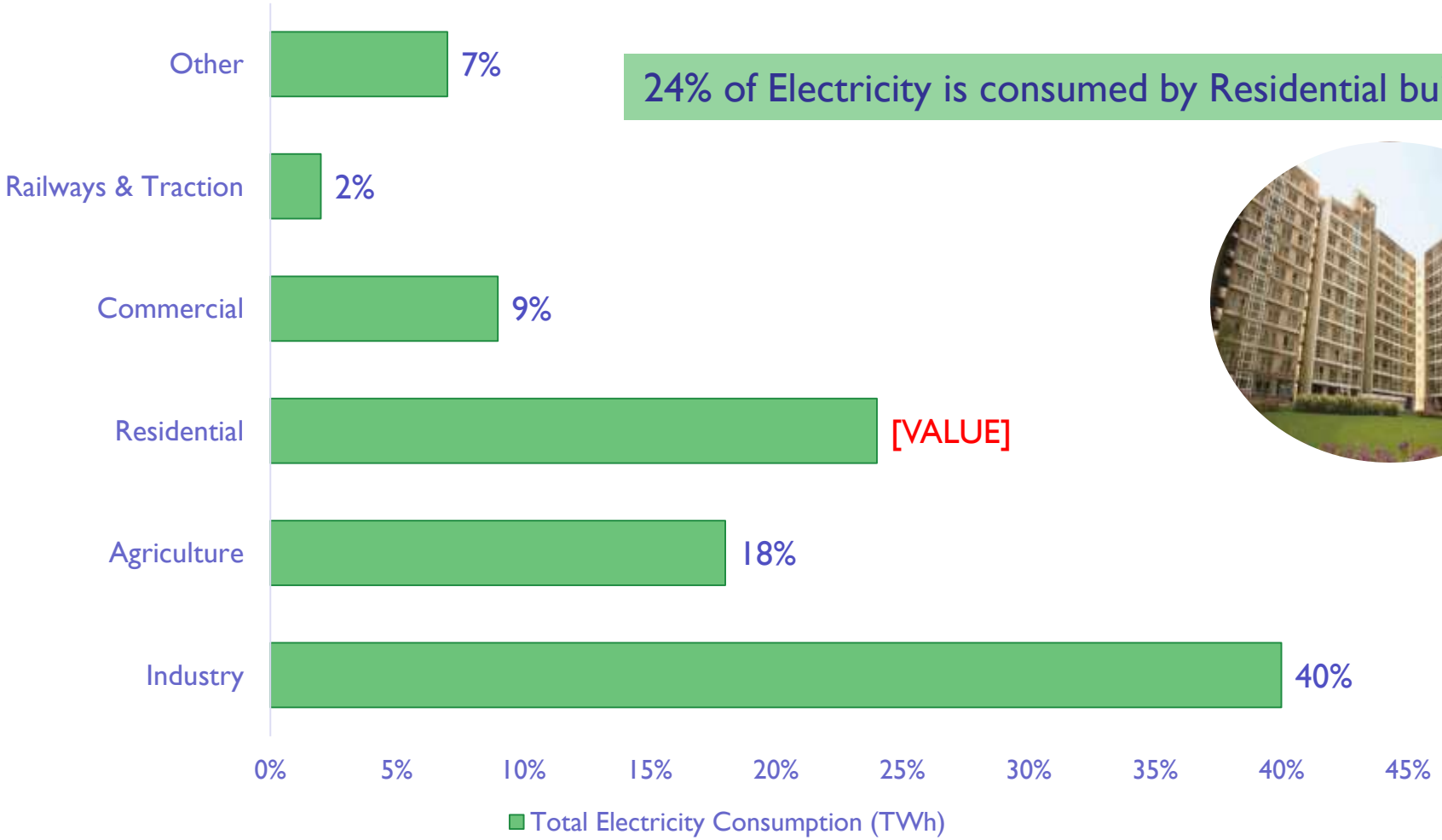
Energy Conservation Building Code for Residential Building Eco-Niwas Samhita 2018

Understanding of Eco-Niwas Samhita 2018

Electricity consumption pattern in India

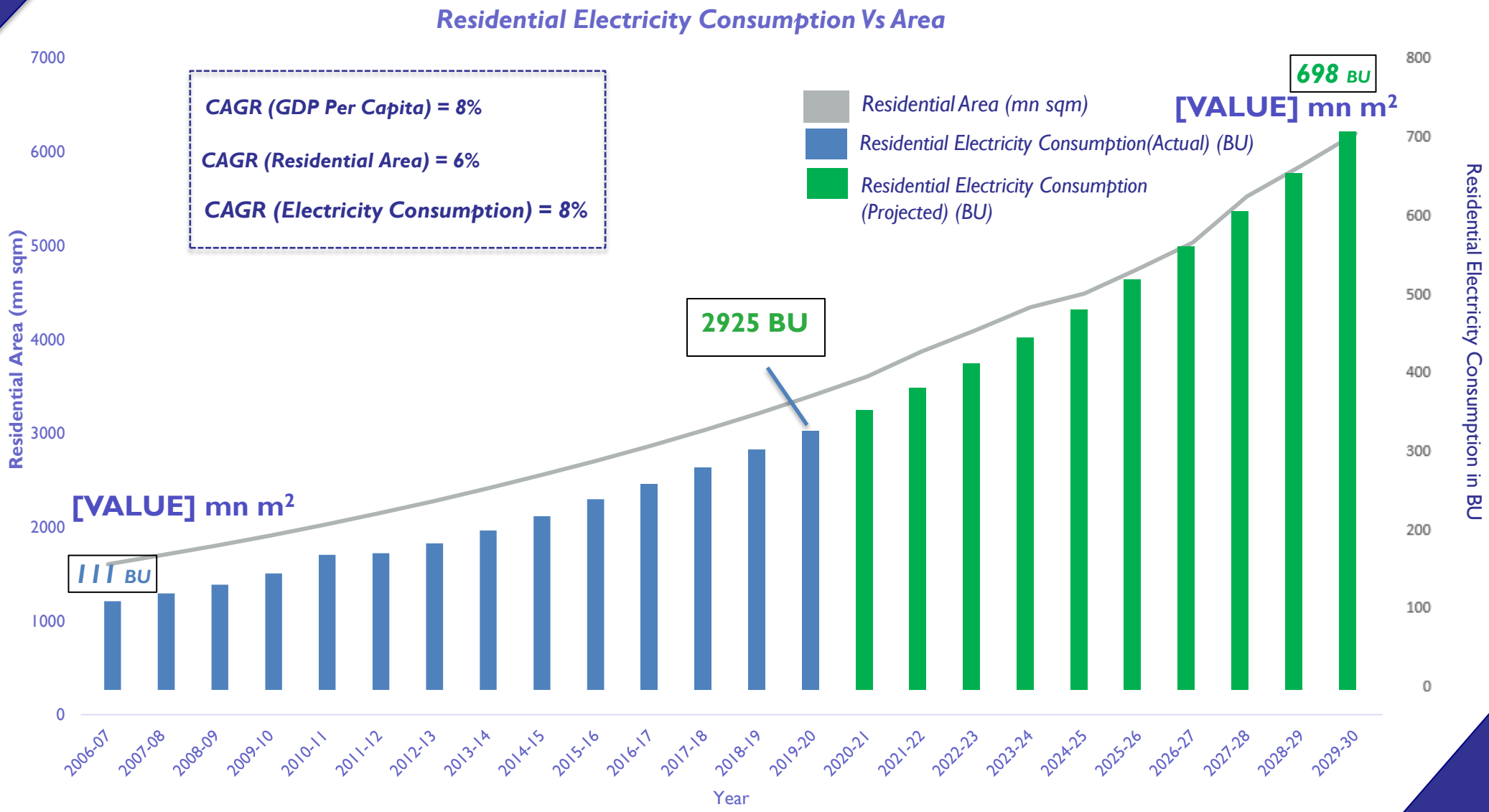
TOTAL ELECTRICITY CONSUMPTION 1066 (BU) IN 2016-17



24% of Electricity is consumed by Residential buildings.

Source: Energy Statistics 2018

Building Sector - Built up area and electricity consumption projection



Introduction of Eco-Niwas Samhita 2018

Why Eco-Niwas Samhita has been created?

- **Built Up Area -** India will add 3 Billion m^2 by 2030 of New residential building w.r.t Year 2018
- **Energy Demand -** There is a 4 times increase in energy demand for residential units from 1996 – 2016
- Projections show energy demand will be approximately between 630 TWh and 940 TWh by 2032

Source: Eco-Niwas Samhita 2018

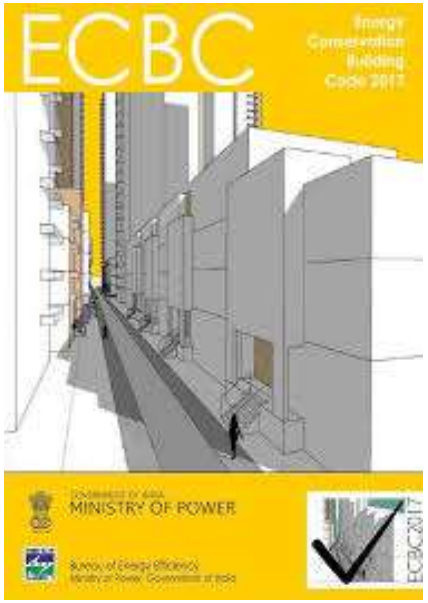
What is Eco-Niwas Samhita 2018?

- ECO-Niwas Samhita 2018 - an Energy Conservation Building Code for Residential Buildings.
- Launched on National Energy Conservation Day in 2018.
- Applicable to all residential units with plot area ≥500m^2 (However, states and municipal bodies may reduce the plot area so that maximum residential buildings fall in the category of ENS compliance)

Other Existing Government initiatives

Energy Conservation Building Code (ECBC)

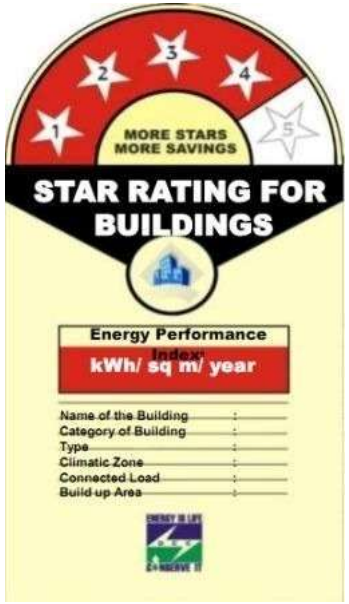
- The ECBC sets minimum energy performance standards for commercial buildings.
- ECBC defines norms of Energy performance for various building components and takes into consideration the climatic region.



Eco-Niwas Samhita 2018

- Energy Conservation Building Code for Residential Buildings

Other Existing Government initiatives



BEE star rating programme for Office buildings.

- BEE has developed a star rating programme for buildings which is based on the actual performance of a building in terms of its specific energy usage in kwh / m^2 / year. This programme rates commercial office buildings on the scale of 1 - 5 star, with 5 Star labelled buildings being the most efficient.

BEE star rating programme for electrical appliance.

- The star rating is a measure of energy efficiency of an appliance, it is a five points scale where higher the rating, lower is the energy consumed by appliance.

