

LEVEL CROSSING SCENARIO OF INDIAN RAILWAYS

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SUMMARY :

Indian Railways is one of the largest Railway systems of the world which spreads across over 64,000 route kilometers, and is fully owned and operated by, Government of India.

There are 31846 level crossings (LC) on Indian Railways, out of which 18316 are manned and 13530 are unmanned level crossings. These level crossings are not only the bottlenecks in Train Operation, but also a major contributor to the accidents and fatalities.

A web based system for overall Safety Management of Indian Railway (SIMS) has been developed in which one of the modules is over level crossing which assigns a unique Identification Number to every level crossing and various information are tagged over it.

Indian Railway have envisioned to eliminate all unmanned level crossings over a time frame which will not only bring down the number of accidents rather also improve the line capacity as trains get held up at busy LC gates. It will further save operation and maintenance costs incurred on the gates.

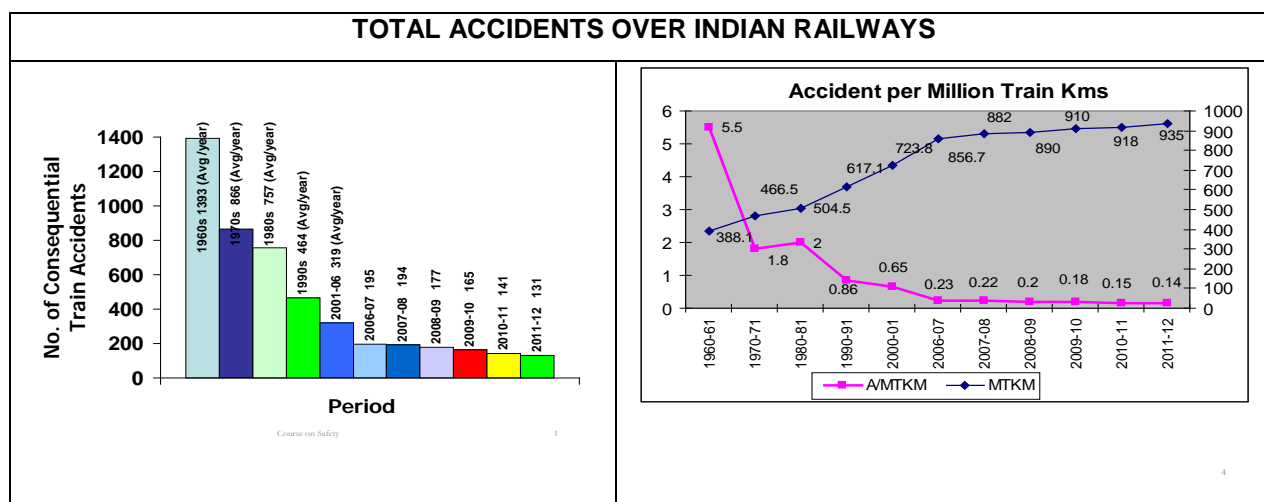
The paper will provide details regarding steps being taken by Indian Railways to improve Level Crossing Safety in detail.

1.0 INTRODUCTION

Indian Railways is one of the largest Railway Network of the world under a single administration i.e. Government of India. Indian Railways has 64460 route Kilometres out of which 55189 KM is broad gauge and balance 14% is meter/narrow gauge. It has 7133 block stations, 53220 passenger coaches and 9213 locomotives. Indian Railways carry about 1000 million tonnes of freight traffic per year and around 23 million passengers per day. Indian Railways employ around 1.3 million staff in the 17 zonal railways and 69 Divisions.

Indian Railways play a significant role in driving economic growth of the country, offering highly affordable, environment-friendly transportation to passengers and freight, specially bulk commodities, across the country.

1.1 ACCIDENT SCENARIO OVER INDIAN RAILWAYS: The Accident data from year 2003-2004 to 2011-12 shows the declining trends of accidents over Indian railways. The trend is clearly visible from graph given below.



