Pedestrian Preference in Different Road Crossing Systems of Dhaka City

Manik Kumar Saha[1]
Tanjiba Rahman Tishi[1]
Md. Sirajul Islam[1]
Suman Kumar Mitra[2]

Abstract:

Dhaka, the capital of Bangladesh, has now been turned into the 26th mega city and 10th most populous city of the world. As the population of Dhaka City is growing very fast, the sustainable transport policy for Dhaka should strive to retain and expand the modal share of walking trips, which may share the majority of all trips made. But unfortunately, pedestrian facilities may be the most neglected and unattended ones in transport planning of Dhaka city. This papers aims to find out the basic problems faced by the pedestrians while crossing the road of Dhaka City. The paper also illustrates the underlying factors which are considered most by the pedestrians while crossing a road. The preference of the pedestrians in choosing different types of crossings (at grade, underpass, and overpass) and the underlying reasons behind their preferences are also identified in this paper. This paper also assesses the relative significance of different problems faced in different types of pedestrian road crossing systems in Dhaka city. Finally it presents specific recommendations to promote the efficient pedestrian circulation system of Dhaka city.

Keyword: Pedestrian, Road Crossing, Preferences, Sustainable, Transport

1.0 INTRODUCTION

Dhaka, the capital of Bangladesh, has now been turned into the 26th mega city and 10th most populous city of the world [2]. It is now facing enormous problems in every sphere of urban services. In the last 35 years the population of Dhaka city increased 10 times than the original and it is estimated that it will be 25 million by 2025. It is really hard to envisage that how this megacity will endure then. Among the diverse problems, transport problems are becoming more and more acute as the day progress. Traffic congestion, delays, lack of traffic safety, poor pedestrian facility, inadequate and inefficient public transport, inadequate traffic management, conflicts of jurisdiction and poor coordination among agencies are becoming common characteristics of the transport environment in this mega city. In addition to this about 50,000 private cars are added every year in Dhaka city which are considerably deteriorating the environment [7].

Walking is considered as the most sustainable and environmental friendly transport mode all over the world but the policy makers are giving emphasis on private car, bus and pedestrian in the respective order due to some untouchable reasons. The order should be reverse to minimize the transport problem to some extent. The latest surveys of people's movement in metropolitan Dhaka under the Dhaka Urban Transport Project showed walking as the predominant mode with a share of 62 percent of total person trips [17]. These huge amounts of pedestrian have to cross the road in different places in the road. They have to be given prospect to cross the road with their convenient opportunities. The appropriateness, pedestrian's requirement, required time, safety and security are some basic questions to be answered.

[1] Urban Planner, Department of Urban and Regional Planning, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh. Email: manik.0415009@gmail.com.
[2] Assistant Professor, Department of Urban and Regional Planning, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh.
Email: sumankumar@urp.buet.ac.bd, i_am_mitra99@yahoo.com.

However in the roads of Dhaka city, the most vulnerable group is the pedestrian in case of safety. Day by day this fatality is increasing at an alarming rate. The involvement of different road user in total accident in Dhaka city in year 1998-2007 is illustrated in Table 1 which shows that pedestrian involvement is higher in compare to other road users.

TABLE 1: CASUALTY INJURIES BY CASUALTY CLASS

Casualty Class	Fatal	Grieve	Simple	Total
Pedestrian	2640	1455	95	4190
Cycle	61	62	1	124
Rickshaw	281	752	127	1160
Push car	29	37	2	68
Motor cycle	56	193	30	279
Baby transport	84	529	102	715
Tempo	52	151	33	236
Microbus	11	89	24	124
Minibus	66	176	31	273
Bus	82	158	50	290
Car	39	308	124	471
Jeep	3	25	13	41
Pick up	28	116	16	160
Truck	17	53	4	74
Heavy truck	70	124	42	236
Artic	0	7	0	7
Oil truck	0	0	0	0
Tract	0	0	0	0
Animal	0	0	0	0
Other	59	126	5	190
Total	**3578**	**4361**	**699**	**8638**

Source: Accident Research Institute, 2008

Beside the increasing vulnerability of pedestrian, most accident occurs during the times of road crossing (Table 2).

