Engineering Drawing and Computer Graphics
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Module – 02
Lecture – 20
Conic Sections - XII

Hello everyone, welcome to our NPTEL Online Certification Courses on Engineering Drawing and Computer Graphics. We are in module number 2 and lecture number 20. In this, we are completing the Conic Sections part.

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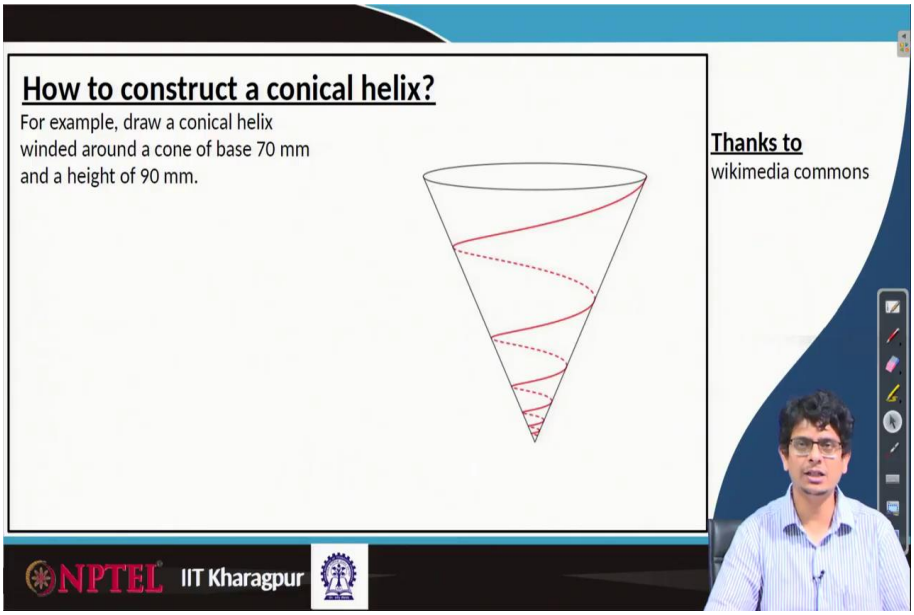

How to construct a conical helix over a cone? So, if we are winding a rope or thread around a cone sorting from apex to base, the geometric curve we get is called a conical helix. For example, let us look at a conical helix winded around a cone of base 70 mm and height 90 mm.

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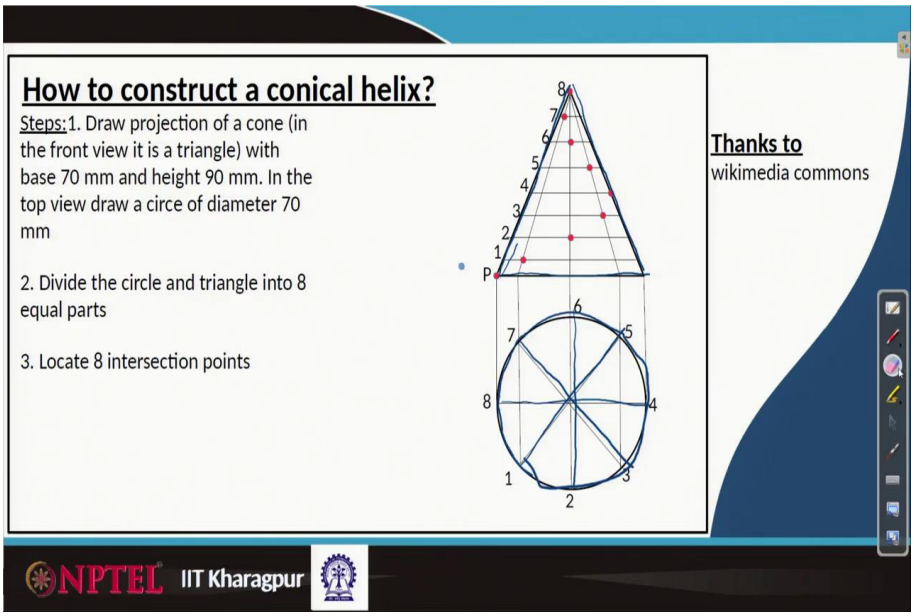

And it has made one revolution starting from the base all the way to top one. So, to do that first of all we have to construct a cone in the frontal view which we will get as a triangle. First, we have to construct a triangle of required base and height. In one of the views, if we are looking at from bottom, it looks like a circle, so one of the views is the circle we have to construct of the same diameter. Then divide the circle into 8 equal parts, number them; 1, 2, 3, 4, 5, 6, 7 and 8.

