

## Low Cost House (Wardha Pattern)

Sandeep Kulkarni

Date of Submission: 27-02-2018

Date of acceptance 14-03-2018

### I. INTRODUCTION

The Depletion Of Building Resources Like Timber, Bamboo And Thatch Have Progressively Made The Village House-Builder's Jobs More And More Difficult. Timber Used To Be The Principal Structural Material While Bamboo Came In Handy For Almost Everything. Shrinking Forests Have Contributed To Removing Timber And Bamboo From The Reach Of The Poor. Even Thatch Has Become Scarce And The Frequent Repair Require For Thatch Roofs Make Them Problematic. Local Mud Fortresses Or Garhis Furnished Excellent Building Mud. These Garhis Are Getting Extinct And The Resource Drying Out. Black Cotton Soil Is Unfit For Wall Making. The Need Therefore Is To Have A Roof Timber Or Thatch Along With Mud Walls Using Ordinarily Available Soil. The Above Need Was Sought To Be Met Through Designing A Low-Cost House With An Arched Roof Of Hollow Cylindrical Clay Tiles Resting On A Ring Beam Supported By Brick Pillars, While The Non Supporting Walls Are Made From Non-Erodible And Rodent-Proof Mud Walls Using Special Techniques. This Technique Has Been Developed And Propagated By Centre Of Science For Villages (Wardha).

### II. THE TECHNOLOGY OF VAULT ROOF

**Guna Vault Roof:** "Guna" In Telugu, Is A Tapering, Burnt Clay Pipe. The Familiar Semi-Cylindrical Pan Tiles Are Obtained By Splitting Such Pipes Vertically Into Two. These "Guna" Tapering Pipes Can Be Socketed Into One Another Forming An Arch Over A Suitably Curved Shuttering. A Series Of Such Arches Make A Barrel Vault Capable Of Withstanding Considerable Loads – Up To 1 Ton/M<sup>2</sup>. The Top Of The Roof Is Given A Plaster Finish. After Joints Are Filled And Topped With Plaster, The Roof Becomes Rigid And Waterproof, Doing Totally Without Steel Or Timber. The Cost Of This Roof Works Out To Rs. 20/Sq.Ft. It Has The Following Advantages:

- Air Inside The Hollow-Tiled Roof Protects From Heat And Cold. A 10o Temperature Difference Is Observed In Slab Roof And Guna Vault Roof.

- It Has No Under Structure, Yet Can Bear Weight Of 1000 Kg/M<sup>2</sup>.
- It Is Fabricated And Ready For Use Within 3 Days.
- Requires No Maintenance And Has Life Span Of More Than 50 Years.
- It Is Not Affected By Rain, Hail Or Wind.
- Being Light In Weight (Less Than 12 Kg/Sq.Ft). The Vault Roof Is Safe Even In Earthquakes.
- Even If The Mud Walls Collapse, The Roof Remains Intact Residing On Pillars And Beams. After Construction Of Brick Pillars, Ring Beams And Gable Walls, The M.S. Trusses Are Placed In Position Above The Opposite Pillars Held With Guy Ropes And Timber Poles. Now Gi Pipes (12 Mm Dia., 10 Nos.) Are Placed On The Trusses In The Ms Rings Provided At Specific Points. They Are Supported By Gable Walls At Both Ends. Guna Pipes Are Now Laid Dry On This Skeleton Shuttering In

A Plug-socket Manner, Completing The Roof Ring By Ring. Lime/Cement Mortar Is Now Poured On The Roof, Trowelling It Into The Gaps And Leaving The Top Rough To Receive The Finishing Coat. Care Is Taken To Remove The Skeleton Support Within 12 Hours To Allow Natural Setting.

**Tile-Faced Mud Blocks:** Several Combinations Of The Locally Available Black Cotton (Bc) Soil, Which Has Good Binding Properties, With Bhaswa And Murram (Hard Soil) Are Possible For Making Adobe Blocks. One Part Of Bc Soil To Four Parts Of Murram Makes Strong Blocks With Reasonable Stability Through Moisture Cycles.



Potter making conical tiles



Laying of conical tile arch roof

**The Technology Of Vault Roof:** The Roof Is Permanently Insulated Since It Consists Of A Series Of Arches Made Up Of Burnt Clay Conical Tile Inserted Into One Another. The Arches Are

Held Together By Plaster From Outside. Fixing Of Broken China Tiles Pieces Over The Roof Renders It Waterproof And Reflects The Sunlight Making The Interior To Remain Cooler. Img Potter The Roof Needs Neither Wood Nor Steel And Is Most Suitable For Disaster Prone Areas Like Flood & Earthquake As It Is Quick To Build, Comfortable To Live And Low In Cost.

**Moulding The Mud Block:** Standard Block Size Adopted At Csv Is 225/300 X 100 X 225 Mm(9"/10" X 4" X 9") Taking Into Account Ease Of Handling. One May Use Wooden Or Steel Moulds, As Available. A Pair Of Workers Usually Produces 200-225 Blocks Per Day. The Facing Tile Is Placed In The Mould Box With Its Face Side Touching The Mould Wall. Mud Mortar (1 Part Bc Soil To 4 Parts Murrum) Is Poured At The Back, Working It Well Around The Dovetail Key.

