International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 13 (2018) pp. 11172-11182

Assessment of Usability of Green Spaces for Low and Higher mobility User in Gated Residential Communities through Accessibility Indicator

Dr. Prashanti Rao
Architect and Urban Planner (Practicing)
Former Assistant Professor in Department of Planning
School of Planning and Architecture Bhopal
Bhopal-462021, Madhya Pradesh State, India.
Email:prashantishyam@gmail.com

Dr. Prashanti Rao
Architect and Urban planner
prashanti_swe@yahoo.com
prashantishyam@gmail.com

Abstract

The residential level green space was said to be legible when the resident able to find the way with ease and unearth it with sense of security and comfort. But in today's context the green spaces in Indian context were provided in gated residential communities only to fulfil the bylaws and economic gain by the developers. Due to limited area as per bylaws, it leads to fragmentation of green spaces, which impacts on location of these spaces, within the boundary. Accessibility itself was a complex process and when viewed in terms of low and high mobility user group to access green spaces within residential community, it became more complex. The unjustifiable location restricts the frequency of usage amongst varied age group. Here in this paper physical (distance) and visual (area under natural surveillance from dwelling) accessibility had been used as an indicator to map the usability of green space to do a need assessment. In this purview observation studies were carried out in selected green spaces of gated residential communities and activities mapped through dot density mapping. Proximity analysis was done for both physical and visual accessibility. The results show that there was a different role of both accessibility on usability of green spaces related to both mobility user group. The results strongly recommend the inculcation of visual accessibility in present regulatory framework for better usability of green spaces.

Keywords: Green Space (GS), Gated residential community (GRC), Physical accessibility, Visual Accessibility, Usability.

INTRODUCTION: BACKGROUND, CHALLENGES, NEED AND RELEVANCE

Urbanization in India is faced with two pronged challenges. On one hand the pressure of the ever-growing existing cities coupled with the colossal challenge of providing them with basic infrastructure and services. On the other front, *increasingly several private developers* are beginning to see private cities and townships as the solution to the woes of existing cities. (Centre for Science and Environment, 2012) Housing demand encouraged the growth of real estate sector; this played an important role in existence of gated residential communities (GRC) in Indian cities. (PWC, 2014) They are sprouting across the city and infrastructure constructions have replaced previously open spaces. This resulted in gap between the major populations living in gated residential community from availing day to day benefits from higher order green spaces compare to those residing in urban limits. As an impact interface this made residents of gated residential communities to rely more on green spaces (GS) within the boundary.

Though GS in GRC is considered as one of the sustainability indicator, but it has lesser percentage (10% to 15%) share to serve with respect to total land parcel as per Model bylaws in Indian context. Due to its limited area, it acts as hindrance to provide all amenities to all age group, which impacts on its usability. The usability of green spaces differs due to different spatial arrangements within the GRC and variation in the provision of it within gate with respect to quantity and quality. Many previous models and theories substantiate that the usability of GS is directly associated with its accessibility. As per Indian standards the accessibility is measured as distance and mentioned as 400 meters for neighbourhood green space whereas, residential within 150 meters respectively. (MOUD, Government of India. 2004,2016) The dependency on quantitative standards in planning practices for the provision of GS had developed a few limitations in its usability. These quantitative measures are relatively easy in operational and practice level, but inadequate to address the complex nature of people's perception regarding green spaces accessibility. Almost all prevailing space standard models comprises of quantitative measures, which indicate relation between population sizes in the target area for instance Small towns 1.0 to 1.2 ha /1000 person, Medium towns 1.4 to 1.6 ha/

1000 person, and Large & Metro cities 1.2−1.4 ha per 1000 person respectively.(MOUD, Government of India. (2014).) With few contextual modification this model is accepted worldwide due to its simplicity in operation, but later on has been critized for its disregard of complex social systems.

The traces from literature also highlights about the qualitative aspects like perceived accessibility (Safety-security & natural surveillance) which bring the benefits like social cohesion and feeling of being safe. This provided new dimension to the physical accessible spaces. Few theories suggest that the degree of the enclosure in urban space having physical accessibility make them a positive, safe or active space. As describe by (Lotfi, 2015); (Ewing & Handy, 2010), positive spaces are conceivable, and can be measured and has definite boundaries whereas negative spaces are inconceivable, continuous and lacking in perceivable edges and forms. Paul Zucker in 1959 argued upon the degree of enclosure and spatial containment in hard spaces. He said "*the amount of enclosure and the resultant level of containment partially depend on the ratio of the width of the space to the height of the enclosing walls. The most comfortable viewing distance of building is or should be designed to be seen in a single view*."Similarly as per crime prevention through environmental design (The State of Queensland, October 2007) report, increased crime enhanced the need of safe green space within the residential community. But bringing the feeling of safety and security depends on the location criteria of the GS. Hence those theoretical arguments develop a construct that visible vicinity felt safer rather than those which were not visible.

The question aroused, "Was the limited byelaws for accessibility for provision of GS, sufficient to cater the needs of the residents of GRC? Whether the perceived or visual accessibility enhances the usage of GS by developing sense of safety and social cohesion? How the various age group users respond to the physical and visual access to the GS? " There was a need to enquire how much GS are accessible to the users within the gate. Hence this paper intended to assess the need of visual and physical accessibility for the usage of green spaces through observational studies.

METHODOLOGY FOR STUDY:-

In order to map the accessibility, it is required to know the mode of measurement. In case of physical accessibility, it can be measured through distance, but in case of visual accessibility, needed to be devised. The methodology for measurement of visual accessibility had been devised on the basis of the Paul zuker theory "*amount of enclosure and the resultant level of containment partially depend on the ratio of the width of the space to the height of the enclosing walls"*. (As shown in figure-1) This statement indicates two important aspects one was how to measure the amount of visible space or enclosed space and also its connectivity with height of the enclosure and width between the enclosures. Hence this made essential to identify the type of enclosures available in the contemporary gated residential communities.

