Type Designs for Energy Efficient Residential Buildings

Webinar for Stakeholder Consultation

18th June 2020

german cooperation
DEUTSCHE ZUSAMMENARBEIT

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

Project Background

- The **residential sector accounts for 20% of the power consumption** of the country and is expected to grow exponentially in the coming years.

- With **India's commitment to sustainable development** and cutting down carbon emissions the building industry becomes a focus area for future development.

- Initiatives undertaken by agencies like **Bureau of Energy Efficiency (BEE**) and **GIZ** play a major role in **supporting the National Action Plan on Climate Change**.

- This project to Develop **Replicable Designs for Energy Efficient Residential Buildings** will **target the housing stock yet to be built** and ensure that it conforms to the best practices. This will ensure that the **relevant information on sustainable buildings is available** in easy to use format and has a **wide reach**.

The Team

ASHOK B LALL ARCHITECTS

(Team Lead)

LEAD CONSULTANCY

Bangaluru

PASSIVE HOUSE INSTITUTE

Germany

KPMG

India

Introduction

- The **Catalogue of Type designs for energy efficient Residential Buildings** and all related data will be made available to the users through a web-based tool.

- This **web-based platform** is a learning tool that will help **designers, builders and promoters** of residential buildings to understand the ways of designing **energy efficient buildings**.

- The tool covers various aspects of energy efficient design for residential buildings, bringing to the user **sample designs with detailed simulations** and identified **criteria for measuring the performance** of the building.

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

- With the help of this tool the user will be able to select the most suitable **Energy Efficiency Measures** (EEMs) applicable to their building to reach a desired performance bench mark.

Objectives

- The objective of the proposed assignment is **Developing a Catalogue of Replicable Design options for Energy Efficient Residential Buildings**.
- The building designs will set an example of energy and environmental performance that goes **beyond existing standards**.
- The project aims to develop a **design template** for building energy efficient homes, catering to:
  - Various **residential types**
  - Across different **house sizes**
  - In **different climatic zones** across India
- It shall implement energy efficiency through:
  - **Energy efficient design** implementing **passive measures**
  - Selection of **Low energy structure and materials**
  - Selection of **efficient mechanical systems** for thermal comfort
- The stakeholders who can benefit from this project include **builders, designers, home owners, Govt. agencies : Municipalities as well as policy makers**.

Sessions for this webinar

Session 1	‘Replicable’ Type Designs for energy Efficient Houses
	Residential typologies
Session 2	Principles of planning Energy Efficient buildings
	Construction Methodology & materials
Session 3	Energy Performance
Session 4	The Web-tool Package

‘Replicable’ Type Designs for Energy Efficient Residential Buildings

Session 1

Part A

What are ‘Replicable’ Type Designs for energy Efficient Houses?

- The type designs are a **medium to learn** about energy efficient design through examples.

- They start with the basic **principle of envelop protection**:
  - For hotter climates by **reducing exposed wall area** at the designing stage itself
  - **Allowing for solar gains** in living zones for colder regions through appropriate orientation & openings.

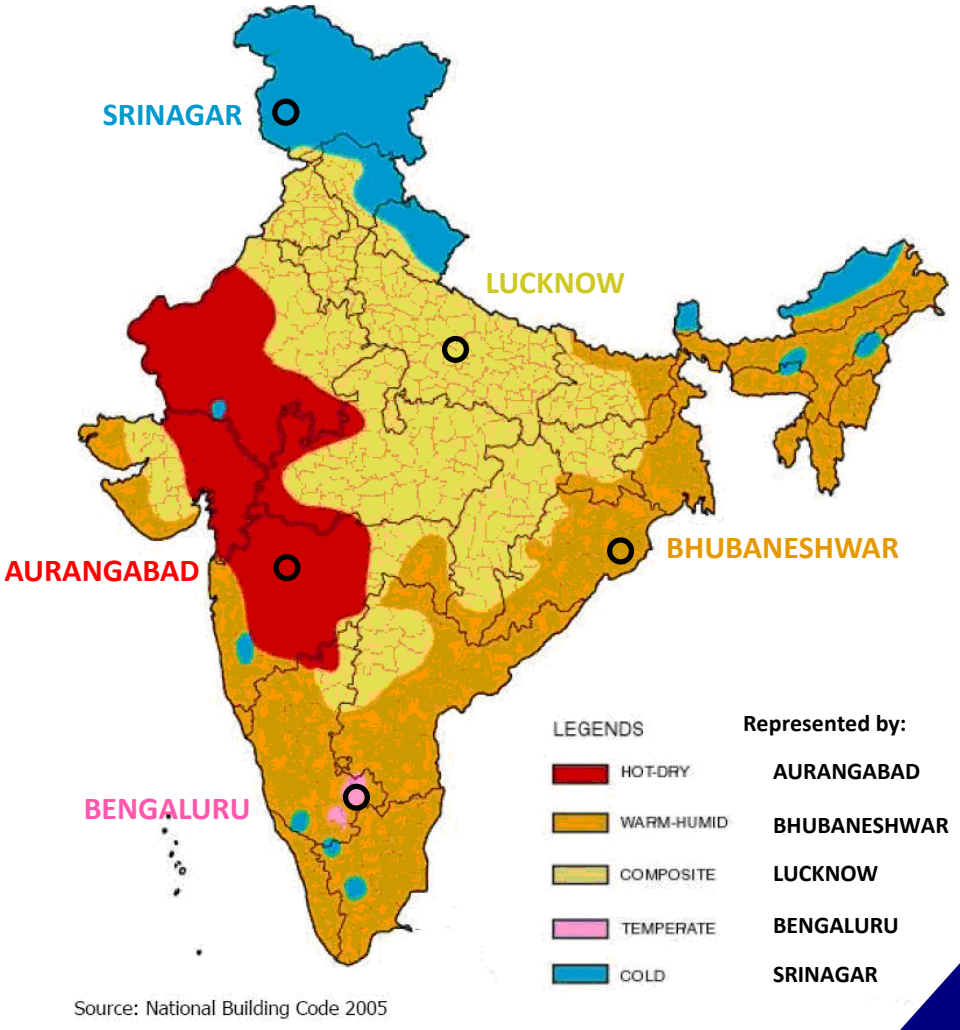
- The users are encouraged to learn from these case examples the **recommended measures and their impact**, to make an informed choice for their projects. These have to be **adapted and modified as per the specific location** and climate of your interest.

What are 'Replicable' Type Designs for energy Efficient Houses?

- In this study we have selected **5 representative cities** for 5 climate zones based on:
  - Their climate characteristics being a fair representation of the climate zone
  - Their development potential in the coming years.

- These are representative and 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.



Source: National Building Code 2005

Residential Typologies

Session 1

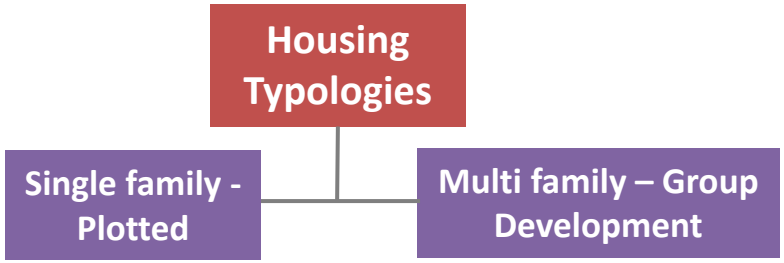
Part B

Residential Typologies

A combination of Expanding horizontally and vertically can lead to various design configurations and layouts:

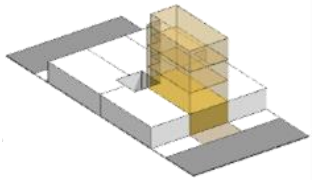
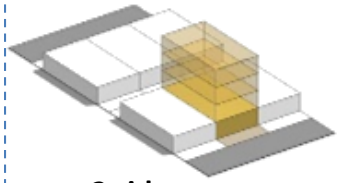
Residential Typologies

Categorization of Residential buildings: Range of building types seen today



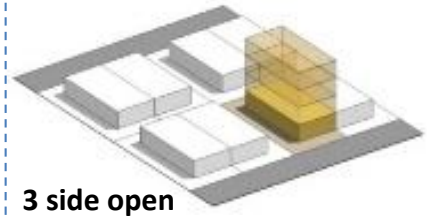
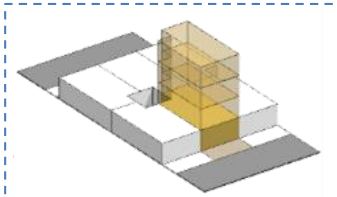
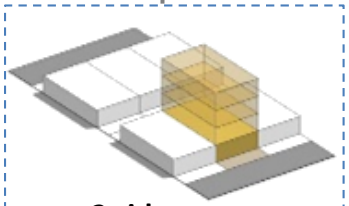
Residential Typologies

Housing Typologies

- **Single family - Plotted**
  - **Row House**
    - 
      Back to back
    - 
      2 side open
- **Multi family – Group Development**

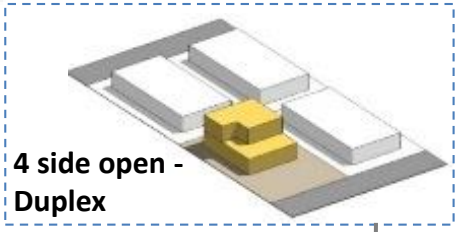
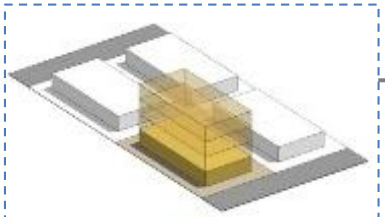
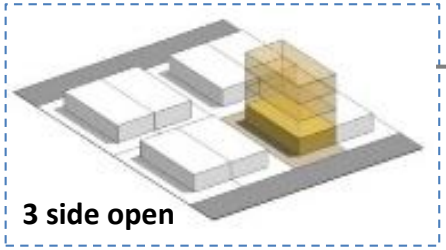
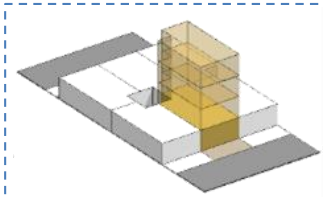
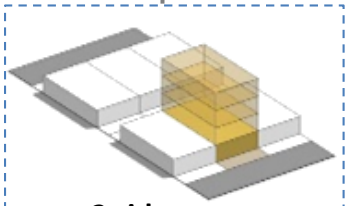
Residential Typologies

Housing Typologies

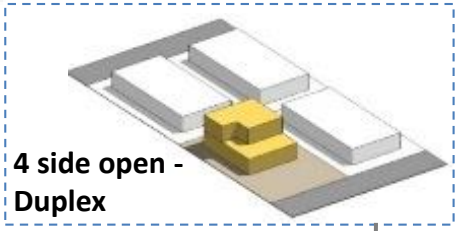
- **Single family - Plotted**
  - **Semi-Detached**
    - 
      3 side open
  - **Row House**
    - 
      Back to back
    - 
      2 side open
- **Multi family – Group Development**

Residential Typologies

Housing Typologies

- **Single family - Plotted**
  - **Detached**
    - 
      4 side open - Duplex
    - 
      4 side open - Single floor
  - **Semi-Detached**
    - 
      3 side open
  - **Row House**
    - 
      Back to back
    - 
      2 side open
- **Multi family – Group Development**

