

Characteristics of Courtyards in the Vernacular Houses of Gondia in Maharashtra, India

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Received	Accepted	Published
29.01.2023	27.10.2023	31.10.2023

<https://doi.org/10.61275/ISVSej-2023-10-10-16>

Abstract

Courtyards have been the part of traditional houses since ancient times. This paper examines the courtyards in traditional houses of Gondia district in Maharashtra, Central India. It puts forth a systematic methodology to explore the characteristics and functions of courtyards like the architectural/physical attributes and functional attributes in the present context.

In this study, a reconnaissance survey and documentation of courtyards in traditional houses in Amgaon taluka of Gondia district, Maharashtra in Central India region were carried out. It ascertained the synthesis of a few case studies in terms their typology, general physical characters, activity patterns and use of the courtyard. It employed activity assessment, space matrixes and proximity analysis. The study helps to understand the courtyards on parameters of space making like porosity, proportionality, flexibility, and connectivity.

The paper divulges the place making attributes with ideas of celebration of a space in all the four seasons of the year while building the psychological attributes of belongingness and attachment to the place. This research along with the guidelines can be applied further to the design of contemporary vernacular residences in any contexts for the effective climate responsive courtyard design.

Keywords: Courtyards, Proportions, Orientation, Activity assessment tool, Proximity analysis

Introduction

Courtyards have been part of Indian buildings since ancient times. The first courtyard houses, according to historical evidence, appeared to have originated in India around 6500-6000 BC. Evidence of the earliest village is from Mehargarh (6500-6000 BC). The settlement consisted of an irregular scatter of mud brick houses and the material for house construction. The idea of settlement planning was well established at Harappa at an early phase, Kot Diji (prior to 2600 BC). The basic overall layout of the settlements is distinguished by the orientation of the streets to cardinal points.

Sir John Marshall describes the courtyard houses as follows.

“To the right of the porter’s lodge a short passage led to the central courtyard of the house, which was open to the sky and provided light and air to the rooms grouped about it on both the ground and upper floors. And here, let me say parenthetically, that the principle of the open court encompassed by chambers was just as fundamental to – Planning at Mohenjo-Daro as it was throughout the rest of prehistoric and historic Asia, and as it has continued to be in India until the present day.”

Marshall,1929:18-19

The courtyard style developed in the Central India during the medieval period of Peshwas and Bhonslas. The style was earlier commonly associated with the large mansions but with its impact and functions the style reached the houses of commoners. The courtyard displays typological and stylistic variations due to economics status, culture, and lifestyle. Courtyards play an important role in shaping the physical, psychological, and climatic environment in the buildings and maximize interior relationships while keeping the outside separate. Traditionally, courtyard has been mostly part of houses in India and has worked efficiently in such houses since long time. But in central India region it has some specific characteristics which is studied and elaborated in the paper.

The aim of the paper is to study the courtyards in traditional houses of Central India region specifically on their physical parameters like shape and form, orientation, scale and proportion, elements defining it along with activities. The objectives of the paper are to collect data about the courtyards of traditional houses in central India region, to derive observations from the study that can be used as a reference for design of courtyards in contemporary buildings. The purpose of the study is to develop a systematic methodology to explore the characteristics and functions of courtyards

Theoretical Framework

Physical parameters of Courtyard

The physical characters comprise of geometry, orientation, and scale. The geometry provides the shape and form of the courtyard. The orientation of the courtyard is the location and number of courtyards in the residence. The proportions of the courtyard will be known from the scale. To know this, there are two measures viz. height to width ratio and surface area to volume ratio.

Geometry

The basic shape and forms of courtyard would be known. Some examples of shape and form are shown in Figure 1 below:



Fig. 1: Shapes and forms of courtyards

Source: Author

Orientation

The location primarily gives the direction in which the courtyard is located as shown in figure 2 below and the number of courtyards in a house.

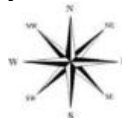


Fig. 2: Cardinal directions

Source: Author

Scale: The two measures as shown in figure 3 below include the height to width ratio and surface area to volume ratio will give the relation of the open space to the built mass.

$$\text{H/W RATIO} = \frac{\text{AREA OF THE COURTYARD FLOOR}}{(\text{AVG. HEIGHT OF SURROUNDING WALLS})^2}$$

$$\text{SA/V RATIO} = \frac{\text{TOTAL SURFACE AREA OF BUILDING}}{\text{VOLUME OF BUILDING}}$$

Fig. 3: Formula for measuring courtyard dimensions.

Functional parameters of Courtyards

The activity and functional use pattern will be based on the different time of day and different seasons of the day. The activities performed let us know how effectively it has been a part of the residence and has been a cherished space in different seasons of the year. A courtyard allows the older people and the people who cannot move swiftly or with mobility disabilities to enjoy the external environment indoors. Another important aspect of courtyards is climate in the region that demands courtyards for comfortable living. The figure 4 below shows the evolution of courtyards from a community level space to a space inside house. The villages in earlier times had these open spaces at community level which over a period transformed in the courtyard and to specifically Wada's in this region. The next three figures show the different type of courtyards that has developed in the central India region. These types have been developed over a period due to many reasons like increase in population, adaptation and influence of diverse cultures and change in lifestyle. The first one is mostly associated with the larger scale of residences commonly called as Wada's. The second and third are mostly associated with dwellings of common people in the central India region. With this known types one can recognize the courtyards in a particular region in central India

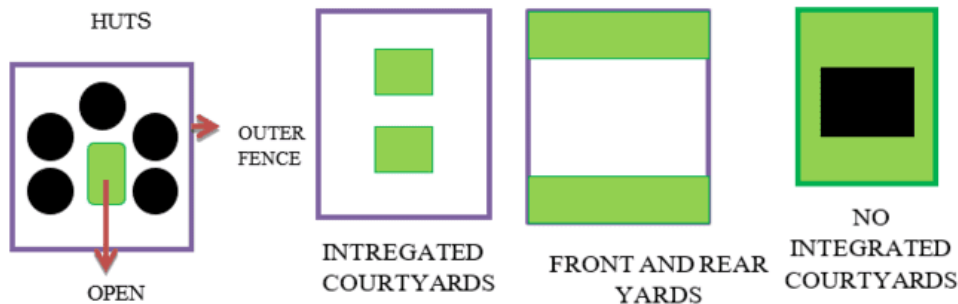


Fig. 4: Evolution of courtyards from a community level space to a space inside house.

