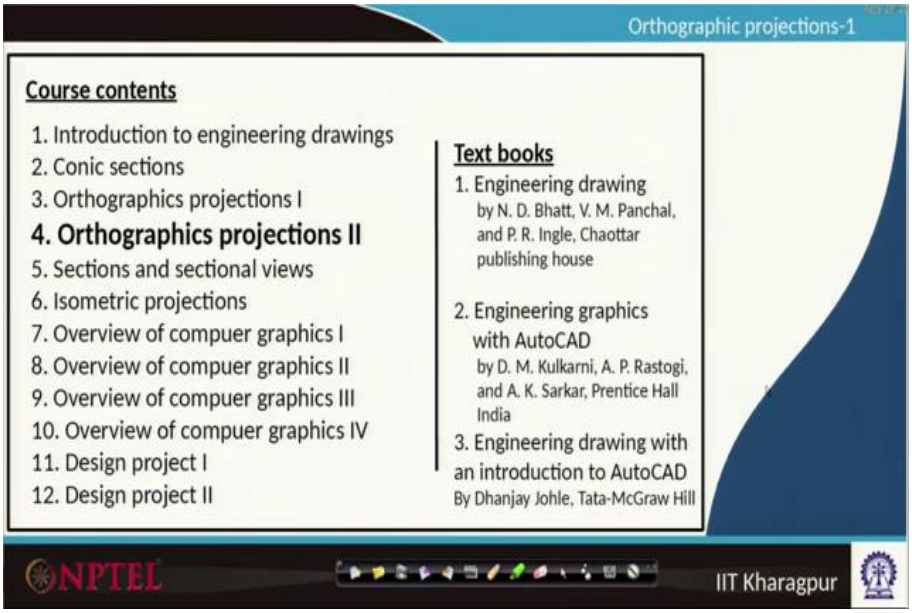
Engineering Drawing and Computer Graphics
Prof. Rajaram Lakkaraju
Department of Mechanical Engineering
Indian Institute of Technology, Kharagpur

Module - 04
Lecture – 31
Orthographic Projections II (Part - 1)

Hello everyone. Welcome to our NPTEL online certification courses on Engineering Drawing and Computer Graphics. We are covering module number 4, lecture number 31. It is on Orthographic Projections II. I am Rajaram Lakkaraju from Mechanical Engineering IIT, Kharagpur.

(Refer Slide Time: 00:36)



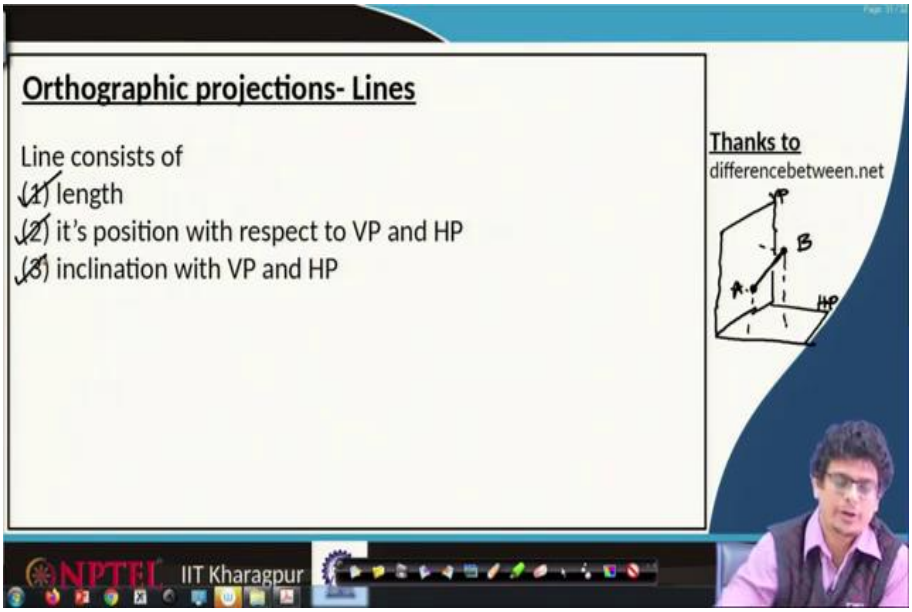
In the earlier classes, we have learnt about the introduction to engineering drawings something about geometric constructions. In that conic sections, we have covered like drawing cycloids ellipse parabola hyperbola and others.

