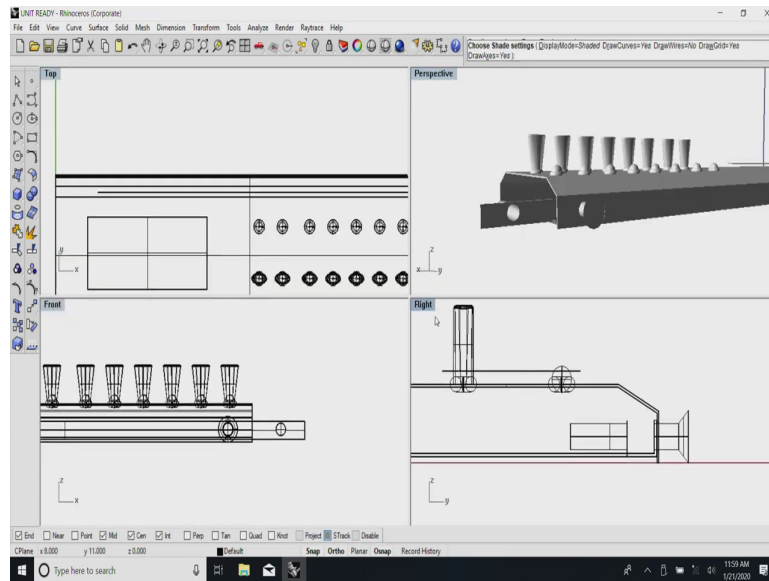
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I have the inside one we have a opening here and a little by mistake a little by intention I have not converted to a solid the earlier portion, it can be a thicker bar. Why do we need a thicker bar? Coming back to the old system, you may not have access at the back for holding the nut. So, for the purpose of holding the nut there we can have instead a long strip which is having two taps on both sides. In fact, long tap strips are available for us which are part of the 19 inch rack system.

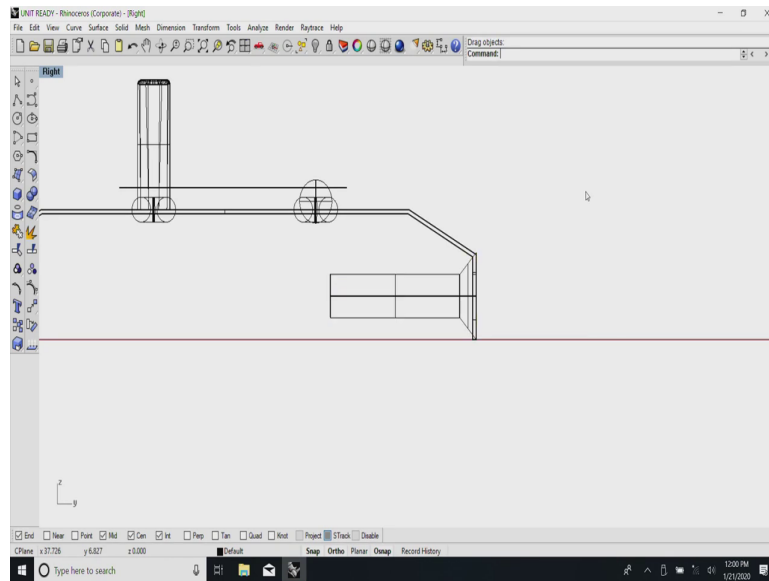
So, if we can get these long strips which typically can have a minimum of 2 or 3 taps on one side, another through a 3 taps on one side, we can insert one of these things at the back and fix the screws. Why this business of fixing the screw, which we once again I will come back here.

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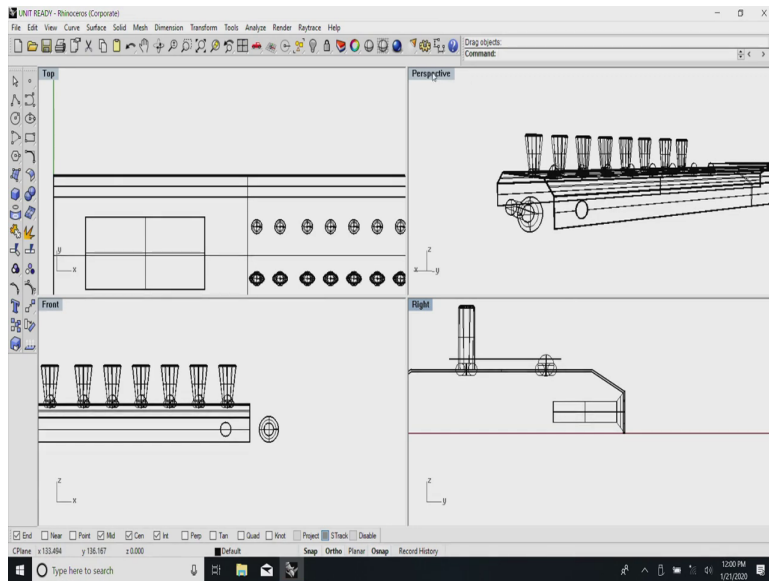
I will try to for the moment I will just hide all these inside ones or delete it best, see here.

