DI04006071: Railway, Harbour & Tunnel Engineering

Lecture 1.2: Typical cross section of B.G.in permanent ways as per IRS

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Civil Engineering

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Introduction to Permanent Way I

The permanent way consists of rails, sleepers, fasteners, and ballast resting on the subgrade. It provides a stable and level surface for the safe passage of trains.

Key Points

- Acts as a guideway for trains.
- Transmits wheel loads safely to the subgrade.
- Must possess sufficient elasticity to absorb shocks.
- Designed to minimize maintenance costs.

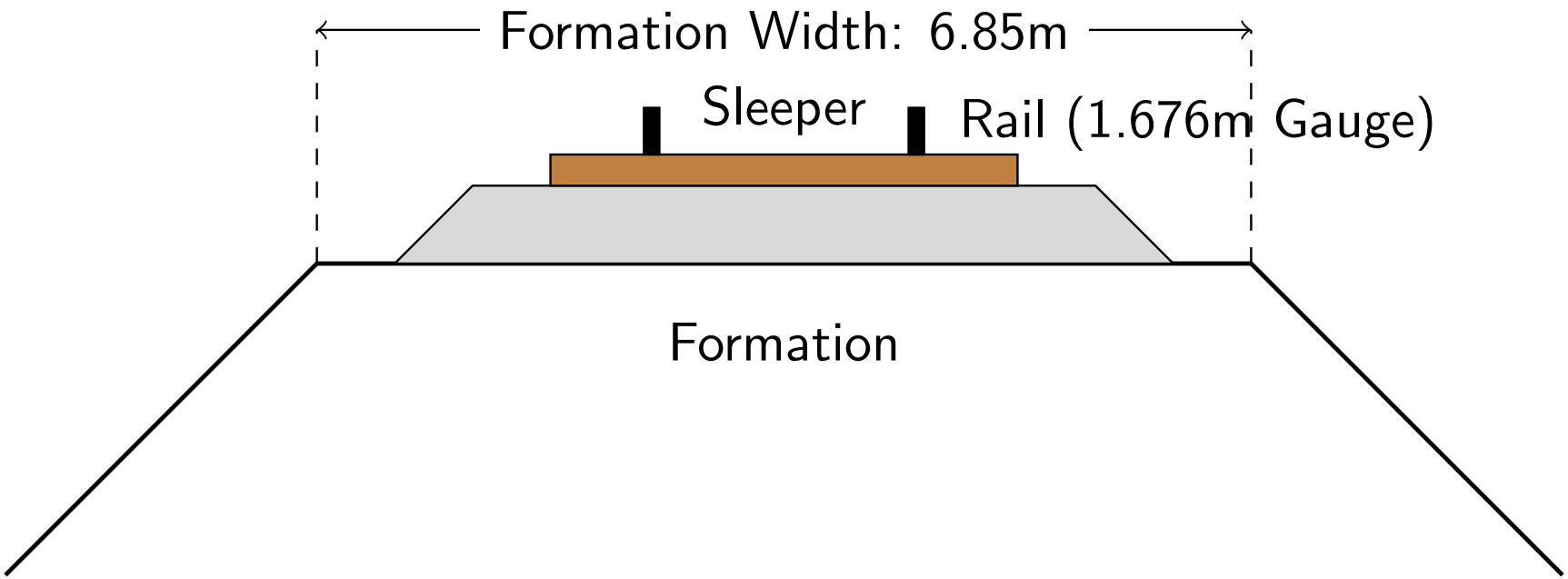
Components of a Permanent Way I

A well-designed permanent way comprises several structural elements that work together to form a cohesive track system.

Key Points

- Rails: Steel girders providing a continuous, smooth surface.
- Sleepers: Transverse supports to hold rails to proper gauge.
- Fastenings: Spikes, bolts, and keys connecting rails to sleepers.
- Ballast: Granular material distributing load and providing drainage.
- Formation: Prepared subgrade earthwork in embankment or cutting.

Cross Section of Single Line B.G. in Embankment I



Formation Width and Slopes I

The formation is the prepared surface of the earthwork upon which the track structure is laid. Its width varies depending on whether it is a single or double line, and whether it is in an embankment or a cutting.

Key Points

- Single Line Embankment: Recommended width is 6.85m.
- Double Line Embankment: Recommended width is 12.16m.
- Side Slopes (Embankment): Generally 2:1 (Horizontal:Vertical).
- Side Slopes (Cutting): Ranges from 1:1 to 1.5:1 depending on soil type.

Standard Dimensions for B.G. Track I

The following table outlines the key standard dimensions for Broad Gauge track configurations as specified by Indian Railway Standards.

