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Feasibility of incorporating open spaces in the design of micro-apartments in residential environments

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ABSTRACT

To address the housing crisis in developing countries the concept of small housing (micro houses) came into existence and took over the open spaces in the city – while an immediate solution for the crisis, this policy has created physical, functional, environmental and social problems. Although micro-houses are sustainable residential dwellings that maximize space usability while minimizing the ecological footprint, the spatial design of the dwelling units have evolved to accommodate the necessary requirements while eliminating open spaces within the units. With the rise in urbanization and the need for accommodation, cities have seen a gradual transformation of courtyard houses to apartments which has significantly contributed to the omission of open spaces within these housing units.

The necessity of these open spaces (public, private, semipublic, semi private) govern the perception of users with regard to commodity and society while bringing forth a sense of belongingness towards the house and the built space, thus providing houses that enhance the lifestyle of the user plays an important role in building social, economic and environmental sustainability.

This research paper aims to explore the feasibility of incorporating open spaces in the design of micro houses in residential environments while understanding the characteristics of open spaces within residential areas in the light of housing layouts and coming up with guidelines to incorporate the same in the initial planning and design stages of the residential complexes.

Snowball sampling method has been incorporated to understand the user behavior in and around open spaces and analyze the issues faced by the user.

The expected outcome is to understand the spatial preferences to balance open spaces within a private and semi-private magnitude.

Keywords: Micro – housing, urbanization, open spaces, balconies, spatial interaction and behavior

1.INTRODUCTION

Open spaces in a city creates a balance between the built and the unbuilt, it forms the perception of the city for the users while constructing a catalyst for social interaction between several strata of the society. With the rise in urbanization cities have seen an upsurge of apartments which have taken over the breathable cores of a city. This continuous growth has resulted in

incessantly evolving the spatial design arrangements of these residential developments, so much so that they have eliminated the provision of open spaces within the apartments and the purging of these open spaces has affected the city and users' physical, social, environmental and economic aspects. (Bonenberg, 2015)

With this extensive growth of built spaces in developing countries, it has become a global real estate trend to incorporate the concept of micro-apartments as a housing alternative in densely populated urban city centers like New York, Tokyo, San Francisco, Hong Kong, Singapore (C.J.Gabe, 2015); places which attract a certain demographic stratum that makes up the majority of an area due to several reasons like the lifestyle, the amenities offered and most importantly the real estate prices and availability of land. Although there isn't a fixed definition for micro apartments yet they can be classified as an abode that is smaller than conventional apartments but equipped with an optimally utilized floor plan which ensures efficiency and provides affordable living in urban city centers at nominal rates (ULIMHC, 2014) . Historically the concept of Micro houses has been prevalent since the 1900's, American cities devised this typology of housing to accommodate the temporary urban workers who preferred a flexible tenure and a location close to their jobs (Geffner, 2018). Evolving with the same design ideology in the densely populated city centers, these dwelling units have taken over the available open spaces in these cities and the spatial arrangements of these units have changed to remove the open spaces in these units resulting in a very unhealthy lifestyle that effects the users physically, mentally and socially. (C.J.Gabe, 2015)

As urbanization has upsurged, a significant change in demographics and economics have become the driving forces for shaping the living standards in cities, these factors have played a noteworthy role in the increased occupancy of these dwelling units while willingly sacrificing the provision of open spaces, this has resulted in an increase in demand for these dwelling units contributing to the loss of open spaces in the city. (De, 2018) India like any major emerging economies has seen a significant growth in urbanization, this has resulted in a surmounted amount of pressure on the already existing infrastructure, which in turn has created a housing crisis in urban city centers, the people affected most by this were the EWS and LIG sectors as well as the 'emerging middle class' of the society (Neogi, 2016). This study is focused to understand the potential market of micro- apartments in the urban city centers of India to address the housing crisis of the "emerging middle class of the society" and comprehend the user pattern and behavior around open spaces with respect to privacy and spatial design. The outcome of this research aims to develop guidelines for the implementation of open spaces with regard to micro-apartments in urban centers of Indian cities. It will assess the impact and satisfaction of open spaces on the users to recognize the dependent factors to understand the interrelationship between users and open spaces of different levels.

1.1 BACKGROUND

1.1.A- Current housing scenario of India

(D'souza, 2019)To cater to the rapidly growing housing needs of the people it is important to understand the existing conditions and schemes taken into consideration to enhance the housing crisis and situation like the implementation of the PMAY 2015 scheme and the challenges that acted as an

obstacle for the successful execution of the same, the main challenges faced were:

I. The estimation of housing is done of basis of demand but with the increasing demand for housing there was a lack of available land.
II. Due to the lack of available land in the urban centers, the developments were pushed to the pre-urban areas and rural areas increasing the connectivity and the cost of connectivity.
III. Although there are many financial schemes yet there is a lack of financial literacy in the weaker sections of the society

The housing schemes implemented in the urban and rural areas to tackle the issue of housing poverty was subject to various challenges due to a myopic approach i.e. to tackle the housing crisis without considering the subsequent consequences the implantation will be subject to such as unemployment, financials, etc. (D'souza, 2019) There were various inconsistencies in the framework of the reforms in the development of affordable housing. (Neogi, 2016)

(Sarkar, Examination of affordable housing policies in India, 2016) explains the failures of the Rajiv Awaz yojana and housing for all 2022 wherein the policymakers ignore the severe distortions with regard to land-use and allocation and the limitation in the design of these policies which fails to address the consequent issues making it a very temporary solution.

