# FOR CLIMATE RESPONSIVE SELF-BUILT AFFORDABLE HOUSING

### **COMPOSITE CLIMATE**





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CENTER FOR URBAN PLANNING AND POLICY



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## Handbook for Climate Responsive Self-Built Affordable Housing

**COMPOSITE CLIMATE** 







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### **GRAPHICAL GUIDE FOR THE HANDBOOK**



### WHO IS THIS HANDBOOK FOR?



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.

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.



Architect / Engineer

> 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:



### INTRODUCTION TO COMPOSITE CLIMATE ZONE



### **KNOW YOUR CLIMATE ZONE**



Map of India highlighting the **Composite Climate** region of india





### **DESIGN OBJECTIVES**



### PASSIVE DESIGN STRATEGIES

### SITE LEVEL

#### > BUILDING ORIENTATION





#### > BUILDING COMPACTNESS





### **BUILDING LEVEL**

### > BUILDING ENVELOPE







### **BUILDING LEVEL**

### > ROOFING STRATEGIES WITH CONSTRUCTION DETAILS



#### **COOL ROOF STRATEGY**

'Cool' roofs are used in hotter climates. As the name suggests, they prevent heat from entering the building. The roof is exposed to the sun throughout the day. It heats up during the day and passes this heat inside.

As the name suggests, cool roofs keep the heat out. In addition to shading and providing insulation in warmer climates, selecting the right roof finish can significantly reduce the need for cooling the house. Cool roofs reflect most of the solar radiation falling on the rooftops. It can be achieved through either of the two following strategies:

#### **OPTION - 1**

#### **GREEN ROOF**

Green roofs are gardens cultivated on terraces. The soil and the plants will help insulate the roof, reducing overall heating and cooling costs. These roofs can reduce the 'urban heat island' effect. In increasingly urbanised spaces, Green roofs also provide easily accessible green spaces.



#### **OPTION - 2**

#### **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**

#### > CONSTRUCTION DETAILS







![](_page_19_Picture_1.jpeg)

### **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 w/m²k.T

![](_page_19_Figure_6.jpeg)

![](_page_20_Picture_1.jpeg)

#### > WALL CONSTRUCTION DETAILS

![](_page_20_Figure_3.jpeg)

![](_page_21_Picture_1.jpeg)

### **BUILDING LEVEL**

### > WALL CONSTRUCTION DETAILS

![](_page_21_Figure_4.jpeg)

![](_page_22_Picture_1.jpeg)

![](_page_22_Figure_2.jpeg)

![](_page_23_Picture_1.jpeg)

#### > FENESTRATIONS WITH WWR RECOMMENDATIONS

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

![](_page_23_Figure_4.jpeg)

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

![](_page_23_Figure_6.jpeg)

![](_page_24_Figure_1.jpeg)

### HOW TO CALCULATE WWR?

#### STEP 1 >>>>

ñ

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

![](_page_24_Picture_5.jpeg)

#### STEP 2 >>>>

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

![](_page_24_Picture_8.jpeg)

#### STEP 3 >>>>

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

#### Wall Area(sq.ft) X WWR(%) = 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

![](_page_24_Figure_14.jpeg)

![](_page_25_Picture_1.jpeg)

#### > NATURAL VENTILATION STRATEGIES AND SHADING

#### WINDOW PLACEMENTS

![](_page_25_Figure_4.jpeg)

![](_page_26_Picture_1.jpeg)

#### SHADOW ANGLES

![](_page_26_Figure_3.jpeg)

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

![](_page_27_Picture_1.jpeg)

#### > WINDOW NOOK OR ALCOVE

![](_page_27_Figure_3.jpeg)

![](_page_28_Picture_1.jpeg)

### > FUTURE EXPANSION SCENARIO

![](_page_28_Figure_3.jpeg)

### SUSTAINABLE MATERIAL CHOICES

![](_page_29_Picture_2.jpeg)

![](_page_29_Picture_3.jpeg)

### WALLING MATERIAL

![](_page_29_Figure_5.jpeg)

Centre for Advanced Research in Building Sciene and Energy (CARBSE). (November 2022). Thermal performance of Walling Materials and Wall Technology. CEPT Research and Development Foundation, CEPT University.

![](_page_30_Figure_1.jpeg)

Centre for Advanced Research in Building Sciene and Energy (CARBSE). (November 2022). Thermal performance of Walling Materials and Wall Technology. CEPT Research and Development Foundation, CEPT University.

![](_page_31_Picture_1.jpeg)

Centre for Advanced Research in Building Sciene and Energy (CARBSE). (November 2022). Thermal performance of Walling Materials and Wall Technology. CEPT Research and Development Foundation, CEPT University.

