Electronics Equipment Integration and Prototype Building

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Lecture – 19
Simple and curved surfaces

Hello, I stopped my lecture in a very critical point last time saying we have various types of things here. So, one of them is thing is about geometric primitives.

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So, in this primitives the common primitives are the points, lines line segments, planes because why the word line and line segments are shown is generally. Lines in general mean not necessarily a straight line depending on mathematical, what you call, how much of thing people do for defining those things. At one point of it line has considered as the shortest

distance between two points something that line joining them at all. Line segments could mean something which is a little longer and arbitrarily shift.

Then you have planes, a plane is typically if you recollect last time something in which several points can lie together in a co-plane. The moment you have a flat sheet then I have taken you an example of the this mouse pad. Remember, the mouse pad it is flat so, if you look like this here know generally, it does look somewhat flat both directions, but now if I connect these three, you see here a triangle forms typically this triangle is planar.

So, coming back to a common example if you have a three legged stool; three legged stool sits stable because they can sit in any plane. But, if we four legged stool we have a problem that three of them will touch and the fourth one will be not touching at all. This is the whole basis of mesh generation; a mesh consists of very elementary triangles.

So, then I have shown you rather I mentioned to you about how ball is made, you can build a ball out of hexagons and pentagons, then we have the famous bucky ball and then we have now the 360, what we call carbon atom and so on. All of these if you see it, it is all based on basic triangles like this. So, coming back to my this display, here you will notice that we have triangles arbitrary polygons and quads are the ones that are the common primitives. You see here; so, we have here triangles arbitrary polygons.

Now, we have this about this spline curves. I will get back to it later, it just means if you have three points you can have a start and end point. And, if this is the start and end at this point, we can put another you know the what you call point and pull it up by which a smooth curve can be drawn to that that at the moment, I will just call it a spline curve and leave it here. I will come back to busier and I will come back to nurbs and so on like that.

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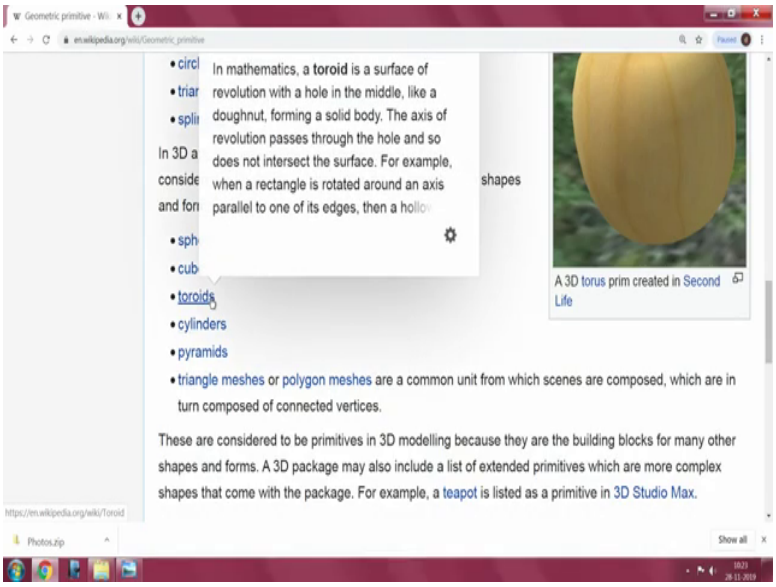

Next if you come down; if you come down, you come to other things here you have seen this spheres, cubes are prismatic objects then we have this toroid. Toroid is a surface of with the hole in the middle like a donut. So, I think that is enough for you to talk about.

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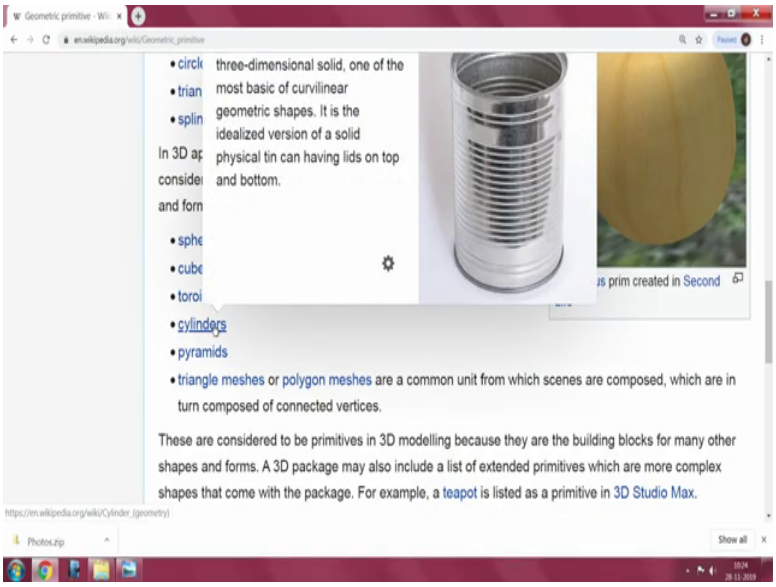

Now, similarly we have a cylinder, you see here exactly know the cylinder is given here there is the good old tin can. So, I think I mean it is been forever as long as we like it has been here.

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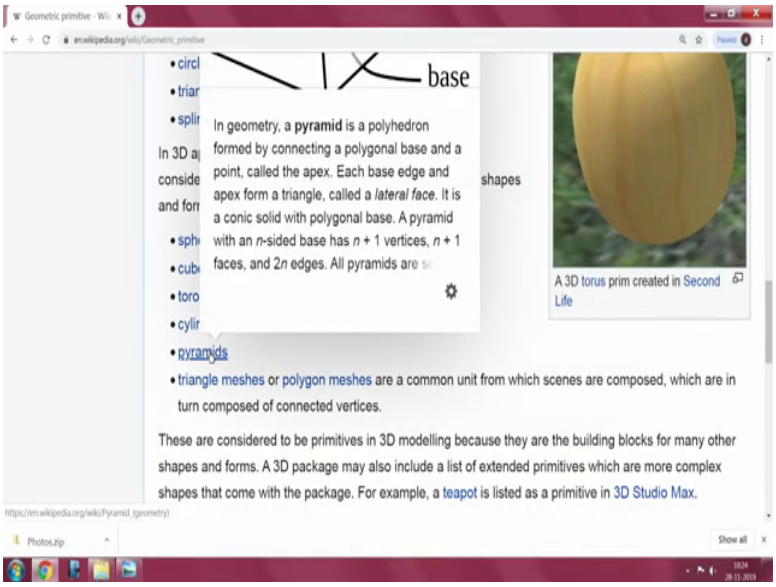

Next we have famous pyramids. So, pyramids are a non-stop I mean, it is its fascinating tens of thousands of years. So, the very simplest permit can have four phases where all three phases are triangles.

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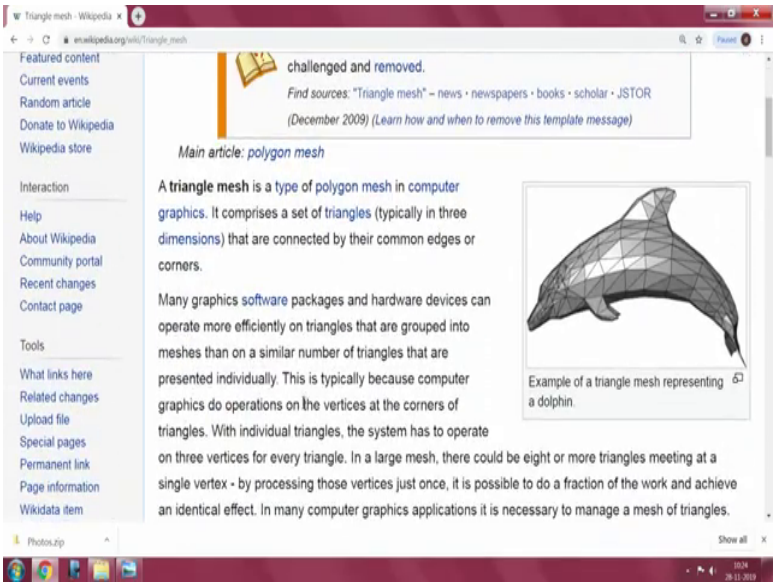

Next we have triangular measures polygon measures. So, the case of a triangular mesh, this is what I was trying to tell you at that point.

