Builder's Resource Guide

The Builder's Resource Guide is designed to maximize the amount of relief aid given by exploring sustainable, alternative building technologies while looking at traditional Indonesian building methods and customs. This resource is also intended to empower individuals at the village level who may not receive any aid.

sustainable technologies +
earthbag +
eco-dome structure +
earthbag hybrid home +
bio-climatic design +

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Earthbag

Earthbag is a construction method that uses plastic or textile bags (earthbags) packed with soil, and sometimes sand, gravel and cementitious materials. It can be used to construct foundations, walls, and domed structures. Earthbag is one of the most inexpensive building methods, and is very practical in areas that are prone to flooding, hurricanes, wildfires or areas with no wood or clay. Earthbag construction requires few skills and is faster than other earth building methods. Few tools, other than a shovel are necessary and any other tools can usually can be hand made. For both temporary and permanent solutions, earthbag construction is a very promising option for the rebuild in the Aceh area. For both temporary and permanent solutions. Emergency shelters made from sandbags and barb wire can be constructed in a few hours and have been proven to last for three winters. As a permanent solution, earthbag dome structures can be finished with a coat of cement or lime plaster. In the Aceh region, all of the other materials except for the bags can be found locally.

Examples

images: Calearth.org

Construction Materials

Bags

Polypropylene bags are the only suitable material for this area of Indonesia because of the high levels of sand in the soil. The weaker the fill material, the stronger the bag must be. Polypropylene bags are made of woven plastic and will deteriorate if exposed to sun, therefore steps should be made to protect the bags from sunlight both before and after construction.

Fill

A mix of sand and clay soil is ideal for earthbag construction. A mixture of sand and lime or lime-rich coral sand common in this region is also good. Any material that degrades in the bags could create pockets, weakening the structure. So all organic matter, rocks, and sticks should

Fill continued

be sifted out of the soil. Also remove all topsoil and only use the substrate and fill material. After the fill material is sifted and lime or coral sand is add the bags can be filled. The fill can be used either wet or dry however when using lime the fill should be moist so that the material sets adding additional structural support.

Barbed Wire

4-point barbed wire is laid between courses to keep the bags from slipping. As a rule of thumb, if the bag is less than 12 inches wide, only one row is needed. Two or more rows of barbed wire may be required for rows wider than 16 inches.

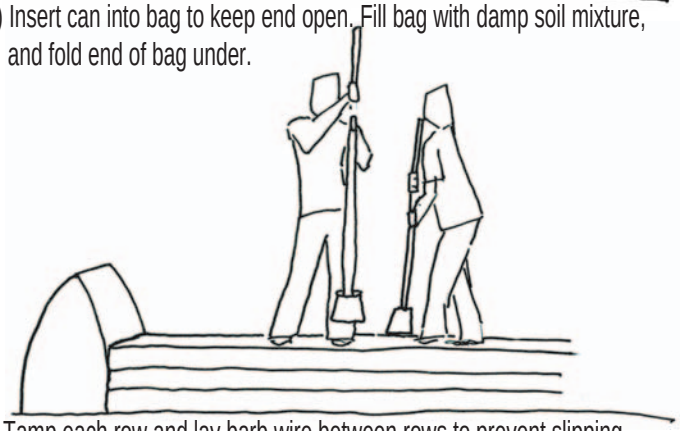
Tools

Shovels, wheelbarrows, coffee cans (with both ends removed), hoes, tampers, and cutting blades.

The 3 Key Steps in Earthbag Construction:

1) Cut bags to the size needed.

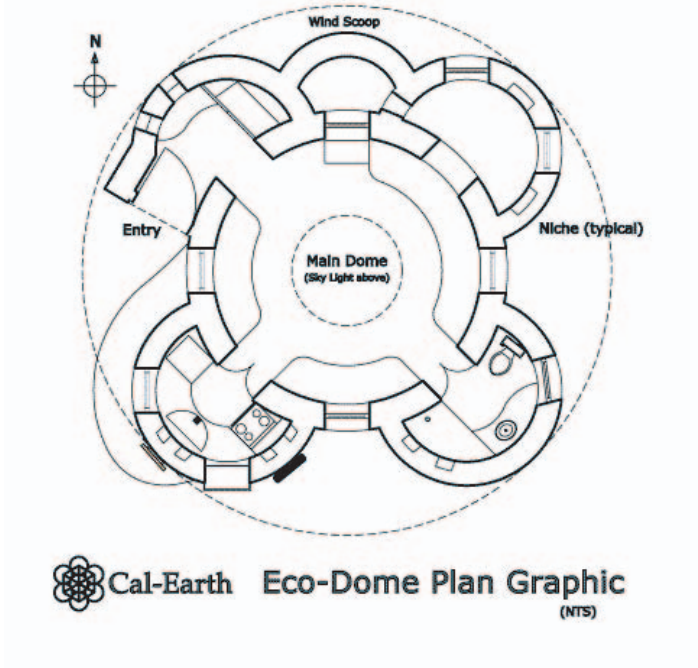
2) Insert can into bag to keep end open. Fill bag with damp soil mixture, and fold end of bag under.



