Enclosure Design of Electronics Equipment
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Lecture - 50
Types of CAD

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Use solid primitives, prisms, spheres, cylinders, cones and Boolean that is union subtraction and interaction to create the solid model. A lack of editing or re-dimensional capabilities, if there is a change in the design, the model in the most cases will have to be reconstructed. They somewhat you call freely downloaded from the net package which I use comes from this, but then since usually we have done a real big goof will not a small adjustment I am more used to making the whole thing again.

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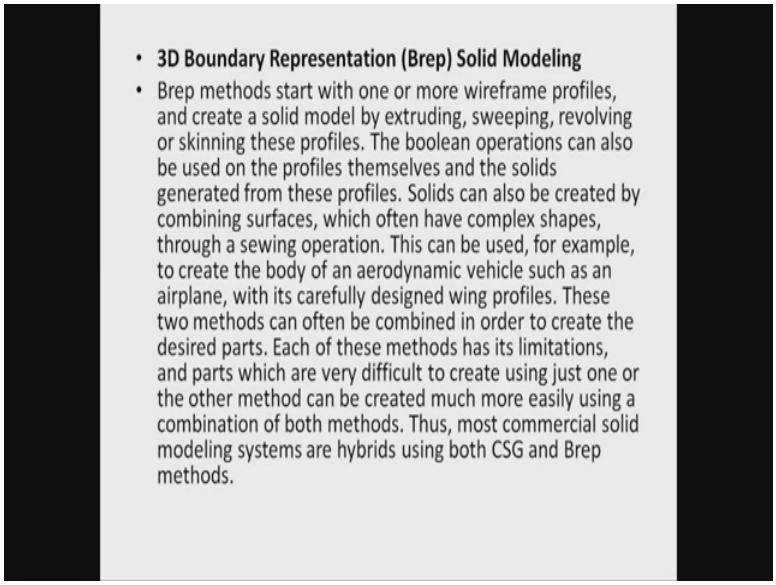

I will show you a last example at the end; Brep method starts with one or more wireframe profiles, create a solid by extrusion sweeping revolving or skinning. These profiles Boolean operations can be used the solids from these profiles can be made solids can be created by combining surfaces which have complex shapes through a sewing or welding operations used.

For example, to create the body of an aerodynamic vehicles such as an airplane with designed wing profiles these 2 methods can be combined in order to create the desired parts each of these methods has its limitations and parts which are difficult to create using just one or the other method can be created by using combination of both methods.

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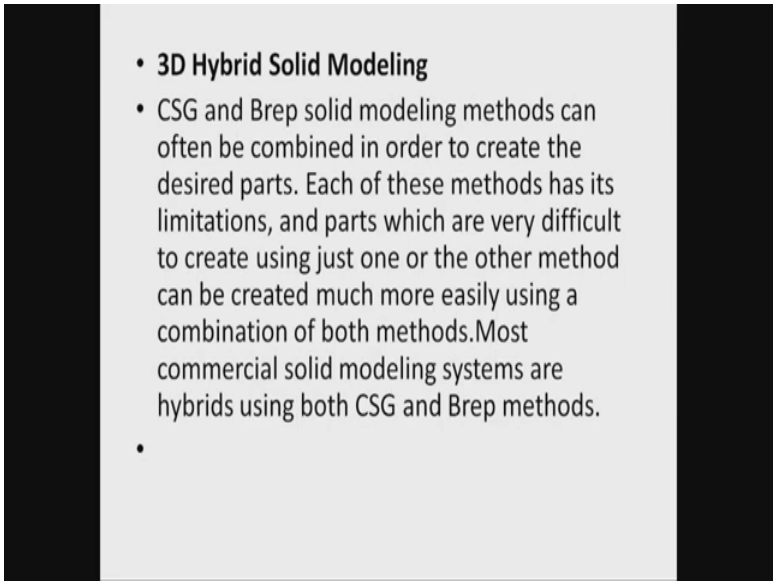

I will probably come back to this later on when I introduce you to one of the things. We have combined solid and boundary representation can be combined in order to create desired parts each of these methods as its limitations most commercial solid modeling systems hybrid with both of them.

