Electronics Equipment Integration and Prototype Building

Dr. N. V. Chalapathi Rao
Department of Electronic Systems Engineering
Indian Institute of Science, Bengaluru

Lecture - 17
Representation on paper

Let me continue with what I had stopped earlier. So, far it was about how to make something out of a flat sheet, related to that was all that sheet metal worked what I told you because, eventually several of the products what we make and all that have a typically a cuboid shape and I took you through a small exercise of how to make a small unit in the workshop. There is a video and then there is a presentation.

Now, I started this whole series with the understanding that with resources available to you, you can make or you can present your concept to a small group of people.

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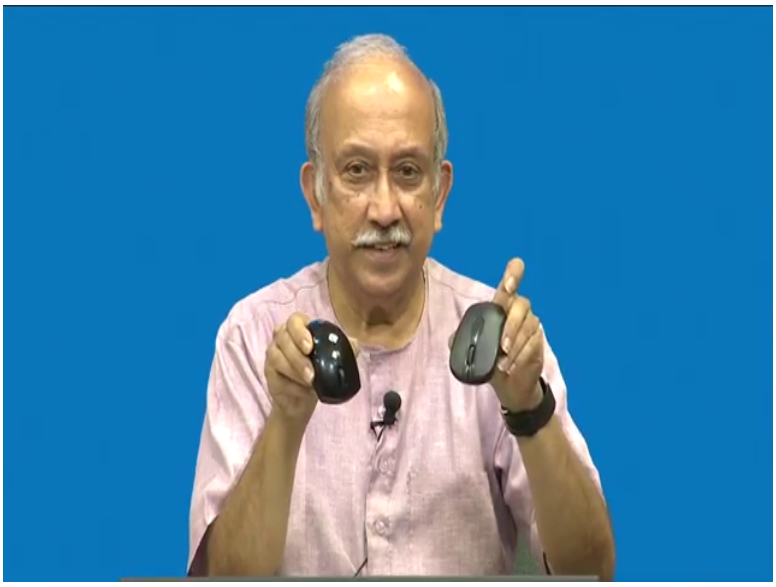

You understand know and most times when people want to talk about any project or a product especially they would like to see something; there you see here this is a very very well known thing. It is a one of the mouse surmised without a tail same thing here. Only the difference you see is this one the surface is not shiny while the surface is shiny here which will be a good starting point for my lecture, this particular session.

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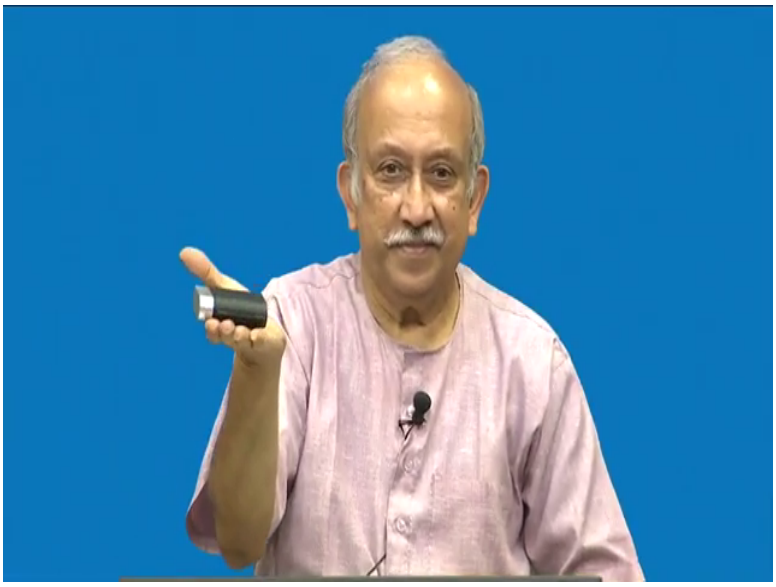

The issue here is saying in real life when you have something like this, it has a volume and you can feel something. And in contrast what you see you cannot say the volume what you see is only the surfaces and your brain interprets that this is this space that it is occupying and inside it may be a solid.

We cannot say and luckily for me for preserve demonstration, this is empty is not it. So, they are two very important properties associated with it. One of it is that it is an enclosed volume, then there are thicknesses everywhere. And after you have closed it what is visible to you is only the surface and the way the surface interacts with you on a screen.

So, if you see any of these CAD packages that we have what they do is, somehow they convert all these features into a some database of features. So, and when it is presented to you

for you to observe, the surface characteristics are added you understand know that is how this looks different and this looks different and this looks different.

Not long ago just a short time back, it was considered important that these things should have a glossy finish. I cannot say why it could be a stereotype where it could be something which was not possible to be achieved and it should feel smooth feel smooth mind the words. First time you are coming into other thing about, how does it feel? In contrast this does not appear glossy, but peculiarly it also feel smooth.

So, we get into this how does it feel in the hand. So, we have very complicated hepatitis interfaces by which you can hold something. Those of you are ever played games and then the costlier game controllers have also a lot of hit and shake and so on like that. What does it have to do with this presentation why am I talking about these things? So, I suggest we just look up on the internet. Though I have all of these I thought it is a good idea.

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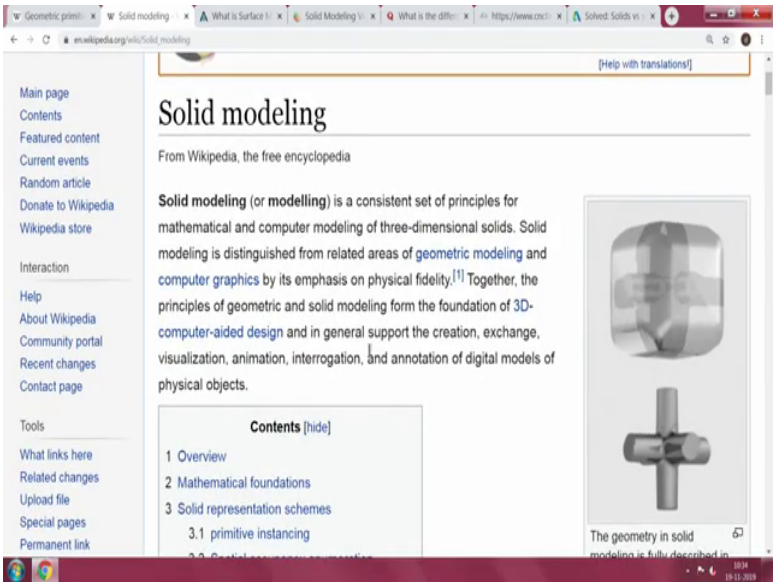

Please look here and we come into an important thing called; before we start anything, we need to learn a little bit about so, called solid modeling, but the moment you the moment anybody mentions solid modelling. The two extremes one extreme is some people who believe that it is a little to do with sculpting and creating certain features on the screen. Good it is correct absolutely correct, what you say is correct; it is about creating some features on the screen.

