

LOW-COST & LOW-TECH EARTH BAG RELIEF HOUSING

Project Ankur Dwelling Units, Uttarakhand
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June 2013 saw a natural disaster of unprecedented scale in Uttarakhand. Heavy rainfall caused spot floods and land slides that washed several settlements. The hilly area was difficult to access more so with the roads washed away. Relief housing made of corrugated sheets could not provide protection from the severe winter. Our proposal looked at using the mud of the landslide and earth bags for a low cost and low tech self help solution for relief housing.

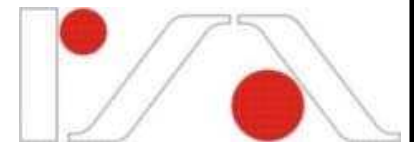




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Material Kit & Costing

SR.NO.	COMPONENTS	MATERIAL SPECIFICATION	DIMENSIONS(in mm)	QUANTITY	UNIT COST	ITEM COST
SUB-STRUCTURE						
1.1	EMBANKMENT	1.LOCAL GRAVEL		1.62 m3	Rs. 800.00	Rs. 1296.00
		2.WOVEN PROPELENE HOSE	hose-450 in width with filling flat out-600	•L-5400 mm no. of bags-2x4=8 total=43.2mtrs	Rs.10.00	Rs.480.00
1.2	FERROCEMENT PIPES		1m dia pipe			
1.3	FOUNDATION	1.LOCAL GRAVEL			-	-
1.4	PLINTH	1.GEO TEXTILE SHEET	To be put	20.25m2	Rs.80.00	Rs.1620.00
		2.PVC HOSE	hose-450 in width with filling flat out-600	24.00m	Rs.10.00	Rs.240.00
		3.FINISHING MATERIAL	Mud plaster	10.80 m2	-	-
SUPER STRUCTURE						
2.1	WALLS without openings	1.WOVEN PROPELENE HOSE	hose-450 in width with filling flat out-600	•L-5400 mm no.of bags- 14 total=75.6 mtrs	Rs.10.00	Rs.840.00
2.2	WALLS with door	1.WOVEN PROPELENE HOSE	hose-450 in width with filling flat out-600	•L-2250 mm no.of bags- 12x2=24 total=52.8 mtrs	Rs.10.00	Rs.540.00
				•L-5400 mm no.of bags-2 total=10.8 mtrs	Rs.10.00	Rs.120.00



2.3	WALLS with window (2 no.s)	1.WOVEN PROPELENE HOSE	hose-450 in width with filling flat out-600	<ul style="list-style-type: none">• L-2250 mm no.of bags-7x2=14 total=31.5mtrs*2no.s Total=63mtrs• L-5400 mm no.of bags-7 total=37.8mtrs*2no.s Total=75.6mtrs	Rs.10.00	Rs.630.00
2.4	WALLS -Plinth	1.WOVEN PROPELENE HOSE	hose 450 in width with filling flat out	<ul style="list-style-type: none">• L-2250 mm no.of bags-6x2=12 total=27 mtrs• L-5400 mm no.of bags-8 total=43.2mtrs	Rs.10.00	Rs.270.00
2.5	ROOFING SHEETS	CORROGATED AC SHEETS	Width- Length-3000 Area- 3.15sq.mts	15 sheet Total area-47.25sq.mts	Rs.600/per sq.mts	Rs.28350
2.6	ROOFING MEMBER	TIMBER SECTIONS/ BAMBOO	75X 150 for timber/ Available section for bamboo			-
2.7	Garland of blunt PVC spike ballson Nylon Rope			1440.00 mtrs	Rs.2.50	Rs.3600.00
2.8	DOORS AND WINDOW(2no.s)	1.CEMENT BOARD FRAME	10'x4' (1220x3050) (20mm thick)	3 sheets @rs.55sq.ft	Rs.2200.00	Rs.6600.00
2.9	HARDWARE	hinges,bolts,tower bolts,latches		1 set per unit	Rs.500.00	Rs.500.00

★ Its recommended to use older timber sections which may have fallen down during disaster



SANITATION

4.1	ECO-SAN PAN	Refer the sanitation manual.
4.2	FLAT PACK SYSTEM	

LABOUR AND OTHER COST

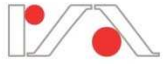
5.1	Skilled	6 days	Rs.750.00			
5.2	Unskilled	18 days	RS.200.00			
5.3	Transport					
5.4	Water and electricity	3% OF TOTAL COST				

TOOLS AND TACKLES

6.1	Crusher+funnel					
6.2	nylon thread and needle					
6.3	line out tools(MS rods,30m measuring tape)					
6.4	carpenters tool box for assembly of door and windows,installation of turbo fan	As per local cost.				
6.5	earthwork tools for excavation and compaction.					

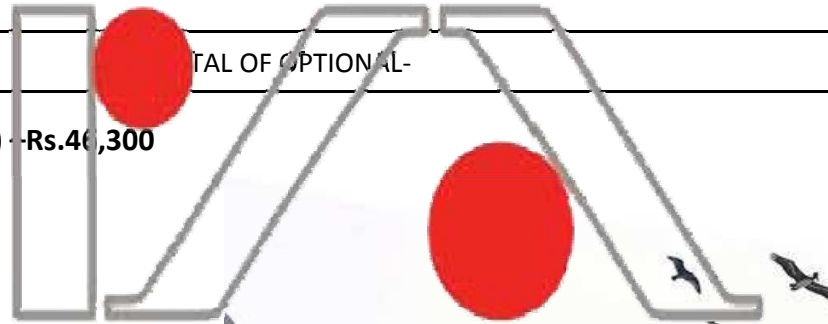
EQUIPMENT & FURNISHING

7.1	PV powered set for 3 no.s 5A power socket, 1LED(5X3 W) light fixture , DC fan etc.	Refer kit on page 18		1 set per unit	Rs.13,500	
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SR.NO.	COMPONENTS	MATERIAL SPECIFICATION	DIMENSIONS(in mm)	QUANTITY	UNIT COST	ITEM COST
OPTIONAL FOR >LIFE						
1.1	Fibre glass chicken mesh(for external plaster)+tacks for fixing			141.08 m2	rs.2.00	rs.282.17
1.2	lime+plaster			141.08 m2	rs.150.00	rs.21,162.48
TOTAL OF OPTIONAL-						rs.21,444.65

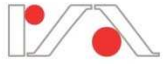
Total cost of unit(except labour cost) -Rs.46,300
Total cost of plaster -Rs.30,000
Cost of lighting system-Rs.13,500



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Model showing relief unit after plastering



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Process of construction



STEP 1



STEP 2



STEP 3



STEP 4



STEP 5



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STEP 5



STEP 6



STEP 7

STEP 8

NOTE: This is a reference for the construction technique used in the process and is a trial and tested.