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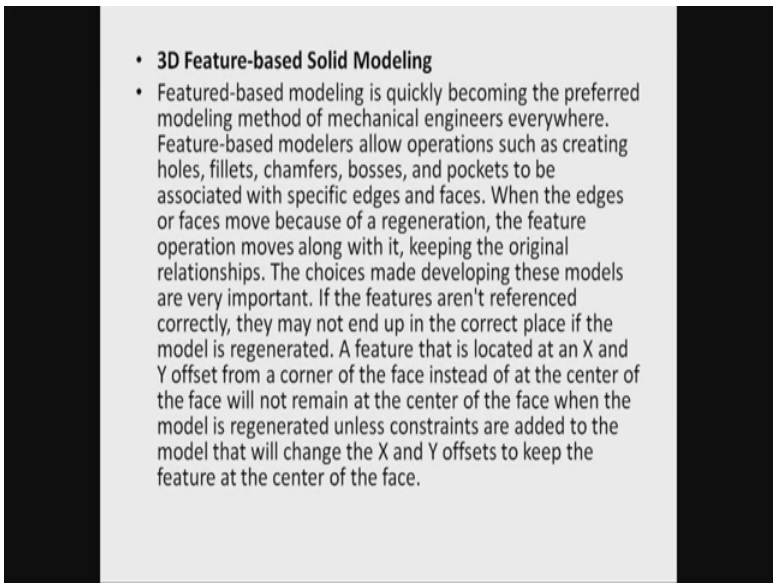

3 D feature base solid modeling is becoming the preferred modeling of mechanical engineers everywhere especially things which involve fabrication using conventional fabrication process.

Feature based models allow operations such as creating holes fillets chamfers bosses pockets to be associated with the specific edges and faces; when the edges or faces move because of a regeneration feature operation moves along with that keeping the original relationships. This is the genuine growth which we intuitively do in our brain when look at the objects themselves when the features are not referenced correctly; they may not end up in the correct place the models are generated.

So, we have this stuff about you know; something which will be in the center to the edge and so on is a matter of initial training and tremendous experience and generally people try to stick around with known limitations and luckily for us, the fabrication shop has a limited number of various operations. If you have to take a hexagonal headed screw an LN key; the key dimensions are fixed the head dimensions are fixed understand know; we have a key then we have a head in which hexagonal key is there; head dimensions are fixed and height of the head is fixed and then at the bottom various screw proportions and all are fixed probably started by at the din VSM and eventually adopted by SI and ISO various dimensions.

The advantage of this is they are nearly interchangeable and CAD packages make use of it. In fact, it is a library components which are available directly if you want a M 6 with the length of may be 24 mm; the whole set is available downloadable from the internet.

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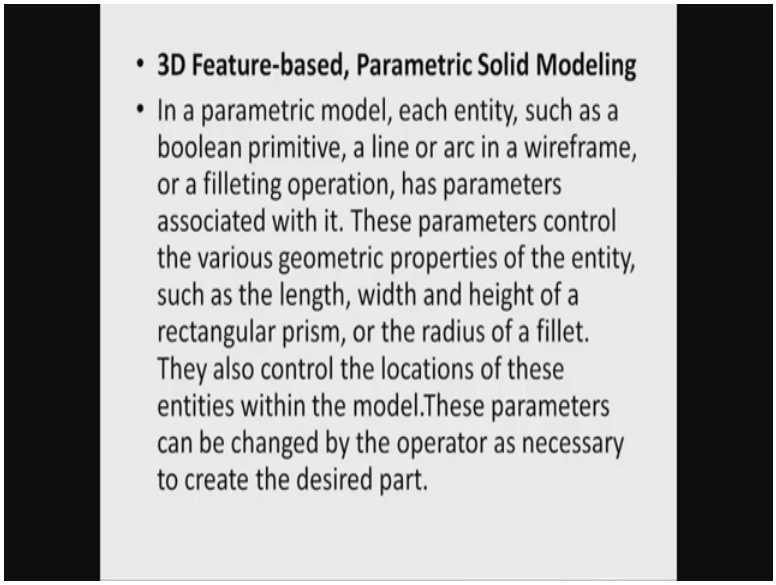

And sometimes built into the packages read it yourself before I read it with you. So, you see here; parameters related to any primitive can be associated with it. So, 2 ways bidirectional that is if you want you can edit it and automatically things get updated. Alternatively if instead of you are typing in the dimensions, if you modify something there; the dimensions get changed magic is real process involve using cutters using involve what you call routers and using involve end mills and all that you know there, they all come in steps like inside if you take a mill for making a routing typically a four mm end mill is a reasonably tough or stable object which is available in that unless you want it very very small the corner radius can afford to be about 4 mm and then in case something square has to be put that take it into the corners and so on.

