



Replicable designs for Thermally Comfortable Affordable housing

Third stakeholder meeting | **12 January 2023**

Knowledge Partners:



Ashok B Lall Architects



LEAD Consultancy



Greentech Knowledge Solutions

Introduction

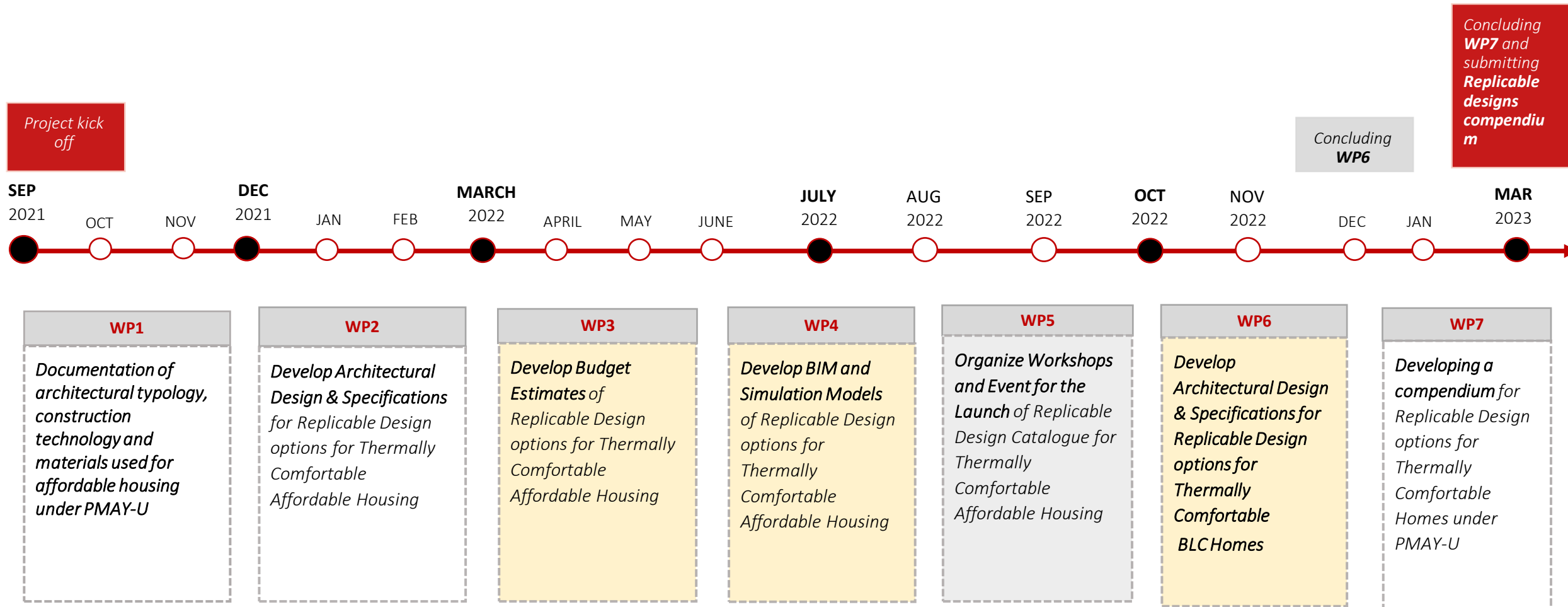
Project Overview

Speaker: Prof. Ashok Lall

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



WP3	
OBJECTIVE	Develop Budget Estimates of Replicable Design options for Thermally Comfortable Affordable Housing
ACTIVITIES	<ol style="list-style-type: none"> Detailed cost estimates of all the developed architectural design options for all climate zones. Techno-Commercial Feasibility of all the developed architectural design options for all climate zones.
DELIVERABLES	<ul style="list-style-type: none"> Detailed BOQs of the master set typologies

WP4	
OBJECTIVE	Develop BIM and Simulation Models of Replicable Design options for Thermally Comfortable Affordable Housing
ACTIVITIES	<ol style="list-style-type: none"> Building Information Model (BIM) of all the developed architectural design options for all climate zones. Energy Simulation Model (including .IDF file) of all the developed architectural design options for all climate zones. Natural & artificial lighting Simulation Model of all the developed architectural design options for all climate zones.
DELIVERABLES	<ul style="list-style-type: none"> BIM models for the master set typologies .IDF files for the master set design typologies .rad files for the master set design typologies

WP6	
OBJECTIVE	BLC -Develop Architectural Design & Specifications for Replicable Design options for Thermally Comfortable Homes
ACTIVITIES	<ol style="list-style-type: none"> Conducting desk research on BLC projects (constructed under PMAY(U) shared by the Ministry/Survey agency) Develop Architectural Design & Specifications for Replicable Design options for Thermally Comfortable BLC Homes. Developing a compendium for Replicable design options for Thermally Comfortable BLC homes Making the compendium web-friendly to be uploaded onto PMAY(U) website
DELIVERABLES	<ul style="list-style-type: none"> 10-page report outlining the relevant research findings and the proposed type design matrix Type designs drawing set and BOQ ,cost estimate based on CPWD plinth area rates. 3D views with an explanation of design principals Detailed high-resolution compendium Drawings package suitable for uploading on web-tool

1st Stakeholder consultation

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

2nd Stakeholder consultation

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

Topics covered in this Webinar

3rd Stakeholder consultation

Jan 2023

SESSION I

Type designs for different building typologies

*Multi family housing
(Warm & Cold)
Single Family House (Warm)*

*Master set Variations for
Warm & Cold climates*

SESSION II

*Simulation results and
Performance Inferences*

*Multi family housing
(Warm & Cold)
Single Family House (Warm)*

SESSION III

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

- *Design principals*
- *Type design matrix*
- *Designs developed*

SESSION IV

*Introduction to Webtool
&
Next Steps*

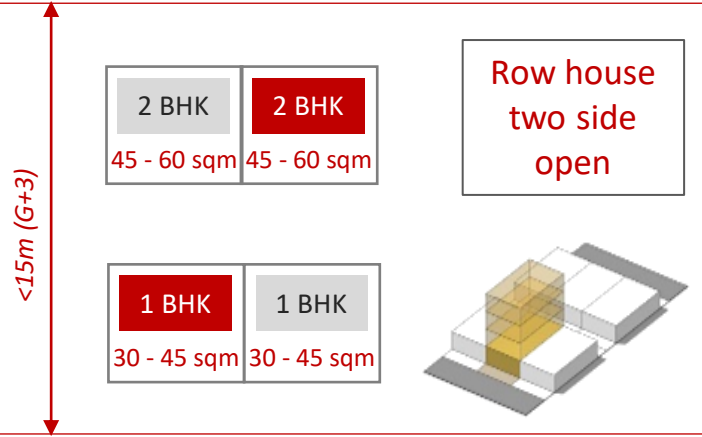
SESSION I

*Type designs for different building typologies &
Master set Variations*

Speaker: Roopa Nair

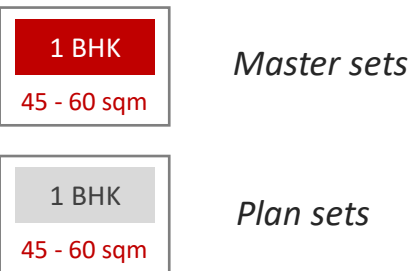
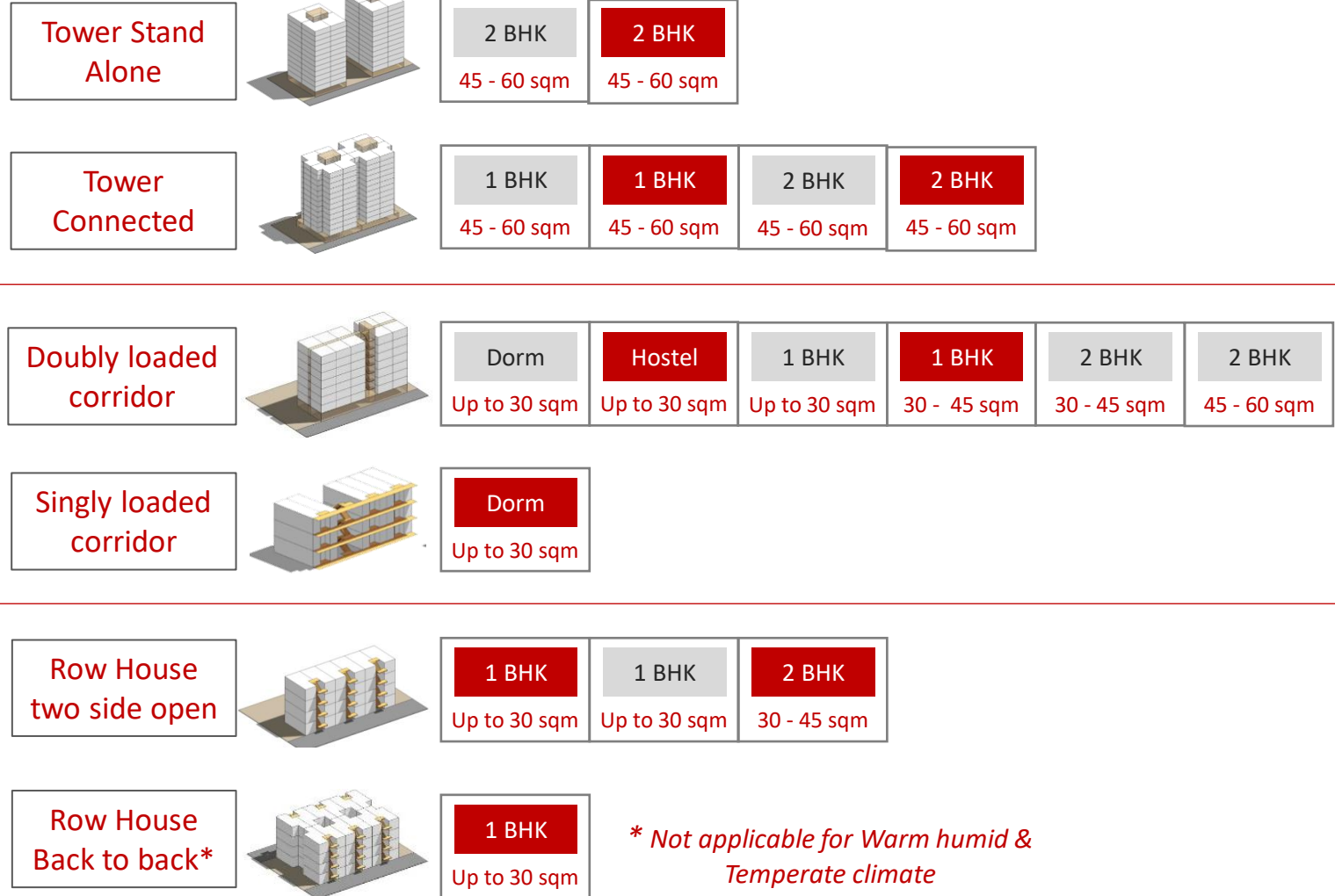
Type designs - 4 nos

Single Family



Multi-Family

Type designs - 17 nos



* Not applicable for Warm humid & Temperate climate

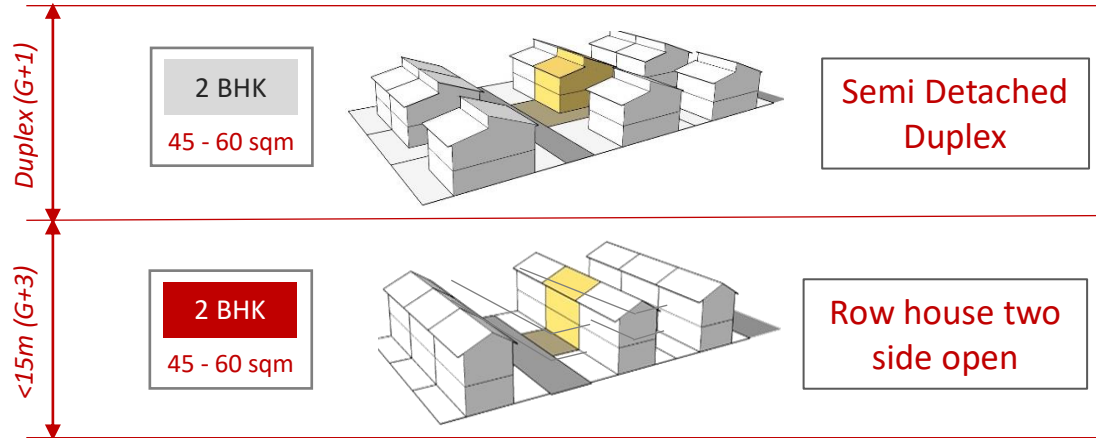
Up to 24m (G+3 - S+7)

Up to 24m (G+3 - S+7)

<math><15m (G+3)</math>

Type designs - 4 nos

Single Family



Multi-Family

Type designs - 7 nos

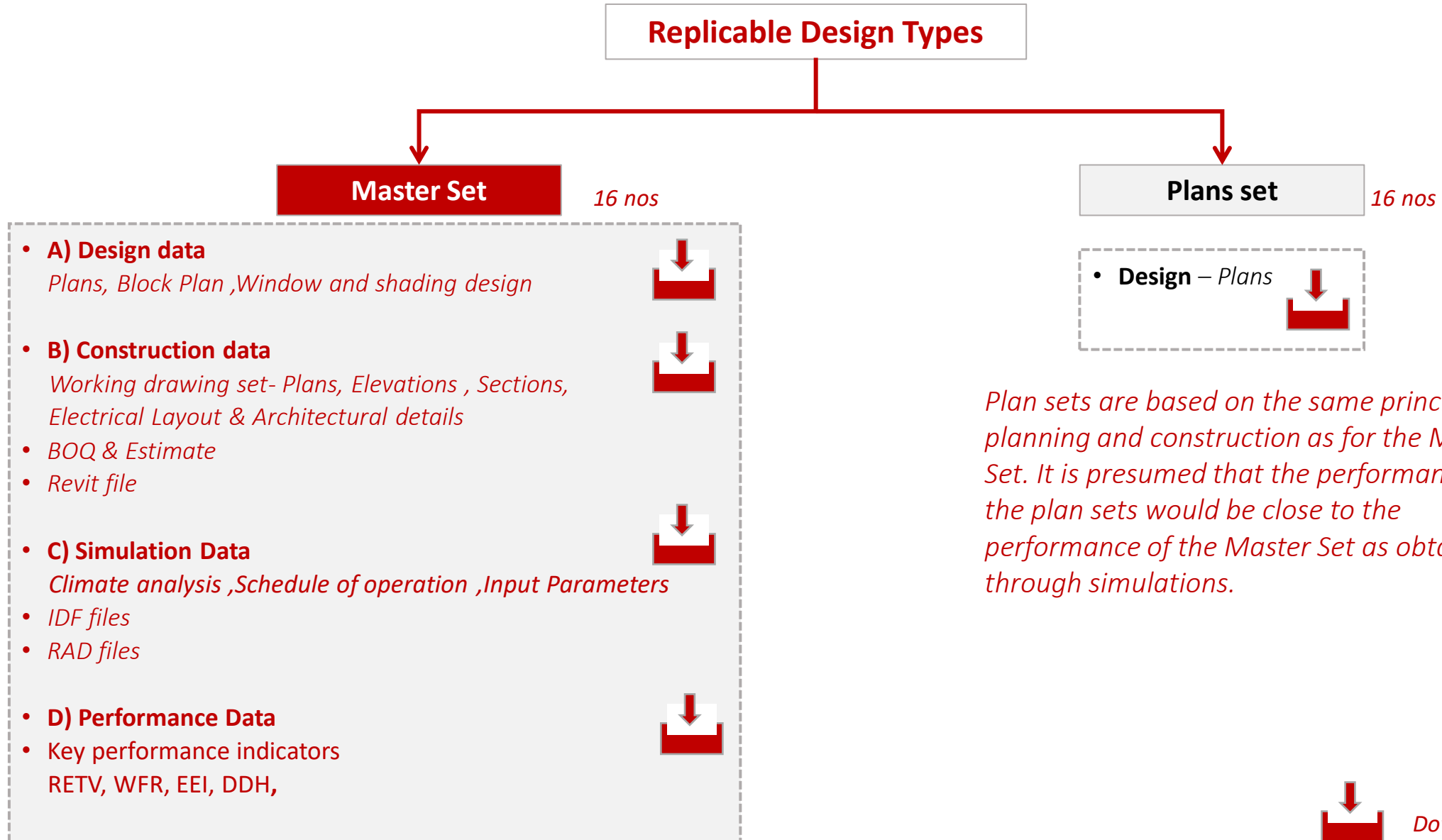


1 BHK
45 - 60 sqm

Master sets

1 BHK
45 - 60 sqm

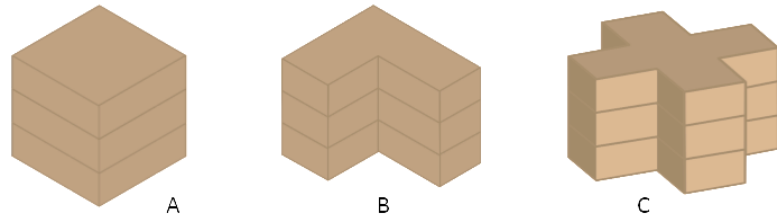
Plan sets



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.

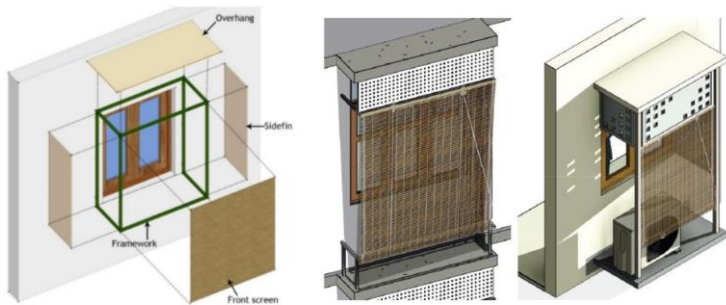
1. Compactness

Surface to Volume ratio increase from A to C as the built form gets more complicated



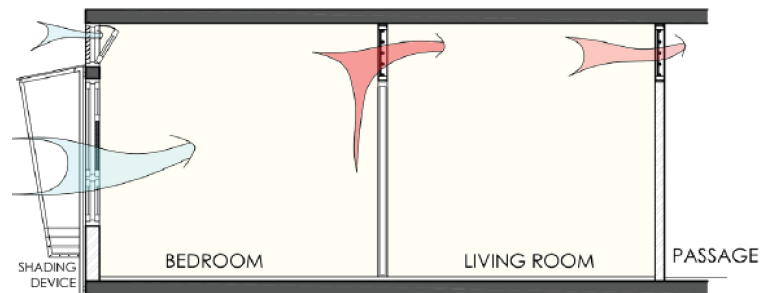
3. Protection through shading

Use of shading devices to cut Solar gains



4. Optimizing openings for ventilation

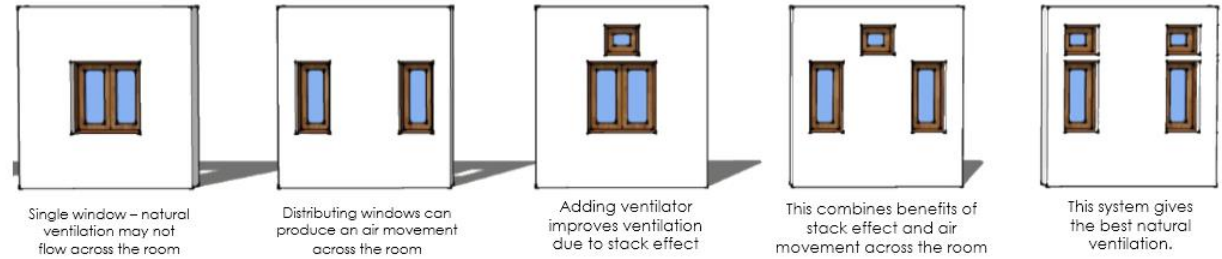
Ensuring cross ventilation through all living spaces of the house



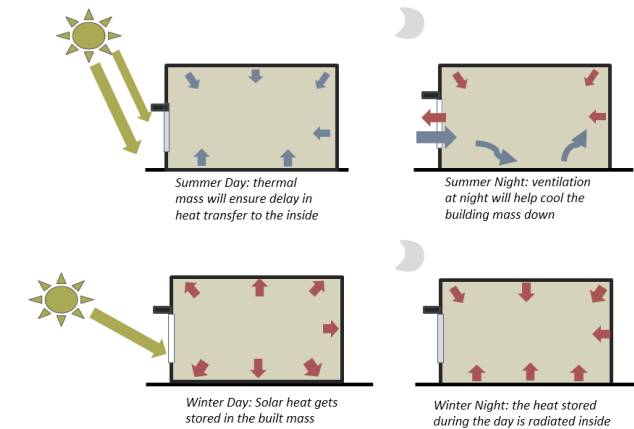
2. Protection from heat

Controlling Window to Wall area Ratio (WWR)

