SPATIAL CONFIGURATIONS OF THE URBAN CORES IN CENTRAL INDIA

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THEME: Urban Structure and Spatial Distribution

Abstract

India, being in a rapid phase of urbanization; the majority of the small and medium size cities are growing since last decade. These cities usually have a traditional settlement as an urban core, developed in the medieval period with an organic pattern and almost frozen in time, protecting its labyrinthine qualities, till the 19th century. For planners, such built environments with an organic spatial organization are usually chaotic due to obvious geometric irregularity which is considered as “disorder”. Yet, the spatial configuration seems quite in harmony with the users of that environment there. But this harmony is getting lost in the emerging urban environments in the developing cities. This is because of the lack of understanding of user preferences, while planning and designing the urban built environments. This has a lot of physical and social implications in developing cities such as environmental and socio-cultural conflicts. This does not mean that these growing cities should not develop, but there is a need to understand the user preferences, to deal appropriately with emerging urban built environments.

The research is intended with the need of understanding built environments in select Indian cities in central India, in terms of their configuration to understand culture specific human preferences about space proxemics. The research has been fostered by questions: (1) How to understand and quantify the spatial configurations of organically evolved built environments of urban cores in Indian cities? (2) Based on the configuration parameters, can one understand the human aspects in terms of user preferences about the space proxemics, in the Indian context.

Continuity and linkages with its kinesthetic is an important characteristic of traditional Indian built environment. Hence, there is a need to understand built environments in the traditional urban cores as a “system of spaces” with its topology and embedded logic about its human aspects. Space syntax is selected as a major theoretical premise for the research undertaken.

India is a vast country with a lot of diversity. Hence, the urban cores of five developing cities in central India with similar topographic, climatic conditions; are considered for the study. They are investigated by representing them in terms of a system of spaces through axial maps and analyzed using Depthmap. Thus,
the deduced syntactic identity in Indian built environments is then reviewed with respect to the other parts of the world; referring the already conducted research works, through secondary sources.

The analysis of selected examples shows some similarity in terms of syntactic identity. The syntactic identity of the Indian traditional built environments shows some similarity with the traditional Iranian cities but otherwise it is quite different than the traditional built environments from other parts of world. The placement of important religious, administrative or commercial urban activity nodes, in the overall spatial configuration has helped to deduce the culture specific human preferences about space proxemics. From this research, an effort is made to explicitly state the spatial configuration as concealed spatial rules or principles of urbanism in the Indian built environments, so as to evolve a humane approach towards the spatial design of emerging built environments in urban India.

1. BACKGROUND

India, being in a rapid phase of urbanization; except very few urbanized metropolitan cities, the majority of the small and medium size cities are now growing since the last decade. These cities usually have traditional settlement as an urban core, developed in the medieval period with an organic pattern and almost frozen in time till the 19th century; protecting its labyrinthine qualities. Traditionally, not only in India but in most of the world, built environments evolved gradually and the values about human preferences got embedded into it. These acted as a regulator or controller of its progression.

For modern planners, the traditionally evolved built environments with organic spatial organization are usually chaotic due to obvious geometric irregularity which is considered as a “disorder”. (Karimi, 1997) The traditionally evolved built environments may have some problems in terms of physical parameters such as accessibility, maintenance level, hygiene etc.; but they seem to be in harmony with the users. (fig. 1) This harmony is getting lost in the emerging urban environments of developing cities, though these urban environments satisfy most of the physical parameters. This is because of the lack of understanding of user preferences, while planning and designing the urban built environments. User preferences in terms of space proxemics vary due to the cultural differences. Space proxemics is a term for the man’s use of space as a specialized elaboration of culture.(Hall, 1966) In India, in the post independence period; the urban environments are usually dealt on the basis of planning norms.

![Fig 1: Traditional core of Nasik: Built environment and its users](image)
based on the British planning legacies. These norms have mostly ignored the culture specific user preferences about space proxemics. The patterns of new spatial configuration, based on the “urban rationality” of the modern planning practices, are being grossly applied to the existing built environments or the developing new built environments in India; without actually understanding its appropriateness to the Indian situations. This has a lot of physical and social implications such as environmental and socio-cultural conflicts. One can observe the repercussions of the approach adopted to deal with the urban built environments, in the metro cities of India which are already developed and are facing innumerable threats. This does not mean that these growing medium size cities should not develop. However, there is a need to understand user preferences and to deal with the emerging urban built environments appropriately.

