



Indian Knowledge Systems and Biophilic Design: Exploring Traditional Connections Between Nature and Built Environment

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Abstract

Indian traditions have long treated people, nature and the built environment as closely connected. Long before the term 'biophilic design' became common, Indian homes and settlements used courtyards, verandahs, water, plants, natural materials, filtered daylight and climate-responsive openings as part of everyday life. These elements were not used only for decoration; they helped people respond to climate, carry out daily activities and experience a stronger connection with nature. This paper explores how Indian Knowledge Systems (IKS) can inform contemporary biophilic interior and spatial design. The study follows a qualitative and comparative case-study approach. It reviews traditional practices and maps them against selected biophilic-design principles. Four recurring strategies are examined: courtyards; plants and water; transitional spaces; and filtered connections through jaali and openings. Examples from Kerala, Rajasthan, Gujarat and Tamil Nadu are compared to understand how these strategies respond to climate, social life, sensory experience and cultural practices. The findings suggest that many traditional Indian spaces naturally achieved qualities now associated with biophilic design, including views of nature, changing daylight, natural ventilation, natural materials, prospect and refuge, and sensory variety. The main value of IKS is therefore not in copying historical forms. It is in understanding the thinking behind them and adapting that thinking to present-day needs. The paper proposes an IKS–Biophilic Design Translation Framework linking traditional knowledge with environmental performance, user well-being, sustainable materials and cultural identity.

Keywords: Indian Knowledge Systems, Biophilic Design, Vernacular Architecture, Courtyard, Jaali, Nature-Based Design, Interior Design, Sustainability, Traditional Knowledge

1. Introduction

Modern buildings often create highly controlled indoor environments through artificial lighting, air-conditioning, mechanical ventilation and synthetic finishes. These systems are useful, but when they dominate the design, people may have fewer opportunities to experience daylight, fresh air, plants, natural materials and seasonal change. Biophilic design responds to this concern by bringing meaningful connections with nature into the built environment.

The idea of connecting people with nature, however, is not new in India. Traditional homes developed through close observation of climate, local materials, vegetation, water and social life. Indian Knowledge Systems also recognise architecture as an important area of traditional knowledge. Across regions, houses such as Kerala Nalukettu and Ettukettu, Tamil Nadu Chettinad houses and agraharams, Gujarat Pol houses, Rajasthan havelis and Maharashtra Wadas show different responses to local

conditions. Although their forms vary, many create an intermediate relationship between enclosed rooms and the natural environment.

The courtyard is one of the clearest examples. Instead of keeping nature outside, it brings the sky, daylight, air, plants and sometimes rain into the centre of the home. Its size, orientation and relationship with openings can influence sunlight, air movement and everyday use of the space.

The jaali is another simple but effective example. It can provide shade and privacy while allowing air and filtered light to enter. Its patterned shadows also add movement and visual interest to interiors.

This is an important distinction for the present study. The aim is not to idealise traditional architecture. The aim is to understand the practical design intelligence within these traditions and consider how it can be used in contemporary interiors.

2. Research Objectives

The main objective of this study is to understand how principles found within Indian Knowledge Systems can support contemporary biophilic interior and architectural design.

To investigate how principles embedded within Indian Knowledge Systems can contribute to contemporary biophilic interior and architectural design.

Research Objectives

1. To identify traditional Indian spatial practices that establish connections between people and nature.
2. To examine the relationship between these practices and contemporary biophilic-design principles.
3. To analyse selected Indian vernacular case studies from different climatic and cultural regions.
4. To identify opportunities for translating traditional environmental knowledge into contemporary interiors.
5. To develop an IKS–Biophilic Design Translation Framework for designers.

3. Research Methodology

The study uses a qualitative, comparative case-study method supported by a review of relevant literature and a biophilic-design mapping approach.

4. Research Structure

The research was carried out in five stages:

Stage 1 – Literature Review

Literature concerning:

- Indian Knowledge Systems
- traditional architectural knowledge
- Indian vernacular architecture
- biophilic design
- climate-responsive design
- courtyards
- jaali
- natural materials
- indoor environmental quality

Traditional architectural knowledge is increasingly being studied as a knowledge system in its own right, rather than only as a collection of old building forms. This perspective helps us understand the principles that shaped traditional residential environments and their possible relevance today.

