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Accident Hotspot Identification using Geometric Problems and Characteristics in Selected Road of the Dhaka-Aricha Highway (N5)

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ABSTRACT

The Dhaka-Aricha highway is an important link for west-south interregional road network in Bangladesh. According to police accident records (each year about 75 km road segment, 180 accidents and 120 fatalities occurs) it is also the most dangerous in terms of per kilometer accidents and fatalities. Total 25000 number of vehicles of all types including motorized and non-motorized run through this highway every day. Road accident is a regular phenomenon of this highway. The data for this study have been collected from field survey, local police stations, Roads and Highway Department, Road Safety Department, Accident Research Institute, BUET and by using MAAP software. The results of the 150 samples reveal that 38 percent of the fatalities were between the ages of 20 and 35. Buses (83.33 %) and trucks are the most common vehicles involved in accidents (62%). At 6am to 12pm is the most accident accruing time. The other result shows pressure of vehicles, geometric characteristics, overtaking in speed by competing drivers, are the major causes of road accidents in this highway. The most vulnerable points of road accident are Dhamria town, Golara, Joypura, Kalampur, Bathuli, Mulzan, Tepra Bus stand, Paturia intersection of the district. To reduce the rate of accidents in this highway some geometric measures and awareness building among the road users should be bring together to reduce accident.

Keywords:-*Accident hotspot, geometric characteristics, road accident, highway, intersection, geometric measures.*

INTRODUCTION

The proper identification of accident-prone locations has a major impact on the reduction of road accidents and the costs associated with them. Due to a shortage of domestic studies and research on accident hotspot identification methods, a thorough and geometric characteristics approach for detecting hotspots is now more important than ever. It is self-evident that focusing greater attention on accident hotspots as the first and most essential stage in all road safety programs, as well as localizing hotspot identification methods, will help to minimize the rising problem of road accidents [1]. Accidents in the highway account for a significant portion of all accidents. According to data, 21 died on roads every day in Bangladesh [2]. A comprehensive road safety management system is required to reduce accidents in a targeted and methodical manner. The initial stage in the road safety management strategy is to introduce accident hotspots. Hazardous road locations, high-risk sites, accident-prone circumstances, places in need of repair, and so on are some of the terms used to describe accident hotspots [3]. Two primary objectives are followed while developing and implementing road

safety improvements: the identification of accident hotspots and the appraisal of regions with the greatest potential for decreasing accidents [4]. The investigation and study of accident hotspots in Bangladesh is at a low and inadequate level due to a lack of a codified plan to identify and prioritize these hotspots, as well as an appropriate database in which the identification of country hotspots can be registered and updated after providing the validity and implementation of corrective measures.

Rapid, unplanned, and unsustainable urban growth patterns [5] are causing a slew of new issues [6]. Every unplanned development has several severe social, economic, and environmental consequences [7,8]. A process of land use conflicts arises owing to incompatibility of land uses [9,10] because the land use change may create conflict on road safety and others [11,12]. A Roads in urban areas [13] are essential for communication and commerce [14,15]. To meet the demand, the roads must be well-functioning and efficient [16,17]. The safe road provides a safe method of transportation [18,19], a safe travel route and journey [20], as well as a safe and healthy environment [21].

The number of traffic accidents has increased significantly in recent years. According to the World Bank, a death rate of about 85.6 per thousand cars is appropriate, however the speed in Bangladesh is extremely high and dangerous [22].

According to traffic police, 8–10 people die every day on average, and 84,000 people have died in road accidents in the previous 20 years [23]. The yearly urban growth rate in Bangladesh is 4%, whereas the motor vehicle growth rate is about 8% [24]. Road accidents have a significant impact on GDP, whether in a developed or developing nation. However, in underdeveloped nations, the economic impact of an accident is significantly larger [25].

According to a WHO research, this expenditure is about 2–3% of GDP in poor countries [26]. The yearly damages caused by road traffic accidents in the United States are more than $400 billion [27]. Reckless driving and overloading have been identified as significant causes of road accidents in Bangladesh, according to the traffic police agency. More than half of all accidents were caused by speeding and irresponsible driving [24,28].

The study's goal is to determine the causes of accidents as well as the cause's data distribution of collisions. The goal of this study is to determine the geometric characteristics for safety measures. Bangladesh shall reduce the rate of road traffic accidents and injuries by half, according to the United Nations Road Safety 2011–2020 action plan and Sustainable Development Goals (SDGs) - 2030 and its GOAL–3.6 [29,30].

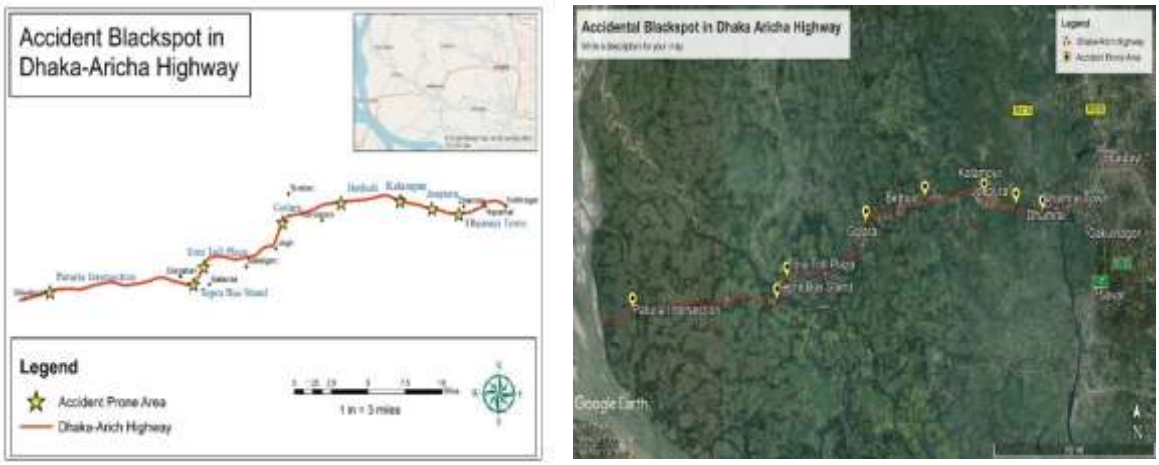
METHODOLOGY

This research was carried out using primary and secondary data sources. For these primary data 150 samples were collected in all the accident hotspot and to identify accident hotspot the past 20 years, data was gathered from various publications and yearly reports from the transportation authority.

