

# Energy Assesment of Residential Buildings IT Toolkit :EnEff ResBuild India

## National Conference on Green Design

- Hina Zia, Sustainable Habitat Division,TERI
- 15th Feb,2013, New Delhi



Background study

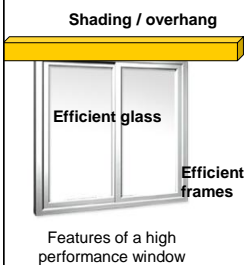
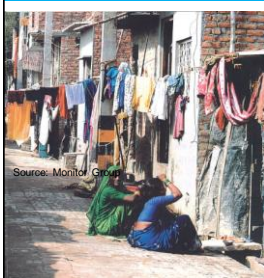
## “PROMOTIONAL PROGRAMME FOR ENERGY EFFICIENT NEW RESIDENTIAL HOUSING IN INDIA”



## About the Promotional Programme

- Study conducted in 2009-2010
- **Objective:** Designing for implementation of promotional programme for EE new housing
- Recommendations on strategies to improve comfort conditions and/or energy efficiency in the identified housing units (AC/non AC) along with incremental costs

## EXAMPLE: NON AC HOUSE



### BASE CASE

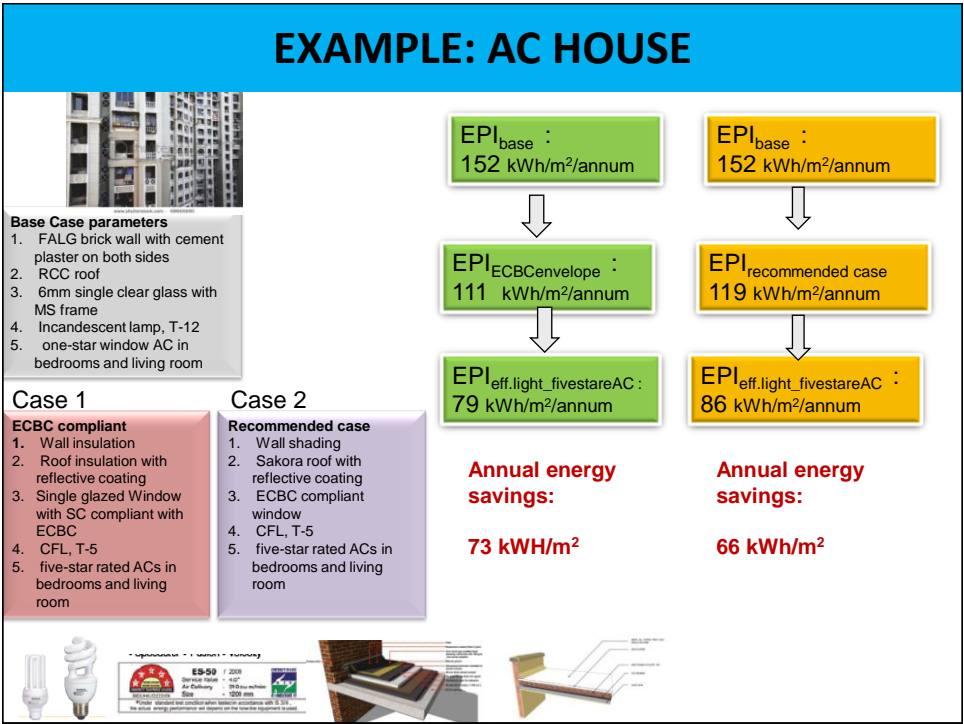
1. FALG brick wall with cement plaster on both sides
2. RCC roof
3. 6mm single clear glass with MS frame

DISCOMFORT  
HOURS:  
64%

### RECOMMENDED CASE

1. Heavy concrete block wall, white paint
2. Mud phuska roof with reflective coating,
3. high performance window(SC:0.29)
4. Enhanced ventilation

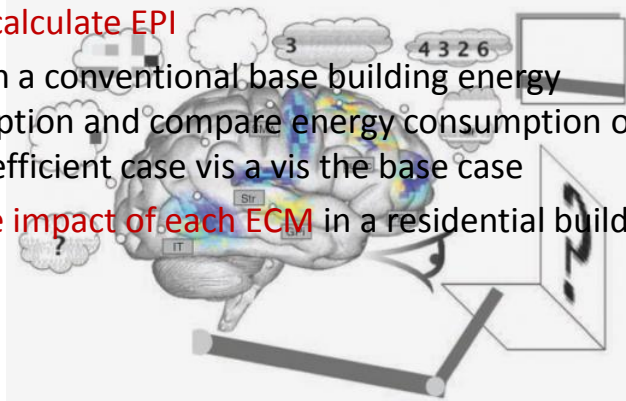
DISCOMFORT  
HOURS:  
44%



## NEED FOR AN ASSESSMENT TOOL

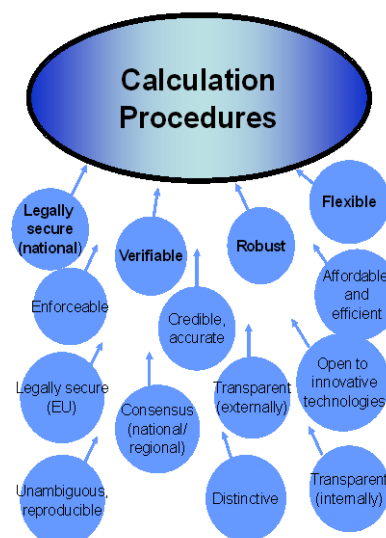
## Need for an Assessment tool

- **Quantification of energy saving potential** in residential buildings as a tool to incentivise EE housing
- **Alternative to complex simulation tools**
- Tool to **calculate EPI**
- Establish a conventional base building energy consumption and compare energy consumption of an energy efficient case vis a vis the base case
- **Evaluate impact of each ECM** in a residential building