New Government initiatives

Policies & Regulations-Residential

- Eco-Niwas Samhita (ECBC-R) Part -I
- Star Rating for Buildings (Building Label)

Supporting Government Initiatives

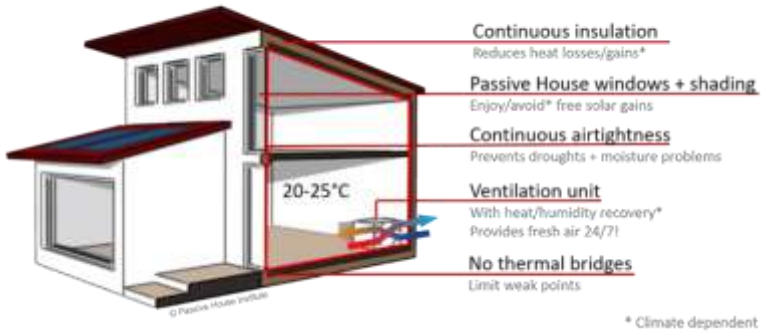
- Replicable Design Catalogue of EE Homes
- Energy Efficient Building Materials Directory
- ECONIWAS Web-Portal
- Smart Home Program
- Eco-Niwas Samhita (ECBC-R) Part -II

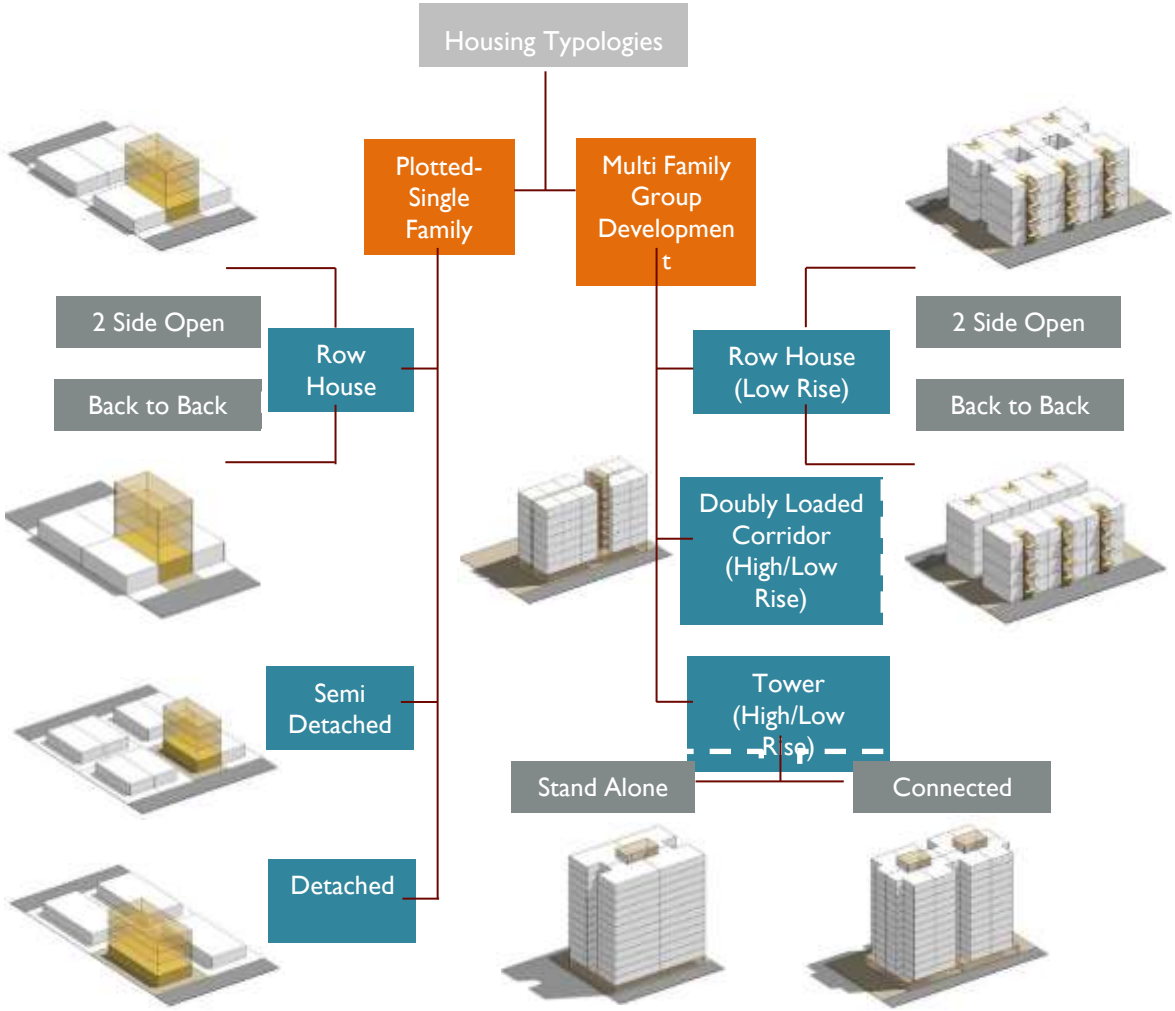
Replicable Designs for Energy Efficient Residential Buildings

- The project aims to develop a **Design Template** for building energy efficient homes, catering to:
  - Various residential types
  - Across different house sizes
  - In different climatic zones across India

- The focus of the project is to **enable the user/ builder/ designer** to easily **adopt energy efficiency** measures into the construction **with immediate impact**.

- The Catalogue will consist of about **7000-10000** Design Typology, considering each climate zone.



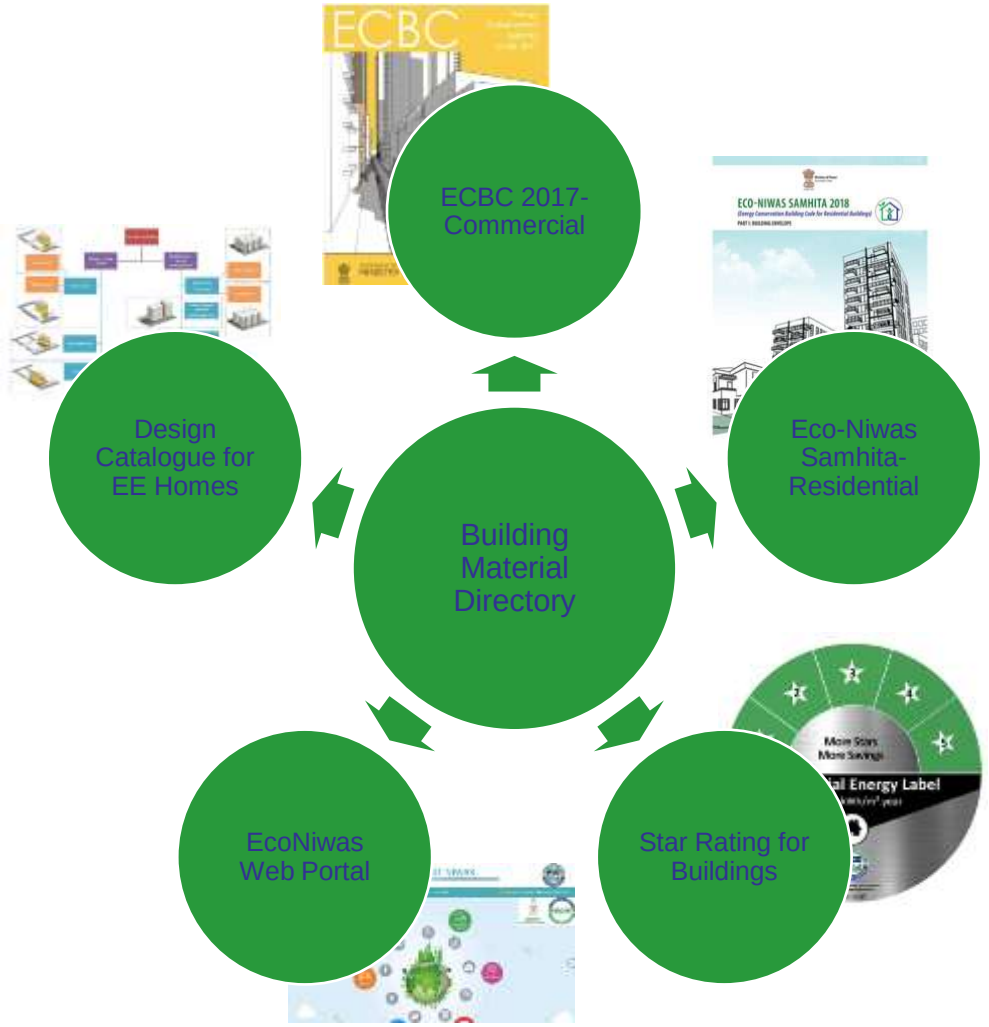


Typology Matrix

Energy Efficient Building Materials Directory for India

Objective of this project :

- To create a national directory of energy efficient building materials.
- To augment the use of energy efficient building materials
- To encourage manufacturers to register their products in the directory
- To enhance energy efficiency and create awareness
- To make effective policies and regulations



Energy Efficient Building Materials Directory for India

What will this Accomplish?

Benefits for Manufacturers

- Enhance Visibility of Manufacturers in the market
- Network Integration of Industries
- Materials can be registered at free of cost

Benefits for Developers

- Informed Choices of Materials while building EE Homes
- Cost information and comparison
- Climate Specific **Decision Support** for Informed Choices

Benefits for Government/Policy Makers

- Awareness
- Making Effective Policies
- Availability of **credible data** in the **public domain**

Benefits for the End consumer

- Access to **Manufacturer's contact details**
- Availability of **credible data** in the **public domain**
- Access to curated list of **locally available products**
- Climate Specific **Decision Support** for Informed Choices in Building Materials/ products
- Facilitate **quick comparison** between different Building Materials/ products based on relevant properties
- Identify **Economically Viable** options as per user requirement.
- Facilitate **green procurement**
- *Ultimately lead to Energy Efficient and Thermally Comfortable Buildings for India*

ECONIWAS Web-Portal

GOVERNMENT OF INDIA
MINISTRY OF POWER

ECO-NIWAS
Energy Conservation – New Indian Way for Affordable & Sustainable homes

BUREAU OF ENERGY EFFICIENCY
Government of India, Ministry of Power

Home | About Us + | ECO-NIWAS + | Information Center + | Publications | Updates + | Connect + | Login | Signup | info@econiwas.com

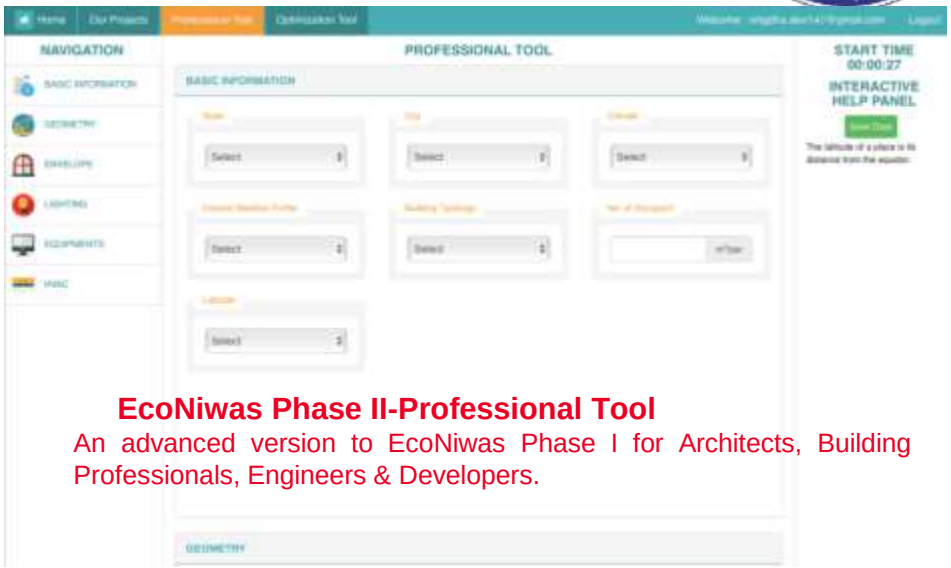
- **Digitalization can support in converting construction boom into an energy savings boom**
- **One stop solution, Awareness raising and empowering website www.econiwas.com**
- **Basic Tool, Professional tool, Compliance tool, Plugins, Prototypes and many more**

