Electronics Equipment Integration and Prototype Building

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Lecture – 20
Describing inclined surfaces

Hello, let me continue or I do not know let us make a fresh start or what is it about; the concept of why do we need solid modeling. Well solid modeling looks fine, if you have an idea of what the, what do you call the item you want to make there is no problem. Usually, it is there somewhere; sometimes it is directly visible, sometimes it is not that directly clear, so somewhere you have to put it out on paper.

And so far I have spoken to you, like the last lecture I have spoken to saying, you can go to a formal solid modeling lectures; solid modeling lectures while they make a thorough job of it, including an analytical approach to it saying how do you convert anything which representation of a 3D solid into something which is visible on the screen.

Like what you see on your screen how it is visible is the thing so, and you cannot keep it like a VR or like any of those you know the things directly in any what you call memory, it is not a video you can play and play it up and down. What you probably need is, you have a huge database. So, if you remember the previous lecture which is taken from one of the professors from IIT Delhi, a little about the simpler one about what is solid modeling; I have shown you saying at one point know, representation of a real object convert it in and store it as a data as a database and then reading it and presenting it to you on the screen, ok.

But then I thought it is about time we also get back to basic a little bit of the old engineering drawing. Because I happened to be from the mechanical engineering stream and we depended a lot on drawings; any engineering they depended drawing. Now kindly have a look at the my monitor.

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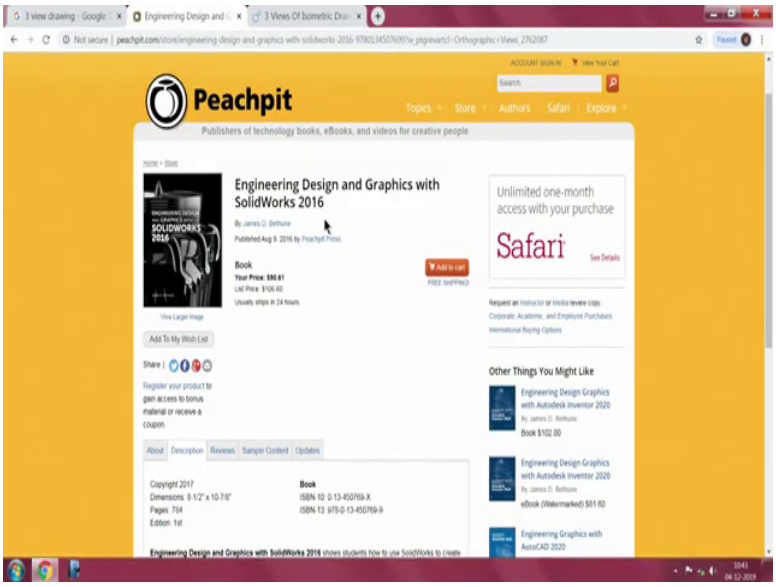

So, here you will notice that, you know design and graphics material is available on the web, ok. Directly I have intentionally kept it, I did not want to look up; I mean what do you call change anything or modify it.

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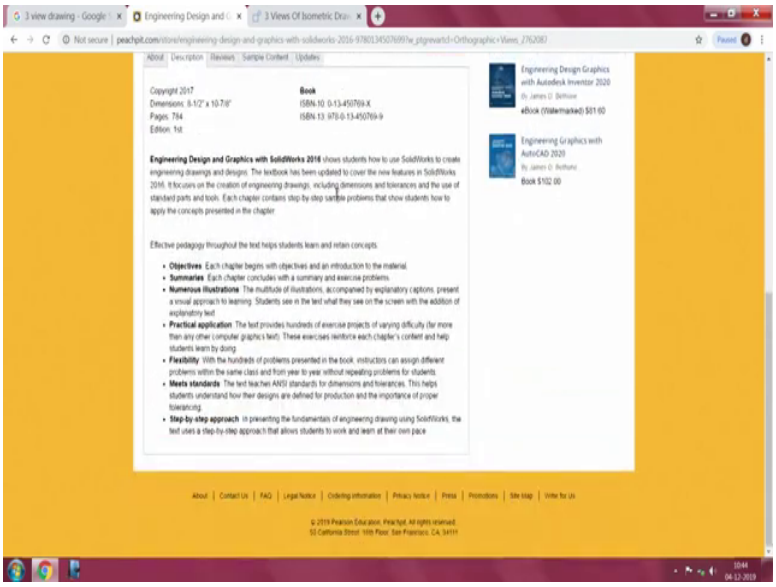

So, you will see one of these things is; obviously, the most common engineering design and graphics with solid works.

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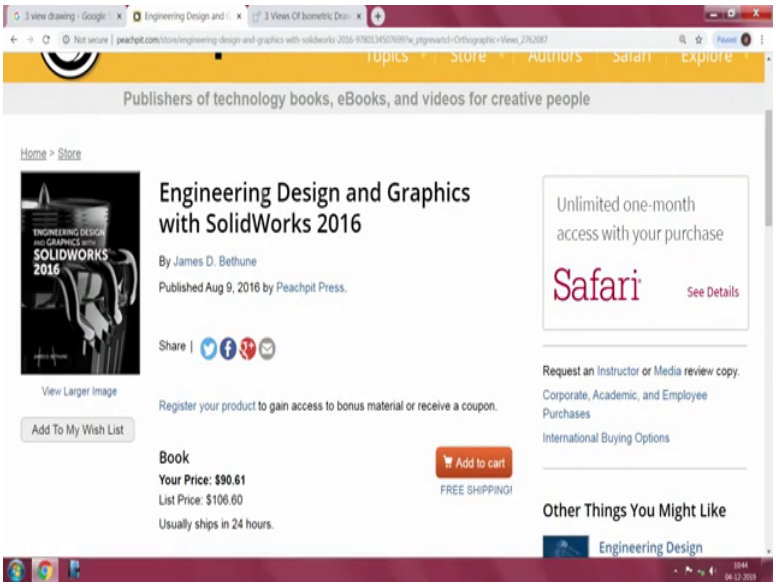

So, this is I will say it is available and I am just reading it for on your behalf, so that you can pick it up from there. And if you can if you intend sticking with this system, you have to buy one of the originals. And then if you buy the package, usually they also come with basic tutorials and any of these things.

So, they once in this part of the world which are all very popular is generally, we have Pro E, then good old what you call auto desk products, then we have solid works, then we have this solid edge and then we have several of the other things which are now formally taught to engineering students. It is good; if you have followed one of them, you have followed all of them, each of them has a specific advantage over it.

And so, let me get back a little to saying what exactly is basic engineering drawing and three view drawing. I have covered it earlier, but one more time after talking a little about the solid works; I mean about the solid modeling, I am coming back here.

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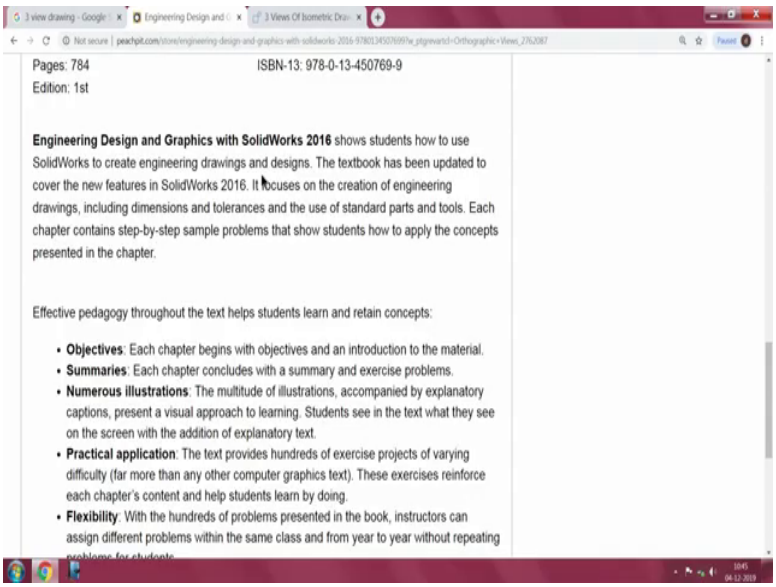

This has been said saying engineering and so on and so on show students how to use solid works to create engineering drawings and designs.

