جامعة الفرات الاوسط التقنية /المعهد التقني سماوة

قسم / تقنيات المساحة

المحاضرة السابعة

اسم المادة / المساحة-٢

المرحلة الدراسية / الثانية

العام الدراسي / 2022 - 2023

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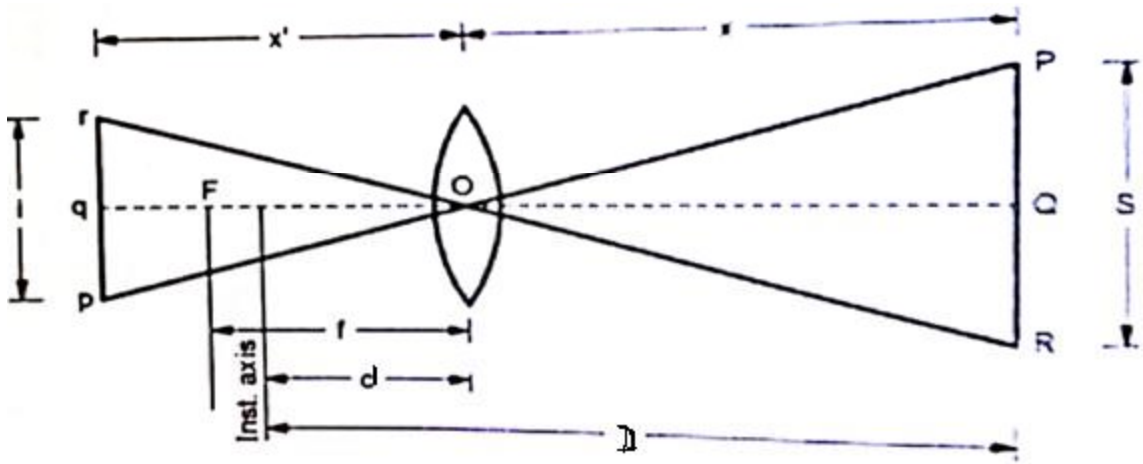
Application of Fixed hair method

- There are main three cases for finding the distance
- and Elevation.
- • Case : 1 When the line of sight is horizontal and
- staff is held Vertical.
- • Case : 2 When the line of sight is inclined and staff
- is held Vertical. ((a) considering angle of elevation
- +θ (b) considering angle of depression -θ)
- • Case : 3 When the line of sight is inclined but staff
- is held normal to the line of sight

Application of Fixed hair method

- Case : 1 When the line of sight is
- horizontal and staff is held Vertical.
- Horizontal Distance Formula



Application of Fixed hair method

- O = The optical center of the object glass.
- • p,q,r = the top, axial, and bottom hair reading.
- • pr = i = Length of the image.
- • f = Focal length of the image glass.
- • S = Staff in intercept on PQ.
- • x = Horizontal distance from O to the staff.
- • x’ = Horizontal distance from O to the plane of the hairs.
- • d = Horizontal distance from O to the vertical axis of the
- instrument.
- • D = Horizontal distance from axis to the staff

Application of Fixed hair method

- The rays Pop and Qoq passing through O are the straight lines.
- Triangle POQ and poq are similar hence $\frac{x}{x'} = \frac{s}{i}$

But x and x′ are conjugate focal length (distance)

