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Identification and Characterization of Hazardous Road Locations on Dhaka-Chittagong National Highway

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Abstract- Road safety problem draws significant attention in a developing country like Bangladesh where road accidents are extremely high. It is estimated by AAA that among eight national highways, over 14% fatal accidents occur on only Dhaka – Chittagong highway, a major transportation artery in Bangladesh. The study was intended to identify the accident-prone locations commonly termed as Hazardous Road Locations on Dhaka – Chittagong highway. The accident data were collected from the database of Accident Research Institute, Bangladesh University of Engineering & Technology, using the Microcomputer Accident Analysis Package Five (MAAP5) software. The Geographic Information System was used as a tool to identify the HRL on Dhaka – Chittagong highway. A total of 35 segments were identified as HRL on Dhaka – Chittagong Highway. This research work comprises the detail accident analysis of one segment on Dhaka – Chittagong Highway which is identified as the most hazardous among the 35 HRL.

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Strictly as per the compliance and regulations of :



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Monisha Alam ^α & Hasib Mohammed Ahsan ^σ

Abstract Road safety problem draws significant attention in a developing country like Bangladesh where road accidents are extremely high. It is estimated by AAA that among eight national highways, over 14% fatal accidents occur on only Dhaka – Chittagong highway, a major transportation artery in Bangladesh. The study was intended to identify the accident-prone locations commonly termed as Hazardous Road Locations on Dhaka – Chittagong highway. The accident data were collected from the database of Accident Research Institute, Bangladesh University of Engineering & Technology, using the Microcomputer Accident Analysis Package Five (MAAP5) software. The Geographic Information System was used as a tool to identify the HRL on Dhaka – Chittagong highway. A total of 35 segments were identified as HRL on Dhaka – Chittagong Highway. This research work comprises the detail accident analysis of one segment on Dhaka – Chittagong Highway which is identified as the most hazardous among the 35 HRL.

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I. INTRODUCTION

Every year more than 1.17 million peoples die in road crashes around the globe [1, 5]. The “Study Global Burden of Disease” undertaken by the World Health Organization (WHO), showed that traffic accidents were the world’s ninth biggest cause of deaths during 1990. The study forecasts that by the year 2020, road accidents would move up to third place in the table of major causes of death and disability [1]. Bangladesh has been found as a country in high risk in terms of number of accidents among the South Asian countries. Bangladesh has one of the highest fatality rate in road accidents higher than 73 deaths per 10,000 registered motor vehicles every year [2]. The national loss due to road accident is estimated to be about 15 billion taka i.e., US\$ 300 million [3, 4]. A recent road traffic accident report shows that nearly 50% [2] of all accidents occur on National Highways of which 75.5% are fatal. The Dhaka-Chittagong Highway (N1) is a main transportation artery in Bangladesh, linking the country’s two largest cities, Dhaka, the capital of Bangladesh and

Chittagong, our business capital. Although it is an important link in national economy, traffic accident rates are very high on this corridor. In 2007, among all national highway accident records, 14% fatal accidents occurred on N1 (6). Very limited study has been done considering the issue of quantitative assessment of the factors involved in traffic accident for Dhaka-Chittagong highway. On this road network, accidents have been shown not to be completely randomly distributed but to be clustered at certain locations. These are the hazardous road locations (HRL). Hazardous road locations are identified as the locations which experiences abnormal frequencies, rates and severities of accident. The period used to identify hazardous road locations varied between 1 and 5 years. In identifying the Hazardous Road Locations (HRL) on Dhaka – Chittagong Highway, the accident database of the Accident Research Institute (ARI) BUET is a rich one. The Microcomputer Accident Analysis Package Five (MAAP5) software helps to obtain the data from the accident database. But these accident databases are usually in the form of linear record file system, which lacked visibility, which is essential for better understanding and good decision making. Geographic information system (GIS) has been identified as an excellent system of linking a large number of separate databases. GIS is also a potential tool for producing maps which provide a clear and immediate impression of the accident distribution on the road network, identifying those locations that have accident concentrations. Several techniques of identification of Hazardous Road Locations have been established but GIS has been applied to display such locations and to analyze problematic cases.

II. ANALYSIS

The study was conducted on Dhaka – Chittagong National Highway. Dhaka – Chittagong Highway has a large volume of traffic. N1 has a bypass and there are three major bridges on this highway which are the Meghna Bridge, the Gomoti Bridge and the Third Karnaphuli Bridge, which is an extra dosed Cable Straight Bridge.

