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INVESTIGATING THE APPLICATION OF BIOPHILIC DESIGN PRINCIPLES IN THE TRADITIONAL POL HOUSES OF AHMEDABAD WITH A CASE STUDY ON MANGALDAS NI HAVELI

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ABSTRACT

" This paper examines the application of biophilic design principles within the traditional "Pol" houses of Ahmedabad, with a focused case study on Mangaldas ni Haveli. Biophilia, a term popularized by Edward O. Wilson in 1984, suggests that humans have an inherent desire to connect with nature, a concept now essential in sustainable design. While biophilic design often incorporates elements like plants, water, natural light, and ventilation to create a stronger human-nature connection, traditional architecture in India, particularly in Pol houses, naturally integrates similar principles. Ahmedabad's designation as a UNESCO World Heritage City in 2017 emphasizes its rich architectural and cultural heritage, with Pol houses serving as enduring symbols of community, sustainability, and environmental adaptation.

Mangaldas ni Haveli, a significant example of this architectural legacy, was evaluated for its biophilic elements using the 15 biophilic design patterns by Stephen Kellert and Elizabeth Calabrese. The study identifies 12 patterns, including natural materials, indirect experiences of nature, and spatial configurations that evoke a connection to the environment. Despite being situated in a dense urban context, Mangaldas ni Haveli effectively promotes well-being and offers a sustainable model for heritage conservation. This research highlights how integrating biophilic design into heritage conservation can preserve cultural and architectural significance while making these spaces relevant for modern needs. The findings underscore the potential for traditional architecture to inspire sustainable urban design, reinforcing the enduring value of biophilic principles in enhancing quality of life in urban areas.".

Keywords: Edward Soja, Third Space Theory, William Shakespeare, As You Like It, Forest of Arden, spatial dynamics, identity transformation, social relations, liminality, hybridity

1. INTRODUCTION

"The relationship between humankind and nature can be one of respect and love rather than domination…The outcome...can be rich, satisfying, and lastingly successful, but only if both partners are modified by their association so as to become better adapted to each other...With our knowledge and sense of responsibility…we can create new environments that are ecologically sound, aesthetically satisfying, economically rewarding…This process of reciprocal adaptation occurs…through minor changes in the people and their environment, but a more conscious process of design can also take place." (René Dubos, The Wooing of the Earth) In his 1973 book The Anatomy of Human Destructiveness, psychotherapist Erich Fromm defined biophilia as a passionate love of life, including people, plants, ideas, and social groups. (Erich Fromm 19730). As a psychotherapist, Fromm offered a broad range and labelled biophilia a physiologically natural instinct. Since, numerous scientists and philosophers have used the word in many fields of study.

In Biophilia (1984), Edward O. Wilson used a biologist's technique to coin the "Biophilia hypothesis" and popularize the concept. Who instigated biophilia- explains that we have a subconscious desire to connect to nature and to embrace natural systems. This concept underpins Biophilic Design, and supports the hypothesis that humans have an inbuilt emotional affiliation to other living organisms, and "are intrinsically connected and linked to visible and non-visible geometric forms and patterns in nature" Wilson described biophilia as "the innate tendency to focus on life and lifelike processes" (Wilson Edward), arguing that a connection to nature is hereditary rather than physiological (as Fromm proposed). Given our evolutionary dependency on nature and other biotic forms for survival and personal fulfilment, the biophilia theory suggests that humans have an innate urge to connect to them (Terrapin Bright Green, 2014). Humans pay money to visit national parks and natural preserves, relax on beaches, trek mountains, and explore rainforests. Nature-based activities include skiing, mountain biking, and surfing. Buyers will pay 7% more for a property with good landscaping, 58% more for one that looks at water, and 127% more for one that is waterfront. This all studies convey humans love nature and their surroundings. Biophilia suggests humans are inextricably linked to nature owing to their survival needs. To link residents to nature, biophilic design includes flora, water, natural light, and ventilation into the built environment. Use direct or indirect nature experiences to do this. Direct nature experience involves touching natural features. However, visuals, natural materials, colors, patterns, and geometries may generate an indirect experience. The built environment refers to the artificial area that encompasses our cities, neighbourhoods, workplaces, and houses, where individuals reside, work, and engage in recreational activities on a regular basis. Several recent research studies have focused extensively on the impact of our constructed surroundings on our physical and mental health, overall happiness, and standard of living.

Residential spaces are an important part of the built environment and have a significant impact on the health and well-being of persons. They provide surroundings that promote physical health, emotional well-being, safety, social interaction, and access to necessary utilities. An optimally planned residential area considers several variables that enhance overall well-being, establishing places where inhabitants may flourish and experience gratifying lifestyles. In today's residential design, there is a growing trend towards constructing homes that not only value sustainability and energy efficiency, but also establish a strong connection with the natural surroundings. The current concept of Biophilic design in buildings strives to enhance the connection between humans and the natural world by including aspects of both direct and indirect nature, as well as particular space circumstances. Biophilia refers to the innate human tendency to connect with nature, which is crucial for the physical and mental health and well- being of individuals even in today's contemporary society. (Stephen R. Kellert, Elizabeth. F. Calabse, 2015)

2. CULTURAL SIGNIFICANCE OF HERITAGE "POLS"

Although Ahmedabad possesses a great deal of architectural riches, the designation of becoming a UNESCO site in 2017. The significance and intended use of the inscription. In contrast to ambiguous phrases such as 'smart city', the UNESCO designation is explicitly and unambiguously defined. The term 'historic city' is inaccurate as it does not include the full city, but rather specifically refers to a small section called the ancient walled city and a narrow buffer zone around it. Moreover, it utilizes a meticulously defined set of criteria. Furthermore, it is crucial for a (local) government to formally apply to UNESCO for the purpose of inscription. Hence, the crucial determinant in this procedure is the extent of regional cognizance about cultural legacy and the ongoing preservation endeavours. Ahmedabad has been making efforts to get the designation for almost fifteen years, during which it undertook many creative conservation projects that may have impacted UNESCO's decision to grant the historic inscription. (UNESCO World Heritage Convention, Inscription 2017).

