Engineering Drawing and Computer Graphics
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Module – 06
Lecture – 48
Isometric Projections

Hello everyone, welcome to our online certification courses on Engineering Drawing and Computer Graphics. We are covering a new module 6, begin with Isometric Projections.

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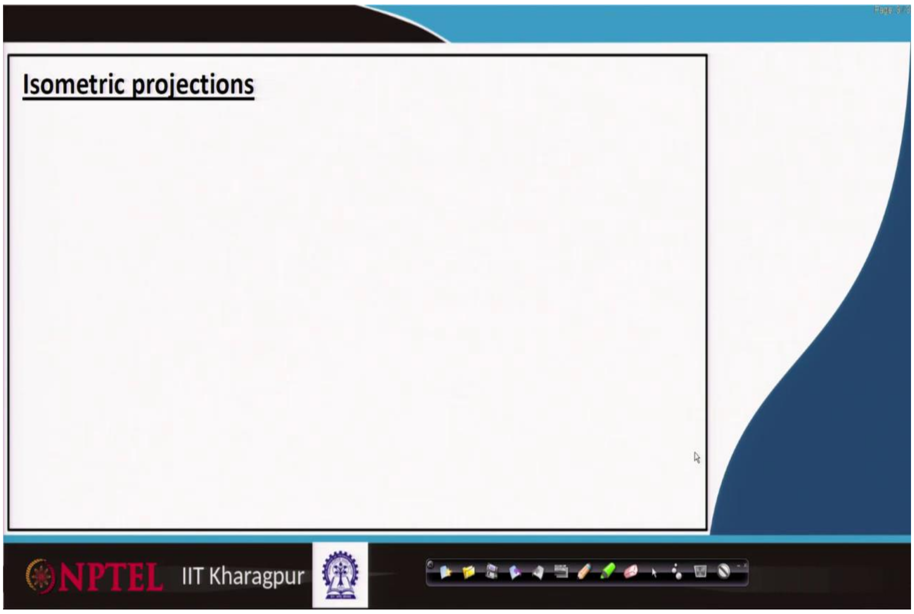

Before really looking at isometric projections, we will see what are these different kind of projections involved in the engineering drawing course.

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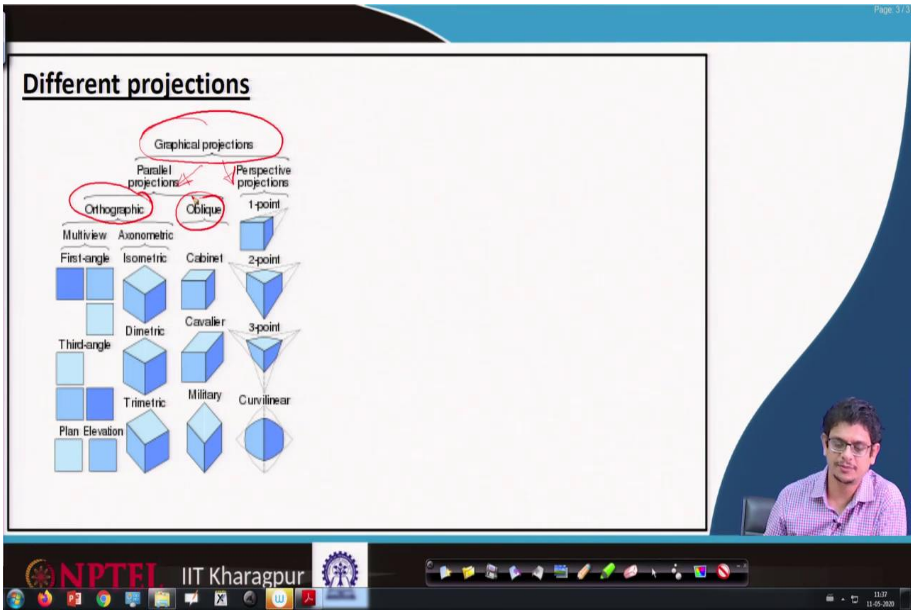

So, the different projections, typically the entire engineering drawing graphical projections can be mentioned as parallel projections and perspective projections. And in parallel projections, we have orthographic projections and oblique projections.

In orthographic projections, especially in perpendicular kind of coordinate systems; we have multi-views and axonometric kind of projections. So, in multi-views, we have the first angle projections. So, different views, top view, side view, front view these kinds of things we will see.

And also third angle projection, perhaps typically civil engineers and architecture guys use plan and elevation kind of techniques, these are views. Coming to three-dimensional object; the projections, in axonometric projections these are orthographic; we have isometric projections, dimetric projections and trimetric projections.

We will see more about these isometric, dimetric, trimetric projections later.

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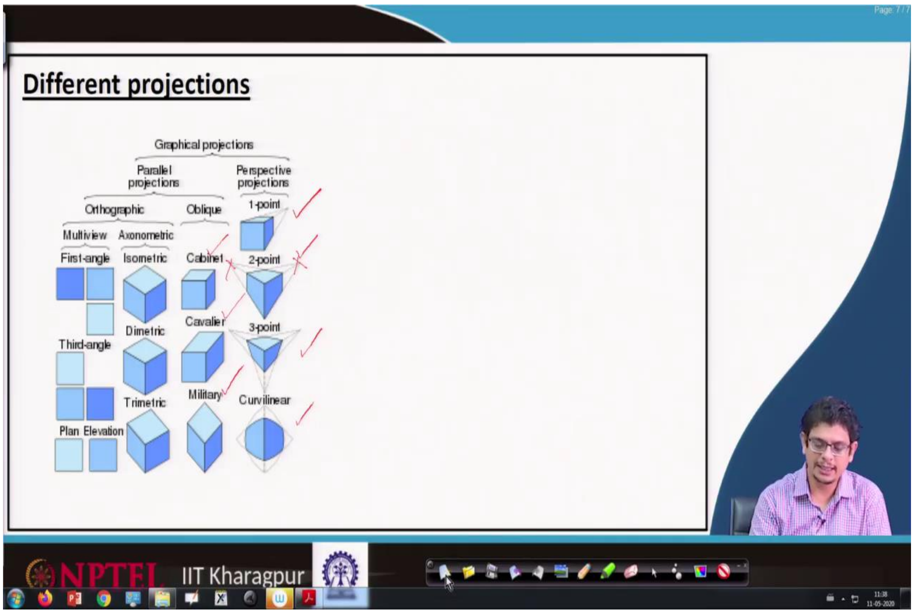

Similarly, if it is oblique kind of projections, we have cabinet kind of views, cavalier kind of views, military kind of views we have. Similarly, in the perceptive projections, these are based on point; we look through a certain point and what kind of views we will see.

Based on that we have 1 point projections, 2 point projections; like 2 points from there, if we have to visualize the views, how it looks like, and 3 point projections and curvilinear kind of projections we have. And specifically in the next two sections, we will look at isometric projections mainly; these come under axonometric projections.