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a) *Reason behind the Selection of Dhaka – Chittagong Highway as Study Area*

This study has been taken on Dhaka – Chittagong highway. This route has been taken critically on two important issues for those it bears a serious effect on not only country economy but also on human lives. The reasons behind the selection of this study area are as follows:

- High volume of traffic on Dhaka – Chittagong Highway
- High rate of accidents on Dhaka – Chittagong Highway

Dhaka – Chittagong Highway is one of the busiest national highways in Bangladesh. High volume of traffic travels through this highway. On the other hand it is a main transportation artery in Bangladesh which connects the capital city Dhaka with the business capital of our country, Chittagong. It is the most profitable linkage road which has become a death trap due to its narrowness and the rise in vehicles over the years. Chittagong port is the only natural port in the world having a very fine navigation and has a tremendous strategic geographic advantage which can contribute immensely to the country to become an ideal global trade and business pivot. Recently works have been

started to convert the Dhaka-Chittagong Highway into a four lane highway which will cause a significant increase in traffic volume on this highway. Selection of Dhaka-Chittagong Highway as the study area also has been done due to its high frequency rate of accidents among all national highways in Bangladesh. In near future, the accident rate is supposed to be increase further due to rise in traffic volume as the highway will be a four lane highway and also because of the improvement works of Chittagong port.

b) *Accident Data Analysis Using MAAP5 and GIS*

The accident analysis was done on Dhaka – Chittagong National Highway by analyzing six years accident data from the year 2004 to 2009. The accident data was collected from the MAAP5 database of Accident Research Institute (ARI) of Bangladesh University of Engineering and Technology (BUET). The Hazardous Road Locations (HRL) were identified by analyzing total and fatal accident data on the highway. Accident data was analyzed at every 100 meter interval on the road. The locations which have three or more fatal accidents and/or five or more total accidents during the six year time period have been identified as HRL.

The procedure followed in identification of HRL on Dhaka-Chittagong highway is divided into several steps. The steps are the following:

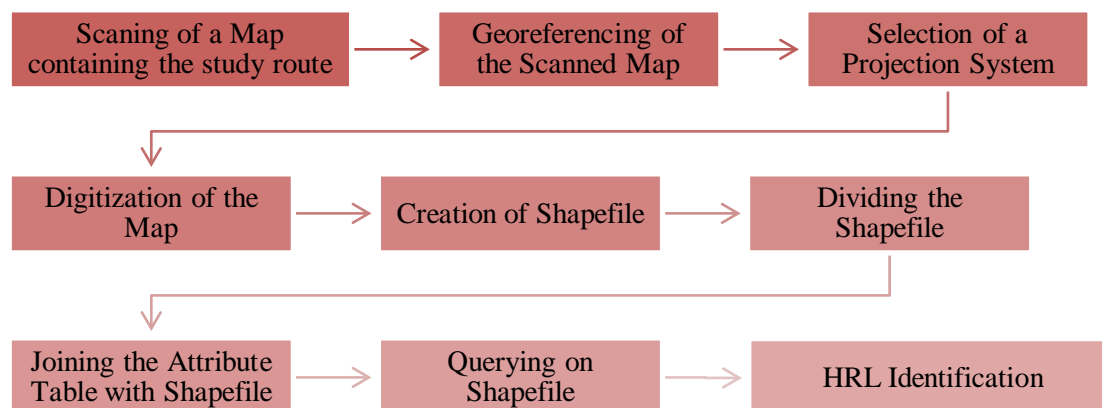


Figure 1 : Steps followed in GIS for HRL identification

The GIS maps of the total and fatal accidents are shown below:

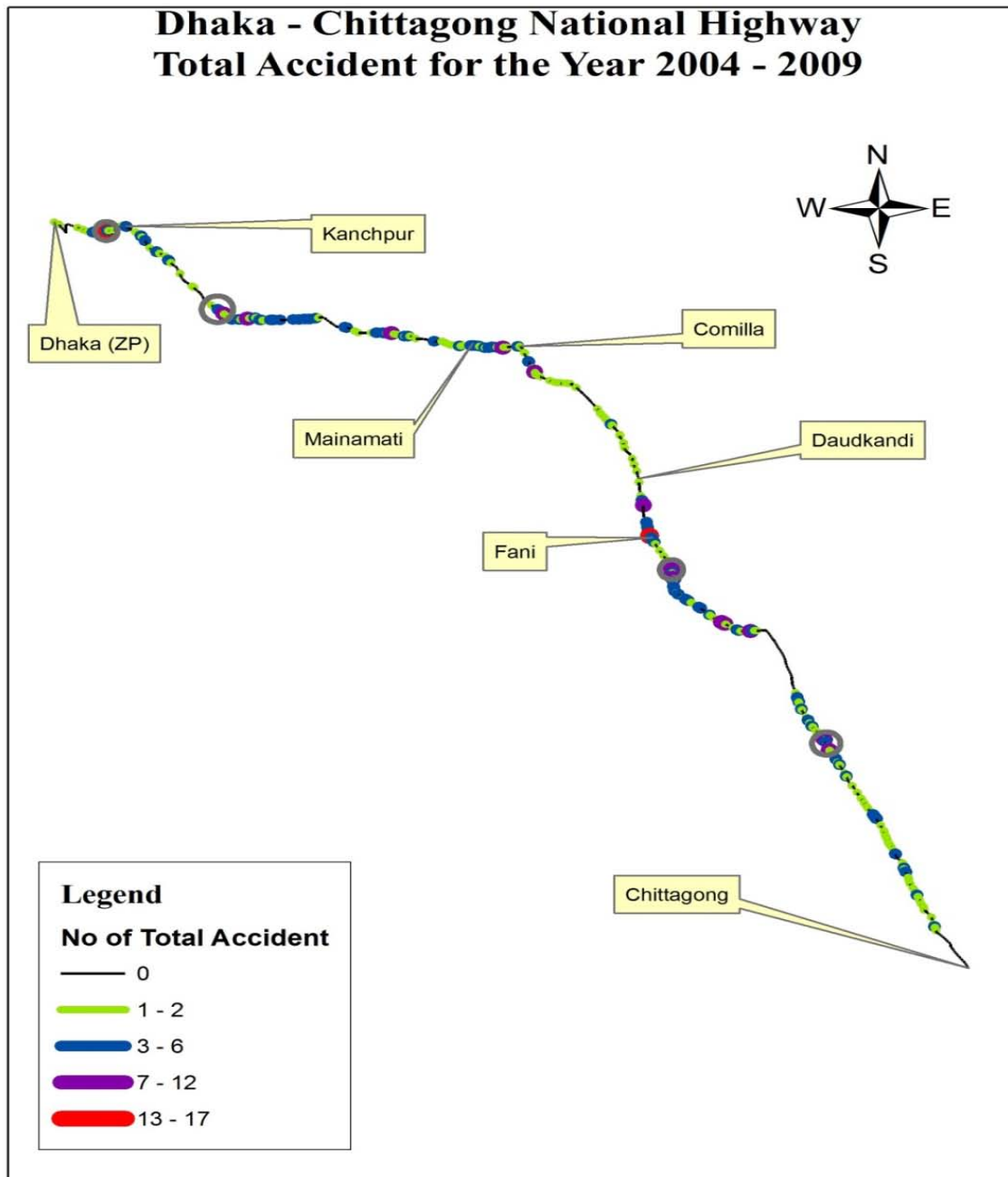


Figure 2 : Total Accidents for the year 2004 to 2009 on Dhaka – Chittagong National Highway

Figure 2 shows the total accidents occurred on Dhaka-Chittagong National Highway during the six years time period. The Hazardous Road Locations on the highway are easily identified from this map.