And in module 3 we have covered orthographic projections I; where we have learnt about planes what is a vertical plane, what is a horizontal plane and what is first quadrant projection, third quadrant projection and how to project points on to different planes if it is on first third or second or fourth kind of quadrants. And in this module, we will especially cover about line projections.

(Refer Slide Time: 01:31)

In projection II; we will cover about how to project a line, what are traces of lines when we are projecting, finding true length apparent length and other configurations if it is on inclined planes what will happen, what are auxiliary planes, how to project a solid onto planes on different kind of planes. These are the things what we are going to learn.

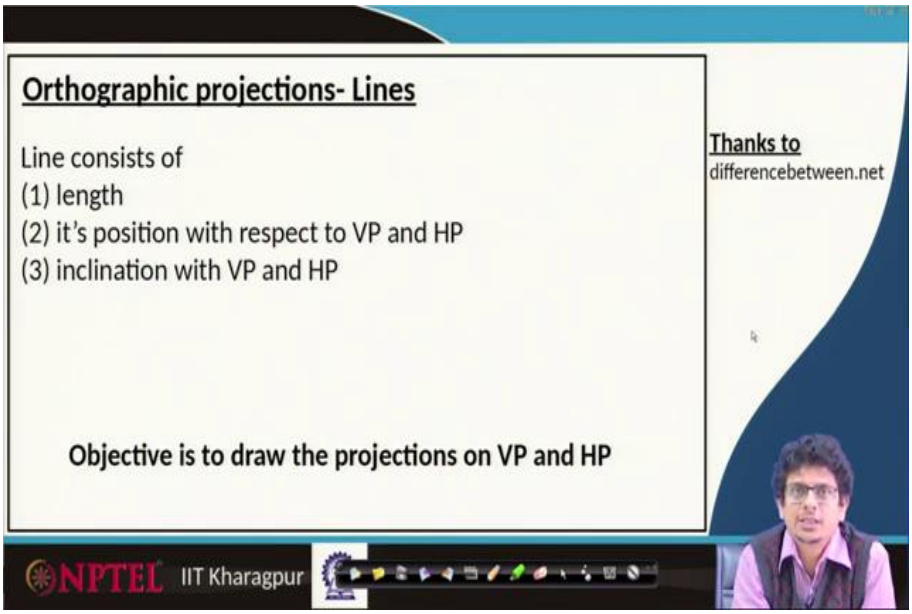
(Refer Slide Time: 02:10)



In today's lecture, we will mainly cover line projections. To represent a line, we require length something like it is 2 centimetres 20 mm and so on. Its position with respect to vertical plane and also horizontal plane is required how far this line points, for example, a line A B if I am representing is not only the length.

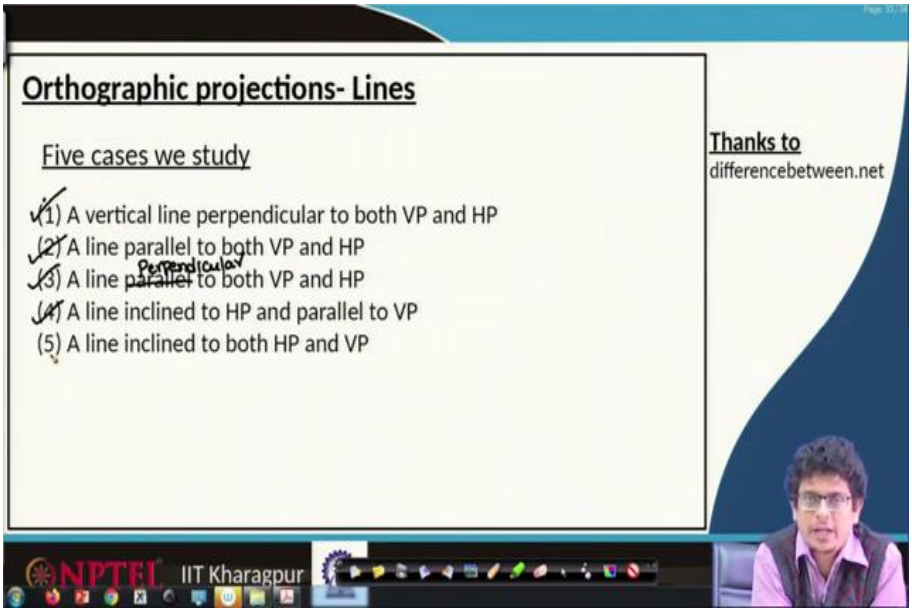
But with respect to a reference plane in this case maybe the vertical plane where exactly A goes, where exactly B goes; this kind of things we require. That is what we call is a position with respect to the vertical plane and horizontal plane. And its inclination not only the position what we require is its inclination with the vertical plane and horizontal plane also required.

