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Courtyard as a Spatial Negotiator: Socio-Spatial Transformation of Domestic Life in Traditional and Contemporary Indian Houses

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A b s t r a c t

This paper examines how changing socio-spatial configurations influence patterns of negotiated domesticity in traditional and contemporary courtyard houses within India's composite climate. A comparative case study approach is adopted, analyzing traditional houses from Ayodhya, Barabanki, and Varanasi, and contemporary houses from the NCR (National Capital Region). Methods include field surveys, photographic mapping, secondary data collection, and space syntax analysis using convex maps, step depth, and visual graph analysis (VGA) to assess spatial hierarchy, accessibility, and visibility. Findings reveal that traditional courtyard houses exhibit layered spatial hierarchies, in which courtyards serve as active socio-spatial mediators that support interaction and cultural continuity. In contrast, contemporary houses demonstrate spatial homogenization, reducing courtyards to symbolic elements with limited integrative function. The study concludes that adaptive reinterpretation of courtyards is essential, emphasizing their role as dynamic socio-spatial architectural elements to sustain negotiated domesticity within evolving Indian housing contexts.

Keywords: Negotiated domesticity; Courtyard houses; Socio-spatial configuration; Living heritage; Adaptive reinterpretation; Indian housing.

1. Introduction

The residential architecture in India has evolved through a close relationship between built form, climate, and socio-cultural practices. Traditional dwellings were physical shelters as well as socio-cultural relationships and ritual spaces. Courtyard houses have many typologies in different regions of the country. The courtyards are functional organizing elements, mediating between public and private realms while responding to various environmental, social, and cultural needs (Naboni et al., 2023).

In traditional houses, spatial organization is layered and strategically arranged. Courtyards are the main transitional spaces in traditional houses. Courtyards serve as gathering spaces for people; they are places of social interaction among family members and with nature. Courtyards should be strategically arranged as intermediate spaces that serve as social, ritual, and cultural gathering spaces, and as venues for activities, ventilation, lighting, and other household activities. There are spatial interactions between family members, community members, and guests (Pandya Yatin, 2023).

Urbanization and changing lifestyles, rising land values, and modern residential practices have transformed residential design and architectural patterns in India. The typologies of modern residential houses have eliminated the concept of courtyard planning in urbanized India. The values of sociality and culture have risen. This reduces the symbolic architectural form of the country. Hence, socio-cultural relationships and practices have declined, leading to fragmented families and distorted cultural practices. The generation-to-generation gap has increased. So eventually, the old knowledge and traditional practices faded or blurred. There is an increased need for private spaces rather than common spaces and interactive areas (Itma et al., 2021).

Eventually, comparing traditional courtyard houses with contemporary residential configurations becomes essential. The overall understanding of special configurations affects the patterns of interactions, transparency, and movement; all of these have been changing with urbanization and shifting lifestyles. Such interactive spaces and understanding contribute to broader discussions of heritage and traditional spatial knowledge, which may be reanalyzed and further inspired by ideas and implications (Khaznadar & Baper, 2023).

Therefore, this study investigates how changes in spatial configurations influence patterns of negotiated domesticity in modern, traditional, and contemporary Indian houses. By focusing on courtyard houses and employing spatial configuration mapping and visibility-based analysis, the research seeks to understand the evolving socio-spatial role of

courtyards. Through a comparative case-study approach, the study aims to identify how courtyards function as mediating elements between privacy, collective living, ritual practices, and environmental comfort, and how their role has transformed in contemporary residential architecture (Verma et al., 2026). Spatial planning is one of the most difficult parts of vernacular planning. Vernacular houses are often defined as mass architecture, architecture without architects, or localized construction (Gao & Kim, 2023).

This paper examines how changes in the spatial configurations of houses influence patterns of negotiated domesticity in traditional and contemporary Indian residential architecture. Focusing on courtyard houses, the study explores the socio-spatial role of courtyards as mediating elements between privacy, collective living, ritual practices, everyday social interactions within domestic spaces, and environmental comfort. The study analyzes how spatial configurations change and their effects on the mediating capacity of courtyards in contemporary and traditional houses, comparatively. The selected house typology is based on climatic conditions and housing typologies. A comparative case-study methodology is adopted by incorporating traditional houses sharing a similar style from Ayodhya, Barabanki, and Varanasi, as well as three contemporary houses from NCR, employing spatial configuration mapping and visibility-based analysis to assess access hierarchy, degrees of exposure, and spatial mediation across the selected dwellings. The survey methods used are field investigation, photographic mapping, and visual interpretation for traditional houses, and secondary data collection for contemporary houses. The quantitative analysis of the space syntax is done using space syntax methods. This includes convex map analysis, step depth calculations, and visual graph analysis (VGA), which presents metrics derived from connectivity maps, as well as visual integration and mean depth maps that compare the contemporary and traditional houses. Spatial and statistical comparisons have been established across the different house typologies included in the study using the above methods (Gunasagaran et al., 2022).

1.1 Aim

The study aims to examine how changes in the spatial configurations of houses influence patterns of negotiated domesticity in traditional and contemporary Indian residential architecture.

1.2 Literature Study

Space syntax is a method for analyzing spatial configurations to understand how the arrangement of spaces influences human movement, interaction, and social behavior in buildings and urban or traditional settings. It is a human-centric approach to urban design and architecture that uses numerical analysis and graph-based models to model spatial configurations (Liu et al., 2024).

There is increasing demand for eco-friendly architectural design, so the importance of intermediate or common spaces is growing. These intermediate transitional spaces are characterized by blurry, middle, border, or in-between spaces. These spaces have long accommodated traditional lifestyles by mediating the natural and artificial spaces (Yang et al., 2025).

1.3 Space syntax

Space syntax, in its simple form, is based on the theme that human society has complete space information, space environment, or residence space, and embedded social information (Jiang et al., 2000). This theme transforms the analytical method for studying the architectural environment from the popular trend of aesthetic visual analysis to a complex quantitative approach that employs numerical analysis to quantify spatial properties and extracts cultural information from the Siheyuan through mathematical models. Social and cultural information describing the formation process is embedded in the spatial layout of each building. The study of space syntax has developed useful tools for collecting such information, outlined the social logic behind the spatial layout of buildings, and analyzed the value of these layouts (Mohamed & van der Laag Yamu, 2024).

