Enclosure Design of Electronics Equipment
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Lecture - 19
Sheet Metal bending

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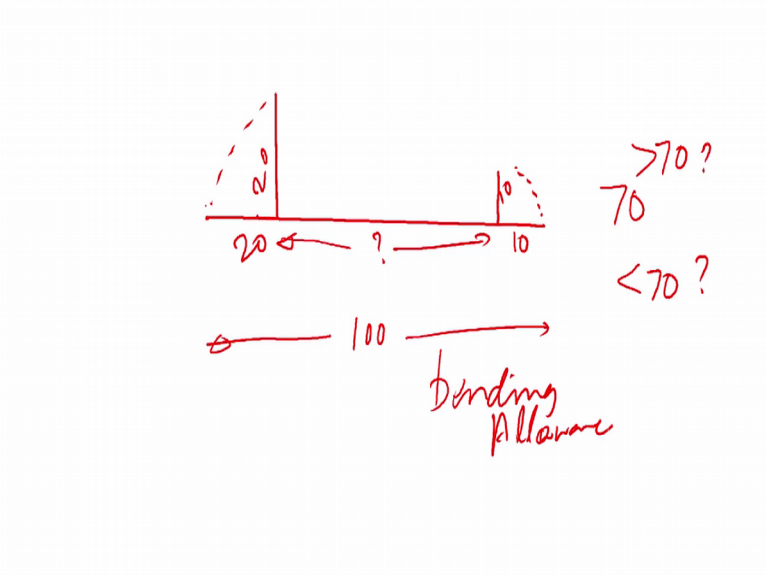

I take a sheet like this, at some point I try to bend it up and then I try to bend it up. This is where we feel instead of going for the over the world design if the basic designer he could be hobbyist or he could a mechanical engineer or he could be a instrumentation engineer he will learn certain little about these things he is much better off. So, if I take a 100 millimetre long sheet, imagine this is a 100 millimetre long sheet and I take a small cut here above 10 the millimetre mark out 20 millimetre bend it up how much will I get here, is it likely to be a simple 70, is it likely to be 70, little less than 70 or little more than 70.

So, we get into what are called blank calculations, how do you calculate the blank size. This is something which we replace where at each call the electronic systems are earlier called electronic design. We have insisted that people learn this small things this particular thing is called a bending allowance, it is very how to tell by it will looks obvious and easy.

There is something about a thickness that is involved here which somewhat intentionally I left out mentioning, depending on if you have a thickness these whole all our calculations everything likely to change. So, I will get back to that thickness point of int; I will erase all these and start fresh again, I know start where a pen, so I have, that is the same sheet, but a thickness has been added now.

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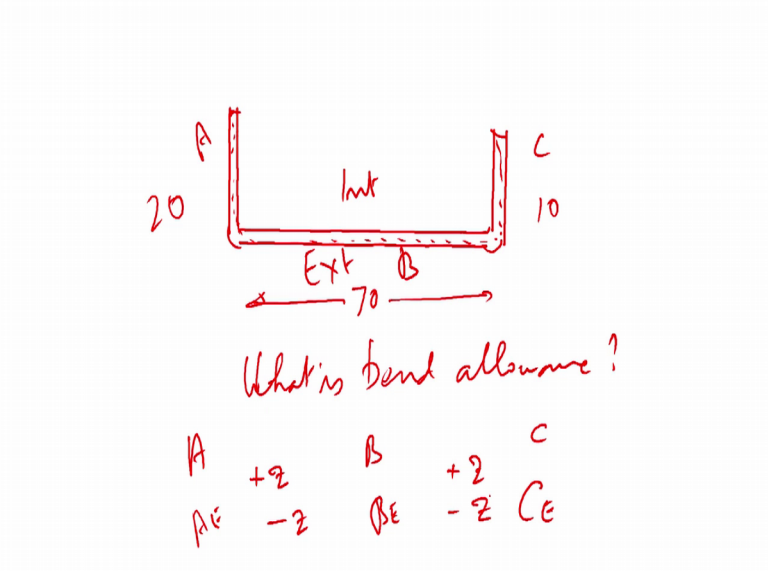

Movement add a thickness some other thing related to material behaviour that sent to the picture. So, this neutral axis does not change dimensions. So, when we are started with 100 mm. So, neutral axis inside it probably remains 70 here and then the neutral axis here know also remains 10 neutral axis here remains 20, but what does change is material here gets squeezed inside and here metal gets extended inside.

