Engineering Drawing and Computer Graphics
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Module - 02
Lecture - 16
Conic Sections - VIII

Hello everyone, welcome to our NPTEL online certification courses on Engineering Drawing and Computer Graphics; we are in module number 2 and lecture number 16. In this module, we are learning about Conic Sections; especially how to construct parabola, how to draw a normal and tangent to it.

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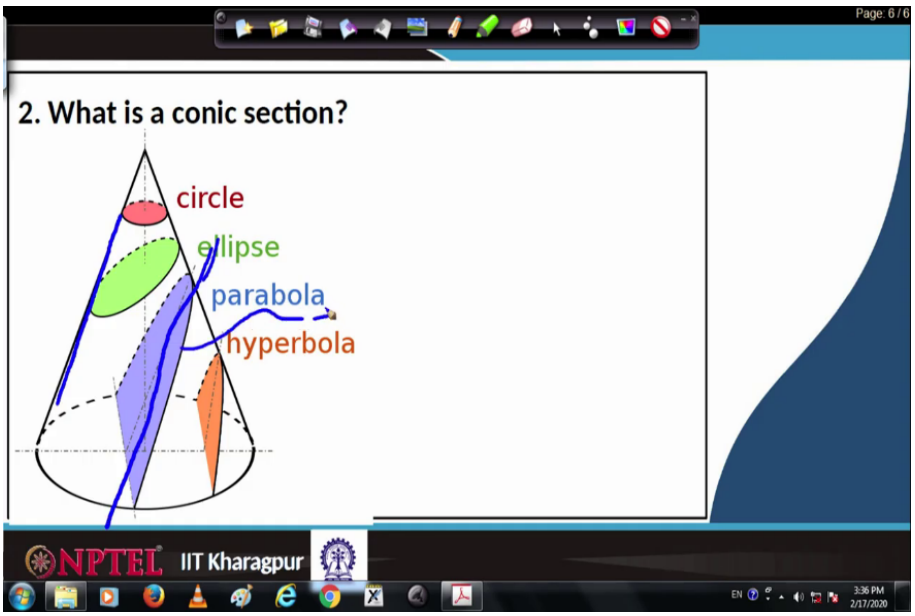

In the last classes, we have seen parabola will be constructed when a section parallel to one of the slant edges; if we are going to construct it, take a section, then we will be in a position to construct a parabola.

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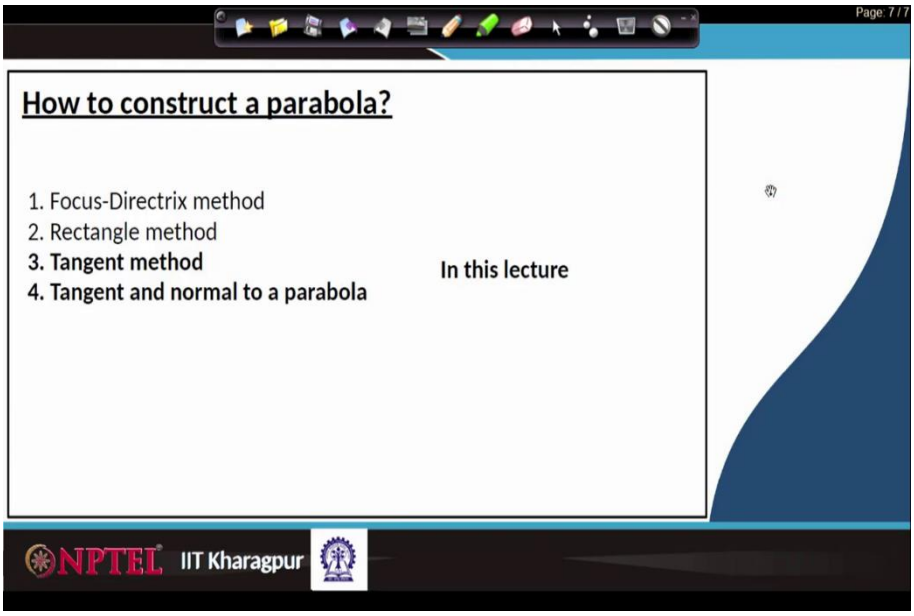

So, in the last classes, we have learned about focus directrix method; how to construct a parabola and a rectangle method. In today's class, we will learn about the tangent method.

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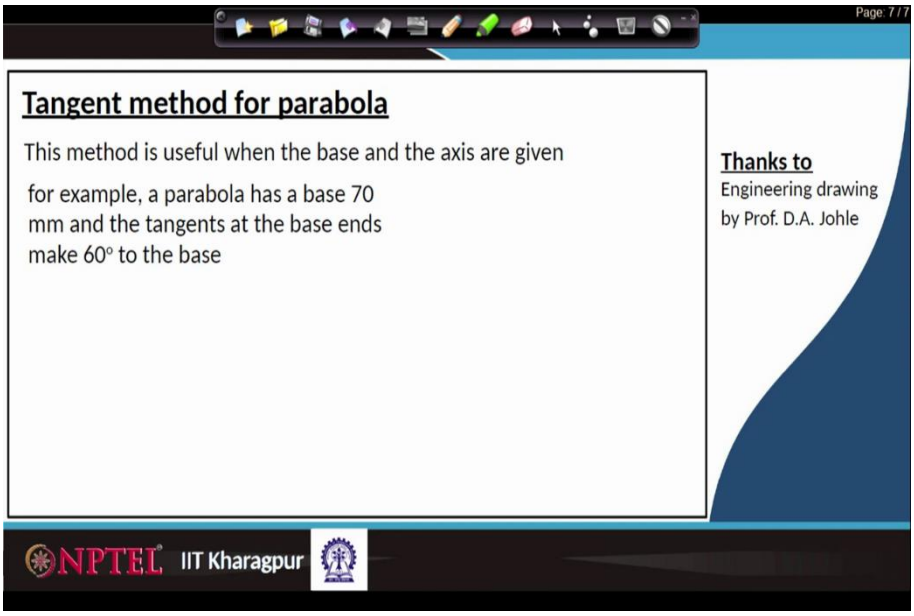

For example, how to construct a parabola with a base of 70 millimetres and the tangents at the base makes 60 to the base?