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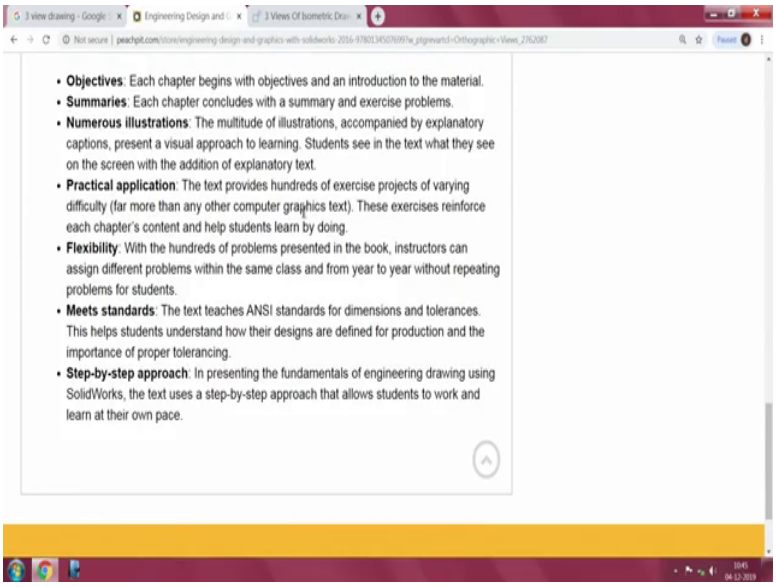

There is an objective some are from practical application, standard step by step approach, ok.

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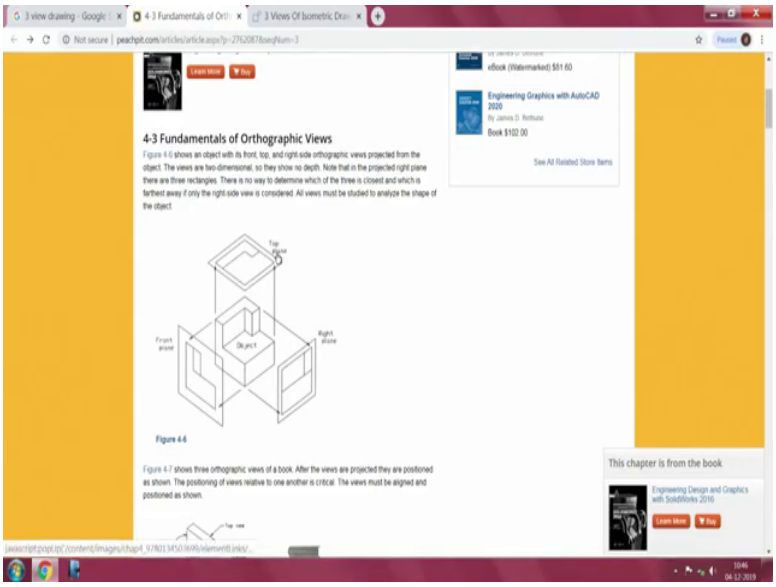

So, when I go back, the main fundamentals of orthographic views are given here.

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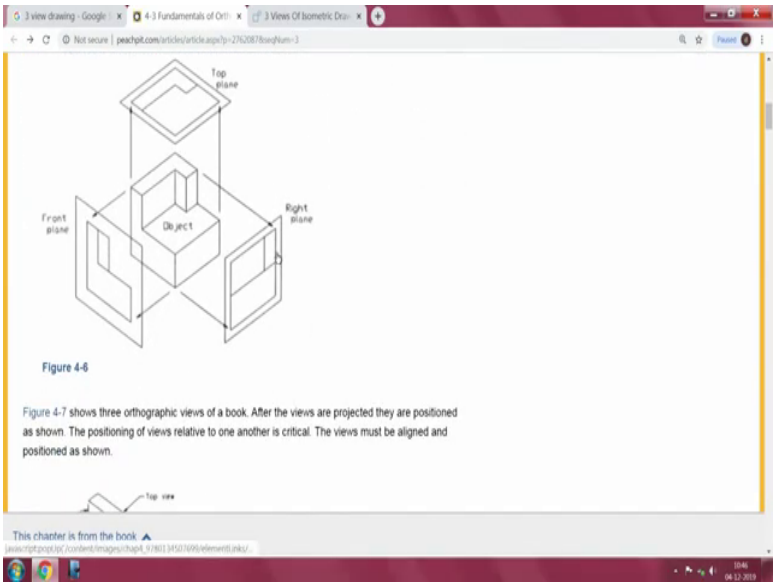

This I think is there are two types are there; one of them is what you see there you write here directly, in this case know we see something here, as we see it from here, you see it here and right here. And similarly, we look at this from here and then what we look at it from there, it is there.

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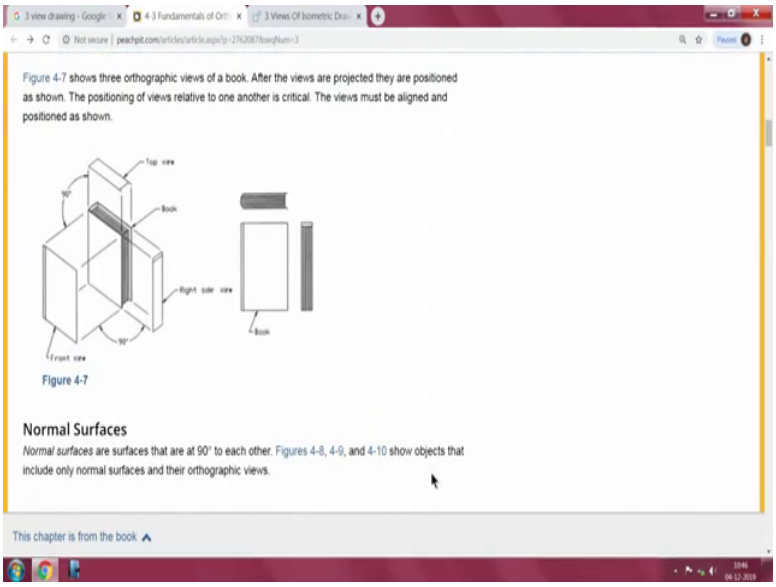

And contrary to this; earlier for some reason well I will not what you call go into this, some parts of the engineering world adopted what is called a projection. Because it made sense saying; if you have to shine a parallel light that thing will come on to the drawing sheet what you want, I do not know why it has come and right now I am sure you can check it up you will get it. So, hence know it used to be called projection and now look at it and take it from there.

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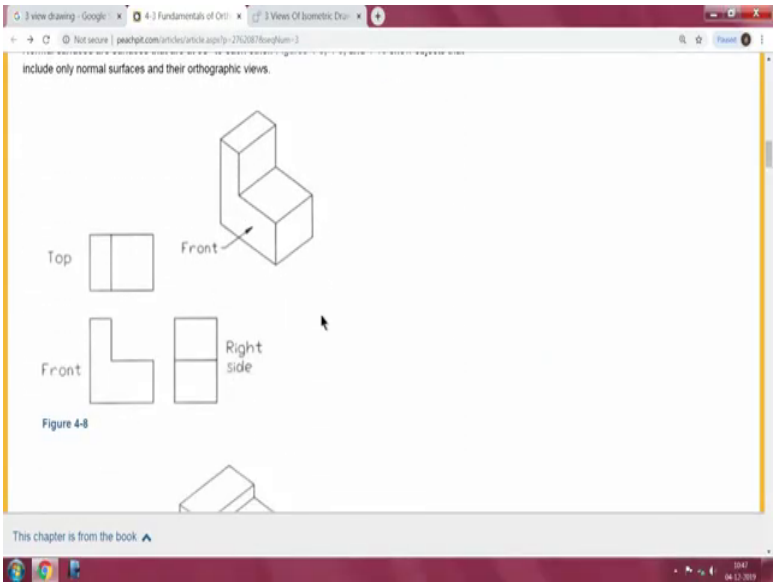

So, both of them are there; in this case it is just easy, you see here because they have you know decided in this case know front is this, top view has given here and right side when you look at it. A small inversion will take place when you use the what you call first angle and third angle projections.

