Eco Resort, Vietnam

Environmental Analysis

Solar Profile: Sun Movement

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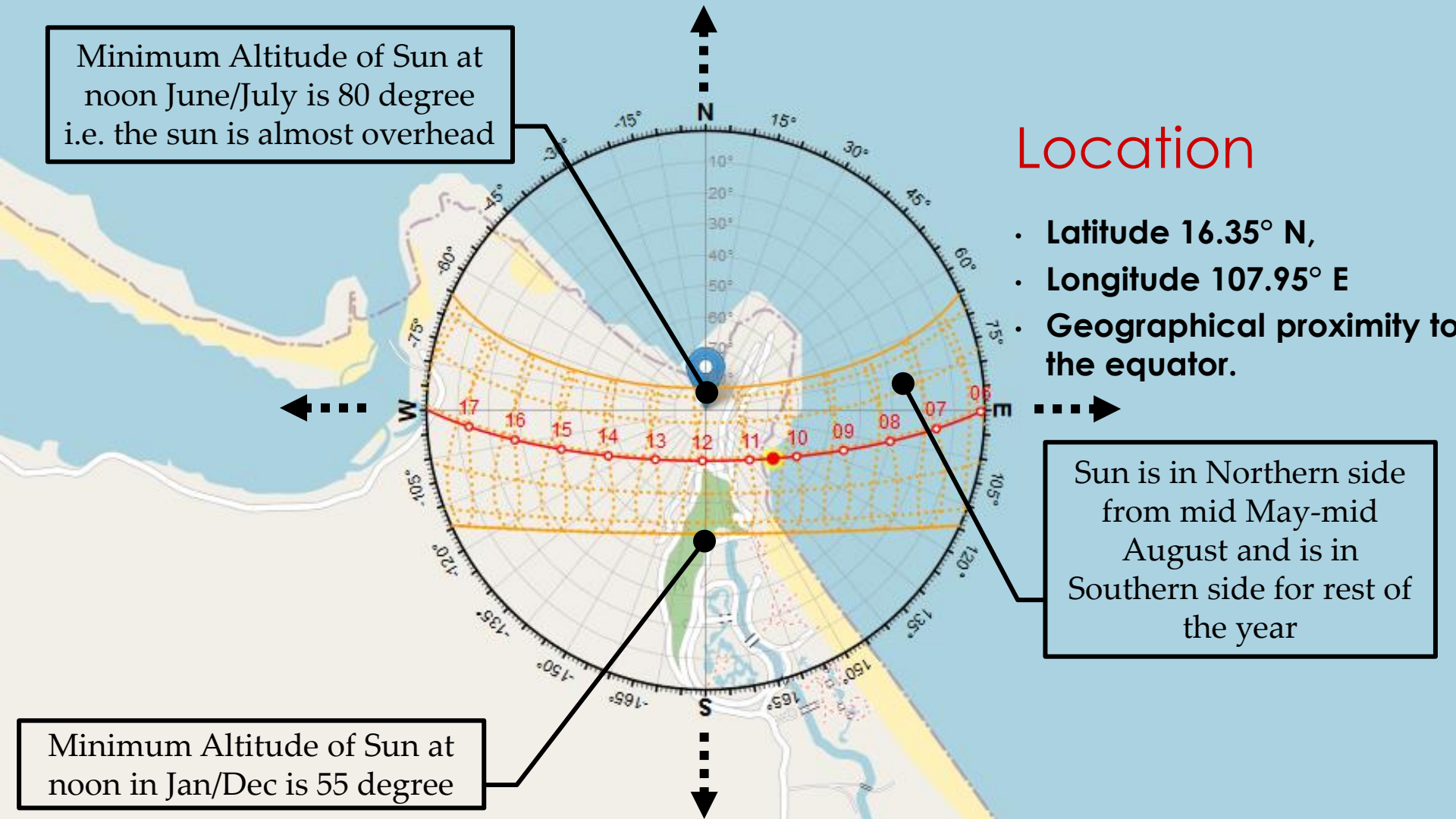
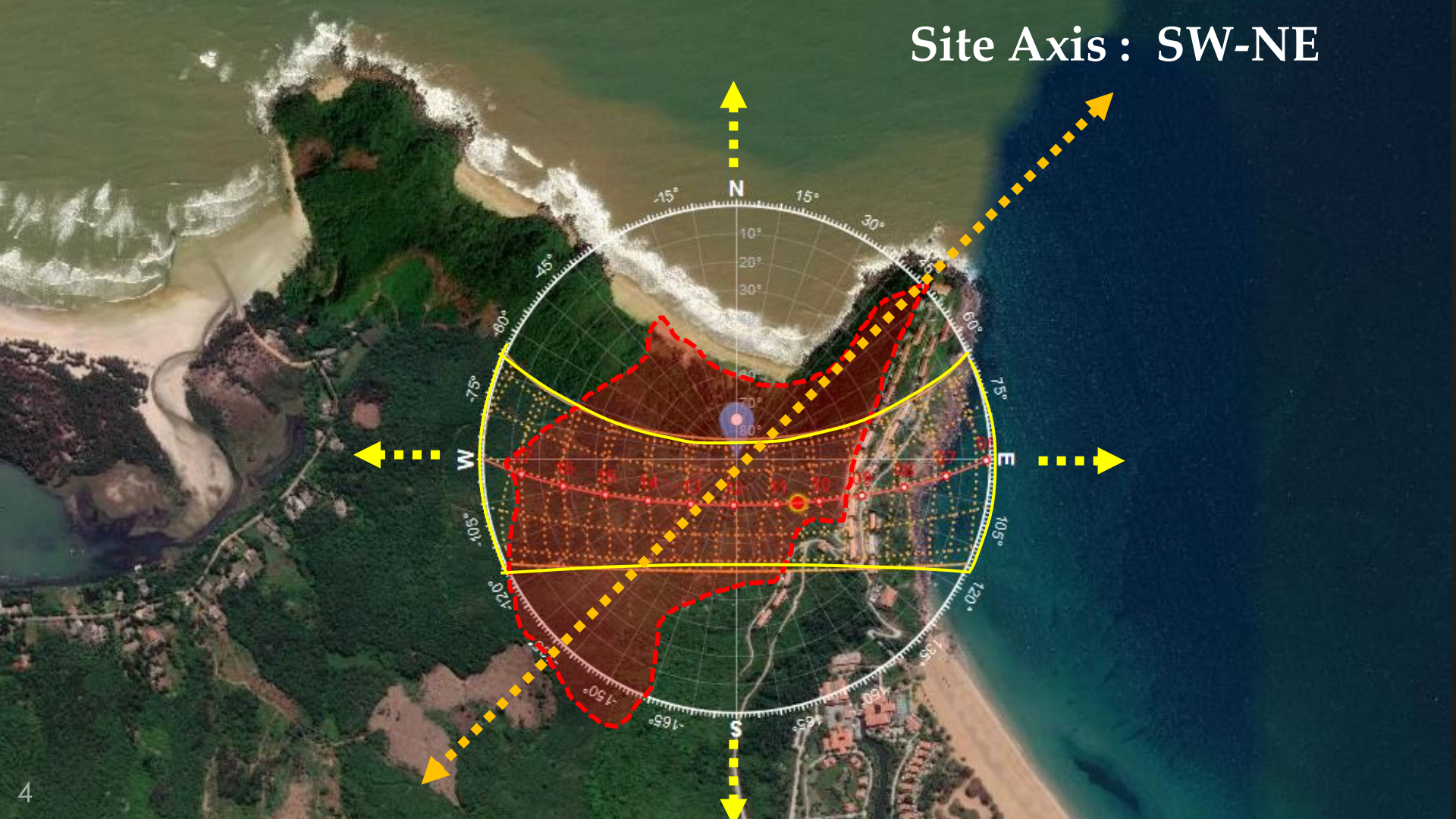

Minimum Altitude of Sun at noon June/July is 80 degree i.e. the sun is almost overhead
Location
Latitude 16.35° N,
Longitude 107.95° E
Geographical proximity to the equator.
Sun is in Northern side from mid May-mid August and is in Southern side for rest of the year
Minimum Altitude of Sun at noon in Jan/Dec is 55 degree
N
S
W
E
17
16
15
14
13
12
11
10
09
08
07
06

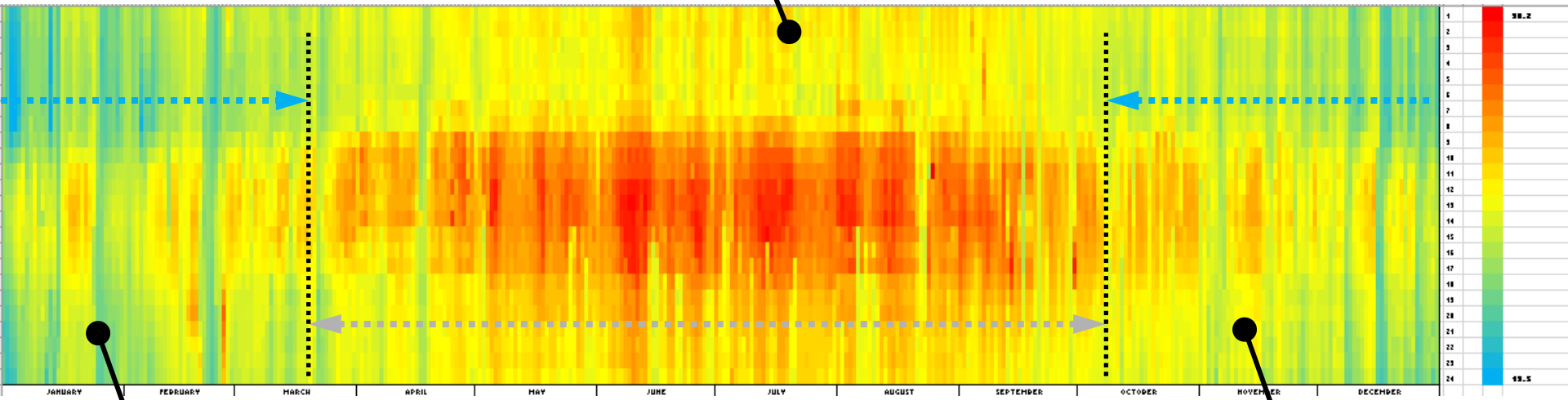
Site Axis : SW-NE



Weather Profile

[

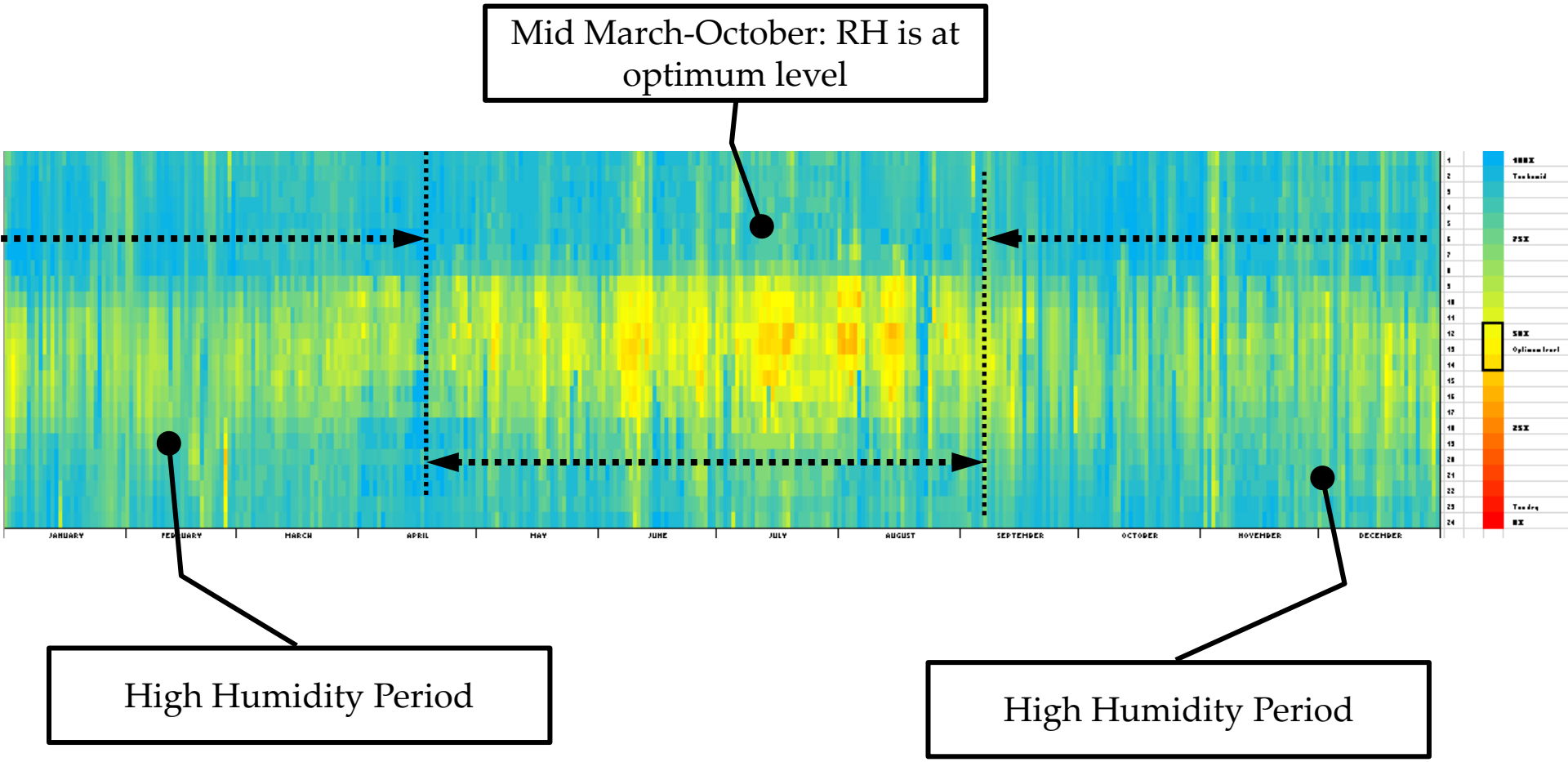
Mid March-October: Hot Period



Jan- Mid March: Warm Period

Oct-Dec: Warm Period

Max Temperature	38.2°C	Min Temperature	13.5°C

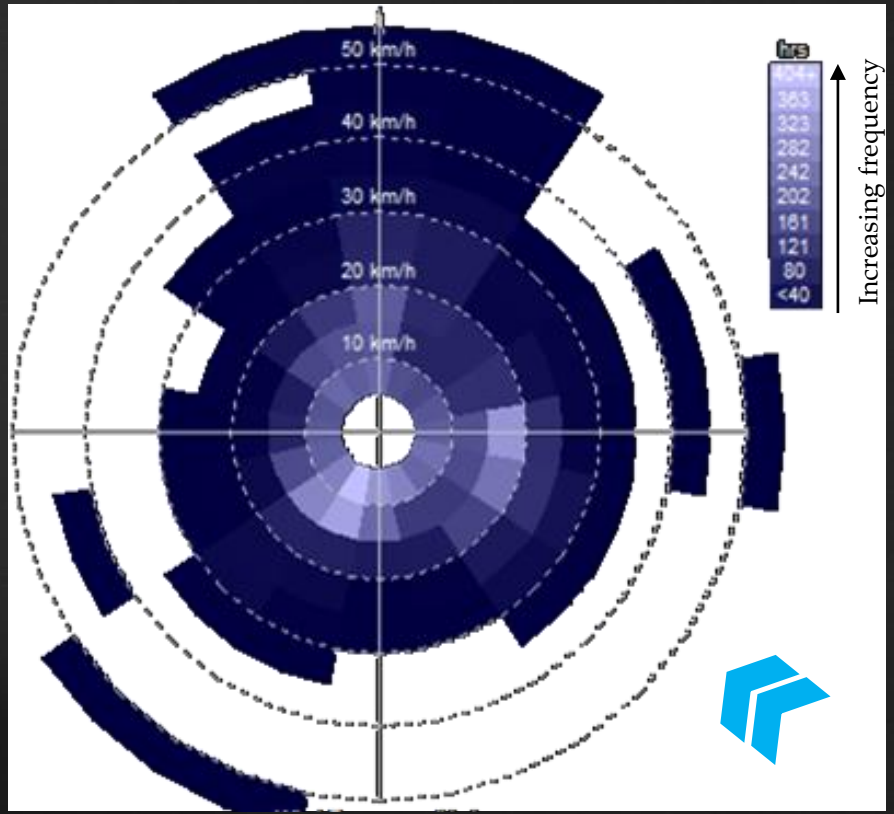

Mid March-October: RH is at optimum level
High Humidity Period
High Humidity Period
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER

WIND

- Site-overlapped Wind wheel
- Monthly wind profiles

The site would experience Light to Gentle breeze from South East – North West. It is sufficient wind movement for flushing minor pollutant sources.

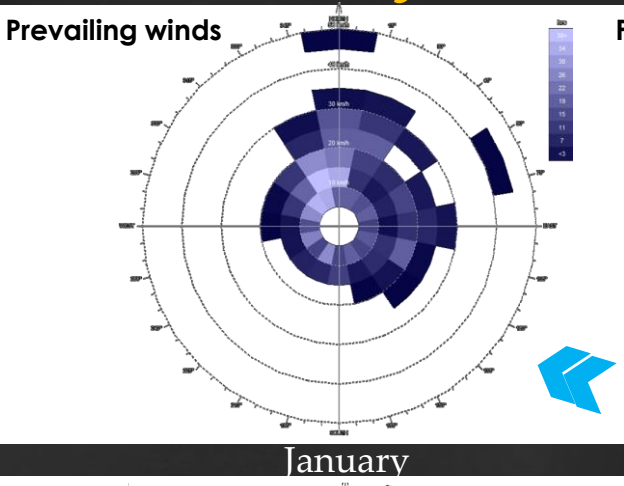
Prevalent Wind Direction



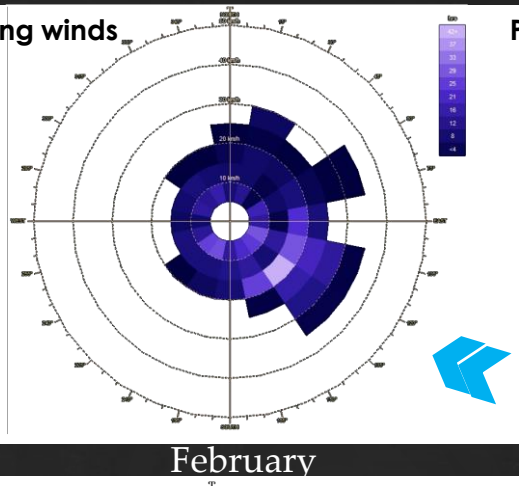
Wind Frequency

- Prevalent Wind direction is South East to North West.
- A site with multiple buildings can explore and utilize this direction while planning for enhanced ventilation and accentuating wind movement.
- Orient buildings to take advantage of prevailing wind. In case of multiple buildings on a site, they must be arranged to avoid built forms falling in the wind shadows created by other buildings on the site.

