

# Understanding Contribution of Physical Accessibility in Perceptual Conviviality of Public Open Spaces using Analytical Hierarchy Process



Leena Thombre, Charumitra Kapshe

**Abstract:** *The objective of this study is to examine contribution of accessibility in creating conviviality at a public open space. In literature, conviviality is discussed as the subjective quality of public spaces, but its quantification is not adequately discussed. Conviviality means, being happy in the company of others. From different studies, it was found that there are physical aspects of built environment which can influence conviviality. Legibility, network integration and walkability in built environment can increase accessibility which can contribute in conviviality of a public open spaces. The methodology of this work is based on comparison between perceptual conviviality with physical parameters of accessibility in public open spaces. With the help of experts, weights are derived through Analytical Hierarchy Process (AHP) for perceptual conviviality parameters and physical accessibility attributes. Based on this work, it was empirically validated that accessibility plays important role in conviviality at a public open space.*

**Keywords:** *Built environment, accessibility, network integration, legibility, walkability.*

## I. INTRODUCTION

Public open spaces act as stage for daily life activities in cities and towns. It is often seen that a street corner or a busy square tends to attract more casual outdoor activities. They are not planned as public spaces but become more convivial than any designated public place. The mixed-use marketplaces in India offer such plan and unplanned open spaces for catching up with friends or spending casual time outside home. Their success in bringing people together in a convivial mode depends on many reasons but one of them could be the physical accessibility. This study is intended towards examining the role of physical accessibility in building conviviality at public open spaces. The discussion on conviviality in public places is continuously under consideration for research in environment psychology and urban design studies [2],[18]. So far conviviality is been presented as subjective concept and attempts to objectively quantify it appears inadequate. This study is an attempt to validate the contribution of built environment in building conviviality through empirical results taking physical accessibility as one of the built environment attributes.

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The structure of the paper first discusses the context of conviviality in public open spaces study.

Then theoretical discussions related to public open space, perceptual conviviality and physical accessibility is presented. The discussion contributed in framing of parameters of perceptual conviviality and physical accessibility for public

open spaces. Finally, Analytical Hierarchy Process for determining weights of perceptual conviviality parameters and attributes of physical accessibility is carried out with the help of experts.

## II. THEORETICAL BACKGROUND

“Convivere” in latin means living together, it has been associated with sociable, friendly and festive traits [20]. The term ‘conviviality’ evokes a connection between a mood and atmosphere that requires the presence of others. People want conviviality because it gives them and others a taste of happiness which they could not get on their own [1]. Convivial behavior at a public open space could be just catching up with friends, passing by, staying for a while, having some food or drinks or could be just people watching [21]. Whyte (1980) says, “people attract more people”, even single person also like to stay or take a break where they find comfort in looking or just being in company of strangers. Conviviality can be used as planning goal and it could be possible for planners to develop a conviviality rating scale for different land uses based on empirical data [2].

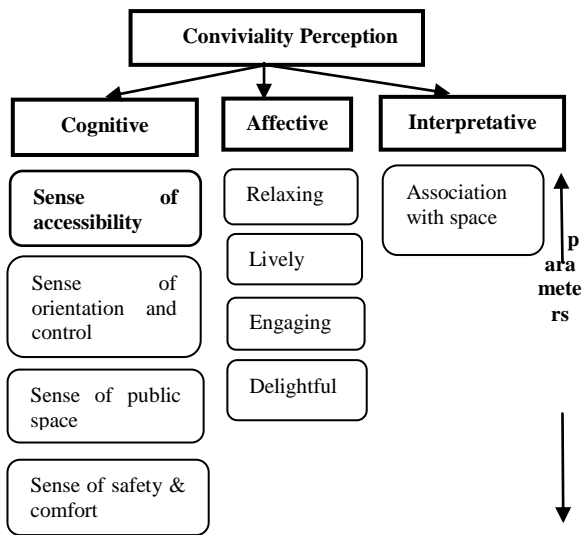
### A. Perceptual Conviviality

The perception of a space is built in different stages.

