A REVIEW PAPER ON CURRENT SAFETY AND OPERATIONAL CONDITION OF INDIAN RAILWAY CROSSING

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Abstract: Railway crossings are the location where a road and Railway line intersect at grade allowing road users to travel over the railway tracks. In India, Early LC had a flagman in a nearby booth that would, on the approach of a train, wave a red flag or lantern to stop all traffic and clear the track. Manual or electrical closable gates that barricaded the roadway were later introduced. Current Railway crossing system faces many problems like cost, traffic, safety, and mechanical problems. From the past years record number of railway level crossing accidents increasing. Chances of failure of Railway crossing is more due to mechanical problems. Every country in the world faces the problem of level crossing accidents. Technology is also available for the railway level crossing accidents also depends on a human behavior. In this paper we represent the accidents, responsible factor for the accidents, steps taken by the Indian railway to prevent the accidents, future technology for the level crossing of different country.

I. INTRODUCTION

Indian Railways is the prime mover and plays a main role in the transport scenario of the India. India has 64,000 kms long route. Indian Railways is presently moving on an average 2.72 million tonnes of freight and 22 million passengers daily. Indian Railway having about 14 lakh employees and it is the one of largest railway systems which works under a single management in the world [1].Ason1st April 2014 Indian Railways network has30,348LevelCrossings out of which 18,725(62%) are Mannedand remaining 11,563(38%)are Unmanned[2]. If all unmanned level crossing are to be manned, Indian Railway requires Approximately Rs. 2450 Crores as capital cost but after this IR requires Rs. 700 Crores as operation and maintenance cost [3]. The efficacy of manned level crossing depends on the skills of gate operators and supporting infrastructure. Operator and maintenance cost at manned level crossing comes to nearly Rs.18 lac per year [4]. In USA2, 26,706 km long tracks[6] and there are over 2, 09,308 railroad crossing, approximately 1, 29,326 intersects with public roads [5]. In Australia, 9639 km long railway tracks [6]. Out of 23,532 railway level crossings only 33% have active protection and 67% have passive protection[7].Active crossing has a dynamic device such as flashing lights only or flashing lights, bells and boom barriers which are activated through approaching train. Passive crossing has no dynamic device to warn the driver it has only signs[11].

II. ANALYSIS OF ACCIDENTS

The term accidents envelopes a wide spectrum of occurrences with or without significant impact on the system, Consequential train accident includes damage to railway property or interruption to rail traffic, loss of human life or injury[12]. In USA train hits someone at every 115 minutes and nearly 2,000 Americans are killed and injured at highway/rail grade crossings each year [8]. In Australia total number of collision is 695, where number of people is injures is 97 from 2000-09. Active crossing which are located at private road number of collision is 27, but fact is that at this crossing no people injured due to collision [9]. Fundamental to the research is the recognition that some 95% of the risk at level crossings in Great Britain is due to human error and violation rather than 'railway' causes [10]. The psychological effects of level crossing incidents on the train crew was a major cause of concern, because some Train Drivers never being able to return on the job [11]. According to Section 161 of Railways Act, 1989, clearly states that any person driving or leading a vehicle negligently while crossing an unmanned level crossing shall be punishable with imprisonment that may extend up to one year[32]. In India from 1960 to 61 number of level crossing accident is 181.At 1960 India has no developed technology for crossing. From 1980 number of accident is below the 100 but this number changing variably. From 2012 to 2013 in India number of accidents is 448; this number is 12 times compared to the year 1990 [12]. The compensation paid in India by the Indian Railways for death/injury in accidents at unmanned level railway crossings in 2010-11 it was 19.89 lakhs, in 2011-12 2.22 lakhs, in 2012-13 it was 11.39 lakhs and in 2013-14 it was 15.15 lakhs [13]. Level crossings not only contribute to a large numbers of accidents and casualties of road users but are also an effect on train operation limiting line capacity. These also cost dearly to Indian Railways for their operation and maintenance. Analysis of Unmanned Level Crossing based on their time of occurrence indicates that day light period of 08:00 to 19:00 hours are most vulnerable during which about 86% accidents occurred. But analysis of Manned Level Crossing based on their time of occurrence indicates no correlation between them [14]. Another reason behind the Level crossing accidents is increasing number of motor vehicles. On 31st march, 1951 number of registered vehicles was 0.3 million but on 31st march, 2011 it was 142 million [15]. It is observed that 85% of all accidents accident occurring at unmanned level crossing by the passenger carrying train [16]. In India, Road users have still not got used to faster