There are two specific criteria. Ahmedabad fulfills the initial criterion by demonstrating a notable interchange of human values over a certain duration or within the cultural area of the world, namely in the domains of architecture, technology, monumental arts, urban planning, and landscape design. According to the second requirement, Ahmedabad is regarded as a prime example of a traditional human settlement, land-use, or sea-use that embodies a culture or cultures, as well as human interaction with the environment. This is especially important when the settlement has become susceptible to irreversible alterations. Both of these conditions recognize that architecture is not autonomous, but rather has a substantial correlation with human behavior and urban organization. From this standpoint, the importance of the city's ancient architecture, including the mosques, Bhadra Fort, and Teen Darwaza, resides not only in their individual significance, but rather in their interconnection and their interaction with the surrounding urban environment. A comparison may be drawn between this site and another UNESCO site situated in Gujarat, namely Champaner. Despite being selected for its remarkable architecture, this ancient capital of Gujarat, which was constructed shortly after Ahmedabad, lacks any surviving residential structures or urban infrastructure. In contrast to Champaner, which gained

fame mostly for its state of abandonment, Ahmedabad serves as a prime example of a thriving cultural heritage. Ahmedabad's residential architecture stands out from other cities for two other reasons, as mentioned above. Initially, as a result of the chaotic circumstances I previously indicated, all the dwellings were organized into enclosed communities referred to as pols. In addition, the architectural legacy of Ahmedabad mostly showcases wood as the main material, rather than stone. The majority of the current traditional wooden pole dwellings range in age from 200 to 70 years. (Matfhijs Van Oostrum, 2018)

The "Pols" in Ahmedabad, India, are a distinctive characteristic of the city's urban landscape and are very significant in the residential domain due to its cultural, historical, architectural, and social significance. Pols homes not only exemplify their role in promoting sustainable urban living and nurturing communal life, but also hold value as a representation of cultural history and identity. Ahmedabad was designated as a UNESCO World Heritage City in 2017, acknowledging its abundant historical heritage and cultural importance, particularly the Polls. This designation has not only raised awareness of Ahmedabad's distinctive architectural and urban legacy, but also stimulated a growth in the examination and fascination with its traditional Pol homes. These ancient residential clusters, which date back to the 15th century, have developed throughout time and are now an essential component of Ahmedabad's cultural legacy, providing insight into the city's historical significance. Pols symbolize Ahmedabad's cultural and historical legacy. They were founded during the reign of Sultan Ahmed Shah and thrived under the Mughal Empire. Every Pol serves as a time capsule, safeguarding the lifestyle, traditions, and customs of its residents.

Recreating the visual representation of the old city during its initial 150-year period is a difficult task. Nevertheless, it is conceivable that the current magnificent residences are the result of a steady advancement that occurred as the city became more prosperous. The little courtyard remains in constant shade, facilitating the dissipation of hot air from above and creating a cooling breeze that affects the haveli. The entire residence functioned as a water collection and storage system. The residents depended on an underground reservoir to catch and store the monsoon rains, which they used for their daily needs throughout the year. Unfortunately, these traditional water-harvesting systems have become outdated in the current period, despite recent efforts to resuscitate them. Although it is accurate that each municipality only possesses a finite quantity of meticulously preserved historic residences, it is imperative to save not just the architectural elements but also the entire assemblage of buildings. Preserving the public space structures and other spatial and social elements that make up the community, such as the gate, water well, chabootras, otlas, etc., is of utmost importance.

An examination of the Pol homes in Ahmedabad within the framework of biophilic design is crucial as it illustrates how traditional architecture integrates features that establish a connection between residents and the natural environment, improving their overall well-being, promoting sustainability, and facilitating environmental integration. Biophilic design is a method that aims to establish a stronger connection between people inside buildings and the natural world by using natural materials, light, plants, and other features and concepts inspired by nature. Although the official definition of biophilic design is very recent, many classic types of building, such as the Pol homes, naturally incorporate its principles.

3. OBJECTIVE Of The RESEARCH

This project aims to investigate and record the integration of the 15 patterns of biophilic design, as established by Stephen R. Kellert and Elizabeth Calabrese, into Mangaldas Haveli, a significant historical and architectural site situated in Ahmedabad, India. This investigation seeks to reveal the degree to which traditional Indian architecture, as demonstrated by this haveli, integrates components of biophilic design, therefore improving the relationship between humans and nature inside constructed spaces. More precisely, the objective of the research is to:

3.1. To examine Mangaldas Haveli's 15 biophilic design themes. This includes personal observations and indirect portrayals of nature and spatial organization of pole houses.

3.2. The goal is to show how biophilic design can be used to protect and rehabilitate old buildings, preserving its cultural and architectural importance while ensuring their current relevance and Haveli's biophilic design application to inspire similar concepts in modern building.

4. RESEARCH METHODOLOGY

The research is characterized by both descriptive and analytical aspects. The study was carried out on-site at Mangala ni Haveli, where the researcher comprehends its architectural characteristics, historical importance, present

circumstances, and utilization of space. The researcher recorded the tangible characteristics of the haveli and its environs, with a specific focus on any present biophilic design components. In order to evaluate the biophilic approach of Mangaldas ni Haveli, the researcher utilized 15 biophilic characteristics. The data analysis entailed utilizing the haveli's architectural floor plan and photographic documentation. The data gathering was dependent on the researcher's proficiency in architectural observation. This study data collection method is a non-participatory observation method. The researcher employed analytical descriptive approaches to ascertain and elucidate the biophilic capability of the haveli.