सौभाग्य

One stop solution for energy efficient homes

ECONIWAS Web-Portal

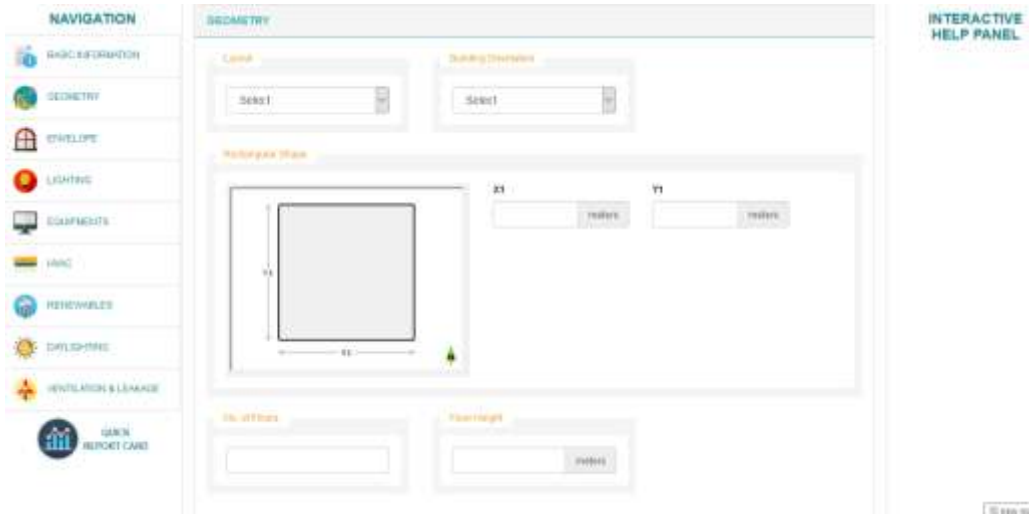
Basic Tool-EcoNiwas Phase I



EcoNiwas Phase II-Professional Tool

An advanced version to EcoNiwas Phase I for Architects, Building Professionals, Engineers & Developers.

Professional Tool



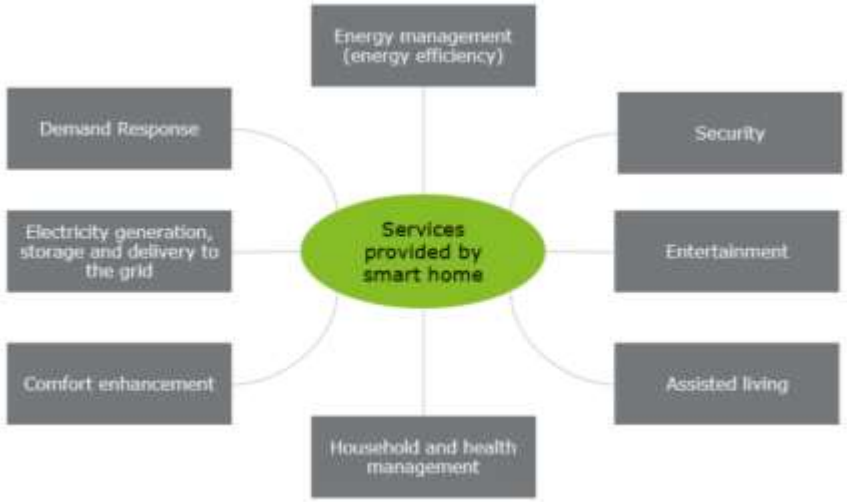
Online simple to use tool for simulation and analysis

Optimization Tool

Smart Home Program - Technology Assessment Study and Pilot Design

Objective :-

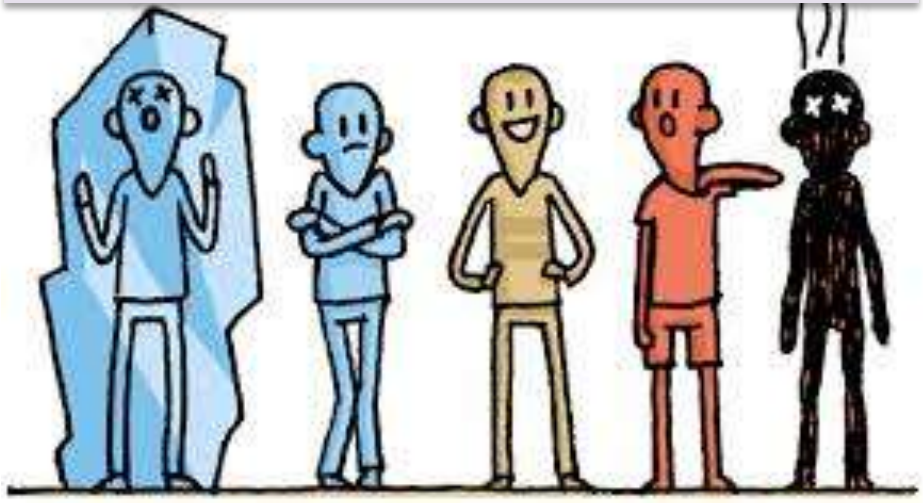
- Home automation Technologies
- Application potential in India,
- Optimal approach for informing demand response.
- Home automation centric energy efficiency policies in future.



- **Preparation of Database and Adaptive Model for Thermal Comfort of occupancy in residential building**

Objective :-

To develop a single nation-wide adaptive thermal comfort model.
Residences of various types located in different climatic zones of the country, spread over major economic and social categories covering major typologies are targeted.



Source: ://www.phsc.co.uk/thermal-comfort-in-your-workplace/

User Benefits of New Govt. Initiatives

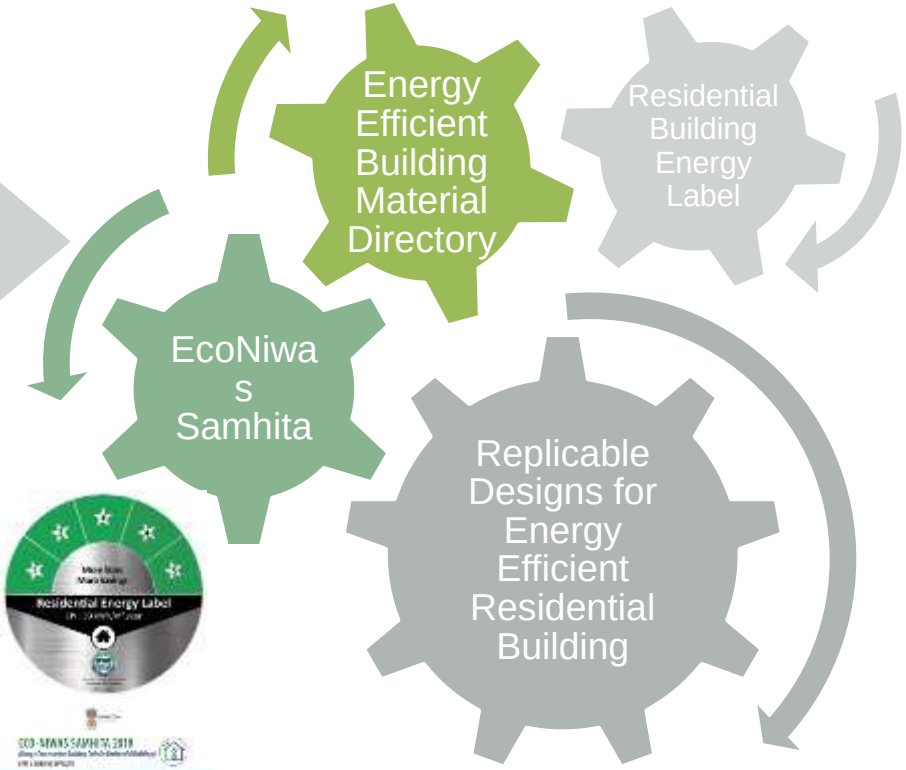
Policies & Regulations- Residential

- Eco-Niwas Samhita (ECBC-R)
- Star Rating for Buildings (Building Label)

Supporting Initiatives

- ECONIWAS Web-Portal
- Energy Efficient Building Materials Directory
- Replicable Design Catalogue of EE Homes

Building Material Directory -*5000+ Materials*
Replicable Building Model -*7000+ Models*



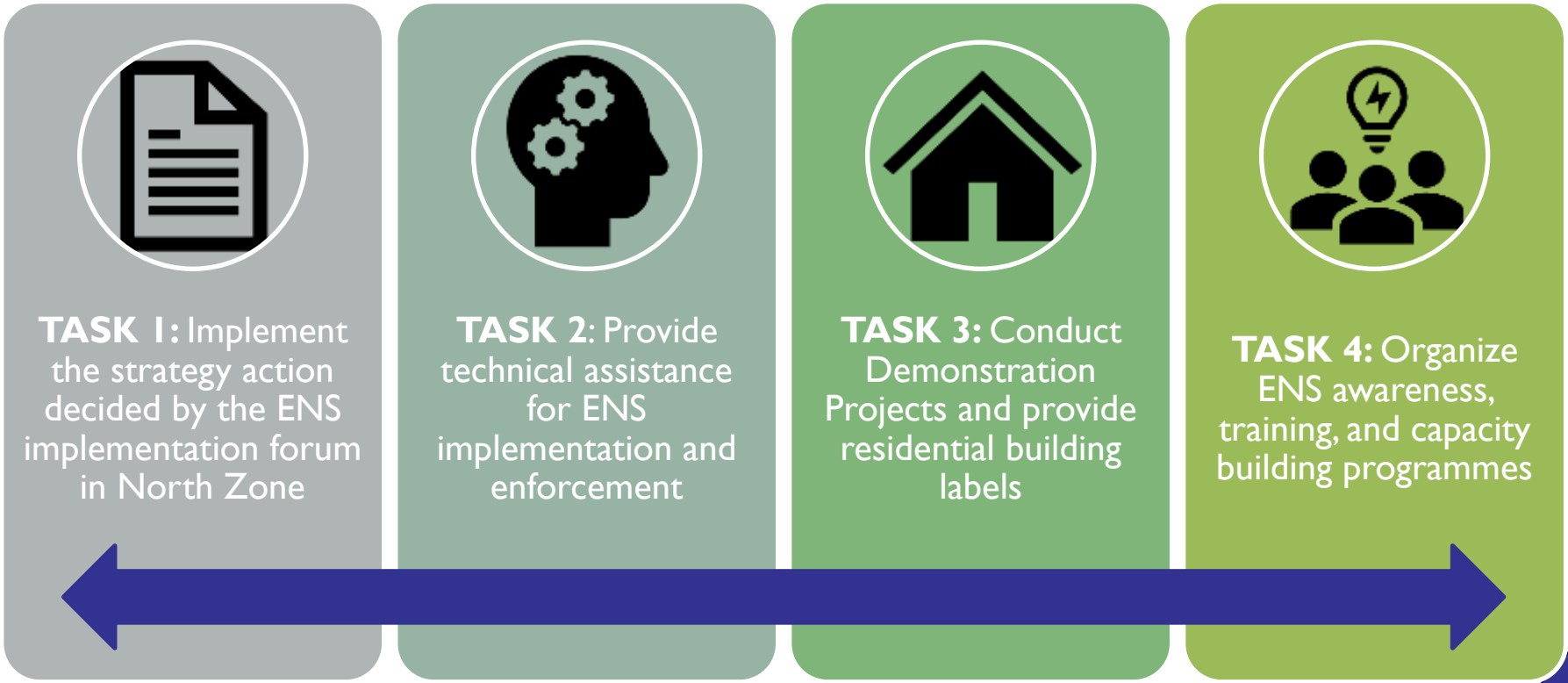
User Benefits

- ***Major energy and cost savings*** for climate responsive design and effective use with the help of ***Energy Efficient Building Materials***
- Evaluation, endorsing building design drawings for ***EcoNiwas Samhita compliance, Residential Building Energy Label*** and assessment of EPI based on building simulation.
- to **enable the user/ builder/ designer** to easily **adopt energy efficiency** measures into the construction **with immediate impact**.
- This will ensure that the relevant information on sustainable buildings is available in easy to use format and has a wide reach.
- To provide ready to use database for further making energy efficient policies

