

Towards Sustainable Future: Typologies and Parameters of Courtyard Design

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Abstract—The environmental issues like global warming, climate change, shortage of energy and water etc could be solved through sustainable approach of design. The courtyards were acting as sustainable solutions throughout centuries all over the world and may act for future buildings too. The courtyard concept could be traced back in Indus valley civilization. The types of courtyards could be categorized in many ways such as based on level of courtyard, regional variation and functional use of buildings etc. The paper will discuss the different typologies of courtyards in general.

The courtyard is very effective solution in all types of climate especially hot arid and hot humid. The use of courtyard in India, Middle East and China were due to their climatic conditions. The various aspect of courtyard design could be divided into three main categories namely climatic aspects, socio-cultural aspects, functional and aesthetic aspects. The climatic aspects will include the use of sun light, ventilation as well use of water etc. The socio-culture aspects will include the social interaction within courtyard and interaction to street, cultural use, religious or mythological belief, different life style, action radius and affordability of courtyards etc. The functional aspects will include all functions of courtyard except the climate such as acoustics, circulation, landscaping etc and aesthetic aspects will be including the feeling of enclosures, use of crafts, façade treatment of enclosures etc This paper will discuss all above aspects in brief only to understand the overview of parameters of design of courtyards in general.

Keywords: aesthetic aspect, cultural aspect, regional variation, socio-cultural aspect, wada, haveli.

1. INTRODUCTION

The population of world had increased manifold in past few decades and there is need of all types of infrastructure to sustain need of this population. The housing is essential need for this population and in past few decades high rise, high density housing were built to fulfill the need of increasing population and to save agriculture land. This high density and high rise solution has created so many problems at level of social, culture and psychological.

The world is going through so many issue related to environment such as global warming, climate change, energy and water shortage, waste generation, pollution etc These

issues can be addressed only through sustainable approach of design.

The vernacular and traditional architecture was always sustainable all over world throughout centuries. After industrial revolution all culture of world especially Asian countries have lost their own sustainable principles of design and started copying the western architecture without understanding its advantages and disadvantage in long run. The courtyard planning could be best solution to address this environmental, social, cultural, psychological issue in Asian Countries and it can also address the high density issue to large extent due to compact planning through courtyard.

2. TYPES OF COURTYARDS :

2.1 Based on Levels:

There are different types of courtyard on the basis of their location on vertical plane i.e. ground level, sunken courtyard and elevated courtyard. It will depend on the site, climate and other factors to determine the type of courtyard to be chosen and accordingly their size and proportion should be worked out.



Fig. 1: Sunken courtyard in American Institute of Indian studies at Gurgaon.

2.2 Regional variations:

In India the courtyard house could be found from Himalaya to south, there is so much regional variation in these courtyard forms due to variation in climate, culture, social system etc. The important type of courtyard on regional basis are the Havelli of Gujarat, Havelli of Rajasthan, Wada of Maharashtra, Nalukettu of Kerala, Chettinad of Tamilnadu and Rajbari of Bengal. Few of these regional variations are discussed below:

Haveli: The concept of haveli was prevalent in north as well North West of India and the most popular are haveli of Gujarat, Rajasthan and Punjab. The Gujarat haveli used to have one courtyard or series of courtyards. The outer courtyard is used to park trolley, tractors and keep buffaloes or cows. The inner courtyard is used for cooking, food preparation and water storage. The rain water is storage underneath courtyard. The Rajasthan havelli have used sandstone and Gujarat Haveli made up of wood. In Rajasthan haveli as one enter inside the courtyard, the noise of street get cut completely due to height of walls.



Fig. 2: Inner courtyard of Rajasthan Haveli

2.3 Wada of Maharashtra:



Fig. 3: Courtyard of Vishrambaug Wada

Wada are typically built by Marthas in the patronage by Peshwa. These are having influence of

Mughal influence of their architecture and it could be seen on the inclusion of courtyards with fountains, pools, terraces, pillared aisles, arches, latticed windows or balconies. Most of the houses are having one courtyard for the business or administrative function and series of inner courtyards for family.

2.4 Based on Functions of buildings:

The courtyard form is initially used in residential buildings but later on the realizing its merit the different civilization used this concept in public buildings too.

The courtyards of public buildings are always monumental scale while the residential buildings are always human scale. The residential courtyards are very functional in respect of climate while the courtyard of public buildings aims to have other utilities like public gathering spaces etc too.