Stage 2 – Identification of Traditional Design Strategies

Four broad nature-related strategies were selected for comparison:

Traditional Strategy	Environmental connection
Courtyard	Sky, daylight, air, vegetation
Verandah/transition space	Shade, breeze, outdoor connection
Jaali/opening	Filtered light, air and visual connection
Plants/water/natural materials	Sensory and ecological connection

Stage 3 – Case Study Analysis

Four regional traditions were selected:

- Kerala – Nalukettu
- Rajasthan – Haveli/Jali tradition
- Gujarat – Pol houses
- Tamil Nadu – Chettinad houses

Together, these examples represent different climatic settings, materials and cultural practices.

Stage 4 – Biophilic Mapping

Each traditional strategy was mapped against selected contemporary biophilic-design principles to identify areas of similarity and difference.

Stage 5 – Framework Development

The results were brought together to create the proposed IKS–Biophilic Design Translation Framework.

5. Conceptual Framework

The relationship between traditional knowledge and contemporary biophilic design can be understood as a simple chain:

- Indian Knowledge
- Observation of Nature
- Environmental Response
- Spatial Strategy
- Human Experience
- Contemporary Biophilic Design

For example:

Climate → Heat and solar radiation → Jaali → Filtered daylight + ventilation → Visual comfort → Biophilic application

Similarly:

Sky + vegetation + air → Courtyard → Open-to-sky space → Daylight + greenery + ventilation → Nature connection → Contemporary courtyard interior

This way of looking at traditional architecture changes the question from “What did traditional buildings look like?” to “What did traditional builders learn from nature and climate?”

6. Traditional Indian Knowledge and Nature

Indian traditional architecture is not one single system. It changes from region to region according to climate, geography, materials, culture and community needs. Even with this diversity, some common relationships between people, nature and space can be seen.

One of the strongest common themes is the use of nature as part of the interior and spatial experience.

6.1 Nature as an Internal Spatial Component

In many modern buildings, plants are added after the main space has already been planned. In several traditional Indian houses, nature was part of the planning from the beginning. The courtyard is the clearest example.

The open-to-sky courtyard allows the house to interact with:

- sunlight
- air movement
- rain
- vegetation
- seasonal changes
- changing shadows
- outdoor activities

The Kerala Nalukettu, for example, is organised as built blocks around an open courtyard. Verandahs around the courtyard provide shade and protection from rain while keeping the connection between inside and outside. Traditional materials such as laterite, timber, bamboo, lime and clay tiles further strengthen the sense of place.



6.2 Vegetation as More Than Decoration

Plants in traditional spaces often served more than one purpose. They could support comfort, everyday activities, sensory experience and cultural practices at the same time.

They could provide:

- shade
- cooling
- sensory stimulation



- food or medicinal resources
- visual relief
- cultural significance
- seasonal variation

A plant in a courtyard therefore represents more than an ornamental object. It can become part of the environmental system, daily routine and character of the space.

7. Case Studies

Case Study 1: Kerala – Nalukettu

The Nalukettu is a strong example of how traditional Indian knowledge can shape a nature-connected interior. Built spaces are arranged around an open central courtyard, allowing daylight and air to enter while surrounding verandahs provide shade and protected movement.

The courtyard creates a direct relationship with sky, light and air, while the surrounding spaces provide a comfortable transition between inside and outside. The use of timber, laterite, bamboo, lime and clay tiles also creates a strong material connection with the local environment.

Biophilic Interpretation

Traditional Element	Contemporary biophilic meaningBiophilic Interpretation
Central courtyard	Direct nature connection
Open sky	Dynamic daylight
Verandah	Prospect/refuge
Timber	Natural material connection
Garden	Visual connection to nature
Rain exposure	Awareness of seasonal change
Operable openings	Natural ventilation

Research Significance

The important lesson is not simply to add a courtyard to a modern building.

The deeper lesson is to organise spaces so that people can benefit from natural environmental conditions in a controlled and comfortable way.

This principle can be adapted to apartments, institutional buildings, hospitality spaces and contemporary homes.

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Case Study 2: Rajasthan – Havelis and Jaali

Rajasthan's hot and dry climate encouraged shaded and inward-looking spaces. In havelis, jaali screens became an important part of this response. They help control sunlight, improve privacy and support air movement while creating a changing visual experience. Jaali screens represent an important environmental device. Research examining jaali in traditional and contemporary buildings



identifies functions including shading, privacy, ventilation and control of direct solar radiation

Biophilic Interpretation

The jaali creates a middle ground between an open window and a solid wall. It does not completely block nature; instead, it filters it.

Instead, it **filters nature**.

Sunlight becomes:

- pattern
- shadow
- movement
- visual texture
- temporal experience

This connects well with biophilic ideas such as dynamic light, material richness and sensory change.

