



New Chautauqua Institute // Singapore

Arch_708-201 // Environmental Design Studio

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Team: José Barria, Bhakti Kothari, Neeharika Siram

Climate Profile

Season Overview

Latitude: 1.37°
Longitude: 103.98°
Köppen: AF- Tropical Rainforest

Sky coverage:
85% of the time above 70% coverage

Temperature:
Max: 35°C
Mean: 26°C
Min: 20°C

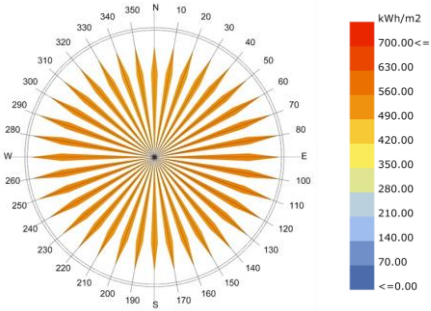
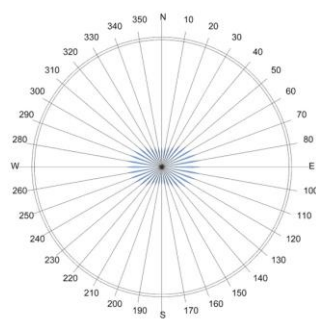
Comfort Metrics:
UTCI: 72% time Heat Stress

Relative Humidity: 30-100%
Average: 80%

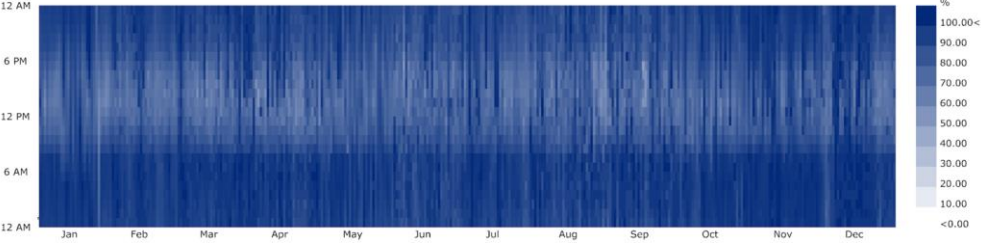
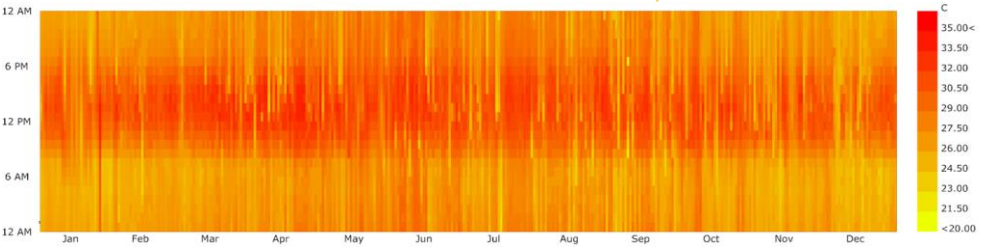
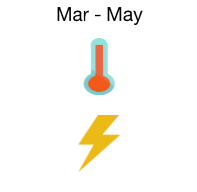
Annual rainfall:
2331.mm
Average rainy days:
178

Direct Radiation(kWh/m2)
SINGAPORE_SGP
1 JAN 1:00 - 31 DEC 24:00

Diffuse Radiation(kWh/m2)
SINGAPORE_SGP
1 JAN 1:00 - 31 DEC 24:00



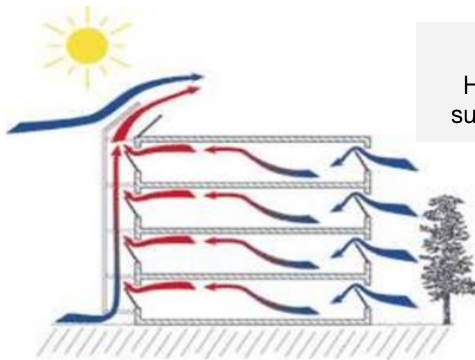
Radiation Rose



Climate Profile

Strategies & Opportunities

Ventilation



Buoyancy Driven
Hot air tends to rise, and having a constantly heated surface on top will “suck” air upwards, improving wind

Green Envelope



Tropical plants called epiphytes such as English Ivy, Peace Lily, Reed Palm, Boston ferns and Tillandsia. These plants that get all their water from the air instead through roots..

Breathable Shaded Envelope

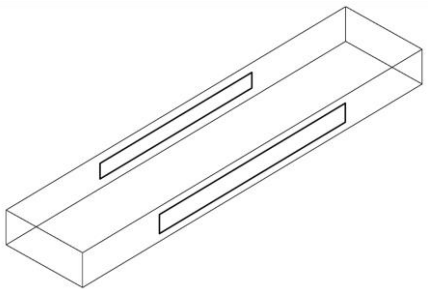


An offset envelope creates a “breathable” buffer zone, increasing overall thermal resistance.

