

Engineering Drawing and Computer Graphics

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Module – 02
Lecture – 12
Conic Sections – IV

Hello everyone, welcome to our NPTEL online certification courses on the engineering drawing. I am Rajaram Lakkaraju from Mechanical Engineering IIT Kharagpur; we are in module number 2 lecture 12 on Conic Sections. To recap if we are having a right circular cone taking a horizontal slice we will get circle an inclined slice ellipse if this section is going to cut both the slants.

(Refer Slide Time: 00:38)

2. What is a conic section?

circle
ellipse
parabola
hyperbola

WHY?
We look for an answer in this lecture

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If a parallel slant cut section if we are taking it to construct a hyperbola and any other section it makes hyperbola.

(Refer Slide Time: 01:03)

Page 7/7

2. How to construct conic sections?

Four methods are available for Ellipse construction

1. Focus-Directrix method
2. Concentric circle method
3. Oblong method
4. Arc of circle method

The diagram illustrates the relationship between conic sections and their eccentricity. A vertical red line represents the Directrix. To its left, a blue curve represents a Hyperbola. To its right, several curves are shown: a purple curve for Eccentricity = 2, a pink curve for Eccentricity = 1 (a parabola), and a green curve for Eccentricity = 0.5 (an ellipse). A black dot labeled 'Focus' is shown inside the green ellipse. A second, smaller ellipse is shown to the right of the main one. The NPTEL IIT Kharagpur logo is visible at the bottom left of the slide.

Now in today's lecture, we will see how to construct an ellipse geometrical means. In principle, there are four methods available Focus Directrix method, the second one is Concentric circle method, the third one is Oblong method, and the fourth one is the Arc of the circle method. For the first method focus and directrix method, we have a definition about directrix, eccentricity and focus. Let us here look at this terminology. For example, let us take an ellipse. In this ellipse, there is a focal point which we are calling focus. Usually, for an ellipse, there always be 2 foci. For example, one of the foci here the second foci might be there. For the simple case, we are just showing only one of the foci.

(Refer Slide Time: 02:14)

Page 8/8

2. How to construct conic sections?

Four methods are available for Ellipse construction

1. Focus-Directrix method
2. Concentric circle method
3. Oblong method
4. Arc of circle method

This slide is identical to the previous one, showing the same diagram of conic sections and their eccentricities. The NPTEL IIT Kharagpur logo is visible at the bottom left of the slide.

Furthermore, there is a line which we call directrix line, about this directrix line one will be in a position to construct an ellipse parabola or a hyperbola.

(Refer Slide Time: 02:37)

2. How to construct conic sections?

Four methods are available for Ellipse construction

1. Focus-Directrix method
2. Concentric circle method
3. Oblong method
4. Arc of circle method

The diagram illustrates the focus-directrix method for constructing conic sections. A vertical red line represents the directrix, and a point represents the focus. A horizontal line passes through the focus and is perpendicular to the directrix. The distance from the focus to the directrix is labeled as $2a$. The diagram shows three curves: a blue hyperbola (eccentricity $= \infty$), a pink parabola (eccentricity $= 1$), and a green ellipse (eccentricity $= 0.5$). The focus is labeled 'Focus' and the directrix is labeled 'Directrix'.

Usually for any curve, whether it is ellipse parabola or directrix, from focus to a point on the curve. What is the distance from the focus to that point, and what is the distance from that point to directrix? This ratio makes one unique thing, based on this ratio focus to the point of the curve and point of the curve to directrix horizontal thing. If it makes one particular unit, for example, less than 1 we get one kind of curve, if it is equal to 1, we get one kind of curve, if it is greater than 1 we get another kind of curve.

(Refer Slide Time: 03:26)

2. How to construct conic sections?

Four methods are available for Ellipse construction

1. Focus-Directrix method ✓
2. Concentric circle method
3. Oblong method
4. Arc of circle method

The diagram is identical to the previous slide, showing the focus-directrix method for constructing conic sections. The focus is labeled 'Focus' and the directrix is labeled 'Directrix'. The diagram shows three curves: a blue hyperbola (eccentricity $= \infty$), a pink parabola (eccentricity $= 1$), and a green ellipse (eccentricity $= 0.5$). The distance from the focus to the directrix is labeled as $2a$.

