4. POINTS & CROSSING

HEEL DIVERGENCE OR HEEL CLEARANCE

For B.G → 13.7 cm to 13.3 cm
For M.G → 12.1 cm to 11.7 cm.
For N.G → 9.8 cm

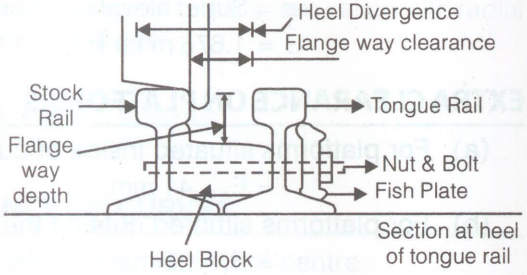
SWITCH ANGLE (α)

$$\alpha = \frac{\text{Heel divergence}}{\text{Length of tongue rail}}$$

(a) When thickness of tongue rail at toe, t = 0

$$\alpha = \sin^{-1}\left(\frac{d}{s_2}\right)$$

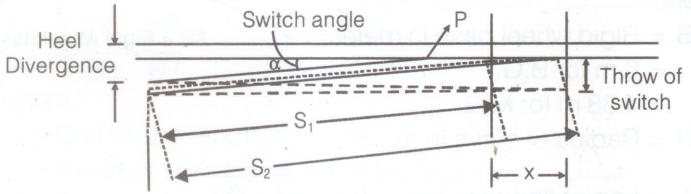
where,
d = Heel divergence
s_2 = Theoretical length of tongue rail



(b) When thickness of tongue rail at toe = t

$$\alpha = \frac{\sin^{-1}(d - t)}{s_1}$$

where, s_1 = Actual length of tongue rail.



FLANGE WAY CLEARANCE

For 1 in 12 crossing: Flange way clearance = 6.3 cm.
For 1 in 8½ crossing: Flange way clearance = 6.6 cm.

MINIMUM LENGTH OF TONGUE RAIL (S)

$$S = R \tan\frac{\alpha}{2}$$

where, S = Theoretical length of tongue rail
R = Radius of curve at turnout.

DISTANCE BETWEEN TNC & ANC

$$d_{ta} = N \cdot t$$

where, d_{ta} = Distance between TNC & ANC
N = Number of crossing
t = Thickness of nose of crossing.

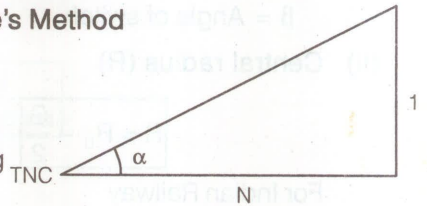
NUMBER & ANGLE OF CROSSING

$$N = \frac{\text{Spread at the leg of crossing}}{\text{Length of crossing from T} \cdot \text{NC}}$$

(a) Right Angle Method, or Cole's Method

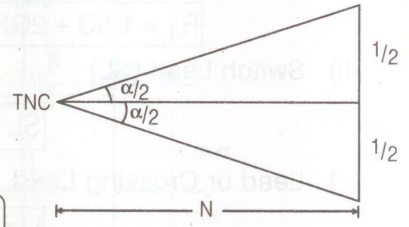
$$N = \cot\alpha$$

where, α = Angle of crossing
and N = Number of crossing



(b) Centre Line Method

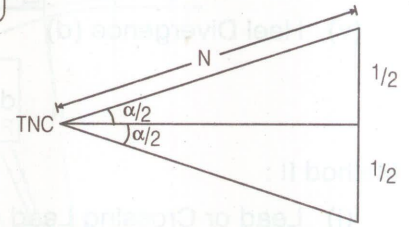
$$N = \frac{1}{2}\cot\left(\frac{\alpha}{2}\right)$$



Remember: For 1 in 12 crossing, N = 12

(c) Isosceles Triangle Method

$$N = \frac{1}{2}\text{cosec}\left(\frac{\alpha}{2}\right)$$

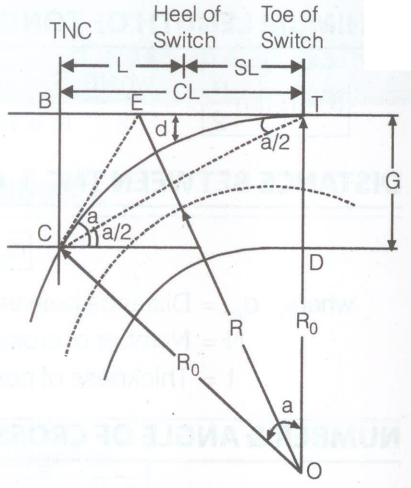


DESIGN OF TURNOUT

$$CL = L + SL$$

where, CL = Curve lead
L = Lead
SL = Switch lead

Method I :



(i) $\boxed{CL = G\cot\frac{\alpha}{2}}$

$\boxed{CL = \sqrt{2R_0G}}$

$\boxed{CL \simeq 2GN}$

where,

α = Angle of crossing.
d = Heel divergence.
R_0 = Radius of outer curve of turnout.
G = Gauge of track.
N = Number of crossing.
R = Radius of centre line of turnoff.
D = Distance between T.N.C & Tangent point of curve.
β = Angle of switch.