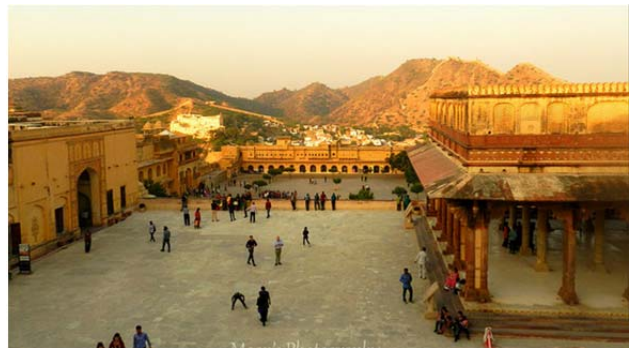


Fig. 4: Use of courtyard in public building: Amer fort, Rajasthan

2.5 Based on Shapes of Courtyard:

The circular, polygons, rectangular, square as well organic forms have been used through historical evolution of courtyards. The most popular among masses were rectangular or square form due to functionality of the building, limitation of structure innovation and less plasticity of material, due to economical in nature. In China, the Tulou buildings were having circular courtyard and these buildings were built by mud. The colonial architecture has also many example of the circular courtyard in their palaces and public buildings due to aesthetic reasons.

The technological advancement and material innovations have finished the limitation of structure and all types of shapes are possible in 21st century depending on need.



Fig. 5: Circular courtyard of palace of Charles V

3. CLIMATIC ASPECTS OF COURTYARD:

3.1 Sun light:

There is no established rule for deciding size and the proportions of courtyards. However these may be worked out on the basis of geographical, cultural, regional and climatic differences. The climate plays important role in determine the size, proportion and orientation of courtyard so as to allow the desired sunlight for creating comfort condition within house ..

The size of courtyard for natural daylight will depend on latitude place .The nearer one gets to the equator the smaller the the width requirement due to sun attains higher orbit. Conversely the width of courtyard is more required towards the poles of earth to enter the natural day light due to low orbit of sun. The height of courtyard is required more for equator and height may be progressively reduced towards poles. The concept of multistoried housing is suitable to equator to get shading in courtyard and low rise housing is required towards poles.

3.2 Ventilation:

In hot arid regions where the temperature difference between day and night is large, the courtyards are very effective solution to create comfort conditions. In day time, due to high temperature of outside ,the air gets warm and become lighter but the temperature inside the courtyard remain less, so air become denser and cool as compared to outside air. This cooler air get inside rooms through courtyard and warm air get outside through rooms. In night time, the outside air become cool due to less temperature and dense, the building is still warm so courtyard air becomes lighter. The outside air gets inside through rooms and get exhausted from the courtyard, so this movement of air creates comfort condition.

In hot humid conditions the the heavy air outside enter from rooms and get out from the courtyard in day as well night. The movement of air in hot humid conditions is very effective for human comfort conditions because it reduces moisture content of the air.

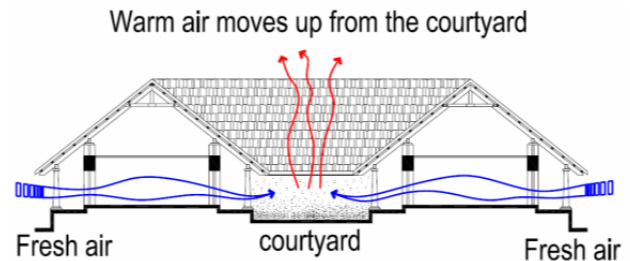


Fig. 6: Air movement in hot humid climate.

4. SOCIO-CULTURAL ASPECTS OF COURTYARD:

4.1 Social Interactive space:

Courtyard works as an extension of the kitchen during the morning and as living room during the evening to entertain the guests. A space for interaction for all family members, and encourage the family to act as a group. Sleeping area during the night when the climate is conducive to outdoor activity.

4.2 Size and proportion:

The Psychological factors also are also determinant for size and proportion of courtyards, different socio cultural have different feeling of enclosures thus having different the degree of introvertness. The Arab culture are having lesser width $D/H=1/2$ or less sometimes due to introvertness in nature while the Canadian courtyards are sometimes having $D/H=3$ or more having less intvovetness.



Fig. 7: Courtyard in Arab culture.

4.3 Street level Interaction in indigenous courtyards:

The courtyard houses in India are designed to have street interaction, most of houses were having platform next to entrance door and before entering to outer courtyard, people used to have sitting on this platform. Inner courtyard use to have less perforation because these are mainly for female of the house, only vendors selling products related to female are allowed in inner courtyard.

Jugglers, acrobats, snake charmers, musicians and theatre groups are allowed to perform their shows for females as well but females are allowed to see through curtain or first floor.

