TRANSPORTATION ENGG-2

Points & Crossings

→ Points & crossings provide flexibility of movement by connecting one line to another according to requirement.

→ The simplest combination of points & crossings which enables one track either a branch line or a sliding, to take off from another track is known as turnout.

→ Points & crossing are provided to facilitate the change of railway vehicles from one track to another. The track may be parallel, diverging or converging to each other.

Direction of turnout :

A turnout is designated as a right hand or a left hand turnout depending on whether it diverts the traffic to the right or to the left.

Diagram :

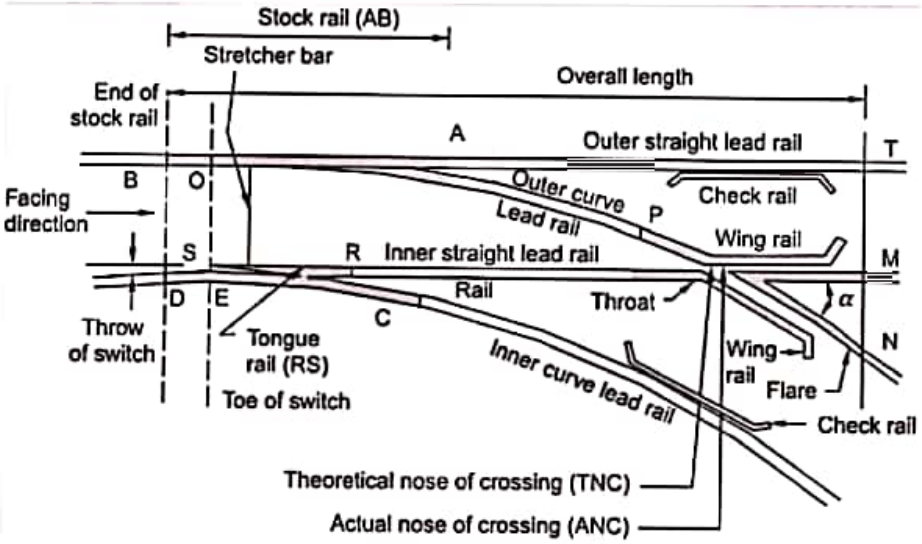


Fig. (a) Constituents of a turnout

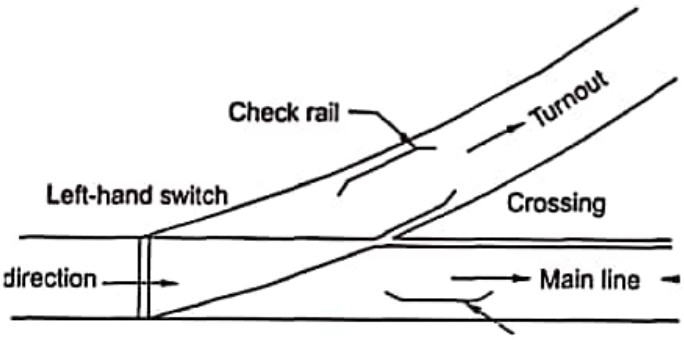


Fig. (b) Left-hand turnout

Elements of Simple turn out (or)

Important terms used in points & crossings:

1) **Facing direction**: If some one stands at toe of switch and looks towards the crossing, then the direction is called facing direction.