So, I suggest you go to the what you call internet and search for what is; there are bend allowances which are already tabulated and large number of them are there on the internet. So, in the end when you would like to make a small enclosure like what I have told you earlier depending on if you have the internal dimensions. You take internal I will call this Int A, I will call this B and c. So, I have A, B and C, I have internal plus Z here or A and B and C this is one we take the internal. Imagine I have the external dimensions in the case of the external dimensions I have once again A external, B external, C external and then I have instead minus zee. And the magic is there are equations are various this about it based on geometry, but the reality is the best if you going check all

the online resources that are available they keep insisting make a sample please that is not getting away from sample piece.

Now, I will go to a next blank here and I see how well I will try to make this. So, I will start with I know it is tough, but no choice I will start with saying I need a box like this, about this much box, to a box I will box is a recruit name to call it I will call it an enclosure.

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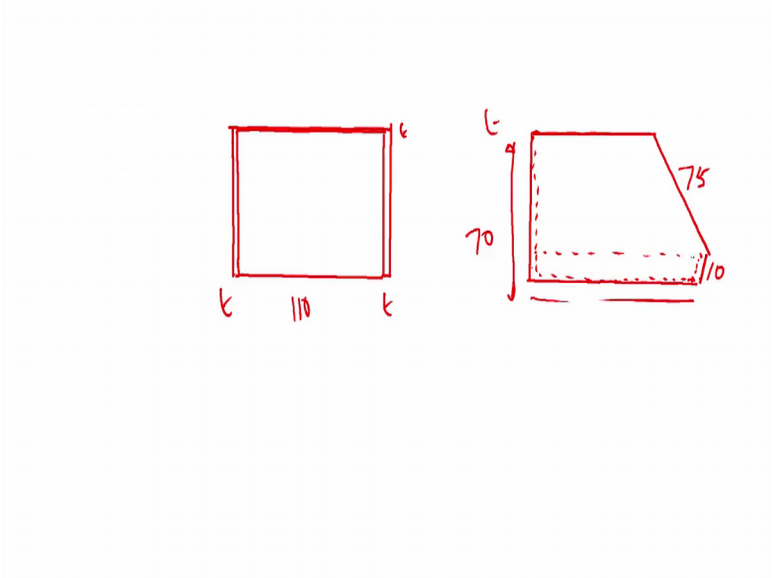

In this enclosure finally, probably has a small inclined front panel that is there see two views approximately it will show me what is the height of the equipment this is typically your height, then I have this then I have this and then I also have this dimension. While for an enclosure these are quite, but if you go into the details we need to now strictly go about finding out this is all or those something more we required do this. Because if you remember no issue out of this in the where you know the very earlier slides saying you now need to take a decision saying how you are going to split the unit. So, you end up with a top cover and the bottom cover and then things like this which have a narrow angle and all that there is a chance of they are not you know easy to fabricate. So, it is conventional for us to take a line here and an after that make a line here.

Having done this now slowly if you design elements will come into the picture. One of them is while there is a nominal size of the box would you like to have this enclosure enclose certain what you call items which require a minimum space. If you are going to

enclose the items with the minimum space we give this as the internal dimension or alternatively if the external dimension is constrained we probably we would like to start with the outer dimension whichever it is you now have to think about how to split the box.

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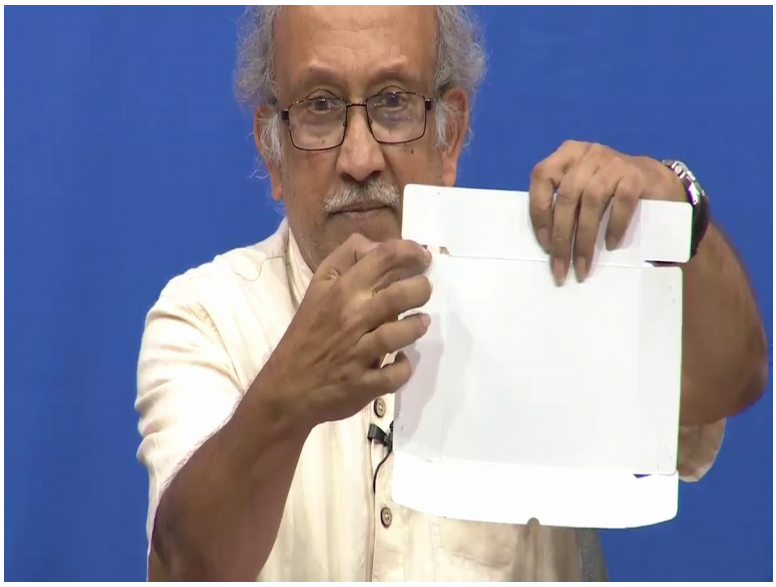