Handwritten formula:
$$\text{eccentricity} = \frac{\text{distance of point from focus}}{\text{distance from directrix}}$$

Furthermore, we call that ratio as eccentricity. So, eccentricity is defined as the distance of a point from the focus. For example, if it is an ellipse this point to that point. If it is a parabola from this point to that point distance of that point from there to focus by distance from directrix for that point.

So, if this is the directrix vertical line from that to that particular point what we are calling this denominator, that forms a unique ratio eccentricity. This eccentricity and directrix are the main things to construct an ellipse or parabola or hyperbola using focus directrix method.

(Refer Slide Time: 04:27)

2. How to construct conic sections?

Four methods are available for **Ellipse** construction

1. Focus-Directrix method
2. Concentric circle method
3. Oblong method
4. Arc of circle method

When eccentricity

- $< 1 \rightarrow$ **Ellipse**
- $= 1 \rightarrow$ **Parabola**
- $> 1 \rightarrow$ **Hyperbola**

Diagram illustrating conic sections based on eccentricity (e):

- $e = 0$: Circle
- $0 < e < 1$: Ellipse (labeled with $e = 0.5$)
- $e = 1$: Parabola
- $e > 1$: Hyperbola (labeled with $e = 2$)

Focus-Directrix method diagram: A point on the curve is equidistant from a focus and a directrix line. The formula is:
$$\text{eccentricity} = \frac{\text{distance of point from focus}}{\text{distance from directrix}}$$

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If the eccentricity is less than 1 we get an ellipse, if it is equal to 1, we get a parabola, that means from focus to point on this parabola and distance from this point to this directrix they are the same. Because the ratio is 1, such kind of curve what we call parabola, if that eccentricity is greater than 1, we get a hyperbola.

(Refer Slide Time: 05:15)

Focus-Directrix method for Ellipse

If the distance of focus from the directrix and eccentricity is given

for example, an ellipse has an eccentricity 0.75 and distance of focus from the directrix is 70 mm

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First of all, let us focus on this focus directrix method. In this case, the distance of focus from the directrix will be given by the distance of focus from the directrix.

(Refer Slide Time: 05:48)

Focus-Directrix method for Ellipse

If the distance of focus from the directrix and eccentricity is given

for example, an ellipse has an eccentricity 0.75 and distance of focus from the directrix is 70 mm

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So, a directrix and perhaps an arbitrary curve it has a focus So, distance from directrix will be given to the focus and what kind of eccentricity, whether it is lower than 1 greater than 1 will be given if that is the case construct this arbitrary curve. For example, here an ellipse has an eccentricity 0.75, any eccentricity less than 1 we will be getting this ellipse and distance of focus from the directrix is 70 mm, if that is the case construct an ellipse.

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Focus-Directrix method for Ellipse

If the distance of focus from the directrix and eccentricity is given

for example, an ellipse has an eccentricity 0.75 and distance of focus from the directrix is 70 mm

CF = 70 mm
VF = 30 mm
CV = 40 mm
 $e = VF/CV = 3/4$

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So, using this directrix focus method, first of all, we will be drawing this directrix. We will be going to construct something like a line C from directrix to that focal point we will locate it something like 70 mm, do geometric construction then draw tangent lines and vertical lines horizontal lines construct intersecting points, then follow the procedure to fill this gap like an ellipse. We will see that step by step.

(Refer Slide Time: 07:23)

Focus-Directrix method for Ellipse

Steps to be followed:

1. Draw directrix AB and axis CC' ✓

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Steps to be followed, so on the right-hand side I am showing the complete picture to indicate the points what we have to follow, on the left-hand side we will show the steps.

The first one is: draw directrix A B, so that means, first of all, a vertical line we are going to draw name it A and B and also axis CC'.

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Focus-Directrix method for Ellipse

Steps to be followed:

1. Draw directrix AB and axis CC'
2. Mark F on CC' such that CF=70 mm

The slide includes a diagram of an ellipse with its major axis CC' and directrix AB. A focus F is marked on the axis. The presenter is visible in the bottom right corner.

So, somewhere at point C draw a line name it CC'. Once it is done mark a point F on CC'. So, we have already constructed AB and CC'. So, now locate a focus F, which will be at 70 mm.