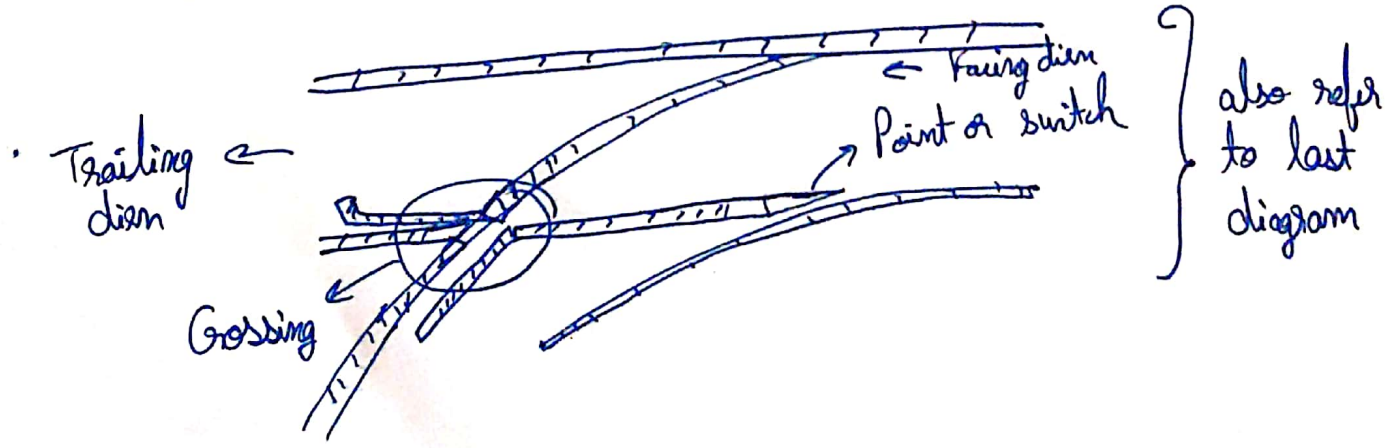
2) **Trailing direction**: If someone stands at the crossing and looks towards the switches, then the direction is called trailing direction. (Refer to fig. 1 given above)

3) **Tongue Rail**: It is a tapered movable rail, made of high carbon or manganese steel to withstand wear. At its thicker end, it is attached to a running rail. A tongue rail is also called a ~~stock~~ switch rail.

4) **Stock Rail**: It is the ~~tongue rail~~ running rail against which a tongue rail operates.

5) **Points or switch**: A pair of tongue and stock rails with the necessary connections & fittings forms a switch.

6) **Crossing**: It is a device introduced at the junction where two rails cross each other to permit the wheel flange of a railway vehicle to pass from one track to another.



Details of switch :

A set of points or switches consist of the following main constituents:

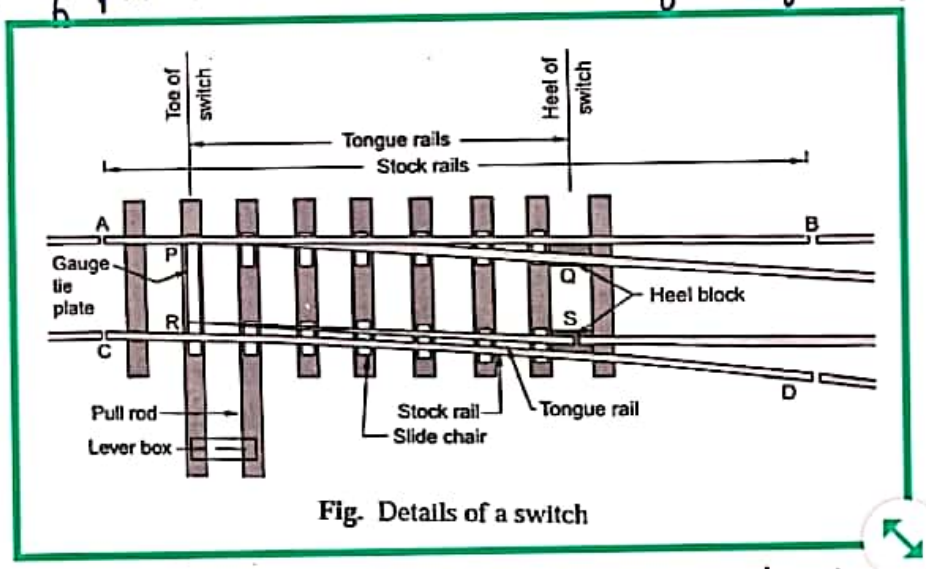


Fig. Details of a switch

(a) A pair of stock rails, AB & CD, made up of medium-manganese steel

(b) A pair of tongue rails, PQ & RS, also known as switch rails, made of medium manganese steel to withstand wear. The tapered end of tongue rail is called as toe and ~~tid~~ thicker end is called as heel.

