ECBC COMPLIANCE ANALYSIS REPORT

PROJECT 3D IMAGE

Project : **PROPOSED HOSPITAL AT SIRASPUR**
Location : **NEW DELHI,INDIA**
Client :
Date : **22.11.2019**

INDEX:

Executive Summary:

This report has been prepared for **Proposed Hospital at Siraspur New Delhi, India**. This report is part of a process towards obtaining Environmental Clearance. The specific objective of this report is to evaluate annual energy usage and apply various energy efficiency measures for ECBC Compliance for maximum Energy Efficiency.

The building was analyzed using hourly energy simulation to evaluate the performance in terms of energy consumption and thermal comfort of the occupants. The purpose of this report is to present the performance of the design building in comparison to a baseline budget building based on ECBC 2017.

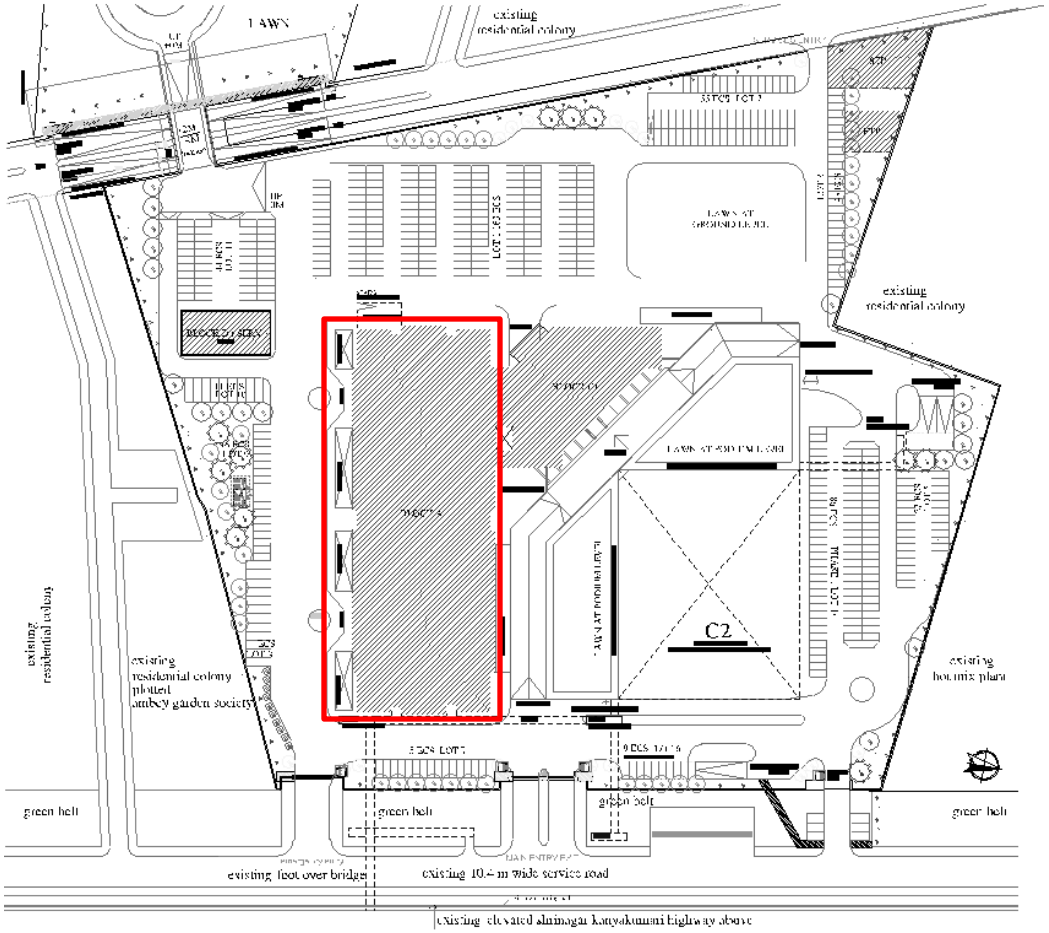
It is observed via various analysis tools that the buildings are properly shaded, equipped with efficient air-conditioning system. Following are the final outcome of energy simulation of the proposed buildings excluding parking areas.

	ECBC 2017	Proposed Case
EPI (kWh/sm/yr)	**694**	**653**
Energy Consumption (MWh)	**33,897.3**	**36,006.9**
Energy Saving	**6%**	

Project Description:

This report has been prepared for **Proposed Hospital at Siraspur New Delhi, India**. This report is part of a process towards obtaining Environmental Clearance from MOEF. The specific objective of this report is to evaluate annual energy usage and apply various energy efficiency measures for ECBC Compliance for maximum Energy Efficiency.

