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Course Title
Manufacturing Process Technology – Part- 2

Module- 48
Fused Deposition Modeling Process

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Hello and welcome toady to porie lab the process we are going to demonstrate for you is the rapid prototyping process okay so let me just comment a little bit about what this rapid prototyping process is and how it helps in garmenting the industry bring into sort if micro features or micro parts okay so the rapid prototyping is about sectional printing of material it is also know as 3 dimensional printing the whole idea is that if there is any complex feature or shape as a cat file which is available.

The system tries to section that particular cat file into small elements okay and each element is being deposited by means of plastics which are typically two in kind one is either polycarbonate or AB as plastic and this particular machine as the capability of handling on the plastics either although in the current domain of terminology there exits machines which also do the same with metals okay.

So they are called fusion deposition modeling or metal fusion depositions systems and they are used for non strategic parts particularly things like let us say cotogoes or you know Astalic furniture's etc made up of metal so the advantage behind 3D printing this area is also known as layered manufacturing because you are manufacturing layer by layer and the advantage behind such manufacturing processes typically in terms of the saving of excess material that you otherwise encore in other contact machining process where there is a lot of waste which is generated in forms of chips okay.

Or even in other forming processes are associated let us say casting process which are primary manufacturing process that is always a tendency of a formulating layer which is eventually

removed okay so in this particular application the layer disposition process the advantages that such savings can happen in terms of obtaining a direct surface finish without performing any other machining process after this process has been done there are several process they are several you know shapes and size which have been fabricated with rapid prototyping this right here shows a part of horse saddle.

You can see this is horse saddle okay so here for example this actually is sort of you know the way that a person customize his requirements for riding horses etc so everybody as a different physiological shape and therefore it is need that particularly something like a saddle should be able to customization to the particular user which is their okay so not only the process is highly economical in terms of material saving because you are just depositing rather than this is a material build a process or I would say A surface machining process rather than a bulk process which is subtractive in nature okay.

So this material is a an additive process but apart from that the main advantage of this process that you can highly customization the parts of the furthers to the taste of the customer and you can make very complex shapes which otherwise is not do able with the these different machining techniques which are around okay and in a way what happens is that once you cat file is designed irrespective of whatever is the complication which is involved.

I will just show you for example the what I mean by complication okay this is a crankshaft okay of a not motive we can see the design and you can look into the kind of complicity which is involved in designing such process typically this is used in automotive industry and the way you generate it to the zinc forming processes but here you basically depositing and making a scaled prototype or a model through which you can probably formulate the next step okay which can be used for time manufacturing fort that forming process to happen okay.

So one advantage of this kind of a process is because of the complexity of the shapes it can handle it can be sued as intermediary for some of the primary manufacturing process also okay so in a nut shell what I am trying to say here is that there are lot of advantages associated with rapid prototyping.

One of them is of course the high level of customization another is the ability to handle complex design or parts 3rd is lot of material saving because it is a layered model and there is no secondary

material which is wasted in the process and then this can formulate an intermediate process for finial primary manufacturing process like forming or casting where probably you have to the mole development or you have to the dye making.

So some kind of a prototype is need okay in order to envision and design such a system so having said that the questions comes how this layered deposition model works so as I told you the 1st step is about making a cat file and sectioning the cat file into slices or pieces these slices could be closed to about whatever the resolution of the equipment gives in this particular case and as I told you this machine handles to different equipments that is AB as well as BC.

So for the AB as plastics the minimum size of a slice which available here is 125 micron so 0.005 of an inch okay and the basic row material for this process comes as a roll you can see this is a wire roll okay and this is what the basic row material come as and this wire is fed form a very small nozzle which actually is able to move in a xy plane with the information that it would have the coordinate positioned information which would have from the cat file.

So supposing now there is a sectioned layer of such a complex part I should you a part can be as complex as this so probably I have made a small section of this somewhere here and I am actually seeing what are the coordinates of that particular section and defining the tool path so the nozzle would actually move in that path and try to many over itself by dispensing this particular plastic here by heating it up to it is melting point.

