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Biophilic Design in Campus Planning – A Critical Review

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ABSTRACT :
Biophilic design, an innovative approach that integrates nature into built environments, has garnered significant attention in campus planning as a means to enhance the well-being of students, faculty, and staff. This design philosophy emphasizes the inherent human connection to nature, promoting psychological and physiological benefits through the incorporation of natural elements in educational settings. This paper explores the principles of biophilic design and its application in campus planning, highlighting its potential to improve academic performance, foster community engagement, and increase overall satisfaction within educational institutions. Case studies from various campuses demonstrate successful implementations of biophilic strategies, such as green roofs, natural lighting, and outdoor learning spaces. The findings suggest that biophilic design not only enhances the aesthetic appeal of campuses but also contributes to sustainability goals, making it a vital consideration for future educational developments. Ultimately, this research underscores the importance of designing educational environments that nurture both the mind and the body, advocating for a holistic approach to campus planning that prioritizes connectivity to nature.

1 INTRODUCTION

As universities and colleges increasingly recognize the importance of holistic educational experiences, biophilic design emerges as a vital tool. By integrating natural features such as green spaces, water elements, and natural light into campus layouts, institutions can promote not only the physical health of students and faculty but also their mental and emotional well-being. Research has shown that access to nature can reduce stress, improve focus, and enhance creativity, making biophilic design a strategic investment in the academic success and overall quality of life for campus communities. Moreover, biophilic design aligns with sustainability goals, promoting ecological stewardship and resource efficiency. By prioritizing native plant species, sustainable materials, and green infrastructures, campuses can reduce their environmental impact while fostering biodiversity and creating resilient ecosystems. In this paper, we will explore the principles of biophilic design and its application in campus planning. We will examine the benefits it brings to educational environments, analyze successful case studies, and discuss the challenges and considerations involved in implementing biophilic strategies.

2 BIOPHILIC DESIGN IN ARCHITECTURE:

Biophilic design is an approach to architecture that seeks to connect people with nature and incorporate natural elements into built environment.

2.1.1HISTORY OF BIOPHILIC DESIN - THE NEED

2.1.1.1 THE BIOPHILIA HYPOTHESIS:

The biophilia hypothesis is the belief that humans are genetically predisposed to be attracted to nature. It states that all humans inherently love the natural world.

2.1.1.2 HISTORICAL EVIDENCES ON BIOPHILIC DESIGN:

Homosapiens as a species have been a part of nature for over 200 millennia As bio- centric species we evolved in

the wilderness of the of nature Early human inhabited the savannah land scapes in east Africa as hunters and gatherers It is these surroundings that our prehistoric ancestors
inhabited throughout evolutionary development .This attachment with the environment become in grained in our psyche, DNA and Brain adaptation. Even when we are detached from nature in todays time ,we feel most connected to over selves in natural surrounding .This affinity towards nature is known as '**Biophillia' INDUSTRIAL REVOLUTION – 260 YEARS –** rapid growth in human population and built environment .we have shifted from the wild to Highly mechanized environments and structures .This in turn affect our wellbeing .

2.1.1.3 HISTORICAL EVIDENCES ON BIOPHILIC DESIGN: NATURAL THEMES – FOUND IN VARIOUS FORMS IN THE HISTORY

- **The stylized animal and plants in frescoes – Ajanta caves**
- **Statues of animals ,lions and elephants** – ancient hindu temples, **fractel theory in temple structure** .
- Other examples – **Egyption sphinx** , **carvings in greek structure** , **sculpture s of dragons in chinese pagaodas .**
- The buildings was also integrated with natural elements such as **– courtyard gardens in spain** ,**ponds in egpt ,**
- **Fish bowls in ancient china** , **hanging gardens in babylon.**

2.2 THEROTICAL BASIS OF BIOPHILIC DESIGN IN ENVIRONMENTAL PSCYCOLOGY:
The value of contact with nature leads to human well being**.**

2.2.1ORIGINS OF BIOPHILIC DESIGN:

- The concept of biophilic design built upon, theory of biophilia. Many theories from **environmental psychology demonstrate humans' need for 'nature'** is due to an **instinctive feeling towards natural elements.**
- Such **theories explain the mechanism** through which **physical and mental functions** are generated from **contact with 'nature**. These theories provide the **theoretical foundation** for the development of **biophilic design.**

2.2.2 POINEERS OF BIOPHILIC DESIGN
The term Biophilia was coined by social psychologist Erich Fromm (1964) : To describe the 'love of life' that explained two fundamental tendencies of living organisms**American biologist Edward O. Wilson in his work Biophilia (1984):**which proposed that the tendency of humans to focus on and to affiliate with nature and other life-forms has, in part, a genetic basis.Wilson used the term biophilia to describe the traits of evolutionary adaptation that allow us to develop a mental link with the living world and Nature (Wilson, 1984),Ecologist Stephen Kellert (1993)The evolutionary dependence on 'nature' was also expounded by social ecologist Stephen Kellert (1993) by identifying nine values of biophilia : 'utilitarian, naturalistic, scientific, aesthetic, symbolic, humanistic, moralistic, dominionistic ,and negativistic'."In every walk with nature one receives far more than one seeks."- *John Muir, 19 July 1877*.Biophilic design can reduce stress, improve cognitive function and creativity, improve our well-being and expedite healing; as the world population continues to urbanize, these qualities are ever more important

Table -1-Ttheories of biophilic design.

Perspective	Theory	Description
Biophilia	The Biophilia Hypothesis (Wilson, 1984, 1993)	Biophilia is 'the innately emotional affiliation of human beings to other living organisms.' After human migrated to the built environment, we inherited a need for nature, which evolved into 'thinking about nature'
	Biophilia Values (Kellert, 1993)	The dependence on nature is 'for survival and personal fulfilment', and the nine biophilia values are: 'utilitarian, naturalistic, scientific, aesthetic, symbolic, humanistic, moralistic, dominionistic, and negativistic'.
Habitat and Dwelling	Prospect-Refuge Theory (Appleton, 1975)	Prospect and refuge occur simultaneously, that is, 'the ability to see without being seen'. Prospect provides 'an unimpeded opportunity to see' (to find and gather sources), and refuge offers 'a shelter to hide' (to be protected from outside threats).
Biophilia	The Biophilia Hypothesis (Wilson, 1984, 1993)	Biophilia is 'the innately emotional affiliation of human beings to other living organisms.' After human migrated to the built environment, we inherited a need for nature, which evolved into 'thinking about nature'
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Habitat and Dwelling	Prospect-Refuge Theory (Appleton, 1975)	Prospect and refuge occur simultaneously, that is, 'the ability to see without being seen'. Prospect provides 'an unimpeded opportunity to see' (to find and gather sources), and refuge offers 'a shelter to hide' (to be protected from outside threats).
	The Savanna Hypothesis (Orians and Heerwagen, 1992)	**The savanna is the mixed woodland and grassland landscape commonly seen in Africa.** It affords abundant resources, open views, and climbable trees that are conducive to survival**. Today, people still have aesthetic preferences for savanna-like environments**

	The Aesthetics of Survival (Hildebrand, 1999, 2008)	Survival advantageous characteristics are identified to discuss landscape preferences and explain why nature is fascinating in architecture. **The five characteristics are: 'prospect and refuge, enticement, peril, and complex order'.**
Restoration	**Stress Recovery Theory** (Ulrich, 1983; Ulrich et al., 1991)	**Stress Recovery refers to unthreatened exposure to nature that produces positive emotions and contributes to health and wellbeing**. It is supported by some preferred natural features **(e.g. vegetations, water, and natural structures, textures, images, and vistas).**
	Attention Restoration Theory (Kaplan, 1995; Kaplan and Kaplan, 1989)	**Attention Restoration helps** relieve **mental stress and brain fatigue**. Interactions with the natural environment do not require much **cognitive work, which is beneficial to restoring exhausted attention**.
	Place Attachment Theory (Hidalgo and Hernandez, 2001; Manzo, 2003)	**Place Attachment Theory explores the emotional connection with places and explains the 'sense of place' and 'sense of community'**

2.2.3 THE BIOPHILIC FRAME WORK

Table -2-Frame work of biophilic design .

