Engineering Graphics and Design
Professor Naresh V Datla
Department of Mechanical Engineering
Indian Institute of Technology, Delhi
Lecture 24
Week 5: Section and Auxiliary views
Auxiliary views

Welcome back to the week five of Sectioning and Auxiliary views. Today's lecture will be discussing on the auxiliary views. First, let us understand, why we are interested in this auxiliary views.

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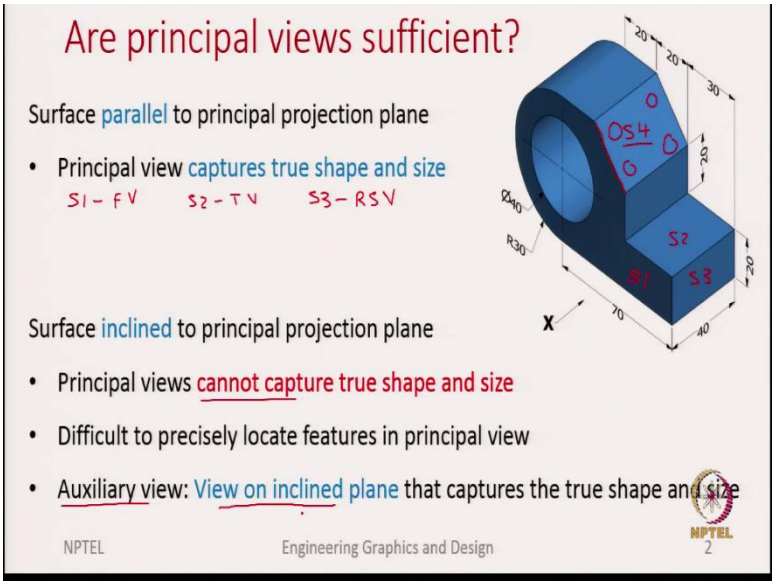

The question to be asked are principal views sufficient or in which cases they are not sufficient? So, let us focus on this solid model. And then, we will have our attention into two different surfaces. Let us say these are surface is S1 let me change the color, surface this surface is S1, S2 and S3. So, these are three surfaces on the solid. What we are trying to say is, can we capture the true shape and size of these surfaces?

So, for example, surface S1. We can capture the true shape and size in the front view. Similarly, for surface S2, we can capture the true size and shape in top view. For surface S3, we can capture the true shape and size in side view. So, in this case, it is the right side view. But now let us focus on an inclined surface S4.

So, what do we see this S4 as in the three principal views, which are the front view, top view and the side view? The front view, what we see is only an edge. We will be able to see this

edge of it. And in the front view, we, the area what we see is foreshortened. What it means is, what you see is smaller than the actual object. The actual height of the object may not appear as the same in the side.

Even in the top view, this size of this surface 4 will be foreshortened because it is an inclined surface. So, essentially what we are trying to say is, principle views cannot capture the true shape and size if we are talking about an inclined surface, such as, S4. And then the problem is, it is difficult to precisely locate features of this surface on the principal views.

So, let us say, one need to drill four holes on the surface. How do you represent this information on a regular orthographic projection? So, because since you are not able to capture the true shape and size, precisely locating these location of the holes it becomes a little difficult. So, to overcome this, one option is to use auxiliary views where the projection plane used is not in line with the principal planes, which are the horizontal plane, the vertical plane or the profile plane, but you can take an inclined plane which is parallel to the surface you are interested in.

So, here the surface of interest is S4. So, let us say you take a projection plane, which is parallel to that and then apply your basic orthographic projection saying that the viewer is at infinite distance then he is looking right into the plane into the object, which means, the projector lines are perpendicular to the projection plane and also perpendicular to the surface we are interested in. So, that is what, we call them as auxiliary views, where the view on the inclined plane captures the true shape and size.

So essentially, what we covered in this slide is to say, when we need this auxiliary views. We need these auxiliary views when you want to project the true shape and size of a surface, which is not parallel to any of these principal planes. And then, we need to come up with an auxiliary plane on which we capture the auxiliary view. So, from now on we will see, how do we capture it, and what are the step by step methods to draw those oscillatory views. Before we start, let us notice a few features of these auxiliary view.

