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Analysing Social Relevance of Spatial Organisation: A Case Study of Traditional *Pol* Houses, Ahmedabad, India

Neeta Lambe[1] & Alpana Dongre[2]

[1] Research Scholar, Department of Architecture & Planning, V.N.I.T., Nagpur, India

[2] Professor, Department of Architecture & Planning, V.N.I.T., Nagpur, India

Correspondence: Neeta Lambe, Asso. Professor, Smt. Manoramabai Mundle College of Architecture, Nagpur, India. Tel: 91-93-7328-6499. E-mail: neetalambe@gmail.com

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Abstract

The spatial orgnisation of the domestic spaces is the manifestation of regional context. The differences in organisational quality of space reveal varied social structures. The paper aims at analysing the relationship of the prevailing social structure and the space organisation. This paper examines domestic spatial arrangements of the traditional *Pol* houses of Ahmedabad, India. In this paper, space syntax theory is used to examine the spatial morphology of the houses to map visibility, permeability, visual fields and movement pattern. Traditional *Pol* houses are distinctive in its character and generic in nature. The houses are evolved over the period of 400-500 years. After a sample of house layouts is analysed morphologically, the relationship of spatial organisation and social behavior is determined. Analysis results show that the traditional house layouts are evolved as per social conditions and offer better social interaction in present context. Hierarchy of spaces demarcates public to the private realm of the house. The flexible activity pattern makes the house more adaptable to the changing social conditions. The analysis will be valuable in the design process to safeguard the social fabric of the community.

Keywords: social structure, spatial organisation, space syntax, domestic spaces, traditional architecture, social interaction

1. Introduction

1.1 Architecture as Social Art

Architect, Leon Battista Alberti described architecture as social art. The reflection of social changes is evident through the spaces designed so far. Societies are evolved with pattern and order in habitat. The behavior of human beings is governed by space organisation and vice-versa. The spatial organisation of dwelling units may differ from place- to- place and culture- to culture, but it is the measure of social structure. Being a unit in a structure of society, a family forms an integral component of it. The space where a human being dwells becomes the main element of the social fabric. The house is an institution, not just a structure created for a complex set of purposes. Because building a house is a cultural phenomenon, its form and organisation are greatly influenced by the cultural milieu to which it belongs. (Rapoport, 1969) Thus it is important to study the social relevance of the built forms to understand its spatial qualities.

Human societies are the complex spatial phenomenon. It occupies the region with varied resources and people. It has definite form and through this, one can realise its existence. The spatial order is one of the most striking means by which we recognize the existence of the cultural differences between one social formation and another, that is, differences in the ways in which members of those societies live out and reproduce their social existence. (Hillier & Hanson, 1984). Socio-cultural differences are evident through the house layouts of different regions. It is important to understand the social relevance of these domestic spaces to understand the evolution of society and evolution of house form.

Man-environment relationship is explored with varied perspective by many researchers. In traditional architecture, it is observed that the house layouts are evolved as a response to the user behavior and social framework. Built forms as a response to locally available resources are customarily owner or community build. Paul Oliver said that, all forms of vernacular architecture are built to meet specific needs, accommodating values, economies, and ways of life of the cultures that produce them. (Oliver, 2006) The spaces function as public,

private and semi-private effectively with the provided spatial organisation. In traditional built forms, segregation is not that rigid as seen in present context, but it supports the social ethos. Analysing the relationship of spatial organisation and its social relevance in today's context would not only provide a basis for the design process, but also would aid in creating the holistic living environment.

The paper focuses on identified social variables; privacy, private territorial behavior and public territorial behavior to examine the spatial organisation of traditional *Pol* houses of Ahmedabad, India. In this paper, the social variables and its impact on space organisation with a particular focus on the hierarchy of spaces is presented. The aim of the paper is to study the morphological characteristics of the spatial organisation of the *Pol* houses that are evolved over a period of time as a response to social conditions. The paper provides the study of representing house layouts to analyse its spatial organisation along with usage and activity pattern.

