BIOMIMICRY

PORTFOLIO
BY

SHUBHASHREE L
1AA21AT043
SEM 7

$\frac{52}{60} + \frac{35}{40} = \frac{87}{100}$
IA + CPM = CIE

EXTERNAL EXAMINER	INTERNAL EXAMINER

ACHARYA'S NRV SCHOOL OF ARCHITECTURE

PINE CONES OPEN AND CLOSE IN RESPONE TO WEATHER

A SLIGHT RISE IN HUMIDITY TRIGGERS PINE CONES TO CURL UP THEIR SCALES TO PREVENT INEFFECTIVE SEED DISPERSAL IN WET WEATHER.

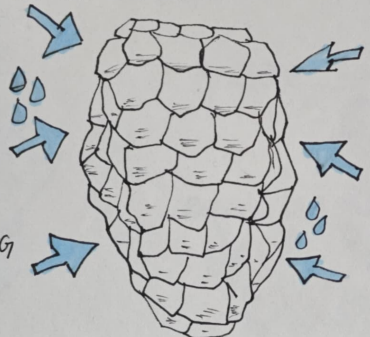
OPEN CONE

ENVIRONMENTAL TRIGGER:

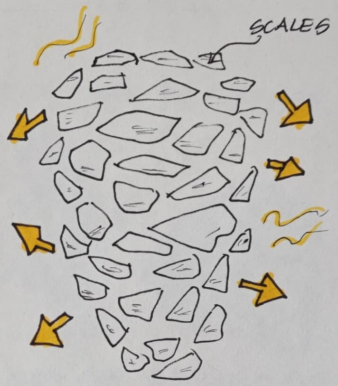
- TEMPERATURE
- HUMIDITY

CRACKING

RE-CLOSURE

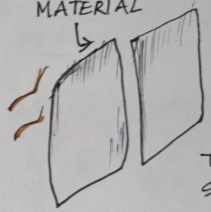


IN HUMIDITY & RAIN THE SCALES ARE CLOSED



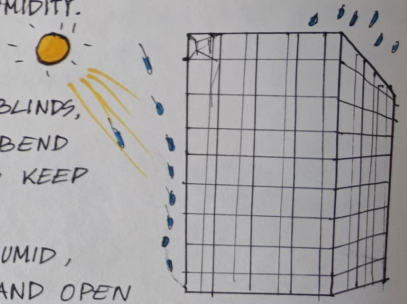
IN DRY WEATHER, THE SCALES ARE OPEN UP.

CLOSED CONE



FABRIC COULD OPEN UP AND CLOSE ACCORDING TO THE HUMIDITY OR SWEAT.

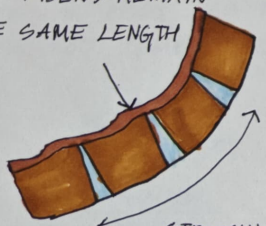
- SIMILARLY, BUILDING MATERIALS MIGHT ALSO RESPOND TO CHANGING HUMIDITY.



- SELF-ADJUSTING BLINDS, FOR EXAMPLE, MIGHT BEND TO CREATE SHADE AND KEEP SPACE COOL.
- AT NIGHT THROUGH HUMID, THEY WOULD RELAX AND OPEN UP AGAIN.

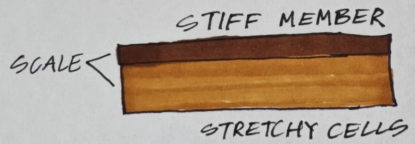
MOIST-CONE CLOSED

STIFF FIBERS REMAIN THE SAME LENGTH



STRETCHY CELLS ABSORB MOISTURE AND EXPAND

DRY-(OPEN) CONE



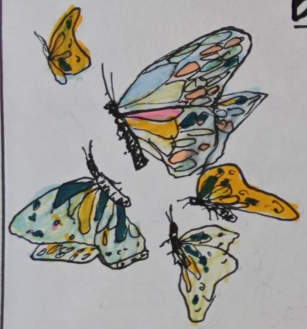
MECHANISM OF PINE CONE.

