Physical Modelling for Electronics Enclosures Using Rapid Prototyping

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Lecture - 25
Common Place Objects

Hello, I am sure, so far what we have come, you have probably able to start a little on how to do this simple 3D printing. As I have showed you before, as in the video that you have seen already, the whole thing is how to create a proper solid model. We have solid model, we print and there is this issue about how to orient the model while you are building up. Now another equally important thing when it comes to CAD is, if you take any practical objects.

Even if you have G codes and if you do it by 3D CNC machining, you start with a solid model and main advantage of any of these working on these things seems to be, you can manipulate the object and store it as you like for as long as you like. So I will start with a small example.

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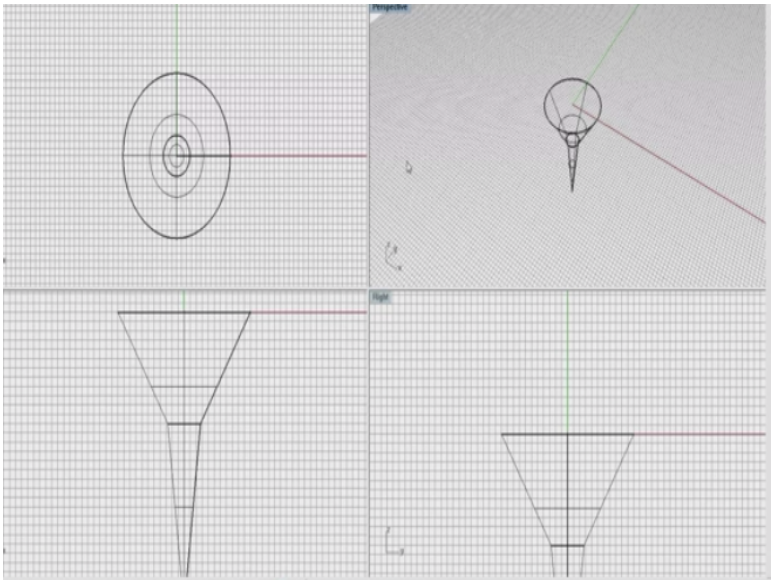

So that you will appreciate. I need not stress it again and again, anyway by now, you know how well things are and all that. Imagine, I just wanted to create a small device, you just have a look at it. I am sure you will enjoy it. I am sure you now have an idea about this device could be. It is nothing, it is just intersection of two cones and I have made an object and then just for good effect, what I will do is explode it, remove one of the n caps, so what do I have here?

I have what looks a little like a funnel. Advantage for me is geometric dimensions are all available for me for whatever I want. Main thing seems to be whenever we want to now, if I want to duplicate it, one of the simple way is to copy it. Now comes the much more important and much more interesting object. See here, I have a funnel with a given shape. They hopper part which collects and then the other feeder part in the bottom, which I can do whatever I want.

Depending on my requirement and these things, I can now improve a need by manipulating the dimensions.

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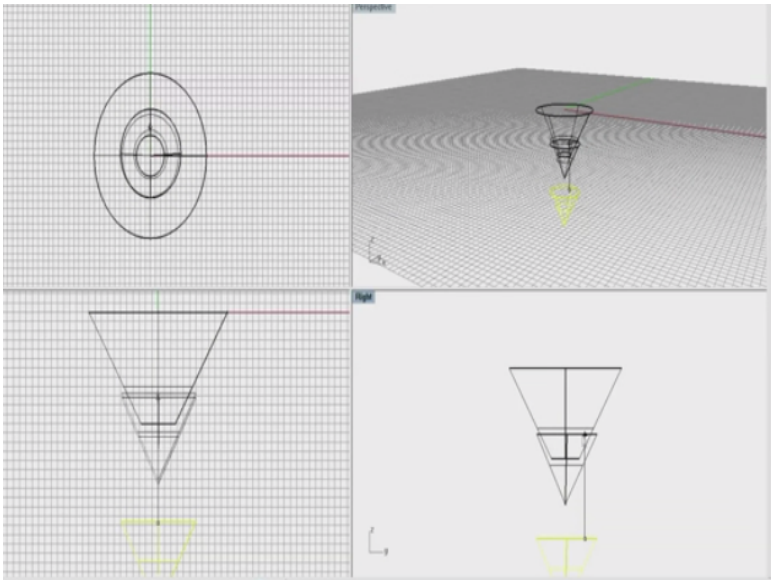

If you see here, I have one surface here, I have another surface here. If I now turn on the points for that and I turn on the points for this, it is possible for me now to play around and make it of any shape I like here. Can you see here. Bottom, this part, I have this surface points, so I can scale it up. I can make a simple scale, 2D. This part has become a little bigger now. Now, I can just drag it here, attach it.

