NZB.RGChan.
5.4 San Marino_JLL

Net Zero Building Design - Residential Study

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R.G.CHAN & ASSOCIATES
ARCHITECTS ENGINEERS ENVIRONMENTAL PLANNERS
888 City Camp Road Baguio City, 2600 Philippines

Undertaken by:

IAN JOHN L. LOLONG

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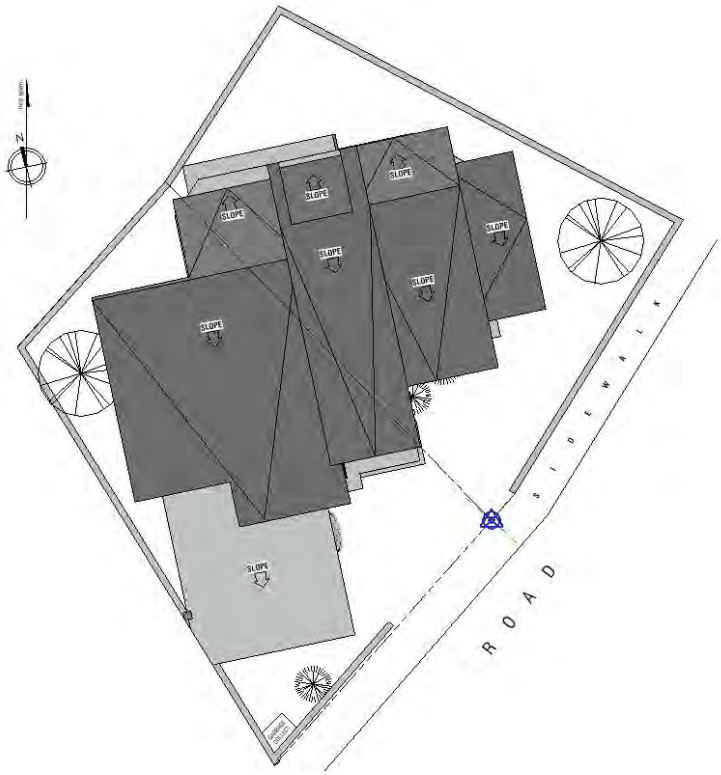
ABOUT THE SERIES

This pdf file-binding is part of the NZB.RGChan.Series on foundational researches undertaken by R.G.CHAN & Associates for in-house office use, towards systematic steps for Net Zero Building Design of projects.

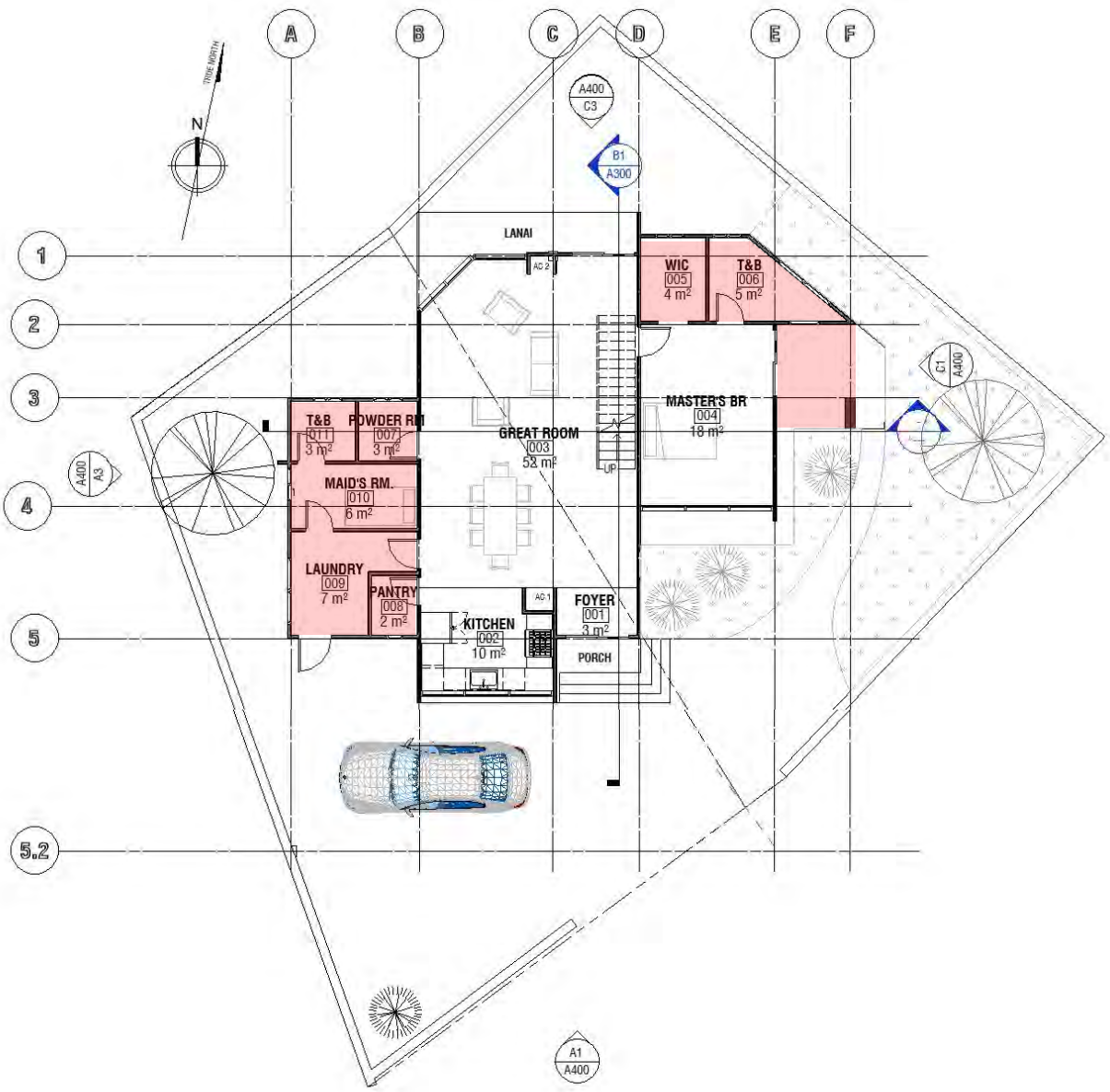
Site context

Project Information

Project Title:	**NZB1_San Marino**
Location:	**San Marino Subdivision, Bonuan, Dagupan, Pangasinan**
Latitude:	**16°03'38.6"N**
Longitude:	**120°20'33.2"E**
Elevation:	**5.00 m above sea level**

