

RAMMED EARTH (RE)

For further information on Rammed Earth (RE)
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House - Ladakh, India



Qsar village - Morocco



Oldest building in India
Tabo monastery, Spti - 996 AC



Castle in France
XIXth century

Village house - Kerala, India

Longest building in Europe - France

Applications of Rammed Earth:

- Foundation (stabilized). Load bearing walls, if stabilised or not
- Hot or cold climate
- Dry or humid areas

Soil Stabilization for Durability:

- Stabilization increases the strength and reduces the maintenance

A Local Material for Reducing Imports:

- RE is rammed in situ, preferably with the soil from the site

Limiting Deforestation, no Need of Firing:

- RE is often stabilized with cement or lime. Thus no firing is required, but one month curing is necessary

More Eco-Friendly than Fired Bricks:

- 5-15 times energy savings
- 8 times less polluting

Cost Saving:

- Stabilized RE is most of the time cheaper than other materials

Made by Semi-Skilled Labour:

- RE uplifts the labour skills and offers a new job opportunity

Need of Proper Soil Identification:

- It is essential to check the soil suitability before doing rammed earth

Need to Manage the Soil Resources:

- It is essential to know before starting the work what to do later on with the hole from where the soil was taken

SOIL SUITABILITY

The Raw Material

- Organic soil present in the topsoil is not suitable for CEB

Don't use the topsoil



Use the subsoil

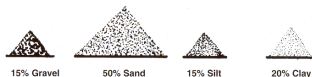


Don't use the rock



- Remove the topsoil and use it for agriculture
- A soil is an earth concrete! Soil contains gravel, sand and binders which are silt and clay. Silt and clay are the cement of the earth but they are not stable under water. They can be stabilized.
- Almost every soil can be used, as such or after improvement to get the best proportions.
- A good soil for CEB is more sandy than clayey or silty

Composition of the Best Soil



Soil Stabilization

It aims at giving long lasting properties to silt and clay

- Stabilization calculations are always with dry weights
- The stabilization percentage is rather low
- Cement is preferably used for sandy soils (average of 5%)
- Lime is rather used for clayey soils with 6% as an average

Soil Improvement

Most of the soils can be used

- Often they need to be improved by simple and natural means:
 - Mixing various soils
 - Adding gravel
 - Crushing or sieving
 - Adding sand
 - Adding clay

Management of Resources

It is essential to be aware of ecological parameters

- Not caring for the environment creates ecological disasters
- Be conscious and respect Nature!
 - Before digging imagine how the hole can be used later on
 - Holes can be created and used in many ways:
 - Basement floor for underground storage
 - Landscaped pond
 - Rainwater harvesting to refill the water table
 - Ponds to water animals and to control water run off, etc.

You can create a new harmonious and beautiful balance between nature and buildings

Field Analyses for Soil Identification

- Smell a humid soil for humus content
 - It should not smell rotten
 - It should not smell musty
 - It should smell agreeable



- Look a humid or dry soil
 - A gravelly soil contains big pieces
 - A sandy soil contains coarse particles
 - A silty soil is thin, with small lumps
 - A clayey soil is very thin, with big lumps



- Touch a humid or dry soil
 - A gravelly soil is very rough
 - A sandy soil is rough
 - A silty soil is soft, with crumbly lumps
 - A clayey soil is thin, with hard lumps



- Add a little water, compress a humid ball
 - A gravelly soil needs a very short pressure
 - A sandy soil needs a short pressure
 - A silty soil needs a medium pressure
 - A clayey soil needs a long pressure



- Add more water to shape a cohesive ball
 - A gravelly soil is very difficult to shape
 - A sandy soil is difficult to shape
 - A silty soil is easy to shape
 - A clayey soil is very easy to shape

- Pull the cohesive ball
 - A gravelly soil breaks apart very easily
 - A sandy soil breaks apart easily
 - A silty soil breaks apart after some length
 - A clayey soil breaks apart after a long pull



- Stick a knife into the ball
 - A gravelly soil does not stain the knife
 - A sandy soil stains very little the knife
 - A silty soil stains easily the knife
 - A clayey soil stains a lot the knife



