Energy Conservation Building Code Report

Of

Proposed Project – "Acme - Ozone"

At

Gut No. 61/1/1, 61/1/2, 3, 4 & 61/2/1,2,3

Village Chitalsar –Manpada,

Taluka & District - Thane

Proposed by

M/s. Acme Housing India Pvt Ltd

Prepared by

Enviro Policy Research India Pvt Ltd (EPRI)

607, Oriana Business Park,
Road No. 22, Wagle Estate
Thane (W) – 400 604, Maharashtra
Email: manager@eprindia.com;
Website: www.eprindia.com

TABLE OF CONTENTS

No.	Topic	Page No.
	Energy Conservation Building Code	
	Executive Summary	05
1.0	About the project	08
2.0	Energy Conservation Building Code (ECBC)	10
2.1	Purpose of Energy Conservation Building Code	11
2.2	Scope of Energy Conservation Building Code	11
2.3	Energy Efficiency Performance Levels	11
3.0	ECBC Compliance – General	12
3.1	Energy Performance Index (EPI) and Ratio	12
3.2	Mandatory Requirement	13
3.2.1	Building Envelope	14
3.2.2	Ventilation	61
3.2.3	Lighting and Control Systems	64
3.2.4	Electrical and Renewable Energy Systems	64
3.3	Energy Savings Calculations and Measures Proposed	65
4.0	Conclusion & Recommendations	71

LIST OF TABLES

No.	Topic	Page No.
ES1	Parameters complied for proposed project to be ECBC Compliant	05
ES2	Overall Energy Savings from Project	07
1.1	Project Buildings	10
1.2	Estimation for Thermal Transmittance (Uroof)	18
1.3	SHGC value for proposed project	21
1.4	Percentage of total daylight area in Building meeting UDI requirement in proposed project	23
1.5	Glazing factors to be achieved	27
1.6	Glazing achieved for different rooms	28
1.7	Window Wall ratio for Proposed Buildings	42

1.8	Actual window open area	44
1.9	Building Envelope Properties	61
1.10	Details of Energy savings calculation for proposed buildings	66
1.11	Details of Energy savings measures for proposed buildings	68
1.12	Overall Energy Savings from Project	70
1.13	Types of windows can be proposed for flats	72

LIST OF FIGURES

No.	*Topic*	*Page No.*
1.1	Location of proposed project	08
1.2	Climate Zone Map of India	09
1.3	Layout plan of proposed project	09
1.4	First floor plan of Eucalyptia building	15
1.5	Typical floor plan of Eucalyptia building	15
1.6	Refuge floor plan of Eucalyptia building	15
1.7	First floor plan of Fenelia building	16
1.8	Typical floor plan of Fenelia building	16
1.9	Refuge floor plan of Fenelia building	16
1.10	Thermal comfort assessment for Typical floor plan of Eucalyptia building	19
1.11	Thermal comfort assessment for Typical floor plan of Fenelia building	20
1.12	Sections of buildings showing 70^0 angle	24
1.13	Indoor Daylight assessment for Typical floor plan of Eucalyptia building	25
1.14	Indoor Daylight assessment for Typical floor plan of Fenelia building	26
1.15	Indoor Ventilation Assessment (m/s) for Typical floor plan of Eucalyptia building	62

1.16 Indoor Ventilation Assessment (m/s) for typical floor plan of Fenelia building 63

EXECUTIVE SUMMARY

The proposed project is located on Gut No. 61/1/1, 61/1/2, 3, 4 & 61/2/1, 2, 3 Village Chitalsar –Manpada, Taluka & District – Thane. This project lies in the Warm and Humid climate of the Country.

The proposed project complies with the points mentioned in ECBC Guidelines 2017 and follows prescriptive method to be compliant. **Table ES1** gives a gist of points complied by proposed project to be ECBC Compliant.

Table ES1 : Parameters complied for proposed project to be ECBC ccompliant

Criteria	ECBC Requirement	Provided by Project Proponent
U factor	≤ 3.0 W/m2.K	2 W/m2.K
VLT	≥ 0.27	0.53 (AIS Ecosense Enhance -Aura Clear Glass will be provided)
WWR	≤ 40 %	Eucalyptia Building - 11.93% Fenelia Building - 14.35 %
UDI %	Minimum 50 % For Residential	Eucalyptia Building - 74.68 % Fenelia Building - 85.59 %
SHGC	≤ 0.50	Eucalyptia Building - 0.077 Fenelia Building - 0.077
EPI Ratio	1	1
Natural Ventilation	Natural Ventilation should follow the wind speed norms mentioned in NBC 2016 for indoor ventilation	Proposed Buildings are naturally ventilated and wind speed for indoor ventilation falls in the range prescribed by NBC 2016
Ceiling FAN	3 star BEE Rating Ceiling Fans should be used	3 star BEE Rating Ceiling Fans are proposed
Air Conditioners	3 star BEE Rating ACs should be used	3 star BEE Rating ACs are proposed
Lighting and Control Systems	Lighting controls occupancy sensors should be provided	Occupancy sensors/Motion sensors are proposed in all public and shared spaces

Criteria	ECBC Requirement	Provided by Project Proponent
	Space control for lighting should be provided	Space controls are proposed lighting in common / shared areas.
	Exterior lighting to be controlled by photo sensor or time switch.	External lighting will be switched on / off by photo sensors.
	Interior lighting power to be within specified limits.	For all spaces where lighting is provided by the developers LPD will be within specified limits
	Exterior lighting power to be within specified limits	LPD for exterior lighting will be as specified.
Energy Efficient Motors	Energy efficient motors should be provided which will aid in reducing energy consumption	All motors of HVAC / PHE systems will have nominal full load efficiency as per IS 12615 and aid in saving 10% energy consumption
Check Metering	Check metering system should be provided and separate check metering system should be given for tenants if any	Check meters will be provided on all major consumption centers such as HVAC, PHE, Lifts, Firefighting etc.. For tenants a common location will be selected and check metering system will be made available for every tenant.
Power Factor	Power factor to be maintained between 0.95 and unity	PF will be maintained above 0.95
Power Distribution System	Power distribution system	Systems will be designed to limit the losses less than 1%
Renewable Energy	Renewable energy should be used and it should be 1 % of total load	Solar energy is proposed and it will be used for external and landscape lighting along with solar water heater. The total energy savings from proposed project using renewable energy is 17.07 %

Table ES 2: Overall energy savings from project

Overall Project Savings	Overall Energy Savings Using Energy Efficient Equipment's and Renewable Energy
21.23 %	17.07 %

1.0 About the Project:

The proposed project is a development of residential project at Gut. No. 61/1/1, Gut. No. 61/1/2, 3, 4, 61/2/1, 2, 3 village Chitalsar -Manpada, Taluka& District Thane. The Thane is nearby Mumbai and the climate of Mumbai is warm and humid. For proposed project to be ECBC compliant, the climate is taken into consideration. The detail location is shown in **Figure 1.1.**

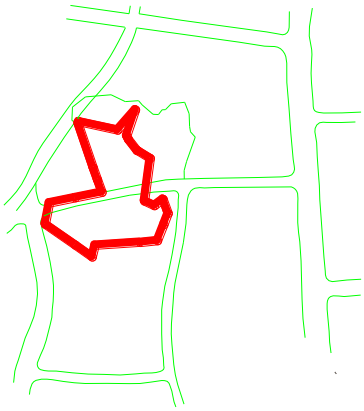




Figure 1.1: Location of the proposed project

The climate zone map of India are shown in **Figure 1.2**

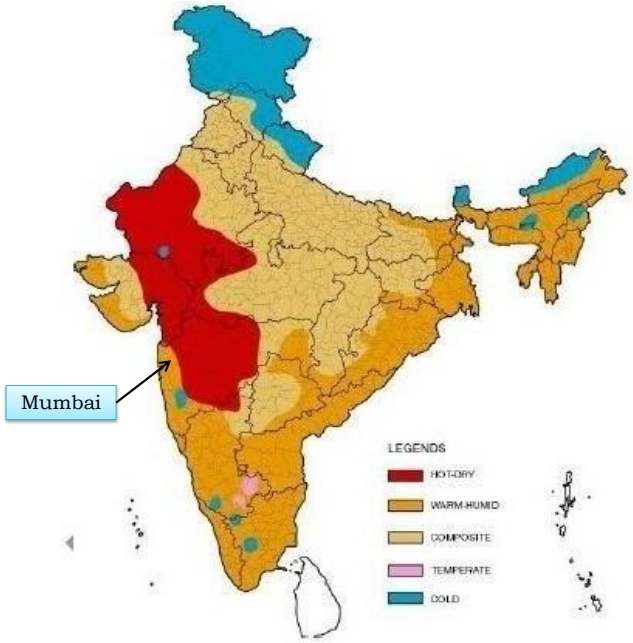


Figure 1.2: Climate zone map of India

Project layout shown in **Figure 1.3**

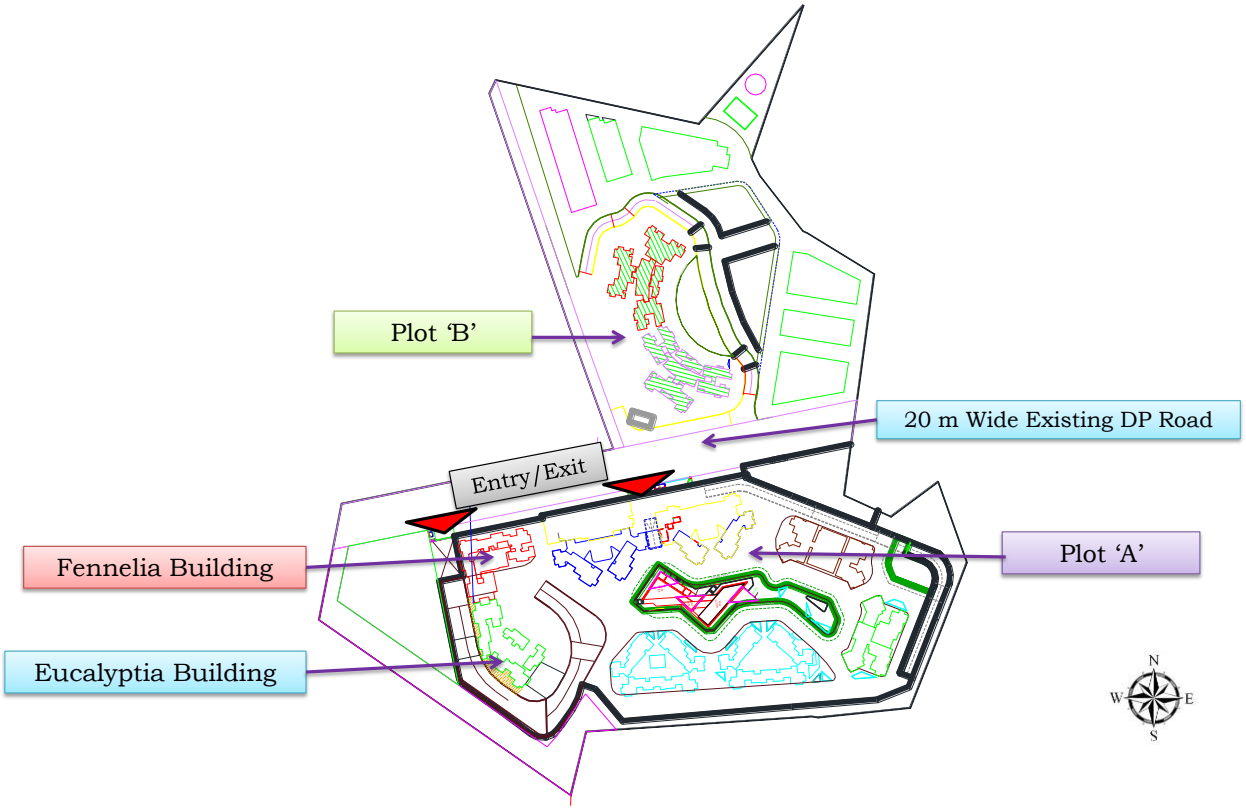


Figure 1.3: Layout plan of the proposed project

The project buildings details are given in **Table 1.1**.

Table 1.1: Project buildings

Name of Building	Previous Status		Current Status		Remarks
	Configuration	Height (m)	Configuration	Height (m	
Eucalyptia	Gr. + 2P + ST + 27 Floor	91.8	2 Basement + Ground + 2 Podium +Stilt +1st - 19th floor + Fire Check floor + 20th - 36th (Pt) floors	121.77	Basement is added and also increase in floor from 27th to 36 floor. Height increased from 91. 8 m to 121.77 m
Fenelia	Gr. + 2P + ST + 27 Floor	91.8	2 Basement + Gr (Pt.)/ 1st level. Podium + Mezzanine (Pt.)/2nd level Podium +3rd Podium + Stilt + 1st to 19th floor + fire Check Floor + 20th - 36th (Pt) floor	121.77	Basement is added and also increase in floor from 27th to 36 floor. Height increased from 91. 8 m to 121.77 m

2.0 Energy Conservation Building Code (ECBC):

Energy Conservation Building Code – Residential (ECBC-R) (Part I: Building Envelope) has been prepared to set minimum building envelope performance standards to limit heat gains (for cooling dominated climates) and to limit heat loss (for heating dominated climates8), as well as for ensuring adequate natural ventilation and day lighting potential. The code provides design flexibility to innovate and vary important envelope components such as wall type, window size, and type of glazing, and external shading to windows to meet the compliance.