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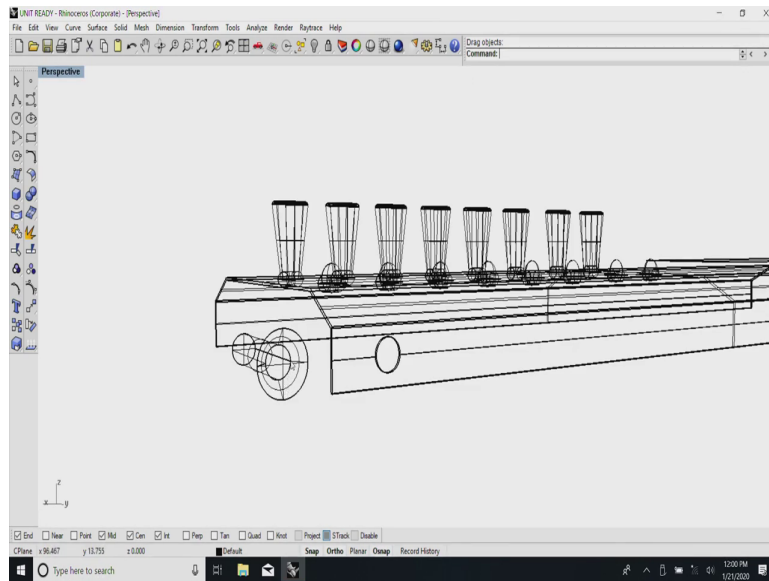


Now, comes the important point saying, can I make a counter sunk. Here we have the advantage. Why you had made that strip? In case the sheet is very thin and then still you want to need a counter sunk, most likely you probably need a small build up at the bottom and have this counter sunk on the top.

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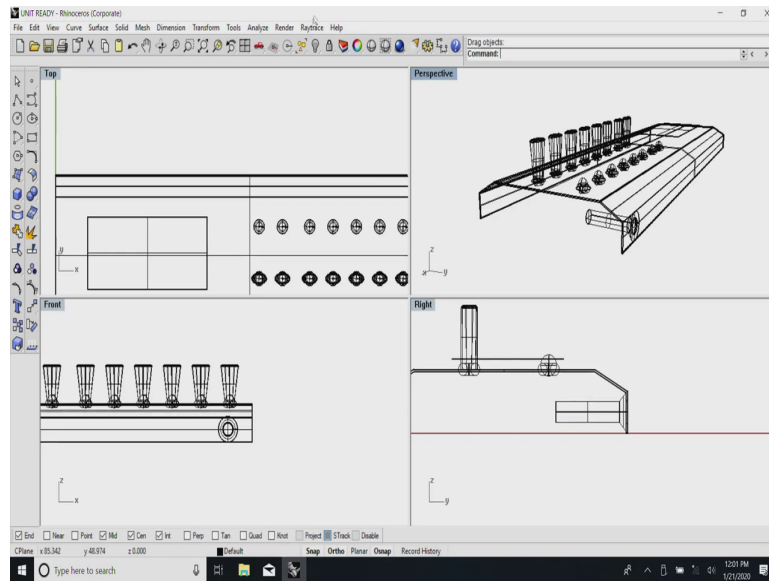


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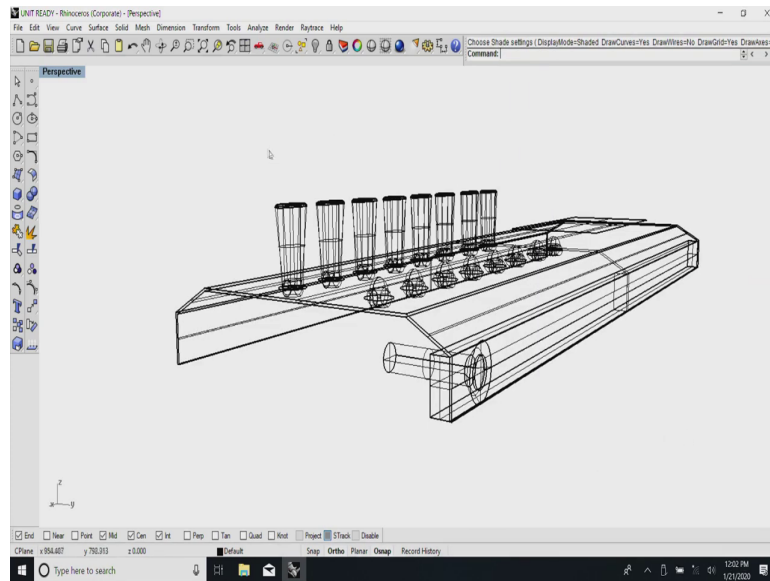


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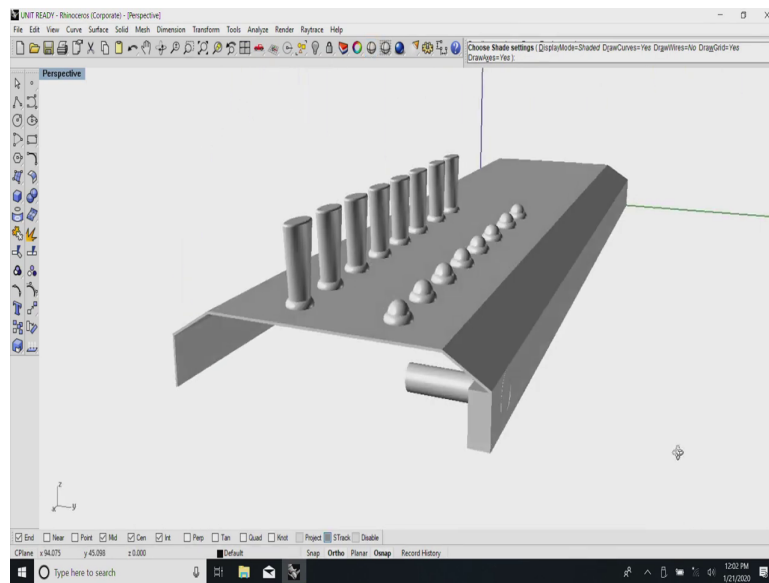


So, I will take it here and see if I can do some method of having a hidden fastener is just as I have explained to you earlier.