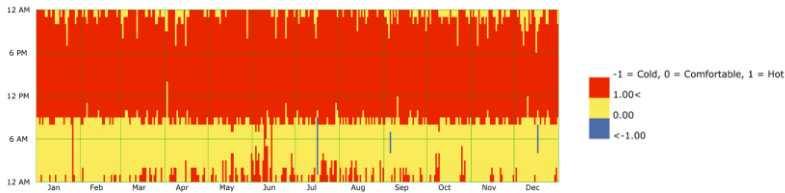
Shoebox Design Iterations

Base Case Vs Final Case

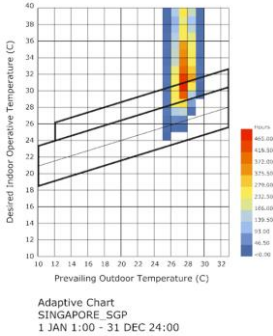
Base Case



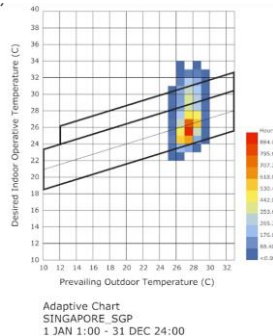
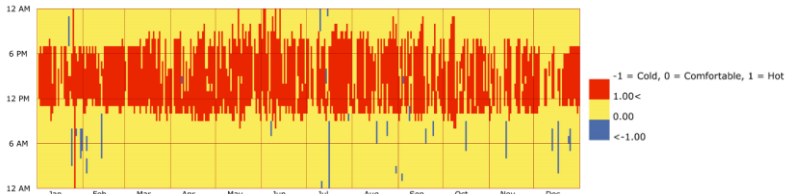
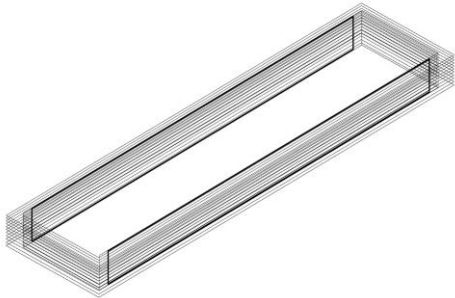
Heat Stress



