*Proceedings of the 4th International Conference on Civil Engineering for Sustainable Development (ICCESD 2018), 9~11 February 2018, KUET, Khulna, Bangladesh (ISBN-978-984-34-3502-6)*

# APPLICATION OF NUMERICAL RATING APPROACH FOR PEDESTRIAN SERVICE QUALITY PREDICTION OF DHAKA

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## ABSTRACT

*In a successful city, there is a clear trend towards plummeting the effect of motor traffic to improve the quality of life and make them more attractive to live in and to do business. Dhaka is one of the biggest metropolitan city in the world, although the living standard is getting worse. Involving more people in walking can reduce environmental impact, traffic trail log, in contrary increase longevity as well as social cohesion. Pedestrian service quality has a great impact on walkability. The objective of this research is to find out the pedestrian level of service using numerical rating approach based on users' perception of the Dhaka city. For the purpose of the study, nearly 400 data were collected from several points of the Dhaka city. The significant observation from the finding was that only accessibility, width, connectivity and sight distance of the footpath of the study area fulfill the pedestrian requirement with poor scoring. The findings would be extremely useful in decision making for the amendment of the pedestrian facility, to improve the living environment.*

**Key Words:** *Numerical rating approach, level of service, walkability, pedestrian*

## 1. INTRODUCTION

Area of Dhaka is 1528 square kilometers with 10,000 per square kilometer population density. Being the metropolis, Dhaka is one of the least motorized cities in the world where 60% of trips are on foot (Rahaman, 2010). People tend to use walking as a mode of transport for their short trips. When pedestrian demand exceeds the walkway capacity, improperly designed walking facilities may fail to operate at satisfactory levels. In this situation, available space for pedestrian movement can drop drastically and there is a possibility of crowd-related problems, thus stampede at the Love Parade dance music festival in 2010 and stampede during the 2013 New Year's firework show in Ivory Coast (Sharifi, 2016). Walking facilities are designed effectively to provide a safe environment with preferred level-of-service for future pedestrian demand (Manik, 2013).

Pedestrians are the most vulnerable users of the road space in a broad sense. Lack of safety provisions or measures offers the pedestrian very dangerous situation. Discontinuation of the walkway alignment provides inconvenience for the older citizen and lack of separation of the walkways from the road space offers to treat to the accident for the school going children (Sakib, 2016). It is more severe for developing countries. In this situation, it is an important part to know the level of Service (LOS) of the Pedestrian so that the policy makers or the transport planners can understand the extent of problems that the pedestrians are facing in their daily life(Zhang, 2012). Every day a large number of people travel through the Shahbag, New Market, and Dhanmondi areas. For this reason, the study aims at finding the existing Pedestrian Level of Service (PLOS). The objective of this research is to find out the pedestrian level of service using numerical rating approach based methodology.

### 1.1 Study Area

Shahbag, New Market, and Dhanmondi have been selected as the study area to assemble different information and Level-of-Services of the walkways. It is the connecting point of old and new Dhaka and one of the congested place of the city. Major educational and medical institutions are located there. A huge number of new and local people are using the pathways regularly. So this location could provide the overall pedestrian service quality of the city according to its users.