Selecting external wall/roof materials for insulation value



5. Use of thermal mass & solar gains to ensure indoor comfort



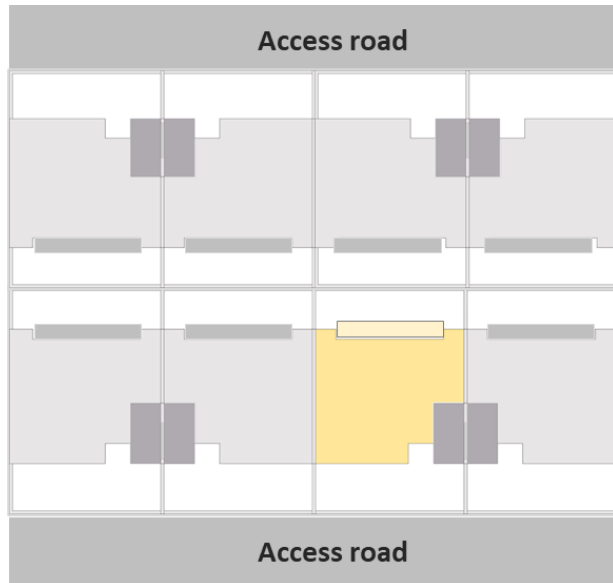
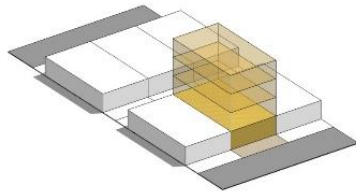
Principles of design for energy efficient design and construction in cold climate:

- *The basic design principle is to **maximise solar gain** to get comfortable temperature indoors.*
- *It is then extended by the **design of the external envelope** – its walls, windows and insulation to retain the heat and minimise losses when night time temperatures are low.*
- *A defining feature of these dwelling unit designs is the **sun balconies** next to living spaces to capture the heat from the sun.*
- ***Orientation plays a major role** in the planning of these layouts so as to capture maximum benefit from solar radiation.*

N

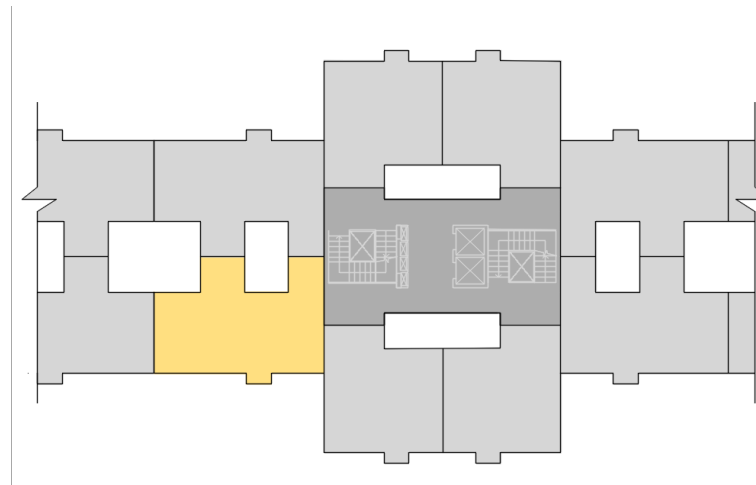
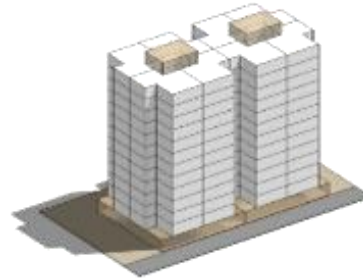
Single Family- Warm

Row house two side open
Carpet area – 54 sqm
Ground floor (Expansion till G+3)



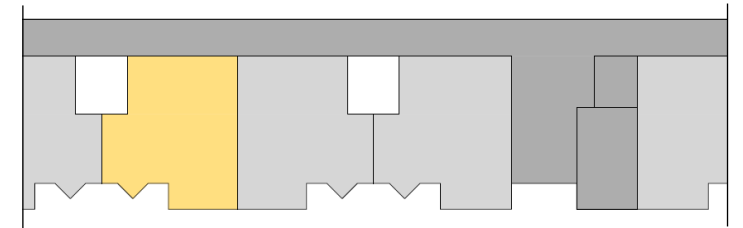
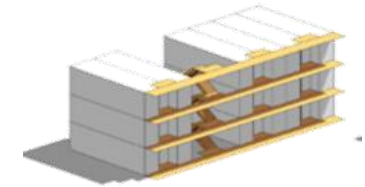
Multi Family- Warm

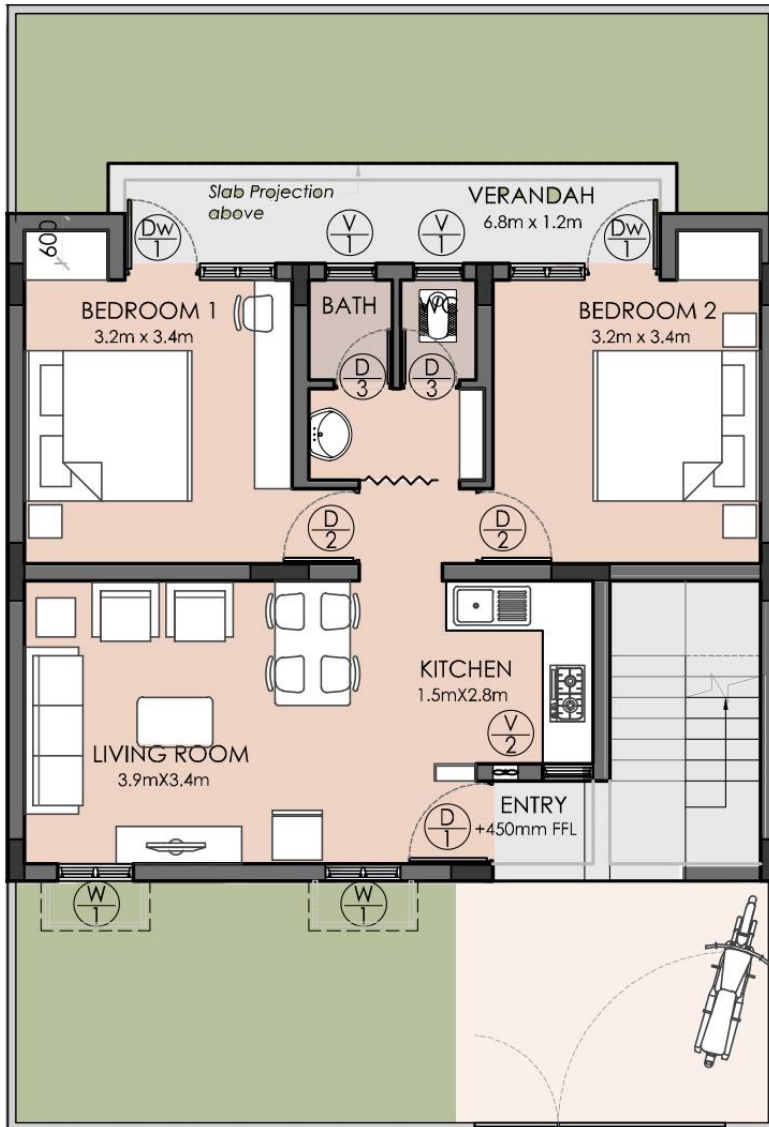
Tower connected
Carpet area – 44 Sqm
Stilt +7 floors



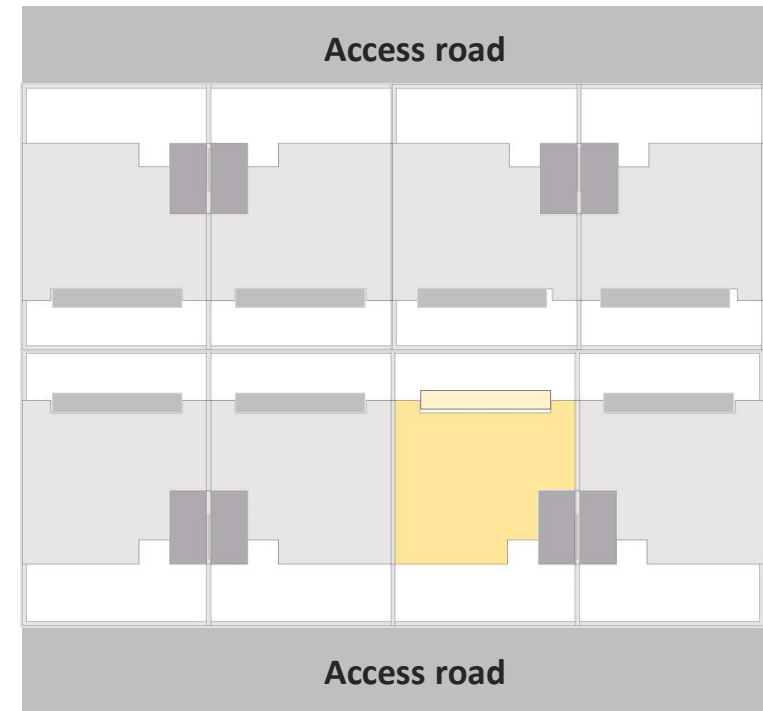
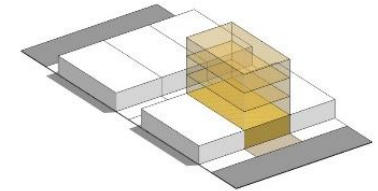
Multi Family- Cold

Singly loaded corridor
Carpet area – 35 Sqm
Ground + 3 floors





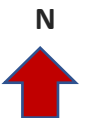
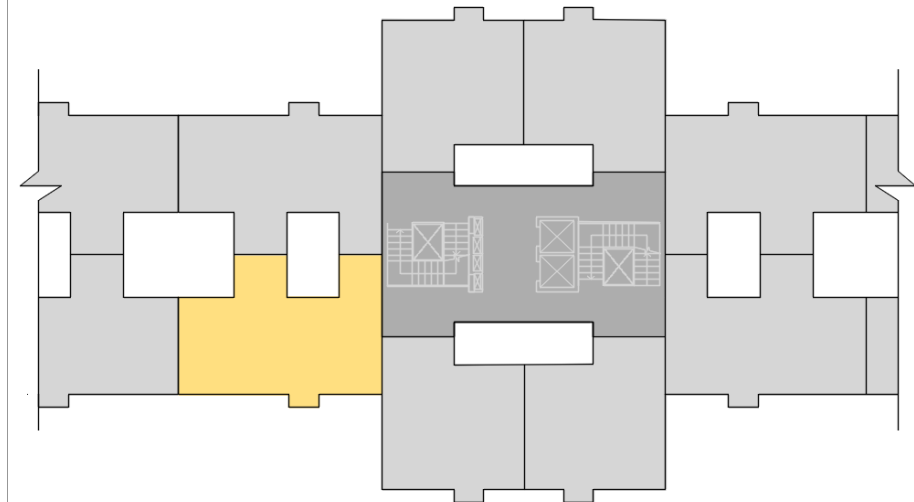
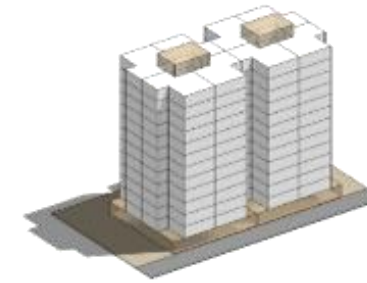
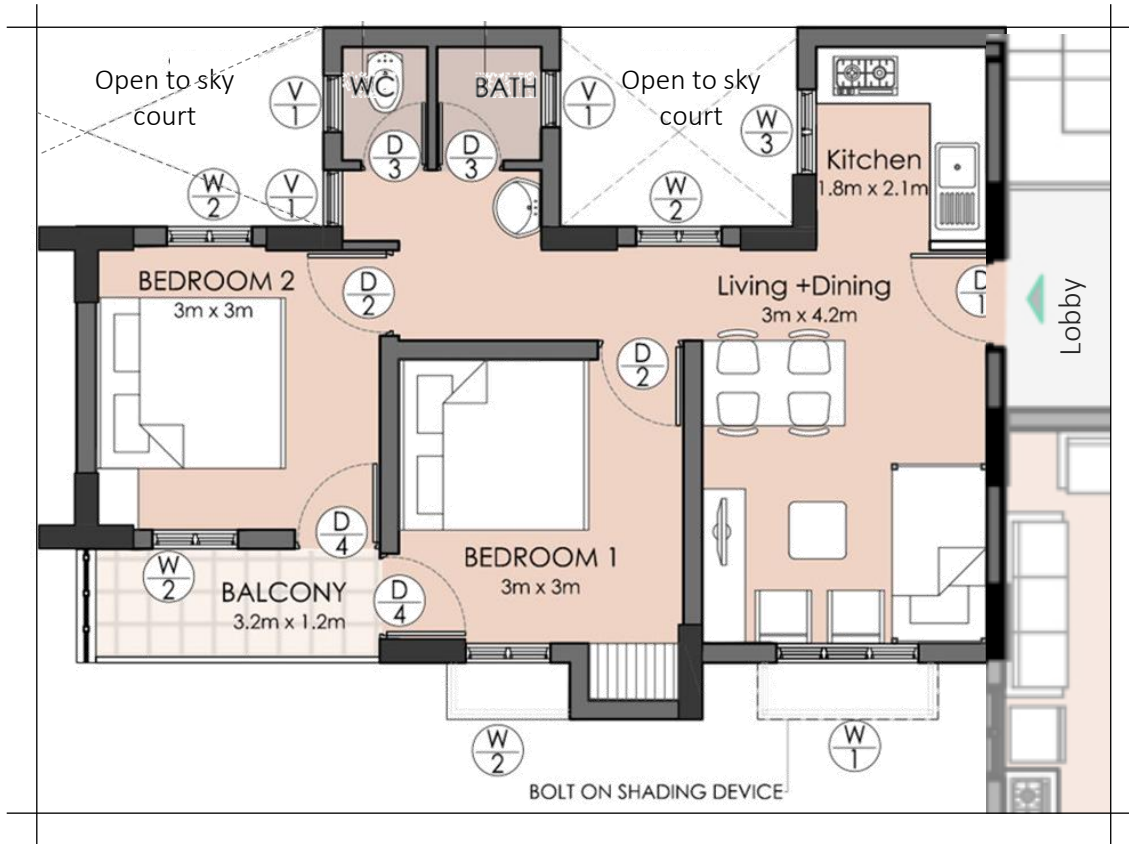
Row house two side open
 Carpet area – 54 Sqm
 Ground floor (Expansion till G+3)



Tower connected

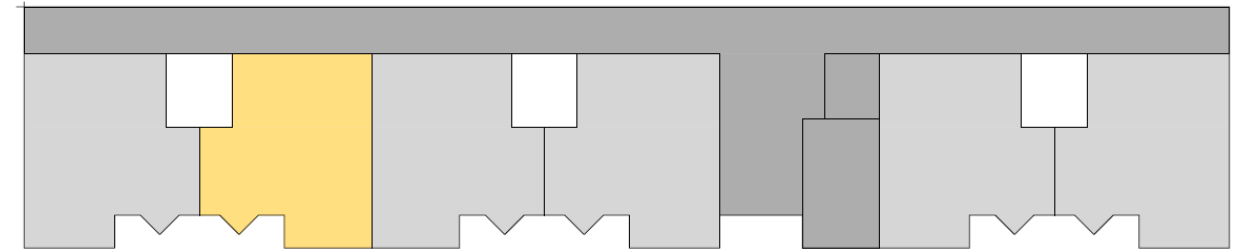
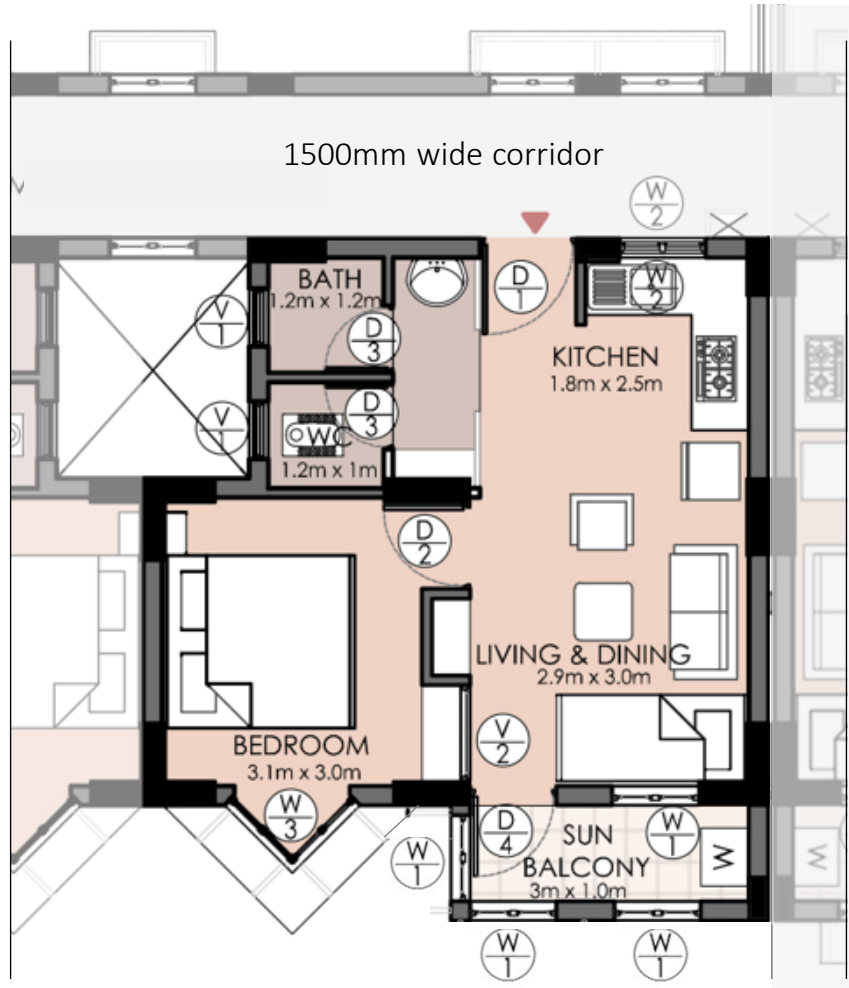
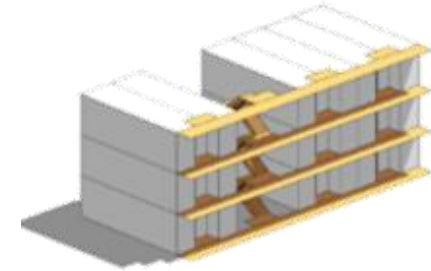
Carpet area – 44 Sqm

Stilt +7 floors



Singly loaded corridor

Carpet area – 35 Sqm
Ground + 3 floors

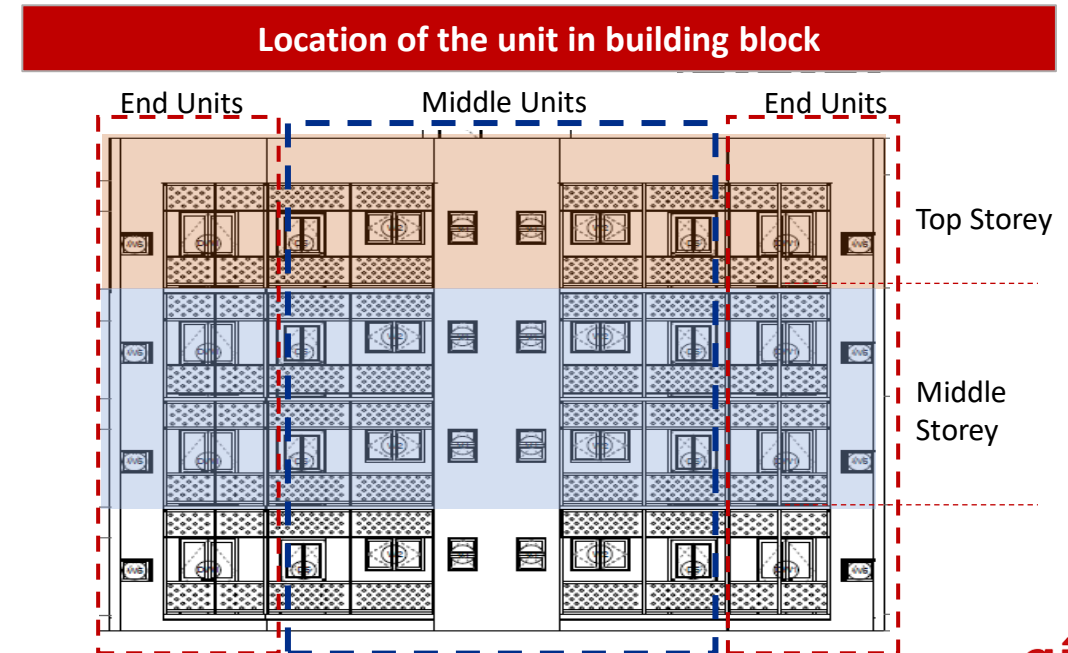
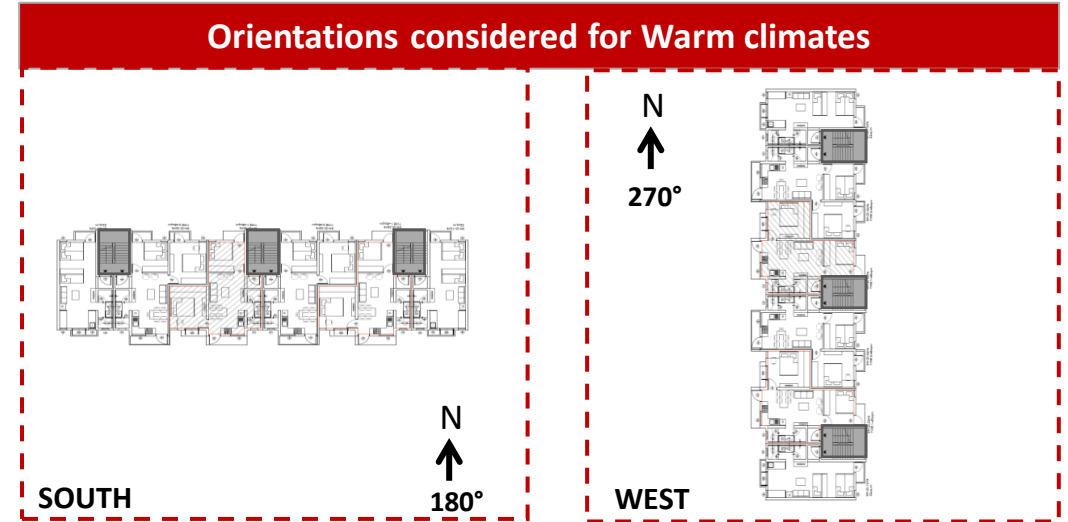