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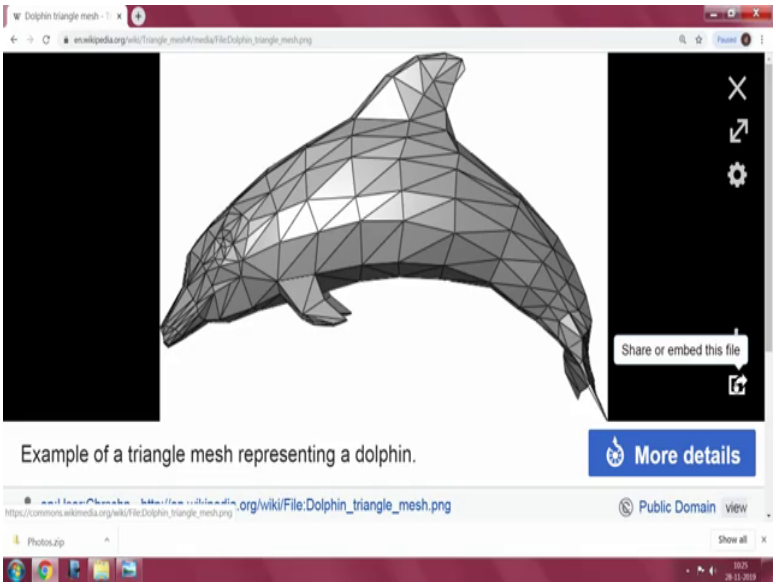

Can you see this even a smooth surface eventually has been to be broken into triangles and depending on your cad package and depending on your way of representation; what you like to see, it can be smoother or coarser..

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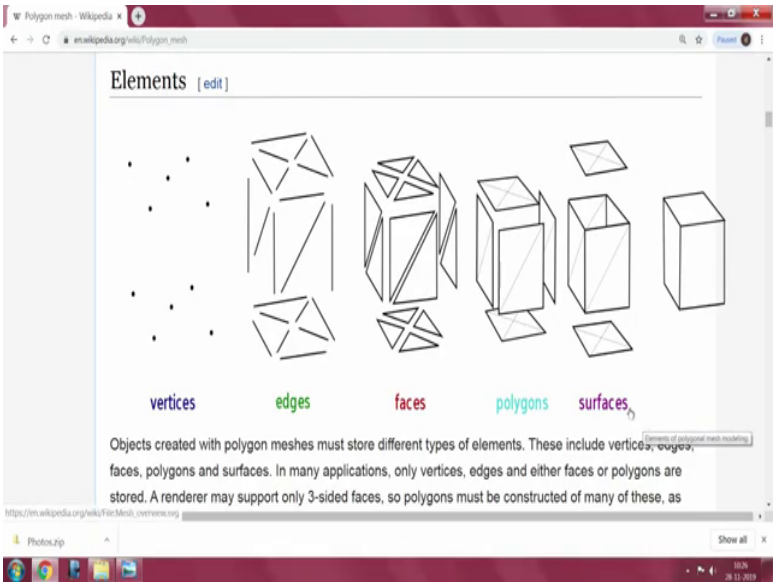

So, polygon meshes a same thing, a triangular mesh and ok. So, if you notice here the very basic things are this vertices, then we have the edges, we have the faces, then we have the various types of polygons and then we have the surfaces.

Why am I; what you call presenting all this it is that unless you know a little about it. Often when you get stuck with actual solid modeling or trying to make any product, you will be wondering why things are not behaving the way they are expected to what was there in your mind. You had some concept and then you try to model it and then suddenly you will discover that these things do not work.

I can get back to the presentation you have, you have seen this vertices are the corner points which are not joined. Edges are where two of the faces meet and faces are those elementary

triangles, we are talking about when everything is flat there is no problem then it becomes various types of Polygon Serio.

See here for example, this is a planar polygon by definition there will be polygon and surfaces are same thing when the two of these things are joined together they form a surface. And finally, in the end you have the full fledged prism it is for you to understand what it is.

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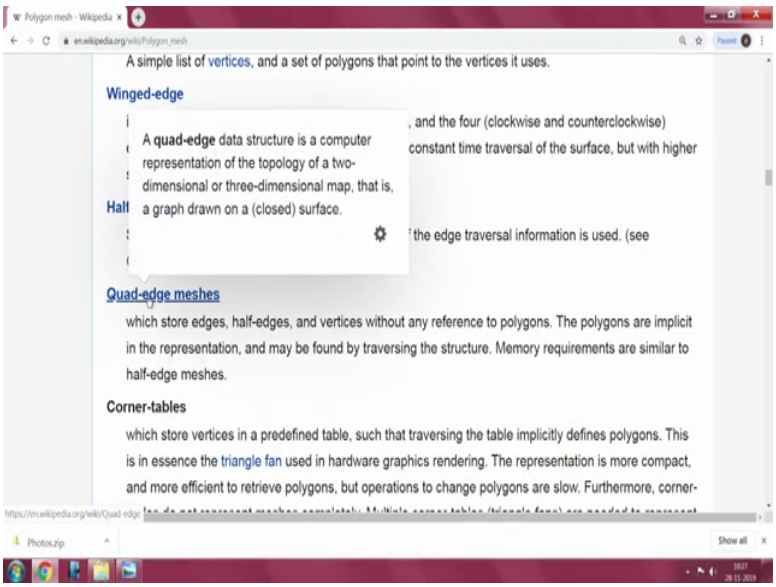

So, my suggestion is go through that just go to the; I mean, any place go and then try to meet read all these things saying so many things are there.

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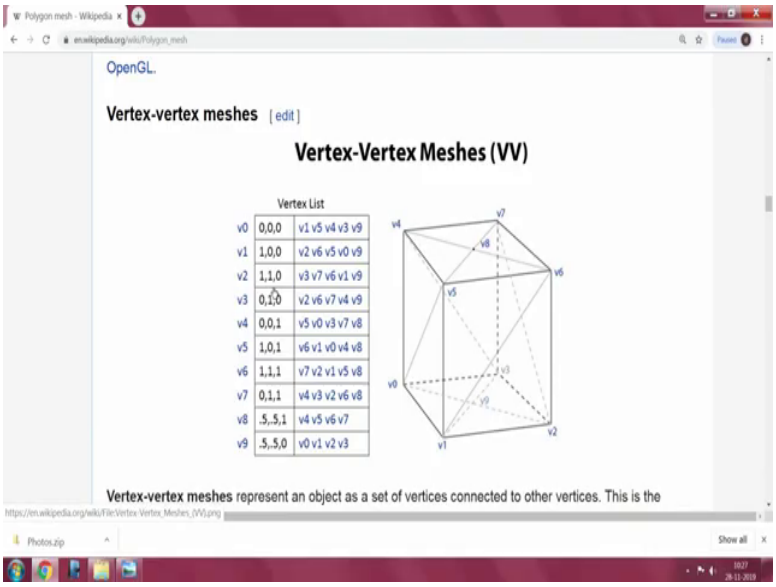

Right now know it will be too much mainly, what is important is all representations or everything will only be this we have there is a list of all these vertices which are joined together and it is presented to you.