You see here I have a beautiful a box, sweet box very sweet, but then sadly students have eaten away all the items.

So, in general all our items you know are probably where it is technical unit or anything it all comes, so how do we assemble it out of a flat sheet. So, you were to open this, not very different from what we would like to do with a sheet metal. If you remember three slides back I showed you what looks like a reasonably complicated thing. So, in this case critical things what you need to notice is that there is a notch here, this notch is the one which will permit you to bend things into a different direction like this. The sequence I have bend is something else is its possibly it is a possible that we bend it like this first and then we bend it here and afterwards this know this alone put something else and bend it and we have a beautiful cover this way.

Now, do you ever use it this is a what is I mean otherwise something use for confessionary is it what we use in all the things yes; yes, yes, yes.

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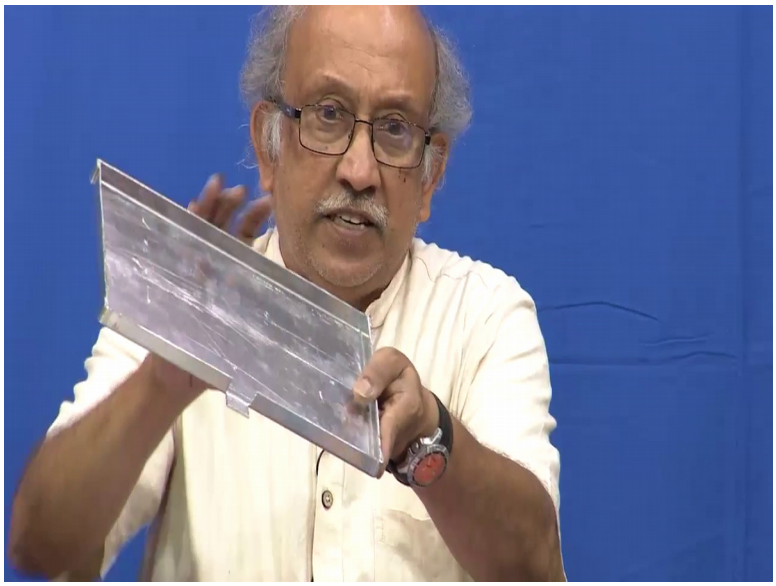

Exactly for this reason I brought you this, this is a wall mount bracket for what is called a cabin fan. So, this is whole thing we will get held on to the ceiling and then at the bottom we have an adaptor this is the bottom adaptor plate for that adaptor plate sits on this is and then we do various things and the whole fan, a fan base is locked on to this.

Now, if you see here if you see this small detail in the corner it is not very different, it is not very different from what we have shown there you see here there is a small overlap. And then eventually they will whether refit it or they will bend it here and refit it or they will weld it and you have a relatively stiff strong box it is not easy for us and its light it is not at all heavy see that just why what you call playing around and then there is a small detail this is some safety detail and all that I will put it down. It is not very different from a routine experience this is where we insists that you learn how to make a cardboard model.

So, well I got away with all these thing.

