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

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

Ramming

- **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 uniform 4” thickness pre-marked on plywood

Ramming

- **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

Ramming

- **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

Ramming

- **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 un-skilled labourers in one single day

Ramming

- **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

Precious projects

Residence, Vadodara, Gujarat

Precious projects

Residence, Vadodara, Gujarat

Precious projects

Weekend Homes, Vadodara, Gujarat

Precious projects

Prayer Hall, Mehsana, Gujarat

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

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