Framework	**Reference**	**description**
Kellert Biophilic design framework	Kellert (2008)	First BD framework developed by Stephen Kellert (2008), with a qualitative focus across 70 attributes.
Practice of Biophilic design	design Kellert and Calabrese (2015)	This has a strong similarity with Kellert (2008) where 25 attributes were synthesised across three experiential categories to reflect the practice of BD.

14 patterns of biophilic design	**design Browning et al. (2014)**	**The 14 Patterns of Biophilic Design is a widely used framework comprising 14 BD criteria given as pattern providing a pattern**
Biophilic and innovativeconducive university campus framework	campus framework Abdelaal (2019)	This is a research-based framework developed to guide campus designs that apply BD principles
The Biophilic framework for sustainable design	Xue et al. (2019)	This BD framework is a development that focuses on the use of BD within the typical ESD approach with the use of four widely used GBRTs from industry

Reference : https://www.sciencedirect.com/science/article/pii/S2095263521000479-Biophilic design in architecture and its contributions to health, well-being, and sustainability: A critical review

2.3 THE PATTERNS OF BIO PHILIC DESIGN:

The patterns have been developed through extensive interdisciplinary research and are supported by empirical evidence and the work of **Christopher Alexander, Judith Heerwagen, Rachel and Stephen Kaplan, Stephen Kellert, Roger Ulrich, and many others.** Over 500 publications on biophilic responses have been mined to uncover patterns useful to designers of the built environment.

These 14 patterns have a wide range of applications for both interior and exterior environments, and are meant to be flexible and adaptive, allowing for project-appropriate implementation**.(Terrapin Bright Green LLC New York NY | Washington DC).**

2.3.1NATURE-DESIGN RELATIONSHIPS:

Biophilic design can be organized into three categories – **Nature in the Space, Natural Analogues, and Nature of the Space –** providing a framework for understanding andenabling thoughtful incorporation of a rich diversity of strategies into the built environment.

***Table - 3- 14 Patterns of Biophilic Design* :**

Nature in the Space Patterns	Natural Analogues Patterns	Nature of the Space Patterns
Visual Connection with Nature	**Biomorphic Forms & Patterns**	**Prospect**
Non-Visual Connection with Nature	**Material Connection with Nature**	**Refuge**
Non-Rhythmic Sensory Stimuli	**Complexity & Order**	**Mystery**
Thermal & Airflow Variability		**Risk/Peril**

Presence of Water		
Dynamic & Diffuse Light		
Connection with Natural Systems		

Reference :Browning, W.D., Ryan, C.O., Clancy, J.O. (2014). 14 Patterns of Biophilic Design. New York: Terrapin Bright Green, LLC.

2.3.1.1NATURE IN THE SPACE:

Nature in the Space addresses the direct, physical and ephemeral presence of nature in a space or place. This includes plant life, **water and animals, as well as breezes, sounds, scents and other natural elements. Common examples include potted plants, flowerbeds, bird feeders, butterfly gardens, water features, fountains, aquariums, courtyard gardens and green walls or vegetated roofs. Nature in the Space experiences are achieved through the creation of meaningful, direct connections with these natural elements, particularly through diversity, movement and multi-sensory interactions.**

NATURE IN THE SPACE ENCOMPASSES SEVEN BIOPHILIC DESIGN PATTERNS:

Visual Connection with Nature.

A view to elements of nature, living systems and natural processes

Non-Visual Connection with Nature.

Auditory, haptic, olfactory, or gustatory stimuli that engender a deliberate and positive reference to nature, living systems or natural processes

Non-Rhythmic Sensory Stimuli.

Stochastic and ephemeral connections with nature that may be analyzed statistically but may not be predicted precisely. Non-rhythmic – because they don't follow a predictable pattern

Thermal & Airflow Variability.

Subtle changes in air temperature, relative humidity, airflow across the skin, and surface temperatures that mimic natural environments.

Presence of Water.

A condition that enhances the experience of a place through seeing, hearing or touching water

Dynamic & Diffuse Light.

Leverages varying intensities of light and shadow that change over time to create conditions that occur in nature.

Connection with Natural Systems.

Awareness of natural processes, especially seasonal and temporal changes characteristic of a healthy ecosyste

2.3.1.2NATURAL ANALOGUES :

Natural Analogues addresses **organic, non-living and indirect evocations of nature**. Objects, materials, colors, shapes, sequences and patterns found in nature, manifest as artwork, ornamentation, furniture, décor, and textiles in the built environment. Mimicry of shells and leaves, furniture with organic shapes, and natural materials that have been processed or extensively altered (e.g., wood planks, granite tabletops), each provide an indirect connection with nature: while they are real, they are only analogous of the items in their 'natural' state.

NATURAL ANALOGUES ENCOMPASSES THREE PATTERNS OF BIOPHILIC DESIGN:

Biomorphic Forms & Patterns.

Symbolic references to contoured, patterned, textured or numerical arrangements that persist in nature.

Material Connection with Nature.

Materials and elements from nature that, through minimal processing, reflect the local ecology or geology and create a distinct sense of place.

Complexity & Order.

Rich sensory information that adheres to a spatial hierarchy similar to those encountered in nature.

2.3.1.3NATURE OF SPACE:

Nature of the Space addresses spatial configurations in nature. This includes our innate and learned desire to be able to see beyond our immediate surroundings, our fascination with the slightly dangerous or unknown; obscured views and revelatory moments; and sometimes even phobia inducing properties when they include a trusted element of safety. The strongest Nature of the Space experiences are achieved through the creation of deliberate and engaging spatial configurations commingled with patterns of Nature in the Space and Natural Analogues.

Nature of the Space encompasses four biophilic design patterns:

Prospect.

An unimpeded view over a distance, for surveillance and planning.

Refuge.

A place for withdrawal from environmental conditions or the main flow of activity, in which the individual is protected from behind and overhead.

Mystery.

The promise of more information, achieved through partially obscured views or other sensory devices that entice the individual to travel deeper into the environment.

Risk/Peril.

An identifiable threat coupled with a reliable safeguard.

