



DEVELOPMENT OF QUALITATIVE EVALUATION METHODOLOGY FOR SIDEWALKS IN DELHI

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ABSTRACT

Pedestrian level of services indicate the environmental qualities of a pedestrian space and serves as a guide for development of standards for pedestrian facilities, but these are based primarily on vehicular traffic flow theory and not on basic requirements of pedestrians like comfort, convenience, safety, security and attractiveness. This paper suggest an alternative planning technique which is more flexible and can be easily incorporated into design considerations.

1 INTRODUCTION

Ancient and medieval planners provided extensive pedestrian facilities within their cities because the primary transportation mode available then was walking. Pedestrian comfort was also accommodated through galleries, canopies and other protective features used to shield pedestrians from the sun and inclement weather. In 1530, the Grand Trunk road from Calcutta to Peshawar, covering about 3,000 km, the longest highway, was planned and built with 3 meter sidewalks and shoulder on either side of the highway. Continuous row of evergreen trees was planted on both sides of the highway to provide shelter to pedestrians.

The advent of motor vehicles and afterwards increasing volumes and speeds of the traffic has culminated in a complete though undesirable reversal of these planning objectives. Pedestrians have been thrust into background as ever increasing vehicular demand continues. The limited road space has to be shared between all road users. However, completely opposite is happening. Motor vehicles and population in the urban areas are rising, calling for a need to widen roads, construct flyovers, freeways etc., disregarding completely the needs of pedestrians. Competition on a common route by users of different type or with different purposes works to the disadvantage of the most vulnerable users i.e. pedestrians.

2 NEED FOR QUALITATIVE EVALUATION

Pedestrian level of service indicates the environmental qualities of a pedestrian space and serves as a guide for development of standards for pedestrian facilities. Pedestrian spaces should be designed in consideration of human convenience and have to be qualitatively suitable to the needs of human beings. Planning and design methods for pedestrians suggested by many researchers are based primarily on vehicular traffic flow theory. Additional environmental factors that contribute to the walking experience and therefore to the perceived level of service, such as comfort, convenience, safety, security and attractiveness, should also be considered. This paper proposes an alternative planning technique that is more flexible and that will enable user needs to be better incorporated into design considerations. The qualitative method of developing level of service models incorporates the perception and need of the pedestrians directly.

3 SURVEY DESIGN AND FIELD STUDY

For qualitative assessment of the sidewalk facilities a questionnaire-based survey was conducted. The pedestrians using the sidewalk facility were asked a set of questions; with a view to ascertain the level of service the pedestrians are experiencing by using the particular sidewalk facility. Rating

scales have been used in this study for qualitative evaluation of sidewalk.

3.1 Rating Scales

One of the simplest and most used of the devices for psychological measurements is the numerical rating scales. The rater is simply given a set of ordered categories or intervals; each associated with a numerical rating and is asked to place the object of judgment in the most appropriate category or at the most appropriate point on a graphic scale. His rating is then taken to indicate the amount of the psychological characteristics he perceives in the object. Thus, for example, the quality of organizing ability is to be rated. The rater may be given a graphic scale consisting of a straight line marked off into seven equal intervals. On the boundaries between the intervals may appear the number 1 through 6. Some times the rater is simply presented with such a scale, and his ratings are treated as the amounts of the psychological characteristics shown by the objects. The implicit assumption is made that the rater is somehow able to translate his perception of the object directly into a number.

One of the oldest and simplest assumptions made in collecting and analyzing rating data is that of equal-appearing intervals. The rater is told explicitly that the intervals into which the rating, scale is divided should be psychologically equal. That is, the rater is to adopt the attitude that an object rated exactly 1 is psychologically just as different from an object rated 2 as the object with rating 2 is from an object rated 3. The assumption is that the rater can indeed hold this instructional set in mind and can assign objects accordingly. In assigning any given object along the scale, the rater is presumed to compare the perceived status of the object to the idealized values represented by the boundaries of the equal intervals. Furthermore, it is assumed that if variability occurs among the ratings of a given object across a group of judges, this variability reflects disagreements about the status of object but does not reflect any disagreement about the boundaries of intervals into which objects may fall.