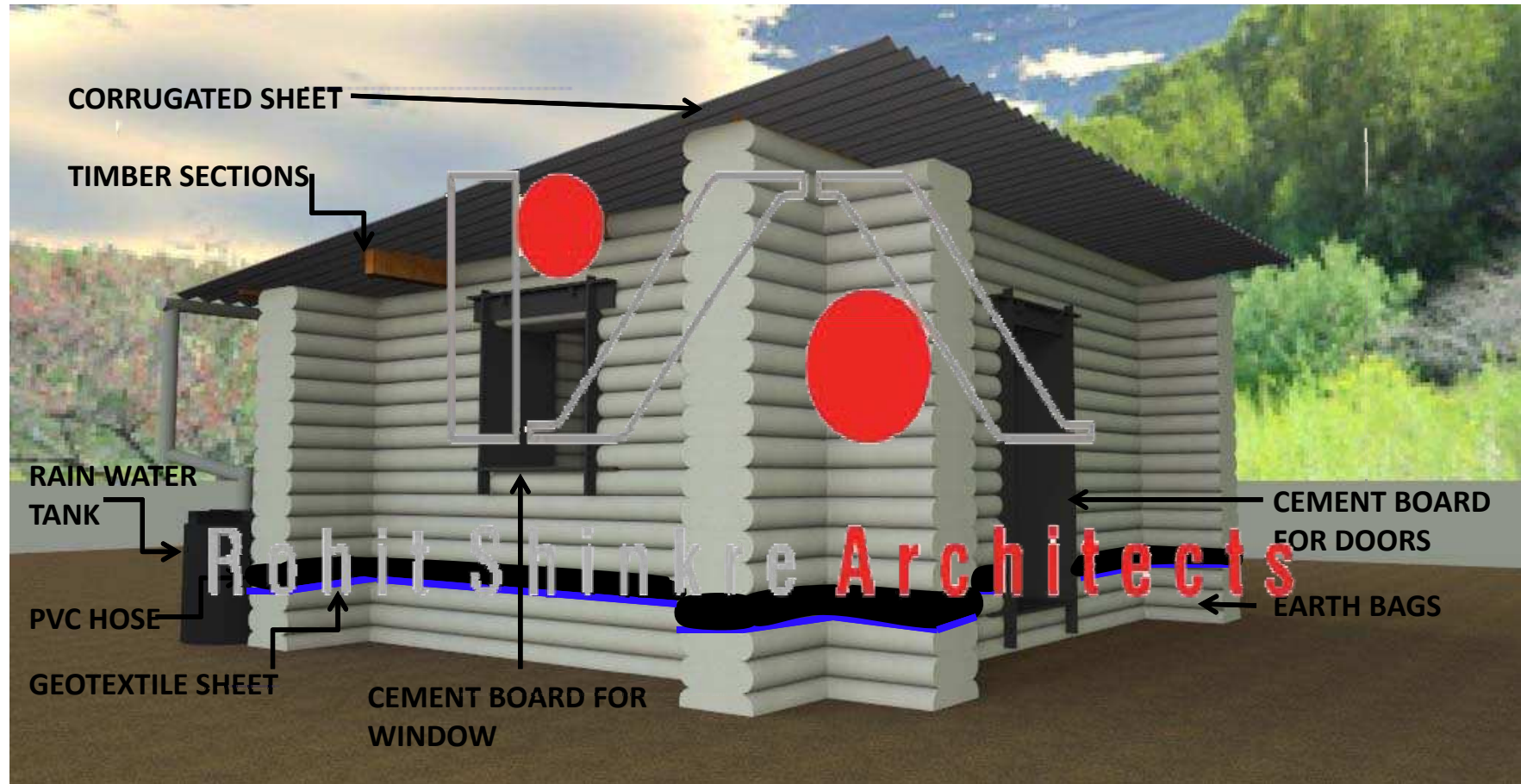
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Options for unit