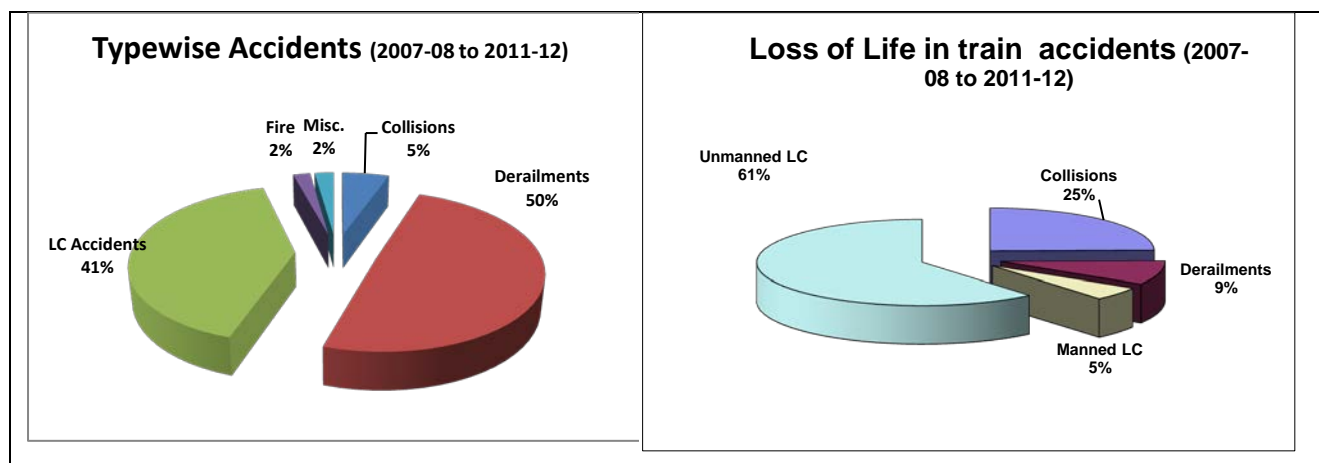
As the Traffic in terms of Train Kilometer is increasing every year, in spite of that accident on Indian railways are having decreasing trend. Improvement in Safety was made by upgrading the signalling systems, modernisation of rolling stock and track as well as replacement of over-aged assets. The accident per Million trains Kilometer (APTKM) of Indian Railways was 0.14 in the year 2011-12. The graph shows the declining trend of APKTKM over past fifty years.

1.2 CORPORATE SAFETY PLAN for Indian Railways was formulated for a period of ten years (2003-2013) entailing multi-pronged strategy, laying emphasis on prevention by reducing human dependence and mitigation of consequential effect in case of an accident. The Corporate Safety Plan envisages reduction of accidents on IR by the year 2012-13, substantially by bringing down the accident rate (accident per million train Kilometer) from 0.44 in 2003 to 0.17 in 2013 which have not only been achieved rather excelled by touching the figure of 0.14 in the year 2011-12 and is better than many of the advance Railways of the world.

1.3 LEVEL CROSSINGS AND ITS VULNERABILITY: The Road Traffic crosses the Railway Track either on “Grade Separated Crossing” (Road and rail at different Levels) or at “Level Crossing” (Road and rail at same levels). The level crossings are made to facilitate the smooth running of traffic in a regulated manner governed by specific rules and conditions.

As on 01.04.2012, there are a total of 31846 level crossings spanning over 64460 route kilometers i.e. average of 49 level crossings per 100 kilometers in Indian Railways. Out of which 13,530 are unmanned and 18,316 are manned . Out of 18316 manned level crossing 9,978(54%) are interlocked i.e. protected by a Gate Signal as an additional Layer of Safety.

Analysis of 5 year data of consequential train accidents for the period from 2007-08 to 2011-12 reveals that a large chunk of 779 deaths (58%) and 670 injuries (27.5%) were due to unmanned level crossing accidents attributed to the negligence of road users and it constituted 36.4% of the total train accidents . Manned level crossing accidents which are 4.5% of total tally resulted in 4.8% deaths and 5.5% injuries.