(Refer Slide Time: 03:31)



The objective of today's lecture is how to draw a projection of a line on a vertical plane and horizontal plane.

(Refer Slide Time: 03:47)

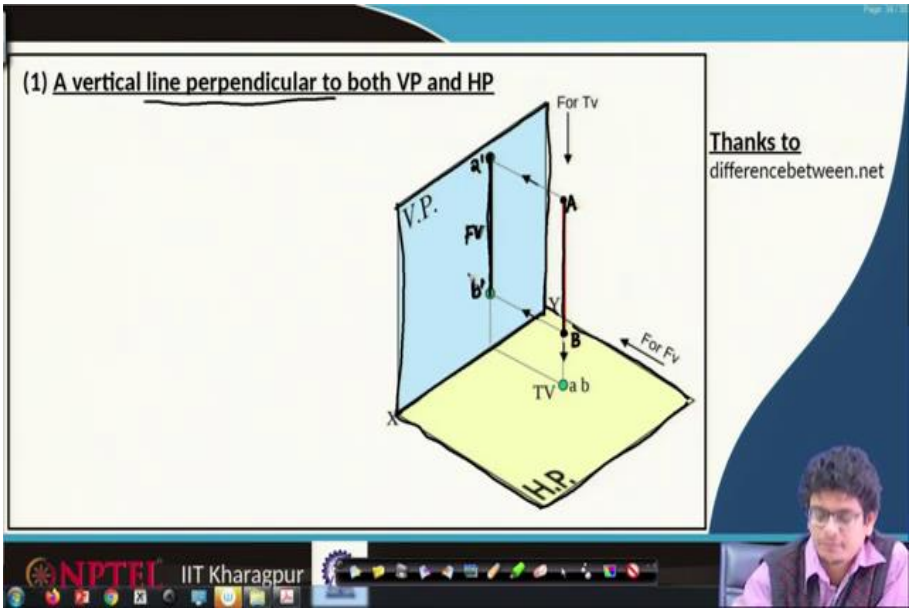


In principle, five cases exist for this projection of lines. The first one; a vertical line perpendicular to both horizontal plane and vertical plane. Second one; a line parallel to both vertical plane and horizontal plane. The third one is a line perpendicular to vertical. A line perpendicular to both vertical plane and horizontal plane.

And the fourth one; a line inclined to the horizontal plane, but it is parallel to the vertical plane. And the fifth line is is a special case a line inclined to both horizontal plane and vertical plane; that means, it makes different angles with the horizontal plane and vertical plane.

If such kind of lines is there how to project them onto this vertical plane, horizontal plane, get the information. The simple strategy is; if we know one of the point project that onto horizontal point horizontal plane and vertical plane. Similarly, the other end of the line also projected suitably connect these projections; that is the way we will be in a position to join the projections onto different planes. Let us look at them step by step.