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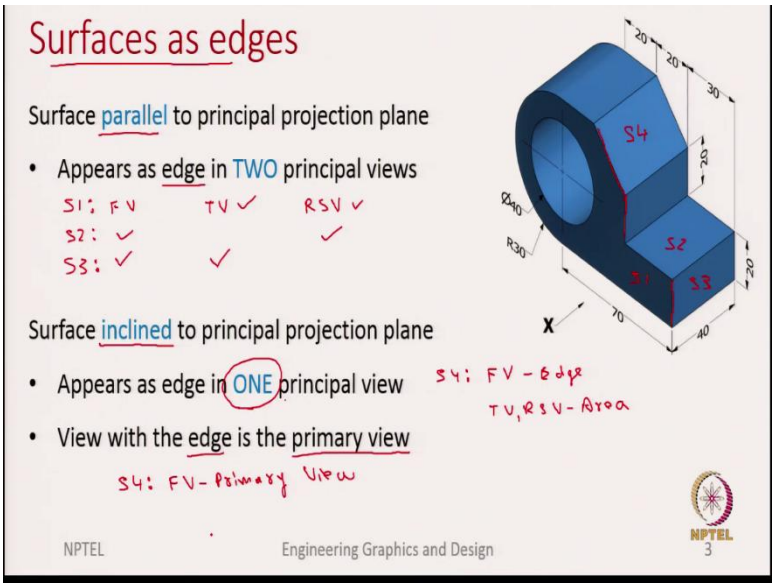

So, now, let us focus on surfaces as edges. You will quickly see, what I meant by surfaces as edges. Let us again consider this surface parallel to the principal projection planes. So, these are the surfaces S1, S2 and S3, we discussed in the previous slide.

So, in each of these surfaces what we are trying to say is, if you look at your primary views this surface will appear as an edge in two principal views. So, let us say, I am considering for S1, the front view, top view and the right-side view. So, in the front view, what do you see? We see the true shape and size. But in the top view, what do we see for surface S1? We only see an edge.

And similarly, in the right-side view, what you see is this edge, as well as this edge, and of course, this edge. So, this is the edge you see in the right-side view. You can repeat the same for surface S2 and S3. You will notice that, for each of these surfaces which are parallel to one of the principal planes, you will only see an edge, as an edge in two views.

So, for example, in surface S2 you will see it as an edge in front view, as well as in right side view. And for surface S3 you will see it as an edge in the top view, as well as the front view. So, the point I am trying to emphasize here is, if the surface we are talking about is parallel to one of the principal planes, it appears as an edge in two other views. But now, let us look about the surfaces, which are inclined to the principal projection plane.

Here, I need to specify what I meant by inclined. Here when I say inclined, I mean, that it is perpendicular to one of the projection planes. So, for example, if I take this surface S4, it is perpendicular to the frontal plane or the vertical plane, but it is at an angle to the horizontal

plane as well as the profile plane. So, it is inclined to the profile plane and the horizontal plane but is perpendicular to the frontal plane. So, this is the inclined plane, we are talking about.

You can have a more general inclined plane where it is inclined to all the three principal planes. Even there you can apply auxiliary views, but at least in this lecture, let us not focus on that. Because, if we focus on the inclined plane and know the concepts, we can extend this even to draw the views for an oblique plane.

So, let us again get back to the inclined plane we are discussing which is surface S4. So, if you look at S4, let us say what you see in the three views. For S4, in the front view, what do we see? Front view, we only see as an edge. In the top view, you see an area, as well as the right-side view, you see it as an area.

So, the important point is this inclined surfaces appears as an edge in one of the primary views. So, this is important because this view where it shows up as a edge, we call it as the primary view or the principal view. So, the view where it shows up at an edge is called a primary view. The reason why we are focusing on this primary view is because we will open all other views onto this plane.

So, in this example, let's say for surface S4, we said that the primary view is the front view, is the primary view. So, since this is the primary view, when we draw the top view, we open up onto the front view, when we draw the side view, we open up on the front view. And, similarly even for the auxiliary view, we open up onto the front view.

So, here it happened that the front view is the one, where we see it as an edge, but depending on the orientation of the same object, for example, maybe this edge appears in a top view. Then what we need to do is, we need to open the rest of the views on the horizontal plane, which captures the top view.