2.1 Purpose of Energy Conservation Building Code (ECBC):

- The purpose of the Energy Conservation Building Code (Code) is to provide minimum requirements for the energy-efficient design and construction of buildings.
- The Code also provides two additional sets of incremental requirements for buildings to achieve enhanced levels of energy efficiency that go beyond the minimum requirements

2.2 Scope of Energy Conservation Building Code (ECBC):

- The Code is applicable to buildings or building complexes that have a connected load of 100 kW or greater or a contract demand of 120 kVA or greater and are intended to be used for commercial purposes.
- Buildings intended for private residential purposes only are not covered by the Code.

2.3 Energy Efficiency Performance Levels:

The code prescribes the following three levels of energy efficiency:

1. Energy Conservation Building Code Compliant Building (ECBC Building)

ECBC Buildings shall demonstrate compliance by adopting the mandatory and prescriptive requirements listed under ECBC Compliant Building requirements in §4 to §7, or by following the provisions of the Whole Building Performance (WBP).

2. Energy Conservation Building Code Plus Building (ECBC+ Building)

ECBC+ Buildings shall demonstrate compliance by adopting the mandatory and prescriptive requirements listed under ECBC+ Compliant Building requirements or by following the provisions of the Whole Building Performance (WBP) Method.

3. Super Energy Conservation Building Code Building (Super ECBC Building)

Super ECBC Buildings shall demonstrate compliance by adopting the mandatory and prescriptive requirements listed under Super ECBC Compliant Building requirements or by following the provisions of the Whole Building Performance (WBP) Method.

3.0 ECBC Compliance - General:

A Buildings hall be called ECBC Compliant by complying with the mandatory provisions (4.2 – Envelope, 5.2 – HVAC, 6-2 SHW, 7.2 – Lighting and 8.2 – Power) and either of the following:

- Prescriptive method (4.3, 5.3, 7.3)
- Whole Building Performance method (AppendixB10)

Proposed Development is being shown ECBC compliant by following the mandatory provisions of 4.2 – Envelope, 5.2 – HVAC, 6.2 – SHW, 7.2 – Lighting and 8.2 – Power and prescriptive method (4.3, 5.3, 7.3) mentioned in ECBC Guidelines 2017.

3.1 Energy Performance Index (EPI) and Ratio:

Energy Performance Index (EPI):

Energy Performance Index (EPI) is annual energy consumption in Kwh per sq. m of a building.

$$\textbf{EPI} = \frac{\textbf{Annual Energy Consumption in Kwh}}{\textbf{Total built up area (excluding unconditional basements)}}$$

$$\text{EPI} = \frac{12733120.00}{243285.76}$$

Energy Performance Index (EPI) = 0.019

To comply with ECBC Code, EPI should be calculated based on prescriptive or whole Building performance method.

Proposed project is shown ECBC compliant by following Prescriptive method. According to ECBC Guidelines, the EPI ratio should be 1 for the proposed project to be ECBC Compliant.

EPI Ratio:

The EPI Ratio of a Building is the ratio of EPI of proposed Building to standard Building

$$\text{EPI Ratio} = \frac{\text{EPI of Proposed Building}}{\text{EPI of Standard Building}}$$

$$\text{EPI Ratio} = \frac{0.019}{0.019}$$

* The Standard Building has the same Building floor area, gross wall area and gross roof area as the proposed Building which complies with all mandatory requirements.

EPI ratio of the standard Building comes to 0.019. Thus following the calculation for EPI Ratio we shall get EPI Ratio of 1.

EPI Ratio = 1

According to ECBC Guidelines 2017, for compliance of ECBC if prescriptive method is followed, then EPI of proposed Building should be equal to EPI of Standard Building, which is achieved in this case. Hence the proposed project is complying with the ECBC code.

3.2 Mandatory Requirement:

Proposed Development is complying with the mandatory requirements mentioned under ECBC Guidelines 2017 (4.2, 5.2, 6.2 and 7.2).

Under Prescriptive Method, a Building should meet the prescribed minimum/maximum values for envelope components (4.3), comfort systems and controls (5.3, 5.4, 5.5) and lighting and controls (6.3), in addition to meeting all the mandatory requirements mentioned under ECBC Guidelines 2017 (4.2, 5.2, 6.2 and7.2).

3.2.1 Building Envelope:

Envelope design strongly affects the visual and thermal comfort of the occupants, as well as energy consumption in the Building. The design of the Building envelope is generally the responsibility of the architect. The Building designer is responsible for making sure that the Building envelope is energy-efficient and complies with the mandatory and prescriptive requirements of the code.

From an energy efficiency point of view, the envelope design must take into consideration both the external and internal heat loads, as well as day lighting benefits. External loads include mainly solar heat gains through windows, heat losses across the envelope surfaces, and unwanted air infiltration in the Building; internal loads include heat released by the electric lighting systems, equipment, and people working in the Building space.

A well -designed Building envelope not only helps in complying with the Energy Conservation Building Envelope (ECBC) but can also result in first cost savings by taking advantage of day lighting and correct HVAC sizing. The Building envelope and its components are key determinants of the amount of heat gain and loss and wind that enters inside. The envelope protects the Building's interior and occupants from the weather conditions and other external elements.

The Building envelope refers to the exterior façade, and is comprised of opaque components and fenestration systems. Opaque components include walls, roofs, slabs on grade (in touch with ground), basement walls, and opaque doors. Fenestration systems include windows, skylights, ventilators, and doors that are more than one-half glazed. The envelope protects the Building's interiors and occupants from the weather conditions and shields them from other external factors e.g.: noise, pollution, etc.

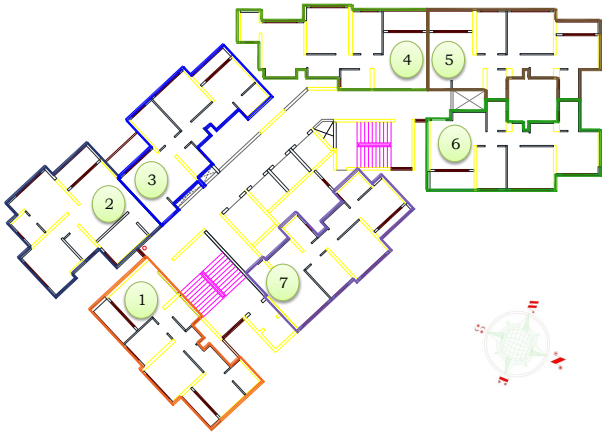
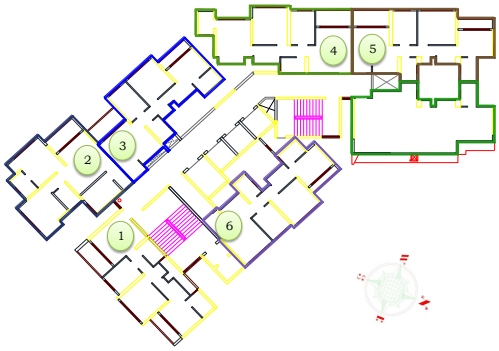
Floor Plans:

Eucalyptia Building

The First floor plan of the Eucalyptia building is shown in **Figure 1.4.** The Typical floor plan of the Eucalyptia building is shown in **Figure 1.5** & the Refuge floor plan of the Eucalyptia building is shown in **Figure 1.6**

Eucalyptia Building

Figure 1.4: First floor plan of Eucalyptia building

	
Figure 1.5: Typical floor plan of Eucalyptia building **(2nd to 4th floor; 6th to 9th and 11th to 14th and 16th to 19th and 21st to 24th and 26th to 29th and 31st to 34th floor)**	**Figure 1.6: Refuge floor plan of Eucalyptia building** **(5th; 10th; 15th; 25th; 30th, 35th & 36th floor)**

Fenelia Building

The First floor plan of the Fenelia Building is shown in **Figure 1.7.** The Typical floor plan of the Fenelia building is shown in **Figure 1.8**& the Refuge floor plan of the Fenelia building is shown in **Figure 1.9**

Fenelia Building



Figure 1.7: First floor plan of Fenelia building

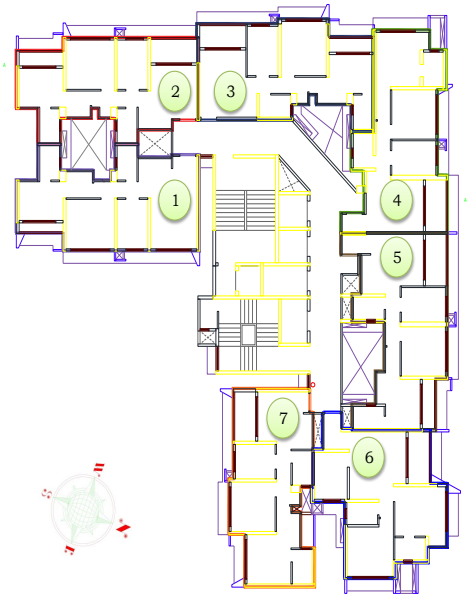


Figure 1.8: Typical floor plan of Fenelia building

(2nd to 4th floor; 6th to 9th and 11th to 14th and 16th to 19th and 21st to 24th and 26th to 29th and 31st to 34th floor)

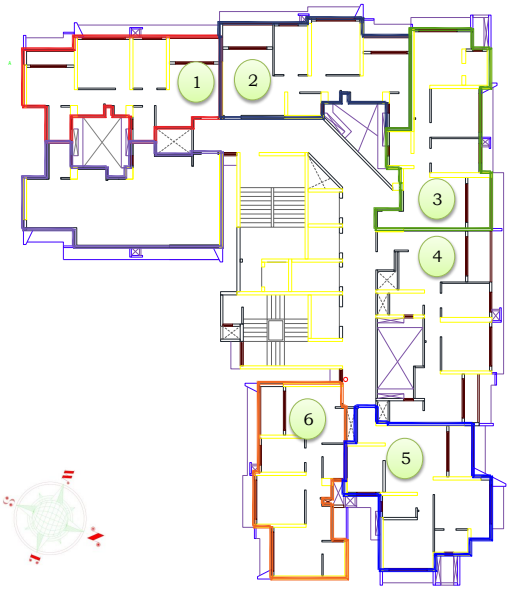


Figure 1.9: Refuge floor plan of Fenelia building

(5th; 10th; 15th; 25th; 30th, 35th & 36th floor

To be ECBC compliant the proposed development should comply with following points

- ***U factor:***

As per ECBC Guidelines 2017, U-factors shall be determined for the overall fenestration product (including the sash and frame) in accordance with ISO-15099, as specified in Appendix C, by an accredited independent laboratory, and labelled and certified by the manufacturer or other responsible party. U-factors for sloped glazing and skylights shall be determined at a slope of 20 degrees above the horizontal.

AIS Ecosense Enhance Aura clear glass will be used in proposed project which has a U factor of 2.8 (W/m².K). The Maximum U factor for Warm and Humid areas as per ECBC Guidelines 2017 is 3 (W/m².K).

Proposed project thus complies with the U factor point mentioned in ECBC Guidelines.

