Engineering Drawing and Computer Graphics
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Module - 02
Lecture -15
Conic Sections – VII

Hello, everyone. Welcome to our NPTEL online certification courses on Engineering Drawing and Computer Graphics. We are in module number 2, lecture number 15 on Conic Sections.

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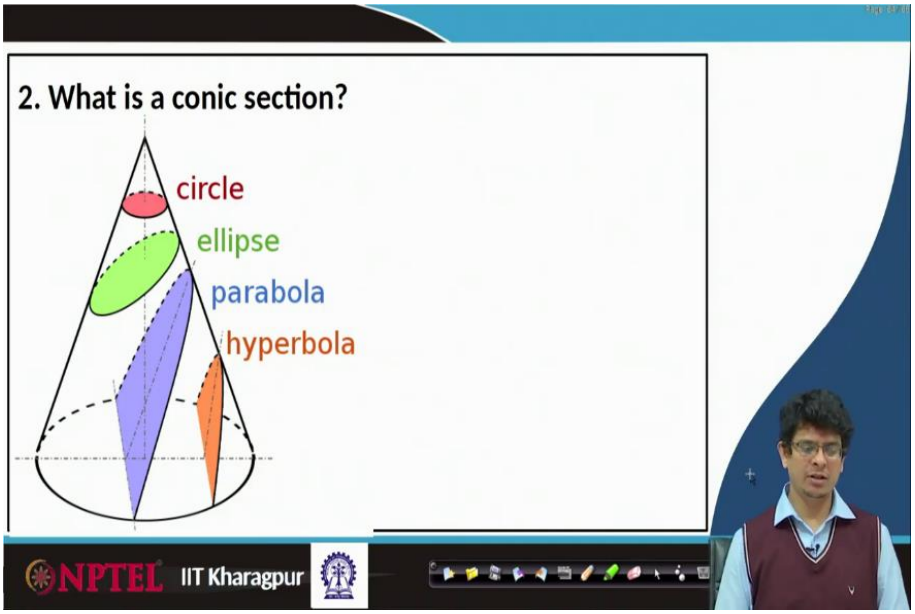

And in today's class, we will learn more about how to construct parabola? So, a parabola will be constructed by taking a parallel section to the slant and passing through this section. That gives us parabola.

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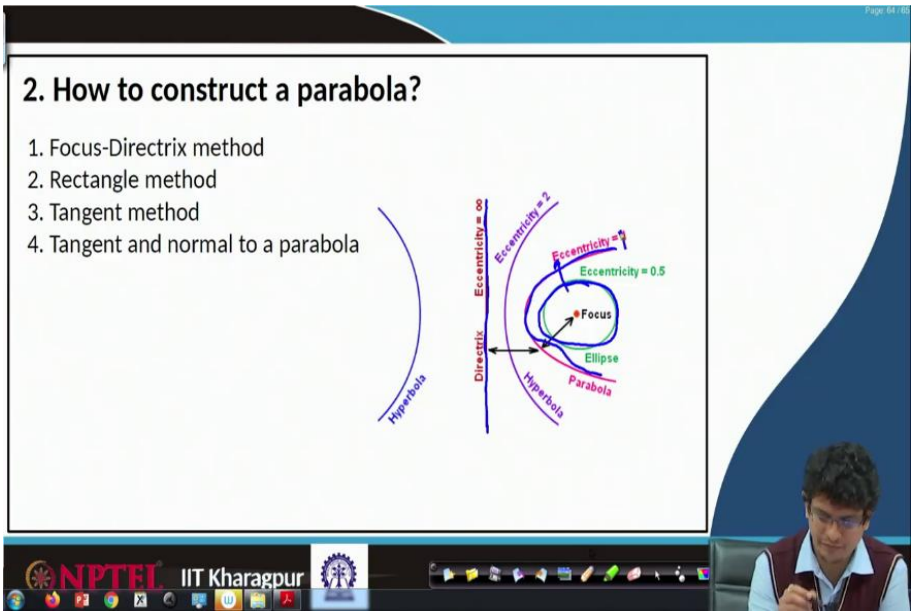

There are mainly three methods available for constructing parabola; one is using focus directrix method. The second one is the rectangle method, and the third one is the tangent method. To construct it through focus directrix method, let us recap how to construct this.

A directrix is the one which is having infinite eccentricity. Let us look at briefly if there is a focus a circle with an increase in eccentricity turns out to be an ellipse. Further increase in this eccentricity from the directrix, it becomes a parabola for which eccentricity is equal to 1.

