Computer Integrated Manufacturing
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Lecture 41
Laboratory Demonstration
Rapid Manufacturing (part 2 of 2)

Good morning, welcome back to the course. In this lecture, we will take you to the lab for the laboratory demonstration.

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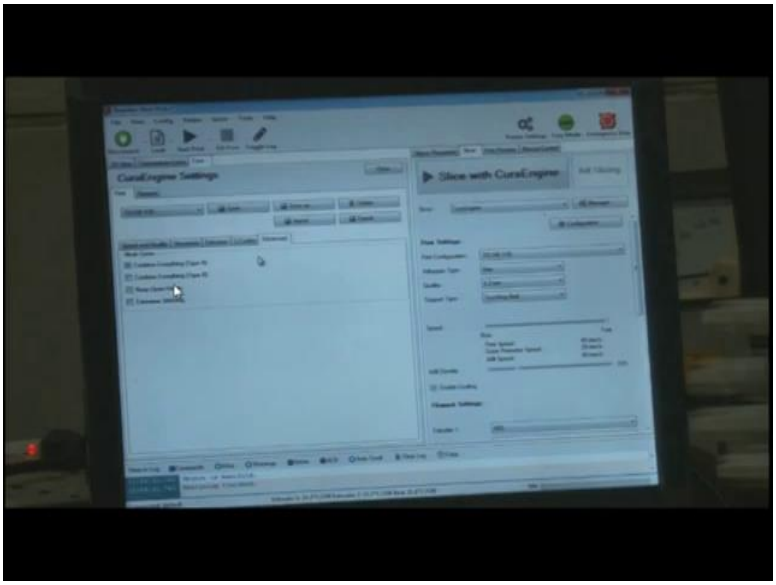

There is another tab here that is advanced tab, advance tab is again is used by manufactures like combine everything, combined type A, and type B kinds of the materials here. Then the second tab is filament to print, we have few filaments.

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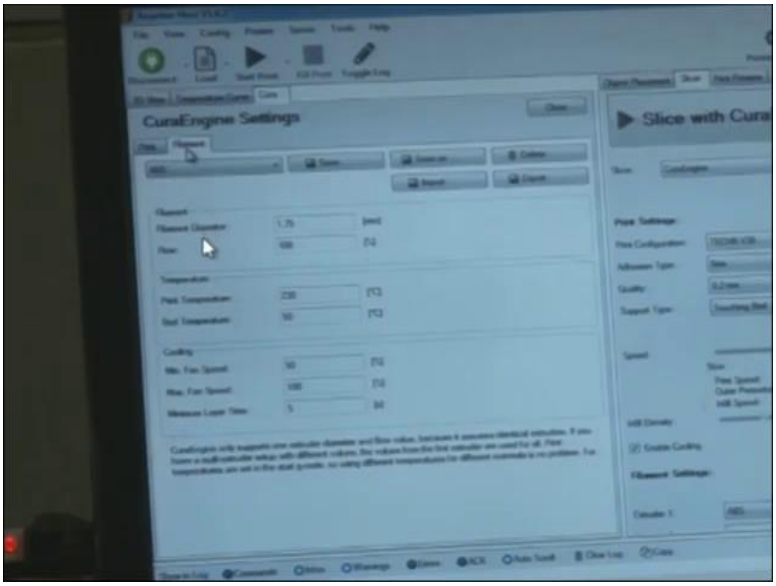

Here, we have the feeding speed, the filament diameter the general diameter size is which are available in the market are 1.75 mm and 2.85 mm this filament that we have here, that we are using to fabricate and to demonstrate it is 1.75 mm the flow is kept 100 percent.

So, this is a particular property of the material the filament that is, what is length of the filament, which is diameter, what is the flow, what is the temperature equivalent temperature all these properties are there for the specific material, for the specific kind of spool that we get from the market. So, those are sometimes given with the material when we purchase.

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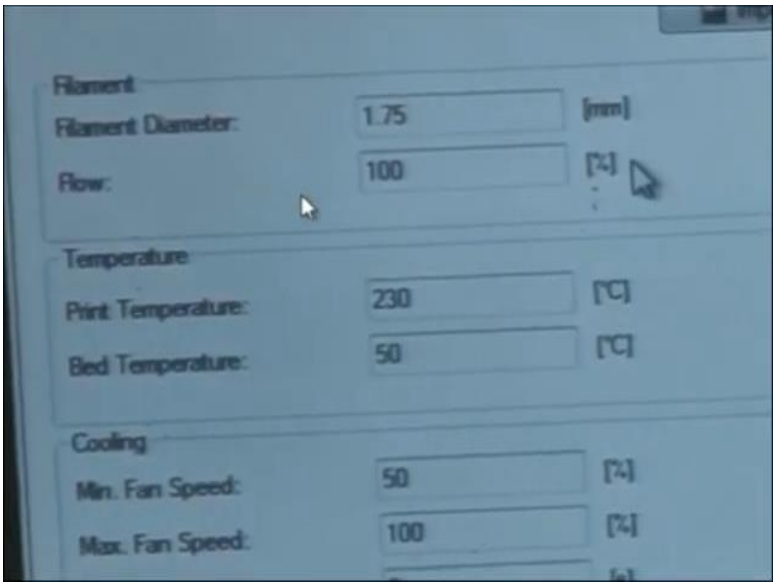

So, this is the filament, so it is in the form of a wire, again the diameter is 1.75 mm, then we see this flow, flow is 100 percent that means, whatever input we give, whatever speed with feed input we give, it will run a 100 percent in that speed only. So whatever we are going to input so it will work in that, according to that only. The next we can talk about temperature.

To what temperature it will deposit at the bed? What would your temperature of the bed? Print temperature is 230 degrees and bed temperature is 50 degrees. So, it is kept at least 50 degrees in general, 230 degrees is the temperature, will discuss about this and well.

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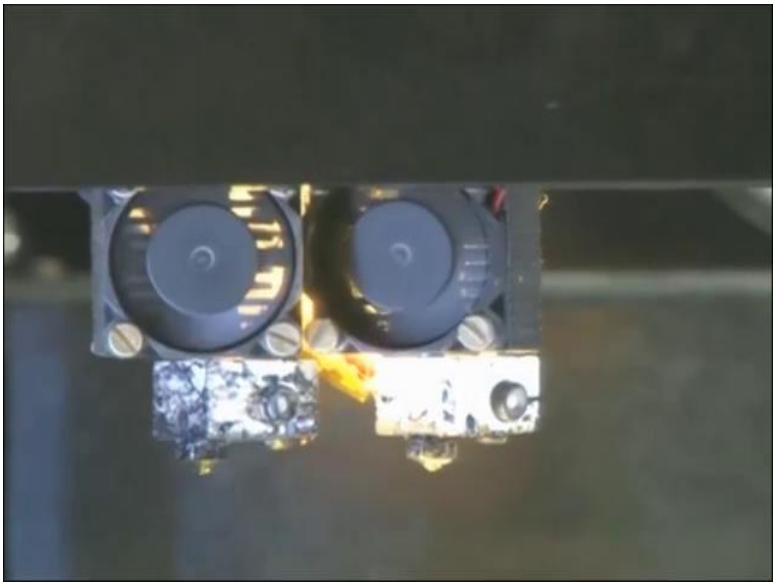

This is one more thing that we mentioned earlier, there are two fans. Fan 1 and fan 2 here, the two fans here, fan 1 and 2. After fuses it becomes viscous, and for the long time, it will de-shape the CAD model, if it is not properly controlled with a structure temperature. So, after depositing, these fans are responsible for the cooling and solidification of the layers.

So, that is why it is mentioned in the software cooling. For minimum fan speed maximum fan speed the two fan speeds here, minimum fan speed is kept at 50 percent, maximum fan speed is kept at 100 percent, and minimum layer time is 5 seconds.

It takes 5 seconds to cool the last layer of what was deposited earlier, so in 5 seconds till it will take care of cooling, 5 second is time set in that, this is called curing of the matter, this is call curing of the matter when we do cure, okay. Cura word is also derived from this curing.

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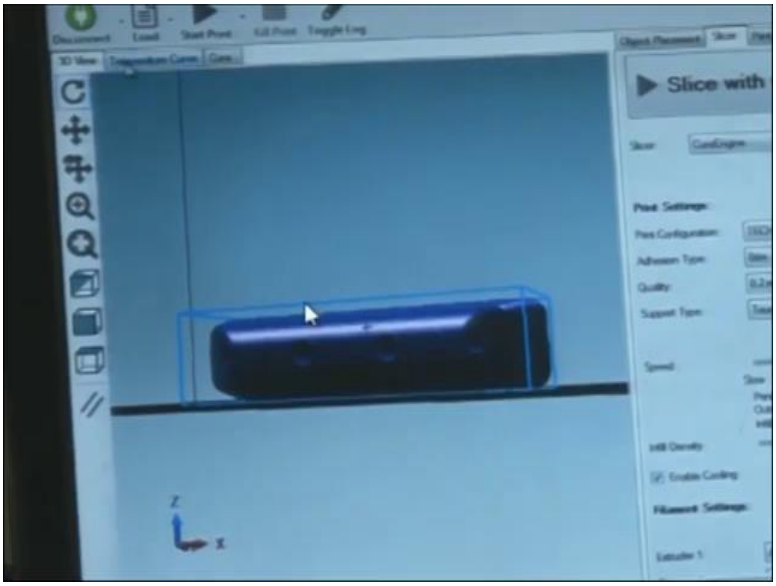

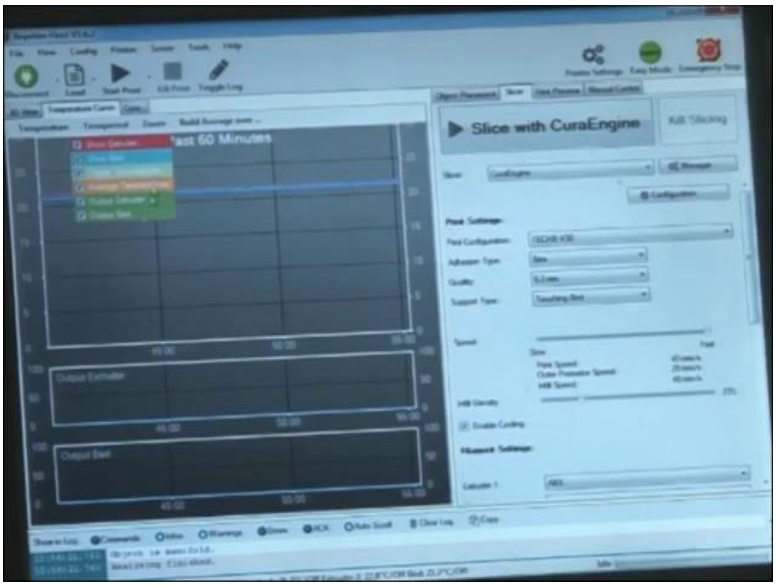

So, this Cura you know we have now, broad understanding of the Cura software. So, this is temperature curve, temperature curve we can see the temperature of the output of the bed it is from 0 to 100 if we say the output, what is the output which is coming actual temperature here, what is output coming, and output of the extruder then it can just show the curve when we actually run the machine when the machine is running.

This is 3D view, this is temperature curve and this is in Cura, now this is in 3D view, we can zoom in and zoom out. This is zoom out, this is zoom in, this is moving up and down, zooming, zooming out.

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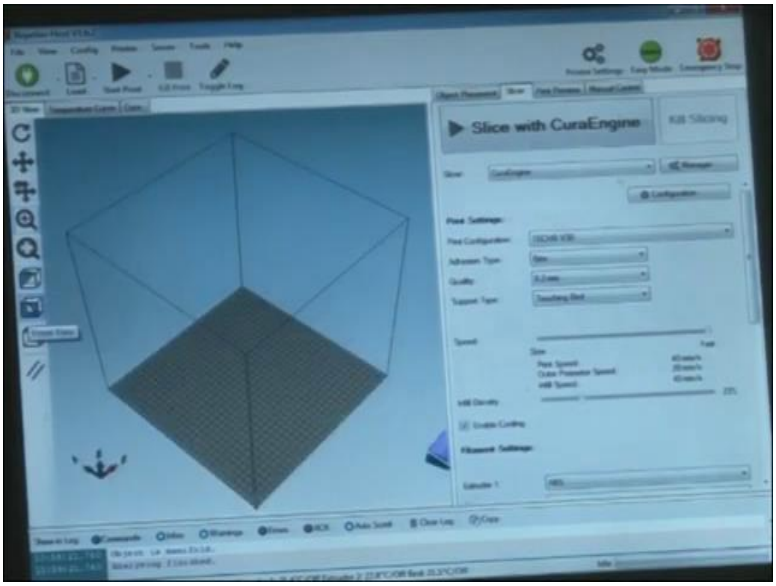

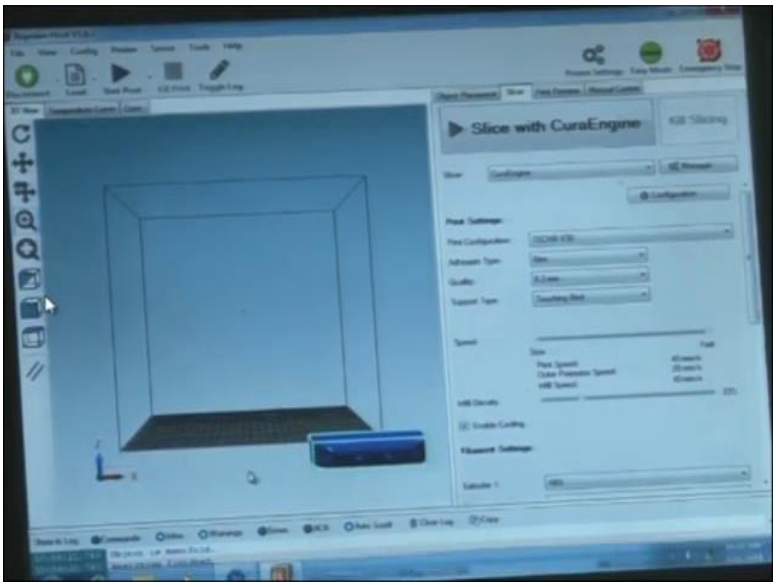

Then isometric, then front view, isometric view and other axonometric views that we can see here, this is top view, this is front view, this is now isometric view. So, we are still working in this tab, slicer, we still working with slicer only.

