Replicable designs for Thermally Comfortable Affordable housing

Second stakeholder meeting | **11 November 2022**

Knowledge Partners:

Ashok B Lall Architects

LEAD Consultancy

Greentech Knowledge Solutions

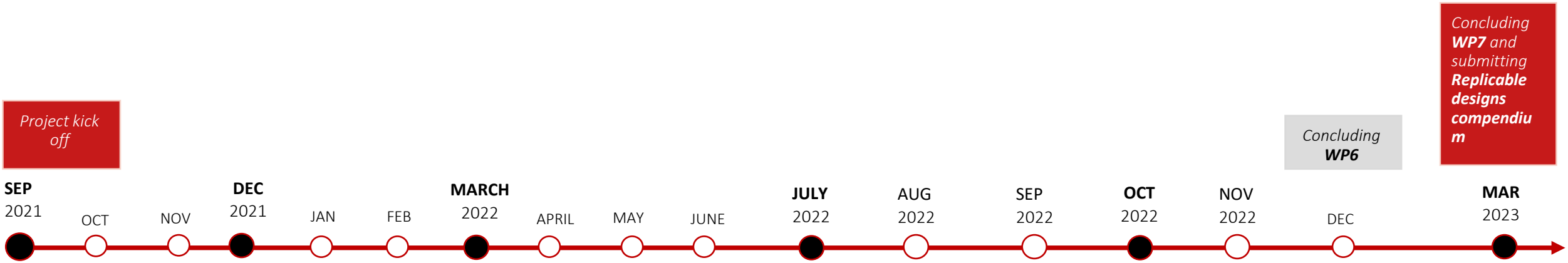
Introduction

Project Overview

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



WP1

Documentation of architectural typology, construction technology and materials used for affordable housing under PMAY-U

WP2

Develop Architectural Design & Specifications for Replicable Design options for Thermally Comfortable Affordable Housing

WP3

Develop Budget Estimates of Replicable Design options for Thermally Comfortable Affordable Housing

WP4

Develop BIM and Simulation Models of Replicable Design options for Thermally Comfortable Affordable Housing

WP5

Organize Workshops and Event for the Launch of Replicable Design Catalogue for Thermally Comfortable Affordable Housing

WP6

Develop Architectural Design & Specifications for Replicable Design options for Thermally Comfortable BLC Homes

WP7

Developing a compendium for Replicable Design options for Thermally Comfortable Homes under PMAY-U

INTRODUCTION - Project Timeline

	WP2
OBJECTIVE	**Develop Architectural Design & Specifications for Replicable Design options for Thermally Comfortable Affordable Housing**
ACTIVITIES	**1**. Develop a detailed work plan including criteria for selection of architectural typologies, construction technologies and materials
	2. Architectural design package and Technical specification documents of all the developed design options for all warm climates
	3. Architectural design package and Technical specification documents of all the developed design options for cold climate.
DELIVERABLES	• .Architectural design package and Technical specification documents for the master sets developed for All 5 climate zones

	WP3
OBJECTIVE	**Develop Budget Estimates of Replicable Design options for Thermally Comfortable Affordable Housing**
ACTIVITIES	**1**. **Detailed cost estimates** of all the developed architectural design options for all climate zones.
	2. **Techno-Commercial Feasibility** of all the developed architectural design options for all climate zones.
DELIVERABLES	• **Detailed BOQs** of the master set typologies

	WP4
OBJECTIVE	**Develop BIM and Simulation Models of Replicable Design options for Thermally Comfortable Affordable Housing**
ACTIVITIES	**1. Building Information Model (BIM)** of all the developed architectural design options for all climate zones.
	2. **Energy Simulation Model** (including .IDF file) of all the developed architectural design options for all climate zones.
	3. **Natural & artificial lighting Simulation Model** of all the developed architectural design options for all climate zones.
DELIVERABLES	• **BIM models** for the master set typologies
	• **.IDF files** for the master set design typologies
	• **.rad files** for the master set design typologies

INTRODUCTION - Topics covered in Webinar 1

April 2022

Webinar 1

SESSION I

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

Criteria for selection of projects for the survey dataset

General trends observed .

Gaps identified in achieving optimal thermal comfort.

SESSION II

Framework for development of type designs

Single family plotted .

Multi-family group development.

Passive design principals.

SESSION III

Type design overview of Thermal Performance and Carbon Footprint of Construction

Key Performance Indicators

1. Thermal performance - ENS compliance and energy simulation

2. Embodied Energy Intensity (EEI) – Steel, concrete and Walling EEI/ Sqm of carpet area.

INTRODUCTION - Topics covered in this Webinar

Nov 2022

Webinar 2

SESSION I

Affordable Housing Typologies

Design development and overview of Thermally comfortable affordable housing typologies.

- ***Categorization of residential buildings for Type designs***

Type Designs
Warm & Cold climate
Multi Family & Single family
Plotted

SESSION II

Type design packages

Plan sets & Master sets

- ***Overview of Master set***

Design data & Construction data

SESSION III

Simulation and Performance concepts & results

Master set variations

Simulation methodology

- ***Key Performance Indicators***
  - *RETV,WFR,EEI,DDH*
- ***Performance Inferences***

Climate Variations
Orientation Variations
Dwelling Unit Placement Variations
Construction technology Variations

SESSION III

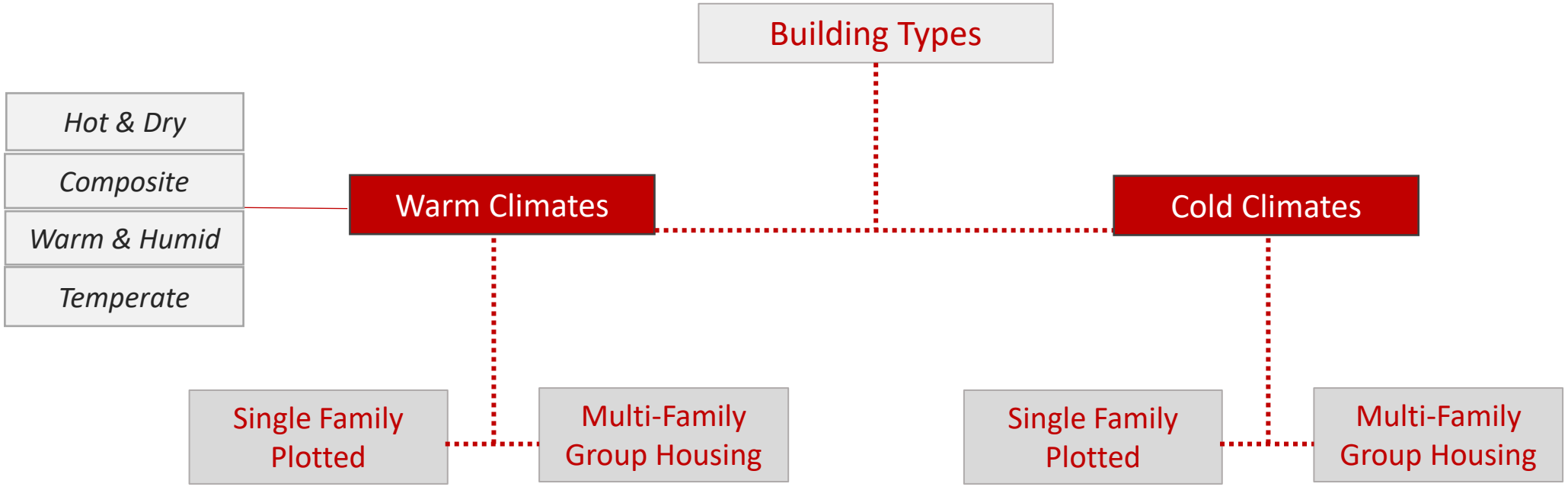
Next Steps

SESSION 1

Affordable Housing typologies :

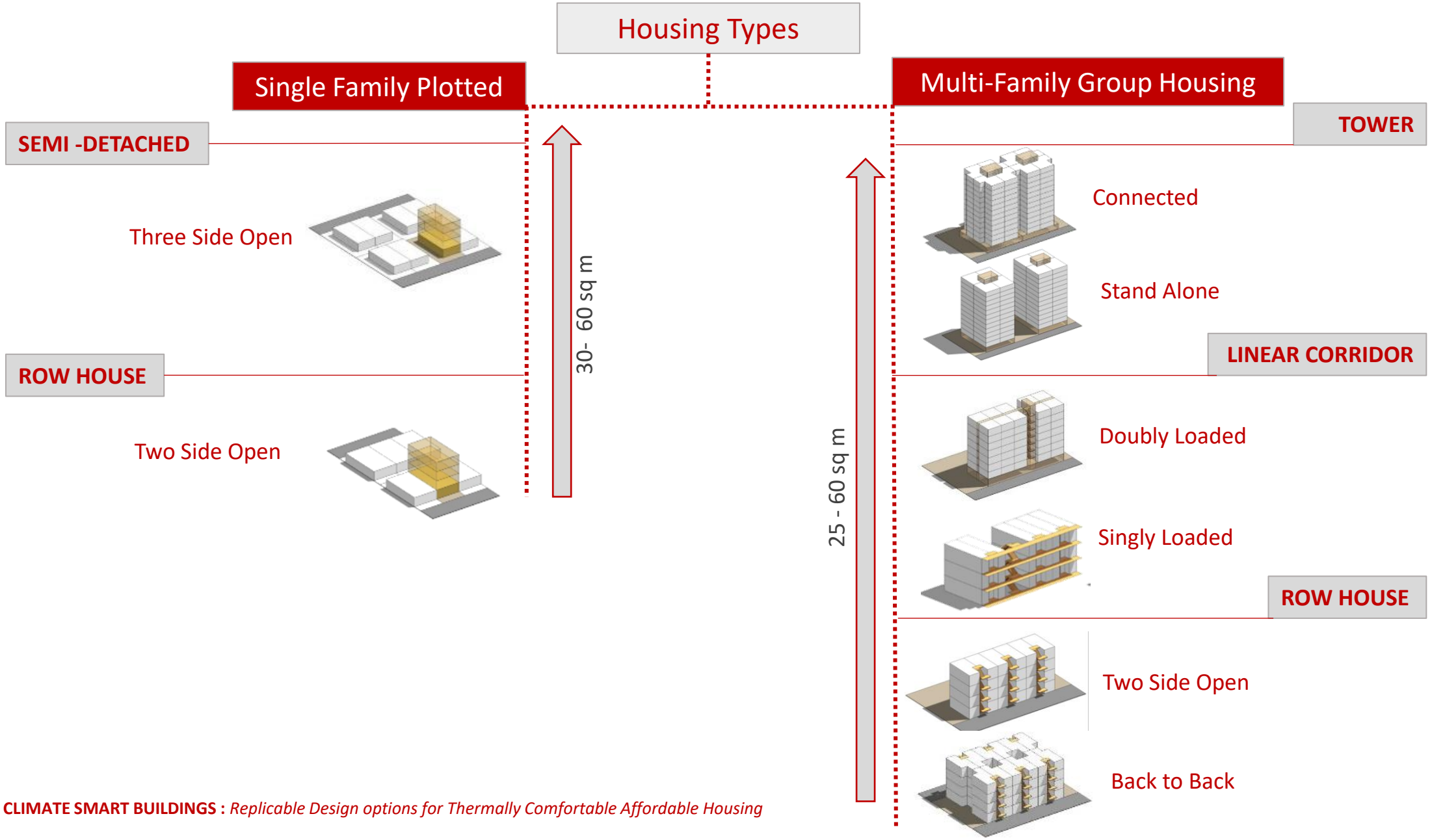
Design development and Dwelling Unit designs

Categorization of Residential buildings for Type designs



SESSION I

Categorization of Residential buildings for Type designs

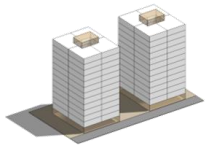
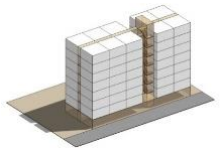
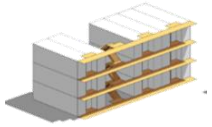
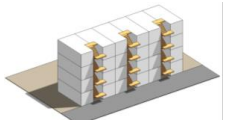


TYPE DESIGN MATRIX : Multi Family group housing – Warm climates

SESSION I

Multi-Family

Type designs - 17 nos

Tower Stand Alone		2 BHK 45 - 60 sqm	2 BHK 45 - 60 sqm				*Up to 24m (G+3 - S+7)*
Tower Connected		1 BHK 45 - 60 sqm	1 BHK 45 - 60 sqm	2 BHK 45 - 60 sqm	2 BHK 45 - 60 sqm		
Doubly loaded corridor		Dorm Up to 30 sqm	Hostel Up to 30 sqm	1 BHK Up to 30 sqm	1 BHK 30 - 45 sqm	2 BHK 30 - 45 sqm	2 BHK 45 - 60 sqm	*Up to 24m (G+3 - S+7)*
Singly loaded corridor		Dorm Up to 30 sqm					
Row House two side open		1 BHK Up to 30 sqm	1 BHK Up to 30 sqm	2 BHK 30 - 45 sqm			*<15m (G+3)*
Row House Back to back**		1 BHK Up to 30 sqm					

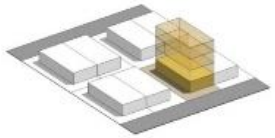
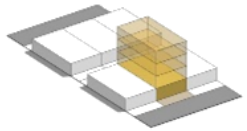
** *Not applicable for Warm humid & Temperate climate*

giz

TYPE DESIGN MATRIX : Single family plotted– Warm Climate

Single Family

Type designs - 4 nos

Semi Detached		1 BHK 30 - 45 sqm	2 BHK 45 - 60 sqm	<15m (G+3)
Row house two side open		1 BHK 30 - 45 sqm	1 BHK 45 - 60 sqm	<15m (G+3)

SESSION I

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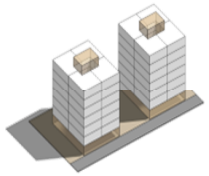
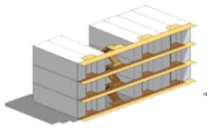
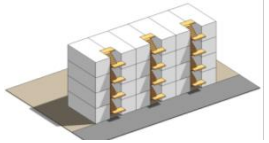
TYPE DESIGN MATRIX : Multi Family group housing – Cold Climate

Multi-Family

Type designs - 7 nos

Tower Stand Alone		1 BHK 45 - 60 sqm 2 BHK 45 - 60 sqm	*<=18m (G+5)*
Singly loaded corridor		1 BHK Up to 30 sqm 1 BHK 30 - 45 sqm 2 BHK 30 - 45 sqm	*<=18m (G+5)*
Row House two side open		1 BHK 30 - 45 sqm 2 BHK 45 - 60 sqm	*<15m (G+3)*

SESSION I

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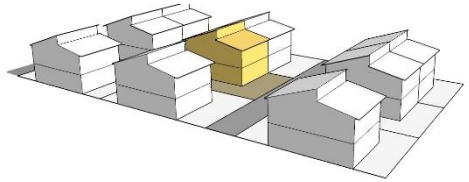
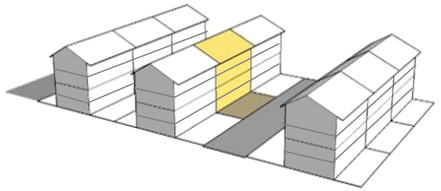
TYPE DESIGN MATRIX : Single family plotted– Cold Climate

Single Family

Type designs - 4 nos

Semi Detached		2 BHK 45 - 60 sqm 2 BHK 45 - 60 sqm	*Duplex (G+1)*
Row house two side open		2 BHK 45 - 60 sqm 2 BHK 45 - 60 sqm	*<15m (G+3)*

