

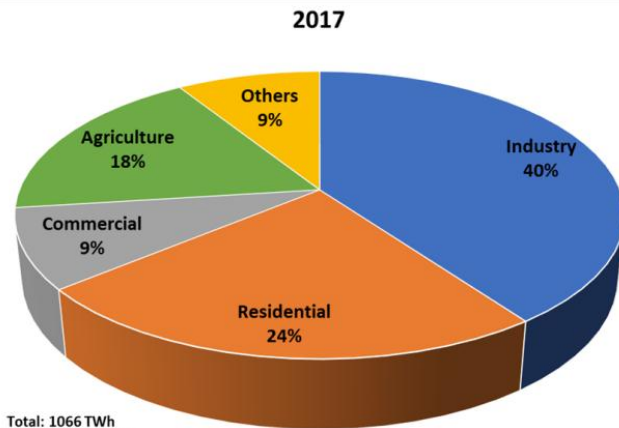


Presentation on,

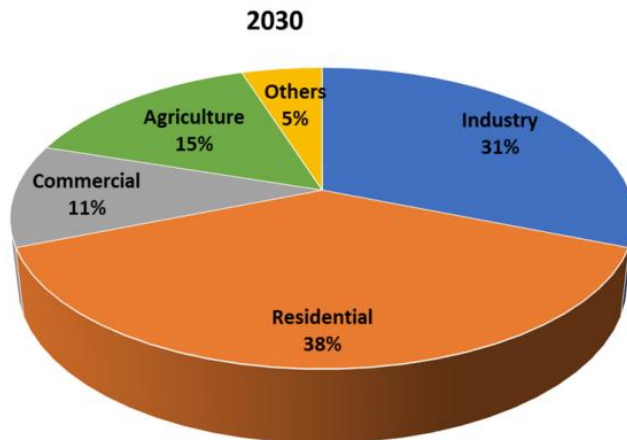
Awareness on Eco-Niwas
Samhita 2018 and its
implementation



Electricity consumption in India



Total: 1066 TWh
Source: MOSPI, Gol

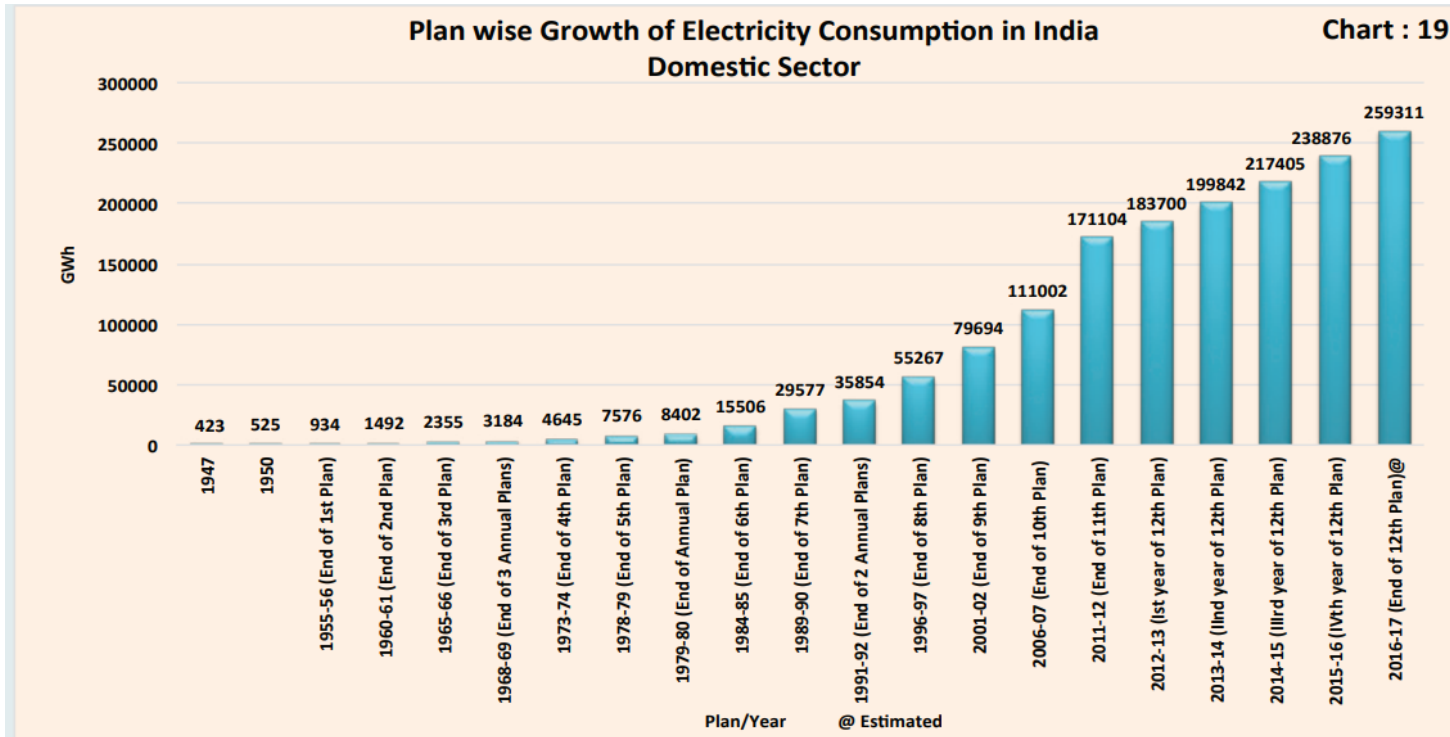


Total: 2239 TWh
Source: IESS, NITI Aayog

- Development and growth of the country is leading to **increased demand for energy**, which leads to consumption of electricity and emission of Green House Gases.
- As per the studies, building sector **consumes around 33% of total electricity** and in future, it is expected to be much higher as 50%.
- Further to this, in case of **residential sector**, its is expected to go up to **75%**.
- Increased use of decentralized **air conditioning units in home** to provide thermal comfort is a major factor of consumption of electricity and eventually, increased GHG emissions.
- Hence, there is need to have energy conservation action plan in place.

Energy scenario in India

Growth of Electricity Consumption In India- Domestic Sector



Year	1947-50	1950-60	1960-70	1970-80	1980-90	1990-2000	2000-10	2010-17
% Growth	11.87	10.14	9.73	9.18	13.41	9.08	7.21	9.57

Source: The booklet "Growth of Electricity Sector in India" published annually by Central Electricity Authority, Government of India

Vernacular



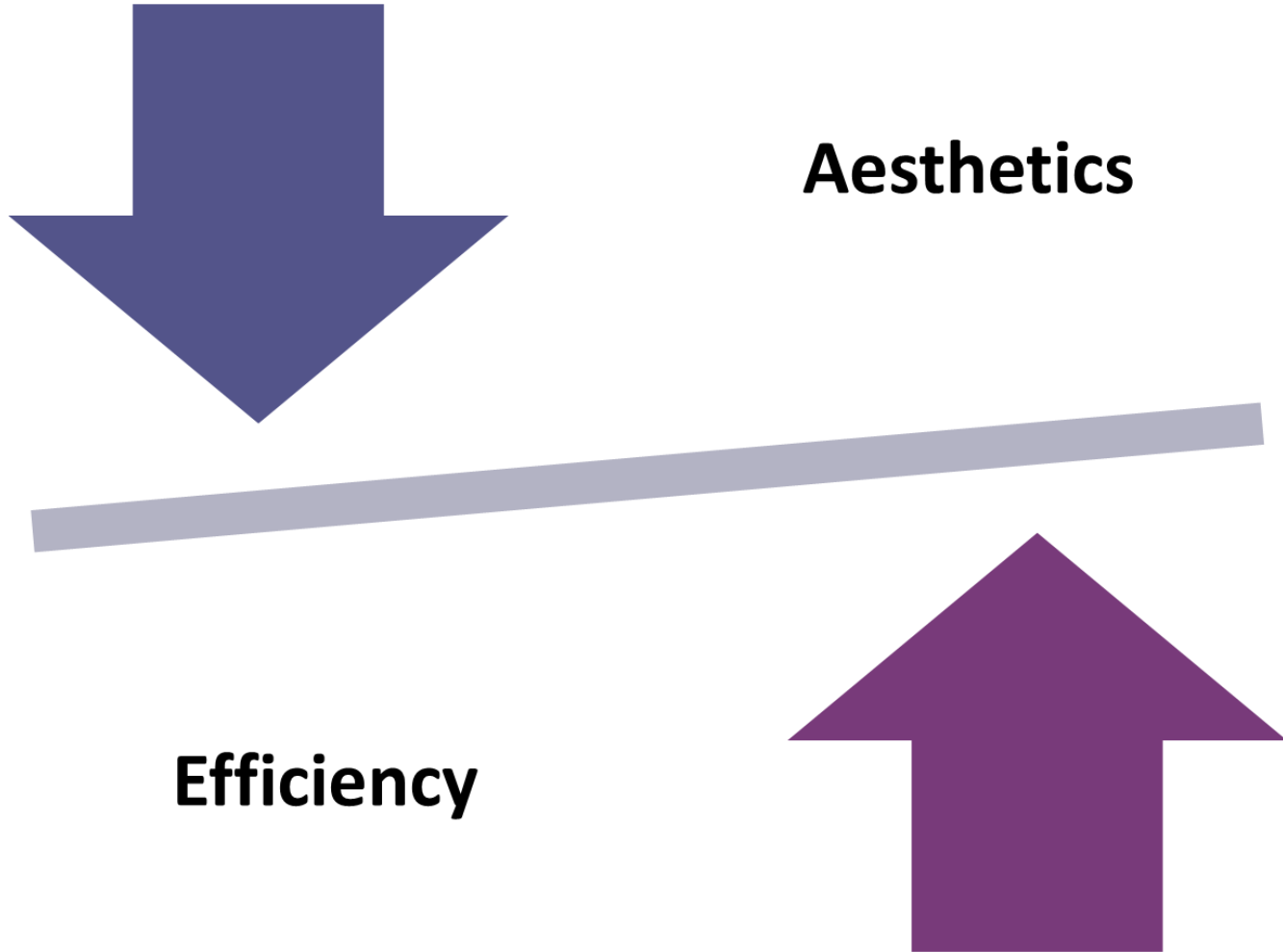
Colonial



Contemporary



Envelope Design





Energy consumption in residential buildings

Governed by

- **Architecture Design**
- **Materials that separate indoor and outdoor environment**
- **Artificial means of creating thermal and visual comfort (Use of fans, air conditioning, artificial lighting etc.)**
 - **System choice and Equipment efficiencies**
- **Electrical System efficiencies**
- **Use of Renewable Energy**

Development of Eco-Niwas Samhita (ENS)



Bureau of
Energy
Efficiency
(BEE)

Deutsche Gesellschaft
für Internationale
Zusammenarbeit
(GIZ) GmbH

giz Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

Extensive consultations
with all stakeholders

Implementation of Eco-Niwas
Samhita, in various states of
India under **Indo-German
Energy Programme- Energy
Efficiency (IGEN-EE)** in
association with BEE



Developed Eco-Niwas Samhita



Launched Eco-Niwas Samhita on
14th Dec 2018

Eco-Niwas Samhita (ENS)

Aim of ECO NIWAS SAMHITA

- Ensure daylight, natural ventilation and reduce heat gain/loss
- Promote energy efficiency

Focus area of code

- Building envelope,
- Mechanical systems and equipment
- Interior and exterior lighting systems,
- Electrical system and renewable energy.