1.1.B- Micro- housing as an affordable housing concept

Micro houses are optimally designed floor plans in a compact area which fits necessities of a conventional apartment in a relatively smaller space to ensure a habitable environment for the user (Gazdag, 2018). Most prominent in high population density locations like the urban center of the city (downtowns) which have very expensive real estate (Geffner, 2018) these dwelling units serve the purpose of housing within nominal rates, the target audience of this housing typology has evolved from migrant urban workers to young adults who move into the city hubs in search of work, lifestyle and the amenities of the city while don't mind sacrificing on the space of living (Kichanova, 2016). The implementation of micro- apartments helps stabilize the demand of housing needs in city centers. The design of the micro apartment plays an important role in fitting the conventional storage and living in a more compact space while ensuring the same functions as in a conventional apartment (Rack, 2016). The ergonomics of the micro units is to make the space more usable for a comfortable long-term living. (Smith A. M., 2014). The concept of micro living has evolved attractively in Japan (Kyosho Jutako) which arose as a design alternative due to the economic changes that increased the cost of real estate subsequently. (Richmond, 2012)

The solution of micro apartments prompts comfortable living in space efficient floor plans while being economically affordable as practiced in Japan. (Smith V. , 2017)

1.1.C - Micro- apartments in India

The global trend of micro-apartments was introduced in India in 2018 with a project in Chembur, Mumbai (11) and subsequently in Bangalore (5.6), Delhi (6), Pune (10) and Kolkata (8) – places with very high house price to annual income ratio. With the implementation of these micro-housing units to increase the affordability the houses have shrunk to a significant percentage Kolkata

(17%) Mumbai and Pune (24%) Bangalore (18%) and Delhi (8%).The factors of the demand of these dwelling units have been observed to be the location of the property, increase in number of single and nuclear households and the availability of community amenities. (Sharma, 2019)

The target user-group of this trend have been the students and young professionals who look for affordable living options in the prime locations of the city with good public transport network since the millennial population is expanding in size as well as economic footprint (Kansal, 2018) while incorporating this trend of housing typology various challenges have been considered such as the design awareness, long term consideration, availability of amenities, etc.

1.1.D- Challenges of implementing micro housing in India

After understanding the user response of the residents in these dwelling units, various issues have been observed with the implementation of these micro-apartments, the major challenge being the availability land for construction, the design and planning of these developments have been wide spread, which increases the cost of construction and maintenance (Mammen, 2018). In certain locations to address the issue of maintenance and construction the designers of the dwelling units have completely omitted the provision of open spaces, although the provision of public amenities have been given yet their upkeep and maintenance creates an obstacle in the concept ***affordability*** of micro-housing, this housing typology in infiltrating the neighborhood by excluding public open spaces like parks for the construction of these buildings. (Steven, 2016)

1.2 SIGNIFICANCE OF THE RESEARCH

This research is an explorative study to understand the potential of incorporating open spaces in micro- apartments in the context of Indian urban city centers which is already in the process of purging the open spaces, it is essential to be familiar with the user behavior and activity in the existing open spaces to comprehend the correlated factors of the ***quality*** of the existing open spaces and the level of satisfaction of the users in those spaces which is done through the systematic equation model. The idea of implementing open spaces in the execution of micro apartments in built upsurged urban centers is to reflect upon the perception of livability of a user in a densely populated city. Addressing the aspect of sustainability and ecological footprint of a building happens to be the need of the hour, the research focuses on the same with respect to opens spaces within micro- apartments. The aim of the research is to come up with guidelines for implementing open spaces with respect to micro-apartments in Indian urban city centers. The objectives to be considered while doing so will be understanding the characteristics of opens spaces and then the types of open space with respect to different hosing layouts an f after understanding these objectives the formulation of the guidelines will be possible.

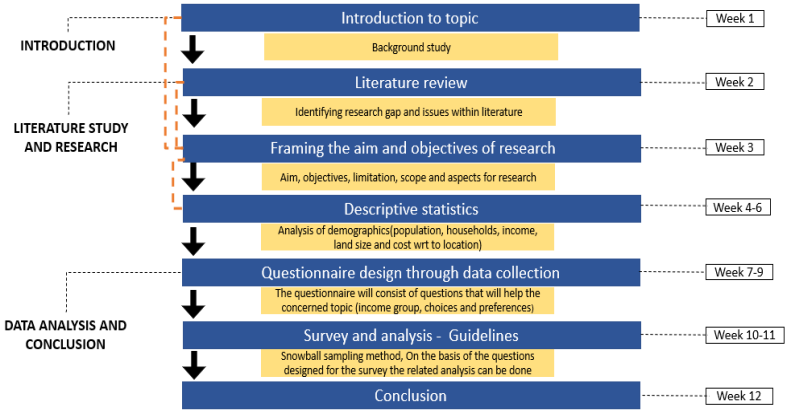


Figure 1. Methodology

The process of the research will be systematic (figure 1) starting with the introduction which will provide a background about the topic followed by the literature review wherein the literature gaps are identified to formulate the objectives of the research after which the design of the questionnaire ensures data collection and demographic analysis with followed by the analysis, guidelines and conclusion.

2. LITERATURE REVIEW

2.1 – Understanding the characteristics of open spaces

Open spaces are understood and perceived through the design of these spaces, the activities it promotes, the intermediate linkage within the spaces and the way these spaces emphasize place attachment within its users. Open spaces should be designed in such a way that it enhances the link between social psychology and architecture research which can only be carried after understanding the user behavior and activities in and around open spaces. (Salil, 2017)

Open spaces primarily effect the behavior pattern of its users while directly impacting the environmental planning. The comprehension of the effect of open spaces on its user helps in assessing spatial features in terms of privacy, naturalness and coherence. (Saiedlue, Reflections on open spaces in a residential complex , 2016)

2.2 – Different types of open spaces with respect to housing typology

Open spaces are a concept that has evolved over the years through culture and transformed with the spaces available in a city, eventually becoming an essential part of the built environment. With the increase in the built environment the condition of implementing open spaces in the design of these built spaces has become equally indispensable. (Payami, 2018) To understand and implement the same it is important to comprehend the satisfaction of the user in these spaces which is dependent on the factors of quality of these spaces, which varies greatly from user to user. The different typologies of open spaces with respect to privacy indicates the possibilities of different types of open spaces within a housing complex. This helps the designer to understand the user behavior and activity with respect to different spaces; Satisfaction of the user can be mapped through crosstabulation to comprehend the dependent factors of the same. (Oktay, 2017)

2.3 –Literature Case Study - *based on objective 1* (to understand the characteristics of open spaces)

a. Ekabatan Residential Complex

Figure 2. Open space distribution in residential complexes

With the objective to measure the quality of an open space a survey is circulated within the housing complex of the Ekabatan residential complex, the survey determines the open spaces with reference to different dimensions of the societal spectrum such as user diversity, accessibility, relaxation in a space, the relationship of the space with nature and climate, the emotions induced through the spaces in terms of built material, the geometry and various other and eventually coming up with design preferences with respect to the history of the place, the needs of the people and the climatic determinants. (Saiedlue, Enhancing quality of life and improving living standards through the expansion of open space in residential complex, 2015) (figure 2)

