

Parameters for Assessing the Street Qualities: A Review

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Abstract : Streets form the backbone or skeleton of any city and determine its spatial characteristics generating outdoor activities. They allow people to be outside in open spaces and are places for social interactions. Streets are physical, tangible spaces comprising of intangible qualities where strangers and friends meet, communicate with each other, recreate, do business, work, wander, relax, sit or just enjoy sights and sound of each other. The streets indicate the culture of a place and thereby provide an identity to the city. The definitions of a street also indicate a street as a 'space' and a 'place' thus highlighting both on the physical attributes and the activities on the street, defining its attributes of movement and place. This paper attempts to identify the tangible parameters for assessing the qualities of street as a 'space'.

IndexTerms-Street, street qualities, attributes, tangible.

I. STREETS

“We go back to some streets more often than to others... maybe a street unlocks memories or offers expectation of something pleasant to be seen...streets are places of social and commercial encounter and exchange... a place to be comforted by the presence of others. (Jacobs A. B., 1995, pp. 2-4)”

The elements of urban public open spaces as classified by Krier (1979) comprise of street and square. Within the boundaries of cities, most of the public realm belongs to streets. They also acquire a significant amount of land that is approximately 25% to 30%. The two main functions of a street are movement and place. As suggested by Lynch (1960), path is a prime element of a city, the others being edges, nodes, districts and landmarks. Streets allow people to be outside in open spaces. They are not only places for social and commercial meeting and exchange, and interaction with others, but are also a political space. Reinforcing the importance of streets, Jacobs (1961) said, “Think of a city and what comes to mind? Its streets” (p. 29).

When one steps out from the private domain, the first public realm that is encountered is the street. It is here that people meet socially and perform numerous social, cultural and economic activities. Jacobs (1995) suggested that it is streets that bring people together and provide the physical setting for socio-economic activities. Whyte (1980) stated that streets are places where children prefer to play and recreate. The street pattern in an urban setting creates an impression about the culture and community and thus provides an identity and image to the city. Carmona et al. (2010) asserts that streets contribute to the spatial structure of a city and have an impact on its image visually.

Khirokitia, a neolithic hilltop settlement of the sixth millennium B.C. in southern Cyprus is the first known and recorded street of which we have evidence (Fig.2.1). The street ran uphill from the riverbank and defined the settlement with the circular houses located on its two sides. It thus acted as the main spine of communication and movement (Kostof, 1995).



Fig. I.1: The first true street, Khirokitia

Source: (Kostof, 1995)

Generally, street systems, patterns and character have evolved over time and varied according to the physical, cultural and political factors. The physical factors included climate, topography and geography. The cultural factors comprised of social, symbolic and functional public life, everyday needs of people, sense of belonging, attachment and being part of larger group. Streets are physical, tangible spaces comprising of intangible qualities where strangers and friends meet, communicate with each other, recreate, do business, work, wander, relax, sit or just enjoy sights and sound of each other. As Alexander et al. (1977) too points out, “Streets should be for staying in and not just for moving through, the way they are today” (p. 590). But today some streets have already lost and some are on the verge of losing their social identity. They are being basically used only as movement spaces for vehicles. This aspect of streets needs to be looked into and taken care of by architects, urban designers and planners so as to keep alive the character and identity of the streets and thereby the city.

II. DEFINING STREET

The word 'street' is derived from the Latin word 'sternere', which means to pave, and is also known as the German Strasse, or the Italian Strada (Rykwert, 1986). Alley, avenue, boulevard describe particular types of streets or roads.

Carmona et al. (2010) defines street as "a linear three-dimensional space enclosed on opposite sides by buildings" (p. 182). In the same way, Jacobs (1995) describes street in two ways emphasizing on its physical qualities: vertically i.e. height of buildings, walls or trees and horizontally i.e. spacing between the vertical elements and their length.

Similarly, Rapoport (1987) defines street as a space and in its description also includes street as a place. The morphological definition state that streets are linear spaces lined with buildings on both sides and, the second definition is based on use, as a setting for certain activities. The resultant of the two gives the common definition of streets which are more or less narrow, linear spaces lined by buildings and used for circulation and other activities. The buildings and streets define each other and cannot be separated.