TABLE2: PEDESTRIAN INJURIES BY PEDESTRIAN ACTION

Pedestrian Action	Fatal	Grieve	Simple	Total
None	330	425	35	790
Crossing the road	1477	571	23	2071
On Road	21	9	2	32
Edge	785	444	34	1263
Play roadside	27	6	1	34
Total	2640	1455	95	4190

Source: Accident Research Institute, 2008

To minimize the pedestrian fatality rate provision have to be made for safe and efficient movement of pedestrian both in crossing the road and walking through footpath. To do so, it is necessary to know the considered factor of a pedestrian in crossing the road and their preference towards choosing a particular road crossing system (at grade, underpass and overpass). It is also very important to reveal the significance of different problems faced in different road crossing system. This study will only concentrate in those above issue.

2.0 OBJECTIVES OF THE STUDY

This study has been focused to the following major objectives:
- To find out the underlying factors which are considered most by the pedestrians while crossing a road.
- To   assess the relative significance of different problems faced in different types of pedestrian road crossing systems in Dhaka city.

3.0 STUDY AREA AND METHODOLOGY

Dhaka City Corporation has 390 kilometers long footpath while it has 1900 kilometers long roads including arterial roads, alleys and lanes. It has a total of 52 foot over-bridges in the city [18]. And there are only four underpasses for pedestrian to cross the road at Gulistan intersection, Gabtoli Bus terminal, Sayedabad (Dhalpur) and Karwan Bazar [19].

An extensive literature survey has been carried out on pedestrian road crossing system. For this study, three intersections have been considered which represent all types of road crossing systems of Dhaka City. The sample crossings are Shahbag Crossing (At Grade), Kawran Bazar Crossing (Underpass) and Newmarket Crossing (Overpass).

After the fixation of research objectives three study areas have been selected. Initially 30 pedestrians were surveyed, 10 from each study area for pilot survey. After necessary modification from the feedback of pilot survey, an extensive 300 questionnaire survey has been carried out, 100 from each of the system. Sample was collected in two categories- (i) pedestrian who obey the rules and (ii) pedestrian who violates the rules. For each of the system, 50 persons were surveyed who obey the rules and another 50 persons were surveyed who violate the rules. Sample was randomly collected.

To measures the relative significance of problem faced in different pedestrian crossing an expert opinion survey has been carried out but the parameters of this expert survey are fixed from the feedback of 300 questionnaire survey.

4.0 FACTORS CONSIDERED IN CROSSING THE ROAD

Pedestrians choose different types of pedestrian crossing systems depending on the availability, advantages of the facility and problems faced to use the facility while crossing the road. For efficient pedestrian circulation it is necessary to find out the factors which are considered by the pedestrian before crossing the roads. The pedestrians have mentioned few factors and ranked the factors as priority 1, 2, 3 themselves individually. By weighted index method the weighted values of factors have been sum up to have the Composite Values of various Factors. Depending on the composite values, the factors have been ranked in descending order (Table 3)in which safety is the most predominant factor considered by a pedestrian while crossing the road followed by required time to use the facility and pedestrian comfort & convenience.

TABLE 3: RANKING OF THE FACTORS CONSIDERED BY PEDESTRIAN AT THE TIME OF CROSSING THE ROAD

Priority	Weight Value (A)	Frequency of Factors			Weighted value of factors (A* Frequency of Factors)		
		Safety	Required Time	Comfort and Convenience	Safety	Required Time	Comfort and Convenience
priority 1	3	216	52	10	648	156	30
priority 2	2	45	111	54	90	222	108
priority 3	1	8	48	61	8	48	61
Composite Value of factors					746	426	199
Ranking of the Factors					1st	2nd	3rd

Source: Field Survey, 2009

5.0 PREFERENCE OF THE DIFFERENT CROSSING SYSTEMS

5.1 Ranking of Preference

To find out the preference of the pedestrian towards the different crossing systems in Dhaka city they were asked to scale the preference level of different crossing systems as Most Preferable, Preferable and Less Preferable. Weighted index method was also followed here to find out the composite score of a particular crossing type by multiplying the frequency of respondents with the weight value assign to every crossing type. Depending on the composite values, the crossing systems have been ranked which is illustrated in Table 4.