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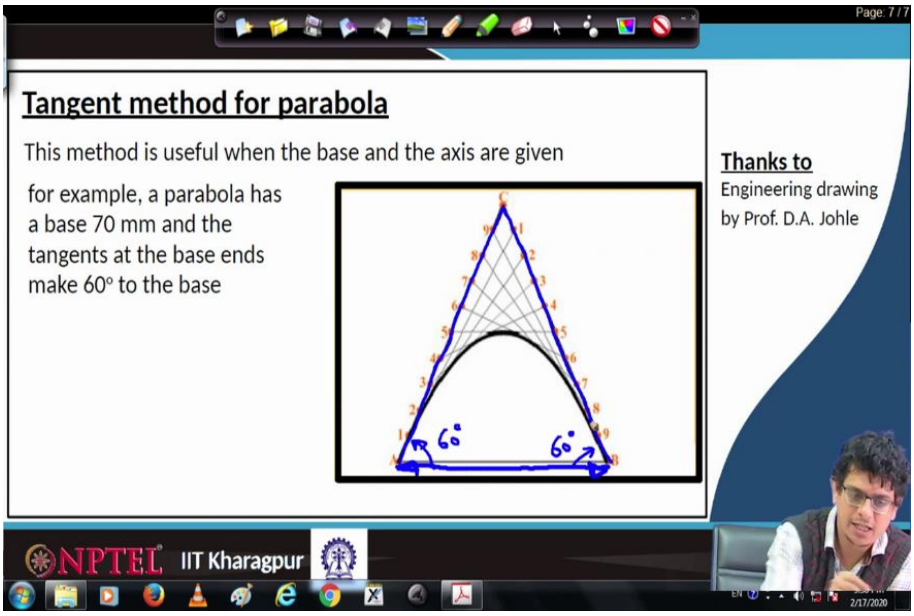

Let us look at this picture. Here the base length 70 mm is given. And the tangents; for example one of the tangent to C makes an angle 60. Similarly, the other tangent which begins at C goes all the way to B; this also makes 60.

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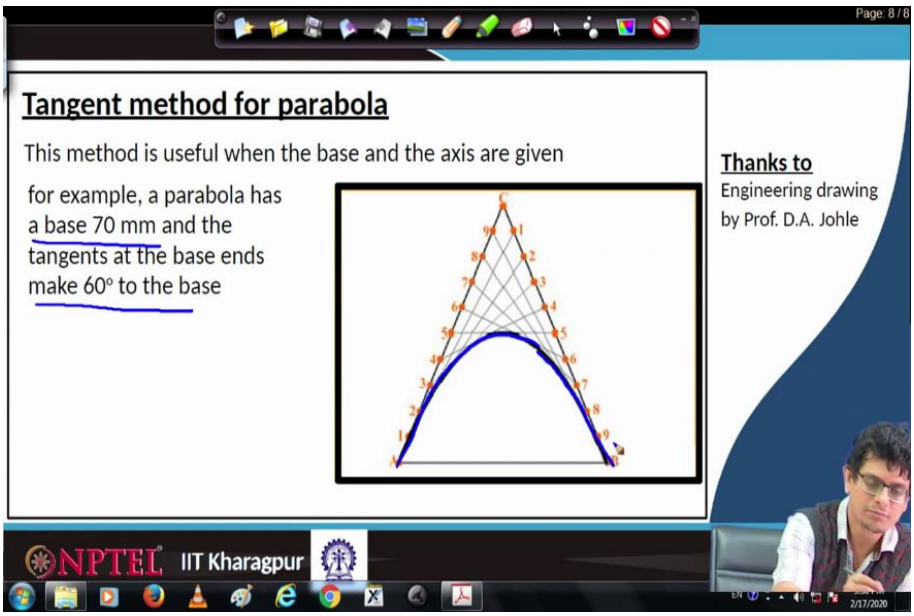

In that case, if only base 70 mm is given and tangents making 60; then how to construct a parabola which satisfies these conditions graphically?

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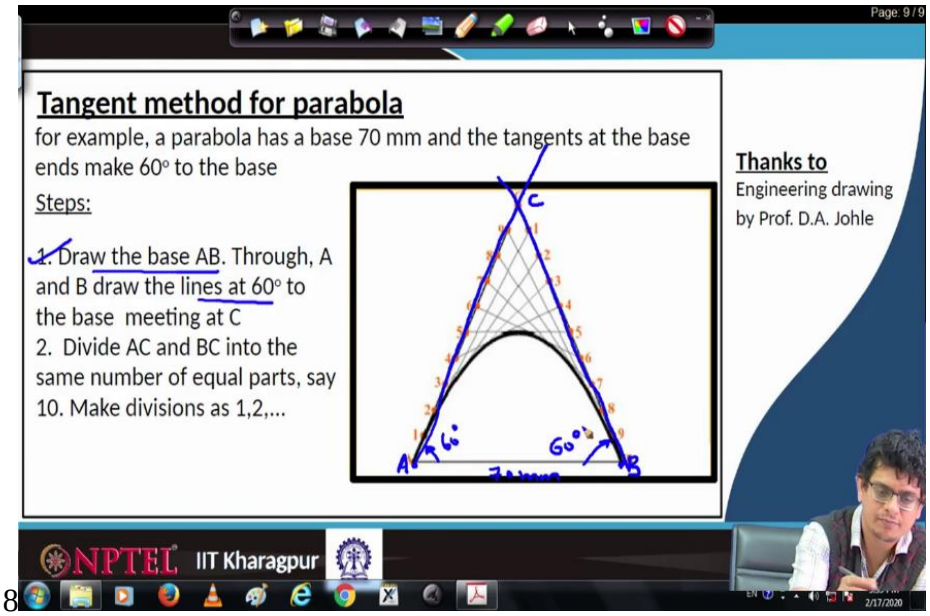

