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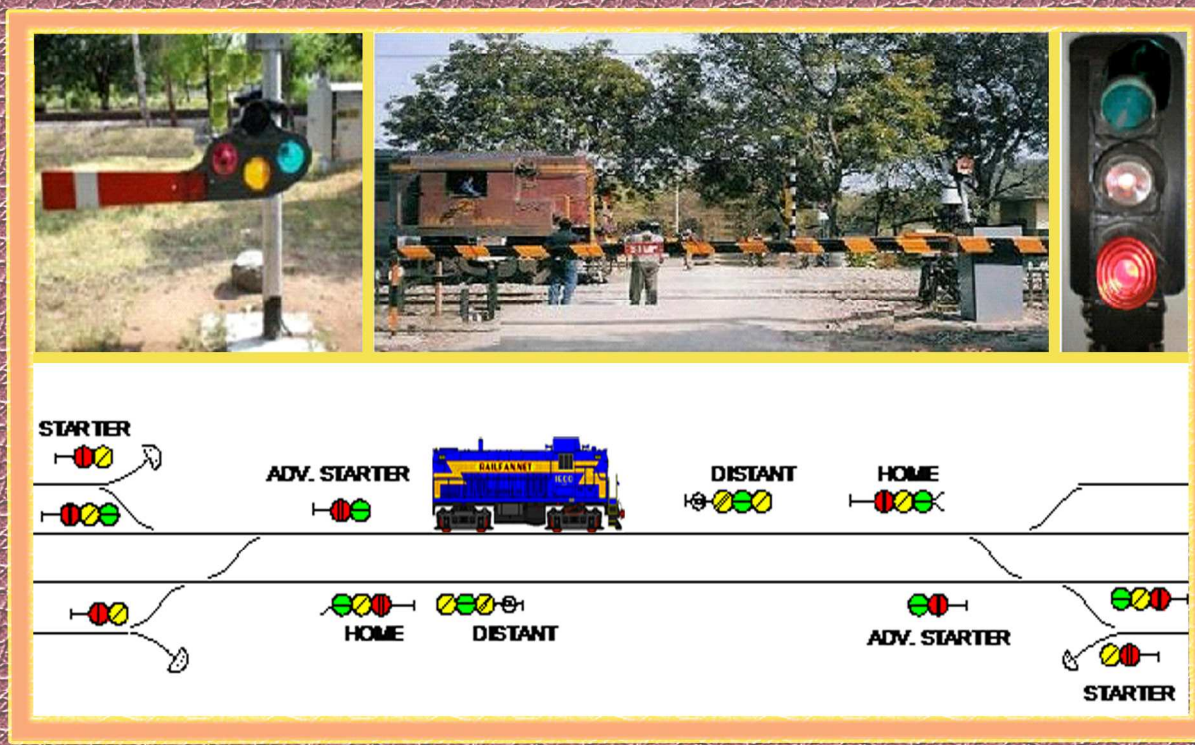
BASICS OF SIGNAL ENGINEERING



Indian Railways Institute of
Signal Engineering and Telecommunications
SECUNDERABAD - 500 017

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SIGNAL ENGINEERING & TELECOMMUNICATIONS

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S-1

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CHAPTER 1: ROLE OF SIGNALLING IN RAILWAY OPERATION

1.1 Railway Signalling and Communication Technology, though evolved primarily for safe working of trains, plays an important part in increasing line capacity with minimum investment. With the advent of computers and extended communication network on the Railways, the scope of Signalling Technology has widened to incorporate even automatic operation. The broad areas of Railway Signalling and Communication Technology are:

1.2 Block Working

Trains are to be adequately spaced apart to prevent collision between trains running in the same direction and prevent trains entering on the same track from the opposite direction. This is achieved by block working between stations.

1.3 Interlocking

When trains are to be crossed or overtaken at stations, points and signals are to be worked in proper sequence to make passage of trains safe and interlocking between points and signals takes care of this. Interlocking also safeguards simultaneous movements in stations. Semaphore signals are worked by single wire, double wire or electric motors. Colour light signals are provided for improved visibility, easier working and maintenance. Points are worked by rod, double wire, pneumatic/hydraulic or electric power. Interlocking between point levers and signal levers can be effected either mechanically by means of tappets or locking electrically by means of electric lever locks or relays. With Route Relay Interlocking, a complete route can be set by one operation and suitably safeguarded against conflicting moves.

1.4 Train detection

Track circuits can detect the presence of a train on a portion of track or axle counters and this information is used for controlling the signal, which in turn controls the train movements.

1.6 Automatic Warning System

As an aid to the driver to know the condition of the signal and to prevent accidents when the driver ignores the aspect of a stop signal, Automatic Warning System is employed. If the driver, due to any reason, does not act upon a signal, the train is brought to stop by automatic brake application.

In addition to warning and stopping, as explained above, the speed of the train is continuously monitored and checked with the information as to the permitted speed, and if the actual speed is different from the permitted speed, corrective action is enforced.

1.7 Centralised Traffic Control and Remote Control

Economy is achieved and efficiency is increased by centralising operation of points and signals over a large area or a stretch of line. Remote stations are controlled from a central location over a pair of lines using coded techniques. Such centralised operation also leads to increased line capacity.

1.8 Train Describer

The designation and number of trains in a section or line can be displayed to the central control office so that the controller is aware of the position and designation of each train over the section monitored by him. The description is advanced from section to section as the train proceeds. Such train describers are normally used with centralised traffic control, remote control as well as in suburban sections.

C H A P T E R 2 : DEFINITIONS (GR 1.02)

In order that interpretation of various terms remain clear and unambiguous, it is necessary to indicate their meanings precisely. This has been done in respect of common terms used in railway signalling in chapter 1 of “General rule”. Some of the important definitions are mentioned below.

2.1 ACT means the Indian Railways Act, 1989

2.2 ADEQUATE DISTANCE means the distance sufficient to ensure safety.

2.3 APPROACH LIGHTING means an arrangement in which the lighting of signals is controlled automatically by the approach of a train.

2.4 APPROVED SPECIAL INSTRUCTIONS means special instructions approved of or prescribed by the Commissioner of Railway Safety

2.5 AUTHORISED OFFICER means the person who is duly empowered by general or special order of the Railway Administration, either by name or by virtue of his office, to issue instructions or to do any other thing.

2.6 AUTHORITY TO PROCEED means the authority given to the Driver of a train, under the system of working, to enter the block section with his train;

2.7 AXLE COUNTER means an electrical device which, when provided at two given points on the track, proves by counting axles in and out, whether the section of the track between the said two points is clear or occupied;

2.8 BLOCK BACK means to despatch a message from a block station intimating to the block station immediately in rear on a double line or to the next block station on either side on a single line, that the block section is obstructed or is to be obstructed;

2.9 BLOCK FORWARD The block section in advance is obstructed or is to be obstructed;

2.10 BLOCK SECTION means that portion of the running line between two block stations on to which no running train may enter until Line Clear has been received from the block station at the other end of the block section.

2.11 CENTRALISED TRAFFIC CONTROL means a system by which the working of trains over a route, to which the system applies, is governed by fixed signals remotely controlled from a designated place.

2.12 COMMISSIONER OF RAILWAY SAFETY means an official appointed to exercise any functions under the Act, and includes a Commissioner of Railway Safety;

2.13 CONNECTIONS When used with reference to a running line, means the points and crossings, or other appliances used to connect such line with other lines or to cross it.

2.14 COMPETENT RAILWAY SERVANT Means a railway servant duly qualified to undertake and perform the duties entrusted to him.

2.15 CONTROLLER Means a railway servant on duty who may for the time being be responsible for regulating the working of traffic on a section of a railway provided with the system of speech communication.

2.16 DAY means from sunrise to sunset.

2.17 DRIVER means the engine driver or any other competent railway servant for the time being incharge of driving a train.

2.18 DIRECTION OF TRAFFIC means

(a) On a double line, the direction for which the line is signalled;

(b) On a single line, the direction for the time being established, under the system of working, to allow trains to move in that direction;

2.19 ELECTRICAL COMMUNICATION INSTRUMENT means either a telephone or a Morse Telegraph instrument;

2.20 FACING AND TRAILING POINTS Points are facing or trailing in accordance with the direction a train or vehicle moves over them. Points are said to be facing points when by their operation a train approaching them can be directly diverted from the line upon which it is running.

2.21 FIXED SIGNAL means a signal of fixed location indicating a condition affecting the movement of a train and includes a semaphore arm or disc or fixed light for use by day and fixed light for use by night.

2.22 FOULING MARK means the marks at which the infringement of fixed Standard Dimensions occurs, where two lines cross or join one another.

2.23 GANGMAN Means a railway servant employed on permanent way or works connected therewith Or Means a competent railway servant posted at a level crossing for working the gates.

2.24 GANG Means the person in charge of a gang of workmen employed on permanent way or works connected therewith.

2.25 GOODS TRAIN Means a train (other than material train) intended solely or mainly for the carriage of animals or goods.

2.26 GUARD Means the railway servant in charge of a train and includes a Brakesman or nay other railway servant who may for the time being be performing the duties of a Guard.

2.27 INSPECTOR OF WAY OR WORKS means any Inspector or Assistant Inspector responsible for the construction or maintenance of permanent way, points and signals, bridges or other works connected therewith. *(This is now re-designated as Section Engineer (works)).*

2.28. INTERLOCKING means an arrangement of signals, points and other appliances, operated from a panel or lever frame, so interconnected by mechanical locking or electrical locking a fixed stop signal in IBS or both that their operation must take place in proper sequence to ensure safety.

2.29 INTERMEDIATE BLOCK POST means a class `C' station on a double line, remotely controlled from the block station in rear.

2.30 INTERMEDIATE BLOCK SIGNALLING means an arrangement of Signalling on double line in which a long block section is split into two portions each constituting a separate block section of a block section by providing an Intermediate Block Post.

2.31 ISOLATION means an arrangement, secured by the setting of points or other approved means, to protect the line so isolated from the danger of obstruction from other connected line or lines.

2.32. LAST STOP SIGNAL means the fixed Stop Signal of a station controlling the entry of trains into the next block section.

2.33 LEVEL CROSSING means the intersection of road with railway track at the same level.

2.34. LEVEL CROSSING GATE Means any form of movable barrier, including a chain, capable of being closed across the road at the level crossing but does not include a wicket or a turnstile for the use of pedestrians.

2.35 LINE CLEAR means the permission given from a block station to a block station in rear for a train to leave the latter and approach the former; or the permission obtained by a block station from a block station in advance for a train to leave the former and proceed towards the latter.

2.36 LOCO PILOT Means the Loco Pilot or any other competent railway servant of the time being in charge of driving a train.

2.37 MAIN LINE means the line ordinarily used for running trains through and between stations.

2.38 MATERIAL TRAIN Means a departmental train intended solely or mainly for carriage of railway material when picked up or put down or for execution of works, either between stations or within station limits.

2.39 MIXED TRAIN means a train intended for the carriage of passengers and goods, or of passengers, animals and goods.

2.40 MULTIPLE ASPECT SIGNALLING means a Signalling arrangement in which signals display at any one time any one of the three or more aspects and in which the aspect of every signal is pre-warned by the aspect of the previous signal or signals.

2.41 NIGHT means from sunset to sunrise.

2.42 OBSTRUCTION and its cognate expressions include a train, vehicle or obstacle on or fouling a line, or any condition which is dangerous to trains.

2.43 OVERHEAD EQUIPMENT Means the electrical conductors over the tracks together with their associated fittings, insulators and other attachments by means of which they are suspended and registered in position for the purpose of electric traction.

2.44 PASSENGER TRAIN Means a train intended solely or mainly for the carriage of passengers and other coaching traffic, and includes a troop train.

2.45 POINT AND TRAP INDICATORS are not signals, but are appliances fitted to and working with points to indicate by day or by night the position in which the points are set.

2.46 RUNNING LINE means the line governed by one or more signals and includes connections, if any, used by a train when entering or leaving a station or when passing through a station or between stations.

2.47 RUNNING TRAIN means a train, which has started under an authority to proceed and has not completed its journey.

2.48 SHUNTING means the movement of a vehicle or vehicles with or without an engine or of any engine or any other self-propelled vehicle for the purpose of attaching, detaching or transfer or for any other purpose.

2.49 SPECIAL INSTRUCTIONS means instructions issued from time to time by the authorised officer in respect to particular cases or special circumstances.

2.50 STATION means any place on a line of Railway at which traffic is dealt with, or at which an authority to proceed is given under the system of working.

2.51 STATION LIMITS means the portion of a railway, which is under the control of a Station Master and is situated between the outermost signals of the station or as may be specified by special instructions.

2.52 STATION MASTER means the person on duty who is for the time being responsible for the working of the traffic within station limits, and includes any person who is for the time being in independent charge of the working of any signals and responsible for the working of trains under the system of working in force.

2.53 STATION SECTION: Pl see Chapter No- 14.

2.54 SUBSIDIARY RULE means a special instruction, which is subservient to the General Rule to which it relates and shall not be at variance with any General Rule.

2.55 SYSTEM OF WORKING means the system adopted for the time being for the working of trains on any portion of a railway.

2.56 TRACK CIRCUIT means an electrical circuit provided to detect the presence of a vehicle on a portion of track, the rails of the track forming part of the circuit.

2.57 PASSENGER TRAIN Means a train intended solely or mainly for the carriage of passengers and other coaching traffic, and includes a troop train.

2.58 TRAIN EXAMINER Means a railway servant duly qualified to examine trains and certify their fitness for safe running and includes and their railway servant who may for the time being be performing the duties of Train Examiner.

2.59 TWO-ASPECT SIGNALLING means a Signalling arrangement in which each signal displays at any one time either of the two aspects.

2.60 CLASSIFICATION OF STATIONS

(a) Stations, shall for the purpose of these rules, be divided into two categories - block stations and non-block stations.

(b) Block stations are those at which the Driver must obtain an authority to proceed under the system of working to enter the block section with his train; and under the Absolute Block System consist of three classes viz. `A', `B', `C', etc (see Chapter 14).

2.61 COLOUR LIGHT SIGNAL A fixed signal in which the indications are given by the colour of a light only.

2.62 EMERGENCY BRAKING DISTANCE is the distance travelled by train before coming to a stop by sudden application of brake at one stretch.

2.63 IN REAR OF A SIGNAL means the territory over which an approaching train has to pass before reaching the signal location.

2.64 IN ADVANCE OF A SIGNAL A term used in defining a territory beyond a signal as seen from the approaching train.

2.65 LINE CAPACITY means the maximum number of trains that can be run on any given section during a calendar day of 24 hours.

2.66 OVERLAP means the length of track in advance of a stop signal, which must be kept clear, either for clearing the stop signal next in rear or for the purpose of granting permission to approach.

2.67 `ON' ASPECT means the most restrictive aspect of the signal.

**2.68 `OFF' ASPECT** means any aspect other than the `ON' aspect of a signal.

2.69 POSITION LIGHT SIGNAL A fixed signal in which the indications are given by the position of two or more lights.

2.70 SEMAPHORE SIGNAL A signal in which the day indications are given by the position of a semaphore arm.

2.71 SERVICE BRAKING DISTANCE is the distance required to stop the train running at the maximum permissible speed of the line, at such a rate of deceleration that the passengers do not suffer discomfort or alarm.

Review questions

1. Under special instruction means approval from commissioner of railway safety. (False/ True)

2. Under approved special instruction means approval from authorized officer. (False/ True)

* * *

CHAPTER 3: SIGNALLING CONCEPTS

3.1 INTRODUCTION

Railway vehicles move on Steel Rail Track and are provided with flanged steel wheels. The rolling of the steel wheel on steel rail has the least friction and it is, therefore, one of the most efficient means of locomotion.

3.2 Control over movement of Trains

Running of flanged vehicles on the steel track has its own inherent problems unlike the road, sea or air transport where the movement is not confined to a particular track. Since the vehicles are constrained to move in a fixed Railway track, they cannot be steered away as in the case of other transports. They are required to follow one another in the same direction on the length of track, as otherwise for every vehicle separate parallel paths are to be provided. This is not practicable. If vehicles are expected from the opposite direction another set of diversion track is required to be provided either for overtaking vehicles moving in the same direction or for crossing the vehicles from the opposite direction. Railway locomotion, therefore, though more efficient, brings in problems of "Control over movement of Trains".

Basically, two types of controls could be catered for. If two separate tracks are provided for trains running in opposite directions, then one set of control can be provided to space the movement of trains running in the same direction so that adequate "interval" is available between two consecutive trains. On the other hand, if a single track is used for movement of trains in both directions, then another set of control is required to prevent a train in the opposite direction from coming on the same track when a train is already occupying it.

3.3 Time Interval Method

Let us take the first case of spacing of trains in the same direction. The spacing should be such that if a train stops, then, the following train driver should be able to notice it and apply brake to his train so that it stops short of the preceding train. The most important aspect is bringing to a stop from the speed at which a train is running. Where the speeds and weights are low, it is not difficult for a following train to stop short of the train ahead, which has stopped. This is how tramways operate even today, as the speed and weight are low and a tram can be stopped from its running speed without colliding with a tram in front. With higher speeds and heavier loads, as in the case of Railway train, the distance required to stop a train is longer, and at this longer distance, the driver cannot definitely decide whether a train in front has actually stopped or not. This is the case when trains follow one another in quick succession. In actual practice, where interval between trains is longer, a following train does not see the earlier train, and the driver has to continuously guess as to where the earlier train will be. If all trains run at the same speed and are required to stop at the same place for the same duration, a certain amount of control can be exercised by having a definite time lag between the trains from one stopping place to another. This time lag should be such that the train, which has a stop, is able to reach the next stop within this time. Thus by having a time interval between trains, a certain amount of control can be achieved. But, in the case of Railway, this is not practicable, as -

(a) Different types of trains like, Express/Mail, passenger, high-speed freight and low speed freight shunting trains are running etc.

(b) The speed of all the trains are not same

(c) The terrain of the country is not same everywhere

(d) The brake power, hauling capacity, load of train is not same for all trains; and

(e) The stopping places of all trains are not the same

Hence, it is not possible to control the movement of trains under the "Time interval method". A better method of control is called the "Space Interval Method" is adopted.

3.4 Space Interval Method

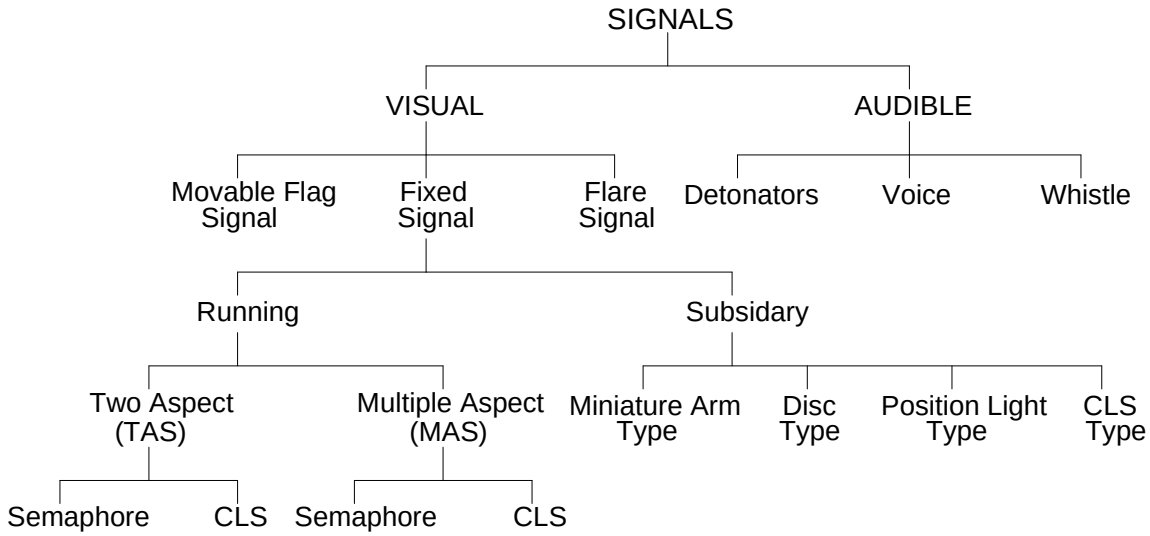
In this method of "Control over movement", the length of track is divided into sections called "Blocks". The entry of a train into the 'block' is controlled in such a way that only when it is free, a train can be allowed to enter it. This means that between two consecutive trains, there is a definite space interval.

This space interval or block is controlled at the entry. This controlling point should know whether the train, which had entered this space, vacated it so that another following train can be sent. Since the length of a block is beyond the normal visual range, another controlling point is set at the end of the block. This point can know whether the train has arrived and advise the controlling point at the entry. So, with the two controlling points and intercommunication, it is possible to control the entry of a train into a block only when it is vacant.

The information about the condition of this block is given by the exit point to the entry point, and the entry point transmits this information to the driver of a train. The driver of the approaching train must be able to know whether the next block is not clear, he should stop and wait. Here is where "signal" comes in to picture.

3.5 Signals

A "Signal", therefore, is a medium to convey a particular pre-determined meaning in non-verbal form. Various methods are used to convey the meaning by "Signals" in a non-verbal form as are used by Scouts, Policemen, road signs, Navy and Air Traffic Control, etc., which convey a definite information. The chart below gives the various forms that could be adopted.



3.6 Block Working

As explained earlier, the space interval system uses the block working wherein the entry of train onto the block section is jointly controlled by the entry and exist points of the block section. The driver is authorised to proceed into a section by the signal controlling the entry to the section. This working could be a manual block system or automatic block system. In any type before the train could be allowed to enter a section "PERMISSION" is required to be obtained from the Exit end to the effect that the section is "CLEAR" of trains and the train could be permitted. Different systems of working for getting this "PERMISSION TO APPROACH" have been evolved on Indian Railways and are classified as "System of Working". The details of system of working are explained in Chapter 13.

3.7 Thus it can be concluded from the above general description of concept of Signalling that the main purpose of Railway Signalling Systems is to maintain a safe distance between trains on the same track.

CHAPTER – 4: FIXED SIGNALS, ASPECTS & INDICATIONS
(GR.3.02-3.08)

4.1 In Chapter 3, a mention was made about the use of different types of visual and audible signals, for controlling the movement of trains in all cases. No exceptions are allowed by approved special Instructions in the following:

(a) Fixed Signals (b) Hand Signals (c) Detonating Signals (d) Flare Signals

4.2 The definition of "Fixed Signals" as given in the General Rules is "a signal of fixed location indicating a condition affecting the movement of a train and includes a semaphore arm or disc or fixed light for use by day and a fixed light for use by night".

4.3 Semaphore signals used on the Railways are in the form of a rectangular or fish tailed arm fixed to a vertical post. The arm is kept horizontal to the post to be easily distinguishable. By this arrangement the arm can be seen from a long distance on a clear day. Whenever the signal is required to convey some information:-

The arm can altogether be removed from the view of the driver by making the arm to disappear in a slot provided on the post; or

(a) The arm can be made to assume a mid-way position below horizontal; or

(b) To assume a mid-way position above horizontal; or

(c) To assume a vertical position parallel to the extended line of the post.

4.4 Method (a) was adopted in the early days and subsequently given up as the absence of arm due to some reason other than it's entering the slot in the post conveyed wrong information. Methods (b) and (c) above could be on the Right hand side or left hand side of a Quadrant as shown below in (Fig. 4.4). Fixed Signals can operate on any one of the four quadrants of a circle as shown. Since `Left hand' rule is followed in India, the "lower quadrant" and "Upper quadrant" of the left hand side is utilised in Indian Railways. Based on this principle, signals are also generally located on the left side of the track.

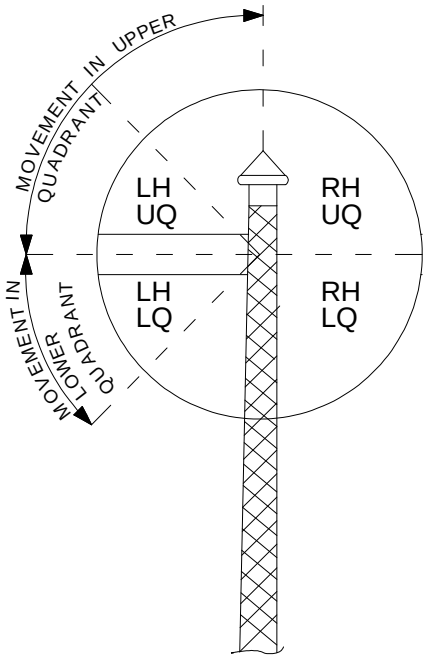


Fig. 4.4 Use of Quadrant

4.5 It can be seen in the figure above that an arm in a lower quadrant can have only two positions, one at horizontal position and the other at midway position on the left-hand side. In Upper Quadrant, three positions can be obtained, i.e. one at horizontal position, one at midway position and the 3rd at vertical position in parallel with the extended line of post. Hence, we have two systems of signalling, one called "Lower Quadrant Signalling" and the other called "Upper Quadrant Signalling".

4.6 Two aspect Lower Quadrant Signalling

(a) Stop-signal (reference SEM 17.115.1)

The semaphore arm of the stop signal is square ended, painted Red with White bar parallel to the square end in front and painted white with black bar in rear. As explained, a lower quadrant signal can show only two different positions. One is horizontal and the other lowered to midway position. They are called "aspects" of the signals. The movement of the signal arm in lower quadrant is generally adopted by countries where there is no snowfall or other external conditions which can result in the arm remaining lowered without being operated. The arm in the horizontal position will convey an aspect "stop" indicating "Stop dead". The arm lowered to midway position in the lower quadrant will convey an aspect "proceed", indicating Proceed. Semaphore arm can be seen during day and so can convey information during daytime. At night the arm will not be visible. Hence, to convey information during night, fixed light signals are used. Right from the early days, red lights were used to denote "Stop" and green lights were used for "Proceed". Red light should, therefore, be exhibited when the arm is horizontal and green light when the arm is inclined midway. A semaphore signal is a combined integrated unit with an arm and light. The horizontal position of the arm during daytime is considered as the `ON' aspect and the inclined position is the "OFF" aspect of the signal. The corresponding light Red & Green during nighttime are `ON' and `OFF' aspects respectively. The `ON' aspect of a signal is also referred to as the most restrictive aspect. The figure 4.6(a) shown below will give the details of the aspect and indications for two-aspect semaphore signal.

ASPECT & INDICATION FOR TWO ASPECT LOWER QUADRANT STOP SIGNAL

ASPECT	STOP	PROCEED
INDICATION	STOP DEAD	PROCEED

Fig. 4.6 (a) Two-Aspect Semaphore Stop Signal (Lower Quadrant (reference SEM I7.115.2)

(b) WARNER SIGNAL

Two-aspect stop signal as explained above is the minimum required to safely space the trains. This is adequate for low speeds and low density of traffic. Safety depends on the driver seeing the signal in time under all conditions. This imposes an enormous strain on the driver who has to be constantly on the lookout, to pick up the signals. Any mistake or loss of attention can lead to serious consequences. Otherwise drivers will play safe by running at lower speeds so that he can stop at the signal even if he sees it at the last minute. With such low speeds, the time of occupation of the block sections by the trains will increase, thereby reducing the number of trains per day that can be run between the block stations.

One method of overcoming this problem will be to give advance information, or "WARNING" to the driver about the presence of stop signal ahead and the aspect displayed by the stop signal. This can be achieved in the form of another signal. This signal can precisely inform the driver that he is approaching a stop signal and also that he is required to stop or proceed. The signal which gives such warning about the condition of the stop signal ahead is called a "WARNER SIGNAL".

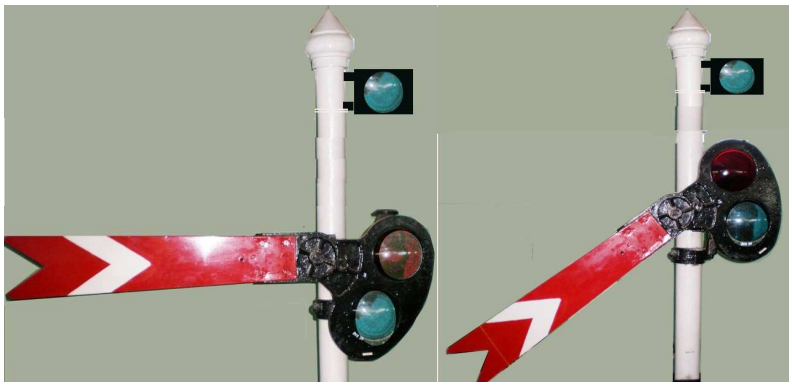
Since the driver is not required to stop at the Warner Signal, as it is only giving an advance warning about the presence of the stop signal ahead, this signal has to be different from the stop signal. The day aspect, therefore, is characterised by a fish tailed arm instead of a square ended arm. This is also a two aspect Lower Quadrant Signal.

Since the Warner Signal is not a stop signal and is exhibiting Red Light when `ON' this should be distinguishable from a Stop Signal during night. This is done by mounting the arm at a lower level in the post and providing a separate additional fixed Green Light at 1.5 to 2.0 metres above the arm. This combination of Green Light above a Red Light distinguishes a signal as a Warner Signal in the `ON' position. When the signal is lowered to midway position, the Red Light changes to green and the Driver sees two green lights one above the other. The aspect and indications of the Warner Signal on a post by itself is shown in Fig. 4.2 (b). Two precise informations are given to the driver by the Warner Signal. When the arm is horizontal during day and showing of a Green Light and Red Light below during nighttime indicates to the driver that he can proceed, but must be prepared to stop at the next Stop Signal. Similarly, the lowering of arm during day and showing of two Green Lights one below the other during night indicates that he can proceed and can expect all the stop signals ahead of Warner for that direction are OFF and he can run through main line.

4.7 A Warner signal must not be capable of being taken `OFF' for any line other than that over which the highest speed is permitted (i.e. main line) and not until all the relevant signals have assumed `OFF' aspect. The last of the stop signals will be the one controlling the entry of the train in the block section ahead. Even if any one of the stop signals ahead is `ON' the Warner cannot display `OFF' aspect.

4.8 Under certain circumstances a semaphore Warner signal is required to be placed on the same post of a stop signal. In such cases, the Warner signal is placed below the Stop Signal, and the fixed green light is dispensed with.

ASPECT AND INDICATION OF LOWER QUADRANT SEMAPHORE WARNER SIGNAL

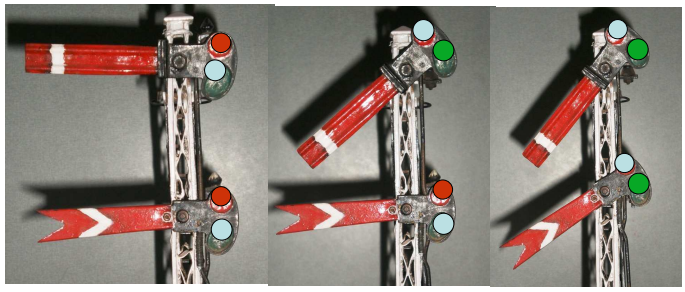


aspect	**Proceed with Caution**	**proceed**
Indication	**Proceed with caution & be prepared to stop at next stop signal**	**proceed**

Fig. 4.6 (b) Semaphore Two-Aspect - Warner Signal on a Post by Itself (Lower Quadrant)

4.9 The combination of two arms (Stop and Warner) on the same post gives the driver three indications in the 2-aspect lower quadrant signalling. When both the Stop Signal and the Warner Signal arms are at horizontal position and the showing of two Red Light one below the other gives an indication to the driver to `Stop dead' at this signal. The lowering of the Stop Signal above the Warner or showing of a Green Light above a Red Light indicates that he can proceed past the signal with caution and be prepared to stop at the next stop signal. A third condition exists when both the arms are lowered to give two Green lights one below the other. This indicates to the driver that he can proceed and can expect all the stop signals for that direction are `OFF' and that the block section ahead is also clear. It is also made mechanically impossible to lower only the Warner Signal when the stop signal above it is `ON'. In this way showing of Green Light below a Red light is eliminated. The details of the signals and aspects are shown in figure 4.9 below.

ASPECT AND INDICATION OF WARNER BELOW STOP SIGNAL



Aspect	**Stop**	**Proceed with caution**	**proceed**
Indication	**Stop dead**	**Proceed with caution & be prepared to stop at next stop signal**	**proceed**

Fig.4.9 Semaphore Two-Aspect - Warner below a Stop Signal

4.10 A comparison between a Warner Signal on a post by itself and a Warner Signal below a Stop Signal is as follows

(a) The night aspect of a separate Warner when `ON' is a green light above a Red Light. If the Red Light gets extinguished for some reason or other, it will give only a Green Light to a approaching driver and he can mistake the signal to be a stop signal in the `OFF' position and can `Proceed' instead of going cautiously.

(b) On the other hand if the fixed green light gets extinguished, the night aspect will only be a "RED" light exhibited which can be mistaken for a "Stop Signal" in `ON' position. This will be noticed only when the driver comes nearer to the signal and he sees a Fish tailed semaphore arm instead of a square ended arm.

(c) Pre-warning to the driver of an approaching train can be given only when a Warner Signal is placed on a post by itself and this will enable the driver to control his train suitably.

(d) In the case of a Warner Signal placed below a Stop Signal the night aspect in the `ON' position is showing of two Red Lights one below the other. Even if any one of the lights gets extinguished, the other Red light will be available which will still indicate to the driver that it is a stop signal. If the stop signal above the Warner, is lowered and the green light gets extinguished then a Red Light of Warner will be visible. However, he could be governed by the stop signal arm above the Warner arm as he comes near the signal, and be guided by it.

(e) In the case of a Warner Signal placed below a Stop Signal, no pre-warning is available for the stop signal.

As explained earlier, the `ON' aspect of a Warner signal on a post by itself, tells the driver that he should proceed cautiously and can expect the next stop signal is in the `ON' or `OFF' position. Hence he is required to pass the signal at a reduced speed (when at `ON').

4.11 From the point of view of the driver, therefore, the `ON' aspect of Warner does not signify positively anything about the signals ahead whereas if such information is available, he can confidently approach the signal ahead. A system of warning about the condition of each signal by a signal in rear is, therefore, very much necessary. This leads to the concept of more than 2 aspects called "MULTIPLE ASPECT SIGNALLING".

4.12 Multiple Aspect Upper Quadrant Signalling

(a) Stop Signal: It has been mentioned in previous para that the semaphore arm can be made to assume a midway position above horizontal and also another position in parallel with the extended line of the post on the left hand Upper Quadrant. In this way, it is possible to obtain more than 2 aspects in the Upper Quadrant region and hence, it is called "Multiple Aspect (more than 2 aspects) "Upper Quadrant" signalling as distinct from "two aspect Lower Quadrant Signalling" mentioned in previous paras.

The Semaphore Arm in Upper Quadrant is similar to 2-aspect lower quadrant square ended arm, painted Red with white bar in the front and painted white with black bar in rear. Since the signal is required to convey 3 aspects, the arrangements in the "spectacle" are such that 3 different colour glasses, namely, Red, Yellow and Green ROUNDELS can be fixed to convey the night aspects of the signal. The arm in the horizontal position in day will convey `ON' aspect indicating "Stop Dead". The night aspect of the horizontal position of the arm by showing of a Red light.

The raising of the semaphore arm to "45 degrees above horizontal" in the left hand Upper Quadrant region will convey an aspect "Caution" indicating "Proceed with caution and be prepared to stop at the next stop signal". The night aspect of the mid-way position by showing of a yellow light. The raising of the arm to 90 degrees above horizontal in parallel with the extended line of post in a vertical position will convey an aspect "Clear" indicating "Proceed" and the next stop signal is also `OFF'. The corresponding night aspect is the showing of a Green Light. The aspects and indications of a Multiple Aspect Upper Quadrant Stop signal are shown in figure 4.12(a) below:

ASPECT AND INDICATION OF UPPER QUADRANT MULTIASPECT STOP SIGNAL



ASPECT	STOP	CAUTION	PROCEED
INDICATION	STOP DEAD	PROCEED & BE PREPARED TO STOP AT THE NEXT STOP SIGNAL	PROCEED

FIG. 4.12(a) MAUQ - STOP SIGNAL

(b) Distant Signal

As discussed in the case of 2-aspect signalling when a driver approaches the first stop signal he should be warned about its condition. Therefore, a signal similar to the Warner Signal in the 2-aspect signalling is also a necessity in Multiple Aspect Upper Quadrant signalling. This pre-warning signal is called a "DISTANT" signal. The term `Distant' is used here, as this is the farthest signal from the station on the approach side. The semaphore arm will have 3 positions - horizontal, 45 degrees above horizontal and 90 degrees above horizontal. The arm is fishtailed similar to lower quadrant Warner signal. The front side facing the train is coloured yellow with a black bar parallel to the end and the backside is coloured white with a black bar. According to the convention adopted that the night aspect in the `ON' position should correspond with the colour of the arm the distant signal exhibits a yellow light in the `ON' position during nighttime. The yellow colour and the fish tailed shape of the arm facilitate the driver in distinguishing a `Distant' signal from a "STOP SIGNAL" from a longer distance.