(Refer Slide Time: 08:48)

Focus-Directrix method for Ellipse

Steps to be followed:

1. Draw directrix AB and axis CC'
2. Mark F on CC' such that CF=70 mm
3. Divide CF into 3+4 = 7 equal parts and mark V at the fourth division from C
 $e = \frac{FV}{CV} = 0.75 = \frac{3}{4}$

The slide includes a diagram of an ellipse with its major axis CC' and directrix AB. A focus F is marked on the axis. A point V is marked on the axis between C and F. The presenter is visible in the bottom right corner.

Once it is done, divide CF. So, C point we know already and F point also we know divide this C to F distance into 3 plus 4 7 equal parts so this 3 plus 4 comes because of eccentricity.

So, focal point to any point on the curve, because if this curve passes through this point B somewhere here the focal point V to F will be 3 units and C to V will be 7 unit ah 4 units. So, total distance C to F will be 7 part. So, 3 by 4 units we are going to construct.

So, divide the complete CF into 7 equal parts 7 parts we have to divide and once we divide that into 7 parts mark V at the fourth division from centre C. So, V will be 4 unit distance. So that eccentricity will be three fourth after that at V draw perpendicular VB is equal to VF.

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Focus-Directrix method for Ellipse

Steps to be followed:

1. Draw directrix AB and axis CC'
2. Mark F on CC' such that CF=70 mm
3. Divide CF into 3+4 = 7 equal parts and mark V at the fourth division from C
 $e = \frac{FV}{CV} = 0.75 = \frac{3}{4}$
4. At V, draw perpendicular VB=VF and then join CB

So, we have already located point V on that curve. So, there using a mini drafter draw a perpendicular line this is the one. So this point is V somewhere point B, such that V B is equal to V F. So, V we know F we know on that perpendicular line what is this distance V F equal distance move it name it as B.

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Focus-Directrix method for Ellipse

Steps to be followed:

1. Draw directrix AB and axis CC'
2. Mark F on CC' such that CF=70 mm
3. Divide CF into 3+4 = 7 equal parts and mark V at the fourth division from C
 $e = FV/CV = 0.75 = 3/4$
4. At V, draw perpendicular VB=VF and then join CB

Page 21 / 21

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Then join B point to C point. So, once we locate that point join it. We have already this F point focus draw the line at 45° s. So, through F point, draw the line at 45° s to meet CB.

(Refer Slide Time: 11:12)

Focus-Directrix method for Ellipse

Steps to be followed:

1. Draw directrix AB and axis CC'
2. Mark F on CC' such that CF=70 mm
3. Divide CF into 3+4 = 7 equal parts and mark V at the fourth division from C
 $e = FV/CV = 0.75 = 3/4$
4. At V, draw perpendicular VB=VF and then join CB
5. Through F, draw a line at 45° to meet CB produced at D.
Through D, draw a perpendicular DV' on CC'
Mark O at the midpoint of VV'

Page 22 / 22

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So, already we have noted C point and B point this we have extended, then from F a 45° line we have to construct it extends down to meet tangent, so this angle is 45° s. So, that we have an intersection point let us call that point as D.

(Refer Slide Time: 12:12)

Focus-Directrix method for Ellipse

Steps to be followed:

1. Draw directrix AB and axis CC'
2. Mark F on CC' such that CF=70 mm
3. Divide CF into 3+4 = 7 equal parts and mark V at the fourth division from C
 $e=FV/CV=0.75=3/4$
4. At V, draw perpendicular VB=VF and then join CB
5. Through F, draw a line at 45° to meet CB produced at D.
Through D, draw a perpendicular DV' on CC'
Mark O at the midpoint of VV'

Page 20 / 21

Now, through D, draw perpendicular lines $D V'$ on C. So, this is the intersection point So, use your mini drafter construct a vertical line perpendicular thing thus name it V' , on one side we have V, on another side we have V' .

