



Replicable designs for Thermally Comfortable Affordable housing

Fourth stakeholder meeting | **16 March 2023**

Knowledge Partners:



Ashok B Lall Architects



LEAD Consultancy



Greentech
Knowledge Solutions

Webinar 4 - March 2023

SESSION I

*Introduction and Project
Overview*

SESSION II

Webtool Interface – Design and Technical Data

SESSION III

Webtool Interface – Download Data

SESSION I

Introduction and Project Overview

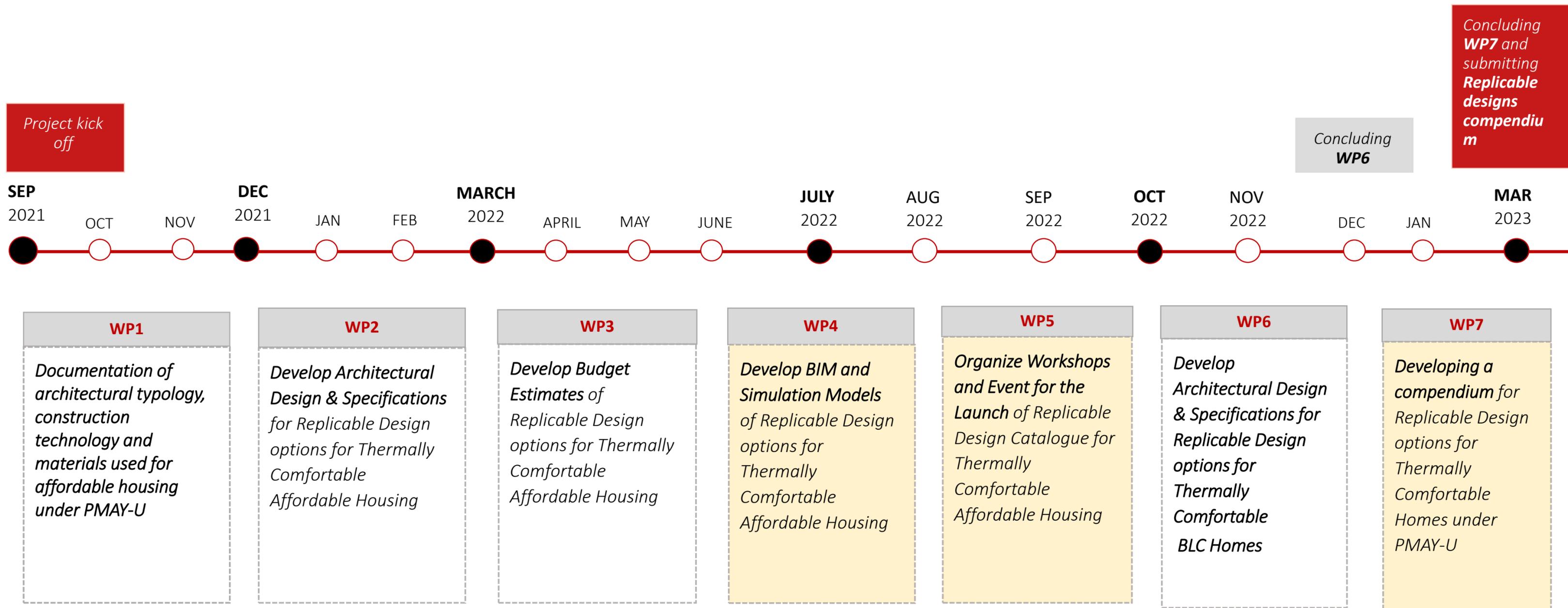
Speaker:

Niroopa Subrahmanyam

To enhance climate resilience and thermal comfort in buildings by adopting innovative passive measures, locally available and low embodied energy materials coupled with appropriate available technologies of construction for affordable housing.

The main objective is minimizing discomfort hours through use of passive design measures to improve the quality of life while ensuring affordability

INTRODUCTION - Project Timeline



WP4
OBJECTIVE
Development of a navigation Tool for hosting on web-portal
ACTIVITIES
<ol style="list-style-type: none"> 1. Develop a database of design options having cost details, energy performance parameters, other selection related parameters, for web-based tool 2. Develop an intuitive web-based tool to visualize and compare building design options based on performance and other selection criteria. The objective of the tool is to assist the user in taking informed decision. 3. The navigation tool should be optimized for both PC and portable device (mobile/tablet) browsing.
DELIVERABLES
<ul style="list-style-type: none"> Web based tool to visualize and compare building design options

WP5
OBJECTIVE
Organize Workshops and Event for the Launch
ACTIVITIES
<ol style="list-style-type: none"> 1. Round Table Meetings With identified stakeholders (e.g., Developers, Financial Institutions, UDDs, PWDs, ULBs, etc.) and incorporate the feedback received from stakeholders in the proposed activities 2 Regional Stakeholder Workshops To present the outcomes under the assignment and incorporate the feedback received from stakeholders.. 3. Training Programs <ul style="list-style-type: none"> Physical and virtual training workshops targeting building design professionals and government stakeholders.
DELIVERABLES
<ul style="list-style-type: none"> Presentations, workshop material and training manual

WP7
OBJECTIVE
Developing a compendium for Replicable Design options for Thermally Comfortable Homes under PMAY-U
ACTIVITIES
<ol style="list-style-type: none"> 1. To develop and deliver print ready InDesign and hi-res PDF formats (along with a web-friendly PDF version for uploading on PMAY(U) website)
DELIVERABLES
<ul style="list-style-type: none"> Two high-resolution compendiums in book format Integration of replicable designs developed in WP 6 in the web-tool

Topics covered in Webinar 1, 2 and 3

Webinar 1 - April 2022

Overview of existing design and construction practices to identify gaps in achieving optimal Thermal comfort

Framework for development of type designs

Type design overview of Thermal Performance and Carbon Footprint of Construction

Key Performance Indicators

Webinar 2 - Nov 2022

Affordable Housing Typologies

Categorization of residential buildings for Type designs

*Type design packages
Plan sets & Master sets*

Overview of Master set

Simulation and Performance concepts

*Key Performance Indicators of one type design
RET_V,WFR,EEI,DDH*

Webinar 3 - Jan 2023

Type designs for different building typologies

Simulation results and Performance Inferences

*Development of BLC
(Beneficiary Led Construction)
type designs*

*Introduction to Webtool
&
Next Steps*

What is the purpose of the webtool ?

- This web-based platform is **an intuitive web-based learning tool** that helps designers, builders and promoters of residential buildings **to understand the ways of designing thermally comfortable affordable residential buildings.**
- The **platform provides type designs and the thermal performance** for a **wide range of residential building types and sizes** of residential units in **different climatic regions.**
- The tool covers various aspects of design, **bringing to the user sample designs with detailed simulations and identified criteria for measuring the performance** of the building. The **objective of the tool is to assist the user in taking informed decision.**
- The navigation tool should be **optimized for both PC and portable device** (mobile/tablet) browsing.

What all will the user get in the webtool?

MASTER SET

- **A) Design data** 
Plans, Block Plan ,Window and shading design
- **B) Construction data** 
Working drawing set- Plans, Elevations , Sections, Electrical Layout & Architectural details
 - *BOQ & Estimate*
 - *Revit file*
- **C) Simulation Data** 
Climate analysis ,Schedule of operation ,Input Parameters
 - *IDF files*
 - *RAD files*
- **D) Performance Data** 
 - Key performance indicators
RETV, WFR, EEI, DDH,

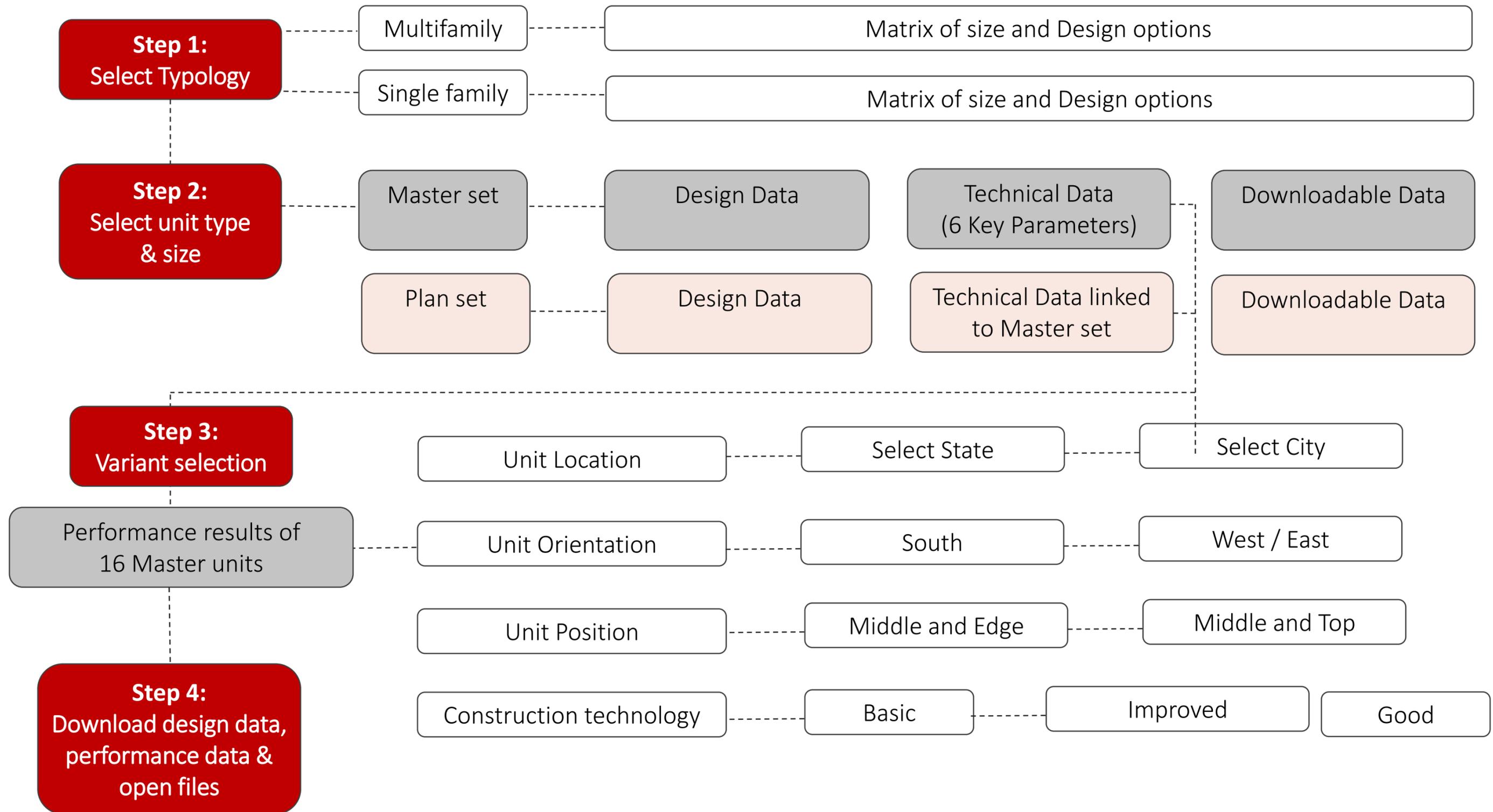
PLAN SET

- **Design – Plans** 

Where can the webtool be found?

- The webtool will be **hosted by the Ministry of Housing and Urban Affairs**
- Details will be announced when the website is ready.

Webtool structure



End of Session

Questions and Feedback

Please follow the link in the chat box to fill the feedback survey:

SESSION II

Webtool Interface – Design and Technical Data

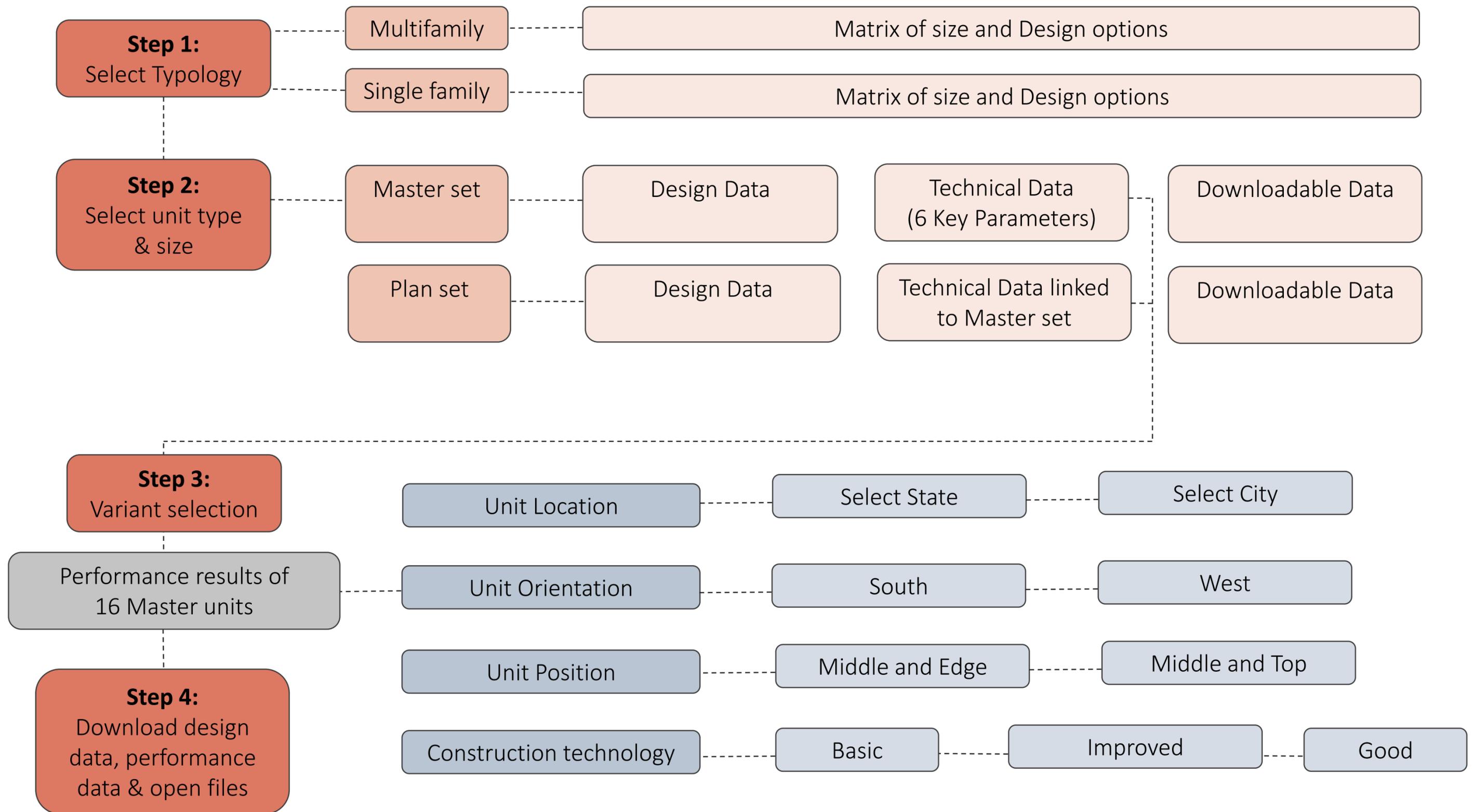
Speakers:

Prof. Ashok Lall & Rathnashree Prakash

Climate Smart Building Designs for affordable housing

NEXT





Climate Smart Building Designs for Affordable housing

The Replicable Design Options for Thermally Comfortable Affordable Housing is a project launched within the Climate Smart Buildings (CSB) Program as part of the Indo-German Technical Cooperation (IGEN).

This project seeks to enhance awareness of thermal comfort, build capacity of stakeholders and government officials at ULB/State/Centre levels, and support the mainstreaming of thermal comfort in affordable housing schemes and policies

Project objectives

To enhance climate resilience and thermal comfort in buildings by minimizing discomfort hours.

To adopt passive measures, locally available and low embodied energy materials with appropriate available technologies of construction for affordable housing.

To improve quality of life for end user while ensuring affordability.

To enhance knowledge of stakeholders and government officials through consultations on thermal comfort.

To equip building design professionals with advanced knowledge on thermal comfort and capacitate them to integrate thermal comfort in upcoming affordable housing projects.

Replicable Designs webtool

This web-based platform is a learning tool that helps designers, builders and promoters of residential buildings to understand the ways of designing thermally comfortable affordable residential buildings.

The tool covers various aspects of design for thermally comfortable residential buildings bringing to the user sample designs with detailed simulations and identified criteria for measuring the performance of the building. The platform provides type designs and the thermal performance for a wide range of residential building types and sizes of residential units in different climatic regions.

Project contributors



Ministry of Housing and Urban Affairs
Government of India



Building materials &
Technology
Promotion Council



Deutsche gesellschaft
für internationale

Knowledge Partners



Ashok B Lall Architects

Experts in sustainable, affordable and climate conscious design at all scales of development since the last 40 years

www.ashokblallarchitects.com



Lead Consultants Pvt. Ltd.

Pioneer in MEP & Green Consultancy in India since 11 years with offices & projects across the country

<http://www.lcsind.org/>



Greentech Knowledge Solutions Pvt. Ltd.

Experts in offering solutions for improving energy efficiency in buildings, improving resource efficiency in the production of building materials and deployment of decentralized renewable energy systems.