About Eco-Niwas Samhita

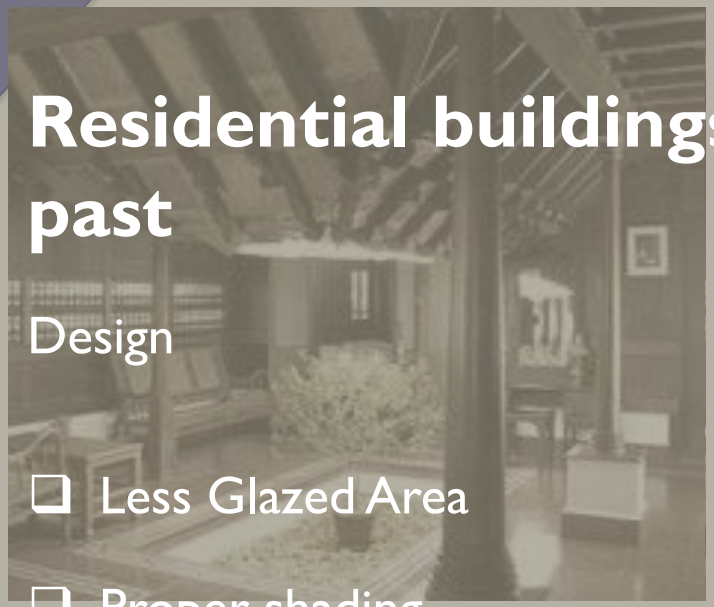
Our Program

- The project aims to support the 5 states of India (Delhi, Punjab, Uttar Pradesh, Karnataka, Maharashtra) to implement Eco Niwas Samhita (ENS) developed by the Bureau of Energy Efficiency (BEE), Ministry of Power.
- PwC will be supporting 3 states for establishing ENS cell in respective states.
- ENS Cell has been established by PwC, under PEDA to achieve the following objectives:



Understanding Eco-Niwas Samhita

Have you observed buildings in past & present…



Residential buildings in past

Design

- Less Glazed Area
- Proper shading
- Open space for natural ventilation
- Proper orientation
- Climate responsive design

Residential buildings in present

Design

- More Glazed Area
- No proper shading
- Natural ventilation is not taken care
- No consideration for building orientation
- Non climate responsive design

Have you observed buildings in past & present…

Residential buildings in past

Materials

- Locally available materials were used in buildings

Operation

- Rely on Natural ventilation for achieving thermal comfort
- No air conditioning system was used.

Residential buildings in present

Materials

- Use of imported materials for aesthetic purpose

Operation

- Minimal Natural Ventilation
- Depends on air conditioning system for thermal comfort

Reason behind the shift in design…

- Rapid Urbanization
- Improved lifestyle of people
- Increase in cost of properties
- Affordability of technologies
- More importance to aesthetics

Effect of the transition in design

This has led to a drastic **increase** in electricity consumption of the building.

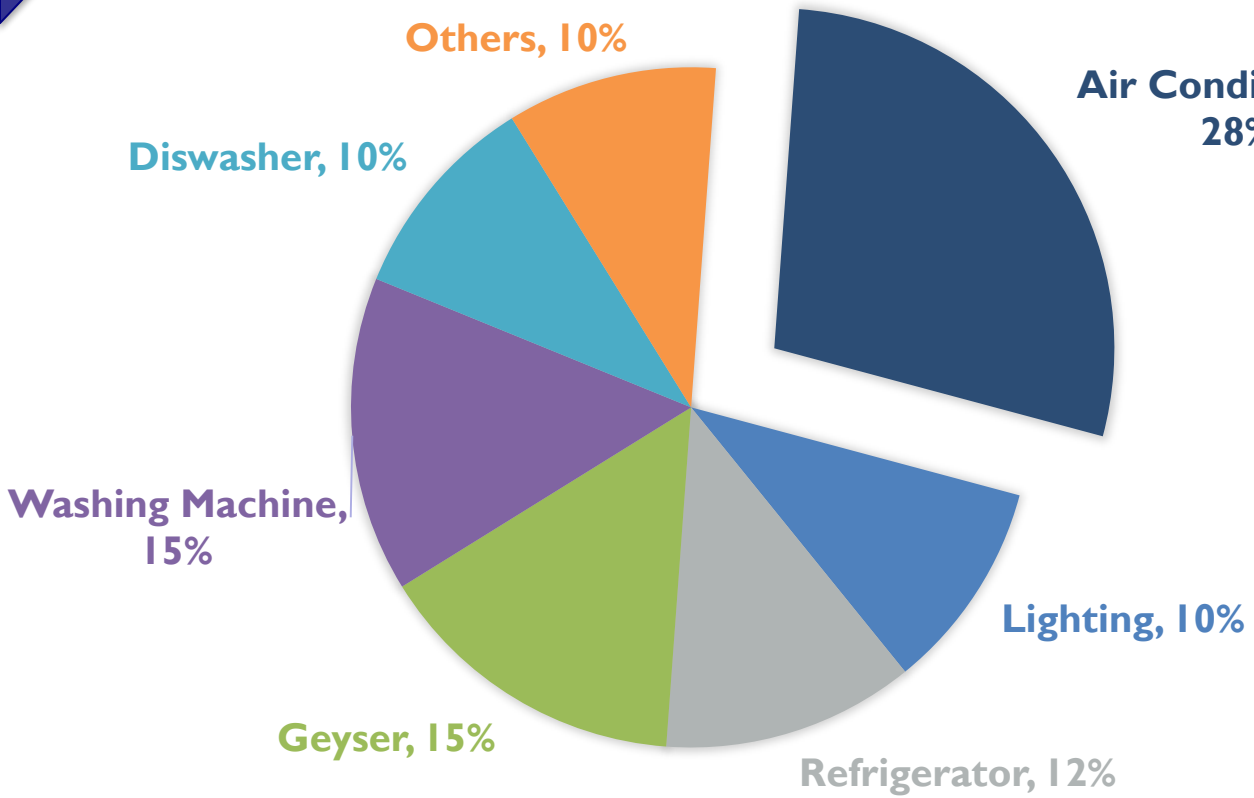
To provide comfort, we started relying on mechanical systems which consume a lot of energy. This has created an abnormal increase in the **energy demand**.

Now it is time to CHANGE, ENERGY EFFICIENT BUILDINGS

are the need of the hour

Energy distribution pattern in typical home

ENERGY DISTRIBUTION IN A TYPICAL HOME



Maximum energy consumption in a typical home is from Air conditioning

Source: IGBC Green Homes

Ways to reduce the energy demand of a building

High amount of electricity is required to remove the heat gain in a building and to maintain indoor thermal comfort level in the building.

Ways to reduce energy demand of a building

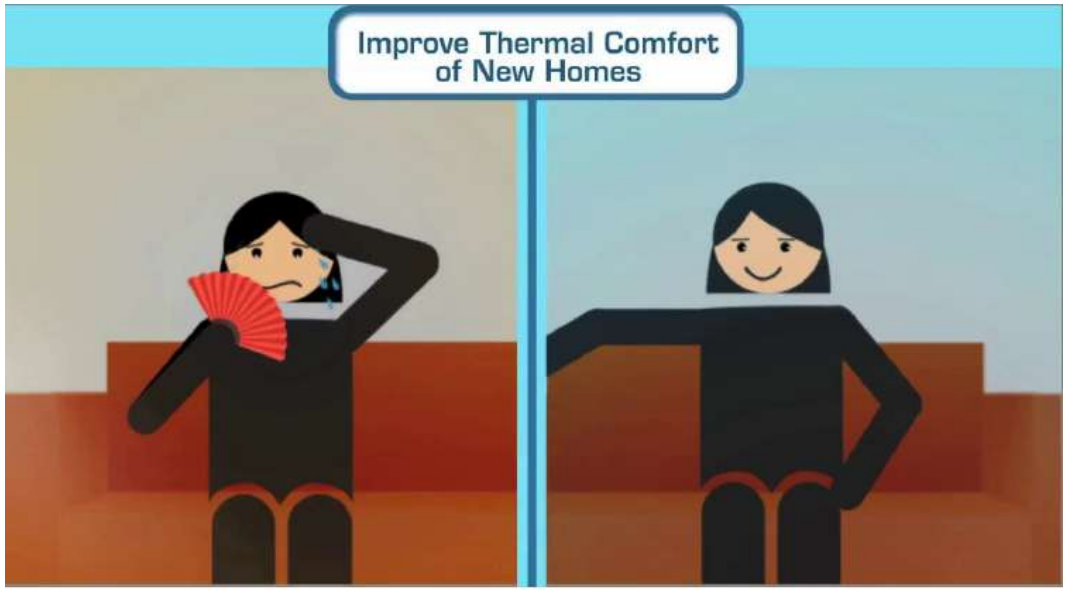
- **Climate Responsive Building Design**
- **Efficient Building Envelope Design**
- **Use of efficient appliances like air conditioning system, lighting etc**
- **Proper maintenance of the electrical appliances**

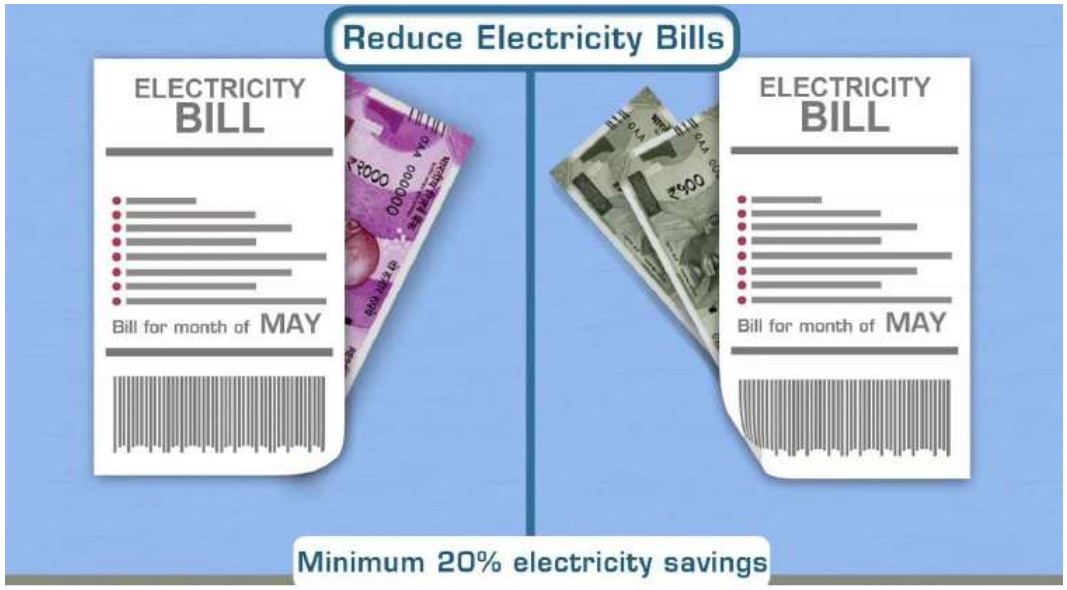
To address the above factors, Eco Niwas Samhita was created

Launch of Eco-Niwas Samhita 2018

Eco-Niwas Samhita 2018 (Part I: Building Envelope) is the new Energy Conservation Building Code for Residential Buildings, launched by Ministry of Power (MoP) on 14 December 2018.

