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# RESEARCH THESIS

related to **SIX CROSS CUTTING THEMES UNDER**  
**URGENT PROJECT**

**The Role of Biophilic Architecture Design Approach in  
Hospital Design**

*Student Name: Hetsi Jani*

*Guide: Dr. Vibha Gajjar*

*Batch: 2018-2022*

**B Arch Program**

**P 12**

**NIRMA UNIVERSITY**

**AHMEDABAD**

**GUJARAT**

**INDIA**



In the final semester of a Bachelor of Architecture (B. Arch) program, students engage in academic research by selecting an area of interest within the field of architecture. This process typically involves several steps to ensure that the research is rigorous, structured, and valuable. The process starts with a course on Research Methodology in VIII Semester followed by Research Proposal in IX semester. Here's an overview of the process:

## 1. Choosing an Area of Interest

- **Exploration:** Students begin by exploring various topics within architecture, such as sustainable design, urban planning, architectural history, construction technology, or digital architecture.
- **Narrowing Down:** After exploring, students narrow down their interests to a specific research question or problem. This could be based on current trends, gaps in existing literature, or personal interest.

## 2. Defining the Research Question

- **Problem Statement:** Students formulate a clear problem statement or research question that their work will address. This defines the scope of the research and sets the direction for the study.
- **Objectives:** Setting clear objectives helps in focusing the research. These could include understanding certain architectural phenomena, proposing new design solutions, or evaluating existing practices.

## 3. Literature Review

- **Existing Research:** A thorough review of existing literature helps students understand what has already been done in their area of interest. This involves reading academic papers, books, case studies, and other scholarly articles.
- **Gap Identification:** Through the literature review, students identify gaps or areas where further research is needed, which helps in refining their research question.

## 4. Research Methodology

- **Qualitative vs. Quantitative:** Depending on the nature of the research, students choose between qualitative methods (such as case studies, interviews, or observations) and quantitative methods (such as surveys or statistical analysis).
- **Data Collection:** Students plan how they will collect data. This might involve fieldwork, archival research, simulations, or experiments.
- **Data Analysis:** Once data is collected, students analyze it using appropriate tools and methods. This could involve software for statistical analysis, 3D modeling, or comparative analysis techniques.

## 5. Design and Proposal Development

- **Conceptual Framework:** Students often develop a conceptual framework that guides the design or theoretical aspects of their research.
- **Prototyping:** In some cases, students create physical or digital models to test their ideas. This is particularly common in research that leads to a design proposal.



## 6. Documentation and Presentation

- **Writing the Thesis:** The research findings are documented in a thesis, which includes the introduction, literature review, methodology, findings, discussion, and conclusion.
- **Visual Presentation:** Architecture students often need to prepare visual presentations of their research, including drawings, models, or digital renderings.
- **Defense:** Students may be required to present and defend their research in front of a panel of faculty members and peers.

## 7. Conclusion and Future Research

- **Summary of Findings:** The thesis concludes with a summary of the findings and their implications for the field of architecture.
- **Suggestions for Future Research:** Students may also suggest areas for further study based on their findings, contributing to ongoing academic discourse.

## 8. Submission and Review

- **Final Submission:** The completed thesis is submitted for review. This may include peer review, faculty evaluation, and sometimes publication in academic journals.
- **Feedback:** Based on the review, students may be asked to make revisions before the final acceptance of their research work.

This process not only helps students gain a deep understanding of a particular area within architecture but also equips them with the skills to conduct independent research, a valuable asset in their professional careers. Some of the research works undertaken by students are listed, examples of the some are also elaborated further.



# The Role of Biophilic Architecture Design Approach in Hospital Design

**Student Name:** Hetsi Jani

**Guide:** Dr. Vibha Gajjar

**Batch:** 2018-2022

**Aim:** The aim of this research paper is to analyse the elements of biophilic architecture that influence the hospital design.

**Objectives:**

- To understand how biophilic principles are explored in architectural expression.
- To identify and analyse the 14 principles of biophilia in the case study of hospitals.
- To create a handbook for existing or upcoming hospitals for biophilic approach.