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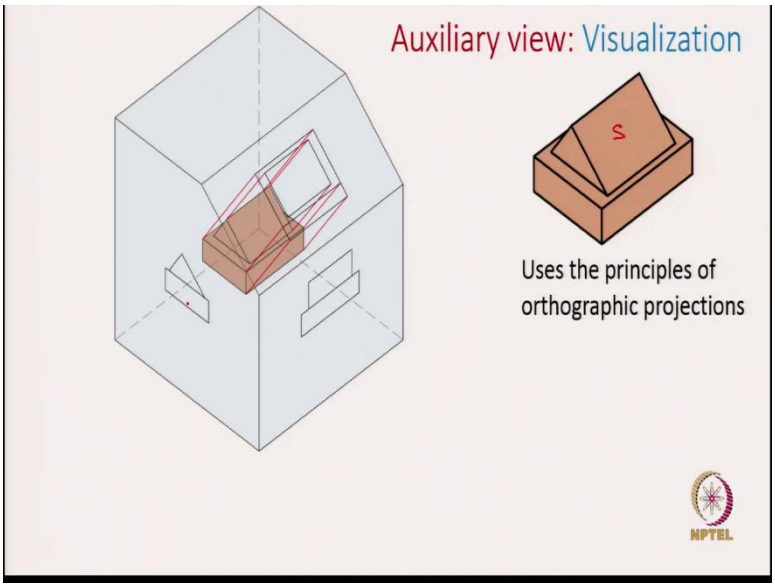

