Enclosure Design of Electronics Equipment
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Lecture - 18
Application of Sheet metal

Good morning. Last time when I left you I was trying to show some samples of some enclosures and then see how well we start our design. Now in these subsequent classes I will try to get down to a few details, on how to fabricate something which will suit your purpose.

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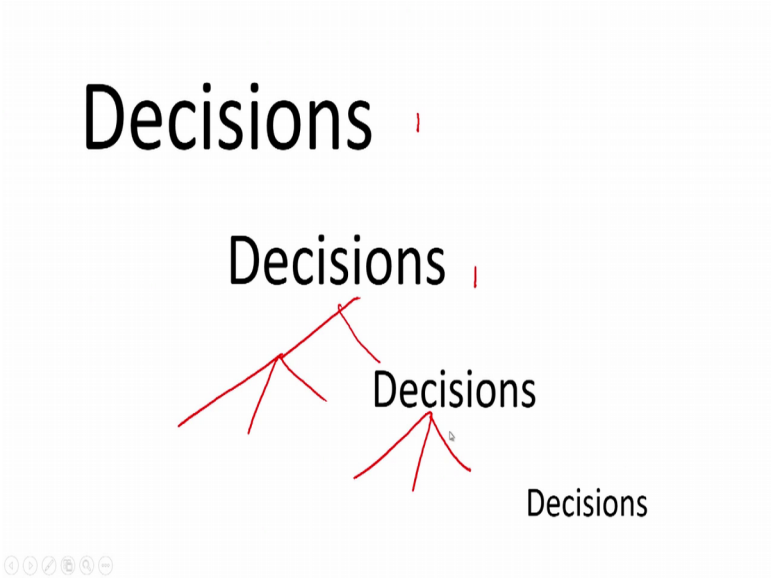

So, I will start with my ppt presentations, unlike a simple decision tree by which you have a high level what you call highest level something here and after that you come down to the next level. Later on you branch out and then you have a decision here decision here and then after that you have now so many of these things. Decisions here decisions here and then decisions here and finally, one correct decision it is not as clear as that in our case in our case what was happened is.

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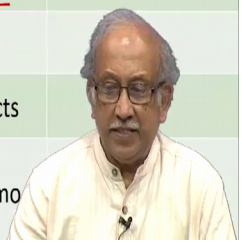
purpose	1	2	example
form	organic (rounded)	Boxy (Flat)	
quantity	small batch <100	Mass produced > 1,00,000	
material	metalllic	'polymer'	
tooling	gen purpose Job Shop	Job Specific	
prototype	working	production	
purpose	proof of tech	Batch products	
concept	Design features	Technical demo	



In case you are looking for a enclosure; obviously, several aspects come into the picture end this is not a simple what you call a matrix, and then everything neatly fits into a small thing. So, if we start with for example, if it has a rounded form, typically we call it organic; organic means not simple geometry and which can form in that thing versus a boxy structure. So, if you have to take a let us say your hard disk and such things know probably fall on this.

Another important thing is and what are the quantities in which you make things mass produced could mean greater than numbers like this, depending on how much of that extra cost can be amortized to the particular piece, for the purpose of making things consistent making of good quality and so on. Small batch could be usually something which runs less than just a figure I will put saying maybe less than a 100 pieces, very easy for us to make things like that then. Another important thing we come about is should it be made out of a metallic meaning at last lecture I have talked to you about the basic aluminum and then I have talked to you about the basic mild steel, or do we go for loosely what we call plastic. The definition of plastic is something which does not have a sharp melting point.

So, if somebody is talking about plastic bucket, it is a bucket made out of plastic material not a bucket which is plastic, because it cannot hold water it could be more like a water balloon. So, instead to avoid that know we use the word polymer something with which we make things, and everything you see around is probably made out of some polymer or the other common I have told you about it again back in my materials lecture, we have

usually modified versions of abs and then polycarbonate and then few other materials. And then very important somehow it is a lot related to this is the cost of tooling.