$$\frac{1}{f} = \frac{1}{x'} + \frac{1}{x}$$

Multiplying both by fx

$$x = \frac{x}{x'} f + f$$

Substituting $\frac{x}{x'} = \frac{s}{i}$

$$x = \frac{s}{i} f + f$$

Application of Fixed hair method

Add c on both the side

$$x + d = \frac{S}{i} f + f + d$$

But x + d = D

$$\mathbf{D = \frac{f}{i} S + (f + d)}$$

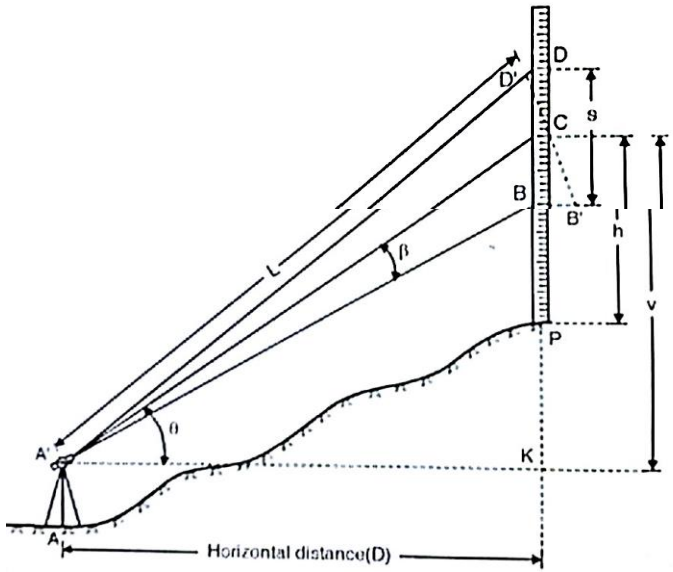
The constant $K = \frac{f}{i}$ is known as the multiplying constant or stadia interval factor and the constant $C = f + d$ is known as the additive stadia of the instrument.

Vertical Distance formula

- When the line of sight is horizontal V = 0

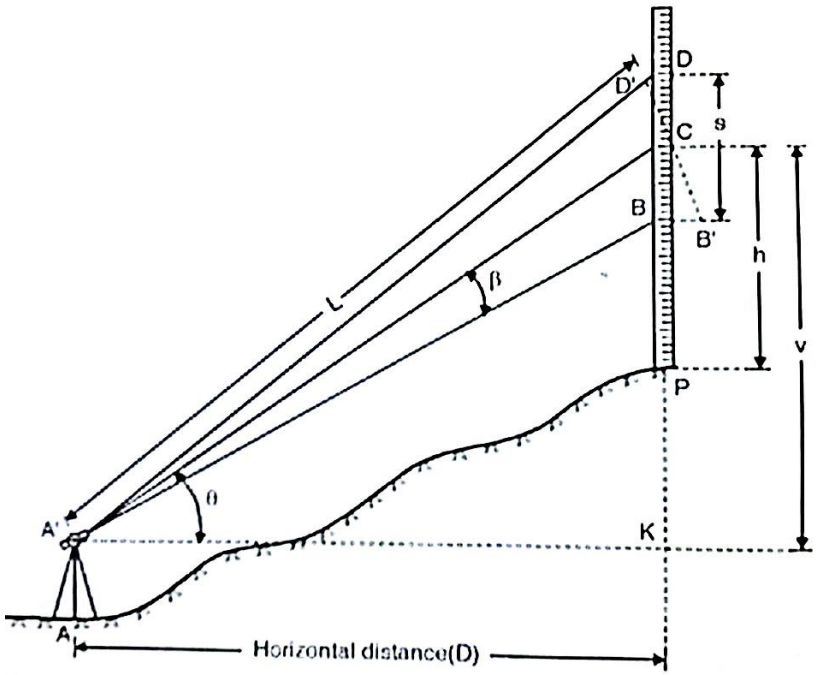
Application of Fixed hair method

- Case : 2 When the line of sight is
- inclined and staff is held Vertical.
- • Considering angle of elevation +θ