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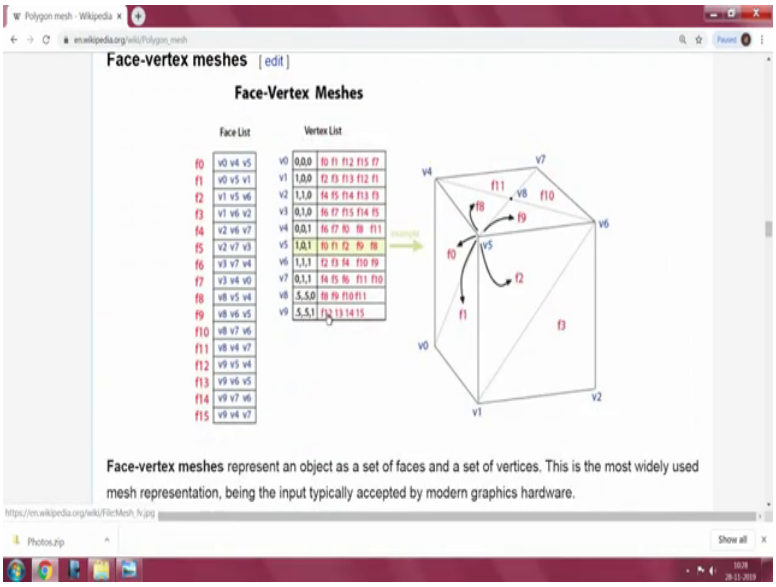

So, at one extreme, you have seen this here face vertical vertices and so on and so on.

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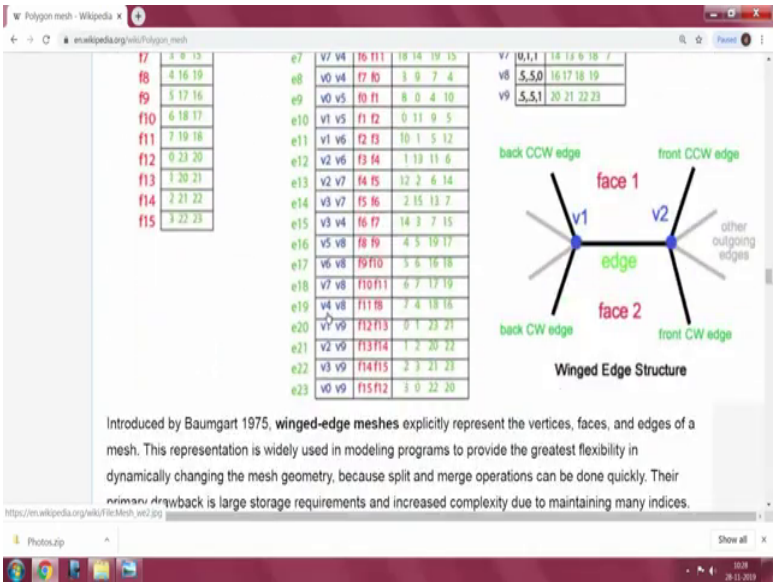

You to satisfy you are this thing you can you can just read it at your own, you will have a chance to come back and then probably get back to these things.

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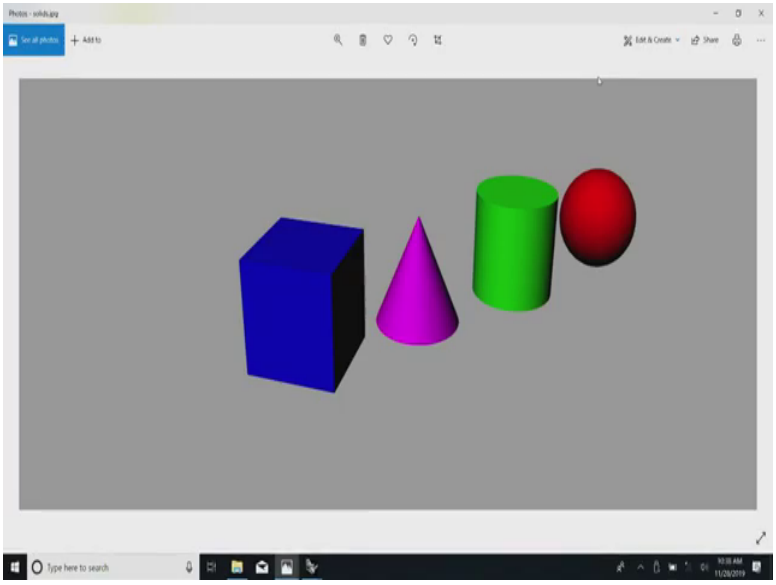

Now, look at the other monitor which I have there; sorry, can you connect this monitor these are typically from one of the software which is now freely trial versions which you can download it as limited thing. So, if you come back here know the very basic solid as you see are there is a cube prismatic cube, there is a cylinder, then there is a sphere and then in between something which you know depending on how you look at it we have a cone also.

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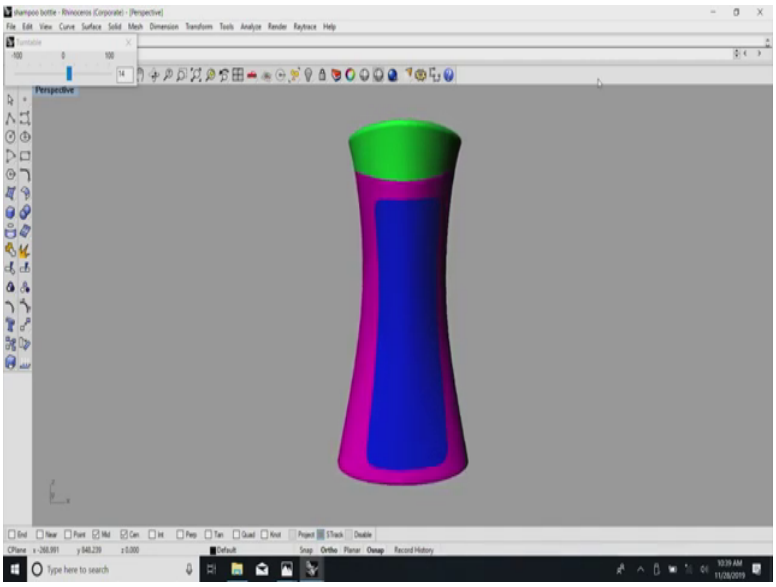

So, now if you look at these things ah; I am sure some of you would have recognized this. Now, this one is a not a simple primitive what you call it does not directly come into the primitives, you understand know this it looks like a very complex solid. So, you can I can look at it from you have seen this all the faces I am able to see. Now, if you look back at this monitor here, you have seen this has been taken from here.

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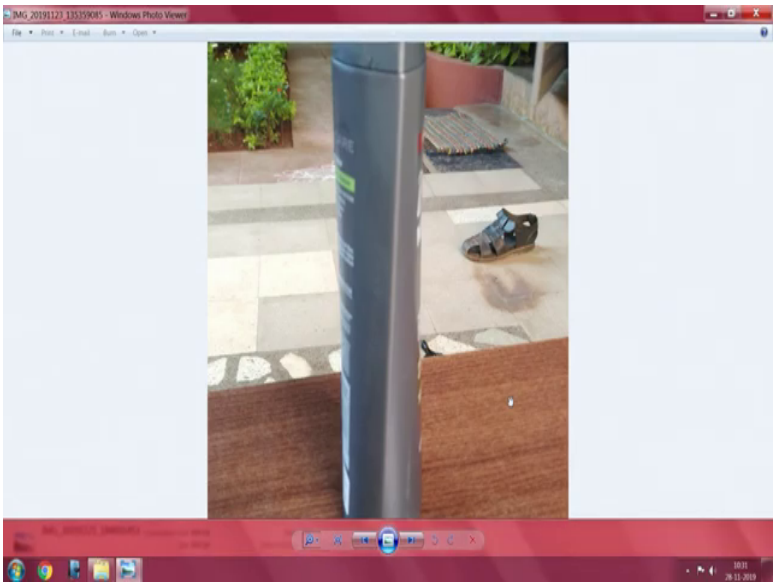

I am sorry for what you call well it; I am not strictly speaking, I am just using it as a common practice and I am not being what you call is not part of product placement. It is just that it is there that is all I can say.