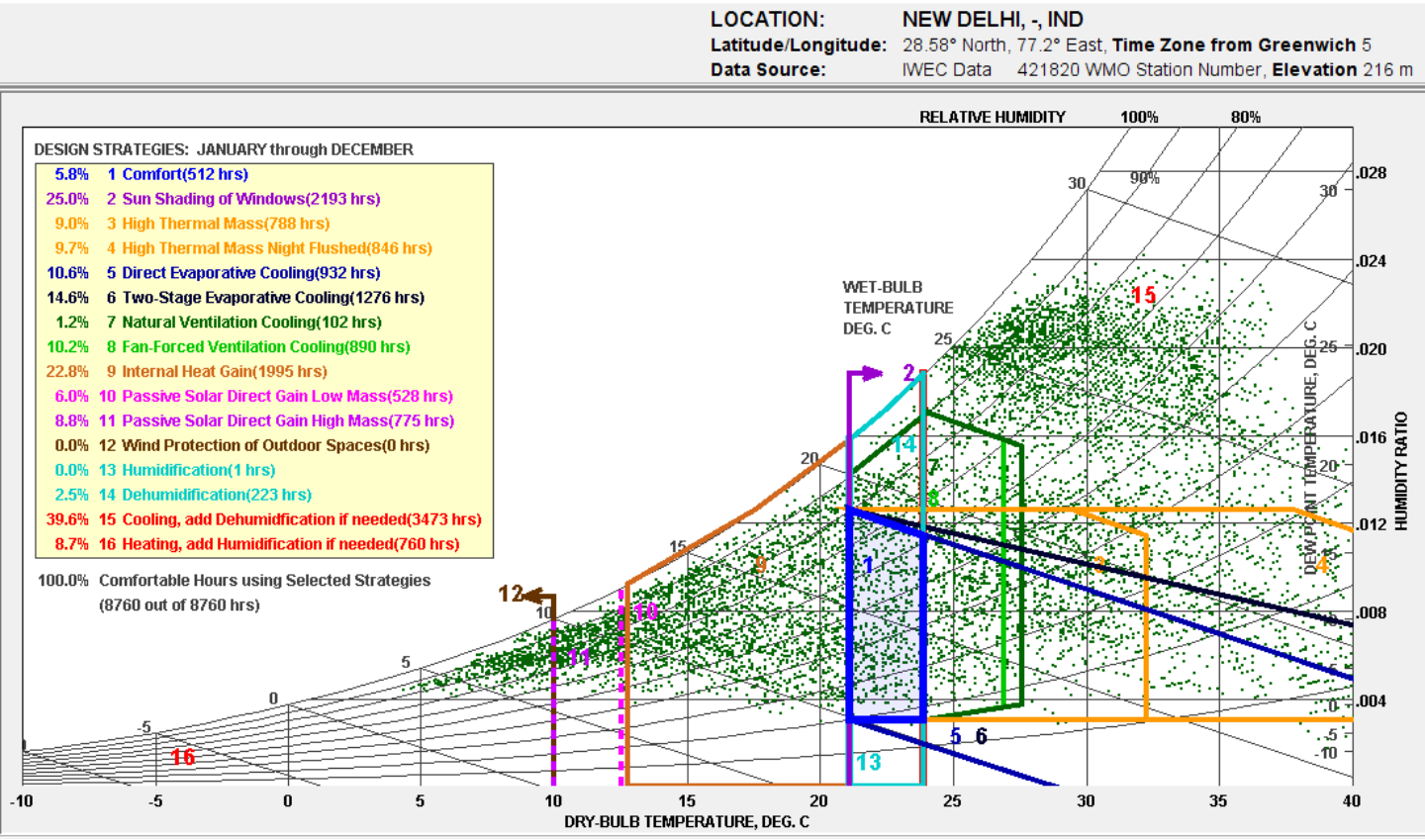
Site Layout



Project Details

• Total Site Area	6,682 sq.m. (approx.)
• Total Built-up Area	70,000 sq.m. (approx.)
• WWR	40 %

Climate Analysis:

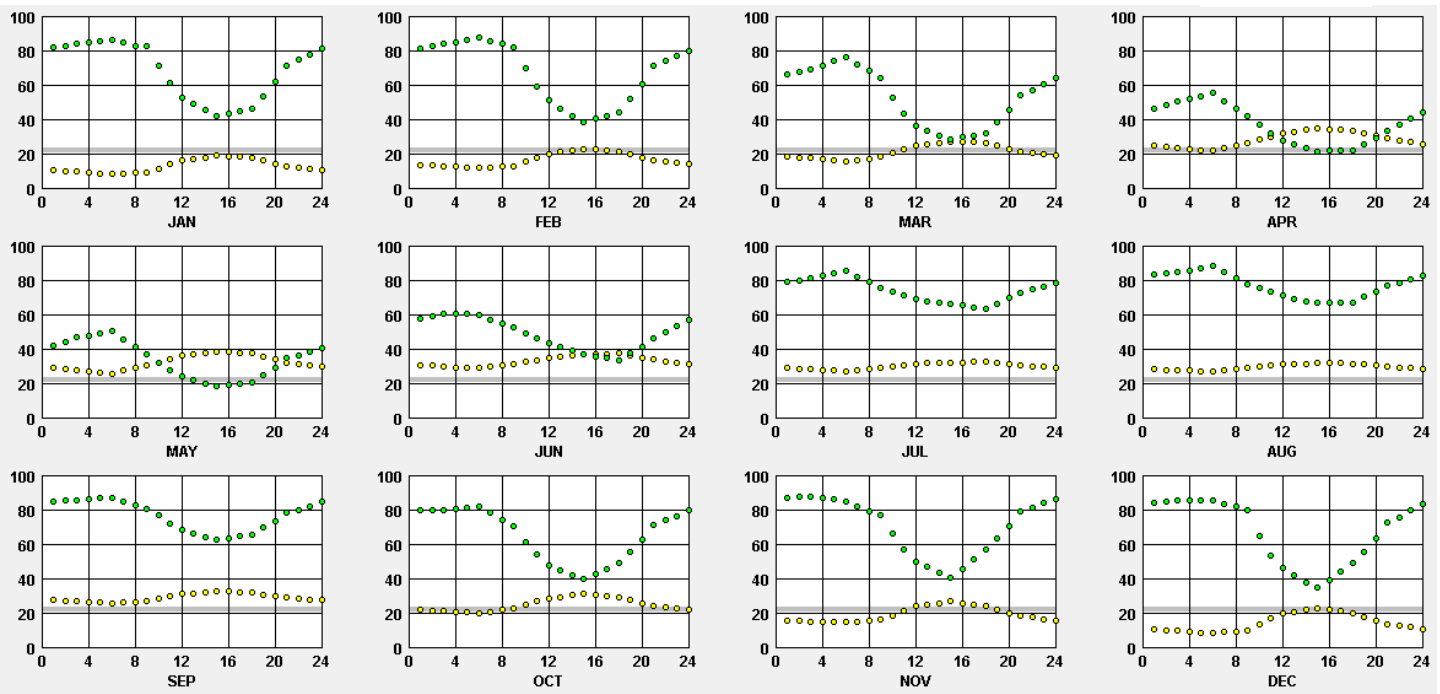


Psychrometric Chart above explains that, no other strategy is effective for passive comfort except Solar Shading & Natural Ventilation. Strategies like direct evaporative cooling, internal heat gain and High thermal mass are also effective, but for a lesser period. Around 25% of total comfort hours can be achieved by Sun Shading. Around 22% of total comfort hours can be achieved by Internal Heat Gain. Around 10% of total comfort hours can be achieved by Fan-Forced Ventilation. From all the above strategies around 50 % of total comfort hours can be achieved by Sun Shading, Internal Heat Gain and Fan-Forced Ventilation & for the rest 40% of the time air conditioning may be required. For this analysis, the Comfort Criterion was set at 20 to 26 degree C for dry bulb temperature & relative humidity to 70%.

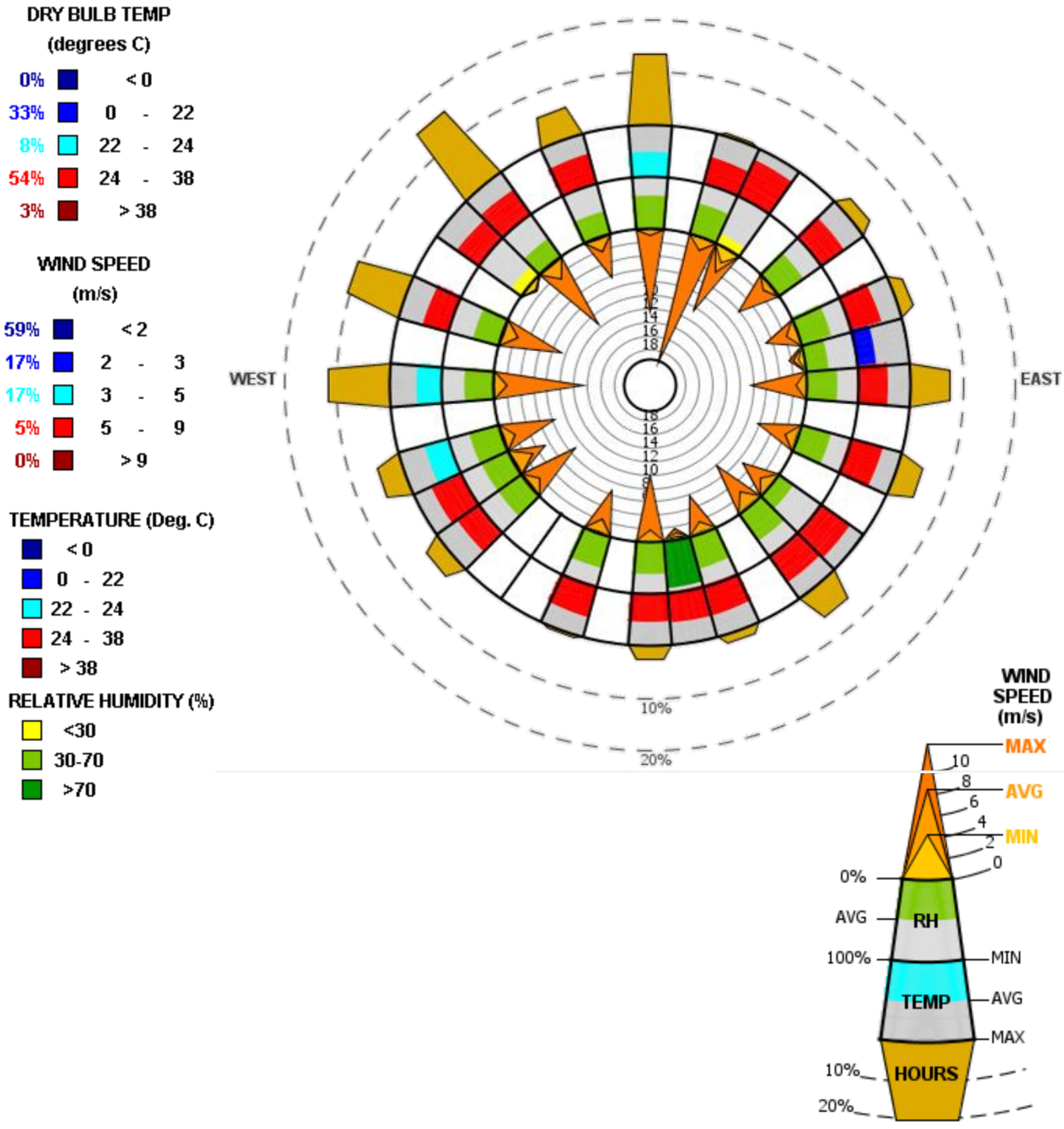
Climate Analysis:

The Psychrometric Chart above confirms that the four effective strategies are Shading, Ventilation, Internal heat gain and Evaporative cooling. The graph plot on next page shows the degree difference between the Dry Bulb Temperature & Relative Humidity. As per the legend, at least 30% of the total hours are in comfort range with an effective wind speed of 3 to 5 m/s. Fan forced ventilation is also an effective strategy during monsoon period.