According to Ellis (1986) a street is defined as, "It is generated by and responds to the characteristics of the vertical wall planes that bound it on either side" (p. 117). Like Rapoport, he too elaborates on the function of streets,

"Because of their well-defined characteristics of felt volume and their interdependent mix of elements and functions, these streets tend to act both literally and metaphorically as exterior rooms in the city. They function as places as well as links; they incorporate various social and operational activities into an integrated and somewhat unspecified mix, much as do the volumes interior to buildings (Ellis, 1986, p. 117)".

His explanation about the street also indicates a street as a 'space' and a 'place' thus highlighting both on the physical attributes and the activities on the street, defining its attributes of movement and place.

III. STREET AS A SPACE: ATTRIBUTES OF STREET QUALITY

The above definitions identify a street as a space and clearly indicate the significance of the physical features of the street. Various urban theorists and scholars including Sitte (1889), Jacobs (1961), Cullen (1971), Alexander et al (1977), Whyte (1980), Lynch (1981), Jacobs (1995), Carmona et al (2010), Ewing and Handy (2009) have discussed about the attributes of street quality.

The primary function of streets is movement of both vehicles and people. Streets that are primarily for pedestrians possess various characteristics that motivate people to walk. In many instances, people walk on streets leading to the religious place and consider it a ritual.

A number of researchers and scholars gave emphasis to mixed land use for stimulating pedestrians to walk (Jacobs J. , 1961; Alexander, et al., 1977; Bently, et al., 1985; Mehta, 2013). Rapoport (1990) identified that factors like topography, environment, climate, safety, distance, presence of services, technology, culture, perceptual and physical characteristics affected the way pedestrians used the street. Other attributes like pedestrian accessibility, human scale, density and soft facades were identified by Gehl (2011) as factors that encouraged walking.

Table 1: Street Qualities and Characteristics

Street Qualities	Characteristics
Physical qualities	<ol style="list-style-type: none"> 1. Articulated street front 2. Public seating 3. Commercial seating 4. Sidewalk width 5. Shade from trees and canopies 6. Other furniture and physical artifacts
Social qualities	<ol style="list-style-type: none"> 1. Community places
Landuse qualities	<ol style="list-style-type: none"> 1. Variety of businesses 2. Independent uses 3. Permeability of store front 4. Personalized store fronts

Source: (Mehta, 2013)

In addition to these architectural attributes, pedestrians also require features like seats, sitting spaces (Whyte, 1980; Gehl, 2010; Mehta, 2013), green areas (Whyte, 1980), sidewalks and building edges (Mehta, 2013) and community gathering places to encourage them to stay on the street and not just walk by (Table 1).

The significant factors defining street qualities as identified by Sitte (1889) include incorporating artistic principles, achieving human scale and enclosure. Jacobs (1961) not only emphasized on human scale but also on vitality bringing people in contact with each other thereby creating activities as major factors of street quality. Similarly, Whyte (1980) gave emphasis to visual quality, easy access and seating spaces. On similar lines, Lynch (1981) suggested that legibility, vitality, sense, fit, and control had a considerable amount of impact on the quality of streets.

Permeability is the quality of a place that offers choices for accessibility, legibility and makes a place more understandable. Varied or mixed uses, variety of sensual experiences, visual and non-visual richness in terms of details, materials, etc, enhance permeability. Visual appropriateness (the interpretations people make about places that also create meaning), personalization (emphasising about the choice and values of the people concerned) and robustness (the quality of a place that can be used for different

purposes and uses) were acknowledged as the most important attributes for understanding the street quality (Bently, et al., 1985). Jacobs and Appleyard (1987) stated various physical qualities for a livable street that consisted of adequate sunlight, clean air, trees, greenery, human scale, mixed use, safety, comfort, cleanliness and diversity. Ewing and Handy (2009) identified imageability, legibility, linkage, enclosure, human scale, coherence, transparency, complexity and tidiness as significant attributes that influenced the street quality and hence walkability. Carmona et al. (2010) recognized accessibility, attractiveness, comfort, inclusiveness, vitality, functionality, distinctiveness, safety, robustness, greenery, fulfilling and cleanliness as factors for enhancing the quality of streets. Many of the researchers are in consensus about the various street qualities as demonstrated in Table 2.