Thus, the research is intended with the need of understanding built environments in traditional urban cores of select Indian cities in central India, in terms of their spatial configurations as a result of user preferences. This may help to evolve a humane approach to deal the emerging built environments in developing cities of India with objectivity. Only traditional urban cores are considered for the study and not the complete cities, as the objective is to understand the embedded human aspects in terms of user preferences about space proxemics. If the complete cities are considered, the planned portions are also included and this would obscure the very purpose of the study.

1.1 Need of the Study

The physical component of the urban environment is the ‘built environment’ which in turn is very much interrelated to the social environment as well. Built environments basically mean everything that is humanely created, modified, arranged or maintained. Thus, collectively, the products and processes of human creation are called the built environments. (McClure, Bartuska, & Bartuska, 2007) It is as old as mankind. Yet, “Built environment” as a concept; is a relatively recent and very much an inclusive concept. We have been studying and analyzing the built environment under the heads such as architecture, urban design, urban planning etc. Understanding “built environment” as an all inclusive concept makes a lot of difference as now the focus is on the interrelationships between it’s the components and the interrelationships between man and environments. Hence built environment as a paradigm is relevant for the study of user preferences.

Built environments are basically organization of space as they consist of space (un-built) and matter (built) (Fig.2). The spaces are linked to each other, forming a “system of spaces”. The way these individual spaces are formed and most importantly, linked together; is responsible for spatial configuration of the built environment. The socio cultural aspects in terms of the user preferences are responsible for the evolution of spatial configuration in a built environment, over a period of time. Thus, the built environment and the social environment are two sides of the same coin and that is the “system of spaces”. They are very much related and one affects the other. It’s a cyclic process and changing quality of the spatial configurations is responsible for the changing social life and vice versa. We, the planners are responsible for shaping the built environment and hence there is a need for understanding human aspects in terms of the user preferences, for a given socio-cultural context. In some sporadic efforts by designers and planners, there is an effort to emulate and transplant some of the qualities of traditional built environments to the contemporary emerging built environments with reference to obvious aspects - such as irregular geometry, without understanding the inbuilt logic, has been mostly unsuccessful.
In the Indian context, one finds that there is a lack of systematic studies to investigate the built environments with respect to the spatial configuration and the user preferences about space proxemics. Whatever studies are done, they mostly focus on individual “places” with its size, shape, quality of enclosure through the descriptive analysis. Understanding a city through parts i.e. places has its own limitations. Places don’t make cities but cities make places. (Hillier, 2007) Hence, a spatial configuration of built environments, as a continuous “system of spaces”, needs to be understood. As mentioned earlier, the present approach of dealing built environments is based on the normative planning practices based on the British planning theories. There is a need to develop positive theories which can help us to understand the user - built environment relationship in Indian context. Though the classical and monumental architecture is well studied and documented, the vernacular and traditional Indian architecture, in terms of vast variety of settlements, is still not researched upon fully. While highlighting about the rich variety of traditional/ vernacular built environments in India, Madhavi Desai(2007) has sighted the quote from De Forest’s book on Indian Architecture; which states, “No country affords a greater variety than India where each city has its own peculiarities in detail and plan.”

Built environments of the gradually evolved traditional Indian settlements have spatial configurations which have encoded the intrinsic patterns of user preferences. Certainly, there is a need to decode that information by analyzing the spatial configurations, using the empirical studies done earlier.

**1.2 Traditional Built Environments in India:**

India’s traditional built environments do not confine to the historic preserved objects frozen in time and space, but rather as cultural traditions which have transcended the time and space to remain alive and appropriate even in the present. (Desai, 2007) India has a history full of intense, political and cultural experiences. Therefore, it has multiple and pluralistic manifestations resulting in multi layered built environments. Thus, the urban cores of cities in terms of traditional settlements; though have developed at a particular point of time, they were left to evolve in a physical pattern as society evolved. Thus, till date, these built environments have been very much “living” and thus “evolving”. The existing spatial configurations in these built environments are a result of the process of natural selection of human preferences over a period of time.
Secondly, as far as the spatial configuration of these traditional Indian built environments is concerned, continuity and linkages are important aspects. Being organic patterns, the spatial configuration has mostly a non-linear organization through shifting axis of movement. (Fig. 3) It helps gradually unfold the spaces and introduce an element of surprise. There are pause points and thresholds that help one reorient and reaffirm bearings in space. (Pandya 2005) They are present in most of the Indian built environments but it is not enough to understand them as descriptions but these should be quantified by specific mechanism. Hence if one wants to understand Indian built environments, it is necessary to understand them as a system of spaces with its intertwined relationships between the parts and a whole.