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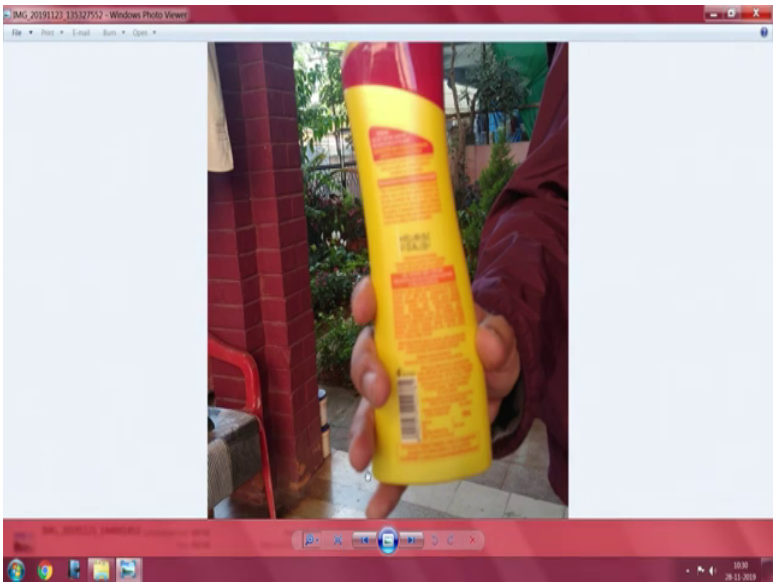

So, this is typically this sort of things you would have seen here, as you will notice here there is nothing, there is a base; the base here then there is something else a small curve here and something which is directly fitted in this. This is typically the simpler of the objects what we see around us.

And, why this particular shampoo bottle I have chosen is that, if you have to cut the shampoo bottle, you will notice that. Of course, all the shampoo will leak out depend; I mean, ignoring the shampoo leak out, if we cut the bottle when you know it has come from the original thing. What you notice is it has only a thin shell, it is not as solid in that you know in the strictest sense that it is how to tell it is full inside; is not a full inside solid, it is just a shell.

You have a surface; surface again all around all surfaces joined together and important thing is this exactly how it is produced a blow molded component. They just generally take a small

former put it in a mold and then inject some gas, I am not very sure about it. You can just take it at the moment can take it as normal little clean air, otherwise nitrogen occasionally carbon dioxide when you push it inside the whole thing fills the mold.

So, typically ideally this sort of if you see these things they are all, best examples of; the solids, but not necessarily a true solid, you understand know it is not a filled solid, it is just a blow molded component. Typically, most solid modelers have this in the thing and surface modelers have only this nothing else in this. So, I will try to show you something.

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Now, I am sure some of you have seen, this is a very common players, MP 3 player.

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So, you will notice this is typically if you will see this is how most of the products, electronic products anything what we would like to make all come into this category. Why I have selected this is it does not have a very complex surface, what it basically has is it is a cube in fact, they have made it intentionally as a cube.

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So, in the front there is a what you call a small gap has been made and they have attached a mask here, you have seen this know and this is I am not very sure if it is actually functional, it is just part of making it look a little more attractive. And at the base if you see, basically they are nothing, but a row of LED's in this ok, then we have the display here and then we have a window and all sorts of technical things which are here, you understand know.

So, when you cover it you come here and now this one I will come back to it, it is actually a waveform which typically if you overdrive and amplifier or anything, there will be a tendency for things to clip. So, probably they have found out that this is attracted people and then they have put it.

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Now, inside this if you see it is nothing, but a cube in which they have removed various things here can you see here. So, at the back of it you see here this is the mask that is they this is this areas are clear ok, on that they have done various types of printing and all. Why it is; why I you know chose this particular thing is, it is a very simple prism and on the prismatic object. First time itself when you have start your design, the designer without even having to build any particular prototype or anything or a very elaborate expensive prototype, all that they need to do is make all this like this.

And if these things are approved by your team not by the customer not by the what they call salespeople or anything your development team or whoever is the core team approves it. Now, you can go ahead and develop it and your effort in creating all this has not gone waste it

with you for life. If you remember a previous, I think two lectures behind I had showed you the various type of these modules and all these things.

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So, this is actually built one it is not come out in order. So, you can see those things underneath, you have seen that this is the starting one, ok.

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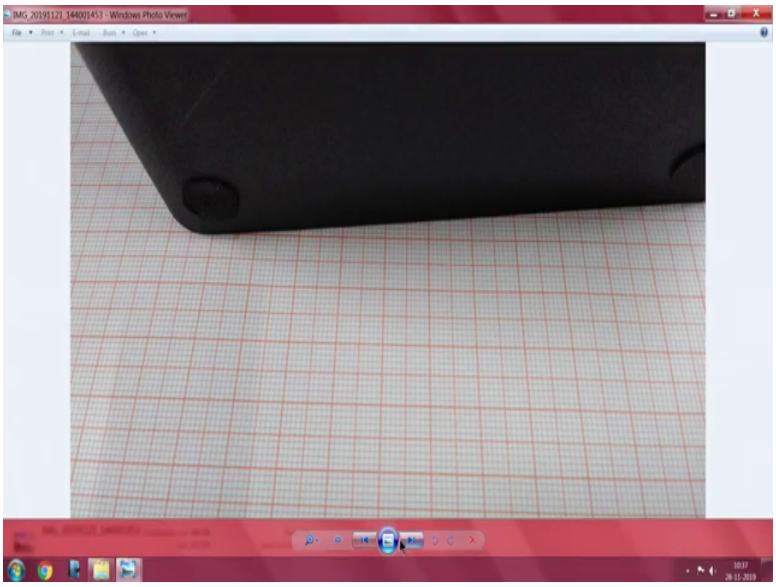

And this is where I wanted to tell you once more again and again, all you need to do is have a graph sheet underneath. This has taken with an old our printed circuit board system by which we used to have the 1.27 millimeter grid system. Even today, most what you call printed circuit board or anything they the pads are all placed on 0.1 inch grid it has gone all the way to 0.05 and 0.025 grid pitcher. So, you have this thing at the bottom, ok.

In this particular case. In fact, we have selected a millimeter grid because unlike the printed circuit board here you will have all our dimensions and all are based on millimeters. Most of the world uses millimeters and even they what you call US system still uses both, that is you have inch variant, but in the brackets usually millimeters are there and in the inch decimal inch is shown. Because, it looks like some machine tools and all that is easier to program in the decimal system.

So, I just wanted to show you this is the base then this the completed project and these are actually taken from the; I mean, one of them I asked one of my friends has been good enough to damages device and see he is curious enough to see what is inside. So, you have seen that.

