Engineering Drawing and Computer Graphics
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Module - 03
Lecture – 21
Orthographic Projections I (Part - 1)

Hello all. Welcome to our NPTEL Online Certification Courses on Engineering Drawing and Computer Graphics. I am Rajaram Lakkaraju from Mechanical Engineering, IIT, Kharagpur. From today onwards, we will cover module number 3 with lecture number 21, Orthographic Projections.

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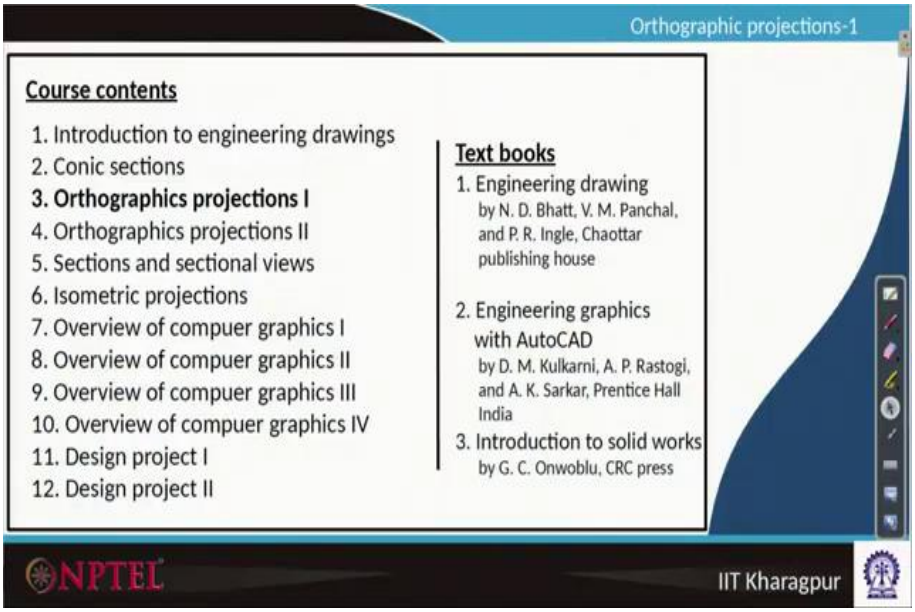

In the last two classes, we have covered the introduction, geometric constructions and conic sections. From now onwards, orthographic projections in 2 modules we will cover, that is for module number 3 and module number 4. Our textbook is engineering drawing by ND Bhatt, and Panchal, and others.

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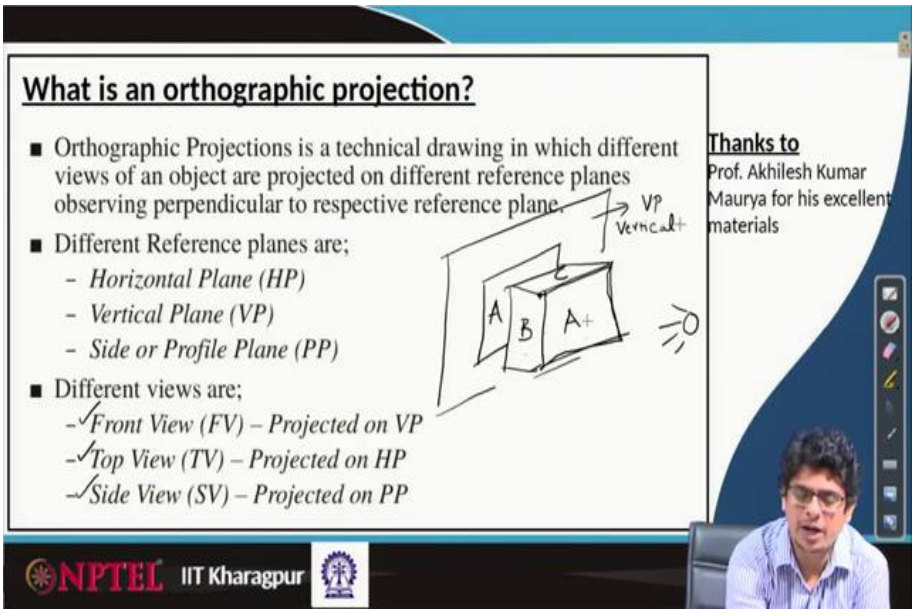

Our sincere thanks to professor Akhilesh Kumar Maurya for his excellent materials provided online on Orthographic Projections. So, most of the slides, information is inspired by his works and taken with his permission.