Residential Typologies

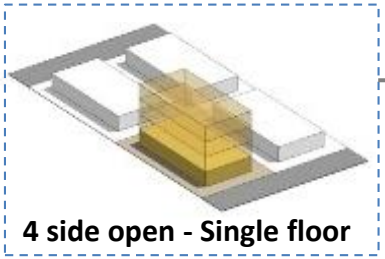


Housing Typologies

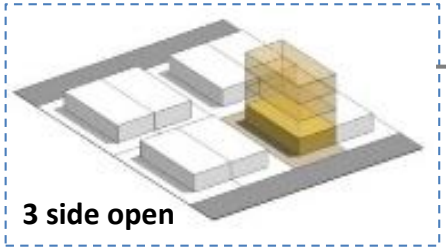
Single family - Plotted

Multi family – Group Development

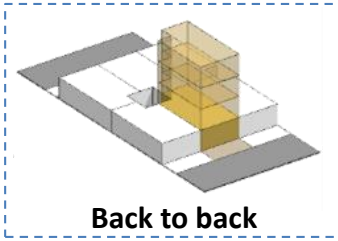
Detached

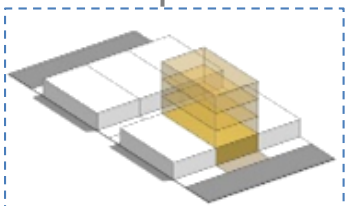


Semi-Detached

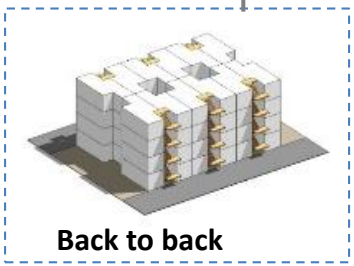


Row House



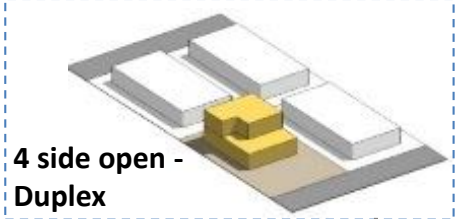
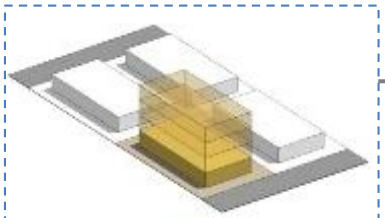
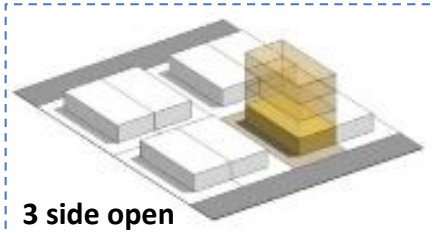
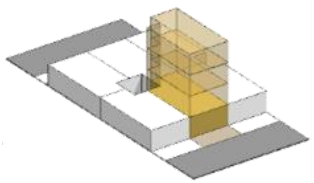
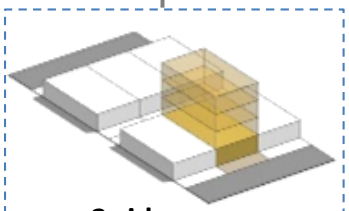
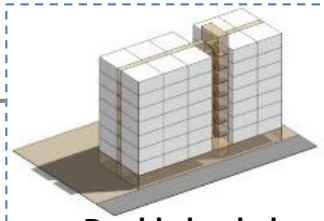
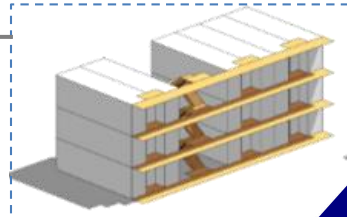
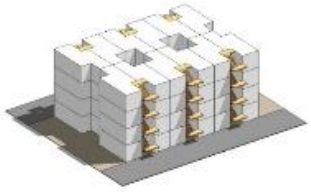
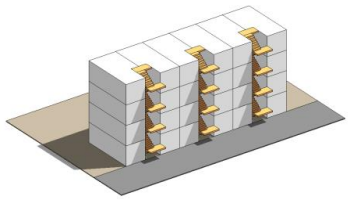


Row House



Residential Typologies

Housing Typologies

- **Single family - Plotted**
  - **Detached**
    - 
      4 side open - Duplex
    - 
      4 side open - Single floor
  - **Semi-Detached**
    - 
      3 side open
  - **Row House**
    - 
      Back to back
    - 
      2 side open
- **Multi family – Group Development**
  - **Linear Corridor**
    - 
      Doubly loaded
    - 
      Singly loaded
  - **Row House**
    - 
      Back to back
    - 
      2 side open

Residential Typologies

Housing Typologies

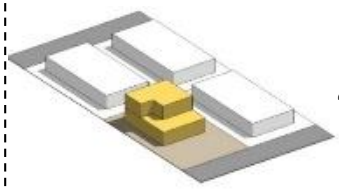
- **Single family - Plotted**
  - **Detached**
    - 4 side open - Duplex
    - 4 side open - Single floor
  - **Semi-Detached**
    - 3 side open
  - **Row House**
    - Back to back
    - 2 side open
- **Multi family – Group Development**
  - **Tower**
    - Stand alone
    - Connected
  - **Linear Corridor**
    - Doubly loaded
    - Singly loaded
  - **Row House**
    - Back to back
    - 2 side open

Residential Typologies: Categorization by height

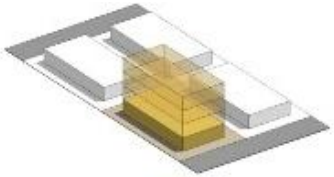
Housing Typologies

Single family - Plotted | **Multi family – Group Development**

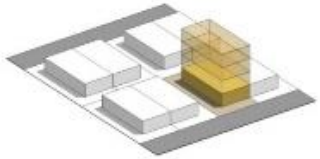
From single upto 4 storey



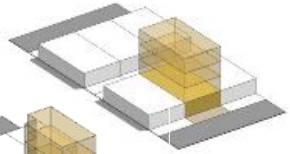
4 side open Row House (Duplex)



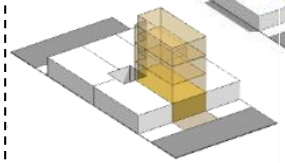
4 side open Row House (Detached)



3 side open Row House (Semi detached)



2 side open Row House



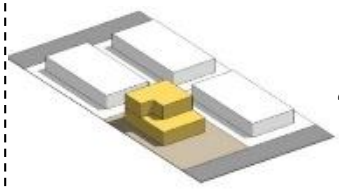
Back to back Row House

Residential Typologies: Categorization by height

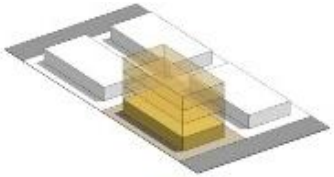
Housing Typologies

Single family - Plotted

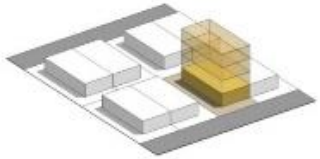
From single upto 4 storey



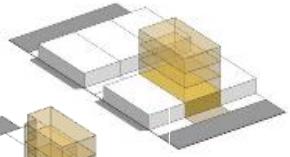
4 side open Row House (Duplex)



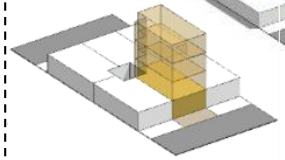
4 side open Row House (Detached)



3 side open Row House (Semi detached)



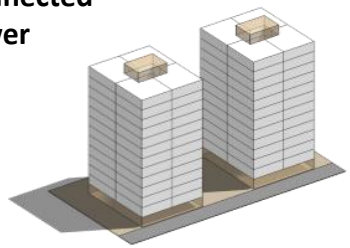
2 side open Row House



Back to back Row House

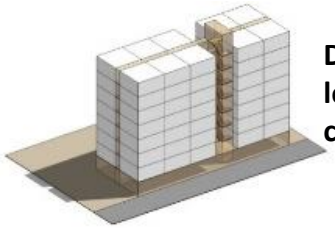
Multi family – Group Development

Connected tower

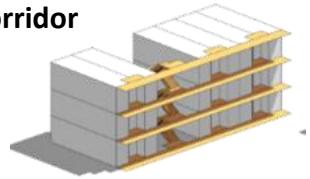


Stand alone tower

High Rise G+12

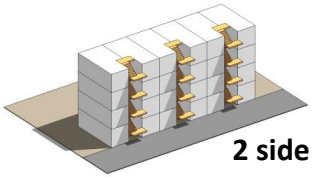


Doubly loaded corridor

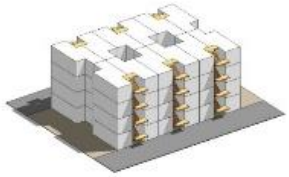


Singly loaded corridor

Mid Rise G+7



2 side open Row House



Back to back Row House

Low Rise G+3

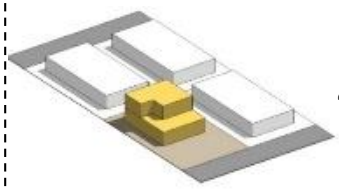
Residential Typologies: Categorization by height

Housing Typologies

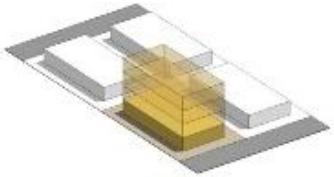
Single family - Plotted

Multi family – Group Development

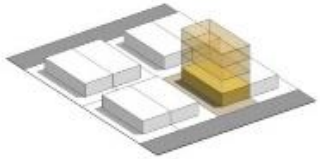
From single upto 4 storey



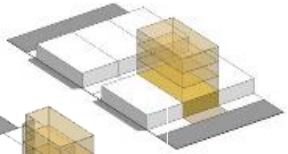
4 side open Row House (Duplex)



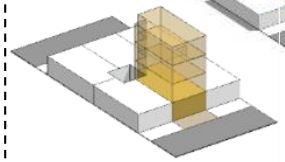
4 side open Row House (Detached)



3 side open Row House (Semi detached)



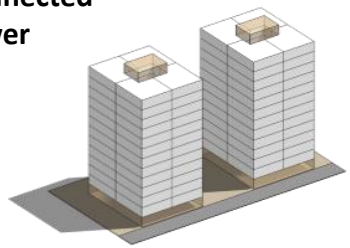
2 side open Row House



Back to back Row House

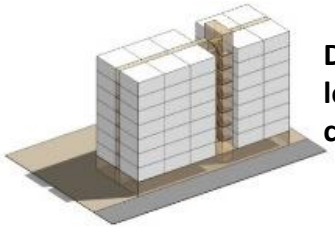
INCREASING BUILDING HEIGHT

Connected tower

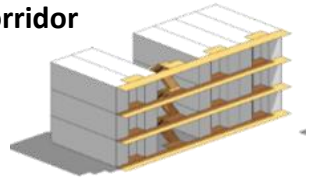


Stand alone tower

High Rise G+12

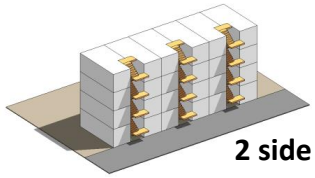


Doubly loaded corridor

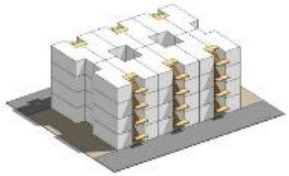


Singly loaded corridor

Mid Rise G+7



2 side open Row House



Back to back Row House

Low Rise G+3

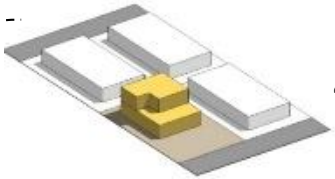
For walk-up row houses low rise works well. For corridor typology mid rise is workable while tower typology works well for high rise