SESSION I

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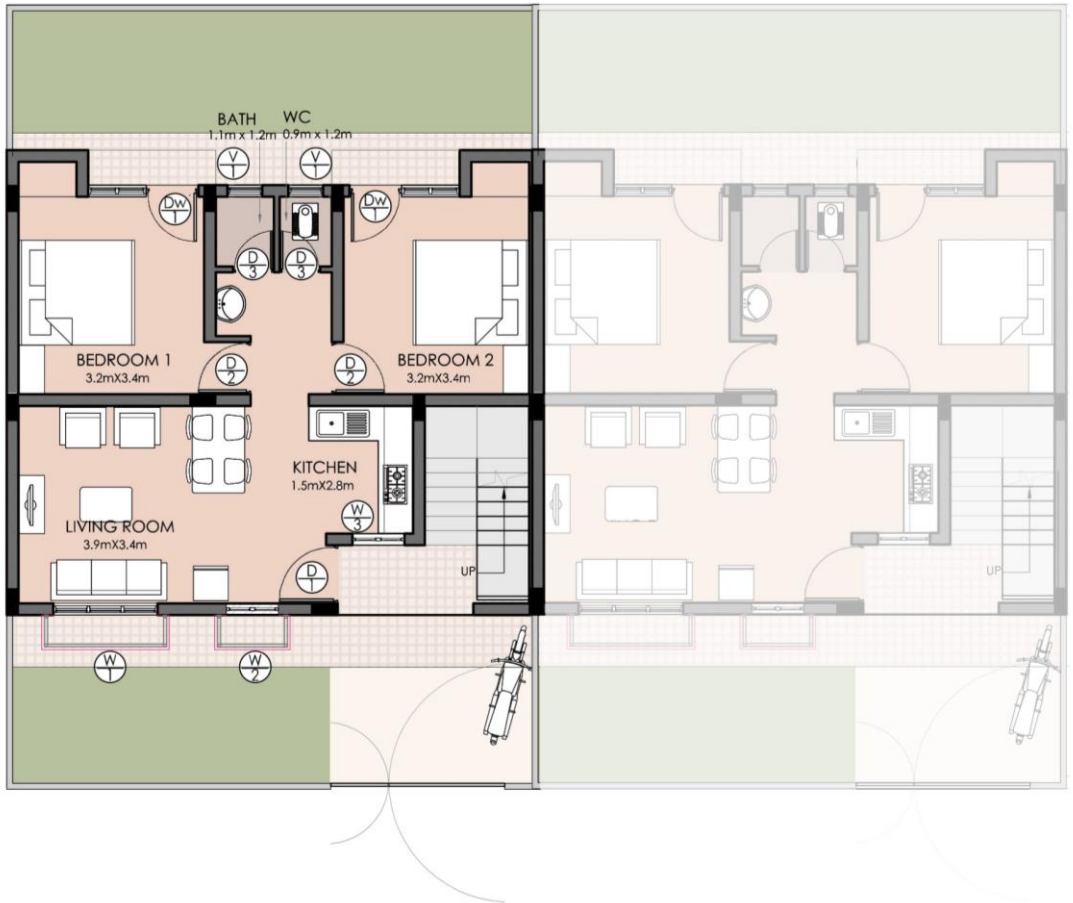
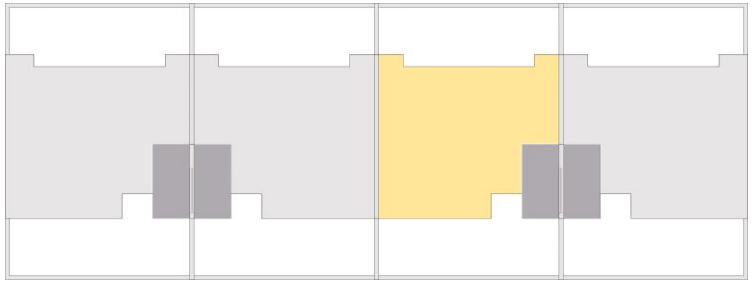
DESIGN DEVELOPMENT : Single-family plotted type designs



PLAN TYPE – SINGLE FAMILY- Row House Two side open

CARPET AREA – 55 Sqm



SESSION I

Semi Detached

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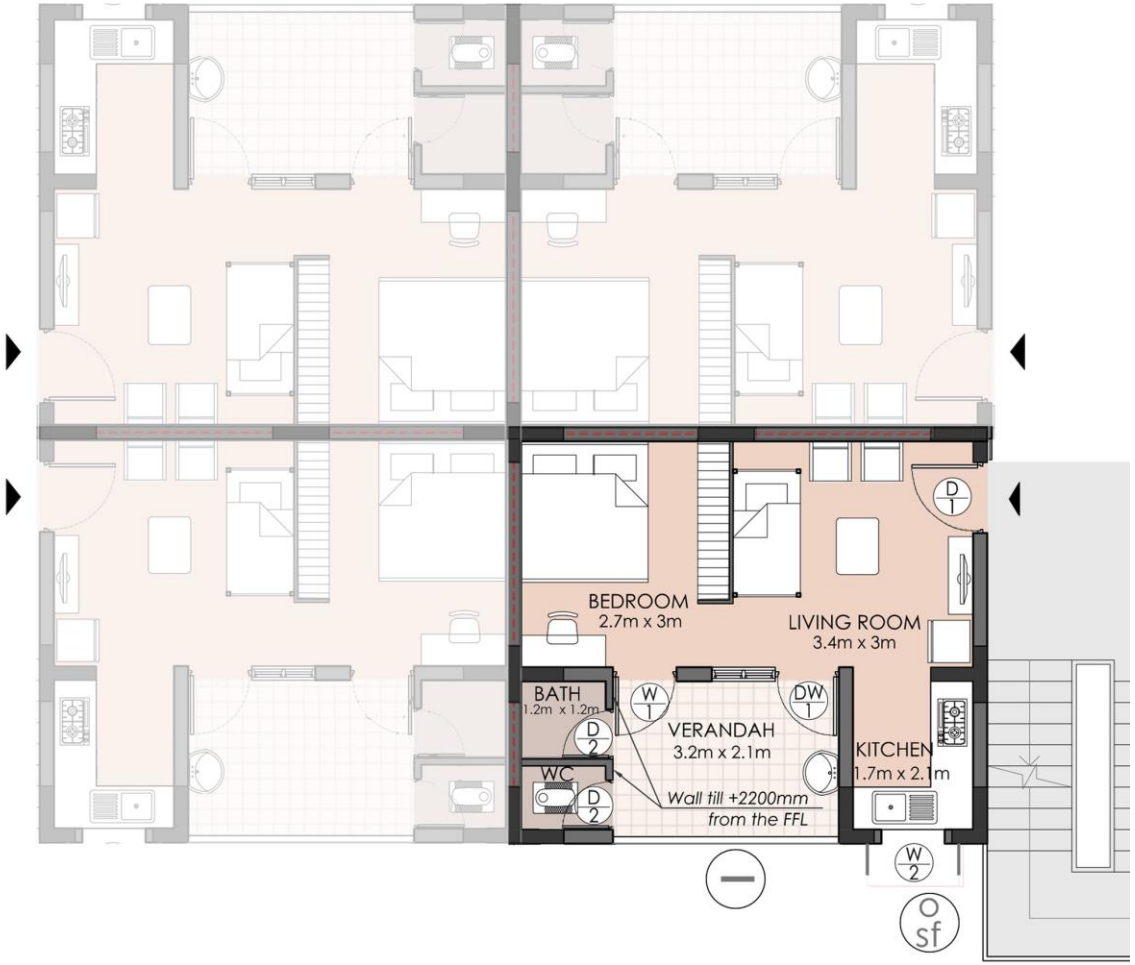
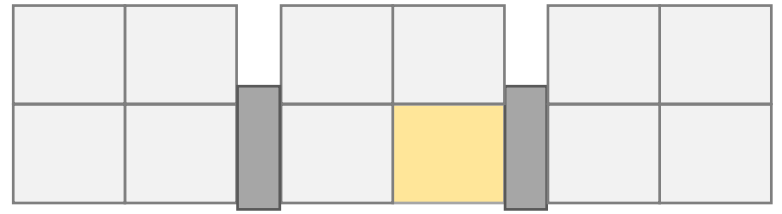
DESIGN DEVELOPMENT : Multi Family - Row house type designs



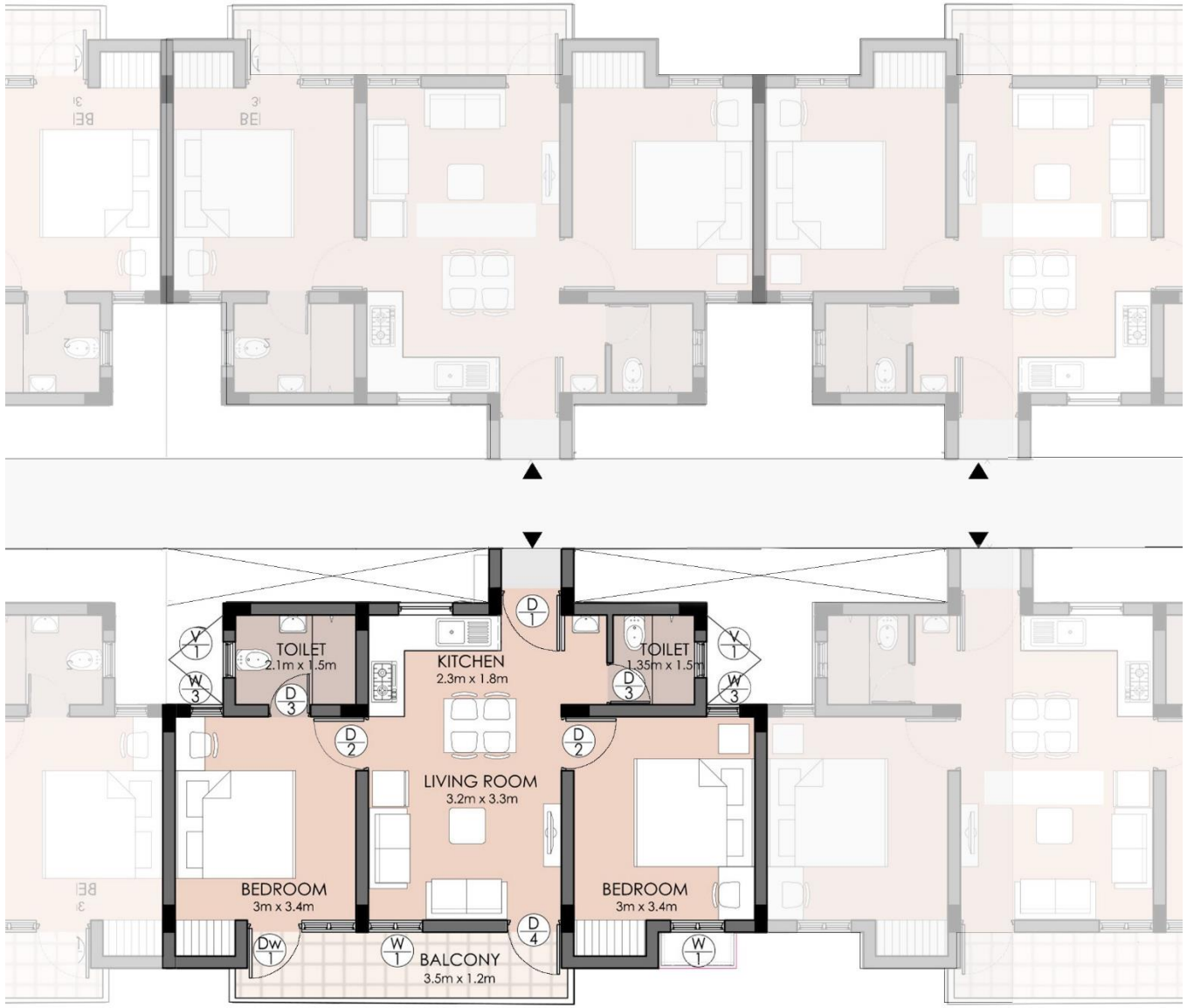
PLAN TYPE – MULTI FAMILY- Row House back to back

CARPET AREA – 27 Sqm



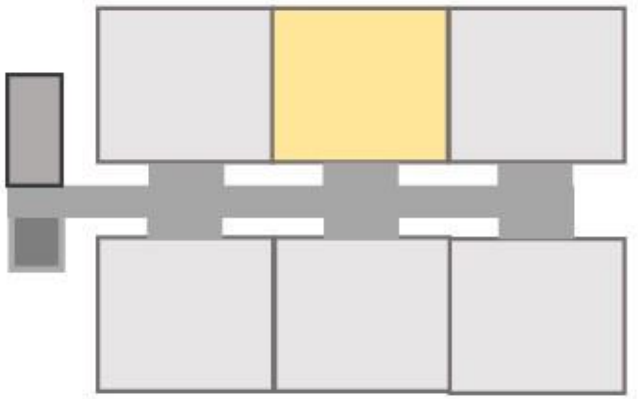
SESSION I

DESIGN DEVELOPMENT : Multi Family - Linear corridor type designs



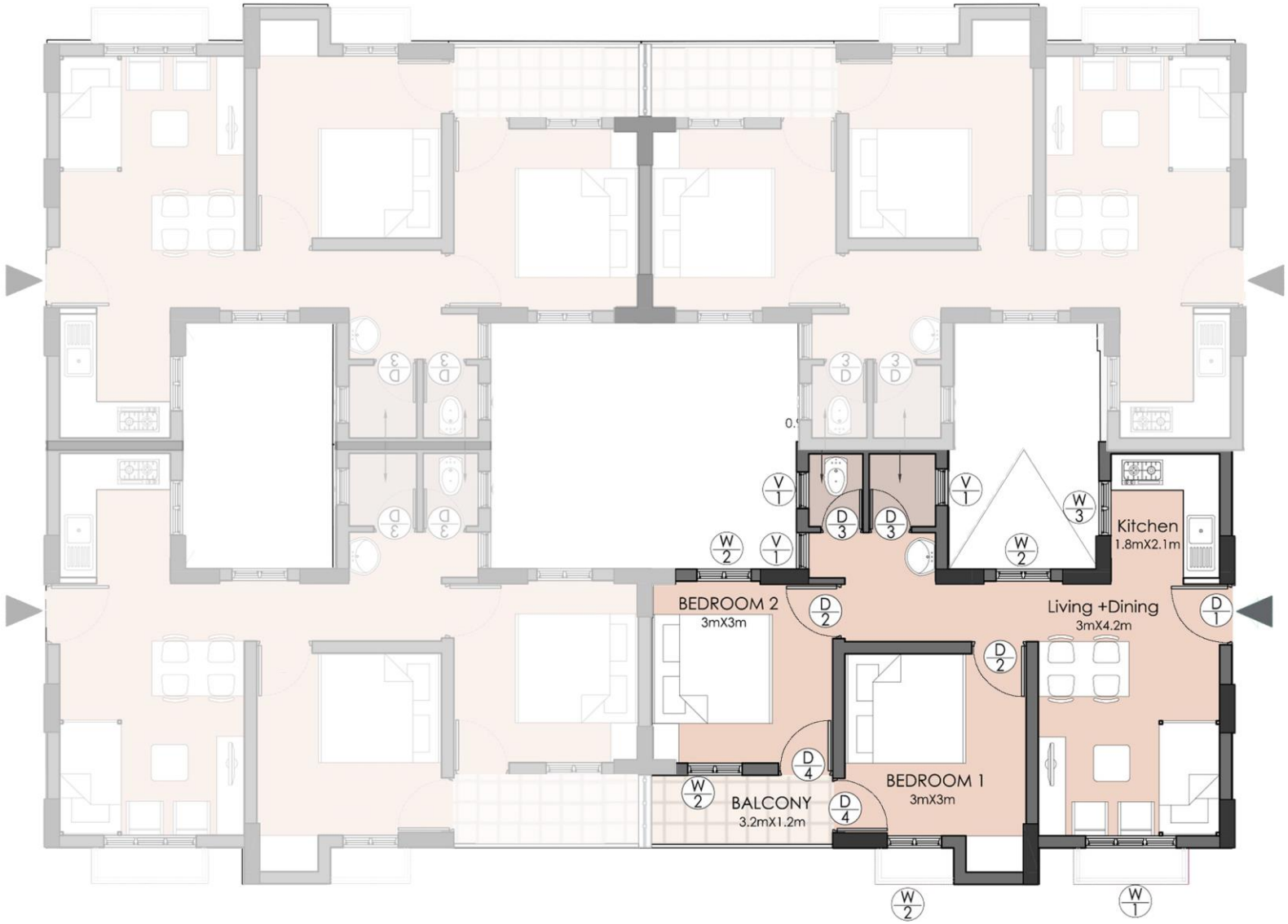
PLAN TYPE – MULTI FAMILY- Doubly loaded corridor

