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The Common Aspect of Spatial Arrangement in Traditional Houses of Moderate and Humid Climate: A Comparative Analysis of Spatial Organization in Extroverted and Introverted Houses

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Abstract

The traditional architecture of Iran's temperate and humid regions, particularly in the northern areas, embodies an intelligent interplay between humans, nature, and culture. The diversity of spatial patterns in traditional houses of Iran's north—ranging from absolute introversion to purposeful extroversion—demonstrates the remarkable capacity of vernacular architecture to balance privacy and interaction with nature. This study focuses on introverted and extroverted patterns in the houses of this region, seeking to uncover the secrets of their sustainability and adaptability in responding to environmental and social needs. It analyzes these intelligent spatial arrangements, aiming to examine the differences in conceptual and functional approaches between introverted and extroverted designs in adapting to climatic and cultural conditions. While numerous studies have explored Iran's traditional architecture, few have specifically examined the contrast between introverted and extroverted patterns in the humid and temperate regions. This research investigates privacy-related spatial arrangements in conventional houses, analyzing physical patterns that integrate private spaces with open and communal areas. Key indicators such as depth, connectivity, integration, and isovist in buildings will be examined. The study reveals that the placement and dimensions of open spaces significantly influence spatial privacy. In addition, the geometry and position of courtyards relative to the building play an important role in visibility. Courtyards with irregular geometries located in the central, rear or side sections minimize the view from the entrance to different parts of the house. In addition, increasing the depth and connectivity of open spaces in traditional houses increases privacy. The findings show that introverted houses emphasize privacy and protection from humidity. In contrast, extroverted houses use natural ventilation and visual connections to nature and provide intelligent responses to the climate and culture of the region. The integration of these two patterns in contemporary architecture can provide innovative solutions for sustainable housing design. The novelty of this research lies in the systematic comparison of introverted and extroverted architecture in a humid temperate climate.

Keywords: Traditional architecture, Spatial configuration, Introversion, Extroversion, Temperate and humid climate.

1 | Introduction

The temperate and humid regions of northern Iran face unique climatic conditions that have directly influenced the formation of local architecture. Within this context, two main types of traditional houses - introverted and extroverted - have emerged as intelligent solutions for adapting to this climate [1].

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Despite numerous studies on Iran's traditional architecture, few research studies have systematically examined the functional and conceptual differences between these architectural types in temperate and humid climates. The main question is: how have these regions' climatic and cultural characteristics shaped different patterns of introversion and extroversion in the spatial arrangement of houses?

Understanding this issue is particularly important as it can provide a theoretical framework for contemporary designs that respond to climatic needs and preserve residents' cultural and social values. This research aims to fill this knowledge gap.

I. The direct impact of climate on architectural formation

II. Lack of systematic studies on the introversion/extroversion dichotomy

III. Need to develop a framework for contemporary architecture

IV. Importance of integrating indigenous knowledge with modern requirements

The vernacular architecture of Iran's temperate-humid regions, particularly in the northern areas, demonstrates an intelligent coexistence with nature. These regions feature two distinct residential architecture types introverted courtyard houses that create protected private spaces and extroverted houses that establish a close connection with the surrounding environment through outward openness [2].

The core research question addresses how a single climate (temperate-humid) has formed two completely distinct patterns in vernacular architecture. This pattern diversity reveals the complex relationships between climatic, cultural, and social factors in architectural formation. Most existing studies have separately examined introverted or extroverted architecture. In contrast, a comparative study could provide valuable insights: the simultaneous impact of climatic and cultural factors on these patterns has been less explored, and the feasibility of applying these patterns in contemporary architecture requires deeper investigation.

After analyzing representative examples of traditional architecture in temperate-humid climates, this study aims to extract adaptive design principles for contemporary architecture inspired by solutions from these two architectural types. Understanding these patterns reveals the intelligence of vernacular architecture and can also guide contemporary housing design in similar climates that are both environmentally compatible and responsive to cultural needs.