Residential Typologies: Categorization by size

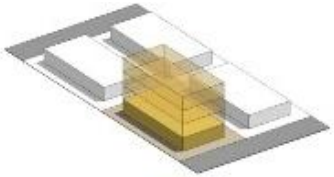
Housing Typologies

Single family - Plotted | **Multi family – Group Development**

PLOTS >300 sqm

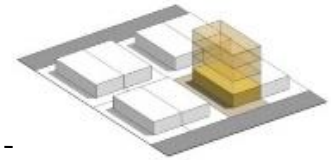


4 side open Row House (Duplex)



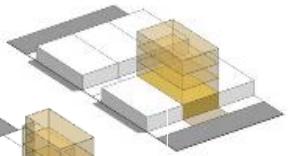
4 side open Row House (Detached)

PLOTS 200-300 sqm

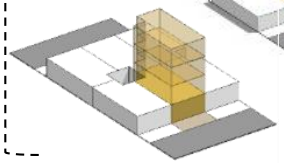


3 side open Row House (Semi detached)

PLOTS 80-200 sqm



2 side open Row House



Back to back Row House

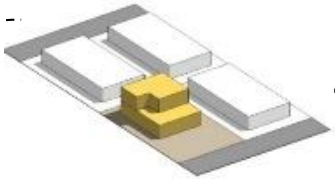
As the plot sizes increase the set back requirements increase resulting in different types

Residential Typologies: Categorization by size

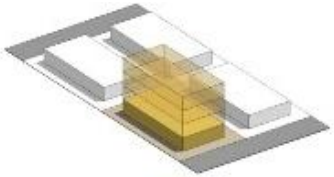
Housing Typologies

- **Single family - Plotted**
- **Multi family – Group Development**

PLOTS >300 sqm

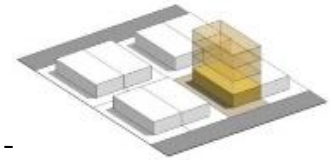


4 side open Row House (Duplex)



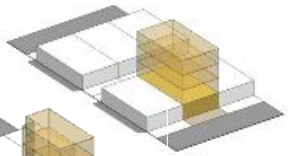
4 side open Row House (Detached)

PLOTS 200-300 sqm

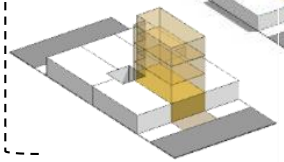


3 side open Row House (Semi detached)

PLOTS 80-200 sqm



2 side open Row House



Back to back Row House

INCREASING UNIT/ PLOT SIZE

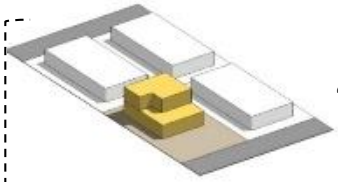
As the plot sizes increase the set back requirements increase resulting in different types

Residential Typologies: Categorization by size

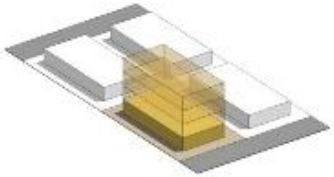
Housing Typologies

Single family - Plotted

PLOTS >300 sqm

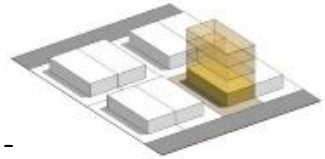


4 side open Row House (Duplex)



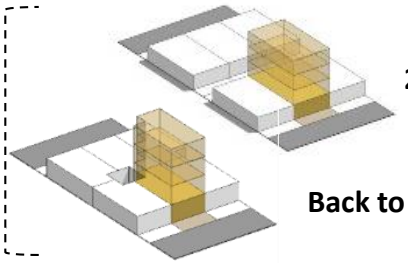
4 side open Row House (Detached)

PLOTS 200-300 sqm



3 side open Row House (Semi detached)

PLOTS 80-200 sqm



2 side open Row House

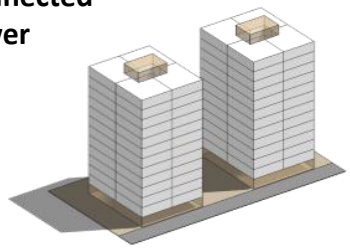
Back to back Row House

INCREASING UNIT/ PLOT SIZE

Multi family – Group Development

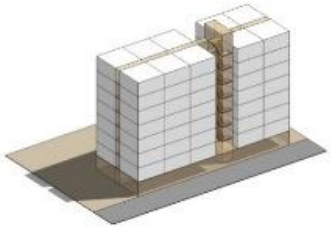
100-250 sqm

Connected tower

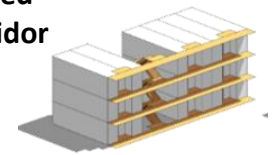


Stand alone tower

50-100 sqm

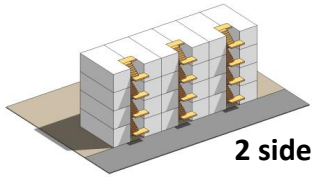


Doubly loaded corridor



Singly loaded corridor

30-70 sqm



2 side open Row House

Back to back Row House

As the plot sizes increase the set back requirements increase resulting in different types

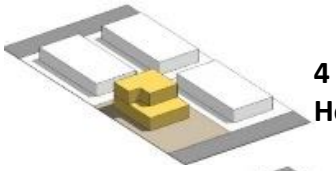
The row house typology is more suitable for smaller homes while the tower typology is more suitable for the bigger homes

Residential Typologies: Trends in Compactness

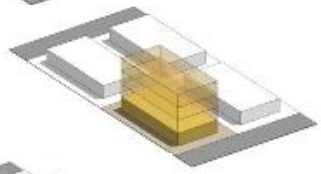
Compactness = Envelope area to Floor Area Ratio
Compactness depends on the geometry of the building and it varies with typology

Housing Typologies

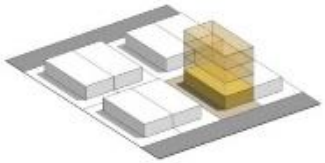
- **Single family - Plotted**
- **Multi family – Group Development**



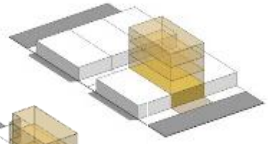
4 side open Row House (Duplex)



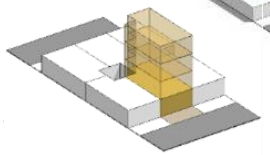
4 side open Row House (Detached)



3 side open Row House (Semi detached)



2 side open Row House



Back to back Row House

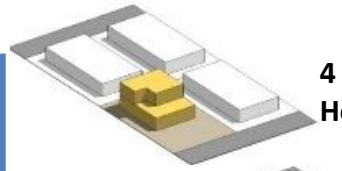
Residential Typologies: Trends in Compactness

Compactness = Envelope area to Floor Area Ratio
Compactness depends on the geometry of the building and it varies with typology

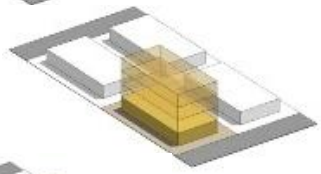
Housing Typologies

Single family - Plotted | **Multi family – Group Development**

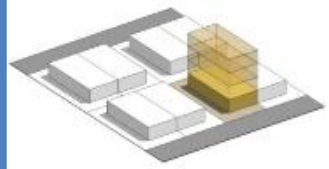
INCREASING COMPACTNESS



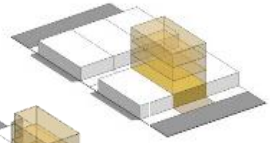
4 side open Row House (Duplex)



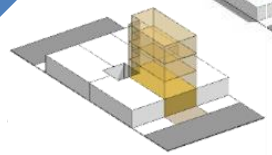
4 side open Row House (Detached)



3 side open Row House (Semi detached)



2 side open Row House



Back to back Row House

The compactness decreases as the wall to floor area ratio increases. This is an important factor to limit the area of external envelop exposed to the outside.

Residential Typologies: Trends in Compactness

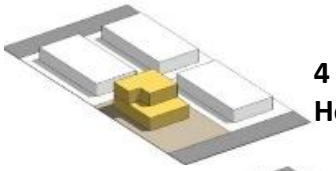
Compactness = Envelope area to Floor Area Ratio
Compactness depends on the geometry of the building and it varies with typology

Housing Typologies

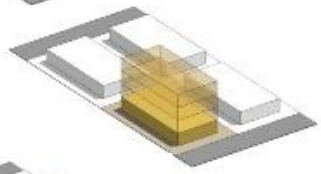
Single family - Plotted

Multi family – Group Development

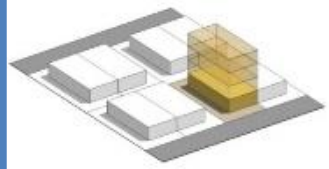
INCREASING COMPACTNESS



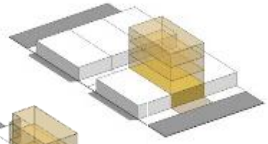
4 side open Row House (Duplex)



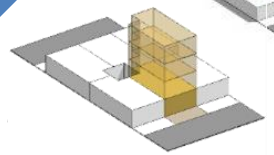
4 side open Row House (Detached)



3 side open Row House (Semi detached)

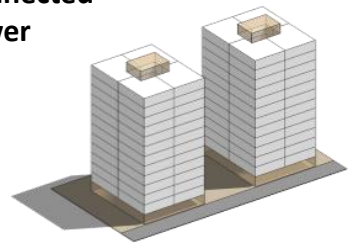


2 side open Row House

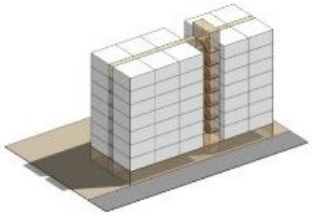


Back to back Row House

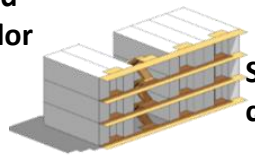
Connected tower



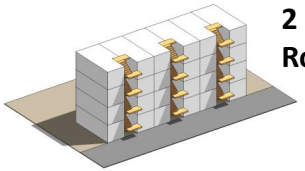
Stand alone tower



Doubly loaded corridor



Singly loaded corridor



2 side open Row House

Back to back Row House

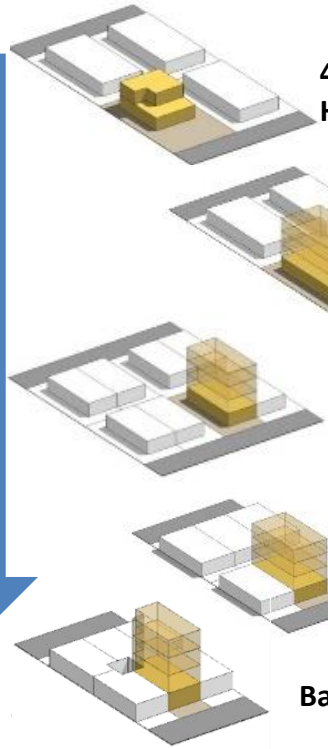
The compactness decreases as the wall to floor area ratio increases. This is an important factor to limit the area of external envelop exposed to the outside.