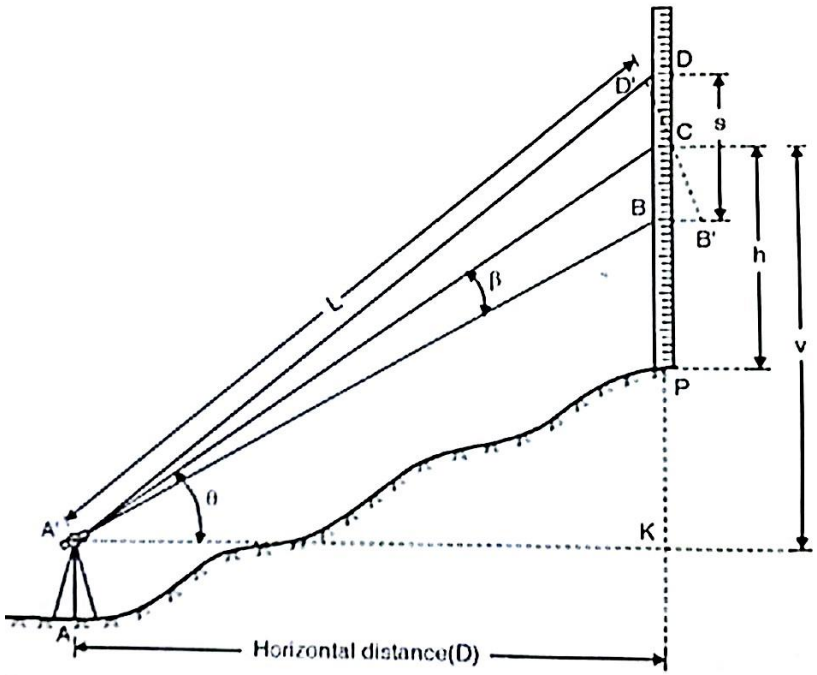
Application of Fixed hair method

- Let A is the instrument station
- • A’ is the position of the instrument axis
- • P is the staff station
- • DBC are the points on the staff cut by the hair
- of the diaphragm.
- • CA’K = is an inclined of the line of sight
- A’C to the horizontal
- • BD = S is the staff intercept (difference
- between the top and bottom hair reading)



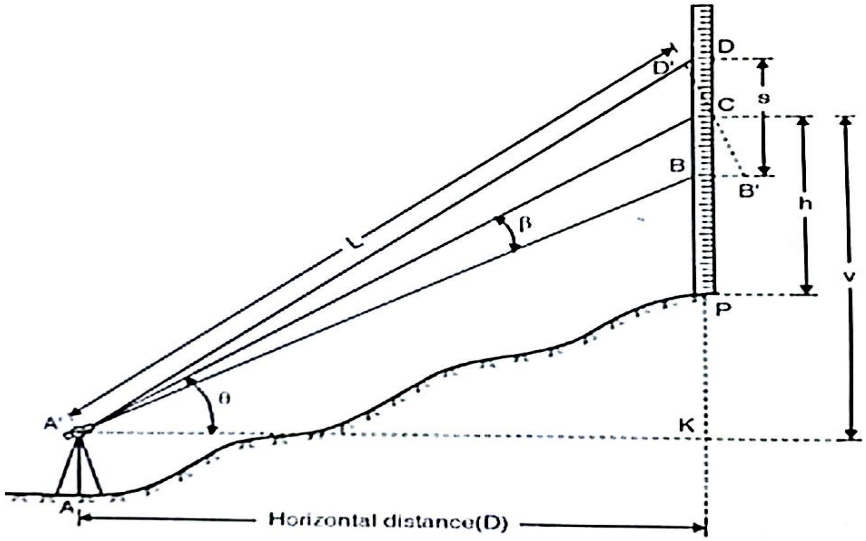
Application of Fixed hair method

- CP = h is the central hair or axial hair reading.
- • A’C = L is the distance along the line of collimation from A’ to C
- • A’K = D is the horizontal distance from the instrumental to the staff
- station P
- • CK = V is the vertical distance from the instrument axis to point C
- (Central hair reading)
- • Draw a perpendicular line through C to the line of sight A’C so that it
- cuts A’D in D’ and A’B in B’ is the projection of DB perpendicular to
- A’C as shown in figure
- • Line BD is perpendicular to the line A’K and B’D’ is perpendicular to
- A’C
- 2