<https://www.gkspl.in/>

Experts

- Environmentally sustainable and affordable architecture expert
- Architectural Design Expert
- Building Construction Expert
- Building Material Expert
- Passive Strategies Expert
- Building Energy Analysis Expert
- Building Performance Analysis Expert
- Structural Systems Expert
- Project management
- Webtool designer
- BIM Expert

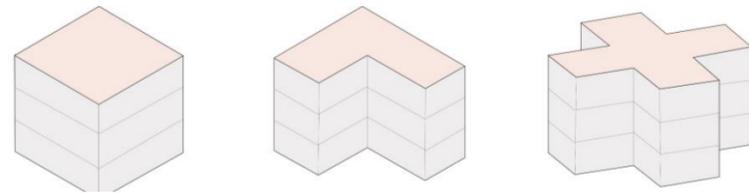
NEXT



It is essential to understand project design principles and performance indicators before proceeding to the next page

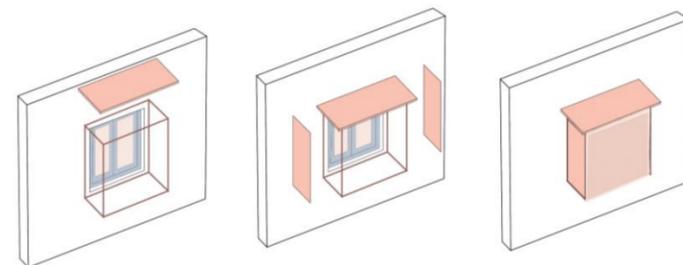
Passive design strategies used for achieving thermal comfort

Compactness



This principle requires minimizing the external wall area while planning the arrangement of dwelling units -whether as a single unit on its plot of land or as a group of units. Lesser the area of exposure of the external envelope to the outside, for a given floor area, lesser will be the heat transfer into the building.

Protection through shading



The external perimeter that separates the outside from the inside, is made up as walls and windows. Opaque masonry walls will have a greater capacity to resist the flow of heat compared to windows. The larger the ratio of window area to wall area, the greater the flow of heat

Indicators for assessing thermal comfort performance

Degree Discomfort Hours (DDH)

The difference in temperature between the indoor air temperature and the IMAC – R comfort temperature over 8760 hours (365 days * 24 hours).

Software: Design Builder/Energy Plus

Embodied Energy Intensity (EEI)

Embodied energy share of the highest contributing materials i.e. cement steel, walling blocks.

Embodied energy intensity is being demonstrated as embodied energy per unit carpet area (**MJ / m²**)

Calculation Required :

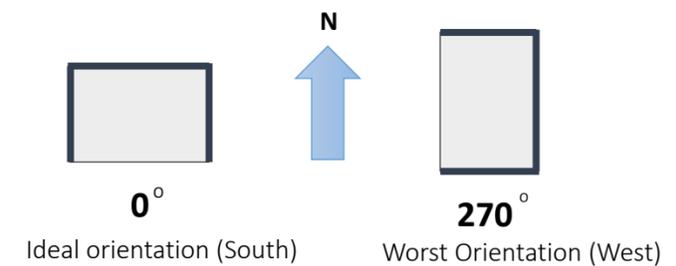
Mass or volume of Cement, steel and walling materials used are taken from the BOQ. This is multiplied by the corresponding embodied energy coefficients of the material (in MJ/kg or MJ/m³). *Coefficients from secondary sources*

Sum of embodied energy of all materials divided by carpet area gives the embodied energy intensity

Cost Efficiency

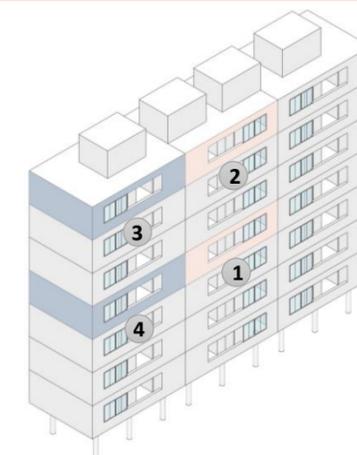
Variations

Variation in Unit Orientation



The variation in performance when a building is turned through different orientations with respect to the sun is also reported by simulation.

Variation in Unit Position

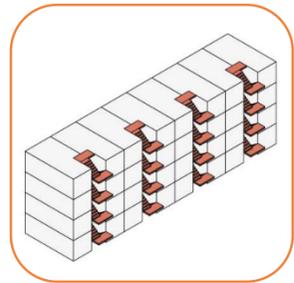


- 1 Middle Floor- Middle Unit
- 2 Top Floor- Middle Unit
- 3 Top Floor- Edge Unit
- 4 Middle Floor- Edge Unit

The differences in performance due to the positioning or placement of a dwelling unit – middle floor or top floor , middle unit, end unit etc. is reported by simulation.

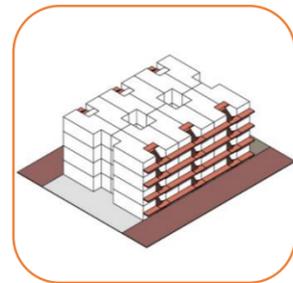
Select Housing type

Multi Family – Group Development



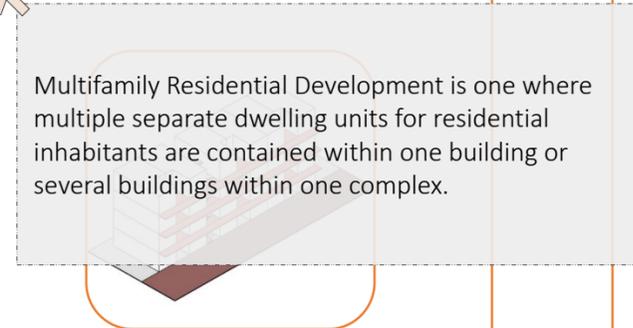
ROW HOUSE-2 SIDE OPEN

Height : Upto G+3



ROW HOUSE-BACK TO BACK

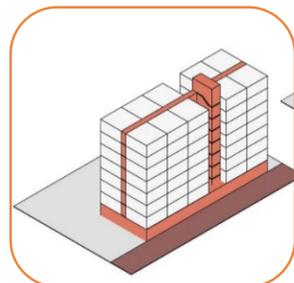
Height : Upto G+3



SINGLY LOADED CORRIDOR

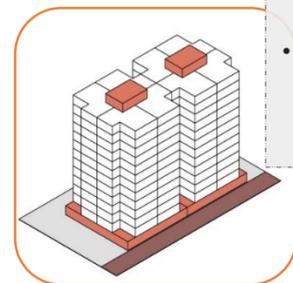
Height : Upto G+7

Multifamily Residential Development is one where multiple separate dwelling units for residential inhabitants are contained within one building or several buildings within one complex.



DOUBLY LOADED CORRIDOR

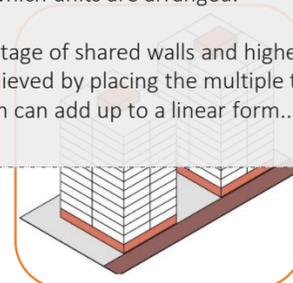
Height : Upto G + 7 OR S + 8



TOWER-CONNECTED

Height : Upto S + 8

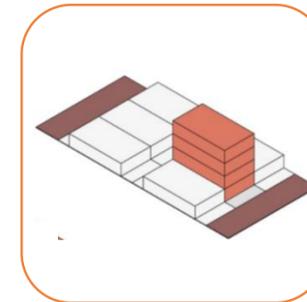
- The tower typology has a central core for vertical circulation around which units are arranged.
- This gives the advantage of shared walls and higher densities can be achieved by placing the multiple towers close together which can add up to a linear form..



TOWER-STAND ALONE

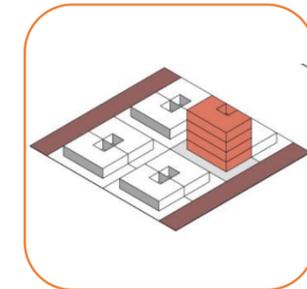
Height : Upto S + 8

Single Family – Plotted Development



ROW HOUSE TWO SIDE OPEN

Height : Upto G+3

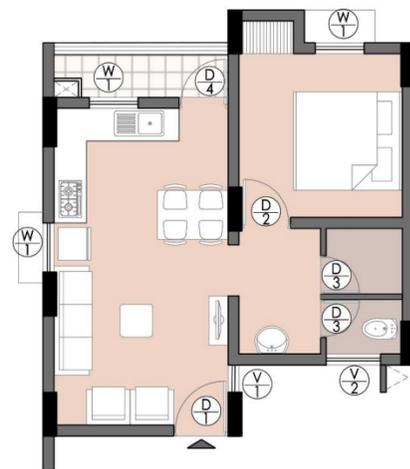


SEMI-DETACHED

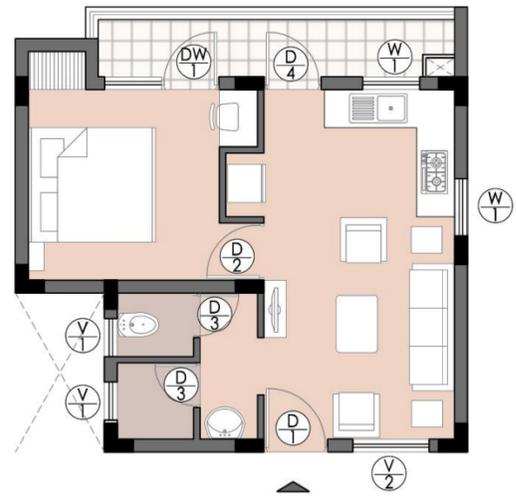
Height : Upto G+3

Select Dwelling Unit type

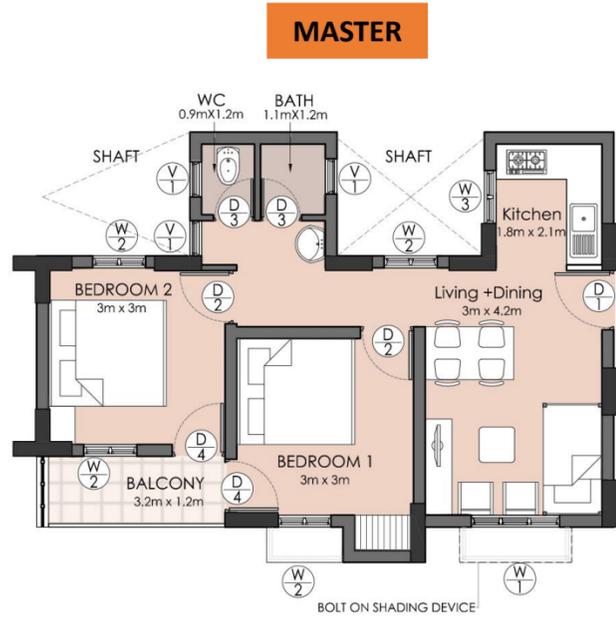
Warm climates



M-4A-1BHK
Carpet Area : 30sqm



M-4B-1 BHK
Carpet Area : 40sqm

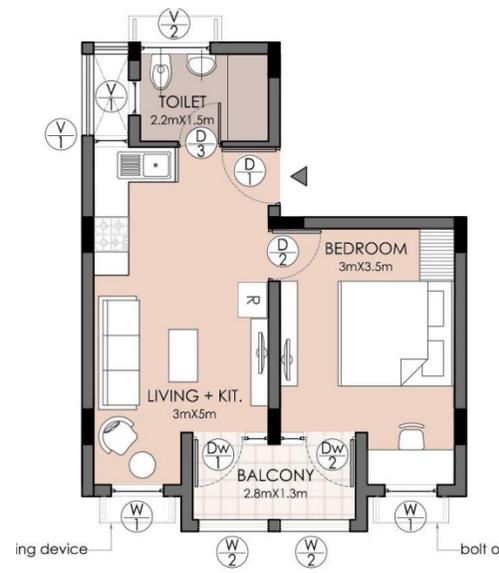


M-4C-2 BHK
Carpet Area : 55sqm



M-4D-2 BHK
Carpet Area : 60sqm

Cold climate



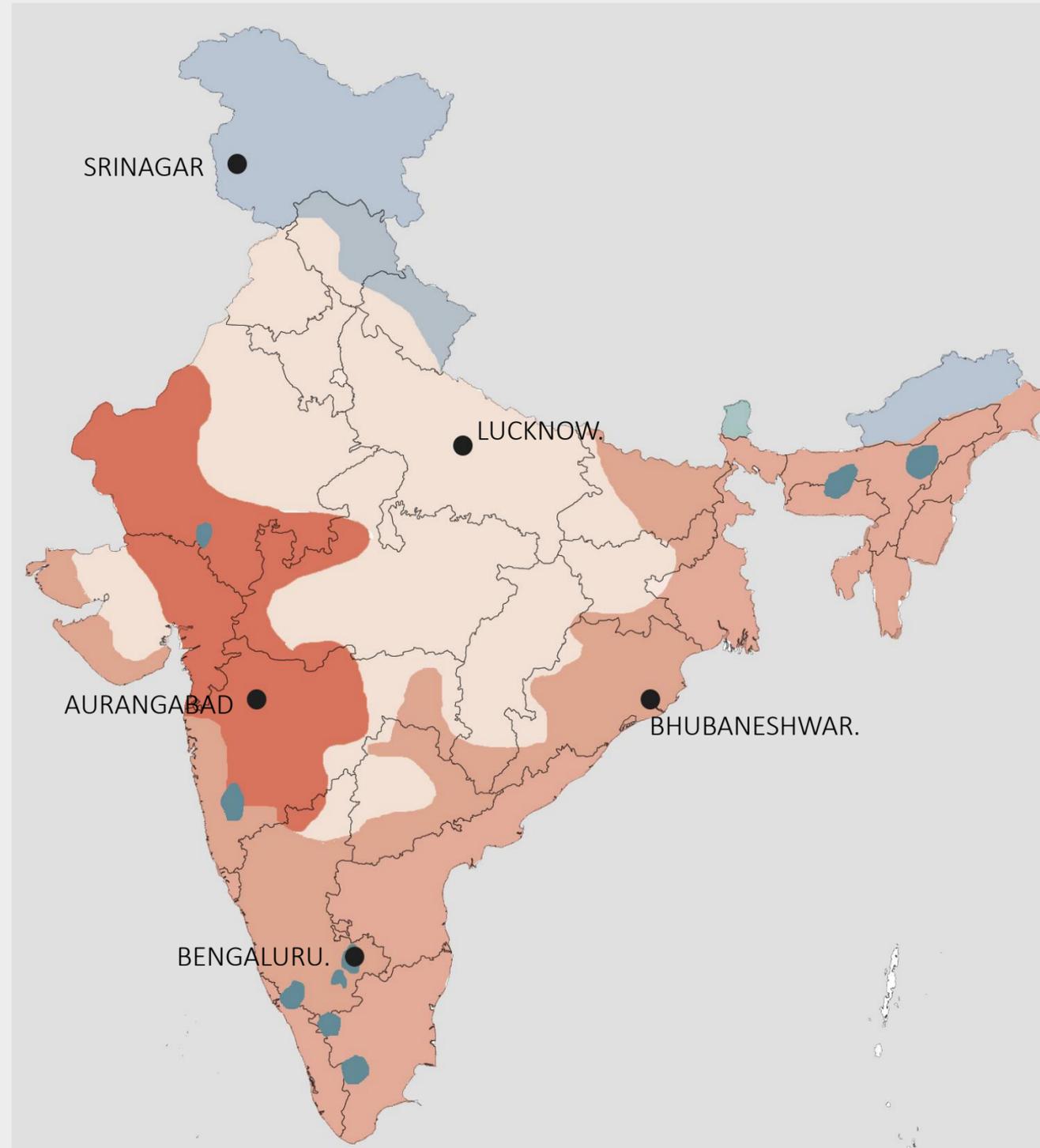
CL-M-4A-1BHK
Carpet Area : 55sqm

Select Dwelling Unit type

About Dwelling unit Type Design:

Warm climates

Cold climate



Climate Zones Map Of India*

*As per NBC and ECBC (2017)

WARM CLIMATES

- Composite Climate
- Warm and Humid Climate
- Hot and Dry Climate
- Temperate Climate

- High temperature in Summer and cold in winter
- Low humidity in summers and high in monsoons
- High direct solar radiation in all seasons except monsoons
- Occasional hazy sky hot winds in summer, cold winds in winters and strong winds in monsoon

COLD CLIMATE

Disclaimer: The study shows results for representative cities in each climate zone. These are not absolute solutions for all locations falling in a particular climate zone as conditions vary geographically. The methodology and rationale for improving thermal comfort step by step is to be understood from this example and applied for other locations.