- ***Thermal Transmittance (Uroof):***

Characterizes the thermal performance of the roof of a building. Limiting the Uroof helps in reducing heat gains or losses from the roof, thereby improving the thermal comfort and reducing the energy required for cooling or heating.

$$U_{roof} = {}^{1}\sum(Ui \times Ai)/ A_{roof\ i=1}$$

Where,

Uroof : Thermal transmittance of roof (W/m^2.K)

A_{Roof} : Total area of the roof (m^2)

U_i :Thermal transmittance values of different roof constructions (W/m2.K)

A_i : Areas of different roof constructions (m^2)

Table 1.2: Estimation for Thermal Transmittance (U_{roof})

Buildings	Thermal Transmittance Estimated	As per guidance value
Eucalyptia Building	0.059	Max limit of 1.2 $W/m^2.K$
Fenelia Building	0.058	

The thermal transmittance values of different roof constructions i.e U value is 0.409 Watts/hr/m^2/°C

The thermal transmittance values for our proposed project ranges from 0.058 - 0.059 Watts/hr/m^2/℃

Thermal Comfort

The main urban climatic factors in high density cities that affect thermal comfort are lower urban wind speed, higher temperatures and restricted access to solar energy compared with climatic conditions in low density cities placed in a similar natural climate. Thermal comfort is estimated using the software Ecotect. Thermal comfort assessment for Typical Floor Plans is shown in **Figure 1.10 and Figure 1.11**

Thermal Comfort Assessment –Eucalyptia Building

Thermal comfort assessment for typical floor plan are shown in **Figure 1.10**

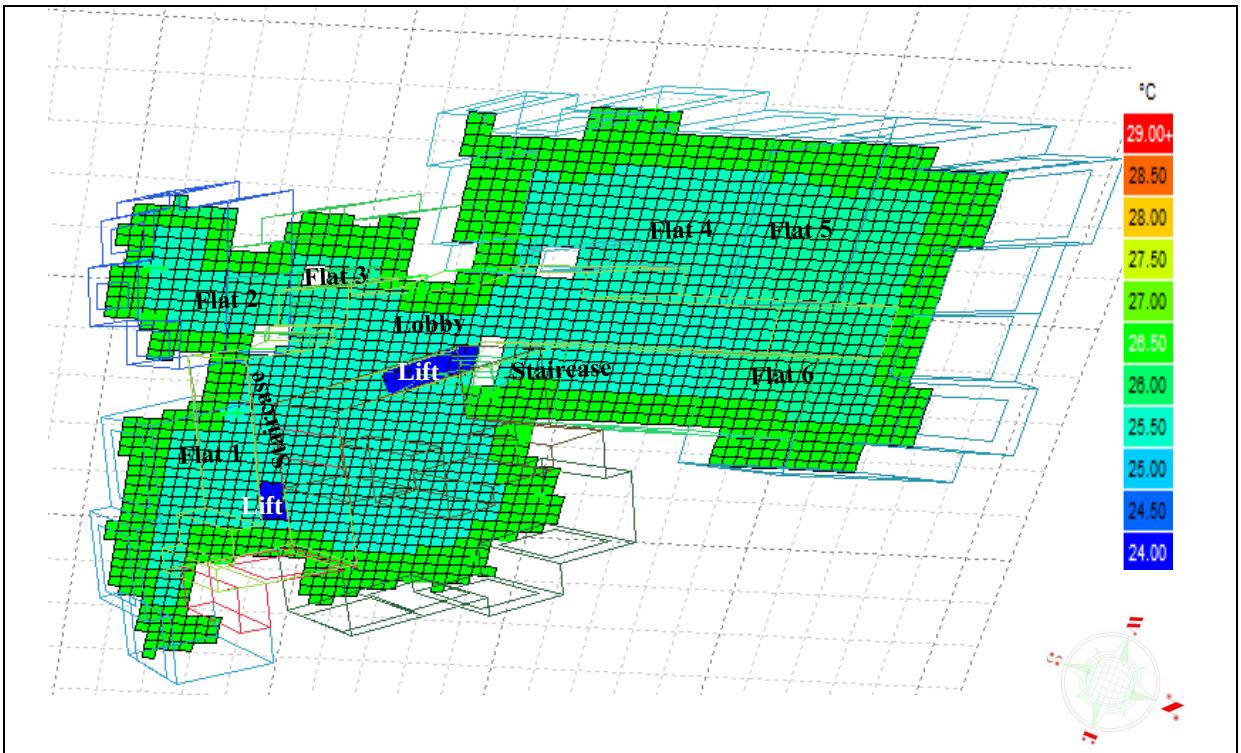


Figure 1.10: Thermal comfort assessment for typical floor plan of Eucalyptia building

Thermal comfort zone observed in Eucalyptia Building are in the range 25° C – 27° C

Thermal Comfort Assessment –Fenelia Building

Thermal comfort assessments for typical floor plan are shown in **Figure 1.11**

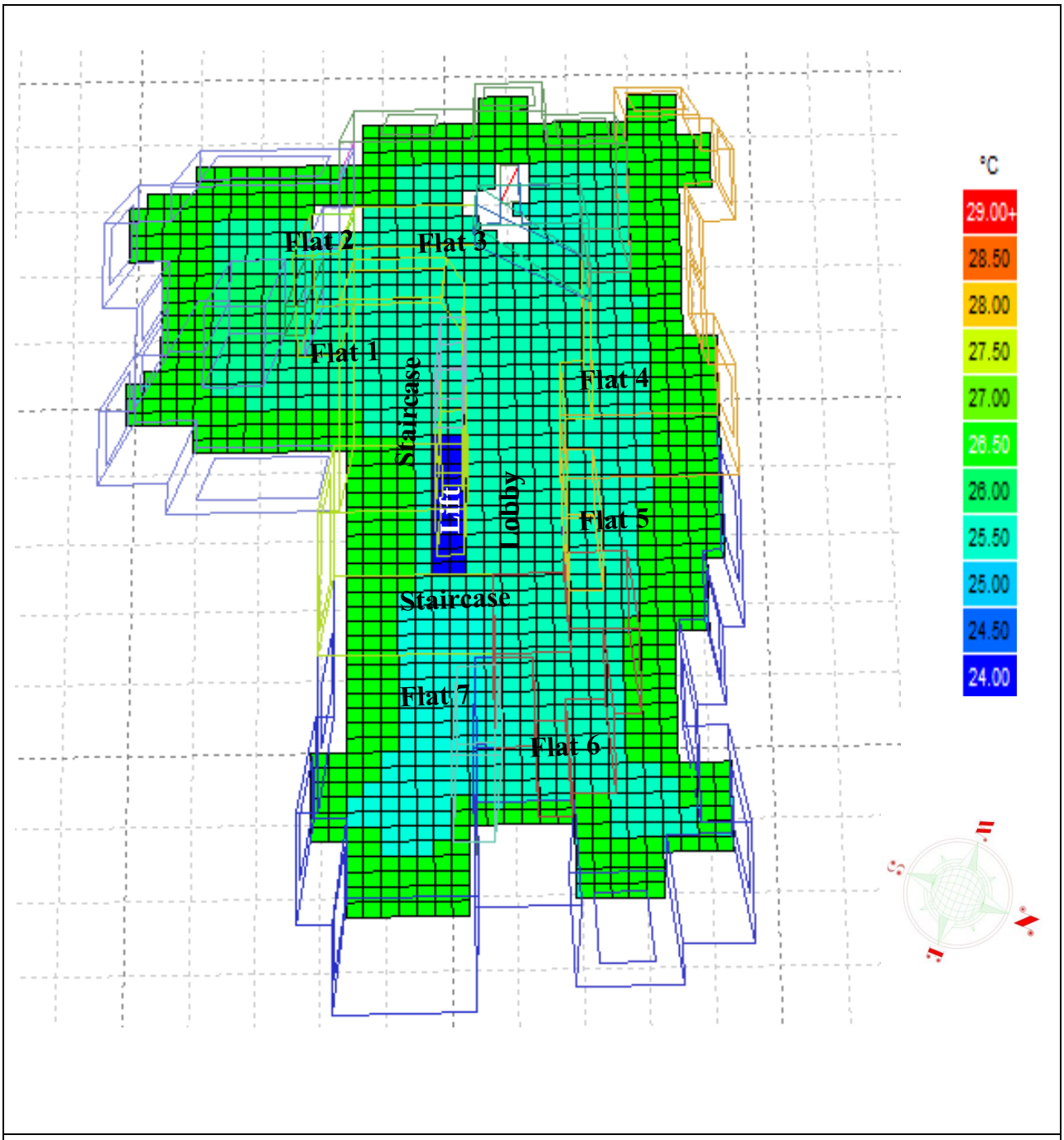


Figure 1.11: Thermal comfort assessment for typical floor plan of Fenelia building

Thermal comfort zone observed in Fenelia Building are in the range 25° C – 27° C

The thermal comfort simulations for proposed project are carried out. **Figures 1.10** and **Figure 1.11** shows the thermal comfort levels for proposed Buildings and it was estimated to be about 25° C – 27° C.

According to NBC 2016 the thermal comfort level should be about 26 ± 2° C which is compiled by this project.

- ***Solar Heat Gain Coefficient (SHGC):***

These are the indicators of total solar heat gain through a glazing. SHGC is the ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation. Solar heat gains include directly transmitted solar heat and absorbed solar radiation, which is then re-radiated, conducted or convicted into the space. These indices are dimensionless numbers between 0 and 1 that indicate the total heat transfer of the sun's radiation. These properties are widely used in cooling load calculations. Glass with a lower SHGC or SC (Shading coefficient) helps in reducing cooling loads in hot climate zones.

As per ECBC Guidelines 2017, SHGC shall be determined for the overall fenestration product (including the sash and frame) in accordance with ISO-15099, as specified in Appendix C§11, by an accredited independent laboratory, and labelled and certified by the manufacturer or other responsible party.

For Buildings to comply with ECBC code the SHGC value should be lower than SHGC value for Warm and Humid areas greater or equal to latitude 15ºN. The Maximum SHGC value for Warm and Humid areas greater or equal to latitude 15 ºN is 0.50.

The SHGC can be calculated as follows,

$SEF_{Direction} = (C_3 \times PF^3) + (C_2 \times PF^2) + (C_1 \times PF) + C_0$
$SHGC_{Direction} = 0.3 / SEF_{Direction}$

Where,

PF **:** Projection Factor

C **:** Coefficients

Table 1.3: SHGC value for proposed project

Proposed Building	SHGC				Average
	$SHGC_{East}$	$SHGC_{West}$	$SHGC_{North}$	$SHGC_{South}$	
Eucalyptia	0.025	0.053	0.15	0.08	0.077
Fenelia	0.025	0.053	0.15	0.08	0.077

The SHGC value for proposed Buildings is less than the maximum value mentioned in ECBC Guidelines 2017, thus complying with this point.

- ***Air Leakage:***

As per ECBC Guidelines 2017, Air leakage for other fenestration and doors shall not exceed 2.0 l/s-m2.

Provisions are made to minimize air leakage as per ECBC guidelines 2017.

- ***Day Lightning:***

Useful Daylight Index (UDI) is defined as the annual occurrence of daylight between 100 lux to 2,000 lux on a work plane. This daylight is most useful to occupants, glare free and when available, eliminates the need for artificial lighting. The floor or flat area should meet or exceed the Useful Daylight Index (UDI) area requirements. As per ECBC Guidelines 2017, for Residential area and Commercial 50% and 40 % of area (minimum) respectively should achieve UDI for 90 % of the potential daylight time.

The UDI can be calculated as follows,

Total Daylight area per floor meeting UDI requirement during 90% of the year	**=**	**Windows length of all Windows X Distance of Overhangs**

Total Daylight area in Building meeting UDI requirement during 90% of the year	**=**	**Total Daylight area per floor meeting UDI requirement during 90% of the year X 4**

% of Total Daylight area in Building Meeting UDI Requirement	**=**	**Total Daylight area in building meeting UDI requirement** / **Total Floor or Flat Area**

Table 1.4: Percentage of total daylight area in building meeting UDI requirement in proposed project

Proposed Buildings	Window Size	Flat Area	Percentage of total daylight area in Building meeting UDI requirement	ECBC requirement
Eucalyptia	423.84	567.47	74.68 %	50 %
Fenelia	494.48	577.68	85.59 %	50 %

The proposed Buildings are complying with the minimum UDI requirement mentioned in ECBC Guidelines 2017.

According to ECBC Guidelines 2017 UDI (Useful Daylight Illuminance) should be in the range of 100 lux to 2000 lux.

Daylight Assessment – Simulation Method

Proposed project comply with 700 angle of obstruction compliance. The section plan of buildings shown in **Figure 1.12**

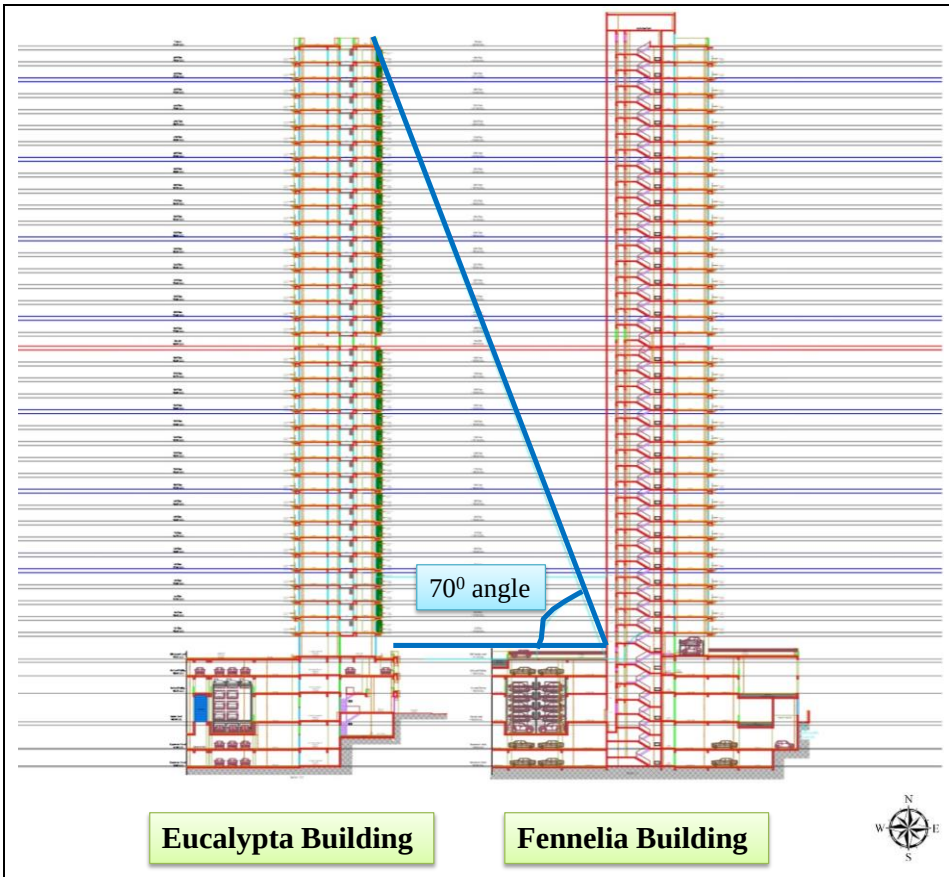


Figure 1.12: Sections of buildings showing 70^0 angle

An angle of 700 between proposed project and nearby structure was calculated in AutoCAD software. Based on the angle the minimum distance required between two buildings was estimated.