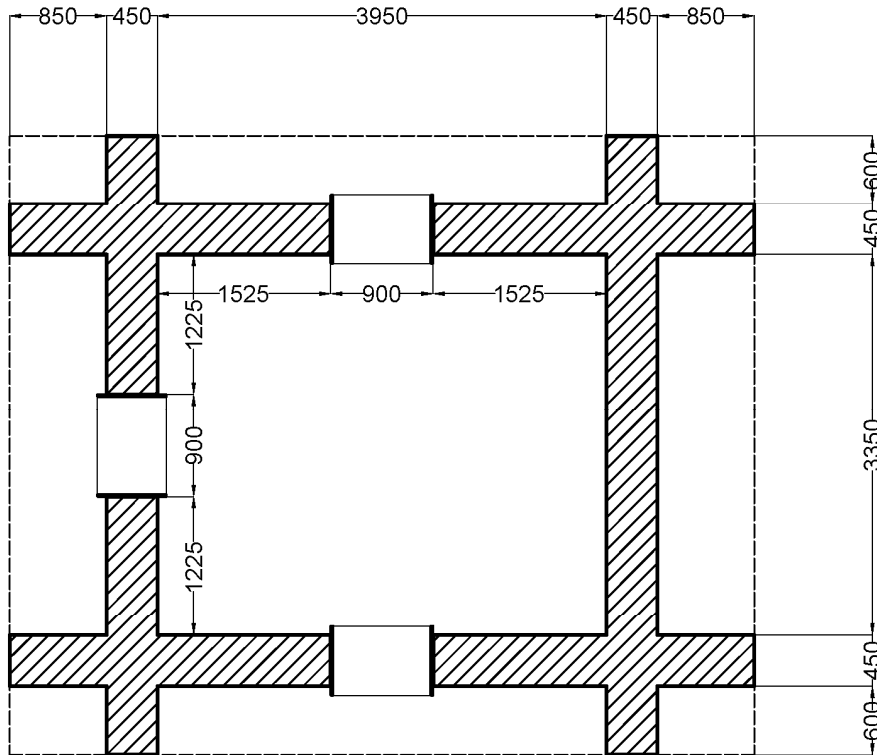




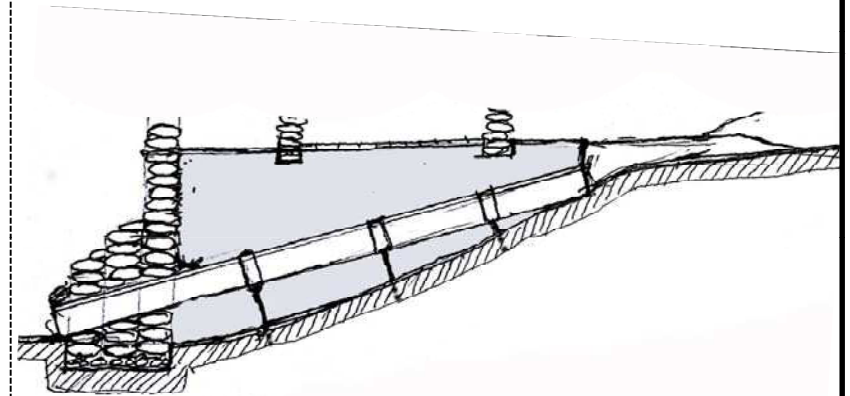
Components of Construction



Plan Dimensions of a Unit Substructure and Embankment



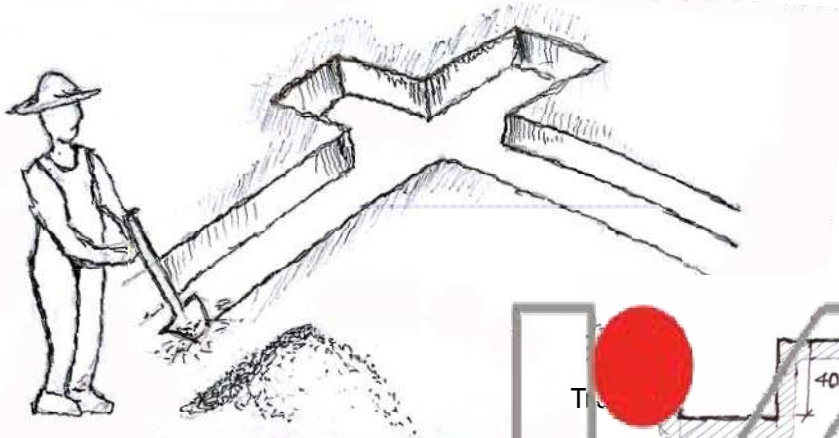
- A Unit is roughly the shape of a square which is slightly curved towards the corners with overall dimensions of 5400mmx6000mm. The usable unit dimensions are 3300mmx3300mm.
- The wall is 450mm thick (with filled earth, flat out dimension-600mm) made of long rolls of woven polypropylene bags, which are then filled with debris found on site.
- The walls have to project 600mm on each of the four edges so that a tie is made between the adjacent walls to provide stability to the design unit.



- To construct on a site having a gradient slope of 1:30, the soil needs to be retained. Hence, an embankment of earth bags is made on edges of the ridges with gravel base on the bottom which is then filled with mud filling till the base of the structure, which is the foundation of the structure.
- In order not to obstruct the flow of water along the slopes a pipe is casted in ferrocement, which has to be placed within the embankment.

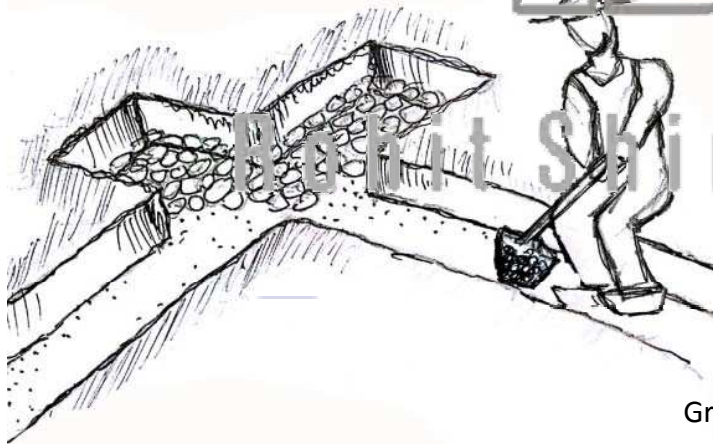


Method of construction



STEP 1:

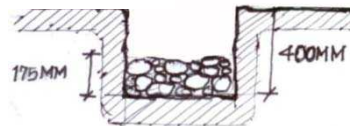
A trench of 400mm deep has to be dug out, to construct the four walls.



Gravel

STEP 2:

175mm of the trench depth has to be filled with gravels of various sizes.



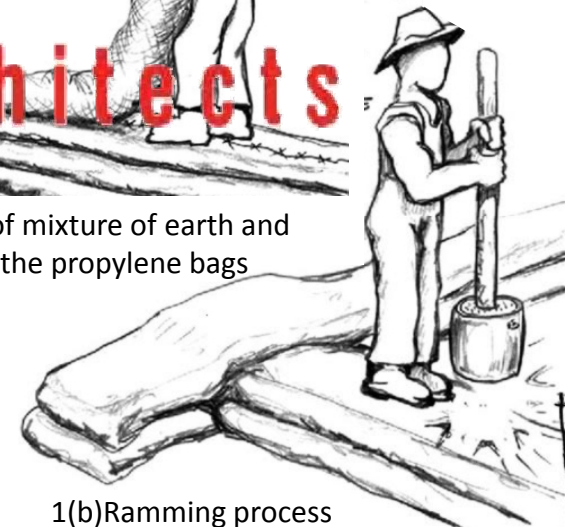
STEP3:

- Woven propylene hose of flat out dimension 600mm are filled with earth and crushed debris found on site.
- These rolls of bags have to be then rammed sufficiently to attain a width of 450mm. By doing so the desired strength and compaction of the soil is achieved.

NOTE: The debris can be filled in manually or by a tunnel connected to a crusher.



1(a) Filling of mixture of earth and debris into the propylene bags

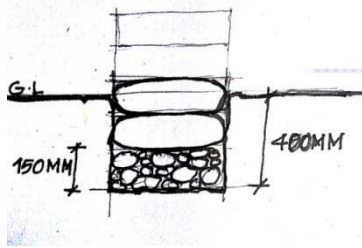


1(b) Ramming process

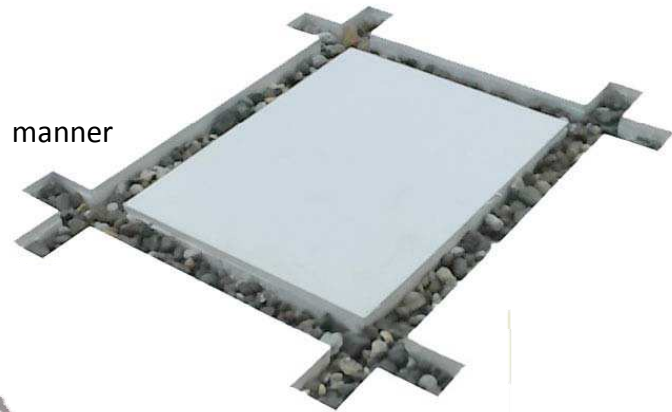


STEP 4:

Above the gravel course, the rammed propylene bags have to be laid in such a manner that one and a half courses of the bags are embedded within the trench.



1.2 Tie between the walls.



1.3 Image showing step 4

STEP 5:

After every two courses of these bags, 2 lines of nylon wire have to be laid onto the entire stretch of the bag.

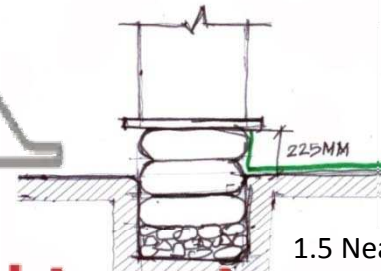


1.4 Picture showing the tie between the walls.

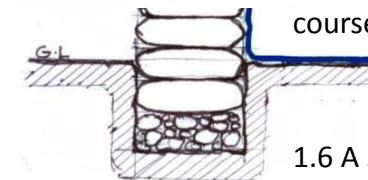
STEP 6:

For finishing the indoor surface a geo-textile sheet is laid onto the floor.

This sheet is taken up against the wall and placed between the 4th and fifth course of the bags they are laid.