10/10 +5/5

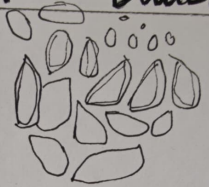
SIGNATURE

SHUBHASHREE.L
1AA21AT043
SEM VII

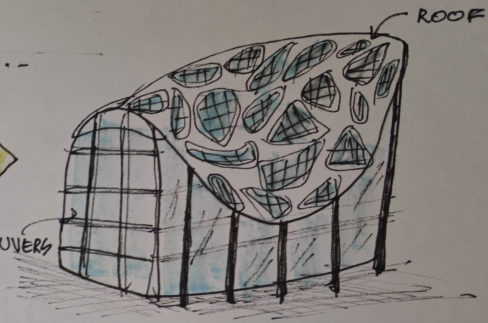
BIOMIMICRY FACADE DESIGN CONCEPT SHEET – Butterfly



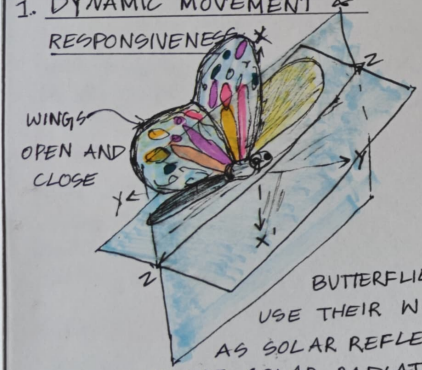
BUTTERFLY WINGS



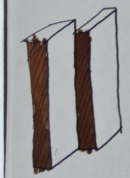
PATTERN



1. DYNAMIC MOVEMENT & RESPONSIVENESS

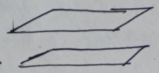


BUTTERFLIES USE THEIR WINGS AS SOLAR REFLECTORS TO REFLECT SOLAR RADIATION ONTO THE BODY AND TO INCREASE THEIR BODY TEMPERATURE.



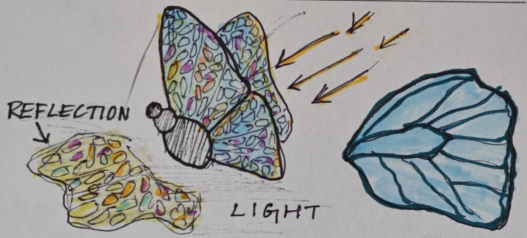
LOUVERS

OR

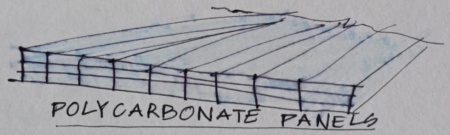


SHADING DEVICES CAN BE DESIGNED TO ADJUST THEIR ANGLE.

2. LIGHT CONTROL AND REFLECTION



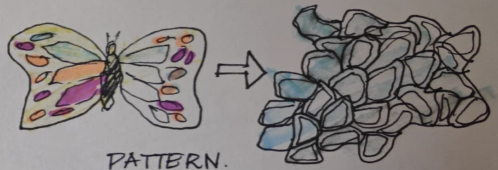
BUTTERFLY WINGS CAN REFLECT AND REFRACT LIGHT THROUGH THEIR MICROSCOPIC STRUCTURES, CREATING IRIDESENT EFFECTS AND CONTROL LIGHT ABSORPTION.



POLYCARBONATE PANELS

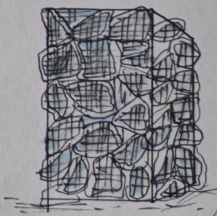
GLASS, TEXTURED SURFACES CAN REFLECT AND DIFFUSE SUNLIGHT, REDUCING GLARE AND ENHANCING DAYLIGHTING.