This research is significant because it has the potential to understand better the logic behind architectural space formation in humid climates, provide solutions for contemporary design inspired by vernacular architecture, and create a framework for integrating Indigenous knowledge with new technologies. Focusing on exemplary traditional architecture in Iran's temperate-humid regions, this study seeks to uncover hidden relationships between spatial systems, climatic needs, and cultural requirements. The results can form a basis for future designs that respond to environmental needs while incorporating cultural values.

I. Highlighting the apparent paradox of developing two distinct patterns within a single climate

II. Simultaneous examination of climatic and cultural factors

III. Bridging traditional knowledge with contemporary needs

IV. Proposing a systematic analytical framework

V. Practical application of findings for modern architecture

2|Research Background

While numerous studies have examined traditional Iranian architecture, research explicitly focusing on the spatial organization of houses in temperate-humid climates remains limited.

Rastegar Moghadam Boqrati et al. [3] explored the concepts of introversion in Persian architecture, and Memarian [4] analyzed the general principles of vernacular architecture across different regions of Iran. Although valuable, these studies paid less attention to the climatic particularities of northern Iran.

Falahat [5] investigated the impact of climate on Gilan's architecture, while Roshanfekr Jourshari and Sadat Saeideh Zarabadi [6] analyzed natural ventilation in traditional Rasht houses. These works primarily focused on physical aspects rather than spatial organization.

In one of the conducted studies, the influential and philosophical factors shaping introverted architecture in the temperate and humid region of northern Iran were identified. The historical city of Esterabad (Gorgan) is one of the most prominent surviving examples from the past that still sustains a vibrant life. Unlike many other historical cities in this climate zone, Esterabad has preserved its coherence and integrity, and it still hosts significant architectural works from the Safavid, Qajar, and Pahlavi periods. Given its relevant architectural features, the tangible examples in this city were examined in the study. The findings, rooted in a philosophical perspective on the factors influencing introverted architecture, provide deeper insight into the essence of Iranian-Islamic architecture and can offer a conceptual link for today's and future architects [1].

In another study, the effects of microclimate on behavioral patterns and the exploration of strategies to moderate harsh climatic conditions in vernacular architecture and urbanism were investigated. This research involved a comparative analysis of users' behavioral patterns in two different climates: the hot and arid climate of Yazd and the temperate and humid climate of Fuman. The results indicate that climatic characteristics significantly affect both the types of urban activities and their temporal cycles. In harsh climatic conditions, urban behaviors are limited to essential activities, and spaces are used merely as passages. Such conditions restrict the occurrence of a wide range of optional and social activities. In the historical morphological-spatial patterns of Iran, several spatial-physical strategies were employed to mitigate these conditions, including building density, enclosure, land coverage, building setbacks on ground and upper floors, material types, and the level of greenery in spaces [7].

The historical Fazeli building complex is notable for its decorative brickwork in the courtyard's interior facade, doors and windows, and other architectural features, offering considerable historical, artistic, and cultural value. The decorations include patterned brickwork (ghovare-bori) across all courtyard walls and traditional motifs crafted with bricks on the Qajar-era building facade. In the traditional architecture of the Fazeli mansion, all elements and components were designed with consideration of environmental conditions, each playing a vital role in creating a favorable living environment. Moreover, the construction of the traditional buildings in the Fazeli mansion in Sari took into account climatic elements such as air temperature, wind direction, sun elevation, sunlight orientation, and more [8].

This literature review indicates that despite valuable existing research, a deeper examination of the relationship between spatial organization and multiple influencing factors in temperate-humid climates remains needed. The current study aims to fill this gap and achieve a more comprehensive understanding of the subject.