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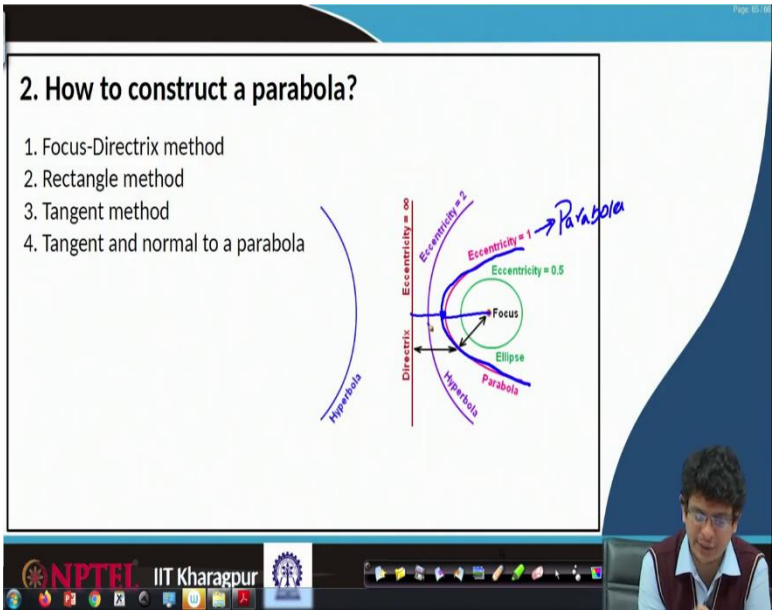

So, this is the parabola for which eccentricity is 1 that means, pick any point on parabola focus to point and directrix to that point makes equal ratio.

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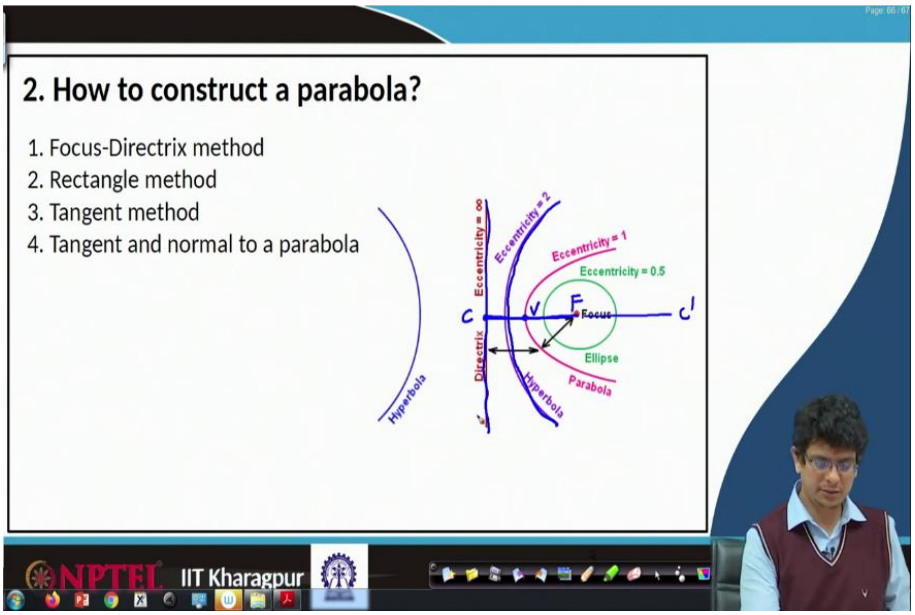

Usually, we note it by focus may be a point V on this point C on CC axis C V and V F are the same for the parabola. Further increase in eccentricity one will be going to get a hyperbola; infinite eccentricity is the vertical line or this straight line.

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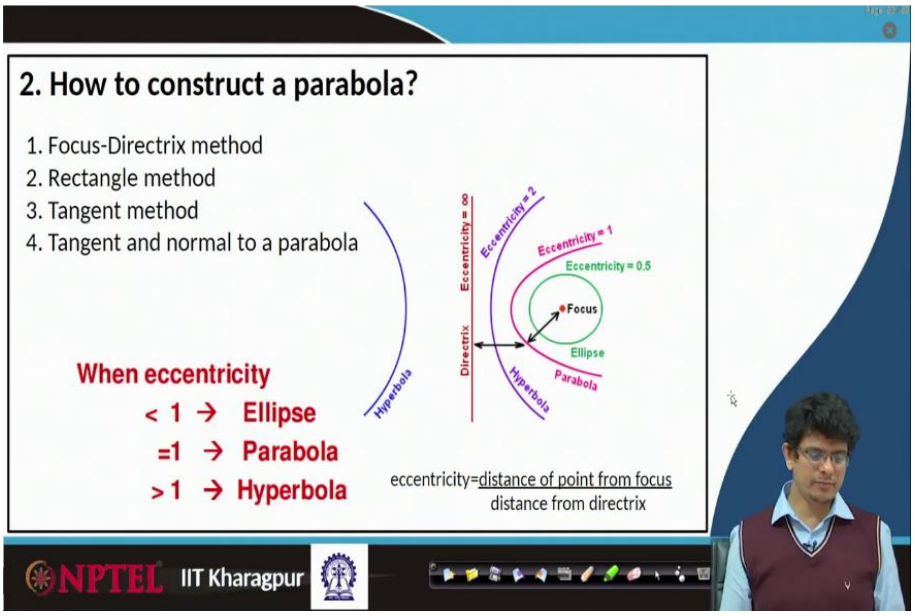

We have already linked eccentricity is the distance of the point from focus to distance from directrix.

