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Biophilia

The Architecture of Liveable Spaces

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Abstract: We frequently create our living areas in ways that both harm the environment and distance ourselves from the natural world. The recent trend in green building has reduced the built environment's environmental impact, but it hasn't done much to restore our connection to nature, the crucial component of sustainable development. The time calls for a design strategy that integrates buildings with nature, creating spaces where people feel better and function more effectively. The principles of "biophilic design" show how to build productive and healthful environments for contemporary people. Buildings that link people to nature can be found. hospitals where patients recover more quickly, schools where students do better on tests, workplaces where employees are more productive, and neighborhoods where people are happier. Biophilic design reveals why the existence of nature in our daily lives is central to our existence and what we can do to reverse the decline over the centuries. This study aims to understand how the built environment can connect people with nature, and provide a positive physical and psychological experience by exploring the role of biophilic design.

Index Terms – Nature, Built Environment, Sustainable Development, Healthy habitats, Biophilic Design, Biophilia.

I. INTRODUCTION

Erich Fromm, a German social psychologist, invented the term "Biophilia" in 1964 to characterize people's attraction to all things alive and energetic. Wilson attempted to elucidate the urge to feel a connection to nature in Biophilia (1984), and he associated evolutionary growth within the natural world as the main reason for this affinity. Finding a thriving habitat that offered food, shelter, safety, and access to water was essential for early humans to survive. People who could identify these resources and take advantage of their wealth were probably more successful and evolutionarily fit.

Biophilia, the innate human propensity to identify with nature, is still essential to people's reactions to natural, not manufactured, or human physical and mental health and wellness in the modern world (Wilson 1986, Kellert and Wilson 1993, Kellert 1997, 2012). People frequently bring an arrangement of flowers as a sign of support when they are visiting sick loved ones or, conversely, when they are commemorating a significant occasion. These and numerous other instances point to one theory that seeks to explain the relationship between humans and nature.

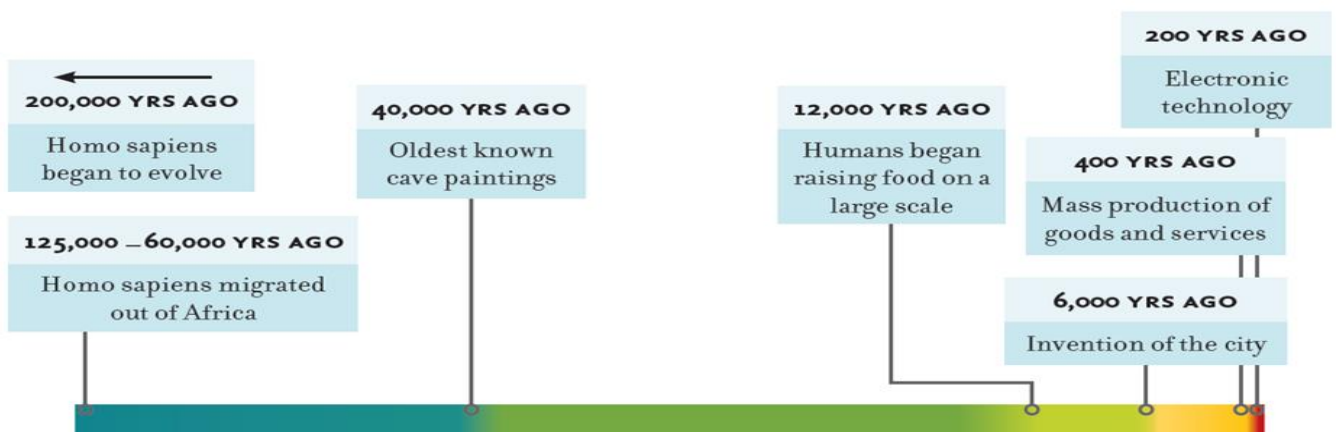


Fig 1: Human Evolution, Source: Kellert and Wilson 1993

Understanding human evolution—where we biologically evolved in adaptable surroundings for more than 99 percent of our species' history—gives rise to the concept of biophilia. The majority of what we take for granted today is very new—large-scale food production only began 12,000 years ago, cities were created 6,000 years ago, mass production of products and services started 400 years ago, and electronic technology just emerged in the 19th century. The human body, mind, and senses developed, not human-engineered or invented world but in a bio-centric one (environmental ethics that "extend the status of moral object from human beings to all living things in nature").

The findings of a famous Swedish study carried out by the psychologist Arne Ohman demonstrate the innate propensity of our species to react to environmental forces and stimuli (1986). In this study, images of snakes, spiders, frayed electrical wires, and handguns were subliminally shown to the subjects. The subconsciously revealed images of snakes and spiders elicited negative responses from almost all study participants, although firearms and exposed electric wires were mostly ignored. The findings of this study both demonstrate and caution about the importance of our innate tendencies to interact with nature in the contemporary world. The findings demonstrate the persistence of our evolutionary reactions to nature, but they also suggest that some of these responses may now be "vestigial" - previously adaptive but irrelevant today and going to become extinct overtime.

