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# To Overcome the Visibility Issues Faced By the Loco Pilots in Diesel Engine by Using Reversing Triangle and Diesel Loco Shed

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**ABSTRACT:** As the technology has been increased and tremendously due to the Industrial revolution there was a huge demand for high speed rail network, but due to the visibility issues faced in the Diesel locomotives in Long Hood Front (LHF) mode there are chances of facing huge technical slow speed restriction and problems which were faced by the loco pilots to handle the diesel locomotive in Long Hood Front (LHF) direction was a huge challenge. So this study says that how Reversing triangles and Diesel Loco shed can help to overcome the visibility issues in Diesel locomotives without doing any extra modification i.e.; Dual cab in engine which will help to reduce the Weight, Improve the Efficiency, Reducing the cost and time for installation (or modification), reducing the length of the Locomotives and will also give shelter to the locomotives, when they will be off duty.

**KEYWORDS:** Reversing triangle, Diesel locomotives, Diesel Loco Shed.

### I. INTRODUCING OF REVERSING TRIANGLE OR WYE

In railroad structures, and terminology, a wye (like the 'Y' glyph) also called a triangular junction (by the traditions of some railroad cultures) is a triangular joining arrangement of three rail lines with a railroad switch (set of points) at each corner connecting to each incoming line. A Turning wye is a specific case.

Where two rail lines join, or in a joint between a railroads mainline and a spur, wyes can be used as a main line rail junction to allow incoming consists ability to travel either direction, or in order to allow trains to pass from one line to the other line.

#### REVERSING TRIANGLE OR WYE

A Reversing triangle or Wyes can also be used for turning railway equipment, and generally cover less area than a balloon loop doing the same job but at the cost of two additional sets of points to construct, then maintain. These turnings are accomplished by performing the railway equivalent of a three-point turn through successive junctions of the wye, the direction of travel and the relative orientation of a locomotive or railway vehicle can be reversed, resulting in it facing in the direction from which it came. When and where a wye is built specifically for equipment reversing purposes, one or more of the tracks making up the junction will typically be a stub siding. Tram or streetcar tracks also make use of triangular junctions and sometimes have a short triangle or wye stubs to turn the car at the end of the line.

### II. HISTORY

The first proper railway was the Liverpool and Manchester Railway which opened in 1830. Like the trams that had preceded it over a hundred years, the L&M had gentle curves and gradients. Amongst other reasons for the gentle curves was the lack of strength of the track, which might have over turned if the curves were too sharp causing derailments. There was no signaling at this time, so drivers had to be able to see ahead to avoid collisions with previous trains. The gentle the curves, the longer the visibility. The earliest rails were made in short lengths of wrought iron, which does not bend like later steel rails that were introduced in the 1850s.

The main factors affecting the minimum curve radii for railroads are governed by the speed operated and by the mechanical ability of the rolling stock to adjust to the curvature. In North America, equipment for unlimited

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interchange between railroad companies are built to accommodate 350-foot (106.7m) radius, but normally 410-foot(125.0m) radius is used as a minimum, as some freight cars are handled by special agreement between railroads that cannot take the sharper curvature. For handling of long freight trains, a minimum 717-foot (218.5m) radius is preferred. The sharpest curves tend to be on the narrowest of narrow gauge railways, where almost everything is proportionately smaller.

### III. REVERSING TRIANGLE AND IT'S METHODOLOGY

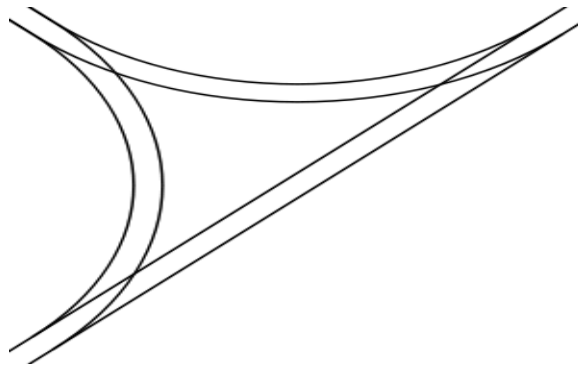


Fig 3.1 Schematic representation of reversing triangle

The use of triangular junctions allows flexibility in routing trains from any line to any other line, without the need to reverse the train. For this reason they are used in most rail networks. Slower bi-directional trains may enter a wye, letting a faster one pass, and continue on the same direction providing service to nearby freight transport or a passenger station.

Where one or more of the lines meeting at the junction are multi-track, the presence of a triangular junction does introduce a number of potential conflicting moves. For this reason, where traffic is heavy, the junction may incorporate flying junctions on some, or all, or the legs of the triangle.