I can make an object, which now looks different and probably, it is useful. One of the important things what we do is, in general, if you see all these objects now I thought I will show here, I start with my samples here. Please show this, can you please show me the main camera.

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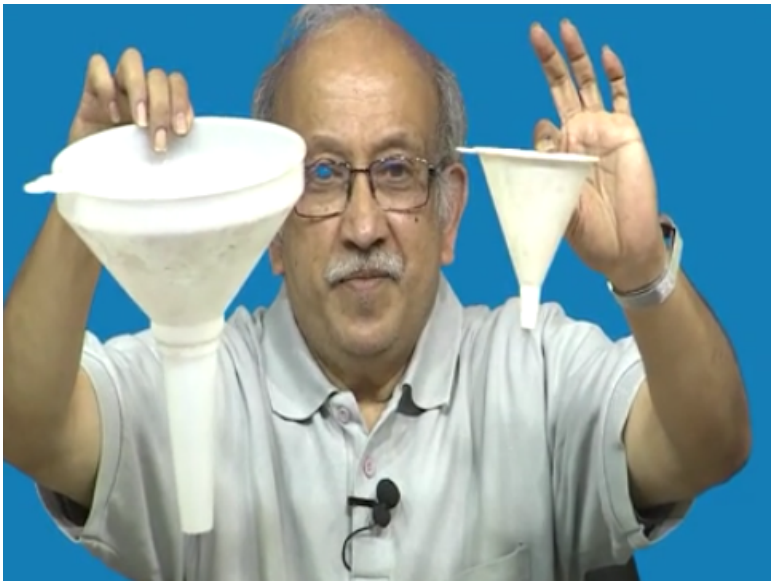

You see here, this is a funnel a little like what I wanted to create it there. This is a normal standard funnel and then if you see here now, some of them come with capacity, some of them come with just numbers and then you have all these features. I have something here. Now let us say after working a little, I have found out this is not just enough for me, I need something else. Now it is a matter of scaling and I can make something almost similar to the other one, except that it is quite small.

In fact, if I want I can make them stackable and here comes the actual beauty of it. I can also make it big. Main thing being the drawing is about the same. This one was a standard thing. This is made for a technical thing. it is made to be part of a standard funnel, which is 200 mm and it is used for rain collection device typically a rain gauge. In the case of a rain gauge, we need this and then remaining things have been put.

Now this material is one thing, it looks fine, absolutely no problem at all and this is where actually I am coming to the corrects of the all lecture today. Now, you have seen this.

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This is also a little about the same, but the material seems to be slightly different. This is shiny and this one is slightly different shine and then the luminosity for both these things are different. They are mildly different materials and a little bit of detailing. It may not be visible there. We keep it in a collecting device, chance is higher. This has a tendency to choke up, because there is no place for the air to go out. So there is chance for the air to go inside and all that.

Instead, this has been made with small flutes all around here. there are small flutes here. When you put it in a jar or measuring jar, air gets out and we can easily pour the material inside. The magic is, all of the samples can be printed by rapid prototyping and just by simple scaling method, you can even find out what is the volume and most 3D objects here, most 3D software here, if you go and point out this thing, I will just go to undo and go back to the original cone and things, which I have made.

If you see this, let me say it is part of the structure what I have made here and if I highlight this, go here to analyse the properties, things like, it is beautiful. Volume is also taken care of. I am not able to see properly, but it clearly says it is around 2000 cubic mm. If I divide it by 1000, it will become 2 cubic cm. It is a matter of scale that I can make things which are bigger and smaller. I will just abandon this here and come to a more interesting object here.

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Imagine, now look at this. This is the fan I have been showing you all along. This is heavy. The part of it is made with a type of aluminum and there are 2 materials and you see the thickness. The thickness also varies depending on the power, the diameter and various things, I can change the material, as I want. There is a mild difference between the two and if you see next is, you see the way the blades are formed, can you see?

These blades was a slightly different profile compared to these blades, slightly different and even if you see the diameter in the inside, that is dependent on the motor characteristics. Now very important thing, which I would like to, I do not know whether it is visible or not, if you see any of this fans, and if you are one of the usual hackers that goes around, assembling and dissembling things, you will see a direction of air and a direction of rotation.