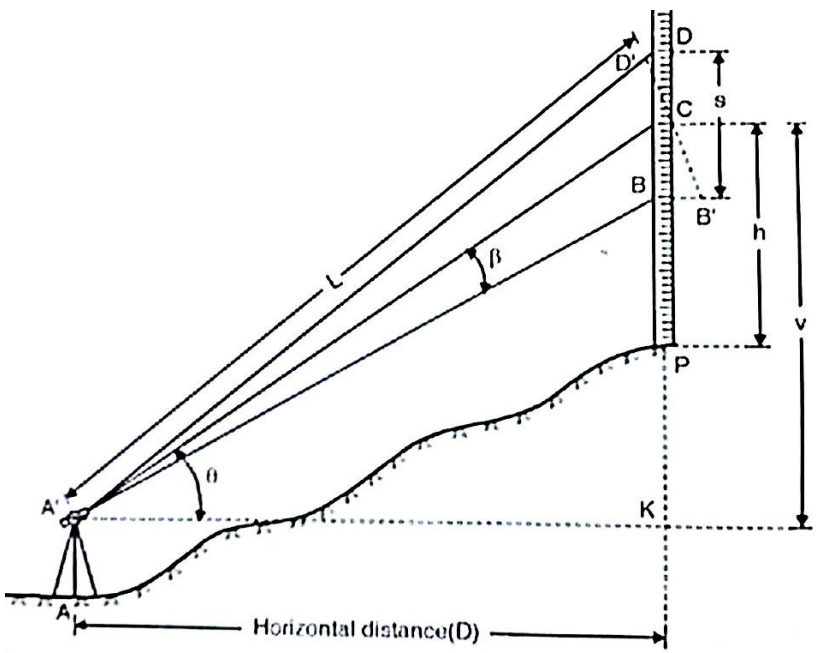
Application of Fixed hair method

- $\angle DCD' = \angle BCB' =$ and
  $\angle DA'C = \angle BA'C = \beta$
- $\angle A'D'C = 90^0 - \beta$
- Angle $\angle DD'C = 180^0 - (90^0 - \beta)$
- $= 90^0 + \beta$
- Angle $\angle BB'C = 90^0 - \beta$



Application of Fixed hair method

- From ΔS DD’C and BB’C
- • D’C = DC Cosθ
- • B’C = BC Cosθ
- • D’C + B’C = DC Cosθ + BC Cosθ
- • D’B’ = (DC + BC) Cosθ
- • D’B’ = DB Cosθ
- • D’B’ = S Cosθ



Application of Fixed hair method

Horizontal Distance D

Horizontal Distance D When the line of sight is horizontal, then:

$$\mathbf{D} = \frac{\mathbf{f}}{\mathbf{i}}(\mathbf{DB}) + (\mathbf{f} + \mathbf{d})$$

Here DB = S

So,

$$\mathbf{D} = \frac{\mathbf{f}}{\mathbf{i}}(\mathbf{S}) + (\mathbf{f} + \mathbf{d})$$

Now inclined distance A'C = $\mathbf{L} = \frac{\mathbf{f}}{\mathbf{i}}(\mathbf{D'B'}) + (\mathbf{f} + \mathbf{d})$