MASTER SET VARIATIONS : WARM CLIMATES

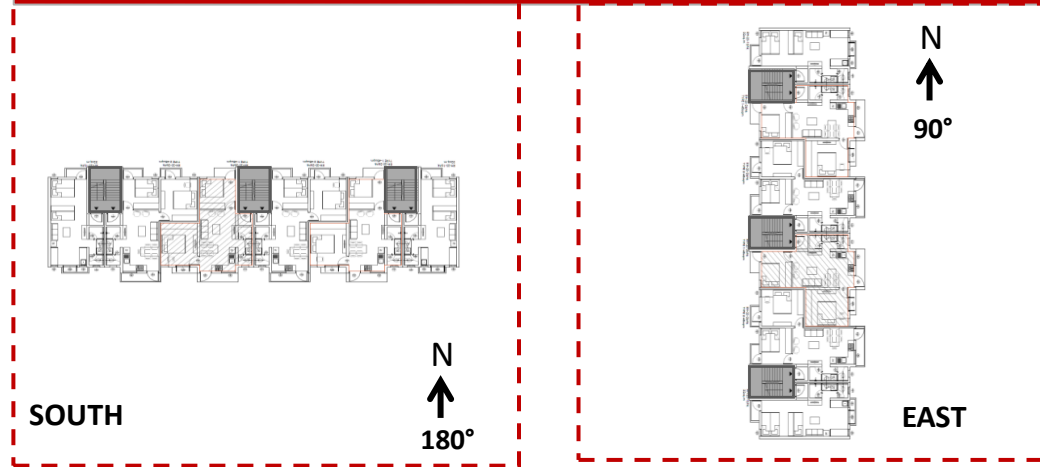
Climate zone			
Hot & dry	Composite	Warm Humid	Temperate

Construction technologies for Warm climate-Low rise buildings			
Construction Technology (CT)	Walling material	External doors/ windows & Glazing	Roofing system
CT 1	AAC Blocks	Rolled steel + SGU	100mm thick Foam concrete + Light colored tile
CT 2	Solid burnt clay brick		
CT 3	Flyash bricks - HD,Co,WH CSEB - Temperate		50mm EPS insulation + Light colored tile

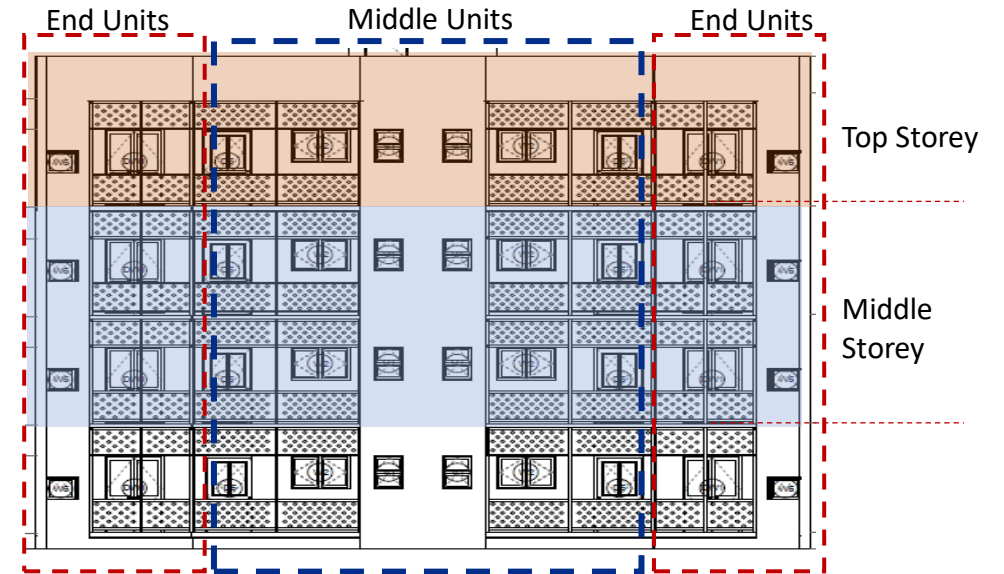
Construction technologies for Warm climate -Mid/High rise buildings			
Construction Technology (CT)	Walling material	External doors/ windows & Glazing	Roofing system
CT 1	AAC Blocks	UPVC + SGU	100mm thick Foam concrete + Light colored tile
CT 2	RCC + Mineral wool insulation + Gypsum board		
CT 3	Autoclaved Lightweight Concrete Panel	Rolled steel+SGU	50mm EPS insulation + Light colored tile



Orientations considered for Cold climate



Location of the unit in building block



Construction technologies for Cold climate

Construction Technology (CT)	Walling material	External doors/ windows & Glazing	Roofing system
CT 1	AAC Blocks	UPVC + SGU	100mm thick Foam concrete + Light colored tile
CT 2	Cavity wall system Solid burnt clay brick + Mineral wool insulation + Solid burnt clay brick		
CT 3	Solid burnt clay brick + EPS Insulation	Wood + SGU	50mm EPS insulation + Light colored tile

KEY PERFORMANCE INDICATOR		
1	Building Envelope Efficiency	Residential Envelope Transmittance Value (RETV) -Warm climates U envelope for Cold climate
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

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

Performance Indicator	Scope	Calculation required
Embodied Energy Intensity (EEI)	<p>Embodied energy share of the highest contributing materials i.e. concrete, steel, walling blocks.</p> <p>Embodied energy intensity is being demonstrated as embodied energy per unit carpet area (MJ / m²)</p>	<p>Mass or volume of Concrete, steel and walling materials used are taken from the BOQ.</p> <p>This is multiplied by the corresponding embodied energy coefficients of the material (in MJ/kg or MJ/m³). <i>Coefficients from secondary sources</i></p> <p>Sum of embodied energy of all materials divided by carpet area gives the embodied energy intensity</p>

Performance Indicator		Calculation required
Cost efficiency	Cost of construction per sqm of carpet area.	Quantities are taken from BIM file.

- *Type Designs – underlying principles*
 - *Type design examples*
 - Single family – Warm climate*
 - Multi-family – Warm climate*
 - Multi-family – Cold climate*
- *Master set Variations for Warm & cold climates*
 - *Key Performance Indicators*

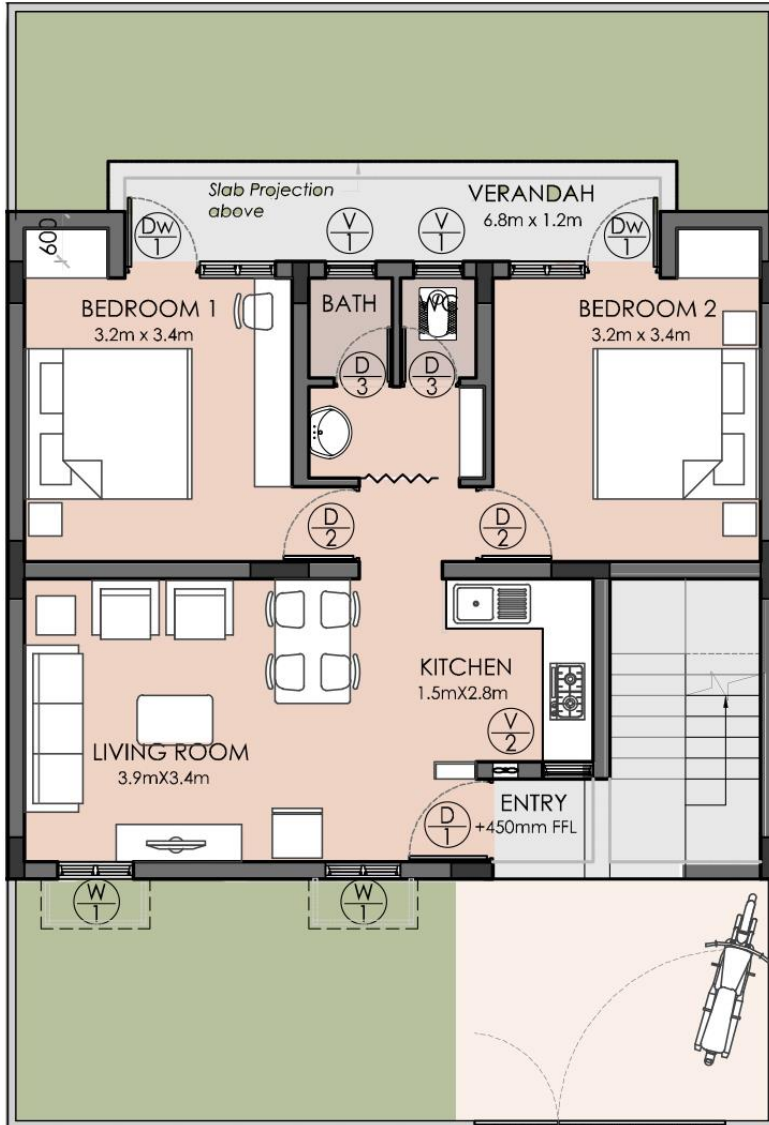
Questions and Feedback

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

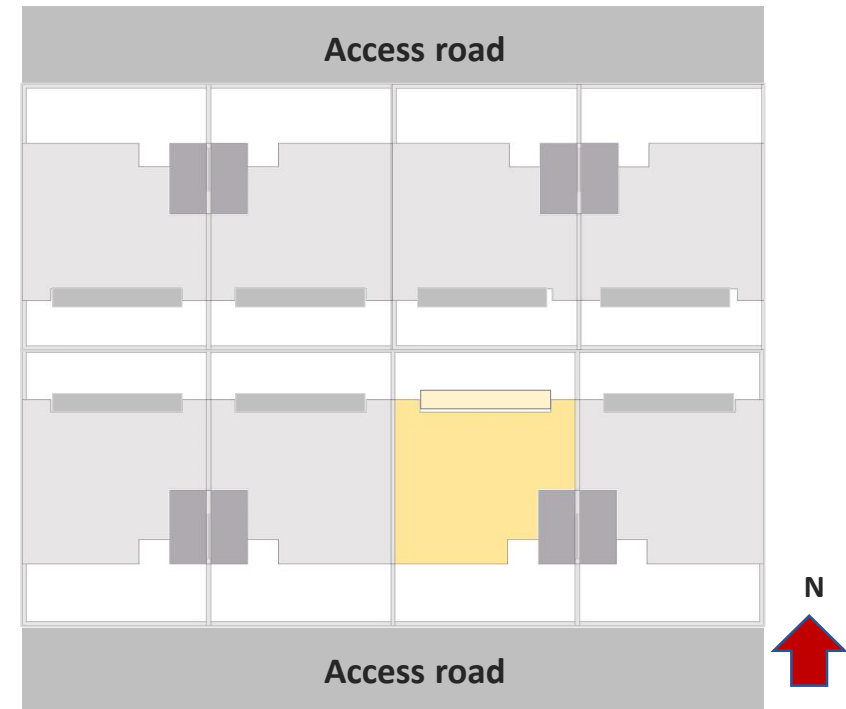
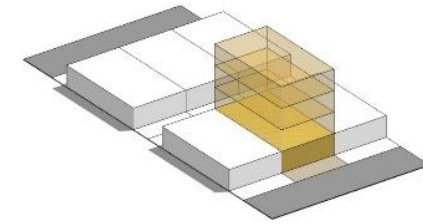
SESSION II

Performance results
and Inferences

*Speaker: Ms.Rathnashree Prakash
Ms.Saswati Chetia*



Row house two side open
 Carpet area – 54 Sqm
 Ground floor (Expansion till G+3)



DEGREE DISCOMFORT HOURS: SINGLE-FAMILY - Row house two side open

Ground floor _ Middle unit	Hot and dry		
Orientation (Degree discomfort hours)	Construction technology		
	CT1	CT2	CT3
South orientation (DDH)	1049	1339	1381
West Orientation (DDH)	795	1193	1233

Ground floor _ Middle unit	Warm humid		
Orientation (Degree discomfort hours)	Construction technology		
	CT1	CT2	CT3
South orientation (DDH)	2085	2285	2441
West Orientation (DDH)	1135	1468	1673

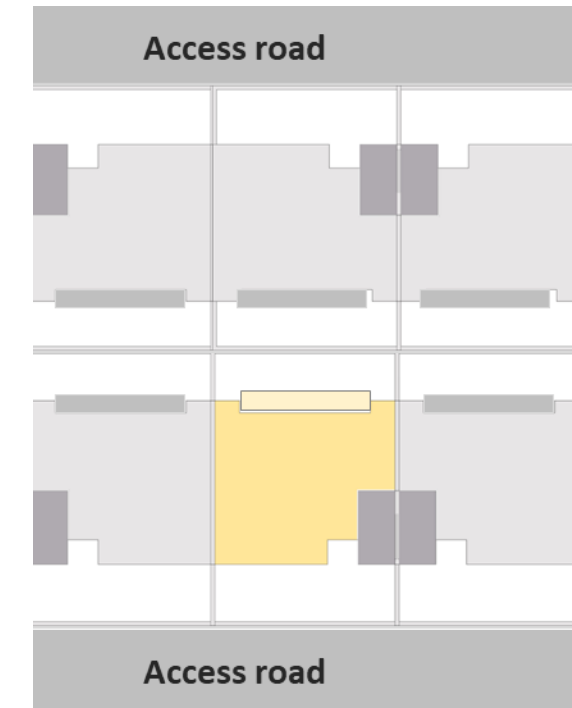
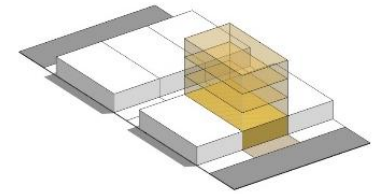
Ground floor _ Middle unit	Composite		
Orientation (Degree discomfort hours)	Construction technology		
	CT1	CT2	CT3
South orientation (DDH)	1149	1363	1393
West Orientation (DDH)	996	1260	1284

Ground floor _ Middle unit	Temperate		
Orientation (Degree discomfort hours)	Construction technology		
	CT1	CT2	CT3
South orientation (DDH)	257	291	273
West Orientation (DDH)	211	293	282

Row house two side open

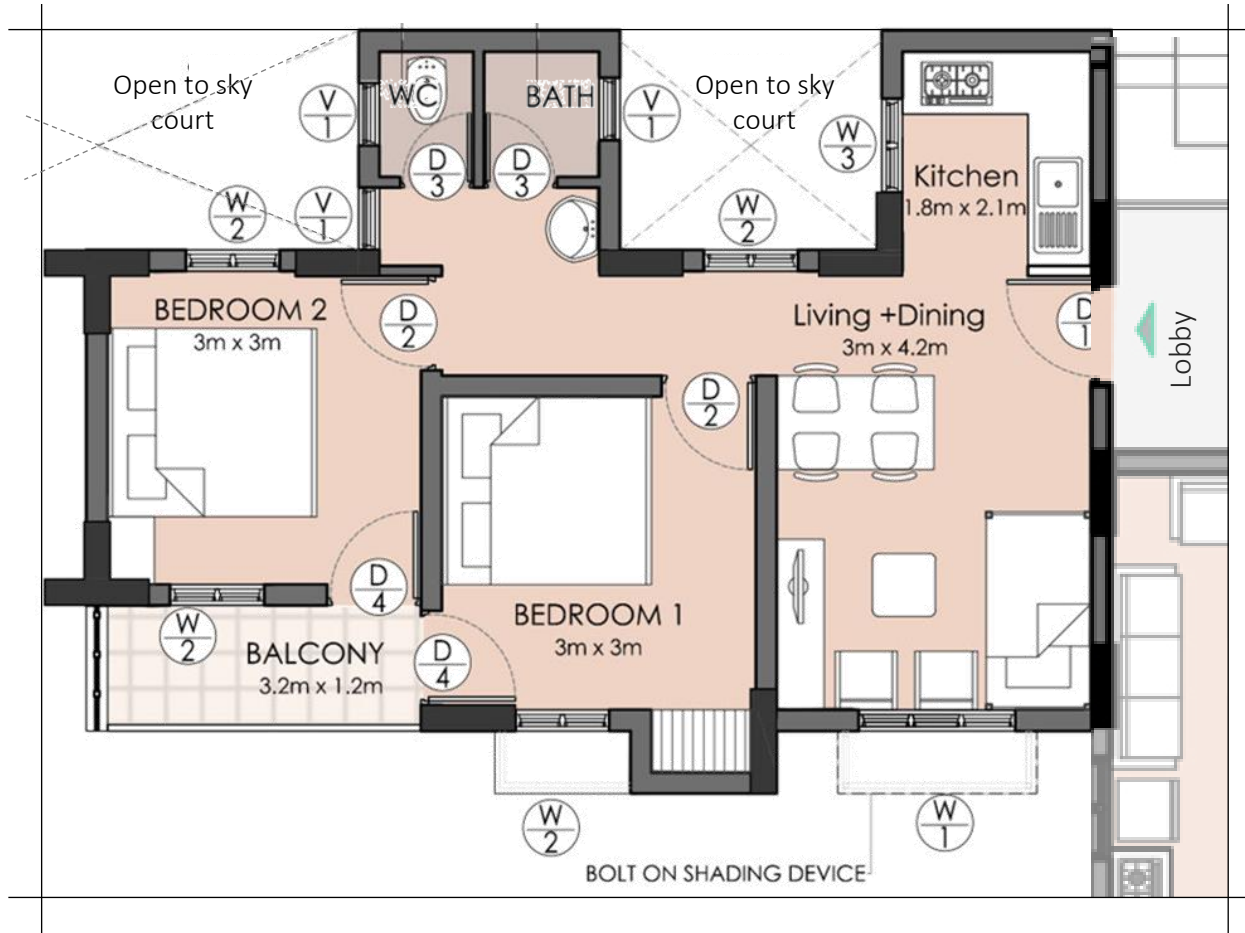
Carpet area – 54 Sqm

Ground floor (Expansion till G+3)



Construction technology	CT1	CT2	CT3
Walling material	<ul style="list-style-type: none"> 200mm AAC Block 	<ul style="list-style-type: none"> Solid burnt clay brick 	<ul style="list-style-type: none"> Flyash brick
External Doors/windows & Glazing	<ul style="list-style-type: none"> Single glazed unit with UPVC frame 	<ul style="list-style-type: none"> Single glazed unit with rolled steel frame 	<ul style="list-style-type: none"> Single glazed unit with UPVC frame
Roofing system	<ul style="list-style-type: none"> 100mm Foam concrete insulation + Light colored glazed tile 	<ul style="list-style-type: none"> 100mm Foam concrete insulation + Light colored glazed tile 	<ul style="list-style-type: none"> 50mm EPS insulation + Light colored glazed tile

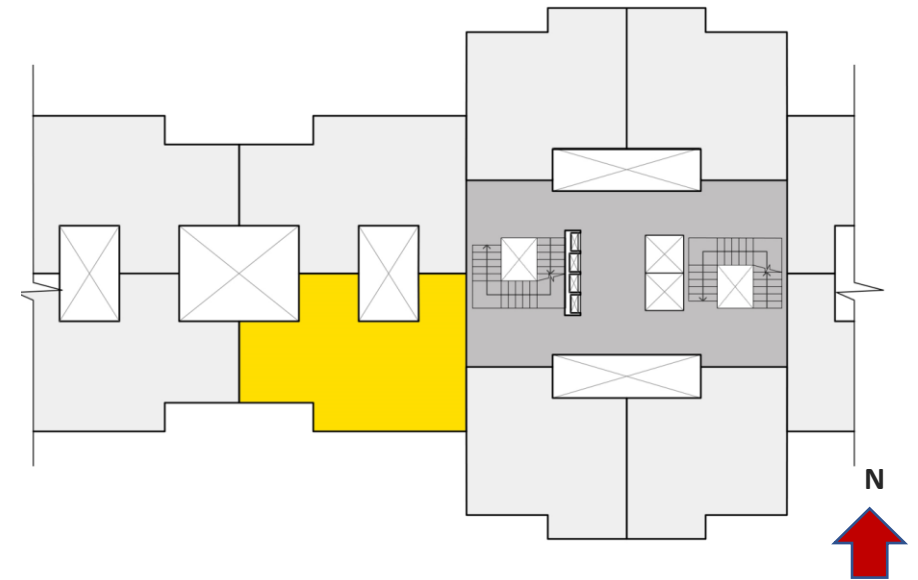
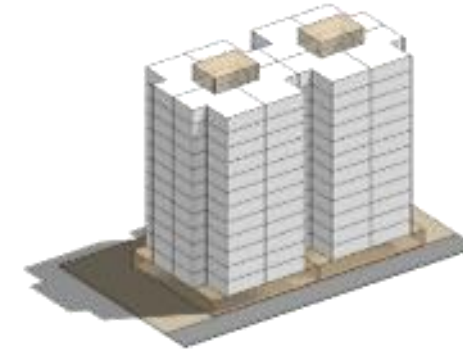
WARM CLIMATES: MULTI-FAMILY – Tower connected