So the nozzle is typically heated at 300^0 C in this case so that melts the plastic and then the plastic flows across the nozzle and it is going and walking across the tool path which is generated in to the overall feature size and it is depositing that layer of 125 micros, so once this layer is complete it is ride up the next layer is deposited and so next layer the information will again from the act file on the basics of next slice which the cat has originated on the basic file of a design of the drawing, so here it is very interesting technique let us look at the machine little bit that is actually open the system up so as you can see here there are two parts basically or the machine one is the controller and part and also the material feeding parts the rolls are now currently in position and there are fed in the system.

And the controller here is actually indicating several different aspects like what is the support material what is the model okay, and then there is a vacuum pressure and another pressure which

are indicated there is a small tussles which here at the formal here opening which would generate the tozzels which would be operational here at the formal here, opening which would generate tussles which would operational here as I showed you only when the machine initialize itself, so there are several process.

Which are happening here of the controller as we switched on, and one of them is basically to auto home or auto position the Spenser unit or nozzles okay in the xyz plane, and also it is a several checks and the balance at the beginning or so that the machine can be completely mechanize for the next run okay so we have to wait for a little bit until the curser here come to and knock door and at that point of time.

We can actually open the door you see the light has been on inside this chamber where the wrap it photo type in can actually happen okay so then first stage of the machine would be related to setting up of this machine will go back on the computer and try to make cad package and try to measured in a particular manner, with all these specifications where a five I a machine of a 5 can be created for this system and then this files would be transported in soft manner into this system and the machine path etc.

Would be predefined so all what we need to do is to transport that file and then set this machine on and to get about it, so that the spark can get manufactured inside this or the part the part containment is together in the machine.

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So we want to now do this auto homes so you just free to enter for doing this command and you can actually see now inside if you have to look at it the stage is going up and there is a position of the nozzle with respect to the stage that is happening, within this particular machine, okay so that you can have a hone position for the work piece with respect to the nozzle okay within the, the machine system so it is still homing xy gently and the z stage okay so if this process will take a little more time.

You can also actually see right on the top here is the dispensing nozzle which is come up and it is now trying to position in the xy direction okay once the c is define for the work piece and then it will be all about the way that the nozzle will dispense in the correct tool path would be map as per the cad slice, which would come inch by or you know few 100 microns where few 100 micros as you construct the part the final part.

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So the controller here as you are seeing for the Rpm the machine after the homing of the xyz as after stage as happened shows a lot of options like build job operator control model status maintains so on so forth, each of these as a certain meaning and I will describe these along the way we do the machining process I have one we want to just actually first clear the stage with the existing whatever is lying inside okay from the also run okay and then basically try to prepare the stage for this particular run.

So what we have wanted to do is to sort of go into this operator control which is the second option here which again use the curser key to go okay and then enter on this operator control which takes me into another menu sub menu, which says analog door load and load so on so forth someone again enter because this is an analog door option which is their okay, and then it goes to another sub menu where again there is a symbol analog door here okay, and a I am going to actually.

Sort of start this and this enter the sort this actually is able to open the door we cannot leave the temperature on for a long time because this actually is the sheet the miler sheet which was from the last run I am going to remove this miler here, and put our sheet here so that this becomes a new run actually of the process the power is actually getting heated up through about 119^0C okay so it is a little risky to actually at this stage and touch the sample surface but you have to just ensure that the heat radio of posting is actually at the very corner, okay of this particular strain and there is a guide there which actually ensures.

That it is at the corner once it is done which is close the door back okay so that now we thinks are in place and the next step that we want it to actually go back to the cad the software in the computer station and be able to process a particular file so that we can transport the file here in a soft manner and start I am initialize the machining system okay, so basically now as I told you in the last term with demonstrated the machine we said that it is really about a cad file and now you can slices into pieces.

Which ultimately would define now the tools moves or the tool path would be define in that manner, so here in this particular work station we would like to actually slice a cad drawing into pieces that is number one number 2 there is a huge issues that suppose this is a part that we want to manufacture is RP now we will have to somehow, so spend it in the manner using supports so that the whole part can be fabricate.

And for doing that the question is that how the support should be cad in the minimum static manner where little one that can be crave there can be a parting line so which the main object can be separated from the support and the support actually is the most hallow part with as less material as possible okay in comparison to the probably the object which is more solid in nature, so therefore there has to be a provision associated with the machine where how to handle the part by keeping at a certain inclination.

