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Capacity Analysis of Pedestrian Facilities in Motijheel CBD Area: Problems and LoS Aspects

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Abstract: Automobile has been the dominant mode of transportation in the last few decades, planning has been primarily concerned with the automobile and motorists comfort and convenience. Walking has now become a secondary consideration in transportation and urban planning. As a result pedestrians face such problems as delay, congestion, discomfort, poor or no accessibility, poor visibility and accident danger. Attaining a better city centre for better pedestrian access, amenity, safety, convenience and comfort is not only good from a social, environmental and equity perspective, it is also good for business. But pedestrian traffic is left with no attention of city managers and planners. This study is an initiative to explore the pedestrian demand and supply situation in a metropolitan city center of a developing country like Bangladesh. The study analyzed the travel pattern, problems and prospects of pedestrian movement and explored for measures and initiatives required to influence pedestrianization in the Motijheel CBD area.

Introduction

Dhaka as the capital of Bangladesh has a major role to play in an era of regional and sub-regional cooperation. The urban hierarchy of Bangladesh is strongly dominated by Dhaka, which are the largest and most industrialized city and also the administrative, commercial and cultural capital. Dhaka also serves as the traditional centre of wholesale trade for the country. It is also a fast growing metropolitan city with highly dense and increasing population. Haphazard urban expansion with minimum attention to the living environment has been the most common scenario here and existing transportation system has become hazardous for the entire city system due to its inherent system deficiencies.

However, in Dhaka city, about 60% trips are making on foot but the pedestrians are facing many problems while using the walkways (Rahman, 2005). A lot of research works are going on for assessing the pedestrian's level of services in the developed nations but in developing countries like Bangladesh, it is not a significant one for the transport planners. It is because; the transport planners or researchers are always emphasizing the problems of the motorized vehicles. Besides, budget allocation is not sufficient to continue research in the field of pedestrians.

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Pedestrians are the most vulnerable users of the road space but lack of safety promotions or measures also offer the walkers very dangerous situation. For example, discontinuation of the walkway alignment provides inconvenience for the older walkers and lack of separation of the walkways from the road-space offers threat to accident for the school going children, Disabled person. As a result, to know the *Level of service (LOS)* of the walkers is an important part so that the policy makers or the transport planners can understand the extent of problems that the pedestrians are facing in their daily life.

This study is an attempts for emphasizing the pedestrian's problems in Motijheel city center as well as quantifying the LOS of the walkways.