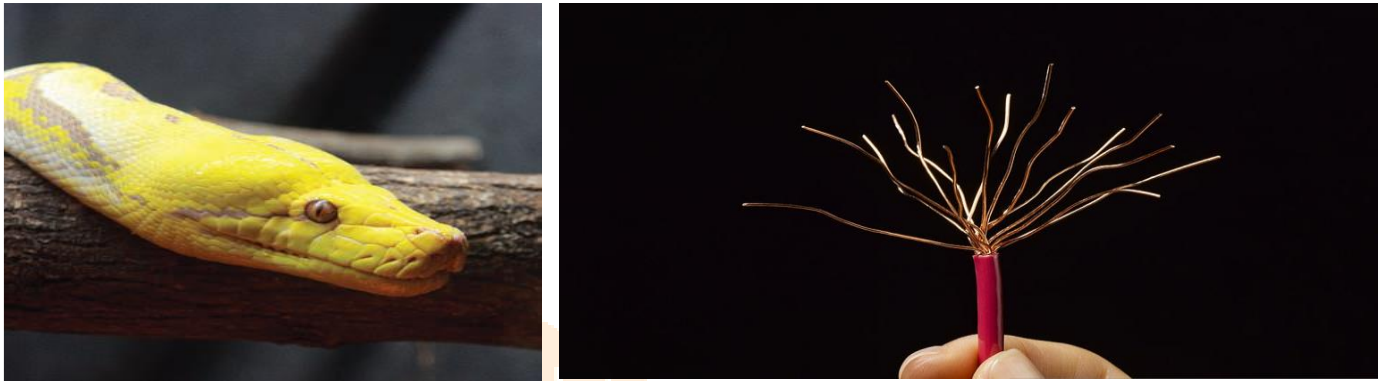


Fig 2: Images of Snake and Exposed wires, Source: Kellert and Calabrese, 2015

1.1 Kellert's Values Of Human-Nature Relationship

Stephen Kellert has developed nine fundamental values that reflect our relationship with nature. Each of these values indicates the human dependence on nature as basis for survival, physical and psychological well-being.

Table 1: Kellert's values of human-nature relationship

VALUES	DEFINITION	FUNCTION
•Aesthetic	•An emotional response to the physical beauty and attraction of nature.	•Inspiration, harmony, peace and security
•Dominionistic	•The tendency to control and manipulate nature.	•Mechanical skills, physical power
•Humanistic	•An emotional response to care for and become attached to nature.	•Bonding, sharing, and companionship
•Moralistic	•Moral and spiritual connection to nature.Emphasizes right and wrong behavior toward the natural environment.	•Order and ethics
•Naturalistic	•The satisfaction we obtain from direct experience with nature.	•Curiosity, outdoor ability, physical well-being
•Negativistic	•The fear and dislikes we have with nature.	•Security, safety and protection
•Scientific	•The study of biological processes and observation of nature.	•The imperative want to obtain knowledge, observation
•Symbolic	•The tendency for humans to use nature to communicate thoughts metaphorically.	•Communication, psychological development
•Utilitarian	•The material gain that humans benefit from the exploitation of nature, either for desire or need.	•Physical sustenance and security

1.2 The Savanna Hypothesis

According to evolutionary theory, humans lived and developed on the East African savannas, a region known for having particular characteristics (Kahn, 1997). Gordon Orians, an ecologist, claims that during the course of this lengthy period of time, the human brain changed and became psychologically attuned to specific environmental features.

He postulated that because the savannah landscape contains essential elements that benefited our ancestors' survival and well-being, humans have a genetic inclination to choose and discover surroundings with characteristics of the savannah landscape.

These qualities consist of:

- Easy-to-move-through grassy meadows with wide-open views.
- A large variety of food-producing plants and animals.
- Hills and vistas that made it simple to monitor the weather or other potential dangers.
- Shallow bodies of water that offered bathing, drinking water, and food. Additionally, the bodies of water served as a defense against adversaries or animals.
- Groups of trees with low trunks and expansive canopies provided climbing opportunities as well as a haven (Heerwagen and Orians,1993)



Fig 3: African Savanna Landscape, Source :(Maion, 2007)

II. BIOPHILIC DESIGN

There are several approaches to incorporate biophilic design in the built environment. Through a building's exterior characteristics, interior layout, interior design, and exterior landscaping, it can connect its users directly, indirectly, or symbolically. The goal of biophilic design is to take use of people's innate kinship with nature in order to enhance their physical and mental health (Kellert, 2005). Above all, biophilic architecture needs to foster a sense of place. Through the use of natural lighting, natural materials, natural ventilation, forms that mirror nature, and vistas of nature, biophilic design can be accomplished (Heerwagen and Hase, 2001).

The fundamental tenet of biophilic design is that structures should serve as human habitats. Environmental psychologist Judith Heerwagen made a parallel with zoo architecture to gain additional understanding. Animals in zoos were housed for many years in modest concrete and chain-link cages. Zookeepers started to worry why their creatures didn't thrive over time. The animals frequently exhibited unpredictable behavior, including pacing, aggressiveness, and withdrawal. Animal psychologists eventually came to the conclusion that the reason why animals weren't thriving was because they had been taken out of their natural home. Today's zoos are built to accurately imitate an animal's natural habitat so that visitors can enjoy seeing them in a setting that nearly resembles their natural home. Animals have been playing, mating, and acting more since these adjustments in zoo architecture. Heerwagen concluded that architects can learn from zoo design and begin to create habitats for humans.

The goal of biophilic design is to create a new framework for the gratifying experience of nature in the built environment in order to remedy the shortcomings of modern architecture and landscape practices (Kellert et al 2008, Kellert 2005, Kellert and Finnegan 2011, Browning et al 2014).