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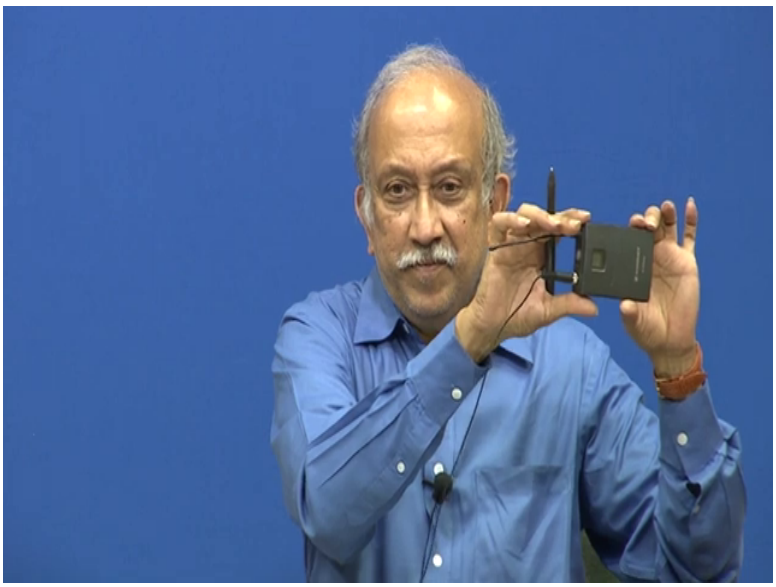

So, typically even if I were to take this, this is basically a simple rectangle, another rectangle, rectangle, and this is the basis of most of the products that we have. And, except for very high end things like cameras most printed wiring boards and all continue to be plain, you do not have 3D yet. And, that plane when if it is a flexible device wherever the connectors and all are there that is bent or it is still essentially a plane which is bent not twists are not yet there, not yet ready accept in very expensive thing.

Now, coming back to my this picture, you will notice here that there is the original thing and my colleague has been good enough to try it open separate it and after separating it, you see

here this is where the sequence of operations. So, whenever you do solid modeling I have jumped a little saying how come here is a different thing. This is I just wanted to tell you that it is worthwhile doing your things in cad and you do not need to depend on anybody, you can do it yourself.

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So, it is open and you see what you see inside, it is nothing, but a empty what you call I am not very clear whether it is a fully molded thing, ok. And, one face you have one more shelf like thing what it does is this is enabling these flat printed wiring board and all to sit here. This is where we have the true example of how to build on genuine solid modules.

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There is a thickness here and the one at the bottom if you see just to accommodate this, I do not know maybe various other devices and all they have made a small depression here. So, if you had started your model like this here, you understand know the external appearance is here, at the bottom we have all these USB. And all these things which are coming here including probably this is a headphone and this is the printed wiring board on top..

Now, this is the only active part of it you understand of this whole system, know this is the only active what you call circuitary portion of it. From here there are places here probably two of the leads go to the; I mean, 3 of the leads go to the speaker 2 of them go to the battery and the charging device, see here it looks quite good.

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And on one of the faces when I open it, I noticed that they were just reduced it to half the thickness so, that a small speaker can be introduced.

Now, it comes to a little acoustic that does not cover the acoustics, now would you like to have an infinite baffle or would you like to have a ported baffle or anything. So, on this side I do not know I have taken a picture, there is a small opening which is slightly improves the low frequency response, ok, this just shorthaired what I wanted to show you in this.

You have seen this we have this beautiful various types of thing and the core part of it is still a very very simple solid model and based on I am trying to bring this back to saying initially when you have a concept. You can freeze on all the dimensions, we are directly starting with these various things like this and I have brought you back again to the what do you call this a

shampoo bottle which will show you basically it is nothing, but a shell. So, this is a very simple shampoo bottle.

So, we have a ellipse, this ellipse has been extruded and something has been cut and this is probably the simplest thing, easy to make. And, some people may even buy it and; however, when we actually want to make real life things probably this type of things are very much involved. So, here what I thought I will show you is this you have seen this there is a beautiful, there is a surface here; there is the surface here and this surface is not a flat surface, it is a very complicated surface.

And, I was just showing you the thing though this is a gray colored dull product, a little bit of light and that is what you see. This is where whenever you actually do solid modeling you have to spend a lot of time and then see that the correct type of look is presented. And, there are computer experts who can make photorealistic rendering of any project.

So, if you give a basic project like this and if you ask one of the commercial artists you know, kindly make a package and all this and they will make something which looks real. Really real meaning very difficult to ignore that, saying that is not a you understand know it will be very very difficult, right.

Now, let me watch for it saying this is actually a real thing, I have taken an a full shampoo bottle and of course, my people did not allow me to cut it. If they had allowed me I would have cut it and shown you. Now, if you come back to my other monitor I will show you this, you have seen this here these are the very very simple, most simple geometric primitives.

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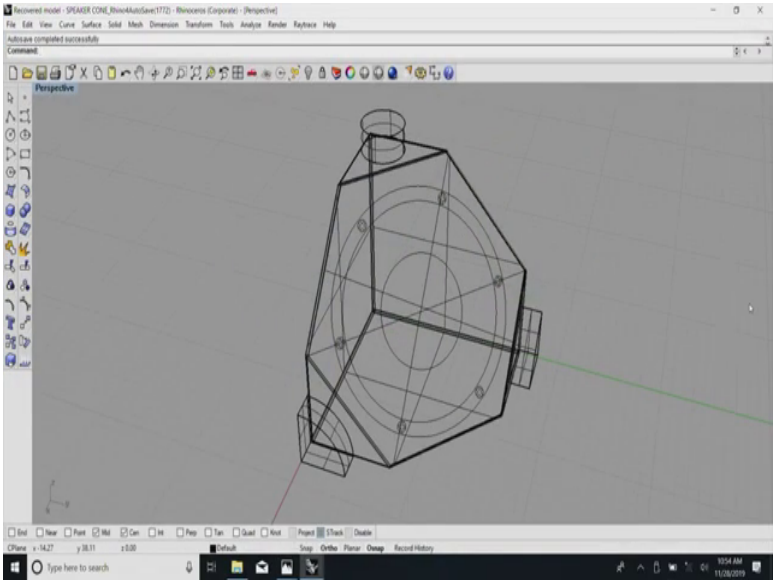

This I had shown you earlier saying instead of showing you that cube of a speaker, I thought I can make something a little more interesting. I made it a little more interesting by taking a cube, joining the midpoints of the edges and trying to fit a speaker on top of it. Now, if I give a rendering on to this, one of the first things you will notice is, see at the back of it.

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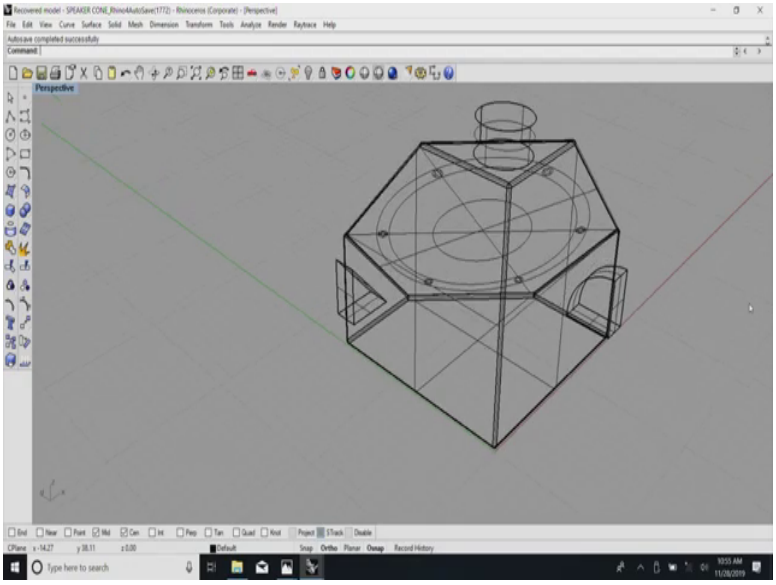

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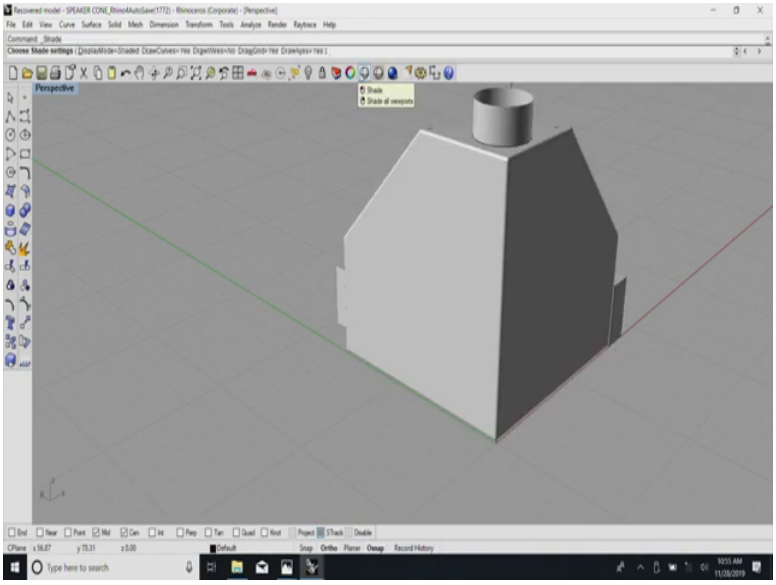

Now, I want you to recall that edge I have shown you. So, I have that edge here that edge is the one that this edge is the one that catches the highlights and sends you will see it like this.