1.3 Problem Identification:

To understand the organic pattern of traditional Indian built environments, it is important to quantify its spatial configuration. The way spaces are configured or arranged or patterned in a system of spaces can be called as a spatial configuration. Irregularity is the primary feature of the organic pattern as it cannot be measured in geometric properties such as repetition, symmetry, parallel elements, and alignment and so on. The Geometrical properties help us to find out order. Lack of such geometric properties in the organic pattern is responsible for labelling it as a “disorder”. A Structure is about the relationship between the parts and a whole i.e. spatial configuration. Thus, these traditional urban cores though lack in any obvious order but certainly have a structure. Hence these organically evolved parts of cities that are urban cores in the contemporary developing Indian cities, if analysed in terms of spatial configuration, will help to understand its spatial structure as a result of the culture specific user preferences in the Indian context. For analysing the system of spaces with focus on the spatial structure, not only the geometry of spaces is important but more important is the topology.

1.4 Research Objectives and Methodology

The research is intended with the need of understanding built environments in select Indian cities in central India, in terms of their configuration to understand culture specific human preferences about space proxemics. The research has been fostered by questions: (1) How to understand and quantify the spatial configurations of organically evolved built environments of urban cores in Indian cities? (2) Based on the configuration parameters, can one understand the human aspects in terms of user preferences about space proxemics, in Indian context?

Thus the primary research objectives are

1. To identify appropriate methodology to study and quantify the spatial configurations of organically evolved built environments of urban cores in Indian cities.
2. To deduce the human aspects in terms of user preferences about space proxemics, in Indian context

2. EPISTEMOLOGICAL BASIS:

The synthesis of various theories to create a framework to investigate spatial configuration; can become the required epistemological basis for such a research. Thus the study of number of identified important theories is done; to formulate basis for pragmatic approach for comprehending human aspects of Indian traditional built environments.

The relationship of human aspects to built environment has been discussed by many pioneers such as Lewis Mumford, Amos Rapoport and Christopher Alexander. Lewis Mumford(1961) was one of the pioneers whose thinking about urban affairs was not limited up to physical structure but also focused on social implications of it as well. Amos Rapoport had highlighted a need to develop the scientific approach to the study of built environment focusing on culture specific human aspects. He argued that the set of rules of spatial organization are different for different groups.(Rapoport 1997). The socio-cultural factors such as user preferences (what you give importance to) keep on changing with time, place and people and can be understood through the study of built environments.

Christopher Alexander, through his theories, always focused on structure and order of built environments. Thus he has explained the concept of “life” in anything around us, including built environments. The idea that Christopher Alexander (2005) has presented is that; a living process always has enormous respect for the state and the morphology of what exists and always finds the next step forward which preserves the structure of what exists and extends its latent structure. In case of built environments also, if we want them to be ‘alive’; the evolution has to be in accordance with existing state. Therefore, to deal emerging built environments in developing Indian cities, there is a need to deduce the configuration of existing traditional built environments and the reasoning behind them in terms of human preferences.

To study the built environments in terms of human preferences responsible for its structure, it is necessary to quantify its spatial configuration. For such a study of spatial configuration, the space syntax theory by Bill Hillier and Julienne Hanson (1984) has been referred. Space syntax describes the topological connections of unit spaces through depth analysis, typically using the graph theory. It is about understanding system of spaces in terms of its configuration properties. A spatial configuration is defined as a relation affected by the simultaneous co-presence of at least a third element and possibly all other elements in a complex. The aim of the numerical side of syntactic analysis is to deepen the descriptions by expressing in a concise way very complex relational properties of spaces and of the system as a whole (Hillier 2007). Thus, the space syntax methodology with its techniques to quantify configurations; can certainly help to deduce user preferences about movement, and subsequently the culture specific norms about space proxemics rooted in it. Hence, it is selected as a major theoretical premise for the research undertaken. It rests on three basic conceptions of space.

a. An isovist ; the field of view from a particular point.
b. Axial space; a straight line
c. Convex space: no line between two of its points goes outside its perimeter.