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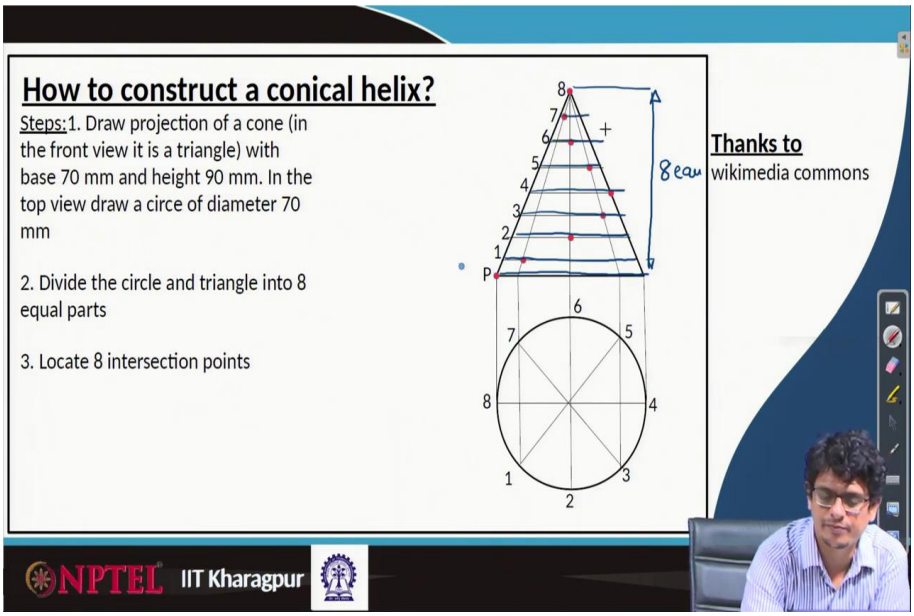

After that, divide this cone height from P to height h into 8 equal parts, this one also divides into 8 equal parts by drawing horizontal lines up to there.

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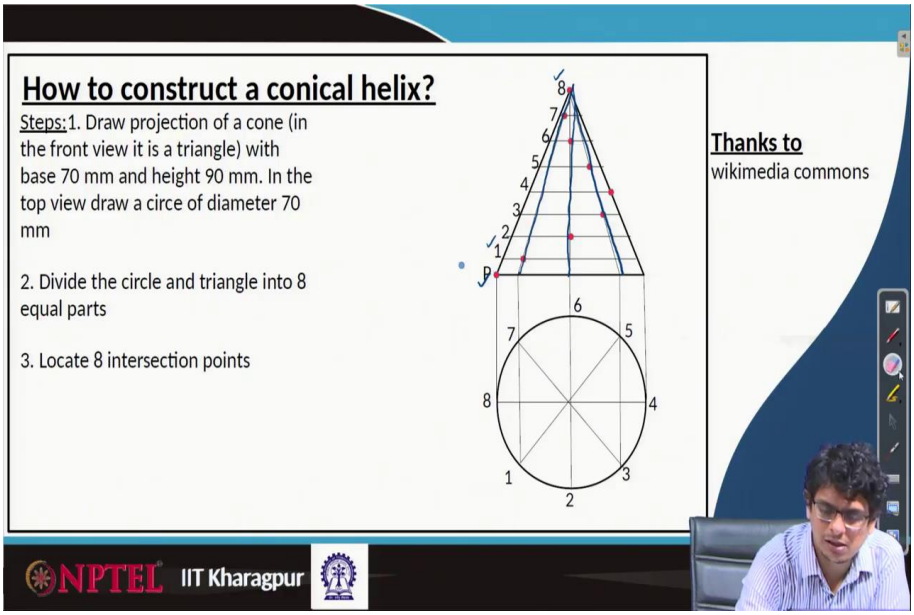