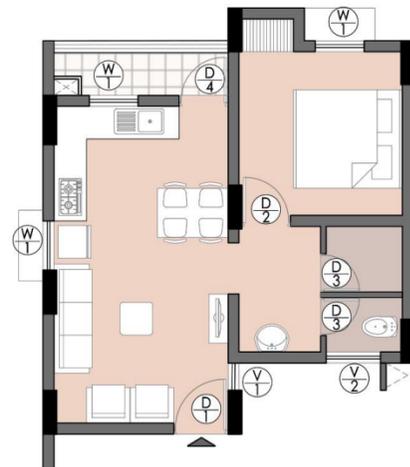


HK
0sqm

Select Dwelling Unit type

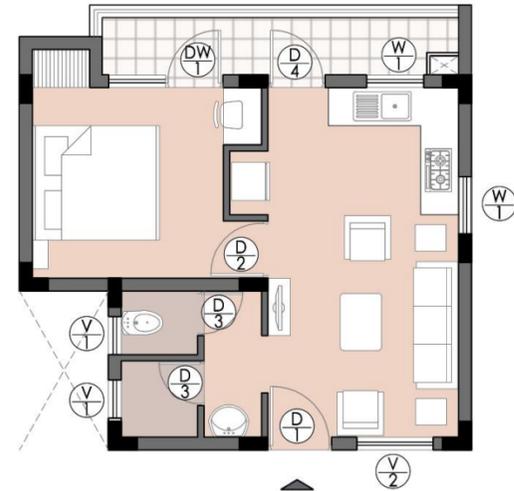
About Dwelling unit Type Designs

Warm climates



M-4A-1BHK

Carpet Area : 30sqm



M-4B-1 BHK

Carpet Area : 40sqm



M-4C-2 BHK

Carpet Area : 55sqm



M-4D-2 BHK

Carpet Area : 60sqm

Cold climate



CL-M-4A-1BHK

Carpet Area : 55sqm

DESIGN DATA

Block Plan

Unit Plan

3D Views

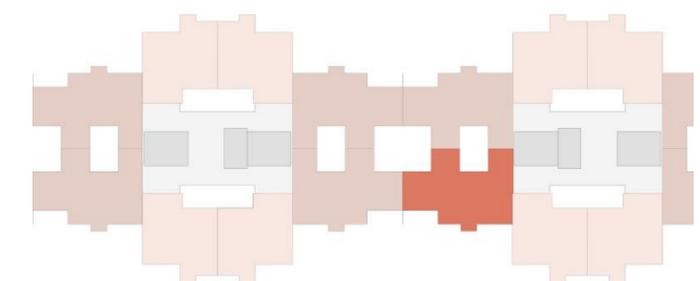
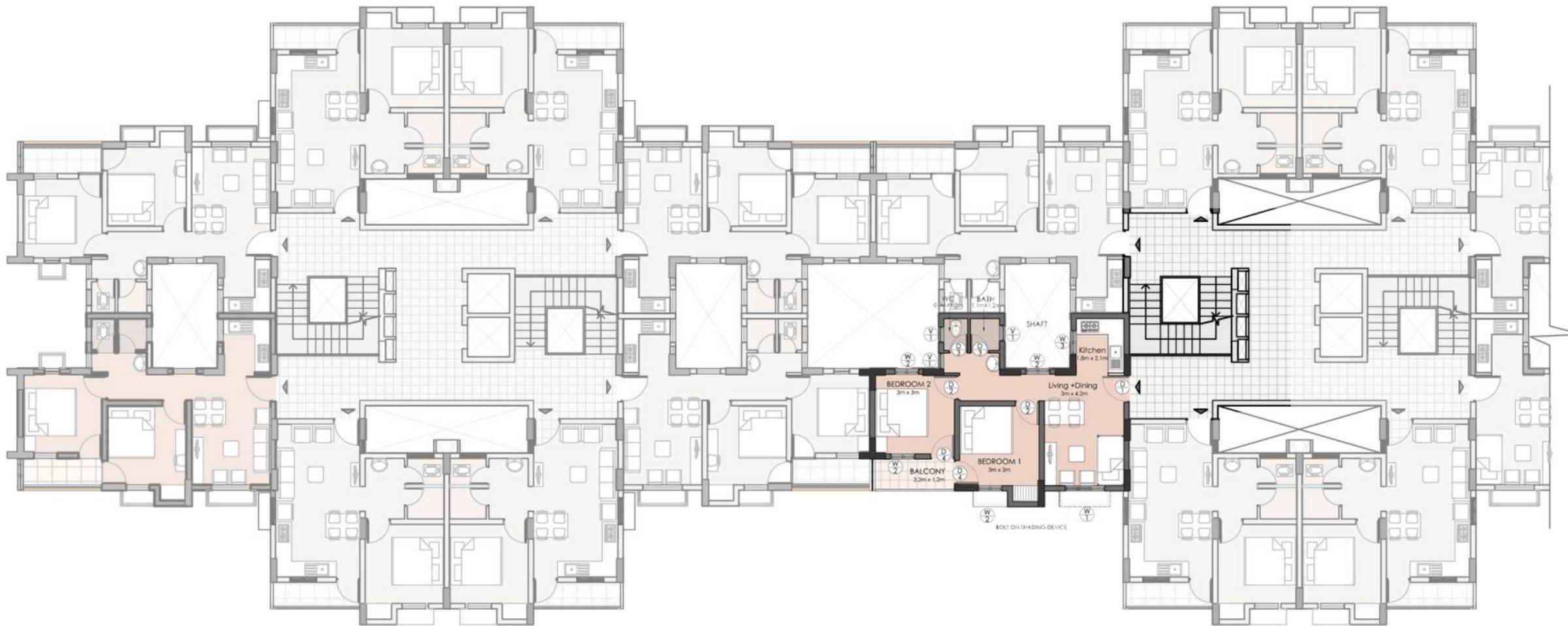
KEY PERFORMANCE INDICATORS DATA

DOWNLOAD

M-4C-2 BHK

DOOR WINDOW SCHEDULE

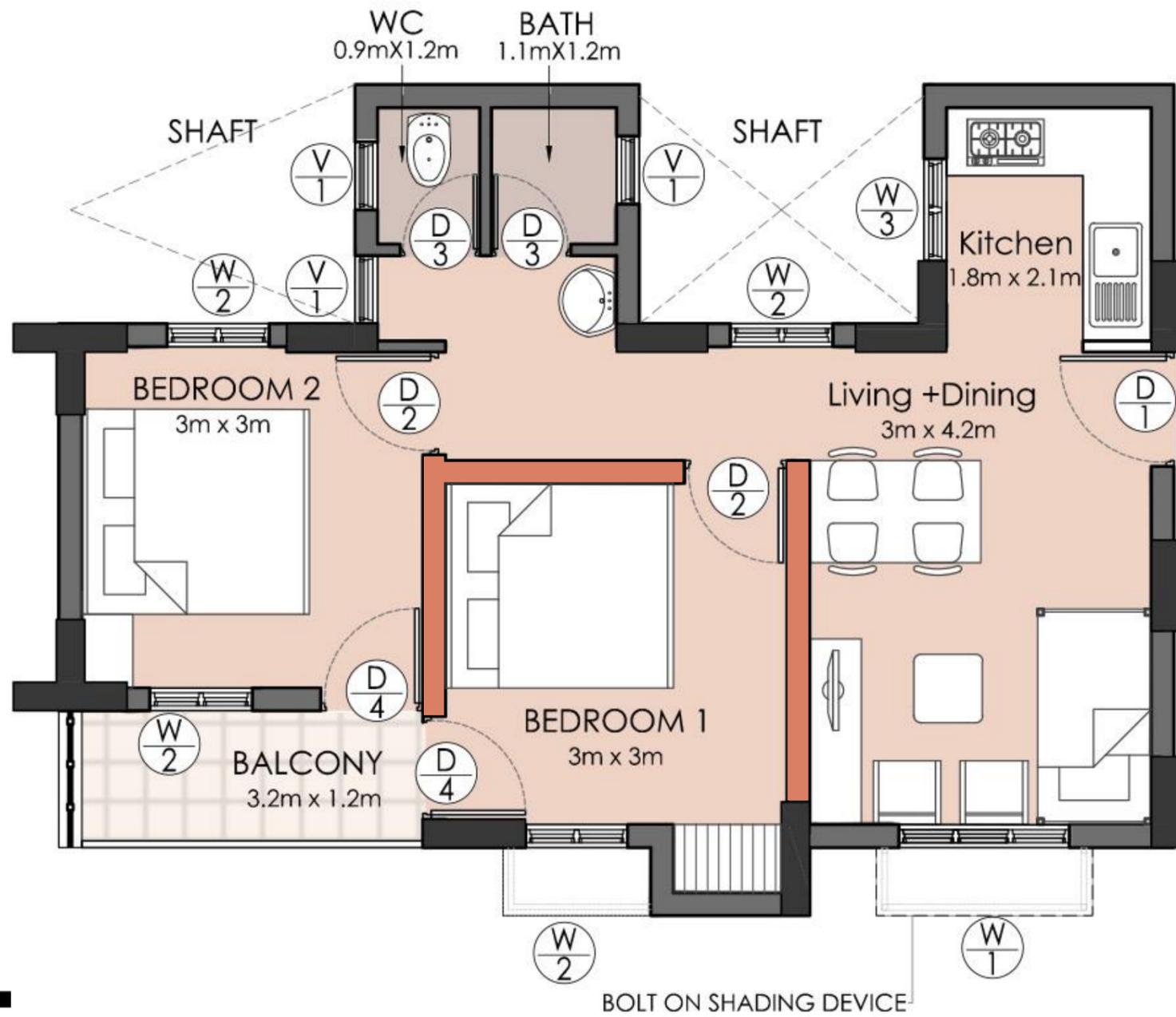
TAG	WIDTH (mm)	HEIGHT (mm)	SILL LVL (mm)	LINTEL LVL (mm)
D1	1000	2550	00	2550
D2	900	2550	00	2550
D3	750	2100	70	2170
D4	900	2100	00	2100
W1	900	1200	900	2100
W2	900	900	1200	2100
W3	450	900	1200	2100
V1	600	600	1500	2100



DESIGN DATA
Block Plan
Unit Plan
3D Views

KEY PERFORMANCE INDICATORS DATA

DOWNLOAD



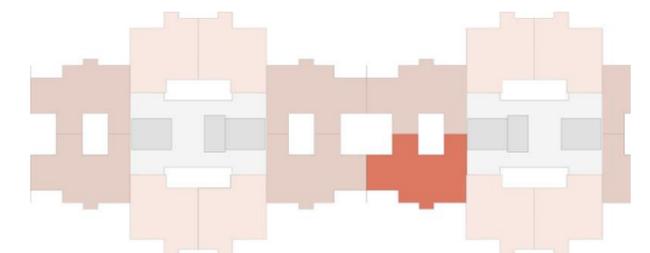
M-4C-2 BHK				
DOOR WINDOW SCHEDULE				
TAG	WIDTH (mm)	HEIGHT (mm)	SILL LVL (mm)	LINTEL LVL (mm)
D1	1000	2550	00	2550
D2	900	2550	00	2550
D3	750	2100	70	2170
D4	900	2100	00	2100
W1	900	1200	900	2100
W2	900	900	1200	2100
W3	450	900	1200	2100
V1	600	600	1500	2100

LEGEND

-  Load bearing external walls
-  Non-Load bearing walls *
-  Structural columns

*It is recommended that the Non-load bearing walls should not be structural to allow flexibility in planning of room sub-division as per user preference.

KEY PLAN



DESIGN DATA

Block Plan

Unit Plan

3D Views

KEY PERFORMANCE INDICATORS DATA

DOWNLOAD

M-4C-2 BHK

North Facing Elevation



North - East façade detail



North - West façade and detail



South Facing Elevation



DESIGN DATA

KEY PERFORMANCE INDICATORS DATA

DOWNLOAD

North - West façade and detail

M-4C-2 BHK



Light colored finish

External shading with side fins to protect from heat gain

Plantation and trees

External window with overhang and side fins



DESIGN DATA

KEY PERFORMANCE INDICATORS DATA

DOWNLOAD

Thermal Comfort Performance

Visual Comfort Performance

Cost of construction and Embodied Energy

M-4C-2 BHK



Light colored finish

External shading with side fins to protect from heat gain

Plantation and trees

External window with overhang and side fins



DESIGN DATA

KEY PERFORMANCE INDICATORS DATA

DOWNLOAD

SELECT UNIT LOCATION

SELECT UNIT ORIENTATION

SELECT UNIT POSITION

SELECT COMFORT PERFORMANCE LEVEL

CLICK TO VIEW RESULTS

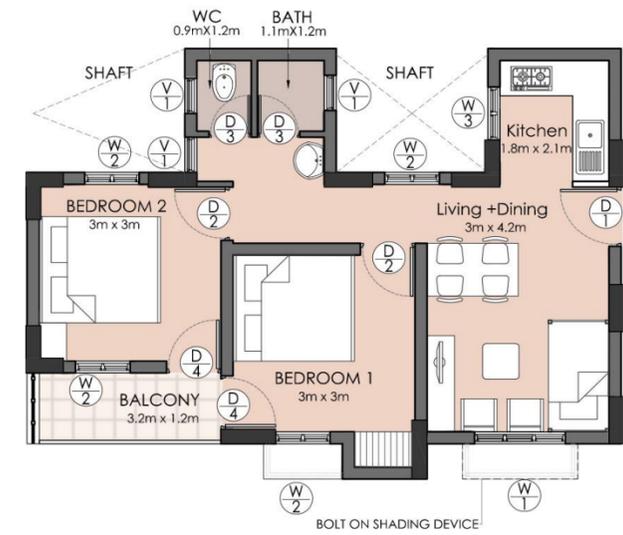
Thermal Comfort Performance

Visual Comfort Performance

Cost of construction and Embodied Energy

M-4C-2 BHK

UNIT PLAN



Note : The performance results shown here are also applicable for **M-4A-1BHK**

DESIGN DATA

KEY PERFORMANCE INDICATORS DATA

DOWNLOAD

SELECT UNIT LOCATION

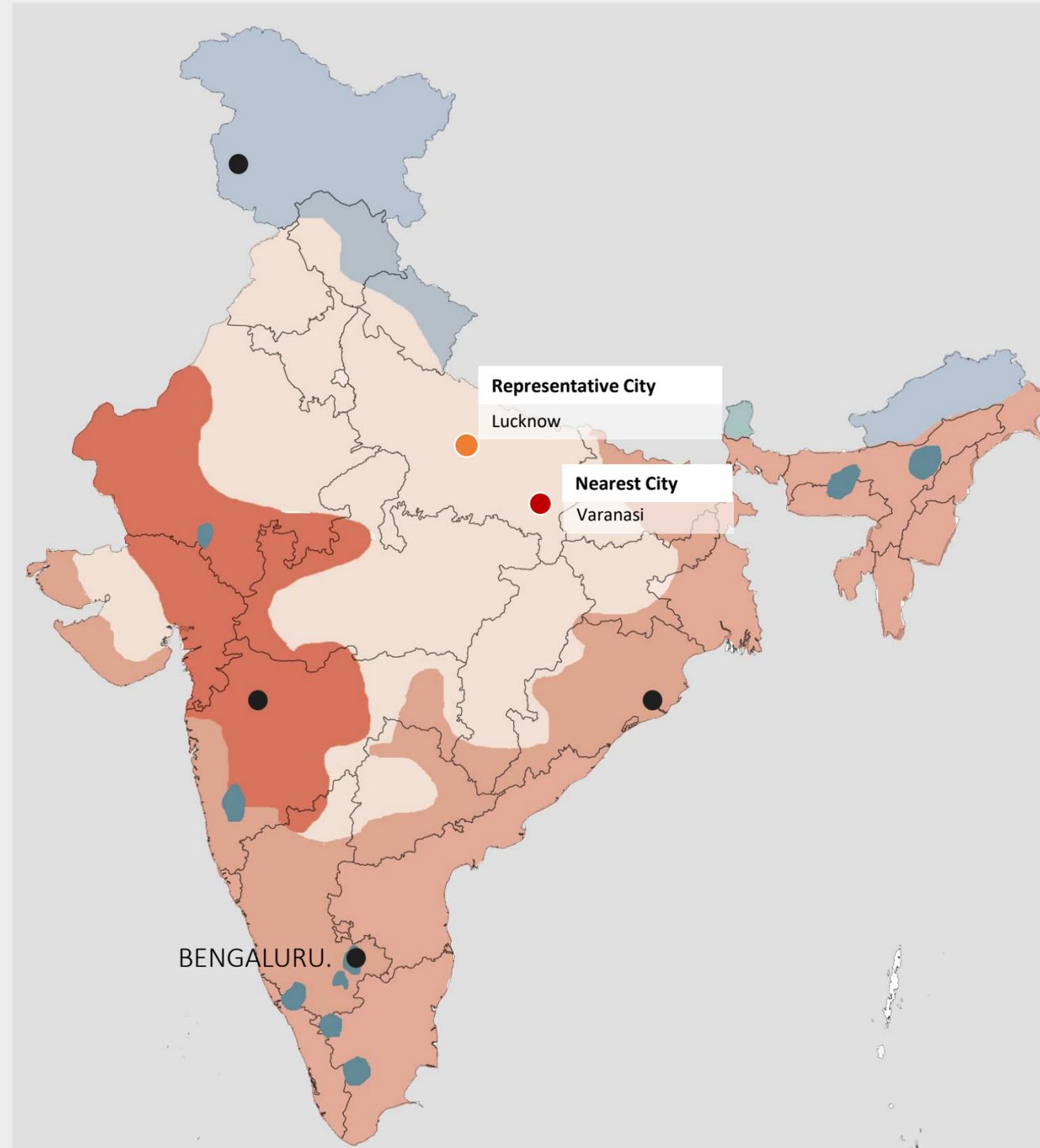
STATE	NEAREST CITY
Uttar Pradesh	Varanasi

SELECT UNIT ORIENTATION

SELECT UNIT POSITION

SELECT COMFORT PERFORMANCE LEVEL

CLICK TO VIEW RESULTS



Climate Zones Map Of India*

*As per NBC and ECBC (2017)