Residential Typologies: Trends in Compactness

Compactness = Envelope area to Floor Area Ratio
Compactness depends on the geometry of the building and it varies with typology

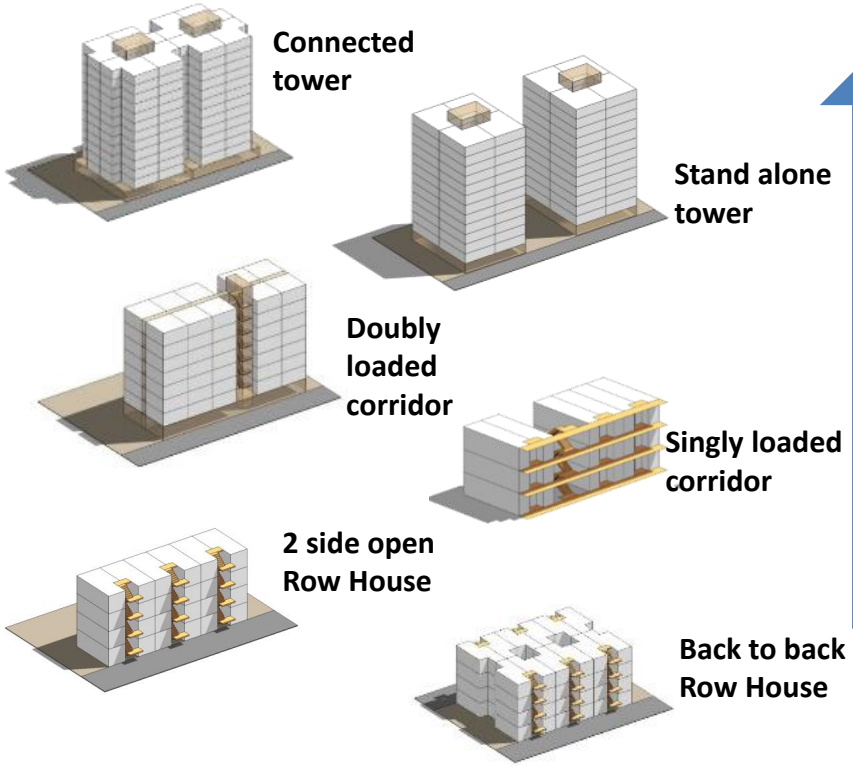
Housing Typologies

Single family - Plotted



INCREASING COMPACTNESS

Multi family – Group Development



INCREASING COMPACTNESS

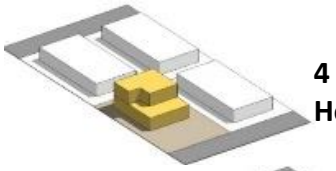
The compactness decreases as the wall to floor area ratio increases. This is an important factor to limit the area of external envelop exposed to the outside.

Residential Typologies: Trends in Compactness

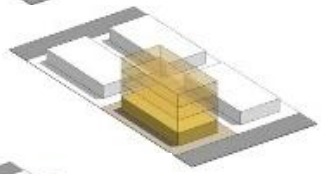
Compactness = Envelope area to Floor Area Ratio
Compactness depends on the geometry of the building and it varies with typology

Housing Typologies

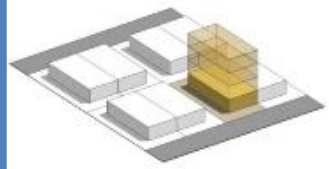
Single family - Plotted



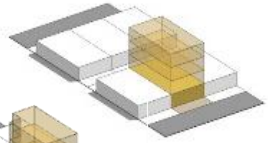
4 side open Row House (Duplex)



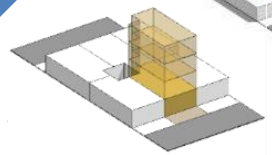
4 side open Row House (Detached)



3 side open Row House (Semi detached)



2 side open Row House



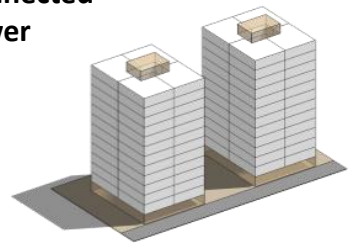
Back to back Row House

INCREASING COMPACTNESS

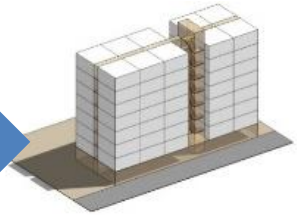
Multi family – Group Development

Multi Family buildings offer better compactness

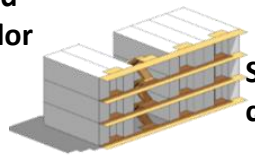
Connected tower



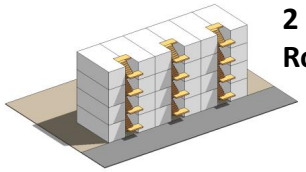
Stand alone tower



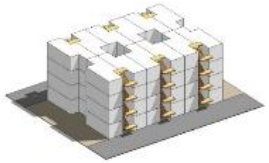
Doubly loaded corridor



Singly loaded corridor



2 side open Row House



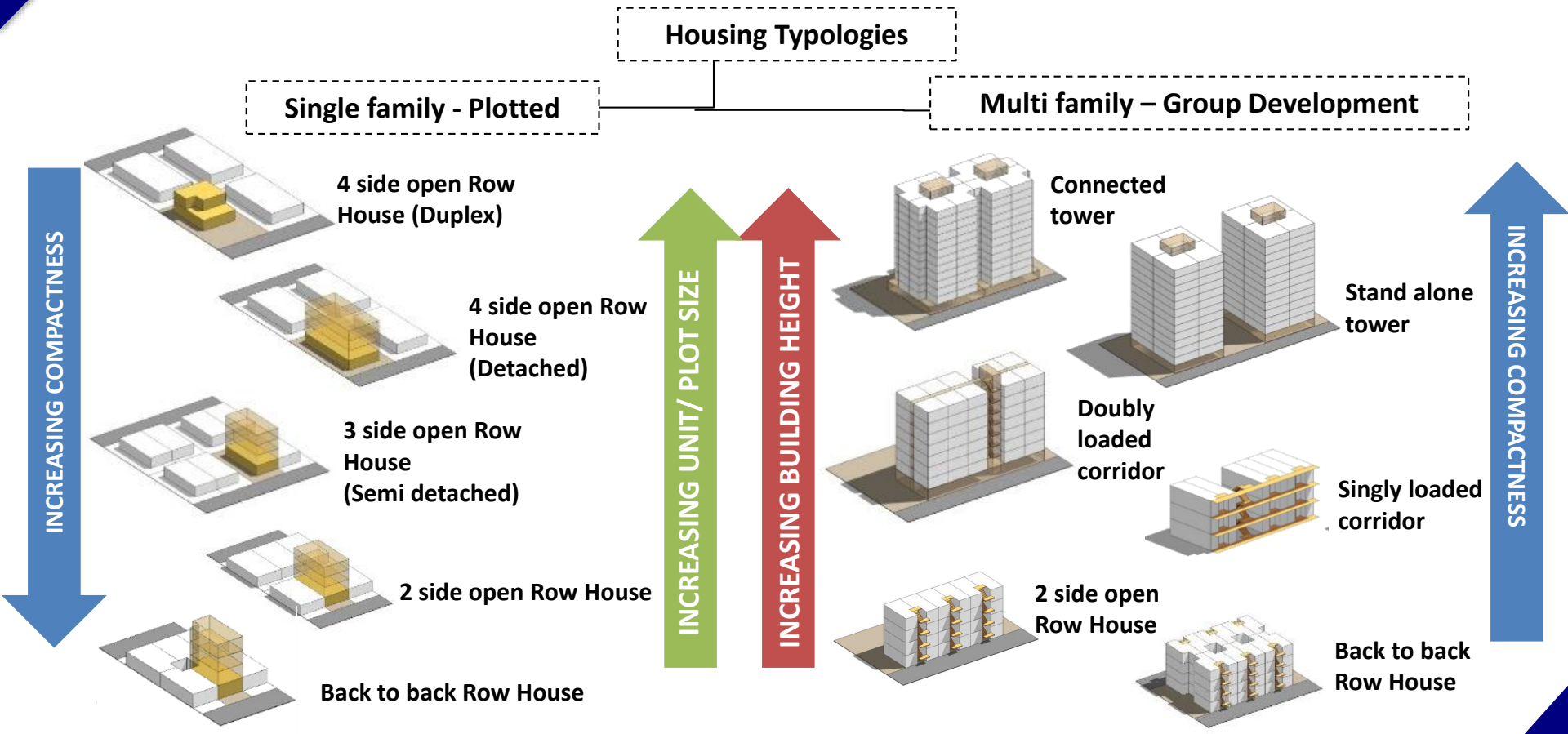
Back to back Row House

INCREASING COMPACTNESS

The compactness decreases as the wall to floor area ratio increases. This is an important factor to limit the area of external envelop exposed to the outside.

Residential Typologies

Categorization of Residential buildings: Range of building types seen today

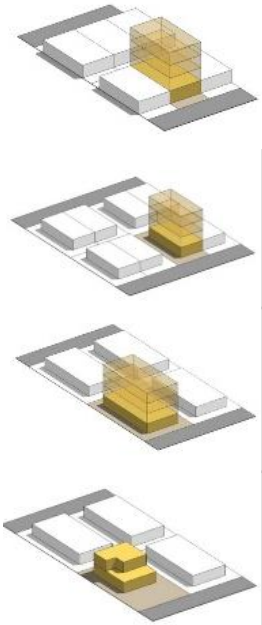


Residential Typologies

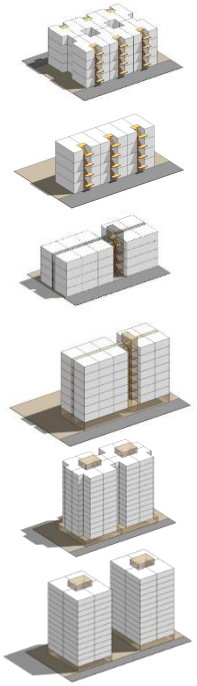
Categorization of Residential buildings: Range of building types seen today

Housing Typologies

- **Single family - Plotted**
- **Multi family – Group Development**



Low Rise (Building Height <=15m)						
Row House – 2 side open	1BHK (Plot area 80sqm)	2BHK (Plot area 160sqm)				
Row House – 3 side open (semi detached)			3BHK (Plot area 200sqm)	4BHK (Plot area 240sqm)	3BHK (Plot area 300sqm)	
Row House – 4 side open (detached)						3BHK (Plot area 375sqm)
Row House – 4 side open (duplex)						5BHK (Plot area 375sqm)