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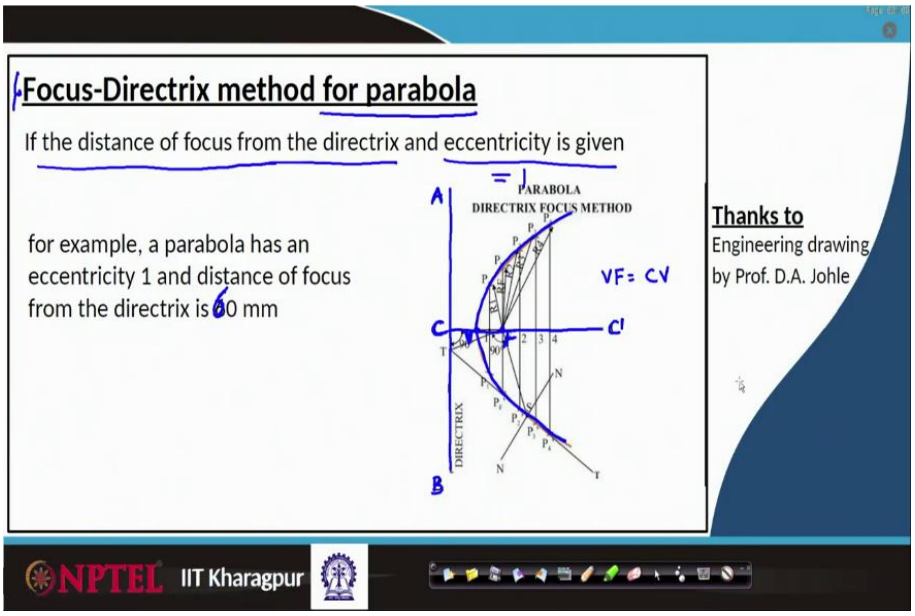

Now, using focus directrix method, the first one focus directrix method, we will construct a parabola. Suppose the distance of focus let us begin with an example. In that case, focus from the directrix is given, and eccentricity is given for parabola eccentricity always be 1, whether it is given or not.

Let us construct a parabola, for example; a parabola has an eccentricity 1 and distance of focus from the directrix. Let us take 60 mm in this case. So, using directrix focus method we are going to construct this parabola, let us call this point is C, and this is C', and focus in our definition F.

By eccentricity, we will be in a position to locate V where VF is equal to CV. For this purpose, what we do is first draw A B line, as directrix then a perpendicular line CC'. The distance from focus from the directrix is known. So, locate this point V by knowing C and F, once this CV VF is known we are going to construct the rest of the parabola.

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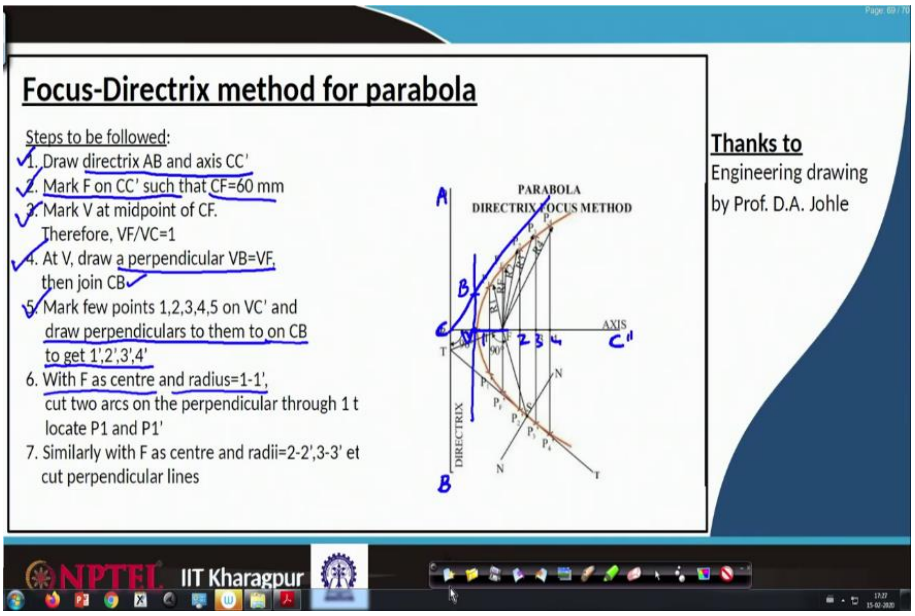

Let us name this is CC' V point A B point as directrix. First, draw directrix AB on axis CC'. So, parallelly let us construct it on our graph sheet.