Tower connected

Carpet area – 44 Sqm

Stilt +7 floors



DEGREE DISCOMFORT HOURS: MULTI-FAMILY – Tower connected

Middle floor _ Middle unit	Hot and dry		
Orientation (Degree discomfort hours)	Construction technology		
	CT1	CT2	CT3
South orientation (DDH)	2087	1903	2543
West Orientation (DDH)	1618	1460	1898

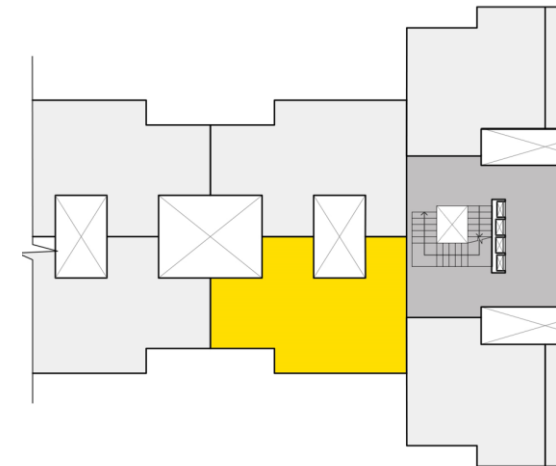
Middle floor _ Middle unit	Warm humid		
Orientation (Degree discomfort hours)	Construction technology		
	CT1	CT2	CT3
South orientation (DDH)	1005	905	1259
West Orientation (DDH)	816	743	954

Middle floor _ Middle unit	Composite		
Orientation (Degree discomfort hours)	Construction technology		
	CT1	CT2	CT3
South orientation (DDH)	2488	2349	2838
West Orientation (DDH)	2786	2580	3118

Middle floor _ Middle unit	Temperate		
Orientation (Degree discomfort hours)	Construction technology		
	CT1	CT2	CT3
South orientation (DDH)	291	261	407
West Orientation (DDH)	299	299	346

Construction technology	CT1	CT2	CT3
Walling material	<ul style="list-style-type: none"> 200mm AAC Block 	<ul style="list-style-type: none"> RCC +Mineral wool insulation +Gypsum board 	<ul style="list-style-type: none"> Autoclaved Lightweight Concrete Panel
External Doors/windows & Glazing	<ul style="list-style-type: none"> Single glazed unit with UPVC frame 	<ul style="list-style-type: none"> Single glazed unit with UPVC frame 	<ul style="list-style-type: none"> Single glazed unit with rolled steel frame
Roofing system	<ul style="list-style-type: none"> 100mm Foam concrete insulation + Light colored glazed tile 	<ul style="list-style-type: none"> 100mm Foam concrete insulation + Light colored glazed tile 	<ul style="list-style-type: none"> 50mm EPS insulation + Light colored glazed tile

Tower connected
 Carpet area – 44 Sqm
 Stilt +7 floors



DEGREE DISCOMFORT HOURS : COLD CLIMATE- MULTI-FAMILY – Singly loaded corridor

Middle floor _ Middle unit	Cold		
Orientation (Degree discomfort hours)	Construction technology		
	CT1	CT2	CT3
South orientation (DDH)	9429	8815	8088
East Orientation (DDH)	7773	7567	7301

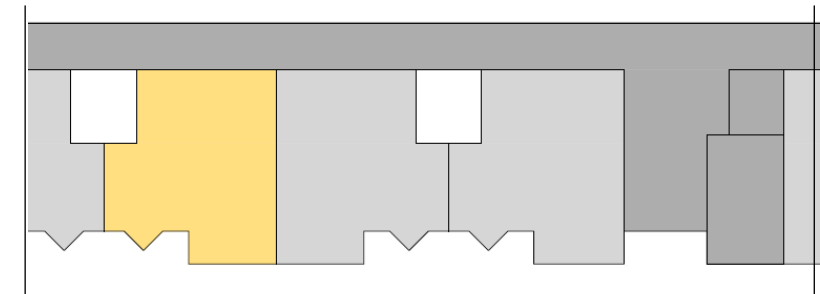
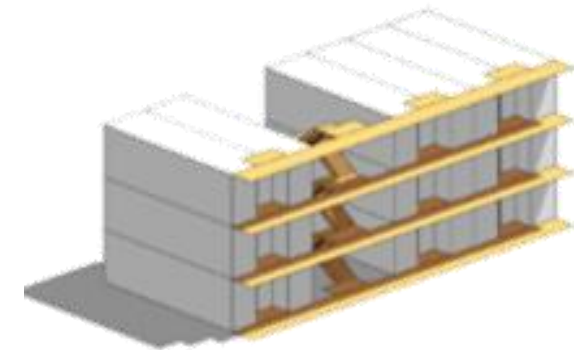
Top floor _ Middle unit	Cold		
Orientation (Degree discomfort hours)	Construction technology		
	CT1	CT2	CT3
South orientation (DDH)	12543	11749	10635
East Orientation (DDH)	9776	9390	8734

Construction technology	CT1	CT2	CT3
Walling material	<ul style="list-style-type: none"> 200mm AAC Block 	<ul style="list-style-type: none"> Cavity wall system - Solid burnt clay brick + Mineral wool insulation + Solid burnt clay brick 	<ul style="list-style-type: none"> Solid burnt clay brick + EPS Insulation
External Doors/windows & Glazing	<ul style="list-style-type: none"> Single glazed unit with UPVC frame 	<ul style="list-style-type: none"> Single glazed unit with UPVC frame 	<ul style="list-style-type: none"> Single glazed unit with rolled steel frame
Roofing system	<ul style="list-style-type: none"> 100mm Foam concrete insulation + Light colored glazed tile 	<ul style="list-style-type: none"> 100mm Foam concrete insulation + Light colored glazed tile 	<ul style="list-style-type: none"> 50mm EPS insulation + Light colored glazed tile

Singly loaded corridor

Carpet area – 35 Sqm

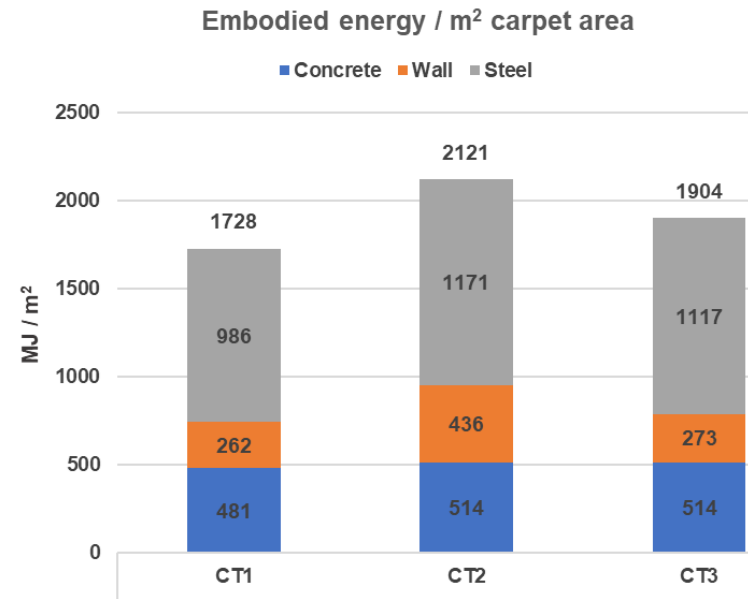
Ground + 3 floors



EMBODIED ENERGY : SINGLE-FAMILY - Row house two side open

Row house two side open - Hot & dry- Ground floor -Middle unit

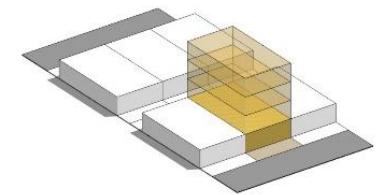
Embodied energy (HD) Ground floor- Middle Unit	Construction technology		
	CT1	CT2	CT3
Concrete	481	514	514
Walling material	262	436	273
Steel	986	1171	1117
Total Embodied energy per sqm of carpet area	1728	2121	1904



Row house two side open

Carpet area – 54 Sqm

Ground floor (Expansion till G+3)



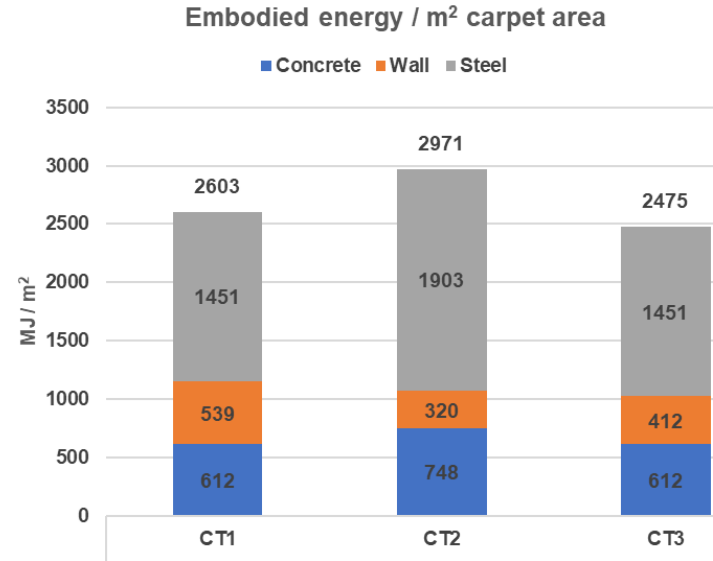
Construction technology	CT1	CT2	CT3
Walling material	<ul style="list-style-type: none"> 200mm AAC Block 	<ul style="list-style-type: none"> Solid burnt clay brick 	<ul style="list-style-type: none"> Flyash brick
External Doors/windows & Glazing	<ul style="list-style-type: none"> Single glazed unit with UPVC frame 	<ul style="list-style-type: none"> Single glazed unit with rolled steel frame 	<ul style="list-style-type: none"> Single glazed unit with UPVC frame
Roofing system	<ul style="list-style-type: none"> 100mm Foam concrete insulation + Light colored glazed tile 	<ul style="list-style-type: none"> 100mm Foam concrete insulation + Light colored glazed tile 	<ul style="list-style-type: none"> 50mm EPS insulation + Light colored glazed tile



EMBODIED ENERGY : MULTI-FAMILY – Tower connected

Tower connected- Hot & dry- Middle floor -Middle unit

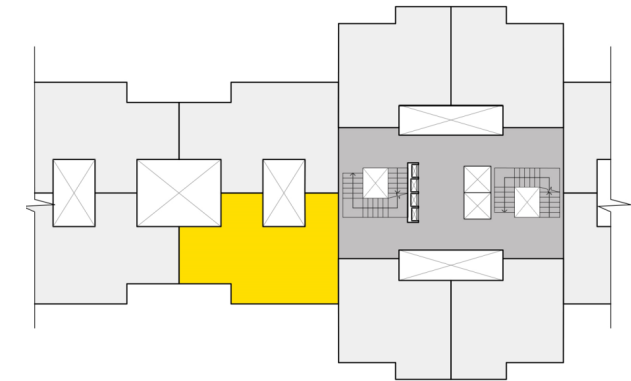
Embodied energy (HD) Middle floor- Middle Unit	Construction technology		
	CT1	CT2	CT3
Concrete	612	748	612
Walling material	539	320	412
Steel	1451	1903	1451
Total Embodied energy per sqm of carpet area	2603	2971	2475



Tower connected
Carpet area – 44 Sqm
Stilt +7 floors



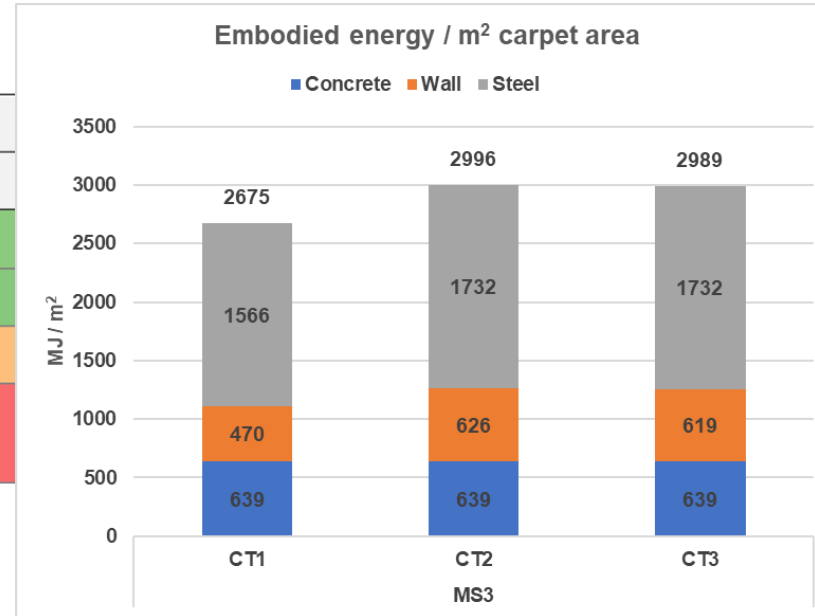
Construction technology	CT1	CT2	CT3
Walling material	<ul style="list-style-type: none"> 200mm AAC Block 	<ul style="list-style-type: none"> RCC +Mineral wool insulation +Gypsum board 	<ul style="list-style-type: none"> Autoclaved Lightweight Concrete Panel
External Doors/windows & Glazing	<ul style="list-style-type: none"> Single glazed unit with UPVC frame 	<ul style="list-style-type: none"> Single glazed unit with UPVC frame 	<ul style="list-style-type: none"> Single glazed unit with rolled steel frame
Roofing system	<ul style="list-style-type: none"> 100mm Foam concrete insulation + Light colored glazed tile 	<ul style="list-style-type: none"> 100mm Foam concrete insulation + Light colored glazed tile 	<ul style="list-style-type: none"> 50mm EPS insulation + Light colored glazed tile



EMBODIED ENERGY : COLD CLIMATE- MULTI-FAMILY – Singly loaded corridor

Singly loaded corridor- Middle floor -Middle unit

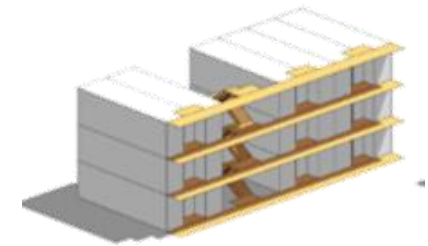
Embodied energy Middle floor- Middle Unit	Construction technology		
	CT1	CT2	CT3
Concrete	639	639	639
Walling material	470	626	619
Steel	1566	1732	1732
Total Embodied energy per sqm of carpet area	2675	2996	2989



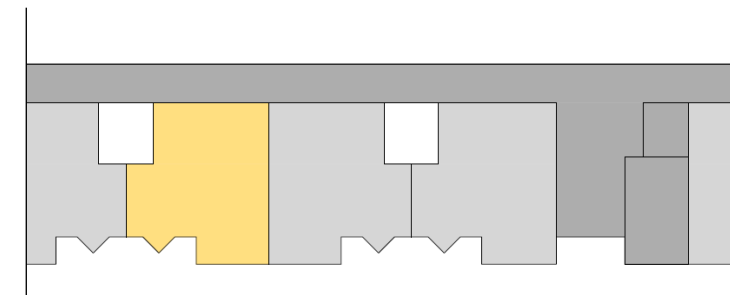
Singly loaded corridor

Carpet area – 35 Sqm

Ground + 3 floors



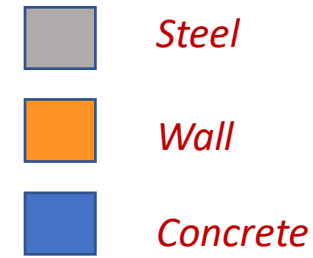
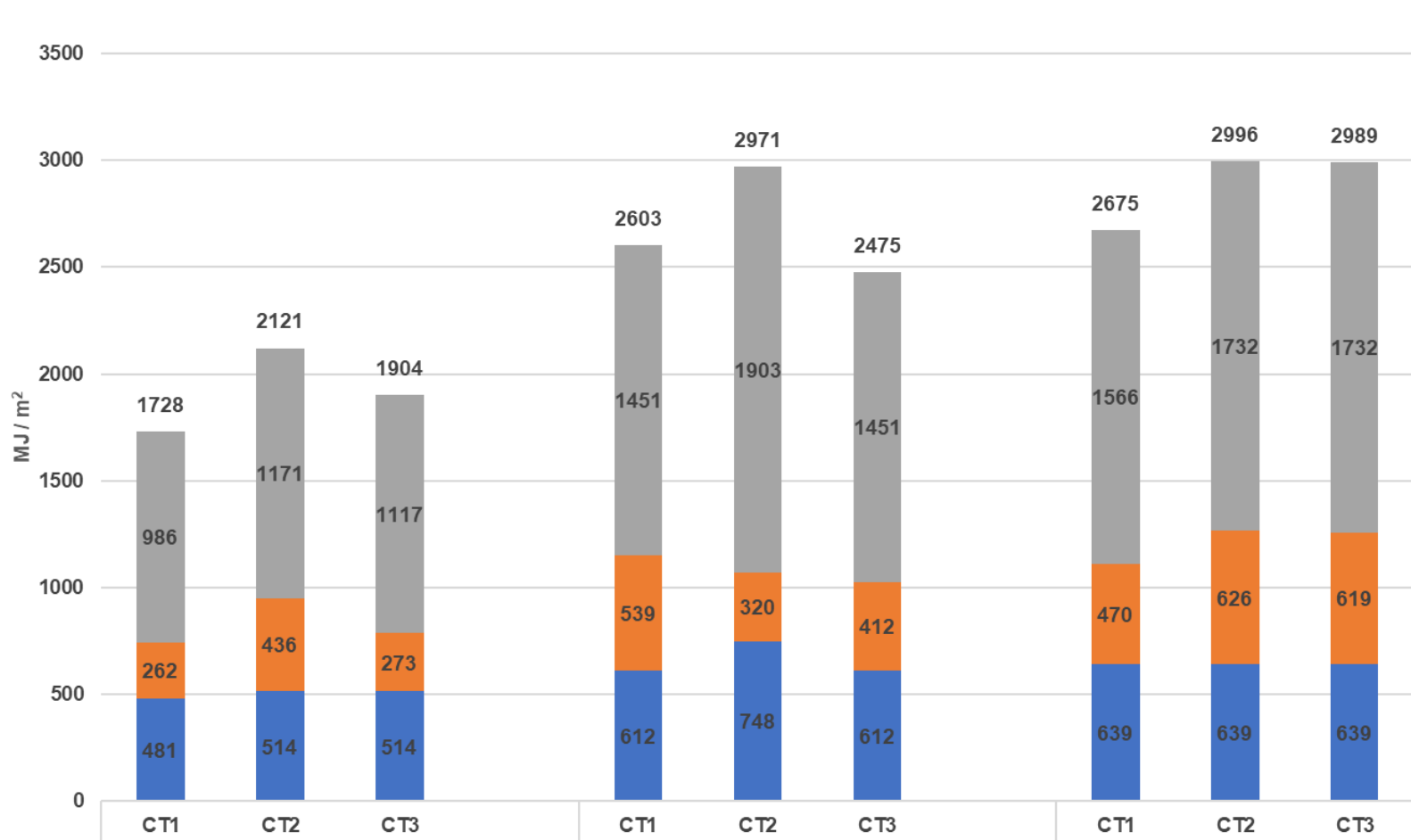
Construction technology	CT1	CT2	CT3
Walling material	<ul style="list-style-type: none"> 200mm AAC Block 	<ul style="list-style-type: none"> Cavity wall system - Solid burnt clay brick + Mineral wool insulation + Solid burnt clay brick 	<ul style="list-style-type: none"> Solid burnt clay brick + EPS Insulation
External Doors/windows & Glazing	<ul style="list-style-type: none"> Single glazed unit with UPVC frame 	<ul style="list-style-type: none"> Single glazed unit with UPVC frame 	<ul style="list-style-type: none"> Single glazed unit with rolled steel frame
Roofing system	<ul style="list-style-type: none"> 100mm Foam concrete insulation + Light colored glazed tile 	<ul style="list-style-type: none"> 100mm Foam concrete insulation + Light colored glazed tile 	<ul style="list-style-type: none"> 50mm EPS insulation + Light colored glazed tile



Observations and learning from the project

*Speaker: Ms.Rathnashree Prakash
Ms.Saswati Chetia
Ms. Roopa Nair*

PERFORMANCE INFERENCES : EMBODIED ENERGY / SQM OF CARPET AREA



Embodied energy will vary with change in construction technology. More concrete and steel used, more is the embodied energy of the design. With lighter walling materials, concrete and steel quantity is reduced, and thus, also embodied energy.