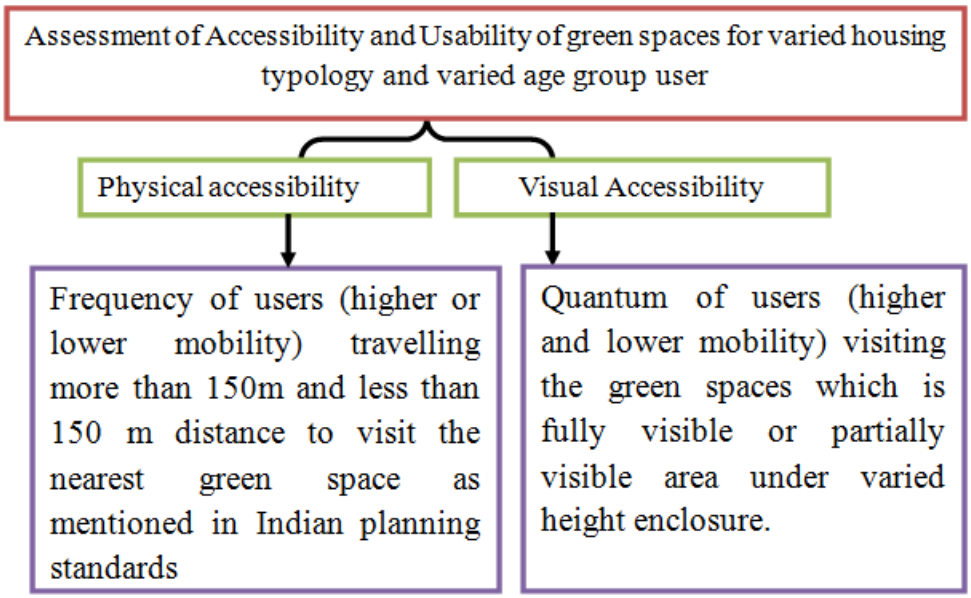


Figure 1. Methodology for studying the impact of accessibility on usability

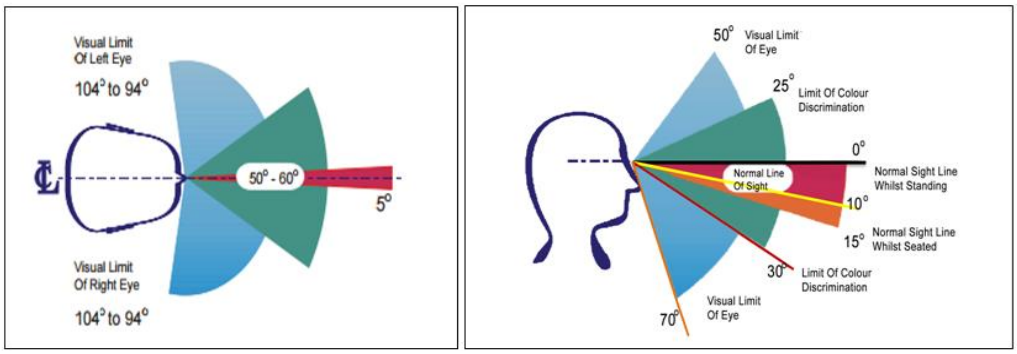


Figure 2. Horizontal Field of View and vertical field view
Source: (Felleman, 1979)

I. Age Group criteria adopted for mapping

This research basically dwells upon the green space experience for varied age group users. Hence the age classification was important. The world health organization (WHO) for environmental and psychological studies suggested the under mentioned classification in which five groups were identified − those under 15, 15−24, 25−44, 45−64 and 65+ years old. But for study the age group had been classified under six categories. They were as follows, under 4 years dependent children (category-I); 5-14 children (Category-II); 15−24 teen (Category-III); 25-44 adult (Category-IV); 45-64 senior adult (Category-V) and 65 above old age (Category-VI). Under which Category- I, II and VI comes under low mobility user and Category –III, IV and V comes under high mobility user.

II. Method for collecting observational data

Observational data had been collected for morning and evening hours of weekends during summer vacation (April to June of 2014) to map the maximum usability of green spaces. Data had been collected on the basis of physical verification of all activities happening during the selected time i.e. morning 6:00 A.M to 8:00 A.M and evening 5:30 to 7:30 P.M. Data had been collected to know four major factors i.e. Who are the users, kind of use, issues of physical characteristics of GS and to examine the impact of the physical and visual accessibility.

III. Method for mapping physical and visual accessibility in six steps

- **Step-1** The location of the identified GS was mapped along with the access roads, surrounding houses and differentiated the height of building with varied color.
- **Step-2** The houses through which residents were visiting the GS highlighted in a grey shade.
- **Step-3 and 4** Taking centre of the green space and outside edge as first concentric ring were generated in the interval of 5 meters and over layered to identify the physical proximity from the entry point of the GS to their respective houses.
- **Step-5** Taking 50^0 as per horizontal field view the area under visual influence had marked from the households in the triangular shapes. Those triangular visual cones were marked for three situations of the green space i.e. fully visible, partially visible and not at all visible.
- **Step-6** Dot density mapping method was adopted to map the frequency of the users visiting the GS. The varied color dots represent varied category of age group user inside and around the selected GS at a particular set of time by considering both kind of accessibility.

To understand the dynamism of accessibility within the GRC the three housing typologies were selected based on predominant building heights i.e. Row housing or plotted development (G+1), Group housing or mixed housing (G+1, G+4, G+6) and Multi-unit residential housing (G+4 & G+6). While selecting the colonies under those housing typologies, special consideration was taken to see that they were fully occupied and about 500 meters or more away from any city or community level green space of the urban area. In this purview, three colonies were selected i.e. one under each category. The observational studies were conducted (as shown in fig-1), based on primary survey for most usable GS of vicinity.