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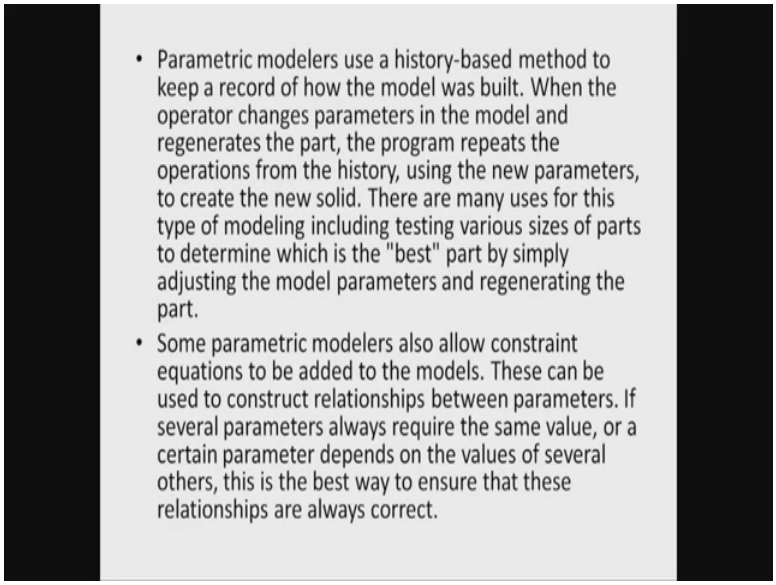

These things can easily be incorporated into your module you see the second important thing is this modelers you just read the first one I will read it in myself before I start. So, the first phara talks about which is the best part by just simply adjusting the model parameters and jin regenerating the part. So, several these parametric base now have a beautiful history only when you make a what you call when you attempt to use and make a PC. You will understand somewhere you would have made a represent; I mean starting point saying in our case of electronics I will say - I have started with locating a connector on one side of a enclosure and then I have put a printed circuit board which comes near it now you see this there is a chance of something attaching with each other if there is a way if I tie up these things I can avoid the unintended interference within these objects.

So, all I need to do is now I lower or higher mean change the PCB height. Similarly, I can change the connector position and then other things related by; it can be made to update themselves automatically you see here some of the parametric modelers allow constraint equations use to construct relationships within parameters a several parameters require the same value or a certain depends on the values of several others these relationships are always correct.

So, unless you face it and try it there is high level of generalization an abstraction probably we will not make sense to you one example one very small example I can give you is

which is not really the crux of it is let us say you start here program by using 3 millimeter screws and cheese head screws. And then we know that 3 millimeter cheese head screws have probably a washer and then there is a spring washer associated with it if you correctly tie up all these things we suddenly find out that for some reason; you need to you need more space.

You can reduce the size of the washer and then associate hings like if you have a counter bore all of them can taken care of. Alternatively if the material especially if it is plastic and all that is likely to fail you can increase the size of the washer and then make sure related buses head all get updated automatically they just one lone instance or a neck dot I am trying to tell you I am not claiming that his package will do it. Automatically in the case of mechanical things like bearings and all that it does work it looks very easy; has to how to select a bearing go to the catalog and select it only when actual if is collect try a object then you will notice that there are constraints I wish I had a another object like this you have seen here the slide there shows about hoe entities can be located. So, my next slide shows you where to put the various parameters.

So, even if I were to talk about a watch like this which is actually simple it has nothing much about it. So, it looks like you can put this what you call illuminating, but in anywhere you like similarly you can put all these things anywhere you like, but if you can tie them entities can be located at the origin of curves end of lines or vertices id points of lines and faces similarly and we located at a distance at the end of a vector from these points.

