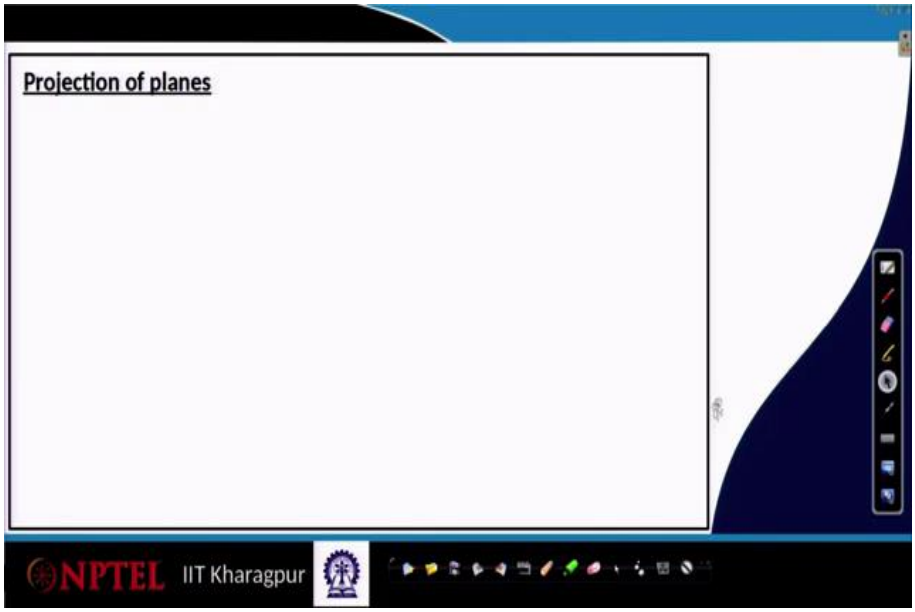
Engineering Drawing and Computer Graphics
Prof. Rajaram Lakkaraju
Department of Mechanical Engineering
Indian Institute of Technology, Kharagpur

Module - 04
Lecture - 40
Orthographic Projections II (Part - 10) Projection of planes

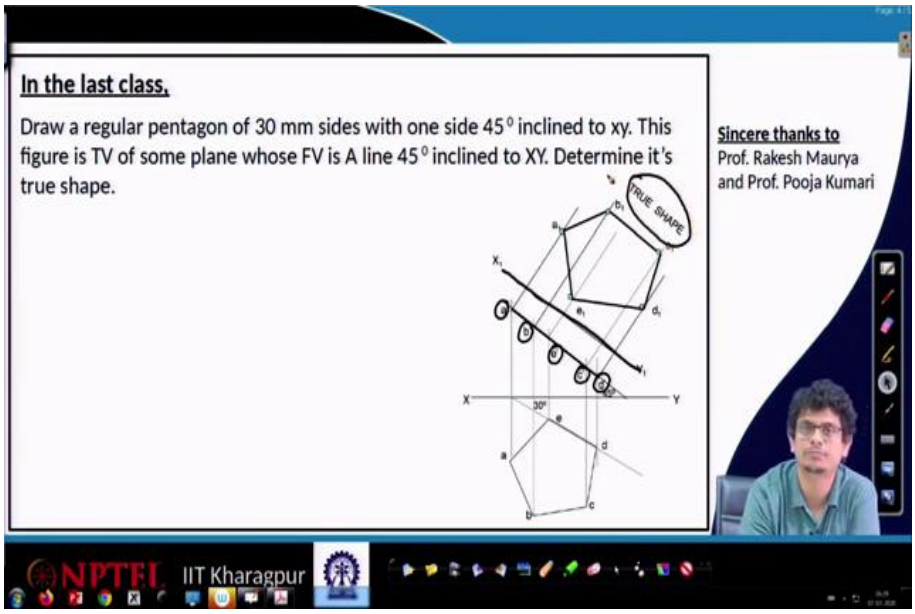
Hello everyone, welcome to our NPTEL online certification courses on Engineering Drawing and Computer Graphics. We are covering "Projection of Planes and Lines". We are in Lecture number 40.