TABLE 4: PREFERENCE OF PEDESTRIAN ON DIFFERENT TYPES OF PEDESTRIAN CROSSING SYSTEMS

Preference Level	Weight Value (A)	Frequency of Crossing Systems			Weighted value of Crossing Systems (A* Frequency of Crossing Systems)		
		At Grade	Overpass	Underpass	At Grade	Overpass	Underpass
Most Preferable	3	78	147	68	234	441	204
Preferable	2	109	103	70	218	206	140
Less Preferable	1	91	36	36	91	36	131
Composite Value of Crossing Systems					543	683	475
Ranking of the Crossing Systems					2nd	1st	3rd

Source: Field Survey, 2009

According to the Table 4 overpass, At Grade Crossing and Underpass has been stood for 1st, 2nd and 3rd position of pedestrian preference. From the composite value of the crossing systems it can be said that the overpass and at grade systems are liked by the pedestrian as 1.44 and 1.14 times respectively than underpass system.

5.2 Causes of Preference

Behind the preference of the systems the pedestrians identified some reasons by which the respondents ranked the crossing systems in preference. The causes of being in different preference level of the crossing systems are to be discussed below.

5.2.1 The first Preference- Overpass

As the overpass has been stood in first preference level, it has some positive characteristics. On the basis of the reasons acknowledged by the respondents here it can be stated that most of the responses (Figure 1) are positive here. Safety (41%), security (23%), comfort (21%) and less time consuming (7%) have been identified as the major positive characteristics of overpass which have made it in number one priority. There is very few negative response. From the comparative analysis of the preference of different crossing system it can be concluded that the most important positive factors are safety and security here. As safety and security are ensured in overpass, it has been set first.
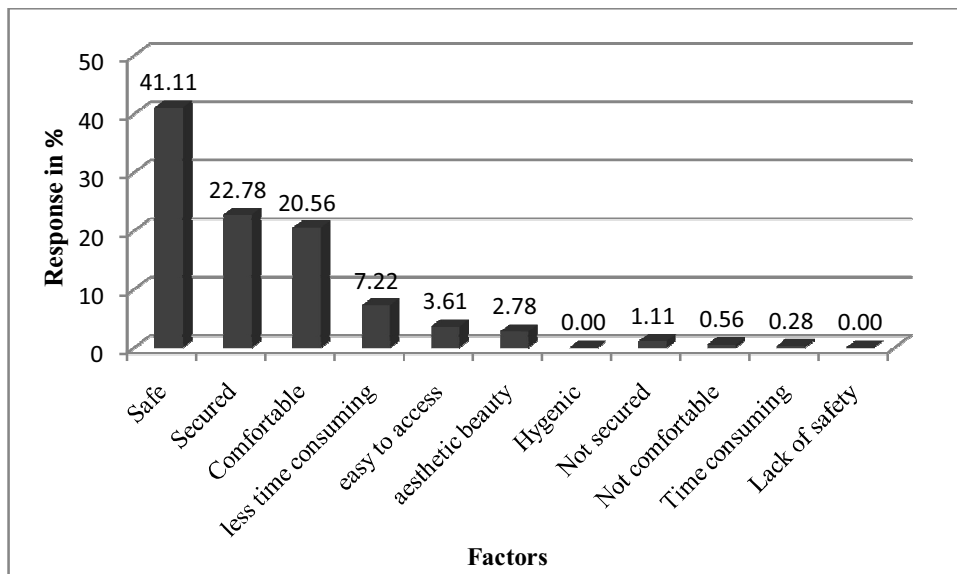

FIGURE1: PERCENTAGE OF CAUSES FOR CHOOSING OVERPASSES

5.2.2 The Second Preference- At Grade System

From the composite score of the responses of the pedestrians, it has been found that, the at grade road crossing system is in the second preference. The reasons behind the preference are illustrated in