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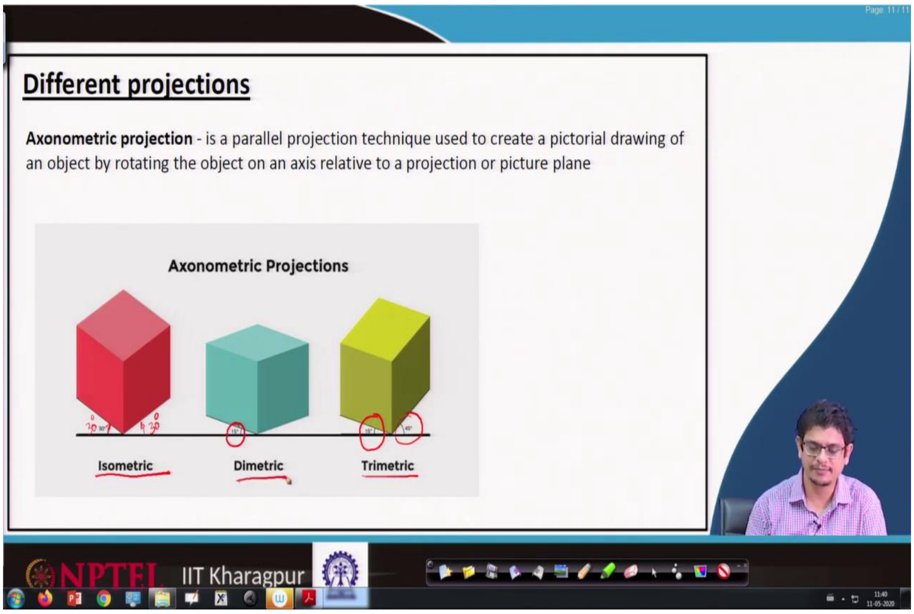

So, under these different projections, we have seen axonometric projection; it is a parallel projection technique used to create a pictorial drawing of an object by rotating the object on-axis, relative to the projection or picture plane.

So, we have an object, we have to rotate in such a way that we will have a different kind of views. And it is a parallel projection technique. So, whatever we see that is the only thing what we show it. In that, we have 3 varieties isometric, dimetric and trimetric projections.

Especially isometric projections one of the lines makes 30 degrees angle on these sides; we will see more about that. In dimetric, this angle is lower than 30 degrees, which we call 15 degrees on one side. If it is trimetric projections, we have three different angles. So, we will have 15 degrees, 45 degrees and the remaining thing makes other angles.

So, such kind of three angles if we use, trimetric; in isometric same kind of angles we will have 30 degrees same, in dimetric we will have two different angles.

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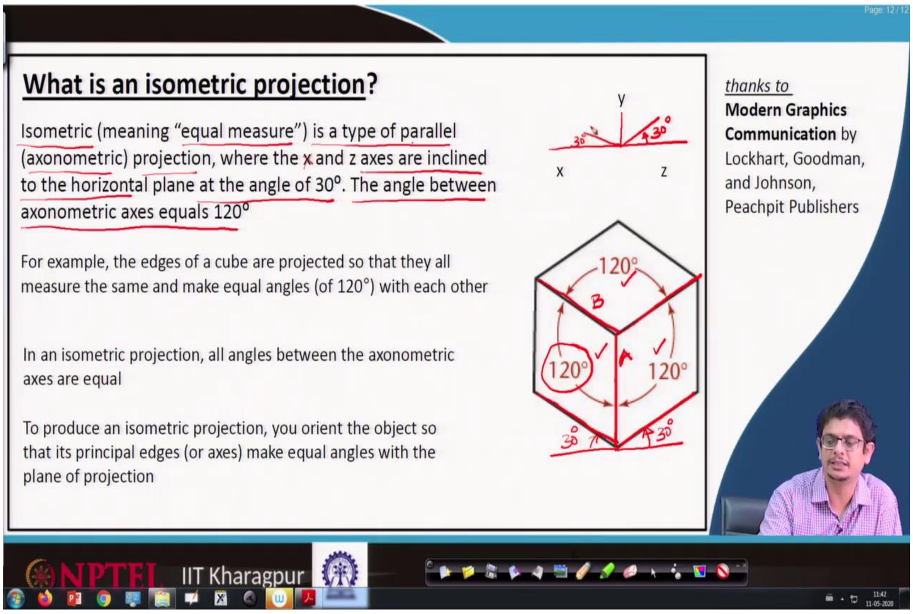

Now, we will learn more about this isometric projection in detail. Isometric means equal measure; here equal measure angles we will have it.

And it is a type of parallel projection, the other word for parallel is axonometric, where the x and z axis are inclined to the horizontal plane at the angle of 30 degrees. That means if I am taken an object, for example, here cuboid; this angle is 30 degrees; similarly, this angle is 30 degrees. The angle between axonometric axis equals to 120 degrees.

So, now we have the cuboid lines, the sides edges. So, let us call edge A, edge B; the angle between edge A and edge B in the view always be 120 degrees.

Though the real object having 90 degrees angle orthogonal to each other; but when we are showing isometric projection on the two-dimensional plane, the edges, the axis isometric axis those makes 120 degrees equally on all sides, this is the first thing what we learn.

So, if I am drawing a picture here, any object thing; object dimension supposed to make 30 degrees here, similarly this one makes 30 degrees

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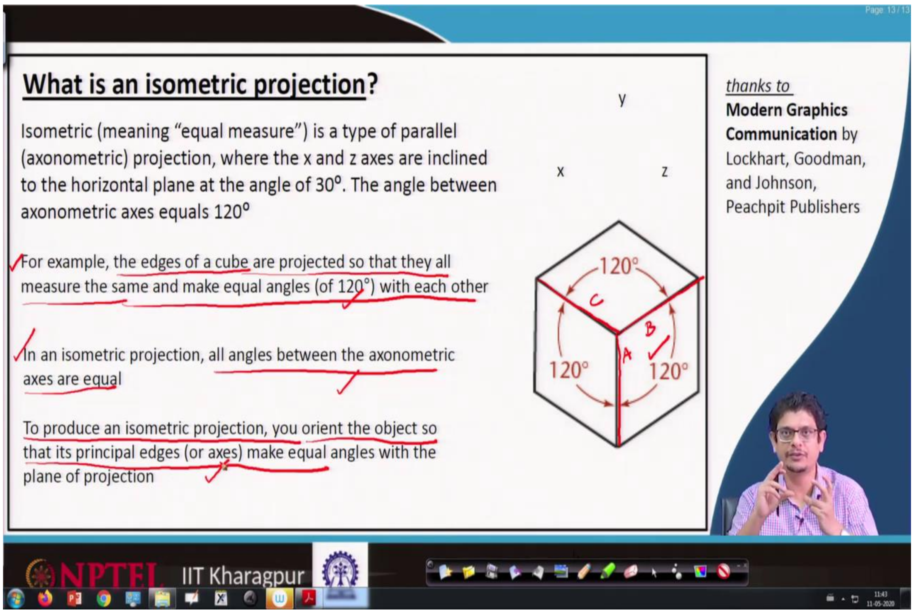

For example, the edges of a cube are projected so that they all measure the same and make equal angles 120 degrees with each other. That is the first thing for the isometric view.

In isometric projection, all angles between axiomatic axis are equal; it is supposed to make 120 degrees and they are equal. The third point, to produce isometric projection; one has to worry in the object, so that its principal edges, whatever the edges we call principal edges, for example, if I am choosing A edge, B edge, C edge, these are arbitrarily I am choosing.

We once we decide what are those principal edges, they should make equal angles with the plane of projection. So, we have to rotate that object in such a way that; when I visualize that object, these edges supposed to make 120 degrees.

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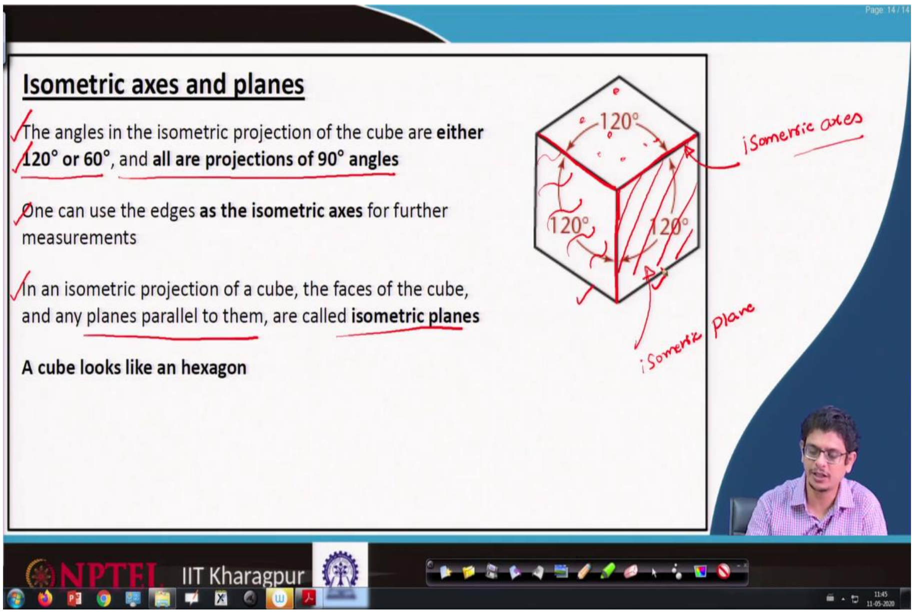

Now, we will look more about isometric axis and isometric planes. The angles in the isometric projection of the cube are either 120 degrees or 60 degrees based on how we are defining and all are projections of 90 degrees angles.