**Framework for Case study:**

*Table 1: Nature in Space*

Biophilic Parameters	Objective	Experience	Checklist	Stress reduction	Cognitive skills	Emotion, mood & preference
<b>Visual connection with nature</b>	To create an atmosphere that allows the user to change their attention, relax their eye muscles, and reduce exhaustion	It can make a person realise the changing time, climate as well as living objects	<ol style="list-style-type: none"> <li>1. True nature should take precedence over simulated nature, and simulated nature should take precedence over no nature.</li> <li>2. Biodiversity should be given priority over quantum, location, or land area.</li> <li>3. Any form of physical activity near the green should be prioritized.</li> <li>4. Any area designed to enable connection with nature for at least 5-15 minutes a day.</li> </ol>	Lowered blood pressure and heart rate, anger and aggression	Increasing work engagement and concentration	Positively impacted attitude and overall happiness
<b>Non-visual connection with nature</b>	The aim is to be dynamic and intricate, as well as relaxed and predictable with audio, smell, and materials that evoke feelings	The area senses freshness and strikes a balance to make it more familiar and comforting	<ol style="list-style-type: none"> <li>1. Give natural sounds precedence above urban sounds.</li> <li>2. The design for such spaces must conveniently be used for free in several places, and a daily view of a minimum 5-25 minutes.</li> </ol> <p>Blend this pattern with other elements and patterns of the space designing.</p>	A positive feeling of mental performance	Positive effect on cognitive skills	Perceived improvements in mental health and tranquility



<p><b>Non-Rhythmic sensory stimuli</b></p>	<p>To foster the use of natural sensory stimuli that grab attention</p>	<p>Gives an appearance of inculcating anything unique, refreshing, fascinating, relaxing and invigorating for a brief moment. It is a short but an enjoyed diversion</p>	<ol style="list-style-type: none"> <li>1. As a rule of thumb, non-rhythmic sensory experiences must exist every 20 minutes for around 20 seconds and from a range greater than 20 feet far for visual stimulation.</li> <li>2. A few times, the involvement may be similar to the patterns of visual and non-visual connectivity to nature, but the quality of being ephemeral and stochastic is the essence of this patterns</li> </ol>	<p>Positively balance heart rate, systolic blood pressure, and the activities of the nervous system</p>	<p>Observed and quantified behavioral measures of attention and exploration</p>
<p><b>Thermal &amp; Airflow variability</b></p>	<p>To enable the people to monitor thermal condition, by personal control, or by giving people connection to variable adjustable parameters within the built structure</p>	<p>It refreshes a person, making him more vibrant, active, energizing, and relaxing. Such spaces offer the security of versatility and a sensation of control</p>	<ol style="list-style-type: none"> <li>1. Integration of natural air and comfortable thermal environment into materials, daylighting, mechanical ventilation, or fenestration to better spread variability across the area over a certain period of thermal comfort is an important pattern amidst biophilic design and sustainable design to fill the gap, mainly due to the changing climate and the exorbitant energy cost.</li> </ol>	<p>Advantageous impact on comfort, well-being, and productivity</p>	<p>Positively impacted concentration  Improved perception of temporal and spatial pleasure</p>
<p><b>Presence of water</b></p>	<p>This pattern aims to use the multisensory experience in a way that it encourages contemplation, improves mood, and provides relief from mental exhaustion</p>	<p>It seems desirable and enthralling. The flexible nature of water, the sound it produces, light effects on it, nearness to a person, and usability all play an important role to determine the nature of the space : calm, soothing, or both at the same time.</p>	<ol style="list-style-type: none"> <li>1. To produce the best results, emphasis on the focusing on a multi-sensory water sensation has to be done.</li> <li>2. Emphasis should be placed on moving or naturally flowing water, than stagnant water.</li> <li>3. Elevated, constantly turbulent water elements can irritate and can hinder the hearing quality of the person. Hence, depending on the distance of which the water body has been placed, the size and appropriateness be decided.</li> </ol>	<p>Lowered stress, more feelings of a piece, lower heart rate and blood pressure</p>	<p>Improved concentration and memory restoration  Observed preferences and positive emotional responses</p>
<p><b>Dynamic &amp; Diffuse Light</b></p>	<p>To give the humans with lighting choices that activate the eyes and retain attention in ways that evoke a favorable mental and physical response. The second one is to assist in maintain the circadian system</p>	<p>It shows the change of time and the dynamic emotions of excitement, mystery, tempered by a sense of serenity.</p>	<ol style="list-style-type: none"> <li>1. Drastically dynamic lighting conditions, such as sustained movement, changing colors, direct sunlight penetration, and high contrasts, may not be appropriate for spaces where directed attention activities are performed.</li> <li>2. According to the activity the quality of light needs to be perfect either stark or diffused.</li> </ol>	<p>Impacts positively in the circadian system functioning</p>	<p>Positive effect on increased concentration.</p>
<p><b>Connection with Natural systems</b></p>	<p>To raise consciousness about environmental properties while also encouraging environmental stewardship of environment in which they prevail</p>	<p>Captures the senses of belonging to a bigger picture. Done by people to realize the change in seasons and the growth of life cycles. This experience is frequently awaited and makes a person calm, insightful, nostalgic, or enlightened.</p>	<ol style="list-style-type: none"> <li>1. Integrating the rainwater collection and its treatment in landscape designing that adapts to rain events.</li> <li>2. In some situations, just offering visual access to the present environment could be the simplest and the cheapest solution. In the situations, using flexible design strategies (e.g., using of materials that alter the shape and extend its rationing in response to increase in solar radiation, air, and precipitation.</li> </ol>	<p>Reduced stress, increased feelings of peace, less heart rate and blood pressure</p>	<p>Enhanced positive health responses; shifted perception of environment</p>