Next is the annual wind pattern of New Delhi. The purpose is to understand this Wind Pattern. If you observe the legend carefully, you will understand that, 22% of the total annual wind is flowing from West direction, which has a temperature around 22 to 24 degree C, with a humidity around 70% & maximum wind speed is 6 m/s at one point of time. The predominant wind direction in Monsoon Period is west.



Climate Analysis:



Climate Analysis:

DRY BULB TEMP (degrees C)

0%		< 0
33%	0 -	22
8%	22 -	24
54%	24 -	38
3%		> 38

WIND SPEED (m/s)

59%		< 2
17%	2 -	3
17%	3 -	5
5%	5 -	9
0%		> 9

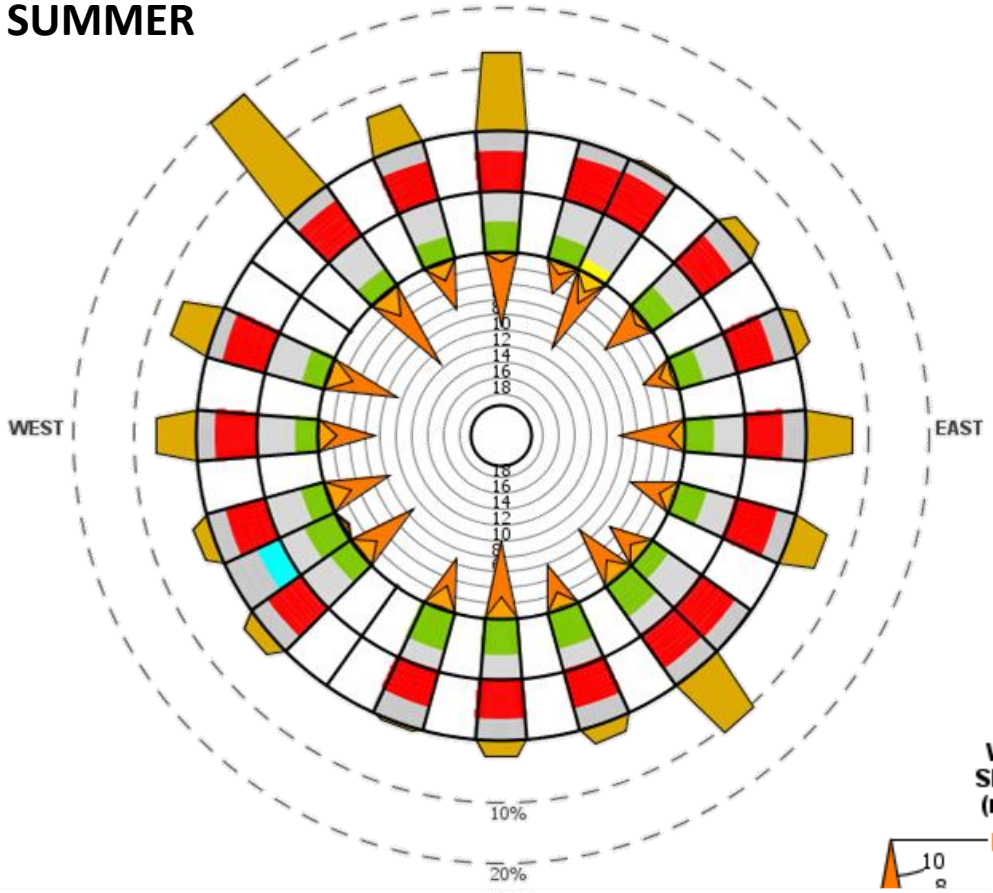
TEMPERATURE (Deg. C)

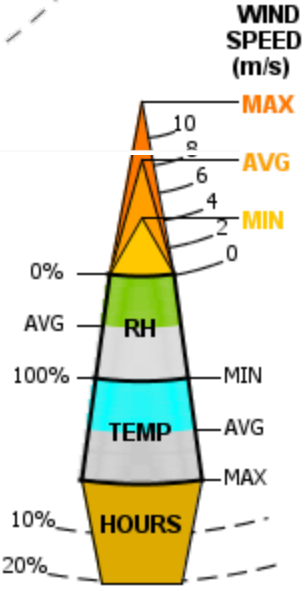
- < 0
- 0 - 22
- 22 - 24
- 24 - 38
- > 38

RELATIVE HUMIDITY (%)