1.5 Near the door the geo-textile sheet is taken above the 3rd course



1.6 A section of geo-textile sheet along the wall

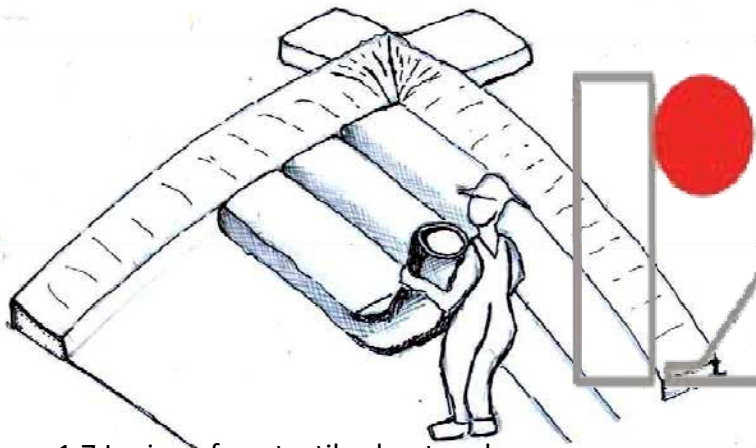
NOTE:

In order to tie the walls, bags of the two adjacent walls are overlapped and the earth filling must be reduced so that the bags are locked in place.



STEP 7:

A layer of polypropylene bags are placed above the geo-textile sheet in the interior space for flooring and then plastered with mud (suitable plastering material)



1.7 Laying of geotextile sheet and floor

STEP 9:

After laying of the fourth course and the geo-textile sheet, the 5th course has to be a PVC hose filled with the same filling material. After this course the same process is followed using polypropylene bags up to a height of 975mm.

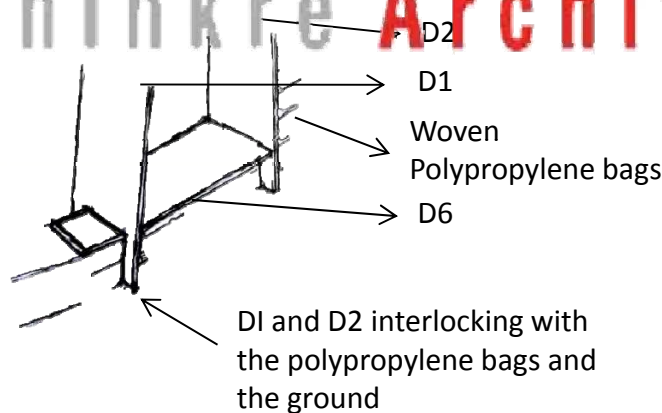


1.8 Image showing PVC hose

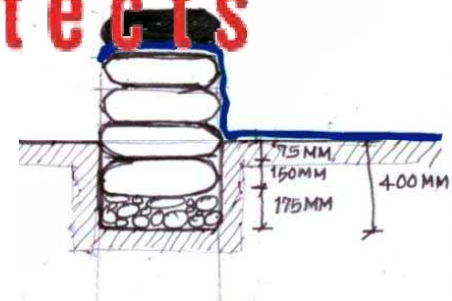
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STEP 8:

After the 3rd course of the polypropylene bag is laid, the door's bottom plank D6 is placed above it such that the planks D1 and D2 interlock themselves with D6 on either sides.



NOTE: Refer the door kit on page 14



NOTE: This is to prevent the seepage of water to the upper courses.



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STEP 10:

Once a height of 975mm of the wall is achieved, the window (assembled earlier) can be laid over the bags.

The assembly is same as the door.

NOTE: Refer the window kit on page 14



STEP 12:

After this timber sections are placed on the wall parallel to the longer side and at a distance of 1400mm c/c. The size of the members at the ends (that are placed on the wall) is 50mm x 100mm and the ones in the middle are 75mm x 150mm



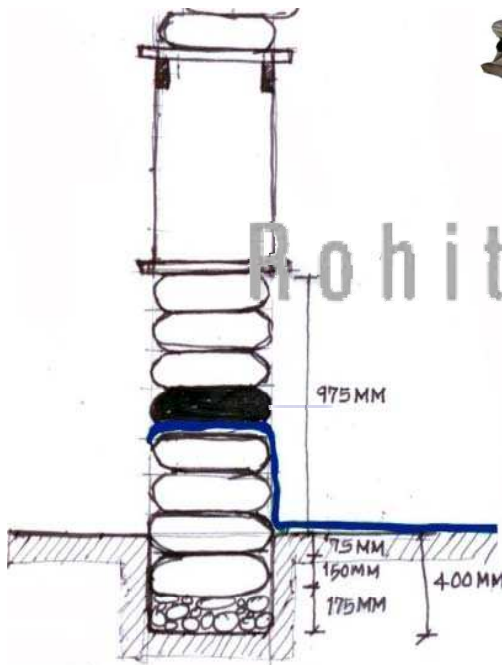
STEP 13:

A.C. corrugated sheets of size 1050mm x 3000mm are placed on the timber sections and a fabric is laid below the sheet from the timber members. The fabric is filled with hemp for insulation

STEP 11:

After the wall is constructed to a height of 2450mm, additional two more courses of earth bricks are laid on one of the walls along the longer side to attain a height of 2750mm.