Bangladesh Bureau of Statistics (BBS), Bangladesh Road Transport Authority (BRTA), Roads and Highway Bangladesh (RHD), and Accident Research Institute (ARI) collected statistics data. Many people do not report accidents; thus the real number of accidents is higher than the number reported. The area of study is the Dhaka-Aricha Highway (Nobinagar to Paturiya T junction) and it is the section of Road N5.

STUDY AREA

Until recently, there has been relatively little work done in Bangladesh to focus on a detailed spectrum of studies of road collisions in order to build a reasonably complete knowledge of the crash problems and, as a result, effective remedies. This research focuses on dangerous road sites on Bangladesh's which connect the country's Southern and western regions to Capital City and play an important role in inter-district and interregional transportation.



***Map 1:**-The location map of 8 accidental spot the Dhaka-Aricha highway*
Source: GIS map made by the Author, 2018

LOCATION AND SHORT DESCRIPTION OF THE STUDY AREA

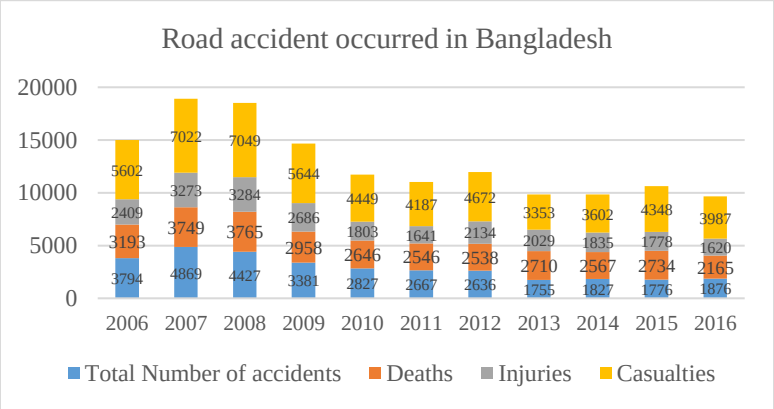
Dhaka-Aricha highway plays a vital role in inter -district and inter-regional transport as it connects the Northwestern and Northern region of Bangladesh with Dhaka, the national capital. It originates from Aminbazar Bridge and ends at Aricha Ghat covering a length of 75.4 km, encompassing six upazillas (UZ) namely, Savar, Dhamrai, Ghior, Saturia, Manikganj and Shibalaya. In this study, an attempt was made to evaluate the effectiveness of the safety measures eight black sport which is dhamrai bus stand. Joypura bus stand, Bethuli bus stand, goloda bus stand, Tara toll Plaza, Tepra bus stand, Paturia intersection black spots in Dhaka-Aricha highway

ROAD ACCIDENT CONDITION IN BANGLADESH

In Bangladesh, road traffic accidents are a regular occurrence. In the previous three years, more than 10,000 accidents have occurred, with 25,000 people killed [27]. This figure depicts the current state of road safety in terms of accidents and deaths. The diagrams and statistics that follow will visually depict the country's road accidents and safety situation.

According to a study by the National Committee to Protect Shipping, Roads, and Railways, the country saw a 35 percent drop in road accidents and a 45 percent decrease in injuries in 2016 compared to the previous year (NCPSRR). There were 470 women and 453 children among the victims. 4,592 traffic accidents, on the other hand, killed at least 6,823 people in 2015, including 781 women and 762 children, and injured 14,026 others. In the just-concluded year, traffic accidents fell by 35%, while deaths and injuries decreased by 50% and 39%, respectively, compared to 2015. The study was compiled using reports from 20 national newspapers, ten regional newspapers, and

eight news portals and news organizations online. Seven major causes of accidents were identified by the national committee (The Bangladesh Tribune, January 2, 2017).



Source: Police Headquarters (FIR) report, 2018

Fig.1:-*Statistics of road accidents occurred in Bangladesh [31]*

RESULT AND DISCUSSION

Analysis of Geometric design and road accident data of Dhaka-Aricha highway

For National Highway two lane road, Standard value of Right of way: 80m/262ft (Highway engineering, Gurcharan Singh)

Table 1:-*Analysis of Right of way*

Area	Standard value (feet)	From field survey(feet)	Difference
Dhamraibus stand	262	130	132
Joypura Bus stand	262	100	162
Kalampur Bus stand	262	123	139
Bethuli Bus tand	262	180	82
Golada T junction	262	240	26
Golora bus stand	262	160	102
Tara toll plaza	262	110	152
Tepra Bus stand	262	180	82
Paruria intersection	262	250	12

A right-of-way (ROW) is a right to make a way over a piece of land, usually to and from another piece of land. A right of way is a type of easement granted or reserved over the land for transportation purposes.

The table 1 show that in Golora T junction maximum value of right of way found but 26ft is less than 262ft standard value. The highest value found in Paturia intersection which is 250ft out of standard value 262ft. The lowest value found in joypura bus stand which is 100ft out of standard value 262ft.

ANALYSIS OF CAMBER

For National Highway two lane road, (Highway engineering, Gurcharan Singh)

Camber, $Y=\frac{2x^2}{nB}$

Where,

B= width of pavement

N= Camber (Bituminous surface, heavy rain 2%)

X= Horizontal distance of the point where offset or ordinate is being determined for the center of pavement.

Y= offset or ordinate of wooden baulk. At center value of Y is zero.