Key Points

- Parameter | Single Line | Double Line
- Gauge | 1.676 m | 1.676 m
- Formation (Embankment) | 6.85 m | 12.16 m
- Formation (Cutting) | 6.25 m | 11.55 m
- Track Centers | N/A | 5.30 m
- Min. Ballast Cushion | 250 - 300 mm | 250 - 300 mm

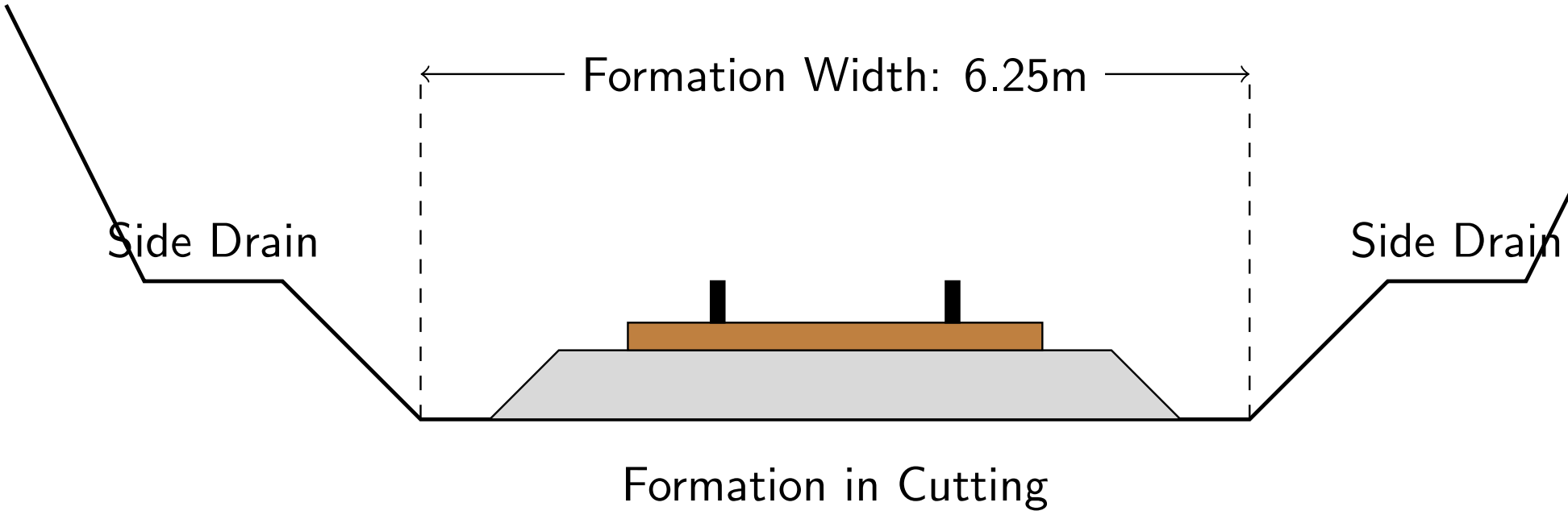
Ballast Profile I

The ballast section is crucial for maintaining track geometry, providing lateral stability, and ensuring proper drainage of the track.

Key Points

- Depth of Cushion: Typically 250mm to 300mm for main lines.
- Shoulder Ballast: Minimum width of 350mm to 400mm from sleeper end.
- Side Slopes: The ballast side slopes are usually maintained at 1.5:1.
- Quantity: Approximately 1.6 to 2.0 cubic meters per meter length for single line B.G.

Cross Section of Single Line B.G. in Cutting I



Formation in Cutting

Sleeper Density and Spacing I

Sleeper density is defined as the number of sleepers per rail length and is expressed as M + x, where M is the rail length in meters.

Key Points

- Standard B.G. rail length is 13 meters.
- Common density is M + 7, yielding 20 sleepers per rail.
- Total sleepers per kilometer is typically 1540 to 1660.
- Uniform spacing ensures even load distribution onto the ballast.

Rails and Fastenings I

Rails act as continuous girders carrying axle loads. In B.G. tracks, high-quality steel rails with specific cross-sectional profiles are utilized.

Key Points

- Typical rail sections used are 52 kg/m and 60 kg/m.
- Flat-footed rails are universally adopted in IRS for broad gauge.
- Elastic fastenings (e.g., Pandrol clips) provide high clamping force.
- Rubber pads are used between rails and concrete sleepers for dampening.

Drainage in Permanent Way I

Effective drainage is arguably the most critical factor in maintaining a stable formation and long-lasting permanent way.

Key Points

- Crossfall: Formation top is provided with a cross slope (usually 1 in 30 or 1 in 40).
- Side Drains: Essential in cuttings to carry away surface water.
- Catch Water Drains: Provided on the high ground above a cutting to intercept runoff.
- Clean Ballast: Ensures quick percolation of rainwater away from sleepers.

Summary I

The typical cross-section of a Broad Gauge permanent way integrates the formation, ballast, sleepers, and rails into a robust system designed for heavy loads and high speeds.

Key Points

- Standardized formation widths and slopes for embankments and cuttings.
- Proper gauge (1676 mm) and track center distances are strictly maintained.
- Adequate ballast cushioning and drainage are vital for track longevity.
- Standard B.G. components ensure interoperability and safety across IRS.