Figure 3. Courtyard within an urban block

b. Understanding user behavior with respect to open spaces

According to a study performed in various residential complexes selected on the basis of the placement of the open spaces i.e. complexes with a central courtyard and societies with open spaces surrounding the residential complex. With the findings showing the impact of a central courtyard in terms of inducing a sense of safety in which in turns brings forth a sense of community within the society. Societies with a featureless courtyard reduces the opportunity for social interaction in the society. The presence of green spaces within the vicinity of housing spaces contributes significantly to the satisfaction of the residents. The factors of study varied from Ecology, effect on society, economic dependency, residential satisfaction. (Kilnarova, 2017) (figure 3)

2.4 – Literature Case Study – *based on objective 2* (exploring the different types of open spaces with respect to apartment) (Milanovic, Influence of

private open spaces on the quality of living in low rise high density housing , 2018)

Typology of open space in low-rise high density residential areas	
Ownership stucture	Purpose
Public	**Public parks** Park; Park within the neighborhood unit ; The inner courtyard **Streets** Pedestrian paths Streets without motorized traffic or with reduced traffic **Green areas and linear parks** **Shoreline**
Semi-private	**Common open spaces** Residential buildings courtyards; Playgrounds; Inner courtyards **Atrium/patio** **Inner courtyards**
Private	**Private garden for the apartments on the ground floor;** **Balconies and terraces; Roof terraces/gardens**

Figure 4 Typology of open spaces

a. Iroko Housing complex (Micro- apartment complex)

There is a centrally placed sports field and playground with the balconies of the surrounding houses looking over it, this design ensures social interaction within the society while ensuring privacy and safety within the residents. (figure 4)

Aspect	Components
Design and comfort	The content and size of space Microclimate Physical characteristics Accessibility
Diversity and abilities	Frame/ the scope of potential purposes Attractiveness and accessibility for different user groups
Safety	Visual surveillance Physical characteristics Maintenance of public open spaces Accessibility
Social interaction	Purpose Accessibility Design and comfort

Figure 5 Quality of open spaces

b. Adelaide Wharf, West London

147 dwelling units' places along the channel, the placement of the open space is done centrally emphasizing the views and vistas in the site. The open spaces distribution is done on the basis of ownership with the incorporation of public, semi private and private open spaces which emphasizes the factor if social interaction within the society complex. (figure 5)

Figure 6 Kosar Green Complex

c. Kosar Green residential towers- Iran

This (figure 6) society consists of 2 high rise apartments and stands as an example of the first green architecture in Iran as it is a "self-sustaining universe" – that is there has been an inclusion of various types of opens spaces on different levels. After the understanding the qualities of open spaces different types of opens spaces have been incorporated in the design. The basement, ground, first floors are the floors which house the commercial units since it's the most accessible by all the residents. The separation of all the open spaces is based on usability with the provision of courtyards and balconies in each dwelling unit, the satisfaction of the residents is heightened due to the presence of all open spaces and commercial units within the vicinity which has subjected to a heavy influx of buyers in this society.

Aspects Considered	Case study 1	Case study 2	Case study 3	Case Study 4
Objectives Covered	Objective 1	Objective 1	Objection 2	Objective 2
Issues Identified	- Effect of open spaces on users - Satisfaction level in and around open spaces - Inter-related factors of place making	- 2 specific type of open space configuration - User behavior within the space - Effect of mixed used spaces within housing complexes	- Characteristics of open spaces wrt to different types of houses - User behavior and analysis within the space	- Mixed land use society development - Possibility of provision of all private, semi private open spaces on each level
Type of study	Experiential study	Study based on user satisfaction	Study based on User behavior and needs	Study based on need – sustainable open spaces
Method	Analysis Network Process	Structural Equation Model	Analysis Network Process	-
Conclusion	- Observation on private open spaces adjoining housing units - Need for various types of open spaces as social interaction is an essential aspect of quality living	- User satisfaction around courtyard based housing units - Resident satisfaction in mixed land use housing units	- Types of open spaces wrt to housing units - Need based open space provision - Design characteristics for planning of these developments	- Self sustaining society complex - Mixed use society development

Figure 7 Case study inference

2.5 Case study Inference

The characteristics of open spaces with respect to **functional factors, semantic factors, environmental factors, social factors, form factors** are the dependent factors to understand the **satisfaction of a user** in a space. These are supported by the activities performed in the open spaces by different age groups and the aspect of social factor plays the most important part in the

design of a space that serves the society as a whole. Since open spaces make up the major part of the users' **urban conception** which also affects the way a user is attached to the place – **place attachment.** For a space that serves the society, accessibility and legibility of the space play an important role in governing the idea of the quality of the space.

Satisfaction of the user is greatly governed by the **quality of the space.** The quality of space is governed by the various dependent factors in the design of these spaces. Open spaces are segregated on the basis of ownership and their purpose. **Public open spaces** refer to the parks, streets, shoreline, linear parks, etc. **Semi – private open spaces** refer to the atriums, patios and inner courtyards and the **private open spaces** are the balconies, terraces, roof terraces, private gardens. The satisfaction within a space also lies in the amenities and provision provided in the certain space and that can be understood by comprehending the **user behavior** in such a place. (figure 7)

Figure 8 Yamuna Apartments

2.6 Literature case study (Indian context implementation of the above inferences)

Yamuna Apartments – Alaknanda, Greater Kailash, New Delhi

A group housing society for the lower middle-income sector if the stratum, with the design concept of village since the user group is very cohesive, the housing was designed as an integral community settlement – traditional housing to create an "urban village" in the city. This case study incorporates the various factors talked about in the above inference. (figure 8)

Functional Factors: since the user group is varied raging from childern to old people the pathways are constructed in such a way that the vehicular pathways is segregated from the walkway an don the periphery. Sicne these pathways are uninterrupted from the vehicular way thus it caters to various activities for all the different age groups.

Semantic factors: Social interactions are the backbone of indian societies and community wellbeing, the spaces in this societies are developed in such a way that each node acts a central gathering space for some recreational activity.