Cognitive, affective and interpretative stages of perception lead to the evaluation whether a place is good or not [8]. Cognition is a continuous process of gathering and filtering information to make the best sense out of it. At the cognitive stage, one is more aware of orientations, directions, identifying the composition of built and open spaces [12]. Affective responses indicate people’s state of feeling. A convivial setting is expected to provide pleasure as well as motivated feelings. At interpretative stage, we assign value to the derived meanings from cognition and affection process to form judgement, for example a building is recognizable as a church, temple or mosque. At different stages of perception, the evaluation is affected by built environment characteristics [18],[19],[3]. To evaluate perceptual conviviality a framework (see Fig 1) is developed which explains dimensions of conviviality in cognitive, affective and interpretative stages of perception.



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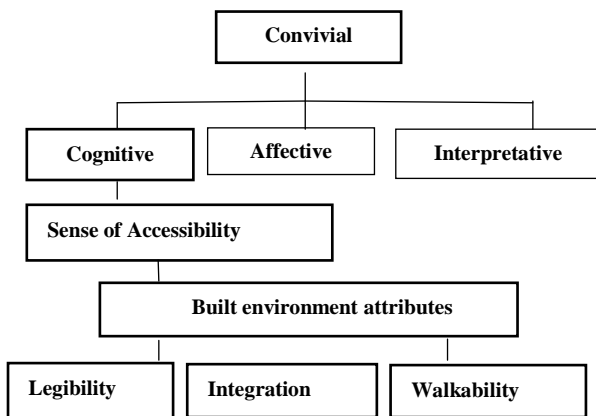
**Fig 1. Parameters of perceptual conviviality**

## B. Physical Accessibility

One of the important aspects of built environment is accessibility which affects perception of a place. Accessibility factor of built environment such as legibility affects at cognition stage to make sense of orientation.

A convivial experience in public space is possible when people move on foot, while walking people pay attention to activities around them and experience different feelings. A well-integrated space is often interpreted as convivial spaces. Accessibility is one of the important phenomena in perception of conviviality which contributes at every stage of perception.

Three important qualities of built environment which contribute in conviviality through accessibility of a space are identified as-legibility, integration, walkability [6],[10],[18],[19],[21] (see Fig 2).



**Fig 2.Attributes of accessibility for evaluation of conviviality**

Role of accessibility parameters in conviviality are vital and significant. But their contribution is difficult to evaluate. Following discussion simplifies and explains role of accessibility parameters through quantifiable indicators.

**Legibility.** Lynch (1960) defines it as ‘the ease of organizing an environment within an image able and coherent pattern.

There are many concepts in the literature that define legible environments: simple, coherent, understandable, perceivable, etc. It is difficult to measure legibility by these concepts. Two main variables to devise a definition based on characteristics deriving from space are 1) the complexity

of spatial layout and 2) the saliency of landmarks [11]. The complexity of spatial layout describes the two-dimensional information about a space, while the saliency of landmarks refers to the three-dimensional information about a space. Landmarks could be identified in three categories: 1) visual salience- color, form and façade 2) semantic salience-historical or cultural importance 3) structural –location [15]. Proper signages also help to locate a place. A well-maintained spaces i.e clean and well-lit makes it more legible.

**Integration.** Shaftoe (2012) says, however well-designed and managed a public space is but if it is in an isolated, under populated or difficult-to-access location it will not thrive [18].

Town centers or popular nodes usually becomes convivial as they provide opportunities to meet more people, it happens because it is well integrated in network of adjoining streets. To quantify how much a public open space is integrated “space syntax” is a prevalent tool. Space Syntax applies the concept of configuration in urban spaces to discover social patterns and structures. Space Syntax can use integration to predict the pedestrian movement at the local and larger scales.

An increase in the degree of integration in a space would result in an increase in how much public is a space [7]. In verbal explanation a space which is compulsory pass by, well connected to other place and have several modes to approach is considered as well integrated.

**Walkability.** A public open space will be happily approached if the experience of travel on foot is also interesting and easy. Walkability has been described as a vital way to promote social and spatial interactions, therefore making public space, and the urban setting, a more convivial place to live.

A good target for a walk able catchment is to have 60% of the area within a five-minute walking distance, or within ten minutes in the case of major transit stops [6]. When planning in 2D (two- dimension), sometimes designers fail to incorporate the impact of changing elevation on route selection [5]. Steep slope or gradient often influence choice of walking.

