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Transformations of Domestic Architecture in the Indigenous Settlements in Assam, India: Relations Between Spaces and the Built Environment

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Abstract

Over the years, the spatial organization of Assamese vernacular domestic architecture has changed because of the changes in the socio-cultural factors. This study examines these architectural changes over four generations, starting from the 1880s to the present. It explores the impacts of social changes, lifestyle, and customs on space and its vernacular utilizations.

It uses a qualitative case study method and interviews and observations as research techniques for data collection. The case study is a house in Bamunpara village Mangaldoi, India. As the research is a vertical study based on transformations that have occurred in a single house, literature related to Assam houses is studied for better understanding and inclusivity. The space syntax technique is used with a focus on Justified Plan Graphs (JPG) to depict changes in the spatial organization of the house in response to the changes in the socio-cultural context over time. The study explores alterations in the arrangement of spaces, clusters, and serving witnessed in the case study.

The findings show that changes in the socio-cultural factors, lifestyle, in particular, act as catalysts for the changes in the usage of space. It has a profound effect on the layout and connectivity. There is a trend which is observed repeatedly. This phenomenon reveals the default power of choice possessed by the people. This paper presents the tools for analyzing vernacular architecture and illustrates its adaptive capacity in situations of socio-cultural changes.

Keywords: Assam, Rural Housing, Vernacular Architecture, Heritage, Culture, Space syntax, Socio-cultural factors

Introduction

Architecture everywhere has seen profound transformations over the past century, witnessing a gradual shift from the traditional design principles. As Frampton (2020) shows, the process embodies changing socio-cultural values, technology and cultural priorities. The shift to modern practices abandoning traditional architecture has initiated a debate about cultural identity, social sustainability, and the role of the built environment in preserving cultural heritage.

Curtis (1996) points out that initially, this shift emerged during the early 20th century, when people started drifting towards functionalism and industrial aesthetics ignoring the traditional and historical references. This shift gained momentum with globalization which acted as a catalyst to spread homogeneous architectural languages across diverse cultures (Lefaivre and Tzonis, 2012). Pallasmaa (2018) says that this shift has resulted in "placeless" architecture that often fails to address local climatic conditions, sociocultural practices, and material traditions.

Rapoport (1969) in his pioneer studies highlight the strong relationship between socio-cultural aspects of traditional house forms globally. According to him, this relationship has evolved over generations by responding to specific environmental, social and cultural contexts. The consequence of ignoring this relationship results in high energy demands, monotonous architecture and diminishing cultural resonance (Rapoport, 1969).

In this context, this study explores the phenomenon of transformations in the state of Assam in India. Assam has 115 ethnic groups and communities, each with its own culture and lifestyle (Yinger, 1985). Their domestic architecture is a living example of their cultural heritage and identity. Architecture is a product of the culture reflecting and influences culture (Hanson, 2017). No resemblance with traditional vernacular styles is witnessed in the contemporary houses in Assam. The impact of globalization and urbanization has led to abrupt and significant shifts away from contextual vernacular architecture. The new buildings are constructed, predominantly using Reinforced Cement Concrete (RCC), and have substantially higher energy requirements in comparison to their vernacular predecessors. As a result, these modern structures often fall short in terms of environmental sustainability. They are built similarly irrespective of the context and do not represent the cultural identity of the places where they are built. In fact, even government-led development of geography-specific rural housing has failed to implement their socio-cultural identity in their houses (Hanjabam, 2023).

However, the solution is not as simple as falling back to the traditional ways. Modern houses have their merits. The modern RCC structures are seen to represent better social status. Research indicates that rural Assamese residents when questioned about the advantages of vernacular architecture, did not express positive sentiments towards them. This lack of enthusiasm stems from the perception that traditional building styles are associated with lower socio-economic status (Doloi and Donovan, 2019). In fact, traditional buildings made from local materials like bamboo and mud are ecologically sensitive but are not durable. They are difficult to be maintained especially with the depletion of materials and craftsmen who can build or renovate.

This necessitates a new hybrid construction technique which imbibes the merits of both styles and can benefit both rural and urban places (Dodo et al., 2014). In this context, making the next stage (present and future) in housing sustainable and responsive to the context would require understanding the needs and aspirations of the local people in relation to the development of vernacular spaces which have been built by themselves and not by the architects or the outsiders. Therefore, a bottom-up approach from the perspective of the people is required, which means that the study should concern the socio-cultural aspects of the people which would help understand their needs, perspectives and design decisions. It is precisely in vernacular architecture where socio-economic sustainability is seen with greater clarity because, since it is architecture without architects, it is the fruit of a collective effort of the society (Gamón, 2020).

The traditions of the rural communities everywhere have been evolving. Culture and vernacular architecture are inherently evolving elements. Cultural changes occur through processes such as globalization, migration, technological advancements, and social movements. Societies adapt to new circumstances while maintaining and renegotiating their cultural traditions (Glassie, 1972). This loss of traditions can be due to many factors; sometimes there are practical reasons why it is advantageous to adopt modern housing elements. This confuses to the extent that good transition and bad transition become hazy. Therefore, even if a housing solution is appropriate for today, it may not be in the future. This means an understanding of the transition of built spaces through its underlying causes and the changes the cause brings in the lifestyle of people is of paramount importance. Here the dynamic relationship of socio-cultural aspects which shape architecture which in turn affects culture is an important area of focus.

In this context, this study examines the transformation in house forms with changing socio-cultural contexts in Assam, India. Its aim is to develop a nuanced understanding of these transformations in house forms in the changing socio-cultural contexts. The objectives of the study are:

- To understand the socio-cultural context of Assam houses,
- To understand the changes in spatial organisation in response to changing family needs, and
- To understand the evolution of transitional spaces over time.

Theoretical Framework

The study of previous theories has been done to examine concepts like culture, socio-culture, changes in relation to socio-culture and architecture, especially spaces as a product of the society or culture in which it exists; to explore methodological approaches and factors of analysis in the study of domestic architecture; to explore works of research on Assamese vernacular domestic architecture; and to find gaps in the available research and place this research work in the context of all the other works.

Culture

Culture is a vast domain and depending on the contexts and objectives of study, can be defined in different ways. Hawkes (2001) proposes two inter-related definitions: the social production and transmission of identities, meanings, knowledge, beliefs, values, aspirations, memories, purposes, attitudes and understanding; and the 'way of life' of a particular set of humans: customs, faiths and conventions; codes of manners, dress, cuisine, language, arts, science, technology, religion and rituals; norms and regulations of behaviour, traditions and institutions. Change is a defining feature of culture. Long-term influences cause cultural transformation. Even the nature of change evolves with time. Some of the old ideas are kept even when new ones are learned. They undergo a process of modification, alteration, tearing apart, combination, full acceptance or rejection (Glassie, 1972). Social change is in most cases the forerunner of cultural change and frequently induces cultural change (Landis, 1935). He also says that social change can be seen as a subset of cultural change in that it is the most dynamic element in all cultural change. Christopher has pointed out that any gradual change becomes part of the tradition making it unidentified from what was already there (Alexander et al., 1977).

