



REVIEW ARTICLE

Comparative Study of the Middle Eastern Vernacular Courtyard Houses Based on the Biophilic Design Patterns

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ABSTRACT

The biophilia hypothesis posits that a connection to nature is an innate human desire. By creating architecture that is an extension of nature, this desire will be satisfied, and consequently, it will positively affect mental and physical health. Along with identifying pertinent biophilic design strategies, this paper aims to conduct a comparative study of the Middle Eastern vernacular courtyard houses based on biophilic design patterns, in addition to comprehending the significance of sociocultural elements and the physical environment in the presence of the patterns of biophilic design in domestic architecture. The qualitative-comparative analysis method is adopted. Three case studies of three different types of vernacular courtyard houses from three different cities—Baghdad, Damascus, and Mardin—are chosen. The architectural features of the traditional houses in the chosen cities are surveyed using data from reported studies. The study revealed that the Middle Eastern Vernacular Courtyard Houses are biophilic structures that use a variety of strategies to be in close proximity to nature to nature, which had an impact on determining the final form of each dwelling. Biophilic strategies vary according to the particulars of different cities' local contexts. The study also shows the role of climate, geographical location, and sociocultural factors in the presence of biophilic design patterns and in identifying relevant strategies.

Keywords: Biophilia hypothesis, well-being, biophilic design patterns, Middle East, courtyard house

INTRODUCTION

Recent studies underline the importance of human–nature connectivity in the built environment and regard it as crucial for designing lasting and comfortable structures. In addition to its influence on the degradation of natural systems, the prevailing approach to creating the modern urban environment has resulted in the isolation of man from the natural world.^[1] Thus, the building will shift from the idea of being green to being good for people, and one of its goals is to create environments that support the well-being of the occupants.^[2] The biophilia hypothesis, on which the biophilic design approach is based, posits that a connection to nature is an innate human desire.^[3] By creating architecture that is an extension of nature, this desire will be satisfied, and consequently, it will positively affect mental and physical health.^[4,5]

The courtyard house is one of the oldest architectural forms and the most common house design in Middle Eastern cities, many studies have been reported on this topic, but studying it from a biophilic design perspective is limited, and important since it expands knowledge in this new field of science.

This article aims to conduct a comparative study of the vernacular Middle Eastern courtyard houses based on the biophilic design patterns that have been recognized for their positive impact on human well-being that may explain the permanence of this form typology for centuries. Moreover, the study is an attempt to understand the role of sociocultural

factors and the physical environment in the presence of biophilic design patterns in domestic architecture and in identifying relevant strategies.

The qualitative comparative analysis method is adopted. Three typical vernacular courtyard houses from three Middle Eastern cities that are different in terms of location, climate, and topography, namely the Baghdad house, Damascus house, and Mardin houses, are chosen to accomplish the objectives of the study.

LITERATURE REVIEW

Biophilic Design Patterns

The design field has begun to consolidate the biophilic building models concerning indoor natural quality and human

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connection with the place.^[6,7] The biophilic design builds on the biophilia hypothesis, defined as the innate tendency to focus on life and life-like processes. Incorporating nature within the built environment directly, indirectly, or symbolically has many psychological and physiological benefits as a result of satisfying the innate human–nature tendency to affiliate with nature and other life forms. These benefits require repeated and sustained engagement rather than occasional, exceptional, or ephemeral experiences.

To put theory into practice, Terrapin Bright Green has introduced a set of Biophilic Design patterns [Table 1] that link architecture to human biology and nature. It has been proven that the presence of these patterns in the built environment promotes the health and well-being of its occupants.

As long as no two loci are the same; this signifies that the peculiarity of the biophilic design stems from the locality. The

Table 1: The biophilic design patterns^[6]