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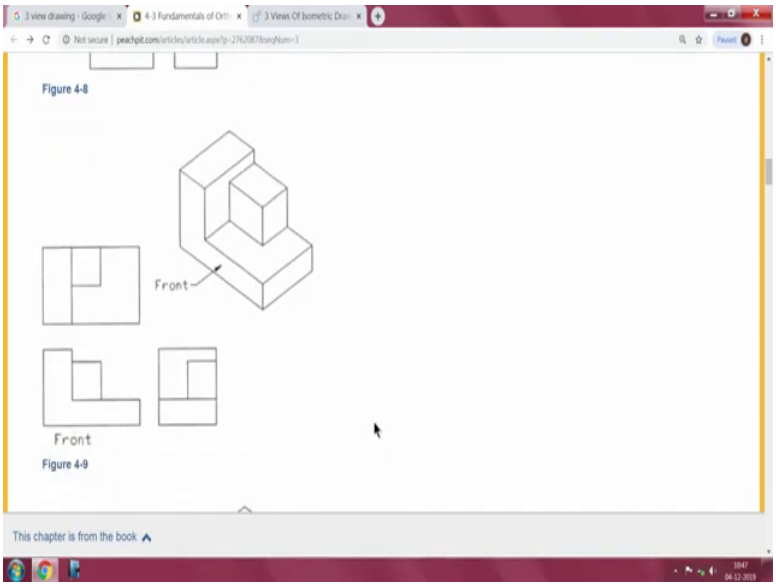

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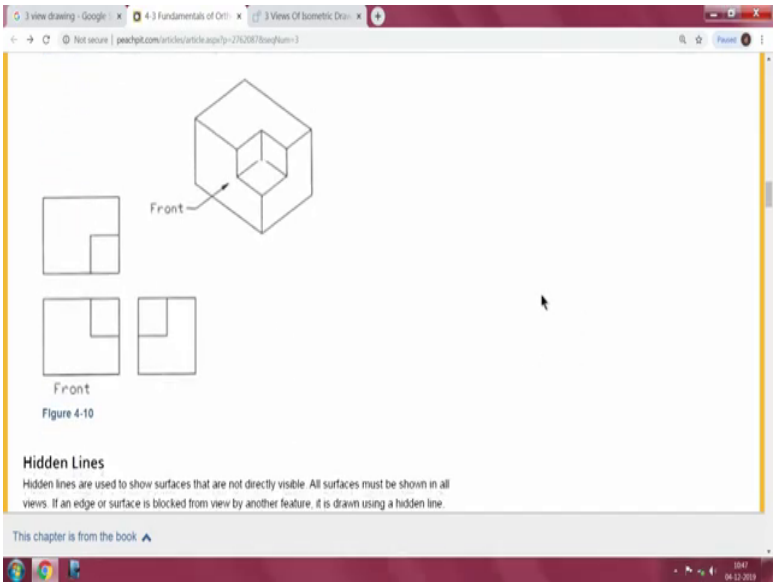

It is just enough for you to understand that this is all that is required here. If you remember I tried to show you saying, I will draw what I call inclined planes; this is nothing, it is just for you know to get used to these things.

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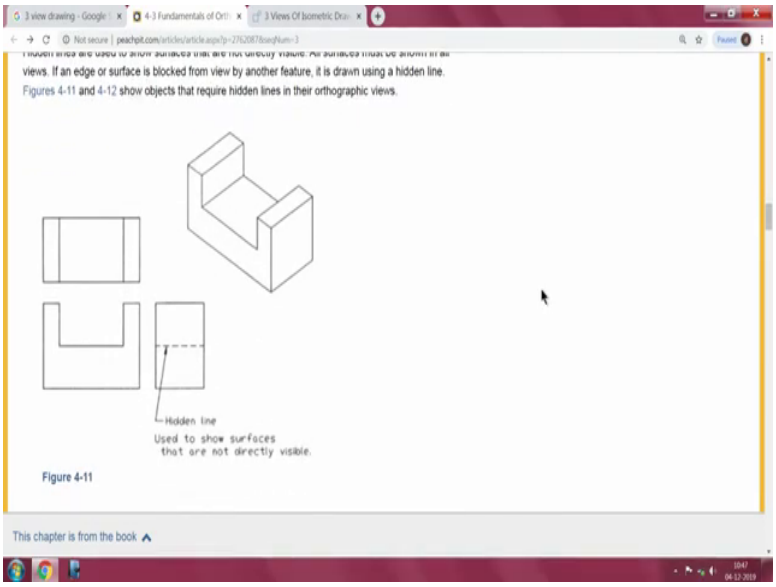

Then the main thing in engineering comes to like all other languages and syntax and what we understand is all about the issue of the hidden lines. This I am sure when you first entered into sketching as part of your normal schooling, they would have told you, how to draw the hidden edge in a cube. So, if you have a cube, I will see if I can just punch it up, nothing it is for me to use it as a sketchbook is the first page.

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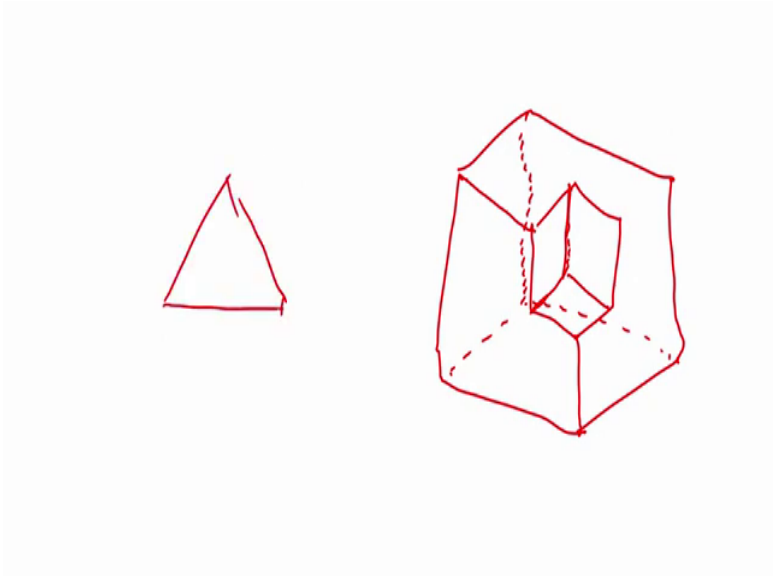

If you remember long long ago, when they taught you simple things; one of the first thing is saying, whenever you draw, we have you know all taught how to draw this simple object and then we have also been taught to make a dotted line of the hidden edge, a dotted line is shown which represents the edge. This is one of the earliest things what most of us have learnt and now if you want to cut things and all it is very easy for us; we go there and then we try to remove.

You are able to understand what I have written here without any problem. Now, there are certain conventions which have been developed saying, do you continue to show these hidden edges by a dotted line or not in engineering drawings. So, depending on the trade in which in; if you are in a mechanical engineering that is where the fabrication shop is there they are

shown in one way, if you are in a piping and such places that is shown one way, if you have to show the internal wiring of a building these things are shown in a different way.

So, if I go back to, you have seen here; we have here the hidden line, in this case it is also used to show surfaces that are not directly visible.

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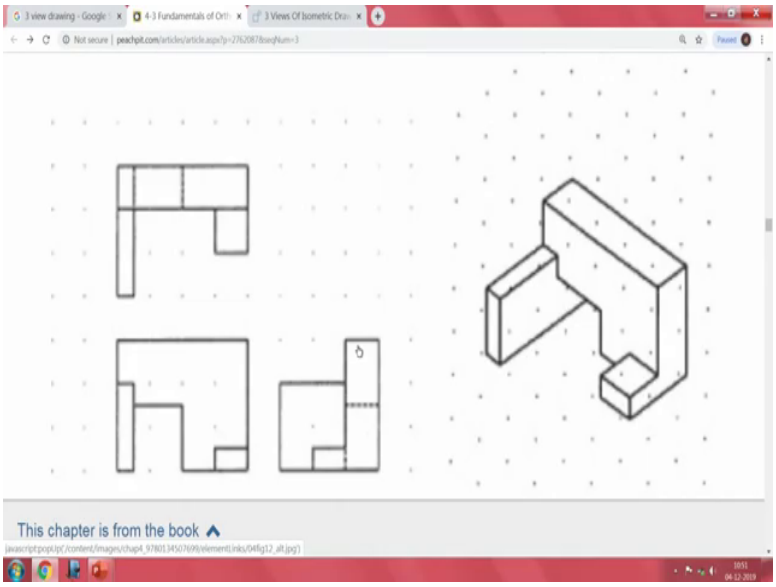

Now, this sort of a thing is very convenient for us. Why this is convenient is? If you want to fabricate this piece and if I add dimensions here; from here to here I add a dimension, here to here and then if I remember, if you recollect earlier, we said the way they have been put we can show one dimension here which is common for both of them.

Similarly, if I show something it is common [vocalized-noise,] most of the features are common and by convention it has been done such that, in case there is any change usually a

small change. You understand supposing something has to fit and then you have made something 12.7 millimeters is actually half an inch and by mistake it has been rounded off or intentionally somebody has made a 12.5 mm or the other way saying it has been made 6 mm while what you needed is 6.35 millimeters.

So, convention is at one point if you try to change the dimension, automatically the operator should understand; saying if I want to make an opening or if I want to make a whole of 6 mm or 6.35 mm, at one point if I change it at the drawing should be complete. So, that is the reason why usually you know they are shown in like this, and things are made. Now, let us have a look at the drawing again.