Socio-Culture

"Socio-culture" is a term used to describe the combined influence of social and cultural factors on individuals and societies. Such an approach provides a comprehensive understanding by recognizing the interconnectedness between social and cultural dimensions and how they shape

and influence each other. Studying the relationship between socio-culture and architecture involves considering various parameters and indicators that help analyze how social and cultural factors shape architectural design, spatial organization, and the built environment (Rapoport, 1969; Oliver, 2007). The parameters of socio-culture provide a framework for understanding the intricate relationship between social and cultural dimensions. Scholars have identified several key parameters that shape societal dynamics (Bourdieu, 1977; Arrindell, 2003). These include: Social Institutions: Family, education, government, economy, and religious structure and govern society (Berger, 1966); Cultural Norms and Values: Shared expectations and guidelines for behaviour within a society (Arrindell, 2003); Language and Communication: Language is a fundamental component of sociocultural. It is a medium through which individuals express ideas, beliefs, and cultural meanings. Language influences social interactions, group identities, and cultural transmission (Fele, 2016); Social Roles and Identities: Many researchers pointed out that the roles represent expected behaviours associated with particular positions, and how identities encompass self-perceptions and perceptions by others within social and cultural contexts (Stets and Burke, 2000); Cultural Practices and Traditions: Traditions, customs, rituals, and practices that are specific to a particular society or cultural group. These practices contribute to the cohesion of the group and reinforce its cultural identity (Banks, 2008; Lin and Jackson, 2019); Socialization: Socio-Culture plays a crucial role in the socialization process, shaping how individuals acquire knowledge, beliefs, and behaviours from their social environment. Socialization occurs through various agents such as family, peers, education, and media (Arnett, 1995); Power Dynamics and Social Hierarchies: Power structures and social hierarchies within a society, including class, gender, race, and other forms of social stratification. These power dynamics influence social interactions, opportunities, and access to resources (Ridgeway, 2013); Cultural Change and Adaptation: Socio-culture is not static; it evolves and changes over time. Cultural change occurs through processes such as globalization, migration, technological advancements, and social movements. Societies adapt to new circumstances while maintaining and renegotiating their cultural traditions (Mestrovic and Tomlinson, 2001).

Socio-Culture & Sustainability

For a Built Structure to be called sustainable, it has to satisfy many conditions. Today, sustainability is not just limited to environmental but also includes economic, social and cultural well-being. However, the latter two aren't unfortunately given as much space as they deserve. In rural and culturally rich but distant places, when modernization arrives irresponsive of its socio-cultural context, there will be negative effects on culture, living standards and identity. At the same time, it is also unfair to expect only the rural people to hold on to the traditional ways in the name of cultural preservation if it keeps them from making the choices they want. Therefore, seeing change from a perspective so that cultural identity isn't lost while accommodating people's lifestyle needs, the research aims to look at domestic architecture from the socio-cultural point of view. Such an approach can also help us identify and retain vital cultural architecture which would make houses more culturally sound and be more sensitive towards the needs of people. Gamón (2020) argues that Vernacular architecture, is the greatest example of sociocultural sustainability and that although an architect's work can be based on principles of environmental and socioeconomic sustainability, only vernacular architecture, carried out by the user (as an individual or as a society), includes principles of sociocultural sustainability and should be a source to learn while developing a more sustainable architecture for the future.

Literature Review

The studies on the relationship between socio-cultural factors and house forms began in the early 20th century. This has been a significant area of research in architecture,

anthropology, and cultural studies. Amos Rapoport (1969, 1982) pioneered these studies, emphasizing the role of culture, climate, and house forms in shaping traditional architecture. Similarly, Paul Oliver (1997, 2006) explored traditional house forms in response to socio-cultural and economic changes. He highlighted the adaptation of house forms to socio-cultural transformations, emphasizing the resilience of vernacular practices in changing times. The influence of colonialism and globalization on house forms was explored by Anthony D. King (1984), who underscored the role of migration, urbanization, and cross-cultural exchanges in domestic architecture, particularly the bungalow as a hybrid architectural form. The reflection of social and cultural practices in spatial organization and house forms was examined in ethnographic studies by Bourdieu. His concept of "habitus" is crucial for understanding how socio-cultural norms shape, and are shaped by built environments (Bourdieu, 1970).

In India, similar studies have been conducted with a focus on the local context, examining the transformation of house forms with urbanization, modernization, and the persistence of traditional practices. Pramar (1989) conducted a study highlighting the evolution of house forms under the influence of colonialism, industrialization, and socioeconomic changes. He explored the tension between traditional forms and modern practices. The adaptation of house forms to environmental and socio-cultural changes in Rajasthan was explored by Kulbhushan Jain and Minakshi Jain (1992), who highlighted the sustainability and cultural significance of vernacular practices. Amanjeet Kaur (2020) investigated the socio-cultural factors influencing the transformation of house forms in the Kangra region, emphasizing the threat posed to the ‘local identity’ of the region.

In the context of Assam, H.K. Barpujari (1998) explored traditional house forms, such as the *chang ghar* (stilt house), and their adaptation to environmental challenges like floods and socio-cultural changes. Das (2000) examined the relationship between ethnic identity and house forms in various communities in Assam, stressing the impact of modernization and government schemes on traditional practices. Dipankar Banerjee (2010) studied the impact of modernization and migration on traditional houses in Guwahati, highlighting the disappearance of bamboo thatch roofs in favour of new materials and techniques. Sharma (2015) emphasized the loss of cultural heritage and the resilience of traditional house forms in the face of socio-economic changes.

Overall, the studies highlight the role of culture as the ‘core’ of house forms. The literature resonates with this concept both globally and in the Indian context. Variations in house forms are particularly pronounced in Assam due to the region's strong ethnic identity. The global trend of adopting hybrid house forms, driven by modernization and globalization, is also evident in Assam.

Research Methods

The study is based on a qualitative research approach, with case studies as the prime method of investigation. The main techniques of data collection included interviews, unstructured interviews, observations and physical surveys. The literature review is done to explore the context and cultural background of the region. The analysis is done with the help of a Justified Plan Graph (JPG) from Space Syntax theory to explore the relationship between socio-cultural aspects and spatial organization.

Data Collection

Initial context analysis relied mainly on observational data from site visits. Information related to the house form, layers of changes in the built form, and changes in material or elevation elements is collected. On-site observations collected are then verified with the feedback of residents to ensure accuracy. Random sampling method is employed to select the people for interviews. These interviews helped to understand the transformations observed in society and houses.

The study is a vertical study understanding how houses transform over the years, hence a single house (H) is taken for detailed study and analysis. A detailed survey of the house is done, and plans of different phases of development are drawn to understand the layers of transformations. The people of Bamunpara-1, of Mangaldoi town were interviewed to understand the forces acting in the change of existing houses. The respondents for unstructured interviews included residents of the house (H) chosen for the study and closely associated neighbours. In total 135 people are interviewed from the study area from which 10 are from the house (H) chosen for study. Prior consent was taken from all and the context of the study was explained to them before the interview.

Data Analysis:

The analysis of the data collected is done using the Justified Plan Graph (JPG) Technique that translates architectural plans into functional spaces (nodes) and connections (lines). The graph is arranged by relative depth from a starting point ("carrier" or "root" space). This method allows for visual analysis of spatial connectivity, permeability, and depth. The key Justified Plan Graph (JPG) concepts include:

- Permeability: Ease of node access;
- Depth: Levels from carrier to deepest node;
- Spatial configurations: Linear, asymmetrical, arborescent, rhizomorphs

The analysis focused on the recurrence and relationships between these socio-cultural and spatial parameters to identify predominant factors and their architectural correlations. Tables were created to highlight the strongest and weakest relationships among these parameters to conclude. The parameters selected for JPG analysis include (C) Socio-cultural characteristics: Family background (C1); Education, Occupation, Social Status (C2); Lifestyle, Food Habits (C3); Traditional Customs & Values as Celebrations & Gender Roles (C4). (A) Spatial characteristics: Siting (A1); Layout (A2); Connectivity (A3); Spatial Segregation (A4).

Study Area

The area chosen for study is the village of Bamunpara (Bamun: Brahmin, Para: Neighbourhood Community), Mangaldoi, some 60 km north of Guwahati. As the village is not very far from a city, it was ideal to understand the effects of urbanization on the changing houses and the people's lifestyle as per the context for the study. Bamunpara is characterized by socio-economically privileged communities, allowing for a clear observation of architectural transitions from traditional kuchha of Assam-type to modern houses over time. This progression provided valuable insights into the changes within this group. The current demographic composition of the area reflects a diverse mix of residents and architectural styles.