So, we take a cuboid, for example, we take a cuboid, where edges are 90 degrees; we orient in such a way that the angle between these edges makes 120 degrees. One can use those edges as the isometric axis; because here the edges are making 120 degrees.

So these lines are our isometric axis one, two, three; if you are looking at this one, this one; they are not making 120 degrees. So, they are not isometric axis; whatever the edges that make 120 degrees, we call them as axis.

In an isometric projection of a cube, the faces of the cube and any planes parallel to them are called isometric planes. So, here the faces are; this is one face, this is the other face and this is the other face. So, these are isometric plane.

Any plane parallel to that also, we call that as the isometric plane.

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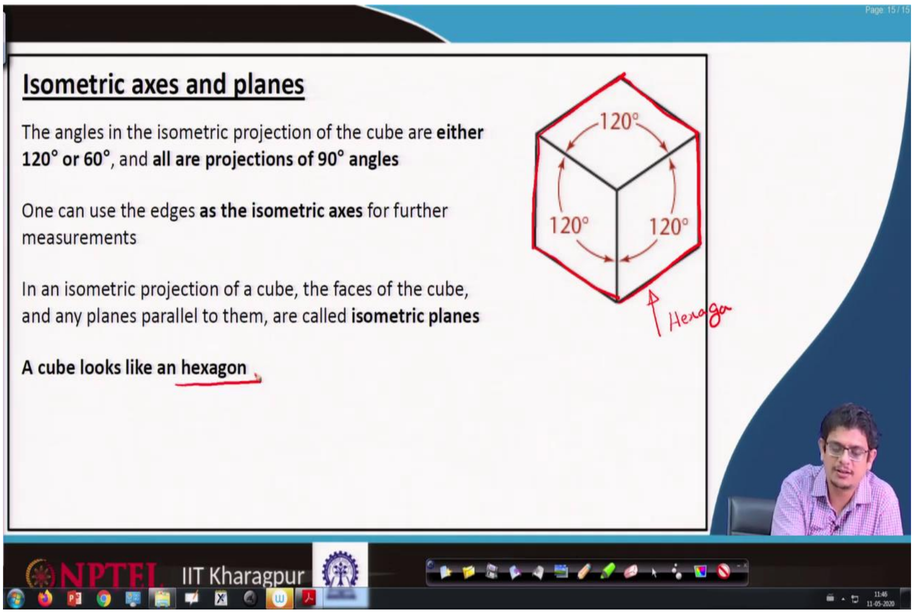

If we are taking a cube in the isometric projection, we sense it like a hexagon; so, let us look at these edges; these are the standard conventions when one supplies drawing sheets for the protection thing.

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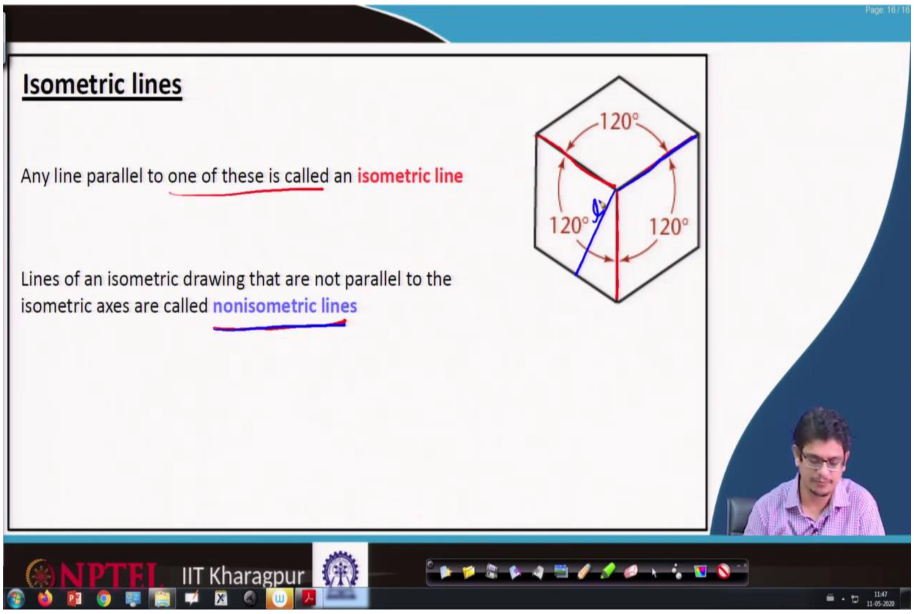

Any line parallel to one of these edges is called isometric lines; this is one isometric line, any line parallel to that also isometric lines. If we are drawing a line, not parallel to these isometric axis; we call non-isometric lines.

For example, let us draw a line in that way; this blue line is not parallel to any of these isometric axis, such kind of lines what we call non-isometric lines. So, later we will see that the true lines are perhaps on the isometric lines when you are measuring the angles when you are measuring the lines.

One has to count it in terms of isometric axis, we should not take any length on non-isometric lines. We locate the points, measure those distance; then convert those distance in terms of isometric, then we will convert into true lines.

So, the first step when you are handling on these isometric planes, isometric axis and lines; any information we have to get it from this isometric axis information only, that has to be modified further.

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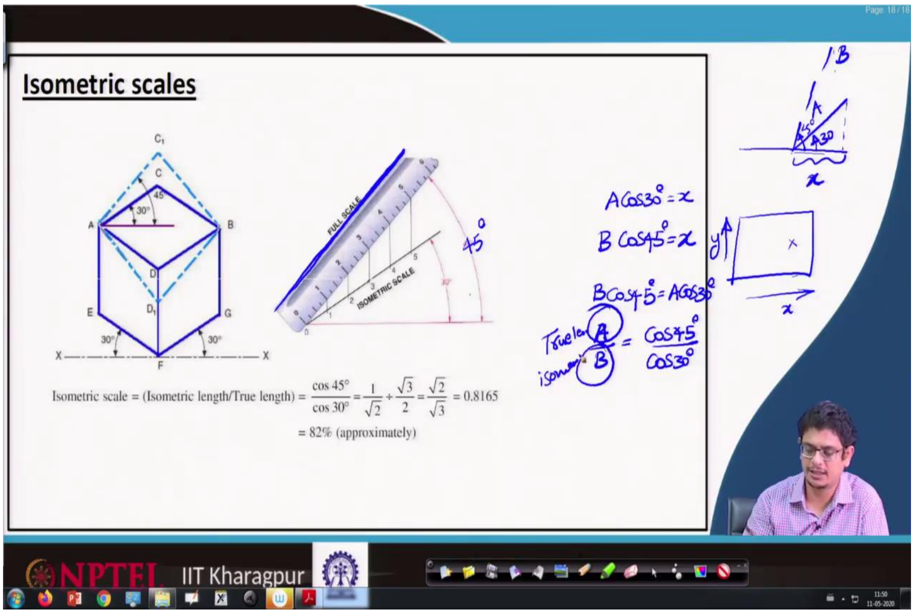

For example, if we are taking a cube here; we use a scale named isometric scale, this is defined as isometric length to true length. So, the cuboid might be having unit dimensions in reality. When we are representing it on a paper in the perspective of isometric projection; the object size may not be one unit length, it changes, usually it changes to 0.82 times of true length.