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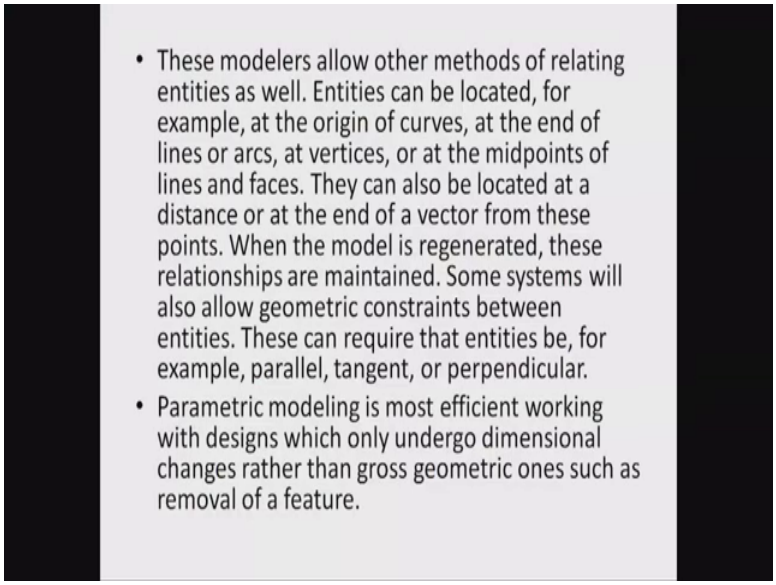

So, if I read it, I mean kindly read it yourself because had a little mixing problem kindly read it by yourself. So, in the first Para, last line, insist that if you can I have things which are parallel tangent to something or perpendicular. So, if we are talking about a belt drive, it look simple if you want to increase a torque reduce the pinion if you want to increase the speeds same way reduce the pinion and then it is possible to do this, but then what happens to the length of the belt and then.

If you keep the belt constant may be a center distance can alter the items. So, you see here the second Para talks about is efficient working with designs which undergo dimensional changes other than gross geometric ones.

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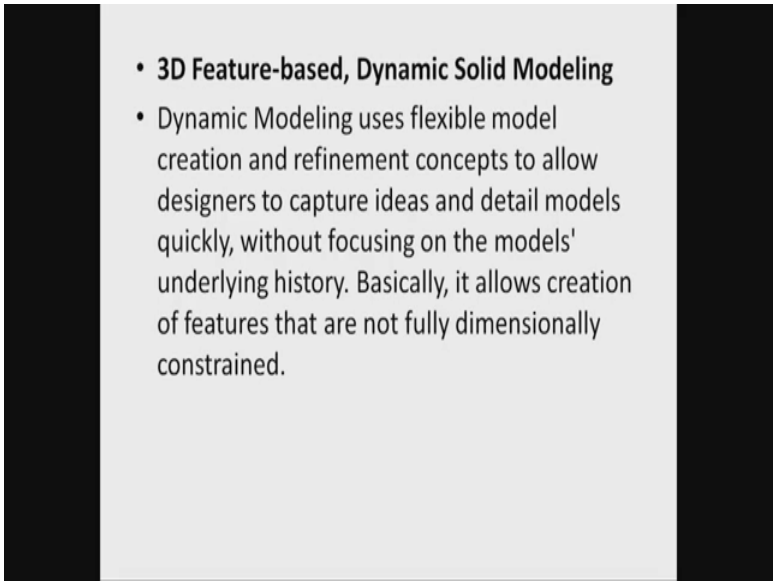

Next slide; dynamic modeling uses flexible model creation and refinement concepts to allow designers to capture ideas and detail models without focusing on the underlying history it allows creation of features that are not fully dimensionally constrained I thought.