(Refer Slide Time: 00:32)



In the last class, we try to look at the projection of planes and had an idea about auxiliary planes through an example.

(Refer Slide Time: 00:46)



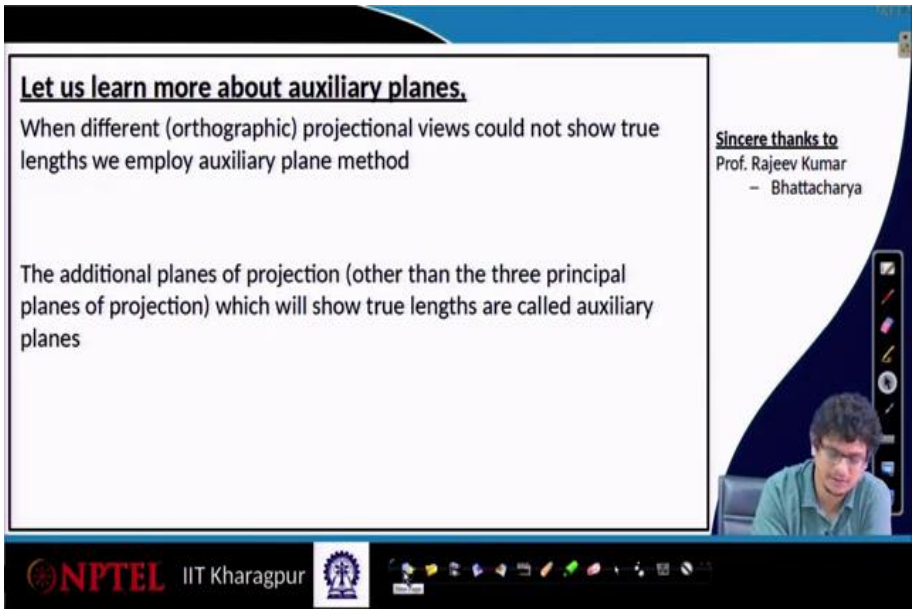
For example, we have taken a pentagon in the last class which is of 30 mm sides with one of the sides is 45 degrees inclined to XY axis. And the front view is a line 45 degrees inclined to XY, then we try to figure it out what might be the true shape. So, for that problem what we have done? First drawn a pentagon, regular pentagon, one of the sides is making 30 degrees angle with this XY axis.

After that, we projected these points a, e, d, c and b all the way into that front view, where the front view is making an angle of 45 degrees because one of the sizes is 45 degrees inclined to this XY axis. After that, we draw a true shape from this view because the auxiliary plane concept is useful when you have front views and top views are given, but these front views and top views may not be the true length information.

Using that what we have drawn? We have used an auxiliary plane X1Y1 then projected these points a', b', e', c', d' points in such a way that the distance between these XY plane to these points represented into a1, b1, c1 and d1 and e1, joining these things we got the true shape.