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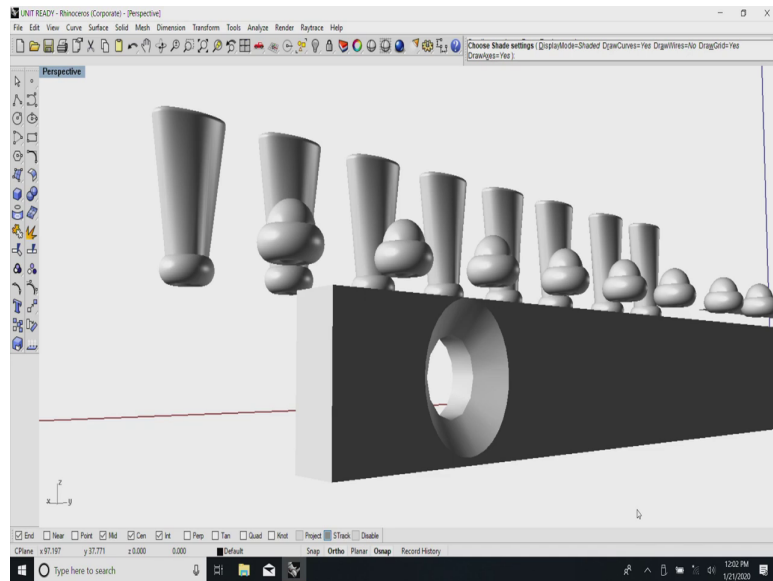


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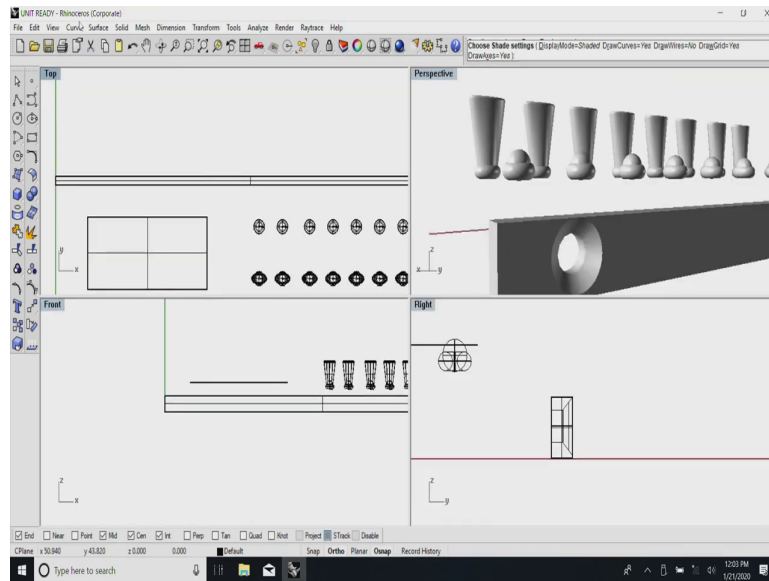
It is all very very easy for me to make. See here at the back of it I touched a small strip and the strip can be part of the chassis which I have told you. Why all the circus all this I mean what you call, this is very a complicated construction is to make sure that in the end we have a nice piece like this which has all the counter sunk which I am talking to about.

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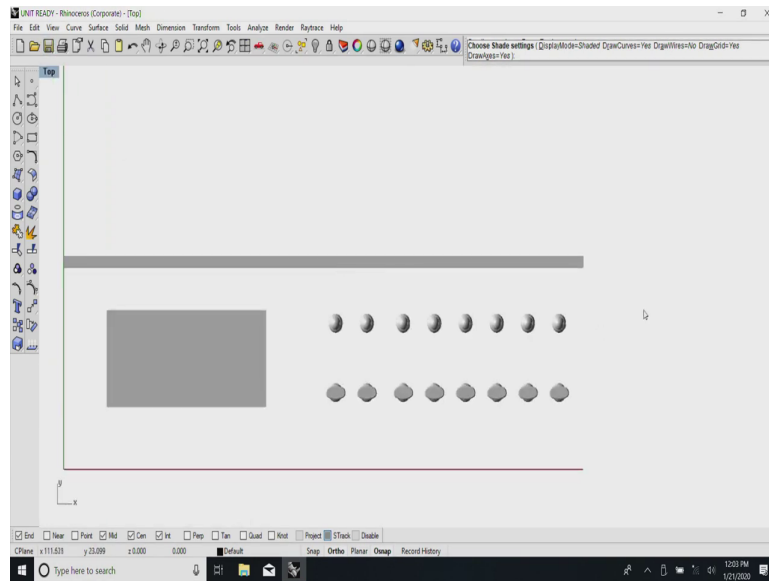


You have seen this know? The bottom base has the counter sunk so that a top portion of the sheet also got the has the counter sunk and it goes inside. Now let us say this piece and the other thin sheet are somehow attached together. Simplest ways that is where I said we can have these things which have tapped holes. So, we can make a nut, we can make a long strip nut which is long and narrow like this.

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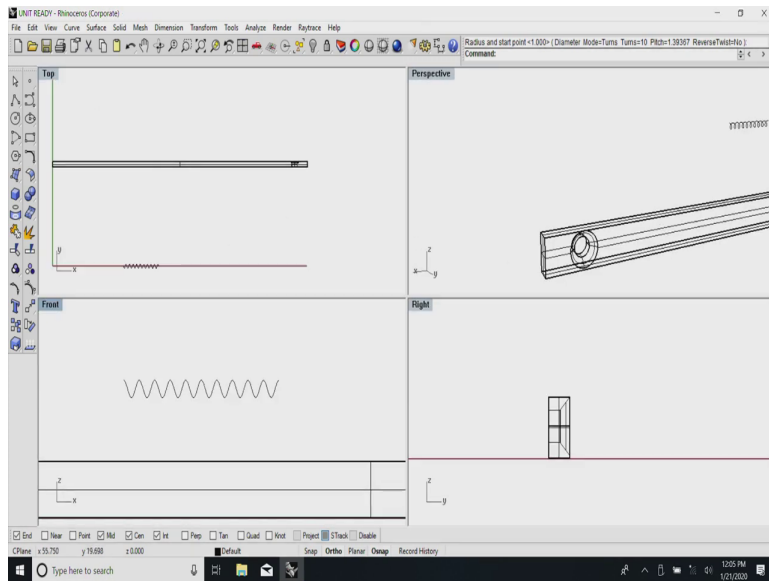