But it can be further modified, in such a way that the Diesel engines can use this triangle as turning equipment through which the visibility issues on the Long hood front (LHF) and the problem faced by the loco pilots can be resolved. This can be further modified in such a way that the loop line where there triangle is been formed that line can be further extended and a Diesel shed can be constructed where the Trains will be safe from the direct contact of the environment. This kind of modification helps to improve the efficiency of the engines by running it into Short hood front (SHF) view where the operator cab is present and loco pilot will not face the visibility issues. The Triangle with a bigger width and length can also be used in such a way that the trains can be reversed to avoid the rake loco reversal which consumes a lot of time and energy.

Since, the Fig. 3.3 represents the layout of the junction where there is a formation of a wye or Reversing triangle which can be used in two ways.

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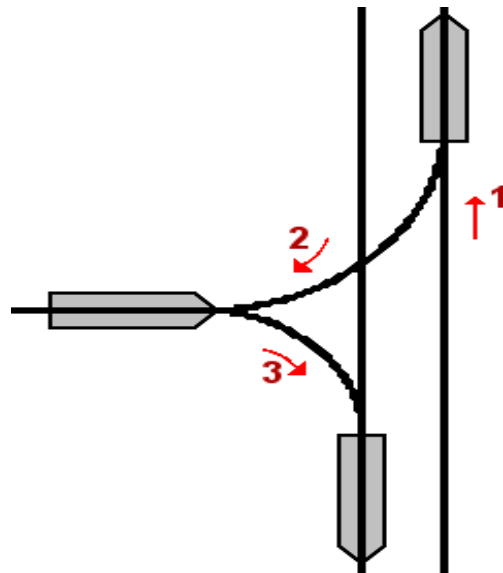


Fig. 3.2 Illustration of the usage of a wye track for turning a railway engine

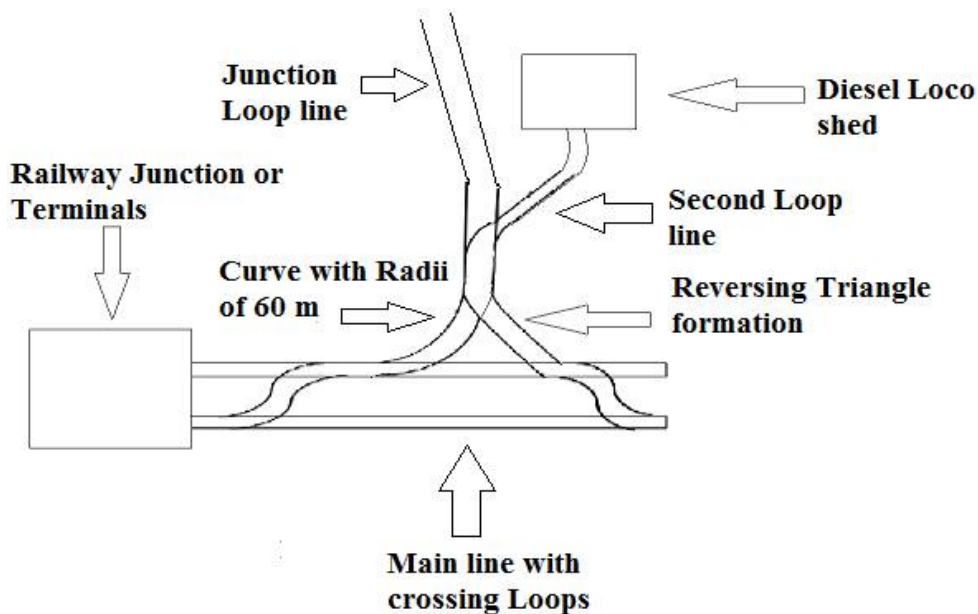


Fig. 3.3 Representation of rough sketch of reversing triangle with an installment of Diesel shed at main Railway junction

For the engines it will work as turning equipment and for the passenger or freight trains it can act as a bypass route. But in this case the Radius of curvature of the track is considered as 60 meters (or can be increased). Since with respect to the junction loop line the triangle has been formed, so one ends get stretched to the junction line and the second loop line which gets stretched to the diesel loco shed.

(Note: - Since it's not necessary that the junction line should be present for the construction of triangle, it is considered

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because it helps to reduce the construction cost. Without junction line also, triangle can be constructed and can be extended upto Diesel loco shed as shown in fig. 3.3.)

## IV. FACTORS AFFECTING REVERSING TRIANGLE

### A. COUPLINGS

Not all couplers can handle very sharp curves. This is particularly true of the European buffer and chain couplers, where the buffers get in the way, and therefore allow around 200 m radius (then at around maximum 60 km/h). Central couplers usually allow sharper curves than this. Narrow gauge railways, tramways and metros normally don't have vehicles going both on them and the standard gauge mainlines, and therefore can have their own standard. They normally have central couplers without buffers in order to allow sharper curves.