First of all, what we have to do is for a graphic construction, mark point A and B; these two points are at 70 mm apart, so this one 70 mm apart.

Then from A use protractor, draw a line A up making 60. Similarly from B draw another line which joins the first line at C point, and from B this also makes 60.

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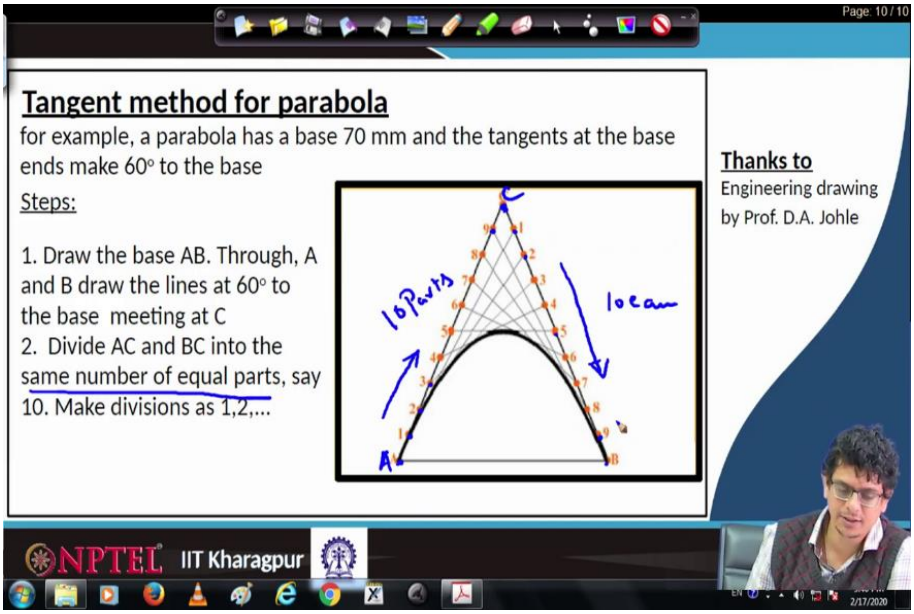

Once it is done, divide A to C into an equal number of parts, the same number of parts like 1, 2, 3 to 9; so 10 equal parts we are going to construct on this side.

Similarly, from C to B also 10 equal parts we are going to construct. After construction, these points we are going to mark in the ascending order and the descending order; something like 1, 2, 3, 4 and so on 9, then 1 begins 2, 3, 4, 5 to 9. So, in the ascending order and descending order, we make an equal number of parts.

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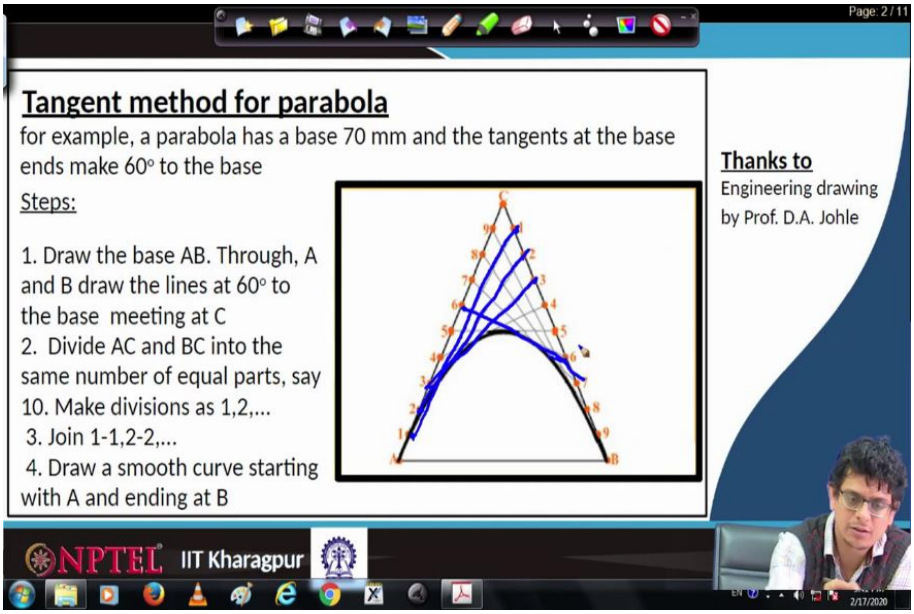

When these lines; for example, let us pick this one, 1st point and 1st point join them by a line. Similarly, 2nd point and 2nd point join them by a line; 3rd to 3rd point, similarly 6th point to 6th one let us join it.