CARPET AREA – 48 Sqm



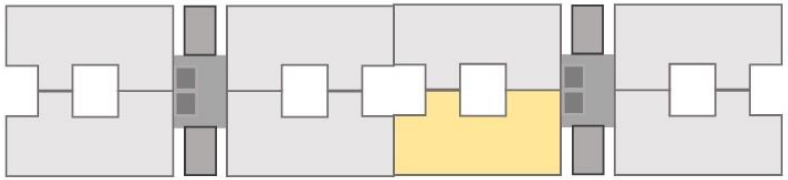
SESSION I

DESIGN DEVELOPMENT : Multi Family - Tower type designs



PLAN TYPE – MULTI FAMILY- Tower connected

CARPET AREA – 44 Sqm



SESSION I

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Questions and Feedback

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

SESSION II

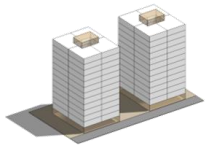
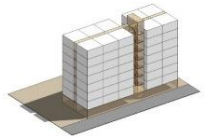
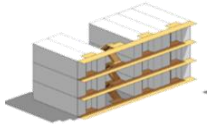
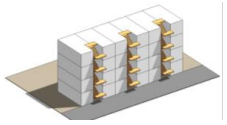
Type design Packages &
Overview of Master Set package

- Design &Construction Data

TYPE DESIGN MATRIX : Multi Family group housing – Warm Climates

SESSION II

Multi-Family

Tower Stand Alone		2 BHK 45 - 60 sqm	2 BHK 45 - 60 sqm			*Up to 24m (G+3 - S+7)*
Tower Connected		1 BHK 45 - 60 sqm	1 BHK 45 - 60 sqm	2 BHK 45 - 60 sqm	2 BHK 45 - 60 sqm	
Doubly loaded corridor		Dorm Up to 30 sqm	Hostel Up to 30 sqm	1 BHK Up to 30 sqm	1 BHK 30 - 45 sqm	2 BHK 30 - 45 sqm	2 BHK 45 - 60 sqm	*Up to 24m (G+3 - S+7)*
Singly loaded corridor		Dorm Up to 30 sqm						
Row House two side open		1 BHK Up to 30 sqm	1 BHK Up to 30 sqm	2 BHK 30 - 45 sqm				*<15m (G+3)*
Row House Back to back**		1 BHK Up to 30 sqm						

** *Not applicable for Warm humid & Temperate climate*

Master sets — *9 Master Sets*

Plan sets — *8 Plan Sets*

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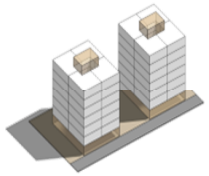
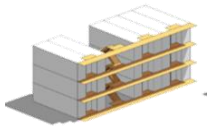
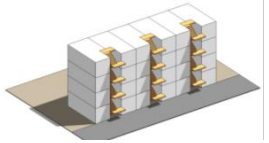
TYPE DESIGN MATRIX : Multi Family group housing – Cold Climate

Multi-Family

Type designs - 7 nos

Master sets — *3 Master Sets*

Plan sets — *4 Plan Sets*

Tower Stand Alone		1 BHK 45 - 60 sqm	2 BHK 45 - 60 sqm	<=18m (G+5)
Singly loaded corridor		1 BHK Up to 30 sqm	1 BHK 30 - 45 sqm	2 BHK 30 - 45 sqm	<=18m (G+5)
Row House two side open		1 BHK 30 - 45 sqm	2 BHK 45 - 60 sqm	<15m (G+3)

TYPE DESIGN PACKAGES : Master Sets & Plan sets

Replicable Design Types

Master Set

16 nos

- **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**,**

Plans set

15 nos

- **Design** – *Plans*

Plan sets are based on the same principles of planning and construction as for the Master Set. It is presumed that the performance of the plan sets would be close to the performance of the Master Set as obtained through simulations.

Downloadable sets

SESSION II

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A) DESIGN DATA : Unit Plan

MASTER SET PACKAGE

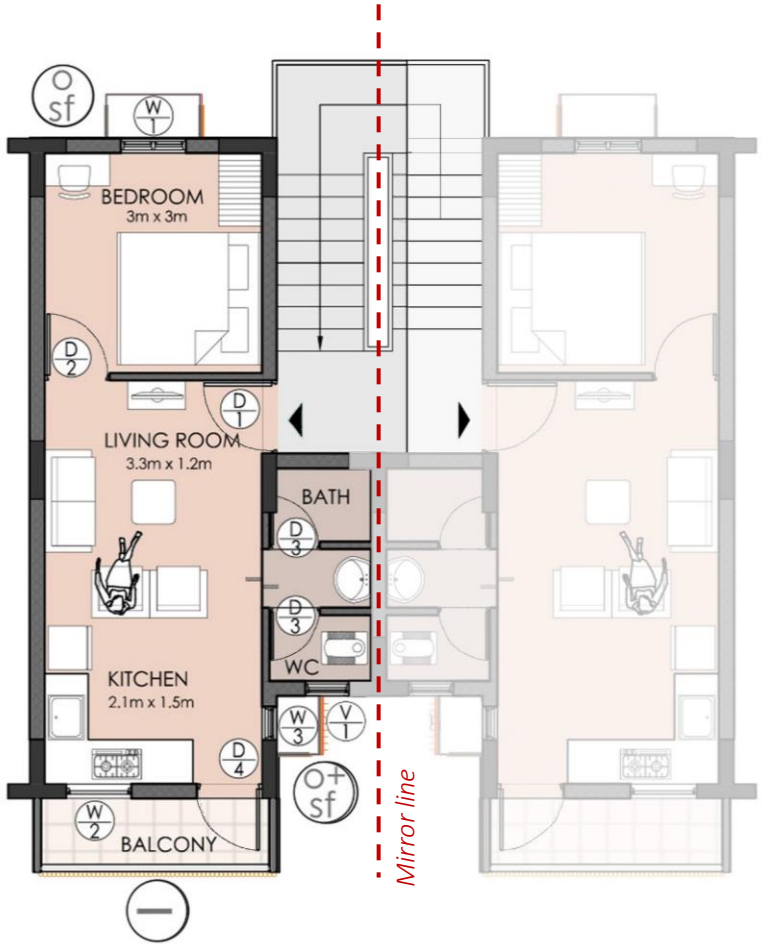
DESIGN DATA

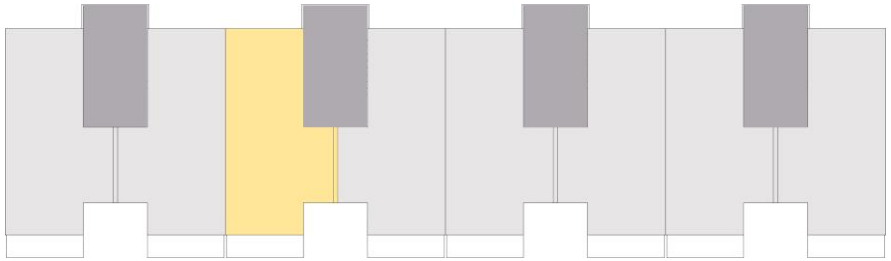
CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS

Row house two side Open	*Hot & dry*	*South orientation* N	*Middle floor*	*Middle Unit*





PLAN TYPE - MULTI FAMILY - Row House Two side open

CARPET AREA - 30Sqm

SESSION II

A) DESIGN DATA : Block Plan

MASTER SET PACKAGE

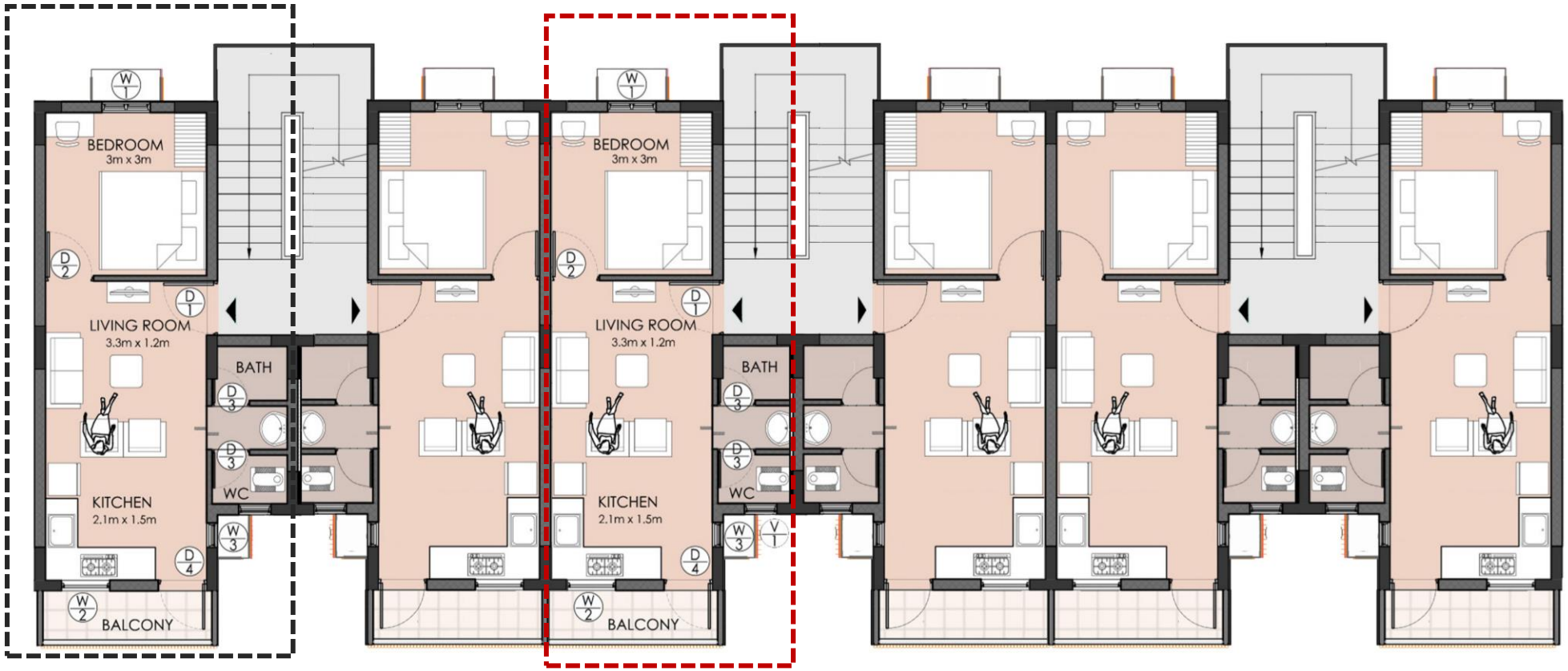
DESIGN DATA

CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS

Row house two side Open	*Hot & dry*	*South orientation*	*Middle floor*	



Edge unit selected for simulation

Master set *selected for simulation*

SESSION II

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B) CONSTRUCTION DATA : Windows & Shading design

MASTER SET PACKAGE

DESIGN DATA

CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS

GENERAL NOTES

1. Top overhang of windows are 600mm wide unless otherwise specified
2. Window side fins are 450 mm wide unless otherwise specified.
3. East and west facing windows will have roll down screens in the front (bottom of overhang till window sill).
4. Balcony jaali screen is added from bottom of the slab to 2100mm from room ffl in all cases except composite climate north direction
5. Roll down bamboo screens are added from 2100 to top of balcony railing in all east & west facing balconies
6. Hot & dry climate- south orientation is considered as master set base.

LEGEND

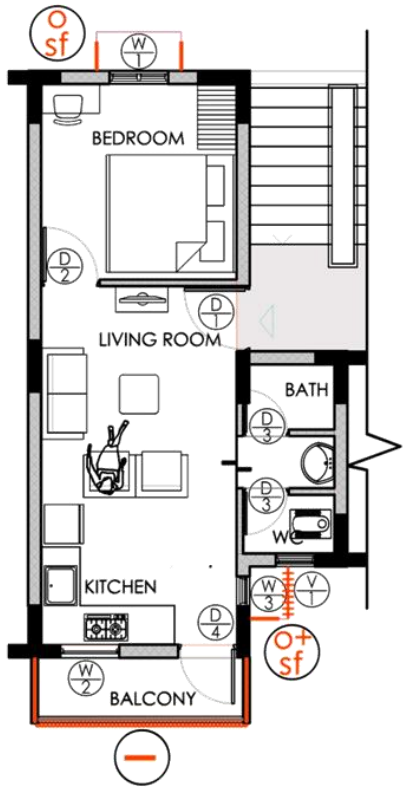
+	FIXED JAALI SCREEN SHADING (from bottom of slab to 2100mm from room FFL) + ROLL DOWN BAMBOO SCREENS (from 2100mm to top of balcony railing) + JAALI SIDE FINS (from bottom of slab to 1000mm from room FFL)
−	FIXED JAALI SCREEN SHADING (from bottom of slab to 2100mm from room FFL) + JAALI SIDE FINS (from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

CONSTRUCTION TECHNOLOGY VARIANTS

LEGEND	WALL	EXTERNAL DOOR WINDOWS	ROOFING SYSTEM
CT 01	AAC	UPVC	Foam concrete+Light colored tile
CT 02	Local Brick	Rolled Steel	Foam concrete+Light colored tile
CT 03	Flyash/ (CSEB for Tem-perate)	UPVC	50mm eps insulation + Light colored tile

ROW HOUSE TWO SIDE OPEN - 1BHK

CLIMATE	LOCATION	ORIENTATION



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SESSION II

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B) CONSTRUCTION DATA : Windows & Shading design

MASTER SET PACKAGE

DESIGN DATA

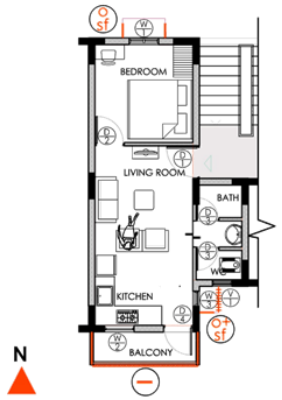
CONSTRUCTION DATA

SIMULATION DATA

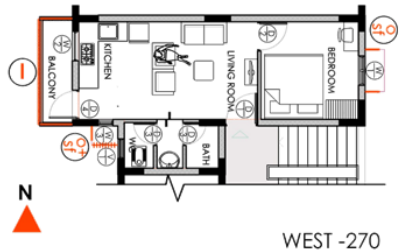
KEY PERFORMANCE INDICATORS

SESSION II

ORIENTATIONS



SOUTH -180



WEST -270

SHADING DEVICE FIXING DETAILS SCHEDULE

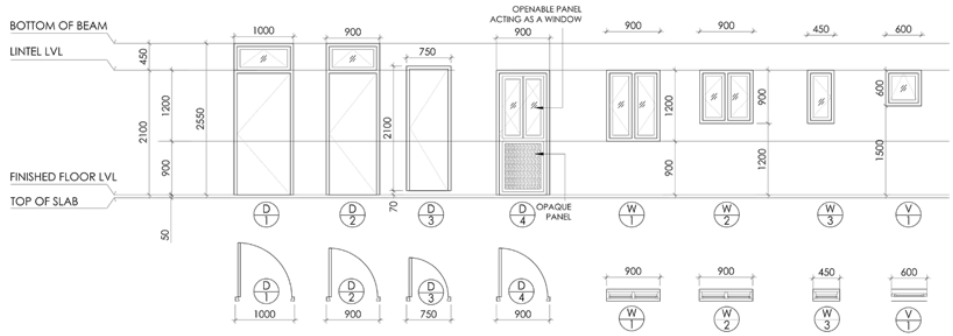
VERTICAL SIDE FIN	FIXED SHADING SCREEN	ROLL DOWN SCREEN	OVERHANG WITH SIDE FIN
DWG NO. A0X	DWG NO. A0X	DWG NO. A0X	DWG NO. A0X
DETAIL NO. XX	DETAIL NO. XX	DETAIL NO. XX	DETAIL NO. XX