Embodied energy also varies with the type of design, with more compact forms having lower embodied energy.

Row house two side open
Single Family- Warm



HD-Ground floor –Middle unit-South

Tower connected
Multi Family- Warm



HD-Middle floor -Middle unit-South

Singly loaded corridor
Multi Family- Cold



Cold-Middle floor -Middle unit-South

COST OF CONSTRUCTION: DIFFERENT TYPOLOGIES

Single Family- Warm
Row house two side open



Multi Family- Warm
Tower connected



Multi Family- Cold
Singly loaded corridor



Item of Work	Row house two side open			Tower connected			Cold - Singly loaded corridor		
	CT1 AAC	CT2 Burnt brick	CT3 Flyash brick	CT1 AAC	CT2 RCC + Insulation	CT3 ALC Panel	CT1 AAC	CT2 Cavity brick wall + insulation	CT3 Burnt clay brick + Insulation
	Amount	Amount	Amount	Amount	Amount	Amount	Amount	Amount	Amount
CIVIL WORK (Building Envelope)	76%	77%	77%	64%	67%	67%	54%	53%	50%
TOTAL	878355	943278	938326	389988	446014	303479	263012	260620	254465
WINDOWS & SHADING	8%	7%	7%	21%	19%	13%	29%	30%	29%
DOOR, WINDOW & BALCONY	83860	83860	83860	121845	121845	53774	144271	144271	144271
SHADING	4940	4940	4940	4516	4516	4516	299	299	299
TOTAL	88799	88799	88799	126361	126361	58290	144570	144570	144570
FINISHING (External walls & Terracing)	13%	13%	13%	15%	13%	19%	16%	16%	15%
TOTAL	154724	154724	154724	88303	88303	88303	76125	76125	76125
INSULATION	3%	3%	3%	0%	0%	1%	1%	2%	6%
TOTAL	36403	36403	36403	3001	3001	1695	7221	8533	1695
TOTAL COST OF CONSTRUCTION (INR)	11,58,282	12,23,205	12,18,253	6,07,652	6,63,678	4,51,767	4,90,928	4,89,847	5,05,340
Cost/ sqm carpet area	21,450	22,652	22,560	13,810	15,084	10,267	16,364	16,328	16,845
Cost/ sqft carpet area	1993	2105	2097	1283	1402	954	1521	1517	1565

- Includes civil structure, building envelope, door-window, external finishing, and costs of ECMS.
- Includes civil structure, building envelope, door-window and external finishing costs
- Excludes common area costs like corridor, staircase, lobby etc
- Includes the proportionate cost of terracing distributed over no of floors

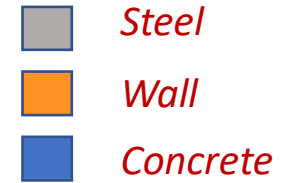
PERFORMANCE INFERENCES : BUILDING TYPOLOGY VARIATIONS-Single family & Multi family

DDH

Row house two side open

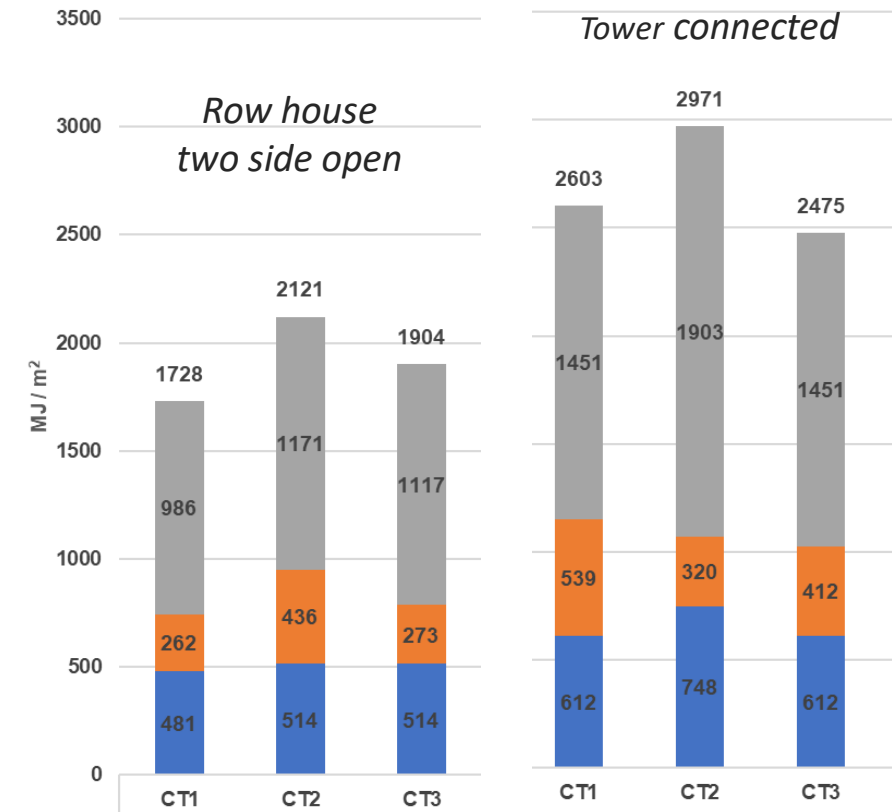
Tower connected

Ground floor _ Middle unit	Hot and dry			Hot and dry		
Orientation (Degree discomfort hours)	Construction technology			Construction technology		
	CT1	CT2	CT3	CT1	CT2	CT3
South orientation (DDH)	1049	1339	1381	2087	1903	2543



Item of Work	Row house two side open			Tower connected		
	CT1 AAC	CT2 Burnt brick	CT3 Flyash brick	CT1 AAC	CT2 RCC + Insulation	CT3 ALC Panel
	Amount	Amount	Amount	Amount	Amount	Amount
CIVIL WORK (Building Envelope)	76%	77%	77%	64%	67%	67%
TOTAL	878355	943278	938326	389988	446014	303479
WINDOWS & SHADING	8%	7%	7%	21%	19%	13%
DOOR, WINDOW & BALCONY	83860	83860	83860	121845	121845	53774
SHADING	4940	4940	4940	4516	4516	4516
TOTAL	88799	88799	88799	126361	126361	58290
FINISHING (External walls & Terracing)	13%	13%	13%	15%	13%	19%
TOTAL	154724	154724	154724	88303	88303	88303
INSULATION	3%	3%	3%	0%	0%	1%
TOTAL	36403	36403	36403	3001	3001	1695
TOTAL COST OF CONSTRUCTION (INR)	11,58,282	12,23,205	12,18,253	6,07,652	6,63,678	4,51,767
Cost/ sqm carpet area	21,450	22,652	22,560	13,810	15,084	10,267
Cost/ sqft carpet area	1993	2105	2097	1283	1402	954

EMBODIED ENERGY INTENSITY



PERFORMANCE INFERENCES : CLIMATE VARIATIONS

DEGREE DISCOMFORT HOURS

Warm climate: Tower connected | South orientation | Middle floor | Middle unit | CT1

Climate zones	Hot and dry	Composite	Warm and humid	Temperate
Bedroom 1 (DDH)	1975	2550	1178	401
Living room (DDH)	2310	2689	1100	280
Bedroom 2 (DDH)	2044	2359	781	237
DDH-Area weighted Average	2087	2488	1005	291

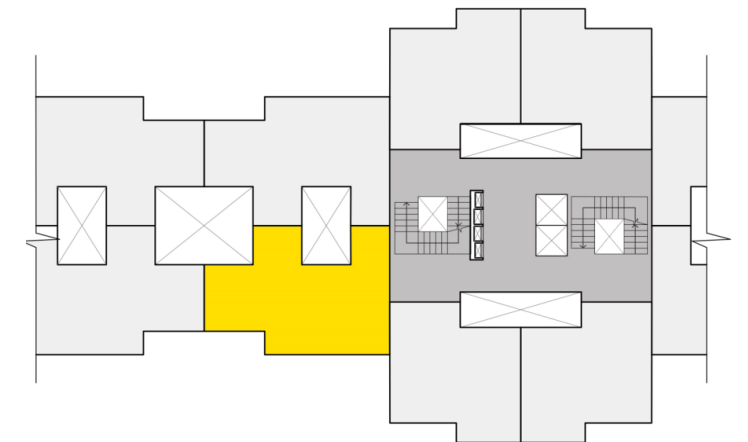
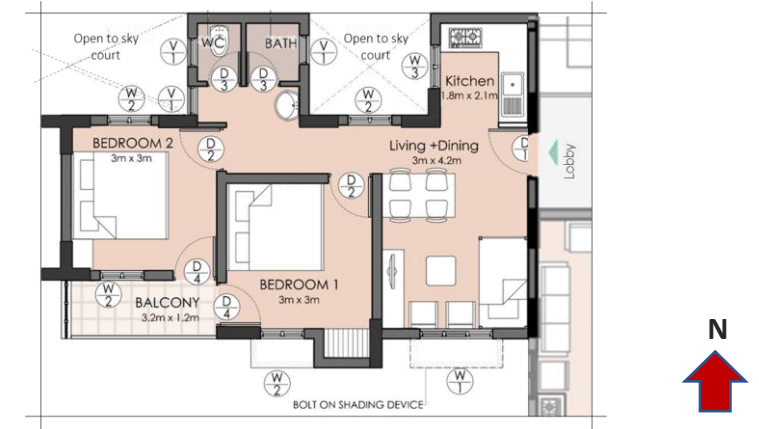
The same dwelling unit type may be suitable for all the four warm climates (Hot-dry, Warm humid, Composite, Temperate) but it will have different performances according to each climatic condition.

The more extreme the climate, the greater the discomfort. Design needs to be adjusted to the local conditions with envelope shape, glazing ratio, shading and envelope materials.

Tower connected

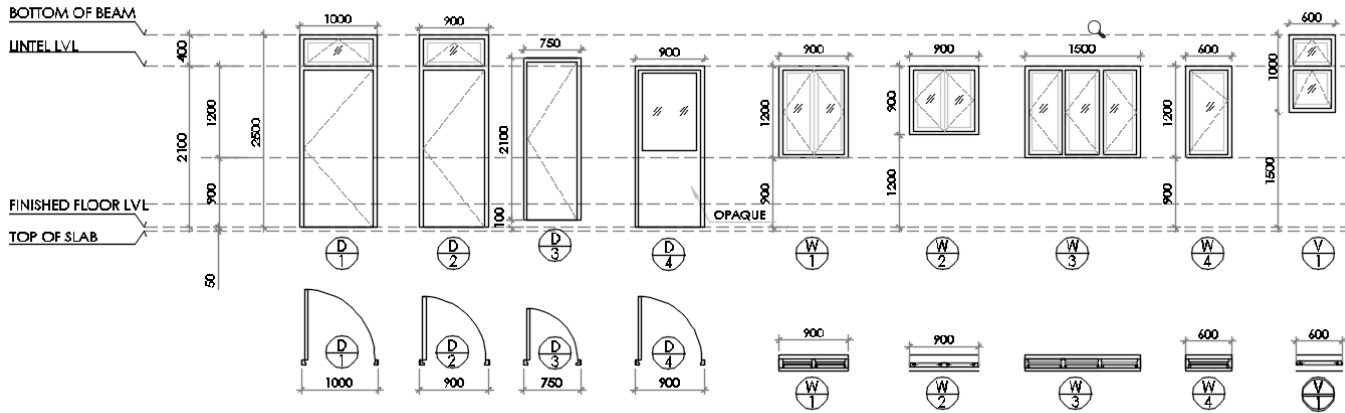
Carpet area – 44 Sqm

Stilt +7 floors



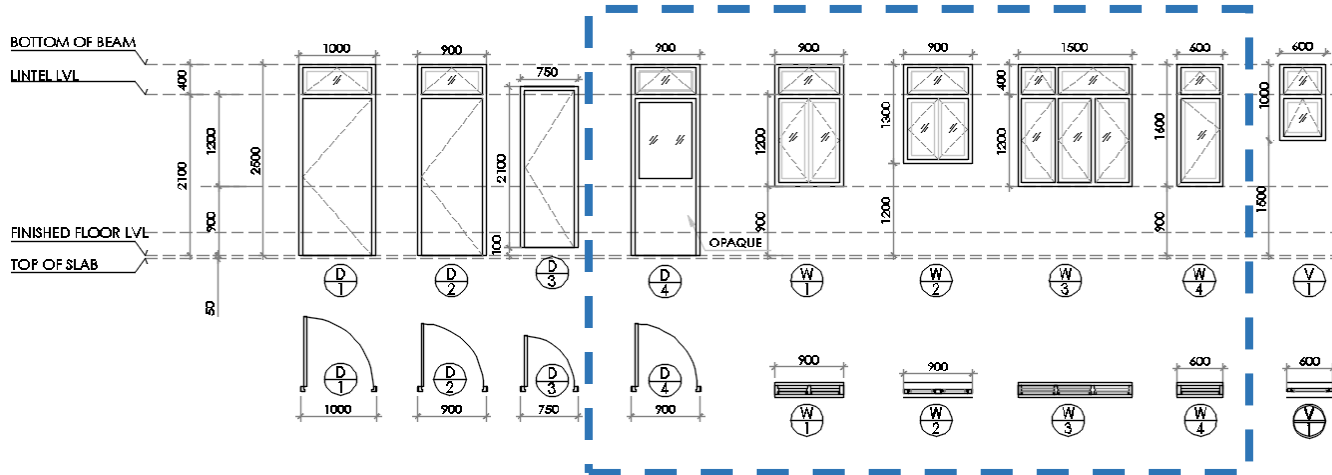
PERFORMANCE INFERENCES : CLIMATE VARIATIONS

Door Windows for Hot-dry & Composite climate



Door Windows for Warm humid & Temperate climate

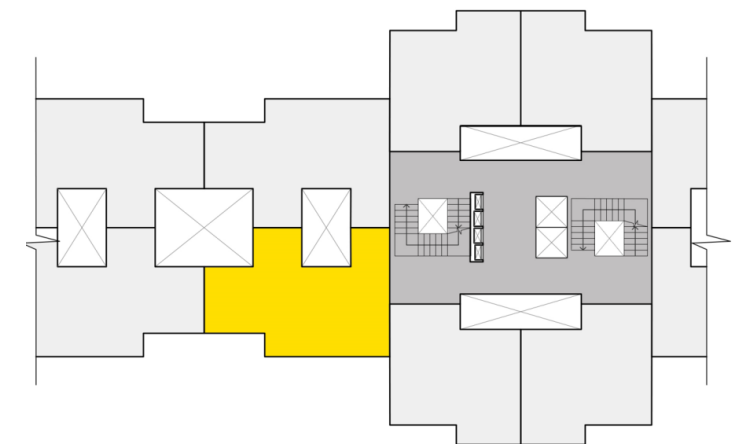
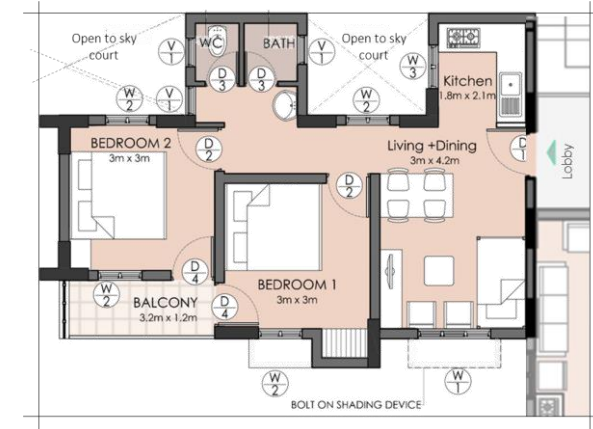
Ventilator added to doors/windows



Tower connected

Carpet area – 44 Sqm

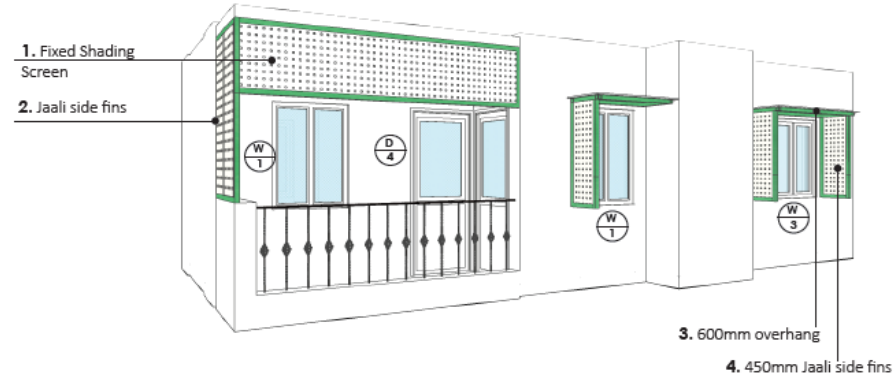
Stilt +7 floors



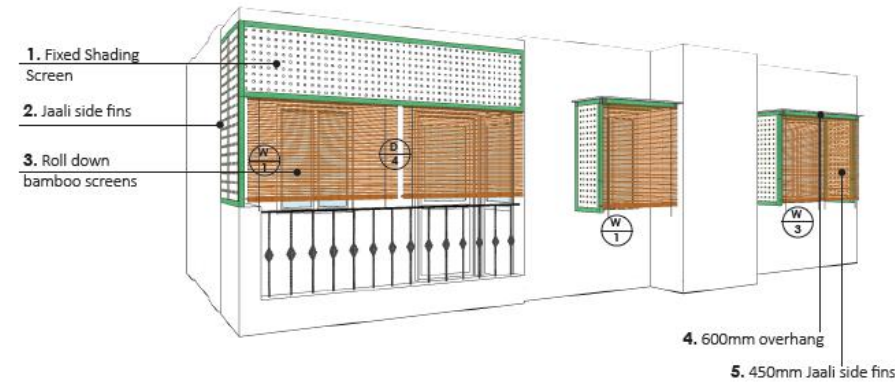
PERFORMANCE INFERENCES : ORIENTATION VARIATIONS

Warm climate: *Tower connected- Middle floor -Middle unit*

Orientation (Degree discomfort hours)	Construction technologies		
	CT1	CT2	CT3
South Orientation (DDH)	2087	1903	2543
West Orientation (DDH)	1618	1460	1898

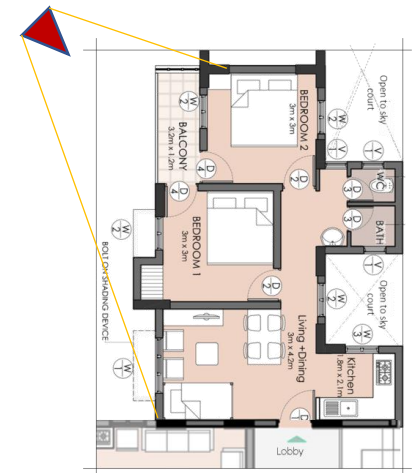
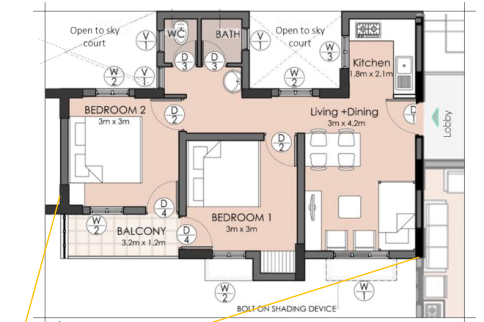


South orientation



West orientation

Tower connected
Carpet area – 44 Sqm
Stilt +7 floors



The effect based on orientation is negated when orientation-appropriate shading is added to minimize discomfort.

