GOVERNMENT OF INDIA

MINISTRY OF RAILWAYS

RAJYA SABHA

UNSTARRED QUESTION NO. 750

ANSWERED ON 05.12.2025

SAFETY, MODERNISATION, AND TECHNOLOGY ADOPTION IN RAILWAYS

750 SHRI KANAD PURKAYASTHA:
SHRI NARAYANA KORAGAPPA:
SHRI NARHARI AMIN:
SMT SANGEETA YADAV:
SHRI BRIJ LAL:
SMT REKHA SHARMA:

Will the Minister of RAILWAYS be pleased to state:

(a) the target date for 100 per cent deployment of the indigenous Kavach safety system across the core network;
(b) the manner in which the Ministry is utilising Al and predictive maintenance tools to reduce signalling failures and accidents;
(c) whether a new policy has been adopted to mandate fire-resistant materials in all new passenger coaches;
(d) the manner in which the Ministry is accelerating the elimination of unmanned level crossings in high-density sections; and
(e) the manner in which rail tracks are fenced and protected across the country, the details thereof, zone-wise?

ANSWER

MINISTER OF RAILWAYS, INFORMATION & BROADCASTING AND ELECTRONICS & INFORMATION TECHNOLOGY

(SHRI ASHWINI VAISHNAW)

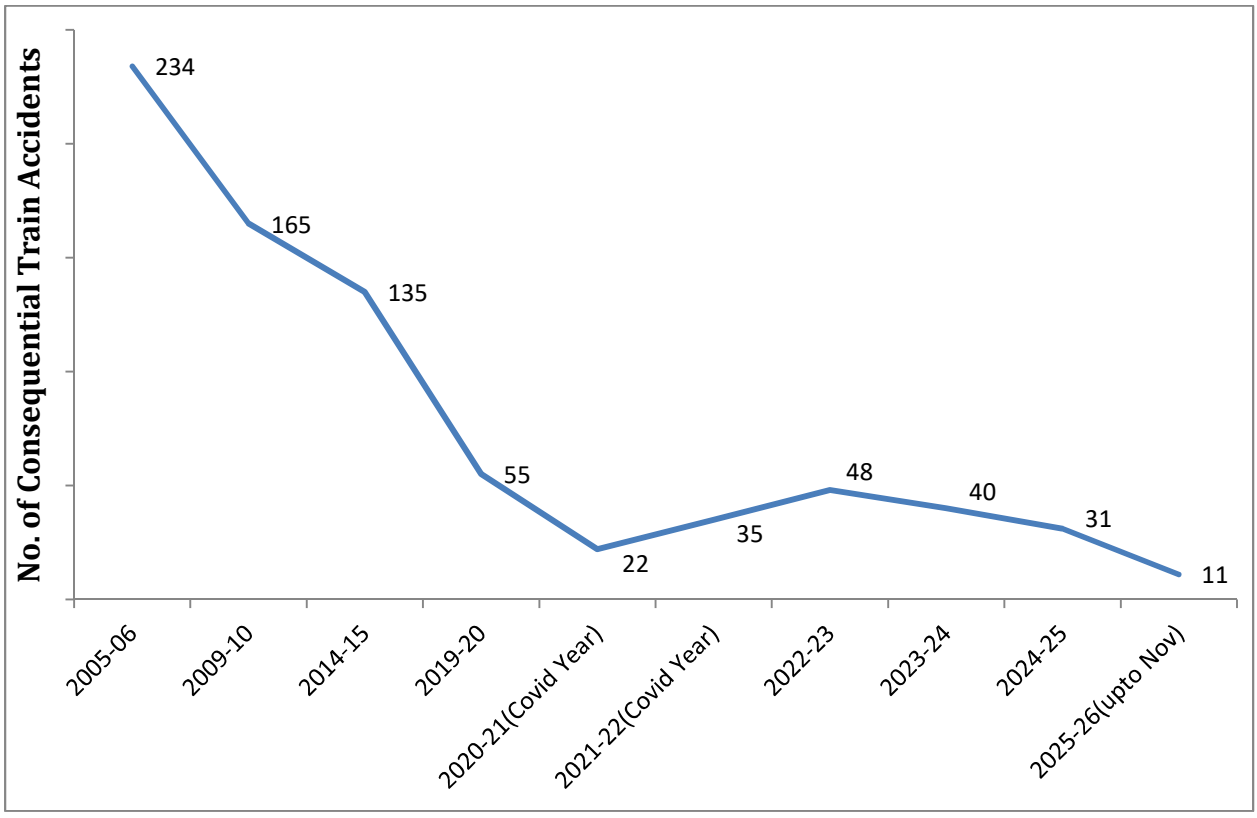
(a): Safety is accorded the highest priority on Indian Railways. As a consequence of various safety measures taken over the years, there has been a steep decline in the number of accidents.