(Refer Slide Time: 12:40)

Focus-Directrix method for Ellipse

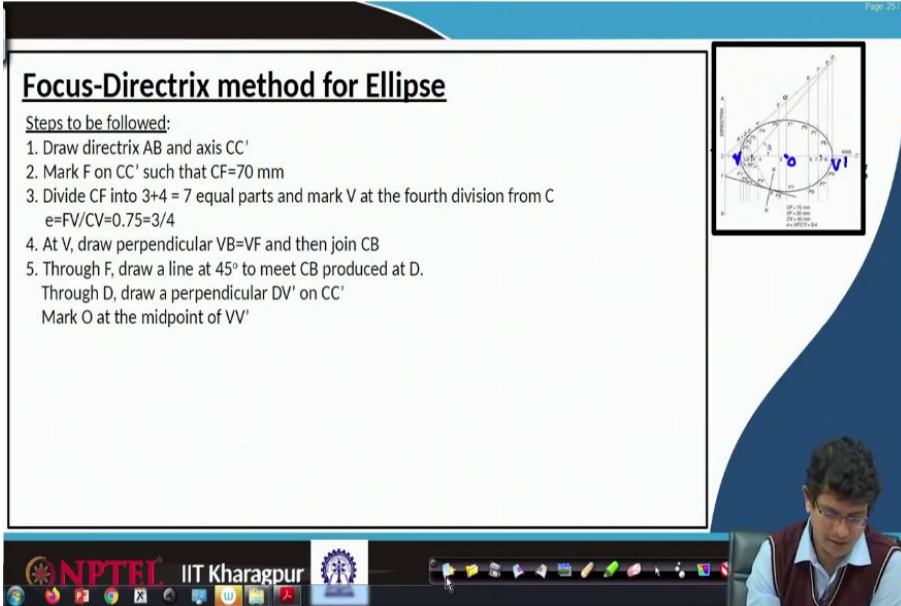
Steps to be followed:

1. Draw directrix AB and axis CC'
2. Mark F on CC' such that CF=70 mm
3. Divide CF into 3+4 = 7 equal parts and mark V at the fourth division from C
 $e=FV/CV=0.75=3/4$
4. At V, draw perpendicular VB=VF and then join CB
5. Through F, draw a line at 45° to meet CB produced at D.
Through D, draw a perpendicular DV' on CC'
Mark O at the midpoint of VV'

Page 21 / 21

So, DV' on CC' is this line DV' line is this. So, we have identified V' . Now we have to mark O at the midpoint of VV' .

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Focus-Directrix method for Ellipse

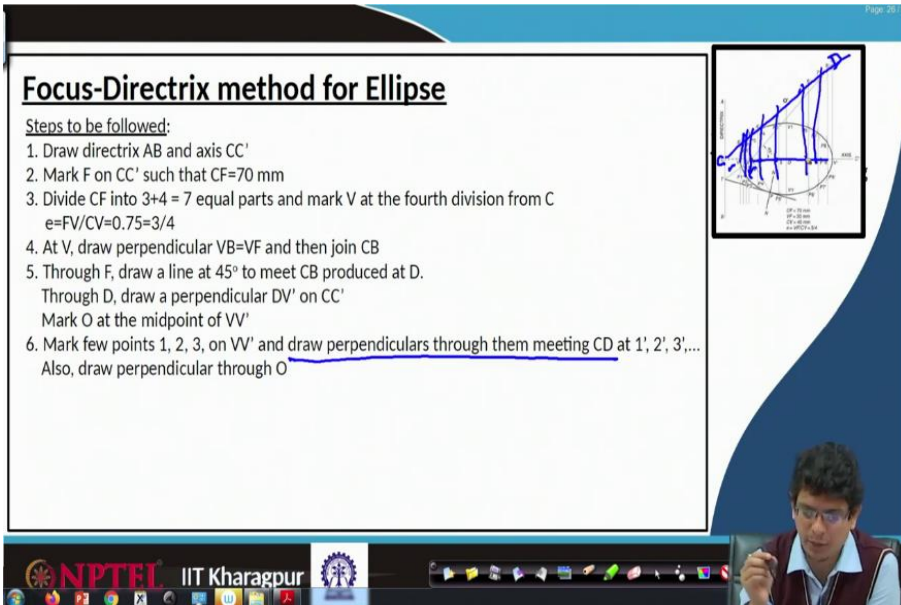
Steps to be followed:

1. Draw directrix AB and axis CC'
2. Mark F on CC' such that CF=70 mm
3. Divide CF into 3+4 = 7 equal parts and mark V at the fourth division from C
 $e=FV/CV=0.75=3/4$
4. At V, draw perpendicular VB=VF and then join CB
5. Through F, draw a line at 45° to meet CB produced at D.
Through D, draw a perpendicular DV' on CC'
Mark O at the midpoint of VV'

Page 20 / 21

So, V is one end another end for this ellipse is VV'. We know perpendicular bisector how to draw that. So, using VV' use arcs construct then drop it. So, that perpendicular bisector O we will be in a portion to know. Then mark a few points 1, 2, 3 on VB'.