Nowadays Buffer couplers and Knuckle coupler are installed which can easily handle the sharp curves and allow around the radius of 100-200 m at the permissible speed of 35-40 km/hr.

### B. SPEED AND CANTONMENT

As a heavy train goes round a bend at speed, the reactive centrifugal force the train exerts on the rails is sufficient to move the actual track, which is only held in place by ballast. To counter this, a cant (super elevation) is used, that is, a height difference between the outside and inside rails on the curve. Ideally the train should be tilted such that resultant (combined) force act straight down.

Through the bottom of the train, so the wheels, track, train and passengers feel little or no sideways force (“down” and “sideways” are given with respect to the plane of the track and train). Some trains are capable of tilting to enhance this effect for passenger comfort. The super elevation can't be ideal at the same time for both fast passenger trains and slow freight trains. The relationship between speed and tilt can be calculated mathematically. We start with the formula for a balancing centripetal force; ‘ $\theta$ ’ is the angle by which the train is tilted due to the cant, ‘ $r$ ’ is the curve radius in meters, ‘ $v$ ’ is the speed in meters per second, and ‘ $g$ ’ is the standard gravity, approximately equal to 9.80665 m/s<sup>2</sup>:

$$\tan \theta = v^2 / gr$$

Rearranging for  $r$  gives:

$$r = v^2 / g \tan \theta$$

Geometrically,  $\tan \theta$  can be expressed (approximately, for small angles) in terms of the track gauge  $G$ , the cant  $h_a$  and cant deficiency  $h_b$ , all in millimeters.

$$\tan \theta \approx \sin \theta = h_a + h_b / G$$

Replacing  $\tan \theta$  with what has just been proposed gives:

$$r = Gv^2 / (h_a + h_b) g$$

### C. AVAILABILITY OF SPACE

Since the space is the on the main issues which can be faced while implementation of this Triangle. But this issue occur majorly in the area where huge junctions and in densely crowded cities where the area surrounding the junctions are occupied by the people legally or illegally.

But these issues can be overcome when the junction loop line which separates from the main line can be used in such a way to form a Triangle. Since in some areas there are some barren land surrounding the junctions or terminals and that areas are best and beneficial for the installment of the Diesel shed and Triangle.

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## V. CALCULATIONS

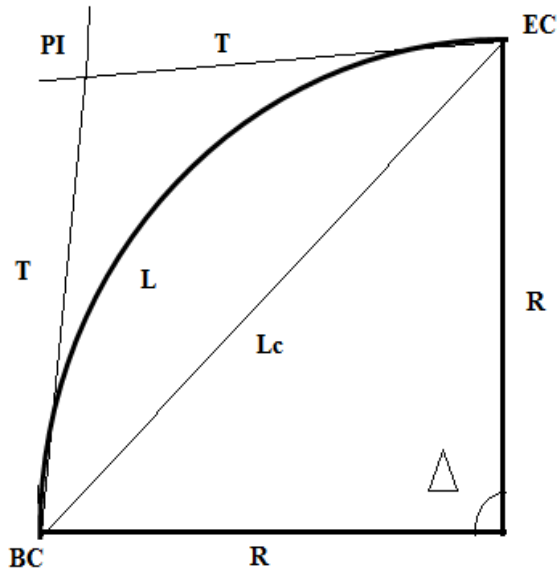


Fig. 5.1 Representing the Horizontal curve used in the Triangle

Since the above figure represents the Horizontal curve which are used in Railways and Roadways (or in Highways) for the diversion on the path in the smooth way. But in this case the curves are used as a part of the Reversing triangle (can be on both the sides) which are connected to the main line for the reversing Diesel Loco.

The abbreviations are as follows:

BC = It is the point where the curve starts.

EC = It is the point where the curve ends.

PI = The point of intersection of two tangents.

L = Length of the Curve (in meters).

Lc = Length of the chord (in meters).

R = Radius of curvature (in meters).

V = Velocity of the Engine (Km/hr).

g = acceleration due to gravity (9.8 m/s)

T = Tangent (in meters).

$\Delta$  = Interior angle formed by the arc

Let us consider that the curve is having the minimum Radius of curvature 75 meters (or 250 ft). The interior angle ( $\Delta$ ) formed is  $23^\circ$ . Since the size and dimensions of the curve is suitable for the passage of Single as well as Twin Diesel Loco Engine with the minimum permitted speed of 10-15 Km/hr. Bigger size curve are suitable for the passage of Freight and Passenger trains with minimum super elevation of  $2^\circ$  to  $4^\circ$  (as per railway standards).

