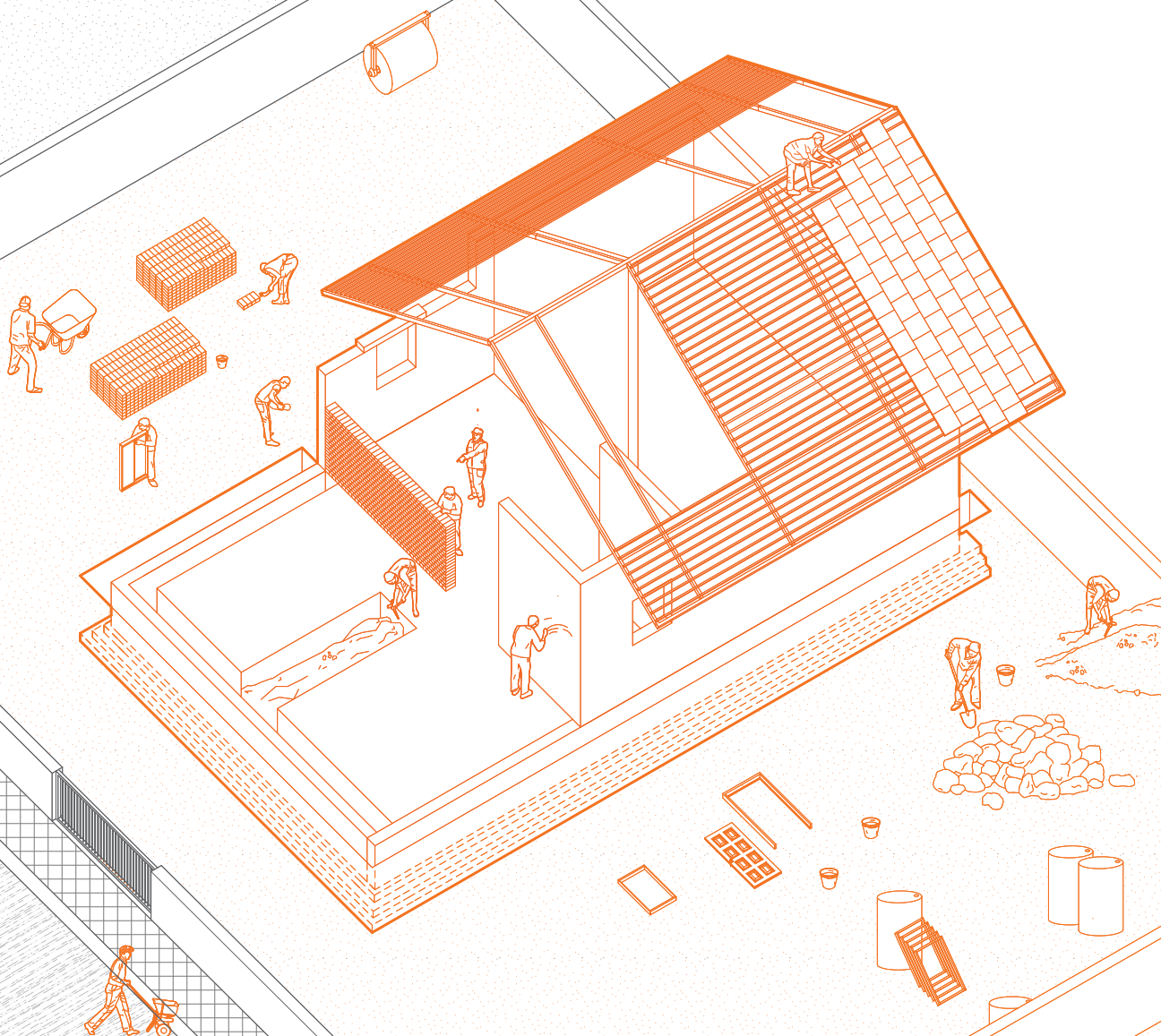


# HANDBOOK

## FOR CLIMATE RESPONSIVE SELF-BUILT AFFORDABLE HOUSING



WARM AND HUMID CLIMATE



**IIFL**  
HOME LOAN

**CUPP**

CENTER FOR  
URBAN PLANNING  
AND POLICY

**CRDF**

CEPT RESEARCH  
AND DEVELOPMENT  
FOUNDATION

# DISCLAIMER

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# Handbook for Climate Responsive Self-Built Affordable Housing

WARM AND HUMID CLIMATE



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AND DEVELOPMENT  
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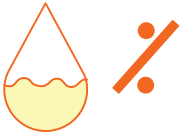
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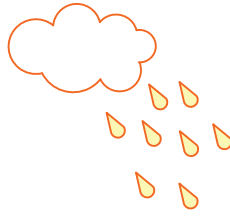


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# GRAPHICAL GUIDE FOR THE HANDBOOK



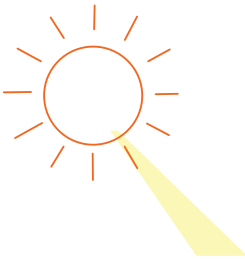
Humidity



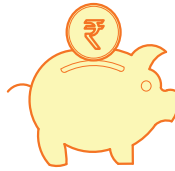
Rain



Wind



Sunlight



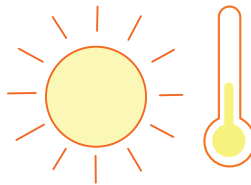
Money / Savings



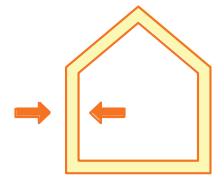
Air Flow



Cool  
Temperature



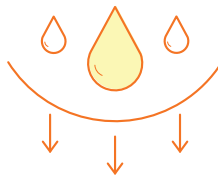
Hot Temperature



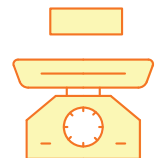
Thermal Mass



Compressive  
Strength



Water  
Absorption



Weight

## WHO IS THIS HANDBOOK FOR?



**Aspiring Home  
Owners**

This handbook guides homeowners to build a climate responsive house for the geography it is located in while keeping in mind cost efficiency in building construction to make it affordable. The book also suggests sustainable lifestyle choices and practices at home.



**Architect /  
Engineer**

Passive architectural strategies with clear design objectives for a particular climate zone given in this book help architects / engineers / technical representatives from HFCs to achieve a sustainable house with ease. Construction details further help in the execution of design goals.



**Civil Work  
Contractor**

Along with decision making, this handbook works as a reference for building construction on site with its detailed drawings made with precision and clear design objectives towards climate responsive building.

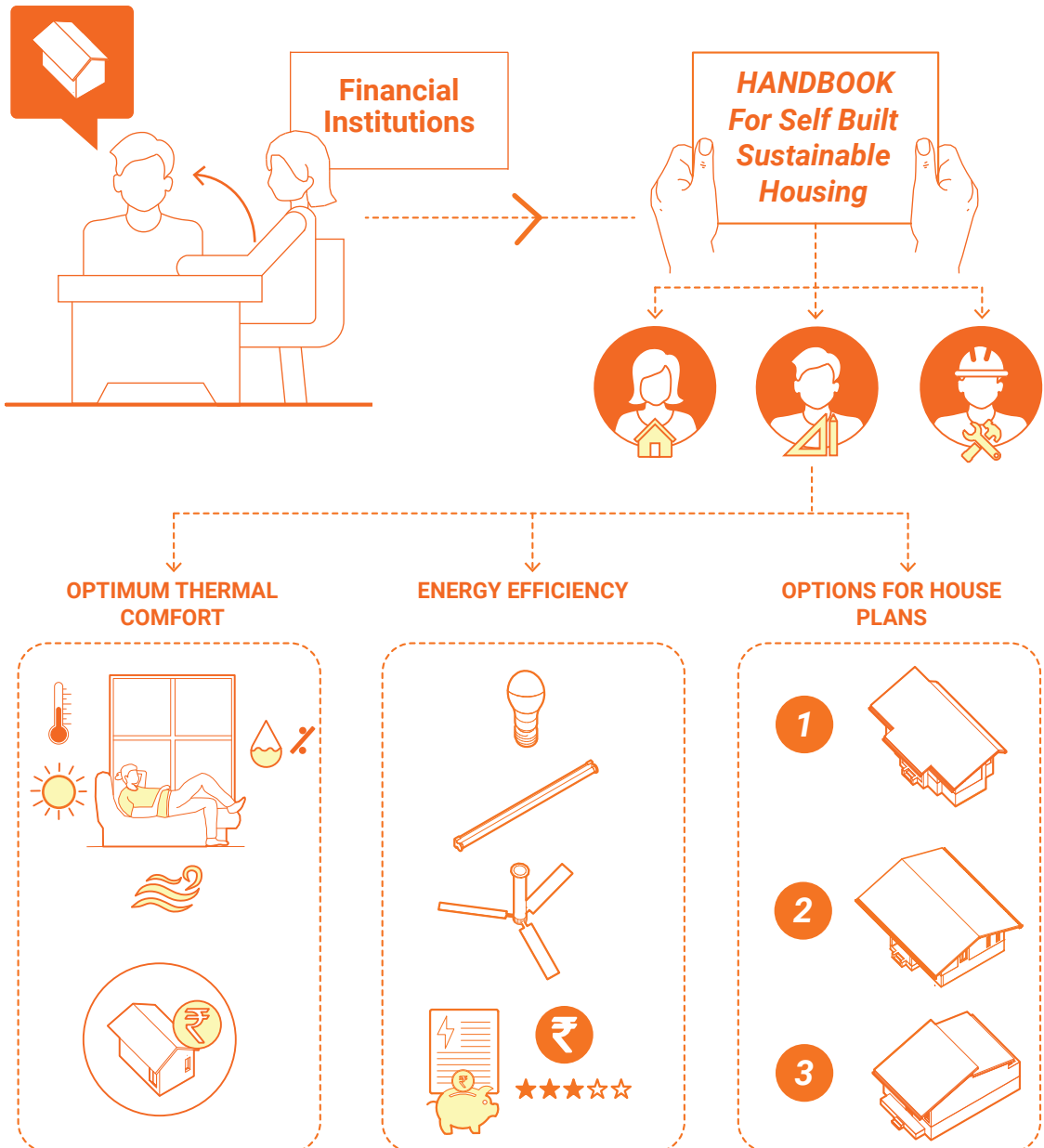


### **NOTE :**

**On the top right corner of the page, the icon highlighted in colour depicts for whom the information is applicable.**

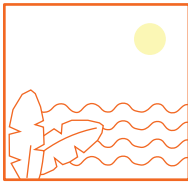
## WHAT IS THIS HANDBOOK ABOUT ?

- This illustrative handbook aims to provide guidance to key stakeholders involved in self-built housing (owners, designers and contractors) to develop sustainable affordable homes.
- The handbook lays out design strategies along with solutions for sustainable affordable construction to achieve optimum thermal comfort and energy efficiency in the house.
- It contains plans for three typologies of houses which can be adapted to different site conditions and context. The book also encourages homeowners to choose sustainable appliances and systems at home.

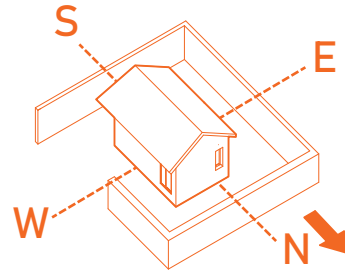


## HOW IS THIS HANDBOOK STRUCTURED ?

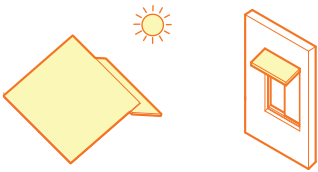
- This handbook begins with macro-level information about geography and design objectives for the particular climate zone. It further delves into specific passive design strategies (micro-level), construction details, material and appliance choices with the aim of achieving comfortable habitat in the given climate zone.
- It is devised into the following segments:



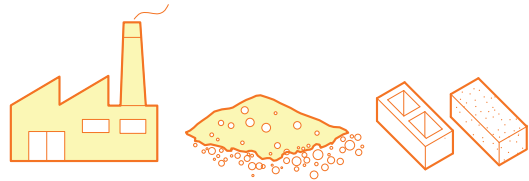
**Fundamentals of Warm and Humid Climate**



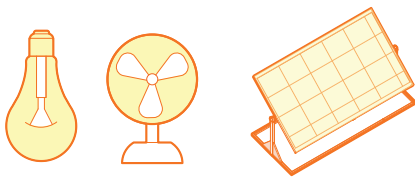
**Recommendations at site level**



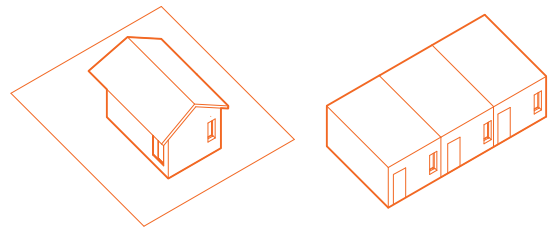
**Recommendations at building level**



**Recommendations for material choices**



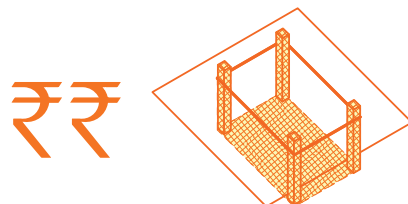
**Recommendations for appliances and systems**



**Unit typologies**



**Waste management**

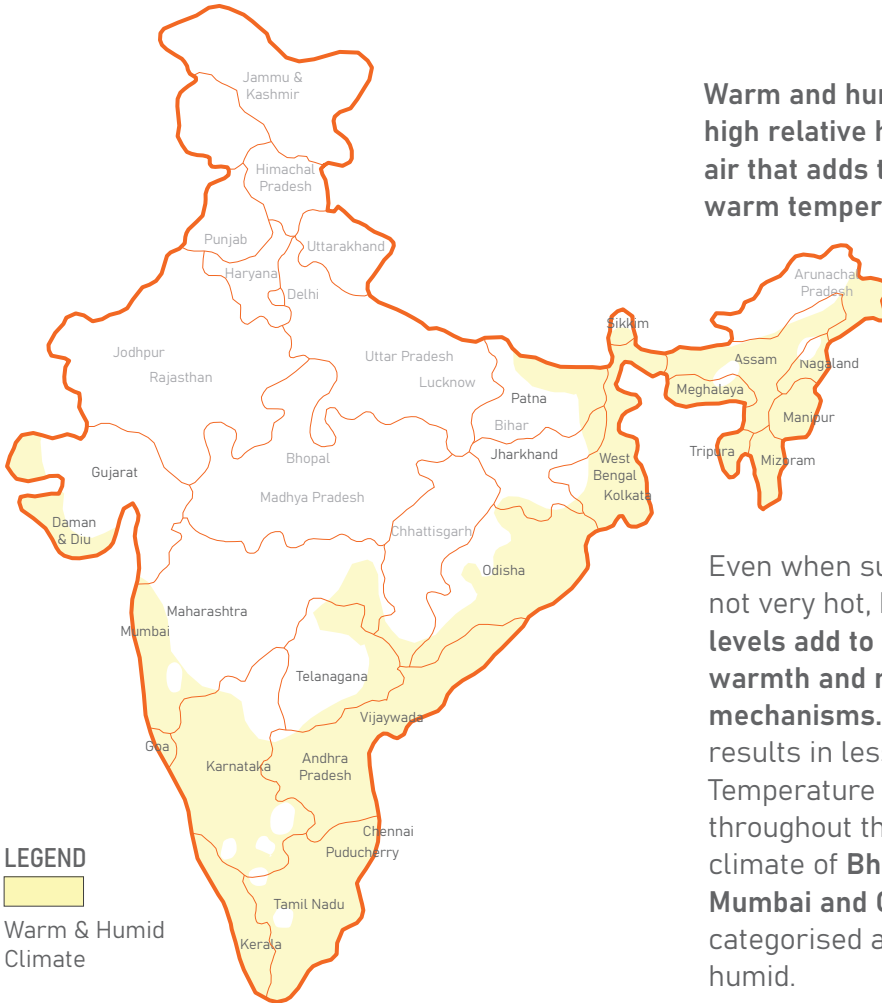


**Cost estimates for construction**

# INTRODUCTION TO WARM AND HUMID CLIMATE ZONE



# KNOW YOUR CLIMATE ZONE



Warm and humid climate has high relative humidity in the air that adds to effects of warm temperature.

Even when surroundings are not very hot, **high humidity levels add to the feeling of warmth and restrict cooling mechanisms.** This also results in lesser Temperature variations throughout the day. The climate of **Bhuvaneshwar, Mumbai and Chennai** can be categorised as warm and humid.

Map of India highlighting the **Warm and Humid Climate** region of india



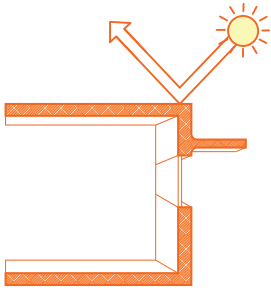
Maximum day- time air  
temperatures : **21 – 38° C**  
(with little diurnal variations)



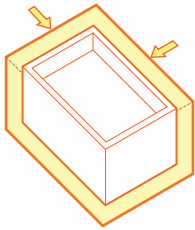
Relative Humidity : ranges  
between **70% to 90%**



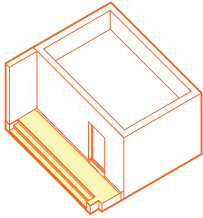
## DESIGN OBJECTIVES



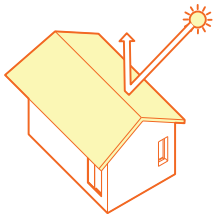
Resist  
Heat  
Gain



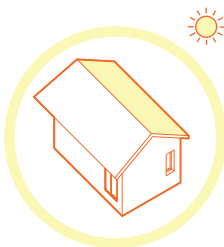
Decrease  
exposed  
surface area



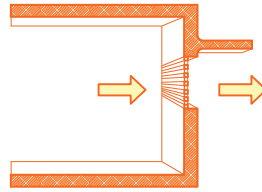
Increase  
buffer  
spaces.