2.1 Principles of Biophilic Design

The goal of biophilic design is to create a new framework for the gratifying experience of nature in the built environment in order to remedy the shortcomings of modern architecture and landscape practises (Kellert et al 2008, Kellert 2005, Kellert and Finnegan 2011, Browning et al 2014). These guidelines (applications) serve as the underlying preconditions for the successful application of biophilic design. They consist of:

1. Biophilic design necessitates consistent and ongoing interaction with nature.
2. Biophilic design emphasises human adaptations to the natural environment that have improved people's health, fitness, and wellbeing over the course of evolution.
3. Biophilic architecture promotes a sense of emotional connection to certain environments and locations.
4. Biophilic design encourages mutual reinforcing, interconnected, and integrated architectural solutions.

2.2 Strategies Of Biophilic Design



DIRECT EXPERIENCE OF NATURE

INDIRECT EXPERIENCE OF NATURE

EXPERIENCE OF SPACE AND PLACE

- Light
- Weather
- Natural landscapes and ecosystems
- Fire
- Air
- Water
- Plants
- Animal

- Images of nature
- Natural materials
- Natural colours
- Simulating natural light and air
- Naturalistic shapes and forms
- Natural geometries
- Biomimicry

- Prospect and refuge
- Organized complexity
- Integration of parts to wholes
- Transitional spaces
- Mobility and way finding
- Cultural attachment to place

Fig 4: Strategies of Biophilic Design, Source: Author

2.3 Biophilic Building Characteristics

Heerwagen has developed a list of biophilic building features that can be applied to interior and exterior architecture.

Table 2: Biophilic Building Characteristics

KEY DIMENSIONS	ATTRIBUTES AND QUALITIES
Prospect (Ability to see into the distance)	<ul style="list-style-type: none"> • Brightness in the field of view (windows, bright walls) • Horizon/sky imagery (sun, mountains, clouds) • Strategic Viewing locations • View Corridors
Refuge (Sense of enclosure or shelter)	<ul style="list-style-type: none"> • Canopy effect, lowered ceilings. • Variations in light levels (darkness suggests refuge) • Enclosing surfaces
Water (Indoors or views)	<ul style="list-style-type: none"> • Glimmering or reflective surfaces • Moving water
Biodiversity	<ul style="list-style-type: none"> • Varied vegetation indoors and out (trees, plants, flowers) • Windows positioned to frame views of nature.
Sensory Variability	<ul style="list-style-type: none"> • Changes that affect the senses • Color, textures, temperature, air movement, natural light.
Playfulness	<ul style="list-style-type: none"> • Incorporation of décor, artifacts, objects, spaces, to delight, surprise and amuse.
Enticement (The desire to know more)	<ul style="list-style-type: none"> • Discovered complexity • Cantilevered balconies, catwalks, obscured or curved pathways and height • Curvilinear surfaces that gradually open information to view

2.4 Relative Merits of Biophilia

The following research is significant because it shows how important nature contact is for human health and productivity:

- Residents who live close to green spaces report fewer social and health issues.
- Exposure to natural environments and features has been linked to healthy childhood maturation and development.
- Activities demanding concentration and memory have been connected to contact with nature.
- Direct contact with nature (such as natural lighting and greenery), as well as representational and symbolic images of nature, have all been demonstrated to improve healing and recovery after illness and major surgical procedures (e.g., pictures).



Fig 5: Many hospital rooms are dominated by technology and devoid of any connection to nature.
Source: Kellert and Calabrese (2015, pg.4)



Fig 6: Research has indicated a view of nature can enhance recovery from illness and surgery, and reduce the need for potent pain medication.
Source: Kellert and Calabrese (2015, pg.4)

- Office settings with natural lighting, natural ventilation, and other environmental features result in improved worker performance, lower stress, and greater motivation.



Fig 7: The majority of offices in the United States are windowless and often sensory-deprived settings.
Source: Kellert and Calabrese (2015, pg.5)



Fig.8: Offices with natural light, materials, and vegetation have been found to increase productivity, improve morale, and reduce absenteeism.
Source: Kellert and Calabrese (2015, pg.5)

III. CASE STUDY 1: AFFINITY BIOPHILIC WELLNESS RESORT

The purpose of this proposed design is to create a solution that addresses the absence of natural elements within urban built environments while promoting biophilic design.

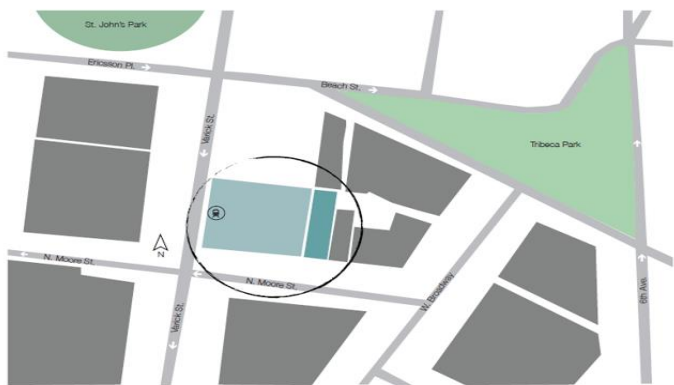
Thus, demonstrating the aspects of a restorative healing environment that can be created to positively influence the overall well-being of clients in dense urban environments. The shell chosen for the Affinity: A Biophilic Wellness Resort is an existing, small residential apartment building with office space on the lower levels. Key elements that have been considered during the selection of the site were its location in Tribeca, New York, a dense urban environment, its modest footprint of 14,600+ square feet, and its close proximity to several natural elements (parks and river walkways). The building is 6-stories high with a basement and rooftop access.