speeds of Mail/Express trains. A train running at 90 km/h covers 25 meters per second. It means if the train appears to be 250 meters away to road users, in terms of time; it is only 10 seconds away to road users[17]. It is conclude that reaction time of 2.5 seconds may be enough for vehicle driver to apply the brake when goods train travelling at 60-70 km/h but this time is not enough for mail/express train approaching at 100/120 km/h in India at unmanned level crossing [16].

III. HUMAN AS A RESPONSIBLE FACTOR FOR ACCIDENTS AT LEVEL CROSSING

Human is directly or indirectly connected to all system. The most highly automated systems are works automatically however these systems are designed, installed, and maintained by Human. Human error plays a part in most accidents, if not all.It has been estimated that up to 90 % of all workplace accidents exhibit human errors as a cause[18].In India people not obey the traffic rules. Vehicle drivers were found to be in great hurry while crossing the level crossing because they do not want to waste their time for after level crossing closing. Usually vehicles are stopped on both sides of the LC gate after level crossing is closed. Pedestrian and cyclist always stopped near to the railway tracks this is one of the responsible factor for the level crossing accidents. People try to sneak the level crossing with their 2 wheeler vehicle after closing the gates. Vehicles which are stopped at closed level crossing gate, they stopped instead of stopping in their own lane only, but they are also occupying the full width of the road. This situation creates lots of the traffic resulting in much more delay when the gate is lifted for the passage. The two wheelers had a different concept altogether about a closed LC gate. 90 % of them thought that the gate closure was not meant for them and they can proceed further by sneaking the closed level crossing gate[19]. Vehicle drivers always wrong to estimate the speed of the train. Younger drivers trying to beat the train at railway crossing is also responsible for the accidents. For an old age people it is found that error in judgement is a responsible for the accidents [20]. A research in Thailand shows that at active crossings, the driver took 5.3 and 7.5 seconds to cover 200 m distance while at the passive crossing, they took 9.82 and 9.11 seconds to travel the same distance [21].

IV. STEPS TAKEN BY THE RAILWAY TO PREVENT THE LEVEL CROSSING ACCIDENT

In Great Britain a website www.lxrmtk.com has been created to allow level crossing risk practitioners working for Network Rail to conduct 'what if' analyses of various human Behaviour to understand what remedial actions could be required at specific locations. This research help implement cost-effective changes which do not require major crossing upgrades, infrastructure works, or crossing closures [10].

By 2020 Indian Railway has proposed to add 25000 kms of new lines [22]. This will also increase the number of level crossing. In India people are not ready for doing the job as a gateman at level crossing because the Grant higher pay scale of Rs. 3050-4590 to Level Crossing Gateman[23]. The biggest hurdle isappointment of gateman. In most of the cases infrastructure is made ready but gate still remains unmanned due to non-availability of gateman[24]. In India the provision of Level crossing and which level crossing need to upgrading is decided on the base of a Train Vehicle Unit. TVU is the multiplication of number of daily traffic volume at level crossing and number of daily train passing at crossing [25].

Item	Daily traffic density / traffic movement	Type of crossing indicated
1	TVU ≤ 6000	Unmanned level crossing
2	6000 ≤ TVU ≤ 10,000	All unmanned level crossing to be manned on programmed basis
3	10,000 ≤ TVU ≤ 1,00,000	Manned level crossing
4	TVU ≥ 1,00,000	Road flyover / Overpass

Table-1 TVU criteria for level crossing type[25]