Source: Author

The courtyard's function depends on its location in the residence. The idea of courtyard can be passed from one generation to the other as a cultural heritage, symbolically or conceptually. Certain biosocial, psychological, and cultural characteristics of human beings influence certain characteristics of the built environment. Culture is difficult to see, but its products can be seen. Built form is a minor part of culture and is a subdivision of it. Balance that exists between Nature and built area, traditional units, folk life, art and habits, values of the local communities and nations and the character or culture of the countryside etc., is to be protected for sustainable development of rural settlements. Culture must also be a part of designed environments to achieve "sense of place". The interaction between the form and its meaning is higher, which is again because of the culture of the place. The courtyard influences the behavioral aspects of the residents of the house by bringing in sun, wind, rain, and sky as a part of the interior of the house. The courtyards exhibit many attributes like porosity, connectivity, flexibility, proportionality, sense of place, etc. It also plays a major role in creating a social space within homes or group of homes. It also acts as a space to gather and space to interact and space with lot of activities, whether in groups or personnel or occupational.

Dayaratne (2006) has adopted the longitudinal method to study the transformation of Sinhalese settlements through a periodical survey of rural and urban settlements of different geographical locations. He has Integrated the longitudinal and comparative methods by studying the cases in the present context with least un-layering of the settlement fabric.

Review of Literature

Courtyards in vernacular houses have long been considered essential elements that preserve and express cultural identity. Bubbar (2005) in “The Spirit of Indian Architecture” brings out that, architecturally a courtyard is better. It draws in cool air, which is useful in the hot and humid climate. Another necessary factor attributed in the courtyard area in the house plan is to have a Vedita (sacrificial altar). It is a place for sacrificial pooja and family marriage.” The courtyard is climatically ideal for the tropics as it draws in cool air, which is circulated within the interior, replacing foul air. In non-tropical countries, the courtyard may have different utility and type, which could be treated by different size of opening depending upon the location. Rapoport (2007) discusses the formal impact of courtyard houses as an important attribute after their privacy: “the courtyard itself provides a critically important setting or subsystem of settings, within which specific activities occur as part of a larger system of activities, within a larger system of settings (which is the dwelling)”. Das (2006) discusses that the courtyard architecture still survives today in almost all countries of the world, either in its original rectangular form or in modified shapes. Raydan (2006) discusses that courtyard buildings somewhere are sun collector and somewhere sun protector. In this regard, it is important to consider sunlight in addition to the thermal effect of the sun. Therefore, the correct orientation of the buildings and its court and the proper position of the void (court) in a solid mass (building) should be considered. Garcia (2015) in "Courtyard Design: Aesthetics in Practice" delves into the detailed architectural elements that contribute to the aesthetics of these spaces. Courtyards continue to be relevant in contemporary architecture. Dayaratne, (2008) argues that ‘The emerging hybridities need to be mapped, theorized and articulated in order to bring to focus the metamorphosis presently taking place in the contemporary settlement and its architecture.’”

These literature highlights the multifaceted roles and significance of courtyards in vernacular houses, encompassing cultural preservation, environmental adaptability, community interactions, spatial efficiency, aesthetic considerations, and their contemporary relevance. They underscore the enduring importance of these architectural elements in both historical and modern contexts, as well as their contribution to sustainable and culturally rich architectural practices.

Research Methodology

This study conducted a reconnaissance survey and documentation of courtyards in traditional houses in Amgaon taluka of Gondia district, Maharashtra in Central India region. The methodology adopted for the study understands first the parameters for the analysis of study and the data collection on three levels.

The data collection comprises of documentation, climatic data, and literature study. The tools of activity assessment, space matrixes and proximity analysis are used for the quantitative and qualitative analysis of courtyards. After proper documentation, the inferences are drawn. The methodology helps to understand the overall process that can be followed for the study and understanding of the subject.

The figure 5 below shows the detail methodology for the study of courtyards in traditional houses of central India:

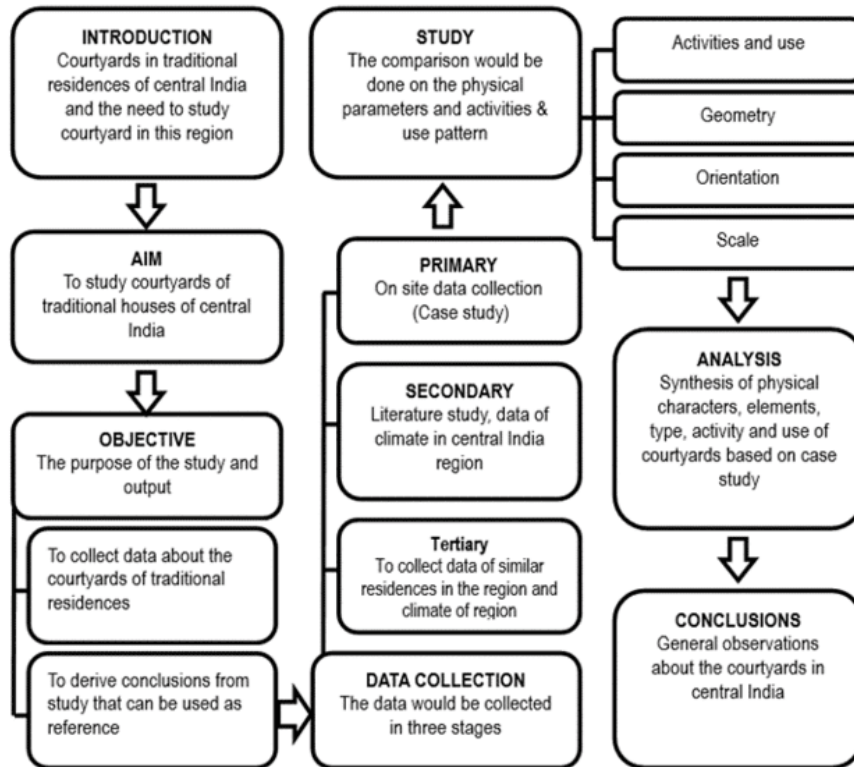


Fig. 5: Methodology for the study of courtyards in traditional houses of central India
Source Author

The space use pattern is analyzed based on its usage in the past and present context. Recording these changes in use of courtyard space through interviews of family members and observations in the house gave an insight on understanding the reasons for the change in the activity and functional usage patterns of the courtyard. This brought forth the study of transformation of the courtyard spaces while responding to the changing times and establishing its relevance in the present context.

The Case Studies

The study is based in Amgaon taluka of Gondia district, Maharashtra in Central India as is shown in the figure 6 map below. It is not defined by any state or many states except Madhya Pradesh and Chhattisgarh, which are the complete two states under central India region. The region was defined as central India during the times of British rule in India.