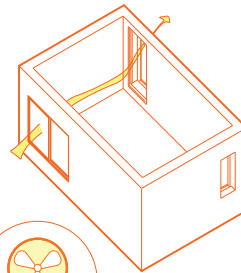
Increase  
shading and  
reflectivity



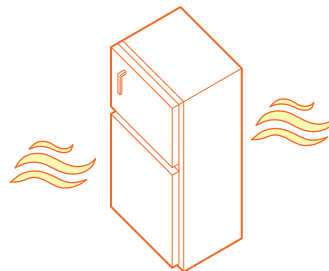
Increase  
thermal  
resistance



Promote  
Heat  
Loss



Increasing  
air exchange  
rate (cross-  
ventilation)  
throughout  
day and  
decreasing  
humidity  
levels



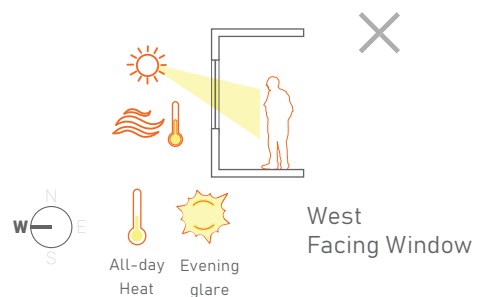
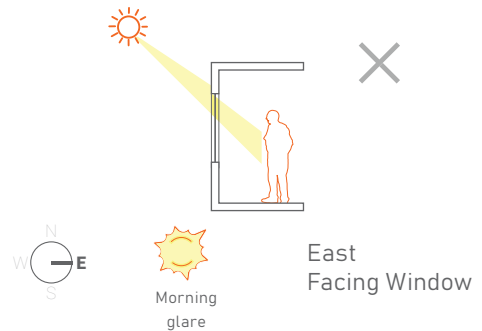
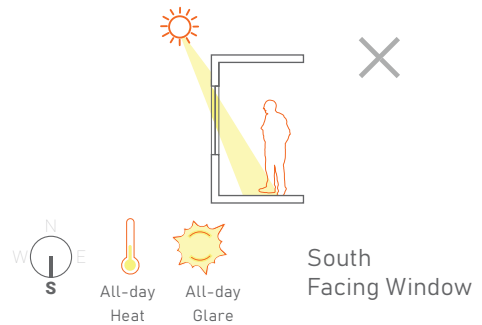
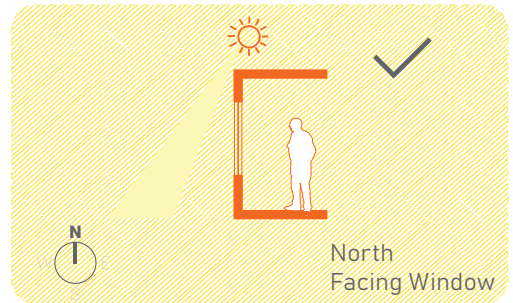
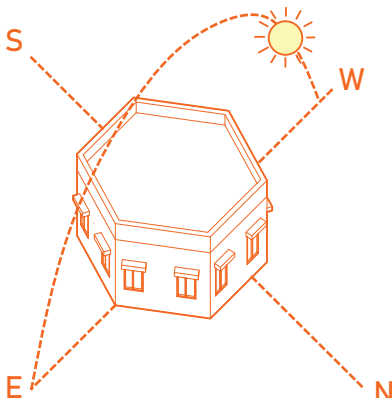
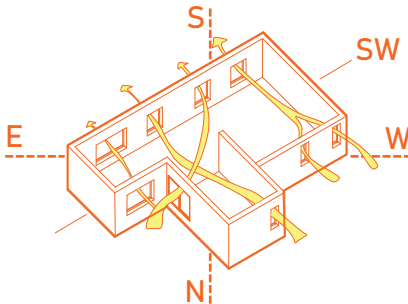
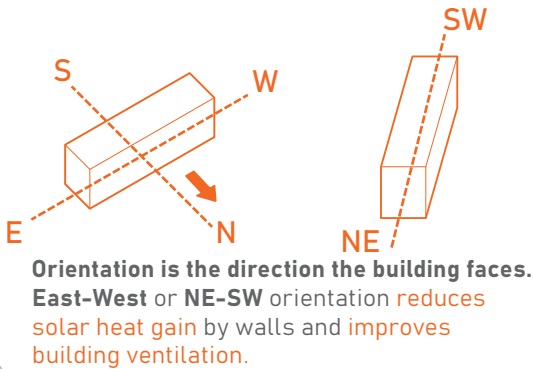
Ventilation  
of  
appliances

# PASSIVE DESIGN STRATEGIES



## SITE LEVEL

### > BUILDING ORIENTATION

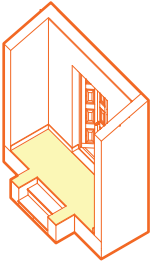


NOTE: For solution, please refer to Page 21

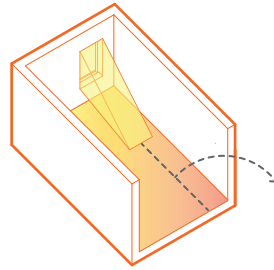




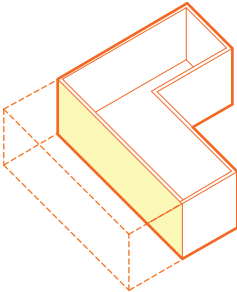
## > BUILDING COMPACTNESS



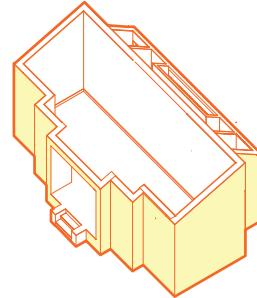
**Semi-open spaces** like balconies, verandas and porches can be used for daytime activities



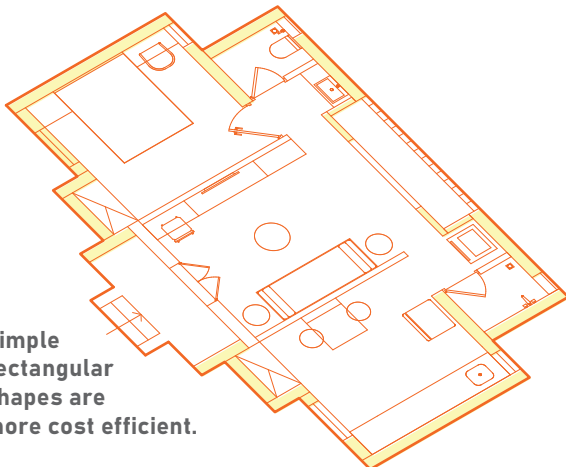
Very **large or deep rooms** should be avoided because the **brightness of light diminishes** while moving away from a window.



Adjacent units can **share walls** and thereby **reduce their exposure to the outside**.



**The building should be enclosed**, compact and inward-looking to **reduce sun-exposure**.



**Simple rectangular shapes** are more cost efficient.

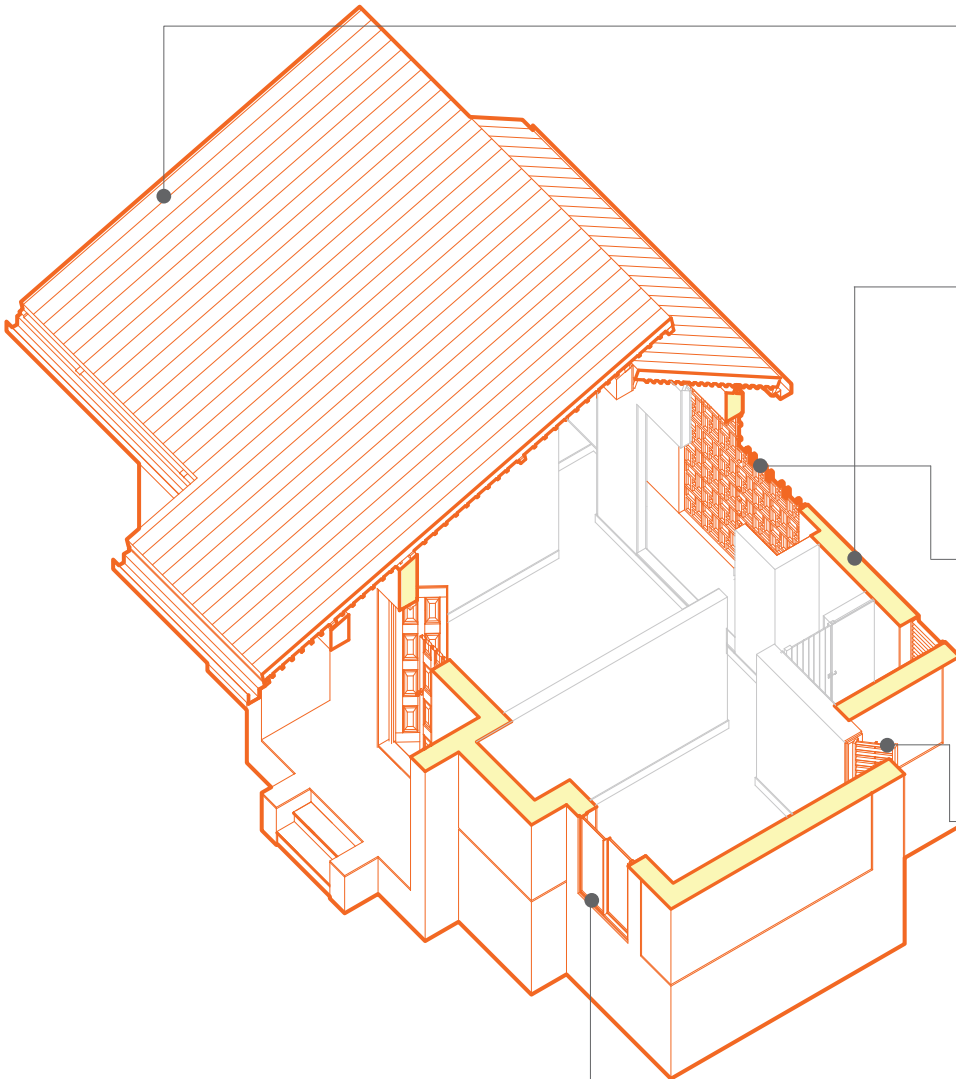


**Simple methods** of achieving compactness in planning also **reduce the cost of construction**.



## BUILDING LEVEL

### > BUILDING ENVELOPE





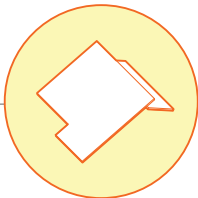
Building Envelope

Thermal Comfort

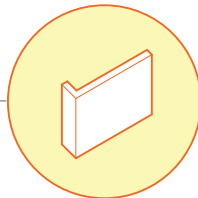
Natural  
Ventilation

Shading

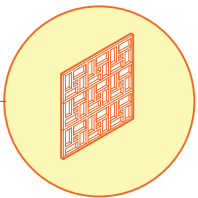
Insulation



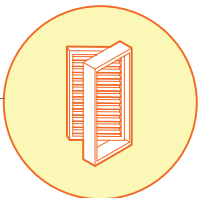
ROOF



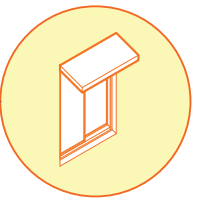
EXTERNAL WALLS



FENESTRATIONS - JALI



FENESTRATIONS - WINDOW



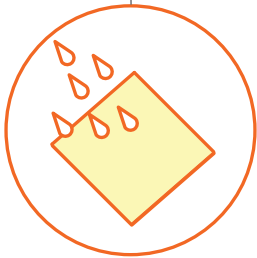
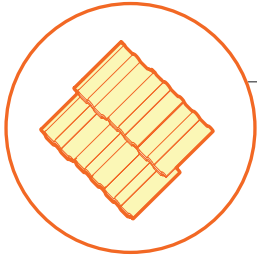
SHADING DEVICES





## BUILDING LEVEL

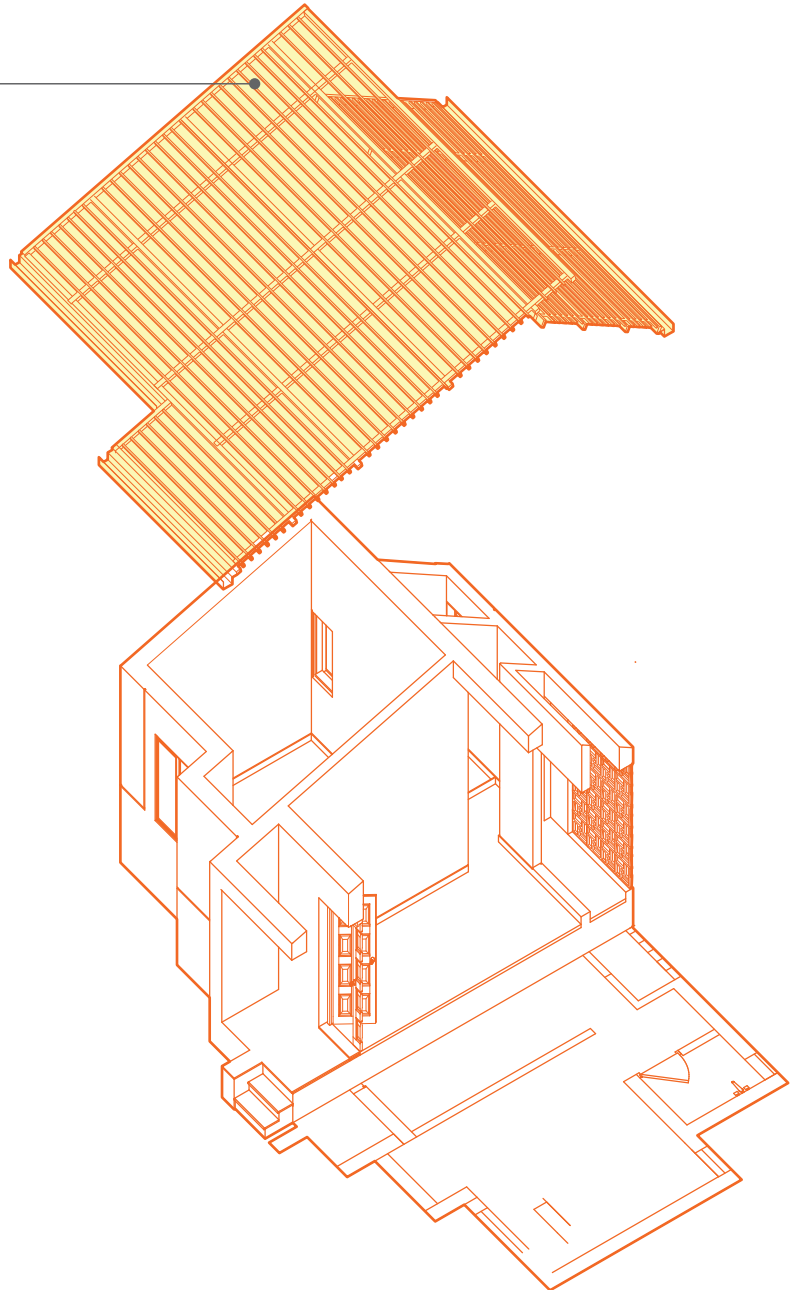
### > ROOFING STRATEGIES WITH CONSTRUCTION DETAILS



#### OPTION - 1

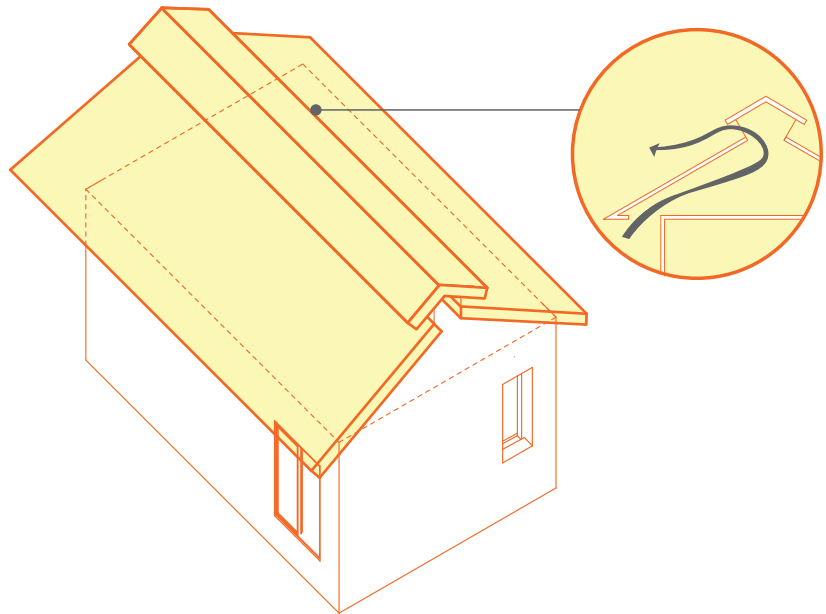
#### SLOPING ROOF

This type of roof helps with cooling along with protection from heavy rainfall. It can be built with metal frames and clay tiles or with insulated roofing sheets.