The first question we will ask what is an orthographic projection. An orthographic projection is a technical drawing in which different views of an object are projected on different reference planes observing perpendicular to respective reference planes. So, it is a technique of showing different views.

The different reference planes can be a horizontal plane which we denoted by HP, a vertical plane we denoted by VP, and side or profile planes by PP. These are the standard conventions for engineering drawing to locate different reference planes as a horizontal plane, vertical plane side or profile planes. The different views of a drawing can be the front view that means, we are going to project it on to the vertical plane. A top view projected on to the horizontal plane. A side view projected on to profile plane. For example, if we have a rectangular block, let us call letter A, side B and C. If this block, we will like to project it. For example, let us takes a light lamp which is shining light. So, this plane A if we are going to project it on a sheet plane, this plane is a vertical plane. So, this is what we call the vertical plane.

If we project it we cannot see anything backside of that object, we cannot even see the side things in most of the cases, we cannot see anything like top view things only. What we can see is A, we will be in a position to see. Only we will be in a position to see A if we are having a shining light on to that object. This kind of thing is called what projection of this surface on to that plane. Here the plane is a vertical plane and what we are projecting is in this direction we are projecting.

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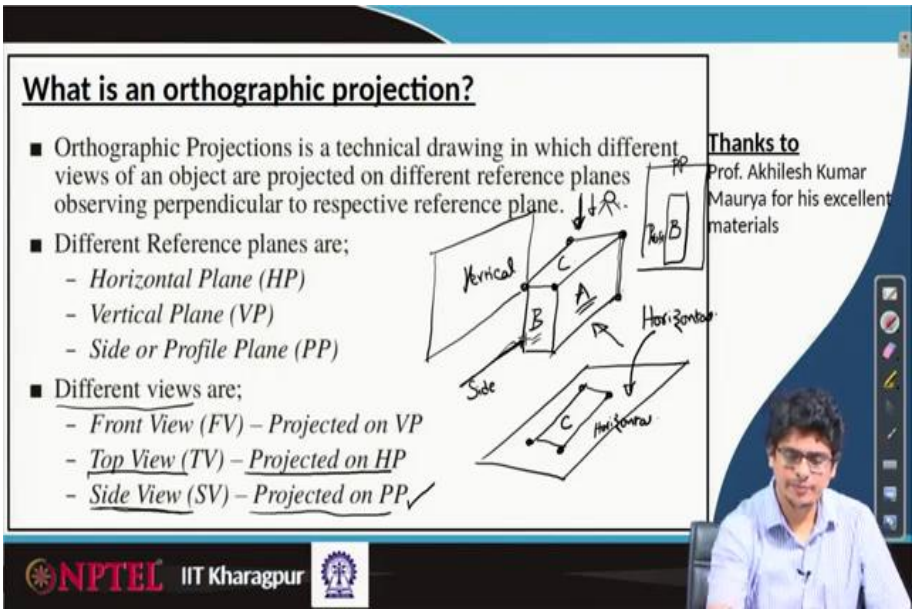

Similarly, for the same object A, B, C, if we are going to view it from the top or a shining light is coming from the top, we cannot see what is A, what is B for this parallelepiped rectangular thing. When we are projecting what we can see is on this horizontal plane. This C will be mapped like a rectangle. So, this point coincides with that point, this one coincides that this one coincides there, and this one coincides there. These two points because of light we cannot really see into two points, but only one point as that we will see. This is what we call a horizontal plane.

On that horizontal plane from the top side, we are viewing. So, top view projected on to the horizontal plane. Similarly, for side view, we will project it on to profile plane or side plane. For example, from this directions side direction we will like to see the object. Then, we cannot see C and A surfaces, what we will see is the projection of this on to another plane what we will call profile plane. We will see something like a rectangle B block. This kind of projection what we will call side view projected on to profile plane. Different views

are a side view, front view and top view. The different planes are what we are going to shine a light so that we are going to construct such kind of front views on to the vertical planes, top views on to a horizontal plane, and side views on to this side planes or profile planes. If we do such kind of projections, the complete information about the object we are going to get.