Adaptive Comfort Chart

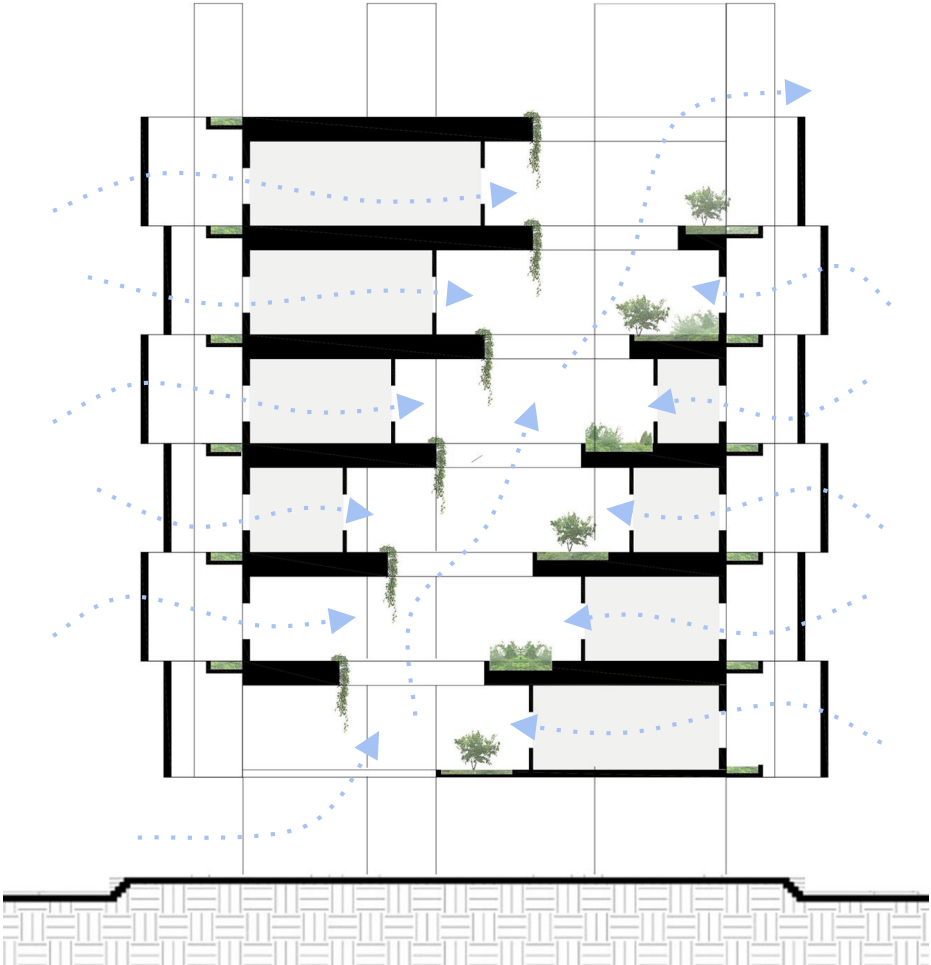


Proposed Case



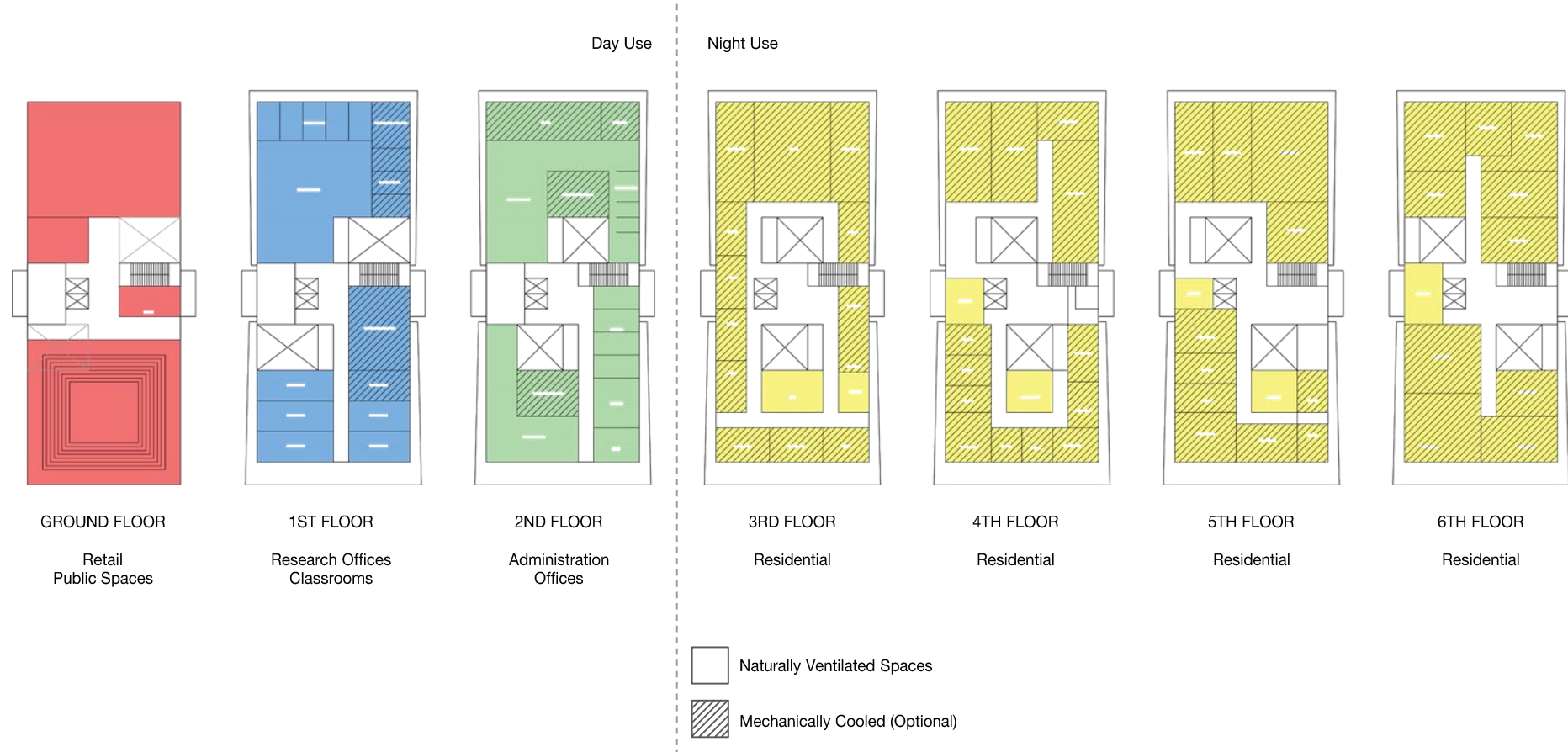