Another set of people who are especially in the engineering profession they have come on to the this thing saying, a lot of it is mathematics and quite a few of us are scared like me. And actually when you go into it you will do is you will discuss that it is a little life has been made simpler to us than anything else.

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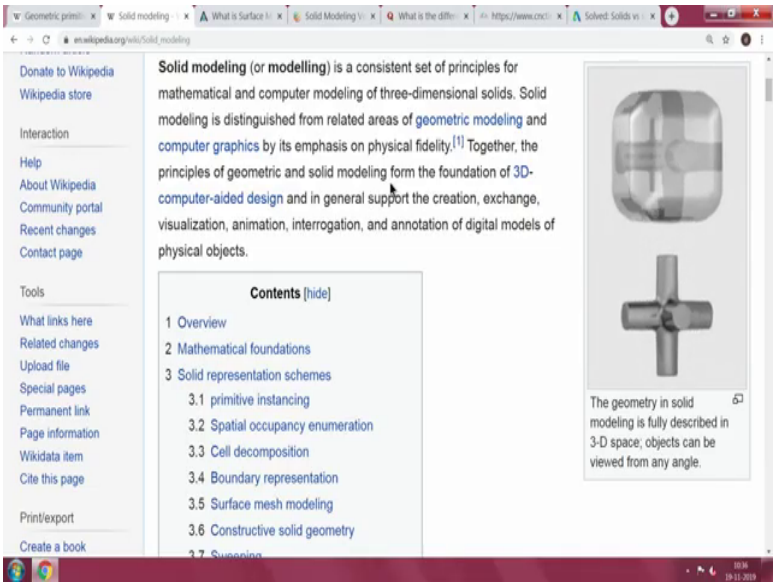

Now, looking back at this press this thing again it talks a lot about three dimensional solids is distinguished from a related areas of geometric modeling and computer graphics by emphasis on physical fidelity. When they talk about physical fidelity how true it is to the original model that you wanted to consume. And the principles of the geometric and solid modeling from the foundation of 3D computer aided design.

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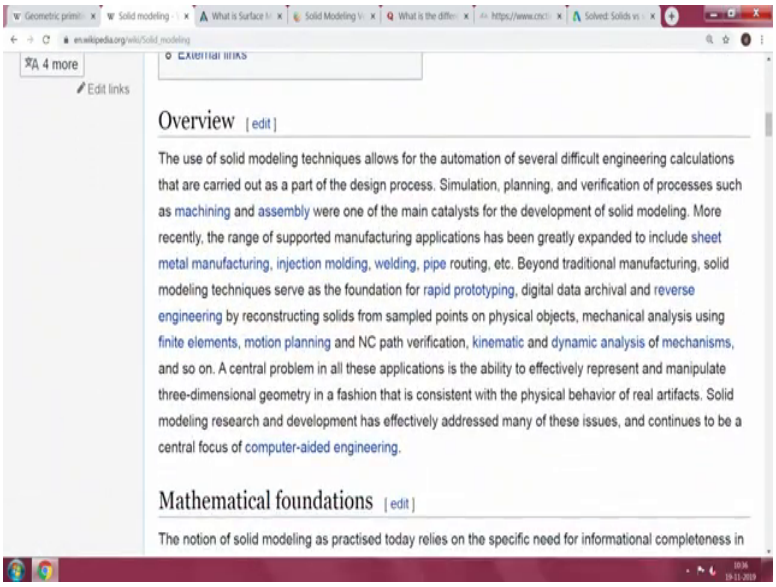

So, let me sort of, we come to the important aspect of why do we need to get it if it is complicated or if it is simply made if you can make it by hand why not make it by hand? However, all these items all these model making eventually should lead to a producible product.

So, coming back to my this thing here, I need to produce it I need to; so, represent it and make a drawing such that the people in the manufacturing setup understand. First level is somebody who can make a drawing and somebody who understands drawing here we seem to get into the very peculiar situation of so called engineering drawing and engineering representation.

So, I will since anyway I have it in the hand. Supposing I need to now show it what we do is we hold it somewhere and all of you must be familiar with the so called engineering drawing in

which we draw three views. One view looks like they saying this is how the part would look when you look at it from here. Another view which looks like this it shows what it is and then yet one more view which shows how the part would look like this and these three views are probably enough for the workshop person to understand.

Typically, this one is a what you call it is not actually an ellipse, it is an elongated this thing to have circles joined together. So, they will now start working on this in trying to calculate the material required, same here. So, there several ways, one simpler way will be probably if I have an extrusion like this I can look for an extrusion and why extrusion? Extrusion in principle is hollow.

And I just need to cut the extrusion to the length that is specified here, I can need to cut it to this length. Similarly, once the length is determined, the other two features are already taken care of while this is a very convenient way of showing this in reality engineering drawing has got a bad name because of ok. I will just type here search for you on your behalf very very interesting thing.

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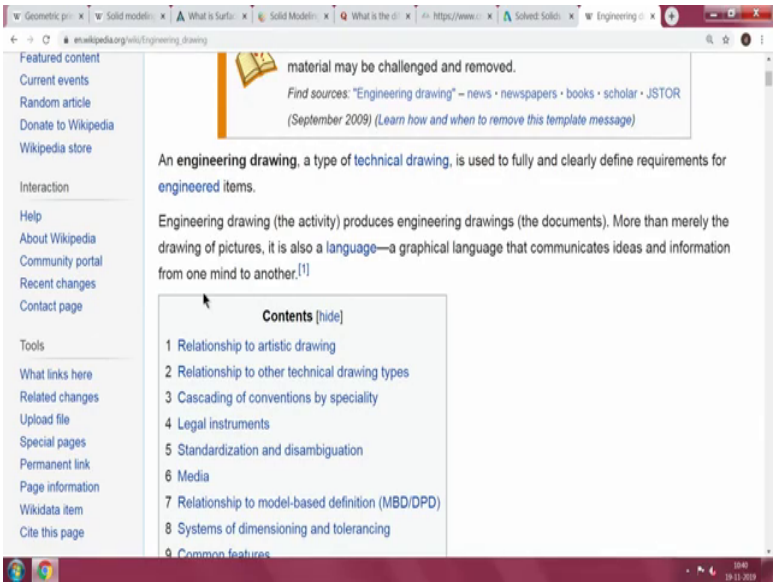

In engineering drawing is a is a technical drawing used to fully and clearly define requirements for a engineered item. So, you write down something and then directly the fabricator workshop person immediately should be able to make a part exactly as for your requirements.