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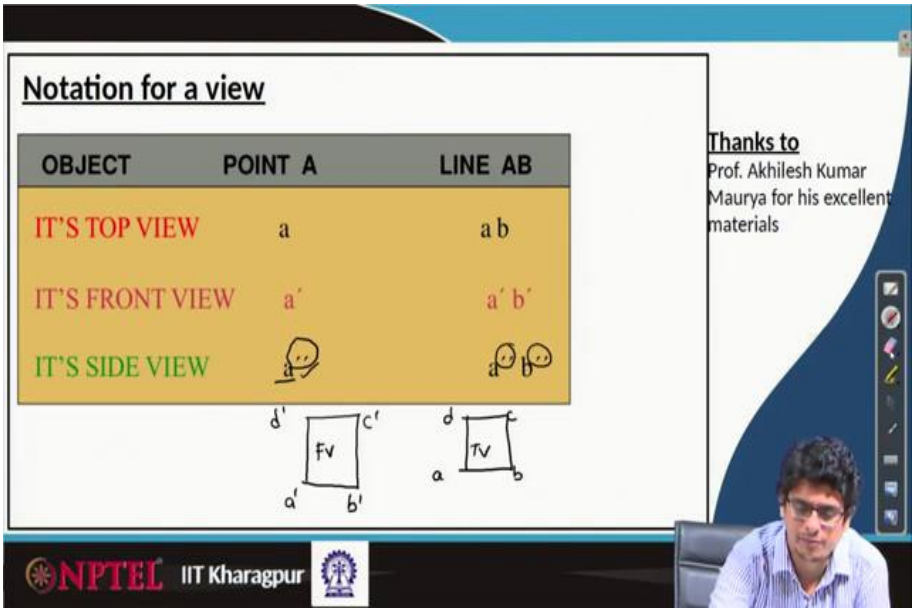

We follow different notations for these objects, when we are projecting there will be points lines on the drawing sheet. So, based on which view we will note the symbols. For example, any view top view if we are looking at usually we projected it into onto horizontal planes

The lines, points are noted as a, b, c, d and so on or perhaps 1, 2, 3 and so on. If it is a line, we show it by a b line, maybe p q line, all these are lower-case letters. Any points a lower-case letter we will show a single one. If it is a line joining two letters a b as one line in lower-case letters, unfollowed. If it is a front view which we usually projected on to the vertical plane, we use a symbol' the dash same lower-case letter a, but a dash or a'. If it is a line a', b' we will note it. If there is a letter a' b' or a' it indicates that we are on the front view, without' we are on that top view. If it is a side view, we show it by two primes (``) notation. The same lower-case letter, but two's indicate that it is a side view. For example, let us consider an object which we are showing a, maybe b, c, d. If we are showing that without any's dashes it indicates that it is a top view. If something like a', b', c', d', if we

are showing it indicates that front view. Similarly, for side view any of this we will show it as double's.

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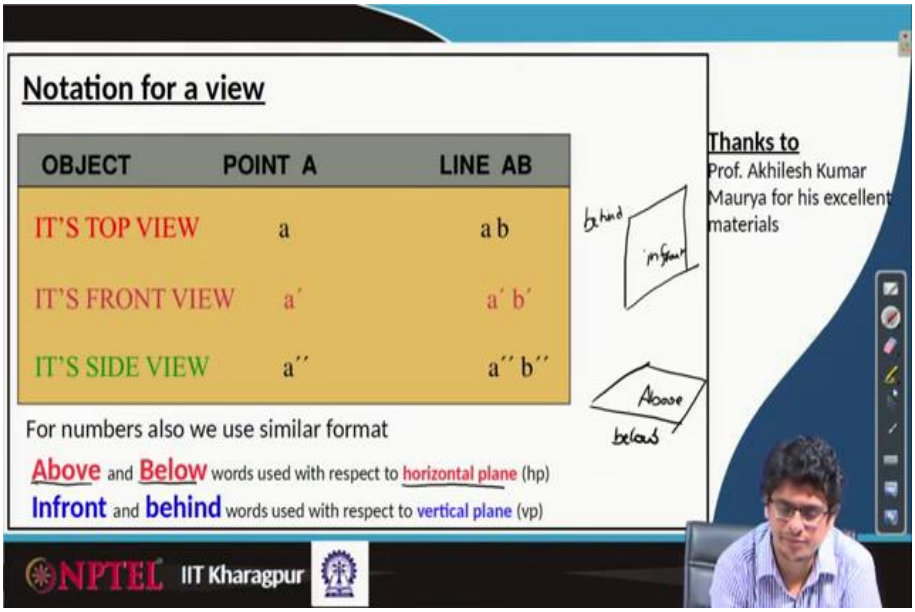

Instead of letters if we are using numbers of similar kind of style we will follow. In later classes, we occasionally use two words above and below frequently in front and behind, this indicates that any above below lines if we come across those for horizontal plane definitions. With respect to that horizontal plane, we will talk about above the plane or below the plane. So, a horizontal plane above that below that we talk about the position of the reference position of that object. If something like in front and behind, there is a vertical plane in front of that plane how far that objective is present, behind the plane how far that objective is present. This is the standard words what we use. That indicates that with respect to either horizontal plane or vertical plane we are referring.