- <30
- 30-70
- >70

SUMMER





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0%	> 9	

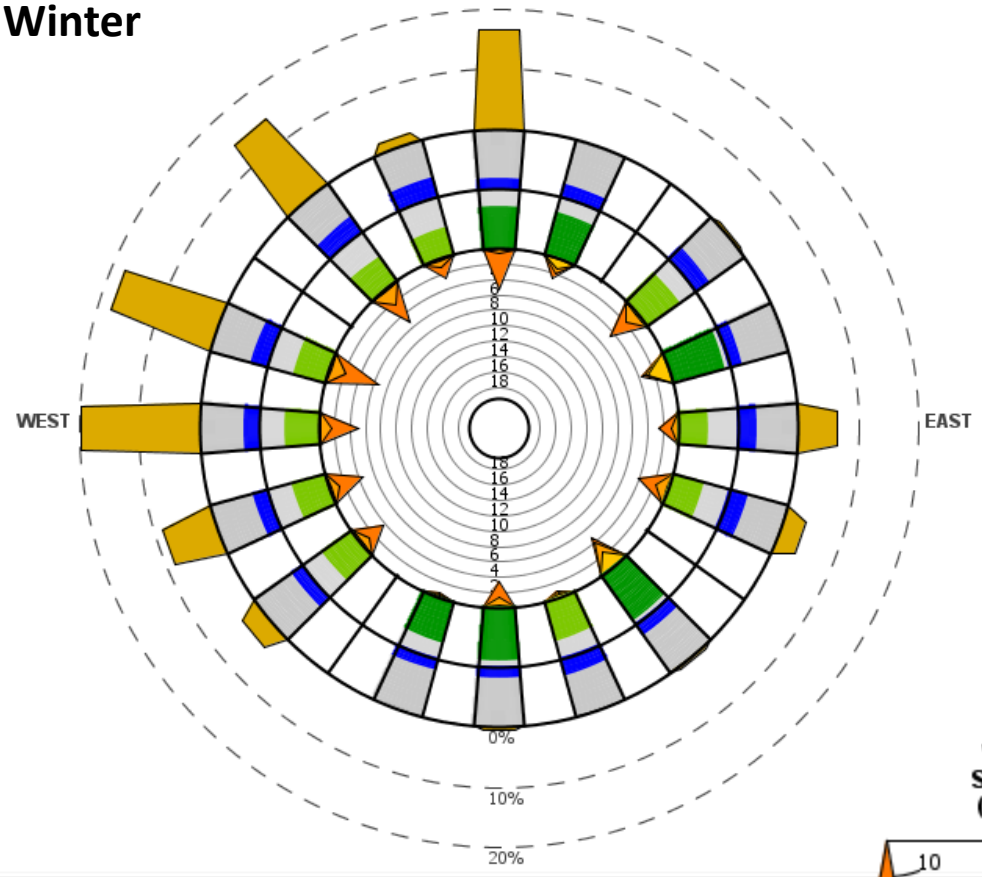
TEMPERATURE (Deg. C)

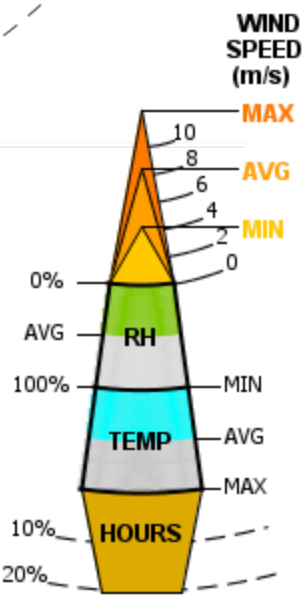
- < 0
- 0 - 22
- 22 - 24
- 24 - 38
- > 38

RELATIVE HUMIDITY (%)