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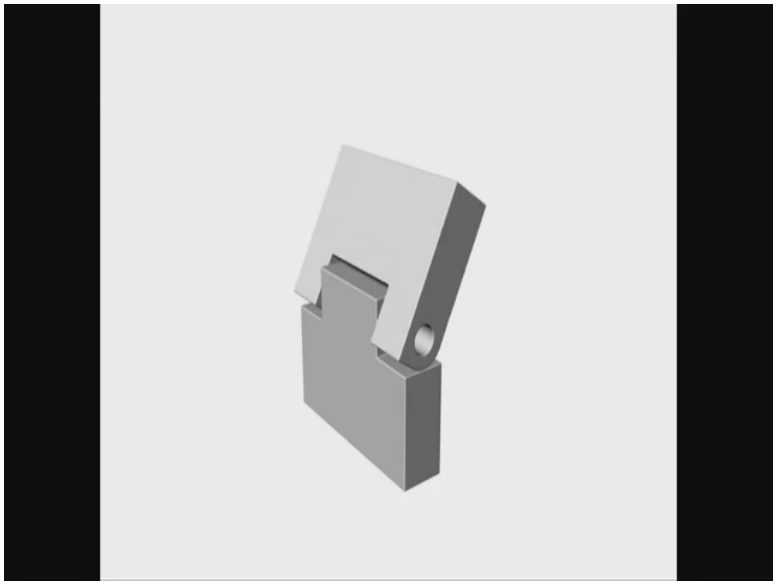

I will show you this may being a mechanical engineer I am very easy for me to create such objects you see here; this one is little like a hinge except that something very special about this hinge sir can I have the main camera. I have a hinge in my hand which is conventionally what you will fit for a what you call a box. So, this hinge sir can I have the camera I have a hinge here which is a small I mean it is small because it seems to measure on 30 millimeters. It has a little problem that it goes back unspecified length.

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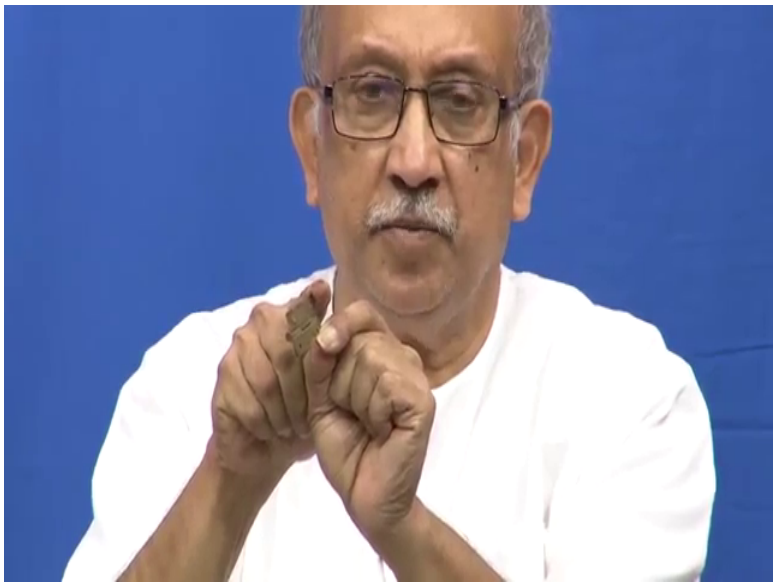

See it goes back by an unspecific, I wanted to stop here. Similarly, I wanted to stop here after it goes here. So, I went about trying to make a hinge which that animation you have seen you see some very interesting thing is by adjusting the this edge I have an edge here by adjusting the edge here I am able to make sure that it goes down by adjusting this feature and then you to make it more smoothly.

I need to give a radius there; this has been somewhat simplified by the same logic I can probably make a smooth surface here and then try to see how well this is typically one way of it is I do not know I mean I am not very familiar that I am not able to remember because each package uses sits on names you see here to make it visible a small radius has been added here in the corners and this line here represents that these things are surfaces.

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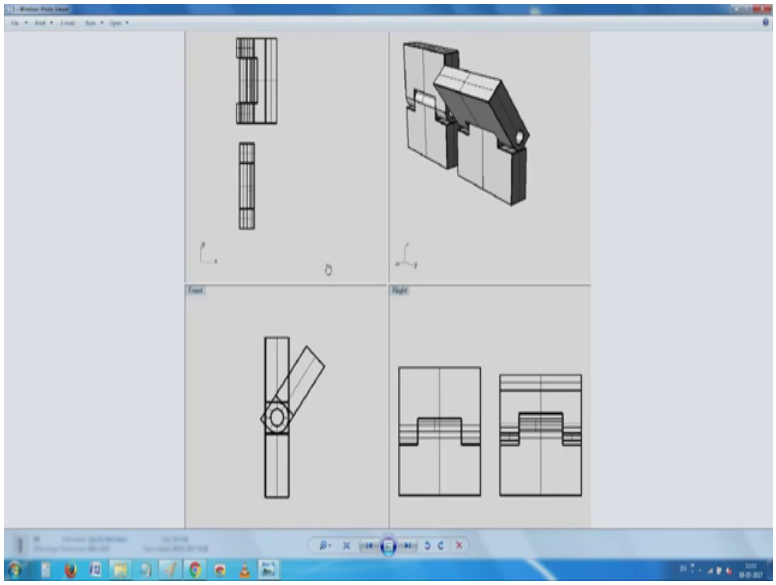