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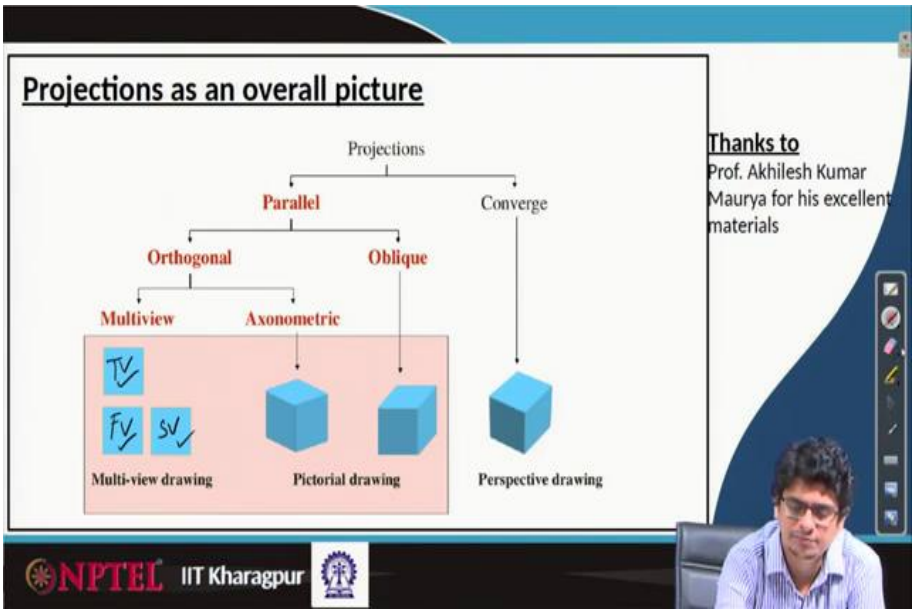

To describe any picture, in the overall perspective we use projections. These projections are mainly two types, one our parallel projections other one is converging projections.

In the case of converging projections, the objects may look small may look large because these points are going to converge on to a plane. For example, if I have a rectangle, if we are looking at converging kind of planes, all these corners will be converged to a single point, if so, then if we are making any plane the object may look a very small object with proper scaling or it might look very large object. The other kind of projections is called parallel projections. In that, this object size hardly changes usually converging drawing used for perspective drawing. We will learn more about that in the later classes. For parallel projections which are quite common for our engineering drawing course and machine designing kind of courses there are two types of projections exists, one is the orthogonal projection, the other one is oblique projection.

These orthogonal projections are also divided into two parts mainly multi-view projections, the other one is axonometric projections. In multi-view projections, we have these front view, top view and profile view or perhaps side views. This is the way an entire object will be projected on two different planes show at suitable locations, something like front view, top view and side view that kind of things we will go with orthogonal projections. In axonometric projections and oblique projections, the complete object will

be shown, but as a pictorial drawing. So, the object might be slightly skewed and we may not get entire information about the object.

In multi-view objects, we have different views like the front, top, side, perhaps from the backside and many views available. So, the entire object will be visible for this orthogonal, especially multi-view projections. In our entire course, we will mainly focus on this multi-view drawings.

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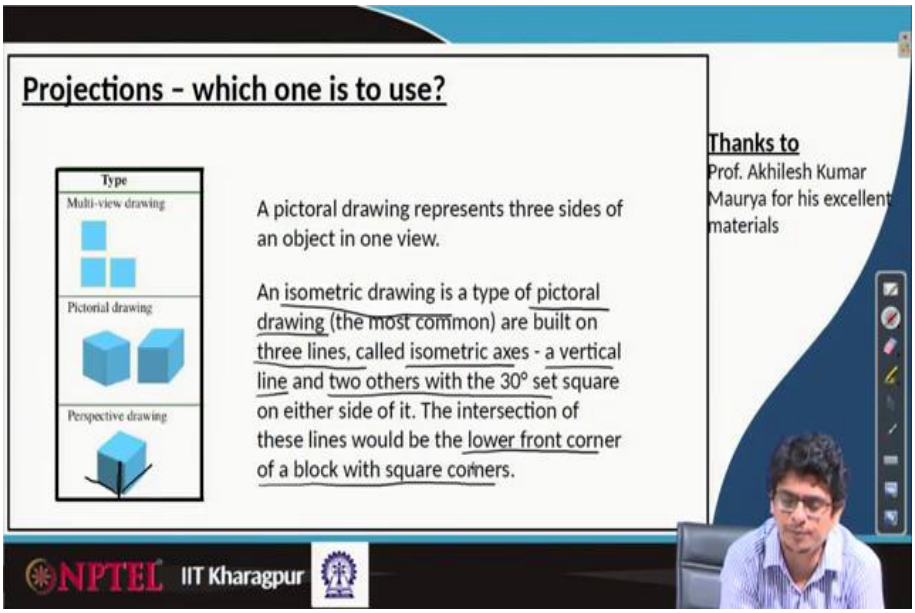