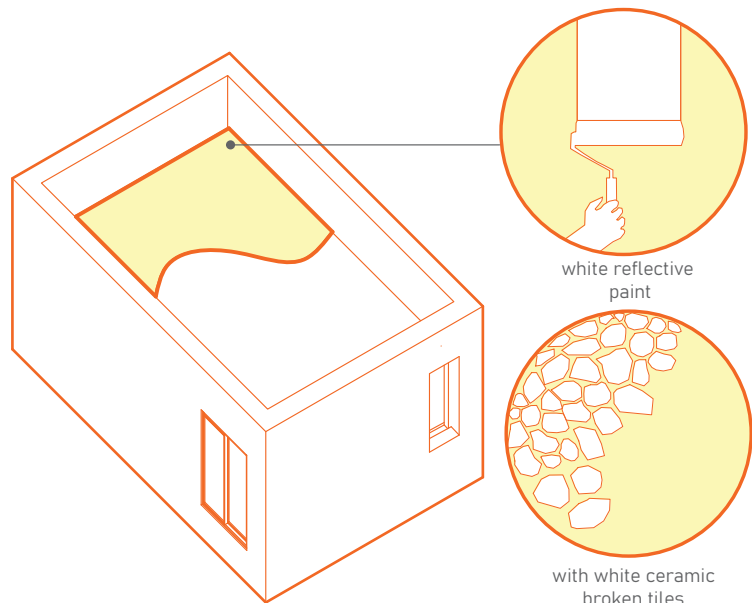


**OPTION - 2****DOUBLE ROOF CONSTRUCTION**

This is a combination of flat slab topped with sloped roof with vents on the upper part of roof that effectively induce ventilation and draw hot air out.

**OPTION - 3****REFLECTIVE SURFACE**

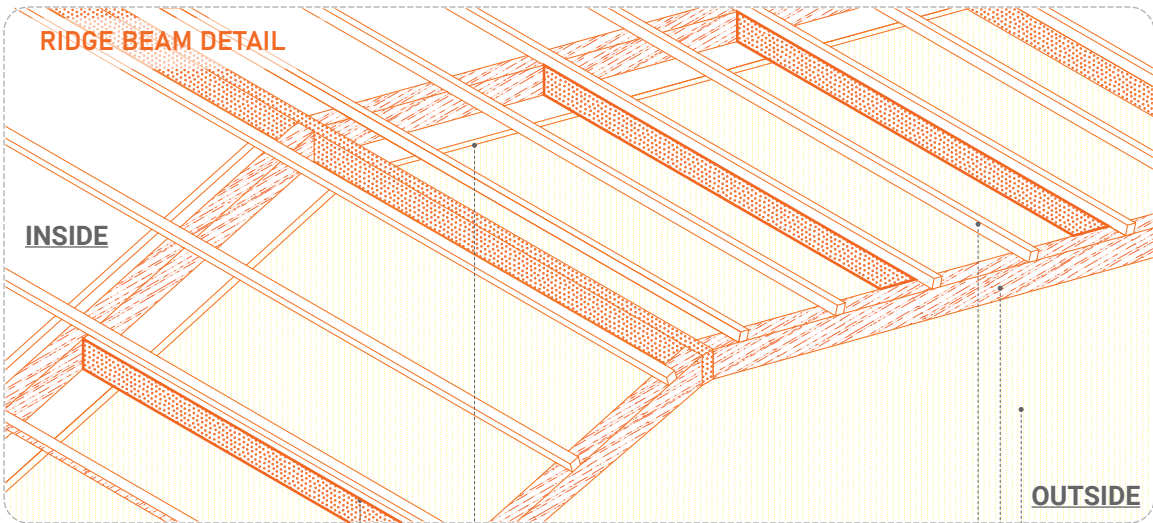
Applying white reflective paint on the roof or using white ceramic broken tiles improves reflectivity of the surface. It reduces heat gain and makes the indoors comfortable.





# BUILDING LEVEL

## > ROOFING STRATEGIES WITH CONSTRUCTION DETAILS



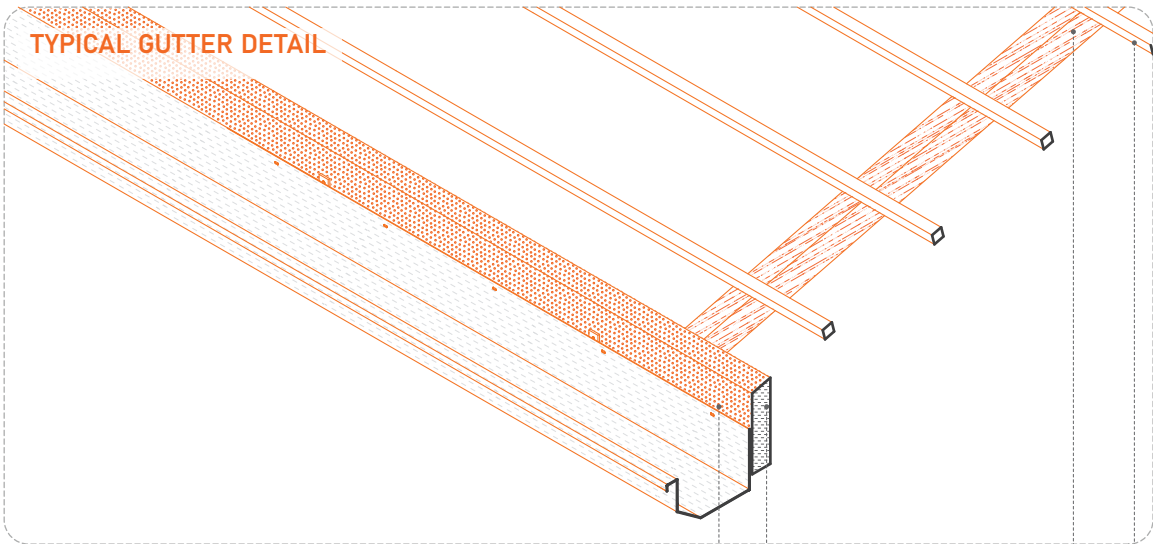
### RIDGE BEAM DETAIL

INSIDE

OUTSIDE

35mm \* 75mm  
Connectors with tension  
strips to resist  
downward forces  
19mm thk external plaster

25 X 25mm battens  
@ 300c-c distance  
50 x 100mm Rafter  
230 mm thk Block  
work Plastered

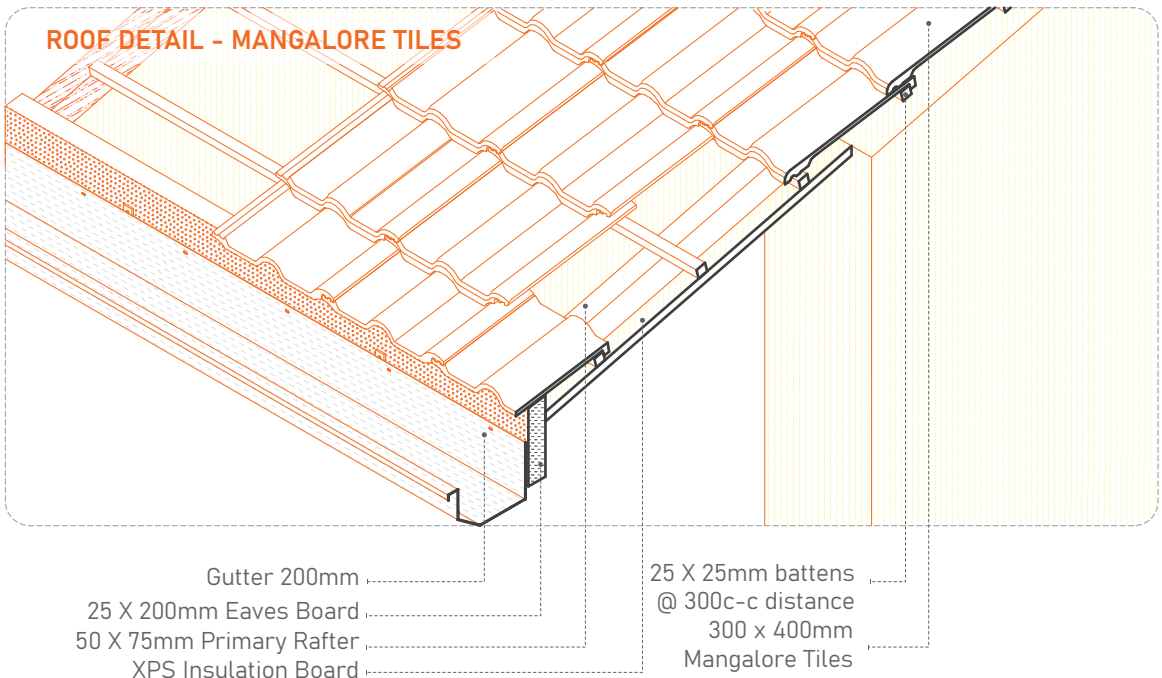


### TYPICAL GUTTER DETAIL

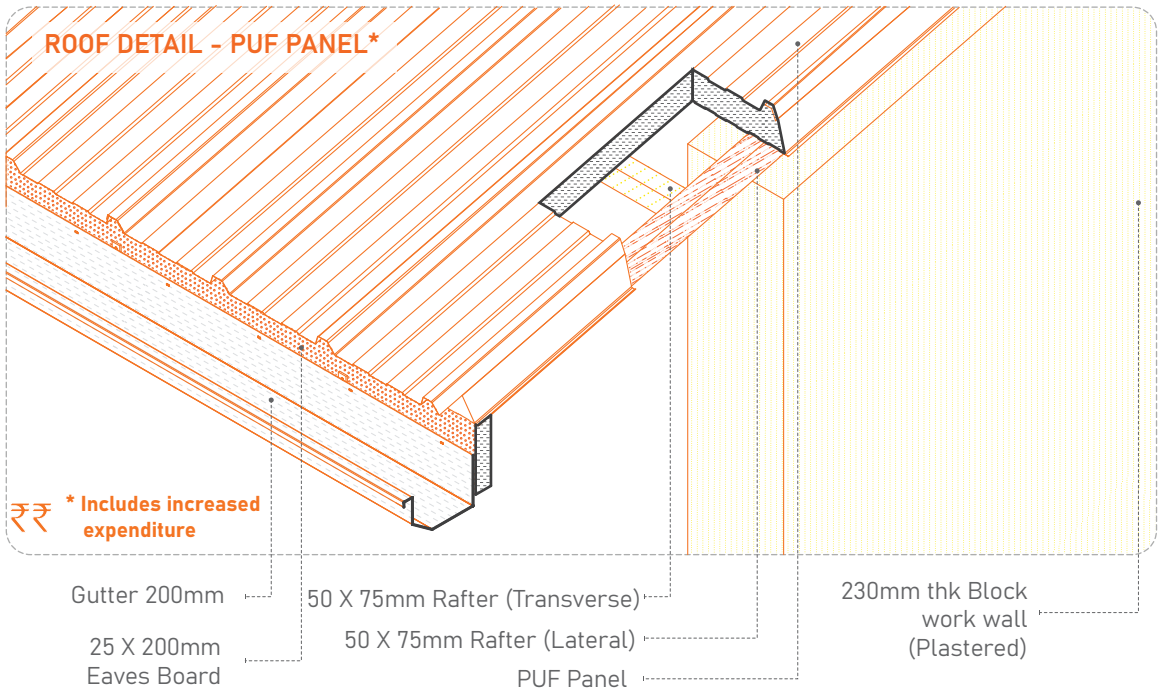
Gutter 200mm  
25 X 200mm Eaves Board  
50 X 75mm Primary Rafter  
25 X 25mm battens @ 300c-c distance



### ROOF DETAIL - MANGALORE TILES



### ROOF DETAIL - PUF PANEL\*



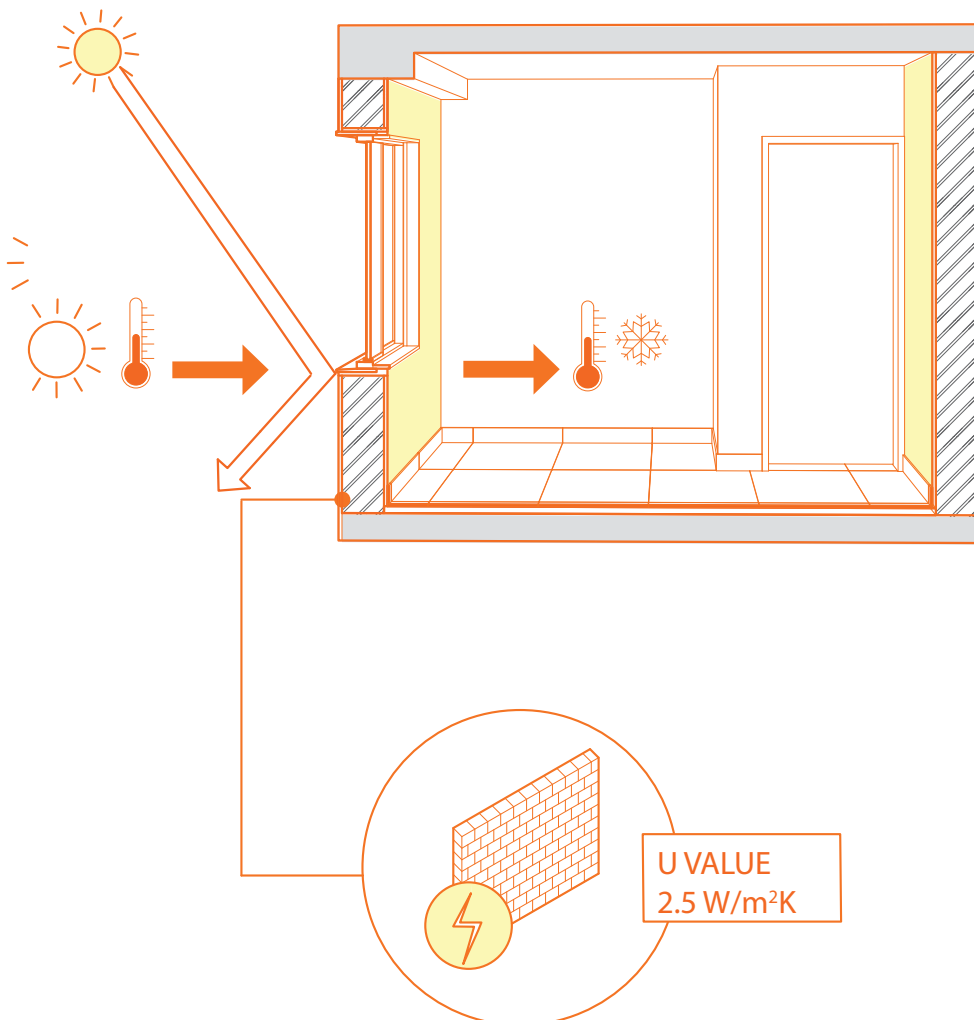


## BUILDING LEVEL

### > WALL CONSTRUCTION STRATEGIES WITH DETAILS

#### Implement efficient wall for building envelope

U-value of the wall assembly shall meet the baseline of  $2.5 \text{ W/m}^2\text{K}$