Then number them as point 1, 2, 3 to 8. Now from these labels 1, 2, 3, 4, 5, 6, 7, 8 of the circle; extend the lines which are going to generate lines on the cones. So, these are called generated lines of the cone. So, let us consider one of the particular lines.

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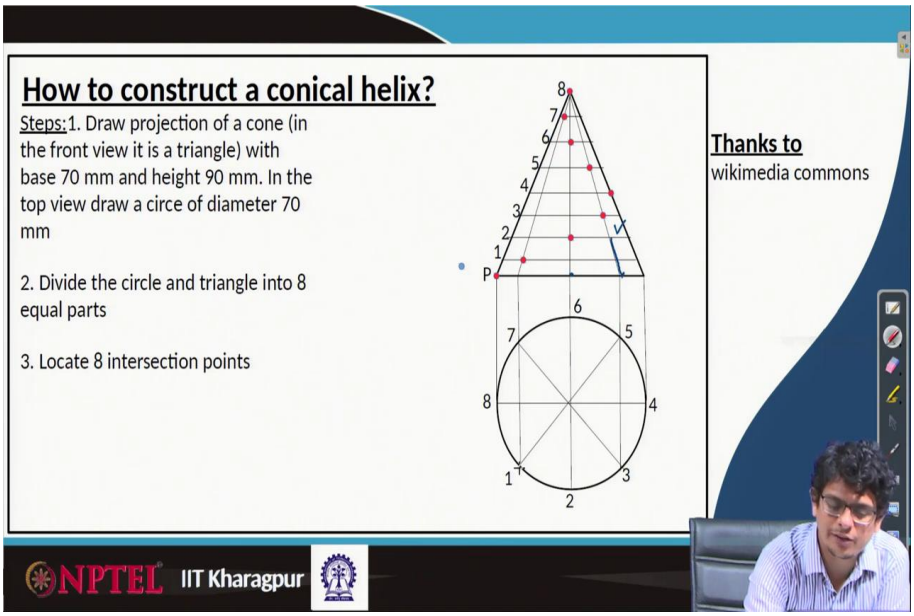

We would like to construct a generator at this point. We extend 3 lines to 5, the place where it is going to cut the base from there connect the point to peak or apex. So, this is the way we will

construct one of the generators. Similarly, from two extend to that point from that point to 8 apexes, if we are connecting another generator we can construct.

Similarly, a line extending from 1 to 7 cuts this cone at this base, connect this base with 8. First of all, we have to construct the generators of the cone and also an equal number of divisions on that cone.

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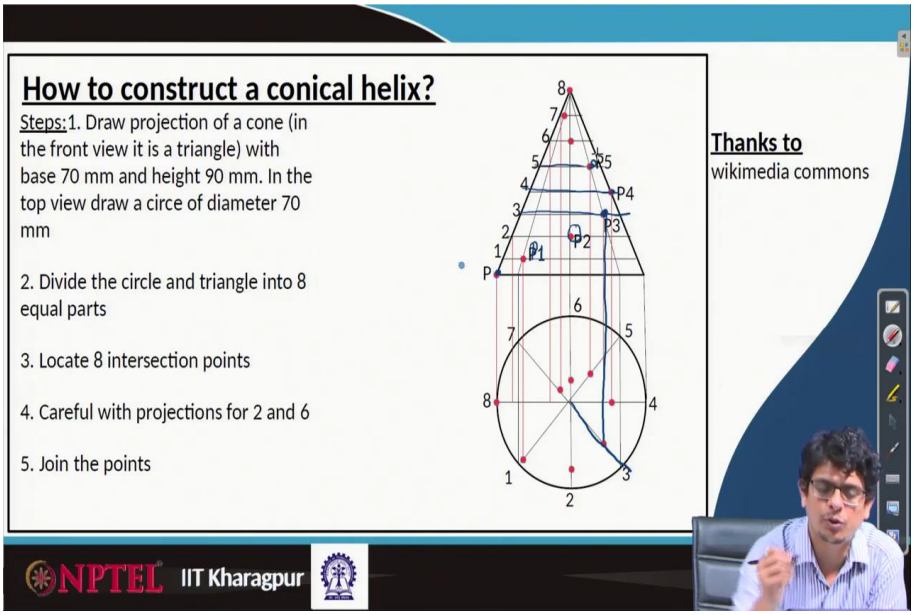