So, which projection is good to represent a picture? Let us look at different perspectives of these drawings, especially the projections. For example, here a multi-view projection a pictorial drawing and a perspective drawing are compared. In multi-view drawing, we have different views by projecting it on different planes like the vertical plane, horizontal plane or profile plane.

In the case of pictorial drawing, it represents 3 sides of an object in one view. So, all the 3 sides like the first one, the second one, the third one, without splitting into 3 different things we show it on one picture. For example, let us look at this one also, all the 3 views are available.

But when we are drawing it on the sheet, it might be slightly skewed, the object might be rectangular on that top surface, but when we are representing it might look like a parallelogram.

This kind of things naturally comes out from this pictorial drawing. If it is isometric drawing a type of it is also a type of pictorial drawing but based on 3 lines which we call isometric access. Rather than showing it on different access, we fix something named isometric access which consists of a vertical line, perhaps this is the vertical line and two others with 30 degrees square on either side of it.

So, if we are going to look it this is the vertical line something like 30 degrees on that side and also on that side 30 degrees kind of representation we will see. Such kind of things if we can construct it that kind of drawings are called isometric drawings. The intersection of this vertical and two others would be at the lower front corner of a block with square corners we will see. More about these pictorial drawings, especially the isometric drawings we will learn in orthographic projections second module.

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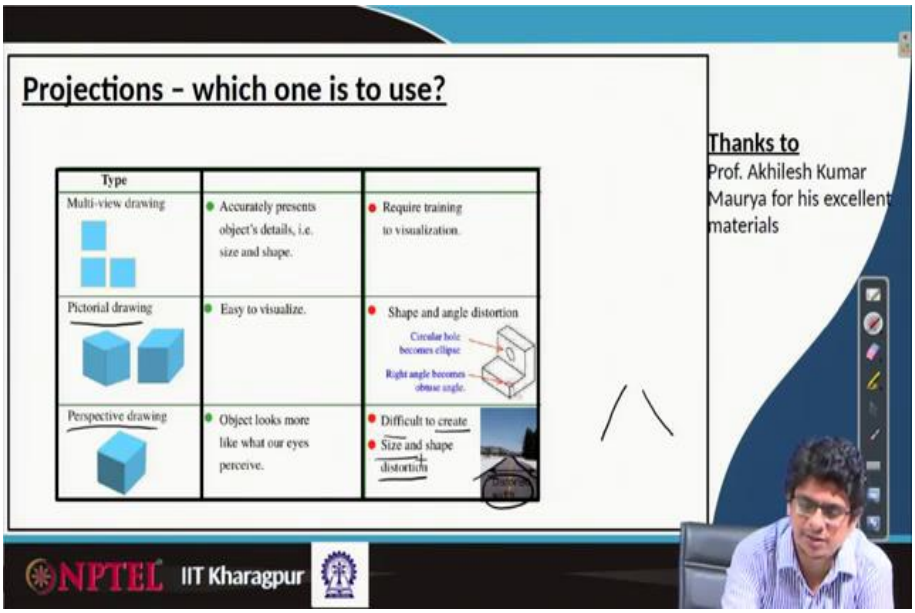

A multi-view drawing having different views it accurately presence the object complete details. We are not going to lose any information, we are not going to create any aberration while looking at it. For example, the monitor in front of you, if we are looking normal to that plane it may look like a rectangle, but if we are looking from sideways it might look like the projection, might look like a parallelogram.

So, by having a view projection view multi-view we can straight away represent what is length, what is width, what is height, and this kind of things without making any aberrational issues. So, it accurately gives complete object details and shape and size.

In the case of pictorial drawing, it gives us directly the object visualization, though the dimensions other things slightly skewed at least on two d sheets, it straight away gives us a visualization of that object. In the case of perspective drawing, the object more likes it looks more like what our eyes perceive. If we are looking at an object which is slightly inclined to us how it perceives at our eyes this similar kind of representation we go with perspective drawing.