The Level Crossings are vulnerable to the extent that it is responsible for 41% of accidents , 63% deaths and 33% injuries over Indian Railways .

The primary causes of accidents at unmanned level crossings include failure of road users is mis-adventure to cross level crossings in the face of an approaching train, road vehicles getting stalled at the locations, rash driving of un-licensed tractor drivers etc. Accidents at level crossings happen primarily because the road users do not respect the right of way of railways.

It is observed that the road vehicle drivers misjudge the speed of trains due to the fact that human reaction time is 2.5 seconds which is just enough to coordinate the reflexes against speed of 60-70 kmph. However trains on Indian railways are plying at about 100-120 kmph for which the reaction time is inadequate. Road users continue to cross the tracks even if the train is visible and approaching causing leading to level crossing accidents. .

The problems of mobility and accident prevention at level crossings can best be addressed by joint efforts of all concerned - Central Government, State Government, Municipalities, NGOs, educational institutions and private operators etc.

2.0 SAFETY INFORMATION MANAGEMENT SYSTEM (SIMS) A web based system for overall Safety Management of Indian Railway has been developed in which one of the modules is over level crossing. This Level Crossing Management System monitors the data of level crossing by assigning a unique to every level crossing. The Unique ID further correlates to all the developments like pattern of Traffic, signage, condition, up gradation works, accident details linked with satellite imagery.

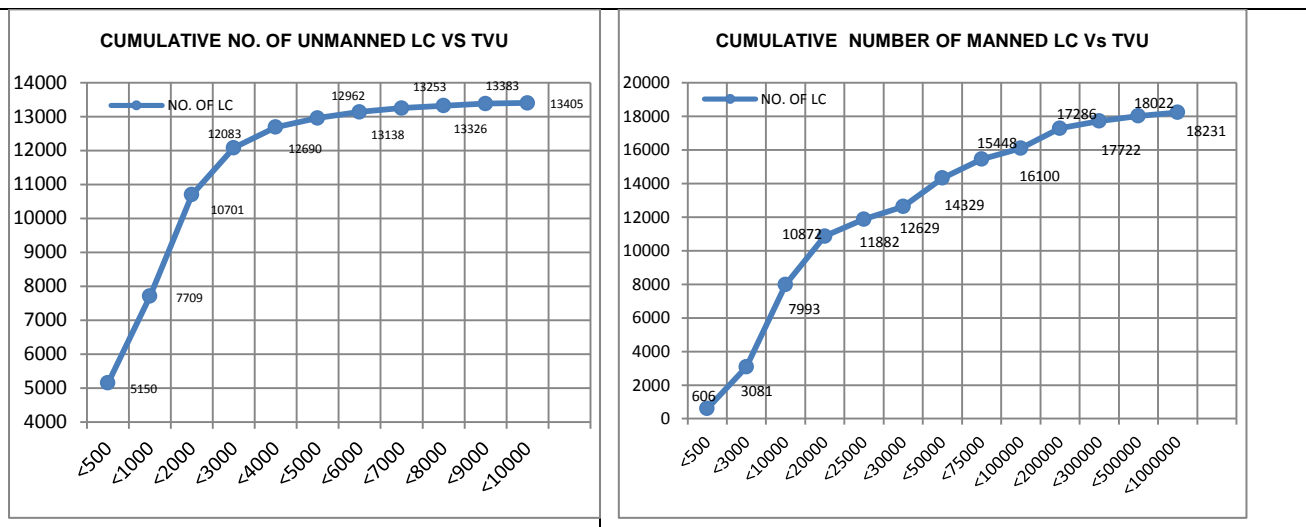
3.0 CORRELATION OF TRAFFIC VEHICLE UNIT AND NUMBER OF LEVEL CROSSING:

TRAFFIC VEHICLE UNIT (TVU): The vulnerability of a level crossing is measured in terms of TVU which is obtained by multiplying the number of trains with the number of road vehicles passing over the level crossing in 24 hours, where, train, road vehicle, bullock carts and tongas are considered one units and cycle rickshaw / Auto rickshaw half unit. A periodical census of all level crossings is done once every three years for seven days.