Building Section

Breathable Shading Element

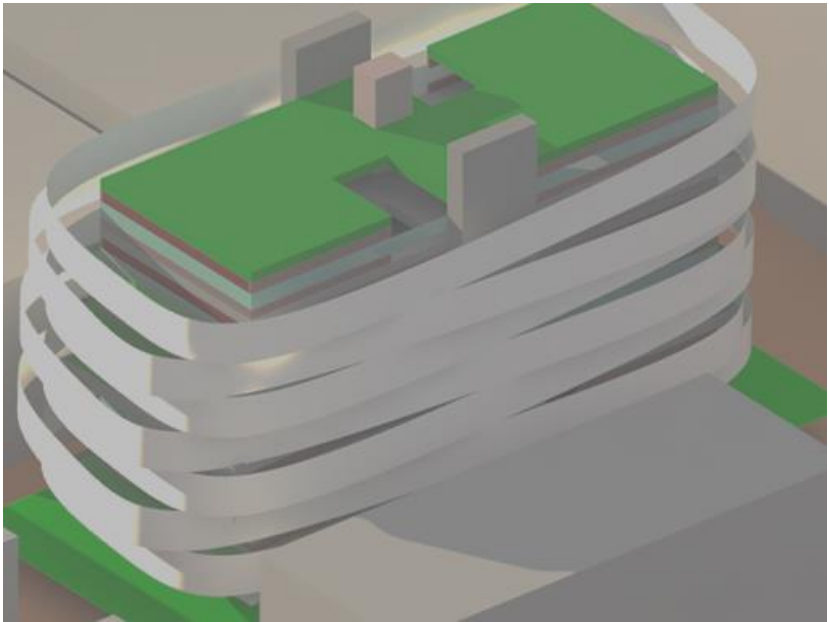
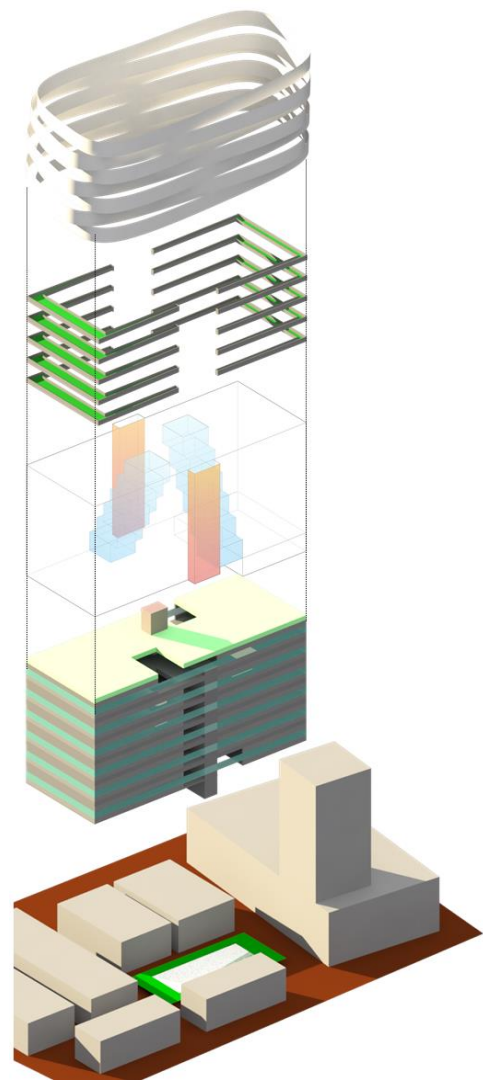


