

Original Research Article

Livable House: The Synthesis of Housing and Landscape in Contemporary Villa Types*

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Abstract | The house has always been more than a closed and functional structure; it is the most fundamental setting of human life, a space that is not merely limited to the function of shelter, but also a bearer of identity, memory, comfort, and social bonds. Among these, the landscape, including open and semi-open spaces as well as natural or artificial views, plays a decisive role in shaping the lived experience of the house. However, contemporary architectural trends have led to a rupture between the house and the landscape, resulting in diminished attachment, weakened social interactions, and reduced livability in residential spaces. Thus, the necessity of this research lies in exploring the relationship between house and landscape and clarifying the mechanisms of their integration in contemporary villa typologies, since rethinking this bond can provide a pathway to enhancing quality of life in today's contexts. This study attempts to analyze the attributes of a livable house from a landscape-oriented perspective by prioritizing the role of landscape in improving residential livability. It also comparatively evaluates the methods of integrating housing and landscape in contemporary villas. The research method is logical and deductive reasoning, using simulations of selected contemporary villas in Depthmap and Agraph software to examine how different mass/void compositions influence livability components. The comparative study covers six distinct spatial organization types of mass/void combinations. The findings indicate that among the examined indicators, accessibility and visibility play the most significant role in enhancing housing livability. Direct and orderly pathways increase presence and spatial dynamism, while open and fluid layouts of landscape-related areas provide the greatest degree of visual openness. Conversely, the indicators of depth and enclosure mainly contribute to preserving territories and private domains. Therefore, housing livability is achieved when these indicators are combined in a balanced manner, simultaneously enabling spatial interaction and the experience of natural views alongside the preservation of spatial privacy.

Keywords | *Livability, Housing, Landscape, Space Syntax, Depthmap.*

Introduction | The disconnection from nature and natural systems in the course of urban daily life is considered a major concern of the contemporary era. The fundamental issue facing modern urban dwellers is living in an unbalanced and alien world, many aspects of which are formed beyond their control or agency, and the home is one such aspect. Today's cities, due to their detachment from ecosystems and natural processes, suffer from numerous environmental problems, soulless public spaces, and dwellings that are incompatible with human natural needs. Yet, incorporating natural conditions into the built environment not only enhances the perceptual and aesthetic qualities of urban spaces but also provides an ecologically healthy and spatially appealing setting. In this regard, "landscape, by establishing

a perceptual relationship between human and environment through a continuous bond, fosters interaction between human and nature and improves spatial experience by producing an entity of both objective and subjective nature" (Hemmati & Saboonchi, 2021). Landscape is the element that connects the house to its natural and social context, giving it meaning, identity, and quality, and extending the residents' lived experience beyond interior walls. The traditional Iranian house was always formed in active dialogue with the landscape, providing light, ventilation, and comfort, while enabling social interaction, presence in nature, and aesthetic experience of the environment. However, the advent of modernity and the shift in housing patterns severed many of these connections. Rapid urbanization, land fragmentation, densification, and a purely functional approach to housing

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have caused a rupture between house and landscape and disconnected residents from nature and outdoor spaces. This not only weakened the spatial perception and aesthetic quality of homes but also affected the psychological and social aspects of daily life. Integrating nature and its meanings into the design of physical environments enhances quality of life and livability. From this perspective, rethinking the relationship between house and landscape is an inevitable necessity in contemporary architecture and essential for designing livable homes, homes experienced not as isolated physical entities but as parts of a larger landscape whole. Accordingly, the practical aim of this study is to address mechanisms for improving livability through the extension and integration of natural elements within the spatial structure of contemporary housing, an aspect that has faded in recent decades due to urban expansion and mass housing production in Iran. The research seeks to define and prioritize indicators of livability in residential landscapes, based on a comparative reading of spatial and physical components in contemporary villa typologies. In this study, the coexistence of housing and landscape refers to the adjacency, conjunction, and combination of various living spaces, enclosed, open, and semi-open, forming the overall configuration of the dwelling. The paper considers this coexistence as the integration of open and semi-open spaces with living areas, where the arrangement and articulation of such relationships directly affect the home's livability quality. The research questions are: How can the livability of a home be enhanced? And how can the configuration of open and closed spaces (landscape and dwelling) foster a livable home? In this research, the term landscape is used as equivalent to open space. This equivalence is grounded in scholarly literature interpreting landscape not merely as a natural vista, but as a physical open setting in relation to human life (Waldheim, 2016; Carmon, 2021). Therefore, open spaces in villas such as courtyards, green areas, and gardens are regarded as tangible manifestations of residential landscape. The research adopts both quantitative and qualitative approaches, combining descriptive-analytical methods with logical and deductive reasoning. It proceeds in two main stages: (1). theoretical studies on housing and the literature on livability, and (2). analysis of theoretical and syntactic indicators through the lens of space syntax theory in a comparative reading of selected contemporary villas.