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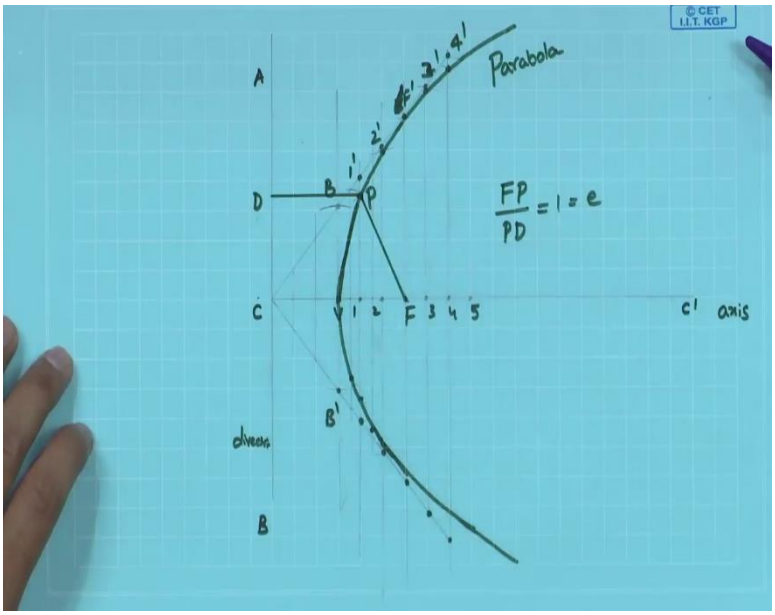

AB we have to draw first, directrix is a vertical line name it, A somewhere B draw something axis CC', which is horizontal line. Perhaps let us draw a very long line name it CC' this is axis, and this is directrix. Once it is done mark F on CC' such that CF is equal to 60 mm.

Let us go on to our sheet, mark F on CC such that CF is equal to 60 mm means here. Let us go ahead mark 60 mm so; this is the point where we have focus. Now, mark V at the midpoint of

CF because eccentricity is 1 we are going to mark at midpoint which is at 30 mm. So, after that at V draw a perpendicular VB is equal to VF, VB is equal to VF means this is VF here. We have to draw a perpendicular in that direction.

Whatever the VF distance here; locate B, that means, now we use our compass whatever VF distance on our graph sheet, we mark it here on both sides join these points. So, this point is our B B B' let us call it. So, VB is equal to VF and then joint C and B so, C and B we have to join. So, on this is the way we have to join something like that. So, CB let us join it so this point.

Now, we have to mark a few points 1 2 3 4 5 on V C'. So, V is this C' is that mark something like 1 2 3 and 4 points these are arbitrary points. So, let us pick somewhere at equi division 1 2 focus 5 6 and 7 points and there, we have to draw perpendiculars. So, there we have to draw perpendiculars to them on to CB to get 1' 2' 3' 4'.

So, here because these are grid points are coinciding, and our parabola passes through F. So, after that F we draw these lines here also we draw these lines, draw this vertical and so on. The way how we have constructed B', B we join C and B' also join C and B'.

Now, we have to mark once we drop these perpendiculars from points 1 2 3 4, let us call 1 2 3 4 5 drawing perpendiculars on to CB to get 1' 2' 3' 4' same things on this side also we will get. With F as centre let us look at sixth one with F as centre and radius 1 1'.

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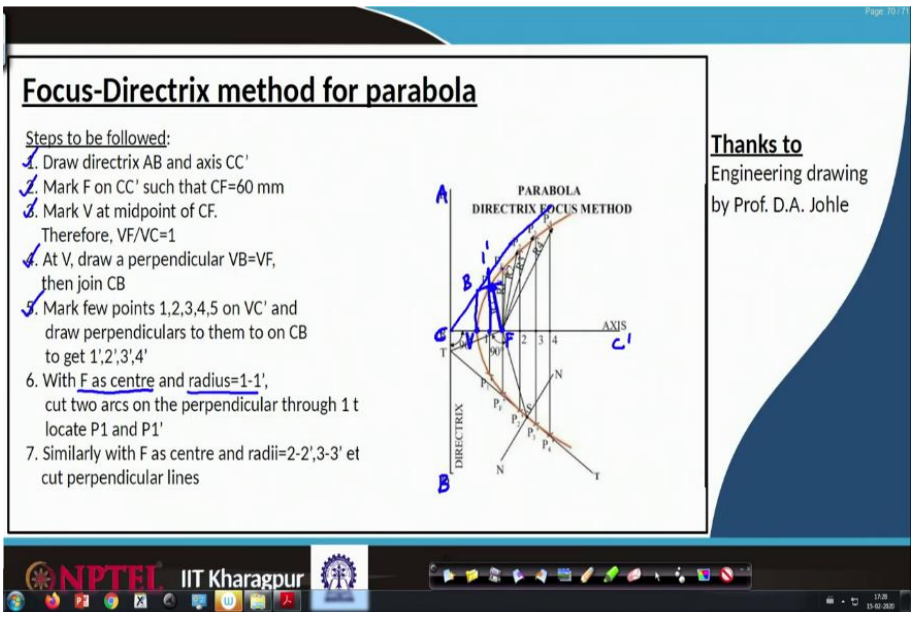

