RESEARCH NOTES

Train Accident In Bangladesh : Causes And Remedies*

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The success of a public transport organisation like the railway depends largely upon the standard of safety and efficiency of the service rendered by it. The lack of public faith in its ability to operate without endangering the life and property of the users may undermine the financial viability of the organisation. There is no accident-free transport system. However, an accident has more consequences for the railway system than for other modes of transport. This is because railway accidents have a two-fold effect, namely, loss of life and property and an adverse effect on traffic mobility as it takes time to clear the railway track and make it fit for further train movement.

TYPES OF TRAIN ACCIDENTS

In broad terms, train accidents may be attributed to the following factors:

(a) Human failure
(b) Equipment failure of loco and rolling stock components
(c) Failure of track, bridge, formation and signalling gear
(d) Wheel-track interaction leading to derailment
(e) Natural hazards like floods, earthquakes, breaches, storms, landslides etc.
(f) Anti-social activities, i.e. sabotage.

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For statistical purposes, train accidents are divided into the following four categories :

(1) Collision
(2) Derailment
(3) Train Fire, and
(4) Train running into obstruction.

Derailments caused in yards and engine failures are not, honever, included in this list.

Unlike other modes of transport, a train must always move on a guided path, namely, the railway track. As a result, the driver of train has no control on its direction other than forward and backward movement. If a train meets another train on the same track, the driver cannot steer his train away to give way to the other. In such situation, if the trains cannot be stopped clear of each other, there is collision.

Bangladesh Railway follows the "Absolute Block System" in which the railway line is divided into a number of block sections with block stations at their ends. No train is allowed to leave a block station and enter the block section unless permission to approach (commonly known as "line clear") has been received from the block station in advance and the same communicated to the driver through a token tablet or the taking off Starter and Advanced Starter signals. Thus, once a train enters a block section with proper line clearance, theoretically there is no possibility of another train entering the same section at the same line and there should not be normally any collision in the block section. But such a collision may occur in the following circumstances :

(a) If the driver of a train enters a block section without "line clear" and in disregard of the signal when another train enters the same block section from the opposite direction, or

(b) If there is a train parting and a part of the train is left behind in the block section and the station master on duty gives "line clear" to another train without ascertaining whether the whole of the previous train has arrived, or.

(c) If a station master gives permission to a train to approach his station and at the same time through a wrong manipulation of the block instrument, gives "line clear" to another train from his station to enter the same block section.

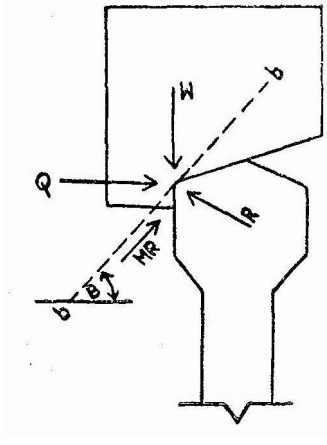
For the reception and despatch of a train, the levers actuating the points and signals are required to be operated by the cabinman in the following order—(i) setting the points for the desired route, (ii) locking the points and (iii) lowering the corresponding signals. The omission of a cabinman to

follow this order of operation may lead to a collision or derailment. To prevent this, the pulling of levers in a systematic order is ensured through the mutual locking of the levers so that any wrong operation will not be possible either inadvertently or intentionally. This mutual locking is called interlocking which may be done either by a mechanical or an electrical device. Out of 328 block stations on the Bangladesh Railway, 192 are provided with different types of interlocking systems, viz. 61 relay-interlocking, 80 double-wire mechanical interlocking, 6 electro-mechanical interlocking and 45 conventional mechanical interlocking.

The wheels of the locomotive and rolling stock (carriages and wagons) run on the rails when a train moves. If due to some unbalanced force one or more wheels fall off the rail, a derailment is caused. Derailments may occur in the block section, on the points and crossings or in the station yard itself. Derailments are normally caused by the following :

(1) Wheel-track interaction
(2) Improper setting of the point resulting in two-road
(3) Excessive wear of the points and crossings
(4) Excessive number of unserviceable sleepers
(5) Overspeed on curves and points
(6) Uneven loading of the wagons
(7) Breakage of any component of the rolling stock
(8) Sudden application of brake
(9) Defects in track like slack gauge, tight gauge, improper superelevation on curves, etc.