Table 2:-*Analysis of Camber*

Area	Carriage way width(Feet)	Providing camber (cm)	From field survey (cm)
Dhamraibus stand	70	21	15.24
Joypura Bus stand	23	7.01	7.63
kalampur	25	7.62	8.89
Bethuli	31	9.45	7.36
Golada T junction	40	12.19	10.16
Golada bus stand	32	9.75	10.16
Tara toll plaza	24	7.32	8.89
Tepra Bus stand	24	7.32	12.7
Paruria intersection	26	7.92	7.62

Camber or cant is the cross slope provided to raise middle of the road surface in the transverse direction to drain off rain water from road surface.
In Golada Bus Standi can be seen on cameras 21 cm of roads. 21 But it is estimated that there is a camber at 15.24, which is 5.76 less standard road wise than calculated. The highest camber value found from field survey in Tepra bus stand which is 12.7 out of providing camber value of 7.32 for 24 feet road. Other camber value are not in considerable numbers which are presented in above table

Measuring Stoppings sight distance: Stoppings sight distance (SSD)

$$SSD = vt + \frac{v^2}{2gf}$$

Where v is the design speed in m/sec^2,
t = is the reaction time in 2.5 sec,
g = is the acceleration due to gravity is the coefficient of friction (9.8 m\sec).
The coefficient of friction f is given below for various design speed.

Table 3:-*Measuring Stoppings sight distance*

Area	**Design speed**	**Stopping distance**
Dhamraibus stand	40	44
Joypura Bus stand	30	30
kalampur	30	30
Bethuli	60	78
Golada T junction	60	78
Golada bus stand	30	30
Tara toll plaza	30	30
Tepra Bus stand	25	24
Paruria intersection	30	30

Stopping sight distance (SSD) is the minimum sight distance available on a highway at any spot having sufficient length to enable the driver to stop a vehicle traveling at design speed, safely without collision with any other obstruction. There is a term called safe stopping distance and is one of the important measures in traffic engineering. It is the distance a vehicle travels from the point at which a situation is first perceived to the time the deceleration is complete. For Dhamrai bus stand stopping site distance 44 for 40 design speed. In Bethulia bus stand stopping site distance 78 for 60 design speed.in Tepra bus stand stopping site

distance 24 for 25 design speed. Another design speed presented on the chart 5.7.

ANALYSIS OF ROAD ACCIDENT DATA OF DHAKA-ARICHA HIGHWAY

The Dhaka-Aricha highway has turned into a death trap. According to sources in police, 214 accidents occurred on the highway from December, 2015 to, 2016 in which 204 people were killed. In the table, the last updated five years data (from the year of 2006 to 2011, where in 281 accident records were found) of the Road accident in Dhaka-Aricha highway (which are collected from Accident Research Institute, BUET) are present.

***Table 4:**-Road accident trend in Dhaka-Aricha highway (2006-2011)*

Year	No of accident	No of severity	Total casualty
2007	58	56 Fatal, 8 Grievous, 2 Simple, 2 Motor Collision	144
2008	54	33 Fatal, 8 Grievous, 1 Simple, 1 Motor Collision	93
2009	43	31 Fatal, 4 Grievous, 1 Simple, 1 Motor Collision	110
2010	40	27 Fatal, 3 Grievous, 1 Simple	85
2011	46	31 Fatal, 3 Grievous, 1 Simple	91
Total	**281**	**201**	**513**

Source: Accident Research Institute, BUET, 2018

From the table that, the number of road accidents and casualties are decreasing day by day. In the year 2007 where the total number of road accidents are 58 and total number of casualties are 144, which is the highest among the five years.

DISTRIBUTION OF ACCIDENTS BY ACCIDENT OCCURRENCE TIME

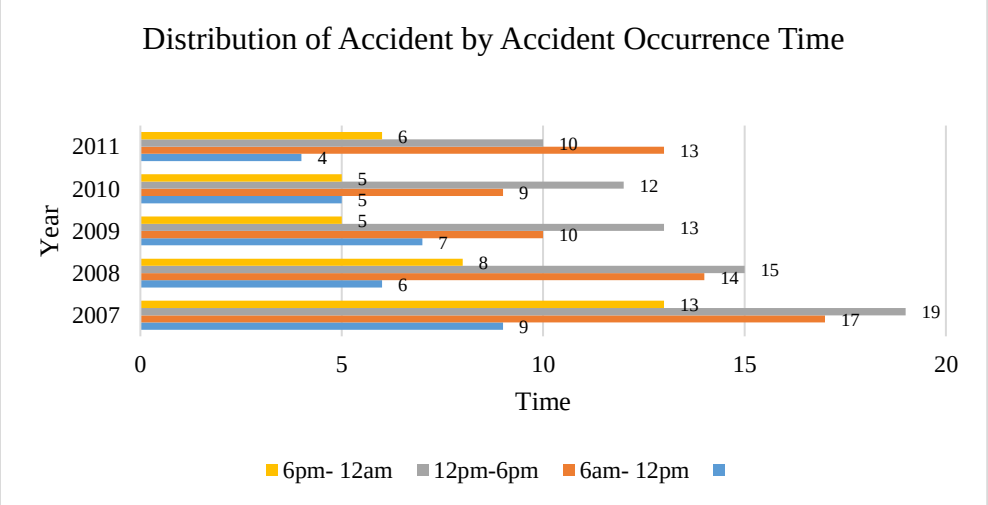


***Fig.2:**-Distribution of accidents by accident occurrence time*
Source: Accidents Research Institute, BUET, 2018

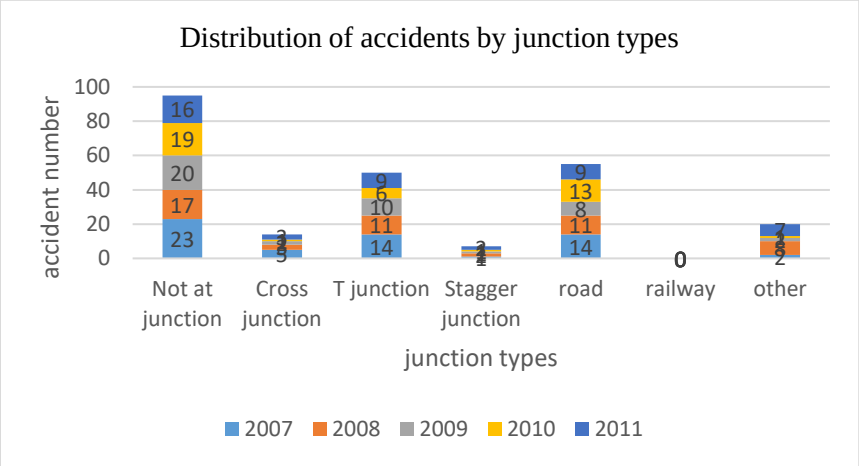
The above figure shows that the highest 69 (40.59%) out of 281 number of accidents occurred in the time between 12pm- 6pm among the five years (2007-2011) data.