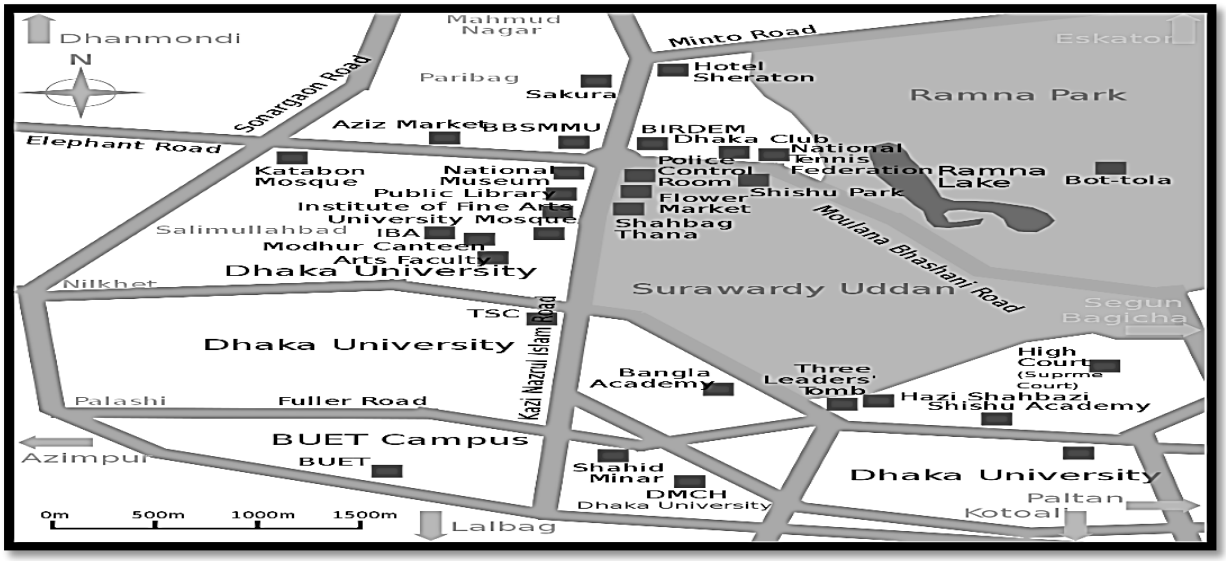


Figure 1: Map of Shahbag

### 1.2 Data Collection

In order to conduct this research, required data have been collected through face to face questionnaire survey. The questionnaire was pretested before final data collection. Necessary suggestions from transportation experts have also been taken during the preparation of questionnaire. The questions were properly explained and then they were asked to write their viewpoints. Total 400 data were collected from several points of the study area at the different time to include different aging groups of the city. The survey format was designed to explore the pedestrian level of service of the Dhaka city. Collected data were processed for subsequent analysis using software such as SPSS and Microsoft Excel.

### 1.3 Method

Numerical rating approach is a simple conventional weighted average method used to calculate Level-of-Service index (LOSI) for pedestrian (Shalini KANUGANTI, 2013).

$$\text{LOSI} = W_i \times R_i \quad (1)$$

Where,

$W_i$ : Relative weight associated with the $i^{th}$ services attribute

$R_i$ : Service quality for the $i^{th}$ services attribute for the existing situation

We find relative weight,

$$W_i = \frac{X}{\sum X} \quad (2)$$

Where,

X : Average weightage

$\sum X$ : Total average weightage

And service quality,

$$R_i = \frac{X}{5} \quad (3)$$

Where,

X : Average weightage

## 2. DATA ANALYSIS AND FINDINGS

### 2.1 Gender Distribution

About 400 people participated in the survey among them 76% male and 24% female. The survey was carried out at the different time of the day to observe the effect of the pedestrian during rush hours and also during dull hours. The people from all age groups were asked to jot down their perception.