The derailments caused by wheel/track irregularities are a cumulative effect of a number of factors developed due to what is called 'wheel-track inter-action' causing the instability of a vehicle. The forces at the point of rail-wheel contract are shown below :



Q = Flange force i.e. the lateral force at the point of contact

W = Weight on rail

R = Reaction at point of contact

M = Co-efficient of friction between wheel and rail

B = Flange angle

At the critical stage of equilibrium, by putting summation of all horizontal and vertical forces equal to zero, we get

$$\frac{Q}{W} = \frac{\tan B - M}{1 + M \tan B}$$

On the Bangladesh Railway the flange angle B=68.50 and the average value of the co-efficient of friction M=0.25. Putting these values in the above equation, we get the critical value of the ratio $\frac{Q}{W} = 1.4$.

Now, the greater the actual value of QW, greater is the chance of derailment.

In the above context, the factors contributing to derailment are as follows :

(i) Higher flange force (Q) which may be caused by excessive wear on flange or gauge face of rail, excessively tight gauge, angularity of wheel axle with respect to the track, excessive side contact of wheel flange with the rail, specially on curves, overspeeding on a curve, etc.

(ii) Lower wheel load (W) arising out of instantaneous reduction in wheel load due to any defect in track or rolling stock, sudden application of brake, etc.

(iii) Higher value of co-efficient of friction (M), thereby lowering critical value of the ratio Q/W

Fires in trains are primarily caused by any of the following :

(a) Electrical short circuit in the carriages
(b) Open flames carried by hawkers during the night
(c) Flames of hurricane lanterns sometimes carried by passengers returning from village 'hats'
(d) Unburnt portions of cigarettes/bidis
(e) Rubbing of brake shoe with the wheel in case of brake binding
(f) Explosion of firework

Normally, fires originating from electrical short circuits are of low intensity as the nominal voltage used for train lighting purposes is quite low viz, 24 volt D.C. Moreover, with the replacement of wooden carriages with steel carriages the possibility of spreading the fire is also low in the absence of combustible materials. However, if some inflammable materials are present in the carriages, there is a likelihood of a rapid spread of fire endangering the safety of passengers, whatever the source of fire.

In this connection the tragic fire on the Simanta Express train which occurred during the night of the 12/13th January, 1985 near Bheramara Station may be recalled. The train fire took as many as 30 lives in addition to causing injury to many others and damage to three passenger carriages. During the enquiry it was revealed that rectified spirit from M/S Carew & Co., Darsana, used to be carried without authorization in this train from Darsana to different places. Records also showed that M/S Carew & Co. had sold about 60 gallons of spirit on that day to their agents at Bogra, Jamalpur and Dhaka. It is believed that a bulk of that spirit was being carried in the ill-fated carriage in which the fire originated. Cloth was also being carried in the carriage by the local cloth merchants returning from a nearby 'hat'. These combustible materials contributed to the spreading of the fire within a short time, which might have originated from flames or candles, unburnt portions of bidis or cigarettes or an electrical short circuit.

A train may run into obstructions at level-crossings such as trucke, buses, cars, etc. Such an obstruction may also be caused by cattle grazing near or on the railway track or by trees falling across the track.

Authorised level-crossings may be manned or unmanned. Unmanned level-crossings do not have barriers but a proper caution board is displayed on both sides of the track. But there are a number of unauthorised level-crossings where neither any barrier nor any caution board exists. Such level-crossings are unauthorisedly developed and used by the people of the locality without the permission of the railway authorities. There is **every possibility** of accident at unzuthorised as well as unmanned level-crossings. However, there are instances of accident at manned level-crossings also. These are usually due to the negligence of the gateman in closing the gate or rash driving. There are 453 manned and 1375 unmanned level-crossings on Bangladesh Railway in addition to a sizeable number of unauthorised ones.