Environmental factors: The society complex is surrounded by trees on all sides, the central sqaures at the end of each pathway is densely vegetated to control the microclimate.

Social factors: since the concpet of the society is based ona an urban village, the activities taken place in a village are considered and the design is done such that they enhance the social interacton within the society, just like in a village. (figure 9)

Form factors: The built form is in such a way that the balconies and opening created create a staggered façade which helps in protecting from the sun.

Place attachment: A driving force in the design process, according to the user behavior is that the users feel the sense of belonging in the in a place where they are constantly connected to their neighbors.

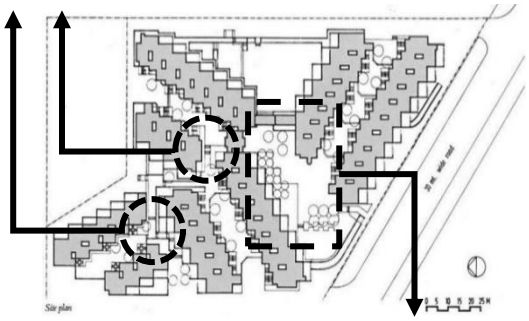


Figure 9 Open space segregation - Yamuna Apartment

3. DATA COLLECTION

The ***questionnaire*** is divided in such a way that the first part of the questionnaire gives the information on the demographics of the respondents that is the age, housing conditions, household income, dependency on public transport for commute. These results help in ***demographic analysis***. This data also interprets number of single households and analyzes the ***price dependent development***. The use of the structural equation model to interpret the behavior of the respondents in and around open spaces and highlight the latent variable (variable which cannot be quantified)

Mode of sampling: Stratified random Sampling

Method of sampling involving the division of population in smaller sub groups (strata) formed on a shared attribute or characteristics

Attribute consideration –

- *Income*
- *Age*
- *Current living conditions*
- *Accessibility to open spaces (experience in and around open spaces: parks, balconies)*

The design of the sample will be based on the following details:

- **Type of universe -** people living in residential apartments, single household users in city centers of Bangalore, Delhi NCR, Hyderabad, Mumbai
- **Sampling unit** – geographical (Bangalore, Delhi NCR, Hyderabad, Mumbai) construction unit (1bhk flats) social unit (single, 2 -3 people households)
- **Parameters of list** – 1BHK and 2 BHK households in apartments

- **Sampling method** – Stratified Sampling (probability sampling)

3.1. DATA COLLECTION – SECONDARY DATA

To collect the secondary data the necessary sources for information are the similar ***research papers*** on based on topic and the ***case studies*** of different such developments around the world.

Analysis of data

The process of analysis is to first analyze the demographics which will make up the base to further interpret the data into the different attributes of consideration. With the attributes classified into tables the data caneb further elaborated to form the descriptive analysis.

3.2 QUESTIONNAIRE DESIGN – INTERPRETATION THROUGH LITERATURE CASE STUDIES

1.Demographic-

Age Distribution	Gender Distribution
Household income	Current Living situation
Mode of commute	Vehicle ownership

2.Open space provision on the basis of factors –

Availability of public amenities (pool, club, park) and open spaces (park, playgrounds, pathways, courtyard, atriums and patio)	Accessibility to these open spaces – **Semantic factor**
Comfort – **functional factor**	Safety – **functional factor**
Social interaction in the spaces – **social factor**	**Place attachment**
Legibility – easily accessed **(Semantic factor)**	Preferred amenities

3.Micro houses

Interest in Micro-apartments	Issues faced with micro-apartment

4. DATA ANALYSIS

4.1. Demographic Analysis

The number of people surveyed for this data collection are – ***121***. *The a*ge group of **20-35** (based on literature review). Densely populated cities of Mumbai, Bangalore, Hyderabad, Delhi NCR – cities that experienced a drastic upsurge in the population of the *emerging middle class (people immigrating for the purpose of work – business and IT Hubs of India).* 60 females and 50 males – the predominant income is that of 1-5 lakhs (27) and 5-10 (38) lakhs per annum. Location of the residential complex near *public transport as a significant no of users are dependent* on it as a mode of daily commute. *(figure 6. Demographic distribution)*

Household distribution						
Places	1bhk	2bhk	3bhk	4bhk	other	
Mumbai	14	12	11	3		40
Delhi NCR(Gurgaon)	6	9	13	4		32
Bangalore	9	8	5		3	25
Hyderabad	10	9	5			24

Figure 10. Household distribution

	Number
Total	121
Gender	
Male	50
female	60
Prefer not to say	11
Age Group	
18-25	57
25-30	60
30-35	4
Income	
<1 Lakh	13
1-5 Lakhs	27
5-10 Lakhs	38
>10 Lakhs	21
Prefer not to say	22

Figure 11.Demographic distribution

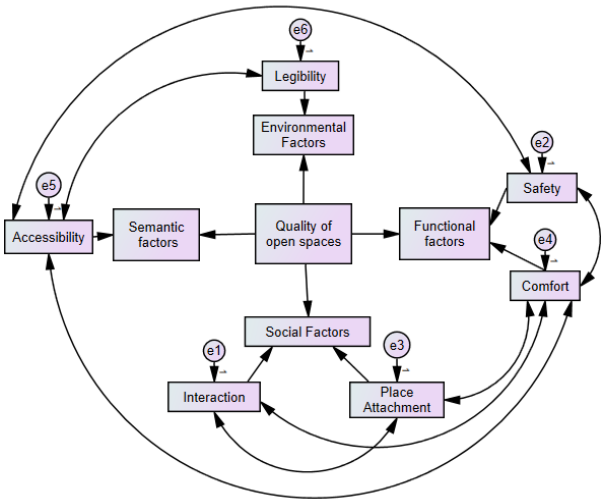


Figure 12 Factors of open space analysis

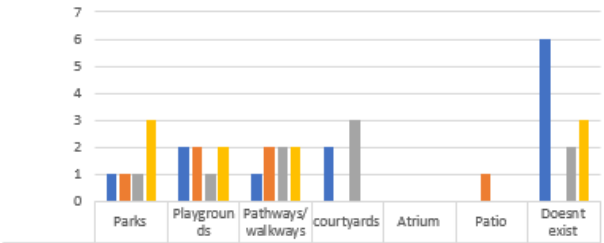
AMOS Equational Model

The equation model explains the correlation of different factors to understand that quality of an open space. Analyzing the collected data in terms of the given factors directs towards the guidelines post analysis. ***The errors are in consideration with the limitations -Context specific implication***

