Transportation Engineering II: Highway Design & Railways

Lecture 11

SIGNAL & INTERLOCKING

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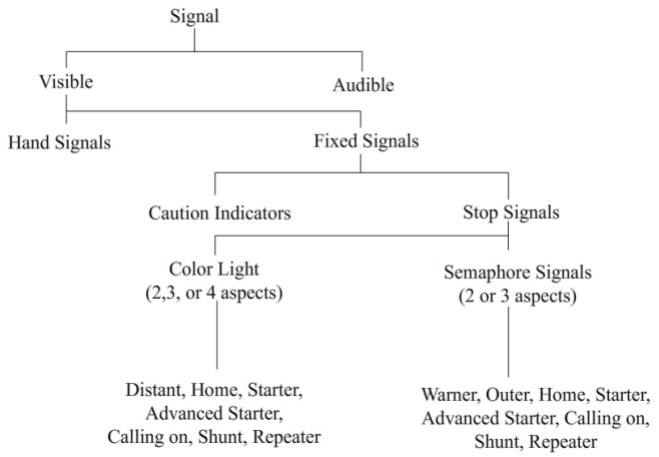
Signal

- A mechanical or electrical device erected beside a railway line to pass information relating to the state of the line ahead to train/engine drivers
- Purpose:
  - Indicate if the line ahead is clear (free of any obstruction) or blocked
  - Confirm that switches/points are set in the correct direction
  - Regulate the speed of the train to ensure safety
  - Ensure safety of train and road traffic in level crossings

History

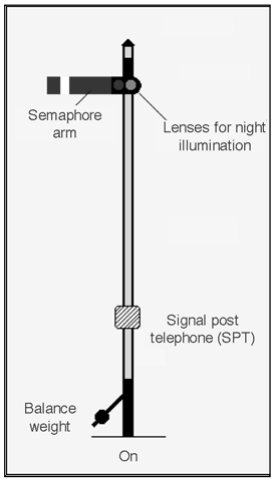
- Two policemen sent ahead on horseback
- Policemen placed at regular intervals to regulate movement of trains
- Mechanized signal first introduced in 1842
- Interlocking introduced in 1867

Type



Semaphore Signal

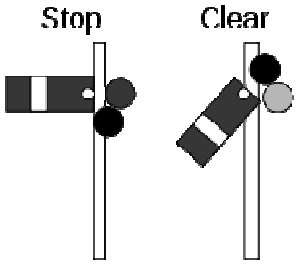
- Parts:
  - Moveable arms
    - painted red with a white vertical band
  - Spectacle (attached with moveable arm)
    - consists of electric lamps with green and red colored glasses
  - Post
  - Balance weight



Operation
(Lower Quadrant Semaphore)

Position of Signal	Position of arm	Color duringnight	Indication
ON	Horizontal	Red	Stop or danger
OFF	Inclined 45° to 60° below horizontal	Green	Proceed or line clear

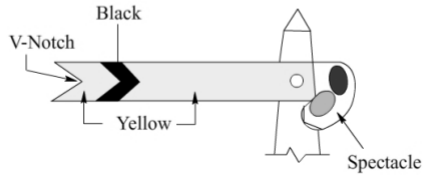
The signal is designed **'fail safe'** so that if there is any failure in working of the equipment, the signal **will always show 'stop position'.**



Warner/distant Signal

In order to speed up the movement of train safely, it is considered necessary that the warning should be given to the drivers before approaching a stop signal. It act as an **advance warning sign**. In a stop signal the driver has to stop when it is in 'ON' position but in a Warner signal, the driver can pass the signal even when it is in 'ON' position. When the warner signal is in the inclined position, it signifies that the signal ahead is in off position and hence, the driver can proceed at speed without any danger.

The warner signal is similar to a stop signal except that a V notch is provided at free end of the movable arm; the white strip is also V shaped.



Operation

Position of Warner Arm or Distant Signal

Position	*Day indication for Semaphore Signal*	*Night indication for Semaphore Signal*	*Aspect*
ON	Arm horizontal	Red light	Proceed with caution and be prepared to stop at next stop signal
CAUTION	Arm inclined 45° up	Yellow ligh	Proceed cautiously to pass the next stop signal at cautious speed
OFF	Arm inclined 90° up or 45° down	Green light	Proceed with full permissible speed; next stop signal is also green