The types of syntactic analysis include visual-field analyses, node analyses and axial-line analyses.
Axial line analysis is chosen as appropriate method for research under consideration, as it captures the basic features of a system of spaces in a built environment. The space is represented by straight lines, so-called axial-lines. In brief, the space to be examined is modeled by ‘fewest and longest straight lines covering all convex spaces’. (Hillier and Hansson, 1984) These axes are the representative lines of sight or visibility- and movement – or permeability. Therefore, the configurations of select traditional cores of developing Indian cities; are inspected by representing the system of spaces through axial maps. There are number of softwares available for doing such type of syntactic analysis and after the study and exploring the use of few softwares; Depthmap by ULC is identified and used for the study.

3. SAMPLES AND PROCEDURES:

India is a vast country with a lot of geographic, climatic, ethnic and religious diversity. Hence urban cores of five developing cities in central India with similar topographic, climatic conditions; are considered for the study. Though there are some changes happening in these urban cores in terms of widening of the roads etc, yet the configurations are not disturbed largely, till date.

3.1 Selection Criteria for Samples:

The criteria for selection of samples for the cities are:

a. Size (population)
b. Climate
c. Developing Cities
d. Similar urban structure (ring radial) with traditional built environment as a core.
e. Cultural differences in terms of predominant religion (Hindu/ Islamic)

The selected cities are Nagpur, Bhopal, Varanasi, Lucknow and Nasik whose urban cores are analyzed(fig 4). All are developing cities with population ranging within 1-2 million, as per 2001 census. The climatic conditions are also similar as tropical or subtropical climate with wet and dry or humid conditions. The elevation of these cities from mean sea level is varying between 300-500m above mean sea level. The densities are varying in these cities but only core areas which are organically evolved are considered. These cores are mostly the dense parts of the cities and are at the geographical centre of the present cities. Secondly, these cores have

![Select cities in Central India](www.mapsofindia.com)
residential, commercial and sometimes industrial activities, thus resulting into a mixed land use pattern.

Bhopal is an administrative capital of a state called Madhya Pradesh. In the core area, there are small scale industries and large retail businesses. It has dominating percentage of Muslim population. Similarly, Lucknow is also a state capital of Uttar Pradesh. It is known for a typical kind of hand embroidery, called ‘chikan kari’ and in the core area, people are mostly involved in this as household industry. It also has dominant percentage of Muslim population. Apart from majority Hindu population, it has substantial percentage of Muslims. There are also small groups of Sikhs, Jains, Christians and Buddhists.

Varanasi is the holiest place in the world as far as Hinduism is concerned. It is one of the oldest continuously inhabited cities in the world and probably the oldest in India. It is a city of temples and traditionally known for craft of silk weaving. Nasik is also a Hindu pilgrimage city, but now becoming a cosmopolitan town due to industrialization.

Nagpur is at the centre of India and is having most of its population engaged in tertiary sector (non agricultural economic activities). It is a cosmopolitan city with more than one fourth of population belonging to schedule casts and scheduled tribes.

3.2 Procedure for Analysis:

The configurations of traditional cores of select cities are investigated by representing them in terms of system of spaces through axial maps. Configuration parameters such as connectivity, local and global integration, and interpretive parameters such as intelligibility and synergy are considered.

Connectivity of an axial line measures the number of lines that directly intersect that given axial line. Thus connectivity of a space represented as an axial space, denotes the number of immediate neighborhoods of a space. Integration of a space is by definition expressed by a value that indicates the degree to which that space is integrated or segregated from a system as a whole (global integration), or from a partial system consisting of spaces a few steps away (local integration)

The correlation between connectivity and global integration is an important indicator of how clear an urban system is for its users; and is called as Intelligibility. The relationship between local integration \( R_1 \) and global integration \( R_m \) is called synergy. It indicates the relationship between parts of the spatial system to whole system. These parameters can quantify the spatial configuration. Thus, deduced syntactic identity in Indian traditional built environments is then reviewed with respect to spatial configurations of built environments from other parts of the world; referring the already conducted research works, through secondary sources. This has helped to highlight the fact that configurations are resulting out of some culture specific human preferences.