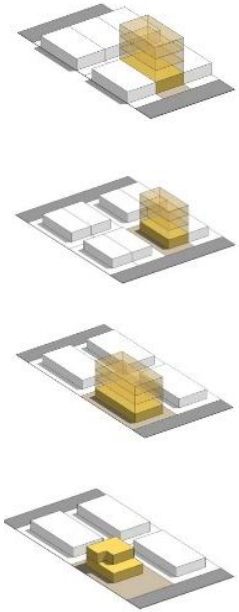
Residential Typologies

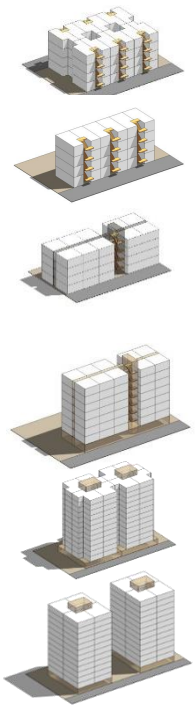
Categorization of Residential buildings: Range of building types seen today

Housing Typologies

Single family - Plotted

Multi family – Group Development





Low Rise (Building Height <=15m)						
Back to back row house	1BHK (30sqm)	2BHK (41sqm)	3BHK (55sqm)			
2 side open row house	1BHK (32sqm)	2BHK (48sqm)	3BHK (62/68 sqm)			
Doubly loaded corridor	1BHK (30sqm)					
Mid/ High Rise (Building Height>15m)						
Doubly loaded corridor		1BHK (44sqm)	2BHK (65sqm)	3BHK (85sqm)		
Connected Towers			3BHK (105sqm)	3BHK (125sqm)		
Stand-alone Towers			3BHK (105sqm)	3BHK (125sqm)	3.5 BHK (156sqm)	4.5 BHK (225sqm)

Questions & Feedback

End of Session 1 –

Replicable designs and Residential typologies

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

https://www.surveymonkey.com/r/VKNTTPM

Principles of planning Energy Efficient buildings

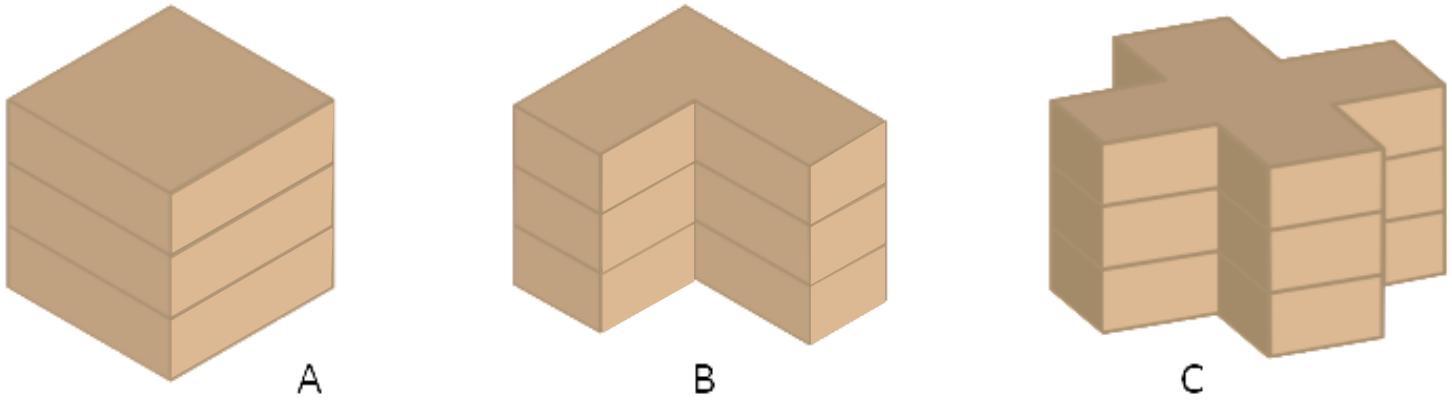
Session 2

Part A

Principles of Planning

Compactness

Compactness = Envelope area to Floor Area Ratio
Compactness depends on the geometry of the building and it varies with typology



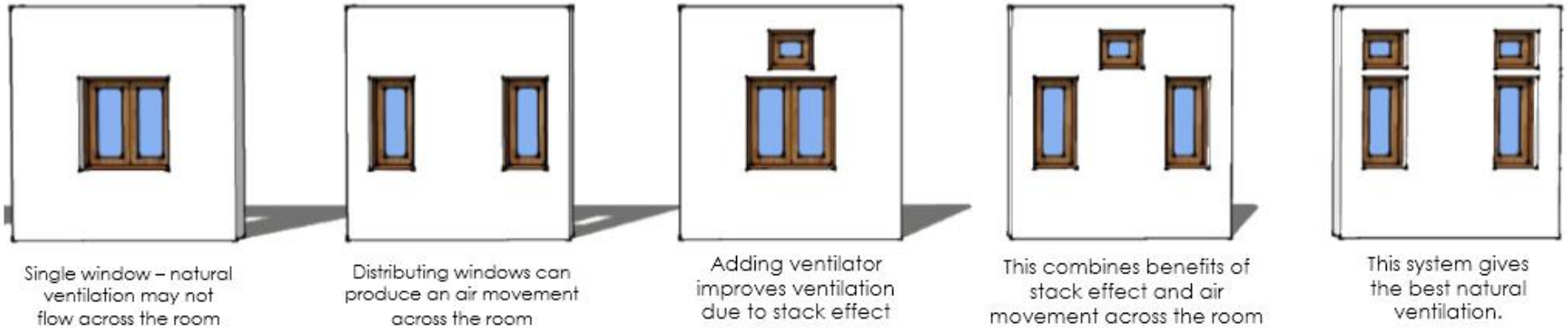
Surface to Volume ratio increase from A to C as the built form gets more complicated

Principles of Planning

Protection from heat:

- **Control Window to Wall area Ratio (WWR)**
- **Select external wall material for insulation value**

Rate of heat Exchange

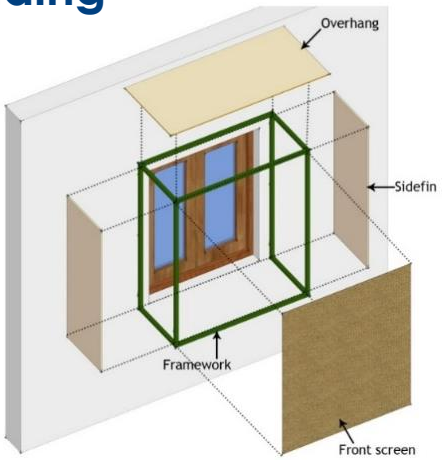


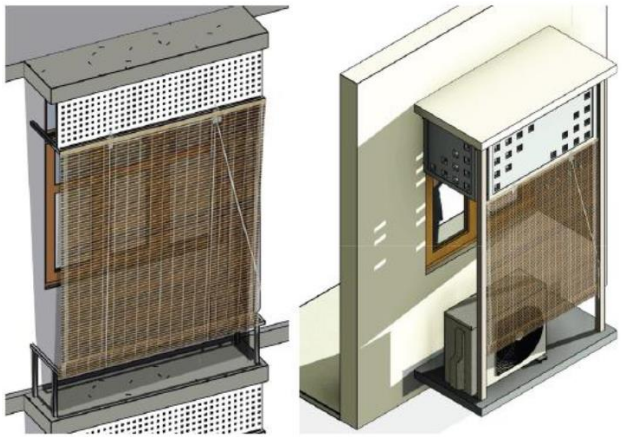
Comparison of different openings on façade with same WWR for heat exchange

Principles of Planning

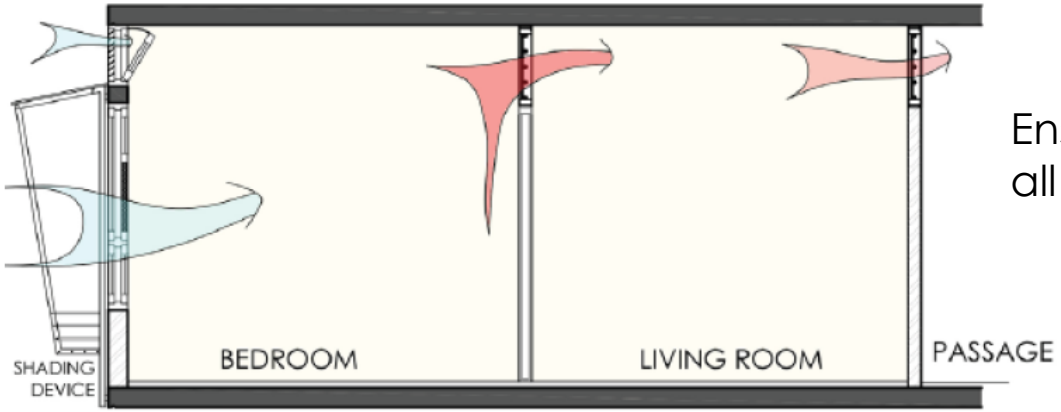
Protection through shading

Shading devices to cut Solar gains





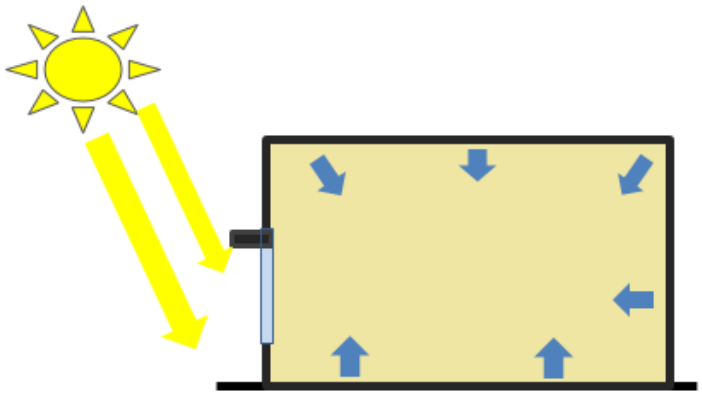
Optimize openings & windows for ventilation



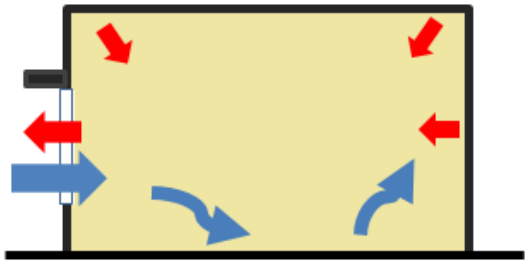
Ensure cross ventilation through all living spaces of the house

Principles of Planning

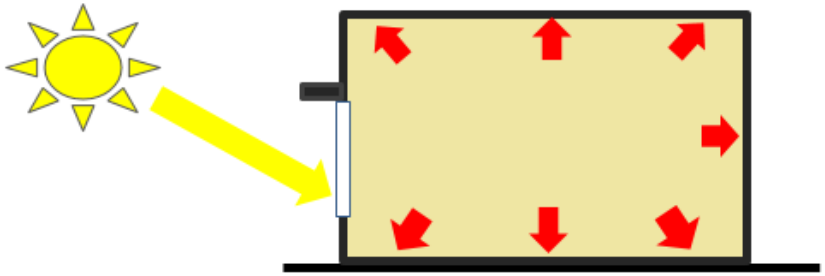
Use of thermal mass & solar gains to make the inside comfortable



