

Introduction

Railway tracks can be maintained either conventionally by manual labour or by the application of modern methods of track maintenance such as mechanical tamping or measured shovel packing. In India, maintaining tracks has traditionally been a manual activity and the 'calendar system of maintenance' has taken deep roots. In this system, a timetable or programme that outlines the track maintenance work to be done by the gangs in the course of a year is drawn out and generally followed. As per the timetable or calendar, the 12-month cycle of maintenance consists of the following operations.

- (a) Through packing
- (b) Systematic overhauling
- (c) Picking up slacks

This chapter discusses these operations together with the organizational structure of track maintenance incorporated by Indian Railways.

18.1 Necessity and Advantages of Track Maintenance

The railway track should be maintained properly in order to enable trains to run safely at the highest permissible speeds and to provide passengers a reasonable level of comfort during the ride. Track maintenance becomes a necessity due to following reasons.

- (a) Due to the constant movement of heavy and high-speed trains, the packing under the sleepers becomes loose and track geometry gets disturbed. The gauge, alignment, and longitudinal as well as cross levels of the track thus get affected adversely and the safety of the track is jeopardized.
- (b) Due to the vibrations and impact of high-speed trains, the fittings of the track come undone and there is heavy wear and tear of the track and its components.
- (c) The track and its components get worn out as a result of the weathering effect of rain, sun, and sand.

A well-maintained track offers a safe and comfortable journey to passengers. If the track is not maintained properly, it will cause discomfort to the passengers and in extreme cases may even give rise to hazardous conditions that can lead to derailments and a consequential loss of life and property. Track maintenance ensures

that such situations do not arise. The other advantages of track maintenance are as follows.

- (a) If the track is suitably maintained, the life of the track as well as that of the rolling stock increases since there is lesser wear and tear of their components.
- (b) Regular track maintenance helps in reducing operating costs and fuel consumption.
- (c) Small maintenance jobs done at the appropriate time such as tightening a bolt or key, hammering the dog spike, etc., helps in avoiding loss of the concerned fitting and thus saving on the associated expenditure.
- (d) When track maintenance is neglected for a long time, it may render the track beyond repair, calling for heavy track renewals that entail huge expenses.

18.2 Essentials of Track Maintenance

Gauge, level, alignment

As mentioned earlier, a well-maintained track provides the base for a safe and comfortable journey. Therefore, for a track to serve its purpose well, the following characteristics are required of it.

- (a) The gauge should be correct or within the specified limits
- (b) There should be no difference in cross levels except on curves, where cross levels vary in order to provide superelevation
- (c) Longitudinal levels should be uniform
- (d) The alignment should be straight and kink-free
- (e) The ballast should be adequate and the sleepers should be well packed.
- (f) There should be no excessive wear and tear of the track and all its components and fittings should be complete.
- (g) Track drainage should be good and the formation should be well maintained.

To achieve these standards, the major maintenance operations performed in a calendar year are described in the following sections.

18.2.1 Through Packing

Through packing is carried out in a systematic and sequential manner as described here.

Opening of road The ballast is dug out on either side of the rail seat for a depth of 50 mm (2") below the bottom of the sleeper with the help of a shovel with a wire claw. On the outside, the width of the opening should extend up to the end of the sleeper. On the inside, it should extend from the rail seat to a distance of 450 mm (18") in the case of BG, 350 mm (14") in the case of MG, and 250 mm (10") in the case of NG.

Examination of rails, sleepers, and fastenings The rails, sleepers, and fastenings to be used are thoroughly examined. Defective sleepers are removed and loose fastenings are tightened. Any kinks in the rails are removed using a Jim Crow.

Squaring of sleepers The sleepers get out of square quite frequently resulting in gauge variations and kinks. To avoid this, one of the rails is taken as the sighting rail and the correct sleeper spacing is marked on it. The position of the sleeper is

checked with reference to the second rail with the help of a T-square. The sleepers are attended to after their defects have been established, which may include their being out of square or at incorrect spacing.