Research Background

Previous studies on the concept of livability have primarily focused on urban-scale issues, with limited attention to housing and intermediate open spaces within the architectural context. While urban livability and its components have been extensively examined in various research frameworks, studies within the field of architecture remain relatively scarce. The content of architectural research on this topic can

be categorized into three dimensions: physical, functional, and environmental. In the physical dimension, for instance, Sun et al. (2025) conducted a systematic analysis of spatial configurations, compositional features, and relationships between courtyards and interior spaces in 72 exemplary cases of independent Japanese villa housing projects. Zhang (2017), through studying the evolution of courtyard house typologies in China, proposed four design models for future courtyard-garden houses. In the functional dimension, Amir et al. (2015) examined residents' participation as a means of achieving livable housing in rental complexes and concluded that participation can positively influence wider environments, while livable places in turn enhance residents' activity, productivity, and the quality of surroundings. Padashi Amlashi et al. (2024) found that livability in traditional housing is shaped by functional and spatial elements such as physical adaptation to the environment, comfort and convenience, sense of place and identity, resident satisfaction, and quality of life, factors that emphasize subjective qualities. In the environmental dimension, Redaei et al. (2022) examined ecological and livability approaches in traditional houses within the historical fabric of Yazd and argued that revitalizing principles of ecological rationality across multiple scales can enhance livability in contemporary urban fabrics. Padashi Amlashi et al. (2021) analyzed vernacular architecture to identify livability indicators in the city of Amlash and concluded, through statistical analysis, that from the residents' viewpoint, the environmental dimension has the highest priority in establishing livable housing patterns based on local architectural traditions. Accordingly, the existing research gap lies in the lack of studies that integrate the three dimensions, physical, functional, and environmental, of livability at the scale of the home. The present study, drawing on livability theory, focuses on landscape spaces within residential settings and specifically analyzes the spatial coexistence of dwelling and landscape in realizing livability in contemporary villas, employing space syntax theory as its analytical tool. The novelty of this research lies in its integrated approach: unlike previous studies that addressed only one or two dimensions of livability, this study simultaneously examines all three dimensions in relation to landscape. Moreover, rather than concentrating on vernacular or urban contexts, it explores contemporary villa typologies to offer a new interpretation of spatial organization based on the coexistence of built form, space, and landscape. The application of spatial simulation through Depthmap and Agraph software to measure livability indicators also represents an innovative methodological contribution rarely used jointly in previous research. Thus, the study's innovation is not limited to describing the composition of housing and landscape, but extends to the development of an analytical framework for understanding the relationship between spatial organization and livability at

the scale of the home. This framework views landscape not merely as an aesthetic element but as a structural dimension of housing livability, one that can be measured through spatial syntax analysis. In summary, the core of the study's innovation lies in its theoretical contribution, as it redefines the relationship between landscape and livability, introducing an interdisciplinary concept into the theoretical corpus of housing architecture and creating new links between landscape theory, environmental psychology, and spatial analysis. Simultaneously, its methodological innovation lies in the concurrent use of Depthmap and Agraph for assessing livability indicators at the micro-scale of residential spaces, a combined approach rarely adopted in prior studies. Consequently, this research bridges the gap between urban-scale livability studies and the theoretical void in housing architecture, advancing the theoretical foundation of livability toward the scale of the house and its landscape.

Research Methodology

The research employs a combination of descriptive-analytical methods and logical-deductive reasoning. In the first stage, data collection included the systematic literature review, aiming to define and categorize indicators and concepts of livability and related theories. This was conducted through a library-based approach, analyzing the objectives and key aspects emphasized in this framework. In the second stage, the study identified various patterns of spatial adjacency among open, enclosed, and semi-open spaces in contemporary villa designs. Both quantitative and qualitative analyses were carried out through a comparative reading of the coexistence of dwelling and landscape in the spatial arrangements of selected case studies. These analyses examined the relationship between observer and natural views, the interaction of open and enclosed spaces, area and adjacency ratios, and social patterns reflected in architectural plans. The evaluation employed spatial simulation software, Depthmap, and Agraph based on the study's defined components, leading to the identification of the key design characteristics of a livable house. The sampling method was purposeful, selecting cases that exhibited diverse spatial and formal configurations of housing-landscape relationships. Since Depthmap software analyzes spatial and social meanings based on the configuration and geometry of architectural plans, the selection prioritized variation in the form of landscape elements and in the geometry of integration and adjacency between indoor and outdoor living spaces. Data analysis combined morphological analysis and space syntax theory. At the morphological level, the adjacency of indoor, open, and semi-open spaces and their relationship with natural views were evaluated through indicators such as the solid-to-void ratio, density, and spatial distribution of built forms, enclosure, and spatial cohesion. At the space syntax level, indices such as observer