Through an Equation model factors of the "Quality of open space" is generated; ***Semantic factors*** *(Accessibility),* ***Environmental factors*** *(legibility),* ***functional factors*** *(Safety and comfort),* ***social factors*** *(interaction and place attachment) (figure 12)*

4.2 Characteristics of open spaces *(Objective 2)*

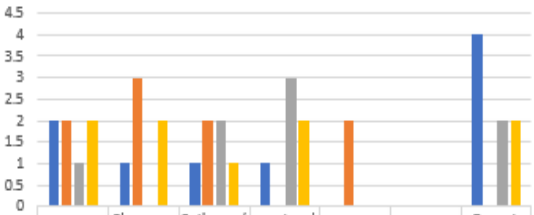
Table 1. Accessibility to open spaces - 1BHK



	Parks	Playgrounds	Pathways/ walkways	courtyards	Atrium	Patio	Doesnt exist
mumbai	1	2	1	2	0	0	6
Delhi NCR	1	2	2	0	0	1	0
Bangalore	1	1	2	3	0	0	2
Hyderabad	3	2	2		0	0	3

Figure 9 Accessibility- 1BHK

Table 2. Accessibility to open spaces - 2BHK



	Parks	Playgrounds	Pathways/ walkways	courtyards	Atrium	Patio	Doesnt exist
mumbai	2	1	1	1	0	0	4
Delhi NCR	2	3	2	0	2	0	0
Bangalore	1	0	2	3	0	0	2
Hyderabad	2	2	1	2	0	0	2

Figure 13 Accessibility- 2BHK

The table indicates the accessibility to nearby and surrounding open spaces in densely populated cities of Mumbai, Delhi NCR, Bangalore and Hyderabad with respect to 1BHK and 2BHK residences – the data collected can be interpreted to understand the distribution of Parks, Playgrounds, Pathways/walkways, courtyard, atrium, patio – Mumbai recorded a significant number of respondents who did not have access to any amenities which shows the unavailability of land in Mumbai. (figure 9 and 10)

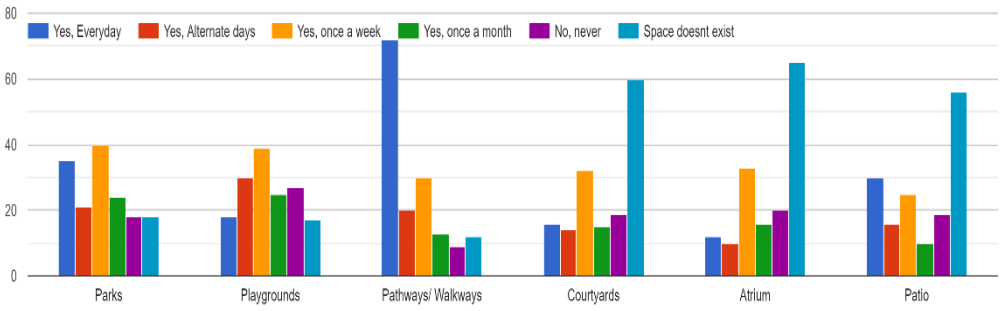


Figure 14 Approachability to open spaces

Graph1(figure 14) construes the **Semantic Factor** for the amount of time spent in these open spaces – this also deciphers the fact that pathways/walkways followed by parks are the most accessed spaces, they are also nonexistent spaces in many cases (15.7%) indicating the lack of the most basic amenity to some of the users. Through literature study it is identified that the provision of open spaces in and around a residential complex creates and enhances the perception of the city for the user, it also enhances the lifestyle.

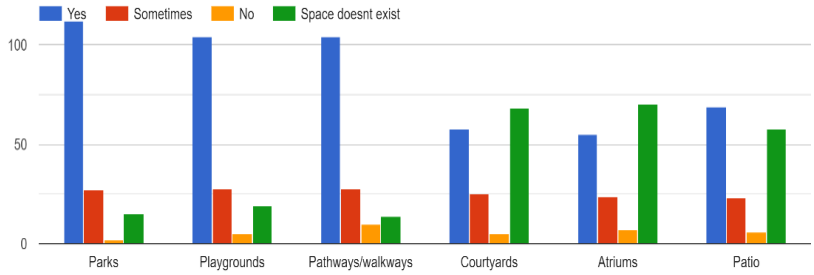


Figure 15 Comfort and safety in open spaces

This graph interprets the **Functional Factor** of comfort and safety to the specified open spaces – although majorly the respondents felt safe and comfortable; yet the reasons for discomfort and lack of security were recorded – these point towards the lack of maintenance in terms of lighting (2.4%),

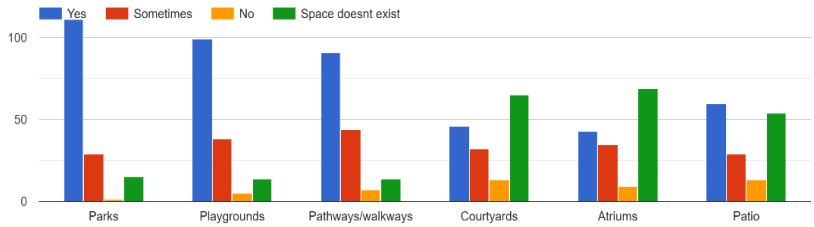


Figure 16 Sense of community through social interaction

barrier between the outsiders and residents of the complex (4.1%) (figure 15)

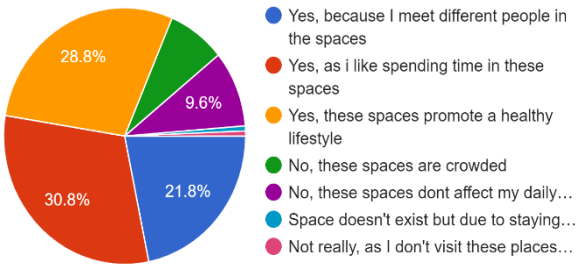


Figure 17 Social interaction in spaces

Through literature case studies and literature reviews it has been established that 'satisfaction of a user' in a residential complex is largely administered by the presence of open spaces and the way these open spaces initiate social interaction among its users. (figure 16)