ROW HOUSE TWO SIDE OPEN - 1BHK

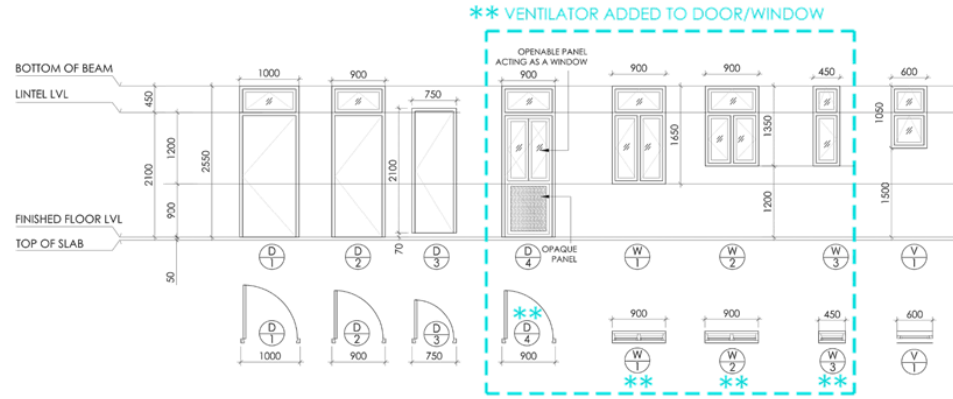
CLIMATE	LOCATION	ORIENTATION

DOOR WINDOW DETAILS

Composite and Hot and Dry Climate



Warm & Humid and Temperate Climate



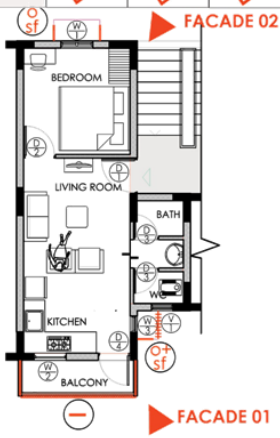
B) CONSTRUCTION DATA : Windows & Shading design

- MASTER SET PACKAGE
- DESIGN DATA
- CONSTRUCTION DATA
- SIMULATION DATA
- KEY PERFORMANCE INDICATORS

MASTER SET PLAN

HOT AND DRY CLIMATE | SOUTH FACING

CONSTRUCTION TECHNOLOGIES	CT 01	CT 02	CT 03
	✓	✓	✓



1. WINDOW AND SHADING DEVICE ADDED TO EDGE WALL

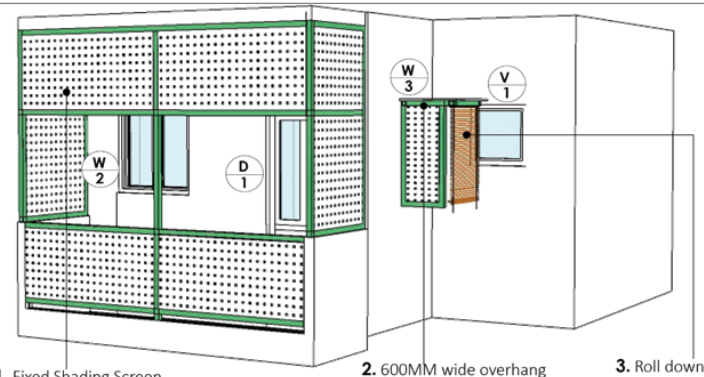
LEGEND

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

ROW HOUSE TWO SIDE OPEN - 1BHK

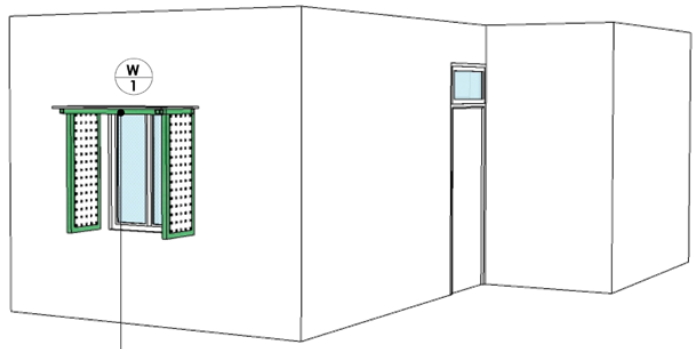
HOT AND DRY	MIDDLE UNIT	SOUTH

FACADE 01



1. Fixed Shading Screen
2. 600MM wide overhang with side fins
3. Roll down adjustable shading screen

FACADE 02



1. 600MM wide overhang with side fins

PAGE 4 OF 11

SESSION II

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B) CONSTRUCTION DATA : Working Drawings- Unit Plan

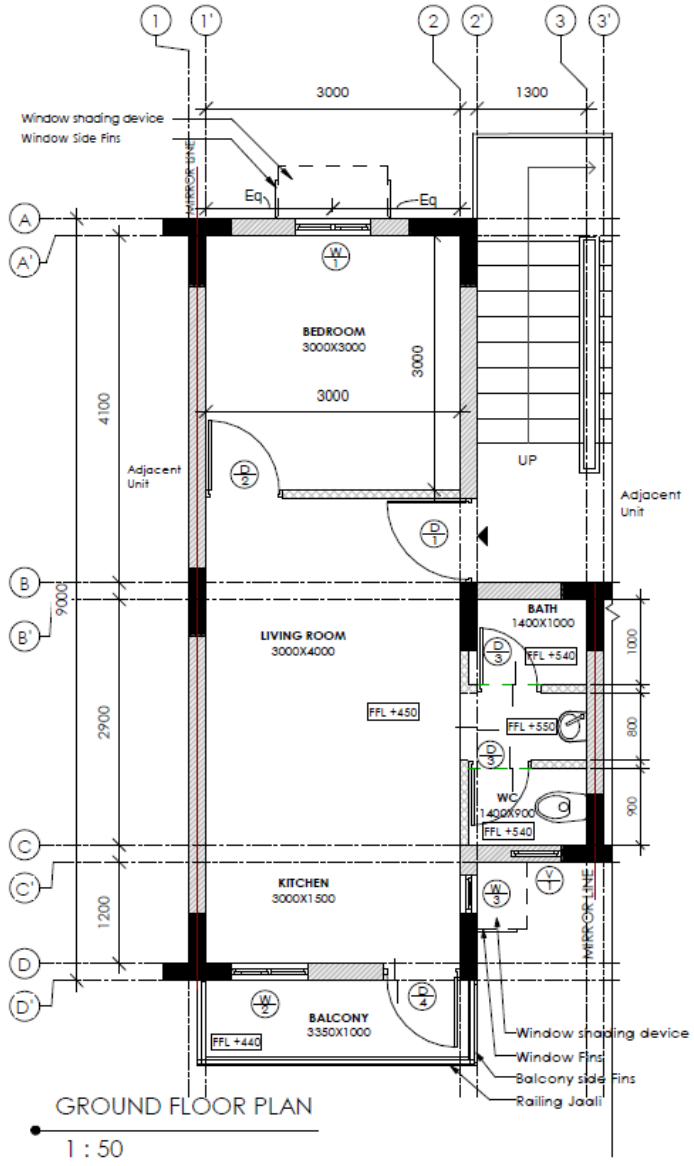
MASTER SET PACKAGE

DESIGN DATA

CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS



LEGEND

	Full thickness walls
	Half thickness walls

Door Schedule

Door Name	Width	Height	Lintel	Ventilator Height
D1	1000	2100	2550	450
D2	900	2100	2550	450
D3	750	2100	2100	
D4	900	2100	2100	

Window Schedule

Window Name	Width	Height	Sill Height
V1	600	600	1500
W1	900	1200	900
W2	900	900	1200
W3	450	900	1200

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PROJECT

CLIMATE SMART BUILDINGS- Replicable designs for thermally comfortable Affordable Housing

NOTES

-All Dimensions and Levels are in Millimeters.
-Drawing to be read in conjunction with Typical Architecture details, Windows and shading design. Refer to windows and shading design for variations.
These construction details are suggestions of construction assembly based on which the cost estimates have been made.

1. Structural system is indicative. Sizes and dimension of structural members may be modified as per structural design for the particular earthquake zone.

2. Walling material in these designs may be selected as per local availability and cost. Recommended options for walling materials are given. The energy performance simulation results are reporting for the recommended options. These may be substituted by materials with equivalent or similar u-value and density to give similar energy performance.

3. Doors and windows : Base-case low-cost doors and windows are powder coated steel. For better performance - less conductive frames and glazing with lower U-value - UPVC, or timber is proposed.

4. Infiltration control - Casement windows are preferred. All casements have a double rebate overlap with the frame. Butyl rubber gaskets are recommended for effective infiltration control. External doors have a frame across the bottom with double rebate overlap. Frame junctions with masonry are sealed with sealant. The door and window sections are indicative. Many proprietary systems are available with these features.

5. Shading systems are indicative. Shading systems should be light weight and perforated for release of heat to surrounding air. Alternative construction details can be devised.

6. Additional insulation for external walls is adopted for the better performance and walls that are exposed to high direct solar radiation (East and west facing). EPS with a protective plaster is proposed. Equivalent proprietary systems can be used.

TYPOLOGY

Row house two side open MS2-RHT-1bhk

N

DRAWING	Block Plan
SCALE	As indicated

https://ghtc-india.gov.in/

SESSION II

giz

B) CONSTRUCTION DATA : Working Drawings- Block Plan

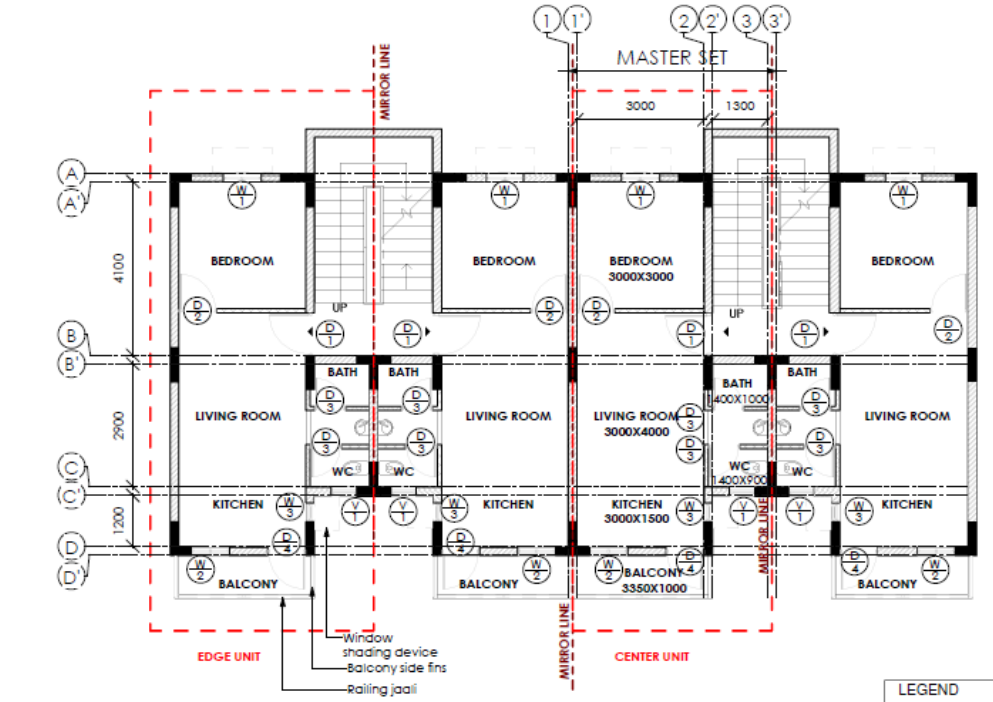
MASTER SET PACKAGE

DESIGN DATA

CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS



TYPICAL FLOOR PLAN

1 : 100

LEGEND

Full thickness walls

Half thickness walls

Door Schedule

Door Name	Width	Height	Lintel	Ventilator Height
D1	1000	2100	2550	450
D2	900	2100	2550	450
D3	750	2100	2100	—
D4	900	2100	2100	—

Window Schedule

Window Name	Width	Height	Sill Height
V1	600	600	1500
W1	900	1200	900
W2	900	900	1200
W3	450	900	1200

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TYPOLOGY

Row house two side open MS2-RHT-1bhk

N

DRAWING	Block Plan
SCALE	As indicated

https://ghtc-india.gov.in/

SESSION II

giz

B) CONSTRUCTION DATA : Working Drawings- Elevations

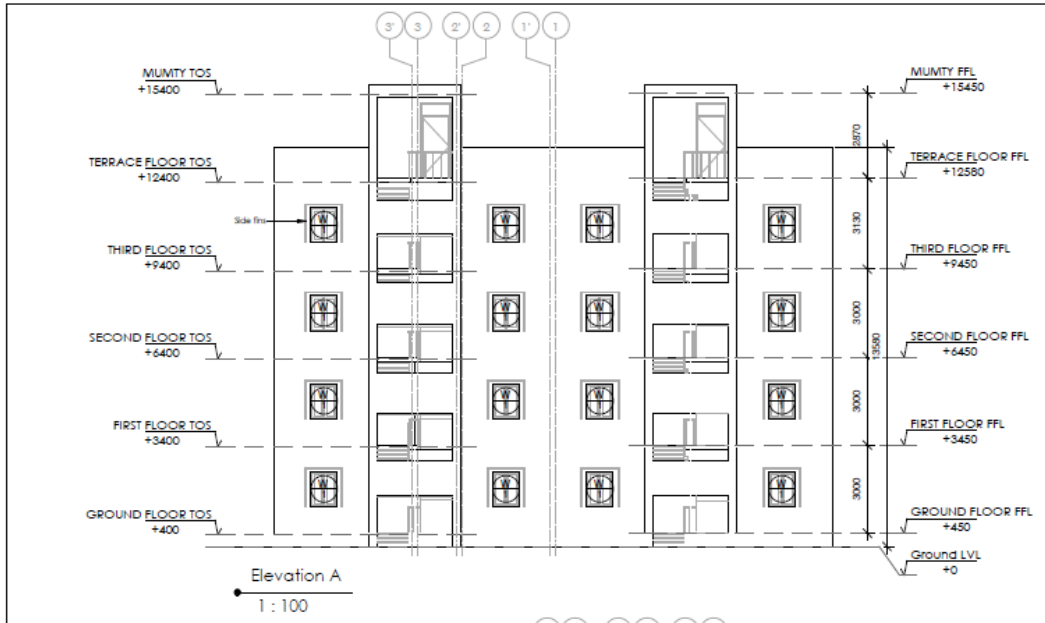
MASTER SET PACKAGE

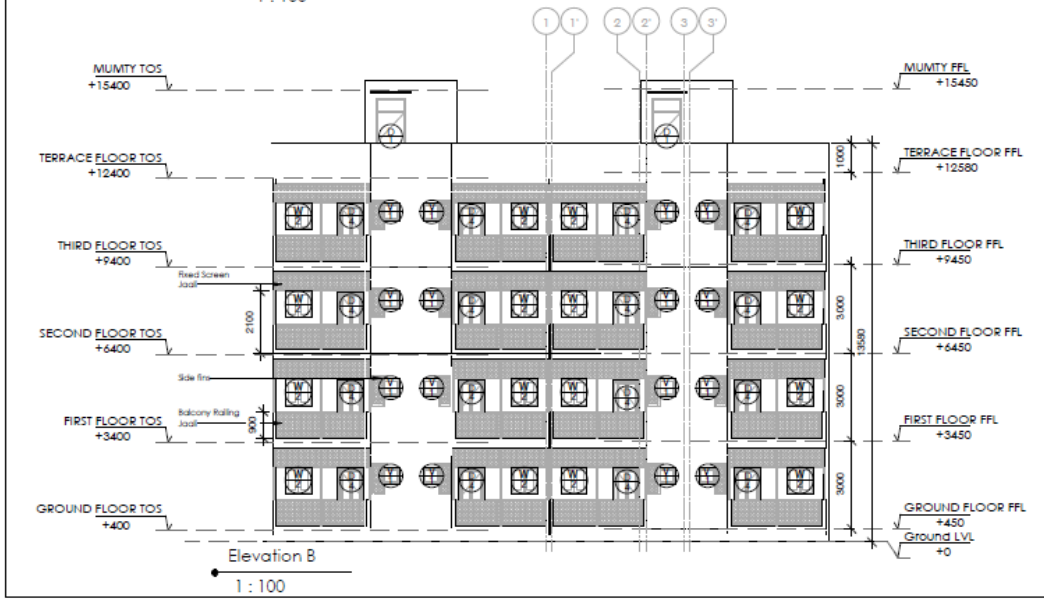
DESIGN DATA

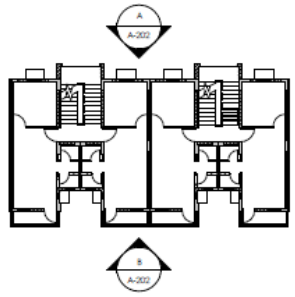
CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS







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PROJECT

CLIMATE SMART BUILDINGS- Replicable designs for thermally comfortable Affordable Housing

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TYPOLOGY

Row house two side open
MS2-RHT-1bhk

DRAWING	Block Plan
SCALE	As indicated

https://ghtc-india.gov.in/

SESSION II

B) CONSTRUCTION DATA : Working Drawings- Sections

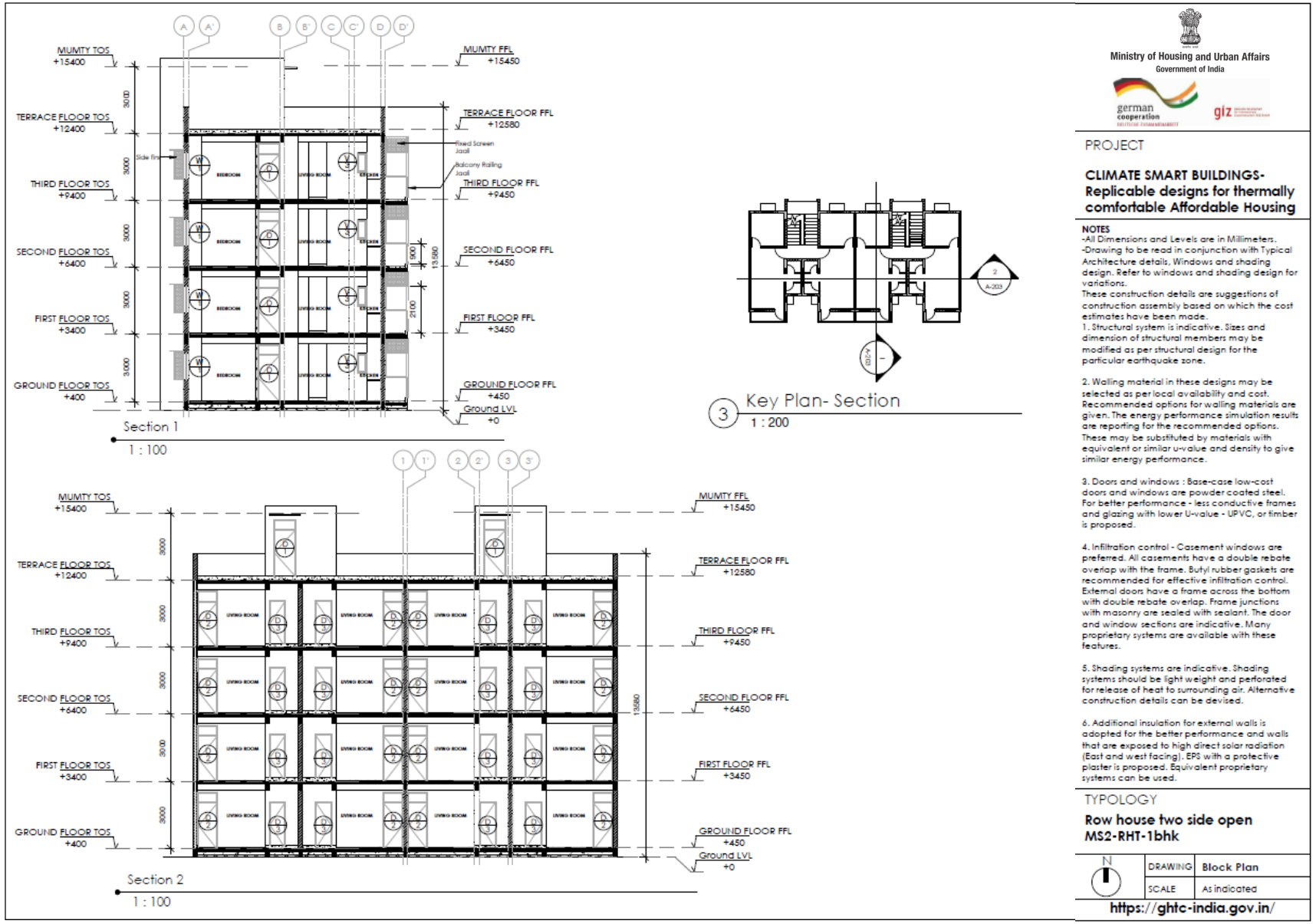
MASTER SET PACKAGE

DESIGN DATA

CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS



SESSION II

B) CONSTRUCTION DATA : Working Drawings- Electrical Layout

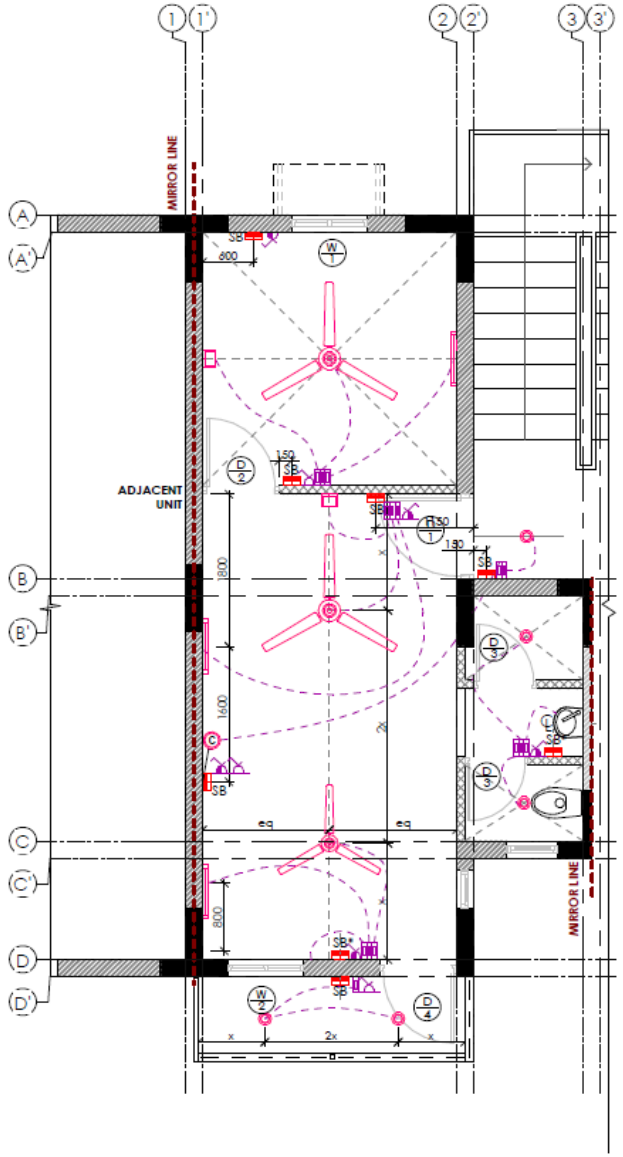
MASTER SET PACKAGE

DESIGN DATA

CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS



LEGEND-ELECTRICAL POINTS	
SB	SWITCH BOARD BOTTOM AT +1050mm FROM FFL
SB*	SWITCH BOARD BOTTOM AT +1200mm FROM FFL
	5 AMP SOCKET WITH SWITCH
	15 AMP SOCKET WITH SWITCH
	SWITCH
	CENTERLINE
	CEILING FAN
	WALL LIGHT POINT - @2100MM FROM FFL
	CEILING LIGHT
	WALL LIGHT POINT - @2100MM FROM FFL
	EXTERNAL WALL LIGHT- @2100MM FROM FFL
C	CALLING BELL- @2100MM FROM FFL
	EXHAUST FAN- BOTTOM @2100MM FROM FFL

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CLIMATE SMART BUILDINGS- Replicable designs for thermally comfortable Affordable Housing

NOTES

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TYPOLOGY

Row house two side open MS2-1bhk

N

DRAWING	Electrical Plan
SCALE	1 : 50

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SESSION II

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Questions and Feedback

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

SESSION III

Master Set package

- Simulation data
- Key performance Indicators

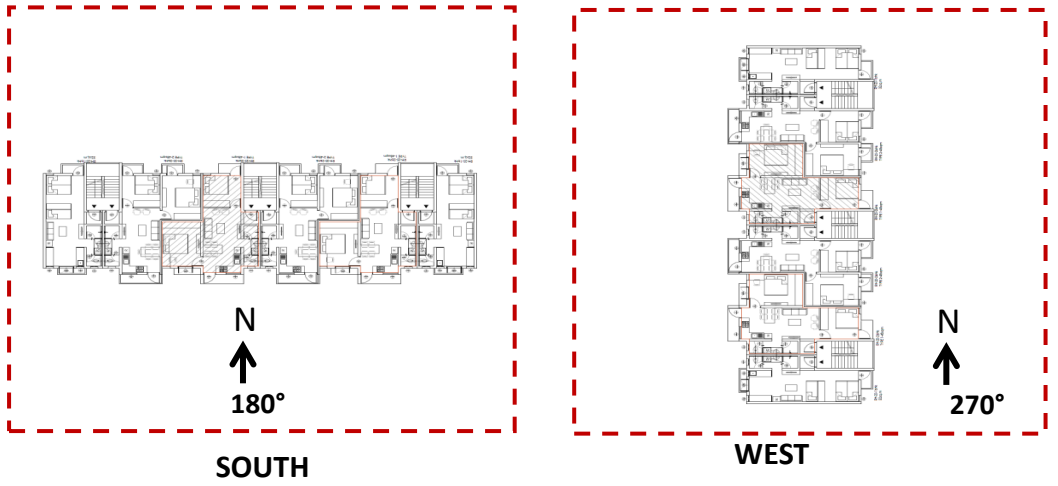
MASTER SET VARIATIONS

*** 1000 SIMULATIONS***

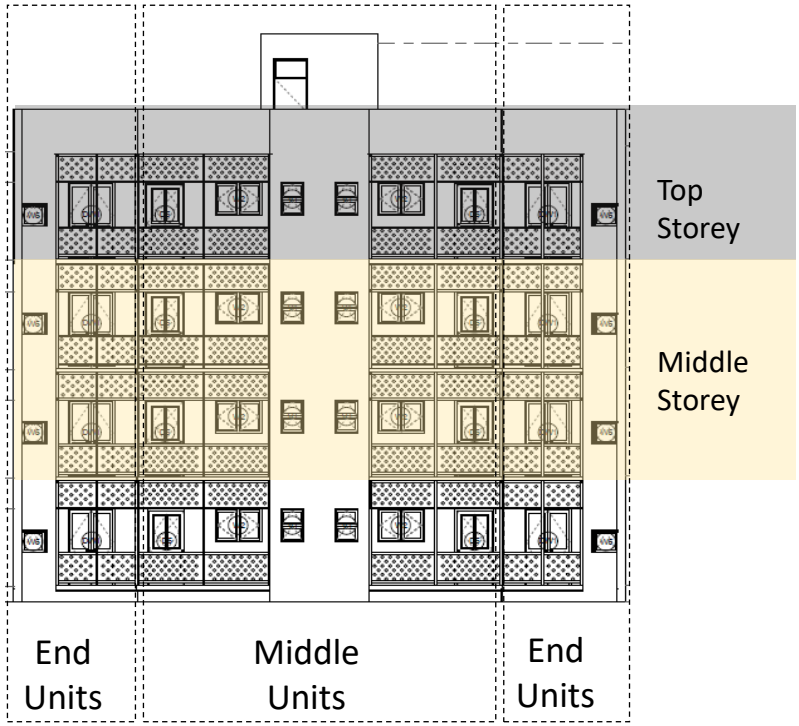
CLIMATE ZONE

Hot & dry	Composite	Warm Humid	Temperate

ORIENTATION



LOCATION OF THE UNIT IN BUILDING BLOCK



CONTRUCTION TECHNOLOGY VARIANTS

Construction Technology (CT)	Walling material	External doors / windows & Glazing	Roofing system
CT 1	AAC	Rolled steel Doors & Windows + SGU	100mm thick Foam concrete + Light colored tile
CT 2	Local brick		
CT 3	Flyash/ (cseb for Temperate)		50mm EPS insulation + Light colored tile

*** Construction technologies for Warm climate-Low rise buildings (Carpet area upt0 45 sqm)***

SESSION III

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MASTER SET PACKAGE

DESIGN DATA

CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS

- Energy simulation is carried out in Design Builder software and detailed modelling is carried out in the Energy Plus engine.
- The modelling is carried out by providing detailed inputs regarding the number of floors, building geometry, Envelope details, internal loads and active systems provided in the simulation software.
- Detailed natural ventilation modelling is carried out in Energy plus.
- The modelling methodology is adopted based on IMAC - R (Indian Model for Adaptive thermal Comfort - Residential).
- The dwelling rooms are considered to be naturally ventilated throughout the year.
- Window operation condition is that the window opens when the
  - ✓ Zone Operative Temperature is greater than or equal to IMAC - R Neutral Temperature (T nuet) and Outside air Temperature is less than Zone Operative Temperature

    (or)
  - ✓ The window opens when the Zone Operative Temperature is less than the Minimum IMAC (90% Acceptability) and the Outside air temperature is greater than the Minimum IMAC Temperature to facilitate maximum indoor thermal comfort in affordable housing.