The pattern	Description
Visual connection with nature	A look into the natural world’s components, living things, and processes.
Non-visual connection with nature	Stimuli are auditory, haptic, olfactory, or gustatory that cause an intentional, positive reference to nature, living things, or natural processes.
Non-rhythmic sensory stimuli	Connections to nature that are stochastic and transient and that can be statistically evaluated but may not be exactly anticipated.
Thermal and airflow variability	Mild variations in surface temperatures, airflow across the skin, relative humidity, and temperature that resemble natural conditions.
Presence of water	A circumstance that promotes the experience of nature through seeing, hearing, or touching the water.
Dynamic and diffuse light	Uses changeable light and shadow intensities that fluctuate over time to imitate natural circumstances.
Connection with natural systems	The consciousness of natural processes, particularly the seasonal and temporal fluctuations that characterize a thriving ecosystem.
Biomorphic forms and patterns	Figurative allusions to naturally occurring curved, patterned, textured, or numerical arrangements.
Material connection with nature	Minimally processed natural materials and components that represent the local ecology geology and contribute to a strong sense of place.
Complexity and order	Detailed sensory information follows a spatial hierarchy like those seen in nature.
Prospect	Unconstrained view in the distance for planning and surveillance.
Refuge	A haven where an individual can isolate themselves from their surroundings or the main flow of activity while still being protected from above and behind.
Mystery	Partially obstructed views promise more information that tempts one to travel into the depths of the environment.
Risk/Peril	A recognized threat and a trustworthy defense.

variety of local ecology that results from various climates and geographic allows applying biophilic design patterns across all climates and settings but may have diverse resulting forms, esthetics, and materials unique to their respective regions. Studying the vernacular architecture of each region may provide the needed knowledge on how local people respond to biophilia through their built environments.^[6,8]

Vernacular Courtyard Houses of the Middle East

In the Middle East, a courtyard house is a house style that is built around an open area defined by the internal building facades and allows the family to be isolated from the street to ensure their privacy, which is considered the main factor that shaped this type of houses along with the physical environment that determines the final form of the dwelling.^[9] In addition, to serving as a hub for daily activities, the courtyard provides natural ventilation and lighting at various levels, ranging from moderate lighting in the courtyard to less lighting in the semiopen spaces, and then indirect lighting that reaches the interior spaces. Not to mention the role of the patio in protecting the occupants from the sun in the morning and afternoon.

The courtyard house of Baghdad

Baghdad is considered one of the hottest cities in the world and is built on a flat, broad desert plain. The vernacular houses of this compact city [Figure 1] resulted from the interaction of socio-cultural conditions, and climate, as well as the available materials that played a significant role in defining the features and attributes of the houses along with the craft tradition and experience. The house is a two-story building with a central courtyard containing a water basin, fountain, or both.

Privacy concerns in Baghdadi society led to the adoption of an oriel window covered with timber latticework screen, known locally as Shanasheel. This architectural element allowed women to initiate eye contact with the outside world while protecting them from others’ gaze. In addition to the social advantages, the lattice screens helped the people, along with other elements, to adapt to the extreme heat of the city. Inside the house [Figure 2], a mezzanine seating area is protected by a screen that emphasizes the idea of women being segregated from strangers. Wind scoops were integrated with the mass of the building for ventilation, while recessed spaces, covered walkways, and earth-sheltered spaces are measures used to protect residents from the hot



Figure 1: The compact urban fabric of Baghdad city^[10]

Table 2: Strategies provide a visual connection with nature

Pattern	Factors	Strategies	Case study		
			Baghdad house	Damascus house	Mardin house
Visual connection with nature	View to a constructed nature	Outdoor Water Fountain	•	•	•
		Indoor Water Fountain		•	
		Water pond			•
		Constructed waterfall		•	
		Garden	•	•	•
		Green wall		•	
		Flowering pots		•	
	Fireplace		•		
	View to naturally occurring nature	Courtyard provides visual contact with the ambient conditions.	•	•	•
		Terrace provides a visual contact with the ambient conditions.			•

Table 3: Strategies enable non-visual contact with nature

Pattern	Factors	Strategies	Case study		
			Baghdad house	Damascus house	Mardin house
Non-Visual connection with nature	Audible Water	Outdoor water fountain	•	•	•
		Indoor water fountain		•	
		Outdoor waterfalls		•	
		Water basin	•		•
Nature sounds	Nature sounds	Courtyard (auditory contact with the ambient)	•	•	•
		Terrace (auditory contact with the ambient)			•
		Fireplace (crackling sounds of the fire)			•
Nature scent	Nature scent	Lushly planted courtyard		•	
Natural material textures	Natural material textures	Masonry flooring	•	•	•