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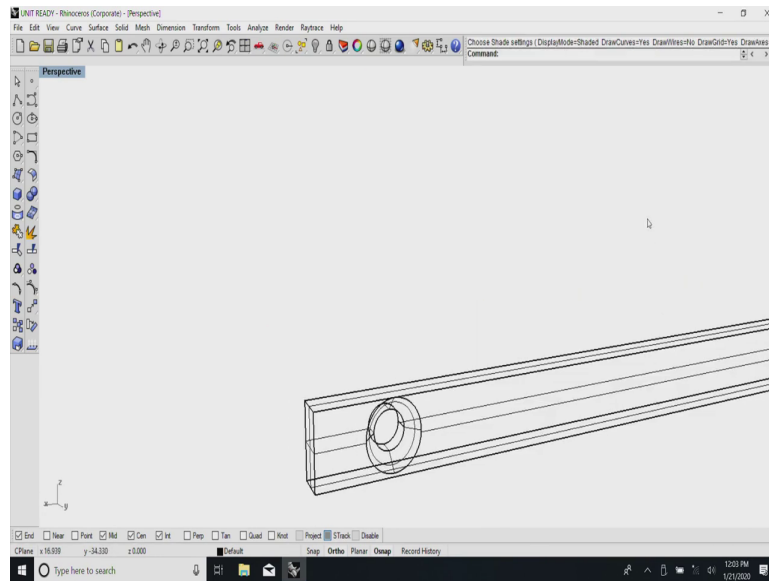


So, further while I will just use this piece hide all other items and see how well whether we can create a strip nut with this. You have seen this, there is a long strip.

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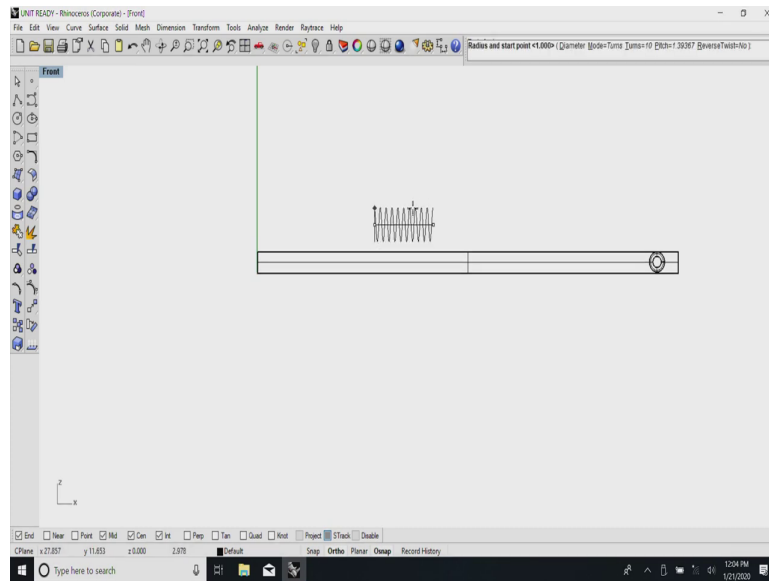
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Now, if we can create a spiral or a what you call a host thing like that which has the necessary amount of various details, it is a relatively simple job for us to create a thing like this.



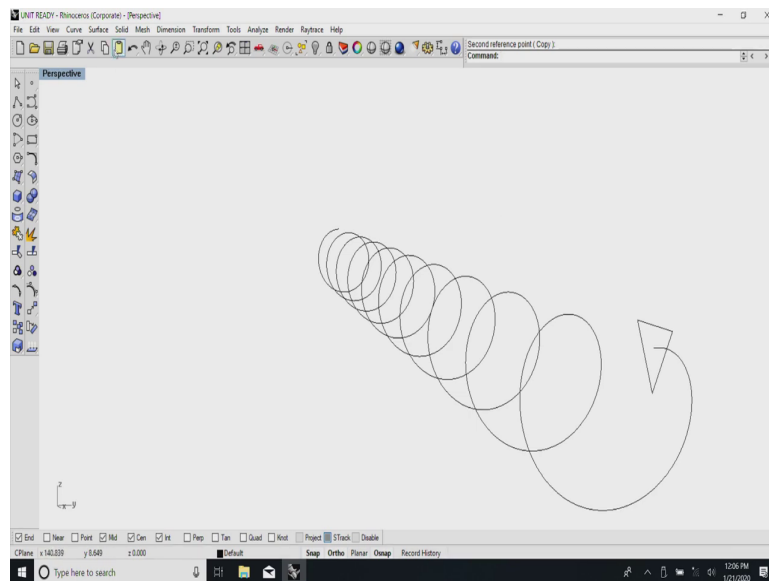
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I will just see here if I can create this a thing like various types of what you call spring like objects, various types of torch like objects, various type of pipes. We can make a spiral like thing and subtract it from this.