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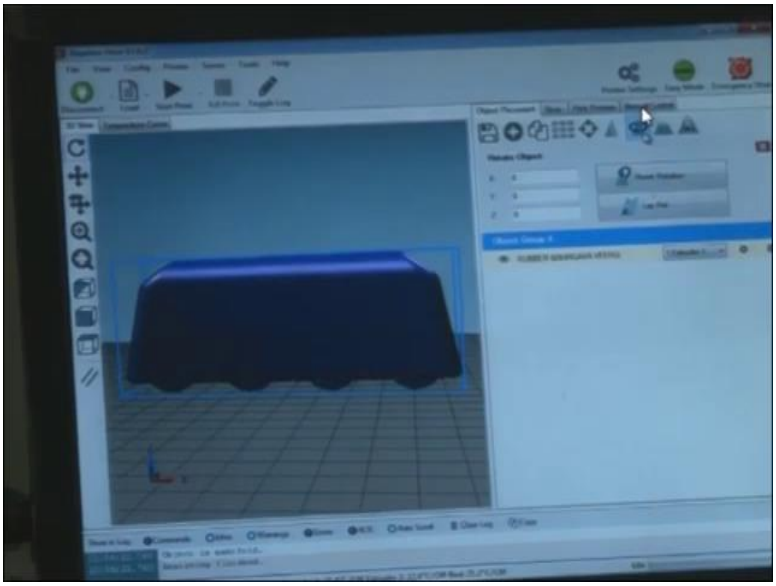

So, as we discussed before, the slicer is the most important tab what I feel in this software when we need to decide most of the parameters are decided here only. So, print preview is just a preview and manually control is when we need to control the machine manually when we do not trust the G-code or there is no about question of trust it is about when we need to make some modifications according to our requirements.

So, as we can machine it in lesser time or we can induce some new features than manual machining control whenever we do new then manual machine control can be done.

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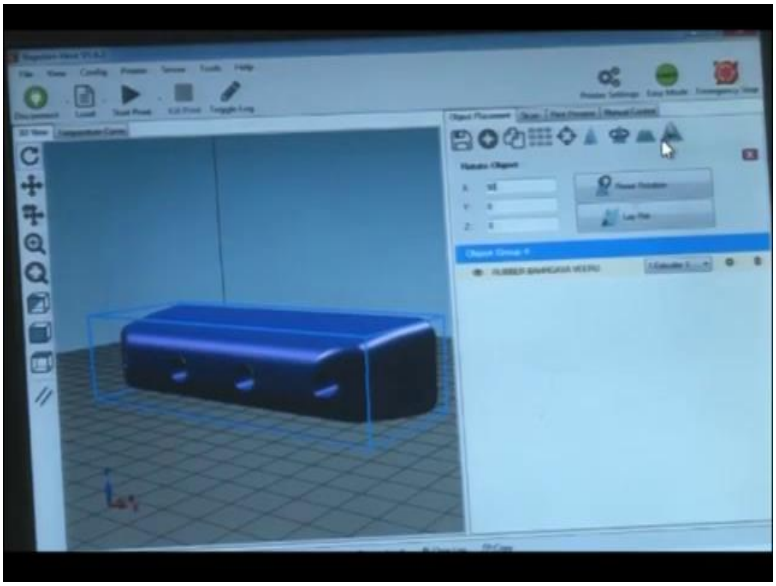

So, we have discussed object placement and slicer so, we have discussed like this is the copy command in object placement, mirror command, rotation command all these commands whatever we have used for the proper alignment.

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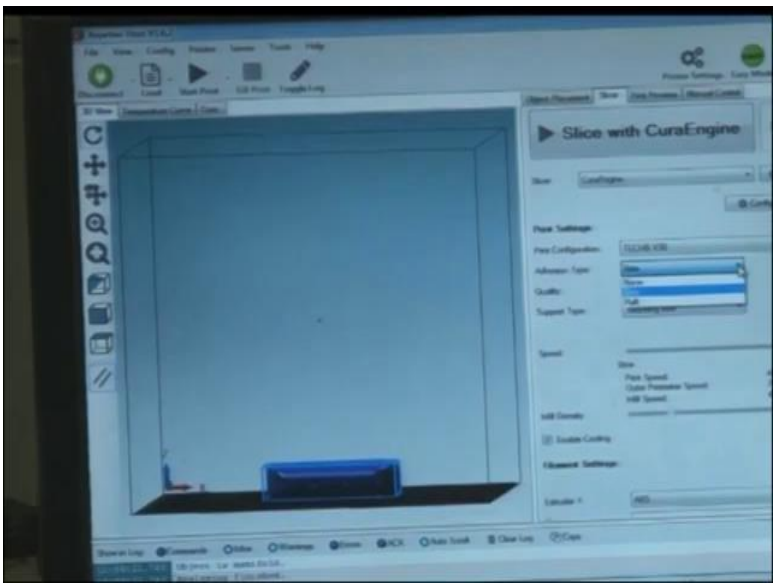

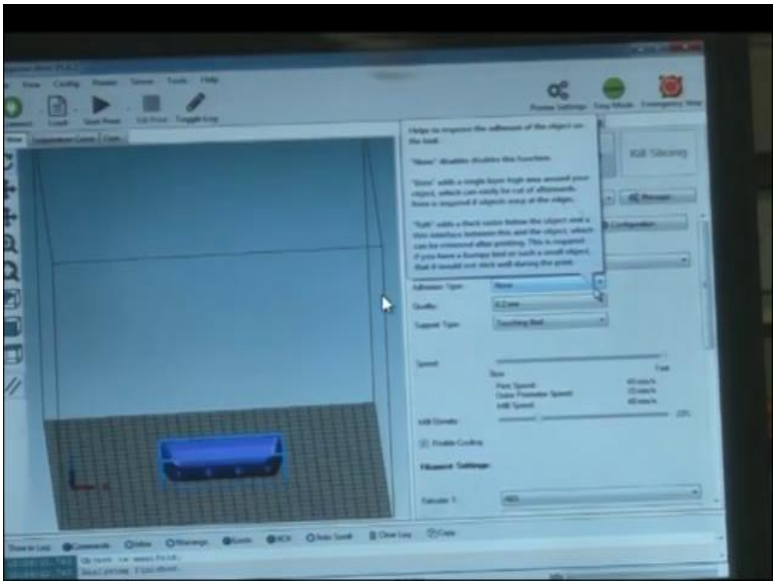

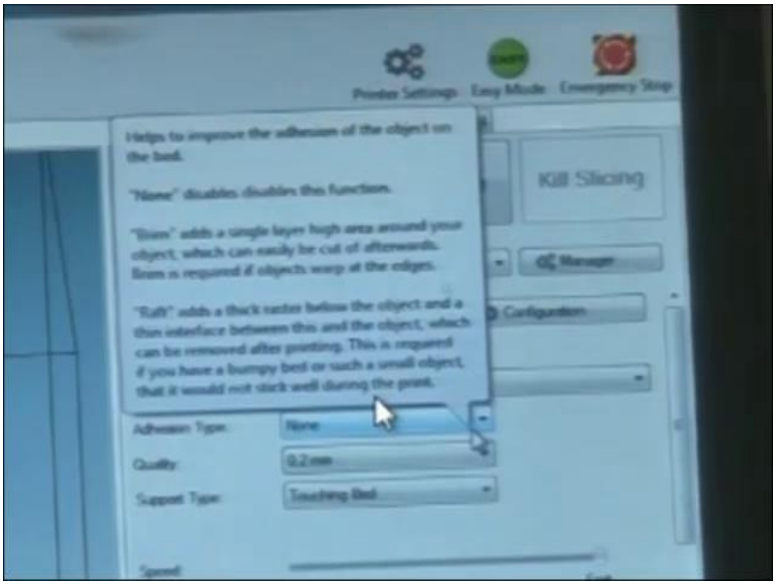

Now, in slicer we have a few things like adhesion type, what is the adhesion type? Adhesion type that is given is brim, brim configuration is a part of the mutual kind of the machine model that is put here, the adhesion type is brim, what is adhesion type?

Now, here we provide a little bit more material here, we use a little bit more area to deposit the first layer, for the very first layer it will be bigger in size from the CAD models whatever we have obtained and what we actually going to print this layer, the first layer will be bigger.

So, but it has to be only first layer, adhesion type is the first layer, first layer where we has it is brim or it is raft, we can, after this first layer the second layer would follow the CAD model. So we can have two major kinds of skirts along our model like, this is the model there skirts along this can be built the skirt can be brim or raft. So, this way, this play very important role.

Because this layer will stick with the machine, it will stick with the machine of this tabletop, this hot plate will stick here so, if we do not provide any extra material to the periphery of the job, the job may stick on the bed, and we may lose some features on the base of the job.

So, we can use this feature only when we find that more material has to be added that this job is necessary, one more area is there, so if we say none it would not have any brim or raft it might be side drift. So, if is that, if we are very much confident that okay, this specific type of job would need a brim or raft are both kinds of skirts.

So, when should we use raft or when should we use a brim, what are advantages that they have with each other that in that we can say, a raft would allow for better adhesion for the whole print as raft attaches the printing surface and the print attaches to the raft, like, if this is a print, and this is a print that we are need to produce, I need to produce this model if there is first layer that is throughout the base okay at the whole base that is raft, brim would only at the outer periphery.

Okay, so this brim and raft can vary, we can see that whether raft is required or brim is required depending upon the material that we are producing. So, brim does not help a lot with layer adhesion, and as it is only one layer, raft can even be more than one layers. Because normally when we use raft it needs a live looking the first layer like in general like we are talking about the first layer only, adhesion type.

But, raft can be even more than one layer, brim is only one layer always. Rafts are primarily used with ABS material to help with warping and bed adhesion, they can also be used to help stabilize models with small footprints or to create strong foundation on which to build the upper layers of your part.

The raft, a lot of work is being carried out, a lot of research is carried out in raft and brim design like how, to decide how many number of years and improvisation is happening in this so, 100 of different machines are produce to minimize because, raft or brim whatever, we have raft and brim would be an extra material that is wasted at the end.

So, this wastage has to be minimum but the quality of the products should not be compromised. So, we can decide between this two, about brim, what is brim? Brim as I said it is just as the outskirts of the job. So, brim are, brim are often used to hold down the edges of your part which can prevent warping, and that is also helps in adhesion with the bed.

It is it is actually known to the manufacturer that would the quality of a product varies with using brim or not. So in general brim command is prefer into that, like to reduce the wastage of the material.

So, the second layer onwards with follow the CAD symmetry in this specific model the brim and raft are only the first layer, as I mentioned before but, in certain machines raft can be more than one layer as I mentioned.

So, we have just kept it as none that is we are not getting any brim raft here. So whatever we do, whatever dimension we give it will just start manufacturing the component without depositing any other layer here, okay.

So, like you can also see, brim none disables this function brim as a single layer high area around your object which can easily be cut-off afterwards, brim is required if objects warp at the edges, if the edges are more important, if the edges are more important, like this edge, this edge, okay this edge, edges are more than brim to use, raft adds this is a help that is given by the software.

Raft adds a thick raster below the object, and a thin interface between this and the object which can be removed after printing this is required if you have a bumpy bed or such a small object that would not stick well during the print, so I think this makes it very clear.

So, normally we do not use this feature, brim or raft we are just kept in here, we can use this feature only when we find that our job whatever we are going to print is perfectly flat at one end that is rectangular, cuboidal, cubicle or at the cross-section or at the bottom of the job, then we can use this or we are going to demonstrate this.

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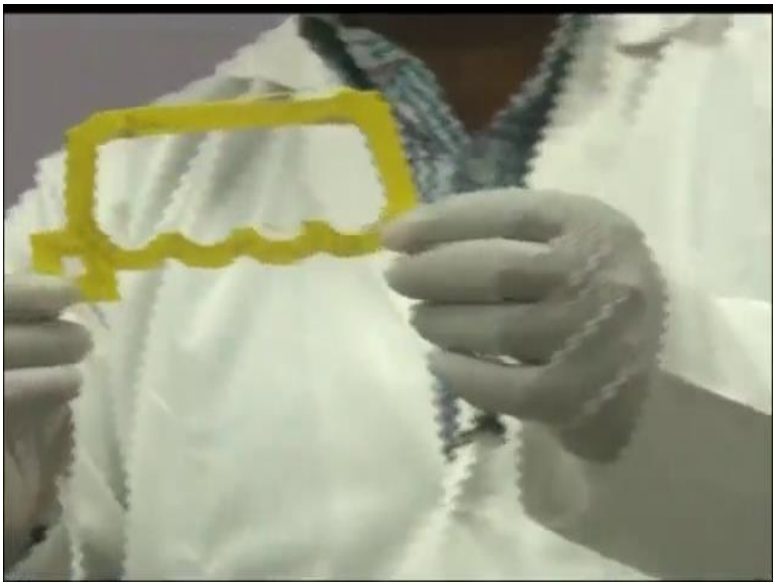

But we are going to clarify you that, that this one thing this is brim.