If it is general purpose we mean here is as in a job shop, a small workshop somebody who can take a job for you or specific to a particular how to tell an item. So, if you take complicated things.

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You see here this is a; I do not know what this monstrous I found it in my car and then somebody suggested probably it is something to hold your what you call GPS or something else and all that. This is a mass produced item it is made in not lakhs millions and in sold all over the place as compared to a small tray here.

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For some purpose I needed this tray actually it was meant for a mounting for a blower to be kept inside.

So, you see here a very peculiar you know a detailing is there. So, we have this issue is this can be made in a general purpose job shop while this needs to be fully made a specialty tools has be made and then they also need to make it a little universal. So, that part of it know if you want we can mount it in one way, we can mount it and then this can be used for other items.

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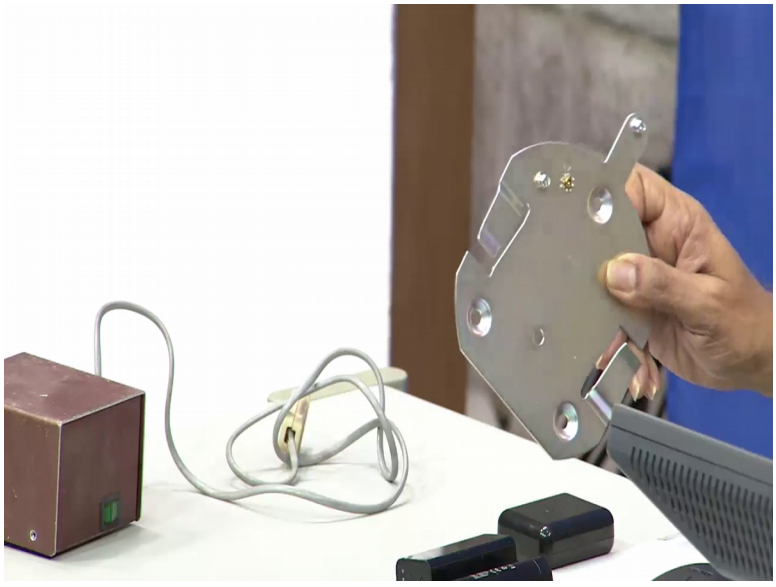

Now we come to something which is between the two. This can probably made in a job shop or if the quantities are very high, we can probably make a proper blanking and a full transfer line.

So, this one is a mounting plate probably for a fan, cable fan you can mount it on the wall or you can mount it on the ceiling. So, lot of work and lot of effort has gone into making tooling for this so that in a economical way we can produce these things. Now coming back to the slide again, the purpose may be just to prototype. To show people that a completely enclosed working prototype can be made and you know generally to make people understand what it is otherwise or it can be a production prototype; a production prototype is saying it is almost ready you pass it down the line.

And then somebody will try to manufacture these items and another is the purpose of making this prototype is it only a proof of technology, if it is a proof of technology we are not really interested in the other what you call static and other aspects of it neither about recycling and all that we would like to show people or one colleagues that this particular technology works.

So, it could be your GPS, it could be child tracker, it could be I will say you know find my things where I am lost or anything know this is typically working prototype and proof of technology. Other is to make batch products; in the case of batch products the purpose is to not just technology we would like to make a first batch of products which can be given to a small group, to see whether we can we need to scale up such things.

So, some of you may have heard about that concept called it is actually a marketing concept, saying how do you start from some early adopters who come into the mass produce thing. Saying how to bridge the gap which I will come back to it later, then another is if it is a prototype and the purpose and the thing is only a concept.

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purpose	proof of tech	Batch products	
concept	Design features	Technical demo	

In concept again know it can be a technical demonstration or it can be design features we need to talk about.

So, in these conditions we need to think of how to produce these parts. So, this lecture and the containing lecture will probably I mean help you understand. So, whether you are in a small company or you are a student or you are hobbyist, I expect it will be of used to you.