3.2 Survey Design for Pedestrian Perception

For qualitative evaluation of pedestrian facilities a performa was designed using rating scale concept.

The survey design in this case is largely based on the theoretical footing of 'psychological measurement'. The initial stage of this method involved the identification of parameters for inclusion in a questionnaire, reflecting the important aspects of level of service experienced by pedestrians. Based on research review and brief pilot study 10 parameters were identified to be included in a questionnaire. Six parameters were pertaining to the physical evaluation of the sidewalk facility, which included sidewalk width, sidewalk surface, obstruction, encroachment, potential of vehicular conflict, and continuity. The four user factors were pedestrian volume, safety, comfort and walking environment. Pedestrians were asked to rate both the performance (indicating 'bad' or 'good' condition) and importance (how important good performance is to them) on a five-point scale. A total of 6,740 pedestrians in 12 different locations in Delhi were interviewed for this survey. All interviews were conducted by direct interview method. Respondent's ratings of importance and performance were obtained for each of the parameters.

The factors affecting the level of Service for pedestrians were classified as physical characteristics or design factors of the sidewalk and the user factors. The factors identified, totaling ten, include the following.

3.2.1 Design Factors (Physical Characteristics)

- **Footpath surface:** a smooth surface without any cracks or bumps for comfortable walking.
- **Footpath Width:** a measure in meters of the width of the sidewalk available to the pedestrian.
- **Obstructions:** The obstruction can be an electric pole, tree, and garbage bin, and hoardings. The number of obstruction per kilometer of the sidewalk was assessed.
- **Encroachment:** The informal commercial activities are an integral part of the sidewalk environment in India. The pedestrians also need them as they cater to their day-to-day needs, but sometimes the extent of encroachment rises to a level that the sidewalk

facility becomes inaccessible / usable by the pedestrians. The extent of encroachment was assessed.

- **Potential for vehicle conflict:** The sidewalks need to be segregated from the roads, where fast moving vehicles ply. The two ways to protect the pedestrians from vehicle conflicts is the raised footpaths and the guard rails. The safety of pedestrians from the hazard of conflicting with vehicles was assessed in the terms of these two factors.
- **Continuity:** The continuity of the pedestrian facility is very important for the pedestrians with disability and of old age. The continuous ups and downs make the sidewalk uncomfortable to use by the pedestrians especially the old and forces the pedestrians to share the carriageway along with the vehicles.

3.2.2 Design Factors (User Characteristics)

- **Pedestrian Volume:** A count or estimate of the number of pedestrians using the sidewalk .As the number of pedestrian increases on the sidewalk the feeling of crowdedness is experienced by the pedestrians, and the level of service goes down.
- **Safety:** The feeling of being safe is the most important governing factor. A pedestrian should feel safe during the day as well as night while using a sidewalk. Characteristics of this factor include provision of adequate street lighting, police patrolling during the nighttime, sufficient activities on the surrounding areas to ensure safety.
- **Comfort:** A pedestrian needs to be comforted from the inclement weather like harsh sun and rain. The trees protect the pedestrians but if planted in a unplanned manner also acts as an obstruction. The location of tree and the species need to be carefully planned. The curbs has to be mountable so that they can be climbed up and down easily. Provision of chairs / benches and rest rooms is another factor that adds to the comfort of pedestrians.
- **Walk Environment:** Walk environment is governed by the surroundings of the facility. The walking should be a pleasant experience. The sidewalk should be clean and free of stinks

Table 1 Location of Qualitative Survey

S No.	Location	Land use type
1	CRRRI Okhla Tank	Institutional + Residential
2	AIIMS	Institutional
3	Azadpur	Commercial
4	Ashram	Residential
5	Janakpuri	Residential
6	ITO	Public- Semi Public
7	Cannaught Place	CBD
8	Hauz Khas	Institutional + Residential
9	Vivek Vihar	Residential
10	Rohini	Residential
11	ISBT, Ajmeri Gate	Terminal
12	Shahdara	Residential + Commercial

3.3 Survey Process

A detailed performa was designed, which was divided into three sections:

- Pedestrian characteristics
- Evaluation of design factors
- Evaluation of user factors.