Impact Assessment of Part I





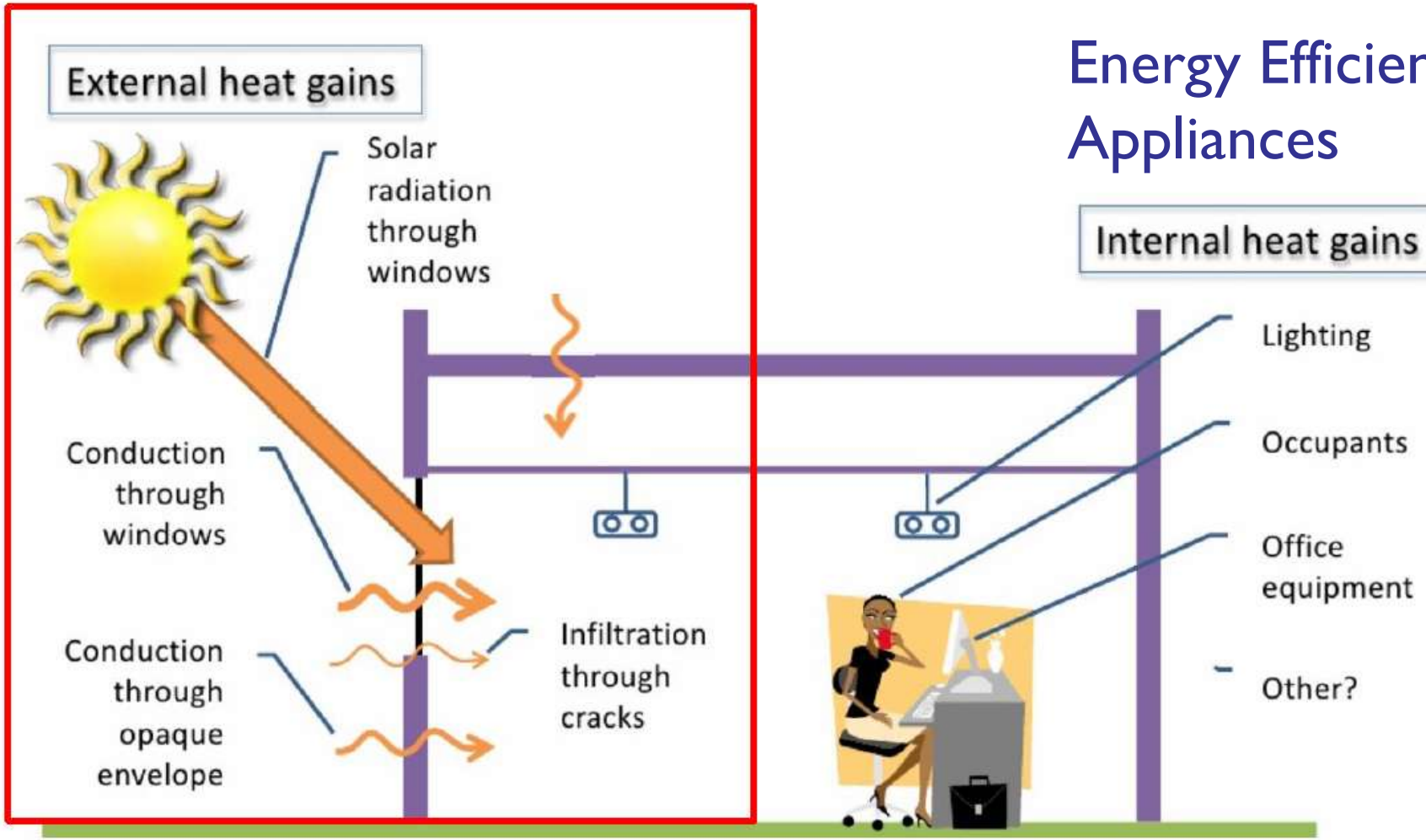
Estimated impact of ECBC-Residential Code from Year 2018 – 2030.

- Minimum 20% energy saving (in cooling) as compared to a typical building.
- Electricity saving of 25 billion kWh.
- 100 million tonnes of CO2 equivalent reduction.

ENS Part I - Building Envelope and It's components

Sources for heat gain in a building

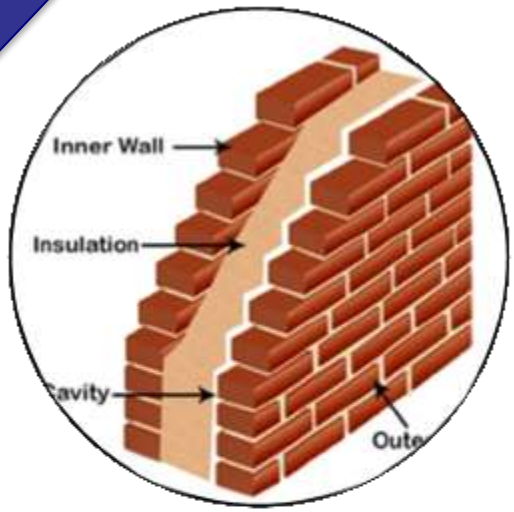
Design and Material Selection



Energy Efficient Appliances

Building envelope design is the key of energy efficient residential buildings

Understand the heat gain through envelope in the building



WALL
15-25%

ROOF
25-35%

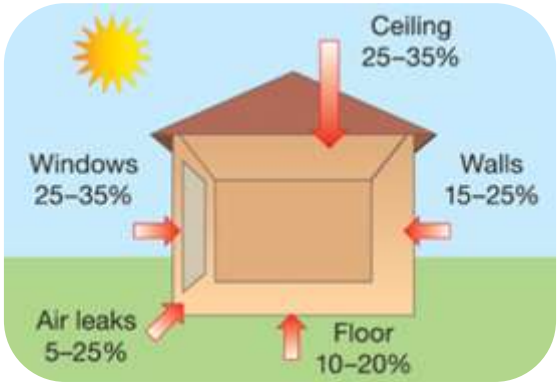
GLAZING
25-35%

AIR LEAKAGE
5-10%

ENS Part I- Building Envelope & its components

Sets limits for glazing to ensure adequate daylight

(Window to Wall Ratio WWR, VLT)



Sets limits for envelope heat gain of the building

(U value of walls, Solar Heat Gain Coefficient SHGC, U value of roofs)

Sets limits for window openings for adequate natural ventilation

(Window to Floor Area Ratio WFR)

Residential Envelope Transmittance Value (RETV)

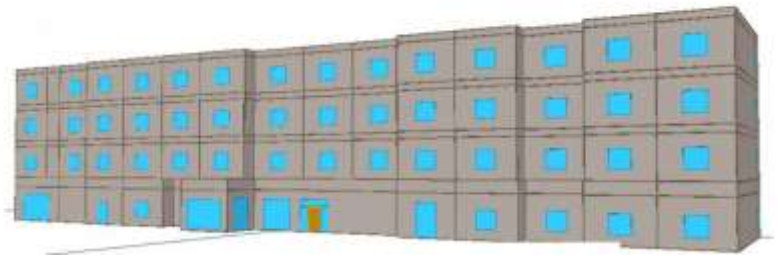
What is WWR?

WWR is Window-to-Wall Ratio

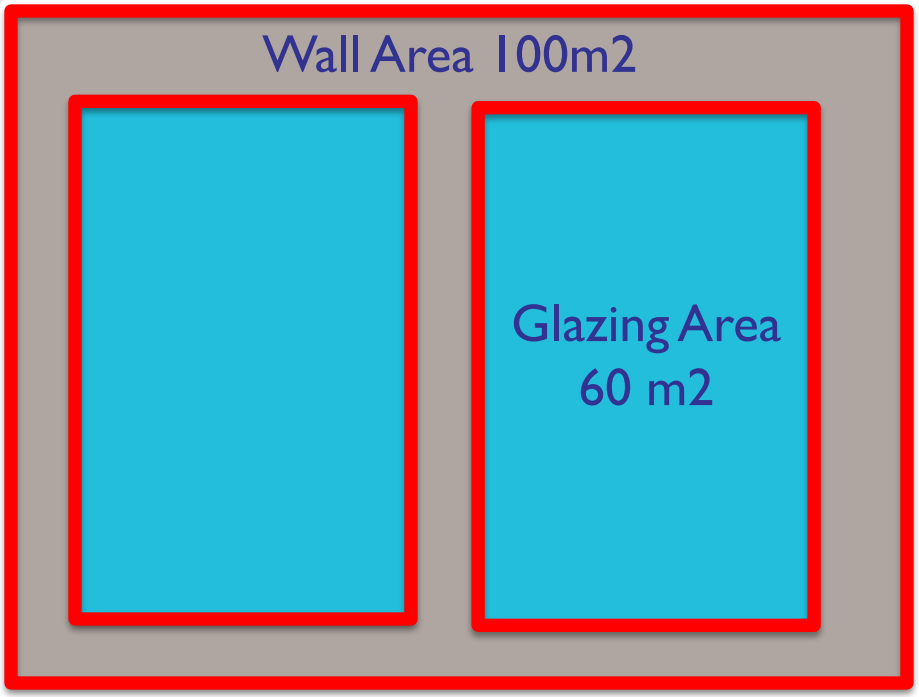
Definition:

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

$$\boldsymbol{WWR} = \frac{Area\ of\ Non-opaque}{Area\ of\ Envelope}$$



WWR Sample calculation



Calculation:

$$WWR = \frac{60}{100}$$

$$WWR = 0.6$$

$$= 60\%$$

$$\boldsymbol{WWR} = \frac{Area\ of\ \ Glazing}{Area\ of\ Wall}$$

What is VLT

VLT is Visual Light Transmittance

Definition:

Visible light transmittance is the amount of light in the visible portion of the spectrum that passes through a glazing material.

5% **15%** **20%** **30%** **35%** **50%** **75%**

Higher the VLT, more is the daylight received inside the building

Sample glass cutsheet

From where can we obtain the VLT of the Glass?

Colour / Performance	Thickness (mm)	Light Transmittance LT	Light Reflectance LR	Total Solar Radiant Heat Transmittance	Total Shading Coefficient	U Value (W/m^2K)	R_w Value (dB)
Clear	10	0.77	0.14	0.67	0.77	2.7	38
Clear	12	0.76	0.14	0.64	0.74	2.7	38
Clear	15	0.74	0.13	0.60	0.69	2.6	40
73/42	10	0.69	0.10	0.40	0.46	1.4	38
70/39	10	0.67	0.12	0.37	0.43	1.3	38
69/37	10	0.66	0.11	0.35	0.40	1.3	38
62/29	10	0.58	0.09	0.29	0.33	1.3	38
50/27	10	0.48	0.10	0.26	0.30	1.3	38
30/17	10	0.29	0.24	0.19	0.22	1.3	38

VLT of a Glass can be obtained from the Glass cut sheet available with any Glass manufacturer

Visible Light Transmittance (VLT) & Window to Wall Ratio (WWR)

For ENS Compliance, Minimum Visible Transmittance (VLT) shall not be less than the values given in Table below:-

Window-to-wall ratio (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

What is U- Value ?