(c) A pair of heel blocks which holds the heel of the tongue rails is held at the standard clearance or distance from the stock rails.

(d) A number of slide chairs to support the tongue rails ~~is held at a standard clearance~~ and enable its movement towards or away from the stock rail.

(e) Two or more stretcher bars connecting both the tongue rails close to the toe, for the purpose of holding them at a fixed distance from each other.

(f) A gauge tie plate to fix gauges and ensure correct gauge at the points.

Types of switches:

Switches are of two types, namely stud switch and split switch. In a stud type of switch, no separate tongue rail is provided and some portion of the track is moved from one side to the another side. Stud switches are no more used in Indian Railways. They have been replaced by split switches.

Split switches consist of a pair of stock rails and a pair of tongue rails. Split switches are also of two types:

(a) Loose heel type
(b) Fixed heel type

} on the basis of fixation at heel.

Loose heel type: In this, the tongue rails are joined to lead rails by means of fish plates. The two front bolts are kept loose to allow the throw of switch and these bolts are kept tight when the tongue is open. This is suitable for short length switches.

Fixed heel type: This switch is an improvement over loose heel type switch. In this, all the four bolts are tight when the tongue is closed. It has given quite satisfactory result when long tongue rails are used. So fixed heel type switch is suitable with long tongue rails only.

The toes of the switch may be of following type :

1) Under cut switch : In this switch the foot of stock rail is ~~planed~~ planned to accomodate the tongue rail. Foot of stock rail is cut.

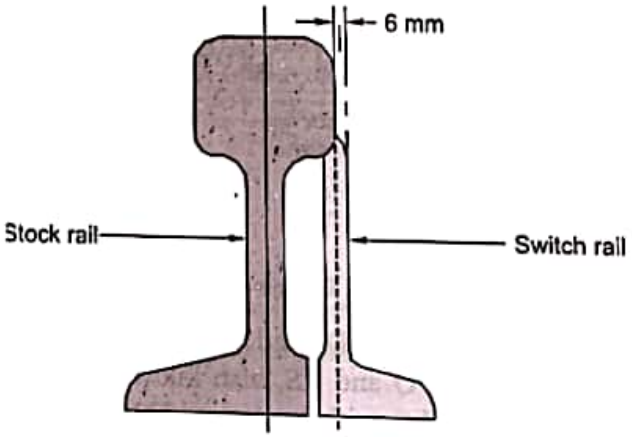


Fig. Undercut switch

2) Overriding switch : In this the stock rail occupies the full section & the tongue rail is planed to a 6mm thick edge, which overrides the foot of stock rail.

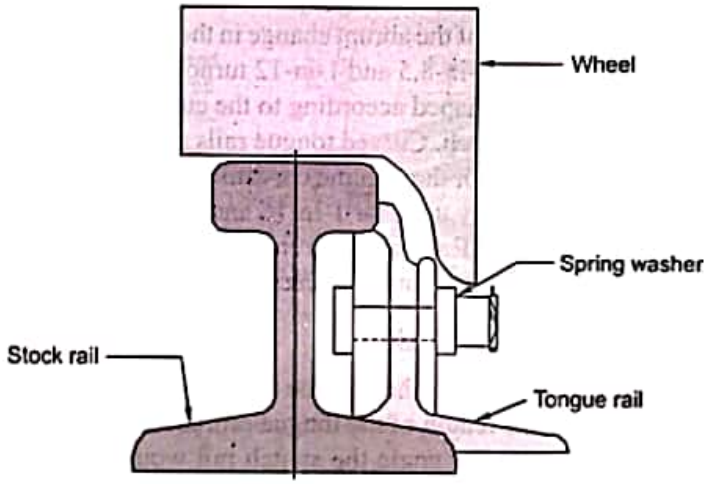


Fig. Overriding switch

Crossing :