Initially, Part-I of the Code has been launched

- Sets minimum standards for building envelope designs with the purpose of designing energy efficient residential buildings.

Eco-Niwas Samhita-Part I

Most of the households designed in recent years fail to provide thermal comfort hence, it leads to use fans and air-conditioning.



As a result, energy consumption gets increased and eventually increase in CO₂ emissions.



NEED to have climate responsive design of residences, which can lead to energy efficiency and conservation



Focus on building envelope design !

Estimated benefits of Eco-Niwas Samhita (ENS-Part I)



Energy saving

- Minimum 20% energy saving (in cooling) as compared to a typical building.

SA  Electricity E

125 billion kWh of electricity saving

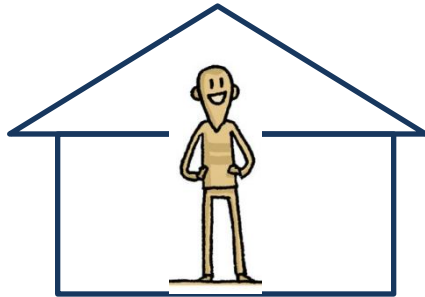


About 100 million tonnes of CO₂ equivalent abatement

Benefits for environment (for period of 2018-2030)

Benefits of Eco-Niwas Samhita (ENS-Part I)-Users

Why adopt ENS for upcoming residential buildings?



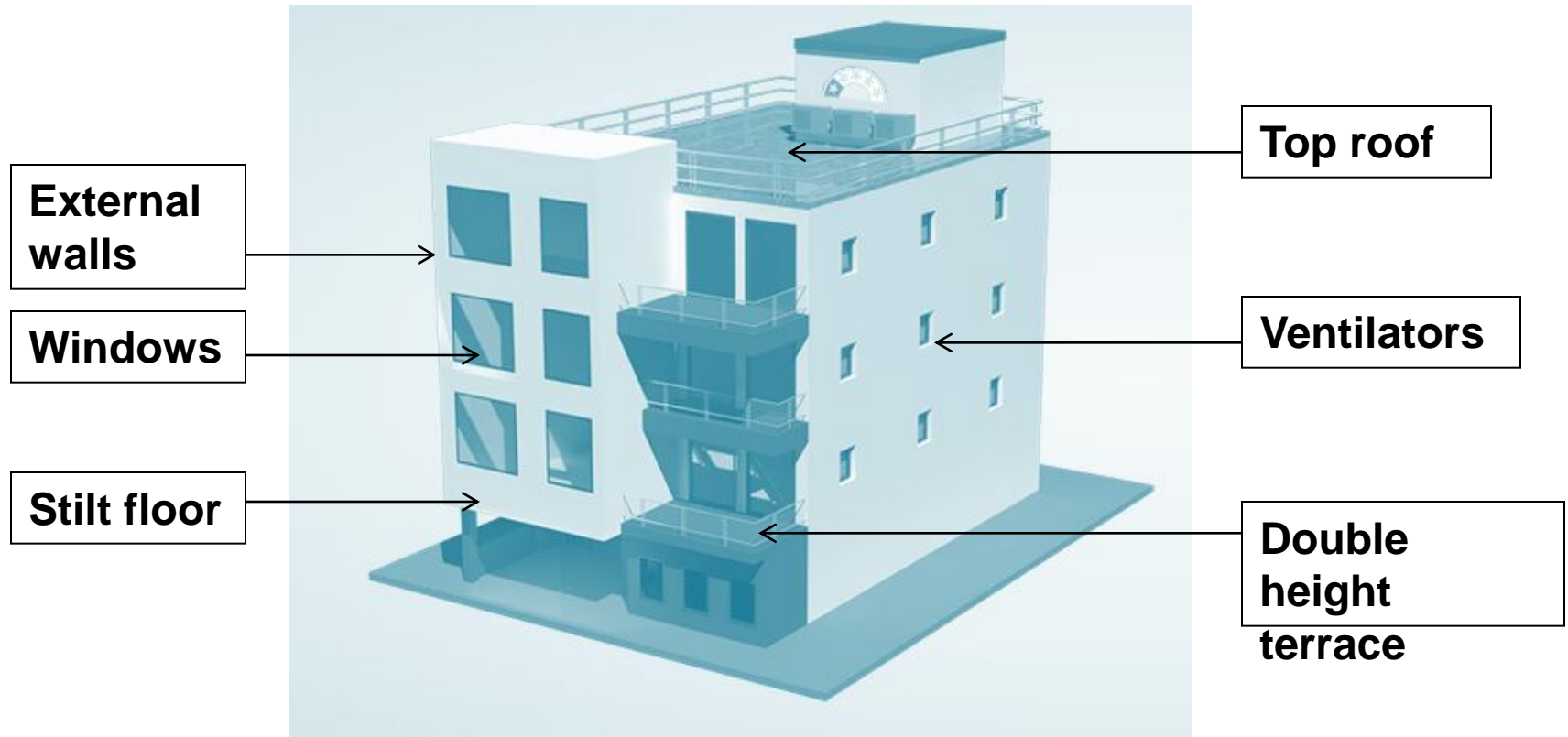
Improved thermal comfort and availability of daylight

Healthier environment

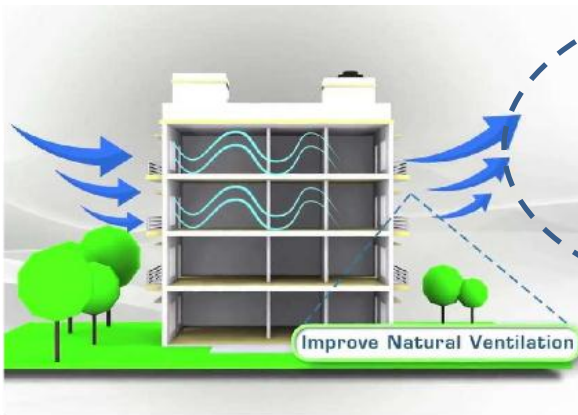
Reduced electricity bills



Components of building envelope



Focus areas of code

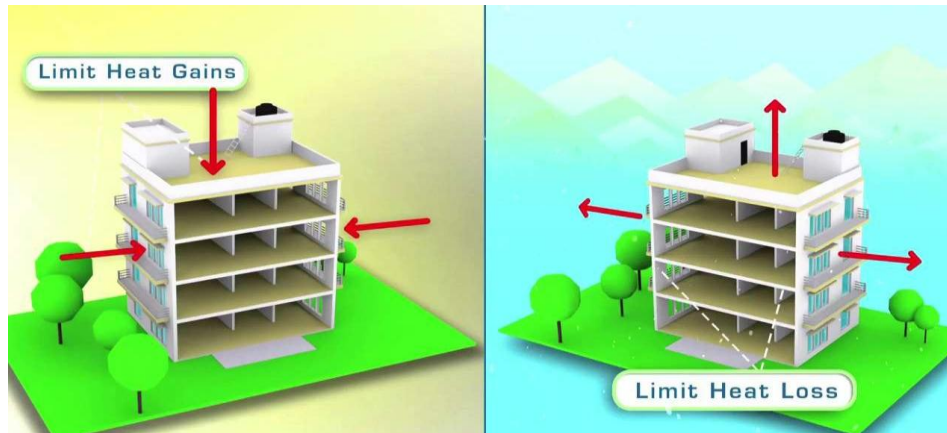


Part -1 of Code sets minimum building envelope performance standards



1. To ensure adequate natural ventilation potential

2. To ensure adequate day light

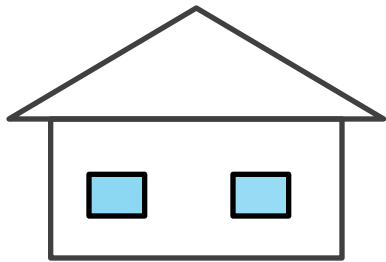


3. Limit heat gains / heat loss (Residential Envelope Transmittance Value)(RETV)

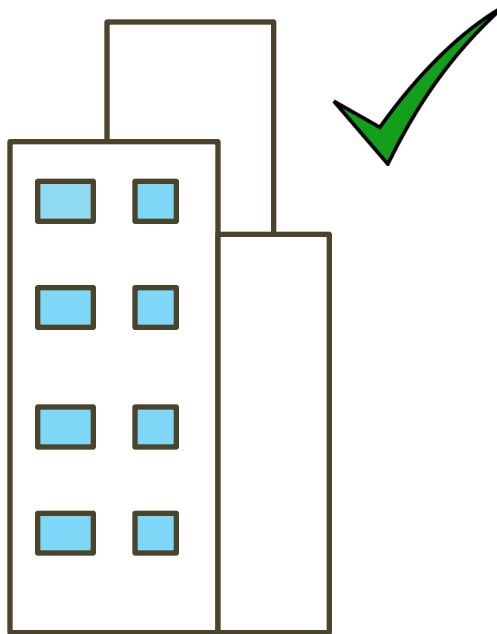
Scope of ENS code

Code is applicable to –

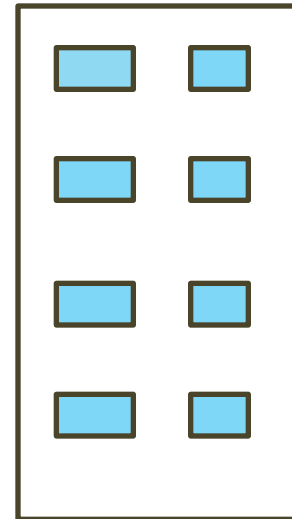
- ✓ 'Residential buildings' built on a plot area $\geq 500 \text{ m}^2$
- ✓ Residential part of mixed land-use building projects, built on plot area of $\geq 500 \text{ m}^2$