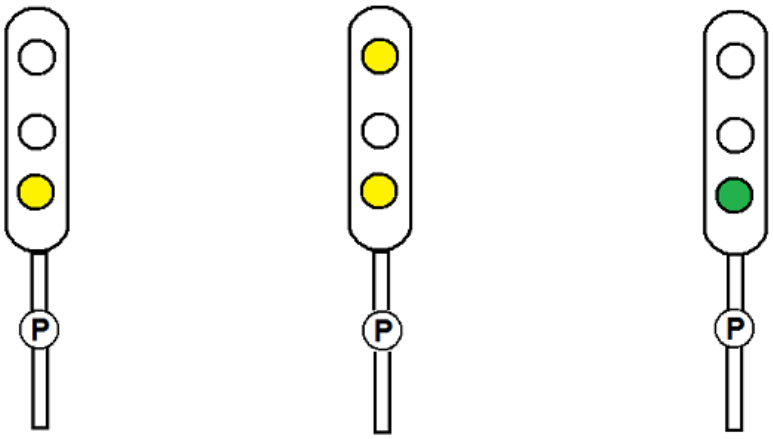
The second aspect that is given by the distant signal is the arm raised to 45 degrees during daytime. But for the night aspect, since the yellow aspect is already used for the `ON' aspect of the signal, a special aspect is given by having `two yellow lights' one below the other. This second yellow fixed light below the yellow aspect of the arm should not be visible in any position other than the 45 degrees position. Hence, a mechanical arrangement is made in the working of this signal such that the fixed yellow light gets `blanked out' in all other positions. In this way 2 yellow lights one below the other is exhibited in the 45 degrees positions only.

The Indications conveyed to the driver are that the next stop signal is `OFF', but he should pass the next Stop Signal at a restricted speed. This aspect of raising the distant arm to 45 degrees position in daytime or showing of 2 yellow lights is the aspect called "ATTENTION". The third aspect given by the distant signal is by raising the arm vertically to 90 degrees position, the night aspect being "GREEN" light, which indicates to the driver that he can proceed and can expect the next signal in the `OFF' is given in Fig. 4.12 (b) below:

ASPECT AND INDICATION M.A.U.Q. DISTANT SIGNAL

aspect	Caution	Attention	proceed
Indication	Proceed & be prepared to stop at next stop signal	Proceed & be prepared to pass next stop signal at such a speed as prescribed by special instruction	proceed

Fig. 4.12 (b) MAUQ - DISTANT SIGNAL



Aspect	Caution	Attention	Proceed
Indication	Proceed & be prepared to stop at next stop signal	Proceed & be prepared to pass next stop signal at such a speed as prescribed by special instruction	Proceed

Fig. 4.12 (c) MAUQ - DISTANT SIGNAL

4.13 The three positions of a Multiple Aspect Upper Quadrant both of a stop signal and a distant signal are horizontal for the `ON' position, raised to 45 above horizontal and raised to 90 Degrees above horizontal are the `OFF' positions.

4.14 It has been mentioned earlier as to how a two aspect stop signal and a Warner can be combined to give 3 aspects. A similar case may occur in Upper Quadrant Signalling also where a signal may have to exhibit 4 aspects, i.e. those of a stop and distant signal. However, the need for such 4-aspect semaphore signals had not been felt very much and no design for such signals had been evolved. Where light signals are used, it is possible to provide a signal exhibiting 4 aspects by combination of lights, which are used in colour light signalling area.

4.15 So far we have discussed two types of signals i.e. Lower Quadrant 2-aspect and Multiple Aspect Upper Quadrant. The Warner/Distant Signals are not stop signals and, therefore, "Permit" the approaching driver to pass the signal in the `ON' position. Hence they are called "Permissive Signals". The stop signals in the 2 aspect and Multiple aspect cannot be passed by the approaching driver in the `ON' position unless and until he is specially authorised. Hence, these signals are called "Absolute Signals".

4.16 The above two types of semaphore signals are 2-aspect lower quadrant and 3-aspect Upper Quadrant whether Permissive signals or absolute signals. The lights exhibited in the nighttime are lighted by "Kerosene Wick Lamps" or by electric lamps and they are lit only during the nighttime. In some areas, where the visibility of arm is very poor due to snow or fog, the night aspects are required to be lit in the day time also. The lighting of the lamps is left to the operating staff.

4.17 Multiple Aspect Colour Light Signals

Instead of having an arm by day and light by night it is preferable to have only lights as signals for both day and night and such signals are called Colour Light Signals. These are mainly used in busy suburban sections and main trunk routes, as these require electric power to operate them. Use of colour light signals is essential in the Electrified sections.

Some of the advantages of Colour Light Signals over the semaphore signals are:

(a) The day and night aspects are the same, therefore no confusion to the Driver.

(b) The visibility can be obtained for longer range and the natural background adds to improve the visibility, especially it is excellent in the nights.

(c) The signals are placed at driver's eye level.

(d) The drooping of signal arm due to snow or external force is completely eliminated.

(e) A combination of 4 aspects can be obtained.

(f) No mechanical transmission, no moving parts, so no wear and tear, and long range of operation is feasible.

(g) No kerosene is required and no necessity to depend on Operating Staff for lighting lamps.

The details of the aspects and indications of a Multiple Aspect Colour Light Stop Signal are as shown in Fig. 4.17 (a) and Fig. 4.17 (b).

ASPECT & INDICATION OF MULTIPLE ASPECT COLOUR LIGHT SIGNAL



ASPECT	STOP	CAUTION	PROCEED
INDICATION	STOP DEAD	PROCEED & BE PREPARED TO STOP AT THE NEXT STOP SIGNAL	PROCEED

Fig4.17a

NO	ASPECT	INDICATION
1	STOP	STOP DEAD
2	CAUTION	PROCEED & BE PREPARED TO STOP AT NEXT STOP SIGNAL
3	ATTENTION	PROCEED & BE PREPARED TO PASS NEXT STOP SIGNAL AT RESTRICTED SPEED
4	PROCEED	PROCEED

ASPECT AND INDICATION FOR 4 ASPECT COLOUR LIGHT STOP SIGNAL

Fig.4.17 (b)

Note: *Where "Distant" and "Inner Distant" signals are provided the Distant shall display only "attention" or "proceed" aspect. (Ref.GR.3.07 & BD's L.68/W3/SG/5/4 of 5/2/70)*

4.18 Similarly the lower quadrant semaphore signals can also be replaced by colour light signals. The aspects and indications in such cases are shown in Figure 4.18 (a), (b) and (c).

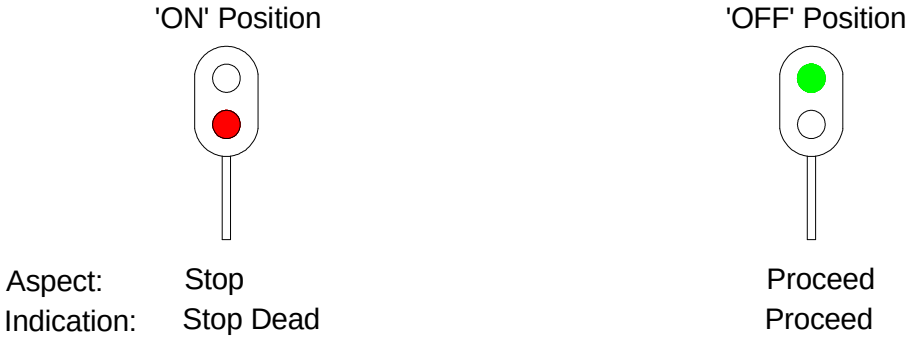


Fig.4.18 (a) 2-Aspect Colour Light Stop Signal

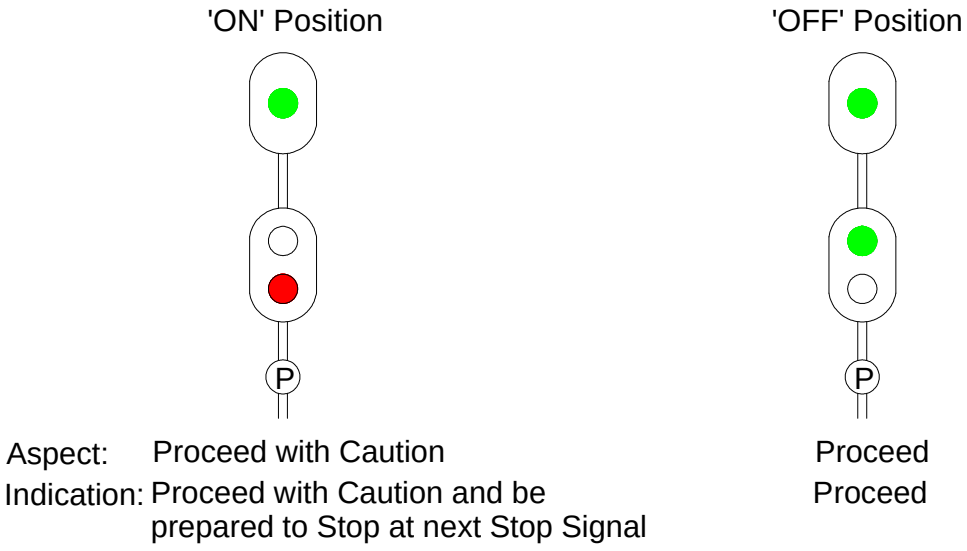


Fig. 4.18 (b) 2-Aspect Colour Light Warner on a Post by Itself

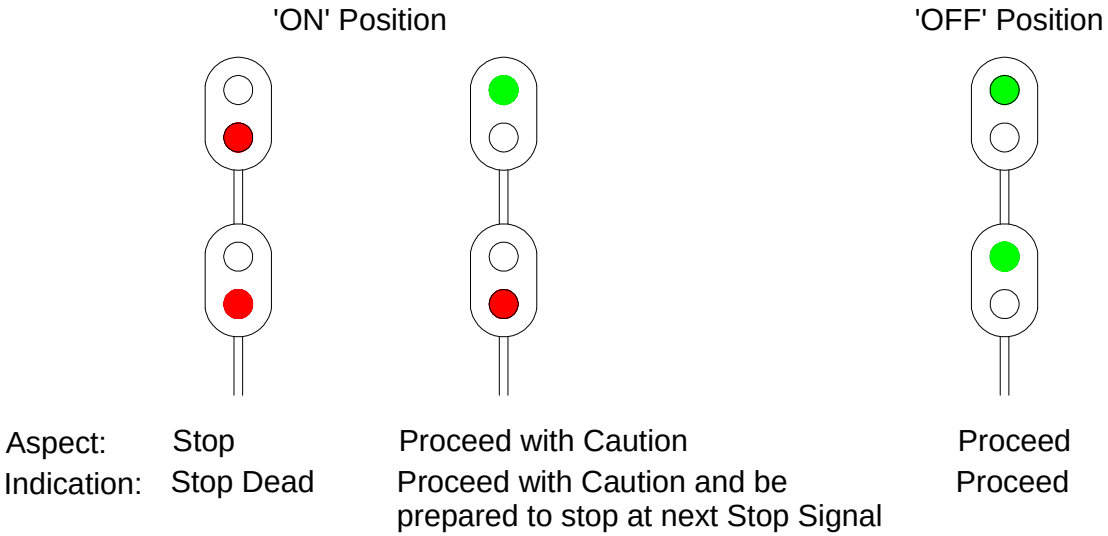


FIG. 4.18 (c) 2-ASPECT COLOUR LIGHT WARNER BELOW A STOP SIGNAL

4.19 From the above, the aspect displayed by these signals and the indication given to the approaching driver, it can be seen that

(a) In the case of 2-aspect lower quadrant, the driver is given only two precise informations at the approach of a station. A Warner Signal at Green (OFF) indicates that he can proceed (run through) at the normal speed and a Warner at `ON' indicates that he has to approach the next signal cautiously, preparing to stop.

(b) In the case of Multiple aspect signalling, the driver is not given any precise information about run through at the approach of a station. The distant signal at Green (OFF) indicates that he can proceed and expect the next stop signal to be OFF and further Stop Signals ahead of this may or may not be OFF.

(c) 4-Aspect Colour Light Stop Signal at `OFF' with green light, indicates the driver to proceed, next stop signal is also `OFF.

Yellow aspect indicates caution and tells the driver to proceed with caution and be prepared to stop at the next stop signal.

In addition to the above aspects, a 4-Aspect Stop Signal has an attention aspect by showing of two yellow lights one above the other informs driver to proceed and be prepared to pass the next stop signal at restricted speed. This may be on account of either the train has to negotiate a turn-out ahead or the breaking distance is not being available between next signal at caution and the signal in advance at Red, so that he could control the speed.

4.20 So far we have seen that a minimum of one stop Signal and a Permissive Signal is necessary to provide the requisite space interval between the trains. Trains are normally dealt with at stations for different purposes such as stopping for passengers, for loading, for servicing, etc., in which case the stop signals are required to be located at different locations to cater to the needs. Stop signals could be provided at the approach end of a station and/or at the departure end of the station and/or at converging or diverging junction points at a station. This involves the introduction of calling the stop signals by different names depending upon the location and hence we come to the details of "DESIGNATION OF SIGNALS".

Review questions

Subjective Questions

1. Write down difference between Warner signal and Distant signal.
2. Write down the advantages of Colour Light Signals over the Semaphore signals.

Objective Questions

State true OR false

1. Indications for caution aspect is proceed and be prepared to pass next stop signal at restricted speed. (False/ True)
2. OFF aspect of a Warner signal is attention. (False/ True)
3. Name of aspect and indication of UQMA signal and MACL signal are not same. (False/ True)
4. UQ distant signal cannot combine with a stop signal. (False/ True)
5. Warner signal at OFF indicate run through condition on Loop Line. (False/ True)
6. A “P” maker shall be provided bellow UQ distant signal. (False/ True)
7. A Warner signal and a distant signal perform same function. (False/ True)
8. A Warner signal (semaphore) is permissive signal and provided with a “P” marker. (False/ True)
9. A Warner signal on independent post at ON provides information regarding aspect of signal in advance (False/ True)

Fill up the blanks

1. If distant signal in single distant territory display proceed aspect then it indicates _____

   a) Run through on main line b) Run through on loop line

   c) Train is going to be received on Main line d) all a,b &c

2. The possible maximum numbers of aspect in LQ signal with combination of signal is/ are _____

   a) Stop b) proceed with caution c) proceed d) all a,b,&c

3. Total aspect in distant signal in double distant signal territory is/ are

   a) Attention b) a &c c) proceed d) caution

* * *

CHAPTER 5: DESIGNATION OF SIGNALS

5.1 At a block station it is obligatory to provide certain number of signals for controlling the movements of trains. There we require some signals to deal with the trains approaching the station and some to deal with departure of trains from the station. When more than one stop signals are used a difficulty to identify them from each other will arise. Hence it is necessary to give some name to these signals.

5.2 SIGNALS FOR RECEPTION: Signals, which are governing the approach and entry of trains into a station, are,

(a) PERMISSIVE SIGNALS: A "WARNER' in case of 2-Aspect signalling can be placed below the first stop signal or below the Last Stop Signal or can be on a post by itself with fixed green light above. It is to warn the driver that he is approaching a stop signal or to warn him about the condition of block section ahead. In multiple aspect signalling a "DISTANT" signal is provided to indicate the driver about the condition of the stop signal ahead. If the sectional speed is 120 KMPH or above, two "DISTANT" signals shall be provided. In such cases, these signals are called 'DISTANT' and 'INNER DISTANT' respectively.

(b) STOP SIGNALS: Minimum one permissive and one stop signal is sufficient for trains approaching a station. When stop signal is taken 'OFF' it permits the train to enter the station, this is called "HOME" signal of the station. At a station where two stop signals are provided in the approach, the first one shall be called "OUTER' and the next shall be "HOME". In some cases where the distance between the Home signal and the Reception lines of the station is far away, one more stop signal may be provided, as One Home signal will not be sufficient to facilitate the reception. So a stop signal provided between Home and the Reception lines shall be called a "ROUTING HOME".

5.3 SIGNALS FOR DEPARTURE OF TRAINS

At the departure end of the station, the stop signals controlling the movement of trains leaving the station are;

(a) STARTER SIGNAL: Where the departure of trains is controlled by only one stop signal, it is called Starter Signal and is the Last Stop Signal of the station. If two or more converging lines are there, the Starter shall be placed outside all connections on the line to which it refers. Where advanced starter is also provided, the starter referring to any line is placed so as to protect the facing point or fouling mark and shall not be less than 400m in advance of the Home signal.

(b) ADVANCED STARTER: Where departure of trains is controlled by more than one Stop Signal, the Outer most starter signal shall be the Last Stop Signal of the station and is called "Advanced Starter". Unless approved under special instructions an "Advanced Starter" shall be placed outside all connections on the line to which it applies. It shall be placed at not less than 180m in the case of two aspect and 120m in multiple aspect signalling from the outermost point on single line and out side all connection. This distance shall be reckoned from the starter on double line. On special nominated sections where frequent shunting involving main line takes place the "Advanced Starter" signal may be placed at a distance of full train length beyond the trailing point and the track between trailing point and the advance starter shall be track circuited (Ref. C.slip No.2 for para 7.16.6 & 7.27.5 of 1988 SEM). Where an advanced starter is provided, the starter referring to any line shall be placed so as to protect the first facing point or fouling mark; and shall not be less than 400m in advance of Home Signal.

(c) INTERMEDIATE/ROUTING STARTER: Intermediate Starter is provided between starter & advanced starter where necessary, and is placed in rear of the point, which it protects. (Refer Figs. 6.2, 6.3, 6.4 and 6.5 of the next chapter)

5.4 We have seen the aspects and indications of an individual signal. The following aspect sequence charts give us the various combinations of signals, their aspect and indications conveyed to the driver of an approaching train. (Using light aspects)

(a) Approaching Signals used in 2-Aspect Signalling

Warner	Outer	Home	Indication
R	R	R	Stop at Outer Signal
R	G	G	Enter the station. Stop at Starter of concerned line if 'ON'
G	G	G	Run through via main line all signals ahead are 'OFF'

(b) Approaching signals used in MAUQ/MACL

Distant	Home	Indication
Y	R	Stop at Home Signal
YY	Y	Enter on Loop line. Stop at Starter if 'ON'
G	Y	Enter on main line. Stop at Starter
G	G	Run through via main line

(c) Using two Distant Signals in approach (MACL).

Distant	Inner Distant	Home	Indication
YY	Y	R	Stop at Home
YY	YY	Y	Enter on Loop Line. Stop at Starter if 'ON'
G	YY	Y	Enter on Main Line. Stop at Starter
G	G	G	Run through via main line

5.5 Aspect sequence chart of Stop signals used for departure of trains

(a) Departure signals in 2-aspect signalling

Starter	Advanced Starter	Indication
R	R	Stand in rear of starter
G	R	Shunt upto adv. Starter
G	G	Proceed line is clear

(b) Departure signals in M.A Signalling

Starter	Advanced Starter	Indication
R	R	Stand in rear of starter
Y	R	Shunt upto adv. Starter
Y/G	G	Proceed line is clear

5.6 To control the through movement of trains to and from a station, it is sufficient to have reception and despatch signals as explained above. But in some major yards, other special type of signals and indicators are provided, (a) to control short moves within the yard; and (b) to convey certain information to the driver (They are discussed in Chapter.7).

Review Questions

Subjective Questions

1. Write down aspect control chart of distant signal in double distant territory.
2. Write down advantages of double distant signal.

Objective Questions

State true OR false

1. When distant signal display green aspect then it indicates run though condition (False/ True)
2. Normal aspect of distant signal in double distance territory is caution. (False/ True)

Fill up the blanks

1. If distant signal in single distant territory display proceed aspect then it indicates-----
   a) Run through on main line b) Run through on loop line
   c) Train is going to be received on Main line d) all a,b &c
2. If distant signal in double distant territory display proceed aspect then it indicates---
   a) Run through on main line b) Run through on loop line
   c) Train is going to be received on Main line d) all a,b &c

* * *

CHAPTER 6: LOCATION OF SIGNALS

6.1 Signal must be so located and aligned as to display the best possible view of their aspects to the driver of approaching train and shall avoid as far as possible the possibility of mistaking the aspect of one signal for the aspect of another, or confusion between the lights of running signals and the lights of subsidiary signals or any other lights. Signals should be normally on the left hand side or above the line to which they apply, unless there are special reasons to the contrary. All signal arms must be fixed on the left-hand side of the post. The other important considerations in locating the signals are that they should afford the required sighting distances and it should be possible to work or operate them efficiently, and should not infringe the schedule of dimensions. None of these considerations can be compromised. Signals should be so designed, failure of which shall assume the most restrictive aspect. It shall be noted that the adequate distances prescribed in these rules are minimum they may suitably be increased but not decreased, unless authorised by special instructions.

6.2 LOCATION OF SIGNALS IN 2-ASPECT L.Q.SIGNALLING

(a) WARNER SIGNAL: A Warner signal may be placed either

(i) On a post by itself with a fixed green light by night 1.5 to 2 metres above it and shall be located not less than. 1200 metres in rear of the first stop signal or Gate Stop Signal, unless otherwise it is permitted by approved special instructions.

Or

(ii) On the post, 1.5 to 2 metres below the arm of the outer signal.

Or

(iii) On the post, 1.5 to 2 metres below the last stop signal of a station.

When placed below a stop signal the variable light of the stop signal shall take the place of fixed green light of the Warner Signal, and the arrangement shall be such that the Warner cannot be taken 'OFF' while the stop signal above it is 'ON'. The Warner signal must not be capable of being taken 'OFF' for any line other than that over which highest speed is permitted, and it must not be capable of being taken 'OFF, until the levers of all the relevant signals have been pulled. Where it is necessary to provide un-worked Warner Signal, it must be fixed at 'ON' position as shown in Fig 6.2.

(b) OUTER SIGNAL: In 2-aspect signalling where outer signal is provided, will be the first stop signal of the station and shall be placed not less than 400 metres in rear of the point upto which the line may be obstructed after the line clear has been given to the station in rear. On single line there should be at least 580 metres between Outer and Home, so as to cater for Block overlap and Signal overlap i.e. (400 + 180m) where advance starter or Shunt Limit Board is provided for shunting facility in the face of an approaching train.

(c) HOME SIGNAL: The Home Signal shall be located in rear of all connections, and close to the first set of facing points clear of lock bar, or the fouling mark (if the first point is trailing) so as to protect the adjacent line. If it is found necessary to increase the distance between the signal and the first facing point beyond 180 metres, other arrangements for route holding must be made like lock retaining bar, with successive interlocking or track circuits or SM's route control.

(d) ROUTING SIGNAL: A Routing Signal must be placed in rear of the point, which it protects.

(e) STARTER SIGNAL: The starter signal shall be placed at not less than 400 metres in advance of the Home Signal. Where a starter signal is provided for each converging line, it shall be so placed as to protect the adjacent running line or lines. Where only one starter is used for two or more converging lines, it shall be placed outside the connections on the line to which it applies.

(f) INTERMEDIATE STARTER: An Intermediate starter shall be placed in rear of the point or fouling mark to which it protects.

(g) ADVANCED STARTER: Unless approved under special instructions, an advance starter shall be placed outside all connections on the line to which it applies. It shall be placed not less than 180 metres from the outermost point on single line. On double line this distance may be reckoned from the starter if this is not adequate enough, may be from the outermost point or fouling point.

However in special cases where frequent shunting involving main line takes place, the advance starter may be placed at a distance of full train length beyond the trailing points and the track between starter and advance starter should be track circuited.

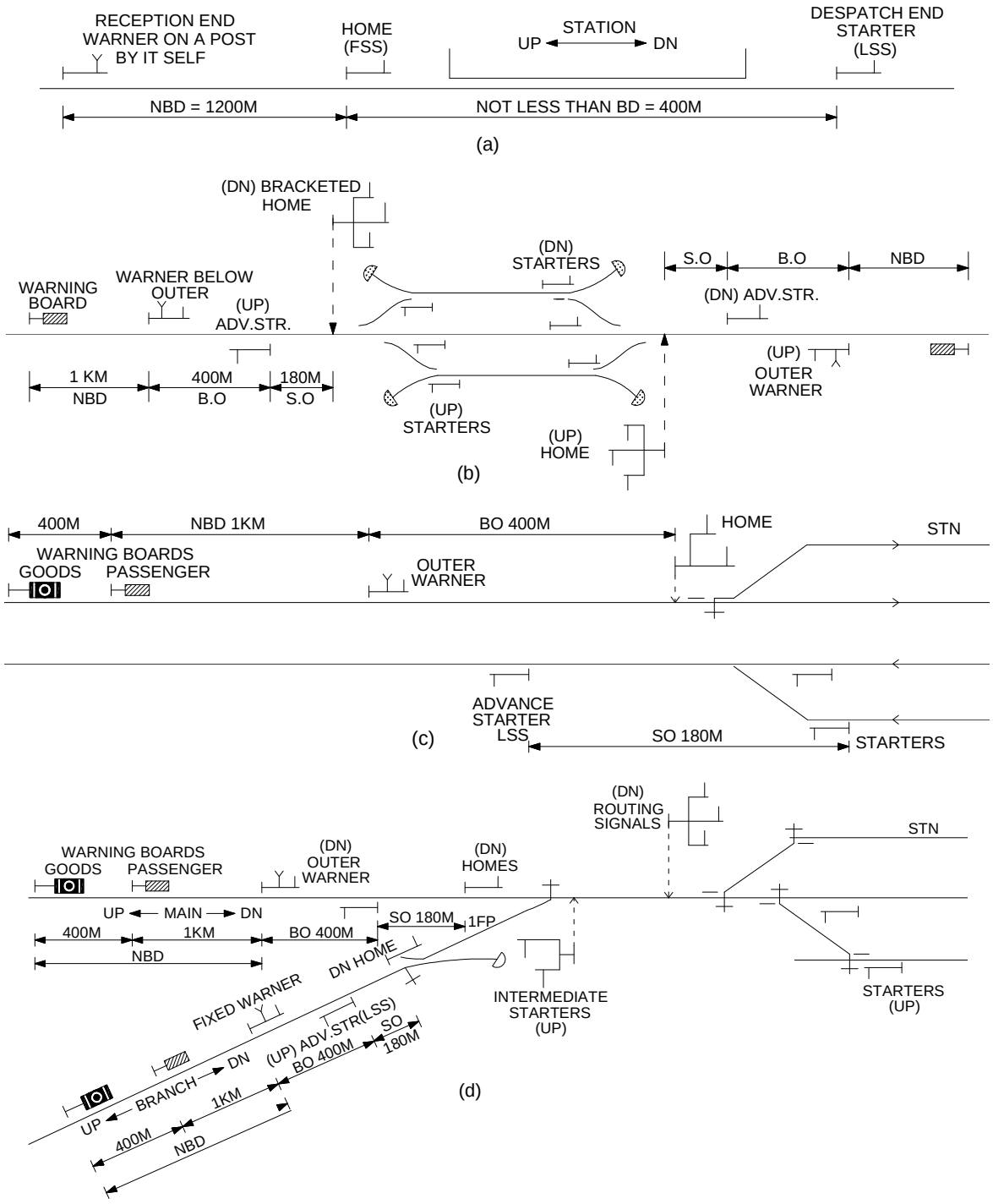


Fig. 6.2 DESIGNATION AND LOCATION OF FIXED SIGNALS IN 2-ASPECT L.Q SIGNALLING

6.3 LOCATION OF SIGNALS IN MAUQ SIGNALLING

(a) DISTANT SIGNAL: On single line or double line, the distant signal shall be placed at an adequate distance i.e. Normal breaking distance in rear of the first stop signal of the station or gate stop signal, which shall not be less than 1 km.

(b) HOME SIGNAL: The Home signal is the first stop signal of the station normally placed at Normal breaking distance in rear of next stop signal and 180m in rear of the point upto which the line may be obstructed, after the line clear has been given to the station in rear. To obtain maximum operational facility on single line, the Home signal shall be placed at not less than 300m i.e. BO + SO (180m + 120m) in rear of the first facing point if the facility of shunting in the face of an approaching train is desired, so that BO is available between the Home and the opposite advance starter/SLB. Route holding is achieved by providing Lock Retaining bar (LRB) or track circuit or SM's control (See Fig 6.3 a) On double line the Home Signal may be located at a distance of BO (180m) in rear of the facing point or Block section Limit Board (if first point in the approach is trailing or no point). Where two or more lines diverge the signals shall be fixed on bracketed post, or gantry. The signal which refers to main line shall be at higher level than of the loop lines (see 6.3 b)

(c) ROUTING SIGNAL: A routing signal must be placed just in rear of the points to which it protects. Generally they are used in junction stations

(d) STARTER SIGNAL: Starter signals are usually placed in rear of the facing point or fouling mark of the converging lines such that they should protect the adjacent running line or lines.

(e) INTERMEDIATE STARTER: It shall be placed in rear of the point to which it protects. They are generally used at Junction stations to inform the driver of the train that to which direction he is being dispatched

(f) ADVANCED STARTER: The advanced starter shall be placed outside all connections on the line to which it applies, and shall not be less than 120 metres from the outermost point on single line. On double line this distance may be reckoned from the starter. However, if this distance is not adequate for working of trains may be reckoned from the outermost point or fouling mark and in special cases up to a distance of full train length beyond the outermost point where frequent shunting is involving the main line. In such cases the track between the starter and advanced starter shall be track circuited

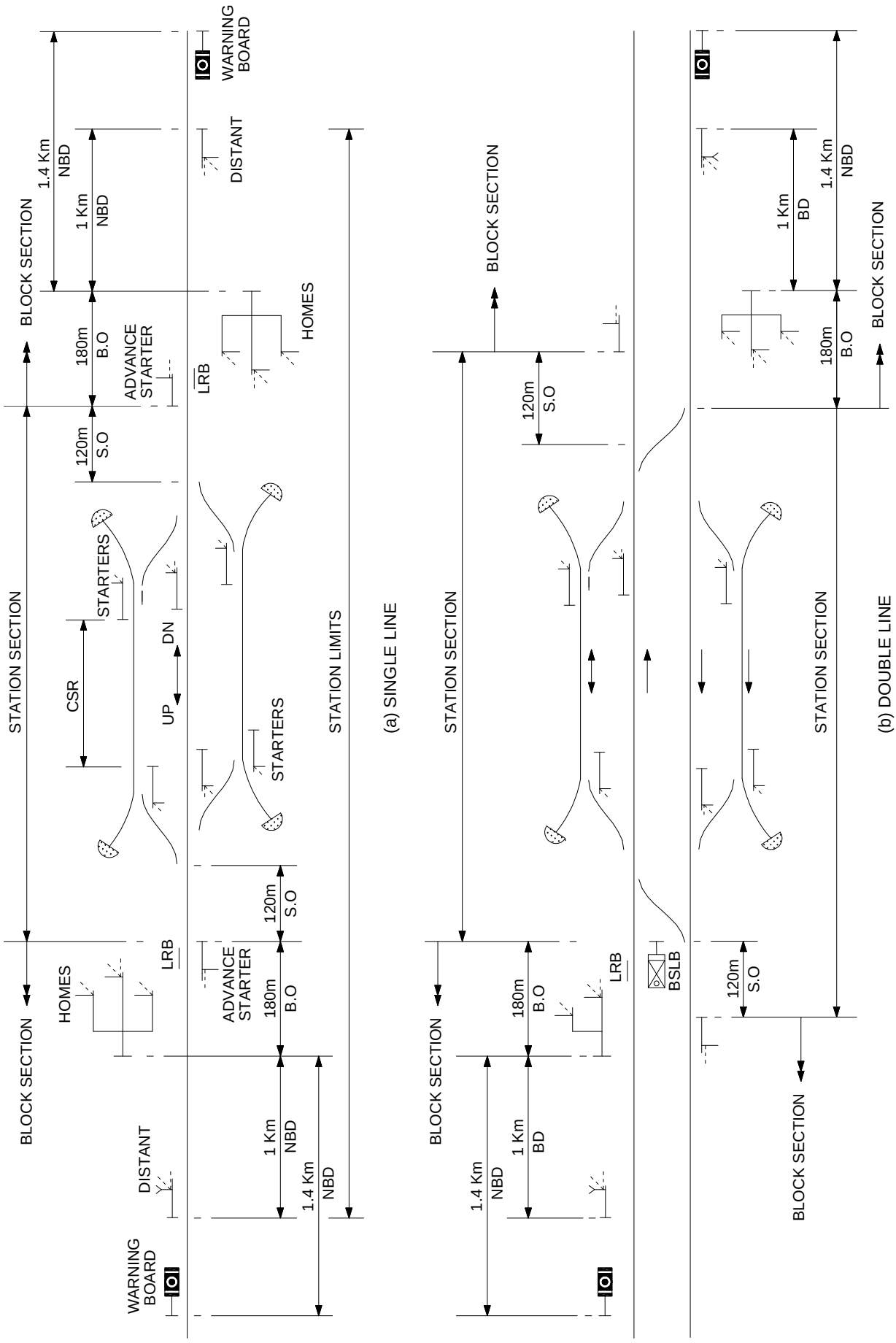


Fig: 6.3 DESIGNATION AND LOCATION OF FIXED SIGNALS IN MAUQ SIGNALLING

6.4 LOCATION OF SIGNALS IN (MLQ) MODIFIED LOWER QUADRANT SIGNALLING

Modified lower quadrant signalling shall be provided only under special instruction issued by the Railway Board. Nowadays it is not usually adopted. Where such signalling is permitted the requirement of signals and their locations shall be as follows:

(a) DISTANT SIGNAL: On single line or double line, the distant signal shall be placed at an adequate distance in rear of the first stop signal which shall not be less than l km.

(b) WARNER SIGNAL: It shall be placed on the same post at 1.5 to 2 metres below the main Home Signal.

(c) HOME SIGNAL: The Home Signal shall be placed at not less than 180m in rear of the point up to which the line may be obstructed after the line clear has been given to the station in rear.

(d) STARTER SIGNAL: It shall be placed on each converging line as to protect the adjacent line or lines

(e) ADVANCED STARTER: Placed outside all connections and not less than 120m from the outermost point. If this distance is increased, the track between starter and advance starter should be track circuited.

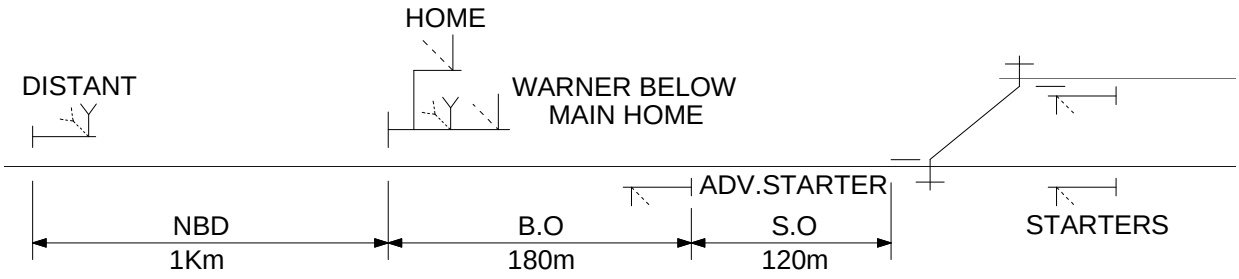


FIG. 6.4 DESIGNATION AND LOCATIONS OF MLQ SIGNALS

6.5 LOCATION OF SIGNALS IN COLOUR LIGHT SIGNALLING

The requirement of signals and their locations in stations equipped with colour light signalling is same as it is for semaphore signalling, whether 2-Aspect or Multiple Aspect. However when colour light signalling is to be provided it is preferable to go for multiple aspect, because it is convenient and advantageous. In the case of semaphore signalling the physical appearance of arm for permissive signal and stop signal is different. Whereas in colour light, the signals look alike, to distinguish a permissive signal from a stop signal a 'P' marker is provided on the post of a colour light Distant Signal. So that the driver need not stop and can pass this signal when it is found blank after seeing the 'P' marker. Similarly providing separate Home signals on a bracketed post for each diverging line, a common colour light stop signal with route indicator is used to indicate the driver as to which route the line is set for him. Route indicator is provided only when the colour light signal is kept common for more than one route for diverging lines and not provided for straight line and when it is for one line. For example starter signals whether on loop line or main line are not provided with route indicator since they are for only one line ahead (see Fig. 6.5).