Objectives and Methodology

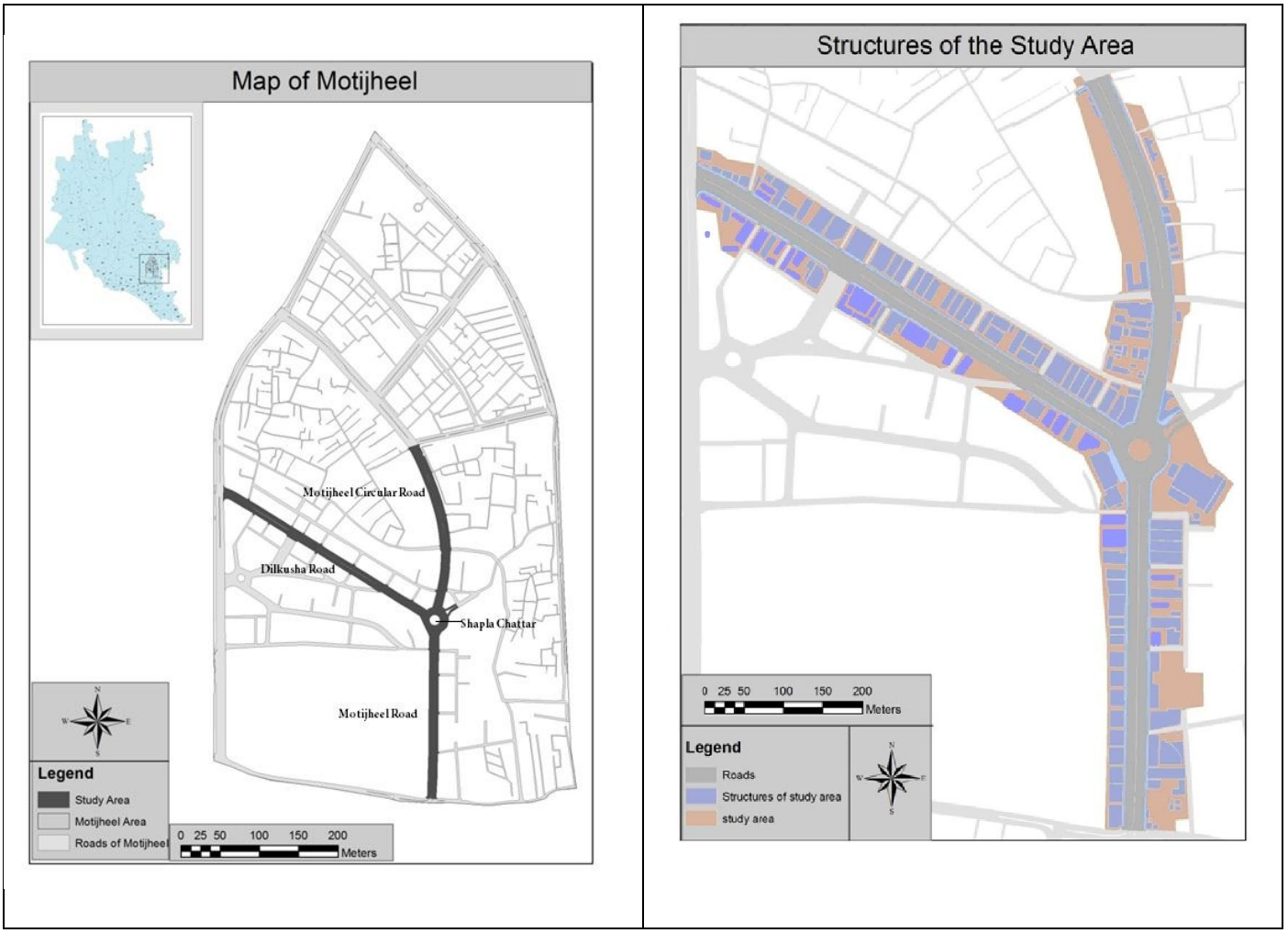
This study has been aimed at achieving the following objectives:

- To evaluate the existing situation of demand and supply of pedestrian way in the study area.
- To investigate the prevailing problems in the current situation of the study area and to identify the reason behind it.
- To recommend some measures regarding the demand and supply of pedestrian way in the study area.

Both primary and secondary data has been used in this research. Questionnaire survey, observation survey, traffic volume survey, pedestrian flow survey and office interviews are involved in primary data source. Different journal, articles, newspapers, reports are involved in secondary data.

Study Area Profile

Motijheel is an administrative division (Thana) of Dhaka city, the capital of Bangladesh. It is situated at the heart of the city. Its area is about 46 sq.km. It is the major business and commercial hub of Dhaka city and has more offices and business institutions than any other part of the city. It is the home to largest number of corporate headquarters in the nation. This area is mainly selected because it's a CBD (Central Business District), facilitates different kinds of activities. People gather their respective places after a short walking. It's a perfect place for working with footway design and safety of pedestrian facilities in any area. Men, women, children, disabled person all uses footway to reach their desired places. Again as a CBD it should provided with good footway facilities considering planning standard at some points. By this study area it will be possible to easily identify the existing condition, problems as well as the remedy. The study area of this research is Arambagh at North side of Shapla Chattar (Motijheel circular road), Ittefaqmor at the South side of Shapla Chattar (Motijheel road) and Dainik Bangla mor at the west of Shapla Chattar (Dilkusha Road).