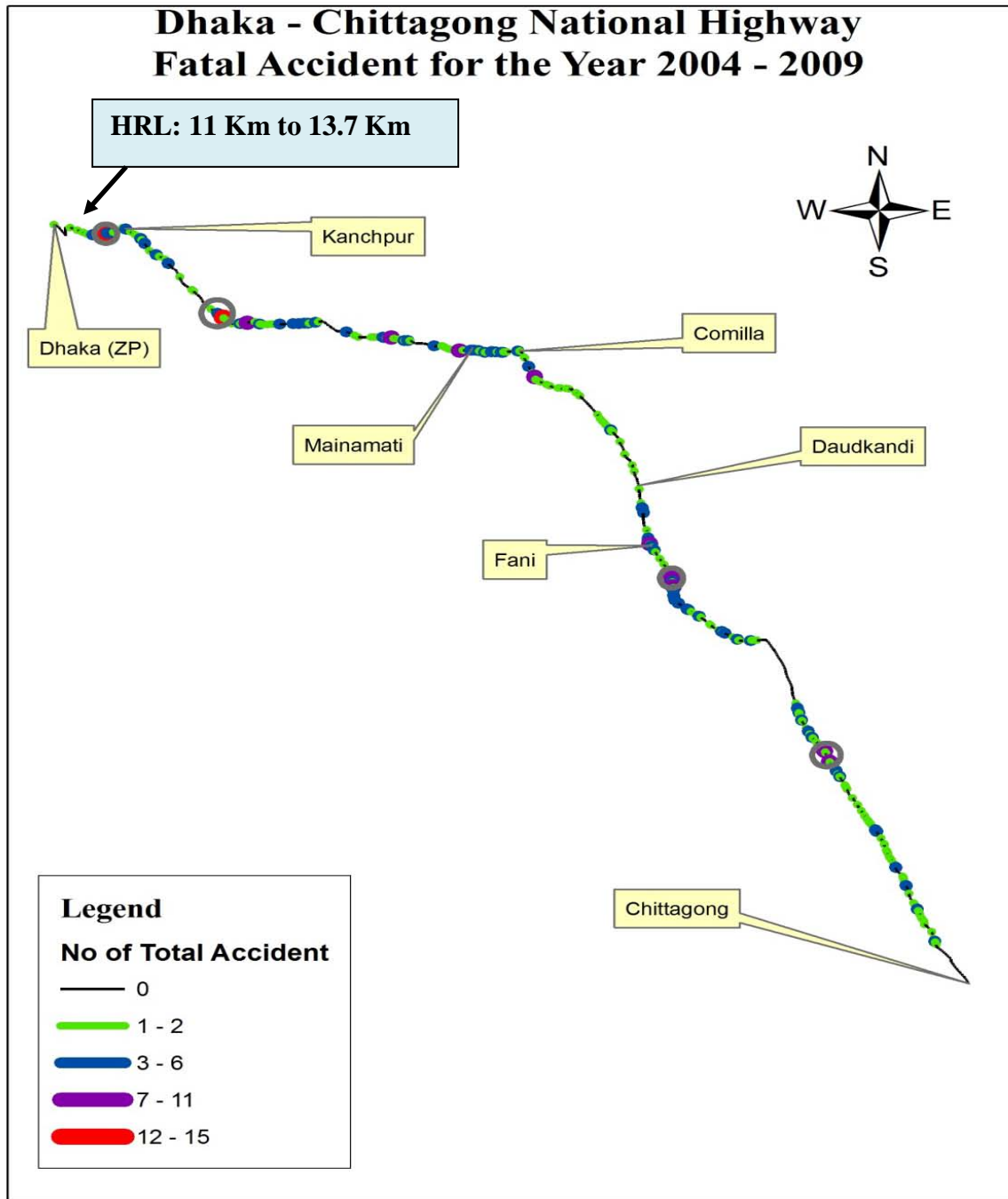


Figure 3 : Fatal Accidents for the year 2004 - 2009 on Dhaka – Chittagong National Highway

The above two figures clearly show that the maximum number of accidents on Dhaka–Chittagong National Highway during 2004 to 2009 are occurring repeatedly in the following areas:

- Kanchpur
- Daudkandi
- Mainamati
- Fani

From the GIS maps, 35 locations on Dhaka-Chittagong highway which have been identified as HRL are listed below in Table 1:

Table 1 : Hazardous Road Locations on Dhaka-Chittagong Highway (2004-2009)

Segment (Km)	Total Accidents	Fatal Accidents
9 – 10.9	9	7
11 – 13.7	46	41
20 – 21.9	11	9
26 – 27.9	8	7
40 – 43	35	32
46 – 48	19	14
50 – 53	21	14
58 – 60	17	15
66 – 69	9	7
72 – 73.9	21	17
74 – 77	24	18
86 – 87.9	17	11
88 – 91	24	19
94 – 95.9	22	8
104 – 105.9	13	10
122 – 123.9	22	19
146 – 148.1	19	13
148.2 – 149.9	23	15
150 – 151.9	9	8
156 – 158	43	30
158.1 - 160	24	16
160.2 – 161.9	12	7
162 – 163.9	10	6
164 – 166.2	18	9
164 – 166.2	18	9
172.3 – 173.9	21	15
178 – 179.9	21	16
198 – 200	13	12
202 – 205.1	15	13
207.2 - 210	29	24
212 – 213.9	14	12
224 – 227	20	15
232.8 – 235.4	12	10
237.9 - 240	17	15
244.4 – 247.4	11	9
252.4 – 258.9	8	6
Total	840	675

Among these 35 segments, the four most vulnerable segment have been selected on the basis of the highest number of accidents occurred during the analysis period. This most hazardous location have

been highlighted in the table. This accident prone zone is located in the Kachpur area on Dhaka-Chittagong highway. The details accident analysis on this HRL is done.

c) Accident Characteristics on the Selected Segment

From the data analyzed, the most hazardous location identified is a 2.7 km long segment which is from 11.0 km to 13.7 km from Dhaka zero point. At the starting of this portion of the road there is a petrol pump and at the end of the segment a spinning mill is located. The figure 4(a) shows the total number of accidents and the number of fatal accidents on this area is shown in figure 4(b).