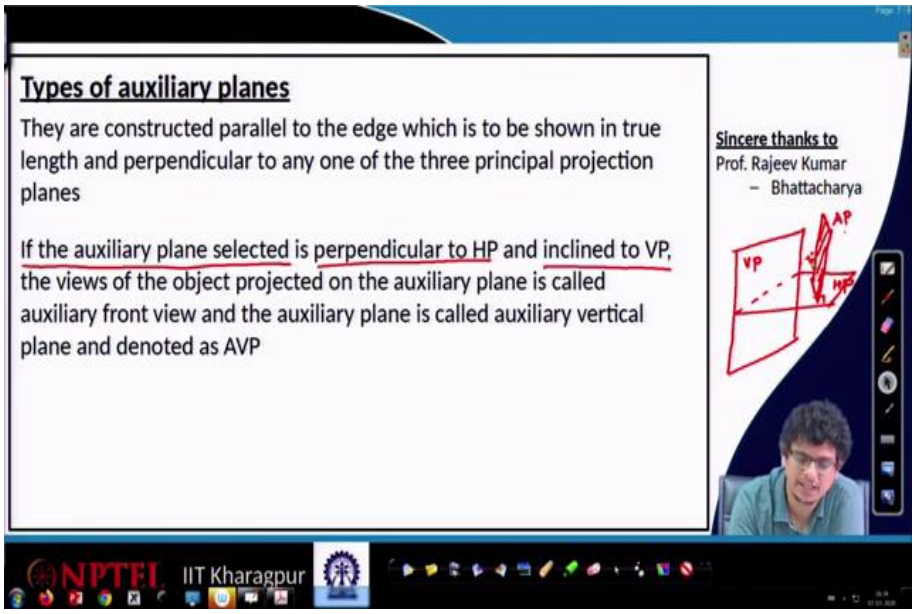
In today's class, we will learn in detail about our auxiliary plane concepts whether these auxiliary planes have to be constructed with respect to the horizontal plane or vertical plane or on both. Let us begin our session.

(Refer Slide Time: 02:58)



So, about an auxiliary plane, when different projectional views especially orthographic projections this could not show true lengths then we employ this auxiliary plane method.The additional planes of projection other than three principal planes of projections that are of a front view, top view and right side or left side views, which will show true lengths are called these auxiliary planes. So, when we are picking a plane, not of a vertical plane, horizontal plane not profile plane, but a plane which is either inclined to the horizontal plane or vertical plane or both; when we are projecting that object onto that plane, we may get true shape.

(Refer Slide Time: 04:09)



Usually, these are constructed parallel to the edge which is to be shown in true length and perpendicular to any of the three principle projection planes. So, our principal projection planes are always vertical plane, horizontal plane and side or profile plane and these auxiliary planes may make an inclination angle with them. And the true shape or true length we would like to find. So, the way how this true length is aligned in that direction we pick this auxiliary plane, so that this plane may make orthogonal or 90 degrees with the other planes.

So, there are two main two planes; one is auxiliary vertical plane other one is an auxiliary inclined plane. Let us look at the first one. If the auxiliary plane is selected perpendicular to the horizontal plane and inclined to a vertical plane that means, let us draw a picture. This might be our vertical plane and this is the horizontal plane. It is supposed to be perpendicular to the horizontal plane but inclined to a vertical plane that means, perpendicular, it can be a plane in that direction.

It can be such kind of plane or it may be making inclined with a vertical plane. So, the general inclination angle, if we are going to draw that this auxiliary plane; so, inclined one, but still perpendicular. So, this is the plane what we are talking about.

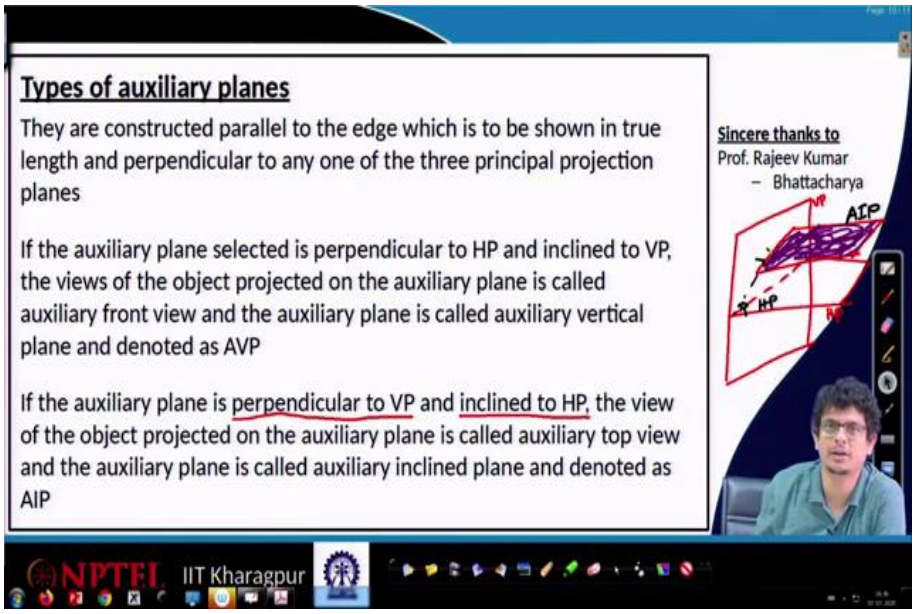
This is vertical plane and this is a horizontal plane and we have an auxiliary plane which is making 90 degrees with the horizontal plane, but it makes an inclination angle with respect to the vertical plane because if we are connecting this entire plane is going to intersect there and it's making an angle.