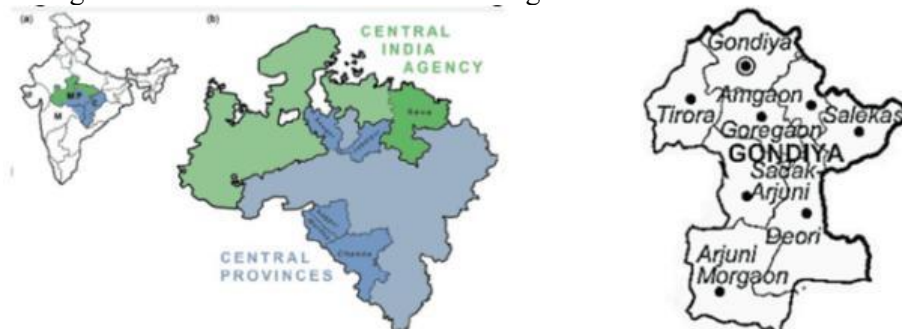


Fig. 6: Map of India, Central provinces and Gondia district.

Source: Maharashtra in Maps

Hence the case studies were selected based on the following criteria which are as under

- Climate of the region was composite.

- Being from the same village.
- Belonging to the same period.
- Should be of same typology only scale was different.

The selected village is Bhosa in Amgaon Taluka of Gondia district Maharashtra State and selected buildings structures are taken as per the criteria mentioned above. Three houses of the same village (Bhosa) are selected of same typology i.e. residential., The time period of the selected houses is from 1850 to 1950 i.e. the age of the structures ranges between 75 to 125 years. The study area is in Vidarbha region with language as Marathi and population of village is about 1250. The altitude of village is 317m above MSL, about 19km towards East from the district Gondia and 14 km from Amgaon. The nearest railway station is Gondia, accessibility is also via bus. The nearby cities to Bhosa include Gondia, Balaghat, Wara Seoni, Tirora and the nearby Villages to Bhosa include Kateri (5 KM) Kattipar (6 KM) , Morwahi (6 KM) , Irri (7 KM) , Kamtha (8 KM).

Names of owners of the residences

1. Muneshwar Damodhar Brahmkankar
2. Puranlal Polan Gautam
3. Ghannu Parasram Kamble

The case examples selected above for the study are the representative residential module. Almost 95% of the houses were made of mud. The Bhosa village was carrying an interesting vernacular fabric. The climate here is moderate which was characterized by weather patterns that remain reasonable except for the extreme hot summers. The building materials in these houses was basically locally available materials like mud, timber, bamboo, lime, agricultural waste, cow dung, grey granite, kadappa and burnt clay tiles.

Reconnaissance Study and Documentation

Case Study 01

- Name of owner: Muneshwar Damodhar Brahmkankar
- Age of structure: 102 years
- No of residents: 3 families- 17 members
- Occupation: Farming

The key plan in figure 7 is to give the overall idea of the residence and the courtyards in the house. The scale of this house is quite large as compared to the other two case studies taken.



Fig. 7: Roof plan and views of Muneshwar Damodhar Brahmkankar's house 1 (A) Courtyard 1 of house (B) Entrance doorway to house

Source: Author

Physical Characteristics

- No. of courtyards: 2
- Location:
- Courtyard-01: North facing
- Courtyard-02: South facing.
- Geometry: Rectangle
- Height to width ratio: 1:4
- Surface area to volume ratio: 1: 0.9



Fig. 8: Detailed plan and views of house 1 (A) Entry to the house
(B) The stable and store for animals

Source: Author

The above plan in figure 8 shows that there are semi open spaces (corridors) that connect the courtyard with built mass. But the main portion of the house is directly associated with the courtyard. The section in figure 9 shows how the front and back yard are being defined by different elements which are described below.

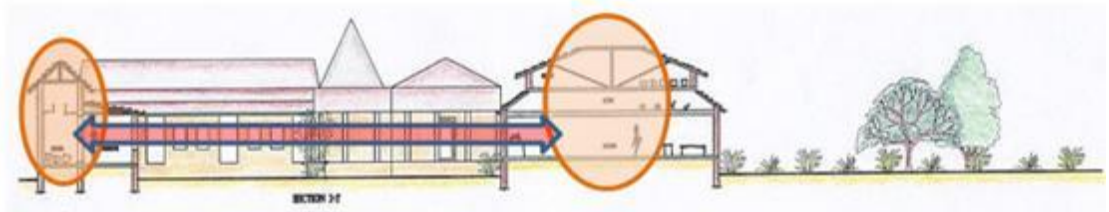


Fig. 9: Detailed sections of house 1 marking connectivity and space associations

Source: Author

Elements defining courtyards.

- The stable and store around the periphery forming boundary of house.
- The columns and opening of the stable and store.
- The height of stable, store and house
- The openings of house
- The roofing pattern and roof overhangs of house, stable and store



Fig. 10: The Roof plan of house 1 and views of (A) Courtyard 1 & (B) Walls, roof overhangs of house
Source: Author

The roof plan in figure 10 is to show the roofing pattern of the residence. It can be seen that there are overhangs of the roof and the roof is double roofing type. The overhangs provide protection from rains as well as sun. The climatic influence can be clearly seen in the section that shows the roof pattern as one of the regulatory factors of it. The sections in figure 11 below indicate that openings and height of built portion are significant factors defining the courtyard as the space. There is also variation in the height of the building. The height of the main built area is more as compared to the other built spaces. Also, the size of the entrance gate is more as compared to other openings of the building. The back yard is facing South and has more plantation to cut off the adverse climatic impact. Also, the backyard has a kitchen garden known as wadi in the local Marathi language.



Fig. 11: Sections through the house 1
Source: Author



Fig. 12: House 1(A) Double storey structure (B) Stable & store (C) Fodder store in front & farm equipment store at back of house (D) Store with a corridor and columns in brick & mud mortar.

Source: Author

Activity Pattern

Table 1: Activity patterns recorded during different times and seasons of the year in House 1

Source: Author

Activities/time	6am to 9am	9am to 12am	12am to 3pm	3pm to 6pm	6pm to 9pm
House-01 Courtyard 1					
Summer	Cleaning, sweeping and rangoli making			Leisure sitting after returning from farm	Dinner, leisure sitting and sleeping
Rainy	Cleaning, sweeping and rangoli making		Cleaning rainwater if it is affecting store area	Cleaning rainwater if it is affecting store area	
Winters	Cleaning, sweeping and rangoli making	Tea and breakfast	Leisure sitting (specially ladies)		
Courtyard-02					
Summer	Cleaning and sweeping	Cleaning and washing clothes and utensils, etc.	Drying of grains and pulses	Cleaning of grains and pulses	
Rainy	Cleaning and sweeping	Cleaning and washing clothes and utensils, etc. (if not raining)			Cleaning rainwater if it affects the store area
Winters	Cleaning and sweeping	Cleaning and washing clothes and utensils, etc.	Making home-made things	Drying of home-made things	

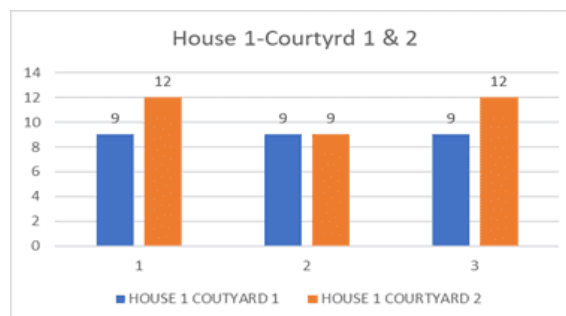


Fig. 13: Activity patterns in courtyards 1&2 of House 1

Source: Author

The activity chart in figure 13 above shows that the different types of activities that are carried out in the courtyard on varying time of day throughout the year in different seasons. The activity pattern changes according to the weather. The male of the house is involved in the farming activity, so the space is often used by the female of the house for household works. There is no farming related activity carried in the courtyard except storage.