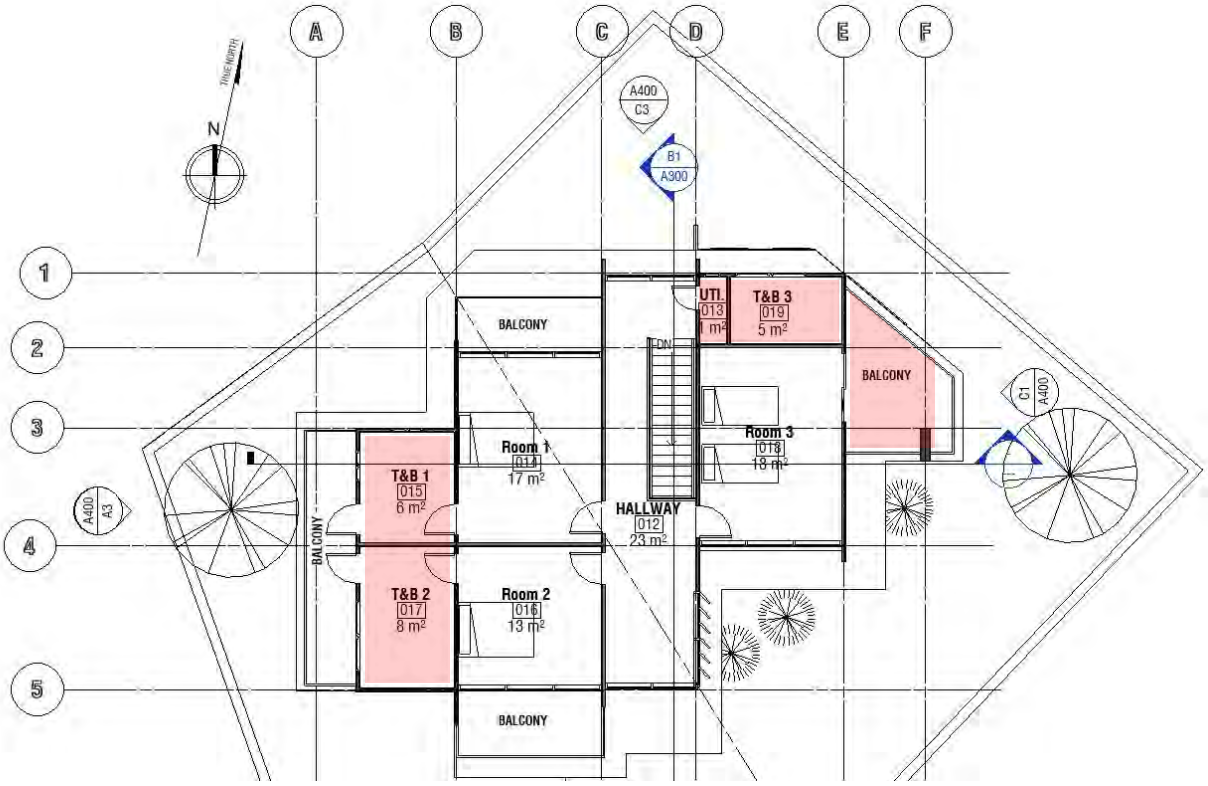


Floor plans



Ground Floor plan

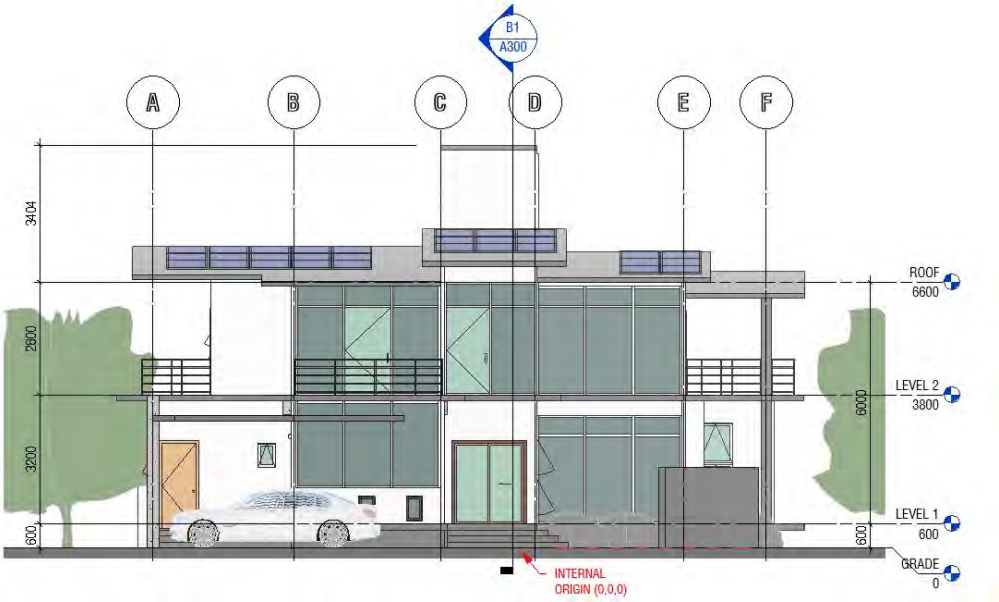
The areas shaded with red are **BUFFER ZONES** strategically located on the east and west side of the house to protect the air-conditioned spaces from direct solar gain. **OUTDOOR SPACES** like the Porches are located facing the sun and wind. Therefore, these strategies will reduce the cooling load and will significantly cut down energy consumption of centralized air-conditioning system.