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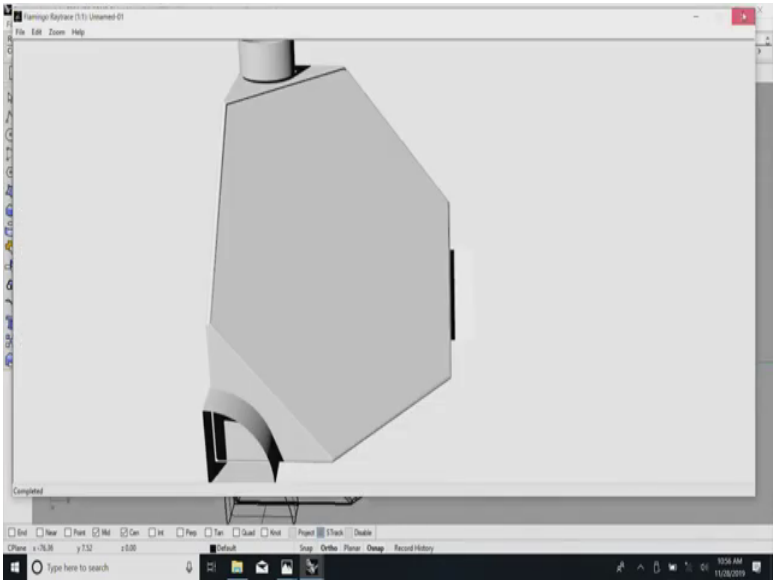

This is a relatively simple object and just to what you call create a little bit of interest as I said I joined the various corners and try to show you this thing. Now, if you go to any of the tutorials based on these things, you will see those things everywhere saying we have these primitives, how to use these primitives and learn at the first time.

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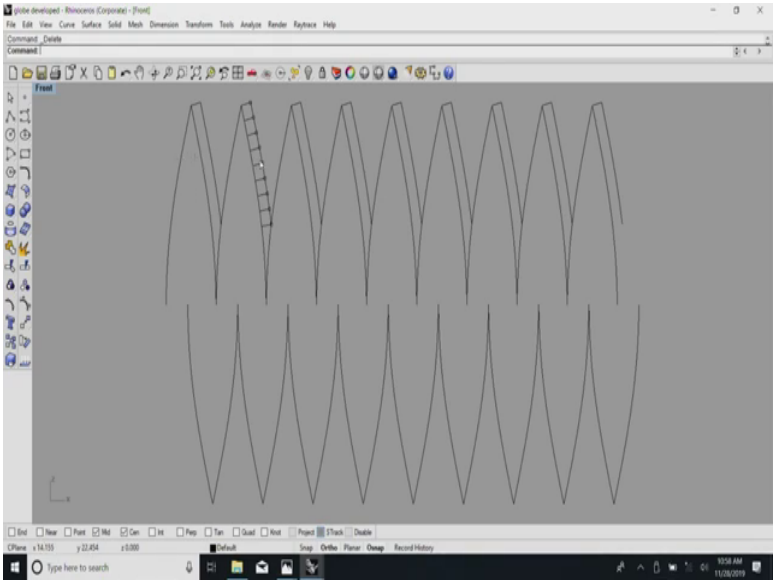

So, I will try to show you a little about yeah, very very interesting thing here. You have seen this I am sure quite of few would have tried this or would have been fascinated as a child. See we know what we have here, a globe has been taken and we tried to split it such that you can make a nearly continuous model of it. So, actually if you see these vertices here on the top most point know that poles there are it has been split into 8 sectors and the center has been offset here.

So, that it will not what you call I will just show you just a once again know to see if; see here the real life thing is going to be a paper can always be cut in this things and the small thing that has been added here is the tab which is used for sticking those things. And, depending on how well you can manage these things, beautiful things like this can be easily created. I will come

here and show you because I have the internet connection here. See a real life it is going to probably look a little like this.

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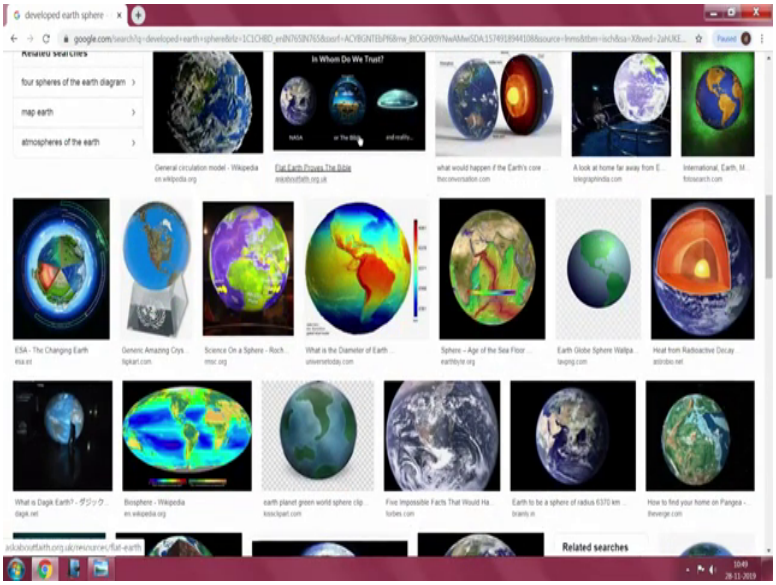

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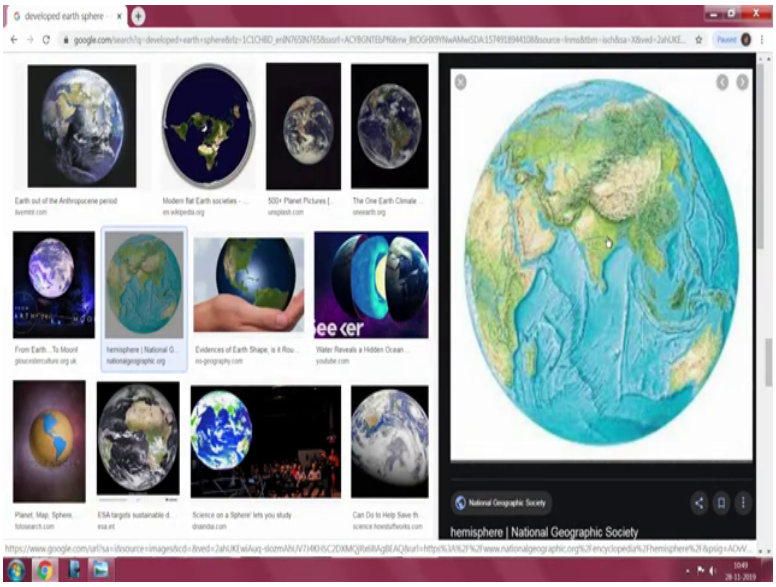

So, if you are one of those people who enjoy making this, this is the real life earth if I click on it know part of the earth is going to look like this. Now, if I take this and try to develop it like a orange pill started at this sphere on top and cut all the way across like this all around and make 8 cuts here, it is very easy for us to develop this into a beautiful project.