Aligning the track The alignment of the track is normally checked visually, wherein the rail is visually assessed from a distance of about four rail lengths or so. Small errors in the alignment are corrected by slewing the track after loosening the cores at the ends and drawing out sufficient ballast at the end of the sleepers. Slewing is carried out by about six people by planting crowbars deep into the ballast at an angle not exceeding 30° from the vertical.

Gauging The gauge should be checked and an attempt should be made to provide a uniform gauge within permissible tolerance limits. Table 18.1 lists the tolerances prescribed for gauge variation, keeping in mind the side wear that occurs at the time of laying of tracks. This is done to ensure a comfortable ride for the passengers, provided that uniform gauge can be maintained over long lengths.

Table 18.1 Gauge tolerance for different tracks

<i>Type of track</i>	<i>Gauge tolerance for BG</i>	<i>Gauge tolerance for MG and NG</i>
Straight track	-6 mm to +6 mm	-3 mm to +6 mm
On curves with radius more than 400 m for BG, 290 m for MG, and 175 m for NG	-6 mm to +15 mm	-6 mm to +15 mm
On curves with radius less than 400 m for BG, 290 m for MG, and 175 m for NG	Up to + 20 mm	Up to + 20 mm

The gauge is adjusted in accordance with the type of sleeper under consideration as described in the following.

Wooden sleepers In the case of wooden sleepers, gauge adjustment is possible only by removing the dog spikes and refitting them at a new location. Therefore, gauge adjustment should be avoided as far as possible unless the gauge is quite irregular. When the gauge must be adjusted, all the spikes on the inside and half of those on the outside are removed while the remaining half are loosened. The old spike holes are plugged and new holes are bored in correct places. The gauge on each sleeper is adjusted and the spikes are re-driven.

Steel trough sleepers In the case of steel trough sleepers, gauge adjustment is done with the help of keys. When the gauge is slack, the keys on the inside are loosened while those on the outside are driven. The procedure is reversed when the gauge is tight. The maximum possible adjustment of the gauge is 2.5 mm to +4.0 mm.

CST-9 sleepers In the case of CST-9 sleepers, gauge adjustment is done with the help of cotters. Normally a gauge is adjusted by ± 5 mm. The maximum extent to which a gauge can be adjusted -3 mm to +10 mm. It has been noticed that adjusting the gauge may sometimes disturb the alignment, which is taken care of prior to

gauging as per the standard practice. In such cases, the track has to be realigned once gauging is completed.

> **Packing of sleepers**

The base rail is identified by the mate and the dip or low joints are lifted correctly to ensure that the longitudinal level of the rail is perfect. The sleepers are then packed by applying the *scissors packing method*. Four men tackle one sleeper simultaneously, two at each rail. The ballast under the sleeper bed is properly packed by the men who stand back to back and work their beaters diagonally by lifting them up to chest level. While the packing is being carried out, the second rail is brought to the correct cross levels thereby ensuring perfect surfacing of the track. In the case of wooden and steel trough sleepers, it should be ensured that the sleepers are not centre-bound and that as such the trough is made in the ballast section at the centre of the sleepers. After packing is completed, the alignment and top should be checked carefully and minor adjustments made as needed.

Repacking of joint sleepers The joint sleepers are then packed once again and the cross levels checked.

Boxing ballast section and dressing Afterwards the ballast section is properly boxed and dressed with the help of a special template. The cess should also be dressed or covered similarly and its level maintained in a way that proper drainage is ensured. Through packing follows a programme which requires that it is undertaken after the monsoon and that it extends from one end of the section to the other. Through packing must be carried out at least once every year.

A gangman normally accomplishes about 11 m to 12 m of through packing on BG, 16 m to 17 m on MG, and 23 m to 24 m on NG tracks.

18.2.2 **Systematic Overhauling**

The track should be overhauled periodically with the object of ensuring that the best possible standards of track conditions are met and maintained. The systematic overhauling of the track should normally commence after the completion of one cycle of through packing. It involves the following operations in sequence.