Second Floor plan

Elevations

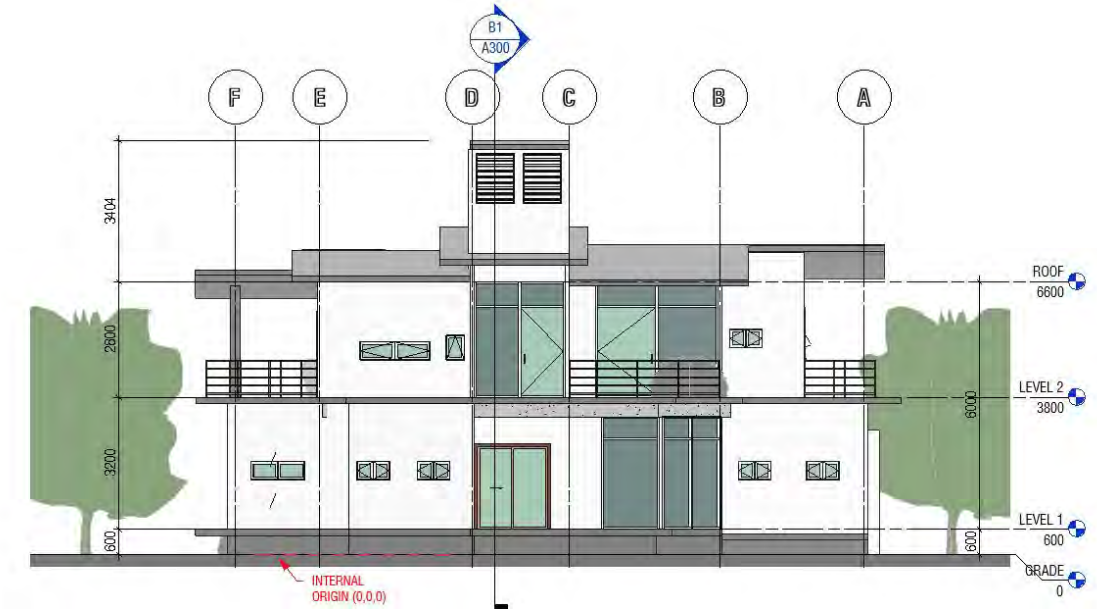
(Strategies affecting architectural forms)



North elevation

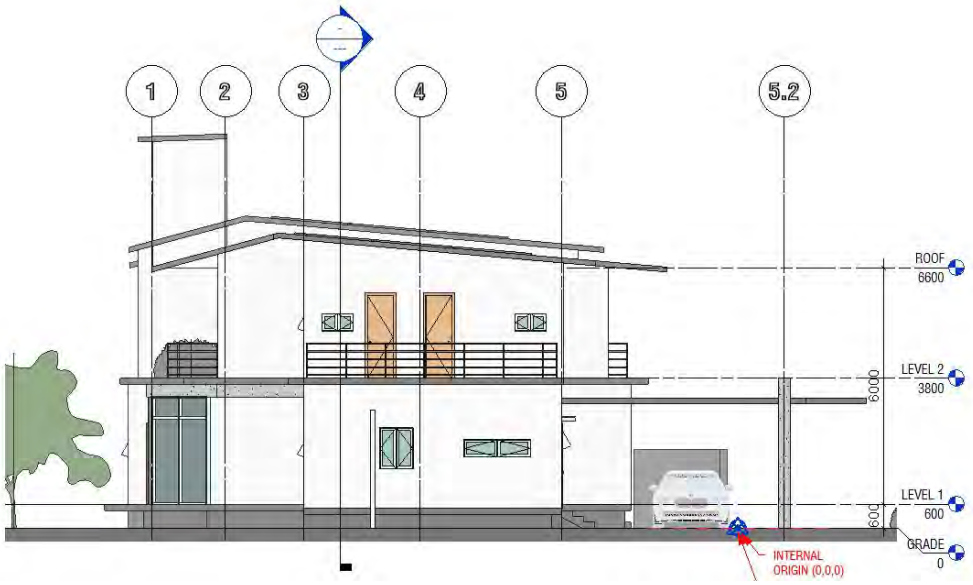
From the figure from the previous page, large openings are located south facing the prevailing winds and sun, thus implementing **ROOMS FACING SUN AND WIND.** From the east and west elevation**, LAYERS OF SHADE** are applied by creating multiple layers of roof and by extending the overhangs. The roof's slope is specifically designed to have 15-degree slope to match the recommended tilts of the Photovoltaic panels.

East elevation



South elevation

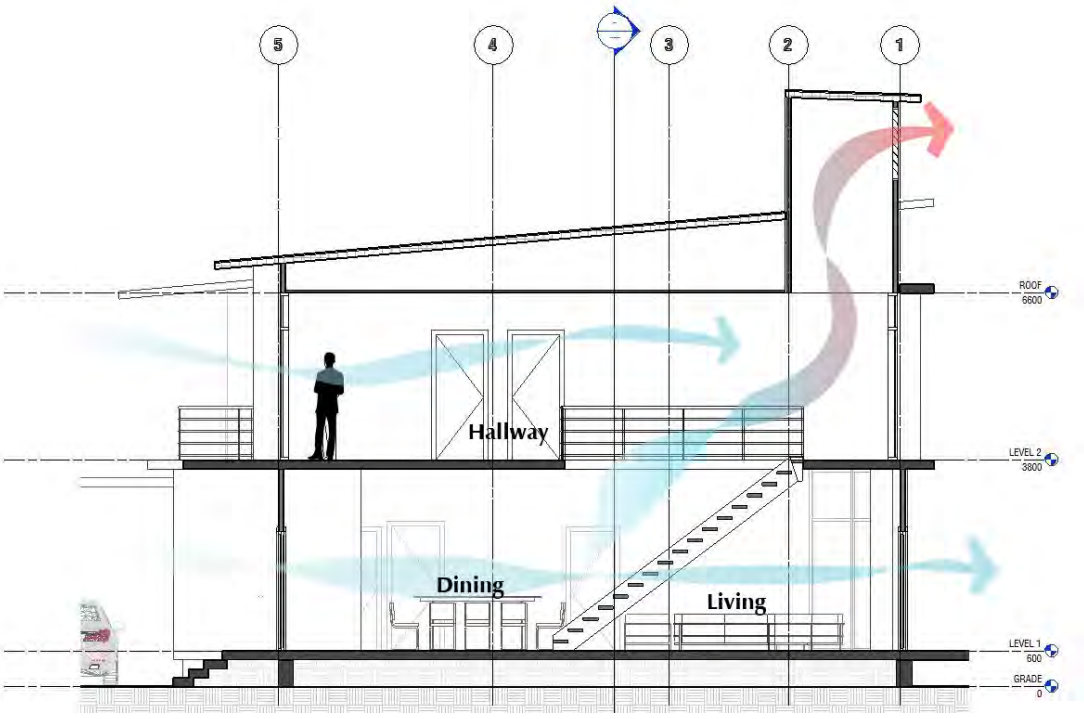
Stack vent tower air is discharged through storm-resistant retractable louvers.