5. ANALYSIS AND DISCUSSION

5.1 SPATIAL ORGANIZATION OF MANGALDAS HAVELI

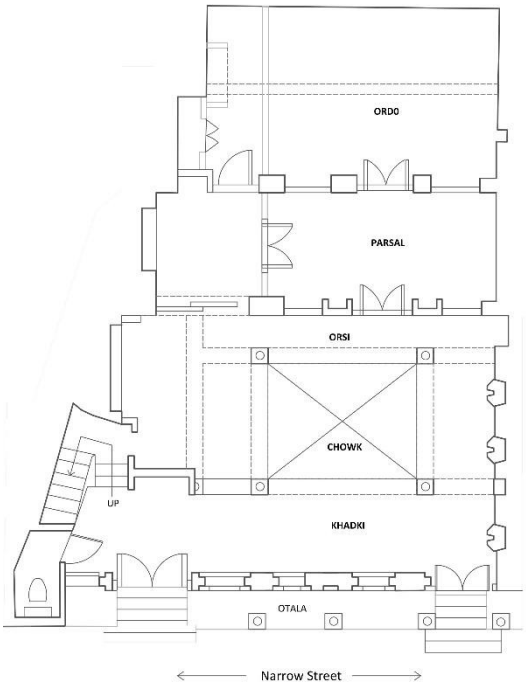

Fig. 1. Floor plan of Mangaldas Haveli

Fig. 2. Front view of Mangaldas Haveli

The 150 years old abandoned traditional Gujarati Nagar Brahmin family home, situated in a short road within one of the 'Poles' in the older part of Ahmedabad, has finely carved doors, windows, and balconies that serve as a reflection of the intimate nature of Gujarati culture. Numerous magnificent edifices have deteriorated and been dismantled due to financial limitations and a dearth of awareness and comprehension regarding the imperative to save our architectural heritage. Mangaldas Haveli serves as a notable illustration of preservation and adaptive reuse. Following the reconstruction, the haveli has transformed into an engaging and educational display that highlights the abundance and sophistication of the traditional ambiance, culture, and architecture of this area. Vaishali Shah, an interior designer and environmentalist, encountered Abhay Mangaldas, the energetic and lively offspring of a distinguished urban family. After conversing with him, she came across a charming narrative of transforming a dilapidated haveli into a stylish and historically significant hotel and restaurant.

Typically, pole homes consist of two-story structures, with the bottom level serving as the first floor. Pole homes are primarily categorized into six fundamental structures: Otla, khadki, chowk, orsi, Parsal, and Ordo.

5.2. OTALA (VERANDAH OUTSIDE)

Prior to entering the Pol house, there exists a designated area known as "otala," as seen in Figure 3. The elevated platform serves as a distinguishing feature between residential areas and the surrounding roadway. It is also utilized for religious purposes.

One side of the otala is designated for the provision of washing facilities and toilets. Over time, these activities that were visible from the street grew outdated and were moved indoors. However, within a limited number of households, individuals are utilizing the area for both laundry and sanitation purposes.

Fig. 3. View showing otala

Fig. 4. Steps defining entrance

5.3 BHAITAK AND KHADKI (DRAWING ROOM AND WINDOWS)

Once you enter the home, there is a drawing room known as "bhaitak," as seen in figure 5& 6 and guests are expected to sit inthis area. Khadki is the name of the windows. In the direction of the courtyard side, Bhaitak opens. as well as the windows of the house, which are another important aspect of a pole house. And this window open towards otla side. Wooden carved frame and window and metal grills jali is the enhance the beauty of house and also give light, ventilation and jali gives protection from unwanted entries of animal and humans.

Fig. 5. & Fig.6. Views showing Bhaitak and Khadki

5.4. CHOWK (COURTYARD)

in Indian society chowks are considered as a most auspicious space in home. Vastupurush Mandala, considered it as a location for Brahma, which signifies a space filled with empty space. The designated area is often known as Brahma Sthan. The primary characteristic of Pol residences is the courtyard. All activities are conducted inside the confines of the courtyard, as seen in Figure 8. The courtyard was designed to minimize direct sunlight throughout the summer and ensure ample illumination for all activities. The courtyard serves as a focal point and is strategically planned based on the traditional indian knowledge system. The courtyard's dimensions have been intentionally created to provide a connection with the higher levels. The top levels' windows face the courtyard. The courtyard effectively establishes a visual connection with the higher levels. A rainwater collecting tank is located beneath the courtyard, serving as a water reservoir. The aperture of the tank is occasionally conspicuously seen inside the courtyard or concealed within the parsal. The courtyard is designed with a modest incline to facilitate the gathering of rainwater. Previously, the courtyard was exposed to the sky. Nevertheless, in certain instances, it is shielded with fiber sheets or garments during the monsoon season to prevent the infiltration of moisture. The courtyard area has been levelled using parsal and bhaitak to optimize space use. And in a few houses put tulsi on a big pedestal which is a cultural biophilic representation.


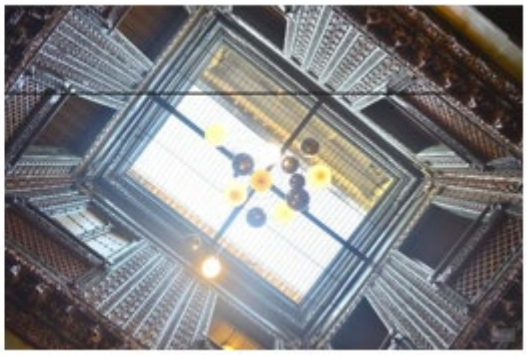

Fig. 7. & Fig. 8. Inside views of the Courtyard

5.5. ORSI

It is a part attached to the courtyard of the house at the back side. The spaces surrounding the courtyard all serve different purposes. Front side is attached with the entrance gate of the house and a khidki window. Central areas are used as a sitting area and the rear sides are attached to the other utility areas and private zones. The Figure number-8 explains it well.

5.6. PARSAL (FAMILY LOUNGE)

In most instances, the courtyard of Parsal (Family Lounge) exhibits a direct connection with the street. The courtyard is accompanied by a verandah, sometimes referred to as a "parsal," as seen in Figure 9. Previously, the kitchen was situated in a corner, but subsequently, one side of the parsal has been often utilized for both the kitchen and toilet. This parsal typically consists of two sides, with a rare occurrence of three sides. It serves as a valuable place for most activities. The swing in Pol homes is a crucial characteristic that is always positioned in parsal. The parsal often features a colonnade around the courtyard. The parsal area displays the swing and several other pieces of furniture. Following the parsal, there are one or two rooms referred to as "ordo" which serve as bedrooms or storage spaces.

