Engineering Drawing and Computer Graphics
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Module – 04
Orthographic Projections II – Projection of solids
Lecture – 42
Projections of Solids - I

Hello everyone. Welcome to our NPTEL Online Certification Courses on Engineering Drawing and Computer Graphics. We are covering module number 4 and lecture number 42. Mainly, we are looking at 'Projection of Solids'.

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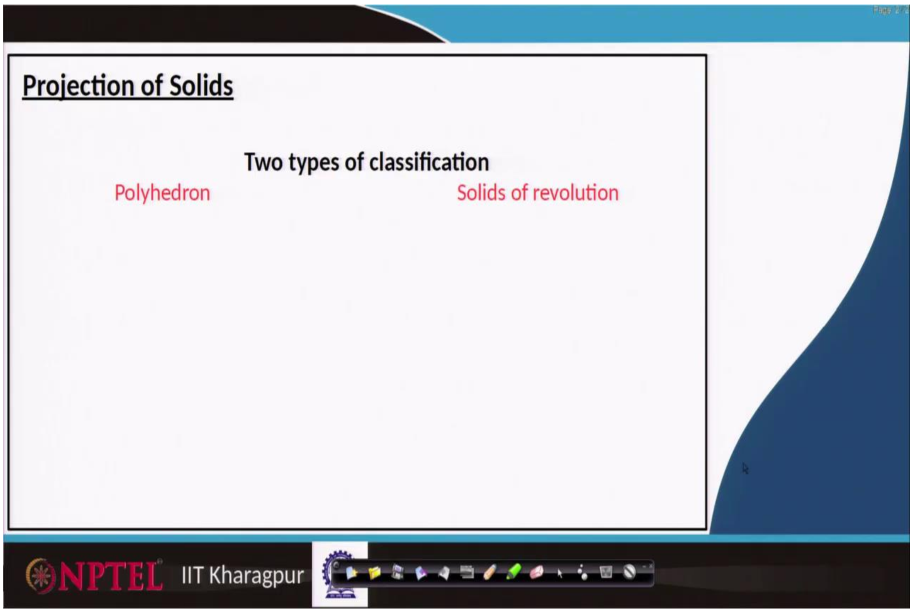

For these solids mainly we have two classifications; one is Polyhedron, another one is solids of revolution.

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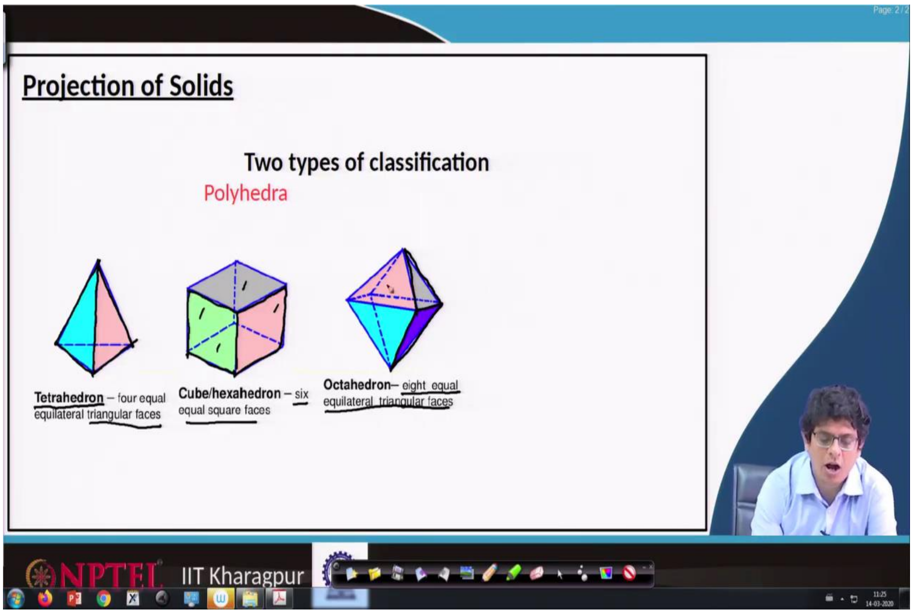

In polyhedra, we have different varieties like a tetrahedron, cubes, and octahedron. So, if we are looking at this object tetrahedron. We have four equal equilateral triangular faces. So, this is the first face, the second one and third and fourth faces. So, in that way we have this tetrahedron fourth faces.

Similarly, if it is a cube or hexahedron, we have the six faces cube by definition equal side faces. Similarly, the other ones in octahedron we have eight equal equilateral triangular faces. So, equilateral triangle every time we have to construct, assemble it in such a way that, it makes a closed object such kind of thing what we call as this octahedron.

Based on how many sides we have different numbers? And, in today's class, we will see if such kind of objects is oriented in three-dimensional space how to draw those pictures? Based on how much inclination angle they make it with the horizontal plane, vertical plane, with the apex on horizontal planes, or vertical planes and so on, whether it is in inclined.

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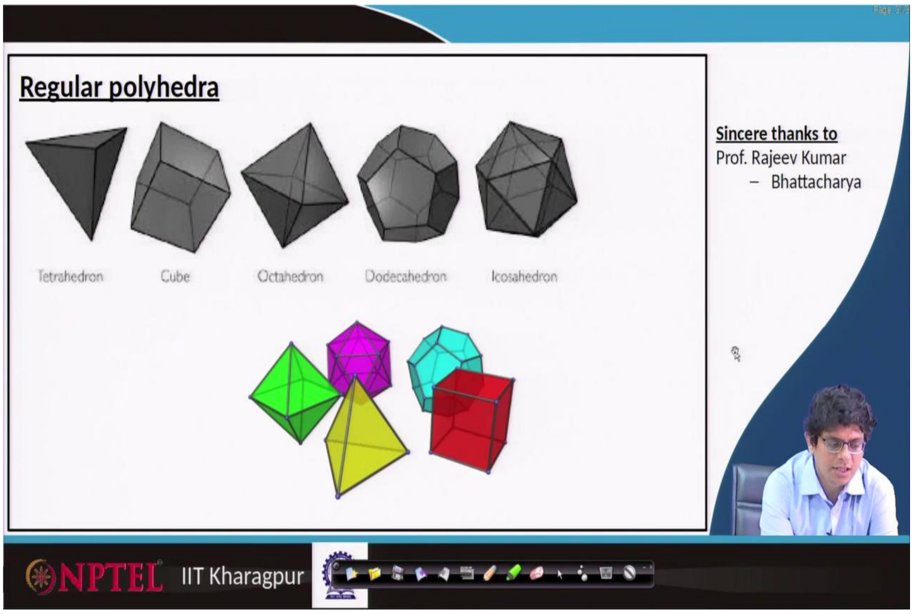

Similarly, we have dodecahedron, icosahedrons and different kind of objects, these are commander category of polyhedra.