So, right now only talk about major features; major features include the basic dimensions and I am now ignoring tolerances, I am ignoring surface finishes, I am ignoring various type of fit and elevenses that are required like that. And here we come to for probably the first time you seen that engineering drawing is a language that communicates ideas and information from one mind to the other.

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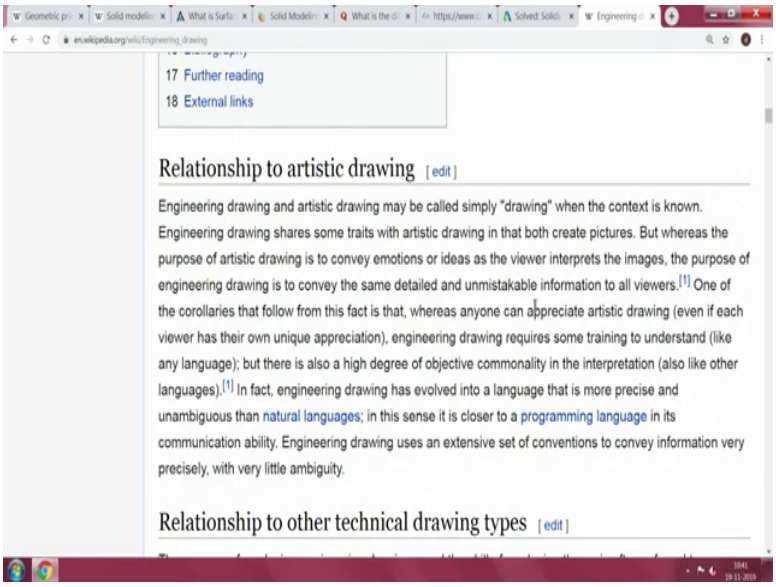

So, any way you can look it up for that. The read it along with me both of them may be called simply drawing when the context is known. Engineering drawing share some traits with drawing in that both create pictures whereas, the purpose of artistic drawing is to convey emotions as the viewer interprets. The purpose of engineering drawing is to convey the detailed and unmistakable information to all viewers.

So, when you look at an artistic presentation you will probably think of oh is it this is what it is like looking at clouds. When you look at a cloud, you can imagine various forms. In fact, I mean there is one philosophical this thing saying a lot of us when we imagine things there from the clouds. But in the case of engineering drawing the idea is unmistakable information to all viewers when I want a part which has to be a particular length a particular shape.

And in some procurement cases including the weight of the final component including the characteristics of the material and occasionally in the case of stampings including the direction of the grains which are used and in the case of forging how things are and in the case of castings various draft angles and various other properties and all.

One of the corollaries that follow is that whereas, anyone can appreciate artistic drawing; engineering drawing requires training to understand like any language. So, in fact, even my English is highly accented except for a few people who come from the area and the same side of the river where I come from, they may have difficulty in understanding what I am talking.

However, if I write something you will know what I am writing about. It will be extremely clear extremely what you call objective. Engineering drawing evolved into a language that is more precise and unambiguous than natural languages. Closer to a programming language in its communication ability, uses an extensive set of conventions to convey information.

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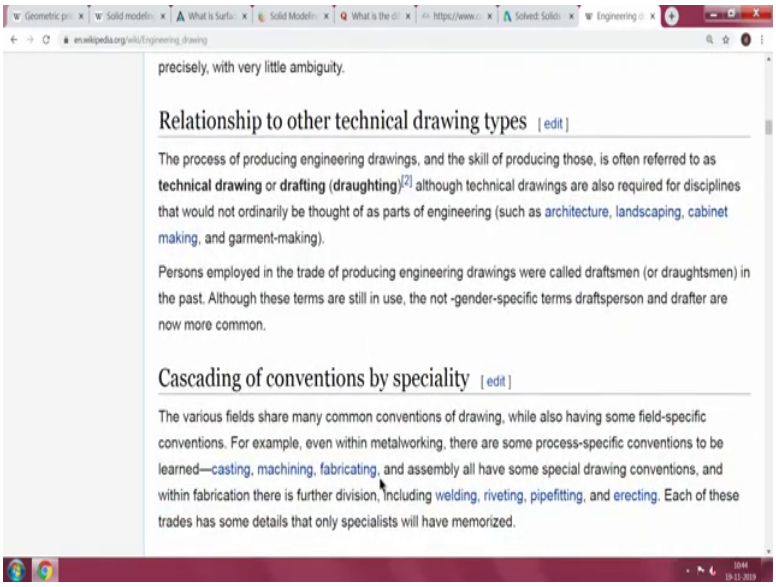

And if you go down technical drawing or drafting and not long ago, long ago means around 30-40 years back. If you looked at the title block of a drawing designed by will be different come the drafted by in the person who has done it somebody who was designed as it in his mind somebody who was done drafting or added things are there like this and finally, it is verified.

I make my field of engineering was mechanical. So, we had to put up with a lot of drawing I also put up, but now I seem to enjoy it civil engineering people had their own this thing saying their style of civil engineering drawings from purpose of basic civil engineering are very different, structural drawings are different and other fabrication related to that are very very different and they are evolved very well.

