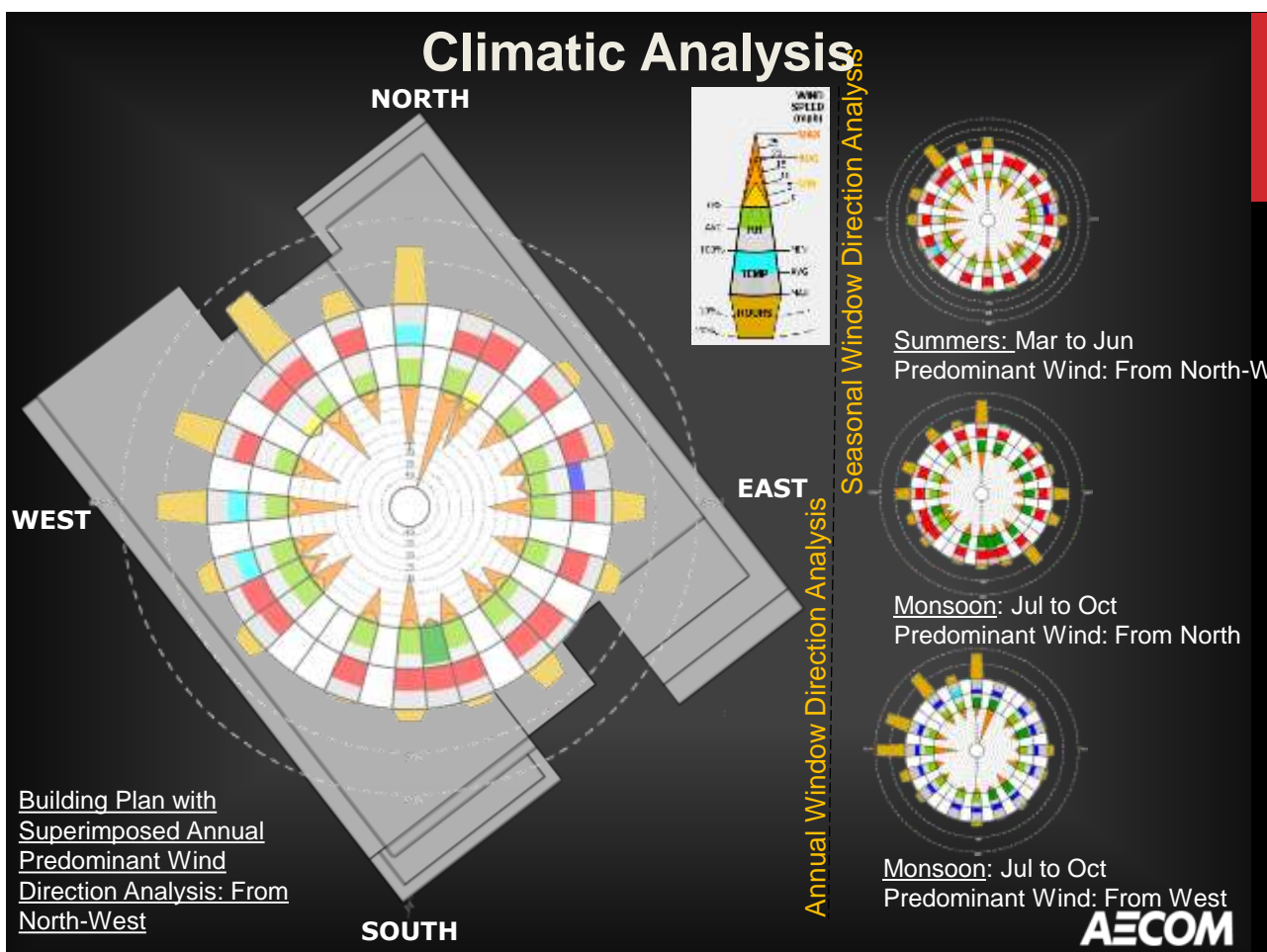


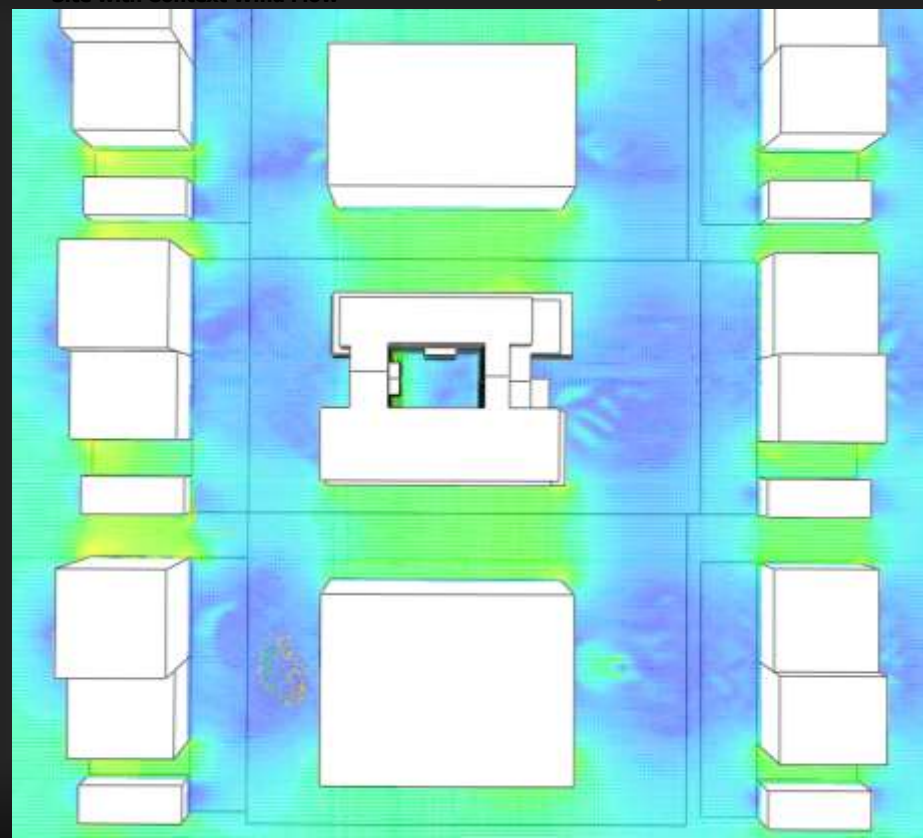


Combining Nature (Passive) with Systems (Active)