So, let us erase this we are already done. 1 2 3 points and this one we named it as CC'. Furthermore, this one as A and this one as B, and this is the focus, and this is V. Now, with F as

centre; that means, this point we have to take and radius 1 1'. So, 1 is this 1' is somewhere is joining CB line somewhere, if it is passing in that way we have identified something like B point. So, 1 to 1' where it is going to intersect that point on B curve from B here, we have located B ok. One we have extended so, that 1' we got. So, whatever 1 to 1' length use that length from focus as the centre, with F as centre and radius 1 1' make an arc which intersects this curve. So, let us look at drawing sheet 1 1' pick that length, this is the 1 from the focus we have to construct it, our focus is this on to one intersect it this is the point. Similarly, 2 to 2' with focus centre intersect it, 3' thing is going to intersect here itself 4 to 4'.

Let us name this one this is F', and this is 3', and this is 4'. So, 3 to 3' let us measure that this is from F intersect, this curve. Similarly, F 4 to 4' use F intersect there. So, if we have those points join them, one can construct even at this point. Let us construct one more point here on BC, let us construct one more point here also we can construct another 1. However, this curve passed through V so; it has to go in this direction; that means, any middle points we can always construct it to improve the accuracy. So, if these points we are going to join in that way it goes. Similarly, if we are constructing on the bottom side, this is one distance from focus intersect 1. Similarly, from this point to all the way perpendicular to B' line, but focus as the centre. Similarly from this point focus with focus intersected and so on. So, we join these intersection points with a freehand curve. It goes in that direction, and this is the way we construct a parabola.

Suppose we are looking at this pick any point on the curve. Let us pick the first point this one point P. Let us pick this horizontal distance, let us call this one D FP by PD always be 1 by eccentricity definition.

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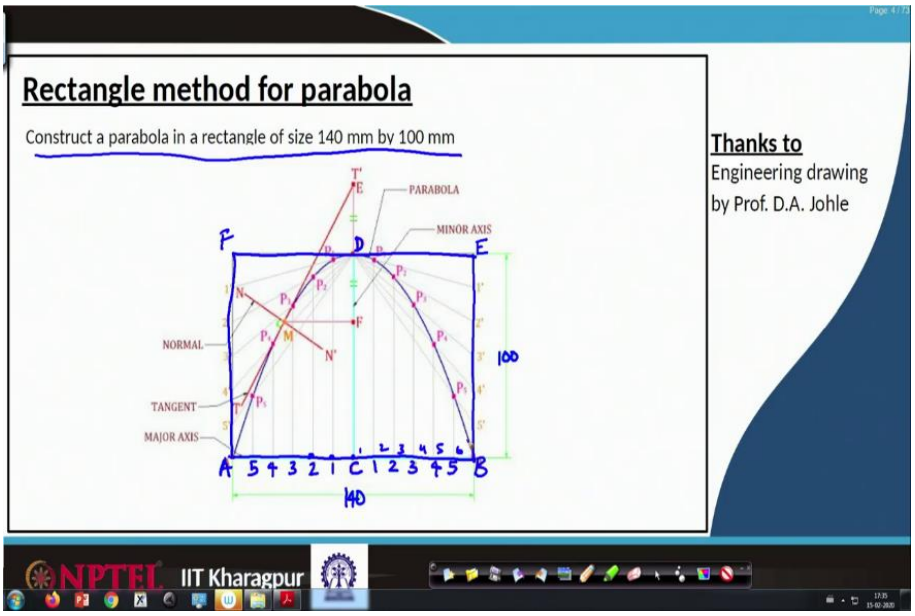

Now, we will go on to construct a second method, which is based on the rectangle method for parabola construction. In this rectangle method which we have learned for the ellipse, a similar strategy we will use. Let us look at that a parabola has to be constructed with a rectangle size of 140 mm by 100 mm. So, first of all, construct a rectangle point A point B something named D maybe E and F. So, this is 140 mm, and this is 100 mm.

Then, what we have to do is this point is C, now the major length A to B which is 140 mm. Because, it is a rectangle length what we are trying to do divide into an equal number of points so, C 1 2 let us say 1 2 3 4 5 on both sides. So, 1 2 3 4 5 6 equal divisions we have constructed. So, divide that into 12 equal parts which are 6 on both sides.