Lowest Accidents occurred in the time between 12pm-6am follows it, total 31 accidents out of 281; as the year of 2012-2016 data are available but Accidents Research Institute con not provide this

year data because of their administration bureaucracy. Chart 5.10 show the scenario of Distribution of accidents by accident occurrence time.

DISTRIBUTION OF ACCIDENTS BY JUNCTION TYPES

Figure show Total 281 accidents data are defined, which accidents were related with the junction type. Considering junction types are- Not at Junction as 'Not-J', Cross section as 'Cross', T-Junction as 'T-Jun', stagger Junction as 'Stag-X', Round about as 'Round', Railway Junction as 'Rail-W' and Other. Most accidents were occurred at the 'Not at Junction' location and the number is 95.This data is followed by the 'T-Junction' location 50 and road location 55 others junction type are not considerable in number.

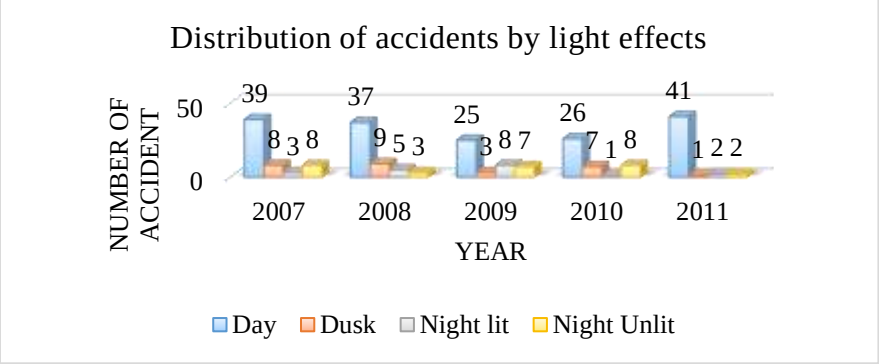


Source: Accidents Research Institute, BUET, 2018

Fig.3:-Distribution of accidents by junction types

DISTRIBUTION OF ACCIDENTS BY LIGHT EFFECTS

Chart 5.13 show that at daytime the people rushes more than in night. So the numbers of vehicles are higher than the night time. Obviously, the numbers of accidents are more in day than the night. Four types light are considered and these are- Day Light, Dawn/Dusk, Night Lit and Night Unlit. 2007 is the year for highest accident between the study periods. Day by day, the rate of accident decrease. In all the time in the study period, day time accident were 168, dawn/dusk light 28, night lit 19 and night unlit 28 of total 281 accidents.

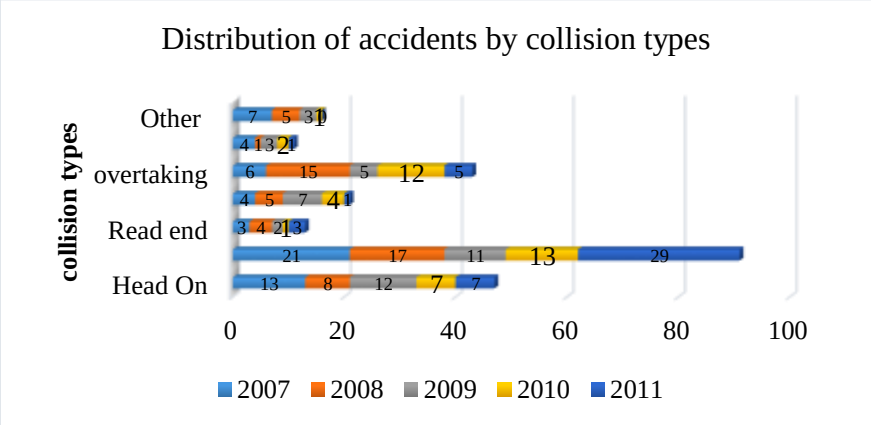


Source: Accidents Research Institute, BUET, 2018

Fig.4:-Distribution of accidents by light effects

DISTRIBUTION OF ACCIDENTS BY COLLISION TYPES

Considering the accident severity from chart 5.14 show that collision types, there are several collision types are considered. This are-Head on, right angle, overturned vehicle, hit pedestrian, hit object on road, rear end and other. Among these types the 'Hit pedestrian' collision is 91 which is the highest number out of 281. 'Head on' collision type is in second position and it is 47 out of 281 number of accidents. 'Overtaking' collision type follows it, 30 (17.65%) out of 170.