The primary purpose of these rooms is to serve as bedrooms or storage areas inside the household. These rooms are dimly lit and lack sufficient ventilation.

5.7. ORDO

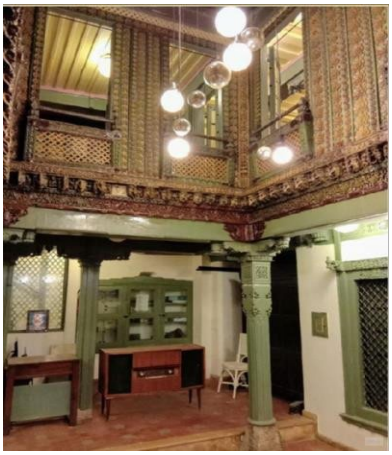

Fig. 9. View through courtyard showing private areas.

Following the parsal, there are one or two chambers referred to as "ordo". The primary purpose of these rooms is to serve as bedrooms or storage areas inside the household. These rooms are dimly lit and lack sufficient ventilation.

6. AN EXAMINATION AND DELIBERATION ON THE PRESENCE OF BIOPHILIC PATTERNS IN MANGALDAS HAVELI.

Typically, individuals have a strong affinity for nature and prefer having green areas in their vicinity. "14 Patterns of Biophilic Design" is a publication that provides a comprehensive set of tools for comprehending the many aspects of

Biophilic Design, together with the scientific principles underlying them. These patterns delineate the connections between nature, humans, and the constructed environment, and present possibilities for design interventions that might amplify the advantages of biophilia, and ultimately boost wellbeing. There are 14 Patterns of Biophilic Design which are following. 1. Visual Connection with Nature 2. Non- visual Connection to Nature 3. Non-Rhythmic Sensory Stimuli 4. Thermal & Airflow Variability 5. Presence of Water 6. Dynamic & Diffuse Light 7. Connection with Natural Systems 8. Biomorphic Forms & Patterns 9. Material Connection with Nature 10. Complexity & Order 11. Prospect 12. Refuge 13. Mystery 14. Risk and peril [5]

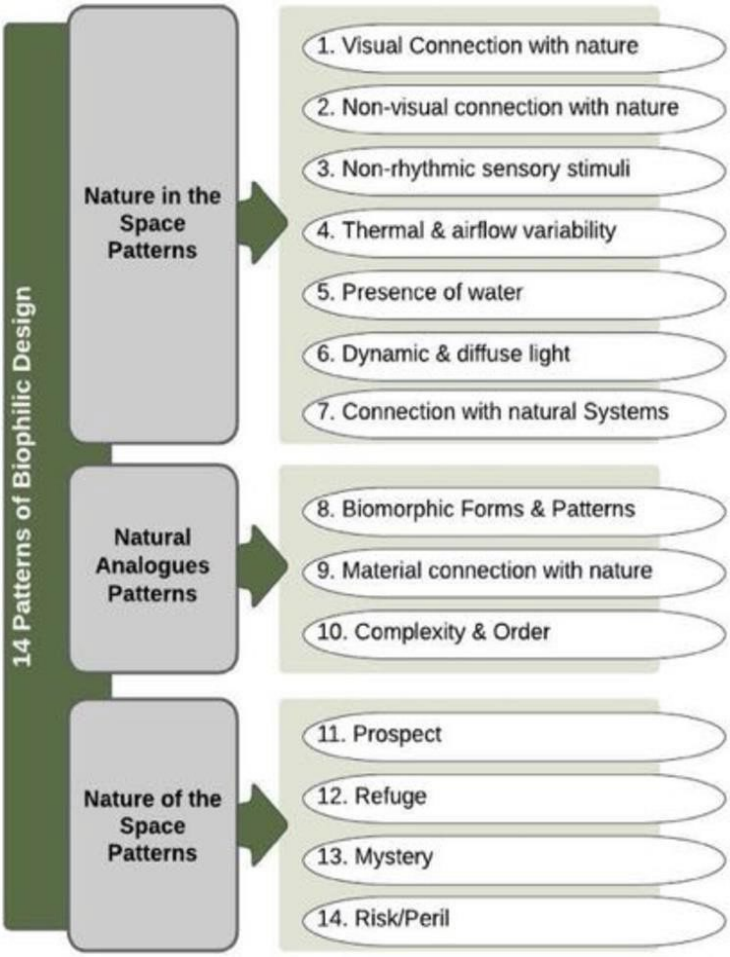

Fig. 10. 14 Patterns of Biophilic Design, 2014: Terrapin bright green

Source: Browning, William D., et al. "Patterns of Biophilic Design." ResearchGate, 2014, www.researchgate.net/figure/14-Patterns-of-biophilic-design-adapted-from- Browning-et-al-2014_fig3_368519102.

The 14 patterns of the biophilic design are categorized into three primary groups. 1. Nature in Space. 2. Nature analogues. 3. Nature of space. The biophilic patterns will be used to evaluate the nature of space, the architectural design, and the complete spatial arrangement of Mangal Das Haveli.

6. 1. NATURE IN SPACE.

6.1.1. Biophilic Pattern 1: Visual Connection With Nature

A visual connection to nature refers to the observation and understanding of natural components, processes, and living systems. The association with the natural environment has resulted in the most significant rejuvenating outcomes in comparison to other biophilic designs. Empirical data has shown that establishing a visual link with the natural world may diminish blood pressure and heart rate, enhance mental well-being and focus, and augment our general disposition and contentment.