3 | Research Concepts and Variables

3.1 | Traditional Iranian Architecture

As one of the world's richest architectural schools, Iranian traditional architecture reflects the profound interaction between human needs, climatic conditions, and cultural values [7]. Rooted in thousands of years of living experience, it has evolved in each region of Iran according to its specific characteristics, with design principles such as smart climate adaptation in hot and dry areas use of central courtyards, windcatchers, and resistant arches, in humid northern regions extroverted buildings with extensive ventilation and sloping roofs ،In mountainous areas thick walls and small windows to retain heat.

Spatial hierarchy intelligent division of spaces into public, semi-private, and private areas, designed around family privacy and Islamic values.

Architectural elements: spacious ivans (verandas) as transitional spaces between indoor and outdoor ، Central pools for air temperature moderation ، ,Domes and muqarnas (stalactite vaulting) with structural and aesthetic functions.

Local materials: smart use of clay, brick, wood, and straw mud (kahal) .Advanced techniques include natural ice pits (yakhchals) and water reservoirs .This architecture demonstrates how environmental challenges were transformed into sustainable design solutions while preserving cultural identity [8].

3.1.1 | Key features of traditional iranian architecture

Spatial flexibility: Ability to change space functions according to needs.

Environmental sustainability: Minimal energy consumption and complete harmony with nature.

Sacred geometry: Use of golden ratios and symbolic concepts.

Integration of art and function: Brickwork and plasterwork serve both aesthetic and climatic functions.

3.1.2 | Traditional Architecture in the Contemporary Era

Today, leading global architects view traditional Iranian architecture as a source of inspiration for sustainable design [9]. Key principles include: Natural ventilation in contemporary designs, use of local materials in modern construction and reinterpretation of traditional spatial concepts in today's projects. Current challenges: Risk of losing traditional technical knowledge, need for documentation of indigenous design principles, necessity of integrating traditional knowledge with new technologies .Iranian traditional architecture represents a valuable cultural heritage and a treasure trove of intelligent solutions for contemporary architecture that can address many of today's environmental challenges.

3.2 | Spatial Configuration

Iran's traditional architecture in temperate-humid areas (such as Gorgan, Rasht, Bandar Anzali, and Mazandaran) responds not only to climatic needs for thermal comfort and natural ventilation but also to social, cultural, and economic factors, resulting in distinct spatial configurations [10]. Some analyzed buildings feature extroverted designs, while others follow introverted layouts .Key features include Central courtyards with surrounding spaces .Strategic window placement (fewer on ground floors for privacy, more on upper levels) .Elite homes are often divided into Biruni (outer/public section) and Andaruni (inner/private section) .Seasonal zones (summer quarters and winter quarters) .This architectural diversity reflects adaptations to:

I. Climate (humidity, airflow, seasonal changes).
II. Culture (privacy norms, family structure).
III. Socioeconomic factors (elite vs. commoner housing).

3.3 | Extroversion

Buildings that receive light, ventilation, and access to interior spaces through open peripheral areas around them, with windows, doors, and openings facing outward in all directions. The exterior section had more decorations compared to the interior. Kushks (Pavilions) were extroverted structures, often surrounded by Western or Eastern-style houses. Even if built within a large central courtyard, they remained extroverted. Extroverted houses are also found in other regions of Iran, such as Kurdistan, Lorestan, and northern Iran. As mentioned, the best climatic method for regulating environmental conditions in humid areas is utilizing wind flow and ventilation. Therefore, unlike the introverted structures of arid regions—which partially embed buildings underground and enclose them on all four sides—buildings in these areas are constructed as tall and open as possible on two or four sides to ensure comfort. Among these, several houses from western Gilan with relatively similar spatial configurations were selected for analysis:

Mohtasham talaab house :located in the cultural-architectural zone of western Gilan's plains, Covers areas within the Sefidroud River basin, including parts of Sowme'eh Sara Fuman, Shaf, Masal, Rezvanshahr, Talesh, Astara [11].