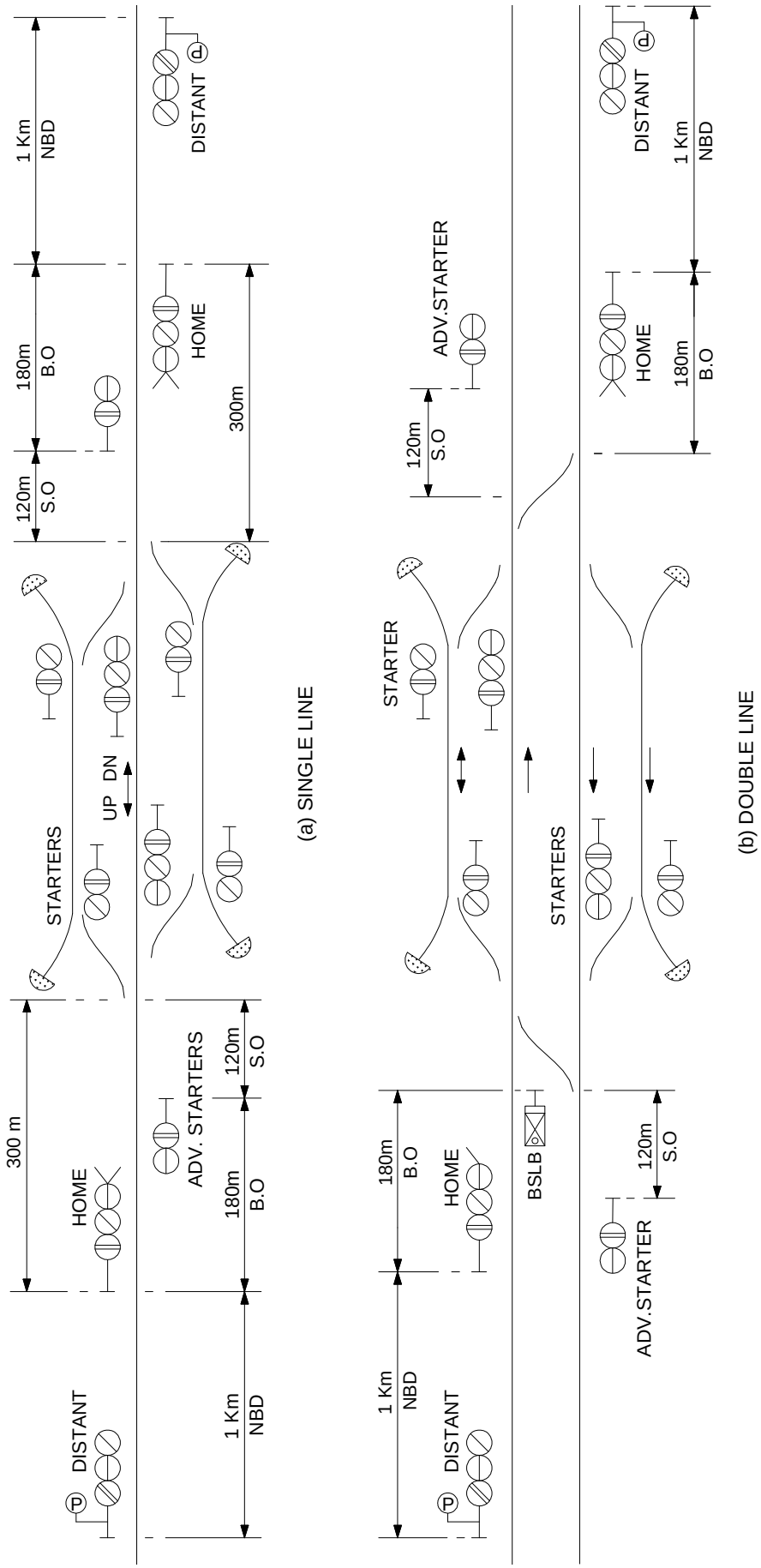


Fig: 6.5 DESIGNATION AND LOCATION SIGNALS IN MACL

Review questions

Subjective Questions

1. Draw a four line **class B** station with multi aspects colour signal on **Double line section** with a siding taken out from common loop line. Provide all necessary signals & boards, distances of signals, station limit, station section, block section& also **demarcate** all possible overlaps of UP home signal.

2. Draw a three-line class B station with UQ multi aspects signal **on single line section** with a siding taken out from one loop line. Provide all necessary signals & boards, distances of signals, station limit, station section, block section& also demarcate all possible overlaps of UP home signal.

Objective Questions

State true OR false

1. First stop signal on signal line station normally shall be placed at distance of 400 Mt plus 180 Mt from outer most point. (False/ True)

2. First stop signal on double station line normally shall be placed at distance of 400 Mt plus 180 Mt from outer most point. (False/ True)

3. The starter signal shall be placed at not less than 400 metres in advance of the Home Signal and is usually placed in rear of the facing point or fouling ma of the converging lines such that they should protect the adjacent running line or lines. (False/ True)

4. Location of distant signal and warner signal on independent post is same. (False/ True)

5. Location of advance starter in LQ and UQ signal on single line and double line may be reckoned starter signal. (False/ True)

* * *

CHAPTER 7: SUBSIDIARY SIGNALS, REPEATERS, INDICATORS, MARKERS & BACK LIGHTS

7.1 In the previous chapters we have seen the signals authorising the drivers to enter the station from a block section by the use of Reception Signals; and enter the block section from the station by the use of Departure Signals. These signals were, therefore, being used for "reception and despatch of running trains. As per definition a "Running train" is a train which has started under an authority to proceed and has not completed its journey whereas "a train" is an engine with or without vehicles attached or self propelled vehicle with or without a trailer which cannot be readily lifted off the track. The signals, which control the movement of trains within the station section, are to be differentiated and convey different indication to the driver. These signals are (a) Shunt signals and (b) Calling on Signals and are called "SUBSIDIARY SIGNALS".

7.2 SUBSIDIARY SIGNALS

In addition to the reception and despatch of train from and to a station some other movements of trains are required such as transfer of vehicles from one line to another, attaching and despatching of vehicles to and from a train, to marshall a train so that vehicles meant for the same destination are always in one line, etc. Such movements differ from regular train moves in which the speeds are low as the movements are confined to a small area and the line on which the movement is to be done may invariably be occupied by vehicles and as such the driver has to exercise more caution. A running signal taken 'OFF' signifies that the line on which the movement is to take place is clear whereas a shunt signal if taken 'OFF' may authorise the driver to go past the signal at slow speed irrespective of whether the line is occupied or not. These movements are also required to be controlled and 'NOT LEFT' to the discretion of the driver. These movements can be carried out by the use of "Hand Signals" exhibited by authorised persons to carry out the shunting. Where these movements are frequent and regular then the use of separate signals called "Shunt Signals" have to be fixed. Naturally the shunt signals are to be different from running signals as the information conveyed by them when 'OFF' is different. Moreover, as the movement is done in a smaller area, the visibility of the signal is not critical and low visibility is adequate. Also no pre-warning is necessary. Since visibility required is less, smaller types of signals can be used compared to running signals.

7.3 SHUNT SIGNALS (GR 3.14)

(a) Shunt signals authorise movement only at such slow speeds as to be able to stop short of any obstruction and control shunting movements.

(b) Shunt signals can be placed on a separate post by itself close to the ground or can be placed below a stop signal other than the first and last stop signal of a station.

(c) More than one shunt signal may be placed on the same post in which case the top-most signal shall apply to the extreme left hand line and the second shunt signal from the top shall apply to the next line from the left and so on.

(d) Shunt signal when taken 'OFF' authorises the driver to draw ahead with caution even though the stop signal, if any, above it is at 'ON' position, and

(e) The shunt signal shall be either

(i) Disc type shunt signal;

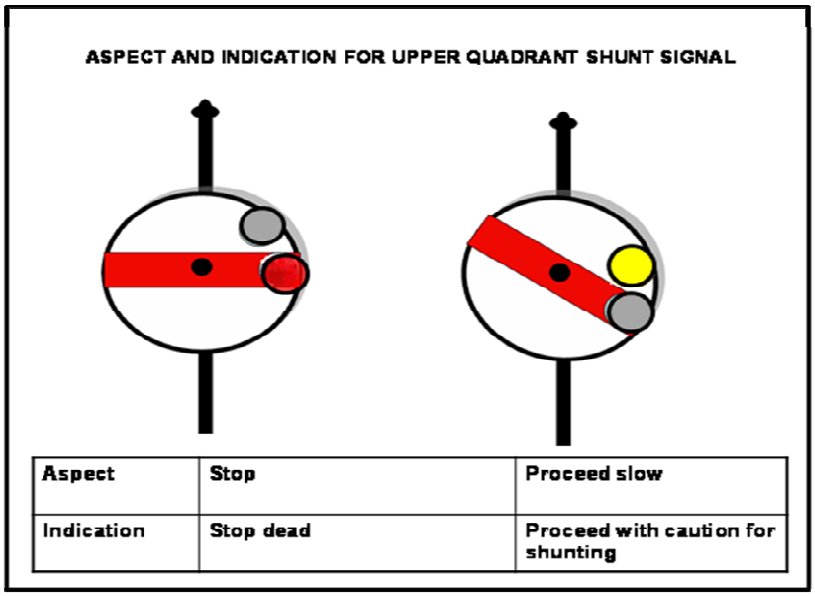
(ii) Position Light Shunt Signals.

(f) Under special instructions, a shunt signal may be a miniature arm.

(g) When a Shunt Signal is placed below a Stop Signal, it shall show no light in the "ON" position.

7.4 DISC TYPE SHUNT SIGNAL

Shunt signal of the 'Disc' type is a circular disc painted white with red horizontal bar in the front and white with black bar in the rear. Disc type shunt signal used in 2-aspect Lower Quadrant Signalling territory moves to the mid-position in the Lower Quadrant when 'OFF' and moves to mid-position in the Upper Quadrant for the Multiple aspect territory for the 'OFF' aspect. The night aspect in the LQ is 'RED' when 'ON' and Green when 'OFF' and in the multiple aspect, it is 'RED' when 'ON' and yellow when 'OFF'. The disc type shunt signal can also be placed below a Semaphore stop signal other than the first stop signal in which case, the 'Red' indication in the 'ON' aspect (Red light) of the main signal will prohibit the driver from passing the signal. However, the night aspect will continue to be Green if the Shunt signal is taken 'OFF'. But, if shunt signal has to be located independently then the problems arise. There is a view that a shunt signal is relevant only for a shunting train and not for a running train. If so, a Red of an independent shunt signal does not mean anything to a running train, and he can ignore it. But ignoring a Red aspect is bad in principle. So this is overcome to some extent by doing away with red lights for shunt signals. The day and night indications of the Disc type shunt signals is shown in Fig. 7.4.



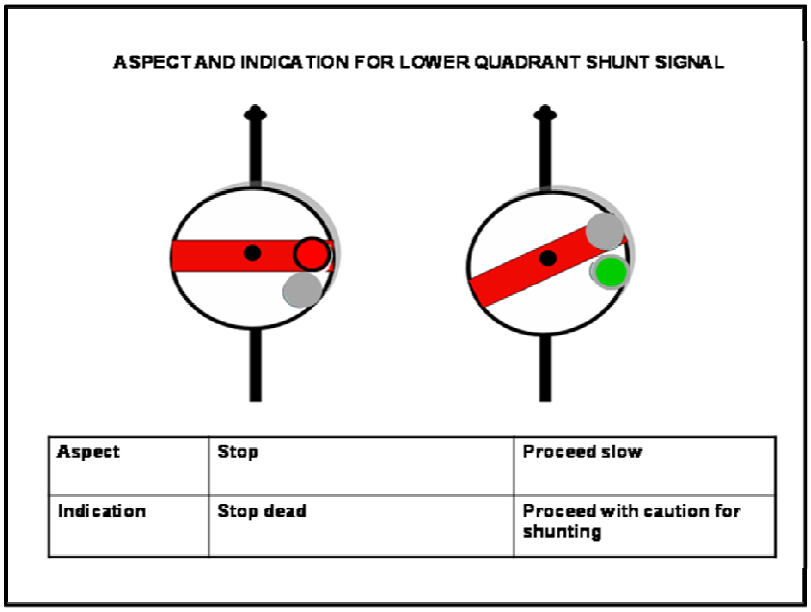
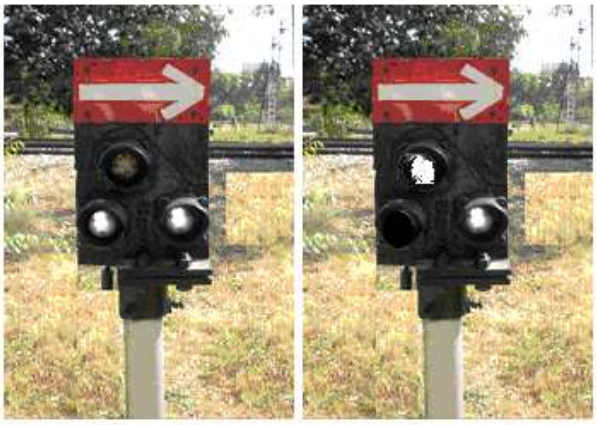


Fig. 7.4 DISC TYPE SHUNT SIGNALS IN MULTIPLE ASPECT & LQ SIGNALLING

7.5 POSITION LIGHT SHUNT SIGNAL

A position light shunt signal provided generally in the colour light signalling territory consists of a row of two white lights; one for the ON aspect and one for the 'OFF' aspect. The position light shunt signal used in the 2-aspect lower quadrant or multiple aspect Upper Quadrant is the same. Since this is also considered as a Colour Light Signal the day and night aspect is the same. The two lights of the position light shunt signals will be white. By day and by night, the lights of the position light shunt signal will be horizontal in the ‘ON’ position and 45 above horizontal in the 'OFF' Position. The aspects are shown in Fig. 7.5.

ASPECT AND INDICATION FOR POSITION LIGHT TYPE SHUNT SIGNAL



Aspect	**Stop**	**Proceed slow**
Indication	**Stop dead**	**Proceed with caution for shunting**

'ON’ POSITION ‘OFF’ POSITION

SHUNT SIGNALS

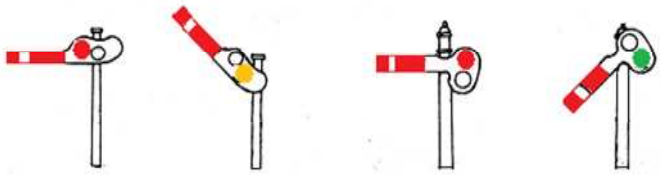
Shunt signal below stop signal **Shunt signal on independent post**

Fig.7.5

7.6 MINIATURE SEMAPHORE ARM TYPE SHUNT SIGNAL

The semaphore arm of miniature shunt signal is square ended. The front of the arm is painted Red with white bar and the back of the arm is painted white with black bar. The day aspect is horizontal for 'ON' position and lowered to mid position for 'OFF' position in the case of lower quadrant and raised to 45 degrees above horizontal in the 'OFF' position in the case of upper quadrant. The showing of 'Red' indication when the arm is horizontal constitutes the night 'ON' aspect, showing of 'Green' indication constitutes the night 'OFF' aspect for 2-aspect lower quadrant and showing of 'Yellow' indication constitutes the night 'OFF' aspect for multiple aspect signalling. The day and night aspects of miniature semaphore shunt signals are shown in Fig. 7.6. The provision of miniature semaphore arm shunt signal is done only under special instructions.

MINIATURE SEMAPHORE ARM TYPE SHUNT SIGNAL



Aspect	Stop	Proceed slow
Indication	Stop dead	Proceed with caution for shunting

Fig.7.6. MINIATURE SEMAPHORE ARM TYPE SHUNT SIGNALS

7.7 SHUNTING MOVEMENTS AND SHUNT SIGNALS IN GENERAL

Shunt signals are additional signalling equipment provided at stations where shunting movements are very frequent and manual shunting is difficult to perform. Driver while busy in shunting movements should not refer to running signals. The conditions for taking 'OFF' a shunt signal in an interlocked station are the same as required for taking 'OFF' a running signal except that it does not require signal overlap and isolation with another shunt movement due to slow speeds. A shunt signal is generally not confined to one route/siding; it may read to any number of diverging lines ahead to which it is accessible, with or without route indicators. It conflicts with all running signals of the line to which the route of the shunt signal is set. Shunt signal is fixed on a post closer to ground, as it does not require long range of visibility. On running lines where starters and advanced starter are provided, the starters of the station can be used for shunting. Where shunt signals are not provided, hand signals are used for shunting movements in such stations.

(a) SHUNTING PERMIT INDICATOR: At certain stations where uninterrupted shunting operation is required in both the directions (to-and-fro towards the shunting neck or other connected lines), a Shunting Permitted Indicator (SPI) may be provided. It is not a stop signal, but an indicator, which is operated by a ground frame and works in conjunction with the stop signal such that either the SPI or the associated stop signal can be taken off at a time. This is of two types:

(i) Disc type: a black disc with yellow cross - painted on it.

(ii) Light type: Yellow cross light

Type	When shunting is permitted		When shunting is not permitted	
	Day	Night	Day	Night
Disc type	Black disc with yellow cross painted on it	Yellow cross light	Edge of the disc	No light
Light type	Yellow cross light	Yellow cross light	No light	No light

7.8 CALLING ON SIGNALS

A calling on signal is a subsidiary signal and has no independent existence. It is provided below a stop signal governing the approach of a train. "CALLING 'ON' signal can be a miniature semaphore arm type or colour light type in two aspect or Multiple aspect territory.

7.9 In the case of semaphore "Calling on" signal, it shall be miniature square ended arm painted white with red bar in the front and painted white with black bar in the back. The bars are parallel to the end of the arm. The Painting of a calling on signal with white is to distinguish it from a shunt signal miniature arm.

By day the arm must be

(a) Horizontal in the 'ON' position;

(b) Inclined downwards to the horizontal in the 'OFF' position in the 2-aspect signalling territory and

(c) Inclined upwards to the horizontal in the OFF position in the multiple aspect signalling territory.

By night the signal will display

(a) No light in the ON position;

(b) A miniature yellow light in the OFF position for 2-aspect lower quadrant; and

(c) A miniature yellow light in the OFF position for multiple aspect territory [(Refer Fig. 7.9 (a) and (b)]. In the case of colour light signalling a miniature yellow light with 'C' marker is used. Fig. 7.9 (c) and (d)

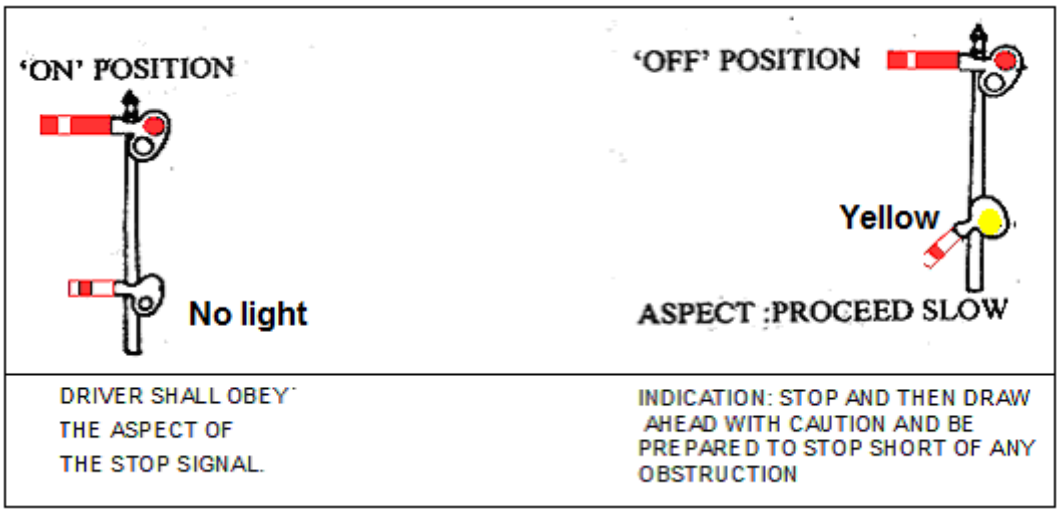


Fig. 7.9 (a) MINIATURE SEMAPHORE TYPE CALLING ON SIGNAL IN 2-ASPECT SIGNALLING TERRITORY

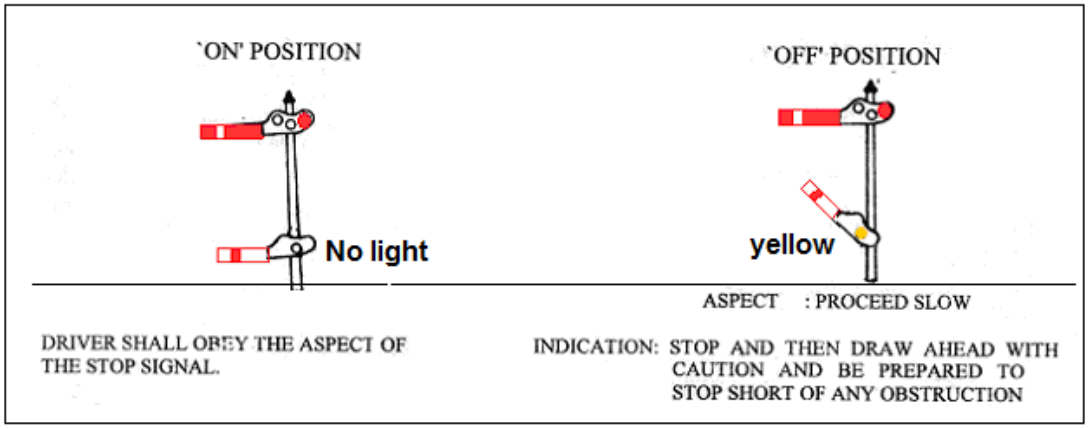


Fig.7.9 (b) MINIATURE SEMAPHORE TYPE CALLING ON SIGNAL IN MULTIPLE ASPECT SIGNALLING TERRITORY

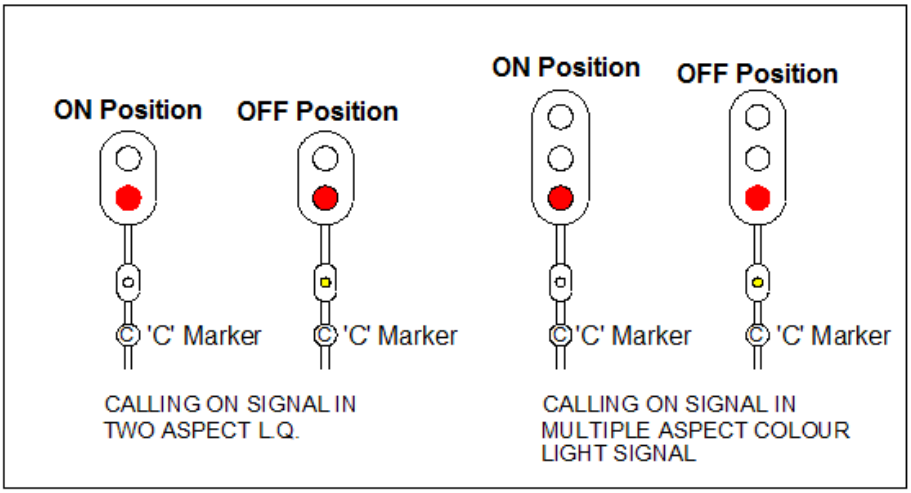


Fig.7.9 (c), (d) COLOUR LIGHT CALLING ON SIGNAL IN TWO ASPECT AND MULTIPLE ASPECT SIGNALLING

7.10 Calling on signals are used only for the specific purpose of indicating to the driver that he is required to draw ahead when OFF and be prepared to stop short of any obstruction even though the stop signal above it, is at ON. Calling on signals are taken OFF only after the train has come to a stop. Calling on signals of the colour light type are provided with a marker plate with letter 'C'. Under approved special instructions, a "calling on" signal may be provided below any other stop signal except the last stop signal.

7.11 OTHER MISCELLANEOUS SIGNALS

(a) CO-ACTING SIGNALS

All fixed Signals must have a minimum visibility to the driver of an approaching train and it is also essential that the signal is continuously visible to the driver of an approaching train. When it is not possible to get the minimum continuous visibility due to a foot-over bridge or road-over bridge, or tunnel or any other partial obstructions, then co-acting signals are required to be provided.

Co-acting signals are duplicate signals fixed below running signals on the same post; and are provided where, in consequence of the obstruction as stated above, the main signal arm or light is not in view of the approaching driver during the whole time the driver is approaching it. Co-acting signals shall be fixed at such a height that either the main arm or light or the co-acting arm or light is always visible. The main signal and the co-acting signal are rigidly connected and they work together (Fig. 7.11).

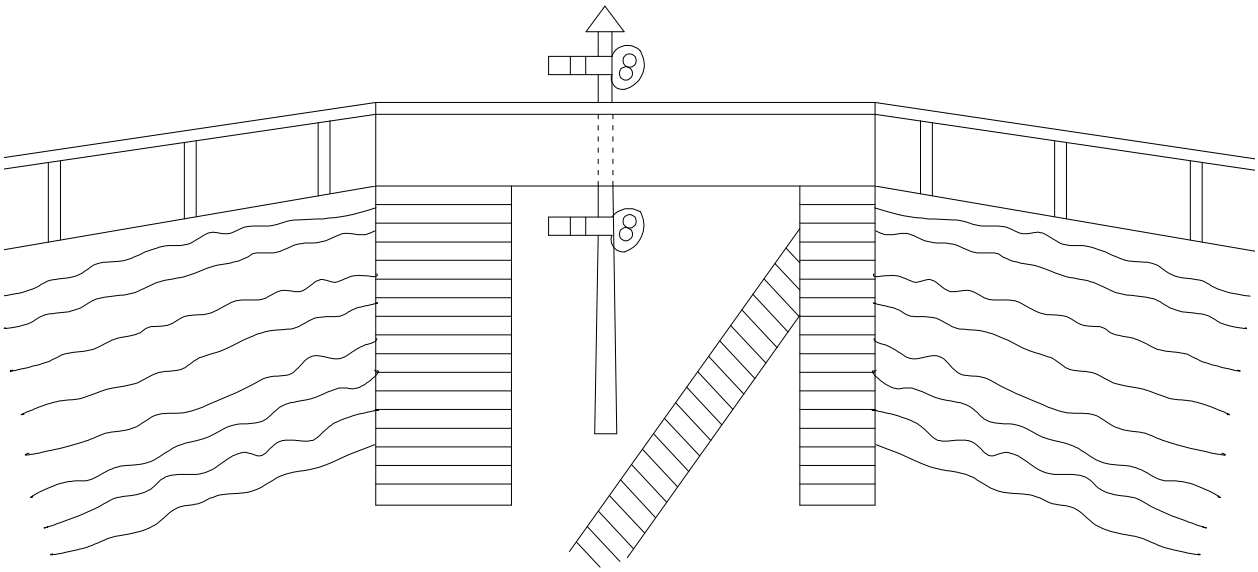


Fig. 7.11(a) CO-ACTING SIGNALS

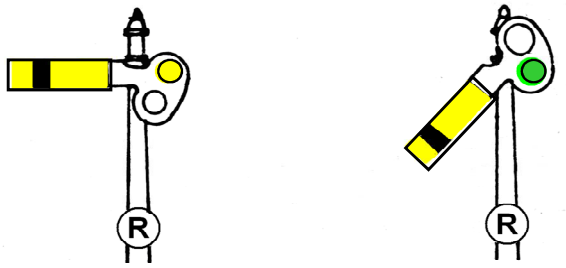
(b) REPEATING SIGNALS

Normally any fixed signal shall be visible to the approaching driver. However, due to the terrain of the land, a tunnel or bridge coming in between or any other obstruction, then it may not be always possible to get a clear view of the signal from the specified distance. To overcome this, repeating signals are provided, to repeat the condition of the main fixed signal, at a place where the main signal is required to be sighted. The purpose of repeating signal is to inform the driver of the approaching train about the aspects displayed by the fixed signal in advance, which it repeats. A repeating signal shall be provided with a marker 'R' and shall be (a) a square ended semaphore arm or (b) a banner type or (c) a colour light signal. Repeating signals are required only for 2-aspect signalling. In the case of multiple aspect signalling, as every stop signal is pre-warned, no repeater signal is necessary.

In the case of 2-aspect lower quadrant semaphore arm type, it is provided with a semaphore arm square ended painted yellow with black bar in the front and painted white with black bar in the rear. The horizontal position of the arm in the daytime and showing of a yellow light by night constitute the ON aspect of the signal. The arm inclined to the lowered position in the daytime and showing of the green light by night constitutes the OFF aspect. The banner type-repeating signal is a disc, painted white with a rectangular bar painted yellow in the middle with black bars on the top and bottom. The horizontal position is the ON position and an upward inclined position is the OFF position. The banner type signal is not lit in the night. The aspect of the colour light signal is yellow in the ON position and green in the OFF position. The details are shown in the Fig. 7.12 (b), (c) and (d).

The semaphore arm type and Banner type repeaters are provided with marker plates with letters 'R' painted black on white disc and colour light repeaters are provided with 'R' marker lights, which indicates to the approaching drivers that the main signal in advance is repeated by the repeater signal. As can be seen the ON aspect of all type repeater signals is either yellow arm or yellow light which is not a stop signal indication and the driver is required to draw ahead upto the stop signal to which it repeats.

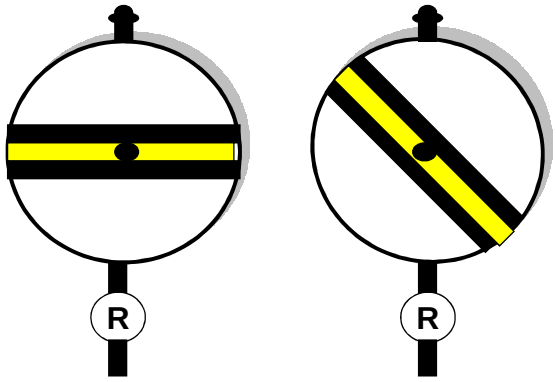
ASPECT AN INDICATION FOR SEMAPHORE ARM TYPE REPEATING SIGNAL



ASPECT	ON	OFF
INDICATION	SIGNAL WHICH IT REPEATS IS AT ON	SIGNAL WHICH IT REPEATS IS AT OFF

Fig.7.11 (b) SEMAPHORE ARM TYPE

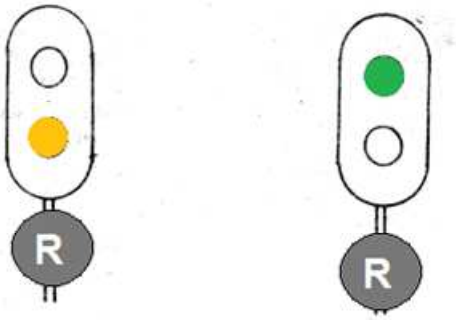
ASPECT AN INDICATION FOR BANNER TYPE REPEATING SIGNAL



ASPECT	ON	OFF
INDICATION	SIGNAL WHICH IT REPEATS IS AT ON	SIGNAL WHICH IT REPEATS IS AT OFF

Fig.7.11 (c) BANNER TYPE

ASPECT INDICATION OF COLOUR LIGHT TYPE REPEATING SIGNAL



ASPECT	ON	OFF
INDICATION	SIGNAL WHICH IT REPEATING IS AT ON	SIGNAL WHICH IT REPEATING IS AT OFF

Fig.7.11 (d) COLOUR LIGHT TYPE

7.12 DISTINGUISHING SIGNS

Sometimes the signals are provided with prescribed markers to distinguish the signals. They will normally be fixed on the semaphore arm itself or in some cases on the signal post below the signals as under

(a) SIGNS FIXED ON THE SEMAPHORE SIGNAL ARM

(i) Approach stop signals for goods running lines are provided with one black ring 'O' on semaphore arm.

(ii) Approach stop signals leading to Dock platforms are provided with letter 'D' in black on semaphore arm.

(iii) Any signal, permissive or stop or shunt signal or colour Signal not in use are provided with crossed bars on the semaphore arm. The details are shown in Fig. 7.12 (a).

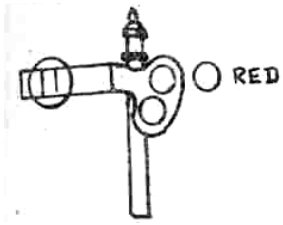
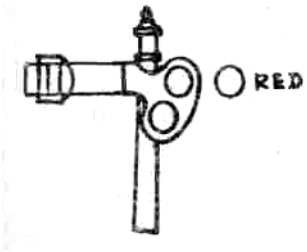
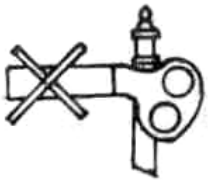
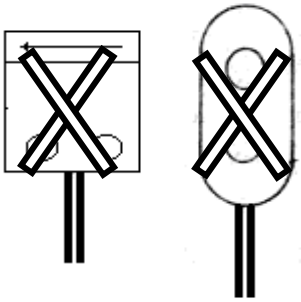
APPEARANCE	PROVIDED ON	DESCRIPTION
	Approach Stop signal for Goods running lines only.	One black ring on semaphore arm
	Approach Stop signal for Dock Platform.	Letter 'D' in black on semaphore arm
	Semaphore Signal not in use	Crossbars on signal unit and such signals shall not be lit.
	Colour light Signal not in use	Crossbars on signal unit and such signals shall not be lit.

Fig. 7.12 (a) DISTINGUISH SIGNS PROVIDED ON SEMAPHORE SIGNAL ARMS

(b) MARKERS PROVIDED ON THE SIGNAL POST

(i) Automatic stop signals are provided with ‘A’ Marker (letter ‘A’ in black on white circular disc) to distinguish the signal as a full automatic signal.

(ii) Semi-automatic stop signals are provided with ‘A’ (white illumincatedletter ‘A’ against black background) lit marker to distinguish the signal. when working as an automatic signal.

Letter 'A' extinguishes when the signal is working as a manual signal.

(iii) Colour light permissive signals on a post by itself are provided with ‘P’ Marker (letter 'P' in black on white circular disc)

(iv) Gate stop signals are provided with ‘G’ Marker (letter 'G' in black on yellow circular disc.)

(v) Intermediate block stop signals are provided with ‘B’ Marker (letter 'IB' in black on white circular disc.)

(vi) Colour light calling on signals are provided with ‘C; Marker (letter 'C' in black on white circular disc.)

(vii) Repeating signals of semaphore type are provided ‘R’ Marker with letter 'R' in black on white circular disc

(viii) Repeating signals in colour light 2-aspect signalling territory are provided with ‘R’ lit Marker white illuminated letter 'R' against the black background. -

(ix) Gate signals in Automatic Block territory are provided with a 'G' marker and a white illuminated letter 'A' against black background. Letter 'A' shall be lit when the gate is closed and locked against the road traffic.

(x) When a semi-automatic signal is to protect a level crossing gate and also points, the signal may be provided with illuminated 'AG' marker in addition to the illuminated 'A' marker (SEM 7.168.2 - 1988). Only one marker (either ‘A’ marker or ‘AG’ marker) can be lit at a time. When the points protected by the signal are correctly set and the gate is also closed, ‘A’ marker shall be lit. If the points are correctly set but the gate is defective, then ‘AG’ marker shall be lit. When both the markers are not lit, the signal shall be treated as manual stop signal.

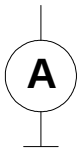
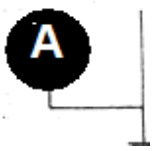
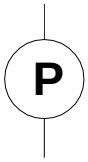
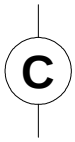
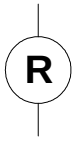
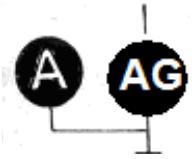
APPEARANCE	PROVIDED ON	DISCRIPTION
	Automatic Stop Signal.	Letter ‘A’ in black on White circular Disc.
	Semi - Automatic Stop Signal.	White illuminated letter ‘A’ against black background when working as an automatic stop signal and letter ‘A’ extinguished when working as a manual stop signal.
	Colour light Distant or Warner Signal on a post by itself.	Letter ‘P’ in black on White circular Disc.
	Intermediate Block stop signal	Letter ‘IB’ in black on White circular Disc.
	Calling ON Signal	Letter ‘C’ in black on White circular Disc.
	Repeating signal in Semaphore signalling territory	Letter ‘R’ in black on White circular Disc.
	Repeating signal in Colour light signalling territory	White illuminated letter ‘R’ against black back ground.
	Gate stop signal	Letter ‘G’ in black on Yellow circular Disc.
	Gate stop signal in automatic block territory.	Letter ‘G’ in black on Yellow circular Disc and White illuminated letter ‘A’ against black back ground.
	Gate stop signal in semi - automatic block territory, when interlocked with points also.	White illuminated letters ‘A’ and ‘AG’ against black back ground.

FIG. 7.12 (b) MARKERS PROVIDED ON SIGNAL POSTS

7.13. INDICATORS

Certain appliances are provided on the un-interlocked points to indicate to the driver and Pointsman, whether the points are set for the straight line or for the diverging line. These are called Point Indicators. Similarly, indicators are provided on the trap points to indicate whether they are open or closed. These are called trap indicators. Point indicators/trap indicators shall be provided at all points/traps on running lines, which are not interlocked with signals unless the position of points/trap points is otherwise provided. The indicators must display the same indication in both directions, whether the movement is in facing direction or in trailing direction over the points. Point indicators and trap indicators shall be of the target type. They are provided with Day and Night indications are shown in Fig. 7.14 (a) and (b).