3.1 Existing Layout and Proposed Design Solution

Set up for separate residential apartments on levels 2 through 6 and an office space on the first level. The existing layout does not meet the needs of the restorative healing resort and spa and therefore a complete renovation is required for this project.

Design criteria for major spaces:

- Overall, include biophilic attributes within the space to lower levels of stress, promote well-being and the human-nature connection.
- Integrate inside-outside spaces that promote a sense of prospect & refuge while allowing clients to connect with the natural environment.
- Provide transitional spaces that encourage a sense of connection & extent, allowing clients visual and physical access to the natural environment.
- Integrate active water features to promote change & metamorphosis and to mitigate noise and to act as a positive distraction.
- Integrate living greenery to promote change & metamorphosis and to encourage a sense of fascination.
- Where possible, include natural lighting or lighting that mimic natural lighting that is sourced from above to promote a sense of reverence & spirituality.



- Empty Paved Lot
- Building Shell
- Green Space
- 🚇 Subway Entry

Fig 9(left) Site Plan; Fig 10 (Right) Proximity Chart of Proposed spaces

	Lobby Area	Registration Area	Treatment Rooms	Spa	Yoga & Meditation	Guest Suites	Healing Garden	Kitchen	Restaurant	Storage	Offices	Restrooms	Janitor's Closet	Laundering	Rooftop Garden
Lobby Area	▲	▲	X	X	X	▲	X	X	▲	▲	▲	▲	X	X	X
Registration Area		▲	V	V	X	▲	X	X	▲	▲	▲	X	X	X	
Treatment Rooms			▲	X	X	▲	X	X	V	▲	▲	X	X	V	
Spa				▲	V	▲	X	X	▲	X	▲	X	V	▲	
Yoga & Meditation					▲	V	▲	X	X	▲	X	▲	X	V	▲
Guest Suites						▲	X	X	X	X	▲	X	▲	▲	▲
Healing Garden							▲	X	X	X	X	V	X	X	X
Kitchen								▲	▲	▲	X	X	▲	X	X
Dining									▲	▲	X	▲	▲	X	X
Storage										▲	V	X	▲	▲	X
Offices											▲	V	X	X	X
Restrooms												▲	V	X	X
Janitor's Closet	▲	High Adjacency											▲	V	X
Laundering	V	Medium Adjacency												▲	V
Rooftop Garden	X	No Adjacency Needed													▲

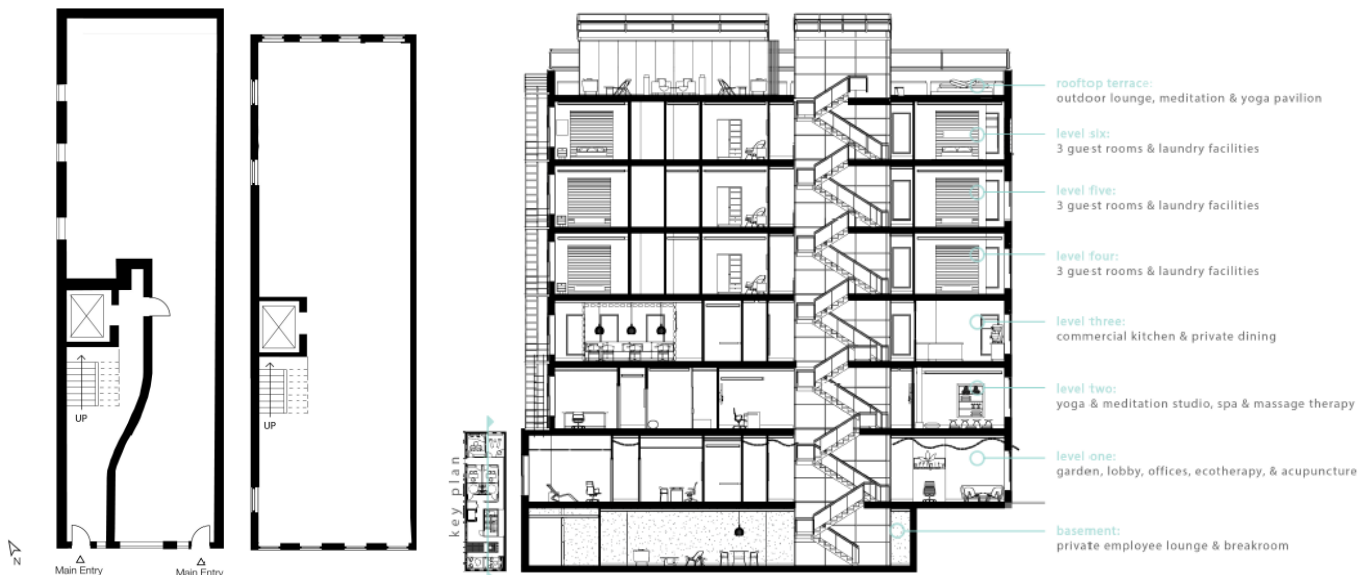


Fig 11: Existing layout (Left) and Proposed Design

The design concept for the Affinity Biophilic Wellness Resort is rooted in the four overarching elements of nature and of biophilic design: earth, water, light, and air. This concept was chosen because we are inclined to share a connection with and respond positively to our natural surrounding habitat, and many studies show how this connectedness often aids in the healing process. These elements reveal themselves in the design through the use of sustainably harvested wood flooring and ceiling installations and through the use of a nature-based color palette of cool greens, purples, natural tones, and brighter accent colors of warm red tones. The elements of nature are also expressed through the use of contrasting smooth and highly tactile surfaces and textures and with curvilinear and rounded furniture pieces and fixtures.