To construct multi-view drawings a slight skill set is required that means, training to visual the object represent that visual on to the sheet requires slight infusion. In the case of pictorial drawing, the main objection is the shape and angle distortion happens. So, the advantages are shown in green colour dots, the disadvantages or problems are shown in red colour dots.

So, multi-view drawings always require slight inclusion about the object what we are looking, how to represent that into different views on the sheet. In the case of pictorial drawing, a circle if we are looking at an inclined direction it might look like an ellipse. For example, here we are seeing that kind of elliptical theme, a circle here looks like an ellipse. Similarly, a rectangle looks like a parallelogram. Right angles this one this right angle completely looks like obtuse kind of angles, this kind of problems comes at pictorial drawing.

If we are looking at perspective drawing these are a bit difficult to create it on the drawing sheets, size and shape distortions happen. For example, if we are riding a bicycle or driving a car, the road is supposed to be parallel lines from one end to another end. These are never-ending lines which supposed to go, at least for that short span of that road.

But when you are taking a picture or perhaps looking through this perspective drawing, these two lines look like they are going to intersect. So, a distortion in the width will be introduced. So, on a drawing sheet when we are representing these road and other objects it looks like they are going to converge. So, this kind of problems exists for this perspective drawing.

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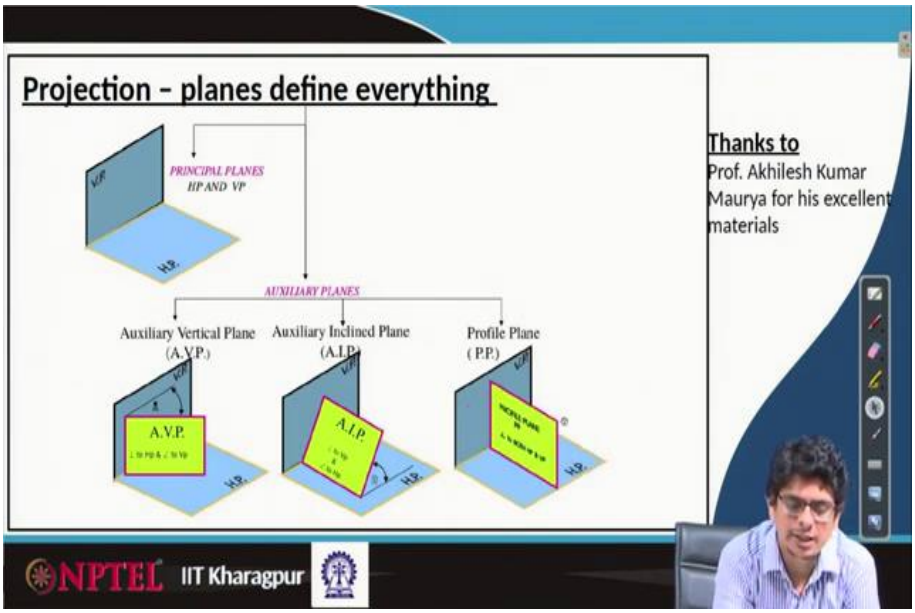

In that context projection of an object on to different views, different planes define everything about that object in terms of shape, size, under the details. Mainly two planes are widely used. These planes are called a vertical plane, vertical to that base, the other one is a horizontal plane. Based on the directions if it is on x-axis horizontal plane, if it is on y-axis vertical plane we will define.

The other plane is profile plane, that profile plane can be on this side or perhaps on that side also. These are additional details. The principal planes or the main planes what we are referring are vertical planes and horizontal planes. Side planes are always profile planes.

The other planes are called auxiliary planes. These auxiliary planes can be auxiliary vertical planes, auxiliary inclined planes and profile planes. For example, let us look at these auxiliary planes. So, horizontal and vertical planes, the vertical one and the horizontal one always fixed. Now, we will like to take any other plane inclined either with the vertical plane or horizontal plane. Let us pick such kind of plane like this one, the one which is shown in magenta colour.

This auxiliary plane also in the vertical direction, vertical to that horizontal base however, it is an inclined to the vertical plane by a certain angle some theta. If we are looking at more details this auxiliary vertical plane perpendicular to the horizontal plane.

For example, let us look at our drawing sheets. If I would like to represent any object on this drawing sheet, the drawing sheet, this is what we call horizontal plane and this one this is horizontal plane and take one more sheet make it perpendicular to that and that sheet what we call vertical plane.