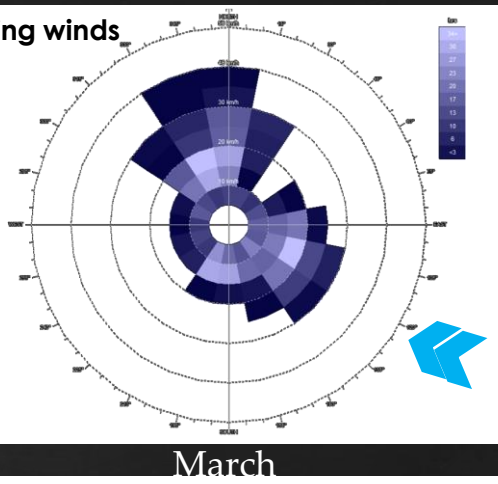
Monthly Wind Flow: Wind Rose



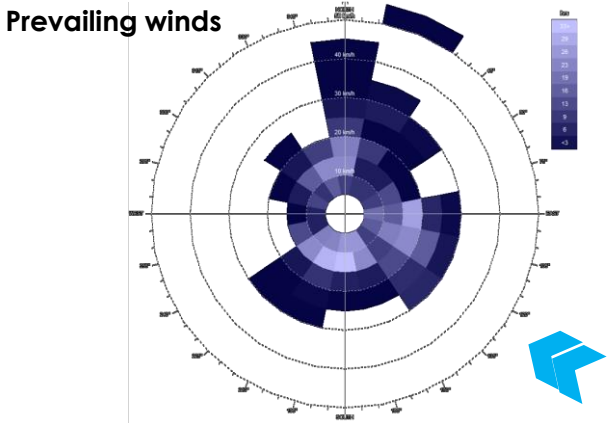
January



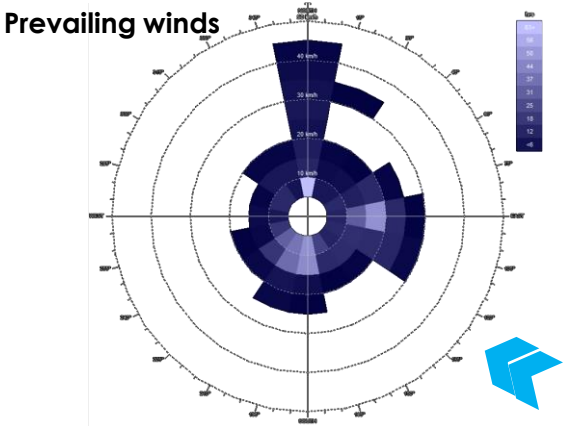
February



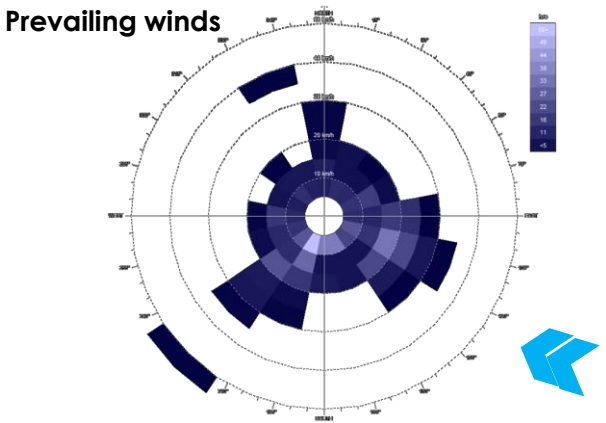
March



April



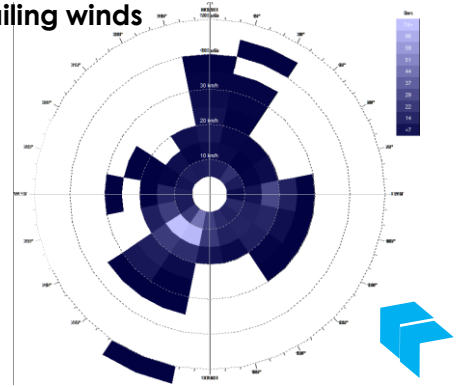
May



June

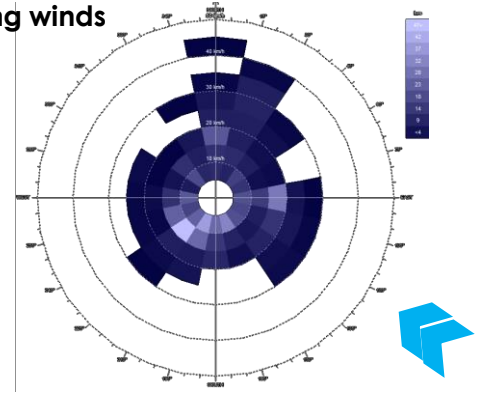
Monthly Wind Flow: Wind Rose

Prevailing winds



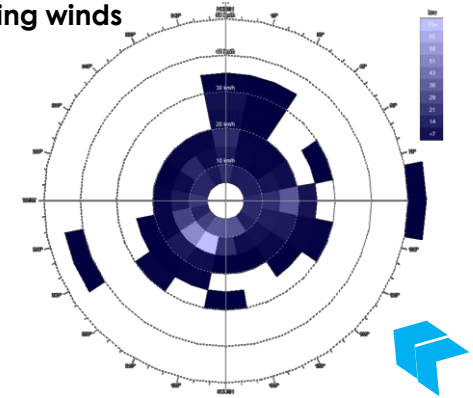
July

Prevailing winds



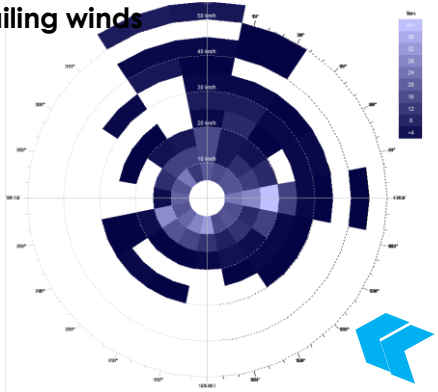
August

Prevailing winds



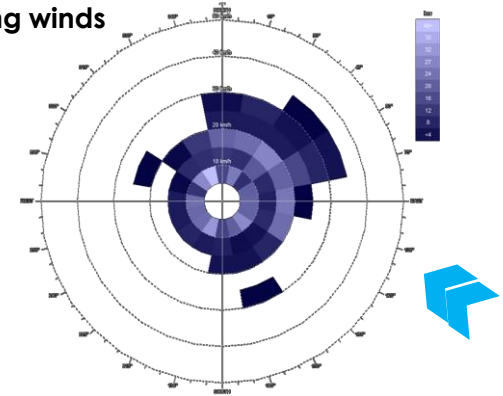
September

Prevailing winds



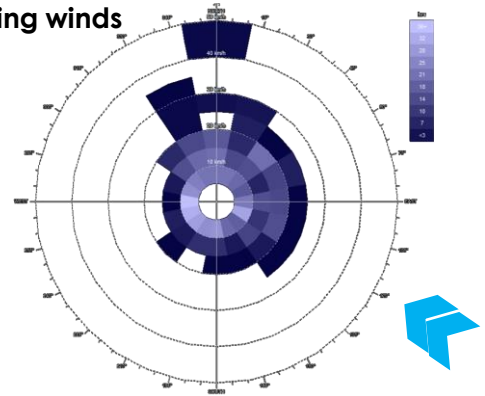
October

Prevailing winds



November

Prevailing winds

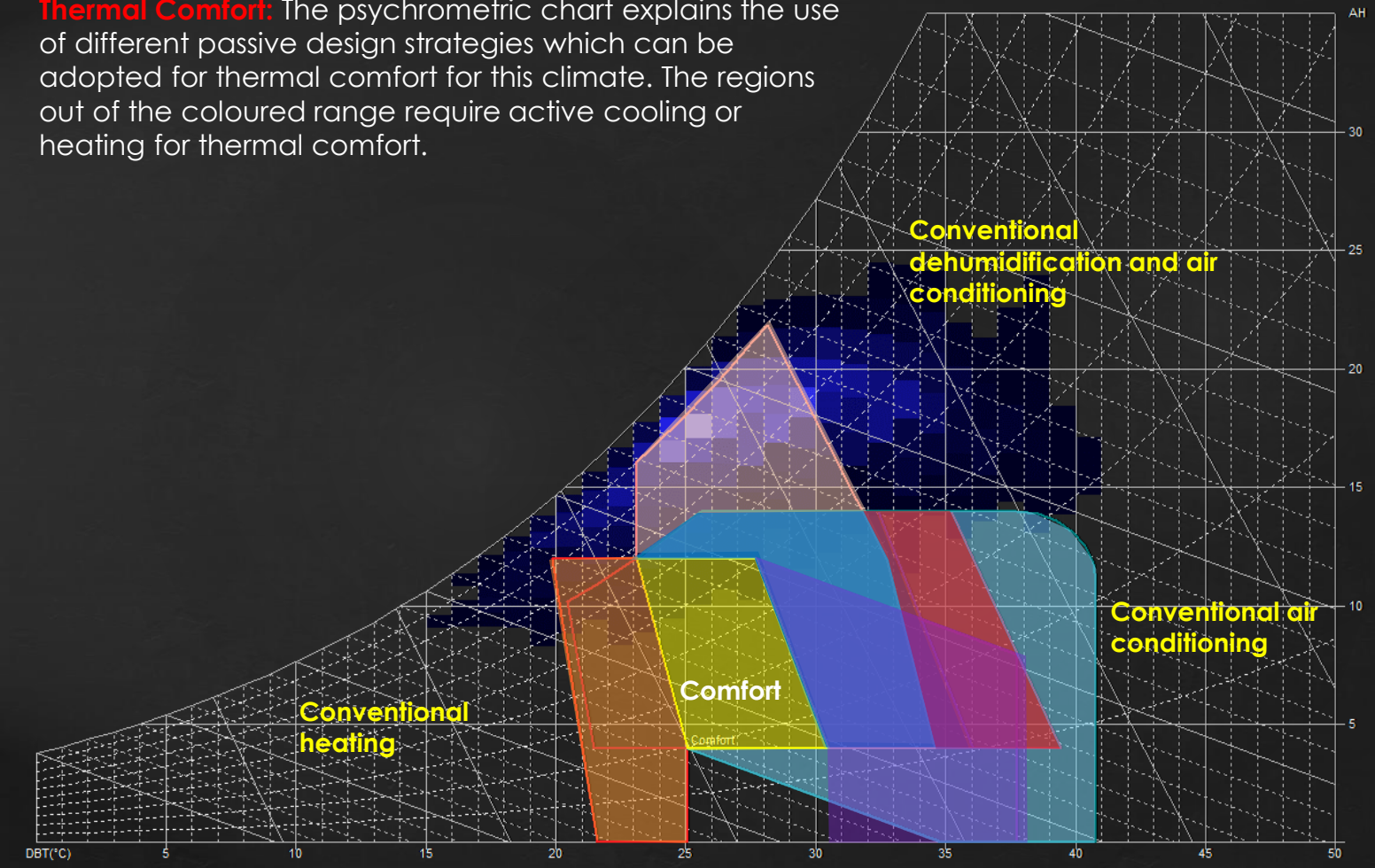


December

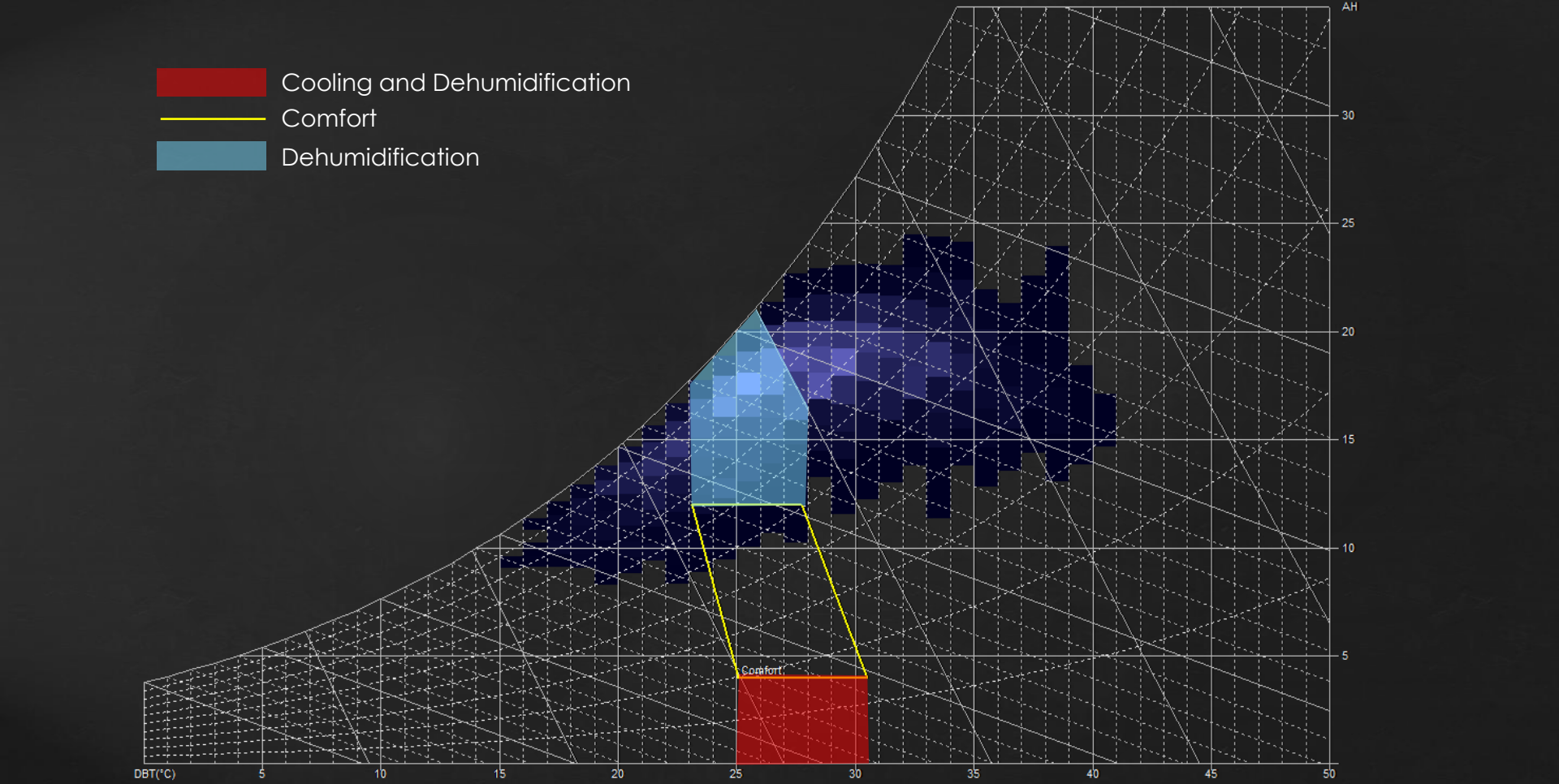
Thermal Comfort

- Comfort strategies

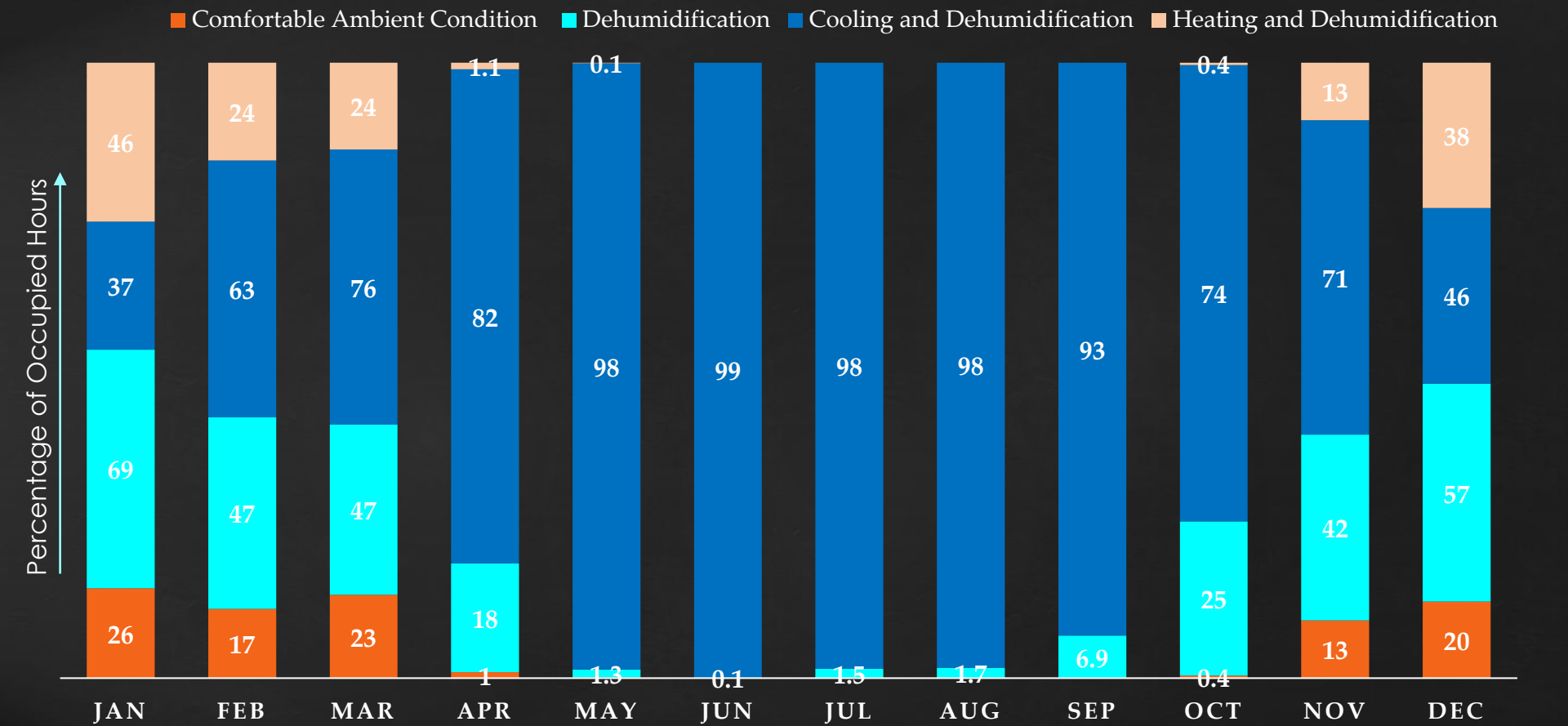
Thermal Comfort: The psychrometric chart explains the use of different passive design strategies which can be adopted for thermal comfort for this climate. The regions out of the coloured range require active cooling or heating for thermal comfort.



- Passive solar heating
- Thermal mass effect
- High thermal mass
- Natural ventilation
- Evaporative cooling
- High thermal mass with night ventilation



According to the pscyhrometric chart the ambient condition for comfort are about 754 hours throughout the year i.e. 8.6 %. Moreover, active Cooling and Dehumidification is required for 70 % of the time



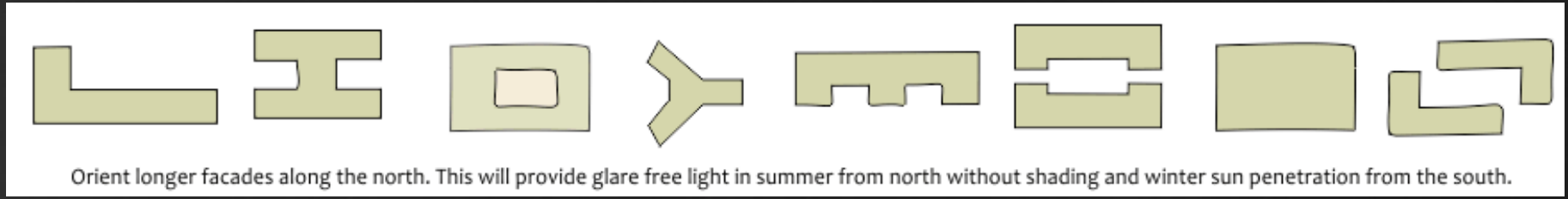
Thermal Comfort Strategies : The comfortable hours are about 754 i.e. 8.6 % throughout the year. It is observed that for cooler months i.e. from October to April dehumidification is required for 18 % of the time to meet comfort. Moreover, April to November i.e. hot and humid months require active cooling and dehumidification for 70 % of the time to meet comfort. Heating and dehumidification is required from November to March for 4 % of The time to meet comfort.

Passive Thermal Comfort Strategies

	Orientation and Form	Cross-Ventilation	Solar Shading	Natural Vegetation
Dehumidification				
Cooling and Dehumidification				
Heating and Dehumidification				

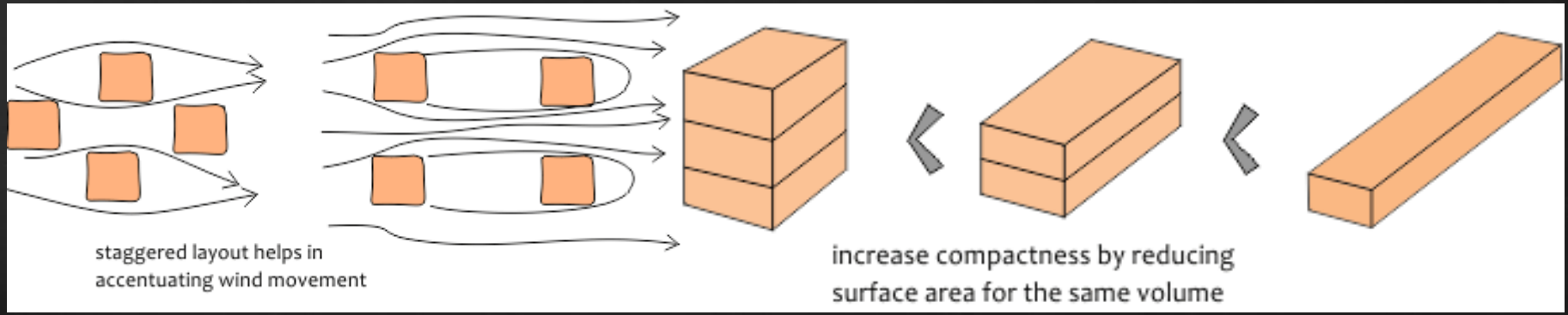
Orientation and Form Cross-Ventilation Solar Shading Natural-Vegetation

Passive Design Strategies – Orientation and Form



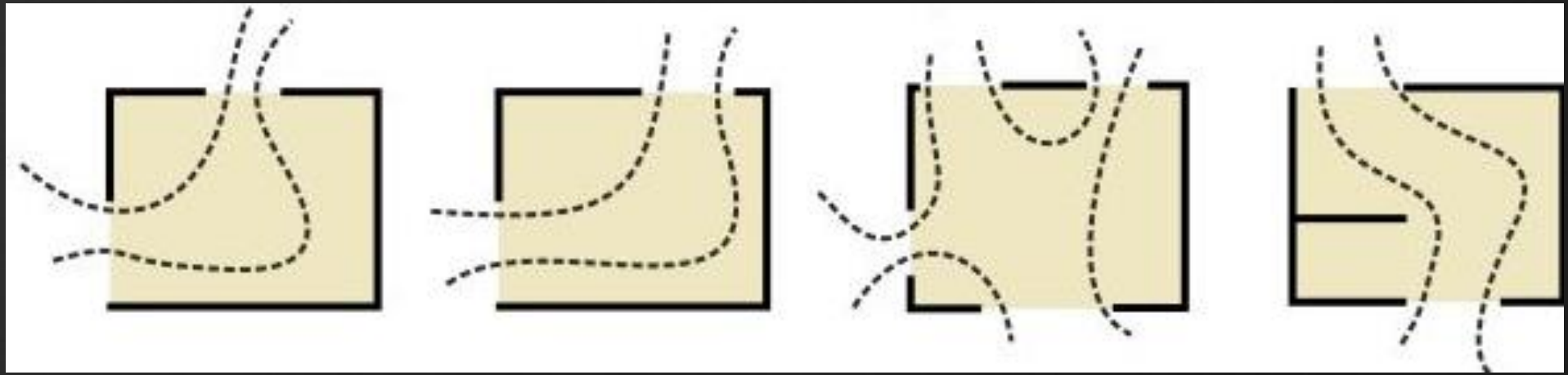
Orient longer facades along the north. This will provide glare free light in summer from north without shading and winter sun penetration from the south.

Orient buildings to take advantage of prevailing wind. In case of multiple buildings on a site, they must be arranged to avoid built forms falling in the wind shadows created by other buildings on the site.



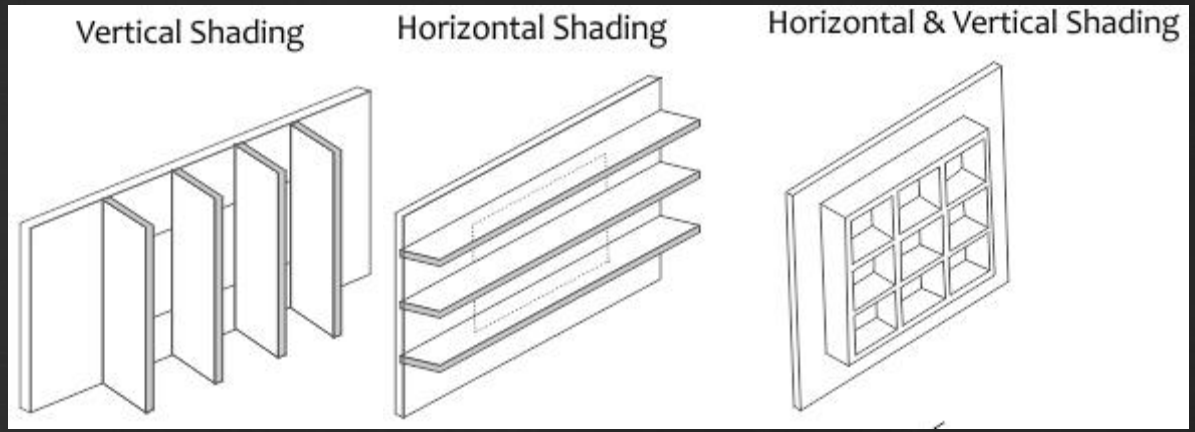
Mutual shading of built forms and compact forms i.e. forms with low surface area to volume (S/V) ratio and low perimeter to area (P/A) ratio are ideal for extreme climates. Compact forms gain less heat during daytime and lose less heat at nighttime.