West elevation

Section

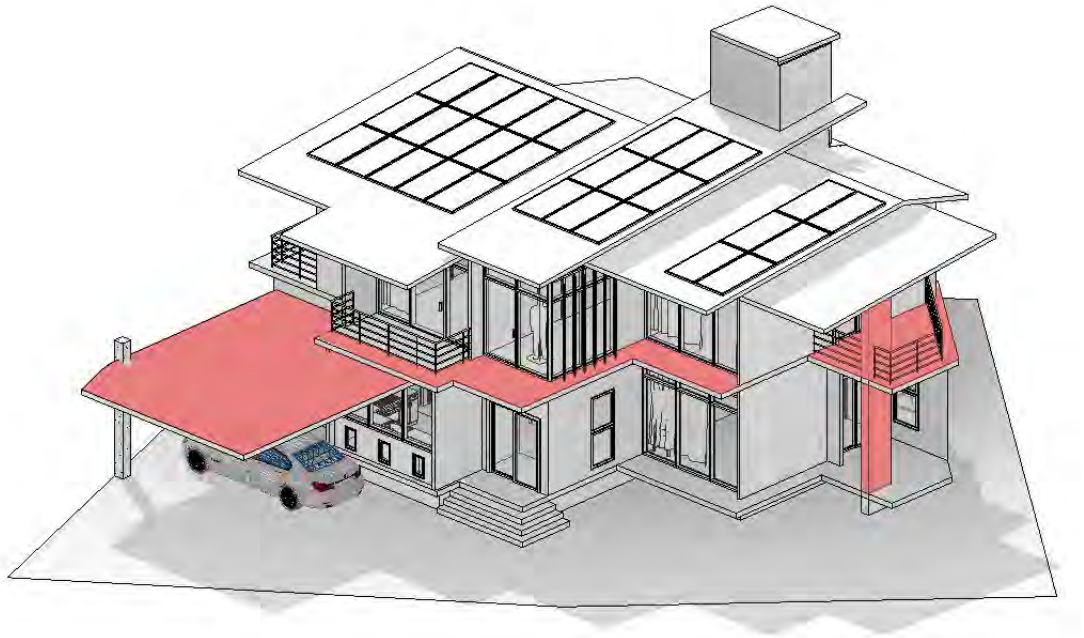
From the section below, strategies like **CROSS VENTILATION** and **STACK-VENTILATION** were emphasize by open sections and unrestricted pathways between the low inlets and high outlets.