One or two family private dwellings

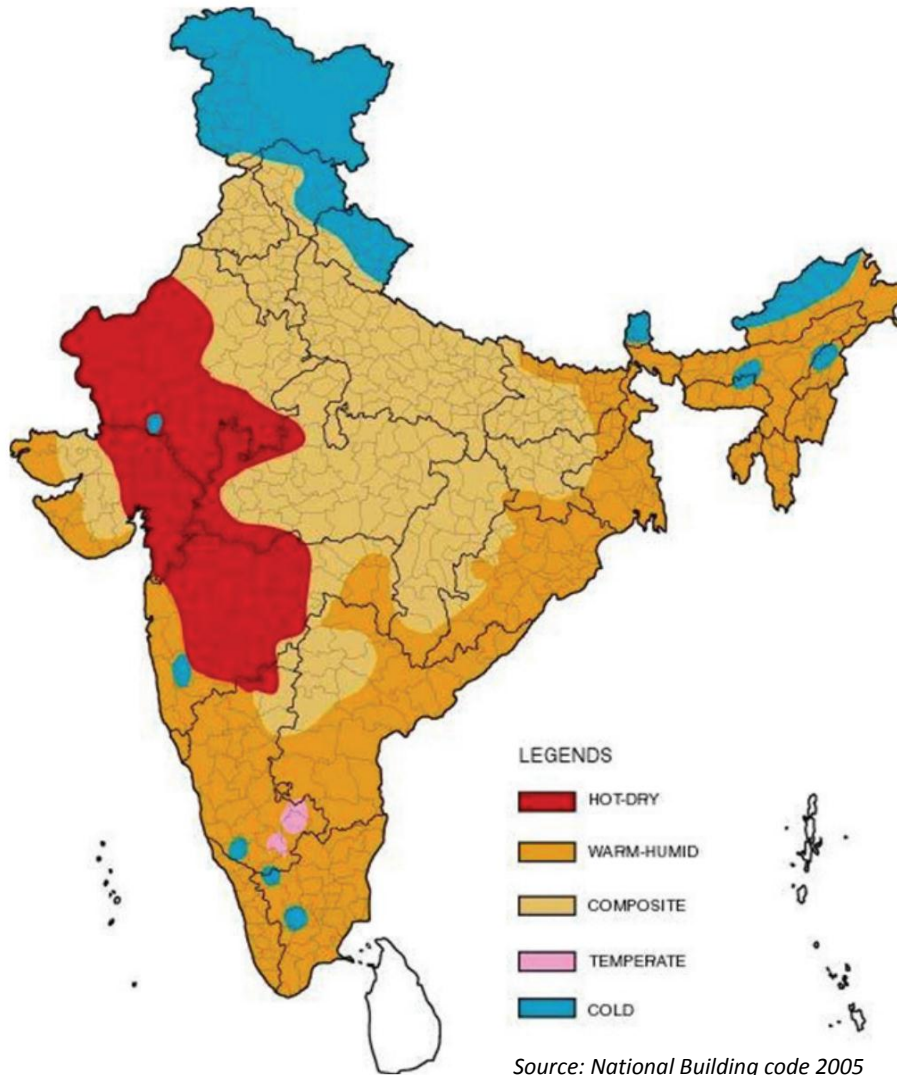


Apartment houses



- Hotels
- Lodging and rooming houses
- Dormitories

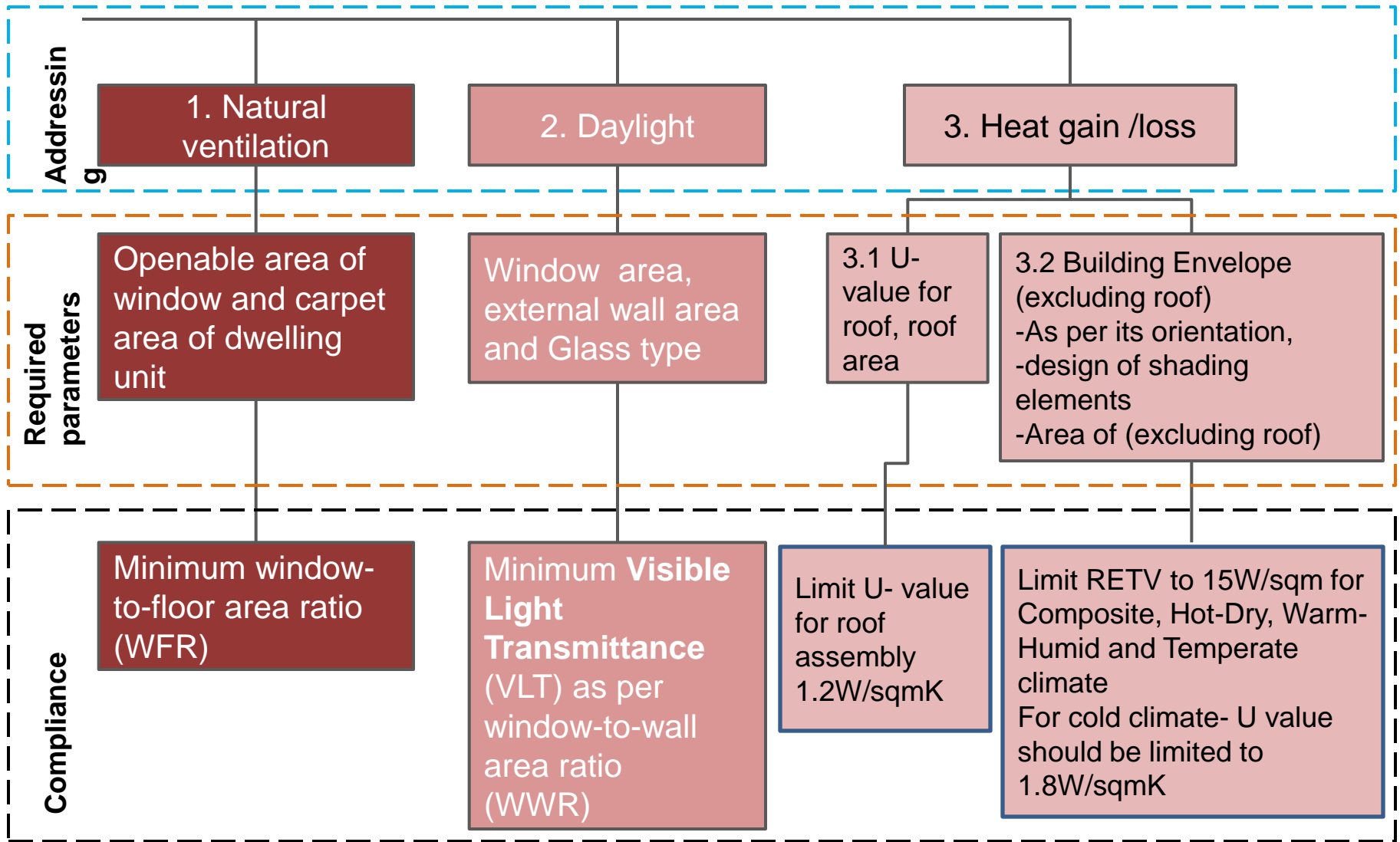
Climate zone map of India



- Code compliance has taken into account variations in climate zone of India.

Source: National Building code 2005

Code provisions



Code provisions-Natural Ventilation

Addressing

1. Natural ventilation

Required parameters

Openable area of window and carpet area of dwelling unit

Compliance

Minimum window-to-floor area ratio (WFR)



NATURAL VENTILATION

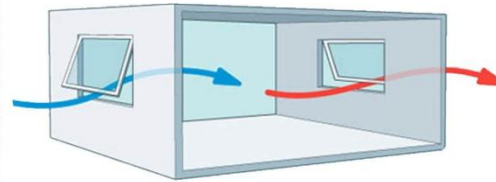
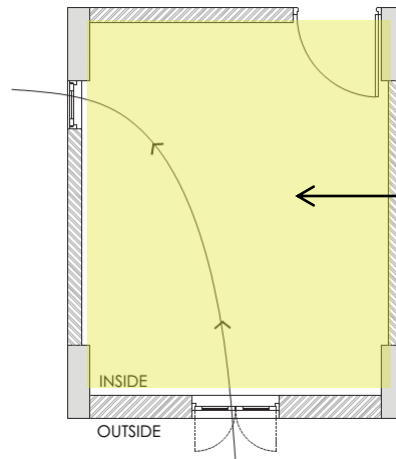


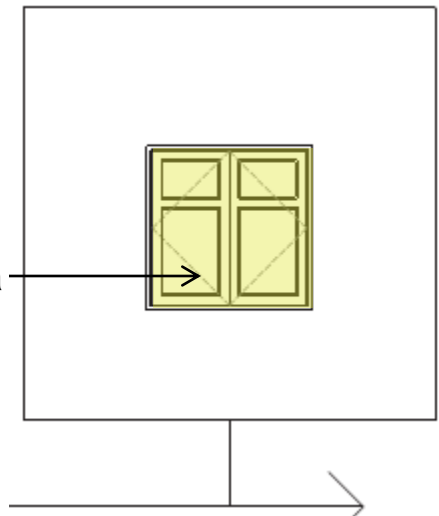
Image for natural ventilation



Room plan

Carpet area

Openable area of window



Elevation

Code provisions-Natural Ventilation

Addressing

1. Natural ventilation

Required parameters

Openable area of window and carpet area of dwelling unit

Compliance

Minimum window-to-floor area ratio (WFR)