According to the graph above the respondents do agree to the fact that these places initiate social interaction for the users but simultaneously the 15.7% of the respondents who are deprived of this amenity – **social factors .**

To try to understand the relationship between opens spaces and its user this pie chart explains how significantly social interaction contributes to the sense of community and belongingness in a society **– Place attachment**

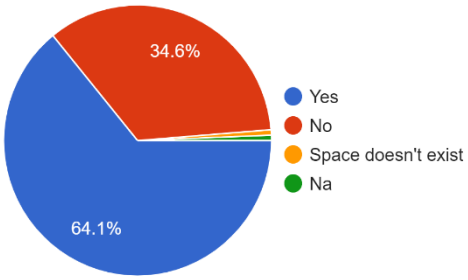


Figure 18 Segregation between pedestrian and vehicular pathway

Legibility – semantic factor, is one significant factor contributing to the satisfaction of the users in a residential complex.

As observed 34.6% respondents established that a prominent demarcation between a walkway/pedestrian pathway from a vehicular pathway was not present in their residential complex- this indicated the unavailability of land to segregate the pedestrian walkway from that of a vehicle, this also causes a factor of insecurity within the users. (figure 18)

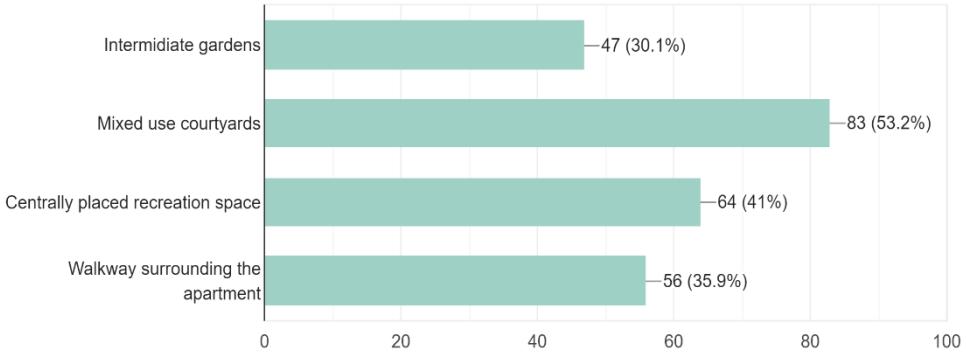


Figure 19 Preference of open spaces

Through the literature case studies this has been established that the way Indian societies function are largely based on the factors dependent of social interaction – the same has contributed significantly to the choices opted for by the respondents for their preferred category of open space, with 53.2% respondents opting for a **mixed-use courtyard** determines the user behavior and activity of the respondents. It shows that recreational spaces and multipurpose courtyards creates a sense of community and belongingness within the user – this highlights place attachment as a prominent feature. (figure 19)

Places	1bhk	2bhk
Mumbai	14	12
Delhi NCR(Gurgaon)	6	9
Bangalore	9	8
Hyderabad	10	9

Figure 20 Household Distribution (1BHK and 2BHK)

4.3. Open space wise analysis *(objective 2)*

From the 121 respondents – the above table shows the household distribution with respect to 1 and 2 BHK residential complexes. (figure 20)

Through literature reviews and case studies several types of open spaces were identified, the survey done was to understand the user behavior in and around the identified open spaces, this is done with regard to the housing typology of 1BHKs and 2 BHKs in the surveyed locations.

The following graphs are an analysis of the *Quality of the identified open spaces* in terms of Semantic factors, Functional factors, Social factors, Place attachment, etc. (Factors considered from literature review)

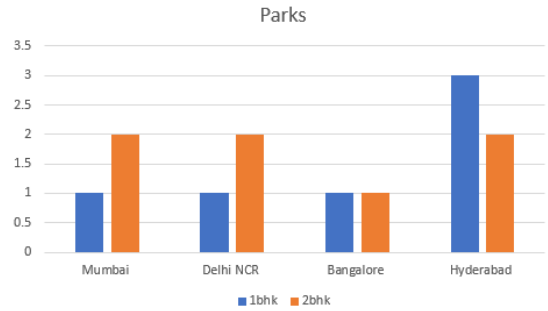


Figure 21 Distribution of Parks

As the survey indicates the highest number of parks with respect to location and residential complexes are in Hyderabad, which indicates the availability of land and open spaces in the region. (figure 21)

Semantic Factor (Accessibility) – Parks are easily accessible, yet the highest frequency of people visiting the parks is *once a week (34.3%)*

Functional Factor (Comfort and safety) – The frequency of respondents corresponding to "yes they feel comfortable in the parks" is 41.2%; 21% people respondents felt "uncomfortable" due to poor lighting, meager segregation between residential and public area.

Social Factor – Highest no. of respondents (64.4%) experience maximum amount of social interaction in parks followed by pathways and playgrounds.

Place attachment – The reason for respondent to feel relaxed and connected to the community is because they meet new people through these spaces and it also promotes a healthy lifestyle.

Semantic Factor (Legibility) - Parks are easily accessible according to the respondents.

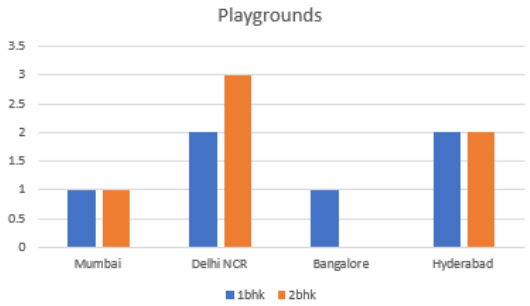


Figure 22 Distribution of Playgrounds

The survey indicates the highest number of playgrounds (figure 22) in Delhi NCR and Hyderabad which highlights the infrastructural effort to improve the quality of lives of the city's netizens.

Semantic Factor (Accessibility) – Playgrounds attract a very specific age group thus the frequency of visiting the playground in *once a week (30.2%)* with 20.2% respondents had playgrounds which were 'too far to walk'

Functional Factor (Comfort and safety) – The sense of safety in playground is lower than Parks (10.2%); approachability plays a significant role in it.