1.2 Spatial Relations and the Social Behavior

House as a living space serves similar function in all cultures and geographical locations. The basic function of providing shelter and accommodating areas to perform basic activities remains same everywhere. The evolution of domestic spaces reveals that, for performing the basic functions; the variety of activity relationships and patterns are accommodated in a house. It is evident through the study that, the socio-cultural background forms the basis for the observed variety. The important thing about a house is not that it is a list of activities or rooms, but it is a pattern of space, governed by intricate conventions about spaces there are, how they are connected together and sequenced, which activities go together and which are separated out (Hanson, 1998). The main components of the house remains the same, the social variables involved in giving the pattern remains almost same in all socio-cultural frameworks. Hence layouts of house plans from the varied time frame and places can be studied on a similar basis. Societies which might vary in their type of physical configuration and degree to which the ordering of space appears as a conspicuous dimension of culture can all be compared on a similar basis (Foster, 1989).

1.3 Hypothesis

The study presented here describes the relationship of spatial organisation and social behavior. The hypothesis states that the spatial organisations of traditional built forms are evolved with the evolution of the society and social framework.

2. Method

The Space Syntax analysis methodology is adopted for analysing spatial organization. It is conventionally used to develop an understanding of spatial typologies and social relations implicit in various architecture or urban settings or types (Lee, 2013). The spatial analysis method is designed to identify the topology of social relationships, how people are organised in space. It is adapted from Hillier and Hanson's Gamma Analysis as described in *The Social Logic of Space*. It can be used to see who inhabits positions of power and who does not. It can also be used to understand the accessibility of individuals to each other and the degree of freedom in circulation between points. A *Justified Graph* is a diagramming technique for revealing the topology of a spatial organization. A justified graph organizes the spaces in a building in relationship to each other with the carrier at the bottom and the other spaces arranged in rows above corresponding to the number of steps in from the carrier. This methodology is adopted to study the depth of the spaces and its relationship with privacy as social variable. Many researchers have adopted this method for identifying genotypes by morphological analysis of dwelling units (Bandopadhyay & Merchant, 2006; Nilufer & Eshika, 2015). Visibility Graph Analysis (VGA) is adopted for studying the relation between visibility and permeability as vital components of the functioning of the house spatially and is experienced by their occupants. This would help in deciding the hierarchy of spaces from the public to private as reflected in sequential organisation to understand public territorial behavior. Isovists, the concept first developed by Benedikt, 1979 as a method for analysis of architectural space is presented in the paper. Depthmap creates polygon that represents the potential field of view from a certain location, called as Isovists. It measures how deep each location is to all others. Alasdair Turner; devised an Agent's model architecture to simulate natural movement patterns in buildings. The Agent model is instrumental to acquire a better understanding of the cognitive basis of natural movement and explain navigation and way finding. This would help in understanding the private territorial behaviour

2.1 Social Variables

Architecture is not a "social art" simply because buildings are important visual symbols of society, but also because, through the ways in which buildings, individually and collectively, create and order space, we are able to recognize society: that it exists and has a certain form (Hillier & Hanson, 1984). Each activity space and its

relation to other, determines the social relation of individuals. The house layout is the systematic arrangement of activity spaces based on the socio-cultural framework. The spatial relationship of these units influences social behavior and at the same time, the social behavior dictates the spatial relations. In this paper, social variables, privacy, private territorial behavior and public territorial behavior are analysed through case study of traditional *Pol* houses of Ahmedabad, India.

The social variable like privacy gradient, transforms the internal organisation of the house as per social norms. The permeability of the house, visibility and circulation with respect to visitors and inhabitants determines the private and public territorial behavior. The internal organization of the room regulates visibility and accessibility between spaces based on cultural customs and social conventions (Lawrence, 1987).

2.2 Spatial Organisation

The organization of the individual units i.e. the *syntax* of space, determines the relationships between individuals in a social unit. Spatial relations influence the level of access between individuals and the level of control each can have over one another. Each unit in a dwelling represents each activity area and their relationship represents user or inhabitant‘s response to space. The way these units are arranged to form a complex phenomenon of a dwelling, it influences the social behavior of the inhabitants. The attributes of spatial organization are explained in terms of depth of space, the hierarchy of spaces, visibility of the spaces, permeability of the spaces and the movement or circulation pattern generated within the layout.