Case Study 3: Gujarat – Pol Houses

Gujarat Pol houses show that even dense urban neighbourhoods can include courtyards and semi-open spaces. Their compact planning responds to both social and environmental needs while maintaining shared internal spaces.

For contemporary cities, the Pol house is especially relevant because it challenges the idea that high density must mean less contact with nature. Its planning suggests that density, shared open space, environmental comfort and social interaction can exist together.

Design Lesson

This makes the Pol house particularly useful when thinking about present-day urban housing, where space is limited but the need for daylight, ventilation, greenery and community interaction remains important.

The Pol demonstrates an alternative:

A useful contemporary lesson is: high density + shared open space + environmental connection + social interaction.

This suggests that biophilic design should not be limited to large independent houses.

It can also be explored within:

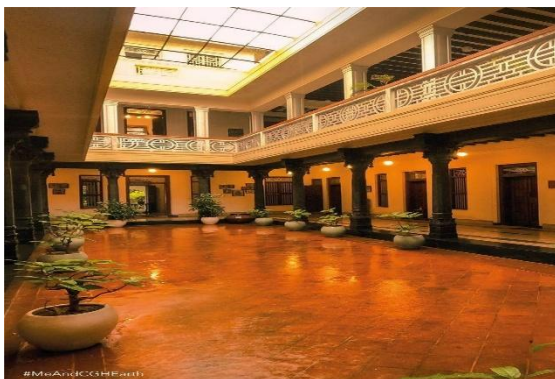
- apartments
- student housing
- co-living
- mixed-use developments
- dense urban neighbourhoods

Case Study 4: Tamil Nadu – Chettinad Houses

Chettinad houses are important because their planning combines courtyards, shaded circulation, natural materials and generous social spaces. The courtyard works as both an environmental and social interface rather than simply as an empty central area.

Its organisation shows how climate response, family life and cultural practices can be brought together within the same spatial system.

The Chettinad courtyard can be interpreted as a **multi-functional environmental and social interface** rather than merely an empty central space.



Biophilic Interpretation

The courtyard produces:

- changing daylight
- views of sky

- movement of air
- connection with vegetation
- changing shadows
- social interaction
- sensory diversity

Because of this combination of environmental and social qualities, the Chettinad courtyard is relevant to both biophilic design and the study of how people experience space.

Comparative Analysis

Design principle	Kerala	Rajasthan	Gujarat	Tamil Nadu
Courtyard	✓✓✓	✓✓✓	✓✓	✓✓✓
Filtered daylight	✓✓	✓✓✓	✓✓	✓✓
Natural ventilation	✓✓✓	✓✓	✓✓	✓✓
Vegetation	✓✓✓	✓	✓✓	✓✓
Transitional spaces	✓✓✓	✓✓✓	✓✓	✓✓✓
Natural materials	✓✓✓	✓✓✓	✓✓	✓✓✓
Cultural/social use	✓✓✓	✓✓✓	✓✓✓	✓✓✓

8. Research Findings

The comparison identified seven main findings:

Finding 1: Traditional Indian architecture often integrated nature spatially rather than decoratively.

Courtyards, gardens, water and sky were often built into the spatial organisation itself. Nature was therefore part of the design rather than something added at the end.

This is different from simply placing indoor plants in a finished interior. The relationship with nature begins at the planning stage.

Finding 2: Transitional spaces are crucial.

Verandahs, shaded corridors, semi-open platforms and courtyards create a gradual transition between indoors and outdoors. They can offer shade, airflow, views, social interaction and a sense of psychological transition.

These spaces can provide:

shade → ventilation → visual connection → social interaction → psychological transition

Finding 3: Light was treated as an experiential material.

Jaali and other filtered openings show that natural light can be shaped and controlled. The changing pattern of light and shadow adds time, movement and visual interest to the interior.

The resulting movement of shadows produces temporal variation within the interior.

Finding 4: Climate and culture were interconnected.

Traditional spaces were not designed only for climate control. They also supported family life, rituals, domestic work, gatherings, privacy and seasonal activities.

They also accommodated:

- family interaction
- rituals
- domestic work
- social gathering
- privacy
- seasonal activities

Recent courtyard research similarly identifies both climatic and cultural relevance as central to these spaces.

Finding 5: Local materials contribute to sensory connection.

Stone, lime, timber, clay tile, brick and other regional materials add tactile and visual qualities that are often difficult to reproduce with synthetic finishes. They also help create a stronger sense of place and local identity. Their importance therefore extends beyond embodied-energy considerations to **sensory experience and place identity**.

Finding 6: Biophilic design and IKS overlap but are not identical.

This is an important finding.