(Refer Slide Time: 05:48)

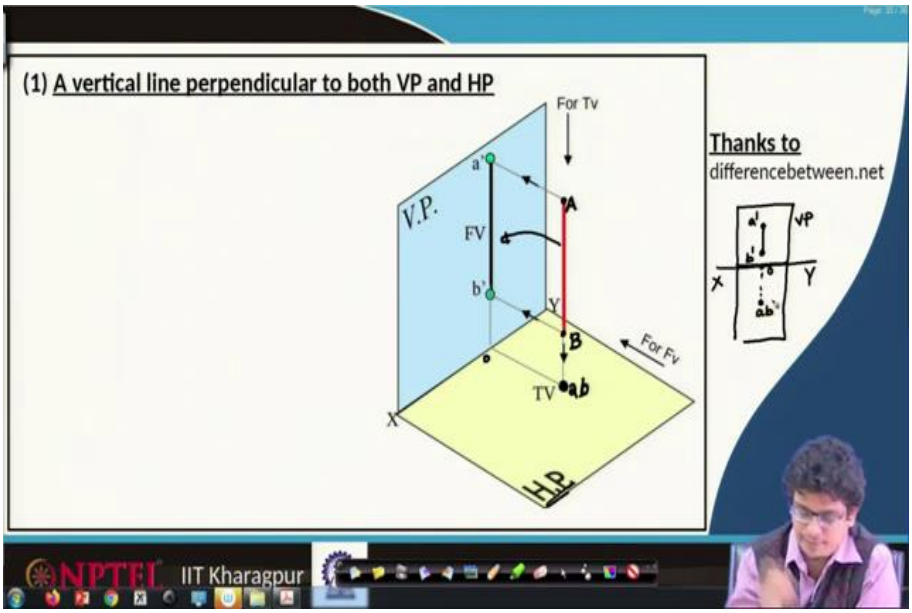


The first question is; a vertical line perpendicular to both vertical plane and horizontal plane. If that is the case how to construct that line. Let us look at this. Our vertical plane is this one and the horizontal plane is this one, in the three-dimensional world. And this is a line perpendicular to both vertical plane and horizontal plane. Let us look at that. Now if we are looking at that this is the perpendicular line.

Now, if we are looking at that the projection of point A gives me a' onto that plane. The projection of point B on to b gives me b'. So, on the front view or perhaps vertical plane these two points map there. So, that we will be in a position to join through a line this is the way A B capital A B line projects to a' b' line.

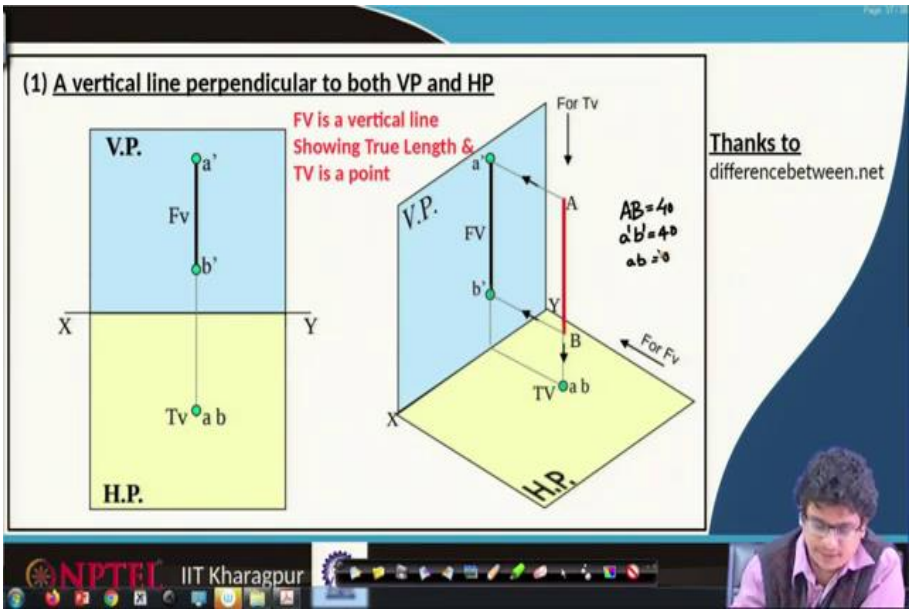
A point maps onto small a in the top view on the horizontal plane. B point also coincides with that projection to b. So, your entire capital A capital B line up a case one projected to a point on a horizontal plane whereas, is projected onto a vertical plane as a line.

(Refer Slide Time: 08:05)



If we are showing in this two-dimensional thing. This is the vertical plane this is the axis X Y; we have a line a' b' there and we have a point which is at this location away from the origin. So, this is origin away from there somewhere here a b line projected.