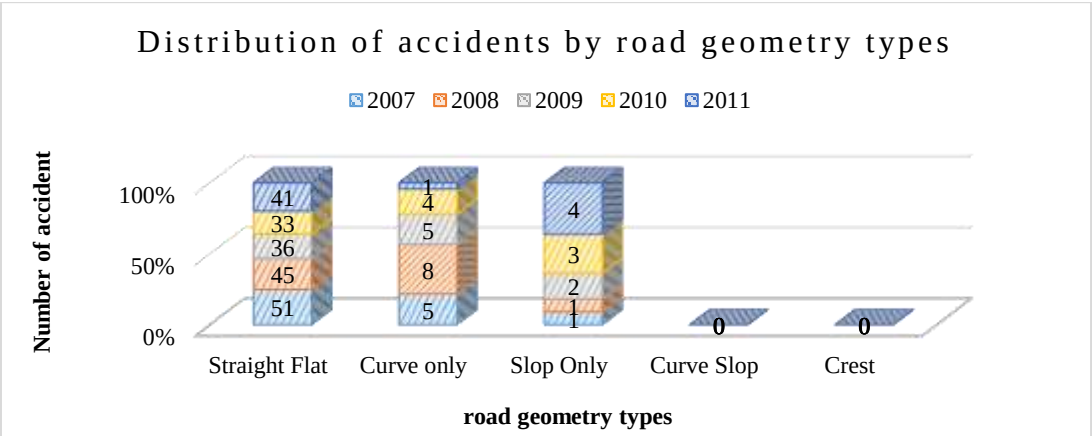


Source: Accidents Research Institute, BUET, 2018

Fig.5:-Distribution of accidents by collision types

DISTRIBUTION OF ACCIDENTS BY ROAD GEOMETRY TYPES

Figure 6 shows that road accidents sometimes depend on the road geometry. In the study area, according to road geometry all roads are straight, a few are curve. So, accidents in the straight roads are common in the Dhaka-aricha highway. 281 accident occurred in the straight roads in the study period 2007-2011, the highest number in 2007; it was 58 and lowest in 2010; it is clear that, day by day the number of accident is decreased.

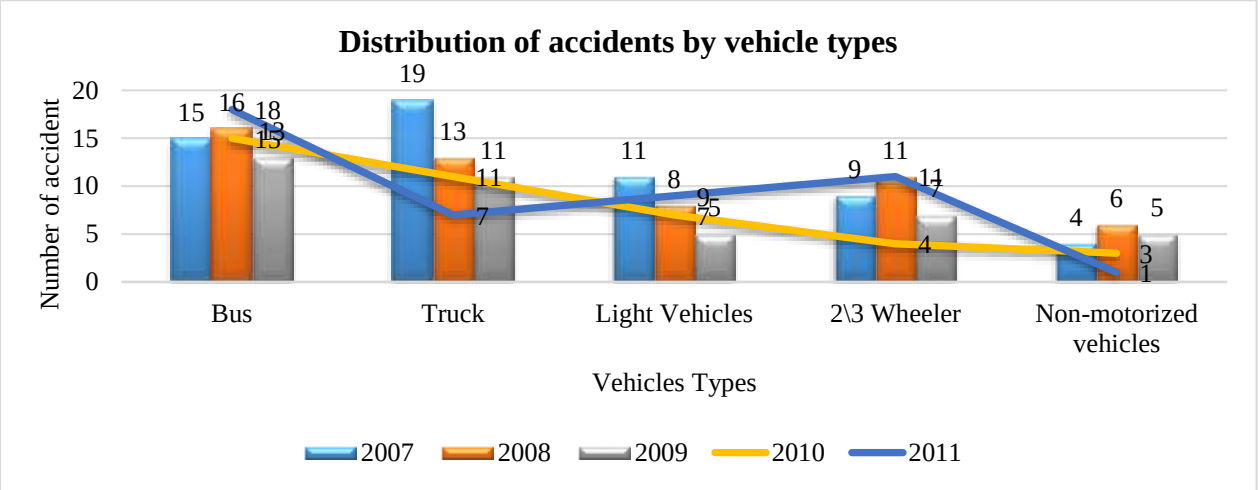


Source: Accidents Research Institute, BUET, 2018

Fig 6: -Distribution of accidents by road geometry types

DISTRIBUTION OF ACCIDENTS BY VEHICLE TYPES

Figure 7 show that all types of vehicles are available in the study area. Although non-motorized vehicles are forbidden in highways, there are a large number of non-motorized vehicles in the Dhaka-Aricha highway. From the data presented in chart most of the accidents are Bus and Heavy truck related accidents. Light vehicles, 2/3 wheelers, nonnotarized vehicles etc. are responsible for others type of accidents. Bus related accidents are 77 and Heavy truck related accidents are 61 out of 281 number of accidents