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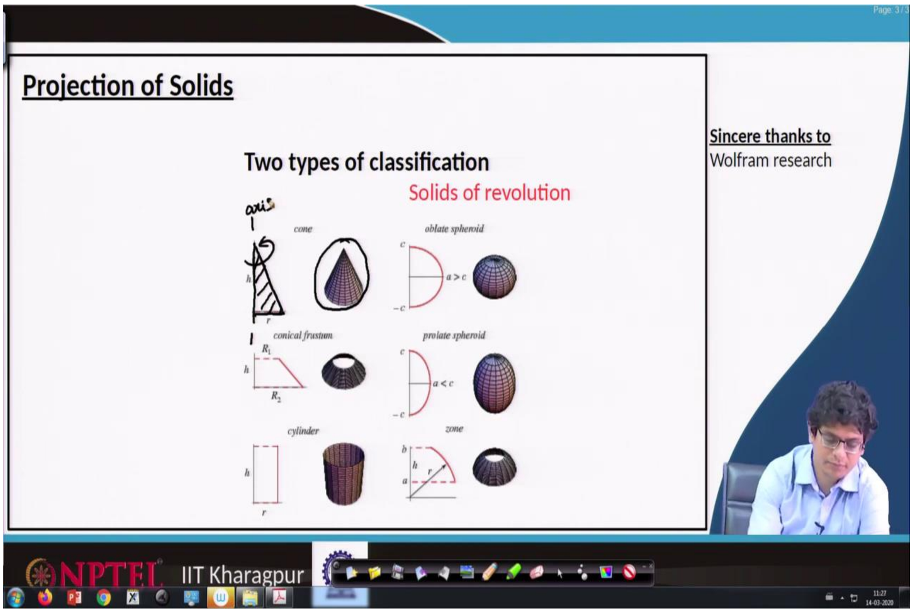

Similarly, there is another set called solids of revolution. So, you pick a curve to rotate that curve around an axis, then we will get these three-dimensional objects.

Let us look at that. For example, a line another line, and another line, if we join that whatever the plane we get that plane if we are revolving around this axis, then we will end up with a cone a three-dimensional solid of revolution we will have.

So, this revolving object is about this axis. If it is just a line, for example, only a line if we revolve around this axis, we get a peripheral surface of a cone.

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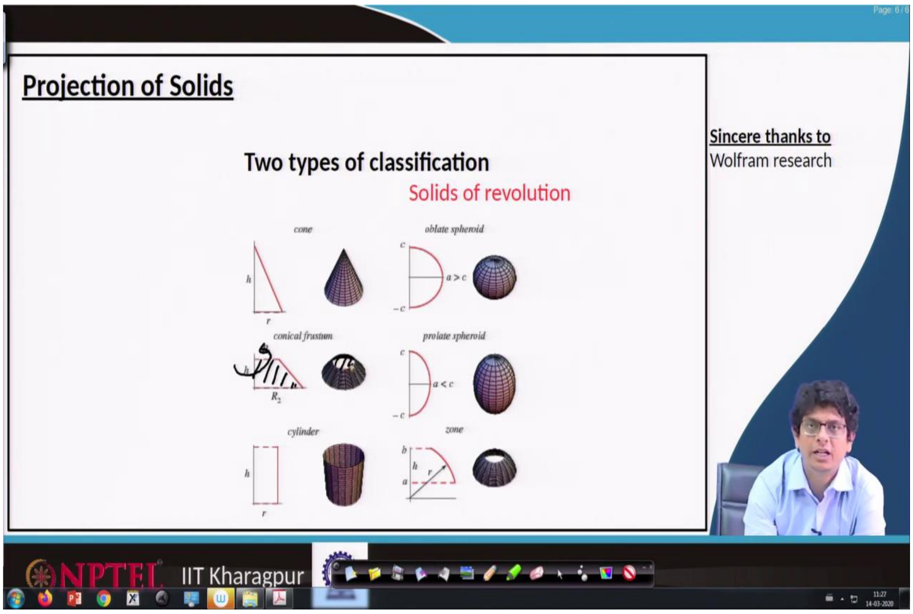

For example here, this is the line which is at a distance R 1, and R 2, if this line we revolve it, it makes a peripheral surface in that way. Which is what we call conical frustum? If it is a plane this entire plane revolves around this axis, then we will get a conical frustum of a solid object; that means, the material will be filled inside also.