UNMANNED LEVEL CROSSING: There are total 13530 unmanned level crossings. It is evident that if we eliminate 1447 (13530-12083) unmanned level crossing, which is about 11% of total Unmanned LC then we can eliminate all Unmanned LC above 3000 TVU. This will reduce the ACCIDENT RISK by 44% of total level crossing accidents.

MANNED LEVEL CROSSING: There are total 18416 Manned Level Crossing. From the analysis it can be observed that if 2316 (18416-16100) manned level crossing, which is about 13% of total Manned LC, then we can eliminate all Manned LC above 0.1 Million TVU. Thus by constructing 2316 ROB (Road Over Bridges) we can get free of High TVU Manned Level Crossings.

CORRELATION BETWEEN CUMULATIVE NUMBER OF LEVEL CROSSING AND TVU

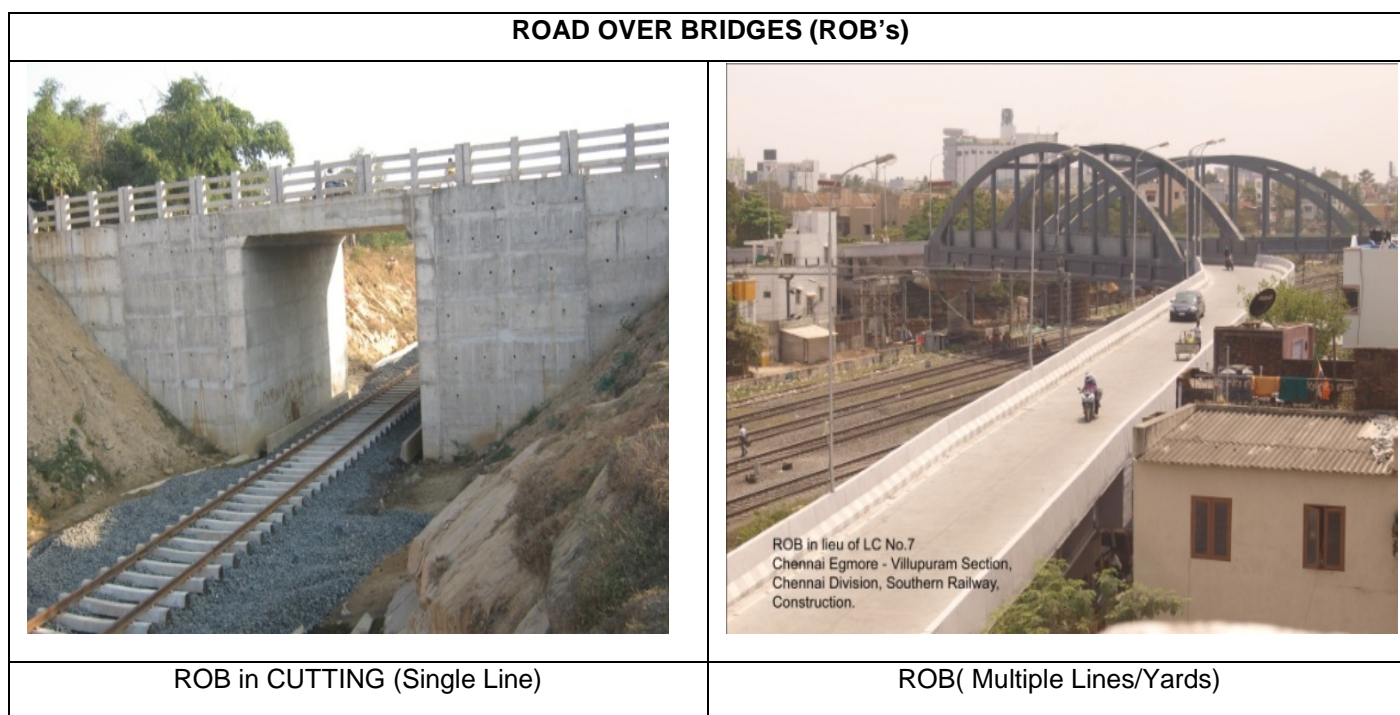


4.0 POLICY ON LEVEL CROSSINGS: Indian Railways have framed multi pronged policy to minimise the accidents and fatalities at level crossings which is summarised below.