ENQUIRY AND COMPENSATION

In case of a train accident there should invariably be an enquiry. The main object of an enquiry is to ascertain fully the causes of the accident with a view to preventing its recurrence as also to fixing responsibility. The scope of the enquiry should be extended to embrace a wider field and ascertain whether there has been any laxity on the part of the concerned personnel and also to determine other indirect causes of the accident.

The following types of enquiry into a train accident may be held :

(i) Departmental Enquiry : These are held only by the officials of the

department concerned, when the cause is clear but the remedy is obscure or where the cause is obscure but only one department is concerned.

(ii) Joint Enquiry : These are held by representatives of more than one department, when the cause is not clear and no one department accepts the responsibility.

(iii) Government Inspector's Enquiry : These are ordered and conducted personally by the Government Inspector for Bangladesh Railway.

(iv) Magisterial or Judicial Enquiry : Whenever an accident as described in Section 83 of the Railway Act, 1890 has occurred in the course of working the railway, the Deputy Commissioner or any other Magistrate, who may be appointed in this behalf by the Safety Controlling Authority, holds such an enquiry.

The liability of the railway administration in respect of accidents to trains carrying passengers has been defined under Section 82A of the Railways Act, 1890 amended by the Indian Railways Amendment Act, 1943. The provisions of this section are as follows :

(1) When in the course of working (the railway) an accident occurs, being either a collision between trains of which one is a train carrying passengers or the derailment of or other accident to a train or any part of a train carrying passengers, then, whether or not there has been any wrongful act, neglect or default on the part of the railway administration such as would entitle a person who has been injured or has suffered loss to maintain an action and recover damages in respect thereof, the railway administration shall, notwithstanding any other provision of law to the contrary, be liable to pay compensation to the extent set out in sub-section (2) and to that extent only for loss occasioned by the death of a passenger dying as a result of such accident, and for personal injury and loss, destruction or deterioration of animals or goods owned by the passenger and accompanying the passenger in his compartment or on the train, sustained as a result of such accident.

(2) The liability of (the railway) administration under this section shall in no case exceed taka ten thousand in respect of any one person.

It appears that the maximum limit of compensation, i.e. Tk. 10,000/- as provided under clause **(2)** above was fixed in 1943 by the Indian Railways (Amdt) Act 1943 which was applicable to both the Indian Railways and the Pakistan Railways at the time of partition in 1947. In the meanwhile, the Indian Railways have enhanced the maximum limit several times, **the** last **being** in March 1983 raising the limit to Tk. 100,000/-

The maximum compensation for casualties caused by road accidents, which is covered by 'Third Party Insurance'' and 'Passenger Life Insurance', is Tk. 20,000/-. This amount is also quite low. The railway, being a Government organisation, does not come within the purview of compulsory 'Third Party Insurance' scheme. However, it is considered that the maximum limit of Tk. 10,000/-which was fixed many years ago, needs to be enhanced in line with present day market conditions.

TRENDS IN TRAIN ACCIDENTS IN BANGLADESH

It is very important to keep a systematic record of various categories of accidents and their causes so that a close watch can be kept on the trend of accidents and the contributory factors for adopting remedial measures. The number of train accidents on the Bangladesh Railway/erstwhile P.E. Railway and resulting casualties for the years 1962-63 to 1964-65 and 1979-80 to 1983-84 as collected from the statistical branch and BR Information Book 1984 respectively, are shown in Table I. To draw a comparison with the situation on other railways the number of train accidents for the years 1979-80 to 1983-84 occurring on one of our neighbouring railways, namely, the Indian Railways, is shown in Table 2.