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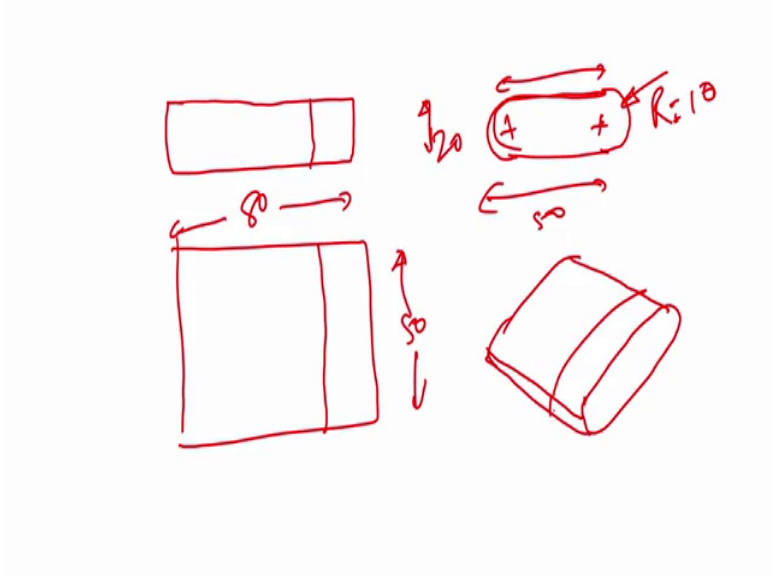

Now, I will see if I can start with something. So, what has been if I get back to what I have shown you that part what I have shown you usually engineering drawing usually starts with a rectangle one more rectangle. And then what I was showing you looks good enough no problem. And why this have been adopted like this is if I give a common dimension here, it looks around 20 millimeters and this looks like 80 millimeters and this looks like 50 millimeters ok. Generally, I have got an idea and I now had a interesting split here.

Now, I know that you know it starts looking a little like this and then so many other things are there. Basically, we have got a idea of it; now, here comes the next problem is for a person was operating a what I call in a machine shop, he understands setting something is easy even if he has to take a solid he will look at it.

And then he will first one of the first thing he will start is say I need to remove these two surfaces. So, that it becomes around 50 millimeters alternatively he will cut both these sides to a length of 80. So, we have 80, then we have 50 and then he makes everything 20. So, we have a beautiful rectangular prismatic object which is of that.

Next comes to how do I produce this radius. So, I need to show here that what this radius is. So, I indicate here saying approximately it is 10 millimeters. It is fairly complete because, normally it is understood what it is and further often people show the centre here they show the centre line sometimes they show the centre distance. But it will be redundant if I put 10 here, 10 here and 50 it will be redundant. So, R is equal to; R is equal to 10 and all that this is sufficient for me

Now, comes the slightly confusing part of it. While this is easy anybody can easily visualize a part. The problem comes when some features which are not normal or perpendicular to the surface get represented.

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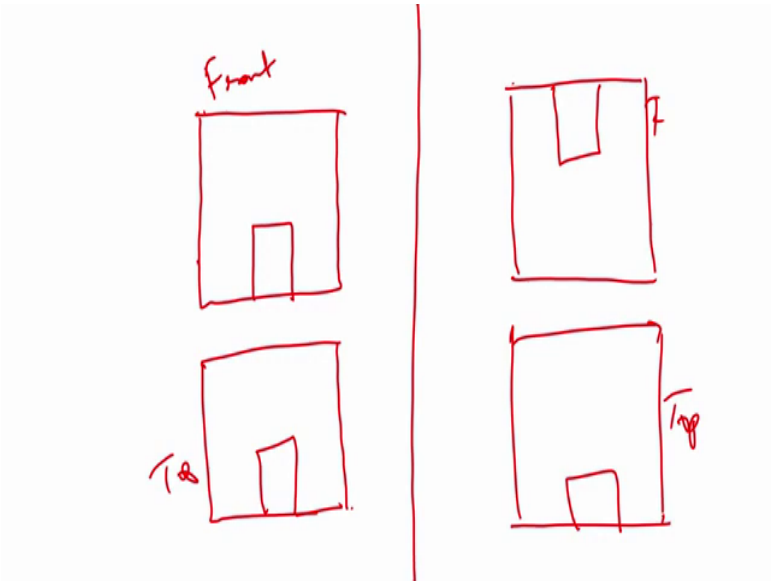

Now, the same representations may not lead to what we are looking for. So, I will give you a picture of an object which peculiarly gives I write the saying this is how it looks from the front. I write here saying how it looks from the top looks sort of ok, is not it?

Now, without the additional view given on one side is very very difficult to understand this object and if you I will say examiners I would not say they took we carry as flesher, they would like you to point out that very peculiar results can come if we interchange a few things. So, I will make it into two parts here. I will write another feature where something looks like this from the front. If you have already seen it you hold it otherwise just follow my this thing.

Another object again front from top. So, seemingly very you know peculiar things have come up here. So, if I add a side view, things will be easier for this object. If I add a side view with

an inclined plane, it is there and then for this object the inclined plane will be different; for the present, I will just delete this start with the other thing.

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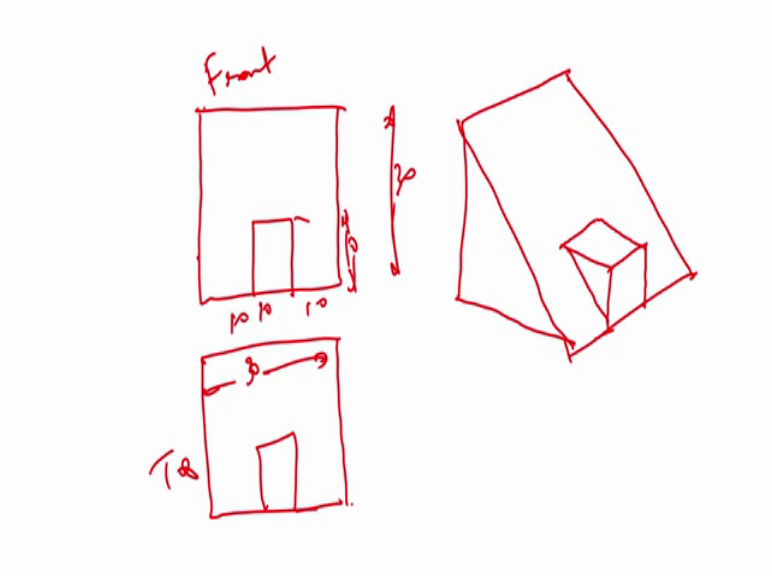

Now, for convenience sake, I start here. Now, it makes sense, is not it? So, when I look from here this is the feature we are seeing and this is a detail about it. The only problem which we may occasionally end up is which has comes two dimensional in earlier. For convenience I will take something which is very very easy, I will say width of this solid is 30 millimeters. And this feature is 10, this feature is 10, this feature is 10 life has solved.