## Expected Features of Assessment tool

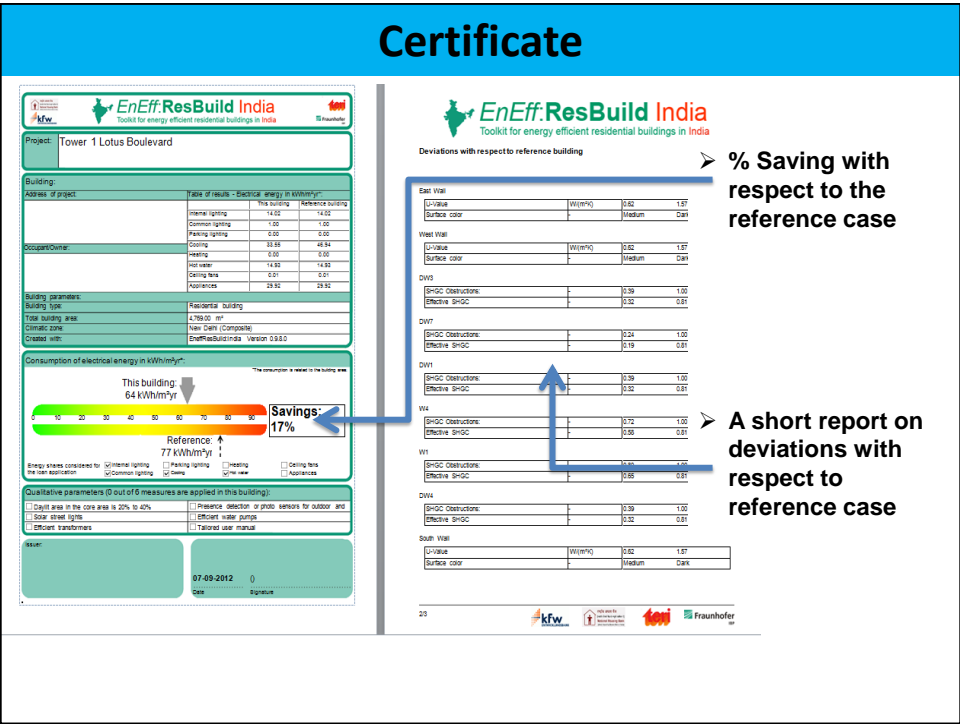
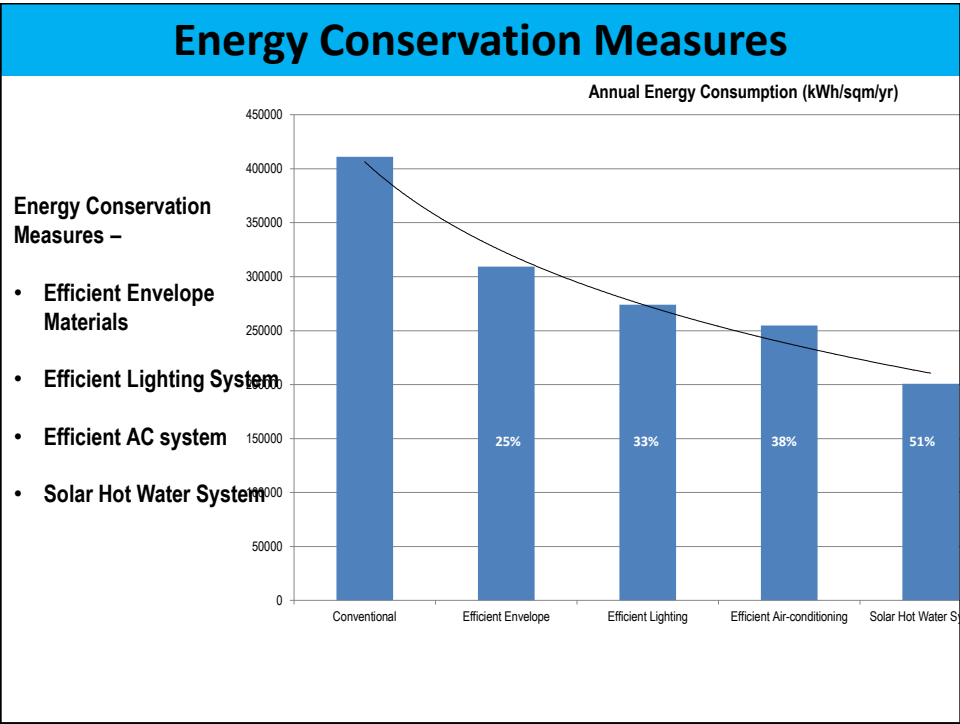
- **Easy to use** with minimum user dependent variables
- **Flexibility** of choosing a prototype
- **Advanced users of the tool** shall be able to provide **customized** buildings specific inputs if template/prototype building information is not used

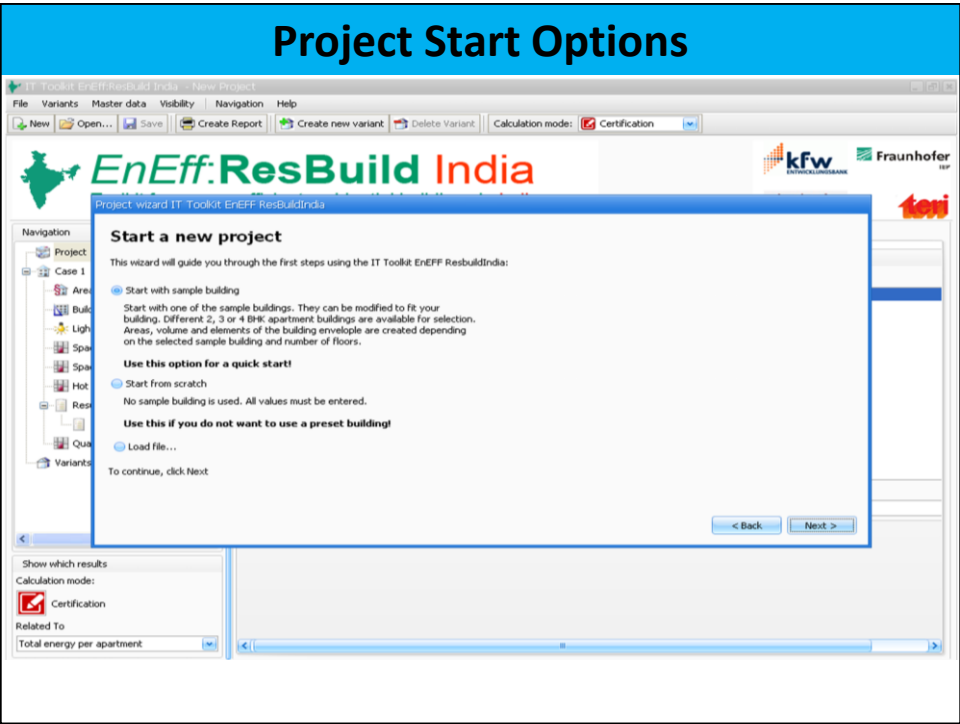
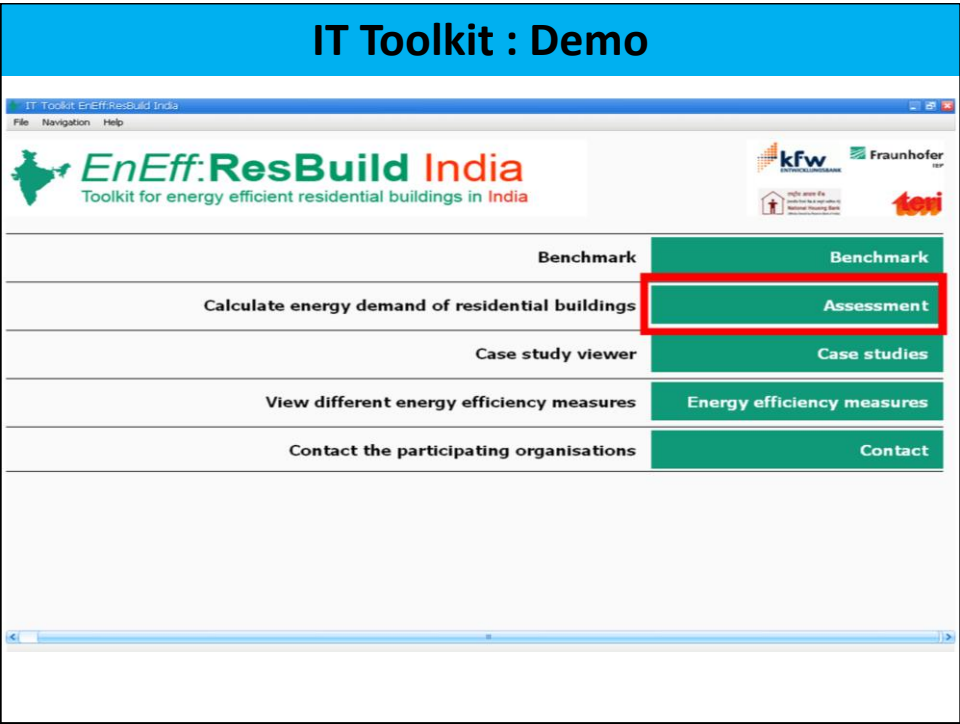