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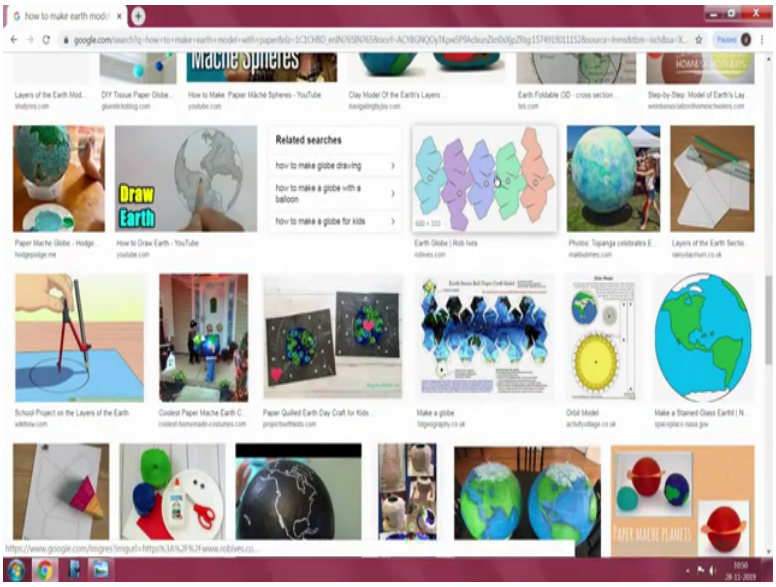

And made my bad luck when I tried a little earlier, it came and little you have seen here, here various ways of developing it is there.

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In this case if you remember right this is what I was telling you saying any particular shape, you can always make a globe one of the easier thing is to cut it along like this, you understand know these are all small things.

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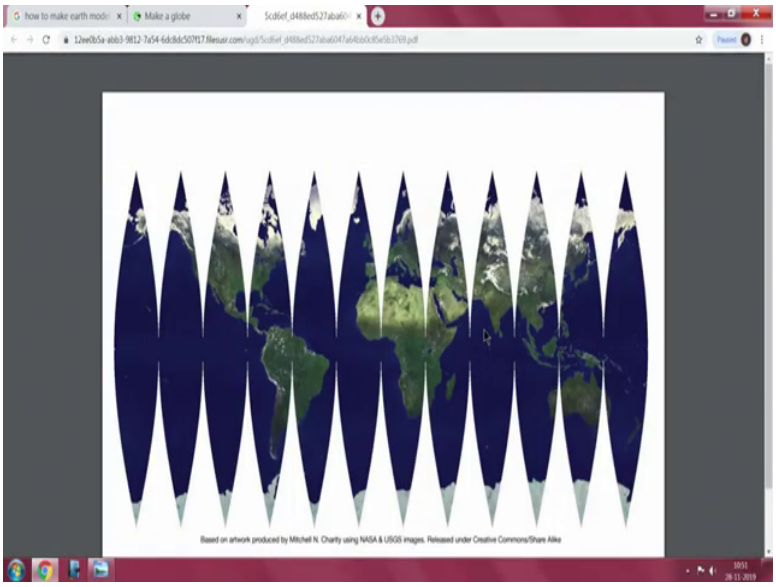

Otherwise this is the picture I tried to show you have seen this, in this case the only difference being we have these things which are cut here and chances are you are likely to you know damage it a little.

So, the one that I have shown you is offset by one pitch when you offset it by one pitch and depending on the resolution you take here 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12. So, in this case 11 sectors have been; I mean, 12 sectors have been made and with this know nicely beautifully you can develop a beautiful globe based still on a surface model. So, even the globes that you see there are probably simple surface models. So, I thought you know you should you will probably enjoy looking at this.

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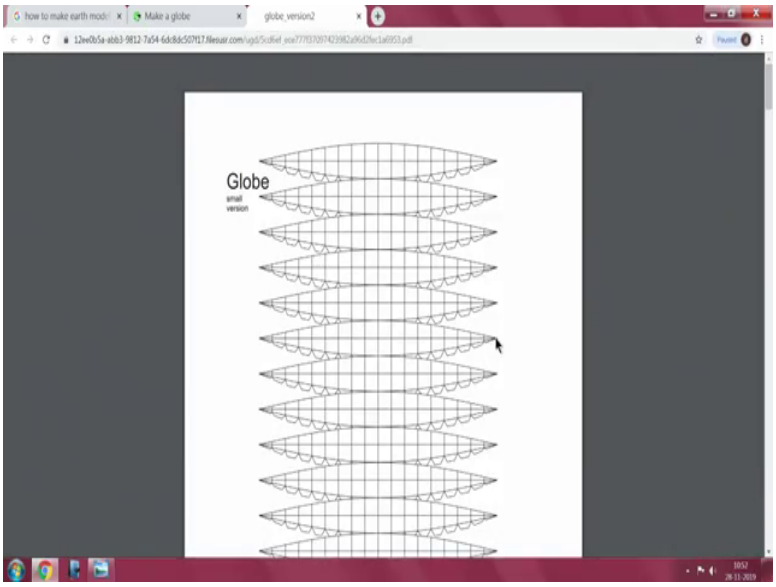

So, I have. in fact used this, seen this here there here they have provided this tab here as a small tab, this is very essential which I have missed. In fact, you have seen this know small tabs have been kept here and one more thing is if you make a simple arc you are going to have a little problem. So, physically on the globe you need to measure the saying what is the surface this thing when I showed you the earth system.

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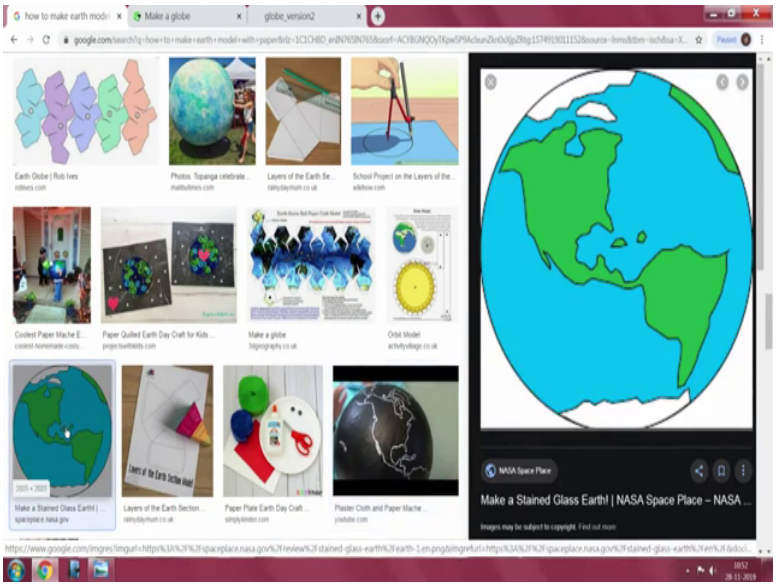

When I showed you the this earth thing like this is best actually you have seen this, it is not easy; anyway you can go through I hope it comes, yeah.