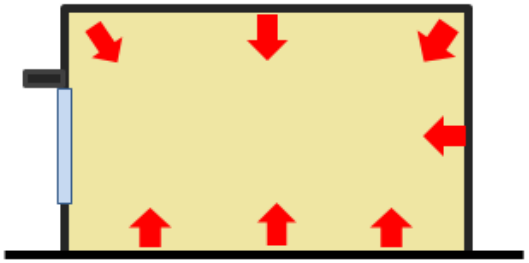
Summer Day: thermal mass will ensure delay in heat transfer to the inside



Summer Night: ventilation at night will help cool the building mass down



Winter Day: Solar heat gets stored in the built mass



Winter Night: the heat stored during the day is radiated inside

Principles of Planning

Passive Strategies adopted in different climate zones

CLIMATE ZONE	COMPACTNESS	SHADING	THERMAL MASS	INSULATION (ROOF, WALL, WINDOW)	VENTILATION	SOLAR ACCESS
Hot & dry (Aurangabad)	✓✓✓	✓✓	✓✓	✓	✓	
Warm & Humid (Bhubhaneshwar)	✓✓	✓✓	✓	✓ Roof & Walls	✓✓✓	
Composite (Lucknow)	✓✓✓	✓✓	✓✓	✓	✓	✓
Temperate (Bengaluru)	✓✓	✓✓	✓	✓ Roof	✓✓✓	
Cold (Srinagar)	✓✓✓	✓	✓✓	✓✓	✓	✓✓✓

Construction Methodology & Materials

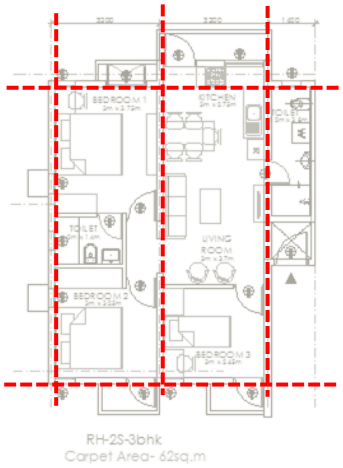
Session 2

Part B

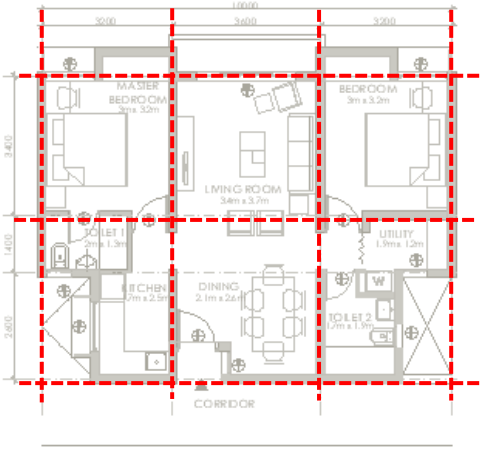
Construction Methodology

Structural system & materials:

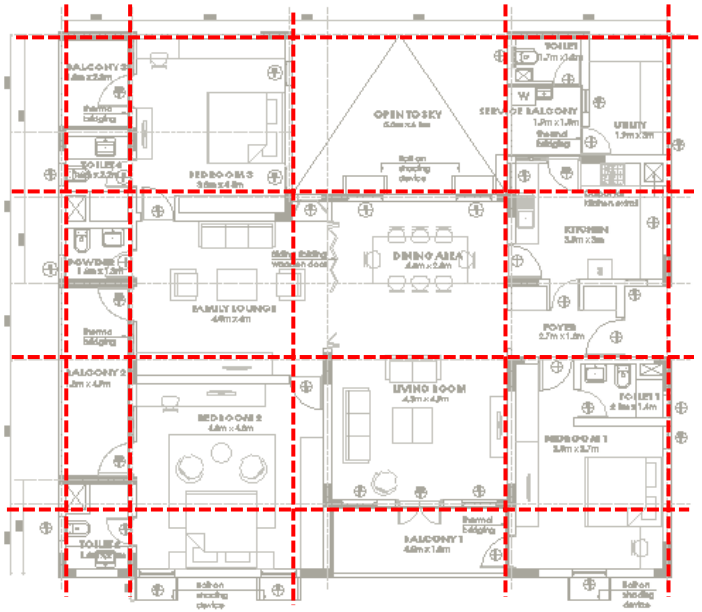
- **Commonly used structural systems** that are available across the country have been adopted for the type designs :
  - Load bearing (constrained) masonry for buildings upto 4 storey high
  - RCC frame with Brick (or flyash) infill
  - RCC frame with Light weight concrete (AAC) blocks
- A **simple structural grid** is maintained. Grid sizes are appropriate for **economical residential construction**.



2BHK Row house



2BHK Doubly loaded corridor



3BHK Tower

Construction Methodology

- Exploring **different house sizes** utilizing the **same grid pattern for greater efficiency** in construction processes.

- Each standard **bay** becomes a **module** which **repeats** to lend **different unit sizes** and configurations. Each typology has different size options varied by the number of bays.

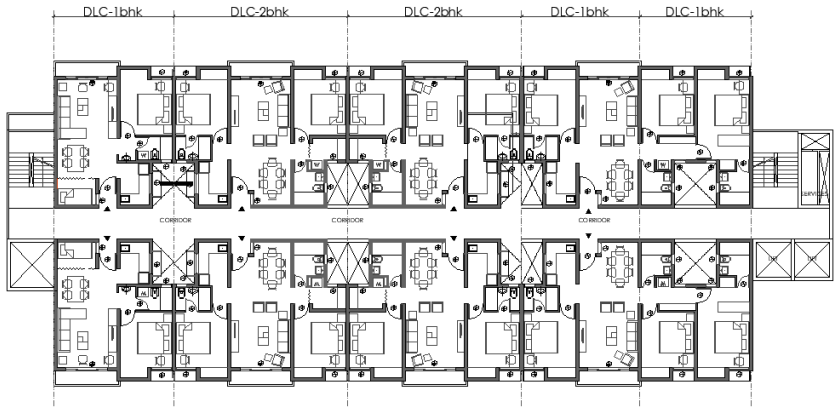
- This allows **flexibility** in planning to have mixed housing in the multi-family blocks.

1.2C-DLC-1BHK
Carpet area - 44sqm

1.3B- DLC-2BHK
Carpet area - 65sqm

1.4A-DLC-3 BHK
Carpet area - 85sqm

DIFFERENT UNIT SIZES



BLOCK LAYOUT

Construction Materials

Walling materials & sub-components:

- We have chosen materials and components such as doors and windows that are **commonly available today**.
- Alternative or more **advanced materials** & components are also explored and **adopted as incremental measures for improved energy efficiency**.

RCC frame with Burnt clay brick infill (or fly ash brick)

RCC frame with Light weight Aerated concrete (AAC) block infill

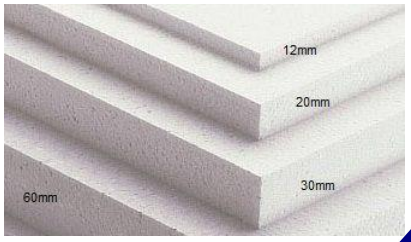
Thermo-insulated concrete block

Bamboo chick screen

Rolled steel section windows

uPVC windows

Double glazed windows



EPS insulation

Questions & Feedback

End of session 2 –

Principles of planning energy efficient buildings

Construction material & methodology

Energy Performance

Session 3

Energy performance

Energy Simulation

The building design - architectural, mechanical and electrical systems will be replicated in the energy simulation software to analyze the energy data, design effectiveness, performance of different systems, energy demand, energy consumption etc.

Software used: Design builder/Energy plus

Outputs: Energy performance Indicators, Life cycle cost, Payback
No. of hours of Natural Ventilation

Daylight Simulation

- Daylight simulation through software model is developed to calculate interior daylight levels in a space using real world weather data files for a specific location.
- **Software used:** Design builder
- **Outputs:** Useful daylight illuminance (Illuminance between 100 Lux and 3000Lux for at least 50% of the potential daylit time)

Approach for Energy performance

Passive design for Thermal Comfort & Higher Performance with Air-conditioned Comfort

- A **base case** representing the common present practice will be established w.r.t **ECBC-R** against which improved performance is measured.
- The simulations are carried out at dwelling unit level for all cases and at building level a few Exemplary Passive House cases.
- The standards of comfort as adopted by BEE for Eco-Niwas Samhita are followed, taking 1 room with Air-conditioned comfort and the remaining area of the house following **Indian Adaptive Comfort Standard**.

Standards or references

- ECBC-R
- BEE Residential building energy labelling program
- Indian Model for Adaptive Comfort (IMAC) standard

Energy performance – Variants based on location

Performance variants based on location of a Dwelling unit within a building in Multi-family homes

- Even when the unit plan is the same, it is interesting to note that the thermal performance of the unit varies according to its location within the building

- Homes of a given design are tested for **different locations within the building**:
  - Unit at the Edge
  - Unit in the middle of the building block
  - Unit on the Top floor, middle floor or bottom floor

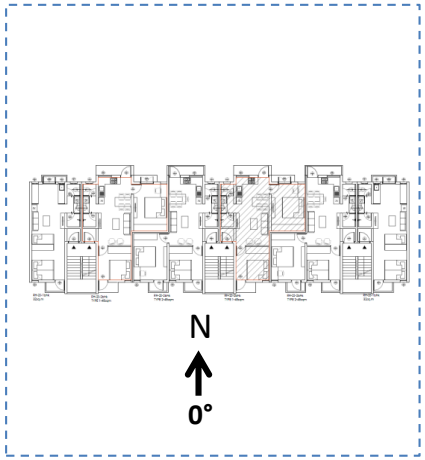
Energy performance – Variants based on orientation

Performance variants based on location & orientation of a Dwelling unit within a building

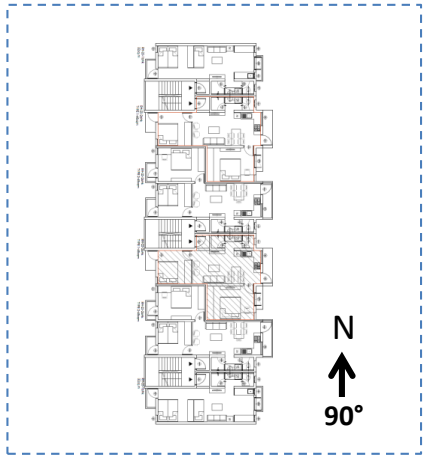
- **Orientations**

  The above variants are in turn tested for **4 different orientations** with respect to true North.

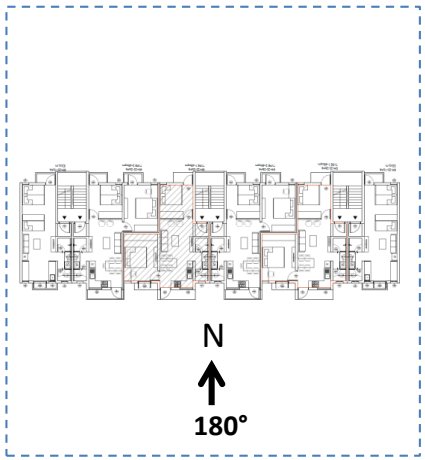
- The proposed design configuration is such that all unit variants meet the minimum standards of thermal performance.