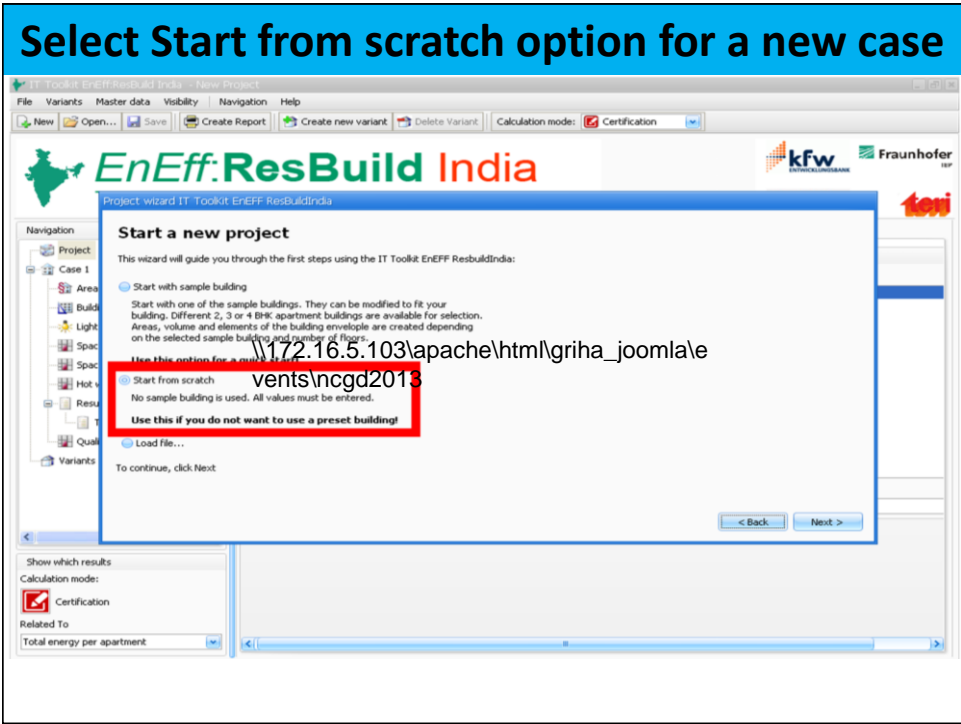
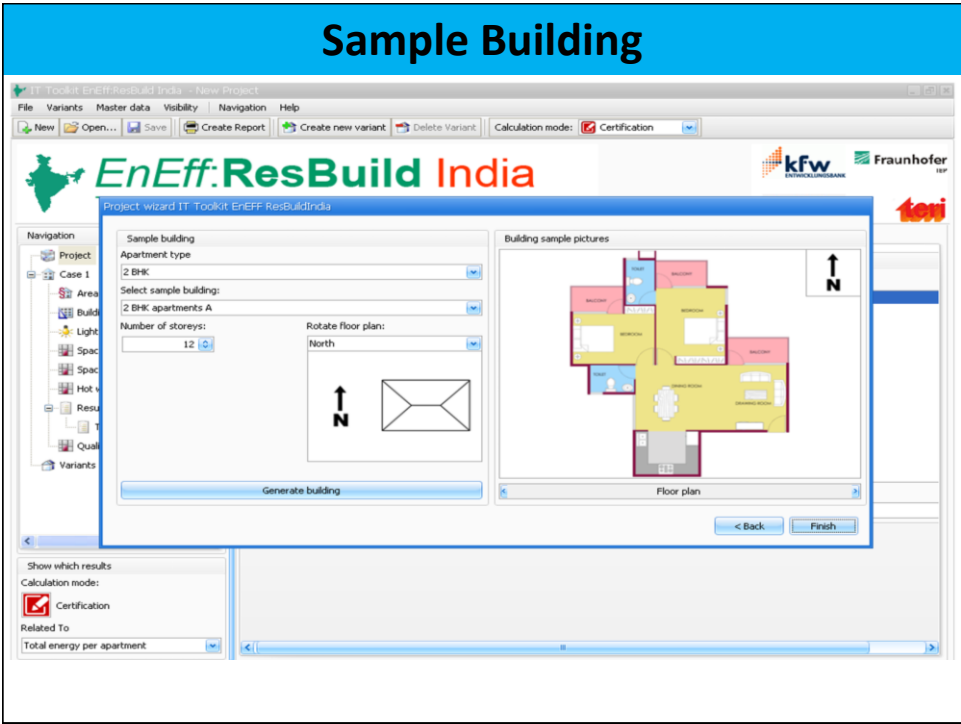
# Overview of Assessment Tool Capabilities and User Interface

