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Walkability to public transport: prioritization of parameters for walkability assessment in the urban areas of Kerala, India

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Abstract

Walkability research is multi-disciplinary and is spread across numerous domains starting from public health to sustainable transportation. Walkability is gaining interest as a non-motorised mode of transportation, and walking to public transport is deemed necessary for sustainable cities. This study intends to select, rank, and prioritise parameters of 'walkability to public transport' for urban areas of Kerala, a southern state in India. Upon a basic framework of walkability parameters obtained after the literature review, the Delphi Method was used to elicit and select the most significant walkability parameters from various domains, including transportation, planning, and urban design. Analytical Hierarchy Process was used to weigh the relative significance of parameters and sub-parameters. The study found that 'Immediate Walking Environment' was top priority, and 'Urban Design Qualities' was ranked least. The methodology will guide future researchers to pursue walkability studies in other cities by adopting this methodology with contextual variations if needed.

Keywords: Walkability; walkability parameters; Delphi; AHP

1. Introduction

Walkability is the foundation of a sustainable city. Like bicycling, walking is a 'green' mode of transport that reduces congestion, has a low environmental impact, and conserves energy without air and noise pollution. It can be more than a purely utilitarian mode of travel for trips to work, school, or shopping, having both social and recreational value. It is also a socially equitable mode available to the majority of the population, across classes, and different age groups (Forsyth and Southworth, 2008). Compared with developed nations, developing countries are at a slow pace concerning walkability studies. In today's world of the oil crisis, environmental pollution, and health hazards, many cities have understood the significance of non-motorised transportation and an effective public transportation system. In Indian cities, most of the population does not own private vehicles and has efficient public transportation. About 16 to 57 per cent of

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people in the cities are walkers not by choice but are captive pedestrians, and still, Indian cities are not walk-friendly (Obstacle course to livable cities, 2009). There is a considerable decline in NMT like cycling and share of public transport in major Indian cities, which implies an average transport performance index. With a high urbanisation trend, public transportation has not been able to cater to the cities, and passengers rely greatly on para-transits like rickshaws and taxis that add to the congestion on the roads (Ministry of Urban Development, 2008). Ministry of Urban Development promotes NMT and initiated to incorporate public transportation in the urban transportation planning with financial allocation. Hence a study to assess the walking environment of pedestrians from the origin to the nearest public transport point was imminent.
While mesoscale aspects like population density, street connectivity, and land-use mix diversity (Saelens, Sallis and Frank, 2003), and microscale urban design qualities (Ewing and Handy, 2009) are considered in walking, integration of certain significant micro-scale/ context-specific factors like pedestrian perceptions, aesthetics, maintenance, and upkeep of walkways are found not considered in previous studies. A method to incorporate vital walkability parameters and assign appropriate weights is proposed with the aid of the Delphi Technique and the Analytic Hierarchy Process.
This study aims to select, rank and prioritise the most significant parameters of walkability to public transport in the urban areas of Kerala, India.

2. Methodology

The methodology as shown in Figure 1, involved various stages from laying out a walkability domain framework, fetching the relevant parameters of walkability to public transport, ranking and selection of the most significant parameters using the Delphi technique, and assigning weight/priority using AHP.

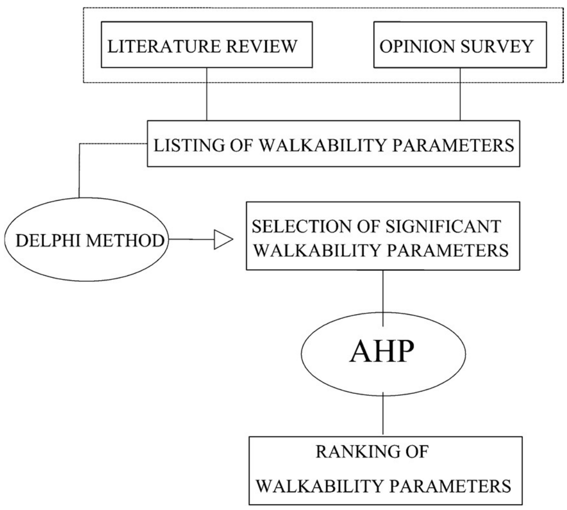

Figure 1: Study Methodology
Source: Author

An extensive opinion survey was administered among experts from the fields of Architecture, Engineering, Planning and Urban Design along with a walkability schema (Figure 2) to get an understanding of the walkability domains. This laid out a ground for eliciting an exhaustive list of walkability parameters for urban areas of Kerala. The methodology is context-specific and hence involved processes and practices to extract valid data throughout, applicable in urban areas similar to that of Kerala. Delphi cycles followed thereafter listed 90 parameters. Relative Importance Index (RII) was used to select the most high-ranked 48 parameters under 5 domains. Thereafter Analytical Hierarchy Process (AHP) was used to prioritise the walkability parameters.