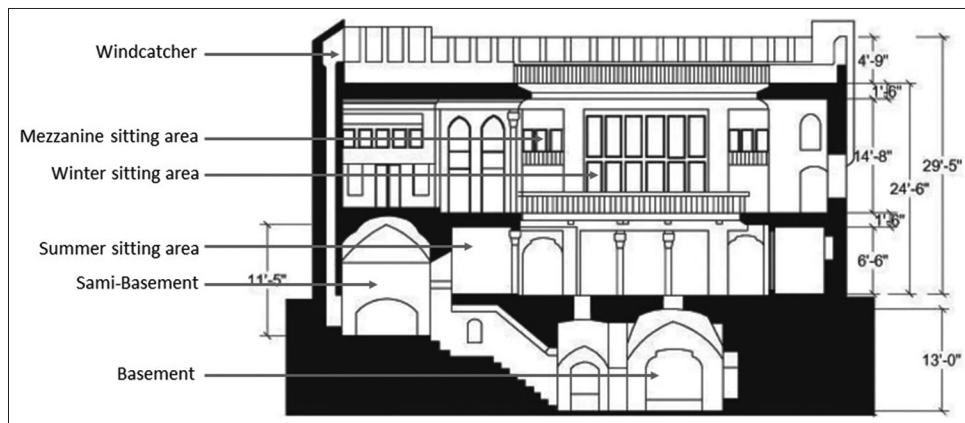


Figure 2: Section passes through the traditional Baghdadi house adapted from^[12]

summer sun. In winter, a south-facing glass-fronted sitting room is used to take advantage of the sun's heat. Mud Brick was frequently utilized for the structural features, such as the domes and vaulted ceilings, as well as for paving the

courtyard's floor along with wood which was also used for sheathing and to make the ubiquitous lattice screens in this house. In contrast to the street frontage, the bricks being entirely exposed and unpainted, the interior walls of the

Table 4: Strategies provide thermal and airflow variability to the residential environment

Pattern	Factors	Strategies	Case study		
			Baghdad house	Damascus house	Mardin house
Thermal and airflow variability	Natural Ventilation	The courtyard serves as a vertical ventilation system for all levels	•	•	•
		Bilateral openings oriented both toward the alleyway and the courtyard, enabling cross ventilation.	•		•
		Air scoops: Air ducts used to capture the breeze	•		
		Multi-level openings support natural ventilation through the stack effect.		•	•
	Shade and Shadow	The courtyard provides self-shading	•	•	•
		A recessed space, open to the courtyard and oriented to the north provides a shaded sitting area in summer	•	•	•
		Portico provides a shaded passage	•	•	•
		Plants provide shading	•	•	
	Solar Heat Gain	Lattice screens for shading	•	•	
		South-oriented rooms were used in winter.	•	•	•
	A recessed space, open to the courtyard and oriented to the south provides a warm sitting area in winter.		•		

Table 5: Strategies that bring dynamic and diffuse light to the residential environment

Pattern	Factors	Strategies	Case study		
			Baghdad house	Damascus house	Mardin house
Dynamic and diffuse light	Ambient diffuse lighting daylight from multiple angles	The lattice screen allows light to enter the spaces and also diffuses it.	•	•	
		Overhead windows capture the ambient defused sunlight.		•	•
		Colored glass offers diffused lighting.	•		
	Ambient diffuse lighting daylight from multiple angles	The use of a multidirectional window (Bay window) helps draw daylight.	•	•	
Firelight	Fireplace brings flickering light.		•		

Table 6: Strategies to engage biomorphic forms and patterns in the residential environment

Pattern	Factors	Strategies	Case study		
			Baghdad house	Damascus house	Mardin house
Biomorphic forms and patterns	Nature forms botanical motifs	Arches, vaults, and domes were employed for both functional and esthetic purposes.	•	•	•
		Botanical Motifs		•	•
	Floral stone craving	Floral brick craving	•		
		Floral wood craving	•	•	

rooms were plastered while woodwork and brickwork were used to sheath the courtyard facades.^[11]

The courtyard house of damascus

Syria’s capital, Damascus, is situated on a plain with a typical Mediterranean climate. Along with the seven branches of

the Barada River that flow through Damascus’s lands and contribute to its fertile soil, the city is encircled by mountains on its west and north sides and verdant plains on its east and south, which moderates its climate.