# Energy Performance Influencing Parameters

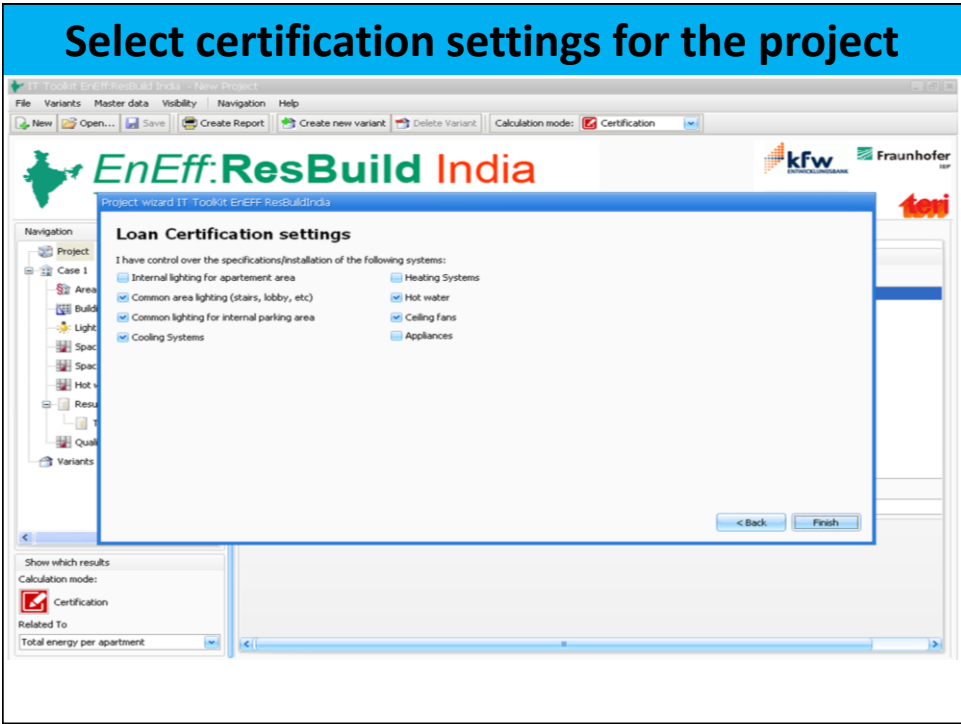
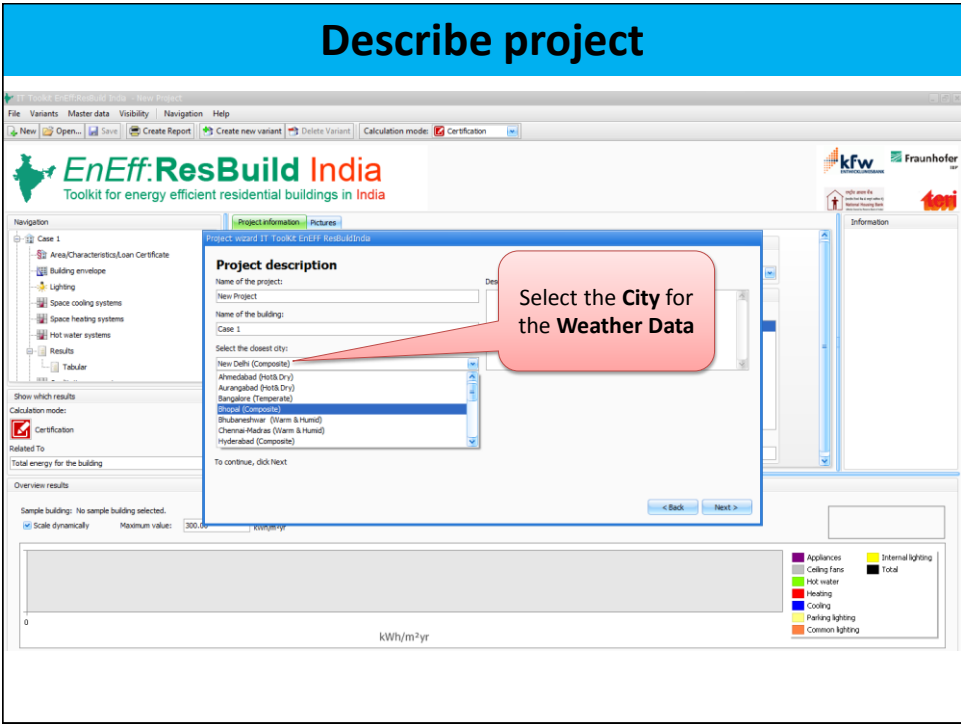
Building Architecture	•Area Calculation for <b>Floor, Walls, Fenestration, Shading devices</b> etc.
Thermo-physical Properties of Building Materials	•Guides the <b>heat ingress</b> in the building
Lighting Load	•Guides the energy consumed towards illumination
HVAC System Efficiency	•Guides the energy consumed towards cooling of building
Hot Water System Details	•Guides the energy consumed by hot water system and energy saved due to Solar Hot Water systems