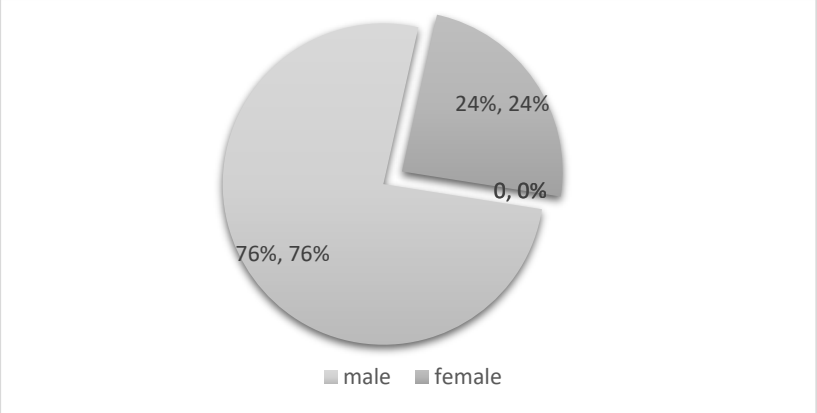


Figure 2: Gender Distribution

### 2.2 Pedestrian Level of Service

If the scale for weight associated with the service characteristics is such that $\sum_{i=1}^{n} W_i = 1$, and the value score is expressed with respect to unity, then the maximum possible LOSI as per equation (1) is one. LOSI values closer to 1 indicate very high LOSI, whereas, closer to 0 indicates very poor service level. However, the practically pedestrian system is expected to provide a LOSI as high as 1. Thus, it is important to know the accepted LOSI, by the users, in a developing country like India. It has been observed that 0.6 may be used as the value for accepted service level (Shalini KANUGANTI, 2013).The same value has been considered in this study also.

As per the objectives framed for this study, data analysis was done using conventional weighted average method for all the pedestrian services considered for this study, the detailed calculations and results are shown in Tables 1, 2, and 3, as for example. Pedestrian's opinions are then averaged. The results shown in column 8 of Table 1 represent a weighted average opinion on the importance of service quality of the nineteen attributes for the pedestrian on a conventional rating scale of 1-5, with ‘e’ being ‘very bad’ and ‘a’ being ‘excellent’ condition. It is evident from the results showing relative weights in Table 1 that Accessibility, Connectivity, and Sight Distance have comparatively high weightage.

Table 1: Relative Weight of the attributes

| **Attributes** | **Number of passengers putting weights on** | | | | | **Average weightage (X)** | **Relative weight** $W_i = \frac{X}{\sum X}$ |
|---|---|---|---|---|---|---|---|
| | a*5 | b*4 | c*3 | d*2 | e*1 | | |
| Accessibility | 23 | 114 | 150 | 89 | 24 | 3.06 | 0.07 |
| Width | 0 | 145 | 153 | 102 | 0 | 3.11 | 0.07 |
| Surface Quality | 0 | 45 | 99 | 165 | 91 | 2.25 | 0.05 |
| Support Facility | 0 | 44 | 89 | 123 | 144 | 2.08 | 0.04 |
| Connectivity | 14 | 123 | 155 | 108 | 0 | 3.11 | 0.07 |
| Environment | 0 | 0 | 55 | 162 | 183 | 1.68 | 0.04 |
| Potential Vehicular Conflict | 0 | 56 | 167 | 100 | 77 | 2.51 | 0.05 |
| Cleanliness | 0 | 78 | 111 | 113 | 98 | 2.42 | 0.05 |
| Lighting Facility | 0 | 88 | 60 | 159 | 93 | 2.36 | 0.05 |
| Comfortableness While Crossing | 0 | 16 | 55 | 141 | 188 | 1.75 | 0.04 |
| Comfortableness While Heavy Vehicle Approaches | 0 | 14 | 60 | 200 | 126 | 1.91 | 0.04 |
| Comfortableness while Lighter Vehicle Approaches | 0 | 67 | 118 | 124 | 91 | 2.40 | 0.05 |
| Comfortableness while Non-Motorized Vehicle Approaches | 0 | 145 | 156 | 99 | 0 | 3.12 | 0.07 |
| Safety Barrier | 7 | 102 | 128 | 122 | 41 | 2.78 | 0.06 |
| Volume | 0 | 73 | 109 | 89 | 129 | 2.32 | 0.05 |
| Sight Distance | 45 | 151 | 102 | 83 | 19 | 3.30 | 0.07 |
| Personal Security | 0 | 48 | 59 | 117 | 176 | 1.95 | 0.04 |
| Aesthetic | 0 | 51 | 201 | 113 | 35 | 2.67 | 0.06 |
| Non-Pedestrian Activity on Footpath | 0 | 11 | 69 | 131 | 189 | 1.76 | 0.04 |

According to pedestrians' opinion, there were better connectivity, width of pathway and visibility than others, though it was not so satisfactory level. At night poor visibility was a hackneyed scenario because of the lacking of the adequate lighting system.