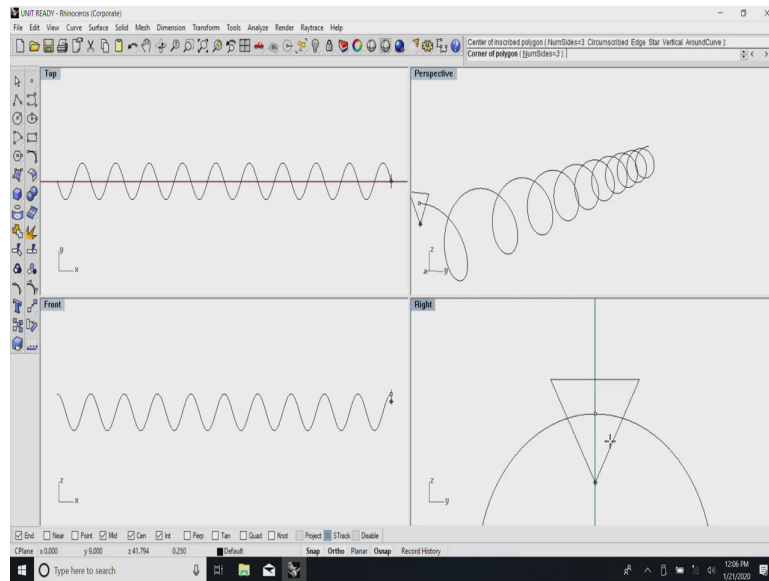
Once we make the spiral like this and subtract it from this very very easy for us to create. So, we have things like the saying you know we can make rails, we can make what you call things like helix then we can make a helix. See what we have here.

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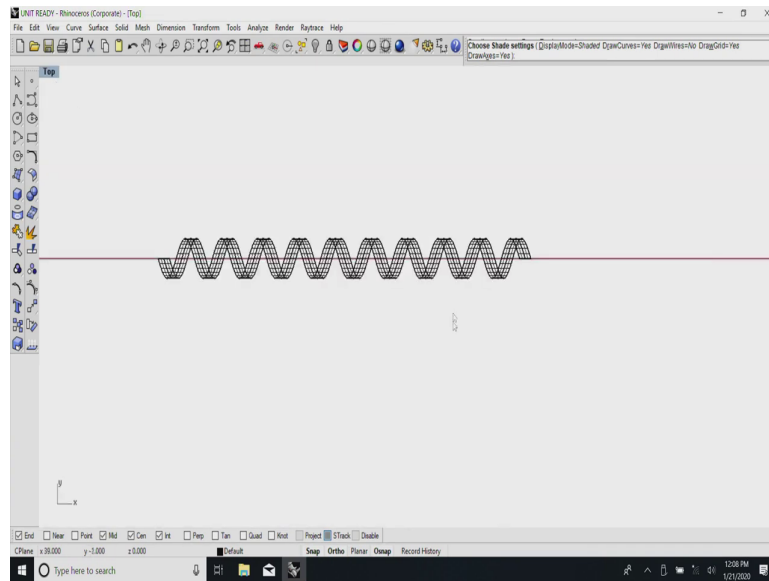
So, in another view it is an object which looks a little like a spring. It is actually a spring like object. All I need to do is make a appropriate thread form and in general what we have in our what you call thing is simple triangular forms.

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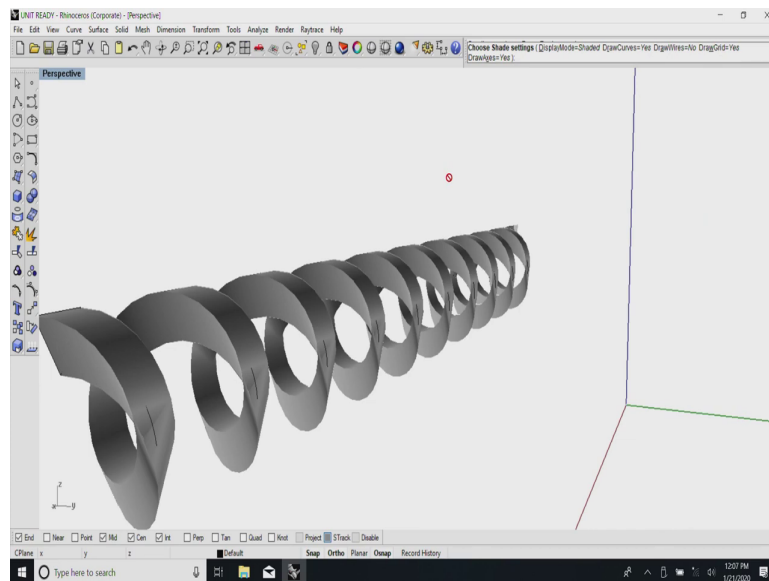
Seen this? All I need to do is somewhere here I create a small what you call number of sides generally all triangles we know you have seen. I have managed to create a triangular thing except a small my indiscretion, I need to rotate it. It looks nice.

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Now, I try to extrude the surface along a curve.

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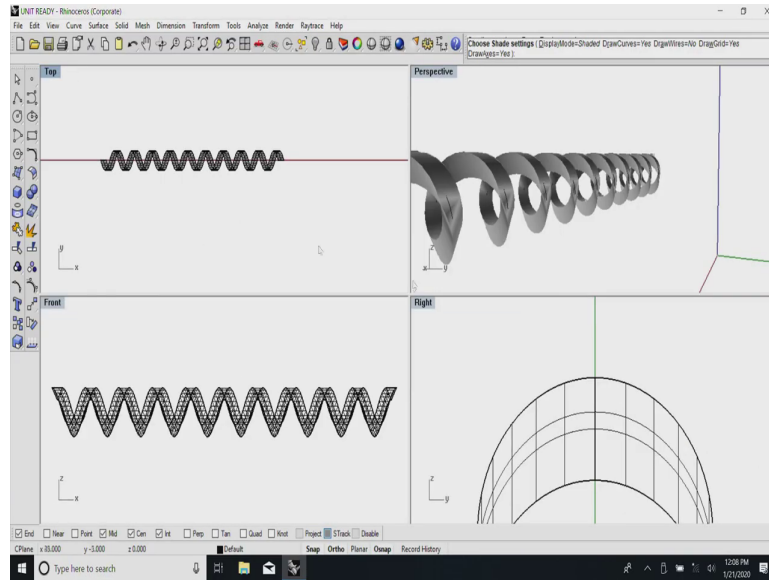
See, I have a reasonable looking thing which looks a little like a screw. If I properly oriented it, in this case the inside forms all right and then in case of I play around with the picture and all that this can be used for showing a screw thread, but as you see it is getting very very complicated.