Space syntax is a term that emerged in the 1970s and refers to the theory and technology related to space and social relations. Space syntax analysis uses the concept of “graph theory” to express geographic space, and the research hypothesis is that the spatial organization structure influences the interaction between humans and the environment. “Graph theory” is also known as “topology”, which expresses the concepts of “space” and “logic” through a structure consisting of “points” and “lines”. The focus of this study is on the structure (connection) relationship between points and lines, not on distance nor direction. In space syntax, the understanding and generalization of space include the following analytical systems: Convex space analysis. Under this rule, the actual building space can be represented as a system of convex spaces. Axial line analysis. In this system, elements are linear when movement is the subject of study. Visibility graph analysis: Including single isovists and isovist fields. Visibility graph analysis is used when the subject of study exhibits complex behavioral patterns (Huang et al., 2019).

1.4 Circulation and spatial configuration

Architectural designers significantly shape the built environment by creating designs that influence users’ minds. In this regard, the building’s circulation system connects sections and spaces within the building. A crucial factor in building circulation is the specific path people take when moving from one space to another. The items in this system can be horizontal (i.e., paths and corridors) or vertical (i.e., stairs, ramps, and elevators). Horizontal circulation includes both between student rooms when friends want to communicate and access the public common spaces at the center of each level. The distribution of these items in the design of a circulation system is crucial, and the circulation system should be built so that its components are easily recognizable and perceptible (Safizadeh, 2024).

1.5 Traditional Courtyard Houses

Local materials and craftsmanship characterize Traditional Courtyard houses. They significantly shape the local environment and interactions among spaces and nature. Traditional houses in India represent region-specific building traditions shaped by climate, culture, and socio-economic conditions. Rooted in the ideas of "architecture without architects" and later defined as localized, need-based construction, these dwellings emerge from the everyday life practices of communities. At the micro level, they reflect the accumulated knowledge of generations, adapting spatial layouts, materials, and construction techniques to local environmental conditions. In the Indian context, examples such as the havelis of Rajasthan, the Nalukettu houses of Kerala, and the pol houses of Ahmedabad demonstrate how courtyard-centered planning negotiates climate, privacy, and social interaction (Zotova & Tarasova, 2023).

At the macro level, vernacular housing embodies both material and intangible cultural heritage, shaped by regional diversity, social structures, and traditional lifestyles. These houses contribute to a distinct sense of place while maintaining ecological harmony and resource efficiency. Recent studies emphasize that vernacular architecture in India offers critical lessons for sustainability, climate responsiveness, and socio-spatial adaptability in contemporary design (Adel et al., 2023).

In the context of rapid urbanization and globalization, there is a growing need to reinterpret vernacular principles rather than replicate traditional forms. Contemporary research highlights the importance of adaptive regeneration, where traditional spatial concepts such as courtyards, transitional spaces, and passive design strategies are integrated with modern materials and technologies to meet current needs. This approach ensures the continuity of cultural identity while enhancing functionality and resilience (Verma & Bano, 2023). Thus, traditional houses in India are not static relics but dynamic systems that negotiate between tradition and modernity, offering a sustainable and culturally rooted framework for future housing development.

1.6 Parameters: Privacy and Space Configuration

Privacy in architecture is a dynamic, culturally defined process of controlling access, interaction, and visibility. In Indian courtyard houses, privacy is achieved through spatial layering, inward orientation, and transitional spaces, reflecting social norms, family structure, and climatic responses. Space syntax provides a framework to analyze how spatial configuration influences movement, interaction, and privacy. The following parameters are used:

1.6.1 Space Syntax-Based Parameters

The following parameters of space syntax-based analysis of courtyard houses have been concluded from the above literature-based studies.

- Connectivity: Number of direct links a space has with adjacent spaces, indicating accessibility (Klarqvist, 1993).
- Control: Degree to which a space regulates access to its immediate neighboring spaces (Hesam et al., 2012).
- Choice: Likelihood of space being part of multiple movement paths (flow of movement) (Jiang et al., 2000; Klarqvist, 1993).
- Depth: Number of spatial steps from entrance to space, indicating level of privacy (Jiang et al., 2000; Klarqvist, 1993).
- Integration: Degree to which a space is connected to the overall spatial system, influencing interaction (Hesam et al., 2012).

1.6.2 Courtyard-Based Parameters

The parameters associated with spatial configurations, integration, and connectivity of courtyard houses have been defined as follows:

- Access Hierarchy: Sequential arrangement of spaces from public to private, organized around the courtyard.
- Courtyard Role: Central space acting as climatic regulator, social core, and cultural anchor.
- Visibility: Degree of visual connection between spaces, balancing openness and privacy.
- Spatial Depth: Layering of spaces that creates gradients of intimacy from public to private.
- Interaction Spaces: Areas (courtyard/Veranda) that facilitate social activities and family engagement.

2. Materials and Methods

A comparative, mixed-method research design was adopted to examine the role of courtyards as socio-spatial negotiators in traditional and contemporary Indian houses. The study integrates quantitative spatial configuration analysis with interpretive socio-spatial evaluation to understand how transformations in spatial layouts influence patterns of negotiated domesticity. The methodological framework is grounded in Space Syntax theory, enabling systematic assessment of spatial relationships through configurational metrics such as connectivity, depth, and integration.

A purposive sampling strategy was employed to select six case studies within the composite climate zone of India, comprising three traditional courtyard houses from Ayodhya (HA1), Barabanki (HB1), and Varanasi (HV1), and three contemporary courtyard-based houses from NCR (HC1, HC2, HC3). The selection of traditional houses was based on criteria including (i) the presence of a centrally located open courtyard, (ii) retention of original spatial organization, (iii) clear functional zoning reflecting socio-cultural practices, and (iv) accessibility for documentation. These houses, aged between 80 and 150 years, represent established courtyard typologies with well-defined spatial hierarchies. The contemporary cases were selected based on (i) incorporation or reinterpretation of courtyard elements, (ii) compliance with similar urban building bylaws, (iii) comparable plot constraints, and (iv) representation of current residential design trends. The selection of NCR as the source of contemporary cases is justified by the relative uniformity of design

approaches, shaped by standardized regulations and lifestyle patterns, making these cases representative of contemporary urban housing across multiple cities.