Colored Light Signals

Operation

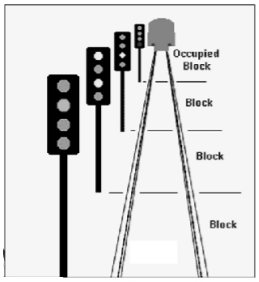
Color of signal	*Aspect indicated*
Red	Stop; danger ahead
One yellow	Pass the signal cautiously and be prepared to stop at next signal
Two yellows together	Pass the signal at full speed but be prepared to pass the next signal at caution speed which is likely to be yellow
Green	Pass the signal at full speed; next signal is also off

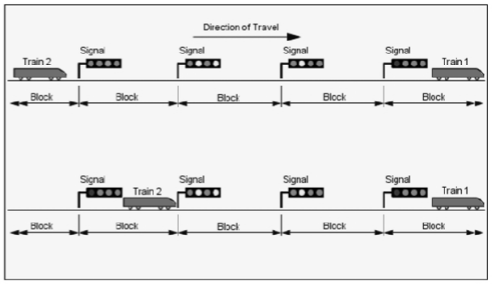
Types of Control

- Following train system
  - Minimum time difference maintained among successive trains in the same track
- Absolute block
- Automated/ actuated
- Centrally controlled

Absolute Block

In this method, instead of a fixed interval of time between successive trains, a varying interval may be kept depending on the time actually taken by particular trains. It is known by some suitable block information equipment. In fact it is a **fixed space interval system** rather than a fixed time interval system. In this system, the track is divided into a no. of sections which is known as **block sections**.





Automated/ actuated

In order **to avoid accidents due to negligence on the part of human** beings, automatic signaling has been introduced. In this system, signals are **operated by train themselves i.e train actuated**.

An electric current is conveyed through the track when a train occupies that particular track and this current puts the signal at danger position until the train has gone far ahead so as to require no further protection. With modern system, in case a driver of the train f**ails to take note of a signal** in danger position, these **brakes are automatically applied**.

Centrally Controlled

Interlocking

- An arrangement of signals and signal appliances so interconnected that their movements must succeed each other in proper sequence
- Components:
  - Level crossings, points, signal, track circuits, etc.
- Purpose:
  - Eliminate human error

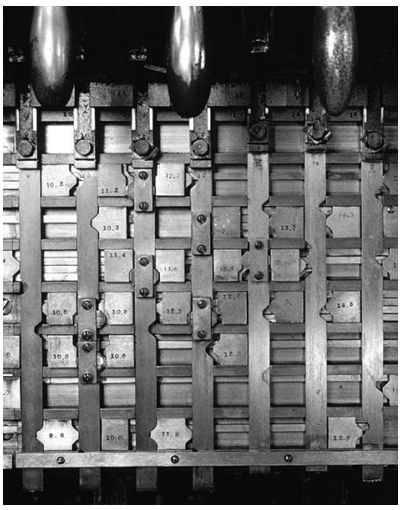
Fundamental Principle

- Signals may not be operated to permit conflicting train movements to take place at the same time.
- Switches and other appliances in the route must be properly 'set' (in position) before a signal may allow train movements to enter that route.
- Once a route is set and a train is given a signal to proceed over that route, all switches and other movable appliances in the route are locked in position until either
  - the train passes out of the portion of the route affected, or
  - the signal to proceed is withdrawn and sufficient time has passed to ensure that a train approaching that signal has had opportunity to come to a stop before passing the signal

Types of Interlocking

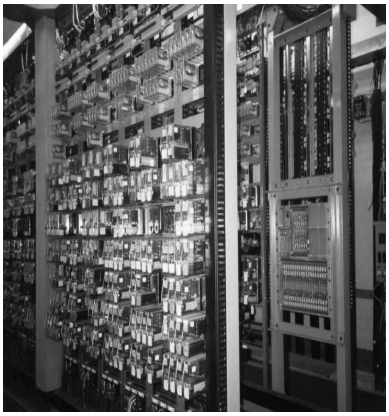
- Mechanical
- Electrical (relay-based)
- Electronic/computer-based

Mechanical



- The levers that operate switches, derails, signals or other appliances are connected to the bars of a 'locking bed'
- The bars are constructed so that, if the function controlled by a given lever conflicts with that controlled by another lever, mechanical interference is set up
- Prevents conflicting lever movement from being made

Electrical



- Consist of complex circuitry made up of electric switches (relays) in an arrangement of relay logic that ascertain the state or position of each signal appliance
- As appliances are operated, their change of position opens some circuits that lock out other appliances that would conflict with the new position
- Other circuits are closed when the appliances they control become safe to operate
- Equipment used for railroad signalling tends to be expensive because of its specialized nature and fail-safe design.

Computer-based Interlock