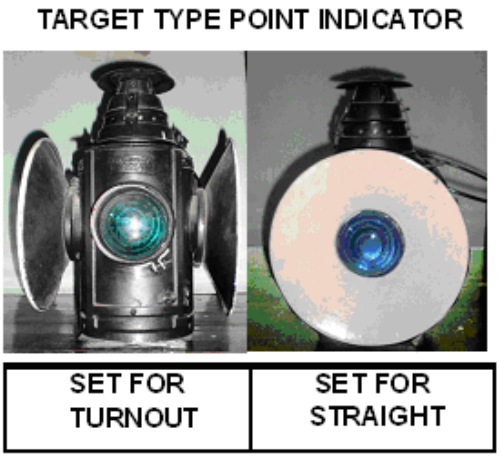


FIG. 7.14 (a) TARGET TYPE POINT INDICATORS

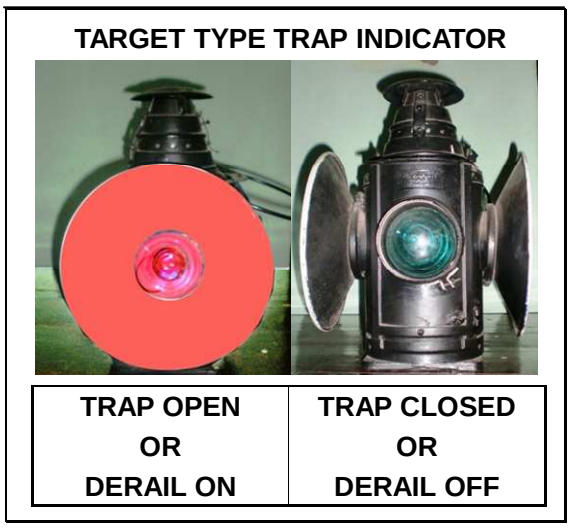


FIG. 7.14 (b) TARGET TYPE TRAP INDICATORS

7.15 ROUTE INDICATORS AND JUNCTION INDICATORS

We have already seen in the previous chapter that home signals of semaphore type can be provided one for each line either on a bracketed post or on a gantry. Similarly, for colour light signals, one signal can be provided for each line on a bracketed post or on a gantry. The number of colour light signals, one for each line can be replaced by one common signal with Route Indicators or Junction Indicators. Junction Indicators will be lighted along with the common colour light signal for all diverted routes only. For straight line only the main signal will go to the OFF position.

The Route Indicator can be a stencil type or multi-lamp type wherein the number of the line made out for the driver is exhibited either as a letter M for Main Line, B for Branch, etc. or as a numerical figure as shown in Fig.7.15. Junction Indicators are also provided which shows a row of lights one for each line or route as shown in Fig. 7.15.

Types of Route Indicators to be provided shall be as under:

(a) Two aspect colour light signalling section - any route Indicator of approved design

(b) Multiple aspect colour light signalling section –

- For speed in excess of 15 Kmph - Direction (Junction) type route Indicator
- For speeds not exceeding 15 Kmph - Any route Indicator of approved design

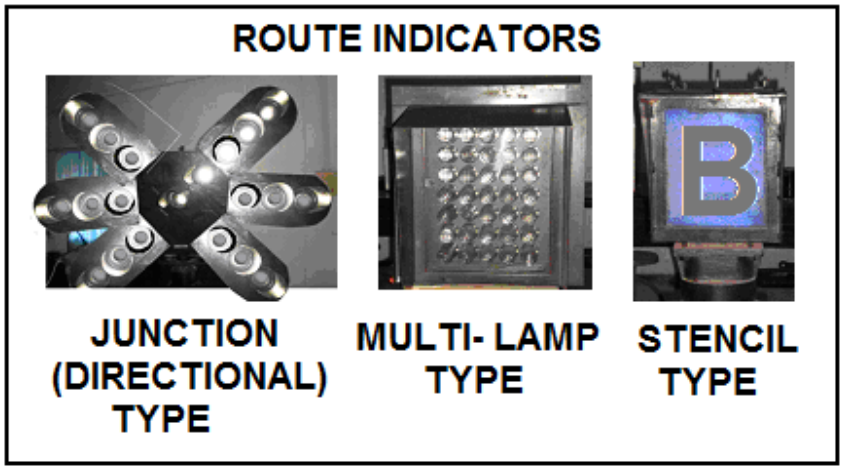


FIG 7.15 ROUTE INDICATORS

(a) STARTER INDICATOR: At certain stations where colour light signalling is provided a Starter Indicator may be provided to repeat the aspect of the starter as an aid to the Guard to enable him to know the aspect of the starter. This indicator is fixed at a convenient place. It should show no light when starter signal is 'ON' and show a yellow light when it is 'OFF'

7.16 BOARDS

(a) SHUNTING LIMIT BOARD: It is a board rectangular in shape with "Shunting Limit" painted black at the bottom with a cross in black on a yellow background on the side facing the station. The board is fixed on a post, which is painted with black and white bands alternatively as shown in fig. 7.16 (a). The shunting limit board is fitted with a lamp showing a white light on both directions to mark its position by night. This is provided on a single line class 'B' station where shunting in the face of an approaching train is permitted. The shunting limit board shall be placed at such a shunting distance from the outer most facing point as the local conditions may require, and shall not be less than 400m or 180m from the opposing first stop signal in 2-aspect or multiple aspect signalling respectively. Shunting Limit Board demarks the station section and block section

(b) BLOCK SECTION LIMIT BOARD: These boards are provided on Double line in multiple aspect signalling territory or modified lower quadrant territory to distinguish the limit of the block section. It shall be provided at a station where there are no facing points or the outer most points at the approaching end are trailing. It shall be placed at distance not less than 180m from the Home Signal and protect the fouling

mark of the trailing point if any in the approach. It is a board rectangular in shape with the words 'Block Limit' painted in a black at the bottom of the Board with a cross painted in black in a yellow background on the side which faces the station. The board is fixed on a post, which painted with black and White bands alternatively. The block section limit board is fitted with a lamp showing a white light in both directions to mark its position by night. This is as shown in Fig. 7.16 (a).

BLOCK SECTION LIMIT BOARD AND SHUNTING LIMIT BOARD

Fig.7.16 (a) (b)

(c) 'S' MARKER: An intermediate siding taking off in the facing direction of running line outside station limits is provided with a 'S' marker to indicate to the driver that a siding is taking off from the main line. It is a circular board with letter 'S' painted in black on a yellow background. The board is fixed on a post, which is painted with black and white bands alternatively as shown in Fig. 7.16 (c).

(d) WARNING BOARDS: Warning boards are provided in rear of the first stop signal of the station for the purpose of giving the driver adequate warning that he is approaching a stop signal. Two types of warning boards are provided, one for the passenger trains and one for the goods trains.

(i) The warning board for the passenger train is a rectangular board painted black with yellow stripes diagonally painted. The board is fixed on the post, which is' also painted with black and yellow bands alternately, as shown in Fig. 7.16 (c) To draw the attention of the driver in the night, self-reflecting sheets or plastic reflectors of approved design are fixed. Passenger warning boards shall be located at not less than 1 km in rear of first stop signal. In MACLS as distant signals are provided passenger warning board is dispensed with.

(ii) The warning board for the goods train is also a rectangular board painted black with two yellow bands horizontally painted one at the top and one at the bottom, with a circular target in the centre painted yellow. The board is fixed on a post, which is painted with black and yellow bands alternatively as shown in fig. 7.16

To draw the attention of the driver in the night self reflecting sheets plastic reflectors of approved design are fixed. This Warning Board shall be located not less than 1.4 km in rear of the first stop signal. The distance may be increased suitably on falling gradients on approach to stations with the provision of second distant signal, this board is dispensed with

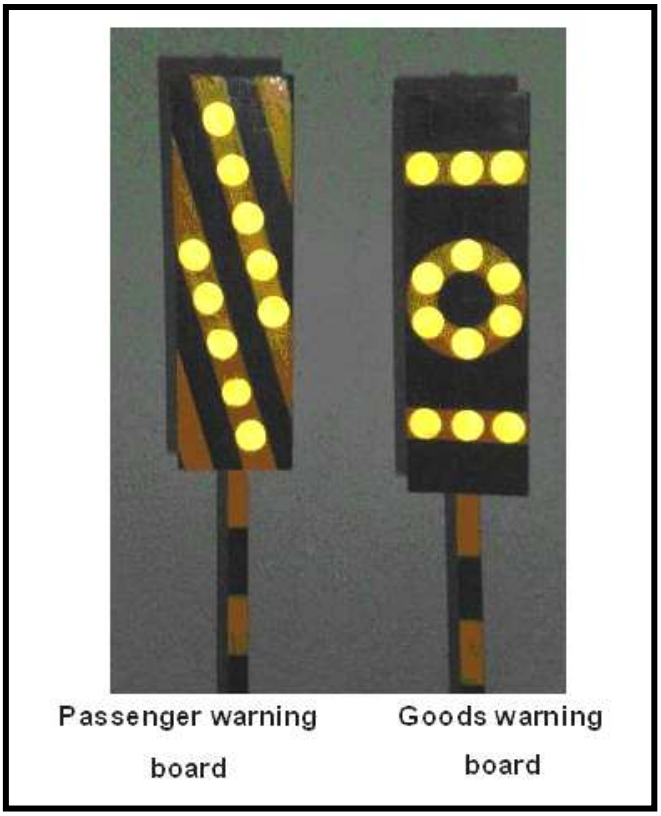


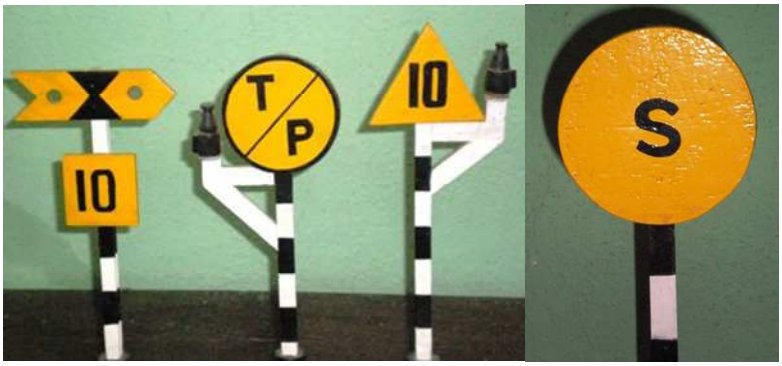
Fig. 7.16 (c) WARNING BOARDS

(d) INDICATION BOARDS: Indication boards are provided to give warning to the driver about change in type of signalling or of block working etc. The board will have suitable legend like,

"Approaching unwarned stop signal" "Entering Absolute block territory"

"Entering token territory" "Entering Automatic block territory"

VARIOUS INDICATOR USED BY PERMANENT WAY DEPARTMENT



CAUTION INDICATOR **TERMINATION INDICATOR** **SPEED INDICATOR** **'S' MARKER BOARD**

Fig. 7.16 (e) INDICATION BOARDS

7.17 BACKLIGHTS & REPEATERS

Obviously, the aspects displayed by signals which are operated or controlled manually should be visible from the place of operation or control and in the case of block stations worked under the Absolute Block System also from the place where block instruments are located (SM's Office).

Signal arms, which are not so visible, by day, are electrically repeated in cabins and SMs offices as required. An exception to this principle is the double wire worked signal controlled by a clutch lever, because such signals may be depended upon to respond correctly to lever operation so long as the transmission is intact and in case it is not, the clutch would trip as soon as wire tensions become unequal and operate an indicator.

Mechanical signals, the front lights of which cannot be seen, by night, from the place of operation of the place where block instruments are located are provided with white back lights. The back light, which is an integral part of the signal lamp, is blanked out by a screen bearing on the spindle when the arm is moved beyond 5 degrees from the 'ON' position. This 5 degrees adjustment of the screen is of very great importance as the ON aspect is verified by presence of the backlights.

Back lights and screen of signals whose front lights are visible from the place of operation and the place where block instruments are located or which are provided with light repeaters should be removed not only for reason of economy, but because the fall, the lights fall in the line of sight of drivers of approaching trains.

The electrical arm repeater wherever provided, is so adjusted for 2 aspect signals, that the arm is shown to be in the correct 'ON' position when it is between -5 degrees and +5 degrees, (OFF) when between 40 degrees and 60 degrees and defective when in any other position. In the case of MAUQ signals, the 'ON' aspect is indicated when the arm is between 0 degrees and 5 degrees and when it is between 40 degrees and 90 degrees the 'OFF' aspect is indicated. It is assumed that there will be no ambiguity in the 45 degrees and 90 degrees aspects displayed by MAUQ signals and since such signals are worked by Double Wire the assumption is not unjustified. In cases where it is important to distinguish between 45 degrees ' and 90 degrees aspects of MAUQ signals such as the Homes and the distant from the point of view of efficient operation the repeaters indicate the two aspects separately.

A combined circuit and indicator are used for both arm and light repeaters for economy. An audible warning is provided for the light out condition.

It is neither practicable nor desirable to provide colour or position light signals with backlights. All such signals, which have a manual control on them and cannot be seen from the place of operation of the controls, are electrically repeated. The repeaters take the form of miniature light units or are included in the circuits for the indication of a correct route line up in the case of relay interlocking. Where indication locks are used on lever type controls to prevent a lever being restored to the position corresponding to the aspect unless and until the correct aspect has been assumed by the signal, repeaters would not be required.

Review Questions

Subjective Questions

1. Write down difference between shunt signal and calling on signal.
2. Write down difference between co-acting and repeating on signal.
3. Write down all various markers used in signaling with signal bellow, which it is fixed, and reason for using it.
4. Write short notes on
   (a) Shunt signal
   (b) Calling on signal
   (c) Repeating signal
   (d) Shunting limit board
   (e) Block section limit board
   (f) Route indicators

Objective questions

State true OR false

1. Shunt signal can be placed below first stop signal. (False/ True)
2. Calling On signal can be placed on last stop signal. (False/ True)
3. Purpose of repeating and co-acting signal is same. (False/ True)
4. More than one calling ON signal can be placed bellow a stop signal. (False/ True)
5. A “C” marker shall be provided bellow a Semaphore miniature calling ON signal. (False/ True)
6. Starter repeater and repeating signal are same signals. (False/ True)
7. Location of shunting limit board & Last stop signal is same. (False/ True)
8. Block section limit board shall be provided at class B station on double line where first point is a trailing point OR no point with lower quadrant signaling. (False/ True)
9. Shunting limit board shall be placed at a distance of signal overlap from outer most point on double line. (False/ True)
10. Passenger warning board shall be placed at distance of 1KMts in rear of first stop signal in a station with multi-aspect colour light signaling. (False/ True)
11. Goods warning board shall be placed at distance of 1.4KMts in rear of first stop signal. (False/ True)

Fill up the blanks

1. Repeating signal is provided when _____
   a) Signal is not continuous visible b) signal is not visible at all
   c) Prescribed visibility of signal is not available d) duplicate signal is to be provided.

2. If speed is less than 15 KMPH then _____ type route indicator shall be provided.
   a) Directional b) stencil c) multi lamp d) any one of three

3. The passenger warning board shall be provided 1 Km in rear of _____ signal.
   a) Home b) first stop c) routed home d) nun of above

4. The section Gate under absolute block system shall be provided with _____ marker.
   a) 'G' b) 'AG' c) 'PG' d) 'A'

5. When the shunt signal and calling on signal is provided bellow stop signal then sequenced from top is _____ signal.
   a) First calling on then shunt b) first shunt and then calling on
   c) Not possible d) any of a, &b

6. A shunt signal can be placed
   a) On post by it self b) bellow any stop signal
   c) Bellow any stop signal other than first stop signal d) a &c

Match the Following:

1. Illuminated 'A' marker	(e)	a) No 'P' marker
2. 'G' marker	(d)	b) P marker
3. 'AG' marker	(c)	c) LC Gate and point
4. Distant signal	(b)	d) LC Gate in block section
5. Distant cum gate home signal	(a)	e) LC Gate in automatic section

* * *

CHAPTER 8: OVERLAPS

8.1 The length of track in advance of a stop signal, which should be kept clear before the signal next in rear can be taken 'OFF' is known as the signal overlap.

In other words, to take off a stop signal, the portion of the track not only upto the next stop signal but also for an adequate distance beyond it has to be kept clear. This adequate distance is known as signal overlap. Fig. 8.1 (a)

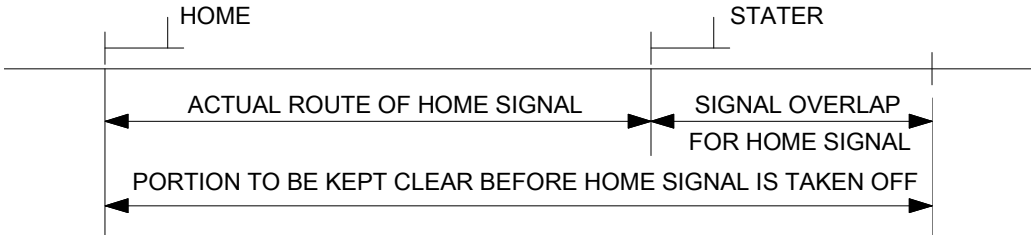


Fig. 8.1 (a)

The overlap provided for last stop signals in Absolute Block territories is greater than for other stop signals and this is referred to as the block overlap. Block overlap, then, is the extra length of track in advance of the first stop signal of a next block station, which should be kept clear before line clear can be given to the station in rear. (These overlaps are being referred to as adequate distances in the General Rules, the term adequate distance also being used to denote the breaking distance in another context). Fig. 8.1 (b)

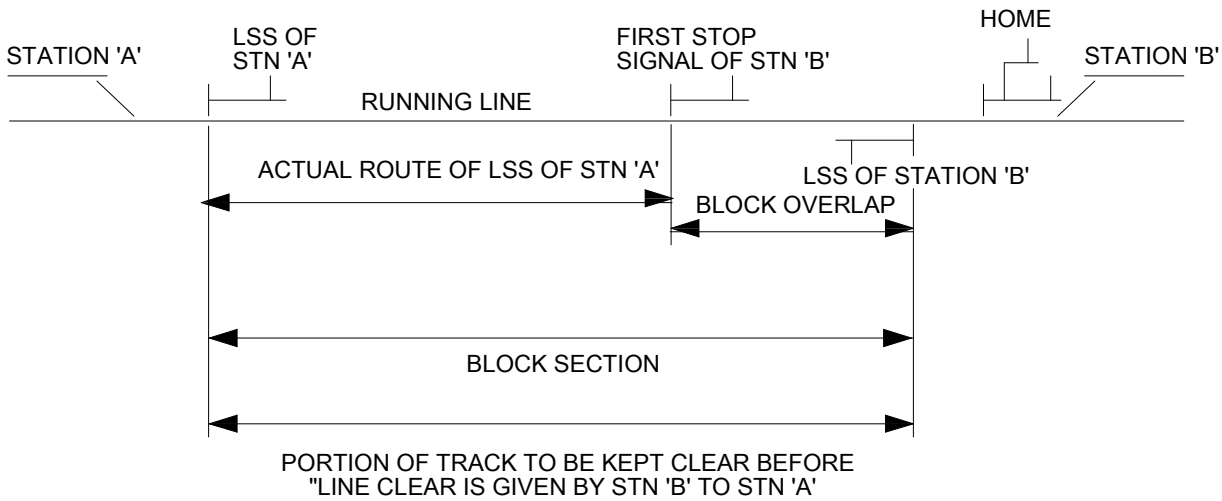


Fig. 8.1 (b)

Every stop signal must have an overlap, although the rules prescribe overlaps only for home and last stop signals in Absolute Block and every stop signal in automatic block. Overlap distances are a function of the number of aspects, Overlaps decreasing as the number of aspects increases.

In 2 aspect signalling the block and signal overlaps are respectively 400 m and 180 m. These two Distances are arbitrarily fixed based on experience and do not depend on speeds, gauge or gradients.

The overlaps are reduced to 180 m and 120 m respectively in MAUQ, MACL and MLQ signalling in automatic block there is no block overlap and the signal overlap is 120m as in MAUQ.

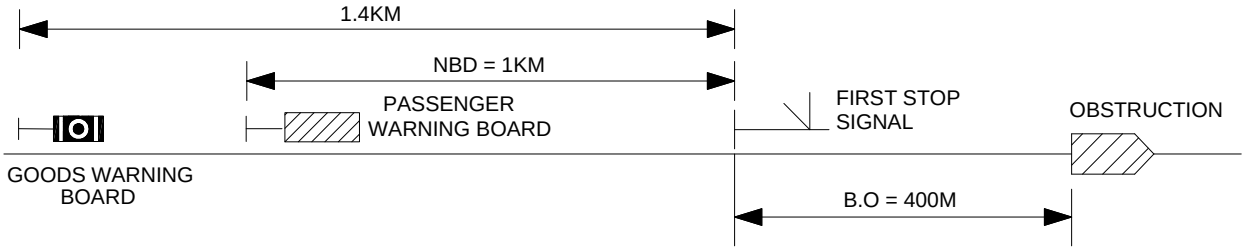
NOTE:- GR 3.40(2)b:- in connection with condition to take OFF home signal stats that on single line , line is clear for an adequate distance beyond the trailing point OR under approved special instructions for an adequate distance beyond place at which train is require to come to stop.

GR 3.40(4) in connection with condition to take OFF home signal stats that "Where a sand hump of approved design, or under approved special Instructions a derailing switch, has been provided for the line on which a train is to be received, they shall be deemed to be efficient substitutes for the adequate distance referred to in sub rules(3)".

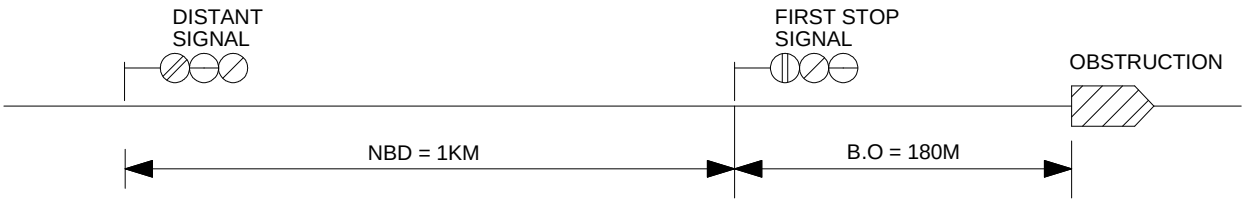
8.2 A reduction in the overlaps in multiple aspect signalling as compared with two aspect is a rational development as it serves to increase section capacity and the efficiency of operation of signals without sacrificing safety. It can be proved that by increasing the number of aspects, the overlaps can be progressively reduced but this will only be of academic interest at the present time. The fact that safety margin is not reduced by the reduction of overlaps in MAS is shown in the figure 8.2.

(a) SIGNAL OVERLAP IN 2-ASPECT

(b) SIGNAL OVERLAP IN M.A.S.



(c) BLOCK OVERLAP IN 2-ASPECT



(d) BLOCK OVERLAP IN M.A.S.

Fig. 8.2 OVERLAPS

Type of signal / Overlap	2 LQ signal	Multi- aspect signal UQ, MACLS & MLQ	Automatic signaling on double line	Automatic signaling on single line
Signal overlap	180 Mt.	120 Mt.	120 M	120 M
Block overlap	400 Mt.	180 Mt.	N.A	

Please see figures (c) and (d) showing the block overlap required in 2-aspect and MAUQ systems. In case of (d) the aspect of the stop signal is pre-warned by the signal in rear. The distance between the obstruction and the indication of the obstruction in the case (c) is NBD + 400 m and in case (d) NBD+180m. The margin of safety is in fact greater in (d). As in MAUQ the first stop signal displaying the 'ON' aspect is approached at cautious speed, but in 2 aspect it may be approached at full speed. It may be argued that the block overlap in 2 aspect can be reduced where a separate Warner is used and this would be correct provided the Warner is completely reliable. But, so long as Warner is operated by single wire without reverser, the irregular operation of the Warner cannot be ruled out. When the Warner is 'OFF' in an irregular manner, conditions then obtaining would be worse than in 2-aspect class W. The 2-aspect Warner is by no means a repeater of the first stop signal but an MA distant is. Figure (a) and (b) show the signal overlaps of a 2-aspect and MAUQ systems respectively. In figure (a), the first stop signal displays the clear aspect whether or not the next signal is 'ON'. The ability of a driver to stop at B depends entirely on the sighting distance of B being adequate and the driver obtaining a view of the aspect of this signal in time. In figure (b) B is repeated on A, and since A is displaying 'Caution' speed is reduced at A and the driver approaches B at cautious speed, prepared to stop at B.

In MLQ Block overlap is reduced because a distant similar to MAUQ distant is provided and this will display caution when the first stop signal displays the stop aspect. S.O. for the main home is reduced because the Warner is located below it and the aspects of the two taken together correspond with the aspects of a MAUQ home. When starter is 'ON', the Warner displays caution. S.O. for loop homes is reduced because the speed over turnouts is restricted to 15 KMPH, the route being set for the loop is indicated by a separate signal placed at some distance in rear of the turnout; also, the distant is held at caution. Therefore, the driver reduces speed to the extent necessary, even before the distant is passed.

By increasing the number of aspects, the overlaps can be reduced without sacrificing safety. This is because (1) the speed can be continuously regulated by signals, (2) signal aspects are repeated by the signal or signals in rear in a rational manner, and (3) safety becomes less and less dependent on the uncertain factor of sighting distance.

Review Questions

Subjective Questions

1. Define overlap and explain purpose & function and that overlap is function of aspect.

Objective Questions

State true OR false

1. The block overlap in multi aspect signaling is more than L.Q. signal. (False/ True)
2. The signal overlap in two aspect signaling is 120 Mts. (False/ True)
3. First stop signal on signal line normally shall be placed at distance of signal overlap plus block overlap from outer most point. (False/ True)
4. Block overlap class C station is 400 Mts always. (False/ True)

Fill up the blanks

1. The block overlaps and signal overlap in Multi aspect signal are _____ & _____ respectively.

   a) 180 Mt b) 400 Mt c) 120 Mt d) 300 Mt

2. The block overlaps and signal overlap in two aspect LQ signal are _____ & _____ respectively.

   a) 180 Mt b) 400 Mt c) 120 Mt d) 300 Mt

Match the Following:

1.	Signal overlap in LQ Signal	(e)	a) 400Mt
2.	Block overlap plus signal overlap in LQ Signal	(d)	b) 300Mt
3.	Signal overlap in automatic Signal (DL)	(c)	c) 120Mt
4.	Block overlap plus signal overlap in UQ Signal	(b)	d) 580Mt
5.	Block overlap in class ‘C’ station	(a)	e) 180Mt

* * *

CHAPTER 9: BRAKING DISTANCE

9. 1 INTRODUCTION

The distance travelled by a train after its brakes are applied is known as the braking distance, and this is an important concept in signalling for determining the signal sighting distance. There are two methods of application of brakes:

(a) A normal or service application which involves only the shutting off the power (steam to the cylinders or electric power to the motors as the case may be) and the gradual application of brakes; and

(b) An emergent application in which shutting off power and full application of brakes are done without any loss of time

Braking distance is a function of speed and other factors, such as the brake power available, gradient, rollability of wheels, and the state of rails (wet or dry), curvature of track and velocity of wind, etc., which cannot be established very accurately.

As the only accurate method of ascertaining the Braking distance is to conduct trials at each location which is impracticable, all that can be done is to prepare curves from test data obtained from isolated test runs or devise a formula based on experience & in different situations and trains.

SERVICE BRAKING DISTANCE is the distance required to stop the train running at the maximum permissible speed of the line, at such a rate of deceleration that the passengers do not suffer discomfort or alarm.

EMERGENCY BRAKING DISTANCE is the distance travelled by train before coming to a stop by sudden application of brake at one stretch.

This braking distance depends on various factors such as speed, Type of Locomotive, Type of Rolling stock , Type of Braking (Air brake/ Vacuum brake, it`s integrity), Load , Gradient , Adhesion on track , Wind speed etc. An example is given below for information

EBD for full load passenger trains on level gradient at 100 KMPH is typically about 1200m.

Sl. No	Train configuration	Speed In Kmph	EBD in (m) at Different Down gradients			
			1 in 250	1 in 200	1 in 150	1 in 100
1	2WDG3A/WAG7/WAG5 + 58 loaded BOXN + 1 B/V (with 'L' type brake block)	65	709	742	777	867
		75	907	935	983	1105
		80	1016	1048	1104	1243
		95	1376	1045	1486	1666
2	1 WAG9 + 58 loaded BOXN + 1 B/V (with 'L' type brake block)	65	588	597	634	680
		75	748	761	793	870
		80	829	845	881	967
		95	1109	1133	1182	1286
3	2 WAG7/WAG5 + 58 loaded BOXNHS + 1 B/V (with 'L' type brake block)	65	731	753	790	888
		75	935	952	1016	1134
		80	1034	1068	1127	1263
		95	1403	1438	1521	1715
4	2 WDG3A/ 1 WAG5 + 40 loaded BOX + 1 B/V (with C.I brake block)	65	1005	1053	1155	1397
		75	1334	1405	1539	1882
		80	1513	1596	1743	2154
		95	2154	2260	2482	3094
5	1 WAM4 + 20 vacuum brake coaches (with C.I. brake block)	75	578	593	610	662
		85	764	782	816	875
		95	985	1001	1045	1139
		105	1227	1251	1308	1430
6	2 WDM2/1WAM4 + 22 air brake coaches (with C.I. brake block)	75	475	480	498	528
		85	634	658	674	719
		95	833	843	877	941
		105	1049	1067	1107	1199
7	1 WAP4 + 24 air brake coaches (with C.I. brake block)	75	479	481	497	527
		85	642	656	672	729
		95	832	842	877	951
		105	1050	1074	1118	1199
Ref : RDSO Letter No SD INV .5 dated 4.11.2004						

* * *

CHAPTER 10: SIGHTING DISTANCE & VISIBILITY OF SIGNALS

10.1 Sighting Distance is the distance over which the most restrictive aspect of a signal is visible from the driving compartment of an approaching train under normal conditions of visibility. It is an inviolable rule of signalling practice that every signal should afford at least the minimum sighting distance required of it. The minimum sighting distance required should be the distance necessary for obeying the most restrictive aspect of a signal.

10.2 Minimum Sighting Distance

Consideration will show that the minimum sighting distances required of signals will be as follows: -

(a) 2-ASPECT SIGNALLING

(i) OUTERS (not pre-warned): Normal Braking Distance + Reaction distance, Reaction Distance is the distance travelled at permissible speed during time taken by driver to react to the aspect of a signal.

(ii) OUTERS (Pre-warned): As the `ON' aspect of outer is pre-warned, sighting distance of outer is not important.

(iii) HOME SIGNALS: The Home Signals shall be continuously visible from Outer Signal.

(iv) MAIN LINE STARTERS: The Main Line Starter shall be continuously visible from Home Signals.

(v) ADVANCED STARTER: Advanced Starter shall be continuously visible from the Starter Signals.

Signals, which indicate the route, should afford a sighting distance, which is sufficient for the driver to control his train in the event of the route is occupied. This principle especially will apply to lines, which are not provided with track circuits or Axle Counters.

When the operation of outer and homes is not completely reliable, it may happen that an outer is irregularly off. An Outer, which is `OFF' when all corresponding homes are `ON' is regarded as a defective signal and cannot be passed. This would mean that the homes should be visible from a point of Normal Braking Distance (NBD) in rear of the Outer unless the methods adopted for the operation of the signals are rendered completely reliable.

(vi) WARNERS: The Warner is not a Stop Signal and the most appropriate point at which action on the indication of a Warner should commence is the signal itself. Therefore, so long as NBD is available between a Warner and the next Stop Signal, the actual sighting distance of the Warner is unimportant. But when this distance is less than NBD, theoretical considerations would indicate that the actual distance between the Warner and the next Stop Signal plus Sighting Distance (S.D) of Warner should not be less than NBD + Reaction Distance. It would not be good practice, however, to rely too much on the S.D. of Warners and, therefore, the distance between a Warner and the next stop signal should not be less than at least the emergency braking distance + reaction distance.

(b) MULTIPLE ASPECT SIGNALS

(i) DISTANT SIGNALS: For distant signals, obviously, the same principle as for a two-aspect Warner should apply.

(ii) STOP SIGNALS: For Stop Signals, as the aspect of each is pre-warned by the signal in rear, no sighting distance would be required provided Braking Distance is available between signals displaying yellow and the signal next in advance displaying red. In the event this distance is not available, the signal in rear is provided with a double yellow aspect, so that the braking distance is available between this signal i.e., the signal having double yellow aspect and the signal displaying red. The Revised Signal Engineering Manual stipulates that the distance between two stop signals shall not be less than 1 kilometre. Where the distance between 2 Stop signals is less than 1 KM, the signal in rear should display a double yellow aspect. In MAUQ signalling the distant signal shall display attention aspect to receive the train on main line, when Normal breaking distance is not available between the Home signal and Main line starter

(iii) ADVANCED STARTER: In the case of advanced starters, sighting distance is not important as the aspect is pre-warned on the homes. Notwithstanding these considerations, it is the usual practice to ensure that stop signals are visible from the signals immediately in rear of them, so that in the event a signal changes its aspect when a train is approaching, the train may regulate its speed suitably.

10.3 Automatic Block Signals

So long as NBD + Reaction Distance is available between signals, the signals do not require any sighting distance. But should the distance between any two signals be less than NBD but greater than EBD, each signal should be visible from a distance greater than NBD minus the distance between the signal and the next signal in rear + Reaction distance. Should the distance between two stop signals be less than 1 KM., the signal in rear should be prevented from displaying the green aspect when the second stop signal in advance is exhibiting Red aspect. It should instead display the double yellow aspect if 4 aspect signals are provided. If only 3 aspect signals are provided, it should display only yellow aspect.

10.4 It should be evident that Sighting Distance is a far more important consideration in 2 aspect territories than in Multiple Aspect. But sighting distance is an uncertain factor as it depends on weather conditions, types of background etc. The superiority of M.A. Signalling lies, inter alia in the fact that when properly located, signals do not require long sighting distances. The aspect of every signal is pre-warned by the signal in rear and action on the indication of an aspect may commence at the signal itself and not at an undefined point. In the case of 2 aspect signalling, safety is dependent entirely on the red aspect being observed at SD in rear, but as this point (SD in rear of the signal) is not defined on the ground, the problem is rendered more difficult.

10.5 Where a stop signal cannot be seen by the driver of an approaching train from the location at which he can control the speed of the train, in case the stop signal is at `ON', a repeating is usually provided.

This repeating signal is provided in rear of the stop signal, which it repeats. It is usually installed at such a location as to provide an adequate distance to the driver to enable him to stop his train in rear of the stop signal in case it is at `ON'.

The use of Warning boards placed at SD in rear of a 2-aspect stop signal is of considerable help to drivers. Such warning boards are in use for first stop signal where speeds exceed 72 KMPH in BG and 48 KMPH in MG and for gate signals in 2-aspect territories. A more liberal use of warning boards will be of advantage in 2-aspect territories. The warning

board is not, of course, by any means a substitute for S.D. Where a signal does not afford the sighting distance required of it, it should be shifted to a better location if possible or a speed restriction imposed or the signal provided with a repeating signal or the need for SD eliminated by using another system of aspects. It should be remembered in this connection that shifting a signal in the rear direction might sometimes have an adverse effect on the track capacity. Further, the extra time taken for piloting of trains in case of failures, render shifting of signals away from station undesirable.

10.6 As per Signal Engineering Manual (1988), the visibility of the signals is prescribed as under

(a) TWO ASPECT SIGNALS

(i) Outer Signal: 1200 Metres in sections where the sectional speed is 100 KMPH or above. 800 Metres where sectional speed is less than 100 KMPH. Where minimum visibility as above cannot be achieved, Warner may be separated. With the Warner separated, the minimum visibility of Outer shall not be less than 400 meters.

(ii) Other signals

Warner on a post by itself	400 Metres
Home Signal	400 Metres
Main Starter Signal	400 Metres
All Other Signals	200 Metres

Where adequate visibility OR continuers of stop signals cannot be provided, repeating or co-acting signals shall be provided to ensure combined visibility. In case the combined visibility is less than the distances prescribed above, speed restrictions shall be imposed.

(b) MULTIPLE ASPECT SIGNALS

Distant Signal	400 Metres
Inner Distant Signal	200 Metres where this signal is provided
All Stop Signals	200 Metres

If it is not possible to ensure 200 Metres continuous visibility of any stop signal while approaching it, a suitable speed restriction shall be imposed.

Review Subjective Questions

Objective Questions

1. Visibility of a pre-warned signal 200 Mt. (False/ True)
2. Visibility of Warner signal shall be 1.2 KMts for speed more than 100 KMPH. (False/ True)
3. Visibility of inner distant signal shall be 400Mts. (False/ True)
4. Visibility of outer signal shall be 1.2 KMts for speed more than 100 KMPH. (False/ True)

* * *

CHAPTER 11: ISOLATION

11.1 The term `Isolation' denotes the condition in which a line for a particular movement is separated from all adjoining lines connected to it in such a manner that the isolated line cannot be fouled or interfered with by any movement taking place on the adjoining lines. Rules for isolation are laid down in Chapter VIII, Part III of “Rules for the opening of a Railway or Section of a Railway for the Public carriage of passengers”. Isolation is compulsory in the following cases.

(a) A line on which train movements at speeds higher than 50KMPH are permitted should be isolated from all connected lines.

(b) Passenger lines should be isolated from all connected goods lines and sidings, whatever the speed may be.

(c) The isolation of goods reception lines from sidings is considered desirable.

(d) It is not necessary to isolate one goods reception line from another or one passenger line from another when dealing with speeds of 50KMPH and less.

In view of the huge expenditure involved in the provision of isolation, which is not regarded as essential in several other countries, isolation, which is not required by the rules or is in consistent with safety should be avoided.

To maintain safety in through running lines, points or trap & sidings should not be inserted in the main or through line. The exceptions to this rule, which may be adopted after obtaining special sanction of the CRS are:

(i) where other means cannot be adopted, to permit simultaneous reception of trains on single line sections,

(ii) to avoid a train being brought to a stand at a stop signal on a rising gradient with the possibility of the train being unable to restart,

(iii) to trap vehicles running away from a station, and (4) to avoid a train entering from Block Section to the station due to heavy falling gradient.

11.2 The provision of isolation does not apply to

(a) Running junctions, where two block section lines meet at the same end of a station equipped with full complement of signals.