If we have such kind of planes, the views of the object projected on the auxiliary plane are called auxiliary front view. In the same, our auxiliary plane is in this direction. For example, if we might be having some square block.

Now, if we are projecting onto that plane what we are going to see is the complete height of that object on the vertical plane, whatever that true height that we will see it on this auxiliary vertical plane. So, that auxiliary front view and the auxiliary plane is called the auxiliary vertical plane and denoted as AVP.

So, we are going to take projections onto that inclined plane making inclination angle with the vertical plane.

(Refer Slide Time: 08:07)



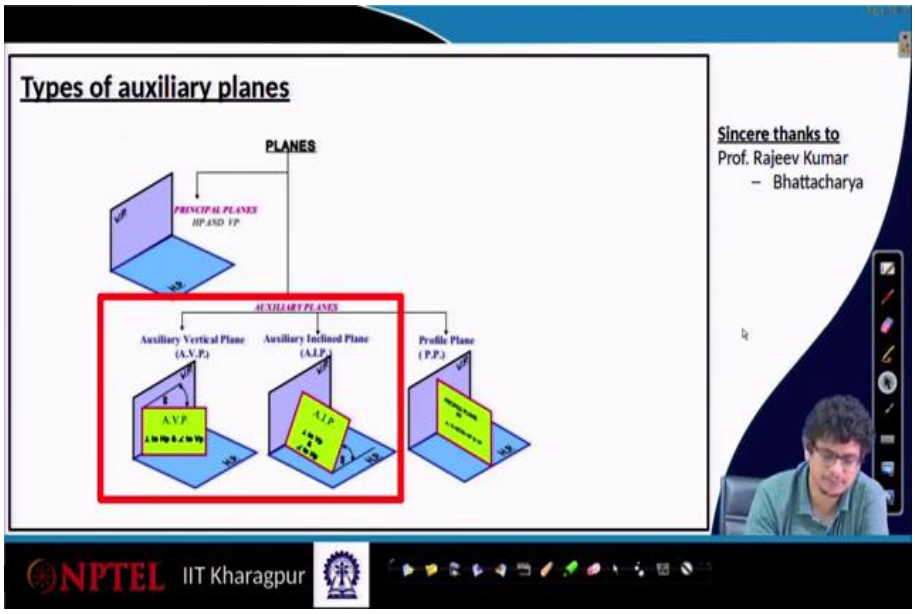
If the auxiliary plane is perpendicular to the vertical plane and inclined to the horizontal plane; this is the vertical plane, horizontal plane.

This is called vertical this is a horizontal plane. Now, it is perpendicular to the vertical plane, but inclined to the horizontal plane; that means if I am drawing a plane in that way. Let us use some color. This is the plane what we are talking about.

If we are extending that is going to make an angle with the horizontal plane. So, this plane AIP let us call this inclined plane, Auxiliary Inclined Plane making an angle with the horizontal plane, but when we are measuring this is always 90 degrees with the vertical plane. And, that kind of plane is called auxiliary top view and the auxiliary plane is called an auxiliary inclined plane.