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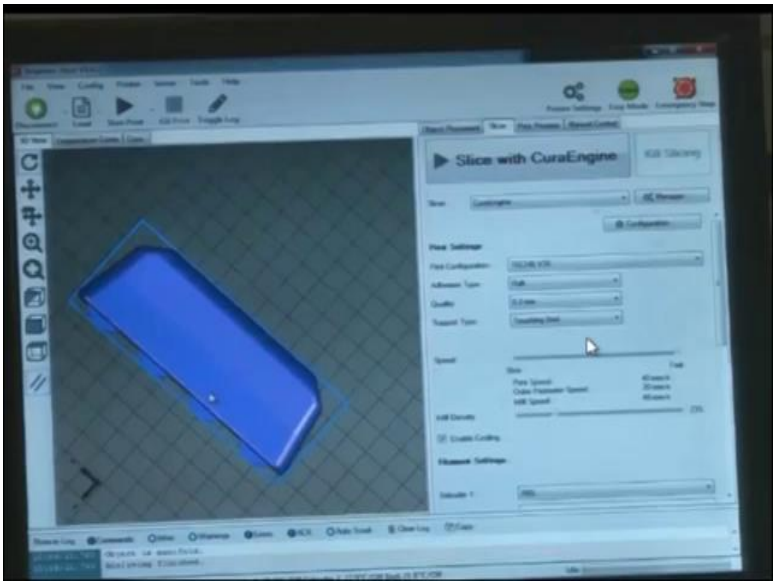

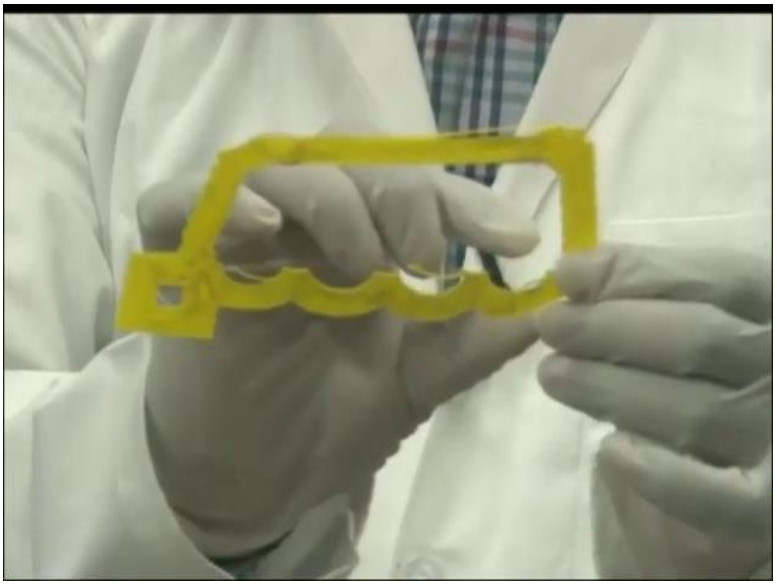

So, this is brim that is taken off from the job that is pre-fabricated. So, this is the model that would be developed. So, this is the pocket, this extra material is brim, this extra material is brim, and this whole material is brim.

So, this is taken off from the project that was manufactured before so, this will stick with the bed properly, and this enlarged area this is the first layer this will provide a good holding with the bed, so we are talking about a selection brim here, the software. So, when the nozzle head starts printing it actually it is the actual model that we want to print.

But it will deposit a little extra material to produce his first layer this is actually the brim okay, this is the model that we have. This is the model that is produced, so it will deposit little more material, so this is, this material was produced in this way, this, so this extra material is brim also we have more extra a material here, those are suppose that will just that to show you how when we remove them.

We can remove brim by hand very easily, manually and we can get the finished final product. If the CAD model is flat, it is flat, it is okay, if it is not flat, if it have some inclination as I said, what will happen? How would the machine take care of the printing? It would provide some support. Now, the printing would take place.

Now, we can see, this profile that is created here this is a mesh this is not a solid profile, this is just a mesh that is created because it has just deposited some material now this support we are trying to remove this support. Yeah, this support can be removed by hand.

So, this is a support material, in this case only one spool is used, and both the model and the support material for spool that is why the colour is also, the colour of the spool is obviously one that is yellow only. So, it is done by single spool here. So we can even have the support material that is a little cheaper because the support material is not the final function that we need to present that we need to provide.

So, this is the potential or the bitty of a FDM technology that, if there is any inclination or any pocket or any profile inside is the machine will program on its own and deposit the material. Then, this is what we mentioned earlier the quality that is at what quality we want to print, that is 0.1 mm, 0.2 mm or 1 point, 0.15 mm support type okay again that selection is there.

Now, this is printed, this product is printed with the quality 0.2, so, there are a little lines, so these are fine lines. We can see fine lines or fine and coarse are subjective terms. But, according to this machine is a coarse line 0.2 mm.

So, if we make with if we make job is 0.1 mm these lines would be a little finer so, the smoothness would be better, so we can select as we mentioned before that 0.1, 0 .15 and 0.2 mm quality there are 2.2 mm per slice, what is the thickness of the slice that we are selecting?

So, again the term quality is here, like by set quality, 0.2 we need to select the quality according to the kind of the finish we require, and also as I said the quality and speed are counting each other if the quality would be higher, the speed would be lesser because 0.1mm and 0.2 mm obviously, the speed would be 50 percent of 0.2, if I use 0.1okay, because 50 percent of the layer, 50 percent size is being deposited at each layer at each line.

The support type, support type as I said when we said we use the word support that is with there is an inclination or any pocket any profile when it support, the support type we can again play in 3 modes, none, touching bed, or everywhere. Touching bed means it would just like to touch the bed. For instance, if this material is here and this is my bed it would just like to touch the bed.

So, touching the bed it will just place support wherever I need to touch the bed, just touching bed.

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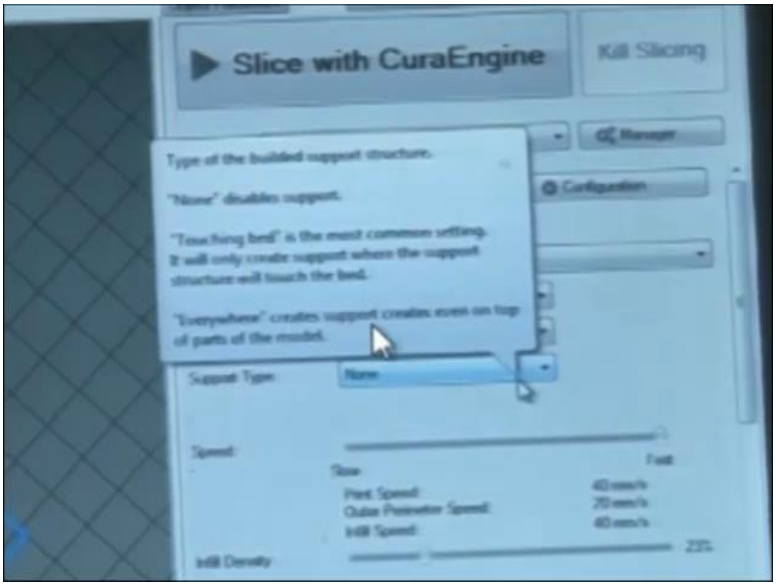

So, if we need the higher quality, we can even use this option everywhere otherwise no support also you know this given none-disabled support, touching bed is the most common setting it will only create support, where the support structure will touch the bed. Everywhere creates support, creates even on the top of the parts of the model, even of the top even if it is not touching the bed it will create support.

So, if we see know that our CAD model is good enough and is flat we need not to have any support we can choose none. So, if we are not aware or we do not have any information about that whatever the CAD model would be from inside or it what their different intricate features, so in case of complicated, very highly complicated CAD models if the face is there is no flat shape or shape anywhere then we need to set the command to generate this command this option to everywhere. See we are talking about the supports type, and support type is set to everywhere.

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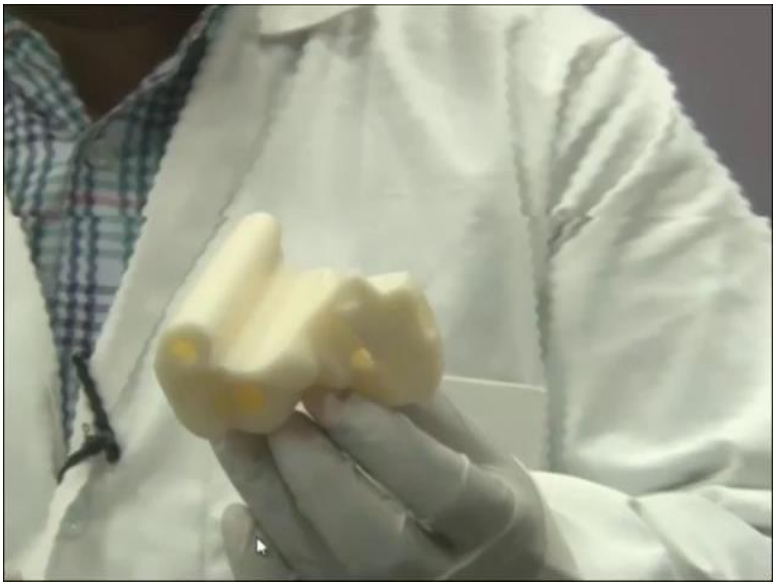

This is one of the jobs that is, the kind of complicated, so you can see that number of multiple shapes here. So in this CAD model, if you see in this CAD model we use everywhere command because it is profiled everywhere like, just not touching the bed for instance this is the model as like I just said it is touching the bed.

If there is another model when stands another thing is manufactured here, this portion, the portion between here, is not touching the bed but it would provide support here as well because it has to produce this thing as well. So, in case of touch bed, it will provide support here only in case of everywhere we provide support here as well. So, this, if the structure is complicated we use the option everywhere.

Now, the software is responsible to fill the support wherever, it is needed, so it is the art and skill both, you know and manufacturing as we know the CAD the computer aided design the different software's are there. But whatever, the software that is just software you might be quite intelligent but it is all the all designs come from here, it does come from the designer, so this is always an art associated in designing then besides the skill as well.

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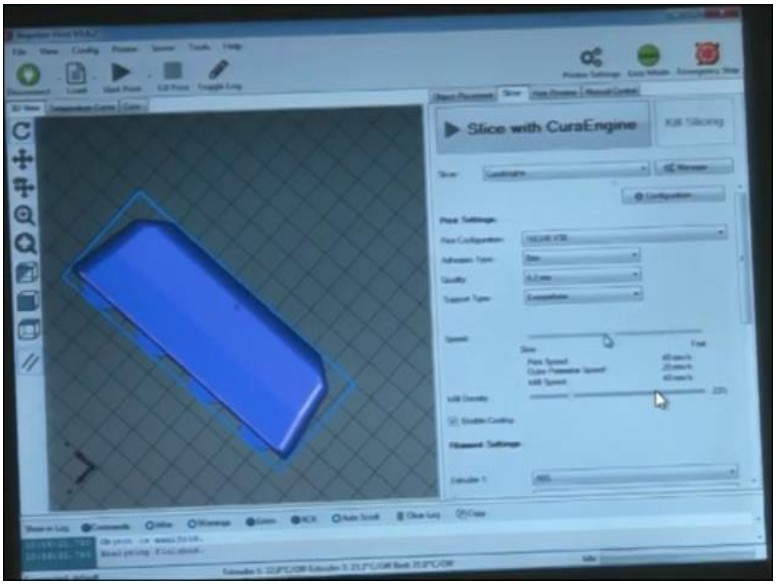

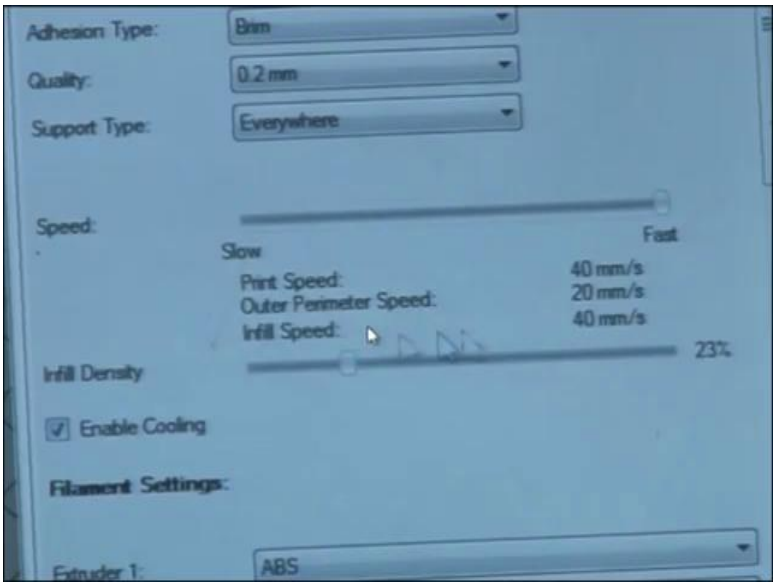

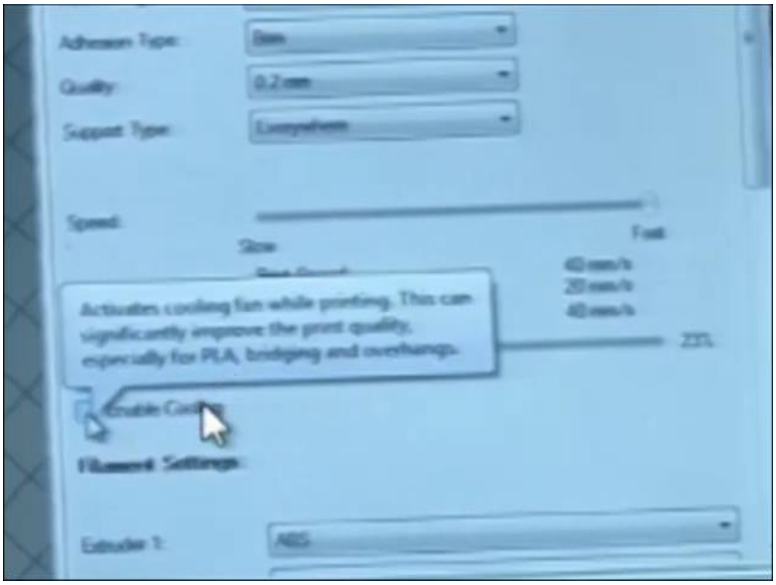

So, this is we are talking about the slicer and we were talking about the support and then speed, speed as we discussed speed in speed as it is fixed to 40 millimetre per second outer perimeter speed is 6 to 20 millimetres per second, and inch feel speed is again 40 millimetres per second. We can make it fast and slow using this tab as well.