The inclusion of different variables in the questionnaire has been based on sound logic. The simple random sampling strategy was employed to select a respondent from the pedestrian stream. The twelve locations for questionnaire based survey (for qualitative level of service) are given in Table 1.

3.3.1 Pedestrian Characteristics

In this category the information about age, sex, income, occupation, purpose of the trip, frequency of the trip, trip distance, availability of footpath, if footpath is available, and still walking on the carriageway then the reason for not using the footpath were included. An endeavor was made to interview people of varying age group, sex, income and profession. The survey was conducted on working days from 6.00 am to 10.00pm, so as to capture people using the footpath with various purposes.

3.3.2 Evaluation of Design Factors

There were six parameters that were identified for evaluation of design factors of a sidewalk. The pedestrians were asked to first assign weights in the scale of 1–5, where 1 is immaterial and 5 is most important, to the parameters as per their perception regarding the pedestrian facility. Then they were asked to tick the rating of the pedestrian facility they are using in terms of the parameters given also on a scale of 1-5. Where 1 is poor operating condition of the particular parameter, while 5 means excellent operating condition of a parameter.

3.3.3 Evaluation of User Factors

The respondents were asked to assign weights to the four parameters identified in this category according to their perception of importance of the parameter. After assigning weights the information was gathered on the rating of each parameter as experienced by the respondent.

After the completion of survey the data was coded and punched. The data so obtained was used to ascertain importance and satisfaction rating of each attribute. The weights assigned to 'Importance' and 'Satisfaction' was employed to develop qualitative level of service of sidewalks.

4 DEVELOPMENT OF QUALITATIVE LEVEL OF SERVICE MODEL

The pedestrians were asked to identify their requirements i.e., importance of various attributes of the sidewalk. The pedestrians of various age groups gender, profession have different needs and they are neglected in traditional methods. In qualitative method of developing level of service all these factors are taken care of.

In this study psychometric method has been adopted to develop relative weights of ten

attributes of sidewalk facilities and satisfaction rating of pedestrians. Besides the primary surveys a Self onsite assessment of the 30 sidewalk facilities was carried out in various locations Delhi On the basis of the weights achieved from primary surveys and the scores assigned by self onsite assessment, attitudinal scores have been estimated for these locations. Finally these scores have been analyzed to define five levels of service (LOS) i.e. LOS A to LOS E. LOS A indicates best level of service and LOS E indicates poor quality of operation for sidewalk facilities.

After the calculation of total weighted scores grading operation has been carried out to define five ranges representing five different LOS. Initially grading has been worked out taking mean and standard deviation as two reference figures. Mean plus one standard deviation i.e., 139 has been defined as the upper limit and any score above this shall qualify for LOS A. The lower limit is mean minus twice standard deviation i.e., 64. Any score less than 64 shall be designated as LOS E. For LOS B to LOS D an interval with a range equal to one standard deviation has been used. With this scheme more than 50 percent locations were qualifying for LOS A and B for the 30 sidewalks selected for onsite assessment. It is desirable that locations in LOS A, LOS B and 50 percent of LOS C should lie within 50 to 60 percent. In view of this the intervals for cumulative scores were marginally modified. These grading schemes are indicated in Table 2 and Table 3.