![](_page_32_Picture_1.jpeg)

![](_page_32_Figure_2.jpeg)

![](_page_33_Figure_1.jpeg)

### **PAINTS - INTERNAL AND EXTERNAL WALLS**

![](_page_33_Figure_3.jpeg)

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

![](_page_34_Picture_1.jpeg)

#### LOW VOC PAINT

![](_page_34_Figure_3.jpeg)

# SUSTAINABLE APPLIANCES

![](_page_35_Picture_2.jpeg)

![](_page_35_Picture_3.jpeg)

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














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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





Steel Bottle





Reusing Newspaper as wrapping paper for Gifts



### 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.











# **S - TYPOLOGY 1 - INDIVIDUAL HOUSE**







# **M - TYPOLOGY 2 - ROW HOUSE**







# L - TYPOLOGY 3 - INDIVIDUAL HOUSE









## **TYPICAL CONSTRUCTION DETAILS**











#### **COURTYARD DETAIL**



# **COST ESTIMATES FOR CONSTRUCTION**

### > BLOCK COST ESTIMATES



S INDIVIDUAL HOUSE 42 SQ.M

INR 12 to 13 lakhs

M INDIVIDUAL HOUSE 56 SQ.M

### INR 14 to 15.5 lakhs



ROW HOUSE 56 SQ.M

INR 17 to 18.5 lakhs



NOTE :

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

### > SUMMARY: BILL OF MATERIALS

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





Units	Individual House 42 sq.m	Individual House 56 sq.m	Row House 56 sq.m
Cum	90	93	108
Cum	51	53	62
Cum	21	29	33
Cum	21	21	27
Cum	22	23	27
<u></u>			
МТ	2	2	3
Sqm	62	75	90
Cum	79	79	93

Sr. no

### ltem

### **ARCHITECTURAL WORKS**

			1. External sand faced plaster
7		Plastering	2. Internal gypsum plaster
			3. Internal plaster rough
	1. Washroom water-proofing: Chemical coat protective coat	<ol> <li>Washroom water-proofing: Chemical coating with protective coat</li> </ol>	
8		Waterproofing Works	2. Washroom brick bat coba
	WORKS	WOIKS	3. Terrace water-proofing chemical treatment
	<b>*</b>		4. Terrace Brickbat coba+ with mosaic tile finish on top

9		Dointing Work	1. Acrylic emulsion paint	
,			2. Exterior grade paint	

<ul> <li>10</li> <li>Flooring, Skirting, Dado</li> <li>Vitrified tile floor</li> <li>Vitrified tile dad</li> <li>Vitrified tile skin</li> <li>Window frame i</li> <li>Threshold in gravita</li> <li>Twin granite slav</li> </ul>	1. Kota flooring for varandah with entry riser	1. Kota flooring for varandah with entry steps tread and riser	
	2. Vitrified tile floor		
	3. Vitrified tile dado		
		Flooring,	4. Vitrified tile skirting
		Skirting, Dado	5. Window frame in granite
	6. Threshold in granite		
			7. Twin granite slab frame
			8. Granite pantry counter
	<u></u>		9. Granite hand wash counter





Units	Individual House 42 sq.m	Individual House 56 sq.m	Row House 56 sq.m
Sqm	250	259	256
Sqm	139	152	200
Sqm	32	33	30
~			
Sqm	16	16	16
Cum	1	1	1
Sqm	58	75	81
Sqm	58	75	81
Sqm	188	227	281
Sqm	250	259	256
Sqm	7	7	8
Sqm	48	62	56
Sqm	33	34	31
Rmt	51	67	71
Rmt	41	65	54
Rmt	2	2	2
Rmt	10	10	10
Rmt	6	6	6
Rmt	3	2	1

Sr.

#### Item no ARCHITECTURAL WORKS 1. Main entry door : 1000mm X 2100mm (single shutter) 2. Main entry door : 900mm X 2100mm (single shutter) 3. Main entry door : 1200mm X 2100mm (double shutter) 4. Bedroom door : 900mm X 2100mm (single shutter) 5. Bedroom door : 1000mm X 2100mm (single shutter) Doors and 11 6. Washroom door : 750mm X 2100mm (single shutter) Windows 7. Backyard door : 900mm X 2100mm (single shutter) 8. Court yard entry door : 1650mm X 2100mm 9. Aluminium windows 10. Louvered windows (powder coated) 11. RCC Jali 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 Plumbing coupling 12 Work 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 1. Electrical wiring & cabling, switch & sockets, Electrical 13 Work 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 42 sq.m	Individual House 56 sq.m	Row House 56 sq.m
Nos	-	-	1
Nos	1	-	-
Nos	1	1	-
Nos	1	-	1
Nos	-	2	-
Nos	2	2	2
Sqm	-	-	1
Sqm	-	-	1
Sqm	7	14	12
Sqm	2	2	2
Sqm	5	4	10
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
		······	·
LS	1	1	1

NOTE :

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

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