(Refer Slide Time: 13:23)



Focus-Directrix method for Ellipse

Steps to be followed:

1. Draw directrix AB and axis CC'
2. Mark F on CC' such that CF=70 mm
3. Divide CF into 3+4 = 7 equal parts and mark V at the fourth division from C
 $e=FV/CV=0.75=3/4$
4. At V, draw perpendicular VB=VF and then join CB
5. Through F, draw a line at 45° to meet CB produced at D.
Through D, draw a perpendicular DV' on CC'
Mark O at the midpoint of VV'
6. Mark few points 1, 2, 3, on VV' and draw perpendiculars through them meeting CD at 1', 2', 3',....
Also, draw perpendicular through O

Page 21 / 21

So, these can be at different kind of lengths already we divided this CV and VF. So, already we have made some division like CV and VF. So 1, 2, 3 points already we know similarly locate some other points on that V B' line somewhere here 4 somewhere here 5 somewhere here 6 and 7, so these are arbitrary points.

Once we know that what we can do is draw perpendicular through them meeting C D. So, through this 1 point, 2 point 3 point, 4, 5, 6 and so on, draw the perpendicular so, that they will intersect the curves at first 1' 2' 3' and so on 6'. Similarly, draw one perpendicular line through O also.

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Focus-Directrix method for Ellipse

Steps to be followed:

1. Draw directrix AB and axis CC'
2. Mark F on CC' such that CF=70 mm
3. Divide CF into 3+4 = 7 equal parts and mark V at the fourth division from C
 $e = \frac{FV}{CV} = 0.75 = \frac{3}{4}$
4. At V, draw perpendicular VB=VF and then join CB
5. Through F, draw a line at 45° to meet CB produced at D.
 Through D, draw a perpendicular DV' on CC'
 Mark O at the midpoint of VV'
6. Mark few points 1, 2, 3, on VV' and draw perpendiculars through them meeting CD at 1', 2', 3',...
 Also, draw perpendicular through O
7. With F as centre and radius 1-1', cut two arcs on the perpendicular through 1 to locate P1 and P1'
 Similarly, with F as a centre and radii=2-2', 3-3' etc, cut arcs on the corresponding perpendiculars
 To locate P2 and P2', P3 and P3',...
 Also, cut similar arcs on the perpendicular through O to locate V1 and V1'

Now with F as the centre and radii 2 2' and with F as centre and radius 1 1'.

So 1 to 1' whatever that radius pick that length from F as centre cut two arcs on the perpendicular. So, the perpendicular line we already know on 1 1' So, make an arc from the centre this F to locate point P 1 somewhere here and somewhere here. So, use F as centre whatever the distance 1 1' cut this one, so that where it is going to intersect this perpendicular line that mark as P 1 point similarly mark other points as P 1'.

So, once we know, these are the points P1 and P 1' through which ellipse is passing already V point we already know focus F, P 1, P 1' join that curve so that an ellipse begin to construct. Similarly what we can do is with F as centre and radius 2 2'. So, once we construct 2 2' distance from F cut an arc so that P 2 point P 2' arc we will be in a position to construct.

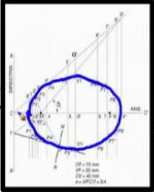
Similarly, 3 3' from F make an arc, so that is going to intersect these perpendicular lines and from there we will be in a position to find out how this ellipse is going to move.