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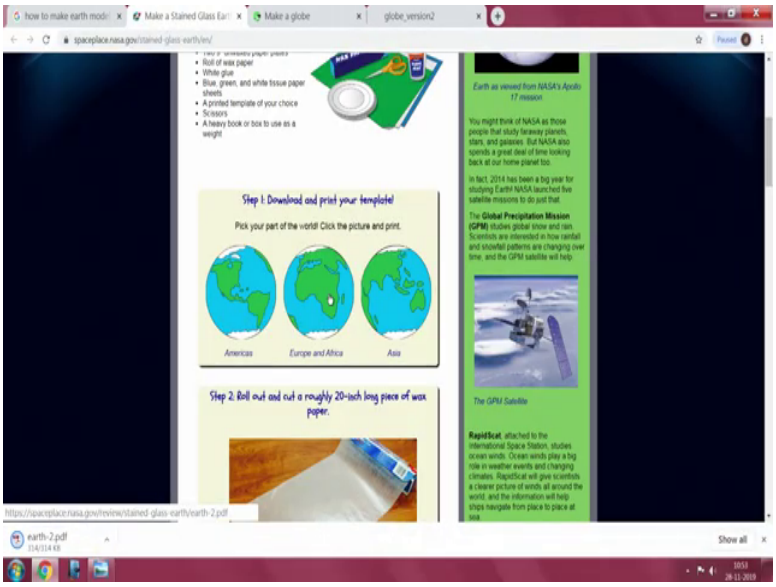

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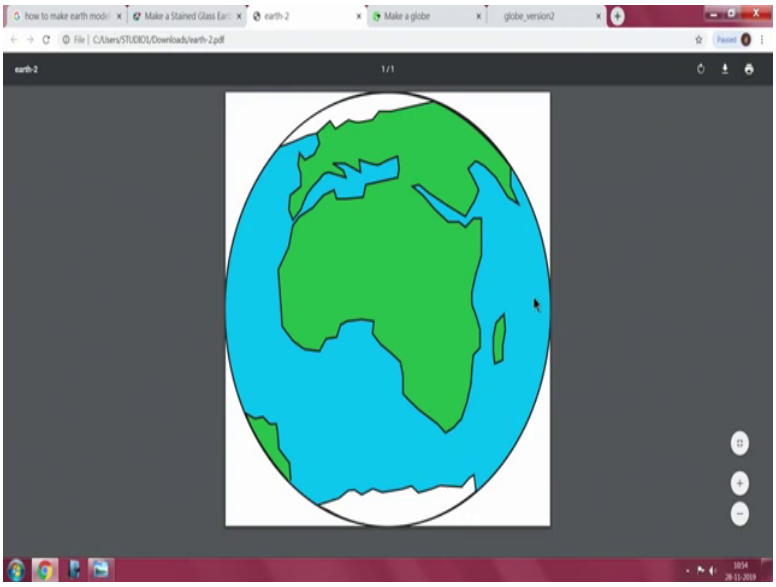

Now, if you get this point those arcs what you see there they represent if you cut the top into 12. So, you have a to make it convenient yeah 12 is easy because you get 30 degrees. So, at this point you have 30 degrees; however, here this is from the horizontal this will be 90 degrees. So, you have the arc where this side is 90 degrees where this side is 30 degrees and the length of the arc should be from the pole to this that is where the small difference is there.

So, there are actually programs which will help you develop this thing given the diameter of the sphere you want and given the diameter of the; I mean, the location of the poles and various other features it is possible for you to transfer all this directly to this. I have kept it at a level where it is a little playful and little for you to get involved. So, those of you are curious can probably try this, it is not impossible to make these things.

So, there are coming back you have things which are made with hexagons and pentagons and other extreme is the c 60 Fullerene model. You have seen this; this is a real beauty, this is a very very fantastic really cute arrangement.

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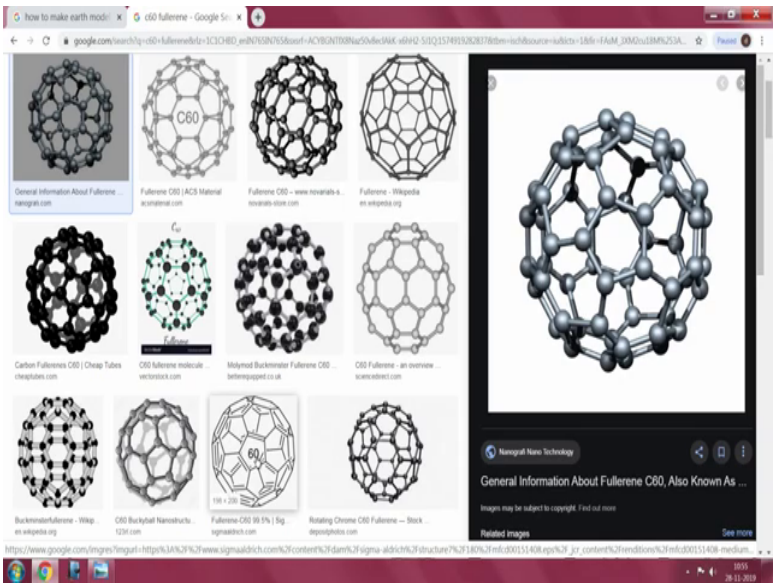

See here now, this what I was telling you what looked like a very simple and what you call play item suddenly it is very very professional. So, you have hexagon, hexagon, hexagon everything sharing edges with the pentagon in the middle. The moment you have a pentagon in the middle that thing will naturally fold over.

So, any of these hexagons if you see, if I take this hexagon it shares an edge with a pentagon here, hexagon, another pentagon, hexagon, pentagon and another not able to make out just a hexagon or a pentagon. So, when this thing happens you have a perfect ball.

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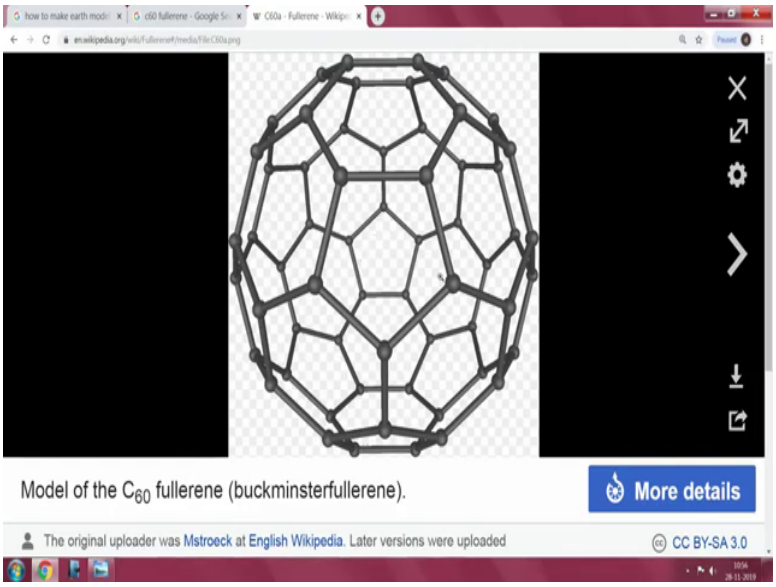

Now, why I am showing this is actually the elemental portion of this is still yeah, this seems to be best. Is still a triangle if you take, if you take this pentagon take the center and join it here this is a basic equilateral triangle.

So, this whole buckminsterfuller globe actually exists in nature which I do not know how it is. So, you see everything which is a any complex shape, any complex surface can easily be built up of small triangles that is all I thought I will show you. And, this is again the basis on which your 3D printing takes place after you have finished building a model when you want to make a 3D file; 3D printable file you have to export it as a STL file called Stereo Lithography File. And, stereo lithography file mentions everything in the form of small triangles like this,

I will continue this next time because I think this is about so much you can what you call anyone can try to understand. My suggestion is yes, I have an accent and difficult to follow;

my suggestion is go back watch the video again wherever I have given links like that to the world wide web, go and follow them up then I expect various things will fall in place for you and.

I just wanted to tell you there are enough software's which are available free of the this thing for a trial version and they are enough for you. However, if you are institutional person like if you are a student from an engineering college, most of them the vendors have permitted an educational version with limited licenses so, that you can work in the lab with that. So, get started and start working on this.

Thank you.