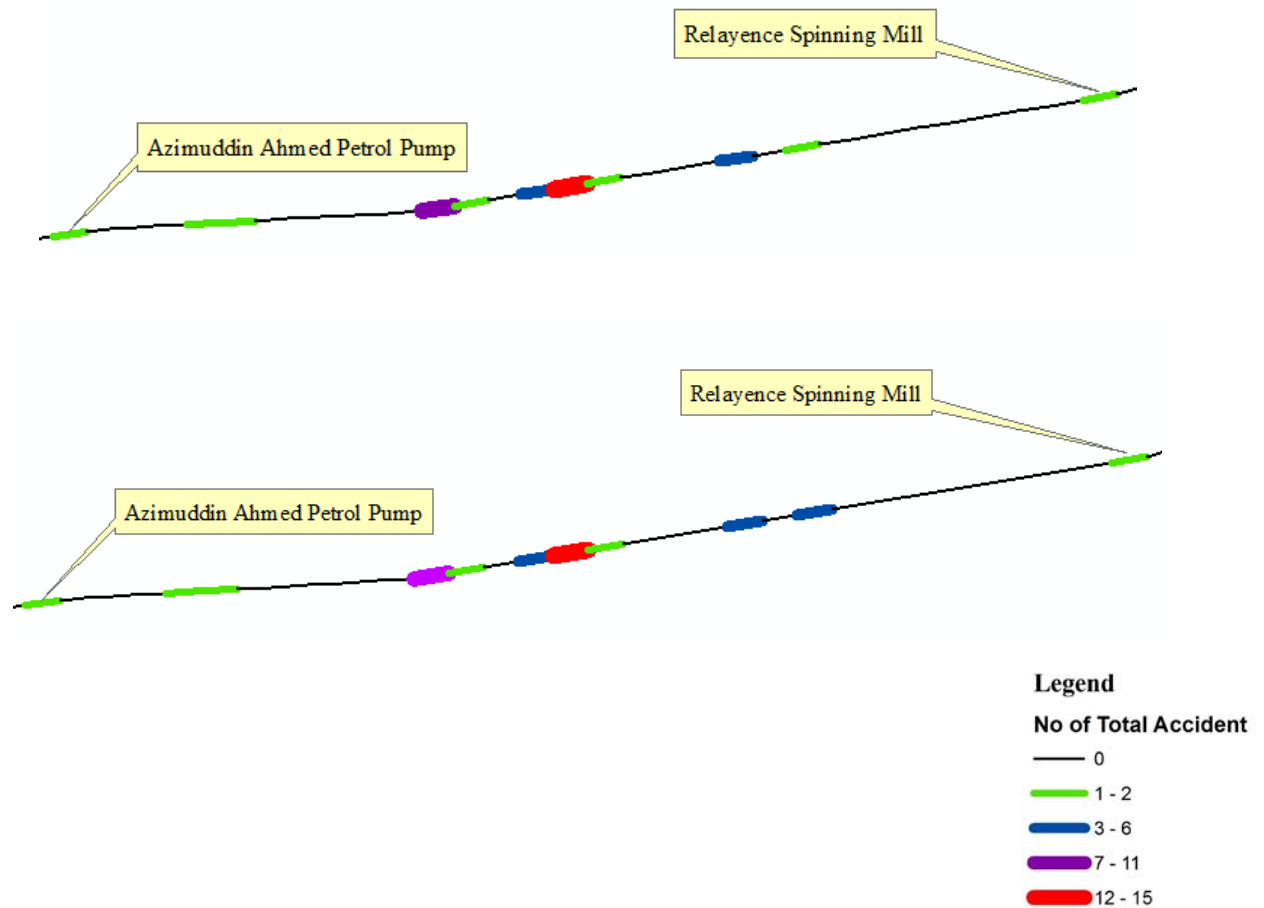


Figure 4 : (a) Total and (b) Fatal Accidents on the selected HRL during the year 2004 – 2009

The accident characteristics of the HRL are discussed below.

i. *Number of Accidents*

Figure 5 shows the number of total and fatal accidents on various kilometer posts on the segment from 11.0 km to 13.7 km.