2.3 Study Area

The house plans of the traditional *Pol* neighborhood area are identified for study purpose. Situated in a hot and dry climatic zone at latitude 23º00′ and longitude 72º35′, Ahmedabad one of the largest cities in the state of Gujarat, India; it was founded by Sultan Ahmed Shah in 1411. It is situated on the banks of the river Sabarmati. The old city is located on the eastern bank of the river and is characterized by more than 300 traditional *Pols*. A *Pol* (pronounced ‘pole’) is a dense housing cluster in the traditional core of the old city (known as the walled city), which comprises many families of a particular group formed by religion, occupation or caste (Ubbelohde & Loison, n. d.). The word ‘*Pol*’ is derived from a Sanskrit word ‘*pratoli*’, meaning ‘gate’ or ‘entrance’ to an enclosed area.

These neighborhoods, which are more than 300-500 years old, were gated for the purpose of protecting against communal riots. The area is entered through a single gate and consists of dead end streets. Each *Pol* is self-sufficient because of restricted singular access. The house form, the grouping of houses in the form of contiguous rows of houses, and its hierarchy of spaces are the main components of these homogeneous and extremely secure settlements. The houses in these *Pol* neighborhoods are called ‘*Pol* houses’ (Ref. Figure 1).

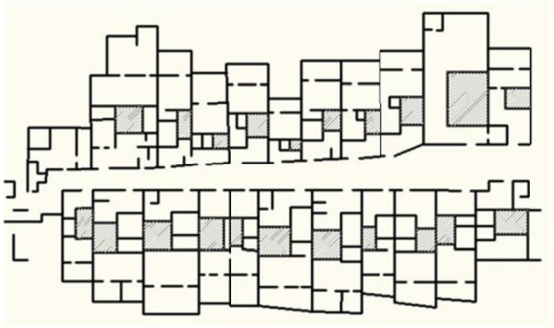

Figure 1. Dense fabric of *Pol* neighborhood (Source: Author)

2.3.1 Research Design

Representative house layouts as samples are analysed to study the social relevance of the spatial organisation of the *Pol* house plan. Space Syntax analysis is carried out for identified plan forms. The social significance of each activity space and its placement in the overall organisation is studied. The paper presents the spatial analysis of layout plans to study the depths of various spaces from the street so as to analyse the hierarchy of spaces according to user preference and required privacy level. The visual permeability and visual fields are studied through Visibility Graph Analysis and Isovists to analyse visual penetration of the layout. The activity usage pattern and circulation within the spatial organisation is studied through Agent Movement.

3. Traditional *Pol* House Analysis

The language of the *Pol* house is analysed by studying a number of *Pol* houses from different *Pols* that are in good condition. The houses presented here are more than 150-200 years old. *Pol* houses are between 2 and 4 stories in height with an open-air courtyard. The densely packed houses have common walls forming the rows of the houses. The houses are deep with a narrow frontage that faces the road. The houses are 5-6 meters wide and 12-18 meters in depth (Ref. Figures 7 & 8). The courtyard is the common characteristics that hold these houses together and makes them more porous. This characteristic forms a peculiarity in terms of their spatial organisation, which is very functional and linear. Characterised by wooden construction with intricately carved columns, brackets, balconies, and sloping roofs, the *Pol* house has evolved through generations to uphold the socio-cultural significance of the community. Its climate responsiveness is evident through the narrow and deep house form with a shorter side facing the street, an open courtyard and semi-open areas (Agarwal, 2009). The linear arrangement of the house follows a specific hierarchy of spaces from public to semi-public and private. The spaces are not labeled for their function but are multi-purpose and provide functional adaptability. The skyline of the neighborhood is characterised by flat and sloping roofs. Usually, the ridge line of the sloping roof is kept parallel to the shorter side (width) of the house. The volume on the upper level is separated by the courtyard and is connected by passages. The front volume is lower than the rear volume. The front facade has a typical composition of openings and projected balconies on the upper floors.