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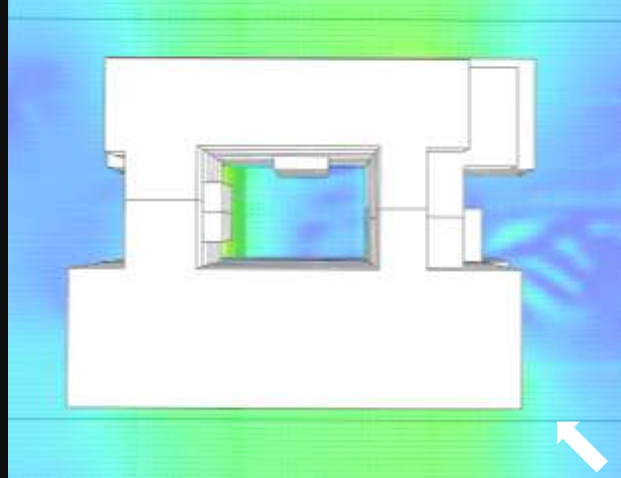


Site CFD Analysis

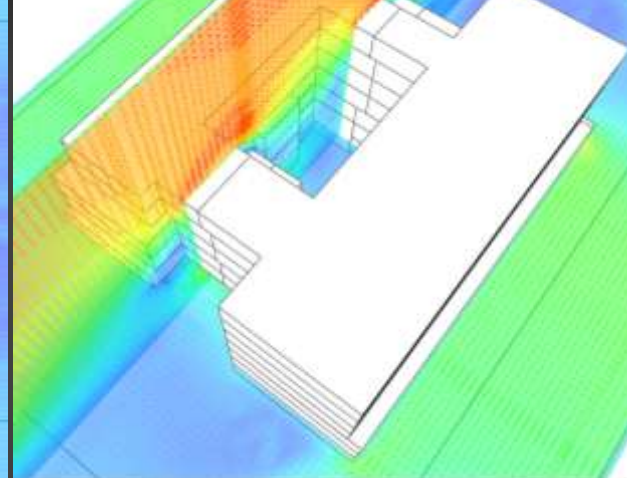


Building Courtyard Analysis

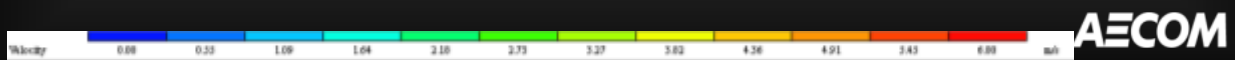
Courtyard One Side Closed & Context– Pedestrian Level Wind Flow



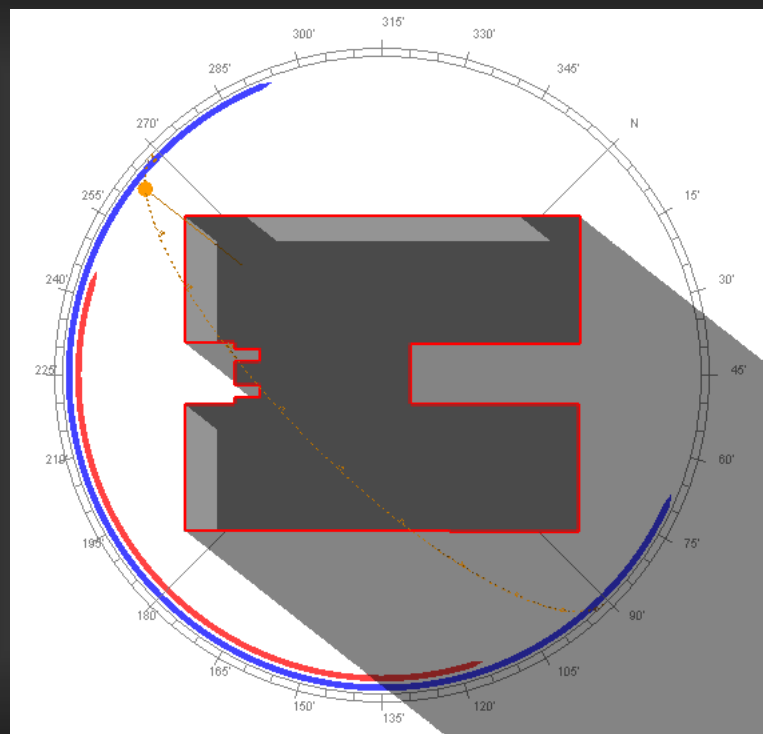
Courtyard One Side Closed with Context– Wind Flow Through Courtyard



- Wind Velocity at Pedestrian Level ~ 2 m/s (Comfortable)
- Wind Flow Through Courtyard ~ 0.5 m/s – 2.5 m/s (Controlled & Comfortable)
- Wind Flow in Open Area at Building Front & Back ~ 0.5 m/s – 1 m/s (Poor Ventilation & Uncomfortable)