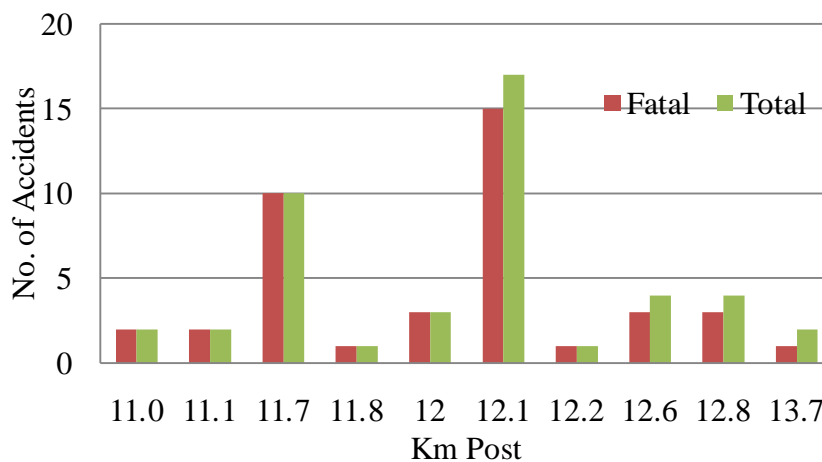


Figure 5 : Total Accidents vs. Fatal Accidents on various km posts on the selected HRL

This road segment lies between a petrol pump and a spinning mill. So, a large number of vehicles as well as pedestrians use this segment every day. So, the

number of accidents is very high in this location. In Figure 6, it is clearly identified that accidents are concentrated on the 12.1 km post. About 37% of the

total accidents occurred on this point only. It is also found that shows that the majority of the accidents are fatal. So, in consideration of the number of the total and fatal accidents, this segment is a vulnerable one.

The Driver, passenger and pedestrian casualties are analyzed. From figure 6, it is found that pedestrians are the most vulnerable group in road accidents on this segment. Passengers are next to the pedestrians facing severe casualties.

ii. *Casualty*

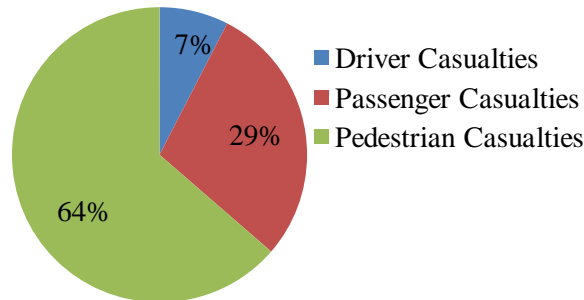


Figure 6 : Casualties occurred on the selected HRL

iii. *Type of Collision*

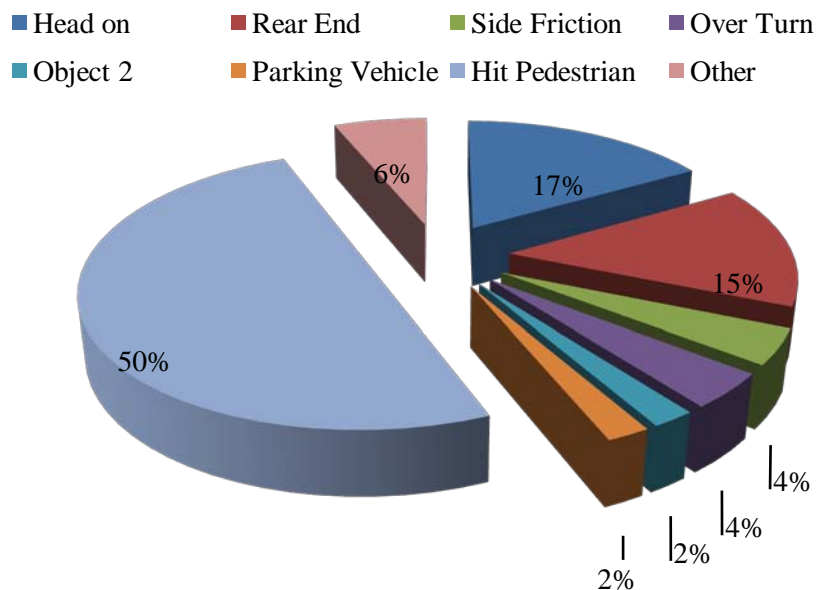


Figure 7 : Collisions occurred on the selected HRL

The figure 7 shows that the maximum collisions occurred on this segment are Hit Pedestrian. So, the pedestrians face the maximum casualty.

iv. *Light Condition*

Since the local traffic as well as the through traffic are high during the day time, accidents occur frequently at this time. Table 4 represents that phenomenon.