(b) Stations where track circuits or other appliances have been provided to prove whether the connected non-isolated lines are clear or occupied and the signalling shall be such that distinctive aspect is given to the driver of run through train, restricting the speed to 50 KMPH when the connected line is occupied.

(c) Catch sidings, Slip sidings, and sidings are provided for isolation purpose only.

11.3 Means of Isolation

Any one of the following methods of isolation may be adopted.

(a) Connection to another line or siding (see figure (a))

(b) The provision of short dead and sidings (this siding should not be long enough to permit vehicles being stabled thereon) (see figure (b)).

(c) The provision of traps, viz., single or double derailing switches (see figure. c & d). The use of scotch blocks and Haye's derails are obsolete but existing installations are permitted to remain. A scotch block is a triangular piece of metal placed on the running line and padlocked in that position. For movements over the block it is lowered in the off side of the rail. The action of the Scotch Block is not positive; cases of vehicles climbing the block and returning to the rail have indeed occurred. It is not possible to operate Scotch Block which can be connected to and worked from a lever frame and which if in good adjustment, can be depended upon to derail a vehicle. It is important that wherever Haye's derails are in use, they are lubricated periodically and maintained in good adjustment.

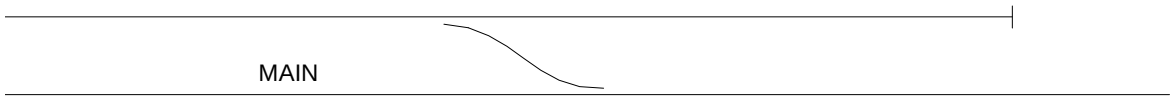
The single derailing switch commonly known as a trap is though inexpensive but dependable derailing device. It is usually located with its heal in rear of the fouling mark, on the straight portion of the track wherever possible and on the rail farther away from the line to be protected. To guide derailed vehicles away from the line to be protected. It is usual to provide double derailing switch with lead rails, but without crossing as shown in figure (d) or place a short length of rail to serve as a guide as shown in fig. (e).The need for guiding derailed vehicles becomes important when there is a possibility of their being pushed from some distance away.

Double derailing switches are sometimes used as traps to facilitate the use of standard facing point layouts but following the design of a standard layout for single derailing switches; the case for using a double derailing switch does not exist.

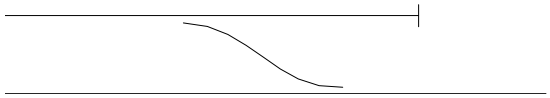
Traps, when located at signal overlaps should be closed before the corresponding signal is taken off and similarly the points leading to short dead end sidings should be set against the sidings and for the cross over. In cases where the short dead end siding has to be extended for the purpose of stabling vehicles, the trap may be located at a distance of signal overlap (180m or 120m as the case may be) away from the points leading to the main or through line and it is ensured that before the signal for the admission of a train on to the running line is taken off, the trap is set and locked against vehicles occupying the further part of the siding (see fig. (f).

SAND HUMPS when all other methods of isolation cannot be used GR 3.40 permits the use of SAND HUMPS of approved design as a substitute for adequate distance. The length of siding should be at least one rail length and the formation is made-up for a short distance beyond the hump (See fig. g).

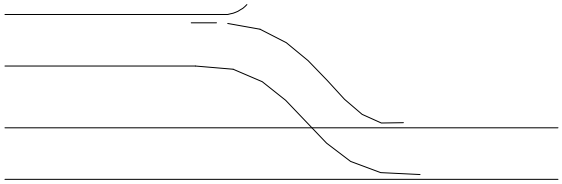
(d) **Slip Sidings and Catch Sidings:** The gradient within the station yard has to be low in order so that, the vehicles standing at the station do not start moving automatically due to the effect of gravity. On Indian Railways for all gauges the maximum gradient permitted is 1:400, whereas 1:1200 is usually allowed within the station yard. No station yard should be constructed on a gradient steeper than 1:260 except due to geographic condition where such a gradient cannot be avoided within the station yard, previous sanction of Railway Board through CRS has to be obtained and special arrangements like "Slip siding" has to be provided, where the gradient steeper than 1:100 falling away from the station in its close neighbourhood. This is to prevent vehicles escaping from the station and trying to enter into the next block section. Similar arrangements have also to be provided if the gradient steeper than 1:80 falling towards the station. This arrangement is known as `catch siding'. It is to trap vehicles coming uncontrolled from the block section and trying to enter into the station."Slip siding" and `catch siding' points must be interlocked with the block instruments, and such sidings should not be used for shunting or stabling purposes (see fig. h).



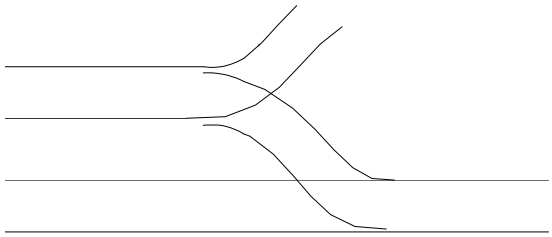
(a) CONNECTION TO ANOTHER LINE OR SIDING



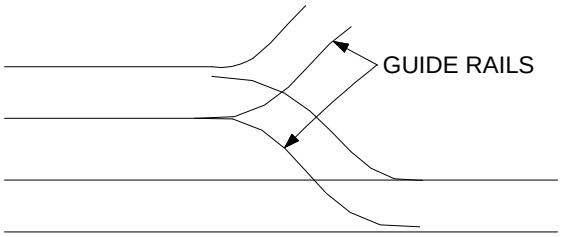
(b) SHORT DEAD END SIDING



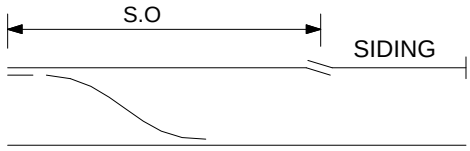
(c) SINGLE DERAILING SWITCHES
ALSO KNOWN AS TRAPS



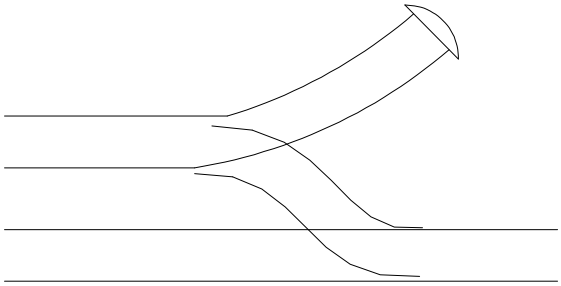
(d) DOUBLE DERAILING SWITCH WITH DEAD
RAILS BUT WITHOUT CROSSING.



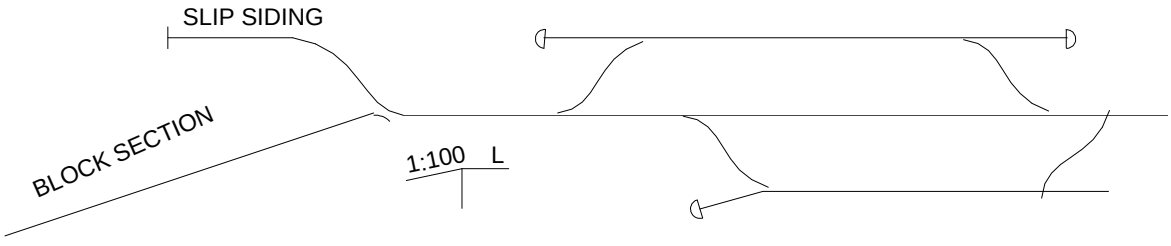
(e) SINGLE DERAILING SWITCH
WITH GUIDE RAILS



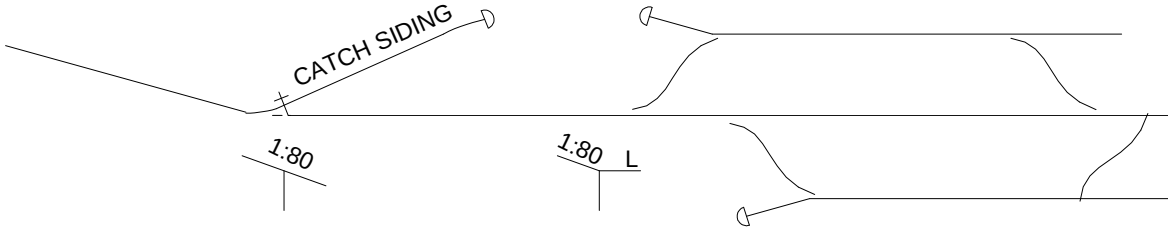
(f) SHORT DEAD END SIDINGS EXTENDED
TO ENABLE VEHICLES BEING STABLED



(g) SAND HUMP SIDING



SLIP SIDING DUE TO GRADIENT STEEPER
THAN 1:100, FALLING AWAY FROM THE STN.
IN THE CLOSE NEIGHBOUR HOOD.



(h) CATCH SIDING DUE TO FALLING GRADIENT WHILE
APPROACHING THE STATION IF STEEPER THAN 1:80

Fig. 11.3 METHODS OF ISOLATION

Summary

Isolation between	Passenger line	Goods line	Siding
Passenger line	Not Required if speed < 50 Kmph. Required if speed ≥ 50 Kmph	Required irrespective of speed	
Goods lines	Required irrespective of speed	Not Required if speed < 50 Kmph Required if speed ⩾50 Kmph	Desirable
Siding		Desirable	NA
For further details refer :- VIII, Part III of "Rules for the opening of a Railway			

Review Questions

Subjective Questions

1. Define isolation and write down when and where isolation is require? Also write down the means of isolation.

Objective Questions

State true OR False

1. Catch siding protect block section and slip siding protect station section. (False/ True)

2. If speed is more than 50 kmph then one goods line shall not be isolated from other goods line. (False/ True)

3. A catch and slip siding shall be provided if the gradient stepper than 1:80 falling away from station and 1:100 falling to word the station in near vicinity of station respectively. (False/ True)

4. If speed is less than 50 KMPH, then isolation of a passenger line from other connecting passenger line is not require (False/ True)

Fill up the blanks

1. A catch siding shall be provided if the gradient stepper than 1:80 in near vicinity of station and falling _____

   a) Away from station b) to words station

   c) To words block section d) all a,b &c

2. A slip siding shall be provided if the gradient stepper than 1:100 in near vicinity of station and falling _____

   a) Away from station b) to words station

   c) To words block section d) all a,b &c

3. maximum permissible gradient on Indian Railways for all gauges the maximum is ----------

   a) 1:1200 b) 1:260 c) 1:400 d) none of this

* * *

CHAPTER 12
SIMULTANEOUS RECEPTION AND DESPATCH OF TRAINS

12.1 In any interlocked yard, interlocking has to confirm to certain basic requirements. These basic requirements are also referred as “Essentials of Interlocking” and are laid down in para 7.82 of Signal Engineering Manual – 1988. The essentials of interlocking are:

(a) It shall not be possible to take off a running signal, unless all points including isolation are correctly set, all facing points are locked and all interlocked level crossings are closed and locked against public road for the line on which the train will travel, including the overlap,

(b) After the signal has been taken off, it shall not be possible to move any points or lock on the route, including overlap and isolation, nor to release any interlocked gates until the signal is replaced to “ON” position,

(c) It shall not be possible to take “OFF” at the same time, any two fixed signals which can lead to any conflicting movements and

(d) Where feasible points shall be so interlocked as to avoid any conflicting movement.

12.2 Taking OFF signals for more than one train at a time is detailed in GR 3.47. This para lays down that when two or more trains are approaching simultaneously from any direction, the signals for one train only shall be taken OFF, other necessary signals being kept at ON, until the train for which the signals have been taken off has come to a stand at the station, or has cleared the station, and the signals so taken OFF for the said train have been put back to ON. There is, however, an exception permitted to this rule which lays down that where under special instructions, the interlocking or layout of the yard renders it safe, signals for more than one train may be taken OFF at the same time.

12.3 Taking OFF signals for different trains at the same time is called simultaneous reception of trains. This will only be possible if for each and every one of the approaching trains, the line on which the train is to be received is clear up to the point where the train is to come to a stand and overlap distance in advance of it. On single line sections, track capacity will increase, if at all crossing stations; the layout is such as to permit the simultaneous reception of two opposing trains.

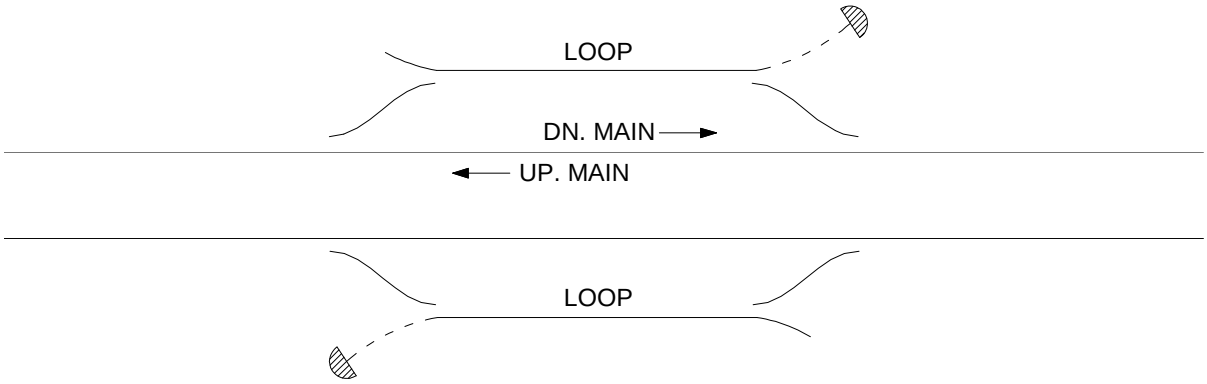
The rules recognise the use of a short sand hump siding (also known as snag dead end) (see figure 11.3.g) in lieu the distance specified for the signal overlap. The points of the sand hump siding when set for the sand hump would also serve as a good method of isolating the adjacent connected line. Such sidings are more expensive, in terms of cost and require periodic maintenance as compare to trap, therefore, used only when required for reception purposes.

Figure (a) shows a typical double line station. The two main lines are isolated by traps. Sand hump sidings (as shown dotted) may replace traps at busy stations to facilitate reception on the loop simultaneously, while a train is leaving from the main line in the same direction.

Figure (b) shows a typical layout of a single line station where simultaneous reception of trains is permitted. It may be noted that the loops on which trains may be received simultaneously shall be located on either side of the main line and the loops terminate at sand humps so that any train may be received on any loop.

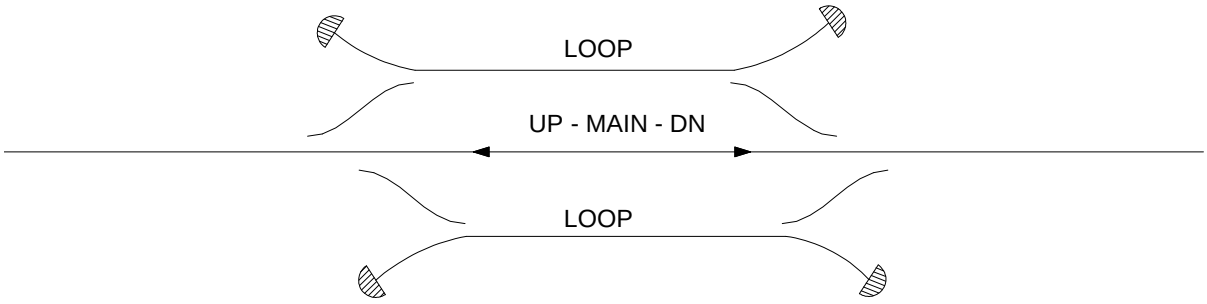
To economise on sand humps, some railways adopt the layout shown in Fig. c. But in this case, only an UP train can be received on line B simultaneously with a Down train on line A. Should the down train be a passenger train, platform will not be available for it. It would be much more expensive to provide two platforms, one for each loop and a foot over-bridge in comparison with two more sand hump sidings.

Simultaneous reception at a 2 line stations would involve the use of sand humps on the main line as shown in Fig. d, but it is not desirable to place traps on fast lines.

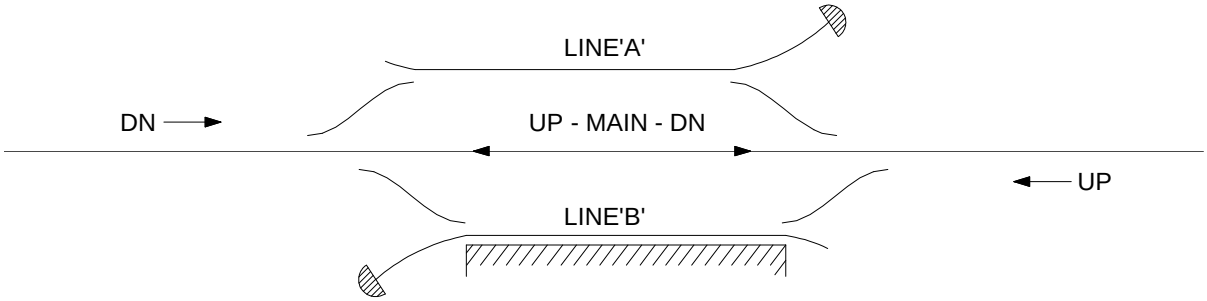


SAND HUMP SIDINGS USED HERE ONLY IF REQUIRED FOR RECEPTION OF ONE TRAIN ON THE LOOP SIMULTANEOSLY AS ANOTHER TRAIN IS DEPARTING FROM THE MAIN IN THE SAME DIRECTION.

(a) ISOLATION OF DOUBLE LINE STATIONS



(b) TYPICAL LAYOUT FOR SINGLE LINE STATIONS



(c) ECONOMICAL LAYOUT FOR SINGLE LINE STATIONS

(d) TWO LINE STATION WITH SAND HUMP SIDINGS ON THE MAIN LINE

Fig.12.1 SIMULTANEOUS RECEPTION OF TRAINS

Note:- If physical isolation is not possible for simultaneous reception/despatch then adequate physical separation between the route shall be ensured. CCRS circular No 35 stipulates that there should be a physical separation of 300mtrs between simultaneous movements. The 300 mtrs. may be further reduced to 120 mtrs., if there is a speed restriction of 15 Kmph in the yard. This 300 mts may be increased further for down gradient/curves/visibility problem.

Review Questions

Subjective Questions

1. Write down modification to done in yard layout to allow simultaneous reception of train at station at same time and draw a single line yard with two loop with simultaneous reception of train facility from both UP &DOWN direction.

Objective Questions

State true OR false

1. Simultaneous reception and dispatch shall be done under special instructions. (False/ True)

2. Simultaneous reception of trains is allowed under approved special instruction. (False/ True)

* * *

CHAPTER 13: SYSTEMS OF WORKING

13.1 As explained earlier, the space interval system uses the block working wherein the entry of trains into the block section is jointly controlled by the station masters at the entry and exit points of the block sections. The driver is authorised to proceed with his train in to the section at the entry point, either by a signal or by any other means under the system of working, after ensuring that the section ahead is clear of all other trains.

13.2 For safe running of trains, different methods are adopted to control the train movement between two given points, say between two stations, mainly to ensure that not more than one train is permitted in to the block section at a time.

13.3 SYSTEMS OF TRAIN WORKING

In Indian Railways, six systems of train working are adopted and they are

(a) Absolute Block System

(b) Automatic Block System

(c) Following Trains System

(d) Pilot Guard System

(e) Train Staff and Ticket System

(f) One Train Only System

Out of the above six systems of train working, the Absolute Block System and the Automatic System only shall be used, unless the adoption of other systems are especially permitted by the Railway Board.

13.4 ABSOLUTE BLOCK SYSTEM

The absolute block system is the most important system of train working for our study, since it is the most widely used system on Indian Railways.

(a) Para 8.01 of General Rules stipulates the essential requirements of the system as under

"Where trains are worked on the Absolute Block System".

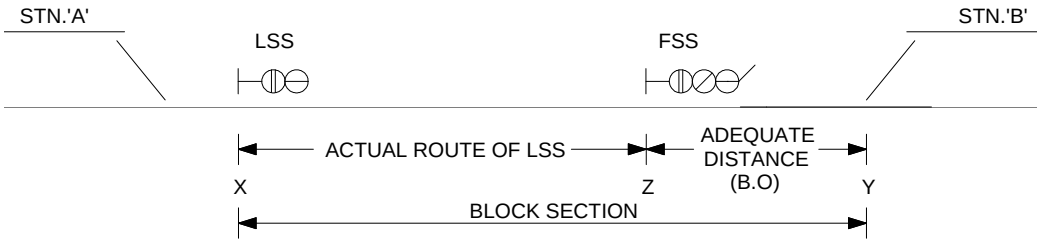
(i) no train shall be allowed to leave a block station unless Line clear has been received from the block station in advance, and

(ii) On double lines, such line clear shall not be given unless the line is clear not only upto the first stop signal at the block station at which such line clear is given but also for an adequate distance beyond it.

(iii) On single lines, such Line Clear shall not be given unless the line is clear of trains running in the same direction not only upto the first stop signal at the block station at which such Line Clear is given but also for an adequate distance beyond it, and is clear of trains running in the direction towards the block station to which such Line Clear is given.

(b) The General Rule further states that the adequate distance referred above shall not be less than 400 metres in case of 2 Aspect signalling and 180 metres in Multiple Aspect Upper Quadrant Semaphore Signalling or Colour Light Signalling and modified lower quadrant signalling. This is generally called the "Block Overlap" in signalling parlance. This distance can be reduced in case of necessity but this can be done, only under "approved special instructions" which means that sanction of Commissioner of Railway Safety is required to be obtained for reduction in the adequate distance.

(c) The sketch below will help us to study the essentials of Absolute Block Signalling as mentioned above. For `B' to give Line Clear to `A' line must be clear of trains between `X` and `Y'.



(d) `A' and `B' are two block stations. Under the Absolute Block System controlling the movements of train between `A' and `B' is such that, Station `A' can allow a train to leave his station towards Station `B' only when the line clear is obtained from Station `B'. Station `B' is supposed to give the "line clear" for a train to approach towards `B' only, when the whole block section is clear of trains.

(e) It can be seen from the above that a train despatched from Station `A' by obtaining line clear from Station `B' can travel only upto 1st stop signal of B unless the Signal is taken `OFF'. The Station Master at B shall ensure that once the line clear is granted portion ZY i.e. adequate distance beyond the first stop signal (also generally referred to as Block Overlap) is in no way obstructed. This in turn ensures that even if the approaching train overshoots the first stop signal at `ON' due to any reason, the driver can still have this extra distance available for him to control the train.

(f) After allowing a train into the block section, the next train can be permitted to enter the block section only when the previous train has cleared the block section and the adequate distance ZY, therefore, if the rules governing the system are followed strictly the possibility of collision between trains is completely eliminated. To make sure that the Station Masters on both sides are able to follow the rules, provision of communication between stations under this system is compulsory. An additional aids to Station Master, Block Instruments, Last Vehicle Check Device etc., also may be provided according to the requirements.

(g) The conditions for granting line clear are given in Chapter 8 of General Rules as detailed below:

(i) Rule No.8.02: Conditions for granting Line Clear at Class `A' Station

(ii) Rule No.8.03: Conditions for granting Line Clear at Class `B' Station

(iii) Rule No.8.04: Conditions for granting Line Clear at Class `C' Station

(h) In all the above cases, two most important points beside other things are stressed. They are

(i) The whole of the last preceding train has arrived complete; and

(ii) All necessary Reception signals have been put back to `ON' behind the said train

(i) The arrival of a complete train is checked either by physical verification (Last vehicle Board or Tail Lamp) or by provision of a last vehicle check device or by having continuous track circuits in the entire block section or by having Axle Counters in the Block section or by any other approved means.

(j) With regard to ensuring all necessary signals have been put back to `ON' after the arrival of a train, “ON” Position of signal are proved by certain relays which ensure that the signals have been restored to `ON' position before closing of the Block Instrument after the arrival of the train.

13.5 AUTOMATIC BLOCK SYSTEM

13.5.1 Automatic Block System on Double Line

(a) What is Automatic Block?

The main difference between absolute block and automatic block is that in the latter, space intervals are secured automatically by the use of Track Circuits or Axle Counters while in the former by human agencies in the form of 2 Station Masters located at the ends of a block section.

(b) The essentials of automatic block system are -

(i) The line shall be provided with Continuous Track Circuits or Axle Counters.

(ii) The line between two stations may where required be divided into a series of section known as "Automatic Block Signalling Section".

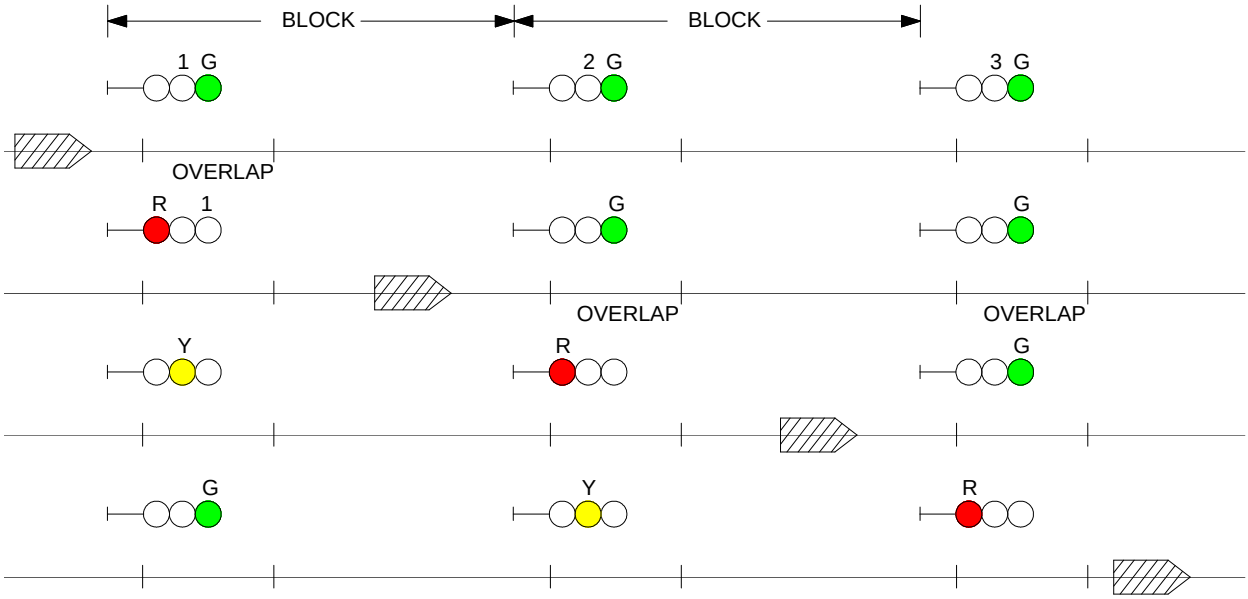
(iii) Entry into each automatic block signalling section is protected by a colour light Multiple Aspect Stop Signal.

(iv) Track Circuits or Axle Counters should controls the aspects of the Signal such that:

– It cannot display the `OFF' aspect unless the line is clear not only upto the next stop signal but also for an adequate distance beyond it. Since the `OFF' aspect can be yellow, double yellow or green, the `OFF' aspect of stop signal mentioned above can be only yellow with the minimum clearance of one Block plus Overlap. The stop signal can exhibit green aspect when the line is clear for 2 blocks and overlap in the one case of 3-aspect signalling or double yellow in the case of 4-aspect signalling. The signal will go to green only when 3 blocks plus one overlap are clear in the case of 4-aspect signalling (refer Fig.No.13.5).

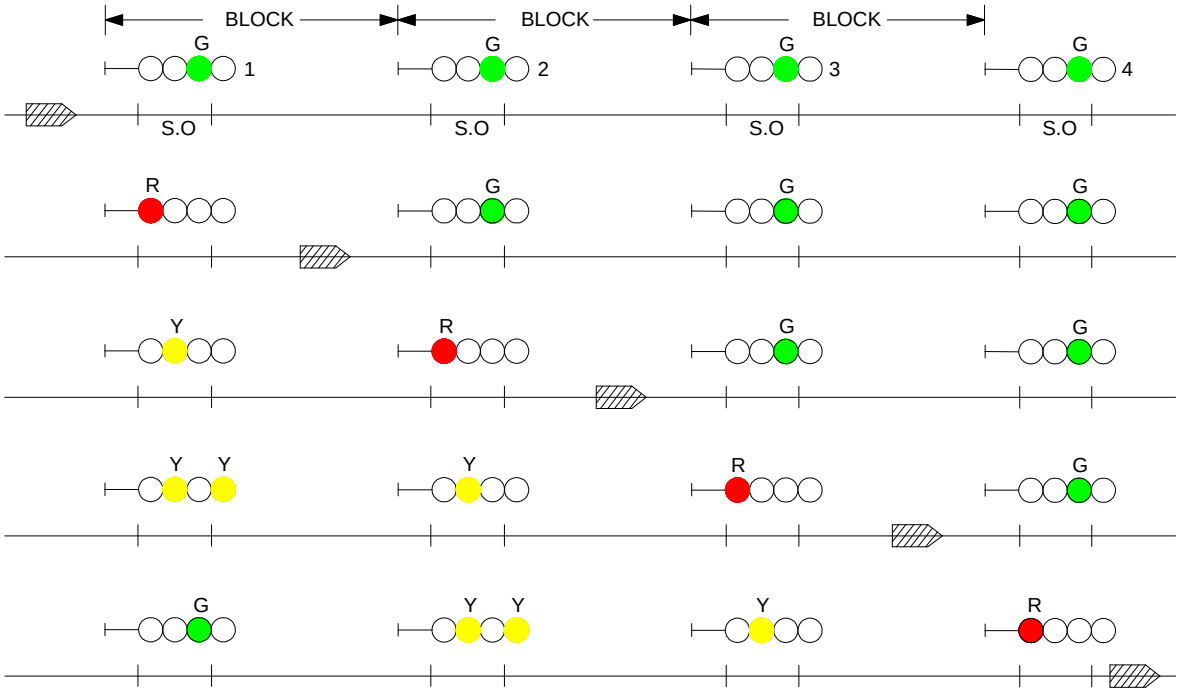
– The Signal is automatically replaced to `ON' soon after it is passed by a Train.

Note: *Unless otherwise directed by approved special instructions, the adequate distance referred above shall not be less than 120 meters.*



FOR SIGNAL.1. TO ASSUME YELLOW - LINE MUST BE CLEAR FOR ONE BLOCK AND ONE OVERLAP
FOR SIGNAL.1. TO ASSUME GREEN- LINE MUST BE CLEAR FOR TWO BLOCKS AND ONE OVERLAP

(a) IN 3 – ASPECT SIGNALLING



FOR SIGNAL.1. TO ASSUME YELLOW - LINE MUST BE CLEAR FOR ONE BLOCK AND ONE OVERLAP
FOR SIGNAL.1. TO ASSUME DOUBLE YELLOW - LINE MUST BE CLEAR FOR TWO BLOCKS AND ONE OVERLAP
FOR SIGNAL.1. TO ASSUME GREEN - LINE MUST BE CLEAR FOR THREE BLOCKS AND ONE OVERLAP

(b) IN 4 – ASPECT SIGNALLING

Fig. 13.5 Sequence of automatic change of aspects as the Train passes

(c) It should be obvious that any system, which complies with these requirements, is deemed to be an Automatic Block System and worked accordingly.

Where 3-aspect signals are provided, the second yellow (provided on top) is dispensed with.

(d) From the requirements, it should be clear that every running signal must be of the multiple aspect colour light type, the red and yellow aspects being compulsory and others are optional. The aspects used are `RED', `YELLOW', `DOUBLE YELLOW' and `GREEN' and the indications of these aspects are identical to the indication of corresponding night aspects of multiple aspect signals used in the absolute block. The `Double Yellow' is used in the same manner and for the same purpose as in multiple aspect signalling i.e. where a turnout is present ahead of the stop signal in advance or the distance between the two consecutive stop signals in advance is less than Braking Distance.

(e) Signal will, however, carry only the aspects required; for instance, at a terminal it is usual to use only the yellow and red, but each of the aspects always conveys the same indication. If a signal unit consists only of green and red, the green will always mean proceed, the next signal is `OFF' and if it consist yellow and red, the Yellow will mean, proceed with caution, preparing to stop at the stop signal next in advance.

(f) The red is placed at Driver's eye level, the yellow above it, the green next above it and the second yellow light above the green light. The two yellows are separated by the green to provide a distinctive "Attention" aspect and the double yellow is chosen as the aspect less restrictive than the single yellow, so that should any one of the two yellow lamps be fused, a more restrictive aspect will result.

(g) In accordance with the essentials, all running signals protecting the entry of trains into automatic blocks should be replaced to `ON' automatically. Such signals must not display `yellow' aspect unless the block and overlap in advance are clear, and double yellow (or green), unless two blocks in advance and overlap are clear as proved by track circuits (see figure 13.17). Signals so controlled by track circuit or axle counter are known as Automatic Signals.

(h) Where there is a choice of route or if required for any other special purpose, a manual control is included in the circuits of the `OFF' aspects of signals, such signals may either behave fully automatic signal or a manual stop signal, and are called as semi-automatic signals.

(i) Signals in which the manual control of the proceed aspects is not always present i.e. the manual control can be introduced or removed at will are known as "Semi-automatic Signals", because they can be worked either as automatic signals or as Manual Signals.

(j) As the aspect and indication of these three types of signals, viz., MANUAL, AUTOMATIC and SEMI-AUTOMATIC are identical; it would be unnecessary to distinguish one from the other under normal circumstances.

(k) In the event of a failure, however, the procedure for passing the red aspect of a manual signal must differ from the procedure for passing `RED' of an automatic signal. A written authority or a pilot is required in the case of a manual signal, but in the case of an automatic signal, not only is a person competent to issue this authority or pilot the train is available or even if he is available, he would, in no

way be concerned with the operation of the signal and, therefore, it would not be safe to rely on him. A special procedure which enables the driver to pass the red aspect of an automatic signal under his own responsibility, has been prescribed and, therefore, it is necessary for a driver to know whether the signal at which he is held up is an automatic signal or not. For this purpose only, automatic signals are provided with an `A' marker sign, letter `A' in Black on a white enamelled disc, Signals with `A' marker light in Semi-automatic signals which remains automatically lit during the period the signal is working as an automatic signal. Signals with `A' marker lights which are unlit are dealt with as Manual Signals.

13.5.2 Procedure for passing an automatic stop signal displaying the red aspect (on Double line)

When an automatic stop signal with `A' marker is at `ON', the driver shall bring his train to stop in rear of the signal. After the train has stopped he shall wait there for one minute by day and two minutes by night. If after waiting for this period the signal continues to remain at ON, he shall give a prescribed code of whistle and exchange signals with Guard and proceed slowly exercising great caution so as to stop short of any obstruction. The `ON' position of an automatic stop signal may be due to presence of a train in the automatic section ahead or due to some obstruction on the track or broken/fracture of rail or any other cause. The train may resume running only after passing the `OFF' aspect of the signal in advance.

As each signal is pre-warned, repeating signals are not required on automatic block territories. Where the distance between two consecutive signals is so great that in the event the signal in advance is in red, the train will be running on the yellow over a long distance, it would be better to split this long block so that one or more stop signals are introduced in between rather than repeat the signal in advance. The most appropriate location for the yellow aspect is braking distance in rear of the red aspect in advance so that it not only warns the driver that he is approaching a stop aspect but also indicates the place at which he must apply the brakes.

13.5.3 Gate Signals

Automatic Signals interlocked with level crossing gates are distinguished by the provision of `G' marker yellow enamelled disc with a letter `G' in black, in addition to an illuminated `A' marker. When a driver finds such a signal at `ON' he is permitted to pass it in the same manner as he would and under the same procedure for an automatic signal displaying the red aspect, provided the `A' marker light is lit. In such cases, it is essential that the 'A' marker light be lit only if the gates are closed and locked against road traffic. In the event, the `A' Marker light is extinguished, the driver is permitted to pass the signal after waiting for one minute by day and two minutes by night, draw his train cautiously ahead and stop in rear of the crossing. After ascertaining that the gates are locked against road traffic and on getting hand signal from the gateman, the driver may then proceed cautiously upto the signal in advance.

13.5.4 Illuminated AG marker with illuminated `A' marker

Automatic signals interlocked with level crossing gates and a point just ahead of gate are distinguished by the provision of illuminated AG and illuminated `A' marker. When a driver finds the signal at `ON', he is permitted to pass it with same manner as he would and under such procedure for an automatic signal displaying the red aspect provided the `A' marker light is lit whereas when he finds the signal at `ON', with `AG' marker is lit, he is permitted to pass it in such manner as he would and under such procedure for an automatic signal displaying red aspect with `G' marker below. If both the markers are not lit, the driver should treat this signal, as an absolute stop signal, showing red aspect.

13.5.5 Automatic Block System on Single Line

(a) **Introduction:** The main object of introducing Automatic Block System on single line is to increase the section capacity by reducing the `head way' between two consecutive trains moving in the same direction.

This system is particularly suitable on single line section where the pattern of traffic is such that trains follow one another in quick succession during certain parts of the day. Further advantage can be had if Centralised Traffic Control is introduced in this section.