Uses of Courtyards

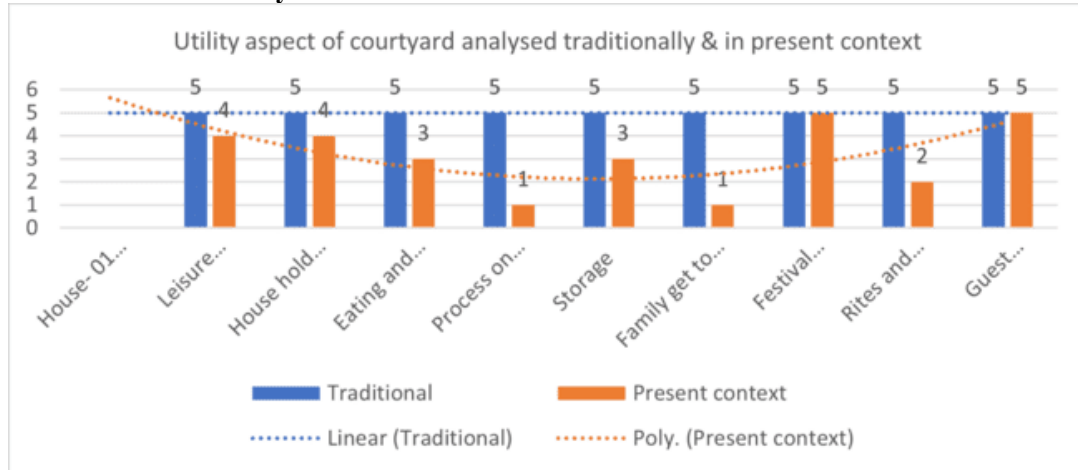


Fig.14: Changes in functional use of courtyards in House 1
Source: Author

Figure 14 above shows the changes that have happened in the use of courtyard based on comparison between earlier and present use. The table indicates that there have not been very drastic changes in the use of the space as the scale of the courtyards is quite large to withhold the activities associated with it. But some changes have taken place due to change in lifestyle and mechanization like the processing of grains and store have gone down although it is still used for festivals and rites etc.

Case Study 02

- Name of owner: Puralal Polan Gautam
- Age of structure: 125 years
- No of residents: 4 families- 22 members
- Occupations: farming, cattle grazing and milking

The plan in figure 15, shows that the scale of the house is moderate and there are two courtyards in the house. Unlike the earlier case the back yard is smaller than the front one. The plan shows that this house falls under the considered typology of residential houses.

Physical Characters

- No of courtyards: 2 courtyards
- Courtyard-01: North facing
- Courtyard-02: South facing.
- Geometry: Rectangle
- Height to width ratio: 1:2.3
- Surface area to volume ratio: 1: 0.68



Fig. 15: Detail plan of Puralal Polan Gautam's House 2 & views of (A) Living room/Baithak (B) Multiple sloping roof of the house
Source: Author

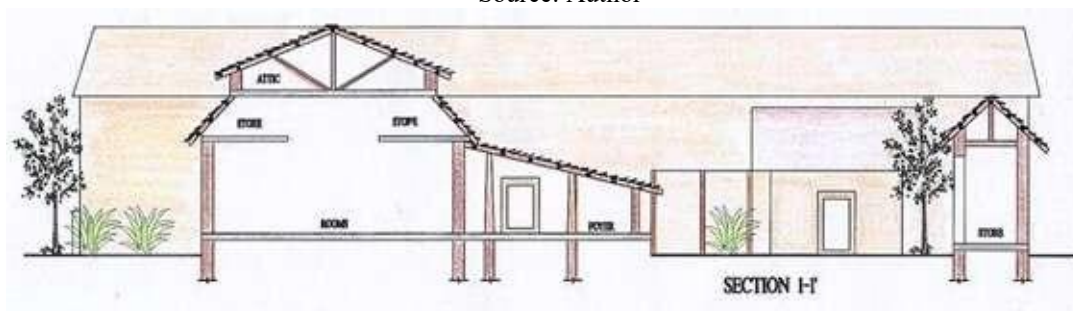


Fig. 16: Section through the House 2
Source: Author

Unlike the earlier case the main portion of the house relates to an entrance foyer with also form the living area of the house. The other areas are directly linked with the house with any linking space between them. The section in figure 16 above shows both the courtyards and their connection with the other elements like columns of foyer and surrounding buildings.

Elements Defining Courtyards

- The columns and opening of the stable and store.
- The height of stable, store and house
- The roofing pattern and roof overhangs of house, stable and store
- The walls of surrounding house

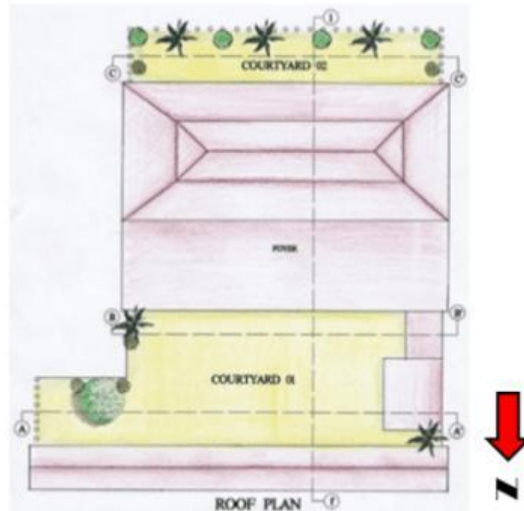


Fig. 17: Roof plan of the House 2
Source: Author



Fig. 18: Section through the House 2
Source: Author

The plan of roofing in figure 17 indicates the pattern of roofing which is single layered except the house area which has the double layered roofing pattern. Also, it shows that there is encroachment of surrounding buildings in the front yard space. Whereas it also provides good shading impact in the courtyard. The backyard has very small kitchen garden. The section in figure 18 displays that the opening and height of the built form has an impact in defining the courtyard as a space. Here the columns in the foyer of the also has influence in giving character to the courtyard. Unlike the earlier case this house does not have peripheral structures. The boundary is defined by the surrounding houses. Views of house is seen in figure 19 below.