Or may be keeping it parallel to the ground with some kind of an angle of so that the whole part can be getting created okay and also about what are the dimension now the cad file which has been designed earlier has to be transported those eyes have to sort of later, so today we are going to do the same so with our FDM Titian machine that is showed in the last illustration there are two different software's which come with the system more them mis called inside okay and inside version 9.1 which is actually used to define the layer heat okay and also define the tool path so one issue is how do slice in the particular sections and another issue of forces how to define the tool path so both of this will be done in this manner and then there is another software which is called the control center 9.1 version which actually further illustrates how the object has to be placed in the overall minor shade that had been shown in the last step.

And if there are parallel objects to be placed then how many objects would be there which had a single go or the machine would be able to build up the job etc and you have to optimize the layout in a manner so that as many independent components can be developed together that

would typically give the yield of the process, okay. So if the components are higher in that manner the yield is also higher in a way.

So that layout that layout of the final placement of the job is in the XY state is given by the second software control center, okay. So we will do this later the first version of course is the inside where we import and stand and try to section okay and so let us look at how we handle it this is the main screen of the software so we actually go to the File menu and in the file menu we actually can open up a file.

So here what I have done is in the interest of time I have actually made a cad file earlier or borrowed it from some source and that typically this cad data has to be saved as a .STL format for enablement of this inside version 9.1 software to be able to read it, okay. So therefore the STL file has to be somehow open using this inside software you open the we go into this desktop and then there is a folder which is there.

So drop down menu okay and then there is a crank final position okay and then there is a small part which is there you will see which we want to build using the system okay so we open this file and transport this back to the scale so it is not scale we have to scale it because there is typically a confinement volume which would be defined by the bed size of the stage I think I had mentioned in earlier that the bed size in the case of FDM tighten is about close to 16 inches times of 12 inches time of 14 inches.

So that is about the size of the biggest part that can be accommodated within this particular system and I also define that the minimum layer size that this system is able to allow is about 125 microns, okay. So having said this the parts appear to be in inches and so it cannot be accommodate within this and they are asking us to convert the scale into mm just for the sake of demonstration we are going to do that just annual is going to be a micro part.

Also is going to give a illustration that how the micro systems can be fabricated using this particular method okay, so we are going to select this model and the model automatically is now translated and opened in the inside version 9.1 software. Now here there is there are different aspects which we need to consider for varying the different dimensions so this is not a very convenient way of locating the object.

Because naturally if you build the part like this there is a tendency of the object to fall down or something like that, okay. So we want to actually located in a manner so that it is more convenient and we can very easily separated from the remaining portion and so I am going to actually make the front portion of the part here as the bottom, okay. So I am going to actually now see what is the bottom okay.

Take this up and then take this cursor all the way to this portion so this comes on the bottom and the part topples okay. So now you can see the part has toppled and it has lie down on a flat surface which is actually more appropriate for the purpose of doing RP or rapid prototype okay. So now there are these questions of what is the slice, height etc lie for which I would like to set up this system.

So for slicing it the first thing we need to control here is actually to do the machine set up okay and you basically try to configure the modeler here in a manner so that you can define what is the layer thickness etc and what is the nozzle that you have to choose we have to remember that there is about 4 nozzles in this system which has been delivered or specified for manufacturer and they are classified as four different types.

So starting from P12, T10, T12, T16 and T20 each of them has a different orifice diameter because ultimately if you slice side has to be more naturally the dispensing rate also has to be more for the tool to actually be able to curve the object out, so if the nozzle is slightly higher in diameter in that case the dispensing would be faster and therefore it can go to a higher layer thickness, okay.

So it all is defined by the layer signal that how the nozzle selection etc to take place typically there are two different material as I told you earlier that this equipment can handle one is poly carbonate another is AB as plastic so when you are talking about ABS there are different layer thickness even which are available, okay. And there are you know all the nozzles including T 10, 12, 16 and 20 all the grades of the nozzle garbing used in that category.

In the case of poly carbonate so it is a little less flexible so there are only two layer thickness which are able to get scattered and one of them is about 0.01 of an inch another is about 0.07 of an inch and there are only two different nozzle sizes which has to be used, so in this particular

drop down menu you can see there are different aspects given here the first is called the modular type.