Table 2: Service Quality with respect to Unity of the Attributes

| **Attributes** | **Number of passengers putting weights on** | | | | | **Average weight (X)** | **Service quality (X divided 5)** |
|---|---|---|---|---|---|---|---|
| | a*5 | b*4 | c*3 | d*2 | e*1 | | |
| Accessibility | 23 | 114 | 150 | 89 | 24 | 3.06 | 0.61 |
| Width | 0 | 145 | 153 | 102 | 0 | 3.11 | 0.62 |
| Surface Quality | 0 | 45 | 99 | 165 | 91 | 2.25 | 0.45 |
| Support Facility | 0 | 44 | 89 | 123 | 144 | 2.08 | 0.42 |
| Connectivity | 14 | 123 | 155 | 108 | 0 | 3.11 | 0.62 |
| Environment | 0 | 0 | 55 | 162 | 183 | 1.68 | 0.34 |
| Potential Vehicular Conflict | 0 | 56 | 167 | 100 | 77 | 2.51 | 0.50 |
| Cleanliness | 0 | 78 | 111 | 113 | 98 | 2.42 | 0.48 |
| Lighting Facility | 0 | 88 | 60 | 159 | 93 | 2.36 | 0.47 |
| Comfortableness While Crossing | 0 | 16 | 55 | 141 | 188 | 1.75 | 0.35 |
| Comfortableness While Heavy Vehicle Approaches | 0 | 14 | 60 | 200 | 126 | 1.91 | 0.38 |
| Comfortableness while Lighter Vehicle Approaches | 0 | 67 | 118 | 124 | 91 | 2.40 | 0.48 |
| Comfortableness while Non-Motorized Vehicle Approaches | 0 | 145 | 156 | 99 | 0 | 3.12 | 0.62 |
| Safety Barrier | 7 | 102 | 128 | 122 | 41 | 2.78 | 0.56 |
| Volume | 0 | 73 | 109 | 89 | 129 | 2.32 | 0.46 |
| Sight Distance | 45 | 151 | 102 | 83 | 19 | 3.30 | 0.66 |
| Personal Security | 0 | 48 | 59 | 117 | 176 | 1.95 | 0.39 |
| Aesthetic | 0 | 51 | 201 | 113 | 35 | 2.67 | 0.53 |
| Non-Pedestrian Activity on Footpath | 0 | 11 | 69 | 131 | 189 | 1.76 | 0.35 |

On the other hand, non-pedestrian activity on footpath, comfortableness and personal security scored the lower as second poorest services. Larceny and female harassment was a trite matter in Dhaka. Poor security system for female discourages them to walk lonely. At night both male and female felt uncomfortable at several locations of the pathway only for burglary. Sometimes it was a deadly thing for the pedestrian to walk lonely when they met with robbers.