A crossing or frog is a device introduced at the point where two gauge faces across each other to permit the flanges of a railway vehicle to pass from one tract to another.
To achieve this objective, a gap is provided from the throw to the nose of crossing, over which the flanged wheel glides or jumps.
In order to ensure that this flanged wheel negotiates the gap properly and does not strike the nose, the other wheel is guided with the help of check rail.
A crossing consist of following components, shown below:

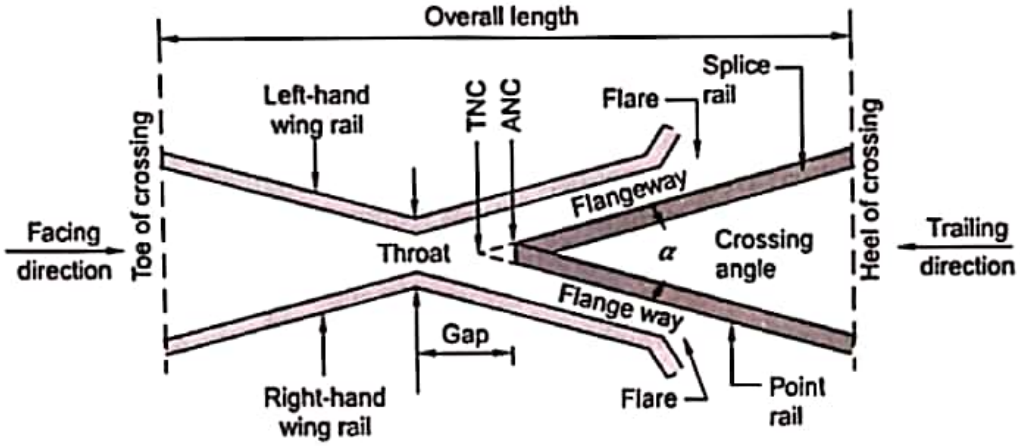


Fig. Details of a crossing

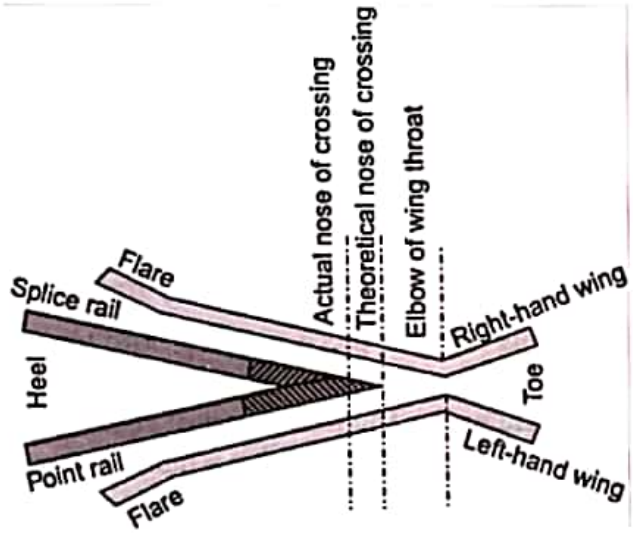


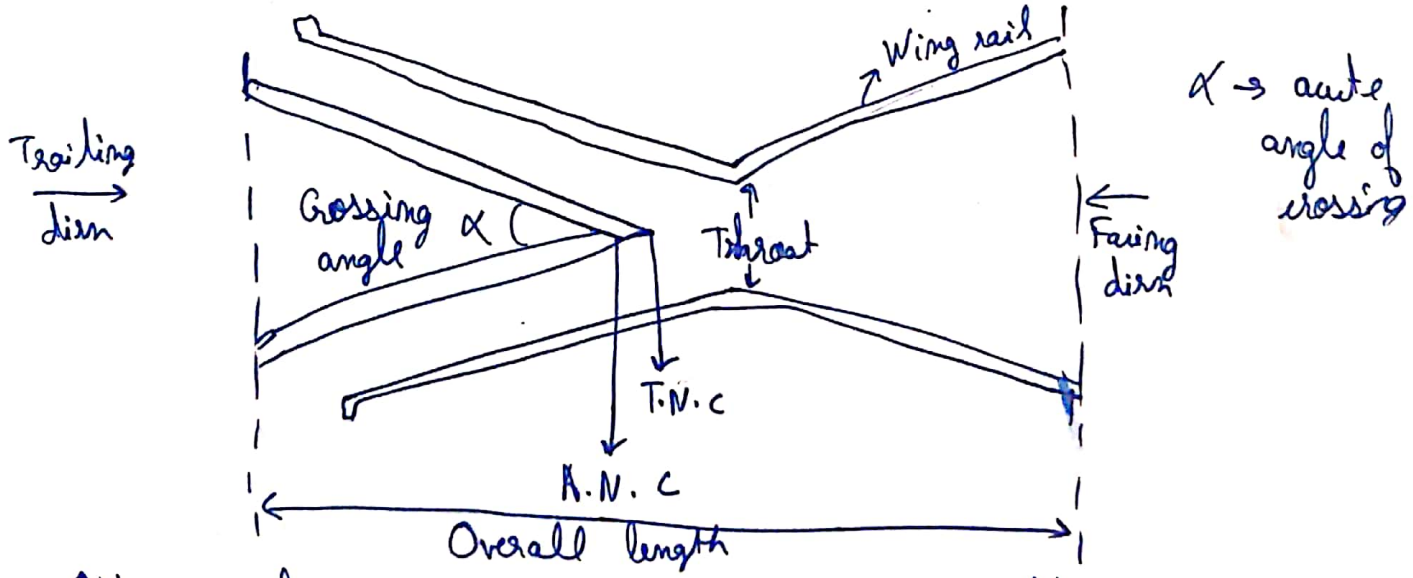
Fig. Point rail and splice rail

→ Two rails, point rail & splice rail are machined to form a nose.