So, it surface with the; you know edge visible and so on, but in the engineering view you will notice that dimensionally it will be perfect, but for you to understand are make the object it is not that easy, but when I am talking about how this geometry how it fits and all that it does make sense. So, this is where various types of operations have been done.

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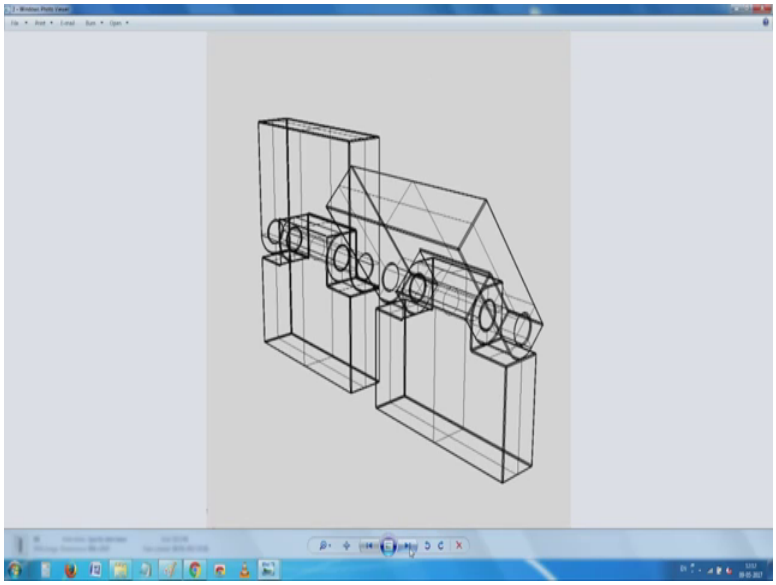

This is a little not a actually a wire frame model, but then it shows a surfaces that attached to each other because edges are also shown and edges have a small radius built in or fillet built into the that will ensure that will be visible see in this here this is not the actually real original object small radius has been made here such that can be done and then you see other extreme how it stops here. This is lightly different from the earliest that models. I have seen you have seen that slight amount of shadow sorry shade has been given to them to make sure that these things look slightly better.

So, we have all these you know nice things here I am trying to load up the one of the what you call beta versions of a package which I have I hope it opens and I would like to thank the associate. So, have been good enough to give it to us you see here if I now go to this window something very nice can e done I can see it for every view how it fits whether there is an interference here in the seen here; I do not see any interference at all now if I have to rotate this object see here there is a clear gap here by which things move smoothly when I said may being a mechanical person get thrilled that this packages are able to do these things for us. So, we have huge number of options that are possible and a huge number of packages that are available I thought maybe this is the one I was reading out from you.

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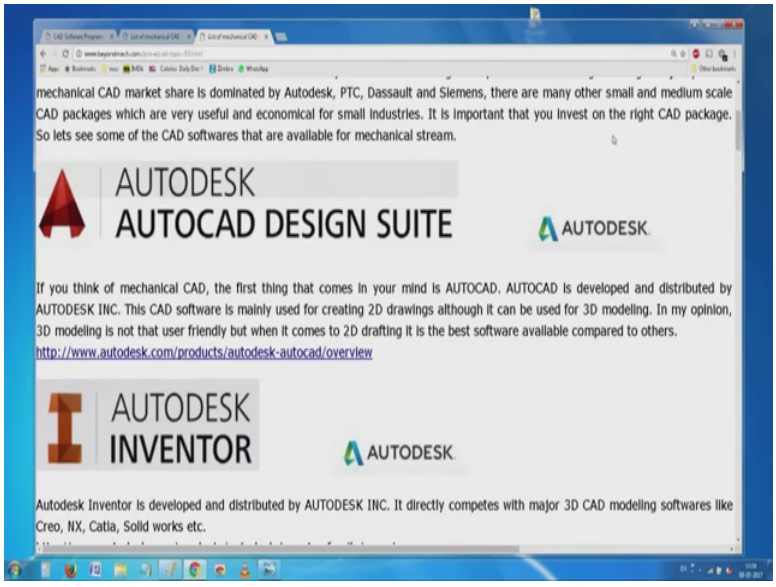