WARM CLIMATES

- Composite Climate
- Warm and Humid Climate
- Hot and Dry Climate
- Temperate Climate

COLD CLIMATE

Disclaimer: The study shows results for representative cities in each climate zone. These are not absolute solutions for all locations falling in a particular climate zone as conditions vary geographically. The methodology and rationale for improving thermal comfort step by step is to be understood from this example and applied for other locations.



here are
IK

DESIGN DATA

KEY PERFORMANCE INDICATORS DATA

DOWNLOAD

SELECT UNIT LOCATION ▾

STATE	NEAREST CITY
Uttar Pradesh ▾	Varanasi ▾

SELECT UNIT ORIENTATION ▾



N



N

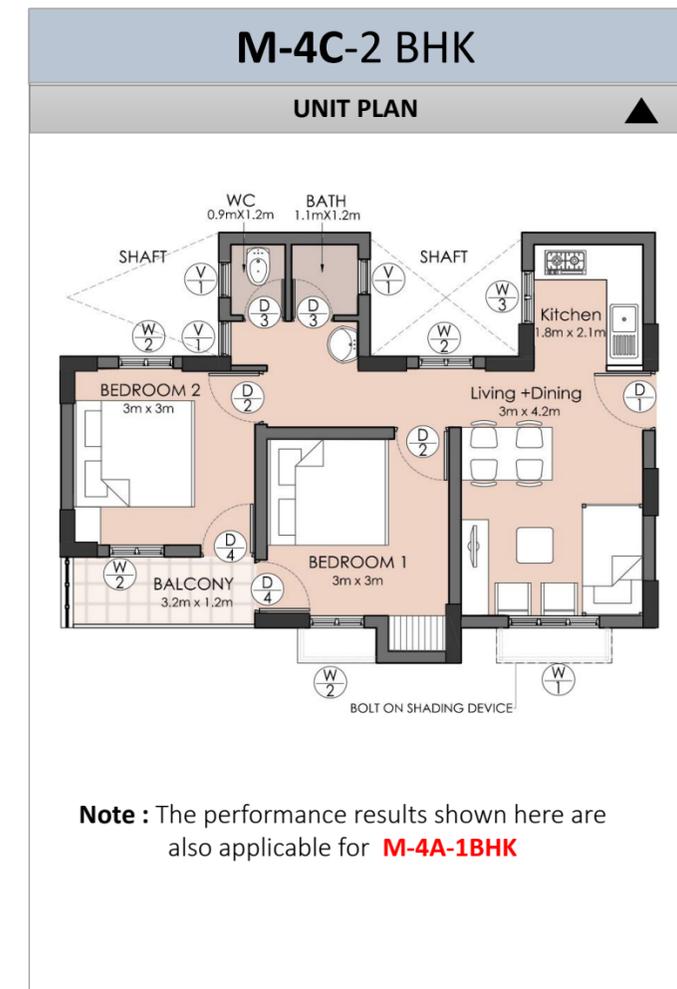
0° Ideal orientation (South)

270° Worst Orientation (West)

SELECT UNIT POSITION ▾

SELECT COMFORT PERFORMANCE LEVEL ▾

CLICK TO VIEW RESULTS



DESIGN DATA

KEY PERFORMANCE INDICATORS DATA

DOWNLOAD

SELECT UNIT LOCATION ▼

STATE	NEAREST CITY
Uttar Pradesh ▼	Varanasi ▼

SELECT UNIT ORIENTATION ▼

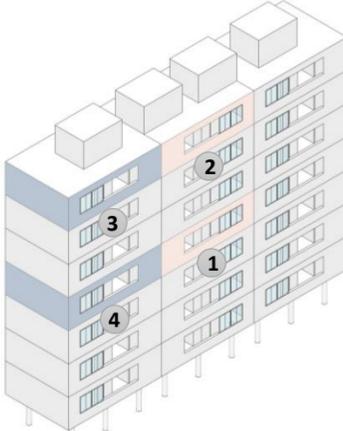


0° Ideal orientation (South)



270° Worst Orientation (West)

SELECT UNIT POSITION ▼



1

Middle Floor-
Middle Unit

2

Top Floor-
Middle Unit

3

Top Floor-
Edge Unit

4

Middle Floor-
Edge Unit

SELECT COMFORT PERFORMANCE LEVEL ▼

CLICK TO VIEW RESULTS



DESIGN DATA

KEY PERFORMANCE INDICATORS DATA

DOWNLOAD

SELECT UNIT LOCATION ▼

STATE	NEAREST CITY
Uttar Pradesh ▼	Varanasi ▼

SELECT UNIT ORIENTATION ▼

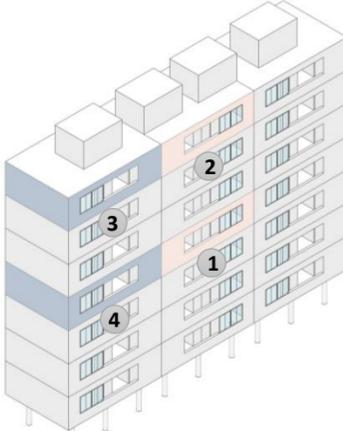


0° Best orientation (South)



270° Worst Orientation (West)

SELECT UNIT POSITION ▼



1

Middle Floor-
Middle Unit

2

Top Floor-
Middle Unit

3

Top Floor-
Edge Unit

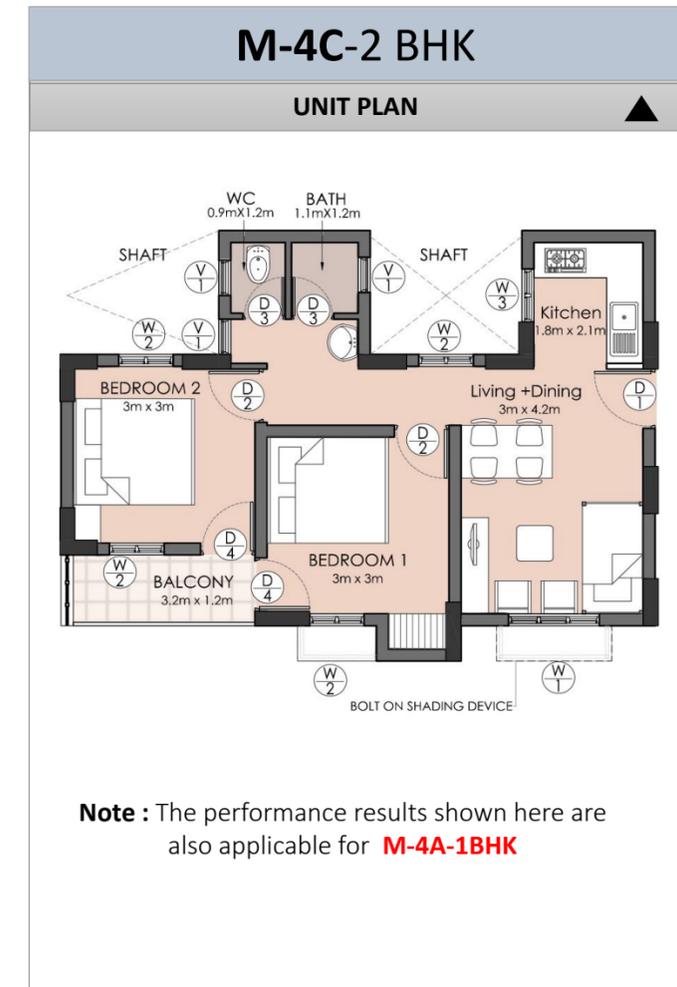
4

Middle Floor-
Edge Unit

SELECT COMFORT PERFORMANCE LEVEL ▼

BASIC	IMPROVED	GOOD
<p>CT 3 : WALL : ALC Wall panel WINDOW : Rolled steel +SGU ROOF INSULATION : EPS insulation +Light colored tile</p>	<p>CT 1 : WALL : AAC WINDOW : UPVC frame +SGU ROOF INSULATION : Foam concrete insulation +Light colored tile</p>	<p>CT 2 : WALL : RCC + Mineral wool WINDOW : UPVC Frame +SGU ROOF INSULATION : Foam concrete insulation +Light colored tile</p>

CLICK TO VIEW RESULTS



DESIGN DATA

KEY PERFORMANCE INDICATORS DATA

DOWNLOAD

1. SELECT UNIT LOCATION

STATE	NEAREST CITY
Uttar Pradesh ▾	Varanasi ▾
Climate : Composite	Representative City : Lucknow

2. SELECT UNIT ORIENTATION

0° Best orientation (South)

270° Worst Orientation (West)

3. SELECT UNIT POSITION

1

Middle Floor-Middle Unit

2

Top Floor-Middle Unit

3

Top Floor-Edge Unit

4

Middle Floor-Edge Unit

4. SELECT COMFORT PERFORMANCE LEVEL

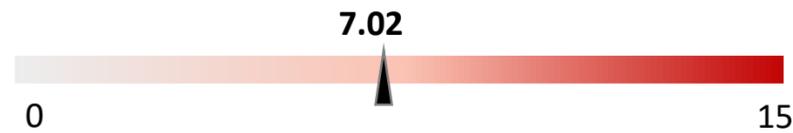
Good		
BASIC	IMPROVED	GOOD
CT 1 : WALL : ALC Wall panel WINDOW : Rolled steel +SGU ROOF INSULATION : EPS insulation +Light colored tile	CT 2 : WALL : AAC WINDOW : UPVC frame +SGU ROOF INSULATION : Foam concrete insulation +Light colored tile	CT 3 : WALL : RCC + Mineral wool WINDOW : UPVC Frame +SGU ROOF INSULATION : Foam concrete insulation +Light colored tile

[CLICK TO VIEW RESULTS](#)

THERMAL COMFORT

RETV

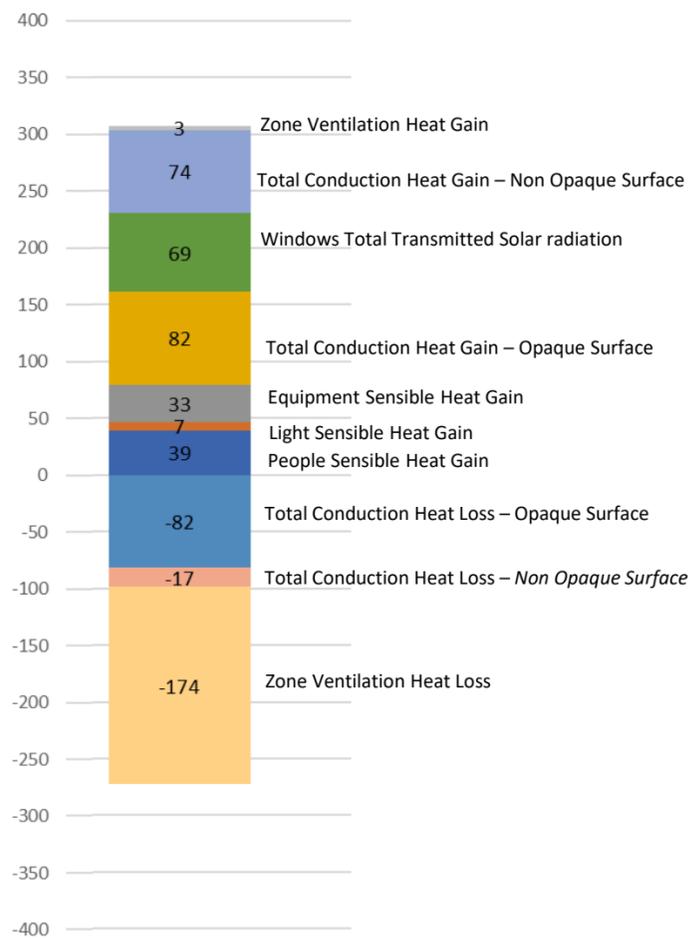
Residential Envelope Transmittance Value
 RETV - Is the net heat gain rate (over the cooling period) through the building envelope (excluding roof) of the dwelling units divided by the area of the building envelope (excluding roof) of the dwelling units



SENSIBLE HEAT GAIN HISTOGRAM

When an object is heated, the object's increase in temperature is sensible heat. Similarly, when heat is removed from an object and its temperature falls, this is also sensible heat

Units : (KWH/Sqm)



DEGREE DISCOMFORT HOURS

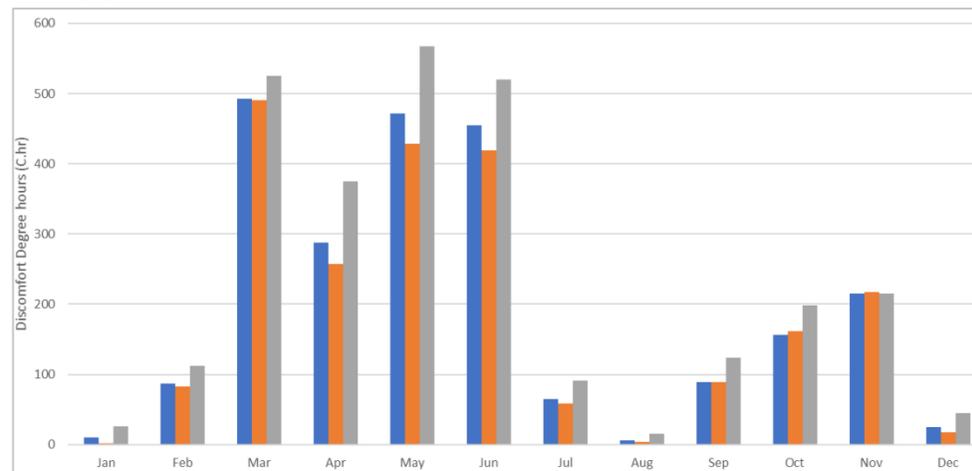
DDH

The difference in temperature between the indoor air temperature and the IMAC – R comfort temperature over 8760 hours (365 days * 24 hours).

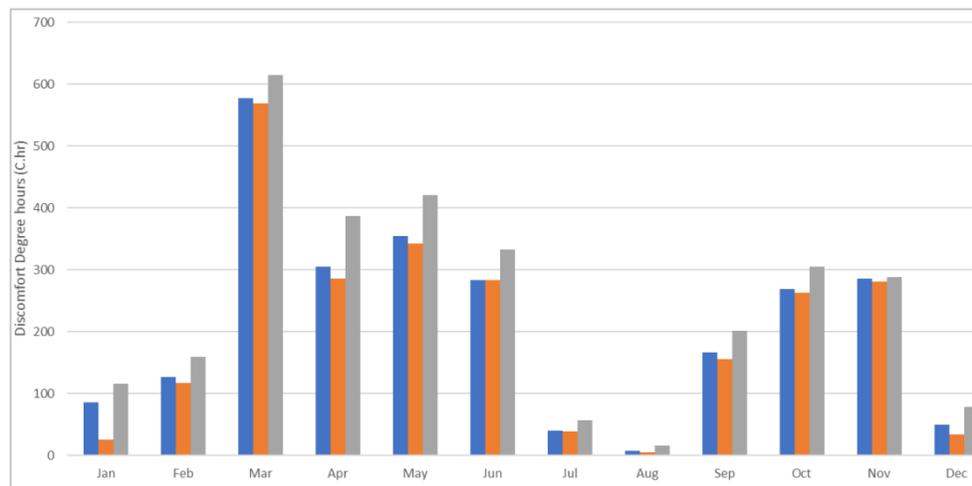
Software : Design Builder/Energy Plus Units : Hours

● DDH - Good ● DDH - Improved ● DDH - Basic

BEDROOM 1

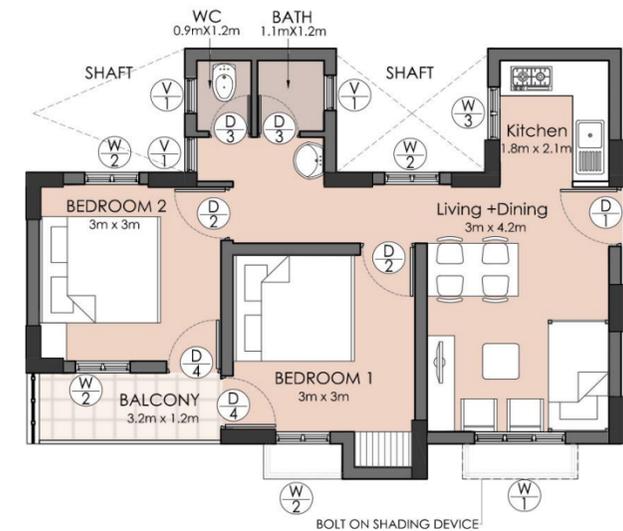


BEDROOM 2



M-4C-2 BHK

UNIT PLAN



Note : The performance results shown here are also applicable for **M-4A-1BHK**

INFERENCES

[DOWNLOAD PERFORMANCE DATA SET](#)

[CLICK TO VIEW COMPARATIVE RESULTS](#)

DESIGN DATA

KEY PERFORMANCE INDICATORS DATA

DOWNLOAD

1. SELECT UNIT LOCATION

STATE	NEAREST CITY
Uttar Pradesh ▾	Varanasi ▾
Climate : Composite	Representative City : Lucknow

2. SELECT UNIT ORIENTATION

0° Best orientation (South)

270° Worst Orientation (West)

3. SELECT UNIT POSITION

1	2	3	4
Middle Floor-Middle Unit	Top Floor-Middle Unit	Top Floor-Edge Unit	Middle Floor-Edge Unit