STUDY AREA

The observational studies for green spaces were conducted for three selected colonies under each housing typology i.e. Tulsi vihar (Row housing), Sagar royal villas (Group housing) and Saumya parkland for (Multi unit residential housing) respectively. Based on primary survey, the selected GS are Tulsi vihar colony-P1: Sagar royal villas –P3 and for Saumya Parkland –P1& P2 respectively. Below mentioned demographic profile for each study area depicts these age group categories.

Tulsi vihar (Row Housing) Sagar royal villas (Group Housing) Saumya Parkland (Multi unit housing)

Figure 3. Three selected colonies for varied housing typology

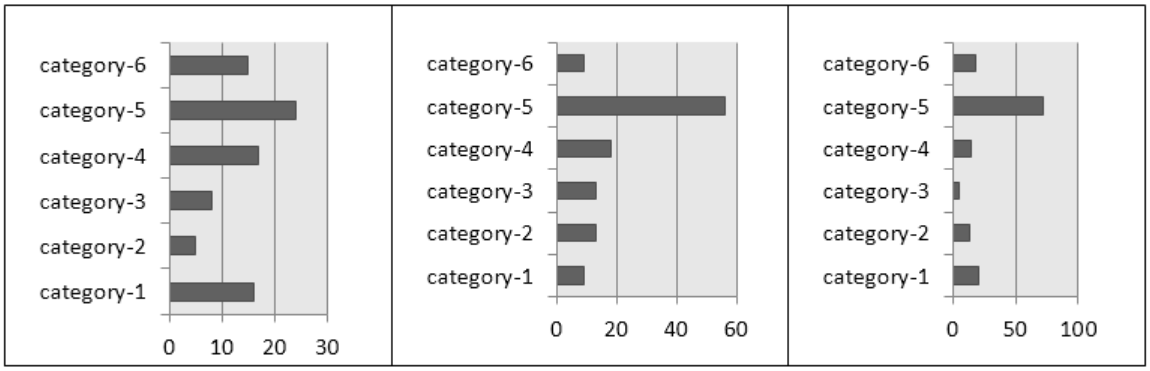


Figure 4. Demographic profile for selected colonies for varied housing typology

Tulsi vihar Colony –P1: The GRC was situated in the periphery of Bharat Heavy Electrical Limited (BHEL) Industrial area. It sprawls over an area of 2.52 acres under Row housing scheme. TNCP (town and country planning) permission was obtained in 2007 and BMC (Bhopal municipal corporation) permission in 2008. It comprises of 80 household units of G (Ground) and G +1(Two floors) structure. It comprises of three GS; one is functional of approximately 716.76 square feet (sqft) area, and other two were not functional of about 506.08 sqft area as shown in Figure -3. The demographic profile of the colony had depicted below in Figure-4 which shown the mix concentration of all age group category of high and low mobility users.

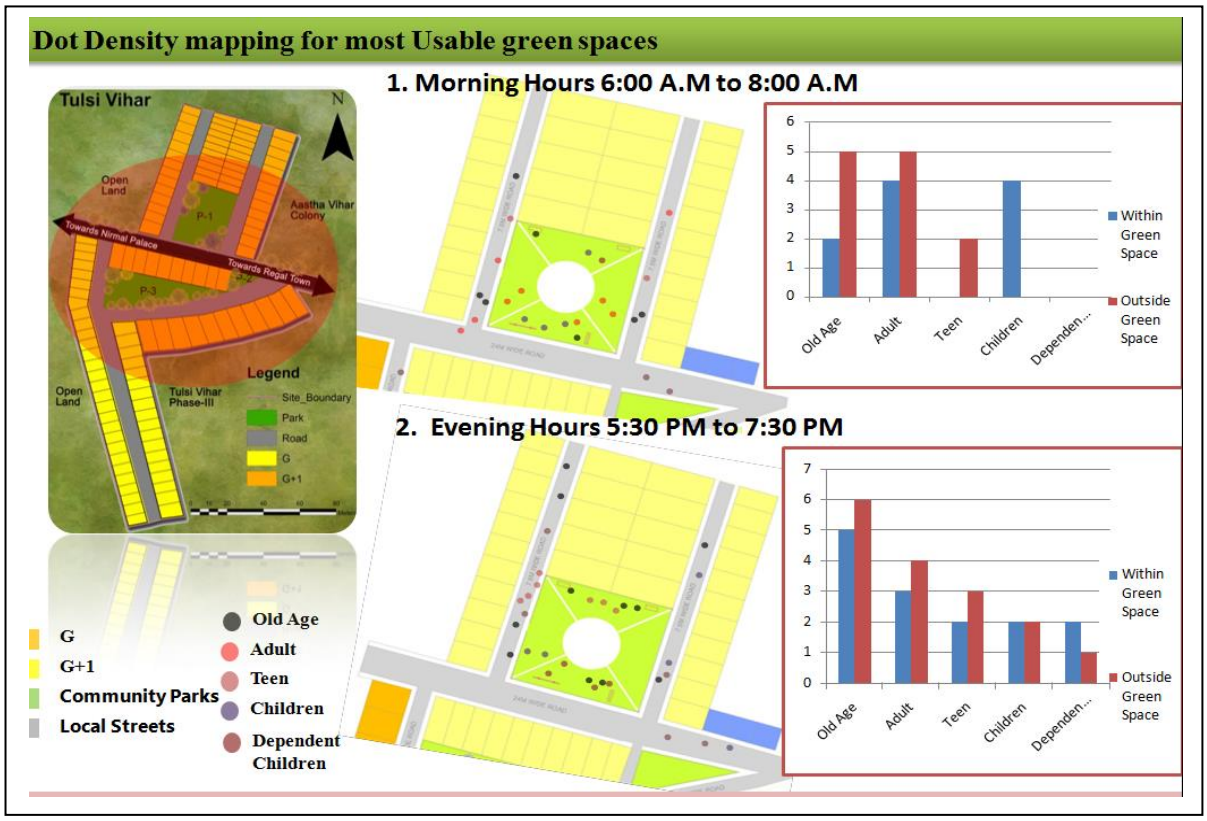
Sagar Royal Villas –P3: The GRC, namely Sagar Royal Villas, was situated on Hoshangabad road, near Habibganj railway station of Bhopal City. It occupies an area of about 11.32 acres. It comprises of Row housing, Multi unit housing and conventional shopping centres. Approximately 750 residential units were there. As shown in Figure -3 there are six GS on the premises. Few of them are regular and few irregular in shape and size. The GS namely P1, P2, P4, P5, P6 is situated with rectangular shape arrangement spatially in between the row housing. But through primary survey P3 was most usable GS. Lack of GS in front of multi-unit residential, make the residents to use the prominent green Space, i.e. P3, P4 and P5 because of their physical accessibility. Most of these GS are passive in nature. (as shown in Figure-3) The demographic profile showed the mix concentration of all age group category of high and low mobility pace. The population of category-5 was more compared to other categories. .(as shown in Figure-3) The rest of the categories were almost evenly distributed in whole colony.