We will see that calculation. For example, if we have a real scale, that length we want to represent it as a projection. So, one-dimensional projection if I want to show it, this scale is at 45 degrees angle. And when we are projecting these in the isometric; for example, this length we are going to project it at 30 degrees thing.

So, this is the length; what we are showing it on the graph sheet. So, on the drawing sheet, we always measure in terms of x coordinate, y coordinate kind of information. So, for example, that x information if I am measuring it; what might be that point on the drawing sheet, this x can be in terms of, I can write it A cos 30 is equal to x.

However, the actual line is at 45 degrees length or 45 degrees inclination. Then, in that case, let us call that line B making an angle of 45 degrees; so, B cos 45 is equal to again x; because we are again projecting that length onto this plane.

So, in both cases x remind same means, B cos 45 is equal to A cos 30. So, on the drawing sheet, if I am going to represent the same x for that real line and also this projected line; then I have to equate each other.

If I am going to equate each other; then B by A by B which is true length; I will get cos 45 by cos 30. So, this one is the true length and this is the isometric length.

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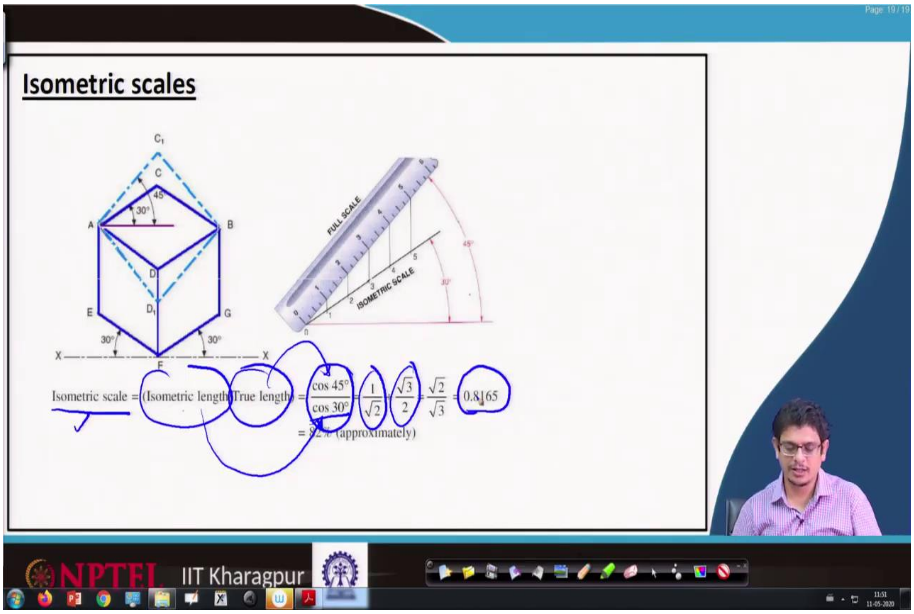

So, the isometric scale defines such kind of terminology, where we are going to compare isometric lengths with the true lengths. So, when we are looking at isometric lengths, it always makes on this x-axis 30 degrees; though axis make 120 degrees, when we are measuring with respect to the horizontal, it makes 30 degrees.

So, that isometric length thing comes faster cos 30 here; the true length factor comes at 45. So, your isometric scale always is cos 45 by cos 30 in this case. So, it will be 1 over root 2 by root 3 by 2, which is 0.8165; this is the scale what we have to use it, approximately it is 80 percent, 82 percent approximately.

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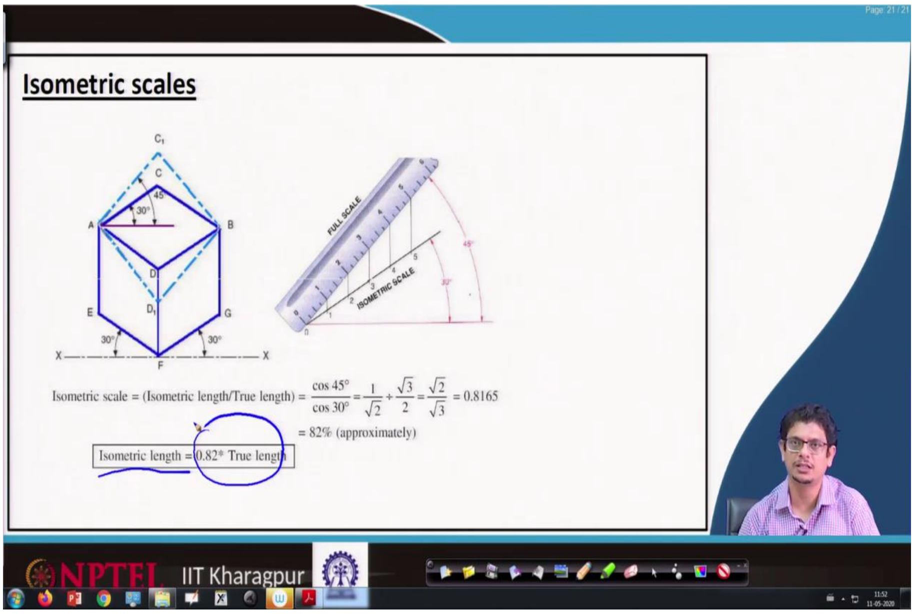

So, any isometric length whatever we are going to represent, that will be 0.82 times of your true length. So, if I am giving you a drawing sheet on which there is something like isometric lengths which we are measuring, the true length will be 0.82 times of that length.

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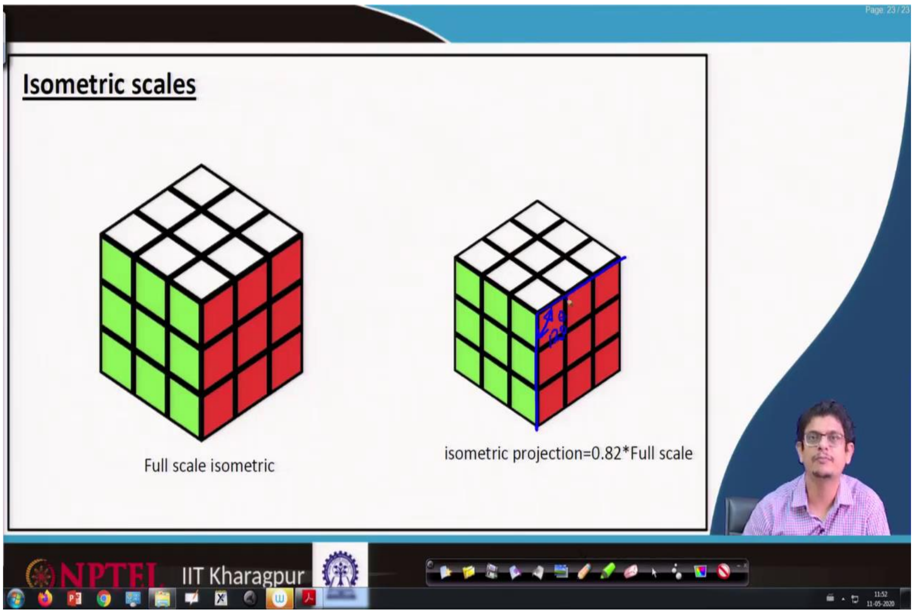

So, for example, on the projection, if I am seeing on the drawing sheet of this object; the original object will be much bigger than that isometric projection, vice versa your full-scale view will be reduced to 0.82 times.