The methodological process was structured into three stages: spatial mapping, configurational analysis, and comparative interpretation. In the first stage, architectural drawings of all cases were digitized and simplified into analytical diagrams. Spaces were categorized into public, semi-public, semi-private, and private zones based on functional use and spatial positioning. Convex maps were generated by subdividing layouts into the fewest convex spaces, ensuring internal visual continuity.

In the second stage, configurational analysis was conducted using DepthmapX software (DepthmapX, 2012). Convex graph analysis was performed to examine topological relationships between spaces. Key metrics, such as connectivity and mean depth, were calculated to assess spatial accessibility and hierarchy. Step depth analysis was conducted using two reference nodes, the entrance and the courtyard, to evaluate access gradients and the relative positioning of spaces within the layout.

To assess visual relationships, Visibility Graph Analysis (VGA) was performed on a uniformly gridded representation of each plan. VGA computes inter-visibility between points and generates measures such as visual connectivity and visual integration, which indicate degrees of exposure, visual dominance, and accessibility. The resulting data were exported and aggregated at the level of functional spaces to enable meaningful socio-spatial interpretation.

In the final stage, results from convex and visibility analyses were comparatively evaluated across traditional and contemporary cases. Statistical ranges and distributions of spatial metrics were examined to identify patterns of spatial hierarchy, integration, and homogenization. Particular emphasis was placed on the courtyard's role in mediating between public and private domains. The findings were interpreted within broader socio-spatial frameworks, linking configurational properties with patterns of privacy, connectivity, and everyday domestic practices.

The study is limited by its relatively small sample size and reliance on spatial configuration as the primary analytical lens, without extensive behavioral mapping or ethnographic validation. Nevertheless, the methodology provides a robust and replicable framework for assessing the evolving socio-spatial role of courtyards in contemporary housing contexts.

The methodology is as follows in Figure 1: -

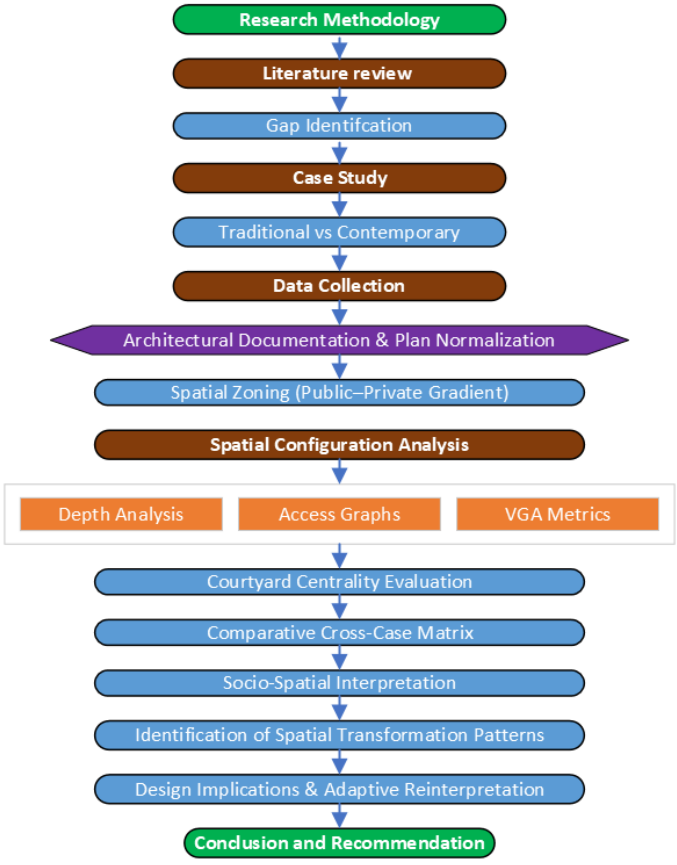


Figure 1. Methodology of the study (Source: Author).

The scope of the study was limited to plan-level spatial analysis and visual relationships within selected courtyard houses in a defined climatic region. Environmental performance, thermal behavior, and longitudinal user studies were not included. Furthermore, the interpretation of socio-cultural dynamics was based on spatial evidence rather than direct ethnographic data. The limited number of case studies and the reliance on two-dimensional analytical tools are acknowledged as constraints. Despite these limitations, the methodological approach ensures analytical transparency, replicability, and theoretical grounding, thereby providing a robust framework for examining the evolving socio-spatial role of courtyards in Indian residential architecture.

1.7 Case Study

A total of six case studies were selected for analysis, comprising three traditional courtyard houses from Ayodhya (HA1), Barabanki (HB1), and Varanasi (HV1), and three contemporary houses from NCR (HC1, HC2, HC3). All cases belong to the composite climate zone, and while all traditional houses share a broadly similar courtyard-based typology, enabling meaningful comparison. The traditional houses, as shown in Figure 2, exhibit centrally placed open courtyards, rectangular layouts, and clear spatial hierarchies that develop over time (80–150 years). In contrast, contemporary houses in NCR were selected for their standardized design approaches, shaped by similar building bylaws and evolving lifestyle preferences across cities. Similar houses subject to byelaw constraints were constructed throughout northern India. While maintaining formal typological resemblance, these houses reflect transformations in spatial organization. Detailed descriptions of contemporary cases are sourced from project documentation, with HC1 designed by "Stacked House. (Studio Lotus, 2019), HC2 by The House in 1970 (Architects Collaborative, 2020), and HC3 by "B-99 House (DADA & Partners, 2006).

House code	House HA1	House code	House HB1	House code	House HV1
Location	Ayodhya	Location	Barabanki	Location	Varanasi
Shape	Rectangular	Shape	Rectangular	Shape	Rectangular
Placement	Central Open	Placement	Central Open	Placement	Central Open
No. of floors	G	No. of floors	G+1	No. of floors	G+2
Entry orientation	W	Entry orientation	E	Entry orientation	W
Courtyard orientation	N-S	Courtyard orientation	N-S	Courtyard orientation	N-S
House orientation	E-W	House orientation	N-S	House orientation	N-S
House age	80	House age	120	House age	150
Site area	350.9	Site area	483.9	Site area	184.5
F to F height	3.6	F to F height	3.3	F to F height	2.8
Effective length	2.7	Effective length	6.6	Effective length	2.8
Effective width	2.1	Effective width	6.0	Effective width	2.7
Mean height	3.7	Mean height	4.4	Mean height	8.4

Figure 2. Description of the several parameters of the selected traditional houses (Source: Author).