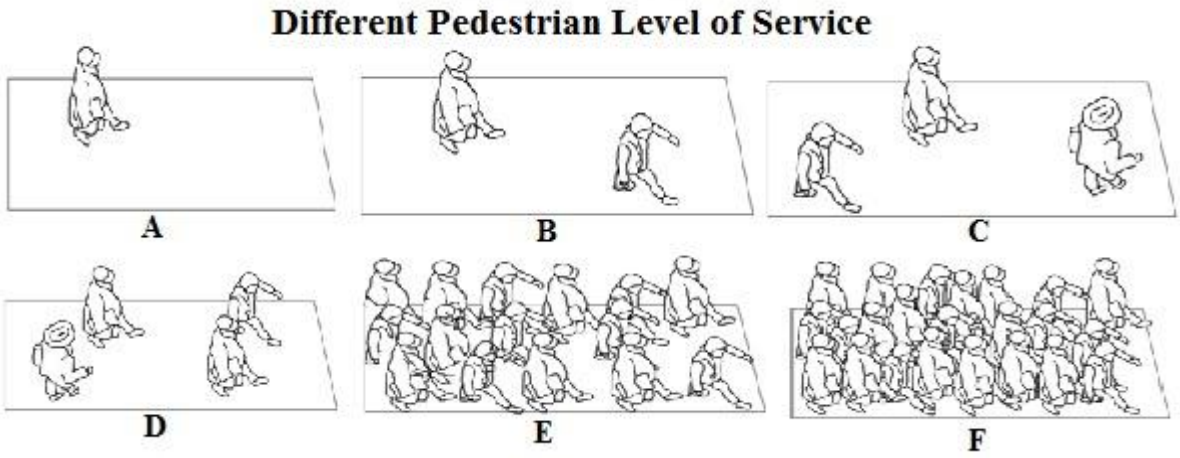


Source: Modified by authors

Figure 1: Location and structure of the study area

Concepts Regarding Level of Service (LOS)

The concept of Level of Service (LOS) is used to denote the level of facility one can derive from a road under different operating characteristics and traffic volume. Level of Service (LOS) is defined as a qualitative measure describing the operational conditions within a traffic stream, and their perception by motorists and/or passengers. Level of Service ratings are grades from A (best) to F (worst) commonly used to evaluate travel conditions and identify problem areas. It generally involves a qualitative assessment of the quantitative effect of factors such as volume of traffic, speed, travel time, delays, geometric features, traffic interruptions, freedom to maneuver, safety, driving comfort and convenience, and operating cost. In practice, selected specific levels are defined in terms of particular limiting values for some of these factors (Clark, 2008; Florida Department of Transportation, 2009; Kadiyali, 2006; Transportation Research Board**,** 2000).



Source: Transportation Research Board, 2000
Figure 2: Different Pedestrian Level of Service (A to F)

The factors which are affecting level of service can be summarized as follows (Mohanty, 2013; Transportation Research Board**,** 2000)

- Traffic volume
- On street parking
- Sidewalk width
- Roadway width
- Speed limits
- Comfort factors
- Convenience factors
- The economics of pedestrian facilities

Pedestrian flow LOS Evaluation Criteria and Standards

The criteria for Pedestrian Level of Service (LoS) evaluation are mainly space among the pedestrians, flow rate, pedestrian walking speed and volume to capacity ratio (V/C) (Transportation Research Board**,** 2000). The Pedestrian flow LOS criteria and their relevant evaluation standards are given in the following table:

Table 1: Average pedestrian flow LOS criteria for walkways and sidewalks

LOS	Space (m^2/p)	Flow rate (p/min/m)	Speed (m/s)	V/C ratio
A	> 5.6	≤ 16	> 1.30	≤ 0.21
B	3.7-5.6	16-23	1.27-1.30	0.21-0.31
C	2.2-3.7	23-33	1.22-1.27	0.31-0.44
D	1.4-2.2	33-49	1.14-1.22	0.44-0.65
E	0.75-1.4	49-75	0.75-1.14	0.65-1.0
F	≤ 0.75	Variable	≤ 0.75	Variable

Source: Transportation Research Board, 2000.