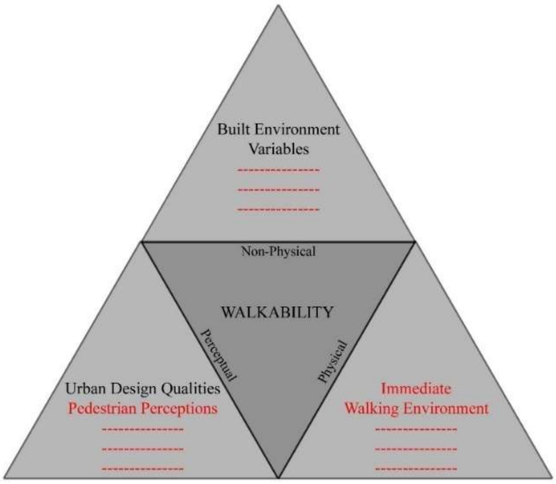

Figure 2: Walkability Schema
Source : Author

2.1 Delphi and Relative Important Index (RII) to select walkability parameters

The Delphi technique, mainly developed by Dalkey and Helmer (1963) at the Rand Corporation, is a widely used and accepted method for achieving convergence of opinion concerning real-world knowledge solicited from experts within specific areas. It is predicated on the rationale that *"two heads are better than one, or...n heads are better than one"*(Dalkey, 197.2) It is considered superior to traditional surveys as it involves stronger methodology (Pawlowski & Okoli, 2004) and the Delphi groups are considerably more accurate than individual experts, traditional groups, and statistical groups. It is well suited as a method for consensus-building by using a series of questionnaires delivered using multiple iterations to collect data from a panel of selected experts (Hsu and Ohio, 2007).

Delphi method is used in this research to elicit, collate, rate, and extract the most significant parameters of walkability, with the help of an expert panel of members - Planners, Architects and Academicians. Experts with a good understanding of transportation planning, sustainable transport, NMT concepts, pedestrian sensitivities and pedestrian behaviour were selected for Delphi. Built Environment Characteristics (BEC) like Land-use Mix Diversity, Household Density and Street Connectivity were kept embedded in the list of parameters as they have been continuously considered in the walkability index formulation studies (Leslie *et al.*, 2005, Ding *et al.*, 2011, Sugiyama *et al.*, 2014, Mayne *et al.*, 2013). Urban Design Qualities (UDQ) like- Imageability, Visual Enclosure, Human Scale, Transparency and Complexity were also integrated into the system (Ewing *et al.*, 2006). After cycle 1 of the Delphi process, three main walkability domains were identified along with BEC and UDQ-Area Characteristics, Immediate Walking Environment, and Perceptions. The consolidated list of 90 parameters obtained

fthe rom previous cycle was provided to the experts asking to rate the relative significance on a 7-point Likert scale, taking into account the degree of influencing capacity on walking to public transport. The outcome from cycle 2 was compiled and statistics like mean and median and standard deviation were assessed to understand the collective opinion of experts (Hsu and Ohio, 2007). Third cycle involved distribution of individual rating and collective rating to each of the experts to re-visit their rating. Experts were given freedom to alter accordingly or not to change their initial rating. The returned responses were again processed and analysed. The findings were that the new mean under each domains was closer to the collective mean and dispersion significantly reduced. To check the acceptability and robustness of the results obtained, Cronbach's Alpha was computed for the process. Since Cronbach's Alpha was above 0.7 (Nardo *et al.*, 2008), Delphi process was concluded as consensus was achieved among the experts. Next procedure was to select the most significant parameters using Relative Importance Index. Relative Importance Index (RII) is a method to choose parameters based on their significance in the context and is found used in walkability studies elsewhere (Papageorgiou *et al.*, 2018, Zainol *et al.*, 2016, Asfour, 2016).
For a 7-point Likert scale, the RII is given as:

$$\text{Relative Importance Index (RII)} = \frac{7n_7 + 6n_6 + 5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{7(n_7 + n_6 + n_5 + n_4 + n_3 + n_2 + n_1)}$$

where n_1 to n_7 represents the number of respondents who responded on a 7-point Likert scale (Lam et al.,2007).
Keeping the median value of the generated RII as 4.5, the top-ranked parameters were selected, as shown in Table 1. Besides the embedded parameters, Area Characteristics dealing with demography, socio-economic aspects and the like were added that would be to supplement the study and hence were not considered for the AHP prioritisation. The domains-Built Environment Characteristics, Immediate Walking Environment, Perceptions, Urban Design Qualities and the sub-parameters under them were the factors considered for the AHP, and the subsequent technique followed for prioritisation.

Table 1: Criteria sub-criteria Description

Criteria	Sub-criteria	Description
****Area Characteristics***	• *Socio-economic status* • *Vehicle Ownership* • *Availability of Public Transportation* • *Demographic Factors*	
1. Built-Environment Characteristics	*1. Land-use Mix Diversity*	• Evenness of distribution of square footage of residential, commercial, and office development
	2. Household Density	• The number of households per residential area
	3. Street Connectivity	• The number of intersections per given area
2. Immediate Walking Environment	4. Maintenance of Walkways	• Upkeep of Streets/Walkways • Condition of Walkway Surface • Continuity of Walkways • Provision for drain-off during rains
	5. Walkway Characteristics	• Availability of adequate width • Separation from Vehicular Traffic • Carrying capacity in terms of volume of pedestrians • Adequate level of illumination during night • Shade provision and micro-climate
	6. Obstacles to Walking	• Presence of potholes, stagnant water and undulations in the walkway • Presence of overhead utility lines, posts or trees • Hoarding and similar barriers on the pathway • Presence of waste and dirt dumping along the way
3. Perceptions	7. Sense of Safety	• Encroachment of walkways • Vehicles' speed and pedestrians ease of manouvering • The vehicles move at a safe speed while crossing

		• On-street parking is not affecting walking ease • Protective railings along walkways • Safe, sufficient locations to cross the street • Proper illumination during night • Open drains along walkways
	8. Sense of Security	• Street activities • Buildings overlooking walkways • Long sightlines • Way-finding signages • Stray dogs & other harmful animals • Antisocial activities and robbery
	9. Comfort	• Attractive trees/ landscaping • Proper shading for pedestrians • Pollution/odour-free air • Acceptable noise on the streets • Convenience to walk without congestion
	10. Visual Interest	• Buildings of architectural interest along the walkway • Landmarks/signage as way finders • Public art/artworks for the visual experience • Billboards/Hoardings not marring visual environment
4. Urban Design Qualities	11. Imageability	Quality of a place that makes it distinct, recognizable, and memorable.
	12. Visual Enclosure	The enclosure is the degree to which streets and other public spaces are visually defined
	13. Human Scale	Corresponds to the size, texture, and articulation of physical elements that match the size and proportions of humans
	14. Transparency	The degree to which people can see or perceive human activity or what lies beyond the edge of a street or other public space
	15. Complexity	The visual richness of a place depends on the variety of the physical environment

Source: Author

2.3 Ranking of parameters using Analytical Hierarchy Process

The Analytic Hierarchy Process (AHP), first described by Saaty (1980) is based on the comprehensive rational theory. The focus of the AHP is to arrive at the most rational decision by accepting subjective data assessment from individuals (usually experts in the field of study), ranking by perceived importance, and then calculating weights based on those constructions (Stimers & Lenagala, 2017). People are often faced with complex problems that require the analysis and understanding of multiple criteria.