### CAVITY WALL OPTIONS

**INSIDE**

100mm thk brickwork in stretcher bond on either sides of the cavity

150mm thk tie band @2100mm height

**Option 1:** 30mm cavity filled with EPS Thermocol (or similar)  
₹₹ \* Includes increased expenditure

**Option 2:** 30mm air cavity

5mm thk mortar

150mm thk tie band @750mm height

12mm thk internal gypsum plaster

100mm high skirting tile, material same as flooring

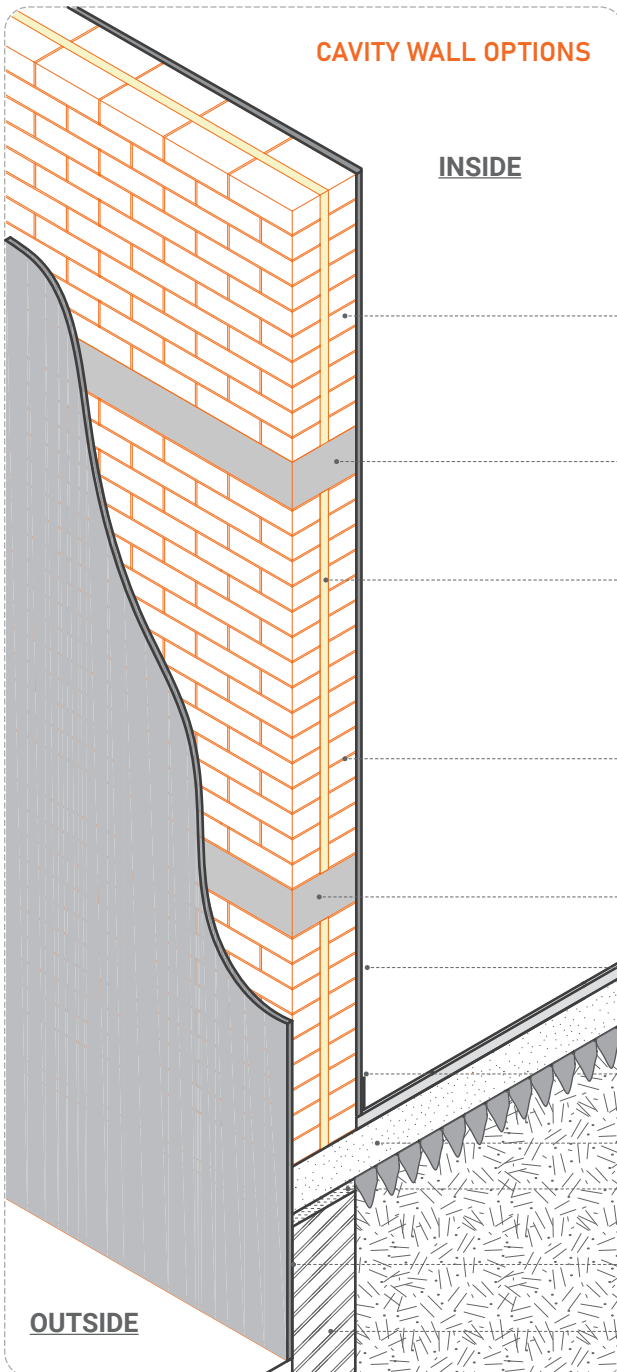
150mm thk pcc slab

40mm thk damp proof course

19mm thk external plaster

Foundation wall as per approved structural design

**OUTSIDE**

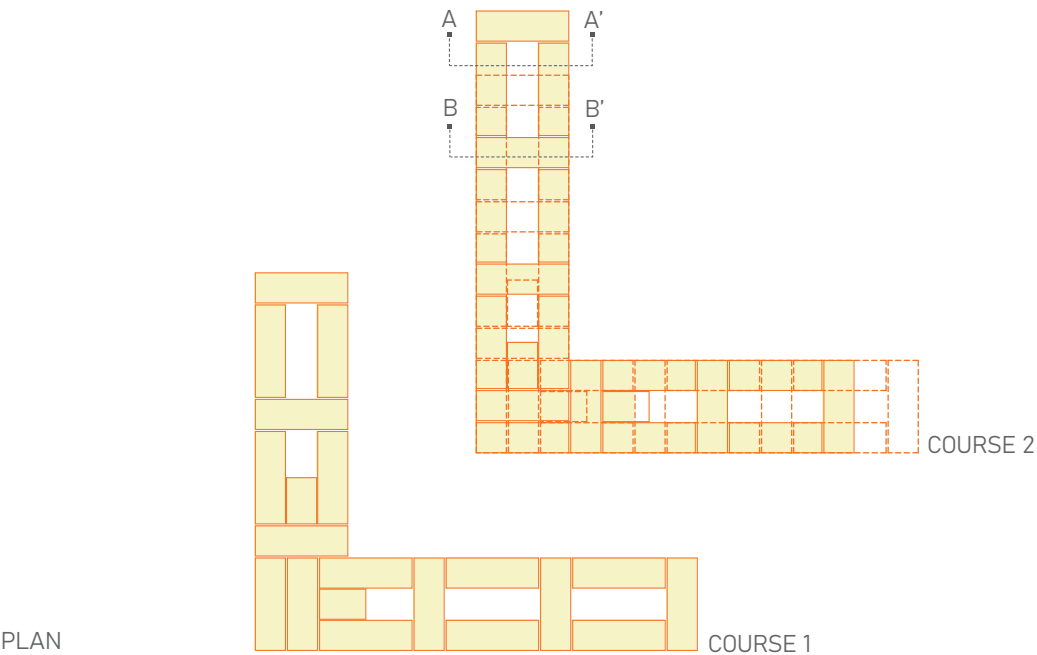
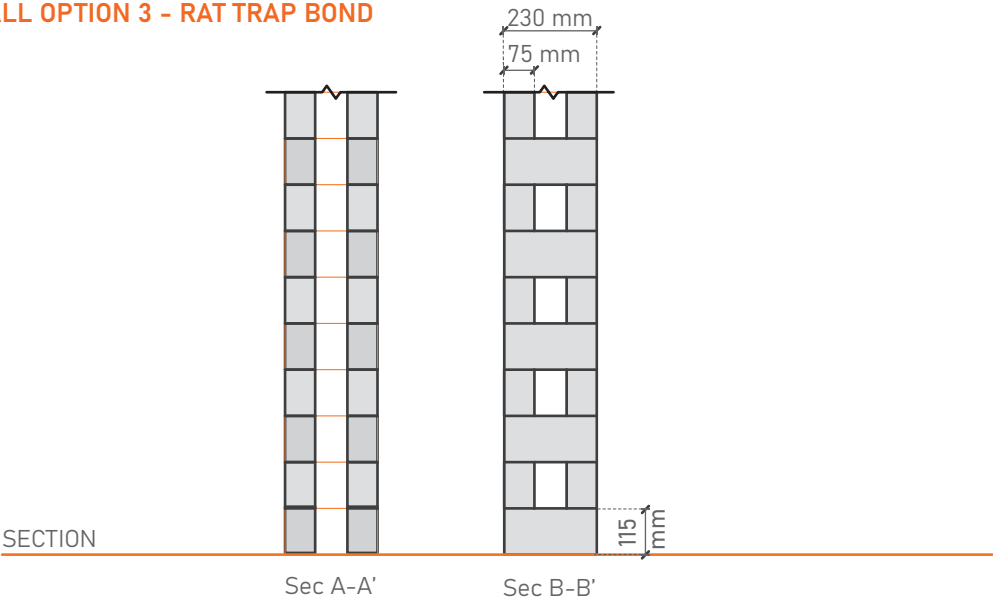


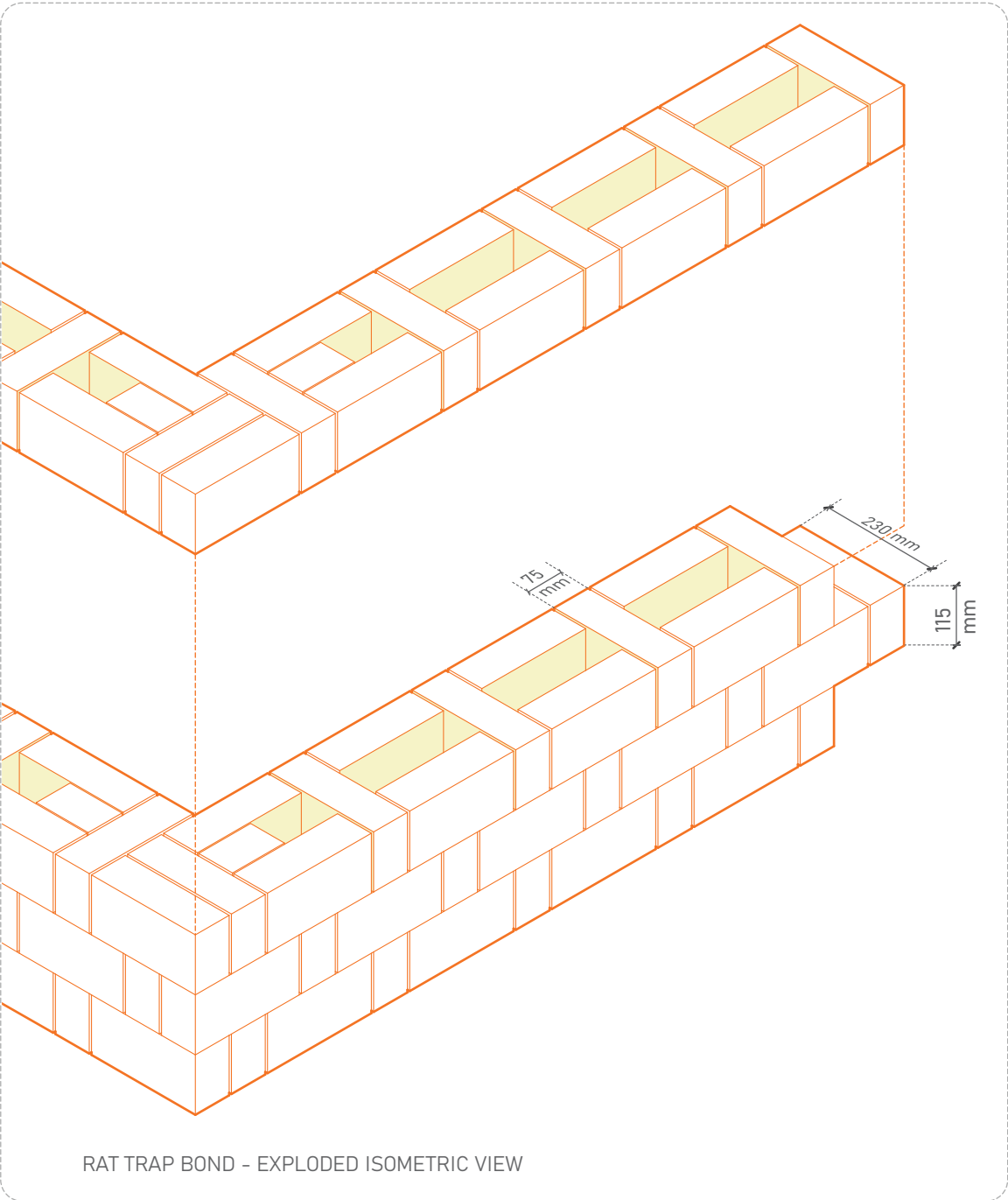


# BUILDING LEVEL

## > WALL CONSTRUCTION STRATEGIES WITH DETAILS

### WALL OPTION 3 - RAT TRAP BOND



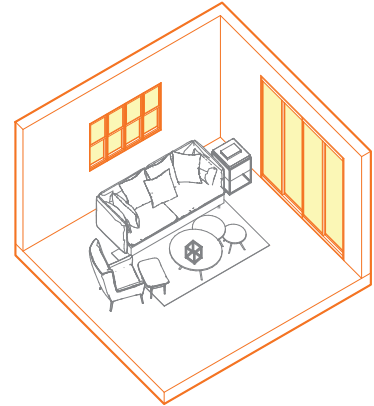
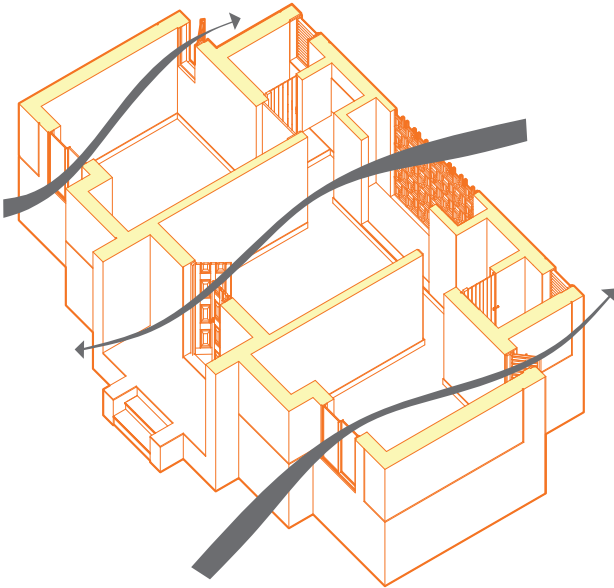


RAT TRAP BOND - EXPLODED ISOMETRIC VIEW

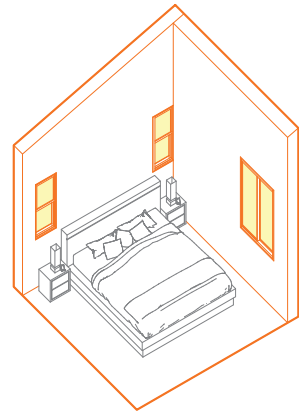


## ➤ FENESTRATIONS WITH WWR RECOMMENDATIONS

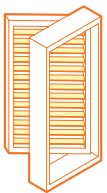
**Window to Wall ratio (WWR)** is a critical aspect of passive design strategies to achieve **energy efficiency and thermal comfort**.



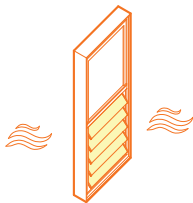
Recommended **WWR for Living Room**  
= 20% - 30%



Recommended **WWR for Bedroom**  
= 10% - 30%



Windows

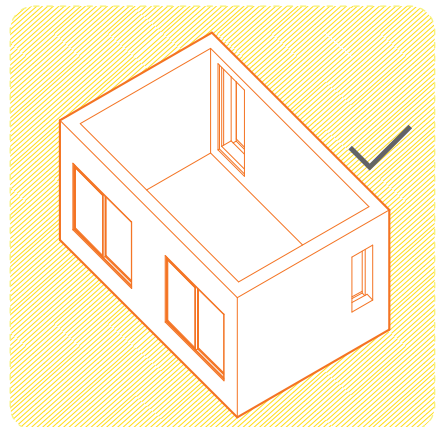


Louvers



Grills

For a Warm and Humid climate zone,  
**WWR should be at least 17%.**  
**Higher percentage is better.**

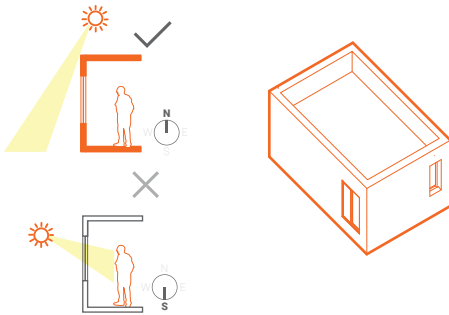




## HOW TO CALCULATE WWR ?

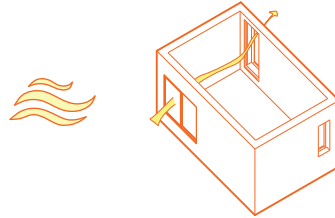
### STEP 1 >>>>

Decide window placement on the building as per orientation recommendations and building structure.



### STEP 2 >>>>

Decide window positions for each room for cross ventilation to maximise natural ventilation.



### STEP 3 >>>>

Determine window size on each wall as per respective recommended WWRs for your climate zone. As follows,

$$\text{Wall Area(sq.ft)} \times \text{WWR(\%)} = \text{Area for Window(sq.ft)}$$

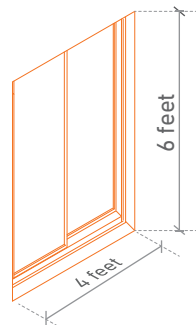
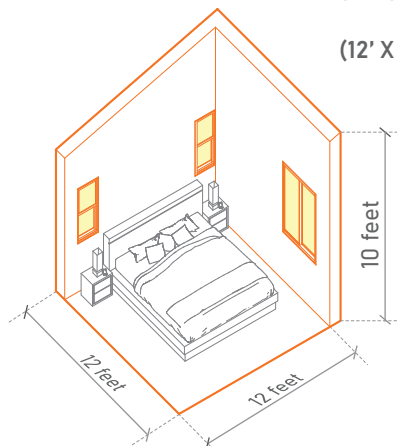
### STEP 4 >>>>

Based on the calculated area, one can decide dimensions for the window considering bedroom size, building structure and orientation

#### FOR EXAMPLE

20% WWR is recommended for a bedroom for your climate zone,

$$(12' \times 10')\text{sq.ft} \times 20/100 = 24 \text{ sq.ft}$$

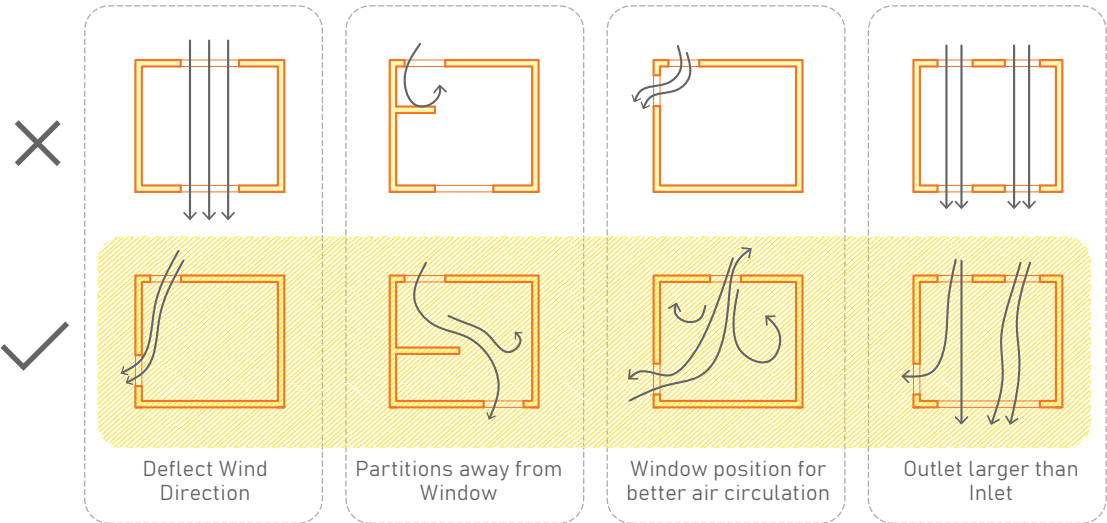


Based on the above calculated area and considering **bedroom size, building structure and orientation**, Window of size **6' x 4'** can be placed in the direction bringing least amount of glare and heat in the bedroom.

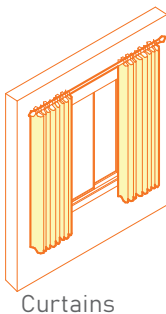
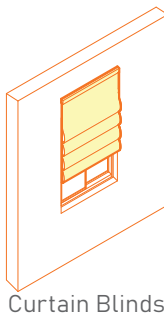
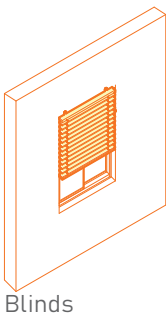
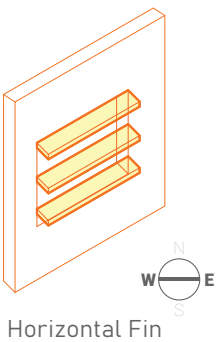
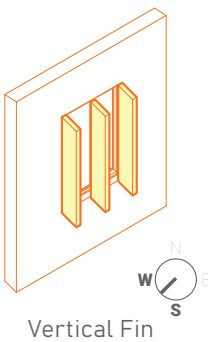
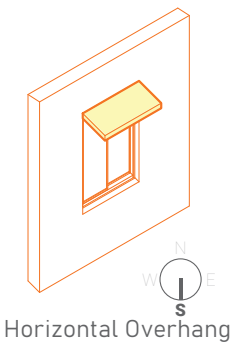


## > NATURAL VENTILATION STRATEGIES AND SHADING

### WINDOW PLACEMENTS


















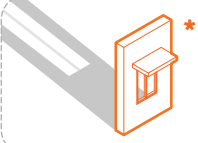


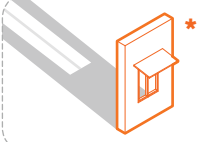





The most effective solution for shading the house is to add an external shading device such as an **overhang or a fin** that would **stop the sun rays from falling onto the glass surface altogether**.