**Table 2: Nature of Space**

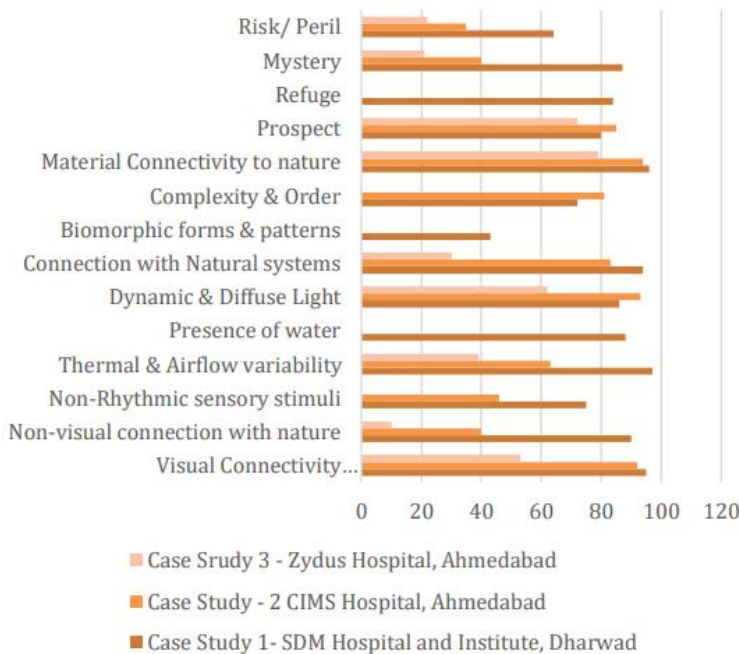
<p><b>Prospect</b></p>	<p>A space with great prospect pattern good free, but gives a feeling of safety and control.</p>	<p>It arouses a sense of accessibility, freedom, and openness. Still imparting a sense of security and power, especially when this pattern is experienced when a person is alone.</p>	<p>Living spaces, elevations, corridors, and work areas should all be oriented to maximize visual connectivity to the interior and exterior spaces, event centers, and attractions.</p> <p>1. Offering focal lengths of a minimum of 6 months ideally 30 meters, when a room has enough depth, architecture features could be used to improve the experiences by eliminating the optical obstacles. Restriction partition length to 42th creates spatial obstacles and still enabling the people to view beyond area.</p>	<p>It reduces a person's reaction to stress, especially when a person is alone or in a new surrounding</p>	<p>Reducing boredom and fatigue.</p>	<p>Improved comfort and perceived safety</p>
<p><b>Refuge</b></p>	<p>The main goal of refuge pattern is to give the people readily available and safe surrounding - a component of a bigger space - that promotes regeneration</p>		<p>1. The refuge spaces that are in the interior area are mainly differentiated by having low-level ceiling conditions. The average height of ceilings is usually 18-24 inches beneath the main ceiling height. This is achieved by using the techniques like using soffit, a false ceiling, acoustical paneling, or using special fabrics.</p>	<p>Impacts in a positive way the system of functioning</p>	<p>Improving concentration and ability to perceive safety.</p>	
<p><b>Mystery</b></p>	<p>A space that has a great condition of mystery has a sensation of suspense, or of being fooled, providing a feeling of doubt and incentive that convinces a person to explore the space even more.</p>	<p>This pattern of mystery is mainly based on the view that humans have basic requirements in their surroundings; understanding and exploring</p>	<p>1. Sharp edges are less effective at attracting people into space when compared to curved edges that invite the users into an area.</p> <p>2. The play of shadows can exacerbate the feeling of mystery.</p> <p>3. Ways that provide deep shadows or superficial depth of things can create an unexpected sense of various feelings.</p>	<p>Induced great and increased pleasure response</p>		<p>Induced strong pleasure response</p>
<p><b>Risk/ Peril</b></p>	<p>This pattern aims to instigate excitement, alertness, and inquisitiveness while also refreshing the memories problem-solving ability</p>	<p>It gives thrilling views and has as implicit danger, it may even feel somewhat playful mischievous or sinister. It appears to be risky and fascinating, worth investigating, and even impossible.</p>	<p>1. Design techniques that depend on spaces' quality would be simpler to execute if they are implemented at the early designing stage that includes the conceptual or the planning stage.</p> <p>2. The factor of safety must be made to protect the people from any kind of damage and at the same time allowing the user to engage in risky behavior.</p>			<p>Results in strong dopamine and pleasuring responses</p>