Moradi house: belongs to the central plains of Gilan; due to high humidity and the need for airflow, buildings in Gilan's plains feature transparent façades; these transparent enclosures, surrounding the central core, often allow circulation around the building or at least along two sides. Generally, plans in plain areas are wide and open, with elongated, narrow forms. They are located in the village of Nasharud Kol in the plains of Rasht [12].

Musazadeh house: part of western Gilan's architecture. Includes Sowme'eh Sara, Fuma, Shaft, Masal, Rezvanshahr, Talesh, and Astara areas [13].

Mousavi House: Also part of western Gilan's architecturCovers regions in Sowme'eh Sara, Fuman, Shaft.

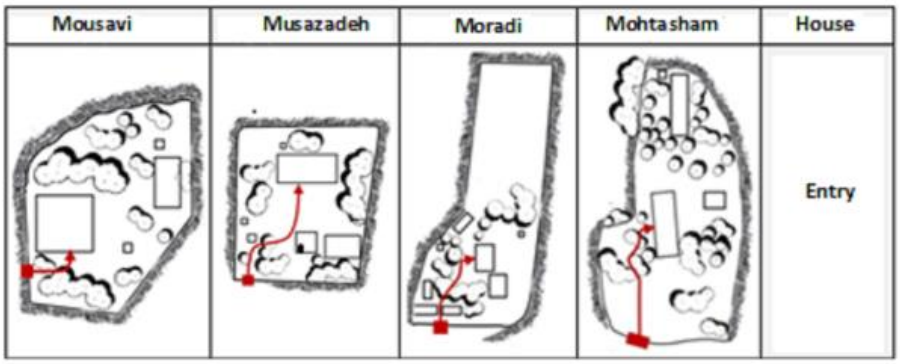


Fig.1. Input features and access hierarchy in extroverted design.

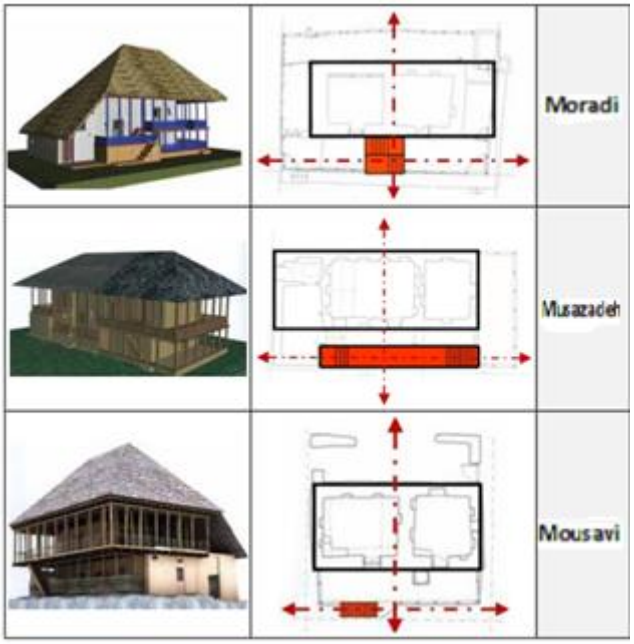


Fig. 2. Staircase arrangement in extroverted buildings.