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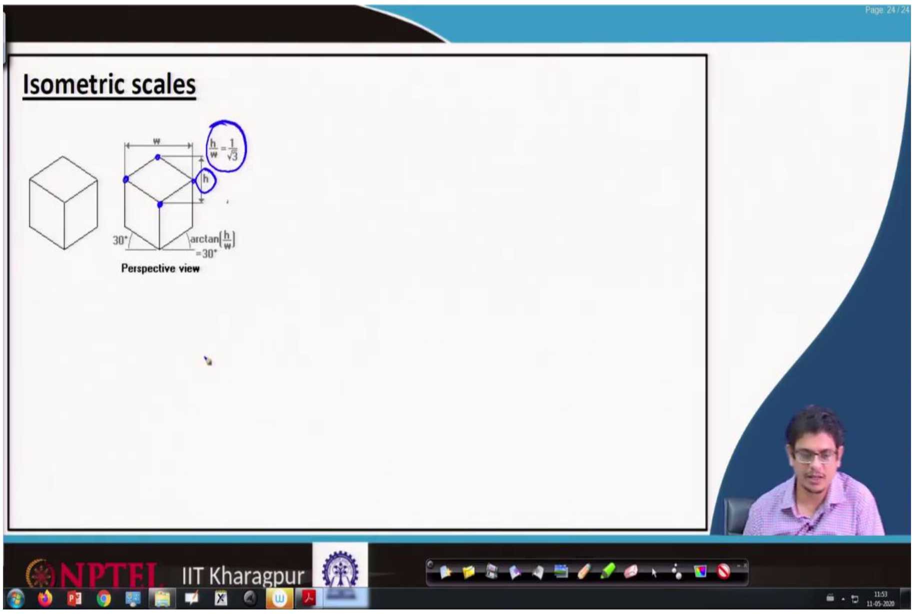

And note that in the isometric, this angle always is 120 degrees. Similarly in the perspective views if we are going to compare; for example, this point to this point let us call length h, and this point to this point let us call w and if h by w is equal to 1 over root 3.

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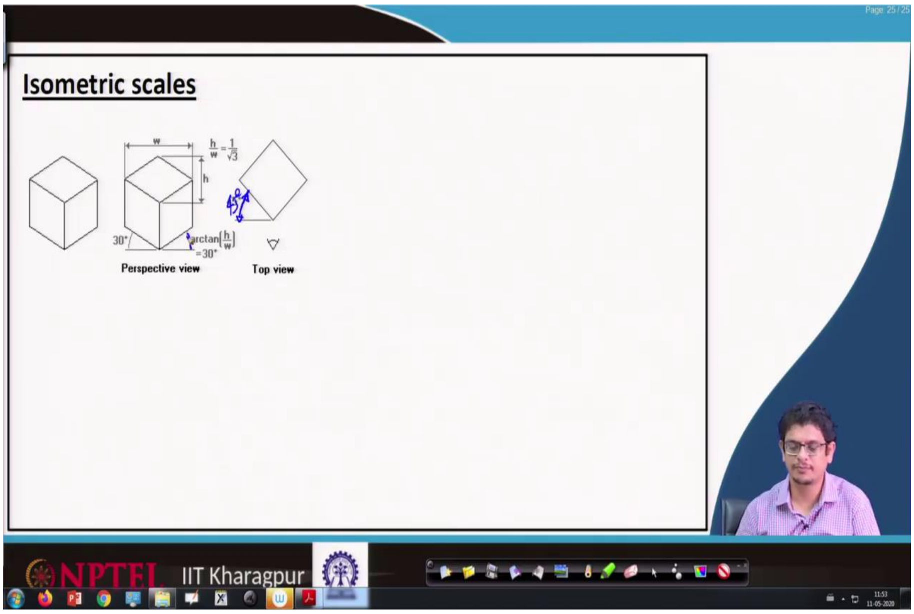

In the top view, it makes that angle 45 degrees; because this one is 30 degrees.

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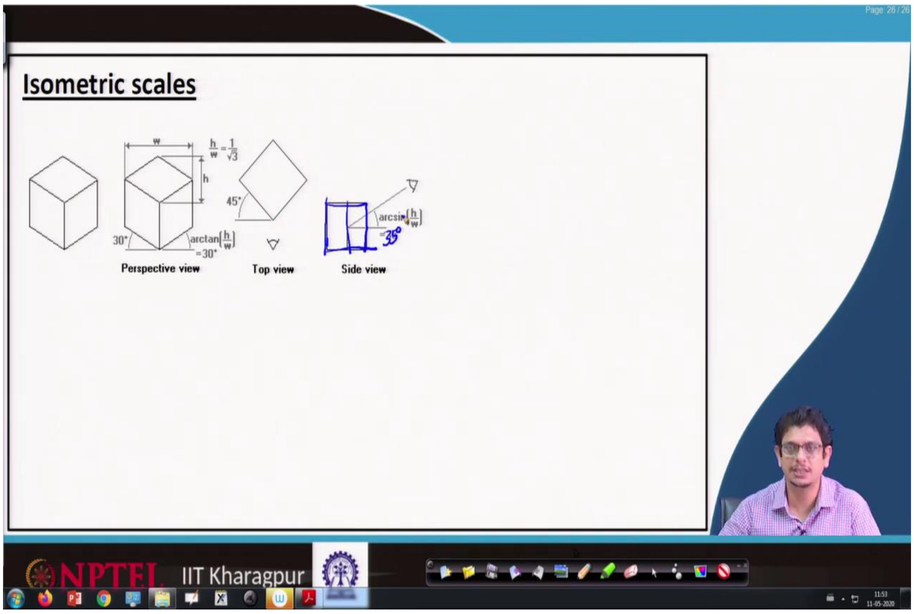

Inside view, the same object looks like a reduce scale making 35 degrees angle. So, the true objects when we are representing it in isometric views; the angles changes, the lengths changes.

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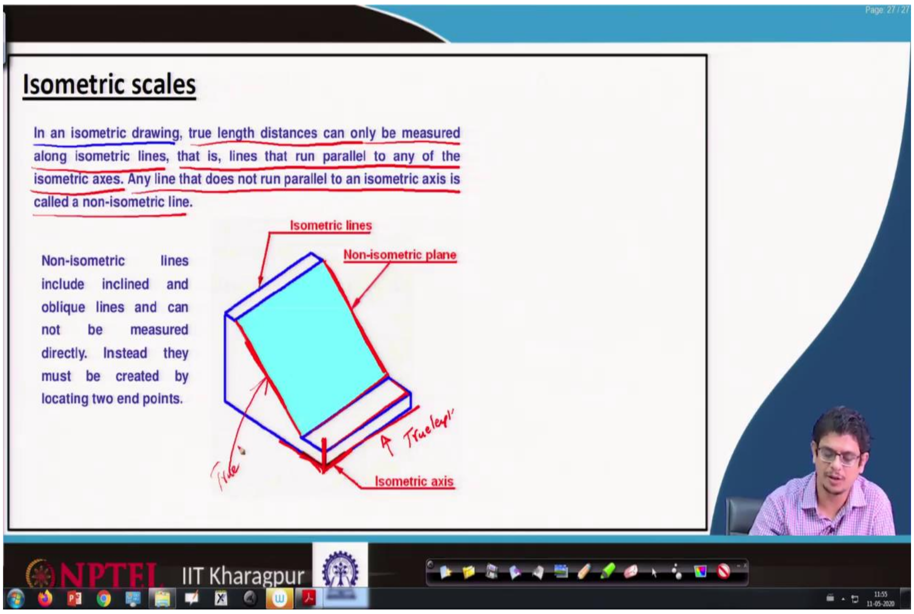

Let us look at more about these lengths scales and other things. In an isometric drawing, true length distance can only be measured along isometric lengths lines; that is lines that run parallel to any of the isometric axis. For example, if I am defining these are the isometric axis; I can measure this one as the true length. Any line that does not run parallel to isometric axis is called non-isometric line.

For example, if I am going to pick a line maybe this one; because this line is parallel to this one is parallel to that, similarly this line parallel to this line. So, these are isometric lines and I can always find these isometric lengths; whereas, any other angle, any other line which is not parallel to any of this isometric axis I can not get the true length of that object.