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Focus-Directrix method for Ellipse

Steps to be followed:

1. Draw directrix AB and axis CC'
2. Mark F on CC' such that CF=70 mm
3. Divide CF into 3+4 = 7 equal parts and mark V at the fourth division from C
 $e = \frac{VF}{CV} = 0.75 = \frac{3}{4}$
4. At V, draw perpendicular VB=VF and then join CB
5. Through F, draw a line at 45° to meet CB produced at D.
 Through D, draw a perpendicular DV' on CC'
 Mark O at the midpoint of VV'
6. Mark few points 1, 2, 3, on VV' and draw perpendiculars through them meeting CD at 1', 2', 3',...
 Also, draw perpendicular through O
7. With F as centre and radius 1-1', cut two arcs on the perpendicular through 1 to locate P1 and P1'
 Similarly, with F as a centre and radii=2-2', 3-3' etc, cut arcs on the corresponding perpendiculars
 To locate P2 and P2', P3 and P3',...
 Also, cut similar arcs on the perpendicular through O to locate V1 and V1'
8. Draw smooth closed curve passing through V, P1, P2,...



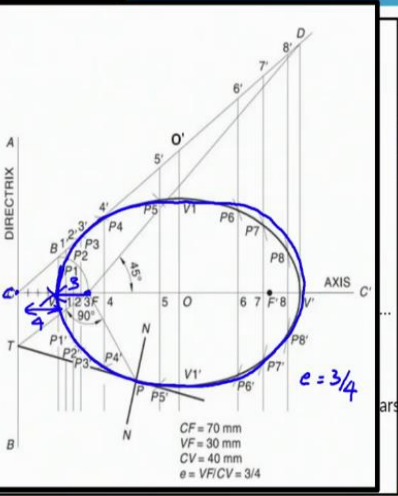
So, once we are done with this entire procedure, a smooth curve passing through this V point P1 P2 P4 and so on, we will be in a position to construct an ellipse.

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Focus-Directrix method

Steps to be followed:

1. Draw directrix AB and axis CC'
2. Mark F on CC' such that CF=70 mm
3. Divide CF into 3+4 = 7 equal parts and mark V at the fourth division from C
 $e = \frac{VF}{CV} = 0.75 = \frac{3}{4}$
4. At V, draw perpendicular VB=VF and then join CB
5. Through F, draw a line at 45° to meet CB produced at D.
 Through D, draw a perpendicular DV' on CC'
 Mark O at the midpoint of VV'
6. Mark few points 1, 2, 3, on VV' and draw perpendiculars through them meeting CD at 1', 2', 3',...
 Also, draw perpendicular through O
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 Similarly, with F as a centre and radii=2-2', 3-3' etc, cut arcs on the corresponding perpendiculars
 To locate P2 and P2', P3 and P3',...
 Also, cut similar arcs on the perpendicular through O to locate V1 and V1'
8. Draw smooth closed curve passing through V, P1, P2,...



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After doing that we will end up with this ellipse.

(Refer Slide Time: 17:55)

Focus-Directrix method for Ellipse

If the distance of focus from the directrix and eccentricity is given

for example, an ellipse has an eccentricity 0.75 and distance of focus from the directrix is 70 mm

Mark F' on CC' such that $V'F'=VF$

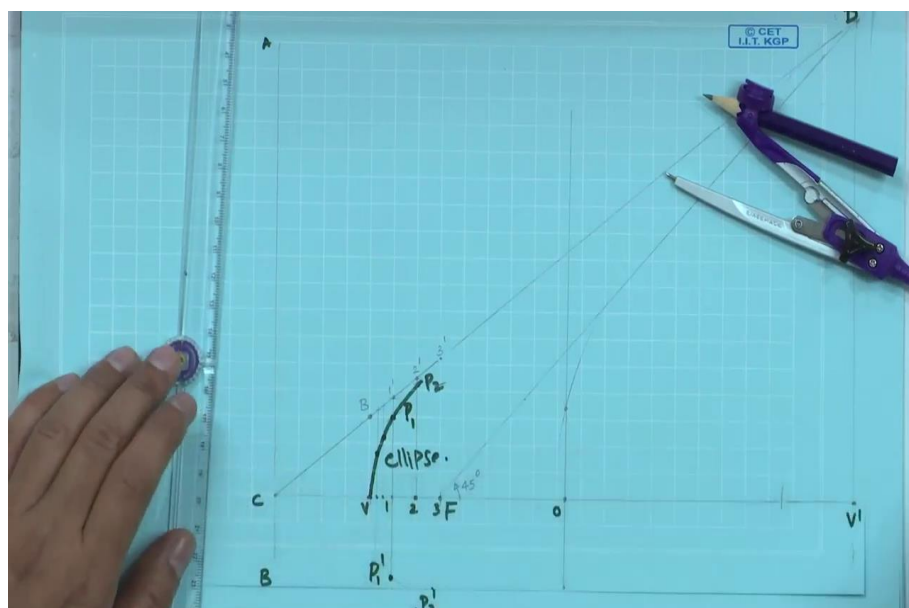
Thanks to David, B. for the images

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If one is interested in constructing tangent normal, we will see in the next class how to construct this normal and tangent. Let us do that step by step on our drawing sheet.