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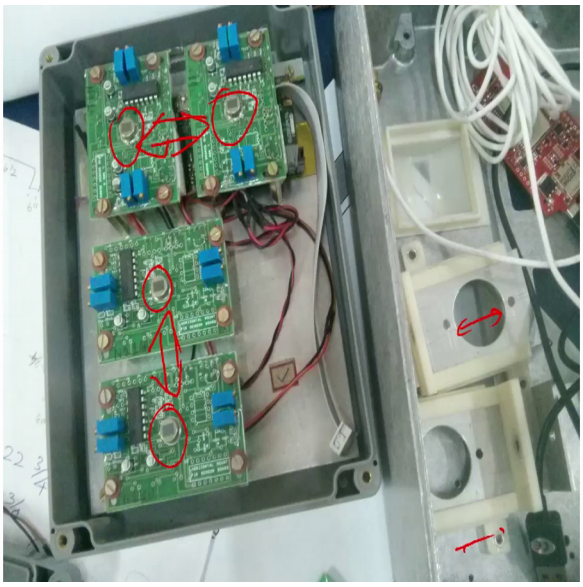

So, the next slide shows this slide which had shown you previously. This is a small prototype to demonstrate the technical feasibility of using some what you call this pyrotechnic infrared sensors, and then can we use this you see this itself is a sensor. I have a sensor here, I have a sensor here, I have two sensors like this I have two sensors like this. This coupled with a small device here which can move make a meaning I can make an adjustment.

So, if mount it somewhere and make it move up and down, can I use it for certain types of estimation direction of motion and all that. It is not the routine what you call CCTV cameras type we have, this one is used for some other you know advanced thing.

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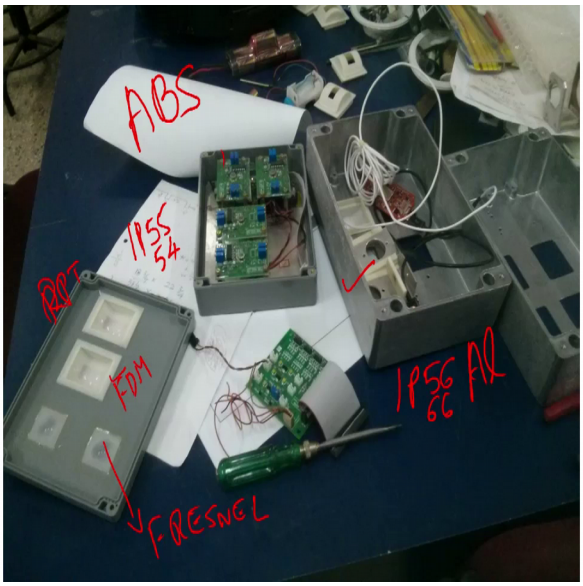

So, the next slide shows you same thing to turn a table, why I keep repeating that slide is so that you will know what it is if you see if you see the way they have been arranged. This is a standard IP 66 enclosure. Index of protection 56 66 and using this enclosure some openings have been made here all these items are mounted on this so, this can continue to be left in a harsh of environment saying we try to keep it in the in the field. So that people can observe certain things. The same thing when the experiments are all carried out in what you call in our lab this really does not confirmed to this ok.

This is probably at best. So, the water and solid contamination thing is a little lower, but you see here they in a essence both the things are same except that this is made out of abs, this is made out of aluminum both are mass produced relative easy for us to make all

these things and if you see a critical components here is we have a Fresnel lens here. This Fresnel lens is probably moulded, moulded and we buy it along within and this is one type of your Fresnel lens which was a spherical or something know which we coincide, this one is something which will which is a panoramic this thing sideways that is more.

