COMPRESSED EARTH BLOCKS (CEB)

For further information on Compressed Earth Blocks (CEB) Please contact:

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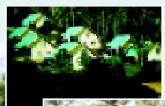
Auram Press 3000


13 apartments on 4 floors, 819 m2 – Auroville, India


Cost effective houses – Mayotte


Cost effective house – Kerala, India


Visitors Centre, 1300 m² Auroville, India


Disaster resistant house New Delhi, India


Vault, 10.35 m span Auroville, India

Applications of Compressed Earth Block:
- Foundation, load bearing walls, arches, vaults and domes, etc.
- Hot or cold climate
- Dry or humid areas

Soil Stabilization for Durability:
- The strength of CEB is often better than country fired bricks

A Local Material for Reducing Imports:
- CEB production is ideally made on the construction site itself

Limiting Deforestation, no Need of Firing:
- CEB are often stabilized with cement or lime. Thus no firing is required, but curing is necessary for a month

More Eco-Friendly than Fired Bricks:
- 5-15 times energy savings
- 8 times less polluting

Cost Saving:
- CEB are most of the time cheaper than conventional materials

A New Market Opportunity:
- Possibility to uplift labour skills and to offer a new product

Need of a Proper Soil Identification:
- It is essential to check the soil suitability before doing CEB

Need to Manage the Soil Resources:
- It is essential to know before starting a production 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
- Crushing or sieving
- Adding gravel
- 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

❶ **Smell a humid soil for humus content**
- It should not smell rotten
- It should not smell musty
- It should smell agreable

❷ **Look a humid or dry soil**
- A gravely 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

❸ **Touch a humid or dry soil**
- A gravely 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

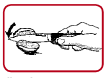
❹ **Add a little water, compress a humid ball**
- A gravely soil needs a very short pressure
- A sandy soil needs a short pressure
- A silty soil needs a medium pressure
- A clayey soil needs a long pressure

❺ **Add more water to shape a cohesive ball**
- A gravely 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

❻ **Pull the cohesive ball**
- A gravely 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

❼ **Stick a knife into the ball**
- A gravely 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

❽ **Cut the ball with a knife**
- A gravely 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

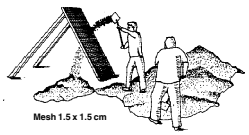


❾ **Do a print in the ball and pour water**
- Water goes very quickly in a gravely soil
- Water goes quickly in a sandy soil
- Water goes slowly in a silty soil
- Water goes very slowly in a clayey soil

❿ **Wash hands with water**
- A gravely 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

PRODUCTION

1. Sieving the Soil



- **Aerate the soil**
- **Remove lumps, stones and pebbles**

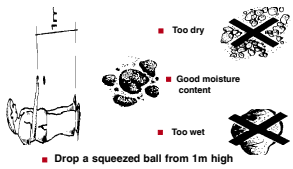
2. Measuring

- **Measure all components directly in the containers (wheelbarrows for soil, buckets for sand and cement)**
- **Fill the containers with accuracy, as per specifications**

3. Mixing

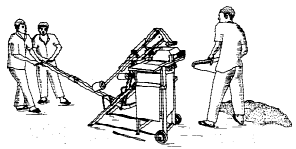
- **Pour in order, soil, sand and stabilizer**
- **First mix dry, 2 times**
- **Add water and mix wet, 2 times**

4. Check the Moisture Content



- **Drop a squeezed ball from 1m high**

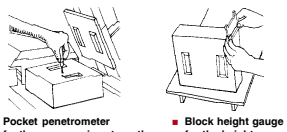
5. Moulding



- **Mould immediately the mix: within 20 minutes!**

6. Quality Control

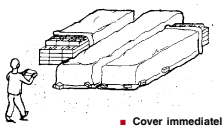
- **Every block of every mix must be checked**



- **Pocket penetrometer for the compression strength**
- **Block height gauge for the height**

7. Humid Curing and Stacking

- **The pile must remain covered 2 days with a plastic sheet**



- **Stacking the fresh block**
- **Cover immediately every row with a plastic sheet**

8. Final Curing and Stacking

- **Water the pile daily (on top and on the 4 sides), as many times as needed, for 1 month**
- **Never let the pile dry for a full month!**

MASONRY

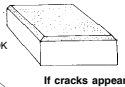
Mortar Quality

- The mortar is stabilized 1.5 times more than the blocks
- Sand (0.2 to 2 mm) should be added
- The mortar should be prepared at a plastic state (not too liquid)

Conduct some test first!
- Mortar for wall: mix = 1 cement + 6 soil + 6 sand, by volume
- Apply 1 cm mortar on a block soaked in water
- Cure the mortar 3 days under shed, let it dry 3 days under sun

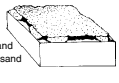
The test sample must be neither cracking nor crumbling

It is not cracking, it is not crumbling:
- The mix 1 : 6 : 6 is OK



If cracks appeared:
- Add more sand
- Try 1 cement + 5 soil + 7 sand
- Or try 1 cement + 4 soil + 8 sand

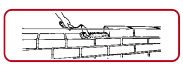
If the mortar is crumbly:
- Add more soil
- Try 1 cement + 7 soil + 5 sand
- Or try 1 cement + 8 soil + 4 sand



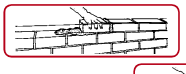
- **The new trial test must be neither cracking nor crumbling**
- **The mortar laid in the masonry must be cured for a month**

Block Laying for Single Bond Wall

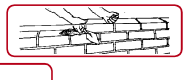
- **The course must be humid**



- **Soak the block into water**
- **Apply mortar on the side of the block**



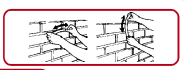
- **Press the side joint**
- **Adjust the block along the string line**



- **Never fill the joint after laying the block**

Pointing the Joints

- **Use a piece of hose pipe, which is soaked in water**

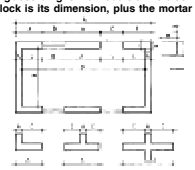


- **Clean the joint with a wet sponge**
- **The pointing must be done every day after laying the blocks**

Dimensioning the Building

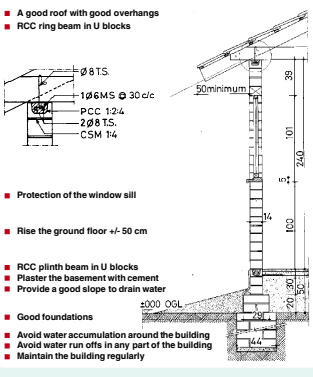
- **Dimension the building according to the module of the block The module of the block is its dimension, plus the mortar thickness (mt)**

A = (x . module) - 1 mt
B = (x . module) + 1 mt
C = (x . module)



Guidelines for a Village House

- **A good roof with good overhangs**
- **RCC ring beam in U blocks**



- **Protection of the window sill**
- **Rise the ground floor +/- 50 cm**
- **RCC plinth beam in U blocks**
- **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**