- <30
- 30-70
- >70

Winter

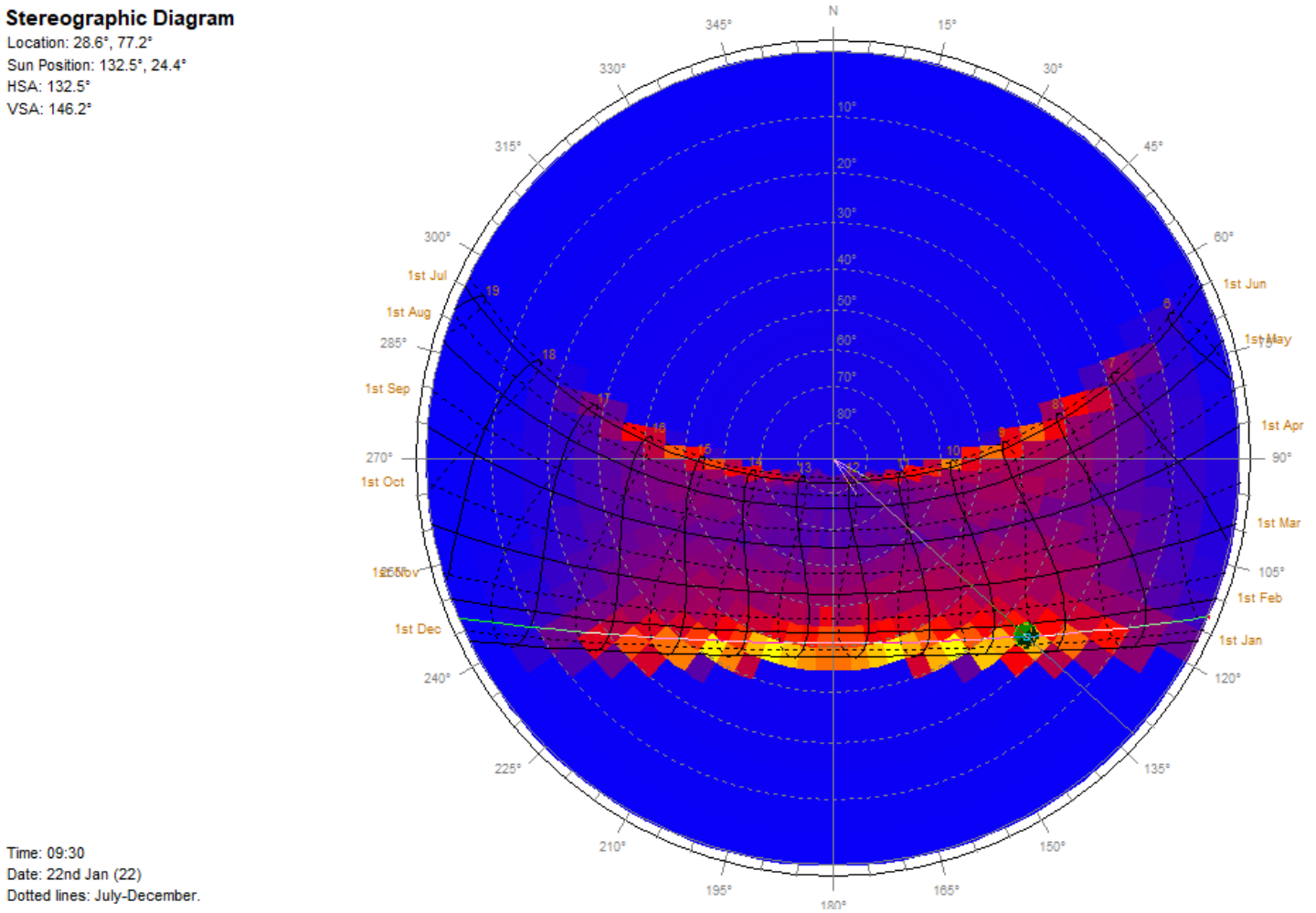




Analysis of Passive Strategies:

Mutual Shading Analysis

Mutual shading plays an important role in heat gain through envelope. Though envelope insulation has more contribution towards heat gain reduction, at the same time Mutual & Window Shading is also effective. The project team has provided the shading devices reducing insolation on walls & windows. The analysis confirms that proposed shading devices help to reduce incident radiation on envelope resulting in lesser heat load.



ECBC 2017 Compliance:

Building Envelope

Fenestration: The vertical fenestration of the project is labelled by manufacturer. The following value has been considered for the same

U Value: 2.7 W/m² deg.K.
SC : 0.38,
VLT:33%

Opaque Construction: The U-value of roof and wall assembly are calculated and provided in Appendix II.

Building Envelope Sealing: The project is air-conditioned and the building envelope sealing has been provided as per Annexure IV.

Comfort System And Controls

Ventilation: The project building is ventilated using an a mechanical system and outdoor air change rate has been designed as per NBC. CO sensors are installed into the basements.

Demand Control Ventilation: The project has many spaces served by air side economizer and/or automatic outdoor modulating control of outdoor air damper.

Minimum Space Conditioning Equipment Efficiencies: The space conditioning equipment meets minimum requirement of both COP and IPLV requirement under ANSI / AHRI 550 / 590 conditions. The chiller capacity of standard design and its efficiency have been mentioned in the next section.

Controls: The controls like timelock, temperature controls, occupancy controls, fan controls, dampers etc. have been provided in the project as and where applicable, as per ECBC 2017.

Piping & Ductwork: Piping for HAVC system will meet insulation requirement as per Table 5-8 in ECBC 20017. Wherever the insulation will be kept exposed to weather, it will be protected by either painted canvas or plastic cover.

System Balancing: The project has total conditioned area exceeding 500 sq.m. Air system balancing and hydronic system balacing will be perform to reduce difference losses.

Condensers: Condensers will be located to make heat sink free of interference from heat discharge by devices located in adjoining spaces, and not to interfere with other such systems installed nearby.

Service Water Heating: The project building will have water heating system to fulfill the demand of hot water.

Lighting And Controls

Automatic Controls: The project has interior lighting fittings for more than 300 sq.m., hence automatic controls have been provided. The project's built-up area is 51,878 sq.m., which is more than 20,000. However, Occupancy sensors have been suggested in habitable, non-habitable spaces like storage, public toilets, corridors, etc. as applicable.

Space Controls: Each enclosed space will have at least one control device to independently control the general lighting within the space.

Control in Daylight Areas: All the luminaires installed within daylighted area will be equipped with manual control device to shut off them.

Exit Signs: Internally illuminated exit signs will be less than 5 watts per face.

Electrical & Renewable Energy System

Transformers: The transformer will satisfy minimum acceptable efficiency at 50% and full load rating. Permissible total loss values will be within limit specify under this clause.

Recording of losses will be carried out by use of calibrated digital meters having minimum class 0.5 accuracy and certified by the manufacturer.

Voltage drop will not exceed 2% and 3% for feeders and branch circuit respectively.

Energy-efficient Motors: The pumps and motors will be used for water pumping and confirm to relevant IS standards. The efficiency of the motors is IE3 class and which meets the ECBC requirement.

DG Sets: The project will have BEE star rated DG sets in all compliant buildings. Total built-up area of the project is 51,878 sq.m. and the DG set will be of 3 BEE 3 star rating at minimum.

Check-Metering and Monitoring: The project will have permanently installed electrical metering to record demand (kVA), energy (kWh), and total power factor. The metering will also display current, voltage and total harmonic distortion (THD) as a percentage of total current.

PF Correction: The Power factor would be maintained in the project with the help of Automatic Power Factor Correction (APFC) system. The system is designed to maintain the power factor of 0.97.

Power Distribution Systems: The power cabling has been designed which limit distribution losses upto 3% of the total power usage.

Uninterruptible Power Supple (UPS): The power cabling has been designed which limit distribution losses upto 3% of the total power usage.

Renewable Energy Systems: The project has decided to install roof top solar PV anels of at least 1% of total demand load of the building. The area is free of any obstruction within its boundaries and shadows by objects adjacent to the zone.

Whole Building Performance Method:

Project: Proposed Hospital at Siraspur New Delhi, India

Zoning: A zoning plan was developed for each floor & entered into the simulation model. Each zone was assigned a set of properties including lighting power density, equipment power density, occupancy rate, outside air requirement etc. Each zone was also assigned physical properties of floor-to-floor height, material conductivity & fenestration area etc.

Modelling: A baseline building as per the properties stated in ECBC 2017 was modelled. The Building was simulated with actual orientation and again after rotating the entire Building by 90, 180 & 270 Degrees and then the annual energy consumption results were averaged out to get the ECBC 2017 Baseline Building Energy consumption in kilowatt hours. As per ECBC 2017, the average base case energy consumption does not consider the effect of building shades & overhangs.