4. SELECT COMFORT PERFORMANCE LEVEL

Good

BASIC	IMPROVED	GOOD
CT 3 : WALL : ALC Wall panel WINDOW : Rolled steel +SGU ROOF INSULATION : EPS insulation +Light colored tile	CT 1 : WALL : AAC WINDOW : UPVC frame +SGU ROOF INSULATION : Foam concrete insulation +Light colored tile	CT 2 : WALL : RCC + Mineral wool WINDOW : UPVC Frame +SGU ROOF INSULATION : Foam concrete insulation +Light colored tile

[CLICK TO VIEW RESULTS](#)

Thermal Comfort Performance

Visual Comfort Performance

Cost of construction and Embodied Energy

Residential Envelope Transmittance Value

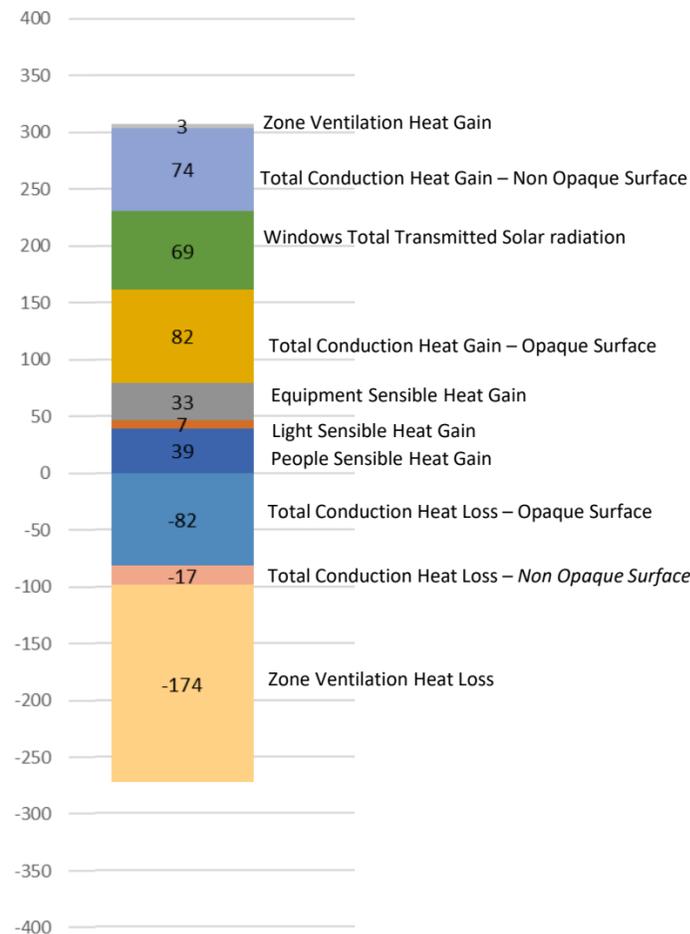
RETV - Is the net heat gain rate (over the cooling period) through the building envelope (excluding roof) of the dwelling units divided by the area of the building envelope (excluding roof) of the dwelling units



SENSIBLE HEAT GAIN HISTOGRAM

When an object is heated, the object's increase in temperature is sensible heat. Similarly, when heat is removed from an object and its temperature falls, this is also sensible heat

Units : (KWH/Sqm)



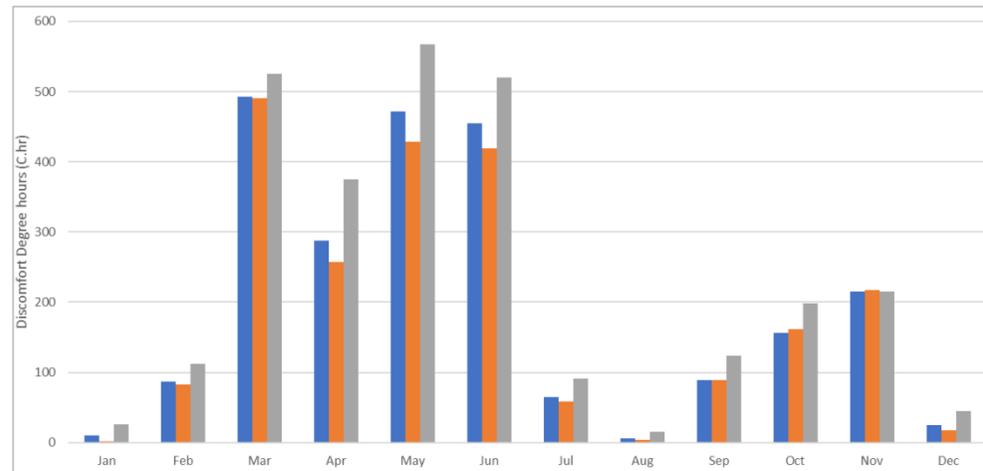
DEGREE DISCOMFORT HOURS

DDH

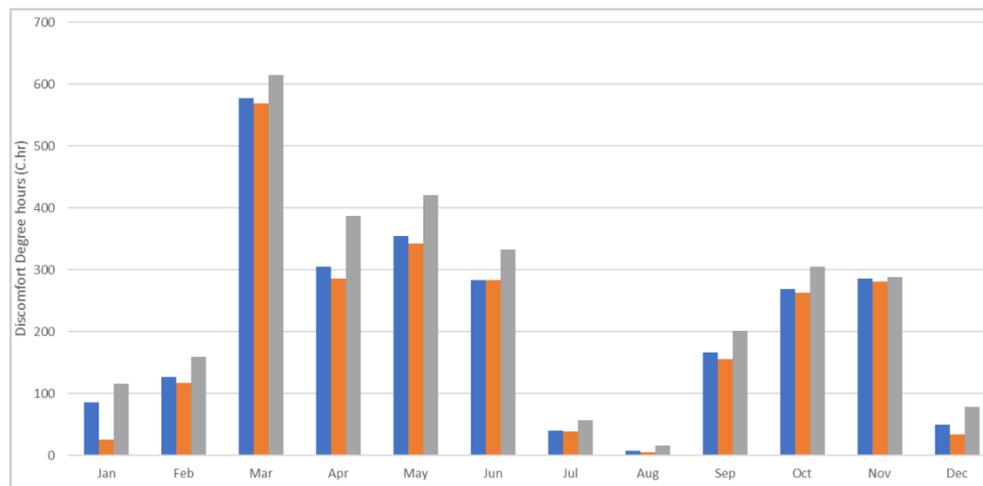
The difference in temperature between the indoor air temperature and the IMAC – R comfort temperature over 8760 hours (365 days * 24 hours).

Software : Design Builder/Energy Plus Units : Hours

BEDROOM 1

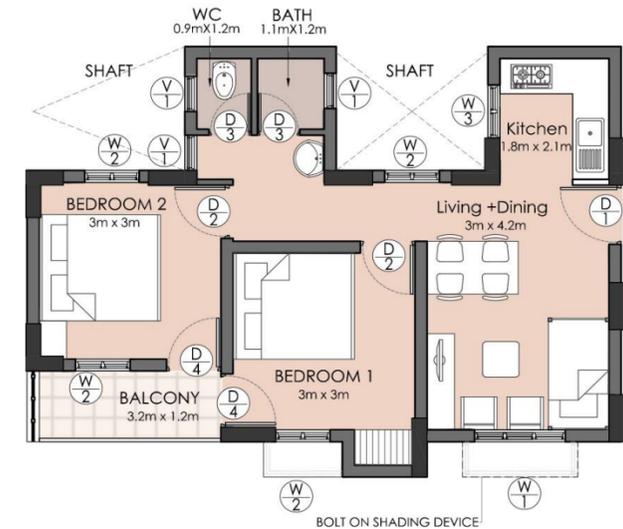


BEDROOM 2



M-4C-2 BHK

UNIT PLAN



Note : The performance results shown here are also applicable for **M-4A-1BHK**

INFERENCES

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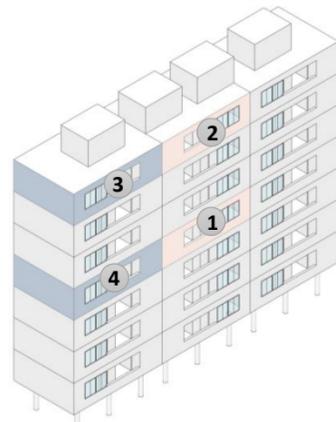
STATE	NEAREST CITY
Uttar Pradesh ▾	Varanasi ▾
Climate : Composite	Representative City : Lucknow

2. SELECT UNIT ORIENTATION

0° Best orientation (South)

270° Worst Orientation (West)

3. SELECT UNIT POSITION



1	2	3	4
Middle Floor-Middle Unit	Top Floor-Middle Unit	Top Floor-Edge Unit	Middle Floor-Edge Unit

4. SELECT COMFORT PERFORMANCE LEVEL

Good

BASIC	IMPROVED	GOOD
CT 3 : WALL : ALC Wall panel WINDOW : Rolled steel +SGU ROOF INSULATION : EPS insulation +Light colored tile	CT 1 : WALL : AAC WINDOW : UPVC frame +SGU ROOF INSULATION : Foam concrete insulation +Light colored tile	CT 2 : WALL : RCC + Mineral wool WINDOW : UPVC Frame +SGU ROOF INSULATION : Foam concrete insulation +Light colored tile

CLICK TO VIEW RESULTS

VISUAL COMFORT

Useful Daylight Illuminance

UDI

Daylight simulation is performed to calculate interior daylight levels in a space for a specific location. Daylight performance of a typical dwelling unit is assessed by the Percentage of area receiving UDI (between Level - 100 Lux to 3000 Lux) in a year for 50% potential daylight time (8 am – 5 pm)

UNITS - %

SIMULATION REQUIRED – Daylight (UDI) Software : Design Builder, Energy Plus



LIVING ROOM



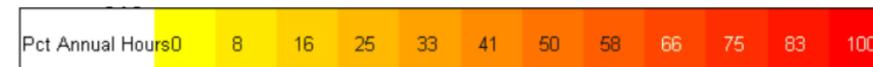
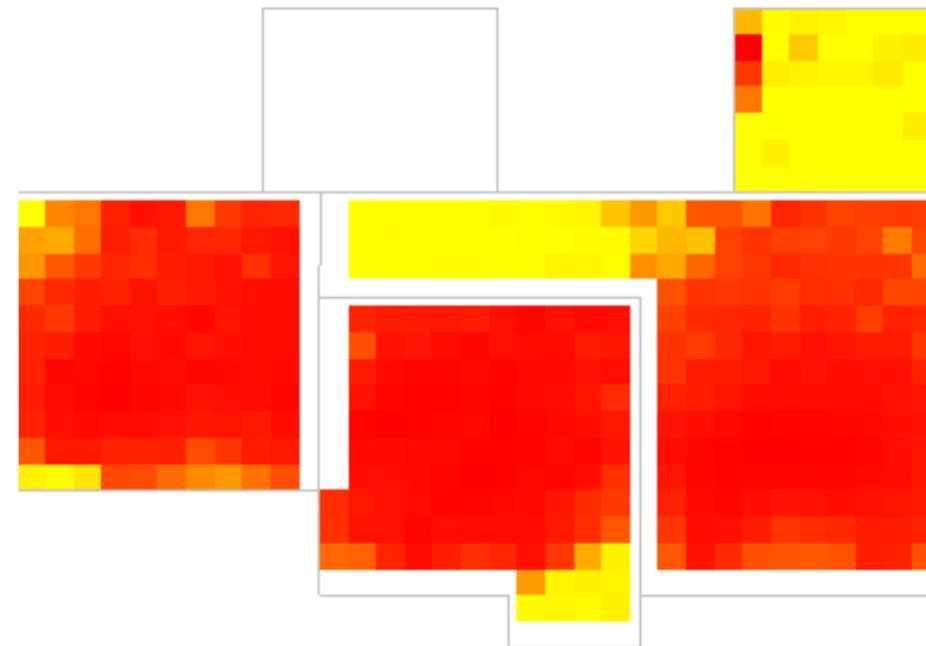
KITCHEN



BEDROOM 1

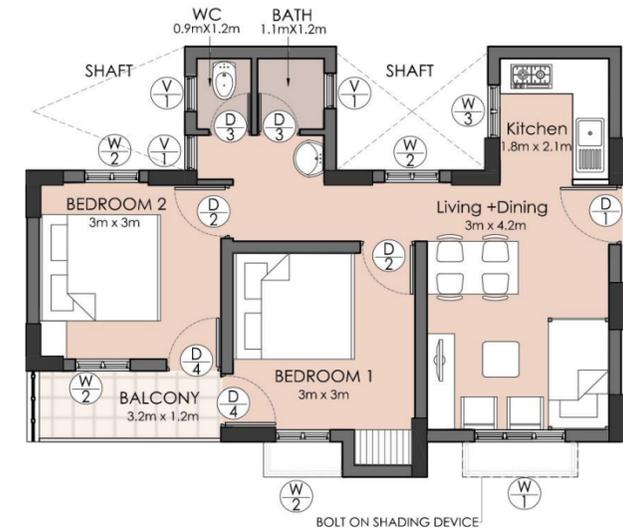


BEDROOM 2



M-4C-2 BHK

UNIT PLAN



Note : The performance results shown here are also applicable for **M-4A-1BHK**

INFERENCES

DOWNLOAD PERFORMANCE DATA SET

CLICK TO VIEW COMPARATIVE RESULTS

DESIGN DATA

KEY PERFORMANCE INDICATORS DATA

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1. SELECT UNIT LOCATION

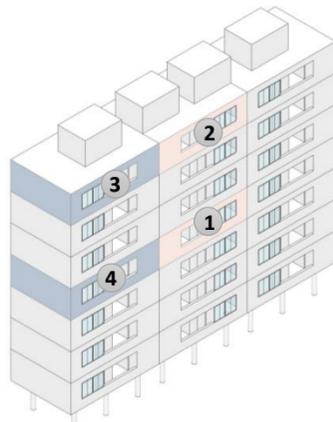
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Good		
BASIC	IMPROVED	GOOD
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CLICK TO VIEW RESULTS

Useful Day

UDI

Daylight simulation is performed to calculate interior daylight levels in a space for a specific location. Daylight performance of a typical dwelling unit is assessed by the Percentage of area receiving UDI (between Level - 100 Lux to 3000 Lux) in a year for 50% potential daylit time (8 am – 5 pm)

UNITS - %

SIMULATION REQUIRED – Daylight (UDI) Software : Design Builder, Energy Plus



LIVING ROOM



KITCHEN

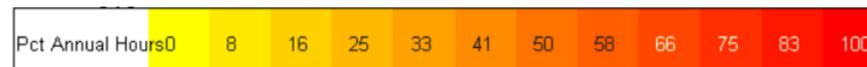
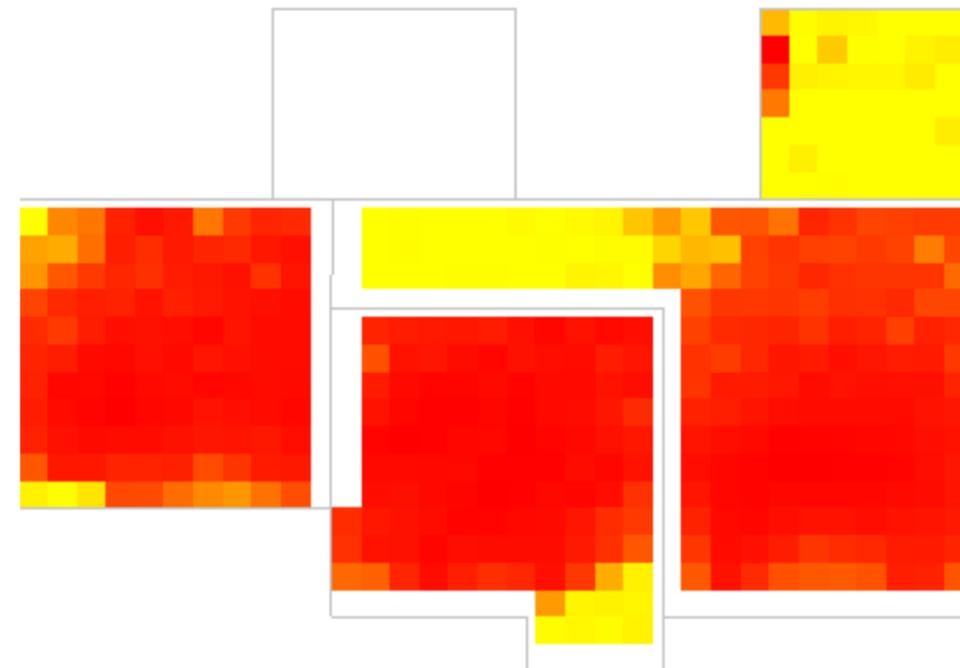


BEDROOM 1



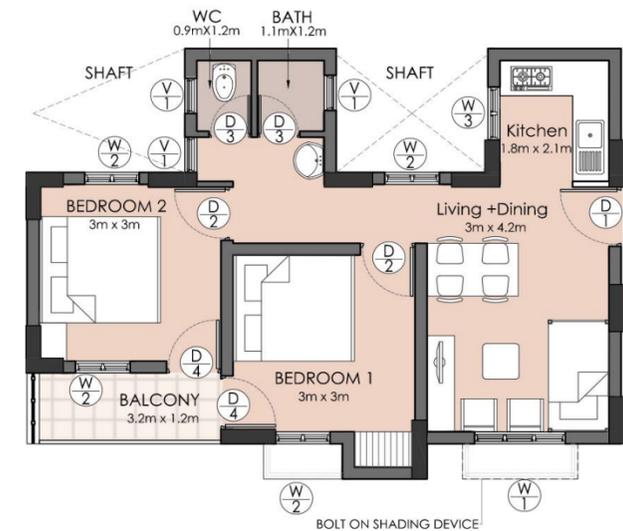
BEDROOM 2

Cost of construction and Embodied Energy



M-4C-2 BHK

UNIT PLAN



Note : The performance results shown here are also applicable for **M-4A-1BHK**

INFERENCES

DOWNLOAD PERFORMANCE DATA SET

CLICK TO VIEW COMPARATIVE RESULTS

DESIGN DATA

KEY PERFORMANCE INDICATORS DATA

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[CLICK TO VIEW RESULTS](#)

COST OF CONSTRUCTION AND EMBODIED ENERGY

Embodied Energy Intensity

E EI Embodied energy share of the highest contributing materials i.e. cement steel, walling blocks.