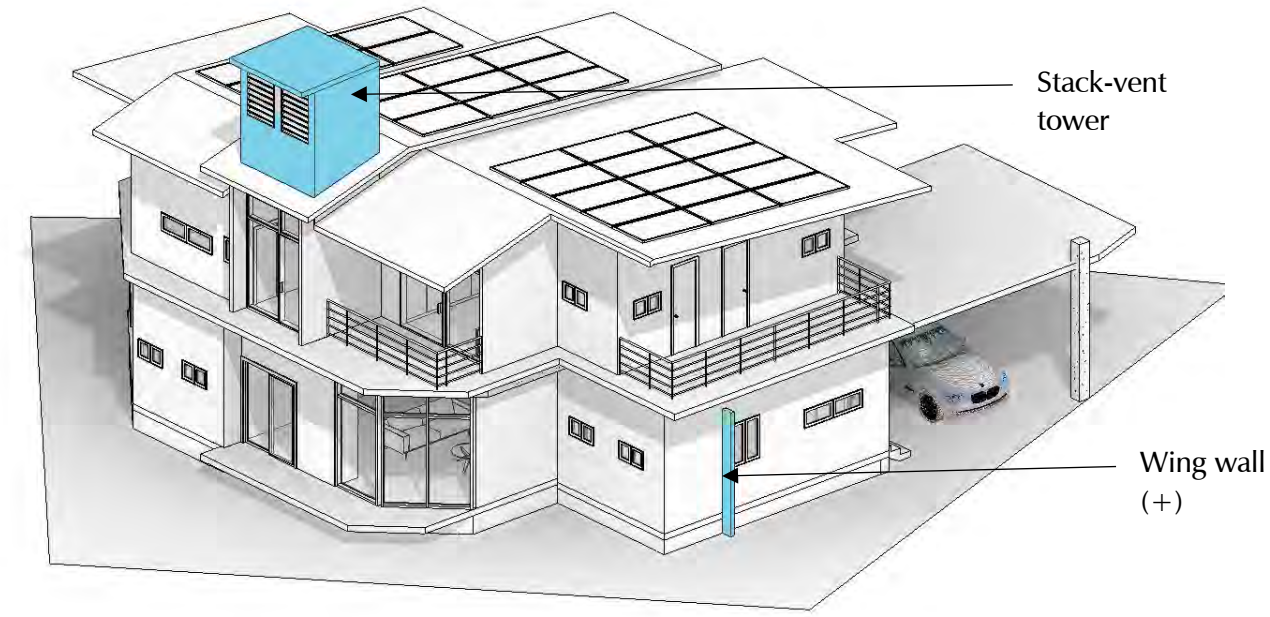
Section through stack vent tower

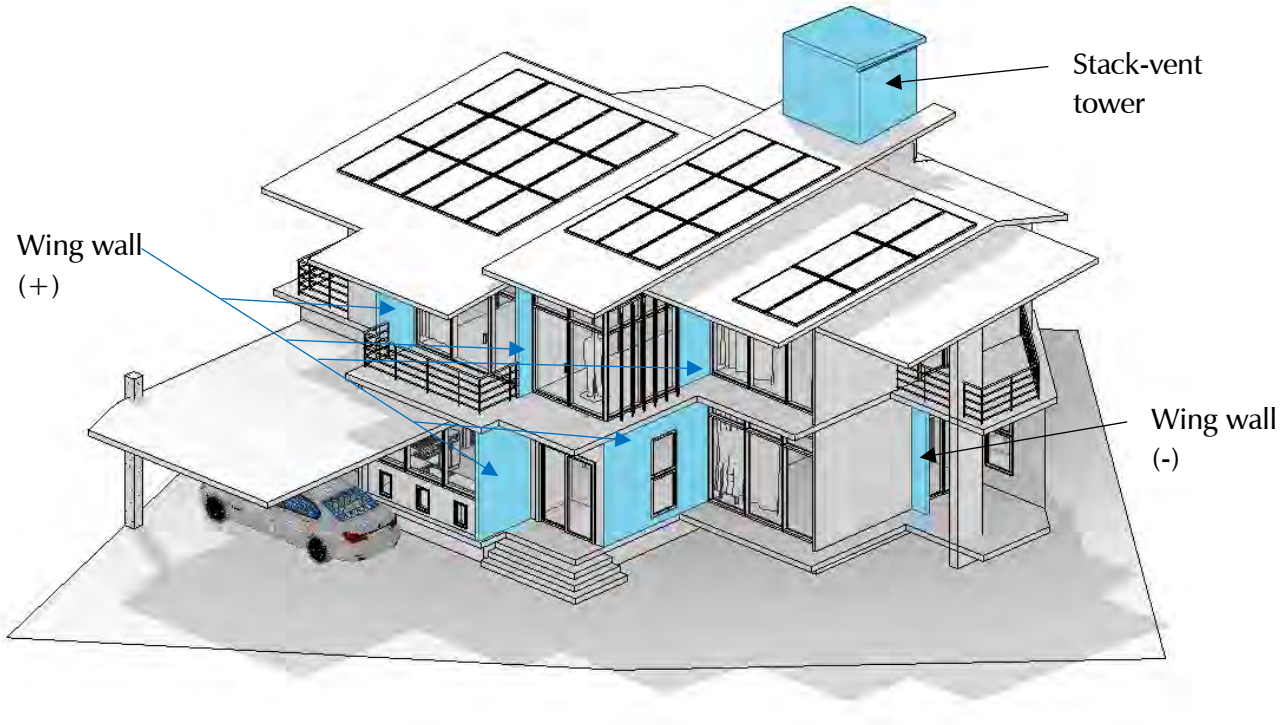
Architectural Features

Shading Devices



Ventilation devices

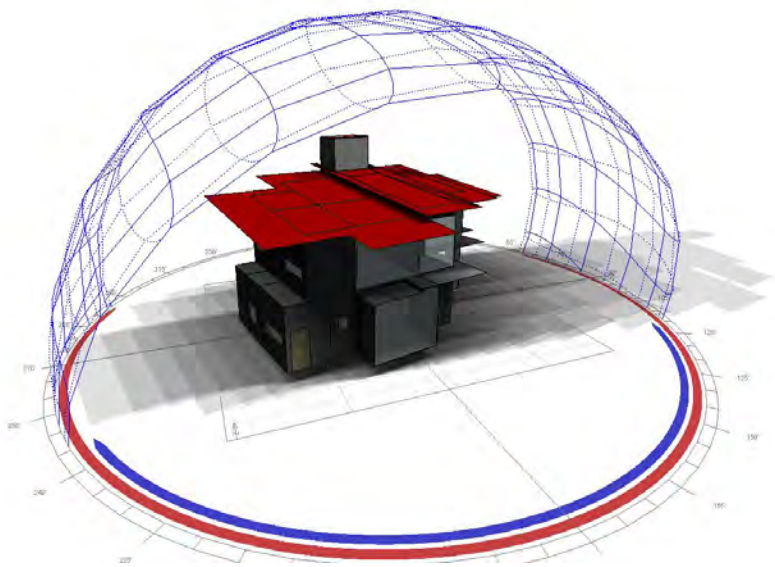




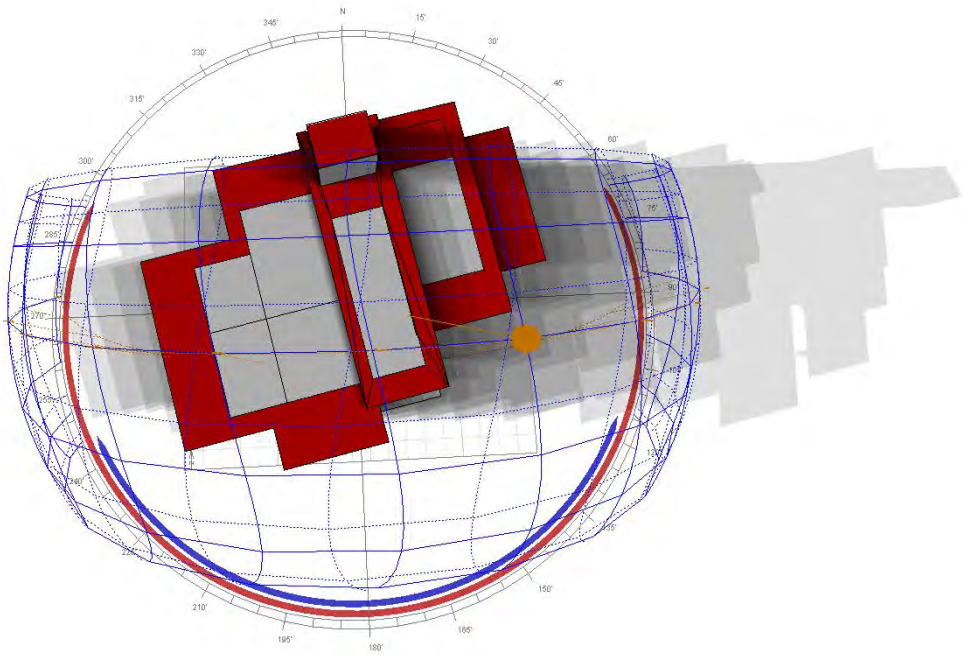
Pressures created by the wing walls are indicated by positive (+) for positive pressure and negative (-) for negative pressure