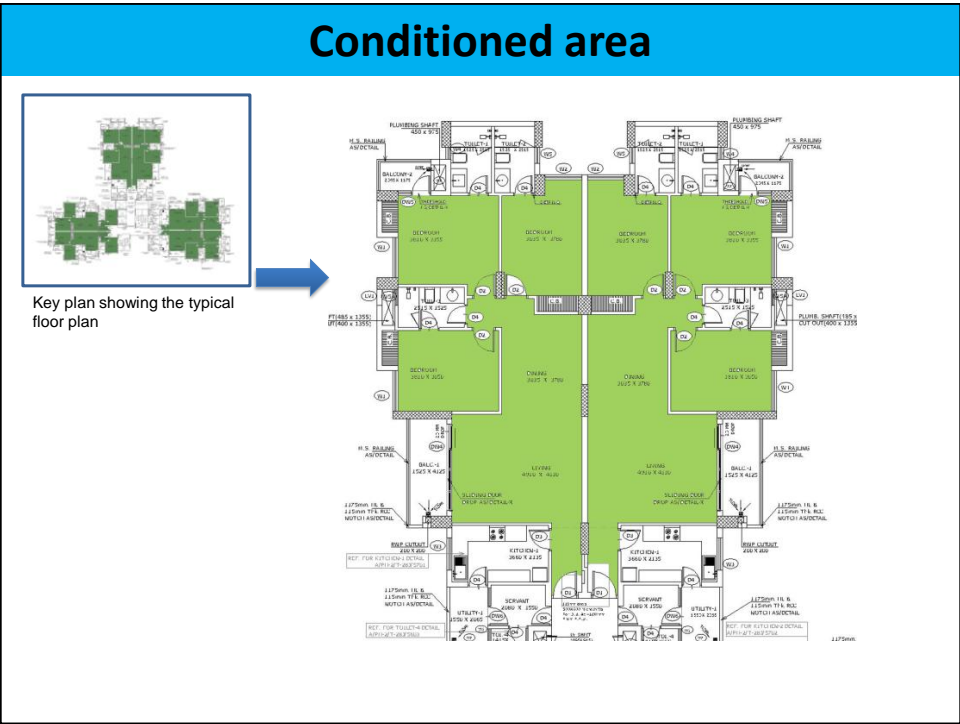
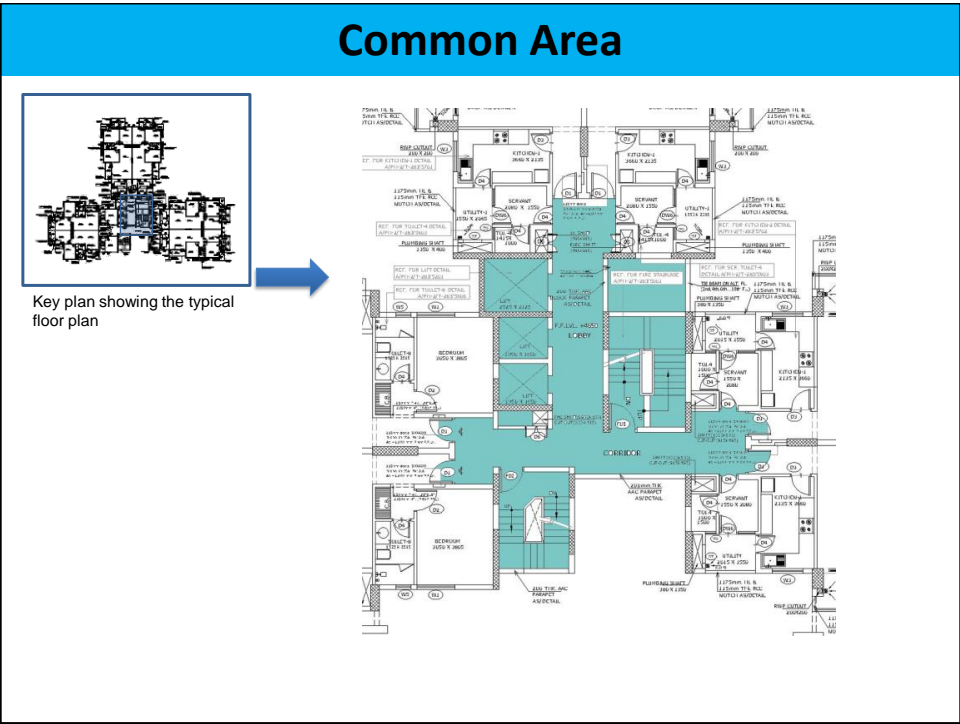


### Fill up various details for Area

The screenshot shows the Eff:ResBuild software interface. On the left is the 'Project Navigator' tree. The main window is divided into several sections: 'Building Geometry', 'Apartment area', 'Apartment characteristics', and 'Building characteristics'. Callouts point to specific input fields: 'Enter number of floors of the building' points to 'Number of storeys'; 'Enter Total common area' points to 'Common area'; 'Enter Total Apartment area' points to 'Apartment area\*'; 'Enter Total Conditioned area' points to 'Conditioned area'; and 'Enter number of apartments' points to 'Number of apartments'.

### Apartment Area

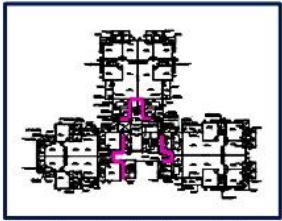
The diagram illustrates the apartment area calculation process. On the left, a 'Key plan showing the typical floor plan consisting of 6 apartments' is shown. An arrow points from this key plan to a larger, more detailed floor plan on the right, which shows the layout of the entire building, including multiple floors and individual apartment units.



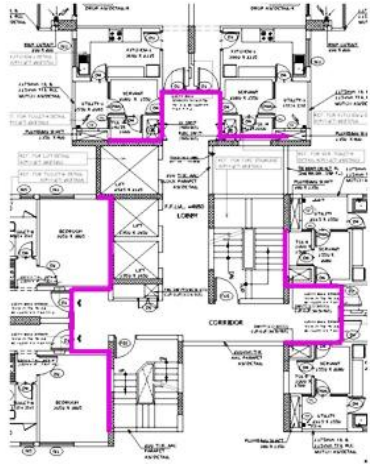
# Fill up various details for Building Envelope

# Apartment Exposed Wall Area

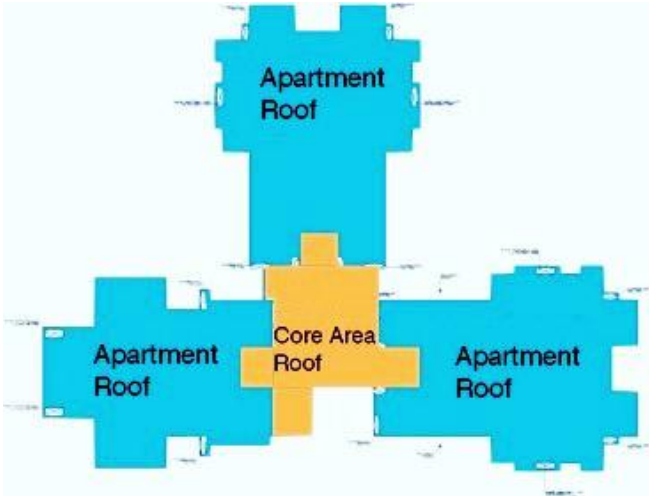
**Core wall Area attached to the apartment area**



Key plan showing the typical floor plan



**Apartment Roof Area**



# Fill up various details for the project

Project Navigator

Eff:ResBuild India  
for energy efficient residential buildings in India

kfw Fraunhofer IEP

Building envelope

Only elements of the heat transferring envelope must be considered here!