This is something; I have retrieved it only this morning I suggest you to people go and ask for what are all the various available packages that are available in the market and then some of them allow you to download a trial version and if you are a student or a first time user for a short time it is nice to make them eventually you get what you prefer.

So, if you pay the full whatever is there that get support and upgradability in case you change your platform from a simple PC eventually into a workstation or have a terminal which is the other workstation because we had release 12 net ware version from novel for a long time until when we checked out our novel net ware and we moved on have we got support. And then eventually after that know we have moved out of the that whole space of teaching CAD and then students learn the other softwares from the college the under level they work and then we go at the graduate level.

So, things have been moved out though the other people yes now coming back to my monitor there you will see that one of the earliest things is the auto desk design suit we think of mechanical first thing that comes to your mind is autocad; autocad is developed and distributed by AUTODESK used for creating 2 D drawings and can be used for 3 D in my opinion 3 D and so on and so on. It is a best software, but again it is an opinion about the person who has compiled these thing, but I am sure the people were familiar with it continued to use it and then they export a including a solid model this start here exported to a package there and then you will be able to build on it from there. And then even now the AUTODESK, DWG, DXF and IGs formats and especially DWJ starting all the way from release 12 to I think 2000 and all that have almost become industry standard and generic.

So, whenever you go somewhere you can see save as you will find the particular thing to save later on inventor now what you call it is a beauty for people who started with AUTODESK suit packages easy for people to learn. And then in case you have started especially when the HP and the Hoostern printers came somehow that printer format and AUTODESKs things matched very well now the any problem we could take prints and back up is out in the market you can just upload the your whatever file you have and they fit everything neatly depending on whether you want a 1 or a 0 print nicely.

They come and then even today it is worth keeping a print because my floppies do not work original we also have now a day will believe that there. There was an 8 inch floppy, they do not work anymore hen we have five inch and all that even sometimes I find that corruption takes place in hard disks pocket hard disk also have corruption. So, whenever you have signed contract everything and all that now original hard copies are still kept somewhere and for this purpose the original AUTODESK formatting and printings still works very well and by default anybody else also gives you backward compatibility.

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And I am sure lot of you have come to good old pro E Creo parametric normal as pro professional engineer is developed and marked by a parametric it is a CAD, CAM; CIE supported software unlike the earlier.

What do you call the AUTODESK weight which is only little with drawing design and making things. This particular pro E became main much more mechanical than simple computer aided design drafting. It had various advantages including what do you call parametric feature based 3 D modeling. So, if I have a square cut out what will happen to the corners have a beautiful opening; what will happen to the three edges what will happen to the inside edge and what will happen to the corner of 2 edges and then 2 edges meeting here these things are taken very very well in pro e best probably while I have not

used it have seen my students and fabricators use it they seem to understand this well, but parallelly both Siemens and Dassault came out.

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With their own fantastic software Dassaults; Catia competes with pro e as well as auto CADs other; especially, as they have written here inventor particularly used in industries where rich surface modeling is needed such as aerospace and automobiles.

When we are talking about surface modeling a thing like a mouse is simple compared to an automobile where even a thing like your front fender is a big issue and then aircraft we need not tell you about you know how complex it is. And finally, in a relation with aircraft and automobile things like a front dam for keeping a formula car down its special aircraft has flexibility and what do you call surface transport has flexibility, but when you are talking about the a spoiler and we are talking about this dam and various things that is really something they keep the drag coefficient down and while we talk about lift to drag surprisingly.

It is the other way in the case of surface transport at high speed instead of lift we want a clamping down force has a technical word for it which I am not able to think about. So, Catia was born out of this requirement by the Dassault pep I do not know how to pro-

nounce these words put up with me or rather my accent Siemens and Uni-graphics solid edge are inseparable so much so that are under graduate program in the place in Bangalore.