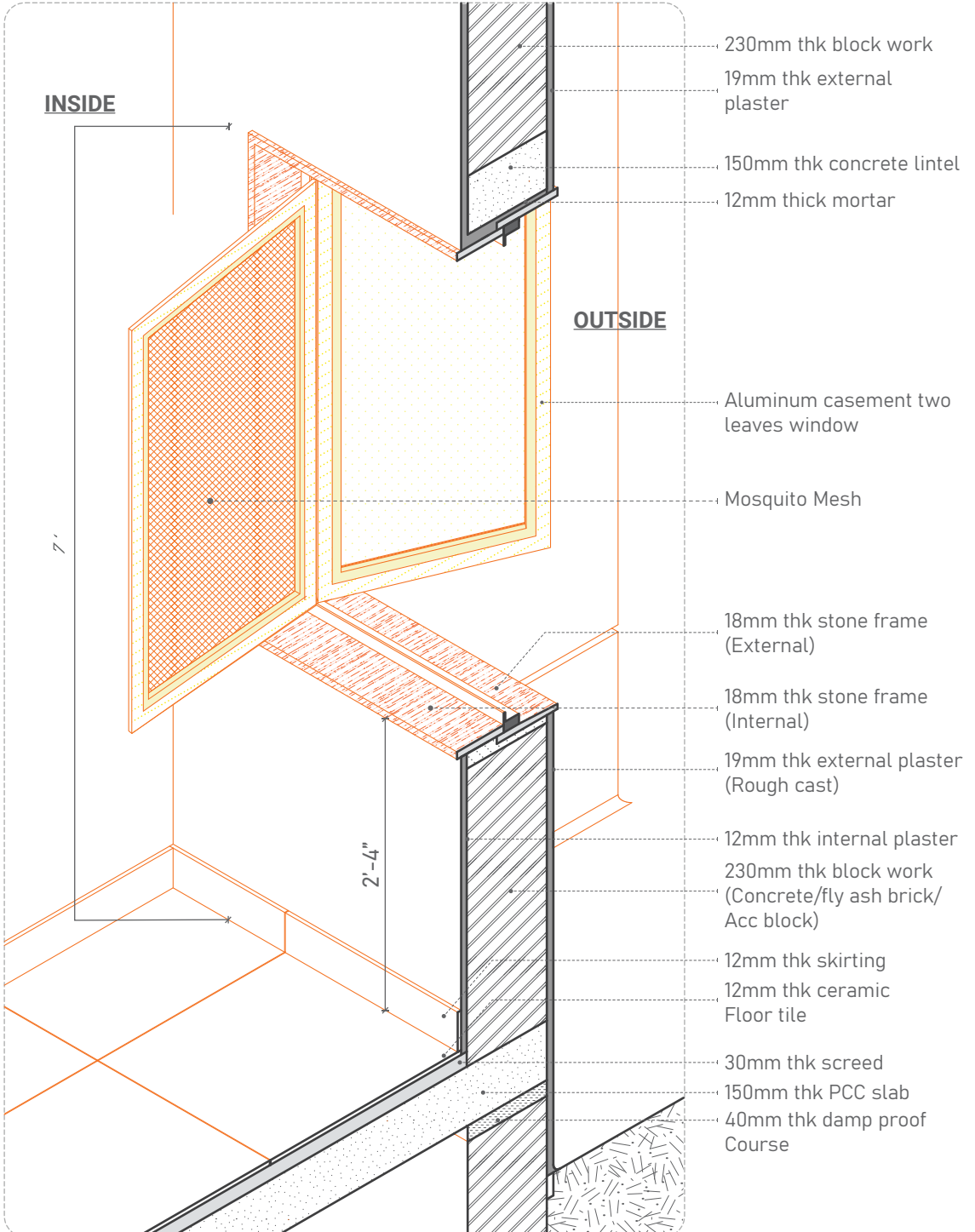
SHADOW ANGLES

South Direction			
Angle	 12 PM	 3 PM	 6 PM
0°			
10°			
20°			
West Direction			
Angle	 12 PM	 3 PM	 6 PM
0°			
10°			
20°			

\* Due to the horizontal shading device, no/minimal shadow cast on the external wall.



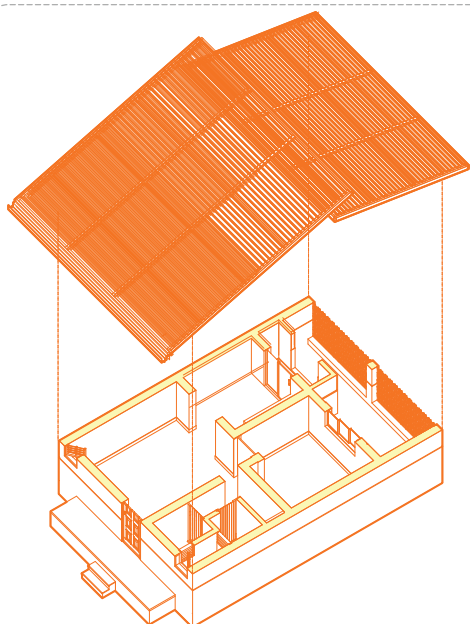
## > WINDOW CONSTRUCTION DETAILS





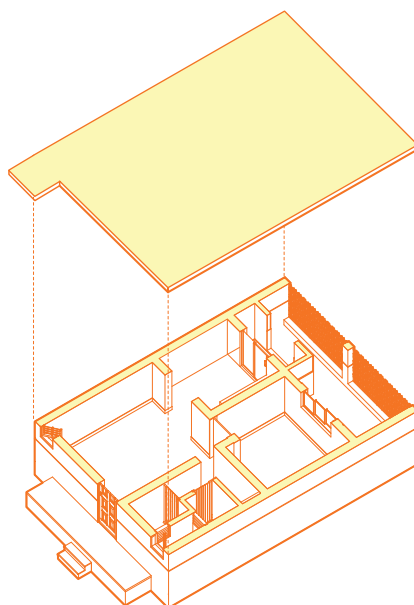


## > FUTURE EXPANSION SCENARIO



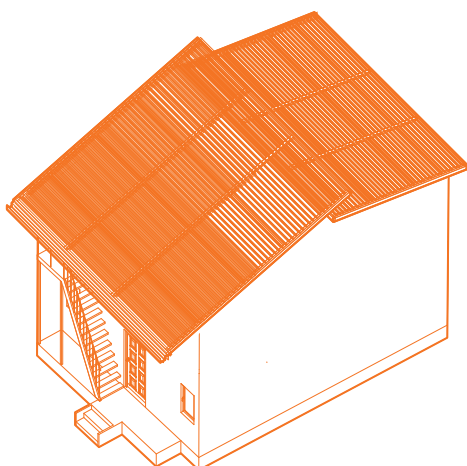
### STEP 1

Dismantle the roof and safely store the materials



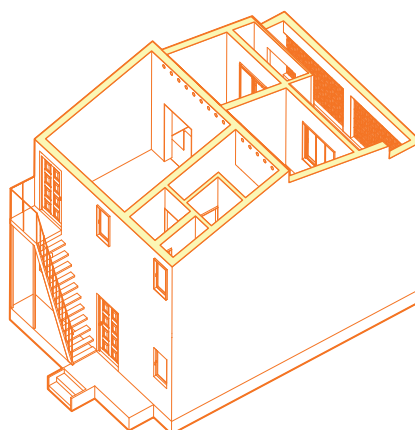
### STEP 2

Construct new slab above existing building



### STEP 4

Reassemble the Roof



### STEP 3

Construct rooms and ladder

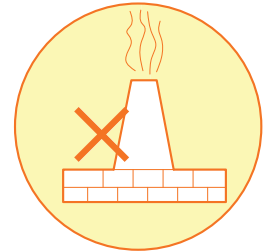
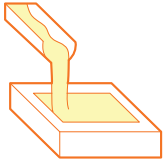
# SUSTAINABLE MATERIAL CHOICES



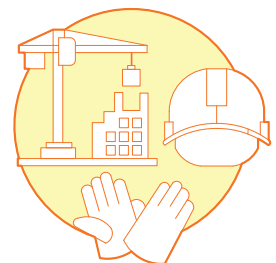
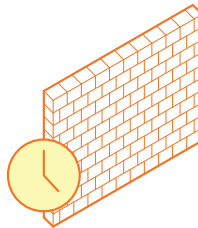
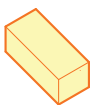
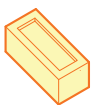
## WALLING MATERIAL



The use of **fly ash** (a by-product of coal combustion) as an **alternative to fired clay bricks** in building construction is being **promoted by the government** and its availability has increased during the last two decades, particularly in the urban areas.



**Solid concrete block** and autoclaved aerated concrete (**AAC**) blocks are also widely used **non-fired bricks**.



**The traditional red clay brick** is a time-tested walling material of choice.



## Types of brick

## Remarks

## PHYSICAL

## THERMAL

## APPLICATIONS



Clay Fired (Extruded)



Concrete brick and block



Calcium silicate brick



Low water absorption



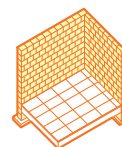
High compressive strength



High thermal conductivity



High thermal mass.



Suitable for load bearing construction



High dead load



Disadvantage for mid- and high-rise buildings.



Clay Fired (Hand Moulded)



Fly ash brick



Compressed Stabilised Earth Blocks



C&amp;D waste brick



Surkhi brick



Medium water absorption



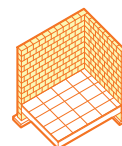
Medium compressive strength



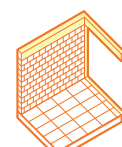
Medium thermal conductivity



Medium thermal mass.







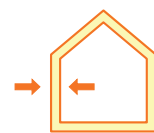
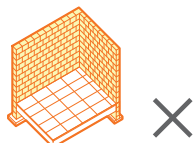





Suitable for load bearing construction





Suitable for Framed construction





Types of brick		Remarks		
		PHYSICAL	THERMAL	APPLICATIONS
<div> AAC blocks</div> <div> CLC blocks</div> <div> Expanded Clay Aggregate Brick</div>		<div> High water absorption</div> <div> Low compressive strength</div>	<div> Low thermal conductivity</div> <div> Low thermal mass.</div>	<div><div> Not Suitable for load bearing construction</div><div> Suitable for mid and high rise buildings</div><div> Low weight</div><div> Savings in Construction</div></div>


Based on above types and characteristics, below are recommendations for choosing bricks for warm and humid climate


  
Fly Ash Brick

  
Compressed Stabilized Earth Blocks

  
Surkhi brick

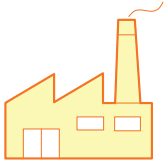
  
C & D waste brick

  
Clay Fired (Hand Moulded)

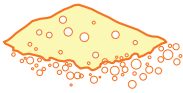
Most to least preferred choices 



## PLASTER - INTERNAL WALLS



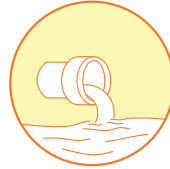
Factory  
made



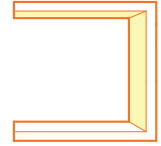
Powdered gypsum  
plaster



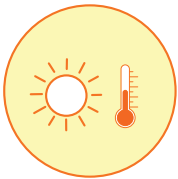
Water



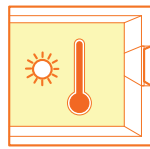
Mixed to form a  
ready paste



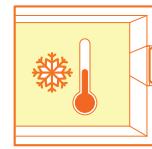
Applied on ceiling  
and walls



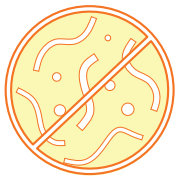
Gypsum has low  
thermal conductivity



It keeps indoors warm  
during the cold months



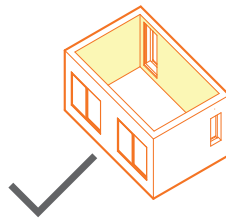
Cooler during the warm  
summer



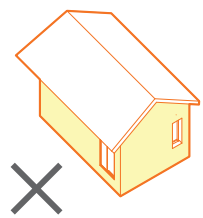
Highly resistant to  
mold and mildew  
when ventilated.



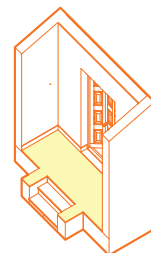
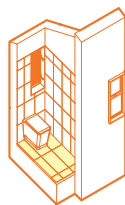
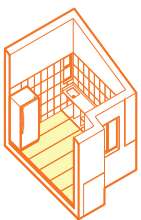
Fire resistant



Suitable for interiors  
of building



Not suitable for  
exteriors



Gypsum plaster **should not be used** in moisture-laden areas like the bathrooms, kitchens, balconies or damp basements. Instead, **cement plaster should be used**.



## PLASTER - EXTERNAL WALLS AND WET AREAS



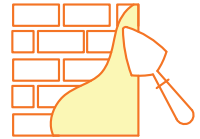
Portland cement



Sand



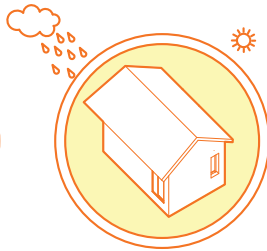
Water



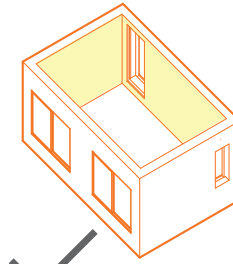
Homogeneous mixture of cement plaster



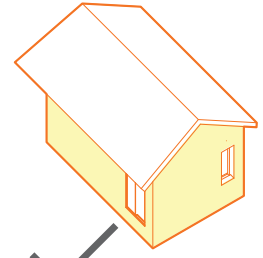
Resistant to moisture



First line of defence to protect from wind, rain, and harmful industrial gases and vehicular pollution.



Suitable for interiors of building



Suitable for Exteriors of the building

## PAINTS - INTERNAL AND EXTERNAL WALLS



Health hazards.



Low water solubility.

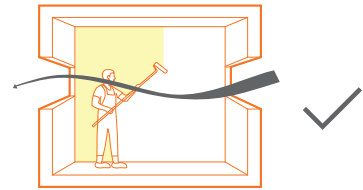
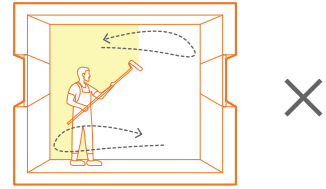
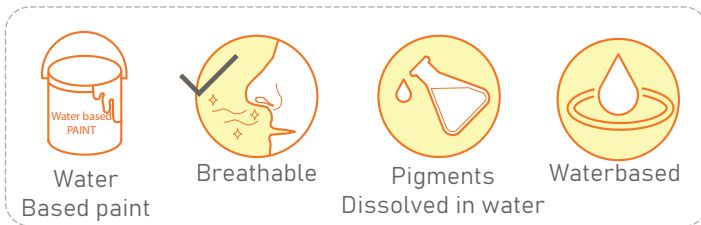


High vapor pressure

The **smell of freshly painted room** or surface experienced is the **result of Volatile Organic Compounds (VOCs) in paint**.



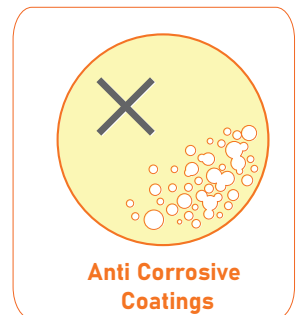
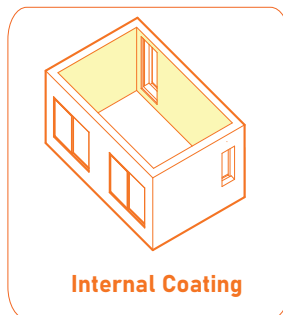
## LOW VOC PAINT



**During painting,** a proper circulation of fresh air while using agents that release **vocs** can be a great tactic to reduce the harmful effects.

One should ensure to **ventilate the rooms** well so that the vocs in paint don't continue to circulate indoors.

VOC of interior and exterior coating, as per GRIHA (2017) for affordable housing abridged manual.