Table 3: Deficiencies on pedestrian level of service

| Attributes | Relative weight (Scale Value) (1) | Service quality (2) | LOSI (3) = (1)*(2) | Acceptance Level (60% of Scale Value) (4) | Deficiencies from acceptance Level (5)=(3)-(4) |
|---|---|---|---|---|---|
| Accessibility | 0.066 | 0.612 | 0.040 | 0.039 | 0.001 |
| Width | 0.067 | 0.622 | 0.042 | 0.040 | 0.001 |
| Surface Quality | 0.048 | 0.449 | 0.022 | 0.029 | -0.007 |
| Support Facility | 0.045 | 0.417 | 0.019 | 0.027 | -0.008 |
| Connectivity | 0.067 | 0.622 | 0.042 | 0.040 | 0.001 |
| Environment | 0.036 | 0.336 | 0.012 | 0.022 | -0.010 |
| Potential Vehicular Conflict | 0.054 | 0.501 | 0.027 | 0.032 | -0.005 |
| Cleanliness | 0.052 | 0.485 | 0.025 | 0.031 | -0.006 |
| Lighting Facility | 0.051 | 0.472 | 0.024 | 0.030 | -0.007 |
| Comfortableness While Crossing | 0.038 | 0.350 | 0.013 | 0.023 | -0.009 |
| Comfortableness While Heavy Vehicle Approaches | 0.041 | 0.381 | 0.016 | 0.025 | -0.009 |
| Comfortableness while Lighter Vehicle Approaches | 0.052 | 0.481 | 0.025 | 0.031 | -0.006 |
| Comfortableness while Non-Motorized Vehicle Approaches | 0.067 | 0.623 | 0.042 | 0.040 | 0.002 |
| Safety Barrier | 0.060 | 0.556 | 0.033 | 0.036 | -0.003 |
| Volume | 0.050 | 0.463 | 0.023 | 0.030 | -0.007 |
| Sight Distance | 0.071 | 0.660 | 0.047 | 0.043 | 0.004 |
| Personal Security | 0.042 | 0.390 | 0.016 | 0.025 | -0.009 |
| Aesthetic | 0.057 | 0.534 | 0.031 | 0.034 | -0.004 |
| Non-Pedestrian Activity on Footpath | 0.038 | 0.351 | 0.013 | 0.023 | -0.009 |

Dhaka may present the poorest scenario concerning others Megacity. Nearly 89% pedestrian felt that the walkway environment was very unpleasant not only for the deficiency of amenities but also for its milieu. The environmental effect with aesthetic view imparts predominating criteria on the pedestrians generally as dirt roads and surfaces are avoided by the general people of all classes.

## 3. RECOMMENDATIONS

Some recommendations and policy measures are given for the amendment of the service quality of the pedestrian pathways. Walking is very crucial for healthy living and effective transportation system.

### 3.1 Educational Measures

Continuous road safety and educational campaign are indispensable to aware, motivate, educate and above all to change the attitude of our people regarding traffic rules and regulation. Proper road behavior instructions, with focused messages should be broadcast through the mass media and separate topics may add on traffic rules and regulation in the institutional academic book mainly for children. Target programs should be arranged for high-risk pedestrian and driver groups.

### 3.2 Policy Measures

Most of the unsafe situation occurred on the road for the competition attitude of the drivers. So, for safe, reliable and friendship movement, all of the mass transit may be offered by one or two larger company. The detail land use master plan must be established and proper implementation should be ensured. Roadside base multi-storied commercial development should be controlled.

### 3.3 Amendment of Footpath

Attractive and user-friendly footpath facility must be ensured by eliminating retailer traders and hawker gradually. Besides this, it will be geometrically and aesthetically improved for increasing attraction and comfort, as pedestrians are encouraged to use the footpath. Haphazard parking on a roadside, illegal use of footpath like a garage, building material should be eradicated. Install pedestrian fencing or other barrier types on the approaches and in the nearby zones of high risk. Pedestrian support facilities like potable water, toilet system, seating, and other amenities must be provided for better walkability in the Dhaka metropolis.

## 4. CONCLUSIONS

Numerical rating approach has been used to find out the pedestrian level of service in Dhaka metropolis to amend the quality in the nearest future for better walkability. According to the objective, the environment of the footpath was ranked poorest in quality based on the perception of the Dhaka city walkers. Waste containers and spreading squalorson the pathways discourage users to walk. Besides, non-pedestrian activity on the pathways, comfortableness, and security were second poorest services in the study area. Few points of the footpaths were blocked by vendors to selling their goods to obstruct flowing and force to use the main carriageway of the road which could be responsible for conflict with vehicles. However, width and connectivity of the pathway were acceptable but not in satisfactory. Overall pedestrian service quality was very poor to attract users to walk than another mode of transports. So adequate support facilities and policy measures would improve the quality of the footpath and efficacy of the overall transportation system of the Dhaka city.

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