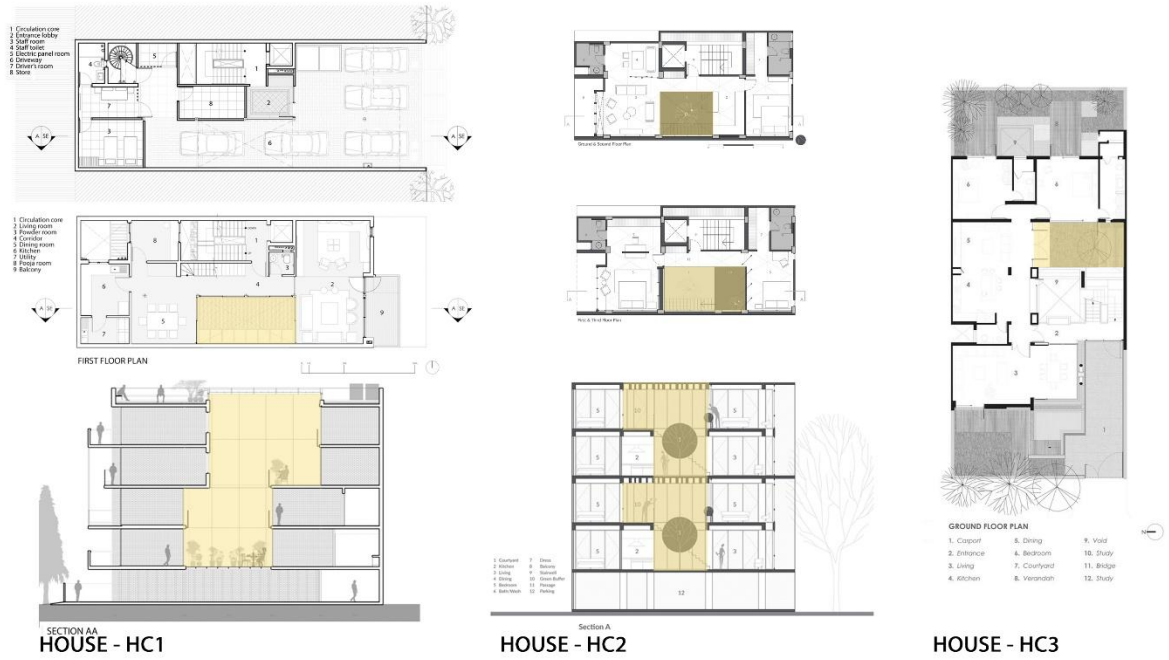


Figure 3. Plans and sections of the selected contemporary houses (Source: (Architects Collaborative, 2020; DADA & Partners, 2006; Studio Lotus, 2019)).

Figure 4. Plans and sections of the selected Traditional house (Source: Author).

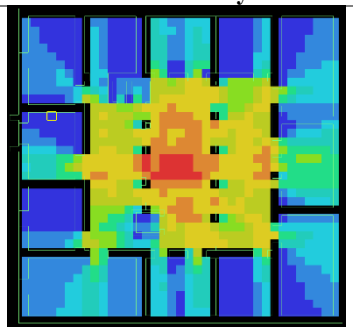
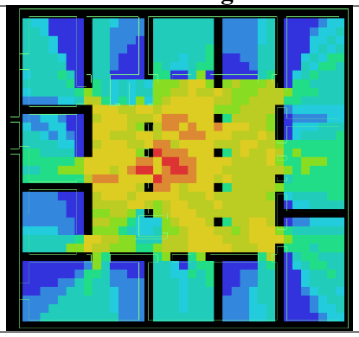
3. Results

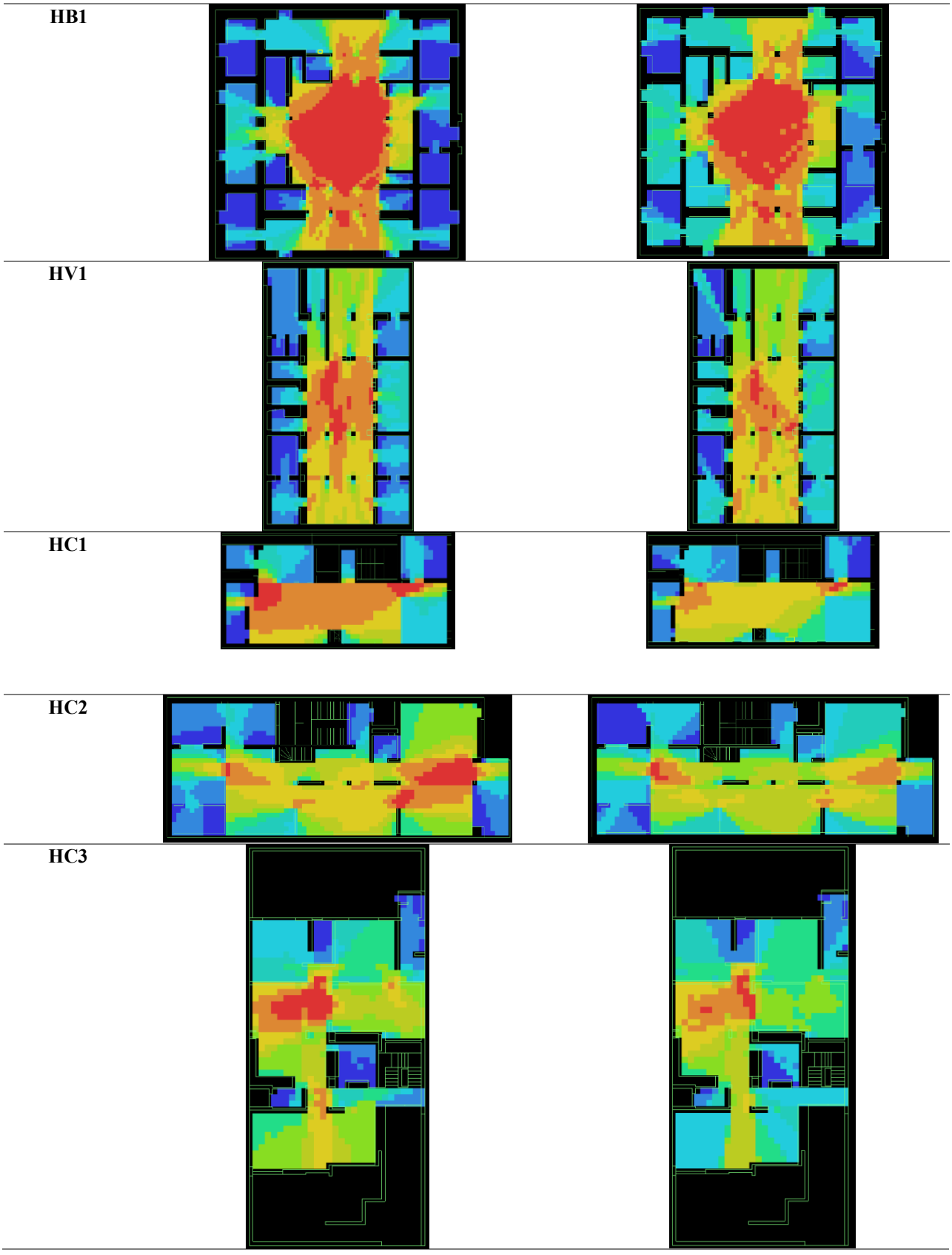
The overall analysis of the case studies of traditional and contemporary Indian houses reveals the significant role of the courtyard. The courtyards demonstrate moderate to high integration values relative to other spaces among the layouts of the studies. It confirms the role as a central node in a spatial network.