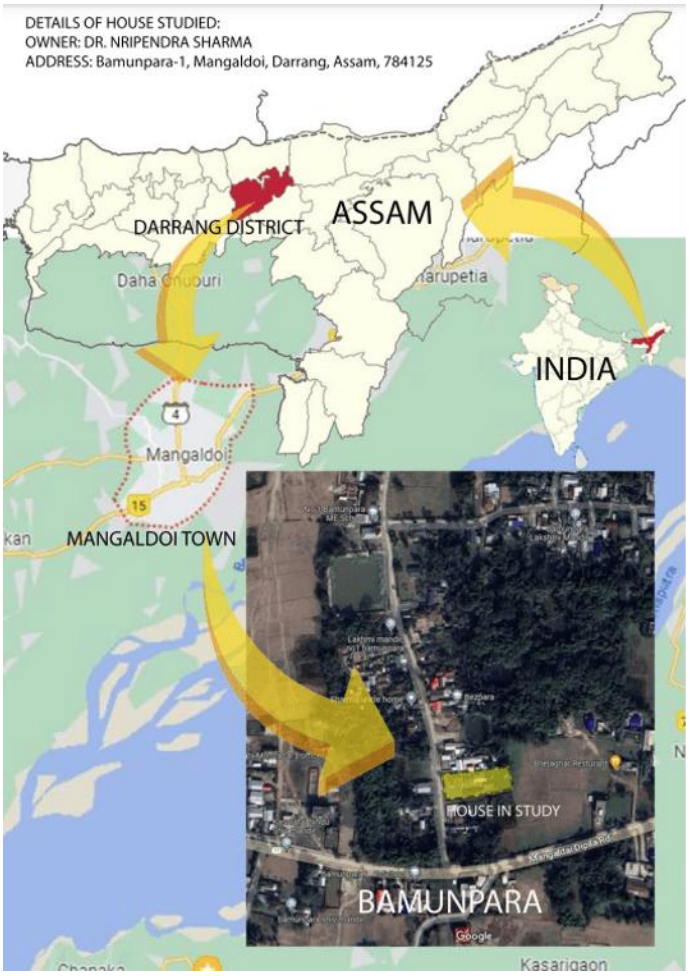

Fig. 1: Location Plan of the Study Area
Source: Author

Retired individuals, whose children have established themselves elsewhere, now seek a tranquil lifestyle in their ancestral homes. Alongside them are properties owned by absentee landlords who have relocated to urban centres, modernizing their houses to attract higher rents. The neighbourhood has also seen an influx of new property owners (not natives of the area), often implementing significant changes from traditional to modern RCC construction. In contrast, a subset of long-term native residents continues to maintain much of their older lifestyle, with their houses showing fewer alterations. This varied composition of inhabitants and architectural approaches provides a rich tapestry for studying the evolution of vernacular architecture in response to changing socio-economic conditions and lifestyle preferences.

This diverse mix of residents and architectural styles provides a rich tapestry for studying the evolution of vernacular architecture in response to changing socio-economic conditions and lifestyle preferences. The neighbourhood exhibits a strong sense of community, evidenced by shared spaces such as community temples, a water body, and a library. These venues host festivals and cultural events, playing a significant role in understanding the local context. The village has a certain homogeneity in religion, ethnicity and caste. The former two gave a common ground for the study so that variables remain comparable and the last apart from the

mentioned reason made sure that the people came from socio-economic privilege which meant a greater chance to see upward mobility in both houses and lifestyle. A visual Survey was conducted in the neighbourhood and houses that showed visible change were shortlisted. The chosen house had visible changes, people ready to collaborate on the research and enough people in the family to see a variety of changes within.

Assamese Culture and Houses

The existing culture and house forms are studied to understand the context of the study area.

Socio-cultural Setup of Assam

While Assamese culture is diverse, covering both tribal and non-tribal communities, this research concentrates on the culture of Assamese-speaking non-tribal people. Key aspects of this culture include festivals, music, art, handicrafts, and culinary traditions.

- **Festivals**: Bihu, celebrated thrice annually, stands out as Assam's most important festival, transcending caste and religious boundaries. The three Bihu festivals - *Rongali*, *Kati*, and *Magh* - each have unique customs. *Rongali Bihu*, marking the Assamese New Year, involves household activities, dances, and public sports events. *Kati Bihu* is characterized by the lighting of earthen lamps under Tulsi plants for a month. *Magh Bihu*, a post-harvest celebration, features feasting and the burning of temporary straw and bamboo structures. Durga Puja is another notable cultural event celebrated by Assamese people.
- Socio-religious functions, such as childbirth celebrations and wedding ceremonies, are important community events. Weddings normally lasting up to five days are particularly festive occasions in rural areas with everyone becoming part of it and enjoying.
- **Culinary Traditions**: Rice forms the staple diet, often accompanied by vegetables and lentils. Tea time typically includes homemade sweets and cakes, many of them being rice-based. Milk-based desserts are also popular. Most people have two main meals daily, with evening tea and snacks being common. Festivals like Bihu and Durga Puja involve the preparation of special dishes at home, including bamboo-rice delicacies like soongapitha.
- **Cottage Industries**: These industries are crucial to village economies and cultural traditions. They include weaving, sericulture, pottery, bamboo and cane crafts, and bell metalwork. The dheki, a foot-operated wooden rice husker can be seen commonly in rural households. Home-based weaving on looms is also widespread, with women creating clothes for the use of family and special occasions.

Vernacular Architecture of Assam

The Vernacular Architecture of Assam can be broadly divided into three categories: Tribal, Non-Tribal and Intermediary (Deka, 2018). The Tribals, such as Karbi, Mishing, and Deori have a unique architectural style with their structures on stilts and spaces designated based on the cultural beliefs of their community. These beliefs are significantly different from the Non-Tribal Population of the State. The Intermediary communities including Indo-Mongoloid tribal groups like Bodo, Rabha, Sonowal, Thengal, and Mech present characteristics distinct from the other Tribals in their architecture. They do not construct their houses on stilts. Their style differs from the other tribes in the layout of their spaces and structures relating to domesticated animals. The Non-Tribal consists of different castes and communities which are dominantly Hindu. The architecture of the non-tribal division displays

considerable homogeneity and it is discerned in the forms, general layout and construction technique (Sarma, 1987; Deka, 2018).

The Non-Tribal architecture of Assam possesses primarily two typologies of architecture being, the thatched-bamboo-made *pajaghar* / *kutcha* variety and the Assam-type variety. The socio-economically more privileged higher castes used to live in this variety and therefore throughout time the transition from the older *kutcha* to Assam type to modern houses is more prominently seen in their architecture. This also means that the scope to see more change is found within this group.

Multi-unit composition (more popular) and single-unit architecture are the two types of homesteads seen. In the multi-unit composition, a number of vital houses are constructed in a homestead while in the single-unit variety usually one house accommodates a family and contains the indispensable units within that architecture. Most of the Non-Tribal Communities have a homestead with a multi-unit single-storied composition.

***The Homestead*:** In Assamese settlements, the fundamental unit is the residence or homestead, typically housing either a nuclear or joint family. This homestead is commonly referred to as '*ghar*' or '*gharbari*' ('*bari*' denoting a garden, implying houses accompanied by an orchard). The layout of an Assamese homestead is characterized by its functional organization. Various utility-based blocks are arranged around a central courtyard. Surrounding these structures are open spaces dedicated to cultivating vegetables, fruits, flowers, and other vegetation, which often serve daily household needs.

The main buildings are constructed on an elevated earthen plinth within a fenced compound. A typical homestead features multiple courtyards: the central courtyard (*chotal*), a front courtyard (*aag-chotal*), and a rear courtyard (*pich-chotal*). The house usually includes a pond and a well-defined passageway leading to an entrance gate. Rural Assamese homestead layouts are often guided by traditional aphorisms or maxims known as Dakor Boson or Daks aphorisms (Sharma, 2021; Sarma, 1987). These principles, along with guidance from medieval literature by saints, influence the construction of smaller units (Barua, 2002).