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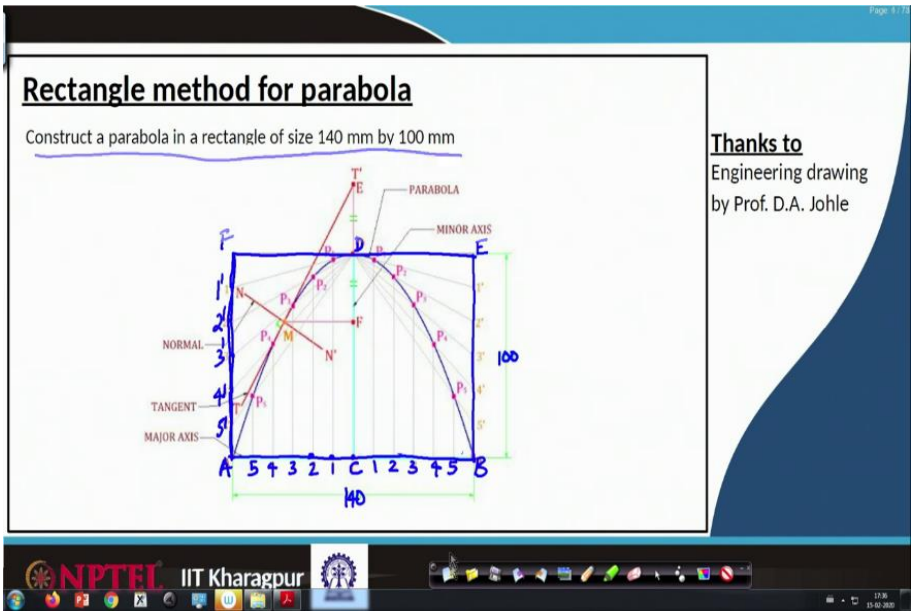

Now, here also first, second, third, fourth, fifth, sixth, six equal divisions let us construct it. Name it 1', 2', 3', 4', and 5'.

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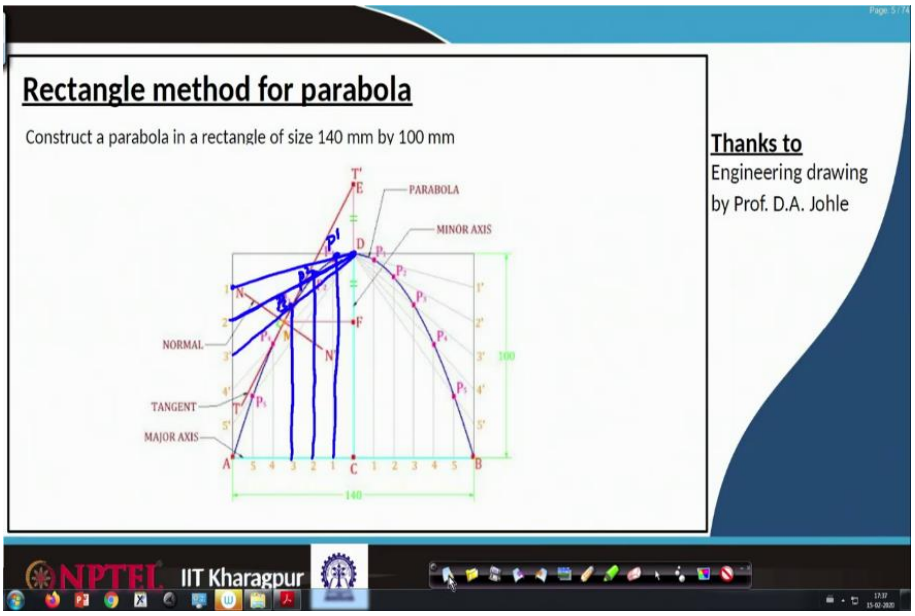

Once it is done from D point, connect the first point. Similarly from D connect the second point third point and so on. The first point the vertical projection do that, wherever it is intersecting call that point as P 1. For the second line; that means, this is the line from second point project it up intersection point P 2—similarly, the third projection on to third line P 3.