→ The toe of blunt nose is called the actual nose of crossing (ANC) and the theoretical point where the guage faces from the both side intersect is called theoretical nose of crossing (TNC).

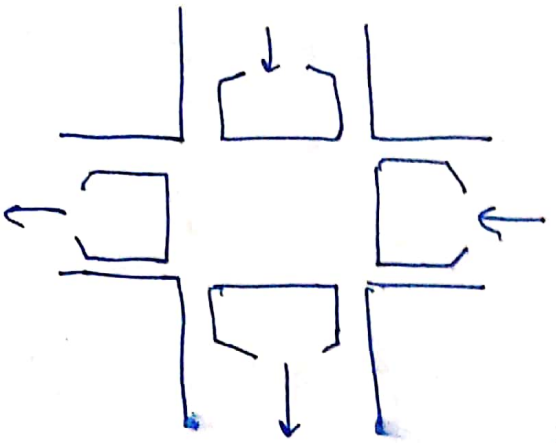
Types of crossing :

1) Acute angle crossing : This type of crossing is widely used. This crossing is obtained when a left hand rail of one track crosses a right hand rail of another track or vice versa. If the angle of intersection of the approaching rails is acute angle it is termed as acute angle crossing.



2) Obtuse angle crossing : This crossing is obtained when left hand rail of one track crosses a right hand rail of another track or vice versa at an obtuse angle.

3) Square Crossing : When two straight tracks cross each other at right angle, they give rise to square crossing.



In India, there is only one place where square crossing is found i.e., Nagpur.