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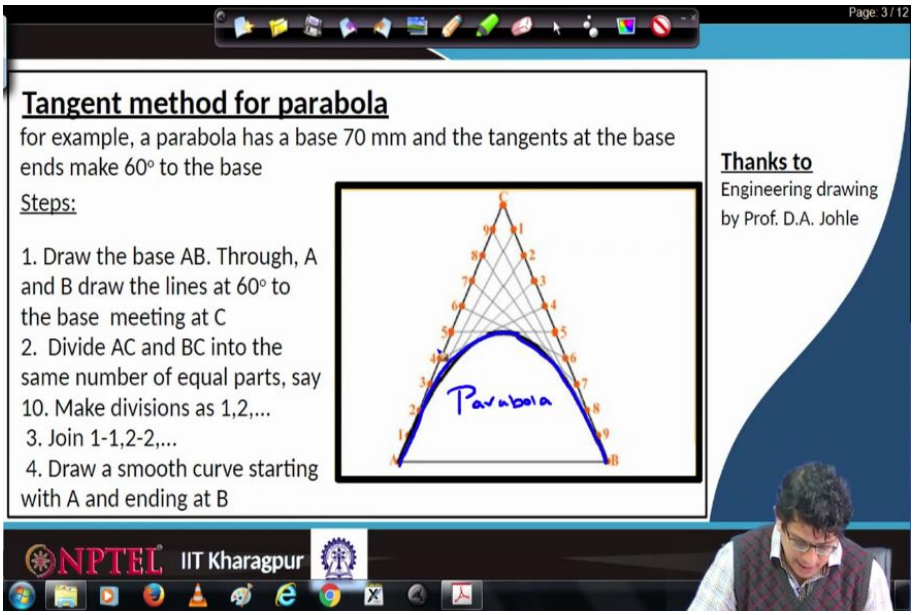

After that, join a smooth curve which passes through all these lines. So, this curve in some sense tangent to this curves, this is the way we construct a parabola by the tangent method. If we have more number of points, it will be a very smooth curve. Let us do that on the sheet. First, we have to construct six 70 mm base.

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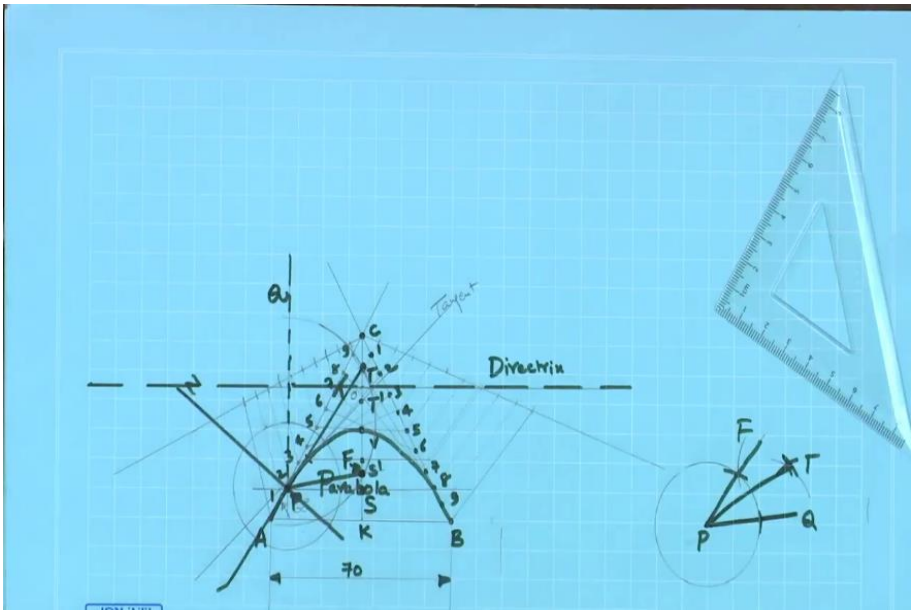

Let us draw that base on this sheet, mark 70 mm; mark these points as A and B, these are the points. After that 60 angle, we have to make with A; the tangents are making 60. Join them, A to up, so that these are going to intersect at point C.

Now, use an inclined angle to make an equal number of divisions on both sides, divide the line; it can be beginning from A to C, or it can be from A ah C to A also, it is perfectly fine. 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9 and 10.

Now, join these points. Now we can use roller scaler if it can pass parallel to that. So, we can mark these points. So, the numbers what we are going to make is 1, 2, 3, 4, 5, 6, 7, 8, 9 points. Similarly divide this line CB also; 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10.

Once it is done, join this 10th one with B and move our roller scale to pass through these points carefully. Once it is done, let us name these points 1, 2, 3, 4 all the way 5, 6, this is the 7th point, 8th, 9. Now what we have to do is join 1 with 1, 1.

Similarly, 2 with the 2, then 3; similarly 4, 5, more number of points it will be a smooth curve, then 8 and 9. So, already we have that converse zone; a smooth curve pass through these lines, we have to construct. So, 1, this is the way we construct a parabola.

If we want to mark these construction lines, drop-down these vertical lines and mark by arrows 70, and the other inclination is this is 60.