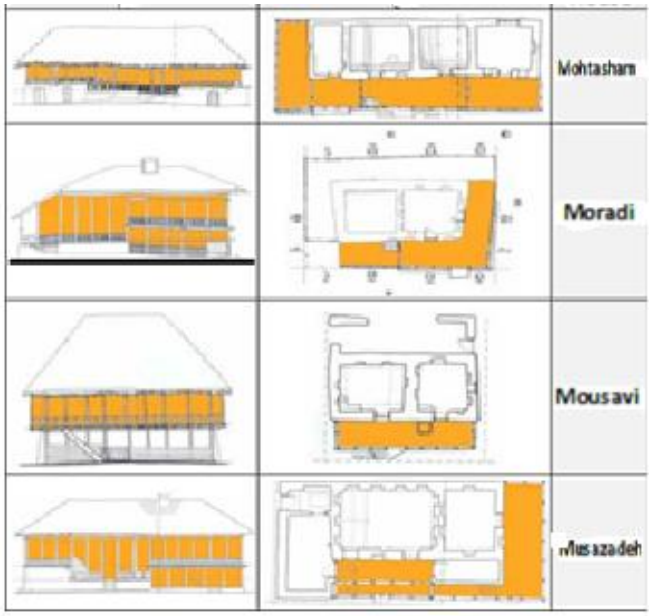
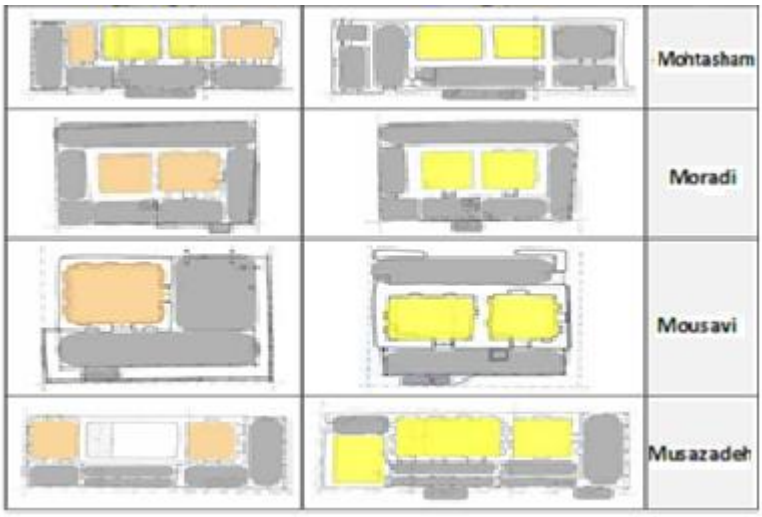


Fig. 3. Veranda design in extroverted architecture.



Fi HDK LRHGI SI RSg. 4. Spatial organization in the inner perspective (right side of ground floor plan and right side of first floor plan) - extroverted design.

3.4 | Introversion

In forming and organizing buildings - particularly traditional houses - people's beliefs have played a fundamental role. Among these beliefs was the value placed on personal life and its sanctity, along with Iranian self-dignity, which collectively contributed to the introverted nature of Persian architecture. Introversion seeks to maintain environmental boundaries where physical structures, supported by contemplation, meditation, and worship, facilitate reaching one's essence and achieving genuine inner peace and serenity, ultimately creating a harmonious and sublime order [14].

This emphasis on inward-oriented principles stems from cultural foundations, lifestyle patterns, traditions, and worldviews, which attain their ultimate meaning through interaction with environmental factors, geographical conditions, and philosophical perspectives. (Soltanzadeh, H., 2015, The Role of Climate in Shaping Courtyard Typologies in Traditional Houses of Arid Regions, Second National Conference on Sustainable Architecture and Urban Landscape).

In traditional Iranian residential architecture, interior spaces are concealed from exterior views, and the entrances of many houses are designed so that even when doors remain open, neither the courtyard nor interior spaces become visible, ensuring complete privacy for inhabitants.

This research examines selected surviving traditional buildings in Mazandaran Province, analyzing their approaches to privacy boundaries, public domains, and spatial connectivity. In Sari city, the Kolbadi, Remdani, and Fazeli houses; in Babol, the Aghajan Nasab, Najafi, and Babapour houses; and in Amol, the Shafahi, Moghimi, and Darzi houses were selected. For each case study, spatial components will be analyzed, including depth, connectivity, adjacency, and isovist (visibility scope from the courtyard entrance). The spatial relationships will be examined to achieve the research objective of understanding traditional buildings' spatial configuration and organization to inform contemporary architectural practices.