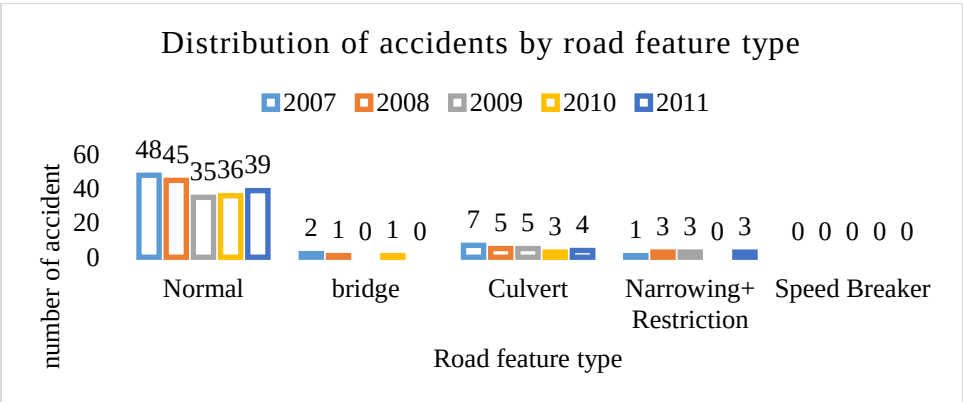


Source: Accidents Research Institute, BUET, 2018

Fig.7:-Distribution of accidents by vehicle types

DISTRIBUTION OF ACCIDENTS BY ROAD FEATURE TYPE

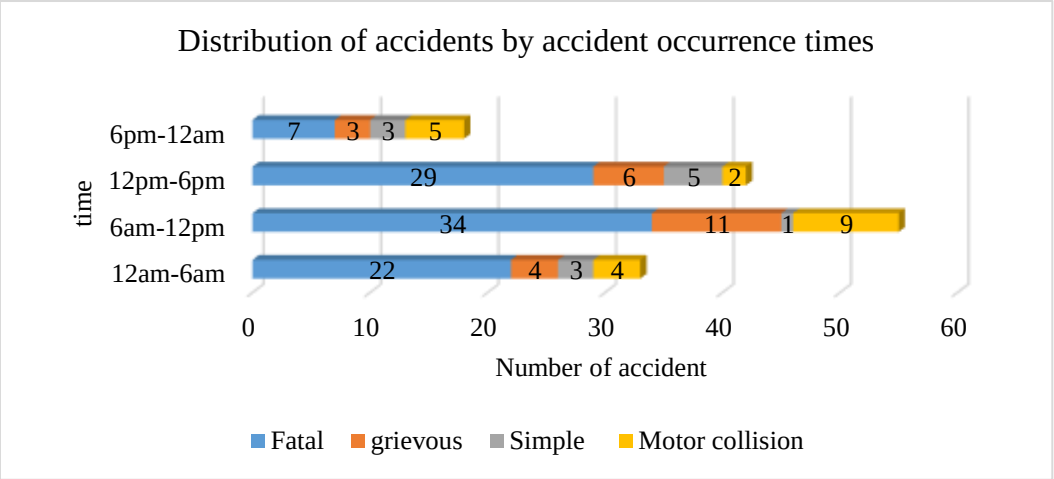
Road feature types are- Norma, Bridge, Culvert, Narrowing Restriction and Speed Breakers. Among all the types 'Normal' road feature type is responsible for the maximum number of accidents in the study area. From Chart 5.18 Total 203 accidents occurred in 'Normal' road feature types. 2007 is the year where the maximum number (58 out of 281) of accidents occurred in 'Normal' road features type. Other types are not considerable in number



Source: Accidents Research Institute, BUET, 2018

Chart 5.18:-Distribution of accidents by road feature type

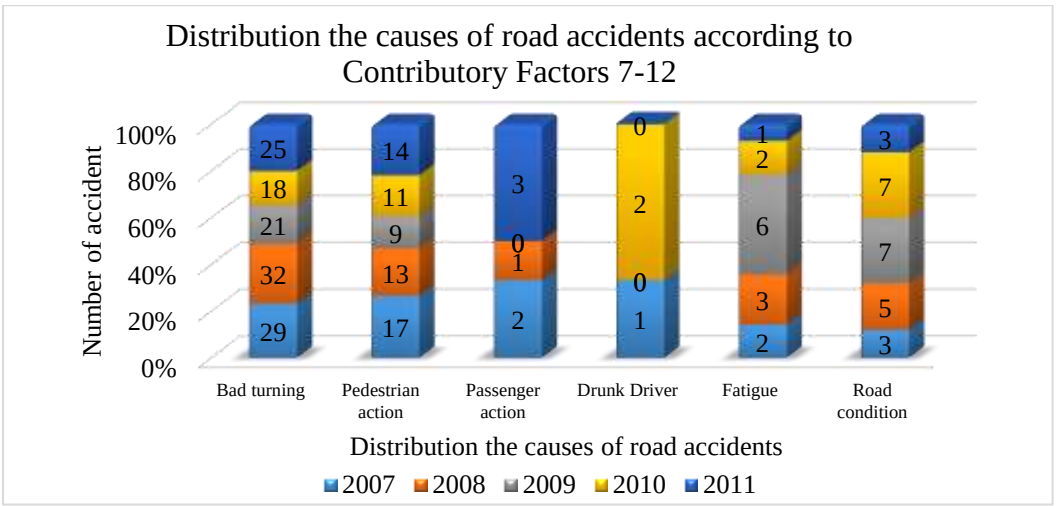
DISTRIBUTION OF ACCIDENTS BY ACCIDENT OCCURRENCE TIMES.
The below figure shows that the highest 55 out of 281 number of accidents occurred in the time between 6am-12pm among the five years (2009-2013) data.



Source: Accidents Research Institute, BUET, 2018
Fig.8:-*Distribution of accidents by accident occurrence times*

Accidents occurred in the time between 12pm-6pm follows it, total 42 accidents out of 281. 6pm-12am is the third highest number where 33 number of accidents were occurred

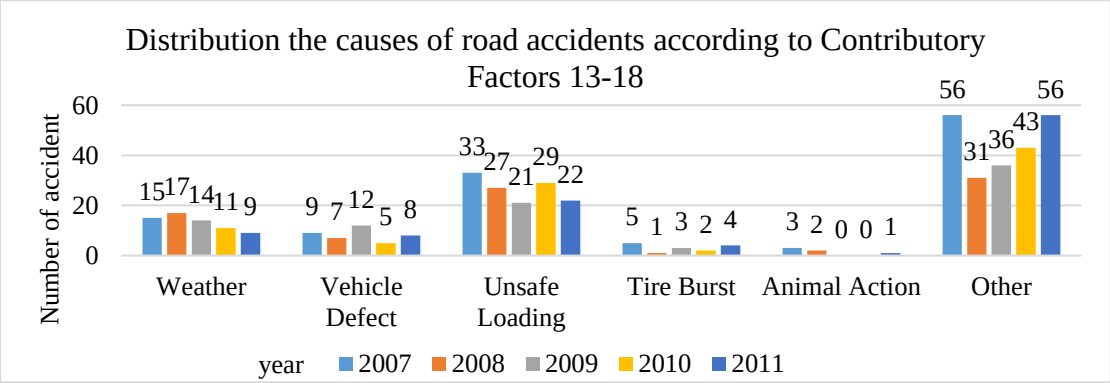
DISTRIBUTION THE CAUSES OF ROAD ACCIDENTS ACCORDING TO CONTRIBUTORY FACTORS 7-12
Here the contributory factors are- Bad turning, Drunk driver, Pedestrian action, Driver fatigue, Passenger action and Road condition. Figure 9 shows that, 'Bad turning' is the highest number of occurring accidents, 125 'pedestrian crossing is responsible for second highest reason for road accidents, 64 out of 281 accidents. Other factors are not in considerable numbers which are presented in Figure 9.