So, what about the projections we are going to get on that plane? Auxiliary top view it becomes and the plane is called an auxiliary inclined plane. So, an auxiliary vertical plane, the projections what we are going to achieve are called auxiliary front views and for an auxiliary inclined plane, the projections what we are going to get is auxiliary top views.

(Refer Slide Time: 10:07)



So, if we are generalizing the concept of this entire plane, mainly, we have principal planes. One is our vertical plane, horizontal plane, these are called principal planes, orthogonal to each other.

The additional one is our profile plane which usually we consider orthogonal to both the planes that are this one. It is perpendicular to both the horizontal plane and the vertical plane. The other categories called an auxiliary vertical plane. It makes 90 degrees angle with the horizontal plane, makes an angle with the vertical plane.

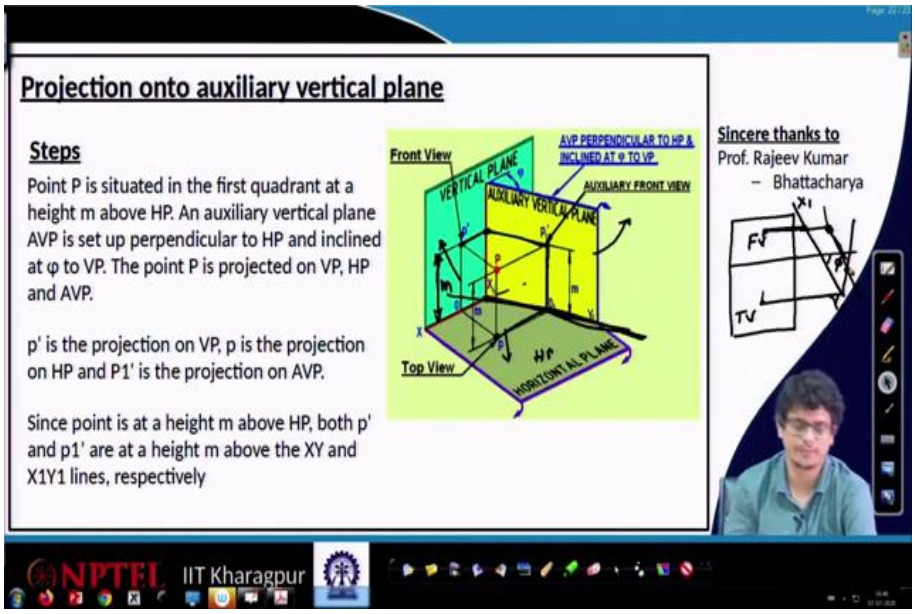
So, any object whatever the projection we would like to consider that has to be in between the vertical plane, horizontal plane and auxiliary plane or auxiliary vertical plane. For that only we can take these projections. Once we take these projections, we flip this auxiliary vertical plane in line with this inclination angle. So, if we are taking any flip rotation about this thing, we can rotate about this so that the projected view we will take it.

Similarly, if it is auxiliary inclined plane and auxiliary top views for that what we have is this is auxiliary inclined plane makes an angle with the horizontal plane.

This is always perpendicular to the vertical plane. So, any object which is in between vertical plane, horizontal plane and auxiliary plane, the projections if we are going to see it that will be taken on this inclined plane; about this axis we construct the projections.

In the last class, we have seen this pentagon, in that pentagon auxiliary plane we have made in such a way that that was making a particular angle. So, in the next couple of classes, we will learn more about these auxiliary planes, for the lines, planes and also solids.

(Refer Slide Time: 12:55)



First of all, we will learn how to construct a projection onto the auxiliary vertical plane. Let us begin with a point P. Here, we have this is the vertical plane, horizontal plane and our auxiliary plane is this. This is an auxiliary vertical plane because it is making 90 degrees angle with respect to this horizontal plane, but making an inclination angle with the vertical plane.