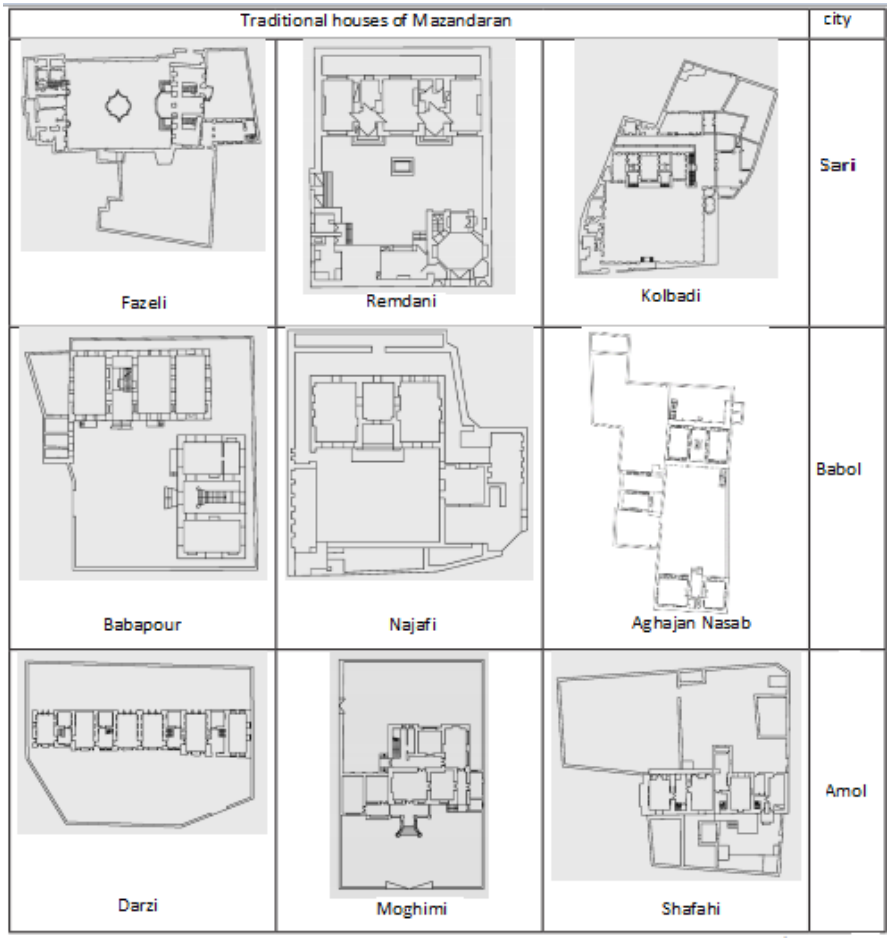


Fig. 5. Floor plan of the studied houses.