Fig. 19: House 2 (A) Courtyard of house 2 (B) Entry to house 2 (C) Living room/Baithak area
Source: Author

Activity Pattern

Table 2: Activities at different times of day and seasons of the year in House 2

Source: Author

Activities/time	6am to 9am	9am to 12am	12am to 3pm	3pm to 6pm	6pm to 9pm
House- 02 Courtyard- 01					
Summer	Cleaning, sweeping, rangoli making & bathing of animals	Milking cow & cleaning the animal area after they go for grazing		Leisurely sitting after coming from the farm, milking cow & giving fodder to them	Dinner, leisurely sitting & sleeping
Rainy	Cleaning, sweeping and rangoli making	Milking cow		Milking cow and giving fodder to them	
Winters	Cleaning, sweeping and rangoli making and bathing of animals	Milking cow and cleaning the animal area after they go for grazing	Leisure sitting (specially ladies)	Milking cow and giving fodder to them	Bonfire and sitting around it
House – 2 Courtyard- 02					
Summer	Cleaning and sweeping	Cleaning and washing clothes and utensils, etc.	Making milk products and drying of grains and pulses	Cleaning of grains and pulses	
Rainy	Cleaning and sweeping	Cleaning and washing clothes and utensils, etc. (if not raining)	Making milk products (if not raining)		Cleaning rainwater if it is affecting store area
Winters	Cleaning and sweeping	Cleaning and washing clothes and utensils, etc.	Making milk and home-made things	Drying of home-made things	

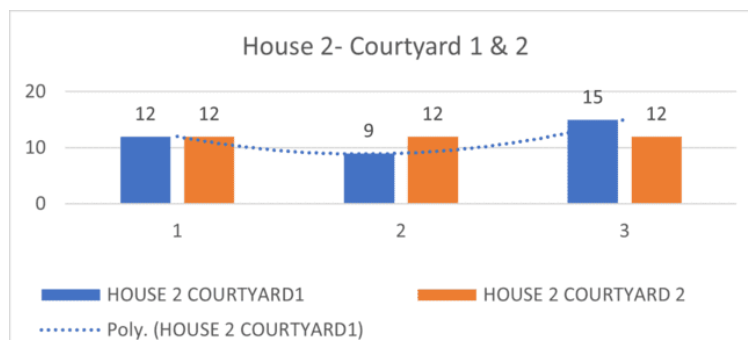


Fig. 20: Activities in the courtyards of House 2

Source: Author

The activity chart in figure 20 above shows the various activities of the house. Here along with farming the other occupations of the residents are grazing of cattle's, milking of cows, making products from it and selling them. Thus, the courtyards are involved in also these activities except farming related activities. The only use of farm activity is storage of grain sacks. The male of the house carries out the field work, milking of cow, grazing of animals. The rest work is done by the female of house.

Use of Courtyard

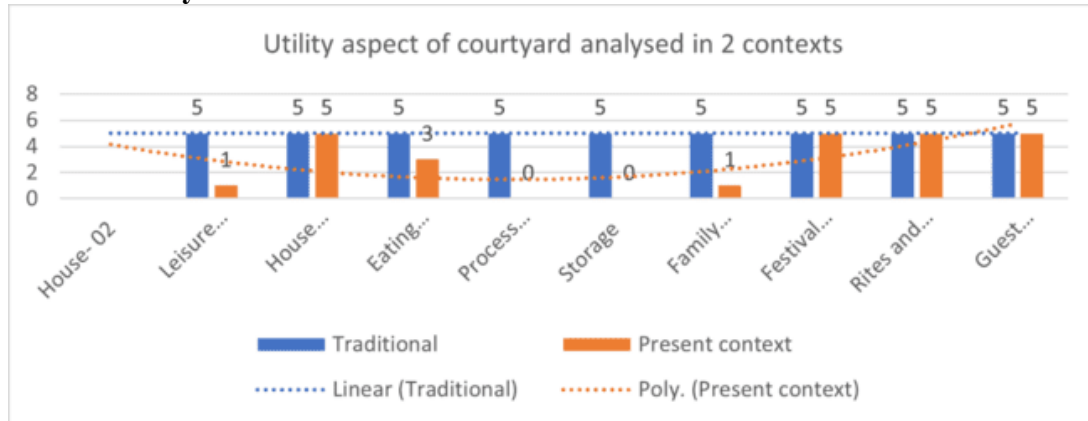


Fig. 21: Activity patterns in house 2 in traditional & present context

Source: Author

The use pattern of this residence differs from the earlier case. As most of the people in the house are associated with some kind of work due to financial reasons, they use the space for less time. But there are some events that are carried out even today. The use of the courtyard for processing grains, storing has gone down in this case study as well due to changing lifestyle and technology as shown in figure 21 above.

Case Study 03

- Name of owner: Ghannu Parasram Kamble
- Age of structure: 87 years
- No of residents: 2 families- 11 members
- Occupations: Farming

The key plan in figure 22 shows the scale of this smallest amongst the three selected case studies. Also, this house has only one courtyard that is front one facing north side as against the above two cases which had two courtyards. But still, it falls under the considered typology as it has the defining factors.

Physical Characters

- No of courtyards: 1 courtyard
- Location: North facing
- Geometry: Rectangle
- Height to width ratio: 1:2
- Surface area to volume ratio: 1: 0.04

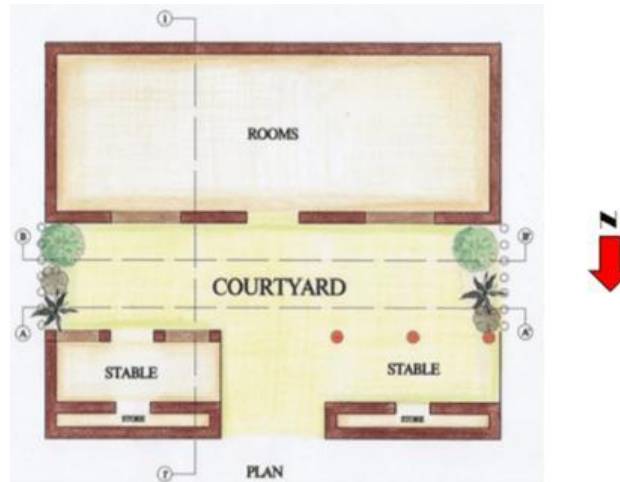


Fig. 22: Detail plan of Ghannu Parasram Kamble's House 3
Source: Author

The plan of this residence in figure 22 is quite different than the other two cases in a way that it has only one portion of the build part connected with courtyard through semi open space which is the stable. As the scale is small most of the space is used for the storage purpose. So, the stable is also used as a store for farming equipment's. There is a temporary stable for the cattle in the front portion of the house.