So, whatever the vertical plane we have with respect to that there is an angle and because of that we call this plane as a vertical plane, auxiliary vertical plane and there is a point P. If we are projecting the coordinates for this P point onto our vertical plane and horizontal plane the coordinates will be this one which is P here and if I am projecting this will be p'.

Now, the true length we may be seeing in the vertical plane if we are projecting p on to this VP. This is the height above the horizontal plane. The true length what we might be going to see is this one m. So, if we are projecting on the vertical plane also m we will see. When we are projecting this P point onto this auxiliary vertical plane again the height what we are going to see is m, this is the height above the horizontal plane because it is a vertical plane and auxiliary one.

We use a notation which is p', the first auxiliary plane. On the projection of this point P, all the way down is P and that projection all the way there we call o1. So, the coordinates of this P point which is projected onto auxiliary planar giving us o1 p1'.

Usually, this point P when it is set up in that way the auxiliary plane makes an angle phi with respect to the vertical plane. The notation what we use for this auxiliary vertical plane is it makes an angle

phi with respect to the vertical plane. p' is always projection on VP and p is the projection on HP. p 1' is the projection on AVP, Auxiliary Vertical Plane.

And true lengths, where we will find? Especially, height above the horizontal plane for such kind of points. On VP we will see that is m and on the auxiliary front view we will see. This is the plane if we are rotating it then that becomes the front view, rotate it in that direction then we will see that is as the frontal view of this auxiliary plane. And, we rotate that about this axis X1Y1. So, fix this X1 point and rotate it so that we will be in a position to see that.

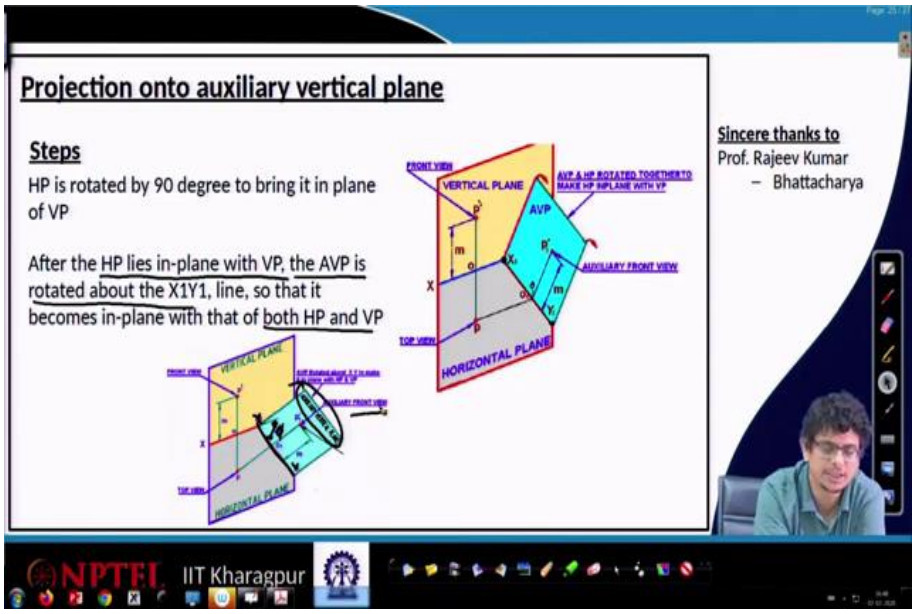
The other way is to look at it in three dimensions. The front view always is that the top view always is there. There is a line if we are drawing. Redrawing that views; this is the front view; this is the top view. This line X1 makes an inclination angle with the horizontal plane. So, somewhere here we make such kind of X1 Y1 plane. There is anyway making an angle with respect to this horizontal thing. So, this is the angle what we are seeing as phi angle.

We draw this auxiliary plane X1Y1; project these point's information's from here all the way. If we are projecting this point p' it projects there and that goes all the way there.

Similarly, this point p comes there all the way goes to that point. So, if we are projecting some point this one we have to project to that point and we are rotating it in that direction it comes all the way there and this p point projected to there that comes to that point onto the auxiliary plane and from there it goes parallel to that line.