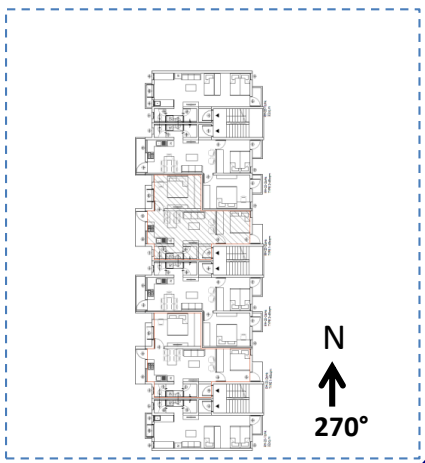
North



East



South



West

Key Performance Indicators

Indicators on energy 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.

	Performance Indicator		Remarks	Units	Simulation required
1	**Building Envelop Efficiency**	RETV	• Base case to meet ECBC-R : RETV < 15 • 4 levels of energy efficiency leading to decreasing values of RETV as the envelop performance increases	W/sq m	Calculation based on formula (wall area, window area, material properties)
2	**Natural Ventilation Potential**	Window to floor area ratio (WFR)	• Meet min. standards of ventilation (WFR) as per ECBC-R min. requirements		
3	**Energy Efficiency**	EPI	• Meet ranges given in BEE star rating plan • Energy saved, cost of energy saved and reduction in co2 emission by improvement to +3	kWh/sq m/year	Energy simulation
4	**Visual comfort**	Day light potential	• % of room area receiving 100 to 3000 lux daylight for 50% of the potential daylit hours		Daylight (UDI)
5	**Thermal Comfort**		• % of comfortable hours without AC		
6	**Cost effectiveness**	Cost of construction & electro-mechanical equipment	Total cost, Additional cost of improvement to +3 levels from base level, Payback period in relation to level 1		

Energy performance status

- For each given design of a dwelling unit, 3 steps of incremental improvements in building envelop & equipment are proposed and their energy performance is reported.
- For some designs we propose the most advanced improvements and report the high performance achieved.

1. Base

- This is the minimum performance to meet the ENS code.

2. Moderate

- This step achieves a better performance from the basic with better construction material.

3. Good

- This is the ideal step of good performance with improved windows, shading & energy efficient electro-mechanical equipment.

4. High

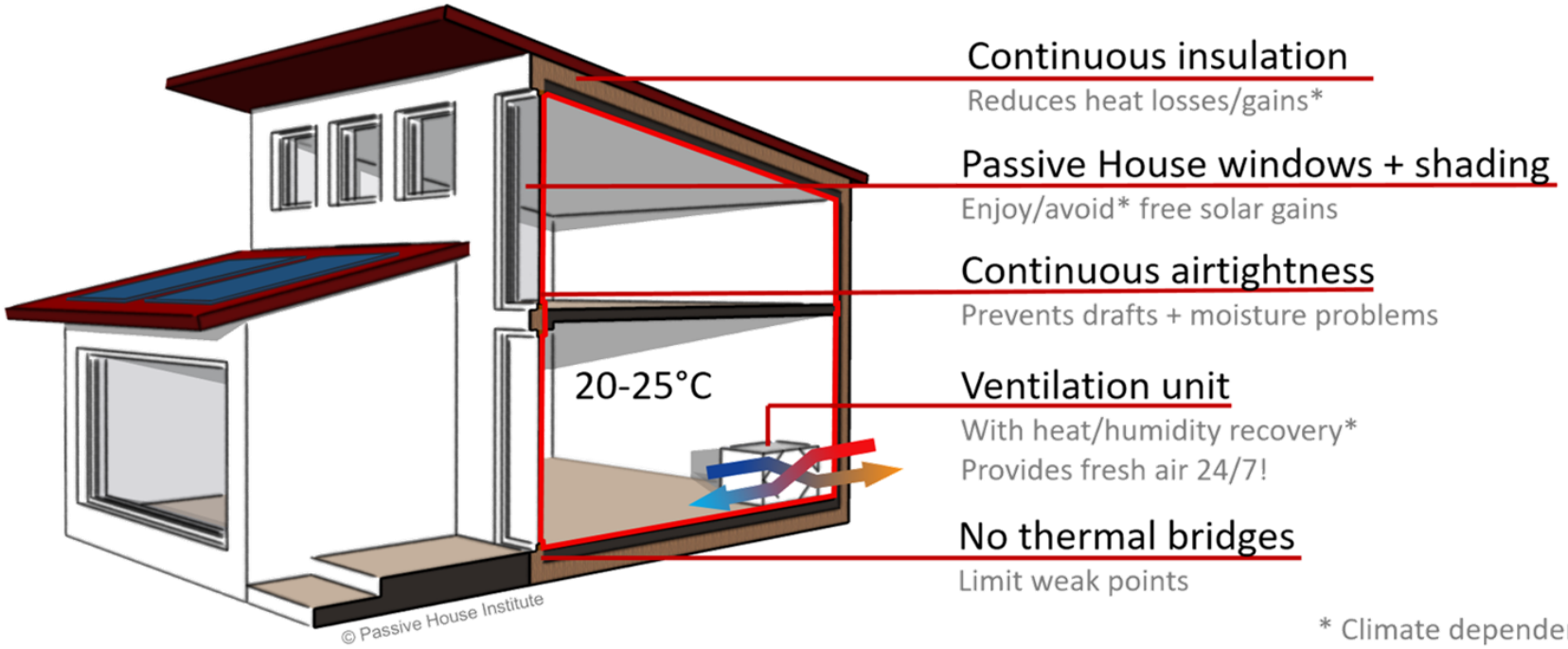
- This step improves the building envelop and mechanical equipment to the best of latest available technologies.

5. Exemplary Passive House

- This is the ultimate step to get close to drastically reduced energy demand, which can then be easily covered by renewable energy while meeting global standards of comfort and air quality.

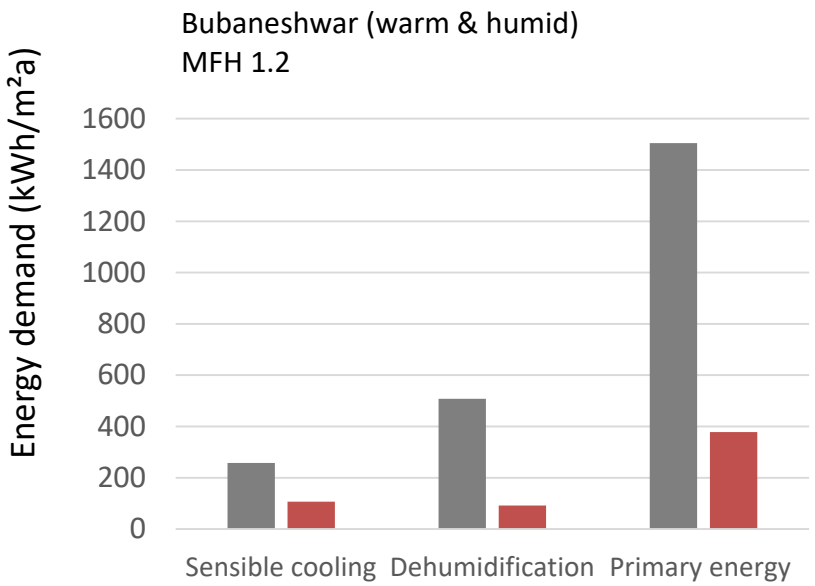
Exemplary Passive House - Principles

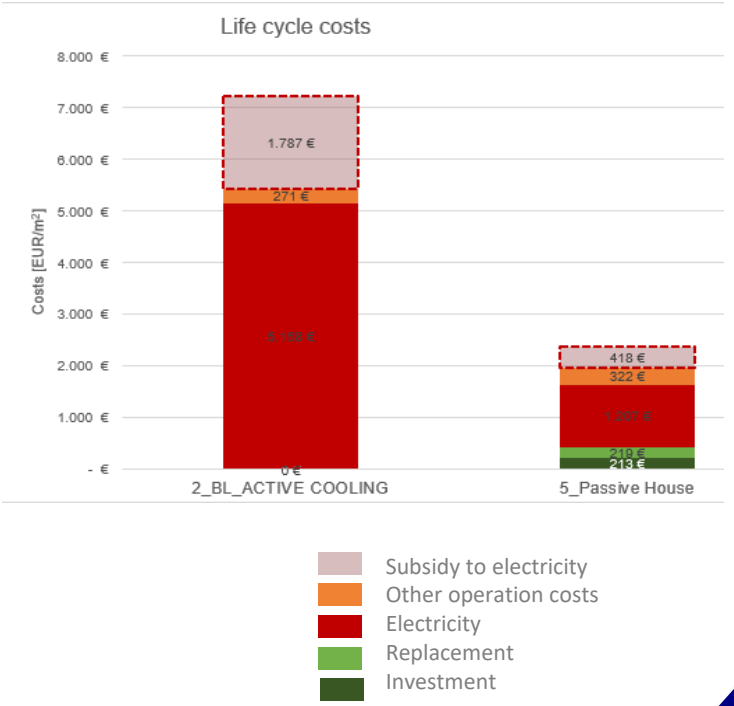
- High comfort according to ISO 7730,
  20-25°C, 60% relative humidity
- Small energy consumption
- Improved air quality



Exemplary Passive House - Energy performance

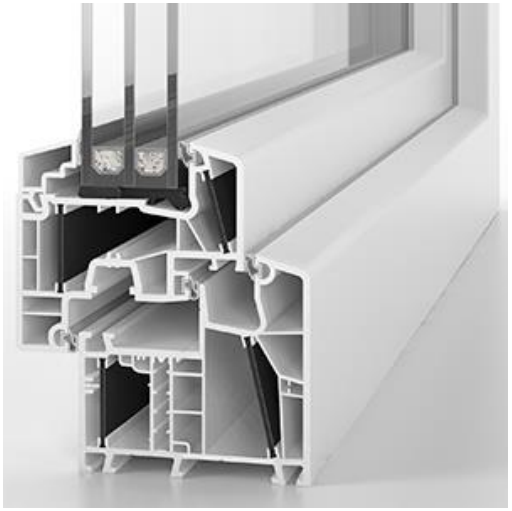
- **The Exemplary Passive House variant offers:**
- Global standards of indoor comfort.
- Up to 50% reduction in sensible cooling
- Humidity control
- Up to 70% reduction in primary energy demand
- Up to 60% reduction is Life Cycle cost





Exemplary Passive House - Components

The highest standards of comfort and energy efficiency are achieved through some advanced components of building construction.