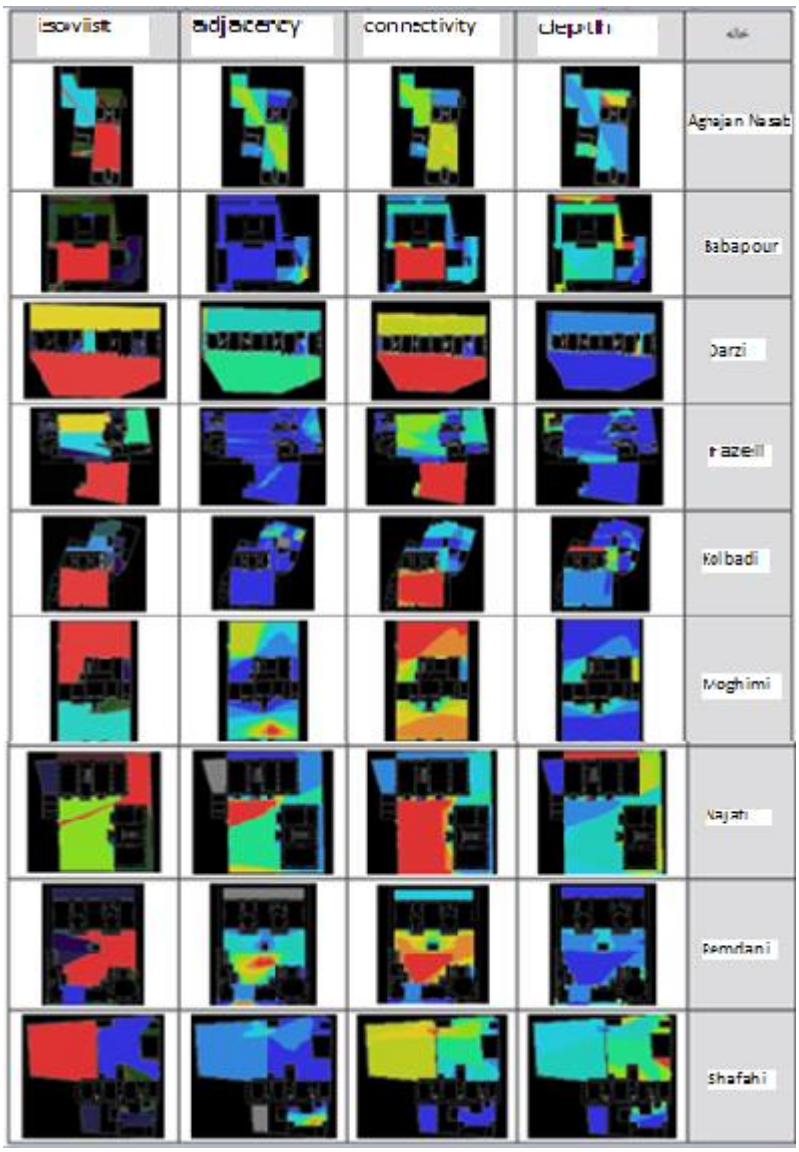


Fig. 6. Analysis of spatial arrangement and positioning of buildings in Mazandaran province.

4 | Findings

This study's findings are examined in four sections: adjacency, depth, connectivity, and spatial isovist.

4.1 | Adjacency

According to the analyses from *Fig. 6*, the Kalbadi house demonstrates the highest degree of adjacency among the studied houses with maximum adjacency values. This indicates superior functional performance related to the adjacency index in the open spaces of this house. Visually, this results from the optimal positioning of the courtyard (open space) relative to the entrance and its appropriate relationship with the overall spatial structure of the complex.

In contrast, the Aghajan Nasab house shows the lowest adjacency value among the studied houses in terms of open spaces. This is attributed to the placement of multiple courtyards in the rear façade of the building, which remain inaccessible and create a sense of privacy for each dwelling unit's residents.

4.2 | Depth

Depth refers to the number of steps an individual must traverse to reach a space [15]. In spatial analysis, as depth increases, so does the degree of privacy within that space.

According to *Fig. 6*, blue and green hues indicate the shallowest depth, while red and orange signify the most incredible depth. The extracted data reveal that the Darzi house exhibits the highest spatial depth, demonstrating that its open space is strategically positioned to maximize privacy compared to other areas of the house. This configuration significantly limits visibility and external observation, primarily due to the building's central placement within the courtyard, which divides the space into two distinct zones and enhances privacy.

The remaining houses follow this order of progressively lesser spatial depth: Fazeli, Babapour, Remdani, Najafi, Aghajan Nasab, Kalbadi, Shafahi, and Moghimi.

4.3 | Connectivity

Connectivity refers to the number of spaces directly linked to a given space [16]. Spatial connectivity enhances spatial cognition and facilitates circulation. A higher degree of connectivity between spaces typically indicates greater privacy.

Based on the data from *Fig. 6*, the Najafi house exhibits the highest level of spatial connectivity among the studied houses, reflecting superior functional efficiency, excellent usability of its open spaces, and enhanced legibility. This suggests that, in terms of connectivity and privacy, the open areas of this house demonstrate more pronounced private characteristics than other case studies.