DWELLING UNIT PLACEMENT VARIATIONS: Middle floor | Top floor , Middle unit | Edge Unit

DEGREE DISCOMFORT HOURS

Cold climate: Singly loaded corridor- South orientation

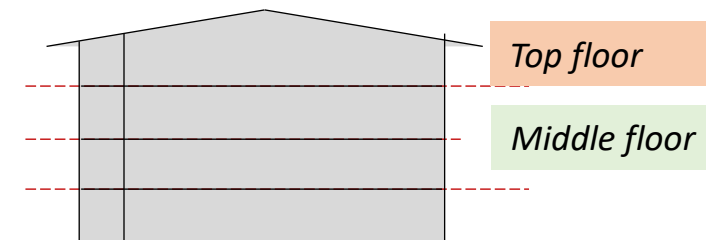
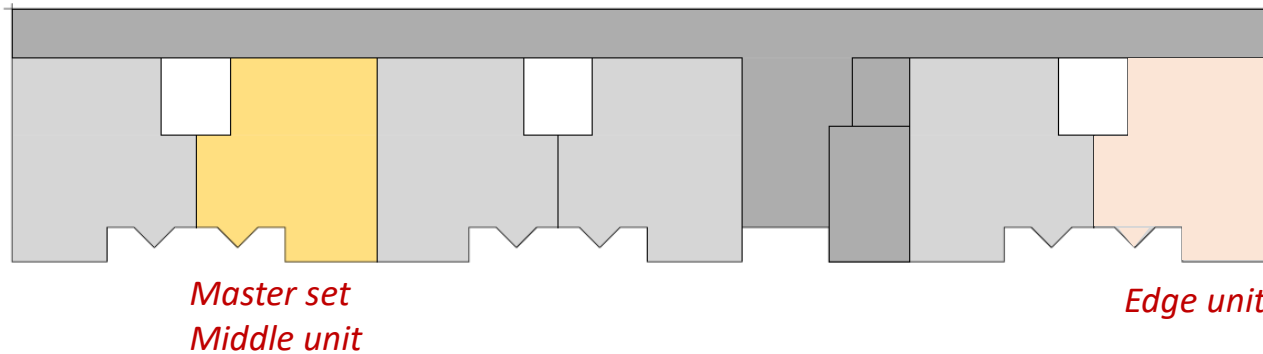
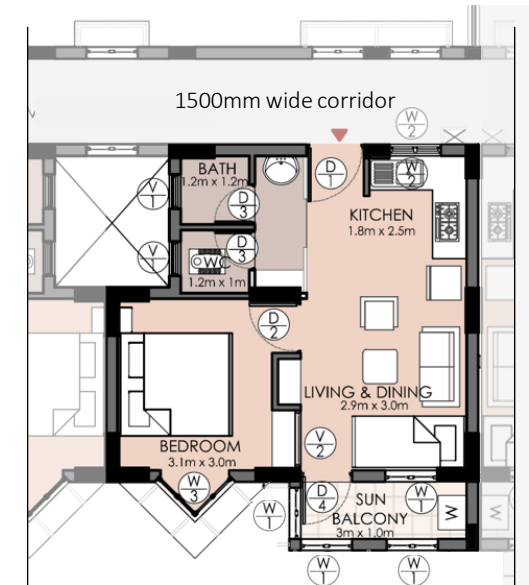
Location of Unit	Middle unit	Edge unit
Middle floor	7773	8257
Top Floor	9776	9900

Singly loaded corridor

Carpet area – 35 Sqm

Ground + 3 floors

1
A

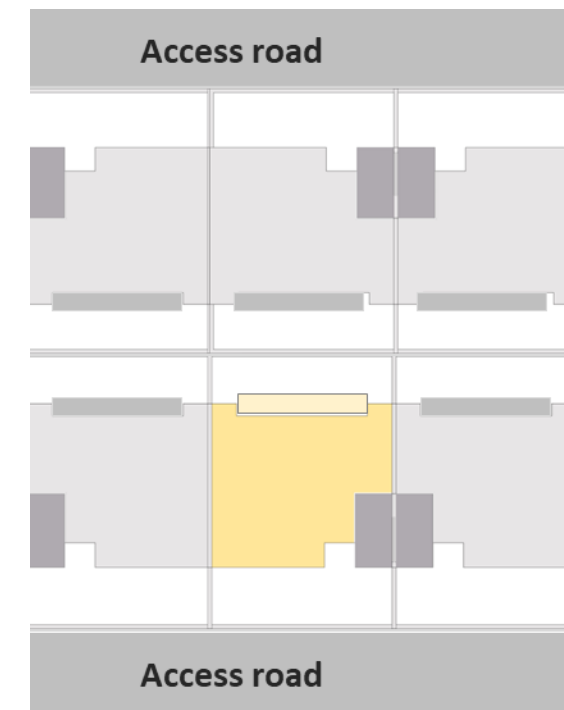
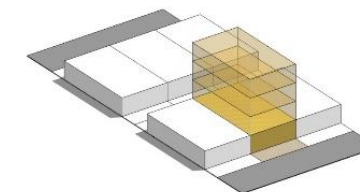


Single Family - Row House Two Side Open – 2bhk

Row house two side open
Carpet area – 54 Sqm



Degree discomfort hours			
Climate	Hot and dry		
Orientation	South-180 deg		
Location in the block	Middle floor_ Middle unit		
Construction technology	CT1	CT2	CT3
Living Room	492	654	679
Bedroom	1704	2158	2221
Bedroom 2	556	709	736
DDH- Area weighted average	1049	1339	1381



Construction technology	CT1	CT2	CT3
Walling material	<ul style="list-style-type: none"> 200mm AAC Block 	<ul style="list-style-type: none"> Solid burnt clay brick 	<ul style="list-style-type: none"> Flyash brick
External Doors/windows & Glazing	<ul style="list-style-type: none"> Single glazed unit with UPVC frame 	<ul style="list-style-type: none"> Single glazed unit with rolled steel frame 	<ul style="list-style-type: none"> Single glazed unit with UPVC frame
Roofing system	<ul style="list-style-type: none"> 100mm Foam concrete insulation + Light colored glazed tile 	<ul style="list-style-type: none"> 100mm Foam concrete insulation + Light colored glazed tile 	<ul style="list-style-type: none"> 50mm EPS insulation + Light colored glazed tile

Questions and Feedback

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

SESSION III

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

Speaker: Ms.Niroopa Subrahmanyam

PMAY(U) Verticals

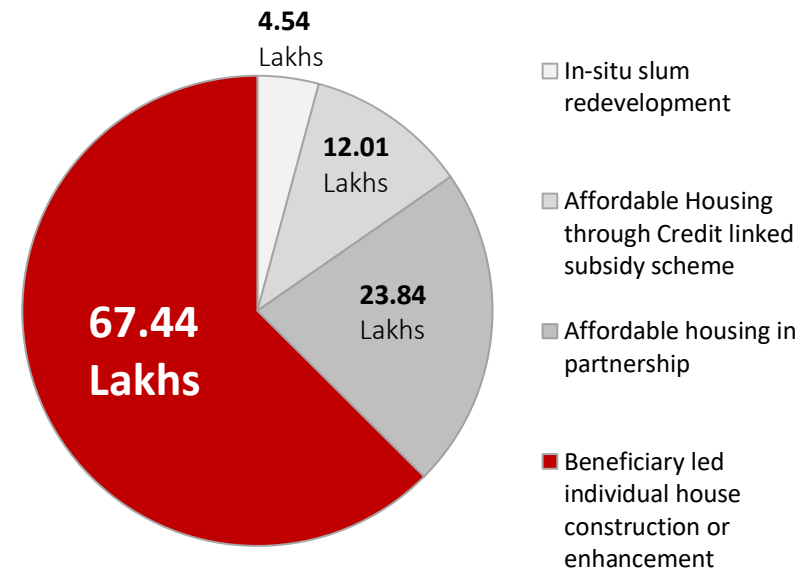
3. Implementation Methodology

The Mission will be implemented through four verticals giving option to beneficiaries, ULBs and State/UT Governments. These four verticals are as below:

"In situ" Slum Redevelopment	Affordable Housing through Credit Linked Subsidy	Affordable Housing in Partnership	Subsidy for Beneficiary-Led Individual house Construction or Enhancement
<ul style="list-style-type: none"> - Using land as a resource - With private participation - Extra FSI/TDR/FAR if required to make projects financially viable 	<p>A. Interest subsidy for EWS and LIG:</p> <ul style="list-style-type: none"> - EWS: Annual Household Income up to Rs.3,00,000 and house sizes upto 30 sq.m. - LIG: Annual Household Income from Rs.3,00,001 to Rs.6,00,000 and house sizes upto 60 sq.m. <p>B. Interest subsidy for MIG:</p> <ul style="list-style-type: none"> - MIG I: Annual Household Income from Rs. 6,00,001 to Rs. 12,00,000 and house sizes upto 160 sq.m. - MIG II: Annual Household Income from Rs.12,00,001 and 18,00,000 and house sizes upto 200 sq.m. 	<ul style="list-style-type: none"> - With private sector or public sector including Parastatal agencies - Central Assistance per EWS house in affordable housing projects where 35% of constructed houses are for EWS category 	<ul style="list-style-type: none"> - For individuals of EWS category requiring individual house - State to prepare a separate project for such beneficiaries - No isolated/ splintered beneficiary to be covered

Source : PMAY Scheme Guidelines Updated , January 2021

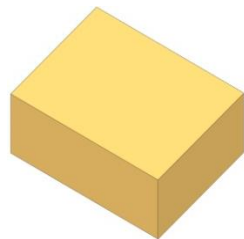
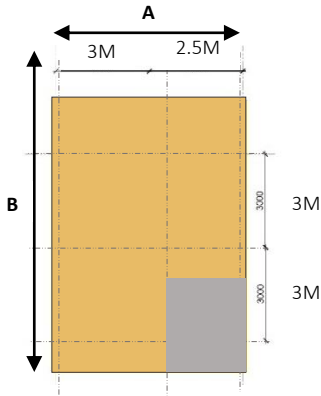
Houses sanctioned till October 5, 2020 under each PMAY(U) Vertical



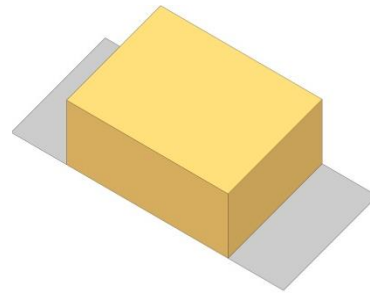
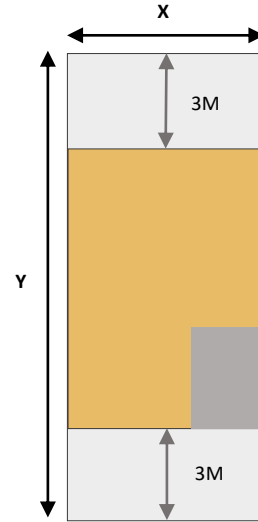
Source : MoHUA, 2020

Considering the shift towards state-led / builder developed BLC affordable housing schemes in urban areas across the country, **type designs are developed for BLC in such urban extension layouts provided by ULBs or the state.** These type designs do not look at marginal improvements or extensions of existing homes.

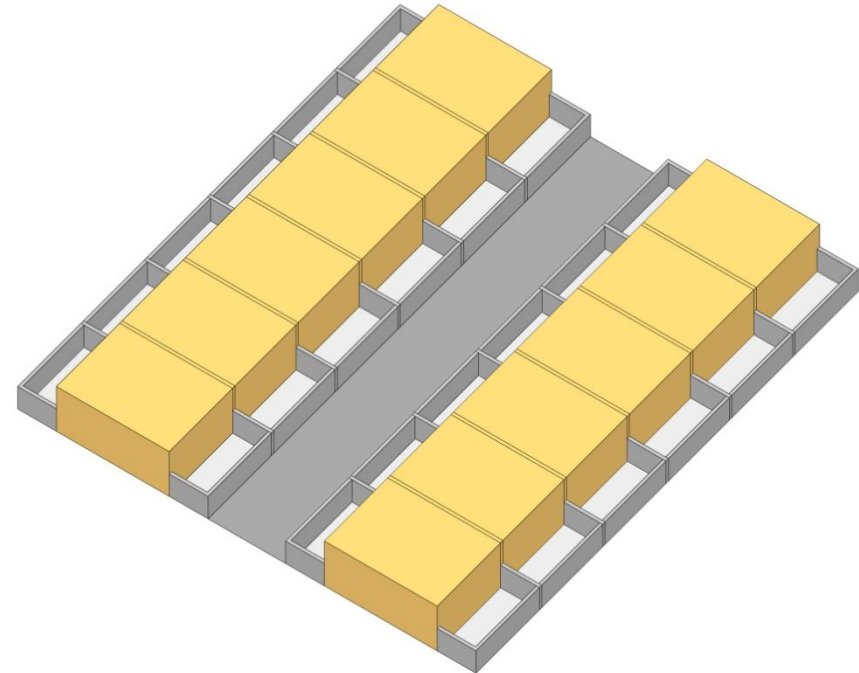
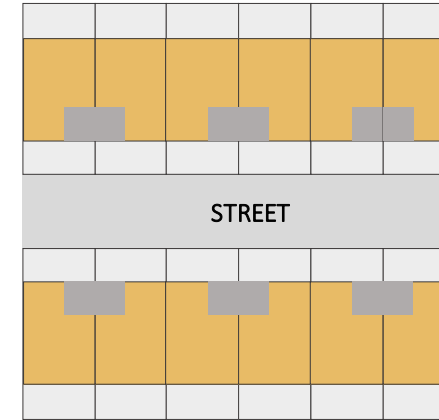
Unit size and design



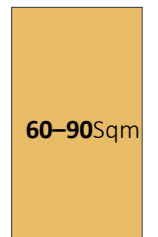
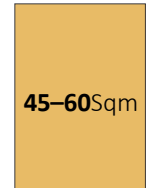
Plot setbacks and size



Site layout

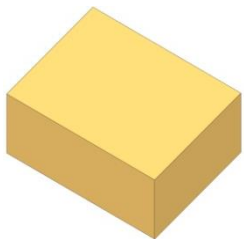
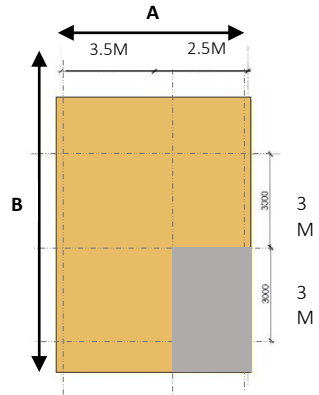


Carpet area range

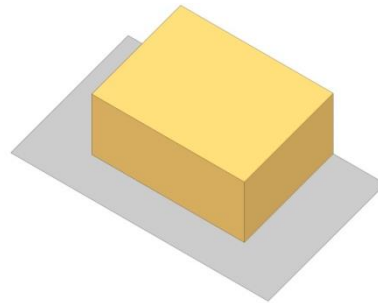
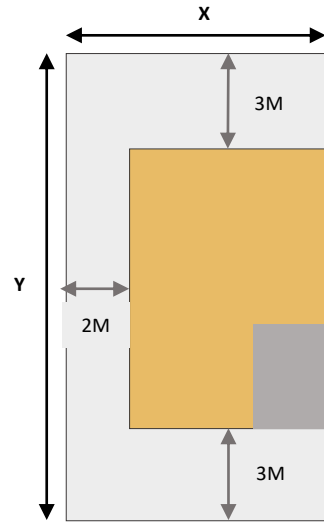


- The BLC units are **designed keeping in mind the integral relationship between the house design, plot size and the sequence of plots**
- The plot sizes and site level layouts are **derived using the unit type design as a building block** which ensures that the available land is most effectively utilized.

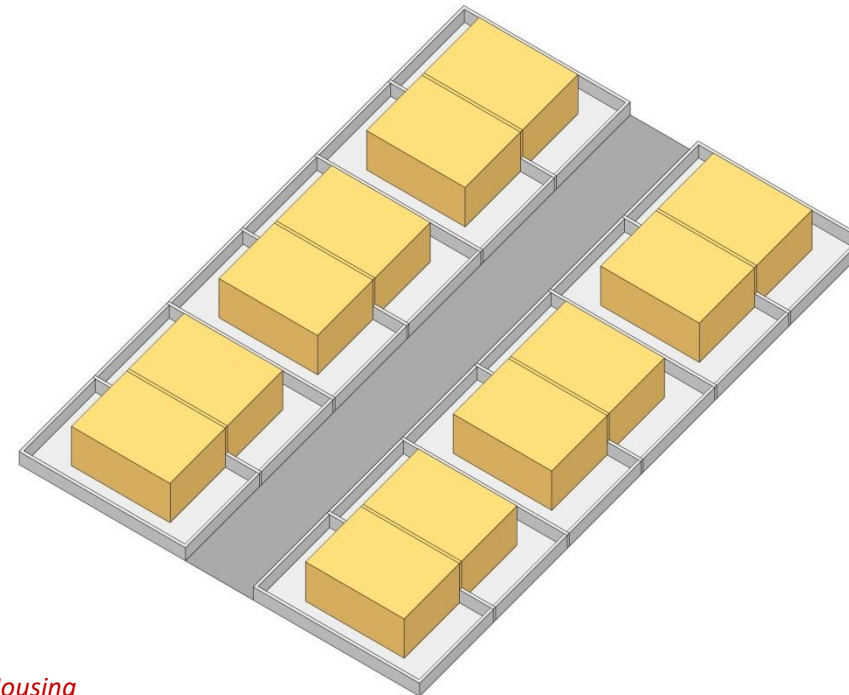
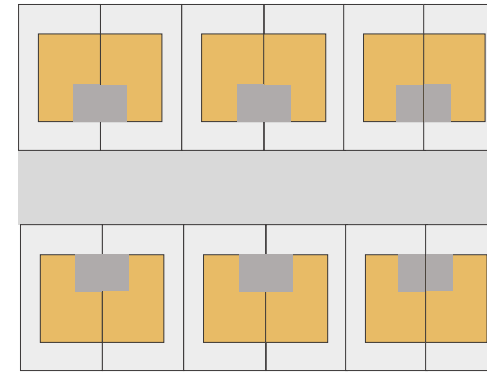
Unit size and design



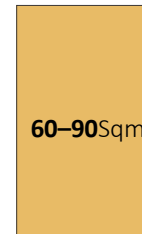
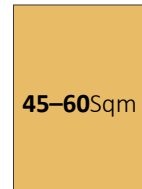
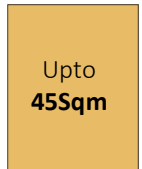
Plot setbacks and size



Site layout



Carpet area range

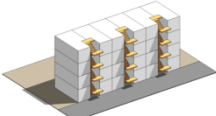
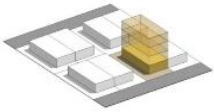
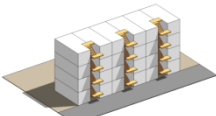
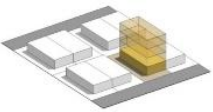
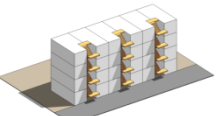
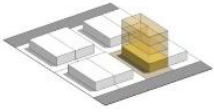






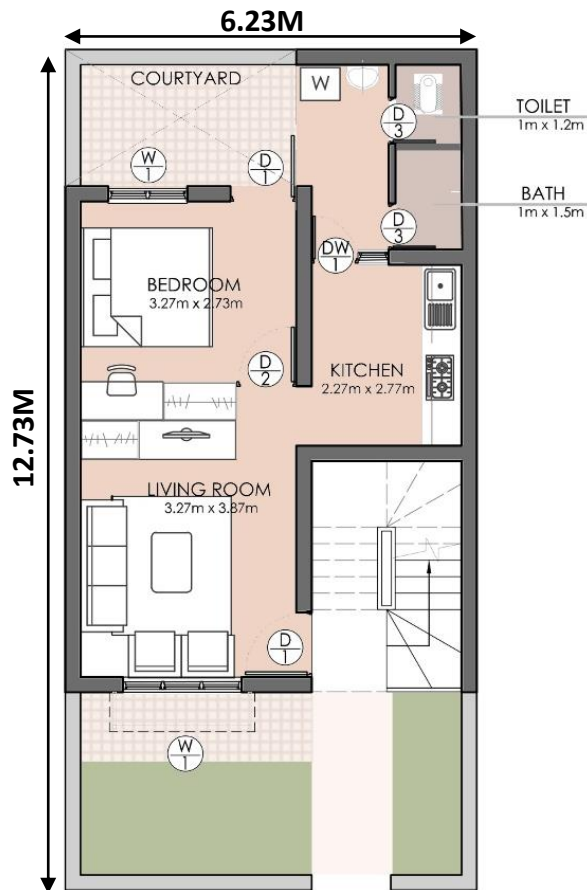


Single-Family

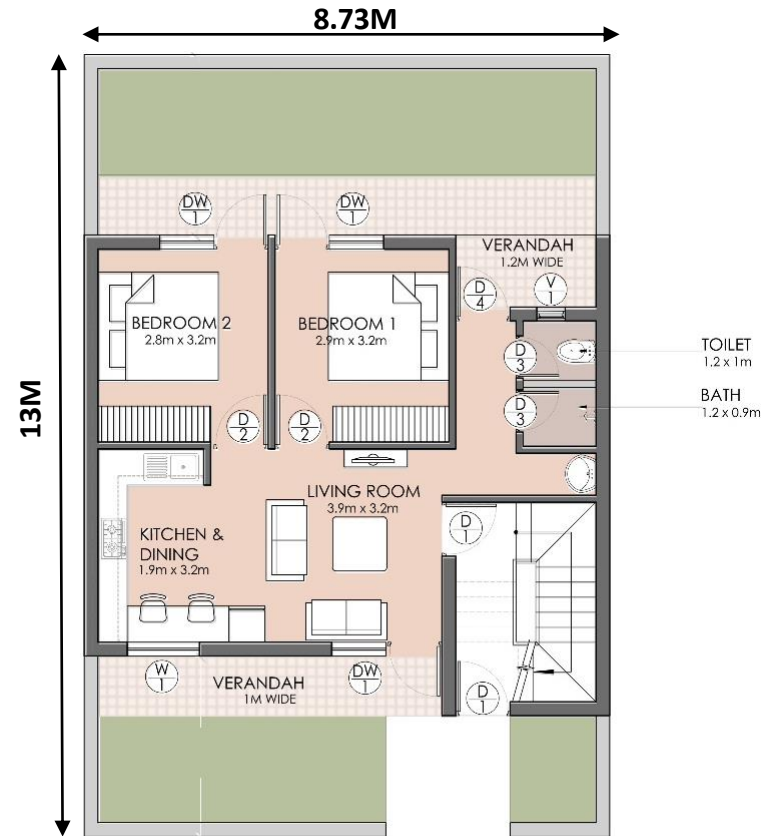
Row House two side open		1 BHK Up to 35Sqm	2 BHK Up to 45Sqm	Upto 45Sqm
Semi detached		1 BHK Up to 45Sqm		
Row House two side open		2 BHK Up to 30 sqm		45 – 60 Sqm
Semi detached		2 BHK Up to 45Sqm	2 BHK Up to 45Sqm	
Row House two side open		2 BHK Up to 75Sqm		60 – 90 Sqm
Semi detached		2 BHK Up to 90Sqm	3 BHK Up to 90Sqm	