4.1 PROLIFERATION OF NEW LEVEL CROSSINGS RESTRICTED ON INDIAN RAILWAYS: As per statutory obligation, Railway's liability is limited to provide RAIL-ROAD CROSSING (Grade Separated or Level Crossing) in consultation with the State Government at the time of laying new railway lines. For next ten years no new crossing is allowed generally. After review of ten years if situation so warrants, a suitable crossing is provided only if State Government agrees to bear the full cost (Capital as well as recurring). Even then preferably Grade Separated crossing is insisted and if not technically feasible than manned Level Crossing is the last resort. Introduction of any new Un-Manned Level Crossing is totally BANNED.

4.2 ELIMINATION OF THE EXISTING LEVEL CROSSINGS: Railways have decided to progressively eliminate unmanned level crossings by various means:

4.2.1 ROAD OVER BRIDGES (ROB): Construction of ROB in lieu of level crossing where the TVU* (Traffic Vehicle Unit) is above 0.1 million. The cost of one ROB is around Rs 300 million INR. Over Indian Railways it is a joint venture wherein the cost of ROB which is equally shared between the concerned STATE GOVT & CENTRAL GOVT (Ministry of Railways) Time taken is 3 to 4 years. Construction of ROB requires land acquisition, encroachment removal for its long approaches making it a tedious job. There are 1154 level crossings on Indian Railway, having a traffic density (Train Vehicle Unit) of 0.1 million or above i.e. qualifying for replacement for Road Over/Under Bridges on cost sharing basis for which the work is being sanctioned.

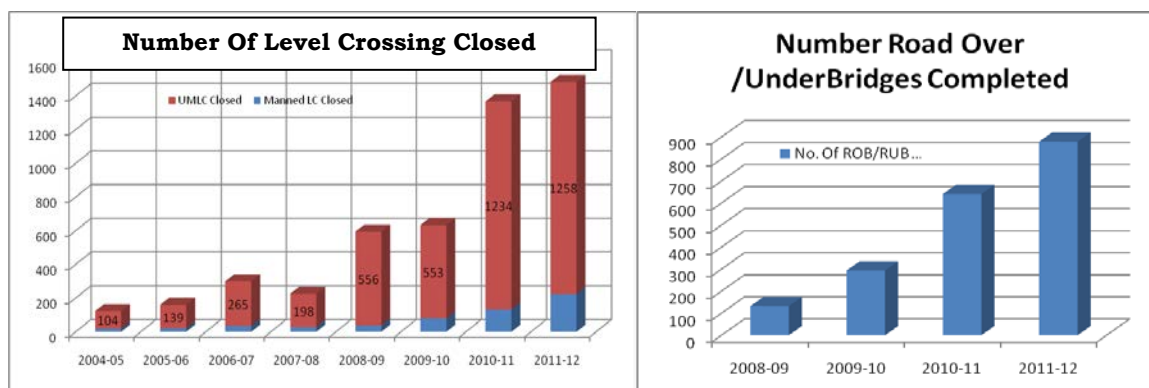


4.2.2 ROAD UNDER BRIDGE (RUB): Construction of RUB in lieu of level crossing. The cost varies from Rs 10 to 50 million INR and completion takes 1 to 2 years. This is the most cherished method of elimination where TVU is low but is technically feasible only where the Rail Track is on high embankment and does not remain on water stagnant area. Construction of RUB/Subway in lieu of level crossings does not require any further sanction of Commissioner Of Railway Safety (CRS), if pre-cast RCC boxes are inserted through cut & cover method under complete blocks of all affected lines .