4.4 Cultural space:

Use of more than one courtyard found in many cases. This is usually to segregate the public and private spaces within the house. The public is mainly for guest and generally used by male (especially in Islamic countries). The inner court is more restricted to the family used as an outdoor area for activity and used by female

4.5 Religious, Mythological beliefs:

Courtyard concept has also related to many religious beliefs or mythological beliefs for different part of world.

In Chinese the courtyard are used to work out of the principles of Feng -Shui, it is believed that application of these principles will bring harmonization with their environment as well bring prosperity to the people. Feng-shui principles describe all design elements such as yards, rooms, walls, doors, steps, draining, orientation, positions, plants etc

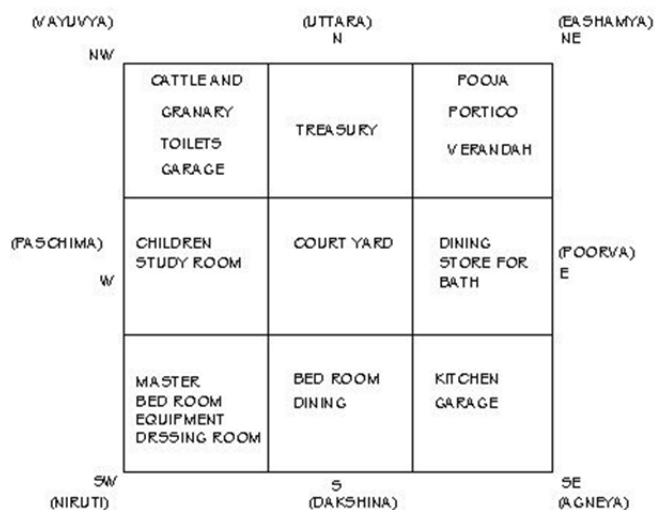


Fig. 8: Courtyard concept as per Vastu Purush Mandala.

The Indian courtyard system is based on Vastupurush Mandala; it is considered the house should be divided into grid of 9 square and the center square should be left open. The center portion is given a place of Brahma and it is lungs and heart of house. This place should be free from obstructing elements such pillars, walls or mechanical services. The courtyard should be almost cooled and shaded, so it can act various activities of household.

4.6 Flexibility and Adaptability to different life style:

The courtyard retains the freedom of individual expression as opposed by suburban detached house. The detached houses are having many norms to follow such as maintaining the green,

washing of front lawns, hedges, fences etc as per neighborhood style and taste while the courtyard house are free from these norms being introvert and individual can express own identity .

There is major change in life style of people in past few decades all over world. There are more possibility of different groups such as nuclear family, single parent families, old age couples, and young couple of same sex or different sex .The detached house may be appropriate for nuclear families but other type of groups need more privacy and courtyard house is able to cater the needs of all groups even nuclear families .

There is concept of home office happening in most part of world, the courtyard can be very effectively act as private space of house and the office can be situated outside without disturbing the house activities or U shape courtyard may be planned to have private activity in one wing and semi public activities in another wing.

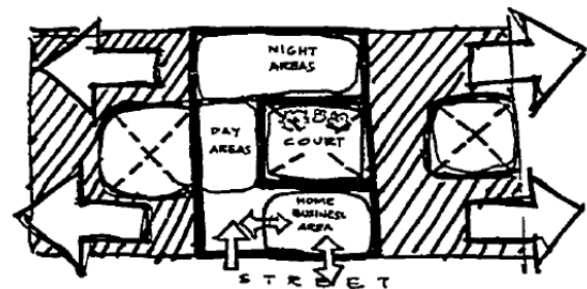


Fig. 9: Home office concept through U Shape courtyard.

4.7 Action radius:

The high rise housing is not ideally good for families having children's of different age group while courtyard housing is very effective for children of different age group for safety purposes.

The action radius can be defined as travel distance from the identifiable physical entity located inside the house. The toddlers and old age persons are having less action radius, the adult and older children have large action radius. The toddler and old age persons can be very well accommodate inside the courtyard house and adults, older children's can use neighborhood parks .

4.8 Affordability:

The concept of affordability is prevalent all over world but the fact remains that affordable housing still not practically reaching to the poor people. The main reason behind is that developer's profit, contractor's profit and labor contribute to 50% of the cost of house. The courtyard houses have been built by poor people in all developing countries by themselves; there is no need of architect or developer. So the cost of house could be reduced to half and it can be affordable to large no of people living in the slums etc.