Type designs - 10 nos

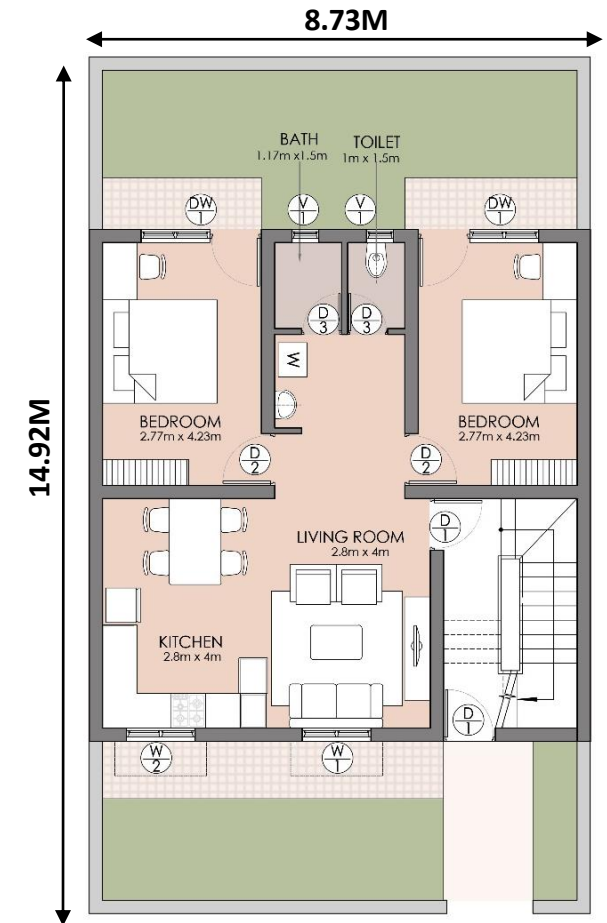
BLC 1 – 1BHK	
CARPET AREA	33.4Sqm
PLOT DIMENSION	12.73X6.23M
PLOT AREA	80Sqm



BLC 2 – 2BHK	
CARPET AREA	45 Sqm
PLOT DIMENSION	13 X 8.73M
PLOT AREA	113.5 Sqm



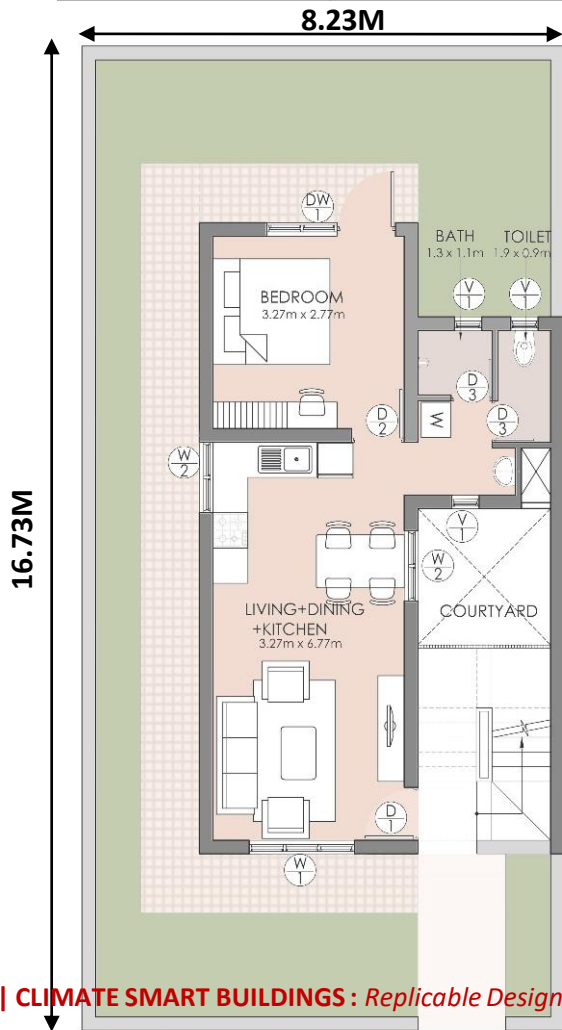
BLC 4 – 2BHK	
CARPET AREA	59Sqm
PLOT DIMENSION	14.92X8.73M
PLOT AREA	130 Sqm



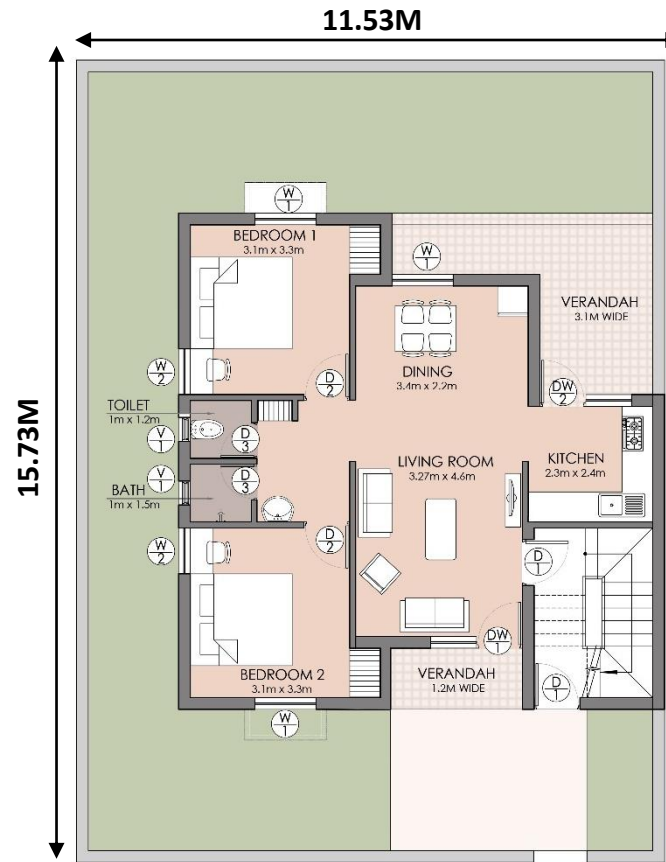
BLC INTRODUCTION

Type designs developed : Semi detached

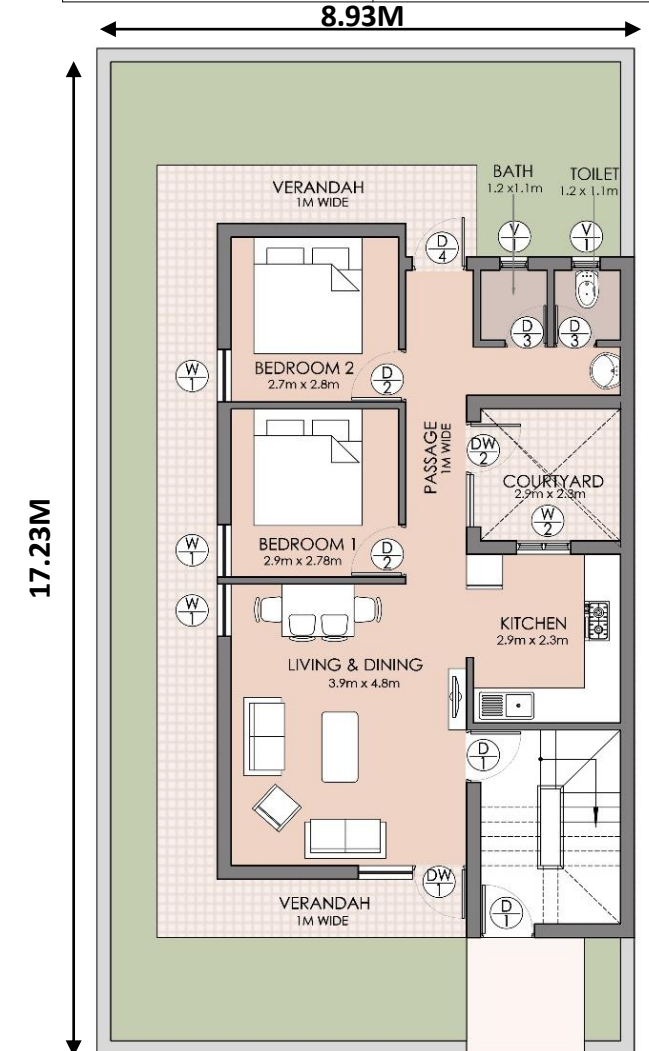
BLC 3 – 1BHK	
CARPET AREA	45 Sqm
PLOT DIMENSION	16.73 X 8.23M
PLOT AREA	138 Sqm.



BLC 5 – 2BHK	
CARPET AREA	54 Sqm
PLOT DIMENSION	15.73X11.53M
PLOT AREA	180 Sqm

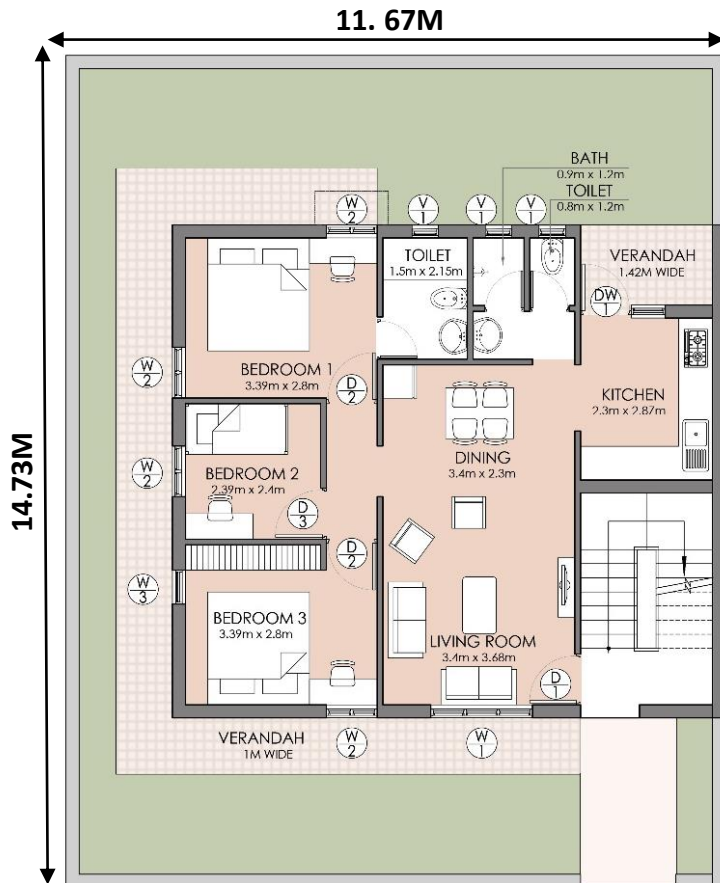


BLC 6 – 2BHK	
CARPET AREA	54Sqm
PLOT DIMENSION	17.23 X 8.93M
PLOT AREA	154 Sqm

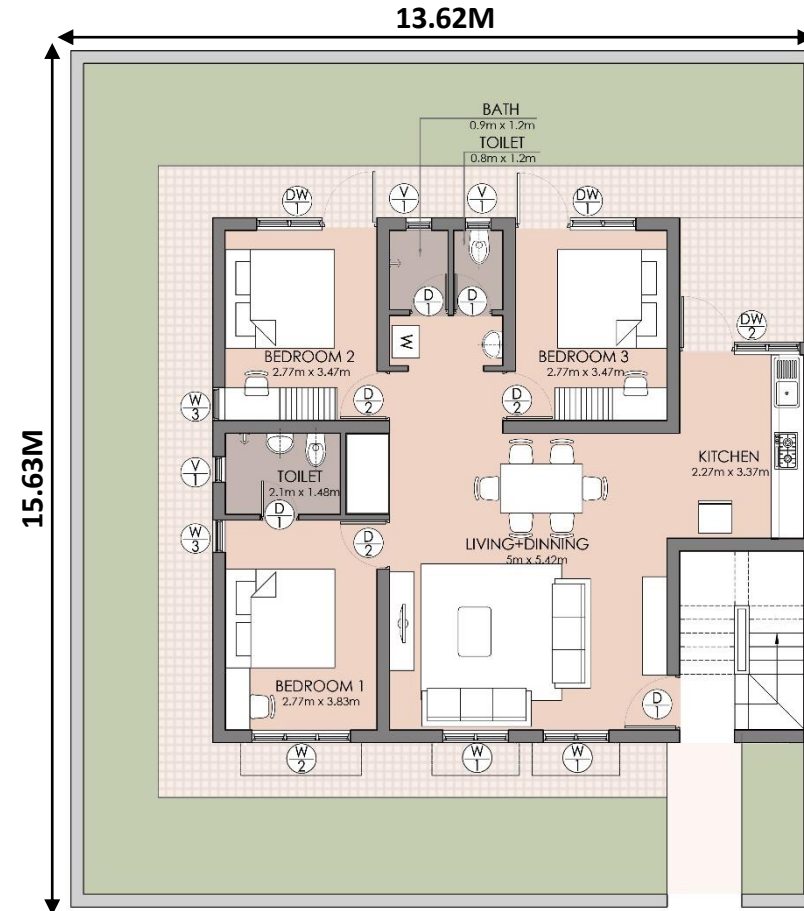


SESSION III

BLC 7 – 2.5BHK	
CARPET AREA	64Sqm
PLOT DIMENSION	14.73 X 11.67M
PLOT AREA	170Sqm

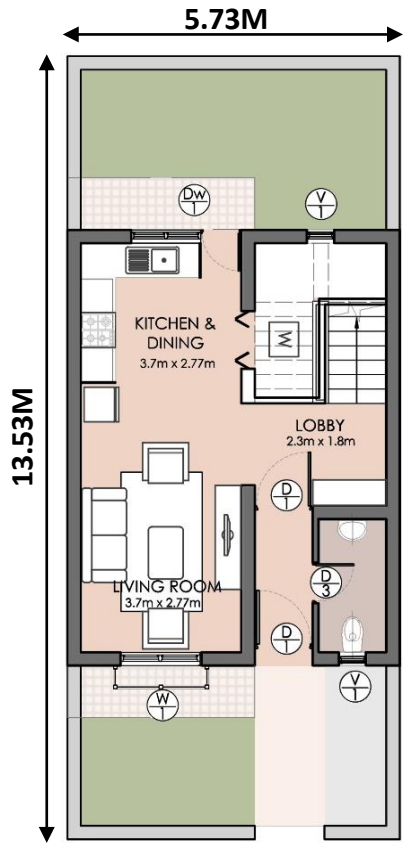


BLC 8 – 3BHK	
CARPET AREA	82Sqm
PLOT DIMENSION	15.63X13.62M
PLOT AREA	212Sqm

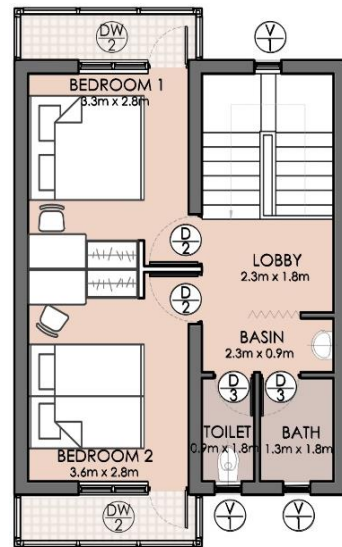


COLD CLIMATE

BLC 9 – 2BHK	
CARPET AREA	37.2 Sqm per floor
PLOT DIMENSION	13.53 X 5.73M
PLOT AREA	76 Sqm

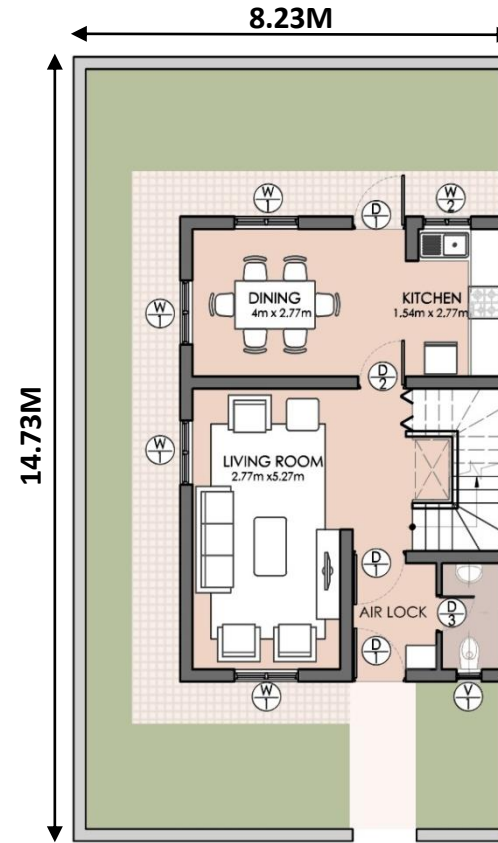


GROUND FLOOR PLAN

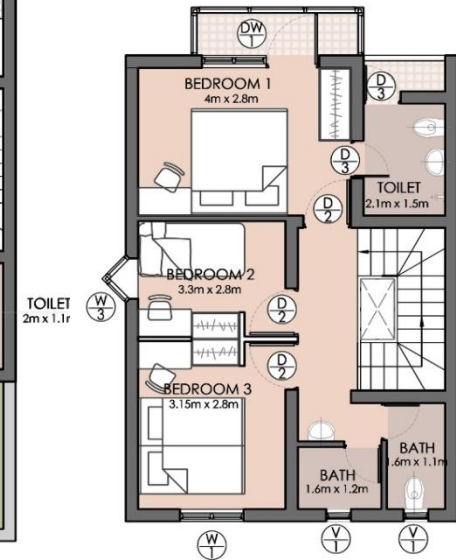


FIRST FLOOR PLAN

BLC 10 – 2.5BHK	
CARPET AREA	47 Sqm per floor
PLOT DIMENSION	14.73 X 8.23M
PLOT AREA	121 Sqm



GROUND FLOOR PLAN

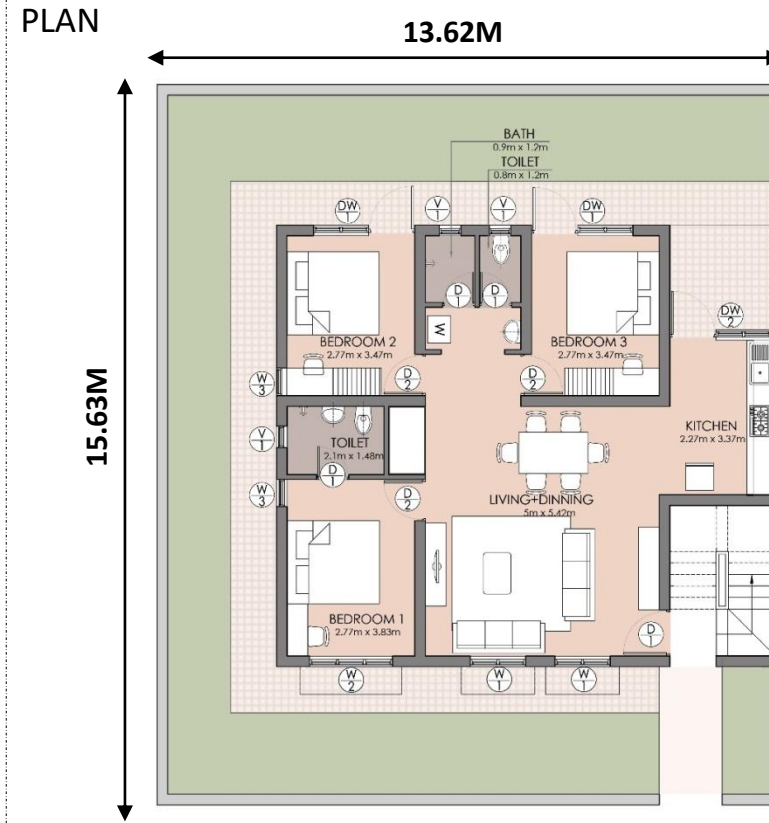


FIRST FLOOR PLAN

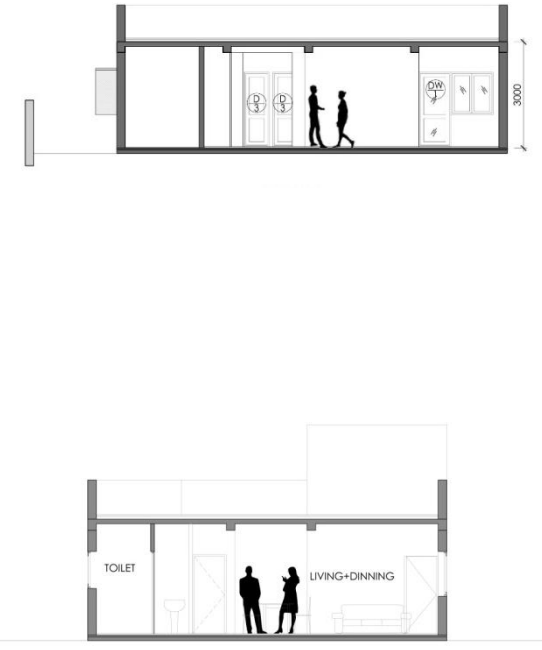
Replicable BLC Design Types

10 nos

- A) Design data**
 - Plans – Unit plan, Block Plan, Site Plan
 - Sections and Elevation
 - 3D Visuals
- B) Construction data**
 - Basic construction details
 - Plinth area based cost estimates