Fig 12: Concept imagery; Amanda Courtney Cleveland;2014

3.3 Major Design Features

The following Design features contribute to making Affinity a Biophilic Wellness Resort.



Fig 13(Left) Central Stair Tower on rooftop terrace and Fig 14 (right): Living greenery wall; Amanda Courtney, Cleveland;2014



Fig 14 (Left): Healing Garden; Fig 15 (Right) Yoga & meditation studio water feature; Amanda Courtney Cleveland;2014



Fig 16 (Left): Rooftop terrace seating area; Fig 17 (Right): Lobby waterfall feature; Amanda Courtney Cleveland;2014

V. CASE STUDY 2: MYST RESIDENCES, KASAULI, H.P

The first residential development in India to use biophilic architecture is called Myst. It's a strategy that offers residents every convenience while bringing them closer to the unspoiled nature of the Kasauli hills. Llewelyn Davies Yeang, the foremost authority in sustainable architecture, created this unique gated neighborhood.

Luxury living is given a new dimension by the expansive Mountain vistas, native flora, fresh air, and cascading streams of water that form a part of the living experience. The end effect is not simply aesthetically pleasing; it also represents a sustainable and enjoyable way to live in harmony with nature.



Fig 18: Expansive Mountain views; Accommodation times (2015)

4.1 Location and Site

Myst is located in the foothills of the Himalayas near Kasauli, 5,500 feet above sea-level. It is about 65 kms from Chandigarh airport.



Fig 19 (left): Site plan; Fig 20 (right) Location plan, Impact projects (2013)

4.2 Major Design Features

Biophilic design permeates deep into the creation of Myst residences, to convey the experience of living closer to nature.

Bright and airy living spaces boast large balconies and extra-large windows to take in the spectacular views of the hills. Double-height green walls in the shower area of select residences soothe and refresh the spirit. Select residences even have a gallery from which to observe the area's unique birds and butterflies while you read or paint. These 76 residences range from double-level 2-bedroom town houses, to 5-bedroom multilevel villas. Materials like stone and faux timber used in the architecture of the residences create a rustic look.

Natural green roofs in select residences are also a distinctive element of this development. Each residence is designed with an open-plan interior that gives a sense of space. The warm rays of the sun penetrate through large glazed windows, giving the residences a bright, airy character.



Fig 21: entering the club house precinct; Utopia consulting (2014)



Fig 22: workout in the gym with scenic view; Impact projects (2013)



Fig 23: grand entrance pavilion detailed as a kund with lotus pond; tata housing.design (2015)



Fig 24: outdoor dining with beautiful views around; tata housing.design (2015)



Fig 25: biodiversity park imparts tranquillity; Utopia consulting (2014)



Fig 26: natural walkways for healthy living ; Impact projects (2013)



Fig 27: lotus pond with seating area ; tata housing.design (2015)



Fig 28: master bedroom with views of surrounding kasauli hills ; Impact projects (2013)