Design Process

Program allocation



Design Process



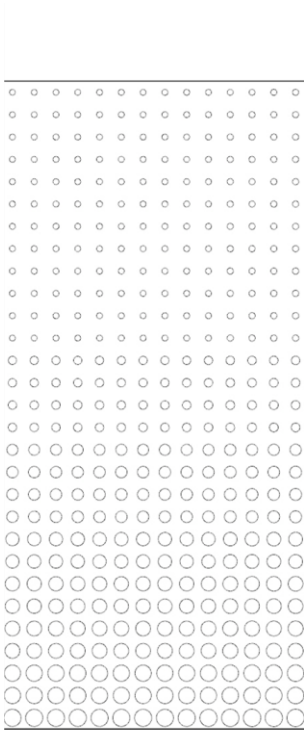
Design Process

Skin Design

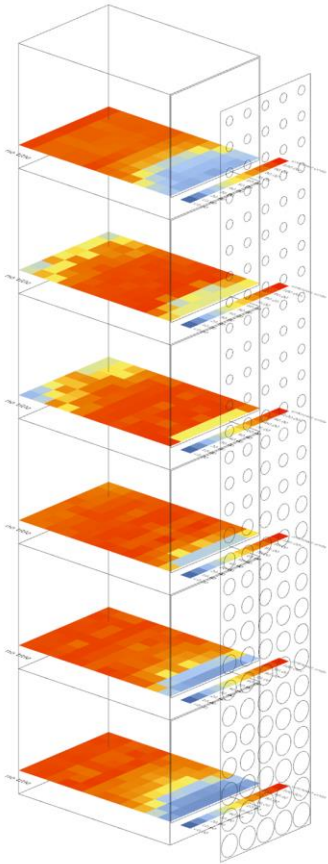


Surface Radiation Analysis

||



Surface Perforation Radius



53% Time Comfortable (Adaptive)
46% Spatial Daylight Autonomy

55% Time Comfortable (Adaptive)
47% Spatial Daylight Autonomy

65% Time Comfortable (Adaptive)
60% Spatial Daylight Autonomy

61% Time Comfortable (Adaptive)
76% Spatial Daylight Autonomy

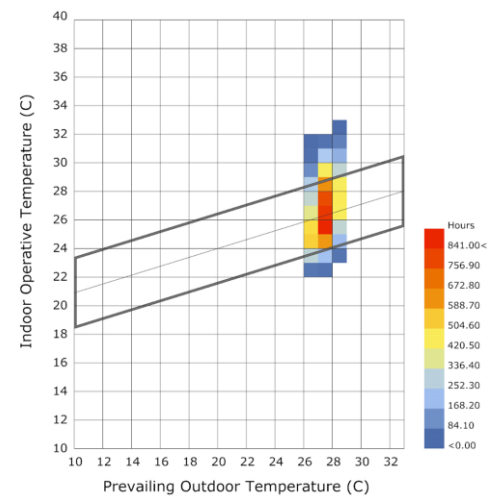
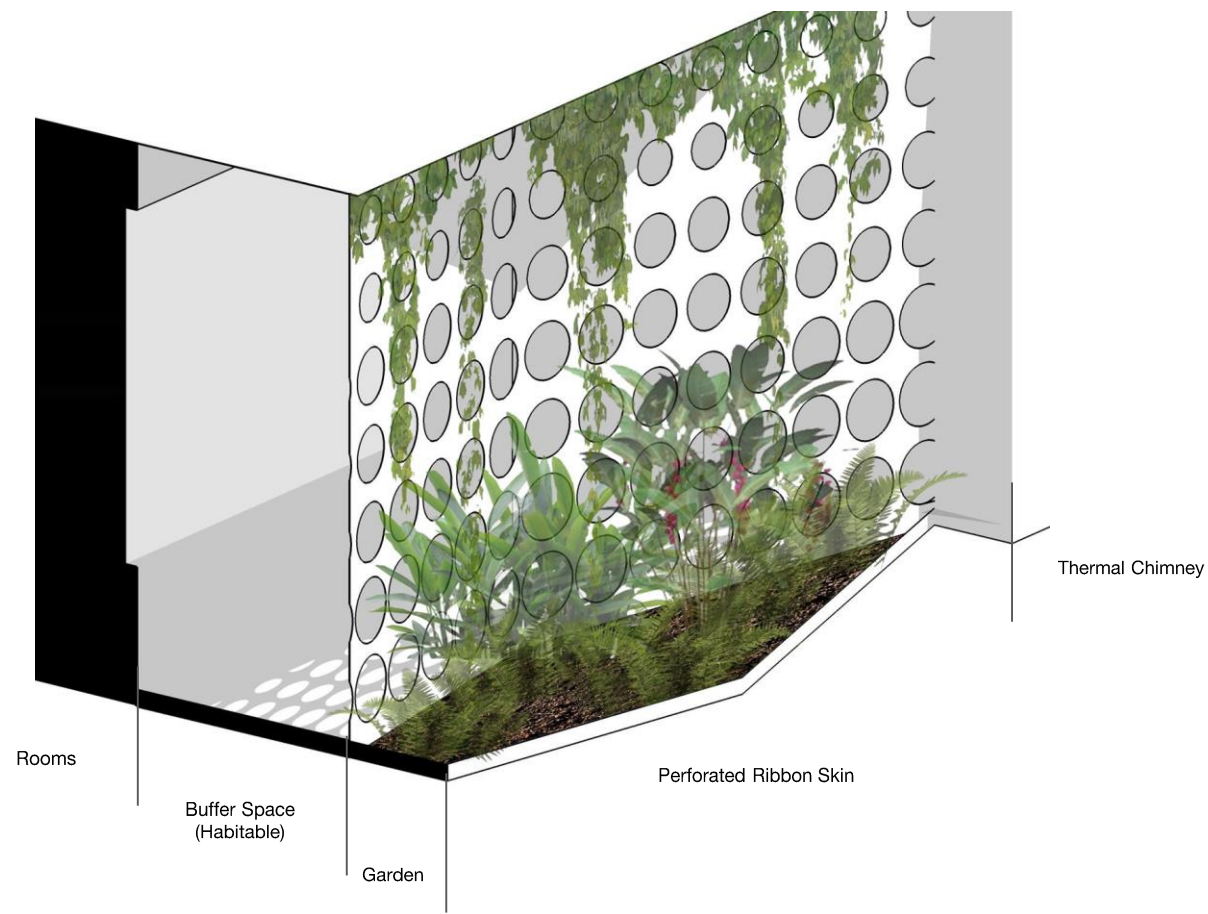
64% Time Comfortable (Adaptive)
98% Spatial Daylight Autonomy

65% Time Comfortable (Adaptive)
100% Spatial Daylight Autonomy

Basic Simulations

Facade Design

Breathable Shading Element



Adaptive Chart
SINGAPORE_SGP
1 JAN 1:00 - 31 DEC 24:00

Shading + Ventilation, = **76%**
time Comfortable (Adaptive)