Elements defining the courtyards

- The stable and store around the periphery forming boundary of house.
- The columns and opening of the stable and store.
- The height of stable, store and house
- The roofing pattern and roof overhangs of house and store

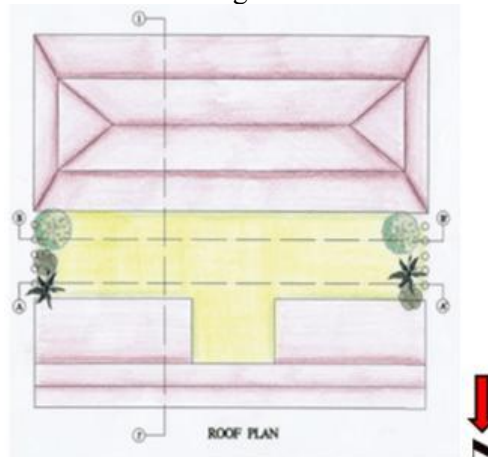


Fig. 23: Roof plan of Ghannu Parasram Kamble's house 3
Source: Author

The roof plan as seen in figure 23, is same as the first two cases which makes it fall in the category of selected typology. The only double roof is on the habitable area of house. Here the boundaries are by the same type of house on both the sides of the house having their courtyard adjacent to the house selected for case study. The sections in figure 24 below show that the opening sizes of this house are quite large compared to the earlier ones. The reason being the small size of court and to get maximum air and light inside the house. There is not very green areas linked with this house as there is no backyard to bother the residents with harsh weather much.

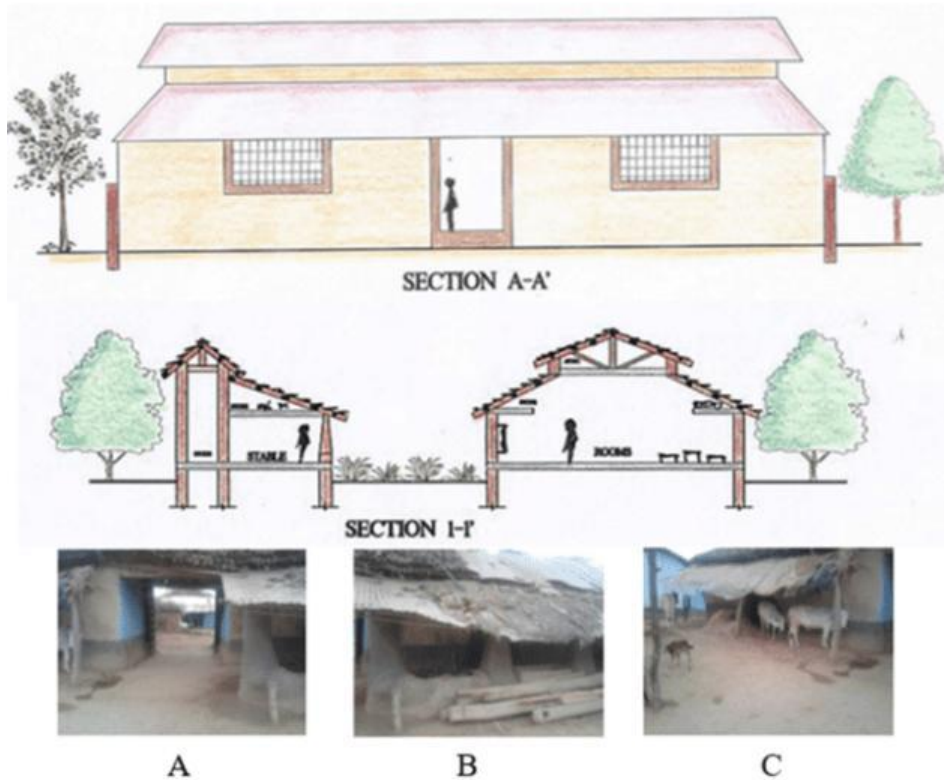


Fig. 24: Sections of Ghannu Parasram Kamble's House 3 and views of building components (A) Entrance gate (B) Store area on left of entry (C) Shed for cows
Source: Author

Activity Pattern

The activity chart in figure 25 shows the various activities in relation to the different seasons i.e., summer, rainy, winter. All the members both male and female go to fields hence we can observe that between 9am to 4pm there are not many activities in the courtyards. The other activities are listed in table 3 below.

Table 3: Activities in different times of day and seasons of the year in House 3
Source: Author

Activities/time	6am to 9am	9am to 12am	12am to 3pm	3pm to 6pm	6pm to 9pm
House- 03 Courtyard- 01					
Summer	Cleaning, sweeping, rangoli making and storing water			Leisure sitting after returning from farm	Dinner, leisure sitting and sleeping
Rainy	Cleaning, sweeping and rangoli making			Leisure sitting after returning from farm (if not raining)	Sleeping (if not raining)
Winters	Cleaning, sweeping and rangoli making			Leisure sitting after returning from farm	Born fire, sitting around it and sleeping

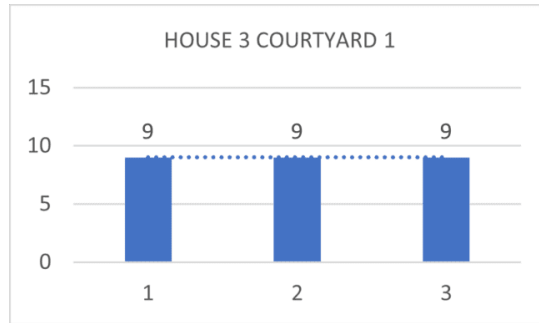


Fig. 25: Activity in House 3

Source: Author

Use of Courtyard

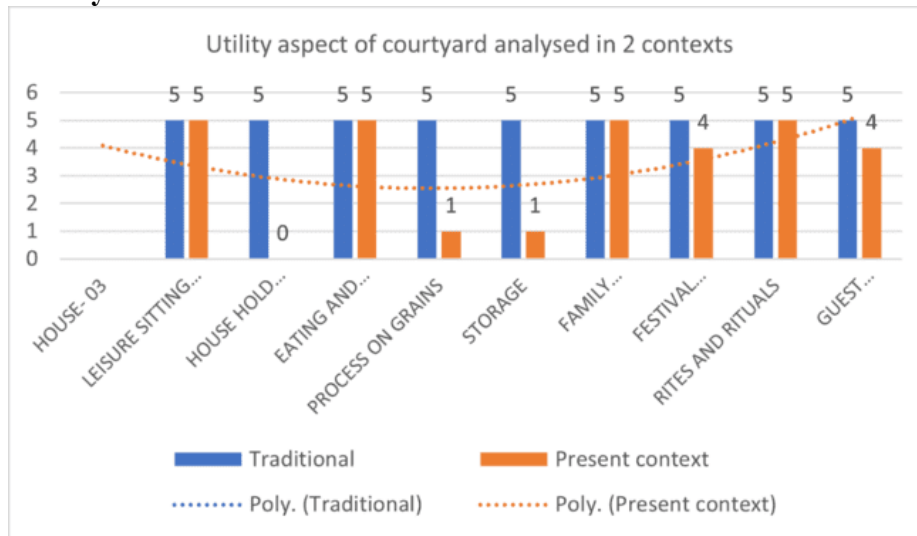


Fig. 26: Comparison between the Traditional & present use of courtyard

Source: Author

The figure 26 shows comparison between the earlier and present use of courtyard. It shows that there is more use of courtyard in this case compared with the others. The reason being the weak financial situation of the residents and less change in the lifestyle. Although there is only one courtyard in this house still it has been used to its fullest. As in the previous 2 cases, the process on grains and store is less in this house as well.