VI. CASE STUDY 3: TUCSON MEDICAL CENTRE FOR CHILDREN (TMC)

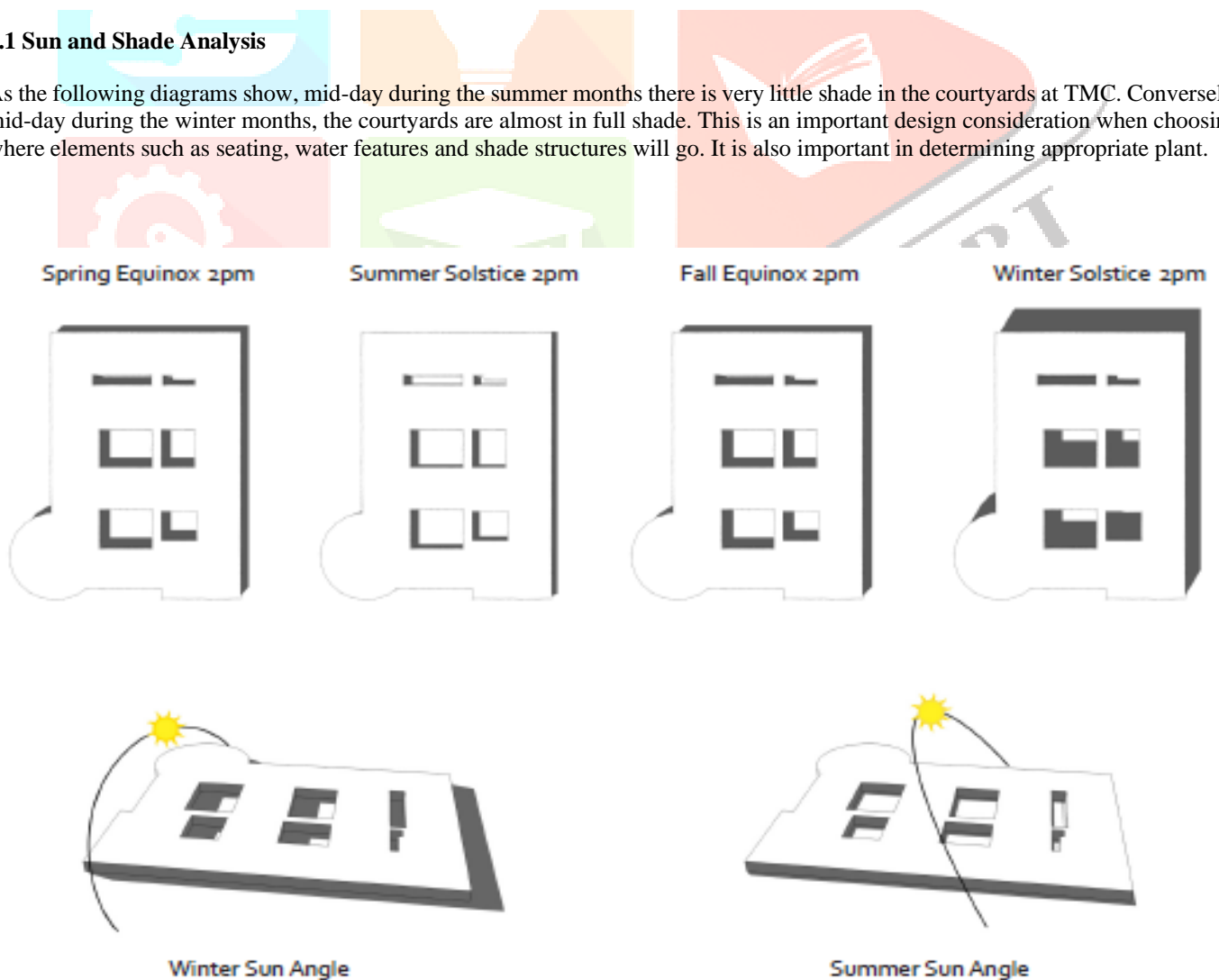
On the eastern fringe of the Sonoran Desert in southern Arizona is where you'll find Tucson. The 300-acre Tucson Medical Center site was developed in 1927. It was first established as the Desert Sanatorium, a top-notch tuberculosis facility, during World War II. The sanatorium was the first in the nation to explore using the sun's radiation to treat tuberculosis. The Desert Sanatorium was intended to feel like a place of recovery rather than one of illness or dread (Tucson Medical Center, 2012). Several courtyards and sunning decks were incorporated into the original design to allow patients to go outside for their recommended sun exposure.



Fig 29: Location: TMC ; Deryn Davidson (2013)

5.1 Sun and Shade Analysis

As the following diagrams show, mid-day during the summer months there is very little shade in the courtyards at TMC. Conversely, mid-day during the winter months, the courtyards are almost in full shade. This is an important design consideration when choosing where elements such as seating, water features and shade structures will go. It is also important in determining appropriate plant.



5.2 Project Goals and Objectives

To integrate elements and principles of biophilic design for incorporating naturalistic spaces into children’s acute health care facilities.

- Incorporate elements of biophilic design as related to landscape architecture.
- Create a plant palette that is regionally appropriate to the medical context of the site.



Fig 31: Site Images; Deryn Davidson (2013)

5.3 Design Program

Table 3: Site Images; Deryn Davidson (2013)

Element	Function	Feature	Qualitative
Wildlife Habitat	Provide habitat for native fauna in the urban context, visual interest	Bee boxes, birdhouse, native vegetation, water features	Native plant palette and handcrafted elements
Sensory Stimulus	Provide positive distraction	Sensory tables, shade wall, animal tracks, water features, vegetation	Diversity of elements
Intimate seating	Provide quiet space for visitors	Shaded pergola, seat walls, citrus tree circle	Small secluded areas
Group seating	Provide space for large gathering, encourage social interaction	Seat walls, rock spiral	Large open areas with ample seating and shade
Shade	Address human comfort needs	Large trees, pergola, entrance shade structure, lean-to, cave	Increase biodiversity and canopy cover
Topography change	Encourage exercise	Rock spiral, tunnels, bird’s nest canopy walk, climbing wall, cave	A variety of spaces to explore and discover
Water features	Provide wildlife habitat, positive distraction for users	Water wall, fountain, seep	Tranquil spaces for relaxation and active space for water play
Play structures	Encourage exercise, encourage mobility, encourage social interaction	Climbing wall, tunnels, cave, lean-to, rock spiral, turtle seat-structures, maze, wash station, citrus tree circle, bird’s nest canopy walk	Variety of elements for active participation in groups or individually
Storage	Provide central place for maintenance equipment	Tool shed/farm stand	
Entrance/exit	Invite people into the site and allow for maintenance	Entrance archway, animal tracks door dressing	Inviting threshold that welcomes users into the space
Wash station	Provide place for users to clean up after playing	Rain collection cistern with splash pad	Active area for clean up and play
Interior/exterior relationship	Create a connection between the inside and outside spaces	Animal tracks, door and window dressing, seating	Blur the line between inside and outside spaces
Vegetation	Create a lush environment	Native vegetation	Vertical structure with vegetation to provide different areas of interest and distraction

5.4 Biophilic Design Features



Fig 32: Courtyard with Shaded seating; Deryn Davidson (2013)