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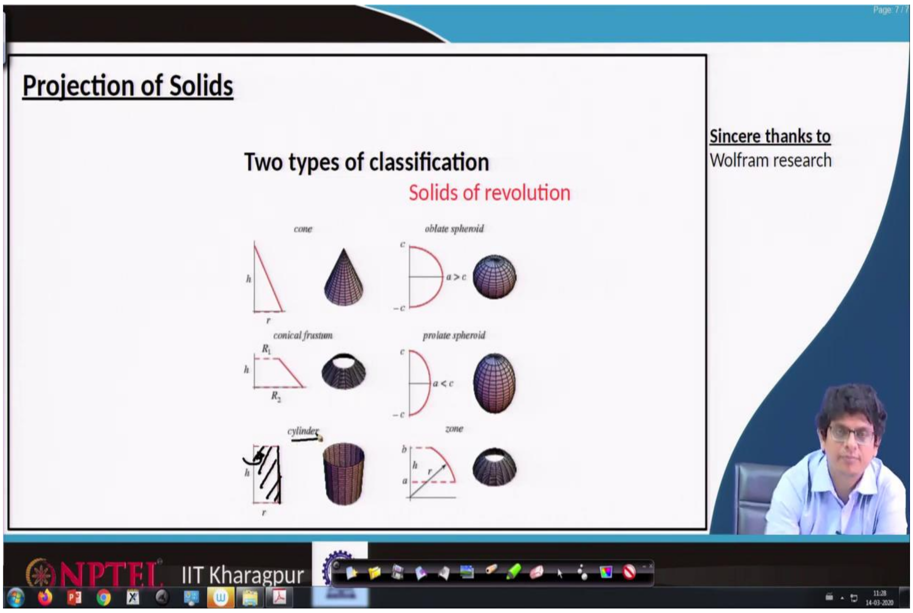

Similarly, a line revolves around this axis give us cylindrical surface; a plane rectangular plane revolving around that axis gives us a cylinder.

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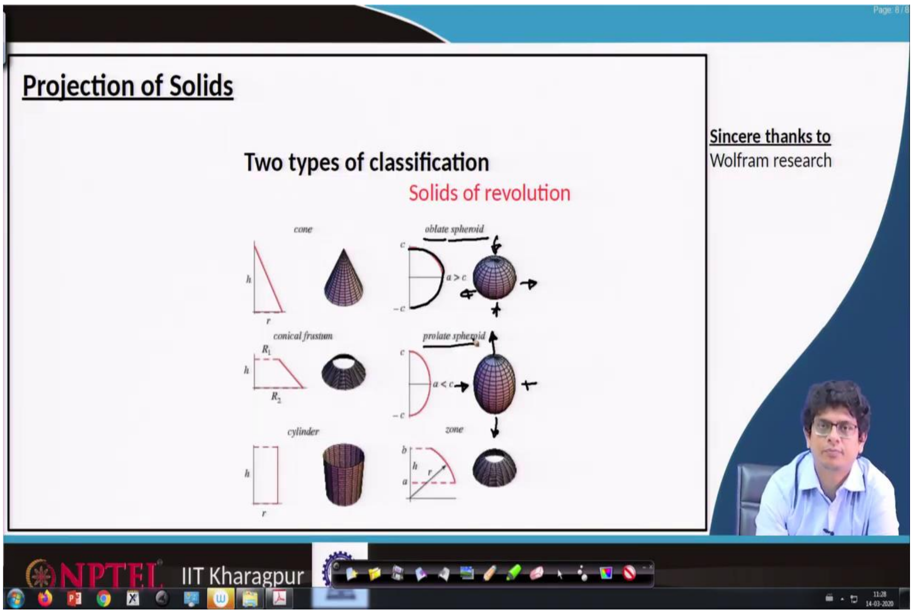

Similarly, if we have curves, for example, this curve, it can be semicircle it can be slightly elongated semicircle also if we revolve it ellipsoidal kind of objects we will get. And, usually, we call these are spheroids from spherical geometry we construct them.

And, oblate you will have pushed in this direction elongate in that direction we call oblate spheroids, and if it is extended in that direction pushed in this direction, we call that as prolates spheroids.

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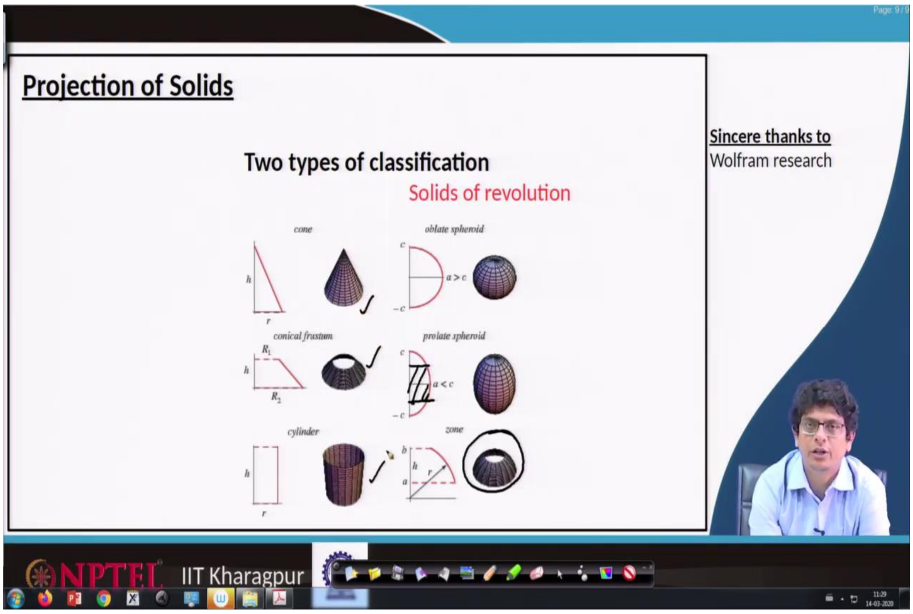

And, any part of the curve plane if we revolve it, we will get a different kind of objects.

And, in our projection of solids, we will learn about mainly the cones frustums cylinders, how they look like on different planes?