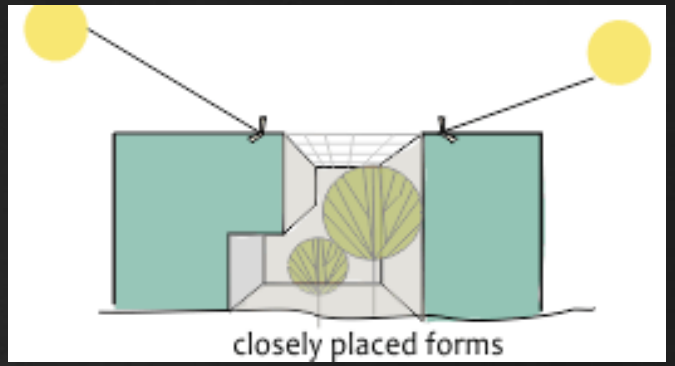
Passive Design Strategies - Cross-Ventilation



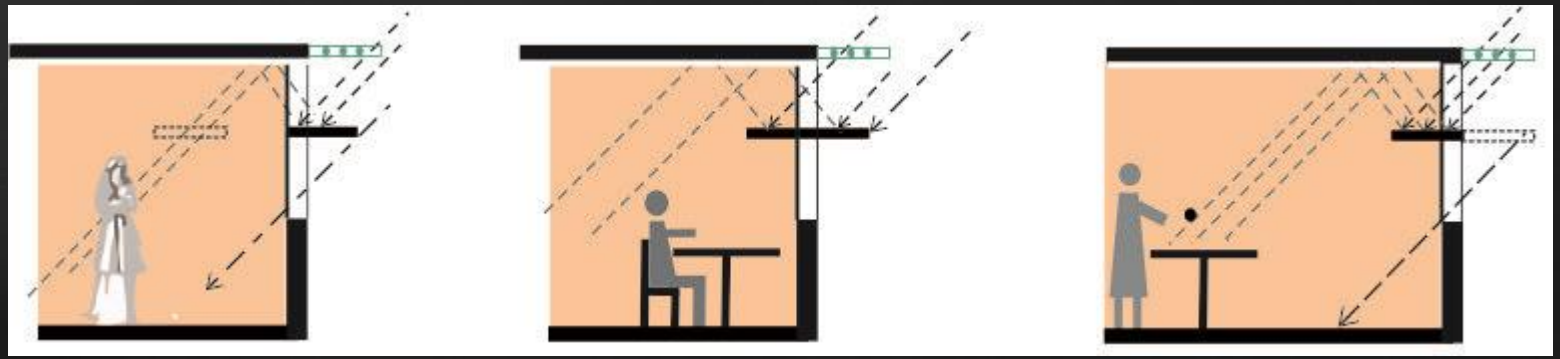
Cross ventilation is dependent on the size and position of openings. Inlets should be in the windward direction and aided with suitably placed outlets that allow egress of wind from the space. Horizontal placement of openings and internal partitions can alter the direction and spread of air stream. Ideally, openings must be placed in opposite walls, and diagonally but not directly opposite to each other. When placed in walls perpendicular to each other, the inlets and outlets should be at the farthest corners of the walls.

Passive Design Strategies – Solar Shading



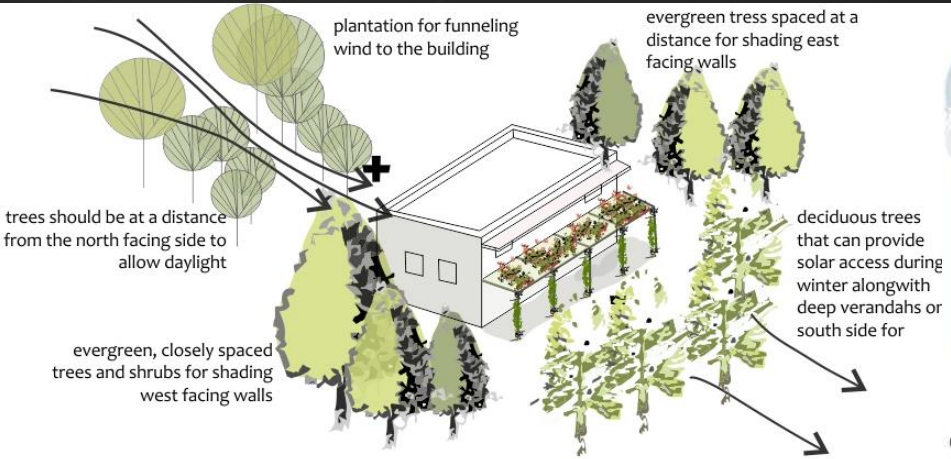


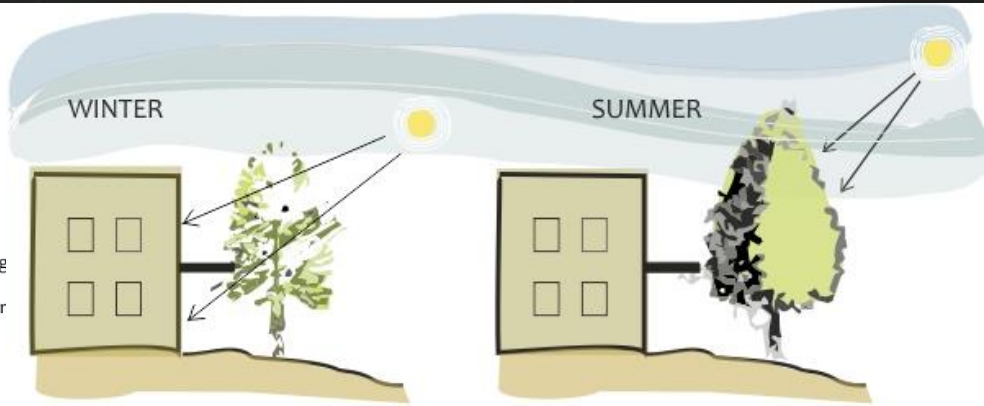
Maximize mutual shading through close built forms



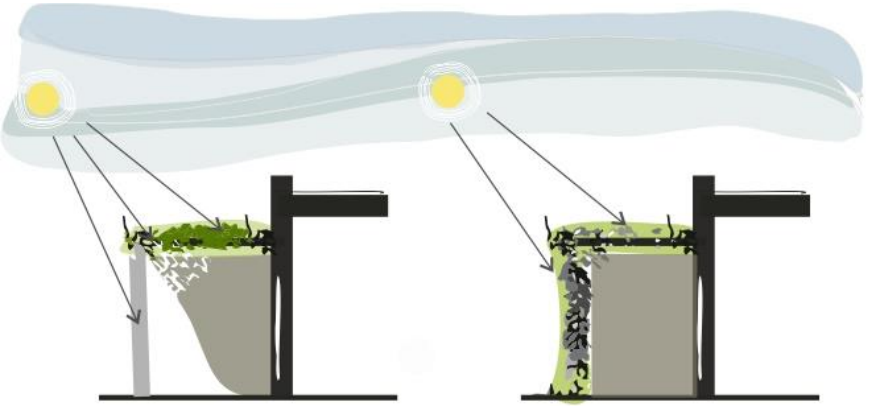
Window overhangs (designed for this latitude) or openable sunshades (awnings that extend in summer) can reduce heat gains and eliminate or reduce air conditioning. They allow diffused light penetration as well.

Passive Design Strategies – Natural Vegetation





deciduous trees allow sun penetration in winter and block sun access during summer

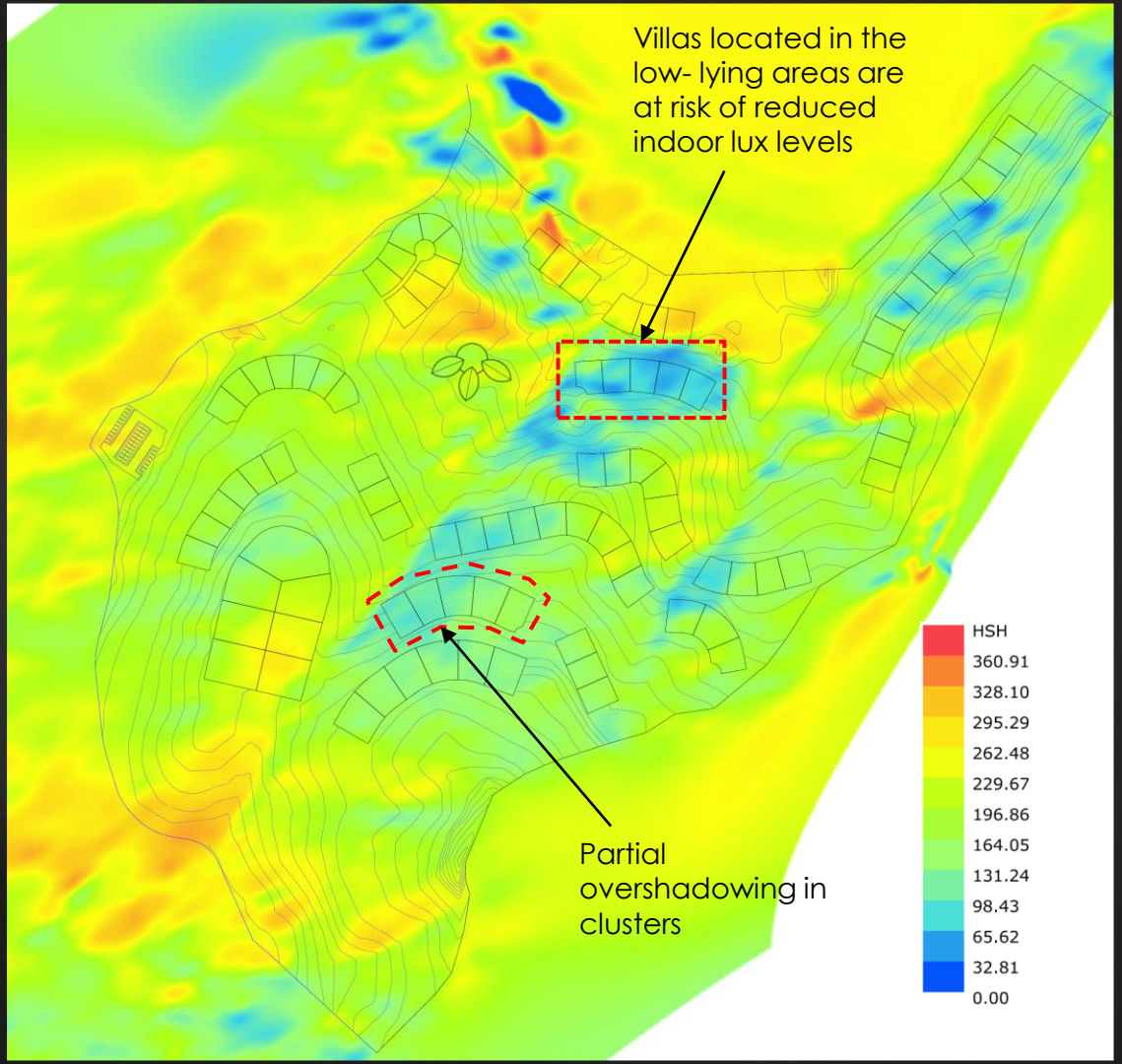


creepers are flexible shading devices for shading verandahs and interior spaces as per the season

Use plants (bushes, trees, ivy-covered walls) especially on the west to minimize heat gain (if summer rains support native plant growth)

Villa level Design Inputs : Shading & Daylight

[



- ‘Hill shade’ Analysis was performed to identify locations on the site which are under shadow due to the terrain.
- The areas which run the risk of having reduced illumination are highlighted in blue.
- Villas sited in these zones may have comparatively lesser illumination levels.

Hill shade Analysis

eds environmental design solutions

BLOCK MODEL for ASSESSMEMT

Shading Analysis

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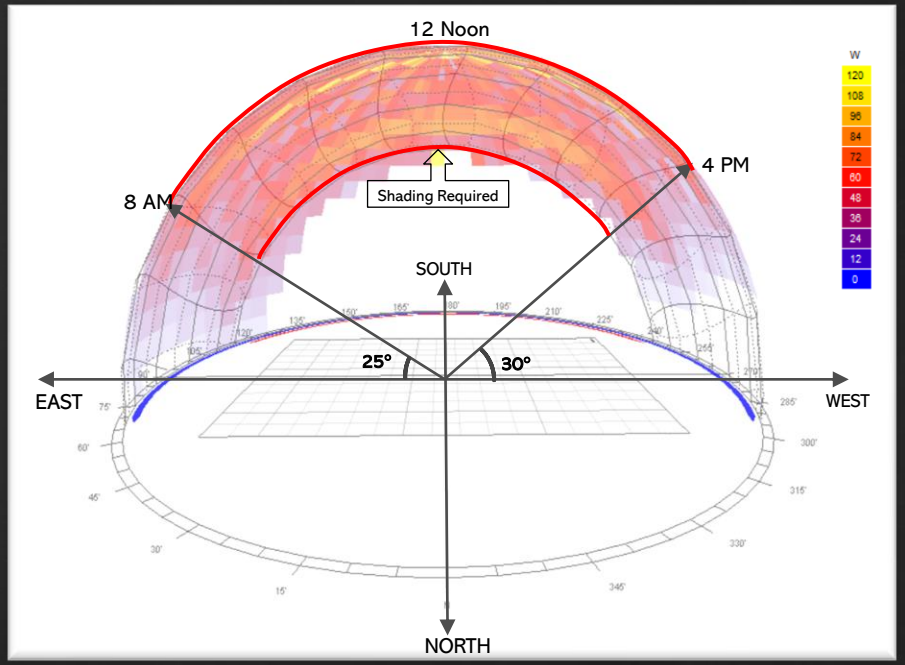
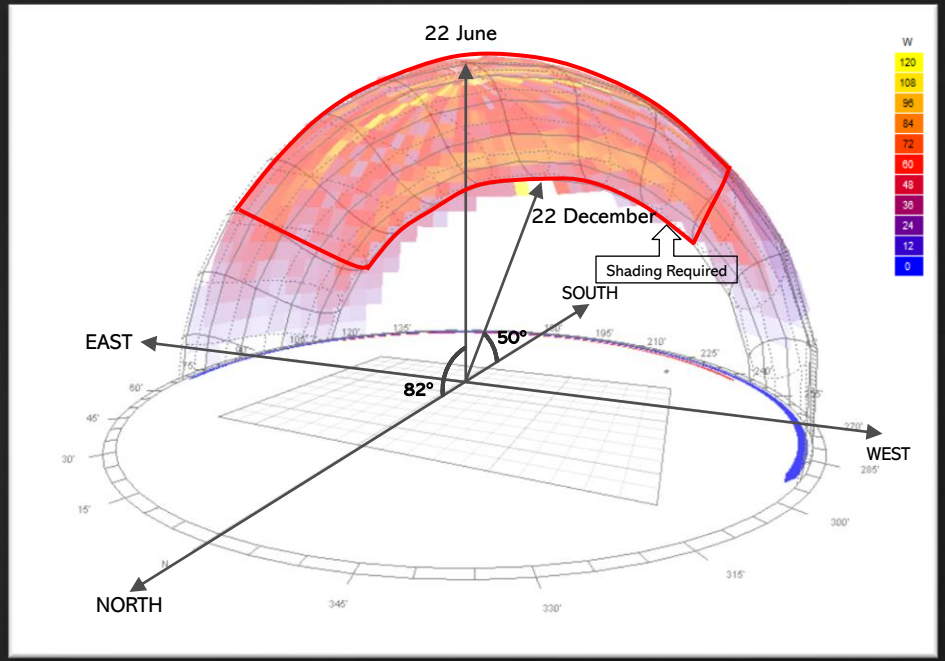
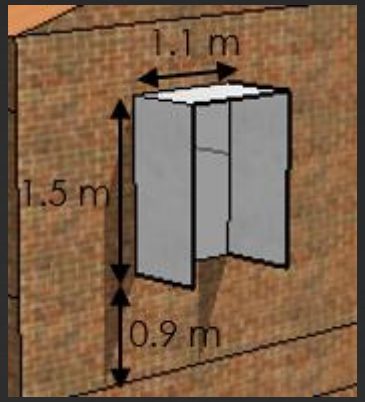
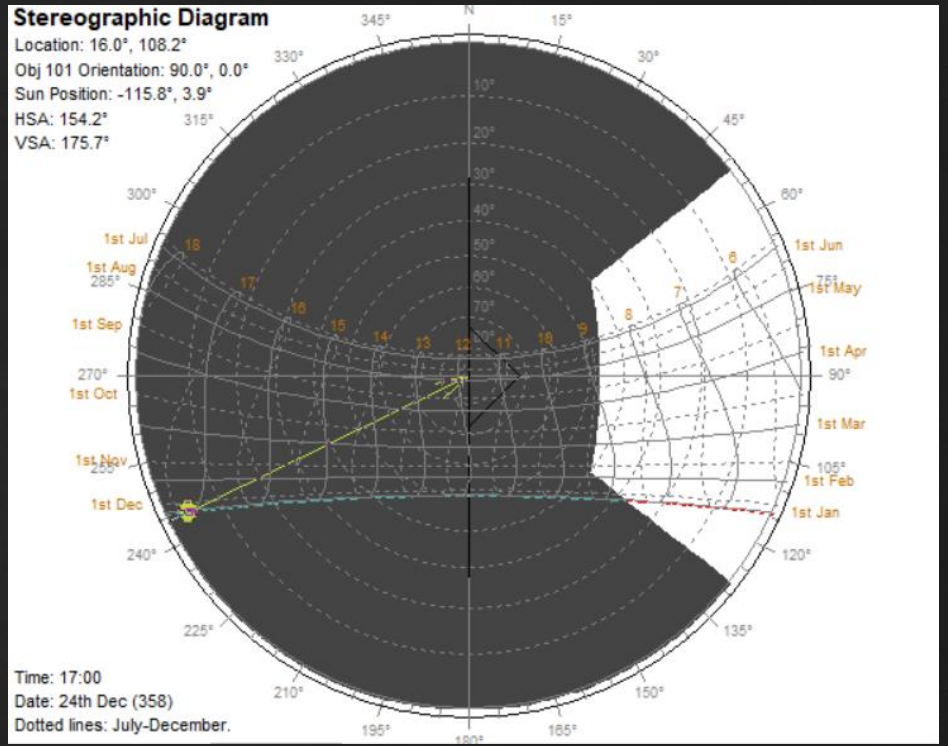




Shading Requirement

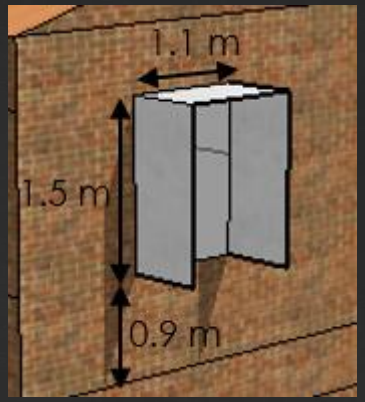


Shading size	
Window height	1.5 m (x)
Overhang depth	0.7 m (x/2)
Vertical fin depth	0.7 m (x/2)

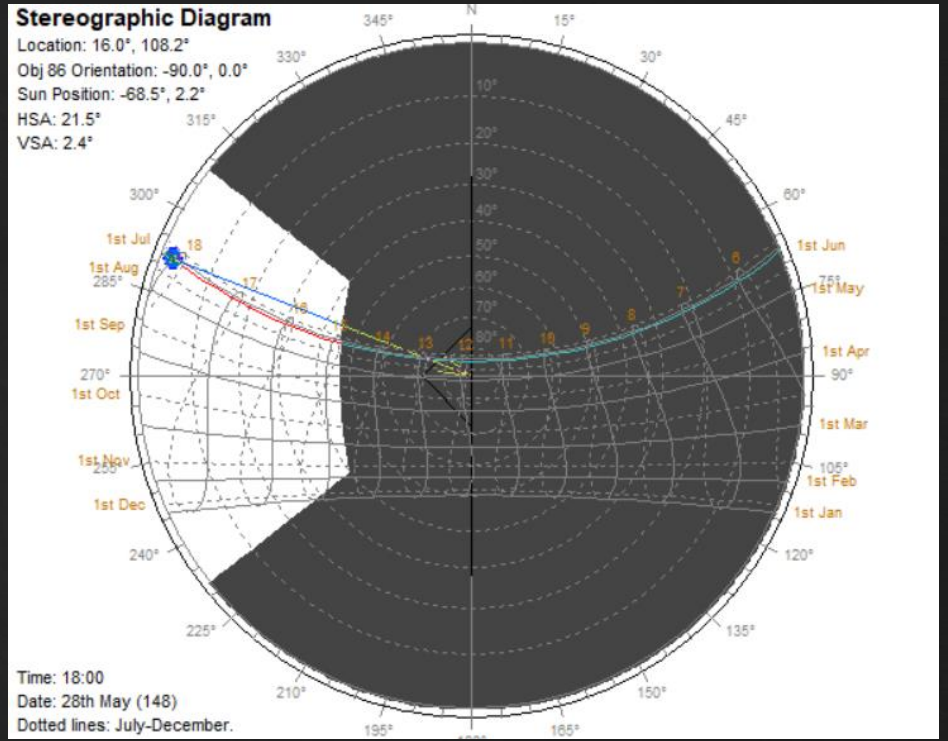


Recommendations

For Windows facing East

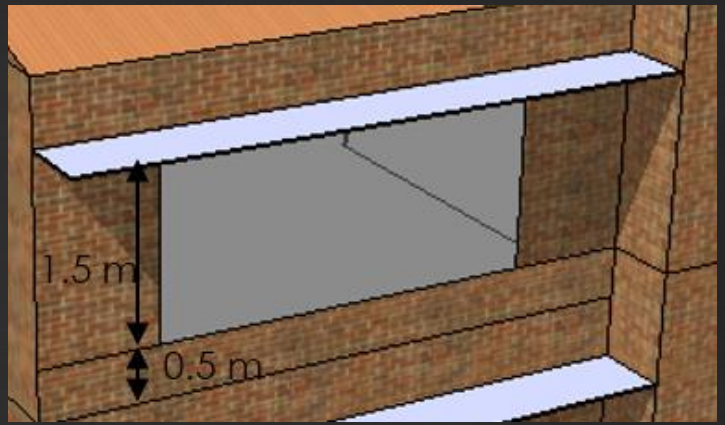


Shading size	
Window height	1.5 m (x)
Overhang depth	0.7 m (x/2)
Vertical fin depth	0.7 m (x/2)

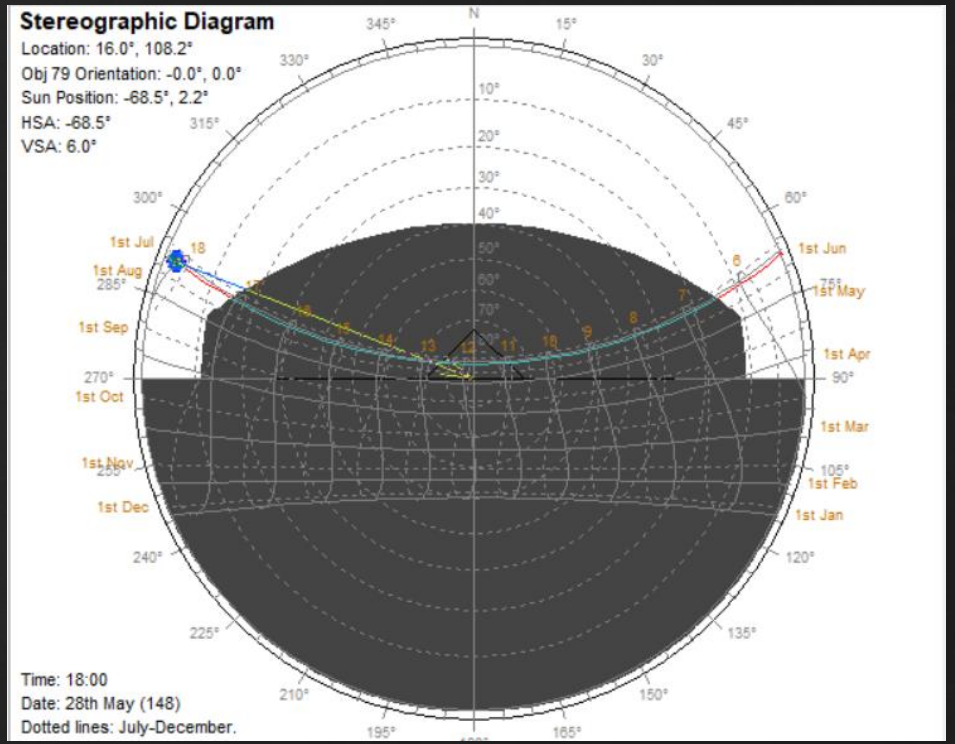


Recommendations

For Windows facing West

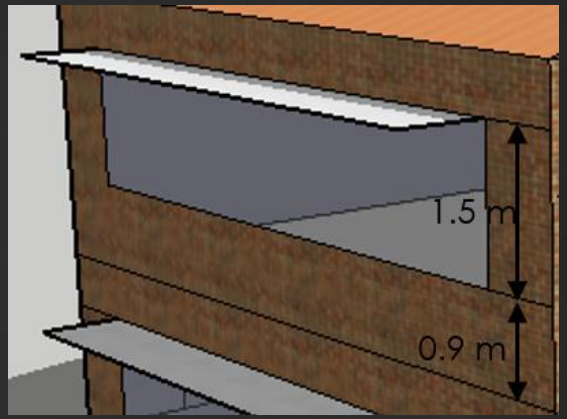


Shading size	
Window height	1.9 m (x)
Overhang depth	0.9 m (x/2.1)
Vertical fin depth	Not Required