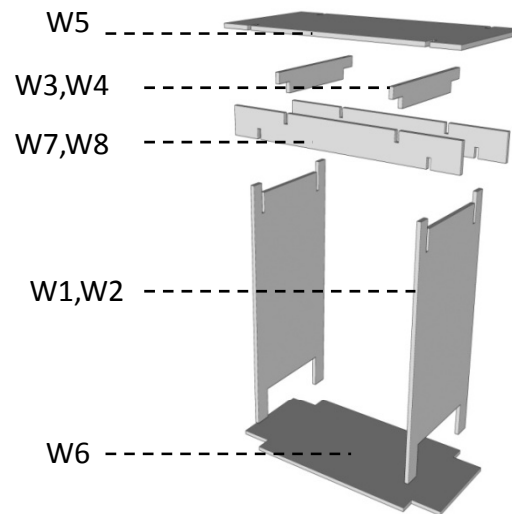
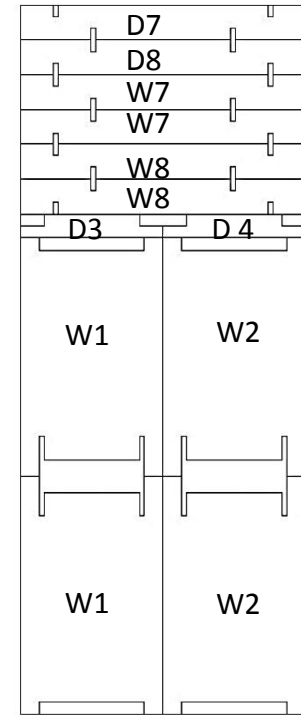
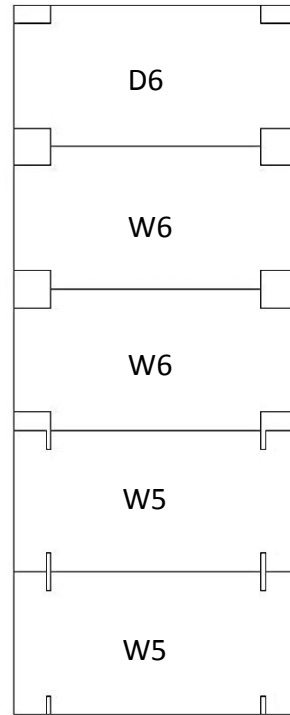
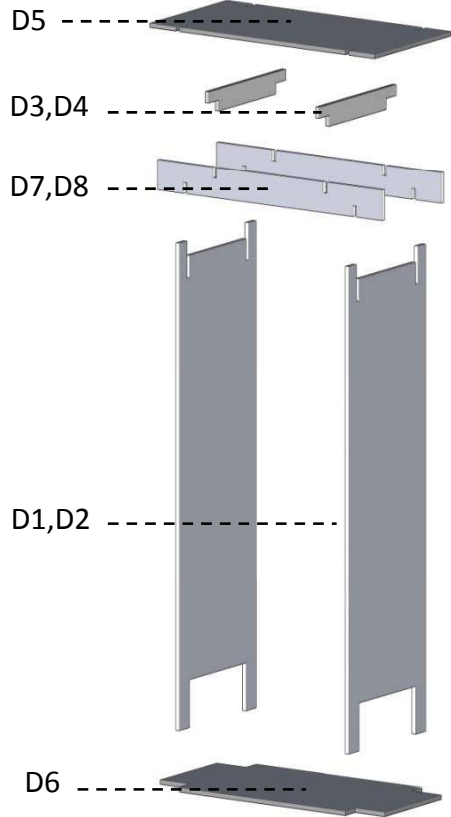
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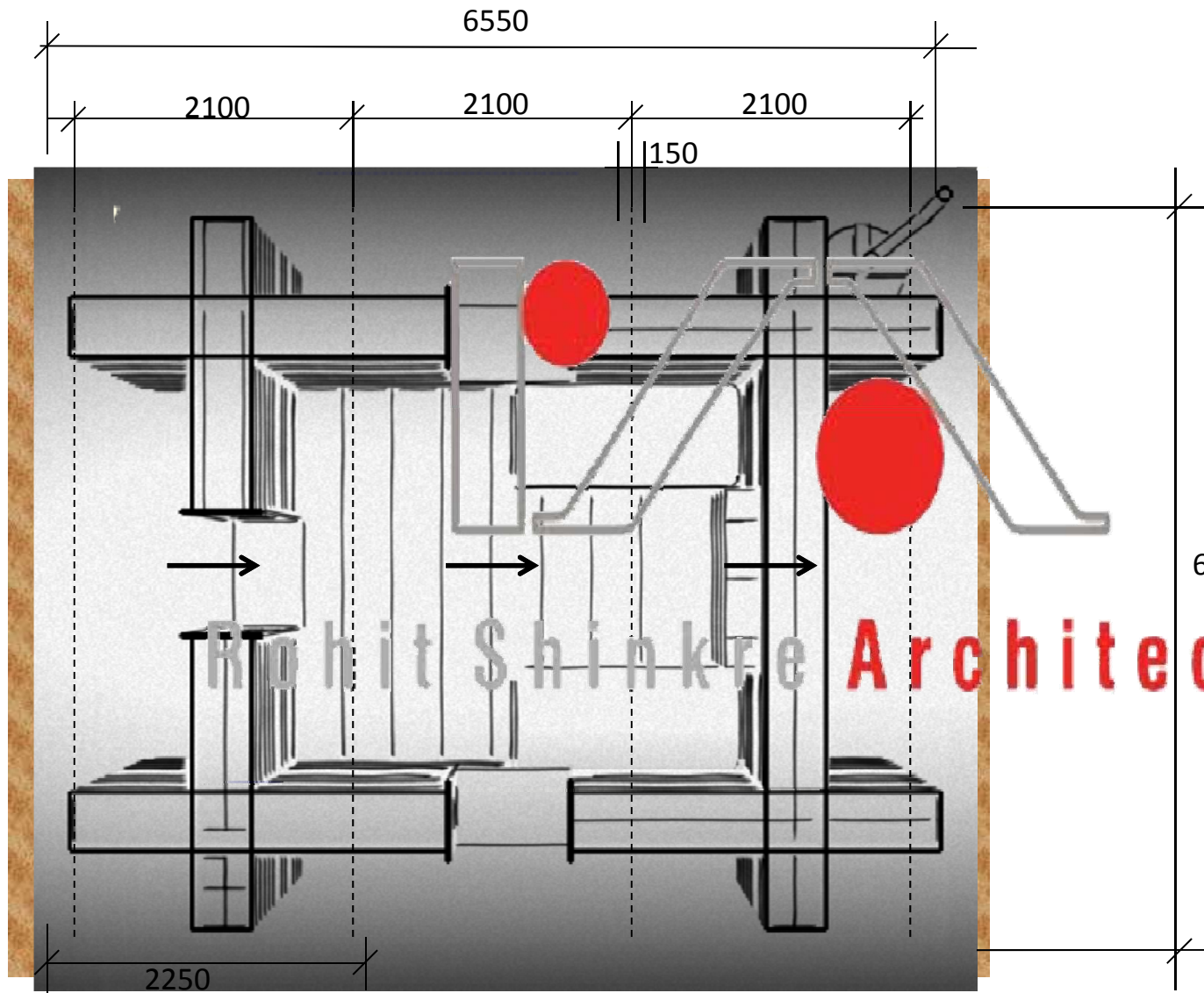
DOORS AND WINDOWS



3 sheets Cement boards of size 10'x4' are provided with surface printing of cut out guidelines. Each of these set of 3 sheets comprises of 1 door and 2 windows.