Non-isometric lines include inclined and oblique lines and cannot be measured directly; instead, they must be created by locating two endpoints. So, first, we have to locate the points, from those points we use the relations isometric true length kind of connections; then try to evaluate what might be that length.

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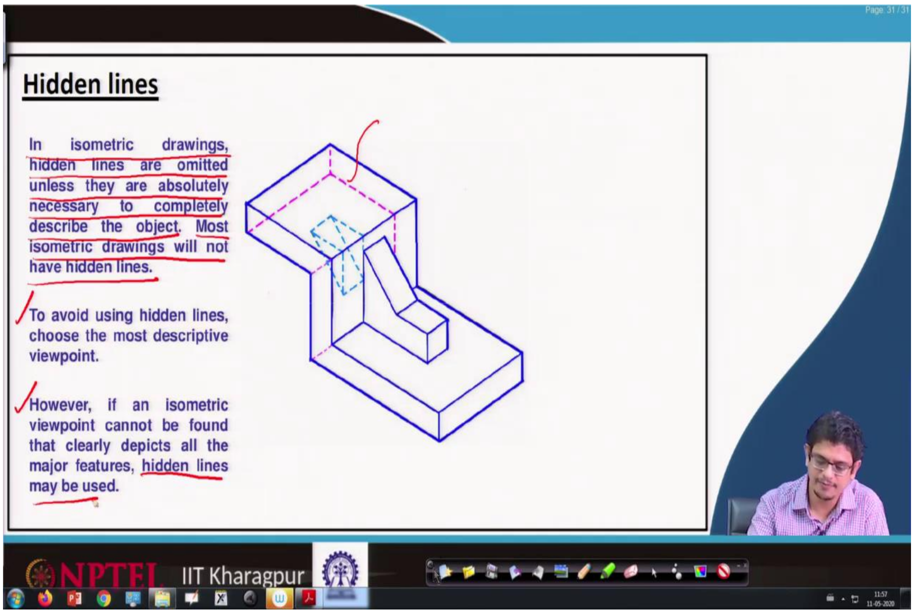

Regarding hidden lines when we are representing on isometric projections; in isometric drawings, hidden lines are omitted unless they are necessary to completely describe the object. Most isometric drawings will not have hidden lines. If you are opening any isometric projections; we usually do not show those hidden lines, unless it is very important to show.

To avoid using hidden lines, choose the most descriptive viewpoint. So, we have to rotate that object in such a way that, most description whatever we can get from that object; in that view, we have to show these isometric projections.

However, if an isometric viewpoint cannot be found that depicts all the major futures; then we are permitted to use hidden lines. So, the object has to be shown with most of this description; if that is we are still in not in a position to sense that, then we can use these hidden lines.

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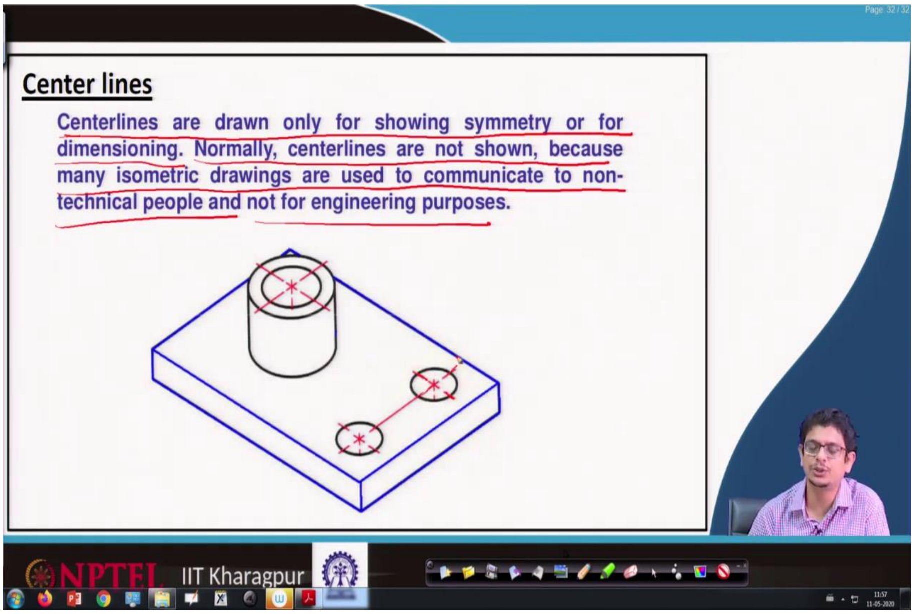

Now coming back to centre lines. Centre lines are drawn only for showing symmetry or for dimensioning point of view. Normally, centre lines are not shown; because many isometric drawings are used to communicate to non-technical people and not for engineering purposes.

So, when you are showing isometric views; if it is most important, then only we will show these kinds of centerlines, otherwise we should not show them.

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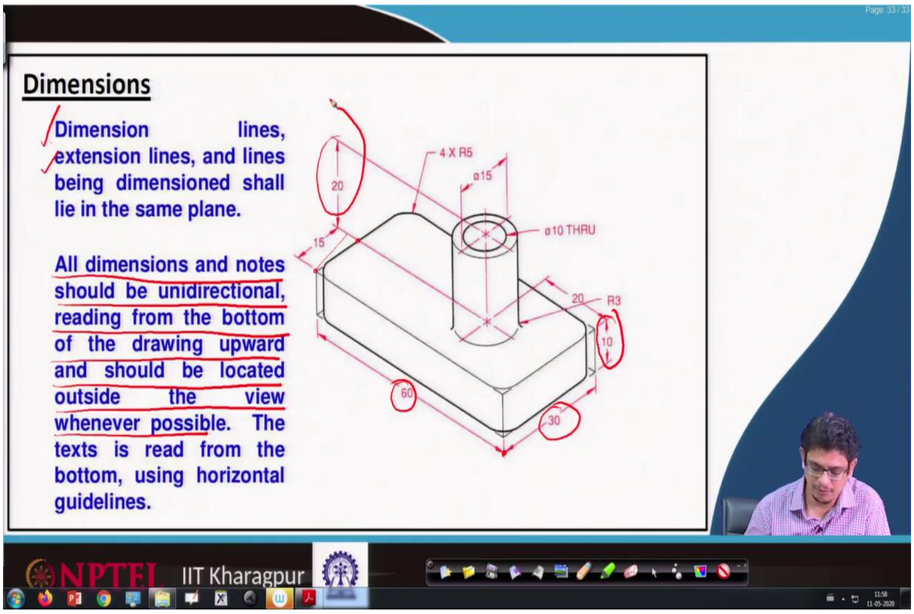

Regarding dimensions when we are showing, dimension lines and extension lines; these shall be on the same plane.

So, whatever the dimensions we will show, extension lines we will show; they should be in the same plane. All dimensions and notes should be unidirectional, reading from the bottom of the drawing upward and should be located outside of the view whenever possible. So, if you are looking, it is outside of that view; this one outside of the view, this is also outside of the view. And usually, we measure it from the bottom to that. Similarly, I want to locate this length; from the bottom, I will show that and these are outside of the things.

The texts are read from the bottom using the horizontal guidelines; the horizontal guidelines are these, with respect to that we have to see that; any line parallel to that horizontal, we will be in a position to see that.