Table III: Quality Attributes of streets as given by various theorists

Street Qualities	Alexander et.al (1977)	Whyte (1980)	Lynch (1981)	Bentley et.al. (1985)	Gehl (1987)	Jacob & Appleyard (1987)	Sitte (1889)	Rapoport (1990)	Ewing & Handy (2009)
Imageability			●		●			●	●
Enclosure	●					●	●		●
Human scale	●				●	●	●		●
Transparency	●				●	●			●
Legibility			●	●		●			●
Linkage	●	●	●			●			●
Coherence	●					●			●
Complexity					●	●		●	●
Tidiness						●			●
Permeability				●					
Variety				●					
Robustness				●		●			
Personalization				●					
Richness				●		●			
Visual appropriateness		●	●	●		●			

Source: Author

The street qualities therefore consist of the physical parameters and features present on the street, the design qualities both at urban and building level and comfort, safety and interest levels of the individuals (Table 3). Collectively, these qualities create and enhance the environment on the street for walking. As the urban design qualities are subjective in nature, researchers relate them to physical features to understand and make them more objective. Many scholars have worked on these parameters to find this relationship between the physical attributes that are tangible and the resultant design qualities that are intangible.

Table 3: Qualities of Street

Physical features	Design Qualities	Individual perceptions
Sidewalk and street width	Imageability	Sense of safety and comfort
Height of enclosing buildings	Legibility	Level of interest created
People	Linkage	
Climate	Complexity	
Trees	Transparency	
Volume of traffic	Human Scale	
	Enclosure	
	Coherence	

Source: (Ewing & Handy , 2009)

Since most of the researchers have given emphasis to imageability, enclosure, human scale, transparency and complexity, the study identifies these street qualities for assessment. Visual appropriateness, legibility and linkage are other qualities that can be used to assess the quality of streets.

3.1 Imageability

Lynch used the word ‘imageability’ in a formal sense for the first time. But initial efforts to understand the image of city can be traced back to Rasmussen (1951) who tried to understand the city image through drawings and words incorporating descriptive and pictorial techniques for analysis. For him, the city image was classified into two groups: a development of its early simple form which he called “Temple City”, whose layout was determined by priests and astrologers and “Colonial Cities” which had more practical layout. Cullen (1971) gave the concept of “serial vision” and examined the fabric of the town by colour, texture, style, character, personality and uniqueness and tried to define it as the element “This and That” (Table 4).

Table 4: Matrix of design elements for Imageability

Serial Vision	Place (Here and There)	Content (This and That)
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<ol style="list-style-type: none"> 1. Sequence 2. Juxtaposition 3. Drama 4. Revelation 	<ol style="list-style-type: none"> 1. Possession 2. Possession in movement 3. Viscosity and change of level 4. Enclosure 5. Focal Point 6. Defining space 7. Truncation and change of level 8. Silhouette 9. Division 10. Punctuation 11. Fluctuation 12. Undulation 	<ol style="list-style-type: none"> 1. Juxtaposition 2. Immediacy 3. Detail, intricacy 4. Bluntness, vigour 5. Nostalgia 6. Exposure 7. Intimacy 8. Illusion 9. Metaphor 10. Animism 11. Notable absence or presence 12. Geometry 13. Multiple Use 14. Relationship 15. Scale 16. Scale on plan 17. Trees incorporation
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Source: (Cullen, 1971)

Imageability can also be called legibility, or visibility where objects are not only be seen but have an influence on all our senses. (Lynch, 1960). It is also related to ‘sense of place’. Cullen (1971) elaborated this concept and asserted that a visual theme enhances ‘sense of place’ and motivates more people to be in the space. In addition, Lynch (1960) stated that for streets to have a stronger identity, it is important to have continuity which in itself is a functional necessity, directional quality, a proper destination and origin, and appropriate scale to sense one’s position in the entire street length.