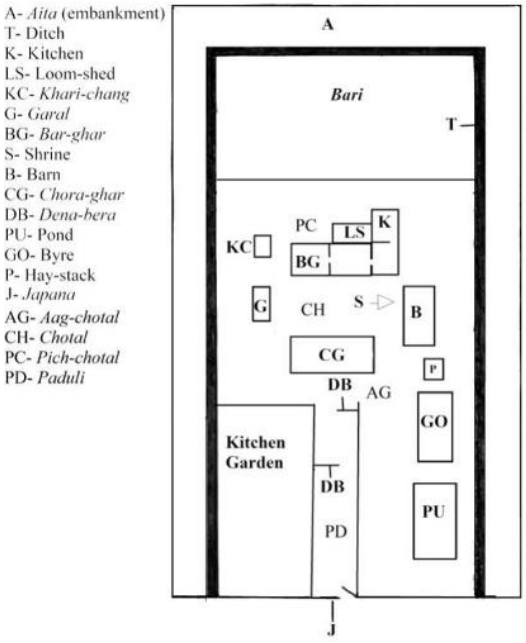

Fig 2: Typical Layout of a Traditional Homestead
Source: Deka,2018

Typically, houses are set back from the main road, connected by an approach way, '*paduli*'. The homestead's entrance features a traditional gate or shed, '*bat-chora'*, providing privacy and preventing stray animals from entering. In some cases, bamboo curtain walls '*dena-bera*' line the approach road for additional privacy. The front courtyard '*aag-chotal*' further enhances seclusion. The spatial arrangement usually progresses from the '*aag-chotal'* to a secondary structure, often the '*Chora-ghar'*, followed by the main courtyard '*chotal*'. Various homestead units are arranged around this central courtyard according to traditional layout prescriptions. The rear courtyard '*pich-chotal'*, a private area not visible from the main courtyard, is primarily used by women for daily chores.

A traditional Assamese household comprises a protected campus that includes: An orchard (*bari*) with essential trees and vegetation; A water source; and Main houses and subsidiary structures. The '*bari'* is an integral element, typically containing bamboo, betel nut, and betel leaf plantations, along with seasonal fruit-bearing and firewood trees necessary for household maintenance. This comprehensive setup is commonly referred to as '*ghar-bari'*, meaning houses with an adjoining orchard. It also often includes a kitchen garden.

Case Study:

The house for the case study was chosen as it has remains of earlier phases, it offers access to a large demographic perspective and the owner was willing to share his experiences and other data required for study. The house has been used by four generations since its inception in the 1880s. The earliest data and physical remains are from around the 1880s.

Findings

The unstructured interviews and observational data collected helped to understand the socio-cultural characteristics that are significant in the area and the spatial characteristics of Assam houses. Based on the information collected, the four phases related to the house are tabulated on the basis of Socio-cultural factors referred to as C: C1 to C4 and Spatial characteristics referred to as A: A1 to A4, refer to Table 1. The inter-relationship between the two is explored in each phase and finally throughout with the help of JPG diagrams.

Table 1: The socio-cultural and spatial characteristics from Phase 1 to Phase 4
Source: Based on information collected during THE interviews

Socio-Cultural Characteristics (C)	Phase 1 (1880-1950)	Phase 2 (1960-1974)	Phase 3 (1975-1990)	Phase 4 (2010-Present)
C1 Family Background	First generation, Family of 10, with 8 children, 5 male & 3 Female	The second generation, one of the male children is now the owner, works in a bank, has a family & children	Third generation, children grown up and participating in family decisions,	Fourth generation, with second-generation not there and third generation grown old, children working at different places, everyone living together but separate households
C2 Education, Occupation, Social Status	Under Graduate, Govt. Employee, Landlord, well respected	Same as Phase 1	Sons became doctors & engineers, well-respected families with contacts from far-off places, and patients visiting the house.	Respectable family with patients visiting, and new people moved into the neighbourhood.

C3 Lifestyle, Food Habits	Rural lifestyle, Activities to support daily needs were performed within the household, including Rice staple food, milk & poultry from neighbours, vegetables grown, mustard & fish from own sources	Same as Phase 1, food habits change with more intake of meat	Becoming consumerist, have vehicles, all children married and have children, dependent on the market for food	lifestyle is more consumerist, gardens don't exist just a few trees and flowering beds, Land has been cleared for new construction, food habits same but sourced from outside
C4 Traditional Customs & Values				
C4 Celebrations	Rituals take place within the house, Bihu celebrated within the household	Same as Phase 1	Celebrations are much-awaited events when the whole family comes together	Same as phase 3 but marriages taking place in cities
C4 Gender Roles	Men worked for a living & women took care of the household, women were educated	Same as Phase 1	Same as Phase 1	still patriarchal though all women of the young generation work
Spatial Characteristics (A)	Phase 1 (1880-1950)	Phase 2 (1960-1974)	Phase 3 (1975-1990)	Phase 4 (2010-Present)
A1 Siting	Unit approached by pathway perpendicular to the road, Garden on one side visible from the road, Kitchen Garden at the back, family well to meet water requirements.	Same as Phase 1	Same as phase 1, well filled with earth & garage made over it	Same as Phase 1
A2 Layout	Dwelling units around a verandah, single space for sleeping, Utility areas at the back	Same as phase 1, the additions include adding of Puja room, placing the kitchen in the SE as per Vaastu, Sizing of Kitchen & dining bigger, and wash & toilet attached to rooms.	Addition of formal living space, open spaces outside of public & semi-public character, corridors added for circulation, verandah for sit-out, addition of bedrooms, toilets, office space, garage	House divided into parts, new block added, common dining & kitchen, no courtyard, some older structures demolished.
A3 Connectivity	There total of 5 levels of depth, the verandah holds control of private spaces, the toilet & kitchen are the least connected, and the living & dining areas permeable spaces .	There total of 6 levels of depth, the verandah holds control of private spaces, courtyard connects semipublic & public areas.	Total 7 levels of depth, addition of new block to meet additional space requirements, dining and kitchen private spaces	There total of 6 levels of depth, the outside pathway is the most connected, and the bedrooms don't have connections.

A4 Spatial Segregation	Toilet and kitchen spaces are most segregated with a visual barrier	Toilet, store and Puja are most private rooms	New bedrooms lack privacy and toilet spaces and the Puja and Store 2 are the most private, The Courtyard is a centre for every activity.	Bedrooms have privacy, toilet, store and puja are private

As per the discussions with the respondents, the relationship between the socio-cultural aspects and the spatial organization is documented and codes based on Table 1 are created to link the relationship between the two in a simplified manner. The phase-wise development of the house is discussed as under.

Phase 1: (1880-1950)

The first phase was built initially in 1880 to suit the family requirements of the house at that time as shown in Fig. 3.

- The house has two maintained gardens at the front and the back traditionally known as the Bari and Kitchen Garden. These gardens provided food and flowers for consumption, festivities and rituals. This dual purpose makes them relevant in sustenance and cultural practices as represented by the code (A1- C3, A1- C4).
- The verandah is a transitional space between public and private areas. It is a communal space for family gatherings and a workspace for activities like weaving, and grounding of rice, highlighting its practical and social significance, coded as (A2-C2, A2-C3).
- The gardens are connected at the back, allowing women to access them without crossing public or semi-public spaces at the front. This spatial arrangement indicates the gender roles and cultural norms of that time, as depicted by code (A3-C4, A4-C4).
- The provision of separate bath & toilet areas is driven by hygiene concerns and cultural appropriateness, as indicated in code (A2-C4). This emphasizes the importance of privacy and cultural norms in the house's design.