TABLE 1

Train Accidents in Bangladesh

Year	Collision	Derailment	Fire in Train	Train running into obstruction	Total	Incidence per million train-km	Casualties	
							Killed	Injured
1962-63	7	74	5	27	113	6.7	164	1035
1963-64	8	67	13	22	110	6.3	138	1062
1964-65	9	60	11	22	102	5.9	197	935
Total	24	201	29	71	325	6.3	509	3032
1979-80	11	200	9	8	228	14.7	83	606
1980-81	16	212	3	8	239	15.2	79	889
1981-82	15	180	—	4	199	12.5	63	757
1982-83	11	176	—	15	202	12.8	53	388
1983-84	20	144	1	6	171	10.9	47	575
Total	73	912	13	41	1039	13.2	325	3215

TABLE 2

Train Accidents in India

Year	Collision	Derail-ment	Fire in Train	Train run-ning into obstruc-tion	Total	Incidence for milli-on Train-km.
1979-80	72	692	21	115	900	1.8
1980-81	69	825	29	98	1013	2.0
1981-82	87	936	23	84	1130	2.2
1982-83	54	653	20	70	797	1.5
1983-84	48	621	17	82	768	1.4
Total	**330**	3727	110	441	4608	1.77

(**Source** : Indian Railways Year Book 1980-81, 1981-82 and 1982-84).

The following conclusions are suggested by the available data of train accidents in Bangladesh :

(i) The total number of accidents as well as incidence per million train-km was much lower during the pre-liberation period.

(ii) Although the number of incidence per million train-km during the post-liberation period showed a slightly declining trend, the overall situation is not satisfactory.

(iii) Derailment is the major category of accident. It alone constituted 62% and 88% of total accidents during the pre-liberation and post-liberation periods respectively.

(iv) Derailment is also the major cause of accident in the Indian Railways where the share of derailment is 80.5% of the total accidents.

The high rate of derailment causes serious bottlenecks in train operation as in most of the cases the running line is blocked due to derailment. In addition, dragging after derailment causes damage to the track and rolling stock involving a heavy financial loss.

The causewise analysis of the accidents for the years **1962-63** to 1964-65 of the erstwhile Pakistan Eastern Railway, 1981-82 to 1983-84 of the Bangladesh Railway and 1980-81, 1981-82 and 1983-84 of the Indian Railways **are** shown in Table 3,4 and 5 respectively.

TABLE 3

Causes of Train Accidents in East Pakistan, 1962-63 to 1964-65.

Causes	No. of incidence			Percentage of total		
	1962-63	1963-64	1964-65	1962-63	1963-64	1964-65
1. Human failure	20	12	19	17.7	11	18.6
2. Technical defects.	31	36	23	27.4	32.7	22.6
3. Miscella-neous.	62	62	60	54.9	56.3	58.8
Total	113	110	102	100	100	100

TABLE 4

Causes of Train Accidents in Bangladesh, 1981-82 to 1983-84.

Causes	No. of incidence			Percentage of total		
	1981-82	1982-83	1983-84	1981-82	1982-83	1983-84
1. Human failure	68	114	84	34.2	56.4	49.2
2. Technical defects						
Mechanical	36	18	33	18.1	8.9	13.3
Track	40	46	27	20.1	22.8	15.8
Signalling	7	3	10	3.5	1.5	5.8
Others	—	8	11	—	4.0	6.4
3. Miscellaneous	18	13	6	24.1	6.4	3.5
Total	199	202	171	100	100	100

TABLE 5

Causes of Train Accidents in India, 1980-81 to 198384.

Causes	No. of incidence			Percentage of Total		
	1980-81	1981-82	1983-84	1980-81	1981-82	1983-84
1. Human failure						
Railway Staff	592	761	500	58.5	67.3	65
Other Persons	112	100	79	11	9.1	10.3
2. Equipment failure :						
Mechanical	160	139	72	15.8	12.3	9.1
Track	24	26	15	2.4	2.3	2
Electrical	2	1	3	—	—	0.4
3. Sabotage	9	12	12	1	1.1	1.5
4. Miscellaneous.	114	88	79	11.3	8	11.7
Total	1013	1130	768	100	100	100

The following salient features are observed from the above tables regarding causes of accident :

(i) The human element is the major constituent factor causing accidents. The average figure is about 47% for the Bangladesh Railway and 73% for the Indian Railways.

(ii) The second major factor for the Bangladesh Railway is technical defects which is about 42% on an average. This factor for Indian Railways is, however, much lower (about 15%).

(iii) The percentage of human failure was quite low during the pre-liberation period, but at the same time the percentage of miscellaneous causes was very high.

Table 6 shows the situation of train accidents in a developed country like Japan.