(Refer Slide Time: 08:37)



So, the answer for this line when we are projecting turns out to be a point mapped to a', b point mapped to b' whereas, in the top view because we are in the first quadrant. So, it goes to a b level.

And the first important observation is when we are projecting these lines onto the vertical plane horizontal plane in this special case, the front view is a vertical line precisely giving the true length of the object. So, if A B is 40 mm, then in this front view a' b' also 40 mm we will get. This is what you call true length. The apparent length of this A B on the horizontal plane when we are projecting that will be 0 this is not true length.

(Refer Slide Time: 09:53)

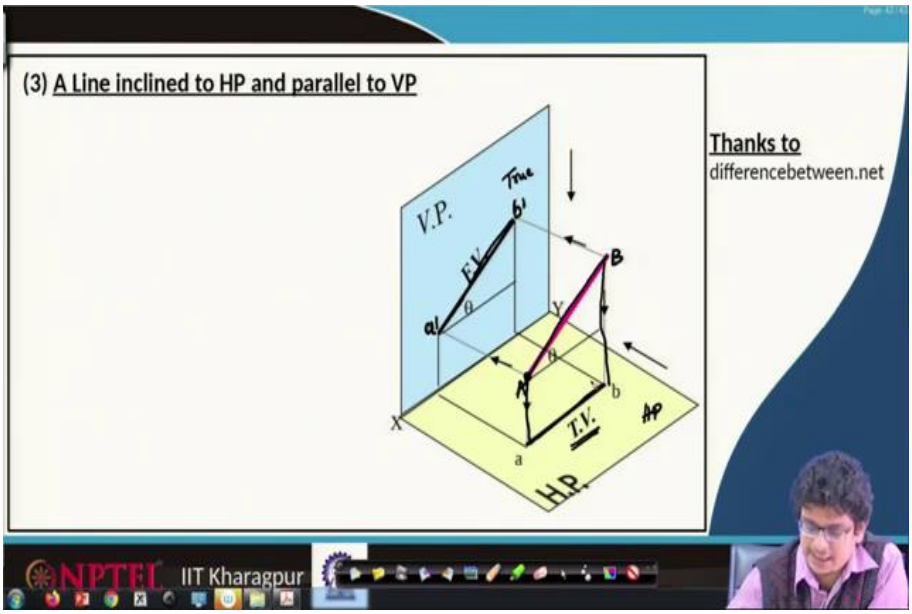
12

Let us look at the second case: A line parallel to both vertical plane and horizontal plane. So, the line this is A B, it is parallel to the horizontal plane and also parallel to the vertical plane. If that is the case, what are the lengths we are observing on the vertical plane and also on the horizontal plane?

Let us look at it. A point projected to a', B point projected to b'. Similarly, A projected onto the horizontal plane a, B point projected on to the horizontal plane to b. So, in the front view, in the top view when we are looking the complete a transferred there, the complete A B transferred on to top view.

So, when we are flipping this horizontal plane by 90 degrees; what we will see is, the vertical plane is this for the front view, the horizontal plane as the top view in the first quadrant. a' b' maps to a b of the same size when your line is parallel to both vertical plane horizontal plane; we will get the true length in both the front view and the top view.

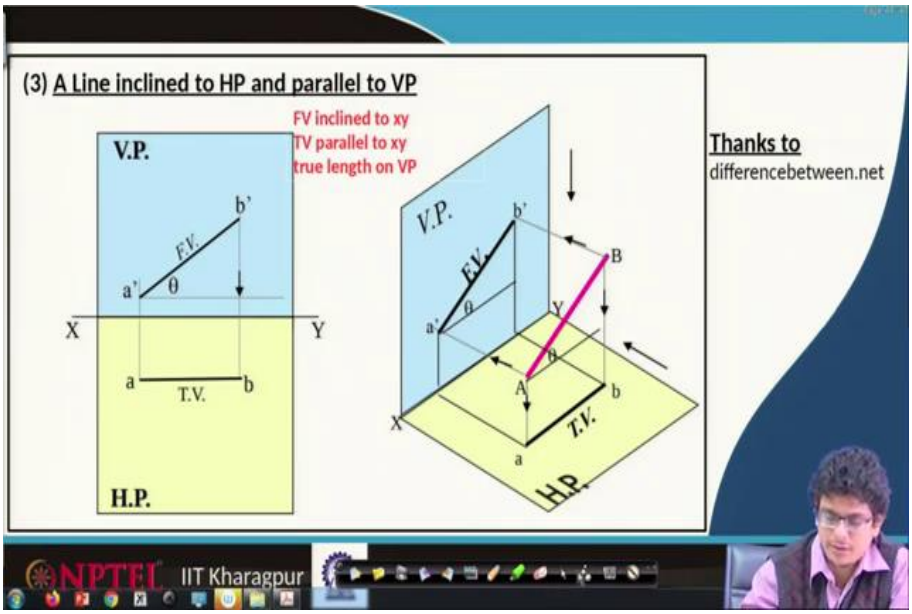
(Refer Slide Time: 11:55)