**Rain-Proof & Rodent-Proof Mud Wall:** With No Need For A Press Or A Ram Or Cement, The Tile Faced Blocks Are Put Out Together To Form Walls That Look And Feel Like Pucca Brick Walls And Do Not Allow Water Or Rats To Enter. In Bc Soil, 9" X 9" Brick Pillars Support The Roof Usually At 5 Ft. Intervals. If Required The Inner Surface Of The Wall Can Also Be Tiled To A Height Of 2-3 Ft.

**Rain Beam:** The Sideways Thrust Of The Vault Roof Requires To Be Overcome By A Ring Beam Of 3" Thickness. This Is Reinforced By Three 8 Mm Bars. Extending And Adding 1 Ft. Around The House, The Total Steel Used For A 250 Sq. Ft. House Is Less Than 50 Kg. Csv Has Integrated These Features Into A Twin House Design And Built A Few Hundred Houses Dispersed In Several Locations In The District. At 1993 Prices Each House Costs Approximately Rs. 8500.

#### Appropriateness Of Roof Of Csv Houses Is As Follows

- Cost Effective
- Use Of Locally Available Material, Mud As A Basic Building Material
- Use Of Energy Consuming Materials (Like Metal, Steel And Cement) Is Minimized Hence These Structures Are Environmentally Friendly.
- High Labour Intensive Technology Hence Generates Employment.
- Environmental Friendly Since The Houses Feel Cooler Inside The House In Summer In Hot In Winter Season.
- As The Mud Is Main Building Material, Unlike Other Materials (Concrete And Steel), It Can Be Recycled Or Reused.

#### The Technology Of Mud Wall



The Wall: Ordinary Mud (80% Murrum & 20% Bc Soil Or Clayey Soil) Is Used To Make 230 Mm Thick Walls Using Tile Faced Mud Blocks Of 100 Mm Thick And Filling The Masonry Joints With Cement Pointing. The Mud Block Wall Is Rain Proof And Rodent Proof. This Is To Be Noted That There Is No Need To Press Or Ram Or Concrete Or Add Any Other Binding Material In These Blocks.

The Mud Blocks Are Made Using 230 Mm X 230 Mm Wood Or Steel Mould In Which Facing Tile Is Kept On One Side And Then It Is Filled With Mud Mix By Hands. If Required Inner Surface Of The Wall Can Also Be Tiled. For Internal Walls Mud Blocks Of 300 X 230 Thick Are Made Without Facing Tiles For Which Appropriate Moulds Are Used. All These Materials Are Locally Available And The Villagers Can Make The Blocks Themselves. For A Villager House Of 250-Sqft Only Three Days Labour Is Required For Block Making. Each Block Costs Very Less Money.

#### Vault Roof And Mud-Walled House



### System Design

Given The Raw Materials, I.E. The Guna Roof Tiles, Wall Tiles, Bricks, Cement And Miscellaneous Building Materials As Indicated Above A Team Trained In These Techniques Can Under Take Construction Of Twenty Houses (Ten Twin Houses) In A Month And A Half. Local Artisans

And Labour Will Be Utilized. In Each District 10 Such Teams Can Work Simultaneously. To Maintain A Supply Of Tiles, 15 Potters Will Be Engaged All The Year Round. The Techniques Being Simple For

Traditional Artisans To Learn, On-Job Training Of Masons And Potters Can Be Done In A Short Period. 2

Masons And 1 Potter May Be Trained At Csv For 3 Months And They Should Subsequently Train Others.

### Economics (Low-Cost Houses For Landless Labour Under Rlegp/Jry)

#### Description Quantity Rate Amt. (Rs.)

- Excavation For Foundation 126 Cft. 68.00/100 Cft. 85.68
- Foundation, Uncrossed Rubble Masonry 160 Cft. 19.20/Cft. 3,072.00
- Brick Pillars 34 Cft. 30.00 1,020.00
- Wall Of Tile Faced Sun Dried Mud Blocks 150 Cft. 13.50 2,025.00
- Ring Beam 10.31 135.00 1,391.85

- Gable Wall 60 Cft. 13.55 813.00
- Guna Vault Roofing 201.25 25.50 5,131.88
- Ordinary Wood Doors 2 Nos 275.00 550.00
- Window With Grills 3 Nos 35.00 105.00
- Flooring Lumpsum 180.00

**Total Cost In Rs/ 14,374.41**

### III. CONCLUSION

The Low Cost House Constructed By This Technology Saves 30 To 40 % Of Total Cost Of Housing Also They Are Suitable For Rural Families. The Houses Constructed By This Tehnologys Try To Minimize The Temperature During Summer Season And Keep It Warm During Winter Season. The Technology Uses The Local Available Material For Preparing Mud Blocks And Waste Glazed Tiles For The Roof.