The spatial relationships are represented in Figure 3, with the help of the annotated convex plan and JPG diagram. The JPG diagram illustrates connections and depth up to 5 levels, with the exterior acting as a carrier. The visual representation is helpful in understanding the intricate spatial layout.

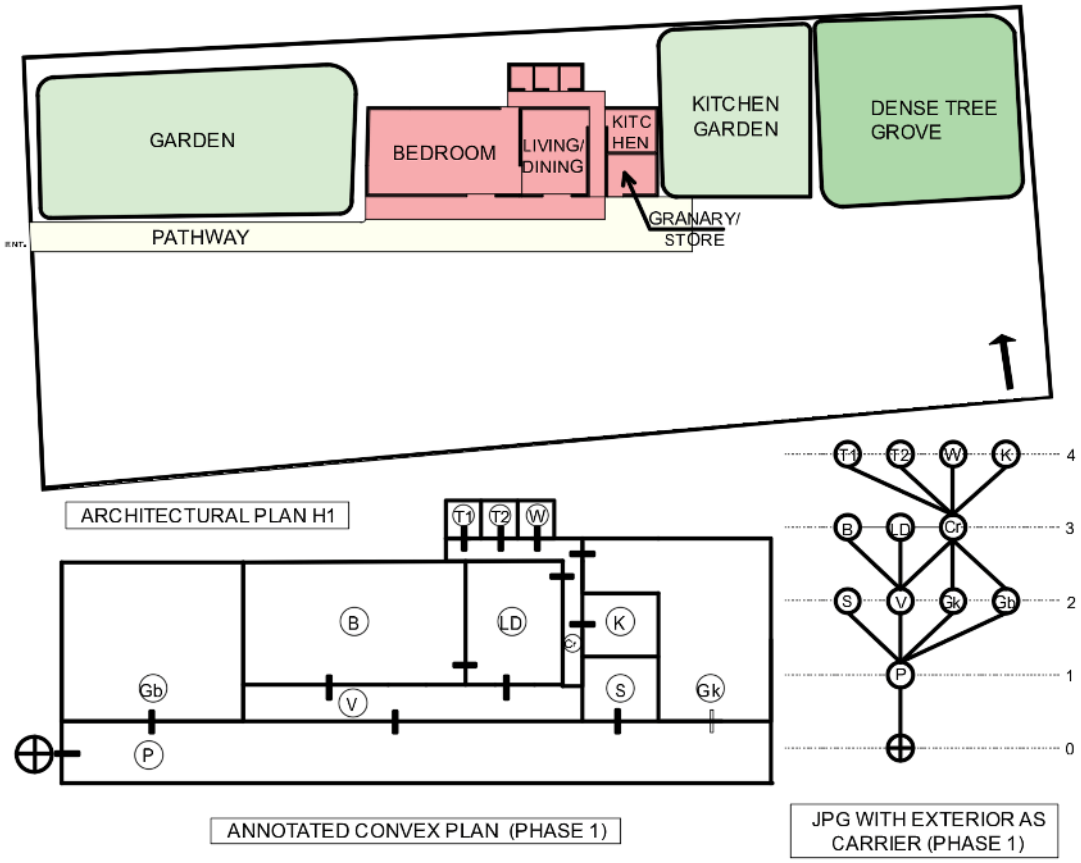

Fig. 3: Phase 01Architectural, Annotated Convex Plan and JPG
Source: Author, 2025

Phase 2: (1960-1974)

Fig. 4 shows the changes in the layout of the house in its second phase during 1960-1974. The grey colour represents areas retained from the previous phase, indicating continuity in spatial elements. The red colour denotes the new construction done during this phase, highlighting additions with change in a socio-cultural context. The hatched portion signifies modifications done to make the existing spaces more functional and enhance their utility.

- The changes in this phase are driven by the need to align with the changing needs of its inhabitants to increase its efficiency. The Bari and Kitchen Garden retained their original purpose, underscoring their enduring importance in both practical and cultural contexts, as indicated by code (A1- C2, A1- C4).
- The verandah continued to serve as a transitional space, maintaining its role as a communal area for family interactions and daily activities, refer (A2-C2, A2-C3). The internal courtyard provides privacy for the users while the pathway visually and physically connecting the verandah in the front is a checkpoint for the public (A2, A3, A4- C3, C4).
- The kitchen and dining areas experience more footfall due to a higher number of women in the household, leading to more permeable and accessible spaces (A3-C4).

The Fig. 4 shows the visual representation of phase 2 with 6 levels of depth. This phase highlights the importance of spatial planning in response to demographic and cultural shifts.

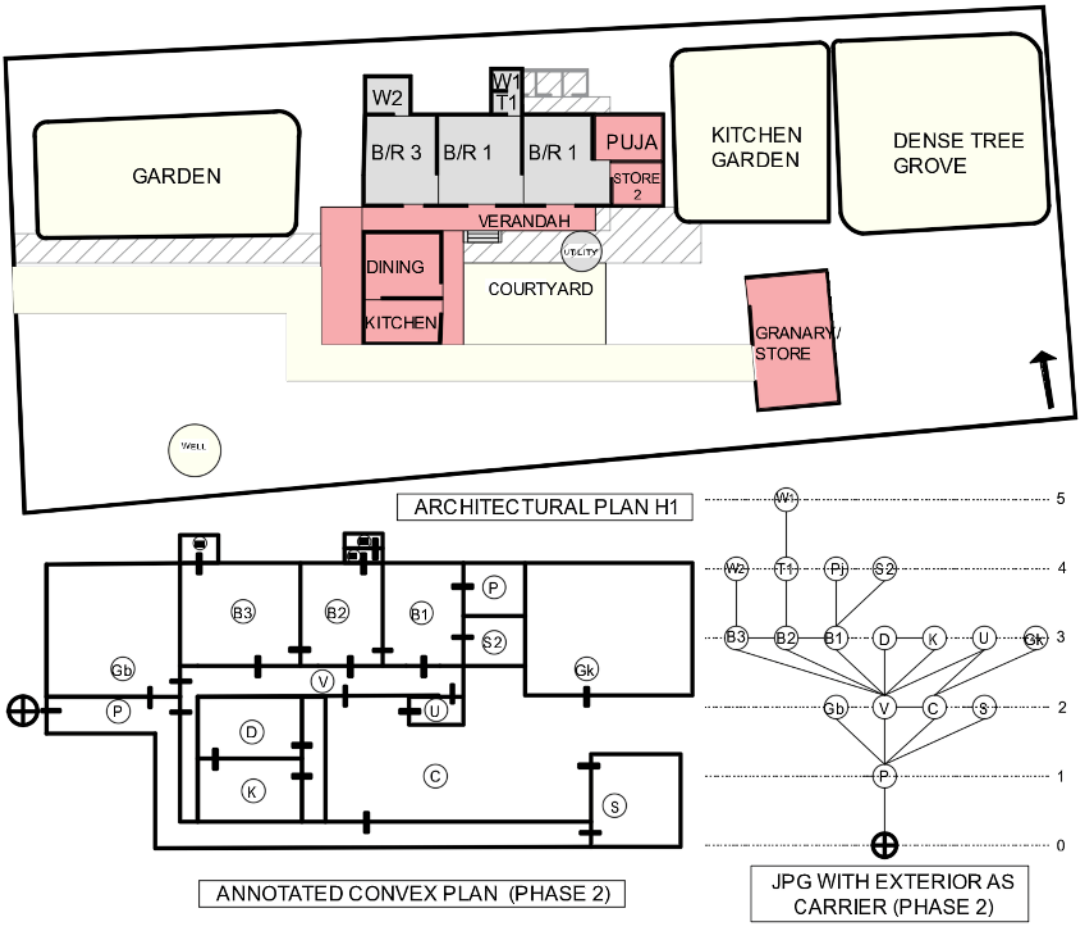

Fig. 4: Phase 02 Architectural, Annotated Convex Plan and JPG
Source: Author (2025)

Phase 3: (1975-1990)

The third phase is depicted in the figure 5, from 1975-1990. A new block is added in the front portion of the house, reducing the front garden or '*bari*'. This addition reflects transformations in spatial priorities due to growing family needs. A separate annotated convex plan, and JPG diagram (figure 5) were created for the new block, highlighting its specific usage patterns.