Let us look at the third case where a line is inclined to the horizontal plane and it is parallel to the vertical plane. The vertical plane, horizontal plane and line are inclined to the horizontal plane, but it is parallel to the vertical plane. So, if we are moving this line parallel to the plane vertical plane. So, parallel to the vertical plane. If we are transporting this A B length to vertical plane a' b' we are straight away seeing true length there.

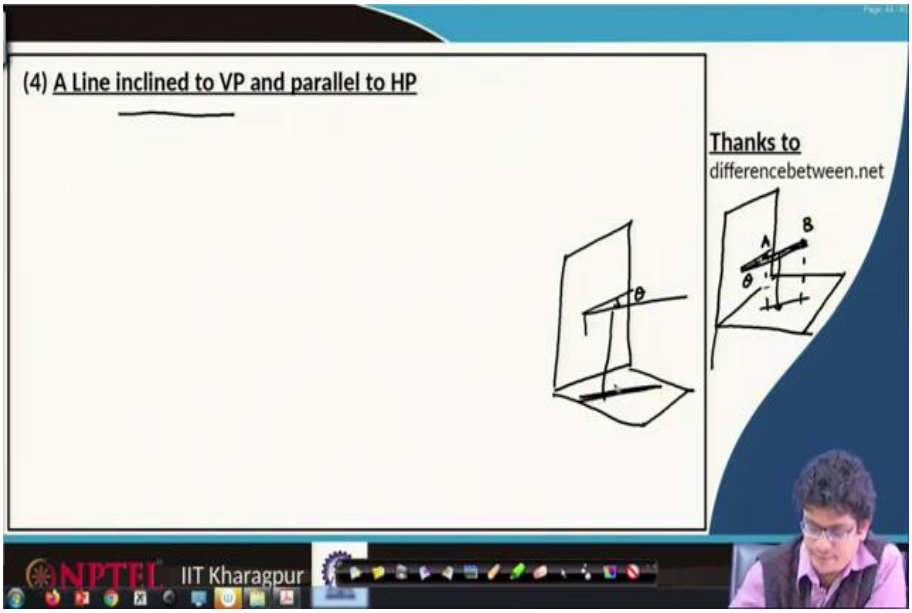
When we are looking at a projection of this A B line on to the horizontal plane as a top view, we are going to have the projection of A projection of B as the apparent length which is smaller than the true length in this case.

(Refer Slide Time: 13:26)



So, this is true length this is projected apparent length.