Here, we have discussed about the pedestrian space. The primary performance measure for walkway is space. It is the average area provided for each pedestrian in a walkway or queuing area, expressed in terms of square meters per pedestrian (m^2/p) (Transportation Research Board, 2000). The average area occupied by the pedestrian can be computed by dividing the square area of the effective walkway width with the peak hour pedestrian volume. The formula is as follows (Azlan, 2010):

$$\text{Pedestrian Space} = \frac{\text{Area of the effective walkway width } (m^2)}{\text{Peak hour pedestrian volume } (V_P)} \quad \text{[Equation no:1]}$$

Existing situation of demand and supply of pedestrian way

A questionnaire survey of a number of 150 pedestrians (50 pedestrian in Motijheel Circular Road, 50 pedestrian in Motijheel Road and 50 in Dilkusha Road) and observation survey has been conducted to reveal their socio-economic status in short, to explore their travel pattern including place of origin, purpose of trips to Motijheel CBD, and some other issues like causes of their walking and walking duration variability and also explore the existing characteristics of pedestrian ways. From the survey it has been identified that majority of the pedestrians are on foot (90%) and others are mobility impaired (6%). 30-40 years aged group people are the maximum here, almost 35% of all surveyed people. These aged peoples are come here mostly their official activities (40%). People come here for others purposes also, such as business (14%), work (12%), education (20%), shopping (8%) etc. People come here from various destination, suppose within walking distance (20%), within 5km (36%), within 10 km (32%), more than 10km (12%). They come here by various mode also, about 25% people used their own vehicle. Others peoples are used public transport and others modes.

The major three road of the study area are Motijheel circular road, Dilkusha road and Motijheel road, footpath width of these road are 3.5 meter, 3 meter and 2 meter each of the side. The widths of roads are not equal at all but this width is average. And majority portion of the pedestrian ways are concrete walkway (more than 55%). Some portion of the walkway is not so good; these are vulnerable or bad condition.

Pedestrian volume flow has been counted three time a day. Where 9:00 am to 10:00 am and 5:00 pm to 6:00 pm are the peak hour and 2:00 pm to 3:00 pm as an off peak hour.

Table 2: Pedestrian flow of the study area

Time	Pedestrian volume of Dilkusha Road (South)	Pedestrian volume of Dilkusha Road (North)	Pedestrian volume of Motijheel Circular Road (West)	Pedestrian volume of Motijheel Circular Road (East)	Pedestrian volume of Motijheel Road (East)	Pedestrian volume of Motijheel Road (West)	Type of time

9:00 am – 10:00 am	4120	4558	2596	2847	2732	3031	Peak
2:00 pm – 3:00 pm	2635	2854	1531	1727	2160	2193	Off peak
5:00 pm – 6:00 pm	4755	4991	6100	6577	4190	4273	Peak
Total	11510	12403	10227	11151	9082	9497	

Evaluation of pedestrian Level of Service (LOS)

Calculation

We know,

$$\text{Pedestrian Space} = \frac{\text{Area of the effective walkway width } (m^2)}{\text{Peak hour pedestrian volume } (V_p)}$$

Again, $\text{Area of the walkway} = \text{Walkway length} \times \text{Walkway width}$