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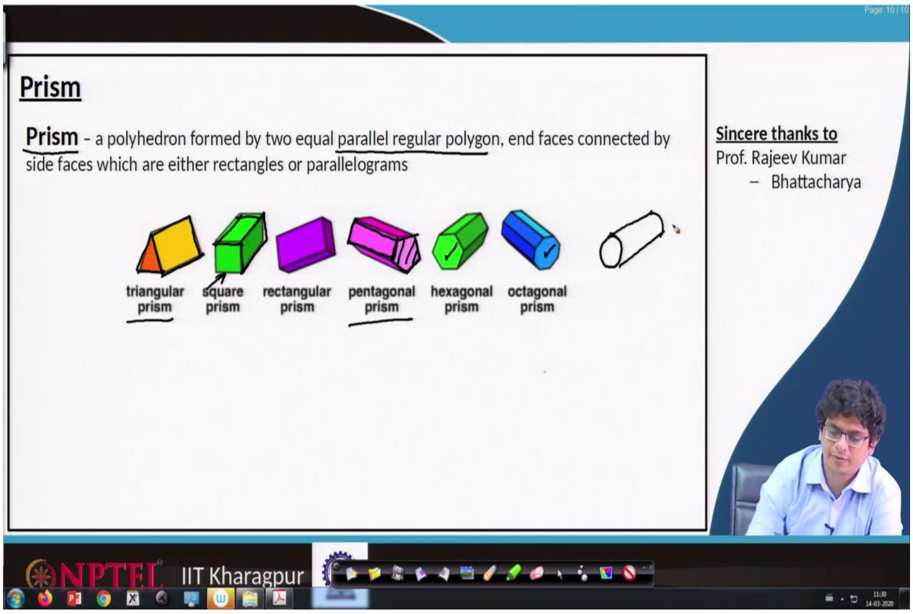

Similarly, there is a different kind of objects which are called prisms. A polyhedron formed by two equal parallel regular polygons, end faces connected by side faces which are either rectangles or parallelograms such kind of objects what we call as prisms.

Here let us look at this, this is a square or rectangle, another rectangle on the backside and another rectangle on the bottom side. So, the complete volume filled by such kind of object, what we call triangular prism? To get square prisms we have to connect these rectangles in such a way that from this view it makes a square.

Similarly, if we are picking rectangles to connect them across this pentagon, we get pentagonal prism. So, the material has to be filled inside that then only we will call it as solid. Similarly, these rectangles connected in the hexagonal framework and maybe in octagonal, if it is the circle we get cylinders.

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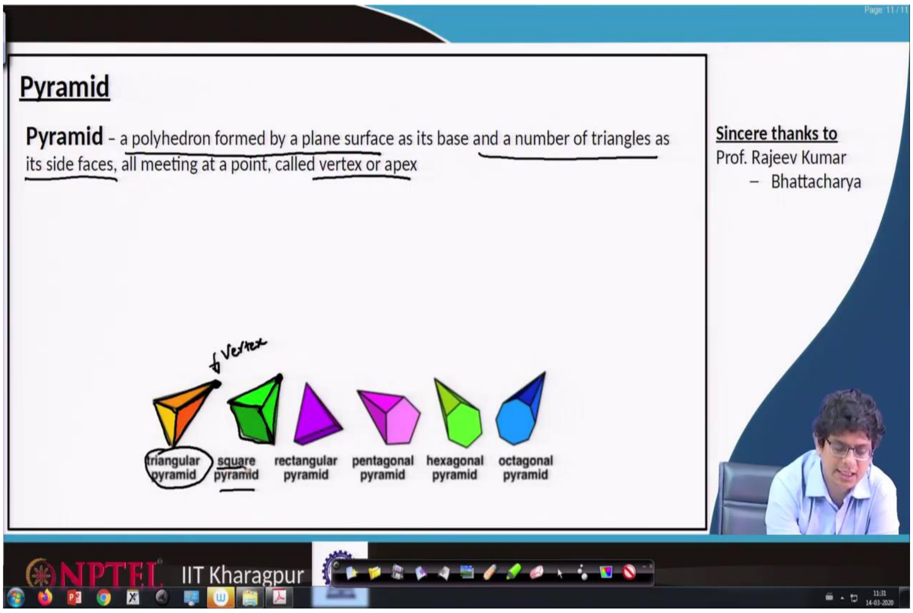

After prisms, there is another object what we call pyramids. A pyramid is a polyhedron formed by the plane surface as it is base and a number of triangles as it is side faces, all these should meet at a point called vertex or apex. For example, let us take a triangular pyramid. We have these triangles all these are meeting at 1 point, this one is apex or vertex.

Similarly, let us pick square pyramid we have triangular faces all are again meeting at that point and the base is a fixed object, here, in this case, it is a square. So, it is called a square pyramid. Similarly, rectangular pyramid having base pentagonal pyramid having a base of the pentagon, and hexagonal and octagonal pyramids also.

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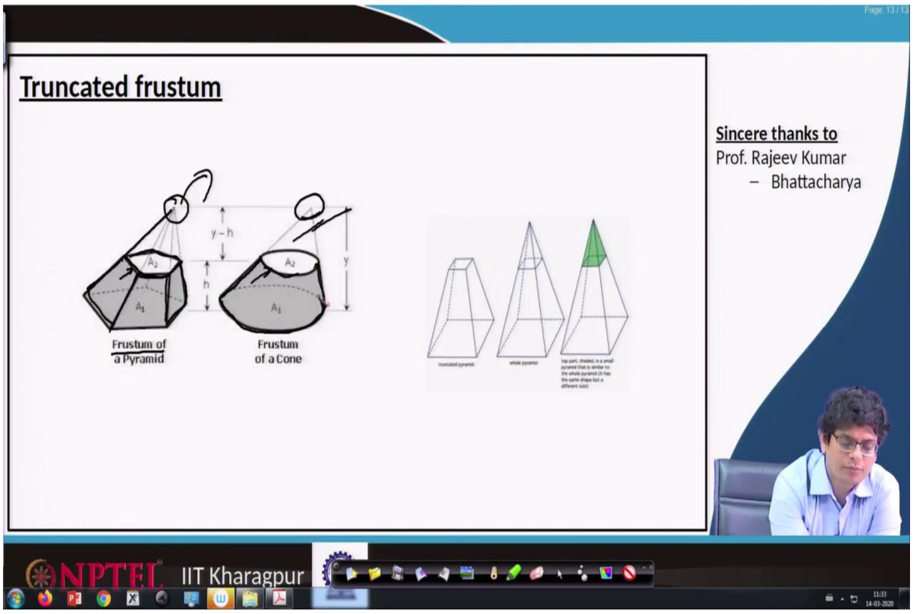

If we have a pyramid take a slice, this is the pyramid it might be right angular kind of thing vertically making 90 degrees. Half perhaps slightly slanted one, if we are taking a slice at this level passing a plane taking a slice of that it makes a frustum. So, there is a leftover part, what we call frustum?