Saumya Parkland – P1 and P2 : The Saumya Parkland (Multi unit residential project) was situated in the peripheral area of BHEL campus namely Gram Khajuri Kalan. It was spreaded over approximately eighteen acres having 375 household and comprises of five numbers of planned GS as shown in fig-2. The GS namely P1 and P2 are a combination of passive and active amenities with regular shape and size. The population of category-5 was more compared to other categories. (as shown in Figure-3) The rest of the categories were almost evenly distributed in whole colony.

MAPPING THE PHYSICAL AND VISUAL ACCESSIBILITY

In order to study the impact of physical and visual accessibility on usability of green spaces the two kind of mapping strategies were adopted here. . Initially, Dot density mapping had been done to understand green space users in terms of mobility and age categories. Secondly, mapping the physical distance through simple concentric circle buffer rings and 50^0 horizontal vision cone standards taken from view shed theory method to assess the visual accessibility (fully, partially)

Tulsi Vihar colony (Row Housing)



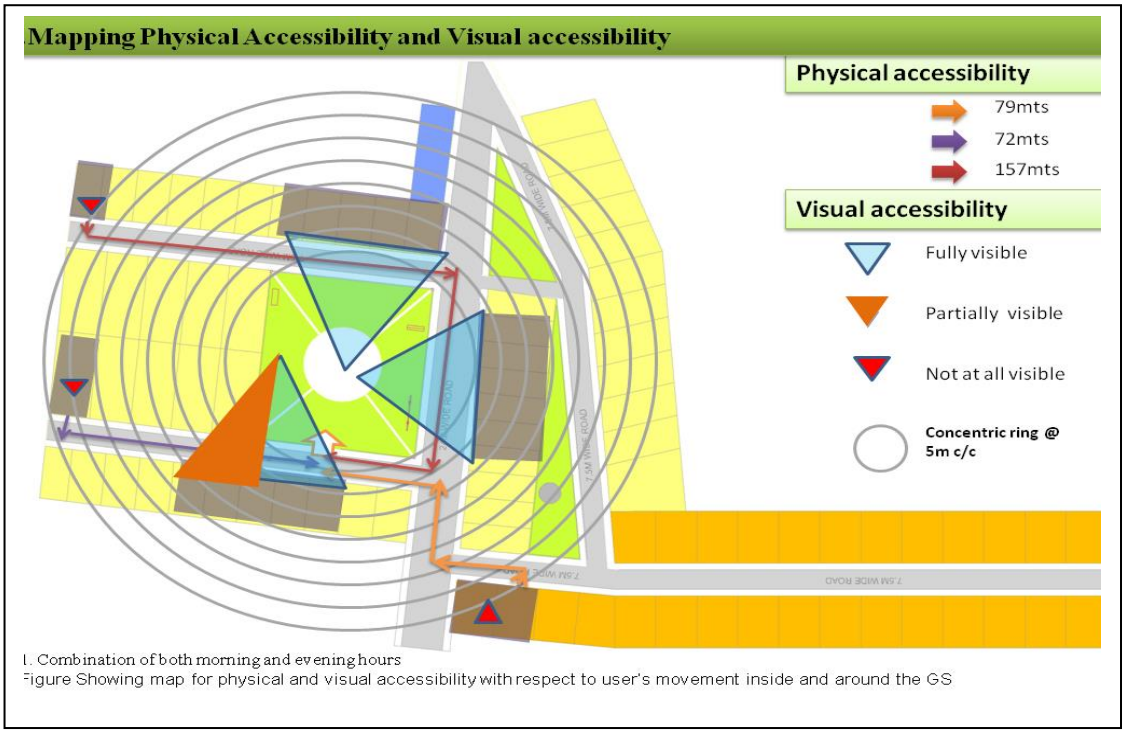
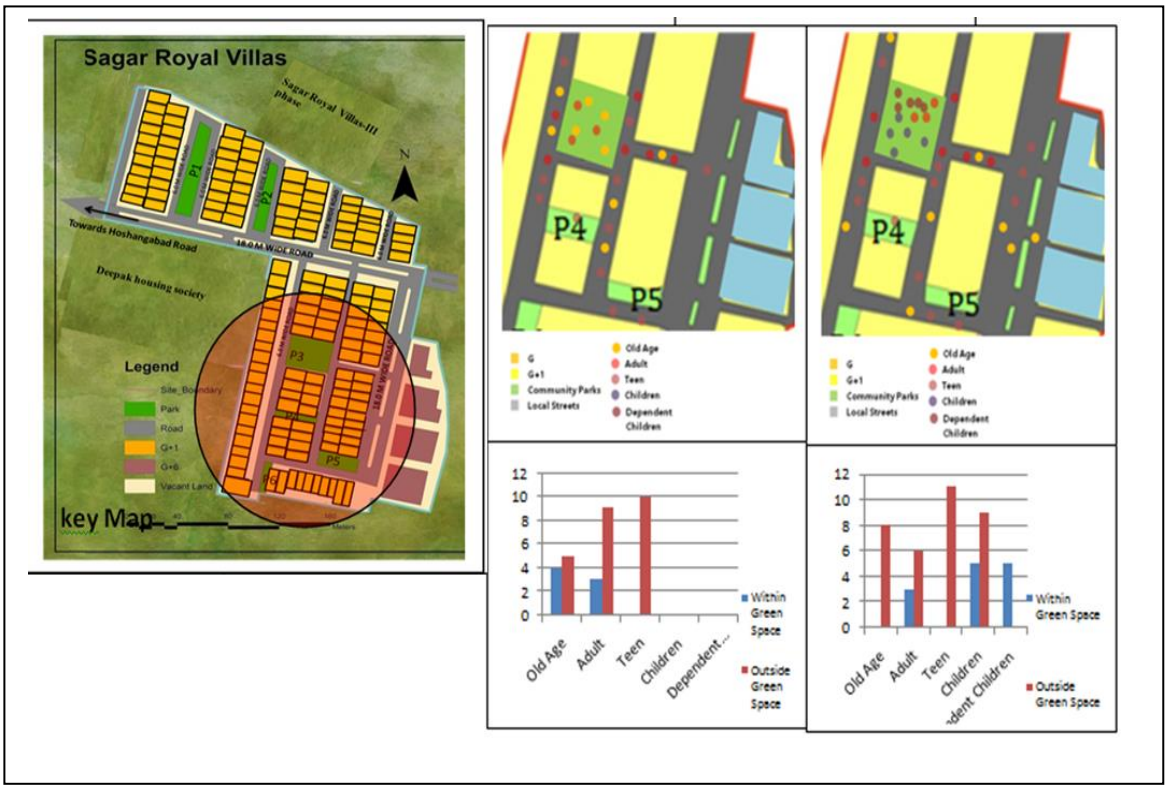