Ecotect analysis

Shades and shadow analysis

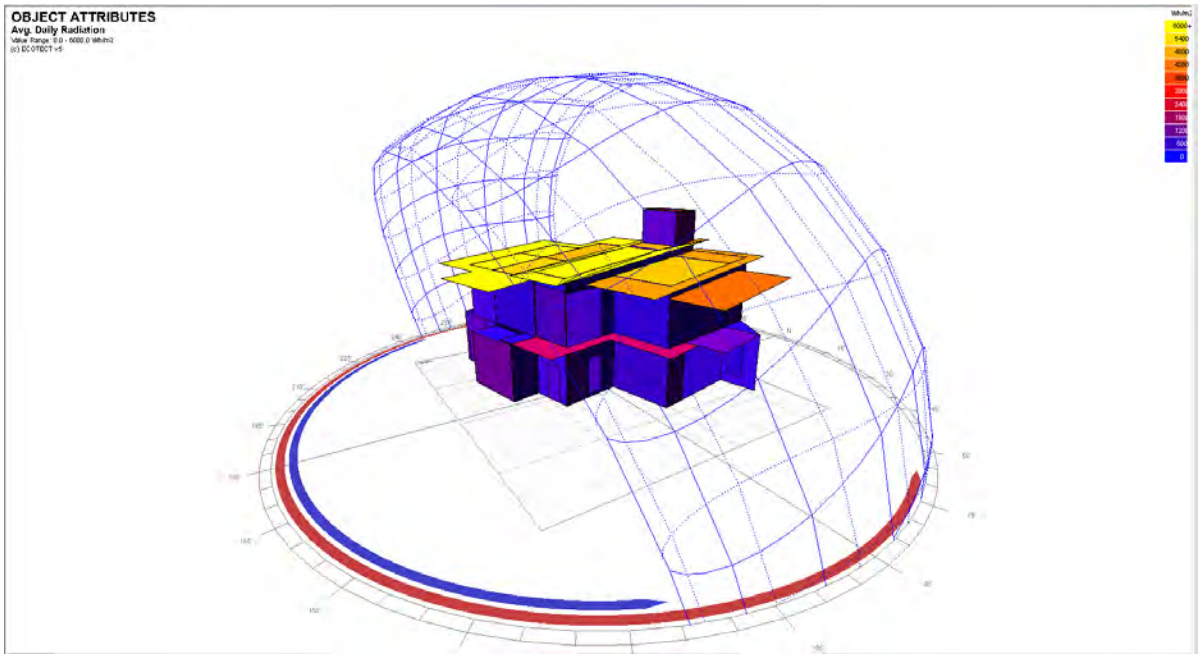


Shadow range and sun path

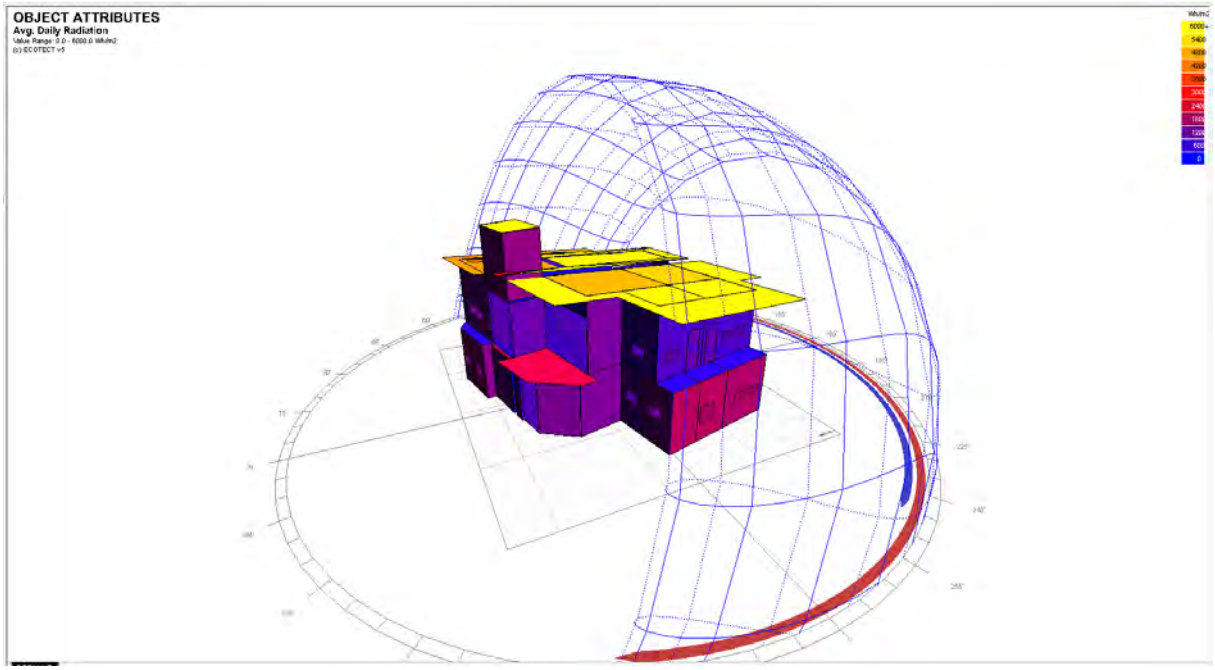


Plan view of shadow Range and sun path

Thermal analysis (average daily radiation)