Table- 4- Nature-Health Relation- 14 PATTERNS

14 patterns	Stress Reduction	**Cognitive Performance**	**Emotion, mood & Preference**
Nature in the Space Patterns			
Visual Connection with Nature	Lowered blood pressure and heart rate (28. Brown, Barton & Gladwell, 2013 ; 29. van den Berg, Hartig, & Staats, 2007 ; 30. Tsunetsugu & Miyazaki, 2005)	Improved mental engagement/ attentiveness (31. Biederman & Vessel, 2006)	Positively impacted attitude and overall happiness (32. Barton & Pretty, 2010)
Non-Visual Connection with Nature	Reduced systolic blood pressure and stress hormones (33. Park, Tsunetsugu, Kasetani et al., 2009 ; 34. Hartig, Evans, Jamner et al., 2003 ; 35. Orsega-Smith, Mowen, Payne et al., 2004 ; 36. Ulrich, Simons, Losito et al., 1991)	Positively impacted on cognitive performance (37. Mehta, Zhu & Cheema, 2012 ; 38. Ljungberg, Neely, & Lundström, 2004)	Perceived improvements in mental health and tranquility (39. Li, Kobayashi, Inagaki et al., 2012 ; 40. Jahncke, et al., 2011 ; 41. Tsunetsugu, Park, & Miyazaki, 2010 ; 42. Kim, Ren, & Fielding, 2007 ; 43. Stigsdotter & Grahn, 2003)

Non-Rhythmic Sensory Stimuli	positively impacted on heart rate, systolic blood pressure and sympathetic nervous system activity (44. Li, 2009 ; 45. Park et al, 2008 ; 46. Kahn et al., 2008 ; 47. Beauchamp, et al., 2003 ; 48. Ulrich et al., 1991)	Observed and quantified behavioral measures of attention and exploration (49. Windhager et al., 2011)	-
Thermal & Airflow Variability	Positively impacted comfort, well-being and productivity (50. Heerwagen, 2006 ; 51. Tham & Willem, 2005 ; 52. Wigö, 2005)	Positively impacted concentration (53. Hartig et al., 2003 ; 54. Hartig et al., 1991 ; 55. R. Kaplan & Kaplan, 1989)	Perceived improvements in mental health and tranquility (56. Parkinson, de Dear & Candido, 2012 ; 57. Zhang, Arens, Huizenga & Han, 2010 ; 58. Arens, Zhang & Huizenga, 2006 ; 59. Zhang, 2003 ; 60. de Dear & Brager, 2002 ; 61. Heschong, 1979)
Presence of Water	Reduced stress, increased feelings of tranquility, lower heart rate and blood pressure (62. Alvarsson, Wiens, & Nilsson, 2010 ; 63. Pheasant, Fisher, Watts et al., 2010 ; 64. Biederman & Vessel, 2006)	Improved concentration and memory restoration (65. Alvarsson et al., 2010 ; 66. Biederman & Vessel, 2006) Enhanced perception and psychological responsiveness (67. Alvarsson et al., 2010 ; 68. Hunter et al., 2010)	Observed preferences and positive emotional responses (69. Windhager, 2011 ; 70. Barton & Pretty, 2010 ; 71. White, Smith, Humphryes et al., 2010 ; 72. Karmanov & Hamel, 2008 ; 73. Biederman & Vessel, 2006 ; 74. Heerwagen & Orians, 1993 ; 75. Ruso & Atzwanger, 2003 ; 76. Ulrich, 1983)

Dynamic & Diffuse Light	Positively impacted circadian system functioning (77. Figueiro, Brons, Plitnick et al., 2011 ; 78. Beckett & Roden, 2009) Increased visual comfort (79. Elyezadi, 2012 ; 80. Kim & Kim, 2007)	-	-
Connection with Natural Systems	-	-	Enhanced positive health responses; Shifted perception of environment .
Natural analogues			
Biomorphic Forms & Patterns	-		Observed view preference (81. Kellert et al., 2008)
Material Connection with Nature	-	Complexity & Order Improved creative performance. (84. Tsunetsugu, Miyazaki & Sato, 2007)	Improved comfort (86. Tsunetsugu, Miyazaki & Sato, 2007)
Complexity & Order	Positively impacted perceptual and physiological stress responses. (87. Salingaros, 2012 ; 88. Joye, 2007 ; 89. Taylor, 2006 ; 90. S. Kaplan, 1988)	-	Observed view preference (91. Salingaros, 2012 ; 92. Hägerhäll, Laike, Taylor et al., 2008 ; 93. Hägerhäll, Purcella, & Taylor, 2004 ; 94. Taylor, 2006)
Nature of the space			
Prospect	Reduced stress (95. Grahn & Stigsdotter, 2010)	Reduced boredom, irritation, fatigue	Improved comfort and perceived safety (97. Herzog & Bryce, 2007 ; 98. Wang & Taylor, 2006 ; 99. Petherick, 2000)

Refuge		Improved concentration, attention and perception of safety. (100. Grahn & Stigsdotter, 2010 ; 101. Wang & Taylor, 2006 ; 102. Petherick, 2000 ; 103. Ulrich et al., 1993)	
Mystery			Induced strong pleasure response (104. Biederman, 2011 ; 105. Salimpoor, Benovoy, Larcher et al., 2011 ; 106. Ikemi, 2005 ; 107. Blood & Zatorre, 2001)
Risk/Peril			Resulted in strong dopamine or pleasure responses (108. Kohno et al., 2013 ; 109. Wang & Tsien, 2011 ; 110. Zald et al., 2008)

Source :Browning, W.D., Ryan, C.O., Clancy, J.O. (2014). 14 Patterns of Biophilic Design. New York: Terrapin Bright Green, LLC.

3.1 NEED FOR THE BIOPHILICARCHITECTURE IN CAMPUS PALNNING .HE CAMPUS

A campus typically refers to a defined area of **land or a collection of buildings that belong to a specific educational institution, such as a university, college, or school**. It serves as a hub for **academic, administrative, and social activities related to the institution.**

3.1.1 A CAMPUS USUALLY INCLUDES VARIOUS FACILITIES :

- **classrooms, lecture halls, libraries, laboratories, dormitories or residential halls, administrative offices, recreational areas, sports facilities, and sometimes even dining halls, cafeterias, or restaurants**.
- It is designed to provide a **conducive environment for learning, living, and community engagement for students, faculty, and staff associated with the institution**.

3.1.2 THE PURPOSE OF CAMPUS:

The design and architecture of a campus often aim to create a cohesive and stimulating atmosphere that **promotes education, collaboration, and personal growth**.

3.2 LITERATURE STUDY - INDIAN INSTITUTE OF TECHNOLOGY GANDHINAGAR

3.2.1 THE SITE

The site, spreading over an area of **399 acres**, stretches for a distance of about 3 km along the western bank of the Sabarmati River, across from the city of Gandhinagar, located in Gandhinagar district, Gujarat .

The site is in two separate parcels, with the village of Palaj (together with its 45 m access road to the river) in between. On the eastern side, the new highway forms the boundary to the site as well as to the village.