So let us actually see there are different machines which the manufacture has so typically hours is the MTM tighter T1 so we have to do this as the selection, incidentally this is also set as a default selection in the software so you need not worry about it, you can keep that as the default value which the software takes the different materials again so in this case it is poly carbonate but there are ABS materials.

There are you know variety of different even poly carbonates okay which are available in this case we want to choose a simple carbonate PC okay, so it is demarcated by PC so we are going to take this up okay, number model automatically the model material color as defined as white in this case and then the question of support material curve so as I told you that if there is a complex shape like this and you want to position it over a certain surface.

You have to give a support to get its standing so most of it is in air and you can actually build by using layer by layer fabrication approach okay and this support is very critical because this is a wasted material later on you have to remove this material and the material would be removed as if it a parting line and it is coming out of that, okay. So here in this particular case you can see the support material being defined by all the poly carbonate.

So the option that is being set up in this software is that if there is a PC part typically the support will also be other PC, okay. So the PC support is defined here although you can change it probably by going into the you know the set up of the software but at this time you want the material to be same as you are selecting PC support then if you want to really invert an inbuilt material the answer we are we do not want to do the invert build material option.

So the invert build up material option actually is particularly when there are more than one materials to be selected unfortunately our machine is not capable of handling this option or selection of multiple material when particular if you want to deposit something which is like you know layer by layer of two different polymeric structure are may be three different polymeric structures the option of invert would come in more handle.

There is a slice side option which is kept here now you can see there are two different slice sides one is 0.007 of an inch and one is 0.01 of inch which makes this about close to about 250microsn

okay and you want to select the lower the thicker slice side because in the interest of time you want to complete this fabrication process earlier. So we are going to build this slice 250 m/ 250m one layer would be 250m and that is how the whole slicing would be done in the insight package okay.

So it is essentially a slicer package of a cad wider that we are talking about and automatically if you see that if you select his point 0.01 option automatically t16 nozzle is selected which means that this would be able handle and dispense the 250m layer so t16 is probably a slightly thicker and diameter nozzle which is existing in this particular case if you add selected point 007 a given earlier gear then you will automatically see that t12 is being selected automatically and which is the lower size RFS nozzle is selected in that particular case.

So it is very obvious that you know the software is quite friendly it will amenably work in a manner so that it actually you know trailer all these systems, finally we make it okay by pressing on this right button here so you can see the text box which comes here on the top is mentioning FDM tide in t1 slice side of 0.01 model of t16 intact to be used a poly carbonate part and a poly carbonate support.

All these options have come here which shows that the machine has now accepted the various different options associated with this system. Now the question of slicing comes in to picture and I would just like to illustrate a little more of how the component is placed, so and the styling how the styling would be happen. So you have different options here on the right side of this particular system you can see there is a part interior a style okay and if I just click down on this drop down menu there are three different options namely solid normal spars and spars double dells okay.

So what it means essentially there are two different options this machine as one is that it has a honey comb layout structure which is sort of a lesser density structure and then there is a flat plate structure which is there so the tool may move in like a honey comb manner tool may also move in like layer by layer okay. And the solid normal would mean that we want the bulk to be equally dens okay and it may be depositing layer by layer or may be even the tool path even if it is like a honey comb like structure would be so close to each other that they would be considered to be one whole okay.

So this is Bensons form which is available there are different other options which are there in this spars which would mean that this is typically spars when you talk about supports etc where very less amount of material is deposited and the gap between the materials are very high so it is like a packet of cardboard a coruscated cardboard okay where there is a honey comb kind structure and then there are two layers which are giving this toughness or the strength of the whole sheet.

So support can easily bitten in that manner because support is not to be use for any future applications so the support is only temporary sort of dismountable structure which is only because want to support the object to its place to build it okay. So you can actually in this particular case select the solid normal because it is a real part is a crime as we are selecting the densest and then you have a visible surface style so there are two different one is normal and other is enhance.

So we will select the enhance option here which meaning that the surface would be quite integrated and the surface would have very good topology okay there is a support style again the support style can be just basic support or a smart support, so let me just illustrate what it means a little bit. Supposing there is a object like this and you want to place it on a certain angel okay in order for the RP system to built it layer by layer when it does it there is a question of support which comes into picture.