Consequential Train Accidents have reduced from 135 in 2014-15 to 31 in 2024-25 as shown in the graph below.

It may be noted that the Consequential Train Accidents during the period 2004-14 was 1711 (average 171 per annum), which has declined to 31 in 2024-25 and further to 11 in 2025-26 (upto November 2025).

Another important index showing improved safety in train operations is Accidents Per Million Train Kilometer (APMTKM) which has reduced from 0.11 in 2014-15 to 0.03 in 2024-25, indicating an improvement of approx. 73% during the said period.

The number of consequential train accidents during the last ten years are depicted in the graph below:-



As per the inquiry reports, the causes of the accidents broadly include track defects, loco/coach defects, equipment failures, human errors etc.

The various safety measures taken to enhance safety in train operations are as under:-

1. On Indian Railways, the expenditure on Safety related activities has increased over the years as under:-

Expenditure/Budget on Safety related activities (Rs. in Cr.)				
2013-14 (Act.)	**2022-23 (Act.)**	**2023-24 (Act.)**	**2024-25**	**2025-26**
39,463	**87,327**	**1,01,651**	**1,14,022**	**1,16,470**

2. Electrical/Electronic Interlocking Systems with centralized operation of points and signals have been provided at 6,656 stations up to 31.10.2025 to reduce accident due to human failure.
3. Interlocking of Level Crossing (LC) Gates has been provided at 10,098 Level Crossing Gates up to 31.10.2025 for enhancing safety at LC Gates.
4. Complete Track Circuiting of stations to enhance safety by verification of track occupancy by electrical means has been provided at 6,661 stations up to 31.10.2025.
5. Kavach is a highly technology intensive system, which requires safety certification of highest order. Kavach was adopted as a National ATP system in July 2020. Kavach is provided progressively in phased manner. Initially, Kavach Version 3.2 was deployed on 1465 RKm of South Central Railway and 80 RKm of North Central Railway. Kavach specification Version 4.0 was approved by RDSO on 16.07.2024.

   After extensive and elaborate trials, Kavach Version 4.0 has been successfully commissioned on Palwal-Mathura-Kota- Nagda section (633 Rkm) on Delhi- Mumbai route and on Howrah-Bardhaman section (105 RKm) on Delhi-Howrah route. Kavach implementation has been taken up in balance sections of Delhi-Mumbai and Delhi-Howrah route.

   Further, Kavach implementation has been taken up on 15,512 RKm covering all GQ, GD, HDN and identified sections of Indian Railways.

6. Detailed instructions on issues related with safety of Signalling, e.g. mandatory correspondence check, alteration work protocol, preparation of completion drawing, etc. have been issued.
7. System of disconnection and reconnection for S&T equipment as per protocol has been re-emphasized.
8. All locomotives are equipped with Vigilance Control Devices (VCD) to improve alertness of Loco Pilots.
9. Retro-reflective sigma boards are provided on the mast which is located two OHE masts prior to the signals in electrified territories to alert the crew about the signal ahead when visibility is low due to foggy weather.