This additional criterion is also getting fulfilled in the proposed Buildings. Daylight Simulation is carried out by using Ecotect software. Indoor daylight assessment for Typical Floor Plans is shown in **Figure 1.13 and Figure 1.14**

Indoor Daylight Assessment –Eucalyptia Building

Indoor daylight assessment for typical floor plan are shown in **Figure 1.13**

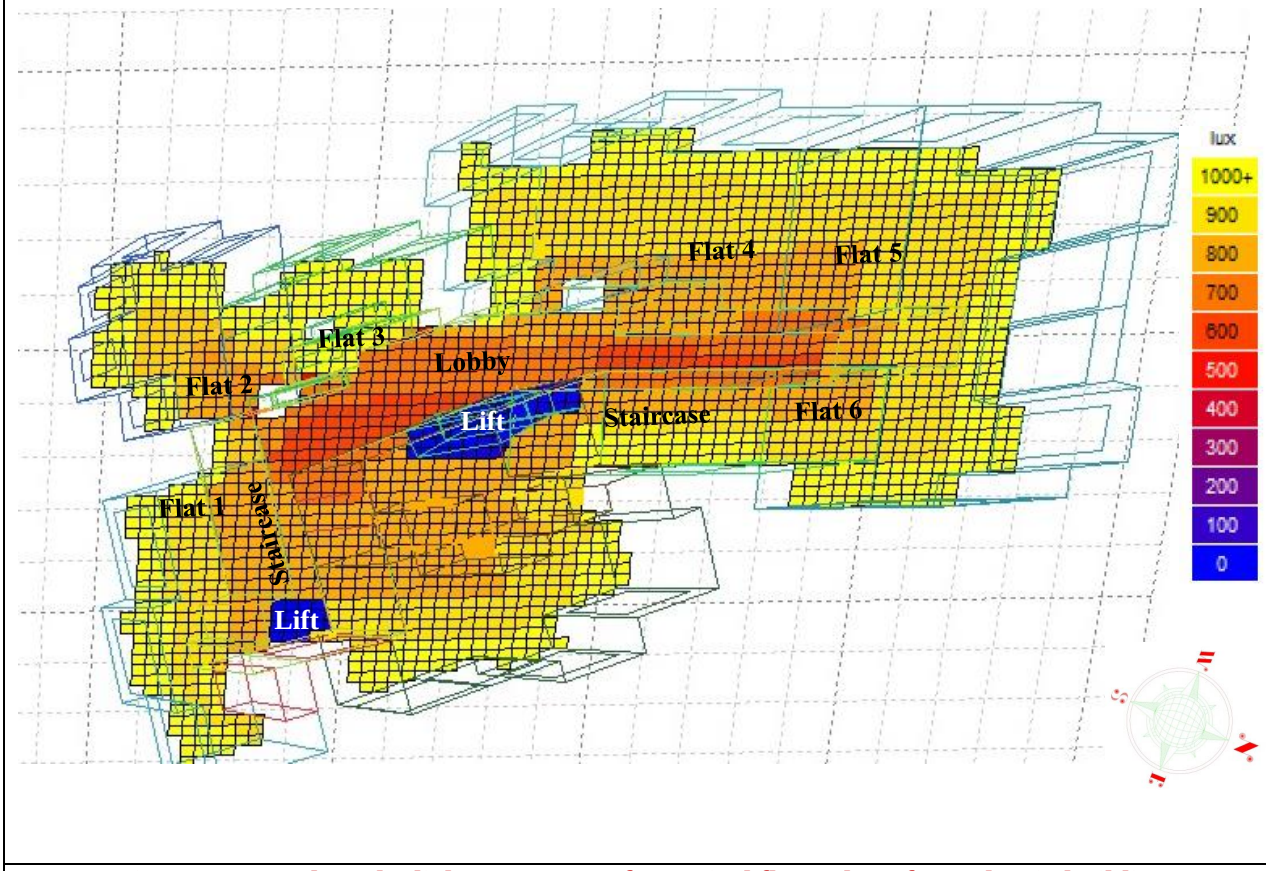


Figure 1.13: Indoor daylight assessment for typical floor plan of Eucalyptia building

Indoor Daylight Assessment –Fenelia Building

Indoor daylight assessment for typical floor plan are shown in **Figure 1.14**

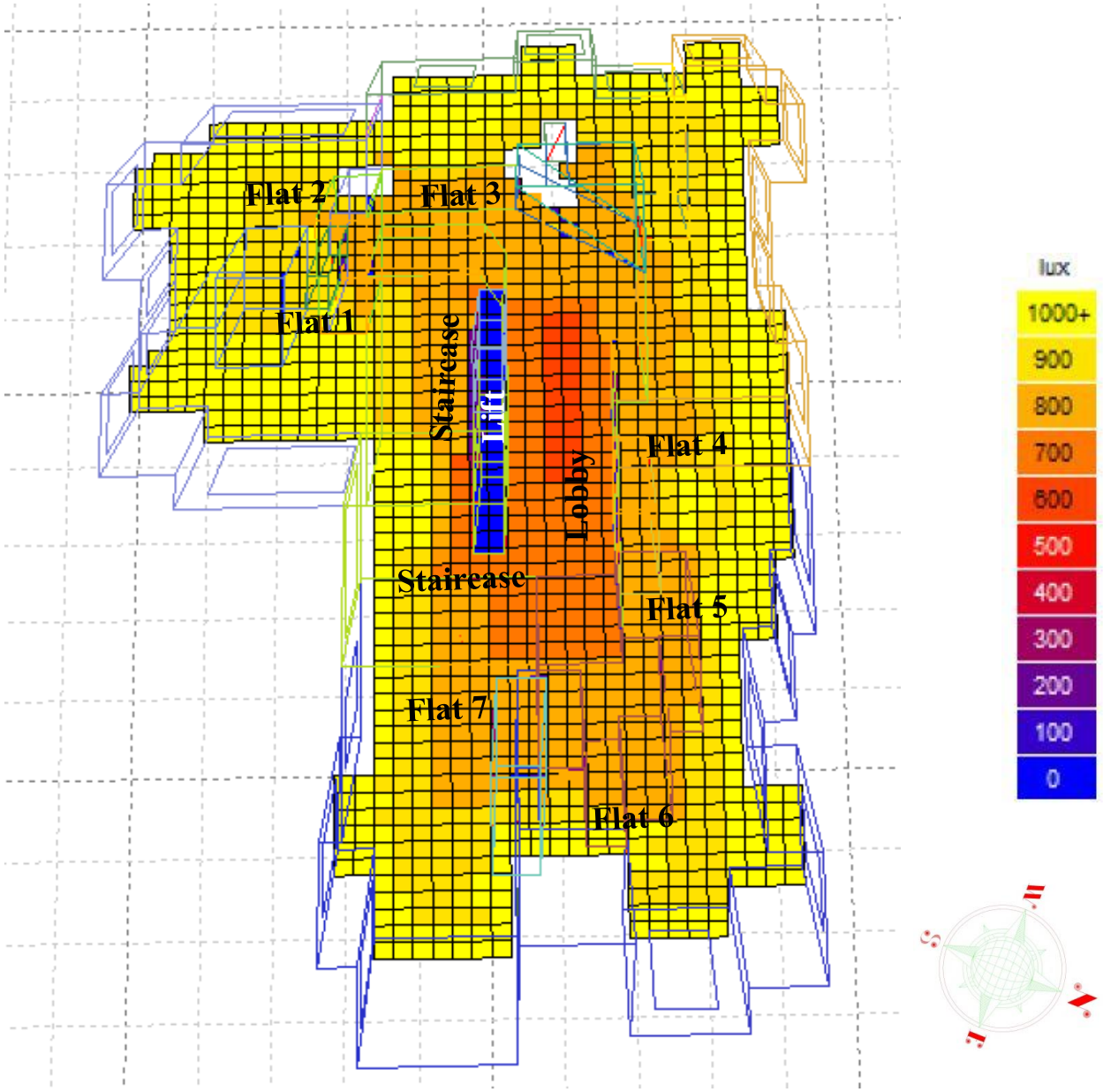


Figure 1.14: Indoor daylight assessment for typical floor plan of Fenelia building

The indoor light levels for typical floor plan range from 150 lux to 1000 lux having an average of about 575 lux. This complies with UDI requirement mentioned in ECBC Guidelines 2017.

- ***Visible Light Transmittance (VLT):***

This is the percentage of normally incident visible light transmitted through the glazing. Glazing with a high visible transmittance is clearer in appearance and provide sufficient daylight and views. Clear glass however, can create glare problem. Glazing with low visible transmittance give better glare control, but offer minimal daylight integration and diminished views.

VLT is another part of vertical fenestration which needs to be complied for Building to be ECBC compliant. Minimum allowable Visible Light transmittance (VLT) is 0.27.

The Manual Assessment for daylight estimation is done by using Glazing Factor. The Glazing factor for different rooms shown in **Table 1.5**

Table 1.5: Glazing factor to be achieved

Type of Regularly Occupied Spaces	Glazing Factors (GF)
Living/Bedroom	1
Study room	1
Kitchen	2
Other spaces	1

Glazing factor is calculated as:

$$Glazing\ Factor = \frac{Window\ Area\ (sq.m)}{Floor\ Area\ (sq.m)}\ x\ Actual\ Visual\ Transmittance\ of\ Glazing\ (VLT)\ x\ Constant\ x\ 100$$

The constant values are:

- Windows to wall: 0.2
- Windows to roof (skylight): 1.0

VLT obtained from glass: 0.53

The Glass used Ecosense Enhance (Aura Clear Glass)

The Glazing achieved for different rooms of proposed project shown in **Table 1.6**

Table 1.6: Glazing achieved for different rooms

Floor	Flat Type	Flat No	Spaces	Floor Area (Sq. m)	Window Area (Sq. m)	Window Glazing (VLT)	Glazing Factor achieved (as per formula)	Glazing Factor to be achieved	Area of regularly occupied spaces meeting criteria (%)
Eucalyptia Building									
First Floor (Refer **Figure 1.4**)	2 BHK	1	Living Room	17.31	4.62	0.53	2.83	1	64.65
			Kitchen	5.84	2.2	0.53	3.99	2	49.91
			Bedroom -1	9.24	4.4	0.53	5.05	1	80.19
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.17
			Average of Flat 1						**68.23**
	2 BHK	2	Living Room	17.70	4.62	0.53	2.77	1	63.86
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	9.33	4.4	0.53	5.00	1	79.99
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 2						**66.62**
	2 BHK	3	Living Room	15.73	4.62	0.53	3.11	1	67.88

Floor	Flat Type	Flat No	Spaces	Floor Area (Sq. m)	Window Area (Sq. m)	Window Glazing (VLT)	Glazing Factor achieved (as per formula)	Glazing Factor to be achieved	Area of regularly occupied spaces meeting criteria (%)
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	9.24	4.4	0.53	5.05	1	80.19
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 3						**67.67**
	2 BHK	4	Living Room	18.18	4.62	0.53	2.69	1	62.87
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	10.18	4.4	0.53	4.58	1	78.16
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 4						**65.92**
	2 BHK	5	Living Room	14.76	4.62	0.53	3.32	1	69.86
			Kitchen	5.84	2.2	0.53	4.00	2	49.95
			Bedroom -1	9.24	4.4	0.53	5.05	1	80.19
			Bedroom -2	9.24	4.4	0.53	5.05	1	80.19

Floor	Flat Type	Flat No	Spaces	Floor Area (Sq. m)	Window Area (Sq. m)	Window Glazing (VLT)	Glazing Factor achieved (as per formula)	Glazing Factor to be achieved	Area of regularly occupied spaces meeting criteria (%)
			Average of Flat 5						**70.04**
	Average of First Floor								**67.70**
Typical Floor 2nd to 4th and 6th to 9th and 11th to 14th, and 16th to 19th, 21th to 24th and 26th to 29th and 31th to 34th Floor (Refer	2 BHK	1	Living Room	17.31	4.62	0.53	2.83	1	64.65
			Kitchen	5.84	2.2	0.53	4.00	2	49.95
			Bedroom -1	9.24	4.4	0.53	5.05	1	80.19
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 1						**68.24**
	2 BHK	2	Living Room	17.70	4.62	0.53	2.77	1	63.86
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	9.33	4.4	0.53	5.00	1	79.99
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 2						**66.62**
	2 BHK	3	Living Room	15.73	4.62	0.53	3.11	1	67.88