Plants (Reducing MRT by 10%)= **81%**

Computational Fluid Dynamics

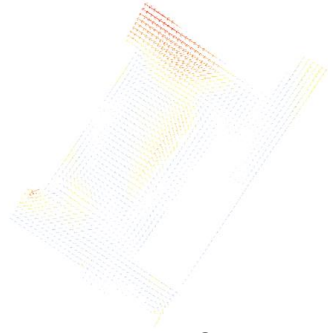
Stage 1

Direction

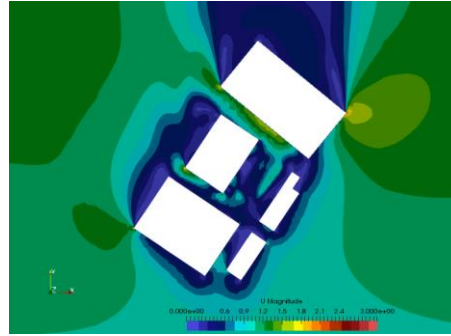
Velocity Vector

Velocity Map

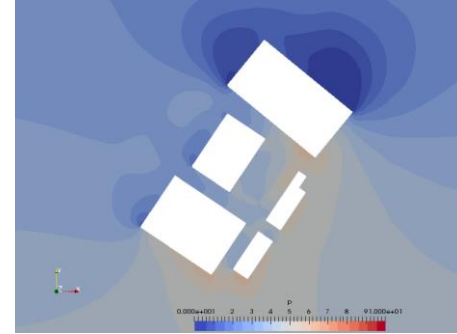
Pressure Map



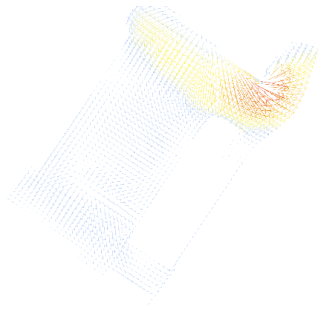
North_Ground



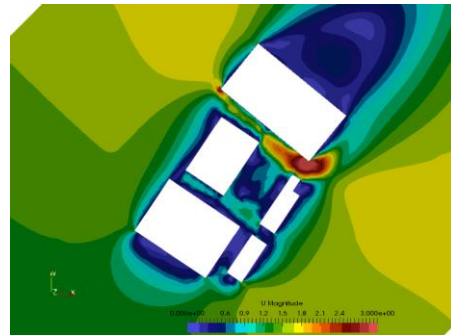
North_Ground



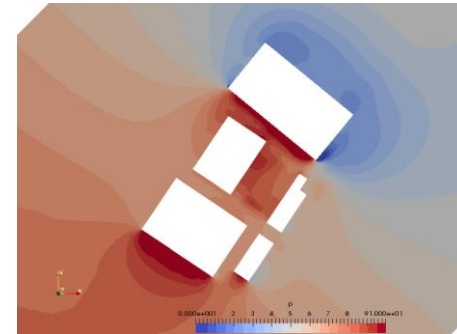
North_Ground



NorthEast_Ground



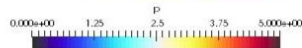
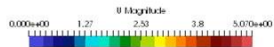
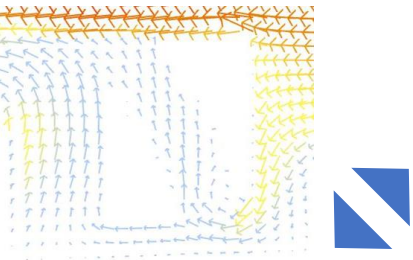
NorthEast_Ground



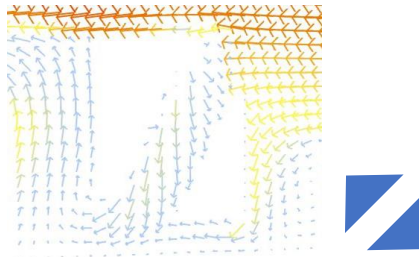
NorthEast_Ground

Stage 2

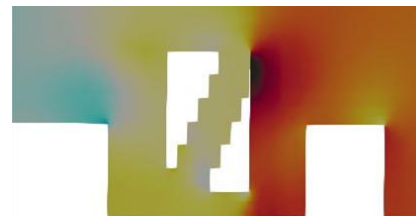
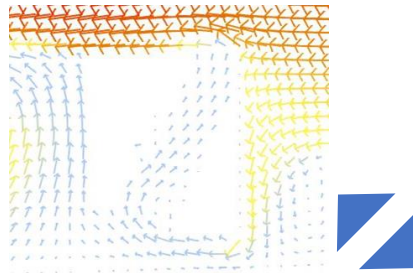
Atrium 1



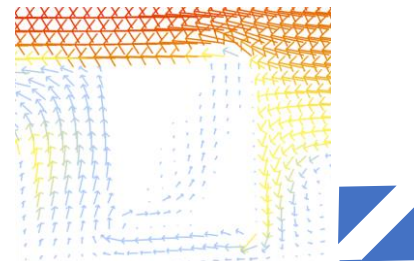
Atrium 2
(Reverse)



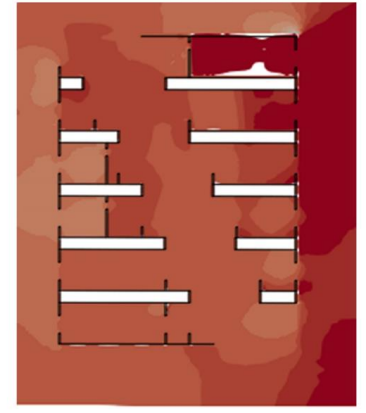
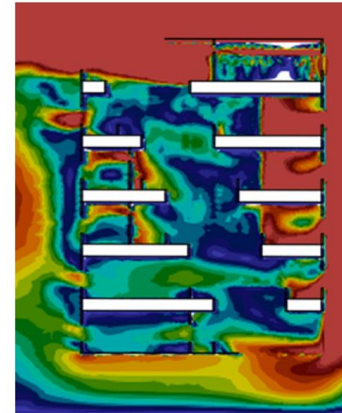
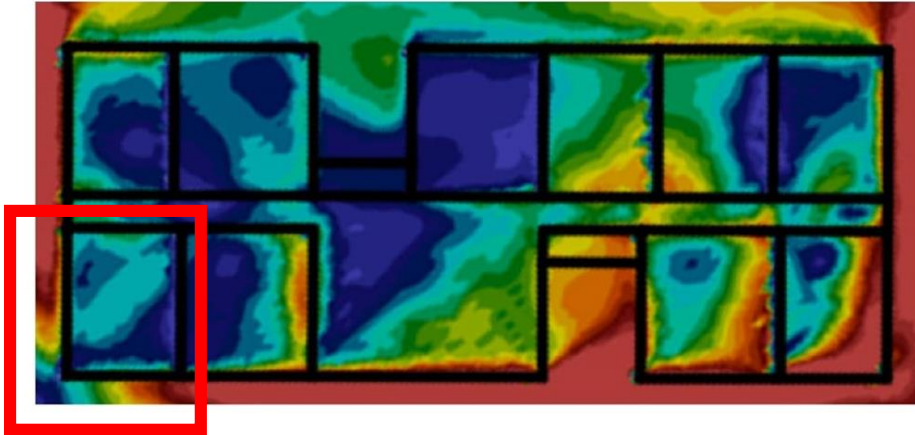
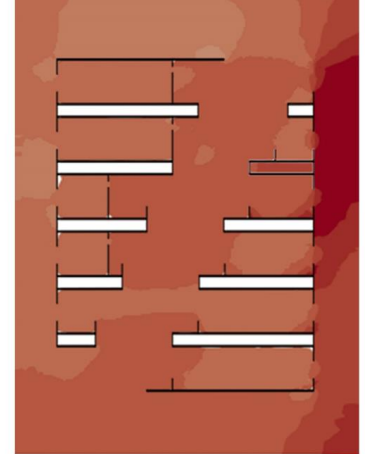
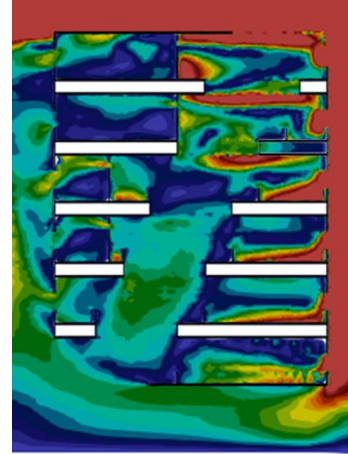
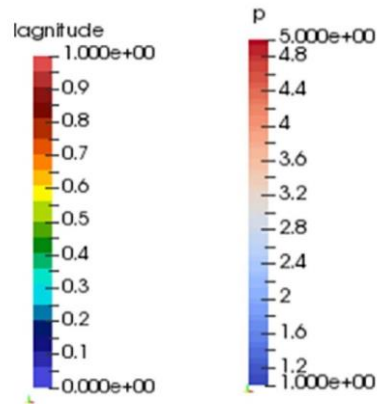
Atrium 2
(Top Outlet single side open)