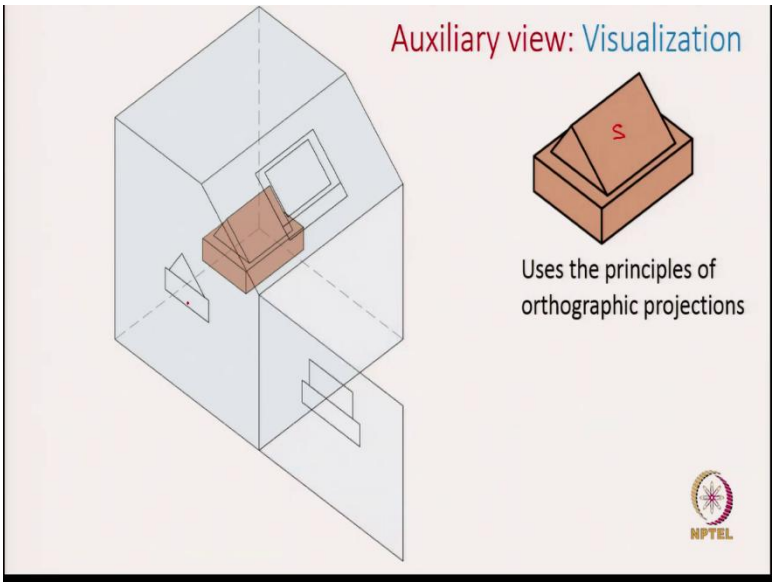

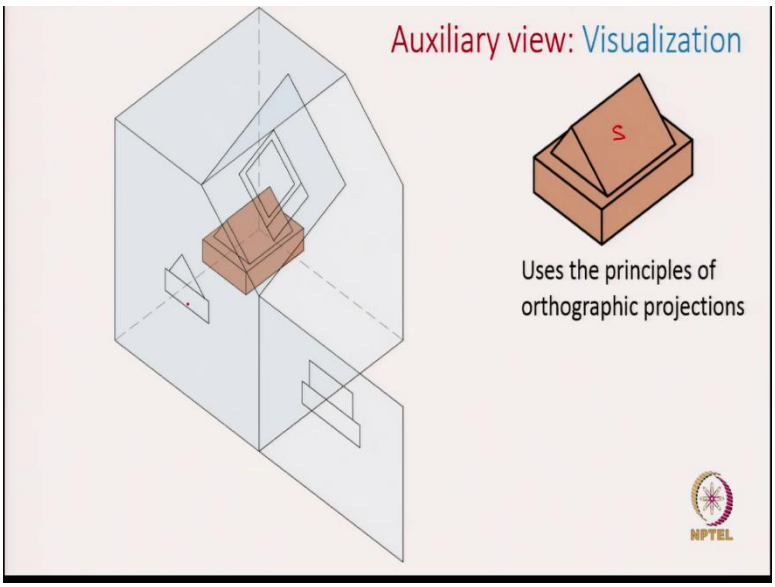

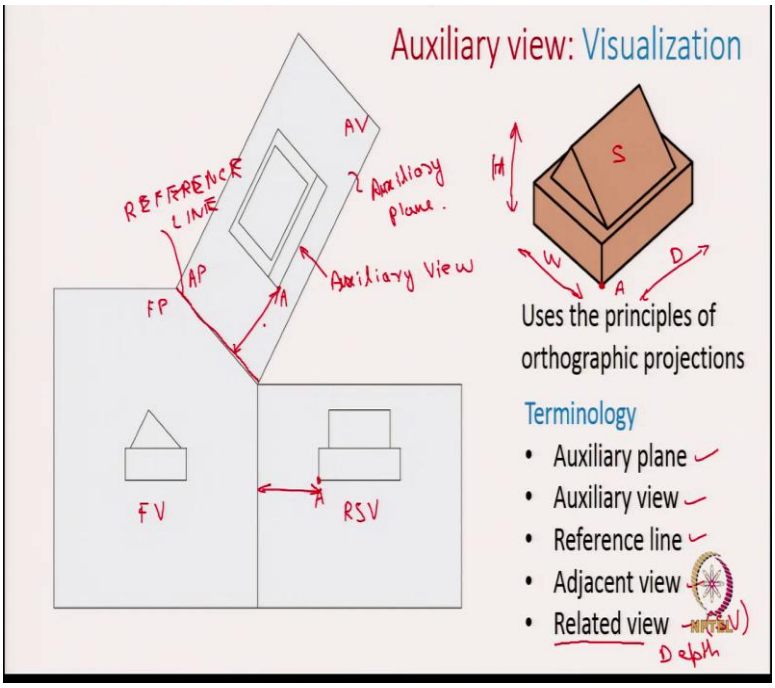

So, next, let us look at from using visualization I want to show you how to develop this auxiliary views. So, the step-by-step procedure we will come later, but this will help you to picture, to get a mental picture of how are we capturing the auxiliary view. So, again, we are saying that we use the principles of orthographic projection.

So, as what we have discussed previously about the orthographic projections, where we said, we are placing this object in a cube, in a glass cube and trying to capture the views on the surfaces of these cube, we will do the same process again to capture the auxiliary view. So, let us look at with an example. Here is an object we see. And now, when I take the glass cube, it is slightly different. As you can notice, you have this inclined surface, this inclined surface is parallel to the surface of our interest.

So, in this object, let us say, this is the surface, which we are interested in with the auxiliary view. Because, as you can notice, it is an inclined surface. So, an inclined surface can be captured in true shape and size through an auxiliary view, that is what we are trying to show in this example. So, the first thing we are saying is, we introduce this inclined surface into this glass box, and then place the object within this glass box.

The first thing is, you first capture the regular views or the principal views. What are those? For example, here, I can capture the side view and the front view. So, in which of these views, the surface of interest is as an edge? So, the surface of interest is, as it appears as an edge in your front view. So, front view becomes the primary view onto which will open the rest of the views. But now let us focus on how do we capture the auxiliary view? How do we

capture the auxiliary view? We already have an auxiliary plane, which is parallel to the surface of interest. We just need to use the projectors. And using these projectors, we draw the auxiliary view.

Once we draw the auxiliary view, the next thing is, to open the box, such that all views are on a single plane. So, first, let us open the side view and then let us open the auxiliary view. So, I hope you are following. What we have done now is, we captured the front view side view and the auxiliary view. But noticing that front view is the primary view, because the surface of interest appears as an edge in the front view, we decided that, we will open the rest of the views in the same plane of the front view. So, we opened the right-side view as well as the auxiliary view. And finally after rotation, this is how it looks like.

So, finally, this is your front view, right side view and the auxiliary view. Maybe I need to specify that, the way we are doing here this is in a third angle projection, because the projection plane is coming in between the observer and the object. So in this process of showing you the auxiliary views we have used a few terminologies. Let me specify those.

So, this is the auxiliary plane. This, as we already mentioned is the auxiliary view, and then a reference line. So, the line about which we open the box. So, this is the line, which intersects the auxiliary plane and the frontal plane. So, this is the frontal plane, and this is the auxiliary plane, let us say.

So, this line about which we open this box is called the reference line. And finally, the important point to note are the adjacent views and the related views. Adjacent view, as you can see, is the view where which is sitting next to the view you are looking at. So, for example, for the auxiliary view, front view becomes the adjacent view from which actually, you use the projector lines to help you draw the auxiliary view. But related view is a view, which helps you to get the dimensions.

So, in this example, if you notice, let us say, we are focusing on this point. So let us say, this point is A, which I am showing it here, as well as in the auxiliary view. So, you will notice that both the auxiliary view and the right-side view will capture the depth of this object. Let us say, this is the height of this object, and this is the width of this object and this is the depth of this object.

This we also discussed when we are lecture, in the lecture of orthographic projections that, two of these views will share the same dimension. For example, what does the front view and

the side view capture? They both capture the height. Similarly, if you are now looking at what does the auxiliary view and the side view capture.