Figure 2. Comfort (28%), security (12%), less time consuming (8%) and safety (5%) are the most prominent among the positive reasons acknowledged by the respondents. Though these positive factors are near about the characteristics of overpass, lack of safety (36%) have made it in the 2nd preference because pedestrian considered safety as their major consideration while crossing the road.
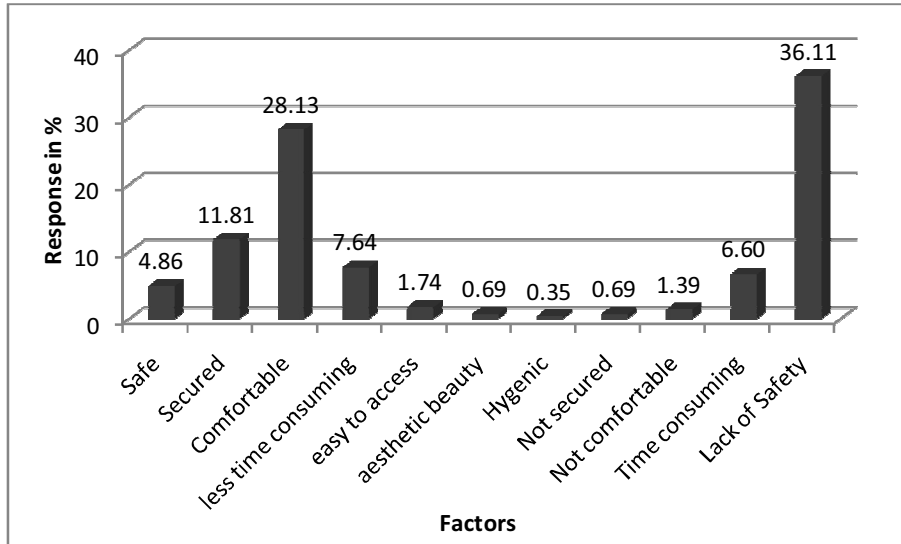

FIGURE 2: PERCENTAGE OF CAUSE FOR CHOOSING ZEBRA/AT GRADE CROSSING

5.2.3 The Third Preference- Underpass

Pedestrian considered underpass as a worst road crossing system among the various types of road crossing system of Dhaka city. They have provided their opinion for the reasons of the preference (Figure 3). According to that providence, the most influencing factor is the lack of security (20%) which compel pedestrian for not choosing underpass. Lack of comfort and time consuming are another two strong reasons here to make the underpass as third preference. The positive responses here were as safety and comfort in 38% and 18% of responses respectively.
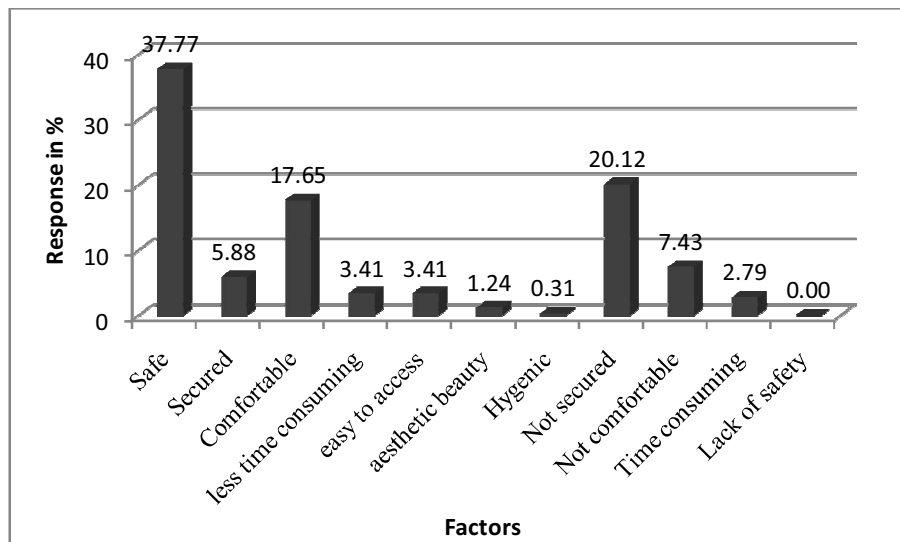

FIGURE 3: PERCENTAGE OF CAUSE FOR CHOOSING UNDERPASSES

6.0 SIGNIFICANCE OF DIFFERENT PROBLEMS IN DHAKA CITY

Pedestrian face many problems in different types of road crossing not only of different types but also of different magnitude. So to understand the proper ranking of the various problems it is necessary to have their normalized value. This section illustrates the relative significance of different problems in case of Dhaka city by Analytical Hierarchy Process (AHP) with the help of expert opinion.

In the first stage of AHP all the problems of a particular crossing system in Dhaka city have been identified by the respondents. Then first six problems have been sorted for the expert opinion by the value of composite score. Composite score of a problem is derived by giving highest weight to the first priority problem and lowest weight to the last priority problems.

6.1 Problems Faced in Zebra Crossing of Dhaka City

There are lots of problems associated with the zebra crossing of Dhaka city. But respondents answer limited to seventh priority maximum. So 7 have been given to the first priority problems and one has been given to the seventh priority problem to derive the composite score of problems. From the composite score, the first six problems (variables) have been selected for the Expert opinion to apply the AHP which is shown in Table 5.