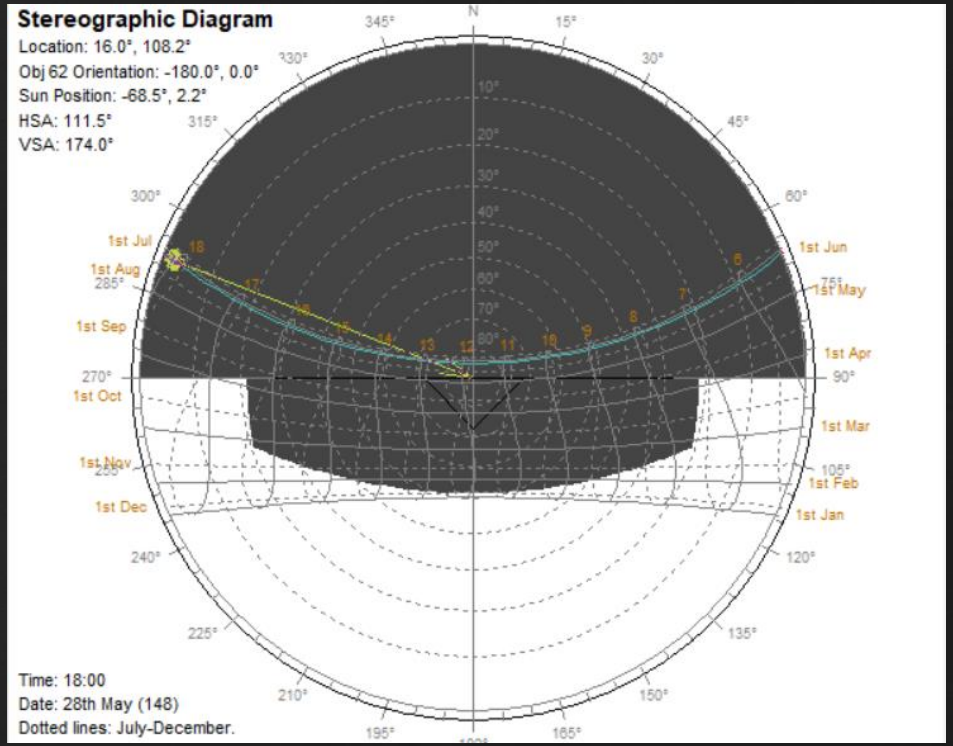


Recommendations

For Windows facing North

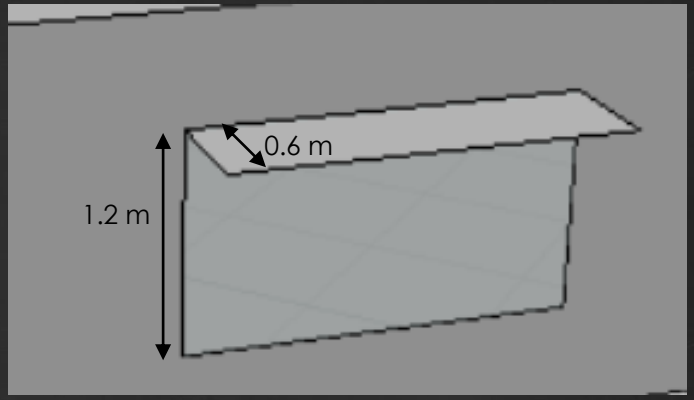


Shading size	
Window height	1.9 m (x)
Overhang depth	0.9 m (x/2.1)
Vertical fin depth	Not Required

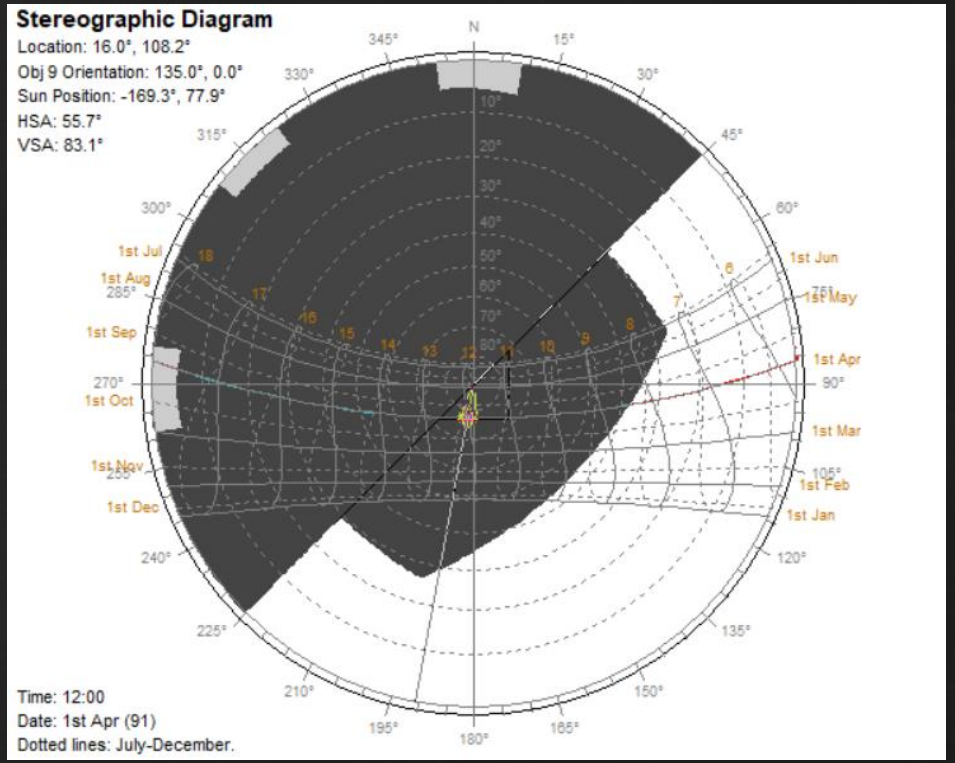


Recommendations

For Windows facing South

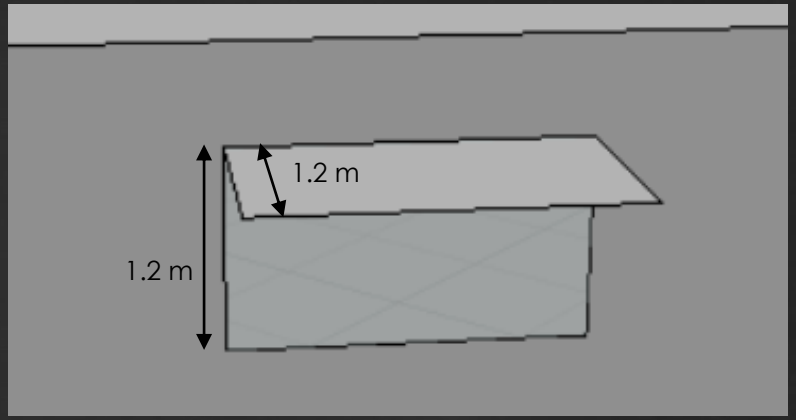


Shading size	
Window height	1.2 m (x)
Overhang depth	0.6 m (x/2)
Vertical fin depth	Not Required

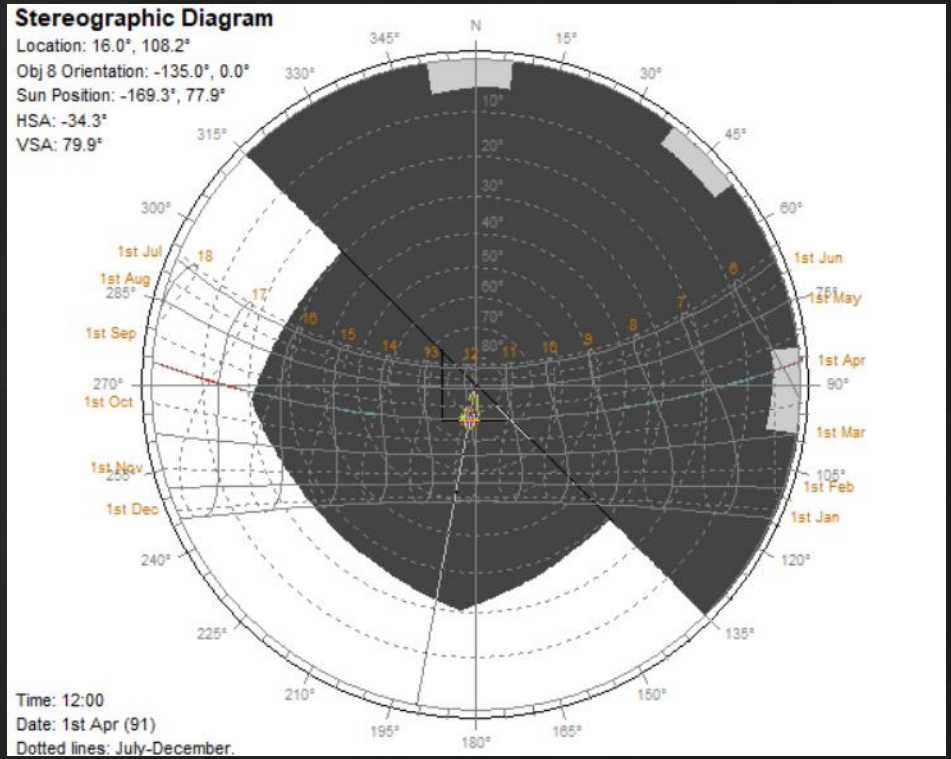


Recommendations

For Windows facing South-East

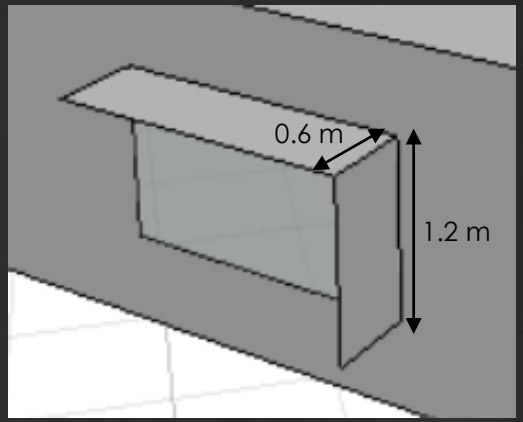


Shading size	
Window height	1.2 m (x)
Overhang depth	1.2 m (x)
Vertical fin depth	Not Required

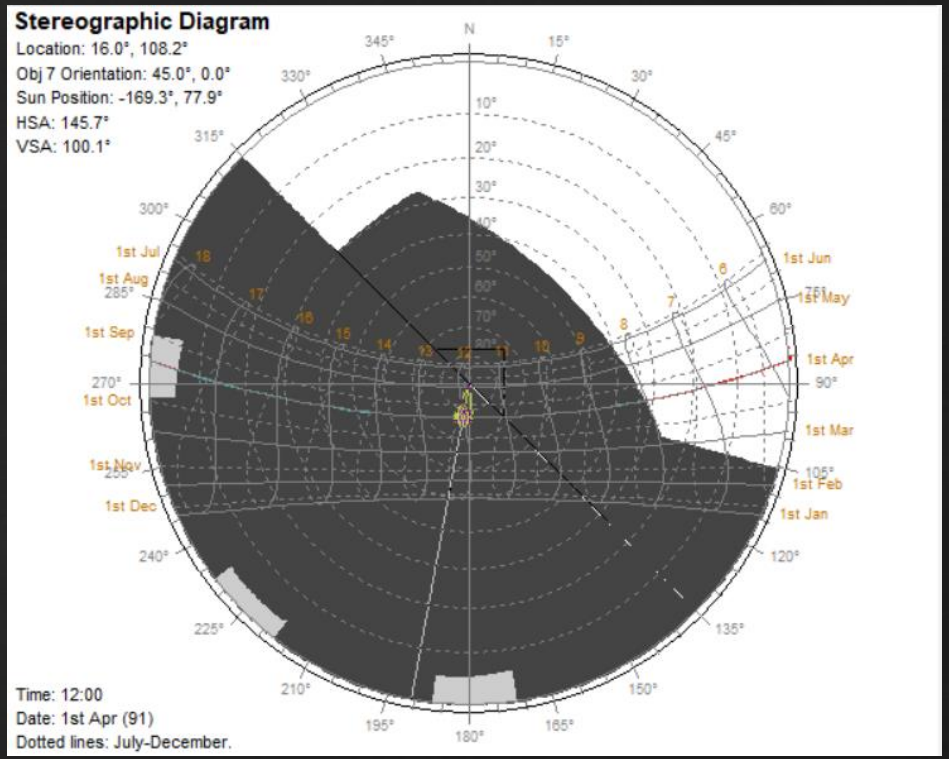


Recommendations

For Windows facing South-West

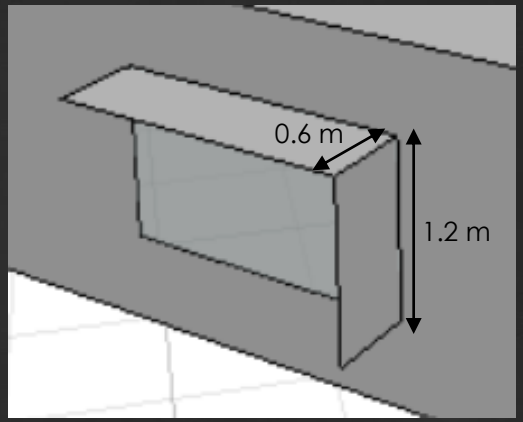


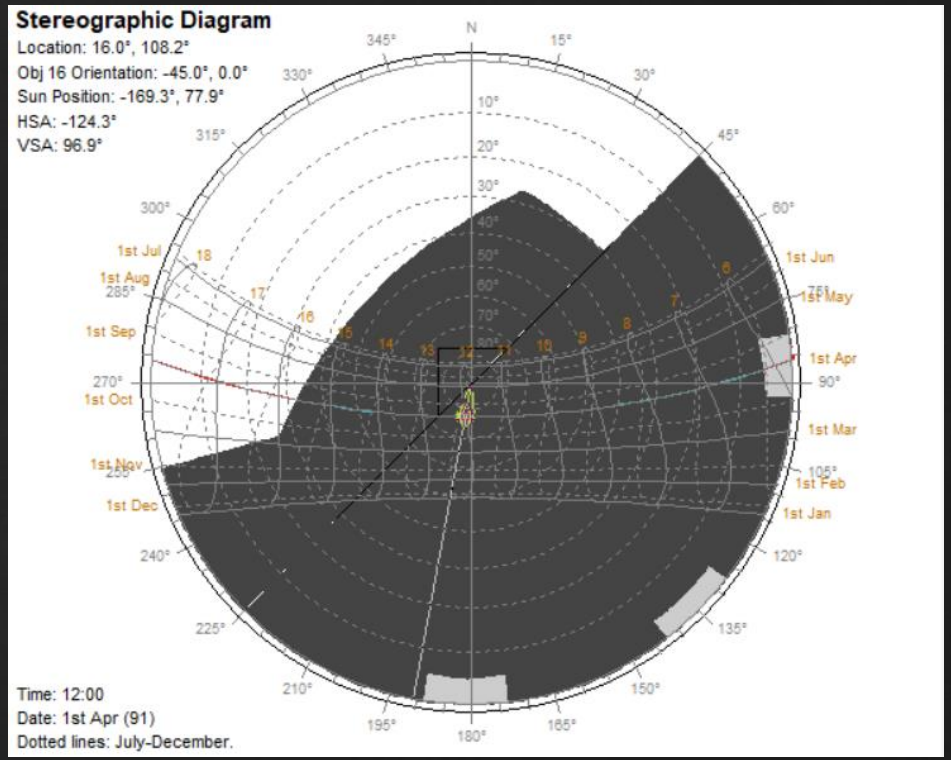
Shading size	
Window height	1.2 m (x)
Overhang depth	0.6 m (x)
Vertical fin depth	0.6 m (x) – only on East side



Recommendations

For Windows facing North-East





Shading size	
Window height	1.2 m (x)
Overhang depth	0.6 m (x)
Vertical fin depth	0.6 m (x) – only on West side

Recommendations

For Windows facing North-West

Daylight Analysis

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UDLI – Useful Daylight Illuminance

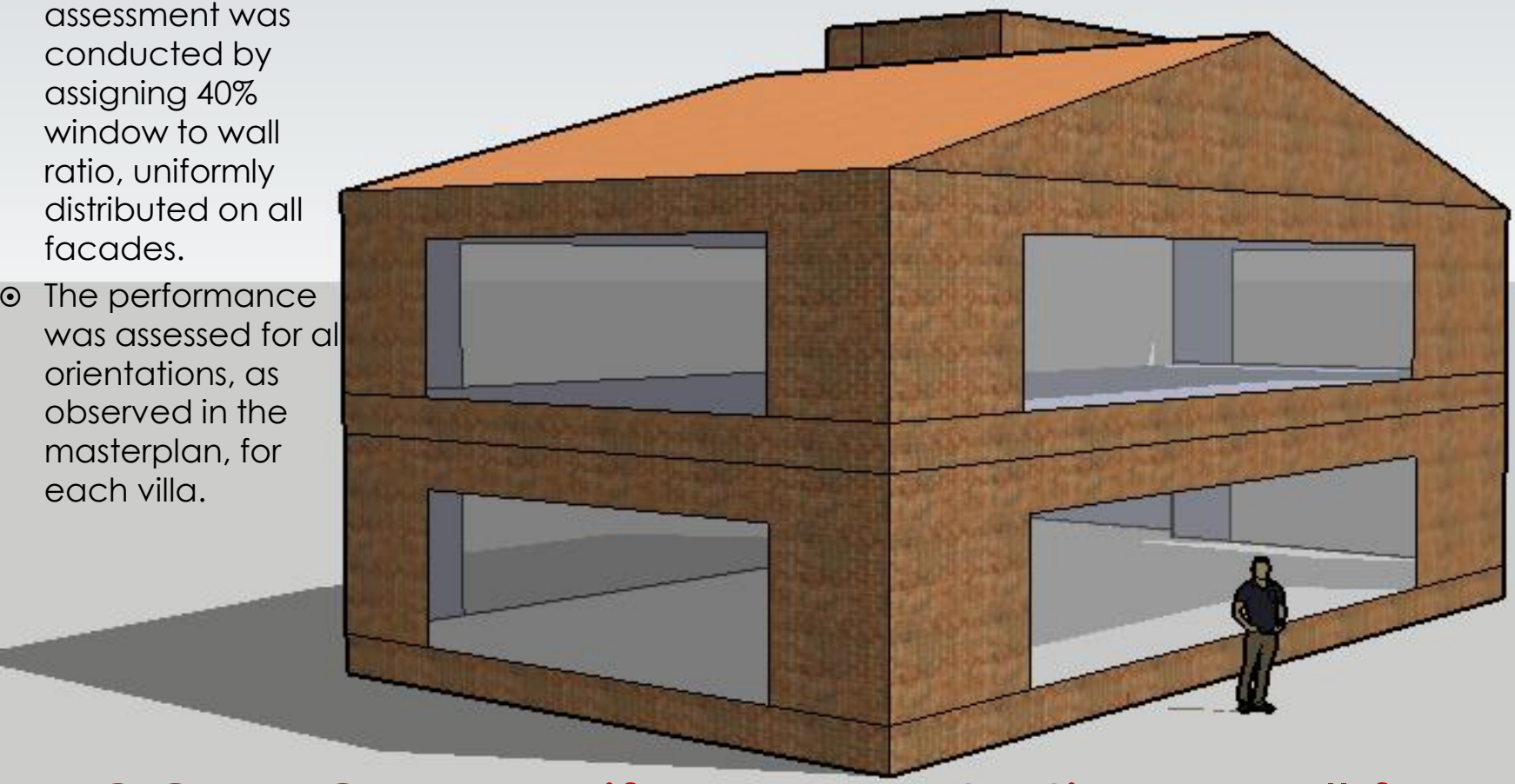
- Percentage of time for which useful daylight (between 100 to 2000 lux) is received within the space.
- Gives preference to quality of light within the space throughout the year, rather than single point in time or relative to outdoor sky conditions.

Parameters

Glazing VLT	40%
Wall Reflectance	50%
Ceiling Reflectance	80%
Floor Reflectance	20%

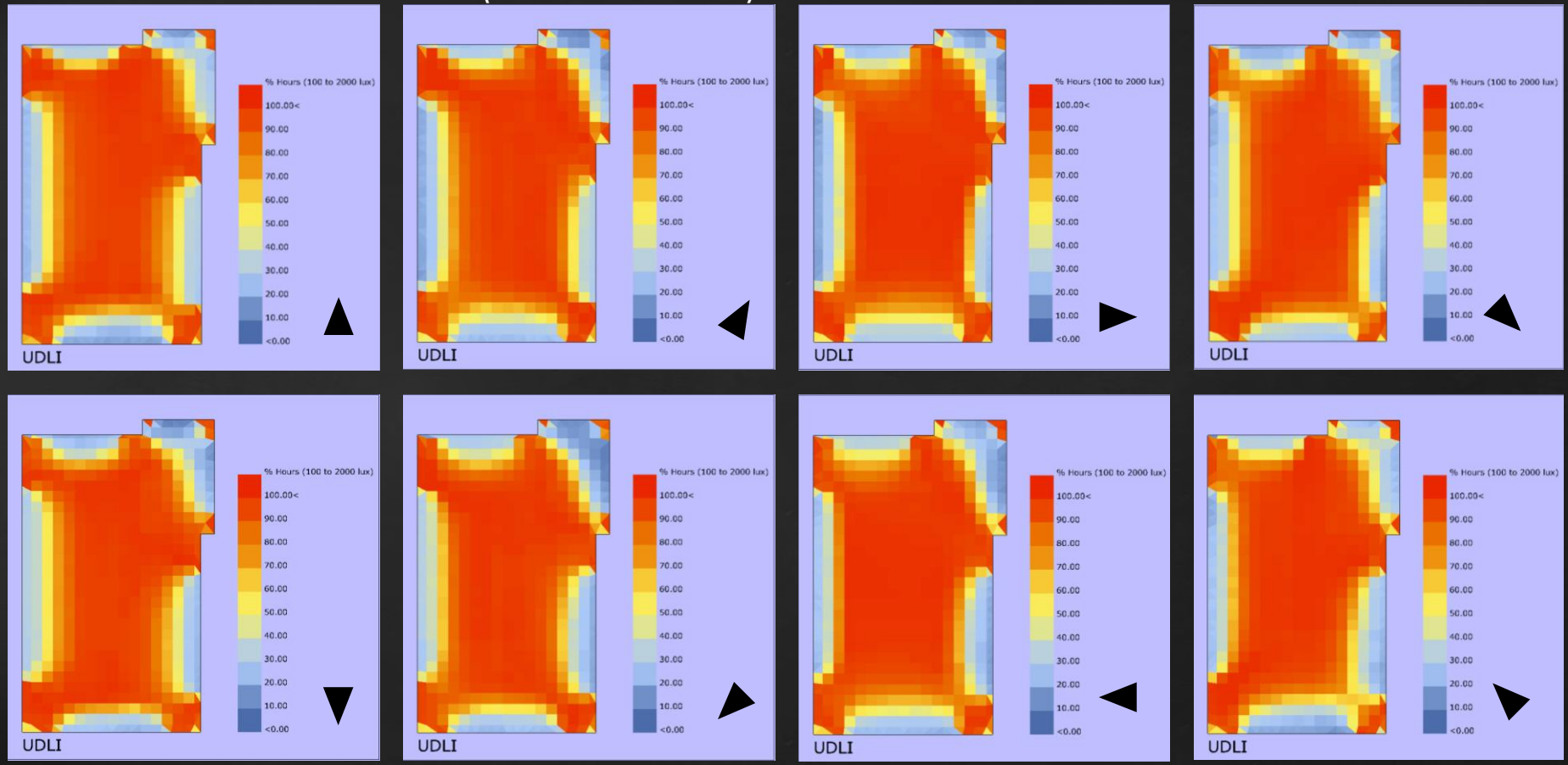
Methodology

- Preliminary assessment was conducted by assigning 40% window to wall ratio, uniformly distributed on all facades.
- The performance was assessed for al orientations, as observed in the masterplan, for each villa.