It would be too simple to describe traditional Indian architecture as ‘biophilic design before biophilic design existed’. IKS and contemporary biophilic design developed from different knowledge traditions. The useful connection is in identifying where their principles overlap.

Instead, the two approaches emerged from different intellectual contexts.

The useful research opportunity lies in **mapping areas of convergence**.

Finding 7: Traditional knowledge should be translated, not copied.

A traditional courtyard cannot always be inserted directly into a high-rise apartment. Instead, its underlying idea can be adapted through vertical courtyards, sky courts, planted balconies, atriums, green internal pockets, shaded communal corridors, operable screens and daylight wells.

Instead, its underlying principles can be translated into:

- vertical courtyards
- sky courts
- planted balconies
- atriums
- green internal pockets
- shaded communal corridors
- operable screens

- daylight wells

This approach provides a more practical way of carrying traditional knowledge into contemporary design.

10. Proposed IKS–Biophilic Design Translation Framework

The proposed framework follows six steps:

- **TRADITIONAL KNOWLEDGE**
- **ENVIRONMENTAL OBSERVATION**
- **DESIGN PRINCIPLE**
- **SPATIAL TRANSLATION**
- **USER EXPERIENCE**
- **CONTEMPORARY PERFORMANCE**

For example:

IKS Element	Underlying idea	Contemporary use
Aangan/Courtyard	Bring nature inside	Internal green courtyard
Verandah	Transitional climate buffer	Semi-open lounge
Jaali	Filter light + air	Perforated façade/screen
Tulsi/plant court	Everyday nature connection	Therapeutic indoor garden
Water element	Sensory + microclimatic quality	Reflective water feature
Lime/stone/wood	Material connection	Natural finish palette
Shaded opening	Solar control	External shading system
Open-to-sky space	Sky connection	Atrium/skylight
Local craft	Cultural identity	Artisan-made interiors

11. Proposed Design Model for Contemporary Interiors

A contemporary Indian interior informed by IKS and biophilic design can be organised through five connected layers:

Layer 1 – Nature

Introduce:

- plants
- water
- daylight
- natural air
- sky views

Layer 2 – Climate

Respond through:

- shading
- orientation
- ventilation
- thermal mass
- appropriate openings



Layer 3 – Material

Use:

- stone
- timber
- lime
- clay
- bamboo
- natural fibres
- locally sourced materials

Layer 4 – Culture

Integrate:

- craft
- local patterns
- spatial rituals
- community practices
- regional identity

Layer 5 – Technology

Technology should support the design rather than replace its environmental logic. Useful tools include sensors, automated shading, daylight controls, smart ventilation and environmental monitoring.

- sensors
- automated shading
- daylight controls
- smart ventilation
- environmental monitoring

Together, these five layers create a contemporary model that respects traditional knowledge without trying to recreate the past literally.

12. Research Gaps

The study also highlights several areas where more research is needed.

1. Many Vastu-based recommendations still need stronger scientific and measurable validation.
2. There are relatively few empirical studies that measure the environmental performance of traditional principles when they are adapted to contemporary interiors.
3. There is also no widely accepted method for evaluating psychological and spiritual effects in a consistent way.
4. The relationship between sacred geometry, traditional spatial knowledge and modern sustainability tools needs further investigation.
5. More post-occupancy studies are needed to understand how people actually experience these spaces after they are built.

13. Proposed Solutions

The following approaches can help address these gaps:



1. Flexible interpretation of Vastu: Instead of applying traditional rules mechanically, designers can interpret relevant principles in relation to climate, site, function and user needs.
2. Integration with environmental design: Traditional ideas can be considered alongside passive solar design, climate-responsive planning and sustainable materials.
3. Interior design interventions: Where major architectural changes are not possible, ideas can be explored through spatial zoning, colour, lighting, motifs and sacred-geometry patterns.
4. Technology integration: Digital simulation and monitoring can be used to study daylight, ventilation and energy performance before and after design interventions.

14. Conclusion

This study suggests that Indian Knowledge Systems can offer useful ideas for contemporary biophilic design when they are understood in context. Traditional Indian homes often created meaningful relationships between people and nature through courtyards, shaded transitional spaces, filtered openings, vegetation, water and natural materials. These strategies responded not only to climate but also to social and cultural life.

The findings also show that traditional knowledge should not be copied as a fixed historical style. In today's dense urban settings, designers may need to reinterpret the same principles through atriums, sky courts, planted balconies, green pockets, shaded corridors, operable screens and carefully designed openings. Vastu, sacred geometry and cosmological ideas can also be studied in this broader framework, provided they are applied thoughtfully and evaluated where possible.

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