Effective Railway Track Maintenance: A Comparative Study of Methods And Techniques

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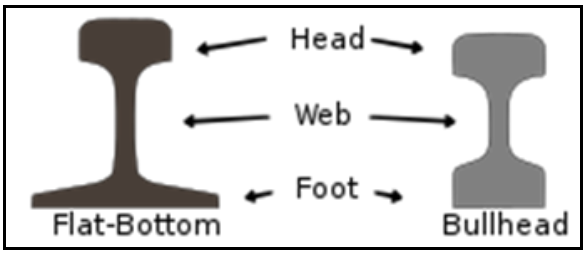
Abstract- *The rivalry between train operations and maintenance has gotten worse in recent years as a result of several causes, including increased railroad traffic, fewer route and track kilometres being used, and a growing trend towards separating ownership of the track from the management of the track infrastructure. After the train schedule and maintenance tasks have been planned, this paper discusses the creation of a model for the short-term scheduling of track maintenance activities. The model sets the track's timetable.*

To reduce overall maintenance expenses, maintenance teams are assigned various tasks throughout maintenance activities. The formula takes into account the distinct set-up and take-down durations required each time an activity is undertaken and enables different crews to be assigned to the same activity at various times.

Keywords- railway track maintenance, BCM, rail defects, maintenance, T-28, destressing, rail gauge

I. INTRODUCTION

The Indian Railway System is the world's fourth-largest railway network, with a route length of 68,155 km. With millions of passengers and tons of goods being transported every day, maintaining the railway track network is a vital aspect of ensuring safe and efficient transportation. In this research paper, we will examine Indian railway track maintenance in detail, exploring its history, methods, and conclusions.



In many nations, railroads are the main mode of transportation and comprise substantial infrastructure. It carries a high level of danger in terms of loss of life and asset value because it is directly related to passenger and freight transportation. Better safety standards and new technologies are continually being implemented, but accidents still happen. Derailments and collisions will always carry some danger, but they can be minimized through a thorough investigation of the underlying factors. Some of the causes, like human error, call for increased competence and efficiency, while others could benefit from increased inspection frequency. As a result, optimizing inspection frequency and improving competence and efficiency necessitates a sound maintenance strategy.

II. HISTORY OF INDIAN RAILWAY TRACK MAINTENANCE

The history of Indian railway track maintenance dates back to the 1850s, when the first railways were built in India. The railway initially used wooden sleepers and iron rails. However, with an increase in traffic and the need for faster trains, these materials proved inadequate. In 1893, the Railway Board began conducting experiments with various types of steel sleepers. After extensive testing, the Board adopted steel sleepers as standard in 1924.

Over the years, Indian Railways has evolved its track maintenance practices. During the early years of rail travel track maintenance was carried out manually, with workers using basic tools to repair and maintain the tracks. Manual labour required a lot of effort and was prone to human error, leading to accidents. From the 1950s to the 1990s, Indian Railways started using more advanced machines, including track-mounted cranes, tamping machines, and ballast regulators, for track maintenance..

III. TRACK THE MAINTENANCE SCHEDULE.

The majority of research on track maintenance has been concentrated on planning the maintenance or figuring out what repairs should be done. The idea of short-term scheduling of trains to avoid conflicts with rail maintenance has received comparatively little attention, both in terms of the resources needed and the upkeep. One such study does not assign the maintenance personnel to specific tasks; instead, it arranges the maintenance by changing the train schedule.

However, the maintenance schedule should not always be created under the presumption that there are sufficient crews available to carry out the activities when the number of crews for a maintenance scheduling region is small. The schedule might therefore need to be significantly adjusted to account for the crews' availability.

IV. METHODS OF INDIAN RAILWAY TRACK MAINTENANCE

Indian Railways uses various methods for track maintenance, which can be categorized into preventive and corrective maintenance. The preventive maintenance procedures aim to prevent problems before they occur, thereby reducing the need for costly corrective maintenance.

1. Ultrasonic Testing: Ultrasonic testers are used to test for rail flaws and track geometry issues. The machine uses ultrasonic waves to detect defects in the tracks, which are then analyzed to identify potential issues early, enabling preventive maintenance.

In ultrasonic testing, faults are found using ultrasonic waves, which are sound waves with a frequency between 2-4 MHz. A tiny piece of piezoelectric crystal is mounted in the probe, which is moved over the rail or weld, and it generates, transmits, and receives the waves from the rail or weld.

2. Track Tamping: Track tamping is the process of adjusting the level of the tracks with the use of machines. This process helps to improve the ride quality of the trains, enabling smoother and safer movement.