Floor	Flat Type	Flat No	Spaces	Floor Area (Sq. m)	Window Area (Sq. m)	Window Glazing (VLT)	Glazing Factor achieved (as per formula)	Glazing Factor to be achieved	Area of regularly occupied spaces meeting criteria (%)
Figure 1.5)			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	9.24	4.4	0.53	5.05	1	80.19
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 3						**67.67**
	2 BHK	4	Living Room	18.18	4.62	0.53	2.69	1	62.87
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	10.18	4.4	0.53	4.58	1	78.16
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 4						**65.92**
	2 BHK	5	Living Room	16.31	4.62	0.53	3.00	1	66.69
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	10.18	4.4	0.53	4.58	1	78.16
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16

Floor	Flat Type	Flat No	Spaces	Floor Area (Sq. m)	Window Area (Sq. m)	Window Glazing (VLT)	Glazing Factor achieved (as per formula)	Glazing Factor to be achieved	Area of regularly occupied spaces meeting criteria (%)
			Average of Flat 5						**66.87**
	2 BHK	6	Living Room	16.02	4.62	0.53	3.06	1	67.29
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	10.18	4.4	0.53	4.58	1	78.16
			Bedroom -2	9.24	4.4	0.53	5.05	1	80.19
			Average of Flat 6						**67.53**
	Average of Typical Floor								**67.14**
Refuge Floor 5th ,10th ,15th ,20th ,25th ,30th, 35th ,36th Floor	2 BHK	1	Living Room	17.31	4.62	0.53	2.83	1	64.65
			Kitchen	5.84	2.2	0.53	4.00	2	49.95
			Bedroom -1	9.24	4.4	0.53	5.05	1	80.19
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 1						**68.24**
	2 BHK	2	Living Room	17.70	4.62	0.53	2.77	1	63.86

Floor	Flat Type	Flat No	Spaces	Floor Area (Sq. m)	Window Area (Sq. m)	Window Glazing (VLT)	Glazing Factor achieved (as per formula)	Glazing Factor to be achieved	Area of regularly occupied spaces meeting criteria (%)
(Refer **Figure 1.6**)			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	9.33	4.4	0.53	5.00	1	79.99
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 2						**66.62**
	2 BHK	3	Living Room	15.73	4.62	0.53	3.11	1	67.88
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	9.24	4.4	0.53	5.05	1	80.19
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 3						**67.67**
	2 BHK	4	Living Room	18.18	4.62	0.53	2.69	1	62.87
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	10.18	4.4	0.53	4.58	1	78.16
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16

Floor	Flat Type	Flat No	Spaces	Floor Area (Sq. m)	Window Area (Sq. m)	Window Glazing (VLT)	Glazing Factor achieved (as per formula)	Glazing Factor to be achieved	Area of regularly occupied spaces meeting criteria (%)
			Average of Flat 4						**65.92**
	2 BHK	5	Living Room	16.34	4.62	0.53	3.00	1	66.63
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	10.18	4.4	0.53	4.58	1	78.16
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 5						**66.86**
	Average of Refuge Floor								**67.06**
Fenelia Building									
First Floor (Refer **Figure 1.7**)	2 BHK	1	Living Room	15.76	4.62	0.53	3.11	1	67.81
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	10.39	4.4	0.53	4.49	1	77.73
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 1						**67.04**

Floor	Flat Type	Flat No	Spaces	Floor Area (Sq. m)	Window Area (Sq. m)	Window Glazing (VLT)	Glazing Factor achieved (as per formula)	Glazing Factor to be achieved	Area of regularly occupied spaces meeting criteria (%)
	2 BHK	2	Living Room	17.70	4.62	0.53	2.77	1	63.86
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	9.24	4.4	0.53	5.05	1	80.19
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 2						**66.67**
	2 BHK	3	Living Room	16.73	4.62	0.53	2.93	1	65.83
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	9.61	4.4	0.53	4.86	1	79.40
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 3						**66.97**
	2 BHK	4	Living Room	17.70	4.62	0.53	2.77	1	63.86
			Kitchen	6.75	2.2	0.53	3.46	2	42.15
			Bedroom -1	10.73	4.4	0.53	4.35	1	76.99

Floor	Flat Type	Flat No	Spaces	Floor Area (Sq. m)	Window Area (Sq. m)	Window Glazing (VLT)	Glazing Factor achieved (as per formula)	Glazing Factor to be achieved	Area of regularly occupied spaces meeting criteria (%)
			Bedroom -2	9.73	4.4	0.53	4.79	1	79.14
			Average of Flat 4						**65.54**
	2 BHK	5	Living Room	14.44	4.62	0.53	3.39	1	70.51
			Kitchen	5.84	2.2	0.53	4.00	2	49.95
			Bedroom -1	9.24	4.4	0.53	5.05	1	80.19
			Bedroom -2	9.24	4.4	0.53	5.05	1	80.19
			Average of Flat 5						**70.21**
	Average of First Floor								**67.28**
Typical Floor 2nd , to 4th and 6th to 9th and 11th to 14th and 16th to 19th	2 BHK	1	Living Room	16.02	4.62	0.53	3.06	1	67.29
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	10.18	4.4	0.53	4.58	1	78.16
			Bedroom -2	9.24	4.4	0.53	5.05	1	80.19
			Average of Flat 1						**67.53**

Floor	Flat Type	Flat No	Spaces	Floor Area (Sq. m)	Window Area (Sq. m)	Window Glazing (VLT)	Glazing Factor achieved (as per formula)	Glazing Factor to be achieved	Area of regularly occupied spaces meeting criteria (%)
and 21th to 24th and 26th to 29th and 31th to 34th Floor (Refer **Figure 1.8**)	2 BHK	2	Living Room	15.73	4.62	0.53	3.11	1	67.88
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	10.18	4.4	0.53	4.58	1	78.16
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 2						**67.17**
	2 BHK	3	Living Room	18.18	4.62	0.53	2.69	1	62.87
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	10.39	4.4	0.53	4.49	1	77.73
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 3						**65.81**
	2 BHK	4	Living Room	17.70	4.62	0.53	2.77	1	63.86
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	9.24	4.4	0.53	5.05	1	80.19

Floor	Flat Type	Flat No	Spaces	Floor Area (Sq. m)	Window Area (Sq. m)	Window Glazing (VLT)	Glazing Factor achieved (as per formula)	Glazing Factor to be achieved	Area of regularly occupied spaces meeting criteria (%)
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 4						**66.67**
	2 BHK	5	Living Room	16.73	4.62	0.53	2.93	1	65.83
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	9.61	4.4	0.53	4.86	1	79.40
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 5						**66.97**
	2 BHK	6	Living Room	17.70	4.62	0.53	2.77	1	63.86
			Kitchen	6.75	2.2	0.53	3.46	2	42.15
			Bedroom -1	10.73	4.4	0.53	4.35	1	76.99
			Bedroom -2	9.73	4.4	0.53	4.79	1	79.14
			Average of Flat 6						**65.54**
	2 BHK	7	Living Room	14.44	4.62	0.53	3.39	1	70.51

Floor	Flat Type	Flat No	Spaces	Floor Area (Sq. m)	Window Area (Sq. m)	Window Glazing (VLT)	Glazing Factor achieved (as per formula)	Glazing Factor to be achieved	Area of regularly occupied spaces meeting criteria (%)
			Kitchen	5.84	2.2	0.53	4.00	2	49.95
			Bedroom -1	9.24	4.4	0.53	5.05	1	80.19
			Bedroom -2	9.24	4.4	0.53	5.05	1	80.19
			Average of Flat 7						**70.21**
	Average of Typical Floor								**67.13**
Refuge Floor 5th ,10th ,15th ,20th ,25th ,30th, 35th ,36th Floor	2 BHK	1	Living Room	15.73	4.62	0.53	3.11	1	67.88
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	10.18	4.4	0.53	4.58	1	78.16
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 1						**67.17**
(Refer **Figure 1.9**)	2 BHK	2	Living Room	18.18	4.62	0.53	2.69	1	62.87
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	10.39	4.4	0.53	4.49	1	77.73

Floor	Flat Type	Flat No	Spaces	Floor Area (Sq. m)	Window Area (Sq. m)	Window Glazing (VLT)	Glazing Factor achieved (as per formula)	Glazing Factor to be achieved	Area of regularly occupied spaces meeting criteria (%)
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 2						**65.81**
	2 BHK	3	Living Room	17.70	4.62	0.53	2.77	1	63.86
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	9.24	4.4	0.53	5.05	1	80.19
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 3						**66.67**
	2 BHK	4	Living Room	16.73	4.62	0.53	2.93	1	65.83
			Kitchen	6.48	2.2	0.53	3.60	2	44.47
			Bedroom -1	9.61	4.4	0.53	4.86	1	79.40
			Bedroom -2	10.18	4.4	0.53	4.58	1	78.16
			Average of Flat 4						**66.97**
	2 BHK	5	Living Room	17.70	4.62	0.53	2.77	1	63.86

Floor	Flat Type	Flat No	Spaces	Floor Area (Sq. m)	Window Area (Sq. m)	Window Glazing (VLT)	Glazing Factor achieved (as per formula)	Glazing Factor to be achieved	Area of regularly occupied spaces meeting criteria (%)
			Kitchen	6.75	2.2	0.53	3.46	2	42.15
			Bedroom -1	10.73	4.4	0.53	4.35	1	76.99
			Bedroom -2	9.73	4.4	0.53	4.79	1	79.14
			Average of Flat 5						**65.54**
	2 BHK	6	Living Room	14.44	4.62	0.53	3.39	1	70.51
			Kitchen	5.84	2.2	0.53	4.00	2	49.95
			Bedroom -1	9.24	4.4	0.53	5.05	1	80.19
			Bedroom -2	9.24	4.4	0.53	5.05	1	80.19
			Average of Flat 6						**70.21**
	Average of Refuge Floor								**67.06**

AIS Ecosense Enhance - Aura Clear Glass will be used for proposed project which will help comply the ECBC code

- ***Window Wall Ratio (WWR):***

As per NBC 2005, Air Exchange Rate (ACH) should be 4 to 6 ACH. This would dissipate most of the indoor pollutants. This would lead to better standard of living for residents of proposed Buildings. Proposed site would have four Buildings having different types of flats. ACH would depend on the volume of the room as well as door and window opening. It would also depend on wind movement, its speed and direction.

Ventilation rate is also important in order to maintain the IAQ of a Building. Both ACH and ventilation rate were calculated as per ASHRAE standard. In order to achieve this level, the door and window should have areas which would provide a WWR of 40 % or below.

WWR is a part of vertical fenestrations wherein maximum allowable WWR is 40 % for Buildings showing compliance using the prescriptive method.

The WWR can be calculated as follows,

Window Wall Ratio (WWR) = Total Fenestration area / Total wall area X 100

Where,

Total Fenestration Area includes Windows and Door;

Table 1.7: Window wall ratio for proposed buildings

Proposed Buildings	Total wall area	Total fenestration area	WWR	ECBC requirement
Eucalyptia	1159.81	138.36	11.93 %	≤ 40 %
Fenelia	1125.01	161.42	14.35 %	≤ 40 %

The WWR is well within the range mentioned by ECBC Guidelines 2017, thus proposed project complies with this project.

Along with ECBC Guidelines 2017, IGBC and GRIHA also gives requirements for window area for particular area in flat. **Table 1.7** gives details of Flats of proposed Buildings and their window open able area along with requirements of IGBC and GRIHA. Opaque

Table 1.8: Actual window open area

Floor	Flat Type	Flat No.	Type of Room	Length (m)	Width (m)	Carpet Area (Sq. m)	Window Type	Window Dimension		Open Type	Window area (Sq. m)	Open Window Area (Sq. m)	% of Open area to carpet area required	% of Open area to carpet area achieved
								Length (m)	Width (m)					
Eucalyptia Building														
First Floor (Refer **Figure 1.4**)	2 BHK	1	Living	3.23	5.36	17.31	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	13.3
			Kitchen	2.74	2.13	5.84	Casement	1	2.2	Open	2.2	1.10	8 - 10	18.8
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			B 2	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	2	Living	3.23	5.48	17.70	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	13.1
			Kitchen	3.04	2.13	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.04	3.07	9.33	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	3	Living	3.23	4.87	15.73	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	14.7
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2	4	Living	3.23	5.63	18.18	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	12.7

Floor	Flat Type	Flat No.	Type of Room	Length (m)	Width (m)	Carpet Area (Sq. m)	Window Type	Window Dimension		Open Type	Window area (Sq. m)	Open Window Area (Sq. m)	% of Open area to carpet area required	% of Open area to carpet area achieved
								Length (m)	Width (m)					
	BHK		Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	5	Living	3.23	4.57	14.76	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	15.6
			Kitchen	2.13	2.74	5.84	Casement	1	2.2	Open	2.2	1.10	8 - 10	18.8
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			B 2	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
Typical Floor – 2nd to 4th Floor (Refer **Figure 1.5**)	2 BHK	1	Living	5.36	3.23	17.31	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	13.3
			Kitchen	2.74	2.13	5.84	Casement	1	2.2	Open	2.2	1.10	8 - 10	18.8
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			B 2	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	2	Living	3.23	5.48	17.70	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	13.1
			Kitchen	3.04	2.13	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.04	3.07	9.33	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6