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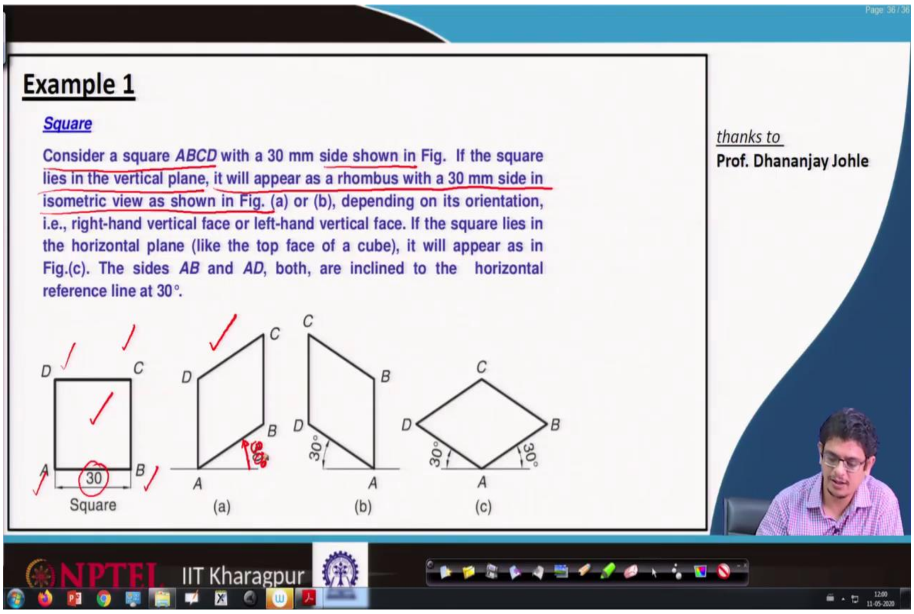

For example, let us look at a square, consider a square ABCD, having a dimension 30 mm side, we have shown it here. If the square lies in the vertical plane, it will appear as a rhombus with 30 mm side in the isometric view in figure a; it looks likes this, if this square is lying on the vertical plane.

In the isometric projections, we have to rotate in such a way that; we will see this angle whatever it is making as 30 degrees thing. So, your square on that isometric plane looks like a rhombus, either this way or that way based on which kind of projections we are trying to look at. If it is right-hand vertical face the orientation, then we will see this one; if it is a left-hand vertical face, we will see it in this way.

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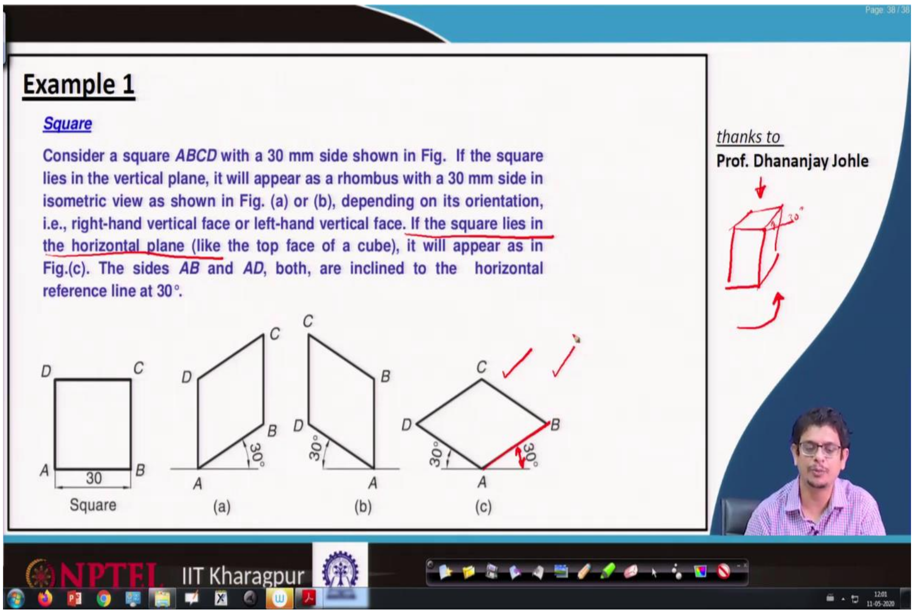

If the square lies in the horizontal plane, like the top face of a cube; we are looking from the top and that plane is on the horizontal plane, it will appear as figure c. We can view it in different directions; but when we are representing it in the isometric plane, we have to rotate in such a way that or we have to shift our position in such a way that, one of these principal edges makes 30 degrees angle with the plane, that is the way we have to represent any isometric projections.

So, though the cube might look like this in one of the views; we have to rotate in such a way that, as an observer moves around that so that one of the edges it makes 30 degrees angle with the view, that is the way we have to visualize it.

So, from top view we are looking at it, we have to rotate that square top face in such a way that it makes a 30-degree angle with these edges; that view we have to present it on the drawing sheet as an isometric projection.

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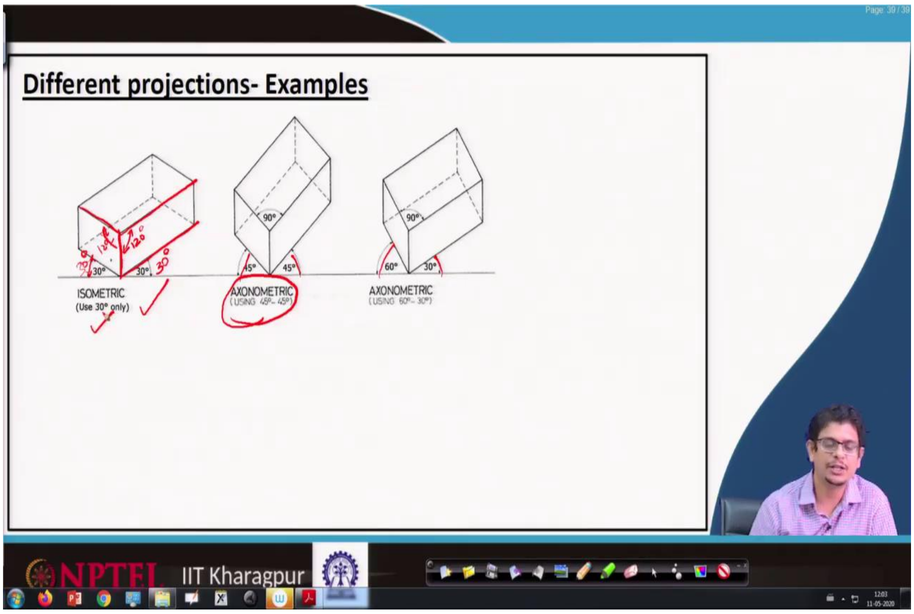

Here we are showing different projections of this rectangle by a rectangular (Refer Time: 25:51). So, for example, in the isometric view the box; we will represent it in such a way that, it will be rotated in such a way that one of these principal edges makes a 30-degree angle.

Because these are orthogonal lines; so when you are rotating it, the other one also makes 30 degrees line. We lift it in such a way that, these angles makes 120 degrees with each other. If you lift it further up, you will have it other axonometric kinds of views. You can have 45 degrees, 45 degrees, 60 degrees, 30 degrees kind of thing; based on how we are visualizing that, you will have a different kind of views. But the standard process of isometric is, you are permitted to use only 30 degrees.

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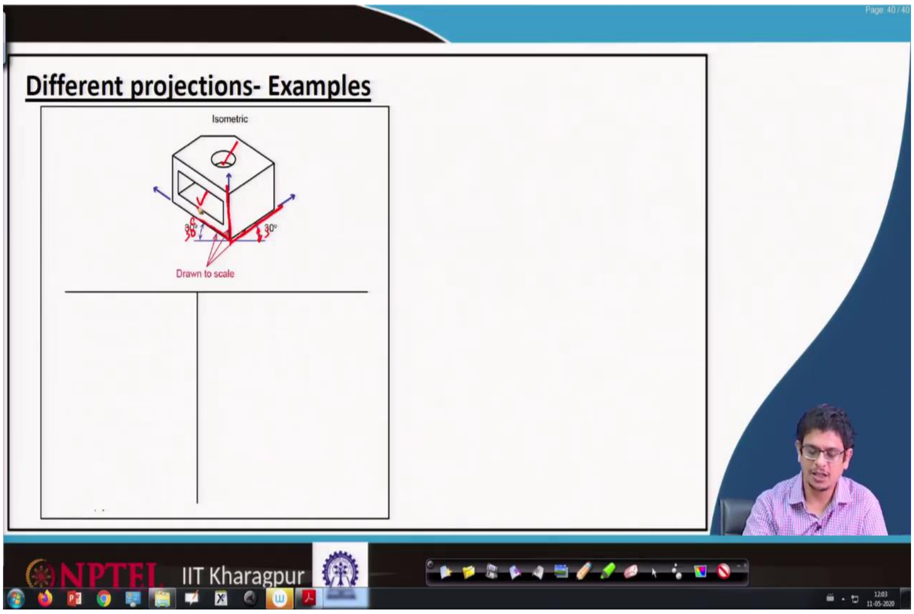

Let us take some other object, having a slot here and it has a hole there also. In the isometric view, once we define these principal edges; one of these principal edges makes 30 degrees with the horizontal. Now, let us look at other views.

