

DI04006071: Railway, Harbour & Tunnel Engineering

Lecture 3.18: Types of Crossing, Clearances, and Special Fittings

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Civil Engineering

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Introduction to Railway Crossings I

A crossing or frog is a device introduced at the point where two gauge faces cross each other to permit the flanges of a railway vehicle to pass from one track to another. It ensures a continuous path for the wheels when tracks intersect.

Key Points

- Allows smooth passage of wheel flanges across intersecting rails.
- Consists of a V-piece (point and splice rails), wing rails, and check rails.
- Manufactured to withstand severe impact and wear from moving train loads.
- Integral component of point and crossing assemblies (turnouts).

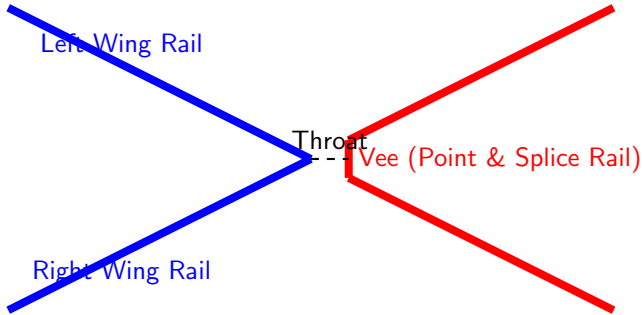
Types of Crossings Based on Shape I

Crossings are classified based on the angle at which the tracks intersect. The geometry of the crossing dictates the speed restrictions and the type of vehicle operations permitted.

Key Points

- Acute Angle Crossing (V-Crossing): Intersection angle is acute. Most common in standard turnouts.
- Obtuse Angle Crossing (Diamond Crossing): Intersection angle is obtuse. Allows tracks to cross but not merge.
- Square Crossing: Tracks intersect at a right angle (90 degrees). Very rare and avoided due to severe jolts.

Geometry of an Acute (V) Crossing I



Key Points

- The 'Vee' consists of a Point Rail and a Splice Rail.
- Wing rails guide the wheels through the throat.
- Throat is the narrowest point where the wheel transitions.

Types of Crossings Based on Assembly I

Depending on the manufacturing process and material used, crossings are built differently to accommodate various axle loads, traffic density, and maintenance requirements.

Key Points

- Built-up Crossing: Assembled from ordinary track rails machined to shape and bolted together.
- Cast Manganese Steel (CMS) Crossing: One-piece casting of manganese steel. Hardens under traffic (work-hardening).
- Spring or Movable Wing Crossing: One wing rail is movable and held against the V by springs, eliminating the gap.
- Weldable CMS Crossing: CMS crossings with flash-butt welded short transition rails for seamless track integration.

Merits & Demerits of Crossing Types I

Comparison of Built-up and CMS Crossings based on operational and maintenance characteristics.

Key Points

- | Feature | Built-up Crossing | Cast Manganese Steel (CMS) Crossing |
- | ————— | ————— | ————— |
- | ****Merits**** | Easy to manufacture and repair locally. Low initial cost. | High durability, no bolts to maintain, longer lifespan. |
- | ****Demerits**** | Rapid wear, requires frequent tightening of bolts, noisy. | High initial cost, heavy, difficult to repair if cracked. |
- | ****Suitability**** | Low-speed, low-density lines, sidings. | High-speed, heavy-haul main lines. |

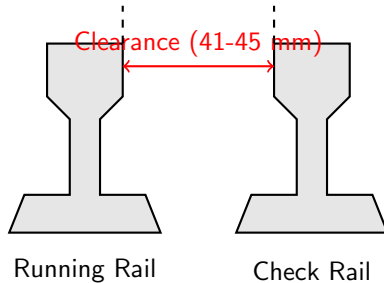
Crossing Clearance (Flangeway) I

Clearances are critical gaps maintained between rails to allow the wheel flange to pass without striking the rail components. They prevent derailments and reduce impact forces.

Key Points

- Flangeway Clearance: The gap provided between the running face of the V-rail and the wing rail (or check rail).
- Standard broad gauge clearance is typically 41 mm to 45 mm.
- Insufficient clearance causes the wheel flange to hit the nose of the crossing.
- Excessive clearance leads to a lack of lateral guidance, increasing the risk of derailment and uneven wear.

Cross-Section: Check Rail and Flangeway Clearance I



Cross-Section: Check Rail and Flangeway Clearance II

Key Points

- Check rails are installed opposite the crossing to guide the opposite wheel.
- They pull the axle laterally, ensuring the wheel on the crossing side does not strike the crossing nose.
- Clearance is strictly measured and maintained during routine inspections.

Special Fittings with Turnouts: Introduction I

Turnouts contain movable parts and intersecting rails that require specialized fittings. These components maintain gauge, secure rails, and ensure safe switching operations.

Key Points

- Special fittings differ from standard track fittings due to the complex geometry of points and crossings.
- They ensure structural integrity under the high lateral forces exerted by diverging trains.
- Include slide chairs, stretcher bars, gauge tie plates, and special blocks.

Key Special Fittings - Switches I

The switch portion of a turnout involves the movement of tongue rails against stock rails, requiring specialized fastening.

Key Points

- Slide Chairs: Flat plates provided under the tongue rails, allowing them to slide smoothly laterally.
- Stretcher Bars: Steel bars connecting the toes of the two tongue rails to ensure they move together and maintain constant gauge.
- Gauge Tie Plates: Steel plates fixed under the toe of the switch to hold the stock rails rigidly to the exact gauge.
- Spherical Washers: Used with bolts at the heel of the switch to allow flexible pivoting of the tongue rail.

Key Special Fittings - Crossing and Blocks I

The crossing portion and the intermediate sections of a turnout require specific blocks to maintain exact spacing between converging and diverging rails.

Key Points

- Distance Blocks: Cast iron or steel blocks inserted between the main rail and check rail (or wing rail) to maintain the exact flangeway clearance.
- Heel Blocks: Inserted at the heel of the switch to maintain the clearance between the stock rail and tongue rail.
- Crossing Chairs: Special flat base plates under the crossing assembly to support the heavy impact loads of the V-piece and wing rails.
- Spherical/Tapered Washers: Used for bolting parts resting on inclined surfaces (like the web of the rail).

Summary I

Railway crossings and turnouts are critical, precision-engineered track components that ensure safe train navigation and switching.

Key Points

- Crossings (acute, obtuse) allow wheel flanges to pass intersecting rails.
- CMS crossings are superior to built-up crossings for heavy and fast traffic due to their wear resistance.
- Strict crossing clearances (flangeway and check rail gaps) are paramount to prevent derailments.
- Special fittings like slide chairs, distance blocks, and stretcher bars maintain geometry, gauge, and structural integrity.