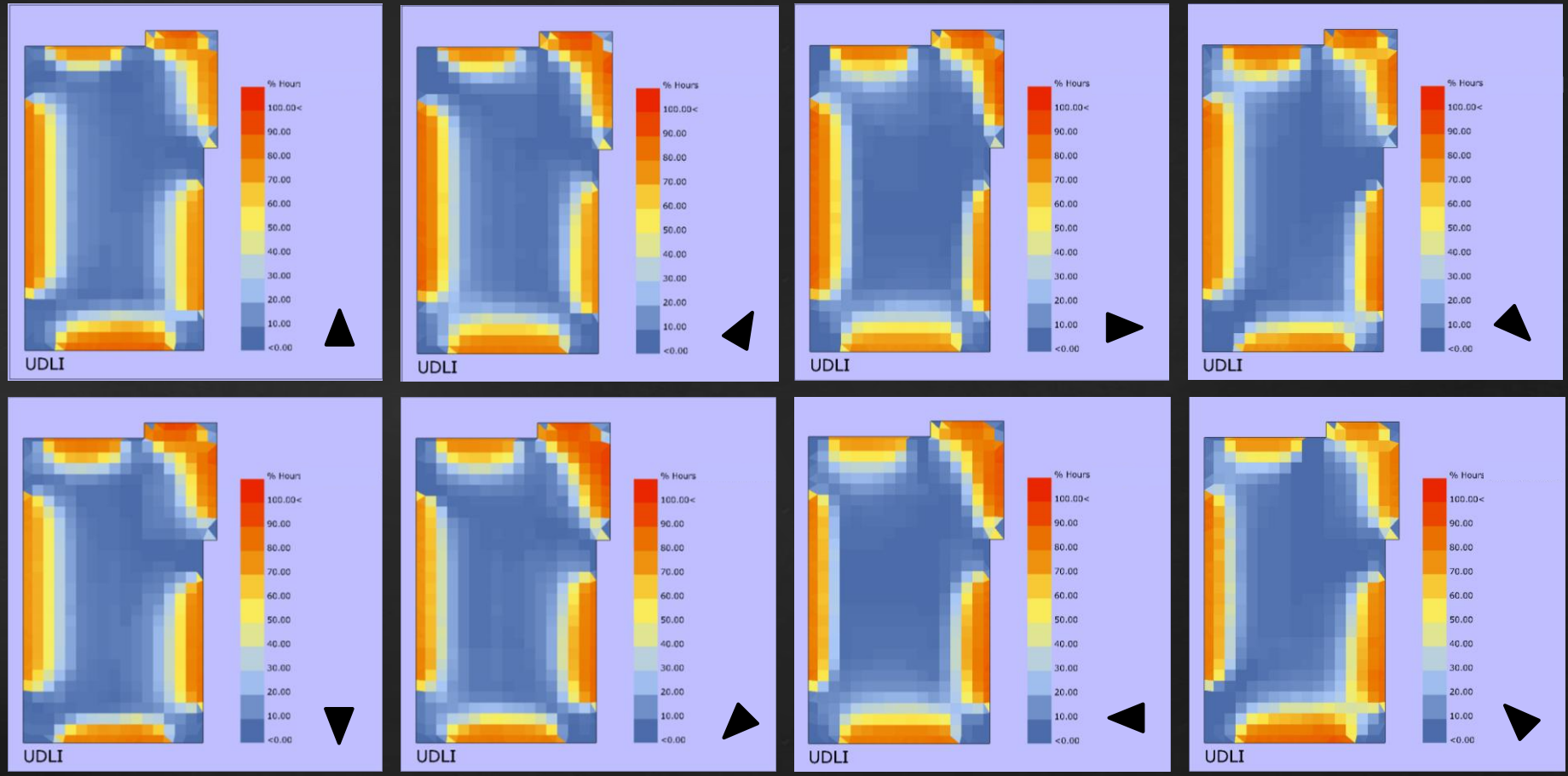
BLOCK MODEL: Uniform Fenestration on all facades

DAYLIGHT ANALYSIS – UDLI (100 to 2000 lux)



Useful daylight is observed over approximately **80% of the floor**, in each orientation for 80% – 90% of analysis hours. Further Analysis is conducted to identify areas with excessive illumination (glare).

GLARE ANALYSIS – UDLI (MORE THAN 2000 lux)

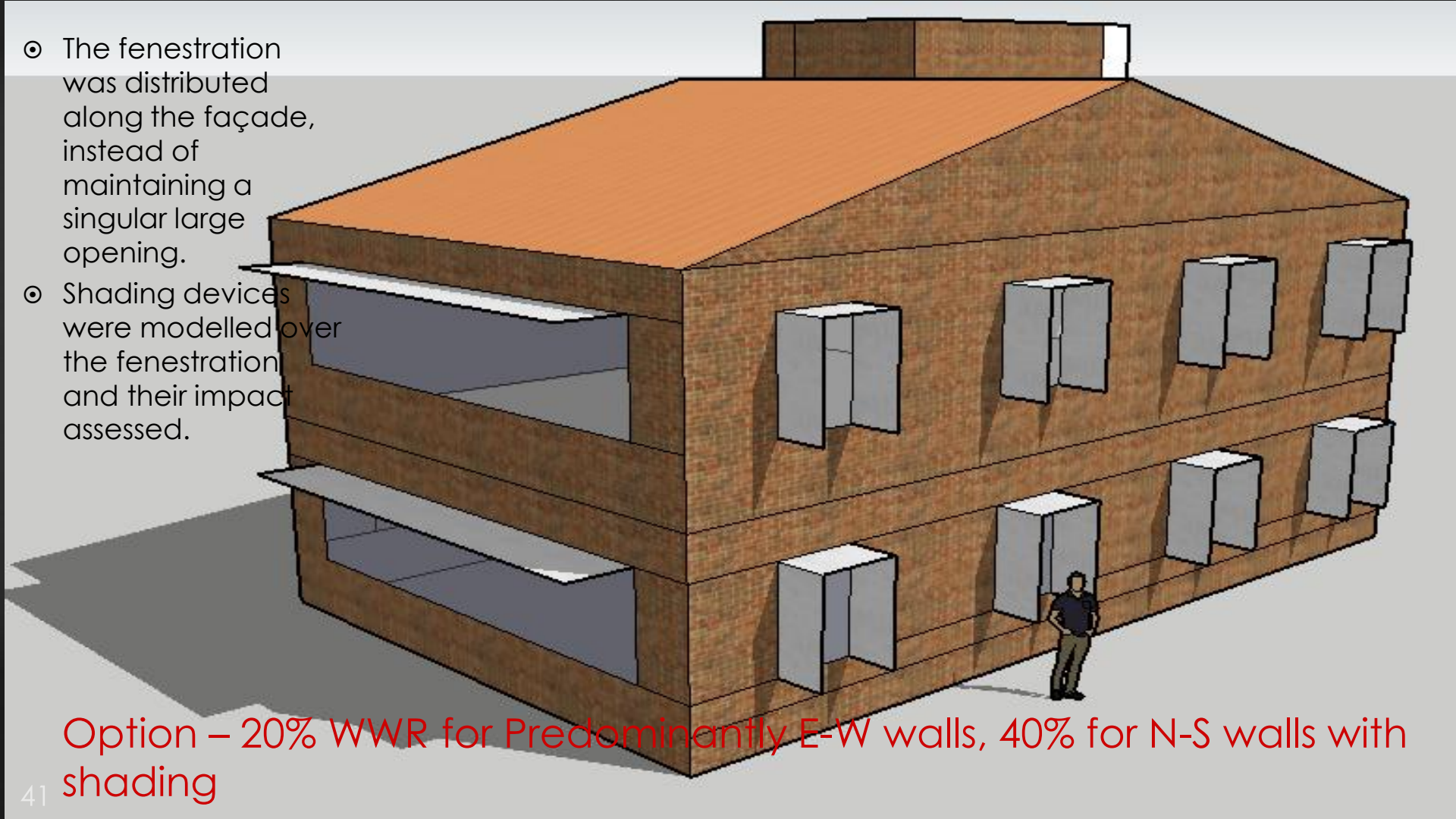


Excessive glare is observed up to 2m from the fenestration for all orientations. Shading devices are to be included to reduce the glare.

- Excessive daylight (glare)above 2000 lux is seen for up to 2m from each opening.
- Daylight control devices required to maintain useful daylight and reduce glare

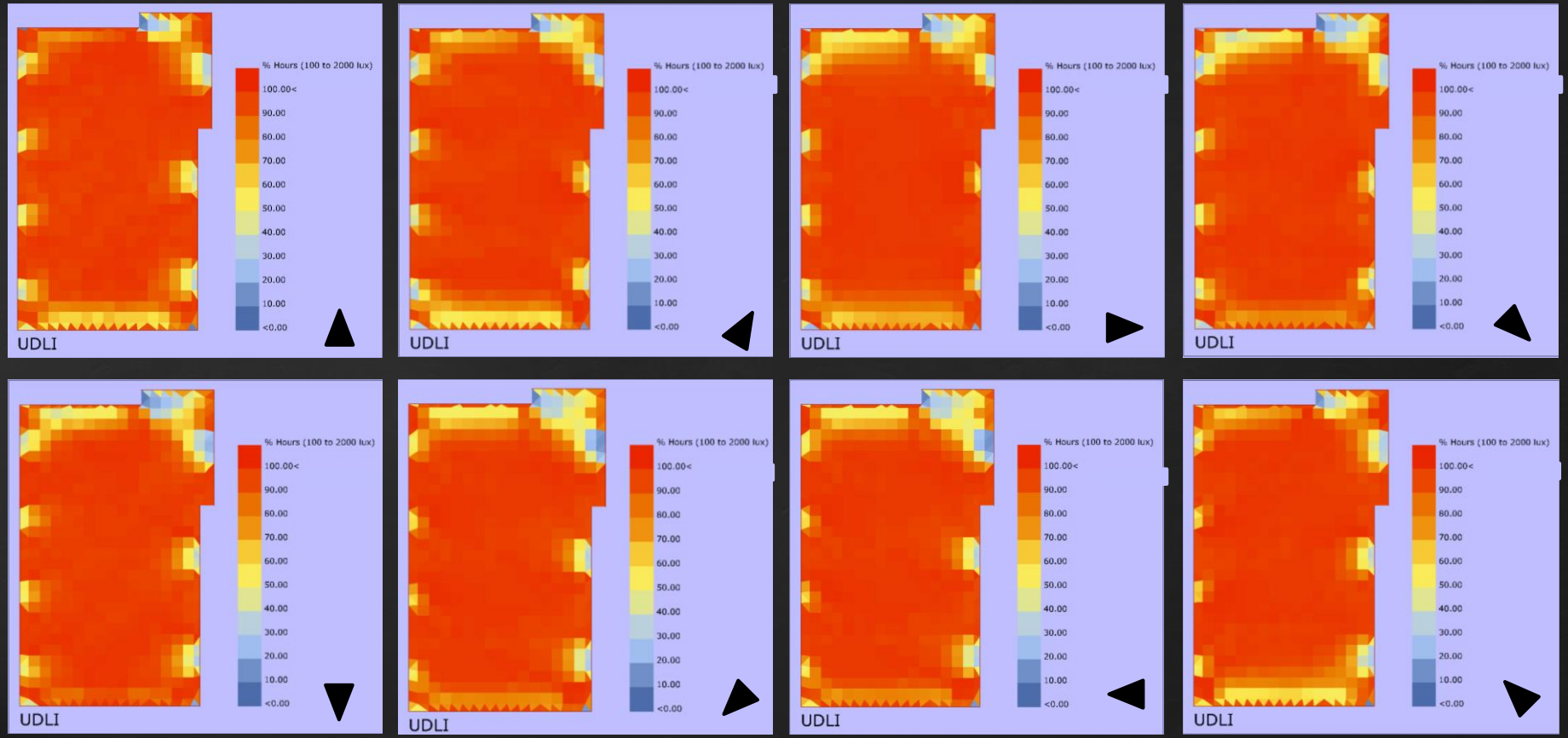
Inferences

- The fenestration was distributed along the façade, instead of maintaining a singular large opening.
- Shading devices were modelled over the fenestration and their impact assessed.

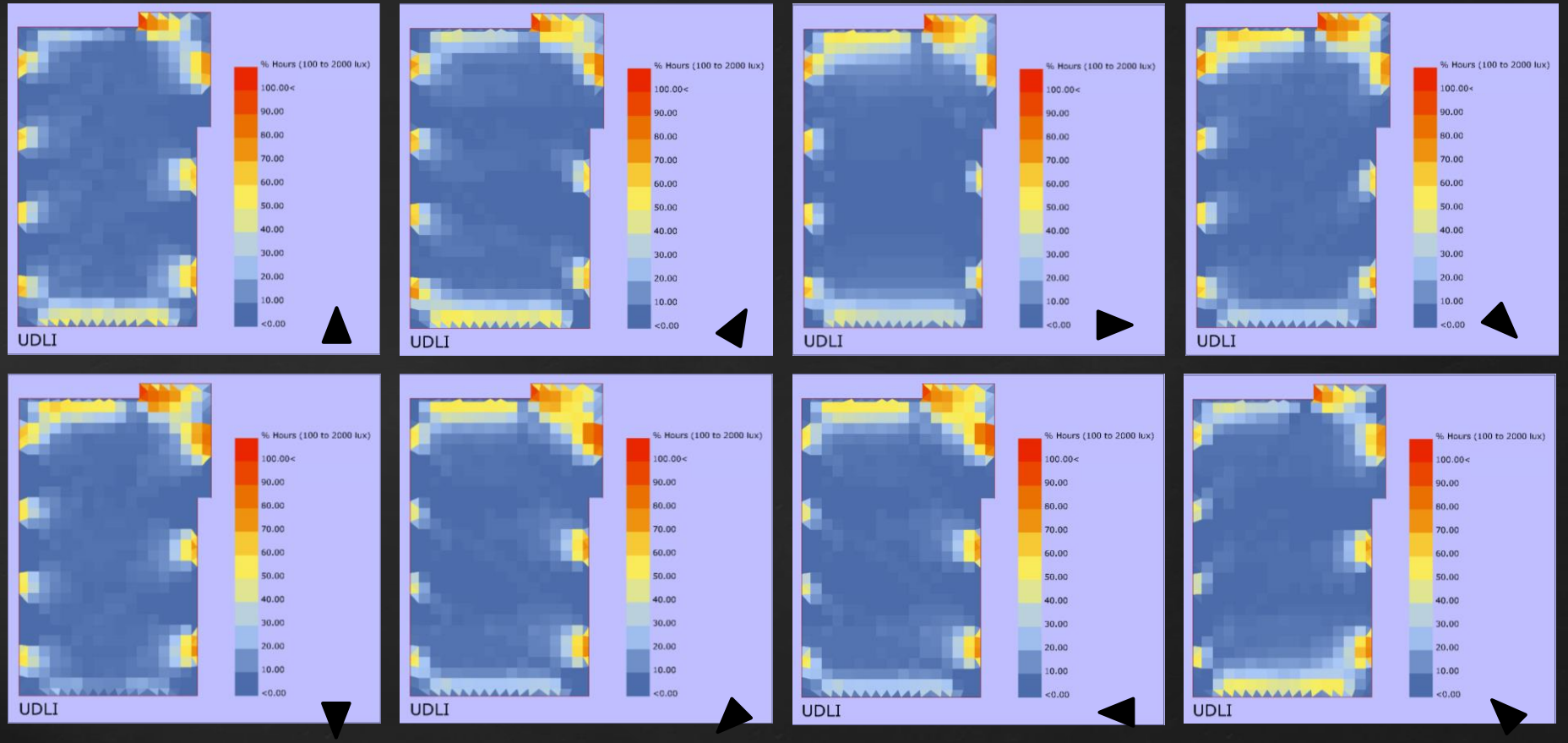


Option – 20% WWR for Predominantly E-W walls, 40% for N-S walls with shading

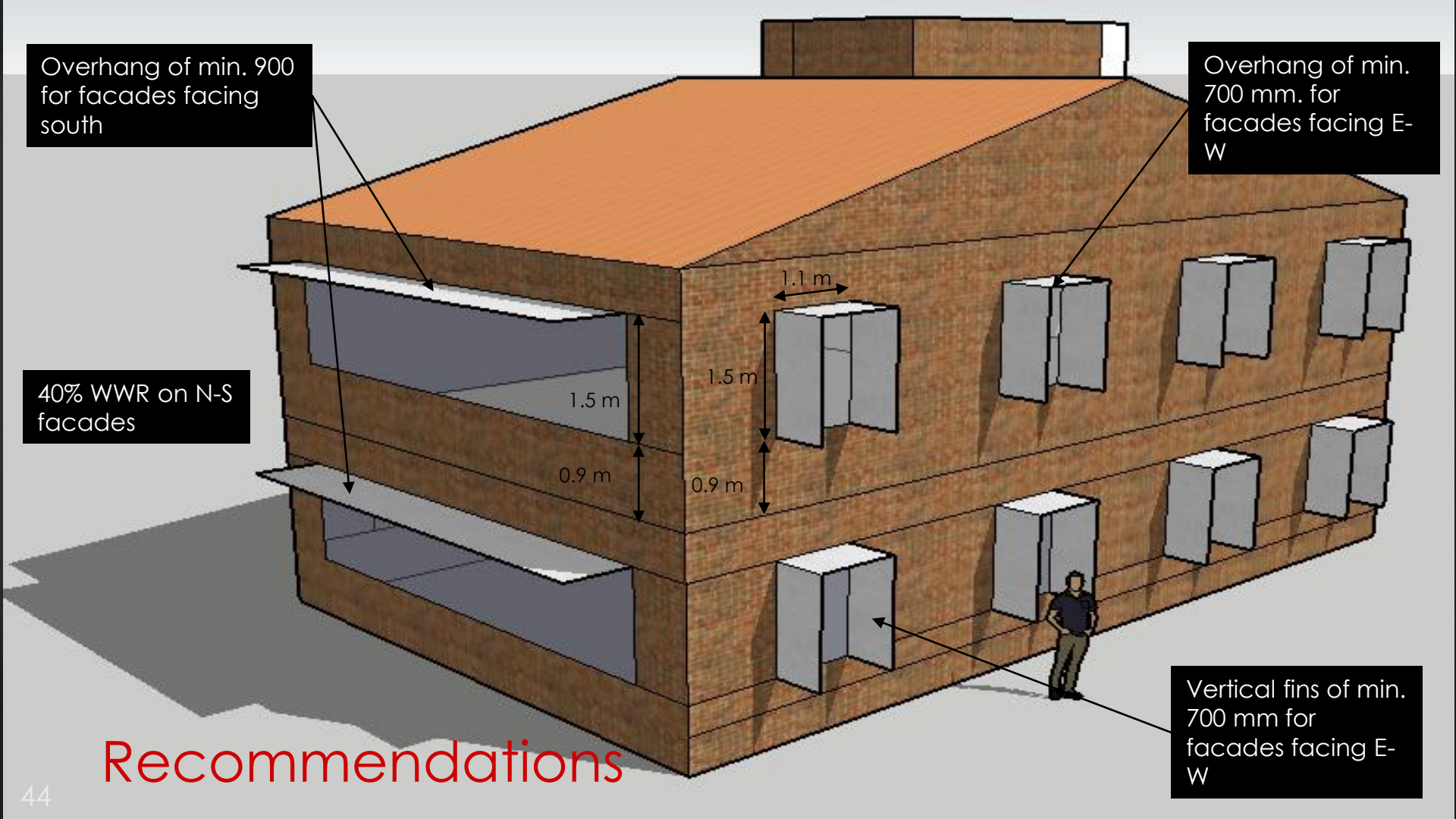
DAYLIGHT ANALYSIS – UDLI (100 to 2000 lux)



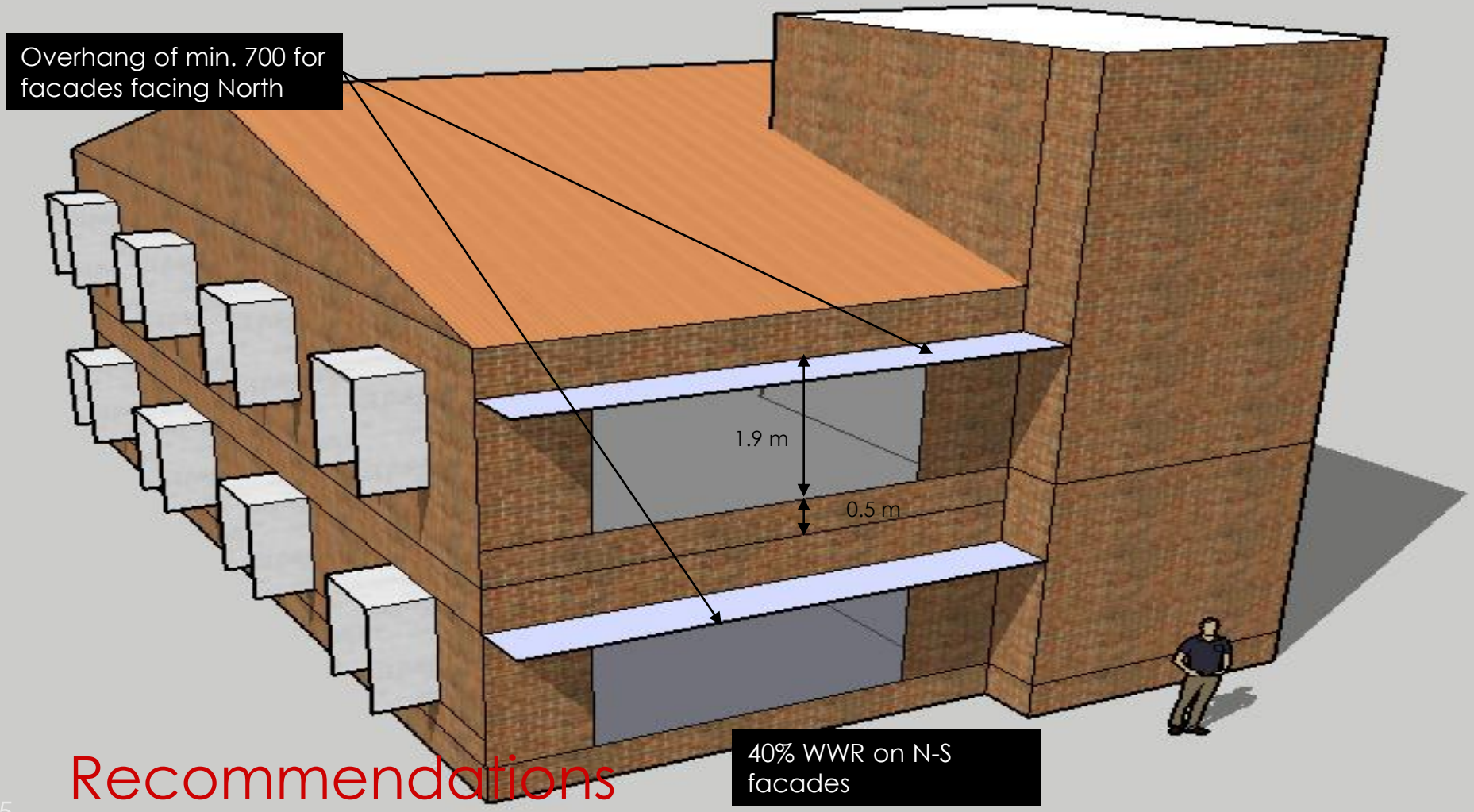
Useful daylight distribution is enhanced compared to the base case. Further Analysis is conducted to identify areas with excessive illumination (glare).