Figure 5. Dot density mapping for identification of green space users (Morning Hours 6:00 A.M to 8:00 A.M). Evening Hours 5:30 PM to 7:30 PM) and mapping the physical distance and visual access through concentric and visual cone method

Sagar Royal Villas (Group Housing)



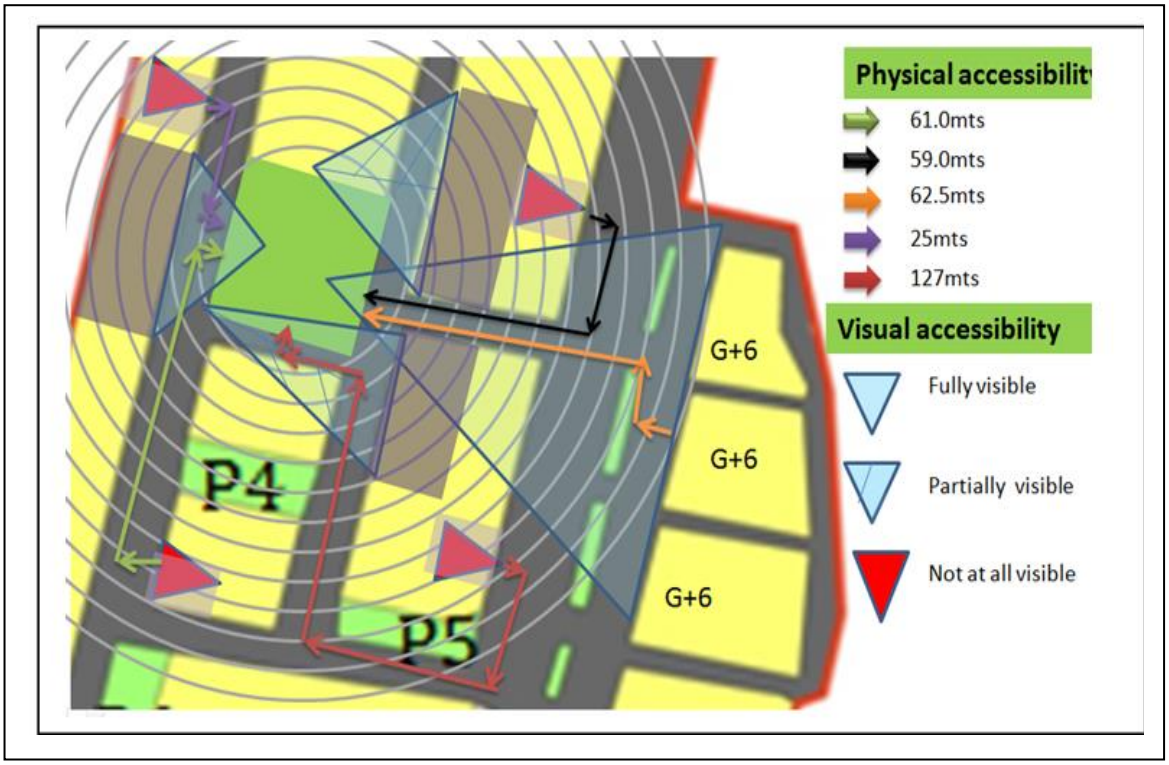
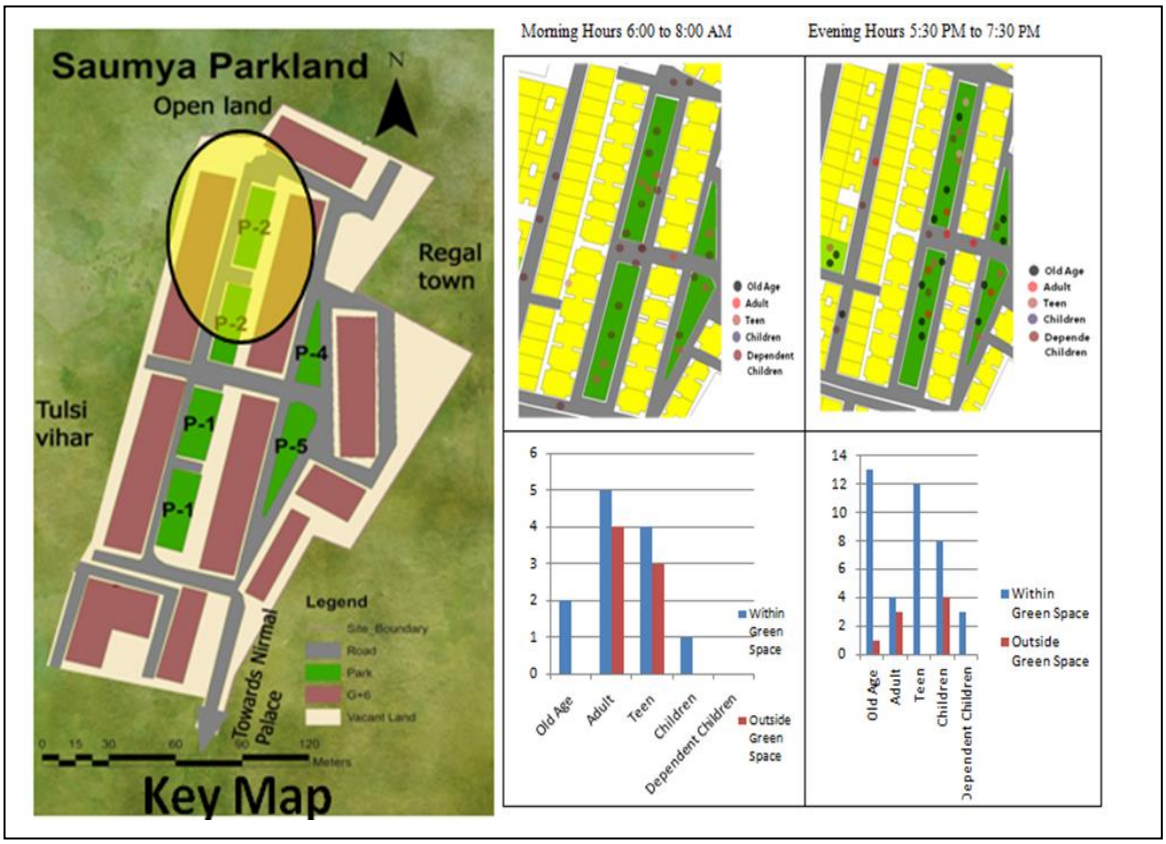