A wide range of actual as-designed parameters such as Envelope (roofs, walls), Windows (type of window glass), Lighting (lighting power density), reduced Exterior Lighting, efficient system design were added to the Baseline case to simulate the performance of the designed building.

The project has been modelled with the Trace Trane 700 energy analysis software.

The project objective is to evaluate energy use and the energy efficiency performance of the Building.

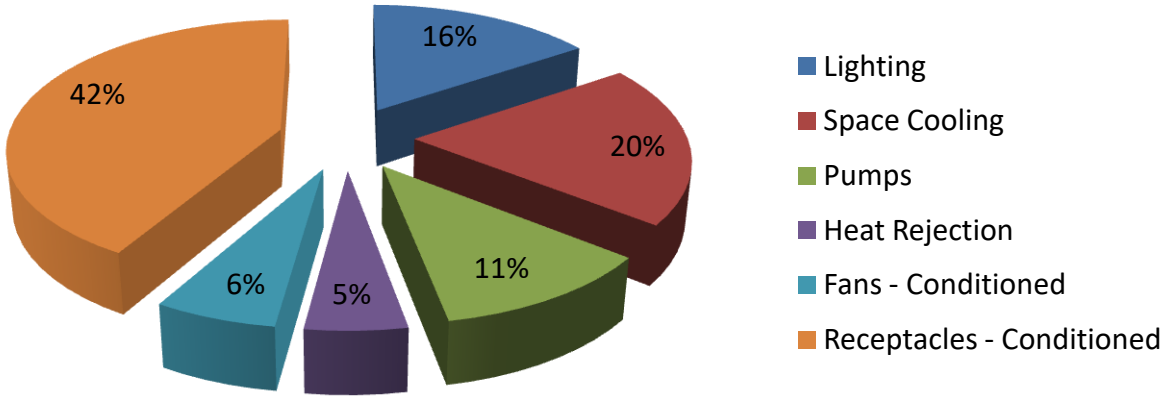
Detailed Comparison Between Base Case & Proposed Case:

Sr. No.	Model Input Parameter	Baseline Case as per ECBC 2017 Perimeters	Proposed Case
1	Exterior Wall Construction	U factor: 0.40 W/sm.K	300mm AAC Block U Value – 0.43 W/m² deg.K.
2	Roof Construction	U factor: 0.33 W/sm.K	6" RCC + 4" XPS insulation with High SRI paint, U Value - 0.33 W/m² deg.K.
3	Glazing	U factor: 3.00 W/sm.K SHGC: 0.27 Non-north 0.50 North	Double glazing unit, U Value: 2.7 W/m² deg.K. SC : 0.38, VLT:33%
4	WWR	40%	40%
5	Shading Devices	Not Considered	As per Design
6	Equ Power Density	As per design	As per design
7	Lighting Power Density	As per Building Area Method LPD: 9.7 W/sq.m. ASHRAE 91.1.2010	As per Building Area Method LPD: 7.76 W/sm ASHRAE 91.1.2010
8	Pumps & Motors	IE 2	IE 3
9	Occupancy Sensors	Recommended in Non-Regularly Occupied Areas	Provided in Non-Regularly Occupied Areas
10	Daylight Sensors	Recommended in building perimeter habitable Areas	Provided in building perimeter habitable Areas
11	Ext. Lighting Load	As per Annexure III	30% lesser than Annexure III
12	Domestic Hot Water	No Hot Water Requirement	Not Provided
13	Process Load	As per design	As per design
14	Renewable Energy	As per design	As per design
15	Data Server Loads	Not Applicable	UFAD System
16	Ventilation Requiremnt	10 CFM / person ASHRAE 62.1 2010	13 CFM / person ASHRAE 62.1 2010 + 30%
17	Chiller Parameter	Chilled Water with water cooled condenser, COP 5.8	WC Centrifugal Chiller System COP 6.1
18	VSD's on Chiller	Not Applicable	Applicable
19	VFD's on Cooling Tower	Not Applicable	Applicable
20	Primary, Fire, Condenser Pump	Standard – 70%	Premium – 75%

Sr. No.	Model Input Parameter	Baseline Case as per ECBC 2017 Perimeters	Proposed Case
21	Primary, Fire, Condenser Motor	Standard – 70%	Premium – 85%
22	HVAC System	VRF : Variable Refrigerant Flow	VRF : Variable Refrigerant Flow
23	VFD in AHU's & Secondary Pumps	Recommended	Considered
24	Demand Control Ventilation	Not Applicable	Not considered
25	Heat Recovery Wheel	Applicable for Hotel & Healthcare	Considered
26	Airside Economizer	Not Applicable for Warm Humid Climate	Considered
27	CO Sensors	Not Applicable	Considered
28	DG Set	BEE 3 Star Rated	BEE 3 Star Rated
29	PF Correction	0.97	0.97
30	Power Dist. Loss	< 3%	< 3%