movement, axial visibility, depth, connectivity, integration, and relative symmetry were analyzed using Depthmap and Agraph. Simulations were performed at two scales: Medium-scale villas integrated within the urban fabric and large-scale detached villas. These analyses assessed how plan geometry, access path length, courtyard arrangement, and vertical connections between floors influence accessibility, presence, visibility, and landscape experience. The color gradients and line densities in the observer movement and axial visibility graphs indicated maximum and minimum presence points and the lengths of visual axes. The justified graphs, generated with the entry point as depth zero, explained the relationships among connectivity, integration, and relative spatial depth. This comprehensive analysis enabled both quantitative and qualitative comparison across the six case studies and clarified the mechanisms of dwelling-landscape coexistence in enhancing livability indicators such as accessibility, legibility, indoor-outdoor interaction, and quality of landscape experience.

Theoretical Foundations

• Theory of livability

Appleyard (1981, 65) used the term "livability" within spatial domains around the concept of Livability and emphasized that physical characteristics continuously improve livability. He defined livable places as safe, free from pollution and congestion. In the statement by Jacobs and Appleyard, this concept was defined as the possibility of comfortable living in the city (Carmona, 2019, 53). The Webster Dictionary also defines livability as the suitability of a place for human habitation (Merriam-Webster, 1993). Livability means people's judgment of the degree or level of desirability of the quality of life; furthermore, happiness and satisfaction from being in communities that meet human needs lead to the formation of more livable places (Veenhoven, 1988, 254). Kevin Lynch (1981) identifies elements of livability as vitality, meaning, fit, access, and control. Jan Gehl (2006) believes that a livable place is chosen for pausing, staying, and meeting rather than passing through quickly. In urban geography, livability is a multidimensional concept dependent on the scale of place; thus, residents of medium-sized cities experience a completely different concept of livability requirements compared to those of small towns (Ley, 1996, 475). This theory has a human-centered perspective and includes a wide variety of objective and subjective characteristics that shape the attractiveness and desirability of a place, measurable at different scales with varying indicators. Newman (1999, 222) evaluates the livability of human environments as intertwined with their natural surroundings. A livable environment possesses qualities such as complexity, diversity, enclosure, and natural elements (Lennard & Lennard, 1987). Hahlweg (1997) defines it more precisely in terms of cleanliness, safety, and

the presence of plants in the local environment. This theory focuses on the habitability of a place, meaning its ability to meet the material and immaterial needs of its inhabitants to enhance their quality of life. Therefore, it is interpreted as “living conditions,” explaining the biological capacities present in the environment. Other factors emphasizing livability include effective population density, diversity, accessibility, safety and security, identity and distinction, creativity, communication, and interaction (Landry, 2000). Privacy and territoriality are among the livability factors that create boundaries, not as separation, but as influential elements in all aspects of life, social relations, and consequently, architecture (Varmaghani & Soltanzade, 2018, 131). The criteria defined by the American Institute of Architects for livable places include human-scale design, providing choice, creating identity, preserving landscapes, creating spaces for interaction, and flexible spaces with functional diversity. Moreover, Li et al. (2021), based on a World Health Organization report, identified four essential conditions for livability: safety, health, comfort, and convenience.

• Livable housing

Housing is considered a safe and private place for rest, tranquility, and escape from social tensions, where individuals become accustomed and develop a sense of belonging (Mojtabavi & Tafakkori, 2023, 37). The house is the most important place of living and the shelter of life, encompassing concepts such as identity, solidarity, security, and protection (Varmaghani, 2022, 177). The function of housing should not be limited merely to shelter; rather, the spirit of life must flow within it, and people should feel attached to it based on their experiences and memories. By creating a proper connection between housing and nature, the relationship between humans and the natural environment also evolves. A livable home encompasses all dimensions of physical, mental, and social health of its residents and surrounding environment, promoting their well-being and welfare (Naseri et al., 2024). Nowadays, the lack of public awareness of healthy lifestyle patterns and the design of unhealthy environments has led to poor quality of life, residents’ dissatisfaction, and increased illness, thereby reducing the livability of residential environments. “Enhancing the health of life means providing appropriate and diverse responses through the environment to users’ different physiological and psychological needs” (Bitaraf et al., 2018, 334). The residential environment, at the top of the natural hierarchy, offers numerous potential opportunities for the welfare and health of its residents and is recognized as an important factor in determining quality of life (Lee & Park, 2022). Among these, the theory of livability, aiming at achieving desirable housing, focuses on quality of life at the local level and represents comfort, health, spatial quality, accessibility, environment, and aesthetic quality. Robert Cowan defines a livable place as a suitable place for living (Cowan, 2005, 44), and