But here D'B' = S Cosθ

Application of Fixed hair method

$$\mathbf{L = \frac{f}{i}(S\ Cos\theta) + (f + d)}$$

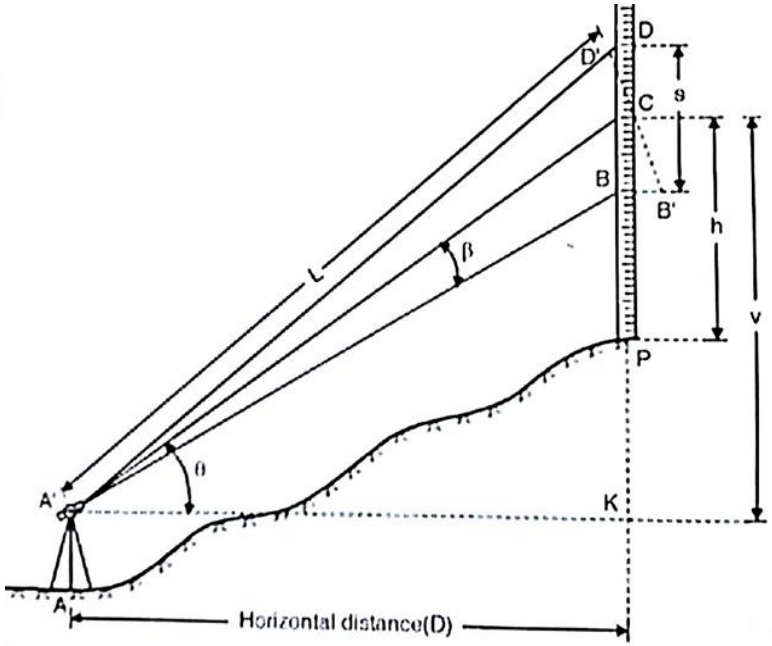
Horizontal distance $D = L\ Cos\theta$

$$D = L = \frac{f}{i}(S\ Cos\theta)(Cos\theta) + (f + d)(Cos\theta)$$

$$D = \frac{f}{i} S\ Cos^2\theta + (f + d) Cos\ \theta$$

Here $\frac{f}{i} = K$ and $(f + d) = C$

$$\mathbf{D = \frac{f}{i} S\ Cos^2\theta + (f + d) Cos\ \theta}$$



Application of Fixed hair method

Vertical distance

From $\Delta A'CK$, $CK = V = L \sin\theta$

Put the value of $L = \frac{f}{i}(S \cos\theta) + (f + d)$

$$V = \frac{f}{i}(S \cos\theta)(\sin\theta) + (f + d)(\sin\theta)$$

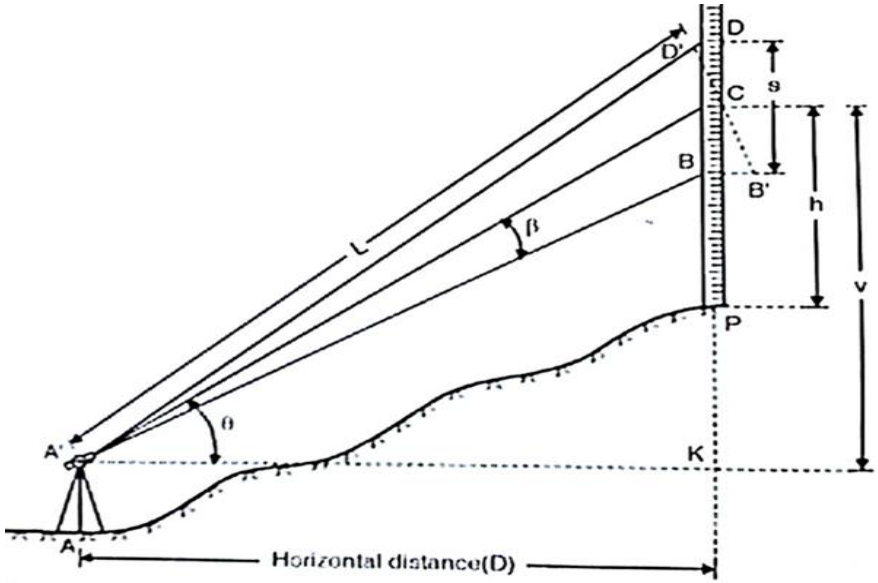
$$V = \frac{f}{i}\frac{S \sin 2\theta}{2} + (f + d) \sin\theta$$

Here $\frac{f}{i} = K$ and $(f + d) = C$

$$\textbf{So, } V = \frac{KS \sin 2\theta}{2} + (C) \sin\theta$$

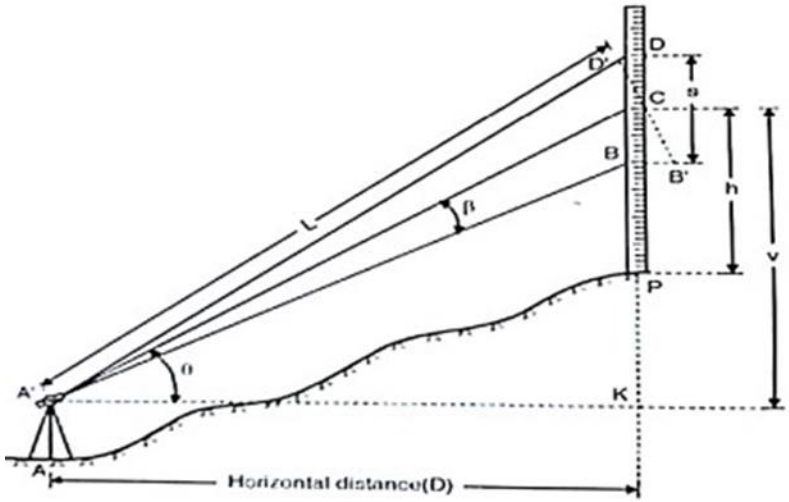
Application of Fixed hair method

- Elevation of the staff station for angle of elevation
- Elevation of staff station= Elevation of instrument + R.L. of B.M. + V- h



Application of Fixed hair method

- Elevation of the staff station for the angle of depression.
- Elevation of staff station= Elevation of instrument + R.L. of B.M. - V- h