Openable Window-to-Floor Area Ratio (WFR_{op})

Provision: Minimum openable window-to-floor area ratio (WFR_{op}) with respect to the climate zone shall not be less than given in Table

It is the ratio of openable area ($A_{openable}$) to the carpet area (A_{carpet}) of dwelling unit

$$(WFR_{op}) = \frac{(A_{openable})}{(A_{carpet})}$$

Climatic zone	Minimum WFR_{op} (%)
Composite	12.50
Hot-Dry	10.00
Warm-Humid	16.66
Temperate	12.50
Cold	8.33

Code provisions-Daylight

Addressing

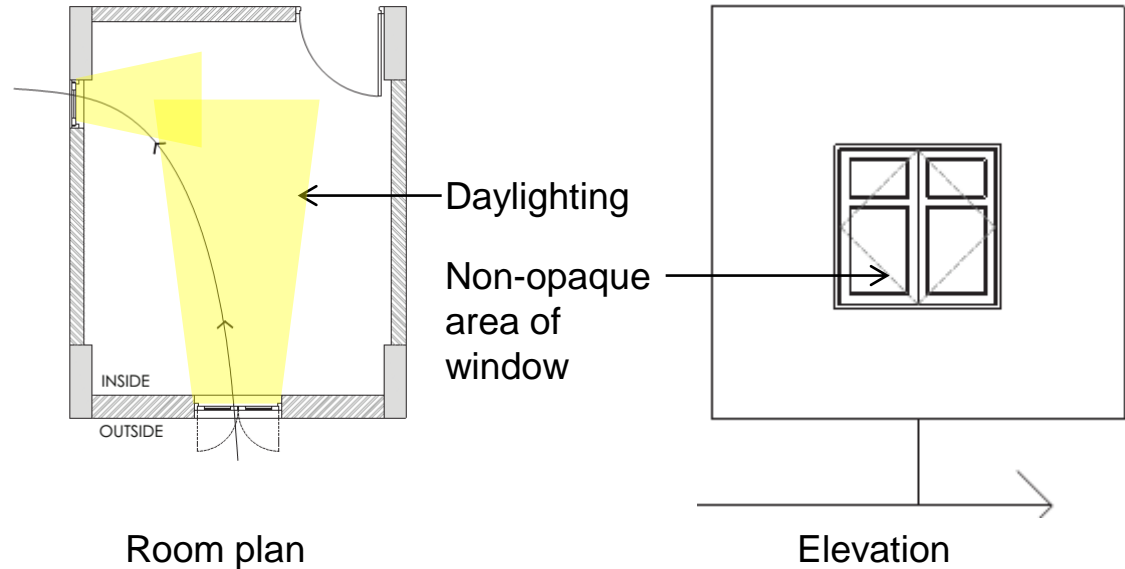
2. Daylight

Required parameters

Window area, external wall area and Glass type

Compliance

Minimum Visible Light Transmittance (VLT) as per window-to-wall area ratio (WWR)



Visible Light Transmission (VLT)
Fraction of visible light transmitted through the glazing and affects daylight and visibility

High VLT = more daylight

Code provisions-Daylight

Addressing

2. Daylight

Required parameters

Window area, external wall area and Glass type

Compliance

Minimum Visible Light Transmittance (VLT) as per window-to-wall area ratio (WWR)

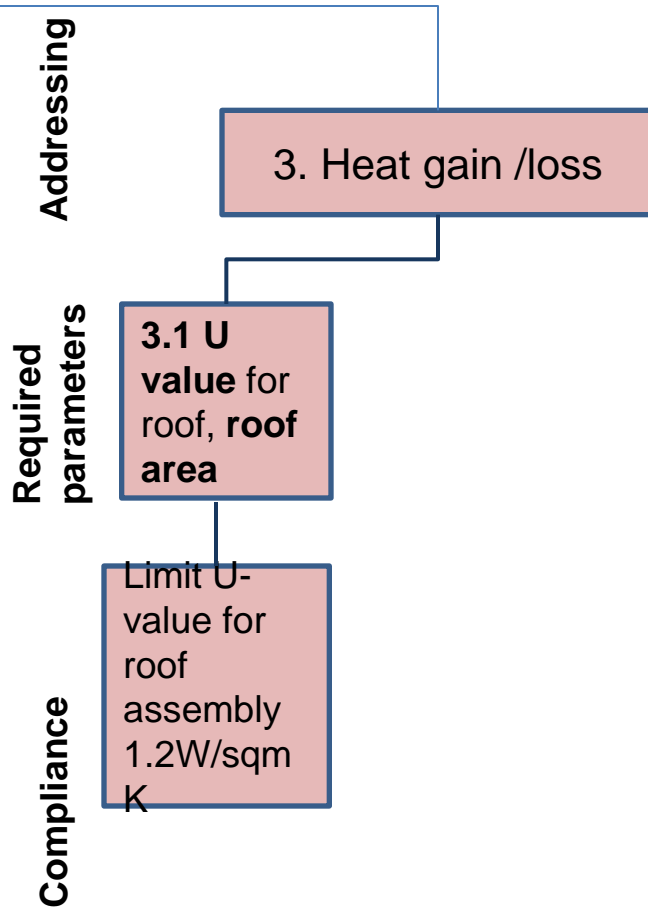
Provisions- Minimum VLT of the glass used in non-opaque building envelope components (transparent/translucent panels in windows, doors, etc.) shall comply with the requirements **with respect to the window-to-wall ratio (WWR) as given in table**

WWR is the ratio of the area of non-opaque building envelope components of dwelling units to the envelope area (excluding roof) of dwelling units.

$$(WWR) = \frac{(A_{\text{non-opaque}})}{(A_{\text{envelope area}})}$$

WWR	Minimum VLT
0 - 0.30	0.27
0.31 - 0.40	0.20
0.41 - 0.50	0.16
0.51 - 0.60	0.13
0.61 - 0.70	0.11

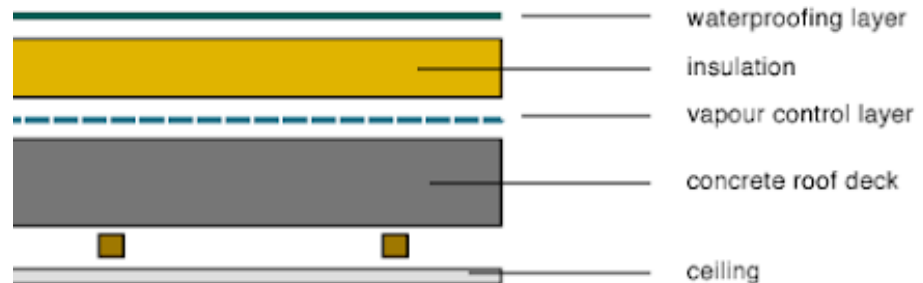
Code provisions-Roof Assembly



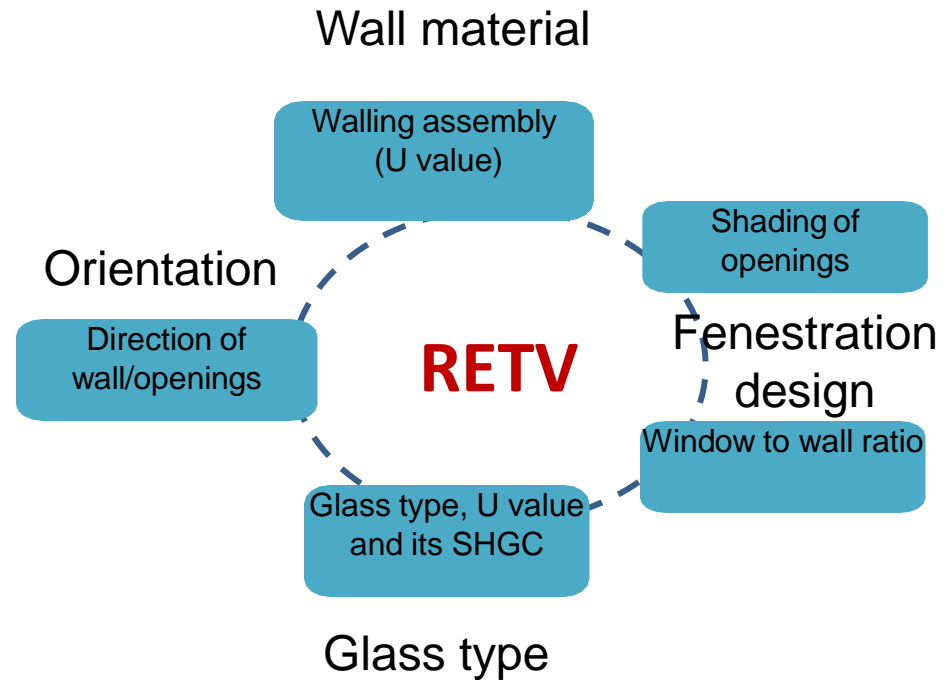
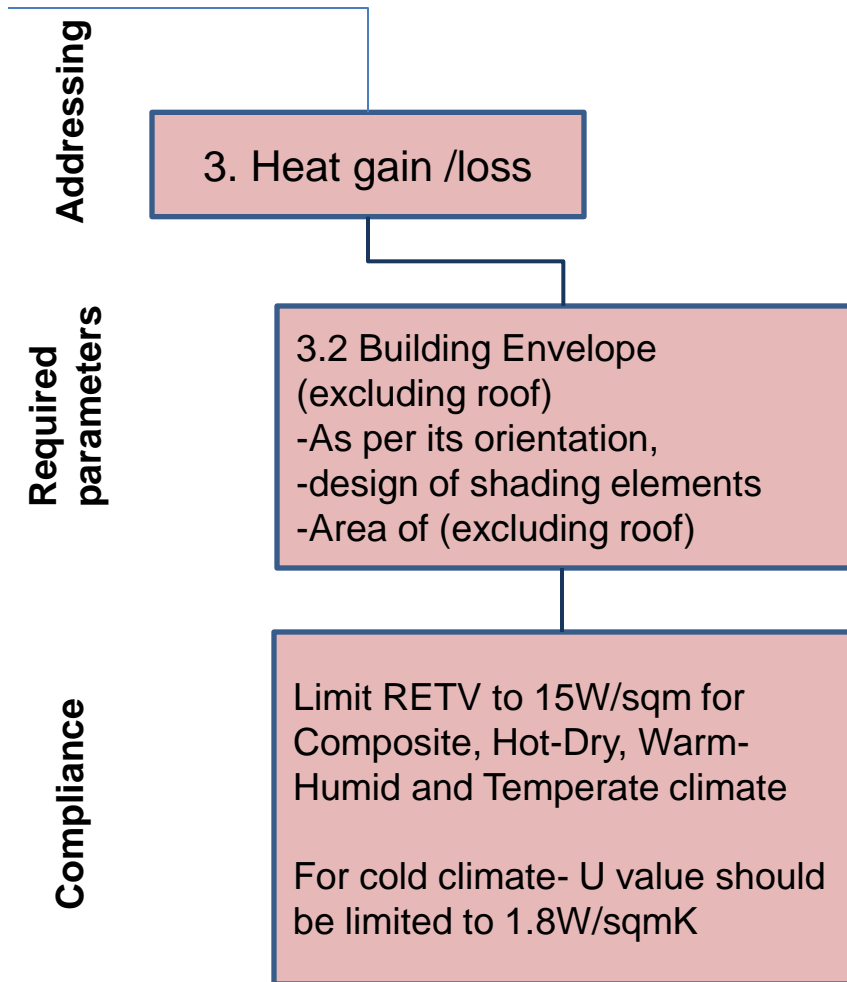
Provision- Thermal transmittance of roof (U value) shall comply with the maximum value of 1.2 W/m².K.