So, again print speed is 40 millimetres per second, outer parameter speed is 20 millimetres per second, infill speed is 40 millimetres. So, there is a check box here, enable cooling. So, if we enable this checkbox, it activates cooling fan when, while printing this can be significantly improved the print quality, especially for the PLA and bridging and overhangs it is specifically mentioned for PLA, if we enable cooling it a cap fans would run when we print.

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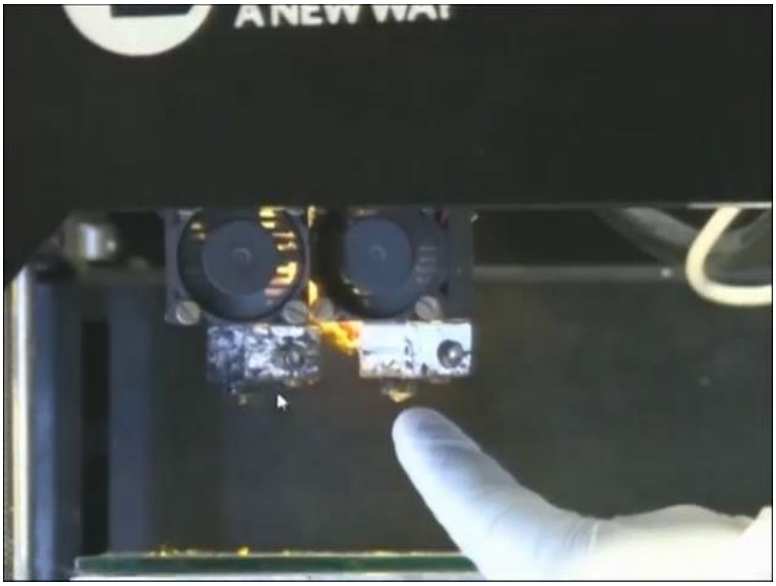

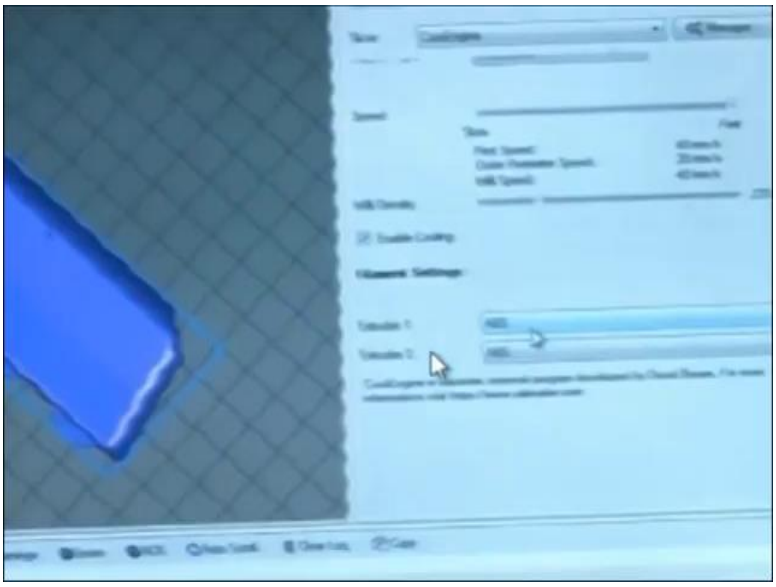

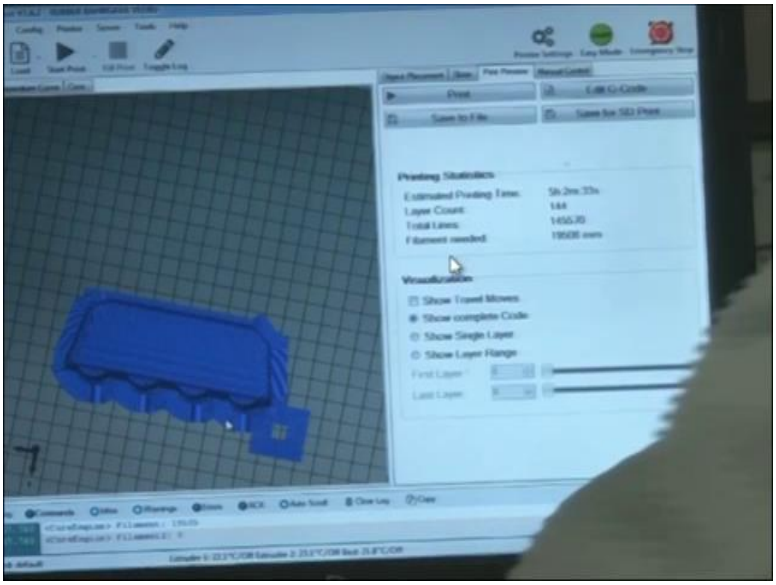

So, there are two nozzles here, extruder nozzle extruder 1 and extruder 2. Extruder 1 and extruder 2, two nozzles are there so accordingly we have two nozzles here, extruder 1 and extruder 2 we can put the material, what is the kind of material? We have put it ABS for extruder 1 and ABS for extruder 2.

So, we can just input some kind of material that we actually have, so as we said, we cannot manufacture multi-coloured jobs with this machine. Because we have only two nozzles which means only two colours can be produced. So, we are just trying to tell you that how slicing would be taken care. So, how do we do slicing?

Slicing is just one click away now, this big button here, slice with CuraEngine after making all these settings in slicer this very big fit button that slicing is just one click away when we click this button, slicing starts.

Now, the slicing starts you can see that it has made a brim by itself, as it might have found it important, the machine is quite intelligent to do this, the software is quite intelligent to decide this thing.

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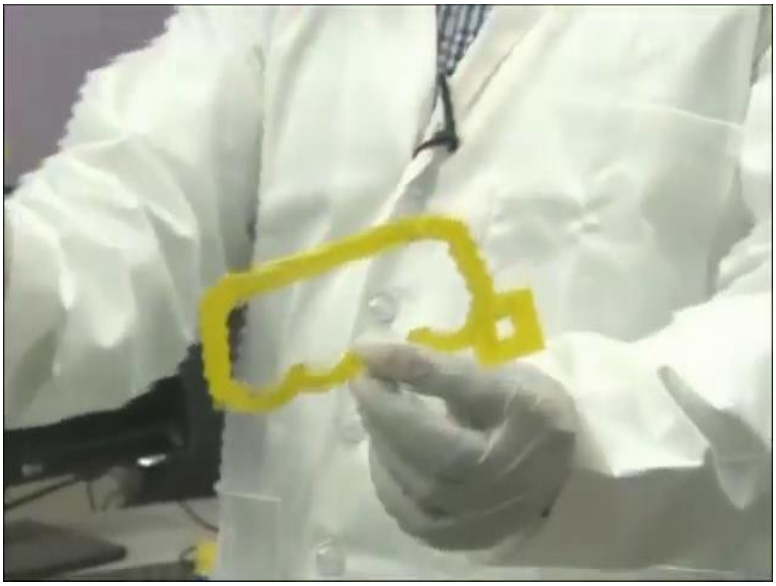

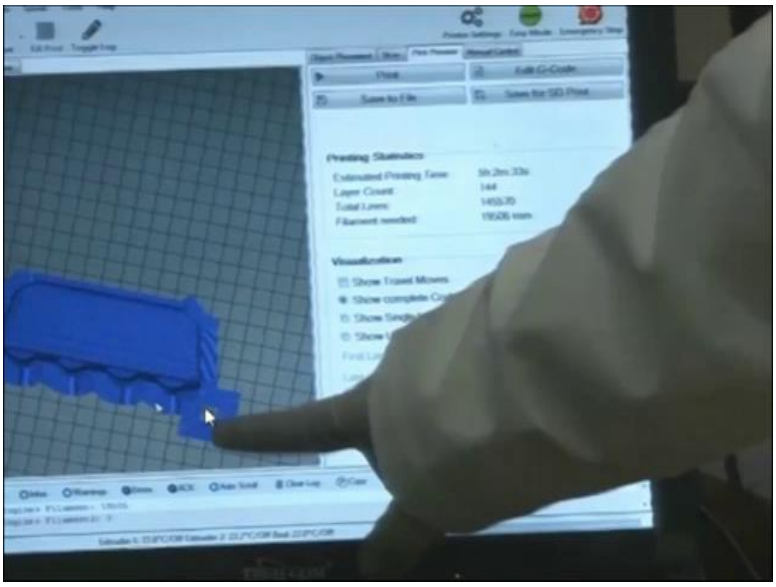

So, this brim is you can see this cure is here, why this cure is here? This cure is for holding we need to hold the job and take it off, to hold the brim hold the brim layer and take it off, this care for holding and the other portion, this outer portion this outer portion is the brim.

Because it has to, it would like to save the edges or the make a edges proper, brim is only at the edges have been raft, it would be along all the surface, complete surface of the job so, this slicing.

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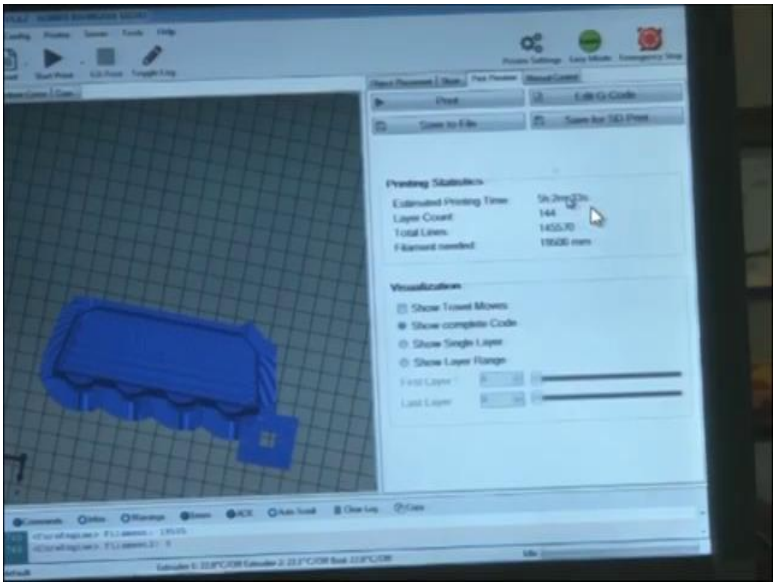

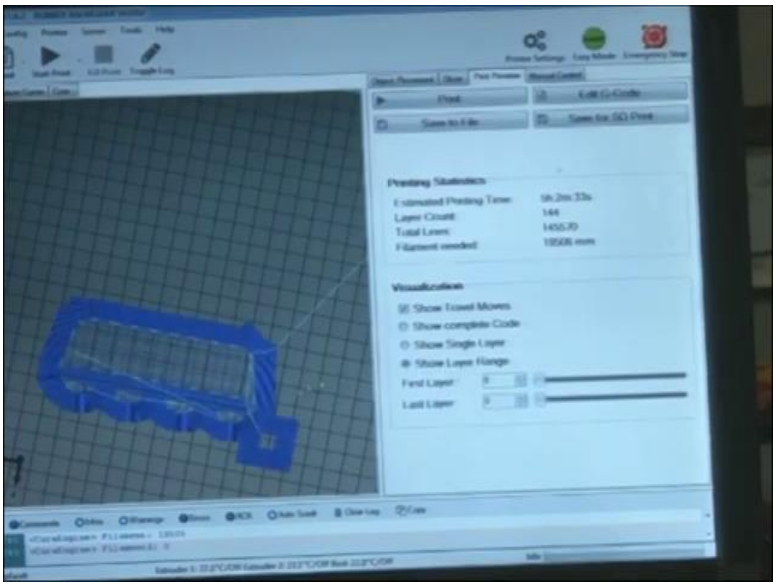

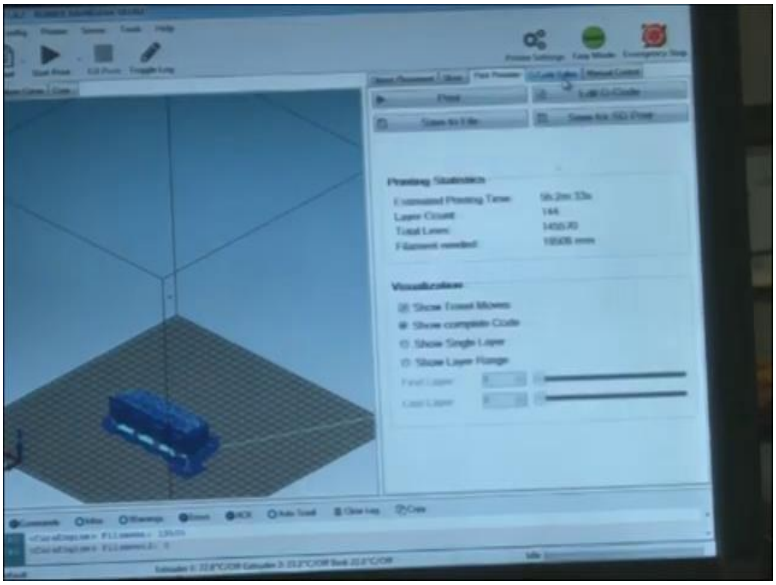

Now, it is showing the properties, now it is showing estimated printing time, estimated printing time is 5 hours 2 minutes 33 seconds. So, it is giving the data, this is print view after slicer it has went to the next tab here, it is print preview, in print preview, it is giving the information that this is the time that would be taken 5 hours 2 minutes 33 seconds.