Selected section length of the walkway = 100 m

For Dilkusha Road (South),

Here, effective walkway width = 3 m

∴ Area of the effective walkway width = 100 m × 3 m

= 300 m^2

Peak hour pedestrian volume, V_P = 4755 pedestrians

∴ Pedestrian space =300/4755 m^2/p

= 0.063 m^2/p

Pedestrian Level of Service (PLOS) = **F [**Refer to Table 1**]**

For Dilkusha Road (North),

Here, effective walkway width = 3 m

∴ Area of the effective walkway width = 100 m × 3 m

= 300 m^2

Peak hour pedestrian volume, V_P = 4991 pedestrians

∴ Pedestrian space =300/4991 m^2/p

= 0.06 m^2/p

Pedestrian Level of Service (PLOS) = **F [**Refer to Table 1**]**

For Motijheel Circular Road (West),

Here, effective walkway width = 2 m

Area of the effective walkway width = 100 m × 2 m

= 200 m^2

Peak hour pedestrian volume, V_P = 6100 pedestrians

Pedestrian space =200/6100 m^2/p

= 0.032 m^2/p

Pedestrian Level of Service (PLOS) = **F [**Refer to Table 1**]**

For Motijheel Circular Road (East),

Here, effective walkway width = 2 m

∴ Area of the effective walkway width = 100 m × 2 m
= 200 m^2

Peak hour pedestrian volume, V_P = 6577 pedestrians

∴ Pedestrian space =200/6577 m^2/p
= 0.03 m^2/p

Pedestrian Level of Service (PLOS) = **F [**Refer to Table 1**]**

For Motijheel Road (East) ,

Here, effective walkway width = 3.5 m

∴ Area of the effective walkway width = 100 m × 3.5 m
= 350 m^2

Peak hour pedestrian volume, V_P = 4190 pedestrians

∴ Pedestrian space =350/4190 m^2/p
= 0.084 m^2/p

Pedestrian Level of Service (PLOS) = **F [**Refer to Table 1**]**

For Motijheel Road (West),

Here, effective walkway width = 3.5 m

∴ Area of the effective walkway width = 100 m × 3.5 m
= 350 m^2

Peak hour pedestrian volume, V_P = 4273 pedestrians

∴ Pedestrian space =350/4273 m^2/p
= 0.082 m^2/p

Pedestrian Level of Service (PLOS) = **F [**Refer to Table 1**]**

It has been shown that all the pedestrian level of services is here is **F,** which means pedestrian flow is sporadic and unstable at this road. There is frequent, unavoidable contact with other pedestrians and all walking speeds are severely restricted. Cross- and reverse-flow movements are virtually impossible because of the presence of too much pedestrians at the road. For having too much traffic pressure in this road there are always conflicts between the pedestrians and vehicles. As a result, unavoidable congestion occurs and there is no pedestrian security.

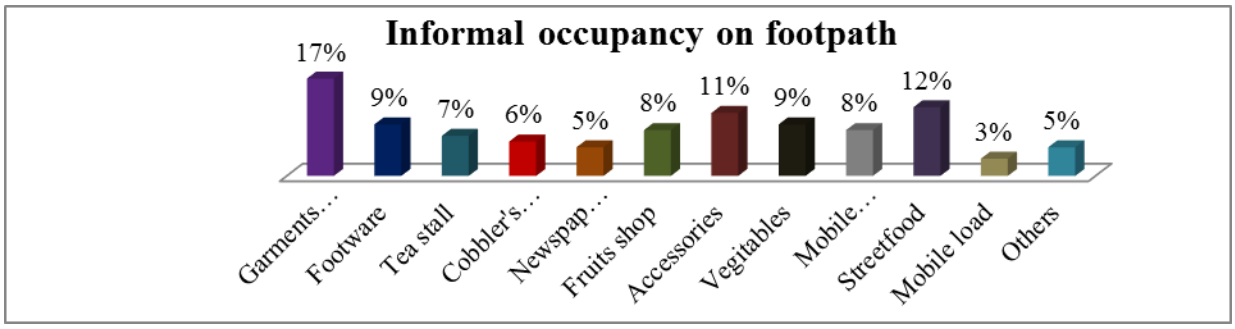
Problems

The major problems which have been come out from the questionnaire and observation surveys these are-

Informal occupancy on footpath

In study area there are almost 114440 sq. feet footpath or pedestrian ways are exist, but pedestrian can't access there properly. Street hawkers are illegally occupied the pedestrian's walking spaces. For that pedestrians are often forced to walk on carriage way or on the road. There are a various types of hawkers are in the study area, most of them are found at

Dilkusha Road area, where the maximum portion of the footpath area are occupied by them. The lowest amounts of the hawkers are at Motijheel Circular Road. They stayed here along the day and majority of their customers are office going people.