Figure- 3.1- The site

3.2.2 ACCESSIBILITY

The site is accessible from the 65 m wide highway from Shahpur to Lakavada that runs along the eastern side of the site. The nearest airport is Sardar Vallabhai Patel International Airport in Ahmedabad (24.2 km) while the nearest railway station is Gandhinagar Railway Station at a distanceof 11.9 km

3.2.3 CLIMATE

Gandhinagar is hot and dry for six months and hot and humid for three months while three months are relatively comfortable. The analysis of temperature and humidity shows that cooling is required for most of the year .During the dry summer months humidification is also All through the summer, sunshine is intense and buildings and pedestrian walkways need protection from the sun.
Wind is variable but the main wind direction is S-SW-W during the windy months, June to September. The preferred orientation of buildings for wind is SW but this is at variance with the North South orientation that is needed for sun protection .In the final analysis, the climate is so hot that without cooling systems the buildings cannot be made comfortable through passive structural arrangements alone.

3.2.4THE CONCEPT

A ‘compact’ option was selected with the idea that a ‘compact’ form of development offeredthe best opportunity for creating an outstanding campus: vital, inward and of a human scale. The site is outside the city in a rural area without any
existing urban character within and outside the site.

The most important feature within the site is its ‘ravines’ and outside, the Sabarmati River.
The proposed Urban Design Concept dwells on these unique features of the site to create an ‘image’ or a ‘sense of place’ for the Institute

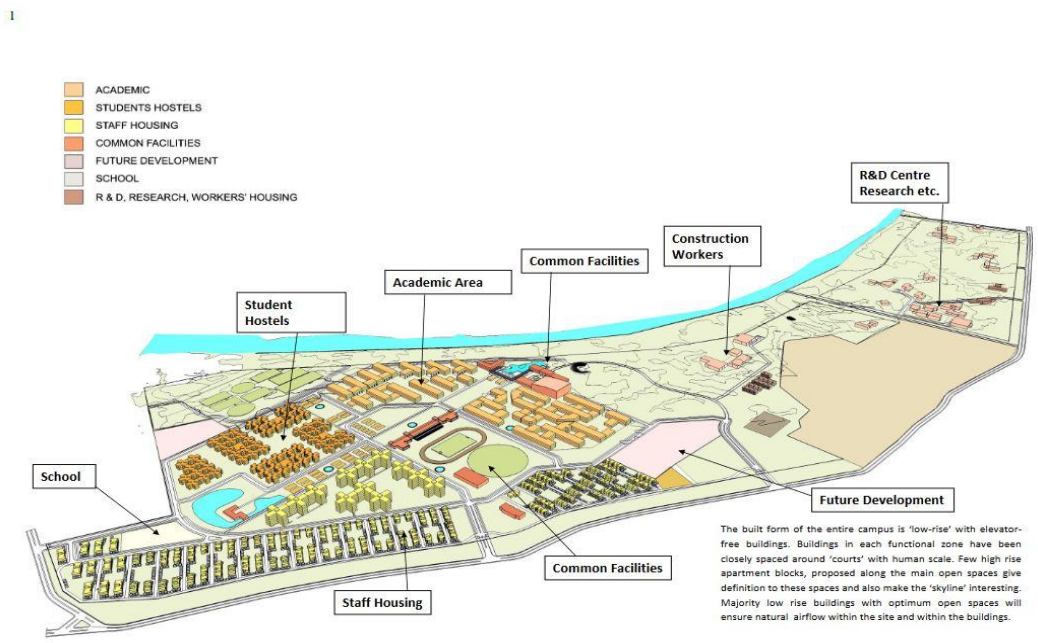


Figure- 3.2- The view-IIT

3.2.5 LANDSCAPE AND OPEN SPACE DESIGN

- **An Entrance Experience**

The Arrival Court has been designed as a visually interesting feature, drawing visitors into the uniqueness of the campus.

- **Open Space System.**

A series of landscape spaces has been used to provide definition to the campus site.
These include:
• The academic spine, largely architectural in its definition, **consists of courts and connecting arcades between academic buildings.**

- **Landscape and Open Space**

• **Green connectors** are a network of secondary open spaces that provide connections from residential areas and hostels to academic areas andto the Central Vista.
• Sports fields, planned at the very heart of the campus, are a centerpiece to the landscape structure, easily seen and accessible from all parts of the campus

- **Landscape Infrastructure**

A series of features have been incorporated in the campus landscape design that provides definition to the campus. These include:

• **The main gate complex designed as a landmark**.
• Boundary wall as a distinctive and recognizable feature, besides fullfilling functional needs of security and privacy.
• **Jal Mandaps**, pavilions marking the presence of underground water storage tanks.
• Nurseries, to be established in the future for the propagation of large quantities of **various types of plants, required to fulfil the horticultural**
requirements of the campus.
• Tree plantation: A wide variety of trees are used in the **landscape, within the Central Vista, in the avenues**, along roads and paths, in the ravines and along the boundaries.

The landscape structure is held together by the following three important spaces:
The River Promenade along the western boundary of the site is one of the main conceptual anchors of the open space system. Designed asa broad landscaped walkway for movement along the riverfront of the Academic Complex, it is also the focus of informal leisure activities ofstudents and faculty.**The Ravines** are the subject of land rehabilitation, storm water management and soil conservation through erosion control and new planting.
A Central Vista in the shape of a landscape mall is the third major element of the landscape structure and is envisaged as the prime open space on campus. It is conceived as a broad sweep of open space. Two seasonal ponds situated in slightly low lying areas amidst the former agricultural fields have been retained and integrated with the stormwater management system.

Figure- 3.3-exsisting pond system

The riverside location offers panoramic views across the Sabarmati and suggests the possibility of a linear landscape edge, as indicated in the Masterplan.

Figure- 3.4-path ways

Open space system

The Academic Spine, largely architectural in its definition, consists of courts and connecting arcades between the academic buildings for people to move comfortably, mostly under cover. It is most active during classroom hours, facilitating communication and interaction across departments and buildings and encouraging informal encounters. Green Connectors are a network of secondary open spaces, chief of which is the residential landscape axis extending parallel to the eastern boundary from the ravine area near the Herbal Garden to the culmination of the Central Vista at its southern end, near the seasonal pond.

Sports Fields were planned at the very heart of the campus, in an expansive meadow-like space, easily seen and conveniently accessible formal parts of the campus. This area is the centerpiece of the landscape structure, to which all other components converge.

Boundary Planting -The site periphery is very extensive and affords the opportunity for major tree planting with species native or hardy in the area. Just the southern section of the site has a periphery of more than 4000 m.

Residential Landscape occurs as avenues and mini neighborhood parks in areas of the faculty residences, and as commonly accessible courtyard spaces at the center of student hostels .