Once it is done, we will construct points or the winding rope around this cone in the frontal view. So, at this front view, we extend this 8 point going to make a point at P level similarly if we are going the intersection line of this 1 equal division and a line which is passing through 1 point that is also going to make a point P1.

Once it is done from second, extend a line and a horizontal line where it is going to intersect locate point P2. The horizontal line P3 on generate at 3; so this is the line where it is going to intersect extend it so that we are going to make another point P3. Similarly, P4 where 4th one and generate a line going to intersect. 5th generator line is passing through this point and 5th one intersecting point that. So we will construct in that way.

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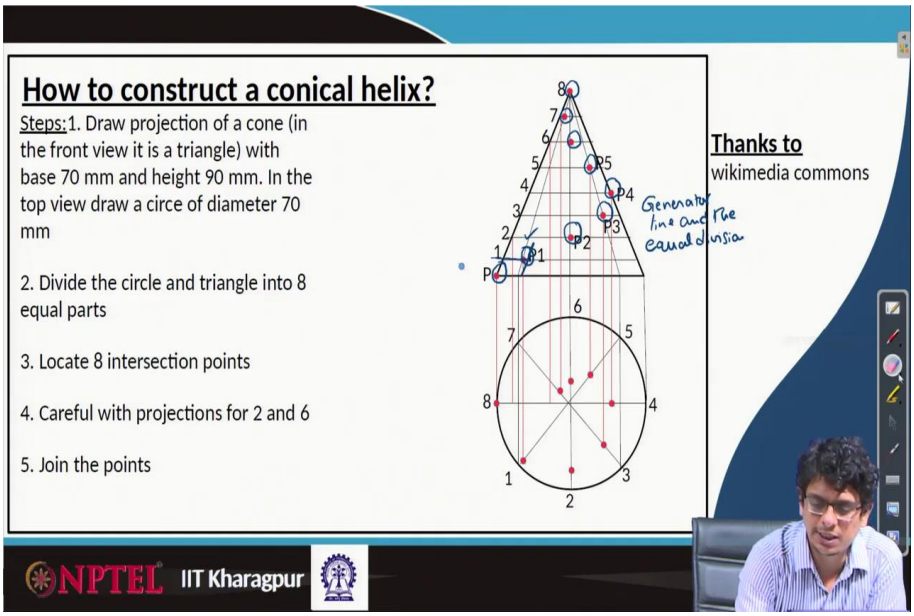

We locate points P1, 2, 3, 4, 5, 6, 7, 8. So, for the top one, we always have to intersect the generator line and the equal division made on one of the generators. So, the equal division made by one of the generators is this one intersecting with generator line 1. So, in that way, we will construct all these stop points.