U value means Thermal transmittance of a material

Definition:

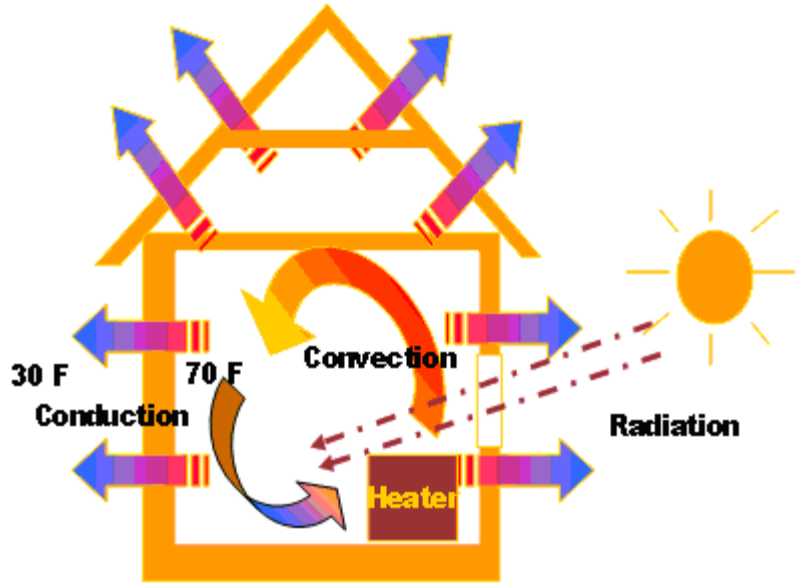
Thermal transmittance is the rate of heat transfer through materials

Unit of U value is W/(m²K)

$$U = \frac{1}{Thermal\ Resistance\ of\ a\ material\ (R)}$$

$$\text{Where R} = \frac{Thickness\ of\ material\ (t)}{Conductivity\ (k)}$$

Conductivity (k) is the rate at which heat is

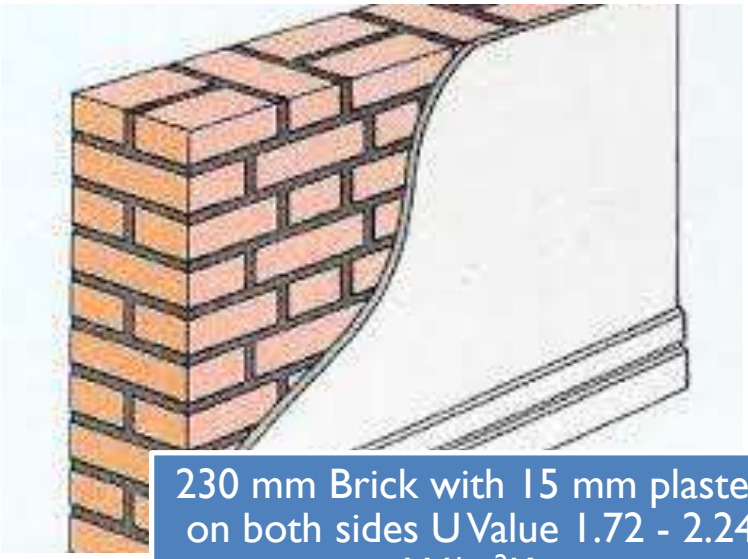


The lower the U-value, the lower is the heat gain/loss in the building.

Types of wall & their U Value

150 mm RCC (No plaster) – U Value 3.77 W/m^{2}K

200 mm Solid Concrete Block with 15 mm plaster on both sides – U Value 2.8 W/m^{2}K



230 mm Brick with 15 mm plaster on both sides U Value 1.72 - 2.24 W/m^{2}K

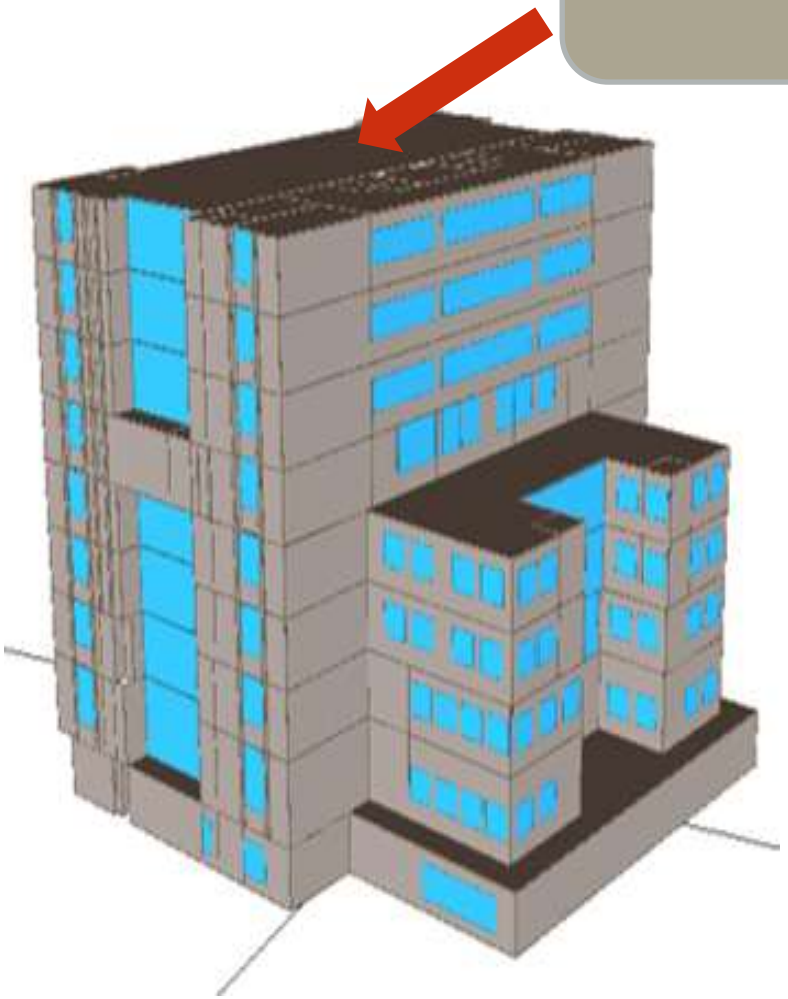
Types of wall & their U Value

200 mm Autoclaved Aerated Concrete (AAC) with 15 mm plaster on both side U Value 0.77 W/m^{2}K

300 mm Autoclaved Aerated Concrete (AAC) with 15 mm plaster on both sides U Value 0.54 W/m^{2}K

Thermal Transmittance of Roof (U_{roof})

Thermal Transmittance of Roof (U_{roof})



Thermal transmittance (U_{roof}) characterizes the thermal performance of the roof of a building.

Thermal transmittance of roof shall comply with the maximum U_{roof} value of **1.2 W/m²K.**

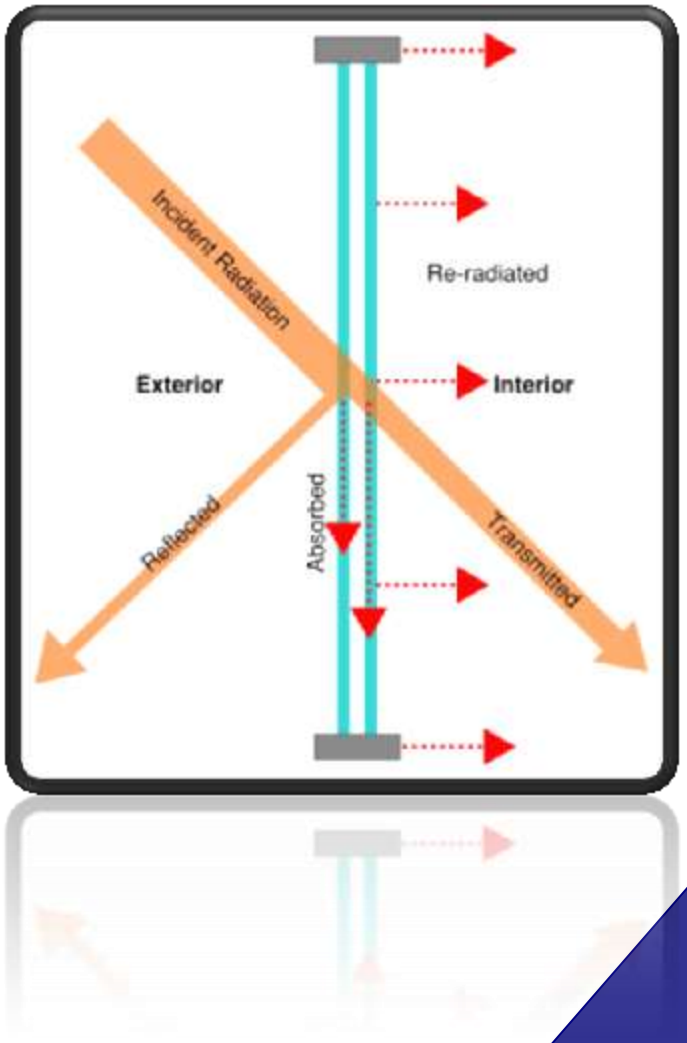
What is SHGC

SHGC is Solar Heat Gain Coefficient

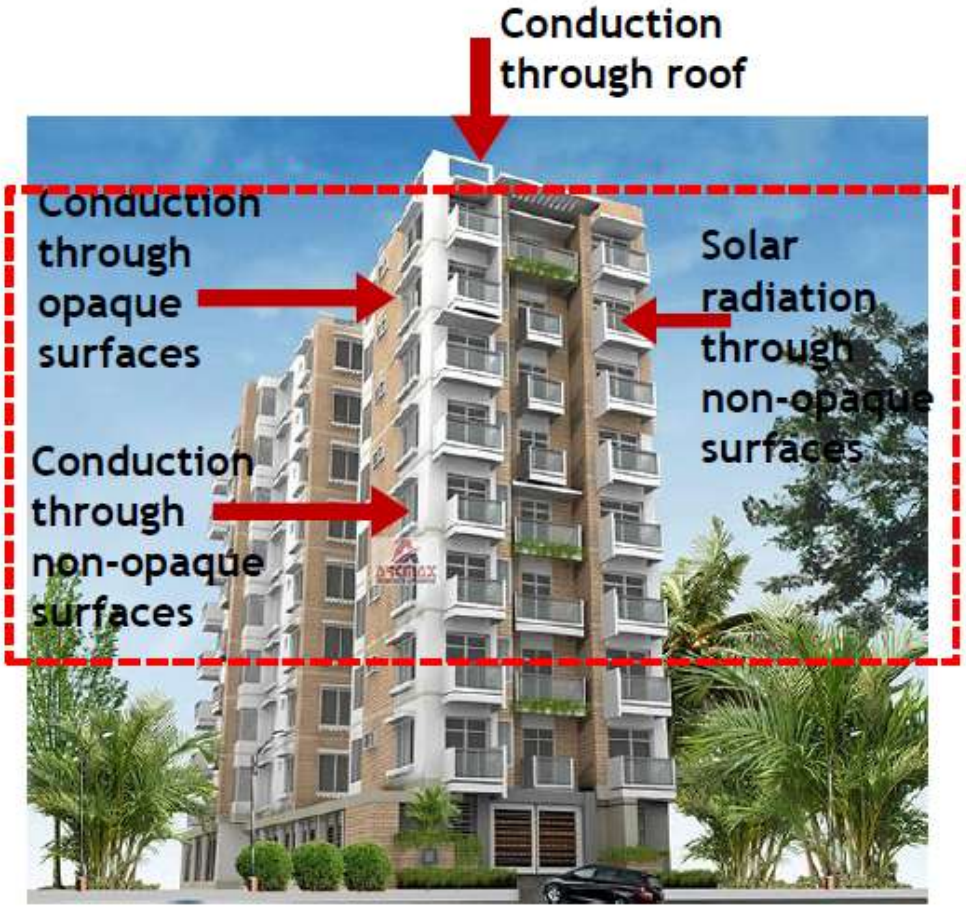
Definition:

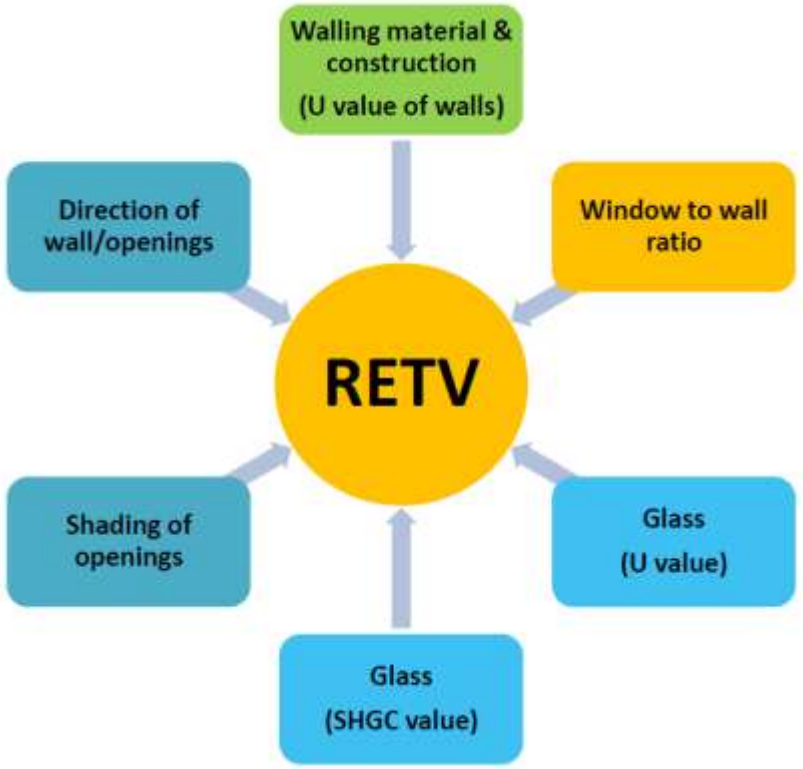
The SHGC is the fraction of incident solar radiation admitted through a window, both directly transmitted and absorbed and subsequently released inward.