So, first of all, draw a directrix AB, and the dimensions what we are going to follow is focus from this C point supposed to be 70 and eccentricity ratio is 3 by 4. So, let us note down that eccentricity is three fourth and from the directrix is supposed to be at 70 mm for the focus. So, first of all draw a directrix line a vertical directrix line we are going to construct.

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Let us name that as AB directrix something like A something as B, then a CC' line we have to construct. Let us use CC' for this a horizontal CC' we are going to use, a horizontal line name it as C somewhere it goes C' axis. So, it is not visible somewhere here C'.

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Focus-Directrix method for Ellipse

Steps to be followed:

1. Draw directrix AB and axis CC'
2. Mark F on CC' such that CF=70 mm
3. Divide CF into 3+4 = 7 equal parts and mark V at the fourth division from C
 $e = FV/CV = 0.75 = 3/4$
4. At V, draw perpendicular VB=VF and then join CB
5. Through F, draw a line at 45° to meet CB produced at D.
Through D, draw a perpendicular DV' on CC'
Mark O at the midpoint of VV'
6. Mark few points 1, 2, 3, on VV' and draw perpendiculars through them meeting CD at 1', 2', 3',...
Also, draw perpendicular through O
7. With F as centre and radius 1-1', cut two arcs on the perpendicular through 1 to locate P1 and P1'
Similarly, with F as a centre and radii=2-2', 3-3' etc, cut arcs on the corresponding perpendiculars
To locate P2 and P2', P3 and P3',...
Also, cut similar arcs on the perpendicular through O to locate V1 and V1'
8. Draw smooth closed curve passing through V, P1, P2,...

The diagram on the right shows the construction of an ellipse using the focus-directrix method. It includes a horizontal axis CC', a vertical directrix AB, a focus F on CC', and a point V on CC' such that CV = 70 mm. A perpendicular VB is drawn at V such that VB = VF. A line CB is drawn, and a 45-degree line is drawn from F to meet CB at D. A perpendicular DV' is drawn from D to the axis CC'. The midpoint O of VV' is marked. Points 1, 2, 3 are marked on VV', and perpendiculars are drawn through them to meet CD at 1', 2', 3'. Arcs are drawn with centers F and radii 1-1', 2-2', 3-3' to locate points P1, P1', P2, P2', P3, P3'. A smooth curve is drawn passing through V, P1, P2, etc.

So, the 1st point draw directrix AB and CC' we have noted down, then mark F on CC'. Second step is we have to mark CC' such that C F is equal to 70 mm C is this point F is that point.

So, we have to mark that 70 mm on our drawing sheet. So, locate 70 mm point here so this is the focus point. So, 2nd step done so C to F is 70 mm. Now divide CF into 7 equal parts, because it is 70 mm is quite easy for us to divide this line. If it is fraction something like 69 mm 68 mm we have already seen how to divide into number of equal parts by using this inclined line and constructing it.

So, because it is 70 mm is easy for us to locate point 1, 2, 3, 4, 5, 6, 7 mark V at the fourth division from C 1st 2nd 3rd 4th, so that distance is 1 unit 2 units 3 units 4 unit 40 mm and from focus to point of the curve. Because curve is passing through this point this will be three units that will be 4 units, so 3 by 4 units we are going to get.

Let us mark this point as V this is the point V. So, that F V to C V will be 3 by 4 units which are 0.75. So, 3rd part 3rd point is done. If we draw perpendicular V B is equal to V F. So, V B is equal to V F line we have to draw, for that purpose first of all V B is equal to V F.

So, first of all measure this distance transfer this V B to this point. So 1, 2, 3 units, let us call that by name B 1, 2, 3 units and then join CB, we have to join this CB line. Now, through F, draw the line at 45° s.