A gradient up to 1:10 are considered comfortable for walking [14]. Modal conflict is another issue which pedestrians face while walking in Public open spaces. Street vendors that include stalls of tea shops, fast food hawkers, encroaches the road pavements creates problem for the pedestrians [4].

Along walking path if street furniture is provided it supports walking and active facades helps to create interesting visuals while walking [6].

The presence of retail activities along streets have been shown to be a significant inducer of walking as mode of transportation as they act as active facades [13].

Based on the literature survey done for understanding of sense of accessibility indicators were identified under aspect of accessibility attributes (see Fig 3).

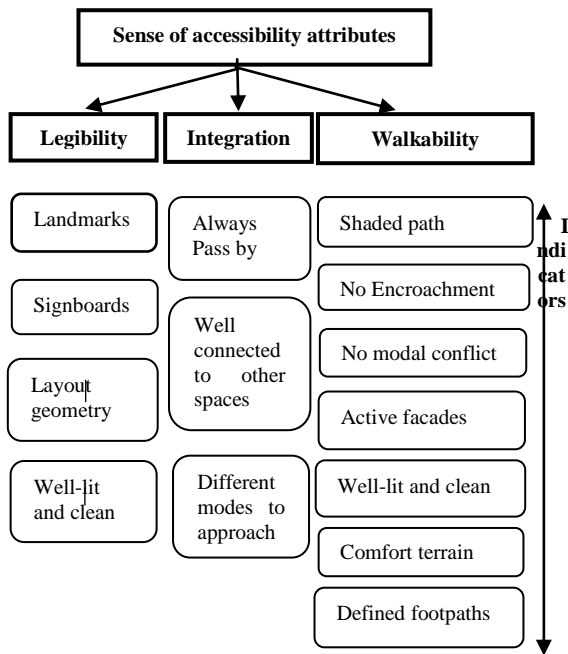


Fig 3. Accessibility attributes and indicators

III. METHODOLOGY

The quantitative evaluation of a complex qualitative subject like conviviality is challenging. To reduce overlapping of multi-dimensional aspects of conviviality, the evaluation through hierarchical organization of each aspect suggested in Analytical hierarchical process (AHP) appeared most logical to this study. The Analytical Hierarchical Process (AHP) is a decision-making procedure widely used in urban and regional planning for establishing priorities in multi criteria decision problem. The AHP process helps to reduce the subjectivity of various decision-making factors by prioritizing the need of alternative attributes against each other. The AHP helps in breaking down a decision into smaller parts, proceeding from the goal to criteria to sub-criteria. Then simple pair wise comparison judgments throughout the hierarchy are made to arrive at overall priorities for the alternatives. Both quantitative as well as qualitative aspects of a decision can be considered through AHP [22].

To examine conviviality at perceptual level and contribution

of attributes of physical accessibility, a questionnaire survey based on AHP was carried out. A team of 20 experts in the field of urban planning and design which includes professionals, academicians and research scholars were provided with questionnaires along with theoretical background and context of the study. The weights of perceptual conviviality attributes based on cognitive, affective and interpretative stage of perception were determined through pair wise comparison of each attribute with another including sense of accessibility. Then, by constructing paired comparison matrices for AHP among criteria and sub-criteria, weights of accessibility parameters were calculated.

IV. ANALYTICAL HIERARCHY PROCESS

Analytical hierarchy process as a multicriteria decision analysis method, solves decision-making problems [16]. The AHP tool is popular in modeling for unstructured problems

of various field which require qualitative and quantitative data analysis such as political, economic, social sciences etc [9]. This method of analysis is based on paired wise comparison of alternatives criteria and sub criterial of a defined goal. It organizes the problem in hierarchical structure to draw priorities of each alternative against other which results in their criteria weights for defined goal.