Thermal transmittance, also known as U-value, is the rate of transfer of heat (in watts) through one square meter of a structure divided by the difference in temperature across the structure. It is expressed in watts per square meter per Kelvin, or W/m²/K

The lower the U-value, the lower is the heat gain/loss in the building.



Code provisions-Building Envelope (Except roof)



Residential envelope transmittance value-RETV

- Residential envelope heat transmittance (RETV) is the net heat gain rate (over the cooling period) through the building envelope (excluding roof) of the dwelling units divided by the area of the building envelope (excluding roof) of the dwelling units.
- Its unit is W/m^2 .
- *Limiting the RETV value helps in reducing heat gains from the building envelope, thereby improving the thermal comfort and reducing the electricity required for cooling.*

Provisions - RETV for the building envelope (except roof) for climate zones, namely,

- *Composite Climate, Hot-Dry Climate, Warm-Humid Climate, and Temperate Climate, shall comply with the maximum **RETV19 of 15 W/m^2** .*
- *For cold climate shall comply with the maximum **RETV of 1.8 $W/m^2.K$** .*

Compliance calculations RETV

$$RETV = \frac{1}{A_{envelope}} \times \left[\begin{array}{l} \left\{ a \times \sum_{i=1}^n \left(A_{opaque_i} \times U_{opaque_i} \times \omega_i \right) \right\} \\ + \left\{ b \times \sum_{i=1}^n \left(A_{non-opaque_i} \times U_{non-opaque_i} \times \omega_i \right) \right\} \\ + \left\{ c \times \sum_{i=1}^n \left(A_{non-opaque_i} \times SHGC_{eq_i} \times \omega_i \right) \right\} \end{array} \right]$$

....1 **Walling assembly and its orientation**

....2 **Thermal conductance of glass/ non-opaque area and its orientation**

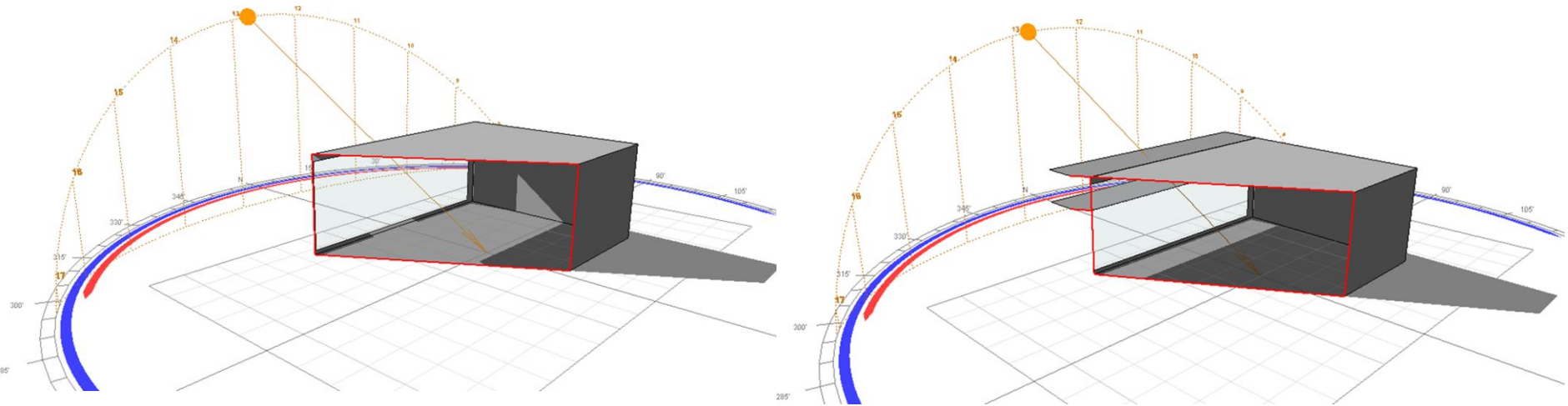
....3 **Solar Heat Gain Coefficient of glass/ non-opaque area, shading element and its orientation**

Where

w

orientation factor of respective opaque and non-opaque building envelope components; it is a measure of the amount of direct and diffused solar radiation that is received on the vertical surface in a specific orientation

Effective of shading device on SHGC



SHGC Equivalent is the SHGC for a non-opaque component with a permanent external shading projection (overhang and side fins).

Step by Step Code compliance

For **Composite, hot-Dry, Warm-humid, and temperate Climate** compliance as follows-

1. **Openable window-to-floor area ratio shall comply with the minimum *WRF* values .**
2. **Visible light transmittance (VLT) of non-opaque building envelope components shall comply with the minimum VLT as per WWR**
3. **Thermal transmittance of roof shall comply with the maximum *U*-value of 1.2 W/m².K.**
4. **Residential envelope transmittance value (RETV) for building envelope (except roof) shall comply with the maximum **RETV of 15** W/m².**

Step by Step Code compliance

For **Cold Climate** compliance as follows-

1. **Openable window-to-floor area ratio shall comply with the minimum *WFR* values.**
2. **Visible light transmittance (VLT) of non-opaque building envelope components shall comply with the minimum VLT values as per WWR**
3. **Thermal transmittance of roof shall comply with the maximum *U* value of 1.2 W/m².K**
4. **Thermal transmittance of building envelope (except roof) for cold climate shall comply with the maximum *RETV* value of 1.8 W/m².K**

Tool to check ENS compliance

Java based ENS compliance check tool has been developed to check compliance for residential project.

Climate zones of India

India can be broadly categorised into 5 climatic zones, with the following characteristics:

Climate Zone	Mean monthly max. temp.	Mean monthly relative humidity
Hot dry	Above 30°C	Below 55%
Warm humid	Above 30°C	Above 55%
Temperate	25-30°C	Above 75%
Cold	Below 25°C	All values
Composite	Does not have a predominant season for more than six months	

LEGENDS

- HOTDRY
- WARMHUMID
- COMPOSITE
- TEMPERATE
- COLD

Available on Bureau of Energy Efficiency's website for download.

Link - <https://beeindia.gov.in/content/ecbc-residential>

Tool to check ENS compliance

Entre data related to building envelope – its material, area, orientation, shading element, glazing type etc.

Wall Construction Details:

Name: North wall | Define Wall: Properties | Wall Layers: | Thickness (mm): 0 | Uvalue (W/m².K): 1.8 | Add Layer

S.No.	Wall Layer	Thickness (mm)	R Value (K.m ² /W)
No content in table			

Wall Area Details:

Wall Construction: North wall | Orientation: N (337.6° ~) | Height (m): 23 | Width (m): 45 | Area (m²): 1035.0 | Add Wall

S.No.	Wall Name	Orientation	Height(m)	Width(m)	Area(m ²)	Delete
1	North wall	N (337.6° - 223°)	23.0	45.0	1035.0	■

HELP !

- Wall definition
- Wall construction
- Wall orientation
- Wall dimensions

Please enter the wall height and width for each orientation of the wall.

- Wall height:** This is the overall height of the wall, including openings such as windows and doors, measured vertically from the top of the floor to the top of the roof.
- Wall width:** This is the overall width of the wall, including openings such as windows and doors, measured horizontally from outside surface to outside surface.

****Note:** Columns, beams and slabs of RCC framed structures are included in the wall area calculation. However, their U-value is neglected in the wall definition (see wall definition). However, if an entire wall is made of RCC, then it will need to be defined and its area entered in the tool.

- Gross Wall area:** This is the overall area off a wall, including openings such as windows and doors, measured horizontally from outside surface to outside surface and measured vertically from the top of the floor to the top of the roof. It will be calculated automatically after filling the wall height and width.