Total layer count would 144, total lines would be 145570, 145000 lines would be drawn and filament, that would be needed would be the length of the filament that we needed would be 19500 mm. So, these, this information is displayed here. So, in this print preview, once we start, click this button print we can show, we can say see how short travel moves, how the layers would move.

Now, these sky blue lines indicate that we will show that if we print material in this way we could go with the single layer also and show layer range. This is the first layer, how it would print? Look it shows, it is showing travel moves here, shrink travel moves, how it will travel when, we will actually do will also try to show you how it moves, and it is showing a layer range or we can just pan through the window.

Show complete code now there is a button here or not button there is a radio button here among these three because, select one show complete code, show single layer, show layer range so, single layer, we have just shown you, show layer range of show complete code this is the complete code.

Code would be like this, the material will come from this side, it will start machining, it will start the producing actually machine when I say machining in general one we think of what we

think of machining is, machining is subtraction here, machining is addition, material addition happens from here, this is produced.

Now, let us click print before we actually do print we have to also prepare the bed, prepare the machine all those things the machine has to be set up properly before we actually start. Because once we click this it will start printing. Now, we have made certain settings, we have made certain inputs here, and some settings are there the CAD model everything is there we can save this to a file using this thing save to file.

Also, if we have deep information or deep knowledge about the G-codes about the CNC programming we are going to add or subtract or edit the features using edit G-code.

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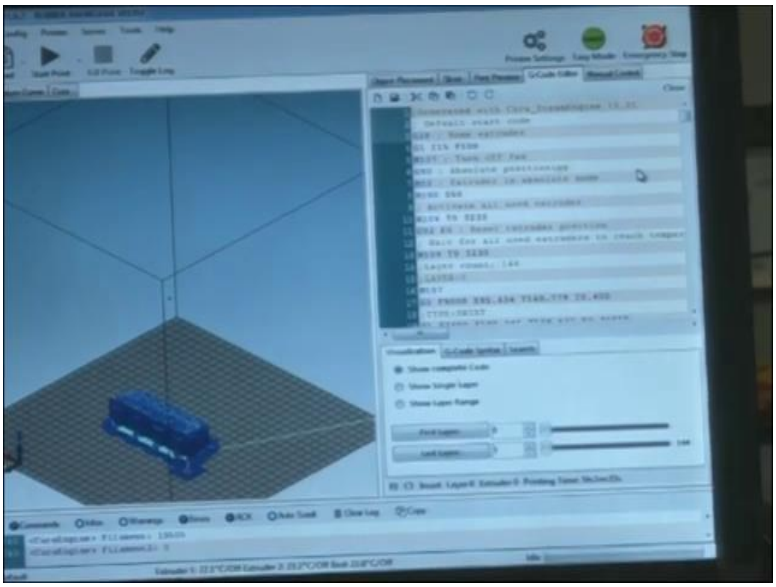

X, Y, Z movements can be controlled using G-codes, G-code programming system, so this is G-code editor, okay, after print preview also have G-code editor here so we can change the CAD profile that what we need to print without printing without using the CAD model.

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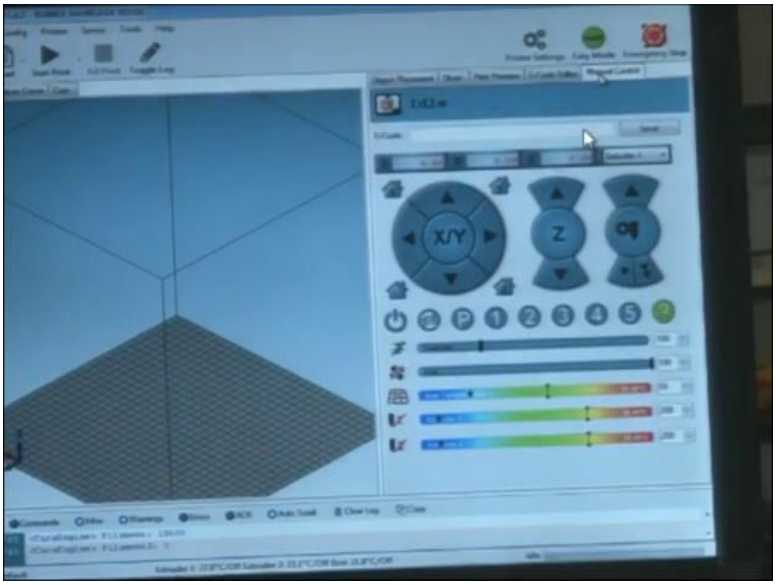

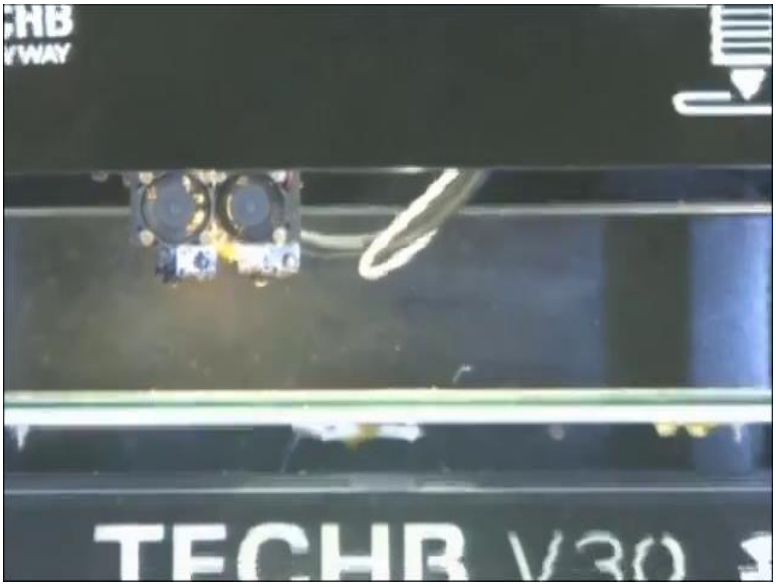

Now the last the tab is, the last tab is manual control, the manual control what happens, we can control the machine manually. You can see X Y direction here, X and Y direction can be controlled manually. Z-direction can be controlled manually, and also this extruder can be controlled manually. In manual control, it is very important that it starts from the beginning if the individual we are doing manual control its start from beginning and it ends at finishing as well.

So, like moment of the nozzle in manual control, we can move the axis manually. Here, we can play with setting changes, and we can change the temperature as well here. So, before printing

we also need to set the temperature, this is known as soaking temperature, the nozzle temperature that was kept 230 degrees.

So, we have to activate, now this controls the extruder temperature, typically the temperature for PLA is from 180 to 220 degrees, and for ABS it is it a little more than that so, we are using signals extruder for both printing, printing that is the actual model and for support.

So, we are activating this, this red cross means it is not activated this, this red cross is taken off means red line is taken over that is it activated now extruder 1, extruder it is now starting, it has now started heating, when we have seen activated the temperature 200 degrees it will now heat up to this temperature 200 degrees temperature, actual temperature we can see here when it is heating, temperature curve here and will open in here.

So, bed temperature, bed temperature is also activated now, bed is also heating, it has started heating. So, the bed temperature again for PLA the bed temperature is 55 degrees and the fan is also switched on manually.

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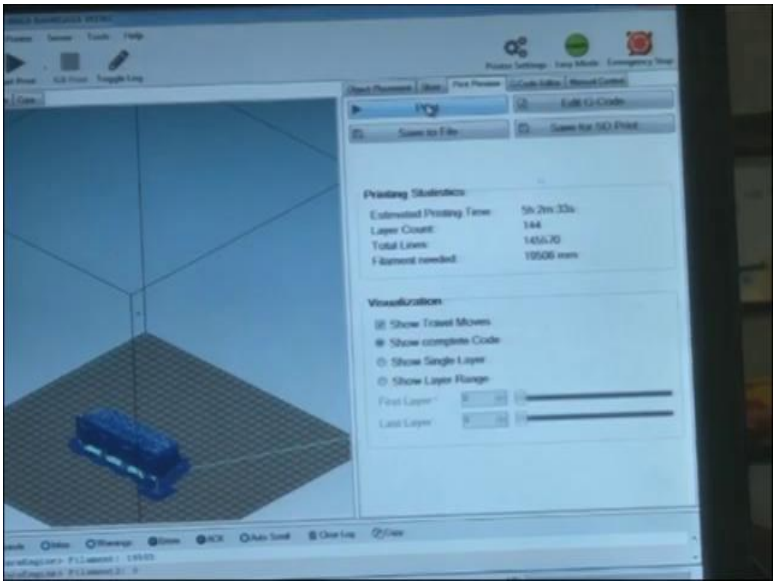

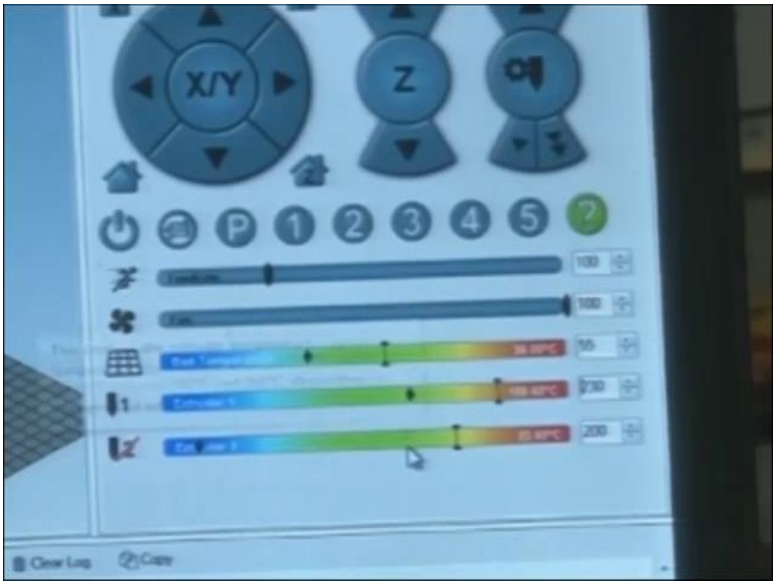

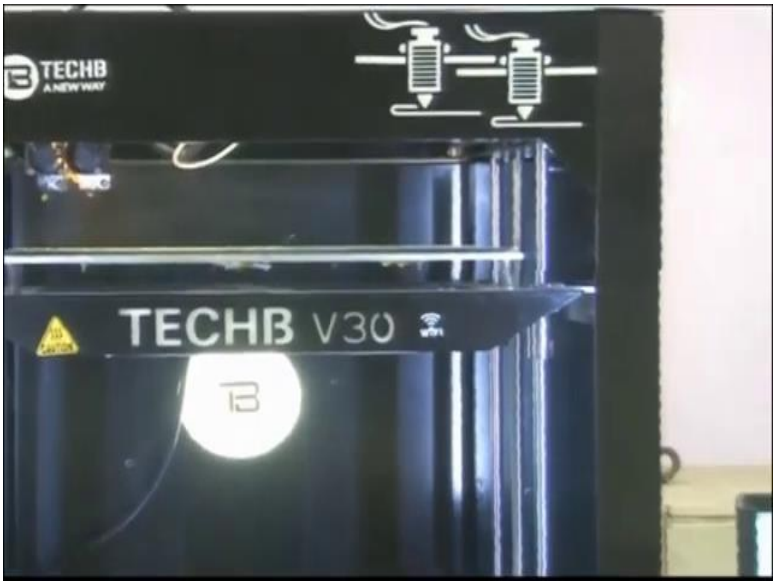

Now, there is another way if, you go to print button here, when we click print all these manual controls that we have done manually, these will be activated or enables automatically because, bed has to be heated, the nozzle has to be heated, fan has to be kept on all the settings that we made before would be activated by just clicking of this button. So, this is the automatic mode.

So, the use of manual control is that we can display the temperature, we can alter here the temperatures but in the automated control, we cannot alter once we fixed so, we can increase or decrease the temperature see we are increasing the temperature of extruder. It was 200 we are increasing it to 230, increase it 230.

So, sometimes we also play with the atmosphere temperature in the summer of the temperature, room temperature is generally here, in Kanpur is from 37 to 43 in average. So, it is quite hot in extreme summer, and in winter is it even comes down to 5 degrees or 6 degrees.

So, depending upon that the temperature is also set if the temperature room temperature is lower this temperature is also kept accordingly, it is winters here, at this point of time when we did this demonstration so the temperature is kept a little higher.

So, because a room temperature is quite low here so the filament temperature is made a little higher otherwise should be kept 200 degrees here. Now, this process is known as parking, we have parking like car parking, we are parking like kind of homing so, it is parking the head at the left side left corner of the machine.

Now, after setting the G-code and making all this settings we are here, to prepare the bed to prepare the bed for machining, okay to prepare the bed and to set up all the things like spool, filament will induce, will filament to the rollers that would come through the extruder, and we will try to see that whether it comes properly or not.

Before that, the heating is there, heating that was done that with the commands that we gave the heating was the bed is getting hot or it has come close to the temperature that was 55 degrees, the nozzles are close to 230 degrees.

So, the temperature is trying to come to this desired input here to 230 degrees for the nozzle, 55 degrees for the bed it will take about 15 minutes by the time we can prepare the bed. So, let us try to start the cleaning and loading and unloading of the material.