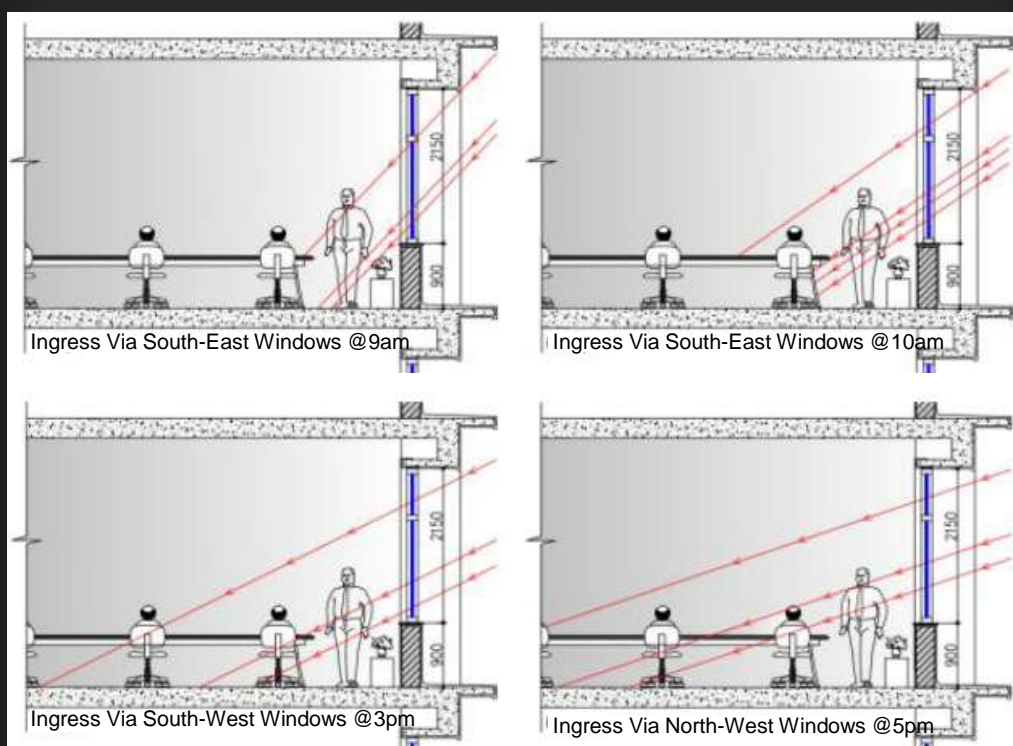
Glare Analysis



Plan View – Glare Extent on Floor From Each Facade

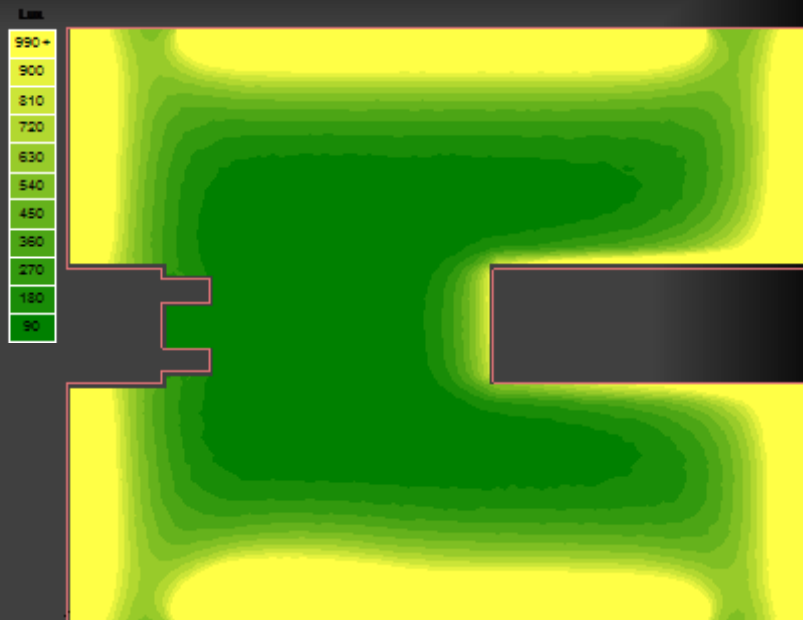


Glare Analysis in Office Premises

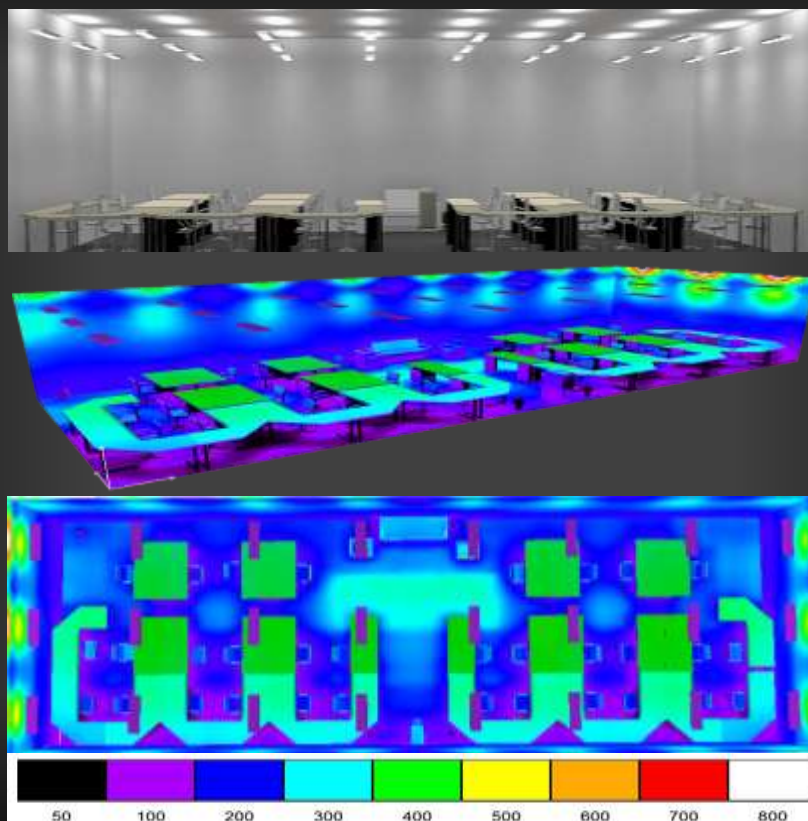


Illuminance Levels Analysis

- The analysis is done at 12pm considering clear sky condition
- Wall: Surface reflectance of 65%
- Floors: Surface reflectance of 50%
- Ceiling Paints with surface reflectance of 85%
- North/South/West/East Glazing: Visible light transmittance 49%
- Building achieves 270lux in 61% areas



Artificial Lighting Design Optimization



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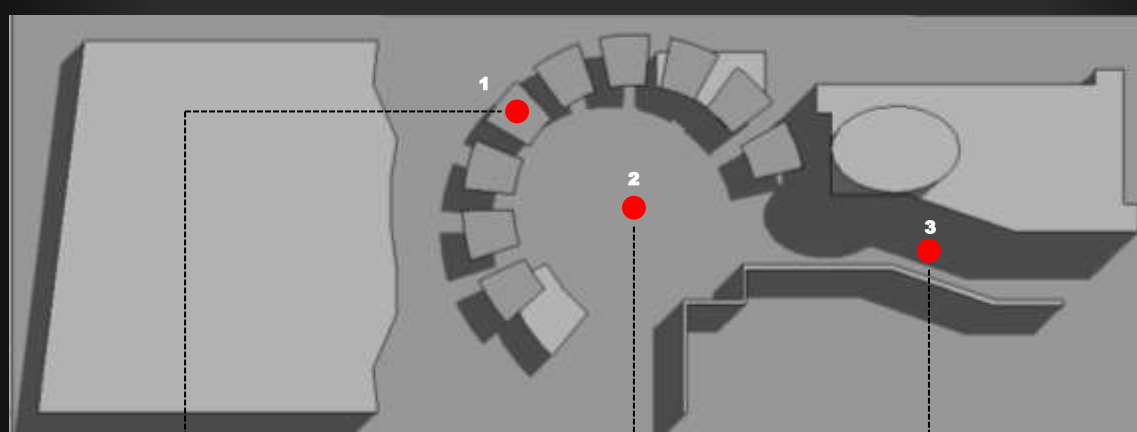
SITE MASTER PLANNING

(MIXED USE DEVELOPMENT AT DELHI)