The Unit Assembly



- OVERALL SHEET SIZE
2250mm*1050mm
- LAID SIZE
2100mm*1010mm

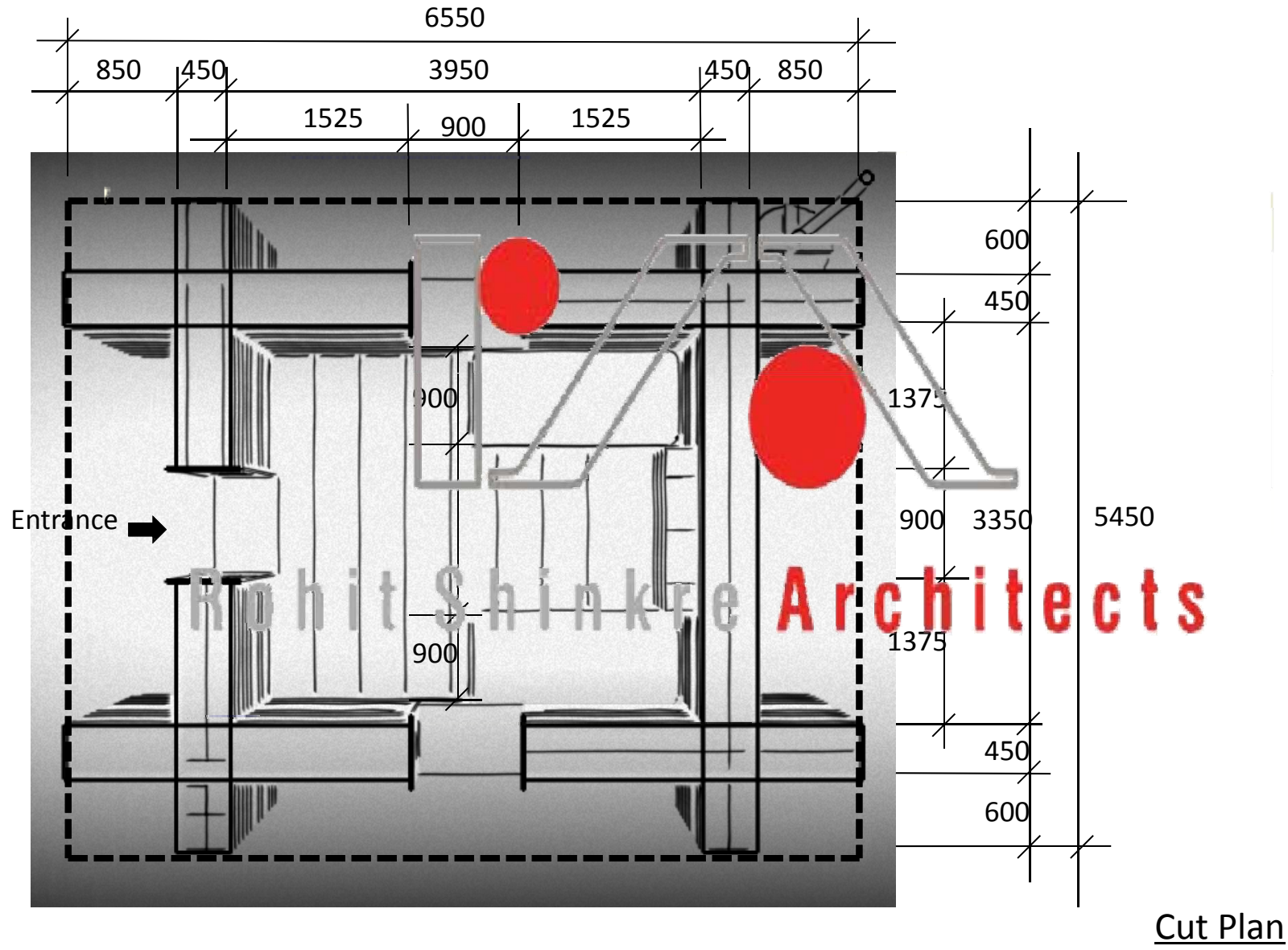
OVERALL SHEET SIZE

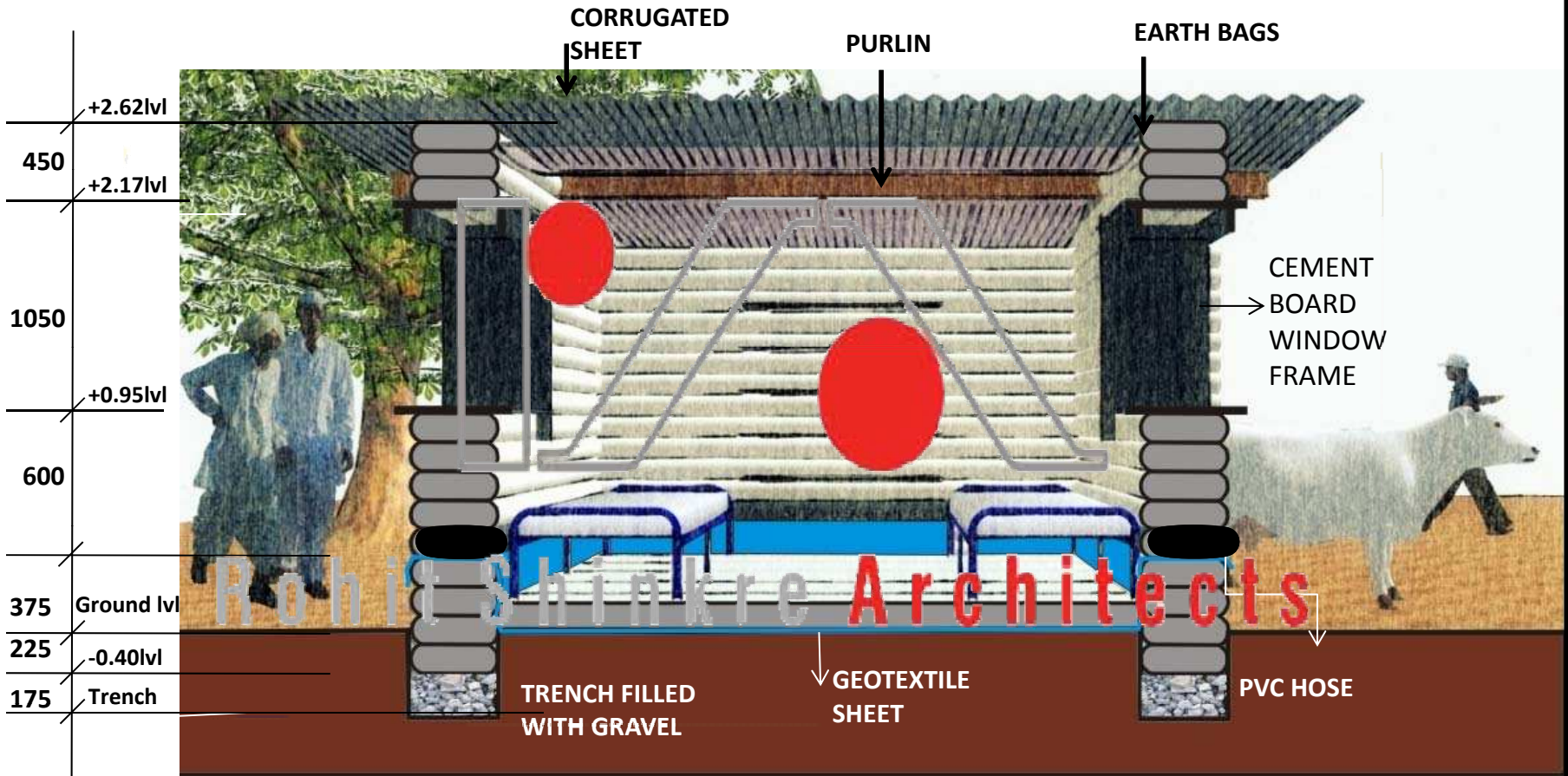
Roof Plan



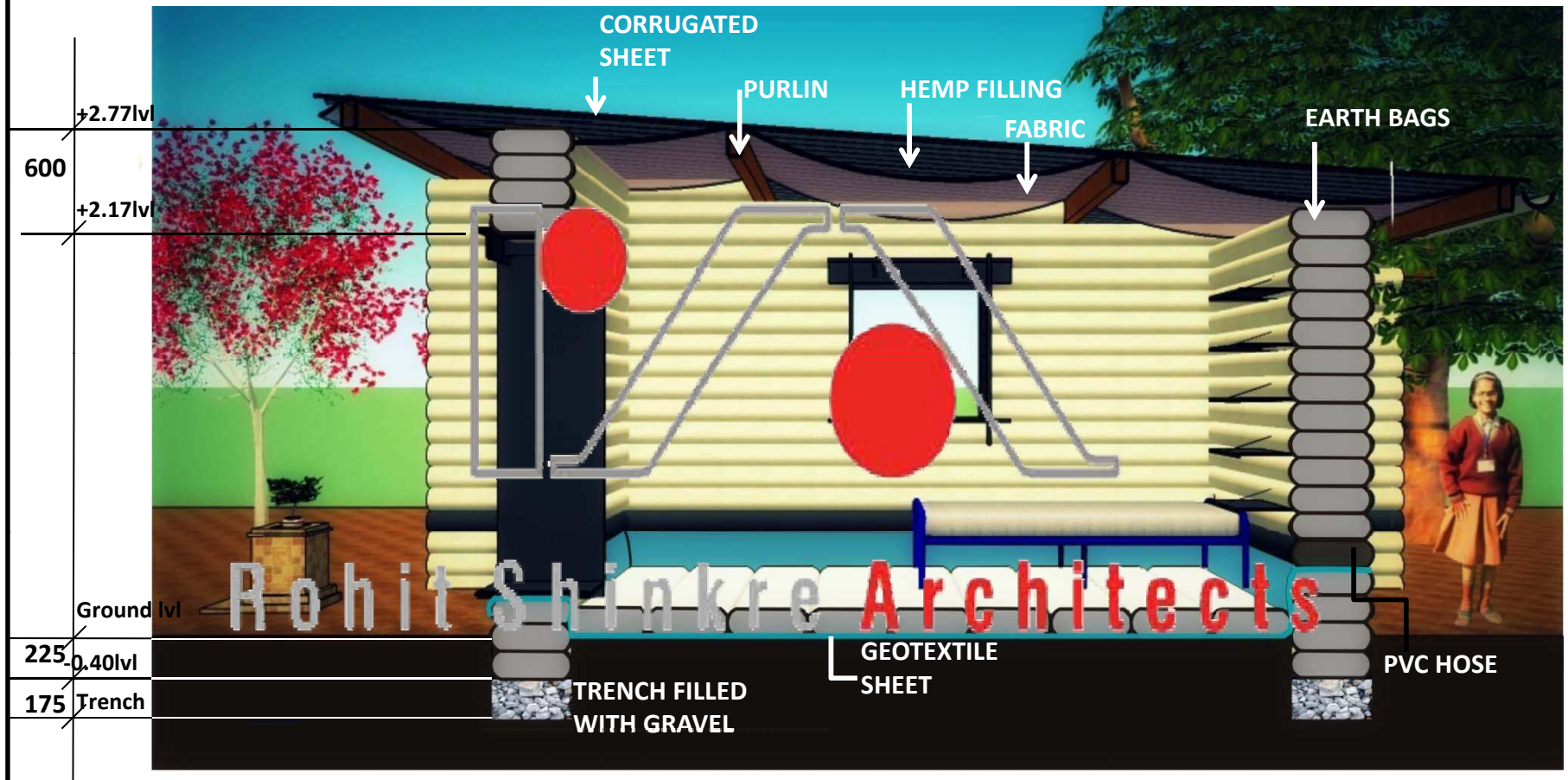
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The Unit Assembly





Section through WINDOWS