So, if you notice carefully, the depth is what is captured in, both, the auxiliary view as well as the side view. In fact, even the top view captures the depth. So that is what you get from the related view. So, in this example, the related view is your side view from which you capture the depth.

The reason why I'm emphasizing about this related view is, you first draw the front view and the right-side view because that is what we have already discussed. But as a third step, you go and develop the auxiliary review, and then, to develop this auxiliary view you need to know how far this is from the reference line, and that information comes from your right-side view or also the top view but at least in this example, the right side view. So, this depth, this distance and this distance are the same. So now, let us look at step by step how to construct this auxiliary views.

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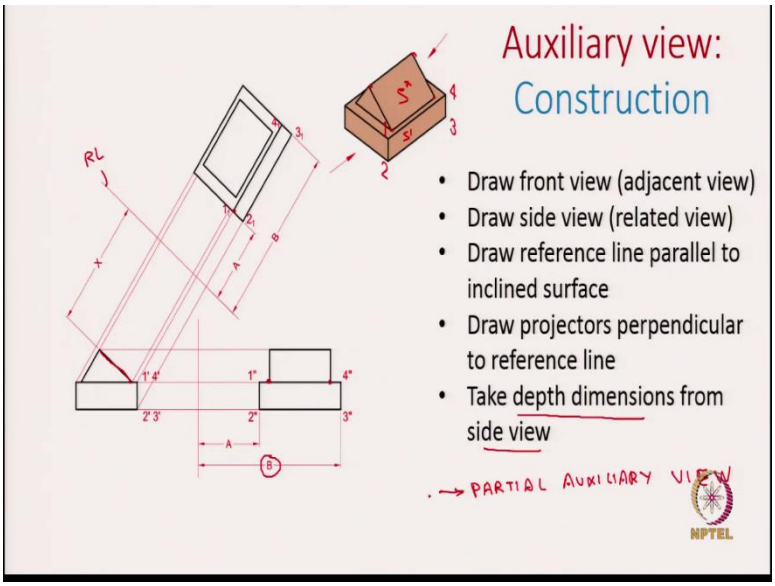

So, again, the same example. So, this arrow shows the front view. So, first thing we do is, draw the front view, which we now call the adjacent view. And then, I use the reference line. This is the reference line, which about which we rotate the front view and the side view, and then draw the projectors from the front view to help us draw the side view. So, once we draw the side view, we also got the related view which will help us in the dimensions for auxiliary view. So, the next thing is, we draw a reference line. How do we draw a reference line? We draw it parallel to the surface of interest.

First label those points 1,2,3,4 of this surface let us say S1, but now once we are focusing on the auxiliary view, we first need to define the auxiliary plane by the reference line. So, this is the reference line, which is parallel to the surface of interest. The surface of interest is S here, which shows as an edge in the front view.

So, this is the edge we are looking at. And this reference line, as I am mentioning is parallel to the edge. After this we draw again the projectors. So, first, let us focus on this projector line and then use this to help us find where our points 1 and 4. So, as I said, we will use the related view to capture the depth, so the depth dimensions are coming from the side view.

So, let us say, this point 1 is at a distance of A from the reference line, we will use the same distance A from the reference line to specify this point 1. Similarly, for point 2 is also at A, that is what we have captured and join these points 1 and 2 in the auxiliary view. Now, let us capture points 3 and 4. How do we capture? You first measure the depth from the side view. The depth is given by this dimension B, and using B we identify the points 3 and 4.

So, once you identify the points 3 and 4, you can now join them, and these points 1,2,3,4 now define this surface S1. So, now, we are able to capture this surface S1 in the auxiliary view. We use the same procedure to capture the rest of the things. So, for example, if the point of interest we said is the surface S that is defined by this corner 4 points.

So, we use the same procedure where we first draw parallel lines or the projector lines, and then measure the depth from the side view for these points. So, these come from the points. So, with this, we are able to capture the auxiliary view. And once we remove, so I show the construction lines on red, but otherwise, if you focus on the black lines, we have captured front view, side view and the auxiliary view.

So, one final comment before we move on is, the reason why we have drawn this auxiliary view is to capture the surface of interest, which is an inclined line, inclined surface. So, this is the surface of interest. But what we have done in this drawing is, we have captured other features. So, for example, S1 in this auxiliary view is not required because that is anyway captured well in the front view and the side view. So, what we are doing is, we are drawing unnecessary things. So, what we can do is, we can only focus on surface of interest and ignore the others, then what we call it is the partial auxiliary view.