Secondly, the important religious, administrative or commercial urban activity nodes evolve along movement patterns, depending upon the culture specific space proxemics about public spaces. Hence, to understand the human preferences in terms of norms about culture specific space proxemics, the placement of important religious, administrative or commercial urban activity nodes, in the overall spatial configuration, are observed.

There is a concern about the validity of application of space syntax methodology in Indian context in terms of subjective interpretation of analytical conclusions. But, it can only be resolved by conducting such a study.
Second important concern about the use of syntactic analysis is whether the implications of topography would be reflected in the axial analysis or not. For that, the research on “Axial lines and contour lines” by Valerio Cutini (2007) was referred. The researcher has investigated if altimetry variations affect on the configuration indices of the built environment, when syntactic analysis is done; using space syntax methodology. It was found that, the topographic features influence the evolved system of spaces and thus gets reflected indirectly in the axial line analysis (Valerio Cutini 2007).

4. FINDINGS: SYNTACTIC ANALYSIS

4.1 Number of Axes: Table 1

<table>
<thead>
<tr>
<th>Cities</th>
<th>Area in sq. km</th>
<th>Number of Axes</th>
<th>Corr. Coef</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bhopal</td>
<td>3.25</td>
<td>2686</td>
<td>1.00</td>
<td>Significant positive correlation for Bhopal, Nasik and Nagpur</td>
</tr>
<tr>
<td>Nasik</td>
<td>2.5</td>
<td>1232</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nagpur</td>
<td>4.1</td>
<td>4360</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucknow</td>
<td>2.6</td>
<td>4502</td>
<td>0.24</td>
<td>Insignificant positive correlation for Lucknow, Bhopal</td>
</tr>
<tr>
<td>Varanasi</td>
<td>2.85</td>
<td>5654</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average no. of axis</td>
<td></td>
<td>3686.8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Number of axes in a specified area can explain how fragmented the spatial configuration is. More the number of axes in a given area; more is the fragmentation. Out of the studied traditional cores of select Indian cities, there is a significant positive relationship between number of axes and square kilometer area in case of urban cores of Nagpur, Nasik and Bhopal.(Table 1, Fig. 5) But the number of axes is much higher, irrespective of area in case of Varanasi and Lucknow. The number of axes is highest in case of Varanasi, making it the most fragmented city followed by Lucknow.
4.2 Comparative analysis of syntactic parameters

The comparative analysis of syntactic parameters of traditional cores of select central Indian cities shows similar syntactic properties with some variations. (Fig 6) The average mean depth varies from 11 to 16 except 21.73 for Varanasi. The average global integration (Rn) varies from 0.49 to 0.76, except for Nagpur which is 0.90.

The average local integration is very much consistent from 1.5 to 1.59, except 1.68 for Nasik. The average connectivity is also quite consistent from 3.3 to 3.42, except 3.82 for Nasik.

If Intelligibility and synergy are considered, the urban core of Nagpur is having better synergy and intelligibility. It is followed by Nasik and Bhopal. Lucknow and Varanasi are equally poor in terms of synergy and intelligibility. (Fig. 7)

![Fig 6: Comparative analysis of Syntactic parameters](image1)

![Fig 7: Intelligibility and Synergy](image2)

### Table 2: Numerical Synthesis: Comparative analyses of urban cores of select Indian cities

<table>
<thead>
<tr>
<th>Name of the cities</th>
<th>Mean depth</th>
<th>Integration Rn</th>
<th>Integration R3</th>
<th>Connectivity</th>
<th>Intelligibility</th>
<th>Synergy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Average</td>
<td>Max</td>
<td>Min</td>
<td>Average</td>
<td>Max</td>
</tr>
<tr>
<td>Bhopal</td>
<td>1</td>
<td>14.82</td>
<td>27.73</td>
<td>0.21</td>
<td>0.64</td>
<td>5.09</td>
</tr>
<tr>
<td>Lucknow</td>
<td>1</td>
<td>16.89</td>
<td>31.38</td>
<td>0.21</td>
<td>0.61</td>
<td>1.08</td>
</tr>
<tr>
<td>Nagpur</td>
<td>1</td>
<td>16.89</td>
<td>31.38</td>
<td>0.21</td>
<td>0.61</td>
<td>1.08</td>
</tr>
<tr>
<td>Nasik</td>
<td>12.35</td>
<td>11.36</td>
<td>27.15</td>
<td>0.29</td>
<td>0.76</td>
<td>1.27</td>
</tr>
<tr>
<td>Varanasi</td>
<td>1</td>
<td>21.73</td>
<td>40.75</td>
<td>0.21</td>
<td>0.49</td>
<td>5.09</td>
</tr>
<tr>
<td>Ahmadabad (Raman 2003)</td>
<td>15.28</td>
<td>0.68</td>
<td>1.566</td>
<td>3.46</td>
<td>2.97</td>
<td>0.115</td>
</tr>
</tbody>
</table>

