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KEY SAFETY APPROACHES IN BANGLADESH RAILWAY

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ABSTRACT

Bangladesh Railways (BR) is an integral part of the country's transportation system since the British era. At present it covers a length of 2,877 route kilometres. Train accident data collected from BR revealed that train accidents reduced from 590 per year for 2001-10, to 250 per year for 2010-2015 and to 166 for 2015-16. Data also shows that derailments are the major concern in railway safety. Mixed railway gauges, rail weight, battered and damaged rails, low sleeper density and damaged sleepers, lack of maintenance of fittings and fastenings, and inadequate amount of ballasts are the main reasons for such derailments. So as a safety approach against derailments BR has taken rail track rehabilitation projects as well as speed restriction programs. 2015-16 data showed benefit of such restriction program. A speed map is prepared according to the speed restriction program and speed capacity of different sections of the railway network.

Keywords: *Safety approach, Speed map, Speed restriction, Train accident.*

1. INTRODUCTION

Increasing demand for transport, increasing road congestion, increasing concern over safety and environmental matters, and technology-led cost reductions have given rising interest in railways for inter-urban, urban and even rural transport services. Many countries, both in the developed and developing worlds, are finding that rail transport is cost effective at meeting some of the growth in demand through the construction of new lines or more effective and efficient use of existing lines and services as well as provides a safe, efficient means of transport with minimal environmental impact (Godward, 1992). Though, railway transportation system is recognized as a safest mode of land transport around the world, railway accident has always been the major challenge for rail safety as well as a point of attention to the engineers and researchers (Agarwal, 2005, 2007; Brabie, 2005; Wu and Wilson, 2006). Moreover, rail accident is not the result of a single cause but the combination of several contributory factors, which are associated with the rail users, the vehicle, the track and the rail environment (Ahsan *et al.,* 2014c). It is therefore, important in our context to understand the overall accident problem so as to be able to reduce accident and thereby improve the safety environment of rails.

Bangladesh Railway (BR) has been experiencing a large number of train accidents since its development in 1972 (Ahsan and Islam, 2015). Disruption to services, substantial financial losses and safety risk to staff and passengers are highly obvious from such occurrence (Barkan *et al.,* 2003). However, very few researches have been carried out regarding train accidents in Bangladesh to determine the underlying causes for the development of effective countermeasures to enhance railway safety. This paper thus attempts to investigate accident data in the light of accident classification, accident distribution, accident factors and accident casualties as well as investigates the effectiveness of the safety approaches of Bangladesh Railway in this regard.

2. ACCIDENT DATA ANALYSIS

2.1 Train Accidents

A train accident is termed as any occurrence which does or may affect the safety of the railways, its engine, rolling stock, permanent way, works, passengers or servants which either does or may cause delays to trains or loss to the railways (Arora and Saxena, 2006).

Data collected from Bangladesh Railway revealed that train accidents reduced from around 590 per year for 2001-10, to around 250 per year for 2010-2015 and to 166 for 2015-16 (BR, 2009-2016). These accidents are presented according to accident classification, accident distribution, accident factors and accident casualties in the following sections.

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2.2 Accident Classification

Accidents are classified into three major groups with a total of ten types as shown in Table 1. Derailments are the highest type of accident around 90 per cent of the total incidence (Ahsan *et al.,* 2014b). However, 2015-16 data showed a reduction of derailments to 74.1 per cent.

Table 1: Accident Classification

Accident Classification (Types)			Percent
(A) Accident to trains:	(1) Collision	a. Passenger trains	5.0
		b. Other trains	1.7
	(2) Derailment	a. Passenger trains	20.2
		b. Other trains	22.0
(B) Fires:	(1) Fire in trains.		0.2
(C) Other accidents:	(1) Trains running over cattle on the line		0.0
	(2) Train running into road traffic at level crossing		0.0
	(3) Train running over obstruction not covered in 1 and 2		0.2
	(4) Derailment of vehicles in yard		41.0
	(5) Derailment of light engines		6.6
	(6) Bursting of points		1.3
	(7) Averted collision		1.9
			100.0

2.3 Accident Distribution (Departments held responsible)

Bangladesh Railway had allocated accidents considering responsibilities of various departments involved in railway services according to their internal process as shown in Table 2.