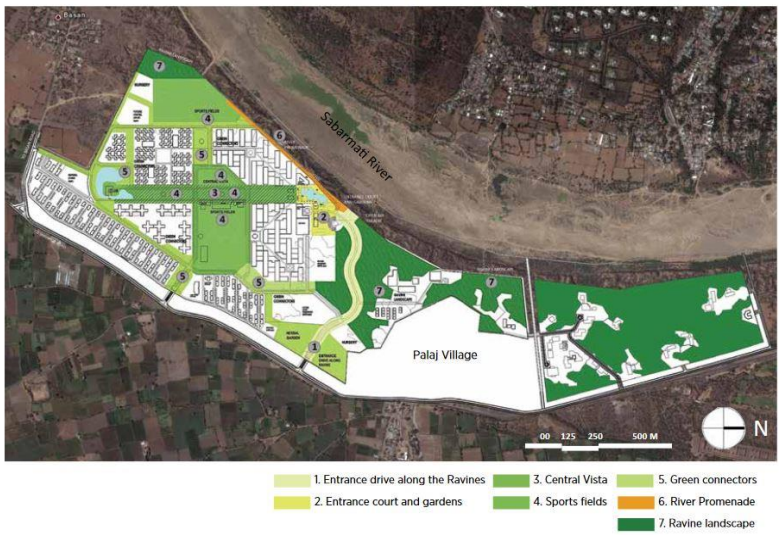


Figure- 3.5-green space

The concept establishes a broad landscape structure for the proposed campus, a planned system of open spaces and vegetation that is responsive to specific landscape qualities of the site.

There is an emphasis on preserving natural lakes and drainage patterns to the extent possible. By isolating the development from the river, the plan also ensures minimum impact on the river and its ecosystem.

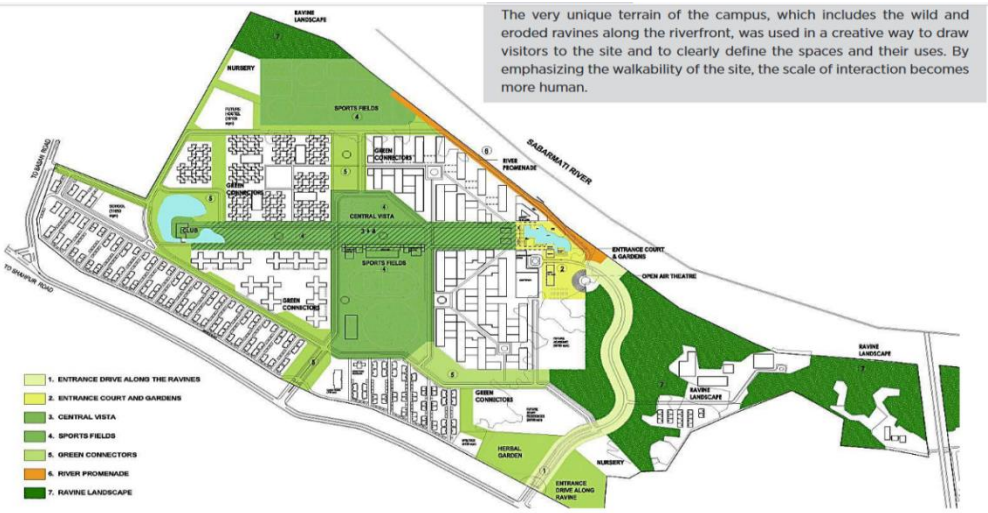


Figure- 3.6-site landscape planning

3.2.6 LANDSCAPE STRUCTURE

The landscape structure has been developed as a series of open spaces arranged as a visually interesting and varied network to facilitate comfortable and unhindered pedestrian movement .Tree-shaded pedestrian footpaths follow the alignment of this open space system, connecting academic, residential and recreational areas not only to each other, but also to the riverfront and to the ravine landscape. The landscape structure is held together by the following three important open space features:

A Central Vista

A Central Vista in the shape of a landscape mall is an important major space of the landscape structure, and is envisaged as the prime open spaceof the campus, as illustrated in the drawing on the next page.

It is a broad sweep of open space, about 50 m wide, to be lined with two or three rows of large shady trees on either side, extending from the Entrance Court at the nothern end, through the sports complex (where it is defined by an arcade under the stands), to the student hostels and staff residences at the extreme southern end.This landscape axis is aligned to integrate, at either end, the two large seasonal ponds within its design. The Masterplan suggests that this would be

a good location for community and shopping facilities of the Institute because of its central location and its potential as a centre of social activityand casual interaction between faculty and students.

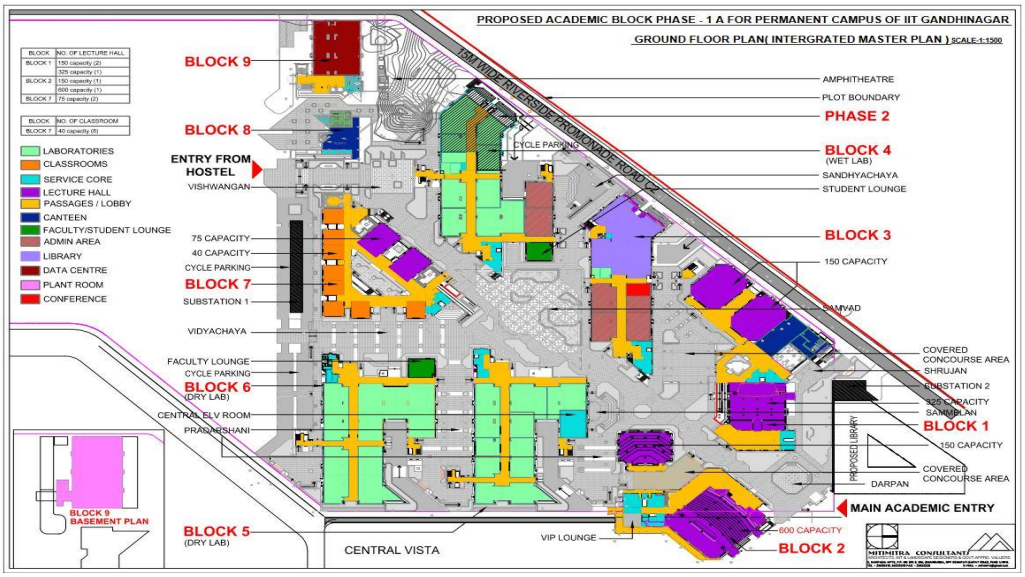


Figure- 3.21-Academic block plan

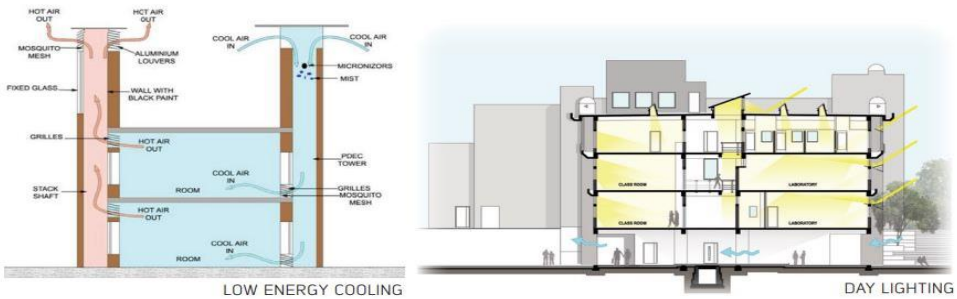


Figure- 3.22-Section

4.1 LIVE CASESTUDY - CARE CAMPUS PLANNING

Figure- 4.1-care campus

LOCATION: Thayanur , Trichy .
AREA OF THE SITE : 504 Acres
No of blocks :3 – school , hostel , college
Area of study : college – 450 students
Year of construction :2008- 2011
Chief architect : AR Sanjai mohe – MIND SPACE ARCHITECTS
Client – SRI K.N.Ramajayam

Figure-4.2-site plan

4.2 PHILOSOPHY

4.2.1 AR - SANJAI MOHE PHILOSOPHY

The design philosophy of **Mindspace** lies in attempting to use 'light' as a building material, respecting the five senses **- sight, sound, smell, touch and taste,** and working with the **five elements of nature**.