In partial auxiliary view, you do not capture the complete object, but instead only capture the surface of interest, the inclined surface in the auxiliary view. But, of course, the front view

and side view will capture the complete object. I am just talking about in the auxiliary view, we only focus on the surface of interest.

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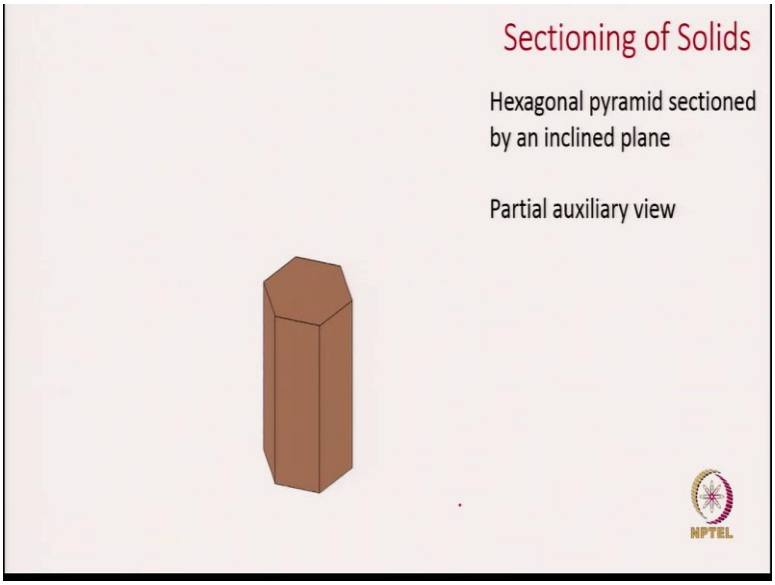

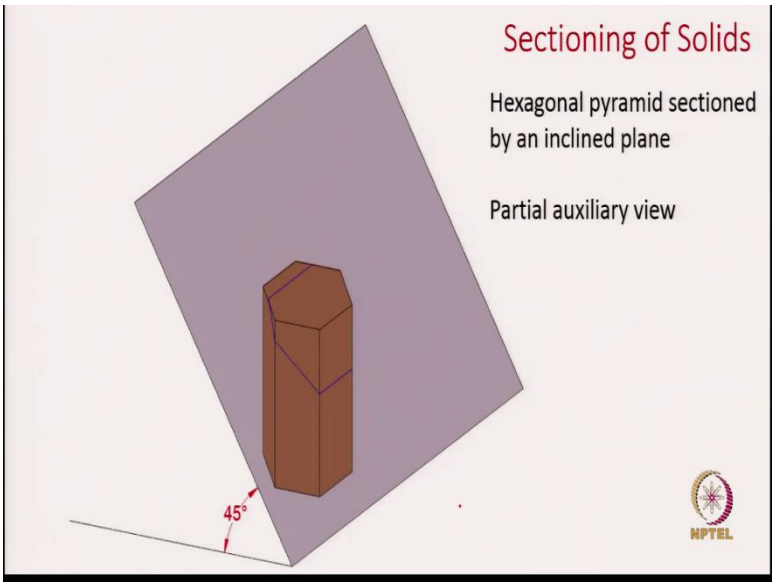

Sectioning of Solids

Hexagonal pyramid sectioned by an inclined plane

Partial auxiliary view

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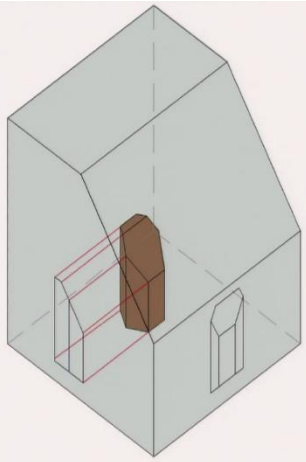
Hexagonal pyramid sectioned by an inclined plane