SECTION



ELEVATIONS



Questions and Feedback

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

SESSION IV

Introduction to Webtool & Next Steps

Speaker: Ms. Roopa Nair

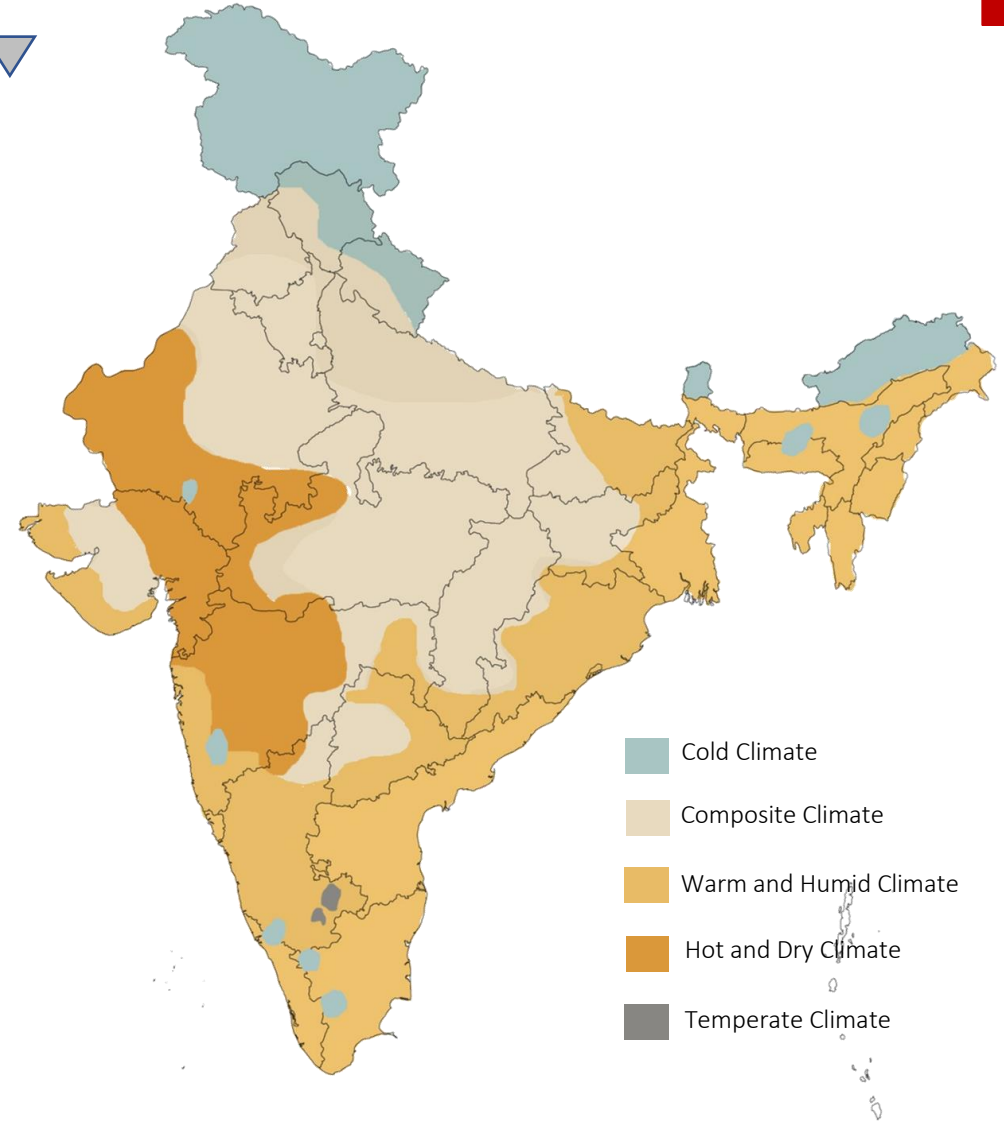
Climate zones

Step 1:
Identify Location

Select State



Select City



Climate zones

Step 1:
Identify Location

Kerala



Kochi



Climatic data

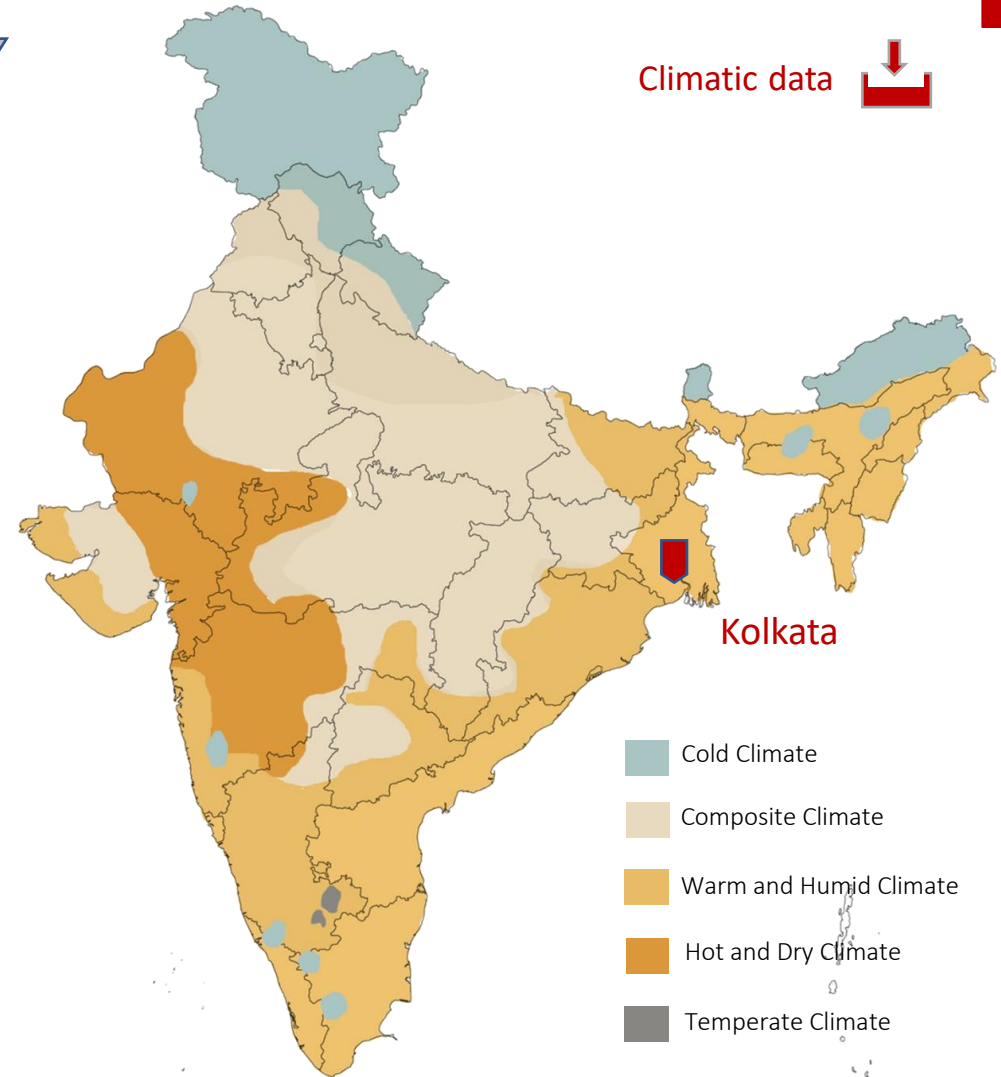


WARM AND HUMID CLIMATE

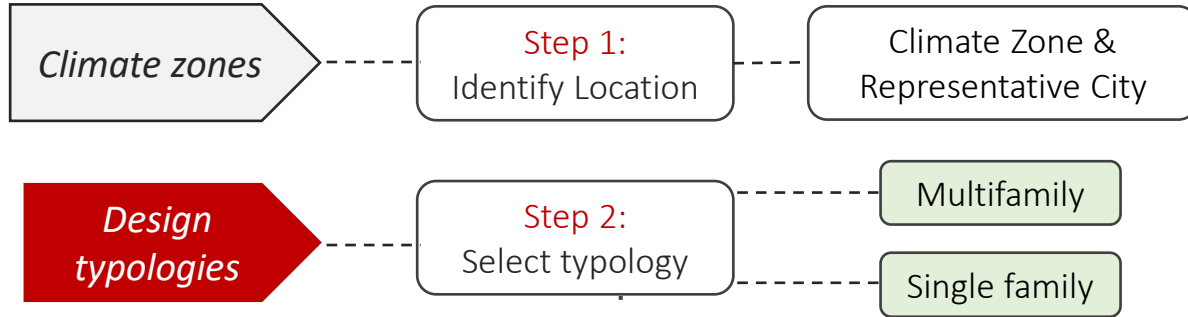
Representative city- Kolkata

Disclaimer:

This 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 of improving energy performance step by step is to be understood from this example and applied for other locations.

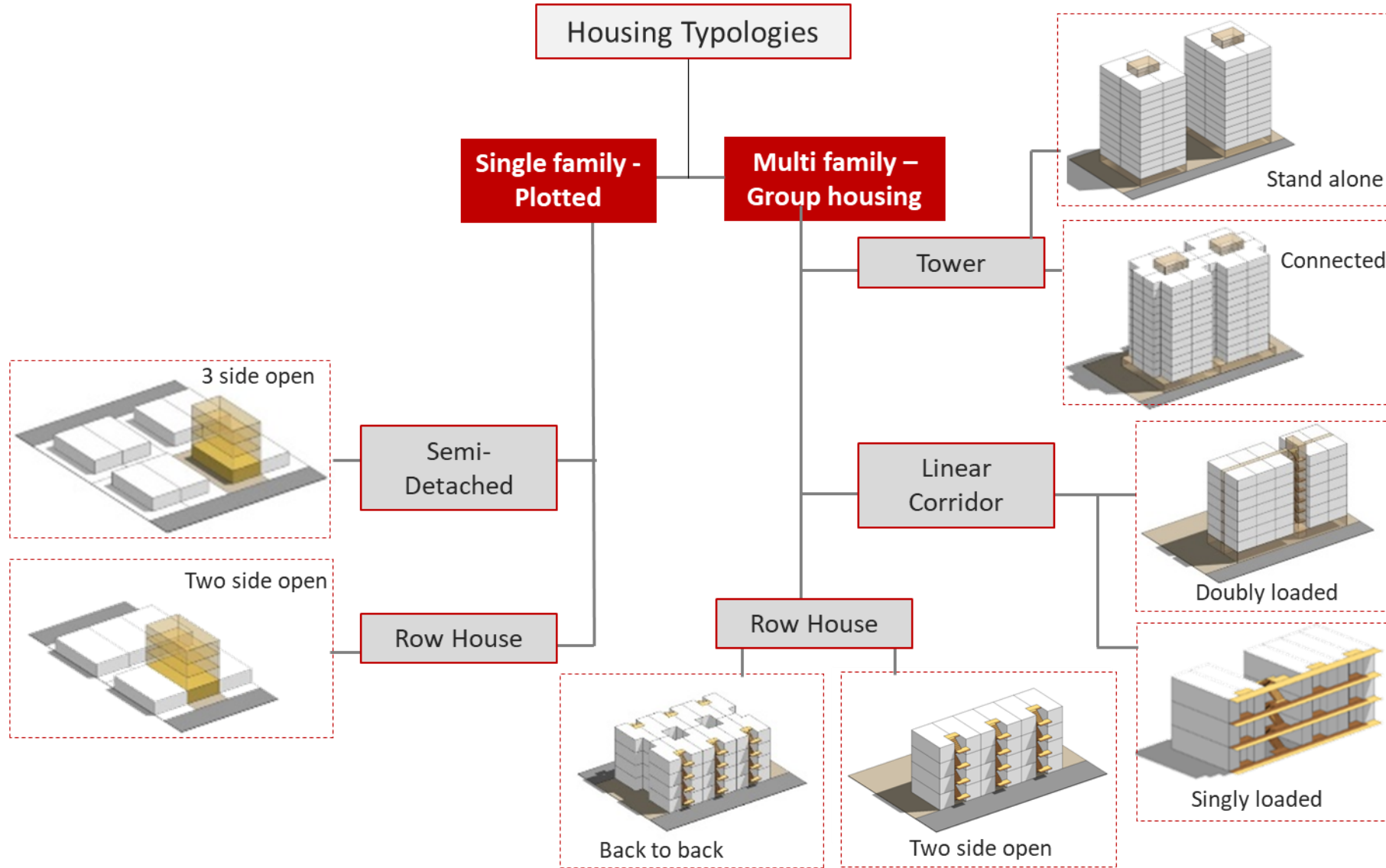


Next



Climate zones

Design typologies



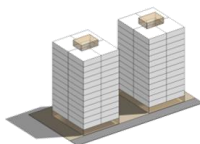
Climate zones

Design typologies

Design catalogue

Multi-Family

Tower Stand Alone



2 BHK

45 - 60 sqm

2 BHK

45 - 60 sqm

Tower Connected



1 BHK

45 - 60 sqm

1 BHK

45 - 60 sqm

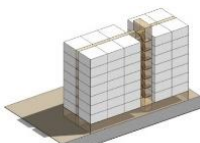
2 BHK

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

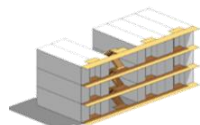
2 BHK

30 - 45 sqm

2 BHK

45 - 60 sqm

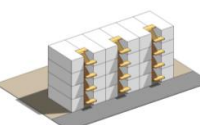
Singly loaded corridor



Dorm

Up to 30 sqm

Row House two side open



1 BHK

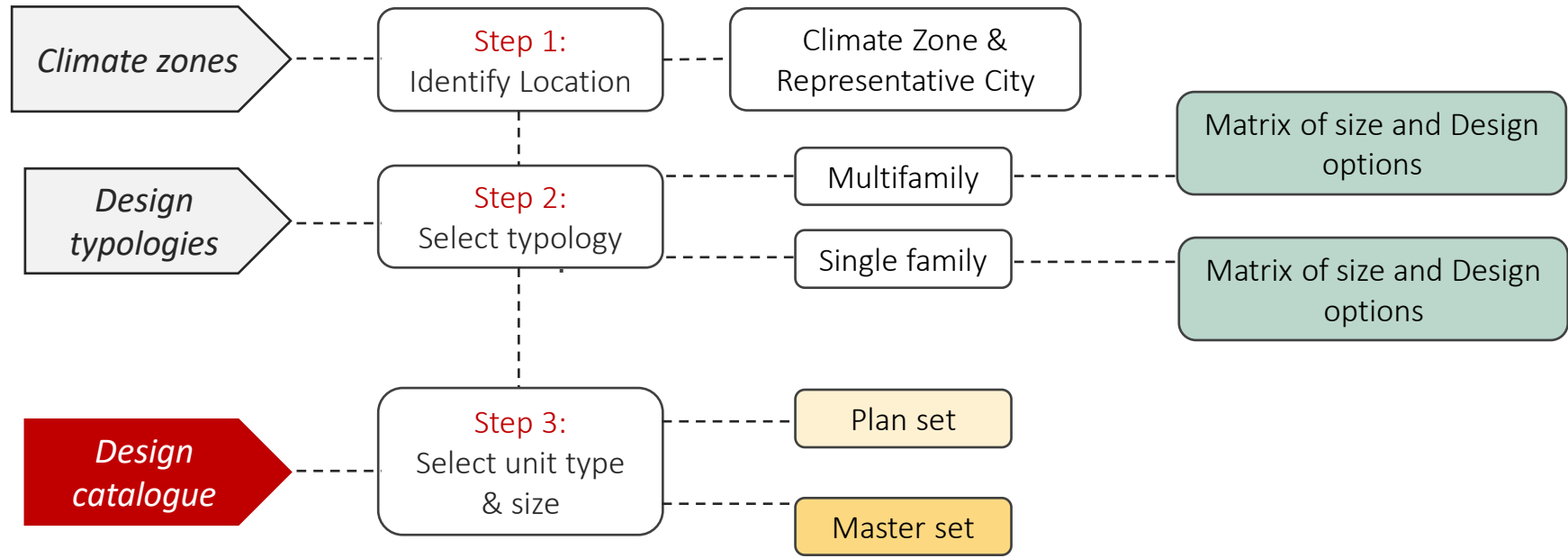
Up to 30 sqm

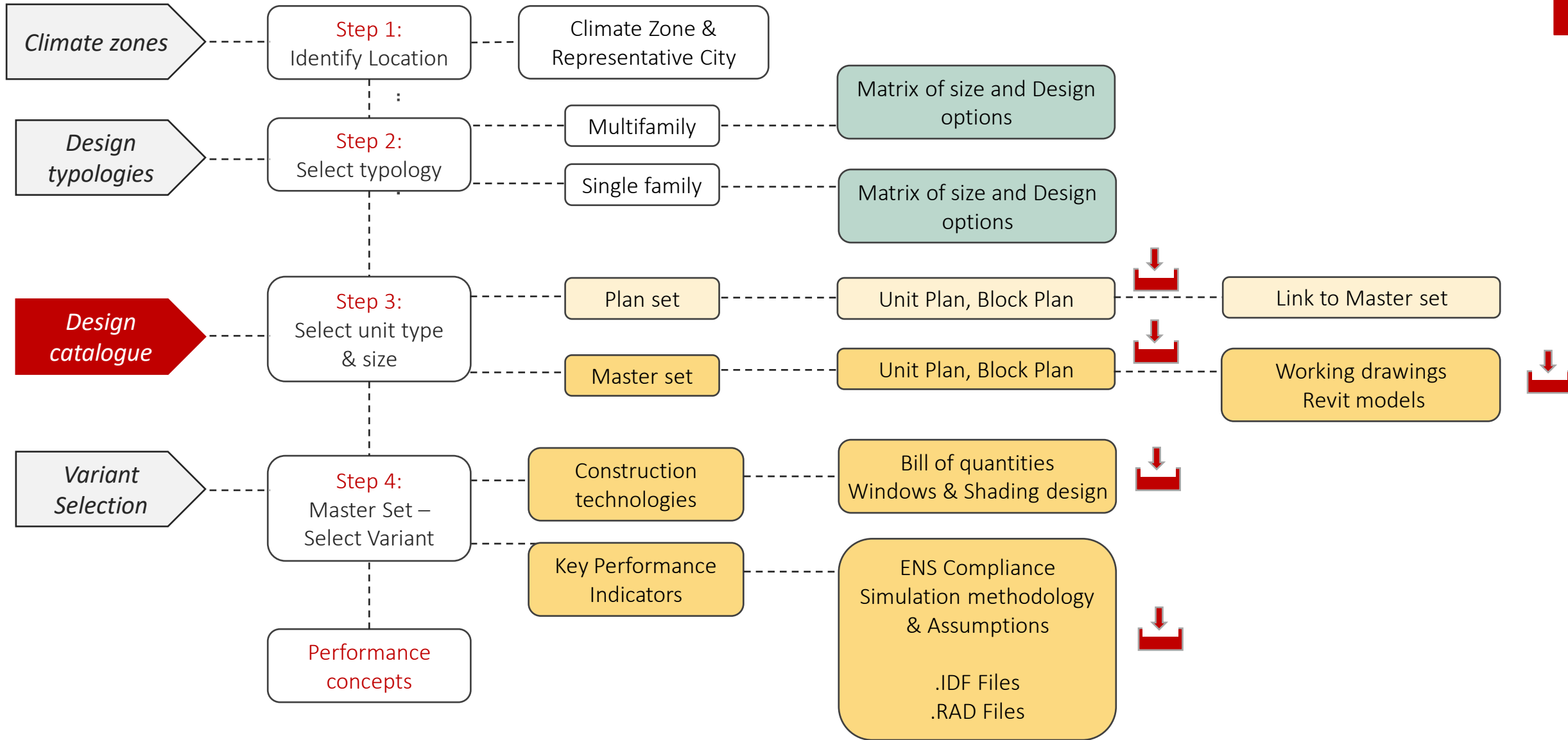
1 BHK

Up to 30 sqm

2 BHK

30 - 45 sqm





4th Stakeholder Consultation

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