4.1 Illustration of Different LOS

To illustrate qualitative level of service five locations are presented in this section. Qualitative level of service model can be used for planning, design and operational analysis of sidewalks. This section deals operational analysis of sidewalk facilities and

Table 2 Grading Scheme for Defining LOS

LOS	Cumulative Score	No. of Sidewalks	Cumulative Score	No. of Sidewalks
A	>139	3	> 140	3
B	114 – 139	13	120 -140	9
C	89 – 114	9	100 - 120	9
D	64 – 89	3	80 - 100	7
E	<64	2	60 - 80	2

Mean = 114, Standard Deviation=25

Table 3 Qualitative LOS Scale for Sidewalks

Range	LOS	No. of Locations	%age
> 140	A	3	10
120 – 140	B	9	30
100 – 120	C	9	30
80 – 100	D	7	23
< 80	E	2	6
Total		30	100

then categorizing them into LOS A, LOS B, LOS C, LOS D and LOS E. For each LOS photographs and Tables giving details of sidewalks parameters have been presented.

4.1.1 Level of Service A

Fig. 1 shows a sidewalk facility in the New Delhi Municipal Corporation (NDMC) area in Delhi, located in Lutyen’s Delhi near the city centre is very well maintained, offers best possible walk environment. Details of all sidewalk attributes are given in Table 4. This location has a cumulative score of 175, which is greater than LOS grade of >140. Thus the location qualifies for LOS-A.

Fig. 1 Level of Service A: A Sidewalk in Lutyen’s Delhi Area



Table 4 Level of Service A: A Sidewalk in Lutyen’s Delhi Area

Attribute	Description	Satisfaction Rating	Relative Weight
Footpath Surface	Smooth surface with no cracks or bumps, well maintained facility	5	3.92
Footpath Width	More than 3 m. wide	5	3.80

Obstruction	No obstruction (trees, billboard, poles)	5	3.06
Encroachment	No encroachment	5	3.93
Potential for Vehicular Conflict	Well protected, completely segregated	5	3.92
Continuity	Continuous, curb cuts, gentle ramps	5	2.23
Pedestrian Volume	Very low (located in elite location)	5	3.97
Safety	Very safe, police patrol vehicles available 24 hours	5	4.81
Comfort	Very comfortable (Protection from inclement weather)	5	3.18
Walk Environment	Lush green environment, aesthetically pleasing	5	3.94
Cumulative core = 175			
Level of Service A			

4.1.2 Level of Service B

Fig. 2 shows a sidewalk facility in Patpargunj, a residential location in east Delhi. Predominantly Middle income group household inhabit residential societies in this area. Sidewalks are planned and used, but not very well maintained. This sidewalk score a little less on account of footpath surface, encroachment and walk environment. Details of attributes, satisfaction rating, relative weights and final scores are presented in Table 5. With a cumulative score of 127 this section falls in level of service 'B'.

Fig 2 Level of Service B: A Sidewalk in Patparganj



Table 5 Level of Service B: A Sidewalk in Patparganj

Attribute	Description	Satisfaction Rating	Relative Weight
Footpath Surface	Moderate quality with few bumps and cracks	3	3.92
Footpath Width	More than 3 meters	5	3.80
Obstruction	Few obstructions, like plantations	3	3.06
Encroachment	Few informal sector shops, slightly difficult to walk	3	3.93
Potential for Vehicular Conflict	Raised footpath, no guard rails	4	3.92
Continuity	1-2 ups and downs	4	2.23
Pedestrian Volume	Moderate	3	3.97
Safety	Safe during day only	3	4.81
Comfort	Comfortable	4	3.18
Walk Environment	Acceptable	3	3.94
Cumulative Score = 127			
Level of Service 'B'			

4.1.3 Level of Service C

No level of service in a metropolitan area should drop below LOS C. In fig. 3 a sidewalk near Safdarjang hospital has been showed. The sidewalk is used by a large number of pedestrians being located near a big government hospital as well as near transit interchange point. Many pedestrians who traverse this sidewalk are sick and old people visiting the hospital. While this sidewalk has strong positive attributes like, footpath surface, width free from vehicular conflict, it offers a poor level of comfort, and lots of obstruction and encroachment. There are few ups and downs and the kerb cuts are not provided. The curb height is slightly difficult to mount for the old and the sick people. With a cumulative score of 112 this sidewalk qualifies for level of service 'C' (Table 6).