Reduction in glare is observed after distribution of windows along the façade and introduction of shading devices.



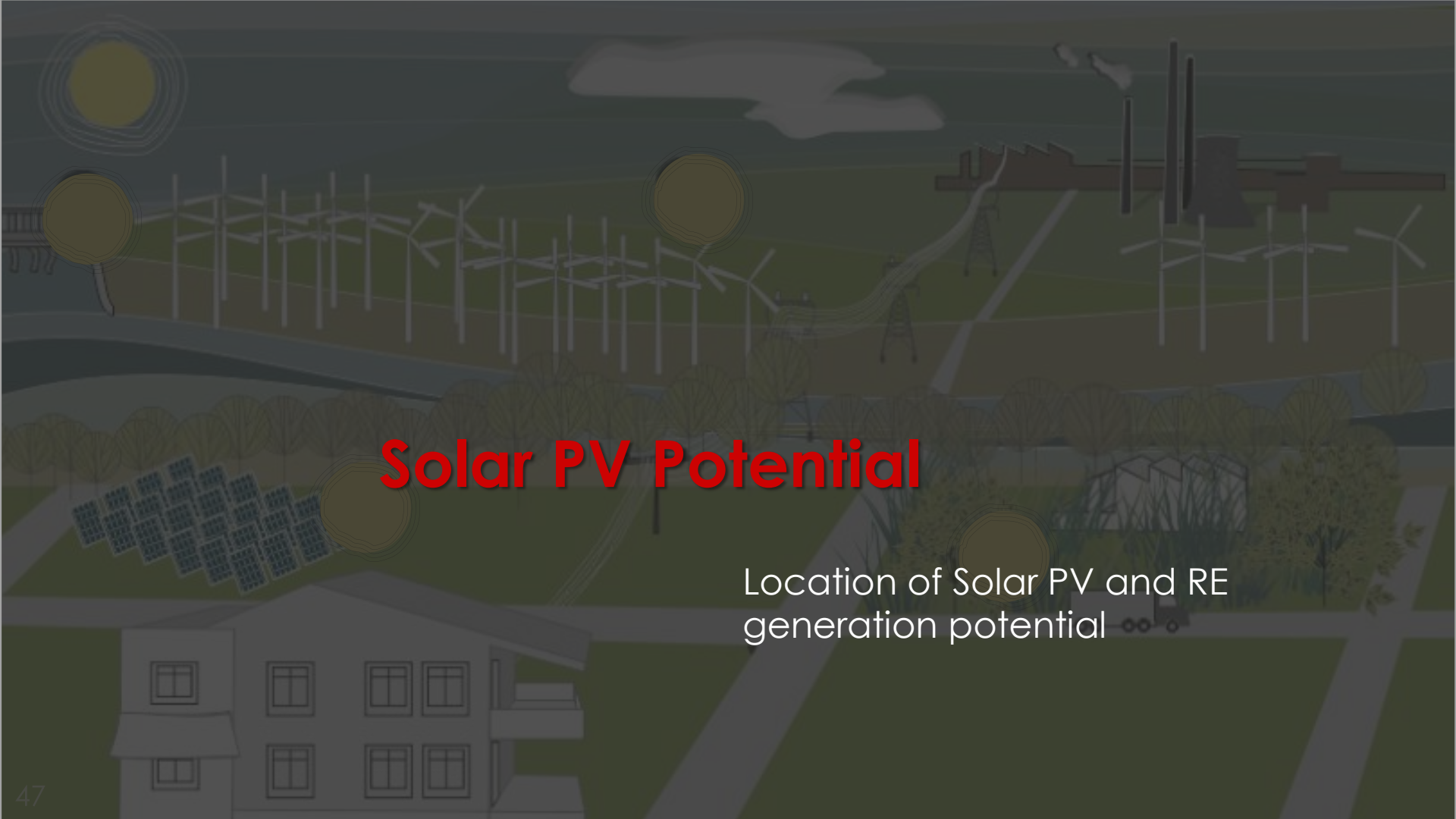
Recommendations



Recommendations

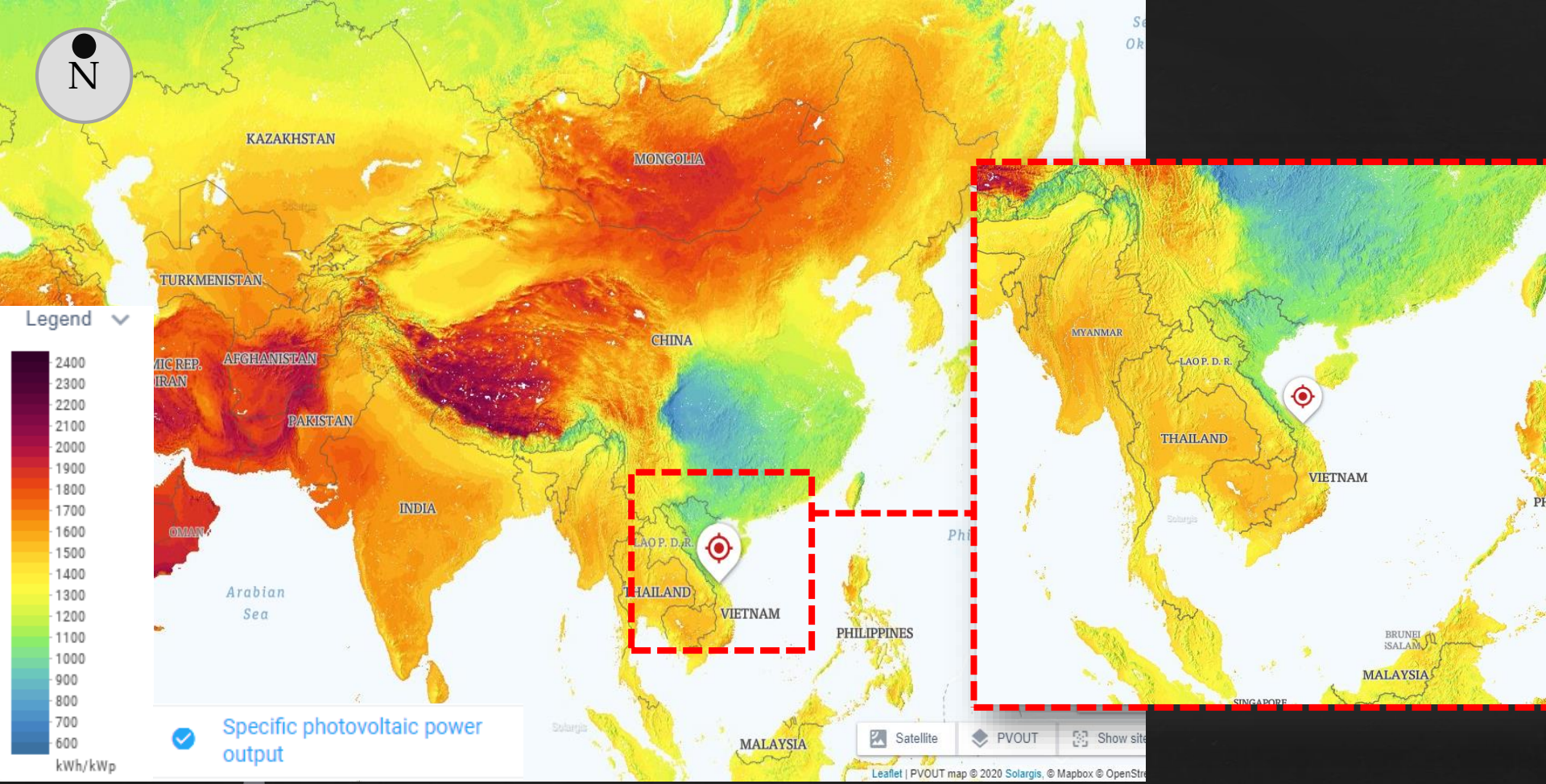
Renewable Energy Potential

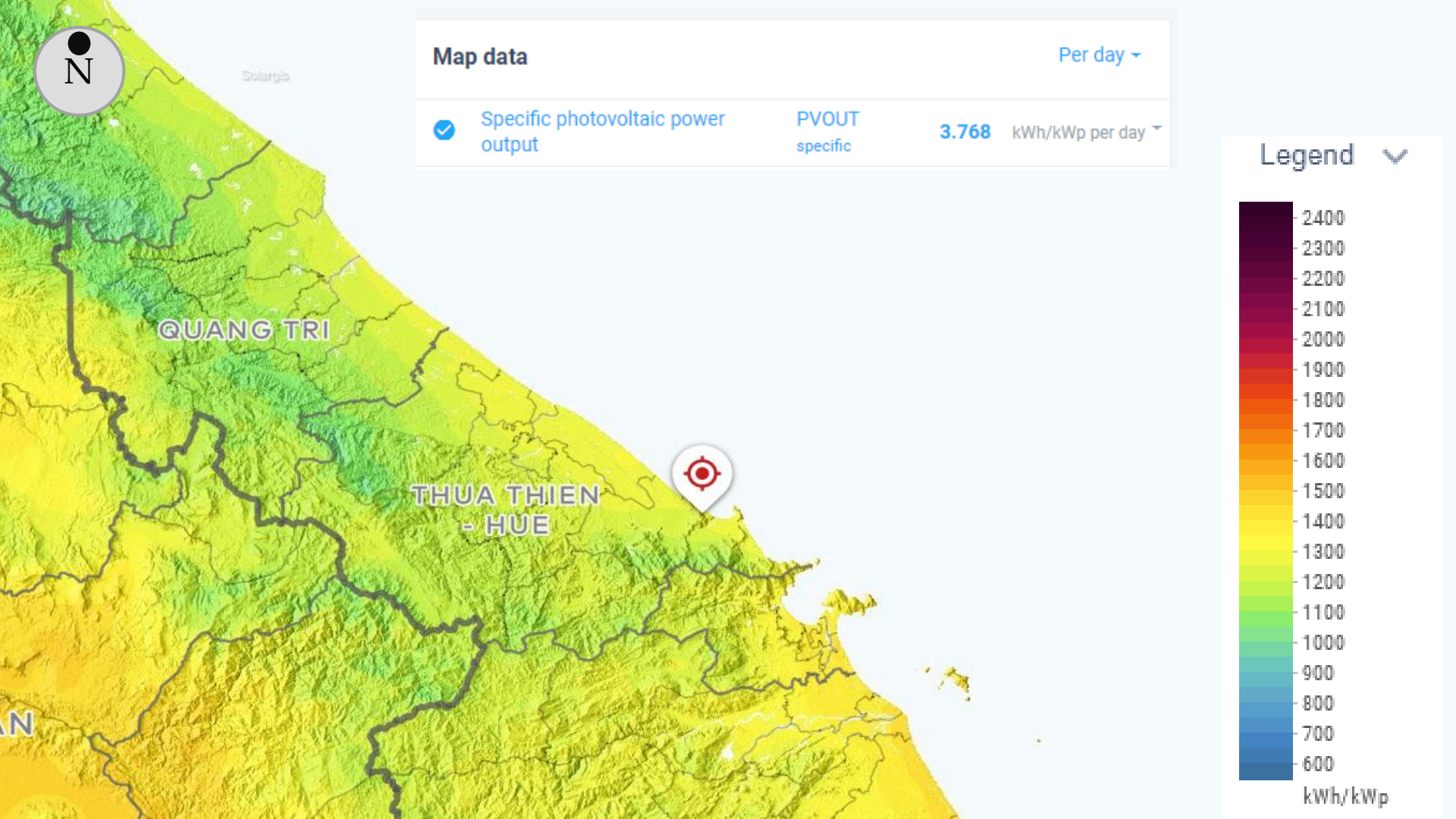
- Solar and Wind Energy



Solar PV Potential

Location of Solar PV and RE generation potential


N
KAZAKHSTAN
MONGOLIA
TURKMENISTAN
CHINA
AFGHANISTAN
PAKISTAN
INDIA
OMAN
Arabian Sea
MYANMAR
LAO P. D. R.
THAILAND
VIETNAM
PHILIPPINES
BRUNEI
MALAYSIA
SINGAPORE
Legend
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
kWh/kWp
Specific photovoltaic power output
Satellite
PVOUT
Leaflet | PVOUT map © 2020 Solargis, © Mapbox © OpenStr


N
Map data
Per day
Specific photovoltaic power output
PVOUT
specific
3.768
kWh/kWp per day
Legend
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
kWh/kWp
QUANG TRI
THUA THIEN
- HUE

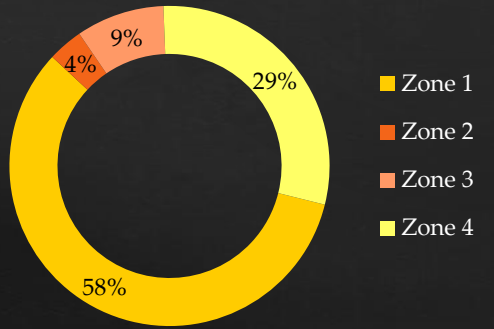

N
Proposed Site

Potential Location for Installation of Solar PV

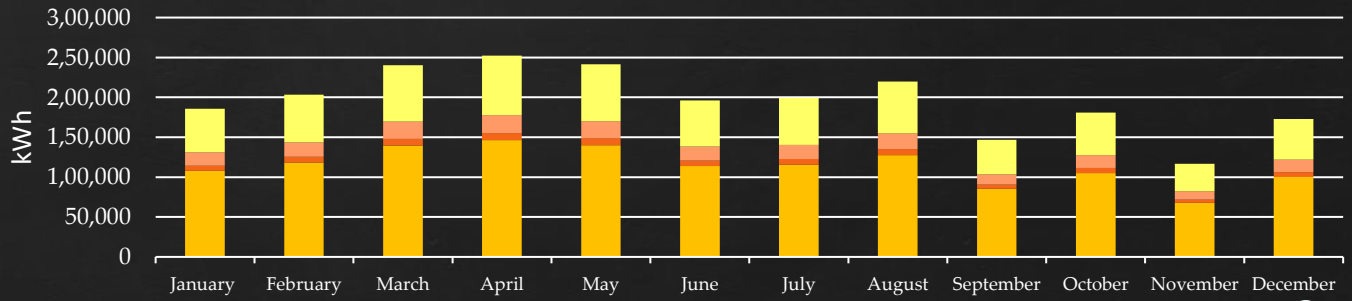
Zone 1 – Southern Open area
Zone 2 – Car Parking Roof 1
Zone 3 – Car Parking roof 2
Zone 4 – Roof area

Sr No	Location	Area (Sq m)	Percentage area for installation of PV panels	Area for installation of PV panels (Sq m)	System Size (kWp)	RE Genration potential per annum
1	Zone 1	13,572	80%	10,858	1085	13,67,069
2	Zone 2	830	80%	664	66.4	83,585
3	Zone 3	2,097	80%	1,678	167	2,10,221
4	Zone 4 (92 units)	11,040	50%	5,520	552	6,94,864
Total		27,539		18,719	1,872	23,55,739

Solar PV Potential



Monthly RE Generation



RESULTS

1,367,069 kWh/Year*

Month	Solar Radiation (kWh/m²/day)	AC Energy (kWh)	Value ($)
January	4.21	107,792	N/A
February	5.14	118,117	N/A
March	5.64	139,519	N/A
April	6.10	146,399	N/A
May	5.76	140,138	N/A
June	4.82	113,793	N/A
July	4.70	115,674	N/A
August	5.20	127,511	N/A
September	3.54	85,198	N/A
October	4.12	104,999	N/A
November	2.68	67,706	N/A
December	3.93	100,223	N/A
Annual	4.86	1,367,069	0

Location and Station Identification

Requested Location	vietnam
Weather Data Source	(INTL) DA NANG, VIETNAM 114 mi
Latitude	16.07° N
Longitude	108.21° E

PV System Specifications (Commercial)

DC System Size	1000 kW
Module Type	Standard
Array Type	Fixed (open rack)
Array Tilt	20°
Array Azimuth	180°
System Losses	14.08%
Inverter Efficiency	96%
DC to AC Size Ratio	1.2

Economics

Average Retail Electricity Rate	No utility data available

Performance Metrics

Capacity Factor	14.4%

Zone 1

RESULTS

83,585 kWh/Year*

Month	Solar Radiation (kWh/m²/day)	AC Energy (kWh)	Value ($)
January	4.21	6,591	N/A
February	5.14	7,222	N/A
March	5.64	8,530	N/A
April	6.10	8,951	N/A
May	5.76	8,568	N/A
June	4.82	6,956	N/A
July	4.70	7,073	N/A
August	5.20	7,796	N/A
September	3.54	5,209	N/A
October	4.12	6,420	N/A
November	2.68	4,140	N/A
December	3.93	6,128	N/A
Annual	4.86	83,586	0

Location and Station Identification

Requested Location	vietnam
Weather Data Source	(INTL) DA NANG, VIETNAM 114 mi
Latitude	16.07° N
Longitude	108.21° E

PV System Specifications (Commercial)

DC System Size	66.4 kW
Module Type	Standard
Array Type	Fixed (open rack)
Array Tilt	20°
Array Azimuth	180°
System Losses	14.08%
Inverter Efficiency	96%
DC to AC Size Ratio	1.2

Economics

Average Retail Electricity Rate	No utility data available

Performance Metrics

Capacity Factor	14.4%

Zone 2

RESULTS

210,221 kWh/Year*

Month	Solar Radiation (kWh/m²/day)	AC Energy (kWh)	Value ($)
January	4.21	16,578	N/A
February	5.14	18,184	N/A
March	5.64	21,465	N/A
April	6.10	22,513	N/A
May	5.76	21,550	N/A
June	4.82	17,499	N/A
July	4.70	17,788	N/A
August	5.20	19,608	N/A
September	3.54	13,101	N/A
October	4.12	16,148	N/A
November	2.68	10,412	N/A
December	3.93	15,412	N/A
Annual	4.86	210,224	0

Location and Station Identification

Requested Location	vietnam
Weather Data Source	(INTL) DA NANG, VIETNAM 114 mi
Latitude	16.07° N
Longitude	108.21° E

PV System Specifications (Commercial)

DC System Size	167 kW
Module Type	Standard
Array Type	Fixed (open rack)
Array Tilt	20°
Array Azimuth	180°
System Losses	14.08%
Inverter Efficiency	96%
DC to AC Size Ratio	1.2

Economics

Average Retail Electricity Rate	No utility data available

Performance Metrics

Capacity Factor	14.4%

Zone 3

RESULTS

694,864 kWh/Year*

Month	Solar Radiation (kWh/m²/day)	AC Energy (kWh)	Value ($)
January	4.21	54,789	N/A
February	5.14	60,037	N/A
March	5.64	70,916	N/A
April	6.10	74,413	N/A
May	5.76	71,230	N/A
June	4.82	57,840	N/A
July	4.70	58,796	N/A
August	5.20	64,812	N/A
September	3.54	43,305	N/A
October	4.12	53,370	N/A
November	2.68	34,414	N/A
December	3.93	50,942	N/A
Annual	4.86	694,884	0

Location and Station Identification

Requested Location	vietnam
Weather Data Source	(INTL) DA NANG, VIETNAM 114 mi
Latitude	16.07° N
Longitude	108.21° E

PV System Specifications (Commercial)

DC System Size	552 kW
Module Type	Standard
Array Type	Fixed (open rack)
Array Tilt	20°
Array Azimuth	180°
System Losses	14.08%
Inverter Efficiency	96%
DC to AC Size Ratio	1.2

Economics

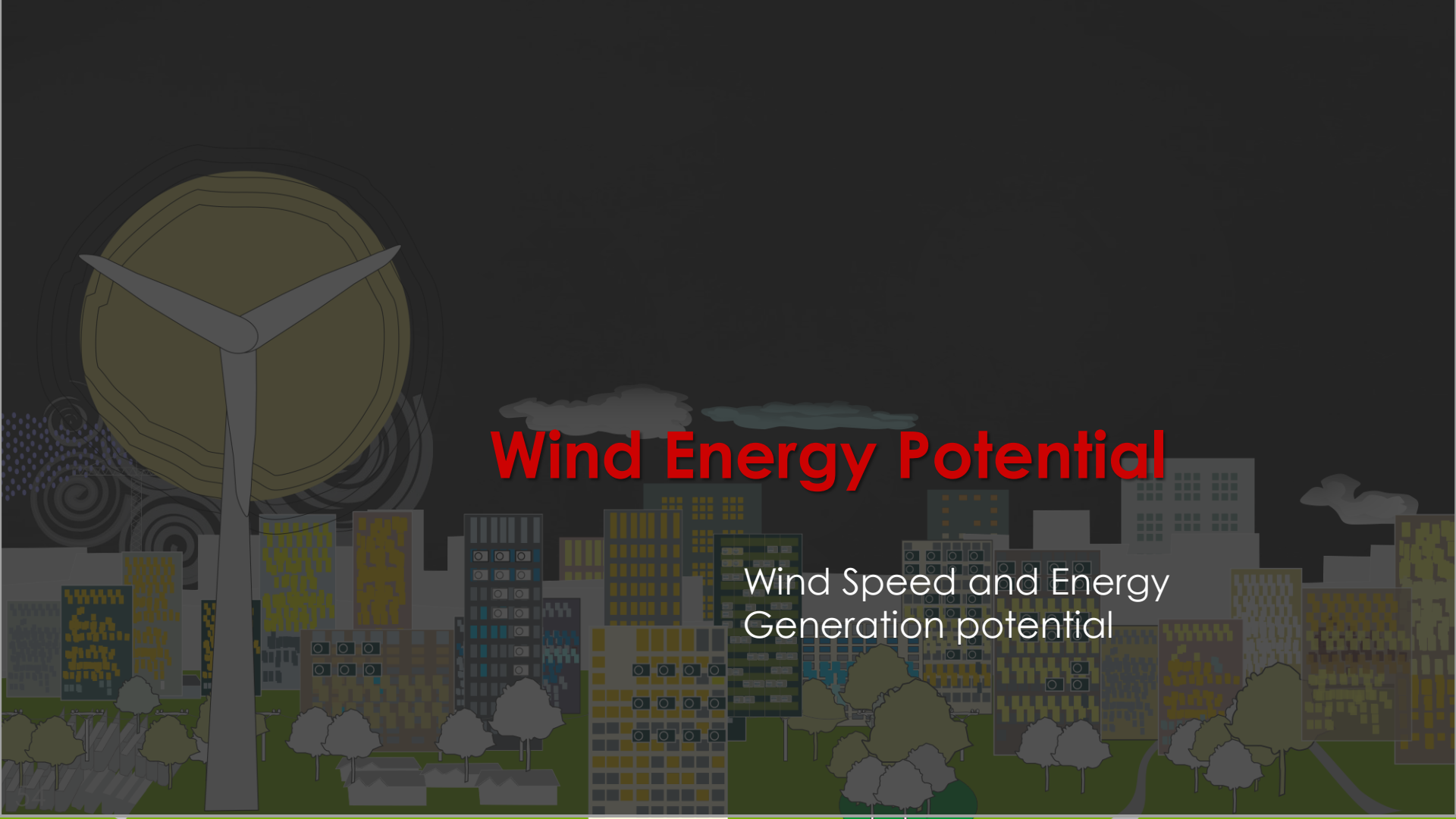
Average Retail Electricity Rate	No utility data available