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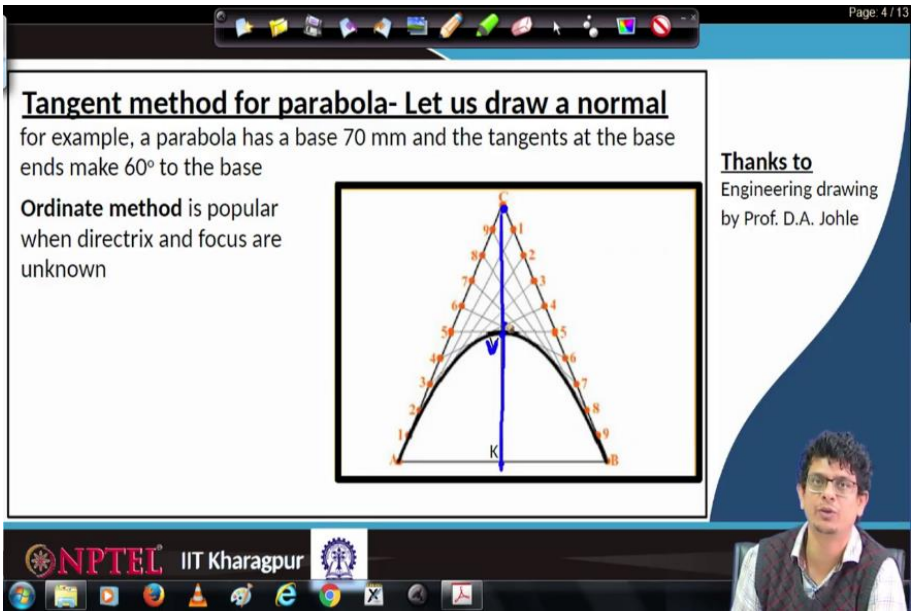

Now let us construct a normal to the drawn parabola. And this is popular as an ordinate method for constructing these normals and tangents. Further first of all what we have to do is, from C drop down a vertical line, from C to K drop a vertical line; the intersection point is the vertex of the parabola, let us name it V.

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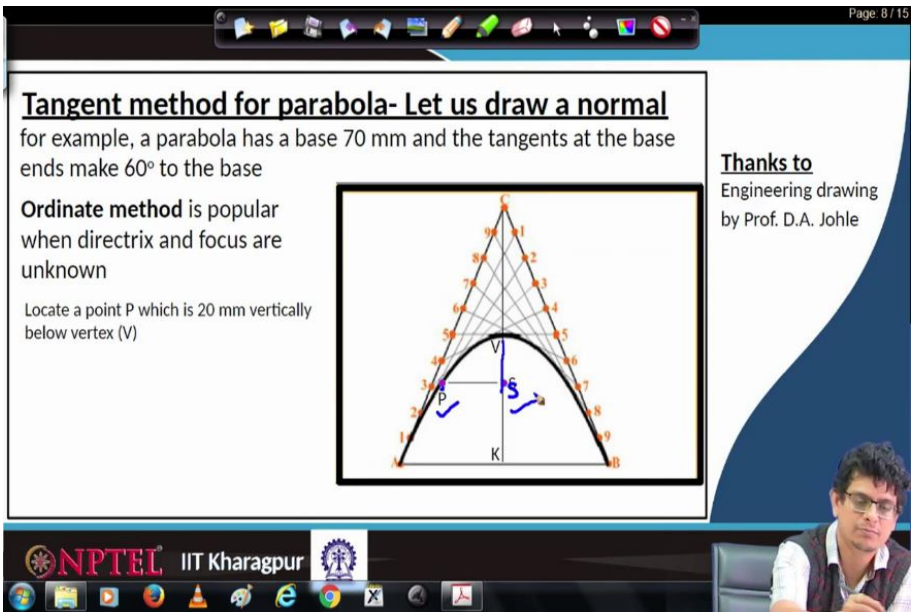

After that if we are interested in drawing a normal at a point P, let us consider this is the point P; here we would like to construct something like a normal in that direction. To do that; first of all, from vertex go below by 20 units, locate the intersection point P and on the vertical line C to K, locate another point S.

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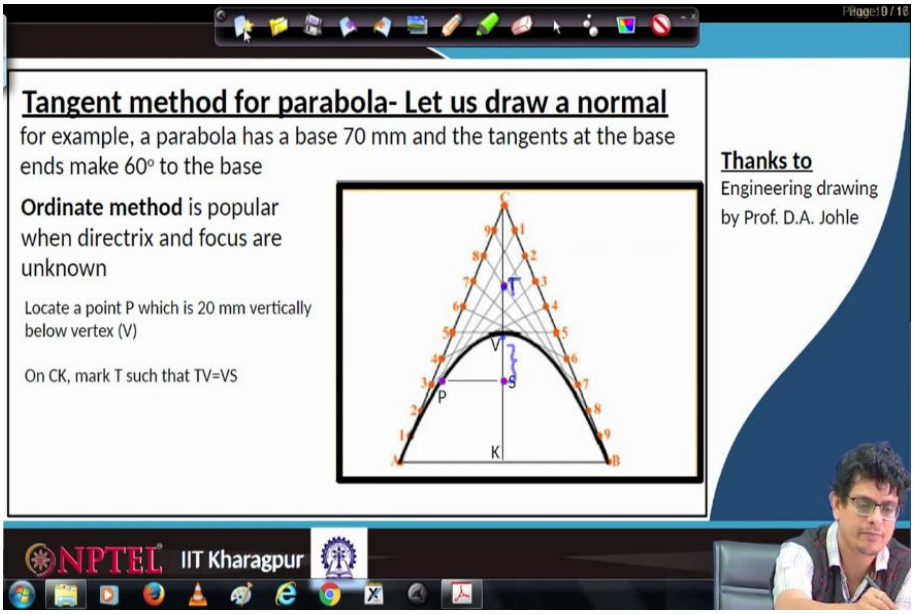

So, first of all, we have to locate P and S. After that measure the distance from V to S; from V to S whatever the distance is there, using compass from V to T also locate it. So, find this point T.