Floor	Flat Type	Flat No.	Type of Room	Length (m)	Width (m)	Carpet Area (Sq. m)	Window Type	Window Dimension		Open Type	Window area (Sq. m)	Open Window Area (Sq. m)	% of Open area to carpet area required	% of Open area to carpet area achieved
								Length (m)	Width (m)					
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	3	Living	3.23	4.87	15.73	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	14.7
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	4	Living	3.23	5.63	18.18	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	12.7
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	5	Living	3.23	5.05	16.31	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	14.2
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2	6	Living	3.23	4.96	16.02	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	14.4

Floor	Flat Type	Flat No.	Type of Room	Length (m)	Width (m)	Carpet Area (Sq. m)	Window Type	Window Dimension		Open Type	Window area (Sq. m)	Open Window Area (Sq. m)	% of Open area to carpet area required	% of Open area to carpet area achieved
								Length (m)	Width (m)					
	BHK		Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			B 2	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
Refuge Floor – 5th Floor (Refer **Figure 1.6**)	2 BHK	1	Living	5.36	3.23	17.31	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	13.3
			Kitchen	2.74	2.13	5.84	Casement	1	2.2	Open	2.2	1.10	8 - 10	18.8
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			B 2	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	2	Living	3.23	5.48	17.70	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	13.1
			Kitchen	3.04	2.13	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.04	3.07	9.33	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	3	Living	3.23	4.87	15.73	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	14.7
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6

Floor	Flat Type	Flat No.	Type of Room	Length (m)	Width (m)	Carpet Area (Sq. m)	Window Type	Window Dimension		Open Type	Window area (Sq. m)	Open Window Area (Sq. m)	% of Open area to carpet area required	% of Open area to carpet area achieved
								Length (m)	Width (m)					
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	4	Living	3.23	5.63	18.18	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	12.7
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	5	Living	3.23	5.06	16.34	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	14.1
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
Typical Floor 6th to 9th and 11th to 14th and 16th to	2 BHK	1	Living	5.36	3.23	17.31	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	13.3
			Kitchen	2.74	2.13	5.84	Casement	1	2.2	Open	2.2	1.10	6 - 8	18.8
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4	23.8
			B 2	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2	2	Living	3.23	5.48	17.70	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	13.1

Floor	Flat Type	Flat No.	Type of Room	Length (m)	Width (m)	Carpet Area (Sq. m)	Window Type	Window Dimension		Open Type	Window area (Sq. m)	Open Window Area (Sq. m)	% of Open area to carpet area required	% of Open area to carpet area achieved
								Length (m)	Width (m)					
19th and 21st to 24th and 26th to 29th and 31st to 34th floor (Refer **Figure 1.5**)	BHK		Kitchen	3.04	2.13	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.04	3.07	9.33	Slider	2	2.2	3 W	4.4	2.20	4	23.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	3	Living	3.23	4.87	15.73	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	14.7
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4	23.8
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	4	Living	3.23	5.63	18.18	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	12.7
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	5	Living	3.23	5.05	16.31	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	14.2
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6

Floor	Flat Type	Flat No.	Type of Room	Length (m)	Width (m)	Carpet Area (Sq. m)	Window Type	Window Dimension		Open Type	Window area (Sq. m)	Open Window Area (Sq. m)	% of Open area to carpet area required	% of Open area to carpet area achieved
								Length (m)	Width (m)					
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	6	Living	3.23	4.96	16.02	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	14.4
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			B 2	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4	23.8
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
Refuge Floor 10th ,15th ,20th ,25th ,30th , 35th ,36th floor (Refer **Figure 1.6**)	2 BHK	1	Living	5.36	3.23	17.31	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	13.3
			Kitchen	2.74	2.13	5.84	Casement	1	2.2	Open	2.2	1.10	6 - 8	18.8
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4	23.8
			B 2	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	2	Living	3.23	5.48	17.70	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	13.1
			Kitchen	3.04	2.13	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.04	3.07	9.33	Slider	2	2.2	3 W	4.4	2.20	4	23.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2	3	Living	3.23	4.87	15.73	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	14.7

Floor	Flat Type	Flat No.	Type of Room	Length (m)	Width (m)	Carpet Area (Sq. m)	Window Type	Window Dimension		Open Type	Window area (Sq. m)	Open Window Area (Sq. m)	% of Open area to carpet area required	% of Open area to carpet area achieved
								Length (m)	Width (m)					
	BHK		Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4	23.8
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	4	Living	3.23	5.63	18.18	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	12.7
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	5	Living	3.23	5.06	16.34	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	14.1
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
Fenelia Building														
First Floor	2 BHK	1	Living	2.8	5.63	15.76	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	14.7
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.1	3.35	10.39	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.2

Floor	Flat Type	Flat No.	Type of Room	Length (m)	Width (m)	Carpet Area (Sq. m)	Window Type	Window Dimension		Open Type	Window area (Sq. m)	Open Window Area (Sq. m)	% of Open area to carpet area required	% of Open area to carpet area achieved
								Length (m)	Width (m)					
(Refer **Figure 1.7**)			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	2	Living	5.48	3.23	17.70	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	13.1
			Kitchen	3.04	2.13	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	3	Living	5.18	3.23	16.73	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	13.8
			Kitchen	3.04	2.13	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.04	3.16	9.61	Slider	2	2.2	3 W	4.4	2.20	4 - 5	22.9
			B 2	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	4	Living	5.48	3.23	17.70	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	13.1
			Kitchen	2.31	2.92	6.75	Casement	1	2.2	Open	2.2	1.10	8 - 10	16.3
			B 1	3.53	3.04	10.73	Slider	2	2.2	3 W	4.4	2.20	4 - 5	20.5
			B 2	3.2	3.04	9.73	Slider	2	2.2	3 W	4.4	2.20	4 - 5	22.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.25	1.4	3.15	Casement	0.6	1.7	Open	1.02	0.51	4	16.2

Floor	Flat Type	Flat No.	Type of Room	Length (m)	Width (m)	Carpet Area (Sq. m)	Window Type	Window Dimension		Open Type	Window area (Sq. m)	Open Window Area (Sq. m)	% of Open area to carpet area required	% of Open area to carpet area achieved
								Length (m)	Width (m)					
	2 BHK	5	Living	4.75	3.04	14.44	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	16.0
			Kitchen	2.74	2.13	5.84	Casement	1	2.2	Open	2.2	1.10	8 - 10	18.8
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			B 2	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
Typical Floor – 2nd to 4th floor (Refer **Figure 1.8**)	2 BHK	1	Living	3.23	4.96	16.02	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	14.4
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			B 2	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	2	Living	3.23	4.87	15.73	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	14.7
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	3	Living	3.23	5.63	18.18	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	12.7
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.1	3.35	10.39	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.2

Floor	Flat Type	Flat No.	Type of Room	Length (m)	Width (m)	Carpet Area (Sq. m)	Window Type	Window Dimension		Open Type	Window area (Sq. m)	Open Window Area (Sq. m)	% of Open area to carpet area required	% of Open area to carpet area achieved
								Length (m)	Width (m)					
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	4	Living	5.48	3.23	17.70	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	13.1
			Kitchen	3.04	2.13	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	5	Living	5.18	3.23	16.73	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	13.8
			Kitchen	3.04	2.13	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.04	3.16	9.61	Slider	2	2.2	3 W	4.4	2.20	4 - 5	22.9
			B 2	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	6	Living	5.48	3.23	17.70	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	13.1
			Kitchen	2.31	2.92	6.75	Casement	1	2.2	Open	2.2	1.10	8 - 10	16.3
			B 1	3.53	3.04	10.73	Slider	2	2.2	3 W	4.4	2.20	4 - 5	20.5
			B 2	3.2	3.04	9.73	Slider	2	2.2	3 W	4.4	2.20	4 - 5	22.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.25	1.4	3.15	Casement	0.6	1.7	Open	1.02	0.51	4	16.2

Floor	Flat Type	Flat No.	Type of Room	Length (m)	Width (m)	Carpet Area (Sq. m)	Window Type	Window Dimension		Open Type	Window area (Sq. m)	Open Window Area (Sq. m)	% of Open area to carpet area required	% of Open area to carpet area achieved
								Length (m)	Width (m)					
	2 BHK	7	Living	4.75	3.04	14.44	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	16.0
			Kitchen	2.74	2.13	5.84	Casement	1	2.2	Open	2.2	1.10	8 - 10	18.8
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			B 2	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
Refuge Floor – 5th Floor (Refer **Figure 1.9**)	2 BHK	1	Living	3.23	4.87	15.73	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	14.7
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	2	Living	3.23	5.63	18.18	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	12.7
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.1	3.35	10.39	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.2
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	3	Living	5.48	3.23	17.70	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	13.1
			Kitchen	3.04	2.13	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8

Floor	Flat Type	Flat No.	Type of Room	Length (m)	Width (m)	Carpet Area (Sq. m)	Window Type	Window Dimension		Open Type	Window area (Sq. m)	Open Window Area (Sq. m)	% of Open area to carpet area required	% of Open area to carpet area achieved
								Length (m)	Width (m)					
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	4	Living	5.18	3.23	16.73	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	13.8
			Kitchen	3.04	2.13	6.48	Casement	1	2.2	Open	2.2	1.10	8 - 10	17.0
			B 1	3.04	3.16	9.61	Slider	2	2.2	3 W	4.4	2.20	4 - 5	22.9
			B 2	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4 - 5	21.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	5	Living	5.48	3.23	17.70	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	13.1
			Kitchen	2.31	2.92	6.75	Casement	1	2.2	Open	2.2	1.10	8 - 10	16.3
			B 1	3.53	3.04	10.73	Slider	2	2.2	3 W	4.4	2.20	4 - 5	20.5
			B 2	3.2	3.04	9.73	Slider	2	2.2	3 W	4.4	2.20	4 - 5	22.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.25	1.4	3.15	Casement	0.6	1.7	Open	1.02	0.51	4	16.2
	2 BHK	6	Living	4.75	3.04	14.44	Slider	2.2	2.1	2 W	4.62	2.31	10 - 12	16.0
			Kitchen	2.74	2.13	5.84	Casement	1	2.2	Open	2.2	1.10	8 - 10	18.8
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			B 2	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4 - 5	23.8
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1

Floor	Flat Type	Flat No.	Type of Room	Length (m)	Width (m)	Carpet Area (Sq. m)	Window Type	Window Dimension		Open Type	Window area (Sq. m)	Open Window Area (Sq. m)	% of Open area to carpet area required	% of Open area to carpet area achieved
								Length (m)	Width (m)					
Typical Floor 6th to 9th and 11th to 14th and 16th to 19th and 21st to 24th and 26th to 29th and 31st to 34th floor (Refer **Figure 1.8**)	2 BHK	1	Living	3.23	4.96	16.02	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	14.4
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			B 2	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4	23.8
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	2	Living	3.23	4.87	15.73	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	14.7
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	3	Living	3.23	5.63	18.18	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	12.7
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.1	3.35	10.39	Slider	2	2.2	3 W	4.4	2.20	4	21.2
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	4	Living	5.48	3.23	17.70	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	13.1
			Kitchen	3.04	2.13	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4	23.8

Floor	Flat Type	Flat No.	Type of Room	Length (m)	Width (m)	Carpet Area (Sq. m)	Window Type	Window Dimension		Open Type	Window area (Sq. m)	Open Window Area (Sq. m)	% of Open area to carpet area required	% of Open area to carpet area achieved
								Length (m)	Width (m)					
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	5	Living	5.18	3.23	16.73	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	13.8
			Kitchen	3.04	2.13	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.04	3.16	9.61	Slider	2	2.2	3 W	4.4	2.20	4	22.9
			B 2	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	6	Living	5.48	3.23	17.70	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	13.1
			Kitchen	2.31	2.92	6.75	Casement	1	2.2	Open	2.2	1.10	6 - 8	16.3
			B 1	3.53	3.04	10.73	Slider	2	2.2	3 W	4.4	2.20	4	20.5
			B 2	3.2	3.04	9.73	Slider	2	2.2	3 W	4.4	2.20	4	22.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.25	1.4	3.15	Casement	0.6	1.7	Open	1.02	0.51	4	16.2
	2 BHK	7	Living	4.75	3.04	14.44	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	16.0
			Kitchen	2.74	2.13	5.84	Casement	1	2.2	Open	2.2	1.10	6 - 8	18.8
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4	23.8
			B 2	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4	23.8
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1

Floor	Flat Type	Flat No.	Type of Room	Length (m)	Width (m)	Carpet Area (Sq. m)	Window Type	Window Dimension		Open Type	Window area (Sq. m)	Open Window Area (Sq. m)	% of Open area to carpet area required	% of Open area to carpet area achieved
								Length (m)	Width (m)					
Refuge Floor 10th ,15th ,20th ,25th ,30th , 35th ,36th floor (Refer **Figure 1.9**)	2 BHK	1	Living	3.23	4.87	15.73	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	14.7
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	2	Living	3.23	5.63	18.18	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	12.7
			Kitchen	2.13	3.04	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.1	3.35	10.39	Slider	2	2.2	3 W	4.4	2.20	4	21.2
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	3	Living	5.48	3.23	17.70	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	13.1
			Kitchen	3.04	2.13	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4	23.8
			B 2	3.04	3.35	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	4	Living	5.18	3.23	16.73	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	13.8
			Kitchen	3.04	2.13	6.48	Casement	1	2.2	Open	2.2	1.10	6 - 8	17.0
			B 1	3.04	3.16	9.61	Slider	2	2.2	3 W	4.4	2.20	4	22.9