The important concerns of imageability are the physical elements like the building facades and street furniture, urban space quality and perception of inhabitants’ also known as visual intelligibility. A place is supposed to have high imageability when the physical elements are not only distinct and identifiable, but the way they are arranged catch our attention and stimulate our feelings. They also act as landmarks and help a person to locate himself on the street. Similarly, presence of plazas, parks or even courtyards on the streets provide places for pause and recreation. People can rest in these places when tired. The landscape features on the streets also provide a soothing environment and encourage more people to be there. Presence of historical buildings connects one to the past and has an everlasting memory to share. Presence of people and thereby outdoor dining or even vice versa provides opportunities for more interaction and communication (Ewing, Handy, Brownson, Clemente, & Winston, 2006; Ewing & Handy, 2009). The relationship between imageability and physical features is established here and can be used to quantify imageability (Table 5).

Table 5: Quantifiable parameters for strong imageability (Rapoport, 1977; Jacobs A. B., 1995)

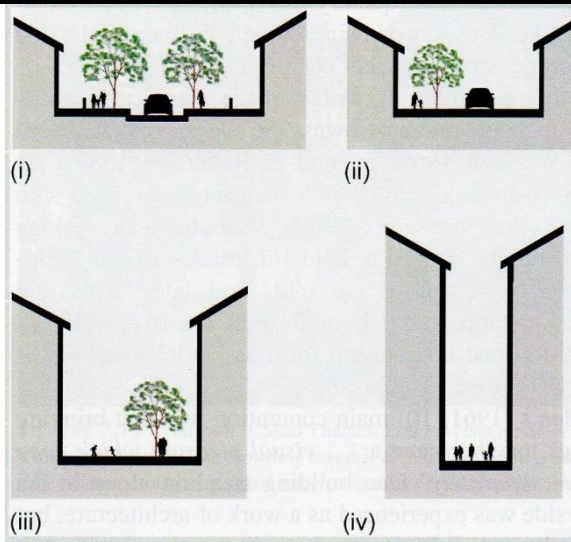
OPEN SPACES	STREETS	BUILDINGS
<ol style="list-style-type: none"> 1. Adequate outdoor space 2. Trees 3. Clean air 4. Physical quality 5. Harmony with nature 6. Amount of greenery 7. Nature of enclosing Elements 	<ol style="list-style-type: none"> 1. Signs 2. Noise level 3. Degree of enclosure 4. Character of space 5. Nature of building elements 6. Transportation and Parking 7. Access to parks 8. Safety and Comfort 9. Street Length and Proportion 10. Paving and Street Furniture 11. Nature of ground floor abutting the street 	<ol style="list-style-type: none"> 1. Building height 2. Building use 3. Colour 4. Materials 5. Fenestrations 6. Appearance and elevation 7. Type of housing units 8. Density 9. Materials and style of dwelling 10. Variety 11. Total massing 12. Levels of complexity 13. Orientation

Source: http://shodhganga.inflibnet.ac.in/bitstream/10603/9571/37/10_chapter%201.pdf

According to Shinde (1988), the climate, physical conditions, linguistic and historic traditions have affected the image of Indian cities. The multilingual, multireligious and multiracial character have a strong hidden bond of common tradition and culture in our cities and thus there is a sense of uniqueness. The tangible factors thus concluded for assessing imageability include the presence of open spaces and people on streets, the quality of built environment and provisions of outdoor activities.

3.2 Enclosure

Enclosure can be defined as the degree to which the street is defined by vertical elements on either side, with the buildings, walls or trees. The degree of enclosure basically depends on the ratio of the street width to the height of the enclosing elements. Enclosure was first discussed by Spreiregen (1965) as “a fundamental requirement of urban space” (p. 75). Cullen (1971) states that “enclosure, or the outdoor room, is, perhaps, the most powerful, the most obvious, of all the devices to instill a sense of position, of identity with the surroundings.... It embodies the idea of here-ness” (p. 29). Enclosure instils a feeling of safety and comfort on the street and also focusses the eyes of the pedestrians along the façade of the street thereby making them a part of the place. Carmona et al. (2010) noted that “The ideal street must be a completely enclosed unit! The more one’s impressions are confined within it, the more perfect will be its tableau: one feels at ease in a space where the gaze cannot be lost in infinity” (p. 177) (Fig.2).



(i) Streets with 1:4 ratio provide weak sense of enclosure.

(ii) Ratios between 1:2 and 1:2.5 provide a good sense of enclosure.