Similarly, height one more time I write saying the height is 30 millimeters and this height is 10 millimetres. Looks good enough is not it. That is how this object looks like. Well it is a simple object which you can write sometime. Imagine there is some other feature which is stuck on

the other side. Right now I do not know what is behind imagine, there is some other feature which is stuck on the other side now.

At that point what is done is further views are given there is a convention which just says looking from here draw here; looking from here draw here like this. Compared to several of the other thing this is a fairly simple object. Now, it sounds a little repetitive anyway you can go back on the video and then check where it started and you will notice how these things come about.

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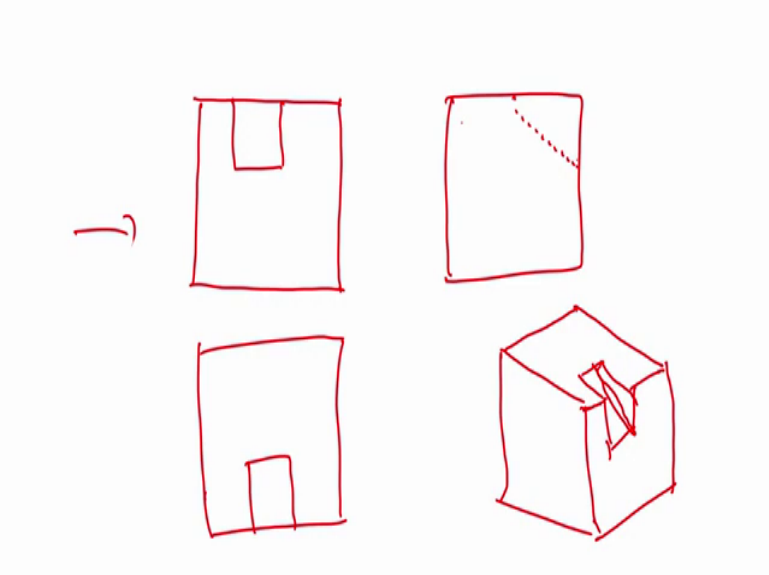

Now, I will take another solid which had started with imagine this. I said this is the front view, this is the top view. So, here comes the beauty about it. It is very easy. If I just write here, I will write here and then I will proceed to the next this thing. Since this it is a solid in which a small portion is removed from there even here there is still a small chance of ambiguity.

So, conventions have been developed which will show clearly what it is. So, if I now draw another view of it from this side just as before, there is no way of because this edges not visible. So, it has come to a see you show this edges in a dotted line.

Now, if I show this dotted line, you can easily imagine this object and more than anything the dimensioning is very very easy no dimension can be repeated. No dimension need to be interpreted in the unlikely case that something has to be done that you need to interpret the dimension, the whole thing to scale. So, somewhere here it will be written scale of the drawing. One whatever drawing unit here represents 10 physical units.

So, if I am asking somebody to make a straight from box in which a small cut is there and this typically is let us say something which is 100 centimeters or meters box with something removed. I need to make something which is small which will fit into my screen and then you can do it here. And well it looks for convenience I have taken something like this.

It is very much possible sometimes even these, there can be an inclined plane here. Imagine if there is an inclined plane here, you end up with all sorts of things when you try to draw this. But if you were to draw here, it will be very very easy.

All I have to do is show here that this is an inclined plane and give all the necessary dimensions this can be easily produced. So, you find these partly in quizzes partly in engineering drawing exercises, I will not call it a test. So, when you have this you know what a modeling what I call software is now let me go back this thing where I wanted to point out.

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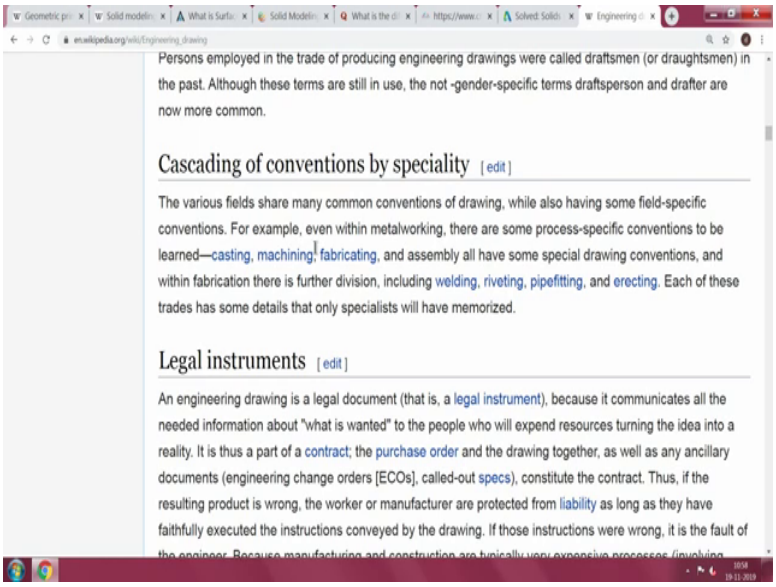

Now, why all this is needed is that is a there will be field specific conventions. Just a little while back if you remember I was talking into about forging, then I was talking to about welding I am sorry what do you call casting. So, in the case of casting, in the case of welding, in the case of machining riveting and all that generally we show the finished product.

So, if I to take even a riveting assembly, a finished product does not fully adequately describe the process of making it. So, certain conventions are used here. So, again going back into the thing. Secondly, show my hand. So, if you see let us say two parts are being welded together like this, I will get back to a welding drawing.

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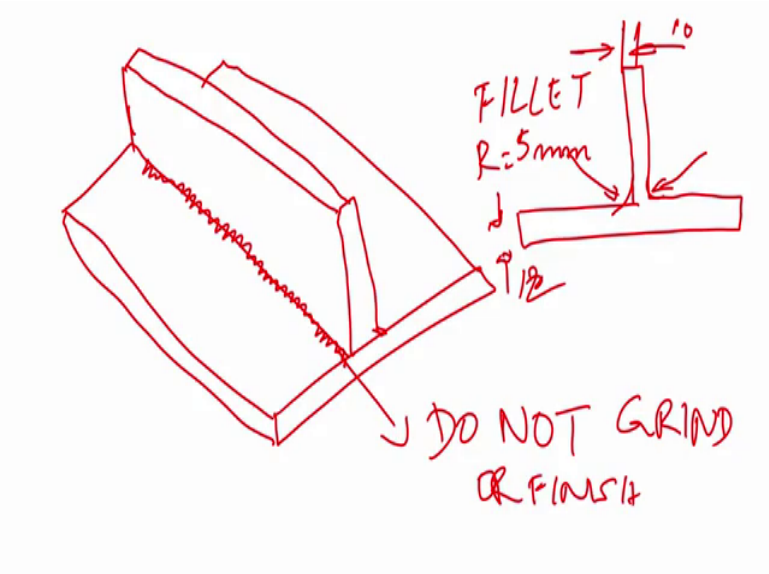

I have a flat and I needed to add another flat here to make it reinforced. Yes for the few of my curious students you if you have a regular section like this, you can get it now. For some reason I need to add it let us say it is not the things. So, several options are there, I said you can always take a section maybe you can machine it and it is much easier actually. If you have these flats, you can do this.