So, if you see in the drawing here, if I change just one dimension here, automatically the machinist can now start working on it and generally; but it is very very difficult to understand what the object is. You have seen this, keeping it like this, so it is also conventional to make what is called a isometric drawing. Isometric drawing one good thing is, it is directly scalable.

So, whatever dimension is here, whatever dimension is here; if there is a way of somehow representing this here, it will be a scalable dimension. Now you will notice, actually if you see the width from here to here, you have seen this; I have a one what you call measure 2, 3, 4, here know it does not look so automatic, that seems to be is there a real error or what could it be, this is where the concept of ISO and metric.

ISO means equal, metric means a measure; saying if you orient the object at 120 degrees in one of the corners and place it above, all the things are represented correctly. While normally it looks fine; real life your eye and the way we look at objects in real life, all of them have a vanishing point as it goes to the horizon, things are vanishing. So, best example is you have seen railway tracks and you have seen a path; in the end it merges there, so intuitively our brain interprets saying the back of the thing unless it is smaller, it does not look natural.

So, these isometric drawings do not look as natural if the scale is very very large; meaning if you are trying to draw a huge room for example, it is pictorial views are used. But otherwise by default, the designer has the object in mind and it is translated into three view drawing, so

that the fabrication can be understood; further only for reference isometric drawing is kept here.

And I have seen both convention; one of the conventions the scaled down thing is written by which if I measure this distance from here to here, it should this represents the height of the object, it should almost be the same as what is here. So, in one of them, actually it is reduced, one of them is maintained as it is; only thing is this does have a little what looks like a very unnatural perspective.

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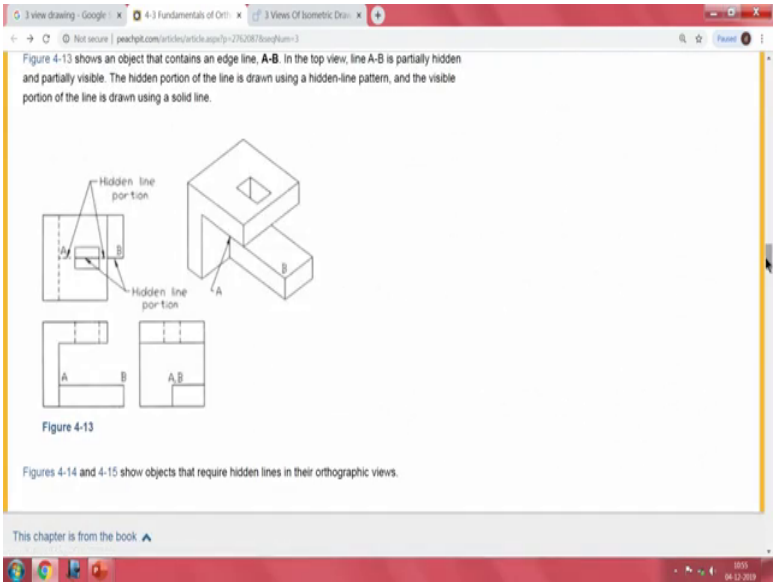

So, added to that, we have other little bit of confusion which often comes to our mind. The confusion is when the object is actually this; you understand the object is this and when you actually make a projection or what you call a view, unless you study this carefully sometimes these are slightly confusing. I would not say really what you call fully confusing, I will say it

needs careful this thing; in this isometric view you cannot now make out actually what is this and what is this and where it is projecting.

So, in these cases you will notice that, a representation like this by which you know where this is; you see here, this is exactly in the middle, then it is exactly in the middle and the way there is where the hidden line and the non hidden line edges are all shown here.

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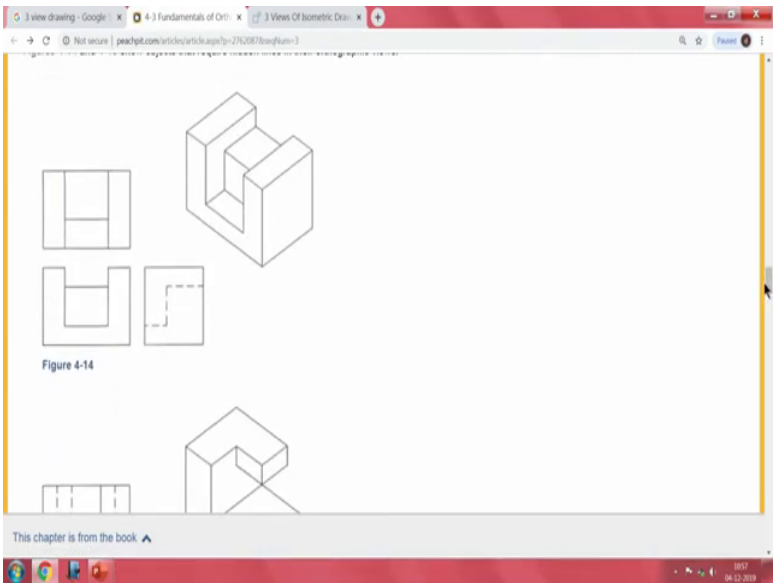

So, engineer spend a lot of time trying to understand, how to do it. If not for the examination and when you are learning it; eventually you will notice that all these things make a lot of sense.

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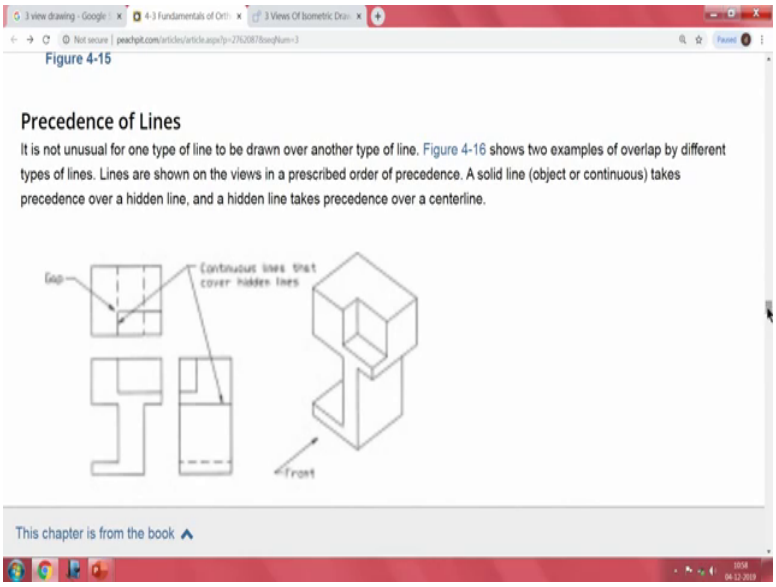

Then you see here very important thing that has been given. I hope it is what you call, I will see if I can somehow, you should read it for yourself. So, sometimes it happens that there is an overlap of one line over the other. So, convention has been, this is depending on your trade and where you are; a solid line takes precedence over a hidden line, hidden line takes precedence over a central line. Because when someone sometimes when they cross each other, we end up with this; you have seen this, this is the convention.

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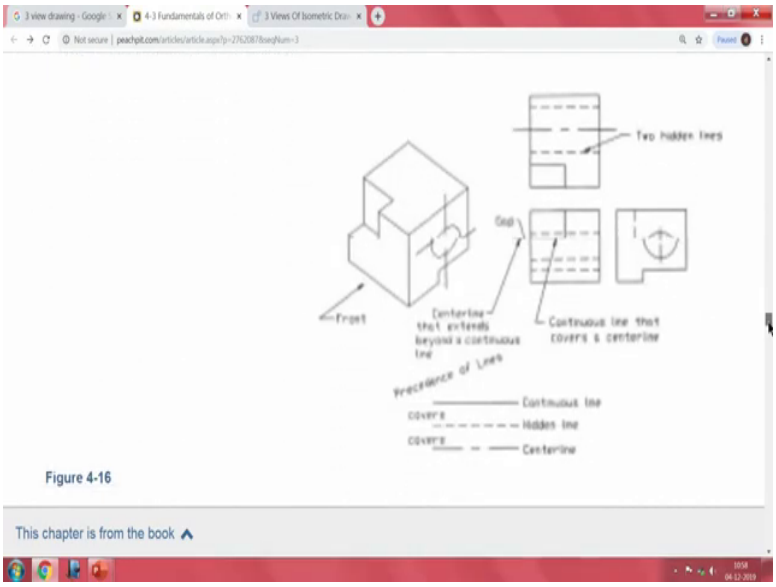

Now, why I started it and why I am what do you call in a way happy to show you this is; in the case of printing, meaning when the print is in your hand and you are not actually operating with a monitor and a computer and all that, you need a printout. And in print out the ISO and where you know the various other IEC and then ANSI and the video all these people have fantastic amount of conventions.