Atrium 2
(Top & Bottom Outlet single side open)



Stage 3 Natural Ventilation



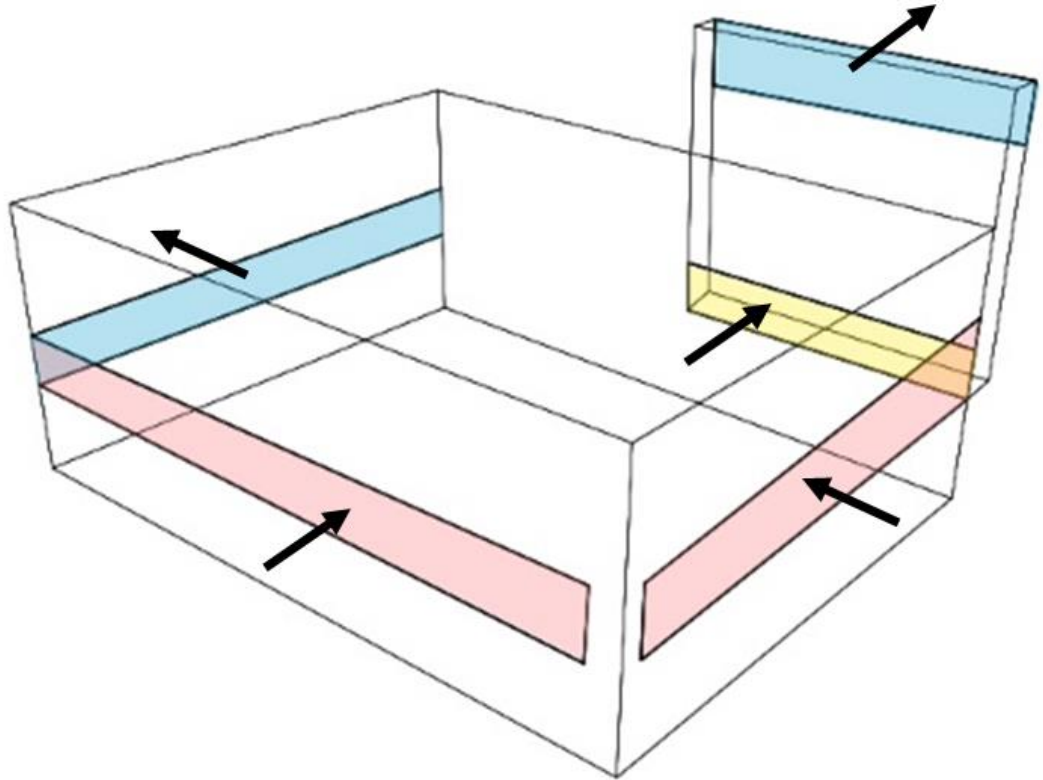
Stage 4

Test for thermal chimney

No Chimney

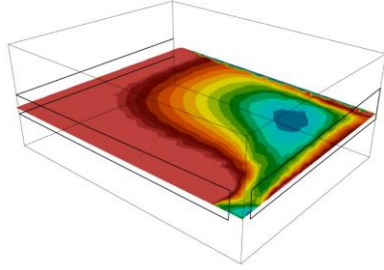
Solar Chimney
(Surface
Temperature: 32C)

Thermal Chimney
(Surface
Temperature: 34C)