- (a) Shallow screening and making up of ballast section
- (b) Replacement of damaged or broken fittings
- (c) All items included in through packing
- (d) Making up the cess

The frequency of overhauling depends upon a number of factors such as the type and age of track structure, the maximum permissible speed and volume of traffic, the mode of traffic, the mode of traction, the rate of track deterioration, and the amount of rainfall in the region. On the basis of these factors the chief engineer decides, the length of the track to be overhauled but normally the plan is so drawn that the systematic overhauling of a section is completed in about 3 to 4 years. The stretch of track to be tackled in a particular year should be in continuation of the

Lubrication of rail joints

The lubrication of rail joints is an important part of the work done on the permanent way and is incidental to systematic track maintenance. Joints are lubricated for the following purposes.

- (a) To allow for free expansion and contraction of rail
- (b) To reduce wear and tear on the fishing planes of rails and the fish plates

All rail joints, are lubricated once a year during the moderate season. This is also known as the *oiling and greasing of fish plates*. This work is not done during the rainy season. The lubricant used is a paste of workable consistency that consists of the following proportions of plumbago, kerosene oil, and black oil.

Plumbago (dry graphite) 5 kg

Kerosene oil (second quality) 3.5 L

Black or reclaimed oil 2.75 L

For 100 joints of 52 kg/90 R or for 125 joints of 75 R/90 R sometimes only plumbago and kerosene oil are used in the ratio of 3:2 for lubricating fish plates. Black oil is, however, used for oiling fish bolts and nuts.

Rail joints should be lubricated only after ensuring that their surfaces are properly cleaned, preferably with the help of wire brushes and clean jute. Joints should not be lubricated in extreme temperatures or when the rails are in tension as a result of creep. Joints should be opened one at a time for lubrication. Even when opening a joint, only one fish plate should be tackled at a time and at no time during the operation should there be less than one fish plate and three fish bolts connecting the two rails.

18.2.3 Picking up Slacks

Slacks are those points in the track where the running of trains is faulty or substandard. Slacks generally occur in the following cases.

- (a) Stretches of yielding formation
- (b) Poorly maintained sections that have loose packing, bad alignment, and improper longitudinal and cross levels
- (c) Improperly aligned curves
- (d) Approaches to level crossings, girder bridges, etc., particularly in sags
- (e) Portions of track with poor drainage
- (f) Sections with an inadequate or unclean ballast cushion
- (g) Other miscellaneous reasons

In every working season, a certain number of days in each week (normally one or two days) are allotted to the picking up of slacks, depending upon the monsoon pattern and other local conditions. However, no through packing is done during the rainy season and slacks are only picked up in order to keep the track safe and in good running condition. In areas with less than 750 mm of rainfall, the allotted time may not be used only to attend to the slack but also to carry out through packing.

18.3 Measuring Equipment and Maintenance Tools for Tracks

The measuring equipment and tools commonly used for track maintenance, together with their purpose, are presented in Table 18.3. Sketches of some of the tools used for the maintenance of tracks are given in Fig. 18.1.

Table 18.3 Measuring equipment and maintenance tools

<i>Name of equipment/tool</i>	<i>Function</i>
<i>Measuring equipment</i>	
Rail gauge	To check the gauge
Straight edge and spirit level	To check the alignment as well as the cross level
Gauge-cum-level	To check the gauge as well as the cross level
Cant board	To check the difference in cross levels or the superelevation
Mallet or wooden hammer	To check the packing of the sleepers
Canne-a-boule	A modern equipment used to assess the voids under the sleepers
T-square	To check the squareness of sleepers
Stepped feeler gauge	To measure wear or clearances
<i>Maintenance tools</i>	
Sleeper tong	To carry sleepers
Rail tong	To lift and carry rails
Beater	To pack ballast under the sleeper
Crowbar	To correct track alignment and to lift the track for surfacing. Clawed crowbars are used for taking out dog spikes.
Jim Crow	To bend or break the rails
(a) Spiking hammer	To drive spikes
(b) Keying hammer	To drive keys
Spanner	To tighten bolts
Wire claw or ballast rake	To draw or pull out ballast while screening, packing, etc.
Phowrah (shovel)	To cut earth or to pull out ballast
Auger	To bore holes in wooden sleepers
Box spanner	For driving rail screws or plate screws
Wire basket	For screening the ballast
Pan iron motor	For leading earth/ballast

- (d) By dehogging the rail, i.e., removing the vertical bends on the reverse side of the rail with the help of a dehogging machine.