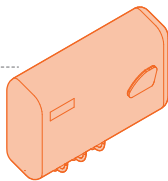
Coating type	VOC weight in grams/litre of product minus water	VOC weight in grams/litre of product minus water	
Non Flat	< 150	< 100	
Flat	< 50	< 200	
Gloss/ Semi Gloss / Flat			< 250

# SUSTAINABLE APPLIANCES AND TECHNOLOGIES



- |                |              |
|----------------|--------------|
| 1. Verandah    | 5. Bedroom 2 |
| 2. Living Room | 6. WC        |
| 3. Kitchen     | 7. Bath      |
| 4. Bedroom 1   |              |

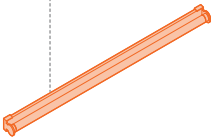




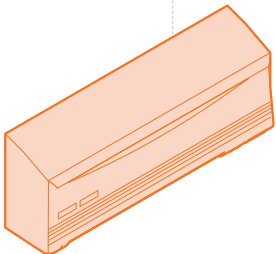
**1**  
Geyser



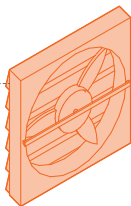
**5-7**  
Bulbs



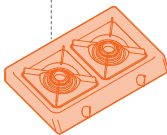
**3-5**  
Tubelight



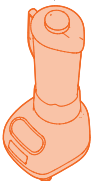
**1-2**  
Air Conditioner



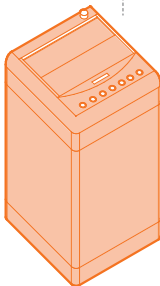
**1-3**  
Exhaust Fan



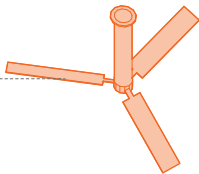
**1**  
Gas Stove



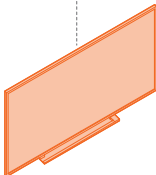
**1**  
Mixer Grinder



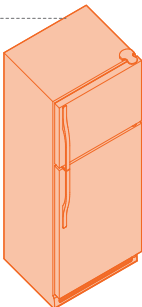
**1**  
Washing Machine



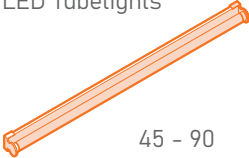





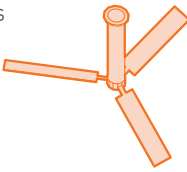

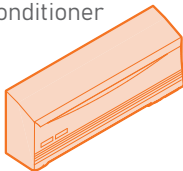





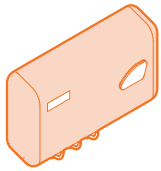

**4-5**  
Fan



**1**  
TV



**1**  
Refrigerator

Sr.no	Appliance/ Technology/ Systems	Watt Capacity	★ BEE Rating	₹ Cost	↑ Pros
1 ELECTRICAL APPLIANCES					
A	LED Tubelights 	22 - 36	★★★★☆	250 - 450	 Reduced Wattage  Increased Life span
B	LED Bulbs 	3 - 12	★★★★★ ★★★★★	90 200	 Reduced Wattage  Increased Life span
C	Fans 	35 - 50	★★★★★	3000 - 4000	 Energy Efficient > 65 % Less Power consumption
D	Air Conditioner 	1 - 1.5 ton Split Ac	★★★★☆ ★★★★★	31,000 36,000	 Energy Efficient  Increased Life span
E	Refrigerator 	192 L to 215 L Single Door	★★★★☆ ★★★★★	12,000 16,000	 Energy Efficient  Better Cooling
F	Geyser 	15 - 25L	★★★★☆ ★★★★★	5,700 7,000	 Combination can supply hot water all day long

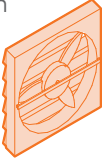


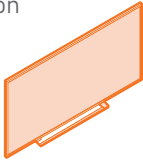






↓  
Cons

☑  
Outcome

↗  
Incrementality

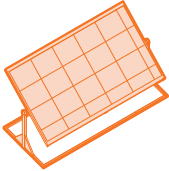


 Initial Cost is more	 >> 50 % Annual Savings	
 Initial Cost is more	 >> 50 % Annual Savings	
 Initial Cost is more	 >> 1500 Rs Per Fan	
 Initial Cost is more	 >> 30 % Annual Savings	 Installation Optional
 Initial Cost is more	 >> 50 % Annual Savings Compared to 0 Star rating	
 Initial Cost is more	 >> 40 % Annual Savings	

Sr.no	Appliance/ Technology/ Systems	WATT Capacity	★ BEE Rating	₹ Cost	↑ Pros
H	Exhaust Fan 	150 - 250	★★★★★ ★★★★★	600 - 1500	  Energy Efficient
I	Television 	24" - 55"	★★★★★ ★★★★★	6000 - 55,000	  Energy Efficient Better Brightness
J	Washing Machine 	Semi Automatic 5 Kg - 7 Kg	★★★★★	9000 - 18,000	 65 % Energy Efficient Less Power consumption

















## 2 LPG/PNG GAS RELATED APPLIANCES



A	Gas Stove 	2 - 4 Burner	★★★★★ ★★★★★	2000 - 3500	68 - 74% Thermal Efficiency  Better Flame
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## 3 SOLAR RELATED SYSTEMS



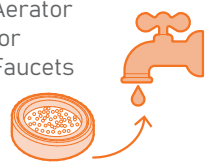



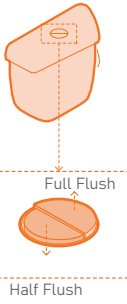
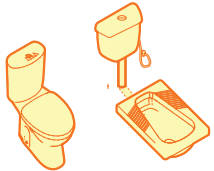
A	Solar Panels 	1 or more KV		30,000 - 60,000 per KV	 100 - 200 units per month
---	---	-----------------	---	---------------------------	--



Cons	Outcome	Incrementality
<div><p>Initial Cost is more</p></div>	<div><div>&gt;&gt;</div><div>10 % Annual Savings</div></div>	<div></div>
<div><p>Initial Cost is more</p></div>	<div><div>&gt;&gt;</div><div>20 % Annual Savings</div></div>	<div></div>
<div><p>Initial Cost is more</p></div>	<div><div>&gt;&gt;</div><div>30 % Annual Savings</div></div>	<div></div>
<div><p>Initial Cost is more</p></div>	<div><div>&gt;&gt;</div><div> One Cylinder Per year</div></div>	<div></div>
<div><p>Initial Cost is more</p></div>	<div><div>&gt;&gt;</div><div>14400 Units Per year</div></div>	<div><p>Installation Optional</p></div>

Sr.no	Appliance/ Technology/ Systems	WATT Capacity	★ BEE Rating	₹ Cost	↑ Pros
B	Solar Water Heater 	100 - 300 Litres per day		30,000 - 60,000 per KV	 Year long Hot water Supply

#### 4 SYSTEMS FOR WATER CONSERVATION

A	Rain Water Harvesting 			10,000 without tank	 Recharge Groundwater
B	Aerator for Faucets 	3 - 5 Litres per min		50 - 90	 Can reduce from 8 - 3 LPM
C	Low Flow Shower Heads 	6 - 8 LPM		1000 - 2500	 Water Flow from 22 - 6 LPM
D	Dual Valve Flush Tank 				



Cons



Outcome



Incrementality



Initial Cost is more



80%



Installation Optional



Recharge Groundwater



Installation Optional



Initial Cost is more

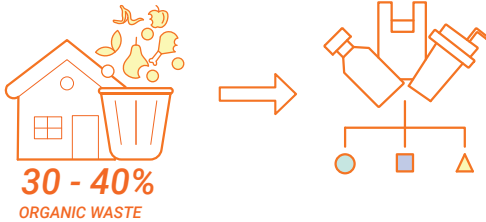
22,500 L  
Eventually  
saving on  
water bill40 %  
Savings than  
regular  
Showerheads**NOTE :**

The above costs of the goods and systems have been defined as per the market scenario as of May 2023. It may vary over time and place.

# WASTE MANAGEMENT AT HOME



## 1. WASTE SEGREGATION



Waste segregation at homes is one of the best methods to reduce the burden on those handling the waste.



Food waste  
garden waste



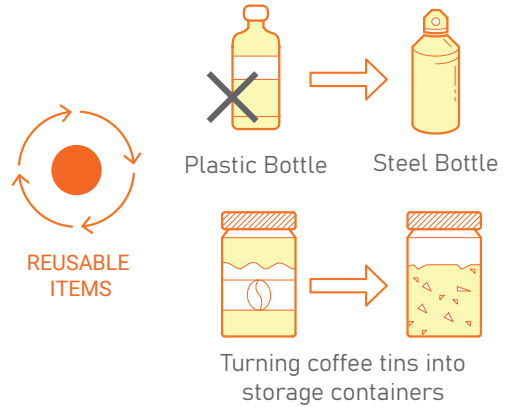
Glass  
Paper



Plastic  
Non-degradable  
waste

## 2. REUSE

- Invest in reusable products
- Utilise products with multiple uses
- Minimise waste generation
- Keep waste away from landfills



## 3. RECYCLE

Recycling can be defined as turning any kind of waste into something new or useful.



RECYCLE  
ITEMS



## 4. REDUCE

Reducing waste is more of an attitude that can be followed while dealing with food, paper and plastic.



Reusing Newspaper as wrapping paper for Gifts





## 5. COMPOSTING



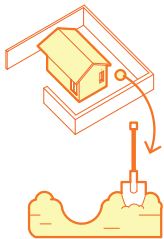
Composting is one of the best solid waste disposal methods when it comes to households, prepare the compost pile and allow the living microorganisms to break down the organic waste materials. The compost, once ready, can be used for improving soil quality and plant growth.

### HOW TO START COMPOSTING?

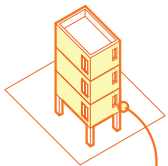
It is interesting to note that 40% – 50% of the waste produced in households is organic. Thus, composting can be done by anyone living anywhere by following the simple steps mentioned below.

#### STEP 1

##### Finding a place ???



Case 1 – open plot  
To dig a pit



Case 2 – residence  
Perforated bin

#### STEP 2

##### Collecting the waste

###### Green waste



Kitchen waste



Dried leaves

###### Brown waste



Saw dust



Shredded paper



Cardboard

#### STEP 3

##### Storing the waste and decomposing



Layering green and brown waste



Green waste  
Adds nitrogen



Brown waste adds  
Carbon rich



Browns to  
greens  
ration

#### STEP 4

##### Waiting for compost to get ready



Resting for sometime



Mixing pile using stick



Optimal moisture and  
temperature level



Ready when smells  
woody and fresh



2  
Months



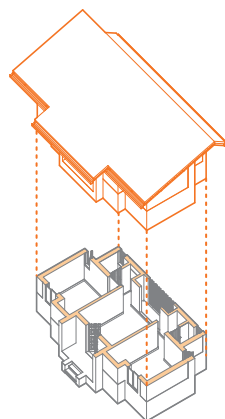
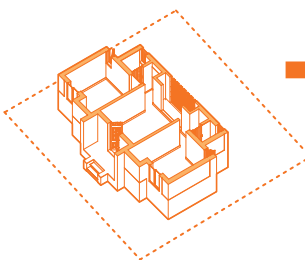
4  
Months

# ARCHITECTURAL DRAWINGS - PLANS

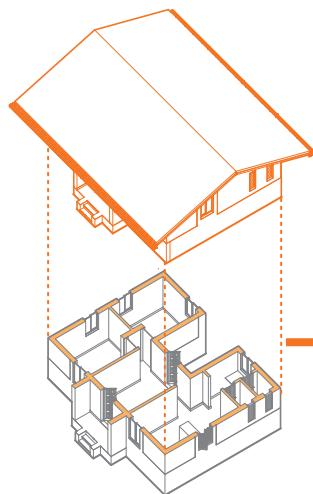
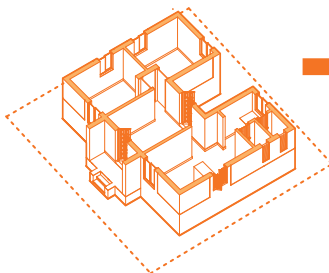
## > INTRODUCTION TO TYPOLOGIES



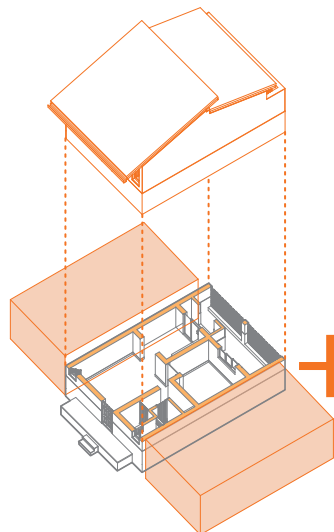
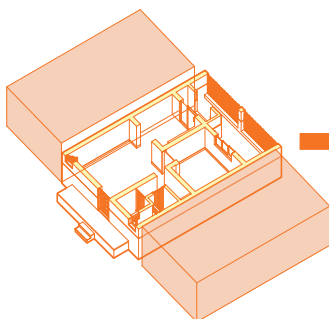
**S**  
INDIVIDUAL HOUSE  
37 SQ.M

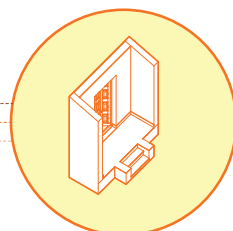
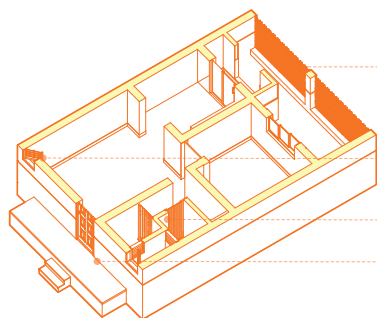
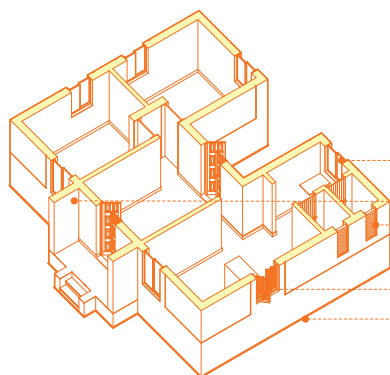
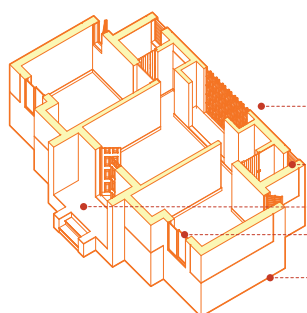