10. A GPS based Fog Safety Device (FSD) is provided to loco pilots in fog affected areas which enables loco pilots to know the distance of the approaching landmarks like signals, level crossing gates, etc.
11. Modern track structure consisting of 60kg, 90 Ultimate Tensile Strength (UTS) rails, Prestressed Concrete Sleeper (PSC) Normal/Wide base sleepers with elastic fastening, fan shaped layout turnout on PSC sleepers, Steel Channel/H-beam Sleepers on girder bridges is used while carrying out primary track renewals.
12. Mechanisation of track laying activity through use of track machines like PQRS, TRT, T-28 etc. to reduce human errors.
13. Maximizing supply of 130m/260m long rail panels for increasing progress of rail renewal and avoiding welding of joints, thereby improving safety.
14. Ultrasonic Flaw Detection (USFD) testing of rails to detect flaws and timely removal of defective rails.
15. Laying of longer rails, minimizing the use of Alumino Thermic Welding and adoption of better welding technology for rails i.e., Flash Butt Welding.
16. Monitoring of track geometry by OMS (Oscillation Monitoring System) and TRC (Track Recording Cars).
17. Patrolling of railway tracks to look out for weld/rail fractures.
18. The use of Thick Web Switches and Weldable CMS Crossing in turnout renewal works.
19. Inspections at regular intervals are carried out to monitor and educate staff for observance of safe practices.
20. Web based online monitoring system of track assets viz. Track database and decision support system has been adopted to decide rationalized maintenance requirement and optimize inputs.
21. Detailed instructions on issues related with safety of Track, e.g. integrated block, corridor block, worksite safety, monsoon precautions, etc. have been issued.
22. Preventive maintenance of railway assets (Coaches & Wagons) is undertaken to ensure safe train operations.
23. Replacement of conventional ICF design coaches with LHB design coaches is being done.
24. All unmanned level crossings (UMLCs) on Broad Gauge (BG) route have been eliminated by January 2019.
25. Safety of Railway Bridges is ensured through regular inspection of Bridges. The requirement of repair/rehabilitation of Bridges is taken up based upon the conditions assessed during these inspections.
26. Indian Railways has displayed Statutory “Fire Notices” for widespread passenger information in all coaches. Fire posters are provided in every coach so as to educate and alert passengers

regarding various Do's and Don'ts to prevent fire. These include messages regarding not carrying any inflammable material, explosives, prohibition of smoking inside the coaches, penalties etc.

27. Production Units are providing Fire detection and suppression system in newly manufactured Power Cars and Pantry Cars, Fire and Smoke detection system in newly manufactured coaches. Progressive fitment of the same in existing coaches is also underway by Zonal Railways in a phased manner.
28. Regular counselling and training of staff is undertaken.
29. Concept of Rolling Block introduced in Indian Railways (Open Lines) General Rules vide Gazette notification dated 30.11.2023, wherein work of integrated maintenance/ repair/replacement of assets is planned up to 52 weeks in advance on rolling basis and executed as per plan.

The details of the Safety related works related to better maintenance practices, Technological improvements, better infrastructure and rolling stock etc. undertaken by Railways are tabulated below:-

S.N.	Item	2004-05 to 2013-14	2014-15 to 2024-25	2014-25 Vs. 2004-14
	Technological Improvements			
1.	Use of high-quality rails (60 Kg) (Km)	57,450 Km	1.43 Lakh Km	More than 2 times
2.	Longer Rail Panels (260m) (Km)	9,917 Km	77,522 Km	Nearly 8 times
3.	Electronic Interlocking (Stations)	837 Stations	3,691 Stations	More than 4 times
4.	Fog Pass Safety Devices (Nos.)	As on 31.03.14: 90 Nos.	As on 31.03.25: 25,939 Nos.	288 times
5.	Thick Web Switches (Nos.)	Nil	28,301 Nos.	
	Better Maintenance Practices			
1.	Primary Rail Renewal (Track Km)	32,260 Km	49,941 Km	1.5 times
2.	USFD (Ultra Sonic Flaw detection) Testing of Welds (Nos.)	79.43 Lakh	2 Crore	More than 2 times
3.	Weld failures (Nos.)	In 2013-14: 3699 Nos.	In 2024-25: 370 Nos.	90 % reduction
4.	Rail fractures (Nos.)	In 2013-14: 2548 Nos.	In 2024-25: 289 Nos.	More than 88% reduction

	Better Infrastructure and Rolling Stock			
1.	New Track KM added (Track Km)	14,985 Km	34,428 Km	More than 2 times
2.	Flyovers (RoBs)/ Underpasses (RUBs) (Nos.)	4,148 Nos.	13,808 Nos.	More than 3 times
3.	Unmanned Level crossings (Nos.) on BG	As on 31.03.14: 8,948	As on 31.03.24: Nil (All eliminated by 31.01.19)	Removed
4.	Manufacture of LHB Coaches (Nos.)	2,337 Nos.	42,677	More than 18 times

Implementation of Kavach

1. Kavach is an indigenously developed Automatic Train Protection (ATP) system. Kavach is a highly technology intensive system, which requires safety certification of highest order (SIL-4).