So, these housings for this, this is made using rapid prototyping how we call it know in our case face deposit mod faced filament deposit modeling, both of them use is otherwise will loosely I will call it rpt. Now cant we make the whole box thus we can make the whole box there are issues there in that this particular rapid prototyping cannot directly replace injection molding contrary to what we think. It cannot directly replace it certain things where we need this features and all that know rapid prototyping is required.

And other extreme coming back to the previous slide that is I come here suppose I just wanted to do only a proof of technology and a technical demo. I need not have even spent the effort in buying this box and all that. This whole thing can even be assembled using polystyrene sheets. The thing is the effort is so much and it is not easily duplicatable, you cannot scale it up you cannot make let us say 50 or 100 numbers in such cases much easier to go for a standard enclosure. So, if you see here this is where know for example, in small batch simple proof of tech those things we need to select this, as I said know the first title if you remember.

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I have started with this beautiful title log saying it is not an automatic decision that you come to one example or the other you take a good call on availability, and then deliberately have avoided availability as well as cost, because generally if you are in a field, you are likely to stock all these items.

So, in our case we have this Fresnel lenses and then we also have these flat cables and we know how to make these what you call a small prototype items and then we are all geared up to make all these things. Now I would like to progress, the little biomedical things from here onwards I would like to show something please bear with me that as example. So, I try to show things which have likely to come across.

This I think you would have seen it is nothing but a blood pressure monitor. I would like to acknowledge that it has been taken from their website either from the manufacturer the oem or probably the online traders, and since it is a class which you know is refer you to students to understand all this, I am not violating any IPR and either I am duplicate any of this automatically. So, you can probably purchase the items and then you can take a call.

Coming back to the other slide I do not even know what it is all I know is there are something some something some 6 numbers to rotate, and then I have some connector here and then I have something here when power on now switch there is something here and. So, on like that I do not know what exactly the equipment is, but why I have picked it up we see this form. Even if you have to make a small number, you have to spend a tremendous amount of effort these things you know probably can be made starting with the rapid prototyping or you start with a polymer material typically you have a glass filled nylon and other materials by which know you scrape it as if you are a sculptor.

So, coming back to my first slide again it may be a design concept for all I know this may be just a design concept. So, if I go back to the here it is a proof of concept it is explaining to me what are all the design futures, saying how do I hold the knobs and how do I how do I use the equipment how convenient it is we have a master gain probably and then we have some channels, and then there are some various options of a how to add the there is a display and all that this of course, is taken from an actual equipment. Say if you have to demonstrate something this has a concept as a design concept you can

make it this way, you can probably some of these items can be locally purchased maybe these are all purchased, but you see the color key there is a key here.

And then you see the way it is how convenient to handle and then we have a pointer here and then they have this channels, and then you see it has a very what could be otherwise a somewhat a squarish box with rounded edges.

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It is basically it looks like just a box it is flat cut at an angle. So, that you can see the view and then corner surrounded it is easier in one way. Now if the equipment is a special equipment and you can probably afford to make a some things more, we have this it could be as I said earlier know just can be a just a proof of concept equipment.

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Most likely in our field that is our basic electronics you may be working with such items in this case this is off the shelf molded case. We need to only fabricate a front panel. Looking at it looks as if this could be a power unit it may be a place for a power thing. So, in our convention we have this as the usual know earth and we have the line and neutral or it may not be that at all thing is this whole panel can be removed and you can put something on top of it. And in this case basically to flat and it is one or two pieces you can probably go to a job shop, or in case you are a curious person you can even fabricate this panel in your own hand can just go about and you know start making it not very difficult for us.

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Huh now you see here slowly you are getting into little more complicated sheet metal parts. This is fairly standardized and this is called actually a rack and in this rack if you see it has all this well known equipment we have, plus it is a log there is a glass what you call opening here and then there is a something which will know share all the cables, and then we have a I do not know what it is most likely it is a modem this is probably one modem or it is a some bandwidth monitor we have all these things all put in a box. Both options are there depending on how extensive, how one of items it is, one of them is you can buy it off the shelf or you can order something to these dimensions and bite.