3) Tamp each row and lay barb wire between rows to prevent slipping.

Source:Elizabeth, Lynne, and Cassandra Adams. Alternative Construction: Contemporary Natural Building Methods. (New York: John Wiley & Sons, Inc. 2000).

Eco-dome



+ Built from local earth-filled coils (soil-cement or lime-stabilized earth).
+ Physically and culturally flexible design. The main dome and four niches can function as:
  a) main living room, entrance hall, kitchen, bathroom, bedroom
  b) living room, entrance hall, and three bed-rooms
  c) living room, entrance hall, two bedrooms, and a bathroom
+ Self-contained single unit
+ Can be repeated and joined together to form larger homes and courtyard houses.
+ Can be built by a team of 3-5 persons.
+ Designed with the sun, shade and wind in mind for passive cooling and heating.
+ Interior furniture can be built-in with same material.

Information and Image source: www.calearth.org

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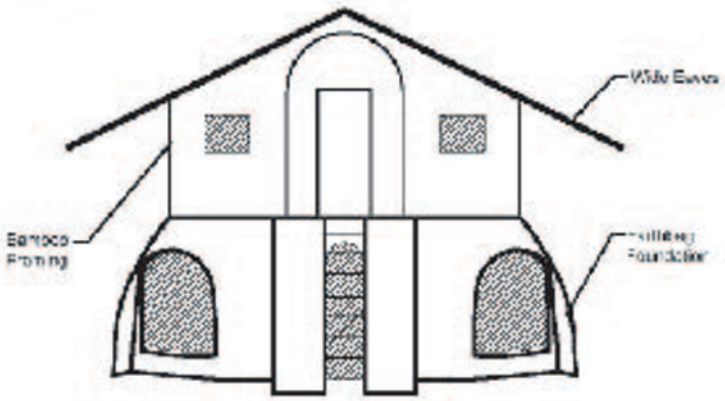
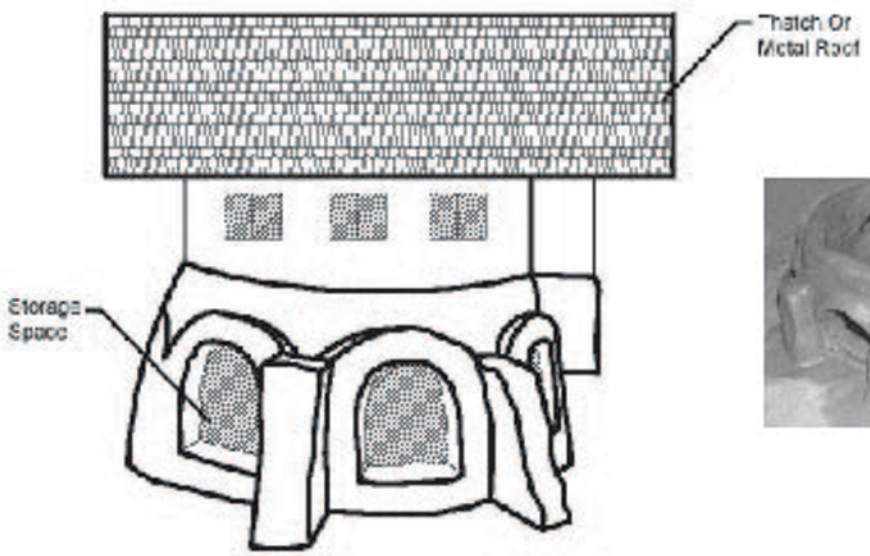
Earthbag-hybrid





- Earthbag foundation is built from local earth.
- Living quarters is built using primarily of local bamboo.
- Familiar and traditional materials are used to finish and furnish upper living quarters.

Foundation

- Earthbag creates a strong foundation that allows wind and floodwaters to pass through.
- Earthbag foundation is resistant to structural failure during earthquakes.
- Earthbag foundation provides a large dry storage area.

Design

- Raised dwelling, similar in style to traditional building methods.
- Living quarters could be built in a traditional manner.
- Floor plan could be modeled after traditional layouts.
- Upper story could be modular and easily disassembled and reassembled.
- People could reuse the earthbag foundation as they reuse the wooden stilts of traditional homes.