Casellati (1997, 225) considers it as an individual’s experience of his or her living environment. Accordingly, livability is associated with residents’ satisfaction regarding both objective and subjective aspects of housing. Livability can be categorized into three main dimensions directly related to livable housing. The physical dimension includes indicators such as mass and space, density, spatial cohesion, enclosure, and legibility, defining the physical structure of the house and its interaction with the environment, a factor directly affecting residents’ accessibility and spatial experience. The functional dimension includes accessibility, choice, spatial distribution of functions, vitality, and spatial flexibility, providing optimal space use, social interaction, and quality of daily life, shaping the individual’s experience of the living environment. The environmental dimension includes indicators related to interaction with natural and artificial landscapes, safety, comfort, mental health, and aesthetic quality of the environment, strengthening the connection of the home with nature, landscape experience, and residents’ well-being. This three-dimensional categorization enables a comprehensive and integrated assessment of livability at the level of housing and environment. Reviewing the literature on livability reveals the interrelationship among a wide range of intertwined environmental, physical, and functional components, whose balanced integration within the physical form of housing can realize the design of a livable home. The research process and the relationship among variables in the theory of livability are developed in Fig. 1 to answer the research question. The categorization of livability variables in experts’ views reveals a wide spectrum of external and subjective components. The five main external components include accessibility, enclosure, spatial order and coherence, the relationship between open and closed spaces, and natural landscape, which are measured in diverse spatial patterns of contemporary villas using five indicators in space syntax: depth, connectivity, integration in axial graph, visual field, and observer movement in Depthmap.

Introduction of Case Studies

The case studies include six contemporary award-winning villas with diverse mass/space compositions located in the cities of Isfahan, Qazvin, and Karaj (Table 1). Different spatial-formal patterns of dwelling-landscape coexistence were selected as case studies. In the plans of “Blue Yard” and “Ivan Khaneh,” the juxtaposition of open and enclosed zones occurs adjacently and continuously rather than in full integration, with enclosed areas occupying a larger proportion of the total surface. The “Numerous Yard House” incorporates multiple courtyards and terraces in its composition, where the sequence of solids and voids can be observed in the section and plan diagrams (Table 2). “Stroller House” presents a distinct pattern of mass/space composition, where open and green spaces and roof terraces