For example, a simple decision problem with 3 criteria and 4 alternatives will require one 3x3 comparison matrix to be built for the criteria weighting and three 4x4 comparison matrices for evaluating the alternative criteria. The comparison between two alternatives in the matrix is done by following Saaty scale of pairwise comparison (see Table 1). The unit eigenvector (orthonormal) is extracted from the comparison matrix and used as weight coefficients in the criteria and sub-criteria. These weights are used for calculating the value of the public open spaces mapping at the step where integration of AHP. The accuracy of the weight results at each level of the hierarchy depends on the consistency of judgments in the pairwise comparisons. The parameter used for controlling consistency is called the consistency ratio (CR). CR measures logical inconsistency of judgments and enables identification of possible errors of judgment in matrix. CR must be 0.10 (10%) or less. If CR is greater than 0.10, the pairwise comparison matrix should be reformulated [17].

$$\frac{CI}{RI} = CR$$

$$\frac{\lambda_{max} - n}{n - 1} = CI$$

λ = Eigen vector value

RI=Random Index generated for matrix of 10x10 (see appendix 1)

n= no. of alternatives

Table 1. Pairwise comparison scale in AHP proposed by Saaty (1980)

Intensity of importance	Definition	Explanation
1	Equal importance	Two factors contribute equally to the objective.
3	Somewhat more important	Experience and judgment slightly favor one over the other.
5	Much more important	Experience and judgment strongly favor one over the other.
7	Very much more important	Experience and judgment very strongly favor one over the other. Its importance is demonstrated in practice.
9	Absolutely more important	The evidence favoring one over the other is of the highest possible validity.

V. ANALYSIS

The initial stage in AHP is to develop hierarchical tree of main criteria and sub-criteria. Then each criterion is weighted against each other. In this study two distinct goals are required to be evaluated.



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Firstly, weights for perceptual conviviality parameters are evaluated, out of which one of the parameters is sense of accessibility (see Fig 1). Second, sense of accessibility - is divided in attributes -legibility, Integration and walkability which are further divided in indicators (see Fig 3). The pair wise comparison develop matrix between indicators. The indicator in the column is rated against the indicator in row. If both the indicators are equally important than value given is 1 and if the indicator in column side is more important than indicator in row, the value given is greater than 3,5,7 or 9 times. If the indicator in column is lesser than indicator in row, the value given is lesser than 1/3,1/5,1/7 and 1/9 times. The comparative rating between two attributes or indicators of criteria and sub criteria provide following matrixes (see Table 2,3,4,5 and 6).

**Table 2. Sense of accessibility-pair wise comparison**

Sense of accessibility	Legibility	Integration	Walkability
Legibility	1	1/7	1/5
Integration	7	1	3
Walkability	5	1/3	1

CR-5.3%

Note – values in the are provided by one of the experts. Actual value is average of responses provided by 10 experts.

**Table 3. Legibility attribute -pair wise comparison**

Legibility	Land marks	Signboards	Layout geometry	Well-lit and clean
Landmarks	1	5	7	3
Signboards	1/5	1	3	1/3
Layout geometry	1/7	1/3	1	1/5
Well-lit and clean	1/3	3	5	1

CR-4.3%

Note – values in the are provided by one of the experts. Actual value is average of responses provided by 10 experts.

**Table 2. Sense of accessibility-pair wise comparison**

Sense of accessibility	Legibility	Integration	Walkability
Legibility	1	1/7	1/5
Integration	7	1	3
Walkability	5	1/3	1

CR-0%

Note – values in the are provided by one of the experts. Actual value is average of responses provided by 10 experts.

**Table 5. Walk ability attribute-pair wise comparison**

Walkability	Shaded path	No encroachment	No modal conflict	Active facades	Street furniture	Comfort terrain	Defined footpath	Well-lit and clean
Shaded path	1	5	1/3	3	3	1	3	1
No encroachment	1/5	1	1/9	1/3	1/5	1/5	1/3	1/7
No modal conflict	3	9	1	5	7	5	5	5
Active facades	1/3	3	1/5	1	3	1/3	3	1/3
Street furniture	1/3	5	1/7	1/3	1	1/5	1/3	1/3
Comfort terrain	1	5	1/5	3	5	1	3	5
Defined footpath	1/3	3	1/5	1/3	3	1/3	5	1/3
Well-lit and clean	1	7	1/5	3	3	1/5	3	1

