DI04006071: Railway, Harbour & Tunnel Engineering

Lecture 3.19: Classification of Signals in details, layout of Signals and control of train movements

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Civil Engineering

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Introduction to Railway Signaling I

Signaling plays a pivotal role in railway engineering by ensuring the safe and efficient movement of trains. The primary objectives are to prevent accidents, such as collisions and derailments, and to maximize track utilization.

Key Points

- Primary objective: Safety of train movements.
- Secondary objective: Efficient use of railway infrastructure.
- Guides engine drivers regarding line clearance and speed restrictions.

Classification of Signals I

Railway signals are broadly classified based on their operating characteristics, functional requirements, and location. Understanding this classification is essential for designing effective interlocking and train control systems.

Key Points

- Classification based on operating characteristics.
- Classification based on functional requirements.
- Classification based on location.

Functional Classification of Signals I

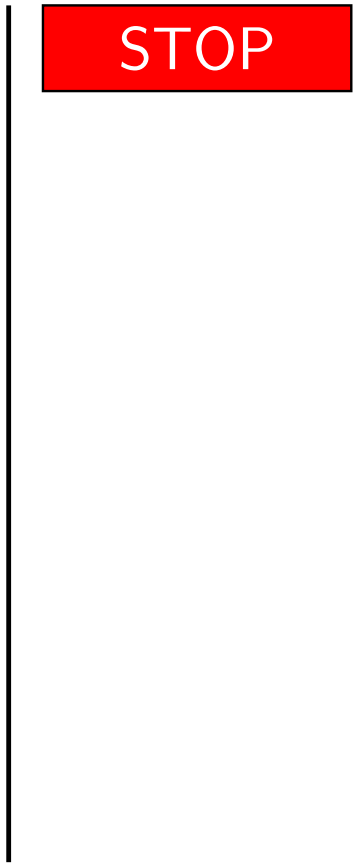
Signals can be functionally divided into Stop signals, Warner or Distant signals, Shunting signals, and subsidiary signals. Each serves a specific purpose in regulating train operations.

Functional Classification of Signals II

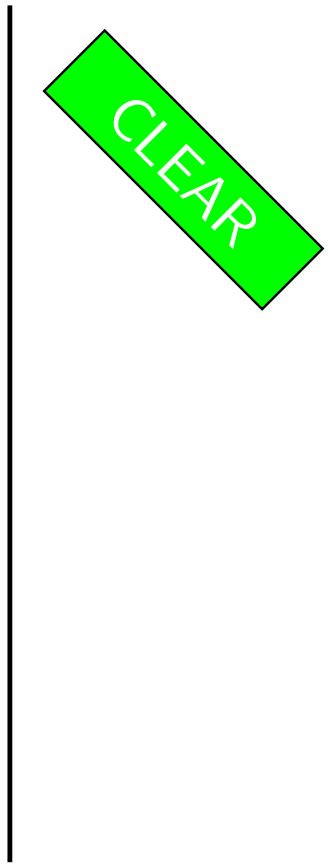
Key Points

- | Signal Type | Function / Purpose | Location / Positioning |
- |—|—|—|
- | Stop Signals | Indicates whether to stop or proceed | Approach to stations or block sections |
- | Warner/Distant | Provides advance warning of the Stop signal ahead | Adequately ahead of Stop signal |
- | Shunting Signals | Controls low-speed shunting movements | Station yards and sidings |
- | Routing Signals | Indicates the route to be taken | Facing points at junctions |

Semaphore Signal Aspects I



ON Position (Stop)



OFF Position (Proceed)

Semaphore Signal Aspects II

Key Points

- Semaphore signals use arm positions to convey information.
- ON position (horizontal) indicates 'Stop' or caution.
- OFF position (inclined downward or upward) indicates 'Proceed'.

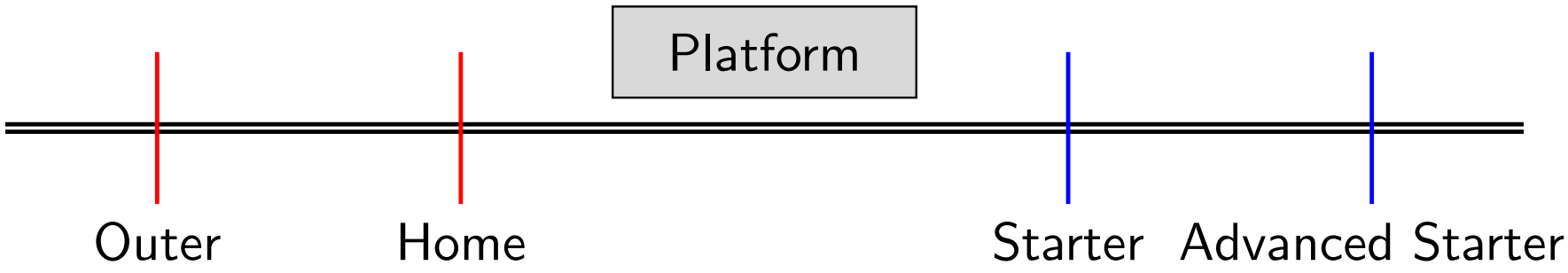
Layout of Signals at Stations I

The layout and positioning of signals at a station depend on the type of station, the speed of trains, and the required level of interlocking. Key signals include Outer, Home, Starter, and Advanced Starter.

Key Points

- Outer Signal: First stop signal approaching a station.
- Home Signal: Protects the facing points and station limits.
- Starter Signal: Permits a train to leave the station line.
- Advanced Starter: Controls entry into the next block section.

Typical Layout of Station Signals I



Key Points

- Outer signal warns the driver of the station approach.
- Home signal controls entry to the platform.
- Starter and Advanced Starter manage departure into the next block.

Control of Train Movements: Interlocking I

Interlocking is an arrangement of signal apparatus that prevents conflicting movements by establishing logical relationships between points (switches), signals, and track circuits. It is fundamental to railway safety.

Key Points

- Ensures a signal cannot be lowered unless the route is properly set.
- Prevents points from being altered while a train is moving over them.
- Types: Mechanical interlocking, Electrical relay interlocking, Solid State Interlocking (SSI).

Block Working System I

The Block Working System divides the railway line into distinct sections called 'block sections'. Only one train is permitted in a block section at a time, ensuring a safe spatial separation between trains.

Key Points

- Absolute Block System: Strictly one train per section.
- Automatic Block System: Signals are controlled automatically by train presence (track circuits).
- Maintains safe headway between consecutive trains.

Track Circuiting I

Track circuits are electrical circuits using the rails as conductors to detect the presence or absence of a train in a specific section. They form the basis of modern automatic signaling and interlocking.

Key Points

- Closed track circuit: Relay is energized when section is empty.
- Train axles short-circuit the track, de-energizing the relay.
- Failsafe principle: Any fault (broken rail, power failure) indicates 'occupied'.

Centralized Traffic Control (CTC) I

Centralized Traffic Control is an advanced signaling system where train movements across a large section of the railway network are controlled from a single central location. It significantly improves operational efficiency and capacity.

Key Points

- Consolidates interlocking and block operation into a single control center.
- Provides real-time visualization of train positions.
- Allows dynamic route setting and reduces delays.

Summary I

This lecture covered the foundational aspects of railway signaling, including the diverse classifications of signals, their strategic layout at stations, and the sophisticated systems used to control train movements and ensure safety.

Key Points

- Signals are essential for safety and efficient track utilization.
- Functional classification dictates signal placement and design.
- Interlocking and Block systems are core to preventing collisions.
- Modern systems rely on track circuiting and centralized control.