TABLE 5: SELECTED PROBLEMS OF ZEBRA CROSSING OF DHAKA CITY FOR EXPERT OPINION

Problems	Composite score
Lack of safety	1241
Too much waiting	917
Block the crossing	679
Drivers do not obey the rules	324
People not aware	321
No sign for pedestrian	286

Source: Field Survey, 2009

From Table 5 a log sheet has been produced for the systematic collection opinion from five experts. After that, calculations have been done according to the AHP to get the normalized value of problems in case of zebra crossing of Dhaka city for each expert. Finally by averaging the value of five experts the actual normalized value is derived which is illustrated in Table 6.

TABLE 6: NORMALIZED VALUE OF PROBLEMS FACED IN ZEBRA CROSSING OF DHAKA CITY

Problems / Experts	Lack of safety	Too much waiting	Block the crossing	Driver do not obey the rules	People not aware	No sign for pedestrian	Total
E1	0.3890	0.0506	0.1728	0.0870	0.0659	0.2347	1
E2	0.4727	0.0867	0.1122	0.1584	0.1088	0.0611	1
E3	0.4172	0.0716	0.2857	0.0800	0.0355	0.1099	1
E4	0.4456	0.0483	0.1213	0.2253	0.0925	0.0670	1
E5	0.0454	0.2427	0.0358	0.1115	0.4666	0.0980	1
Average	**0.3540**	**0.1000**	**0.1456**	**0.1325**	**0.1539**	**0.1141**	**1**
Percentage	**35.40%**	**10%**	**14.56%**	**13.25%**	**15.39%**	**11.41%**	**100%**

Source: Field Survey, 2009

From the aforementioned table it is clear that lack of safety (35.4%) is the major problem faced by the pedestrian while using the zebra crossing to cross the road. Other than safety rest of the problems are quite same where lack of awareness among people are prominent (15.39%) followed by blocking the crossing by vehicle (14.56%) and violation of traffic rules by the driver (13.25%). This normalized

value justifies the preference of the pedestrian in which at grade crossing is their second preference mainly due to the lack of safety.

But the result varies widely between the experts and the pedestrian who are the direct user of the crossing system. According to the pedestrian the main problem of Shahbag zebra crossing is the longer waiting time to cross the road which get only 0.1 (normalized value) in case of overall Dhaka city by the experts. This is because direct users are mainly concentrate their views towards the problems immediately they are facing but in case of experts their perception tends to concentrate on wider aspect like safety issue.

6.2 Problems Faced in Underpass of Dhaka City

There are plenty of problems associated with underpass of Dhaka city. But respondents answer limited to seventh priority maximum. So seven have been given to the first priority problems and one has been given to the seventh priority problem to derive the composite score of problems faced while using underpass. Form the composite score the first six problems (variables) have been selected for the expert opinion to apply the AHP which is shown in Table 7.

TABLE 7: SELECTED PROBLEMS OF UNDERPASS OF DHAKA CITY FOR EXPERT OPINION

Problems	Composite score
Presence of unwanted people (mugger, pic-pocket etc.)	1027
Lack of security	954
Insufficient light and ventilation	849
Not hygienic	820
Little room for pedestrian to move	603
Extra walking to access the facility	339

Source: Field Survey, 2009

From the above table AHP method is also followed to derive the normalized value of problems faced by pedestrian in using underpass which is illustrated in Table 8.

TABLE 8: NORMALIZED VALUE OF PROBLEMS FACED IN UNDERPASS OF DHAKA CITY

Problems \ Experts	Presence of unwanted people (mugger, pic-pocket etc.)	Lack of security	Insufficient light and ventilation	Not hygienic	Little room for pedestrian to move	Extra walking to access the facility	Total
E1	0.0737	0.4410	0.2690	0.1248	0.0456	0.0458	1
E2	0.2024	0.2614	0.2481	0.1582	0.0976	0.0323	1
E3	0.1560	0.3462	0.0947	0.0992	0.0963	0.2076	1
E4	0.1777	0.3376	0.2143	0.1539	0.0752	0.0413	1
E5	0.1748	0.1881	0.2236	0.0386	0.0146	0.3602	1
Average	**0.1569**	**0.3149**	**0.2099**	**0.1149**	**0.0659**	**0.1375**	**1**
Percentage	**15.69%**	**31.49%**	**20.99%**	**11.49%**	**6.59%**	**13.75%**	**100**

Source: Field Survey, 2009

From the above table it is clear that people faced lack of security (31.49%) vigorously in using underpass followed by insufficient light and ventilation (20.99%), extra walking to using the underpass (13.75%) and hygienic problem (11.49%).