- In this phase, the house transitions into a proper joint family structure. The bedrooms are interconnected and the integration of attached bathrooms compromises some privacy as depicted in codes (A2, A3, A4 -C3).
- The verandah continues to be a transition space between public and private areas, but now accommodating other household activities as shown in (A2-C2, A2-C3). The internal courtyard provides privacy, while the pathway acts as a checkpoint for public access, allowing familiar individuals to enter the courtyard (A2, A3, A4- C3, C4).

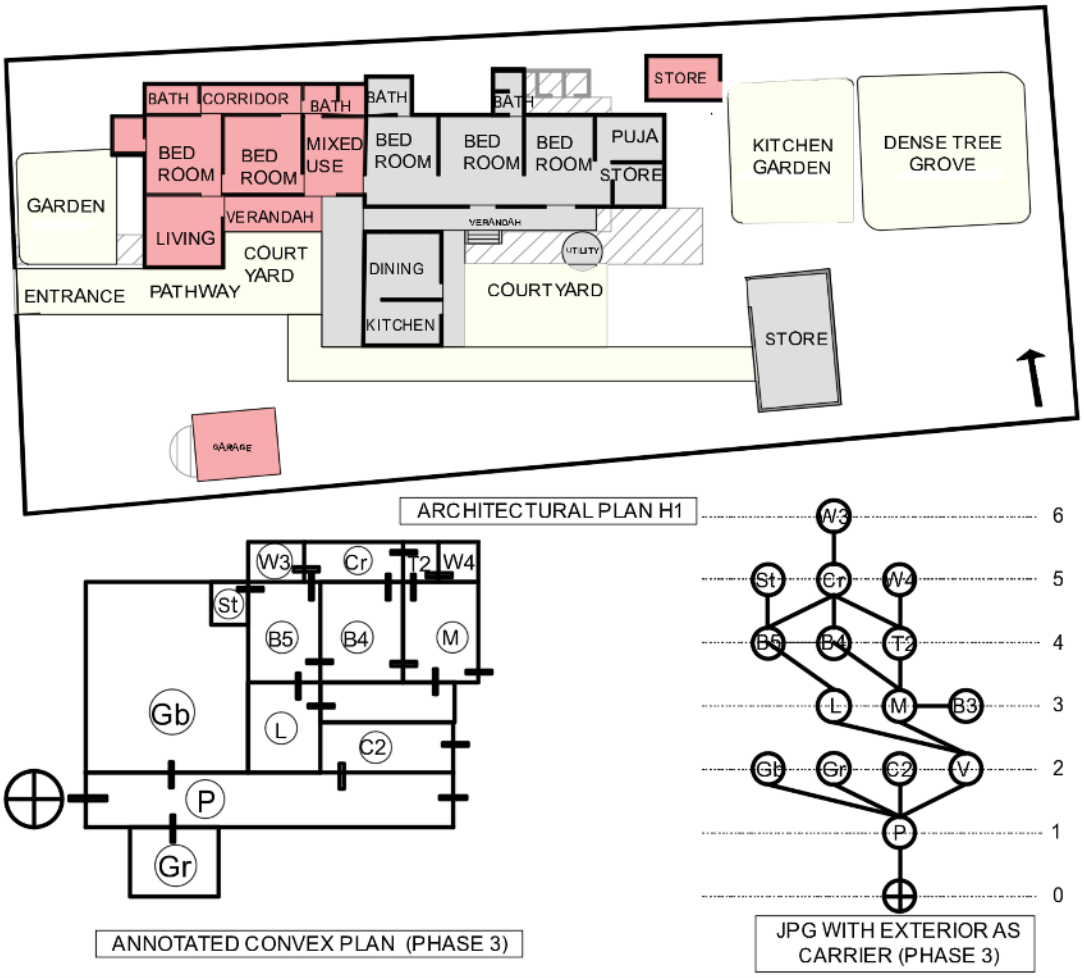

Fig. 5: Phase 03 Architectural, Annotated Convex Plan and JPG
Source: Author (2025)

- With more women in the household, the kitchen and dining areas experience increased footfalls, becoming more permeable and accessible (A3-C4).
- A new Living room is introduced, reflecting a shift towards professionalism and a departure from the traditional village lifestyle (A2, A3, A4- C1, C2, C3). At the same time, efforts to maintain a hierarchy-less environment are evident through easy access to the verandah (A2, A3 – C1, C3).

Phase 4: (2010- Present)

Phase 4 as shown in Figure 6, shows significant transformations in the house with the addition of new rooms at the front and back, and portions of existing structure removed to meet the current family requirements. The depth level at this phase is 7, indicating a complex and layered design.

- In this phase, the household transitions from a joint family structure to a fragmented layout, with self-serving parts and serving families independently. This shift is coded as (A2-C1, C2, C3), facilitating flexible uses from individual use to renting and

potential commercial enterprises (A2, A3, A4-C1, C2, C3, C4). The shift reflects a move towards modern, adaptable living spaces.

- The bedrooms offer increased privacy, with no space exerting strong control, hinting towards a more individualistic house personality (A2, A3, A4-C1, C3). This change depicts the presence of more personal space but compromising on communal interaction.

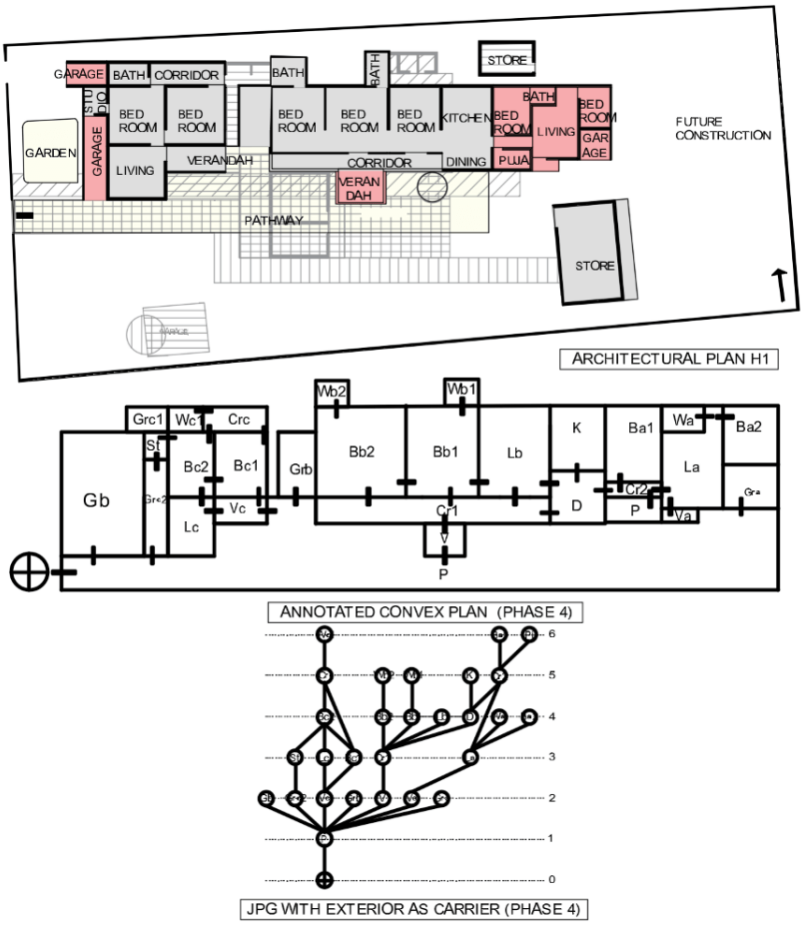

Fig. 6: Phase 04 Architectural, Annotated Convex Plan and JPG
Source: Author (2025)

- The verandah, a dynamic space facilitating circulation, activities, and connections transforms into more of a corridor in this phase. Despite retaining its sitting space, it has lost its social quotient (A2, A3-C3, C4). This transformation may reflect a diminished emphasis on communal social spaces in favour of individualized areas.
- The removal of the courtyard results in fewer communal activities and a loss of intimate social gatherings (A2, A3-C3, C4). The absence impacts the social cohesion of the household, showing a tradeoff between modernization and traditional communal spaces.
- The pathway has been enlarged and constructed using PCC, alongside multiple garages, showcasing the increased vehicular requirements of the families (A1, A2, A3- C1, C3). This change underscores the adoption of a modern lifestyle, emphasizing personal convenience and functionality.