The remaining houses follow this descending order of spatial connectivity: Shafahi, Babapour, Darzi, Moghimi, Kalbadi, Aghajan Nasab, Fazeli, and Remdani. Notably, the Remdani house shows significantly lower connectivity than others, primarily due to its irregular courtyard geometry and suboptimal building placement within the open space. This configuration substantially compromises privacy preservation in the dwelling.

4.4 | Spatial Isovist

The spatial isovist is determined by establishing observation points to analyze a visitor's field of view, measuring the degree of visual control over different building areas from courtyard vantage points [17].

Typically, one point is set at the entrance and another along a wall, though additional points may be added depending on corridor configurations. *Fig. 6* evaluates the spatial isovist for each case-study house.

The studied houses feature separate entrances:

I. A front entrance (for guests/strangers) is connected to the main courtyard via a hash (vestibule) or winding corridors.

II. A rear entrance (for livestock, supplies, and servants).

III. Notably, the Aghajan Nasab, Babapour, and Najafi houses (owned by elite families) exhibit:

IV. Lower enclosure compared to aristocratic houses in Sari.

V. Expansive courtyards that enhance spatial privacy despite lower connectivity—their size inherently limits sightlines from entry points.

In Mazandarani traditional houses:

I. Open corridors link front and rear courtyards.

II. Houses like Shafahi, Moghimi, and Darzi integrated adjacent orchards as courtyard extensions.

III. A centrally placed building mediates between courtyards, requiring passage through the structure to access the rear courtyard—a distinctive feature that maximizes privacy.

5 | Conclusion

In conclusion, introverted houses, with their emphasis on privacy and protection against humidity, and extroverted houses, with their utilization of natural ventilation and visual connection to nature, offer intelligent responses to the region's climate and culture [18]. Integrating these two patterns in contemporary architecture could pave the way for innovative solutions in sustainable housing design. The novelty of this paper lies in its systematic comparison of these two architectural typologies in a temperate and humid climate, providing a theoretical framework to explain the mutual influence of climate and culture on spatial organization. As demonstrated in the analysis of Gilan province case studies, factors such as building placement, entry hierarchy, access points, stair arrangement, and terrace positioning play crucial roles in ensuring residents' comfort and security. Regarding traditional Mazandaran houses, we conclude that while implementing these elements varied according to the users' social status and occupation, all cases consistently featured private courtyards - whether rear or small central courtyards nestled between low-rise structures. Observations indicate that in this climate, buildings typically employed separate outer and inner courtyards instead of central courtyards, with the main structure positioned at the center of the plot. Key findings demonstrate that courtyards fundamentally influence a house's privacy levels, where open spaces can significantly enhance private domains. From a visual perspective, courtyards with irregular geometries and central, rear, or side placements (as seen in the Darzi, Fazeli, and Babapour houses with greater spatial depth) minimize visibility from entry points, thereby maximizing privacy. Conversely, with their regular geometries and optimized layouts, the Moghimi, Shafahi, and Kolbadi houses permit greater interior visibility from entrances, resulting in reduced privacy and spatial depth. The Najafi and Shafahi houses showed the highest connectivity among the Mazandaran cases studied. Finally, *Fig. 7* summarizes the spatial structure and connectivity patterns of each analyzed house in Mazandaran.

Spatial diversity	Spatial connectivity	Building orientation	Number of axes	
		Dispersed	4	Aghajan Nasab
		Terminus	2	Babapour
		Center	2	Darzi
		Dispersed	2	Fazeli
		Dispersed	5	Kolbadi
		Center	2	Moghimi
		Dispersed	4	Najafi
		Dispersed	3	Remdani
		Terminal third	6	Shafahi

Fig. 7. Spatial structure and connectivity of buildings in Mazandaran province.

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Author Contributions

Naeem Hashemi Sajjadi is the sole author of this article and was responsible for the conceptualization, methodology, data collection, analysis, and manuscript writing.

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Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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