Discussion

In all the above three case studies done, there are some significant features -

- Typical sloping roof to cope up with heavy rainfall covered with red colored country tiles.
- Walls finished with mud plaster having colorful facades.
- The interior was neatly maintained giving you a pleasant feeling. The spaces were crafted to fulfill their daily routine.
- The module basically consisted of Awar (front yard) chapri (drawing hall) sayapakghar (kitchen), sleeping area, special store room for storing the grains and back yard acting as a kitchen garden.
- Each element was carved out so efficiently responding to the climate, environment, and their social needs.

Table 4: The building materials and techniques of construction in the 3 house forms studied.
Source: Author

	Building element	Description	Measurements
1	Foundation	Foundation in the 3 cases studied above started from 2 to 3 feet below ground level. Random rubble stone masonry was used up to 1 to 2 feet above ground level with raised plinth.	The width at the bottom was more (500 to 600 mm) and goes on reducing towards the upper floor
2	Walling	The brick walls and the cob wall technique were used for erecting the structure. The soil types available in this region are rich in iron ore and magnesium, available in red and yellow color. The wall was plastered with a mixture of cow dung and mud. The final layer of white soil and yellow soil available near the village was put on the finished surface.	The composition of cow dung, rice husk and local red soil (mud) in the ratio of 1:1:4 is used. First layer of 0.30m. to 0.45m in width starts from the first end finishing the outline of the house.
3	Plastering-	The wall plastering is done in single layer. The final finished layer was with white and yellow soil which gives the appearance of paints	A mixture of cow dung and mud in the ratio 1:2 in a 20 mm. thick layer was put on the mud wall which acts as a filler within the gaps of cob
4	Flooring	The area to be floored is first filled with soil and Murom taken out of trenches. It acts as a stabilizing agent for the soil. A layer of soil is then pressed and finished with layer of cow dung and mud slurry.	Good quality Murom is available in Gondia which can be found after 1.2 m to 1.5m.
5	Roofing	The pitched roofs are very common in response to the climatic conditions. It is supported by timber truss and covered with country tiles manufactured locally.	The roof overhangs are 1-1.2 m.
6	Lintel door and window	The houses have openings made from timber and having the iron grills. They are of a lower width and height to balance the load of the roof. The door and window frame are fixed within the mud walls and then the shutters are hinged to the frames. The wooden elements used are well seasoned.	Lintels are constructed out of locally available good quality timber. The size of the square openings is around 1 to 2 feet. The local treatment with oil and wax is also given to it which protects it from insects and termites.

The synthesis of the above three case studies gives the common typology of courtyard houses. The physical characters of the houses with their walling, flooring, roofing techniques and materials as detailed in table 4 gives beauty and vernacular character to the courtyard along with the general activity and usage patterns.

Ideal Typology

After studying the three houses and their courtyards the common characteristics of courtyards in Central India can be drawn. All the three-case study had some common elements

that led to the derivation of this common typology. The figure 27, show the typical plan and section of house and its courtyard.



Fig 27: Plans & sections of an Ideal house
Source: Author

Findings

All the above studied factors that form the basis of typology can be clearly seen in the houseform in figure 27. The defining elements like roof overhangs, openings, height, etc can be distinctly seen above. The two courtyards one facing north and other south are also visible. The plantation is also on the south side to prevent harsh effects of weather.

Physical characters

The physical characters defined below are the resultant of the three case studies which shows that the following are the significant physical characteristics of courtyards in Central India.

- Geometry: rectangle
- No of courtyards: 2 courtyards
- Location of courtyards: front facing north and rear facing south
- Height to width ratio: ranges from 1:2 to 1:4
- Surface area to volume ratio: ranges from 0.05 to 0.09

Elements defining the courtyards

The widely used elements that define the courtyards in Gondia district of Maharashtra in Central India include the following activity, spaces and building elements -

- The stable and store around the periphery forming boundary of house.
- The columns and opening of the stable and store.
- The height of stable, store and house
- The openings of the house
- The roofing pattern and roof overhangs of house, stable and store
- The walls of surrounding houses

Activity Pattern

The figure 28 below shows the overall activity pattern of the courtyards in houseform of Bhosa village in Gondia district in Maharashtra in Central India. It shows that the least use of courtyard is during monsoon. Whereas in other seasons the use of courtyard is more. In summers the courtyards are often used at night whereas in winters they are more used during daytime in winters.

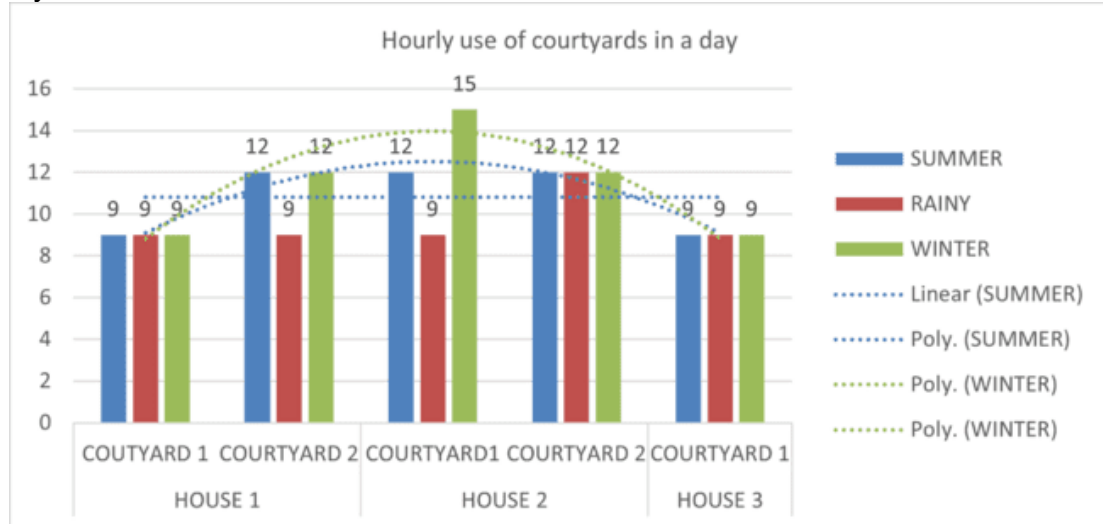


Fig. 28: Prevalent activity pattern of the courtyards in house form of Bhosa village

Source: Author

The figure 29 below shows the use of courtyards on some specific occasions and activities. There is a comparison made between the earlier and present use of space to know how space has changed and what are the factors associated for this change. From the given figure it is clearly known that the use of space has changed due to many reasons like increase in number of members, change in lifestyle, attraction to urbanization, mechanization, and use of modern technology.