All colleges teach either solid edge or solid works from their I think second year f engineering studies I am happy or rather well I am not apologetic for it I am proud to say I cannot work with this packages as well as the students; students have started already young and then without too much effort they are able to make really complex solids seen that. So, anything I want to make here all the most of the majority of things which have been presented or going to be presented have been made by my graduate students who when they were young like when they were what you call nineteen years old they started with either solid edge or solid works; works beautifully and one of these is solid works I think now has fantastic sheet metal capability.

So, all that which I have shown you about how to add a bending allowance and then how things interfere with each other how to make notching all these sheet metal works are available in this packages. So, what started what looks simply as they what you call some general talk about CAD you will see that CAD has come to very very forward place well at one place as I said things like more and things like in the case of aircraft we have analysis about drag and lift and all that same way in sheet metal tremendous amount of progress has been made.

If you can make the start with an original drawing there is a shell commend which will make things into a thin shell and then you can bend things you can make which can be used for any other things. So, we have so many of these you know Ashlar Vellum 2 D-3 D CAD software then this bottom one. So, now, I have not used all these, but then if you go we have a few things like the Google's sketch up I am not very good at it. So, sketch up is developed and marketed by Google a pull combined techniques and so on I suggest you go to this Google's place and then we have so many of them.

So, I will go back here again on top. So, we have the Ashlar Vellum it has a huge mechanical parts library and parametric modeling similarly 2 D mechanical which are easy to learn the one; the very complex things are little difficult to learn. But the once you learn you can manage very well as you go down sketch up is available any of you were just curious

about it you can try this sketch up then we have free CAD open source parametric 3 D and this is probably we have come to the end of this listing of the various packages my suggestion is please go back to the net and then try one more time.

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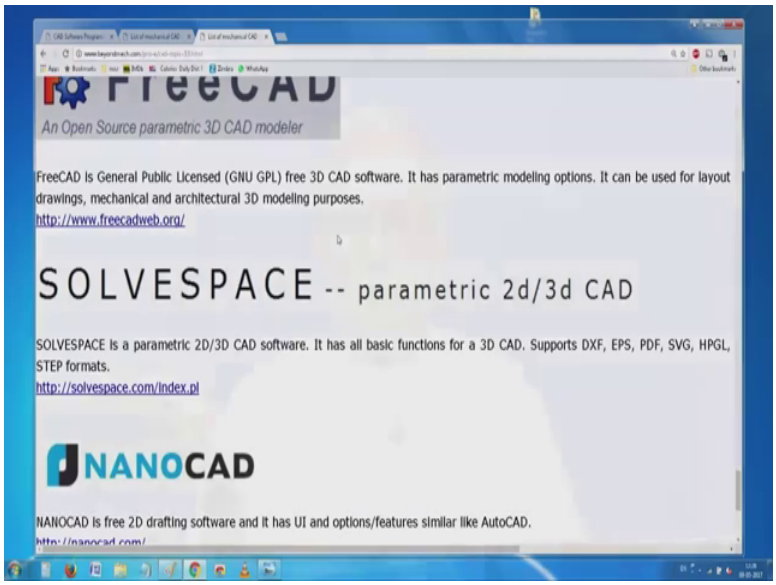

What are all available and in case you are in a group or in a friends circle you can always learn from them otherwise any of these packages have their own tutorials and things built inside and some of you can afford it and have do not have time can probably join a class where they teach you the fundamentals it is expensive. But expect that you get support with the package in case you are stuck they will not think you are a dumb fellow or asking the same question and again and again.

So, you can get help from them otherwise I am sure several of you intelligent I mean most of us do not read the instruction manual anymore I will end the stock with the thing if nothing else works read the instruction manual say in our case if nothing else works keep trying or get on to a blog and then you will get information about; how to attach surface characteristics how to give you know a bump or texture file to a surface how to adjust lighting and all that which is actually beyond the except that I wanted to introduce you saying you try to make this if you see one of the GIF animations was created using the some solid modeling software and it is done in a very crude way it does not use proper animation things.

So, it was stored with you know every 15 degree or something was rotated and where (Refer Time: 33:54) it. If you have proper animation software, you can probably have a handle and make things move and see how well things move. So, thank you if nothing else works keep trying.

Thank you.