(b) **System:** In this system of working, the entire block section may, where required, be divided into two or more automatic Block signalling sections each of which being controlled by a colour light stop signal on both the directions. The movement of trains in the section is controlled by the stop signals in the direction for which, direction of traffic is established, while the stop signals in the opposite direction display `ON' aspect. This is to prevent movement of trains in opposite direction at the same time. The entire block section is track circuited or provided with axle counters.

(c) Before despatching the first train of a series in any particular direction, the direction of traffic for that particular direction is to be established by obtaining line clear from the station in advance and for the following subsequent trains line clear need not be taken from other end.

(d) To facilitate direction of traffic to be established and for the purpose of granting line clear, one panel at each block station is provided generally.

13.5.6 Essentials of Automatic Block System on Single Line

Where trains on a single line are worked on the automatic block system -

(a) The line shall be provided with continuous track circuiting or axle counters.

(b) The direction of traffic shall be established only after line clear has been obtained from block station in advance.

(c) A train shall be started from one block station to another only after the direction of traffic has been established.

(d) It shall not be possible to obtain line clear, unless the line is clear, at the block station from which line clear is obtained, not only upto the first stop signal but also for an adequate distance beyond it.

(e) The line between two adjacent block stations may, where required, be divided into two or more automatic block signalling sections by provision of stop signals.

(f) After the direction of traffic has been established, movement of trains into, through and out of each automatic stop signalling section shall be controlled by the concerned Automatic Stop Signal and the said Automatic Stop Signal shall not assume `OFF' position unless the line is clear upto next Automatic Stop Signal, provided further that where the next stop signal is a manual stop signal, the line is clear for an adequate distance beyond it, and

(g) All stop signals against the direction of traffic shall be at `ON'.

Unless otherwise directed by approved special instructions, the adequate distance referred to in clause (d) and (f) of para 13.5.6 above shall not be less than 180 metres.

13.5.7 Minimum equipment of fixed signals in Automatic Block Territory on single line

(a) Manual stop signals at a station

(i) A Home

(ii) A starter

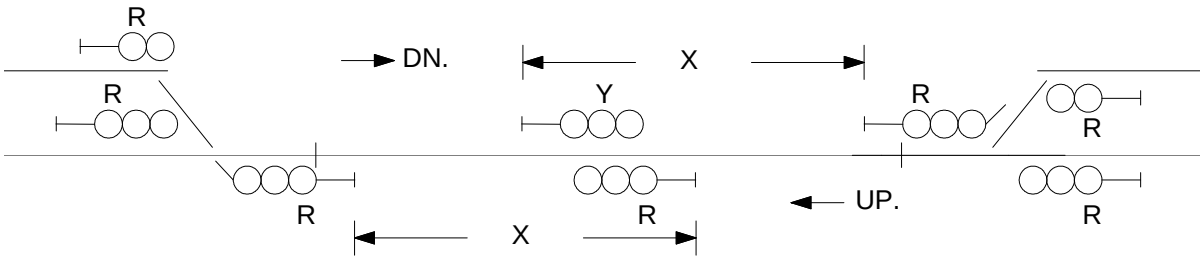
(b) An automatic stop signal in rear of the Home signal of the station.

13.5.8 Additional fixed signals in Automatic Block territory on single line

(a) Besides the minimum equipment prescribed above, one or more additional Automatic Stop Signals, as are considered necessary, in between block stations may be provided.

(b) In addition, such other fixed signals as may be necessary for the safe movement of trains may be provided.

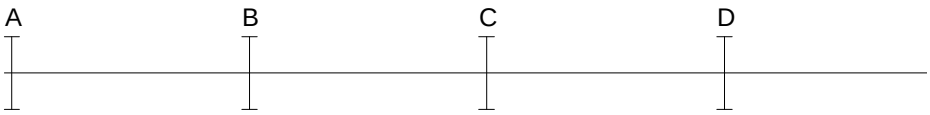
A typical layout is shown below:



NOTE: 'X' - AUTOMATIC BLOCK SIGNALLING SECTION
DIRECTION OF TRAFFIC LAST ESTABLISHED IN DOWN DIRECTION

13.5.9 Description of Panel

A control Panel is provided at every station of the Automatic Signalling Section. Each station controls all the movements of one adjacent section as given below:



Station A controls all movements between A & B
Station B controls all movements between B & C
Station C controls all movements between C & D and so on.

The Figure No.13.5.9 shows a typical control panel. The control panel consists of two parts; one part is termed as `Controlling side' and the other as `Controlled side'.

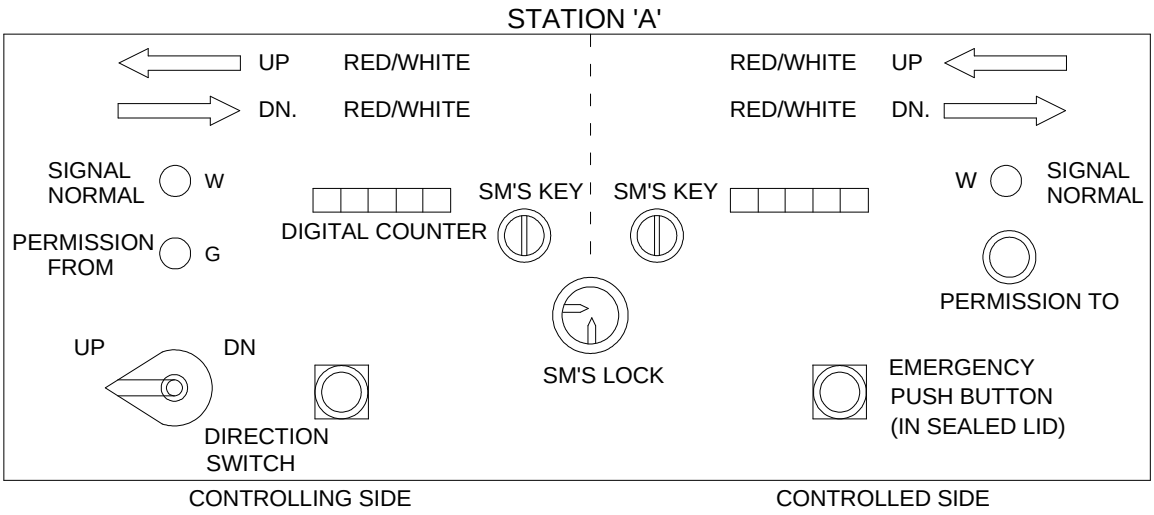
In the panel, the following switches and indications are provided:

(a) Illuminated arrows: Two arrows for each direction are provided on both sides of the panel. Only the arrow corresponding to the direction of traffic established would be illuminated and the other arrow will not be lit. White light appears when relevant block section is clear and changes to Red when the block section is occupied or due to failure of track circuits/Axle Counters.

(b) Signal normal: (White indication): This is provided on either side of the panel. When Illuminated indicates that the signals of that side of the station are at `ON'

"Permission from . . . . . (Green indication): This is provided at the controlling side of the panel only. When illuminated, indicates that the push button of controlled station in advance has been pressed, permitting controlling station to establish direction of traffic towards "controlled side" station.

(c) Direction switch: A two position switch is provided on the controlling side of the panel to enable the controlling station to establish direction of traffic from station A to Station B or vice-versa.



(e) SM's lock up key: This key when removed will keep the panel locked in the last operated condition to prevent inadvertent or unauthorised operation of panel.

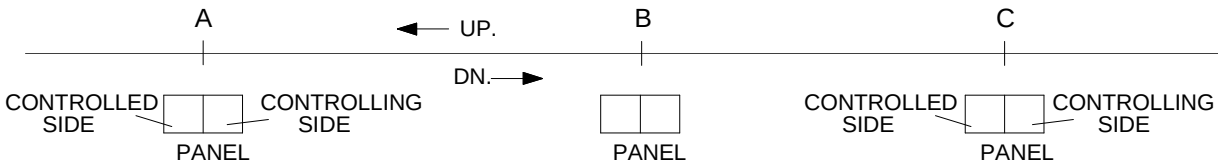
(f) Permission button: This is provided on the controlled side of the panel which when pressed grants permission to controlling station to establish direction of traffic from controlling station A to the controlled station B.

(g) Emergency Push Button: Two push buttons are provided: one on the "controlled half" and the other on the "controlling half" of the panel. When it becomes necessary to change the direction of traffic under track circuit/axle counter failure, the button pertaining to that section shall be pressed at controlling station is turned to the required position, for permitting a movement in emergencies.

(h) **Counters:** Each operation of emergency push button registers next higher digit on the digital counter of the respective half of the panel.

13.5.10 Establishing direction of traffic movement

Let us take a case of stations A and B on a single line section provided with Automatic Signalling and let us assume that station A is the controlling station for any movement of train between A&B.



Station `A': Controls all movements between `A' & `B'

Station `B': Controls all movements between `B' & `C' and so on.

13.5.11 Let us assume that the direction switch at Station `A' is in "UP" direction by a previous operation, the "UP" arrow is illuminated white (which means that the Block Section AB is clear) and Station `A' has a train to despatch.

Station `B' will press the push button provided on the `controlled side'. This will cause lighting up of a `green' indication in the panel at `A' signifying the receipt of "Permission" to despatch a train to Station `B' from Station `A'. After getting this green indication, the SM at Station `A' will turn the direction switch to "DOWN" and establish the direction of traffic. This will cause the "DOWN" arrows at both the stations to be lit to white and extinguish the light of the `UP' direction arrows at both the stations. The white indication of `DOWN' arrows will turn to red when the trains enter the section.

For despatching an UP train from Station B to Station A all that the SM at the controlling station A has to do is to turn the `Direction Switch' to the `UP' position provided the whole section is clear of train. This will cause the `UP' arrows at both the stations of the controlled section to be lit white, extinguishing the white lights of "DOWN" arrows. The white lights of the "UP" arrows will turn to `Red' when the train enters the section.

13.5.12 Rules for passing the Automatic Stop Signal at `ON': (On single line)

(a) When a Driver finds an Automatic Stop Signal with an `A' marker at `ON', he shall bring his train to a stop in rear of that signal and wait there for one minute by day and two minutes by night.

(b) If after waiting for this period the signal continues to remain at `ON', and if telephone communication is provided near the signal, the Driver shall contact the Station Master of the next block station or the Centralised Traffic Control Operator of the section where Centralised Traffic Control is provided, and obtain his instructions. The Station Master or the Centralised Traffic Control Operator, as the case may be, shall, after ascertaining that there is no train ahead upto the next signal and that it is otherwise safe for the Driver to proceed so far as is known, give permission to the Driver to pass the signal in the `ON' position and proceed upto the next signal, as may be provided under special instructions.

(c) If no telephone communication is provided near the signal or if the telephone communication provided near the signal is out of order and cannot be made use of, the Driver shall give the prescribed code of whistle and exchange signals with the Guard and then proceed past the signal as far as the line is clear, upto the next Stop Signal in advance, exercising great caution so as to stop short of any obstruction.

Review questions

Subjective Questions

1. Write down essential requirement of absolute block system
2. Write down essential requirement of automatic block system on double line
3. Write down procedure to cross automatic gate signal on double line at ON.

Objective Questions

Fill up the blanks with correct answers

1. Semiautomatic signal is provided with

   a) 'A' marker b) illuminated 'A' marker c) 'AG' marker d) 'P' marker

2. Adequate distance in automatic block system on double line is _____

   a) 180 Mt b) 400 Mt c) 120 Mt d) 300 Mt

3. If a semiautomatic stop signal is protecting LC gate as wel as point then _____ shall be provided on the post.

   a) 'A' marker b) illuminated 'A' marker c) 'AG' marker d) b&c

4. If two automatic block section and overlap ahead of an automatic signal is clear of train then it will display _____ aspect

   a) Attention b) a OR d c) stop d) caution

5. Adequate distance in automatic block system on single line is _____

   a) 180 Mt b) 400 Mt c) 120 Mt d) 300 Mt

6. The normal aspect of automatic stop signal is

   a) Proceed b) caution c) stop d) attention

* * *

CHAPTER 14: CLASSIFICATION OF STATIONS - A, B & C

14.1 For the purpose of rules, stations in absolute block system are classified as shown below.

(a) CLASS `A' STATIONS: Where line clear may not be given for a train, unless the line on which it is intended to receive the train is clear for atleast 400 metres beyond the Home Signal, or upto the starter.

(b) CLASS `B' STATIONS: Where line clear may be given for a train before the line has been clear for the reception of the train within the station section.

(c) CLASS `C' STATIONS OR BLOCK HUTS: Where permission to approach may not be given for a train unless the whole of the last proceeding train has passed complete at least 400 metres beyond the Home Signal (IBS / IBH) and is continuing its journey. This will also include an Intermediate Block Post.

(d) Class 'D' Stations

14.2 As the classification is laid upon the minimum signalling equipment provided, in each direction for class of stations are shown below. Stations in automatic block territories are not classified, as from the point of view of the operation of trains, the stations as such have no significance.

Class of Station	Minimum Equipment	Additional Equipment
A. Two Aspect Signalling:		
1. A	Warner, Home, Starters	Or under approved special instructions an outer, Warner in rear of outer and starter
2. B-Single Line	Outer, Home	Warner if trains run through at speeds exceeding 50 kmph without stopping. Advanced starter or SLB where shunting in the face of an approaching train is required.
3. B-Double Line	Outer, Home & Starters	Warner if trains run through at speeds exceeding 50 kmph without stopping.
4. C	Warner, Home	
5. D	(These are passenger Halts & non- block stations)	
B. Multiple Aspect Signalling:		
6. B	Distant, Home, Starters	Advanced Starter or SLB on single line where shunting in the face of an approaching train is required. Starters on double line. Block section limit board where there are no points or outermost point at the approach end is in trailing direction on double line.
7. C	Distant, Home	
C. Modified Lower Quadrant:		
8. B	Distant, Home, Warner below main Home & Starters	MLQ Signalling may be used only where it is expressly sanctioned by a special order of the Railway Board
9. C	Distant & Home	

14.3 On the double line, starter signals are included in the minimum equipment for A & B class as entry into the next block section is controlled by signal indications alone without the use of a tangible authority in the form of a tablet, token, etc. Warners are provided for high-speed operation to indicate the run-through condition and to provide the means for adequate interlocking. Starter signals are not used in `C' class working because trains are not booked to stop at such stations.

In all those types of stations, before permission to approach is given, the line must be clear upto the first stop signal and the block overlap beyond it and before a signal is taken off, it should be ensured that the line is clear upto the next stop signal and the signal overlap is reckoned from the trailing points (GR.38) and often from the opposing home which provides a more convenient point of reference to staff.

For the purpose of comparison of the stations definition of block section and station section is given bellow

BLOCK SECTION means that portion of the running line between two block stations on to which no running train may enter until Line Clear has been received from the block station at the other end of the block section.

STATION SECTION is that portion of station limits which can be used for shunting even after granting Line clear to station in Rear. It exists only for Class B Station explained below in the table.

	STATION SECTION	
At a class `B' station provided with	**On Double Line**	**On Single Line**
Two-aspect signals	Between Home Signal and the Last Stop Signal of the Station in either direction	Between the Shunting Limit Boards or Advanced Starters (if any), Or Between the Home Signals if there are no Shunting Limit Boards or Advanced Starters, Or Between the outermost facing points, if there are no Home Signals or Shunting Limit Boards or Advanced Starters.
Multiple-aspect or modified lower quadrant signals	Between the outermost facing points and the last Stop Signal of the station in either direction, Or Between the Block Section Limit Board, where provided, and the last Stop Signal of the station in either direction	Between the Shunting Limit Boards or Advanced Starters (if any), Or Between the outermost facing points if there are no Shunting Limit Board or Advanced Starters.

14.4 COMPARISION OF CLASS A, B AND C STATIONS WITH MAUQ & MLQ OPERATION

14.4.1 Class A & B Stations

In class `A' operation, the block section extends from the last stop signal of one station to the home signal of the next and the block overlap from the home to the starter signal. On normal single line layouts, therefore, shunting in the face of an approaching train cannot be performed and when two trains are approaching the station simultaneously from opposite directions the first train as well as the second in most cases will have to be stopped at the home, unless separate signal overlaps are available. Hence, class `A' working is adopted on the single line only for special reasons such as for instance (1) trains cannot be stopped at the first signal because of rising gradients or (2) the sighting distance of the first signal would be inadequate if it was a stop signal. In such cases, loops terminating on snag dead ends are provided on either side of the main line so that independent signal overlaps for the homes are available for the direct reception of two opposing trains, one on each of the two loops.

On the double line, the only advantage of class `B' over `A' operation is that more trains can be dealt with on a given section. In Class `B' there can be at a given time, one train on each reception line of the station and one train in each block section, but in class `A' if all reception lines are occupied there cannot be any trains in block section. This disadvantage can be overcome by providing one more loop at each station or by berthing a train at the advanced starter or by locating the home at Block overlap in rear of nearest fouling mark. From the safety point of view, class `A' is to be definitely preferred especially on high-speed heavy density sections.

Safety in class `B' operation is too much dependent upon the sighting distance of the outer which is an uncertain factor and the correct operation of outers and homes which are difficult to ensure with single wire operation. The point beyond which the line may be obstructed, after permission to approach is given, is protected by 2 stop signals in the case of class `A' but by only one in the case of class `B' station where shunting in the face of an approaching trains is permitted. It may be argued that by separating the Warner from the outer and placing it at NBD in rear of the outer, the margin of safety can be increased and there is no denying this argument. But by doing so section capacity is reduced as the Warner at ON may mean stop on main line, or "run through over loop", and the driver on seeing the Warner at ON at once reduce speed and be prepared to stop at the outer. As the aspect of separate warners can be picked up when approaching trains are between 2 to 3 KM away from the stations, the loss of capacity will be considerable.

From the point of view of speed class `A' is better as there is no outer at which a train may be detained and drivers can approach such stations with more confidence than they do stations with an unwarned outer.

14.5 Comparison of class `A' and class `B'

From the para 14.4 the comparison of class `A' and class `B' of 2-Aspect signalling is as follows

Class 'A'	Class 'B'
1. Class `A' stations are only in 2-Aspect signalling.	1. Class `B' stations can be in 2-Aspect or Multiple Aspect.
2. Provided under special circumstances like (a) Sighting distance is not adequate (b) Due to steep rising gradient in approach (c) Presence of long Bridge in approach.	2. Normally most of the stations are Class 'B'
3. There is no station section	3. There is station section.
4. Shunting in the face of approaching train is not possible.	4. Shunting in the face of approaching train is possible within station section.
5. Line Clear cannot be granted simultaneously for trains from either side, unless special arrangements like separate overlap for each reception line is provided.	5. No such problem for granting line clear.
6. If all reception lines are occupied, there can be no train in the block sections. Unless train is drawn ahead between starter & advanced starter on double line.	6. No such problem more trains can be dealt with.
7. Obstruction is protected by two stop signals, so more safe.	7. Obstruction is protected by one stop signal, Safety depends on sighting distance.
8. Driver is approaching with more confidence as FSS is prewarned.	9. Driver is approaching with less confidence, if adequate sighting distance is not available, so takes more time to clear the block section.

14.6 Class `C' Stations

Class `C' working is mainly intended to serve the purpose of splitting double line block sections in an economical manner, such stations are employed on the single line either for a special purpose or where there is a pre-ponderence of traffic in one direction over long periods of the day such as, for instance, near terminals. It should be remembered that the only stop signal available is the home and when a train is held up at the home, a stop signal is not available to protect the train. It is for this reason that trains cannot be booked to stop at such stations and the stations should not normally be provided with a loop or siding class `C' stations are usually so located that the time taken to clear the section on either side of it is nearly the same. When permission to approach is given soon after train has been dealt with, it is not enough if the line is clear upto the home and block overlap beyond it; it should also be ensured that the last preceding train is continuing its journey. This additional precaution is taken because the limit of block overlap is not defined by a signal as in the case of A&B and class `C' stations, not having loops cannot deal with more than one train at a time.

14.7 Multiple Aspect Signalling (M A S)

MAS combines the advantages of Class A & B working. As there is station section between the two advanced starters or SLBs shunting may be permitted in the face of approaching trains. There is a separate distant signal which not merely repeats the home but also distinguishes between reception on the main line, reception on the loop and stop at home. When a train is being received on the main, it may run at normal speed upto the home, as BD is available between the home and the starter. When a train is to be received on the loop, the speed is reduced, just before passing the distant, to the extent necessary for taking the loop at 15 KMPH. When a train is to be stopped at the home, it has its brakes applied again at the most appropriate point viz. BD in rear of the train. It is thus possible to control the speed of trains within the station limits in such a manner that unnecessary speed reductions are avoided. The resulting increase in capacity as compared with class A & B will be considerable on sections which are near the saturation point.

The reduction in overlaps enables quicker crossings. In Class `B' the opposing starter is at a distance of 580m + length of cross overs from the outer while in MAS, this distance can be reduced to 300m+length of cross overs. The loss of time at class `B' stations on this account would again be considerable when a whole section is considered. The use of a distant and the location of the first stop signal closer to the facing points than the location of an outer allows more time for obtaining permission to approach for a second train which is to run through the station after the arrival of the first train in the opposite direction.

From the safety and speed points of view, MAS, is superior to both class A & B. In MAS, signals repeat the signals in advance and when correctly located, eliminate the problem of sighting distances, repeating signals, etc. Thus when a fast train is approaching a distant, the driver is spared from the strain of picking up the aspect of the signal from a distance. When he is close to it, he would pick up the aspect of the signal comfortably; if it is at 90 degrees he proceeds at normal speed, if it is at 45 degrees he knows, he will be entering a loop and begins to reduce speeds, if it is at 0 degrees, he has to stop at the home and therefore makes a normal brake application. When he is close to the home, if the main home is at 45 degrees, he makes a normal brake application to stop at the starting.

It is the policy, therefore, to provide MAS signalling on all main line sections.

14.8 MLQ

MLQ provides the same operational advantages as MAS except that it does not distinguish between receptions on the loop and stop at the home. From the safety point of view, however, it is inferior to MAS, as the indication of the green aspect on the distant signals and the Warner are widely different. *(Note:-MLQ signalling was adopted in some railways like SERly but is now out of use.)*

Review Questions

Subjective Questions

1. Write down the difference between class “A” and class “B” station.
2. Write down the classification of stations, basis of and purpose of classification.

Objective Questions

State true OR false

1. The class “A” station with multiple aspect signaling (False/ True)
2. Shunting is not allowed in class “A” station (False/ True)
3. Class “A” does not have station section (False/ True)
4. Class “C” is not possible on single line (False/ True)

Fill up the blanks with correct answers

1. Shunting in the face of approaching train can be performed at ---------- station/stations
   a) Class ‘A’ b) Class ‘B’ c) Class ‘c’ d) all a,b &c
2. The block overlap in class ‘C’ station provided with colour light signal is---------
   a) 180Mt b) 400Mt c) 120Mt d) 580Mts

* * *

CHAPTER 15: STANDARDS OF INTERLOCKING

15.1 Obviously in the interests of safety, train speeds should depend upon the Signal & Telecommunication equipment provided. Four standards of interlocking are actually prescribed. This standards were amended / revised to suite the new requirements. On the basis of speed the previous and revised standards of interlocking are,

Comparison of Speeds in previous & revised standards of interlocking

Standard of Interlocking	Previous standard (speeds up to Kmph)	Revised standard (speeds Up to Kmph)
Un-interlocked	15	-
I	50	50
II	75	110
III	Unrestricted speed	140
IV	-	160

The term unrestricted speed may not be taken literally. It is being increasingly realised that an unwarned first stop signal should not be employed in high-speed sections. Generally speaking, two aspect system in which safety is dependent on sighting distances of signals, is not conducive either to efficiency or safety of operation because the sighting distances required would become too long.

15.2 MINIMUM EQUIPMENT FOR PREVIOUS STANDARDS OF INTERLOCKING

The minimum equipment prescribed is based on considerations of safety alone. Thus a large station at which all trains stop may well be left un-interlocked. But since considerable delays to train movements would occur and number of operating staff required would be large, it is usual to interlock such stations. In fact from the points of view of efficiency and staff economy, it would be best to work all points from a central location. The complement of signals and the number of aspects provided should again conform to the requirements of operation and safety, subject to the minimum equipments prescribed for each standard: -

Previous Standards of Interlocking				
Minimum Equipment	**Un Interlocked (15 KMPH)**	**Standard I (50 KMPH)**	**Standard II (75 KMPH)**	**Standard III (unrestricted speed)**
I. Points				
1. How Gauge is maintained	A Gauge tie plate where steel sleepers are not provided			
2.How Operated	May be worked locally			From a Frame where Point & Signal levers are grouped.
3. How Locked	Bolt & Cotter fitted to each switch rail and padlocked or clamp to hold switches and padlock to lock them in position	A key lock of approved type locking each switch independently* (in most installations the type of lock prescribed for Standard II is used)	A Plunger type of FPL locking each switch independently which may be hand operated.	A plunger type of FPL worked from the frame.
4. How switches are prevented from being unlocked Under a train.	No special arrangements	An arrangement in which a key is used to release signals which cannot be brought back to the points until signals have been replaced to 'ON'.		Lock bar/ or TC or such other means.
5. Switch detection	Not required	A means for detecting each switch independently should be provided **		
6.Lock detection	Not required	Not required	Yes, if plunger is hand operated or is of the economical type	
II. ISOLATION				
1. Isolation of main line	Not required	Not required	Required	Required
2. Isolation of passenger lines from good lines & sidings	Required	Required	Required	Required

Note: ** Although the two switches of a turnout are invariably coupled by at least two stretchers & operated together, wherever a lock is provided, each switch is to be locked independently to safeguard against the possibility of both stretchers being broken at the same time.*

*** For the same reason and in order to ensure that the switches are not bent or broken, detectors, where provided, also detect each switch separately and independently.*

Min equipment of Signals:-

Minimum Equipment	Class of working	Un interlocked (15 KMPH)	Standard I (50 KMPH)	Standard II (75 KMPH)	Standard III (unrestricted speed)
III. Signals:					
Two Aspect	A	(Not usually adopted) {see Discussions}			Warner, Home, Starters.
Two Aspect	B	Outer & common home (the home may be omitted if traffic is very light)	Outer & Bracketted home Warner in MG only if considered necessary Starters are optional	Outer bracketed home Warner should interlocked with block instruments if starters not provided	Outer Bracketted Home, Warner and Starters
Two Aspect	C	(Not usually adopted)			Warner & Home
MAUQ & MACLS	B	Distant Home	Distant Home	Distant Home & Starter	Distant Home & Starter
MAUQ & MACLS	C	(Not usually adopted)			Distant Home
MLQ		(Not prescribed)			Distant bracketed Homes, Starter, Warner below main Home
IV. Grouping of Levers		Not required	Signal levers should be grouped & key provided to enable SM to lock up frame	Point & Signal levers should be grouped	Point & Signal levers should be grouped.
V. Interlocking		NIL	Indirect by means of key locks. Warner should interlock trailing points. Direct locking between signal levers.	Indirect interlock- ing should be extended to all trailing points direct locking between signal levers or as prescribed for Std.III	Direct between points & signals & where there are different locations SMs supervisory control should be provided.

NOTE:-

(a) Common Homes may be used for contiguous loop lines if TCs are provided to prove that route set is clear or for a group of goods loop lines.

(b) Minimum equipment of signal for MAUQ uninterlocked is not prescribed; hence, the same equipment as for Standard I. In this case, the distant should not carry the green aspect.

(c) In case of Standard I interlocking, on sections with light traffic, Outer Signal may be operated from a separate location near the facing points. But arrangements should be provided to ensure that outer signal cannot be taken OFF unless the Home Signal is taken OFF.

(d) For speeds above 72 KMPH on broad gauge and 48 KMPH on meter gauge, a warning board should be provided at full breaking distance, not less than 1 KM in rear of the 1st stop signal. The Passenger Warning Board at 1 KM need not be provided where the first stop signal is preceded by a Permissive Warner/Distant Signal, if the distance between the Permissive Warner/Distant Signal and stop signal is 1 KM or more.

(e) Where sectional speed is 120 KMPH or above, two distant signals shall be provided. In such cases, these signals are called 'DISTANT' and 'INNER DISTANT' signal respectively.

(f) Unrestricted speed may be allowed over indirectly interlocked siding points taking off from the main line within the station limits where

(i) The equipment provided at the points are in accordance with the requirement of the speed over 75 KMPH (Para 144 of IRSE Manual).

(ii) A control for operation of points is transmitted through `E' type of key transmitters manufactured as per IRS design or lever lock and circuit controllers.

(iii) A control for operation of points is transmitted in conjunction with electrically speaking instruments and special instructions have been laid down for the operation of points.

(iv) Route holding is provided to ensure the integrity of the points till the signalled movement over the same is completed.

15.2 Explanation

It will be noted that the main difference between standards I and II is that isolation is not required in Standard. I. Starter signals are compulsory in Standard III, as they are required for high-speed operation. Standard I and II are not usually employed on the double line, where train densities are usually high. But should they be used on the double line, starter signals should be used, as the general rules requires that starter signals cannot be dispensed with on the double line except in the case of 'C' class stations. The main difference between Standard II and III is that the latter does not permit indirect locking with keys between points and signals and compels the use of starter signals. The view that indirect locking with keys is less safe than direct locking is not correct, except that it does not permit higher speed.

There cannot be an un-interlocked `A' class station as the use of Warners is prohibited in un-interlocked working (and also Standard I on the B.G.). The reason for permitting a Warner in MG Standard I and not in BG Standard I, perhaps is that the maximum permissible speed in MG is 75 KMPH which is close to the Standard I speed of 50 KMPH, while in BG. it is 110 KMPH which is more than double the Standard I speed permitted. The Warner is regarded as a high-speed signal and is not used for comparatively low speeds or where speeds are restricted. However, since there is no other method of indicating the run through condition, the use of Warners in Standard I BG is being authorised in some individual cases. A better solution of course is to provided isolation and adopt standard II instead of Standard I in BG.

It will be noted that in Standard I, the Home Signal need not be interlocked with trailing points, but this interlocking is essential in Standard II. In Standard I, therefore, when two opposite trains are approaching a single line station at which the two trains cannot be received simultaneously, it is usually to set the Up facing points for the Up train and Dn facing points for the Dn train, take off signals for the first train first and then immediately after second train. Under such circumstances, trailing points incorrectly set are not deemed to be an obstruction in so far as the overlap for the home is concerned. Under similar conditions, in case of Standard II, the second train would be considerably delayed, as prior to signals being taken off for its reception; (1) the signals for the first train must be replaced to ON, (2) the point keys carried from the platform frame to the points at both ends of the yard. (3) Both near and far endpoints reset and locked and (4) point keys again carried to the frame.

In Large Yards Main Line is not isolated, as all trains stop even though the signalling is couplying with std III requirement all other respect, it should be classified as Standard. I.

15.4 Revised standard of interlocking

The standards of interlocking amended by Railway board and hold good for all new & existing installations.

INDIAN RAILWAY SIGNAL ENGINEERING MANUAL, PART - I (1988 EDITION)

Addendum and Corrigendum Slip No. 6 (RB's Letter No. 2003/SIG/SEM/3 Dt. 19.05.2004)

Chapter VII, Para 7.131, Section M Important Minimum Signalling features

Sl. No	ITEM	As per New Revised Para 7.131			
		Std I	Std II	Std III	Std IV
1	Allowable Speed (Kmph)	Up to 50	Up to 110	Upto 140	Upto 160
2	Isolation	Y*	Y	Y	Y
3	2A Semaphore/ MAS	2A/MA	2A/MA	MA	MA
4	Double Distant	N	Y**	Y	Y
5	Point Operation	Mech	Mech/Elec	Mech/Elec	Elec
6	Point Locking	Key/FPL/ HPL	FPL/Pt M/c	FPL/Pt M/c	Clamp type direct – (Desirable)
7	Point Detection	Mech/Elec	Mech/Elec	Mech/Elec	Elec
8	Lock Detection	N	Y	Y	Y
9	Interlocking	Key/Mech	Mech/Elec/Electronic	Mech/Elec/Electronic	Elec/Electronic
10	Track Circuiting	N	Run thro lines / All RLs	All Running Lines	All Running Lines
11	Block Working	Token	Token / SGE	# SGE / TC	# SGE / TC
12	Preventing SPAD	N	N	N	Y (Desirable)

Note:-

* *Speed not exceeding 50 kmph, if permitted all shunting to be stopped, no vehicle unattached to an engine or not properly secured may be kept standing on a connected line which is not isolated.*

** *Double Distant on sections where goods trains have a breaking distance of more than 1 Km*

 # At CPI or high density routes Means for verifying complete arrival of train by suitable means

15.5 EXPLANATION

The main difference between standards II and I is that isolation and lock detection is not required in Standard. I. The multi aspect signals are made compulsory in standard III and standard IV. Double distant signal are mandatory in standard III and standard IV and conditionally require in standard II if on sections where goods trains have a breaking distance of more than 1 Km. For standard IV the clamp type point machine are make desirable and relay OR electronics interlocking is compulsory. Standard III and standard IV are applicable on double line only. Starter signals are compulsory in Standard III, as they are required for high-speed operation. Standard I and II are not usually employed on the double line, where train densities are usually high. But should they be used on the double line, starter signals should be used, as the general rules requires that starter signals cannot be dispensed with on the double line except in the case of 'C' class stations. The main difference between Standard I and remaining standard is that the latter does not permit indirect locking with keys between points and signals. The view that indirect locking with keys is less safe than direct locking is not correct, except that it does not permit higher speed.

It may be noted that in Standard I, the Home Signal need not be directly interlocked with trailing points, but this interlocking is essential in Standard II. In Standard I, therefore, when two opposite trains are approaching a single line station at which the two trains cannot be received simultaneously, it is usually to set the Up facing points for the Up train and Dn facing points for the Dn train, take off signals for the first train first and then immediately after second train. Under such circumstances, trailing points incorrectly set are not deemed to be an obstruction in so far as the overlap for the home is concerned. Under similar conditions, in case of Standard II, the second train would be considerably delayed, as prior to signals being taken off for its reception; (1) the signals for the first train must be replaced to ON, (2) the point keys carried from the platform frame to the points at both ends of the yard. (3) Both near and far endpoints reset and locked and (4) point keys again carried to the frame.

Large stations where main line isolation is not provided because all trains stop, but which may comply with Std.III requirements in all other respects should be classified Standard. I

Review Questions

Subjective Questions

1. Write down main difference between old and revised standards of interlocking

Objective Questions

State true OR false

1. Isolation is not require in standard III interlocking (False/ True)
2. Lock detection is not require in revised standard II interlocking. (False/ True)
3. standard IV station is possible with centralized lever frame (False/ True)
4. double distant is not required in standard I station (False/ True)

Fill up the blanks with correct answers

1. Isolation is require for station with ----------of interlocking
   a) Standard I b) standard II c) standard III d) b & c

* * *

CHAPTER 16: OPERATION OF POINTS

16.1 Point in general

Points, which are used to divert trains from one line to the other, will become a source of danger unless adequate precautions are taken, points are said to be facing when they are approached from the toe end.

Points should be correctly set for trailing movements, but even if they are not, the probability of an accident to a train is remote, but the points themselves will certainly be damaged. Points are said to be trailed through or burst when a movement in the trailing direction takes place with the points incorrectly set. The points are then unsafe for facing movements until repaired (this shall do not apply to trailable points).

Even a casual study of points will indicate that for movements in the facing direction more precautions should be taken. The points should be correctly set, i.e., the closed switch should be housed correctly against the stock rail and the open switch should be well clear of the corresponding stock rail. A large gap between the closed switch and its stock rail or an insufficient clearance between the open switch and its stock rail will cause a serious accident to the train. The switches should be held in position by an external force, and/or a lock, if not, the vibrations set up by the movement of trains over them may cause the closed switch to open or the open switch to close. The points should be prevented from becoming unlocked during the passage of a train.

16.2 Location of point and range of operation

Points must be so located that movements over them shall be within the view of the cabin or other location from which they are worked, unless an approved alternative for direct vision by cabin man, e.g., electric indication, is provided.

The distance at which points may be worked by rodding is stipulated in section 2 of chapter VIII of “Rules for opening a railway” and must not exceed 320m except where the stroke at the lever tail is not less than 200 mm in which case the above distance may be increased to 460m. These distances are also indicated in SEM-1988 para 7.61. Unless otherwise permitted under approved special instruction, rodding must be used throughout for the mechanical working of points and also for bolting them when required.

The correct setting of switches should be proved or detected before a signal can be taken OFF for a movement in the facing direction. This is performed either by the signal wire (or wires) itself or by a separate wire (or wires) operated by an independent lever in the case of mechanical signalling and by electrical detection in the case of power signalling. In India normally the two switches are coupled together by at least two flexible stretcher bars (The thick wed switches with clamp type locking may not have stretcher bars) to flex equally in the normal and reverse positions.

It is important that gauge at all points and crossings are correct. A metal gauge tie plate is used for this purpose where the points are laid on wooden sleepers.

16.3 Parameter for setting of switches

The maximum gap permitted between the closed switch and the stock rail is 5mm, but it is usual to ensure that the points cannot be locked or detected with a 3.25mm obstruction, placed 150 mm (six inches) from the toe, between the switch rail and stock rail. The switches are coupled together and, therefore, the detector checks only the independent movement of each of the two switches over the correct stroke of 115 mm in Broad Gauge and 100 mm in Metre Gauge. But so long as the gauge is correct, it will mean that the switches are correctly set with reference to stock rails and it is for this reason among others, that the gauge should be frequently checked. The frequent checking of the gauge will serve as precaution against worn stock rails, which is not checked by interlocking.