Number & angle of crossing:

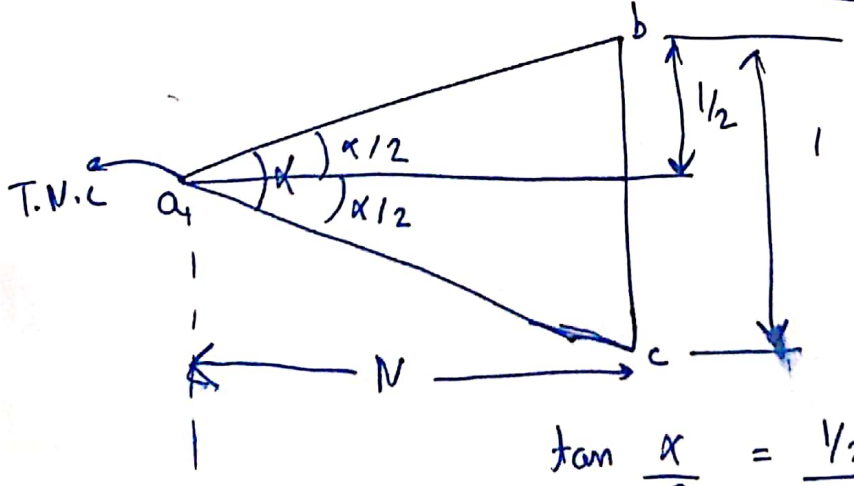
A crossing is designated either by the angle the gauge faces make with each other or more commonly by the number of crossing, represented by N. There are three methods of measuring the number of a crossing and the value of N also depends upon the method adopted.

↳ N is ratio of:

$$N = \frac{\text{Spread at leg of crossing}}{\text{length of crossing T.V.C}}$$

1) Centre line Method:

This method is used in USA & UK.

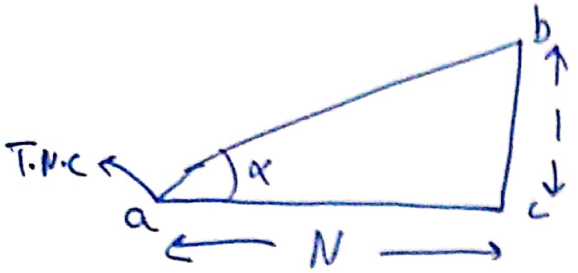


$$\tan\frac{\alpha}{2} = \frac{1/2}{N} = \frac{1}{2N}$$

$$\cot \alpha/2 = 2N$$

$$N = \frac{1}{2}\cot\frac{\alpha}{2}$$

2) Right angle Mtd or Cole's Mtd :
Used in Indian Railway.



$$\tan \alpha = \frac{1}{N}$$

$$\cot \alpha = N$$

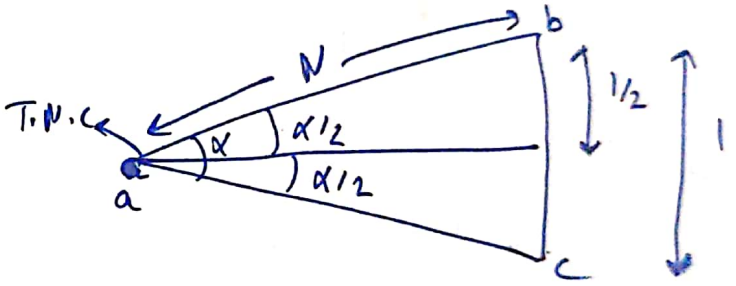
$$\boxed{N = \cot \alpha}$$

3) Isosceles traingle Mtd : In this, the measurement of 'N' is taken along one side of isosceles traingle,

$$\sin \frac{\alpha}{2} = \frac{1/2}{N} = \frac{1}{2N}$$

$$\operatorname{cosec} \alpha/2 = 2N$$

$$\boxed{N = \frac{1}{2} \operatorname{cosec} \alpha/2}$$



Design of turn out:

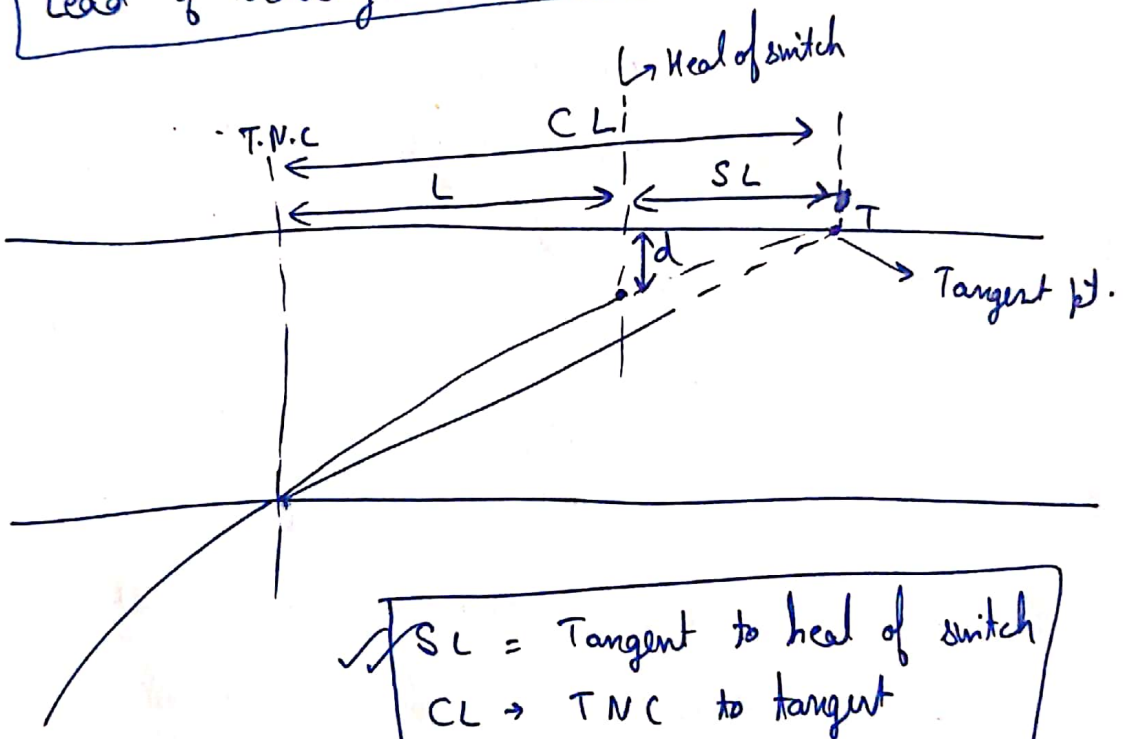
The important terms used in describing the design of turnout are:

a) Curve lead (CL): This is the distance from the tangent point(T) to the theoretical nose of crossing (TNC) measured along the length of main track.

(b) Switch lead (SL): This is the distance from the tangent point(T) to the heel of the switch measured along length of main track.

(c) Lead of crossing (L): This is the distance measured along the length of main track.

Lead of crossing (L) = Curve lead (CL) - switch lead (SL)



SL = Tangent to heel of switch

CL → TNC to tangent

L = CL - SL

d → heel divergence or clearance

Method of designing turnout:

Important steps to be followed in designing are:

(i) All three leads, CL, SL & L are calculated. CL & SL are particularly calculated in this method.

(ii) Crossing angle (α) is calculated using right angle method.

(iii) Crossing curve is considered to start from an imaginary tangent point ahead of actual toe of switch & ~~ends~~ should end at T.N.C.