- **ENHANCED MICROCLIMATE**
- **HEAT ISLAND REDUCTION**
- **ENHANCED PEDESTRIAN THERMAL COMFORT**

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Focus Areas Of Analysis



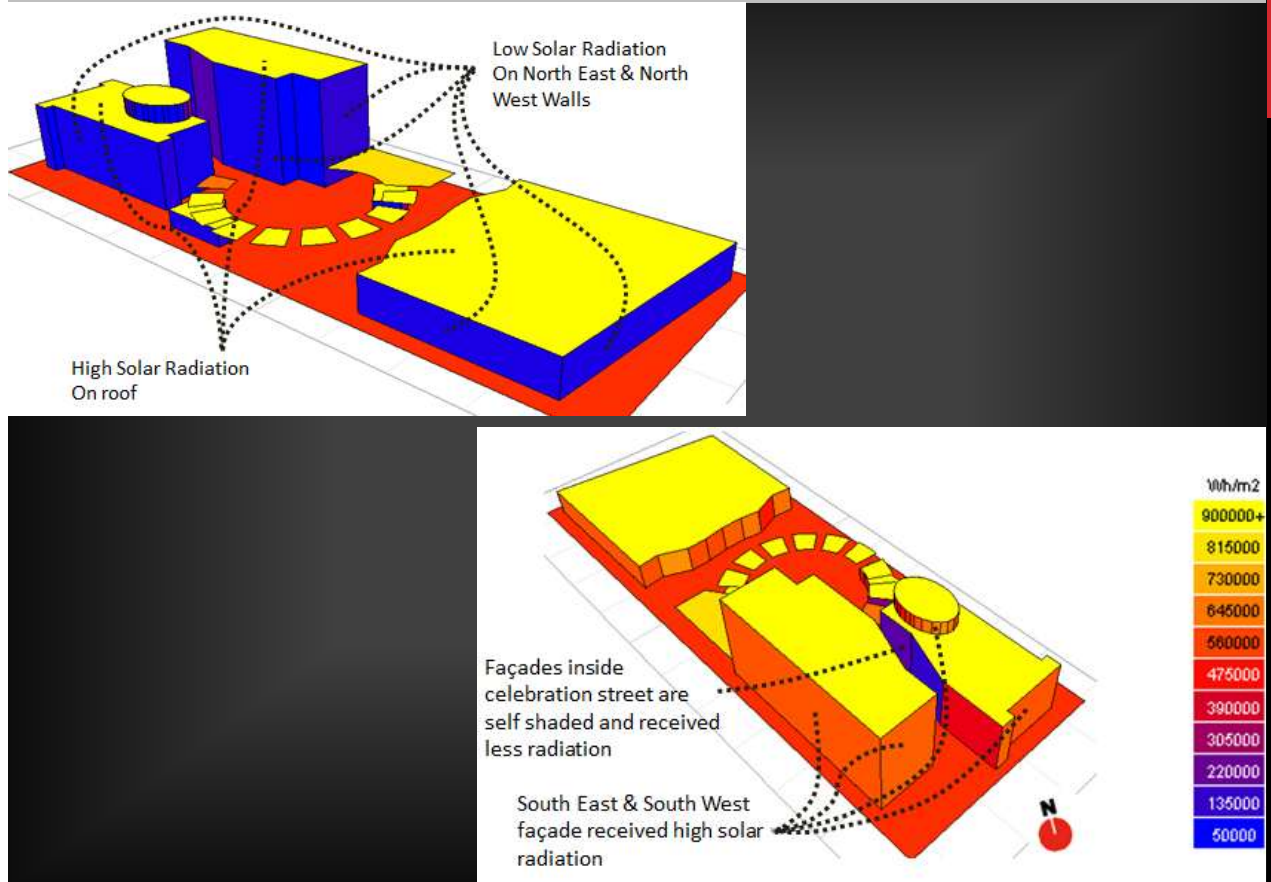
OUTDOOR SEATING

CENTRAL PLAZA

STREET

AECOM

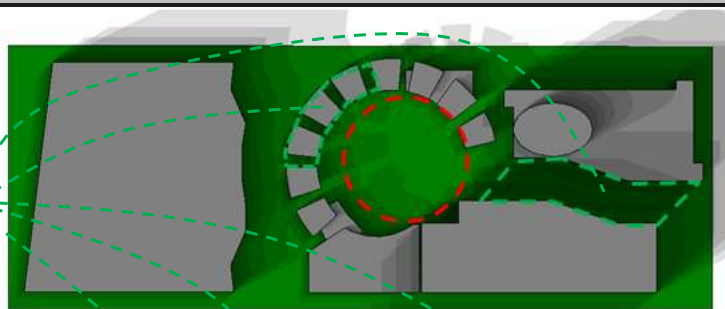
Direct Solar Radiation Analysis



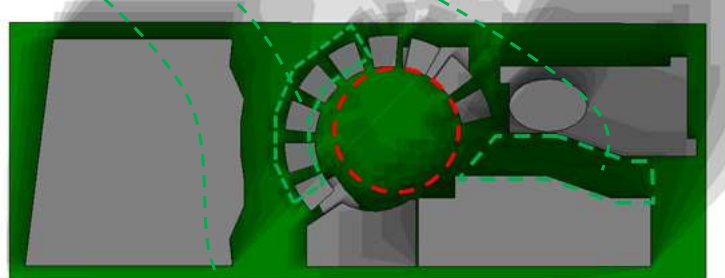
Solar Shading Analysis

SUMMER SOLSTICE
(21st June, 9AM-6PM)

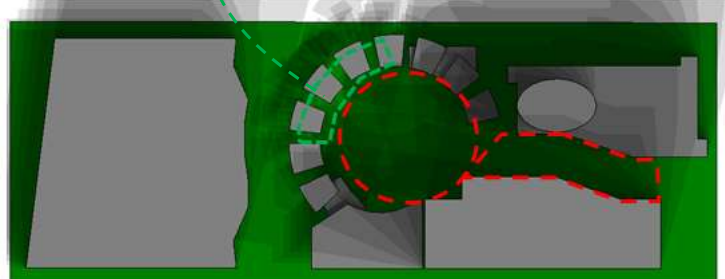
Preferred Location for Pedestrian Seating/Movement/Activities



EQUINOX
(21st September, 9AM-6PM)



WINTER SOLSTICE
(21st December, 9AM-5PM)