Average
Though the urban cores of select Indian cities show similar syntactic identity, there are pairs of Bhopal & Lucknow, Nagpur & Nasik; which show distinctions from other pair. The syntactic parameters are similar for Bhopal and Lucknow. The intelligibility is extremely poor in both the cases and synergy values are also low. The two cities have similar social environment as the core areas are dominated by Muslim population in both the cities. Hence in table, these two cities are highlighted with same colour. (Table 2)

Nagpur and Nasik have similar syntactic identity as they both are cosmopolitan cities with major percentage of population belonging to Hindu religion.

Varanasi is the oldest Hindu Pilgrimage centre and the syntactic parameters are quite different than other four cores. This is because of the social environment and the typical geographical setting as well. The larger than life importance to the river Ganges for most of the religious rituals has also resulted into the typical spatial configuration. (Table 2)

<table>
<thead>
<tr>
<th>Name of the cities</th>
<th>Number of Cases</th>
<th>Number of Axes</th>
<th>Average Integration Rn</th>
<th>Average Integration R3</th>
<th>Average Connectivity</th>
<th>Average Intelligibility</th>
<th>Average Synergy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban cores of central Indian cities</td>
<td>5</td>
<td>3687</td>
<td>0.68</td>
<td>1.566</td>
<td>3.46</td>
<td>0.082</td>
<td>0.282</td>
</tr>
<tr>
<td>Iranian traditional Cities( Karimi 1997)</td>
<td>6</td>
<td></td>
<td>0.482</td>
<td>1.6</td>
<td>2.772</td>
<td>0.116</td>
<td>0.16</td>
</tr>
<tr>
<td>English traditional cities( Karimi 1997)</td>
<td>6</td>
<td></td>
<td>1.44</td>
<td>2.02</td>
<td>3.45</td>
<td>0.264</td>
<td>0.427</td>
</tr>
<tr>
<td>USA( Raman 2003)</td>
<td>12</td>
<td>5420</td>
<td>1.61</td>
<td>2.956</td>
<td>5.835</td>
<td>0.224</td>
<td>0.559</td>
</tr>
<tr>
<td>Brazil ( Medeiros , Holanda 2007)</td>
<td>44</td>
<td>7881</td>
<td>0.77</td>
<td>3.88</td>
<td>0.15</td>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td>Arab ( Raman 2003)</td>
<td>18</td>
<td>840</td>
<td>0.65</td>
<td>1.619</td>
<td>2.975</td>
<td>0.231</td>
<td>0.16</td>
</tr>
<tr>
<td>Asia Pacefic (Medeiros , Holanda 2007)</td>
<td>32</td>
<td>6332</td>
<td>0.87</td>
<td>3.5</td>
<td>0.15</td>
<td>0.44</td>
<td></td>
</tr>
<tr>
<td>Portugal ( Medeiros , Holanda 2007)</td>
<td>10</td>
<td>1453</td>
<td>0.86</td>
<td>3</td>
<td>0.28</td>
<td>0.59</td>
<td></td>
</tr>
</tbody>
</table>
Comparative analysis of syntactic parameters such as integration and connectivity; of traditional cities from other parts of the world and Indian traditional urban cores; shows configuration similarities with Iranian traditional cities and Arab cities. (Table 3, fig 8) The intelligibility of urban cores of central Indian cities is lowest compared to rest but they are better synergistic compared to Iranian or Arab cities. (Fig. 9) One of the objectives of the research was to identify and quantify spatial configuration of traditional Indian built environment. The above mentioned findings bring out the fact that the traditional cores of select Indian cities point out a specific syntactic identity, which is indicative of a culture specific spatial structure. The Indian traditional built environments have a distinct structure in terms of its spatial configuration, which is quite different from traditional built environments from other parts of the world.