**M**  
INDIVIDUAL HOUSE  
52 SQ.M

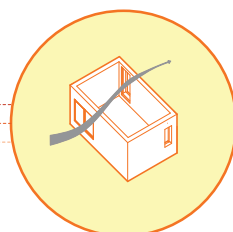


**L**  
ROW HOUSE  
56 SQ.M

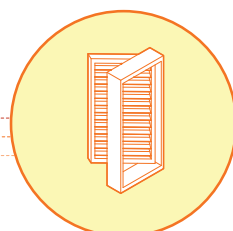




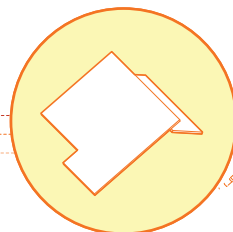
Semi open space  
Verandah



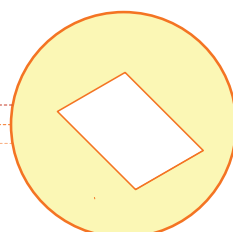
Cross - Ventilation



Louvered Windows



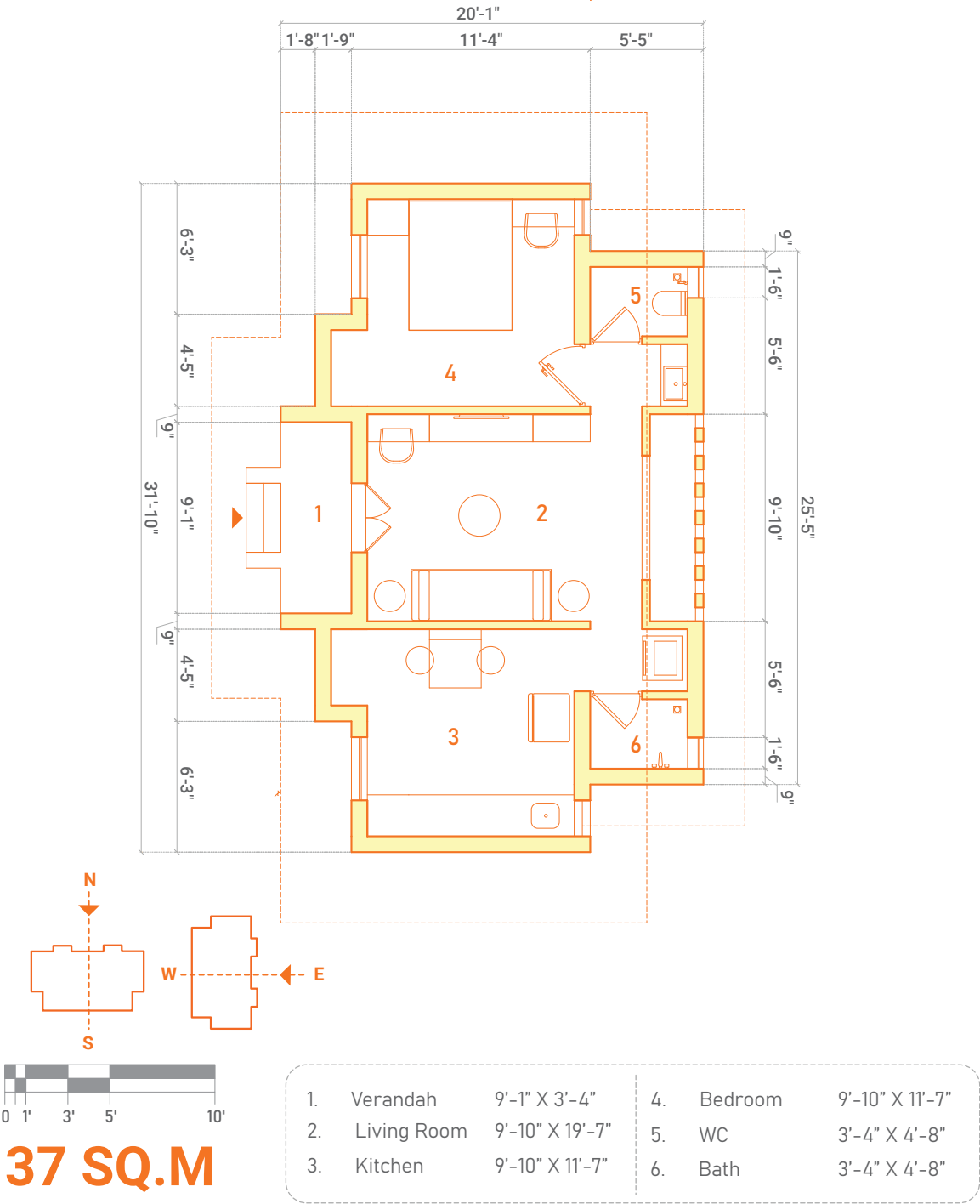
Roof Overhang

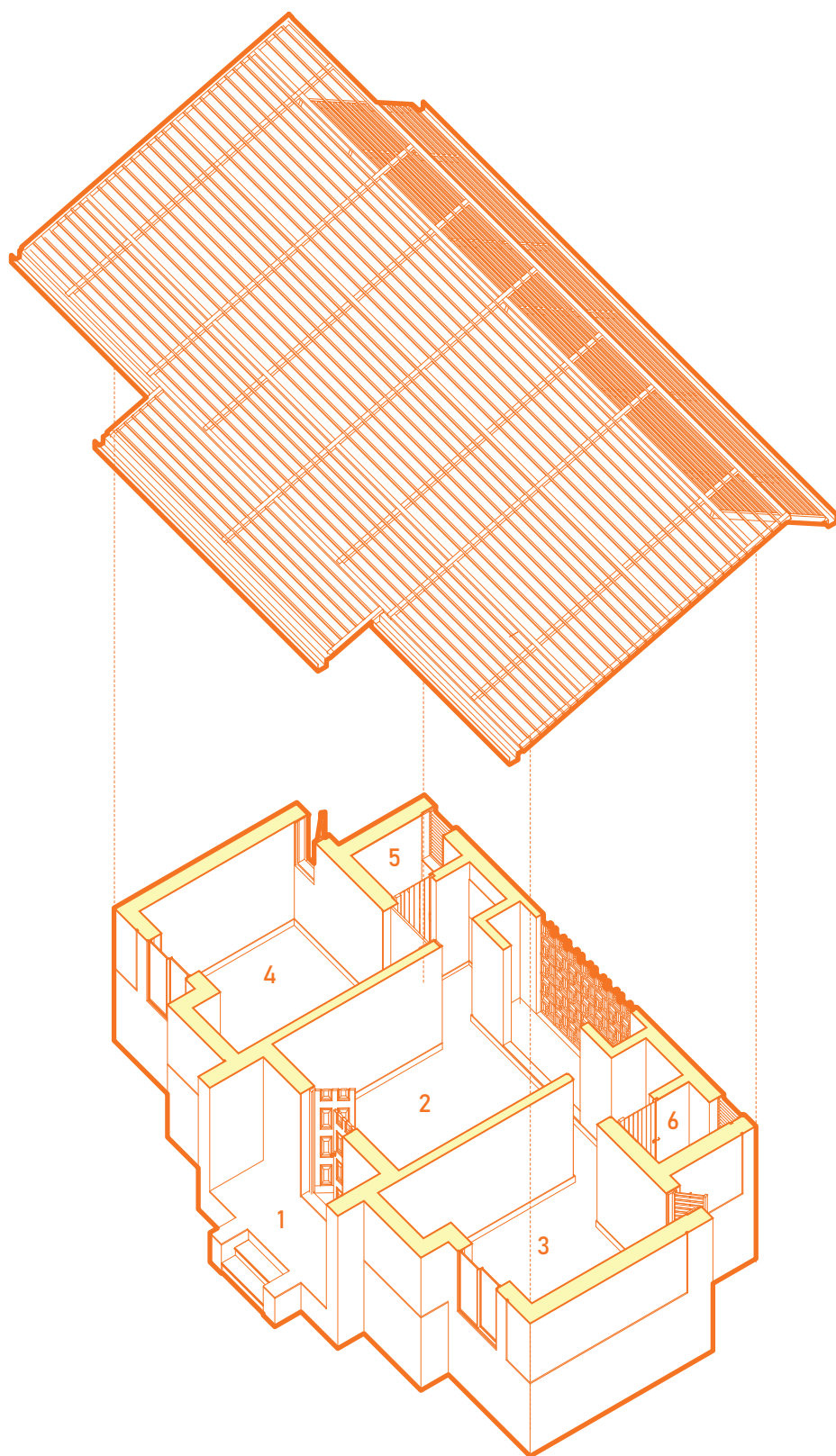


Small Footprint



S - TYPOLOGY 1 - INDIVIDUAL HOUSE

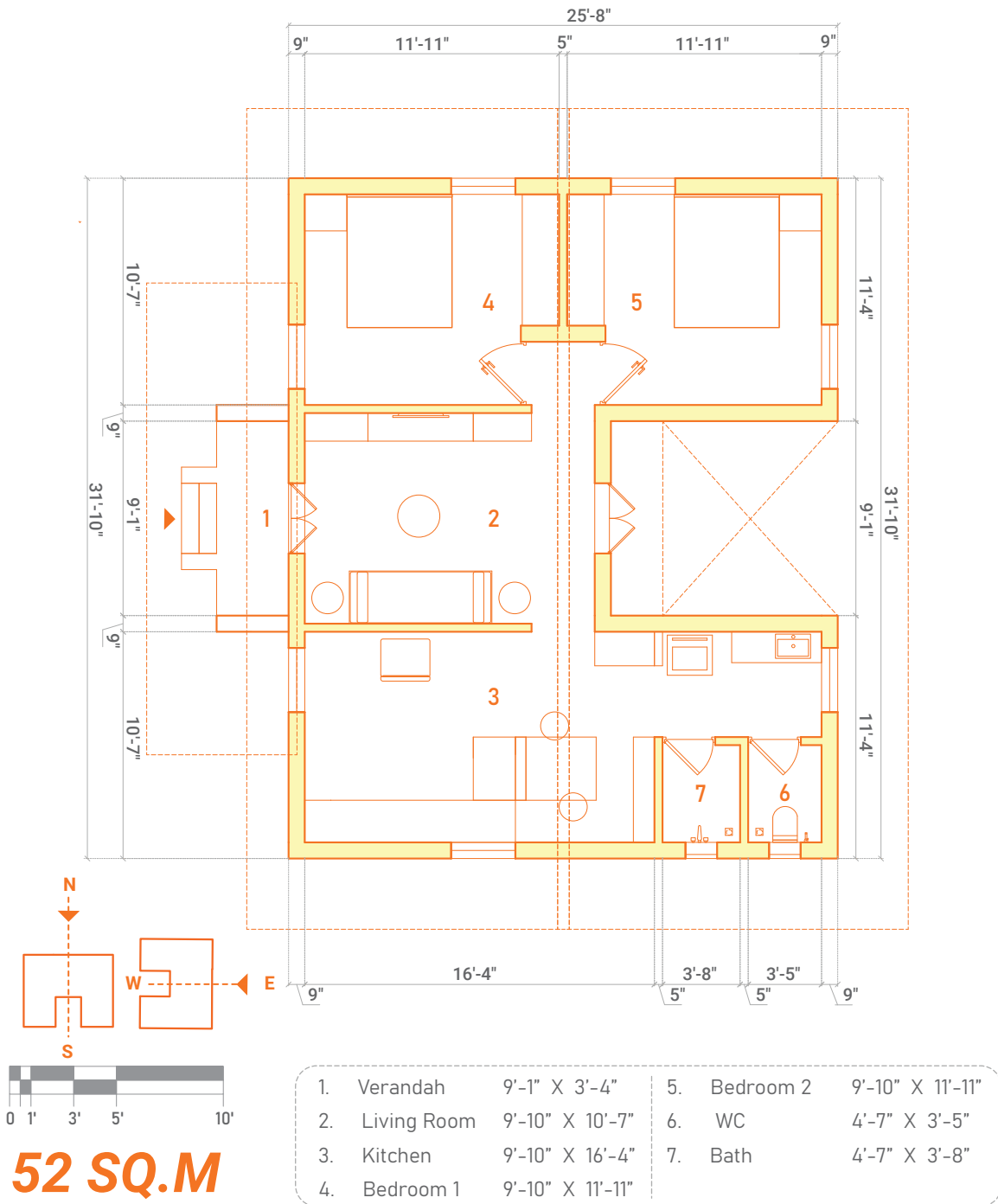


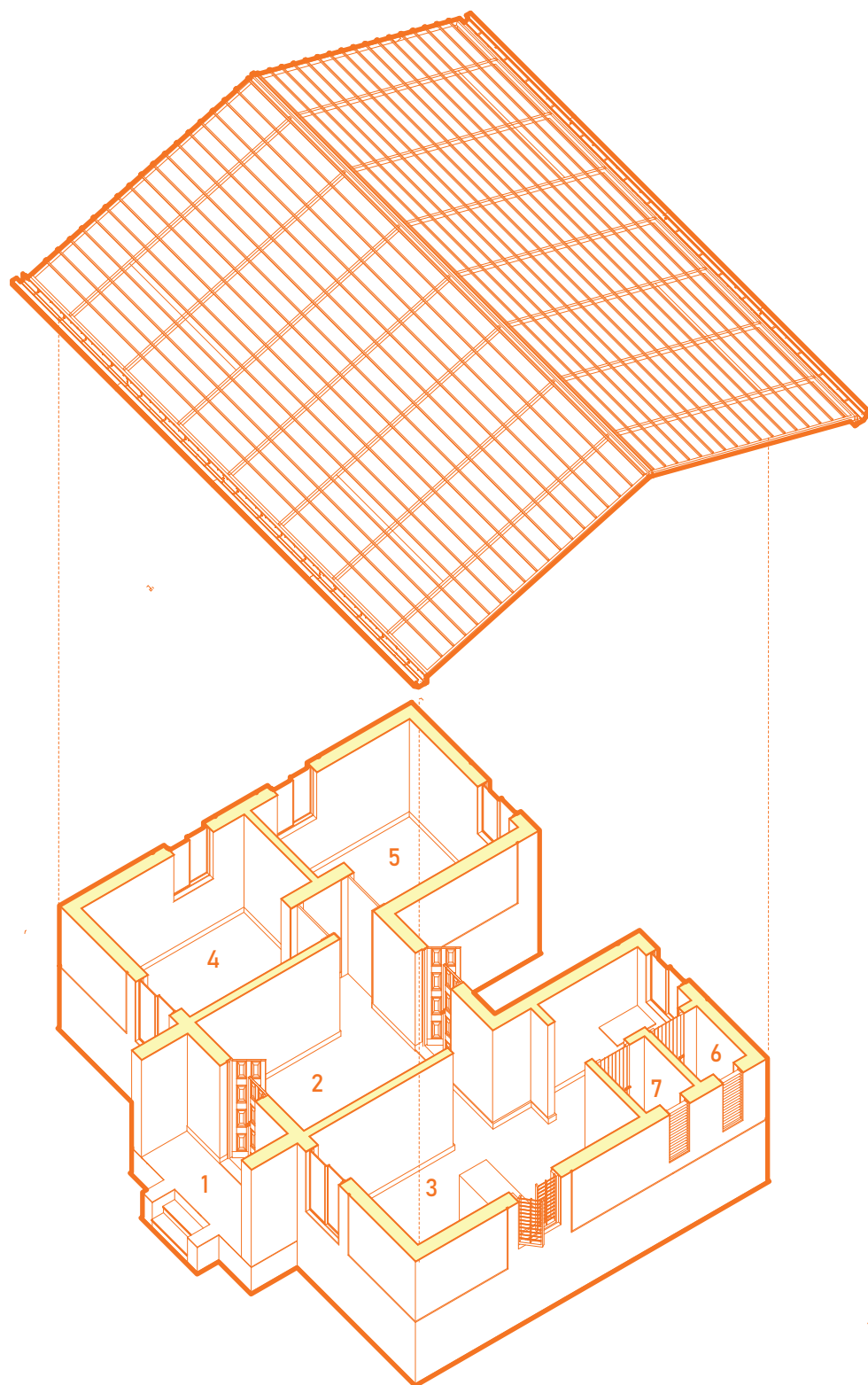


Exploded Axonometric View of the House



## M - TYPOLOGY 2 - INDIVIDUAL HOUSE

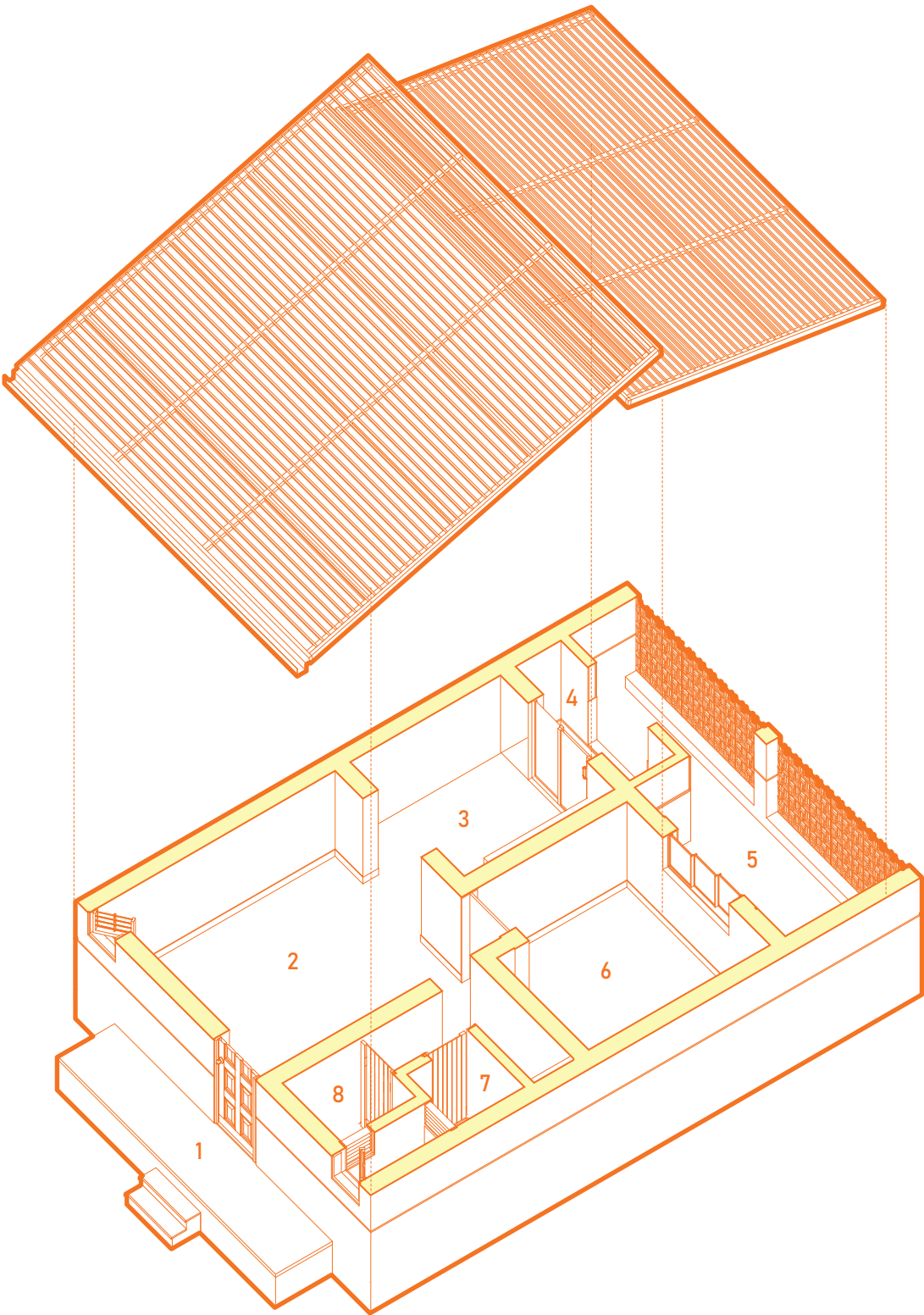




Exploded Axonometric View of the House

1.	Verandah	15'-4" X 3'-3"	5.	Backyard	19'-3" X 3'-4"
2.	Living Room	13'-6" X 11'-11"	6.	Bedroom	10'-3" X 10'-8"
3.	Kitchen	8'-3" X 8'-10"	7.	WC	3'-9" X 4'-0"
4.	Store	8'-3" X 2'-9"	8.	Bath	3'-10" X 4'-6"