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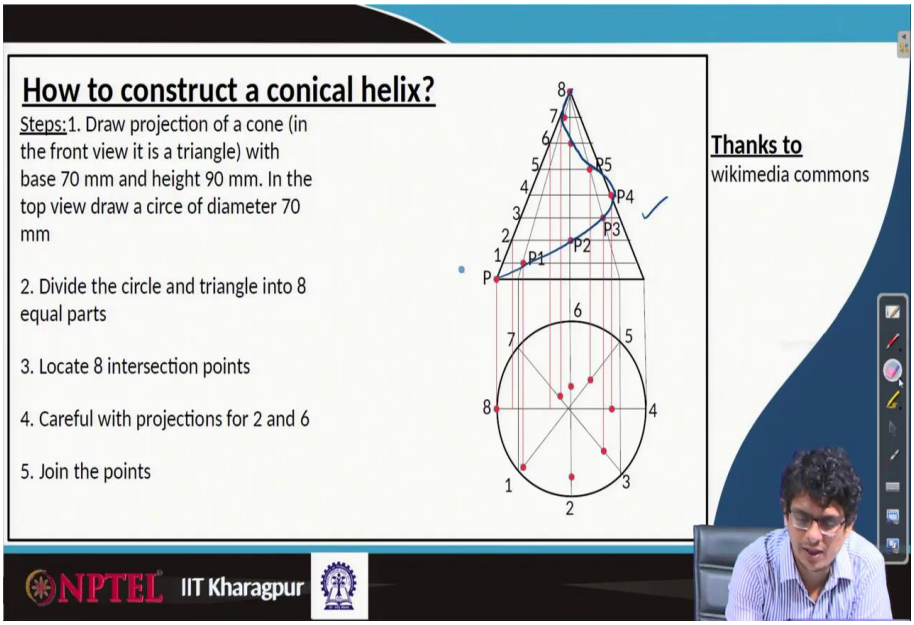

Once the stop points are made we can make a freehand sketch passing through P1, P2, P3, P4 takes a turn goes via that. This is the way we construct a conical helix winding a cone on the top side.

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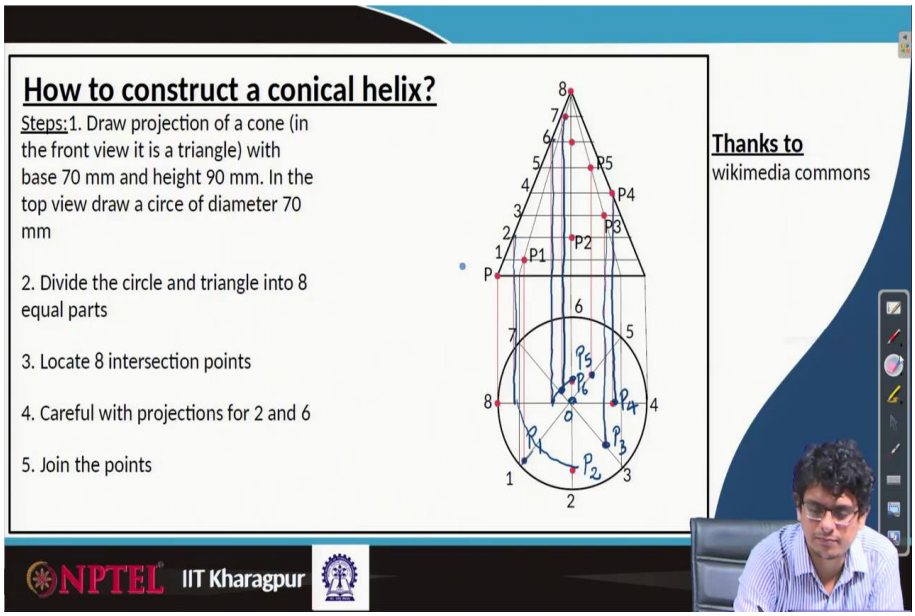

For the bottom view also, if we drop a perpendicular line from P, it is going to intersect the first line at this point locate that first point P1. Extend this P2 from one of the generator lines. Once it is done from the centre, make an arc which is going to intersect this point call it as P2, for P3 also drop a perpendicular so that it is going to intersect the 3 line call that P3, for P4 drop a line where it is intersecting call that point as P4.

Similarly from point P5 extend it down it is going to intersect there so call that point P5, for P6 drop a line from one of the generator all the way to end with equal radius from O to this point make an arc locate P6, P7 extend the line down is going to intersect at that point.