2. Kavach aids the Loco Pilot in running of trains within specified speed limits by automatic application of brakes in case Loco Pilot fails to do so and also helps the trains to run safely during inclement weather.

3. The first field trials on the passenger trains were started in February 2016. Based on the experience gained and Independent Safety Assessment of the system by Independent Safety Assessor (ISA), three firms were approved in 2018-19, for supply of Kavach Ver 3.2.

4. Kavach was adopted as National ATP system in July 2020.

5. Implementation of Kavach System involves following Key Activities:

   i. Installation of Station Kavach at each and every station, block section.
   ii. Installation of RFID Tags throughout the track length.
   iii. Installation of telecom Towers throughout the section.
   iv. Laying of Optical Fibre Cable along the track.
   v. Provision of Loco Kavach on each and every Locomotive running on Indian Railways.

6. Based on deployment of Kavach version 3.2 on 1465 RKm on South Central Railway and experience gained, further improvements were made. Finally, Kavach specification version 4.0 was approved by RDSO on 16.07.2024.

7. Kavach version 4.0 covers all the major features required for the diverse railway network. This is a significant milestone in safety for Indian Railways. Within a short period, IR has

developed, tested and started deploying Automatic Train Protection System.

8. Major improvement in Version 4.0 includes increased Location Accuracy, Improved Information of Signal Aspects in bigger yards, Station to Station Kavach interface on OFC and Direct Interface to existing Electronic Interlocking System. With these improvements, Kavach Ver.4.0. is planned for large scale deployment over Indian Railways.

9. After extensive and elaborate trials, Kavach Version 4.0 has been successfully commissioned on 738 Route km on Palwal – Mathura- Nagda section (633 Rkm) on Delhi – Mumbai route and Howrah–Bardhaman section (105 Rkm) Delhi – Howrah route. Kavach implementation has been taken up in balance sections of Delhi – Mumbai & Delhi – Howrah corridors.

10. Progress of key items of Kavach on High density routes including Delhi– Mumbai & Delhi–Howrah corridors are as under:

SN	Item	Progress
i	Laying of Optical Fibre Cable	7129 Km
ii	Installation of Telecom Towers	860 nos
iii	Provision of Kavach at Stations	549 nos
iv	Installation of Track side equipment	2674 RKm
v	Provision of Kavach on Locos	4,154

11. Further, track side Kavach implementation work has been taken up on 15,512 RKm covering all GQ, GD, HDN and identified sections of Indian Railways.

12. Bids have been invited for equipping another 9,069 locomotives with Kavach version 4.0. Kavach is being provided progressively in a phased manner in locomotives.

13. Specialized training programmes on Kavach are being conducted at centralized training institutes of Indian Railways to impart training to all concerned officials. By now more than 40,000 technicians, operators and engineers have been trained on Kavach technology. This includes 30,000 Loco Pilots & Assistant Loco Pilots. Courses have been designed in collaboration with IRISET.

14. The cost for provision of Track Side including Station equipment of Kavach is approximately Rs. 50 Lakhs/Km and cost for provision of Kavach equipment on locomotives is approximately Rs. 80 Lakh/Loco.

15. The funds utilized on Kavach works so far up to Oct'25 is Rs. 2,354.36 Crores. The allocation of funds during the year 2025-26 is Rs. 1673.19 Crores. Requisite funds are made available as per the progress of works.