3. AESTHETIC AND BIOMIMETRIC DESIGN.-

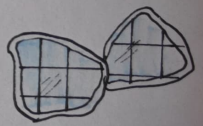


PATTERN.

THE INTRICATE PATTERNS OF BUTTERFLY WINGS ARE NOT ONLY FUNCTIONAL BUT ALSO VISUALLY CAPTIVATING.



FACADE



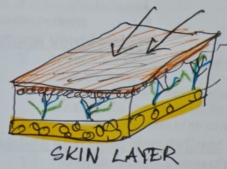
FACADE DESIGN

SIGNATURE
SHUBHASHREE.L
1AA21AT043
SEM VII

CONCEPT - HUMAN SKIN

Feature of Human Skin.

1. **PROTECTIVE BARRIER -**



outer layer protects against UV radiation, environ - mental factors.

2. **REGENERATION -**

Skin has a ability to heal with mechanisms to repair itself quickly

3. **THERMOREGULATION -**

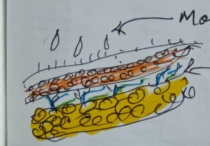
Skin helps regulate body temperature through sweat glands and blood vessel dilation or constriction.

4. **SENSATION -**

Contains receptors for touch, pressure, temperature & pain.

5. **MOISTURE MANAGEMENT -**

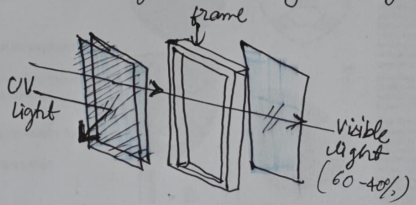
Skin maintains hydration & prevents excessive water loss.



APPLICATION:

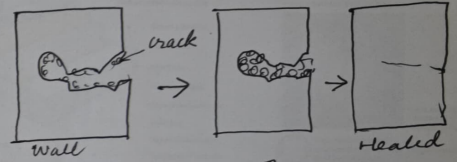
1. Adaptive Facade -

dynamic glass facades that tint automatically in response to sunlight, reducing heat gain.



2. Self - healing Properties -

Self - healing Concrete, where microcapsules containing healing agents are released to repair cracks.



3. Integrated Sensory Systems

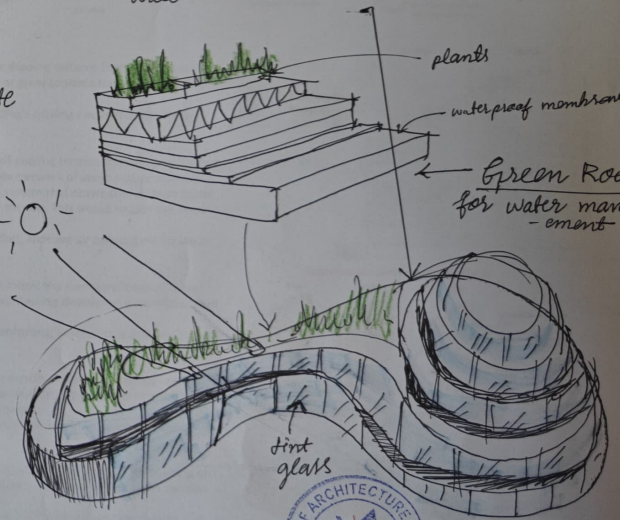
Smart Facade - that incorporate sensors to monitor temperature, air quality & humidity, adjusting ventilation accordingly.

4. Textured Surfaces

Textured coatings that mimic the rough surface of skin, helping to prevent dust & pollutants from settling on the facade.

5. Thermal Regulation

Phase change materials (PCMs) integrated into facade systems that absorb, store and release heat.