DISCUSSION

Otala establishes a strong visual Connection with outdoor Environments. Despite the density of the Pol neighbourhoods, the orientation of houses and the presence of open spaces in the street lane allows views of the sky. Otla serves as an extension of the living space, providing an outdoor area where occupants can spend time during different times of the day, allowing them to experience the changing elements of nature, such as sunlight, breeze, and views of the surrounding landscape. As Otalo is slightly raised above the ground level it offers an elevated perspective of the surrounding and facilitates a stronger connection with the natural environment, enabling us to observe and appreciate elements such as wildlife and the sky.

Frequently observed are scenes of cows and dogs wandering through the streets and occasionally settling on the steps in front of homes, seeking refuge. The presence of squirrels and birds, such as sparrows and parrots, is a common sight in the holes and carved apertures of the facades of adjacent houses.

Residents can observe and experience seasonal changes more intimately from the vantage point of an otla.

Courtyard of the house, often open to the sky, allows residents to experience the changing elements of nature throughout the day. The strategic position of the courtyard allows for natural ventilation and daylighting to penetrate the interior spaces of the house. This not only helps in regulating the indoor climate but also brings the occupants closer to the natural elements, as they feel the breeze and observe the patterns of sunlight filtering through the courtyard.

Whether it's feeling the warmth of the sun, witnessing the play of light and shadow, or stargazing at night, the courtyard provides an unobstructed view of the sky, fostering a sense of connection with the celestial realm.

6.1.2. Biophilic Pattern 2: Non-Visual connection with nature

According to (Browning et al 2014). Non-visual Connections with Nature refer to the auditory, olfactory, gustatory, and tactile sensations that signify being in the presence of nature. Illustrations of this pattern encompass elements such as flowing water, fragrant flowers, tactile and organic materials, horticulture, natural airflow, animals, and auditory noises, whether artificial or natural, evoking a sense of nature. There is a correlation between non-visual interactions with nature and decreases in systolic blood pressure and cortisol levels, which are linked to stress. Furthermore, there have been enhancements in cognitive performance and psychological well-being.

DISCUSSION

Use of the natural materials like wood, stone, and brick in the construction of the house brings a tactile sensation of nature. Extensive use of wood can be seen in articulating the exterior front facade and courtyard. various elements of space making ranging from the stone steps and columns to wooden doors, windows, brackets, beams, roof structure, carved fillers in walls can be seen highlighted in the house. These materials can vary in temperature, texture, and even smell, offering a multisensory experience that connects occupants to the outdoors.

Extensive use of opening in the front facade in the form of doors, windows, jalis and protruding element mimicking jharokha allows natural ventilation. These openings facilitate cross ventilation, allowing the occupants of the house to feel natural breezes and also regulates changes in air temperature thereby enhancing the sensory connection to the natural world.

The sound of birds chirping is often experienced in the outdoors near the entry point of the house(otla) and sometimes in chawk (courtyard). As the birds reside nearby in the streets contributes to a serene atmosphere, reducing stress and promoting wellbeing. The architecture and design of the house encourage seamless indoor-outdoor living.

6.1.3. Biophilic Pattern 3: Non - rhythmic sensory Stimuli

Non-rhythmic Sensory stimuli refer to natural diversions that facilitate relaxation and provide respite from an activity. The primary health advantages are observed when engaging in activities with limited visual focus, such as computer usage. This is due to the subconscious attraction of attention and the facilitation of brief mental breaks from the job through the utilization of natural sensory inputs. These little interruptions (lasting up to 20 seconds) might enhance an individual's ability to concentrate on a task by inducing relaxation of the eye muscle, leading to the flattening of the

lenses. On the other hand, prolonged contraction of eye muscles due to prolonged attention (lasting more than 20 minutes) might lead to headaches and weariness.

Discussion

The intricately carved surfaces of the exterior facade and courtyard allows the play of light and shadow in the interior spaces. Use of Jali and wooden carving on the vertical surfaces not only create depth in the spaces but also create dynamism. The movement of the sun creates a dynamic interplay of light and shadow throughout the day in the courtyard. This natural spectacle provides an ever-changing visual experience that is never exactly the same, engaging occupants and visitors with the passage of time marked by natural light.

The layout of the courtyard and placement of the openings of both outdoor and indoor encourages the gentle yet unpredictable flow of breezes that weave and shift course. This varying sensory encounter fosters a direct and profound connection between individuals and the outdoor landscape.

The design of the courtyard, along with the strategic positioning of openings to both indoor and outdoor spaces, enables a gentle and playful movement of air flows that drift and change direction. This variable and dynamic sensory experience deepens the direct and meaningful relationship between people and the natural surroundings.

6.1.4. Biophilic Pattern 4: Thermal and airflow variability

Thermal and airflow the concept of variability pattern refers to the incremental fluctuations observed in airflow, temperature, relative humidity, and the utilization of diverse thermal materials, which emulate natural conditions. The thermal comfort of a home is a critical determinant of the productivity, tranquillity, and well-being of its residents. The concept of thermal comfort is inherently subjective, and it operates by introducing adjustable thermal conditions and airflow inside a given area. This enables individuals to regulate their thermal comfort by actively navigating and adjusting their surroundings. Research findings suggest that individuals prefer moderate degrees of sensory diversity, encompassing fluctuations in light, temperature, and sound. The absence of sensory diversity in environments can have a detrimental impact on productivity and lead to feelings of boredom. The objective is to enable the individuals to modify their degree of comfort by shifting their chairs (either towards the sun or shade) and by opening windows.

DISCUSSION

The incorporation of thermal and airflow variability is very well thought of while constructing the house. Thick walls, which are constructed from locally produced materials like sand and lime, offer good thermal mass, keeping interiors warm at night and cool during the day. This natural insulation is essential where night-time temperatures differ significantly from daytime temperatures.

The layout of the house was planned considering the orientation and the standard practices to optimize thermal comfort and natural ventilation. In order to keep the interior cooler, it is positioned to catch prevailing winds and protected from direct sunshine. By increasing the number of openings on the outer walls facing the shaded street, cool breezes are facilitated, allowing for cross ventilation in the house. Additionally, the strategic positioning of the courtyard as an open area inside encourages airflow throughout the building, contributing to the natural cooling of the living areas.