Adhering to Islamic teachings, the use of an introverted house with solid external walls was the best solution to achieve

Table 7: Strategies bring materials connection with Nature

Pattern	Factors	Strategies	Case study		
			Baghdad house	Damascus house	Mardin house
Material connection with nature	Minimally processed construction materials	Mud bricks (walls, roofing, flooring)	•		
		Timber (columns, sheathing, screens)	•	•	
		Natural stones (walls, roofing, balustrades, flooring, sheathing)		•	•

Table 8: Strategies bring complexity and order to the residential environment

Pattern	Factors	Strategies	Case study		
			Baghdad house	Damascus house	Mardin house
Complexity and order	Fractal geometry	A three-dimensional decorative feature (Muqarnas)	•	•	

Table 9: Strategies for applying the refuge concept in the residential environment

Pattern	Factors	Strategies	Case study			
			Baghdad house	Damascus house	Mardin house	
Refuge	Space with weather/ climate protection	Partial refuge	A recessed space used as a shelter from the summer sun.	•	•	•
			Covered walkways protect from climate conditions.	•	•	•
	Space with social protection	Extensive refuge	Earth-sheltered space used to take advantage of the constant temperature of the earth	•	•	•
			South-facing glass-fronted sitting room (Sunroom) used to take advantage of the sun's heat.	•		
			Bay window protected by a screen, provides a private sitting area	•		
		The Mezzanine sitting area protected by a screen provides a private sitting area	•			

Table 10: Strategies provide mystery to the residential environment

Pattern	Factors	Strategies	Case study		
			Baghdad house	Damascus house	Mardin house
Mystery	Winding paths	Winding doorway: The transition from the narrow alley to the open courtyard was made by a winding doorway to create seclusion.	•	•	



Figure 3: Damascene house from the outside versus the house's internal environment^[13]

segregation for women from strangers, while ensuring an attractive and lush internal garden planted with fruit trees and fragrant plants. The simplicity of the house from the outside did not prevent the wealthy families from showing their social

status through the quality of the interior finishing materials [Figure 3] and the decorations that adorned the walls, ceilings, and floors, in addition to the use of ornate furniture.

The hot summer in this city necessitated protection from the sun through building elements such as the Iwan while shading screens are infrequently used in these houses. South-facing winter rooms and climbing plants supported by trellises are other methods used in this regard. On the other hand, the high ceilings of the spaces with three rows of openings allowed the light to penetrate while ensuring natural ventilation for the spaces. Regarding the building materials, the ground floor is built of thick natural stone that serves as the basis for the brick walls of the first floor, which is characterized by its multiple openings and its white plastered surface.^[13]

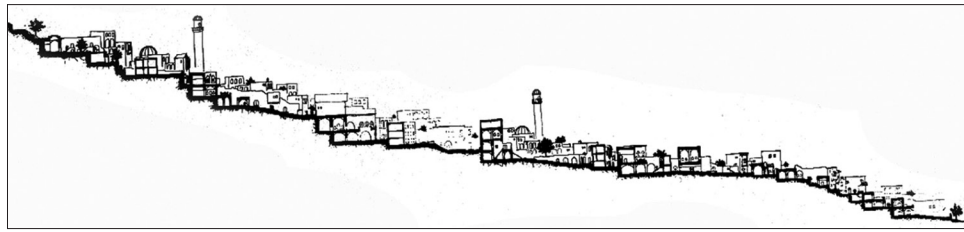


Figure 4: Section passes through the Mardin settlement^[14]



Figure 5: Mardin houses offer unlimited views of the southern plain^[17]

The courtyard house of Mardin

Mardin is a province in Turkey's south-eastern region. The city is nestled on the slope of Mazî mountain overlooking the Mesopotamian plain and is characterized by a hot-summer Mediterranean climate. Due to the calcareous nature of the soil, rainwater drains to the flat lands at the bottom of the mountain. However, water is present in these houses, either in the form of a fountain in the middle of the courtyard or a small water basin in the center of the Iwan that is used as a summer guest area that is open to the courtyard while the vegetation is sparse.

The design of Mardin dwellings was influenced by social, climatic, and geographical considerations. Privacy concerns were evident in the introverted form and modest windows on the street-facing facade, while the topography of the area was mirrored in the tiered mass that provides a view of the southern plain [Figure 4].

Building the residences on the southern side of the hill opened up most of the spaces to the south, including the portico or Revak as it is called in Turkish, which serves as a family space used for daily activities in addition to being a passage to the interior spaces. Limestone, which is abundant in the region, is the principal material used in the construction of Mardin dwellings. Its application varied depending on how it was cut. Rubble stones are used to build structural features including vaults and domes. The inner walls and courtyard facades were coated with rectangular-cut stones. The rest of the house's walls are made of rough-cut stone. The extensive use of stone in construction and finishing did not prevent residents from expressing interest in the esthetic characteristics of their architecture. Dark yellow limestone was used to ornament the facade and around the openings, being softer.^[15]

CASE STUDIES ANALYSIS

Visual Connection with Nature

This section addresses possible strategies that provide a "Visual connection with nature" inside the courtyard houses

of the Middle East region [Table 2]. Elements of nature may be naturally occurring, such as water, earth, and living species, or through human intervention, such as elaborately designed landscaping and fountains. The "Presence of water" pattern overlaps with this pattern as it provides an opportunity to contact an element of nature visually.