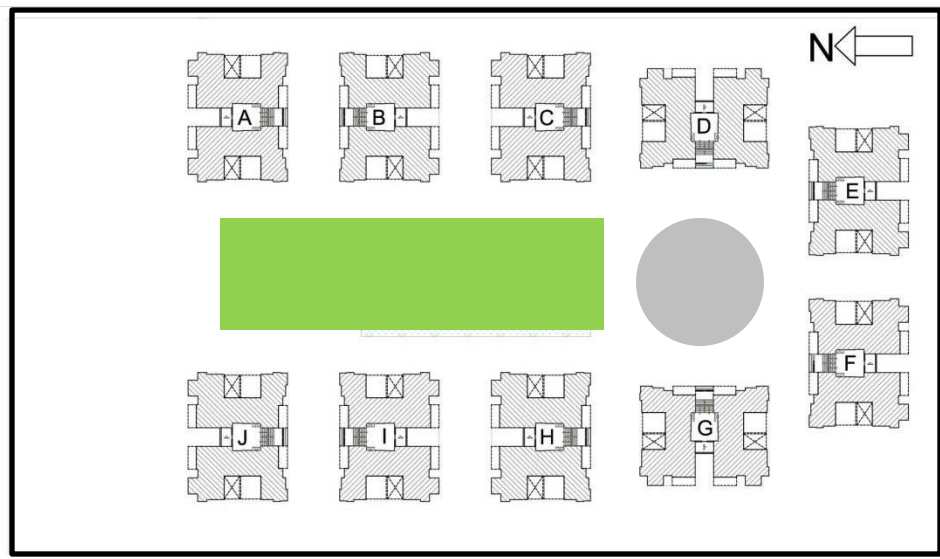
Compliance can be viewed for each building and detailed report can be generated.

Case example to understand ENS compliance and suggestions to comply with ENS

Case example to understand ENS compliance

Project Details-

Type of project	Stand alone building with P+5 structure
No of Dwelling Units	10 Nos. (Building A to J)
Types of Dwelling Units	3BHK
Location	Nagpur
Climate	Composite
Latitude	19.22 EN



Site layout

Methodology to identify typical dwelling unit

Step 1

- Check building type (residential/ commercial) while calculating compliance

Step 2

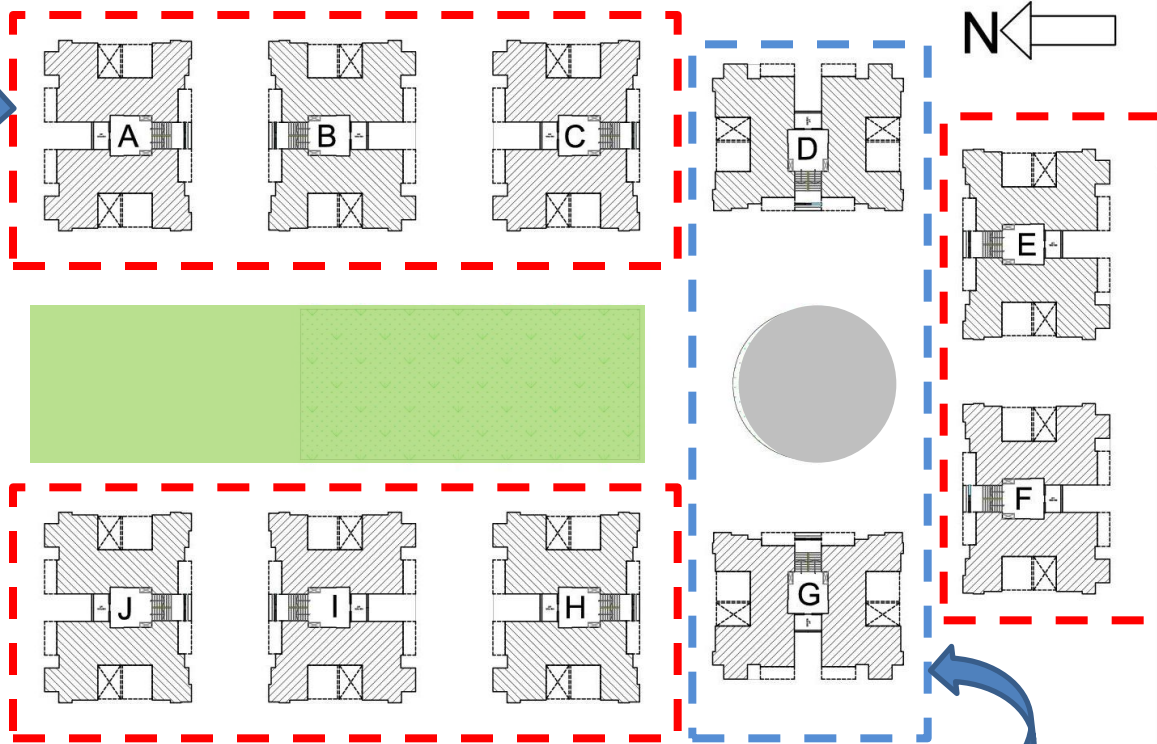
- Identify typical building with respect to its planning
- Check orientation of typical building

Step 3

- Further, check configuration of dwelling units in the identified typical building.
- Understand number of various type of dwelling units

First identify typical building

Building A,B,C, E, F J, H, I has same layout and orientation



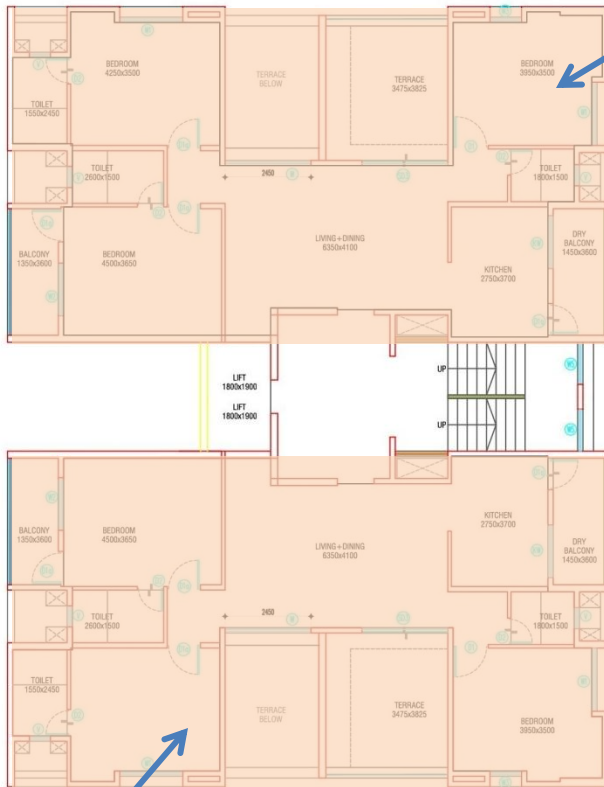
Hence, ENS compliance to be checked for all flats with different orientation in Building A and D

Building D and G has same layout as of A, however, have different orientation

However, here we will be demonstrating compliance calculations for only one sample residential unit type in Building A.

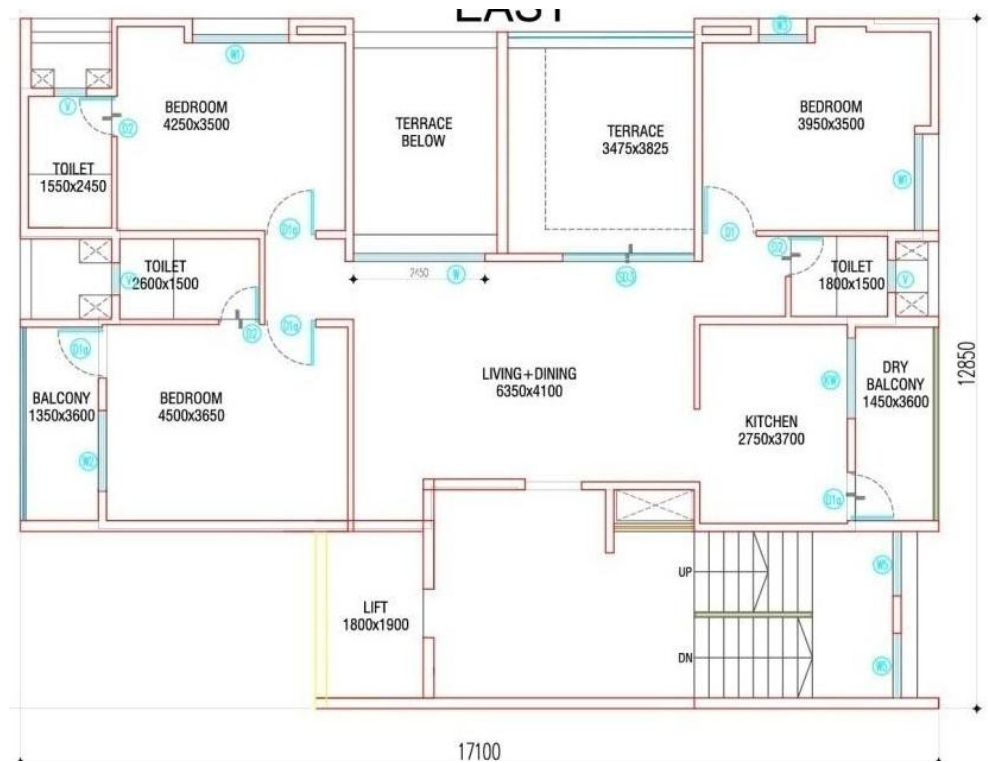
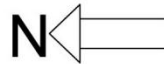
Identify typical dwelling unit

3 BHK



3 BHK

BUILDING A



FLOOR PLAN OF TYPICAL UNIT

A1

Building envelope details of the flat

Type of envelope	Details of assembly along with type of materials
1. Wall assembly	230mm solid burnt clay brick with 20mm external cement plaster and 15mm internal gypsum plaster
2. Roof assembly	180 mm thick of RCC slab, with 25mm dense concrete on top, 100 mm thick brick-bat coba, 15mm thick finished with IPS flooring over 25mm concrete (laid to slope)
3. Windows and Sliding doors (opening in terraces)	5mm thick, single clear glass with aluminium powder coated frames.
4. Doors	40mm thick factory press laminated door
5. Shading elements	No weather shades provided for windows/ glazed doors

ENS compliance check

After entering all applicable details of Building-A in ENS Compliance check tool, following results have been derived-

S/No.	Code provisions	Calculated values for Building -A	Compliance required as per ENS	Status of Compliance
1	WFR (Window to Floor are Ratio)	16.48	12.5	Compliant
2	VLT (Visible Light Trasmision)	85.0 %	27.0 %	Compliant
3	U_{roof} (Thermal Transmittance of Roof)	2.06 W/m ² K	1.2 W/m ² K	Non-Compliant
4	RETV (Residential Envelope Transmittance Value)	17.44	15.0	Non-Compliant

Result:

1. Opening sizes and type (two track windows) of window/ door are appropriate therefore result for WFR is compliant.
2. Window –to-wall ratio and choice of glass having an appropriate VLT and U value hence, VLT complies with recommended value.