The value of SHGC varies from 0 - 1



Residential Envelope Transmittance Value (RETV) for building envelope (except roof)





Residential Envelope Transmittance Value (RETV) for building envelope (except roof)

The RETV of the building envelope (except roof) for four climate zones, namely, Composite Climate, Hot-Dry Climate, Warm-Humid Climate, and Temperate Climate, shall comply with the maximum **RETV of 15 W/m²**

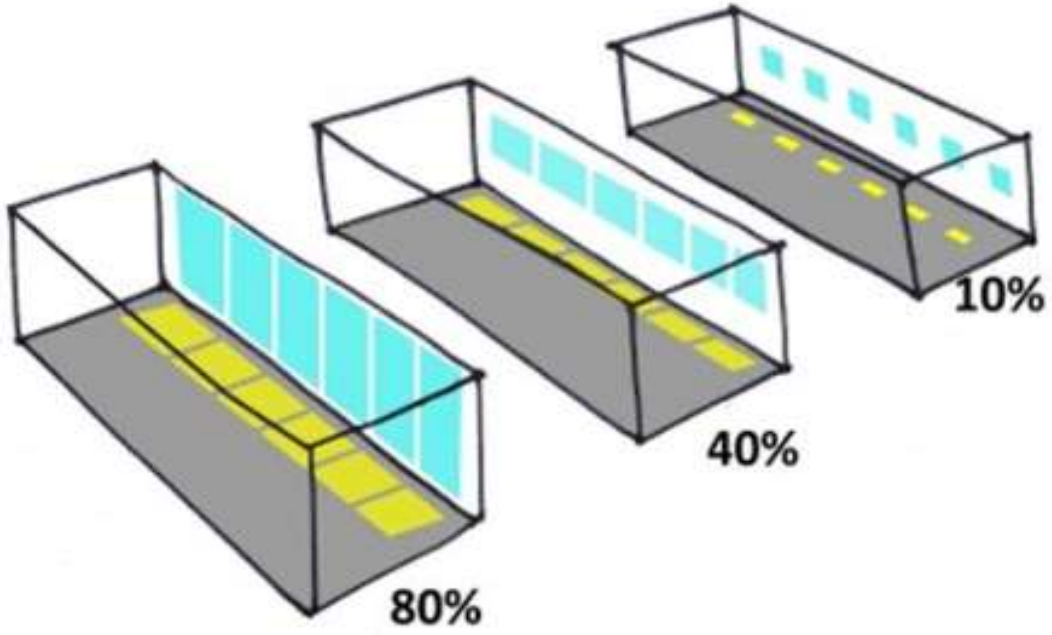
What is WFR?

WFR is Openable Window to Floor Area Ratio

Definition:

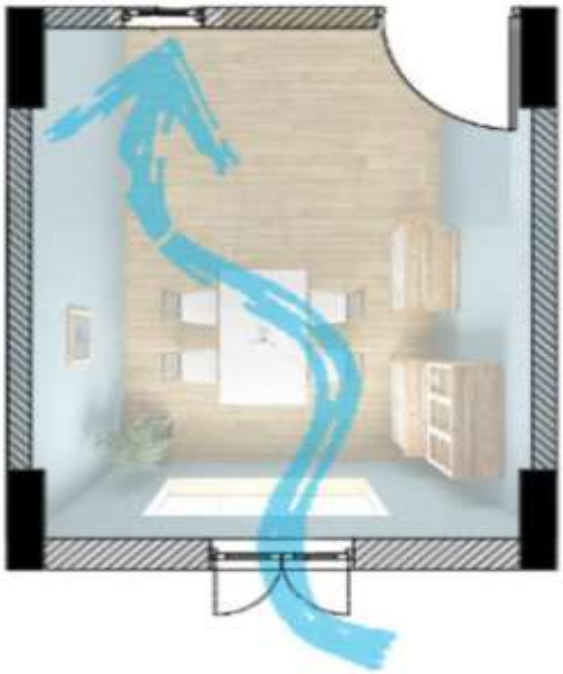
The openable window-to-floor area ratio (WFR_{op}) is the ratio of openable area to the carpet area of dwelling units.

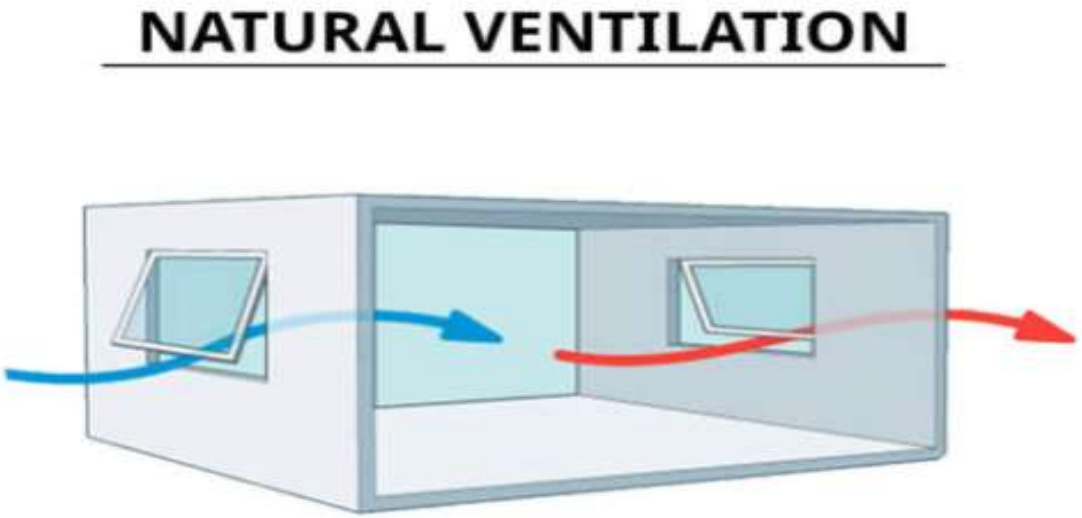
$$WFR_{op} = \frac{A_{openable}}{A_{Carpet}}$$



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

WFR_{op} helps in natural ventilation, improvement in thermal comfort, and reduction in cooling energy.





WFR Sample Calculation

Calculation:

$$WFR = \frac{54}{100}$$

$$WFR = 0.54$$

$$= 54\%$$

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

The openable window-to-floor area ratio (WFR_{op}) shall not be less than the values given in table below:-

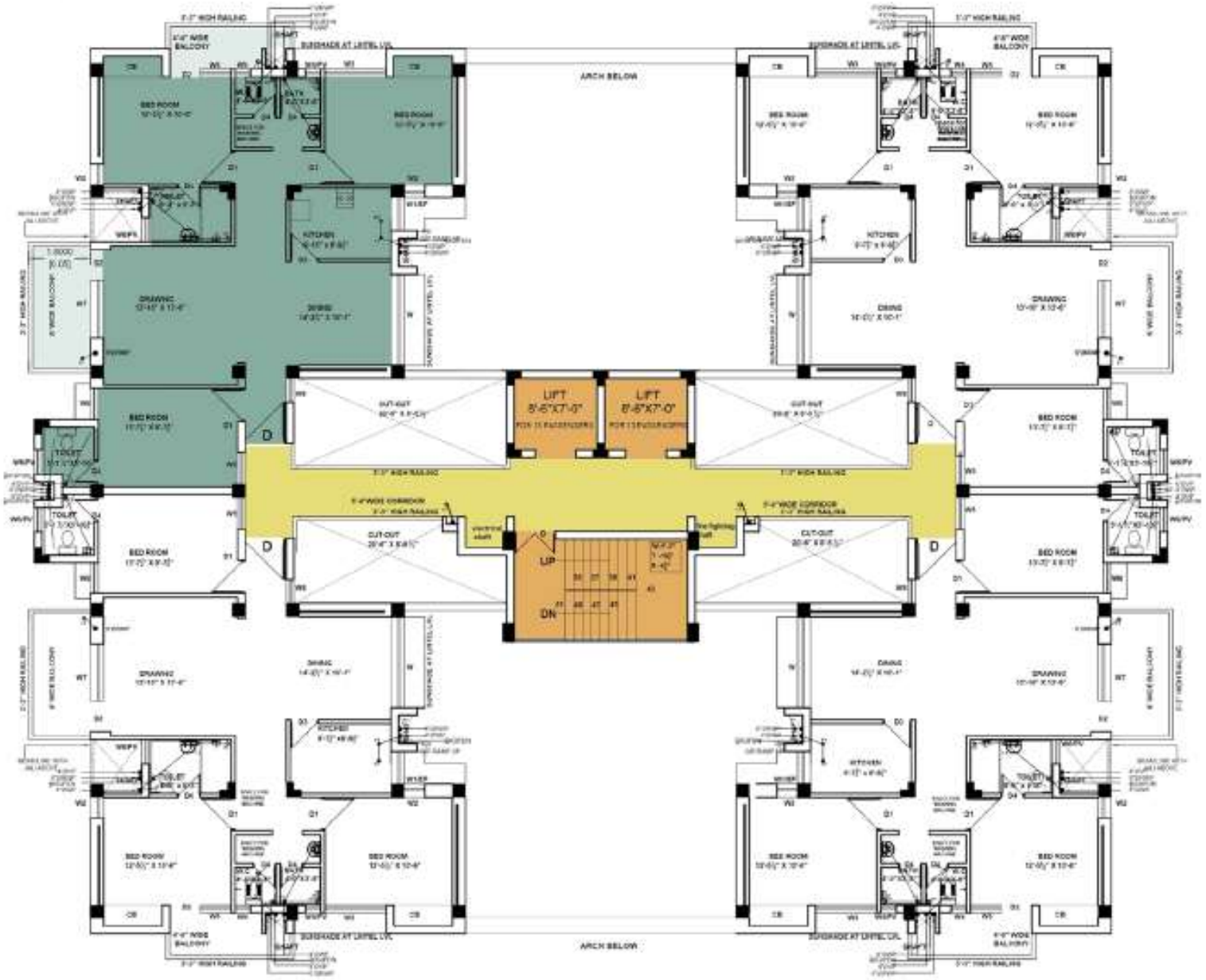
Climatic Zone	Minimum percentage (%) of WFR_{op}
Composite	12.50
Hot-Dry	10.00
Warm - Humid	16.66
Temperate	12.50
Cold	8.33