Embodied energy intensity is being demonstrated as embodied energy per unit carpet area (MJ / m2)

3124 MJ/ Sqm

LEGEND

- Steel
- Walling
- Concrete

WALL : RCC + Mineral wool
WINDOW : UPVC Frame +SGU
ROOF INSULATION : Foam concrete insulation +Light colored tile

Cost Analysis

COST / Sqm of carpet area
Cost of construction per sqm of carpet area.

16,670 INR

LEGEND

- Civil Work
- Windows and Shading
- Finishing
- Insulation

WALL : RCC + Mineral wool
WINDOW : UPVC Frame +SGU
ROOF INSULATION : Foam concrete insulation +Light colored tile

ITEM OF WORK	AMOUNT		
	% contribution	INR Contribution	TOTAL (INR)
CIVIL WORK (Building Envelope)	70%	5,09,860	5,09,860
WINDOWS AND SHADING	17%	1,21,845	1,26,360
Door, Window and Balcony		4,515	
Shading			
FINISHING (External walls and terracing)	13%	93,420	93,420
INSULATION	1%	3,880	3,880
TOTAL COST OF CONSTRUCTION		7,33,515 INR	
COST / SQM CARPET AREA		16,670 INR	
COST / SQFT CARPET AREA		1,550 INR	

M-4C-2 BHK

UNIT PLAN

Note : The performance results shown here are also applicable for **M-4A-1BHK**

INFERENCES

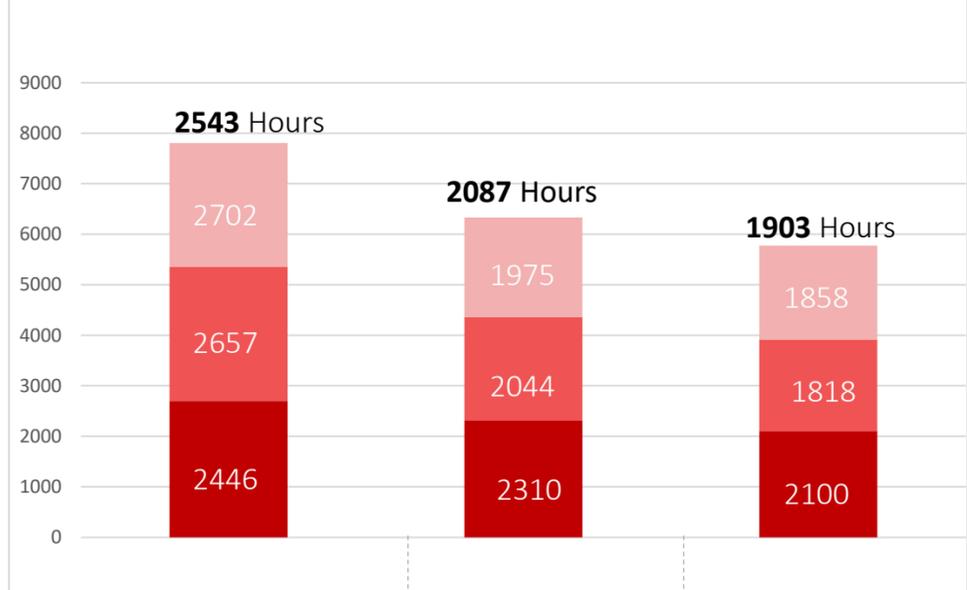
[DOWNLOAD PERFORMANCE DATA SET](#)

[CLICK TO VIEW COMPARATIVE RESULTS](#)

M-4C-2 BHK

COMPARATIVE PERFORMANCE ANALYSIS

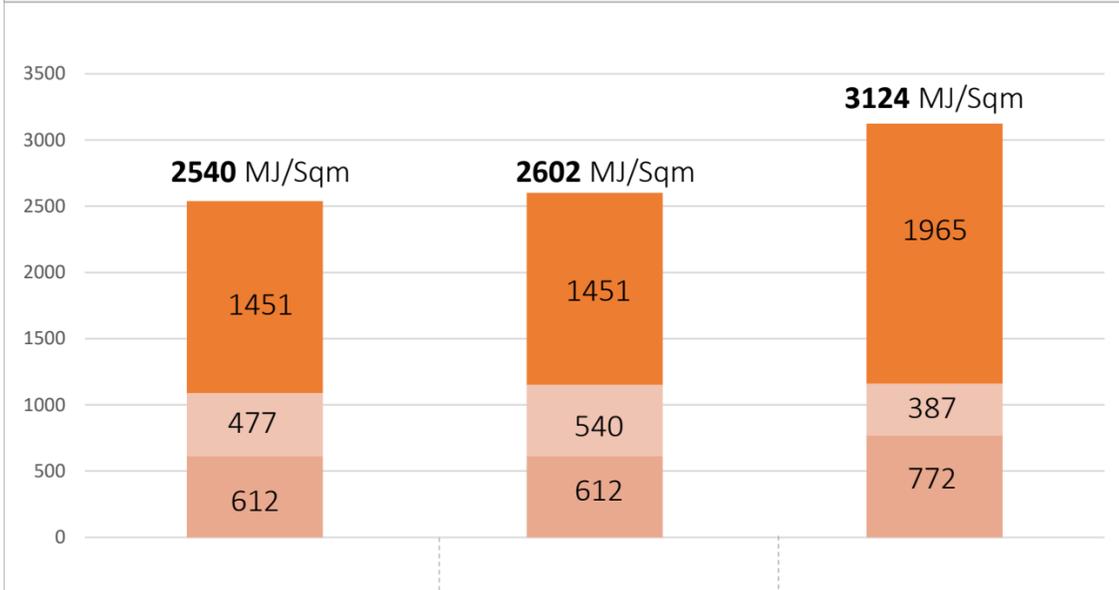
Degree Discomfort Hours (DDH)



<p>WALL : ALC Wall panel</p> <p>WINDOW : Rolled steel +SGU</p> <p>ROOF INSULATION : EPS insulation +Light colored tile</p>	<p>WALL : AAC</p> <p>WINDOW : UPVC frame +SGU</p> <p>ROOF INSULATION : Foam concrete insulation +Light colored tile</p>	<p>WALL : RCC + Mineral wool</p> <p>WINDOW : UPVC Frame +SGU</p> <p>ROOF INSULATION : Foam concrete insulation +Light colored tile</p>
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LEGEND ● Living Room DDH ● Bedroom 1 DDH ● Bedroom 2 DDH

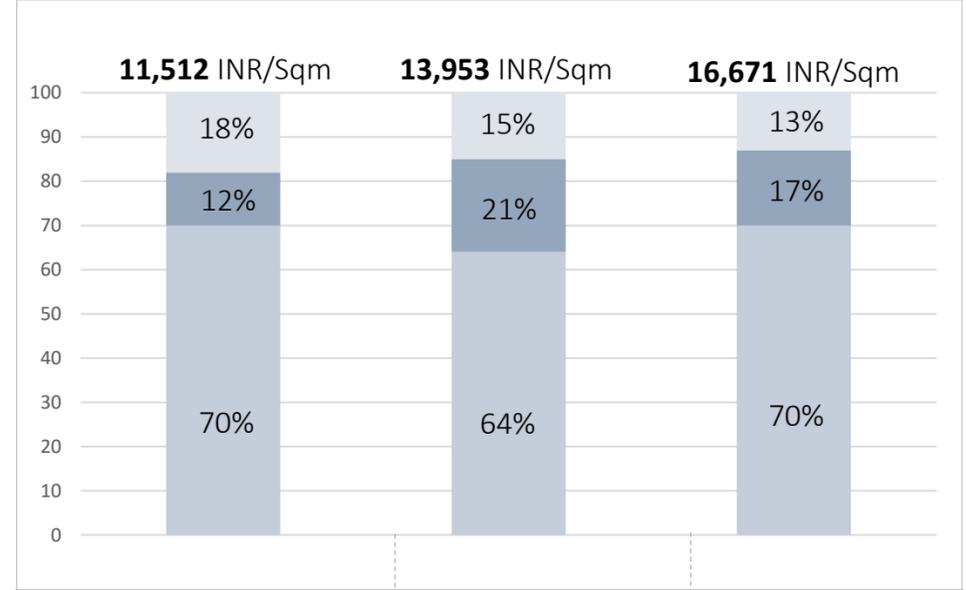
Embodied Energy Intensity (EEI)



<p>WALL : ALC Wall panel</p> <p>WINDOW : Rolled steel +SGU</p> <p>ROOF INSULATION : EPS insulation +Light colored tile</p>	<p>WALL : AAC</p> <p>WINDOW : UPVC frame +SGU</p> <p>ROOF INSULATION : Foam concrete insulation +Light colored tile</p>	<p>WALL : RCC + Mineral wool</p> <p>WINDOW : UPVC Frame +SGU</p> <p>ROOF INSULATION : Foam concrete insulation +Light colored tile</p>
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LEGEND ● EEI - Steel ● EEI - Walling ● EEI - Concrete

Cost of Construction



<p>WALL : ALC Wall panel</p> <p>WINDOW : Rolled steel +SGU</p> <p>ROOF INSULATION : EPS insulation +Light colored tile</p>	<p>WALL : AAC</p> <p>WINDOW : UPVC frame +SGU</p> <p>ROOF INSULATION : Foam concrete insulation +Light colored tile</p>	<p>WALL : RCC + Mineral wool</p> <p>WINDOW : UPVC Frame +SGU</p> <p>ROOF INSULATION : Foam concrete insulation +Light colored tile</p>
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LEGEND ● Civil Work ● Windows and Shading ● Finishing ● Insulation

End of Session

Questions and Feedback

Please follow the link in the chat box to fill the feedback survey:

SESSION III

Webtool Interface – Download Data

Speakers:

Rathnashree Prakash & Niroopa Subrahmanyam

DESIGN DATA

KEY PERFORMANCE INDICATORS DATA

DOWNLOAD

SELECT UNIT LOCATION

SELECT UNIT ORIENTATION

SELECT UNIT POSITION

SELECT PERFORMANCE LEVEL

CLICK TO VIEW RESULTS

M-4C-2 BHK

UNIT PLAN

Download Sets

DESIGN DATA

- **PLANS**
Unit and Block Plan (ACAD File)
- **CONSTRUCTION DRAWINGS**
Dimensioned plan, section, elevation and typical details (PDF Files to scale)
- **EXTERNAL SHADING**
External façade shading location and layout (PDF)
- **BILL OF QUANTITIES**
(Open excel file)

PERFORMANCE DATA

- **DAYLIGHT REPORT**
PDF File with UDI graphs
- **SENSIBLE HEAT GAIN HISTOGRAM**
External façade shading location and layout (PDF)
- **DEGREE DISCOMFORT HOURS DATA**
PDF File with DDH graphs
- **EMBODIED ENERGY INTENSITY DATA**
Excel file with EEI values for concrete, walling and steel for all performance levels
- **ENS COMPLAINT**
Excel file with ENS compliance data (RETV, WWR and U-Value) for all climates

OTHER OPEN FILES

- **CLIMATE DATA (Of nearest City)**
EPW File
- **DAYLIGHT**
.RAD File
- **SIMULATION DATA**
(.IDF File)
- **REVIT FILE**
.RVT File (Version 2021)

Download Sets

DESIGN DATA

- PLANS**
 Unit and Block Plan (ACAD File)
- CONSTRUCTION DRAWINGS**
 Dimensioned plan, section, elevation and typical details (PDF Files to scale)
- EXTERNAL SHADING**
 External façade shading location and layout (PDF)
- BILL OF QUANTITIES**
 (Open excel file)

TAG	WIDTH (mm)	HEIGHT (mm)	CILL LEVEL (mm)	LINTEL LEVEL (mm)
D1	1000	2500	00	2500
D2	900	2500	00	2500
D3	750	2100	100	2200
D4	900	2100	00	2100
W1	900	1200	900	2100
W2	900	900	1200	2100
W3	1500	1200	900	2100
W4	600	1200	900	2100
V1	600	1000	1500	2500

TYPOLOGY	TOWER CONNECTED	REPLICABLE DESIGNS FOR THERMALLY COMFORTABLE AFFORDABLE HOMES
M-4D-2BHK	TOWER CONNECTED	UNIT PLAN
BUILDING HEIGHT	STILT + 7 FLOORS	0 1 3 6
CARPET AREA	51Sqm / 550Sqft	

TYPOLOGY	TOWER CONNECTED	REPLICABLE DESIGNS FOR THERMALLY COMFORTABLE AFFORDABLE HOMES
M-4D-2BHK	TOWER CONNECTED	BLOCK PLAN
BUILDING HEIGHT	STILT + 7 FLOORS	0 1 3 6
CARPET AREA	51Sqm / 550Sqft	

TYPOLOGY	TOWER CONNECTED	REPLICABLE DESIGNS FOR THERMALLY COMFORTABLE AFFORDABLE HOMES
M-4D-2BHK	TOWER CONNECTED	
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Download Sets

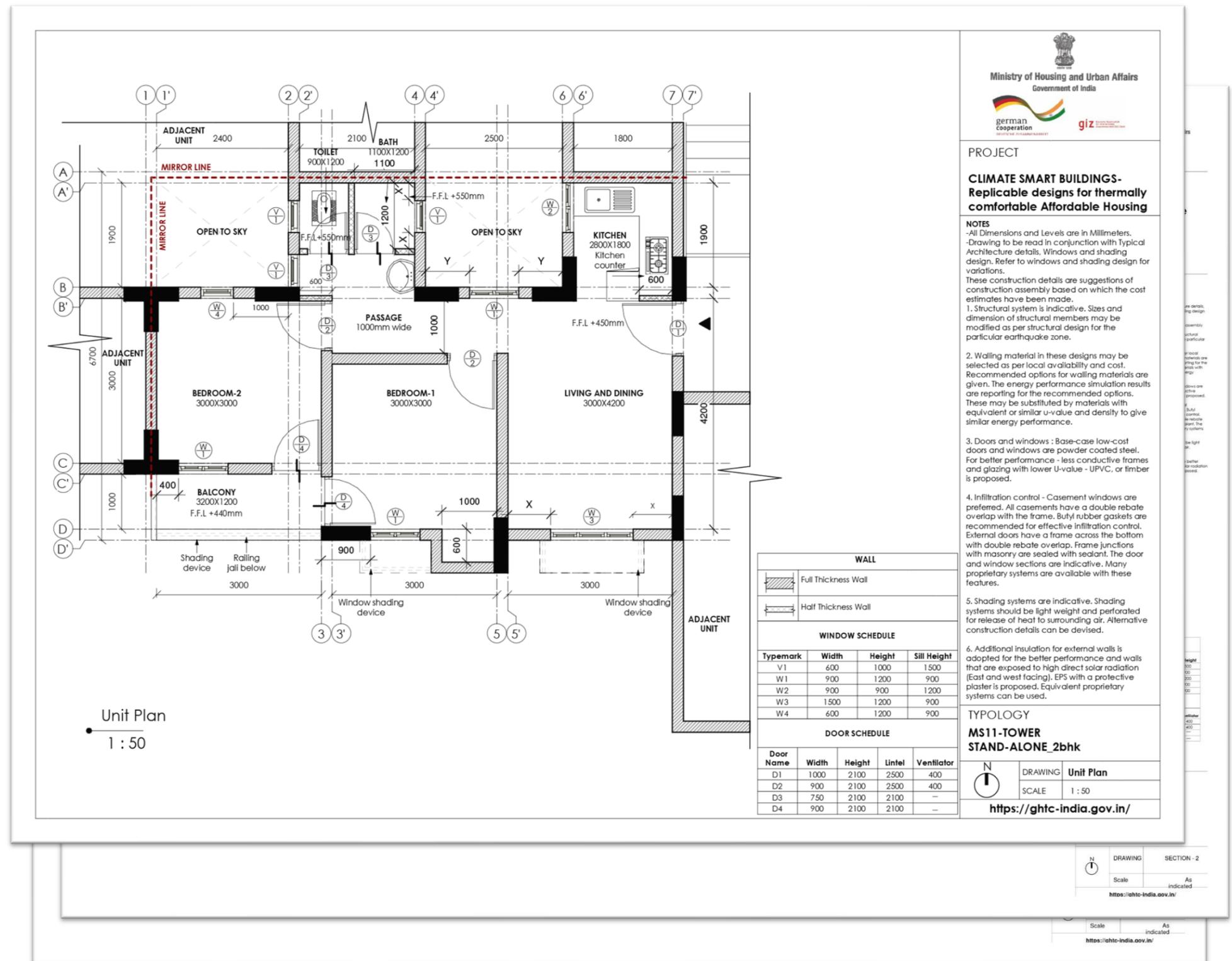
DESIGN DATA

• **PLANS**
Unit and Block Plan (ACAD File)