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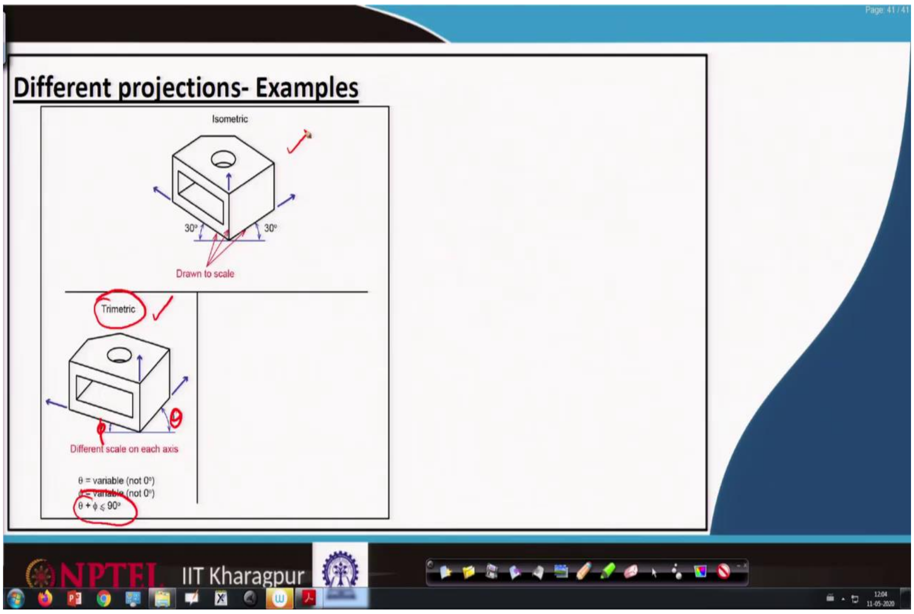

If it is trimetric, where this 30 degrees iso, 30 degrees is going to change in different size; it may not be 30 degrees, differently it varies. So, something like an angle phi on one side, another angle theta, and total theta plus phi is always less than is equal to 90 degrees; because we are rotating in such a way that, dimetric ah, trimetric kind of views we are going to have.

So, if we are having theta and phi different and their summation is less than 90 degrees, we have a trimetric view. So, the same isometric object what we have it; we are going to have it in a different plane so that we will be having different views. Now, let us look at the dimetric view.

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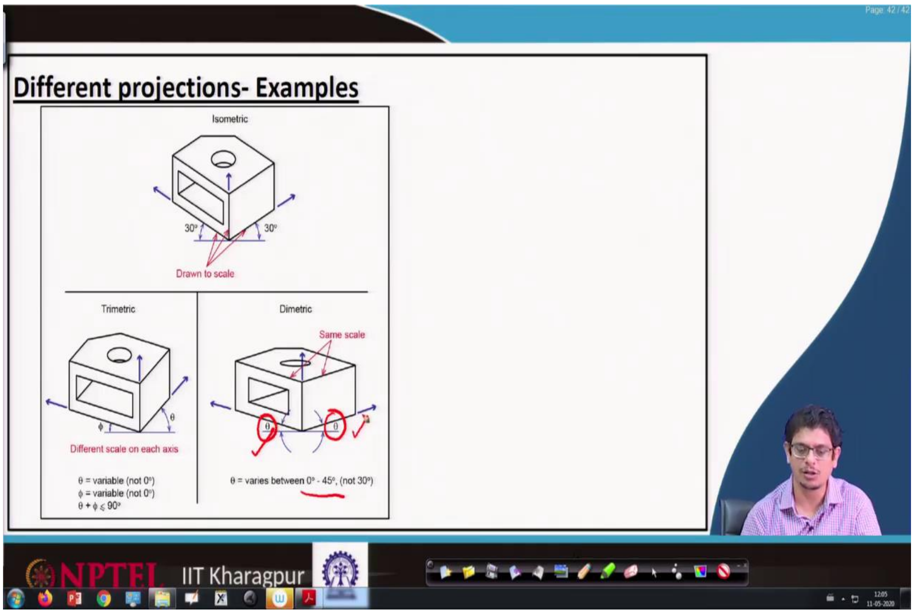

In the dimetric view, we have theta angle on both sides and this theta angle varies in between 0 to 45 degrees and this is not 30 degrees. So, we always have this object, for example, like if we have this object; we have to rotate this object in such a way that, different views we are going to see.

In dimetric, one of these edges always makes an angle in between 0 to 45 degrees; on the same angle, one has to see it on the other side also.

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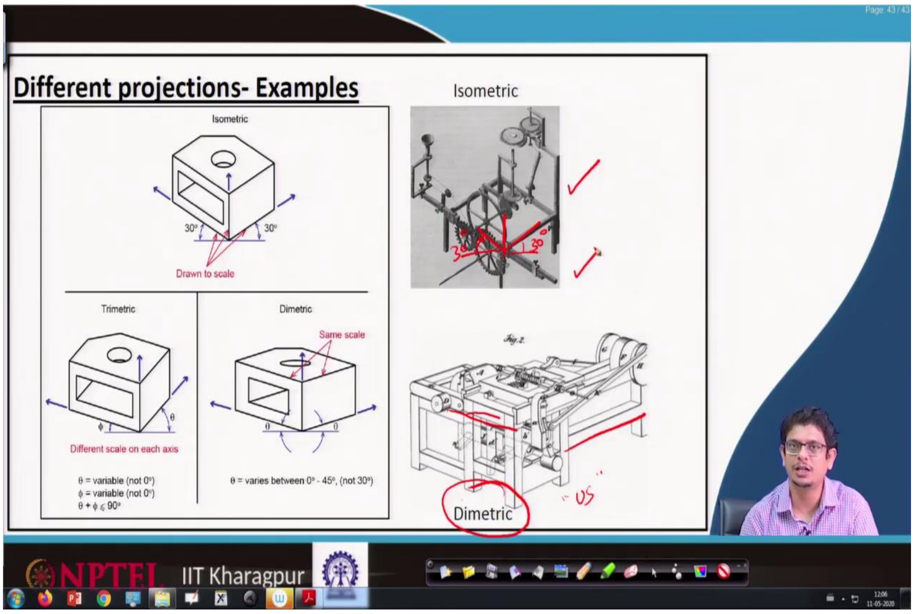

Just an example, we have an object here for isometric view; if we are fixing some of them as axis, for example, this is one axis, this is another axis, this is another axis.

We have this axis is 30 degrees, this axis is also 30 degrees and this is orthogonal. In the case of dimetric, we have this axis which is parallel; we have another axis that that is also parallel, these are having the same angle, but not 30 degrees; so, this kind of things what we call dimetric kind of projections.

Earlier days like some 100, 150 years back in the US the patents usually used to go with this dimetric kind of projections; mainly UK kind of projections, they try to use for isometric projections. In the next class, we will learn more about these isometric projections.

Thank you very much.