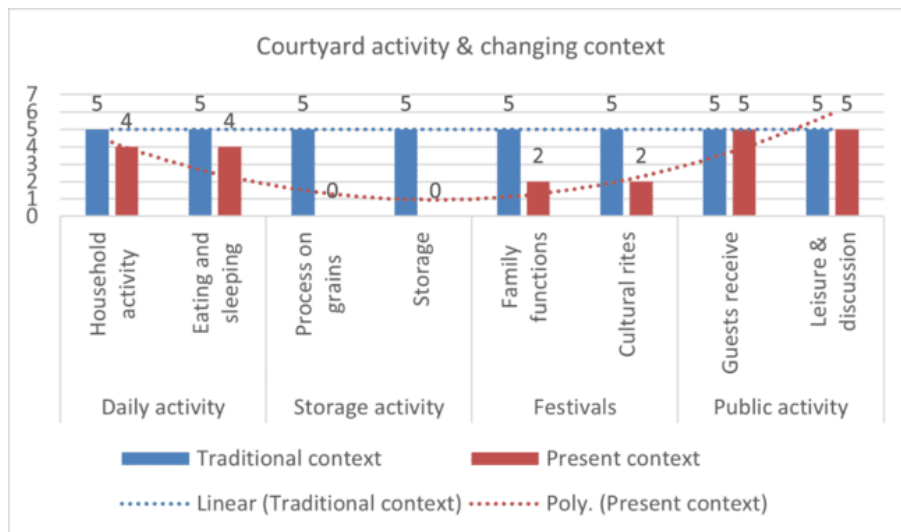


Fig. 29: Courtyards activity on special occasions in traditional & present context

Source: Author

The study defines courtyards in the central India region as spaces made with their specific characteristics and attributes which are as follows.

- Connectivity- Connects all the spaces at a single point and generates regulates movement pattern.
- Porosity- Responds to the climatic conditions and provides ample air and light because of its proper orientation.
- Flexibility- Being an extension to the built form, its offers provision to make use of the space for activities pertaining to outdoor utilization.
- Proportionality- Built to un-built ratio is 48-54%. Enclosure ratio is 36-40%.

The courtyards in all the three house forms studied in the Bhusa Village of Gondia district, exhibit these attributes which were depicted in the form of a graphical space matrix which is seen in figure 30 below. The green dots represent the courtyards in the house with the blue dots representing the activity spaces of the house. The solid red lines mark the connectivity and the flexibility of activity spaces and the courtyards in the house, while the dotted red lines depict the visibility and porosity offered by the courtyards in the 3 house forms.

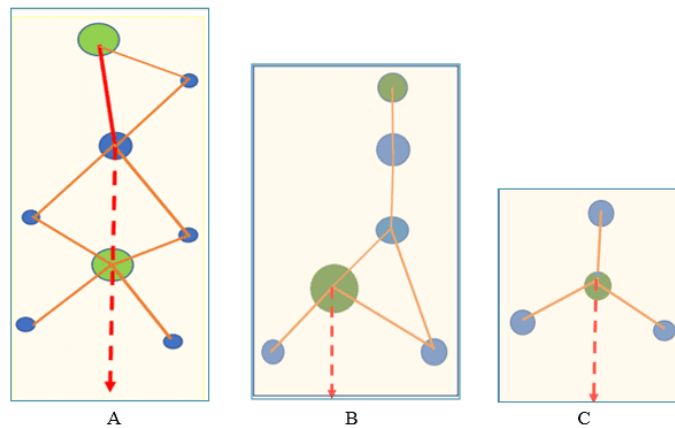


Fig. 30: Space matrix diagram of (A) Courtyard House 1 (B) Courtyard House 2 (C) Courtyard House 3

Source: Author

On assigning weightage score (from 1 to 5) to the attributes of courtyards of the 3 houses studied, the tabular form of quantitative data was generated. The scores as seen in Table 5 below range from 16 to 18 out of 20 which shows the optimum utilization of the courtyards in the house.

Table 5: Attributes of courtyard

Source: Author

S.no.	Attributes	House 1		House 2		House 3
	Attributes of courtyard	House 1		House 2		House 3
		Courtyard 1	Courtyard 2	Courtyard 1	Courtyard 2	Courtyard 1
	Porosity	4	5	3	4	4
	Connectivity	3	4	5	3	3
	Flexibility	4	5	4	5	5
	Proportionality	5	3	4	5	4
	Total scores	16	17	16	17	16

Conclusions

The research concludes that the courtyards in traditional Indian architecture are designed to fulfill the daily routine of the inhabitants and provide a sense of privacy, security, and comfort. The courtyard displays typological and stylistic variations due to economics status, culture, and lifestyle. The study reveals that the use of courtyards has changed due to many reasons like an increase in the number of members, change in lifestyle, attraction to urbanization, mechanization, and use of modern technology. The research also provides a detailed analysis of the activity patterns in the courtyard, which changes according to the weather and time of day throughout the year in different seasons. The male of the house is involved in the farming activity, so the space is often used by the female of the house for household works or for storage purposes. The study compares the earlier and present use of courtyards and shows that there is more varied use of courtyard in the present context compared with the earlier use.

The research is significant as it provides valuable insights into the traditional Indian architecture and the role of courtyards in shaping the physical, psychological, and climatic environment in the buildings. The methodology helps to understand the overall process that can be followed for the study and understanding of the subject. The research undertakes a systematic analysis that involves the synthesis of multiple case studies, considering typology, general physical characteristics, activity patterns, and courtyard usage.

Overall, this research draws references from studies and underscores the enduring importance of these architectural elements in both historical and modern contexts, as well as their contribution to sustainable and culturally rich architectural practices. The article is relevant to architects, designers, and researchers who are interested in traditional Indian architecture and the design of courtyards in contemporary buildings.

Acknowledgements: This research did not receive any financial support. However, the authors wish to acknowledge the support received from the Manipal Academy of Higher Education, and the Manipal School of Architecture and Planning, Manipal, Karnataka, India

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