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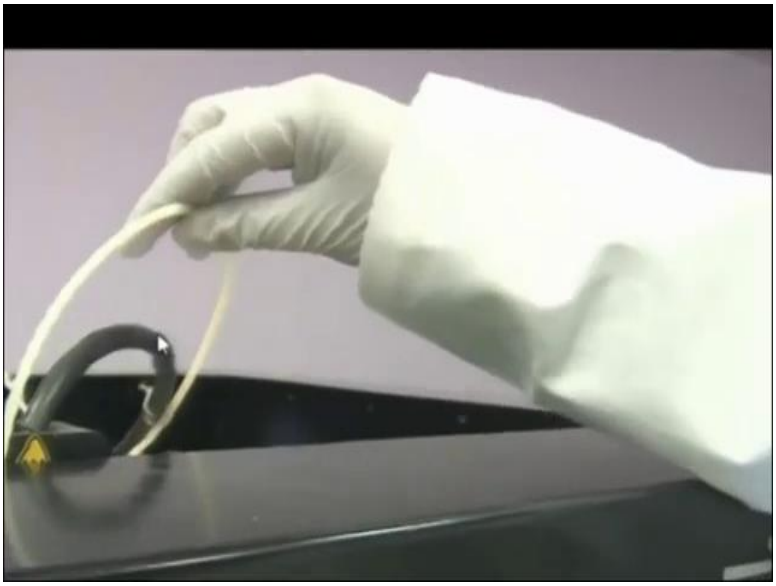

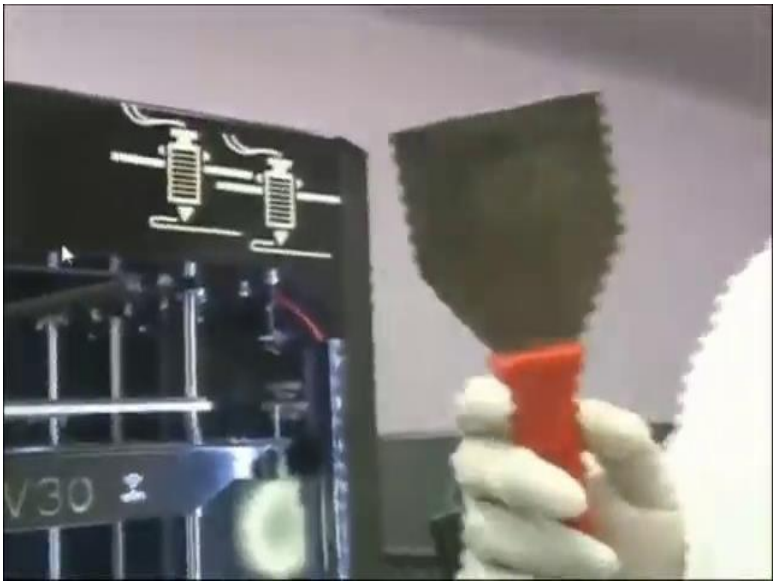

This is the cutter that is be used to cut the filament if required, this is the tube, this is the tube through which the filament would for come through, it provides proper path to the filament, this tube filament had, this is spatula this is usually used to clean the bed.

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So, this is distilled water with some cleansing agent here, few drops, some of the liquid cleaner is spread and it is cleaned with the help of spatula so, the whole machine had there is actually glass, so we have to be careful, what is this white milky gear, white milky material? It is nothing but, we have used Fevistik that is the adhesive material, this Fevistik.

So, we are again applying some more Fevistik, so it will help you lock the first layer, as we said before, we have put our CAD at the centre of the envelope. So, that is why we are preparing the portion that is at the centre, so a thin coat of Fevistik is applied at the centre.

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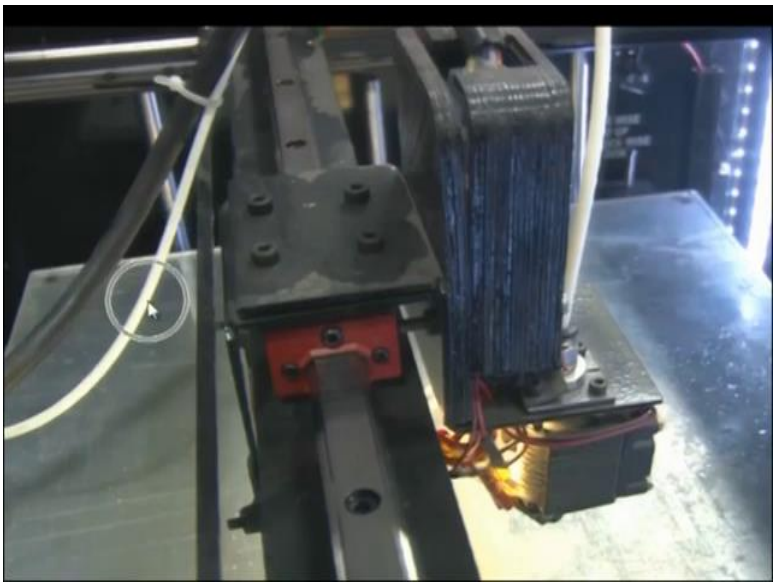

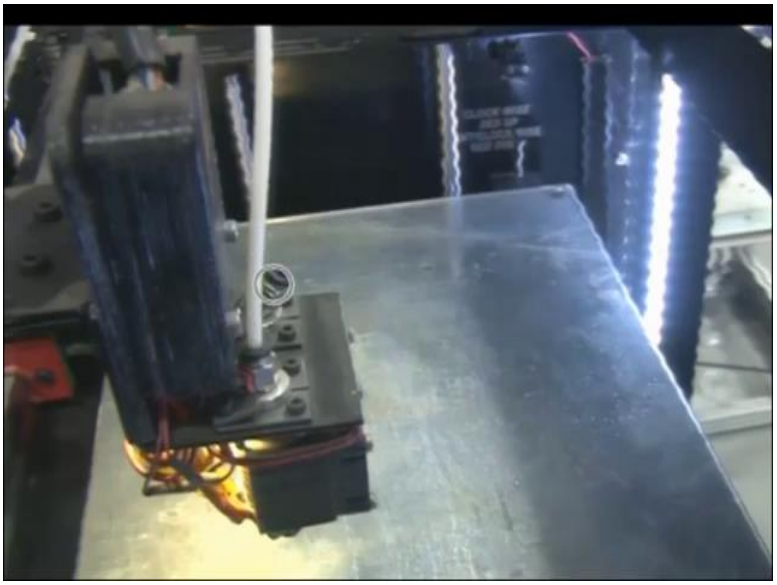

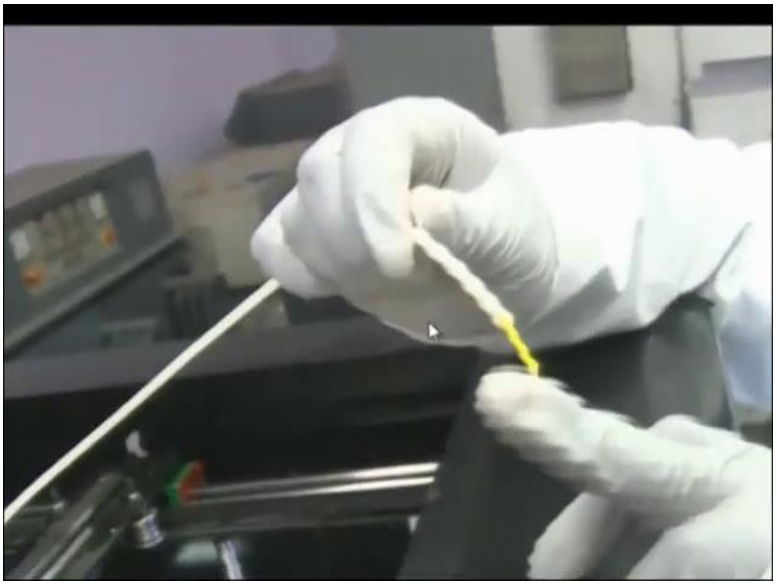

Now, this is our head this our and there are heaters here that are heating. The filament, the spool is coming through this tube, the white tube, the filament is coming through this white tube. So, this is the head that can be moved, or this is our X and Y movement, Z movement that actually bed is moving up, and down that movement is controlled with bed and they are two nozzles here, the only one nozzle is active at this point of time.

So, let us see how to load and unload the filament so, this is, this black portion this is a PU connector, so, PU connector can be connected it can be screwed in and out. So, we have unscrewed it, so, in PU connector is according to the size of a tube PU connector is exactly that, the tube exactly fits into that so, the support.

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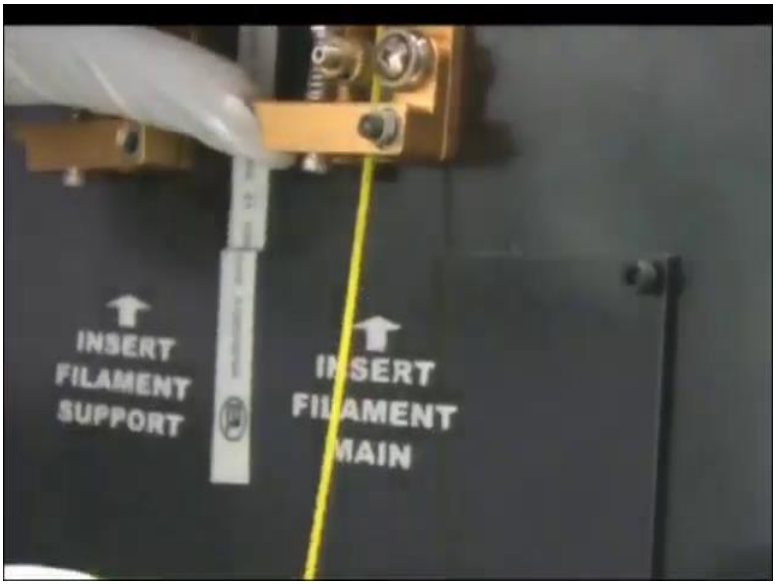

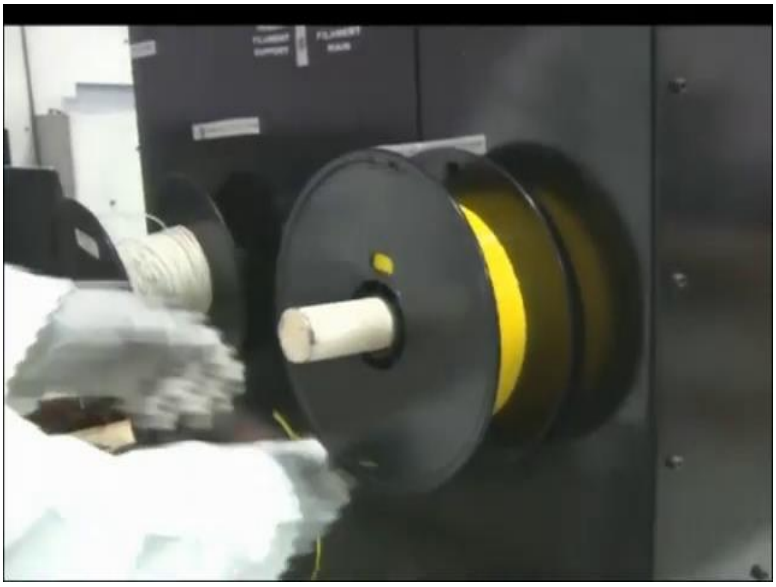

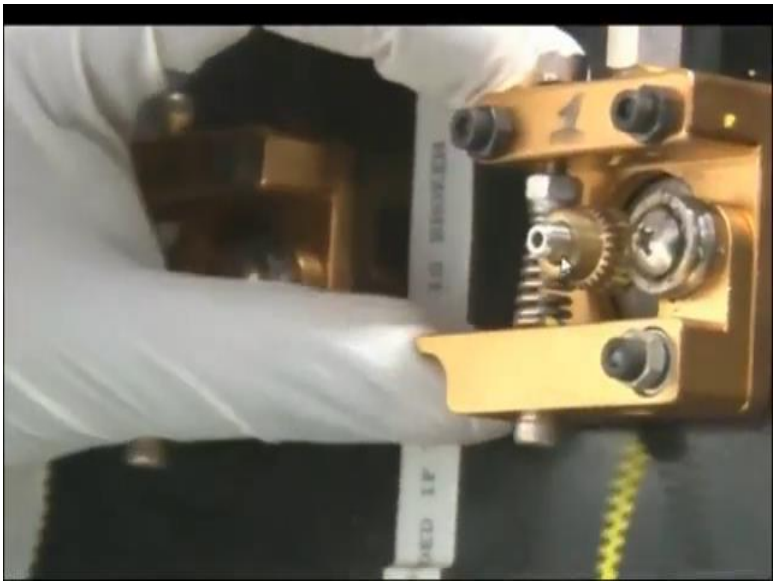

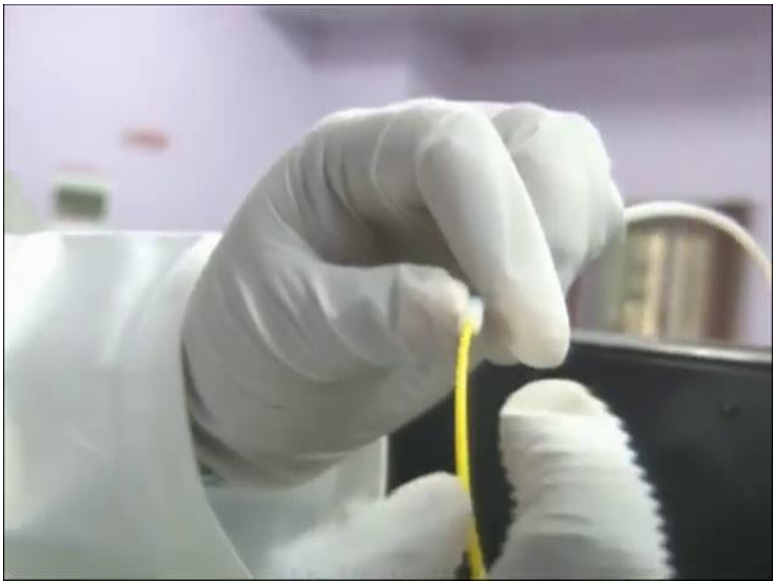

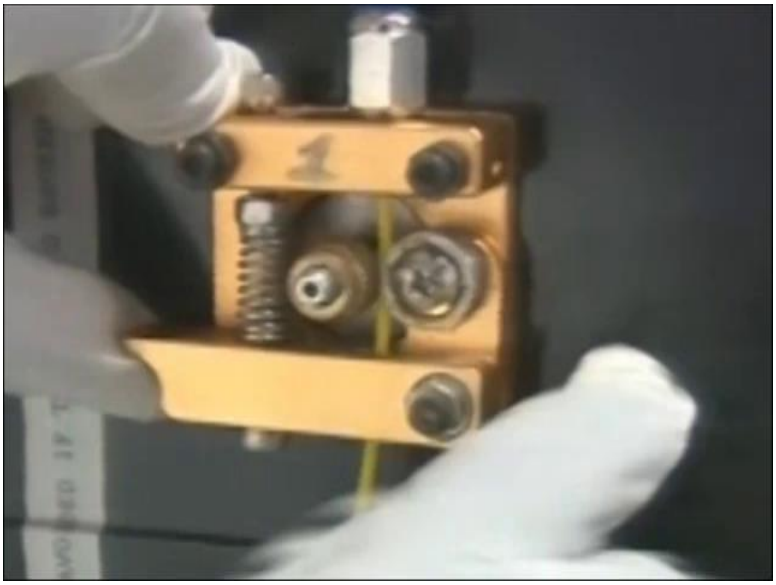

So this is, these are our rollers, we are taking it off. We are unloading the filament now, okay unloading the filament you can see, again this is the filament of size 1.75 mm. Now, we can see that the filament is little distorted from the tape that is it would not enter the rollers properly.