They are more accessible than private rooms but slightly less than primary circulation spaces like corridors or verandas. Courtyards consistently exhibit low mean depth, indicating that most spaces can be reached with fewer steps, reinforcing their function as easily accessible hubs for movement and interaction. Courtyards connect directly to multiple functional, semi-public, and private spaces (living rooms, dining areas, verandas, bedrooms), enabling fluid circulation and interaction across the house. Courtyards mediate between highly integrated circulation zones (corridors, passages, verandas) and segregated private areas (bedrooms, baths, kitchens), acting as spatial negotiators that balance accessibility and privacy. By linking communal and private zones, courtyards facilitate social gatherings, family interactions, and visual connectivity, while also accommodating privacy and functional segregation, showing their continuing relevance in both traditional and contemporary domestic layouts.

The results reveal that traditional houses exhibit layered spatial hierarchies in which courtyards function as active socio-spatial mediators, facilitating everyday social interaction and cultural continuity. It is also hypothesized that the transformation from hierarchical to homogenized spatial structures reduces the courtyard's integrative function in usual. In contrast, contemporary houses demonstrate spatial homogenization, reducing the courtyard to a symbolic or residual space and weakening its mediating role. The study concludes that meaningful integration of courtyards lies not in stylistic replication but in adaptive reinterpretation. By reframing courtyards as dynamic socio-spatial devices, the paper contributes to culturally grounded approaches to future residential design in rapidly transforming Indian contexts, as the overall understanding of their spatial configurations affects interaction patterns, transparency, and movement. The paper emphasizes the significance of courtyards in both contemporary and traditional houses and highlights the contrasts between them in the Indian context.

Table 1: Comparative Analysis of connectivity and visual integration (HH).

House	Connectivity	HH visual integration
HA1		



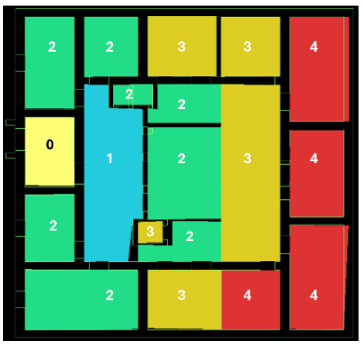
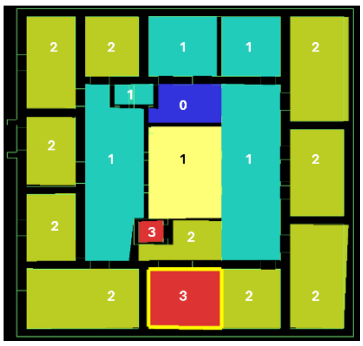
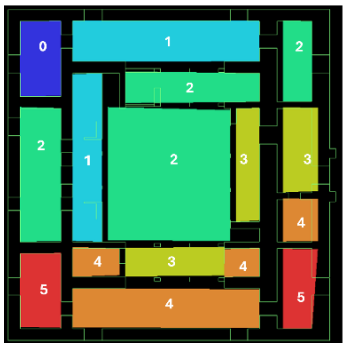
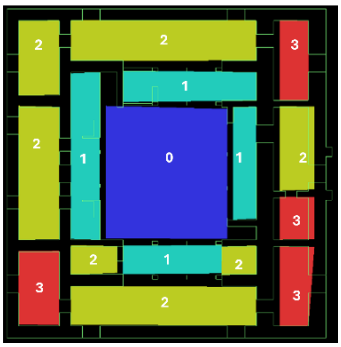
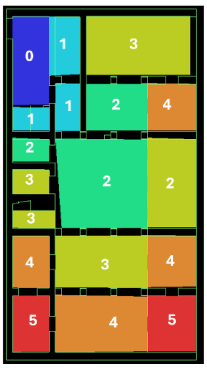
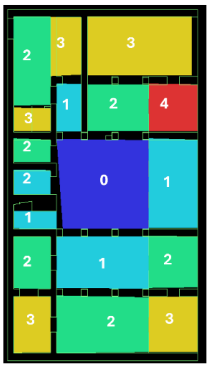
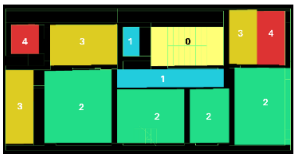
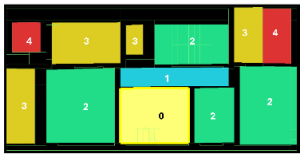
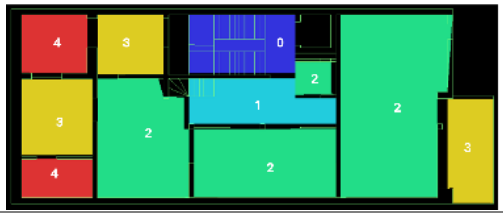
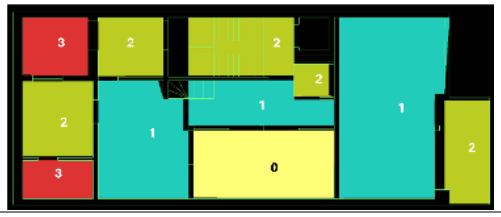
The Visibility Graph Analysis (VGA) of the selected case studies reveals a consistent pattern of hierarchical visual organization across both traditional and contemporary courtyard houses. The results indicate that visual connectivity and integration values are highest within the central open spaces, predominantly the courtyard, establishing it as the primary visual and spatial core of the dwelling. These spaces demonstrate strong inter-visibility and accessibility, facilitating interaction and movement across adjacent zones.