Their underlying attempt in all projects is to participate, understand and work with nature, while also trying to imbibe culture and people's aspirations. They try to create buildings that are **simple, but not simplistic; that are modest and not monumental.**

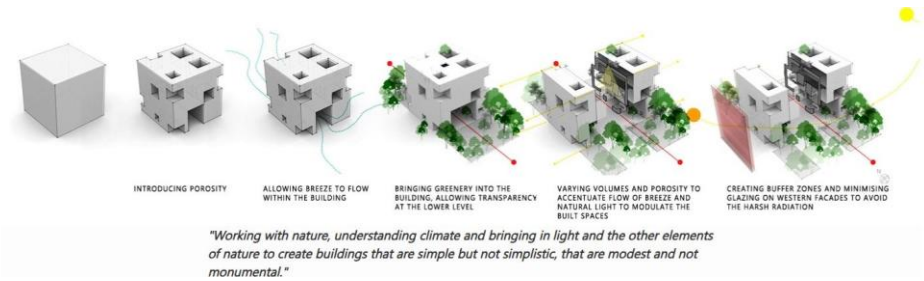


Figure- 4.3-From evolution

4.2.2 CARE CAMPUS PLANNING – CONCEPT

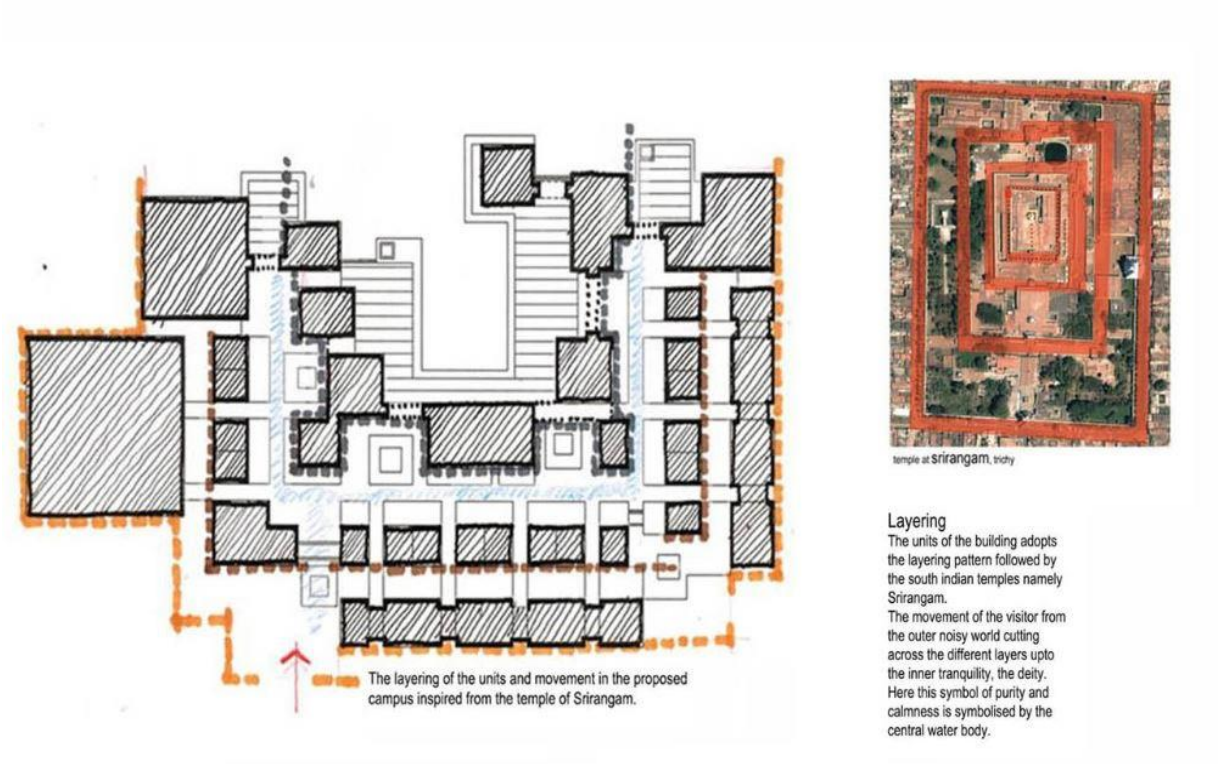


Figure- 4.4-planning

Inspired by **srirangam temple Trichy**
The concept of layering where in there is a **sense of discovery** when one proceeds from the **noise outer layer to the Pure inner layer**, finally reaching the inner shrine

INNER LAYER – The water pond is situated at the center of the college block around which rooms are planned thereby Visually connecting the water body

MIDDLE LAYER – All the departments are oriented in the same corridor allowing interaction between them the Class rooms are planned in between two open courtyards so as to promote nature driven learning experience
OUTER LAYER – Workshops are designed.