Social Factor – Playgrounds extend interaction within various age groups.

Place attachment – Since there is interaction within different age groups of people playgrounds create a sense of community within its users.

Semantic Factor (Legibility)- Access to these open spaces is such that it is 'too far to walk' for over 20.2% of the respondents

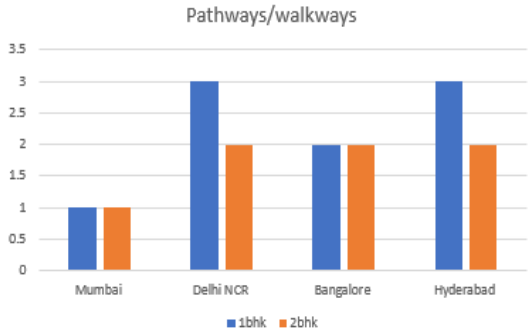


Figure 23 Distribution of Pathways/Walkways

Pathways connect different open spaces to each other and form the big part of a complex, it segregates the pedestrian from the vehicular way. (figure 23) The highest number of pathways and walkways are recorded in Hyderabad and Delhi NCR indicating the availability of land to provide such amenities.

Semantic Factor (Accessibility) – According to the respondents the pathways and walkways are the most accessed spaces (59.6%) followed by parks

Functional Factor – Respondents feeling an absence of security is higher this is related to the absence of segregation between vehicular and pedestrian, onlookers etc,

Social Factor – As the most accessed space these walkways increase the opportunity for meeting different people which plays a significant role in social interaction.

Place attachment – A sense of community is brought forth due to the increased social interaction.

Semantic Factor (Legibility) – Absence of segregated pathway and vehicular way causes obstruction in easy access

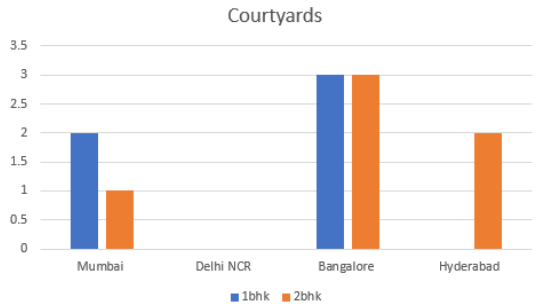


Figure 24 Distribution of courtyards

The presence of courtyards is largely context specific as can be observed since the concept of courtyards are prevalent in the construction in the western and southern regions of India.(figure 24)

Semantic Factor (Accessibility) – residential complexes built surrounding a courtyard act as multi purpose spaces eg: Chawls in Mumbai(1BHK)
Functional Factor (Comfort and safety) – Since in the vicinity of the complex it provides a sense of safety with regard to its users.
Social Factor – Different activities take place in and around courtyards which enhance social interaction within users
Place attachment –Due to this there is an increased sense of community within users.
Semantic Factor (Legibility)- ease of access**.**

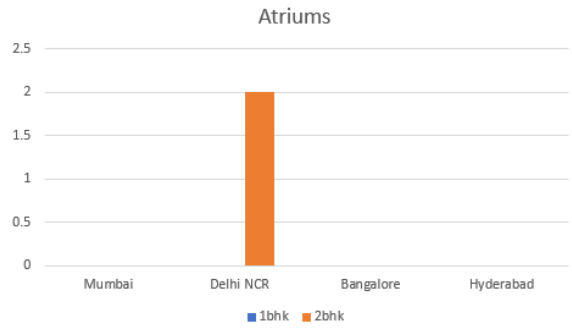


Figure 25 Distribution of Atriums

Atriums create the perception of the visitor and the user, the presence of which was recorded in Delhi NCR. (figure 25)
Semantic Factor (Accessibility) – Since atriums are usually places at the entrance or the lobby there is ease of access.
Functional Factor (Comfort and safety) – Since present at the entrance users feel safe.
Social Factor – The lobby is usually a hotspot for social interaction within users
Place attachment – Contributes significantly to a sense of community
Semantic Factor (Legibility)- Ease of access.

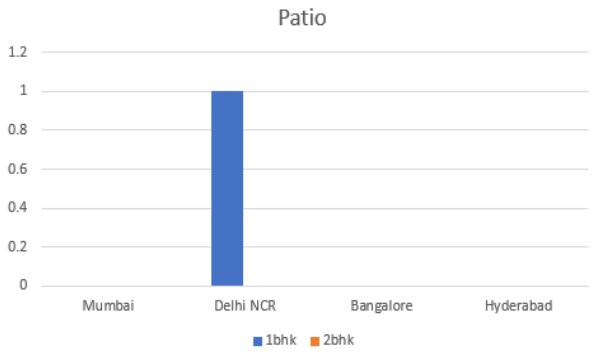


Figure 26 Distribution of Patio

Patios are specific to a type of housing, through the survey collected on patio is recorded in Delhi NCR. (figure 26)

Semantic Factor (Accessibility) – Since patios are considered in private open spaces the access is through the residence.

Functional Factor (Comfort and safety) – Patios serve the same comfort and safety as a balcony

Social Factor – Just as balconies patios serve the purpose of social interaction.

Place attachment – Contributes significantly to a sense of community

Semantic Factor (Legibility)- Ease of access.

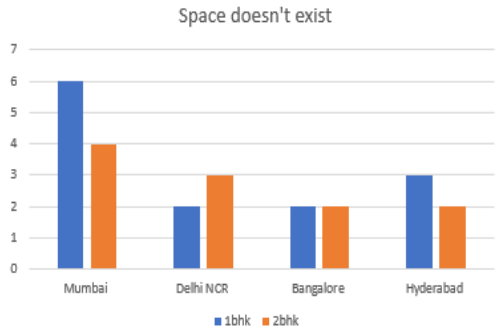


Figure 27 Absence of spaces with respect to location

The absence of various open spaces directs towards the different land availability and regulations in the surveyed locations.

The absence of the most basic open space amenities such as walkways and parks indicate the variation in housing expenses and the FAR of the region.