The tip of the filament or the end of a filament is not proper, so we are going to cut it, we have cut it so, it is now flat at the end or square at the end, so this is the roller this would help to take the filament forward, when this rotates, the filament is carried forward in this direction, upward direction.

Now, we are entering the filament into the tube that is connected to the PU connector and this tube is also very much according to the diameter of the filament 1.75 inside diameter, 1.75 plus allowance, allowance is 1.85 mm in a dia, now this PU support to, the filament support to is connected to the PU connector now, we will see that whether it is working properly or not.

Now, we will lock the PU connector we have locked PU connector up to there we lock this PU connector here, as this is PU connector is locked here, so, this roller that I mentioned that is responsible for feeding this is also known as feeder, so we are using this pulley and feeder. Two rollers, one ruler is pulley, another ruler is feeder.

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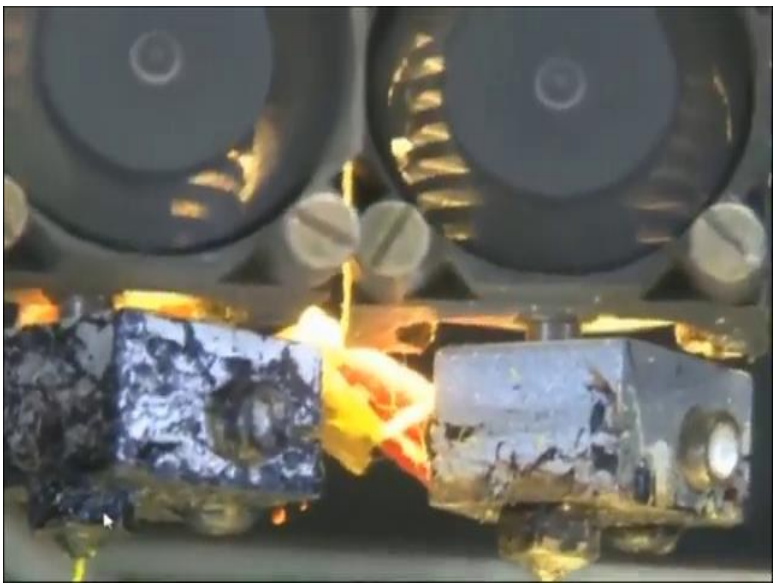

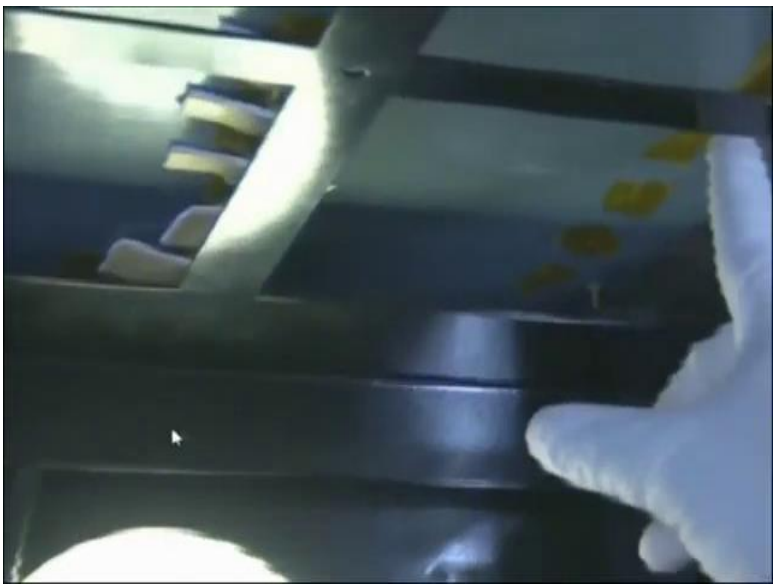

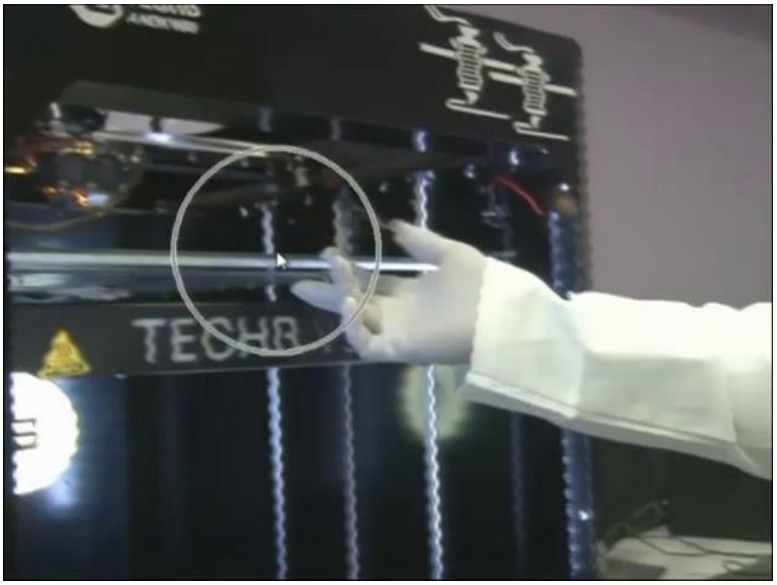

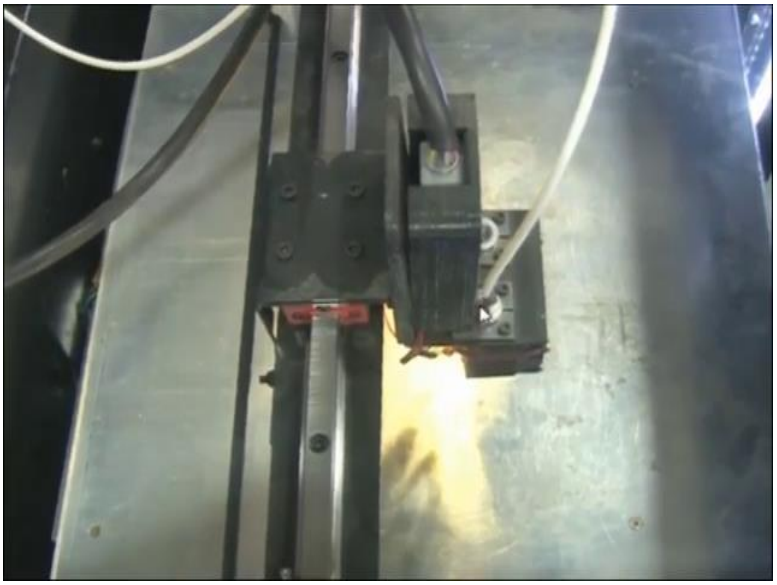

We can see that the loading of filament is properly done. Now, we can see that whether the filament is coming through the nozzle or not? Yes, it is coming. Now, this means the temperature is now maintained, now we will use this two clips to hold the glass with the bed, with a table bed.

So, this bed is the temperature of 50 to 55 degrees centigrade. So, to hold them we use these two clips, we will put clips here and here so, that it holds gets properly over here and then at the other diagonal end. So where are the heaters for the bed? Now we can go at the bottom of the bed, the camera would go at the bottom of the bed, this is the bottom of the bed there are heaters here.

We can see, there are heaters attached here, and the base is aluminium, this bed base is aluminium they are heaters there and on the aluminium base over, and on the top of the aluminium base we have put a glass, glass plate on which the actual application would take place.

So, it is the one clip is put here another clip is put on another side. So, everything is in its place. Now, the temperatures are like we see filament was coming out of the nozzle the temperature is close to what we require close to means if we have put input 230 degree centigrade as we know that it would not be exactly 230 degree centigrade all the time it might vary like 2-3 degree or 5 degrees variation.

But yes, it is the working temperature, the temperatures are set 230 degrees centigrade for filament, 50 to 55 degrees for table, the loading of the material is there, the rollers are engaged, rollers means the roller one is the pulley, and the feeder is engaged filament is coming properly, the bed is prepared, we have applied Fevistik to make sure that the material sticks there. And the cleaning of the bed is done.

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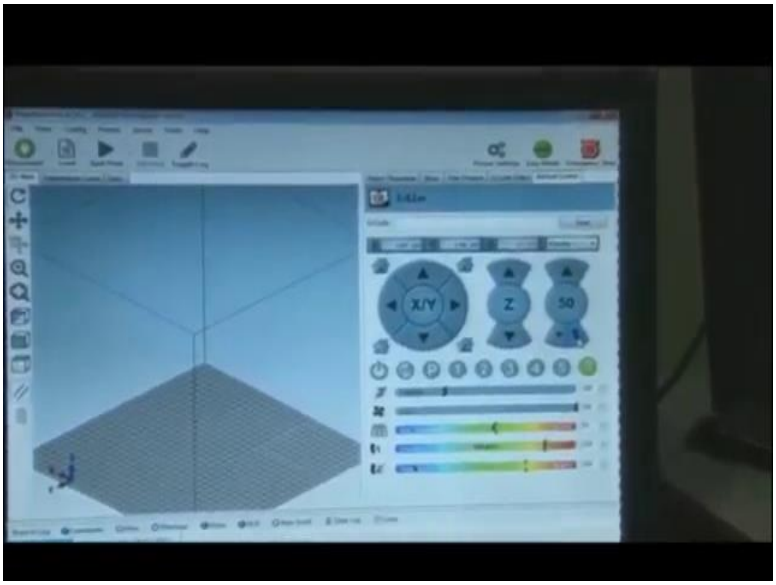