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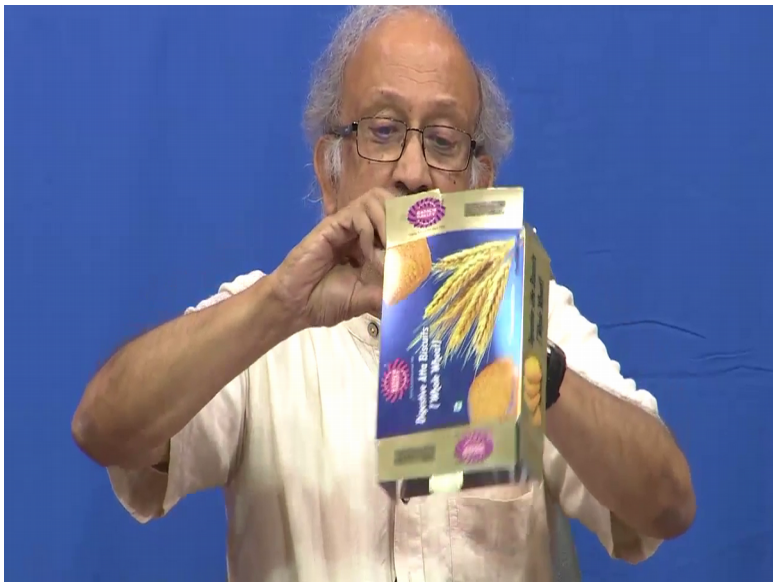

This is again one more beautiful this thing, I am sorry same thing here know you did not have all these stuff seen this here it is happily, oh now I am looking for a (Refer Time: 12:33). So, this probably whole thing has been laid out and cut in a card board manufacturing unit and the way the layout has been made just see here, maximum amount of material has been used there only if you notches here.

And it is not one of those multiple laminated things; it is easy very easy for us to recycle this box. Why I keep insisting that is just using card board it is possible for you to make mock ups of your units and present it to what you call your team mates and others who know how things work. So, I am very what you call I am very proud about it to show you these things I will get to I want it avoid this. So, invariable you know we have this lying about only difference there is that is a simple throw away device.

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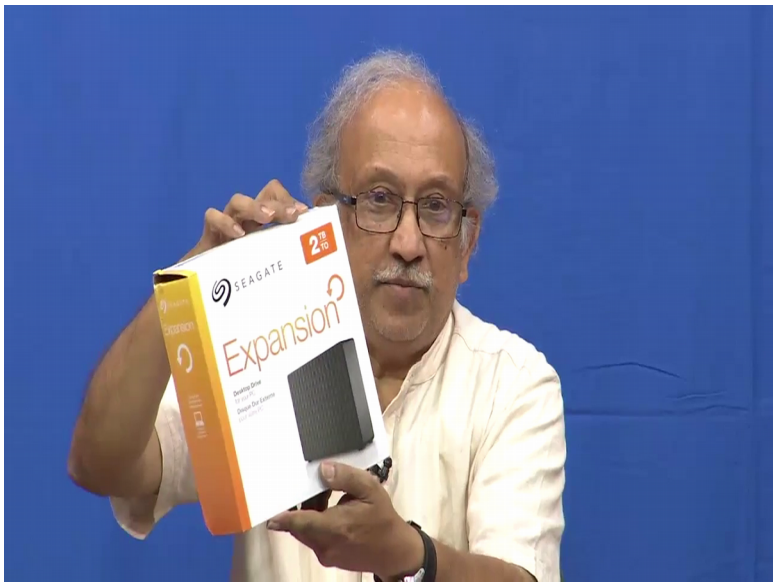

In this case this has additional thing and then it needs protection, but the same elements have been used here even the way that closing if you see at bottom closing is one type of an overlapping and at the top it is something else and it has several security features and see it is a beautiful thing. And you have noticed even the contents know is probably something I made out of a plastic or something which is still a 6 sided cubed.

Going in we get more and more complicated thing, but the common thing is base similar the top opening is similar then we have a small security what you call device here which you need to pull and once you pull it now it opens. This sort of features and all are about the same and then it has of course, all the other things.