The planning of the class rooms around the central vista

The central spine corridor

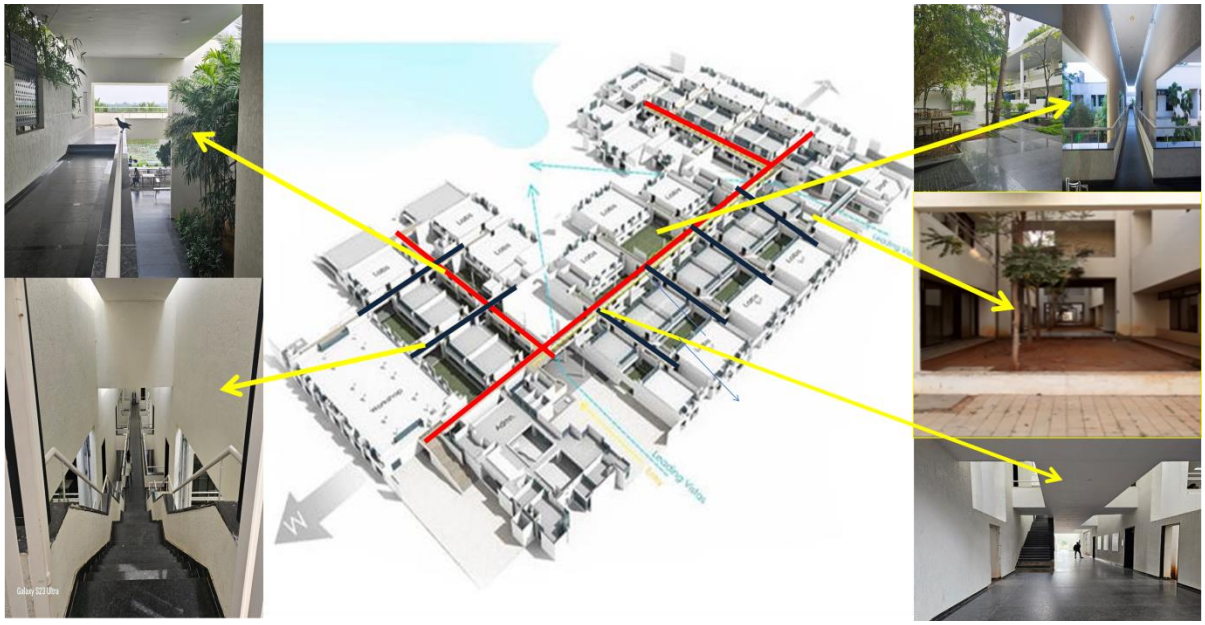


Figure- 4.5-corridor

The open air theatre- central space

Figure- 4.6-court yards

The court yards

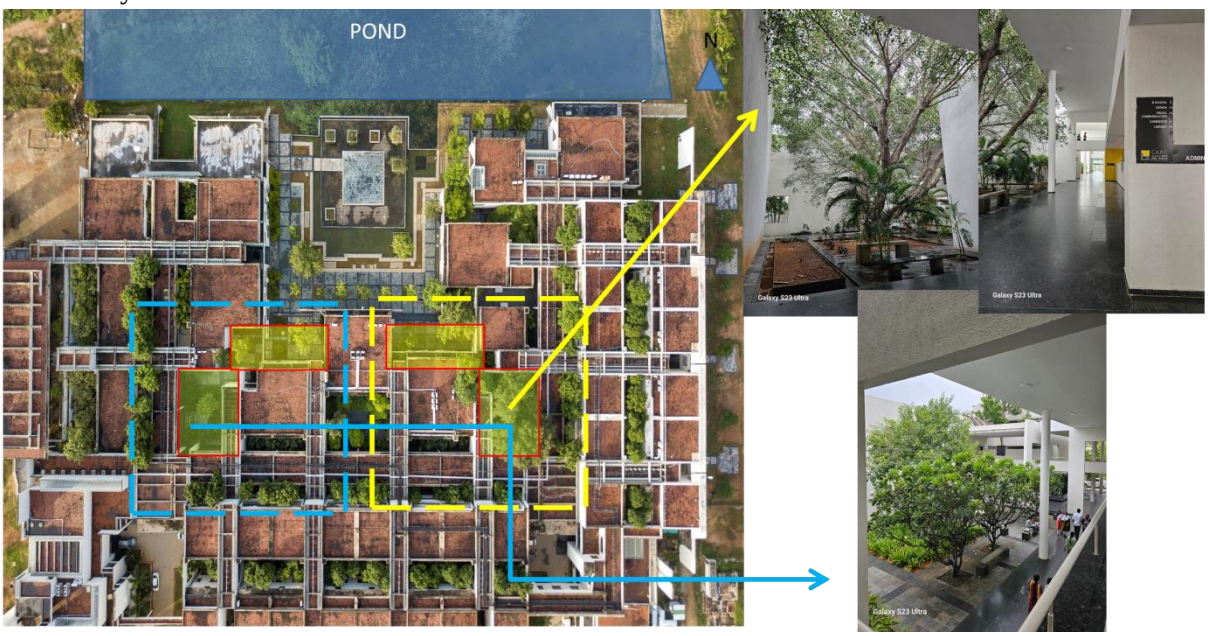


Figure- 4.7-court yards

The planning of court yards in two sides of the class rooms which makes the space bretheable and with thermal comfort.

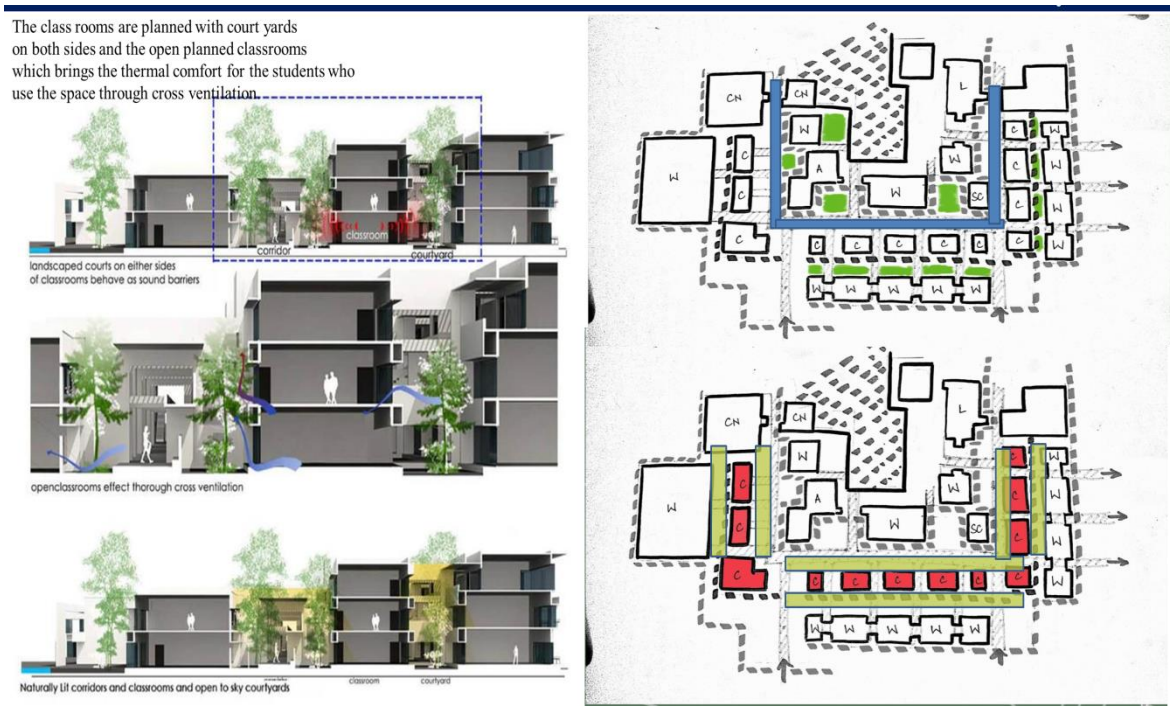


Figure- 4.8—section

Corridors and court yards

Figure- 4.9-corridors

The view of the nature from the cafeteria which calms the studies during the leisure time.