So, at least once if you spend the time find out which is the thread profile and on what this thing is that screw moves around. It is very much possible for you to create several items together at one point. One of it is part of the fastener is the actual the cylindrical portion and part of the cylindrical portion is the clearance hole.

Again two types of holes are possible and we also have important thing is the diameter and then if you go back to that metric or this thing the length of the threaded portion, the unthreaded portion and the formation of the head on top of it, also attached to that is this thread

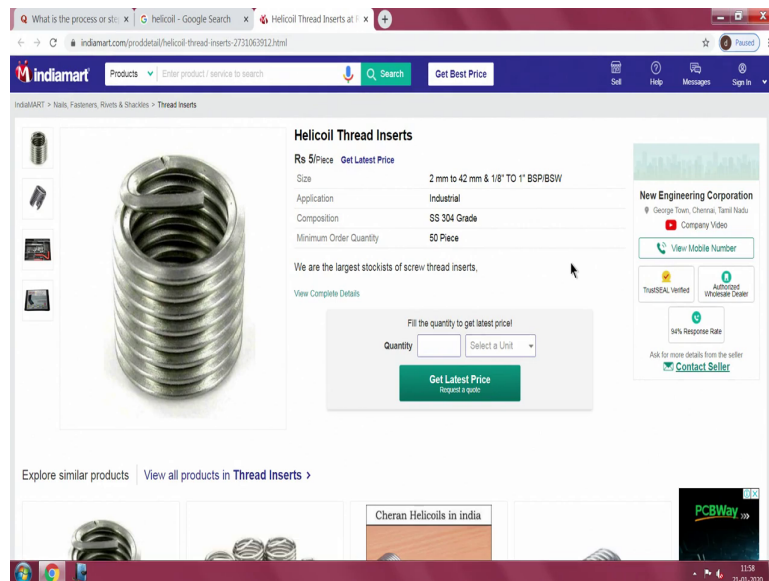
form. So, if you once if you create the proper thread form the proper pitch and all that all the pitch details and all are available in the corresponding ISC manual.

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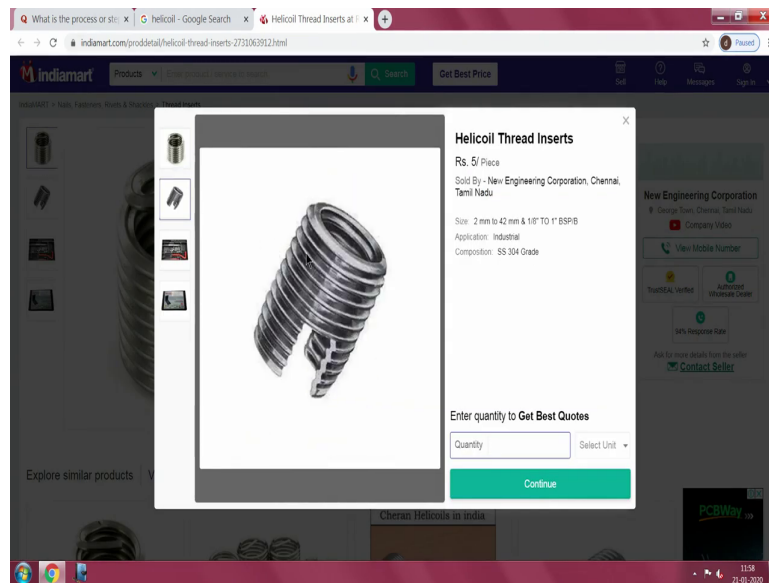
So, quickly I thought I will show you this. Now, you will see that its its possible that the thread pitch and these things have to be adjusted carefully. The triangle you make and sometimes things like a Heli-Coil, Heli-Coil uses a very different thing. Please look at the other monitor. I will give you a thing called a Heli-Coil here.

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For soft materials we end up with this thread inserts.

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The screenshot shows a web browser window displaying the Indiamart website. The main content is a product detail page for "Helicoil Thread Inserts". The product is shown as a coiled spring with a threaded end. The page includes the following information:

- Product Name:** Helicoil Thread Inserts
- Price:** Rs. 5/ Piece
- Sold By:** New Engineering Corporation, Chennai, Tamil Nadu
- Size:** 2 mm to 42 mm & 1/8" TO 1" BSP/B
- Application:** Industrial
- Composition:** SS 304 Grade

Below the product details, there is a section for "Enter quantity to Get Best Quotes" with a "Quantity" input field and a "Select Unit" dropdown menu. A green "Continue" button is located at the bottom of this section.

The background of the page shows the Indiamart logo, a search bar, and a navigation menu. On the right side, there is a sidebar for "New Engineering Corporation" with contact information and a "Contact Seller" button. The bottom of the page shows the Windows taskbar with the time 11:58 and date 21-01-2020.



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The screenshot shows a web browser window displaying the Indiamart website. The main content is a product detail page for "Helicoll Thread Inserts". The product is priced at "Rs. 5/ Piece" and is sold by "New Engineering Corporation, Chennai, Tamil Nadu". The product specifications are: "Size: 2 mm to 42 mm & 1/8" TO 1" BSP/B", "Application: Industrial", and "Composition: SS 304 Grade". The page includes a "Get Best Price" button and a "Continue" button. The background shows a sidebar with "Explore similar products" and a top navigation bar with "Products" and "Search".