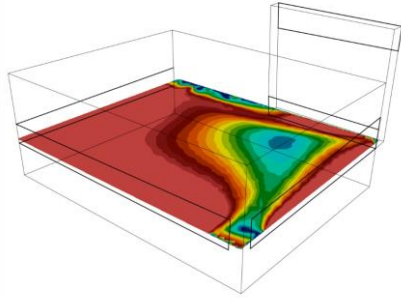


Velocity

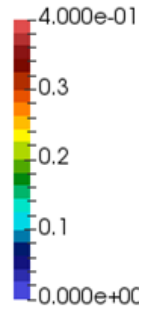
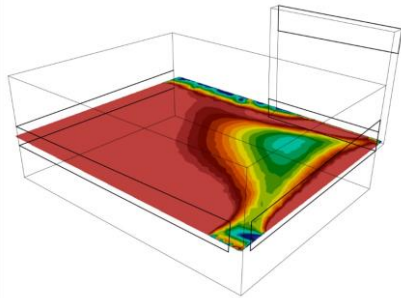
No Chimney



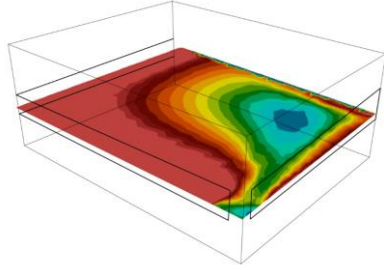
Solar Chimney
(Surface
Temperature: 32C)



Thermal Chimney
(Surface
Temperature: 34C)

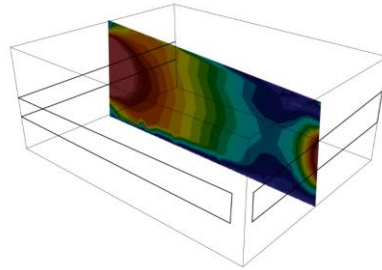


Velocity

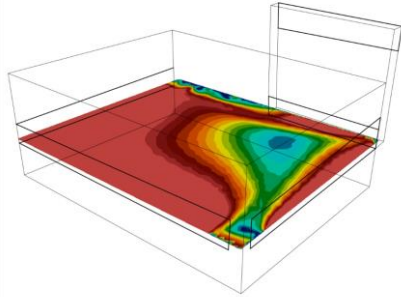


No Chimney

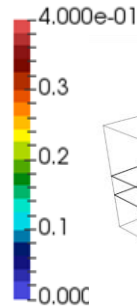
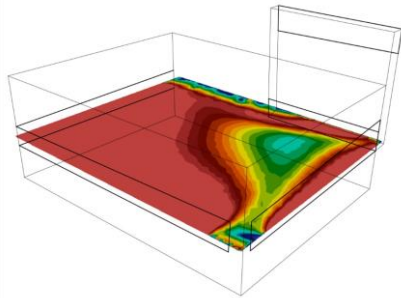
Velocity



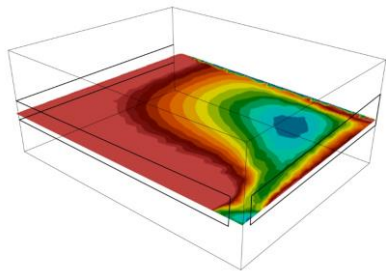
Solar Chimney
(Surface
Temperature: 32C)



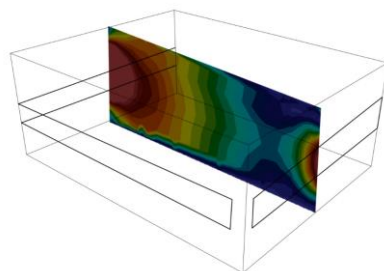
Thermal Chimney
(Surface
Temperature: 34C)



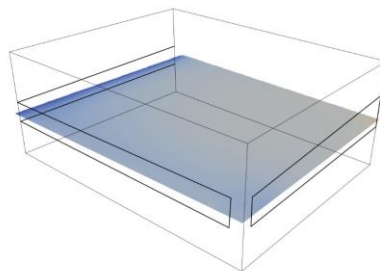
Velocity



Velocity

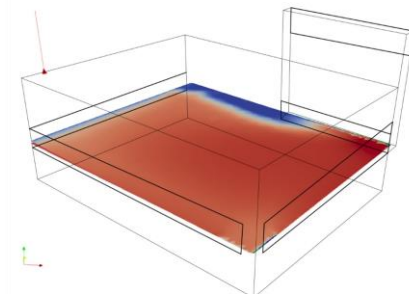
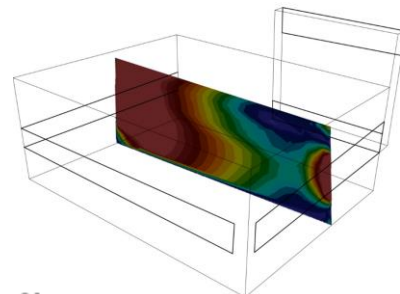
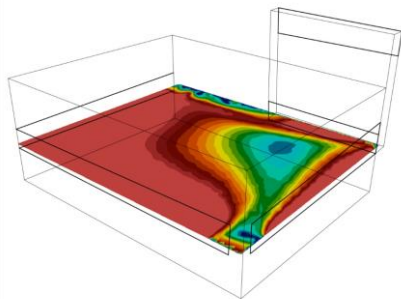


Pressure



No Chimney

Solar Chimney
(Surface
Temperature: 32C)



Thermal Chimney
(Surface
Temperature: 34C)