And, the top apex part has to be removed. Similarly, if we have a cone it can be right circular cone or perhaps it might be having a slanted edge, if we are making a slice at this level, remove this apex portion this entire part, the leftover part what we call frustum of a cone.

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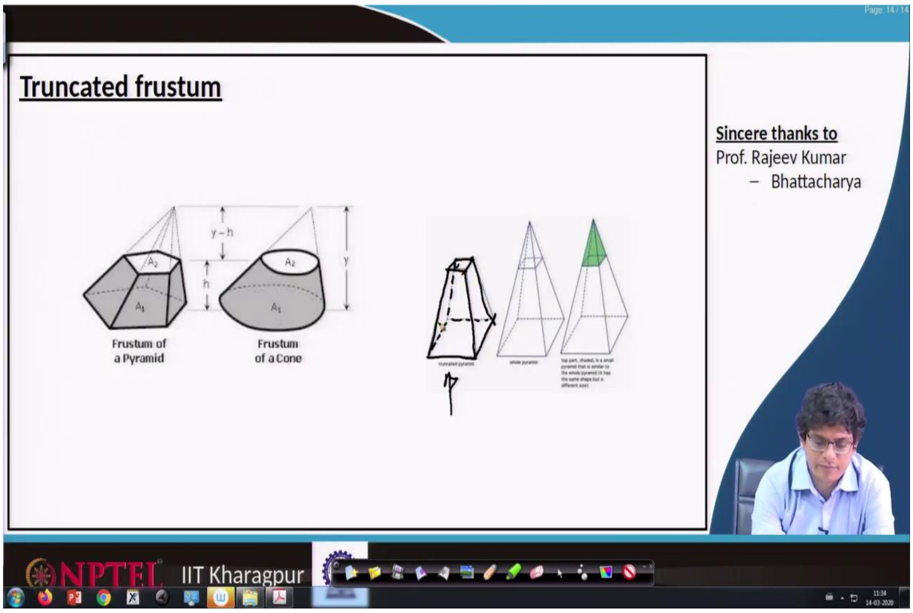

So, truncated pyramids have such kind of shape where the top portion is removed. Any lines which are not visible and maybe at the backside, we usually show it by dashed lines. When we are looking from this view, the back sideline we cannot see. Because this is a solid object it is not directly a transferring kind of object. So, in that case, we will show it by dashed lines.

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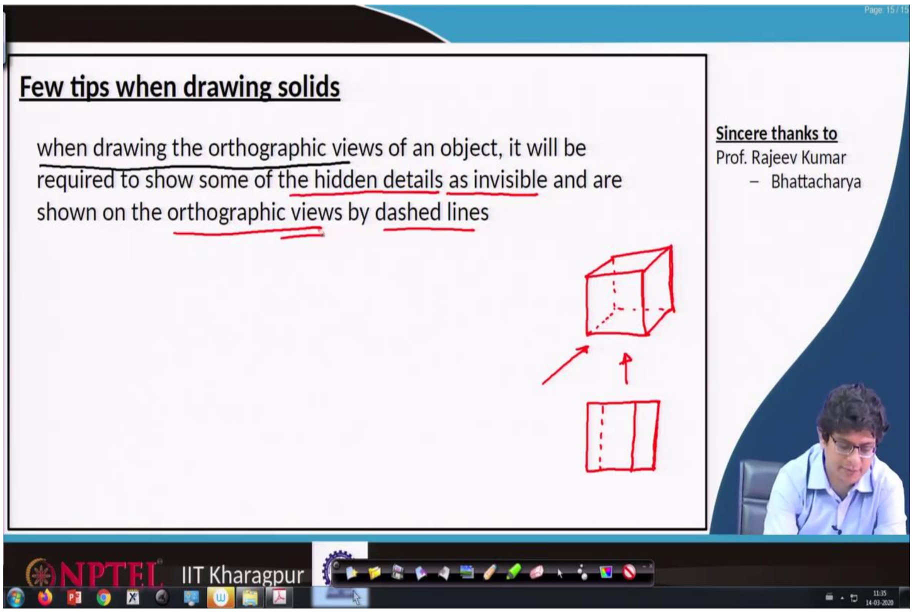

So, when we are drawing these solids, there are a few tips which we have to follow. Especially, when drawing the orthographic views of an object, it will be required to show some of the hidden details as invisible. That gives us a feeling that it is not a two-dimensional object, it is a three-dimensional object. And, these are shown on the orthographic views by dashed lines.

For example, if we have a square. Just to indicate the backside we have this surface; we show it by a dashed line. For example, we are looking from this direction, not in that direction. Then, this cube looks like this one. If we are looking from this view, this line will be visible perhaps it might be coming that, this line naturally comes here and this line perhaps going a backside. This is the way we represent that when we are showing these orthographic views projections.

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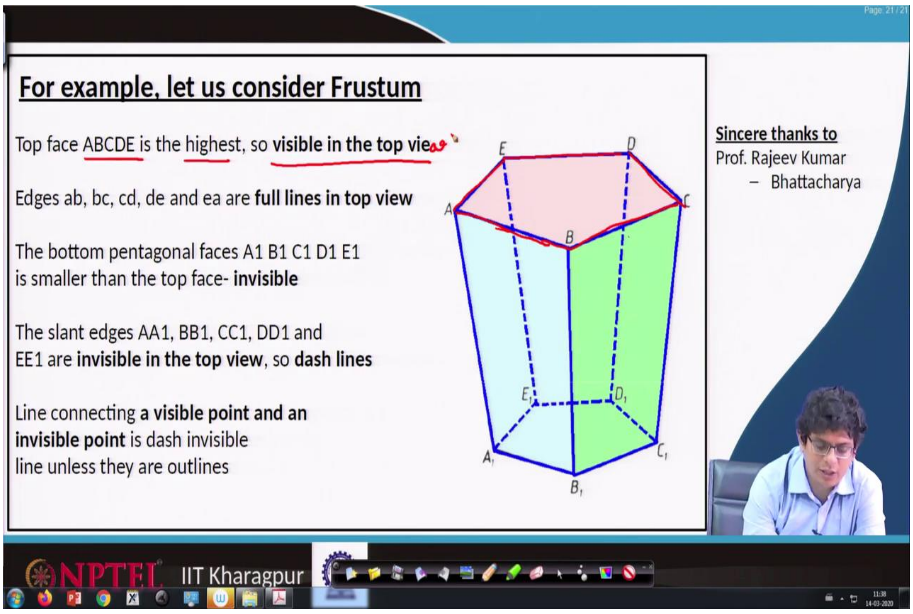