Table 2: General abbreviations for rooms (Phase 1 to Phase 4) used in Justified Plan Graph (JPG)
Source: Author,2025

1	⊕	Exterior	16	B4	Bedroom 4
2	P	Pathway	17	B5	Bedroom 5
3	Gb	Front Garden	18	T1	Toilet 1
4	Gr	Garage	19	T2	Toilet 2
5	C2	Courtyard Public	20	S1	Store/ Granary 1
6	V	Verandah	21	S2	Store/ Granary 2
7	L	Living Room	22	Gk	Kitchen Garden
8	M	Mixed Use	23	PJ	Puja
9	B1	Bedroom 1	24	W1	Bathroom 1
10	B2	Bedroom 2	25	W2	Bathroom 2
11	B3	Bedroom 3	26	W3	Bathroom 3
12	C1	Courtyard 1	27	W4	Bathroom 4
13	U	Utility Space Outdoor	28	Cr	Corridor
14	K	Kitchen	29	St	Studio
15	D	Dining	30	S3	Store 3

The transformations across four phases reflect the changing needs of families in terms of privacy, flexibility, catering to changing socio-cultural contexts. Certain changes like the reduction of communal spaces: verandahs and courtyards, detract from the social vibrancy of the traditional house pointing to a potential imbalance between individualization and community. The addition of rooms and garages adds to the functional value of houses, compromising on house's social spaces.

Data Analysis

The analysis of the relationship between sociocultural factors and spatial characteristics across four phases of the house's evolution from the 1880s to the present day reveals several key findings that align with, extend, and in some cases challenge existing literature on vernacular architecture and sociocultural sustainability. The comparison of all four phases helped in understanding the transformations with change in the socio-cultural context of the family. Refer to tables 3, 4 and 5 to understand transition in spatial design, their interdependence on socio-cultural factors and vice-versa.

Table 3: Predominant SC Factors that Influence Spatial Design
Source: Author

Phase 1	Phase 2	Phase 3	Phase 4
C4-2	C3-3	C3-5	C3-6
C3-2	C4-3	C1-2	C1-4
C2-1	C2-1	C2-2	C4-3
C1-0	C1-0	C4-2	C2-2

Table 3 highlights the Socio-cultural factors affecting the spatial design in the study area in different phases.

Table 4: Predominant Spatial factors expressing SC factors
Source: Author

Phase 1	Phase 2	Phase 3	Phase 4
A1-1	A2-2	A2-5	A2-6
A2-1	A3-2	A3-5	A3-5
A4-1	A1-1	A4-3	A4-2
A3-0	A4-0	A1-0	A1-1

The table 4 highlights the Spatial factors that express Socio-cultural factors affecting the in the study area in different phases. Based on Tables 3 and 4, a comparative Table 5 is prepared to understand the relationship between socio-cultural and spatial factors.

Table 5: Recurrence of Patterns of Relationship between SC characteristics & Space
Source: Author

	A1	A2	A3	A4	
C1	P4	P3X2, P4X4	P3X2, P4X3	P3, P4X2	
Total Patterns	1	6	5	3	15
C2	P2	P1, P2, P3,P4X2	P3, P4	P3, P4	
Total Patterns	1	5	2	2	10
C3	P1, P2, P4	P1, P2X2, P3X3, P4X6	P2, P3X3,P4X5	P2, P3X2,P3X2	
Total Patterns	3	12	9	5	29
C4	P1, P2	P2, P3,P4X3	P2, P3X2, P4X3	P1, P2, P3,P4	
Total Patterns	2	5	6	4	17
Total Patterns	7	28	22	14	

Inferences from Table 5: It's easy to understand the relationship of socio-cultural factors on the spatial arrangement and architecture of a place with this comparison. The m*ost Related Socio-Cultural Category is* Lifestyle (C3). Lifestyle is a broad category; it includes the widest range of human behavior from food habits to individual actions. Also, lifestyle even though it changes time to time, good architecture is supposed to reflect and change with one's lifestyle. Similarly, the l*east Related Socio-Cultural Category is* Education, Occupation, and Social Status (C2), even though they are not insignificant. Vernacular rural architecture is typically a versatile craft, created using readily available materials and local labour, which might explain this lack of correlation. As a result, the formal and material properties of buildings often remain consistent within a locality that shares the same vernacular practices.

Most Related Architectural Characteristic: Connectivity (A3) with its various factors like Permeability, depth and control is the most related architectural characteristic. These factors could be tested by the Justified Plan Graph (JPG) method to show how configurational spatial relationships affect and are affected by socio-cultural dynamics.

Least Related Architectural Characteristics: Siting (A1) is the least related Characteristic which seems least affected by socio-cultural forces. Changes in the site are big developments which would require considerable motivation, whereas we generally tend to find spatial or material change to be more common. Responsibilities on site also require people. –while if it's a conscious decision by

people, then land shortage shouldn't be a worry however for the same reason, these socio-cultural relations might be lost forever.

Most Recurring Relationship: Lifestyle (C3) and Layout (A2) were found to be the most recurring relationship. While this might seem intuitive, we could see how internal spaces changed with changes in the way of living of the people brought about by various forces. Layouts changing with lifestyle means that the users have control over design decisions and the agency to bring change in their living choices.

The analysis examined the relationship between socio-cultural factors and spatial characteristics across four phases of the house's evolution from the 1880s to present day.

- Lifestyle as a Key Driver of Spatial Change: The main finding that lifestyle (C3) was the socio-cultural factor most strongly related to spatial changes over time aligns with (Francaviglia and Rapoport, 1969) assertion that built form is primarily influenced by socio-cultural factors, particularly lifestyle. This is evidenced in our study by the transformation of the verandah from a multi-functional space in earlier phases to a more specialized circulation space in later phases, reflecting changing daily routines and social interactions. This reinforces the (Glassie, 1972) idea that vernacular architecture is a dynamic response to changing cultural needs. The adaptability of the built environment to changing daily routines and activities demonstrates what (Gamón, 2020) refers to as the "promotion of ingenuity and collective intelligence" in vernacular architecture. This study extends this concept by showing how this adaptability operates over multiple generations within a single household.
- Resilience of Vernacular Design Principles: The weak relationship between education, occupation, and social status (C2) and spatial changes supports the (Oliver, 2007) argument that vernacular architecture embodies time-tested design principles that transcend socioeconomic constraints. In our case study, despite significant changes in the occupants' education and social status over time, certain spatial principles, such as the importance of transitional spaces between public and private areas, persisted. This resilience of vernacular design principles aligns with (Hawkes, 2001) of culture as a way of life that adapts while maintaining core values. However, our study also reveals that this resilience has limits, as seen in the gradual disappearance of certain traditional spaces like the courtyard in later phases.
- Spatial Connectivity and Social Dynamics: The strong influence of socio-cultural factors on connectivity (A3) emphasizes the importance of spatial organization in reflecting and shaping social relationships. In our study, this is particularly evident in the evolution of the kitchen and dining spaces, which became more permeable and centrally located over time, reflecting changing family dynamics and gender roles. The shifts in permeability, depth, and control of spaces in response to changing social dynamics demonstrate what (Giddens, 1984) refers to as the "duality of structure" where social practices both shape and are shaped by spatial configurations. Our study contributes to this theory by providing a longitudinal perspective on how this duality operates over time in a specific cultural context.
- Persistence of Site Layout: The relative stability of siting (A1) despite socio-cultural changes aligns with the (Bourdieu, 1977) concept of "habitus," where certain spatial practices persist due to deeply ingrained cultural dispositions. In our case study, the consistent orientation of the house and the preservation of certain outdoor spaces like the bari (orchard) demonstrate this persistence. This persistence of site layout amidst other changes reflects what (Mestrovic and Tomlinson, 2001) describe as the tension between global influences and local traditions in cultural change. Our findings suggest that this tension is particularly evident in site-level decisions, which may be more resistant to change than interior spatial arrangements.