Add opaque element... Select wall

Name	Orientation	Gross area [m²]	Net area [m²]
External Wall	East	50.00	50.00

Choose Orientation

External Wall

Name: External Wall

Orientation: East

Gross area: 50.00 m²

Slope: 90°

Surface color: Medium

Select construction: Brick with Plaster

U-Value: 1.98 W/(m²K)

Description of the construction: 25.4mm cement plaster, 228.6mm Brick, 25.4mm cement plaster with sand

Select construction material from library

Select to create customized wall assembly

# Create/Edit wall construction materials

Constructions

Show constructions for: Wall, exposed to outside air

Available constructions

- Brick with Plaster
- AAC Block Wall
- Conventional External Wall
- ECBC External Wall

Manage constructions

New

Copy

Delete

Move to user database

Construction data

Name: Brick with Plaster

U-Value: 1.98 W/(m²K)

Description of the construction: 25.4mm cement plaster, 228.6mm Brick, 25.4mm cement plaster with sand

Info

Calculation of U Value according to EN ISO 6946:

$$U_i = \frac{1}{R_{se} + \sum \frac{\alpha_n}{\lambda_n} + R_{si}} \dots \text{in } W/(m^2K)$$

Create/edit construction panel

Select to create customized wall assembly

### Add Window details

**Add window**

**Select Shading for the fenestration – Adjusted SHGC calculator based on ECBC**

**Select Glazing type from library**

**Select Window frame**

Results for this fenestration system			
U-values:	Glazing	6.17	W/(m²K)
	Frame	13.51	W/(m²K)
	Total	7.27	W/(m²K)
	SHGC		
	Glazing	0.81	
	Overhangs and fins	0.90	
	Effective	0.73	

### Create/Edit window material

**Create/edit window panel**

**Select to create new glazing system**

Results for this fenestration system			
U-values:	Glazing	6.17	W/(m²K)
	Frame	13.51	W/(m²K)
	Total	7.27	W/(m²K)
	SHGC		
	Glazing	0.81	
	Overhangs and fins	0.90	
	Effective	0.73	

# Lighting Template

EnEff:ResBuild India  
Toolkit for energy efficient residential buildings in India

Remarks: - The areas can be set under "Building parameters / areas". If an area is 0 m<sup>2</sup>, the calculation is disabled.

Internal lighting for apartment area

Open lighting power density (LPD) calculator

Installed LPD (Lighting power density) 7.50 W/m<sup>2</sup> Maximum LPD for this area is 7.50 W/m<sup>2</sup>

Lighting Control options

Common area lighting (stairs, lobby, etc)

Open lighting power density (LPD) calculator

Installed LPD (Lighting power density) 6.50 W/m<sup>2</sup> Maximum LPD for this area is 6.50 W/m<sup>2</sup>

Lighting Control options

Manual On/Off

Common lighting for internal parking area

Open lighting power density (LPD) calculator

Installed LPD (Lighting power density) 0.00 W/m<sup>2</sup> Maximum LPD for this area is 2.20 W/m<sup>2</sup>

Lighting Control options

Enter LPD for Apartment area

Enter LPD for Common area

# Lighting Power Density (LPD) Calculator

EnEff:ResBuild India  
Toolkit for energy efficient residential buildings in India

LPD Calculator by TERI

Details

Type of lamp: TPL (Tubular fluorescent lamps)

Power per lamp: 65.0 W

Type of ballast: Incandescent lamps

Number of fixtures: 71.5

Manage Lighting Systems

Lighting system

Total

Per fixture: 65.0 W

Area: 5,000.00 m<sup>2</sup>

Effective Wattage

Area: 5,000.00 m<sup>2</sup>

Lighting power density (LPD)

0.00 W/m<sup>2</sup>

Apply LPD and exit

Savings: 0%

Actual Building

Reference Building

kWh/yr

0 17449 34897 52346 69794 87243

Appliances

Ceiling fans

Hot water

Heating

Cooling

Parking lighting

Common lighting

Internal lighting

Total

Select Lamp Type, wattage, numbers






# Space Cooling Systems Template


IT Toolkit EnEff:ResBuild India - New Project

File Variants Master data Visibility Navigation Help

New Open... Save Create Report Create new variant Delete Variant Calculation mode: Certification

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Toolkit for energy efficient residential buildings in India



Navigation

- Project
- Case 1
  - Area/Characteristics/Loan Certification
  - Building envelope
  - Lighting
  - Space cooling systems**
  - Space heating systems
  - Hot water systems
  - Results
    - Tabular
    - Qualitative parameters
  - Variants

Remarks: - The number of units is always the total number of those units in this building

Space cooling options

Select the cooling systems:

- ☐ No cooling
- ☒ Decentralized cooling (split and/or window AC systems)
- ☐ Centralized cooling (VRF systems)

Operation mode of cooling systems:

- ☒ 24h/7d operating schedule (1st of May to 19th of October)  
Automatic setting of power and operating times to maintain temperature.
- ☐ User defined operating schedule  
The user can set the operating time of the devices.
- ☐ User defined operating schedule and cooling capacity  
The user can set size and operating time of the devices.

Space cooling operating times

All operating times must be given in hours/day [h/d]

Jan	Feb	Mar	April	May	June
0.00	0.00	0.00	0.00	0.00	0.00
Jul	Aug	Sept	Oct	Nov	Dec
0.00	0.00	0.00	0.00	0.00	0.00

Design resources

Additional resources and design guidelines can be found here:  
<http://www.savesenergy.co.in/20-module-positions-mainmenu-44.php>

Wind

Number of installed units: 1 Cooling output: 0.0

BEE Star rating: 1 Star \* EE Rating: 2.3

Split AC

The split air conditioner comprises of two parts - the outdoor unit and the indoor unit. The split air conditioner can be used in a room, or often a window sill.

Number of installed units: 0 Cooling output: 0.0

BEE Star rating: 1 Star \* EE Rating: 2.3

VRF

Variable Refrigerant Flow (VRF) air-conditioning system is a newly widely used system, due to its flexibility and high coefficient of performance (COP) in part load condition. Indoor units in a VRF system can be independently controlled to meet the cooling or heating requirement in each room.

Number of installed units: 0 Cooling output: 0.0

BEE Star rating: EE Rating: 0.0

Show which results

Calculation mode:

- ☒ Certification

Related To


Total energy per apartment



# Hot Water Systems


IT Toolkit EnEff:ResBuild India - New Project

File Variants Master data Visibility Navigation Help

New Open... Save Create Report Create new variant Delete Variant Calculation mode: Certification

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  - Results
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    - Qualitative parameters
  - Variants

Remarks: - The number of units is always the total number of those units in this building

Space hot water options


Operation mode of cooling systems:

- ☐ No hot water
- ☒ Decentral hot water

Design resources


Additional resources and design guidelines can be found here:  
<http://www.ratscreen.net/>

Instant water heater

 Instant water heaters instantly heats the water as it flows through the device, and do not retain any water internally, except for what is in the heat exchanger coil.


Storage capacity: 1.00 l Number of installed units: 1

Solar water heater

 Solar water heater absorbs solar radiations in the collector panel during daytime to heat the water. Both Flat plate collector, and evacuated tube collector are commonly used.