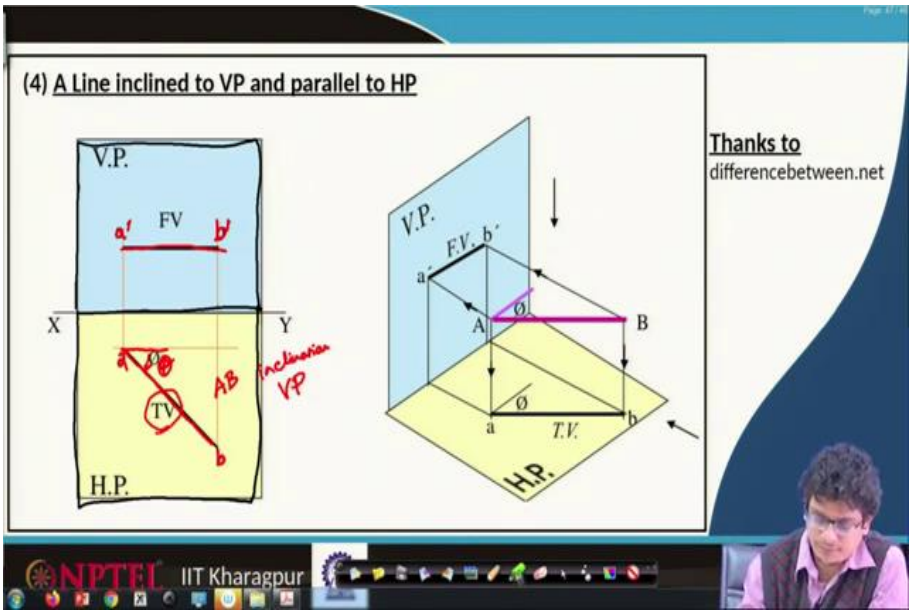
(Refer Slide Time: 13:42)



Let us look at another case where a line is inclined to the vertical plane and it is parallel to the horizontal plane. Can you draw that picture if it is inclined to the vertical plane line? But it is parallel to the horizontal plane; that means, first of all, construct a vertical plane from there construct a horizontal plane. Line supposed to be inclined to vertical plane and parallel to the horizontal plane. Parallel to horizontal plane means; if something like line already present on the horizontal plane, I should move it parallel, but that supposed to make an inclination angle with the vertical plane.

So, if I am going to join this, this is the point A this is the point B if we are extending this A B line perhaps it might intersect at that point. So, that it makes an angle theta with the vertical plane. So, it is more like you have this your line makes an angle theta, that kind of thing is inclined to the vertical plane, but it is parallel to the horizontal plane. So, if I am moving this line all the way down, it straight away maps there. Let us look at that pictorial view.

(Refer Slide Time: 15:44)

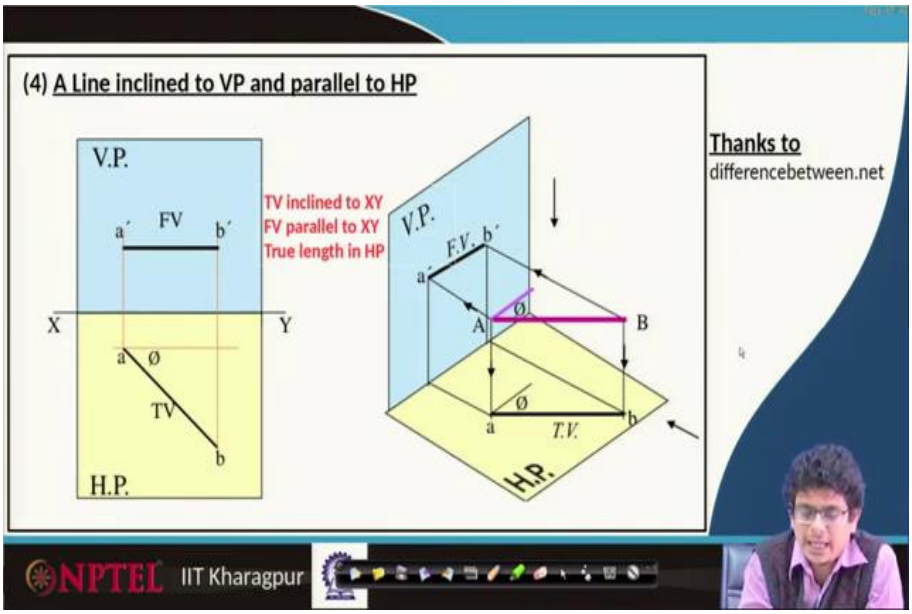


So, this is the line what we are seeing. This line is parallel to the horizontal plane, but if you are extending it this line might intersect there it is inclined with the vertical plane. In that case, the projection on the vertical plane a' b' gives us only the apparent length, not true length whereas, it is the projection on the horizontal plane gives us complete information of that line.

Let us draw it as a front view and top view in the first quadrant. So, the front view for this and the top view for this. In that the a' b' smaller than a b whereas, a b is the true length giving us complete information on a b. And in most of the drawing sheets, you will see with respect to horizontal what is the angle it is making.