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MASTER SET PACKAGE

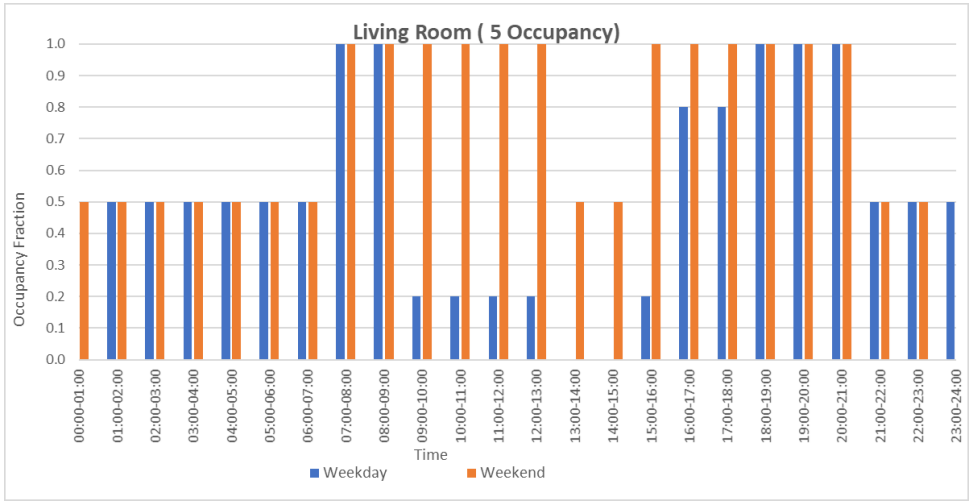
DESIGN DATA

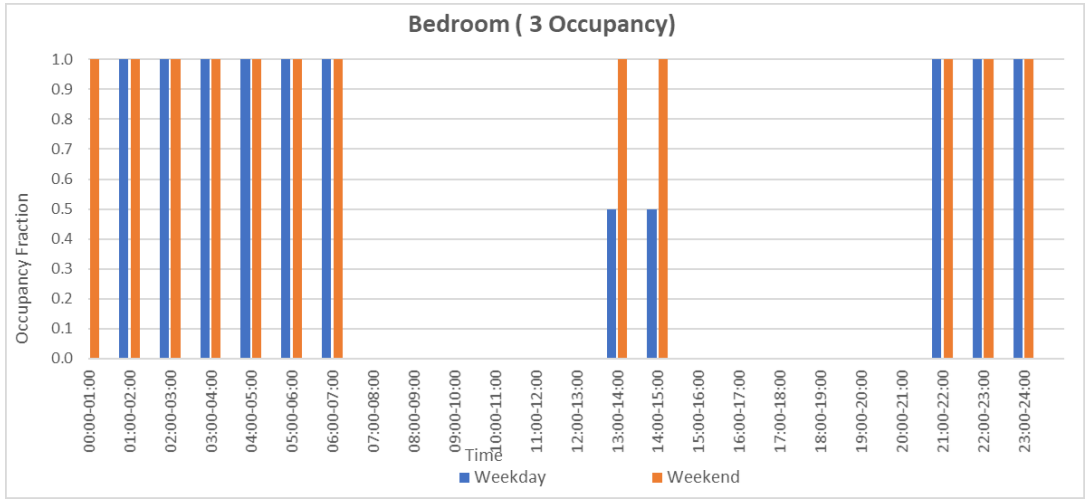
CONSTRUCTION DATA

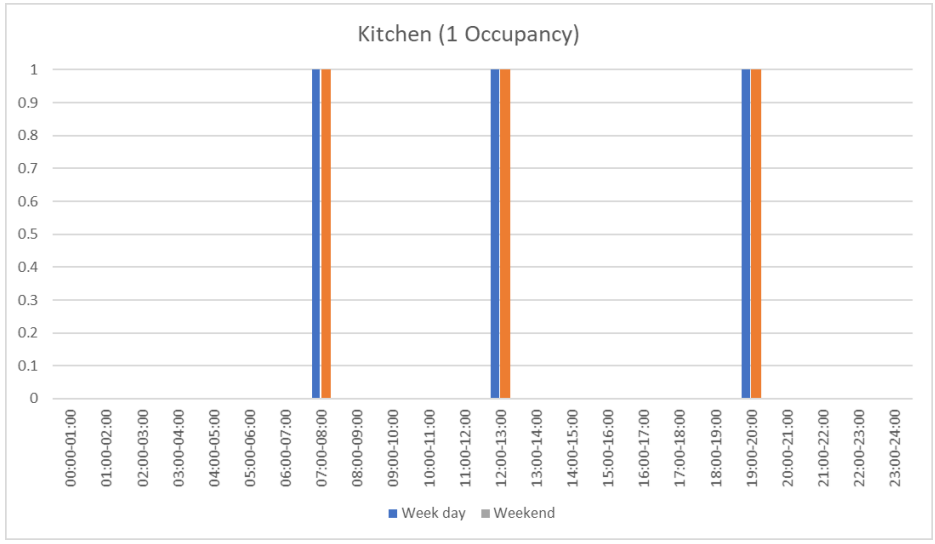
SIMULATION DATA

KEY PERFORMANCE INDICATORS

OCCUPANCY SCHEDULE







C) THERMAL PERFORMANCE SIMULATION – Input Parameters

MASTER SET PACKAGE

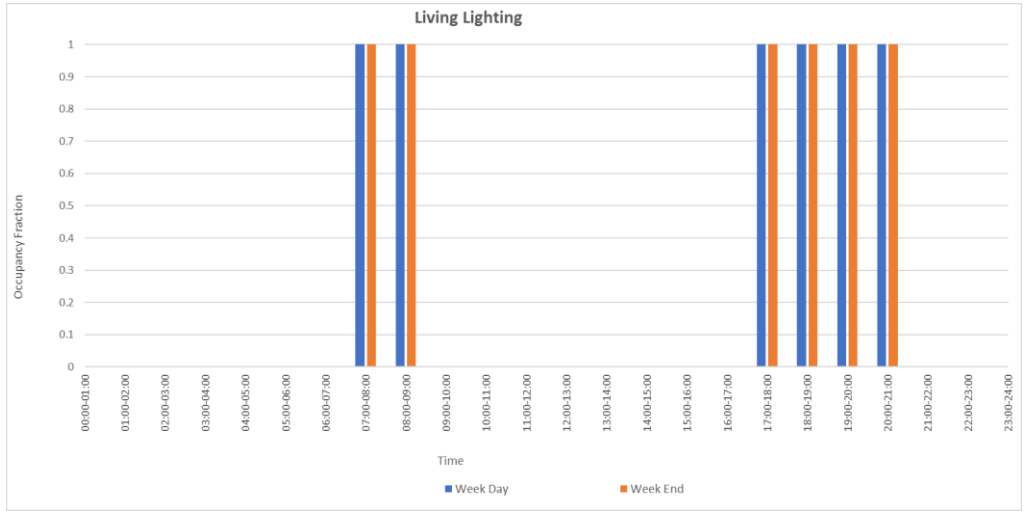
DESIGN DATA

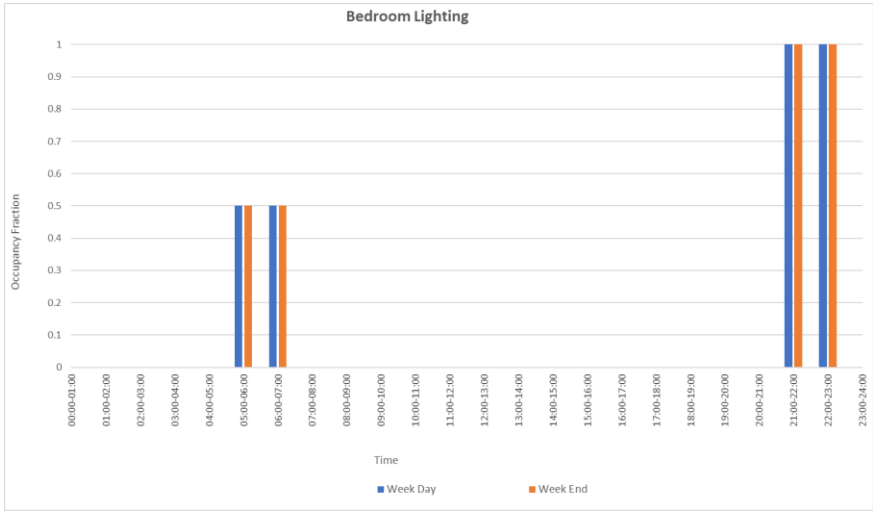
CONSTRUCTION DATA

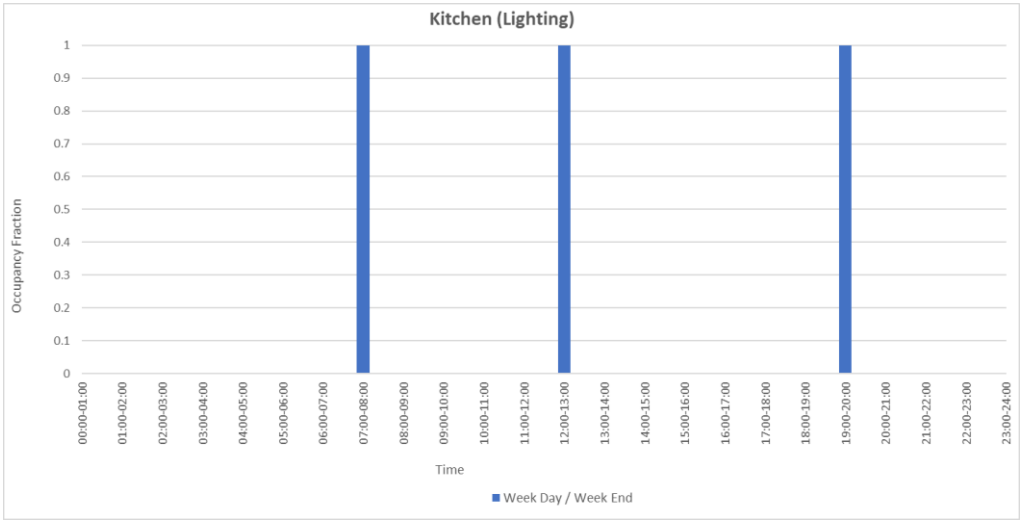
SIMULATION DATA

KEY PERFORMANCE INDICATORS

LIGHTING SCHEDULE







SESSION III

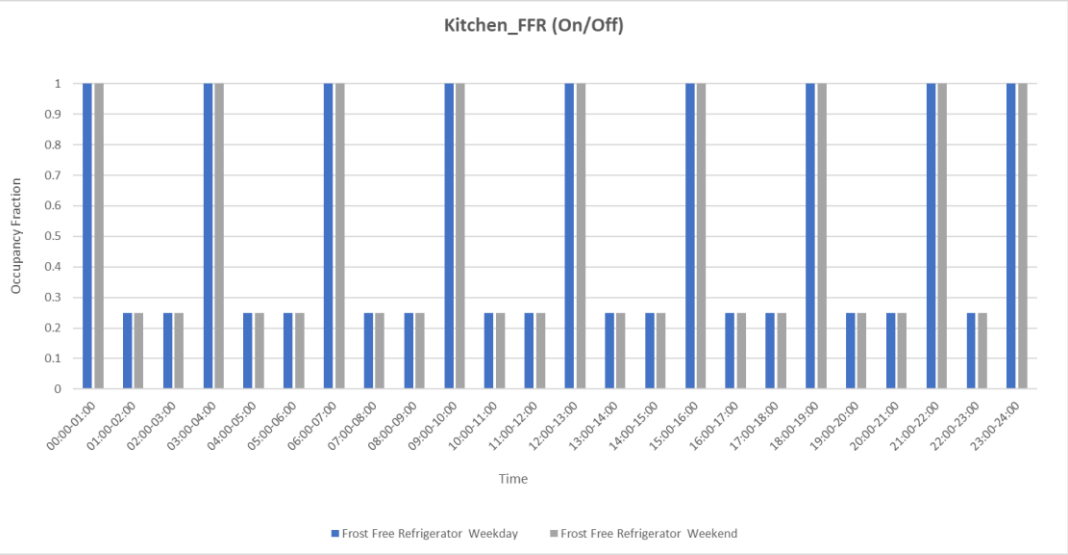
MASTER SET PACKAGE

DESIGN DATA

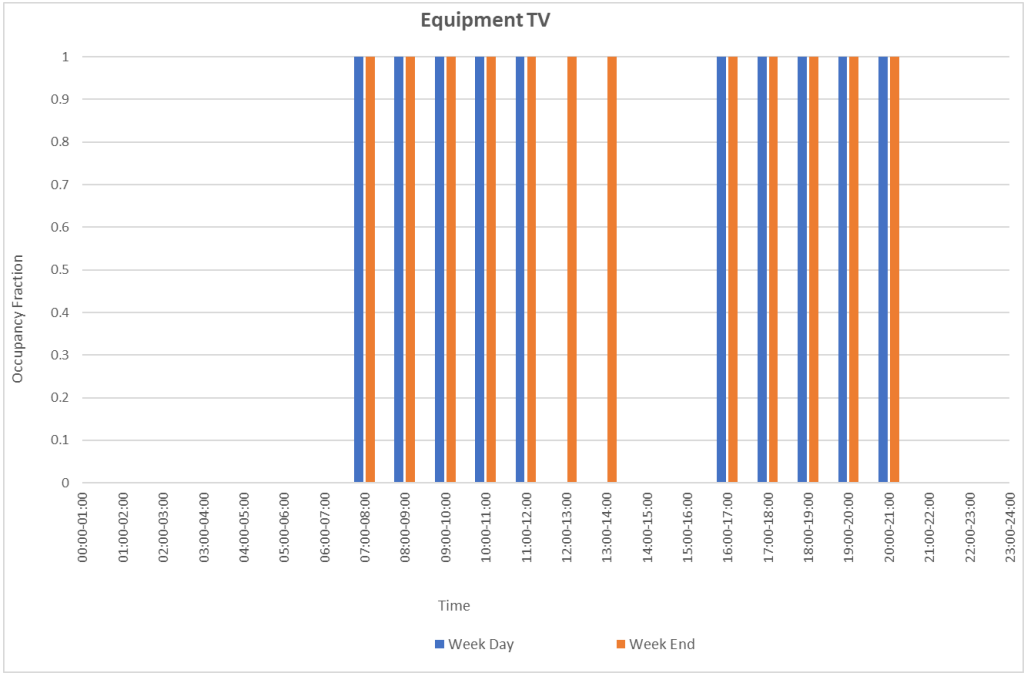
CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS



EQUIPMENT SCHEDULE



ENVELOPE, LIGHTING AND VENTILATION PARAMETERS

MASTER SET PACKAGE

DESIGN DATA

CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS

S.No	Description	Inputs	
		CT1	
		South	West
Building Envelope			
1	**Exterior Wall**	200mm thick AAC Block	
		U-value : 0.784 W/m2k	
2	**Roof construction**	125mm thick RCC slab + 100mm thick Foam concrete insulation	
		U-value : 0.593 W/m2k	
3	**Floor slab**	125mm thick RCC slab	
4	**Glazing**	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 screen
6	**Balcony**	Side fins of 1000 mm depth+Fixed shading screen	Side fins of 1000 mm depth+Fixed shading screen + Front roll down screen
7	**External doors & window frames and shutters**	Rolled steel	
	Door	Timber frame and Timber Door - Conductivity = 0.144 W/m K	

MULTI FAMILY - Row House Two side open

Hot& Dry | South |Middle floor | Middle Unit

Construction technology 1 (CT1)

Construction Technology CT1	**Walling material**	AAC blocks
	External doors / windows & Glazing	Rolled steel + SGU
	Roofing system	100mm thick Foam concrete + Light colored tile

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ENVELOPE, LIGHTING AND VENTILATION PARAMETERS

MASTER SET PACKAGE

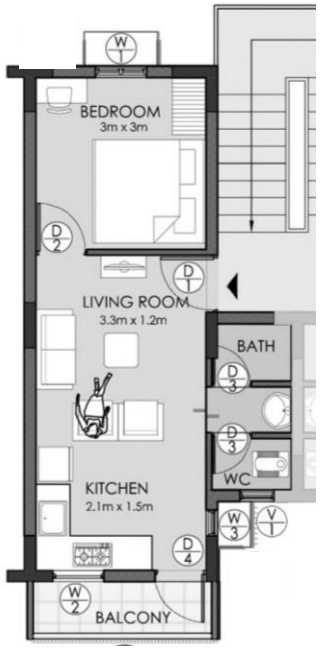
DESIGN DATA

CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS

S.No	Description	Inputs	
		CT1	
		South	West
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-R	
11	**ACH (Window ventilation during the day)**	Natural ventilation: As per detailed natural ventilation modeled in the software	
Windows, Shading Devices and Fans Schedule			
12	**Window**	**90% operable** for Casement Windows - the window opens when the Zone Operative Temperature is greater than or equal to IMAC - R Neutral Temperature (T nuet) and Outside air Temperature equal to less than Neutral Temperature or the window opens when the Zone Operative Temperature is less than Minimum IMAC (90% Acceptability) and Outside air temperature is greater than Minimum IMAC Temperature	
13	**Roll Down screen**	ON if High Zone air Temperature and High Solar on Windows	
14	**Ceiling Fan**	On if Zone air temperature is Greater than IMAC neutral Temperature	
15	** **Exhaust Fans**	ON When Zone Operative temperature greater than IMAC neutral Temperature and Zone ventilation is less than 5 ACPH	



MULTI FAMILY - Row House Two side open

Hot& Dry | South |Middle floor | Middle Unit

Construction technology 1 (CT1)

Construction Technology CT1	**Walling material**	AAC blocks
	External doors / windows & Glazing	Rolled steel + SGU
	Roofing system	100mm thick Foam concrete + Light colored tile

KEY PERFORMANCE INDICATORS

MASTER SET PACKAGE

DESIGN DATA

CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS

KEY PERFORMANCE INDICATOR		
1	**Building Envelope Efficiency**	Residential Envelope Transmittance Value (RETV)
2	**Natural Ventilation Potential**	Window to floor area ratio (WFR)
3	**Visual comfort**	Day light potential (Useful Daylight Illuminance –UDI)
4	**Thermal Comfort**	Degree Discomfort hours
5	**Embodied Energy Intensity**	Embodied Energy Intensity / Unit sqm of carpet area
6	**Cost Efficiency**	Cost of construction /Unit sqm of carpet area

Indicators on thermal performance and cost help compare the results across performance levels for the user to judge what they can achieve today & how they can progress in the future.

