SPATIAL ANALYSIS IN DETERMINING PHYSICAL FACTORS OF PEDESTRIANISED NEIGHBOURHOOD STREETS.

Case study: A Neighbourhood Street in Bangalore

K C Tanuja, Dr. Mamatha P Raj
1Research Scholar, 2Director, BMS College of Architecture, Bangalore
1BMS College of Architecture, Bangalore, Karnataka, India

Abstract—The Street in the urban scenario performs various human activities and becomes an important issue in the present context. Due to urbanization and improved technology and automobile advancements, cars and motor vehicles dominate streets in various cities around the world. On the other hand, human activity on the street is the determinant of the city livability. According to Alan Jacobs, “If we can develop and design streets so that they are wonderful, fulfilling places to be - community-building places, attractive for all people - then we will have successfully designed about one-third of the city directly and will have had an immense impact on the rest.” Streets are life of any city. Livable streets are the streets with lots of human activities engaged in stationary and sustained activities, especially those are social in nature. Livable streets are pedestrian oriented. This paper attempts to analyse the spatial factors required for the pedestrian streets. A case is selected in Bangalore city, which is neighbourhood Commercial Street. The activities on street is analysed on the stretch of the street overlaying the physical factors present on the street. A mapping of both, activities and spatial analysis is presented and the research is to provide valuable input for street and pedestrian space planning that are comfortable for human activities.

Keywords: Pedestrian space livability, spatial analysis, Neighbourhood commercial streets.

I. INTRODUCTION

People utilize streets for their activities on daily basis, as streets are the main public spaces in cities. Streets are the container of human activities, especially their movement, and as urban form. Kostov(1992), defines street as an entity made up of a roadway, a pedestrian way and flanking buildings which purpose traditionally has been for traffic, exchange of goods, and social exchange and communication. Neighbourhood streets are more or less a narrow lane, linear spaces lined by buildings and used for circulation and sometimes for other activities.

Streets are not just a thoroughfare for vehicles and pedestrians but will accommodate many aspects such as, economic, aesthetic and social aspects. Economic aspects related to commodity circulation, aesthetic aspects related to visual and imageability. Social aspects related to human activities and interaction conducted on the streets. Alan Jacobs says that if there is activity in the street, then the city will be interesting. But now a days, in present context cars and motor vehicles have dominated over the human activities on street. The street gets more attractive and visually pleasing only when there is human activity i.e., socialness happens on street.

Various cities and organisations around the world are now thinking of different concept to rejuvenate streets. The Livable street concept is that which enhances the pedestrian space which in turn enhances the human activities and promotes more socialness on streets.

Many urban designers like Alan Jacobs, William H Whyte and Jan Gehl gave importance to the impact on people oriented approach. Donald Appleyard successor of Alan Jacobs explained livable streets have diversified human activity and pedestrian oriented schemes and street livability. Livable Street is increasingly becoming a vital factor of city attractiveness. The pedestrian oriented streets can address a lot of problem and become a solution in different aspects like congestion, suburbanization, pollution, etc. The concept of livable streets is the ideal strategy for urban designers and planners to rejuvenate the urban form.

This paper researches on the factors influence the street livability. Especially physical factors of pedestrian space influence streets’ livability and is indicated by diversified human activity. The research located in the street of Malleswaram, Bangalore, a metropolitan city in the state. Malleswaram 8th cross road is a mixed land use neighbourhood Street which have diversified activities in various range of time.
LIVABLE STREETS

Livable streets depend on people and social interaction to be successful street. People need a sense of place which is created from the surrounding context of the street.

Street without considering the street edge and pedestrian movement and interaction among people, lively streets cannot happen.

Lennard and Crowhurst further explains that,

‘The street level is the most critical element of the façade, and deserves special handling; since it is here that the greatest degree of interaction between inside and outside should be possible. There should not be blank walls to the streets, as William H Whyte explains, but rather windows, window displays, doorways, alcoves and outdoor cafes. (Lennard, Suzanne H. Crowhurst 1995, 35),’

The street is a truly public space. Diversity of users on the street makes the street truly a great place. The potential of livable streets to the urban community is endless. Streets are much more than the vehicular movement. Streets are the places for interaction with friends and relatives, places for sitting, people watching and shopping.