3.1 Spatial Organisation of Pol House Plan

The homogeneous structure of the neighborhood is achieved through compact planning and a hierarchy of spaces. At the same time, it is porous in nature because of the arrangement of open-air spaces in the form of courtyards in the otherwise dense built environment. The main elements of the plan of the traditional *pol* house with a courtyard are as follows (Ref. Figure 2):

1. ***Otla* (a veranda):** The *otla* is a transition space between the street and the house. It demarcates the extent of the house and creates the plinth for the house with steps to enter into it. It is a semi-covered space, shaded by the projections of the upper floor balcony.
2. ***Khadki/Baithak* (a living space):** The *khadki*/*baithak* is the front portion of the house, and it is usually a reception space and a formal social space. It is a sitting space for guests, and many times, it is equipped with a traditional swing called a Gujarathi swing.
3. ***Chowk* (a courtyard):** The *khadki* leads into the *chowk*, which is the most important element of the *Pol* house; it is interiorly adjacent to the *khadki*. It is the central open-air part of the house and holds all other spaces together; it also acts as the activity hub in a house. All the activities take place in and around the *chowk.* The narrow proportion of the *chowk* acts as an aperture in a compact layout and serves as the climate regulator of the built form.
4. ***Osri* (a semi-open family space):** The *osri* is a small *veranda* near the *chowk*. It is a semi-open space and accommodates the spill-over activities of the *chowk.* On the upper floors, the space is known as the *revasha.*
5. ***Parsal* (a family space):** The *parsal* is multifunctional space deep inside the house behind *chowk* and is considered a private space for family members. It is also used as a dining room or an extension of the kitchen.
6. ***Ordo* (a bedroom):** The *ordo* is the inner most space of the house, deep inside from the street; essentially, it is a private space used for sleeping and storage.
7. ***Resodu* (a kitchen):** The *resodu* is the kitchen of the house that is adjacent to the *osri*, *chowk*, or *parsal* and is near the traditional water-storage system known as the *tanka*. Domestic activities are usually extended from the *resodu* to the *osri, chowk* or *parsal.*
8. **Utility areas (water closet, bathroom, wash area, storage):** The water closet is generally placed in front and is attached to the *otla* or *khadki* rather than to the private spaces in the traditional house. With the changing lifestyles of modern residents, however, it is now placed in private areas of the *Pol* house. Other utility spaces, such as the wash area for washing clothes and utensils and bathing, are attached to a common wall. Storage is a narrow space attached to other activity areas and acts as a multifunctional space.
9. **Passage:** The passage is a transition space connecting one room to another. Generally, on the ground floor, the passage is a narrow space around the *chowk* and is attached to activity spaces for circulation. On

the upper floor, the passage acts as a balcony overlooking the courtyard, and it connects the front volume to the rear volume of the house.

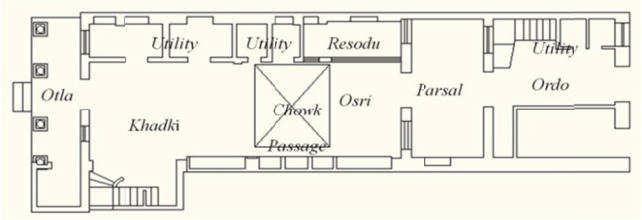

Figure 2. Elements of the traditional *Pol* house (Source: Bhatt, Joglekar, & Pandya, 1997)

3.2 Three Houses

Case 1: *House of Jagrutiben, Jethabhai ni Pol*

The house is more than 100 years old with linear spatial organisation. The open -air courtyard is attached to the common wall from one side with utility areas on the other side. The *resodu* (kitchen) is extended as the *parsal* (family area). The *ordo* (the sleeping area) is the last activity area placed at the end of the house. (Ref. Figure 3)

Case 2: *House of Bipin pasawala, Desai ni Pol*

The house is more than 150 years old. The centrally place open-air courtyard binds all other activity areas together. The *ordo* is placed as the last activity area and attached to the utility area while, the *resodu* and the *parsal* forms the kitchen-dining area. (Ref. Figure 4)

Case 3: *House of Raman Koshti, Jethbhai ni Pol*

The house is more than 130 years old. The house has a slightly different spatial organisation. The house has two open-air courtyards; one is placed on the back side of the house and near to the *resodu* while other is toward the access route near the *khadki* (living area). The *ordo* is placed before the *resodu* and acts as multifunctional space. The passage as transition space is placed next to the courtyard to connect semi public areas with inner private areas. (Ref. Figure 5)