• **CONSTRUCTION DRAWINGS**
Dimensioned plan, section, elevation and typical details (PDF Files to scale)

• **EXTERNAL SHADING**
External façade shading location and layout (PDF)

• **BILL OF QUANTITIES**
(Open excel file)



Download Sets

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Dimensioned plan, section, elevation and typical details (PDF Files to scale)

- **EXTERNAL SHADING**
External façade shading location and layout (PDF)

- **BILL OF QUANTITIES**
(Open excel file)

LOCATION MIDDLE FLOOR, MIDDLE UNIT

ORIENTATION WEST FACING

CONSTRUCTION TECHNOLOGIES

CT 01	CT 02	CT 03
✓	✓	✓

ROLL DOWN SCREEN ADDED

LEGEND

- + FIXED JAALI SCREEN SHADING (from bottom of slab to 2100mm from room FFL)
+ ROLL DOWN BAMBOO SCREENS (from 2100mm to top of balcony railing)
+ JAALI SIDE FINS
- FIXED JAALI SCREEN SHADING (from bottom of slab to 2100mm from room FFL)
+ JAALI SIDE FINS (from bottom of slab to 1000mm from room FFL / top of balcony railing)
- O 450 WINDOW SHADING (450MM OVERHANG)
- O 600 WINDOW SHADING (600MM OVERHANG)
- O sf WINDOW SHADING (600MM OVERHANG) + SIDE FINS (450MM WIDE)
- O sf WINDOW SHADING (600MM OVERHANG) + SIDE FINS (600MM WIDE)
- O sf WINDOW SHADING (600MM OVERHANG) + SIDE FINS (450MM WIDE) + ROLL DOWN SCREEN IN FRONT (Only when windows face the East/West)
- O sf WINDOW SHADING (600MM OVERHANG) + SIDE FINS (600MM WIDE) + ROLL DOWN SCREEN IN FRONT (Only when windows face the East/West)
- SIDE FINS- BALCONY / WINDOW
- ROLL DOWN SCREEN ADDED TO WINDOW SHADING
- BALCONY SHADING DEVICE

CONNECTED TOWER (G+7) - 2 BHK

EXTERNAL SHADING - FACADE 01

EXTERNAL SHADING - FACADE 02

CONNECTED TOWER (G+7) - 2 BHK

M-4C

CONSTRUCTION TECHNOLOGY VARIANTS

LEGEND	WALL	EXTERNAL DOOR / WINDOWS	ROOF INSULATION
CT 01	AAC	UPVC + SGU	Foam concrete roof insulation
CT 02	Local Brick	Rolled Steel + SGU	Foam concrete roof insulation
CT 03	Flyash/ (CSEB for Temperate)	UPVC + SGU	EPS roof insulation

Download Sets

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Dimensioned plan, section, elevation and typical details (PDF Files to scale)

- **EXTERNAL SHADING**
External façade shading location and layout (PDF)

- **BILL OF QUANTITIES**
(Open excel file)

BILL OF QUANTITIES – MATERIAL SHEET

	Walling materials	Density (kg/m3)	Thermal conductivity (W/mK)	C (J/kg.K)	Thickness (mm)	U-value (W/m2.K)
CT1	200mm AAC	642	0.184	1240	200x 100x75	0.77
						0.59

BILL OF QUANTITIES - SUMMARY

Item of Work	CT1 MIDDLE UNIT SOUTH		CT2 MIDDLE UNIT SOUTH		CT3 MIDDLE UNIT SOUTH		CT1 EDGE UNIT SOUTH		CT2 EDGE UNIT SOUTH		CT3 EDGE UNIT SOUTH	
	Amount	% Contribution of cost	Amount	% Contribution of cost	Amount	% Contribution of cost	Amount	% Contribution of cost	Amount	% Contribution of cost	Amount	% Contribution of cost
CIVIL WORK (Building Envelope)	64%		70%		70%		64%		70%		71%	
TOTAL	390280.43		509858.01		352622.03		404202.19		544123.92		386211.39	
WINDOWS & SHADING	21%		17%		12%		20%		16%		11%	
DOOR, WINDOW & BALCONY	121844.59		121844.59		53773.83		121844.59		121844.59		53773.83	
SHADING MIDDLE FLOOR	4516.20		8462.54		4516.20		8462.54		4619.70		8566.04	
SHADING TOP FLOOR (7th floor)	4649.60		8595.94		4649.60		8595.94		4753.10		8699.44	
TOTAL MIDDLE FLOOR	126360.79		130307.13		58290.03		62236.37		126464.29		130410.63	
TOTAL TOP FLOOR (7th floor)	126494.19		130440.53		58423.43		62369.77		126597.69		130544.03	
FINISHING (External walls & Terracing)	15%		13%		18%		16%		13%		18%	
TOTAL	93417.99		93417.99		93417.99		98055.36		98055.36		98055.36	
INSULATION	1%		1%		0%		1%		1%		0%	
TOTAL	3877.14		3877.14		2190.48		3877.14		3877.14		2190.48	
TOTAL COST OF CONSTRUCTION (INR) - MIDDLE FLOOR	613936.35		617882.69		733513.93		737460.27		506520.53		510466.87	
TOTAL COST OF CONSTRUCTION (INR) - TOP FLOOR	614069.75		618016.09		733647.33		737593.67		506653.93		510600.27	
Init Carpet Area (sqm)	44											
Cost/ sqm carpet area (Middle floor)	13953.10		14042.79		16670.77		16760.46		11511.83		11601.52	
Cost/ sqm carpet area (Top floor)	13956.13		14045.82		16673.80		16763.49		11514.86		11604.55	
Init Carpet Area (sqft)	473.44											
Cost/ sqft carpet area	1296.76		1305.09		1549.33		1557.66		1069.87		1078.21	
Cost/ sqm carpet area (Top floor)	1297.04		1305.37		1549.61		1557.95		1070.15		1078.49	

Note:
 includes civil structure, building envelop, door-window and external finishing costs
 includes cost of ECMs (Civil)
 Material and labour cost is considered for most items
 excludes internal finishing costs except Internal plaster
 excludes common area costs like corridor, staircase, lobby etc
 includes proportionate cost of terracing distributed over 4 floors

0.9

DESIGN DATA

KEY PERFORMANCE INDICATORS DATA

DOWNLOAD

Download Sets

PERFORMANCE DATA

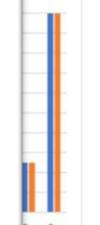
SCHEDULE OF OPERATIONS



Schedule of Operation

INPUT PARAMETERS

S.No	Description	Inputs					
		CT1		CT2		CT3	
		South	West	South	West	South	West
Building Envelope							
1	Exterior Wall	200mm thick ACC Block U-value : 0.77 W/m2k		150mm thick RCC wall + 40mm thick Mineral wool U-value : 0.59 W/m2k		150mm thick ALC wall panel U-value : 0.9 W/m2k	
2	Roof construction	125mm thick RCC slab + 100mm thick Foam concrete insulation U-value : 0.593 W/m2k		125mm thick RCC slab + 100mm thick Foam concrete insulation U-value : 0.593 W/m2k		125mm thick RCC slab +50mm EPS insulation U-value : 0.593 W/m2k	
3	Floor slab	125mm thick RCC slab					
4	Glazing (Exterior)	Single glazed Unit - U Value = 5.7 W/m2k, SHGC = 0.8, VLT=0.85					
	Glazing (Interior)	Single glazed Unit - U Value = 5.7 W/m2k, SHGC = 0.8, VLT=0.85					
5	Window Shading	Overhang of 600mm+Side fins of 450mm depth	Overhang of 600mm+Side fins of 450mm depth + Front roll down bamboo screen	Overhang of 600mm+Side fins of 450mm depth	Overhang of 600mm+Side fins of 450mm depth + Front roll down bamboo screen	Overhang of 600mm+Side fins of 450mm depth	Overhang of 600mm+Side fins of 450mm depth + Front roll down bamboo screen
6	Balcony	Slab projection of 1200 mm depth+Fixed shading screen	Slab projection of 1200 mm depth+Fixed shading screen + Front roll down bamboo screen	Slab projection of 1200 mm depth+Fixed shading screen	Slab projection of 1200 mm depth+Fixed shading screen + Front roll down bamboo screen	Slab projection of 1200 mm depth+Fixed shading screen	Slab projection of 1200 mm depth+Fixed shading screen + Front roll down bamboo screen
7	External doors & window frames and shutters	UPVC Frame		UPVC Frame		Rolled Steel	
Electrical loads							
8	Interior Lighting power Density (W/m2)	4.0					
9	Equipment loads	Ceiling fan - 65W Television - 56W Refrigerator - 185W					
Ventilation							
10	Adaptive Comfort Temperature	IMAC B					



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External façade shading location and layout (PDF)

- DEGREE DISCOMFORT HOURS DATA**

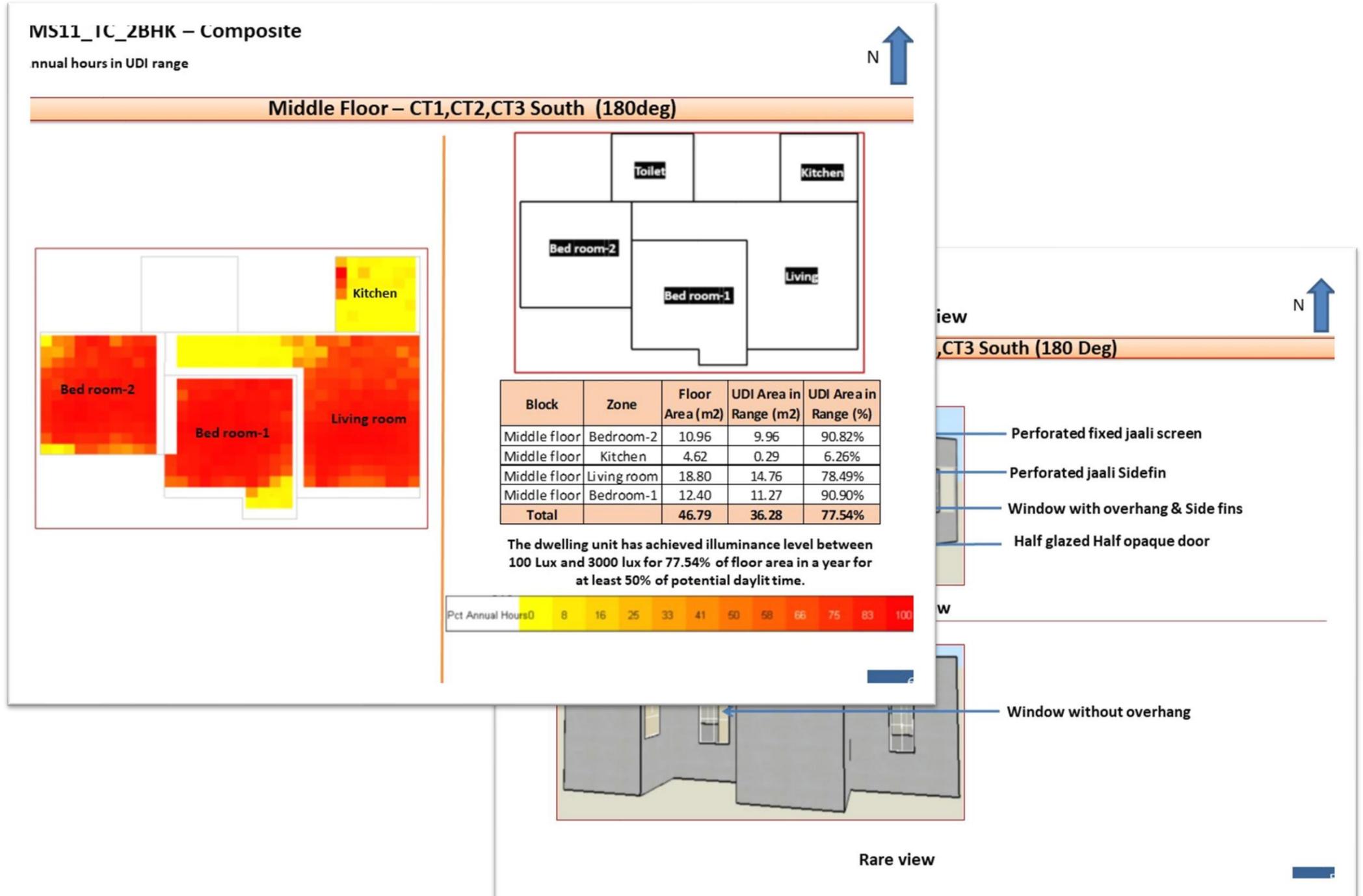
PDF File with DDH graphs

- EMBODIED ENERGY INTENSITY DATA**

Excel file with EEI values for concrete, walling and steel for all performance levels

- ENS COMPLIANCE**

Excel file with ENS compliance data (RETV, WWR and U-Value) for all climates



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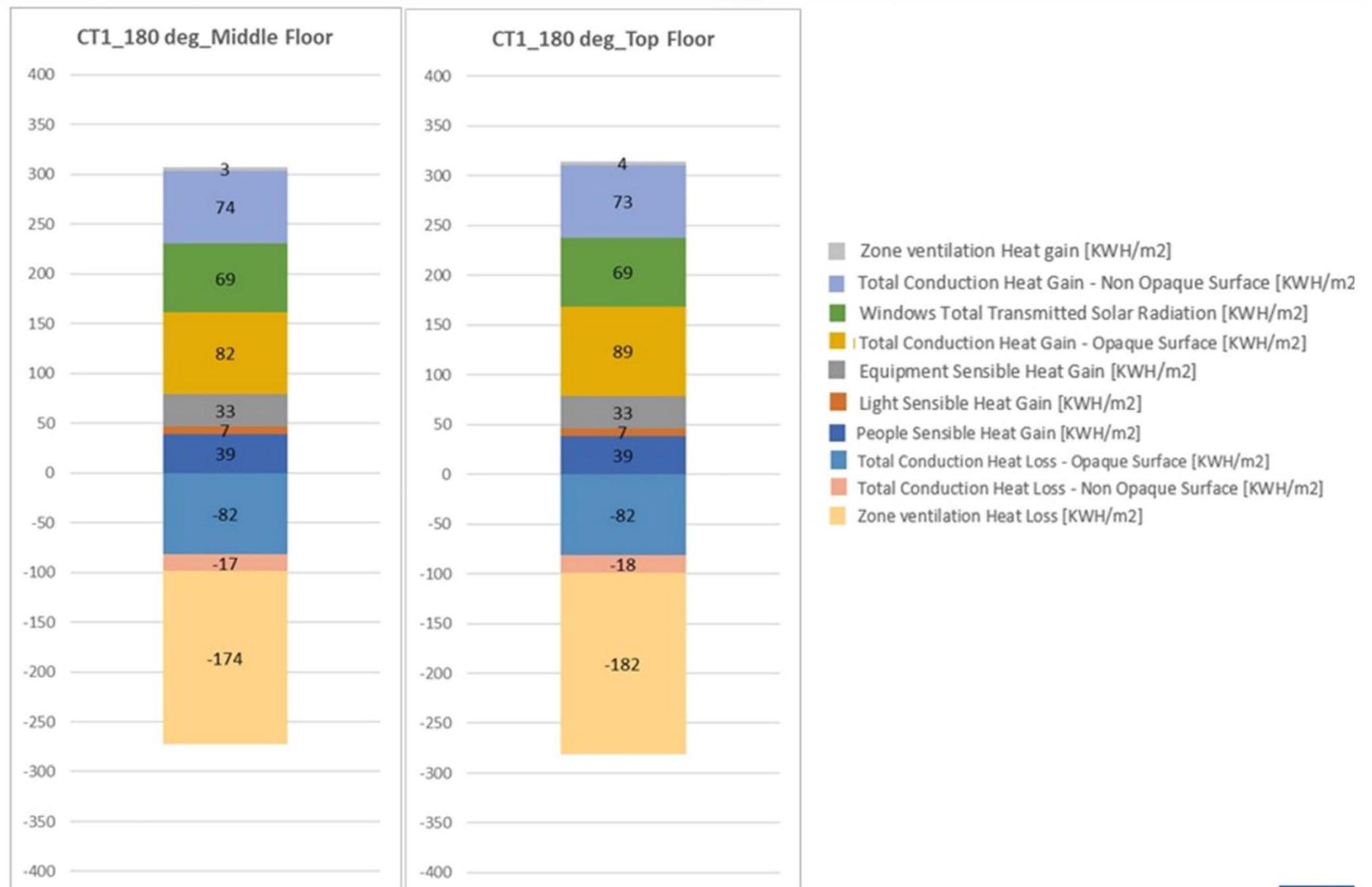
Excel file with EEI values for concrete, walling and steel for all performance levels

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Histogram Graph | MS11_TC_2BHK - CO