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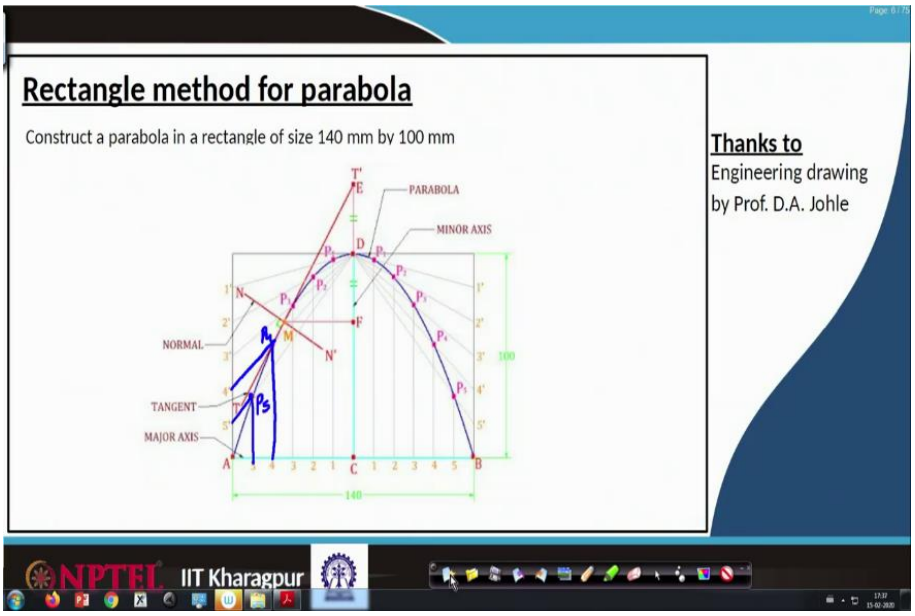

And similarly fourth projection on to fourth line P 4. Similarly P 5 we will be in a position to construct it.

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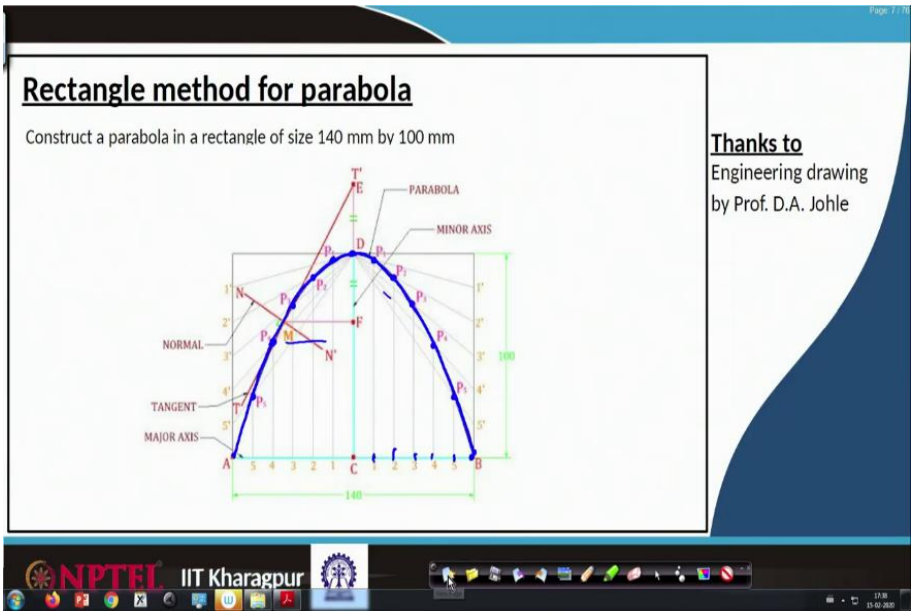

Once these points are located those are this 4 3 2 1 and D already A point is there join, these points by freehand one will be constructing this parabola. It is a symmetric one so; one can horizontally project it to get this. Otherwise, already we have constructed this 1 2 3 4 5; same procedure.

We can repeat it to construct the symmetric points on the other side after that join them to construct this parabola. Let us do it on the sheet. First of all, we have to draw 140 mm by 100 mm rectangle on the sheet.

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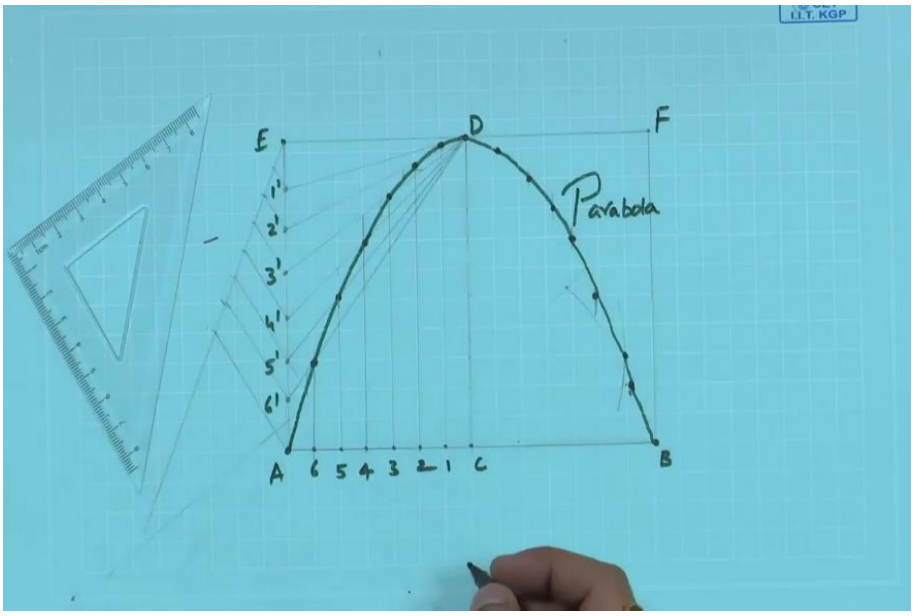