Figure- 4.10canteen

4.3INFERENCE

4.3.1THE COURTYARDS

- The court yards which brings in the **visual connection** with nature and provide immense amount o natural light to the Classrooms as it is present on both sides of the class room it helps in **direct interaction with the natural environment.**

Figure- 4.11courtyard sesign

Figure- 4.12court yard

Figure- 4.13 class room

Figure-4.14 class room court yard

4.3.2 THE CORRIDORS

- **The** Double loaded corridor design which helps in effective use of sky lights and brings **the diffused natural light to the circulation space.**

Figure- 4.15 diffused light

4.3.3 THE CENTRAL MAGNET –THE CENTRAL SQUATRE

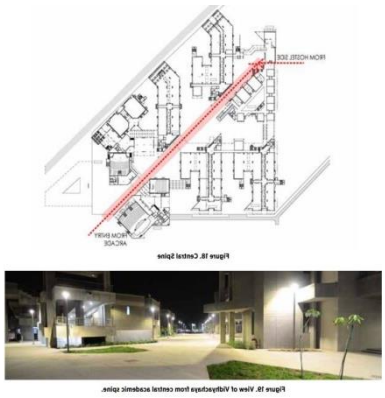
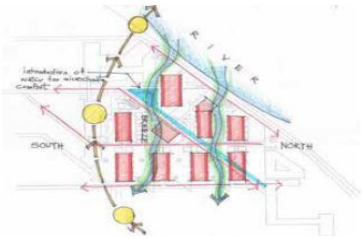
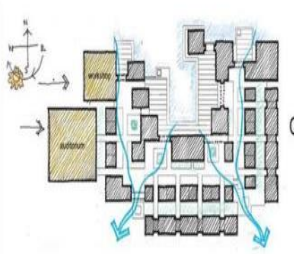
- The Central square with artificial pond which act as a edge and creates a feel of infinite edge and brings the feel of continuity to the users .
- This square which connects the cafeteria and library Which brings the **sense of calmness because of the presence of water element** .
- It act as a multipurpose area like recreation space resting space , exhibition space etc. students of the campus often use the space for relaxing purpose.

Figure no: 4.16 central square

open planning and low height walls allow maximum ventilation and **sunlight to enter**
natures view from every point

5 COMPARATIVE ANALYSIS

14 PATTERN	**IITG – GANDHINAGAR**	**CARE CAMPUS TRICHY**	**PERFORMANCE**
Nature in the Space Patterns			
Visual Connection with Nature	**THE COURTYARDS AND FORE COURT They have given visual connection with nature with all the recreation and leisure spaces .**	**THE COURTYARDS The court yards which brings in the visual connection with nature and provide immense amount o**	**Lowered blood pressure and heart rate**

	It helps the students relive from stress after any long lectures Every depatament is accessed with fore court which gives sense of entry **All the blocks is has the court yard for the connenction of natrure.The academic spine which is the axial open space for cirulation and connectivity .**  ***Figure no:5.1 central spine***	**natural light to the Classrooms as it is present on both sides of the class room it helps in direct interaction with the natural environment.**   ***Figure no:5.2 central court yard***	**Improved mental engagemet/ attentiveness** **Positively impacted attitude and overall happiness**
Thermal & Airflow Variability	**THE OREINTATION**  ***Figure no:5.3 site analysis*** The major axes of all major functions are oriented along direction E-W to achieve the best cooling. Compact planning of academic building which gives the thermal comfort for the users by the shading of the building space with the open space.	**THE OREINTATION**  ***Figure no:5.4 site analysis*** The open spaces orientation towards With the north . Building planned in such a way which gives immense amount shading and natural lighting . The building is poros at the	**Improved perception of temporal and spatial pleasure**

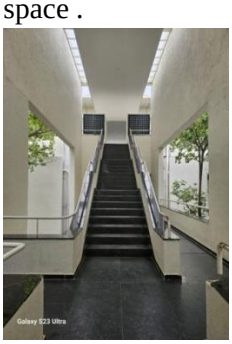
		same time it s shaded and open is effective usage of court yard planning .	
Dynamic & Diffuse Light	The Space Frame At the heart of the campus, the space frame over the Samvad Court was designed to symbolize the soaring nature of the academics at IITGN as well as the annual kite festival in Gujarat. The architects thus made the transition of this festival to the idea of the central court, meant for interaction, stimulation, discussion and debate. The court symbolises the gathering of families and friends and the space frame symbolises the kites in the sky, linking the Institute to Gujarati philosophy and culture. The kites also play a role in providing shade and changing the character of the Samvad court. As the sun moves across the sky the shadows cast by the kites keep changing, with the effect of continually cooling the ground a bit. The space quality defined by the shade and shadow light is different in the morning than in the afternoon or evening, and this will further change throughout the year.	**THE CORRIDORS** The Double loaded corridor design which helps in effective use of sky lights and brings the diffused natural light to the circulation space .  ***Figure no:5.5diffued light***	**Positively impacted circadian system functioning**

	 *Figure no:5.7 dynamic light pattern*	 *Figure no:5.6 diffused Light*	
Presence of water	**THE ENTRANCE COURT** Darpan (Mirror) Meaning – A mirror that reflects one's own image as well as reflecting the world. In a metaphoric sense, the library as a repository of knowledge is about seeing yourself in the world of knowledge. Spatial Character – A nodal space to act as a link with the future library building. Design Expression – A dry water body with water jets, where seating areas create the required pause on the way to the library.  *Figure no:5.8 fountain*	**THE CENTRAL MAGNET –THE CENTRAL SQUATRE** The Central square with artificial pond which acts as a edge and creates a feel of infinite edge and brings the feel of continuity to the users. This square which connects the cafeteria and library Which brings the sense of calmness because of the presence of water element. It act as a multipurpose area like recreation space resting space , exhibition space etc. students of the campus often use the space for relaxing purpose.  *Figure no:5.9 central pond*	**Observed preferences and positive emotional responses Improved concentration and memory restoration Reduced stress, increased feelings of tranquility, lower heart rate and blood pressure**

6 CONCLUSION:

Designing a biophilic campus involves incorporating elements of nature and natural systems into the built environment to create a healthier and more sustainable space for occupants. here are some strategies for designing a biophilic campus.

- **Maximize Natural Light: Incorporate large windows, skylights, and light wells** to bring in ample natural light. This provides a connection to the outdoor environment, reduces reliance on artificial lighting, and enhances the well-being of occupants.
- **Integrate Green Spaces:** Design the campus to include abundant green spaces such as **courtyards, gardens, and parks**. These areas can be used for **relaxation, socialization, and outdoor learning**. Use native plants and trees to promote biodiversity and create a sense of place.
- **Provide Access to Nature:** Ensure that the campus provides easy access to nearby natural elements such as forests, rivers, or lakes. This can be achieved through **walking paths, pedestrian bridges, or designated nature trails**. Access to nature encourages outdoor activities and promotes physical and mental well-being.
- **Incorporate Water Features:** Integrate water elements such **as ponds, fountains, or rain gardens** into the campus design. The sound and sight of water can have a **calming effect and create a sense of tranquility.** Additionally, water features can help **manage stormwater runoff and support local ecosystems.**
- **Create Biophilic Indoor Spaces:** Bring elements of nature indoors by incorporating natural materials, such as wood or stone, and using colors inspired by the natural environment. Use living walls or vertical gardens to introduce plants into interior spaces, improving air quality and providing visual interest

References

Terrapin Bright Green LLC New York NY | Washington DC
https://www.sciencedirect.com/science/article/pii/S2095263521000479
https://www.britannica.com/science/biophilia-hypothesis
https://www.sciencedirect.com/science/article/pii/S2095263521000479- **Biophilic design in architecture and its contributions to health, well-being, and sustainability: A critical review.**
Reference :Browning, W.D., Ryan, C.O., Clancy, J.O. (2014). 14 Patterns of Biophilic Design. New York: Terrapin Bright Green, LLC.
https://campus.iitgn.ac.in/pdf/IIA_commendation_award.pdf
https://mindspacearchitects.com/