In the Death and Life of American cities, Jane Jacobs discusses the various ways to safe and secure the public spaces. She states the characteristics of the street which makes them safe and livable.

i. Character of the buildings: Buildings facing street should have proper setback to create the sociable space in the front. Building façade should create transparency and assure safe movement of pedestrians.

ii. Sidewalks: Sidewalks to be used frequently. This fosters the sense of community and encourages people to use the street.

iii. Traffic: Livable Street should have a narrow and accommodate the least traffic. This makes the streets a lot easier for pedestrians to cross and makes them enjoyable for a wide variety of activities such as strolling along the sidewalk or sitting at a nearby outdoor café.

iv. Lighting: Good lighting encourages people to use sidewalks at night as it can help to create a larger field of view.

Streets are the central focus of cities and towns. Donald Appleyard(1981) describes “ The street has always been the scene of activity, the framework in which streets are utilized and what is made of that chosen space is determined by the street’s design and function. Street without considering the street edge and pedestrian movement and interaction among people, lively streets cannot happen.

A livable street is a roadway that is designed to cater the needs of every individual user. Users are drivers, transit vehicles, bicyclists and pedestrians of every kind such as the disabled, elderly, children and lingerers. The traffic lanes are minimum in order to safely cross the street.

Streets provide a variety of different functions in one’s daily routine. Although the nature and composition of each street may be varied, each street can act as a means for various transportation modes, or as a location for a community assembly. The ways in which streets are utilized and what is made of that chosen space is determined by the street’s design and function.

Livable Street is a public place where the car is no longer the dominating element. Neither car is eliminated completely, but rather the pedestrian is the prominent factor.

DONALD APPEYARD'S LIVABLE STREETS

‘People have always lived on streets. They have been the places where children first learn about the world, where neighbors met, the social centers of towns and cities.’

The street is a positive for of urban space that has its own characteristics and physical boundaries. Street has its own cultural significance with its utilization by public activities.

The concept of Livable streets was first coined by Donald Appleyard in 1981 after studying the traffic and territoriality of human activities on high, medium and low traffic roads. Many attempts have been made to define the characteristics of livable streets.

Appleyard states that an ideal street is one which provides safe, healthy, green and enjoyable surroundings.

The livable street should achieve the following aspects:

i. Enhances senses of safety, comfort and rejuvenation

ii. Provide easy access and connectivity between important destinations, social connections, exchanges and learning

iii. Provide a positive and enriching sense of place.

In 1983, Donald Appleyard

i. The street as a sanctuary: streets should be safe from traffic and speed; pedestrian and children should be able to walk safely through the neighbourhood streets.

ii. The street as a livable, healthy environment: streets shouldn’t be subjected to noise, vibrations, fumes and soot from traffic, which stress their daily life indoor and outdoor.

iii. The street as a community: street should encourage activities and social life between neighbours’, and be provided with suitable sidewalks, street furniture, and play places for children

iv. The street as a neighbourly territory: residents have to feel that street belongs to them, sense of responsibility in which they maintain cleanliness and trees

v. The street as a place for play and learning: in several cities the street is the only available public space for children, so it should be an adequate and safe place for them to play.

vi. The street as a green and pleasant land: trees, plants and landscape are most desire in big cities; they provide a relief from pollution, shade, and a pleasant visual natural environment.

vii. The street as a unique historic place: identity and unique quality of the street through history, culture, or certain details and features that give sense of place rather than a moving channel.

### IV. LIVABILITY AND PEDESTRIANISATION

Livability is the achievement of quality of life. Research proved that the pedestrian streets give a quality of life in the community. Pedestrianisation is part of livability component in order to promote a livable space. Pedestrianisation is an effective tool in order to increase the livability, by improving accessibility, mobility, safety and environment that make the street a good quality place to all its users. The pedestrian streets are not just a corridor to move and reach destination but acts as a public space where sociability, activities and accessibility take place. Project for public spaces organisation (PPS) has developed the place diagram, to define the quality of space. Diagram has four main factors such as, Accessibility, Comfort & Image, Sociability and Uses & activities. Every parameter consists of quantitative and qualitative aspects that can be measured either statistically or practically.