Performance Metrics

Capacity Factor	14.4%

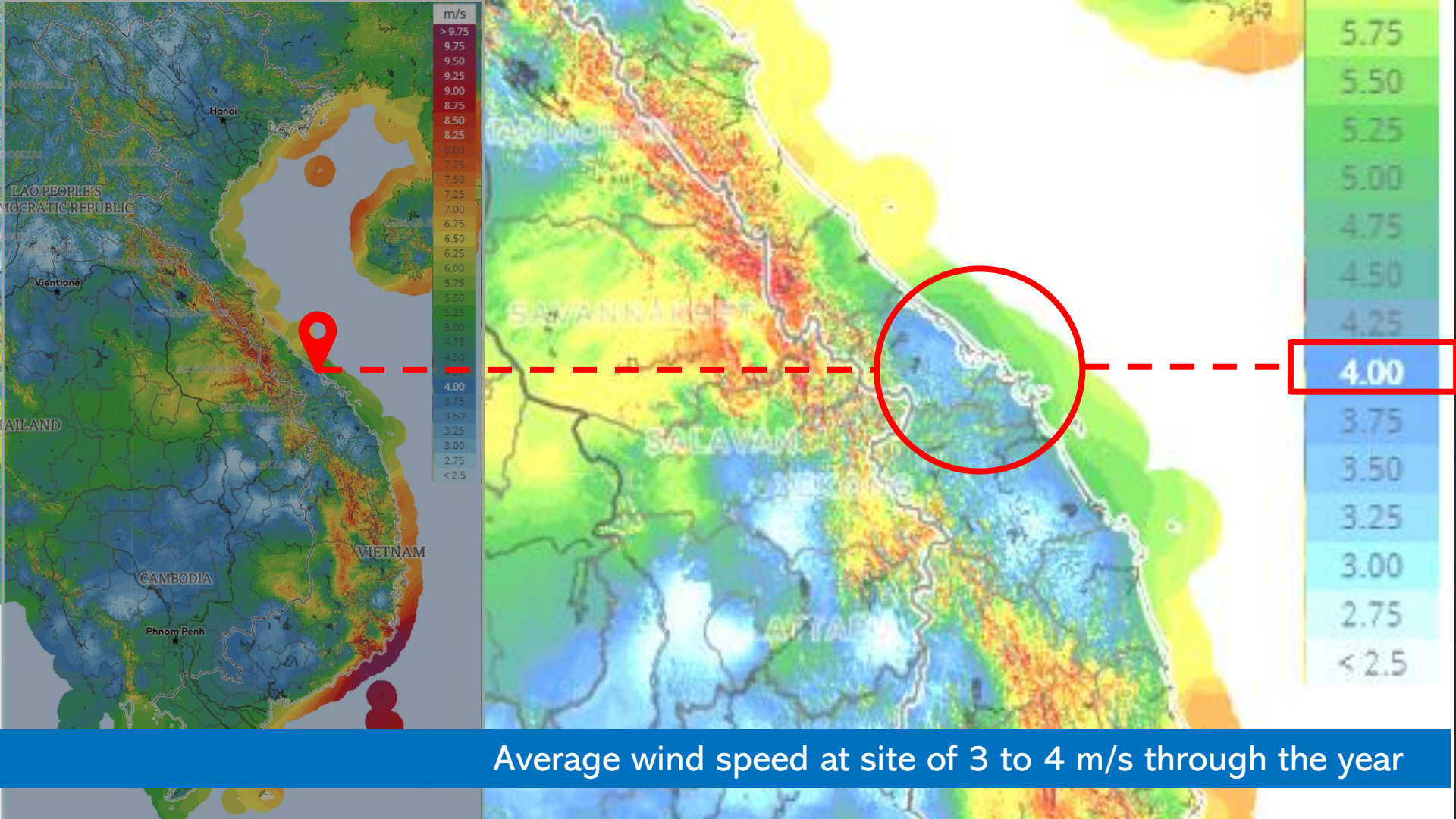
Zone 4

eds environmental design solutions

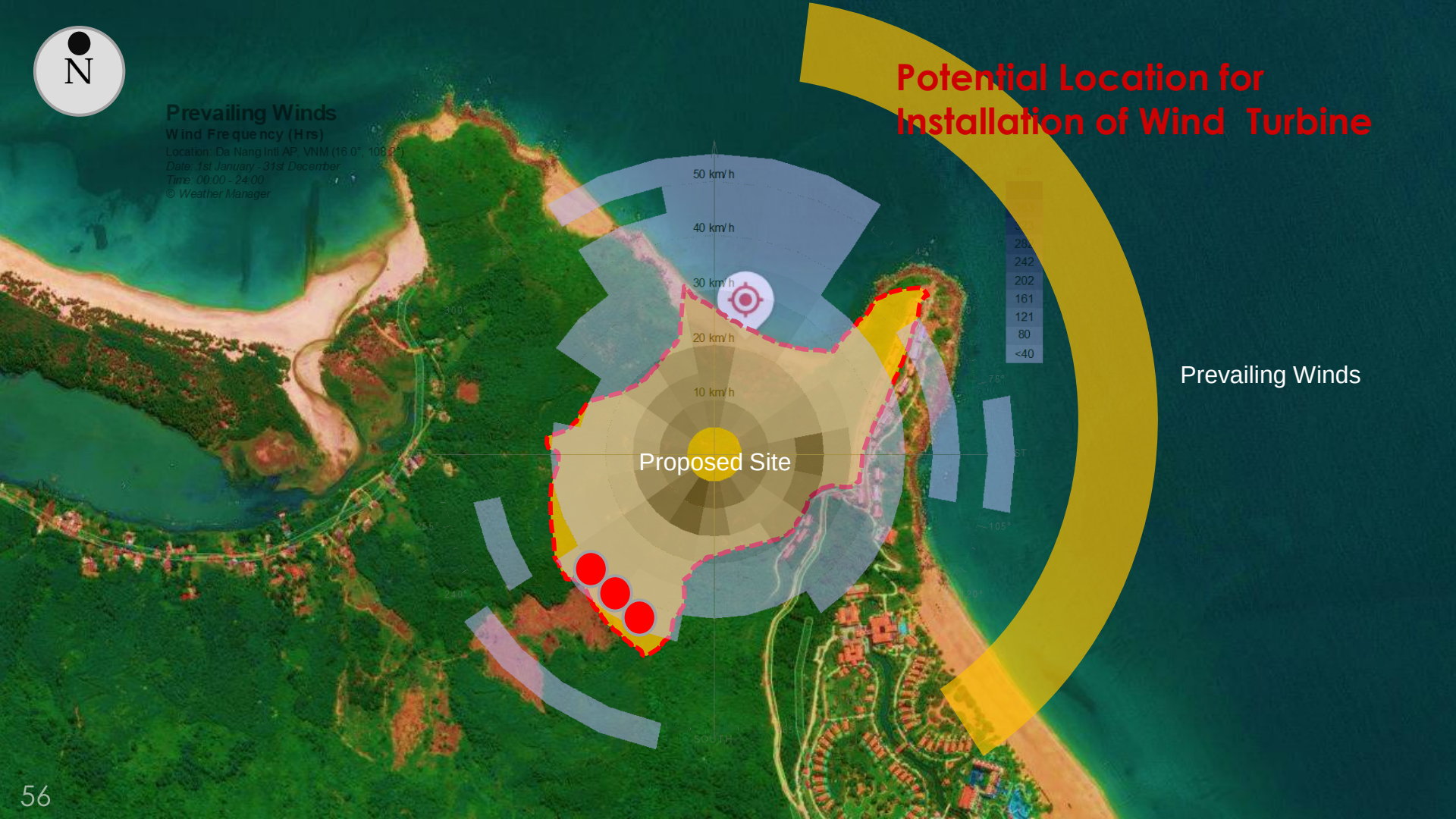


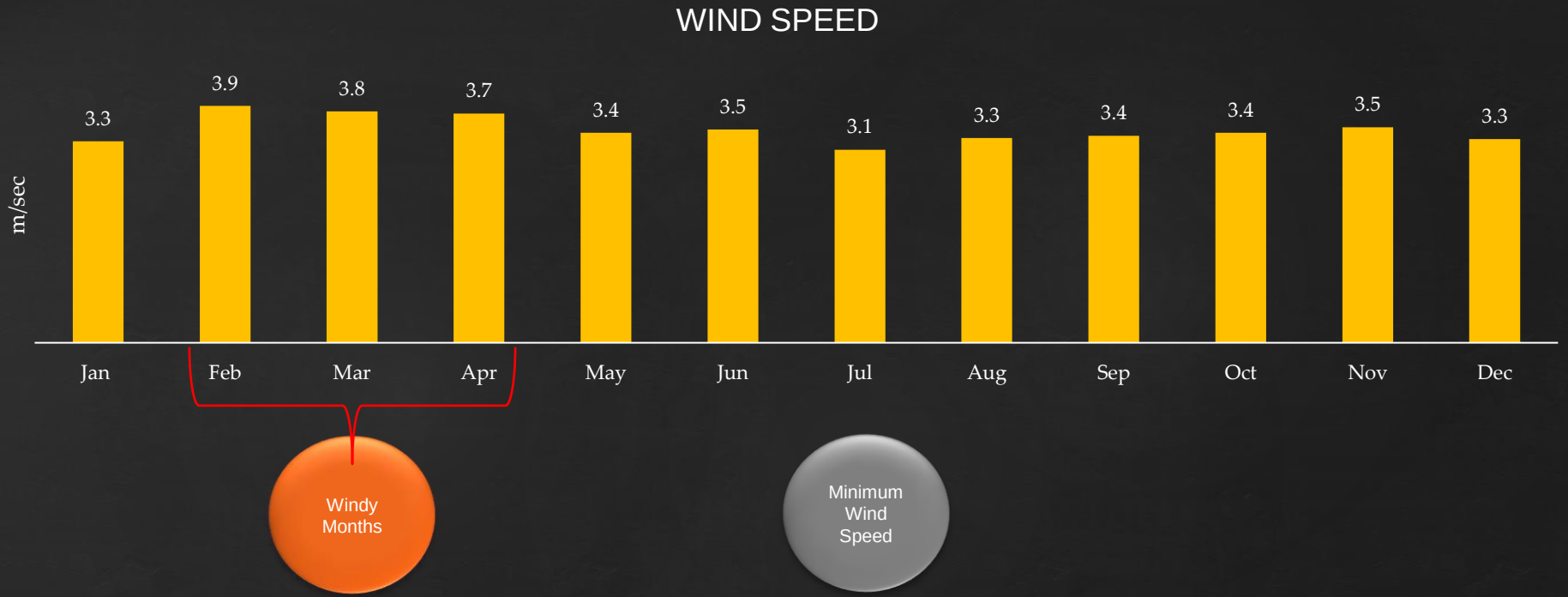
Wind Energy Potential

Wind Speed and Energy Generation potential



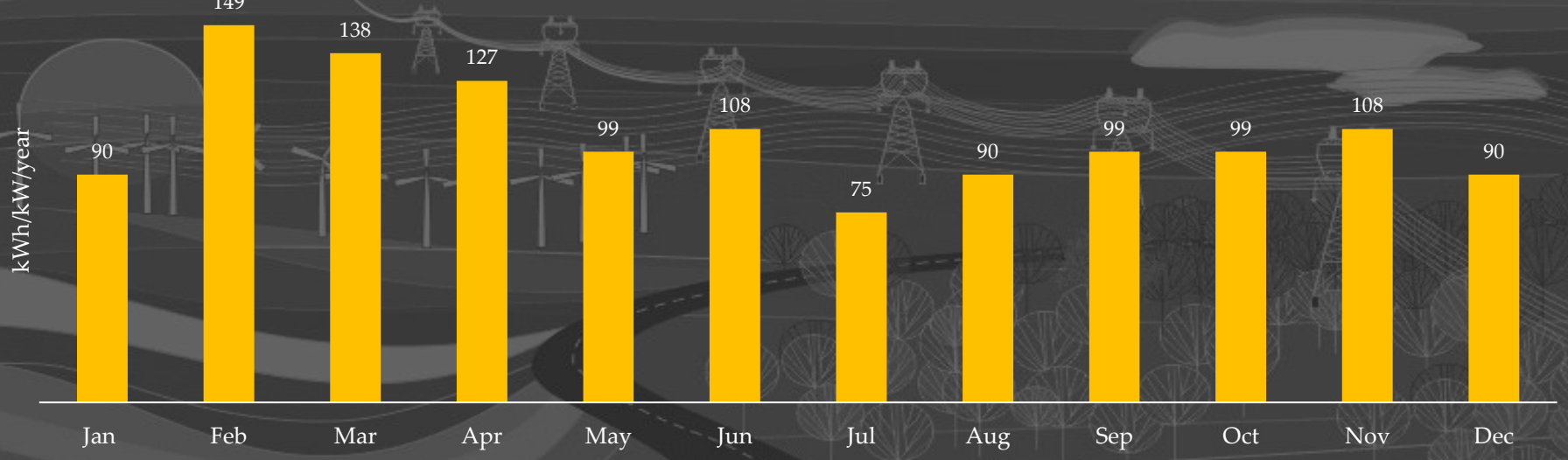
Average wind speed at site of 3 to 4 m/s through the year


N
Prevailing Winds
Wind Frequency (Hrs)
Location: Da Nang Intl AP, VNM (16.0°, 108.2°)
Date: 1st January - 31st December
Time: 00:00 - 24:00
© Weather Manager
50 km/h
40 km/h
30 km/h
20 km/h
10 km/h
242
202
161
121
80
<40
Potential Location for Installation of Wind Turbine
Proposed Site
Prevailing Winds



- Average wind speed is nearly 3.5 m/sec
- February, March & April are windy months

Wind Speed Analysis

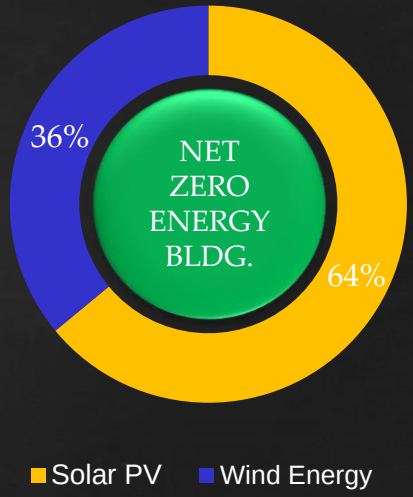


Maximum Energy Generation

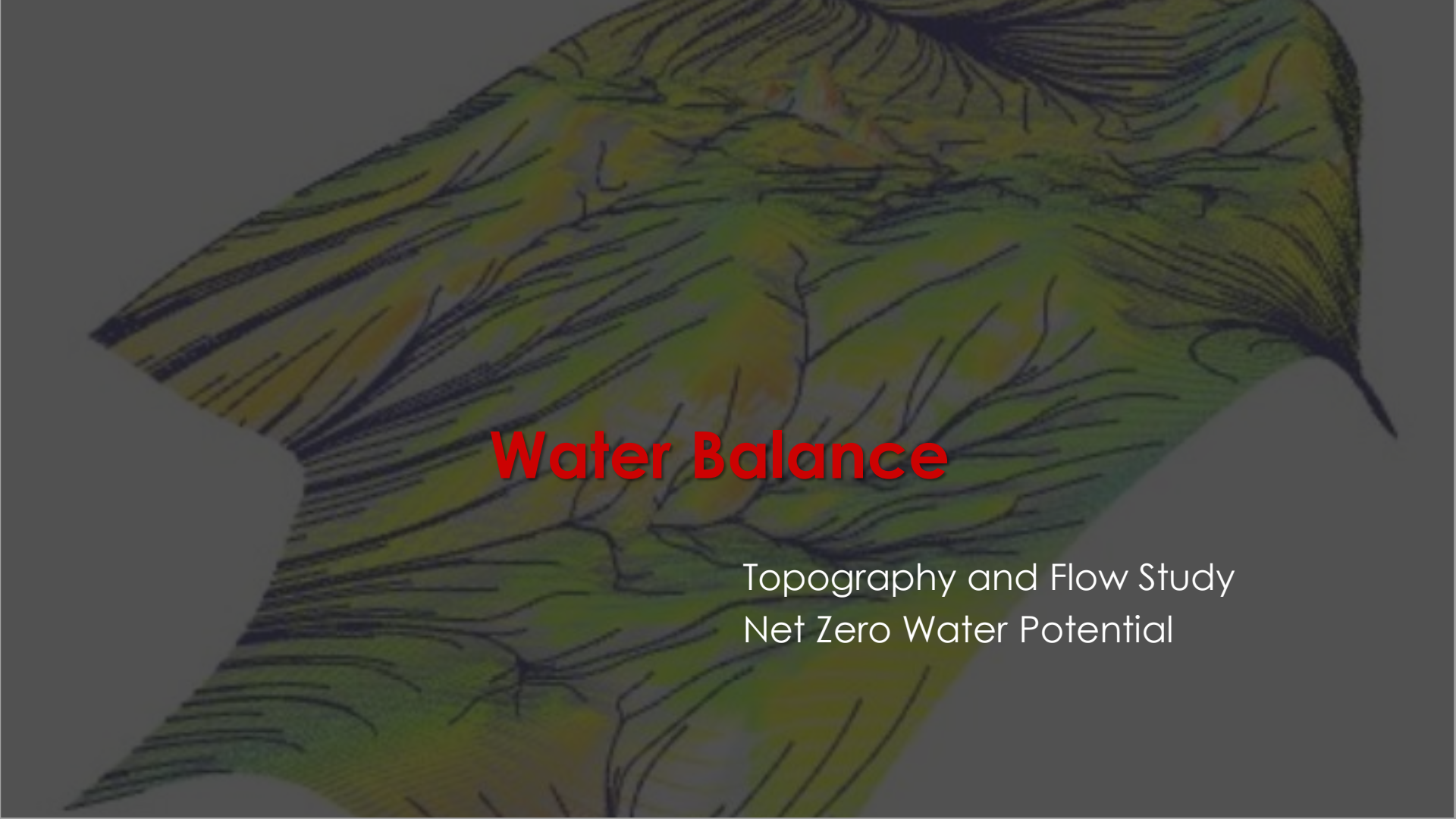
- Energy generations potential is calculated for 1kW system
- Maximum generation will be in month of Feb 138 kWh/ kW
- Minimum generation potential will be in Aug & Dec 75 kWh/ kW
- Average monthly energy generation potential 106 kWh/kW
- Annual Energy generation potential -1272 kWh/kW.year

Wind Energy Generation Potential

Renewable energy system reequipments for Net Zero Energy Building		
1	Total construction Area (Sq m)	61,208
2	Energy consumption (kWh/Sqm/year)	60
3	Total estimated consumption (kWh/ year)	36,72,480
4	Total estimated energy generation through solar PV (kWh/year) System Size 1872 kW	23,55,739
5	Potential RE generation through solar PV (%)	64%
6	Total estimated energy generation through wind energy (kWh./year) System Size 1035 kW	13,16,741
7	Potential RE generation through wind turbine (%)	36%



- Project may also use individual solar water heating system for each villa.
- Also, considering the available biomass on the site, biomass can also be converted to energy.



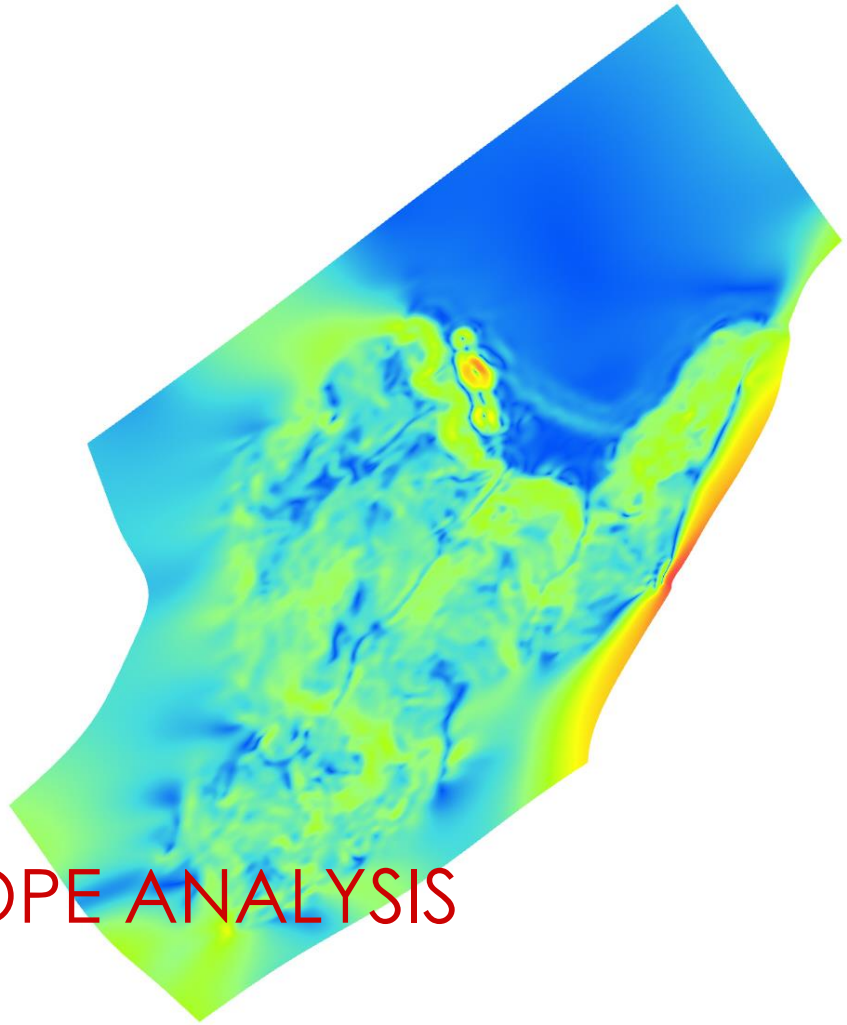
Water Balance

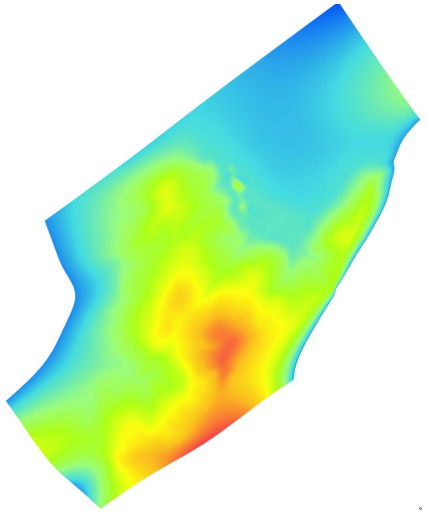
Topography and Flow Study
Net Zero Water Potential

Rainfall Study

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average precipitation mm	60.08	22.35	48.43	57.67	37.37	60.62	139.8	138.58	399.87	428.83	458.43	469.03
Average precipitation days	14	8	6	7	10	9	10	12	15	20	20	18

The average annual rain fall received is 2300 mm, distributed throughout the year with predominant concentration in month of **September to December** .