Figure 6. dot density mapping for identification of green space users (Morning Hours 6:00 A.M to 8:00 A.M). Evening Hours 5:30 PM to 7:30 PM) and mapping the physical distance and visual access through concentric and visual cone method**.**

Saumya Parkland (Multi Unit Housing)



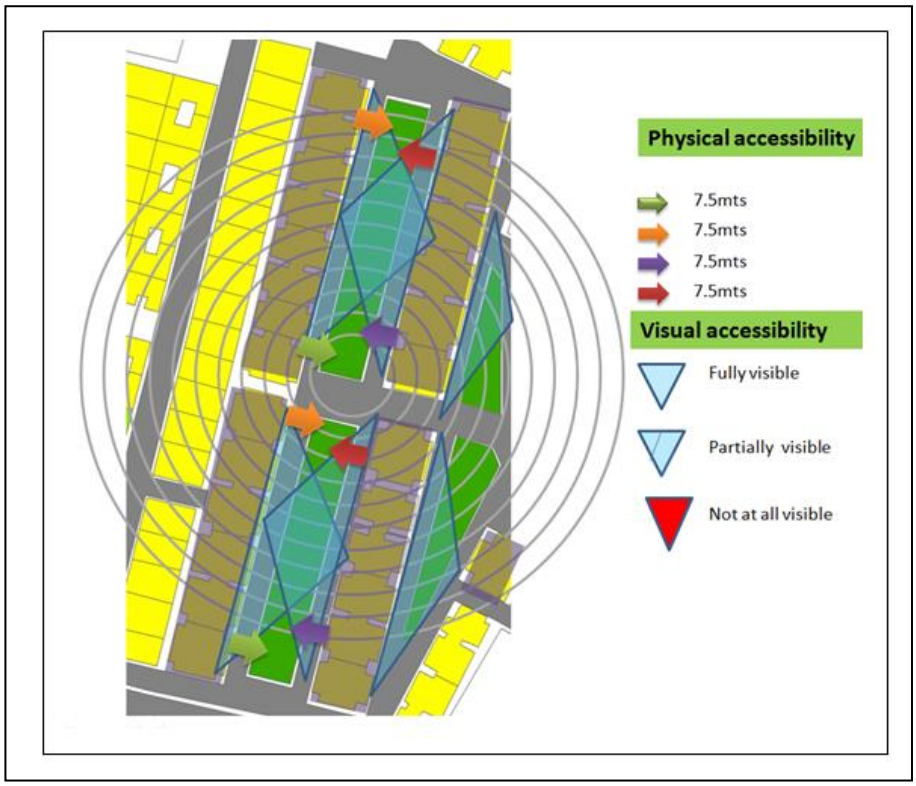


Figure 7. Dot density mapping for identification of green space users (Morning Hours 6:00 A.M to 8:00 A.M). Evening Hours 5:30 PM to 7:30 PM) and mapping the physical distance and visual access through concentric and visual cone method

ANALYSIS AND INTERPRETATION

Three criteria had been adopted to analyze the observational studies in order to establish a relationship between accessibility and usability. Initially, the frequency of all category users in the most usable green space of the vicinity in morning and evening hours was studied. This often helps in identifying the relation between use with size, shape and location and reason for over and under utilization. Secondly the visual proximity analysis using the concept of horizontal view shed where 50^0 angle as maximum limit of vision had been utilized to identify dwelling under fully visible and partial visible with respect to height of the dwelling. The final criteria were adopted to identify the physical proximity of the user's dwelling from the nearest green space. This had been done by using concentric buffer of 5 meter around the green space.