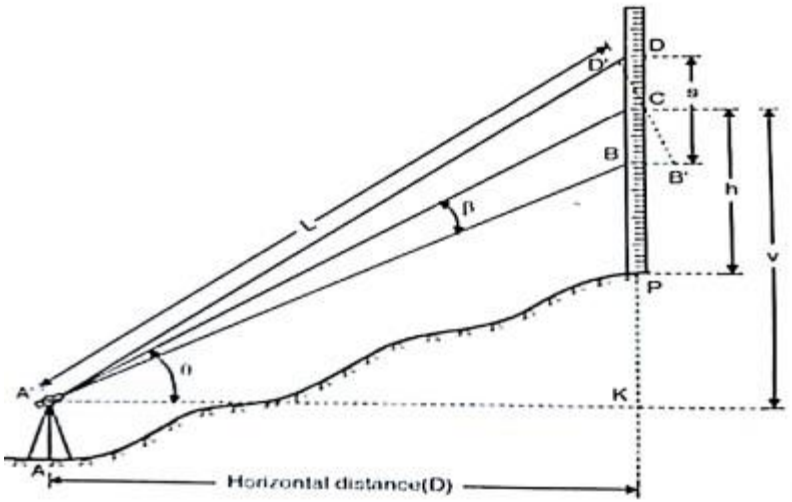
Application of Fixed hair method

- Horizontal Distance D:

$$D = \frac{f}{i} S \cos^2\theta + (f + d)\cos\theta$$

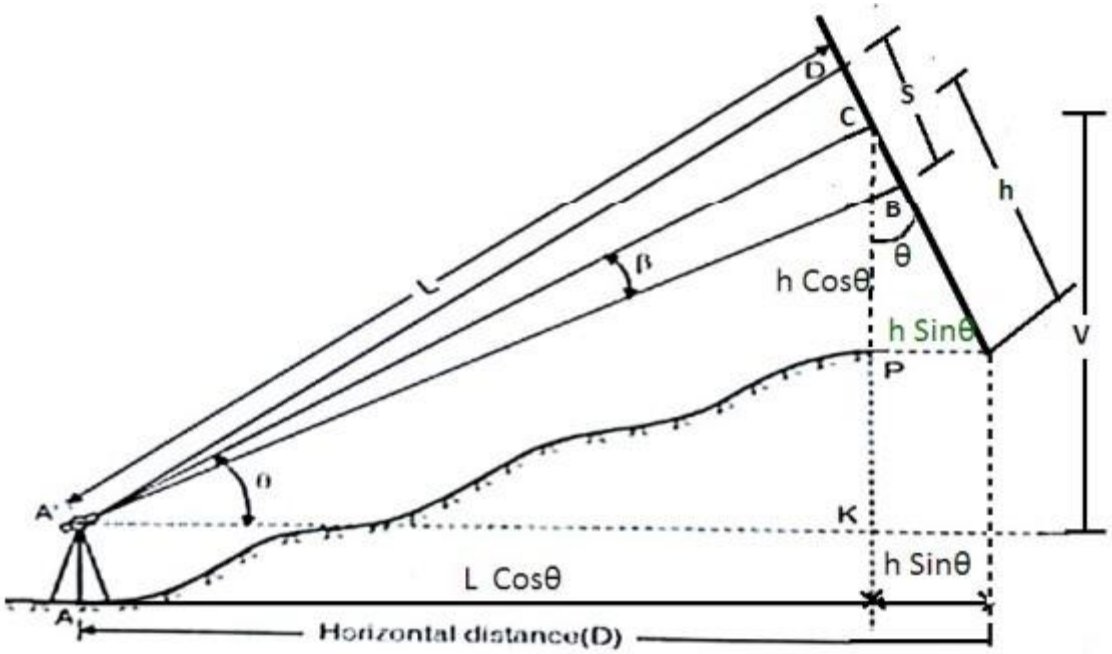
- Vertical Distance V

$$, V = \frac{KS \sin 2\theta}{2} + (C) \sin\theta$$



Application of Fixed hair method

- Case : 3 When the line of sight is inclined, and staff is held normal to the line of sight.
- Considering angle of Elevation +θ