So, in case you really want a professional equipment and then you need to get it quickly into the a market and few numbers, most likely it is easy to buy it directly go to this big enclosure manufacturers and something which about suits your purpose is already available online. You can go inspect it and then get a few things and you need not worry too much about how to fabricate or how to design things coming back to our slides you will notice here that things like this.

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Know these mounting holes and all are fixed very peculiarly, it comes to 44.45 pitch. It has come from you know someone and a quarter inch plus half inch. So, one and three quarter inch and comes to all this need not worry too much about it. Except when there is a space constraint we have this small things know meant for 1 U, 2U, 3U all these rack mounted components are available and the rack itself is available and the main advantage

for is there are alternate vendors for it. You need not get caught saying in case there is a capacity constraint or if you want to scale it up suddenly, you need not worry too much about buying so many of them more.

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Now we will come back to some very routine thing which we see all the time. So, if I tell you about the whole thing know does it form a simple geometric; geometric shape or does it have this is what I meant by organic shape in the case of an organic shape. You see here it will it is a lot like any of the what you call living things you find here were more than living some things which follow a nature. Nature would not be obviously, know nature may not have this know, but nature has all these things.

And you see here they have played around a little instead of making them very very smooth and all that know giving it a few sharp edges and all that suddenly makes it into what could be a gaming device. We are used to it we expect these items and all to have a certain semi tick about it, saying what they mean to the other people.

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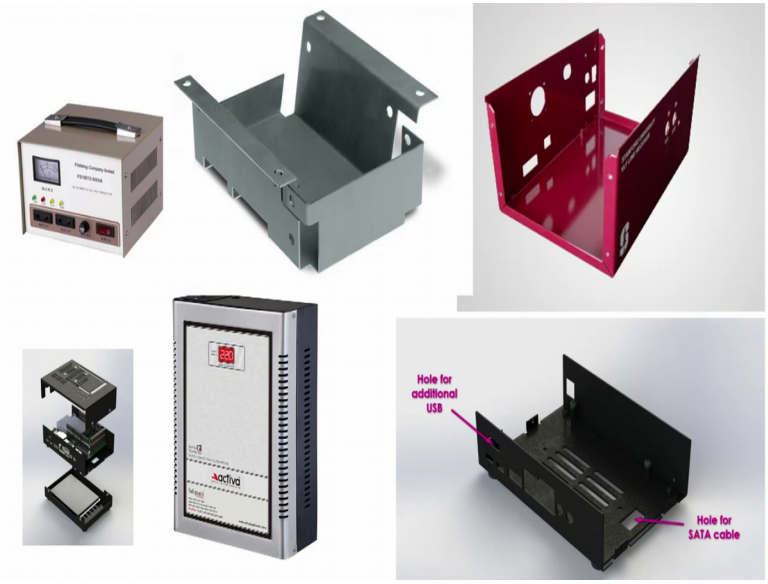

At this point I would like to bring you back to the good old boxy structures.

So, if you see things like this know, I have a I do not know what it is it something-something; something it is probably something which has a power equipment and then you have a voltage here, and then we have some regulator to be used for something else you have seen that know basically it is like a box, and then you have a beautiful wall mounted a power equipment. It could be an inverter, it could be as power conditioner, air it could be a lift what you call saving mechanism all are lifts have a small mechanism now, which are in case the power fails you need not worry about that lift slows down, but goes to the next floor and stops there.

So, some of them very small box like this which was a if some batteries outside and then normally, if your motors run on 50 hertz and 230 volts or 400 volts that 50 hertz is reduced to probably 10 hertz or if you divide it 12 and a half and then correspondingly lower voltage instead of 400 volts, it will come to 100 volts and then it moves slowly and the whole thing invariably has a boxy structure like this it could be a something.