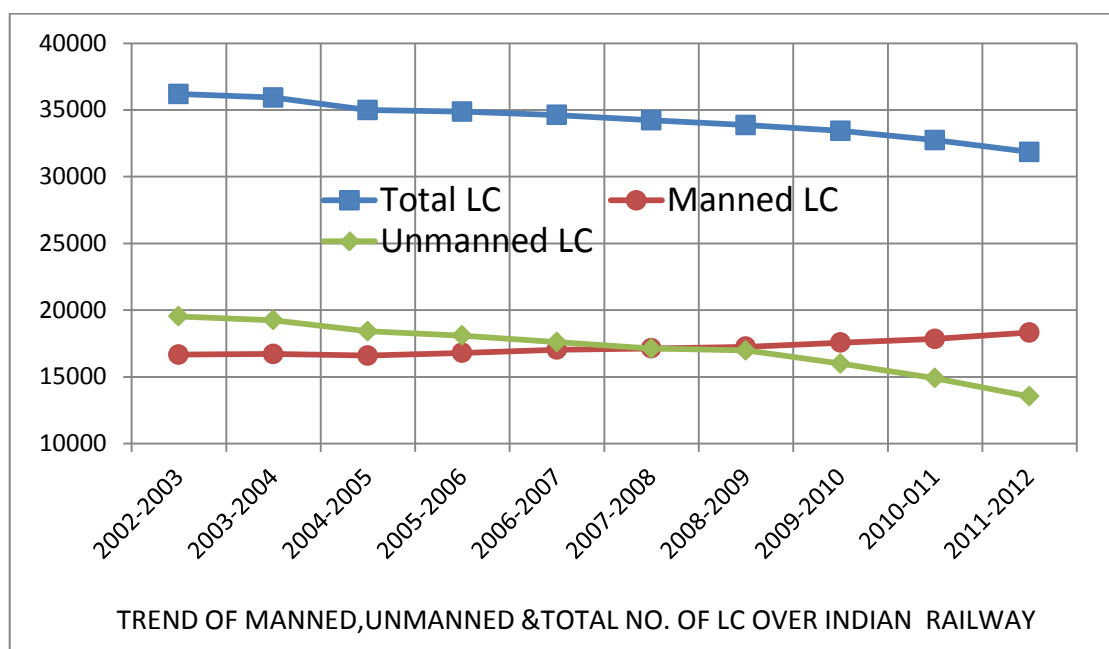
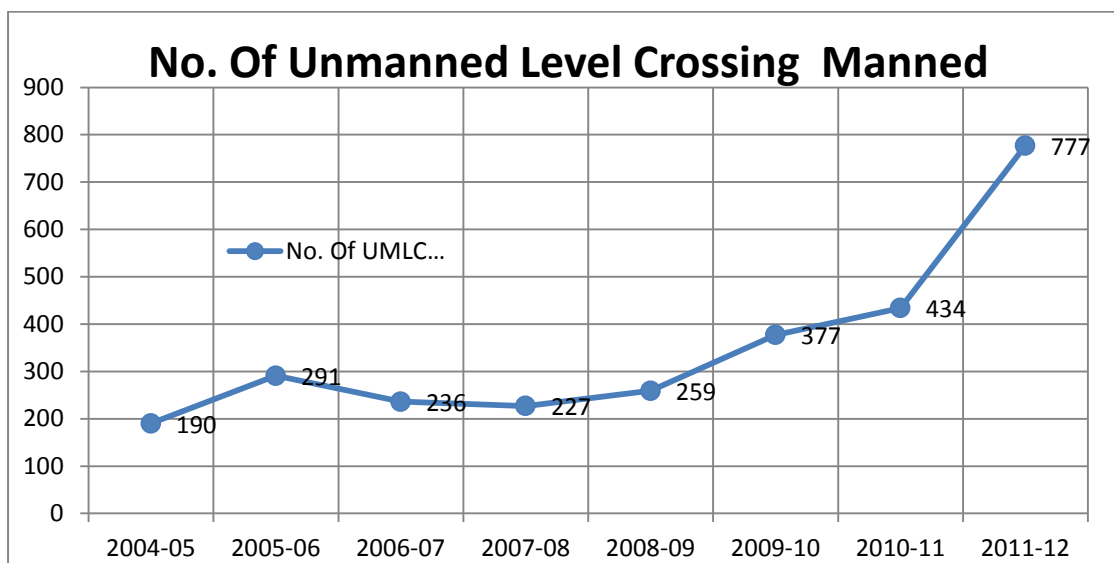
ROB/RUB completed under various schemes in last three & current Years				
Type of schemes	08-09	09-10	10-11	11-12
Cost Sharing (50:50 cost sharing)	38	80	67	83
Deposit works	5	18	38	33
Accommodation works (New Line, Gauge Conversion, Doubling) fully at Railways cost by Constr.	1	39	98	69
Built Operate Transfer(BOT)	0	8	16	8
NHAI under NHDP	23	47	38	33
RUBs/Subways by open line	65	102	384	653
Total	132	294	641	879

