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RESEARCH THESIS

related to SIX CROSS CUTTING THEMES UNDER URGENT PROJECT

Incorporating biomimicry into the design process to attain
Optimization.

Student Name: Burhanuddin Lokhandwala

Guide: Prof. Shweta Suhane

Batch: 2017-2022

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.

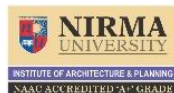
7. Conclusion and Future Research

- **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.

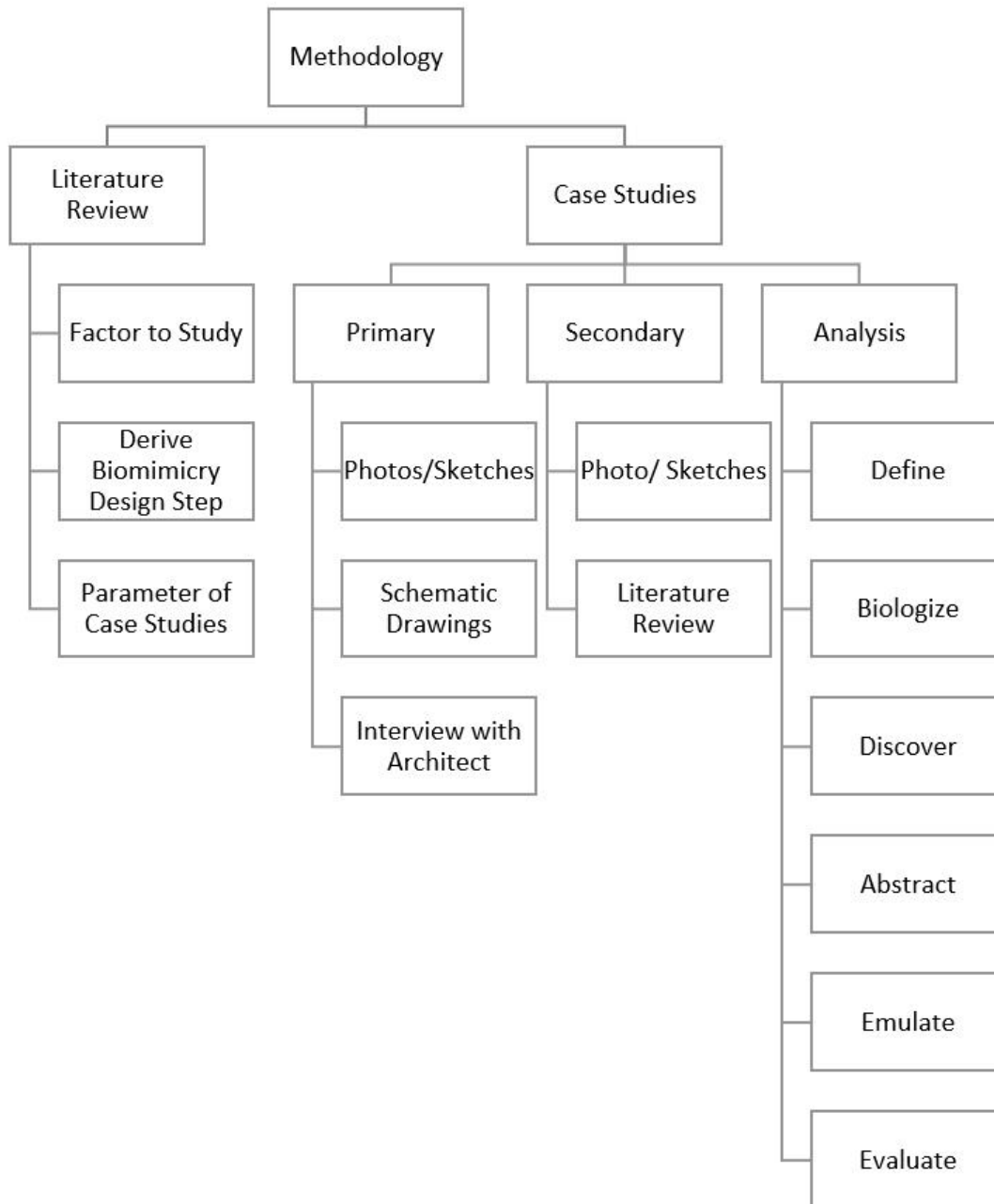


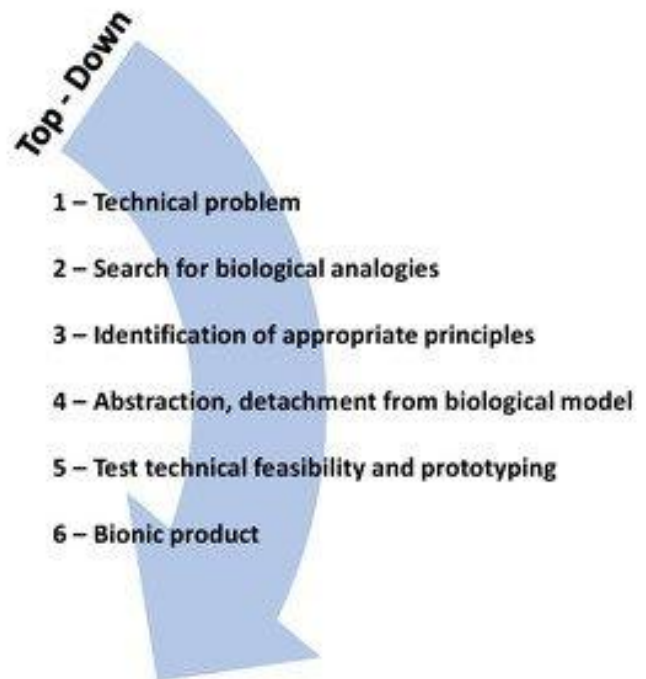
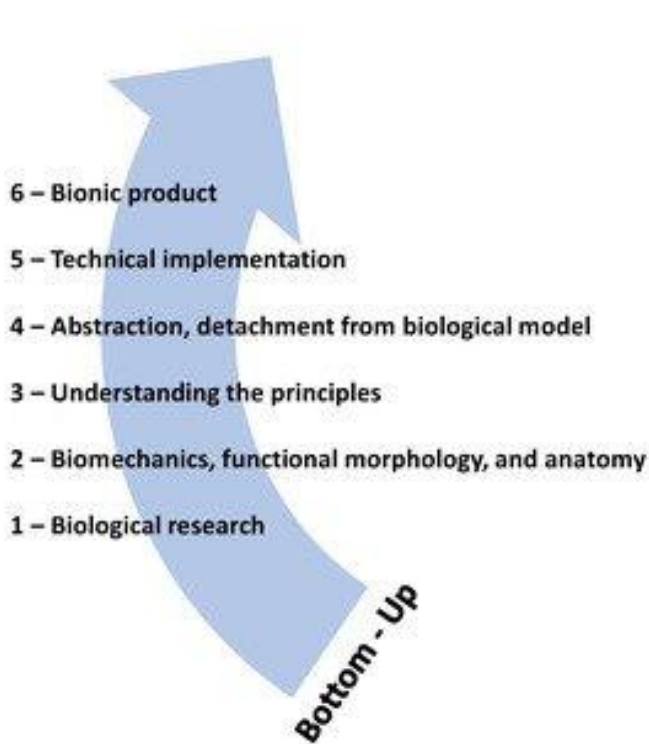
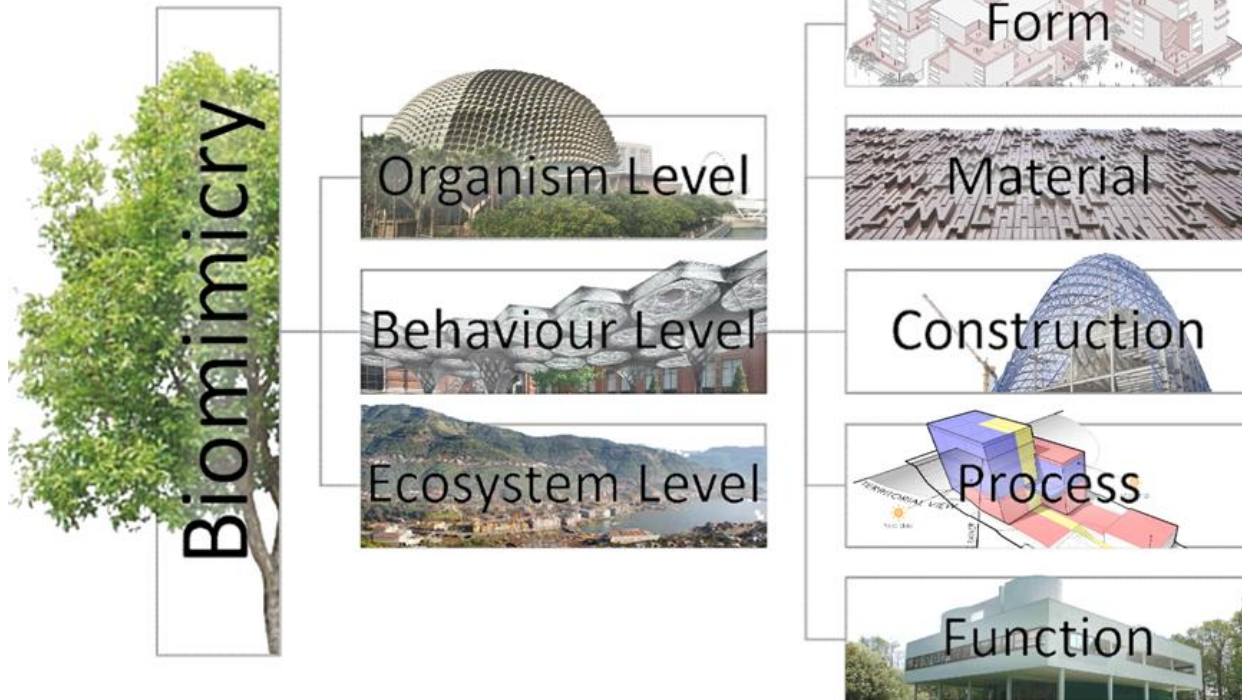
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| Sr.No. | Name | Biomimicry Level | Inspiration | Objective |
|--------|---------------------------------|--|---|---|
| 1 | The Eastgate building, Zimbabwe |  Behaviour Level |  Termite Hill | To make the building Energy Efficient |
| 2 | 30 St Mary Axe, London |  Behaviour Level |  Sea Urchens | To have a naturally ventilated Building which can also withstand high wind pressure of U.K. |
| 3 | Elytra Filament Pavilion |  Behaviour Level |  Hard shell of Beetles called Elytra | Make a lightweight and modular structure |
| 4 | Eden Garden Project |  Behaviour Level |  Geodesic Dome | Large light weight Structure |
| 5 | The Hive, Surat |  Behaviour Level |  Bee Hive | Facade which can variate the light intake of the structure |