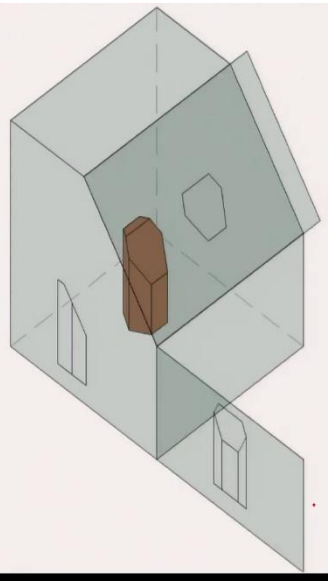
Partial auxiliary view

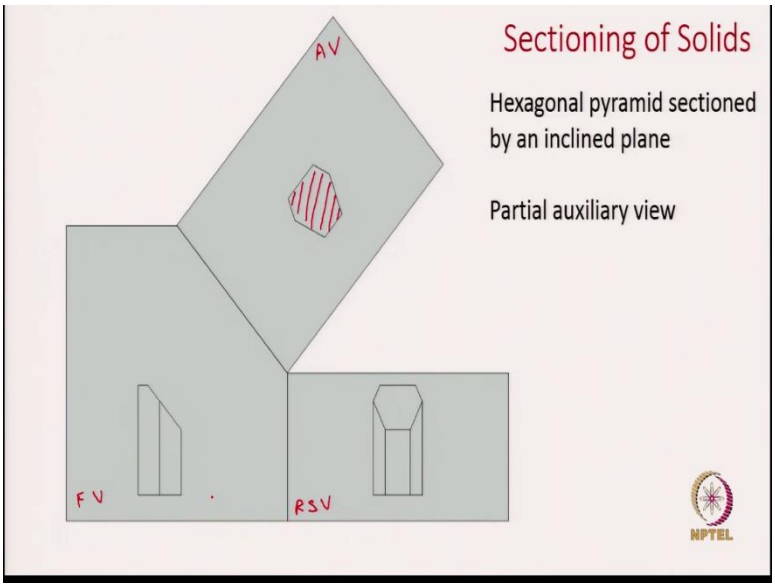


Sectioning of Solids

Hexagonal pyramid sectioned by an inclined plane

Partial auxiliary view





So, we use the same technique, also to section solids. So, let say, you have a pyramid or a prism, and then you say you section the solid using a plane. So, once you section a solid using a plane, you know the shape it cuts it is not the cross section of the pyramid or the prism.

So, for example, if you take a cone, if it is a right circular cone standing and you cut it parallel to the horizontal plane, what you get is a circle. But if you cut it with an inclined plane, that is when you get an ellipse or different shapes depending on where you are cutting. The same thing happens with any other pyramids and prisms.

So, what I will do is, using one example demonstrate how to capture that cross section made by this cut plane. So, in this example, we will be looking at a hexagonal prism, and then, we will cut it with a inclined angle of 45 degrees. So, this plane cuts this solid into two pieces. So, let us focus on the bottom piece. And then what we are saying is, I am more interested in capturing the cut surface. So, I want to know the true shape and size of the cut surface. How do we get it?

So, for this, we can use the auxiliary views that we discussed in the last two slides. So, we just need to follow the same procedures to capture this true shape and size. So, let us quickly first look through visualization how we are capturing this cross section. And in the next slide, I will show you step by step how to do it on a paper.

So first, let us put it in a glass box with the auxiliary plane. And this auxiliary plane is parallel to the cut surface. So, that is the different definition of the auxiliary plane we need to

take. So, once you do that, the first thing is, capture the regular views or the principal views. So, we will capture the side view and the front view.

So, we notice that in the front view, this cuts surface appears as an edge, so that becomes your primary view. And you will open the rest of the views about this primary view, which is the front view in this example. So, the next thing is you capture the auxiliary view. We already have an auxiliary plane using project lines, we capture the auxiliary view.

So, after this, we said, we need to open the box. We will first open the right side view and then the auxiliary view. And finally, we get the three views, which are the front view, right side view and the auxiliary view. So usually, as a practice, we do the hatching to represent that it is a cut surface. But in this slide, I have only shown you for visual purposes, how do we capture it. But let us look at how do we do this on a drawing sheet.

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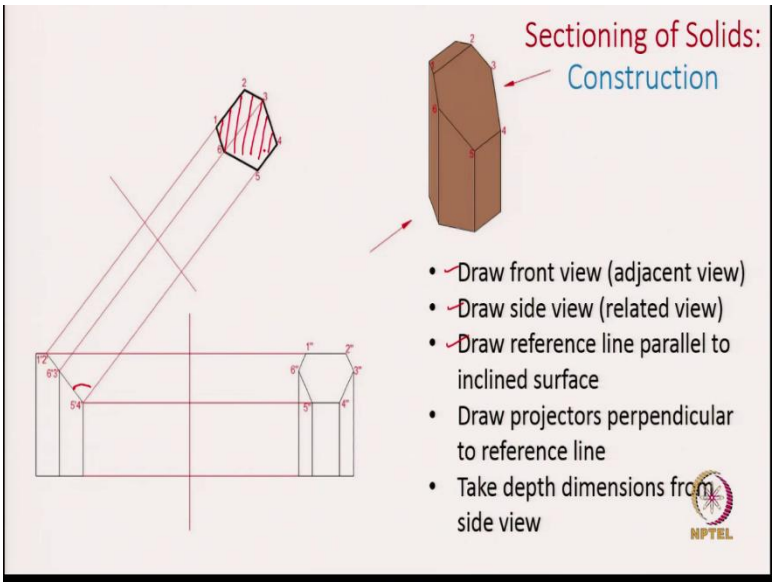

So, the steps are identical to what we discussed in the previous example. First, we capture the front view and then the side view using the projector lines. So, we are done with the front view and the side view. Then we need to draw this reference line, which is parallel to the surface of interest.