Recommended Strategies

Shading Structures For Seating Area/ Pedestrian Activities



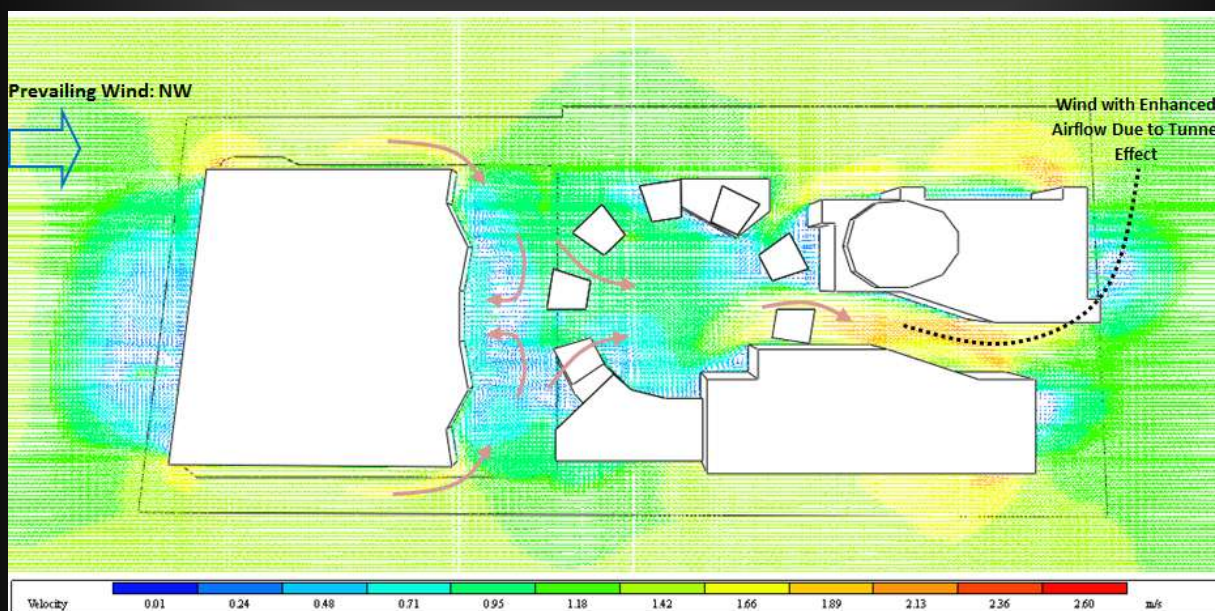
Light Colored Paving/Vegetation



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Wind CFD Analysis

WIND DIRECTION : NORTH-WEST
 AVERAGE WIND VELOCITY : 2 m/s

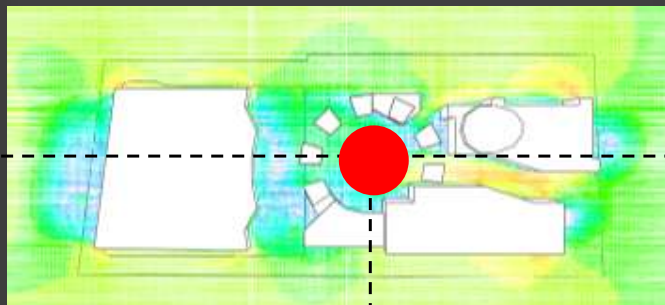


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Recommended Strategies

Water Features For Central Open Space

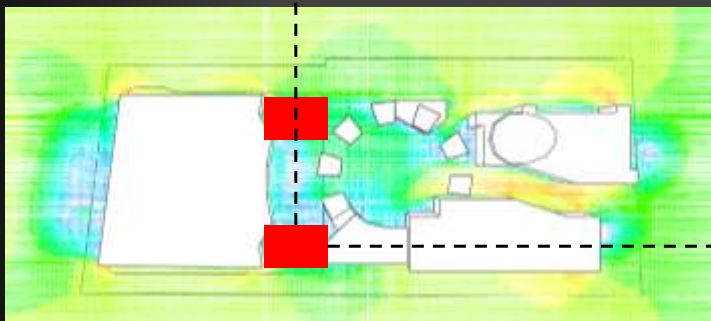
Water Fountain, Mistifiers Etc Provide Evaporative Cooling For Open Spaces



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Recommended Strategies

Water Features For Open Space Of Existing Mall

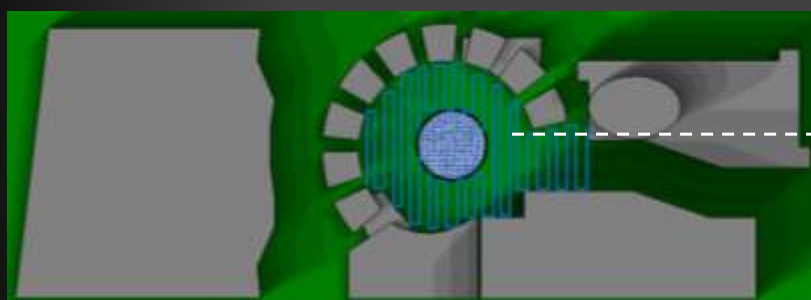
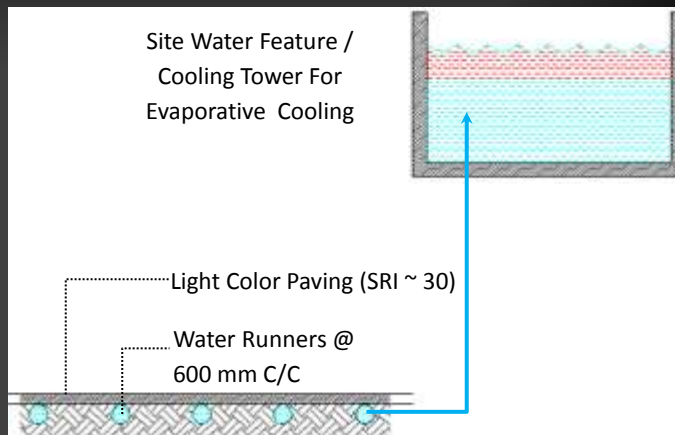