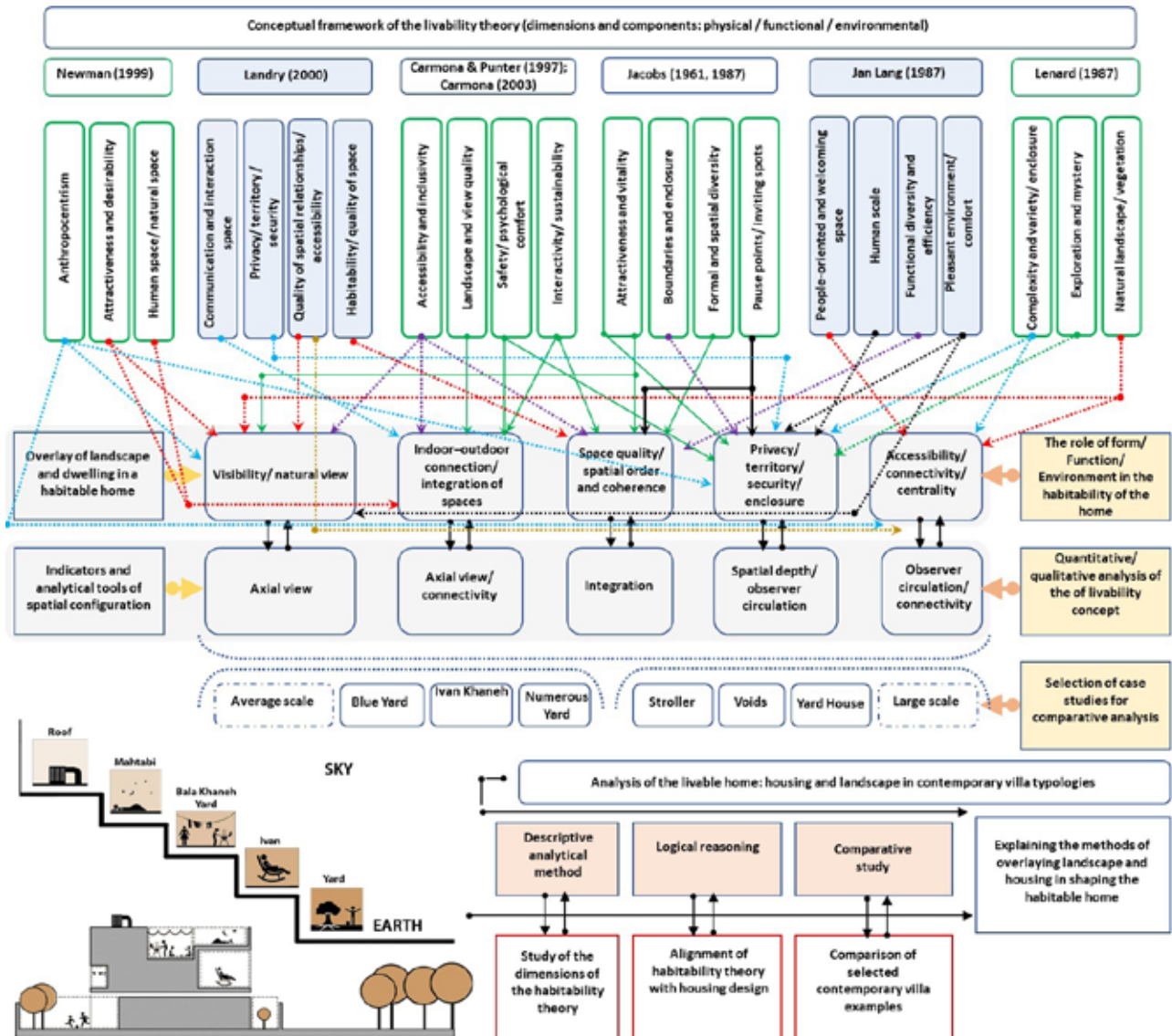


Fig. 1. Explanation of the relationship between external livability variables and space syntax indicators in advancing the research process. Source: Author.

serve as key areas for the residents' presence and movement, while enclosed L- and U-shaped forms partially frame the extensive green domain. "Voids" exhibits a regular geometric and grid-based pattern of mass/space composition, forming a chessboard arrangement; the sliding of solid and void cubes across the surface and height produces a unique configuration of dwelling-landscape coexistence. "Yard House" displays the mass/space composition through a large courtyard area with two different configurations at the ground and first-floor levels, comprising two elongated, aligned volumes surrounded by open spaces on the ground floor, and terraces and inner courtyards enclosed within a continuous, spiral form on the first floor. Table 2 shows open and semi-open spaces, enclosed spaces, and open-to-below spaces using three colors: green, yellow, and white.

Analysis of Case Studies

The analysis of the two indicators, observer movement and

axial view, was conducted through first- and second-floor simulations of the houses using Depthmap software. In the first and second rows of Table 3 (observer movement graphs), the density of lines in warm colors represents the highest probability of movement through spaces, while cool colors indicate minimal likelihood of passage and presence. Based on this, the degree of physical accessibility, enclosure, and spatial presence can be assessed. The color spectrum in the third and fourth rows of Table 3 (axial view) identifies the maximum and minimum lengths of visual axes; the longest sight corridors are simulated in red, while short and intersecting view lines are represented in dark blue and green hues. Table 4 presents the numerical values of these two indicators for the first and second floor plans of the studied houses.

Table 5 Justified graphs of the six studied houses, where each space is represented by a node and immediate spatial connections are shown by linking lines. The color gradient

Table 1. Introduction of the characteristics of the case studies. Source: Author.

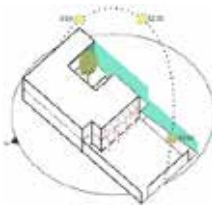

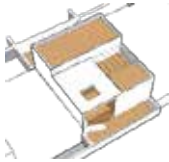







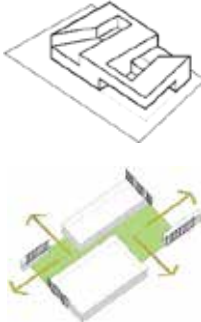
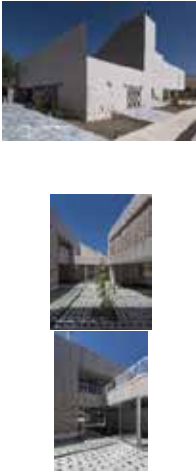
House/ Location	Year of Construction	Site Area	Description	3D View	Image
Blue Yard House/ Isfahan	2016–2017	300 m ²	Evoking the traditional pattern of the central courtyard in the form of a blue courtyard, this house combines identity-giving, memorial, and context-oriented elements. Access to the courtyard is provided through the entrance courtyard via a gap on the western side of the house and a short flight of steps. The blue tiles recall the historical and memorial color of Isfahan, while their juxtaposition with brick softens the roughness of the west-facing ground and creates a sense of coolness.		
Ivan Khaneh/ Shahin Shahr, Isfahan	2014–2016	273 m ²	It features a variety of open and semi-open spaces such as the entrance courtyard (Ivan), upper courtyard, terrace, and rooftop, as well as an Ivan designed for viewing the city while maintaining controlled visibility.		
Numerous Yard House / Najafabad, Isfahan	2017–2019	385 m ²	Designed as a porous volume with multiple courtyards, it evokes the garden houses of the Safavid garden-city tradition.		
Stroller House / Haft- Sangan, Qazvin	2014–2019	1900 m ²	A private promenade formed along a linear path with three focal courtyards: a small entrance courtyard, an enclosed courtyard, and a larger one with a calmer, more natural geometry.		
Void House / Kouhsar, Karaj	2021–2024	1000 m ²	It forms an extroverted–introverted composition of solid and void spaces within a relatively regular and static box.		
Falahatian Yard House/ Pirbakran, Isfahan	2015–2016	1,289 m ²	Through two semi-central, interconnected courtyards and by maximizing internal transparency toward them, the design directs the visual focus from outside to inside. Movable elements, such as sliding doors, transform the courtyards from enclosed and private open spaces into semi-enclosed realms. These spaces also function to separate private and public activities within the house.		