In this particular case, it says rotation should be in this direction and in that condition, the air flies towards me. Why is it important and maybe if you just run it in reverse, will it be equally efficient or not, so we have a little issue here about, which I will come back here. Now using the same file, it is possible for me now to manage to make something, which is thinner.

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You see here, much, much thinner and if you see the inside that thing is the impeller pad, this is a heavy fan, this is one is a little lighter fan and the mounting walls are the same. All of them are based on probably a similar or single drawing. Long ago, it was not possible like this. Now come to the interesting thing, having this file, just like whatever I have done with the funnel, I can now do it with the fan, very interesting. I have a fan which is a little smaller.

Now maybe I will take this as a reference. I have a fan and you see here, this is even smaller than this. This seems to be a practical limit and then actually if you open one of your computer power supplies, you will find really tiny fans and still further if you go down to you see the PC cooling devices, they are very really, really tiny things. The advantage of the 3D printing is at least in the first CAD, you can try all these things, seeing how well they work.

Now again coming back to each fan, every fan has this one direction of rotation and direction of air also, it is marked. Same thing here also it is marked here, air direction, which will come to the very, very important things. Why is it so important?

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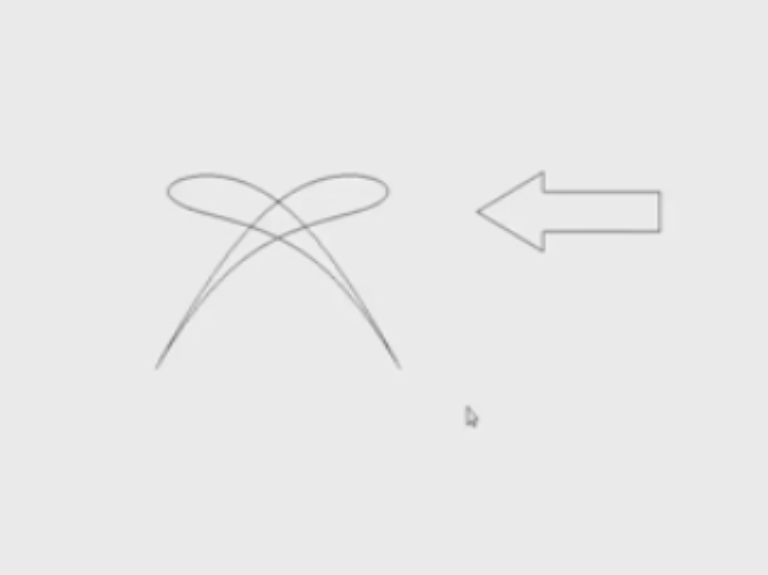

I will just go here and try to see what best I can do, kindly bear with me. What is done is usually a bit of fluid mechanics, a bit of everything is tried. Typically, this is how several of the fan blades look. So one of the characteristics have you noticed. The characteristic seems to be that the air, as it enters comes in this direction. Seeing this, air comes like this and then finally it exits here and this is typically depending on the complexity of the device and so on.

The direction of rotation, this is how probably cross section of the blade looks like. It looks like what is called a cambered aerofoil. Now comes the very important thing, why is it required. Why is this very peculiar this thing is given is when the air enters, typically it enters actually. When it leaves, because of this rotation, it has a tendency to go at a slightly angle. I have unnecessarily made it a little drastic.

Now just be with me, very quickly I will create an arrow. Air enters there, looks good enough, is it not? Now when we reverse the flow this whole characteristic is gone. By just reversing it, you are not achieving anything, in fact it will be very, very impractical. I have written it in the reverse direction. Actually when it enters, the other way it is correct. So allow me to just rotate it to the other direction. Air enters here.

This edge tries to cut it and this tends to go here and all that, just ignore the shape and all that. The aerofoil will be in reverse. Now if you are to rotate the thing in the other direction often, the

whole purpose of it will be lost. It does not behave properly. This is where our 3D printing and trials and all easily help. It is very easy for me to create. So if this is one of the things, I will take a detailed thing later to make a mirror image is very, very easy.

This particular thing helps when the blade is rotating in this direction and if you want it in the other direction, just reversing the polarity will not help. It will not be equally efficient. Those times they also need to create a mirror image of this. If you make a mirror image of this, like this and also reverse the rotation, then the efficiency of the wing or efficiency or the aerofoil is protected, which is very, very easy in the case of our rapid rotating.