TABLE 6

Train Accident in Japan, 1979-83.

Year	Train accidents	Level-crossing accidents	Other accidents
1979	61(0.09)	839(1.35)	0
1980	51(0.08)	846(1.40)	0
1981	33(0.05)	771(1.30)	2
1982	34(0.05)	689(1.19)	1
1983	49(0.08)	738(1.17)	0

(Figures in parenthesis indicate the number of accidents per million train-km and train accidents denote train collisions, derailments and fires. Source : Japanese National Railways, Facts and Figures, 1979 and 1984 Edition.)

It appears that accidents per million train-km other than those at level-crossings on Japanese National Railways are negligible. This may be due to the fact that in addition to the proper maintenance of track, vehicles and equipment, Japanese National Railways uses such safety devices as the Automatic Train Stop (ATS), the Automatic Train Control (ATC) and the Centralised Traffic Control (CTC) systems, thereby minimising the human element in train operation. Continued measures like the elimination of level-crossings by relocating tracks, constructing underpasses and over-passes, the inslallation of automatic barriers or warning signals and the closing of some level-crossings have also resulted in a significant reduction in level-crossing accidents in recent years.

Comparison of Road and Train Accidents

For the purpose of comparison let us have a look at the accidents in another important transport subsector, namely, the road subsector. In 1983, a study was carried out by a committee set up to identify the causes of road accidents and suggest remedial measures. Data regarding vehicle-wise road accidents in Bangladesh as collected by that committee are presented in Table 7.

TABLE 7

Road Accidents in Bangladesh, 1981-83.

Types of vehicle	Accident statistics		
	1981	1982	1983 (Upto June)
1. Truck	9911(29.35)	929(29.8)	557(31.49)
2. Bus/Mini-bus	1122(36.14)	1131(36.59)	631(35.67)
3. Motor car, Jeep, Station Wagon, Pick-up.	541(17.43)	517(16.59)	305(17.24)
3. Auto-Rickshaw Motor Cycle.	206(6.64)	270(8.66)	139(7.86)
5. Cycle Kickshaw, etc.	324(10.44)	270(8.86)	137(7.74)
Total :	3104	3117	1769

(Figures in parenthesis indicate percentage)

The total number of road accidents in 1983 and 1984 were 3071 and 2648 respectively as reported in the deliberations in a seminar on "Road Accidents and their Remedies" held in Dhaka from the 7th May to the 9th May, 1985. One important point is that there is no machinery to record all road accidents occuring all over the country and hence the actual figures may be higher. The number of road accidents as such may not be comparable to the number of train accidents because of dimensional variation in these two modes of transport. A comparison may, however, be made between the casualties caused by these accidents. The share of passenger traffic using different modes of inland transports are—rail 34%. road 30% and water 36%. This means that the proportion of passengers carried by rail is slightly higher than those carried by road. But the casualty figure for road accidents is abnormally high. While the average casualty per year in railway accidents is 75.6 deaths and 660 injuries inclusive of passengers, railwaymen and other persons for the years 1974-75 to 1983-84, the figures for road accidents are 784 and 1824 respectively for the years 1979 to 1983. These have increased during the recent years.

The study report gave the following causewise breakdown of road accidents showing the share of the contributing factors :

TABLE **8**

Causes of Road Accidents **in** Bangladesh

Cause of accidents	1981		1982		1983 (upto June)	
	No.	%	No.	%	No.	%
1. Driver's negligence in driving	1064	34.28	1129	36.22	691	39.06
2. Overspeeding	964	31.05	1087	34.87	568	32.11
3. Overloading	252	6.12	265	8.50	177	10.01
Sub-total :	2280	73.45	2481	79.59	1436	81.18
4. Defective roads	132	4.25	109	3.50	52	2.94
5. Defective vehicles	246	7.93	191	6.13	115	6.50
6. Fault of rickshaw-pullers	245	7.89	161	5.17	90	5.09
7. Fault of pedes-trians etc.	201	6.48	175	5.61	76	4.29
Total	3104	100	3117	100	1769	100

It is interesting to note that the human element is overwhelmingly predominant in road accidents in as much as the drivers of road vehicles are responsible for about 80% cases of road accidents through their negligence in driving, over-loading or overspeeding. Unlike a railway driver, the road vehicle driver enjoys a lot of freedom while on the road in manoeuvering the vehicle. On the other hand, this freedom may render him vulnerable to the situation if he is not careful, as he is not guided by any system of operation like the train driver.