5. FUNCTIONAL AND AESTHETIC ASPECTS OF COURTYARD:

5.1 Accessibility and Circulation:

The courtyard minimizes the circulation area of house and make house more compact. The unnecessary corridors may be avoided by the use of courtyard.

5.2 Use of Water in Courtyard:

Water is the element used in courtyard of hot arid climates especially the Middle East countries and this influence could also be seen in India .In hot arid regions the moisture content in the air is less, so use of water adds more moisture to create comfort condition within house. Water is used in stagnated as well dynamic flowing water bodies, used in the form of fountains, cascade etc.



Fig. 10: Use of water in courtyard of Islamic architecture.

5.3 Acoustics:

The acoustics of courtyard may be worked out depending on the location and culture of place; few cultures tolerate more noise while others are not able to tolerate even slightest noise. The courtyard wall should not face another courtyard wall but it preferable that blank wall of other house should face the courtyard wall, if the distance between the two courtyards houses increased; there is less possibility of noise.

The length and width of courtyard at least should be preferably twice or more then max height for acoustically viable noise control device.

5.4 Dust Control:

The courtyards can act as dust controller in desert climate. The opening of rooms of house could be open in courtyard so as to avoid dust storm outside. The paving materials of courtyard could collect the dust and regular cleaning should be done .The jail on the walls of courtyard is also used in the desert climate to avoid dust.

5.5 Landscaping:



Fig. 11: Landscaping elements in Islamic courtyard

The Islamic and Japanese architecture were using the landscaping as major component for courtyard design throughout centuries. The landscape was not only ornamental or theological function but was used to create microclimate in these regions. The landscaping elements may include the trees, shrubs, hedges, flower bed etc The trees are also creating shades on walls as well ground to create microclimate conditions.

5.6 Proportion for the feeling of enclosure:

Feeling of enclosure is determined by relationship of viewing distance to height as seen by frontal view. When $D/H=1$ the angle formed is 45 degree, it is termed as full enclosure. If $D/H=2$ the angle formed is 30 degree, it is termed as threshold enclosure and if $D/H=3$ the angle formed is 18 degree, it is termed as minimum enclosure and if $D/H=4$, the angle formed is 14 degree, it is termed as loss of enclosure.

Different locations. Cultures and Situations require different D/H ratios and the above mentioned proportions should be considered as mere guidelines. The enclosures are weakened by gap between walls, abrupt changes in the cornices height and drastic variation in façade levels. In Arab courtyard $D/H=1/2$ or less is appropriate while Canadian courtyard $D/H=3$ or 4 is suitable.

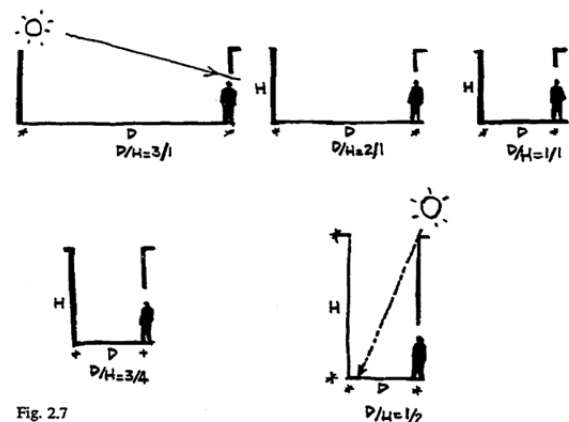


Fig. 27

Fig. 12: D/H combination of courtyards.

6. CONCLUSION

There are various types of classification of courtyard and it has been found that there is so much variation of courtyards in different part of India, it is concluded that these variation are possible only due to difference in geographical location, climate, culture, social system, functional need etc

The parameters of courtyard design are analyzed and it can be concluded that courtyard design is very simple if you consider only few parameters but it can also become very complicated if you consider more parameters or all parameter. The climate aspects of courtyard were always very significant throughout centuries and primary aim of courtyard design was to create comfort condition in harsh climate. In present context also this factor should be given top priority to achieve sustainability and the proportion as well sizes may be worked out by using simulation tools for light, shadow and ventilation.

The socio cultural aspect has been given importance through centuries and in present context this factor has been ignored so there is need to consider this aspect in light of changed life style of people. The aesthetic aspect of courtyard was also important in most of India because people were using these courtyards on daily basis but this factor need to be addressed in present context in light contemporary architecture of the India.

It can be concluded that courtyard design is not easy process because it has so many parameters to consider but study of traditional or vernacular architecture might give insight for design process. There is need to consider the wisdom of ancient courtyard system along with use technological advancement and changing life style of people of present context.

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