Collector area: 24.00 m² BEE Star rating: 1 Star \*

Electric Geyser

 Electric Geyser

Storage capacity: 15.00 l Number of installed units: 1

BEE Star rating: 1 Star \*

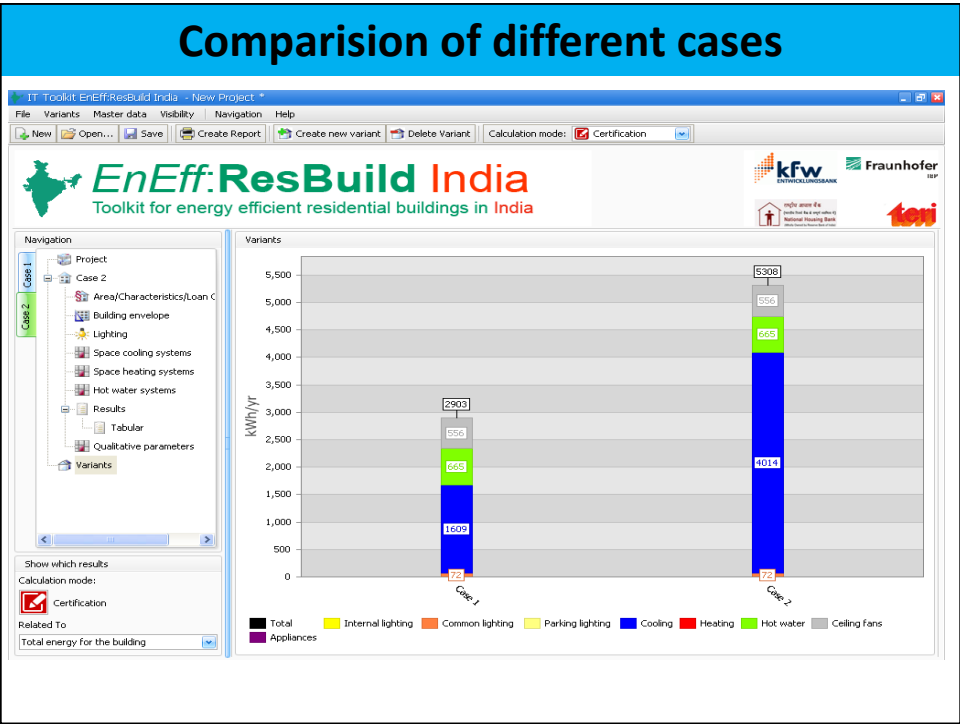
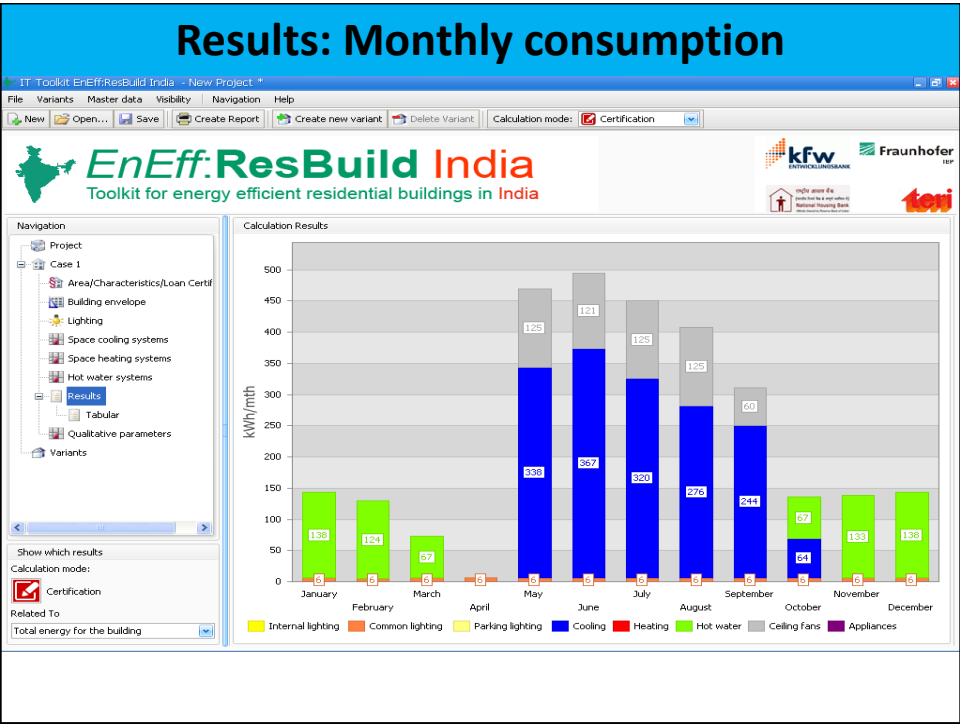
Show which results

Calculation mode:

- ☒ Certification

Related To

Total energy per apartment

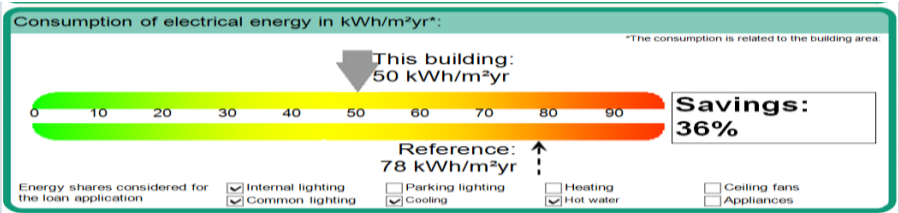


# Certified Project Example

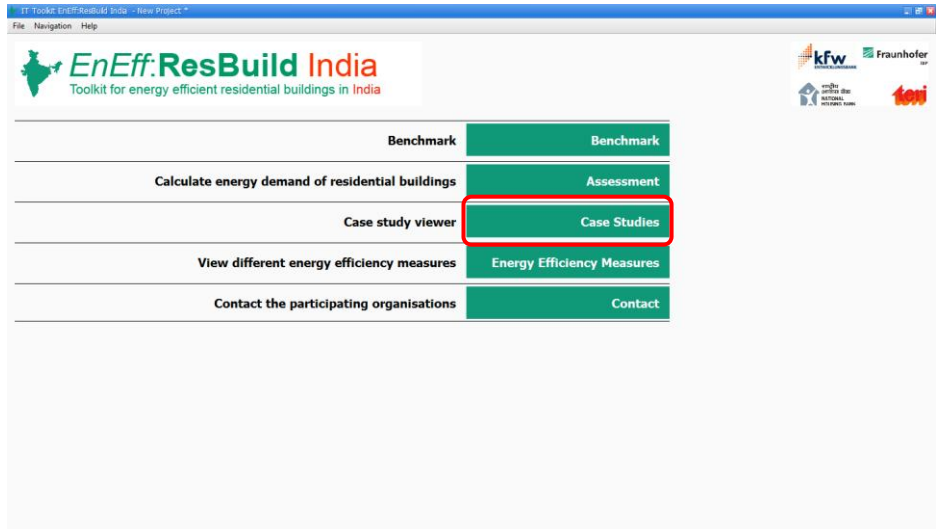
**HIRCO Project – Panvel**

**ECMs (energy conservation measures) adopted:**


- 1. **Roof Insulated**
- 2. **Wall with AAC block**
- 3. **Windows well shaded**
- 4. **Efficient Lighting – LPD in range of 5.4-5.7 W/sqm**
- 5. **Efficient Air-Conditioners – BEE 4\* Acs**
- 6. **Solar Hot Water System – 25% of the roof top area**



# Case Studies



## Case Studies



# EnEff: ResBuild India

Toolkit for energy efficient residential buildings in India

## Project Description

How to use the Case Study Viewer


The Case Study Viewer is easy to use.