© Aluplast

Double to triple glazing with insulated frame

© Zehnder

Ventilation with heat and humidity recovery

© Pro Clima

Airtightness tape

Questions & Feedback

End of session 3 –

Energy Performance

The Web-Tool package

Session 4

The Web Tool

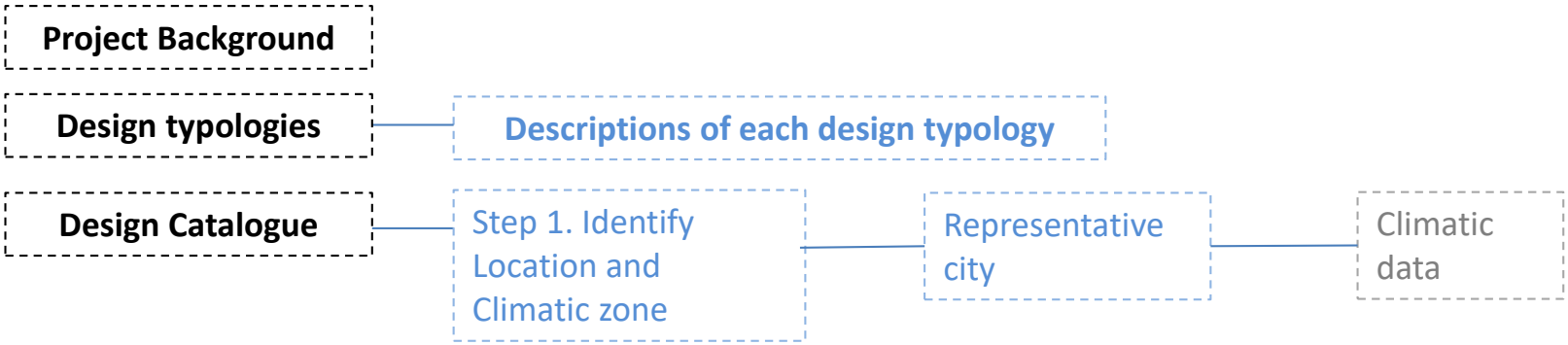
All the work from this study set will be made available to the user through the web tool for all design typologies to understand the performance through the tool and then to be able to input their own specific details and get results.

This tool will be available at the Eco-niwas Website.

Project Background

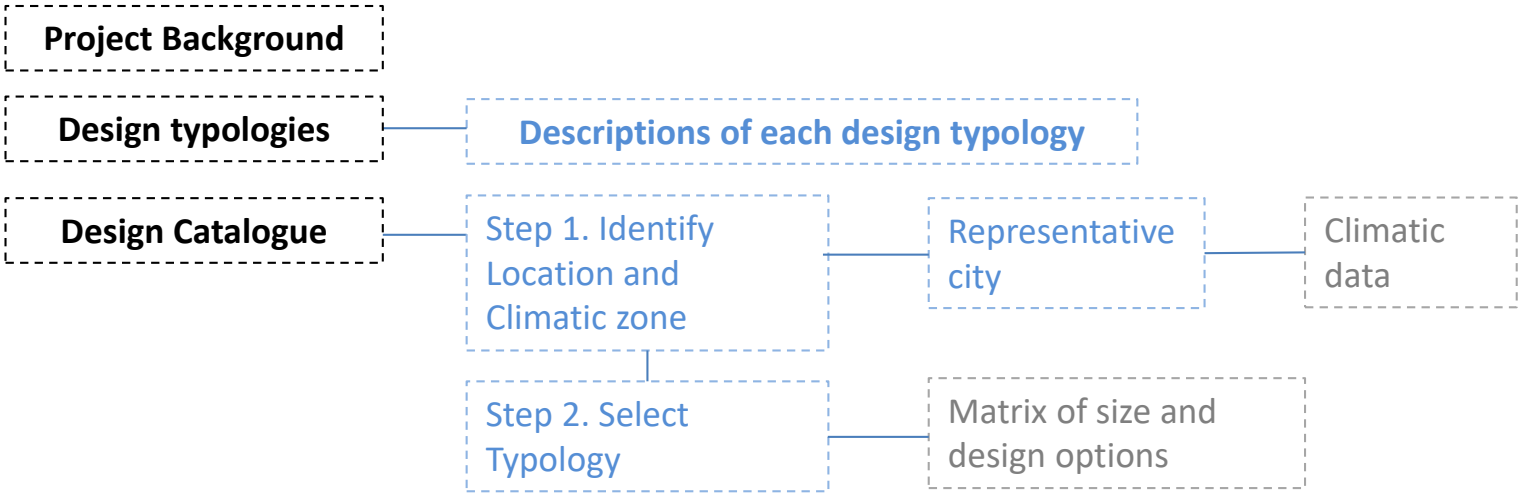
Design typologies — **Descriptions of each design typology**

The Web Tool


Project Background
Design typologies
Descriptions of each design typology
Design Catalogue
Step 1. Identify Location and Climatic zone
Representative city
Climatic data

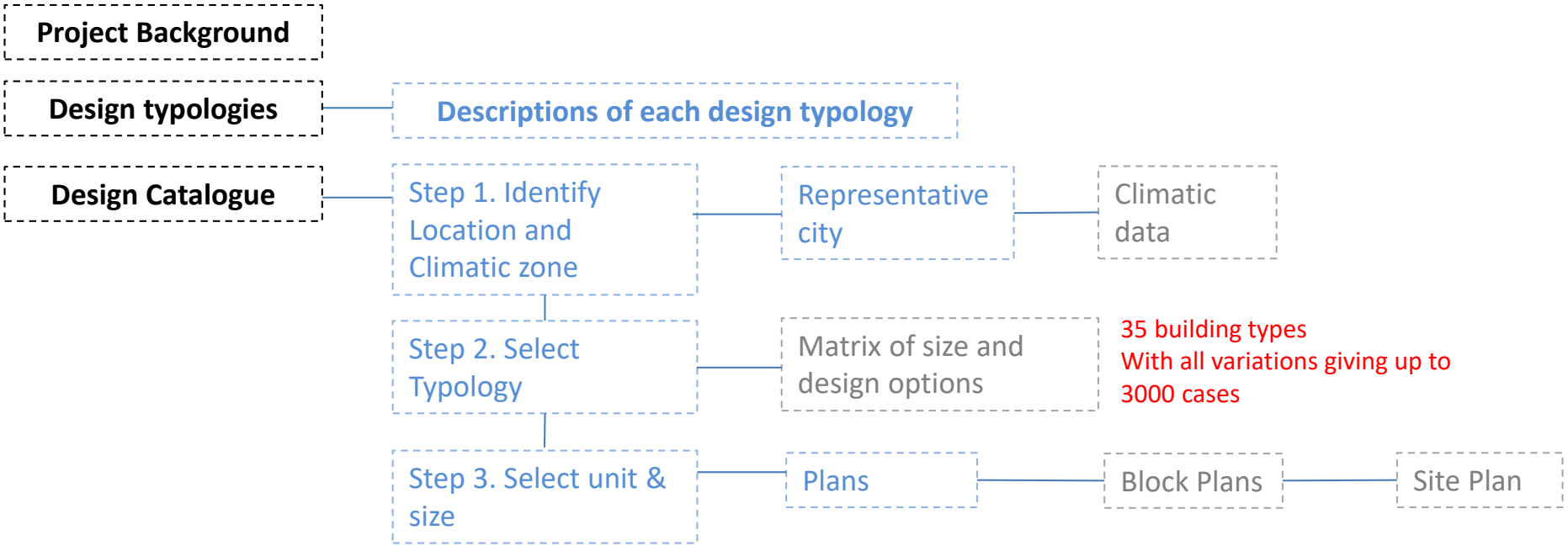
The Web Tool

The web-tool is designed to go into greater technical depth. It is designed to make information available to a large user base.



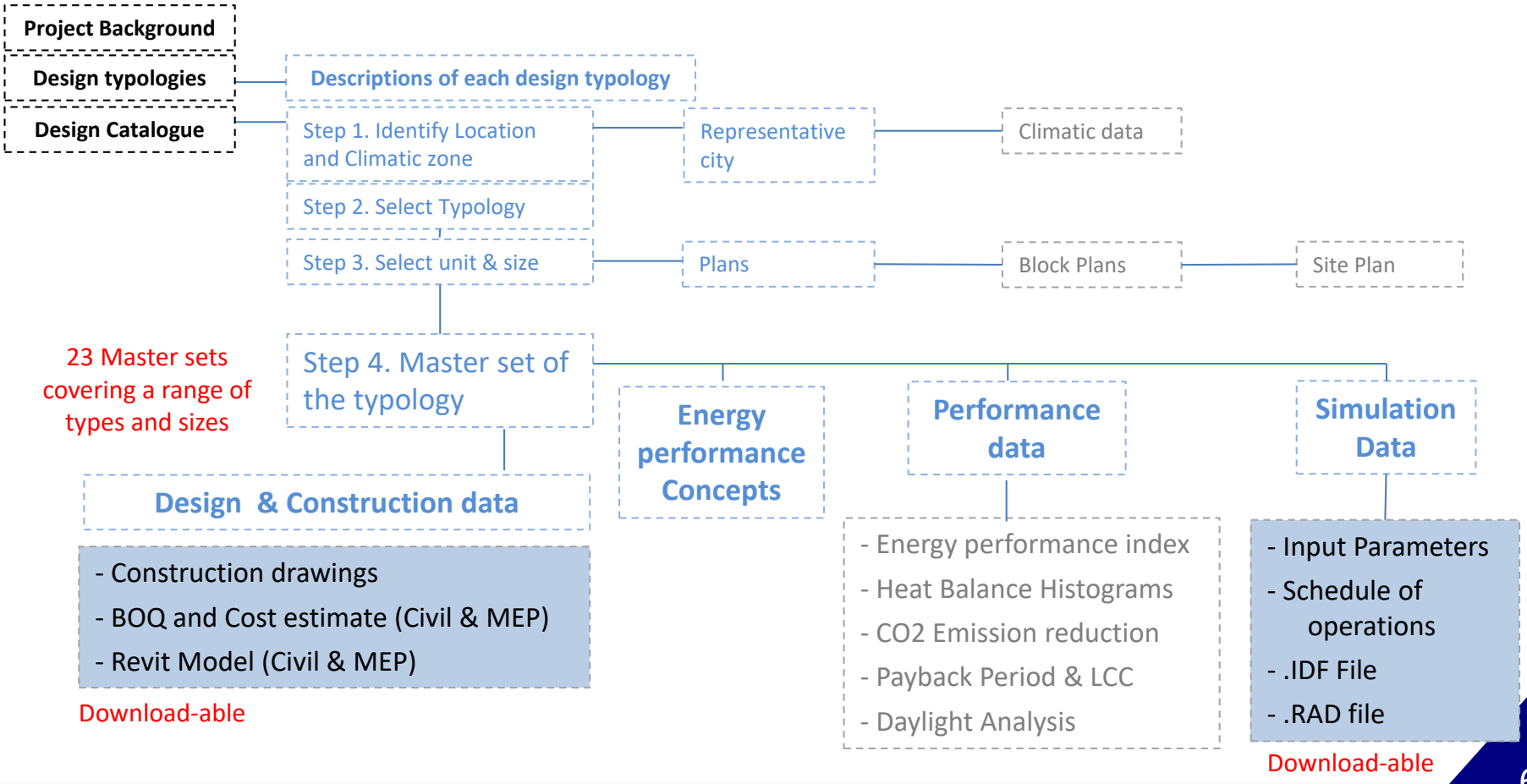
The Web Tool

The data from this study set will be made available to the user through the web tool for all design typologies to understand the performance through the tool and then to be able to input their own specific details and get results.



The Web Tool

The data from this study set will be made available to the user through the web tool for all design typologies to understand the performance through the tool and then to be able to input their own specific details and get results.



Questions & Feedback

End of session 4 –

Web-Tool Package

Please follow the link to fill the feedback survey:

https://www.surveymonkey.com/r/V8CQ2BZ

Thank you

german cooperation
DEUTSCHE ZUSAMMENARBEIT

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

Knowledge Partner

ASHOK B. LALL ARCHITECTS

LEAD Eco² Friendly Solutions

Passive House Institute

KPMG