Table 2: Accident Distibution

Departments held responsible	Percent
(1) Traffic department	8.8
(2) Engineering department	12.7
(3) Mechanical department	17.7
(4) Signal and Traffic department	1.2
(5) Engineering and Traffic department	0.7
(6) Engineering and Mechanical department	2.5
(7) Traffic and Mechanical department	1.7
(8) Other departments	8.9
(9) Pending	45.8
	100.0

2.4 Accident Factors (Causes)

The total train accidents were attributed by human elements, technical defects and other causes. Table 3 shows that other causes consist of the highest share of 47 per cent. This is perhaps due to weak reporting system. However, there is a sudden change in 2015-16 reporting with human elements as 84.94 per cent, technical defects as 10.84 per cent and other causes as remaining 4.22 per cent.

Table 3: Accident Factors

Accident Factors (Causes)		Percent
(A) Human elements	(1) Breach of rules, wrong manipulation of block instruments and setting of points, etc.	6.2
	(2) Passing of signal at danger	4.5
	(3) Breach of rules by Locomotive Masters and Assistant Locomotive Masters	15.2
(B) Technical defects	(1) Engines	1.4
	(2) Vehicles	8.7
	(3) Tracks	14.9
	(4) Signaling and interlocking apparatus	0.7
	(5) Other technical defects	1.4
(C) Other causes	(1) Miscellaneous	47.0
		100.0

Track condition causes the highest accident reflecting technical defects. Mixed railway gauges (BG, MG & DG), rail weight (75 & 90 lbs) and wear (battered, damaged, increase in friction and expansion gap), inadequate amount of ballasts, sleeper materials and density, and lack of appropriate fastenings are found to be the weaknesses of railway track (Ahsan *et al.,* 2014a).

2.5 Accident Casualties

Table 4 shows percentage of killed and injured for passenger, railway employees and other persons.

Table 4: Accident Casualties

	Casualties (Percent)	
	Killed	Injured
Passenger	12.8	37.5
Railway Employees	1.3	9.2
Other Persons	8.3	30.9
	22.4	77.6

3. SAFETY APPROACH

Around the world, railways have come to be recognized as a safest mode of mass transportation because of its inherent characteristics. Therefore, safety becomes the foremost issue while transporting man and materials in railway system. To ensure railway safety around the world all the activities includes according to the three-tier approach as follows (Rail Safety New Zealand, 2011).

3.1 Education

Education includes (i) Advertising, (ii) Publicity and media relations, (iii) Awareness raising events and campaign, (iv) Development of education resources for schools (v) Publication and display of rail safety pamphlets brochures (vi) Training, etc.

3.2 Engineering

Engineering includes (i) Ensuring structural and functional integrity of the infrastructure and its subsystem (Track improvements, periodic maintenance, level crossing up gradation, Enhanced track inspection technology etc.), (ii) Ensuring structural and functional integrity of the rolling stock, (iii) Ensuring appropriate operational procedures and information management for effective train handling etc. (improved signaling and interlocking system).

3.3 Enforcement

Enforcement includes (i) Application of appropriate warnings or prosecution against those who fail to obey the rules and regulations. However, Bangladesh Railway has considered speed restriction as the most effective safety measure against derailments. Some rail track rehabilitation projects along with modernization of signal interlocking system are also in the process.

4. MAXIMUM SPEED AND SPEED RESTRICTIONS

Permissible line speed is the maximum speed at which trains may operate on a track. It is also called maximum allowable speed or allowable speed. Each route section has a published speed limit which will vary locally according to track and route features such as junctions where trains pass between different routes (Bangladesh Railway, 2016). There are two types of speed restrictions.

4.1 Temporary speed restriction

Due to engineering works, a temporary speed reduction (TSR) may be enforced at a particular location. Temporary Speed Restrictions apply to all other conditions not covered by the permanent timetable including track defects, line side hazards and maintenance works.

4.2 Permanent speed restriction

Permanent speed restrictions are imposed where the route encounters a hazard such as a tight radius curve, level crossings, certain junctions, tunnels and bridges. It is also called a slow zone. Permanent Speed Restrictions are those that represent maximum safe speed.

5. SPEED MAP

Based on the information collected from Bangladesh Railway on speed restriction on different lines a speed map is prepared and is shown in Figure 1. From the map, it can be seen that Parvatipur-Shantahar section has a maximum speed of 95 km/hr. This section has newly installed concrete sleeper, correctly aligned rails, uniform ballast formations and elastic fastenings. In contrast, Jamalpur- Tarakandi section has a maximum speed of 30 km/hr due to having worn out steel sleepers and non-maintained rails. Similarly in Santahar-Parvatipur section, maximum allowable speed is 10 km/hr due to severly damaged rails. But Poradaho-Pachuria section, despite of having wooden sleeper, has an allowable speed of 80km/hr.