Now, I need to show that I need to weld these portions. Right now this is not about the convention, but I will say I will show something saying this is a welded portion. They have their own conventions and more important than this a very common thing that is used you know all this is saying, there is a fillet here because of stress concentration because of limitations in fabrication, we need to add this two things.

So, if I give a fill it radius saying is equal to 5 millimeters while this is say 10 millimeters and this is say 12 millimeters. Now this is fairly complete and this is where the instructions are very very important. And in the case of especially in the case of welding especially in the case of welding let me repeat they usually write because this seems to be very important.

Once a weld is there, you should not dress a welder should not grind it because it is likely to create some problems. However, the person was carrying out the job the welder knows how to achieve these things. So, he will try on a trial piece and then he will achieve it and then it is not just enough if you write it as 5 millimetres.

So; obviously, there is a small tolerance or elements that is given which is mentioned everywhere. All filleted radius should be a what I call a minimum of say 8 mm and a maximum of 5 mm like this. So, they know how to continue the welding and all these representations end up in a technical drawing. .

So, if I now go back to this thing saying these are filled specific. So, if you have seen an air conditioning installation, the way they bend the pipes the way make things is one type. And if you see the way buildings are constructed columns and spacing of it, they have something. And these conventions and have some details that only specialists will have I mean he said memorized you mean they use regularly and they can recall they know what it means.

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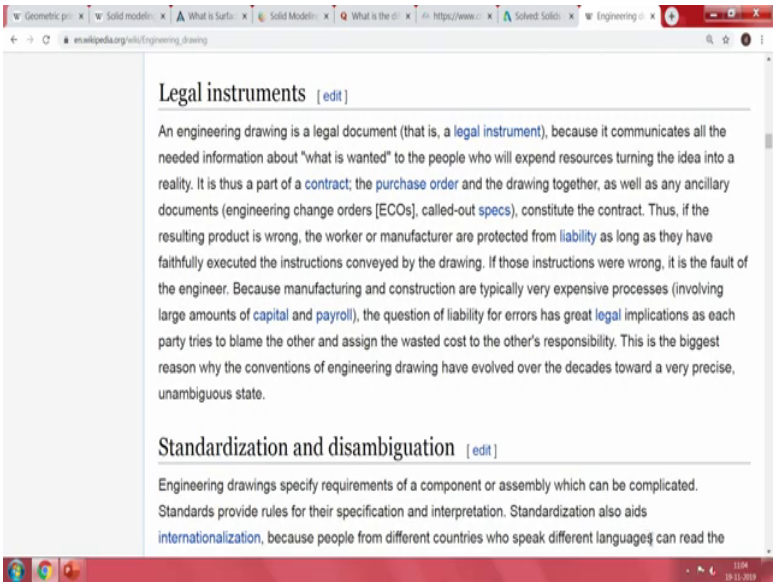

Now, we can check come to something else about the important thing saying standardization is required one specification and interpretation. Also aids in internalization because people from different countries who spray we can understand these languages. So, we have the IEC which has standardized several things including how two parts fit

So, I have this is made separately, this is made separately and anything from a bin from here can you know it can take anything from a bin here and fit it. And if you say a big thing like a truck or a bus you will be surprised that the whole drive out chassis is assembled from components that come from various parts in the world. And miraculously when they come to that place and they try to fit it, it looks as if the truck was originally assembled and it was you know completely knocked down and is being assembled here.

The reality it is not like this the main ladder chassis drawings and all at least in the case of the trucks manufactured here. I understand come from Spain where they have a special machine where the materials are you know there and so on. Similarly the various parts come from different parts in the world and they have just mentioned it in the drawing and it works every time and I am sure all of you would have heard about even a huge thing like a aircraft. Various parts are made.

There is a specialists who do make the service the specialist to make the what you call various flight instruments and air from people are different. And if you take typically if you take buoying it comes with either you can choose a GE engine or a Pratt and Whitney engine or a Rolls Royce engine. And miraculously they all fit you just order the engine you can hang it and in fact, there is an airplane which carries engines they have a part in which they carry an extra engine.

So, if you see a picture of aircraft with three engines in the front, do not get confuse. They are just transporting the engine that is the safest way and it does not create thrust what I am trying to say is the standardization ensure disambiguation in. We have the legal issues with it saying, you have ordered a half inch rod or you have ordered a quarter inch rod a quarter inch rod is by definition 6.35 millimeters which is very different from a 6 millimeter rod which is metric and is go down to the small sizes.

For example we have one-eighth inch sheets which are quite thicker than a 3 millimeter sheet. A 3 millimetre is very different because that is a 3.2 millimeter sheet which is actually slightly less than that it is you know you go from 15.4, 12.7, then you come to 6.35, then you come in to 3.175. So, 3.175 sheet looks a little like a 3 mm sheet. It is again different from a 3.2 mm sheet this is where the legal requirements come inside.

So, let us say you are building a car or have been an example of a truck. There whatever is specified is clearly, it communicates all the needed information about what is wanted and the people who will expend resources turning that idea into a reality is part of a contract. The

purchase order in the drawing together as well any other engineering change orders construed the contract.

So, from that point of view, this is a very very interesting and what do you call way of conveying language. So, I will probably end this here. It is the worker or manufacturer protected from liability as long as they have executed the conveyed in the drawing instructions are wrong the fault of the engineer. So, I will now what I call close this window. Go back to solid modeling usually refers to the features of the solid it is a three dimensional solids.