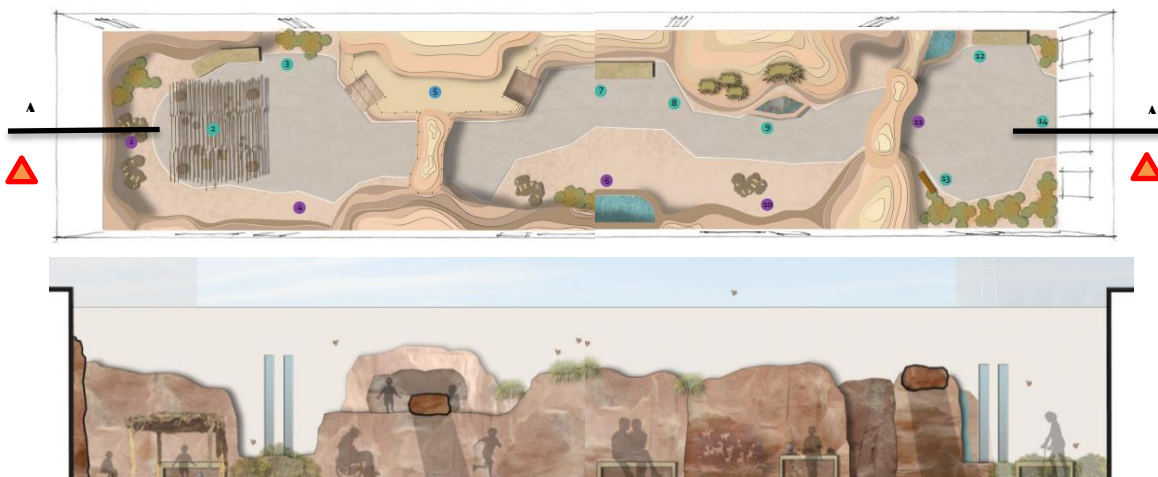


Fig 33: The Canyon with Biophilic features; Deryn Davidson (2013)

VII. CASE STUDY 4: HOTEL TRIDENT, GURGAON

There is an oasis right in the middle of the busy city of Gurgaon, where you can take a moment to enjoy the scenery, listen to the birds chirp, and smell the new grass. Trident, Gurgaon extends a gracious welcome to you with grandeur and style.

Low-rise and covering seven acres, Trident in Gurgaon was created by Thai architect Lek Bunag. The hotel's design incorporates the elements of air, water, and light from nature. 136 modern rooms and suites are housed inside the original beige dome-like facade and are outfitted with all the current conveniences for discerning visitors.

Trident, Gurgaon has reflecting pools, courtyards, and gardens that give the neighborhood a resort-like feel. The tranquil atmosphere permeates every area of the hotel, including the spa, swimming pool, palm courtyard, dining areas, and the main lobby. Then the hotel transforms itself when fire torches light up and create drama while reflecting light on the pool.



Fig 34: Views; hotel trident pvt. Ltd. (2015)

6.1 Location

443, Udyog Vihar Phase V, Phase V, Sector 19, Gurgaon, Haryana 122016.

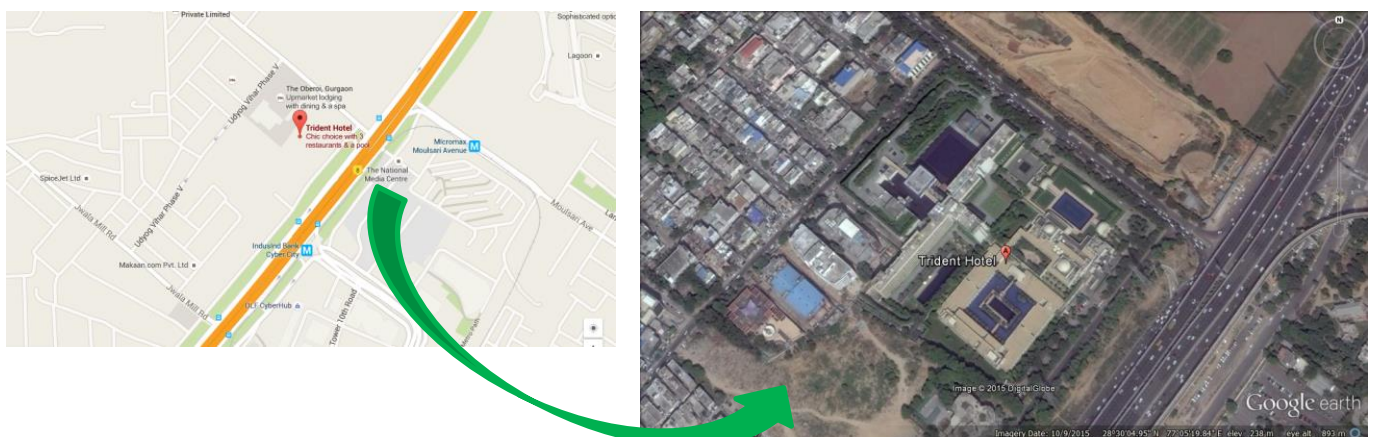


Fig 35: Site location; Hotel Trident pvt. Ltd. (2015)

6.2 Design Features



Fig 36 The Superior Garden View Rooms overlook the hotel's manicured lawns. Trident gurgaon,(2015). hotel trident pvt. Ltd. (2015)



Fig 37 Measuring 309 square feet, the Superior Pool View Rooms offer a beautiful view of the reflection pools. Trident gurgaon,(2015). hotel trident pvt. Ltd. (2015)



Fig 38 Hear the water splash against the picture windows in Executive Suites, built on the edge of a vast reflection pool. Furnished in warm, earthy tones, the rooms are thoughtfully designed. Trident gurgaon,(2015). hotel trident pvt. Ltd. (2015)



Fig 39 Measuring 1560 square feet, the Presidential Suite lies at the edge of the reflection pool dotted with Frangipani trees. The spacious living room is just the place to enjoy these serene views, with its large floor to ceiling windows that bring the outdoors in. The traditional 'gold' work on the walls and the wooden bookshelves add a classic grandeur to the décor. Trident gurgaon,(2015). hotel trident pvt. Ltd. (2015)

VIII. INFERENCES

Thus, concludingly we can see that all the above biophilic elements are not present in all the case studies but all have tried incorporating many of the elements in the best way possible. So far, Tuscan medical centre incorporates most of the elements in its design. Poor indoor air quality or lack of access to nature can become sources of environmental stress affecting recovery time and staff productivity. Therefore, these elements are extremely important to look at, as they can address many of the physical and psychological responses to well-being for patients, visitors, and staff.