| | | | | |
|----|---|--|---|--|
| 6 | The Tote, Mumbai |  Organism Level |  Trees | Light weight and aesthetic Structural system |
| 7 | Esplanade Theatre, Singapore |  Organism Level |  Durian Fruit | Minimize heat gain and make the building more aesthetically appealing |
| 8 | The Lloyd Crossing Project, Oregon, USA |  Ecosystem Level |  Wild life (Deer) of Oregon | Make human made structure blend with natural environment |
| 9 | The Lavasa Hill Project, Maharashtra, India |  Ecosystem Level |  Vegetation of Lavasa Hill | Make a water efficient water drainage system without the erosion of soil |
| 10 | Thematic pavilion, Expo 12 |  Behaviour Level |  Ocean Waves | Make a parametric Facade to variate the intake of light into the building |
| 11 | The biomimetic office |  Behaviour Level |  Translucent four-eyed spookfish | Optimization of solar gain, floor space, and facade area for photovoltaic panel installation |



| | | | | |
|----|---------------------------------|--|--|---|
| 12 | Heliotrope building |  Behaviour Level |  Sunflower | Make a structure which maximizes the use of natural sunlight |
| 13 | SKolkovo Innovation Center |  Ecosystem Level |  Wild life of Russia | Make a car less, public transportation system |
| 14 | Metal that breathes |  Organism Level |  Skin | Make a parametric Facade which acts as similar to our skin |
| 15 | Palazzeta dello sports |  Organism Level |  Shells | Make a large span light weight and aesthetically appealing structural system |
| 16 | Sahara Forest Project Qatar |  Ecosystem Level |  The vegetation of Saharan Desert | In hot, arid locations, provide fresh water, food, and renewable energy, as well as reforest deserted desert areas. |
| 17 | The cardboard to caviar Project |  Ecosystem Level |  Ecology of U.K. | Make a fishing system that do not harm natural cycle of fishes |
| 18 | Art science Museum | |  | Make a sustainable building with good rain water harvesting system |



Analysis

| Steps | Elytra Filament Pavilion, University of Stuttgart | Eden Project, UK | Biomimicry Office, UK |
|-----------|--|---|---|
| Define | How might we get a Lightweight and Evolving Pavilion? | How might we make a spherical shaped exterior that can have minimum structure so that we can also bring in most amount of natural sunlight. | How may we design a workplace to maximise solar gain and façade area for photovoltaic panel installation? |
| Biologize | Where in nature can we find Lightweight yet strong and durable substance which also has a range of motion. | What in nature is naturally spherical and also have a light and strong structure. | How does nature solve the issue of lack of light? |
| Discover | Exoskeleton of insects are rather Strong and Durable, despite of being lightweight. Insects that fly have motion in their exoskeleton as well. | Geodesic Dome structure is lightweight and also spherical in shape. The structural members can also be very thin | Fishes thrives and survives in dark environment and make use of the little light available |
| Abstract | How can we use or replicate the material in the Exoskeleton? | How can we use geodesic dome as it can have limitation in terms of height to width ratio? | Spookfish uses lenses to reflect and refract light to see better. |
| Emulate | Carbon fiber have lot of similar properties and we can make a hollow structure out of it as well. | Multiple Geodesic Domes can be connected to form a large structure, but at the same time we can also keep the structure lightweight and open. | We can use materials such as glass and plastic and mold them into shape similar to the lens of Spookfish to create a soft constant light source with minimum heat generation. |
| Evaluate | Making a modular carbon fiber structure can solve our design problem. | Geodesic Domes connected in series can solve our design problem. | This can solve our problem of light gain while keeping the office cool. |