For example, let us consider a frustum; that means, some part we have removed it. Frustum by definition it might be having a cone or pyramid kind of shape or perhaps pentagonal thing. And, one part we have removed and the part what we have removed is apex side of the part. That means, in this case, the size of this pentagon is very smaller than the size of this pentagon.

That means, these lines go intersect far away and makes something like apex and that part we have removed it, and the leftover part is this, and that frustum what we are trying to look at. So, when we are looking at that naturally in any engineering drawing we have to represent by those letters. Our standard convention is this three dimensional kind of objects we show it by capital letters and projections by small letters.

So, let us call part A B C D E through these edges these lines are passing. Similarly, at the bottom ones let us call A 1, B 1, C 1, D 1, and E 1. Are a completely solid object and this line is at the backside of that that is a reason we show it by dashed lines, which are usually not visible. Whereas these lines are in front of us so, these lines are always visible.

And, second thing edges are always visible. If you are picking any object backside we might not be in a position to sense it, but front side the edges are always visible. That is also one of the reasons we show it by dark continuous lines. Whatever not visible by dashed lines.

Let us carefully look at these ABCD terms step by step. ABCD is the highest points what we can see and these are visible. So, we show it by continuous lines it is the top view.

Now, let us look at the edges. The edges are ab, bc, cd we will write it, that is a reason we are showing these lower-case letters. And, especially these are this supposed to be full lines in the top view.

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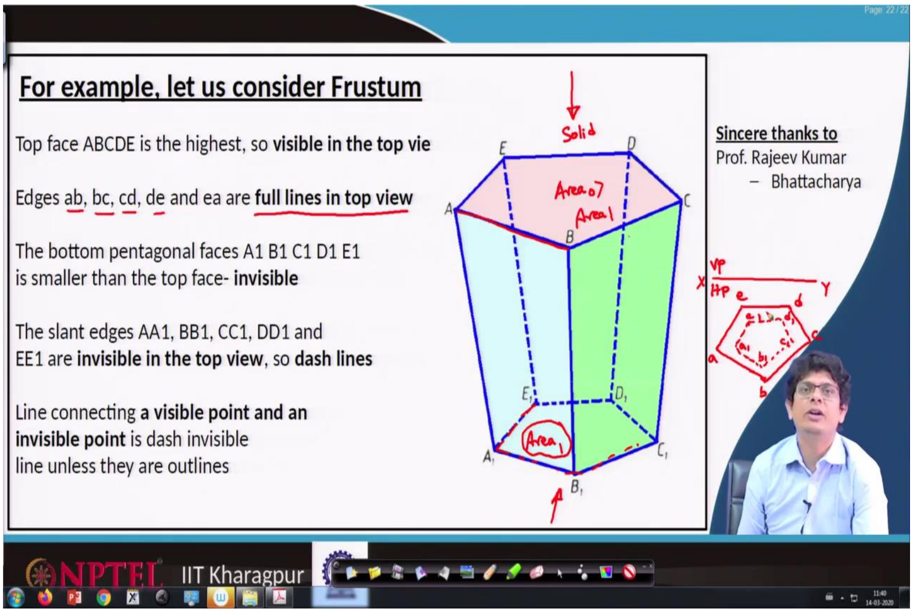

For example, we are looking from this direction. This might be the front view top view. When we are looking top view this one, this is the horizontal plane and this is the vertical plane, X coordinate, Y coordinates visible. So, perhaps our pentagon looks in that way.

Now, this one because we are looking from top and it is a solid object, it is not straightforwardly transparent thing. So, we cannot sense this A 1, B 1, C 1, D 1, E 1 in the top view, but this area smaller than this area. Let us call area nought and area 1, area nought is greater than area 1. In that case, what we will see is somewhere here it is a frustum.

If we want to represent this area one completely in the picture, then these things come in the inside of that object. So, in the top view, this bottom one is invisible and this ab, bc, cd, ea are full lines in top view. So, if you are representing a b c d e are visible whereas, this A 1, B 1, C 1, D 1, E 1 these are invisible.

So, a 1, b 1, c 1, d 1, and e 1 this is the way we should write it. Similarly, any line connecting a visible point and an invisible point is a dash invisible line. For example, this is a frustum of a cone. So, for example, this point A goes connects to this A 1. Do we not see this line when we are looking from the top view.

What we will see is the top pentagon; the bottom one is anyway invisible and the line because we are looking from top view this line goes inside of that. So, it is beyond our visibility.

When we are representing this A 1 to A 1 whatever connection, that is always invisible. Point A is visible A 1 is an invisible point. Unless these are outlines, we show them by dash lines, any outlines or the edge kind of things we have to show it by continuous lines.