The speeds permitted over facing points set for the straight road is dependent on the extent to which these precautions are taken.

16.4 Speed of train over point Standard wise

Points in which the only equipment is a gauge tie plate and a padlock for locking them in position, and which may or may not be locally operated are said to be un-interlocked. A speed restriction of 15 KMPH is imposed over them in the facing direction and of 50 KMPH in the trailing direction. Unrestricted speed in the trailing direction is, however, permitted on the straight road if the points are interlocked with signals, even though locking and detection are not provided.

On points interlocked to standard I requirements, a speed of 50 KMPH is permitted in the facing and unrestricted speed in the trailing direction when the points are set for the straight. When set for the turnout, speed will be further restricted by the curvature of the turnouts (15 KMPH in the case of 1/12) in both facing and trailing directions.

On points interlocked to standards II, III speeds of 75 and 100 KMPH are permitted in the facing direction respectively and unrestricted speeds in the trailing direction on the straight road. When set for the turnouts speeds will be further restricted by the curvature of turnouts (15 KMPH in the case of 1/12 and 10 KMPH for 1 in 8 1/2 turnouts).

The restriction of 15 KMPH should not be confused with a corresponding restriction over turnouts. The restriction of 15 KMPH over 1 in 8 1/2 and 1 in 12 turnouts is on account of curvature (super elevation cannot be provided on turnouts) is applicable both in the trailing and facing directions for movements over turnouts. Actually, a higher speed may be permitted over 1 in 12 than over 1 in 81/2 as the former has a greater radius but this is not being done. There should be no change in gradient within 30 m for BG, 15m for MG. from points and crossings.

* * *

CHAPTER 17: INTER CABIN CONTROL

17.1 Principles of Slotting

The term `Slotting' has come to mean in signalling parlance the control of a signal by source or sources other than the operating source. The control of signals by more than one source is much more frequent than in the use of points.

Signals, for convenience, are worked from the nearest source, but when the control lines which extend into adjoining territories, they are slotted from cabins or stations located in all such contiguous territories. A slotted signal cannot be taken `OFF' unless the controls from all remote locations have been operated, but it should be possible for any one of the controlling agencies to replace the signal to its most restrictive aspect.

17.1.1 The purpose of slotting is two fold

(a) To ensure that the points located on the line controlled by the signal including the overlap are set correctly and facing points locked and the line is clear, before the signal is taken off and

(b) These conditions are maintained until the train movement is completed. In other words, no other conflicting or fouling movement is allowed to take place and the points are not altered until the train movement is completed.

Because a slotted signal can be replaced to its most restrictive aspect by any one of the slotting agencies, it follows that other signals which are dependent upon or released by the slotted signal, should also be similarly slotted so that the aspects displayed by all these signals are in correspondence.

These principles are best understood by a reference to the Fig. 17.2. Homes 3, 4 & 5 are worked from Cabin A for convenience but they read into territory controlled by B cabin. The block instruments are located in the SM's office and the SM has overall control over movements and is responsible for line nomination. Before the Homes can be taken off the line must be clear upto the far end trailing points and the S.O. of 180 m beyond it. The signals are therefore, controlled from B cabin as well as by the S.M. Because the loop lines terminate into sand humps and the far end points can be set either way, it may be argued that the loop homes need not be controlled by B cabin. This argument is only partially true, i.e. only in so far as the setting of the far end points for the overlap is concerned, but unless, slots are provided. B cabin cannot be held responsible for the maintenance of the line `clear' until the train movement is completed nor will be in a position to replace the signals, which lead into his territory in the event of an emergency occurring in his territory.

The outer signal No.2 is released by any one of the homes and, therefore, it should also be slotted so that it returns to the `ON' position as soon as the Home is returned to the `ON' position by B cabin or by the SM, so that any one of them can replace it and it can be ensured that

(i) the main line is clear,

(ii) all points are set and locked for the main line

(iii) permission to approach from the next station in advance has been received and

(iv) all main line signals have been taken off, before the Warner can be taken off and

(v) These conditions are maintained until the train movement is completed.

17.2 Types of Controls Slots

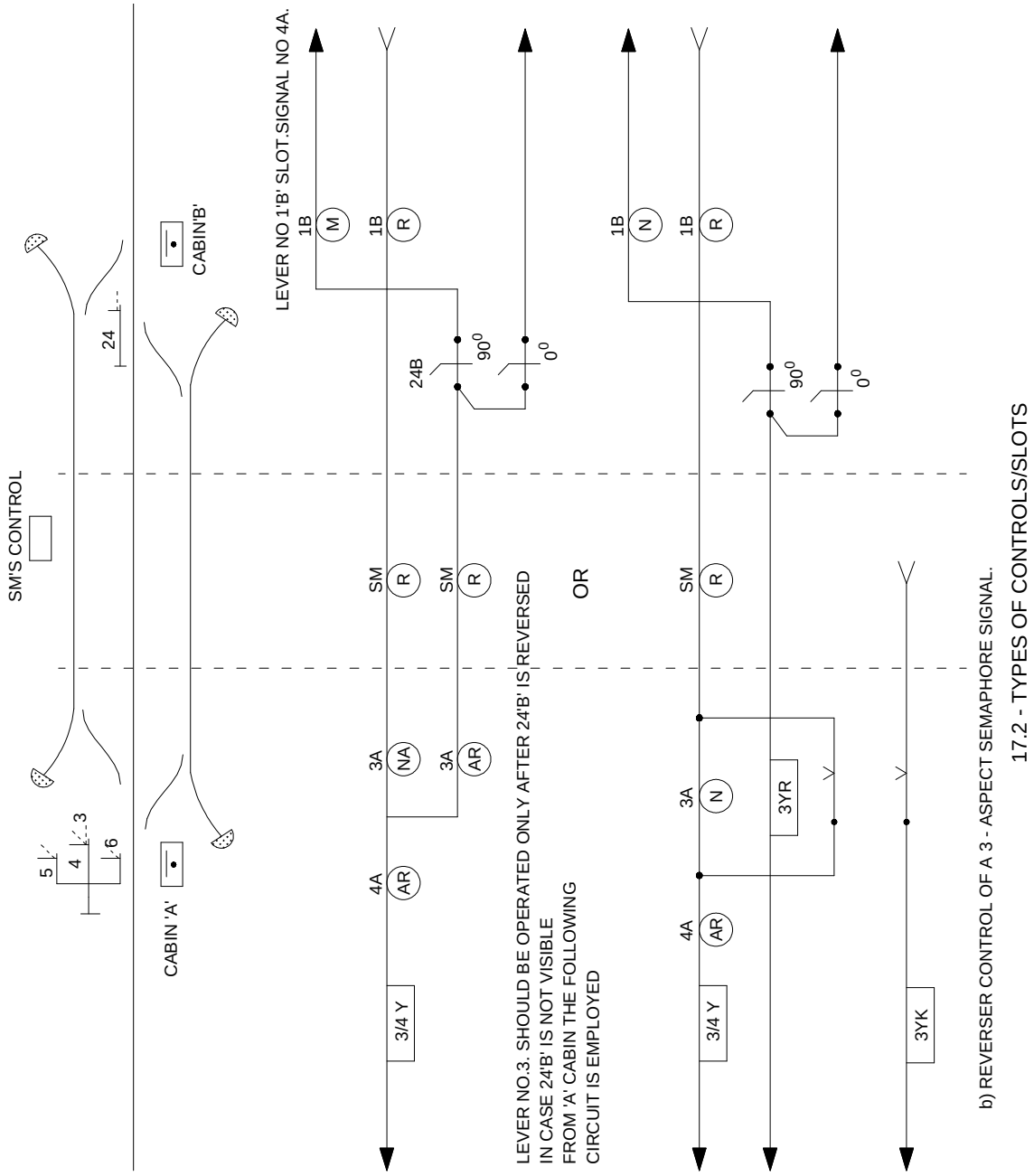
The following types of Controls/Slots are in general use in mechanical installations:

(a) The mechanical lever lock worked by key transmitted electrically

(b) The electric lever lock

(c) The electric signal reverser post type

The design, construction and maintenance of the various types of slots are dealt with elsewhere.



Review questions

1. Write down in short the purpose of slotting.

* * *

CHAPTER 18: LEVEL CROSSING GATES

18.1 INTRODUCTION

When road traffic crosses rail traffic over a bridge or under a bridge at a different level no signalling arrangements are required. When road traffic crosses the rail traffic at the same level they are known as level crossings and signalling arrangements at such crossings may be required if they are busy. A road rail crossing at different levels is, of course, the best arrangement as it is completely safe and the movement of road traffic is then unrestricted but in view of the high initial cost of bridges, such crossings are employed only where road and rail traffic are both heavy.

In level crossings, the roadway is brought upto the level of rail tables and guard rails provided to contain the roadway clear of wheel flanges.

Level crossing gates are either of the swing type with one or two leaves on each side depending on the width of roadway, or of the barrier type. There are two types of barriers, the movable and the lifting. The movable barrier is superior to the swing type gate because they can be quickly operated and since they move parallel to the track they are not obstructed by road traffic as may happen with swing gates opening away from the track. However, in view of the difficulty involved in keeping the bearing rails free from dirt etc. They are not popular and are obsolete now.

The use of lifting barriers constitutes the best arrangement from the points of view of quick clearance and the control can be local or remote or automatic as required. In lifting barrier operation, it should be ensured that the road vehicles are not trapped over the tracks. When the barriers are controlled manually either from site or from a remote location such as from a nearby cabin, the operator must be able to see that the crossing is clear of road vehicles before signals for a train are taken off. In the event of a good view of the level crossing being not available to the operator in the cabin, closed circuit TV is employed, in the continent, for the surveillance of roadways. In U.K. all automatic barriers are of the half barrier type (see figure 19.1.) to eliminate the possibility of road vehicles being trapped over tracks. But in the case of manually operated barriers, it is the practice that they shall be of the full barrier type; because manual barriers may remain closed for longer durations than necessary. When this happens frequently, the road users may be tempted to take the risk of zigzagging their way through the closed half barriers.

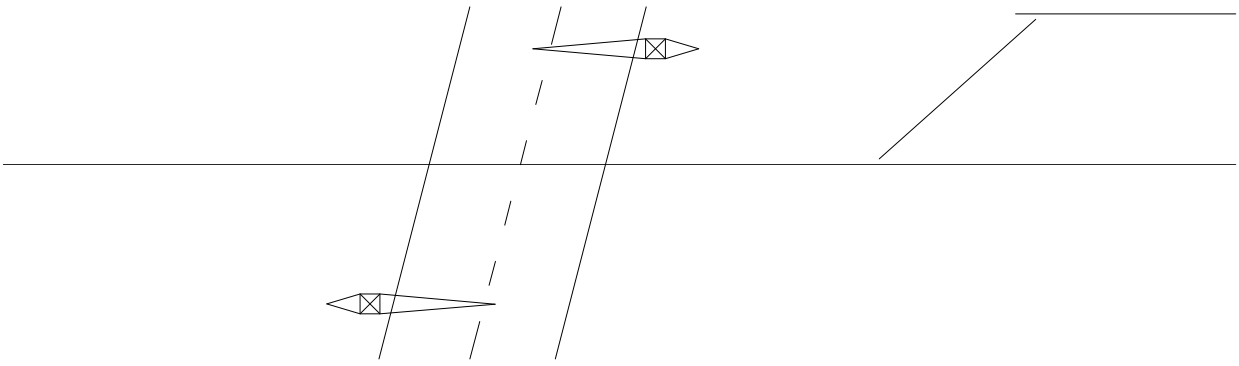


Fig.18.1. LIFTING BARRIERS – HALF BARRIER TYPE

In U.S. there are several level crossings in which gates or barriers are not provided, the road traffic being entirely controlled by road signals. Although this practice eliminates expenditure on staff, accidents take place occasionally and, therefore, the present trend is to provide lifting barriers worked automatically or controlled remotely.

All level crossings in this country (except cattle crossings) are provided with gates of one or the other type, or at least chains and the vast majority of them are manned. In Europe and USA, it is very common to provide only signals (and no physical barriers) at level crossings to warn road users of approaching trains. However, this arrangement is not practicable in India. Therefore, manning of level crossings becomes necessary even though it is expensive. Remote operation (using closed circuit television for surveillance of the roadway over and near the crossing) is a possibility but has not so far been tried either with full barriers or with half barriers.

Where lifting barriers are operated from the nearest cabin, the distance from the cabin to the L.C. is limited to 150 meters. It is necessary that the operator have a clear view of the L.C. and approach road on either side to ensure that speedy vehicles do not damage the lifting barriers or get trapped between the barriers. To prevent speeding vehicles damaging the barriers at the time of closing, the present directives are to provide humps or speed breakers on both sides of approach of level crossings.

18.2 CLASSIFICATION OF GATES

The classification of level crossings is made after conducting the level crossing census once in 3 years by a team consisting of supervisors of Engg and traffic department shall do the census of TVA for seven days generally and average per day is taken.

(TVU train vehicle unit = No of trains x No of road vehicles . Train motor vehicle, bullock card and tanga – 01 unit Cycle rikshaw and auto rickshaw - ½ unit)

Classification of level crossing gate is given below

For road vehicles : - Special class, A Class , B Class , C Class

For cattle crossings :- D Class.

Details are shown in the table below.

SL. No.	Class	Criteria	Interlocking/ Remarks
1	Special class	TVU greater than 50,000	R.O.B to be provided Gate to be interlocked till ROB is functioning)
2	'A' class	TVU between 30,000- 50,000 and number of road vehicle greater than 1000	Compulsory
3	'B' class	TVU between 20,000- 30,000 and number of road vehicle greater than 750	
	'B1' class	TVU between 25,000- 30,000	Compulsory
	'B2' class	TVU between 20,000- 25,000	
4	'C' class	All other LC Gate not cover in above class	If TVU is greater than 6000 OR LC Gate visibility is poor then gate to be manned
5	'D' class	For cattle crossing	

Requirements of LC gate

Gate – Open / Closed, Interlocking etc –classification wise.				
Detail	**Special**	**A Class**	**B Class**	**C class**
1. Normal position of Gate	Open to Road traffic	Open to Road traffic	Closed to road traffic. Can be kept open to road traffic provided either gates are interlocked with signals and provided telephone communication with adjacent station/cabin or when the following conditions are satisfied: (a) LC should not be located in suburban section (b) LC should not be in automatic block Signalling territory. (c) Should be provided with lifting barriers (d) Should have a telephone connection with the nearest station with exchange of private numbers (e) Visibility at the level crossing should be good (f) Should be provided with Whistle boards on either side at adequate distance to enjoin the drivers of approaching trains to give audible warning of the approach of the train to the road users. (g) As long as the L.C gate is kept open to road traffic, a red flag by day and red light during night should be displayed towards approaching trains on either side of level crossings	Same as for B
2. Interlocking of gates with signals if gates are within station limits	Should be interlocked with station signals	Same as for special	Should be interlocked with signals:- (a) In suburban sections (b) In non-suburban sections where operated from cabins (c) In automatic signalling territories	Should be interlocked with signals:- 1. within station limits where operated form cabin 2. in automatic signalling territories
3.Interlocking of gates with signals if gates are outside station limits	Should be interlocked with gate signals	Same as for special	To be interlocked (a) In suburban sections (b) In automatic signalling territories	To be interlocked in automatic signalling territories

Gate – Open / Closed, Interlocking etc –classification wise.				
Detail	**Special**	**A Class**	**B Class**	**C class**
4.Telephone comunica-tion from the gate lodge if gate within station limits	Telecomm unications with ASM's office to be provided	Same as special	Same as special	Telecommunic ations with ASM's office to be provided in case of manned level crossings
5.Telephone Comunica-tion from the gate lodge if gate outside station limits	Telecomm unication with ASM's office of adjoining station to be provided	Same as special	Telecommunication with adjoining station to be provided on :- (a) All level crossings on Rajdhani route; (b) On suburban sections; and (c) On curve obstructing the view of the level crossing from approaching train and vice versa	Same as B class
6.Warning bell operated by approaching train	Should be provided where LC is outside station limits	Should be provided where LC is outside station limits in all suburban sections and on non-suburban sections provided with automatic signalling territories	Same as for A class	Same as for A class

Note:

(a) The level crossing inside station limits should be beyond the advanced starters or beyond the limits up to which shunting is normally carried or at an adequate distance of at least 250m ahead of the starters and trailing points of the station where advanced starters/shunting limit boards are not provided

(b) In case of level crossings falling on suburban section they may be considered for upgradation to B class in the event of their not qualifying for upgradation to special or A class and when so upgraded to B class the facilities as indicated for B class should be provided

(c) In the case of level crossings located outside station limits, protected by signals where the sighting of the signal by the engine driver is inadequate a warning board should be placed at not less than emergency breaking distance in rear of the gate stop signal.

(d) Where level crossing is situated outside station limits in close proximity thereof, the clear distance between the LC and an outer signal should not be less than a full train length

(e) In cases where communication with ASM is stipulated, the connection may be given to the switchman in the cabin as per the local condition.

(f) Provision of warning bells operated by approaching trains should be confined to interlocked level crossings only.

(g) *Railway Boards letters No 20000/safety (A&R) /19/39 Pt Dt 01.10.2009 stipulates the essential condition to maintain normal position of manned level crossing gate provided with telephone* ***" open to road traffic"*** *subject to clear view of an approaching train In case the telephone at such manned Level Crossing Gates, with normal position "open to road traffic" becoming defective (other than at interlocked gates), Railways are advised to treat these LC Gates (with restricted visibility) to have a working system similar to that applicable for gates with normal position" closed to road traffic".*

It will be noted that in accordance with the rules, the interlocking of gates with signals is compulsory only in the case of the most important category, viz., special class and in the case of A class only if located within station limits. However, in accordance with the instructions issued by Railway Board, all special and A class gates are interlocked and B class if the gates are operated from the cabin.

In all busy level crossings, the gates on each side should be coupled so that they may be closed quickly. Wicket gates are provided at all special, A and B class crossings so that slow moving pedestrian traffic (which may be depended upon to exercise due caution, is not unnecessarily detained. For similar reasons, V shaped traps, which enable cycles being carried across the gates closed, are also provided where necessary.

All level crossings, irrespective of their classification, must be interlocked if they fall in sections provided with automatic signalling. `B' class gates falling in Suburban Sections shall also be interlocked. Further interlocking shall be provided for all `B' and `C' class gates if they are operated from the Cabin.

18.3 LOCATION OF LC GATE

Level crossings should not be located fouling reception or stabling lines or within the signals overlaps at stations. In the case where a level crossing is located within signal overlap, it is to be ensured that the signals are taken off only after the gates are closed against road traffic and the crossing is clear of road traffic. Level crossings do not, however, constitute an obstruction in so far as block overlaps are concerned and may, therefore, be located in them. (This is consistent with the practice of level crossings being permitted in block sections).

Level crossings between stations located in block section should as far as possible, provide an uninterrupted view to drivers of approaching trains. Where visibility is not available due to sharp curves or deep cuttings, a telephone connection with the adjacent station is required to be provided.

18.4 PROTECTION

Figure below shows two methods of interlocking the level crossing gate located outside the station limits i.e in the block section:

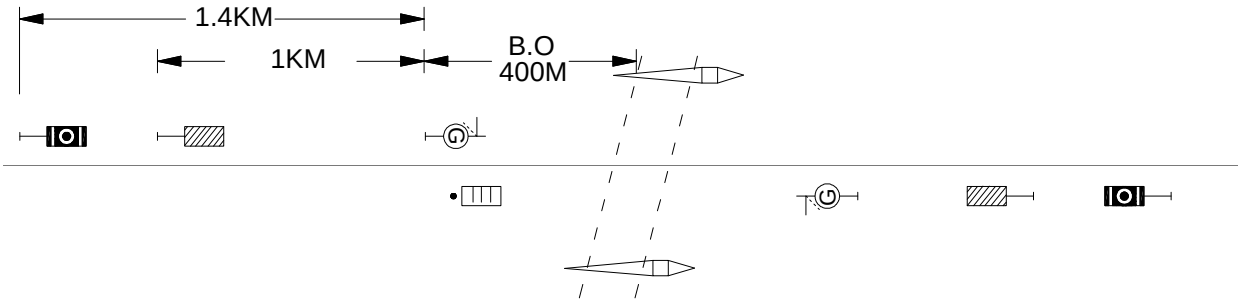
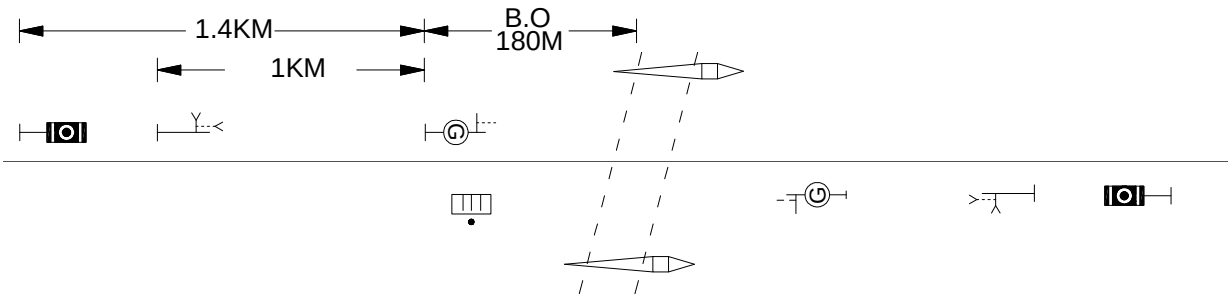


Fig (a) 2 - ASPECT



Note: Goods Warning Board to be provided if the speed of Goods train exceeds 72 KMPH

Fig. 18.4 PROTECTION OF LEVEL `X' INGS OUTSIDE STATION LIMITS

In case of two aspect territories, a stop signal at 400 m from the gate with a `G' marker and a warning board at 1 Km in rear of the gate signal shall be provided.

In case of multiple aspect territory, both colour light signalling and upper quadrant, a stop signal at 180 metres from the gate with a `G' marker and a distant signal at 1 km in rear of the stop signal shall be provided.

In the case of MLQ territories the same procedure as in multiple aspect may be followed.

Where the speed of goods train exceed 72 KMPH, a second warning board also should be provided at a distance of 1.4 kms in rear of the stop signal in all types of signalling.

A lever frame or some other operating device is provided for the control of the gate lock and signals and to provide the interlocking.

18.5 Warning Arrangements

A warning arrangement is provided at all Special class level crossings located outside station limits and `A' class level crossings falling on suburban sections and Automatic Signalling Sections. It is also desirable at other `A' class level crossing when justified on account of local conditions. This may consist of a bell worked by trains when they pass over track circuits located at adequate distances in rear of the level crossings. A telephone must be provided at all special and `A' class level crossings in addition to the warning bell arrangement. A telephone is also required at `B' and `C' class/level crossings located within station limits or on suburban and Rajdhani routes.

An automatic warning arrangement in the form of a bell controlled by the trains is mandatory in automatic signalling sections. This is ideal at suburban sections where the frequency of trains is high and the trains are of identical types. If this were employed at locations where train densities are low and different classes of trains (fast express and slow goods) are in operation, road traffic will be unnecessarily detained in the case of goods trains, as the treadle or track circuit controlling the bell has to be located at a fixed distance in rear of the signal protecting the crossing adequate for the fastest train. Although comparatively more expensive, the automatic bell is the most dependable warning system; even if there is a failure the bell will ring.

In some countries, a speed detection device is employed in conjunction with the automatic warning system so that the period the gates or barriers remain closed is not excessive, when dealing with slow trains, as compared with the faster trains or, in the other words, the warning is on a fixed time basis rather than on a fixed distance basis.

18.6 Protection of level crossing inside the station Limits

In the case of level crossings located inside the station limits of block stations worked under the absolute block system, the stop signals on either side of the level crossing are utilised to function also as gate signals by providing interlocking between them and the level crossing gates or barriers. But, if stop signals are not available for the purpose, a new signal or signals is/are installed for protecting important level crossings.

In the case of the automatic block system, the question of inside or outside station limits does not arise; stop signals on either side of the level crossing if available at appropriate distances from the level crossing are made use of to function also as gate signals. In the event the stop signal on one or the other side of the level crossing is not located at the correct distance, the signal or signals as the case may be, are shifted to new positions, but if this cannot be done for operational reasons, new signals are provided. Some specific cases of gates or barriers located inside station limit will now be considered: -

18.6.1 Level Crossings At Class B Stations

There are three possible positions for level crossings inside the station limits of stations on the single line: -

(a) Between outer and home not infringing the signal overlap

(b) On the signal overlaps

(c) On reception lines.

Although (b) and (c) are undesirable positions, they unfortunately exist.

In the case of (a) assuming the L.C. gate is between down outer and up advance starter (as shown fig. below). The outer signal shall also work as gate signal, which must be placed minimum 400 metres in rear of the L.C. gate. For quick opening of gate after train has passed it. The gate should be interlocked only with down outer (instead of Dn. Homes) and with up-advance starter for up direction trains.

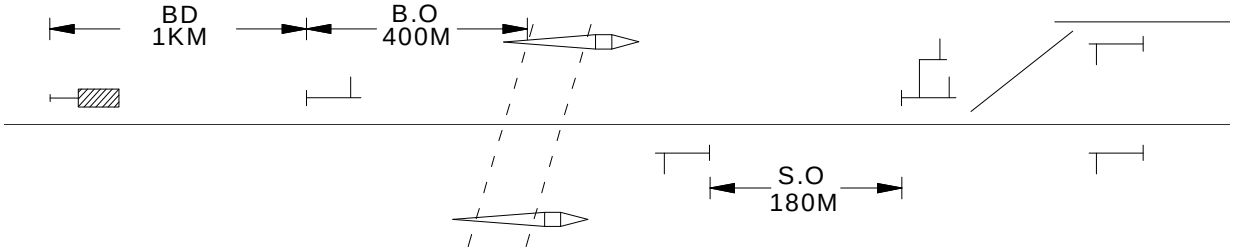


Fig. 18.6.1 L.C Gate is between outer and advance starter

In the case of (b) if the L.C. gate is on the signal overlap i.e. between up advance starter and down homes (as shown in Fig. below) no signals are required to be shifted whereas the interlocking will be extended upto up home signals in addition to the Down Homes, up advance starter and starters.

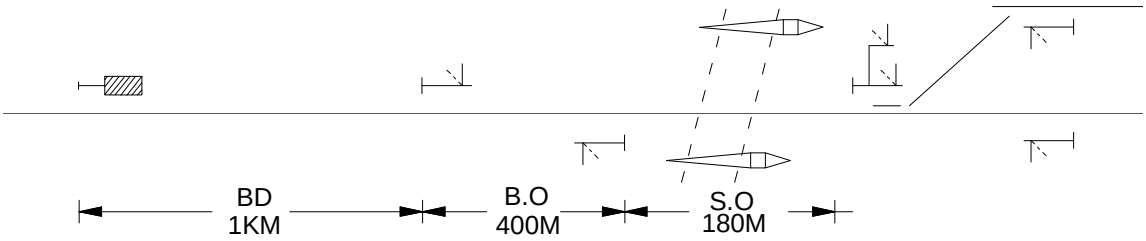


Fig: 18.6.1 LEVEL CROSSING IN CLASS 'B' STATIONS

In the case of (c) if the L.C. gate is interlocked with up and down Home signals. This may be noted that in all the above cases the signal controlling L.C. gate is not provided with `G' Marker.

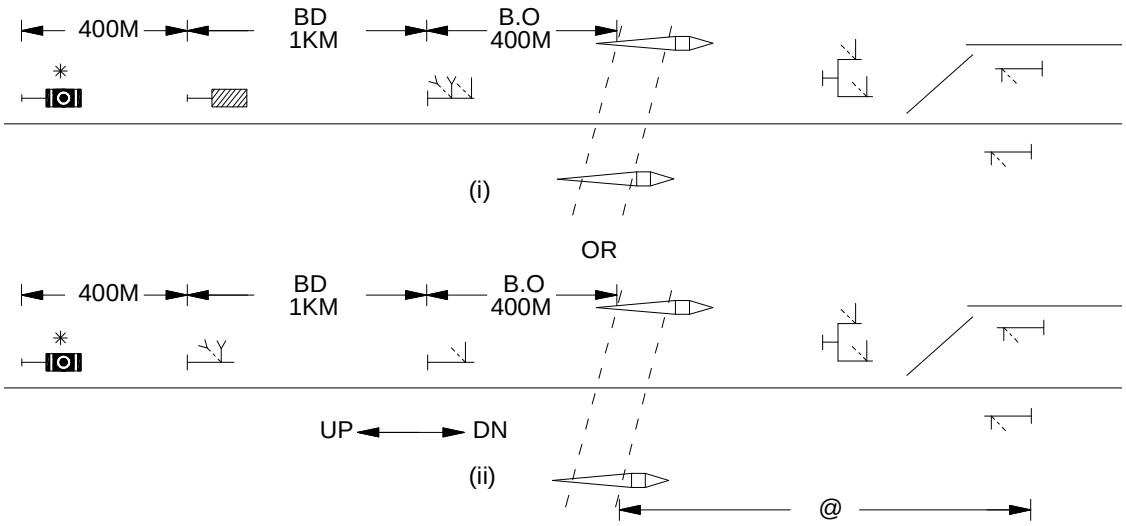
The L.C. gate located inside the station limits of a double line class `B' are protected in a similar way.

18.6.2 Level Crossings at CLASS `A' and `C' STATIONS

(a) **CLASS `A':** Taking the case of a level crossing located between the DN Warner and the DN Home of a Class `A' station the interlocking arrangement should be as shown in Figure below.

In the Dn direction, a gate stop signal has to be provided at not less than 400m from the level crossing. This signal may be provided on the same post of the Warner as shown in figure (i) or on a separate post by itself and the Warner shifted as shown in figure (ii).

In the Up direction, the gates are interlocked with the starter signal and where the distance between the starter and the level crossing is less than 180m the interlocking should be extended to the Up home signal also.



* Necessary when the speed of the Goods train is more than 72 KMPH
@ If the distance is less than 180m interlocking should be extended to Up Home Signal

Fig.18.6.2 Level Crossing situated between Warner and Home at Class 'A' station

(b) **CLASS `C':** In the case of a Class `C' station, where the gate is in a similar location as above the Interlocking of the gate in the Up direction should be achieved by the Up home signal as there is no starter signal in Class `C' station.

18.7 Level crossing located within station limits in MAS signalling

A typical layout with MAS signalling as shown in Fig. 18.7, may have a level crossing at any location it is possible within the station limits is marked as (1) (2) & (3).

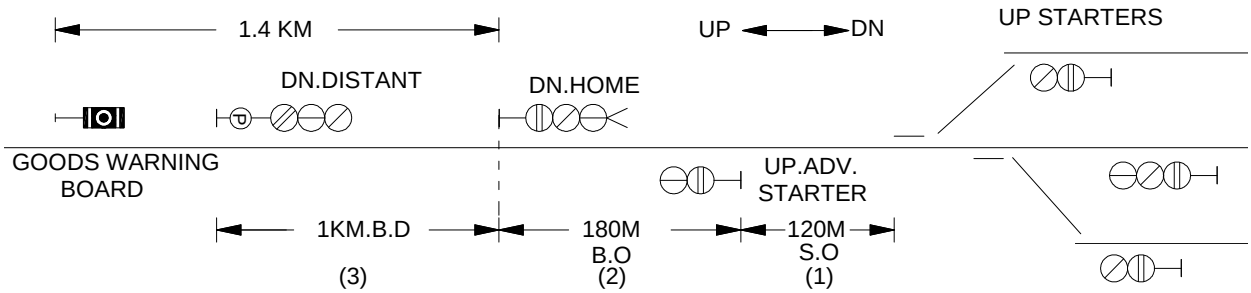
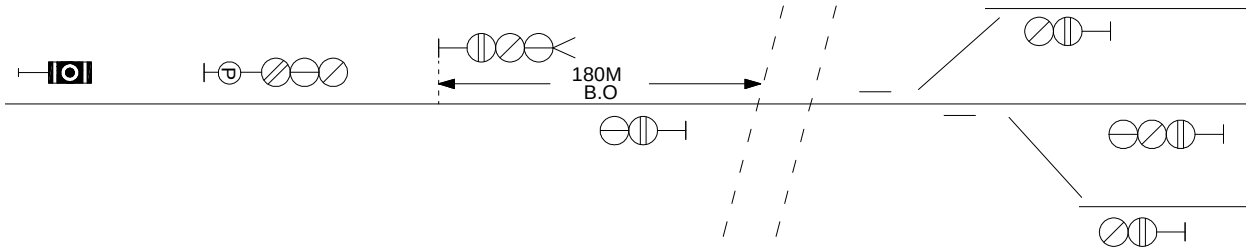
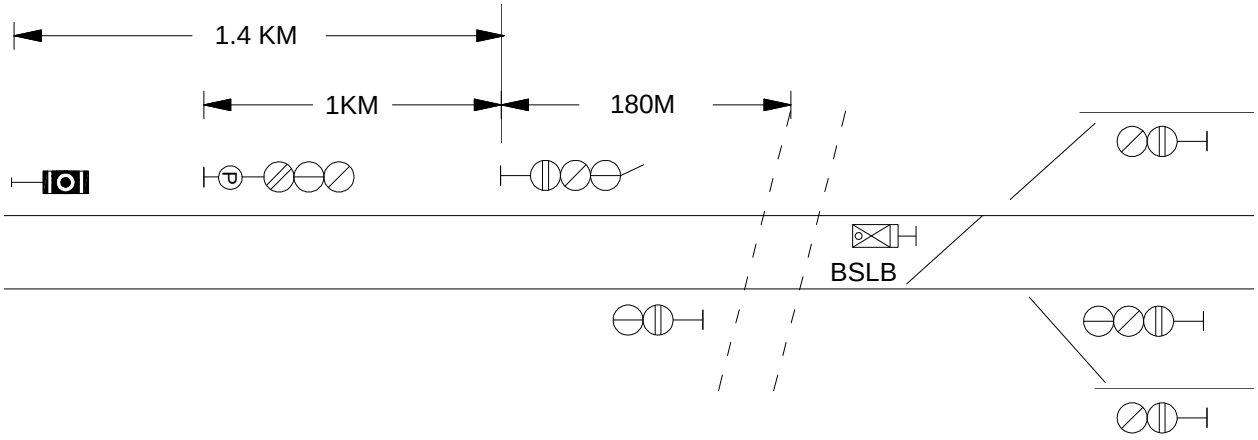


Fig.18.7

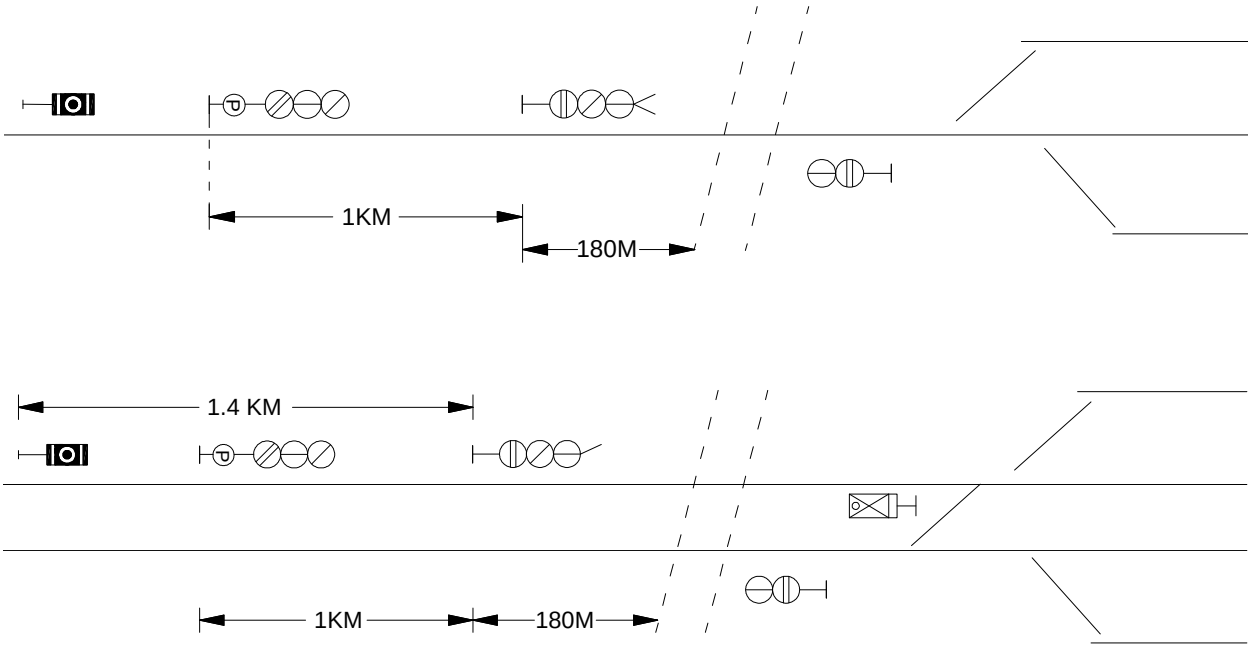
(a) In the case of (1) if the gate is located on signal overlap i.e. between the up advance starter and the outer most trailing points on single line, as shown in fig.18.7 above the location of signals need not be changed as shown below. The gate shall be interlocked with down Homes, up starter, up advance starter and up Homes.