Source: Accidents Research Institute, BUET, 2018
Fig.9:-*Distribution the causes of road accidents according to Contributory Factors 7-12*

DISTRIBUTION THE CAUSES OF ROAD ACCIDENTS ACCORDING TO CONTRIBUTORY FACTORS 13-18

Here the contributory factors are- Weather, Vehicle defect, Unsafe loading, Tire Burst, Animal action and others. From the Figure 10, it shows that among these factors 'Others' related factors are the leading cause for road accidents in the study area during the study period, 222 out of 281. 'Unsafe loading' is the second highest cause, 132 out of 281. 'Weather' factors follows it, 66 out of 170 accidents. Other factors are not in considerable numbers which are presented in figure 10



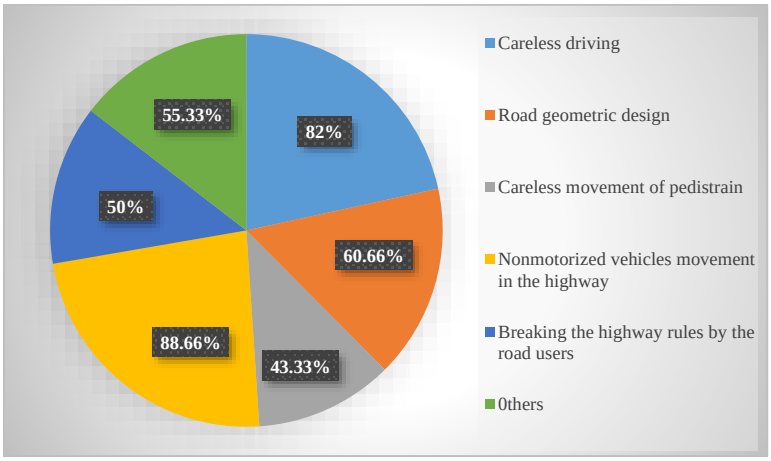
Source: Accidents Research Institute, BUET, 2015

Fig.10:-*Distribution the causes of road accidents according to Contributory Factors 13-18*

ANALYSIS OF ROAD ACCIDENT FROM SAMPLE DATA OF DHAKA-ARICHA HIGHWAY

Causes of Accident

A field survey was conducted among the road users and local people of the study area. The data obtained from the field survey represented in the chart, where the figure 11 shows that Nonnotarized vehicles movement in the highway is the major cause of road accidents in this highway. 88.66% which is 133 out of 150 respondents. Respondent said that 'Careless Driving' and Nonnotarized vehicles movement in the highway is the main causes of road accidents in this highway.



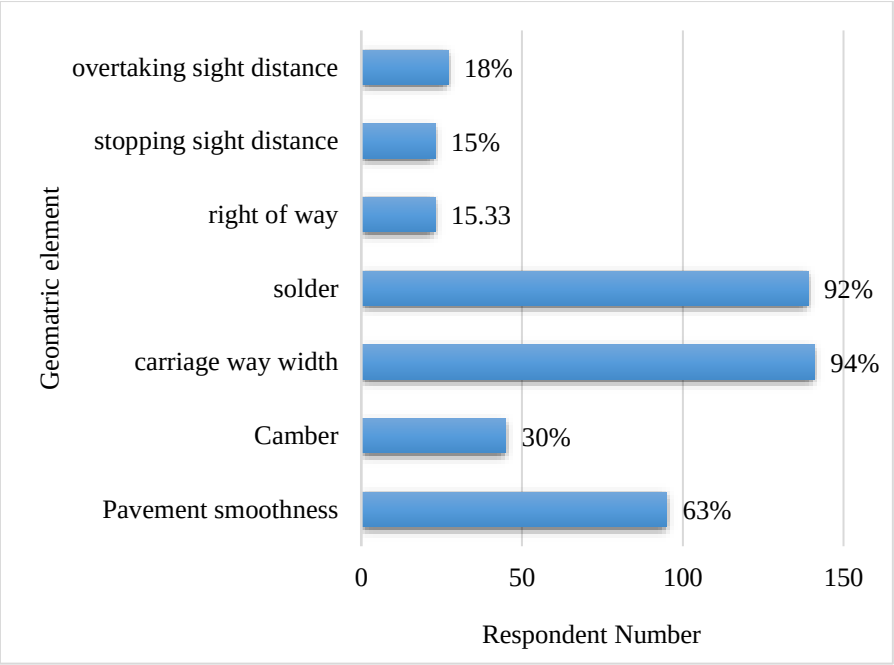
Source: *Field Survey by the Authors; February, 2018*

Fig.11:- *Analysis of causes of accident that are obtained from field survey in the study area*

Other causes are follows it. Among them 15% (83 out of 150 respondents) said for said for 'Road Geometry Design', 16% (91 out of 150 respondents) said for 'Careless Movement of Pedestrians on the Highway' and 11% (65 out of 150 respondents) said for' Other' causes which are related to Traffic Jam, Busy Road, Roadside Animals etc.

TYPES OF GEOMETRIC ELEMENT OCCURRING ROAD ACCIDENT

The geometric design of roads is the branch of highway engineering concerned with the positioning of the physical elements of the roadway according to standards and constraints. The basic objectives in geometric design are to optimize efficiency and safety while minimizing cost and environmental damages. The data obtained from the field survey represented in the chart 5.26, where the chart shows that carriage way width is the main geometric element occurring road accident in the highway respondent said. 94% which is 141 out of 150 respondents. Respondent said that Pavement smoothness solder in the highway is another geometric element occurring road accident in Dhaka aricha highway. Camber, right of way, sight distance, stopping sight distance, overtaking sight distance also geometric element occurring road accident