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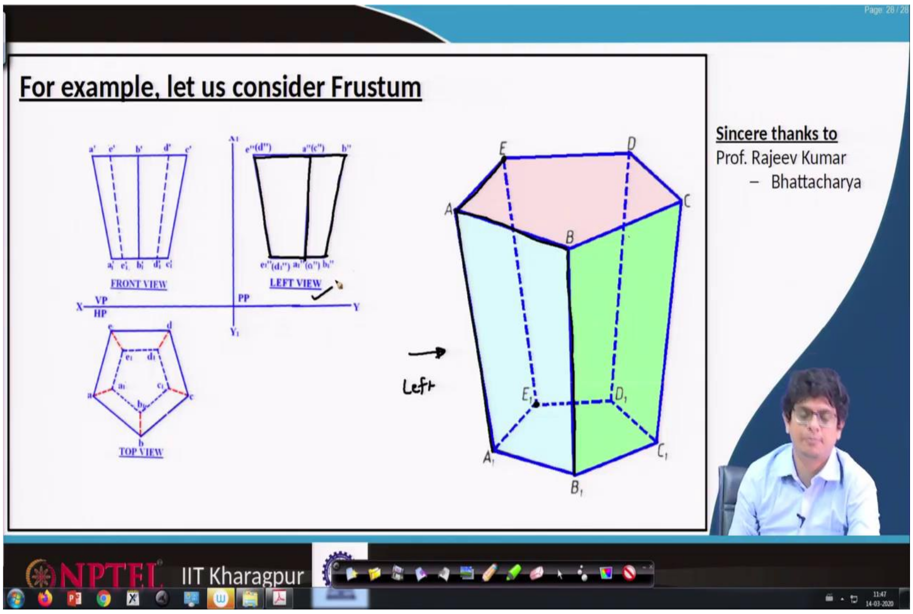

Let us take the top view. So, the top view we are looking at from that direction. So, X Y plane, a horizontal plane like, what we have guessed ED, AE, AB, BC, CD are visible. This is always visible, inside one not visible, not visible line. Similarly, when we are looking A to A 1 there is a line this one. So, let us use some other color.

This line is not visible when we are looking from the top view and that is this line. Similarly, let us connect C point to C 1 point, this one is also invisible so, C 2, C 1 invisible. Similarly, D to D1 so D to D 1, that way we join these lines. Let us look at front view. So, when we are looking in front view, these points mapped to that one.

Similarly, this point all the way mapped to this C 1. Similarly, each point mapped there a point, e point, d to d, c to c, b to b points, this is the way we connect these maps.

Once, done from a different view we will be in a position to see this slant edge. So, that slant edge is this one, because we are looking from the front view, we do not know this E E 1 do not know in the sense these are not visible lines. So, connect E 1 to E' by dashed lines.

Similarly, point D to D 1 also invisible from this front view so, join them by dashed lines. Now, B to B 1 always be visible in the front view. So, we join that by a continuous line. What about side view?. So, we have to look from that side. When we are looking from that side, this one always is visible. This line will be visible, possibly this line also visible in that side view.

. So, let us look at that. So, this A A 1 we can see that visible. This B B 1 will also be visible when we are looking from the side view. Similarly, E to E 1, E to E 1, because it is a pentagon naturally asymmetry is there in terms of this line. So, this AE line might be elongated 1, and this ab line might be shortened, because we are looking from the left side, left side view what we have on the profile plane.

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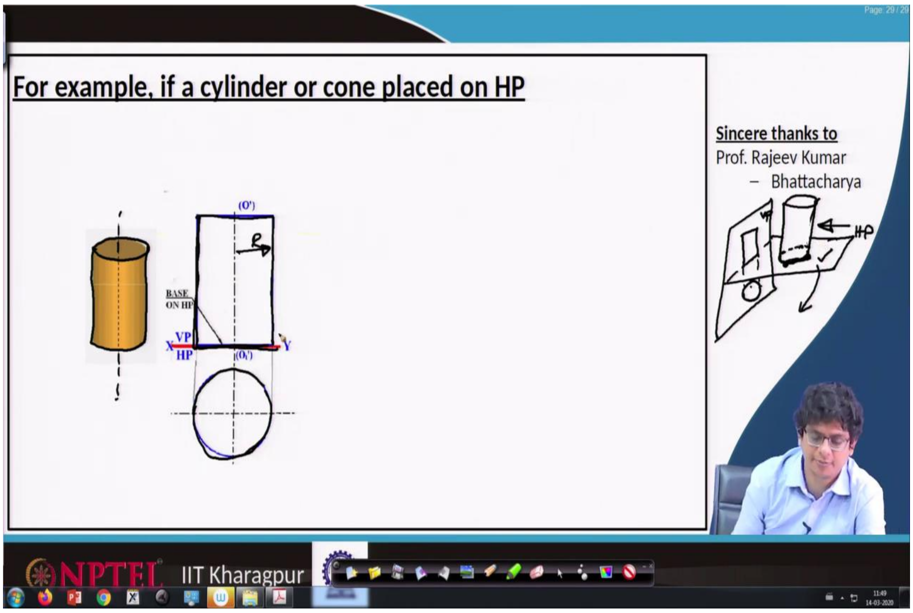

Now, let us ask a question if a cylinder or cone is placed on a horizontal plane, how it looks like, what are the projections for the solid? So, let us consider this cylinder. It is a solid object; the axis is that. Now, this cylinder is placed on a horizontal plane. So, again construct our 3 D picture. This is the vertical plane, this is the horizontal plane, and what we have is cylinder resting on the horizontal plane.

That means this might be the cylinder goes in that way, because some part is invisible when we are keeping. So, this part dash 1. So, we want to look at this view. If you are saying these points will be mapped all the way there. So, what we will see is such kind of rectangle and this one mapped to a circle.

And, when we are rotating it, this is the place where we get this circle. So, the same thing what we can observe it on this projection plane? For cylinder the edges because it is having many edges on that side which is at a given radius that edge, we will be in a position to see that.

And, base this base is resting on the horizontal plane. So, that is a reason it is on the XY axis. Second thing whenever we are drawing the cylinders symmetric kind of objects, we always show by axis dash-dot lines. Similarly, first circle dash-dot lines we will show it.