In case if we know this picture; that means, in the top view the line a b if it is making an angle theta phi with the horizontal that indicates that it is this line A B in that first quadrant making an inclination angle with respect to the vertical plane. This is the way we have to understand that.

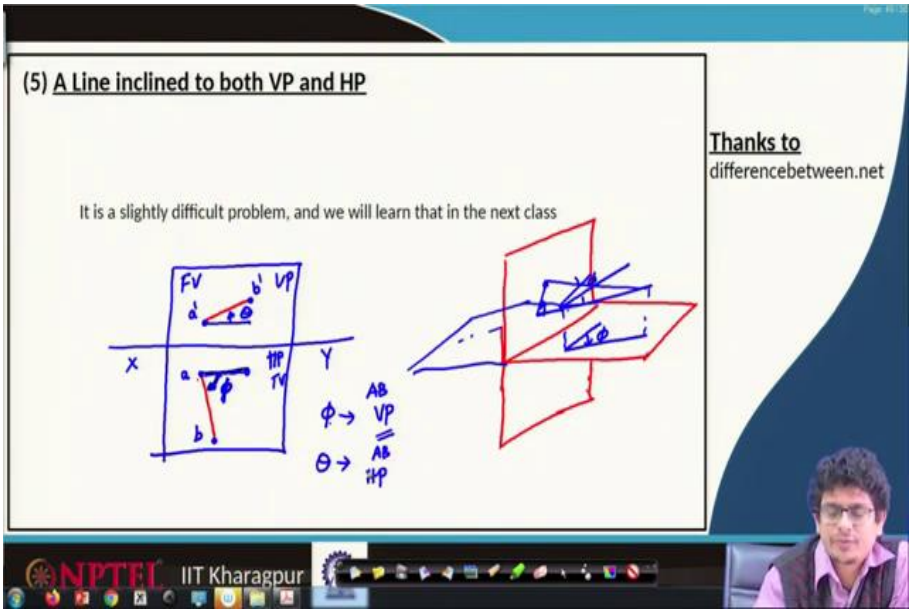
(Refer Slide Time: 17:50)



In case if we know this picture; that means, in the top view the line a b if it is making an angle theta phi with the horizontal that indicates that it is this line A B in that first quadrant making an inclination angle with respect to the vertical plane. This is the way we have to understand that.

So, the top view is inclined to X Y, the front view is parallel to X Y and true length we will find it only on the horizontal plane. Look at this angle; this is phi angle the projection also giving us phi angle and this phi angle is it indicates that parallel to that vertical plane because this is the vertical plane parallel to that vertical plane. This one is making an angle phi which we represent it here in the top view.

(Refer Slide Time: 18:30)



Let us look at if a line is inclined to both vertical plane and horizontal plane, that will be a more difficult problem to handle. Can you think about it? We will look at this problem through examples, but by guessing it what we have to do? If this is the vertical plane and this is the horizontal plane, the line has to be inclined to both vertical plane and horizontal plane; that means, if it is inclined, we will be in a position to sense something like in that way. So, that this angle is going to make a phi angle.

But now, this line is not the complete information because it cannot be parallel again it has to make an inclination angle with respect to the horizontal plane; that means, if I am going to project this one onto a horizontal plane, it has to make an angle.

So, if we are having that projection. It makes an angle phi here and this line if we are projecting, it makes another angle. So, that means; if we are going to show it on these planes this is the X Y coordinates if your line creates an angle here. Similarly creates an angle in this direction. This angle phi, this angle something theta and this is the vertical plane front view what we call. And this is the horizontal plane top view. The angle what we are going to sense here phi means phi is the angle.

Let us note it this one is a, this one is b. Similarly, this one is a' this one is b'. We will learn about the rules on how to really transform this onto those planes. But if this is a' b' this, if this is a and if this is b with respect to horizontal thing; whatever the angle phi it is making. Phi is the angle which is making with the vertical plane. So, AB is a line which is making phi angle with the vertical plane.

Similarly, if theta is the angle what we are observing in the front view for this inclined line; that means, we are saying that is the angle for the AB which is making with the horizontal plane. More details of these lines and their projections through examples we will learn it in the next class.

Thank you very much.