So one support can be just simply orthogonally place like this and other support can be at a certain angle which is able to still support the weight of this guy because you will have to calculate when the CG of this person or the CG of this particular object is within the periphery the support okay. so if supposing the CG is within that support then it will not toppled and that is the basic idea that you do not want the part to be toppled while it is being made.

So you can tell it might's the support material in a manner so that it can do its job by at a certain angle also so this called as smart support which will actually saves the material. So one option could be to just give a thick grill like this in a perpendicular manner and other can be to go like this make a certain base size and then from their go at an angle and be able to supported. So that the overall CG is still within that basement area okay.

So this is the way that he support is design I think you probably understand philosophically how the support would be able to manage and the idea is the support should be minimalistic as

possible so in this case we will do the smart support so we will actually select the smart option here, okay so the automatically this software will calculate that the support is not much of the material okay way exit.

And then of course you have a system mode which again is you know pine a system in a normal so we will select the pine option because the system has to do a good job and making the integrates surface quality of this part by depositions, and we have kind of done at this level by setting up all the parameters for the slicing. So let us look at how the slicing happens so if I pres this option right here you can see that the system slice is available you can actually go up and you know you can see each individuals slice being made in the software so each slice has now a thickness of about 250micron that is the beauty of this whole process okay.

And what I would also like to illustrate here is that once this slicing is made you can actually also look at the independent slices by these options here on the left corner where you can go from the top end okay and then with the pay jump within one option you can actually keep on varying this and see what is the various layers which you have to deposit and in fact this also mentions what is the tool path to deposit that layer okay and finally you will see that the whole surface is being constructed based on that okay.

And then you can also do it simultaneously from the top surface as well and you can go up by doing the page up okay you know similar manner. And that is how typically you get all the support so here again coming back to the same option again this there is an option here with the all slices shown together in a reinstated vague the hole sample of the piece okay in the system.

And so therefore this is how tentatively you can look at the slice plot so what is slice plot is done and the question of defining the tool path comes into the picture so the other option now we have a once we have a actually done this slicing we have to create a support system here there are certain holes etc which are not able to see because of the intense slicing but you can see there are certain holes etc which has to be created okay.

And therefore there has to be support within then where typically the density would vary etc there can be easy cleavage okay so that the support can be later on takeoff to create that hole in that particular tensile structure so having said let us actually go to this other option here with say support so create support for the current job.

So I am going to just express click on this and now the software is going to create supports here so here you can see that there are yellow lines which are actually reflecting what are the support media which is their there are the supports which are made here supports which are made on the peripheral of the objectives something like this so you have build up the supports here and then finally we want to actually find out that within one side section what is the tool part which is getting created.

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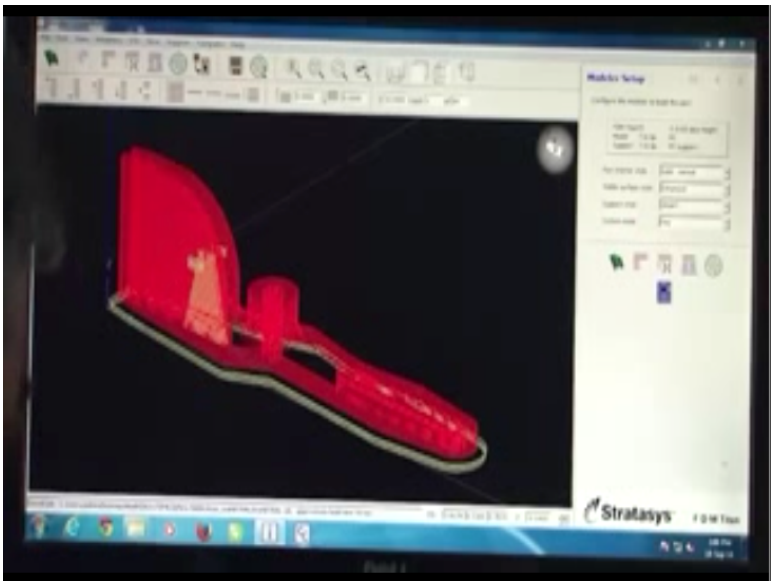

And then tool part I reflected by this green symbol which is actually reflecting the zigzag position of the tool path within such a domain and I want to create the auto tool path so the software actually now tries to compute and create a layer by layer tool path so that you can easily look at by going to the various layers of the tool path are barring and you can see that how the different layers are been the green actually represents the tool path so you can see that how the different layers are having a certain tool path define that nozzle would actually do the dispersive action okay.