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MASTER SET PACKAGE

DESIGN DATA

CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS

RETV (Residential Envelope Transmittance Value)

Performance Indicator		Standard	Units	Calculation required
Building Envelope Efficiency	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.	• All levels to meet an RETV < 15	W/sq m	Calculation based on formula (wall area, window area, material properties)

Building Envelope Efficiency

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DESIGN DATA

CONSTRUCTION DATA

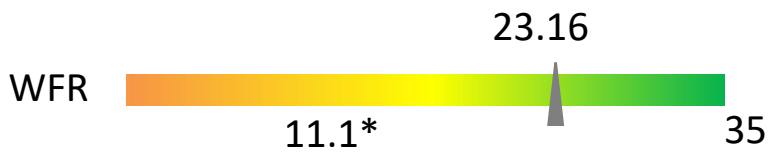
SIMULATION DATA

KEY PERFORMANCE INDICATORS

WFR (Window to Floor area Ratio)

Performance Indicator		Standard	Calculation required
Natural Ventilation Potential	WFR -Is the ratio of openable area to the carpet area of dwelling units.	• Meet min. standards of ventilation (WFR) as per ECBC-R requirements	Calculation based on formula (floor area, window area)

Natural Ventilation Potential



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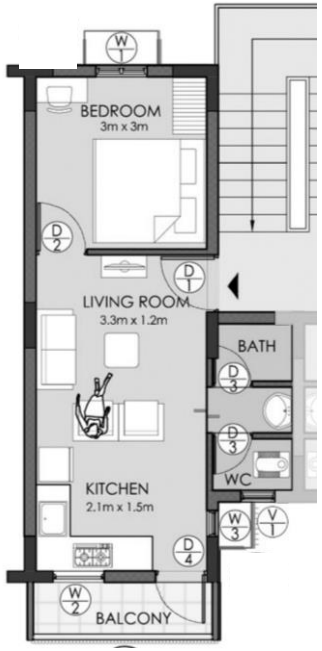
DESIGN DATA

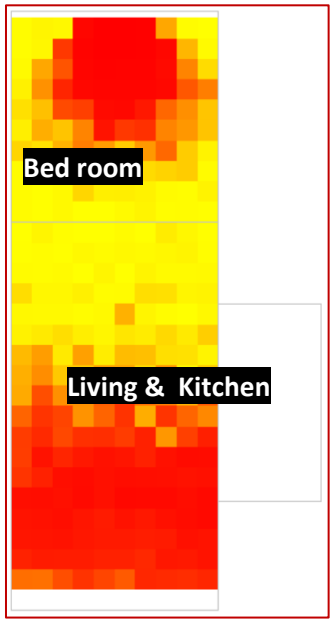
CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS

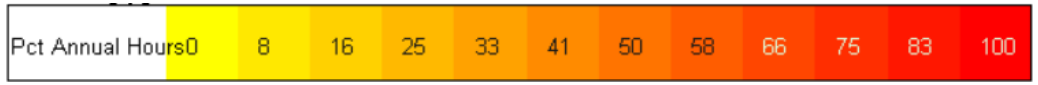
Performance Indicator		Standard	Simulation required
Visual Comfort *Useful Daylight Illuminance (UDI)*	Daylight simulation is performed to calculate interior daylight levels in a space for a specific location.	• Daylight performance of a typical dwelling unit is assessed by the Percentage of area receiving UDI (between Level - 100 Lux to 3000 Lux) in a year for 50% potential daylit time (8 am – 5 pm)	Daylight (UDI) Software: Design Builder/Energy Plus





Block	Zone	Floor Area (m2)	UDI Area in Range (m2)	UDI Area in Range (%)
Middle Floor	03. Living and Kitchen	17.10	8.79	51.40
Middle Floor	02. Bedroom	9.30	3.29	35.35
Total		26.40	12.08	45.75

The dwelling unit has achieved an illuminance level between 100 Lux and 3000 lux for 45.75% of the floor area in a year for at least 50% of the potential daylit time.



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DESIGN DATA

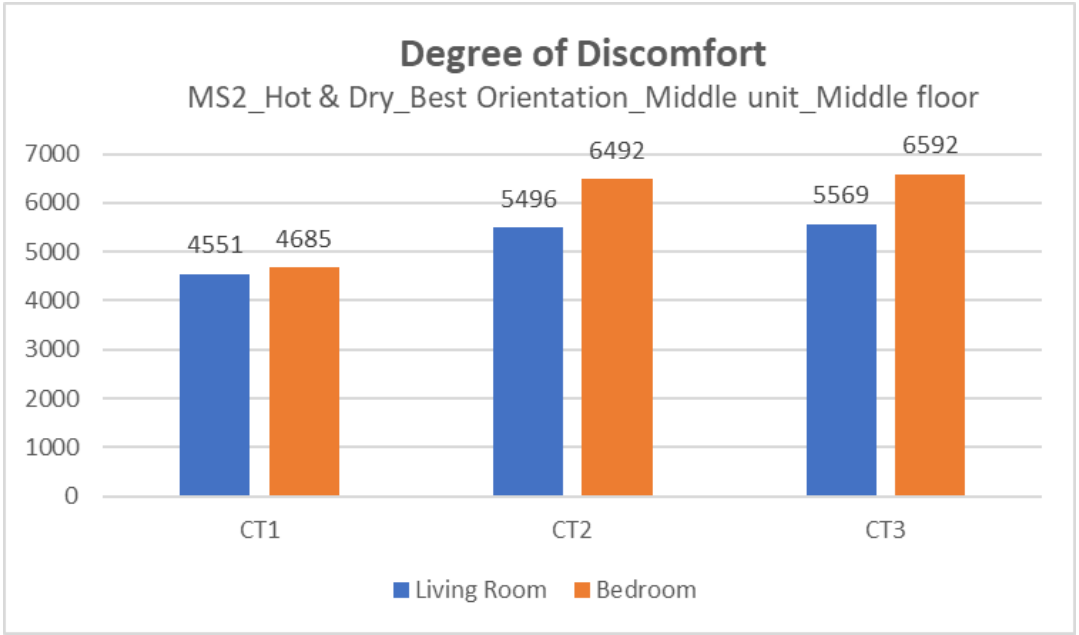
CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS

Performance Indicator	What is DDH (C hr)	Simulation required
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

Hot and Dry Location: Ahmedabad		
Months	**Description**	**90% Acceptability Temperature (degC.)**
Jan	Minimum	23.34
	IMAC R	25.49
	Maximum	27.64
Feb	Minimum	24.65
	IMAC R	26.80
	Maximum	28.95
Mar	Minimum	26.74
	IMAC R	28.89
	Maximum	31.04
Apr	Minimum	28.79
	IMAC R	30.94
	Maximum	33.09
May	Minimum	29.51
	IMAC R	31.66
	Maximum	33.81
Jun	Minimum	29.20
	IMAC R	31.35
	Maximum	33.50
Jul	IMAC R	29.64
	Maximum	31.79
Aug	Minimum	27.12
	IMAC R	29.27
	Maximum	31.42
Sep	Minimum	27.49
	IMAC R	29.64
	Maximum	31.79
Oct	Minimum	27.56
	IMAC R	29.71
	Maximum	31.86
Nov	Minimum	25.93
	IMAC R	28.08
	Maximum	30.23
Dec	Minimum	24.49
	IMAC R	26.64
	Maximum	28.79



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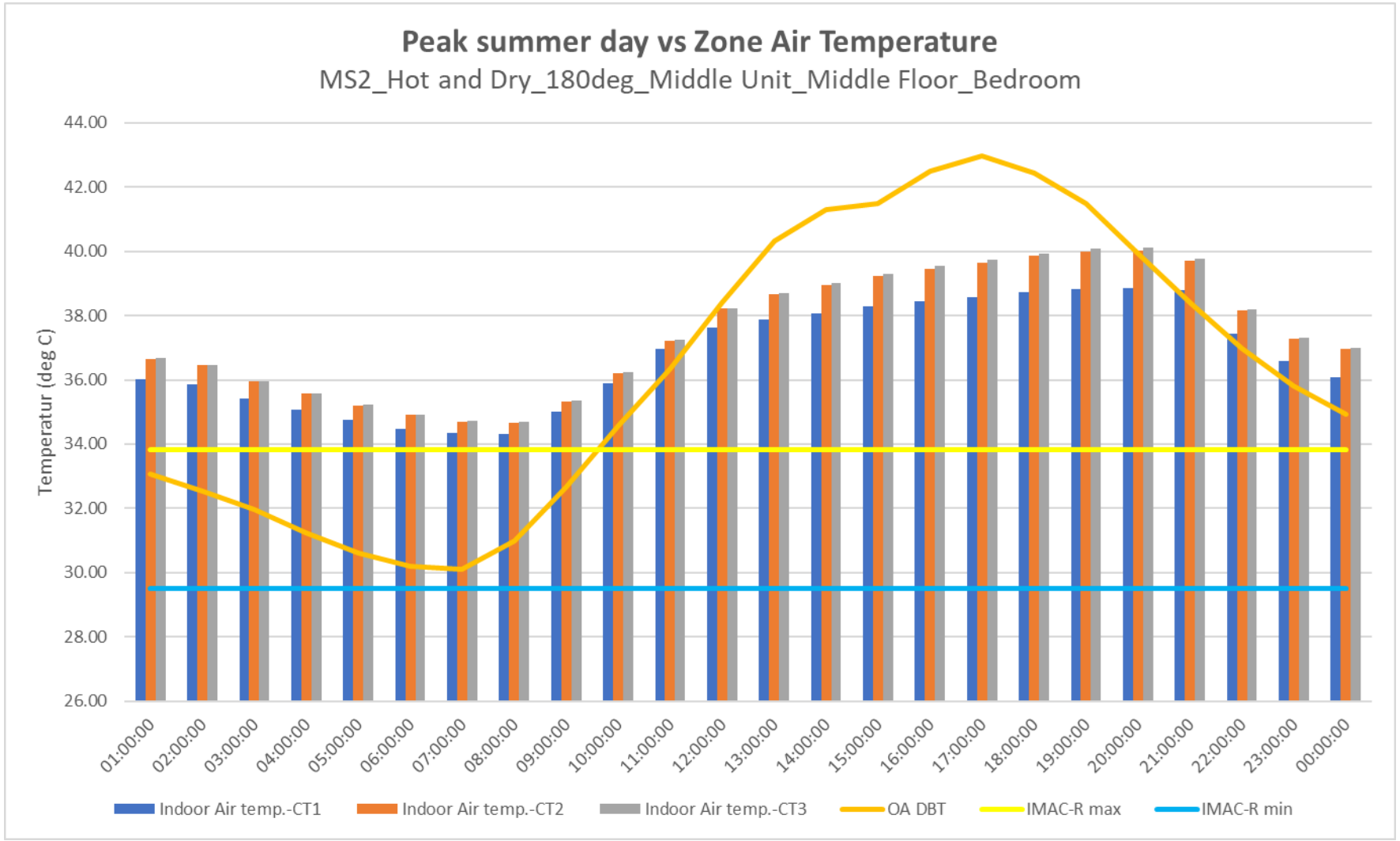
DESIGN DATA

CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS

Peak summer day (26th May) vs Zone Air Temperature



SESSION III

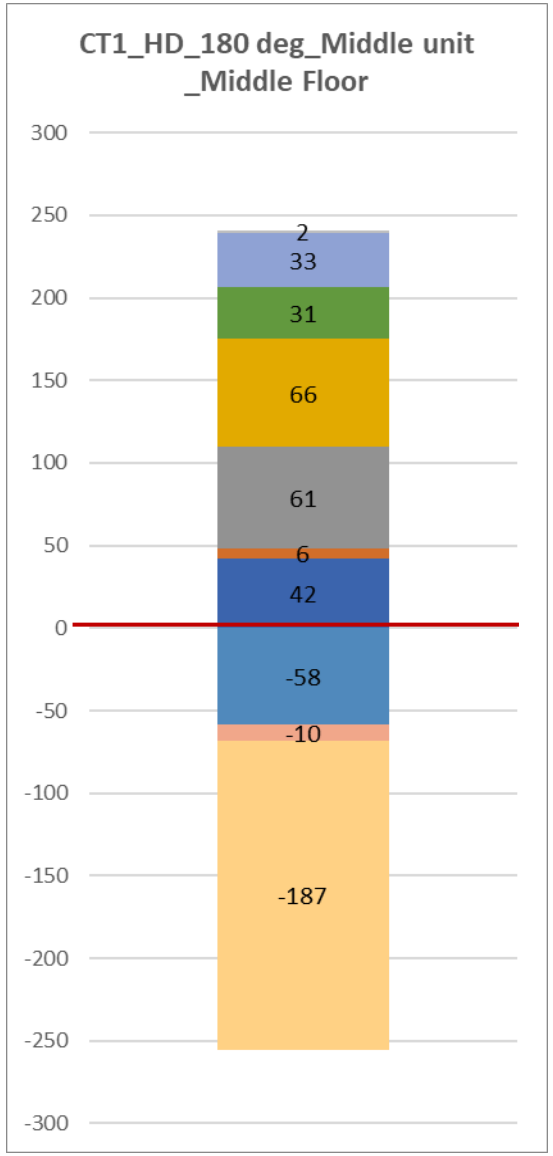
MASTER SET PACKAGE

DESIGN DATA

CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS



HEAT BALANCE / HISTOGRAM

- Zone ventilation Heat gain [KWH/m2]
- Total Conduction Heat Gain - Non Opaque Surface [KWH/m2]
- Windows Total Transmitted Solar Radiation [KWH/m2]
- Total Conduction Heat Gain - Opaque Surface [KWH/m2]
- Equipment Sensible Heat Gain [KWH/m2]
- Light Sensible Heat Gain [KWH/m2]
- People Sensible Heat Gain [KWH/m2]
- Total Conduction Heat Loss - Opaque Surface [KWH/m2]
- Total Conduction Heat Loss - Non Opaque Surface [KWH/m2]
- Zone ventilation Heat Loss [KWH/m2]