Source: Field survey 2016,

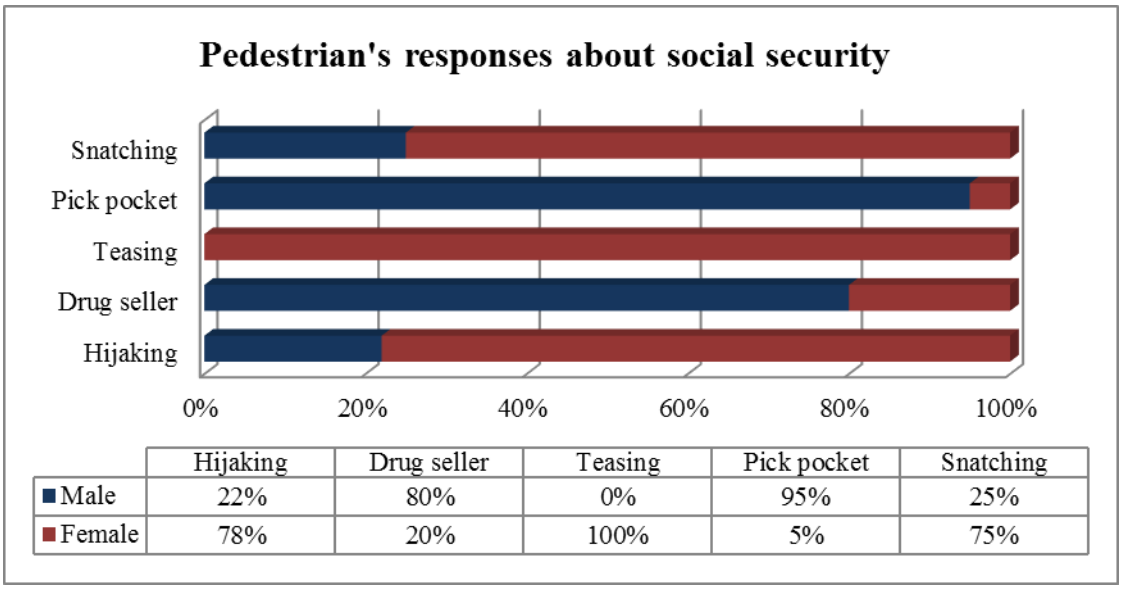
Figure 3: Informal occupancy

Source: Field survey, 2016

Figure 4: Informal occupancy on footpath

Pedestrian's safety and security

Various types of security problem have been found at the study area at survey time. Snatching, pick pocketing, teasing, hijacking and drug sellers are the major security issues in here. Maximum male people suffering on pick pocketing problem, where female people are suffering teasing problem. Female are also suffering hijacking and snatching problem, 78% and 75% female faced hijacking and snatching problems respectively where 22% male people suffering on hijaking problem.



	Hijaking	Drug seller	Teasing	Pick pocket	Snatching
Male	22%	80%	0%	95%	25%
Female	78%	20%	100%	5%	75%

Source: Field survey, 2016

Figure 5: Pedestrian response about social security

Misuse of footpath

There are various reasons behind the misuse of footpath of the study area. Sometimes various types of vehicles are parked on the footpath; they occupied the whole space of the footpath, for that pedestrian force to walk on the main road. There are some slum dwellers on the footpath, they live in on here. Some road besides shops put their shop materials on the footpath, sometimes construction materials are also on footpath, for that pedestrian can't walk smoothly here. These are the major cause of misuse of footpath.