The house exemplifies a thoughtful integration of natural climate control methods that enhance living comfort while fostering a connection to the natural environment. This approach not only aligns with sustainable design principles but also leverages traditional architectural wisdom to create a harmonious living space.

Jali walls or lattice screens, typical in traditional Indian architecture, are incorporated into the house. These finely crafted screens serve to provide ventilation and diffuse light, thus

establishing a pleasant indoor climate. The airflow facilitated by these screens not only serves a functional purpose in cooling the space, but also contributes to the aesthetic appeal.

High ceilings and centrally placed courtyard acting as ventilation shafts contribute to enhancing airflow and lowering indoor temperatures. As warm air naturally ascends and exits through these shafts, it draws in cooler air from lower levels or shaded sections of the house, establishing a natural circulation of air.

6.1.5. Biophilic Pattern 5: Presence of water

Water's presence may enrich an area by establishing a visual, tactile, and aural bond with it. According to Biederman and Vessel and Alvarsson the existence of water has the capacity to reduce heart rate and blood pressure, enhance cognitive function, promote restfulness, and exert a favourable influence on emotions. Engaging in multi-sensory interactions with water enhances the perceived health advantages. The combination of auditory and maybe tactile sensations can effectively decrease stress levels by introducing a single modest water element, this multi-sensory experience can be further enhanced. A study conducted by Biederman and Vessel (2006) revealed that repeated exposure to the same body of water did not lead to a decline in interest levels. In fact, it was discovered that repeated exposure can enhance cognitive function by restoring memory and improving focus. Utilizing the auditory stimuli produced by water, the tactile experience it offers, and the scenic vistas across water are all possible avenues for establishing a Biophilic bond.

DISCUSSION

This Biophilic pattern is not present in the house.

6.1.6. Biophilic Pattern 6: Dynamic and diffuse light

According to Browning et al. (2014). Dynamic and diffuse light exert an impact on the levels of light and shadow, mirroring the fluctuating light conditions found in the natural environment. Daylight is frequently sought for in constructed surroundings, and the presence of dynamic and diffuse light can have a beneficial effect on human circadian cycles The objective of this pattern is to elicit ocular stimulation, hence eliciting a favourable psychological reaction and preserving circadian cycles. According to design considerations, it is recommended to achieve a balance between dynamic and diffuse light in order to enhance the interstitial spaces during outdoor transitions. Additionally, it is advisable to incorporate circadian lighting in areas that are utilized for the most of the day.

DISCUSSION

The architectural design incorporates a centrally positioned courtyard, serving as focal point for natural light. These open-to-sky courtyards, surrounded by living spaces, allow sunlight to filter in, casting dynamic patterns of light and shadow throughout the day. This interplay of

light adds visual intrigue and a sense of movement to the interior, strengthening the occupants' connection to the outdoor surroundings. To enhance the dynamic and diffuse light, strategically placed clerestory windows capture and distribute natural light throughout the interior spaces. These openings allow daylight to penetrate deeply into the building, reducing the need for artificial lighting and promoting sustainability. The shifting patterns of light and shadow cast by these features enrich the sensory experience, evolving with the passage of time. Use of traditional architectural elements like jali screens, intricately carved wooden panels, and lattice work are integrated into the design to diffuse incoming sunlight. This creates a soft, dappled effect, filling the interior with a warm and inviting glow. The play of light through these screens adds depth and texture to the environment. Reflective surfaces like whitewashed walls are utilized to bounce natural light deeper into the interior spaces. By maximizing sunlight reflection, these surfaces create a brighter and more expansive ambiance, blurring the boundaries between indoor and outdoor realms. This amplifies the sense of spaciousness and elevates the visual aesthetics of the living environment.

6.1.7. Biophilic Pattern 7: Connection with natural system

Engaging with Natural Systems fosters a robust bond between humans and the natural world. This link fosters an understanding of seasonal variations, temporal fluctuations, and a connection with natural phenomena. According to Browning et al. (2014), the predictability of the experience frequently contributes to a state of calm for the spectator. This pattern aims to enhance individuals' understanding of natural processes and encourage human stewardship of the environment and ecological systems. Integrating the pattern might be as simple as observing a deciduous tree or building using materials that undergo aging and transformation over time.

DISCUSSION

There is a profound link with natural systems, where architectural design and lifestyle practices are intricately connected to the surrounding environment. In Mangaldas Haveli, traditional rainwater harvesting techniques are integrated to efficiently manage water resources. Rainwater is collected from rooftops and directed into storage tanks or underground reservoirs for future use. This sustainable approach reduces dependence on external water sources and aids in replenishing groundwater levels, thereby contributing to the overall well- being of the local ecosystem.

The architectural design of Mangaldas Haveli is customized to suit the local climate, incorporating features such as thick walls, shaded courtyards, and natural ventilation systems to regulate indoor temperatures. By employing passive design strategies, the houses maintain a comfortable environment year-round while minimizing energy consumption and mitigating environmental impact.

6.2. NATURE ANALOGUES.

6.2.1. Biophilic Pattern 8: Biomorphic forms and patterns

The concept of biomorphic architecture and patterns involves the symbolic portrayal of nature via the utilization of patterns, textures, and materials that are naturally present. The aforementioned shapes frequently encompass abstract aspects that elicit naturally existing forms, like plants, shells, branches, and creatures. Humans exhibit a predilection for seeing biomorphic and organic structures, yet the scientific data supporting this inclination is not substantial. The human mind possesses an understanding that biological forms lack life, yet certain individuals perceive them as symbolic manifestations of living entities, therefore establishing a symbolic association with the natural world.

The objective of this biophilic pattern is to incorporate symbolic design elements that elicit a sense of connection between people and live organisms. It is desirable to incorporate these elements in order to create a visually appealing environment for the individual, which has the potential to improve cognitive function and reduce symptoms of stress. The Fibonacci sequence is a fundamental biomorphic pattern that is observed in various living organisms, characterized by a numerical arrangement that is recognized as wholly biological. It is a phenomenon observed in several flowers and plants, where the spacing of leaves prevents new vegetation from shading or obstructing the old vegetation's access to rain. The golden ratio, which is observed in several rotational organisms, is closely associated with the Fibonacci sequence and has a ratio of 1:1.618. Seashells and flowers exemplify the growth patterns that adhere to the golden ratio.