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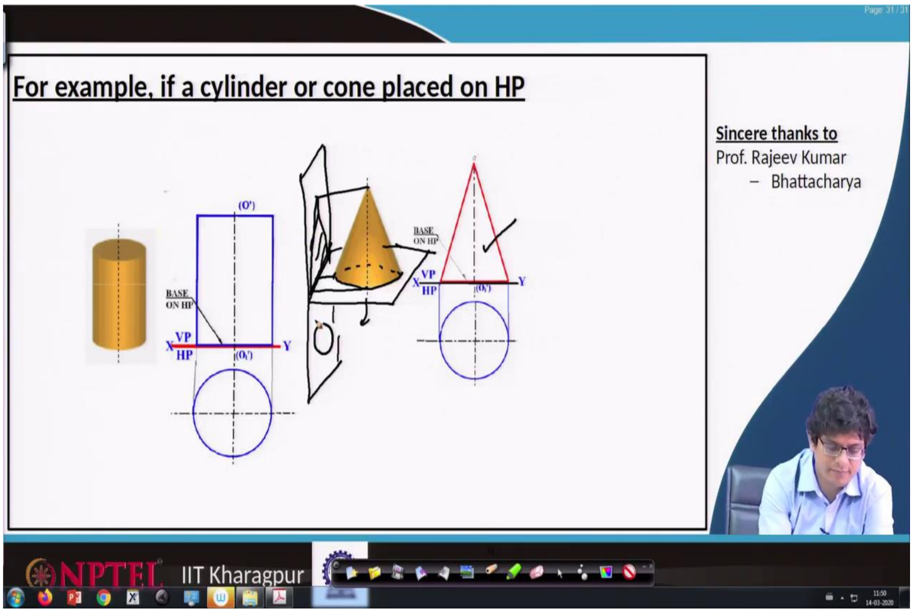

Now, if a cone is resting on the horizontal plane, how it looks like the same way?

This is the horizontal plane, what we are intended for and this is the vertical plane. So, project that and this edge map happens that one also happens. So, what we will see is a triangle there, which is this. When we are projecting on the horizontal plane, we see a circle and rotate that on to this horizontal plane, then we will see it as a circle and that is one what we are seeing.

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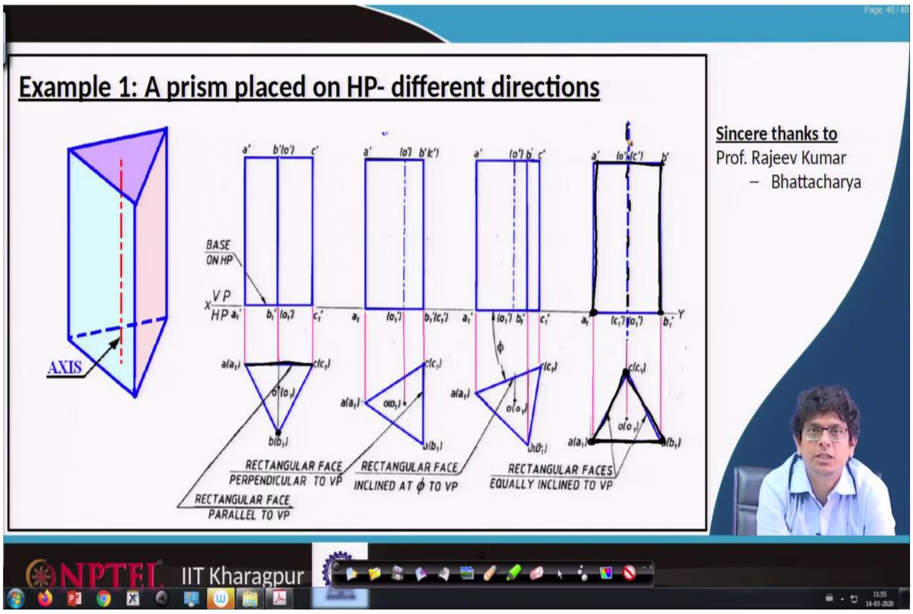

Let us look at this example if a prism is placed on a horizontal plane; however, at different directions. So, this prism is always be placed on a horizontal plane, but one of these edges making different inclination angles if so, how it looks like? For example, one of the edges on the base, because this is the one, which is placed on this vertical plane, no horizontal plane.

So, this is the horizontal plane what we have, this is the vertical plane, horizontal plane, and that is the vertical plane. When we are projecting that we will have such kind of arrangement.

The first one what we are trying to look at is in case one of these edges are rotated in such a way that that will be parallel to our horizontal plane so this one. Anyway, projection on the horizontal plane if we are looking at the top view always be a rectangle. And, when we are projecting onto that vertical plane, because one of the faces we will be in a position to see that and that is this rectangle, the edge we always are seeing so that will be this one.

Because this edge what about the line passes through that that we will see it as a line there. Let us rotate this rectangular face not parallel to the vertical plane, but it makes an inclination angle.

For example, this one slightly rotates it in this way, then remaining edges also rotates. Now, when we are looking this entire one this edge we will see, similarly, this one maps we will see that edge, this entire thing will be projected. So, we will have these lines. And, the axis we usually show by dash-dot lines. Here axis we are not showing because one of the faces is parallel this edge and this x-axis, coincides that is the reason we are showing by a continuous line.

Whereas in this case in this case edge this one, this one map, but axis still there which is invisible. So, we are showing just by an axis seen a dashed line. Slightly rotate these objects further this ac has slight rotation. So, that this point comes to this direction this point comes in that direction this one goes there.

If we are rotating this entire prism on the horizontal plane, we will see it as a triangle, when we are projecting that this point always with the edge. So, we will have that line this one coincide. So, when we are looking from this direction this entire face we will be in a position to see and that edge we will see. This one also gives us an edge.

So, this face shrunk to the small kind of rectangle. And, the axis maps by this dashed dot line. Now, if we further rotate this object ac in such a way that, here we have this one at the backside and this one front side for the front view, now flip these directions. So, that this edge goes it back and this one comes to the front. So, this is the configuration. What we will have? That means this line is not visible whatever the vertical line passing through that.

So, a point b points maps to this a 1' b 1' and we will see that line and again top face we will see that, but this line we cannot see. So, we show it by the dashed line. This is the way we project these solids in the next class we will look at more examples on this projection of solids.

Thank you very much.