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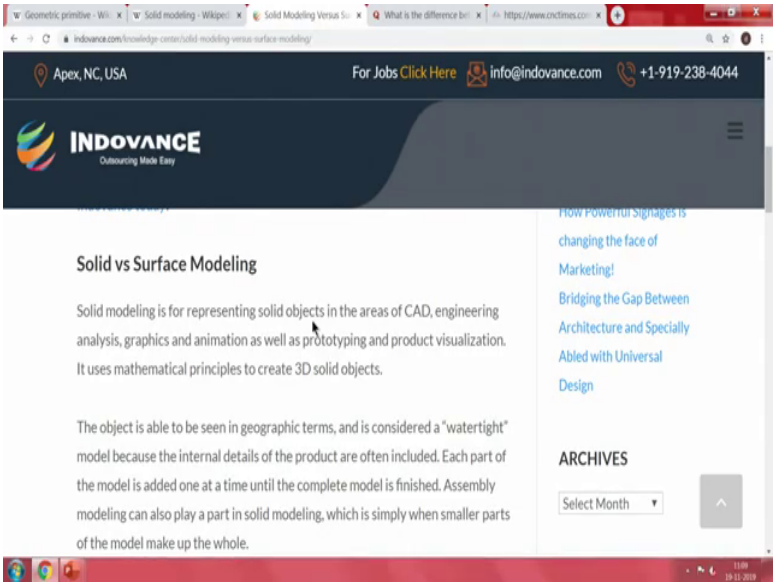

In contrast is for representing objects in the area of CAD engineering analysis graphics and animation as well as prototyping and product visualization and object is able to seen in a geographical terms as watertight.

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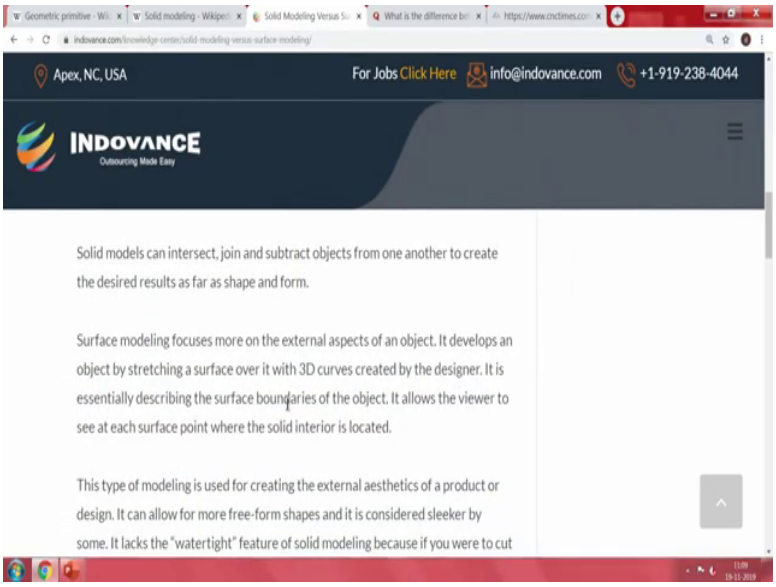

In contrast surface model focuses more on the external aspect.

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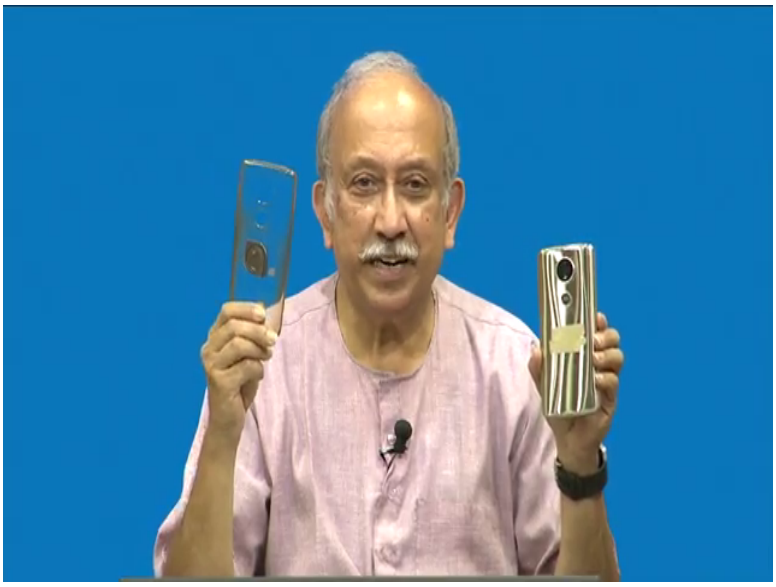

So, if I now show you my mobile which I keep carrying all around you seen this. It has a peculiar what you call I do not know glass about it or you know pointless glitz about it I think looking at it you will know that it is definitely not gold. Then why all this is required, that is our selling point or maybe the everybody tries to copy the first successfully sold something.

What you see is our surface characteristics and this appears opaque and reflective and this appears partly translucent. And in fact, you can even make out that there is a hole here and there is no hole here. Your eyes are able to understand this object by catching in the highlights in the corner. You see here we have the lights get reflected here.

Now you know that it is probably a thin skin, but still your eye is able to make out that what it is in. The moment if I bend it a little the way the light changes, you know very well that it is

probably a curved or flexible object. So, I will give a break here. I will continue next time saying the starting was saying we have two things we have a solid model.

A solid model always has an enclosed volume and it inherits all the properties of the volume. So, typically a volume can have weight. A typically the volume can have certain other things saying one of the main thing is if they cut the volume, it will become two half volumes. Got it know, you take a cube and cut it diagonally you get two wedge shaped pieces that is the property of a solid. In contrast a surface is only the external portion.

So, if you make a nice beautiful a cube with 6 surfaces and in fact, you must have seen the photo cubes where it is made of two transparent probably acrylic parts. And then you keep all your you know loved ones photos and put it together you know very well that it is hollow inside only these surface is represent the object and they inherent all the properties of the surfaces. Typically, the simplest thing you can think about is the way the light reflects and the way the texture is and the way the colour and various other things appear.