(iii) Ratios of 1:1 provide a strong sense of enclosure and are considered minimum for comfortable urban streets.

(iv) Ratios where building height exceeds the street width are claustrophobic.

Fig. 2: Height to width ratios for street enclosure
Source: (Carmona, Tiesdell, Heath, & Oc, 2010)

Previous researches have suggested different proportions for the street to have a sense of enclosure. Alexander et al. (1977) stated that for a comfortable feeling of enclosure, the building heights should be less than or equal to the total width of the street. Jacobs (1995) noted that the proportion of building height to street width should be at least 1:2. In addition, he also gave equal emphasis to the angle of view of the observer. He proposed that the height to horizontal distance ratio as 1:4 to provide a sense of definition when looking at 30° angle to the street direction. The definition starts with the height to width ratio of 1:3 but becomes very strong at 1:2. Other designers have recommended proportions as high as 3:2 and as low as 1:6 for a sense of enclosure.

Spreiregen (1965) states, “Spatial enclosure is weakened by too many gaps in building walls, drastic variations among the facades and abrupt changes in cornice line” (p. 75). Rows of closely spaced trees, visual termination points and small walls and fences add to a sense of enclosure and humanize the height to width ratio. Winding, twisting streets provide short sight lines and similarly, irregular frontages too provide varying sights thereby enhancing sense of enclosure (Alexander, et al., 1977). While breaks in continuity of the enclosing elements, inactive uses, setbacks, drastic variations among facades and abrupt changes in cornice line destroy the sense of enclosure. Alexander et al. (1977) agrees that the building setbacks deter sense of enclosure and states, “Building setbacks from the street, originally invented to protect the public welfare by giving every building light and air, have actually helped greatly to destroy the street as social space” (p. 593).

Therefore, it is the proportion of enclosing walls on both sides of the street that contributes to the perception of enclosure. The sense of enclosure is reduced when more percentage of sky is visible and there are long sight lines (Ewing & Handy, 2009). The said identified tangible features to assess enclosure can thereby be used to evaluate enclosure on streets. For this study secondary data has been collected. From the website of KSE the monthly stock prices for the sample firms are obtained from Jan 2010 to Dec 2014. And from the website of SBP the data for the macroeconomic variables are collected for the period of five years. The time series monthly data is collected on stock prices for sample firms and relative macroeconomic variables for the period of 5 years. The data collection period is ranging from January 2010 to Dec 2014. Monthly prices of KSE -100 Index is taken from yahoo finance.

3.3 Human Scale

Human scale defines the relationship that a human body size has with the environment. If the object can be seen as a whole and its smallest part recognized, it is said to be in human scale. The texture, size, articulation of physical elements that corresponds to human proportions and the walking speed of humans are said to be in human scale. This indicates the significance of not just the building height but also its width, human speed and personal interaction distances in designing for the human scale. Apart from these parameters, various small scale elements like building details, paving patterns, trees, street furniture, presence of cars nearby, etc. can moderate the scale of streets. As Spreiregen (1965) points out, “Facade articulation can bring large buildings down to human scale. A long façade can be subdivided periodically into more digestible elements” (p. 78).

Alexander et al. (1977) noted that buildings more than four floors seem to be out of human scale. He further discussed about the human scale limits for interaction and suggested that at a distance of 70 feet, a person’s face can be recognized and similarly, up to 48 feet portrait like detail can be seen.

Therefore, street furniture, windows and small planters on the street are identified as the features that augment human scale (Ewing & Handy, 2009). Long sight lines and more building height destroy sense of human scale. The same identified tangible features can be used for the study of human scale.

3.4 Transparency

Transparency pertains to the communication and transition between the public space and private space, the degree to which people perceive human activity or what lies beyond the edge of a street e.g. outdoor dining and merchandising, display windows,

etc. Since interaction between outdoors and indoors happens at street level, it is most important. Jacobs (1995) describes transparency as an important quality of great streets,

The best streets have about them a quality of transparency at their edges, where the public realm of the street and the less public, often private realm of property and buildings meet. One can see or have a sense of what is behind whatever it is that defines the street; one senses an invitation to view or know, if only in the mind, what is behind the street wall (p. 285).