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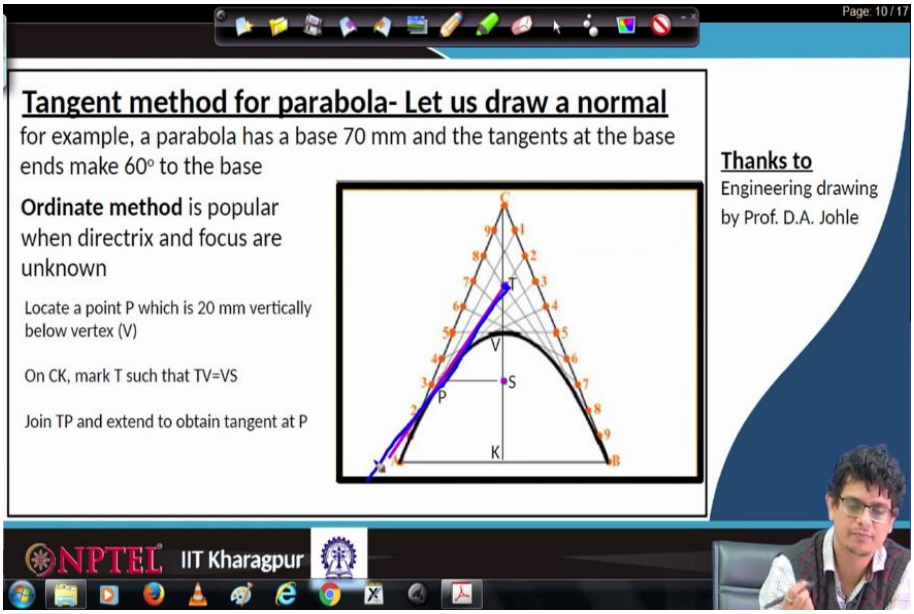

After that draw a line connecting from point T to P; if we are extending this line, this is what we call tangent line.

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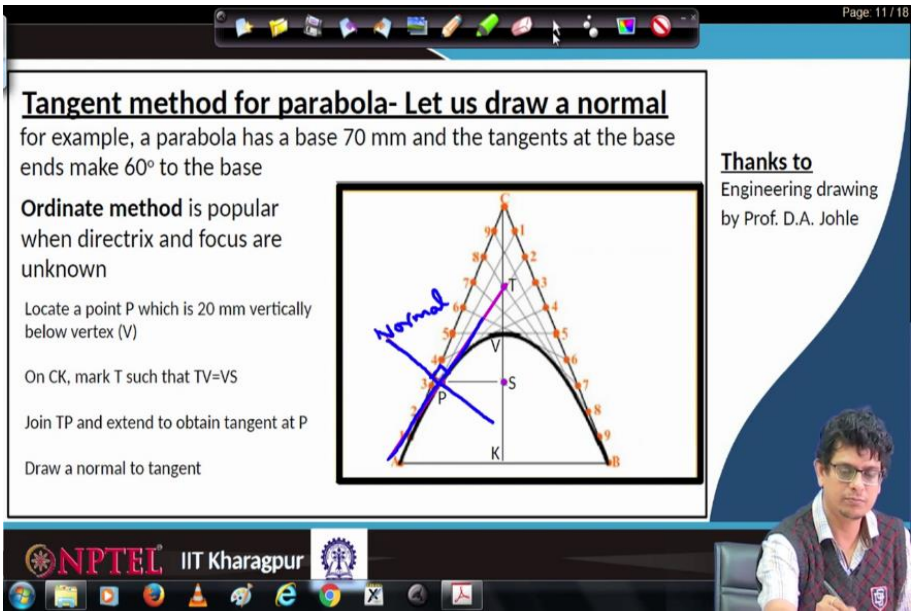

Once the tangent line is there, we can easily construct a 90 normal passing through that point; this angle supposed to be 90 and this one is a normal line, and this one is a tangent line. Let us construct that step by step.

Let us look at this sheet; we have already constructed the parabola this one. Now locate a point, for example, this one; let us mark this point here, We are interested in constructing tangent and normal.

Now, the first step is from C to K; we have to construct a vertical line. One we can use perpendicular bisector so that we will be in a position to join; or any way base is 70 mm, so we can locate 35 mm on the curve, from here to here 35, this is the one. Now join C and point K.

Let us name this point K and the intersection point as V. Now below V we have to go by 20 mm, where we are going to draw a horizontal line, the point 20 mm below. So, if I am going to construct it, that point goes somewhere here; if this is the point where we want to construct, we have to drop a horizontal line there. So, if it is 20 mm, locate this point.

This point what we are calling S and this point as P. The next point is we have to use a compass to mark V S is equal to T S; V, so locate this point as T. Now join T and P points. So, let us use our pens, this is a tangent line, and normal is 90 to it passing through point P. So, locate 90, join P with line and after that darken it.

So, this is normal. So, a tangent and normal, one can construct it in that way. If some point P, somewhere here we would like to construct; first of all what we have to do is draw a horizontal line, this is the horizontal line, this is let us call S'. Measure from S' to V, use the same length; mark other point T', join T' and a new point.

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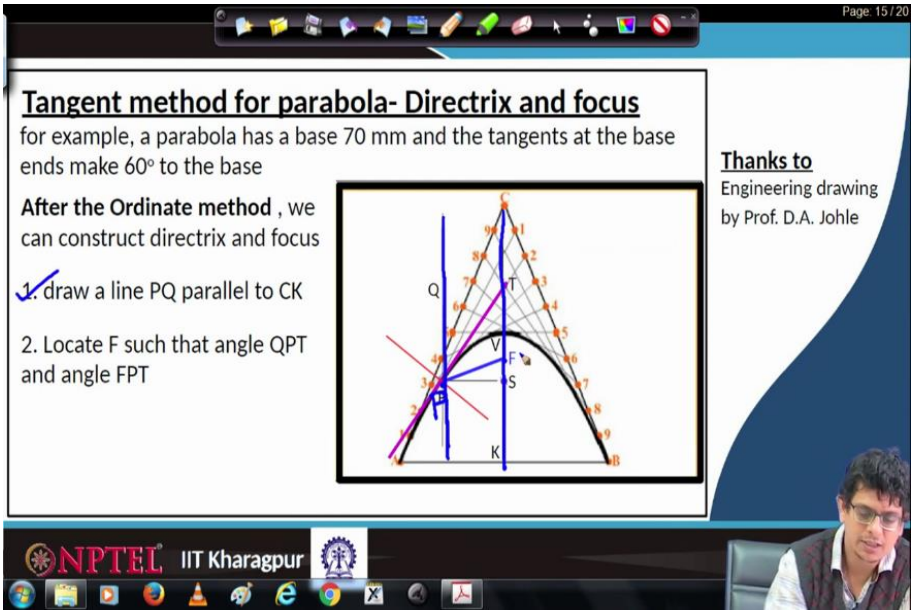