By layering the place diagram on street through its placement at the center as a place, it is known that the pedestrian is one of the primary qualitative aspects within the access and linkage factor. It is understood that the Pedestrianisation is the crucial indicator of a good quality street and can be considered as part of livability. It’s not only Pedestrianisation which makes street livable but includes multi-functional activities and also socialisation and community interaction which enhances the quality of life. But streets have traffic movement which is considered as major threat on quality of life. The correlation between the livability and Pedestrianisation is depending on spatially and functionally in diverse aspects, aesthetical and environmental, social and physical. Users can experience a better quality of life by integration of pedestrian and livability for a long period of time.

Donald Appleyard in his book “Livable streets” explains that the streets have social and facility functions. Gehl states that the suitable planning of streets for pedestrian is to be done to highlight the social activities. Simpson believes that the old city centers to be oriented to walkable a street which enhances the quality of urban spaces.

**Pedestrianisation and its interrelation between quality of urban environment:**

Gehl (1996) defined social activity as a function while two are more people together in the same place. The purpose of being with each other might vary. The meeting represents some inclusive forms of social activities. This assumption is important in relate to Pedestrianisation. The physical setting and its organisation have an impact on Pedestrianisation can affect the possibilities for meeting, seeing and hearing people.

In this regard, a hypothesis is that the quality of public urban spaces has direct relation with walkability in urban spaces. The intension is to increase the density of people in the urban spaces. The environment should fulfil people’s requirements by applying the principles of Pedestrianisation.
The interrelation between walkability and quality of physical environment based on Gehl, 1996

V. PEDESTRIANISATION

Pedestrianisation is a process of walkable streets that is avoiding traffic on street. Pedestrian improves safety and accessibility for pedestrians. This process brings larger environmental, economic and social benefits for its cities. Pedestrianisation helps to increase business in small scale and economic growth of streets. Implementation of Pedestrianisation in streets leads to generate urban spaces that are sustainable and livable by refining the quality for residents of community.

VI. PEDESTRIAN- PRIORITY STREET

Pedestrian-priority Street is a concept where the street is pedestrian oriented urban public space. Cyclist is also recommended in the pedestrian priority streets. Some synonyms such as, a car free street, a pedestrian zone, a pedestrian or walkable street explains the pedestrian priority street. A pedestrian priority street can be explained through a physical structure, a place of commercial activity and a place of social interaction. Physical planners and designers promote the streets from physical point of view and enhance the better quality of streets and in turn the better community. Economists and shop owners promote the streets in commercial point of view to increase the business and in turn the better economy. Sociologists and often planners promote the streets to be a public precinct, where people meet, socialise and interact. Pedestrian priority commercial Street combines activities like walking and shopping. A neighbourhood commercial street to be promoted as pedestrian priority which increases the retail shopping and neighbourhoods would be safe for walking and cycling. The streets can be more for social interaction and community activities rather than vehicular transit.

Pedestrian streets in the urban context increase the quality of urban environment. As a result of Pedestrianisation in the urban context safety and social activity might increase in turn an enjoyable atmosphere that people involve from diverse cultural and social contexts.


VII. TYPES AND BENEFITS OF STREET PEDESTRIANISATION

There are three main types of Pedestrianisation,

i. Fully pedestrianized, where pedestrians have the absolute priority over vehicular traffic. Vehicular movement is completely prohibited on streets. A fully car free neighbourhood street is the first category of pedestrian type of streets. Such streets are more for social interaction and livable streets where many activities can happen on street.

ii. Partially pedestrianized that is vehicular movement is allowed during certain times with no on street parking. An intermittent car free commercial street is the second category of pedestrian type of streets. Vehicles are prohibited during the peak hours and weekends and also on special events and performances to avoid high traffic movement.
iii. Pedestrian streets with no restriction to vehicular access. But vehicles are slowed down through the use of traffic calming measures such as speed tables, raised crosswalks, textured pavement, roundabouts, chicanes, curb extensions, partial roadway closures, diagonal diverters and median barriers. The street is being shared by pedestrians and vehicular movement in third category of pedestrian streets. A shared commercial neighbourhood street will increase the level of activities and make the street more livable. A livable street is a balanced urban public space with pedestrian and vehicular movement and mixed activities and functions creating a sociable urban precinct.

An advantage of pedestrian streets happens at different levels and benefits at various domains.