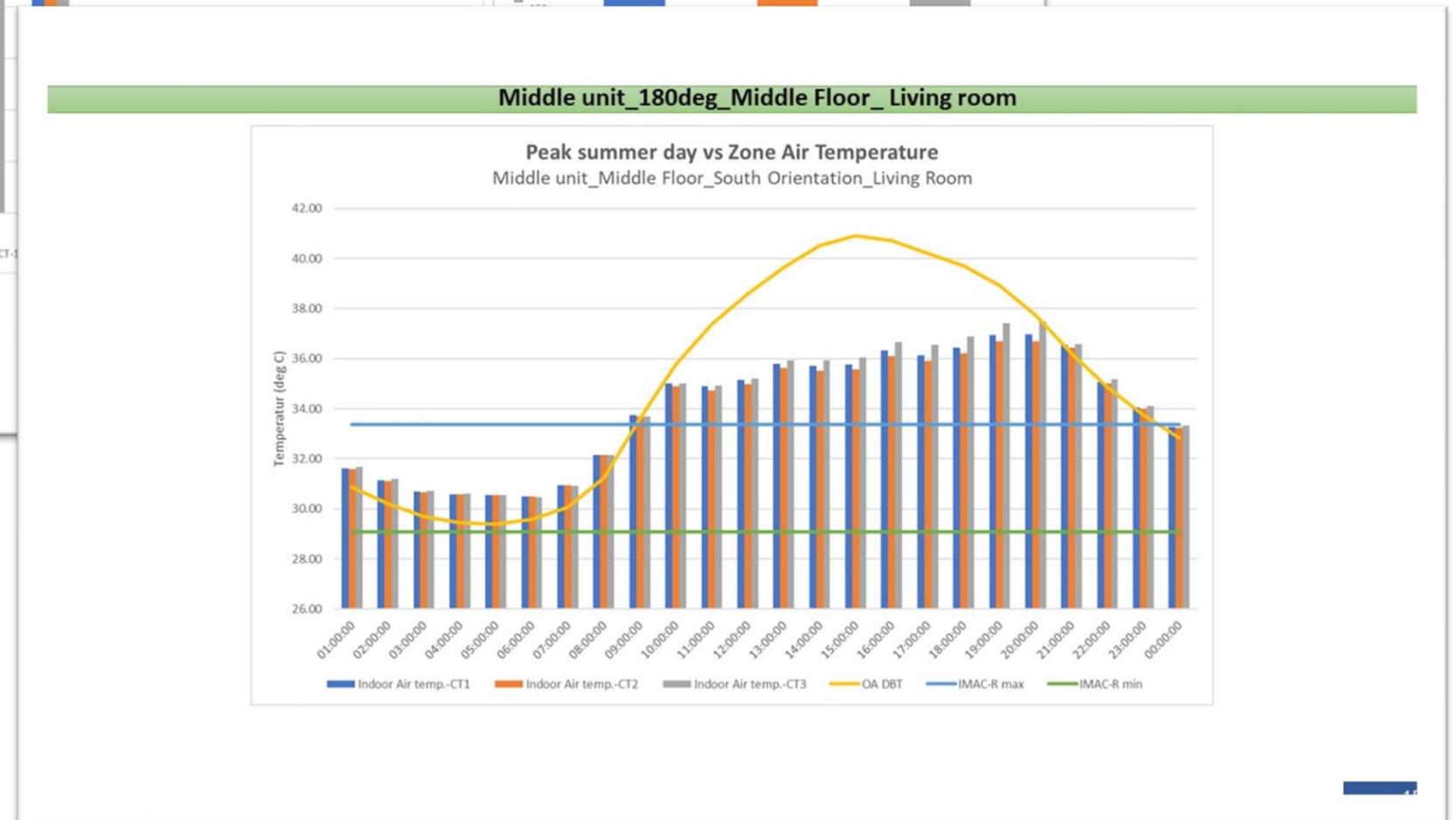
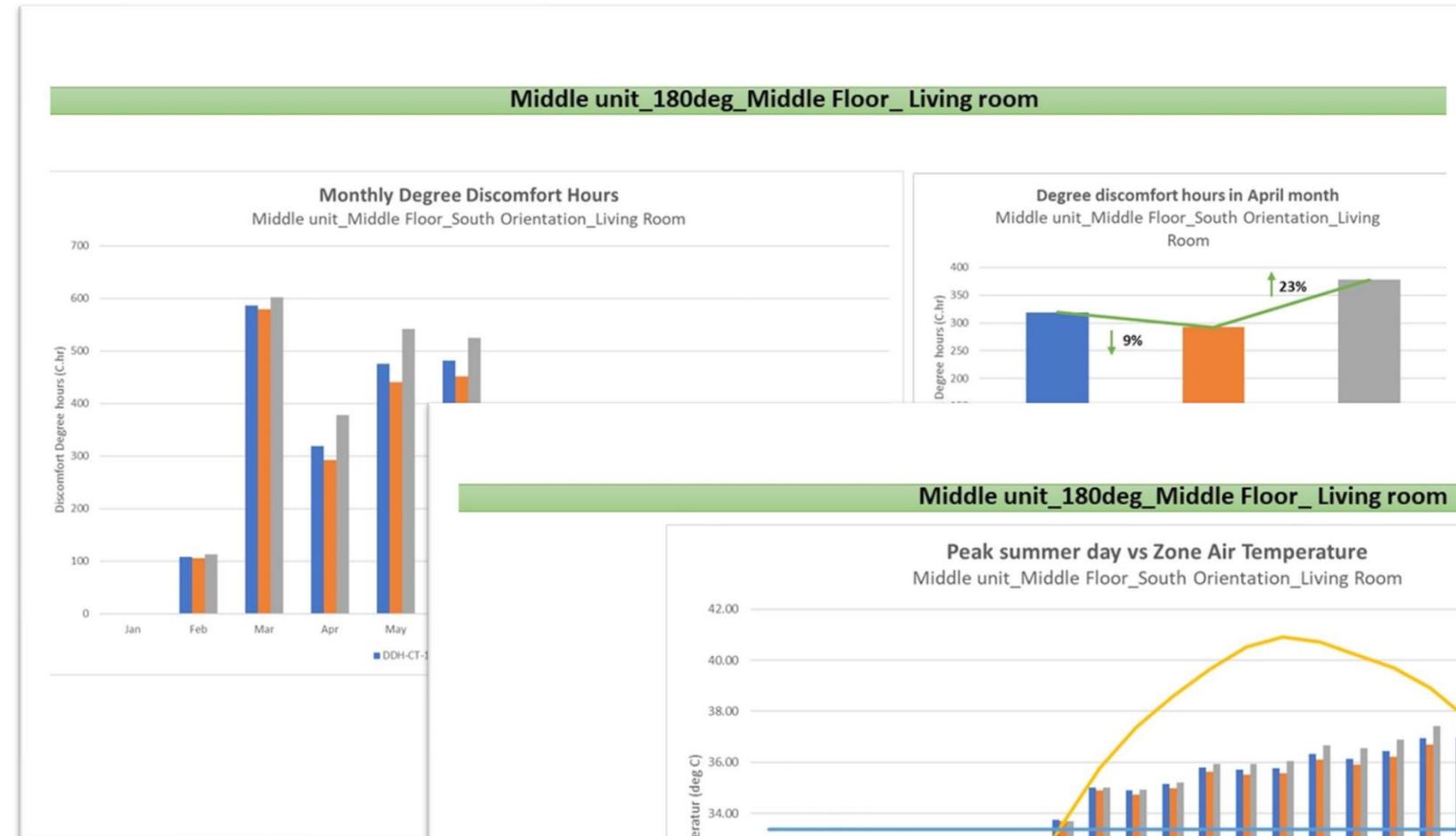
Construction Technology1_180deg



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MIDDLE UNIT						
Embodied energy- CT1- AAC						
Type	Quantity	Unit	Density kg/m ³ (IS 875 (Part 1) : 1987, 2008)	Weight (kg)	Embodied energy (MJ)/kg	Embodied energy (MJ)/m ³
CONCRETE						
Cement	4.15	m ³	1440.0	5976.0	3.99	23844.24
Fine agg. / sand	4.15	m ³	1840.0	7636.0	0.02	155.77
Coarse agg.	8.30	m ³	1600.0	13280.0	0.22	2921.60
Embodied energy for concrete					26921.61	611.85
WALLING						
Cement	0.46	m ³	1440.0	661.9	3.99	2641.10
Fine agg. / sand	2.34	m ³	1840.0	4303.4	0.02	87.79
LC	14.01	m ³	642.0	8991.2	1500.00	21007.50
Embodied energy for walling					23736.39	539.46
STEEL						
Steel in RCC	1865	kg		1865	34.24	63857.60
TOTAL					114515.60	2602.63

MIDDLE UNIT						
Embodied energy- CT2- RCC + 40mm mineral wool insulation + 12mm gyp board						
Type	Quantity	Unit	Density kg/m ³ or kg/m ²	Weight (kg)	Embodied energy (MJ)/kg	Embodied energy (MJ)/m ³
CONCRETE						
Cement	5.24	m ³	1440.0	7540.4	3.99	30086.12
Fine agg. / sand	5.24	m ³	1840.0	9634.9	0.02	196.55
Coarse agg.	10.47	m ³	1600.0	16756.4	0.22	3686.41
Embodied energy for concrete					33969.08	772.02
WALLING						
Cement	0.46	m ³	1440.0	661.9	3.99	2641.10
Fine agg. / sand	2.34	m ³	1840.0	4303.4	0.02	87.79
Mineral wool	2.07	m ³	73.5	152.0	16.60	2523.17
Gyp board	51.70	m ²	10.8	555.8	3.30	1834.06
LC	6.62	m ³	642.0	4250.7	1500.00	9931.50
Embodied energy for walling					7086.11	386.76
STEEL						
Steel in RCC	2525.7875	kg		2525.7875	34.24	86482.96
TOTAL					127538.15	3124.31

MIDDLE UNIT						
Embodied energy- CT3- ALC wall panel						
Type	Quantity	Unit	Density kg/m ³ (IS 875 (Part 1) : 1987, 2008)	Weight (kg)	Embodied energy (MJ)/kg	Embodied energy (MJ)/m ³
CONCRETE						
Cement	4.15	m ³	1440.0	5976.0	3.99	23844.24
Fine agg. / sand	4.15	m ³	1840.0	7636.0	0.02	155.77
Coarse agg.	8.30	m ³	1600.0	13280.0	0.22	2921.60
Embodied energy for concrete					26921.61	611.85
WALLING						
Cement	0.46	m ³	1440.0	661.9	3.99	2641.10
Fine agg. / sand	2.34	m ³	1840.0	4303.4	0.02	87.79
LC panel	5.54	m ³	642.0	3555.4	1500.00	8307.00
LC	6.62	m ³	642.0	4250.7	1500.00	9931.50
Embodied energy for walling					20967.39	476.53
STEEL						
Steel in RCC	1865	kg		1865	34.24	63857.60
TOTAL					114515.60	2602.63

EDGE UNIT						
Embodied energy- CT1- AAC						
Type	Quantity	Unit	Density kg/m ³ (IS 875 (Part 1) : 1987, 2008)	Weight (kg)	Embodied energy (MJ)/kg	Embodied energy (MJ)/m ³
CONCRETE						
Cement	4.32	m ³	1440.0	6213.6	3.99	24792.26
Fine agg. / sand	4.32	m ³	1840.0	7939.6	0.02	161.97
Coarse agg.	8.63	m ³	1600.0	13808.0	0.22	3037.76
Embodied energy for concrete					27991.99	636.1
WALLING						
Cement	0.46	m ³	1440.0	661.9	3.99	2641.10
Fine agg. / sand	2.34	m ³	1840.0	4303.4	0.02	87.79
AAC	14.47	m ³	642.0	9286.5	1500.00	21697.50
Embodied energy for walling					24426.39	555.1
STEEL						
Steel in RCC	1960	kg		1960	34.24	67110.40
TOTAL					119528.78	2716.5

EDGE UNIT						
Embodied energy- CT2- RCC + 40mm mineral wool insulation + 12mm gyp board						
Type	Quantity	Unit	Density kg/m ³ (IS 875 (Part 1) : 1987, 2008)	Weight (kg)	Embodied energy (MJ)/kg	Embodied energy (MJ)/m ³
CONCRETE						
Cement	5.48	m ³	1440.0	7887.8	3.99	31472.24
Fine agg. / sand	5.48	m ³	1840.0	10078.8	0.02	205.61
Coarse agg.	10.96	m ³	1600.0	17528.4	0.22	3856.25
Embodied energy for concrete					35534.10	807.5
WALLING						
Cement	0.46	m ³	1440.0	661.9	3.99	2641.10
Fine agg. / sand	2.34	m ³	1840.0	4303.4	0.02	87.79
Mineral wool	2.76	m ³	73.5	202.9	16.60	3367.48
Gyp board	69.00	m ²	10.8	741.8	3.30	2447.78
AAC	6.62	m ³	642.0	4250.7	1500.00	9931.50
Embodied energy for walling					18475.64	419.9
STEEL						
Steel in RCC	2668.9125	kg		2668.9125	34.24	91383.56
TOTAL					145393.30	3304.3

EDGE UNIT						
Embodied energy- CT3- ALC wall panel						
Type	Quantity	Unit	Density kg/m ³ (IS 875 (Part 1) : 1987, 2008)	Weight (kg)	Embodied energy (MJ)/kg	Embodied energy (MJ)/m ³
CONCRETE						
Cement	4.32	m ³	1440.0	6213.6	3.99	24792.26
Fine agg. / sand	4.32	m ³	1840.0	7939.6	0.02	161.97
Coarse agg.	8.63	m ³	1600.0	13808.0	0.22	3037.76
Embodied energy for concrete					27991.99	636.1
WALLING						
Cement	0.46	m ³	1440.0	661.9	3.99	2641.10
Fine agg. / sand	2.34	m ³	1840.0	4303.4	0.02	87.79
ALC panel	5.88	m ³	642.0	3775.5	1500.00	8824.50
AAC	6.62	m ³	642.0	4250.7	1500.00	9931.50
Embodied energy for walling					21484.89	488.2
STEEL						
Steel in RCC	1960	kg		1960	34.24	67110.40
TOTAL					119528.78	2716.5

EDGE UNIT						
Embodied energy- CT1- AAC						
Type	Quantity	Unit	Density kg/m ³ (IS 875 (Part 1) : 1987, 2008)	Weight (kg)	Embodied energy (MJ)/kg	Embodied energy (MJ)/m ³
CONCRETE						
Cement	4.32	m ³	1440.0	6213.6	3.99	24792.26
Fine agg. / sand	4.32	m ³	1840.0	7939.6	0.02	161.97
Coarse agg.	8.63	m ³	1600.0	13808.0	0.22	3037.76
Embodied energy for concrete					27991.99	636.1
WALLING						
Cement	0.46	m ³	1440.0	661.9	3.99	2641.10
Fine agg. / sand	2.34	m ³	1840.0	4303.4	0.02	87.79
ALC panel	5.60	m ³	642.0	3583.2	1500.00	8392.50
LC	6.62	m ³	642.0	4250.7	1500.00	9931.50
Embodied energy for walling					21052.89	478.4
STEEL						
Steel in RCC	1960	kg		1960	34.24	67110.40
TOTAL					119528.78	2716.5

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ENS COMPLIANCE SHEET- MATERIAL SHEET



Ministry of Housing and Urban Affairs
Government of India



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MS11-TC-2bhk					
Walling materials	Density (kg/m3)	Thermal conductivity (W/mK)	C (J/kg.K)	Thickness (mm)	U-value (W/m2.K)
(Hot & Dry)					
RCC+Insulation (Min Wool)					0.59
Reinforced concrete cement (RCC)	2288	1.58	880	150	
Mineral wool (unbonded)	73.5	0.03	920	40	
Gypsum plaster Board	1120	0.16	NA	12	
				150	
				200x 100x75	0.77
					0.59
				150	
				40	
				12	
				150	
				200x 100x75	0.77
					0.59
				150	
				40	
				12	
				150	
				200x 100x75	0.77
					0.59
				150	
				40	
				12	
				150	
				200x 100x75	0.77
					0.59
				150	
				40	
				12	
				150	
				200x 100x75	0.77

ENS COMPLIANCE SHEET



Ministry of Housing and Urban Affairs
Government of India



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MS11-TC-2bhk- Composite climate

ENS Compliance

Openable area to Floor Ratio (WFR)				
	Minimum WFRop	Openable Area	Floor Area	WFR (Whole Block)
Openable area to Floor Ratio (WFR)	12.50%	62.64 sqm	355.2 sqm	20.81%

Minimum VLT requirement			
	WWR	Minimum VLT as per ENS	VLT for all variants
Minimum VLT requirement (Whole block)	0.084	0.27	0.85

Thermal Transmittance of Roof				
	U- Value in W/m2 K Required	U- Value in W/m2 K for CT1 Roof	U- Value in W/m2 K for CT2 Roof	U- Value in W/m2 K for CT3 Roof
Thermal Transmittance of Roof	1.2	0.62	0.62	0.56

RETV (Whole Block)			
Construction technology	Orientation	Min RETV as per ENS (W/m2 K)	RETV Whole block (W/m2 K)
CT1	Best (180 deg)	15.00	8.03
	Worst (270 deg)	15.00	9.47
CT2	Best (180 deg)	15.00	7.20
	Worst (270 deg)	15.00	8.54
CT3	Best (180 deg)	15.00	10.64
	Worst (270 deg)	15.00	12.42

Roofing system
Foam concrete + Light colored tile
Foam concrete + Light colored tile
50mm eps insulation + Light colored tile

End of Session

Questions and Feedback

Please follow the link in the chat box to fill the feedback survey:

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on webtool training sessions!