(ii) **Central radius (R)**

$$\boxed{R = R_0 - \frac{G}{2}} \quad \boxed{R_0 = G + 2GN^2}$$

For Indian Railway

$$\boxed{R_0 = 1.5G + 2GN^2} \quad \boxed{R_0 = CL\,\text{cosec}\,\alpha}$$

(iii) **Switch Lead (SL)**

$$\boxed{SL = \sqrt{2R_0d}}$$

(iv) **Lead or Crossing Lead**

$$\boxed{L = CL - SL}$$

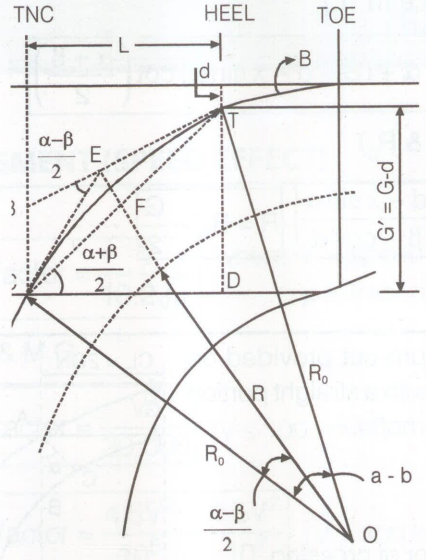
(v) **Heel Divergence (d)**

$$\boxed{d = \frac{SL^2}{2R_0}}$$

Method II :

(i) **Lead or Crossing Lead (L)**

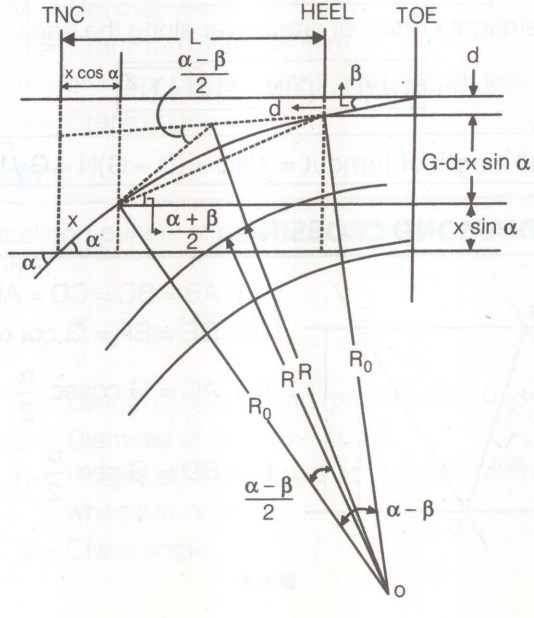
$$\boxed{L = (G - d)\cot\left(\frac{\alpha+\beta}{2}\right)}$$



(ii) **Radius (R)**

$$\boxed{R = R_0 - \frac{G}{2}} \quad \boxed{R_0 = \frac{G - d}{\cos\beta - \cos\alpha}}$$

Method III :



(i) Crossing Lead (L)

$$L = x\cos\alpha + (G - d - x\sin\alpha)\cot\left(\frac{\alpha+\beta}{2}\right)$$

(ii) Radius (R & R_0)

$$R_0 = \frac{G - d - x\sin\alpha}{\cos\beta - \cos\alpha} \qquad R = R_0 - \frac{G}{2}$$

CROSS OVER

Type (I) : Two turn out provided on two tracks joint with a straight portion between two turnoffs.

$$N = \cot\alpha$$

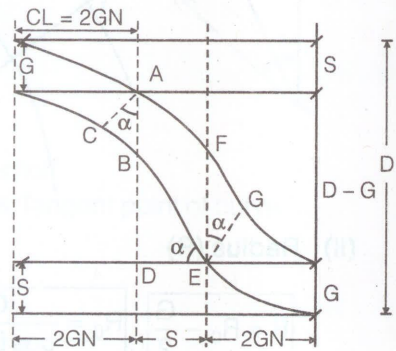
where,

N = Number of crossing

α = Crossing angle

D = Centre to centre distance between two tracks

G = Gauge.



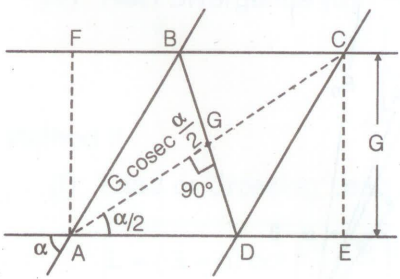
$$\text{Length of one turn out} = CL = 2GN$$

Length of straight portion of cross over along the track

$$S = (D - G)N - G\sqrt{1+N^2}$$

$$\text{Overall length of turnout} = 4NG + (D - G)N - G\sqrt{1+N^2}$$

DESIGN OF DIAMOND CROSSING



(i) AB = BC = CD = AD = G cosec α

(ii) DE = BF = G cot α

(iii) AC = G cosec $\frac{\alpha}{2}$

(iv) BD = G sec $\frac{\alpha}{2}$.

■■■