3. Ballast Cleaning: Ballast cleaning removes debris and dirt from the ballast bed. This process restores the drainage of the ballast bed, preventing waterlogging and improving track stability.

The main functions of BCM are

(1) Disposal of muck far from the railway and screening of polluted ballast
(2) Cleaning up the ballast cushion and restoring it increases the ballast bed's elasticity (resilience).
(3) Give the formation's cross slope.
(4) Make the track's drainage better.

Types of Ballast Cleaning Machines

Plain Track Ballast Cleaning Machine (RM80) (Plasser India)
Points and Crossing Ballast Cleaning Machine (RM76) (Plasser India)

Plan tracks, points, and crossings. Ballast Cleaning Machine

Shoulder Ballast Cleaning Machine

The equipment is employed to clean the shoulder ballast and enhance track drainage. The operating model of SBCM is comparable to that of BCM (RM-80). Two digging cutter chains are attached to the machine, one on each side and moving vertically. Each chain excavates, gathers, and sends the shoulder ballast to a series of vibrating screens with sizes resembling those in BCM. Clean ballast is placed on the shoulders of the ballast profile after the excavated muck has been filtered. The primary purposes of SBCM are to improve track drainage and eliminate muck from the shoulder ballast.

Ballast Regulating Machine (BRM)

These types of equipment are used for disseminating, transferring, and profiling ballast. The machine can move ballast towards the centre of the track or away from the centre of the track, transfer ballast across the track, and transfer ballast from a surplus zone to a deficient zone.

4. Rail Grinding: Rail grinding is the process of removing worn steel from the top of the rails. This process helps to extend the life of the rail, providing a smoother ride for trains. Rail grinding is done by using specialized machines that can grind and smooth the rail.

5. Replacement of worn-out or outdated rails with new rails. The security of people and cargo depends on this procedure. In order to ensure minimal downtime, rail replacement is a time-consuming process that requires extensive preparation and coordination.

6. Rail Destressing: The process of rail destressing is weather-dependent because it must be carried out while the rail's temperature is 38 °C or lower. A section of rail up to 2 km long is divided down the middle, and the two lengths are

pulled and stretched in the direction of one another by a tensor machine.

7. Deep screening of ballast is done to ensure that a clean ballast cushion of the required depth is available below the bottom of sleepers, which is very necessary for proper drainage and giving elasticity to the track. In the absence of a clean ballast cushion of the desired depth, the track geometry may get disturbed, and the running of the tracks may be adversely affected.

8. Track Relaying Train (TRT): TRT is a system for the complete mechanization of the track renewal process. assemblies and It does the following jobs:

i) threads out old rails from the track.
ii) removes old sleepers.
iii) Levels and compacts the ballast bed.
iv) places new sleepers.
v) threads new rails into the track.

V. RAILWAY TRACK MAINTENANCE CHALLENGES

Indian railways have a vast network, and maintaining it efficiently is a formidable challenge. The primary challenges faced by Indian Railways concerning track maintenance are:

1. Limited Budget: The maintenance of tracks is a costly affair, and Indian Railways have a limited budget allocation. Therefore, the railways have to manage their resources efficiently to maintain the tracks.

2. Weather Conditions: India experiences extreme weather conditions, with heavy rainfall and high temperatures. Maintaining the tracks during monsoon season is a significant challenge, as waterlogging often leads to derailments and is a danger to passenger safety.

3. Aging Infrastructure: Most of the Indian Railway network, including the tracks, is ageing and requires regular maintenance. The infrastructure requires upgrades and replacement to meet current transportation needs.

4. Safety Concerns: Safety concerns are always present in the minds of railway officials. as any issues with the track lead to an accident. Thus, the maintenance of tracks becomes even more critical for passenger and freight safety.

VI. CONCLUSIONS

Indian railways carry a massive number of passengers and goods every day across a vast network of tracks. Maintaining the railway track network is critical to ensuring safe and efficient transportation. Ultrasonic testing, track tamping, ballast cleaning, rail grinding, and rail replacement are the critical methods used for track maintenance. These methods have enabled the railways to maintain a safe and reliable transportation system.

In conclusion, track maintenance is a vital aspect of Indian railways to ensure the safety and comfort of passengers and the efficient movement of goods. Indian Railways need to allocate funds and invest in modern technologies to maintain its position as one of the most extensive rail networks globally. Continuous improvement in track maintenance is essential for Indian Railways to meet its transportation needs and provide a seamless experience to its passengers.

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