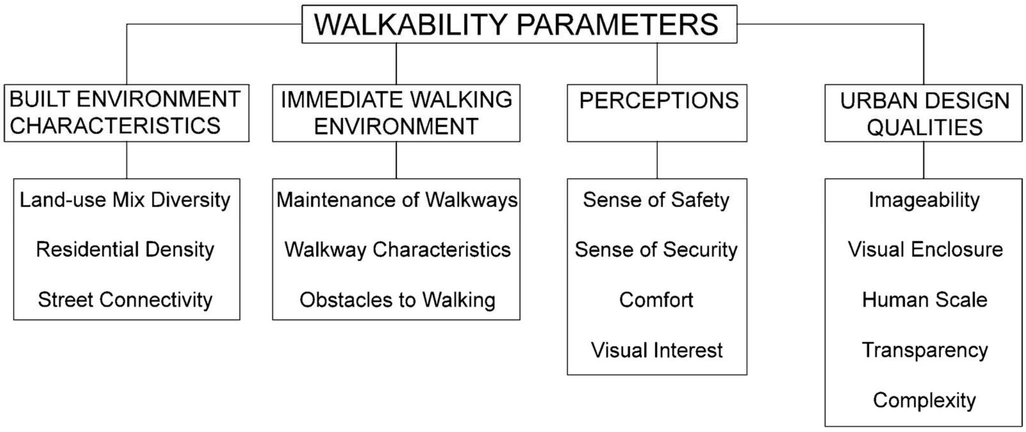

Figure 3: Outline of walkability parameters listed for Delphi and AHP
Source: Author

The AHP is a desirable method to apply in situations where qualitative information may otherwise be difficult to assess quantitatively, as the ranking, weighting, and priority setting features allow the analyst to transform more abstract concepts into quantitatively derived packages (Saaty, 2008). It helps in the interpretation of a phenomenon, it is a simple mathematical formulation in nature, and it can be applied to both individual and group level decisions (De Luca, 2014). AHP has been successfully used in previous studies to assess pedestrian needs hierarchy (Mateo-Babiano, 2016), for assigning weights and determining scores for walkability indices for an Indian City (Juremalani & Chauhan, 2017) and to attain priorities for criteria that determine pedestrians' choice of walking in an Indian city (Bivina and Parida, 2019).
The following processes were involved in AHP:

1. Presenting the goal-criteria representation graphically in which main parameters and sub-parameters are listed.

2. Preparation of a pairwise comparison matrix in which the experts are required to feed in their preferences over parameters and sub-parameters.

3. Computation of Eigenvalues from each pairwise matrix to arrive at the weights to check the consistency of the resultant matrix.

2.3.2 AHP Methodology

The selection of parameters of walkability is a complex problem, and the analytic method chosen for it needs to be apt for the same. Analytical Hierarchy Process, a multi-criteria decision-making method (MCDM), is used here as intuitive decisions cannot be assumed in this study. Opinions and ranking priorities from Architects, Academicians, and Planners (n=86) are adopted to arrive at weights corresponding to various walkability parameters. Urban Planners from Town and Regional Planning authorities, Architects from organisations inclining research/academics, and Academicians from reputed institutes constituted the expert group. Those priority matrices which did not satisfy the consistency check were eliminated from the process. Hence, the number of responses varied under each criterion. The method has incorporated four major parameters under which sub-parameters occur, which are quantitative as well as qualitative in nature. The method is found useful in assigning weights to all parameters and sub-parameters in a systematic manner. This weighting procedure is important in determining the walkability index in the empirical study. Fig.3 shows the Goal-Criteria Diagram illustrating all parameters and sub-parameters. It helps the experts in an easier comprehension of the problem. A brief description of each sub-criterion, as shown in Table1, accompanied the Goal-Criteria Diagram. This description elaborates on the aspects being considered under sub-criteria.