**Urban benefits:** Car use, congestion and parking reduction, accessibility improvement and urban rejuvenation. Pedestrian Street in the community increases the sustainable growth of the urban scenario.

**Economic benefits:** More pedestrian density increases the retail business. Pedestrian Street improves economic productivity and also employment ratio. Encourages different types of business may be formal or informal business and local economy gets revived.

**Social benefits:** Increases socialisation and interaction. A pedestrian street creates sense of safety and security. It also enhances social interaction and community livability. This also enhances the public spaces and community interaction.

Pedestrianized streets also have environmental benefits and have an impact on sustainable community. Pedestrianisation and livability moves together and achieve livable streets which are socialised precincts in urban scenario.

**VIII METHODOLOGY**

The research methodology is derived based on reviewing literature of street as space and street Pedestrianisation in scientific journals, research projects and main parameters are still broken into sub parameters to observe on site.

Conceptual variable consist of three parameters: Comfort, Safety and Socialness. The selection of the attributes based on the most commonly attributed determinant by experts. Three main parameters are still broken down into sub parameters to observe on site.

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>SUB INDICATORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMFORT</td>
<td>Physical comfort</td>
</tr>
<tr>
<td></td>
<td>Traffic comfort</td>
</tr>
<tr>
<td></td>
<td>Climatic comfort</td>
</tr>
<tr>
<td>SAFETY/SECURITY</td>
<td>Pedestrian safety</td>
</tr>
<tr>
<td></td>
<td>Traffic safety</td>
</tr>
<tr>
<td>SOCIALNESS</td>
<td>Building activity</td>
</tr>
<tr>
<td></td>
<td>Building frontage</td>
</tr>
<tr>
<td></td>
<td>Transitional spaces</td>
</tr>
</tbody>
</table>

Conceptual variables are derived to analyse the factors that influence the streets livability. Conceptual variables are observed directly on site and observation data is collected.

Spatial analysis was done by deriving the livable points on the streets. These points were analysed based on the conceptual variables. The results then strengthened by field observation to find the physical factors of pedestrian space livability.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td>v</td>
<td>y</td>
<td>y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Comfort</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>Building Function</td>
<td>v</td>
<td>Y</td>
<td>Y</td>
<td>v</td>
<td>v</td>
<td>Y</td>
<td>v</td>
</tr>
<tr>
<td>Variation of accessibility</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>Social interaction</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>Economic improvement factor</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>Level of obstructions</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>Pedestrian dimension</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>Pedestrian performance</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>Parking difficulties</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>Visual interest</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>Public health</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>Landscape conserves</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
</tbody>
</table>

Source: IOP Conference Series: Earth and Environmental Science A F Fauzi and A Aditianata
XI CASE STUDY OF BANGALORE STREETS.

Bangalore is one of the metropolitan cities in the country and has exhibited a great enhancement in the field of information technology and biotechnology sector. The rise in the urbanisation degree was observed since 1990 and there is a major shift in the urban form. The number of people in the tertiary sector of occupation and their demands and requirements has changed the physical setting of the city. Larger investments are made in the logistics sector and housing improvements and different kinds of urban form evolved. People’s preferences, cultural diversity, economic balance, and physical characteristics changed the older parts of the city and gave a new dimension to the newer developments.

Bangalore is the capital of Karnataka state and has a population of 9,621,551 as per 2011 census data. The history of the settlement dates back to the first half of the 16th century and has experienced the significant growth till today. Bangalore is the only city in Karnataka state that could accommodate any economic insert and experienced pull factor from other parts to the state. Population has increased significantly and has an impact on the urban infrastructure and urban amenities. Due to increased population, the resultant space in the city like streets and other public spaces became neglected.

In this context, it is essential to understand the complexity of urban streets and factors that shape them. This research attempts to analyse the spatial factors of streets and understand the existing paradigms on streets which would quantify with the requirement of livable streets.