So, focus point we locate something like this point oh oh ok. From F to that point draw these two lines are going to intersect somewhere here. Now, in this case, it is outside of the box, let us pull it down. So, it is going to intersect somewhere there. So, one has to be careful with these drawing sheets. So, it will be going to intersect somewhere at this point.

Once we know that points we will locate D somewhere here, drop a vertical thing so that we will be in a position to construct where is that V', so, we are at point number 5, where we have drawn a 45° line from point F, and already we have located V F equal to V B. So, that a line is passing from C all the way B we extended it and a line at 45° s from focus point F which is going to intersect at D.

Once we know this D point intersection point drop a perpendicular from D down to a horizontal line where C O V' meets. So, V is one end of this ellipse V' is another end of an ellipse.

If we are drawing an ellipse, it goes via this points, once we know V' and V we can make intersection point so that a perpendicular bisector meets at O. So, this is the centre of that ellipse 2 foci we always are going to have from V to F and O is centre. So, FO again equal to this new point F' where another focus one can locate it.

The other way is from V whatever the distance of F we have same another focus we are going to have it at this point. So, the focus point again will be at that location, once we defined these lines, so let us look at only half part of this curve once we know that locate points 1, 2, 3 and 4 and 5 kinds of points on this curve.

Use a distance of 1 to 1' whatever this one as the distance from focal point F try to make an arc which is going to cut this 1 1' let us call this one. Similarly, on the other side, make a cut, so name these points as P 1 and P 1'. Similarly, as distance 2 to 2' and F as the centre, make an arc. So, call that one as P 2. Similarly, make another arc from here 1 to 2 line.

So, if we are extending these lines, it is going to intersect at this point. So, this is P 2' and this one P 2. Based on how many points we are going to have if we are going to divide

many more points drawing these vertical lines. We can have many more points, only thing is from this point we have to mark what is this distance from focus point make an arc.

Similarly, from this point, what is this vertical distance, use that vertical distance make an arc so that we will be in a position to mark these points. So, if we are going to have a free hand curve for this purpose, one can use French curves also. If we are making a freehand curve, it forms an ellipse which tracks all the way there and again pass through V 1 point and comes back. This is the way one supposed to construct this ellipse.

So, we have constructed part of the ellipse here. If we go with this procedure, finally we will construct this ellipse. For any ellipse, we pick a point from focus what is the distance, let us call that in this case 3 and from point to directrix C that is 4 in this case. So, eccentricity here $3/4$.

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Focus-Directrix method

Steps to be followed:

1. Draw directrix AB and axis CC'
2. Mark F on CC' such that CF=70 mm
3. Divide CF into 3+4 = 7 equal parts and $e=VF/CV=0.75=3/4$
4. At V, draw perpendicular VB=VF and D
5. Through F, draw a line at 45° to meet VV'. Through D, draw a perpendicular DV'. Mark O at the midpoint of VV'
6. Mark few points 1, 2, 3, on VV' and draw perpendicular through O. Also, draw perpendicular through O
7. With F as centre and radius 1-1', cut the perpendicular through V to locate P1 and P1'. Similarly, with F as a centre and radius 2-2', locate P2 and P2', P3 and P3', ... Also, cut similar arcs on the perpendicular through O
8. Draw smooth closed curve passing through these points

$CF = 70 \text{ mm}$
 $VF = 30 \text{ mm}$
 $CV = 40 \text{ mm}$
 $e = VF/CV = 3/4$

Thanks to
Engineering drawing
by Prof. D.A. Johle

If it is something like another factor any e less than 1 we get an ellipse, in this case, we have used three fourth; one can also use something like half. If e is equal to half three fourth ratio 0.75, it makes. So, 1 2 ratio means that we have to make it into 3 parts first of all, then locate 2 parts in that direction 1 part then go with the same procedure we will get another ellipse. This is the way any general ellipse one will be in a position to construct it.

(Refer Slide Time: 34:37)

2. How to construct conic sections?

Four methods are available for **Ellipse** construction

1. Focus-Directrix method
2. **Concentric circle method** **In the next class**
3. Oblong method
4. Arc of circle method

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In the next class, we will learn about the concentric circle method and after that oblong method.

Thank you very much.