18.4.2 High Joints

High joints result in a very uncomfortable ride on the track. High joints are the outcome of the following.

- (a) Changes in track structure, e.g., provision of wooden sleepers in a track that is normally laid with metal sleepers. Since it is easier to maintain wooden sleepers as compared to metal sleepers, this discrepancy in the type of sleepers results in high joints, which in turn produces the effect of camel back riding.
- (b) Sinking of intermediate sleepers
- (c) Overpacking of joint sleepers

This defect is removed by lifting and packing the intermediate sleepers.

✓ 18.4.3 Blowing and Pumping Joints

A joint is called a *blowing joint* when it blows out fine dust during the passage of a train. The surroundings of such a joint are always coated with fine dust. A blowing joint becomes a *pumping joint* during the rainy season when it pumps out mud and water from the mud pockets formed below the joint. This defect is caused because of poor maintenance of the joint, particularly of the packing of the joint sleepers, unclean ballast, and bad drainage, and also sometimes due to surface defects in the rail such as scabbing. As moving loads pass over the joint, the joint sleepers get depressed and lifted up constantly. As this happens, the dust or mud gets sucked up and spreads in the vicinity of the joint. The remedy lies in

- (a) deep screening the ballast below the joint and shoulder sleepers,
- (b) packing the joint sleeper and shoulder sleepers thoroughly,
- (c) providing proper drainage at the joint,
- (d) tightening loose fittings, and
- (e) adjusting the creep, if any.

Lifting of track

Normally, lifting a track becomes necessary when the track undergoes regrading. This may be due to yard remodelling, construction of a bridge, etc., or in an effort to eliminate the sags that develop in the approaches to level crossings and bridges and at other locations made vulnerable due to defective maintenance or yielding

18.5 Deep Screening of Ballast

Deep screening of the ballast is done to ensure that a clean ballast cushion of the required depth is available below the lower half of the sleepers, which is necessary for providing the proper drainage and elasticity to the track. In the absence of a clean ballast cushion of the desired depth, track geometry may get disturbed, affecting the performance of the track.

Deep screening is normally carried out under speed restrictions without obtaining a traffic block. It is desirable to proceed with deep screening in a direction opposite to that of the traffic. An adequate quantity of ballast, the necessary equipment and tools, and the required labour should all be arranged well in time. Work should not be carried out during monsoons. The procedure for deep screening is as follows.

- (a) A group of four sleepers are tackled one at a time in sequence. As shown in Fig. 18.2, each of the sleepers (numbered 1, 2, 3, and 4, etc.) is tackled individually.