SESSION III

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DESIGN DATA

CONSTRUCTION DATA

SIMULATION DATA

KEY PERFORMANCE INDICATORS

EEI (Embodied Energy Intensity)

Performance Indicator	Scope	Calculation required
Embodied Energy Intensity	Embodied energy share of the highest contributing materials i.e. concrete (cement, coarse and fine aggregates), steel, walling blocks. Embodied energy intensity is being demonstrated as embodied energy per unit built-up area (MJ / m2)	Mass or volume of each material used is taken from the BOQ. This is multiplied by the corresponding embodied energy coeffcients 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

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PERFORMANCE INFERENCES : Embodied Energy Intensity –Different Construction technologies

Row house two side Open	*Hot & dry*	*South orientation* N	*Middle floor*	*Middle Unit*

Embodied energy per m2 of Carpet area

	CT1 (200mm AAC)	CT2 (230mm Local brick)	CT1 (230mm Fly ash brick)
Cement	561.18	658.21	658.21
Fine agg. / sand	6.36	9.13	9.13
Coarse agg.	56.32	61.27	61.27
Walling block	351.21	556.43	289.34
Steel in RCC	1203.19	1474.44	1474.44
Total	**2178.27**	**2759.48**	**2492.40**

Construction Technology (CT)	Walling material	External doors / windows & Glazing	Roofing system
CT 1	AAC	Rolled steel Doors & Windows + SGU	100mm thick Foam concrete + Light colored tile
CT 2	Local brick		
CT 3	Flyash/ (cseb for Temperate)		50mm EPS insulation + Light colored tile

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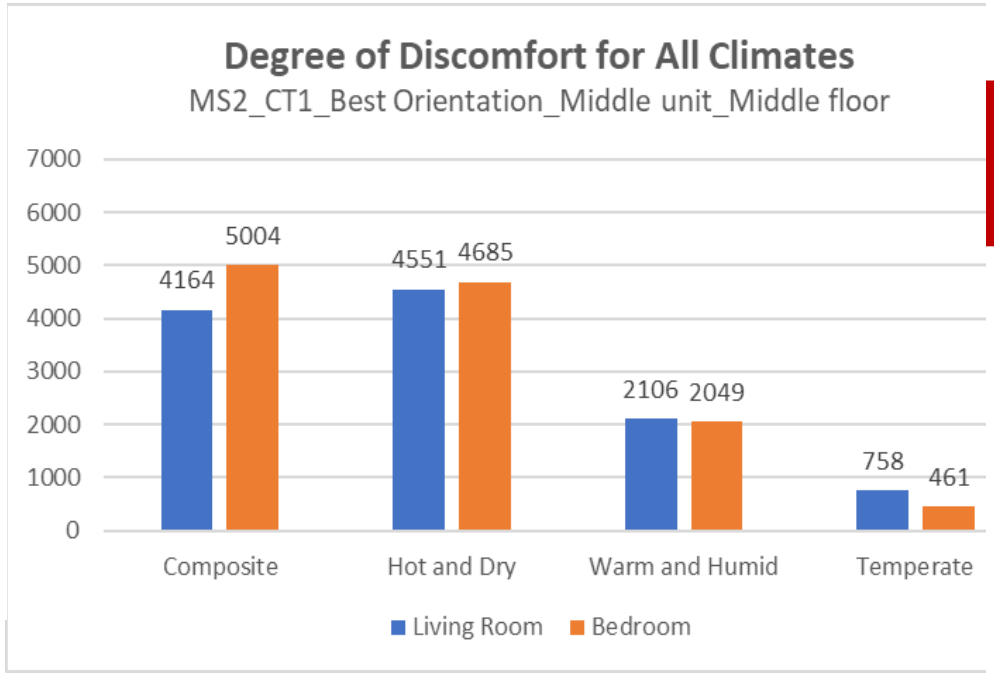
PERFORMANCE INFERENCES : Climate variations

Multi Family - Row House Two Side Open – 1bhk- 30 Sqm Carpet Area

Degree of Discomfort hours				
Construction Technology	**CT1 - AAC + Rolled steel + SGU + 100mm thick Foam concrete roof insulation + Tile**			
Orientation	**Best orientation _180deg_ South**			
Location in the Block	**Middle floor _ Middle unit**			
Climate	**Composite**	**Hot and Dry**	**Warm and Humid**	**Temperate**
Living Room	4164	4551	2106	758
Bedroom	5004	4685	2049	461
Area weighted Average	**4460**	**4598**	**2085**	**654**



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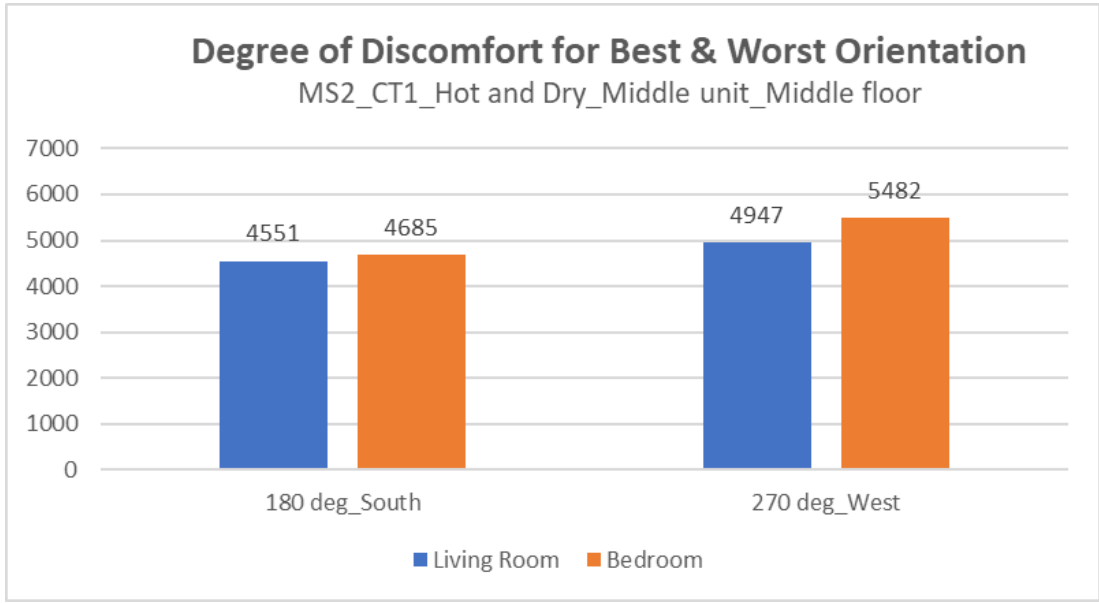
PERFORMANCE INFERENCES : Orientation variations

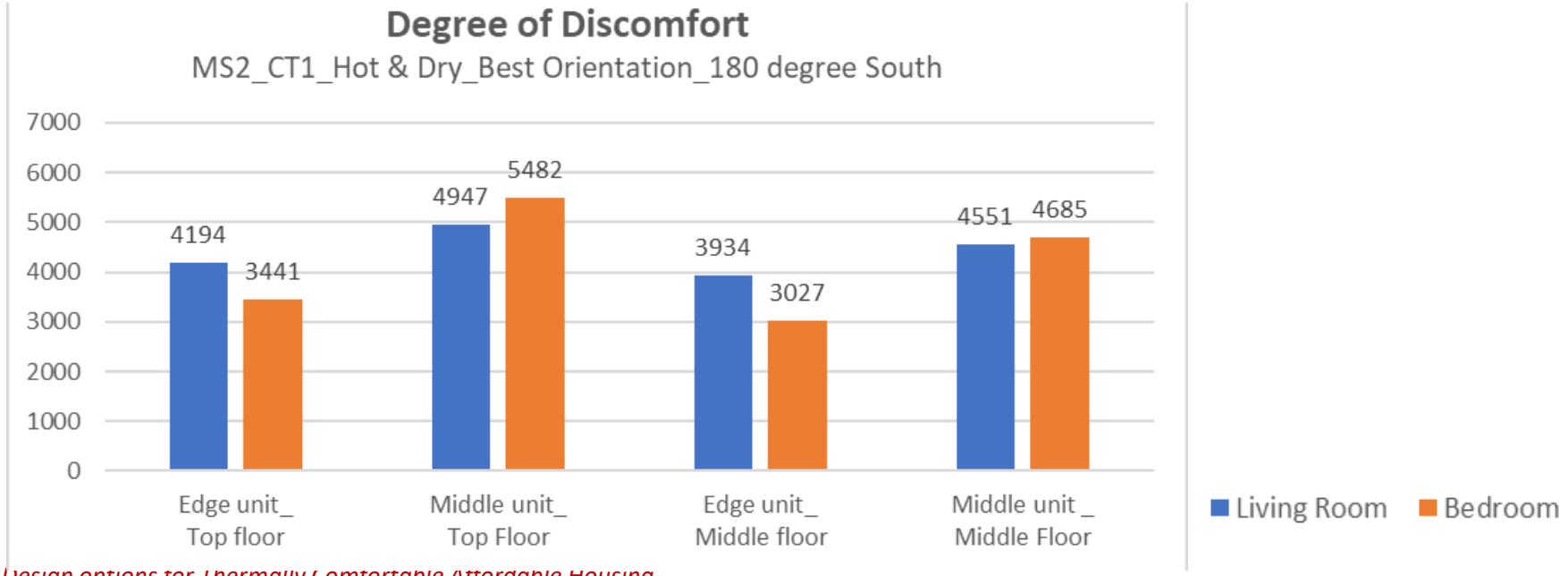
Degree of Discomfort hours		
Construction Technology	CT1 - AAC + Rolled steel + SGU + Foam concrete roof insulation	
Climate	Hot & Dry	
Location in the Block	Middle floor _Middle unit	
Orientation	**180 deg_South**	**270 deg_West**
Living Room	4551	4947
Bedroom	4685	5482
Area weighted Average	**4598**	**5136**



SESSION III

PERFORMANCE INFERENCES – Dwelling Unit placement variations

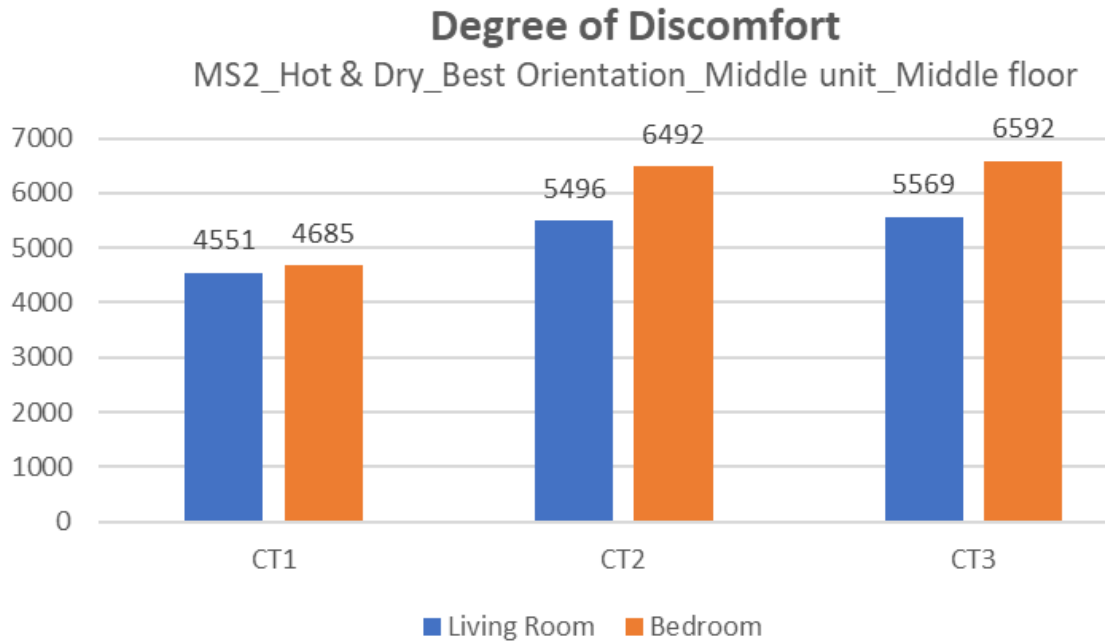
Degree of Discomfort hours				
Construction Technology	CT1 - AAC + Rolled steel + SGU + Foam concrete roof insulation			
Climate	Hot & Dry			
Orientation	Best Orientation - 180 degree South			
Location in the Block	Edge unit_ Top floor	Middle unit_ Top Floor	Edge unit_ Middle floor	Middle unit _ Middle Floor
Living Room	4194	4947	3934	4551
Bedroom	3441	5482	3027	4685
Area weighted Average	**3929**	**5136**	**3615**	**4598**



PERFORMANCE INFERENCES – Construction technology variations

Multi Family - Row House Two Side Open – 1bhk- 30 Sqm Carpet Area

Degree of Discomfort hours			
Climate	**Hot & Dry**		
Orientation	**Best orientation _180deg_ South**		
Location in the Block	**Middle floor _ Middle unit**		
Construction Technology	**CT1**	**CT2**	**CT3**
Living Room	4551	5496	5569
Bedroom	4685	6492	6592
Area weighted Average	**4598**	**5847**	**5930**



Construction Technology (CT)	Walling material	External doors / windows & Glazing	Roofing system
CT 1	AAC	Rolled steel Doors & Windows + SGU	100mm thick Foam concrete + Light colored tile
CT 2	Local brick		
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PERFORMANCE INFERENCES – Cost Efficiency

CLIMATE ZONE	HOT & DRY CLIMATE					
CONSTRUCTION TECHNOLOGY	CT1		CT2		CT3	
LOCATION OF THE UNIT IN THE BUILDING	MIDDLE UNIT		MIDDLE UNIT		MIDDLE UNIT	
ORIENTATION	SOUTH	WEST	SOUTH	WEST	SOUTH	WEST
Item of Work	Amount		Amount		Amount	
	% Contribution of cost		% Contribution of cost		% Contribution of cost	
CIVIL WORK (Building Envelope)	67%		68%		68%	
TOTAL	213292.42		223097.36		224006.33	
WINDOWS & SHADING	10%		10%		10%	
DOOR, WINDOW & BALCONY	29327.80	29327.80	29327.80	29327.80	29327.80	29327.80
SHADING	3812.69	6500.52	3812.69	6836.36	3812.69	6836.36
TOTAL	33140.49	35828.32	33140.49	36164.16	33140.49	36164.16
FINISHING (External walls & Terracing)	22%		21%		21%	
TOTAL	69083.62		69083.62		69083.62	
INSULATION	2%		1%		1%	
TOTAL	4827.68		4827.68		2727.50	
TOTAL COST OF CONSTRUCTION (INR)	320344.21	323032.04	330149.14	333172.81	328957.94	331981.60
Unit Carpet Area (sqm) 30						
COST/ SQM OF CARPET AREA	10678.14	10767.73	11004.97	11105.76	10965.26	11066.05
Unit Carpet Area (sqft) 323						
COST/ SQ FT OF CARPET AREA	992.39	1000.72	1022.77	1032.13	1019.08	1028.44

***Carpet area Rera**

Construction Technology (CT)	Walling material	External doors / windows & Glazing	Roofing system
CT 1	AAC	Rolled steel Doors & Windows + SGU	100mm thick Foam concrete + Light colored tile
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SESSION III

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Questions and Feedback

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

SESSION IV

Next Steps

Next Steps

WEBINAR 3

Discussing different building plan typologies to understand their thermal performance and cost efficiency

Progress on BLC

Observations and learnings from the project with examples and comparisons
1. Different Climate zone
2. Typologies.
3. Orientation
4. Construction technologies

Introduction to Webtool

WEBINAR 4

Overview of Web-tool interface

Navigating the web-tool

- Plan sets
- Master sets
- Performance concepts
- Key parameter indicator results

THANK YOU

Knowledge Partners:

Ashok B Lall Architects

LEAD Consultancy

Greentech Knowledge Solutions