From Southeast

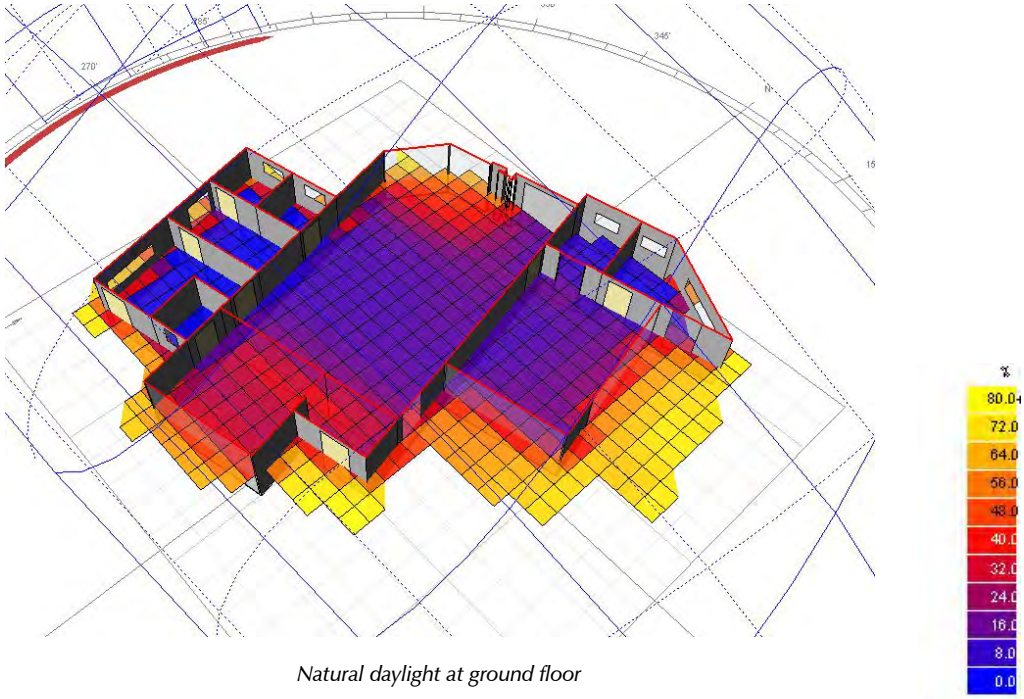


From Northwest

A balcony on the northwest side of the house shows undesired Thermal exposure. Therefore, the roof can be redesigned to protect this space or Natural shading can be employed.

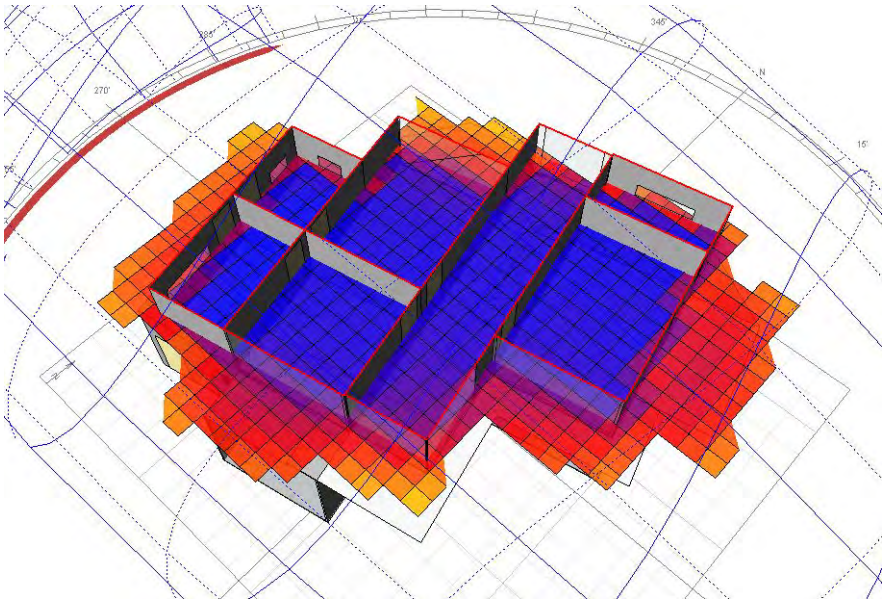
Lighting analysis

(Grid set at 850 from the floor; residential standard)



Natural daylight at ground floor

The ground floor lighting analysis shows that the design can utilized daylighting at the living and work areas.