One of them is saying; how is a hidden line represented, how is the center line represented and related to that is the thickness of the lines. Conventionally, when we are using so called Indian ink or China ink; what is the thickness of the line? So, things like 0.25, 0.35, 0.5, 0.7 these line thicknesses have been standardized; similarly what is the spacing in case it is a dotted line and so on.

So, most CAD packages, you can see things whenever you want to enlarge a small portion; but if we enlarge a small portion and if that line scale is disturbed completely, it will make it does not make sense anymore. So, the higher end packages will also scale the visibility of these lines on the screen. And this is where first time after having made a solid; when you want to take a printout and then pass it on to a fabricator, and even though if you have a CNC machine and such things, still somebody has to have a file of drawings.

In the case of civil we used to call them blueprints and for some time the blueprint only was the thing that is used in the fabrication shops. Now, we have got the thing the conventional way of line, so how it is represented a piece of paper; any package which you take, any drafting package you take, eventually at the time of printing, you will get a prompt saying how do you like the scaling of the various types of features, which have shown there which I think is very very important.

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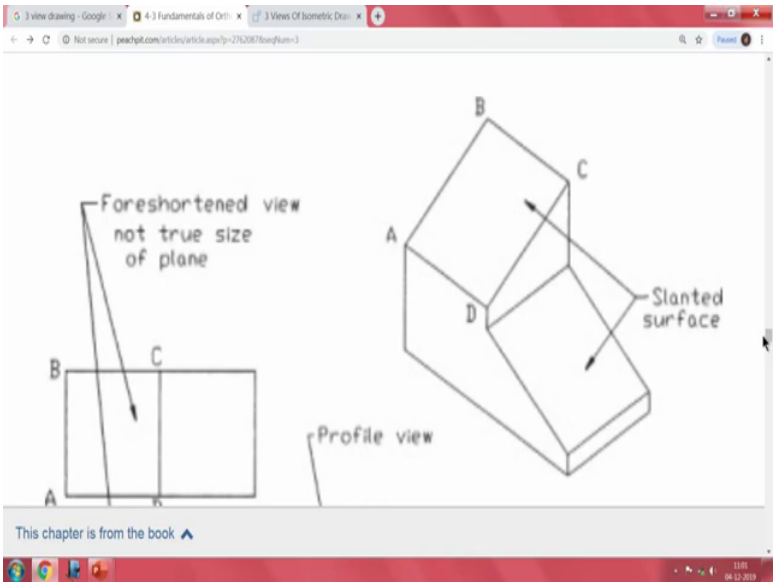

So, this whole thing is about this, how do you scale the lines? Now, we come to something which I have shown you earlier saying, you have seen this.

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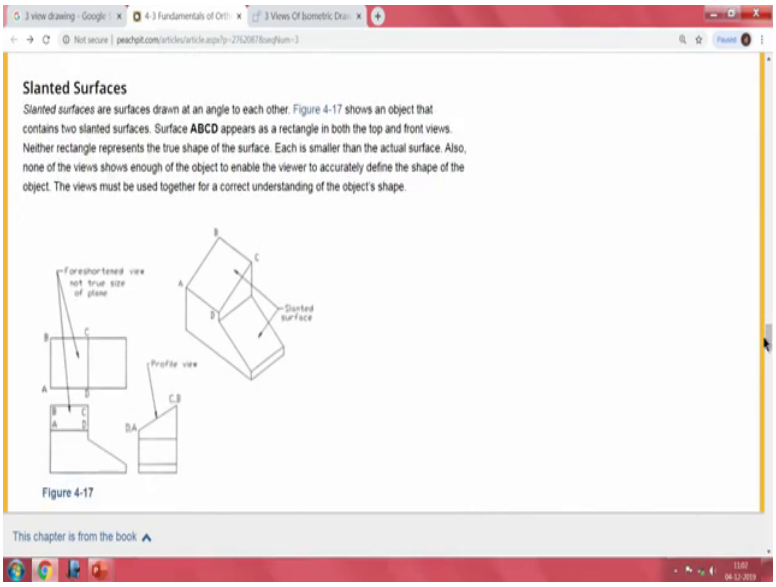

What do you do with surfaces which are not perfectly orthogonal or perpendicular to each other? So, we I mean, I think you should just read it here; an object that contains two slanted surfaces. So, we have the A B C D is one of the surfaces which shows here; similarly we have the rectangle at the top and front views.

Neither rectangle represents the true shape of the surface. Each is smaller than the actual surface; none of the view shows enough of the object to enable the viewer to accurately define the shape of the object. Views must be used together for a correct understanding of the object shape. This seems to be the crux of whenever actually you want to use something for fabrication purpose; we end up with having to follow certain conventions.

So, the next thing talks about see here, why I selected this particular one is; if you remember long ago when I took you to the workshop and we made a pyramidal structure. So, now, if

you look at the this monitor; one of the first things you will notice is, there are several views of it, ok.

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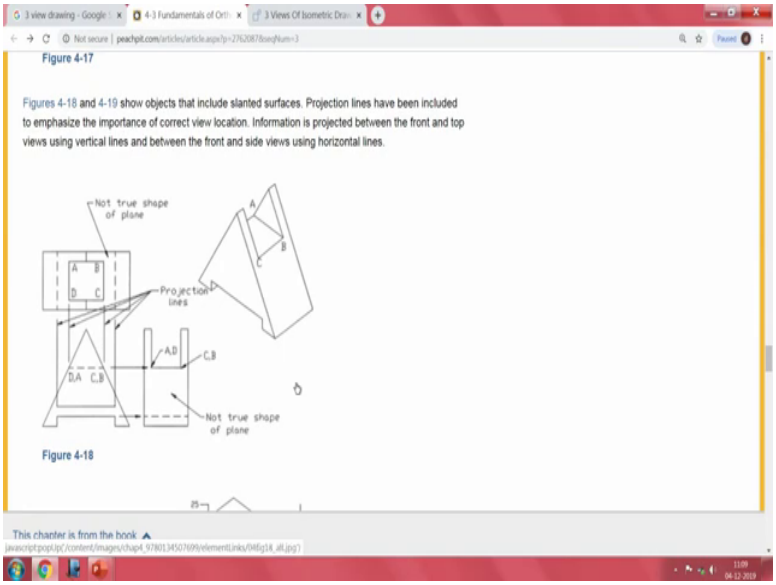

Then this pyramid shows something, then we have dotted lines, we have you have seen this here; this is the timer box I had shown you as part of the workshop for this thing. For convenience here they have just used a almost equilateral triangle; in reality such things do not work, because edges and all will come here and everything depends on the way things are made. So, it just only some imaginary this thing now, the imaginary object.

So, if you look here, this coupled with this the part can be fabricated without any problem; because the method of fabrication depends on usually the whole way. So, the operator or the what we call the process planner will decide what is the raw material that we need to use. It

will be probably wasteful to take a thick solid and try to mill it off from there, it is very very wasteful, so much of material is lost.

And alternatively you will have various solid profiles; this is a specific triangular profile, if this job is going to be done in let us say aluminum or brass, you can easily go get a profile of that shape. Now, if you see, if the dimension of one of the edges is given here; this exactly represents this edge which again represents this edge, just one this thing.

And then if you make a note saying, this is a profile with an equilateral triangular cross section; you can always look for something which is 40 mm or something which is 37 mm, which is you know equivalent to one and a half inches and the 40 mm is the metric equivalent or you can go for a 50 mm or 50.8.

So, by looking at your representation and the solid model; the type of selection of the stock material takes place, this is where I feel as a designer you have an obligation probably to maintain a file to see which are available. Now, let us say in case of our, not correct for us to really go about trying to get each and every profile, is it not.

So, what the person in the machine shop or fabrication shop; what he will do is, look how well he can fabricate the particular item. So, several options are there, one of them is look for the correct profile; you understand, look for the perfect profile and then if you get the perfect profile, life is easy.