Table 2. Representation of open and semi-open spaces (green), enclosed spaces (yellow), and open-to-below spaces (white) in the villa plans. Source: Author.

	Blue Yard	Ivan Khaneh	Numerous Yard	Stroller	Void	Yard House
Ground Floor						
First Floor						
Section						
Mass/void pattern	Adjacency of space and mass/space enclosed within mass	Adjacency of space and mass/space enclosed by mass	Multiplicity of mass and space	L- and U-shaped masses within a vast space	Modular grid of mass and space	Parallel and spiral masses within a vast courtyard space

Table 3. Simulated spatial values of observer movement (rows 1 and 2) and axial view (rows 3 and 4) in the floor plans of the villas. Source: Author.

	Blue Yard	Ivan Khaneh	Numerous Yard	Stroller	Void	Yard House
Ground Floor						
First Floor						
Ground Floor						
First Floor						

Table 4. Numerical simulation values of the two syntactic indicators, observer movement, and axial view in the floor plans of the villas. Source: Author.

		Blue Yard	Ivan Khaneh	Numerous Yard	Stroller	Void	Yard House
Observer circulation	Ground Floor	30.7568	25.5713	20.4489	38.1628	26.369	15.9254
	First Floor	39.2138	36.909	29.1338	139.098	82.3788	32.4884
Axial view	Ground Floor	288.547	194.89	317.048	275.085	142.722	438.372
	First Floor	182.678	315.291	176.397	272.044	178.776	689.291

Table 5. Justified graphs based on the subspaces of the floor plans of the case studies, from the entrance to the deepest spaces of the house. Source: Author.

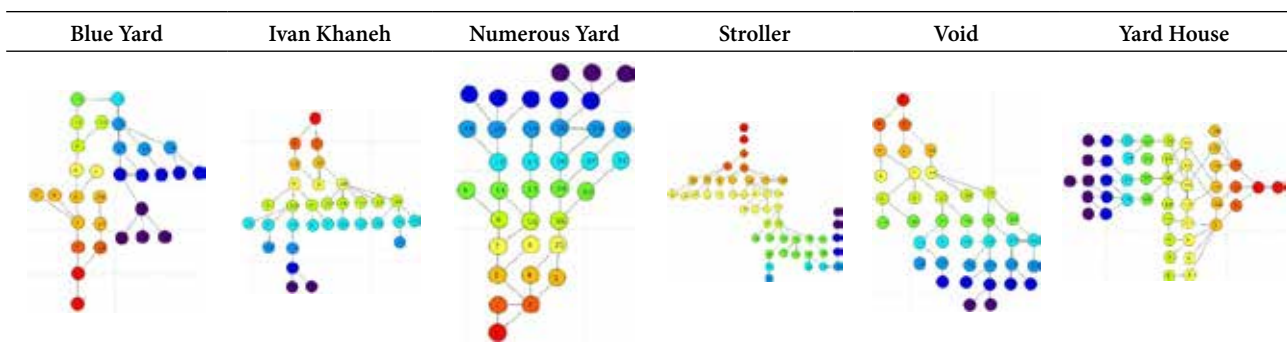


Table 6. Numerical values derived from the justified graphs (Depth / Connectivity / Integration / Relative Symmetry). Source: Author.

	Maximum depth of density	Total number of spaces	Total number of connections	Relative symmetry	Mean connectivity	Integration	Average relative depth
Blue Yard	12	30	60	0.385	2	2.59	6.4
Ivan Khaneh	5	32	64	0.136	2	7.35	5.092
Numerous Yard	7	36	78	0.32	2.16	3.125	6.45
Stroller	5	48	102	0.223	2.12	4.48	6.143
Void	5,6,7	39	80	0.241	2.05	4.14	5.47
Yard House	4,5	46	108	0.191	2.34	5.23	5.21

from red to dark purple indicates the gradual increase in depth value relative to the movement origin (here: the building entrance). Fewer connections result in linear graphs with greater depth, while more connections create denser graphs with reduced depth. Table 6 presents the numerical values of depth, connectivity, and integration indices obtained from the e-graph software output. The relative symmetry also represents the visual depth of spaces from the main area, derived from the relationship between the mean relative depth and the number of nodes.