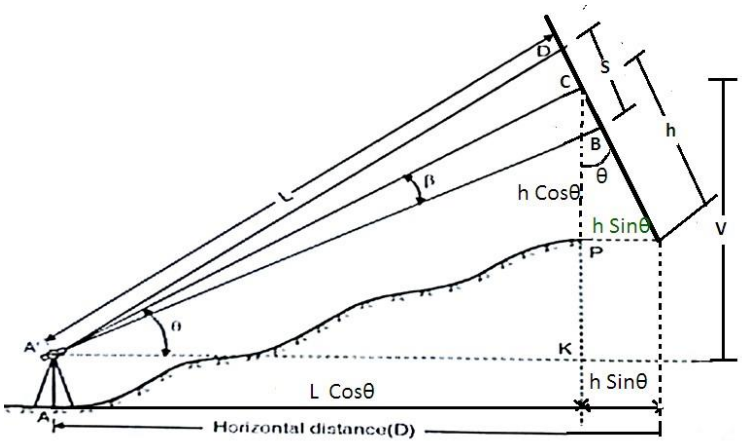


Application of Fixed hair method

- Horizontal distance formula :-

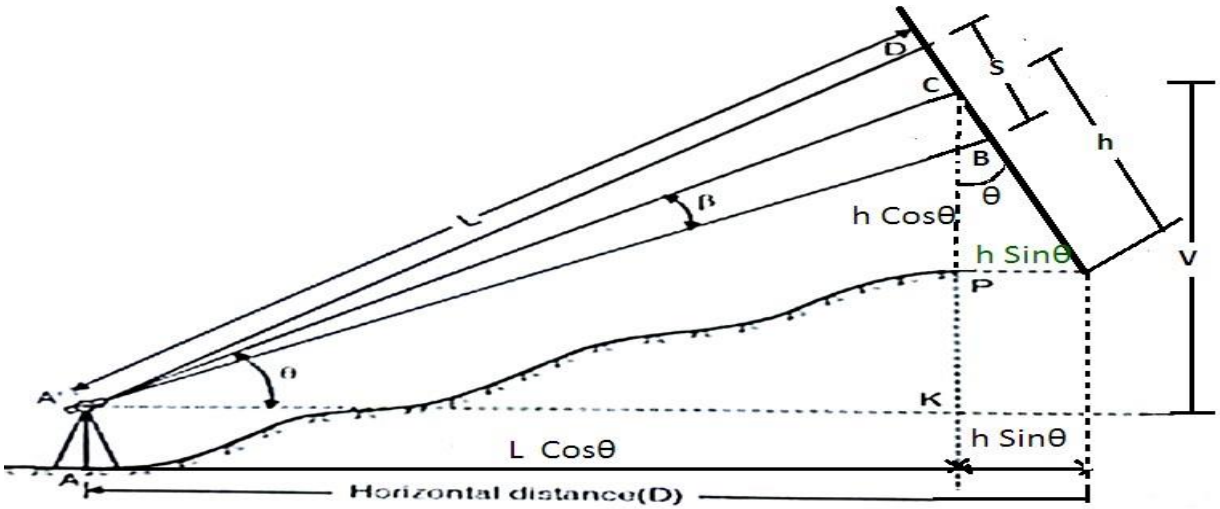
$$D = \frac{f}{i}(S) + (f + d)$$

- From the figure the Horizontal distance D :-
- D = L Cosθ + h Sinθ
- = (KS + C) Cosθ + h Sinθ
- = KS Cosθ + C Cosθ + h Sinθ



Application of Fixed hair method

- Vertical distance formula :-
- • Vertical distance V = L Sinθ
- = (KS + C) Sinθ
- = KS Sinθ + C Sinθ



Application of Fixed hair method

- Elevation of the staff station :-
- • Elevation of staff station= Elevation of
- instrument + R.L. of B.M. + V- h Cosθ
- Considering angle of depression – θ
- • Horizontal distance formula:-
- • Horizontal
- distance D = L Cosθ - h Sinθ
- = (KS + C) Cosθ - h Sinθ
- = KS Cosθ + C Cosθ - h Sinθ

Application of Fixed hair method

- Vertical distance formula :-
- Vertical distance $V = L \sin\theta$
- $= (KS + C) \sin\theta$
- $= KS \sin\theta + C \sin\theta$
- Elevation of the staff station :-
- Elevation of staff station = Elevation of
- instrument + R.L. of B.M. - V- $h \cos\theta$