Floor	Flat Type	Flat No.	Type of Room	Length (m)	Width (m)	Carpet Area (Sq. m)	Window Type	Window Dimension		Open Type	Window area (Sq. m)	Open Window Area (Sq. m)	% of Open area to carpet area required	% of Open area to carpet area achieved
								Length (m)	Width (m)					
			B 2	3.35	3.04	10.18	Slider	2	2.2	3 W	4.4	2.20	4	21.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
	2 BHK	5	Living	5.48	3.23	17.70	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	13.1
			Kitchen	2.31	2.92	6.75	Casement	1	2.2	Open	2.2	1.10	6 - 8	16.3
			B 1	3.53	3.04	10.73	Slider	2	2.2	3 W	4.4	2.20	4	20.5
			B 2	3.2	3.04	9.73	Slider	2	2.2	3 W	4.4	2.20	4	22.6
			Toilet 1	2.13	1.4	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	2.25	1.4	3.15	Casement	0.6	1.7	Open	1.02	0.51	4	16.2
	2 BHK	6	Living	4.75	3.04	14.44	Slider	2.2	2.1	2 W	4.62	2.31	8 - 10	16.0
			Kitchen	2.74	2.13	5.84	Casement	1	2.2	Open	2.2	1.10	6 - 8	18.8
			B 1	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4	23.8
			B 2	3.04	3.04	9.24	Slider	2	2.2	3 W	4.4	2.20	4	23.8
			Toilet 1	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1
			Toilet 2	1.4	2.13	2.98	Casement	0.6	1.7	Open	1.02	0.51	4	17.1

***Note:**

2 W – sliding 2 nos.; 3 W – sliding 3 nos.; Open – Full open able; Casement – window that is attached to its frames by one or more hinges at the sides; Slider – slide window

Table 1.9: Building envelope properties

Proposed Buildings			
Building Envelope	**Eucalyptia**	**Fenelia**	**ECBC Requirement**
SHGC	0.077	0.077	0.50
UDI %	74.68 %	85.59 %	50 % For Residential and 40 % for Commercial
WWR	11.93 %	14.35 %	≤ 40 %
VLT	0.53		≥ 0.27
U Factor	2.8 W/m2.K		≤ 3.0 W/m2.K

3.2.2 Ventilation:

Indoor air Quality depends upon ventilation and low ventilation (low air rate) reduces indoor air quality. The main urban climatic factors in high density cities that affect thermal comfort are lower urban wind speed, higher temperatures and restricted access to solar energy compared with climatic conditions in low density cities placed in a similar natural climate. Mumbai is high density city having average annual wind speed about 3.2 m/s (as procured from MPCB).

- ***Natural Ventilation Requirement:-***

In order to maintain IAQ, ventilation rate should be maintained. The Proposed Project is naturally ventilated and no mechanical ventilation technique used for ventilation.

The Indoor Air ventilation assessment has been carried out for proposed project and it has been observed that for naturally ventilated Building the wind speed ranges from 0.25 m/s to 2.28 m/s which falls in the range prescribed by NBC 2016 (Part 8: Building Services, Section 1: Lighting and Natural Ventilation, Subsection 5: Ventilation).

Thus complying the point mentioned in ECBC Guidelines 2017.

Indoor ventilation assessment for Typical Floor Plans is shown in **Figure 1.15 and Figure 1.16**

Indoor Ventilation Assessment –Eucalyptia Building

Indoor ventilation assessment for typical floor plan are shown in **Figure 1.15**

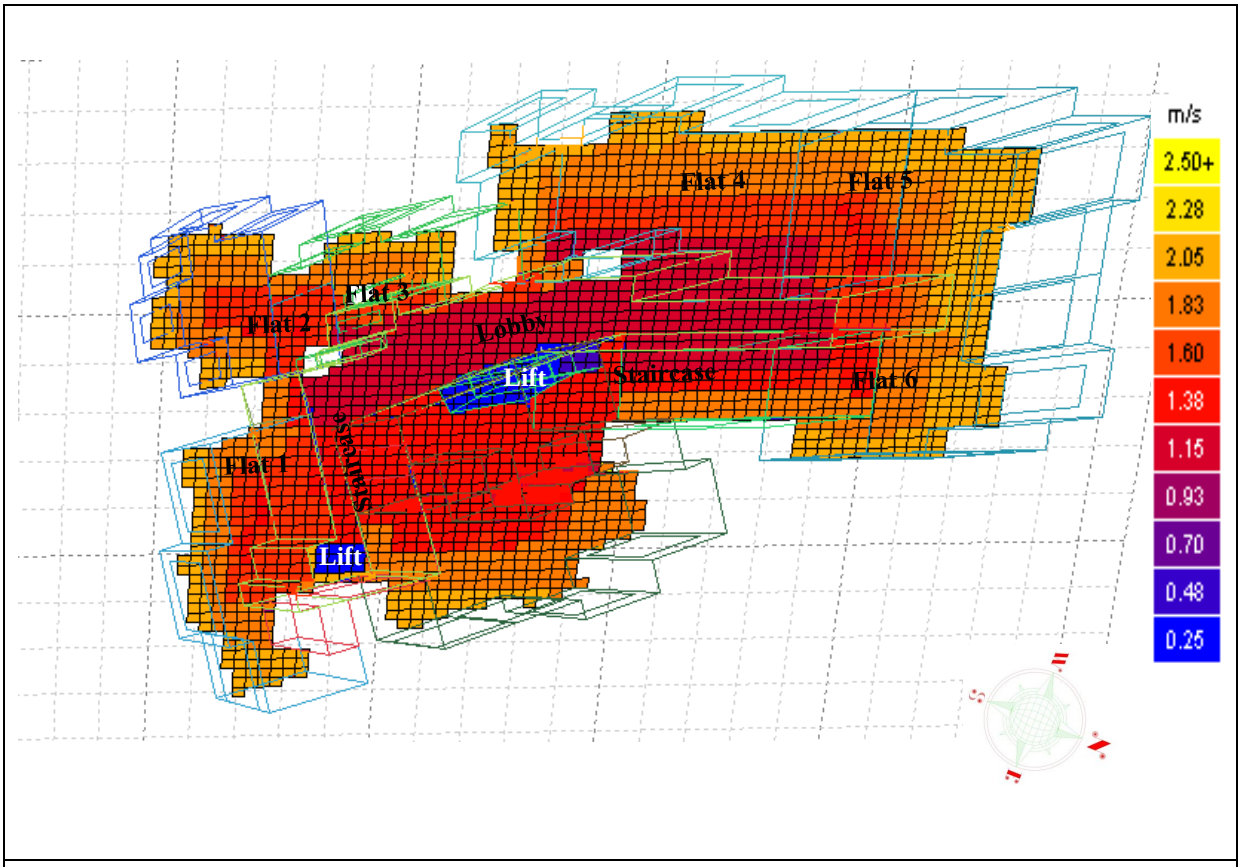


Figure 1.15: Indoor Ventilation Assessment (m/s) for typical floor plan of Eucalyptia building

0.25 m/s to 2.28 m/s wind speed can be observed for Typical floor plan of Eucalyptia Building

Indoor Ventilation Assessment –Fenelia Building

Indoor ventilation assessment for typical floor plan are shown in **Figure 1.16**

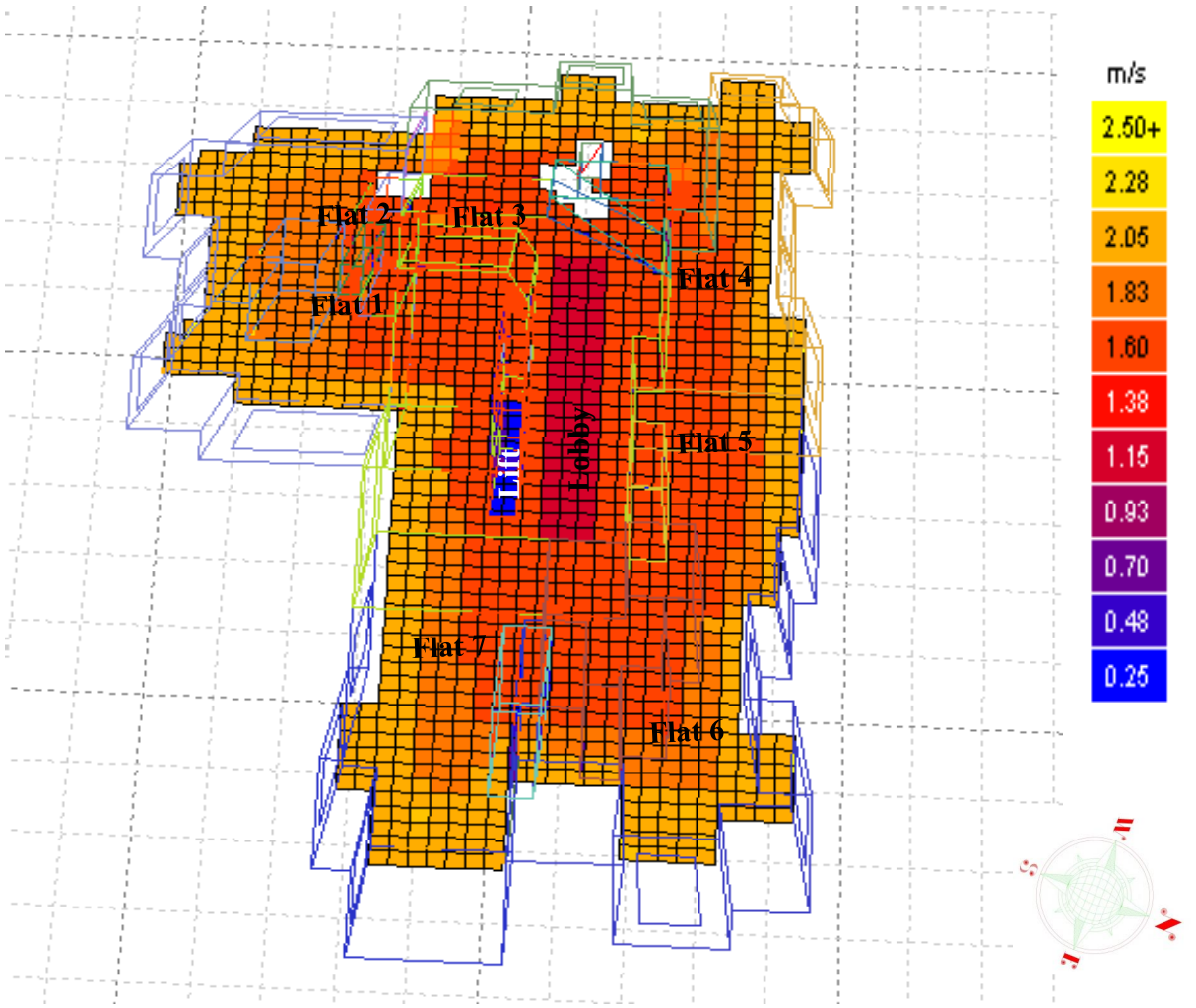


Figure 1.16: Indoor Ventilation Assessment (m/s) for typical floor plan of Fenelia building

0.25 m/s to 2.28 m/s wind speed can be observed for Typical floor plan of Fenelia Building

- ***Minimum BEE 3-star rated equipment for ventilation:***

Users would be advised to select the equipment (Ceiling fan, Air Conditioners) as per energy efficient and star rating. They would be provided with BEE 3 star rated ACs. A manual would also be provided which would highlight types of electrical equipment along with their BEE Star rating.

3.2.3 Lighting and Control Systems:

Lighting alone accounts for almost 15% of the total energy consumption in India. Lighting is an area that offers many energy efficiency opportunities in almost any Building facility, existing or new. Using efficient lighting equipment and controls is the best way to ensure lighting energy efficiency while maintaining or even improving lighting conditions. For a lighting designer, an energy efficient lighting design involves careful integration of many requirements and considerations such as Building orientation, interior Building layout, task illumination, daylight strategies, glazing specification, choice of lighting controls, etc.

- ***Lighting Controls occupancy sensors***

Occupancy or motion sensors will be provided in all public and shared spaces like conference rooms, etc. These occupancy sensors shall turn off the lighting fixtures within 15 min of occupant/user leaving the space and a manual switch for the same will also be provided.

- ***Space control***

Space control for lighting will be provided for lighting in common/shared areas. This device shall be activated either manually by a user or automatically by sensing.

- ***Exterior lighting control***

Lighting for all the exterior applications shall be controlled by a photo sensor or astronomical switch that is capable of automatically turning off the exterior lighting when daylight is available or the lighting is not required.

- ***Additional Control***

Task Lighting shall be provided in commercial Building on working desks which shall have control device integral to the luminaries or be controlled by wall mounted control device.