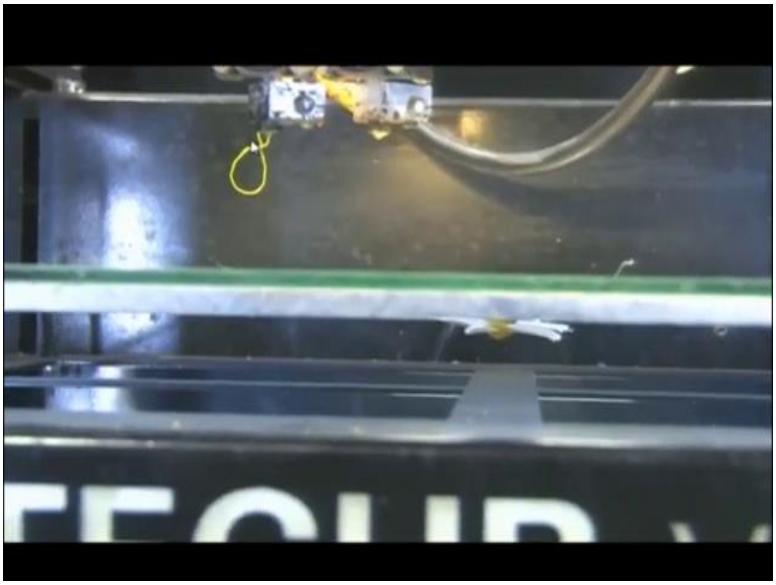

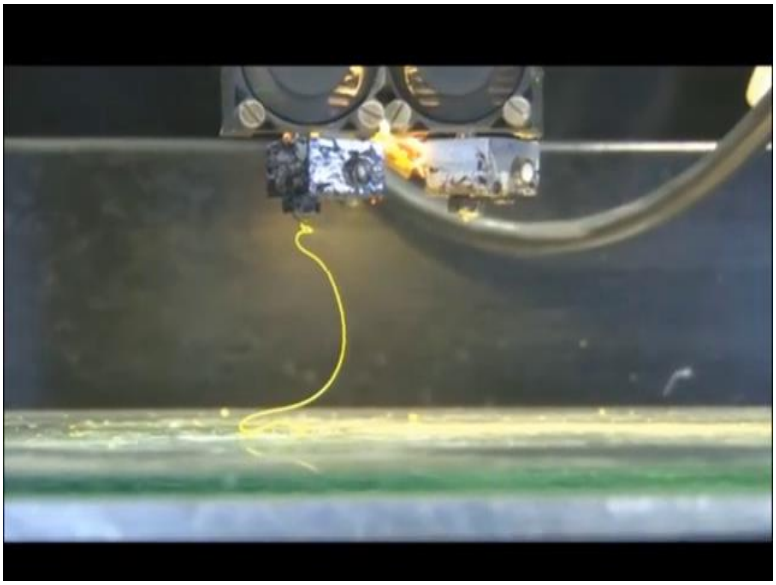

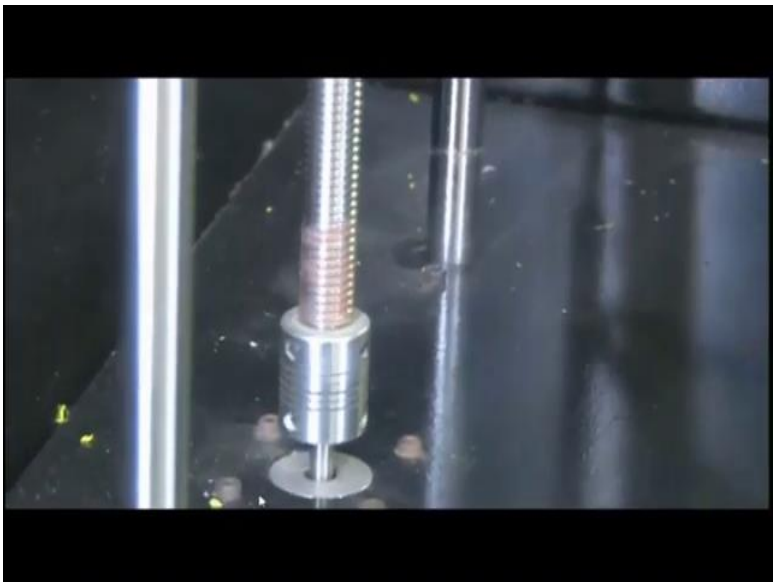

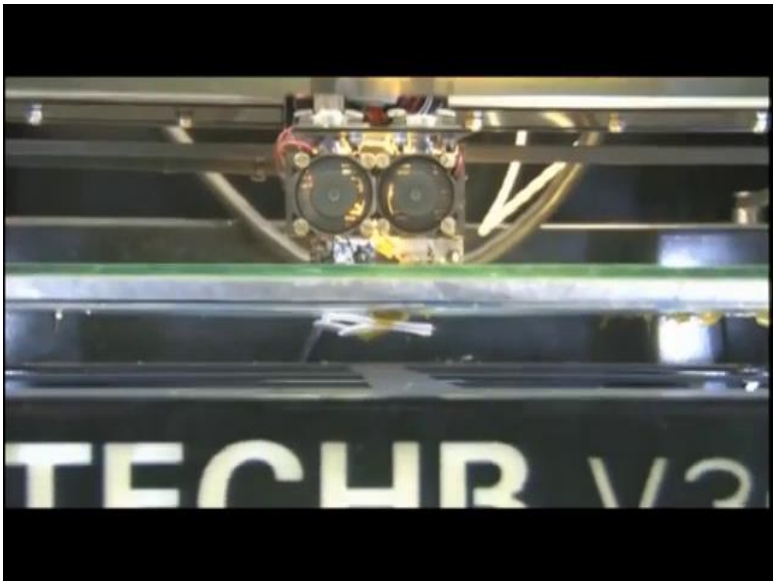

Before print preview, we will just come to manual control here. In manual control, so we are going to check manually that whether the things are moving up. Yes, we are checking the materials is coming in, materials is coming out you can see the materials is coming out, so we are manually checking whether the feeder is working or not, okay.

So the material is coming out, the extruder is being checked here for its proper setting. Again, we can see extruder is activated in this way we checked that everything is quite well or not. Now, the temperature is actually is 53, 230 degree yes, the temperature is 230 degree, 230 degrees for the extruder 1, 53.6 degrees is for the bed. Yes, that means as I said 5 degree variation I would like to correct myself. This machine is quite precise or sensitive to temperature.

So, the temperature 53 was set so, it is within 1 degree like, 230 might be 229 or 231 so, within 1 degree of the resolution. So, last thing left is we come to print preview, and we start the print. Now, when we start printing, machine will go and check everything first it will go and check the parking place that at the corner, so this is one as referencing, it is checking the height, the height of the job.

You can see the rotation, the Z direction is moving up, the table is moving up. So, the bed is trying to touch the nozzle top, the bed is trying to touch the nozzle top to set the 0 value, again you can see the rotation the bed is moving up, in upward direction because we do not know what is the thickness of the glass, glass plate that we have put on.

And also there is there of this Fevistik as well that we have, that is there. So, the bed would touch the nozzle end to set the 0 value. Now, yes it has started the printing, the first layer is started here now.

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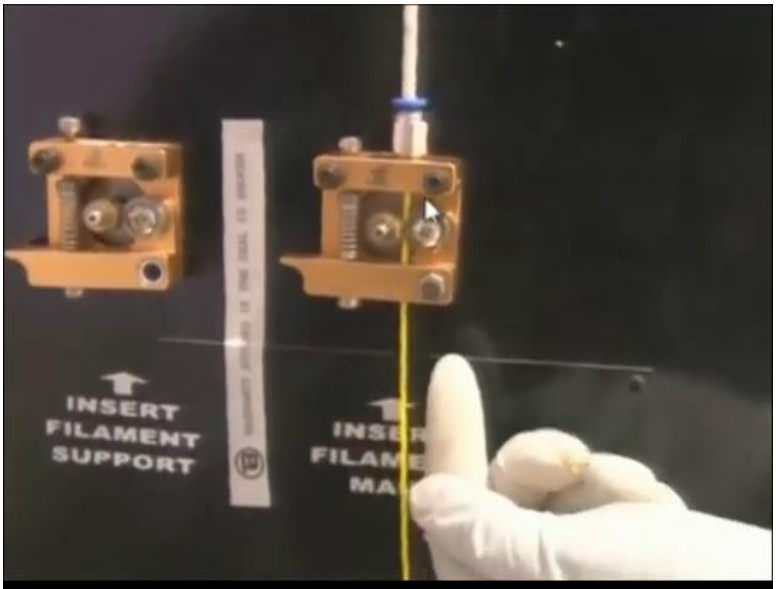

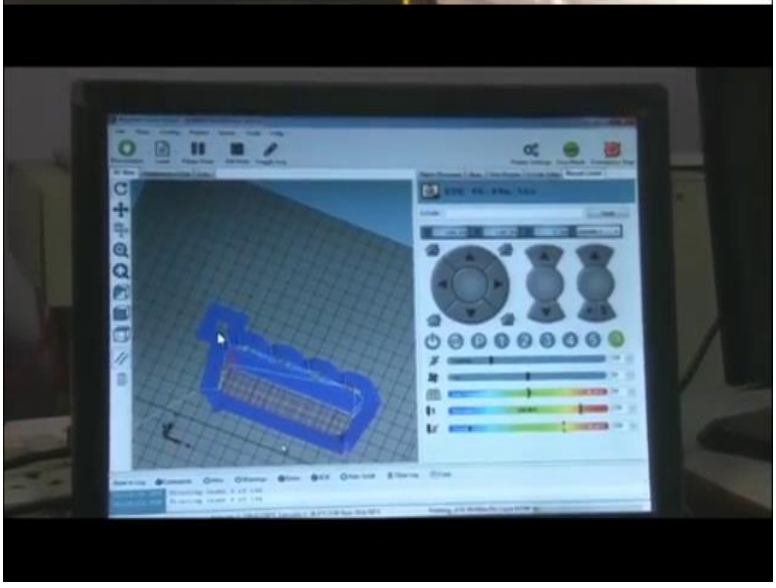

It is now printing, it is printing, this is the brim command that we mentioned before and brim is, brim fabricated before, actual model. So, this is the very first line that is being drawn by the machine.

So, it is running at the speed. So, it is actually while brim the, it is actual printing only while printing the speed of the first layer was 40 millimetres per second is moving that is speed, this part would stick with the base again, brim would stick to the base is the extra part.

Now, we can see here that how the feeder helps to feed the material, this is a feeder, feeder is rotating, this is the roller mechanism here, pulley and feeder, pulley and feeder is there. Feeder is rotating to feed the material towards the upward direction, so this is not the part of the CAD, so, this is used for the deposition, so this is how the machining is happening.

So, it will make the first layer brim that will start manufacturing the part, so the time for the machining if you remember was 5 hours and few minutes, it will take this much of time. So, by the time the machining happens let us try to see the different parts, different components which are here in the manufacturing in the 4 I lab actually, we have to wait for 5 hours to see the final production the final part you can see the roller mechanism closely, this is used for the deposition.

So, it will take 5 hours for the machining to happen. Now, this is happening, this first layer was brim, and after first layer the other layers the second layer is now, being manufactured, it preparing support you can see, it is preparing support here because there was an angle in the component, now what this component is?

This component is actually a key that is to be kept in machine, a key, and key that will be inserted and that will lock the two different parts of the assembly. You can see the machine moving.

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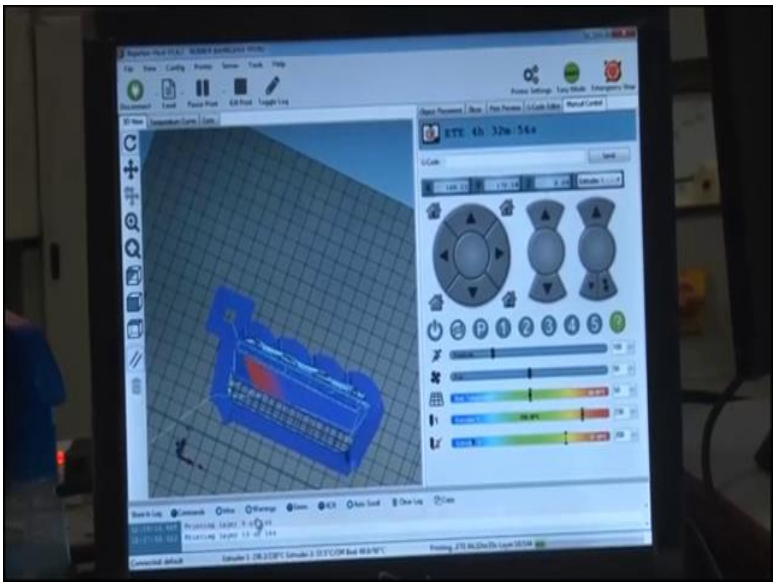

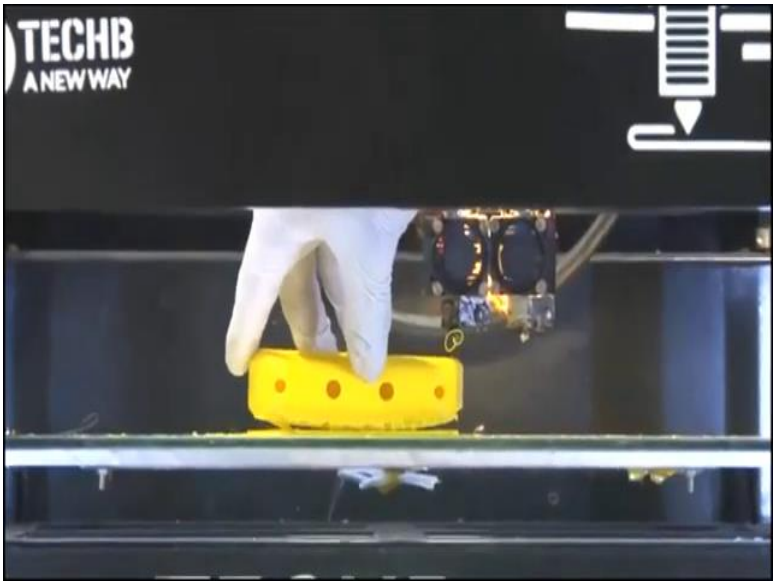
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So, what we can see here is the machine is running we can see the simulation of the machine as well as the actual machine is running here, so the simulation happening, you will see the material is being deposited here, so all these layers that you can see as mesh here, these are supports, these supports would make the material to deposit over it.

So, when the machine it has been completed on this side, now it has made one line here, so it would not waste time to restart the machining from this point when it is it has done, machining here means adding material. So, when the material added over here, it will restart from this point only, and keep depositing the material here.

So this is total 144 layers would be made to manufacture the part that we have designed and estimated time here is 4 hour 32 minutes that is the total time that is left here. So, it has been an hour that we have been manufactured this product so, I can pick this products from here I will just pick it up.

So this part, this support I am removing. So, the brim part is there on the machine only. So, this is the final product that we have manufactured so, we can see here that on this support the complete material deposit is not it is only the mesh. So, as the minimum material is deposited that can support the main material that is the main filler material that is used here.

So, here as we are using single spool the same material is being used as support and main material so these supports you can see this was the final component that was desired here, final feature of my component here, and this is the support that is removable. So, it is hollow from inside, so this is the product that we have manufactured in our demonstration in rapid prototyping all we also call it additive manufacturing here.

So, this is TECHB V30 machine fused deposition method machine, again, we are talking about this, this is 3D printing machine like we have multiple additive manufacturing or rapid manufacturing or rapid prototyping technologies like stereolithography, digital light processing, stereolithography, and fused deposition method are the major ones.

Then also we have laser methods by selective laser sintering, selective laser melting, electron brim melting then, laminated manufacturing like laminated object manufacturing all those methods are there, this is a 3D printing machine out of the types of the 3D printing machine this uses Cartesian coordinates they are certain types of FDM machines, it is specifically 3D

printing fused deposition machining methods that use different kinds of coordinates, Cartesian uses the X, Y, Z this is the Cartesian method, other methods are other kinds of machines are delta.

Delta, FDM printers, the printers use 6 axis 3D printer which are based upon delta technologies machines operate with, they also operate with Cartesian technology but there is more freedom in that then the polar machine is there, the polar machine, the polar 3D printers in that the positioning is not determined by X, Y and Z coordinates. But, by an angle like the polar coordinates system.

So, another with 3D printing machine can be with the robotic arm, different robotic arms can come, and keep printing at one point, so these are four kinds Cartesian, delta, then polar, and robotic arms. So, this is Cartesian FDM machine, we have gone through demonstration of this machine in the 4I lab and I hope you have enjoyed the demonstration, and please come up with the questions anyway.

Because, this was produced in 3 or 4 phases and, please come up with the questions wherever you think the things are not clear, and we will meet in the next lecture, we will discuss further about the course.

Thank you.