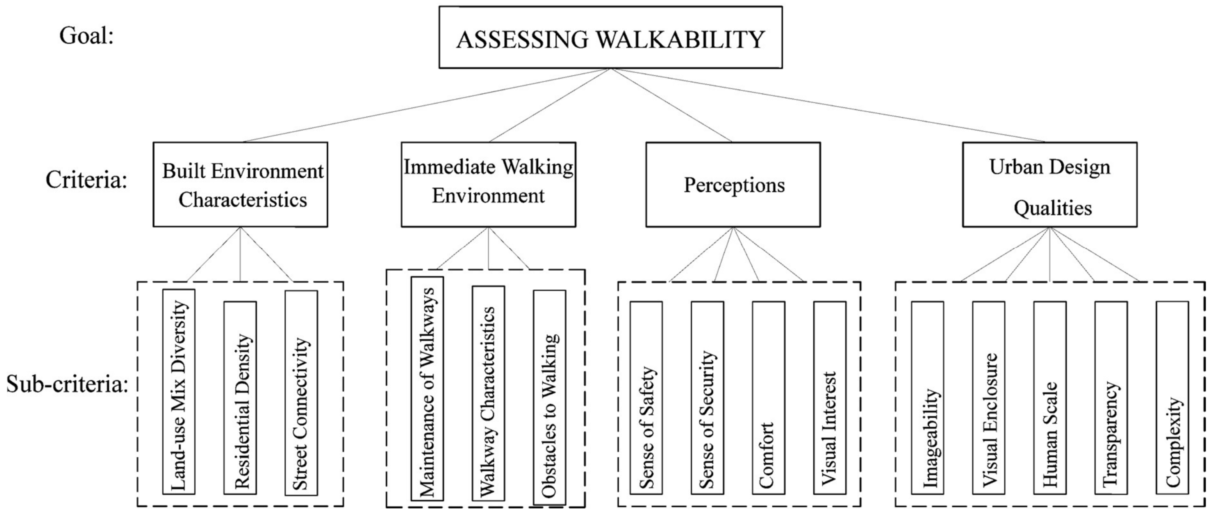

Figure 4: Goal-Criteria Diagram
Source: Author

For a given objective, the comparisons are made between pairs of individual indicators, asking which of the two is the more important and by how much. The preference is expressed on a semantic scale of 1 to 9. A preference of 1 indicates equality between two individual indicators, while a preference of 9 indicates that the individual indicator is 9 times more important than the other one (Saaty, 2008; Nardo et al., 2008) (Table 2).
The results are represented in a comparison matrix. If $\boldsymbol{a_{ij}}$ is the element of row $\boldsymbol{i}$ column $\boldsymbol{j}$ of the matrix, then the lower diagonal is filled using this formula

$$aij = \frac{1}{aji}$$

Next, we sum each column of the reciprocal matrix. Then we divide each element of the matrix with the sum of its column; we have normalised relative weight. The sum of each column is 1. The normalised principal Eigenvector can be obtained by averaging across the rows. The normalised principal Eigenvector is also called **a priority vector.** Since it is normalised, the sum of all elements in the priority vector is 1. The priority vector shows relative weights among the things that we compare. The weighted sum matrix is found by multiplying the pairwise comparison matrix and the priority vector. Then all the elements of the weighted sum matrix are divided by their respective priority vector element. λ_{max} is obtained by computing the average of this value. Consistency Index, CI, is found as:

CI $= \frac{(\lambda max - n)}{(n-1)}$, where n is the matrix size

Consistency ratio, CR is calculated as CR= $\frac{CI}{RI}$

The RI value is based on the number of items being compared and random indices employed by Saaty (1977). Consistency can be checked by taking the consistency ratio (CR) of CI with the appropriate value from (Table 3). The CR is acceptable if it does not exceed 0.10. If it is more, the judgment matrix is inconsistent.

Table 2: Saaty's 1-9 scales of pairwise comparisons

AHP Scale of Importance for Comparison pair(a_{ij})	Numeric Rating	Reciprocal (Decimal)
Extreme importance	9	1/9(0.111)
Very strong to extremely	8	1/8(0.125)
Very strong importance	7	1/7(0.143)
Strongly to very strongly	6	1/6(0.167)
Strong importance	5	1/5(0.200)
Moderately to strong	4	1/4(0.250
Moderate importance	3	1/3(0.333)
Equally to moderately	2	1/2(0.500)
Equal importance	1	1(1.000)

Source : Saaty (2008)

Table 3: Random Consistency Index (RI)

Matrix size	1	2	3	4	5	6	7
RI	0	0	0.58	0.9	1.12	1.24	1.32

Source: Saaty (2008)

2.2.2 Responses Aggregation

The responses were obtained from Architects, Academicians, and planners (n=86), and the geometric mean method (GMM) was used to aggregate individual judgments. GMM is considered superior to the arithmetic mean method (Aczbl & Saaty, 1983, Saaty, 2008). The advantage of the weighted geometric mean is demonstrated in another study too (Stoklasa & Krejci, 2018). Many other recent studies have also considered the use of GMM for the aggregation of individual judgments (De Luca, 2014; Shanujas, 2020). De Luca (2014) explains that GMM is found to preserve the reciprocally symmetric structure of the judgment matrices and satisfies the Pareto principle and homogeneity condition.