So, this we said is the surface of interest, which appears as an edge, so the reference line is parallel. So, maybe, you might be confused about how far or how close or far these reference lines should be. That is immaterial, you can choose any length, but you should be planning it in a way that when you capture that auxiliary view, it should fit on the drawing sheet.

So, that distance between this edge and the reference line is up to you. So, you can take it either too close or too far, but make sure, that the auxiliary view fits in your engineering drawing. So, once you capture the reference line, then we use these projectors, which are perpendicular to both the inclined line as well as the auxiliary plane. And then we capture the depth information from the side.

So, now, let us look at how do we capture this cross section. This cross section has 6 points labeled as 1 to 6, so we will use those 6 points one at a time. So first for point 1, we see it is at a distance A. The same distance A I am using in the auxiliary view to capture the point 1. I repeat the same process for point 2, which is at a distance of B, in the side view I just copy it into the auxiliary view. So, the same procedure continues for the 6 points. And once you get the 6 points, you just need to connect them with straight lines. So, and then we get this auxiliary view. So, as I said, usually we section them to indicate that this is a sectional view.

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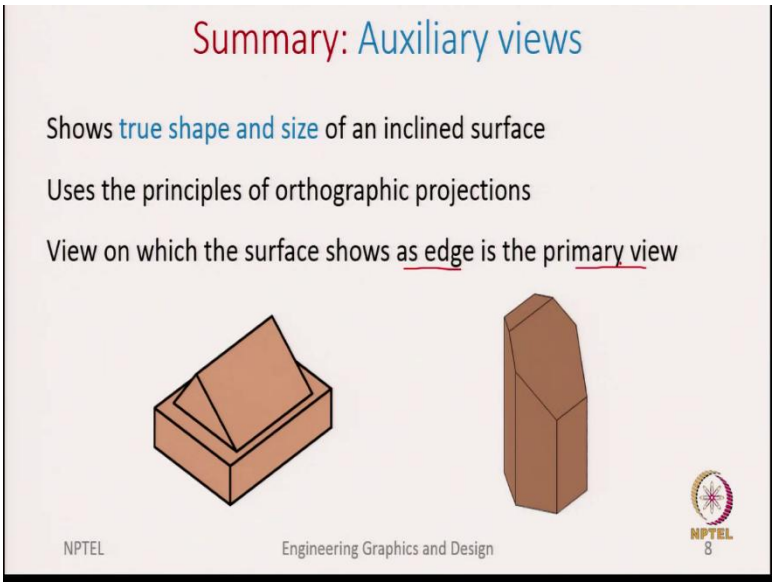

So, in summary, what did we learn in this lecture? We said the principal views may not always capture the true shape and size, especially, if your surface of interest is incline. So, in those cases, we need these auxiliary views where we define an auxiliary plane, and which is parallel to the surface of interest.

And on this auxiliary plane we capture the auxiliary view. And the principles we use to develop the auxiliary view are the same as what we already discussed about the orthographic projection. So, saying that the observer is at a very far distance, and then, the projection lines are perpendicular to the projection plane.

So, finally we said, we need to decide the primary view because that helps to open up the rest of the views. So, we noticed that this primary view we captured the point surface of interest as an edge and then it becomes the primary view upon which you open up the auxiliary view and the other views.

So, here are the two examples we have gone through thoroughly to see step by step how to develop them. So, this lecture will be followed by one example of drawing it on a sheet of paper. With enough practice, I think this will be a powerful tool, which one can use to capture the true shapes of inclined surfaces.

But before we close, I need to mention that the emphasis on these auxiliary views is decreasing nowadays with the use of computers because once you develop the solid model, the capturing of the auxiliary view becomes a very easy task.

So, though previously, there was a lot of emphasis to capture these auxiliary views on a sheet of paper, but nowadays, because of the use of the computers, it became much easier. Thank you all for joining.