3.2.4 Electrical and Renewable Energy Systems:

- ***Energy efficient motors***

The motors shall be provided which conforms to IS 12615 standards and which would be energy efficient. For the proposed project, Energy efficient motors which conform to IS standards and aiding in 10% energy savings are proposed. The certificated shall also be obtained and kept on record indicating the efficiency of motor.

- ***Diesel Generator (DG) Sets***
  BEE 3 star rated DG sets are proposed in compliant proposed project.

- ***Check Metering and Monitoring***
  The proposed project is a residential cum commercial project. Hence, the metering proposed is provided at a location where each tenant could attach their services.

- ***Renewable Energy Systems***
  Solar panels are proposed for project and the solar energy generated from the project will be used for external lighting and landscape lighting and as solar water heater. The total energy savings from the proposed project using renewable energy sources is about 13 % which is more than the minimum requirement mentioned in ECBC Guidelines 2017.

3.3 Energy Savings Calculations and Measures Proposed

- Each apartment will have 3 phase DB's with RCBo.
- Copper/Aluminum Bus-bars will be provided for all power distribution boards and motor control centers used for common amenities.
- All the cables will be aluminum conductor, insulated with PVC insulation of 1100 volts grade, armored and PVC/FR sheathed.
- All flexible wires used shall be Copper conductor.
- Generators shall supply power within ten to thirty seconds upon failure of normal power supply. Residential silencers shall be provided for each DG Set. D.G. set will be acoustically insulated for noise.
- The DG set would be of capacity to run for 6 – 8 hours in case of power failure.
- Developer would prepare a manual for maintenance of DG sets. After formation of society, society members would bear the maintenance of DG sets. All the members would be made aware for the need of backup power system in case of emergency.
- Earthing system shall be designed in accordance with IS: 3043 for earthing system.
- Developer would install solar lighting in compound area.
- The maintenance of the society lighting would be carried out by society members. They would be highlighted about the importance of solar lighting and energy saving from these environment friendly measures. Developer would also assist in this activity.

- Maintenance of the solar water heater would be carried out by society. They would also be highlighted about the importance of solar water heater and energy saving from these environment friendly measures. Developer would also assist in this activity.
- A manual would be prepared by developer which would highlight types of electrical equipment along with their star rating. This manual would be shared with residents. This manual would also highlight cost saving towards using energy efficient equipment.
- Residents would be advised to select the equipment as per energy efficiency and star rating.
- Residents would be provided with 3 star ACs as per BEE guidelines. Similarly, they would be advised to use star rating equipment.
- Awareness about using AC to operate at near comfort temperature of 26 – 27^0C.
- Society member would be advised to operate half of the lifts from 11.00 pm to 6.00 am. This would aid towards energy saving.
- Use of VFDs for motive loads to ensure part of loads efficiencies and energy savings.
- Energy saving and solar saving calculations from proposed project would be as per following **Table 1.10 to Table 1.11.**

Table 1.10: Details of Energy savings calculation for proposed buildings

SR. NO.	LOAD DESCRIPTION	AVG. KW	QTY.	AVG. HRS/DAY	AVG. KWH/DAY
1.0	**SALES BLOCK:**				
b	2BHK	2.30	699.00	7.00	11,254
d	3BHK	4.48	476.00	7.00	14,927
e	4BHK	6.50	54.00	7.00	2,457
f	Commercial	6.50	6.00	7.00	273
1.2	Lifts - All tower	396.00	1.00	8.00	3,168
1.3	Common Areas Lighting / Stilit level	42.00	1.00	12.00	504
1.4	Amenities/Club House	56.00	1.00	6.00	336
1.5	Compound/Street Lighting	32.50	1.00	4.00	130
1.6	Common area small power	30.00	1.00	2.00	60

SR. NO.	LOAD DESCRIPTION	AVG. KW	QTY.	AVG. HRS/DAY	AVG. KWH/DAY
1.7	Plumbing load	222.00	1.00	8.00	1,776
	Therefore Average KWH/Day:				**34,885**
	Therefore Average KWH/Annum:				**1,27,33,120**
REDUCTION IN CONSUMPTION BY USING ENERGY SAVING MEASURES					
	By using CFL / T5 lamps for parking areas instead of conventional T8 lamps and LED for lobbies / atrium / staircases				
	Basis - lamp comparision				
	Diff between 28W T5 and 36W T8 lamp	*8 W which comes to 22%*			
	Diff between 18W CFL and 36W T8 lamp	*18 W which comes to 50%*			
	Hence overall saving can be considered as 35% for parking areas				
	Diff between 14W LED and 36W T8 lamp	*22 W which comes to 61%*			
	Hence overall saving can be considered as 60% for lobbies / staricases and atrium				
	Basis - ballast comparision				
	Watt losses for VPIT copper ballast compared to electronic ballast	*5 W which comes to 15% for T5 and 21% for CFL*			
	Hence overall saving can be considered as 18% for parking and refuge areas				
	Area	**Per day unit consumption**	**Saving percentage**	**Per day unit consumption with savings**	**Savings in units**
A	**Savings due to lamp**				
1.0	Common area lighting	504	35	328	176
2.0	Street lighting / landscape lighting	130	35	85	46
3.0	Apt & commercial lighting app - 0.75 KW - CFL	7,410	35	4,817	2,594
B	**Savings due to electronic ballast**				

SR. NO.	LOAD DESCRIPTION	AVG. KW	QTY.	AVG. HRS/DAY	AVG. KWH/DAY
1.0	Common area lighting	504	18	413	91
2.0	Street lighting / landscape lighting	130	18	107	23
3.0	Apt lighting app - 0.75 KW - CFL	7,410	18	6,076	1,334
C	**Savings due to solar lighting**				
	Providing 25% of street lighting on solar				
1.0	Street lighting / landscape lighting	130	25	98	33
D	**Solar water Heater**	1.5	1,229	0.5	922
	Savings due to use of VFD driven hydropneumatic plumbing systems and LIFTS @ 25% minimum	4,944.00	25	3,708	1,236
E	**Savings due to capacitors for common area load and club house load - Annexure attached**				953
	Therefore Average KWH/Day Saving:				**7,407**
	Therefore Average KWH/Annum Saving:				**27,03,495**
	THEREFORE AVERAGE ANNUAL ENERGY SAVINGS IN %:				**21.23%**

Table 1.11: Details of Energy savings measures for proposed buildings

Net Energy Saving Measures Considered and Calculations					
Sr. No	**Description**	**Power Saving Calculation (No of Lamps x Type of Lamp wattage x Operational hours x Days x Usage Factor)**	**Unit consumed without energy conservation (Lac Unit)**	**Unit consumed with energy conservation (Lac Unit)**	**Remarks**
1	**Car Parking Level Lights:**				
	Providing T-5 Lamps instead of T-8 fluorescent lamps.	With T-8 Lamps = 36 watts*1251Nos*10 hrs/day*365 days /1000 With T-5 Lamps = 28 watts*1251Nos*10	0.6575256	0.5114088	Replacing 36 W T-8 lamps with T-5 28 W CFL / FTL lamps

Net Energy Saving Measures Considered and Calculations					
Sr. No	**Description**	**Power Saving Calculation (No of Lamps x Type of Lamp wattage x Operational hours x Days x Usage Factor)**	**Unit consumed without energy conservation (Lac Unit)**	**Unit consumed with energy conservation (Lac Unit)**	**Remarks**
		hrs/day*365 days /1000			
2	**Staircase Lights/Lobby Lighting:**				
	Providing T-5 Lamps instead of T-8 fluorescent lamps.	With T-8 Lamps = 36 watts*3175Nos*10 hrs/day*365 days /1000. With T-5 Lamps = 28 watts*3175Nos*10 hrs/day*365 days /1000	1.66878	1.29794	Replacing 28 W T-5 lamps with 18W CFL lamps
3	**Usage of energy efficient Lifts (VVVF Non gear lifts):**				
	Energy Efficieny of VVVF motors 5% more than conventional lifts	conventional lift =30 KW*35nos*8hrs/day*365 days. VVVF lift =15 KW*35nos*8 hrs/day*365 days	30.66	28.5138	Group control of elevators with PM motors and VFDs
4	**Ventilation Load x Operational Hours x Days x Usage factor. With energy efficient motors and co sensors** **(6 hours as peak + 10 min.s Every Hour)**	35.80 kw x5 hours x 365 days x0.5	0.326675	0.117603	Demand based ventilation with Energy saving Motors for basement ventilation
5	**PHE Load x Operational Hours x Days x Usage factor**	135kw x 4 hours x 365 days x0.8	1.5768	1.26144	Energy efficiency motors for PHE systems

Net Energy Saving Measures Considered and Calculations					
Sr. No	**Description**	**Power Saving Calculation (No of Lamps x Type of Lamp wattage x Operational hours x Days x Usage Factor)**	**Unit consumed without energy conservation (Lac Unit)**	**Unit consumed with energy conservation (Lac Unit)**	**Remarks**
6	**Solar Hot water**				
	Providing solar hot water for single bathroom of each apartments. **Total No. of Apartment- 1484 Nos. Geyser load=3kW**	3kW * 1484 nos* 0.25hrs/day*300 days.	3.339	0	With the Use of solar renewable energy we are heating the water, thus no power required
	TOTAL ENERGY USE		**38.23**	**31.70**	
	Total Energy Saving			**6.53**	
% of renewable energy generated w.r.t to energy consumed			**8.73**		
% of energy saving by using energy efficient equipment and renewable energy w.r.t to energy consumed by normal equipment			**17.07**		

Table 1.12: Overall energy savings from project

Overall Project Savings	Overall Energy Savings Using Energy Efficient Equipment's and Renewable Energy
21.23 %	**17.07 %**

4.0 Conclusion & Recommendations:-

- Proposed project would be developed with following standards and codes:
  - National Building Code of India (NBC) 2016
  - ASHRAE Hand Books
  - Relevant BIS Codes & SMACNA standards
  - Air filters as per ASHRAE 52.1-1992 and 52.2-2007
  - Indoor Air Quality as per ASHRAE 62.1-2007
  - National Fire Codes (NFPA) – 2018
- The thermal transmittance values for our proposed project ranges from 0.058 - 0.059 Watts/hr/m2/°C which is lower than Max limit of 1.2 W/m^2.K.
- The thermal comfort levels for proposed buildings estimated to be about 25° C – 27° C. According to NBC 2016 the thermal comfort level should be about 26 ± 2° C which is compiled by this project.
- The SHGC value 0.077 for proposed Buildings is less than the maximum value 0.50 mentioned in ECBC Guidelines 2017.
- The proposed buildings are complying with the minimum UDI requirement 50 % mentioned in ECBC Guidelines 2017.
- AIS Ecosense Enhance - Aura Clear Glass will be used for proposed project. This glass improves energy efficiency and daylight parameters. It allows the optimum amount of light to pass. The VLT value for this glass is 0.53.
- Energy savings by using Energy efficient equipment's and renewable energy is 17.07%.
- The types of window that can be proposed is given in **Table 1.13**

Table 1.13: Types of windows can be proposed for flats

Floor	Flats	Type of room	Type of windows		
			3W	2W	Casement
Eucalyptia building					
1st Floor	2 BHK	Living	✓	✓	✓
		Kitchen	✓	✓	✓
		Bed room 1	✓	✓	✓
		Bed room 2	✓	✓	✓
		Toilet 1	✓	✓	✓
		Toilet 2	✓	✓	✓
Typical Floor (2nd to 4th and 6th to 9th and 11th to 14th and 16th to 19th and 21st to 24th and 26th to 29th and 31st to 34th floor)	2 BHK	Living	✓	✓	✓
		Kitchen	✓	✓	✓
		Bed room 1	✓	✓	✓
		Bed room 2	✓	✓	✓
		Toilet 1	✓	✓	✓
		Toilet 2	✓	✓	✓
Refuge Floor (5th; 10th; 15th; 25th; 30th , 35th & 36th floor)	2 BHK	Living	✓	✓	✓
		Kitchen	✓	✓	✓
		Bed room 1	✓	✓	✓
		Bed room 2	✓	✓	✓
		Toilet 1	✓	✓	✓
		Toilet 2	✓	✓	✓
Fenelia building					
1st Floor	2 BHK	Living	✓	✓	✓
		Kitchen	✓	✓	✓
		Bed room 1	✓	✓	✓
		Bed room 2	✓	✓	✓
		Toilet 1	✓	✓	✓
		Toilet 2	✓	✓	✓
Typical Floor (2nd to 4th and 6th to 9th and 11th to 14th and 16th to 19th and 21st to 24th and 26th to 29th and 31st to 34th floor)	2 BHK	Living	✓	✓	✓
		Kitchen	✓	✓	✓
		Bed room 1	✓	✓	✓
		Bed room 2	✓	✓	✓
		Toilet 1	✓	✓	✓
		Toilet 2	✓	✓	✓
		Living	✓	✓	✓
		Kitchen	✓	✓	✓
		Bed room 1	✓	✓	✓

Floor	Flats	Type of room	Type of windows		
			3W	2W	Casement
Refuge Floor (5th; 10th; 15th; 25th; 30th , 35th & 36th floor)	2 BHK	Bed room 2	✓	✓	✓
		Toilet 1	✓	✓	✓
		Toilet 2	✓	✓	✓