Analysing the relationship between kind of user (Lower and higher mobility user) and green space type (passive and active) through dot density mapping.

Table 1. Showing the Morning Hours 6:00 A.M to 8:00 A.M users

S.no	Age category	Tulsi Vihar (Passive)		Sagar Royal Villas (Passive)		Saumya Parkland (Active and Passive)	
		Inside	outside	Inside	outside	Inside	outside
1	I	0	0	0	0	0	0
2	II	5	0	0	0	2	0
3	III	0	2	0	5	4	3
4	IV & V	2	4	3	5	5	4
5	VI	1	4	3	4	2	0

Table 2. Showing the Evening hours 5:30 PM to 7:30 PM users

S.no	Age category	Tulsi Vihar (Passive)		Sagar Royal Villas (Passive)		Saumya Parkland (Active and Passive)	
		Inside	outside	Inside	outside	Inside	outside
1	I	6	4	5	0	3	0
2	II	2	2	5	7	8	4
3	III	2	4	0	12	12	0
4	IV & V	2	4	3	6	4	3
5	VI	2	4	0	8	13	2

Table 3. Showing number of dwelling units and apartment which have visual access to green space

S.no	Age category	Tulsi Vihar (Passive)		Sagar Royal Villas (Passive)		Saumya Parkland (Active and Passive)	
		Fully visible	Partially Visible	Fully visible	Partially Visible	Fully visible	Partially Visible
1	G+I	**13**	**3**	**15**	4	0	0
2	G+II	0	0	0	0	0	0
3	G+III	0	0	0	0	0	0
4	G+IV	0	0	0	0	0	0
5	G+V	0	0	0	0	0	0
6	G+VI	0	0	3 (Apartment)	0	14 (Apartment)	0

Table 4. Showing number of dwelling and apartment from where users visited the green spaces within and more than prescribed physical accessible distance in standards

S.no	Age category	Tulsi Vihar (Passive)		Sagar Royal Villas (Passive)		Saumya Parkland (Active and Passive)	
		Within 150 m distance	More than 150 m distance	Within 150 m distance	More than 150 m distance	Within 150 m distance	More than 150 m distance
1	G+I	**20**	**1**	**21**	0	0	0
2	G+II	0	0	0	0	0	0
3	G+III	0	0	0	0	0	0
4	G+IV	0	0	0	0	0	0
5	G+V	0	0	0	0	0	0
6	G+VI	0	0	3 (Apartment)	0	14 (Apartment)	0

The inferences drawn from dot density mapping show that in case of row housing, the conflict of use space exists more and may be because of lack of regular space designated for active and passive activities. This enhanced the conflict of the space usage for the varied age group. But in case of multi unit residential and group housing, though they had ample amount of green space, but uneven distribution in terms of proximity and functions reduced the user frequency. It had been observed that the category-I, II and VI group which also comes under low pace mobility using more passive and visual proximity green spaces compared to high mobility users of category III , IV and V. In case of Row Housing it had been observed that the maximum distance travelled by a user is approximately 157mts but they are very few in number. The users visiting the green space are maximum from the zone of visibility, followed by partial visibility and very few from invisible zone. But in case of group housing it has been observed that the maximum distance travelled by a user is approximately 127mts but they were more in numbers because the height of the building which was in the backdrop of green space allows visual access and made them to use the space around green space. Most of the high mobility user groups were using the space. The catchment area for this green space was more because of its connection with P4 and P5 green space and also because of its three side access to the green space. Similarly in case of multi unit residential it had been observed that the maximum distance travelled by a user is approximately 7.5mts because of more number of access the user group had to travel not more than 7.5mts The catchment area for those green space was only G+6 structures which enclosing the green space, as it restricts the vision to the back side structures; hence they used the green space which exist in their visual territory.

CONCLUSION

The observational study had brought two important aspects into account that the GS which have more visual and physical proximity are more usable as compare to those which has only physical accessibility. On the basis of observation studies and the existing demographic profile it had been concluded that low mobility user group requires more passive and visual GS compare to higher mobility user group. In all the three selected colonies the category VI concentration was more which comes under the lower mobility age group , when added with other category like I and II , it increases in quantum and demand for more passive GS. Another important aspect reveals the impact of fragmentation of GS on its usability. Due to this, the GS which serve the catchment area, sometimes become over or underutilized. For instance, dot density mapping in case of row housing revealed that the GS of regular shape and size are more usable as compared to other two GS. It also strongly depicts that there was a need to address qualitative parameters in regulatory framework for the provision of GS in gated residential community.