The available case studies are listed below. By clicking on one of them, the details of that case study are shown in the main window.


The information on each case study is structured onto the same topics.

Additionally, there are images available which can be browsed on the left hand side. By clicking on one of these images it gets zoomed.

List of available Case Studies



Lotus Boulevard



Lotus Panache

<p><b>Project name:</b> Lotus Boulevard</p> <p><b>Location/Address:</b> Sector-100, Noida</p> <p><b>Type of construction:</b> Earthquake resistant concrete frame structure</p> <p><b>Site area:</b> 30 Acres</p> <p><b>No. of Towers/Apartments:</b> 30 towers</p> <p><b>Typical apartment types:</b> 2/2/4 BHK Apartments</p> <p><b>Project Status:</b> On going</p> <p><b>Developers:</b> Three C. Universal Developers Pvt. Ltd.</p> <p><b>Architects:</b> Design and Development India Pvt. Ltd.</p> <p><b>Design Team:</b> Vidur Bhardwaj, Sheetal Ralheja, Mona Behl, Ruchi Vp, Priya, Ragneev, Sakin, Obaid, Rahul, Hemru</p> <p><b>MEP and Energy Consultants:</b> Spectral Service Consultants</p>	<p><b>Project Description:</b></p> <p>"Where there is more than the sum of its parts"</p> <p>Lotus Boulevard is a suburban habitat nestled amidst 40 acres of tranquil and select; located right off the Noida expressway in sector 100. Flawlessly excellent connectivity with main road, as well as with other strategic locations within the national capital, it presents an outstanding opportunity to live a well-balanced life in the lap of luxury. Lotus Boulevard is also unique in terms of how, through its planning, it has prioritized the regeneration of green spaces, healthy community living and sustainable development. The development is planned in clusters of towers. Each cluster is planned as a green court and form a series of courts which offer a sense of community interaction, which is named to this central "Vibrant" community interaction office for the planet. The "Green" project. The urban planning arrangements of the units to have three sides opening to the complex provides a range of recreational activities. The building is designed keeping in mind the lush, soft and prevailing wind direction to naturally diffuse and ventilate interior spaces; it also uses low-emission building materials for its construction. The project also incorporates the highly energy efficient MEP design and equipment; use of daylight sensors, energy efficient lighting and HVAC system further reduce the building energy load.</p> <p>Business center at the entrance of the residential complex overlooking the central green space not only provides an opportunity for visitors to work from home, but also a place for learning about the green living. The building envelope is designed using low-emission energy materials like fly-ash bricks, ferrocement roof, well-insulated green wall on the periphery and the use of high-performance double insulated glass to reduce the heat gain.</p> <p>The project is equipped with sustainable measures for energy, water conservation and environmental protection. The project is intended to comply with IGBC (Indian Green Building Council) Green Homes rating system in order to achieve Gold certification for the project.</p>
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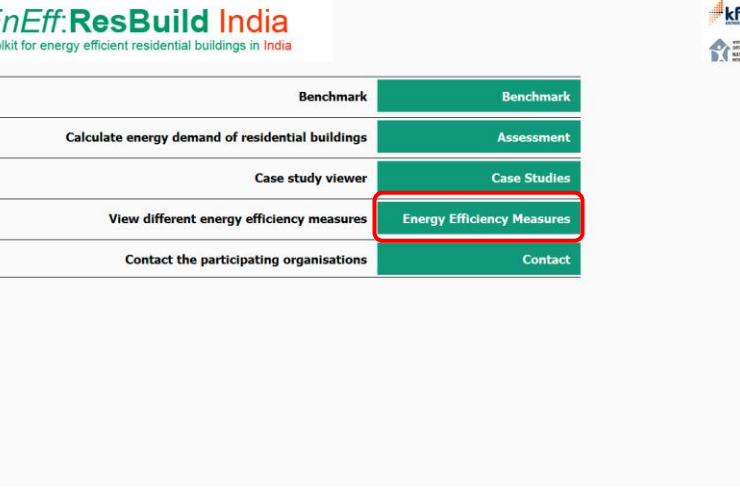
## Project Photographs

Business Center Side View

Business Center Top View

## List of Case Studies





## Energy Efficiency Measures



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File Navigation Help

 **EnEff:ResBuild India**  
Toolkit for energy efficient residential buildings in India

Benchmark	Benchmark
Calculate energy demand of residential buildings	Assessment
Case study viewer	Case Studies
View different energy efficiency measures	<b>Energy Efficiency Measures</b>
Contact the participating organisations	Contact

# Energy Efficiency Measures

**IT Toolkit EnEff:ResBuild India - New Project**

File Navigation Help

**EnEff:ResBuild India**  
Toolkit for energy efficient residential buildings in India

kfw Fraunhofer

How to use the Energy Efficiency Viewer  
The Energy Efficiency Measures (EEM) database is easy to use. Select your point of interest in the building or your technical interest in the tree below.  
As the user highlights individual EEMs, information is displayed below.

**List of EEMs**

Energy Efficiency Measures  
Building Design/Envelope  
Solar Passive  
Orientation  
Buffer Space  
Roof  
High performance roof  
Cool Roof or Low Emissivity Roof  
Vegetated Roof or Green Roof  
Wall  
High performance wall  
Surface finishes  
Fenestration  
Window size and placement  
Glazing  
Frame  
Shading devices  
High performance glazing  
Cooling Equipment  
Cooling Fans  
Efficient equipment selection  
Equipment size selection  
Air conditioners  
Efficient Equipment selection  
Operating criteria

**Energy Efficiency Measure Description**

**Window-wall ratio (WWR)**  
Window to wall ratio is the net glazing area (window area minus mullions and frame or approximately 80 per cent of opening) divided by gross exterior wall area.  
WWR should be restricted to maximum 60% to avoid excessive heat ingress. Glazed area should not be solely decided on the basis of external aesthetics.

$WWR = \frac{a \cdot b}{W \cdot H}$

**Individual EEM Details**

For free download of the tool, logon to

**www.ittoolkitindia.com**