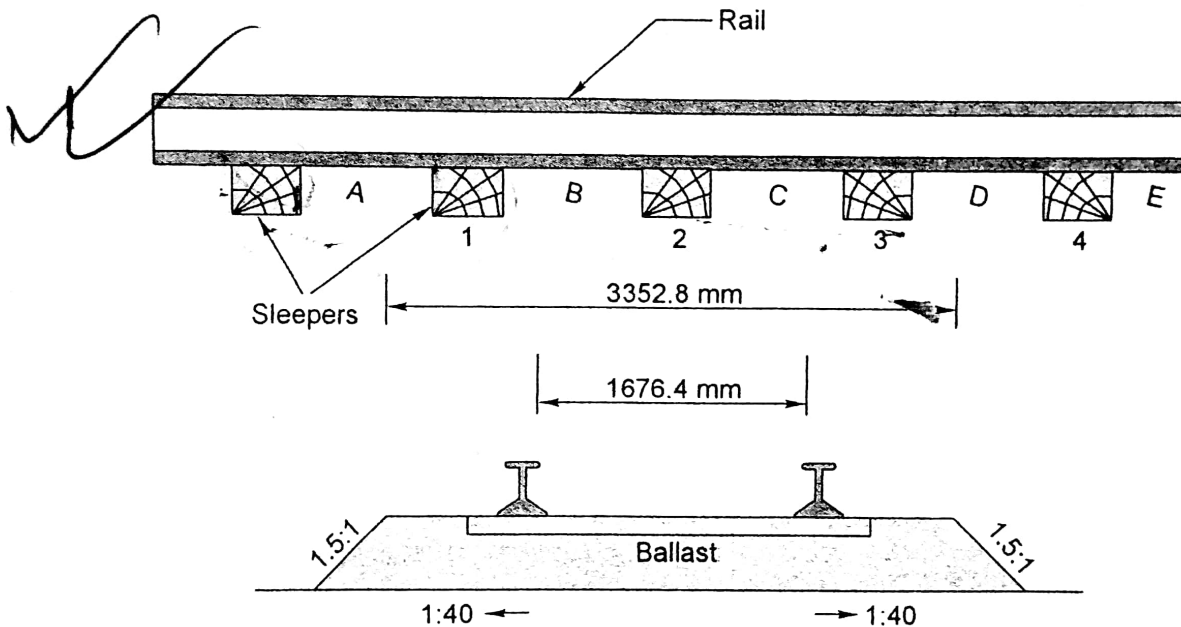


Fig. 18.2 Deep screening of ballast

- (b) The ballast from spaces A and B is removed right down to the formation and wooden blocks are put in its place to support the track. Precautions are taken to avoid digging out the consolidated top of the formation.
- (c) The ballast is removed from under sleeper 1, screened, placed under the same sleeper, packed.
- (d) The wooden block is removed from space A.
- (e) The ballast from space C is removed and placed after screening in space A. If additional ballast is required, it may be taken from the extra ballast trained out in advance along the side of the track.
- (f) The wooden block that was removed from space A is placed in space C. Sleeper 2 is provided with wooden blocks on either side in order to support the track.

Inspection diagram The PWI should maintain an inspection diagram of all inspections carried out during the month as per the schedule laid down in the pro forma and submit the same every month to the divisional engineer via the AEN, bringing out the reasons for failure in adhering to the schedules of inspections, if any.

Safety of track The PWI is directly responsible for the safety of the track. He or she should be vigilant so as to promptly locate faults in the permanent way and get them repaired without delay.

In addition to the inspections, a PWI also carries out the following duties.

- (a) To accompany high officials during their inspections along with the relevant records. The PWI should carry all the important measuring equipment such as the gauge-cum-level, flange gauges, fishing chord, tape, and inspection hammer on these inspections.
- (b) To accompany any track recording and oscillograph car that runs in his or her section.
- (c) To check the proximity of trees that are likely to damage the track and get them removed.
- (d) To check night patrolling at least once a month by train as well as by trolley.
- (e) To take the necessary safety measures while executing maintenance work that affects the safety of the track.
- (f) To rush to the site of an accident and take the necessary measures to safeguard the line and restore traffic.
- (g) To periodically inspect and supervise LWR tracks to ensure their safety.
- (h) To ensure the cleanliness of station yards.
- (i) To keep proper records of the training out of ballast.
- (j) To witness the payments made out to the staff every month.
- (k) To look after all establishment work, including the welfare of the staff working under his charge, and to maintain their service records.
- (l) To ensure the safety of the track during the execution of work that affects the track.

Based on the system of maintenance, the permanent way inspector in charge of the section should prepare detailed short-term plans covering a month's work (split into weekly programs) at least a month in advance of the commencement of actual work. The PWI should ensure that adequate arrangements have been made for the requisite tools, materials, and manpower for the allotted task and that work is executed within the specified time. The following procedure of track maintenance is followed on Indian Railways.