Discussion

• Analysis of presence/ accessibility indicators using the agent

This analysis is conducted at two scales: first, medium-scale villas connected to the urban fabric, and second, large-scale detached villas, the latter characterized by spacious courtyards rather than necessarily larger built areas. Therefore, in the second group, the observer movement index in the second-floor plans (due to the lack of physical access to the courtyards)

is evaluated within the first group. Comparing the medium-scale samples shows that the tendency of plans toward direct and elongated movement paths in regular geometries increases the likelihood of presence in the functional spaces adjacent to these paths, thereby increasing overall observer movement within the configuration. Accordingly, the greatest potential for presence and movement belongs to House “Stroller” (139.098), which features high geometric order and elongated access corridors, whereas complex access paths (short and interrupted routes) in House “Numerous Yard” result in the lowest spatial presence values (20.4489 and 29.1338) among the samples. The simulation of the second group (ground floors of large-scale villas) shows that the maximum value belongs to “Stroller” (38.1628) and the minimum to “Yard House” (15.9254). The raised form at the entrance front of “Stroller”, together with the connection between the northern and central courtyards and the subsequent access to the southern courtyard through the central gap of the U-shaped form, allows fluid spaces to flow between static and dynamic volumes. This not only

creates spatial variety but also enhances natural vistas and both visual and physical accessibility to nature. The graph of “Yard House”, with the lowest observer movement, shows that although diversity in the layout of landscape elements and physical partitions among functional zones reduces overall spatial movement, it produces multiple pause points with high presence levels in the central courtyards and the large living terrace (open and semi-open spaces) that are directly linked visually and physically to the main living and reception areas (closed spaces). This spatial arrangement prioritizes the maintenance of privacy and livable territorial boundaries over spatial dynamism and movement within natural landscapes.

• **Analysis of visibility/interior–exterior connectivity using axial view**

Comparison among axial view graphs is also carried out at two scales. Quantitative and qualitative analysis of the first group’s graphs reveals a clear difference in spatial openness between the ground and first floors. For example, the maximum and minimum axial view index values belong respectively to the ground (317.048) and first (176.397) floors of “Stroller.” Other samples show similar patterns. In the ground floor of “Stroller,” a long and wide central visual corridor passes through sequential open and closed zones, linking three landscape nodes (the large southern courtyard, the central courtyard, and the small northern courtyard). This spatial layout blends interior and exterior realms and reduces spatial enclosure. On the upper floor, the addition of physical barriers and perpendicular partition walls divides the space into distinct public/private (open/closed) zones, as clearly shown by the color distinction of the view lines in the northern and southern halves of “Ivan Khaneh.” This separation simultaneously allows maximum visibility while maintaining visual privacy and independent residential/landscape territories. In the second group, with large courtyards, the ground and first floors show similar axial view index values. “Yard House” shows the highest, and “Voids” the lowest values in both levels. Despite its introverted structure, “Yard House” achieves maximum axial visibility through its extensive internal open zones. The shell-

like building envelope contains a broad inner courtyard, and limited external openings toward surrounding yards effectively control sightlines from inside to the green outer spaces, while still encompassing vast open and semi-open vistas with landscape elements of water and vegetation, thereby achieving maximal axial vision. Conversely, despite Voids’ large green courtyard, the arrangement of solid and void masses in a grid-like orthogonal system creates short view corridors between interior and exterior spaces, reducing visual permeability toward the surrounding open areas. Thus, the expansive mass of “Yard House” across the site and the compactness of “Voids” determine their respective morphological and numerical axial-view values.

• **Analysis of privacy and territoriality/ spatial order and cohesion using depth, connectivity, and integration indices**

The indices of depth, integration, and connectivity were examined through justified graphs of the ground and first floors, linked vertically by floor connections, with depth zero set at the main entrance. The outputs confirm a direct relationship between connectivity and integration and an inverse relationship between these two and depth. “Blue Yard” shows the lowest connectivity and integration among the samples and, conversely, the highest relative depth. “Ivan Khaneh” shows the lowest depth and the highest integration. Comparison of maximum connectivity values in the justified graphs highlights the importance of open-space placement for functional efficiency. The highest values correspond to the central corridor linking opposite courtyards (Ivan Khaneh), peripheral corridors around the inner yard (Stroller), intermediate bridges and voids (Voids), and the main terrace and courtyards (Yard House), which serve as distributive zones of the house, while deeper nodes represent private areas and their attached terraces. Another determinant of courtyard importance is adjacency (the functional relation of neighboring zones). The peripheral placement of secondary spaces around the three courtyards of “Stroller” reduces the courtyard’s functional role, rendering it primarily visual. Similarly, in “Blue Yard,” shifting the inner courtyard to the western edge adjacent to the outer wall leads to its functional