However, modifications are required in flat A1 to comply with ENS ie to achieve compliant value for U_{roof} and RETV.

Suggested modifications in Roof of Building-A

Roof Name	Layer	U-Value (W/...
R1	1. Cement screed [15.0 mm]	2.062
	2. Concrete (laid to slope)[25.0 mm]	
	3. Solid burnt clay brick (1920 kg/m3)[100.0 mm]	
	4. Dense concrete (2410 kg/m3)[25.0 mm]	
	5. RCC slab[180.0 mm]	
	1. Cement screed [15.0 mm]	

As is Roof Assembly



- Consider over-deck insulation for roof.
- Calculate U value for roof assembly.

- Apply modified U value to respective area of Roof.
- Calculate overall U value for Roof and check with compliance requirement.

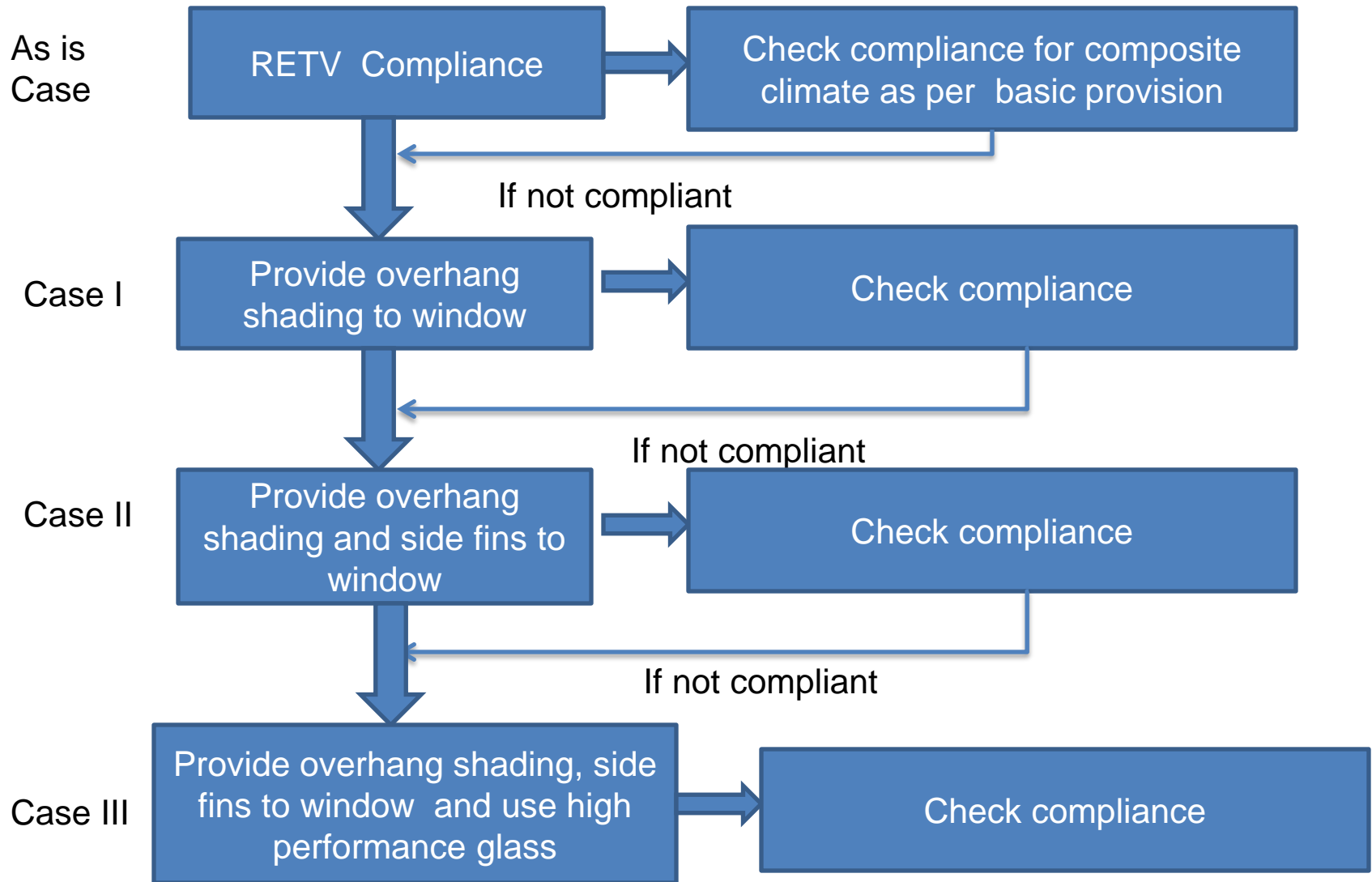
Modified Roof Assembly



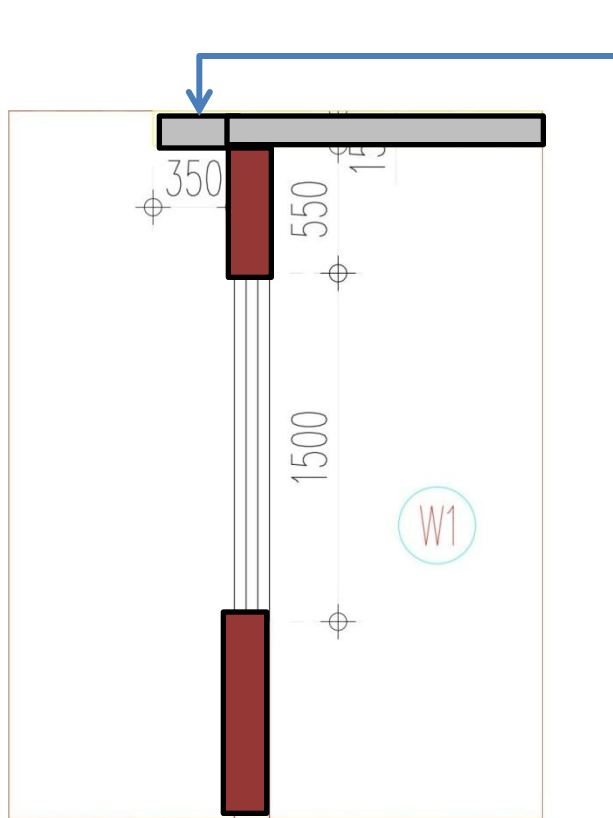
Roof Name	Layer	U-Value (W/...
R1	1. Cement screed [15.0 mm]	0.555
	2. Concrete (laid to slope)[25.0 mm]	
	3. Expanded polystyrene (16 kg/m3)[50.0 mm]	
	4. Solid burnt clay brick (1920 kg/m3)[100.0 mm]	
	5. Dense concrete (2410 kg/m3)[25.0 mm]	
	6. RCC slab[180.0 mm]	



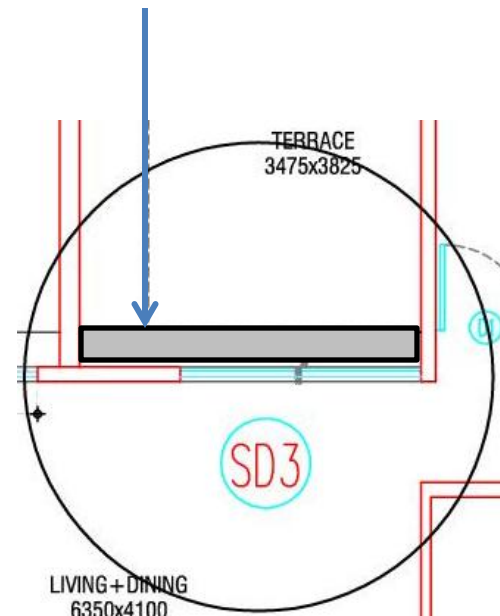
Suggestions to provide compliant RETV



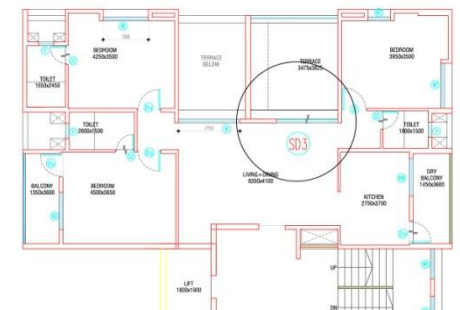
Case I: Provide 350 mm overhang for windows/ doors



Assume 350mm overhang



Floor Plan



Key Plan

Cross section of over hang shading

Compliance check for RETV for Case-I

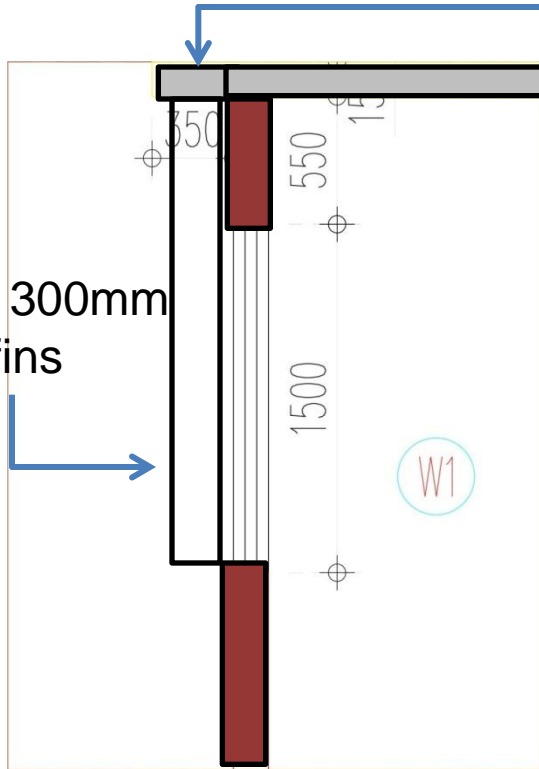
Eco-Niwas Samhita Compliance Result			
Block A			
	Calculated	Criteria	Status
WFRop (Window to Floor Area Ratio)	16.48	12.5	Compliant
VLT (%) (Visible Light Transmittance)	85.0	27.0	Compliant
Uroof (W/m ² .K) (Thermal Transmittance -Roof)	0.56	1.2	Compliant
RETV (W/m ²) (Residential Envelope Transmittance Value)	16.55	15.0	Non-Compliant