**Table 3: Natural Analogues**

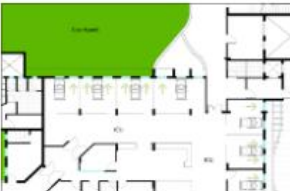
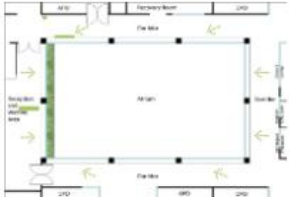
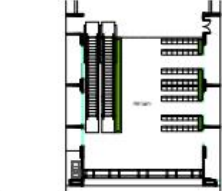



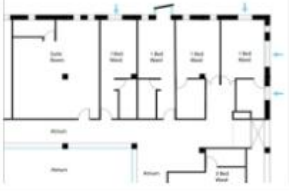


<b>Biomorphic forms &amp; patterns</b>	To incorporate symbolic design features into the built structures that enable a connection with the environment	Makes the user feel engaging and relaxing, probably enthralled, introspective, or indeed absorptive	<ol style="list-style-type: none"> <li>To increase the variety and intensity of exposure, this pattern must be in 2-3 surfaces or sections. For instance use on the flooring and vertical surfaces; soffits and windows.</li> <li>Overusing the pattern and shapes must be discouraged to prevent visual toxicity.</li> </ol>	Less stress due to induced shift in focus, and increased concentration		Observed view preference
<b>Complexity &amp; Order</b>	A perfect balance between boring and exciting	It results in exciting and knowledge - intensive, this field may be useful as a fascinating balance between dull and intimidating	<ol style="list-style-type: none"> <li>Give priority to art and material selection, structural expression, and environment and site planning ways that tell about the patterns geometrics and social orders</li> <li>Fractal structures that have a repetition of times are way more effective than the fractals that only have one or two repetitions.</li> </ol>	Positively impacts the perceptual and physiological stress responses		Observed view preference
<b>Natural Connectivity to nature</b>	It aims to determine natural materials that have essential qualities and proportions of natural materials	It makes the person feel rich, cozy and being in the original space. It even stimulates the feeling of touch.	<ol style="list-style-type: none"> <li>The quality and color of the material have to be determined based on spaces intended larger ratios of either one materials of preferred color.</li> <li>Actual material and textures are favored over the artificial variance because the human brain can distinguish between the two.</li> </ol>	Reduced stress, increase feelings of peace, less heart rate and blood pressure	Improves creative performance	Improved comfort