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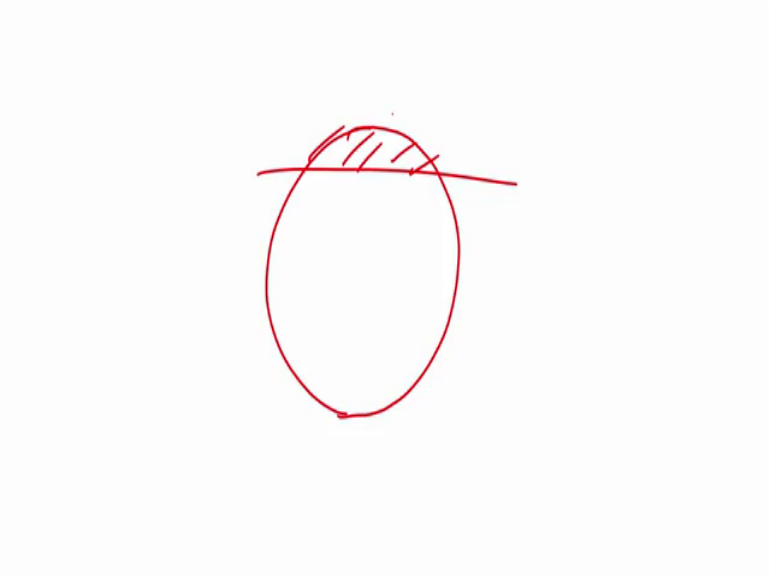

Otherwise, typically rounds like this are stocked and kept; followed right this is a regular round of a specified size. In the case of millimeters, usually up to the smaller let us have up to 6 millimeters every 0.5 millimeter you can get; from 6 onwards every millimeter you can get, crossing around 20 generally every 2 or 5 millimeters you can get.

So, you can always have a look at this and decide probably; if you have a round like this, it may be much easier to do machine of hold it properly and remove that material, you know all this material is removed.

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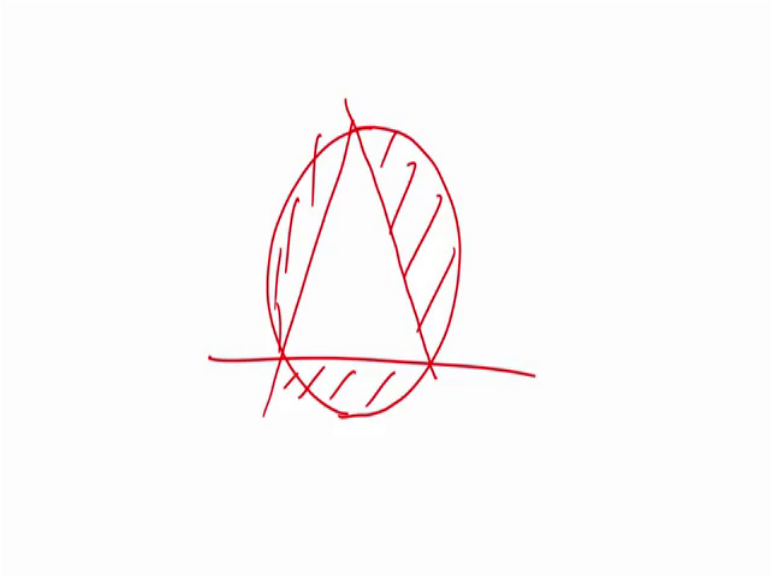

And then now clamp it the other way and clamp this onto a bed like this. You remember this material is not there anymore. Now, go ahead and see whether you can remove this material, similarly remove this material. So, the item you want, this has been removed, all those things have been removed and you have this stock that is available here.

And you will have a small additional advantage also; if you plan your things properly and go back to the drawing, probably it does not matter if there is a slight variation in this. If you see the, if you see this probably it is not such a big deal, if there is a small radius in the corner, small radius in the corner.

So, both representations are important; you need to imagine something in the mind, try to probably make a representation and usually fabrication people are very very happy if they see an object like this, I mean a representation of an object like that and then also an isometric

view. With is they are 100 percent sure that it will work under all conditions and if job can be done.

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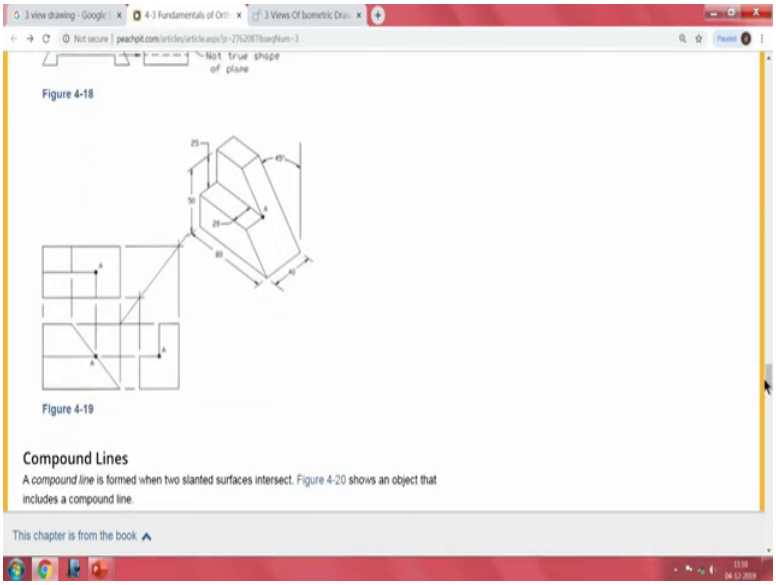

Now, to just continue with this lecture, you have a look at this; it is slowly getting more and more I would not call it vague, getting involved and how to make representation of all these things.

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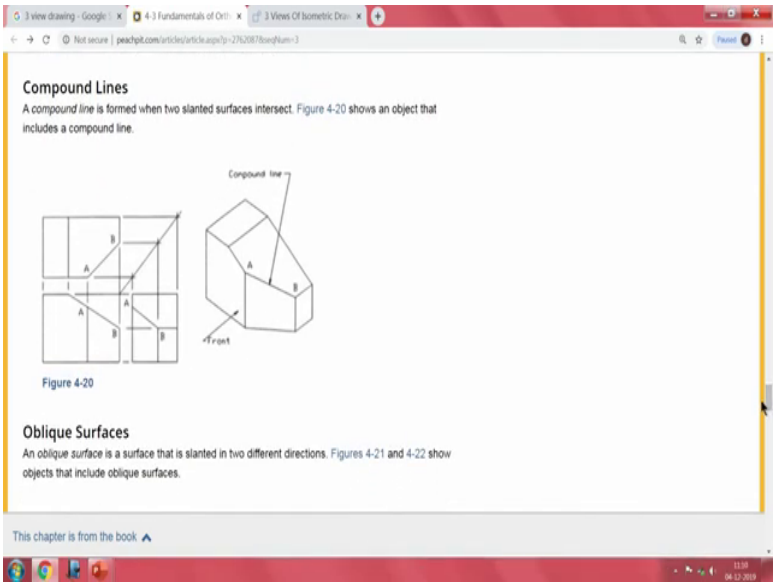

You see here, a component line is found when two slanted surfaces intersect; shows the object that includes a component line.

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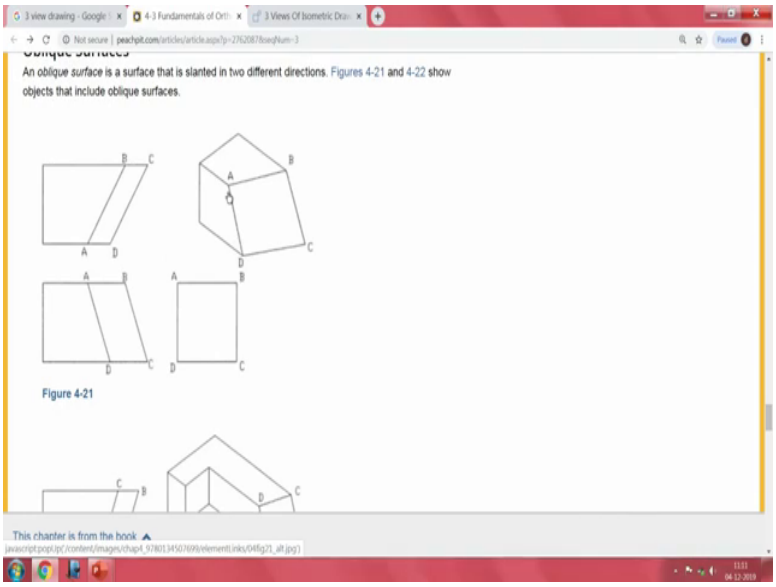

So, where it is a matter of what you call a naming convention. Then you have surfaces which are peculiarly not easy to define it; it is oblique understand, in one view it is cut like this and in one view it cut like, that representation is like this. But the advantage of this what you will notice here is, it is very very easy saying; if you have this and if you mark these things. And usually most machine tools the expert machinist, they are able to make a fixture and then oriented such that; the surface you want, the milling surface is flat.