Result:

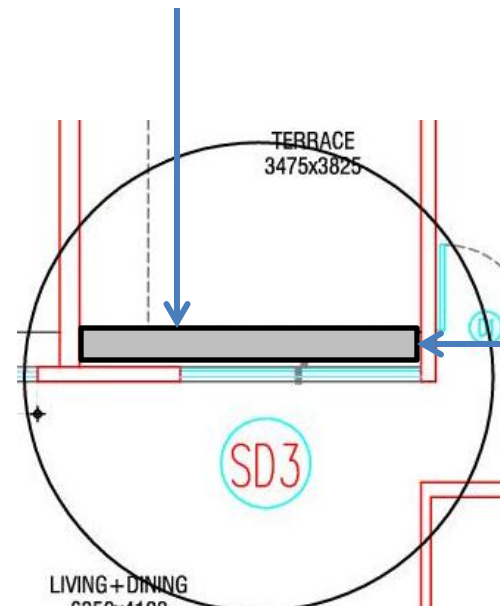
- RETV for Case-I is 16.55 W/m^2 , which is less than RETV of As is case (17.44 W/m^2), however **non-compliant as per ENS requirements**.
- Hence, further modifications in building envelope material is required to comply with RETV.

Case II: Provide 350mm overhang and 300mm vertical fin for windows/doors

Assume 350mm overhang

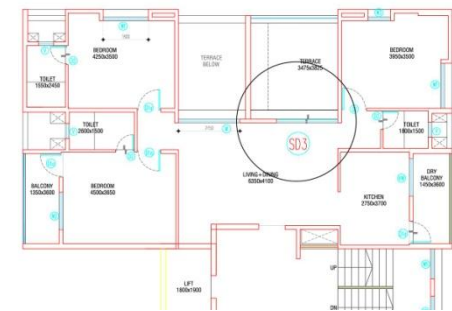


Assume 300mm vertical fins



Assume 300mm vertical fins

Floor Plan



Kye Plan

Cross section of over hang shading

Compliance check for RETV in case of Case-II

Eco-Niwas Samhita Compliance Result			
Block A			
	Calculated	Criteria	Status
WFRop (Window to Floor Area Ratio)	16.48	12.5	Compliant
VLT (%) (Visible Light Transmittance)	85.0	27.0	Compliant
Uroof (W/m ² .K) (Thermal Transmittance -Roof)	0.56	1.2	Compliant
RETV (W/m ²) (Residential Envelope Transmittance Value)	15.87	15.0	Non-Compliant

Result:

- RETV for Case-II is 15.87 W/m^2 , which is less than RETV of As is case (17.44 W/m^2), **however non-compliant as per ENS requirements.**
- **Hence, further modifications in building envelope material is required to comply with RETV.**

Provide single glazed high-performance glass

GLASS DETAILS			LIGHT FACTORS			ENERGY FACTORS		
COLOUR SHADE	BRAND	CODE	TRANSMISSION%	REFLECTION%		SOLAR FACTOR (SF)	SHADING CO-EFFICIENT (SC)	U VALUE (W/ SQM K)
				EXTERNAL	INTERNAL			
SINGLE GLAZED UNIT								
Light Gold	Reflectasol		32	45	54	0.5	0.58	5.7
Dew Drop	Antelio Plus	ST 150	51	18	17	0.54	0.62	5.6
Sparkling Ice	Antelio Plus	ST 167	65	19	19	0.66	0.75	5.6
Graphite	Cool-lite	ST 136	37	22	18	0.42	0.48	5.5
Clear Cosmos	Evo	ET 125	28	27	9	0.29	0.33	3.8
Neutral	Evolite	ET 150II	50	13	11	0.5	0.58	5(0.88)

5mm thick, High performance glass (with lower U value and SHGC) with aluminium powder coated frames.

Glass manufacturer company is Saint-Gobain.

Compliance check for RETV in case of Case-III

Eco-Niwas Samhita Compliance Result			
Block A	Calculated	Criteria	Status
WFRop (Window to Floor Area Ratio)	16.48	12.5	Compliant
VLT (%) (Visible Light Transmittance)	36.33	27.0	Compliant
Uroof (W/m ² .K) (Thermal Transmittance -Roof)	0.56	1.2	Compliant
RETV (W/m ²) (Residential Envelope Transmittance Value)	14.88	15.0	Compliant

Result:

- RETV for Case-III is 14.88 W/m², which is COMPLAINT with ENS requirements. Hence, Case-III is compliant with all requirements of ENS

Summary of all cases of building envelope

	WFR (openable)	VLTV%	U roof (W/m ² K)	RETV (W/m ²)
ENS compliance with respect to composite climate	12.5	27	1.2	15

Sr. No.	Building Envelope details for AS IS CASE	WFR (openable)	VLTV%	U roof (W/m ² K)	RETV (W/m ²)	Remark
1	Wall Assmby: 20mm external Cement plaster+ 230mm burnt brick masonry+15 mm gypsum plaster internally	16.48	85	2.06	17.44	Only WFR (openable) and VLT Comply with recommended value.
2	No weather shades					
3	Single clear glass with two track sliding panels					
4	Roof : 180 mm RCC slab +100 mm brick batt coba and finished with IPS flooring					

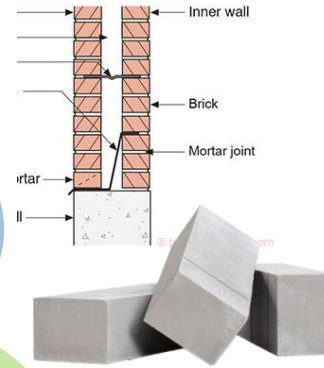
Summary of all cases of building envelope

Sr. No.	Building Envelope details for Modified ROOF	WFR (openable)	VLT%	U roof (W/m ² K)	RETV (W/m ²)	Remark
1	Wall Assmby: 20mm external Cement plaster+ 230mm burnt brick masonry+15 mm gypsum plaster internally	16.48	85	0.56	17.44	WFR (openable) ,VLT, and U value for roof comply with recommended value
2	No weather shades					
3	Single clear glass with two track sliding panels					
4	Roof : 180 mm RCC slab +100 mm brick batt coba + 50mm Expanded polystyrene insulation , finished with					
Sr. No.	Building Envelope details for CASE- I	WFR (openable)	VLT%	U roof (W/m ² K)	RETV (W/m ²)	Remark
1	Wall Assmby: 20mm external Cement plaster+ 230mm burnt brick masonry+15 mm gypsum plaster internally	16.48	85	0.56	16.55	Only WFR (openable) and VLT and U value for roof comply with recommended value
2	Overhang for windows/doors					
3	Single clear glass					
4	Roof : 180 mm RCC slab +100 mm brick batt coba + 50mm Expanded polystyrene insulation , finished with IPS flooring					

Summary of all cases of building envelope

Sr. No.	Building Envelope details for CASE- II	WFR (openable)	VLT%	U roof (W/m ² K)	RETV (W/m ²)	Remark
1	Wall Assmby: 20mm external Cement plaster+ 230mm burnt brick masonry+15 mm gypsum plaster internally	16.48	85	0.56	15.87	Only WFR (openable) and VLT Comply with recommended value
2	Overhang and vertical fins for windows/ doors					
3	Single clear glass					
4	Roof : 180 mm RCC slab +100 mm brick batt coba + 50mm Expanded polystyrene insulation, finished with IPS flooring					
Sr. No.	Building Envelope details for CASE- III	WFR (openable)	VLT%	U roof (W/m ² K)	RETV (W/m ²)	Remark
1	Wall Assmby: 20mm external Cement plaster+ 230mm burnt brick masonry+15 mm gypsum plaster internally	16.48	36.33	0.56	14.88	WFR (openable), VLT and RETV comply with recommended value.
2	Overhang shadings and side fins					
3	High performance glass with low SHGC and U value					
4	Roof : 180 mm RCC slab +100 mm brick batt coba + 50mm Expanded polystyrene insulation, finished with IPS flooring					

Building design flexibility offered by ENS Code

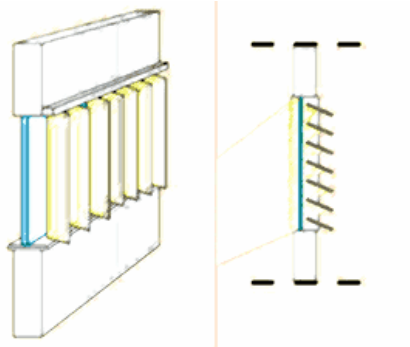


To select material for Wall assembly

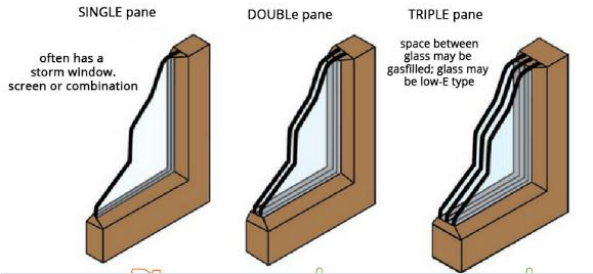
To design external shading windows

ENS compliant building envelope

To design Window



To select type of glazing



Articulation in facade design



Sensitive Approach



Implemented by



Supported by



Thank You

Knowledge Partner