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Recommended Strategies

Ground Embedded Water Runners For Paved Area

These Will Absorb Heat From Paved Surface On Ground & Enhance Thermal Comfort

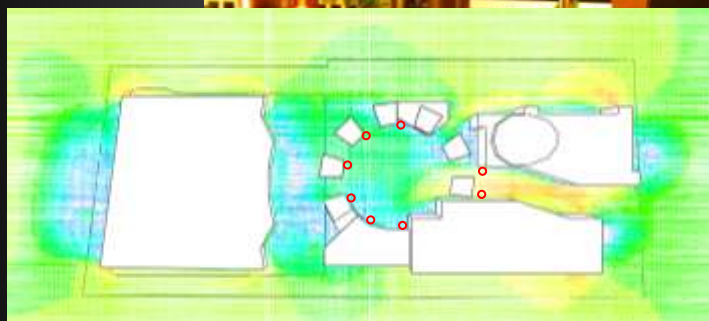


Water Runners Embedded in Ground

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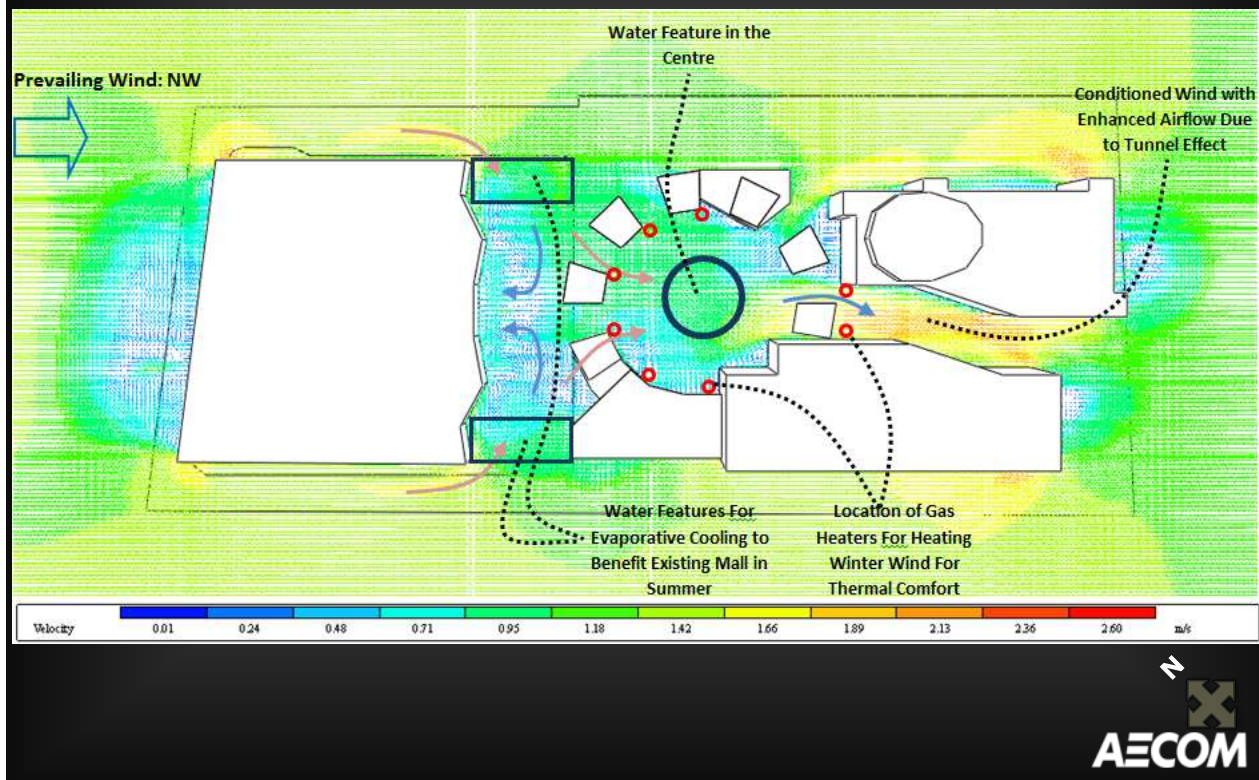
Recommended Strategies

Gas Heaters For Heating Winter Winds

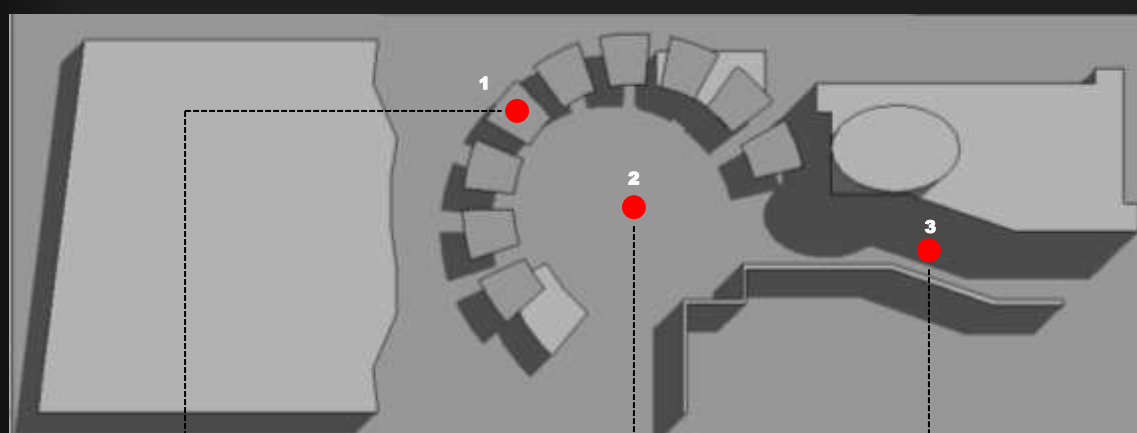


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Recommended Strategies



Recommended Strategies In Critical Areas



OUTDOOR SEATING

Cooling Strategies:

- Shading
- Evaporative Cooling using Mystifiers

CENTRAL PLAZA

Cooling Strategies:

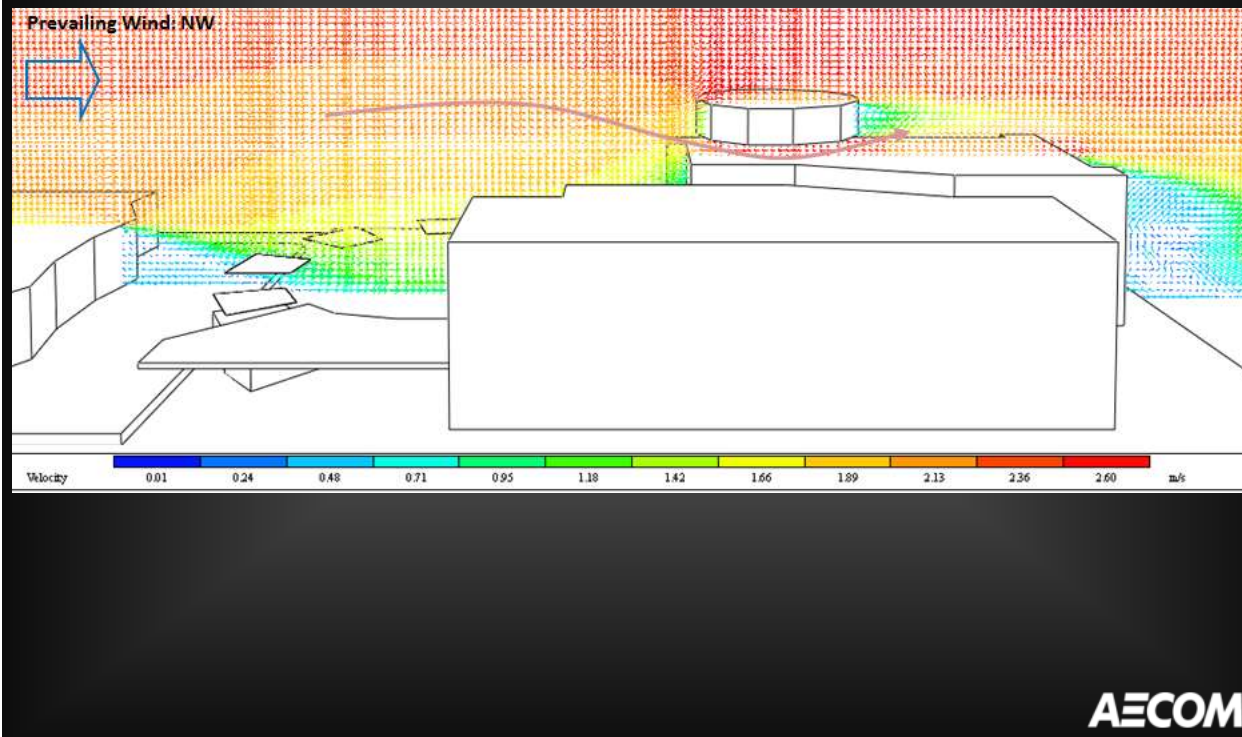
- Evaporative Cooling
- Radiant Cooling using Runners