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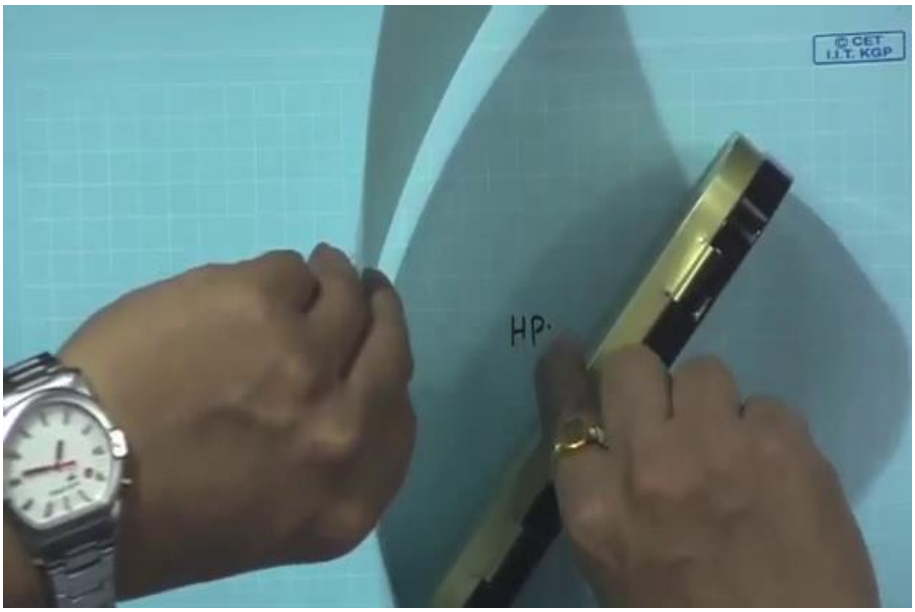

So, this is a vertical plane which is making 90 degrees with the horizontal plane and horizontal plane is this. If we want to construct any other plane, for example, let us pick the geometry box vertical plane is 90 degrees with the horizontal. We can construct one more plane normal to horizontal plane inclined with the vertical plane such kind of planes is called auxiliary planes. So, let us go back to our presentation. Similarly, one can construct one more auxiliary plane having an angle with respect to the horizontal plane. This vertical plane, the horizontal plane remains fixed.

One more plane we are going to take and the name is an auxiliary inclined plane. The auxiliary vertical plane is also inclined, but inclined to vertical thing. The notation what we use is its auxiliary vertical plane because it is always 90 degrees with the horizontal plane.

The other plane is the auxiliary inclined plane. So, this vertical word is avoided because it is not anymore vertical, it makes an angle beta with respect to the horizontal plane and

inclined with respect to the horizontal line. So, we call that one as an auxiliary inclined plane.

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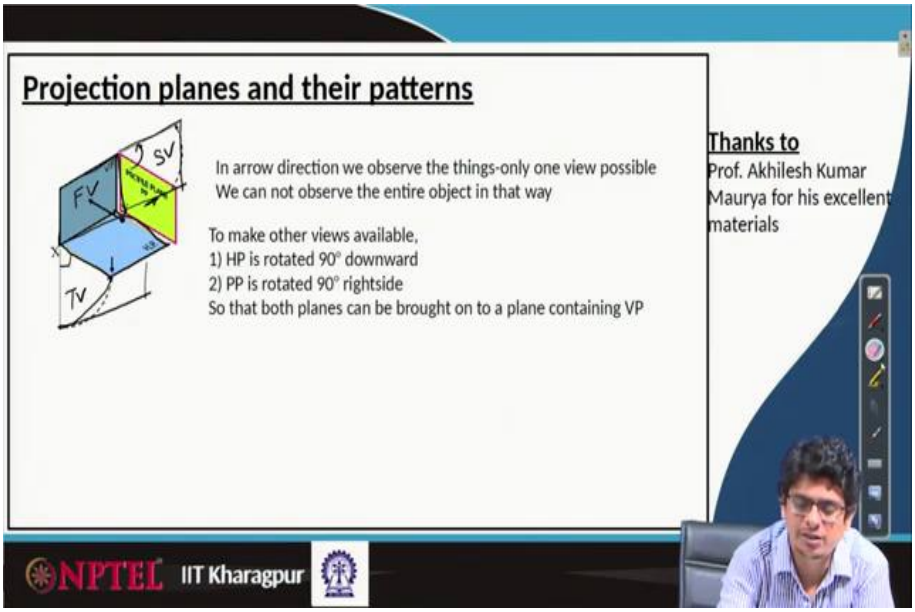

The other one is called a profile plane, horizontal plane, vertical plane. Take one more plane which is normal to both horizontal plane and also vertical plane. So, if we are measuring this angle this is 90 degrees and this angle is also 90 degrees. So, such kind of planes is called profile planes.