According to the pedestrian, presence of unwanted people is the first problem not the lack of security but the scenario is reverse for experts. Actually both the problems are identical. Presence of unwanted people is one of the component for which people feel lack of security. If we merge these two problems

into one, then the result is much more reflective both for the pedestrian and experts. It is one of the shortcomings of this study.

6.3 Problems Faced in Overpass of Dhaka City

Plenty of problems are also associated with the overpass of Dhaka city. But respondents answer limited to seventh priority maximum. So seven have been given to the first priority problems and one has been given to the seventh priority problem to derive the composite score of problems faced while using overpass. Form the composite score, first six problems (variables) have been selected for the Expert opinion to apply the AHP which is shown in Table 9.

TABLE 9: SELECTED PROBLEMS OF OVERPASS OF DHAKA CITY FOR EXPERT OPINION

Problems	Composite score
Presence of unwanted people (mugger, pic-pocket etc.)	922
Uncomfortable	844
Lack of cleanliness and not hygienic	611
Too steep stair	532
Time consuming	473
Extra walking to access the facility	416

Source: Field Survey, 2009

From the Table 9 a log sheet has been produce for the systematic collection opinion from five experts. After that the calculations have been done according to the AHP to get the normalized value of problems faced in overpass by the pedestrian of Dhaka city for each expert. Finally by averaging the value of five experts the actual normalized value is derived which is illustrated in Table 10.

TABLE 10: NORMALIZED VALUE OF PROBLEMS FACED IN OVERPASS OF DHAKA CITY

Problems ⟍ Experts	Presence of unwanted people (mugger, pic-pocket etc.)	Uncomfortable	Lack of cleanliness and not hygienic	Too steep stair	Time consuming	Extra walking to access the facility	Total
E1	0.3281	0.1892	0.1892	0.1476	0.0573	0.0885	1
E2	0.3212	0.1193	0.1404	0.2096	0.1126	0.0970	1
E3	0.1622	0.2241	0.0422	0.2138	0.1583	0.1993	1
E4	0.3315	0.1657	0.1657	0.1657	0.0957	0.0756	1
E5	0.3281	0.1892	0.1892	0.1476	0.0573	0.0885	1
Average	**0.2942**	**0.1775**	**0.1454**	**0.1768**	**0.0962**	**0.1098**	**1**
Percentage	**29.42%**	**17.75%**	**14.54%**	**17.68%**	**9.62%**	**10.98%**	**100%**

Source: Field Survey, 2009

The above table explains that among all the problems, presence of unwanted people is the most significant (29.42%) followed by lack of comfort (17.75%) and steepness of stair (17.68%). The normalized values of the problems are very much similar to the ranked problem by the pedestrian. Because the pedestrian of Dhaka city ranked presence of unwanted people and lack of comfort as 1st and 2nd problem respectively. The normalized value of presence of unwanted people (0.2942) and lack of comfort (0.1775) justify the above discussion. Besides, there is no significant difference in normalized value of the other problems of overpass in Dhaka city.

7.0 RECOMMENDATION

The study has identified some problems of the pedestrian crossing systems in Dhaka city and it has acknowledged some positive characteristics of the road crossing systems that influence the pedestrians

to use the systems. The factors, which are considered by the pedestrian at the time of crossing decision, have been illustrated in the study. The preferences of the pedestrian road crossing systems have been identified also. Based on the previous discussions and analysis some recommendations have given here.

- Lack of safety is one of the main problems in zebra crossing system. To solve the problem at first the signal must be maintained properly either by the electronic signal system or manually by the traffic police. Regular license checking of the drivers must be ensured and they have to be well known about the traffic regulation. Besides people's awareness about the crossing systems have to be increased so that they can be respectful to the rules and regulations. Pedestrian crossing signs have to be provided at intersection and at link depending on the particular situation. And zebra crossing must be kept free for the movement of pedestrian.

- Though underpass using is relatively a new culture in our country it can be an effective solution in pedestrian road crossing system. To make this system more effective at first the security of the pedestrian must be ensured. Guards must be assigned to provide security to the pedestrian and to maintain the proper use of underpasses. At the same time, it should be properly designed to avoid the water logging inside the underpass due to rainfall. Regular maintenance must be ensured as well as sufficient light and ventilation must be provided.