- (a) Each mate should be supplied with a gang chart and a gang register. The gang chart should have a record of the day-to-day track maintenance work to be done over the gang length, maintained by the permanent way inspector (PWI) according to specified instructions. The gang registers contain a record of the weekly programme of the work to be carried out, also maintained entered by the PWI in charge of the section. At the end of the week, the PWI should qualitatively and quantitatively assess the completed work and record

18.9.1 Engineering Indicators

When a track is under repair, trains are required to proceed with caution at restricted speeds and may even be required to stop. Temporary engineering indicators (Fig. 18.4) are set up at the affected portion of the track to alert the drivers to reduce the speed of (or even stop) the train and also to resume the normal speed once the affected portion has been treated. The following indicators are used.

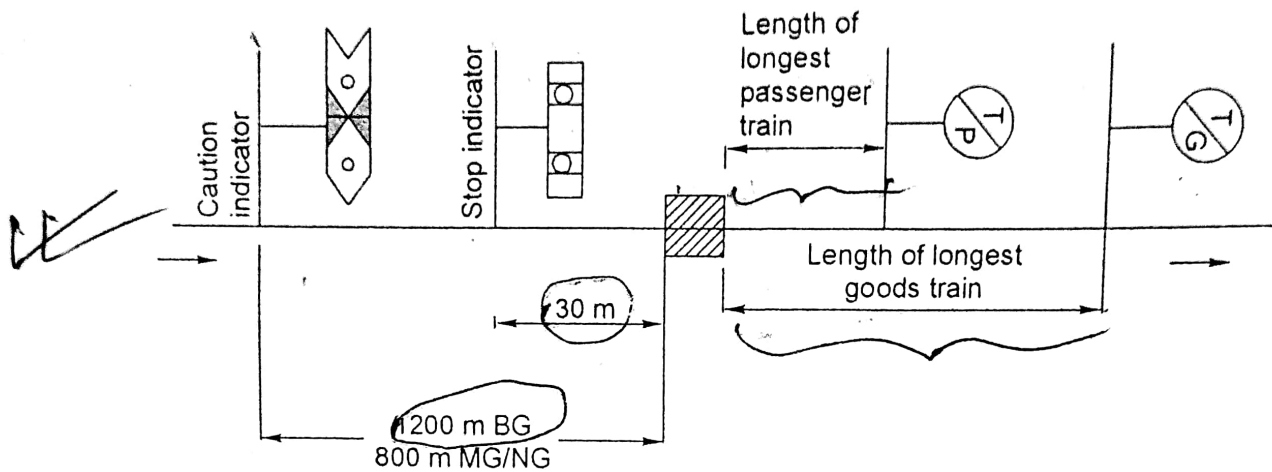


Fig. 18.4 Protection of track for works of long duration

Caution indicator This indicator cautions the driver to get ready to reduce the speed of the train (Fig. 18.5). It is placed at a distance from the stop indicator—1200 m away on BG tracks and 800 m away on MG and NG tracks.

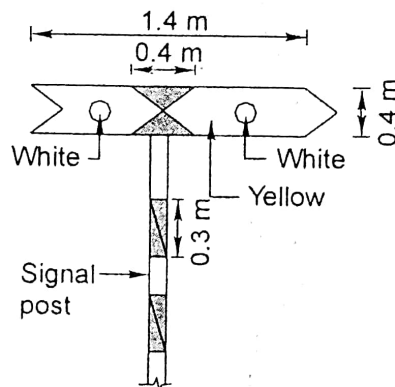


Fig. 18.5 Caution indicator

Termination indicator This signal indicates that the driver can resume normal speed and that the speed restriction zone has ended (Fig. 18.6).

Speed indicator The driver has to reduce the speed of the train at location bearing this indicator (Fig. 18.7).

Stop indicator The driver is required to stop at locations bearing this indicator (Fig. 18.8). It is normally placed 30 m away from the obstruction.

These indicators are also called *temporary fixed engineering signals* and are provided in the direction of the approaching train in the case of double-line tracks and in both directions in the case of single-line tracks. These signs or indicators should be luminous as per the latest policy of the Railway Board.