CR-9.2%

Note – values in the are provided by one of the experts. Actual value is average of responses provided by 10 experts

**Table 6. Perceptual conviviality -pair wise comparison**

Perceptual conviviality	Sense of safety and comfort	Sense of orientation and control	Sense of public space	Sense of Accessibility	Relaxing	Lively	Engaging	Delightful	Association with space
Sense of safety and comfort	1	5	5	5	5	3	3	7	3
Sense of orientation and control	1/5	1	1	1	5	1	1	5	3
Sense of public Space	1/5	1	1	1	5	1	1	5	3
Sense of Accessibility	1/5	1	1	1	5	1	1	5	1
Relaxing	1/5	1/5	1/5	1/5	1	1/5	1/3	3	1/3
Lively	1/3	1	1	1	5	1	1	5	5
Engaging	1/3	1	1	1	3	1	1	5	1
Delightful	1/7	1/5	1/5	1/5	1/3	1/5	1/5	1	1/5
Association with space	1/3	1/3	1/3	1	3	1/5	1	5	1

CR-5.6%

Note – values in the are provided by one of the experts. Actual value is average of responses provided by 10 experts

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Each matrix provides the weights for all indicators. In this study 20 experts composed of urban planners, designers and civil engineers were asked to provide their individual weights for each attribute by Analytical hierarchy process. Out of which some responses were not following consistency ratio <10%.

The responders were contacted back and asked to reconsider their priorities for logical scaling. Overall 10 responses were held satisfactory after reconsideration, therefore average outcome of 10 responders were considered.

## VI. RESULTS AND DISCUSSION

The responses obtained from 10 experts asked for perceptual

conviviality and physical accessibility according to Table 2,3,4,5 and 6 were evaluated. The final weights obtained after average value of all responses are presented in Table 7,8,9,10 and 11.

**Table 7. Accessibility attribute weights**

S.no	Accessibility parameters (a)	Weights by experts (wa)
1.	Legibility	0.071
2.	Integration	0.650
3.	Walkability	0.277

Note: Weights are normalized on value of 1

**Table 9. Integration indicators weights**

S.no	Legibility indicators(l)	Weights by experts (wl)
1.	Landmarks	0.564
2.	Signboards	0.117
3.	Geometry layout	0.055
4.	Clean and well lit	0.262

Note: Weights are normalized on value of 1

**Table 11. Perceptual conviviality weights**

S.no	Walkability indicators (w)	Weights by experts (w')
1.	Shaded path	0.131
2.	No encroachment	0.021
3.	No modal conflict	0.378
4.	Active facades	0.072
5.	Street furniture	0.041
6.	Comfort terrain	0.184
7.	Defined footpath	0.055
8.	Well-lit and clean	0.115

Note: Weights are normalized on value of 1

The multi criteria decision making method -AHP chosen for this study has helped to quantify the importance of each aspect in a subjective qualitative matter like conviviality. From theoretical background, it has explained that how built environment contributes in bringing sense of conviviality at a space. The AHP method performed for perceptual conviviality implies that sense of safety and comfort is predominant requirement for experience of conviviality with .325 weight followed by liveliness factor at .113 weight and

sense of orientation and control at .111 weight. Accessibility of public open space is taken as one of the physical built environment aspects which can enhance conviviality at public open space. The sense of accessibility factor scores .98 weight ranked as fourth most important parameter to judge a public open space as convivial or not. From AHP method experts recommended integration as the strongest parameter of accessibility with .651 weight followed by walkability with .27 weight and legibility with .07 weight. Landmarks is strongest attribute for legibility with .56 weight and modal conflict is strongest barrier in walkability with .37 weight.

## VII. CONCLUSION

The use of Analytical Hierarchy process adopted in this study helps to understand a subjective concept like conviviality in objective manner. The derivation of weights for perceptual conviviality and physical accessibility aspects with expert's view through AHP provides strong foundation for several decision-making exercise in planning public open space. Physical accessibility is important aspect to improve quality of public open spaces. This study provides detailed process to examine influence of accessibility criteria and sub criteria which helps to make a public open space convivial and friendly. The method used in this study can be utilized by planners and designers to quantify accessibility parameters of public open spaces.

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