NAME - SHUBHASHREE.L
USN - 1AA21AT043
SEM - 7

ONE ANGLE SQUARE

Location: Singapore
•Architect: Foster + Partners
•Completion: 2018
•Function: Office Building

Design Concept
The design of One Angle Square draws inspiration from natural forms and processes, aiming to create a structure that is not only aesthetically pleasing but also environmentally sustainable. Here are some key aspects of its biomimetic features:

Biomimetic Features

1.Natural Ventilation:

1. The building employs a natural ventilation strategy, reducing reliance on mechanical cooling systems.
2. Inspired by the way trees and plants regulate airflow, the design incorporates operable windows and ventilation shafts that allow fresh air to flow through the building, mimicking the natural processes of air circulation in nature.

2.Shading and Heat Regulation:

1. The façade features a series of sunshades that respond to the sun's position throughout the day.
2. This design mimics the way certain plants orient their leaves to optimize sunlight exposure while minimizing heat gain, reducing the building's energy consumption for cooling.

3.Water Management:

1. The building includes a rainwater harvesting system, collecting and reusing rainwater for irrigation and other non-potable uses.
2. This approach is inspired by natural water management systems in ecosystems that effectively utilize rainfall and minimize runoff.

4.Green Spaces:

1. The incorporation of vertical gardens and green roofs helps improve biodiversity, similar to how forest ecosystems support a variety of plant and animal life.
2. These green spaces provide insulation, improve air quality, and enhance the aesthetic quality of the building, akin to how natural habitats contribute to environmental health.

5.Materials and Sustainability:

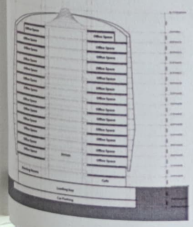
1. The design emphasizes the use of sustainable and locally sourced materials, reducing the environmental impact of transportation and extraction.
2. Biomimicry principles are applied in selecting materials that enhance energy efficiency and durability, drawing parallels to the resilience found in natural materials.

eneral Arrangement

building has an open plan of a high-quality ern office environment that encourages ntive working.

ilder is free of internal columns with a span of m from the atrium to the external wall.

structure and form allow for flexibility, ibility, and easy reorganizing and ining of the space to satisfy needs. The ding stands upon a steelwork structural grid m x 16.5m and on three main structural



AIR FLOW, LIGHTNING & PASSIVE DESIGN STRETEGIES

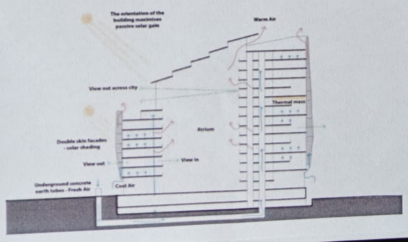
Airflow is managed by a natural ventilation system that draws fresh air inside the building by using underground concrete earth tubes that follow passive heating and cooling energy strategy. Warm air is ejected through louvers at the top of the façade.

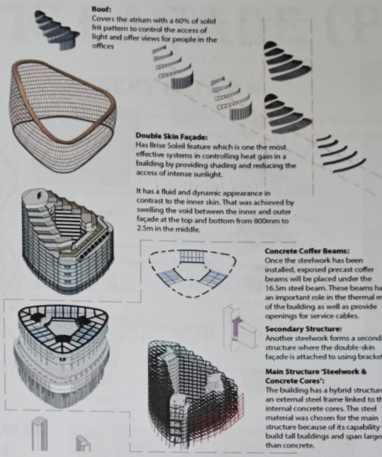
The double skin facades help the ventilation system and provide shading.

Thermal mass is provided by the double-skin façade and exposed concrete soffits in the office areas.

The open atrium plays an important role in the strategy of natural heating, cooling, and lighting.

The design of the roof provides enormous views of the city.





1. Façade Inspired by Plant Leaves
Implementation: The building's exterior could feature dynamic shading systems that adjust based on the sun's angle throughout the day. This mimics how leaves tilt or grow towards the sun, optimizing light intake and minimizing heat gain.
•Benefit: Energy efficiency would improve by reducing the building's cooling needs and maximizing natural lighting.