**Graph 1: Comparative Graph for 14 patterns of Biophilia in 2 Case Studies**

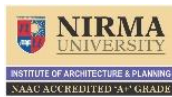



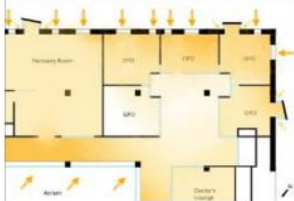








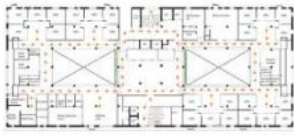



**Table 4: Comparative Analysis of the case studies through architectural representation**


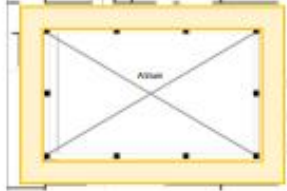



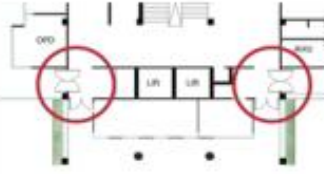



Biophilic Pattern	Case Study 1 - SDM, Dharwad	Case Study 2 - CIMS Hospital, Ahmedabad	Case Study 3 - Zydus Hospital, Ahmedabad
<p><b>Visual Connectivity with Nature</b></p>	<p>1. Open courtyards with landscaping, green OTS corners. 2. Landscaping on the outside of the building making all rooms and spaces have atleast one way to view nature. 3. Indoor plants</p> 	<p>1. Green Atrium and courtyards. 2. Trees and landscaping on the outside of the building. 3. Indoor plants</p> 	<p>1. Few planters in the entrance of the hospital 2. Small green garden on the rear-end of the hospital.</p> 
<p><b>Non-visual connection with nature</b></p>		<p>Spill out spaces in forms of courtyards and decks that when in contact with for 5-20 mins effectively works</p> 	<p>-</p>
<p><b>Thermal &amp; Airflow variability</b></p>	<p>1. Courtyards, semi-open corridors, balconies make the spaces naturally well ventilated and comfortable in all the seasons. 2. Predominant wind direction of South-West for 5.8 months, and South-East for 6.6 months.</p> 	<p>1. Centenary AC hospital 2. Adequate possibility of airflow given per room, however rarely used 3. Openings given according to the direction of wind 4. No functioning openings in the corridors</p> 	<p>1. windows in the patient rooms aligned perfectly to get the most of the S-W winds. 2. Wall-to-window ratio of 80% in the rooms</p> 
<p><b>Presence of water</b></p>	<p>Small water bodies with aquatic life in all the larger courtyards</p> 	<p>-</p>	<p>-</p>





<p><b>Dynamic &amp; Diffuse Light</b></p>	<p>1. Diffused light in the waiting area because of the acrylic structured roofing that doesn't allow harsh light to come through. 2. Wall to window ratio in majority of all the spaces ranges between 60-90% 3. No need of lighting in the common spaces and corridors throughout the day</p> 	<p>1. Sufficient direct and indirect light sources. 2. Window-to-wall ratio – Minimum 20%, with the corridors having 90% 3. Artificial light not necessary except in OT.</p> 	<p>1. Wall-to-window ratio of 60-80% 2. Thick walls prevent harsh south light to enter the spaces, while sufficiently lighting up the rooms. 3. The corridors and foyers on the higher levels are darker, due to the depth and width, where natural light is insufficient.</p> 
<p><b>Connection with Natural systems</b></p>	<p>1. A lot of landscaping done inside and outside the building. Allowing a small ecosystem of birds and other living things to interact. 2. Trees on the outside also allow the season change, color, pattern and even fragrance change to be felt and seen.</p> 	<p>1. Direct view access through the atriums 2. Trees on the outside also allow the season change, color, pattern and even fragrance change to be felt and seen.</p> 	
<p><b>Biomorphic forms &amp; patterns</b></p>	<p>1. Repetitive patterns in the façade 2. Biomorphic patterns seen in the landscaping in the courtyards. 3. Use of natural materials such as marble and stone</p> 		
<p><b>Complexity &amp; Order</b></p>	<p>1. Spatial repetitiveness in the layout of the zonal spaces. 2. Information rich planning, with complex layout, yet enriching and easy for circulation.</p> 	<p>1. Repetitive nature in planning 2. Ease of access and movement in and around the layout.</p> 	



<p><b>Prospect</b></p>	<p>1. Use of color for the ease of movement and distinct guidance. 2. Designed to make the inner atriums the focal points and ease of movement around it. 3. Orientation of fenestrations and building to optimize visual access indoors and outdoors.</p> 	<p>1. Use of color to easily lead to the openings and other spaces. 2. Designed to make the inner atriums the focal points and ease of movement around it. 3. Use of transparent/ translucent materials 4. Orientation of fenestrations and building to optimize visual access indoors and outdoors.</p> 	<p>Locating stairwells with glass façade and interior walls to enhance prospect</p> 
<p><b>Refuge</b></p>	<p>1. Walkways above and over the landscaping and water features</p> 		
<p><b>Mystery</b></p>	<p>1. Depth, curved and angled surfaces create a sense of mystery. 2. Changing of scales and volumes of the spaces</p> 	<p>1. Depth and sharp turns create a sense of mystery 2. The difference in opacity also aids to the same cause</p> 	
<p><b>Risk/ Peril</b></p>	<p>Balconies and decks looking into the courtyards from a height have short railings, keeping the person safe yet at risk.</p> 	<p>Glass railing given on the inside of the spaces looking into the atrium</p> 	<p>Glass railing given on the inside of the spaces looking into the atrium</p> 



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