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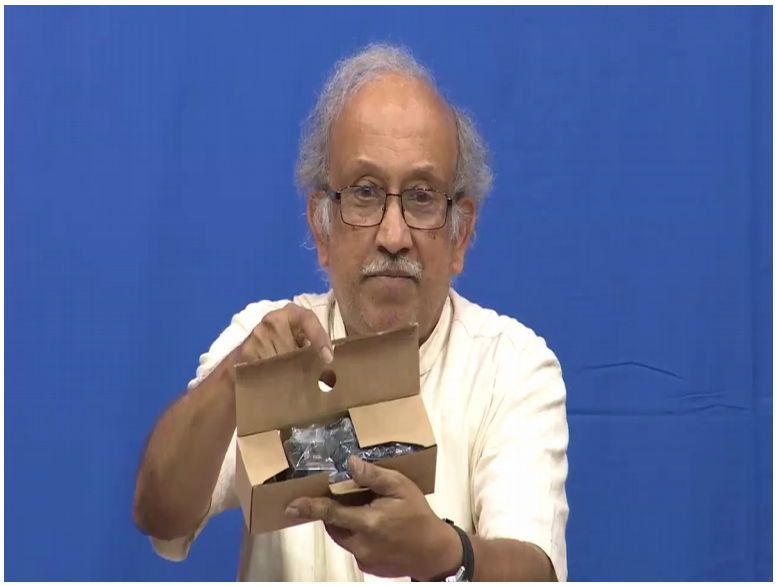

You see this here this is a top one, we could have easily simulated in card board or any of the we have what you call foam core board and then make this beautiful equipment same thing, this whole thing no could have easily been simulated in a card board all this is here.

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Now if you see here carefully inside you have beautiful set of what you call all sets of components and eventually if complicated sheet metal fabrication can be carried out, if you being still and the basic raw material is flat a little bit of planning and then

optimization eventually you have things which are very comfortable you manage things and all that where is it used anywhere you can think about.

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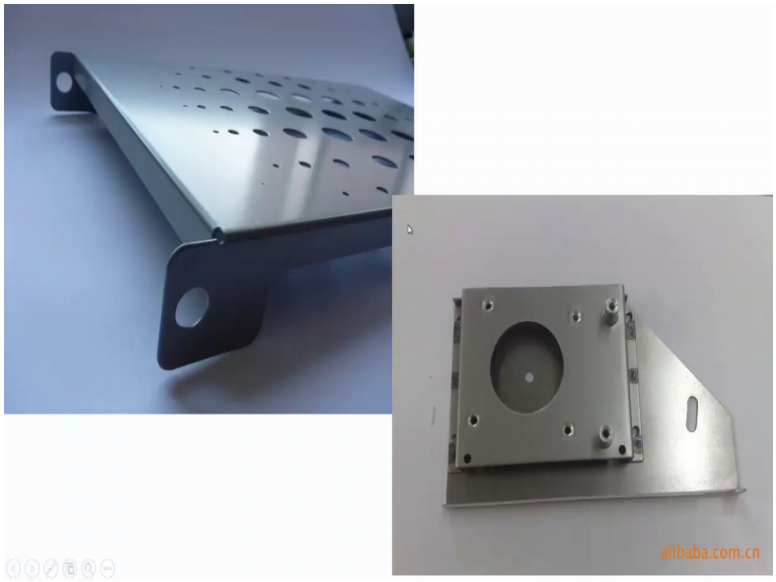

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So, this full thing the another scud cages, see this how I make it well I will have come back the first slide again to say what you say a type of construction you would require so on and then now I will take you to the last slide where I left it here. Now you take a decision about what you want to mount and where you want to mount and how much you see space that is left inside. It has been conventional for a long time for has use what

is called a single euro card single euro card typically has a 100 mm width length of 160 mm length of 160 mm width is 100 mm, 100 by 160 has been a good the string instantly the same thing will go into a through your rack. So, around 30-40 years back this single euro and double euro were standardised. So, if I to make an equipment which probably has a printed circuit board inside like this.

Now we see the inside this pcd will the depth can be about 160 millimetres this can be 100 millimetres. So, have it and then it can probably have an edge connected the back and some other features here. It could a little like your extension cards in a PC, the PC at the bag you also have this except there is a mounting device and all that. Now I am trying to make show you how to make this. Now if you agree on this basic you know the purpose of this if there is a PC be which is about 100 mm wide inside probably need around 5 millimetres gap on both the sides and that will make us 110 mm minimum width.

So, the inside space in this case I would like to point out saying it should be 110 internal, similarly here 170 millimetres internal dimension. Now we come to various features which are where on printed circuit board or other thing and in fact, we can have a two tire also we can have one more small PC B here and then at the back we can have various type of connectors input output connectors and all this. Considering all these let us say our height turns to be around 70 millimetres, once again internal and then here we try to play around with this angle it has been customary to make things which have an inclination of at least 15 degrees. So, we have this 15 degree inclination and then we have this it is possible for us to calculate what is its panel size here what is this and so on, well (Refer Time: 19:11) I am not able to tell you I expiate the whole thing approximately comes to around 80 millilitres I have 10 and about 75-85 millimetres it comes.