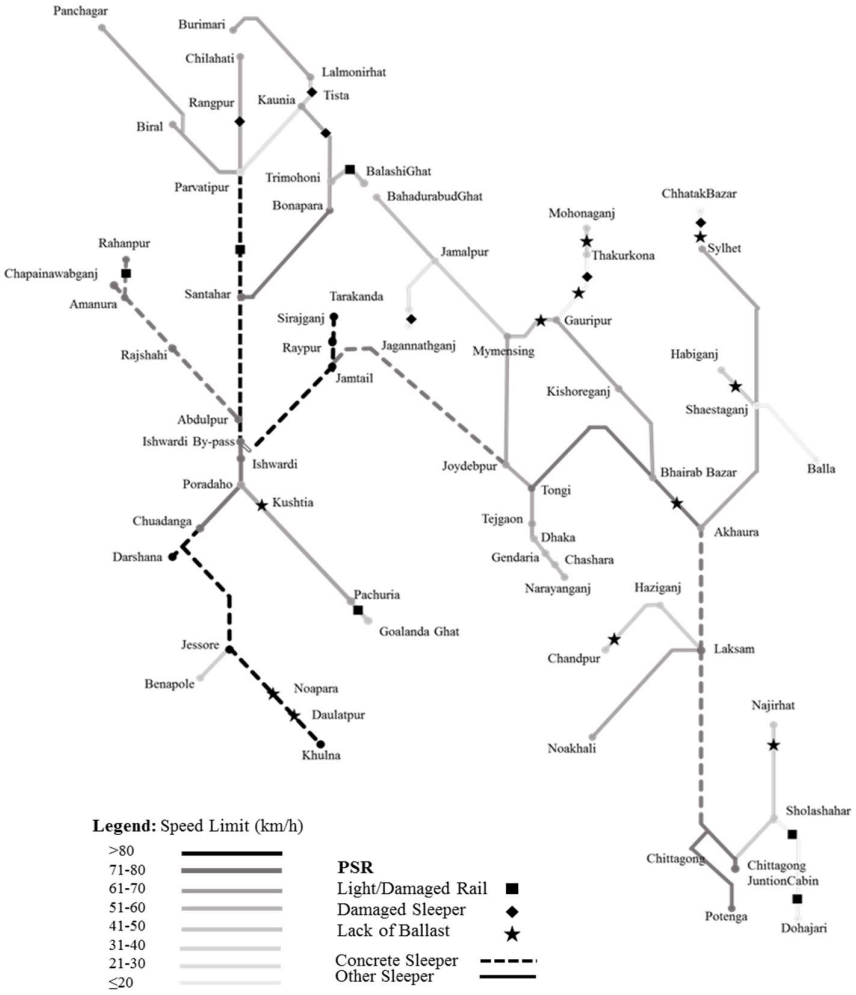

Figure 1: Bangladesh Railway Speed Restriction Program

6. KEY IMPROVEMENT OPTIONS

The accident problem can be corrected to a great extent by simple engineering techniques as well as by the enforcement of laws. In this respect some measures are suggested which may be considered to minimize the frequency and severity of accidents.

6.1 Accident Report Form

There is a need for suitable refinement in present accident reporting criteria and data collection system. The present system of preparing accident report is time consuming and not ideal. Specific details of accident location, track, signal, interlocking, and vehicle condition are not mentioned. The exact time of accident and types of vehicles involved in each accident should also be recorded properly.

6.2 Track Maintenance

Accident data shows that track condition is responsible for maximum number of accidents. Rehabilitation is therefore, needed for tracks and bridges (Ahsan *et al.,* 2016). The conventional method of track maintain by human resource are still in practice. More sophisticated track maintain arrangements such as, mechanical track lifting, slewing, tamping and laying machines should be used for track maintain. Moreover, maintenance work does not complete on schedule time because of administration complicity and lack of budget. So, the administration complicity should be eliminated and as well as budget is needed to be increased.

6.3 Modernization of the Signalling System

Modernization of the signalling system using colour lights and relay interlocking should be done to minimize the incidence of accidents particularly on account of human failure (Ahsan and Biswas, 2015). Such improvements also have the potential of increasing the line capacity.

7. CONCLUSIONS

Train accident data of Bangladesh Railway revealed that accident reporting and analysing system should be improved for fruitful detailed engineering based investigation and derailments are the major concern in railway safety. Rehabilitation and modernisation of the track network, signalling and rolling stock are needed for safe running of the Bangladesh Railway. However, as a safety approach against derailments Bangladesh Railway has taken rail track rehabilitation projects as well as speed restriction programs. 2015-16 data showed benefit of such restriction program.

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