And typically that is how the whole system is based on so this typically the support structure as you can see it is much lesser in terms of the density of the material because it will be like a honey comb kind of a structure the distance between the tool dispersive point would be much more okay in that this is something which is many event going to be sacrificially removed a the

material has to be has low density as possible so that we can make lesser losses then it is possible.

So therefore this I ho actually the whole system is made so let me just recall what all steps we did it we opened a cap pile in dot sterile available in the dot sterile format then we tried to size it down to the volume of the box within 16 times or 14 times of 16 inches cube in our system FDM titan after doing this fitment of the component within the volume of the box we did various options to it.

For first of all we tried to define the material we did want to define the slice hide okay and then tip size these things were selected once that was selected then we kind of ready with the next slicing option so we go to the slicer command or slicer menu okay and then slicer will do this 250 microns you can see that slice slot is coming out by going to logo here in the top left corner which says from top to bottom.

You can actually look at various slicers see if there are interfering each other is there are the problem in the tool path etc in the slice etc and normally there is no such problem because of software is the highly error free slicer which has been developed and the then you can also give the various material texturing or patterning by mentioning whether it is a solid normal or whether it is a sparse or sparse double dense.

And the kind of the lay out which automatically means that you know may vary the density of various zones making it corrugated in some places and un corrugated if you need here in this case we want it the whole model to be made out of a solid block with uniform strength altogether so we have chosen the solid normal okay we also talked about visible surface style and also the finish with the machine would deposit and also give support style which would say of the material remember we did the smart style in this case which would allow the material to be minimal as take for doing the supporting action of the components.

So all these things had a fine with then try to see the or give the support structure of the material and once the support structure is also defined then we do the tool path since the tool path is planned as you saw that the material had a tensile tool path then the support structure which means the support was much less material just only intend to support the material of which would impart available later in a non useful material.

Once this is done the pile is complete we can say this pile looking at a complete illustration here okay and save it I m going to the save option here so when we save the current job it will automatically we saved off at the same place okay just this new folder the same location just we need the pile that was initially extracted as dot sterile pile okay.

And so therefore we just save this here of course there is some overwriting existing job in the same name we had just do that over writing here so that the job is not save as a dot CMV pile which would be later on able to get extracted by the other version of the software which I actually told you at the beginning is this is a control center okay.

And this control center software which would now fire particularly the job all the way to the tool so before starting this also I would just like to sort of do some settings in the internet protocol because this machine here the computer is connected to the FD and title through a certain LAN protocol okay and this LAN protocol has to be initiated for this particular Pc so what I am going to do this to actually go all the way to the network connections here okay.

Open the network, open network sharing center and then go all the way to the local area connection network here and then enable or disable certain properties so what I am going to do is to go end to the property is here and select this internet protocol version 4 by virtue of which it is been select so we see the properties here you can see the machine is pre set in the IP address on 72.28.21.42 this is the IP address of the machine.

So this protocol has to be tidally define so that you can whatever you do in the CC the toll center here would automatically they operated online or it would be send online to the FDM titan once we do eventually through all this process will again go back to the machine and see how this job which now got cured up in the machine server on the machines controller would be able to do the printing, the printing in the machine itself.

So here again this system is very easy we just insert the particular CMV file by opening the final which had been done before so this is selecting this particular file so we will open it now you can see the crank final file has been replaced exactly at the state okay of the FDM titan so you any decide to make several versions of the copy or put different parts together or lay out in a confuse manner so that you know you have then whole area being exploited.

You remember every time the tool has to deposit go back to 0 position or home position so it is the better idea to do the parallel processing the printing any parts together and so here the idea is to be able to sort of take this feature and make something where you can have multiple features okay. so that you can actually make a copy of the same okay, so you can make a copy and you can say that you want three copies, so the same thing would be copied like this okay and you can place it one by one, you know if you want to do that way, so that you have many such items.