Now it is for us to decide how do we want to split the box. One of the simple ways of splitting the box is like what we have shown before, slowly it is getting better again can kindly it right let regulate this 110 millimetres there is a 170 millimetres you have around 70 millimetres to the height.

Now, there are several ways of splitting this unit one of them is I tried to now stick to the internal dimensions and then try to make a cover over this see here. So, end up the very

convenient 110 internal plus 2 thicknesses, I have small t here, small t here and the width is 110 millimetres. If in this case now I need to take a decision what overlaps the other, but since I have shown this, this is already overlaps this width here probably the outside only you see it again we have a thickness here. So, the outside here known the inside will become what are that 70 plus we have a t here and then depending on this I have just I will make this 75 I will make this 10, then in this case if you see carefully now comes the thing if that side panel overlaps this you see here we have something which has made here like this, see here.

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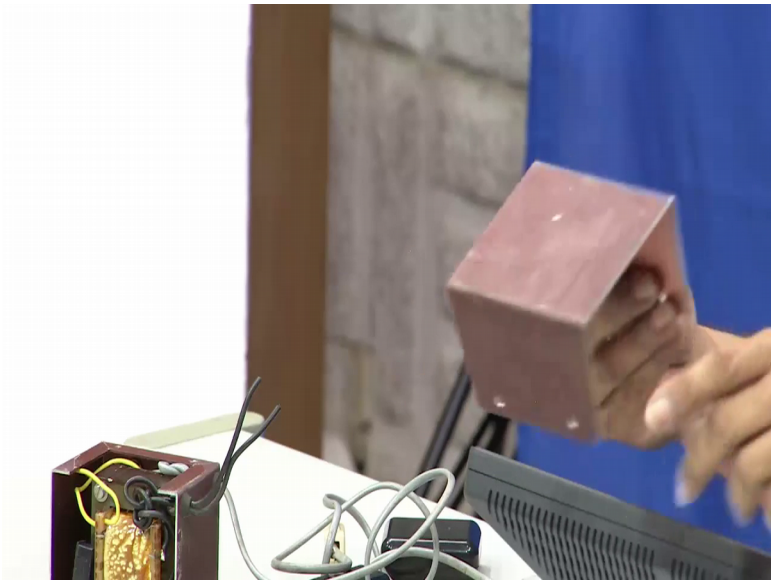

In my case I am trying to make something I think I should put in the other direction, I have seen this something which is likely to a little like this. Now you see here if you see I have a flange which is used for mounting a few items plus also closing cover depending on how stiff it is and depending on whether I want it would I like to have two screws here would you would I need one something more something here and all that we still we slowly get into this.

Now if you see this looks a little like the boxes trying to draw can you see it quite a little like that box except that it appears upside down that was intentional very much intentional.

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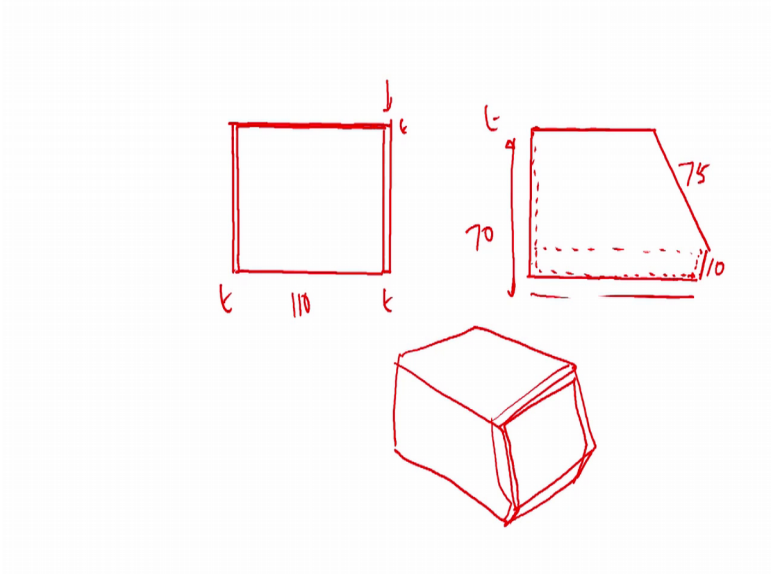

So, coming back to my OHP slide, I have a beautiful what you call enclosure which is eventually going to look like this, not bad, for an extempore something which is there.