4.2.3 MERGER OR DIVERSION: Railways have planned construction of Diversion Roads from Unmanned crossing to nearby Manned Xing or ROB/RUB to divert road vehicles for safe passage and have permitted upto one km long Diversion Roads through Railway land or Railway Bridges. Railways have closed 206 unmanned gates by providing Diversion road since 1.4.2010 and identified 1085 mores, out of which 199 being sanctioned this in current year Railway Budget.

4.2.4 CLOSURE: By closing unmanned level crossings having NIL/ negligible traffic by way of Train Vehicle Unit where roads are non-existent on either side. **Closure of unmanned level crossings does not require CRS sanction.**



4.2.5 MANNING: The unmanned level crossings which cannot be eliminated by other means (ROB/RUB, Merger/Diversion, and Closure) will be progressively manned based on rail-road traffic volume, visibility conditions. One time capital cost of about Rs 1million INR. Annual maintenance cost is around Rs 0.2 million INR. The problem faced by Indian Railways is the non-availability of Gatemen. For regulating the MANNING and fixing up of priority the Un-Manned Level Crossing are categorised. All Unmanned Level Crossings Gates with TVU above 3000 qualify for manning. However if the visibility is restricted (Below to 800 meters for road users) then the criterion of 300 is relaxed to 2500. However, any level crossing found vulnerable and technically feasible to be eliminated can be taken up for manning irrespective of the TVU. Manned level crossings having heavy traffic density are being progressively interlocked with signals on a planned basis.



4.3 REQUIREMENT OF FUNDS: Requirement of funds to carry out the various Railway works related to Road Safety is Rs. 132 billion INR excluding the funds already available and accrual in Railway Safety Fund (RSF). In addition to that, Railway requires approximately Rs.142 billion INR to construct ROBs/RUBS/Subway on Dedicated Freight Corridors (DFC) to eliminate all level crossings on DFC routes. So the overall requirement for Indian Railway works out to 273 billion INR excluding the funds already available and accrual in RSF.

4.4 OTHER PREVENTIVE MEASURES: Although the accidents at unmanned level crossings primarily and largely occurred due to negligence of road vehicle users is in clear violation of Section 131 of Motor Vehicle Act, **Indian Railways have been taking steps to ensure additional safety** at these locations. Some of these measures targeted at safety at unmanned and manned level crossing are as under:

4.4.1 TECHNOLOGICAL INNOVATIONS:

- ❖ **ANTI COLLISION DEVICE (ACD)** : The Anti-Collision Device (ACD) has already been provided on 1736 Route KM at a cost of one billion INR, which also provides additional safety shield at manned and unmanned level crossings, through an audio-visual indication to road users. Moreover, in case of emergent needs, gatemen at manned level crossings will be able to reduce the speed of an approaching train to prevent an accident at the crossing.