(b): Technological improvements in Indian Railways (IR) are a continuous process. Some of the Artificial Intelligence based predictive maintenance applications are as follows:

i. Pilot initiatives involving AI-driven predictive maintenance of Signalling system is being undertaken over Indian Railways at some of the stations to evaluate its efficacy. Measurable outcome includes Standard Failure and Prediction Logics and Alerts mechanism to be derived from trial results at these stations.

ii. Artificial Intelligence (AI) enabled Intrusion Detection System (IDS) using Distributed Acoustic System (DAS) for detecting presence of elephants on Railway tracks is implemented in 141 RKms section on NF Railway and further tenders have been awarded for 981 RKms section of Indian Railways. The system is designed to generate alerts for loco pilots, station masters and Control Room about the movement of elephants in proximity of railway tracks, for taking timely preventive action.

iii. 1) IR has adopted advanced/improved technologies like Online Monitoring of Rolling Stock System (OMRS), Wheel Impact Load Detector (WILD) for predictive maintenance of Rolling stock.

2) A Memorandum of Understand has been signed between IR and Dedicated Freight Corridor Corporation of India Limited (DFCCIL) in July 2025 for induction of wayside Machine Vision based Inspection System (MVIS). This is an AI/ML driven system for detecting hanging parts or missing components in moving trains.

3) A Memorandum of Understanding has been signed between IR and Delhi Metro Rail Corporation to induct Automatic Wheel Profile Measurement System (AWPMS). The AWPMS allows for automatic non-contact measurement of train wheel profile ensuring real-time measurement of wheel geometry and wear.

(c): The inherent design of rolling stock is done keeping in mind various safety provisions. Further modification and up-gradation of coaches to enhance fire safety is a continuous and ongoing process on Indian Railways (IR). Following measures have been taken for safety including fire safety in coaches:

i. Provision of Minimum two Fire Extinguishers in all coaches over Indian Railways.

ii. Fire Detection & Suppression System has been provided in fire prone areas of Power cars and Pantry cars.

iii. Fire and smoke Detection system has been provided in coaches as per extant guidelines.

iv. Water mist type fire suppression system is being provided on pantry cars and power cars in phased manner.

v. Provision of emergency windows in coaches for evacuation in case of fire.

vi. Use of Fire-retardant material as per global fire-retardant norms in coaches for seats/berths, panels, flooring, insulation, toilets etc for improved fire safety.

vii. Use of fire retardant E-beam cable in coaches.

viii. Use of different level of protection in the form of fuses, Miniature Circuit breaker (MCBs) and Motor protection Circuit Breakers (MPCBs) in the electrical circuits to prevent the damage from electrical faults/surges.

ix. Provision of Aerosol based fire suppression system in electrical cabinets.

x. Further, up-gradation of material in line with global standards is regularly being carried out with fitment of new generation material in Amrit Bharat & Vande Bharat Sleeper trains.

xi. Display of "Fire Notices" for widespread information in all coaches to inform and alert passengers regarding various “Do’s” and “Don’ts” to prevent fire. These include messages regarding not to carry any inflammable material, explosives, prohibition of smoking inside the coaches and penalties etc.

xii. Prohibition of flame based cooking in coaches.

Regular maintenance of various fire safety equipments/components as per the prescribed periodicity is carried out by the designated officials at Depots/Sheds for ensuring their proper upkeep.

(d): All unmanned level crossings (UMLCs) on running lines of Broad Guage (BG) network of Indian Railway including high density sections have been eliminated by 2019.

Elimination of manned level crossings (MLCs) is a continuous and dynamic process of Indian Railway. Such works are taken up on the basis of its impact on safety in train operations, mobility of trains & impact for road users and feasibility etc.

MLCs are eliminated either by providing Road Over Bridges/Road Under Bridges (ROBs/ RUBs) in lieu of LCs or through direct closure (for low traffic LCs) or by diversion of road traffic to nearby ROB/RUB/LC depending upon the site conditions.

Nos. of ROBs/ RUBs constructed and MLCs eliminated on Indian Railways during the period 2004-14 vis a vis 2014-25 (Oct’25) is as under:

Period	ROBs/ RUBs constructed
2004-14	4,148 Nos.
2014-25 (Oct'25)	13,653 Nos.

(e): Indian Railways is providing fencing along its railway tracks progressively in a systematic manner. Existing provisions stipulate fencing at vulnerable locations for speed above 110 kmph to 130 kmph and all along the track for speed above 130 kmph. So far, 12,480 km of fencing has been provided along the tracks. Further, works for providing about 19,500 km of fencing have been sanctioned.

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