4.1.4 Level of Service D

A sidewalk near Ashram intersection, where recently a flyover has come up is shown in Fig. 4. The construction of flyover has constricted the

Fig. 3 Level of Service C: A Sidewalk near Safdarjang Hospital**Table 6 Level of Service C: A Sidewalk near Safdarjang Hospital**

Attribute	Description	Satisfaction Rating	Relative Weight
Footpath Surface	Reasonable quality, walking is comfortable	4	3.92
Footpath Width	2-3 meters	4	3.80
Obstruction	Too many obstructions (Hoarding, signboards)	2	3.06
Encroachment	Slightly difficult to walk	3	3.93
Potential for Vehicular Conflict	Well protected with railings	5	3.92
Continuity	Few ups and downs	3	2.23
Pedestrian Volume	High pedestrian volume	2	3.97
Safety	Safe during day only	3	4.81
Comfort	Uncomfortable	1	3.18
Walk Environment	Acceptable environment	3	3.94
Cumulative Score = 112			
Level of Service 'C'			

width of the sidewalk in this area. The sidewalk has been provided by the principle of subtractions. Though the vehicular traffic as well as pedestrian traffic is very high on this arterial road, still neither guardrails are provided nor is the footpath raised. The sidewalk width, footpath surface, comfort and walking environment have eroded over a period of time. Table 7 gives the details of attributes of this location. With a cumulative score of 95 this location belongs to category of level of service D.

**Fig. 4 Level of Service D:
A Sidewalk near Ashram**



**Table 7 Level of Service D: A Sidewalk
near Ashram**

Attribute	Description	Satisfaction Rating	Relative Weight
Footpath Surface	Moderate with few bumps and cracks	3	3.92
Footpath Width	Varies at places with width 0.5 – 1 meter	2	3.80
Obstruction	Few	3	3.06
Encroachment	No problem to walk	4	3.93
Potential for Vehicular Conflict	Footpath not sufficiently raised and no guard rails	2	3.92
Continuity	Few ups and downs	3	2.23
Pedestrian Volume	High	2	3.97
Safety	Safe during day only	3	4.81
Comfort	Uncomfortable	2	3.18
Walk Environment	Poor	2	3.94
Cumulative Score = 95			
Level of Service 'D'			

4.1.5 Level of Service E

Fig. 5 illustrates the level of service E at Chelmsford Road. This is a very important road connecting main railway terminal to south, west and east Delhi. This road is characterized by a heavy volume of motorized and non-motorized vehicles, as well as pedestrians. Despite a heavy flow of pedestrians no pedestrian sidewalk is available. This sidewalk suffers on all parameters. With all attributes on the lowest possible level the cumulative score for this sidewalk is 57 (see Table 8). Such sidewalks

**Fig. 5 Level of Service E:
A Sidewalk along Chelmsford Road**



**Table 8 Level of Service E: A Sidewalk
along Chelmsford Road**

Attribute	Description	Satisfaction Rating	Relative Weight
Footpath Surface	Very bad condition	1	3.92
Footpath Width	No Footpath	1	3.80
Obstruction	Can not walk on footpath	1	3.06
Encroachment	Very difficult to walk	2	3.93
Potential for Vehicular Conflict	Very unsafe	1	3.92
Continuity	Non existent	1	2.23
Pedestrian Volume	Very high	1	3.97
Safety	Safe during day only	3	4.81
Comfort	Uncomfortable	2	3.18
Walk Environment	Poor	2	3.94
Cumulative Score = 57			
Level of Service 'E'			

impart the objective of safety in design and need immediate attention for their improvement.

5 CONCLUSIONS

There is an urgent need for improvement of sidewalk facilities in cities in the country. A qualitative evaluation methodology, as deployed in case of Delhi, helps to establish correlation between different physical attributes of sidewalks and satisfaction level of users. Earlier sidewalks used to be designed using quantitative level of service model. Development of a qualitative level of service model provides a wider domain for the planning and design of sidewalks in urban areas.