- ❖ **TRAIN ACTUATED WARNING DEVICE (TAWD)** : Development of a reliable Train Actuated Warning Device (TAWD) for giving audio/ visual warning to road users about an approaching train has been under process on IR to reduce accidents at unmanned level crossings. Field trials have been carried out to prove its reliability and fail-safe feature, apart from suitability and miscreant prone environment. The trials have been completed and few designs have been found suitable. These devices will be installed at selected 100 level crossing gates on IR. Further adoption of these devices will be considered after observing the performance of these 100 devices.

4.4.2 EDUCATING THE PUBLIC: These primarily consist of educating the public en-mass so as to act as PREVENTIVE MEASURE. This is achieved by including chapters on safety at level crossings in the school syllabus of children.

4.4.3 SAFETY CAMPAIGNS: To educate road drivers about safety at unmanned level crossings, publicity campaigns are periodically launched through different media like quickies on TV, cinema slides, posters, radio, newspapers and street plays etc. Involvement of village Panchayats is also organized in railways' public awareness program.

Road users have still not got used to faster speeds of Mail/Express trains. A train running at 90 KMPH covers 25 meters per second. Thus, although to the road user the train appears to be 250 meters away, in terms of time, it is only 10 seconds away. This message is being conveyed to them by various public campaigns.

4.4.4 SAFETY DRIVES & AMBUSH CHECKS: Joint Ambush Checks with civil authorities are conducted to nab errant road vehicle drivers under the provisions of the Motor Vehicles Act, 1988 and the Railways Act, 1989.

Surprise checks and night inspections are regularly conducted to check the alertness of gatemen.

4.4.5 SIGNAGE: Proper signage along the track (Whistle Board) and road (Breaker & Stop Board) have been provided on approaches to level crossings so that road vehicle drivers become aware of the existence of a level crossing. Also the drivers of trains get pre-warned become cautions to lookout for infringement if any and to whistle intermittently so that the road users get indication of coming trains. To improve their visibility the signboards are being made of retro-reflective sheets.

4.4.6 SPEED BREAKER: Speed breakers/rumble strips have been provided on approaches to level crossings so that road vehicle drivers are reminded to reduce their speed.

4.4.7 SPEED RESTRICTIONS: Where the visibility distance is inadequate, speed restrictions for trains are imposed to allow for longer time interval for road traffic to pass in the face of approaching trains.

4.4.8 COMMUNICATION: Telephones are also being provided at all manned level crossing gates.

4.4.9 TYPE OF BARRIERS: Lifting barriers are installed in lieu of leaf gates to facilitate simultaneous closure/opening of gates on both the ends.

Sliding booms in place of chains are also being provided so that even if primary lifting barrier is broken, sliding boom can protect level crossing and train can run at normal speeds.

Funds received from the `Central Road safety Fund' are being used for safety related works pertaining to level crossings.

Though Indian Railways has envisioned eliminating the level crossing and same is progressing at good pace, but it will take time to achieve the goal. In the mean time other innovative methods are also being thought upon and implemented to minimize the accidents and fatalities to the extent possible.

5. CONCLUSION

Indian Railways have high density of level crossing and is a major contributory factor for loss of human life on account of railway accidents. To monitor the condition of level crossing a unique ID is provided to every level crossing and being managed through a module of Level Crossing in "Safety Information Management System". Road map has been made to eliminate the unmanned level crossings and same has been envisioned in "VISION-2020". Accordingly concrete steps are being taken for improving the safety at level crossings in Indian Railways and the progress is satisfactory.

6. REFERENCES

- i) 'Corporate Safety Plan (2003-2013)', Ministry of Railways, Govt. of India
- ii) 'Indian Railways Permanent Way Manual'
- iii) 'Report of High Level Safety Review Committee (Kakodkar Committee)', Feb. 2012, Ministry of Railways, Govt. of India
- iv) "Indian Railways Vision 2020 (Dec. 2009)", Ministry of Railways, Govt. of India
- v) 'Railroad-Highway Grade Crossing Handbook', Department of Transportation, Federal Railroad Administration, USA
- (vi) Statistical statements from Ministry of Railways (Railway Board).