Now, can you remember I showed you about that cardboard simulation which we should have carried out in the first thing. If you remember the I had asked you to make a small multimetre I continue to test or anything which I have done in the second or third slide (Refer Time: 23:06) if you have that already you have a place for how much of front panel let us there and because of this thickness here you see here a thickness. So, we will end up with something where the thickness is still visible here, seeing that no.

I have a visible thickness there now it is for us to decide whether we want it like this or you want this front panel to cover this thickness. If you want the front panel to cover the thickness the detailing is going to be different here if you do not want to be this thickness to be shown the front panel needs to cover this. So, the thickness will come out on top here like. So, it is for you to know imagine the actual sheet metal enclosure. So, in the case of sheet metal it is easy to fabricate and all them, but in the case of let us say mass manufactured items things are all any part can fit the other part.

But in the case of one of our samples you can make one piece make sure the other one fits over it that is that is match and then after words a trim and drill and so on. So, we can very happily I will try to now remove all these unwanted items and see what best I can do. So, one option I will try to make for you or best is I will go, I will start another what

you call go for the next slide, start with the blank sheet and fresh absolutely blank and fresh (Refer Time: 24:57) my work has been saved.

Now, I try to see how to develop the whole product inside with the two parts just before, so I have a flat sheet here which forms the top cover, which have one piece which forms the top cover. So, these go down and then this goes down and you know we have these things. So, we have what is called a bending line here. So, when you bend it you have the top part of the cover you have seen this no. So, when you bend I get this here this is relatively easy.

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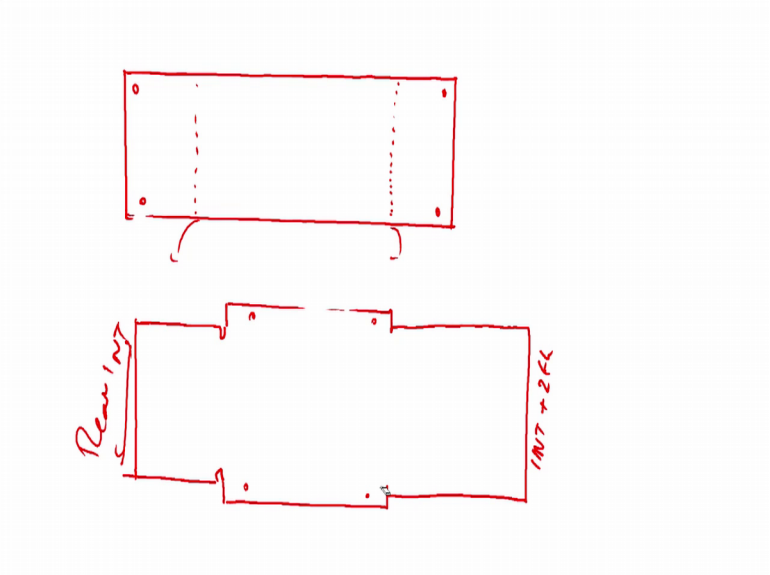

Now, when you come to the other part the bottom part we have a little what you call some decisions we need to take. If the back portion was flat we probably end up with something which is exactly like the back portion what we wanted approximately, but the dimensions are a little different, back portion looks a little like is this there is no issue about the back portion. Now we need to take a call about the centre width here we come to an interesting thing called you need a small notch here to carry out the bending without any problems and this ends up with that small tab on one side which should need for fixing the top. So, if the top is going to fixed obviously, you will have to small openings here which will probably correspond to some openings here and then we have also come to that beautiful front panel.

The rare portion this is the rare we have internal, but in the front we took a decision at that time saying why cannot the front panel overlap the sides, so that we do not see the ugly cover then we end up with a very small peculiar detail which will make a internal plus two thicknesses.

So, we start dimensioning all this and then you will probably you would have noticed that obviously, this line we did not want this line is it not, that the this line is required this is our blank going to look good.