Table 4 : Number of accidents at various Light Conditions on selected HRL

Km Post	Day	Dawn Day	Night Lighted	Night Unlighted
11.0	1	1	0	0
11.1	1	1	0	0

11.7	5	1	1	0
11.8	0	1	0	0
12	0	1	0	0
12.1	12	3	4	2
12.2	1	0	0	0
12.6	1	1	1	0
12.8	2	1	0	1
13.7	1	0	0	0
Total	24	10	6	3

v. Types of Vehicles Involved

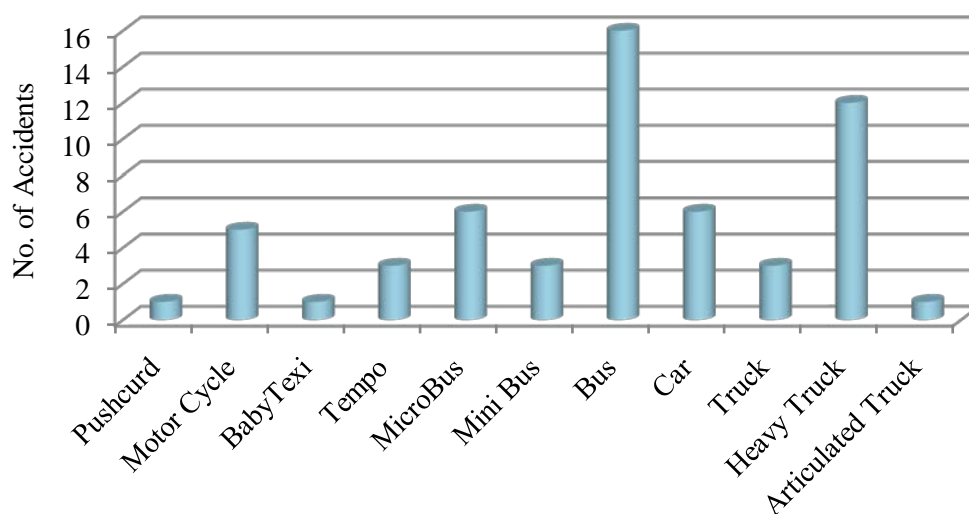


Figure 8 : Involvement of Vehicles in Accidents on the selected HRL

We can see from figure 8 that, a number of vehicles are involved in accidents on this segment. Among those, buses, trucks, cars, micro buses are predominant type of vehicles.

vi. Contributory Factors

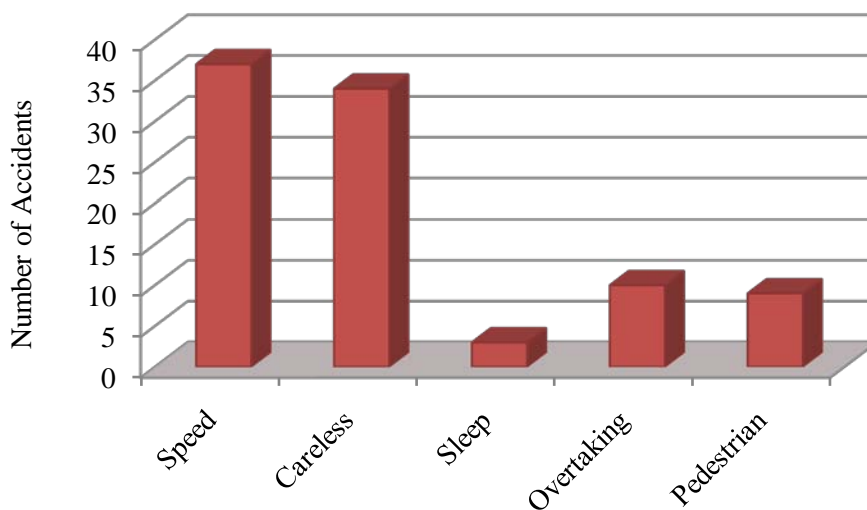


Figure 9 : Involvement of Vehicles in Accidents on the selected HRL

Figure 9 shows the factors contributing mostly in accidents on the selected HRL. It is found that over speed and carelessness of driver are the major causes of accidents.