Doorways, street level windows or glass with signs of habitation add to transparency. The presence of a number of entryways on the street makes us believe and realize the existence of human activities beyond the street. In contrast, blank walls along the edges of street signify that people are far away. If there are bushes or trees overhanging on blank walls, they provide signs of habitation and can exhibit some transparency.

An interesting aspect about transparency is described as, “The sight of action is an incentive for action. When people can see into spaces from the street their world is enlarged and made richer, there is more understanding; and there is the possibility for communication, learning” (Alexander, et al., 1977, p. 774). Connections with the street can be enhanced by making the wall along the street of glass, or fully opening the wall itself and including some part of the activity on the other side of street, so that people walk through the activity and become a part of it. Gehl et al. (2006) proposed that the façade of the ground floor of a building has different requirements than its upper floors. This is because we only have ‘close encounters’ with the façade at street level and not with floors at upper level. Gehl et al. (2006) further concluded that buildings must ‘learn to make meaningful conversation’ (p. 47) with people who use them and the public spaces.

Ewing and Handy (2009) derived physical features that contribute to transparency. Proportion of street level windows, street wall and active uses enhance transparency in a street. Large building setbacks, arcades and reflective glass detract from transparency. Hence, the tangible parameters that can be used for study include proportion of openings at street level, proportion of street wall and proportion of active uses on the selected streets.

3.4 Complexity or Richness

Complexity signifies the visual richness of a place. It enhances the interest of the people in the place when walking due to changing views. It results due to the presence of varying building shapes, sizes, heights, setbacks, colours, articulation, ornamentation, texture, street furniture, trees, signage and presence and activity of people.

Rapoport (1990) related complexity to the number of differences noticed by a viewer in unit time. He identified elements for achieving complexity like availability of a variety of possible movement paths, the juxtaposition of varied elements and areas, the location, mix, and changes of activities, multi-sensory experiences, the presence of open-ended design that allows changes over time, greater enclosure, turns, changes of direction, blocked views, etc. (Table 6).

Trees, people on streets, complex building facades with changing light and shadow patterns, colours, textures enhance complexity on streets (Jacobs A. B., 1995). In agreement to Jacobs, Gehl (2011) too noted that integration of land uses, housing types, activities, transportation modes, and people create diversity and that adds to complexity.

Buildings with varied uses of colours, public art pieces and walking pedestrians on the street and existence of outdoor dining add to the level of complexity on the street (Ewing & Handy, 2009). These specific tangible features can be used to study complexity in the streets.

Table 6: Visual fixed-feature elements for achieving complexity

High level of Enclosure	Tall enclosing elements Narrow streets Width-height ratio Low percentage of visible sky
Complex spaces	Variation in width Many turns and twists per unit length Articulation of space Presence of major projecting elements Large number of projecting elements
Short or blocked views	Limited length of views Level changes Overhead elements Bends, curves and angles Cross streets
Articulated surfaces of enclosing elements	Large number of elements or units Rich treatment of units and visual texture Variety of materials Highly textured materials Different colours Irregular rhythms Sharp or abrupt changes Skyline

Layout	Large number of possible paths and choice paths Indirect views Sequence of different spaces High contrast among spaces
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Source: (Rapoport, 1990)

IV. CONCLUSION

Since most of the researchers have given emphasis to imageability, enclosure, human scale, transparency and complexity, the study identifies these street qualities for assessment. The study indicates that these street qualities can be objectively assessed by taking into account the tangible factors that define these qualities.

The tangible factors thus concluded for assessing imageability in streets include the presence of open spaces and people on streets, the quality of built environment and provisions of outdoor activities.

The proportion of enclosing walls on both sides of the street contributes to the perception of enclosure and can be used to assess enclosure on streets. Similarly, human scale can be assessed by the presence of various small scale elements like building details, paving patterns, trees and small planters, street furniture and windows.

The tangible parameters used for study of transparency include the openings at street level, proportion of street wall and active uses on the streets. Complexity and richness on the street can also be assessed by tangible factors that include articulated surfaces of enclosing elements, buildings with varied uses of colors, public art pieces, pedestrians on the street and existence of outdoor dining and activities.

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