Helicoll Thread Inserts

Rs. 5/ Piece

Sold By - New Engineering Corporation, Chennai, Tamil Nadu

Size: 2 mm to 42 mm & 1/8" TO 1" BSP/B

Application: Industrial

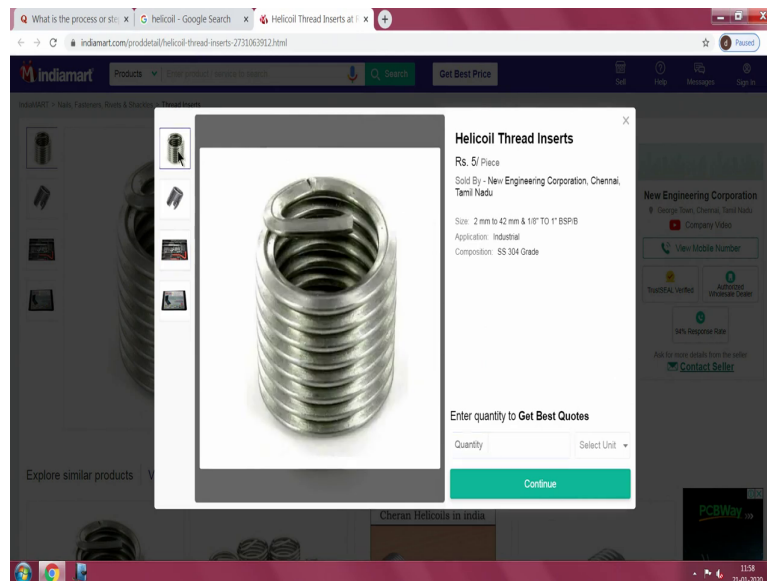
Composition: SS 304 Grade

Enter quantity to Get Best Quotes

Quantity  Select Unit

Continue

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One of the things you will notice about this thread insert is it comes with its own threading system, its own full kit it comes here. Magic being in software materials, suppose let us say you want to do something in aluminium, you cannot afford to cut a fine thread in aluminum.

So, this particular form has a diamond shape. The outside diamond and goes and sits in the opening that you tap using an oversized tap and once you push it inside inside forms again very hard threads again and inside will strictly follow the thread norms which are specified either is metric or in the case of us we have the unified national union say course fine and extra fine.

In the case of we have of course, so many other things including Japanese just including ghosts from Russia and all that and they ever present British standards. We have the BSS and the

British shell, so, many BA threads and all that. For all each of these items small accessories like this and the basic fasteners themselves are available.

But once depending on your what you call interest, you have to create one fastener with the necessary details including the proper type of head and from there you can play around with making make it a (Refer Time: 27:15) set, make it a contrast and head make it a pan head, make it any other head and inside the head we have the opening inside.

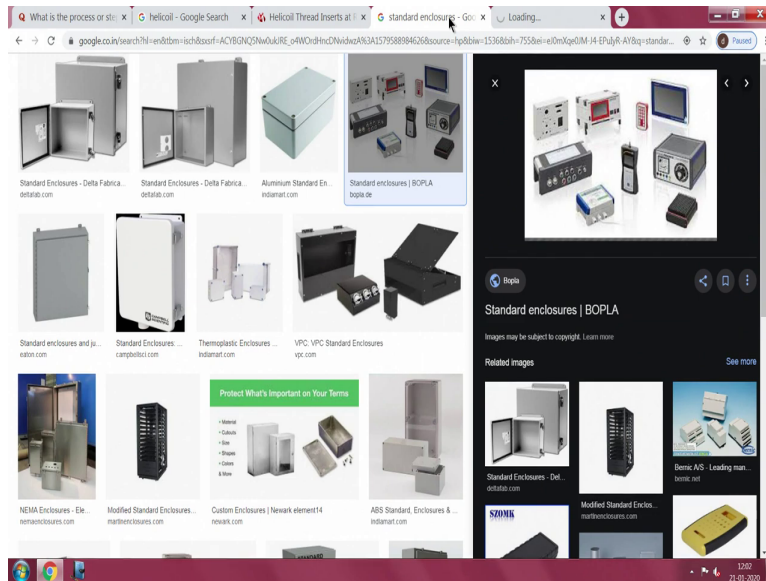
So, commonly we have things like loosely what we call the Phillips head or they call it I do not know have you called cross head and I am sure there are other names and one important thing in mechanical engineering we also have a Posi force. Just like we have Posi force, we also have offset what you call this offset Phillips or offset star headed things they have special purposes. If you create once you can use them everywhere and drawings related to that are freely available, they are open source.

So, next time I will try to show you using a basic 3 mm which we commonly use. We can easily make 2 mm 3 mm and then anything else except that is very convenient to start with this 6 millimeter fastener. And you know why? The while the nominal diameter 6 millimeters, the pitch comes to exactly 1 millimeter. So, half of it is for 3 mm meter come to 0.5 mm.

So, while creating that whatever you have seen here, if I followed that pitch properly and if I followed the nominal diameter and final thing, once if I make the fastener in fact, the fastener can always also come with the thread on top of it. I just need to take two copies two instances of the fastener. One instance is where you want to make the opening and all that.