2.2.3 Calculation of Weights using AHP

This section explains how the parameters and sub-parameters of walkability are systematically weighted to arrive at the walkability index model. Microsoft Excel was used to perform the AHP calculations.

a) Ranking Major Parameter- Walkability Parameters

The four major walkability parameters of Built-Environment Characteristics (BEC), Immediate Walking Environment (IWE), Perceptions (PER), and Urban Design Qualities (UDQ) were considered first for the ranking process.

Pairwise comparisons matrix

$$\begin{array}{r} \\ \text{BEC} \\ \text{IWE} \\ \text{PER} \\ \text{UDQ} \\ \textbf{Column Sum} \end{array} \begin{array}{c} \begin{matrix} \text{BEC} & \text{IWE} & \text{PER} & \text{UDQ} \end{matrix} \\ \begin{bmatrix} 1 & 41/50 & 17/12 & 73/47 \\ 50/41 & 1 & 17/8 & 2 \\ 12/17 & 8/17 & 1 & 88/79 \\ 47/73 & 1/2 & 79/88 & 1 \\ \mathbf{25/7} & \mathbf{92/33} & \mathbf{87/16} & \mathbf{17/3} \end{bmatrix} \end{array}$$

The normalized matrix corresponding to the pairwise comparison matrix is given as:

$$\begin{array}{r} \\ \text{BEC} \\ \text{IWE} \\ \text{PER} \\ \text{UDQ} \end{array} \begin{array}{c} \begin{matrix} \text{BEC} & \text{IWE} & \text{PER} & \text{UDQ} \end{matrix} \\ \begin{bmatrix} 7/25 & 5/17 & 25/96 & 3/11 \\ 14/41 & 33/92 & 25/64 & 28/79 \\ 19/96 & 13/77 & 16/87 & 10/51 \\ 11/61 & 5/28 & 1/6 & 3/17 \end{bmatrix} \end{array}$$

Normalized average weights are calculated as follows:

W_1/n= (7/25+5/17+25/96+3/11)/4=0.28

W_2/n= (14/41+33/92+25/64+28/79)/4=0.36

W_3/n= (19/96+13/77+16/87+10/51)/4=0.19

W_4/n= (11/61+5/28+1/6+3/17)/4=0.17

Relative Priority Matrix is:

$$\begin{bmatrix} 0.28 \\ 0.36 \\ 0.19 \\ 0.17 \end{bmatrix}$$

The sum is found as:

$$0.28\begin{bmatrix} 1 \\ 50/41 \\ 12/17 \\ 47/73 \end{bmatrix} + 0.36\begin{bmatrix} 41/50 \\ 1 \\ 8/17 \\ 1/2 \end{bmatrix} + 0.19\begin{bmatrix} 17/12 \\ 17/8 \\ 1 \\ 79/88 \end{bmatrix} + 0.17\begin{bmatrix} 73/47 \\ 2 \\ 88/79 \\ 1 \end{bmatrix} = \begin{bmatrix} 1.10 \\ 1.45 \\ 0.75 \\ 0.70 \end{bmatrix}$$

A weighted sum is found as:

$$\frac{1.10}{0.28} = 3.9285$$

$$\frac{1.45}{0.36} = 4.0277$$

$$\frac{0.75}{0.19} = 3.9473$$

$$\frac{0.70}{0.17} = 4.1176$$

$$\lambda_{max} = (3.9285+4.0277+3.9473+4.1176)/4=4.0052$$

CI= $\frac{\lambda max-}{n-1} = \frac{4.0052-}{4-1}$ = 0.0018

Inconsistency ratio, $\frac{CI}{RI} = \frac{0.0018}{0.9}$ = 0.002

The pairwise comparison matrix is considered consistent, as the inconsistency ratio is less than the threshold value of 0.1 (Saaty, 1980).

b) Ranking Sub Parameter- Built Environment Characteristics

Here, three sub-parameters were considered, namely, Household Density (HHD), Land-use Mix Diversity (LUM), and Street Connectivity (SC).