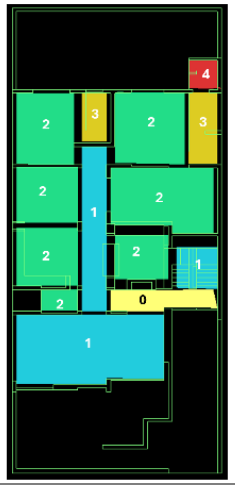
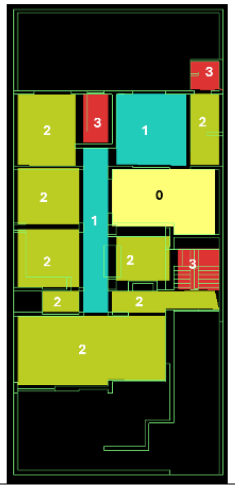
Transitional spaces, including living areas and circulation corridors, exhibit moderate levels of connectivity and integration, indicating controlled visual permeability and supporting gradual transitions between public and private domains. In contrast, peripheral and enclosed spaces, such as bedrooms and service areas, consistently show lower values, reflecting visual segregation and reinforcing privacy.

A comparative assessment highlights that while both typologies retain a hierarchical structure, contemporary houses exhibit a wider range of connectivity and integration, suggesting greater visual exposure. This indicates a shift towards more open, less filtered spatial configurations, in which the courtyard, although still central, functions with reduced control over visual and spatial mediation.

Overall, the findings confirm that the courtyard remains the dominant visual integrator across all cases. However, its role evolves from a controlled socio-spatial mediator in traditional houses to a comparatively exposed and less regulated space in contemporary dwellings, reflecting changing domestic spatial practices.

Table 2: Comparative Analysis for step depth from the entrance and the courtyard.

House	Step depths
HA1	Step depth (from entry)  Step depth (from courtyard) 
HB1	Step depth (from entry)  Step depth (from courtyard) 
HV1	Step depth (from entry)  Step depth (from courtyard) 
HC1	Step depth (from entry)  Step depth (from courtyard) 
HC2	Step depth (from entry)  Step depth (from courtyard) 

HC3	Step depth (from entry)	Step depth (from courtyard)
		

According to Table 2 above, the step depth analysis confirms that courtyards serve as the center of traditional or contemporary houses, enhancing accessibility and reducing travel distance or the number of steps within the house. It reduces the number of steps within the house. The entry points indicate the points of entry to the house and access to the interior. Whereas the entrances mark the entry points of the houses, the steps within the houses lead to the central courtyard or to other private spaces, such as bedrooms. This reinforces the courtyard's socio-spatial role as a mediator that facilitates movement and interaction, helping balance public and private zones in both traditional and contemporary Indian homes. The step depth analysis is useful for showing the spatial disparity between the number of steps taken from the entry point and the number of steps taken from courtyards to other rooms. This analysis shows that the private rooms are much deeper and require more steps from the entry point, making them more secluded and private. In contrast, the step depth in courtyards shows that private rooms are more accessible and centrally located for socio-cultural integration, and that they provide proper connectivity within the house's central interior spaces for users. It makes the space more connected and a social gathering place for all users, as fewer steps or a smaller step depth are required between adjacent rooms. Which means it is easier to access the courtyard from any interior location in the house due to its central position. Thus, the comparative analysis shows that the courtyard's central placement is best suited for a centrally connected and integrated space.

1.8 Convex Space Syntax Analysis of Traditional Houses

The comparison metrics of the considered cases of traditional houses of NCR and Contemporary houses of Ayodhya, Barabanki and Varanasi with respect to Integration, mean depth, step depth, total depth and connectivity is shown in the following tables as in (Table 3, Table 4, Table 5, Table 6, Table 7 and Table 8) which have been analysed for the study of the research work for proper findings and results.

Table 3: Convex Space Syntax Analysis of House HA1 Showing Integration, Mean Depth, Connectivity, Total Depth, and Step Depth Values for Individual Spaces.

Spaces	Ref no	Integration	Mean depth	Connectivity	Total depth	Step depth
Pooja space	0	1.17799	2.666667	1	48	2
Store	1	1.17799	2.666667	1	48	2
Veranda	4	1.53651	2.277778	2	41	1
Guest room	5	1.10437	2.777778	1	50	2
Drawing room	6	1.10437	2.777778	1	50	2
Guest room	7	1.10437	2.777778	1	50	2
Bedroom	8	1.10437	2.777778	1	50	2
Kitchen	9	1.13999	2.722222	1	49	3
Bedroom	10	1.17799	2.666667	1	48	2
Bedroom	11	1.17799	2.666667	1	48	2
Veranda	12	1.13999	2.722222	1	49	3
Veranda	13	1.60635	2.222222	2	40	1
Veranda	14	2.71844	1.722222	9	31	1
Courtyard	15	2.52427	1.777778	4	32	1
Veranda	16	2.52427	1.777778	5	32	2
Veranda	17	2.52427	1.777778	6	32	0
Veranda	18	2.35598	1.833333	8	33	1
Veranda	19	1.13999	2.722222	1	49	1
Veranda	20	1.17799	2.666667	1	48	2

Table 3, shown above, clearly highlights the spatial hierarchy of house layouts, where courtyards serve as the most accessible and centrally integrated spaces, with high connectivity and lower mean depths, making them major circulation and socio-interaction zones. Conversely, private areas such as bedrooms, guest rooms, pooja spaces, and drawing rooms show low integration and greater depth, indicating a sense of segregation and privacy. Similarly, semi-private spaces such as the kitchen and certain verandas occupy an intermediate position. Overall, the layout is organized with central, accessible, and transitional spaces linking more secluded rooms, reflecting a well-balanced design that balances accessibility and privacy.