Corporate Safety Plan envisages reduction of accidents on Indian Railways by the year 2012-13 substantially. Collisions are targeted to be completely eliminated. Derailments will come down by 60% and Fire accidents by 80%. It has not been possible to project assured improvement in level crossing accidents as there is no control over the circumstances that lead to such accidents [26]. Advance Warning safety equipment's earlier tried at level crossings have failed due to thefts. It is recommended by the committee that total elimination of all level crossings weather it is manned or unmanned within 5 years at an estimated cost of Rs. 50,000 Crores which will get recovered over 7-8 years due to saving in operation and maintenance costs and improved train operation [14]. The Anti-Collision Device (ACD) has already been provided on 1736 Route KM at a cost of one billion Indian rupees. This system provides an audio-visual indication to road users of approaching at manned and unmanned level crossings [17]. In India system can be stolen by the theft so the Provision of Train Actuated Warning System at unmanned Level Crossings can be implemented after an effective and theft proof system is developed by Research Design & Standards Organization (RDSO) [13]. Indian Railway has to wait for the installing Train Actuated Warning System till the theft proof system developed by the train Research Design & Standards Organization. Indian railway also implements the solar panels and hybrid system (solar + wind) for level crossing gates [27]. This is very useful in India where the electricity is not available for operating the interlocked signals and electrical lifting barrier. The cases of LC gates damage have increased considerably, due to phenomenal increase in the road traffic and the rush driving. If damaged to an interlocked lifting barrier results into heavy interruption to the train traffic. Provision of the dummy booms at the railway crossing is the solution. The dummy booms are closed and opened before and after closing and opening of the interlocked boom respectively [33]. Indian railway takes following steps to educate road users about safety at unmanned level crossings by publicity campaigns are periodically launched through different media like quickies

on television, cinema slides, SMSs, posters, radio, newspapers, street plays, etc. [27], but this will work only if people of India understand the "why the level crossing is provided?"

V. CURRENTLY AVAILABLE LEVEL CROSSING PROTECTION SYSTEMS IN THE WORLD

Mechanical crossing barriers are operated by level crossing staff using hand or electrically powered levers, winches or windlasses. Mechanical barriers providing complete protection of level crossings are connected to manually operate warning signals. Combination systems of this type are widely used within the developing countries of Asia Swinging type gate provides more safety than lifting type barriers. Train Detectors device detect the speed of train and the distance of the train from the crossing this type of system can be installed at unmanned level crossing. It consists of a series of transponders inserted in track at certain intervals and interlocked with level crossing barriers and warning signals [3]. Intelligent Transport System based warning systems provides level crossing information to road users of multiple trains and communicate effectively the state of an active or passive level crossing. ITS technology provides vehicle to vehicle (V2V), train to vehicle and infrastructure to vehicle (I2V) communications which can be used to make road users aware of an approaching train at level crossings [28]. In japan an automatic approaching train detector detects the approach of a train and control the level crossing system by activating level crossing gates and level crossing signals. Level crossing obstruction detectors detect the existence of pedestrians and vehicles trapped in the level crossing and turn on special signals to stop an approaching train. A driver in the trapped vehicle can turn on the special signal by pushing on the obstruction warning device of the signal to inform the driver at the approaching train about the emergency[29].

VI. FUTURE TRENDS OF LEVEL CROSSING PROTECTION SYSTEM

Advanced Radio-Based Train Control System has involved the use of radio, satellite and radar communications. This system provides for the detection of a train's position by means of a radio transmitter installed on the locomotive which then transmits this information control base. Control base determines the velocity at which the train will be able to run safely within the section given information inputs as to the gradient, curvature and condition of the track. For operation through level crossings, the train onboard computer calculates the time at which the level crossing warning lights or bells are switched on based on the train velocity and level crossing position[30].Automatic Train Control System is start working from the position at which an emergency brake application would be needed in order to bring a train to rest before a crossing in case of obstruction on the tracks. Emergency brake is directly connected to the controller[30].GPS-based Advanced Train Control Systems are now in common use for sea, air and land transport navigation applications. GPS uses communications links with number of satellites to establish the navigation coordinates of aircraft or surface transport receivers. GPS systems are costing as little as US$ 500[30].GPS-aided geo-augmented navigation (GAGAN) system in a train with the necessary receivers would know the location of the level crossings and a warning signal can be sent and it can activate the train's hooter automatically when it nears the level crossing at the level crossing itself[31].

VII. Conclusion

It can be concluded that technology has been developed and financial sources is also available to prevent the level crossing accidents. But as mentioned above all the systems directly or indirectly connected with the human, so the reason behind the railway level crossing accidents is human Behaviour. Most of the research is done on the how human behave at railway level crossing. There is no any research paper found on a how to tackle the human Behaviour to prevent the railway level crossing accidents.

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