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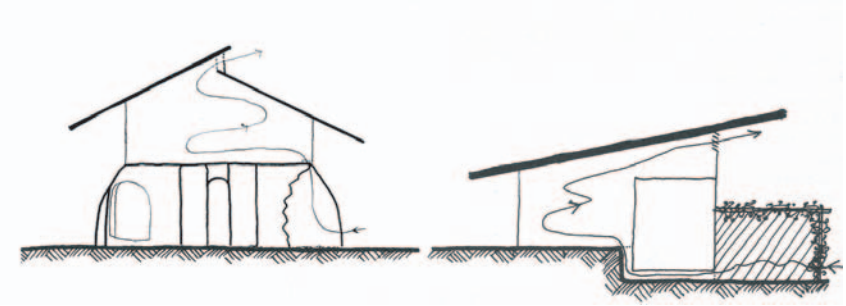
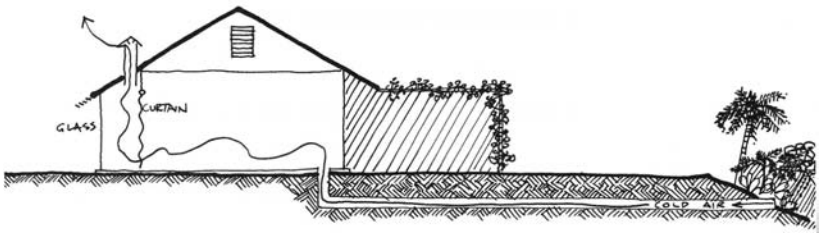
Bio-climatic Design

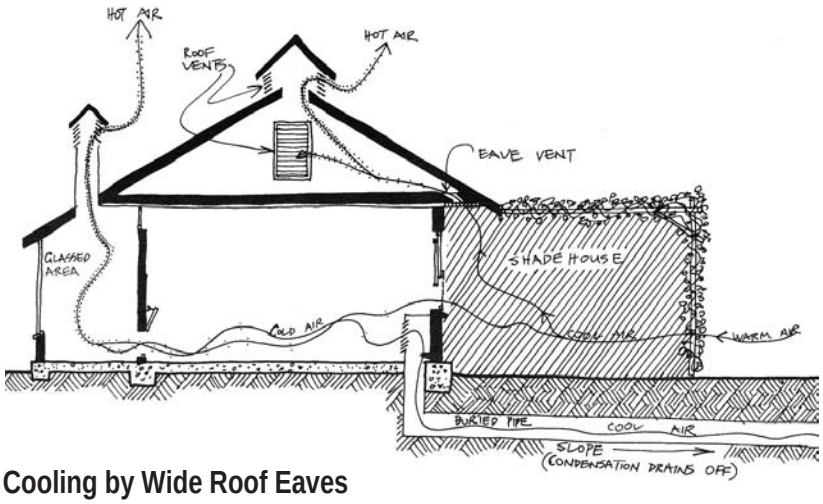
Cross-ventilation for Houses



Vented ceiling slopes allow hot air to escape the room, and cool trellis air to enter. The key to successful cross-ventilation is to allow air to flow along a simple path(no corners), and use large vents that allow for a lot of air to pass through. (Figure Source: Permaculture A Designer's Manual by Bill Mollison.)

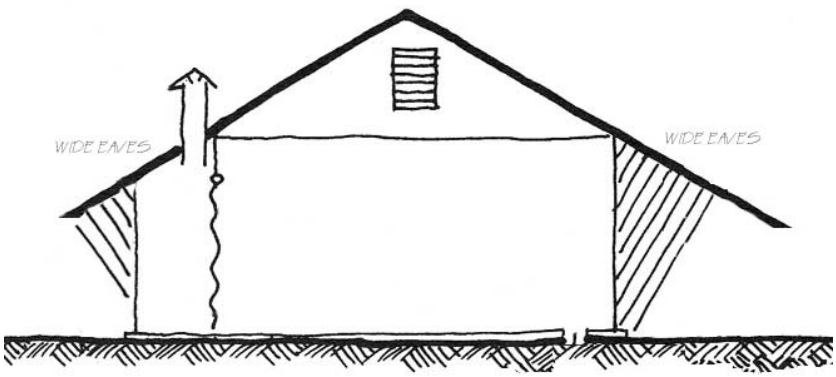
Cooling by Shadehouse and Buried Pipe





A 0.5 x 0.5 m tunnel 1 m deep and 20 m long sloping to the outside intake to de-humidify and cool the air, with a solar chimney to draw air through the house. Metal chimney or a hot roof (a roof that is unventilated) are the best cooling systems in a tropical house. The metal chimneys or hot roof draws in cool air from underground pipes. Where the earth cools the air that is in the pipe. The air that is drawn in from the pipe is more dense so it naturally sinks to the lowest level of the house but a fan can move the cool air throughout a room or house.
The cool air pipe needs to be buried at least 1 meter, and should be 15-20 meters long. The pipe should be laid at an angle that slopes away from the dwelling to allow for the moisture that develops to drain away from the house. The Outlets of the pipe should be covered with screen to keep animals out. A shade house which is a trellis covered with vegetation, can also be a good way to creatie cool air that could be utilized by creating vents in the exterior wall of the structure and at the eaves of the roof. (Figure Source: Permaculture A Designer's Manual by Bill Mollison.)

Cooling by Wide Roof Eaves



Designing a house with large over-hanging eaves shades the house. Shading the house makes the interior much cooler and the air coming in through the windows will be cooled by the eaves. Wide eaves also directs rainwater from the roof farther away from the house.

Information and noted images courtesy of: Permaculture A Designer's Manual by Bill Mollison.