Now let us find out directrix and focus to the parabola. For this parabola construction, what we have used is, by using base and tangents, we are in a position to construct parabola. Then at any given point if we are interested in constructing parabola, tangent and normal, we went ahead measure this T V is equal to V S point and based on that we have constructed it.

Now, how to construct a directrix which is generating parabola and also where exactly focus is located. After constructing parabola, draw a P Q line. So, use vertical line all the way passing through point P, this is the point P. And this line P Q always be parallel to C K line, this is the way one has to construct it.

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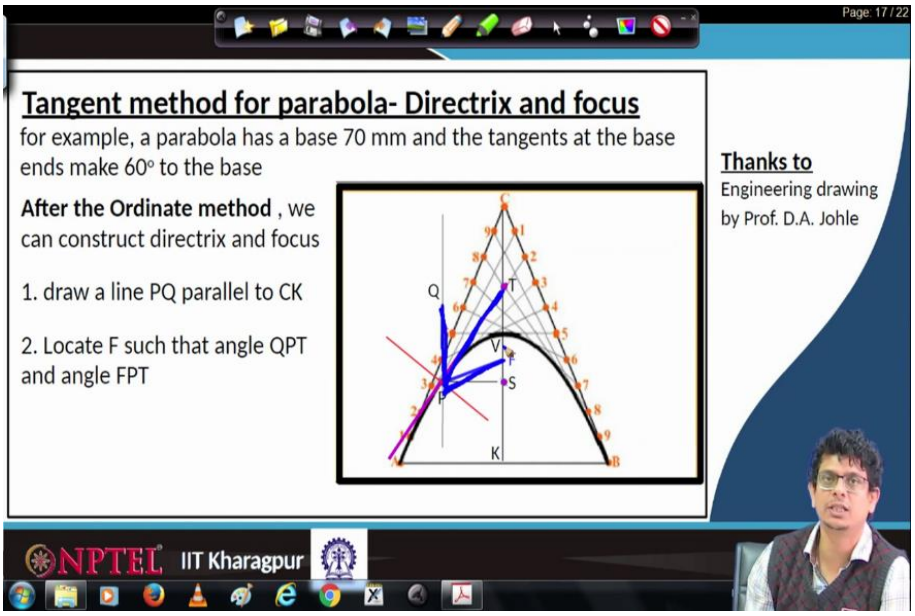

Then we have to locate focus point, focal point F such a way that, ∠Q P, ∠Q P F is divided into two equal parts by ∠Q P T and ∠T P F; this is the way one has to locate focus point.

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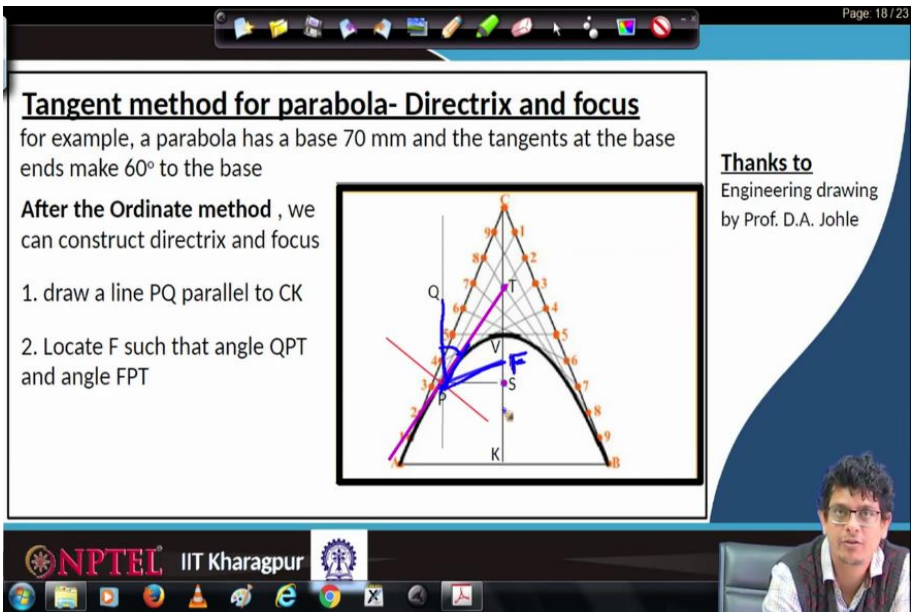

So, already we have tangent at a given chosen point, here we already constructed tangents; so first draw a vertical line, measure this angle, from that angle again reproduce another angle to focus point. If it is straight away measurable, we will be in a position to use that; otherwise angle bisector method we will use it to locate this focal point F. So, let us do that step by step.

Let us begin it on our sheet. For example, here we have already have constructed a tangent line passing through point P. Now what we have to do is, draw a vertical line through this P. So, use our protractor or perhaps set-squares to draw a line, locate this point somewhere Q.