DISCUSSION

The exterior and interior walls of Mangaldas Haveli are adorned with intricate carvings depicting floral motifs and geometric patterns. These carvings often emulate the shapes and textures of plants, flowers, leaves, and animals, establishing an organic unity with nature. Biomorphic forms and patterns are also evident in the decorative details throughout the haveli, including doorways, windows, balconies, and ceilings. These features often showcase elaborate embellishments like twisted vines, floral garlands, and stylized animal figures, showcasing the region's rich cultural heritage and artistic traditions. The integration of biomorphic forms and patterns in Mangaldas Haveli reflects a deep admiration for the beauty and intricacy of the natural world. These elements not only enhance the haveli's visual allure but also foster a sense of harmony and connection with the environment, enriching the cultural legacy and daily life of its residents.

6.2.2. Biophilic Pattern 9: Material connection with nature

The concept of a Material Connection with Nature encompasses the use of natural materials, grains, textures, and components in design that resonate with the local environment and contribute to the establishment of a distinct feeling of place. The objective of this design is to elicit favourable cognitive reactions by integrating various natural materials. Materials derived from natural sources that are used into design typically undergo partial manufacturing

processes and exhibit variations from their original condition. However, this modification enables the utilization of natural materials in many ways, such as incorporating them into marble bench tops and timber flooring/wall panelling. Discussion:

Use of natural materials such as wood and stone are extensively used in the house in the front facade wall, courtyard and inside spaces as a structural element and decorative element. Wood is utilized for intricate carvings, doors, windows,

and various structural elements, infusing the interiors with warmth and natural charm while fostering a sense of connection with the environment.

In parallel, stone is employed extensively in the construction of walls, floors, and ornamental details within the haveli. Providing durability, stability, and an enduring presence, stone contributes to the sense of permanence within the structure. Its natural textures and hues evoke the rugged beauty of the surrounding landscapes, enriching the biophilic appeal of the haveli. Interacting with stone surfaces enhances the tactile connection with nature, promoting feelings of well-being and tranquillity among occupants.

6.2.3. Biophilic Pattern 10: Complexity and order

Complexity and Order encompasses sensory information that follows a spatial hierarchy akin to that observed in natural environments. The objective of this pattern is to create symmetries and fractal geometries that are visually appealing and have the potential to enhance beneficial psychological or cognitive outcomes. The difficulty of this pattern is in achieving equilibrium between a complex and visually stimulating environment, and one that is overpowering and causes stress. The research pertaining to this pattern has expanded via an examination of fractal geometries and preferences in viewing, as well as an exploration of the favourable physiological reactions observed in natural fractals. The term "fractal" denotes a configuration that is fragmented, and in this context pertains to designs or patterns that exhibit similarity and are multiplied and replicated through a scaling ratio. Benoit Mandelbrot, a mathematician, used the term "fractal" to describe natural fractals as geometric shapes that are rough or fractured and may be divided into pieces, each of which is a reduced-size replica of the whole. When nested fractals are scaled with a factor of 3, they tend to exhibit more complexity in comparison to fractals scaled with factors of 1 or 2. Vernacular architecture, such as the colonnade capitals in ancient Greece and Islamic art, as well as crops like cauliflower, exhibit fractal patterns.

DISCUSSION:

The architectural arrangement of Mangaldas ni Haveli frequently integrates symmetrical patterns and proportionate structures, mirroring the orderly principles found in the

natural world. Symmetry is evident in how courtyards, rooms, and architectural elements are organized, creating a harmonious and balanced ambiance reminiscent of natural scenery. This symmetrical layout cultivates a serene and peaceful atmosphere within the haveli, encouraging a sense of well-being and communion with the surrounding environment.

The haveli showcases elaborate architectural features including ornate carvings, delicate latticework, and intricate motifs inspired by nature. These details, mirroring the complexity of natural elements such as foliage, flowers, and animals, demonstrate a meticulous level of craftsmanship.

6.3. NATURE OF SPACE.

6.3.1. Biophilic Pattern 11: Prospect

The Essence of the Space The Prospect pattern posits that humans have a natural inclination towards favouring vast vistas over landscapes. This preference may be attributed to the fact that throughout our evolutionary history, such views have provided us with opportunities for surveillance and planning, thus enhancing our chances of survival. The concept of prospect may be described as an unimpeded visual perception spanning a considerable distance, which engenders a feeling of security and enables individuals to see prospective risks and advantages. Prospect pertains to broader perspectives of our surroundings, encompassing both internal and external aspects. Prospects in interior design include elements such as mezzanine levels, open-plan workplaces, windows with views extending beyond 6 meters, and glass or transparent barriers that provide unobstructed vistas.

Prospect has been found to have possible advantages such as reducing weariness, feelings of vulnerability, stress, and improving comfort levels. Hertzog & Bryce (2007) argue that having views or panoramas that extend beyond 30 meters is more desirable than shorter views (about 5 meters) because it enhances one's comprehension and consciousness of the surrounding environment. The advantages of having a broader perspective include experiencing a sense of ease and decreased levels of tension, particularly in a new environment.

DISCUSSION

Otala, a raised platform and balcony within the haveli offer increased chances for enjoying vistas. Located at elevated heights, these areas offer expansive vistas of the surroundings, allowing residents to appreciate the beauty of the surrounding landscape. Whether utilized for social events, introspection, or leisurely observation, these platforms elevate the biophilic encounter by enveloping residents in the natural sights and sounds of their environment.

Strategically placed windows throughout the Haveli are designed to frame scenic views of the outdoor surroundings. Whether they face the courtyard, or nearby streets, these windows provide glimpses of nature from different perspectives within the haveli. Inhabitants can

appreciate the shifting interplay of light and shadow, and foster a sense of connection with the outside world.