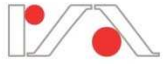
Section through DOOR



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VIEWS

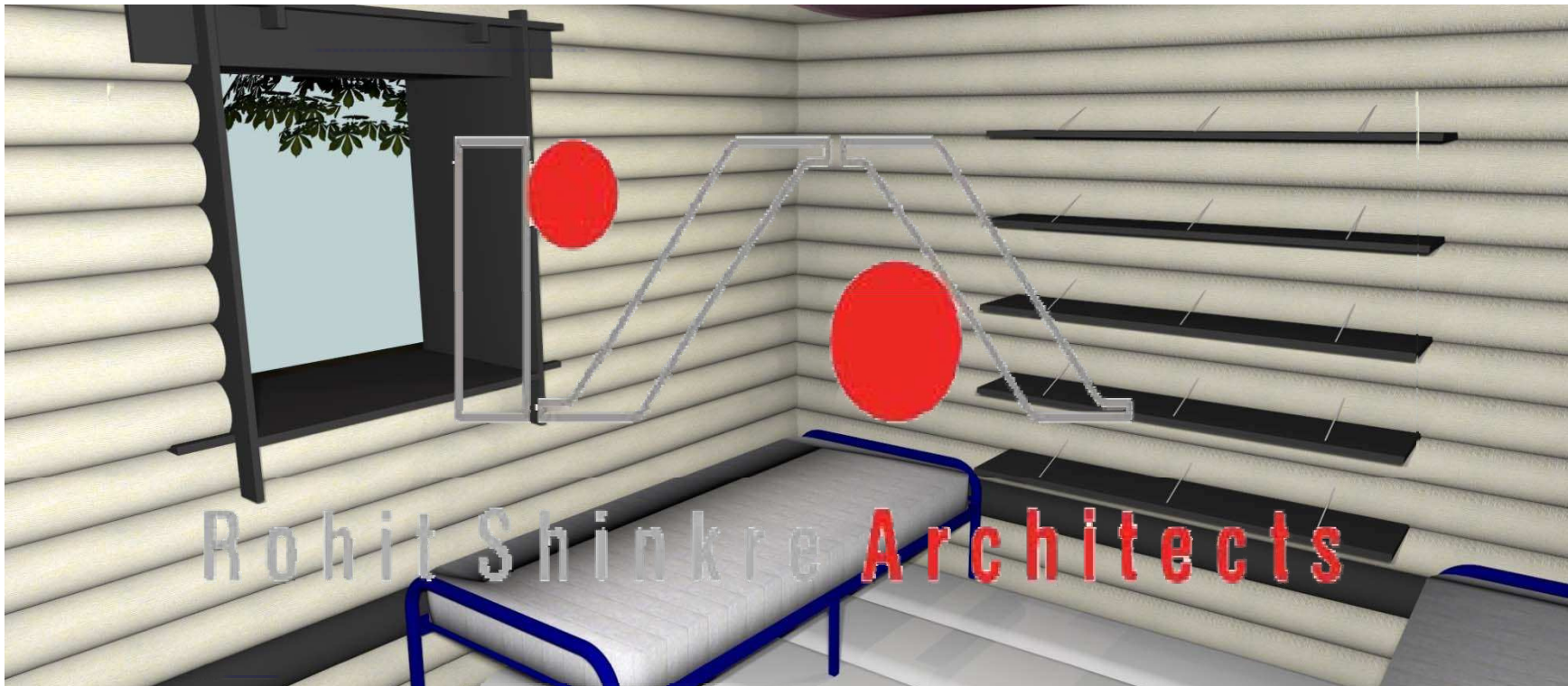
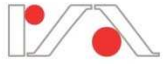




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VIEWS





- WOODEN SHELVES ARE PROVIDED FOR STORAGE OF GOODS, WHICH PROVIDES BETTER USABILITY OF SPACE.