STREET

Cooling Strategies:

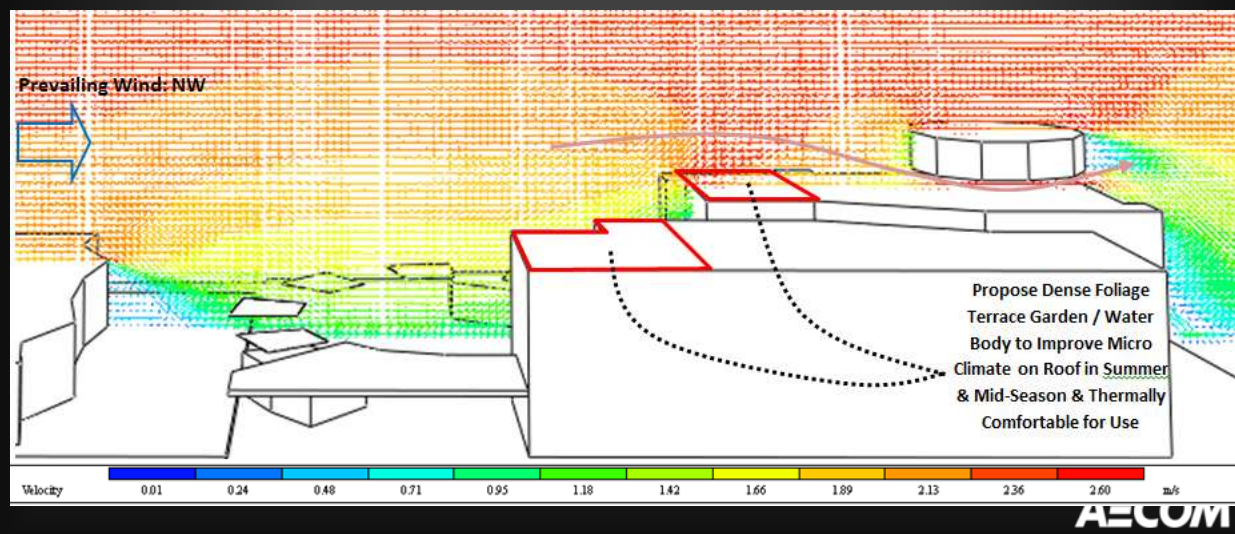
- Evaporative Cooling
- Partial Shading
- Radiant Cooling using Runners

Roof Design



Recommended Strategies

- **Relocate Restaurant**
Relocating restaurant towards SE & introduce terrace garden on the NW
- **Propose Terrace Gardens & Water Bodies**



Recommended Strategies



Introduce Garden & Water Bodies On Roof.

- Cool Dry Summer & Mid-season Wind For Terrace Users
- Reduce The Heat Island Effect On Roof
- Reduced Heat Load of The Building

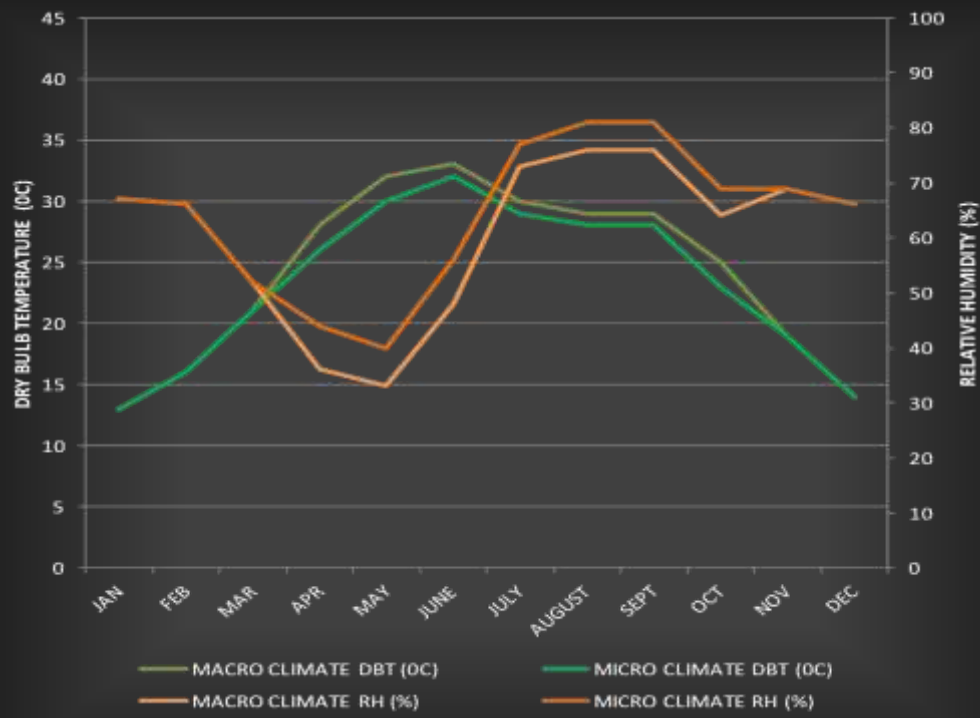


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**ENHANCED MICRO-CLIMATE:
IMPACT ON ENERGY CONSUMPTION
OF BUILDING**