Table 4: Derived Inferences

Biophilic Elements	Present	Design Implications
Environmental features	yes	Water features, rock seating, cave, bee boxes, rabbit den, bird houses.
Natural shapes and forms	yes	Spirals
Natural patterns and processes		
Light and space	yes	Shadow wall, shaded seating, ramada, lean to, cave, pergola.
Place--based connection	yes	Native vegetation, trees.
Evolved human--nature relationship	yes	All environmental features.
Change and resilience	yes	Sensory tables, shade walls, animal tracks, water features, vegetation.
Discovered complexity	yes	Rock spirals, tunnels, climbing walls.
Multi--sensory	yes	Sensory tables, shade walls, animal tracks, water features.
Transformability	yes	Animal tracks, Door and Window Dressing, Seating.

IX. PROPOSAL

The following ways should be incorporated in a space to achieve efficient biophilic design.

Table 5: Proposal

WAYS	DESIGN CONSIDERATIONS
1. Extend Gardens into Lobbies and Waiting Areas	<ul style="list-style-type: none"> Bound spaces with features that relate to the exterior. Continue paving patterns and materials into the lobby or waiting areas.
2. Provide Terraces	<ul style="list-style-type: none"> Provide terraces in mild climates. Provide a solarium in more extreme climates. Specify furniture and native plant material
3. Locate Meditation Gardens or Atriums	<ul style="list-style-type: none"> Create a space that is protected and private . Include design features that allow for sitting among plant material or flowers.
4. Place Window Seats and Alcoves Along Public or Long Corridors	<ul style="list-style-type: none"> Locate convenient, smaller spaces throughout the facility. Very ceiling heights and seating options within these spaces. Introduce materials and plants that relate to the exterior.
5. Provide Nighttime Lighting of Gardens for Views from Interior	<ul style="list-style-type: none"> Highlight a focal point or larger trees within the space . Consider lighting any water features.
6. Incorporate In-between Areas from Interior to Exterior	<ul style="list-style-type: none"> Provide portals or thresholds that blur the line of interior and exterior. Consider fenestrations that allow for dappled sun and breezes to move through the in-between space.
7. Views to the Exterior	<ul style="list-style-type: none"> Consider the proportions of these views in relation to human scale. Provide views that are in proximity to natural ecosystems around the site.
8. Situate Courtyards so They Can Serve as Way-finding Elements	<ul style="list-style-type: none"> Provide access into the courtyard and terraces or windows from levels above
9. Provide Indoor Nature Walking Path	<ul style="list-style-type: none"> Provide handrails, goals, and resting points throughout the designated path. Consider the path as an opportunity for physical exercise and movement.
10. Provide Access to Sensory Features and Materials	<ul style="list-style-type: none"> Consider introducing sounds of nature or water in interior spaces that are adjacent to exterior spaces containing these features. Introduce fireplaces into waiting areas or lounge. These create a sense of warmth and a residential quality that is soothing. Consider plantings and materials that have tactile qualities. Select some plants whose foliage moves easily.
11. Incorporation of Day-light	<ul style="list-style-type: none"> Reflect light into interior spaces to avoid glare. Introduce pools of light to encourage movement into a space. Use Screens to Filter Light and Views.
12. Introduce Plant Material into the Interior	<ul style="list-style-type: none"> Design built-in features for plants to insure their incorporation into projects. Introduce native plant species where applicable.
13. Forms – Simulate Rather than Replicate Natural Element	<ul style="list-style-type: none"> Introduce sinuous, flowing shapes. Consider golden proportions and hierarchy
14. Materials	<ul style="list-style-type: none"> Incorporate natural colors. Reference local and indigenous materials whenever possible to increase the sense of place. Include materials that have an expression of age such as salvaged wood, honed stone, etc. Use material color and texture to assist in way-finding.

X. CONCLUSION

At the heart of this thesis research lies the theory of biophilia which describes the innate affinity that humans have for nature. Natural environments afford healing and restorative benefits in the form of positive shifts in cognitive, physical, and social functioning. By creating verdant environments that are sensory-rich and accommodate physical experiences with nature beyond the passive experience of simply viewing it from the interior, a garden can provide healing benefits beyond the architectural walls of the healthcare building.

To further facilitate well-being, the built spaces need to be environments that reconnect the body and mind and foster a sense of place. These healing effects can be achieved through biophilic and sensory encounters within the facility.

Using concepts of biophilic design to guide decisions for the built environment, spaces are designed to support healing through biophilic responses and connection to natural elements and systems. Through continued research, innovation, and interdisciplinary approaches, new solutions for increased integration of natural elements within the built environment can begin to foster greater levels of connection to nature and improved human health and well-being.

XI. REFERENCES

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