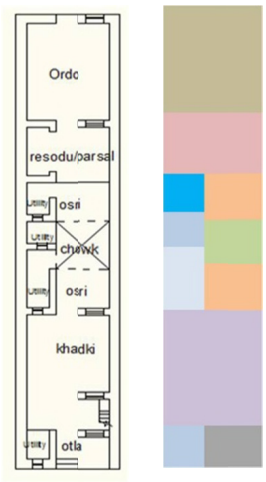

Figure 3. Case 1 house plan

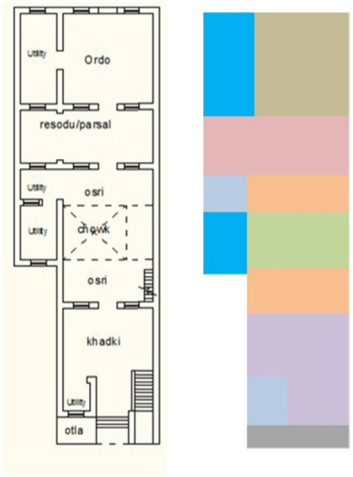

Figure 4. Case 2 house plan

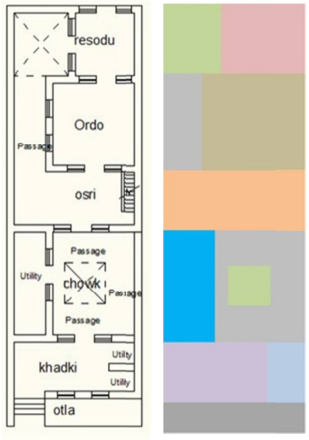

Figure 5. Case 3 house plan

3.3 Justified Graph Analysis

A JPG can be used to demonstrate how a "culture manifests itself in the layout of space by forming a spatial pattern in which activities are integrated and segregated to different degrees" (Hillier, 2006). This is possible because the spaces are not just multi-purpose voids awaiting appropriate furnishings and fittings, but they are also locked into a "certain configurational relation to the house as a whole"

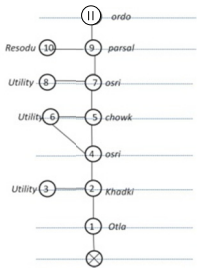

Figure 6. J- Graph of Case 1 house plan

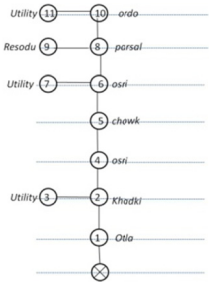

Figure 7. J- Graph of Case 2 house plan

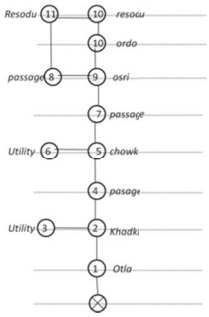

Figure 8. J- Graph of Case 3 house plan

All three houses are analysed with j-graphs, in which street as the access point is considered as root spaces and then as per layout, other levels are marked. Here the spaces are designated as nodes and the edges radiating from them signify access points to and from space. (Ref. Figure 6, 7, 8)

3.4 Visibility Graph Analysis

The visibility graph is a tool to explore the visibility and permeability relations in spatial systems. The relation between visibility and permeability is a vital component of how houses work spatially and are experienced by their occupants. Visibility graphs analyse the extent to which any point in a spatial network is visible from any other. (Turner & Doxa, 1999)

Where points are not directly visible, graph measures of a matrix of points can be calculated to test how many intervening points are needed from one point to see others. The points are colored according to how many other locations are visible from it. The range runs from Blue (for low) through Green and Yellow to red (many visible locations). High values – red to yellow range; suggest the high connectivity, whereas the colour ranging from cyan to blue suggests many turns and comparatively less connectivity. Visibility graphs drawn for three *Pol* houses are presented (Ref. Figure 9, 10, 11).

