Contemporary Rammed Earth Technology

Ar. Shreya-Kalpesh Dalwadi

At Conclave of Green Architecture,
Building Sense: Towards Sustainable Buildings and Habitat,
CSE, New Delhi, 22-09-2014



_ n

ھ

Material preparation

Step 1: Cleaning of mud

- Mud to be dug from plot of construction
- 10' X 10' X 10' pit suffices for G+1 2000 sq.ft. construction
- Sieving /cleaning essential in order to make it free from pebbles, organic growth
- Can be done manually





Material preparation

Step 2: Dry mixing of ingredients

- Mud needs binders before it can be cast as a wall
- Sand and cement are easily available binders
- Proportion of binders to be decided as per quality test reports of soil
- Binders can vary with adequate understanding of physical properties of soil
- Dry mixing of 75% mud, 20% sand, 5%cement





Formwork

Step 3: Erection of formwork

- Mud needs to be cast-on-site as a wall
- Formwork can be designed for repetitive modules
- Thickness of wall to be taken as width of vertical supports and preferred length of wall to be taken as size of horizontal supports
- Vertical metal studs (W-9" H-10") fixed to plinth beam or base
- Horizontal plywood sheets (L-8' or length of wall, H-2') fixed to metal studs through bolts



Formwork

Step 4: Resistance to thrust

- Ramming generates thrust on horizontal formwork
- Formwork needs to resist this thrust or else may fall apart
- Metal bolts, through and through, hold bracing, which, resists thrust of compression
- The bracing also becomes platform for standing while ramming



Material preparation

Step 5: Addition of water to ingredients

- Water needs to be added to dry mixture of mud, sand, cement
- Water quantity to be added gradually
- Simultaneous hand mixing to be carried out
- Quantity of water should be only that much which is just enough to make a ball by pressing





Step 6: Pouring in formwork

- Mixture to be poured manually in formwork
- Pouring of mixture to uniform 6" thickness, marked on plywood
- Manual compression to begin using metal rammer
- Mixture to be compressed to uniform4" thickness pre-marked on plywood



Step 7: Ramming in formwork

- Speed of ramming to be moderate, not very fast
- Ramming to be carried out till mixture starts giving metallic ringing sound (say, tang-tang)
- Mud when compressed to desired level will generate metallic ringing sound with a metal rammer
- Job can be executed by un-skilled labour also



Step 8: Progression in height

- First level ramming for first 0'-2' height to be accomplished
- Shuttering to be added for second level of ramming, 2'-4' height
- Ramming for 2'-4' to be carried out in similar way
- Shuttering/s to be fixed for further heights of 4' and beyond







Step 9: Ramming at higher levels

- Bottom level shuttering, 0'-2' and 2'-4' can be removed immediately upon completion of ramming
- Shuttering to shift vertically up, upto higher levels as may be required
- Ramming for height of 10', for a wall 8' long, can be carried out by 2 unskilled labourers in one single day







Step 10: Finished wall

- Finished rammed earth wall with inherent beautiful texture
- Aesthetics vary with colour of base mud
- Eliminates need of paint or plaster
- Offers opportunity of composition with varying tones



Advantages

Strength

- Wet compressive strength 1.5 times that of brick wall
- Difficult even to scratch with hand or pointed nail

Weather effects

- Technology is water resistant
- Safe even in heavy rain
- 1' X 1' X 1' sample cub, submerged in water for 28 days, did not show even
 1mm reduction by volume, neither even 1% reduction by weight
- Ramming as technology may be indirectly compared to natural compression of soil in earth's crust to form stones

Texture

- Can take the texture of local mud
- Colours can be explored layer wise
- Innovations can be tried for different colours



Advantages

Sustainability

- High degree of sustainability
- Low carbon footprint

Construction technology

- Cost saving
- Fast speed of construction

Ownership cost of building

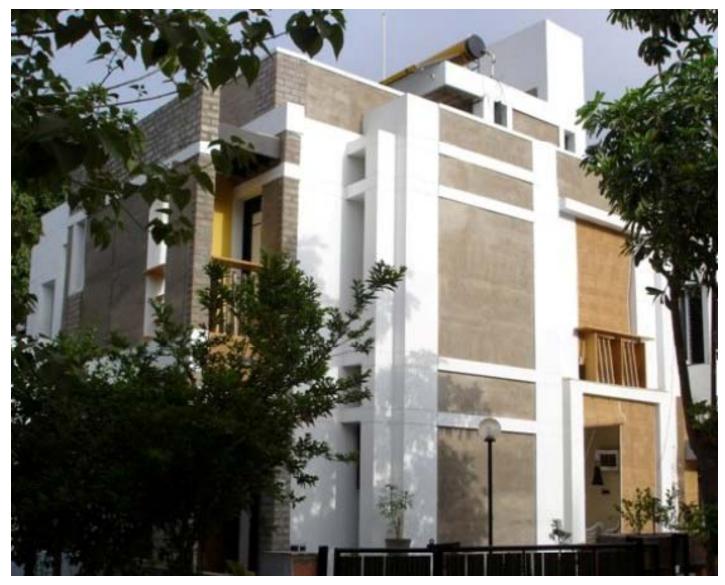
- Beautiful texture
- Low maintenance

Mass adaptation

- Modular, so easy replication
- Can be precast and used
- Suitable for infill, in high rise



O



Residence, Vadodara, Gujarat



Residence, Vadodara, Gujarat



Weekend Homes, Vadodara, Gujarat

nnovati

₪ _____



Prayer Hall, Mehsana, Gujarat

0

<u>۔</u>

J

a

_

Global presence









The above images do not depict works of the author; have been sourced from internet for presentation purposes only; the intention of depicting these images is to provide inspiration and motivation to use the technology; due credit goes to respective sources and architects/agencies

H n n o v a t

Φ _

Global presence









The above images do not depict works of the author; have been sourced from internet for presentation purposes only; the intention of depicting these images is to provide inspiration and motivation to use the technology; due credit goes to respective sources and architects/agencies

Way ahead

- Further research and development urgently required
- Standards and testing methods to be formalised
- Motivation needed for replication at mass level

.....We are a very small part of a VERY LARGE ECOSYSTEM; we have survived successfully for the last 5000 years, let us minimise our footprint to be able to survive for another 5000 years.....

.....Thank you for patience

www.harmonyarchitect.com contact@harmonyarchitect.com