Eco-Niwas Samhita - Case Study

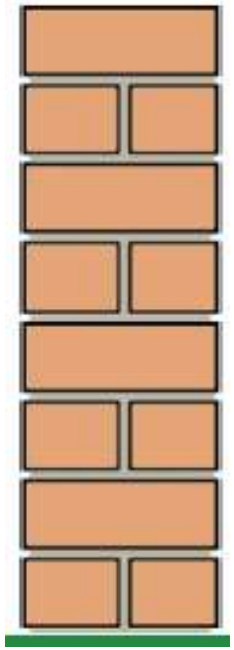
Case study project details

- Case study project is a residential quarters built for the NABARD *(National Bank For Agriculture & Rural Development)* staff at Mohali.
- The climate type is composite and is similar to that of Chandigarh.
- **No. of dwelling units in Block II (DU): 20 (all 2 BHK) Stilt + 5 storeys**

Floor Plan layout of the NABARD project



Case I: 230 mm brick wall + Normal WWR + Single Clear Glazing + No Shading of Windows

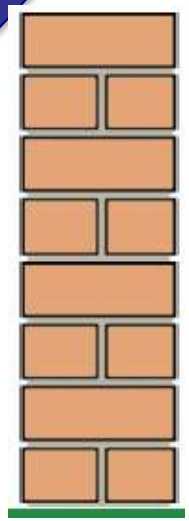


230mm Normal Brick wall with U value – 2 w/m^{2}k

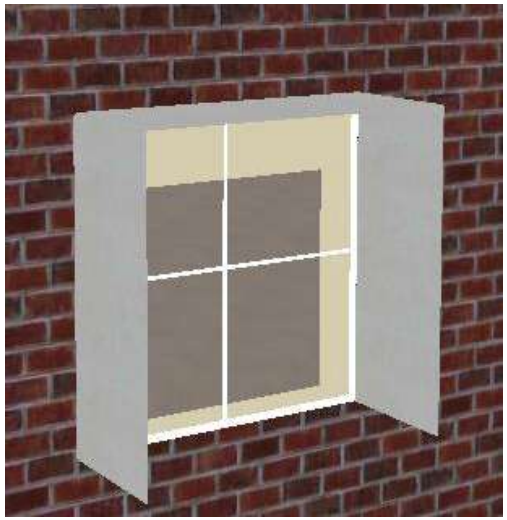
	RETV (I Term) Wall conduction	RETV (II Term) Window conduction	RETV (III Term) Window transmittance	RETV (TOTAL)
Case.I • Brick Wall • No Shading • Single clear glazing • WWR: ~14%	10.1	1.8	9.6	**21.5**

- **RETV = 21.5, (high compared to cut-off of 15 W/m^2 as per ECBC-R)**
- **Heat conduction through wall is high and high heat gain through windows with no shading**

Case II: Case I + Proper Shading of Windows



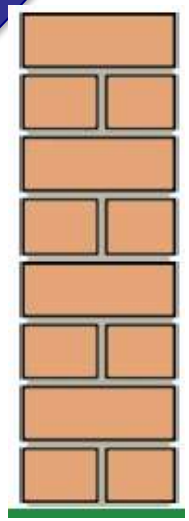
230mm Normal Brick wall with U value – 2 w/m^{2}k



	RETV (I Term) Wall conduction	RETV (II Term) Window conduction	RETV (III Term) Window transmittance	RETV (TOTAL)
Case.2 • Brick Wall • Shading with overhang & Fins • Single clear glazing • WWR: ~14%	10.1	1.8	**6.7**	**18.6**

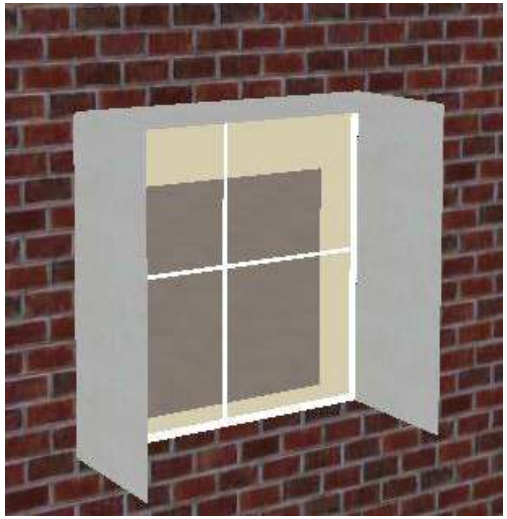
- **RETV = 18.6 W/m^2**
- **Shading helps in reducing heat gain through windows**

Case III: Case II+ Single reflective glass



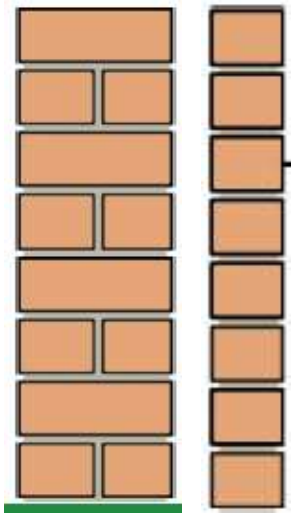
230mm Normal Brick wall with U value – 2 w/m^{2}k

	RETV (I Term) Wall conduction	RETV (II Term) Window conduction	RETV (III Term) Window transmittance	RETV (TOTAL)
Case.3 • Brick Wall • Shading with overhang & Fins • Single reflective glazing • WWR: ~14%	10.1	1.8	**4.5**	**16.3**

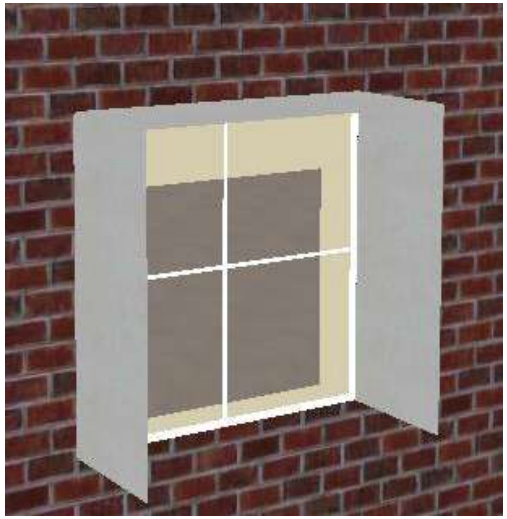


- **RETV = 16.3 W/m^2**
- **Using single reflective glass instead of single clear glass reduces heat gain due to window transmittance**

Case IV: (Final Design Constructed) Brick cavity wall+ Shading+ Single reflective glass



230 mm + 40 mm cavity +115 mm brick with U value – 1.1 w/m^{2}k

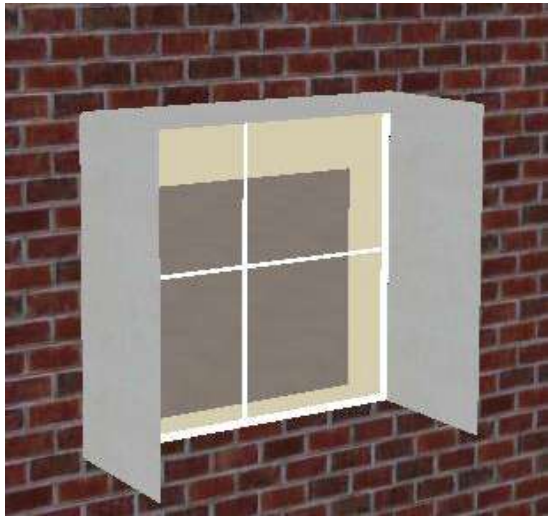


	RETV (I Term) Wall conduction	RETV (II Term) Window conduction	RETV (III Term) Window transmittance	RETV (TOTAL)
Case.4 • Brick Wall • Shading with overhang & Fins • Single reflective glazing • WWR: ~14%	**6.6**	1.8	4.5	**12.8**

- **RETV = 12.8 W/m^2**
- **Using Brick cavity wall with 40mm air gap reduces the heat gain due to wall conduction**

Case V: Extra measure: AAC block wall + Shading of Windows+ Single reflective glass)

200 mm AAC block with U value – 0.7 w/m^{2}k



	RETV (I Term) Wall conduction	RETV (II Term) Window conduction	RETV (III Term) Window transmittance	RETV (TOTAL)
Case.5 • AAC Block • Shading with overhang & Fins • Single reflective glazing • WWR: ~14%	**4.7**	1.8	4.5	**10.9**

- **RETV = 10.9 W/m^2**
- **Reduced thermal conduction from walls; use of single reflective glass and shading helps in reducing heat gain through windows**

Key Envelope Parameters & it's impact on RETV

	RETV (I Term) Wall conduction	RETV (II Term) Window conduction	RETV (III Term) Window transmittance	RETV (TOTAL)
Case.1 • Brick Wall • No Shading • Single clear glazing • WWR: ~14%	10.1	1.8	9.6	**21.5**
Case.2 • Brick Wall • Shading with overhang & Fins • Single clear glazing • WWR: ~14%	10.1	1.8	**6.7**	**18.6**
Case.3 • Brick Wall • Shading with overhang & Fins • Single reflective glazing • WWR: ~14%	10.1	1.8	**4.5**	**16.3**
Case.4 • Brick Wall • Shading with overhang & Fins • Single reflective glazing • WWR: ~14%	**6.6**	1.8	4.5	**12.8**
Case.5 • AAC Block • Shading with overhang & Fins • Single reflective glazing • WWR: ~14%	**4.7**	1.8	4.5	**10.9**

Eco-Niwas Samhita Compliance Approach

Eco-Niwas Samhita (ENS) Compliance Tool

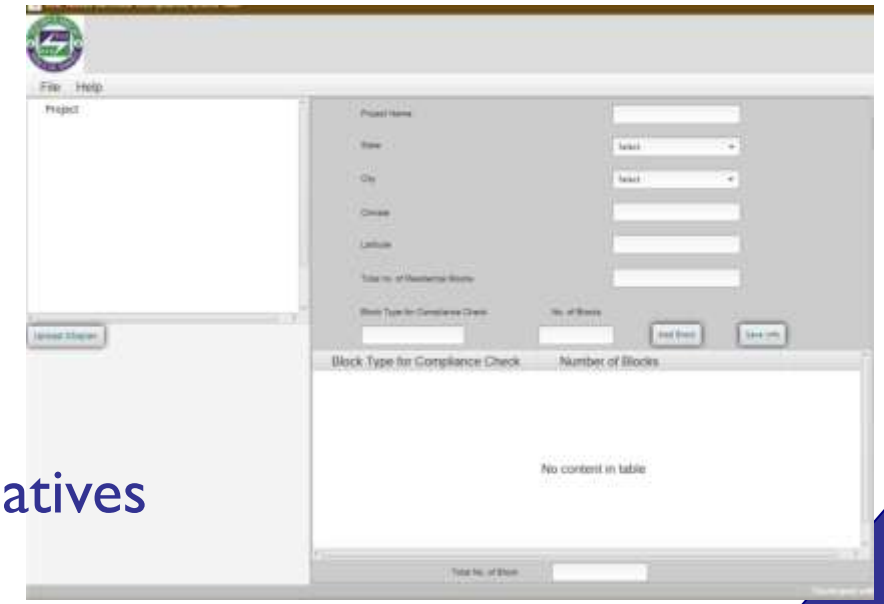
- Offline application tool along with it's user manual and tool demonstration video can be downloaded from **BEE website**

Inputs to software

- Architectural drawings (plans, sections and elevations)
- Construction material details

Results

- Code Compliance check
- RETV
- Comparison of different design alternatives



Eco-Niwas Samhita (ENS) Compliance Tool

Eco-Niwas Samhita: Compliance Check Report

1. ECBC-R Compliance Results

S/No.	REQUIREMENT	CALCULATED	CRITERIA	STATUS
Block-1				
1	WFRop	28.83	12.5	Compliant
2	VLT %	85.0	27.0	Compliant
3	Uroof	0.49	1.2	Compliant
4	RETV	4.54	15	Compliant

Eco-Niwas Samhita (ENS) Compliance Tool

- Online application tool along with it's user manual and tool demonstration video is available on **ECONIWAS.COM website**

THANK YOU

Supported by giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Implemented by pwc