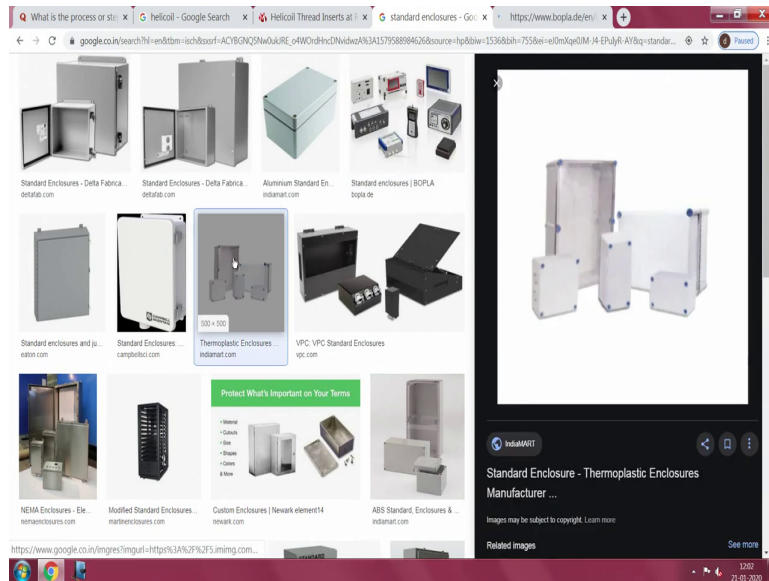
So, it can have a just a cylindrical portion. One instance where it needs the thread also inside. If I now Boolean the thread portion of it with any of the other things, have a beautiful tapped location and if a Boolean the Boolean difference the other thing, I can have the opening inside. Advantage of carrying all this is that its relatively easy for you to make things.

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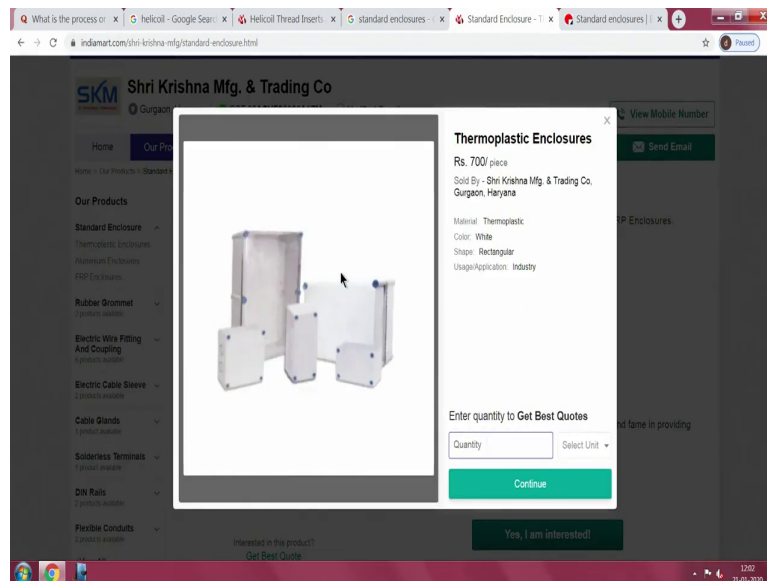


Now one last time before I go I go back to the internet, so, if I had to see any of these things, for example, aluminium standard enclosures; various details are available here and very quickly you can order get these things as you want.

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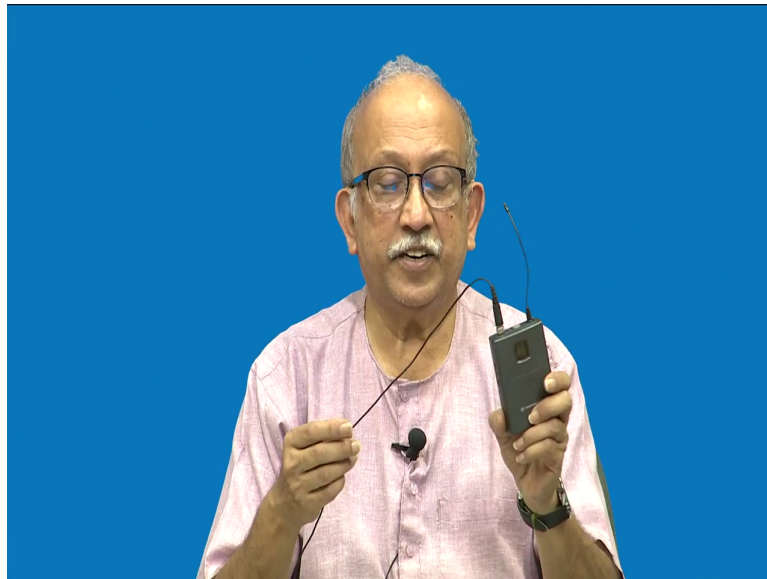


You will see here, this is one of the things which commonly people use. These are typically the plastic thermoplastic enclosures and any enclosure you want is available. So, I will stop here. I suggest you on your own try to locate all the in this various details I am talking about.

One is various types of electrical items which are useful in your field. If you are into a conventional type of electronics where you have things like switches and displays were very familiar, the most tricky part of it is usually the rear panel where all the connectors are there. And offlate we are very familiar with saying very simple thing like the USB A and the USB mini and USB micro, then C also has come.

We are very familiar about those things that part of it is the opening that is visible, but inside there is a huge shell and limited hardware is there.

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And in the case of our electronic and audio, you have several other things including the ubiquitous 3.5 mm jack and all the way to XLR connectors. And anytime next time you go to a music program or next time you go anywhere outside, you see that every audio source everything by standard has changed over to XLR. And an XLR also some some mild variations of things, the way they lock including and just push including bennett including what you call things with a screw threaded all variations are available.

And if you make all these details, it takes a lot of effort for the first time. For the next time onwards its very very easy for you. You just have to call the library component, just like you do with your printed wiring board layout, put them everywhere on your front panel and the whole equipment, do necessary Boolean operation, so, you have an enclosure ready with all allowances and tolerations also tolerances also taken care of.

So, thank you. I will now say next time whether actually I can give you a practical slightly more complicated unit. Two variants: one of it is using a standard enclosure taking taken from the one of the catalogues and another one from the what you call various other options. A lot of this equipment which we have made in our own this thing I have kept on my hard disk. I will try to show one or two of them saying now how do we create it in the new system which I which I am sure you will adopt as soon as we finish this.

So, thank you. We will meet again.