As established opens spaces create the perception of the city for the users, the absence of these cause a threat towards the social, economic and sustainable factors of livability in a city. (figure 27)

4.4. Design guidelines from analysis *(objective 3)*

Housing and open spaces with respect to context

The surveyed locations are Bangalore, Delhi NCR, Hyderabad and Mumbai.The extent of open spaces in neighborhoods is directly proportional to the locations with varied dependent factors such as – Availability of land (dependent factor of cost of living), building regulations, surrounding amenities, etc.

Mumbai – 10% of the land area is supposed to be left for recreational area with all the recreational spaces in one space (Urban Development Department Maharashtra).

For the purpose of group and cluster housing a minimum of 200 sqm of recreational open space is a necessity.

- *Bangalore – For sites admeasuring 2000 sqm, 10% of the land area will be earmarked for open space, for sites admeasuring 1000 sqm, 5% of the land will be used for open spaces.Minimum of 10% 15% of land area has to be kept for open spaces – eco sensitive zones – existing lakes and parks*

- *Delhi NCR – Provision of open courtyard (2mx2m) for plot size of 50sqm to 100smq. Minimum of 15% of permissible area can be utilized for the purpose of recreational open spaces*
- *Hyderabad – The open spaces are demarcated on the basis of the height of the proposed building which ranges from 8m to 19m all around the site. For group housing and apartments, a minimum of 12% of the site has to be provided for opens spaces.*

Effects of open spaces on neighborhood

The provision of opens spaces increases the cost of living in the respective neighborhood, but it also causes a shift in the neighborhood from urban city centers to the outskirts of the city due to the availability of land; increasing the cost and effort of commute.

Although there are positive impacts of open recreational spaces on the home buying behavior yet buying a house is not a principal behavior of the age group living in 1 and 2 BHKS. The satisfaction of a resident in these neighborhoods is determined by the various tangible factors.

- ***Semantic Factors***

Factors such as ***legibility of the space (ease of access)***, ***restriction in access***, ***identity of a place*** play an important role in defining and accentuating ***the character of the place (with respect to the context)*** as well as play a significant role in satisfaction.

- ***Functional Factors***

The functional aspects of an open space Is greatly dependent on the ***user diversity in the space (inclusive design)***, the ***views of space and from the space create the perception of the user*** within the space, ***demarcated pathways for access.***

- ***Social Factors***

Open spaces build the ***foundation for social interaction within different people from various walks of life*** – thus the space should promote ***interaction through the activities performed***, ***the furniture used (open gyms)***, ***safety*** also a significant factor which plays a predominant role in satisfying a person in a certain space.

- ***Environmental Factors***

The vegetation used in the open spaces ***controls the micro climate*** within the space (context specific).

SEMANTIC FACTORS

Legibility of space

The open space should be easily identified – use of signs to approach the space and move around within it.

Restriction in access

Open space within the neighborhood should have an ease of access (devoid of any barriers- railway line, crisscross roads etc.), considering the different age groups of people accessing it.

Identity of the place

Open spaces should have an identity of its own which can be on the basis of the proposed activities (children's park – theme parks etc.) which can also be context related.

FUNCTIONAL FACTORS

User Diversity

Recreational open spaces are spaces made to admit people from various walks of life – thus inclusive design is a necessity

Views

Perception of a space is created in a space through the views the user gets within the space – use of murals, artifacts, sculptures to creates a perception of the space, lighting can also be used to achieve the desired views and perception.

Pathways

To cater to the functional factor of pathways it's important to create intermediate pause points, seating, etc. to address the older age groups.

SOCIAL FACTORS

Safety

The safety within an open space ensures social inclusion – visual surveillance, maintenance of the space and an easily accessed pathway are points of consideration for safety in open space.

Social interaction

As open spaces are hotspots for social interaction within various groups of people thus the space should encourage various activities- the furniture used, open courts, open gyms, playground, etc.

Segregation of spaces

The recreational open space should be exclusive for the residents of the society – creating a barrier between the outsider and resident – promotes social security and comfort

ENVIRONMENTAL FACTORS

Microclimate

As opens spaces aim at being and active and passive recreational thus it demands to be heavily vegetated since it creates a buffer between the built and the unbuilt.

Natural Shading

The open space is devoid of built shading devices as the trees used would create the same effect and contribute significantly to the micro climate of the space.

Contextual flora

The vegetation used should be maintained regularly and species with regard to the context should be used in these open spaces.

5. CONCLUSION

This study is conducted to understand the distribution of open spaces in residential neighborhoods with respect to 1 and 2 BHK housing types. The necessity of the open spaces is highlighted through the study; throwing light on the satisfaction of a user in a neighborhood - determined by their experience in the open spaces within their vicinity. Recreational open spaces are an essential component in maintaining the healthy wellbeing of the residents thus a certain percentage of land area is always demarcated in the urban

development laws, but over the time the urban city centers with a lack of available land have tweaked the bye-laws in their favor depriving the residents of 1 and 2 BHK residents of open spaces as seen in the survey conducted for Mumbai. The location of these apartments are predominant factor in attracting the target user- group as they are dependent majorly on the public transport for commute- as seen in Mumbai and Delhi NCR but these urban city centers also face a major issue of land availability which makes the provision of open spaces in residential neighborhoods a difficult task ; this usually ends up pushing the project further away from the city centers thus increasing the time taken to commute.

Thus, this study explores the user behavior of the target group with respect to daily commute, access to open spaces and their user activity in and around those open spaces. In this study, the characteristics and dependent factors of open spaces were explored with respect to residential neighborhoods of 1 and 2 BHK apartments. The dependent factors were categorized in terms of semantic factors, functional factors, social factors, environmental factors which highlight the quality of space which is a dependent factor to the satisfaction of a user in an open space. The survey collected explores their accessibility, safety, comfort, etc. with respect to context which throws light on how the various land regulations play an important yet an indirect role in creating the perception of the user. The guidelines are proposed in agreement with the factors explored and are a general outline to create an open space that attains the satisfaction of the user while maintaining the quality of the open space.

6. LIMITATION

The limitation of this research is that the guidelines produced are of a broader classification rather than being context specific. There is further scope of research in terms of context specific factors related to open spaces. The factors of satisfaction with respect to different age groups to facilitate their need sin the design of recreational open spaces can also be a field of further research.

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