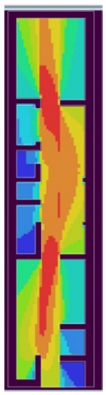

Figure 9. VGA: Case 1 house plan

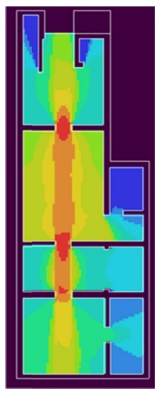

Figure 10. VGA: Case 2 house plan

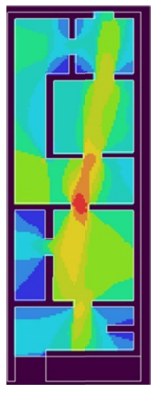

Figure 11. VGA: Case 3 house plan

3.5 Isovists Analysis

This method is first developed by Benedikt, 1979 for analysis of architectural space. Depthmap creates polygons that represent the potential field of view from a certain location, called as Isovists It measures how deep each location is to all others. According to Benedikt, an Isovist is: "the set of all points visible from a given vantage point in space and with respect to an environment" (Benedikt, 1979). It visualises the panoptical view from the viewer from a particular standing point in a built environment. Here in this paper, three *Pol* houses are analysed through Isovists with reference to the entrance and open -air courtyard.

A well- integrated location (colored in Red) is shallow, that means, no turns are required to get from that location to any other location. Poor integrated location (colored in dark blue) is deep with respect to the other locations. Ref. Figure 12, 13, 14)

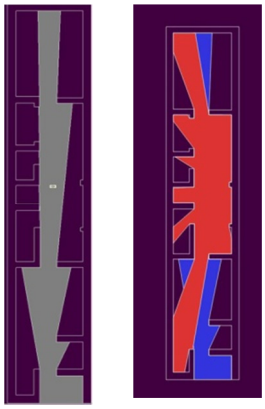

Figure 12. Isovists: Case 1 house plan

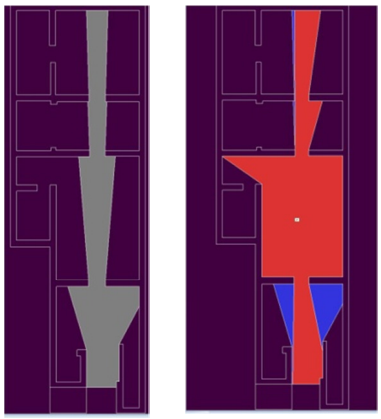

Figure 13. Isovists: Case 1 house plan

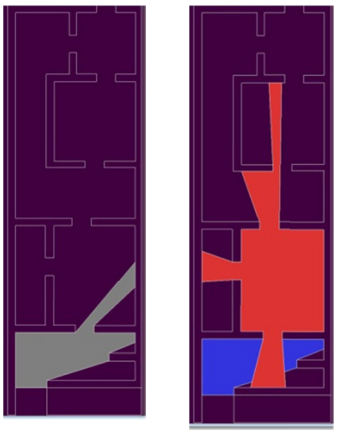

Figure 14. Isovists: Case 1 house plan

Four basic spatial qualities; spaciousness, openness, complexity, and order are translated into Isovist measurement. The Isovist area suggests the spaciousness of the space while Isovist openness suggests the openness of the space. The number of vertices and vertex density suggest the complexity while order suggest the symmetry and redundancy

3.6 Agent Movement Analysis

Alasdair Turner; devised an Agent's Model architecture to simulate natural movement patterns in buildings. The Agent model is instrumental to acquire a better understanding of the cognitive basis of natural movement and explain navigation and way finding. The gate count represents the pedestrian flow per unit. At each and every reference point, the gate count is observed. (Ref. Figure 15, 16, 17)