If you had multiple items in general, I mean all the parts may be different parts also you can place like this and make a array. So the purpose of this control center is really is to minimalistic part of the distance unit there within the FDM title, so that maximum printing can be done in the stage altogether okay. So it makes it from the serial to a parallel process. So once this is done, I would just like to remove some of the things that I have made, I just want to print only one for the sake of clarity okay.

And you can actually invert it and you can actually select this particular part here and you can rotate to any particular direction okay. I would just like to prefer the othonic direction here, in the interest of the printing, so that the tool part is same for quiet sometime, every time it positions backs to the xy a lot of work for the tool as well okay. so once this is done I think I would just like to build the job.

And there is a build menu here, so the moment I click it the job is now almost ready okay and you can see probably that the job is in Q already. So you can see already that there is a pack slash final admin, which is actually been started at 1502 hours on today's date that is 18/9/ 2014 and the estimated bill time is give here to be out 47 minutes also what is important for us to look is that what the machine loading at this time.

So you already saw the material confinement I am going illustrate this again that there these material can which are the initial raw material those wires which have to fed in so there is actually a calculation done by the machine itself which talks about how much amount of material is left here which is about 86" ^{3} okay in the model canister and the support canister as a material of both 37"^{3} and the amount of model and the support material which are needed are also mentioned here as 0.47"^{3} and 0.38" ^{3}.

So typically you have to understand that these two which are need should be lower than the material which is available okay so once this condition is met I think we are also set to do the machining operation which we will see in the next illustration, so here now you know you can also in this software after looking at the Q you can look at the systems view which gives you an idea of the time you know this is going to take about 47 minutes.

So the position here really shows the start time it is about 210 right now in the day you know so you can actually get the switch going to start at 210 and complete at about close to you know some where beyond 3 you know something like that now because there is going to be a heating time there is going to be a cooling time then the actual printing about 47 minute weather is going to be preprocessing time which is needed for the controller to be set in so that the total time duration that the whole job would take is near about close to 340.

So it is more than hour from which the job would be finished so all these details can be described on this particular system is very helpful for the user so that you can actually process and plan how much time you know the machine will operate and when it needs to be done so once this is done I think I will just simply close this particular software and we are now machine able to go to the box station and so basically now you know I would just like the demonstrate what happens with the controller of the machine the slice part as already come and it has been quad online to this machine here if you just look into the controller this screen right here say build job okay.

So there is an option called billed Job down here or set of keys where there are different controllers which are available if you want to escape for a certain command you just press this escape button if you want to go into the command you just press enter button and the you can actually go up and down with this curser arrows and then need pool would be done in terms of parameter setting later on okay so we just enter the build job menu.

So once we do that you can see that they are talking about build next job and then they are staying crack final so this is a job which has being quad to the machine I am going to build this job now and the movement I press the menu key here you will see that first the stage would go all the way to the initial potions and also there would be a setting of that nozzle to one corner which is the home position for the nozzle.

From where the printing would start to take place so I need to just do this build next job E crank final the moment I have enter it now you know they are saying need all four canisters present so I you know the job can be done by two canisters because I just saw that the Pc support material as well as the normal Pc which was their it was volume wise much larger volume in comparison to the need which was their develop this particular job.

So I just go to the continue option here and I just by pass this so now you can see that inside the machine cabinet you have the auto positioning of the dispersive tip and then slowly the stage is coming up all the way to the point when the initial dispersive will start one thing which is very clear here is that the tip is gone to its home position and we had also defined our job in that particular pocket only so that there is not much motion of the dispersive to be made with expect to the state.

So once it is all set up there is a option here with say demo bounding box okay so if you go back to this particular controller here you see there is an option which says demo bounding box all it mains that hen I am going to pres this demo bounding box it will show that domain within which the printing has to be done on the surface of the independent okay.

So I am going to just select this particular operation here do the center and you can see that there is a domain tool path as gone inside so the domain which the tool path is going inside the moment I enter the demo on that you can see that there is a square domain which the tool dispersive is going this is kind of the domain where the work piece printing would be actually done.

So now I just continue it so go to the next option and continue and enter it and now the whole auto calibration activity and the machine would be automatic mode and then whole printing would start happening okay where there would be dispensing and writing of the particular shape on a slice by slice on the miler transparency film.

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