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Macro Climate Vs Micro Climate



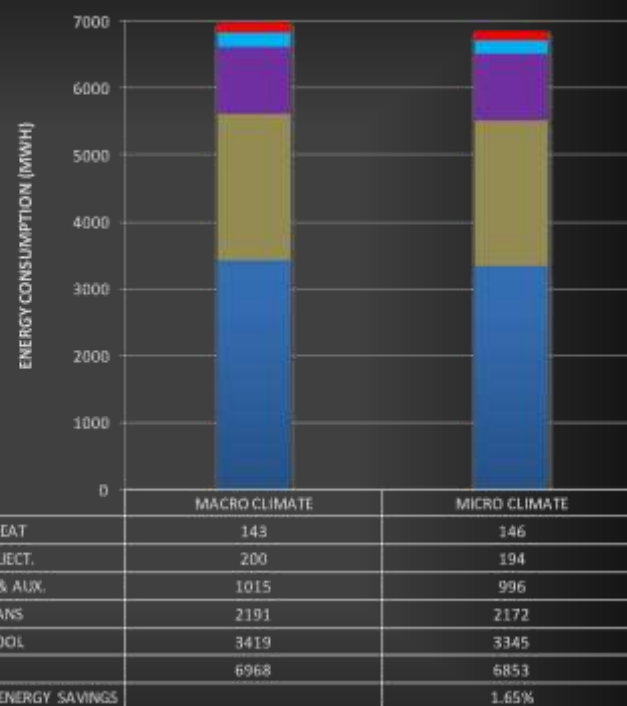
Enhanced Micro-Climate Will Impact G.F. & F.F.



ENERGY SAVINGS

SAVINGS
 Peak Envelope Load : **1.95%**
 Total Annual Energy Consump.: **1.65%**

ENERGY USE COMPARISON FOR ALL HVAC END-USES (MWH)



1.65% Savings Through Enhanced Micro-Climate



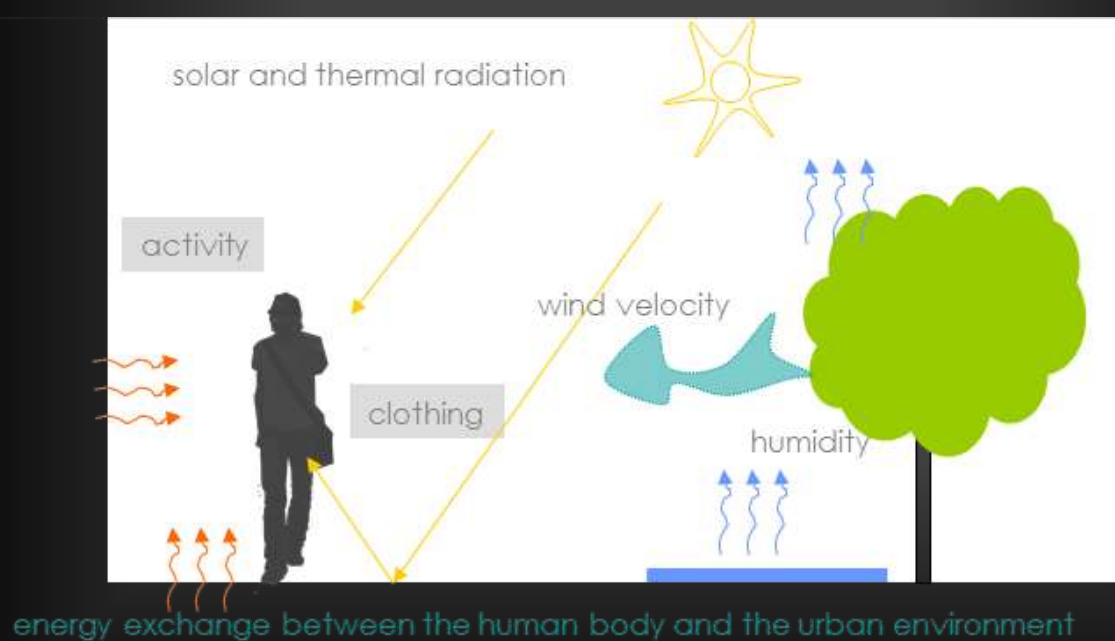
PET ANALYSIS FOR **VERIFICATION** OF OUTDOOR THERMAL COMFORT

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Outdoor Thermal Comfort Analysis

- PET – Physiological Equivalent Temperature

Universal index for assessment of outdoor thermal comfort



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PET ANALYSIS

ENVIRONMENTAL PARAMETERS

- Air temperature
- Relative Humidity
- Wind velocity
- Cloud Cover
- Global radiation
- Mean Radiant Temperature



PHYSICAL PARAMETERS

- Clothing
- Activity (MET)



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Conclusion

| AREA | SEASON | PET ANALYSIS | | PASSIVE STRATEGIES |
|-----------------|-----------|--------------|-----------|---|
| | | BEFORE | AFTER | |
| OUTDOOR SEATING | SUMMER | UPTO 53°C | UPTO 30°C | 1.Shading 2.Evaporative cooling using mystifiers |
| | MONSOON | UPTO 42°C | UPTO 30°C | |
| | MIDSEASON | UPTO 48°C | UPTO 32°C | |
| CENTRAL PLAZA | SUMMER | UPTO 52°C | UPTO 37°C | 1.Evaporative Cooling 2.Radiant Cooling using Runners |
| | MONSOON | UPTO 42°C | UPTO 37°C | |
| | MIDSEASON | UPTO 45°C | UPTO 36°C | |
| STREET | SUMMER | UPTO 50°C | UPTO 23°C | 1.Evaporative Cooling 2.Partial Shading 3.Radiant Cooling using Runners |
| | MONSOON | UPTO 35°C | UPTO 27°C | |
| | MIDSEASON | UPTO 45°C | UPTO 26°C | |

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Sky Earth Water Fire Air

Passive + Active

↓

Sustainability

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Integration of
Passive & Active Strategies

Leads to

Net Zero

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“Net Zero”

The Next Wave Of Green Buildings

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Our “Net- Zero” Experience



ECO COMMERCIAL BUILDING

- First Net Positive Energy building of India
- LEED-India Platinum Rated building
- Awarded with ASHRAE Technology Award



INDIRA PARYAVARAN BHAWAN

- Largest Net Positive Energy building in Asia
- GRIHA 5 Star rated building
- LEED-India Platinum Rated building



SHUNYA

- First Net Zero Energy Home of India

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Even little things make difference
in getting to zero

(as you get to zero, small items become significant)

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Quantification of Impact of
these little things is important!

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*leave the earth better than
when we started for
existence and enrichment
of our future generations...*

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