So, a vertical line up in the Q direction first we have to draw and point P we have already located. This ∠Q P T supposed to make an equal angle at somewhere here to locate the focal point.

If it is something like angle bisector, the way how we have constructed is; if there is a point P, if there is a line, first of all with some equal radius make two arcs, from this again make one more arc, from here make one more arc join this. However, in this problem what we have is; we have this line, we have this line if I am keeping this one Q, point P and T we know. Now the question is, how to find this line F somewhere there?

First of all make an angle A, from there try to make an arc from the Q. So, for example, if we want to figure it out where this F line or arc might be going; first of all P point is known, locate Q, and it has to pass through these lines. So, make a semicircle or full circle in that way, then from this Q mark an arc in that way.

Because we do not know anything about F where exactly it is going to intersect; what we are going to do is, already T point we know, from T point, make a cut. So, once we cut that, we have a point something like that and join these two lines; the same method we will use it to construct equal angle bisector here.

From P first of all mark a point somewhere here and this one going to intersect somewhere on these lines. So, draw a circle, it is going to intersect at this point Q. Furthermore, the point what we are interested in a tangent line which is passing through this point; so make an arc which is passing through T. So, what we have constructed is, from P mark some radius, once radius is there from that point mark an arc. It goes via T point in this way; pass via T point in that way.

Once it is done, already T point we know; so locate that point, intersect this already constructed circuit. So, this intersection point is here. So, this supposed to be the focal point. Now join P point and F point; this is the way we construct focus.

Once focus is now directrix is easy to find out; because for parabola eccentricity is one, so from F to V whatever the distance, from V to that point also same distance we will be going to have. So, let us call this point as O. Now use roller scaler, move parallel, draw'-dot kind of line. So, for this parabola this is the directrix, the focal point is F and any point P; this is the way we construct focus point and directrix for a given parabola.

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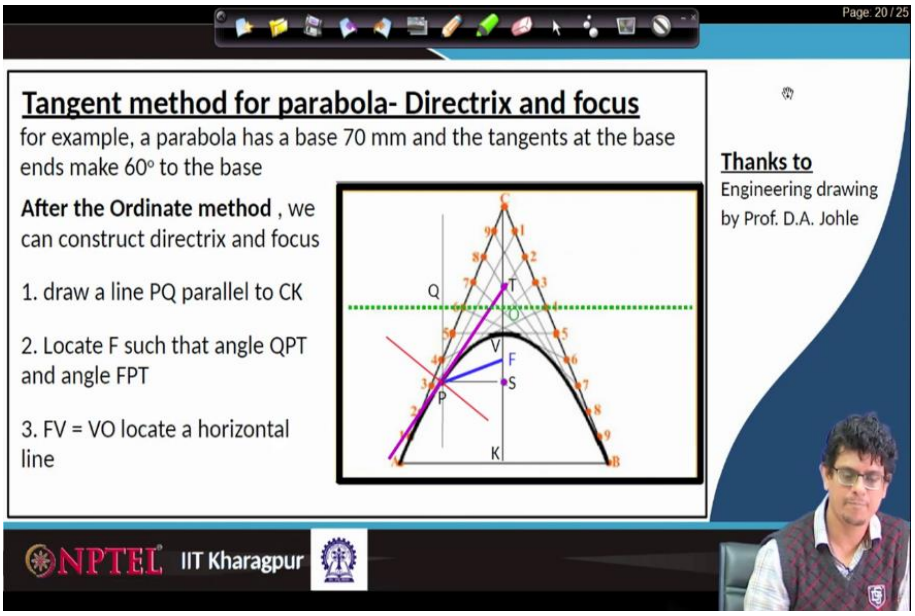

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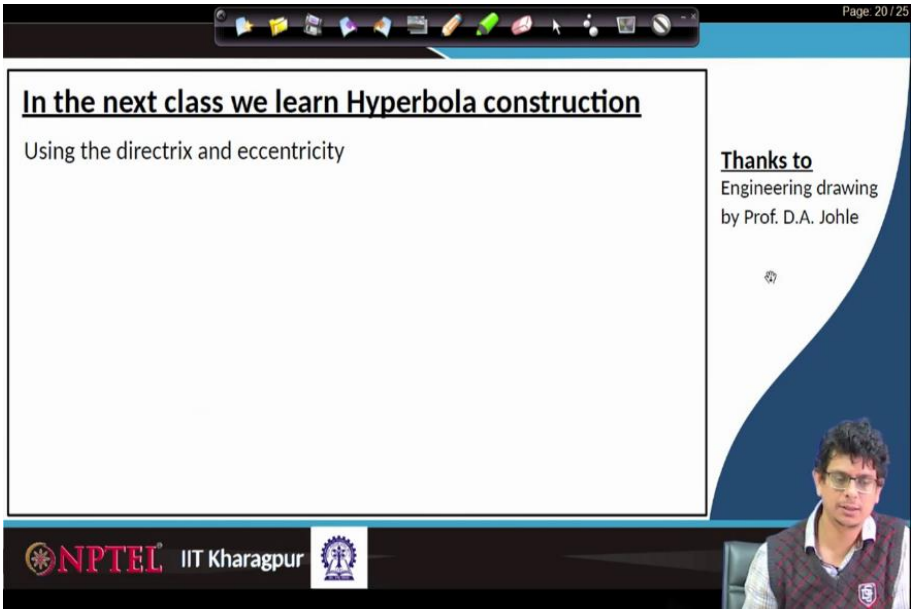

In the next class, we will learn about how to construct hyperbola, especially using directrix and eccentricity.

Thank you very much.