It appears from the analysis of causes of accidents both on the railway and the roads that the human element plays the most important role in causing the accidents. There is a saying that an 'accident does not occur but it is made to occur'. An in-depth analysis of other factors causing accidents, **e.g.** technical defects, is likely to reveal that the root cause is some human element like failure to take timely and proper care of the equipment concerned. The factor of human element may be attributed to errors of judgment,

forgetfulness, improper application of rules, absent-mindedness, fatigue caused by over-work, negligence, etc. In the context of Bangladesh, the most predominant factor is perhaps negligence which may comprise sleeping on duty, reliance upon less responsible staff, adoption of short-cut methods in violation of rules and prescribed procedures, temporary absence from duty place, use of intoxicating drug while on duty, allowing handling of equipments by unauthorisedipersons, etc.

RECOMMENDATIONS

The following measures may be taken to minimise accidents :

(i) Emphasis should be placed on toning up the system by intensive inspection and frequent surprise checks to ensure the observance of correct procedures by the staff connected with train operations. Exemplary punishment to the delinquent staff for causing accidents and rewarding the staff with accident-free service may improve the situation. Vigilance which prevents accidents should be recognised, rewarded and advertised.

(ii) In addition to adequate training of all categories of staff connected with train operations, drivers should be deputed from time to time to educate support staff and inculcate a greater degree of safety consciousness. Regular observance of safety weeks/fortnights for this purpose, which in fact, is sometimes done by the Bangladesh Railway will help to improve the situation.

(iii) It has been observed that most cases of 'disregard by drivers'occur during the later part of the night and in winter, specially in foggy weather. To keep the drivers free from drowsiness in the later part of night, special care should be taken while assigning drivers for night trains in respect of their physical and mental fitness and the provision of adequate rest. An extensive use of fog signal should be ensured during foggy weather to put the drivers on alert. It should also be ensured that all the signal lamps are lit and kept burning during the night time.

(iv) There was a vacuum after liberation in the skilled and semi-skilled categories of staff on the Bangladesh Railway. The situation has not improved significantlyowing to frequent bans on recruitment. There should be a firm policy in this matter and recruitment should be made on a regular basis according to requirement with provision of proper training.

(v) Various technological safety devices like track circuiting, axle counters, panel interlocking, etc. may be adopted gradually. For minimising collisions, the most serious type of accident involving the loss of human life, the Auxiliary Warning System may be provided. This system gives an audio-visual warning to drivers about the signal aspect and if the driver does not respond, the brakes are automatically applied to bring the train to a halt. However, the priority for such technological developments should be fixed in accordance with the resources available.

(vi) In order to prevent the recurrence of similar accidents, it is necessary to learn what mistakes were committed in the past which could have been avoided. The apparent causes of accidents need to be analysed objectively to find out the fundamental maladies so that the same can be eliminated through timely action. As it is too costly to learn through one's own mistakes, the benefit of the enquiry findings should be extended even to those who are not directly involved in the accident. Every employee should be told where a fellow employee had failed and why.

(vii) To minimise accidents at level-crossings, the use of unauthorised level-crossings should be stopped. Arrangements 'should also be made to convert the unmanned level-crossings linto manned ones gradually.

(viii) There is need for publicity concerning the prevention of accidents and for creating safety consciousness in the railway staff as well as among the members of the public. The printing of suitable safety slogans on railway time tables, Railway Gazette, etc. may be extensively done. Other publicity media, e.g. posters, 'radio, T.V. and the newspapers, may also be used for this purpose.

(ix) A safety organisation may be set up in the Railway for the prevention of accidents.

(x) Occassional seminars should be held on "train accidents, their causes and remedies."

I conclude with a slogan printed in the working Time Table of the Bangladesh Railway.

"The best safety device known is a CAREFUL MAN."