BASELINE MODEL - AS PER ECBC 2017

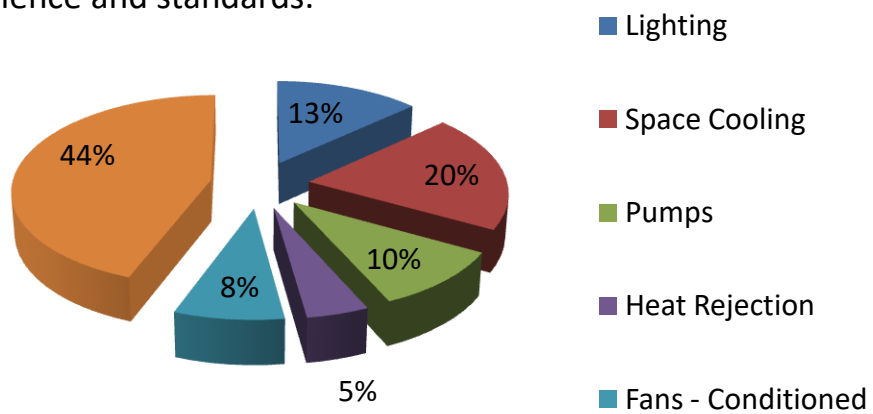
The ECBC 2017 Minimally Compliant Baseline model is used to benchmark the design case. This model geometry is based upon the design case, but the performance parameters listed below are defined to reflect the minimum efficiency levels that ECBC 2017 defines for various building components.



Based on the above parameters, the average base-case consumption 36,006.9 MWh and 694 kWh/sq.m./yr

PROPOSED CASE MODEL

Proposed case assumptions are based on project drawings and operating parameters assumptions based on experience and standards.



Based on the above parameters, the average proposed case consumption 33,897.3 MWh and 653 kWh/sq.m./yr

SUMMARY:

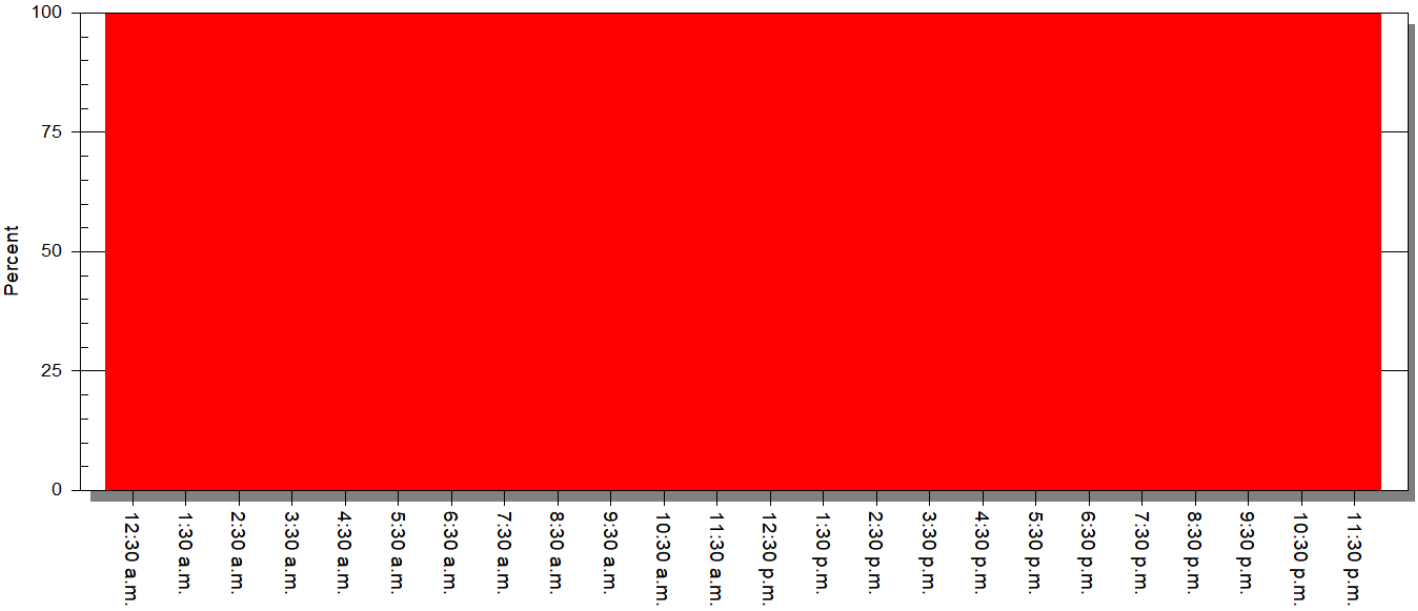
The Proposed case model shows significant savings in internal lighting as well as space cooling energy consumption as compared with the ECBC 2017 stipulated baseline model. These energy reductions can primarily be attributed to improved lighting power density and reduction in cooling loads due to improved envelope and glazing specifications.
For the purposes of determining energy savings in rupees, the energy costs for the proposed case model are compared to the energy costs for the ECBC 2017 minimally-compliant model.

Based on the final design considerations for building envelope and equipment, it is noted from the results of energy simulation that by using efficient envelope and lighting, the total per year energy required for the project - **Proposed Hospital at Siraspur New Delhi, India** are as under:

Proposed project	653	MWh
Base line - ECBC 2017	694	MWh
Saving over ECBC 2017 - MWh	**41**	**6%**
In addition to this, if we consider Solar PV generation, the saving will be increased further		

Appendix I: Schedules

Occupancy | Lighting | Equipment | HVAC
Available (100%)
Day type: Cooling Design Month: January - December



Appendix II: Building Sealing Requirement

Following areas of the building envelope, of all except naturally ventilated buildings or spaces, shall be sealed, caulked, gasketed, or weather-stripped:

a) Joints around fenestration, skylights, and door frames
b) Openings between walls and foundations, and between walls and roof, and wall panels
c) Openings at penetrations of utility services through roofs, walls, and floors
d) Site-built fenestration and doors
e) Building assemblies used as ducts or plenums
f) All other openings in the building envelope
g) Exhaust fans will be fitted with a sealing device such as a self-closing damper
h) Operable fenestration should be constructed to eliminate air leakages from fenestration frame and shutter frame