- It is obvious that rising up to use overpass is difficult for the pedestrian. So it should be designed carefully with minimum height of the risers so that it can minimize the physical trauma of the pedestrian especially for the children, older and physically handicapped persons. At the same time, security systems have to provide to ensure security to the pedestrian after sundown. Proper use of overpasses must be ensured by prohibiting the presence of unwanted people. Overhead shed should be given over the overpass to protect the pedestrian from rainfall as well as sun ray. Generally people feel more secured if they can be viewed by others. In Dhaka city, some over passes are curtained by the advertisement banners which create insufficient light as well as a sense of insecurity. So the advertisement curtain must be allotted sincerely so that the views of pedestrian are not interrupted.

8.0 CONCLUSIONS

In Dhaka city, highest percentage of trips is made on foot. But the pedestrian hardly get any importance in formulating transport policies. As a result, the pedestrian have become the most vulnerable group in road crossing system. They are mostly the victims of fatal road accidents in Dhaka city. Though some pedestrians are following the existing system they are facing so many problems in using the recommended system. These problems include mainly lake of safety, lack of security, lack of comfort and convenience, lack of cleanliness etc. Moreover there is lack of awareness among the pedestrians and the drivers. At the same time, the authority is not so strict to maintain and manage the system properly. And day by day all these negligence are contributing more and more to the deterioration of the existing systems. So the identified problems and the preference should be considered while proposing a new road crossing system whether it is zebra crossing, underpass crossing or overpass crossing. And the pedestrian issue should be integrated into the transport planning process to ensure safe, secure and convenient pedestrian movement in Dhaka city.

Reference

1. Hamed, M. M. (2001), "Analysis of pedestrians' behavior at pedestrian crossings". *Safety Science*, 38, 63–82.

2. Haque,M.M. (2004), "Overview of Urban transport Problems and The Role of Public transport System*"*, Paper Presented at the Training Course on Public Transport System, Department of Civil Enginerring, Buet, Dhaka.

3. Rahman, D. K., Afrin, S., & Alum, A. (2006), "how safe are the walkways in Dhaka city? An empirical study". *Road Safety in Developing Countries* (pp. 78-83). Dhaka: Accident Research Center, BUET.

4. Saaty, T. L. (1980), "The Analytical Hierarchical Process, Planning, Priority Setting, Resource Allocation". Yew York: USA.

5. http://www.dhakacity.org/Page/Department/Link_1/1/List_id_1/6/Subid_1/76/Over_Bridge__Under_pass__Flyover referred on 18 September, 2009.

6. http://www.thefinancialexpress-bd.com/2008/06/02/35383.html referred on 18 September, 2009

7. http://bd-halchal.blogspot.com/2010/03/traffic-jam-in-dhaka-city-bangladesh.html referred on May 31, 2011

8. http://www.thefreedictionary.com/underpass referred on August12, 2009

9. http://en.wikipedia.org/wiki/Zebra_crossing referred on August12, 2009

10. http://www.merthyr.gov.uk/Home/Local+Services/Traffic+Management/Pedestrian+Crossings.htm referred on August12, 2009

11. http://www.trafficsignsandmeanings.co.uk/different-types-pedestrian-crossing.html referred on August 12, 2009

12. http://www.sefton.gov.uk/Default.aspx?page=3208 referred on August13, 2009

13. http://www.merriam-webster.com/dictionary/overpass referred on August13, 2009

14. http://en.wikipedia.org/wiki/Overpass referred on August13, 2009

15. http://www.dhakacity.org/Page/Search_item_details/Search/Item_id/31/Item/employment/Dhaka_City_At_a_Glance referred on September14, 2009

16. http://en.wikipedia.org/wiki/Dhaka#Geography_and_climate referred on September14, 2009

17. http://www.codatu.org/english/publications/proceeding/conference/codatu11/ Papers/hoque.pdf referred on September 26, 2009

18. http://www.dhakacity.org/Page/Department/Link_1/1/List_id_1/6/Subid_1/76/ Over_Bridge__Under_pass__Flyover referred on September26, 2009

19. http://www.dhakamirror.com/?p=8107 referred on September 26, 2009

20. http://www.absoluteastronomy.com/topics/Pedestrian referred on September 28, 2009