Table 4: Priority calculation for sub-parameter: Built Environment Characteristics

Factors	Relative Priority	Sum	Weighted Sum	
LUM	0.38	1.13	3.0028	λ_{max}=3.0025 CI=0.0012 CR=0.00212
HHD	0.26	0.78	3.0019	
SC	0.36	1.08	3.0027	

Source: Primary data

Here, as the consistency ratio is less than 0.1, the matrix is considered to be consistent. The sub-parameter Land-use Mix Diversity is ranked first with a weight of 0.38.

c) Ranking Sub Parameter- Immediate Walking Environment

Three sub-parameters, namely Maintenance of Walkways (MW), Walkway Characteristics (WC), and Obstacles to Walking (OW) are considered here for ranking.

Table 5: Priority Calculation for sub-parameter-Immediate Walking Environment

Factors	Relative Priority	Sum	Weighted Sum	
MW	0.47	1.42	3.0212	λ_{max}=3.0067 CI=0.0033 CR=0.0058
WC	0.24	0.72	3.0167	
OW	0.29	0.86	2.9759	

Source: Primary Data

The matrix is consistent as the consistency ratio is less than 0.1. Out of the three factors, Maintenance of Walkways is of top priority.

d) Ranking Sub Parameter- Perceptions

The sub-parameters Sense of Safety (SS), Sense of Security (SC), Comfort (CO), and Visual Interest (VI) are considered here for ranking.

Table 6: Priority calculation for sub-parameter: Perceptions

Factors	Relative Priority	Sum	Weighted Sum	
SS	0.42	1.68	4.06	λ_{max}=4.043 CI=0.0143 CR=0.0159
SC	0.36	1.46	4.07	
CO	0.13	0.51	4.02	
VI	0.09	0.37	4.01	

Source: Primary Data

As the consistency ratio is 0.0159, which is less than 0.1, the matrix is consistent. Sense of Safety is of the highest priority here.

e) Ranking Sub Parameter- Urban Design Qualities

Imageability (IM), Visual Enclosure (VE), Human Scale (HS), Transparency (TR), and Complexity (CX) are the factors considered under Urban Design Qualities.
Table 7: Priority calculation for sub-parameter: Urban Design Qualities

Factors	Relative Priority	Sum	Weighted Sum	
IM	0.23	1.17	5.0057	λ_{max}=5.0056 CI=0.0014 CR=0.0013
VE	0.21	1.02	5.0053	
HS	0.21	0.96	5.0062	
TR	0.24	1.17	5.0065	
CX	0.11	0.70	5.0046	

Source: Primary Data

The matrix is considered consistent, as CR is less than 0.1. All factors except Complexity are more or less of equal priority.
After the AHP procedure, the ranks (priorities) for each of the parameters and sub-parameters were obtained. It is graphically shown in Figure.4.