5. TRADITIONAL INDIAN BUILT ENVIRONMENT: DISCUSSIONS

The axial line models of traditional cores of select Indian cities were analyzed in Depthmap. The analytical maps for the syntactic measures such as the local integration, global integration, connectivity; were generated. The global integration maps for traditional cores of Nagpur, Bhopal, Nasik, Lucknow and Varanasi are shown in figures. Apart from the numerical synthesis of syntactic parameters, which indicates a syntactic identity for Indian traditional built environments; there are fine variations within the selected five. These variations point toward the varying human preferences for space proxemics, due to cultural differences. The cultural differences are mainly due to social norms rooted in the religion followed by majority of the population in the select five examples.
In case of Nagpur (fig 10), the overall system of spaces is such that it forms a sort of orthogonal grid at the global level with better connectivity and integration as it connects as well as segregates the local area with the rest of the urban system.

The same orthogonal grid is not continued in the residential clusters. The subsystems formed within the system have truly organic pattern with tree system of spaces. The analysis through queries has highlighted that; these are the areas with higher mean depth and lower connectivity. This makes these areas less intelligible and permeable, thus avoiding unnecessary through traffic. Such slightly segregated spaces from the global grid, yet having better integration at local level are present inside residential clusters. The internal organic and tree pattern of system encourages pedestrian movement. It helps in making better use of these spaces by residents for outdoor activities, social interactions and playing.

In case of Bhopal, there is a system of spaces with orthogonal grid in the centre which was a walled city.( fig 11) But the same orthogonal grid is not continued in the area surrounding the walled city. The subsystems formed outside the walled area are truly organic, making outside walled area unintelligible and impermeable.

In Nasik, there is a system of spaces with deformed orthogonal grid with high integration and connectivity, making it quite intelligible for users (fig 12). It is on the banks of river Godavari, which flows through the city. Yet, the spatial configuration has little orientation towards the river.

In case of Varanasi, there is a system of spaces with deformed radial grid oriented towards the holy river Ganges.(fig 13) The river plays an important role in the socio cultural and religious activities of the city. The spatial configuration is quite indicative of that. The local parts are quite segregated and every part is finally oriented towards the river, Ganges, thus establishing continuous visual and physical linkages to the river.

The overall system of spaces is highly segregated and unintelligible, making the city impermeable and inaccessible to strangers entering the city from riverside. The city was invaded number of times by Islamic rulers during 9th and 10th century. It may be one of the reasons for immerge of such an unintelligible spatial configuration.
For Lucknow, the overall system of spaces is radiating from the political and religious core evolved on the banks of river Gomati. (Fig 11) Unlike Varanasi, the local subsystems are not oriented towards the river. The global system is formed by the 2-3 radiating roads which easily connect the core with rest of the system. But the same radial grid is not continued in the residential clusters which are organic. Public areas are distinctly separated from residential areas.

Thus, the spatial configurations of the selected five examples show variations. The variations highlight that there were differences in terms of user preferences about space proxemics. It is obvious that the norms about how the public and residential domains are integrated or segregated; are different for different cities.

To investigate further about the human preferences in terms of norms about culture specific space proxemics, the placement of important religious, administrative or commercial urban activity nodes, in the overall spatial configuration, are observed. The local integration syntactic maps are superimposed on the maps of urban cores where the important urban activity nodes are marked. As a representative example, one such map of traditional core of Nagpur is shown. (Fig 15) It has highlighted that the activity node having local bazaar, religious activities and administrative activities; is not located on highly integrated streets. It is located on second order streets, in terms of their integration values. This makes these activities slightly segregated from the global system. Similar observations were found in the case of Nasik, where important activity nodes such as temples are placed on streets with second rankings in terms of integration values. In the case of Bhopal and Lucknow, the main urban elements and activity nodes are mostly the mosque and the bazaar street. These are placed on streets with high integration level, which means on global network. In the case of these cities with dominating Muslim population, the important activity node which is a public domain; is segregated from local network. For Varanasi, as the river is the most important focus of urban life since ages. Hence, here the observation is very peculiar. The important urban elements such as palaces, temples, cultural activity centers and bazaars; all are along the river, and segregated them from global network. This was because of the fact that the main accessibility then was through river. Except, for Bhopal
Indian built environments were continuously evolving. The continuity of this evolution based on the culture specific human preferences, seems to be lost in the emerging built environments in developing cities. To deal these emerging built environments in contemporary times, it’s important to understand the spatial configurations of the traditionally evolved built environments. The research has tried to establish the problems associated in studying organically evolved built environments of urban cores in central Indian cities. In such an approach, the syntactic analysis helps in understanding the spatial configuration and the embedded reasoning of user preferences. The syntactic analysis of selected examples shows some similarity in terms of syntactic identity. The syntactic identity of Indian traditional built environments shows some similarity with traditional Iranian cities but otherwise it is quite different than traditional built environments from other parts of world. The placement of important religious, administrative or commercial urban activity nodes, in the overall spatial configuration helped to deduce the culture specific human preferences about space proxemics. From this research, an effort is made to make explicit the spatial configuration as