On double line the down Home signal, which is 180 metres from the facing point or BSLB, will now be shifted at 180 m from the L.C gate. Consequently the distant signal at 1km from Home. The interlocking arrangements will be same as shown for single line above.

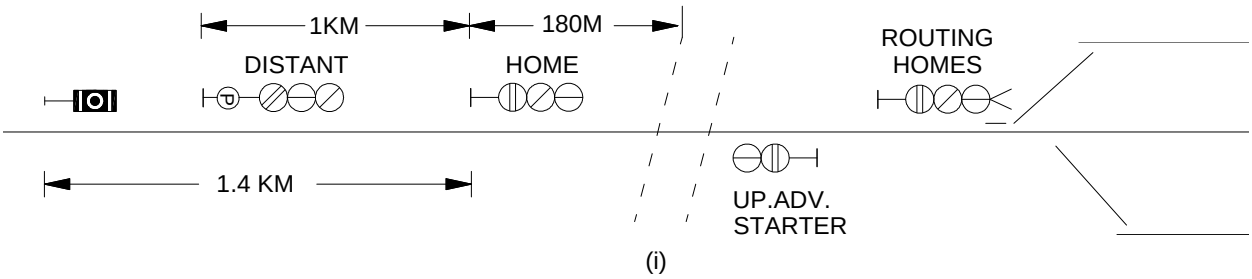


(b) In the case of (2) of Fig. 18.7, if the L.C gate is between the down Homes and up advance starter on single line or double line. The down Home signal only need to be located at 180m in rear of the L.C gate and the down distant at 1km in rear of the down Homes. The gate should be interlocked with down Homes and up advance starter only (see fig. below).



(c) In the case of (3) where the level crossing is located between down Homes and the down Distant, the interlocking arrangement may depend upon the vicinity of gate from the Home signal. If the gate is just in rear of the Homes the Home may be shifted at 180m in rear of the gate and the distant at 1km. in rear of the Homes, as in the case of (b) above whether single line or double line.

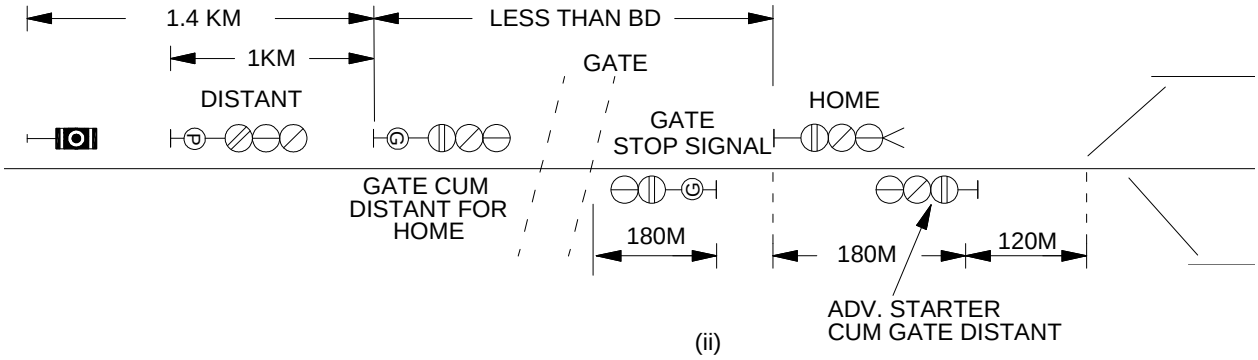
(i) But if the L.C gate is little away from the down Homes say less than a train length (approx. 300 to 400m) it is better to provide the Home Signal at 180m in rear of the gate and a routing Homes near the points as shown in the Fig. below.



(i)

The gate shall be interlocked with down Home signal and the up advanced starter and with routing homes if required. The Home signal as permitting the entry of trains into the station shall be interlocked with routing homes and shall not have `G' marker.

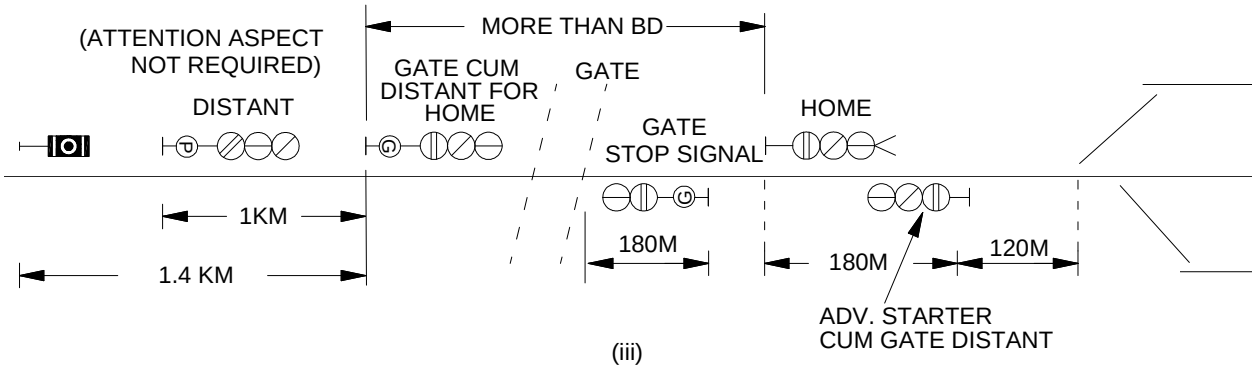
(ii) Another situation is that when the L.C. gate is located more than a train length in rear of the Homes and less than BD. (1km) between gate signal and Homes. The gate stop signals in both directions have to be provided with `G' marker at 180 m in rear of the L.C gate as shown in fig. below.



(ii)

At that time the up advanced starter shall work as advanced starter cum gate distant, capable of showing red, yellow and green (0-45-90). The gate cum distant for down home will have red, yellow and green.

(iii) If the L.C gate is just ahead of the Distant Signal and far in rear of Homes as in the case of (3) of Fig. 18.7. The gate stop signals with `G' markers are provided on either side of the L.C. gate at 180 metres, similar to that of (ii) above. The down distant will have only yellow and green aspects, the YY (attention) aspect can be dispensed with, since the distance between the down gate signal and the down Home is more than BD. The interlocking arrangements will be the same as mentioned for (ii) above.



(iii)

Owing to these reasons, the distant signal is being shifted to a very long distance from the place of operation, so this can be a motor operated, or under approved special instructions this can be a colour light, while all other signals at the station are semaphore signals.

Introducing a gate stop signal capable of showing stop, caution and clear aspects and shifting the down distant signal so as to have BD in rear of the gate stop signal. The arrangement shown in fig. (ii) & (iii). This may be noted that the Distant signal shall show all the three aspects in the case of (ii) and shall show only caution and clear aspects in the case of (iii) since BD is available between down gate and down Home.

The aspects required for condition obtaining in Fig. (iii) are shown below: -

Distant:	(Y) 0 degrees for stopping at the down gate signal.
	(G) 90 degrees for stopping at the down Home
Gate Signal:	(R) 0 degrees for stopping at the signal (level crossing open for road traffic)
	(Y) 45 degrees for stopping at Home and for entering loop.
	(G) 90 degrees for entering main on the assumption that BD between Home and the Starter exists.

The aspects required for conditions obtaining in Fig. (ii) are shown below:

Distant:	(Y) 0 degrees for stopping at the down gate signal.
	(YY) 45 degrees for stopping at down Home.
	(G) 90 degrees for stopping on Main or Loop
Down Gate Signal:	(R) 0 degrees for stopping at the signal.
	(Y) 45 degrees for stopping at down Home and for entering loop
	(G) 90 degrees for entering Main Line.

18.8 Control of level crossings in Automatic Signalling sections: BOARD'S DIRECTIVE: (Board's letter No.77/W3/SG/LX/2 dated 16.3.79)

(a) All level crossing gates shall be interlocked irrespective of the classification.

(b) All level crossings shall be provided with warning Bells operated by the approaching trains.

(c) Approach locking should be provided on the control lever of the level crossing so that, only when the portion of the track/tracks between the level crossing and the signals protecting the level crossing are clear, can the gates be opened.

(d) Flashing lights to be provided.

It may be seen from the above that all the Level Crossings in Automatic Signalling sections shall be interlocked, provided with Warning Bells and approach locking. In addition, as per extant directions in vogue, lifting barriers are to be provided.

The lifting barriers at the Level crossings can be operated locally either by winches or by electric motor. In busy sections where automatic signalling is provided, the lifting barriers are electrically operated for quicker operation thereby eliminating the mechanical wire transmission required for operating barriers from the winches.

(i) Interlocking: Interlocking of Level Crossing gates in automatic signalling territory is compulsory for protection of Rail and Road traffic. Signals at adequate distance from the level crossing shall be provided on either side and the signals can be cleared only after the Level crossing is closed and locked against road traffic.

The gate signals thus controlled by Level Crossings have `A' Marker lights in addition to `G' Marker disc. The `A' Marker light will be lit only after the Level crossing is closed and locked against road traffic. Normally no train shall pass a signal at `ON' without proper authority when `A' Marker light is extinguished. But where `A' Marker light is provided in conjunction with `G' Marker disc and `A' Marker light is not burning, the driver is authorised to pass the gate signal at `ON' after stopping the train at the signal for one minute by day and two minutes by night and then proceed cautiously to stop short of the Level Crossing to ascertain the cause. If the L.C gate is closed, the driver may start the train and proceed cautiously upto the next signal and then obey the aspect of the next signal. If, however, the Level Crossing is not closed due to gateman not being available or for any other reason, the driver will ensure the closing of the Level Crossing gates against road traffic before passing the Level Crossing and arrange for opening the Level Crossing for road traffic after passing the Level Crossing completely.

If however `A' Marker light is lit, with the Signal at `ON' the driver need not stop at the Level Crossing but proceed as per the normal rules pertaining to automatic signals.

(ii) WARNING BELLS: Provision of Warning Bells is compulsory at all level crossings in Automatic Signalling sections. The Warning Bells shall be operated by approaching trains and, track circuits are used for this purpose. The treadles or track circuits are provided at appropriate distances from the Level Crossing to enable the gateman getting the warning of the approaching train well in advance so that the Level Crossing can be closed and locked immediately and gate signals cleared. The warning distances shall be so judiciously chosen that

- The level crossing is not closed too early; affecting the road traffic
- The clearance of the signal is not delayed affecting the train traffic

(iii) APPROACH LOCKING: Directives stipulate that all the Level Crossings in automatic signalling sections are approach locked. Generally a single lever frame is provided at the Level Crossing for operating the lifting barriers. The lever when reversed feeds the electric motor of the lifting barrier and causes the Lifting barrier to lower across the road. When the boom is lowered, the circuits for clearing of signals are completed and the signals are cleared.

When it is necessary to raise the lifting barrier for road traffic to pass over the crossing, the lever must be placed to its normal position. This can only be done if there is no train in the immediate vicinity. If a train has approached as near as to have passed beyond the service braking distance i.e. a point of hundred metres on the approach side of the signal at which the first warning aspect is given, the lever can only be replaced to their normal check lock position and it should not be possible to restore it to its full normal position. The lifting barrier will, therefore, remain locked although the protecting signal aspects may have been returned to `ON'.

Flashing Lights are provided at the Level Crossing with lifting barrier to warn the Road Traffic when a train is approaching the level crossing with gates open. When the gates are closed, the flashing lights become steady.

Note:

1. *All level crossing gates irrespective of classification, on Automatic sections Single/Double, Treble and Quadruple lines shall be interlocked and provided with warning bells operated by approaching train. In addition, Approach locking to be provided on control levers.*
2. *Flashing lights to be provided, where power supply is available, at all important level crossing gates provided with lifting barriers.*

(iv) EXCEPTION: Non-interlocked `B' and `C' class gates with heavy traffic can be kept normally open to Road Traffic provided the following conditions are satisfied:

- The level crossing should not be on a suburban section.
- The section concerned should not have automatic block signalling.
- Level crossings should be equipped with lifting barriers.
- The level crossings should be provided with a telephonic connection with the Station Master and should have a system of exchange of private numbers.
- The Railway track at the level crossing should be straight on either side to afford a clear view of an approaching train.
- As long as the gate is kept open to road traffic a red flag by day and red light (by using Trolley Lamp) during night should be displayed towards the approaching trains on either side of the level crossings.
- The level crossing shall be provided with whistle Boards on either side at adequate distance to enjoin the drivers of approaching train to give audible warning of the approach of the train to the road users.

REFERENCES:

(a) Rly.Board's letter No.77/W-3/SG/LX/2 dated 16.3.79.

(b) Rly.Board's letter No.77/W-3/SG/LX/2 dated 01.11.80.

(c) Rly.Board's letter No.83/W1/LX/16 dated 26.02.83.

(d) RAIC 1968 para 121 (Board's letter No.77/W3/SG/LX/2/0 dated 17.7.80

Review Questions

Subjective Questions

1. What is an interlock gate and classify the LC Gate on the Basis of department of operator, type of barrier and TVU?
2. Draw lay out of an interlocked LC gate in block section and indicate location of signal, boards and markers.
3. Draw lay out of an interlocked LC gate located between starter and advance starter on double line station provided with MACLS and write down signal to be interlocked with Gate.

Objective Questions

State true OR false

1. If LC Gate is interlocked with advance starter then a G maker shall be provided bellow advance starter. (False/ True)
2. Permissible distant between the LC Gate and place of operation is 150 Mts. (False/ True)
3. Interlocked gate signals shall be located at block overlap (False/ True)
4. If gate is within overlap of a home signal but beyond 180 Mts from starter then home signal can taken to OFF even though LC Gate is in open condition (False/ True)

* * *

CHAPTER 19: SECTION CAPACITY

19.1 The maximum number of trains that can be dealt on a given section of Railway during the period of twenty four hours is called the Section Capacity. This is calculated as number of trains that can be run each way on single line during this period. On double line sections it is worked out separately. A train takes some amount of time to run between two block stations. This is called "Running time of the train". In addition to this time there is little more time is required for the purpose of closing the section by normalising the signals and points behind the train and reporting to the station in rear, granting/receiving line clear for the next train, setting route taking `off' signals etc. This additional time is taken as 5 minutes and is called the "Block Operation Time". For calculating section capacity, total time of 24 hours is divided by "Running Time" of any slowest train over this section, plus "Block Operation Time".

Scott's formula is the simplest for this purpose which is as under:

Scott's FORMULLA:

$$C = \frac{1440}{T + t} \times E \times 1/2$$

Where, C = Section Capacity

T = Running Time of slowest train

t = Block operation time

E = Efficiency factor (80)

Calculating the section capacity on the basis of above formula taking into consideration of slowest train on the section which would generally be a goods train. EX GIP Railway, refined this formula further and calculated the available capacity for running of goods train. In this formula the total time consumed in running of passenger trains is deducted from the total time available to calculate how many trains that can be run in the remaining time. The formula is as under:

$$Cg = \frac{1440 - (Tp + t)}{Tg + t} \times K \times ½$$

In this formula efficiency factor (K) is taken as 50% as number of gaps between passenger trains may not be usable for running of goods trains. South Eastern Railway had employed once an American consultant to suggest more accurate formula for working out the section capacity. This formula is known as STEINBECK's formula which is as under:

$$C = \frac{1440}{S} \times y$$

Where, S = Ta + Tb + 0 + W

Ta = Running time on `a' side

Tb = Running time on `b' side

0 = Block operation time for two trains

W = Waiting time for next train

y = Efficiency factor (70)

All these formulas are however, theoretical and do not take into consideration of physical features over the entire section.

Indian Railways therefore adopt charting method which is the most practical way of assessing section capacity. For this purpose, running of trains is plotted on time-distance graph relating to the section. The time of all scheduled passengers trains are plotted on the graph and in the gaps between different scheduled trains as many goods trains are inserted as possible to give the maximum section capacity.

19.2 Section capacity mostly depends upon proper evaluation and detailed study of present and future traffic requirements to obtain the optimum utilisation of fixed assets. On single line section the line capacity can be augmented by improving `T' and `t' of Scott's formula, as well as the `E' factor, T can be reduced by

(a) Reducing the length of block section by providing additional crossing stations.

(b) Increasing speed by providing better mode of traction, tracks, rolling stocks and signalling.

`t' may be reduced by introducing

(i) Higher standard of interlocking

(ii) Tokenless block instruments

(iii) Panel interlocking

(iv) CTC and Automatic signalling

`E' (Efficiency factor) can be improved by proper time tabling, punctuality, staff efficiency, upkeep of equipments efficient operation, adequate number of loop lines, suitable length of block section by spacing of block posts or stations and IBS on double line, etc. Simplification of rules, training of staff is also the factors to improve the operating efficiency.

19.3 The ultimate objective of increasing section capacity is to carry more traffic, not merely to increase number of trains, but to effect more reliable source of remuneration as well.

* * *

CHAPTER 20: PRINCIPLES OF SIGNAL ENGINEERING

20.1 Safety of passengers and efficiency of operation being the twin purposes for which fixed signals are installed, in no other field of technology is the formulation of principles and their observance of greater importance than in the field of Signal Engineering. A consideration of its role and functions will indicate that the following may be regarded as its fundamental principles:

(a) Each and every apparatus and circuit employed in a signalling system shall be so designed that a failure is occurring in any of all the component parts of the system results in the signal or signals controlled by the system displaying their most restrictive aspects.

Explanation: This principle is being widely observed but there are exceptions. For instance, when the front contacts of a relay stick or the broken wire lock of a double wire points mechanism fails to function, unsafe failures would results, but to minimise the effect of such failures, other precautions are taken. In the case of track relays, it is ensured that relay is operating satisfactorily by making use of both its front and back contacts in vital circuits having a close time sequence. In regard to broken wire locks, the detector is used also to function as a lock. A constant endeavour is being made to comply with this principle by improving upon the techniques employed.

(b) Reliability, simplicity and expansive capabilities shall be important consideration in the design of apparatus, circuits and systems.

Explanation: The specifications for signalling apparatus employed in vital circuits are far more exacting then the specifications for similar apparatus employed in other fields. Unless maximum reliability is provided, frequent failures will cause serious delays to the movement of trains and in cases where the first principles cannot be complied with lead to serious accidents.

Simplicity is essential to facilitate easy maintenance without having to interrupt traffic and affecting quick repairs. As traffic density grows, the size of the signalling system will correspondingly increase. It should be possible to begin with a system of small size and extend it to meet changing conditions. Only if the system originally employed has expansive capabilities, will it serve the interests of economy.

(c) The aspects of fixed signals shall be distinctive and unambiguous.

Explanation: Aspects of fixed signals should obviously, be capable of being readily and unmistakably determined. There should be no possibility of one aspect being mistaken for another.

Signals are, as far as possible, located to the left of and adjoining the track to which they refer. In the case of converging roads, there is a separate signals for each line located in rear of the fouling point to afford maximum protection to opposing movements. In the case of diverging junctions, there should only be one post, and the signals mounted on this post so arranged as to be applicable to the lines on consecutive order from left to right, the signal at the left extreme being applicable to the extreme diverging line. Signals applicable to the through line are placed higher than the signals applicable to other lines.

(d) One aspect shall have but one name and one indication, conversely for a given indication the same aspect shall be used everywhere and at all times.

Explanation: A given signal aspect must transmit the same indication at all times, at all places and under all conditions, so that a driver will know instantly what it means and whether or not it is properly displayed.

(e) The action required by a signal indication shall be definite and capable of easy implementation.

Explanation: This is an important principle. The indication of proceed aspect must be clearly and unambiguously stipulated in the rules, preferably in terms of the speed at which the signal in advance may be approached. The point at which action on an indication should commence must be well defined and not left to the driver's discretion. Signals should be so located with respect to each other that the indication of a signal displaying a restrictive proceed aspect can be complied with by means of a normal brake application initiated at the signal itself and as a result either the train comes to a stand without undue loss of speed at the signal in advance displaying stop or the speed is reduced to the rate prescribed for the signal in advance, where reduced speed is required.

(f) Each and every signal shall afford the sighting distance required, of it.

Explanation: For obvious reasons this principle supersedes the older assumption that every signal shall afford the maximum possible sighting distance.

(g) The number of fixed signals provided shall be the minimum for each *route.*

Explanation: This supersedes the older assumption that the number of signals in a yard should be the minimum. The correct principles is that the number of signals per route should be the minimum required to obtain a given track capacity.

(h) The overlaps required for each system of aspects shall be clearly specified.

Explanation: Although the proceed aspect of a signal authorises the movement of a train at the speed indicated by its aspects only upto the signal next in advance, a specified overlap distance in advance of a stop signal must also be maintained clear before the stop signal in rear can display a proceed aspect. While the overlaps in the two-aspect system may be chosen arbitrarily having regard to practical considerations, there should be a gradual reduction in the overlaps as the number of aspects increase.

* * *

Annexure 1
INTERMEDIATE SIDINGS

App1.1 INTRODUCTION

Sidings taking off from running lines and located between block stations known as outlying or intermediate sidings. The most frequent justification for siding is either a ballast or stone quarry when the siding is used for departmental purposes or to serve an industry located too far away from a block station when it is known as an assisted siding.

The problem is to afford adequate protection to the siding points inserted on the running line. Working the siding as a block station is the simplest and the best solution from the safety point of view, but is at the same time the most expensive initial as well as recurring costs. This solution is, therefore, adopted only where movements over the siding are too frequent and/or in the case of double line sections in which access into and out of the sidings have to be provided from both main lines Up and down. In this context, it may be mentioned that the switching out of block stations when not in use during certain portions of the day is comparatively easier in double line than in single line, a subject which will be dealt with separately.

An outlying siding location is not, for reason of economy manned. The responsibility for movements into and out of sidings and most important of all, after such operations are completed, for ensuring that the running line or lines are clear and then the correct re-setting of the points to the normal position (i.e. for the running lines) is placed on the guard of the train entering or coming out of the siding. In U.K. the use of track circuits to prove that running lines are clear is compulsory but not yet in India. Therefore, the points of outlying siding whether facing or trailing whether in double line or single line is not permitted to remain un-interlocked.

App1.2 Minimum Equipment

The minimum equipment prescribed for points is as for Standard I without detection (since the provision of fixed signals is not compulsory) as shown below: -

Facing Points, Single and Double Line:

A gauge tie plate where steel sleepers are not provided a facing point lock, or equivalent mechanism, the plunger of which shall lock each switch independently. The control of the points shall be by means of key or other suitable device which must secure the bolting mechanism of the point in the plunged or locked position when the points are set and locked for the running line.

A speed restriction of 50 KMPH is imposed for all movements on the running line over facing points. Where the section speed is higher than this, the restriction is indicated by a `S' marker at the points, Speed indicator placed not less than 30m in rear of the marker, A caution and termination indicators. (See 17.2) neither of which need be lighted.

Where the sanctioned speed of the section does not exceed 50 KMPH, the marker at the points and the indicators need not be provided. (SEM-1988 para 7.75.3).

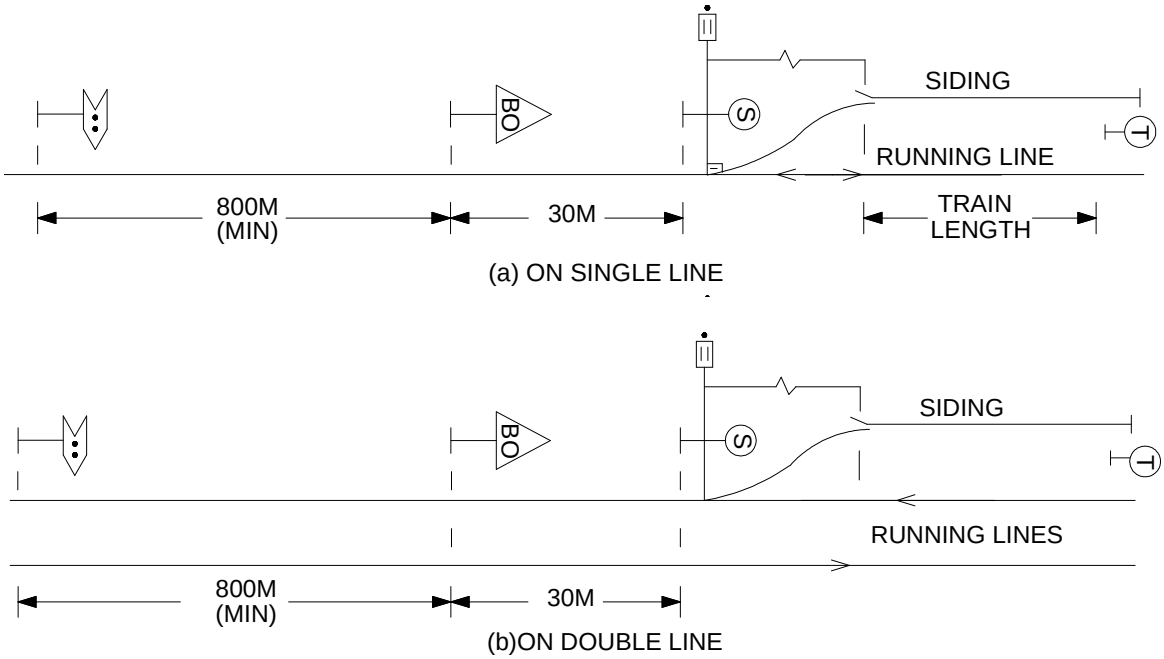


Fig. App1.2 Facing Point of Outlying siding, minimum requirements using 'S' marker and speed indicator for speed higher than 50 KMPH

App1.3 Trailing points, double line

A gauge tie plate where steel sleepers, are not provided, a suitable type of key lock or equivalent mechanism, the key of which can only be extracted when the points are set and locked for the running line, an `S' marker at the points which need not be lighted. No speed restriction is imposed as points are trailing. See figure.

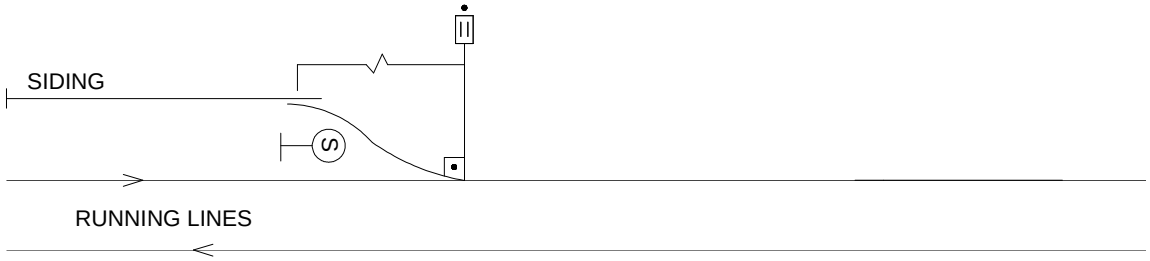


Fig.17.3 Trailing Points of outlying sidings Double line provided with minimum equipment (No speed restriction)

App1.4 Equipment for speeds over 50 KMPH

If the speed restriction of 50 KMPH over facing points is to be avoided the point equipment should conform to Standard III requirements and a stop signal adjacent to the points detecting each switch and facing point lock or equivalent mechanism provided. A Warner or Warning Board should also be provided at minimum B.D. in rear of the stop signal in the case of 2 aspect signalling and a distant in the case of MAUQ.

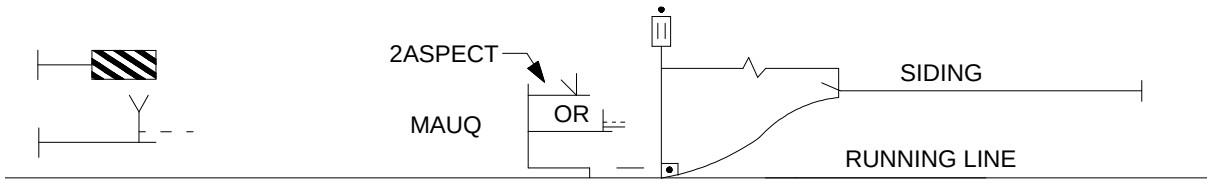


Fig. App1.4 Facing points of outlying sidings Single or Double line signalling for speed above 50 KMPH

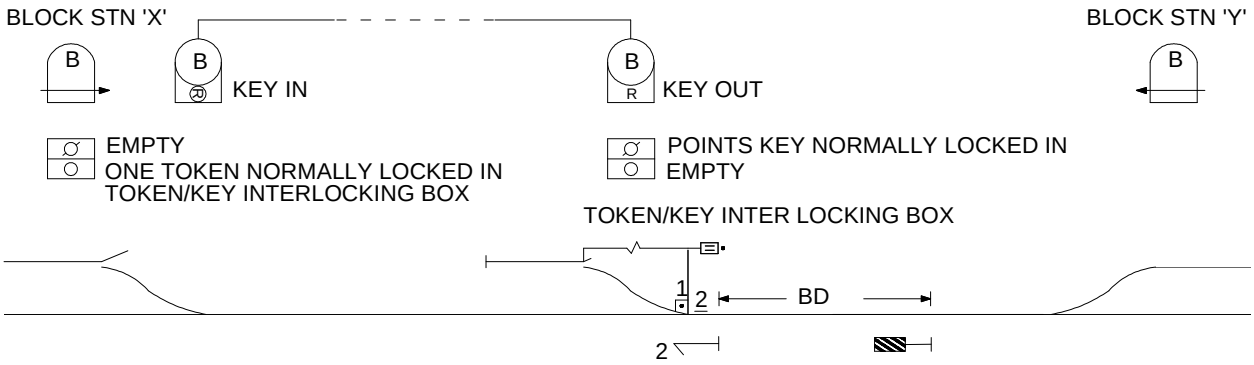
App1.5 Points control through Block Instruments

The rules stipulate that the points should be controlled through the block system in use only in the case of facing points on the single line over which there is no speed restriction. It also recommends, as a desirable practice for a similar provision in the case of facing points over which a speed restriction of 50 KMPH is imposed, as well as, in the case of double line trailing points. In actual practice, however, wherever single line block instruments are available, the points which are normally set and locked for the running line are released by token and in the case of trailing points on the double line, railways device their own methods of controlling the points through the block instruments of the section. Where block instruments are not in use, approved special instruction describing the working and control of the siding, are included in the working rules of the adjacent station (known as the parent station) which controls the movements into and out of the siding.

In the case of sidings located on busy sections, in which shunting has to be performed, it would be of advantage to provide means for clearing the section after a train has been berthed in the siding. On the double line as the Lock & Block instruments cannot be restored to the normal position until and unless the train has actuated a treadle or T.C. located near the Home Signal of the receiving station, the section cannot be cleared with the train berthed in the intermediate siding. Interlocking may, however, be provided between the block instruments and the points so that the points cannot be unlocked without the block instruments being in the T.O.L position. Should the facility of clearing the block section with a train berthed in the intermediate siding be considered necessary, the intermediate siding is worked as block station and switched out when the use of the siding is not required. There are, however, double line block instruments which provide for an occupation key to enable trains to enter Block Section in the right direction and return to the same station. This occupation key when removed from the instrument locks the instruments in the normal position. In such cases the occupation key may be exploited for sending trains into intermediate siding and clearing the section after the train is berthed in the siding. This train can only return to the station from which it entered the block, travelling in the wrong direction. The arrangements in force in one railway on sections fitted with Carson's instruments are shown in the figure.

In the case of single line sections, two alternative methods are available for clearing the block section with a train berthed in the intermediate siding, which is briefly dealt below:

App1.6 Based on the use of token/key interlocking boxes and electrically transmitted keys. Please see figure. Block Section is X - Y with a siding between stations X & Y. At station X a token key interlocking box with a spare token locked in it and at the siding, a similar box, but with the points key locked in it are provided. An HKT circuit is provided between Station X and the siding, a key is locked in the HKT at X and, therefore, there is no key in the HKT and at the siding. A train proceeds from X or Y with a token and is stopped at the siding and the token is exchanged for the points key on the token key interlocking box, the points key is used to unlock the points the train then enters siding. The points are then reset in normal; and after ensuring that the running line is clear, the key is transmitted to X. The key is exchanged at X for a token (in the token exchanger at the Station) which is used to clear the section. When the train has to come out of the siding, the guard informs X on the telephone of the fact X obtains a token exchanges it for the key and transmits the key to the siding. The key is used for unlocking the siding points, the train enters the running line, the points are reset to normal and the key released from the points exchanged for the token originally deposited in the token key interlocking box. The train proceeds with the token to either X or Y. This system allows of a train either from `X' OR `Y' using the siding and the train from the siding proceeding to either `X' or `Y'. The disadvantages are (1) only one train can be dealt with in the siding at a time and (2) at least two line wires one for HKT circuit and the other for telephone are required between X and the siding.



1. Points key from token/key interlocking box releases lock on lever No.2 which works SPL & Signal FPL can be plunged when points are for the Main line Telephone provided between Siding and station 'Y'

2. Single line section using token/key interlocking boxes electrically transmitted keys.

Fig. App1.6 Points Control Through Block Instrument (Intermediate Siding)

App1.7 Based on the use of two auxiliary block instruments

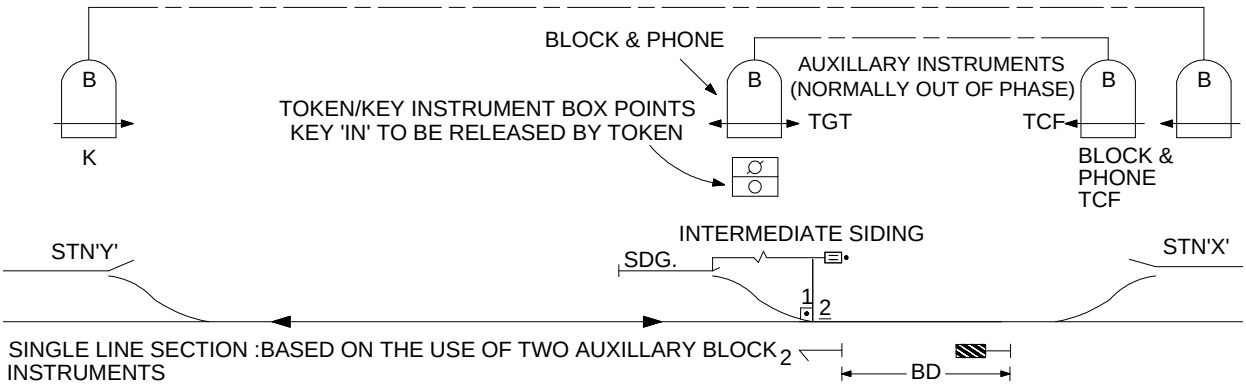


Fig. App1.7 Points Control Through Block Instrument (Intermediate Siding)

A separate auxiliary block instrument circuit is established between station X and the siding, the instruments being of the same type as used in X and Y, but arranged to be out of phase so that a token cannot be extracted from either of the two. A token key interlocking box in which the points key is normally locked is provided at the siding.

A train from either X or Y may proceed to the siding. On arrival at the siding the token is exchanged for the points key. After the train enters the siding and the running line is ensured to be clear, points are reset and locked normal and the key exchanged for the token. The token is then inserted into the block instrument which brings the pair of auxiliary instruments in phase and enables a station X to extract a token from the auxiliary instrument at his station. This token is then used for clearing the section on the block circuit X-Y. The auxiliary instruments are now again out of phase. A similar procedure is adopted for coming out of the siding. This system permits any number of trains being berthed in the siding but requires an extra line wire for the extra pair of block instruments.

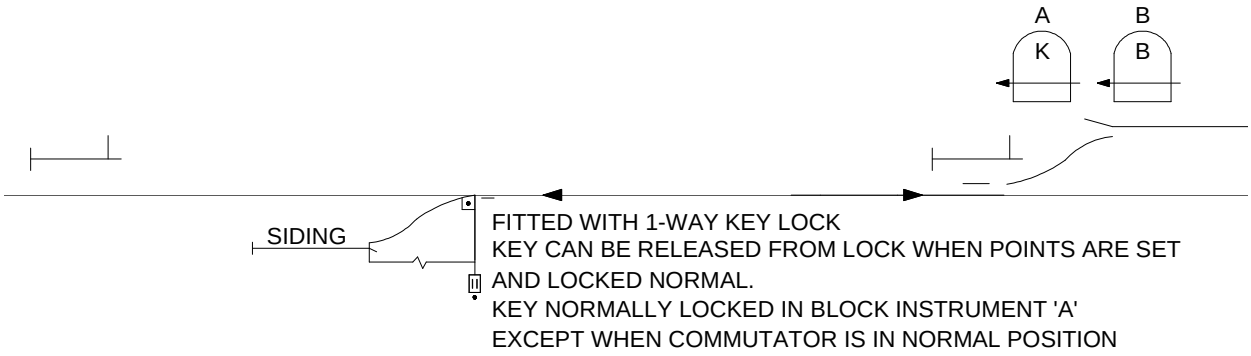


Fig. App1.8 Control of Siding within Station Limit of Un-Interlocked Station

App1.8 General

As a precaution against unauthorised interference, all bolts, studs pins, etc of apparatus used for locking and control of siding points are rivetted over or otherwise adequately secured.

In view of the rule that all passenger running lines must be isolated from goods and stabling lines, isolation must be provided and the isolating traps locked for all movements on the running lines at all outlying sidings. A trap indicator has to be provided but it is not lit during night hours.

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