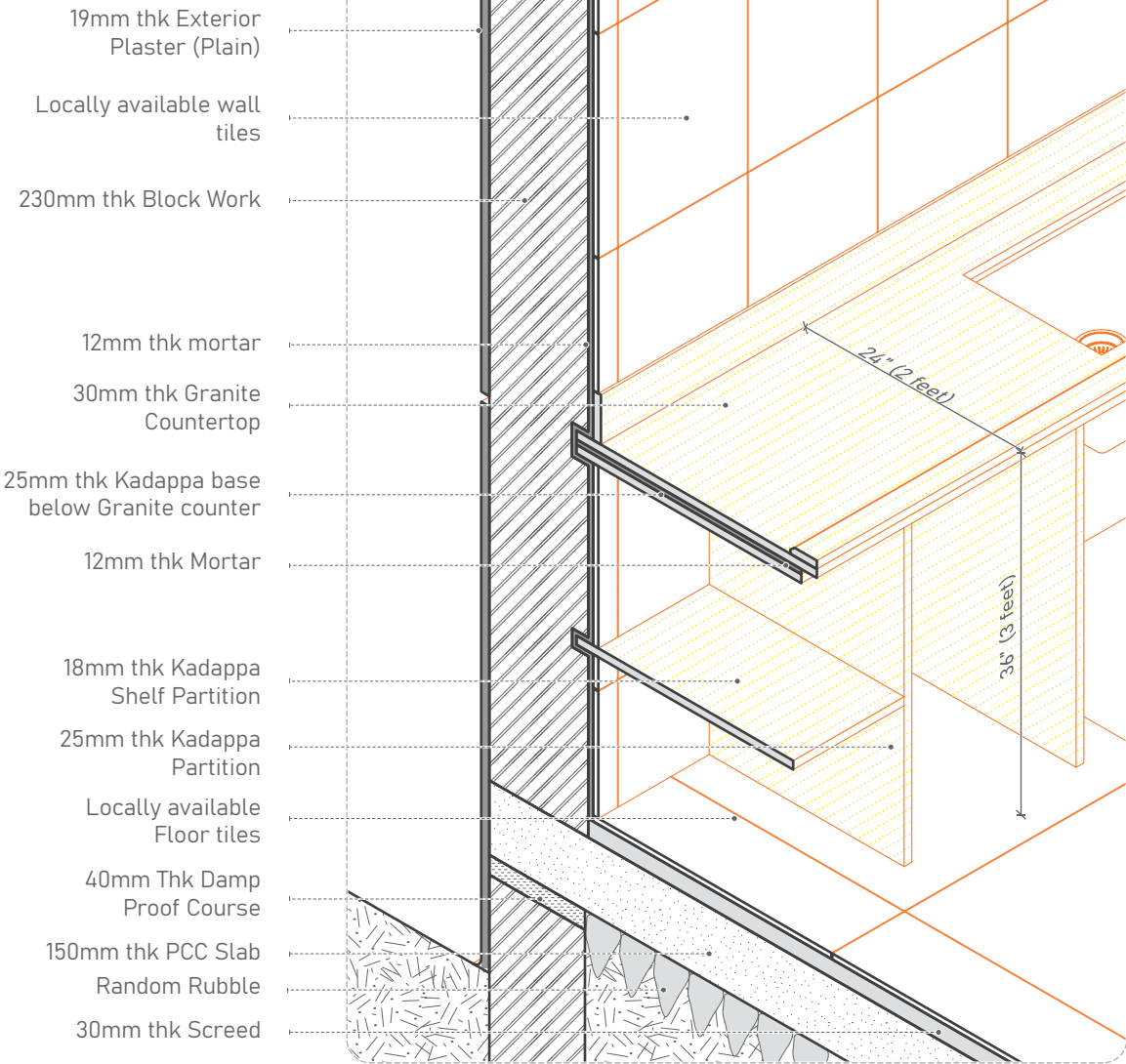


Exploded Axonometric View of the House



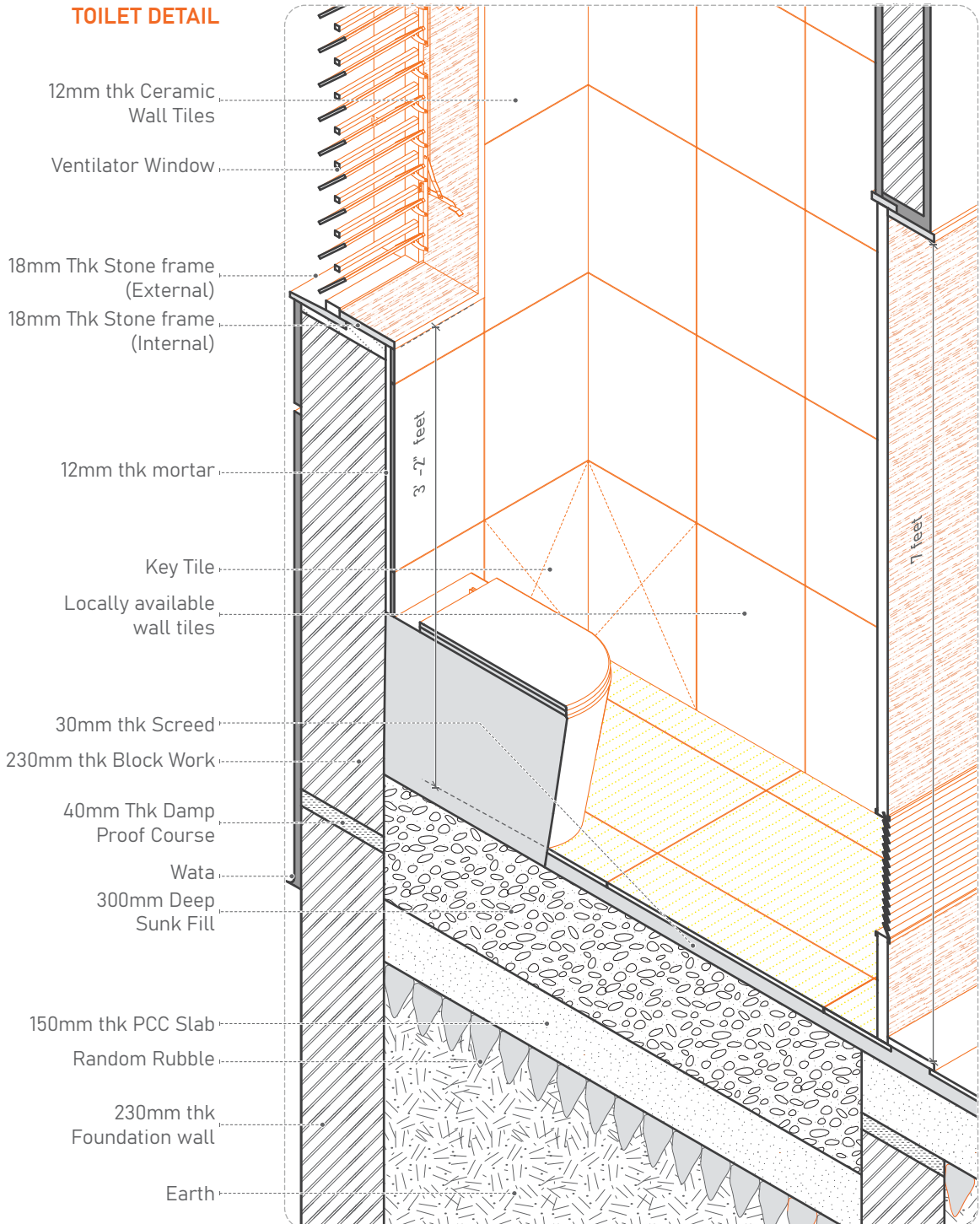
# TYPICAL CONSTRUCTION DETAILS

## KITCHEN PLATFORM DETAIL



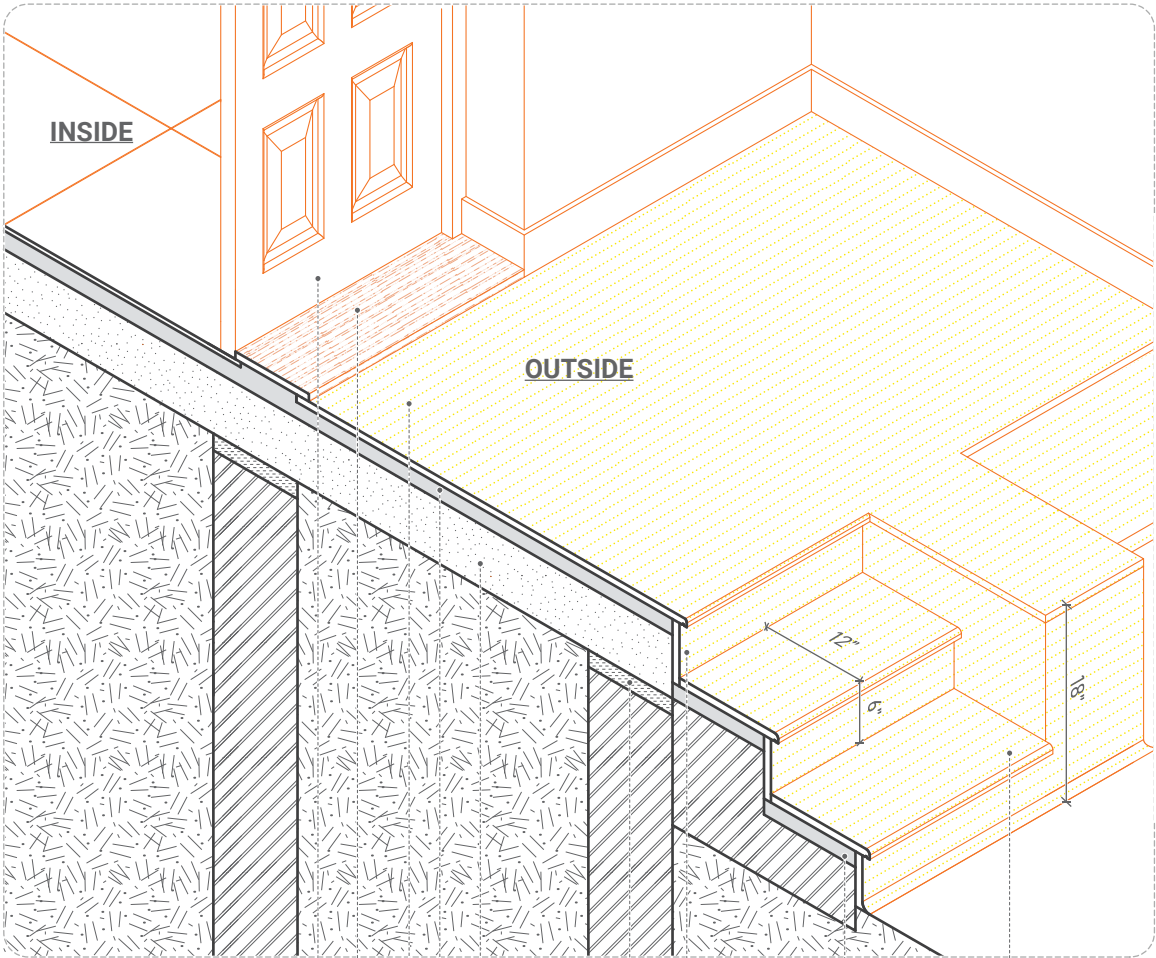


## TOILET DETAIL





## COURTYARD DETAIL



Timber Door -  
Double Shutter

Locally available Stone  
Threshold

Locally available  
Stone Flooring

30mm Screed

150mm Thk PCC Slab

40mm thk Damp  
Proof Course

19mm thk External  
Plaster (Rough Cast)

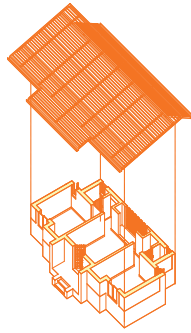
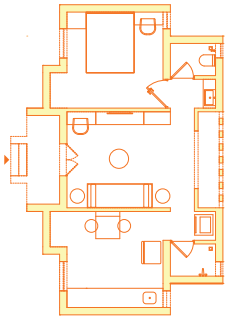
Stairs in  
Block work

Locally available  
stone flooring



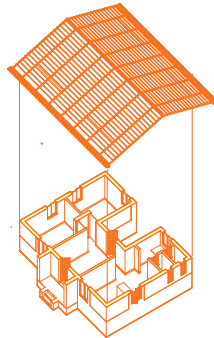
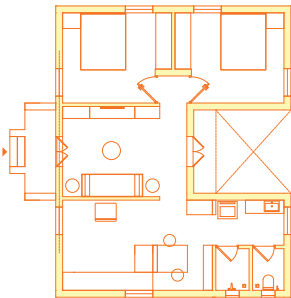
## COST ESTIMATES FOR CONSTRUCTION

### > BLOCK COST ESTIMATES



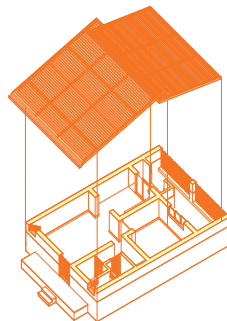
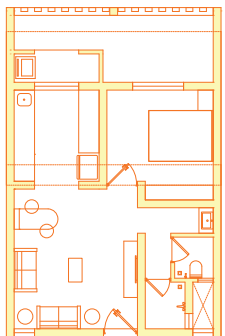
**S** INDIVIDUAL HOUSE  
37 SQ.M

**INR 10 to 11  
lakhs**



**M** INDIVIDUAL HOUSE  
52 SQ.M

**INR 13 to 14  
lakhs**



**L** ROW HOUSE  
56 SQ.M

**INR 12 to 13  
lakhs**



#### NOTE :

The above costs have been defined as per the overall construction industry scenario (costs of material, labour, etc.) in Karwar, Karnataka, as of May 2023. It may vary as per the conditions of the place of construction.

> SUMMARY: BILL OF MATERIALS

Sr. no	Item	
ARCHITECTURAL WORKS		
1	<div></div> <div>Earth Work Excavation</div>	<div>1. Excavation: Local</div> <div>2. Plinth filling</div> <div>3. Rubble soling</div>
2	<div></div> <div>Plain Cement Concrete</div>	<div>1. PCC Work</div>
3	<div></div> <div>Reinforced Cement Concrete</div>	<div>1. RCC M-25</div>
4	<div></div> <div>Steel Reinforcement</div>	<div>1. Steel re-inforcement: Fe = 500 N/sq.mm</div>
5	<div></div> <div>Pest Control</div>	<div>1. Pre-construction anti-termite treatment</div>
6	<div></div> <div>Masonry</div>	<div>1. Full-width brick/block</div> <div>2. Half -width brick/block</div>



Units	Individual House 37 sq.m	Individual House 52 sq.m	Row House 56 sq.m
-------	-----------------------------	-----------------------------	----------------------

Cum	71	80	84
Cum	43	47	49
Cum	22	28	27

Cum	16	19	19
-----	----	----	----

Cum	4	7	5
-----	---	---	---

MT	1	1	1
----	---	---	---

Sqm	55	76	65
-----	----	----	----

Cum	47	58	62
Sqm	45	46	14

Sr.  
no

Item

ARCHITECTURAL WORKS

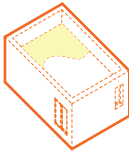
7



Plastering

1. External sand faced plaster
2. Internal gypsum plaster
3. Internal plaster rough: Washroom

8



Waterproofing  
Works

1. Washroom: Water-proofing, chemical coating with protective coat
2. Brick bat coba

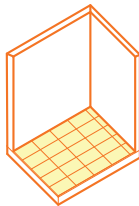
9



Painting Work

1. Acrylic emulsion paint
2. Exterior grade paint

10



Flooring,  
Skirting, Dado

1. Kota flooring for varandah with entry steps tread and riser
2. Vitrified tile floor
3. Vitrified tile dado
4. Vitrified tile skirting
5. Window frame in granite
6. Threshold in granite
7. Twin granite slab frame
8. Granite pantry counter
9. Granite hand wash counter





Units	Individual House 37 sq.m	Individual House 52 sq.m	Row House 56 sq.m
-------	-----------------------------	-----------------------------	----------------------

Sqm	98	132	96
Sqm	154	175	203
Sqm	24	22	38

Sqm	14	14	14
Cum	1	1	1

Sqm	154	252	203
Sqm	98	132	96

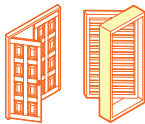
Sqm	5	8	7
Sqm	44	65	56
Sqm	25	25	39
Rmt	50	64	64
Rmt	23	38	20
Rmt	2	2	2
Rmt	11	11	11
Rmt	3	3	5
Rmt	1	2	1

Sr.  
no

Item

ARCHITECTURAL WORKS

11



Doors and  
Windows

1. Main entry door : 1000mm X 2100mm (single shutter)
2. Bedroom door : 900mm X 2100mm (single shutter)
3. Utility door : 1300mm X 2100mm (single shutter)
4. Washroom door : 750mm X 2100mm (single shutter)
5. Aluminium windows
6. Louvered windows (powder coated)
7. RCC Jali

12



Plumbing  
Work

1. Plumbing works for kitchen
2. Plumbing works for WC and shower
3. PVC nahni traps
4. Kitchen sink with tap, stop cock, bottle trap, waste coupling
5. EWC with concealed flush valve, stop cock, health faucet and bib cock
6. Washbasin with tap, stop cock, bottle trap, waste coupling
7. Shower unit

13



Roofing Work

1. Mangalore tile roof with MS structure support and gutter

14



Electrical  
Work

1. Electrical wiring & cabling, switch & sockets, lightfixtures, fan etc

EXCLUSIONS

- Interior work including carpentry furniture, loose furniture, wall panelling, false ceiling work
- Artwork and artefacts
- External electrical and irrigation work
- Landscape work, septic tank, compound wall



Units

Individual House  
37 sq.mIndividual House  
52 sq.mRow House  
56 sq.m

Nos	1	2	1
Nos	1	2	1
Nos	-	-	1
Nos	2	2	2
Sqm	4	10	4
Sqm	2	2	2
Sqm	8	-	15

Nos	1	1	1
Nos	2	2	2
Nos	3	3	3
Nos	1	1	1
Sqm	1	1	1
Sqm	1	1	1
Sqm	1	1	1

Sqm	103	126	78
-----	-----	-----	----

LS	1	1	1
----	---	---	---

**NOTE :**

For costing estimates on white goods, light, fan, etc., refer to the section 'Sustainable Appliances and Technologies' (pages 33-38).

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# ACKNOWLEDGEMENTS

The following individuals graciously contributed to the reviews, discussions, decisions and content development under this capacity building program.

## CLIENTS



## PROGRAM DONORS



## LEAD CONSULTANTS



## SUB - CONSULTANTS