Fig. 15: Traditional urban core of Nagpur with urban elements superimposed on local integration map.

6. CONCLUDING REMARKS

and Lucknow; which has dominating Muslim population; Nasik, Nagpur and Varanasi have urban elements on local networks.

The analysis helps to understand the fact that; important religious, administrative or commercial urban activity nodes evolve along movement patterns, depending upon the culture specific space proxemics about public spaces.
concealed spatial rules or principals of urbanism in Indian built environments, so as to evolve a humane approach towards spatial design of emerging built environments in urban India. More detailed analysis is required to exactly assess the user preferences, but this study is representative of its possibility. Also, the study can be furthered for number of cities.

The approach to deal with emerging built environments based on notion of rationality and intelligibility has grossly ignored the culture specific user preferences. The study highlights that in Indian context, intelligibility is not the criterion for better harmony amongst users and built environment. It is not necessary to emulate the past but to contribute positively to the evolution of contemporary Indian built environments; one can use the configuration understanding and reasons behind it. Thus, this approach which is based on understanding user preferences to study/ conserve/ redevelop existing built environments or design totally new built environments in case of developing cities of India; can help to maintain them as humane as the traditional built environments were.

REFERENCES

Books
Alexander Christopher,(2005) “The Nature of Order Book I( the Phenomenon of Life) and Book II( The process of Creating Life)” Published by the Centre for Environmental Structure, Berkeley , California, USA


Rapoport Amos,(1969) “House Form and culture’, Milwaukee, University of Wisconsin, USA

Rapoport Amos,(1977) “The Human Aspects of Urban Form”, Published by Pergamon Press, England, United Kingdom


Handbooks and Reports

Retrieved from ucl.academia.edu/AlasdairTurner/.../Depthmap_4A_Researchers_Handbook

Fürstand Attila,(2007) “Space Syntax In Urban Research” Thesis Summary Of Doctoral Dissertation Corvinus University Of Budapest, Faculty Of Landscape Architecture, Department Of Landscape And Urban Design, 1118 Budapest
Retrieved from phd.lib.uni-corvinus.hu/283/3/furstand_attila_ten.pdf


Research Papers

Ahyun Kim, Young Ook Kim,(2009) “ Influences of Spatial Configuration Learning on Spatial Behaviour-Focused on shortest distance and behaviour” proceedings of the 7th international Space syntax Symposium, Ed. By Daniel Koch, Lars marcus and jesper Steen, Stolkholm. retrieved from sss7.org/Proceedings_09.html


Karimi Kayvan (1999)” Urban Conservation and Spatial Transformation preserving the fragments or ‘spatial spirit’ ” , Published in proceedings of Space Syntax Second International Symposium, Brasilia . Retrieved from 217.155.65.93:81/symposia/index.html


WEBSITES:
en.wikipedia.org/wiki/The_City_in_History

http://en.wikipedia.org/wiki/Spatial_design

http://www.wikipedia.org/wiki/morphogenesis

http://en.wikipedia.org/wiki/Spatial_cognition


MAPS, PHOTOGRAPHS AND FIGURES:

- All city maps or part maps are acquired from Local authorities/ Municipalities/ Improvement trusts/ development authorities of respective cities.

- The map of India showing million plus cities is retrieved from
www.censusindiamaps.net/page/India_WhizMap/IndiaMap.htm

- The demographic aspects, topography, climate and socio-cultural economic aspects of the select cities are referred from the respective development plans.

- Photographs are by the author.

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