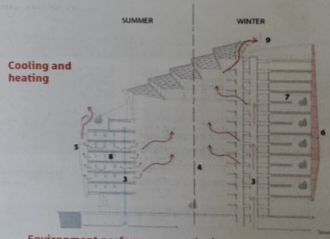
2. Natural Ventilation like Termite Mounds
•Concept: The ventilation system could be modeled after the self-cooling termite mounds found in hot climates, which regulate internal temperature through a complex network of vents and air channels.
•Implementation: The building could have a natural ventilation system that draws cool air from lower levels, circulates it through the building, and expels warm air at the top. This would reduce the need for mechanical HVAC systems.
•Benefit: This biomimetic design would lower energy consumption, improve air quality, and create a more comfortable indoor environment.

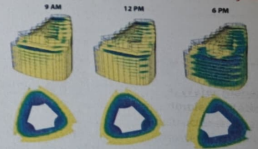
3. Self-Cleaning Façade Inspired by Lotus Leaves
•Implementation: A self-cleaning façade made of materials that mimic the microstructures of lotus leaves could be applied. Such materials repel water and dust, maintaining cleanliness without frequent maintenance.
•Benefit: Reduced cleaning costs, less maintenance, and a longer-lasting, aesthetically pleasing exterior.

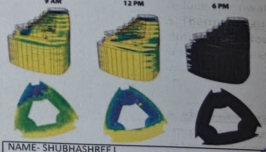
4. Water Management System Based on Tree Roots
•Implementation: The building could incorporate a rainwater harvesting system inspired by root structures. Channels embedded within the building's foundation could direct rainwater to a storage system, which could then be used for irrigation or greywater purposes.
•Benefit: The building would reduce its reliance on municipal water, promote sustainability, and reduce stormwater runoff.

5. Thermal Regulation Like Human Skin
•Implementation: The façade could be designed with materials that expand or contract depending on the temperature, opening to let heat out or closing to retain warmth, similar to how pores in the skin work. Smart materials or dynamic façades could be used for this.
•Benefit: This would significantly improve the energy efficiency of the building, reducing heating and cooling needs.

6. Efficient Energy Use Like Photosynthesis
•Implementation: The façade could integrate **solar panels** or photovoltaic cells that resemble chlorophyll in plants, capturing sunlight and converting it into usable energy.
•Benefit: The building could become a net-zero energy building, reducing its carbon footprint by generating its own renewable energy.

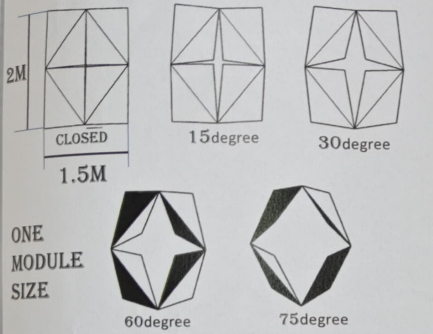


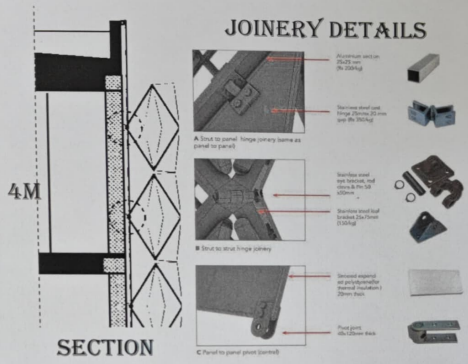




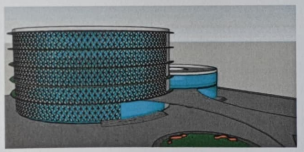
NAME- SHUBHASHREE L
USN- 1AA21AT043
SEM – 7
SIGNATURE