Source: Field Survey, 2016

Figure 6: Misuse of footpath

Recommendations

Administrative measures

- Establishment of a traffic and transportation cell attached with the planning cell of Dhaka South City Corporation empowered to deal with all the issues of traffic and transportation management function as a key coordinator with all agencies concerned with traffic in Dhaka city, supported by qualified staff and necessary flexibility.
- Priority should be given to upgrading traffic enforcement effectiveness. A special branch of police in the DMP with well trained personnel may be assigned to enforce traffic laws in the city.
- Expansion of pedestrian and driver education on traffic laws and behavior through mass media and training program.
- Coordination, cooperation and joint action among transport authorities, associated planning and development authorities, relevant engineering departments, metropolitan traffic police personnel, traders and public transport operators. The public agency suggested earlier may coordinate such joint action.
- Promotion of citizen involvement mechanism.

Improvements in Roadway Design, Maintenance and Management

- Adequate measure should be taken for maintenance of carriageway and sidewalks.
- Improvement of quantity and quality of street lighting.
- Improvement of traffic signals is essential for study area.
- All traffic signs and signals should be standardized and be displayed properly at appropriate locations and a number of signs and signals should be installed in all intersection.
- Removal of objects obstructing sight distance.

Improvement in Pedestrian Planning

- Integration of walking as a mode in transportation planning.
- Active participation of public and private sectors to improve the street environment.
- A systematic program to raise consciousness for pedestrians and to develop a change in attitudes characterized by a general demand for a quality environment.
- An interdisciplinary approach to plan should be involved in establishing effective pedestrian planning guidelines.
- There is a need for developing a constituency for pedestrianization.
- Needs of different groups, such as concerned officials, merchants, engineers, planners and developers, should be considered properly in any comprehensive transport plan.

Improvements in pedestrian mobility, accessibility, safety and convenience.

- Standard or guidelines should be developed to facilitate selecting the most appropriate levels of pedestrian control to handle individual situations.
- Pedestrian networks should be well connected to interfaces with the public transport system through pedestrian friendly routing and stops.

- Pedestrian quality of service should be improved through urban design, landscaping, pavement improvement, weather protection etc.
- Pedestrian activities should be segregated from vehicular traffic as far as possible.
- Driver's stoppage should be made mandatory at pedestrian grade crossings.
- Public spaces and pedestrian facilities should be designed for the users of all ages and physical needs.

Recommendations for Informal Occupancy

- There should be a legal arrangement regarding the informal activities on footpath so that the informal users get a legal status of doing or not doing business on footpath.
- Space should be specified for particular use so that conflicts between uses can be avoided.
- Some types of informal business activities like tea stall, cobblers, some newspaper stand, food shops and cigarette shops can be accommodated with pedestrians on footpath of some road sections.
- 'Evening market' can be a very effective one in the Motijheel CBD in respect of informal sector business activities.

Recommendation for on street parking

- On street parking activities should be strictly prohibited.
- All the offices and others organizations should provided parking facilities at their own responsibilities.
- High rate of fine should be imposed on street parking.
- There should impose some restriction on private vehicle at the Motijheel CBD area.
- 'City Centre' is one of the renowned structures at this area, where a huge area of parking space is available. Where 350+ private vehicles can easily park.

Conclusion

The study findings gave birth to the fact that pedestrian traffic movement and its otherrelated issues are not yet being properly considered as a part of transportation policy and planning in the Dhaka City. While most cities of both developed and developing countries are highly devoting their attention for increasing pedestrian movement in the city centers and adopting pedestrian traffic as an integral part of their transportation thoughts, at the same time, in the Dhaka city, the issue has not yet been recognized as an effective transportation policy. Dhaka City, the transport authorities or the researchers are still thinking with managing only the motorized vehicles. For this, the most vulnerable road users in the transportation planning, the pedestrians are neglected for their safety as well as convenience. This research work is an attempt to aware the transportation planners and researchers about the existing demand and supply of pedestrian of Motijheel CBD area of Dhaka City so that they can understand the problems and the need for the pedestrians.

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