So, somewhere 140 mm locate these endpoints A and B, the vertical one 100 m m is already a graph sheet so, on this 100 mm. We are going to call this point something E same 100 mm locate it on this side also, join these E and F points call F. Now, divide this into equal parts 140. So, it passed through the centre of this. Now, bisector we can construct it otherwise 50 mm join these. So, that perpendicular bisector will be in a position to construct. Now, for parabola, we do not have to divide into 4 quadrants like an ellipse. Parabola is always symmetric about this vertical axis what we are going to get after naming this point C and D; we can divide this into equal parts something like 7 equal parts here. Let us do 1 2 3 4 5 6 and the 7th one. Similarly this we have to divide into 7 equal parts.

So, we already know 100 mm if we want to construct, 7 equal parts what we have to do is make an inclined line use our compass to make seven points 1 2 3 4 5 6 and 7th one. Once we know that join these points parallel to that, we have to go. So, the easiest thing is, first of all, construct a perpendicular line. So, the set square can be adjusted. So, let us extend this line all the way end. So, that we get support for our set square, on this, we can construct equal divisions let us begin here. So, we have identified these points remaining things we can erase ok, points are identified. Let us call them 1 2 3 4 5 and 6 these are 1', 2', 3', 4', 5' and 6' connect from point D. So, we have to extend these lines D to 1 D to 2 D to 3 D to 4 D to 5 D to 6.

Now, from one we have to draw perpendiculars which are going to intersect the first line. The perpendicular 1 is on the graph sheet here, this 1 for 2 we have to intersect with 2 for 3 again it decreases 4. This is the point of intersection. So, let us name it 1 P 2, P 3, P 4, P 5 and from 5 and 6.

If we join these points so, a freehand sketch, so, let us do a freehand sketch from bottom construct parabola. This part of the thing and one can make symmetric arguments by measuring whatever this distance, for example, the easiest way to extend this line is, we have to construct many horizontal lines 1. Using drafter, one can easily construct these horizontal lines, in that way measure from this centre on. Similarly, whatever these horizontal distance on this point, for example, let us pick this one, the same point we will be having on this side. Similarly, let us pick this point somewhere where it intersects. So, let us name these points, similarly if this is the point on the horizontal graph sheet is going to intersect here and on this horizontal, this will be the point. And for this is the curve whatever it is intersecting, similarly, from this point the curve is symmetric. So, using that argument, the rest of the curve can be constructed. So, let us pick this unit horizontal. So, from here and this is the point so, a freehand sketch. In this direction can give us this parabola.

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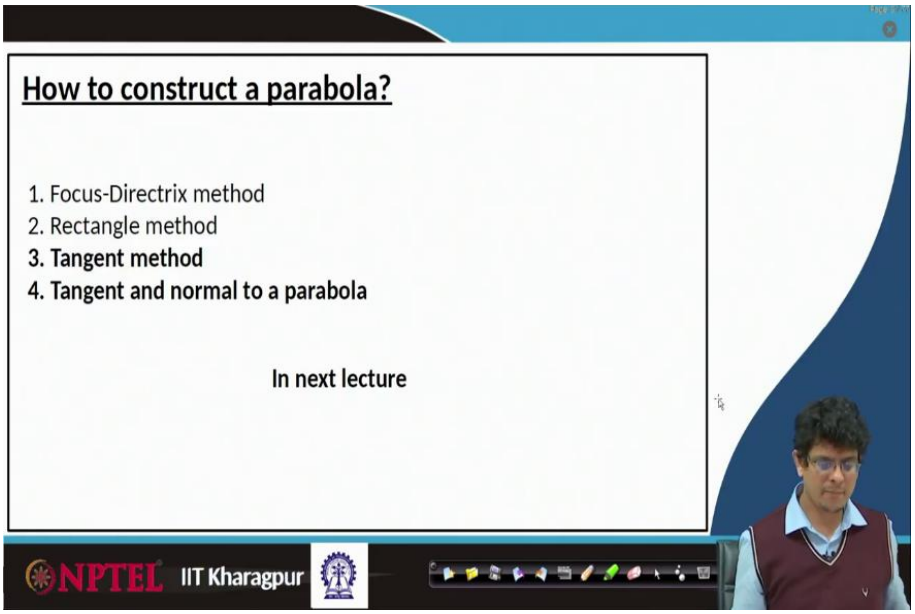

In the next lecture, we will learn more about how to use the tangent method and how to construct tangent and normal to a parabola.

Thank you very much.