Malleswaram: Residential neighbourhood in Bangalore city:
Malleswaram is an old residential neighbourhood in Bangalore. Malleswaram is a well-planned locality like a chess board situated in the North West part of Bangalore city. There is a boundary defined to this neighbourhood where the railway line marks the boundary. Main roads run North to South are main roads and perpendicular are the cross roads. This neighbourhood has mixed demographics, comprising all different income families. This area is very near to the CBD of Bangalore city and has a greater impact on commercial and residential sector. New developments are seen in terms of residential typology that means individual old plots to newer high rise apartments. Malleswaram is the hub of the retail commercial sector. This area is known for its daily shopping, clothes and apparels and street shopping. This area is well accessed by different modes of public transportation like Metro, BMTC buses and auto rickshaws. The interconnecting roads which link this area to other parts of the city are Sampige road and Margosa Road.

Source: Redrawn by Authors based on open city maps.
Part of Malleswaram 8th cross road delineated for study.
Source: Authors

Malleswaram 8th cross is a mixed land use neighbourhood street

Physical factors of selected part of the street is extensively studied and analysed composing the following maps,

- i. Building function map
- ii. On street parking
- iii. Trees
- iv. Setback width
- v. Sidewalk width
- vi. Curb height
- vii. Street vendors location
- viii. Livable points
- ix. Obstructions on street

<table>
<thead>
<tr>
<th>Physical factor</th>
<th>Observation data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building function map</td>
<td><img src="image" alt="Building function map" /></td>
</tr>
<tr>
<td>On street parking</td>
<td><img src="image" alt="On street parking" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical factor</th>
<th>Observation data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building function map</td>
<td><img src="image" alt="Commercial land use" /></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Residential land use" /></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Public and semi public land use" /></td>
</tr>
</tbody>
</table>

Commercial land use is prominent either on shop or on street vending. The whole stretch of street have commercial set up on to the street frontage. Different types of commercial shopping like, women clothing and suits, jewelry, men’s branded showrooms, interior decorative items, restaurants and cafés and etc., Residential land use is at the third floor and higher level giving space to commercial at lower spaces due to high land value. Either apartments or individual housing is found all along the stretch of street. Various banks, head offices, charity offices are part of offices land use.

Parking on one or both sides of a road is often permitted
Trees present on street gives a climatic comfort, shade the sidewalk and accommodate vendors underneath.

Setback width is 3 meters along the street.

Observation points of this study were determined through mapping on the most active points on the study area. Activities were categorized into dynamic and static. Observation was done three times a day, in the morning, afternoon and evening. Observation data was collected on weekday and also on a weekend. The observation timings were based on the time of activities happen on street.

XII RESULT AND DISCUSSION

Observation shows that the static and dynamic activities occur on study area, Malleswaram 8th cross. Static activities consist of talking, eating, standing, shopping with vendors or waiting for others. While dynamic activity consists of walking. All these activities occur all the day long, either morning or afternoon or evening. There were more than 5 livable points based on the number of activity occurred.

The width of the sidewalk, activities on the sidewalk, functions abutting to sidewalk and obstructions on sidewalk has an impact on pedestrians. The comfort and safety of pedestrians depend on the alignment and proper design of the physical factors on street. A detail analysis of the physical factors on the study area is done through mapping and statistics. Sections were derived to understand the shading, volume and visibility of the street. The interrelation of shading and activity points were noted.

The presence of street vendors relates to the ability to attract people to engage and interact. Allan Jacobs explains that the street vendors in pedestrian space enhance the activity points. In the study area, the research analyses that the street vendors creates the sense of safety and security to the pedestrians. At the same time, street vendors raise sense of discontent and conflict while walking to the pedestrians.

Malleswaram, 8th cross is a mixed land use neighbourhood street has lots of various activities. Literature says that the mixed use street affect diversity of pedestrian than non-mixed use street.

REFERENCES
1. Allan Jacobs ‘Great Streets’ 1993
3. A F Fauzi and A Aditianata 2018 ‘Spatial Analysis in Determining Physical Factors of Pedestrian Space Livability, Case Study: Pedestrian Space on Jalan Kemasan, Yogyakarta
8. Jeffrey T. Flositz 'Livable Streets: Establishing Social Place Through a Walkable Intervention
10. Lusher L, Seaman M and others 2008 Streets to live by: how liveable street design can bring economic, health and quality-of-life benefits to New York City
11. MA. NAIMALDIN HUSSEIN The Pedestrianisation and Its Relation with Enhancing Walkability in Urban Spaces. JOURNAL OF CONTEMPORARY URBAN AFFAIRS, 2(1), 102-112 / 2018