So, somebody can just need to take a profile, a square profile in this case and orient it properly; once you do the orientation, it is very I mean easy to it is easy to do, it is achievable.

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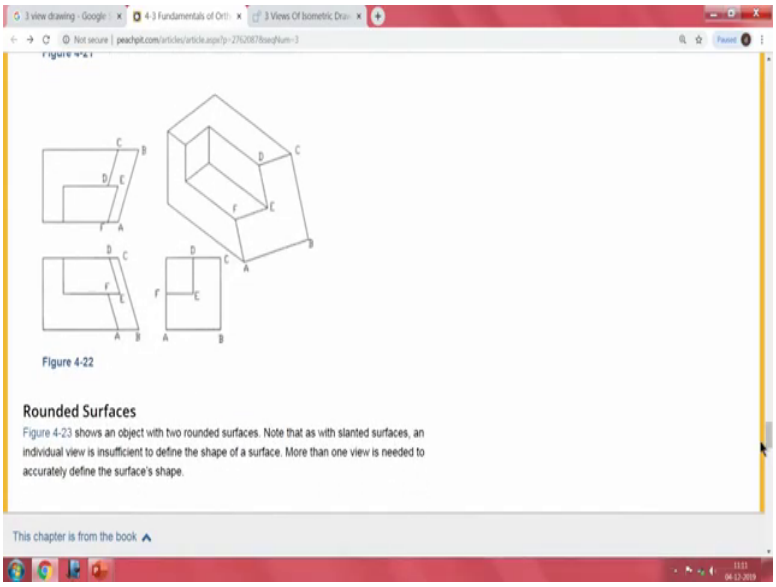

Further if you go down; do such things happen? Yes, they do very very often such things happen. What happens is; during assembly you will end up with all this complicated what you call shapes and geometries that are required for holding things together. This has evolved over the years, over a long; it is not something know which has happened just suddenly and I will use the word trial and error instead of saying empirical.

Yes people have had a problem and there are experts who can interpret your drawings and then they are experts who make the drawings; that thing has been made a little easy now with the advent of the solid modeler software I have shown you about.

So, in this case if you just taken it to objects and have an intersection, a Boolean, addition then anything which you can think about, those surfaces are generated automatically and the CAD

file can be sent for fabrication. But unfortunately the, it is not as inexpensive and as quick as we think.

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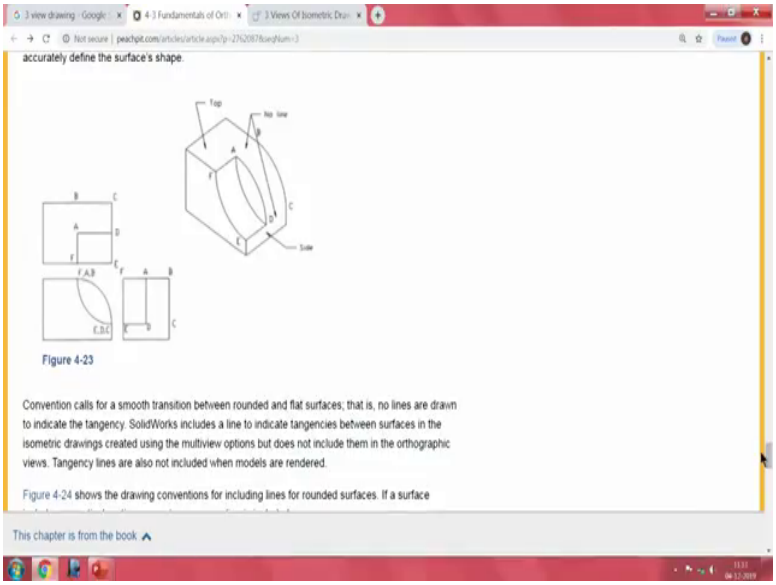

So, this where now can lay the last point of this is probably these things saying; if you have circular faces like this you see here, how do these things take place. Here we get into the interesting thing saying, in reality is there strictly speaking mathematically this is a arc and this is the flat, so is there a line or not there.

Again it says, rounded surface convention calls for a smooth transition rounded and flat surfaces, no lines are drawn to indicate the tangency. You have seen this, so these conventions are there. So, typically I can think of the way you are driving a car; you go straight on a path and then after that you need to take the minimum turning radius to the left, but still you have

to turn. The only way you can think of it is, you have to stop and then completely turn the steering and then let it go, then you can get it.

But in reality that is not how you drive the car; it is more like a progressive this thing partying what I call forming part of the ellipse, so it will be an elliptical turn. A little like this happens even in the case of machine tools; one face this face is machine continuously, this face is machine. After that the other phase the, this face is made straight and this is made; alternatively some other way of manufacturing it is that this appears relatively easy, compared to that this surface seems to be easy, all they have to do is find a appropriate mill or a cutter of this diameter.

And then once this is there, you keep feeding it and removing the material. So, you have the center somewhere here and then depending on the diameter you can do it and depth is controlled by this.

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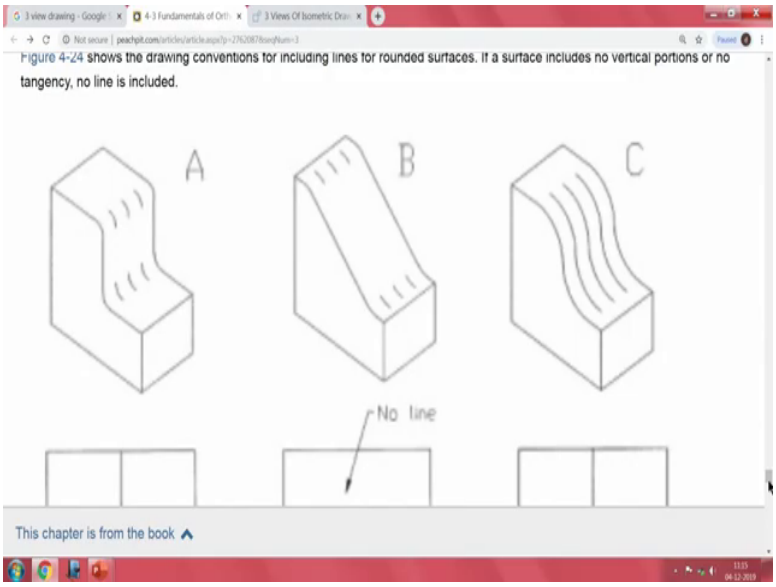

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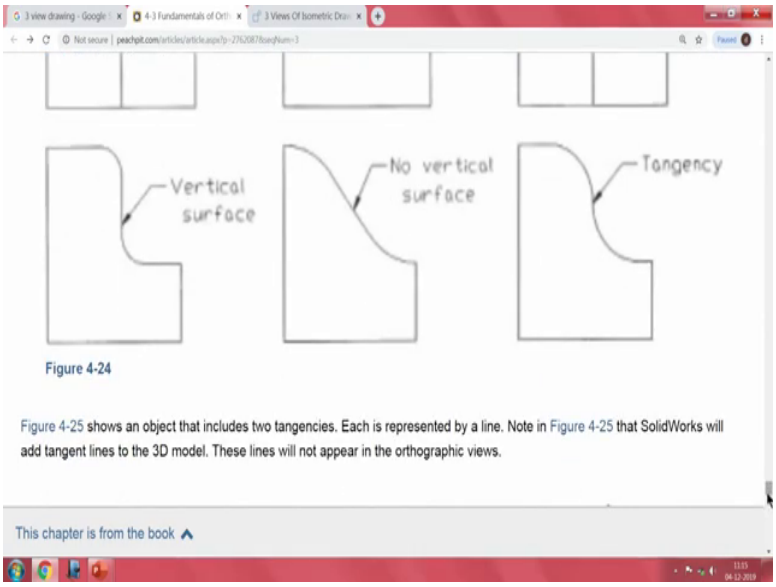

See so, drawing has become somewhat easy for us.