Table 4: Convex Space Syntax Analysis of House HB1 Showing Integration, Mean Depth, Connectivity, Total Depth, and Step Depth Values for Individual Spaces.

Spaces	Ref no	Integration	Mean depth	Connectivity	Total depth	Step depth
Pooja space	0	1.17799	2.666667	1	48	2
Store	1	1.17799	2.666667	1	48	2
Veranda	4	1.53651	2.277778	2	41	1
Guest room	5	1.10437	2.777778	1	50	2
Drawing room	6	1.10437	2.777778	1	50	2
Guest room	7	1.10437	2.777778	1	50	2
Bedroom	8	1.10437	2.777778	1	50	2
Kitchen	9	1.13999	2.722222	1	49	3
Bedroom	10	1.17799	2.666667	1	48	2
Bedroom	11	1.17799	2.666667	1	48	2
Veranda	12	1.13999	2.722222	1	49	3
Veranda	13	1.60635	2.222222	2	40	1
Veranda	14	2.71844	1.722222	9	31	1
Courtyard	15	2.52427	1.777778	4	32	1
Veranda	16	2.52427	1.777778	5	32	2
Veranda	17	2.52427	1.777778	6	32	0
Veranda	18	2.35598	1.833333	8	33	1
Veranda	19	1.13999	2.722222	1	49	1
Veranda	20	1.17799	2.666667	1	48	2

Table 4, above, indicates that verandahs and courtyards are the most integrated and spatially accessible spaces, show high connectivity and lower mean depth, and serve as central zones for movement and interaction. Private spaces, including bedrooms, guest rooms, drawing rooms, pooja spaces, and stores, exhibit low integration and high depth, emphasizing privacy and segregating spaces. Semi-private areas, such as kitchens, are mediating or intermediate spaces between private spaces. Concludingly, the layout shows a hierarchy in which centrally located, highly connected spaces link to more separate or private rooms, balancing accessibility and privacy.

Table 5: Convex Space Syntax Analysis of House HV1 Showing Integration, Mean Depth, Connectivity, Total Depth, and Step Depth Values for Individual Spaces.

Spaces	Ref no	Integration	Mean depth	Connectivity	Total depth	Step depth
Room	0	0.87204	4.117647	1	70	3
Drawing	1	0.60878	3.176471	3	54	2
Room	2	0.82732	4.117647	1	70	3
Room	3	0.78696	3.411765	1	58	2
Veranda	4	0.78696	2.470588	4	42	1
Room	5	1.29062	3.411765	1	58	2
Stairs	6	1.40284	3.058824	1	52	1
Courtyard	7	1.1126	2.117647	5	36	0
Room	8	1.1126	3.058824	1	52	1
Bath	9	1.1126	3.058824	1	52	1
Toilet	10	0.97774	3.176471	1	54	2
Room	11	0.71701	4.705883	1	80	4
Toilet	12	1.04082	3.882353	1	66	3
Lobby	13	1.69818	2.235294	4	38	1
Kitchen	14	0.71701	2.941176	2	50	2
Room	15	1.1126	3.764706	2	64	3
Store	16	2.48195	3.882353	1	66	3
Lobby	17	0.97774	2.941176	3	50	2

The spatial analysis from Table 5 indicates that the courtyard (Ref 7) serves as a central, highly accessible space, with a relatively high integration (1.1126), a low mean depth (2.12), and high connectivity (5), making it a key hub for movement

and interaction within the layout. Surrounding spaces, such as the lobby (Ref 13) and verandas (Ref 4), also exhibit high connectivity and low depth, supporting their role as transitional or semi-public areas linking private rooms. In contrast, most rooms, baths, toilets, and the kitchen are less integrated and deeper within the system, reflecting their private or functional nature. The store (Ref 16), despite its depth, has a very high integration, suggesting it is an important functional node connected to multiple spaces. Overall, the layout demonstrates a spatial hierarchy centered around the courtyard, which organizes circulation and interaction while maintaining privacy for peripheral rooms.

1.9 Convex Space Syntax Analysis of Contemporary Houses

Tables 6, 7, and 8 present the convex space syntax analysis of the contemporary houses selected for our case studies.

Table 6: Convex Space Syntax Analysis of House HC1 Showing Integration, Mean Depth, Connectivity, Total Depth, and Step Depth Values for Individual Spaces

Spaces	Ref nos.	Integration	Mean depth	Connectivity	Total depth	step depth
Stairs	0	0.97	2.45455	2	27	0
Passage	1	1.95	1.72727	5	19	1
Courtyard	2	0.87	2.63636	1	29	2
Green buffer	3	0.87	2.63636	1	29	2
Bedroom	4	1.11	2.27273	2	25	2
Dress	5	0.71	3	2	33	3
Bath	6	0.48	3.90909	1	43	4
Dress	7	0.78	2.81818	2	31	3
Bedroom	8	1.3	2.09091	3	23	2
Passage	9	0.71	3	1	33	3
Balcony	10	0.52	3.72727	1	41	4
TOILET	11	-1	-1	-1	-1	-1
LIFT	12	0.6	3.36364	1	37	1

In this type of traditional house, the spatial analysis highlights that the passage (Ref 1) and bedrooms (Refs 4 and 8) function as the most integrated and accessible areas. They exhibit high connectivity and a lower mean depth, serving as a key zone for circulation and integration. The courtyard (Ref 2) and the green buffer (Ref 3), which are centrally located, show moderate integration and slightly high depth, serving as semi-private transitional spaces. It connects the private zones. The private zones, such as baths, dressing areas, and balconies, are segregated, as indicated by low integration levels and high mean depths, which emphasize privacy and segregation. In the end, the house exhibits a clear spatial hierarchy, with a central passage and accessible bedroom spaces that organize movement. The seclusion of private spaces in the outer areas reflects a traditional layout that balances interaction with privacy.