So, parallel to that line if we are new position to construct around that we will bring a new position to construct the views.

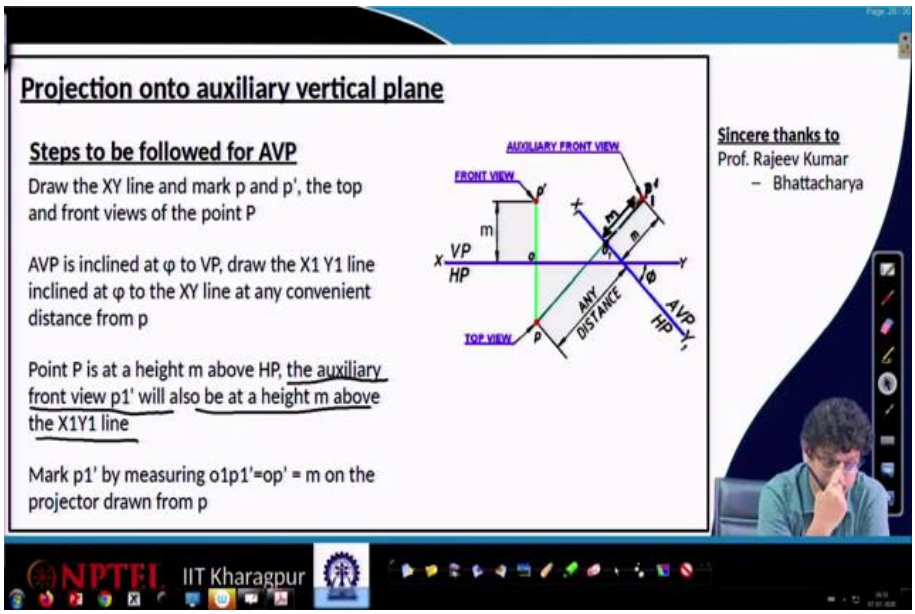
(Refer Slide Time: 19:22)



So, by rotating these HP 90 degrees we bring it to the plane on VP. So, let us go back. So, we have to rotate it by 90 degrees to this HP, so that we will be getting this plane, this one while flipping it in that direction.

Once this HP lies in a plane with VP, the AVP is rotated about X1Y1 line. So, that it becomes in the plane with that of both horizontal plane and vertical plane. So, that pictorially here we are showing X1Y1 we are going to rotate it so that it makes an angle phi angle with that and that entire thing is AVP plane and this view is the auxiliary front view.

(Refer Slide Time: 20:59)



Steps to be followed, let us pick it through an example. The same point p, where we have both the front view and top view. The first step is to draw the XY line and mark point P and p'. So, first what we will do? XY plane we will write, draw then mark point P and p'. So, P point in the top view p' point in the front view, we will draw.

Then, second point auxiliary vertical plane is inclined it phi angle to VP. So, already we know XY axis p, p's are noted down, give some distance, draw a line X 1 Y 1; X1 Y1, but it is supposed to make an angle phi with respect to our vertical plane. So, that projection what we will see it with respect to XY and this plane can be here it can be there also.

So, at any arbitrary distance, we should be in a position to construct this plane. Then point P is at a height m above; that means, that height above we will see it in the vertical plane. So, o p' is m. The auxiliary front view p1' will also be at a height m above the X1Y1 line, because the point p we are projecting it onto the auxiliary vertical plane.

So, about X 1 axis X1Y1 axis it will be above on the other side. So, this is the X1Y1 axis above that point because it is a vertical plane, projection also front view. So, it will be p1' and this distance m, we have to maintain because there is a true length what we will see in the frontal view. This frontal view can be above a vertical plane thing or AVP is the frontal view also. After marking p1' if we measure o 1, this is the intersecting point p1' if we are dropping there by a line, o 1 p 1' is equal to o p p o p' that is the way we mark it.

Thank you very much.