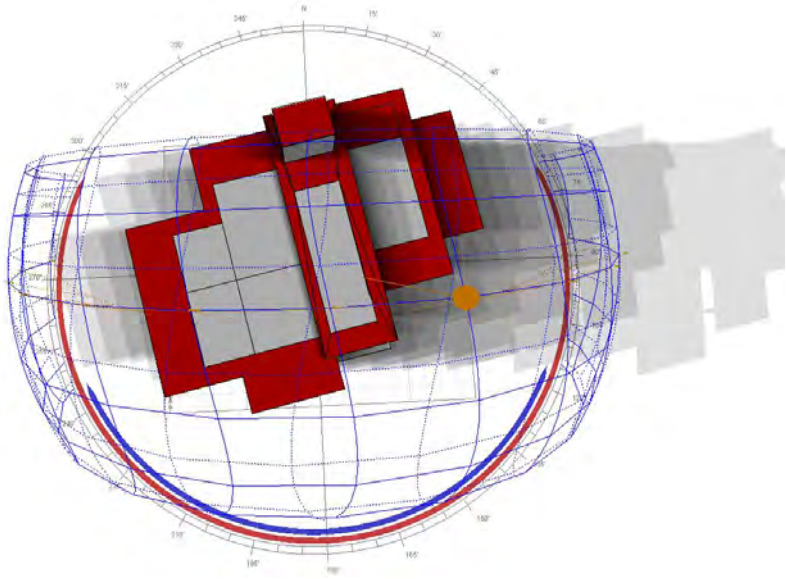


Natural daylight at second floor

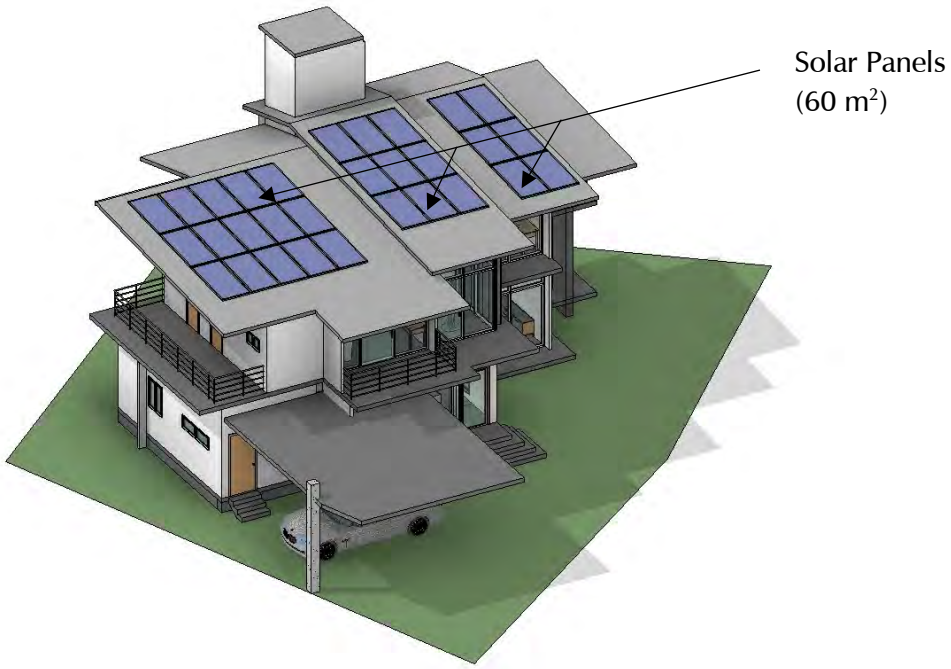
The analysis shows that the second floor will have to use artificial lighting even during the day.

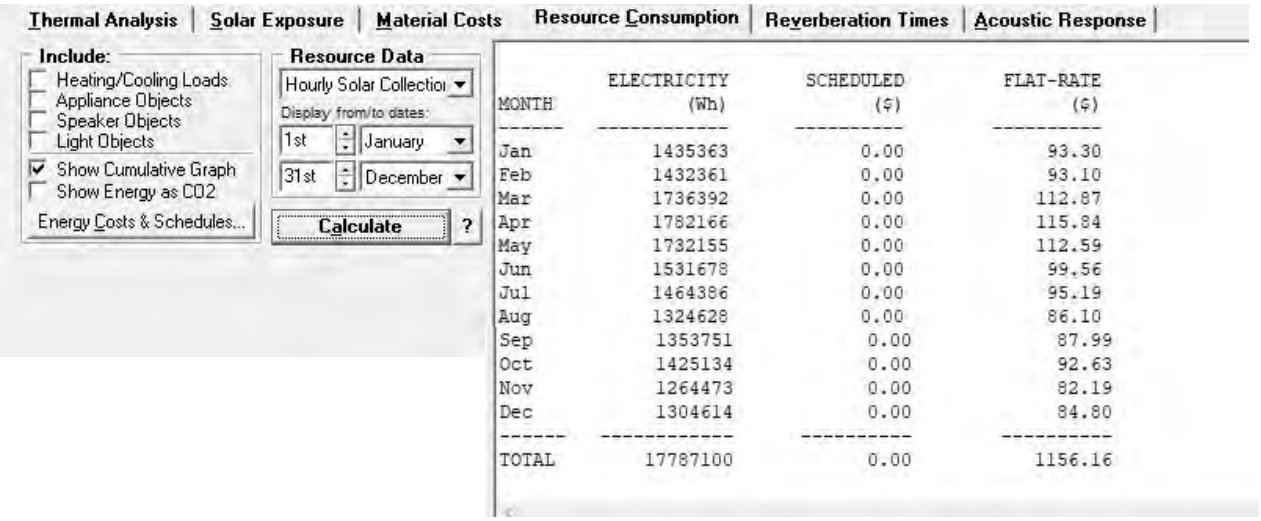
Photovoltaic panel projected collection

South facing roof were used as solar panels for Ecotect calculation thus obtaining 94 m^2 of PV panels. Solar panels are indicated as grey rectangles as shown in the figure below.



Material indicator for Ecotect





MONTH	ELECTRICITY (Wh)	SCHEDULED ($)	FLAT-RATE ($)
Jan	1435363	0.00	93.30
Feb	1432361	0.00	93.10
Mar	1736392	0.00	112.87
Apr	1782166	0.00	115.84
May	1732155	0.00	112.59
Jun	1531678	0.00	99.56
Jul	1464386	0.00	95.19
Aug	1324628	0.00	86.10
Sep	1353751	0.00	87.99
Oct	1425134	0.00	92.63
Nov	1264473	0.00	82.19
Dec	1304614	0.00	84.80
TOTAL	17787100	0.00	1156.16

Hourly Solar collection from January 1 to December 31

Based from the results, the projected electric generation of the proposed solar panels is 17,787 kWh. This value was proportioned with the actual area cover with solar panels at 60 m^2. Therefore the actual solar collection of the solar panels is 11,353 kWh. In comparison with the average annual power consumption of 3,905 kWh (365 days x 10.7 kWh) there should be an excess electric generation of 7,448 kWh.

Table. Difference in power generation vs. consumption.

Power Generation (kWh)	Power Consumption (kWh)	Difference (kWh)
11,353	3,905	7,448

Therefore, the house have the option to be off-the-grid. In addition, the excess power generation calls for additional electric storage equipment.

Conclusion

Designing a net-zero house in a tropical hot-humid climate is a straightforward process. Reducing the cooling load as much as possible through a series of strategies. Orientation plays the biggest part by locating areas that can tolerate temperature swings on east and west to protect the living areas. Unlike the common notion, north-facing openings is more prone to overheating than south facing openings. Incorporating stack-vent tower is more effective than cross-ventilation since it does not rely on the prevailing wind. Finally, solar power is abundantly available in the hot humid and must be utilized by investing on photovoltaic panels for electric generation.