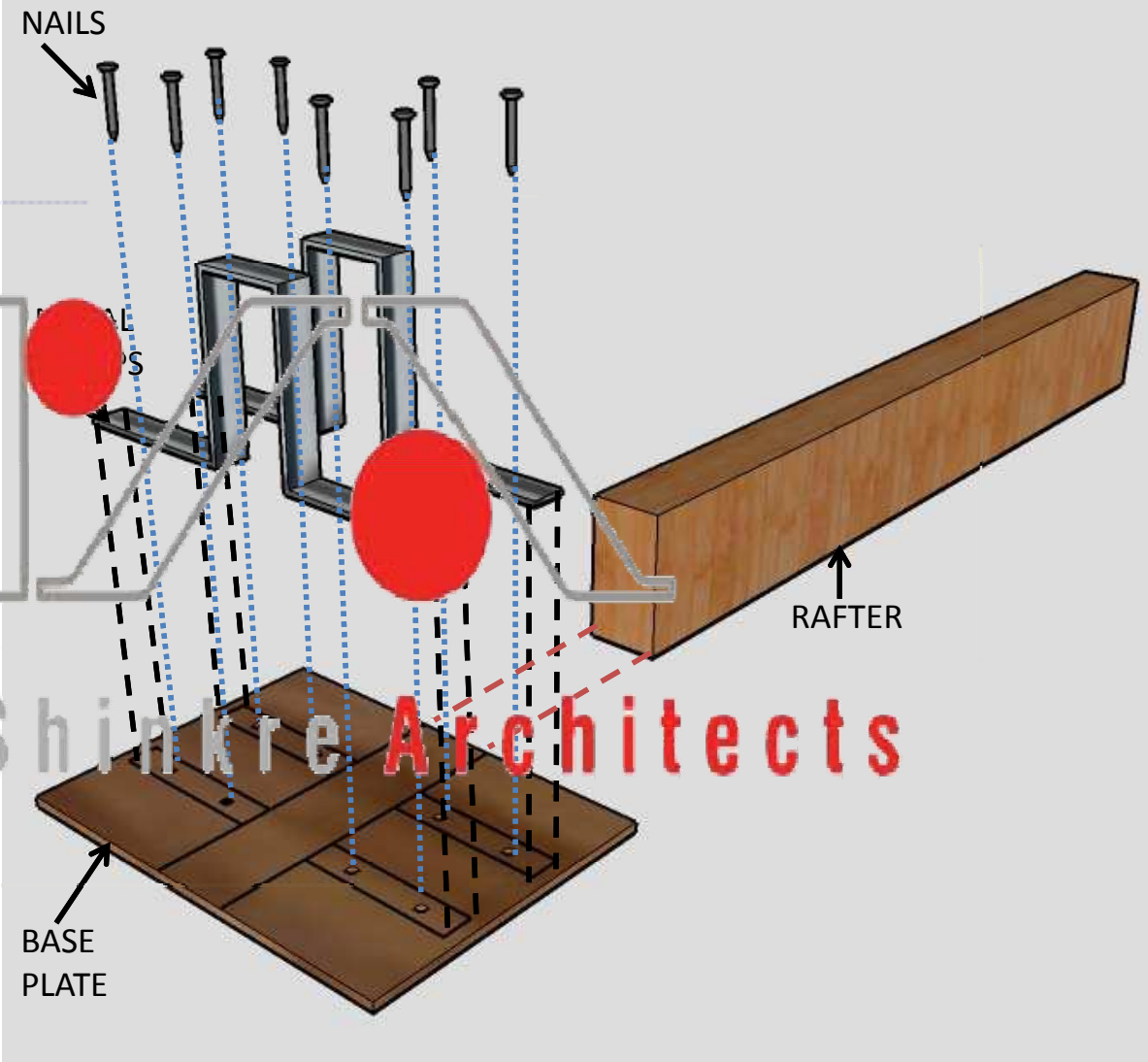
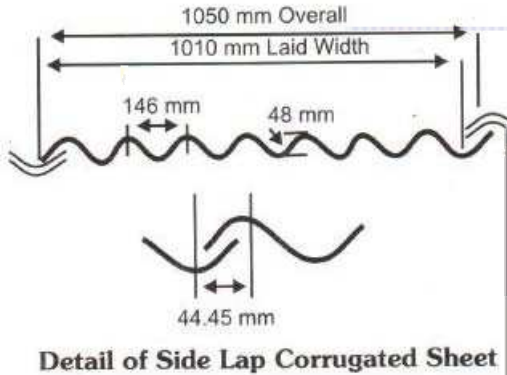


Figure 1 : Sectional Details

1.DETAIL OF CORRUGATED SHEET WITH JOINERY

2.DETAIL OF JOINERY BETWEEN RAFTER AND EARTH BAGS.

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Components of Home Lighting system

Mini LED Home Lighting System



Eco friendly



Solar powered



LED Technology
High bright White LED technology



Charges mobile phones



Energy efficient



"Lighting up Lives in Villages, Forests & Towns"
THRIVE SOLAR ENERGY PVT. LTD.
AN ISO 9001-2008 COMPANY

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Mini LED Home Lighting System

PRODUCT FEATURES

- A 5W system with three bright LED lamps.
- A unique 2W LED bulb (Sebule bulb) with three lighting modes: Dim, medium and bright. & 2 other bulbs of each 1Watt.
- Can light up three rooms at a time.
- LED bulbs do not break or burn.
- High efficient solar panel.
- Plug and play system.
- Easy to maintain and operate.
- Charge mobile phones with 5 pins different mobile phones.
- Full charge and disconnection up to 5hrs*
- Luminous efficacy of 135 Lumens /Watt.

PRODUCT BENEFITS

- Saves money on kerosene.
- Has bright and white LED light - good for studying.
- Light up more rooms.
- Multi-purpose usage (lighting and charging of phone).
- Simple, easy to install, operate, use and maintain: no fundi required.
- Reliable as the solar energy is freely available: No more blackouts.
- No health hazards – chest pain, inhaling of fumes, coughing, eye problems.
- Charges a mobile phone at no extra cost.
- Can charge the phone comfortably at home.
- Environmentally friendly(clean energy, no emissions).
- The system light up for 5hrs and more.
- Warranty of 1year and service support.

PRODUCT SPECIFICATIONS

- Battery Bank: 5Ah - 6V 4Ah
- 3 LED bulbs with switches
- Poly-crystalline solar panel: 5wp
- Solar panel cable: 8meters
- Micro process based electronic circuitry
- Solar mobile phone charging facility.
- ABS plastic body.



Eco friendly



Solar powered



LED Technology
High bright White LED technology



Charges mobile phones



Energy efficient

Designed, Developed and Manufactured by:



"Lighting up Lives in Villages, Forests & Towns"
THRIVE SOLAR ENERGY PVT. LTD.
AN ISO 9001-2008 COMPANY

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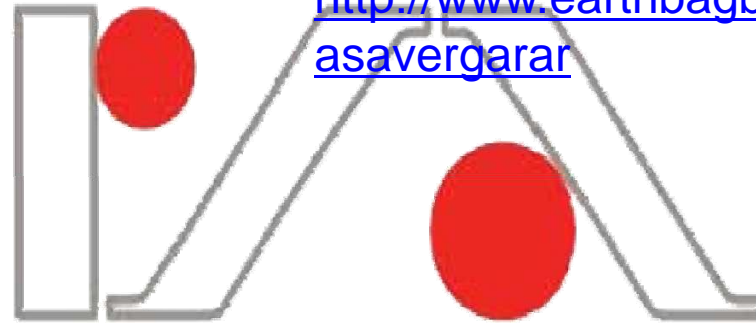


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Acknowledgements

<http://www.jovoto.com/projects/300house>

<http://www.earthbagbuilding.com/projects/casavergarar>



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