Table 7: Convex Space Syntax Analysis of House HC2 Showing Integration, Mean Depth, Connectivity, Total Depth, and Step Depth Values for Individual Spaces.

Spaces	Ref nos.	Integration	Mean depth	Connectivity	Total depth	Step depth
Stairs	0	0.82939	2.6	1	26	2
Corridor	1	1.89575	1.7	5	17	1
Living room	2	1.02079	2.3	3	23	1
Powder room	3	0.82939	2.6	1	26	2
Dining room	4	1.89575	1.7	4	17	1
Courtyard	5	1.47447	1.9	3	19	0
Pooja room	6	0.94787	2.4	2	24	2
Open OTS	7	0.57697	3.3	1	33	3
Kitchen	8	0.94787	2.4	2	24	2
Utility	9	0.57697	3.3	1	33	3
Balcony	10	0.60319	3.2	1	32	2

In these types of houses, the spatial analysis shows that the corridor (Ref 1) and dining room (Ref 4) are the most accessible and integrated spaces of the house. They show high connectivity and low mean depth, serving as the primary zone of circulation and interaction. Overall, it concludes with a similarly clear hierarchy of centrally positioned courtyards and dining spaces; this shows an organized movement and social interaction space in the house.

Table 8. Convex Space Syntax Analysis of House HC3 Showing Integration, Mean Depth, Connectivity, Total Depth, and Step Depth Values for Individual Spaces.

Spaces	Ref nos.	Integration	Mean depth	Connectivity	Total depth	Step depth
Entrance lobby	0	1.48647	2.076923	3	27	2
Stairs	1	0.8004	3	1	39	3
Living room	2	1.38737	2.153846	2	28	2
Kitchen	3	1.38737	2.153846	3	28	2
Dining	4	1.30066	2.230769	2	29	2
Corridor	5	4.16211	1.384615	9	18	1
Courtyard	6	1.48647	2.076923	2	27	0
Ots	7	1.22415	2.307692	1	30	2
Bed room	9	1.73421	1.923077	3	25	1
Dress	10	0.77076	3.076923	1	40	3

Bed room	11	1.38737	2.153846	2	28	2
Toilet	12	0.94593	2.692308	2	35	2
Utility	13	0.61207	3.615385	1	47	3
C. Toilet	14	1.30066	2.230769	2	29	2

In this type of house, the spatial analysis indicates that the corridor (Ref 5) is the most integrated and accessible space, exhibiting the highest connectivity and the lowest mean depth among all spaces. It also functions as the primary functional spine. The entrance lobby (Ref 0), courtyard (Ref 6), and central bedrooms (Refs 9 and 11) also show higher integration and moderate depth values, serving as transitional and activity zones. The private and service areas, such as the dressing rooms, toilets, utility areas, and the OTS, exhibit low integration and high mean depth values, indicating functional segregation and specialization. Concluding, the layout illustrates a clear spatial hierarchy. The central corridors and accessible living and dining spaces facilitate movement and social interaction. The peripheral private and service spaces maintain the functional separation.

4. Discussion

The courtyards consistently emerge as a central spatial negotiator that mediates circulation and enhances social interaction and privacy, as observed and analyzed in traditional and contemporary Indian houses. The courtyards exhibit moderate to high integration among the houses, lower mean depth values, and strong connectivity with nearby spaces. This makes them a transitional hub and a social gathering place. The areas adjacent to the courtyards, such as corridors, verandas, and lobbies, as well as centrally positioned living or dining rooms, show a direct connection to the courtyards. On the other hand, private or more functional spaces, like bedrooms, kitchens, baths, and utility spaces, are positioned deeper within the houses. They have a deeper integrated position in the household. These patterns illustrate the role of the courtyard in enduring Indian domestic architecture. This consistent pattern organizes movement, facilitates common interaction, and also negotiates the balance between the communal and private life. It also illustrates a socio-spatial transformation that incorporates and adapts traditional spatial principles to contemporary layouts while retaining the courtyard's central role as a socio-spatial mediator.

A layered access hierarchy recognizes the traditional houses. A clear hierarchical sequence is followed when traveling from public to private spaces. On the other hand, contemporary houses have a much simpler accessibility system. In traditional houses, the courtyard plays a central role, serving social and climatic functions. Whereas in contemporary houses, the role of the courtyard is reduced to a mere residual or symbolic element. The visual factors are more carefully controlled and modified to maintain a sense of privacy in traditional houses in India; contemporary houses feature an open layout and greater visual connectivity. As inferred from all the houses considered, traditional houses exhibit greater spatial depth, meaning the spaces are more interconnected in a sequential pattern. In contrast, contemporary houses place less emphasis on spatial depth, with more direct and accessible layouts. In conclusion, courtyards are seen as central spaces in traditional houses, whereas the living room serves as a primary space for social interaction in contemporary houses in India.

5. Conclusions

The observations conclude that traditional houses exhibit a courtyard-centered socio-spatial system. In contrast, contemporary houses illustrate a living room-centered, more functional system with reduced levels of hierarchy and greater social and visual integration. According to the observed and analyzed typologies of traditional and contemporary houses, courtyards serve a dual role as physical and social mediators, orchestrating movement patterns that enhance integration and privacy. This phenomenon, or critical function, of courtyards supports the concept of courtyards as a major agent in the socio-spatial transformation of the domestic Indian lifestyle, bridging traditional spatial practices and contemporary living patterns.

The overall findings indicate that courtyards serve as central nodes that facilitate controlled, moderated interactions, maintain a sense of privacy, and foster socio-cultural connectivity within the traditional housing typologies of Indian houses. However, the courtyards function as mediators and act as residual or symbolic elements due to reduced differentiation in spatial depth and increased spatial uniformity in contemporary houses in India. Based on the positioning of courtyards within broader domestic activities, spatial negotiations, and cultural continuity and balance, the paper proposes a conceptual model in which courtyards act as an adaptive socio-spatial entity. The overall study contributes to the development of culturally responsive and spatially informed design strategies for contemporary houses in rapidly transforming Indian contexts.

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