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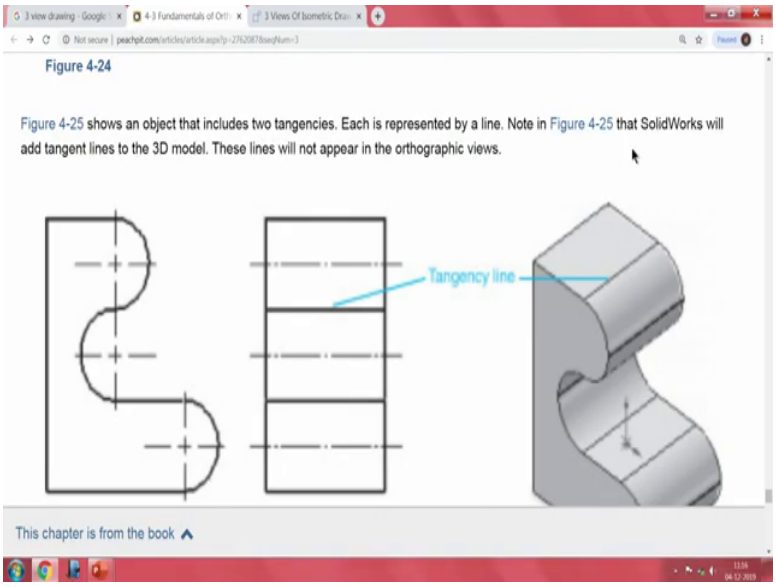

Now, we come to this very very complex objects; depending on the type and depending on the conventions, all sorts of these things are followed. Now, I will go to the, this is again specific to the particular package that we are drawing, you have seen this. So, in this point in this development, this is a tangency is shown here; otherwise it becomes difficult to define. However, if you here, incidentally this tangent is also; there is one place where the this face is visible, actually it is a zero what you call I mean length face, this face forms the, this face forms the tangency line here.

So, I will stop here my suggestion is kindly lay your hands on either a professional paid for software package, alternately buy one; otherwise you can try downloading a what you call temporary version and practicing your things.

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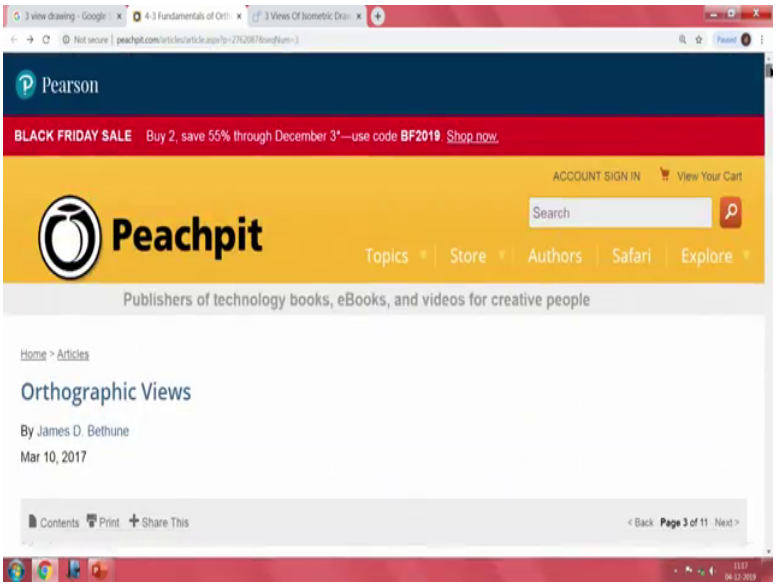

And more than that, I have shown you the source where this has been taken; this has been taken from a thing called Peachpit, this I have found that this has been very interesting.

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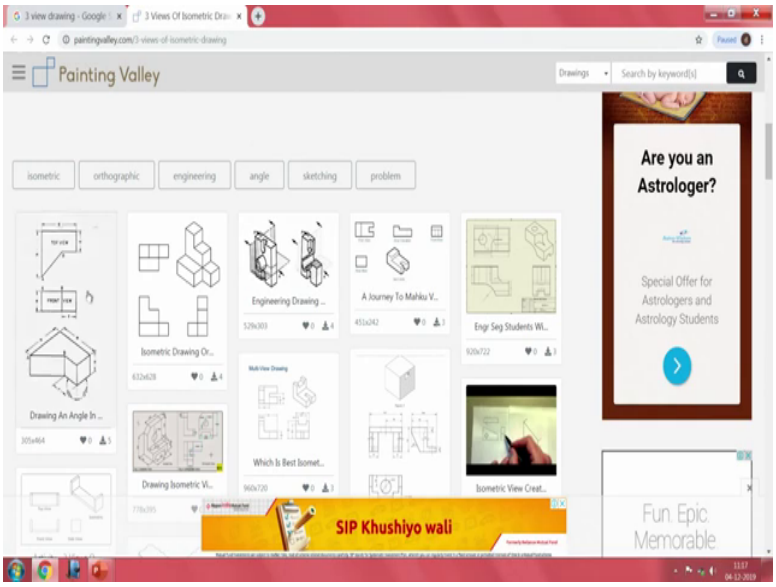

Now, similarly we have other things, this particular thing know.

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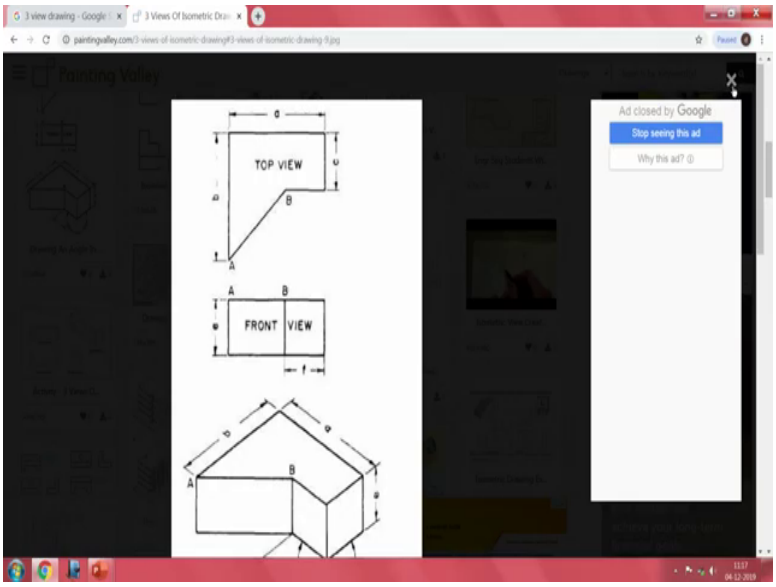

We have something called the, there are other tutorials or resources are available; I think you should be able to acquire one.

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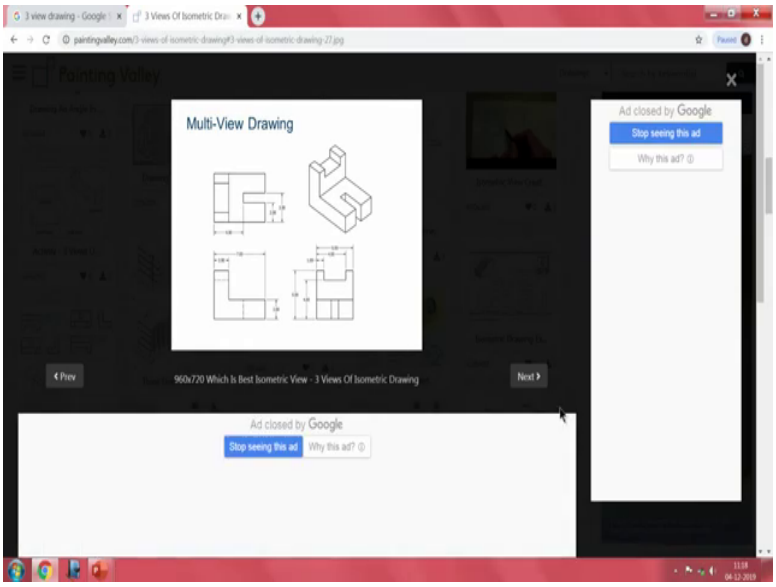

And you will notice that, they are all about the same; they will just show you what a multi view thing and all, of course these are ads. And both of them we have the thing know saying do you need ads; yes, we need ads; do you need to block ads, your take if it is very annoying you can block, otherwise you can keep them there. Please get hold of one of these packages and start your practice.

So, thank you, I will stop there. I will continue on this for maybe another one or two lectures and stop there. I know that it gets monotonous and by definition you need to have hands on practice; only then you become perfect. And how do you get a practice? It is you know you have to have an object for which you want to do. Hence in the very beginning I started with saying, why do not we make a remote control or why do not we just you know take a print and make a timer or something.

Yes, it takes time and it does look you know repetitive, monotonous and all that in the end; you will notice that if you follow all these conventions. And if you have an object instead of immediately trying to run to the fabrication shop or dealing with a fabricator, majority of the things you can solve, so that only once your drawing needs to be sent there, probably a file and they will interpret it. And then if you are lucky and if you are in a place where these facilities are available; it will be directly fabricated and handed over to you.

So, thank you, we will meet again.

Thank you.