Non-Visual Connection with Nature

This part of the study looks at strategies for establishing non-visual connections with nature [Table 3]. Some elements of this pattern overlap with elements of the "Non-rhythmic Sensory Stimuli" pattern, such as the unexpected sound of nature supplied by the courtyard surroundings. The "presence of water" methods can be found here since they create an auditory connection with nature.

Thermal and Airflow Variability

This pattern is associated with the idea that a space with moderate levels of sensory contrast such as contrast in light, sound, and temperature has a positive effect on comfort. This section explores strategies that can be used to achieve the pattern factors [Table 4].

Dynamic and Diffuse Light

This section examines the strategies for achieving lighting variations and variances in the lighted surfaces that arouse feelings of drama and mystery while maintaining a sense of serenity [Table 5].

Connection with Natural Systems

The three houses' open spaces provide families with a visual connection to existing natural systems such as climate and weather patterns, seasonal patterns, and night sky.

Biomorphic Forms and Patterns

The word biomorphic is used to describe an architectural design that mimics the appearance of the natural form.^[16]

MATERIALS CONNECTION WITH NATURE

The use of local natural resources gives vernacular homes their distinctive look. The houses were built in the three cities using natural building materials [Table 7].

Complexity and Order

This pattern deals with fractal geometry which is an integral part of nature [Table 8]. Simulating this feature makes the space charming and informative.

Prospect

Unlike the houses of Damascus and Baghdad, where looking at the sky is the only means of visual contact with naturally occurring nature, the Mardin house offers unlimited views of the southern natural landscape [Figure 5].

Refuge

A refuge is a space enclosed by solid walls of minimal floor-to-ceiling dimensions that allows some visual or aural contact with the surroundings and gives a sense of safety and security, a sense of withdrawal from undesirable climatic conditions or main flow of activity that enables the inhabitants to have a protective, contemplative environment.^[1,6,18] This pattern is classified into three types: A modular shelter in which the user gets little protection while the second type is a partial shelter, meaning that the space is surrounded on several sides, and finally the extensive shelter in which the inhabitants come close or hide completely.^[6]

Mystery

Mystery characterizes a place where an individual feels compelled to move forward to see what is around the corner. This pattern is found in both Baghdad and Damascus houses [Table 10].

RESEARCH RESULTS

1. Due to the hot summer of the three cities, the “Thermal and Airflow Variability” pattern is dominant over the other patterns, as the emphasis has been placed on providing solar shading and natural ventilation for their effective role in achieving thermal comfort.
2. The patterns “Visual Connection with Nature,” “Non-Visual Connection with Nature,” “Presence of water,” “Material Connection with Nature,” and “Biomorphic Forms and Patterns” are more evident in the Damascus house, indicating that this house is the most biophilic structure among the case studies. As a result, it has the best residential atmosphere.
3. The extreme summer temperature in Baghdad, as well as the necessity for shade from direct sunshine, accentuated the “Dynamic diffused light” and “Refuge” motifs in this home.
4. The Baghdadi and Damascene houses provide a visually nourishing residential environment due to the “complexity and order” that appears on the interior surfaces.
5. The “Mystery” pattern was featured in the Baghdadi and Damascene houses through a winding doorway, which piques one’s interest in what is happening behind corners.
6. The “Prospect” pattern was found only in the Mardin house because the city’s topography provides an unlimited view of the southern plain.
7. Religious beliefs influenced the type of Biomorphic forms and patterns employed in the houses. The abstract floral patterns were used while direct depictions of people were avoided because it is forbidden in Islam.

CONCLUSION

The traditional courtyard houses of Middle Eastern cities are biophilic structures of varying levels that employ a range of strategies to satisfy residents’ intrinsic need to interact with nature, which explains why residents have stuck with this style of house for centuries. Residents of the three cities (Baghdad, Damascus, and Mardin) were able to create a suitable living environment that met both the social and climatic

requirements. People were able to reconnect themselves with nature through various strategies despite the solitude that the introverted form may bring. In addition to serving as a living lung and a source of natural lighting, the courtyard allows families to experience nature both visually and non-visually, and often at unpredictable periods. In other words, the courtyard contributes to the well-being of the occupants.

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