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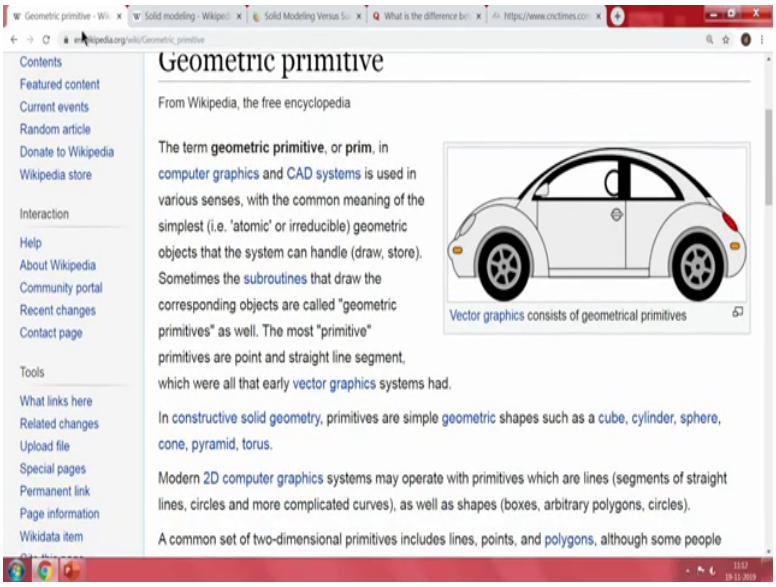

So, the software all the time is trying to take all this geometric primitives. Typical geometric primitives which you understand know simplest irreducible geometric object.

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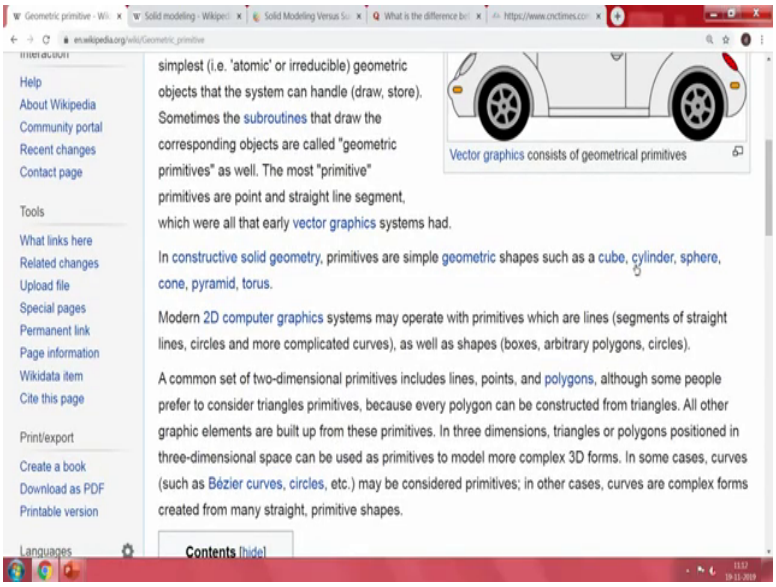

So, in solid geometry, we typically have cylinders sphere cube and so on.

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And you have beautiful common primitives like points line and line segments.

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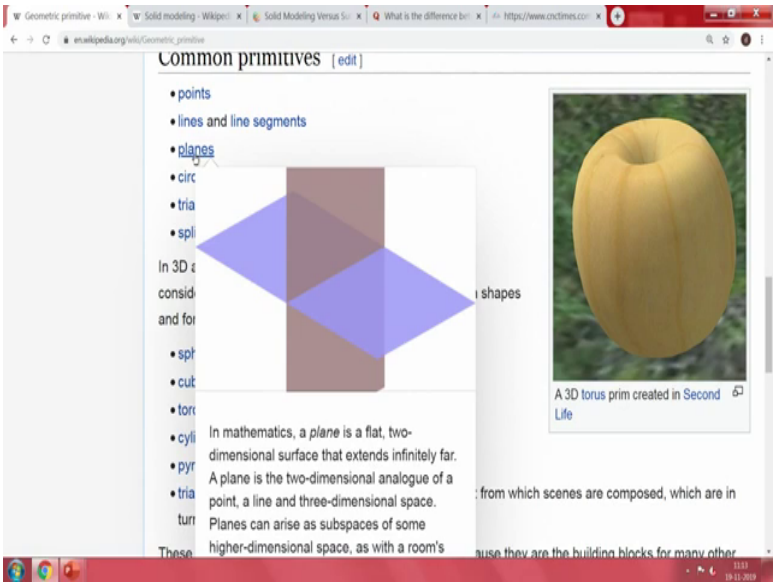

And then if you go down yours spheres cubes or boxes, the one thing which is common is these planes are the ones that make all these prismatic objects ok.

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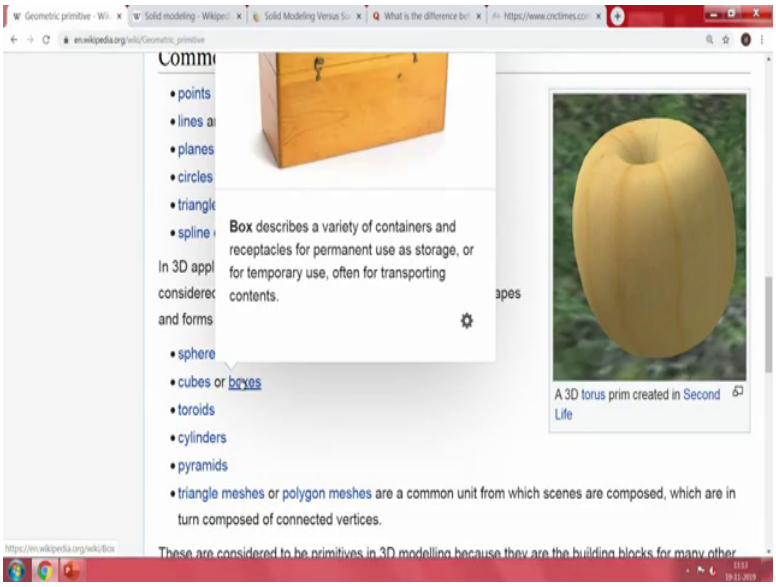

So, next time I will show you a little more about it saying which are geometric primitives and how do you go about making a what looks like a real object at least on the screen and right now at the moment we are talking about simple 2D screen. Eventually you have vr and then if you are one of the lucky people who had a chance to say Ford versus Ferrari. The Ford DX animated movies where this has been taken to an extreme. Simplest will be probably toy story and the most complex is the latest Dord D.

So, thank you. I will continue in the next session.

Thank you.