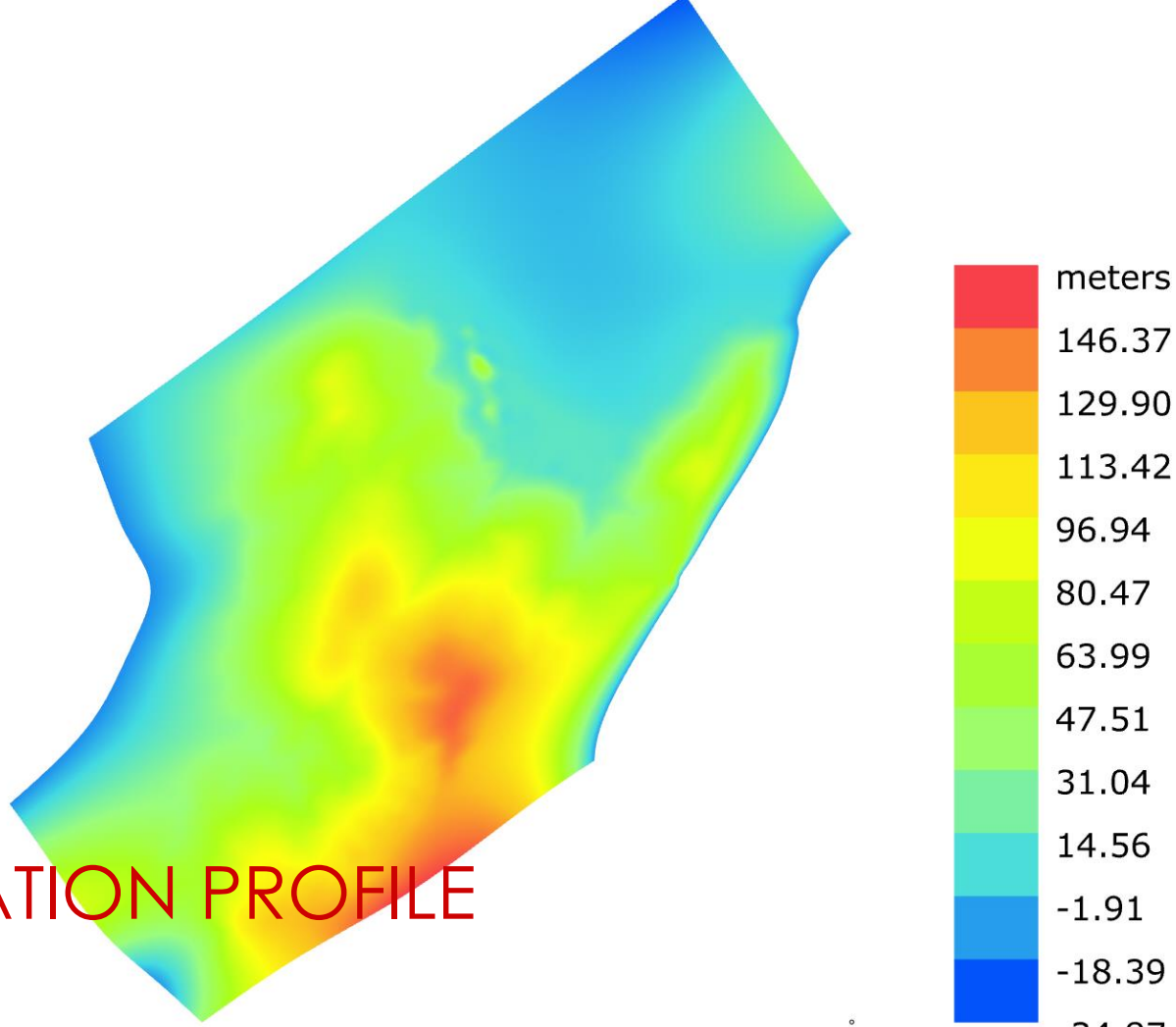




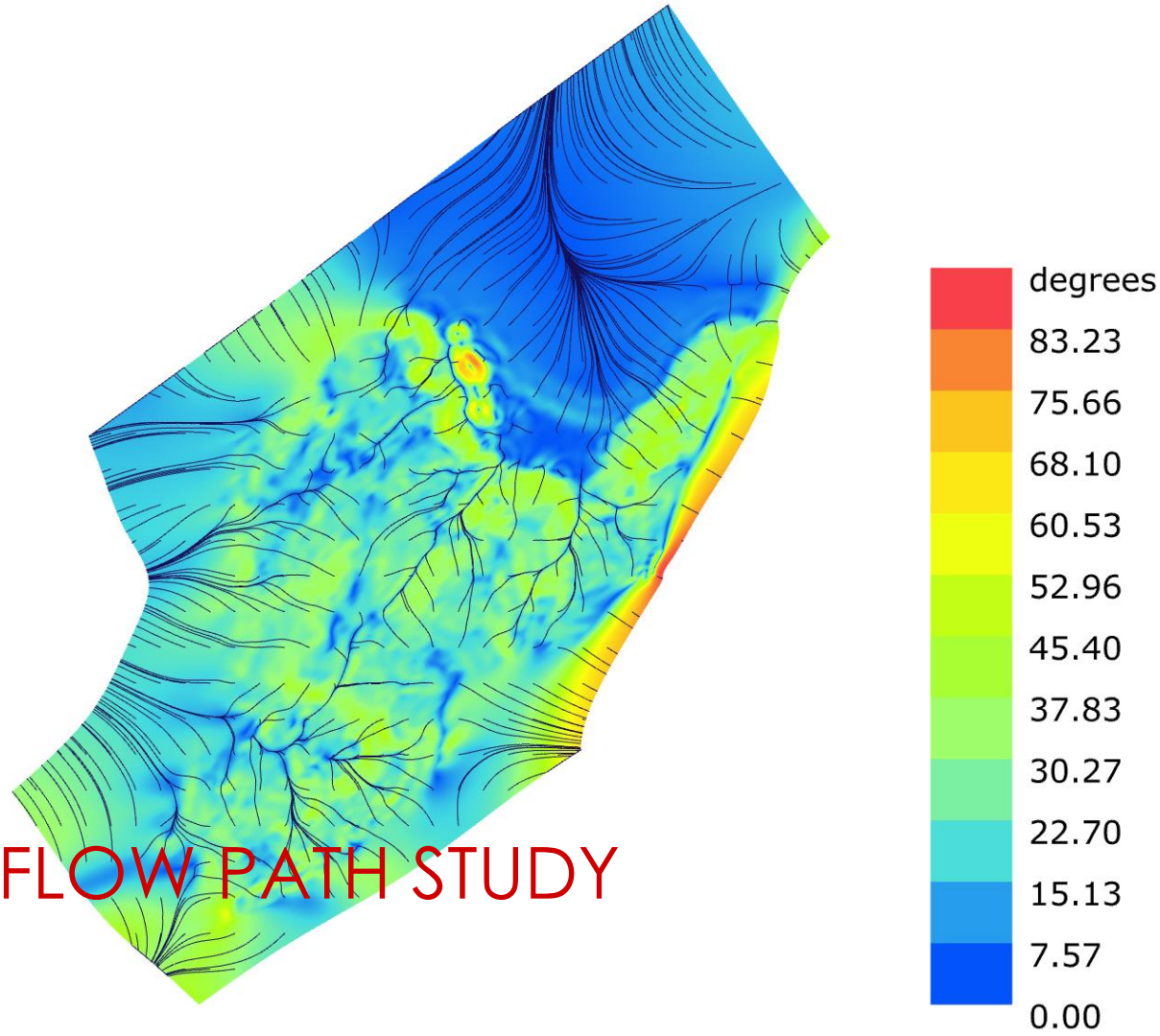
d
8
7
6
60.53
52.96
45.40
37.83
30.27
22.70
15.13
7.57
0.00

m
14
12
11
90
80
63
47
31
14
-1
-1
-3

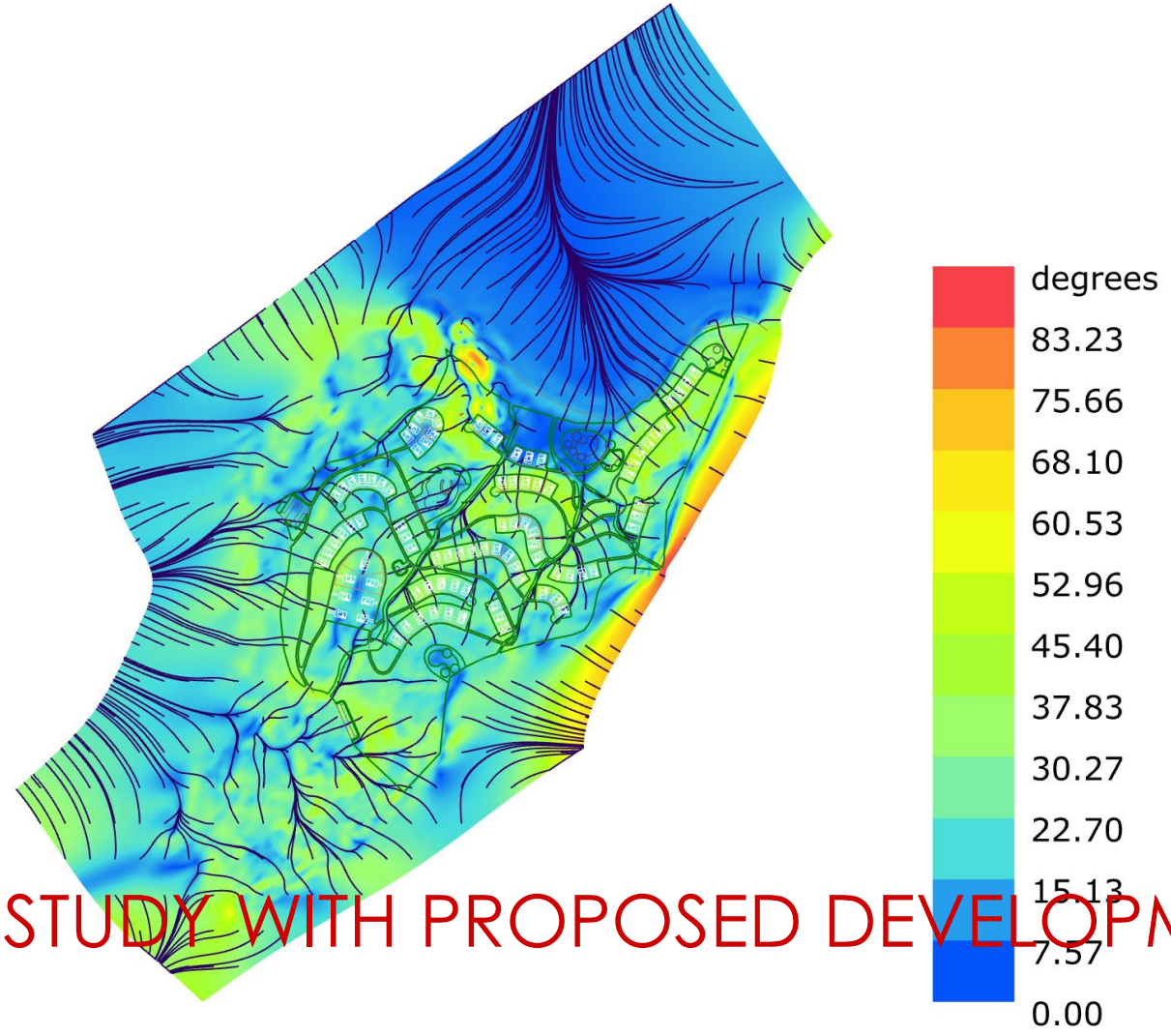
SLOPE ANALYSIS



ELEVATION PROFILE

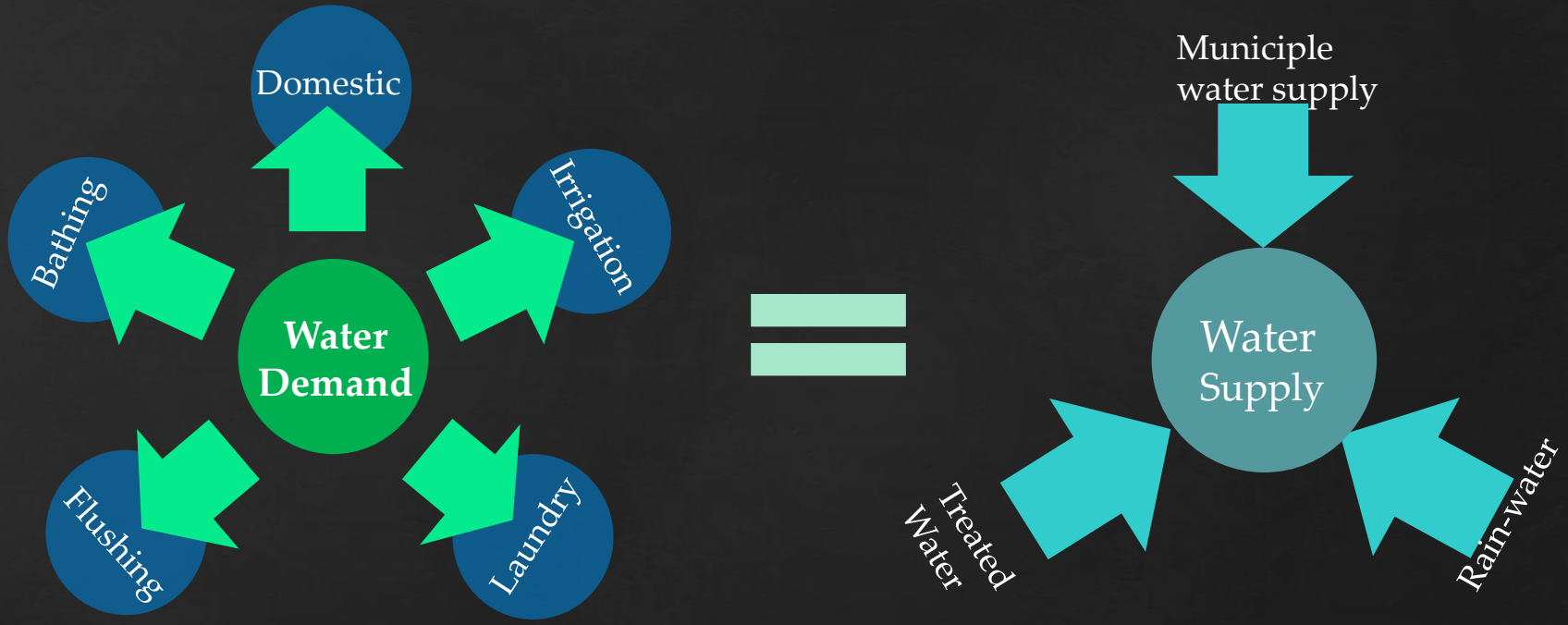


FLOW PATH STUDY



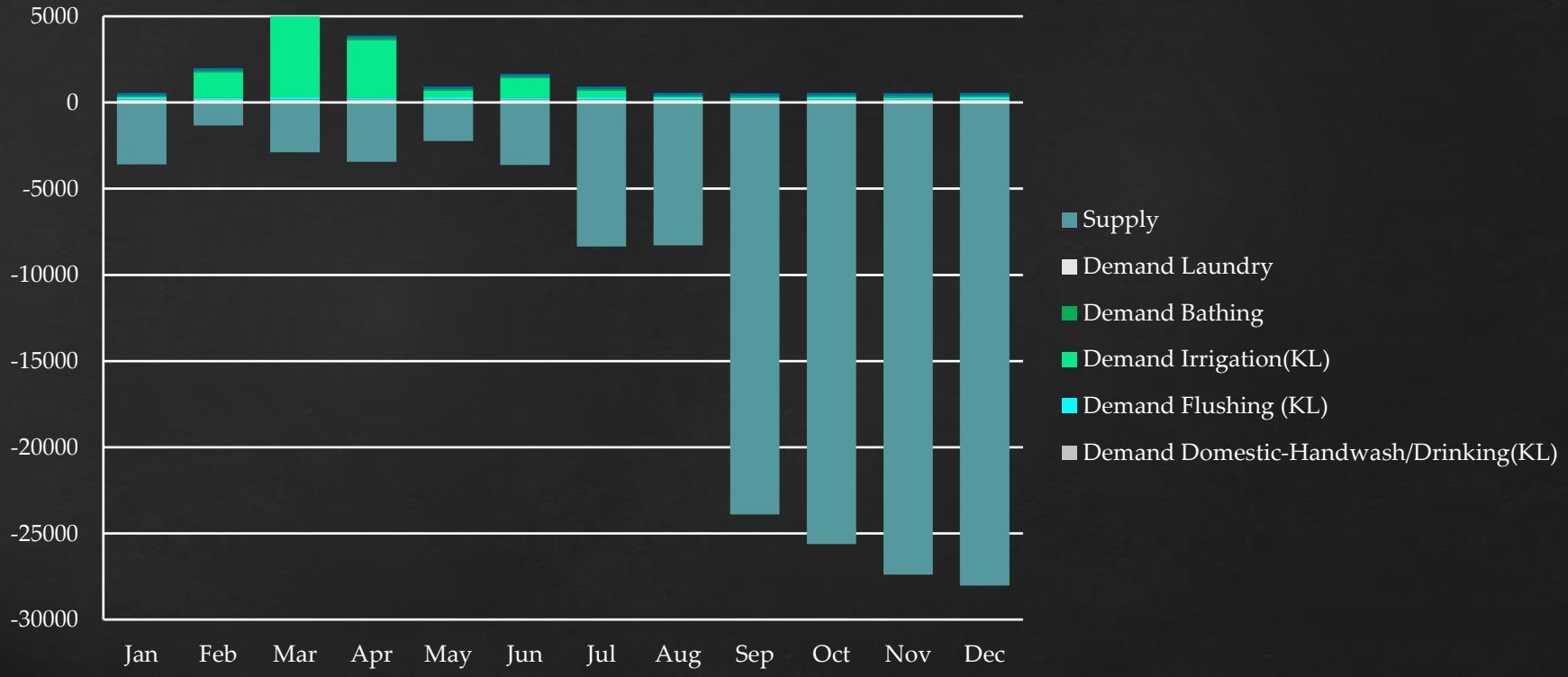
FLOW PATH STUDY WITH PROPOSED DEVELOPMENT

Net- Zero Water Property

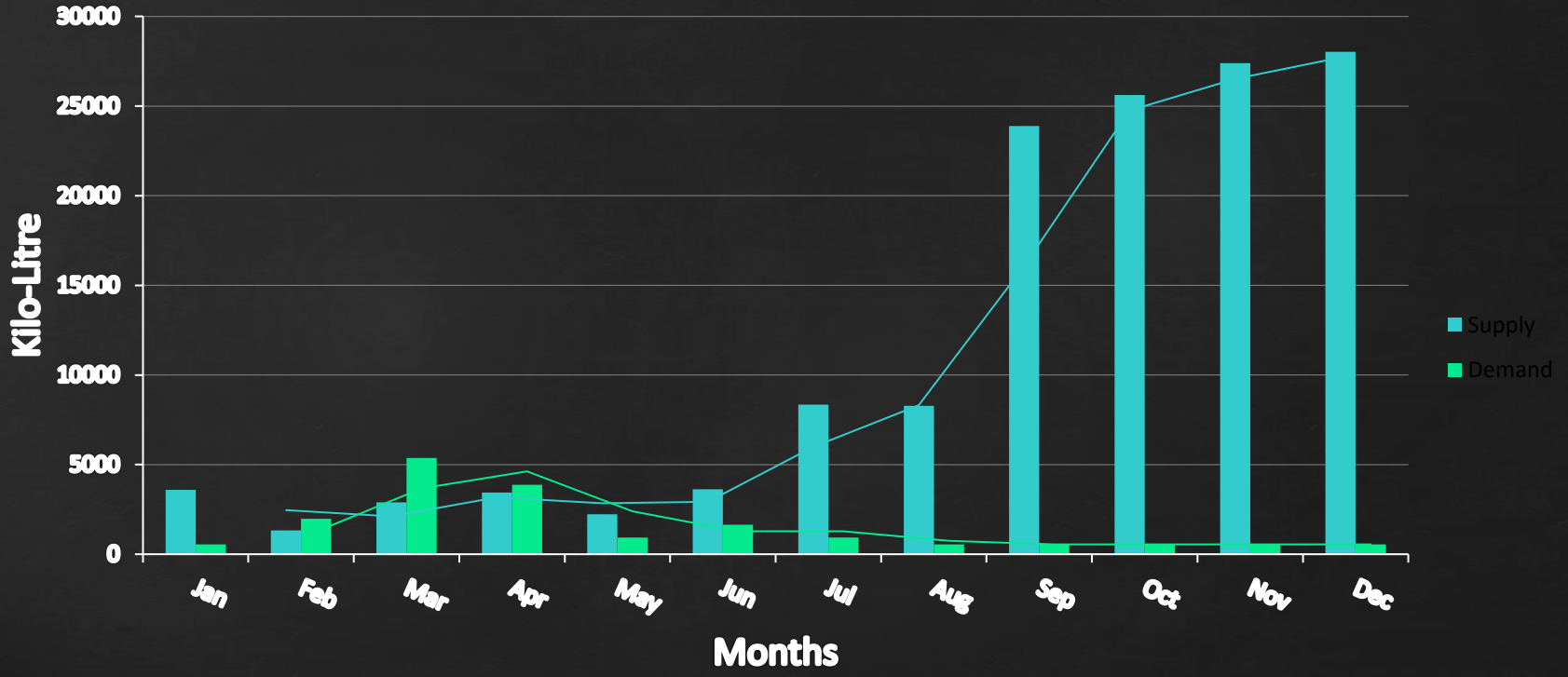


The aim of a net zero property is to reduce the burden on natural resources and to create a self sufficient building/property.

Monthly Water Balance



Monthly Water Demand v/s Supply



To cater the water demand during dry months, a rain water collection tank/pond of 7,500 Cu.m capacity needs to be provided.

THANK YOU

[