vii. Accident Trend

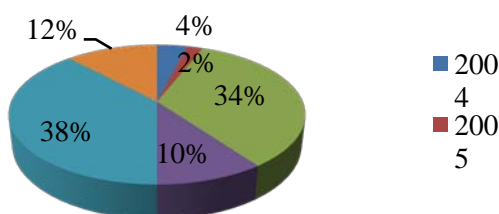


Figure 10 : Yearly Distribution of Accidents on the selected HRL

The rate of accidents at each year during the six years interval from 2004 to 2009 is shown in figure 10. It is seen from this figure that the accidents do not follow any fixed trend. Highest number of accidents occurred on segment during the year 2008 and the minimum number of accidents occurred in 2004. So, it is clear that accident rate is increasing in recent times.

III. RESULTS AND DISCUSSION

After conducting the detail study, it has been found that a total of 840 accidents have occurred on Dhaka – Chittagong Highway during the six year duration from 2004 – 2009 and 675 accidents among the total accidents are fatal. So, it is clearly visible that about 80% of the accidents are fatal accidents which have caused severe casualty and loss to life as well as the economy of our country.

The GIS maps prepared from analyzing the six years accident data from 2004 to 2009 have shown that 35 locations on Dhaka – Chittagong National Highway are hazardous. One of the most important features is that although the hazardous locations have been found in the entire portion of the highway, the highest accident rates have been found in the first 77 km length of Dhaka-Chittagong highway. About 31% of the total accidents occurred in this portion of Dhaka-Chittagong highway. So it has been clearly identified that accidents are concentrated on this portion of the Dhaka – Chittagong Highway and this portion requires proper treatment and remedial measures to decrease the higher accident rates and improve the road traffic condition.

One segments on Dhaka-Chittagong Highway have been selected from all the 35 hazardous locations on the basis of the highest number fatal accidents. Details accident analysis on this segment on various parameters has given the following accident scenario.

- About 70% to 90% of the total accidents are fatal
- Pedestrian casualties occur in 50% to 60% accidents whereas passenger casualties occur in 35% to 41% accidents and driver casualties occur in only 10% to 15% accidents
- Hit pedestrian (40% – 50% fatalities) is the most dominating collision type
- About 80% - 85% of the total accidents occur during day time, where only 16% - 20% accidents occur in night and dawn.
- Buses (30%-37% casualties) and trucks (25%-30% casualties) are mostly responsible for accidents. Cars are responsible for about 20% accidents whereas involvement of cycle and baby taxi is negligible
- Speed (75% to 80% fatalities) and carelessness (80% to 90% fatalities) contribute mostly in accidents on the four segments.

IV. CONCLUSION

The recommendations based on the findings of the study are discussed here. Some more general recommendations have been also provided. Further site study is required to design appropriate remedial measures.

- The rate of fatality is very high on the HRL on Dhaka-Chittagong National Highway. So immediate site investigation should be done on all the hazardous road locations identified in our study.
- Over speed and careless attitude of the drivers are the two most contributory factors of accidents on the highway found in the study. So adequate enforcement should be provided to ensure that the drivers follow the traffic rules strictly.
- Pedestrians are the most vulnerable group facing the highest rate of casualty on the studied segment. So, reduction of the pedestrian casualty is a must. To do that some facilities for the pedestrians such as overpass, underpass, zebra crossing, pedestrian signal etc should be provided where required.
- The identified most hazardous location on the studied route is near a bridge. So, proper attention should be given on the nearby locations of the bridge to reduce the accident frequency.
- Head on collision is one of the dominating collision types on the selected HRL of the highway. Undivided highway, reckless overtaking are the main causes of head on collision. Speed variation is the main cause of rear end collision. So exclusive lane for non motorized vehicles may reduce rare end collision.
- Buses and trucks are the vehicles responsible for the highest number of casualties. So dangerous and inappropriate operation of heavy vehicles should be prohibited strictly to reduce accidents on the hazardous locations of Dhaka-Chittagong highway.
- As our study results show that most of the accidents occur during day time, so drivers should have safe attention while driving during day time and also at night.
- As during our study, some errors have been found in the accident data, so the accident database should be improved. Upgrading MAAP5 software from DOS to windows version can be an effective measure.

Recently the Dhaka-Chittagong highway is being converted to a four-lane highway, which will turn its operation more complicated and hazardous. So the necessary remedial measures should be provided immediately to ensure the safe and efficient operation of Dhaka-Chittagong Highway.

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