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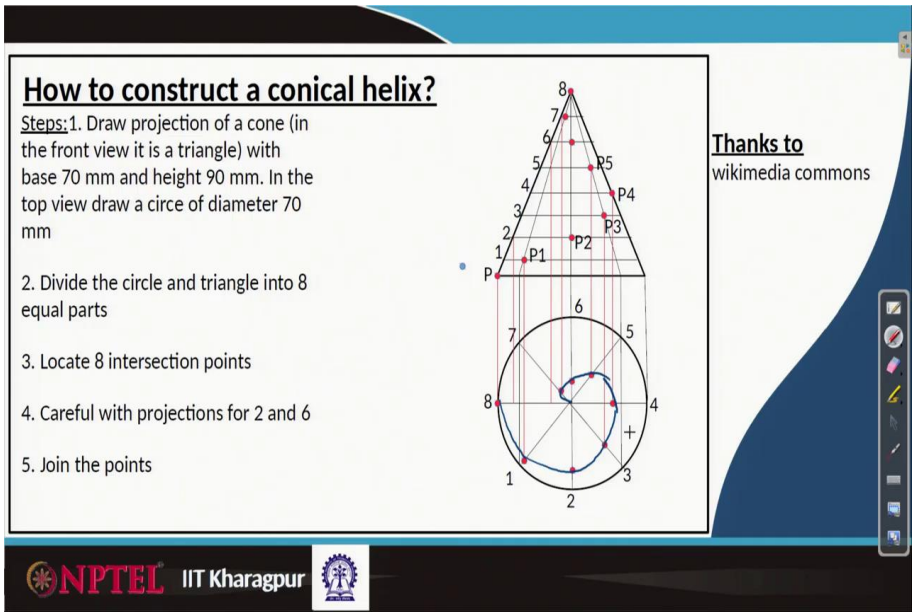

In that way, we will construct points P1, P2, P3 in the bottom view also. Then draw a line passing through these points this is the way from top view the conical helix looks like. Let us do that these steps on a graphical sheet.

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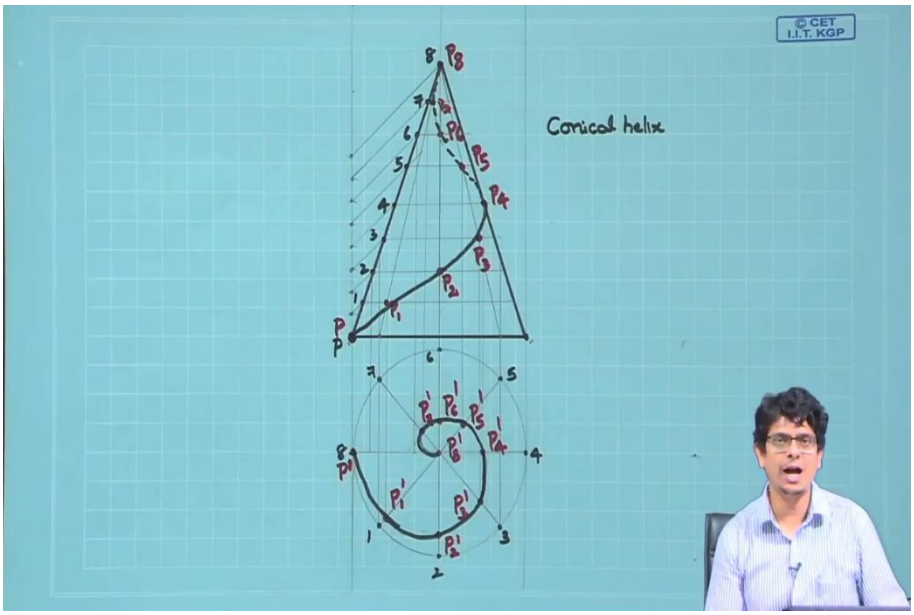

First, we have to construct a circle of diameter 70 mm. So, locate a point of 35 mm 0, 35mm. Let us extend the scale so that we can draw a tangent to that circle, parallel to that we have to move to construct parallel lines.

Similarly, draw one more parallel line up. Locate apex on these lines from any base let us join the baseline. So, let us make it the cone base.