- User Agency in Spatial Adaptation: The strong recurring relationship between lifestyle (C3) and layout (A2) supports (Stets and Burke, 2000) theory on the role of individual agency in shaping social identities and, by extension, living spaces. This is exemplified in our study by the occupants' decisions to modify internal spaces to accommodate changing family structures and professional needs, such as the addition of a formal living room in Phase 3. This finding also aligns with (Alexander *et al.*, 1977) observation that gradual changes become part of tradition, making them indistinguishable from what was already there. Our study extends this idea by showing how these gradual changes accumulate over generations to produce significant transformations while maintaining a sense of continuity.
- Evolution of Privacy and Communal Spaces: The transitions observed across phases, such as the addition of internal courtyards and the shift from joint families to more individualized units, reflect what (Banks, 2008) describes as the evolution of cultural practices in response to changing societal norms. In our case study, this is particularly evident in the increasing privacy of bedrooms and the changing nature of communal spaces over time. These changes also demonstrate (Arrindell, 2003) the concept of cultural dimensions, particularly the shift in individualism versus collectivism. Our findings suggest that this shift is not a simple linear progression but a complex negotiation between traditional values and modern influences, as seen in the simultaneous increase in private spaces and the attempt to maintain some form of communal living in the latest phase.

Discussion

Lifestyle (C3) was the socio-cultural factor most strongly related to spatial changes over time. This reflects how the built environment adapted to changing daily routines, activities, and ways of living. Education, occupation and social status (C2) had the weakest relationship to spatial changes. This suggests vernacular architecture can achieve good spatial design regardless of socioeconomic constraints. Connectivity (A3) was the spatial characteristic most influenced by socio-cultural factors. Factors like permeability, depth and control of spaces shifted in response to changing social dynamics. Siting (A1) was least affected by socio-cultural changes, likely due to the significant effort required to alter the overall site layout. The strongest recurring relationship was between lifestyle (C3) and layout (A2), indicating users had the agency to modify internal spaces as their way of life evolved.

Notable transitions across phases: Phase 1-2: Addition of internal courtyard provided more privacy while maintaining connections; Phase 2-3: New formal living space added to accommodate professional guests; Phase 3-4: Shift from joint family to more individualized units within the same structure.

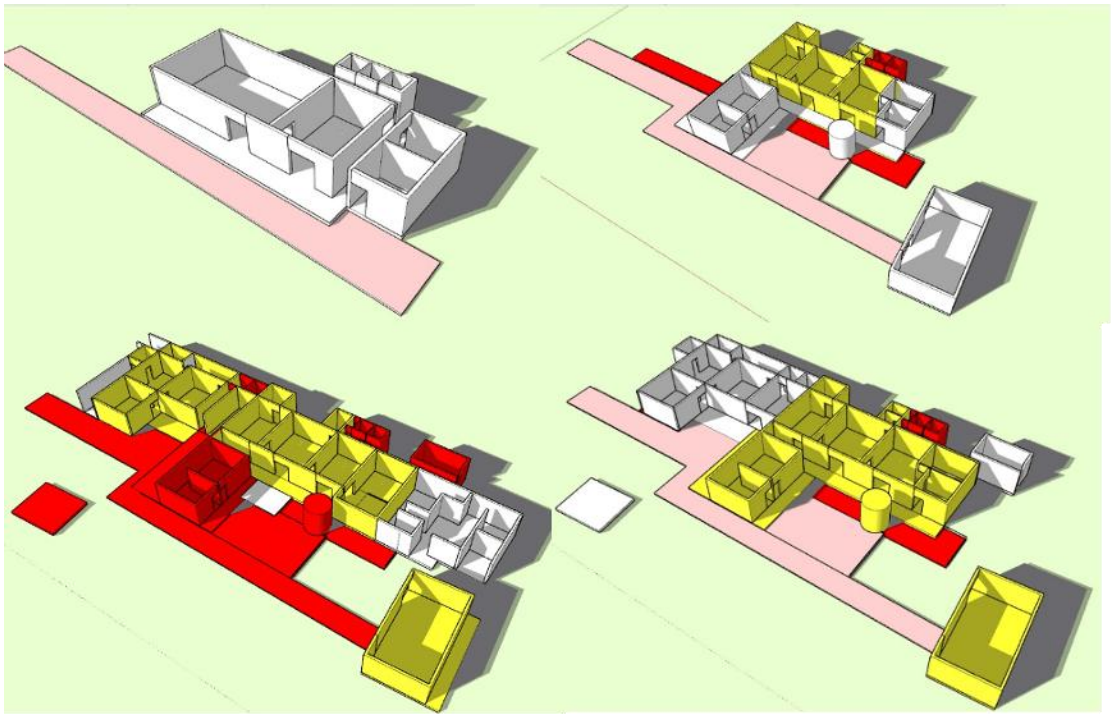

Fig. 7: 3D representation of transformation in the house from Phase 1 to 4
Source: Author

This analysis demonstrates how vernacular architecture organically adapts spatial configurations in response to changing socio-cultural needs over time (refer to Figure 7). The methodology combining space syntax analysis with socio-cultural factors provides insights into this dynamic relationship between people and place.

Conclusions

The study concludes that the spatial organization of Assam houses is strongly influenced by the changes in socio-cultural aspects such as education level, economic status, size of the family, and lifestyle. A dynamic relationship between space and culture where evolving needs and aspirations bring modifications in vernacular architecture. The study also emphasizes the adaptability of vernacular architecture, evolving through time and adjusting to shifts in socio-cultural aspects thus highlighting the value of traditional design principles as context-specific and socially sustainable. The study further emphasizes the importance of preserving the essence of traditional architecture through a thoughtful contextual design process, retaining the socio-cultural significance and blending with the needs of the modern world.

The strength of the study lies in a structured approach that can be replicated in a different context and a bigger sample size. It reinforces the value of traditional knowledge of designing and adds to the repository of sustainable design principles and context-sensitive design, quite relevant in the present context. However, the study is limited in terms of the ability to generalize the findings and to produce more representative conclusions a robust data set is required. Another limitation is the dependence of collected data on interviews. These interviews may carry certain biases that need to be removed. This could be checked by using the quantitative framework in addition to the qualitative framework used in the present study. A comparative analysis between rural and urban contexts could provide insights into how urbanization impacts these relationships. Additionally, longitudinal studies tracking

contemporary housing adaptations could help bridge the gap between vernacular wisdom and modern design practices.

Future research could address these limitations by expanding to multiple case studies across Assam, conducting rural-urban comparisons, and developing quantitative frameworks for socio-cultural-spatial relationships. Applying this approach to other cultural contexts and exploring its implications for contemporary sustainable design could further enhance our understanding of vernacular architectural evolution across diverse settings.

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