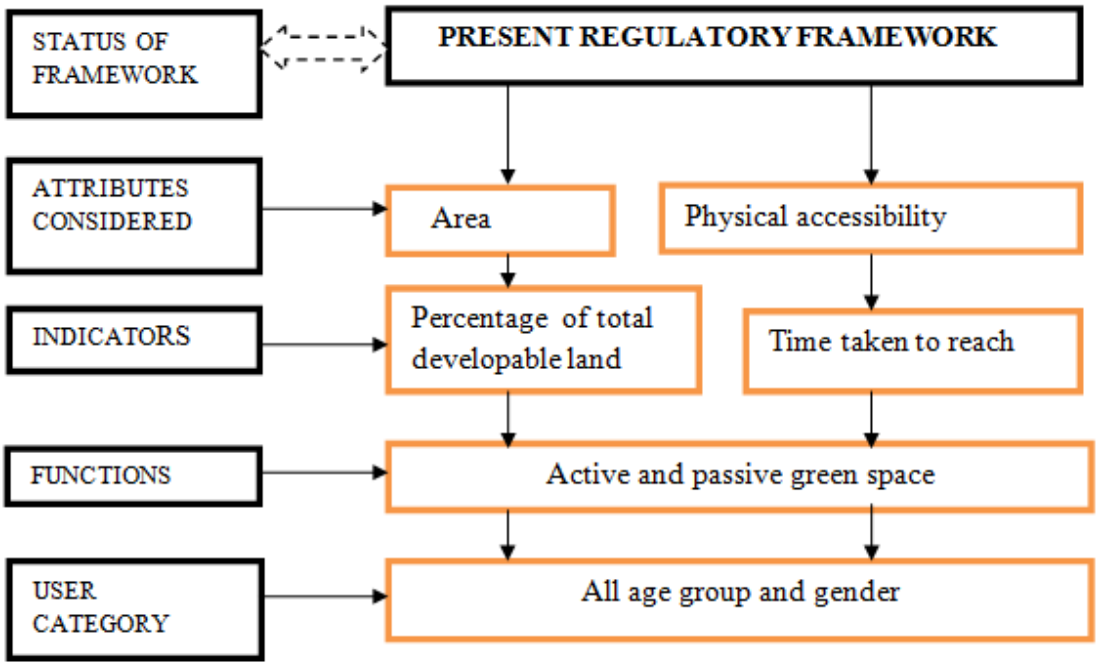


Figure 8. Depicts the framework of present regulatory system for provision of green spaces in residences.

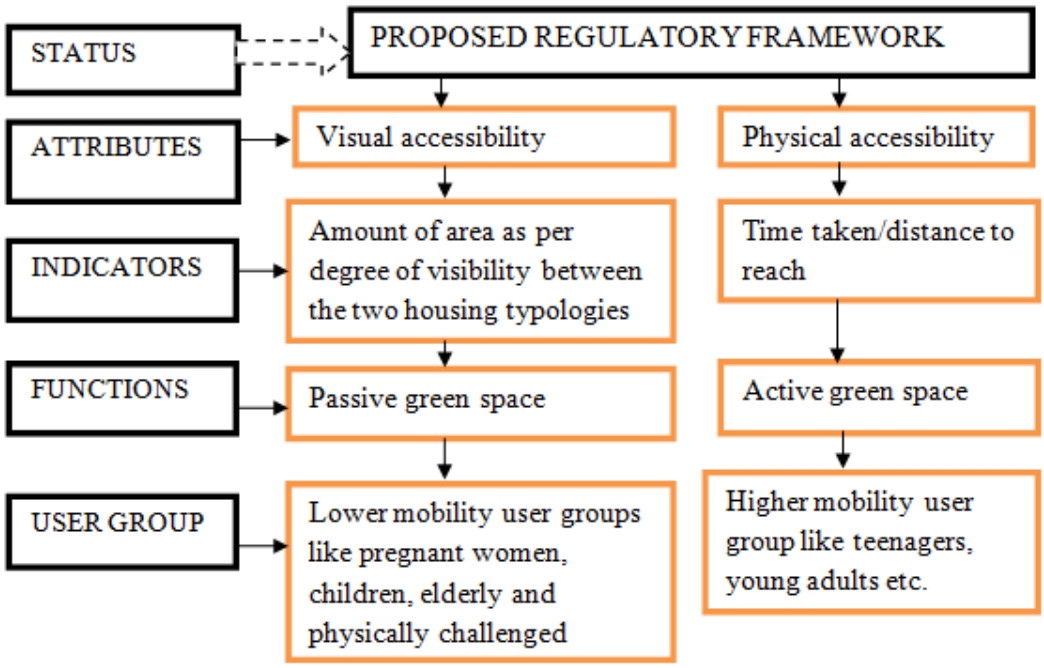


Figure 9. Depicts the framework of Proposed Regulatory system for provision of green spaces in residences.

The dependency on quantitative standards in planning practices for the provision of green space had developed a few limitations in its usability as shown in figure 8. This approach was unable to address the complexity of the accessibility concept. These quantitative measures are relatively easy in operational and practice level, but inadequate to address the complex nature of people's perception regarding GS accessibility. Hence there was a need to address and benchmark, visual accessibility in present regulatory framework for provision of GS to usability within the boundary for varied age group as proposed and depicted in figure 9. This inclusion helps in balanced mode of provision of green active and passive spaces for high and low mobility users.

ACKNOWLEDGEMENT

I would like to acknowledge Associate professor Dr. Natraj Kranthi (Architect and Urban Planner) School of Planning and Architecture, Vijayawada for his valuable suggestions for my research.

REFERENCES

[1] Centre fo Science and Environment.. *resource in efficient townships.* Retrieved dec 27, 2015, from www.cseindia.org. ,2012.

[2] Ewing, R., & Handy, S. Measuring the Unmeasurable: Urban Design Qualities Related to walkability. Journal of Urban Design , 2010, pg-65-84.

[3] Felleman, J. P. Landscape visibility mapping. New York: National Oceanic and Atmospheric Administration, US Department of Commerce.,1979.

[4] Lotfi, K. A Study on Identity of Pertev Pasa District in Famagusta, North Cyprus, Considering Urban Design Dimensions. Gazimağusa, North Cyprus: Eastern Mediterranean University, thesis report.,2015

[5] MOUD, Government of India. Model byelaws . In G. o. MOUD, *Development code pertaining to residential and non residential zones. In Town and country planning* ,New Delhi: Govt. Of India.2004,2016, pp. pg. 36-57.

[6] MOUD, Government of India. URDPFI Guidelines. New delhi: Government of India.,2014

[7] Peter J Seaman, R. J. It's not just about the park, it's about integration too: why people choose to use or not use urban greenspaces. *International Journal of Behavioral Nutrition and Physical Activity* ,2010, 1186/1479-5868-7-78.

[8] PWC. *Real Estate 2020 building the future.* UK: PWC.,2014.

[9] The State of Queensland. *Crime prevention through environmental design.* queens land: Queensland Government., october 2007.

[10] Zucker, P. Town and Square: From the Agora to the Village Green. Mishawaka, IN, U.S.A.: Published by The MIT Press.,1959.