So you will notice that it is not just a matter of printing just for the sake of printing and so on. It is about playing with all the technical parameters. If you want to create a smaller fan, done. If you want to make a wider fan, done and next comes the very, very important thing. Now please have a look at this. We have so far successfully showing you only fans. This is made with transparent material, do not ask me why transparent material is required.

In this particular one, it even seems to have some LED and all that. I do not know why it is required. Probably, we need to look at things inside. This probably is the same file, which was used for printing, transparent. I am not very sure what the material. I will risk saying it could be a type polycarbonate or something similar, but fully dyed black. Both are plastic, both are thermoplastic, both are injection moulded, transparent versus opaque.

All dimensions being the same. This is where we come to my topic of today's lecture, I hope I make justice to it. Other than the samples, we have not been actually able to fire any jobs and give you first hand information. I cannot give you any first hand information. All the information I have here is all about, which is taken from the websites. I have also posted a lot of links, if time permits and during editing, I will see if I can make things.

Now, if you can look at my main screen, which I am going to show, maybe you can read along with me.

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If you see here, there are a very large number of objects out there, which require various types of materials. This is a very common place, LED bulb, lot of difference and lot of commonalty. The parts of the country where this is being required, we have old Bennett type of cap and you see here this material is a heat proof opaque material. Advantage of this opaque material is it can hide all the electronics inside.

Then, we have a translucent material, which is an opal type of material, which can diffuse the light, so that it looks a little like the regular bulbs and all, which you see there. If I go to the next picture, same thing except that we have a 22 mm screw base there and you see it is a little more, the bulb seems to be a little circular compared to the one, which you have seen here. It is not that much of a circle. It is only a half a hemisphere.

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Thing of interest is we can now even colour it and you see here, obviously it has some other function. In this case, there is hyper electronics and it is able to buy wireless and both by IOS as well as android, you can control the colour of this whole device and we have a heat synch that is made here.

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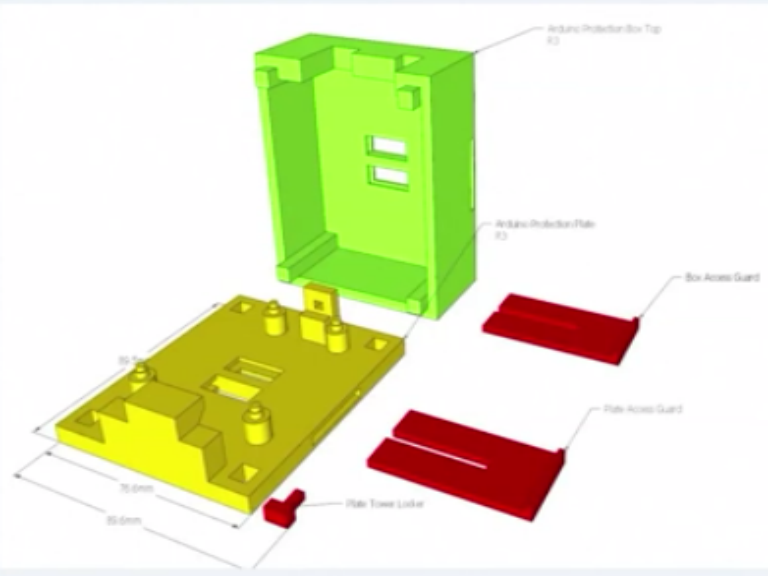

Obviously they are made of very, very interesting absolutely breath taking materials. This is same thing. I have a beautiful LED bulb here, which is almost round perfect globe and when you suspend it and then from a distance it has a look, which spread light around and it is really, really interesting to see such things. The point I am trying to make here is you have different materials for the different purposes here and maybe I got it here.

At the base, it could be a plastic, obvious and this part of it is a metal, the screw part and then you have the one part, which is an opaque material and you have a beautifully near perfect sphere. So design of those luminaries are light fittings becomes very, very interesting when you have this thing here. You see here, it is even better. I have even more globular, even more interesting this beautiful near perfect spherical, which I can use for all my purposes here.