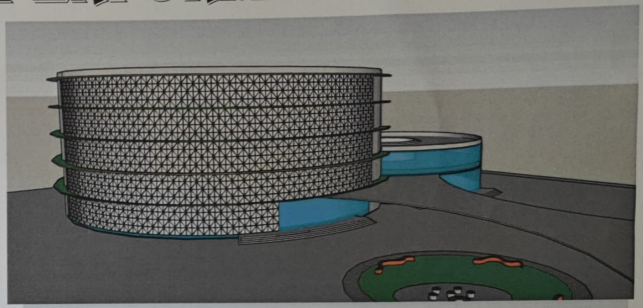
FAÇADE – KINETIC FAÇADE (PERFORMATIVE)

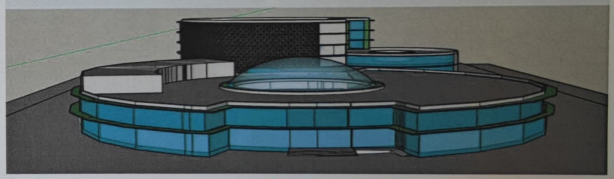


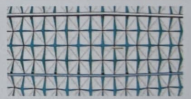


The kinetic facade creates a folding and unfolding movement, which adapts to the sun and changing environmental conditions. The movement of each panel of module depends on its degree of opening(declination angle) and the kinetic control and mechanism. The modules are able to control the visibility and the transparency of the façade. By responding to the desires of the occupants, the system is able to increase the comfort. Moreover, the panels of the façade are lightweight and can be mounted almost everywhere

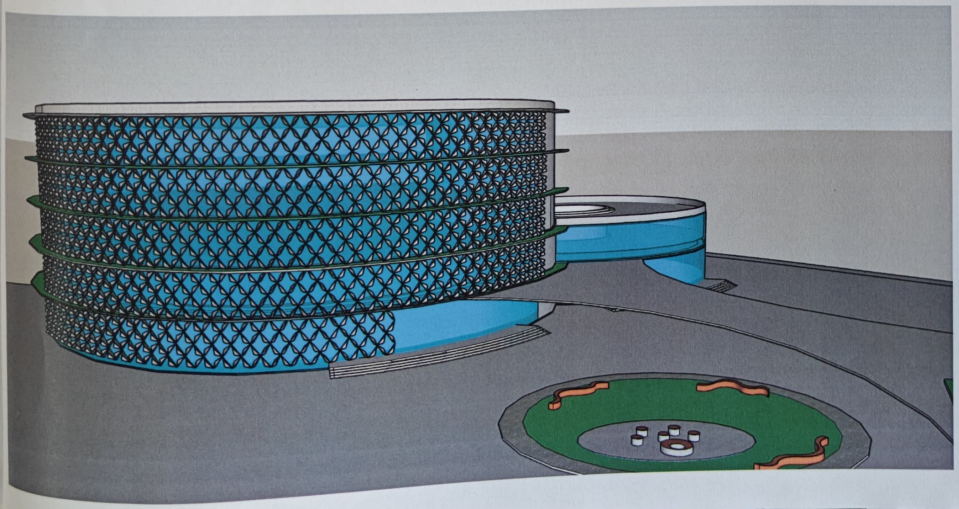


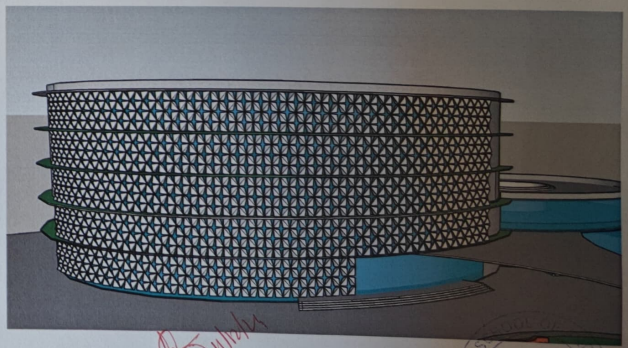






15degree 60degree 75degree





NAME- SHUBHASHREE L
USN- 1AA21AT043
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SIGNATURE