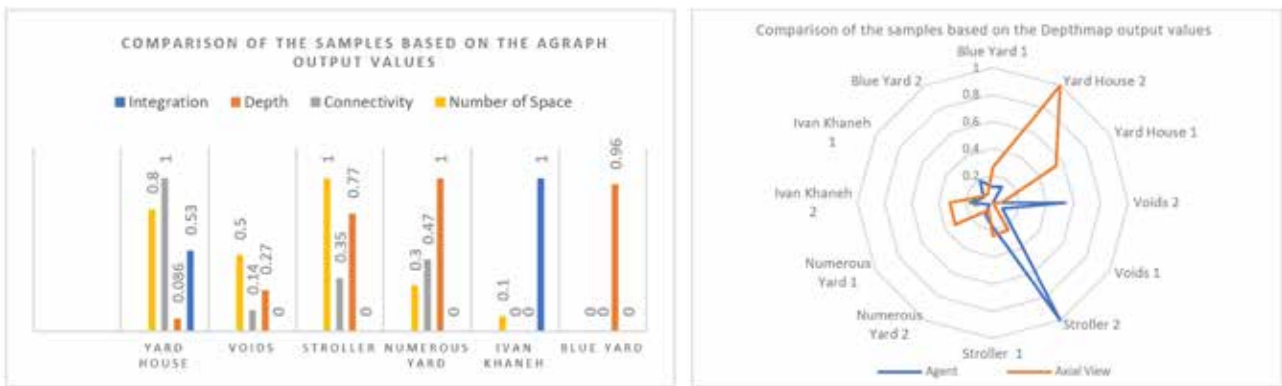


Fig. 2. Comparison of the studied cases based on the syntactic indices from Depthmap and e-Graph software. Source: Auhtor.

isolation and reduced distributional capacity. Consequently, both “Stroller” and “Blue Yard” exhibit the greatest depth and the least integration, order, and spatial coherence among the samples. Fig. 2 compares the syntactic indices corresponding to the theoretical components of livability in the studied villas based on quantitative analysis of output values and presents maximum and minimum indices in bar and radial charts. According to the diagrams, the highest observer movement, and thus the greatest accessibility and lowest enclosure is found in the first floor of “Stroller,” while the highest axial visibility and thus the greatest visual openness is observed in the first floor of “Yard House.”

The comparative study of six selected villas revealed that a balanced composition of mass and space, along with the integration of interior areas and landscape domains, provides maximum accessibility, visibility, and spatial interaction while maintaining privacy and territorial boundaries. Houses with long and regular access routes exhibit higher observer movement, whereas those with dense mass networks and short visual axes show greater limitations in presence and visibility. These findings indicate that each spatial indicator, both individually and in interaction with others, plays a distinct role in enhancing livability, and their proper combination leads to improved residential livability.

Conclusion

The examination of the livability theory, in response to the first research question and its analysis within the spatial structure of the house, highlights the significance of three dimensions (environmental, functional, and physical) in designing a livable home. The integration of the natural and built environments occurs through incorporating nature into design, creating transitions between adjacent natural and artificial spaces, and shaping discoverable landscape complexities, all of which relate to the environmental dimension. The accessibility of spaces, appropriate

spatial distribution, functionality, and the sequencing of movement and pause constitute the functional dimension of residential livability, encompassing spatial enclosure that ensures privacy, territoriality, and security. In the physical dimension, factors such as spatial diversity and attractiveness, the design of landscaped domains and multiple small viewpoints, openness, and spatial fluidity alongside order and coherence contribute to the physical livability of the home. In response to the second research question, quantitative software-based analyses were conducted to determine which modes of housing–landscape integration best realize the environmental, physical, and functional aspects of a livable home. The results showed that multiple long, direct access routes increase the observer movement index, while frequent directional changes in movement paths reduce accessibility. Straight routes, when combined with open and semi-open spaces, generate spatial diversity and natural visual perspectives. Moreover, the arrangement of open and semi-open spaces, their areas, and the presence of elements acting as barriers or facilitators of movement influence whether a space becomes static (a protected territorial domain) or dynamic (an exploratory realm). The axial view graph analysis further revealed that different configurations of housing–landscape integration yield distinct effects on visual and physical accessibility. In other words, the quality of “visual openness and fluidity” (natural and scenic views) and the function of “distributivity” (the landscape as both a collector and distributor of residential functions) each demand distinct spatial and formal compositions. The alignment of these two goals within a single coherent structure leads to the realization of the livable home model.

Declaration of No Conflict of Interest

The authors declare that they have no conflict of interest in conducting this research.

Endnotes

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