⇒ Value of gauge (G), heel divergence (d) & angle of crossing (α) are given as:

$$CL = 2GN$$

$$R = R_o - G/2$$

$$R_o = 1.5G + 2GN^2$$

$$SL = (2R_o d)^{1/2}$$ as d^2 is very small compared to $2R_o d$

$$L = CL - SL$$

$$L = 2GN - (2R_o d)^{1/2}$$

Heel divergence (d):
It is the distance b/w main line & the turnout side at heel
R → Radius of turnout

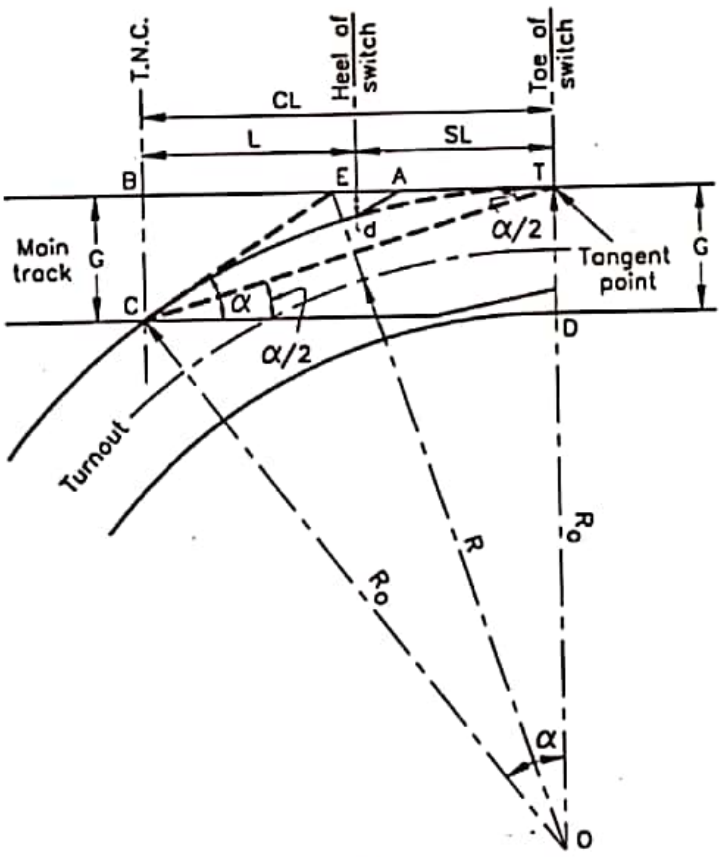
R_o → Radius at outer turnout.
d = heel divergence or clearance.

Heel divergence (d):

$$SL = (2R_o d)^{1/2}$$

$$d = (SL)^2 / 2R_o$$

(Refers to next diagram)



2. Calculate all necessary elements required to set out a 1 in $8\frac{1}{2}$ turnout, taking off from a straight B.G. track with its curve starting from the toe of switch i.e tangential to gauge face of the outer main rail & passes through theoretical nose of crossing.

Given heel divergence, $d = 11.4\ cm$

$N = 8.5$; $G = 1.676\ m$ (B.G); $d = 11.4\ cm = 0.114\ m$

(1) $CL = 2GN$

$= 2 \times 1.676 \times 8.5$

$= 28.49\ m$

(2) Radius, $R = R_o - \frac{G}{2}$

$R_o = 2GN^2 + 1.5\,G$

$= 2 \times 1.676 \times 8.5^2 + 1.5 \times 1.676$

$= 244.69\ m$

$R = 244.69 - \frac{1.676}{2}$

$= 243.85\ m$

(3) $S_1L \Rightarrow \sqrt{2 R_o \cdot d}$

$= \sqrt{2 \times 244.69 \times 0.114}$

$= 7.45\ m$

(4) $L = CL - SL = 28.49 - 7.45 = 21.04\ m$

Overall length of curve is 28.49 m & radius of outer curve is 244.69 m

Try to study the given content in next 2 days, assignments will be given on the content after 2 days and the assignments would be self ~~end~~ evaluatory. Any doubts shall be sent ~~to~~ by email to:
gaurav.ap1793@gmail.com