- Cut the ball with a knife
 - A gravelly soil has a very rough aspect
 - A sandy soil has a rough aspect
 - A silty soil has a smooth, not shiny aspect
 - A clayey soil has a smooth, shiny aspect



- Do a print in the ball and pour water
 - Water goes very quickly in a gravelly soil
 - Water goes quickly in a sandy soil
 - Water goes slowly in a silty soil
 - Water goes very slowly in a clayey soil



- Wash hands with water
 - A gravelly soil does not stick, is very easy to wash
 - A sandy soil sticks very little, is easy to wash
 - A silty soil sticks a lot, is very difficult to wash
 - A clayey soil gives a thin film and is quite easy to wash

RAMMING A FORM

1. Sieving the Soil



Mesh 1.5 x 1.5 cm

- Aerate the soil
- Remove lumps, stones and pebbles

2. Measuring the Components

- It is needed only in case stabilization is required!



- Measure all components (soil, sand, stabilizer)
- Fill the containers with accuracy, as per specifications

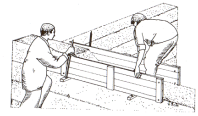
3. Mixing the Components

- It is needed only in case stabilization is required!



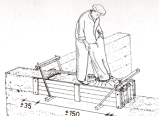
- Pour in order, soil, sand and stabilizer
- First mix dry, 2 times
- Add water and mix wet, 2 times

4. Setting up the Form



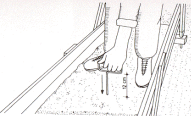
- Check with a plumb line that panels are vertical

5. Pouring the Soil in the Form



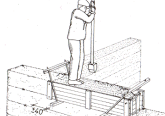
- The soil present must be loosened and slightly humid
- Pour layers of only 12 cm thickness

6. Checking the Layer Thickness



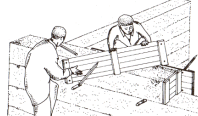
- Before ramming, use a layer gauge (Ø6 mm MS rod) to check the thickness of the loose soil
- Level evenly the layer (add or remove some soil)

7. Ramming



- Ram first on the sides of the panels, and then in the centre
- Ram the loose soil till you hear a clear and sharp sound

8. Removing the Panels

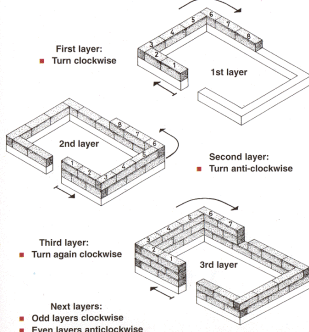


- Immediately after finishing the ramming, dismantle the form and proceed further in the same way
- Never keep a form in place overnight

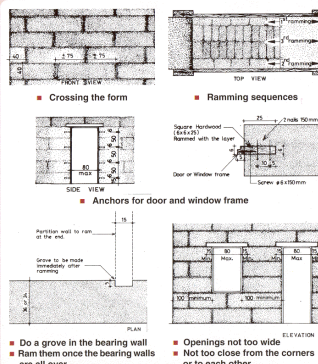
DETAILS AND SPECIFICATIONS

Ramming the House by Layers

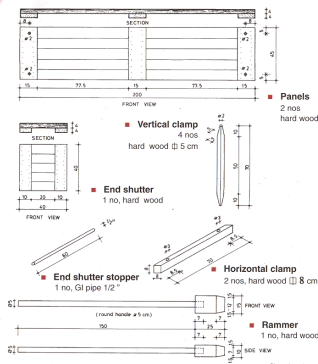
- The form end shutter will shutter the opening of doors and windows.



Typical Details



Typical Form



Guidelines for a Village House

- A good roof with good overhangs
- RCC ring beam in brick casing
- Bricks on edge
- 2 nos. 15 cm x 15 cm x 10 cm concrete
- 12 nos. concrete
- Rammed Earth Wall
- Protection of the window sill
- Rise the ground floor +/- 50 cm
- RCC plinth beam in brick casing
- Plaster the basement with cement
- Provide a good slope to drain water
- Good foundations
- Avoid water accumulation around the building
- Avoid water run offs in any part of the building
- Maintain the building regularly