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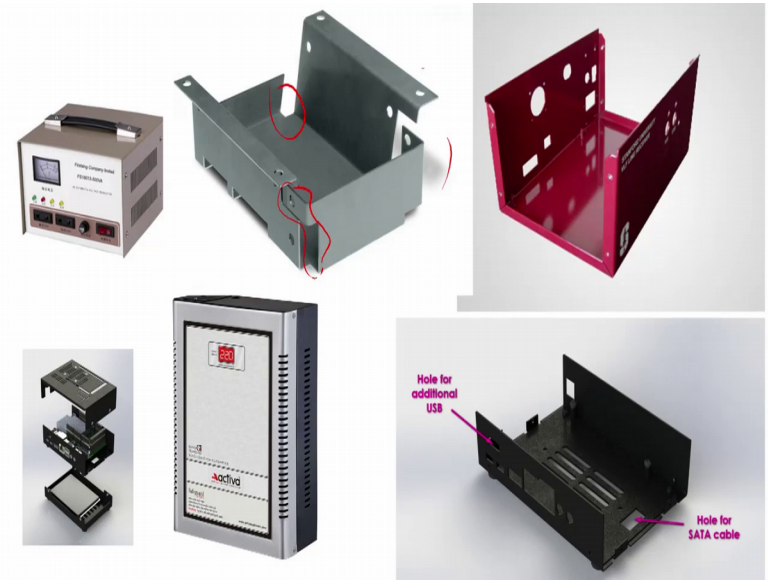

Now, if you look a little closer it is nothing but you have a part one here they have something know they have a front and back are here they have back part and anyhow the front part. Similarly you have sheet metal parts which are very very simple you seeing this know very simple sheet metal point and then you have a little the bigger the part for you know cables and all that. Now if you were to make the same thing in large quantities you see here very very interesting matching has been given here and then a flange has been given here, these are all made with tools may be in a job shop (Refer Time: 24:33) anything.

So, I will just try to get back to you and show you what I have here. So, I am here I will now remove this item.

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And I will show you this do you remember this; I brought it in the other class this is relatively easy to make. All it needs is it take a flat sheet mark it out bend it and then maybe driller holes here seeing this know good it works and easy to make, and then you can make it in your lab or your workshop or anything.

At this point I would like to bring you here the blank page, because it is going to be a practical thing.

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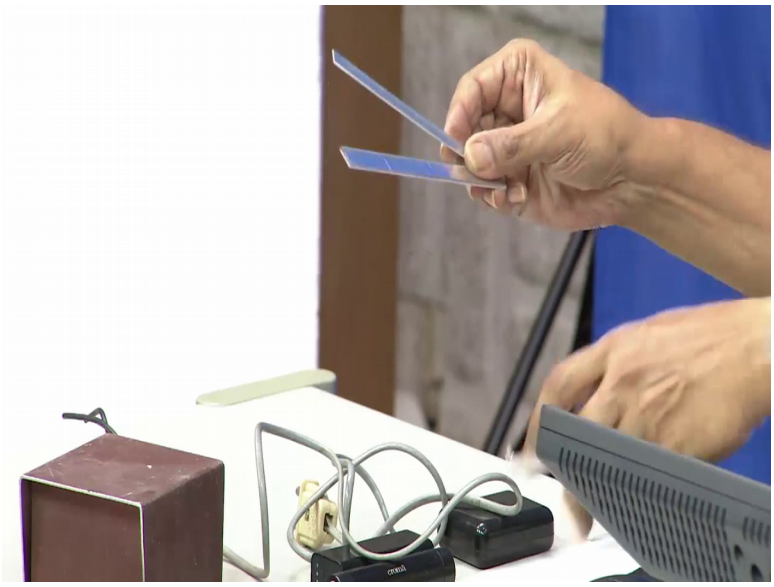

If you have to take a flat sheet a strip, you have to make it strip and then try to bend it you see here one thing I would like to point out is one of them is little thick it is a two aluminum sheet this one is a little thin it may be 1.2 aluminum sheet. If I have take that aluminum sheet and bend it.