Central courtyard connects the occupants with the rest of the floors and facilitates interaction along with the expansive views of the surrounding landscape. These courtyards serve as focal points within the haveli, offering occupants and visitors opportunities to gaze upon the distant horizon the openness of the courtyards creates a sense of spaciousness and connection with the natural environment, enhancing the overall biophilic experience.

6.3.2. Biophilic Pattern 12: Refuge

Refuge Geographer Jay Appleton introduced the Prospect-Refuge hypothesis in his work "The Experience of Landscape" by emphasizing the relationship and interdependence between the concepts of Refuge and Prospect. According to Beatley (2016), this hypothesis posits that the likelihood of our survival throughout the course of evolutionary history was enhanced by possessing a broad perspective and seeking shelter in caves and cliffs. Hence, the sensation of seeking sanctuary is intensified when combined with the element of anticipation. According to Dosen and Ostwald (2013), the prospect-refuge notion posits that individuals experience restorative benefits, such as emotions of safety and protection, when they are situated in situations that provide enclosure, preferably on three sides, together with favorable outlooks. The tree house can be considered the ultimate combination of Refuge and Prospect, since it provides a partially disguised space for residents to shelter themselves from imagined danger, while yet affording a view that allows for surveillance of the surrounding area.The primary objective of this pattern is to provide residents with a conveniently accessible and safe place, namely a small section inside a bigger room, that facilitates the process of recuperation. Furthermore, the objective is to reduce the visibility of the refuge area. From an architectural perspective, the presence of several sides (protection) enhances the restorative experience. However, an excessive quantity of protection, characterized by full closure, that lacks integration with the surrounding space, is ineffective in producing a sense of sanctuary.

DISCUSSION

The design of Mangaldas Haveli thoughtfully integrates refuge, providing occupants with an array of secluded spaces to find solace, unwind, and recharge amid the serene and beautiful surroundings.

Bhaitak, Parsal and Ordo are the interior spaces of the haveli that offer intimate refuge areas where occupants can seek solace and relaxation. Ordo, a private space and cozy alcove, provide secluded spots for contemplation or quiet activities. Furthermore, soft lighting, comfortable furnishings, and natural materials in the Parsal and Oro, contribute to the sense of warmth and comfort, inviting occupants to unwind and recharge.

6.3.3. Biophilic Pattern 13: Mystery

The presence of mystery in design creates a feeling of excitement that motivates individuals to venture deeper into the area for exploration. This is frequently accomplished by deliberately concealing some perspectives. The primary health advantages are derived from the ability to foresee or anticipate what may be unveiled in the space. The presence of a high- quality mystery condition stimulates interest, leading to the activation of robust pleasure responses in the brain. The activation of VTA dopamine neurons is responsible for these pleasurable reactions, which often occur when an unexpected yet positive event takes place.

The enigmatic pattern fosters locomotion and investigation inside a certain area, with the objective of diminishing tension and facilitating cognitive rejuvenation. Predictably, this trend may be diminished over time with consistent

exposure. Japanese gardens serve as a prime illustration of the concept of Mystery, characterized by intricate pathways, veiled focal points, and intricate mazes that entice visitors to navigate around the gardens.

DISCUSSION

The spatial organization of Interior spaces of Parsal and Ordo areas evoke a sense of mystery and adventure. These spaces are placed at the back of the house and often tucked away behind intricately carved doors or disguised within the walls, waiting to be discovered by curious explorers. Occupants may stumble upon these hidden spaces while navigating the corridors of the haveli, adding an element of surprise and intrigue to their journey through the building.

Hidden passageways, concealed staircases, rooms and circulation space adjoining the courtyard also add a feeling of excitement that motivates individuals to explore the areas.

6.3.4. Biophilic Pattern 14: Risk / Peril

Risk/Peril may be described as an environment characterized by the presence of potential danger, accompanied by a dependable protective measure. The objective of this design pattern is to elicit reactions pertaining to problem-solving abilities, inquisitiveness, and risk evaluation abilities - cultivated throughout our early years.The recognition of a controllable danger has the potential to elicit pleasurable reactions, leading to heightened dopamine levels, akin to the thirteenth pattern of the Mystery. Hence, the incorporation of risk into the design process can provide favorable health consequences. In the case of adults, this can lead to a reduction in the production of dopamine, which is responsible for initiating the fight-or-flight response. Additionally, it can enhance motivation and enhance memory function. There exists a potential for enhancing beneficial health responses through the establishment of a link with

natural systems. One of the primary characteristics of a link to natural processes is the phenomenon of aging and the subsequent temporal changes that transpire throughout time. Natural systems, including aging, change, and the passage of time, elicit a feeling of familiarity and contentment among individuals, even in the face of the unavoidable and subsequent demise and deterioration of all-natural entities.

DISCUSSION

The biophilic element of risk or peril is not typically present in the house design, however few spaces like concealed passages or narrow corridors within the haveli might evoke a mild sense of risk or excitement for occupants exploring the structure. The passage spaces near the staircase are often dimly lit and unexpected turns near the courtyard create as element of uncertainty.

7. CONCLUSION

Analysing the patterns of Biophilic design it can be determined that the Mangaldas Haveli adheres to the principles of Biophilic design. Out of 14 patterns of Biophilic design, 12 patterns have been identified in the building each establishing a very strong connection to nature. It is observed that indirect experiences of nature and experience of space & place are majorly contributing in determining biophilic patterns in the haveli as compared to the direct experience of nature due to the absence of water, plants and trees in the building and surroundings. Despite the location in dense urban fabric and historic context, Haveli demonstrates a compelling example of traditional architecture embodying the principles of biophilic design by offering various experiences of nature in the form of natural materials, patterns and representations that evoke nature's essence. These interventions not only enhance the living quality for its inhabitants but also highlights the relevance of traditional wisdom in contemporary discussions about sustainable and environmentally friendly approaches in urban settings.

CONFLICT OF INTERESTS

None

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None

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