So the following calculations for the curve are;

### a. LENGTH OF THE CURVE (L)

$$L = \frac{2\pi R \Delta}{360^\circ}$$

$$= \frac{2 \times \pi \times 75 \times 23^\circ}{(360^\circ)}$$

$$L = \underline{30.10 \text{ meters (or 100.36 ft)}}$$

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**b. LENGTH OF THE CHORD (LC)**

$$\begin{aligned} L_c &= 2R \sin \frac{\Delta}{2} \\ &= 2 \times 70 \times \sin (11.5^\circ) \\ L_c &= \underline{27.912 \text{ meters (or 93.033 ft)}} \end{aligned}$$

**c. TANGENT (T)**

$$\begin{aligned} T &= R \tan \frac{\Delta}{2} \\ T &= 100 \times \tan (^\circ) \\ T &= \underline{15.258 \text{ meters (or 50.086 ft)}} \end{aligned}$$

**d. CANTONMENT OR SUPER ELEVATION**

Since on the steep tight curves and junction loops tracks the minimum speed restriction by Railways is maintained at 10-15 km/hr with the standard Super elevation or Bank angle of  $2^\circ$  to  $4^\circ$  on Railway Tracks.

### VI. ADVANTAGES

- The main advantage is that it can resolve the visibility issues faced by loco pilots on tight curves during riding in Long hood front (LHF) mode.
- Locos can be reversed in Short hood front (SHF) mode where the cab is in the rear end and visibility is clear.
- The modification and installment of Dual cab can be reduced which can help to reduce the cost and improve the efficiency of the engine.
- By the installation of a Diesel Loco shed connecting to the triangle, Diesel engine can be parked over there to utilize the space on the main line track.
- The engines can be protected from direct contact with environment when it is not in use.
- Construction cost can be minimized, if there is a main line connected with Junction line, which gives the base layout for the construction.
- The triangles with bigger width and length can also be used to reverse the Freight or Passenger train which skips the main junction and the time for rake loco reversal can be cut short.

### VII. LIMITATIONS

- The only limitation of the reversing triangle is the initial construction cost and the availability of space near the junction and Terminals.
- The loco pilot and guard should be well trained to drive the train in the reverse direction when it enters the junction line or track.

### VIII. COMMON QUERY ABOUT REVERSING TRIANGLE WITH A DIESEL SHED INSTALLED ON LOOP LINE, WHICH IS ATTACHED TO THE JUNCTION LINE.

1. Can a Triangle can be constructed on the Junctions and Terminals?

Ans. Yes, Since Junctions are the best area which can reduce the construction cost for the extra loop line and provides the base structure which will be useful for the initial stage of construction. Only on the other end the tracked should be lay down to complete the switch and on the Terminals also it can be constructed.

2. Is installing of a Triangle is costly then modifying the Diesel engine to Dual cab?

Ans. No, as compared to single engine it will be costly, but diesel engine are used all over the world so as compared to that count it can be cost effective.

3. What are the other benefits of the triangular loops?

Ans. It is used for reversing the Diesel engine or used as turning equipment. It can be used as turning equipment for a

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whole train i.e.; Freight and Passenger so the time and effort for the rake loco reversal can be reduced and cut short. If a Diesel shed is installed then the engine can be parked in such a way that the space on the main line will be prevented from getting blocked and that space can be used for other purpose.

4. Is converting of Dual cab Locomotive to Single cab will be cost effective with a Triangle in this present era, where Electric locomotive are coming into the picture?

Ans. It's a fact that in some countries Diesel as well as Electric hauled locomotives are used for Freight and Passenger Trains. Electric locomotives are used when speed and less pollution (i.e.; Eco –friendly) come into the picture, but construction cost is very high for generating electricity, transmission lines. Diesel locomotives are used basically for Freight trains, where Torque is the main component and the operation and overall cost for the Diesel locomotive is less, since Diesel is a petroleum product which is naturally obtained and a non-renewable resource. So by using Hydroelectric fuel cell, LPG and Biodiesel are the alternate energy generating source, which can act as an alternative for Diesel in future. The Engine which are Dual cab and converted to single cab can be beneficial and that second cab can be assembled to the newly manufactured engine which can help to utilize the resources smartly.

## IX. CONCLUSION

Since, the above theory concludes that by having certain modification in the railway track system and installing of the diesel shed can reduce the visibility issues faced by the loco pilots while driving in Long hood front (LHF) and can reduce the modification cost in diesel engine to reduce the weight, size and to improve its efficiency without any modification, i.e.; in Single cab mode. It also states that the space adjoining the junction loop line or track can be switched and extended in such a way that a Diesel Loco shed can also be installed and can be connected to the main line. This will improvise the space on the main line and there won't be any blockage or Rail traffic on the tracks can be prevented.

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