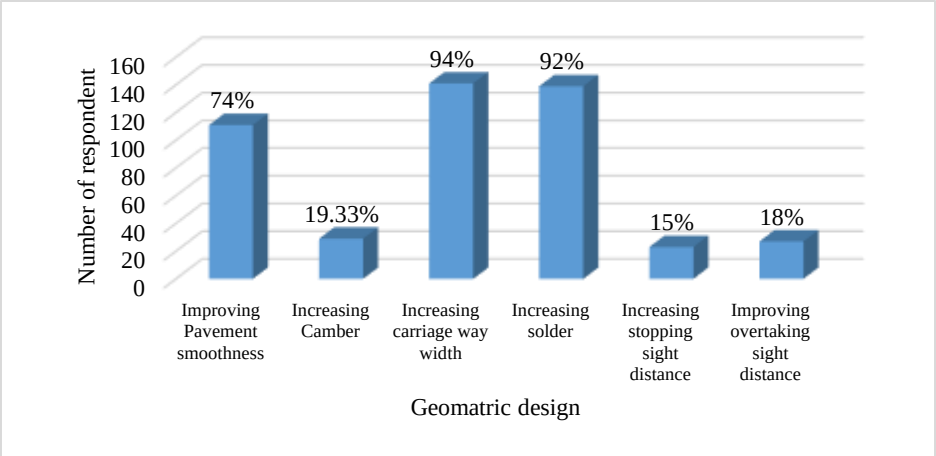


Source: *Field Survey by the Authors; February, 2018*

Fig 12:*-Analysis of geometric elements occurring road accident that are obtained from field survey in the study area*

ACCIDENT SHOULD BE REDUCE BY APPLYING CORRECTED GEOMETRIC DESIGN

The data obtained from the field survey represented in the chart, where the Figure 13 shows that 94% respondent said increasing carriage way size which is 141 out of 150 respondents. Respondent said that Improving Pavement smoothness and increasing solder in the highway is for reducing road accident in Dhaka aricha highway.



Source: *Field Survey by the Authors; February, 2018*

Fig 13:-*Analysis of geometric elements reducing road accident that are obtained from field survey in the study area*

EXISTING ROAD SIGN AND SYMBOL

The traffic sign and symbols are sufficient in Dhaka-Aricha highway but it was not well managed. In may accidental black sport, traffic sin are not seen at all because of most of the sing and symbol are broken or roads are tilted on the side and many dust stays there, which makes them look not right. Terms of public safety, beside the ones, which are present, are not being obeyed properly by the vehicles drivers. So people are always at a risk. Some of the situations are seen in the Figures 14.

Source: *Field Survey by the Authors, February, 2018*

Fig.14:-*Road Sign and Symbol*

INVESTIGATION FINDINGS

According to the findings of this study, with a few exceptions, the majority of the striking characteristics, road and road environmental problems, and operational risks are found in all sites. The most notable geographical characteristics, as well as road environmental and traffic dangers, are described.

- Road and roadside defects or hazards

were very prevalent in almost all of the dangerous sites.

- Accidents are more frequent during day time However; it cannot be said with certainty whether accidents take place at any particular time of times during the day. No discernible pattern is visible in this regard
- In the last year of 2007-2011 major accidents occurred in the area one involving a head collision.
- Vehicles most involved in the accidents in the area are passenger buses
- Main causes identified for accidents were carelessness of drivers and their disrespect o fundamental safe driving norms, tendency on their part to speed up suddenly, fatigue and sleeplessness, mechanical defects of vehicles
- Between 6am to 12 AM mostly students local businessmen, passengers bound for Aricha and local public cross the road somewhat however they Between 12am to 6 am road users number decreases
- Substandard road way alignment or geometry, lack of shoulders and shoulder defects, absent or inappropriate pedestrian facilities, narrow and defective lanes and bridges/bridge approaches, and uncontrolled as well as staggered access roads were all contributing factors in highway accidents in many of the locations.

Source: *Field Survey by the Authors, February, 2018*
Fig.15:- *Lack of shoulder (left place: BthuliaBus stand Right Place: Kamalpur bus stand)*

- Unmarked pavement quality is assessed to be good in several areas across the study region. There were no potholes or undulations to be observed on the road.
- Local people do not know the emergency telephone numbers they can use in case of serious accidents
- Availability of ambulances for accident victim transportation on demand is difficult and rare
- People meet with accident while crossing roads without taking due care and while boarding or descending from vehicles.
- Road signs, markers, and other regulatory devices were shown to be negligible in regulating and controlling traffic in general.
- In several stretches of the road, poor sight distances and visibility, unmarked and inappropriately designed crossroads such as the Paturia intersection, and significant delineation issues pose a serious safety danger.
- On both sides of the Tepra junction, the road is in pretty excellent shape
- Most of the temporary stores and booths are constructed close beside the road, obstructing vision when traffic from access roads combines into the main traffic stream.
- Due to the large concentration of

retail/trading centers, particularly on Bazaar Day, there are very complicated and significant roadside frictions with a variety of local activities and functions.

- There are few dedicated pedestrian sidewalks or crosswalks, and there are no regulatory/warning signs or signals, which are critical, especially in bazaar and built-up areas.
- Pedestrians are compelled to utilize high-speed carriageways in the lack of footways, resulting in confrontations with motor vehicles.

CONCLUSION

This article is part of a larger research on geometric design and hazardous road locations on the Dhaka-Aricha highway, and it aims to highlight some of the most prominent accident issue characteristics in Bangladesh's most significant highway corridor, with a focus on hazardous road site accidents.

The study's aims, methods, and conclusions are all described in detail. The investigation revealed that road and roadside environmental deficiencies are the major problems of the selected hazardous locations, and that significant safety improvements are possible through broader application of low-cost engineering measures such as treatments and provision of roadway shoulders, self-enforcing speed reducing measures, special facilities for pedestrians and other non-motorized traffic, and treatment of the selected hazardous locations. Pedestrian and vehicle conflicts are the most vulnerable, so it is critical to change behavior, attitude, and physical separation through community-based safety initiatives and the provision of physically separated spaces in the form of segregated footways, particularly in Bazaar areas where pedestrian density is high. This research was done as a first step in identifying and investigating dangerous road locations. For adapting and implementing remedial measures, a detailed study and inspection in accordance with a road geometry survey by a group of safety experts is advised.

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