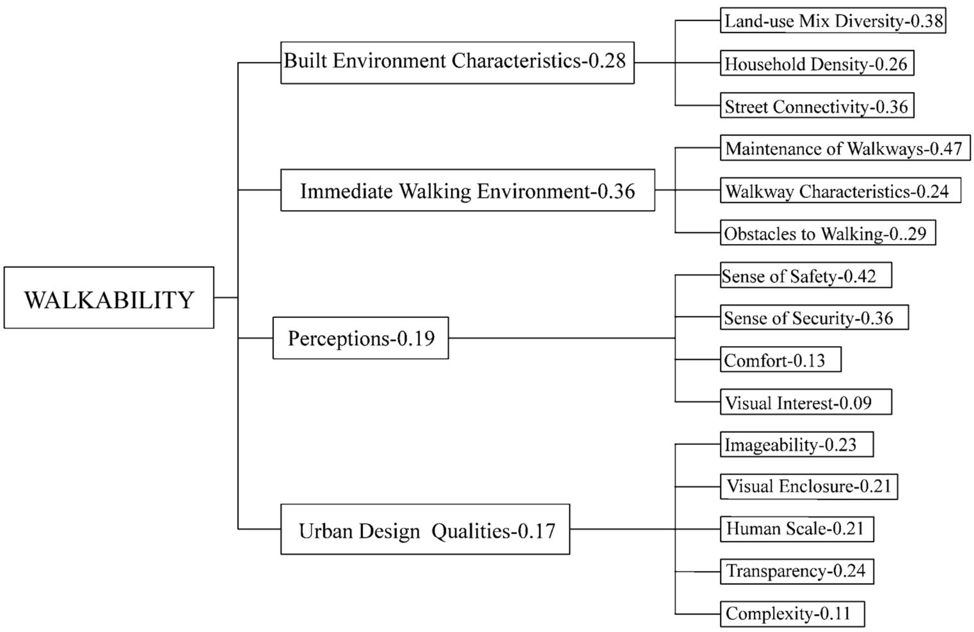

Figure 4: Hierarchical listing of weighted walkability parameters and sub-parameters
Source: Primary Data

3. Results and Discussion

The major outcome after the Analytical Hierarchy Process is the revealing of the comparative significance of a few walkability parameters/sub-parameters over others. As can be seen from fig.4, out of the main parameters, the micro-scale factor Immediate Walking Environment has been prioritised by the experts. This shows why the pedestrian environment is much important in a walkability study. The walkway characteristics, its maintenance, and the obstacles were considered under this criterion, out of which, maintenance of walkways is ranked higher, with a score of 0.47. This higher score also points out the importance of purpose walking, which differs from recreational walking. Built environment characteristics, which is a mesoscale factor, with a weight of 0.28, is the second-ranked main parameter. Hence, diversity, density, and connectivity, as proposed as significant by many researchers, are deemed important in this study too. Main walkability parameters of Perceptions and Urban Design Qualities, both qualitative, were expected to rank higher at the outset, though; their score was lesser and more or less equal (Perception: 0.19 and Urban Design Qualities: 0.17). This ranking thus indicates the role of quantitative parameters like Built Environment Characteristics and the Immediate Walking Environment as key variables in the research. A fact to be mentioned here is that Built Environment Characteristics like Land-use Mix Diversity, Household Density, and Street Connectivity are those parameters that cannot be improved further, and hence other parameters are the only factors that can be changed and managed (Neto, 2015).

Maslow (1954) has established a theory of human motivation. It is a hierarchy pyramid with basic needs occupying the base and higher-order needs at the top-most level. According to the theory, an individual should satisfy the basic needs before considering his/her higher-order needs. Alfonzo (2005), based on this theory, describes the hierarchy of prepotency that influences the walking-decision process. According to this model, some variables such as safety occupy much relevance over variables such as that of comfort and pleasurability. The AHP outcome of this particular study emphasises the theory explained above. Experts have ranked pedestrian micro-scale environment and their built environment much higher than perceptual qualities and urban design qualities, pointing out the significance of factors like safety and security in walkability research. It is to be noted that, under the sub-parameter Perception, visual interest and comfort are both ranked very low, strengthening the findings of Alfonzo. As can be seen from the line chart, the Sense of Safety is ranked 0.42, and the Sense of Security is ranked second 0.36. Comfort has a rank of 0.13, while Visual Interest has only 0.09.

Discussing Urban Design Qualities, which are qualitative, all except sub-parameter complexity are prioritised equally. As stated in the hierarchy of walking needs, for a pedestrian, the basic needs of safety, security, built environment factors, and pedestrian environment factors are to be satisfied before considering purely aesthetic and qualitative features like urban design qualities. The lowest ranking does not undermine the role of aesthetics in the walking environment. Overall enhancement of walking environment by beautification, installation of street furniture, and landscaping strategies is important in elevating the urban design quality of streets.

4. Summary and Conclusions

This study successfully helped to select and rank the significant walkability parameters for urban areas of Kerala, India. The weighting process signified the magnitude of the Immediate Walking Environment and Built Environment Characteristics over the qualitative parameters of Perceptions and Urban Design Qualities. The process was successful enough to shed light on the effect of micro-level and mesoscale pedestrian walking environments upon walking. According to the experts, the neighbourhood walkability was largely influenced by these factors than aesthetical factors and perceptions. If it was for recreational walking, factors of aesthetics and perceptions would have profound significance. This ranking shows the importance of functionality in utilitarian walking, as that of a walk to public transport. Future research can refine the study parameters and proceed in new directions. The study would act as a proven methodology for upcoming research, though with minor modifications to suit the urban area under consideration. The methodology developed is context-specific, but open to accommodate further parameters and/or research methods for better results.

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