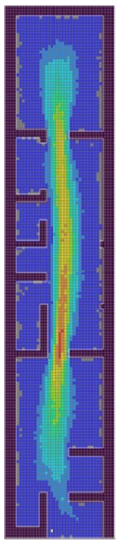

Figure 15. Agent model: Case 1 house plan

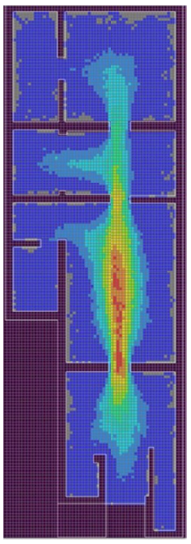

Figure 16. Agent Model: Case 1 house plan

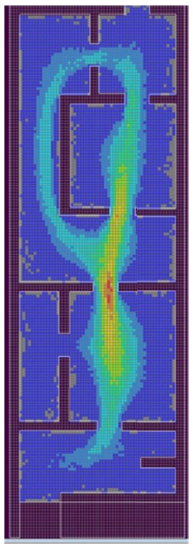

Figure 17. Agent model: Case 1 house plan

4. Discussion

As an element of the traditional settlement, the spatial organisation of the *Pol* house is the manifestation of the socio-cultural background of the society. The traditional house form of *Pol* neighborhood is primarily for joint families with three generations staying together. The space constraints make the space utilisation more flexible in terms of its usage. The same space is used for different activities throughout a year depending upon weather conditions. The activity pattern changes, but at the same time hierarchy of spaces depicts the behavioral pattern of the user. The spaces are not separated on the basis of gender; they are organised sequentially according to use

the pattern.

The Pol house form depicts the way of life of the people as well as their social behavior and activity pattern. The linear structure of the house is the outcome of this depiction, with a sequential organisation of spaces with respect to the level of privacy. From the most public spaces towards the front side of the access road to the most private spaces deep inside the house away from the road, the *Pol* house plan represents the spatial characteristics that are most suited to the climate of the region. The public and the private spaces are separated by an open-air *chowk*, which acts as a thermal regulator for the house. The public spaces are social spaces, whereas private spaces are functional spaces. The linear organisation offers this type of separation. Here, the *chowk* becomes the hub of all the activities and binds the other spaces together.

The J-graph analysis shows that, the spatial orgnisation is asymmetrical with a 'tree' type graph. Two or more spaces have an indirect relationship with each other. The depth of the social domain of the *Pol* house is between1 to 5. The modal value of the depth of space is 3. This suggest that the spaces are more shallow and for social interaction. The *otla* space is at the first level of depth and forms the space for socialising and visually connects the outdoor with the indoor. It also serves as street furniture for the narrow winding lanes and provides security along with privacy to the house. The semi public space, like the *khadki*, is near to entrance and placed at the second level of depth. It is observed through analysis that, private areas like the *ordo* are place in deeper areas and need to cross all other levels to access that.

Visibility Graph Analysis and Isovists analysis suggest that, the spaces are visually well connected and determine the space pattern of spatial configuration. From the courtyard, multidirectional view fields of views suggest the low disorder in spatial configuration. Multi directional view field suggests the low clustering coefficient, thus making the space more permeable. The regular spatial configuration allows free flow of activities. As research has shown, the degree of visibility of spaces affects the way users behave in these spaces. The higher the inter-visibility, the more it generates a social interaction in the space. The higher Isovist area from the courtyard view field makes it more spacious. The deeper Isovist perimeter makes the plan more open. Low disorder of the courtyard view field makes it more accessible and visible. Agent Model analysis shows that, the semi public areas like the courtyard, the *khadki* and the *osri*, concentration of agent movement is observed. Less concentration of agent movement is observed in private areas like the *ordu.* The linear movement pattern shows that the sequential arrangement of spaces with private spaces at the end of the organisation.

The spatial configuration of *Pol* house is highly introvert, tree like configuration, with room distributed around an internal courtyard. The spaces around the courtyard are with multidirectional views such as *khadki* and *osri* whereas other spaces are highly enclosed and with deliberately restricted connectivity and visibility, like *ordu* and *parsal.* Similar spatial configuration is seen in *Pol* variations. The space pattern of the *Pol* house is strongly related to visibility and connectivity of spaces.

The spatial organisation is socially relevant as the neighbourhood represents a cohesive, homogeneous clustering of houses of the medieval period. The protection from invaders and need for secured community spaces was culminated in gated communities of this Walled City of Ahmedabad. The social interaction was highly encouraged within the community and it gets reflected through spatial configuration. Hierarchy of spaces clearly demarcates the various activity domains and at the same time, the multi functionality of spaces dictates the flexibility of use pattern and way of life. Here qualities of spatial organisation are evolved with the social and the private life style of the inhabitants. The *Pol* areas with *Pol* houses are socially integrated neighborhoods and demonstrate the holistic living environment.

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