If this profile plane makes an angle beta with the horizontal plane, we called an auxiliary inclined plane. If this profile plane tilted in the direction of the vertical plane with an angle theta, we call that one as auxiliary vertical plane. These are the special cases of the planes.

So, from this line we can lend mainly the planes are divided into two, principal planes, auxiliary planes. Principal planes are always be fixed like vertical planes horizontal planes. Auxiliary planes point is to give you more features about the object, the intricate details, how it looks like on the side, perhaps if there are a tapered shape and other things, projecting that on to auxiliary inclined planes or auxiliary vertical planes gives us more details of that object.

How do we construct this kind of auxiliary planes? To do that let us look at the views available. From the vertical plane and horizontal plane, if we are taking if we can rotate a parallel plane on the horizontal thing by 90 degrees in the downward direction.

Let us consider this is the horizontal plane. Perhaps there might be an object here. The projection what we are going to have it on that horizontal plane take it, then rotate this entire plane by 90 degrees. Then, we will get one kind of view, that is what we call top view.

The vertical projection always is on that vertical plane. So, that is what we are going to get a front view. This is what we are going to get on that view as top view. Something on the profile plane pick it the projection, rotate that profile plane by 90 degrees. So, whatever the plane we are going to get on that we are going to have is a side view. Let us look at more details there.

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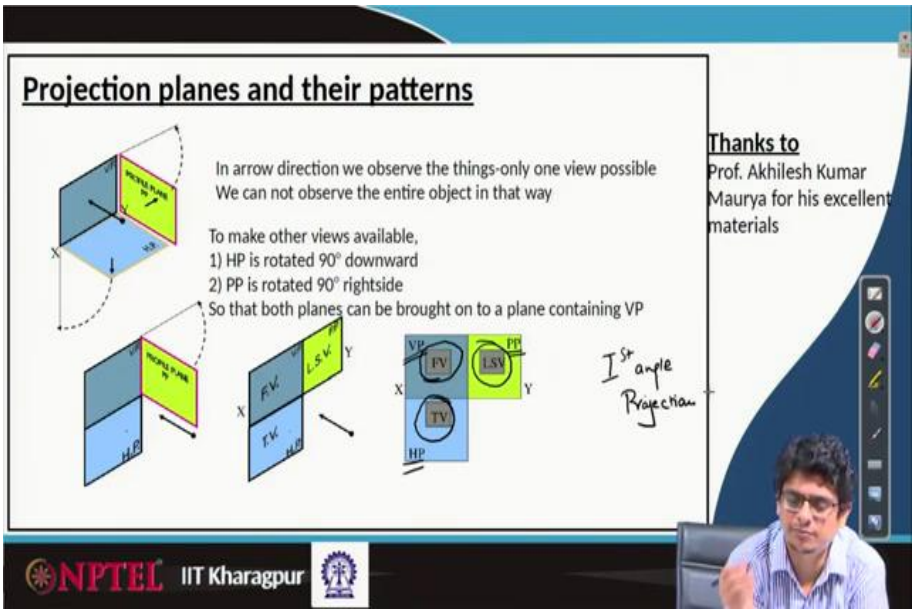

For example, for this horizontal plane projection, if we are rotating it downwards 90 degrees, we get this horizontal plane on the drawing sheet because on the drawing sheet constructing 3-dimensional objective is always be difficult. And that may not give us complete information.

Instead of that, we project this entire object information on to the vertical plane, on to the horizontal plane, on to profile plane. Then, this horizontal plane information we rotate it 90 degrees so that a vertical plane projection on to that downward direction which gives us this horizontal plane object we will get.

Similarly, the profile plane projection if we are going to ah rotate it 90 degrees, we will get a side view. And this side view because we are looking from the left side of the object. If the object is this, with respect to our hands like right-hand, left-hand from left side direction we are trying to look at it, so the projection what we are going to get on that plane is left side projection. This is what we call left side view. The front view naturally towards that direction we are going to look. From top whatever we are going to look at that will be projected on to top view, on the horizontal plane. Because we cannot show the horizontal plane in the horizontal direction of a 2D sheet we make it below that vertical plane.

If we can show all these plane information, the projected views showing side by side one below the other that kind of projection is called first angle projection. So, there we will be having a front view on top, a top view on the bottom, and a left side view on the right-hand side, a vertical plane on top, a horizontal plane at the bottom, a profile plane information at the side that what we call first angle projection.

In the next class, we will learn more about these projections of different objects on planes to understand the information.

Thank you very much.