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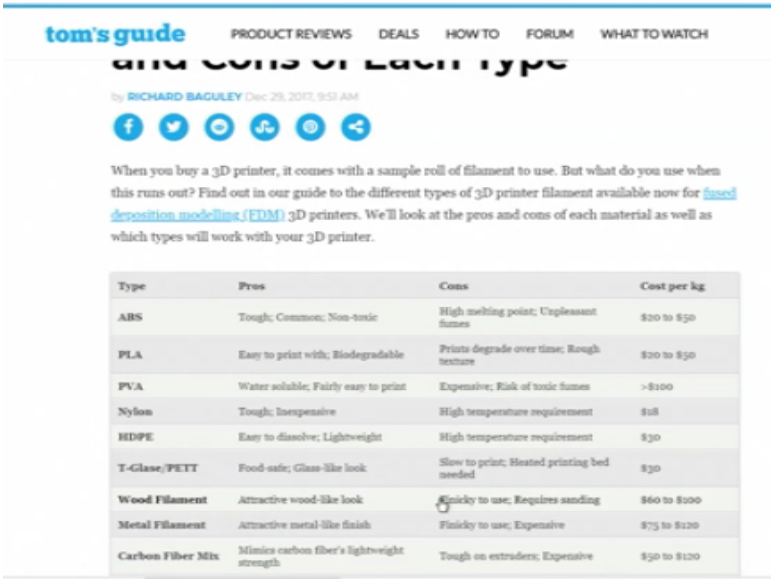

I will now skip and get back to one of the points in my lecture. Allow me to start with, it is not an apology, an acknowledgement that somebody has printed using different materials the same type of a job and they have made this available to us. It is for us to read along. This particular thing is called the Tom's Guide, various materials here. Let me make it just smaller and it will be easier for me to manage.

You see here, the starting point is usually ABS. ABS is acrylonitrile butadiene styrene tough, very common non-toxic. There is something about high melting point. Why is it a con, why it is not a pro. The con is because that much higher melting is required and hence the layup and all may be smelly and on the right column they have given deal about how these things are and, next very commonly used thing is probably this polylactic acetate.

These materials are used to print and biodegradable, but degrade without our thing, over time. Like this, large number of materials have been put here.

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If you see here, same object has been printed here. Now you will see toward the other things. Generally, people will show you a finished product, but the finished product has got into that stage after it is finished. When it is printed, typically if you take this, I do not know it could be a candle holder, or it could be a just a decoration or anything. It can be a 3D screensaver, something picked from the usual screensavers, if you see.

We have a multi pointed star and you see here at the bottom, what do we have here, these are all the support materials. You read it for yourself at this point. The interesting thing, just like the little way I like to talk. If anybody stepped on a lego brick will tell you the base stuff, it hurts and it is sharp with these things and all that. It is also water and chemical resistant and in general, it is not toxic. So even if a baby tries to chew, there is no issue about it.

Only problem is that we have a little problem in melting. Cons, high melting point, unpleasant fume, not suitable for outdoor because it is not resistant to UV, mild degradation is there. First sign of it is the surface colour fades, whatever filler is used, it starts fading and once it fades, whatever the aesthetic effects for which we have printed it will be los and it is partly shielded or things like that, then we have a problem of it looking ugly.

Because a lot of our life depends on identifying things by shades of colour. When UV happens, the colour changes, compatible with usual heat up to 220 such as this so on and so on like that.

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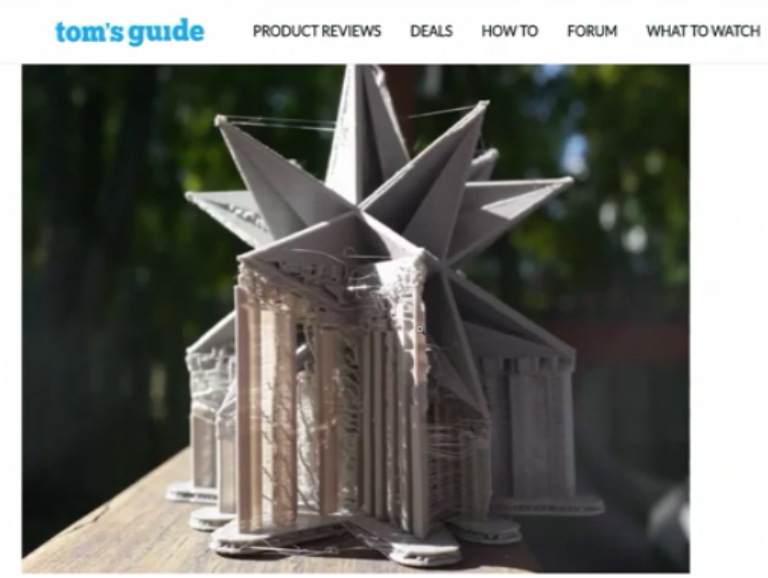

Next one is you see the other one.