We have to locate 90 mm as height for the cone, 90 mm. Join these endpoints to construct one of the views of a cone which looks like a triangle. Now divide this cone slant thing into an equal number of parts. Let us use this projected line into an equal number of parts. Use compass make 8 equal divisions; 1, 2, 3, 4, 5, 6th one, 7th and 8. Name these points 1', 2', 3, 4', 5', 6, 7', 8'.

Now join the first last point with the peak or apex of that cone, parallel to that construct. So, we need parallel lines so that other divisional lines, we will be in a position to construct it, draw a parallel. Now name these as 1, 2, 3rd point, 4, 5, 6, 7 and 8th point; 8 divisions are done. Now divide the circle into 8 equal parts 4 parts are done. Locate 45° angle on both sides; join it by a line.

Now name them 1, 2, 3, 4, 5, 6, 7 and 8 draw a line which passes perpendicular to these points. Which will be connecting this 1st point 3rd point, so it cuts the axis at this point. Similarly, extend 2 to 6 all the way up along this line. Similarly, extend 1st and 7th point. Now draw horizontal lines passing through 1, 2, 3 on this cone.

So, these are the lines which are going to intersect the generatrix. Now locate the intersection points for this generatrix. So, the first one is intersecting at this point 1, join that with apex. Similarly, join 5th one to point 8. Now the intersection points for 8 to P is P, so let us use red colour ink. The first point that P, the second point where these generatrix horizontal line intersecting, is P1.

Similarly, the generatrix and this line horizontal one intersecting at P2, extend 3 which is going to intersect 3 goes via these generatrix intersecting at P3, 4th line via generatrix intersects at this P4, 5th line again it intersects here, 6th one passes via this point P6 and 7th line it passes via this generatrix here, and 8th one passes via this generatrix P8.

Now join these lines by a freehand curve. When a rope is winded around a cone, the front part of that rope will be visible. While it is winding the backside of the cone, it will be invisible at the first front though it is there it is invisible for us. So, such kind of lines invisible things, but still present we show it by dashed lines.

So, let us connect; from P4 onwards it goes back and tries to wind, so we show it by the dashed line, so a dashed line passes through that. Now make a colour, so our conical helix looks in that way on the frontal view. So, let us do that for the bottom part of the curve also, from top view if we are looking from top view in this direction how does that helix wind on that plane let us draw that. So, the intersection points are at this P1, P2, P3, P4, and so on.

So, the projection projections what we are going to get here goes via these bottom-most points. So, let us move parallel to let us move parallel to this plane intersect P1 to first generatrix here located by a red line. So, the first point is here P again.

This one is P1 let us just use's for this P1', the second one it goes via generatrix. So, move parallel to 2 make it on to the horizontal line from there take a compass to make an arc on to the second one is intersecting here call that one P2'. Now move parallel to 3 it intersects here call that point P3'.

Similarly, pass parallel to this fourth one it intersects on 4 here so let us call P4'. Similarly, pass parallel to 5 it is intersecting at this point P5' for 6 again it goes via this point; however, we want

precise measurement which is going parallel to the 6. So, we intersect the horizontal one, measure the distance of this point on that axis. Connect this point as P6', P7 it passes via 7 it intersects this point call this one P7' and P8 anyway here.

Now join these because we are looking from top view in that direction so the entire row will be visible. So, on this view it will be a continuous line from the top we are looking, I am trying to show it on this horizontal plane. So, join by a smooth, freehand curve, which passes through P4, P5, P6, P7 and P8. Now join this entirely by a continuous curve to get a smooth curve we can use French curves.

So, this is what we call conical helix. Here it made one revolution. In certain cases, if we are making many more revolutions, a similar procedure has to be followed. Instead of one revolution if two revolutions are passing we are going to extend this curve to two more revolutions by dividing into many more number of parts and smoothly connecting it; with this, we are closing conical sections.

In the next class onwards we will learn more about these projections like; what is a vertical plane, what is a horizontal plane, how to visualize something in front view something as a top view, something as side view and the directionality of these views. See you in the next class.

Thank you.